User's Manual

R-Studio for Mac

www.r-tt.com

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I Introduction to R-Studio for Mac

R-Studio is a family of powerful and cost-effective undelete and data recovery software. Empowered by new unique data recovery technologies, it is the most comprehensive data recovery solution for recovering files from from FAT12/16/32, NTFS, exFAT, NTFS5 (created or updated by Windows NT/2000/XP/2003/Vista/2008/7/8/8.1/10), ReFS (Resilient File System, a new local file system Microsoft has introduced in its Windows 2012 Server), HFS/HFS+ and APFS (Macintosh), Little and Big Endian variants of UFS1/UFS2 (FreeBSD/OpenBSD/NetBSD/Solaris), Ext2/3/4FS (Linux), and XFS partitions. It functions on local and network disks, even if such partitions are formatted, damaged or deleted. Flexible parameter settings give you absolute control over the data recovery.

1.1 R-Studio Features

R-Studio is a family of file restoring utilities. It recovers files both on local disks, even if their partition structures are damaged. A unique ***IntelligentScan*** technology and flexible parameter settings give you real control over the fastest data recovery ever seen.

R-Studio features:

- Host operating systems: macOS Big Sur (11.4), macOS High Sierra (10.13), macOS Sierra (10.12), OS X El Capitan (10.11), Yosemite (10.10), Mavericks (10.9), Mountain Lion (10.8), Lion (10.7), Snow Leopard (10.6), Leopard(10.5), Mac OS Server 10.5 Tiger, Mac OS 10.5 Leopard, macOS Server 5.5-5.0, OS X 10.10 (Yosemite Server 4.0), Mac OS X 10.9 (Mavericks Server), 10.8 (Mountain Lion Server), 10.7 (Lion Server), Mac OS X Server 10.6 (Snow Leopard Server) and Mac OS X Server 10.5 (Leopard Server running on a computer with Intel, PowerPC G5 or PowerPC G4 processors.
- Automatic check for updates.
- Remotely recovers data over network. Data can be recovered on network computers running Windows, macOS, Linux, and some other UNIX OS.

- Supported file systems:
  macOS: HFS, HFS+, HFSX, APFS, FAT/exFAT;
  Windows: FAT12/16/32, exFAT, NTFS, NTFS5, ReFS/ReFS2+ file (Resilient File System);
  Linux and UNIX: Ext2/3/4FS and XFS (created by Linux or other OS), and UFS1/UFS2, UFS BigEndian (used by the FreeBSD, OpenBSD, and NetBSD operating systems);
  CD/DVD/Images: ISO9660;
  Magnetic tape devices: UStar/Tar/CPIO/Pax (**R-Studio Technician/T80+**).
  Please note, that when a file is being deleted on the HFS, HFS+, HFSX file systems, the computer completely removes all system information on it, and there is no way to recover the deleted file except by using the **Extra Search for Known File Types** option. Nevertheless, **R-Studio** is able to read existing files from HFS, HFS+, and HFSX disks.
- Full access to the system disk even when the Apple's System Integrity Protection is enabled.
- Support for known file types. **R-Studio** searches for files with known typical features of their structures allowing the user to search for files on devices with unknown files systems, including an HD, CD, DVD, floppy disk, Compact Flash Card, USB drive, ZIP drive, Memory Sticks, and other removable media.
- Scan process visualization. While scanning an object, **R-Studio** graphically shows items that have been found, including files of known types, FAT and NTFS MFT records, boot records, etc.
- Mass file recovery support.
- Support for estimation of chances for successful recovery.
- Support for file recovery lists - lists of files that can be exported from **R-Studio**, manually edited, and then loaded back. Files from such lists will be automatically marked for recovery.
- APM, Basic and GPT support. **R-Studio** supports all three partition schemes used to define the low-level organization of data on disks formatted for use with Macintosh computers.
- Dynamic disk support.
- Support for BitLocker Drive Encryption encryption, both for the ToGo and System Drive Encryption methods.
- Software RAID, volume set, and stripe set support. Support for RAID 6, RAID 5, and RAID 4 layouts. Support for custom RAID layouts. Parameters like block size and order, offsets, and even the number of stripe blocks can be explicitly specified. Custom RAID configurations can be saved.
- Support for Windows Storage Spaces, created by Windows 8/8.1 and Windows 10/Threshold 2/Anniversary/Fall Creators updates.
- Support for software Apple software RAIDs
- Support for Apple CoreStorage/FileVault/Fusion Drive Volumes
- Support for Linux mdadm Volumes
- Support for Linux LVM/LVM2
- Support for Intel Software RAID.
- RAID consistency check (check for valid data parity values).
- Hardware RAID, volume set, and stripe set support.
- Automatic RAID parameter recognition.
- Reverse RAIDs: A technique that decomposes real disk objects into virtual RAIDs. Then those components of reverse RAID scan be processed like real objects. They can be viewed, edited, imaged, copied to physical drives, etc. This technique also can re-construct data on the real parents of a virtual RAID. For example, it becomes possible to re-construct data on a missing disk.

- Virtual objects can be connected to the host system as read-only virtual drives. They can remain connected even then **R-Studio** has been closed.
- Creates image files for an entire drive, logical disk, or its part. Such image files can be processed like regular drives. In addition to simple exact object copies (Plain images) and **R-Drive Image** compatible images. It can create other disk image and virtual disk formats, together with opening several file formats "read-only". You may read more about those formats and their properties on the Supported Virtual Disk and Disk Image Formats page. Images may be saved either on the local or remote computer. Image creation can be stopped and then resumed. **R-Studio** can scan objects while creating their images. **R-Studio Technician/T80+** supports multi-pass and runtime imaging. Images can be mounted in the operating system as devices which makes their content accessible to any program including any other data recovery software.
- Advanced object copy. In addition to byte to byte copy of any object visible in the Drives panel, smart copy of partitions and hard drives is available (**R-Studio Technician/T80+**).
- Recovers files on damaged or deleted partitions.
- Recovers compressed files (NTFS, NTFS5).
- Recovers encrypted files (NTFS5).
- Recovers alternative data streams (NTFS, NTFS5).
- Support for NTFS deduplication.
- Support for symbolic links. Symbolic link recovery options in the **Technician/T80+** version.
- Support for file system journal on the HFS+ and Ext3/4fs file systems.
- Support for soft updates journal on the UFS file system.
- Support for extended attributes on the HFS+, Ext3/4fs, XFS, and UFS file systems.
- Support for compressed files on the HFS+ file system.
- Extended file information (**R-Studio Technician/T80+**)
- Recognizes localized names.
- Recovered files can be saved on any (including network) disks visible by the host operating system.
- A hexadecimal disk and file editor supporting NTFS file non-resident attribute editing. Data alteration is available on the **Technician/T80+** and **Corporate** versions only.
- Patterns (or templates) in the hexadecimal editor allowing for parsing the data according to specific data structure. Such patterns may be custom-created.
- File previewer to estimate recovery chances. It shows picture tiles and first frames of video files as icons, and supports a large number of video/audio/graphic/document file formats. These files can be played back without their respective applications installed.
- Enhanced remote host scanning procedure. In the new **R-Studio** network versions, data are analyzed on the remote host rather than on the home host, thereby the speed of recovery procedure greatly increases.
- Recovered files may be saved on a disk on a connected remote computer rather than be transferred over network to the local one. Saving recovered files on a remote computer may be useful when the remote computer has a healthy disk because you do not have to transfer files over network. It may be an external USB hard drive, for example.
- Support for S.M.A.R.T. (Self-Monitoring, Analysis and Reporting Technology) attribute monitoring.
- Forensic mode. (For the **Technician/T80+** version only).
- Support for third-party hardware. (For the **Technician/T80+** version only).

- **R-Studio Emergency***. The **R-Studio Emergency** version starts from a floppy or compact disk when it is necessary to recover data on a computer, on which Windows cannot start up because its system files are corrupted or deleted.

*The **R-Studio Emergency** is a part of the **R-Studio** software package. When you buy an **R-Studio** single license you may run the **R-Studio Emergency** or/and install the **R-Studio** Windows version on one PC only and you may not transfer the licensed software to another PC.

R-Studio recovers files:

- That have been removed without **Trash**, or when **Trash** has been emptied;
- Removed by virus attack or power failure;
- After the partition with the files was reformatted, even for different file system;
- When the partition structure on a hard drive was changed or damaged. In this case, **R-Studio** can scan the drive trying to find previously existed partitions and recover files from found partitions.
- From disks with bad sectors. In this case, **R-Studio** can first copy the entire disk or its part into an image file and then process such image file.

R-Studio can create image files for an entire hard drive, logical disk, or its part. Such image files can be processed like regular disks. Images are very useful if there is a risk of total data loss due to hardware malfunction. If bad blocks are constantly appearing on a hard drive, the only way to save the data is to immediately create an image of that drive. All data search, scan and recovery can be done from this image.

To learn more about the ***IntelligentScan*** technology, go to the **IntelligentScan** topic .

1.2 System Requirements

- A Mac computer with Apple Silicon, Intel, PowerPC G5 or PowerPC G4 processors.
- At least 256 MB of RAM, a mouse, and enough disk space for recovered files, image files, etc.
- macOS 12 Monterey, macOS 11 Big Sur, macOS 10.15 Catalina, macOS Mojave (10.14), macOS High Sierra (10.13), macOS Sierra (10.12), OS X El Capitan (10.11), OS X Yosemite (10.10), Mavericks (10.9), OS X Mountain Lion (10.8), Mac OS X Lion (10.7), Mac OS X Snow Leopard (10.6).
- The administrative privileges are required to install and run R-Studio for Mac.
- A network connection for data recovering over network.

1.3 Contact Information and Technical Support

To obtain the latest version of **R-Studio**, go to:

Product Site: http://www.r-tt.com
Sales Department: sales@r-tt.com

Many specific data recovery cases are discussed in the R-TT's Data Recovery Guide.

R-Studio Technical Support Team is available 24 hours a day, seven days a week, and has an average response time less than 4 hours.

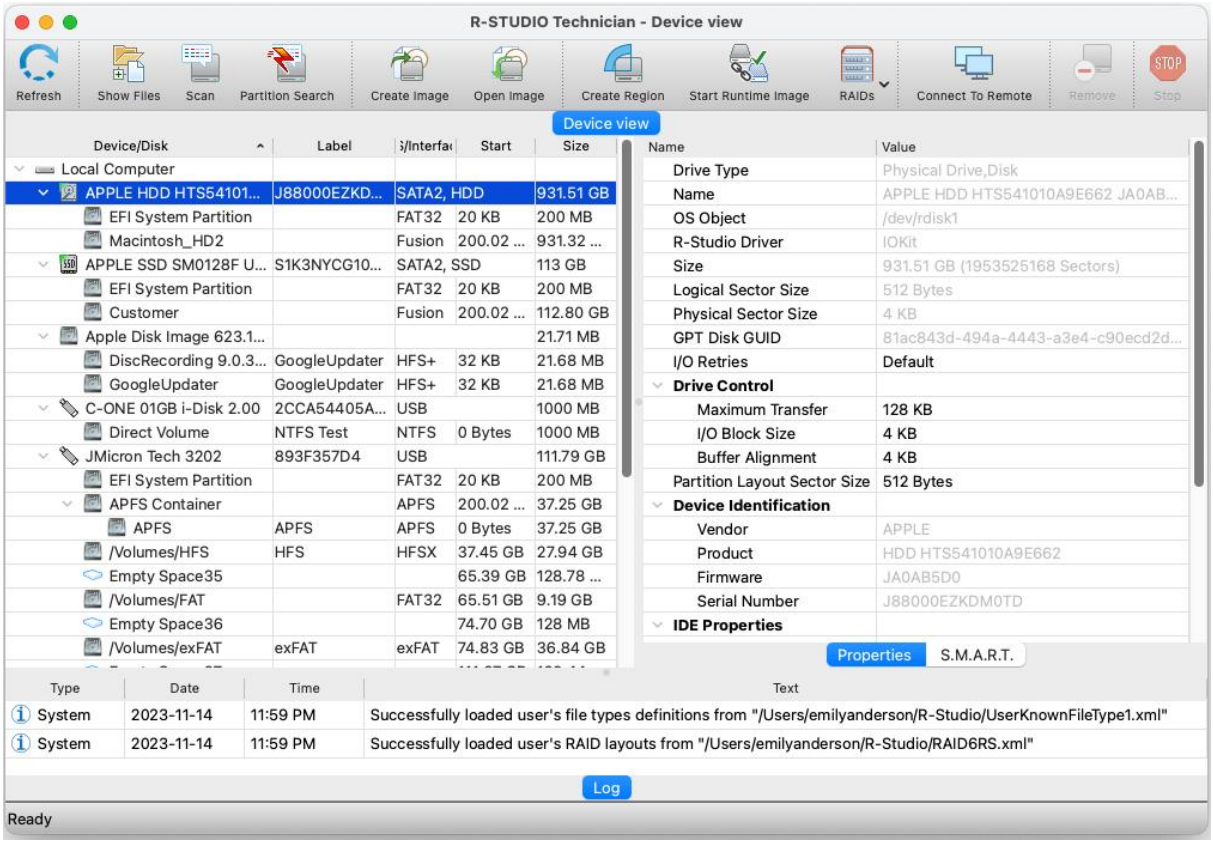
Tech. Support: support@r-tt.com
Send your support request to: http://www.r-tt.com/SupportRequest.shtml

File Recovery FAQ: http://www.r-tt.com/File_Recovery_FAQ.shtml
R-tt Forum: http://forum.r-tt.com

1.4 R-Studio Main Panel

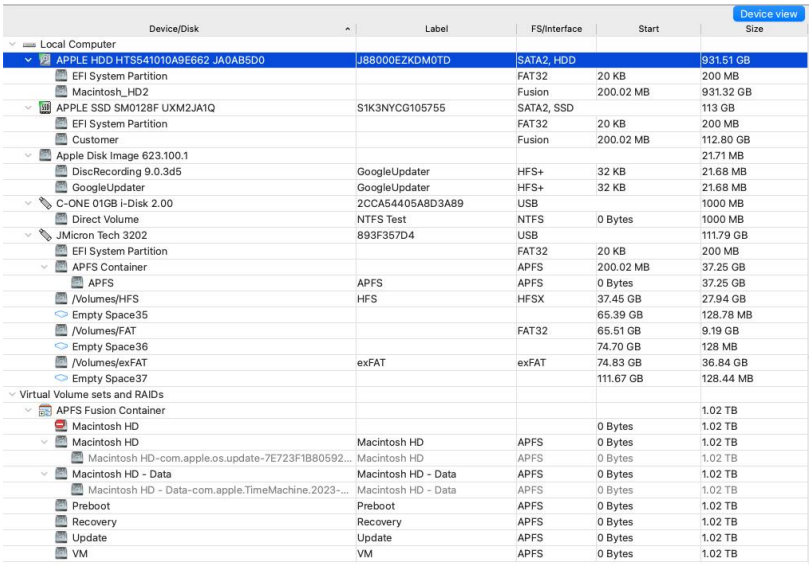
When **R-Studio** starts, its main panel appears on the desktop.

R-Studio Main panel



Drives panel:

You can select an object by clicking on it.



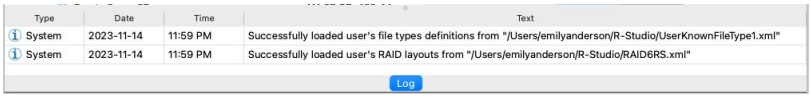
Properties tab:

This tab shows the properties of an object selected on the Drives panel.

Depending on the selected object, information on this Properties tab may vary.

The Properties tab names and values are described in detail on the Properties tab topic.

Log panel

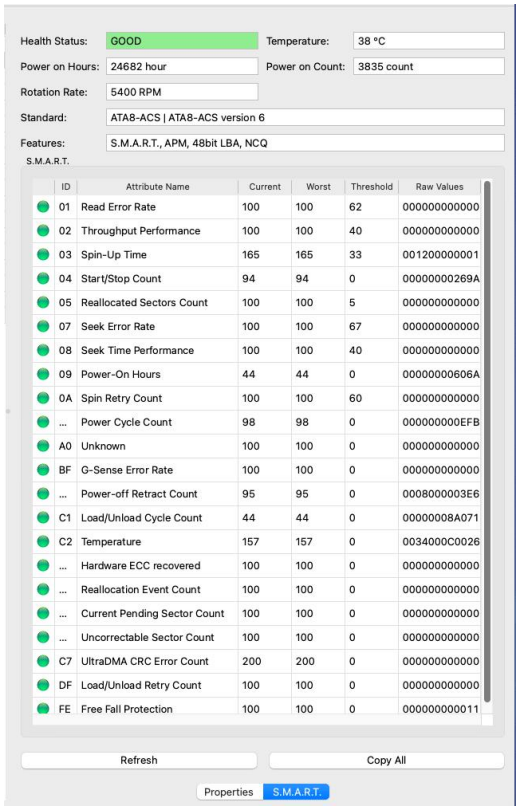


S.M.A.R.T. Info for a Hard Drive

When a hard drive is selected on the **R-Studio** main panel, an additional S.M.A.R.T. tab will appear. You may view the hardware conditions of the drive and copy all S.M.A.R.T. attributes to paste them into a text editor. .

S.M.A.R.T. (Self-Monitoring, Analysis and Reporting Technology) is a technology widely-used in hard drives and solid-state devices that monitors their reliability conditions to predict possible hardware failures.

S.M.A.R.T. panel



R-Studio shows hard drive **S.M.A.R.T.** states using their icons.

Hard drive S.M.A.R.T. states and icons

Normal: This state indicates that the hard drive is in good conditions.	
Warning: This state indicates that some small problems with the disk are possible in the future, you may work with it but with cautions and regular check of these parameters. Disk imaging is strongly recommended.	
Critical: This state indicates that the hard drive conditions are critical and chances of hardware failure are great. The best recommendation for this case is to stop working with the disk and bring it to professional data recovery specialists. You may though continue to work with the disk at your own risk, but disk imaging is very strongly recommended.	

When a hard drive is selected on the **R-Studio** main panel, an additional S.M.A.R.T. tab will appear. You may view the detailed **S.M.A.R.T.** data of the drive.

S.M.A.R.T. (Self-Monitoring, Analysis and Reporting Technology) is a technology widely-used in hard drives and solid-state devices that monitors their reliability conditions to predict possible hardware failures.

Changing the program language

You may select the language of **R-Studio** main panel. To do so, select an available language on **Change Language** on the **Help** menu

Panel view options

You may set which panels and bars to enable/disable.

To enable/disable:

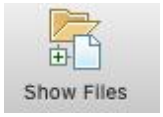
Toolbar	Select/clear **Toolbar** on the **View** menu
Toolbar Button Text	Select/clear **Toolbar Button Text** on the **View** menu
Status bar	Select/clear **Status bar** on the **View** menu
Device pane	Select/clear **Device View** on the **View** menu
Properties pane	Select/clear **Properties View** on the **View** menu
The Log panel	Select/clear **Event Log** on the **View** menu
Search results	Select/clear **Find results** on the **View** menu
If you have several tabs in the right pane, you may easily switch to any of the tab by selecting the **View** menu	
Properties Tab	to view the Properties tab
Scan Information Tab	to view the Scan Information Tab tab
Parents Tab	to view the Parents tab
Properties	Select data types in which the data will be represented

Connect
Click this button to connect to a remote computer on a network.

Refresh
Click this button to refresh the panels.

Scan
Click this button to start scanning a selected object.

Fast Partition Search
Click this button to start fast searching for lost and deleted partitonsi.



Open Drive Files
Click this button to start enumerating files on a selected object.

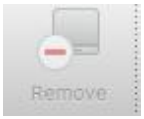
Open Image
Click this button to open a previously created image.

Create Image
Click this button to create an image of a selected area.

Create Region
Click this button to create a region on a selected disk.

Create Virtual RAIDs
Click this button to create a virtual volume set or RAIDS.
Select an appropriate type from the menu.

Start runtime image
Click this button to start runtime imaging of the selected object.
(**Technician/T80+** versions only)



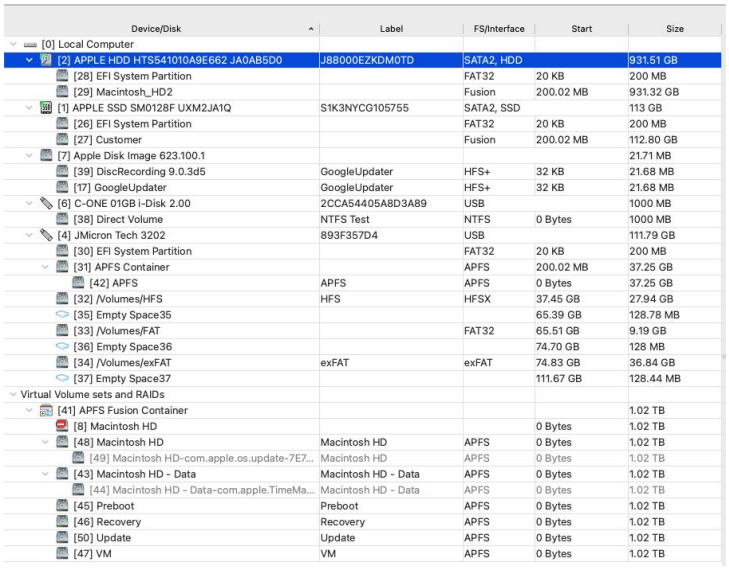
Remove
Click this button to remove a selected object on the main panel.

Stop
Click this button to stop the current operation.

Sometimes, there may be a lot of similar objects on the Drives panel. Those may be components of a RAID, for example. You may turn numerical indexes for such objects to distinguish them better. Those indexes will appear before the object names on the Drives panel.

To turn the numerical indexes on/off, go to the **Device** item on the **View** menu, and select/clear:

Show Physical Drives Indexes to display the indexes only for hard drives
Show All Objects Indexes to display the indexes for all objects on the Drives panel



Device/Disk	Label	FS/Interface	Start	Size
[0] Local Computer				
[2] APPLE HDD HTS541010A9E662 JA0AB5D0	J88000EZKDM0TD	SATA2, HDD		931.51 GB
[28] EFI System Partition		FAT32	20 KB	200 MB
[29] Macintosh_HD2		Fusion	200.02 MB	931.32 GB
[1] APPLE SSD SM0128F UXM2JA1Q	S1K3NYCG105755	SATA2, SSD		113 GB
[26] EFI System Partition		FAT32	20 KB	200 MB
[27] Customer		Fusion	200.02 MB	112.80 GB
[7] Apple Disk Image 623.100.1				21.71 MB
[39] DiscRecording 9.0.3d5	GoogleUpdater	HFS+	32 KB	21.68 MB
[17] GoogleUpdater	GoogleUpdater	HFS+	32 KB	21.68 MB
[6] C-ONE 01GB i-Disk 2.00	2CCA54405A8D3A89	USB		1000 MB
[38] Direct Volume	NTFS Test	NTFS	0 Bytes	1000 MB
[4] JMicron Tech 3202	893F357D4	USB		111.79 GB
[30] EFI System Partition		FAT32	20 KB	200 MB
[31] APFS Container		APFS	200.02 MB	37.25 GB
[42] APFS	APFS	APFS	0 Bytes	37.25 GB
[32] /Volumes/HFS	HFS	HFSX	37.45 GB	27.94 GB
[35] Empty Space35			65.39 GB	128.78 MB
[33] /Volumes/FAT		FAT32	65.51 GB	9.19 GB
[36] Empty Space36			74.70 GB	128 MB
[34] /Volumes/exFAT	exFAT	exFAT	74.83 GB	36.84 GB
[37] Empty Space37			111.67 GB	128.44 MB
Virtual Volume sets and RAIDs				
[41] APFS Fusion Container				1.02 TB
[8] Macintosh HD			0 Bytes	1.02 TB
[48] Macintosh HD	Macintosh HD	APFS	0 Bytes	1.02 TB
[49] Macintosh HD-com.apple.os.update-7E7...	Macintosh HD	APFS	0 Bytes	1.02 TB
[43] Macintosh HD - Data	Macintosh HD - Data	APFS	0 Bytes	1.02 TB
[44] Macintosh HD - Data-com.apple.TimeMa...	Macintosh HD - Data	APFS	0 Bytes	1.02 TB
[45] Preboot	Preboot	APFS	0 Bytes	1.02 TB
[46] Recovery	Recovery	APFS	0 Bytes	1.02 TB
[50] Update	Update	APFS	0 Bytes	1.02 TB
[47] VM	VM	APFS	0 Bytes	1.02 TB

You may select the units in which object's start and size are displayed

To select the units

1 **Select Devices on the View menu**

2 **Select the units in which you want to see object sizes.**

You may select

Show as Bytes
Show as Sectors
Show as Bytes and Sectors

Depending on the task **R-Studio** performs, its panel may vary. Those panels are described in appropriate topics. The Properties tab names and values are described in detail on the **Properties tab** topic.

The general settings can be set on the Settings dialog box.

You may also copy the object's information displayed on the Drives panel. Control-click the object on the necessary column and select **Copy Device/Disk**, **Copy Label**, and so on

R-Studio has two operation modes:

File search on a partition (including recently found during disk scan).

In this mode, **R-Studio** analyzes MFTs on NTFS partitions, FATs on FAT partitions, and SuperBlocks on Ext2/3/4FS partitions. Then it displays all files which records have been found in the analyzed tables. Then recently deleted files, which records still remain, can be recovered. If files have not been found, that means that their records have been deleted. In this case, the disk must be scanned.

File search supports file masks and regular expressions. Multiple files in different folders can be found and recovered in one recover session.

R-Studio supports mass file recovery. There is no limit in the number of files that may be recovered during one session.

File content may be previewed before recovery.

File or disk binary data can be viewed and edited in the text/hexadecimal editor. Also can be viewed and changed all attributes for NTFS files.

Disk scan, searching for partitions.

In this mode, **R-Studio** scans the entire disk or its part. Using a number of statistic and deterministic criteria known as the ***IntelligentScan*** technology, it determines existing or existed partitions on the disk, and their file systems. It is also possible to add new partition, by setting manually all required parameters.

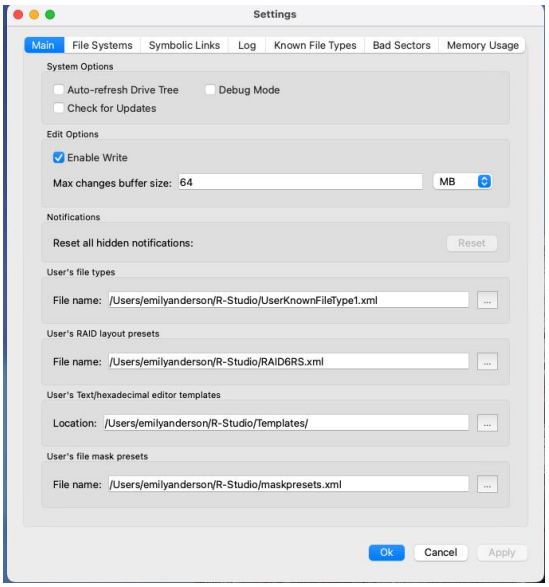
A disk can be scanned through several successive scans, each with its own parameters. **R-Studio** accumulates the information from successive scans and keeps track of changes in the information obtained from different scans. The information obtained from the disc scan can be stored in a file. It may be loaded and processed later at any convenient time.

1.5 R-Studio Settings

You may specify some global setting for **R-Studio** on the Settings dialog box. You may reach it by selecting **Preferences** on the **R-Studio** menu.

Main

Main **dialog box**



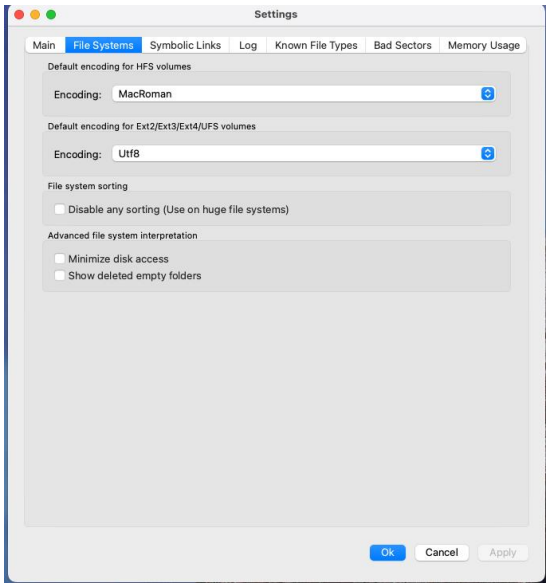
Main settings

System Options	
Check for update	If this box is selected, **R-Studio** will automatically check for updates.
Debug Mode	If this check box is selected, **R-Studio** displays an additional command **Create FS Snapshot** on the context menu for an object with a file system. An FS Snapshot contains system data for the file system only (file descriptions without file contents). If a problem appears, this snapshot can be sent to **R-Studio** technical support to identify the problem. This option greatly slows **R-Studio**.
Auto-refresh Drive Tree	If this box is selected, **R-Studio** automatically refreshes the list of connected disks. You may disable it if **R-Studio** experiences problems with connected devices.
Edit Options	
Enable Write	If this check box is selected, **R-Studio** enables you to write any changes made in the **Text/hexadecimal editor**.
Max changes buffer size	Maximum amount of data stored for the **Undo** command in the **Text/hexadecimal editor**.
Notifications	
Reset all hidden notifications	This button enables all previously disabled notification and warning messages.
User's file types	
File name	Specifies a file name and path to the file where the descriptions of user's known file types are stored. You need to re-start **R-Studio** or

	click the Reload User's File Types button on the Known File Types tab for the new file to take effect.
User's RAID layout	
File name	Specifies a file name and path to the file where the descriptions of user's RAID layouts are stored
HexView templates path	
Location	Specifies the path for pattern description files for **Text/Hexadecimal editor**.
User's file mask presets	
File name:	Specifies a file name and path to the file with file mask presets.

File Systems

File Systems **dialog box**



File Systems settings

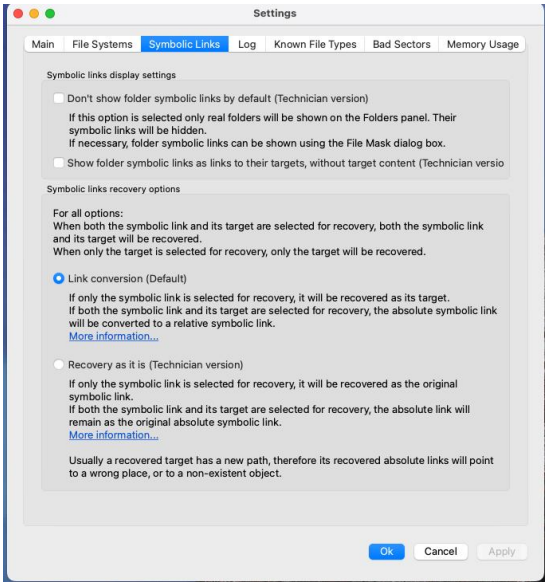
Default encoding for HFS volumes	
Encoding	Select the national encoding for the HFS partitions
Default encoding for Ext2/3/4FS/UFS1/UFS2 volumes	Select the national encoding for the Ext2/3/4, and UFS partitions.

Symbolic Links

Settings are available in the Technician version only!

Symbolic links (of symlinks for short) are object that contains references to other files or folders directory in the form of absolute or relative paths and that affect pathname resolution. For example, if a symlink `C:\ProgramData\Documents` points to `D:\Recovered Files\Root\Users\Public\Documents`, entering it will result in entering `D:\Recovered Files\Root\Users\Public\Documents`.

Symbolic Links **dialog box**



Symbolic Links

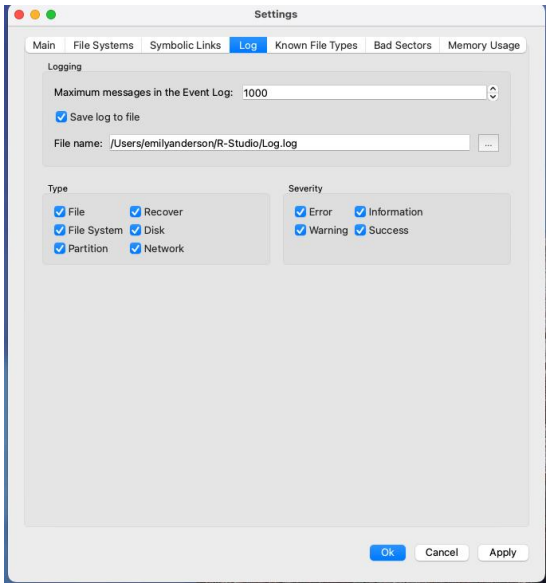
Don't show symbolic links by default (Technician version)	If this option is selected, **R-Studio** hides all symbolic links by default. Only real objects will be visible. You may make them visible by clearing the Hide symbolic links option on the **Mask** dialog box.
Link conversion (Default)	
Both an object and its symbolic link are selected for recovery:	If both an object and its symbolic link are selected for recovery, both the object and its symbolic link will be recovered. The file path in that symbolic link will be converted from absolute to relative. Example: If the object `C:\ProgramData\Documents` is a symbolic link to `C:\Users\Public\Documents`, it will be converted to a symbolic link to `..\Users\Public\Documents`. Therefore, the symbolic link will point to its object regardless of the place to which the object has been recovered.
Only an object is selected for recovery:	Only the selected object will be recovered.
Only a symbolic link is selected for recovery:	The selected symbolic link will be recovered as a real object.
Recovery as it is (Only in the Technician version)	
Both an object and its symbolic link are selected for recovery:	If both an object and its symbolic link are selected for recovery, both the object and its symbolic link will be recovered. The file path in that symbolic link will remain the same. **Example:** The place to store recovered data: `D:\Recovered Files`. The object to recover: `C:\Users\Public\Documents` The symbolic link: `C:\ProgramData\Documents` **After recovery:**

	The recovered object: `D:\Recovered Files\Root\Users\Public\Documents` The recovered symbolic link: `D:\Recovered Files\Root\ProgramData\Documents` pointing to `C:\Users\Public\Documents`. Therefore, if someone tries to enter to the symbolic link, the system will open the object `C:\Users\Public\Documents`, rather than recovered `D:\Recovered Files\Root\Users\Public\Documents`.
Only an object is selected for recovery:	Only the selected object will be recovered.
Only a symbolic link is selected for recovery:	The symbolic link will be recovered as a symbolic link which may contain a path to a nonexistent object.

The Data Recovery Topics topic explains processing of symbolic links recovery in more detail.

Log

Log **dialog box**



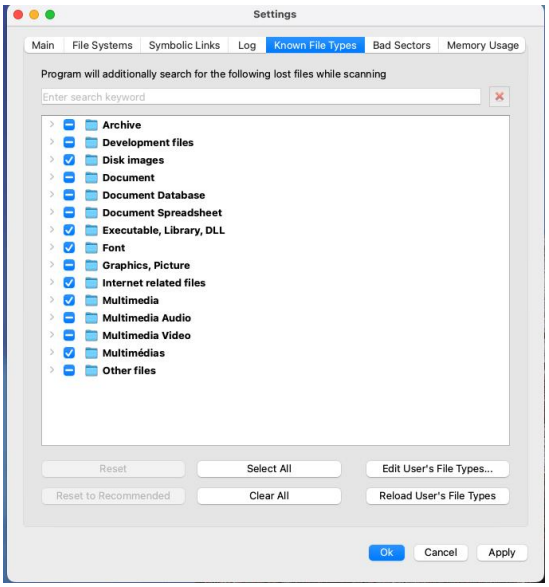
Log options

Maximum messages in the Event Log	Specifies the number of messages stored in the log file
Logging	
Save log to file	If this checkbox is selected, **R-Studio** writes its log into a log file specified in the File name field.
File name	Specifies the file name of the log file. If that file already exists, the data will be appended to that file.
Type	

Files	If this checkbox is selected, **R-Studio** logs all events with files.
File System	If this checkbox is selected, **R-Studio** logs all events with the file system.
Partition	If this checkbox is selected, **R-Studio** logs all events with FAT.
Recover	If this checkbox is selected, **R-Studio** logs all events with the recovering processes.
Disk	If this checkbox is selected, **R-Studio** logs all events with disks.
Network	If this checkbox is selected, **R-Studio** logs all events with network operation.
Severity	
Error	If this checkbox is selected, **R-Studio** adds error messages into its log.
Warning	If this checkbox is selected, **R-Studio** adds warning messages into its log.
Information	If this checkbox is selected, **R-Studio** adds information messages into its log.
Success	If this checkbox is selected,, **R-Studio** adds success messages into its log.
NEVER WRITE A LOG FILE ON THE DISK FROM WHICH YOU RECOVER DATA!!! Or you may obtain unpredictable results and lose all your data.	

Known File Types

Known File Types **dialog box**



You may specify which **Known File Types** will be enabled/disabled by default. You may also specify know file types to search for during a specific scan session on the Scan dialog box.

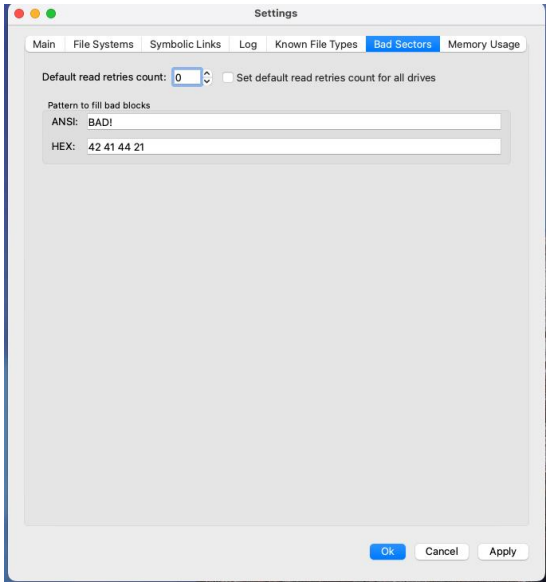
- ***Known File Types***

Reset	Click this button to reset the settings to the previous state. Active until the **Apply** button is clicked.
Select All	Click this button to select all file types in the list.
Clear All	Click this button to clear all file types in the list except some predefined ones.
Reload User's File Types	Click this button to apply new file types after the user's file types file has been changes from the Main tab.

Edit User's File Types	Click this button to add a new customer's Known File Type, or to edit already existing ones. See the Customizing File Types help page for more details

Bad Sectors

Bad Sectors **dialog box**

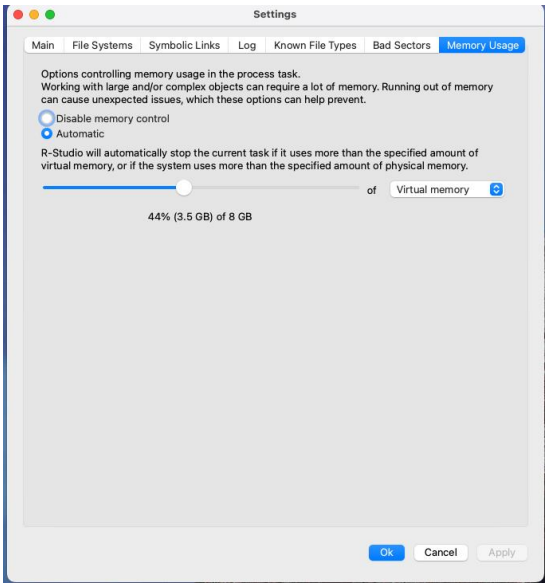


Bad Sectors settings

Default read retries	Specifies how many times **R-Studio** will try to read a bad sector. You may specify this parameter for each drive separately on the Properties tab. **R-Studio** treats bad sectors in the following way: It reads a certain part of disk (predefined by Windows) and • If Default read retries is set to 0, the entire part with bad sectors will be filled with the specified pattern. • If Default read retries is set to a non-zero value, **R-Studio** reads again that part sector by sector, repeating the attempts the specified number of times. If **R-Studio** still cannot read a bad sector, it fills the sectors with the specified pattern. In this case only the bad sectors will be filled with the pattern, but that extremely slows the disk read process. For example, if you set Default read retries to 1, a bad sector will be read 2 times.
Set for all drives	Click this button to reset I/O Tries for all drives to the default value.
Pattern to fill bad blocks	Specifies a pattern **R-Studio** will use to fill bad sectors in files to recover, in images, or when showing data in the **Text/Hexadecimal Editor**. You may specify the pattern either in the ANSI or Hex data format. **Note: R-Studio** will never ever try to write anything on the disk from which data is to recover or an image is to create.

Memory Usage

Memory Usage **dialog box**



These settings control how much memory **R-Studio** uses for its work. They help preventing **R-Studio** from locking when trying to perform very memory-consuming tasks like scanning large disks or processing file systems with a lot of files.

Memory Usage settings

Disable memory control	If this option is selected, the memory control is disabled.
Automatic	If this option is selected, **R-Studio** will automatically stop performing the task when the amount of used memory reaches the specified value. You may specify the limit for either the virtual or physical memory.

You may see how much memory **R-Studio** actually uses on the Memory Usage dialog box.

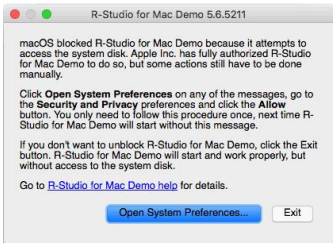
1.6 High Sierra- Monterey: Running R-Studio for the First Time

When you start **R-Studio** for the first time on macOS High Sierra - Monterey, a System Extension Blocked warning message will appear.

System Extension Blocked **message**

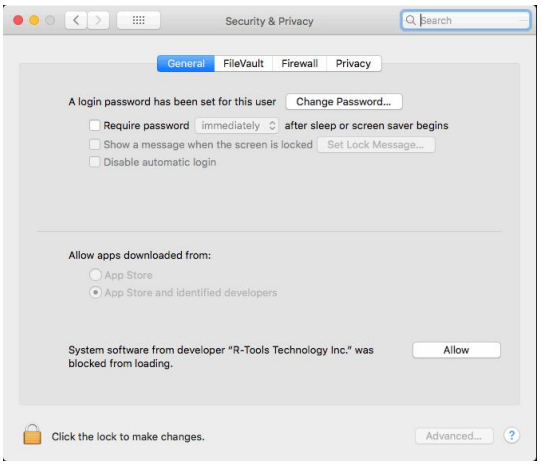
At the same time **R-Studio** will throw its own message:

R-Studio Warning Message



If you need access to your system disk, click the **Open Security Preferences** button on any of the messages, go to the **Security and Privacy** preferences, and click the **Allow** button..

Security and Privacy preferences



R-Studio will start with full access to your system disk. You need to follow this procedure only once, next time **R-Studio** will start without these messages.

If you don't want to unblock **R-Studio**, click the **Exit** button on the **R-Studio's** message. **R-Studio** will start and work properly, but without access to the system disk and when you start **R-Studio** next time, its message will appear again. You will be able to unblock the program if needed.

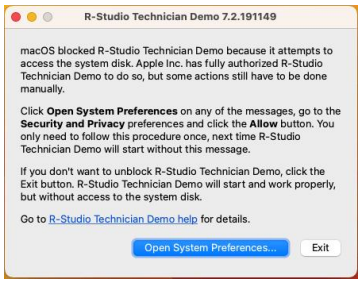
1.7 Ventura+: Running R-Studio for the First Time

When you start **R-Studio** for the first time on a Mac computer with Apple Silicon running under macOS Ventura, a System Extension Blocked warning message will appear.

System Extension Blocked **message**

At the same time **R-Studio** will throw its own message:

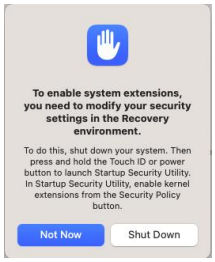
R-Studio Warning Message



If you need access to your system disk, click the **Open System Preferences** button on any of the messages, go to the **Privacy & Security** preferences, select **App Store and identified developers** in the **Security** section.

The To enable system extensions, you need to modify your security settings in the Recovery environment message will appear.

To enable system extensions...



Click the **Shutdown** button.

Wait until you Mac is completely off and restart it to **macOS Recovery Mode**.

Loading to macOS Recovery Mode

1. Quickly press the **Touch ID** button and then quickly hold it until the **Loading up startup options** message will appear on the screen.
2. Click **Options** and then click **Continue**.

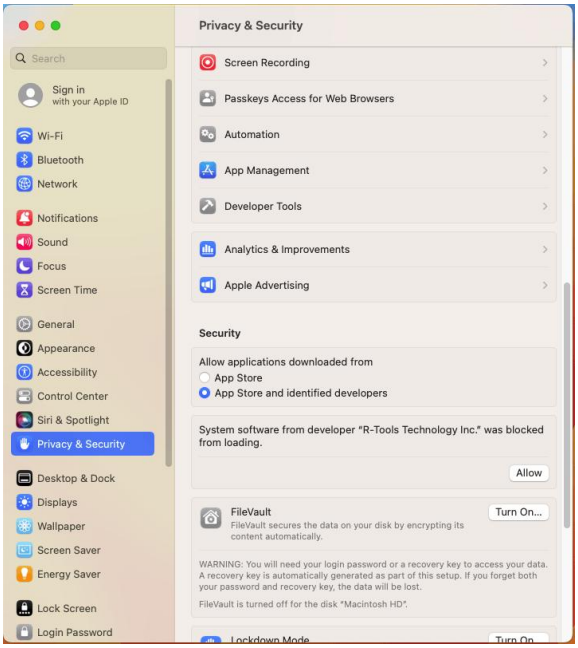
Select **Startup Security Utility** from the **Utilities** menu and then click **Security Policy...**

In **Startup Security Utility**, select **Reduced Security** and then **Allow user management of kernel extensions from identified developers.**

Click the **OK** button and then restart your computer.

Upon restart, go to the go to the **Privacy & Security** preferences again and click the **Enable System Extensions...** button in the **Security** section.

Security



And restart computer.

R-Studio will start with full access to your system disk. You need to follow this procedure only once, next time **R-Studio** will start without these messages.

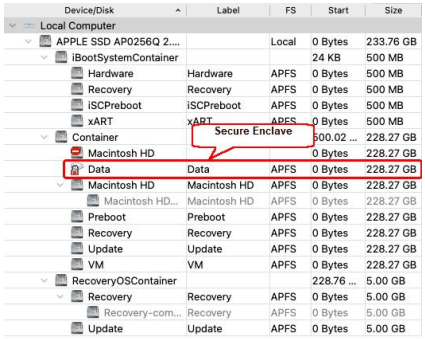
If you don't want to unblock **R-Studio**, click the **Exit** button on the **R-Studio's** message. **R-Studio** will start and work properly, but without access to the system disk and when you start **R-Studio** next time, its message will appear again. You will be able to unblock the program if needed.

II Data Recovery Using R-Studio

File recovery from Apple computers with Secure Enclave.

Due to hardware implementation of data encryption, data recovery from Apple's Secure Enclave is currently impossible.

Secure Enclave



Secure Enclave is used in Intel-based Mac computers that contain the Apple T2 Security Chip and Mac computers with Apple silicon.

Many specific data recovery cases are discussed in the R-TT's Data Recovery Guide.

Depending on the situation, data recovery may vary:

1. **Recovery of deleted files that have resided on an existing logical disk**

   This can be done using Basic File Recovery.

2. **Recovery of files that have resided on a data disk with a damaged file system, or on a previously deleted or re-formatted partition**

   If the file system on such logical disk is damaged, the operating system does not see that logical disk as a partition without a valid file system. Such partition should be previously scanned. Also, it should be scanned if you want to recover data on a previously deleted or re-formatted partition.

   You may use Fast Search for Lost partitions if you want only to find partitions previously existed on the disk. It's much faster.

   When the partition is scanned, a number of recognized partitions will appear. **R-Studio** shows them in different colors depending on which elements of the partition have been found.

/Volumes/exFAT	An existing partition
Rec. HFS (Recognized)	An existing partition after drive scan
Rec. Recognized	A recognized partition. Both boot records and file entries are found for this partition
Rec. Recognized	A recognized partition. Only file entries are found for this partition
Rec. Recognized	A recognized partition. Only boot records are found for this partition
Rec. Recognized	A fast found partition
Empty Space	Empty space on the object
DeletedPart	A deleted partition
Rec. Raw Files	Files that have been found using scan for known file types (raw file search).

   Although such recognized partitions are virtual objects, files can be searched for and recovered from recognized partitions as from real logical disks using Basic File Recovery.

   To successfully recover files from a recognized partition, it is necessary to find a right one which corresponds to the real logical disk on which the files resided. No strict rules can be applied to that, but the following considerations should be taken into account:

   - If you are going to recover files from a **disk with a damaged file system**, most likely the right recognized partition will be a green one.
   - If you are going to recover files from a **previously deleted** or **re-formatted partition**, most likely the right recognized partition will be a yellow one.

   Also always check the recognized partition's file system, start point, and size. They should be the same for the recognized partition and real logical disk/partition. When in doubt, try to preview a couple of files from the recognized partition. If the files are seen correctly, this is the right partition.

R-Studio Features
Contact Information and Technical Support
Basic File Recovery
Advanced Data Recovery
Mass File Recovery

2.1 Basic File Recovery

NEVER TRY TO SAVE RECOVERED FILES/FOLDERS TO THE SAME LOGICAL DISK WHERE THEY RESIDE!!!

Or you may obtain unpredictable results and lose all of your data.

See the **Data Recovery Issues** topic for details.

Basic file recovery can be made for deleted files that has resided on an existing disk visible by the operating system. In all other cases, Advanced Data Recovery is required.

To recover deleted files from a logical disk (recognized partition),

1 **Double-click a logical disk on the R-Studio's** Drives **panel to enumerate files on the disk**

Other ways to enumerate files

- Select the disk and click the **Open Drive Files** button,

or

- Control-click the selected disk and select **Open Drive Files** on the contextual menu,

or

- Select **Open Drive Files** on the **Drive** menu

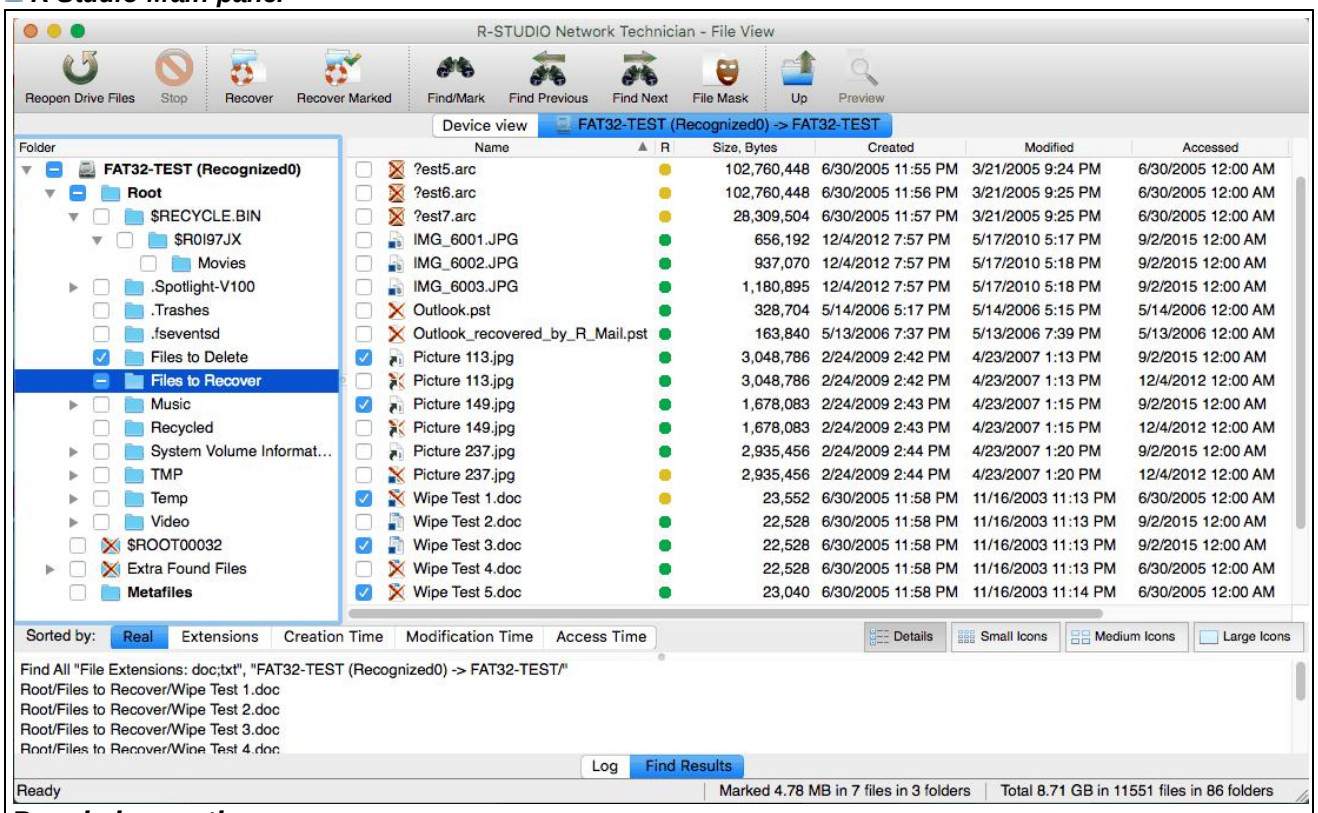
If you try to enumerate files on a hard drive or another object without a valid file system on it, a Double-click a logical disk... message will appear. Select a logical disk on the object or scan the object.

2 **R-Studio will change its panel showing the disk's folders/files structure**

R-Studio analyzes data on the object and displays all files which records have been found in the analyzed tables. Then deleted files, which records still remain, can be recovered. If files have not been found, that means that their records have been deleted. To find such files, Advanced Data Recovery is required.

Please note that **R-Studio** shows only those files/folders that match a specified file mask.

R-Studio Main panel



Panel view options

You may set which panels and bars to enable/disable. To enable/disable

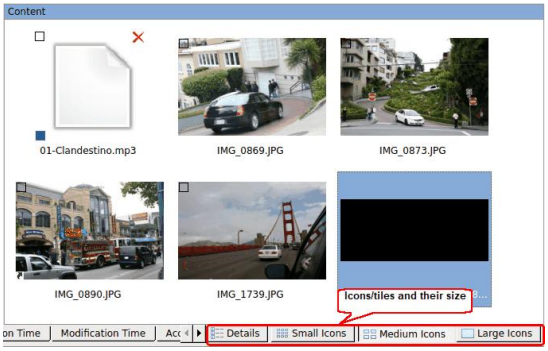
The **Toolbar**	Select/clear **Toolbar** on the **View** menu
Toolbar Button Text	Select/clear **Toolbar Button Text** on the **View** menu
The **Status** bar	Select/clear **Status bar** on the **View** menu
The Folders panel	Select/clear **Folders View** on the **View** menu
The Files panel	Select/clear **Contents View** on the **View** menu
The Log panel	Select/clear **Event Log** on the **View** menu
The Find Results panel	Select/clear **Find Results** on the **View** menu

You may also arrange the data as required. On the **View** menu, select **Arrange** and them a required arrangement.

You may specify which columns will be visible on the Files panel. On the **View** menu, select **Contents Columns**, and select the columns you want to see.

Files can be shown as a list or as icons/tiles of different sizes.

Files shown as icons/tiles



Recovery chances

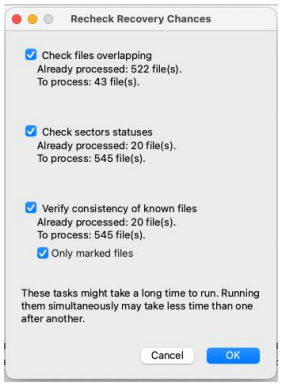
R-Studio shows its estimates of chances for successful file recovery in the **Rec** column.

Recovery chances

	Undefined
	Good
	Above average
	Average
	Below average
	Bad

When **R-Studio** has enumerated files, those estimates may not be accurate and aren't available for most files. You may improved them by control-clicking any folder on the Content pane and selecting **Recheck Recovery Chances** on the contextual menu, and specifying required parameters.

.

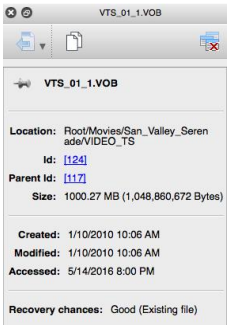


The best estimations are though after scanning the disk/partition

File Information

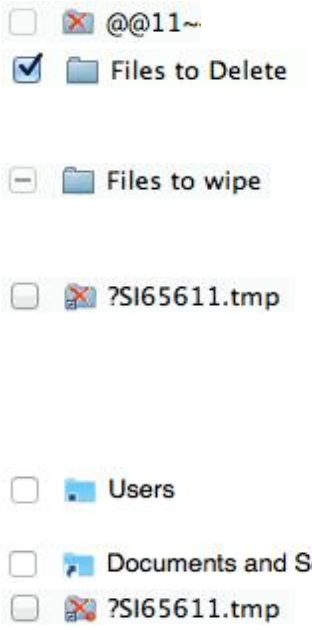
You may view some information about a file. Control-click the file and select **Get Info** on the context menu.

File Information



R-Studio Technician/T80+ shows much more information about a file. See the Information about a File topic for more details.

Folders panel



Deleted folder

Marked folder (all child objects in this folder are marked)

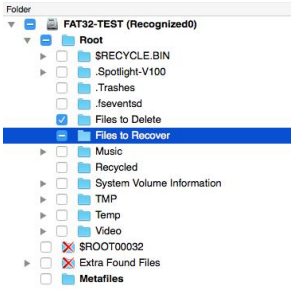
Partially marked folder (some child objects in this folder are marked)

Cross-linked deleted folder (A FAT folder containing data which also belongs to other FAT folders.)

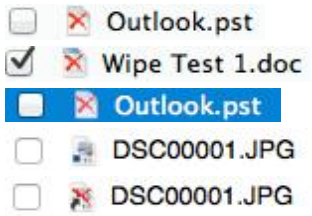
Target of a symlinked folder

Symlink to a folder

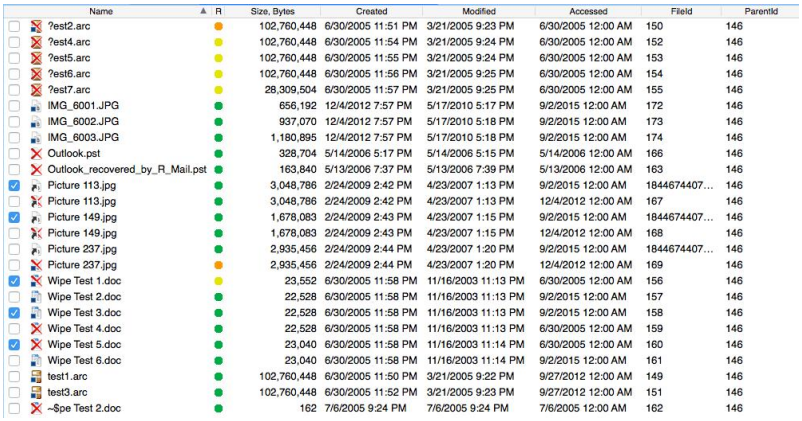
Questionable deleted folder (A FAT folder found by **R-Studio**, but with apparently invalid content.)



Files panel:



Deleted file:
Marked deleted file
Selected deleted file
Target of a hard link
Hard link to a file

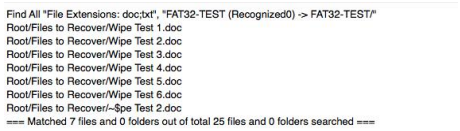


Name	R	Size, Bytes	Created	Modified	Accessed	FileId	ParentId
?est2.arc		102,760,448	6/30/2005 11:51 PM	3/21/2005 9:23 PM	6/30/2005 12:00 AM	150	146
?est4.arc		102,760,448	6/30/2005 11:54 PM	3/21/2005 9:24 PM	6/30/2005 12:00 AM	152	146
?est5.arc		102,760,448	6/30/2005 11:55 PM	3/21/2005 9:24 PM	6/30/2005 12:00 AM	153	146
?est6.arc		102,760,448	6/30/2005 11:56 PM	3/21/2005 9:25 PM	6/30/2005 12:00 AM	154	146
?est7.arc		28,309,504	6/30/2005 11:57 PM	3/21/2005 9:25 PM	6/30/2005 12:00 AM	155	146
IMG_6001.JPG		656,192	12/4/2012 7:57 PM	5/17/2010 5:17 PM	9/2/2015 12:00 AM	172	146
IMG_6002.JPG		937,070	12/4/2012 7:57 PM	5/17/2010 5:18 PM	9/2/2015 12:00 AM	173	146
IMG_6003.JPG		1,180,895	12/4/2012 7:57 PM	5/17/2010 5:18 PM	9/2/2015 12:00 AM	174	146
Outlook.pst		328,704	5/14/2006 5:17 PM	5/14/2006 5:15 PM	5/14/2006 12:00 AM	166	146
Outlook_recovered_by_R_Mail.pst		163,840	5/13/2006 7:37 PM	5/13/2006 7:39 PM	5/13/2006 12:00 AM	163	146
Picture 113.jpg		3,048,786	2/24/2009 2:42 PM	4/23/2007 1:13 PM	9/2/2015 12:00 AM	1844674407...	146
Picture 113.jpg		3,048,786	2/24/2009 2:42 PM	4/23/2007 1:13 PM	12/4/2012 12:00 AM	167	146
Picture 149.jpg		1,678,083	2/24/2009 2:43 PM	4/23/2007 1:15 PM	9/2/2015 12:00 AM	1844674407...	146
Picture 149.jpg		1,678,083	2/24/2009 2:43 PM	4/23/2007 1:15 PM	12/4/2012 12:00 AM	168	146
Picture 237.jpg		2,935,456	2/24/2009 2:44 PM	4/23/2007 1:20 PM	9/2/2015 12:00 AM	1844674407...	146
Picture 237.jpg		2,935,456	2/24/2009 2:44 PM	4/23/2007 1:20 PM	12/4/2012 12:00 AM	169	146
Wipe Test 1.doc		23,552	6/30/2005 11:58 PM	11/16/2003 11:13 PM	6/30/2005 12:00 AM	156	146
Wipe Test 2.doc		22,528	6/30/2005 11:58 PM	11/16/2003 11:13 PM	9/2/2015 12:00 AM	157	146
Wipe Test 3.doc		22,528	6/30/2005 11:58 PM	11/16/2003 11:13 PM	9/2/2015 12:00 AM	158	146
Wipe Test 4.doc		22,528	6/30/2005 11:58 PM	11/16/2003 11:13 PM	6/30/2005 12:00 AM	159	146
Wipe Test 5.doc		23,040	6/30/2005 11:58 PM	11/16/2003 11:14 PM	6/30/2005 12:00 AM	160	146
Wipe Test 6.doc		23,040	6/30/2005 11:58 PM	11/16/2003 11:14 PM	9/2/2015 12:00 AM	161	146
test1.arc		102,760,448	6/30/2005 11:50 PM	3/21/2005 9:22 PM	9/27/2012 12:00 AM	149	146
test3.arc		102,760,448	6/30/2005 11:52 PM	3/21/2005 9:23 PM	9/27/2012 12:00 AM	151	146
~$pe Test 2.doc		162	7/6/2005 9:24 PM	7/6/2005 9:24 PM	7/6/2005 12:00 AM	162	146

You may also arrange the data as required: by their extensions, creation/modification time, or as a real file structure

See Find and Mark Multiple Files for more details

Find Results panel



Reopen Drive Files
Click this button to list files again.

Recover
Click this button to recover selected folders/files.

Recover Marked
Click this button to recover marked folders/files.

Find
Click this button to find or/and mark a particular file/folder.

Find Next
Click this button to find the next object specified in the **Find/Mark** dialog box.

Find Previous
Click this button to find the previous object specified in the **Find/Mark** dialog box.

File Mask
Click this button to specify a file mask.

Stop
Click this button to stop the current operation.

Up
Click this button to move highlighting one folder up.

The Log panel will show how many files and folders are on the object, and their size. You may specify which events will be shown in the log pane by setting a log filter.

Note: Metafiles are the file system's internal files invisible to any user, or file system data, which **R-Studio** represents as files. These files do not contain user data directly. Unless you want to scrutinize a disk file system, do not restore them.

If the Too many files... message appears, you may temporally stop file listing and browse through found files. Then you can resume file listing. You also may skip this file topic and continue. **R-Studio** will keep information about the entire file structure.

You may also copy the information about folders and files.

For the folder (the Folders pane):

Click **Copy Folder**:	To copy the folder's name
Click **Copy Path**:	To copy the path to the folder

For the file (the Contents pane):

Click **Copy (Column Name)**:	To copy the file's **Name**, **Size**, **Created**, etc., depending on which column is selected
Click **Copy Path**:	To copy the file path.
Click **Copy Selected Text**:	To copy all the columns of the selected file.

3 Select a file/folder to recover

You may select several files/folders in the same parent folder by pressing the **Shift** button and clicking the objects simultaneously.

Marking multiple files/folders from different parent folders manually:

Mark a file/folder to recover by clicking the box left to the object, or select **Mark** on the contextual menu. You may mark several files/folders in different parent folders. You may mark all objects in the folder by selecting **Mark All** on the **Tools** or contextual menu. To unmark an object, click the box left to the object once more or select **Unmark** on the contextual menu. You may unmark all objects in the folder by selecting **Unmark All** on the **Tools** or contextual menu.

The Log panel will show how many files and folders you have marked, and their total size.

R-Studio can search for a particular file. Go to the Searching for a File topic for details. If you need to find and mark many files, go to the Find and Mark Multiple Files topic for details.

File content may be previewed before recovery. Go to the Previewing Files topic for details.

If you do not find files that you want to recover:

Sometimes **R-Studio** can find the files but not the entire file paths to them. It puts such files into the **Extra Found Files** folder. Try to search for the files there. If that does not help, try to find them by using file search globally on the entire disk. Go to the Searching for a File topic for details

If you still cannot find files that you want to recover but are sure they have existed on the logical disk, you need to use Advanced Data Recovery to find them.

4 Click the Recover or Recover Marked button

Other ways to recover selected files

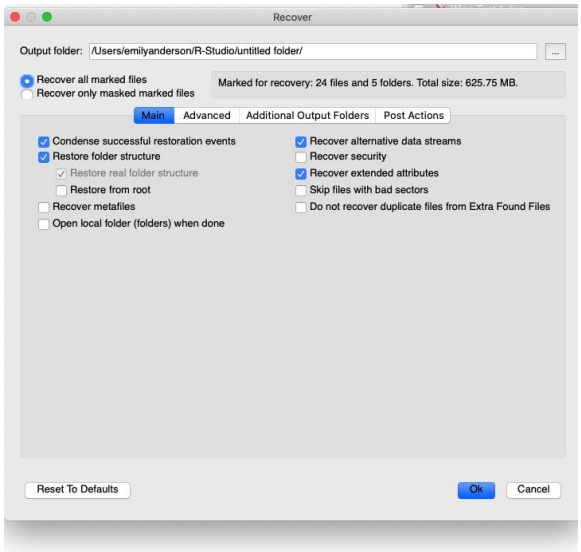
- Control-click the selected file/folder and select **Recover** or **Recover Marked** on the contextual menu,

or

- Select **Recover** or **Recover Marked** on the **File** menu

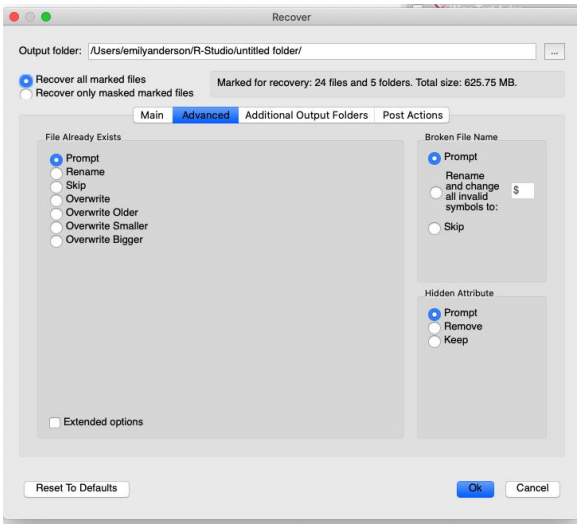
5 Specify recover options and output folder on the Recover **dialog box and click the OK button**

Recover **dialog box**



If you have another computer connected to **R-Studio** over network, the Recover dialog box will be slightly different. See **Data recovery over network** for details.

Recover (Advanced) **dialog box**



Recover options

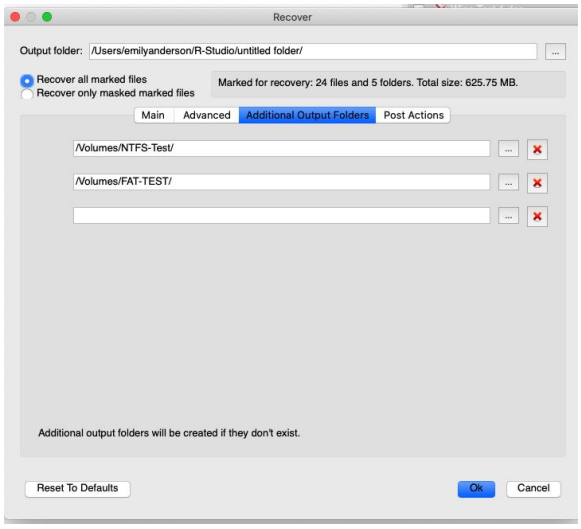
Recover all marked files	All files, regardless of the applied mask, will be recovered.
Recovered only masked marked files	Only files matching the applied mask will be recovered.
Condense successful restoration events	If this check box is selected, **R-Studio** will display only error and warning messages in its Log
Restore folder structure	If this check box is selected, **R-Studio** recovers the entire path to the selected object.
Restore from root	If this check box is selected, **R-Studio** recovers the entire path to the selected object starting from the root folder of the disk.
Recover metafiles	If this check box is selected, **R-Studio** recovers disk metafiles. Metafiles are the file system's internal files invisible to any user, or file system data, which **R-Studio** represents as files. These files do not contain user data directly. Unless you want to scrutinize a disk file system, do not restore them.
Recover alternative data streams	If this check box is selected, **R-Studio** recovers alternative data streams for file systems that support them. Has no effect on FAT files. See **Extended Information Recovery** for the NTFS file system, and **Data Recovery on HFS/HFS+ File System** for the Mac computers.
Recover security	If this check box is selected, **R-Studio** recovers security attributes for NTFS files. Has no effect on FAT files. See **Extended Information Recovery** for details.
Recover extended attributes	If this check box is selected, **R-Studio** recovers extended (HPFS) file attributes.
Recover real folders structure	Enabled when the files are sorted by their extensions or date. See **Find and Mark Multiple Files** for details. If this check box is

	selected, **R-Studio** recovers the real folders/files structure on the disk rather than that of sorted files.
Skip files with bad sectors	If this check box is selected, **R-Studio** skips files with bad sectors and displays their list on the Files with bad sectors dialog box when the recovery has been completed. You may separately decide later what to do with those files. See **Bad sectors** for details. If this check box is cleared, **R-Studio** tries to read those sectors several times (specified on the Settings/Bad Sectors dialog box), and, if fails, fills bad sectors in the recovered file with the pattern specified on the same box. Information about such files will appear in the Log.
Do not recover duplicate files from Extra Found Files	If this check box is selected, **R-Studio** does not recover files from Extra Found Files (raw files) that coincide with files recovered from the file system.
Ignore file mask	If this check box is selected, **R-Studio** recovers all content of a selected folder, ignoring a specified **File Mask**.
Open local folder (folders) when done	If this check box is selected, the folder with recovered files will be opened upon recovery completion.
Advanced	Specifies options for mass file recovery

If you want to recover multiple files at once, go to the Recover Multiple Files for more information

R-Studio Technician/T80+

Recover (Additional Output Folders) **dialog box**



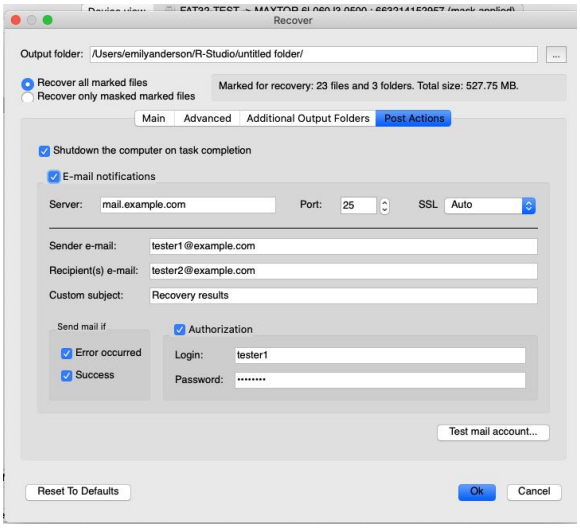
Additional Output Folders

Additional Output Folders	Additional output folders where recovered files will be stored when **R-Studio** runs out of space.

NEVER TRY TO SAVE RECOVERED FILES/FOLDERS TO THE SAME LOGICAL DISK WHERE THEY RESIDE!!!

Or you may obtain unpredictable results and lose all of your data.

Recover (Post Actions) **dialog box**

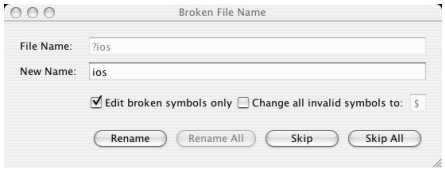


Post Actions Options

Shutdown the computer on task completion	If this check box is selected, **R-Studio** will shut down your computer when file recovery has been completed. The program will warn you if any option on the Advanced tab is set to Prompt.
E-Mail notifications	If this check box is selected, **R-Studio** will inform you about the outcome of the operation via email.

If a file to be recovered appears to have an invalid name, a Broken File Name dialog box will appear. You may correct the name and resume file recovery.

Broken File Name **dialog box**



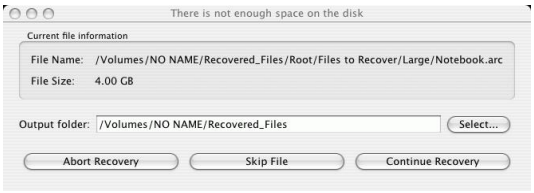
Broken File Name properties

File name	Shows the current incorrect file name.
New name	Field for a new file name.
Edit broken symbols only	If this check box is selected, only invalid symbols may be corrected
Change all invalid symbols to	If this check box is selected, all invalid symbols will be changed to the specified symbol

Buttons	
Rename	Click to resume file recovery
Rename All	Click to resume file recovery. All other files will be renamed according to the specified rule.
Skip	Click to skip this file
Skip All	Click to skip all files and stop file recovery

If there is no space available for the recovered files, the There is not enough space on the disk dialog box will appear. You may either select other place to store the files, skip that particular file or abort the recovery process.

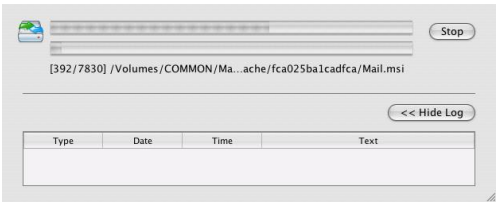
There is not enough space on the disk **dialog box**



> **R-Studio will recover the selected/marked files/folders to the specified folder and show the results in the** Log **pane**

The Recovery progress indicator will show the log and progress of recovery process.

Recovery progress indicator



Note: R-Studio recovers files from Ext2/3/4FS partitions, but writes it to FAT or NTFS local disks. Or you may write such files to network disks. **R-Studio** successfully recovers files from Ext2/3/4FS partitions except its security attributes. **R-Studio** recovers *symlinks* as files containing the path to files which *symlinks* point to.

2.1.1 Opening several partitions in one tab

You may open several partitions in one tab. Then you may search for files and recover them from several partitions at once. This is especially useful if files are to be recovered from several recognized partitions found on one real partition or a drive.

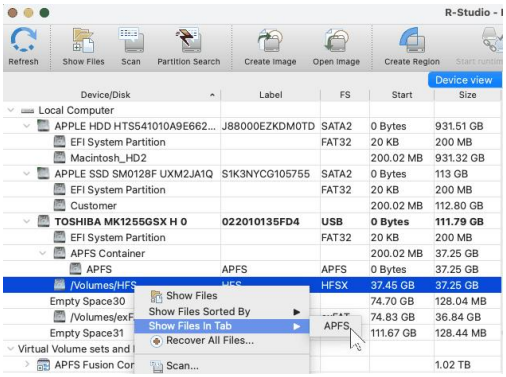
To open several partitions in one tab,

1 **Open one partition in a usual way (double-click a partition, for example).**

2 Control-click the next partition, select Show Files In Tab, and select the tab you want the partition appear in, or

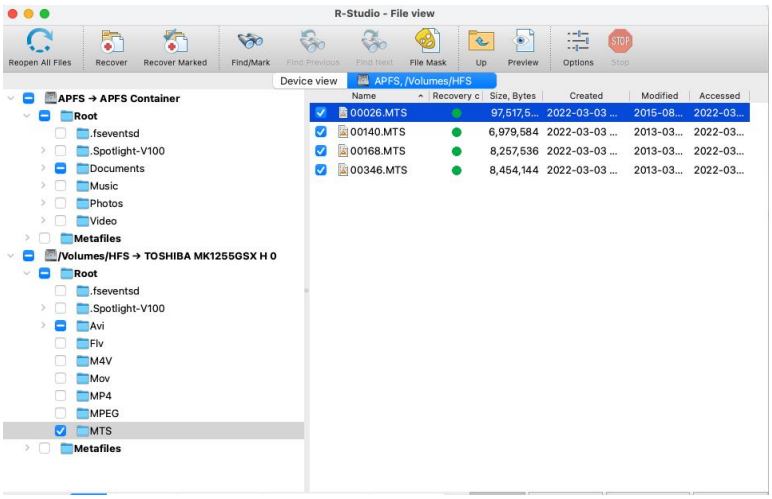
drag the partition from the Device view to the required tab.

Several partitions in one tab



> R-Studio will show files from several partitions in one tab

Several partitions in one tab

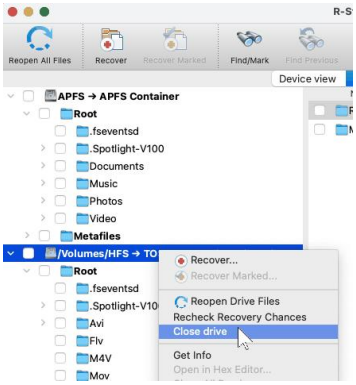


Now files may be searched for, marked for recovery, and recovered.

To remove a partition from the tab,

1 Control-click the required partition in the tab and select Close drive in the contextual menu.

Several partitions in one tab



> **R-Studio remove the selected partition from the tab**

2.1.2 Searching for a File

R-Studio can find a particular file, if it is difficult to find it manually on the Folders or Files panel. You can also automatically mark all found files.

To search for a file,

1 **Click the Find button**

Other ways to search for the file

- Control-click a folder and select **Find** on the contextual menu,

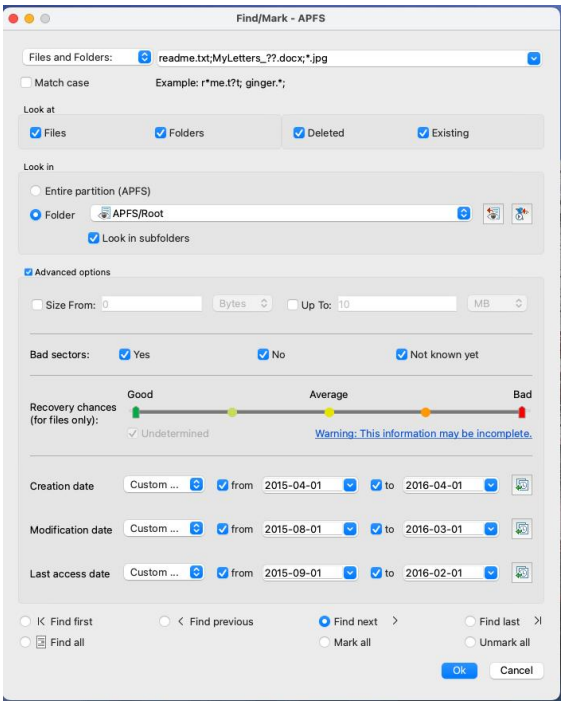
or

- Select a folder and select **Find** on the **Tools** menu

2 **Specify a file to be found and its options on the** Find **dialog box, and click the OK button**

Note that a **File Mask** may be applied.

Find / Mark **dialog box**



Find/Mark options

You may specify how to treat specified strings. Please note that **R-Studio** stores previously entered search strings.	
All Files and Folders	If this option is selected, **R-Studio** applies Advanced Options to all files.
File Extensions	If this option is selected, **R-Studio** treats specified strings as file extensions
Files and Folders	If this option is selected, **R-Studio** treats specified strings as file names. Use ? for one unspecified character and * for an unlimited number of them to specify file masks.
Regular Expressions	If this option is selected, **R-Studio** treats specified strings as regular expressions

File Id	Specifies File Id that **R-Studio** assigns to a file.
Match case	If this check box is selected, **R-Studio** makes a case-sensitive search
Look at	
Files	If this check box is selected, **R-Studio** includes files into a search.
Folders	If this check box is selected, **R-Studio** includes folders into a search. Disables when the Mark/Unmark All option is selected.
Deleted files	If this check box is selected, **R-Studio** makes a search among deleted files/folders.
Existing files	If this check box is selected, **R-Studio** makes a search among existing files/folders.
Look in	Specifies where **R-Studio** searches for, and marks, files. It can look for them on the Entire disk, or in/from a certain folder. You may specify the starting folder for the search.   identifies current opened folder.  identifies current starting folder for the search.  sets starting folder to the current opened folder.  sets back current starting folder.
Advanced options	If this check box is selected, **R-Studio** will use the advanced options.
Size from/up to	Specifies file size limits. See the **Data Formats and Multipliers** topic for more details on data formats.
Bad sectors	Specifies whether there are bad sectors in the files. Not known: it's unclear if there are bad sectors in the files.
Runtime image	Specifies whether the files have already been included into the runtime image.
Recovery Chances	Specifies files with certain recovery chances.
Date	Specifies file date boundaries. Dates for Modified, Created, and Last Accessed timestamps may be set separately.
	The **Set for all** button sets the specified data for all fields.
Find/Mark options	Specify what **R-Studio** does with the found files. The Find first/previous/next/last options. **R-Studio** stops at the first/previous/next/last file that matches the specified search criteria. Find all files. **R-Studio** searches for all files that matches the specified search criteria.. The search results appear on the Find Results panel.

	Mark/Unmark All. **R-Studio** marks/unmarks all files that match the search criteria. When these options are selected, **R-Studio** marks/unmarks files only, not folders, regardless of what Look at: Folders specifies. Please note, that when performing a new find and mark/unmark task, **R-Studio** does not takes into consideration the previous marked/unmarked state of files. For example, if you first mark all doc files, and then all txt files, all doc files remain marked, too. To unmark them, you should specify doc once again and select Unmark files.
Find/mark objects only in real paths, ignore links to folders	If this check box is selected, links to folders will be treated as real folders: they will appear among search results or marked objects.

> **R-Studio will show/mark the found file(s)**

If you need to find and mark many files, go to the Find and Mark Multiple Files topic for details.

To repeat the search,

* **Click the Find Next or Find Previous buttons**

Other ways to repeat the search

- control-click a folder and select **Find Next** or **Find Previous** on the contextual menu

or

- Select a folder and select **Find Next** or **Find Previous** on the **Tools** menu

To find all files and show them on the Find Results panel,

* **Select** Find all **on the on the** Find **dialog box,**

or

select **Find all** on the **Tools** menu

> **R-Studio will show the found files on the** Find Results **panel**

You may do the following actions on the found files:

Recover, Mark, Preview

by control-clicking the found file and selecting the appropriate item in the contextual menu.

2.1.3 Finding Previous File Versions

R-Studio can find previous versions of files. It searches for them in the file's current folder and in **Extra Found Files**.

File versions are searched for using file size. If the size of a files is within 10% of the original filesize, the following conditions are checked:

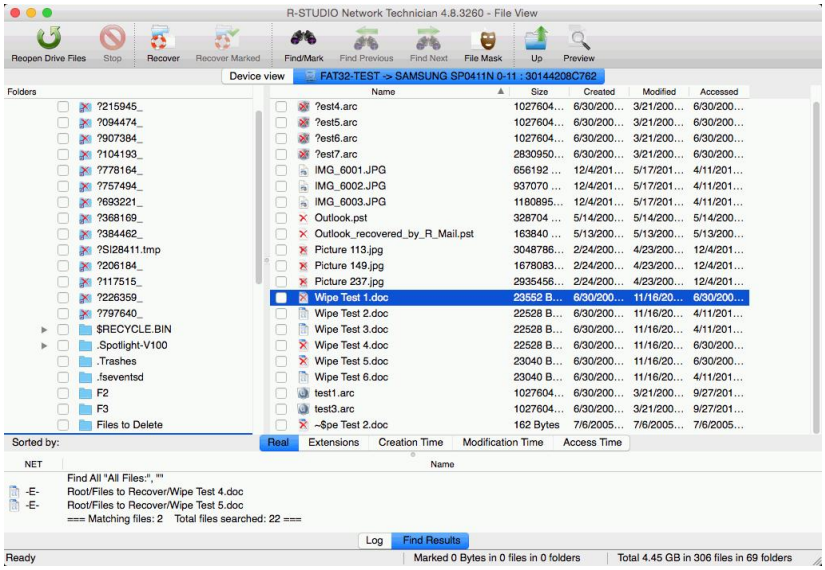
Conditions	Legend
File name	N
File extension	E
Recognized file type	T

To search for previous file versions,

1 Control-click the file and select Find Previous Versions of the File on the contextual menu

*** R-Studio will show the files in the list:**

File versions



This technique can be used to find deleted original files after attacks of file encrypting viruses.

2.1.4 Previewing Files

R-Studio has a built-in file previewer that allows you to preview both existing and deleted files. You may use this feature to estimate recovery or a file to be recovered.

Note: If you use a Mac computer with Apple Silicon, you may need to install Rosetta, a special macOS system component that enables execution of apps built exclusively for Intel-based Mac computers on Apple Silicon. If this is necessary, a respective dialog prompt will appear automatically the first time you start the previewer. Follow its instructions and then start the previewer once again. Remember that a working internet connection is required to download Rosetta.

If this dialog doesn't appear but the previewer doesn't start, you need to install Rosetta manually. Run Terminal, enter this string: `softwareupdate --install-rosetta`, and follow the on-line instructions.

While previewing a file in the external viewer, you may recover it or mark the file for recovery using Previewer buttons.

Previewer buttons

Mark for recovery, Previous file, Next file, Recover

To preview a file

1 Control-click a file to preview on the Files **panel and select Preview on the contextual menu**

Other ways to preview the file

- Select the file on the Files panel and click the **Preview** button,

or

- Select the file on the Files panel and select **Preview** on the **File** menu

2 R-Studio will show the content of the file

If you have several files open in the previewer, you may instantly close all of them by selecting **Close All Previews** on the **File** menu.

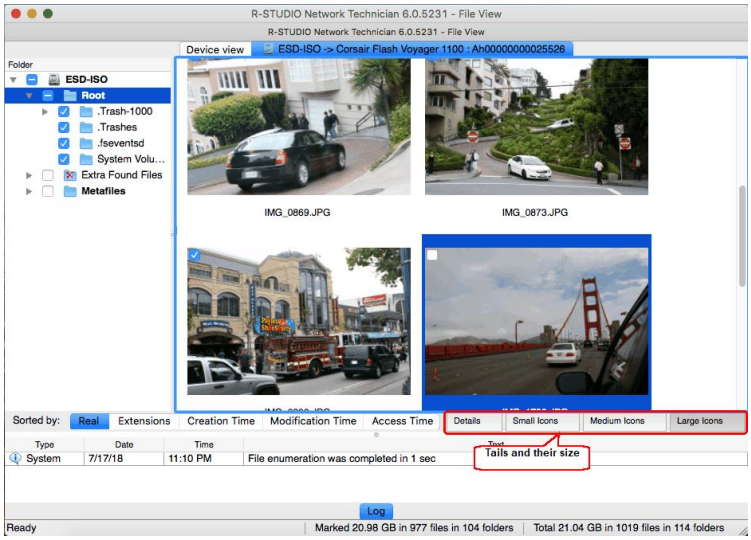
File Previewer for Pictures:

Pictures can be previewed either as tiles within the main window of **R-Studio** or in an external previewer.

Within the main window as tiles:

Tile size can be changed..

Pictures as tiles



In the external viewer:

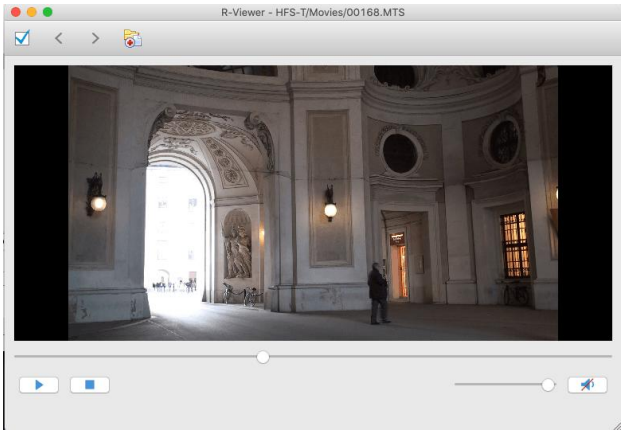
Picture files can be zoomed in/out and rotated.

Picture file previewer

File Previewer for Video and Audio files:

Video and audio files can be played even without their respective application installed.

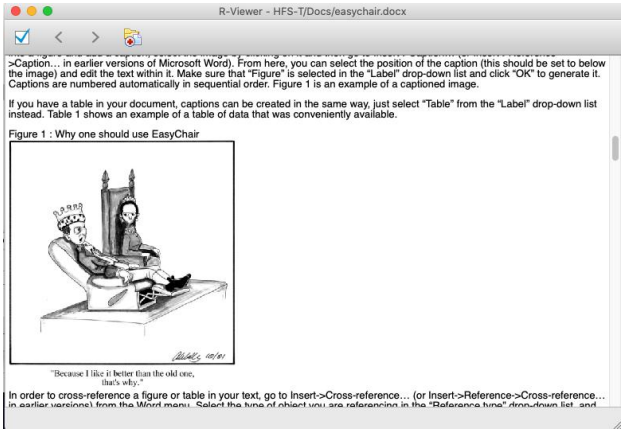
Video file previewer



File Previewer for Microsoft/Open/Libre Office Documents:

Documents can be shown (including embedded pictures) even without their respective applications installed. They can be zoomed in/out for better viewing.

Microsoft / Open / Libre Office document previewer

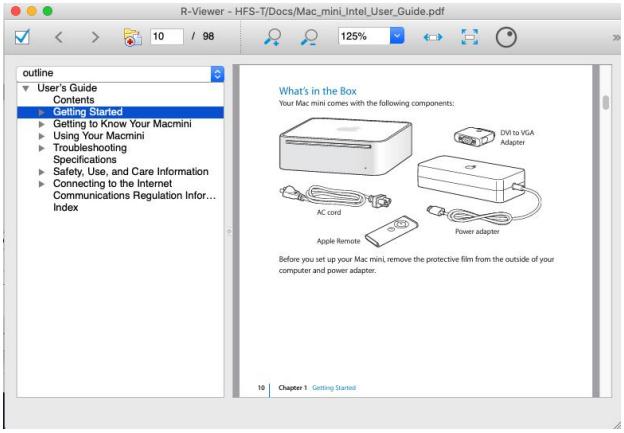


File Previewer for Adobe Acrobat PDF Files:

Files can be shown even without Adobe Acrobat installed.

The previewer allows the users to jump to a required page, zoom the document, and search for a required text.

Adobe Acrobat pdf document previewer



The files can be shown in different layouts and rotated. Click the View menu and select the required options.

Supported File Types:

Documents:

MS Office and **Open/Libre Office** files, even without the programs installed:

- Word/Writer documents: docx;
- Excel/Calc spreadsheets: xlsx;
- PowerPoint presentation: pptx.

Office 97-2003, without the program installed:

- Word documents: doc;
- Excel spreadsheets xls;
- PowerPoint presentation ppt.

Adobe Acrobat document: pdf.

Multimedia Files

Video formats:

AIFF, ASF, AVI, BFI, CAF, FLV, GIF, GXF, HLS, QuickTime, 3GP, MP4, Matroska, Maxis XA, MPEG-DASH, MPEG program stream, MPEG transport stream (including AVCHD), MXF, Material eXchange Format, SMPTE, MSN Webcam stream, NUT, Ogg, OMA, RL2, TXD, WTV.

Audio formats:

8SVX, AAC, AAC+, AC-3, ADPCM, AMR-NB, AMR-WB, Amazing Studio PAF Audio, Apple lossless audio, QuickTime, ATRAC, CELT, DCA (DTS Coherent Acoustics), DPCM, DSD (Direct Stream Digitial), DSP Group TrueSpeech, DST (Direct Stream Transfer), DV audio, FLAC (Free Lossless Audio Codec), G.723.1, G.729, GSM, IAC (Indeo Audio Coder), iLBC (Internet Low Bitrate Codec), IMC (Intel Music Coder), Interplay ACM, MACE (Macintosh Audio Compression/Expansion), MACE (Macintosh Audio Compression/Expansion), MLP (Meridian Lossless Packing), Monkey's Audio, MP1 (MPEG audio layer 1), MP2 (MPEG audio layer 2), MP3 (MPEG audio layer 3), MPEG-4 Audio Lossless Coding (ALS), Musepack SV7/SV8, Nellymoser Asao, AVC (Audio for Video Codec), PCM

A-law/mu-law, QCELP / PureVoice, QDesign Music Codec, RealAudio, Vorbis, Voxware MetaSound, WavPack, Westwood Audio, Windows Media Audio, Xbox Media Audio

Graphic files (with file extensions)

3DS Max thumbnail (max), AAA logo (bpr), ACE texture (ace), ADEX (img, rle), AIM Grey Scale (ima, im), AIPD image (aipd), ARF (arf), AT&T Group 4 (att), AT&T multigen (icn), AVHRR Image (sst), AVT RAW (raw), AWD (awd), Ability Photopaint Image (apx), Access (g4, acc), Aces200 (ace), Acorn Sprite (acorn), AdTech perfectfax (adt), Adobe Illustrator (ai), Adobe PhotoParade(images) (php), Adobe Photoshop (psd), Advanced Art Studio (ocp, art, pic), AirNav (anv), Album bébé (frm), Alias Image File (pix, als, alias), Alpha Microsystems BMP (bmp), Amapi (2d), Amica Paint (ami, [b]), Amiga IFF (iff, blk), Amiga icon (info), Amstrad Cpc Screen (cpc), Analyze (avw), Analyze-7 (img), Andrew Toolkit raster object (atk), Apollo HDRU (hdru, hdr, gn), ArcInfo Binary (hdr), Art Director (art), Artisan (art), Artist 64 (a64), Artrage (ptg), Artweaver Document (awd), Astronomical Research Network (arn), Atari grafik (pcp), Aurora (sim), Auto F/X (afx), AutoCAD DWG (dwg, dwt), AutoCAD DXF (dxf), Autocad CAD-Camera (img), Autodesk Animator (fli, flc), Autodesk QuickCAD thumbnail (cad), Autodesk SKETCH thumbnail (skf), Autodesk SketchUp component (skp, skb), Autologic (gm, gm2, gm4), Award Bios Logo (epa), Axialis Screensaver(images) (ssp), B3D(images) (b3d), BFLI (bfl, bfli, fli, flp, afl), BIAS FringeProcessor (msk, img, raw, flt), BLP textures (blp), BMF (bmf), BSB/KAP (kap), BYU SIR (sir), Bert's Coloring (bmg, ibg), Bfx Bitware (bfx), Bio-Rad confocal (pic), Blazing Paddles (pi), Bob Raytracer (bob), Brender (pix), Brooktrout 301 (brk, 301, brt), Brother Fax (uni), Buttonz & Tilez texture (til), CALS Raster (cal, cals, gp4, mil), CDU Paint (cdu), CGM (cgm), CImage (dsi), CMU Window Manager (cmu), CP8 256 Gray Scale (cp8), CSV (csv), Calamus (cpi, crg), Camera RAW (raw), Canon EOS-1D Mark II RAW (cr2), Canon Navigator Fax (can), Canon PowerShot (crw), Cartes Michelin (big), Casio QV-10/100 Camera (cam), Casio RAW (bay, raw), Chinon ES-1000 digital camera (cmt), Cisco IP Phone (cip), Cloe Ray-Tracer (clo, cloe), ColoRIX (rix, sci, scx, sc?), CompW (wlm), CompuServe GIF (gif, giff), Computer Eyes, Digital Vision (ce), ComputerEyes Raw (ce1, ce2), Contax RAW (bay, raw), Core IDC (idc), Corel Draw Bitmap(preview) (cdr), Corel Draw Pattern(preview) (pat), Corel Flow(preview) (bmf), Corel Metafile Exchange(preview) (cmx), Corel PhotoPaint 6.0 (cpt), CoverDesigner(images) (ncd), CoverDesigner Template(images) (nct), Crayola (art), Creative PC-CAM RAW (bay, raw), DBW Render (), DIV Game Studio Map (map), DIV Game Studio Multi Map (fpg), DKB Ray-Tracer (dis), DNG (dng), DPX (dpx), Dali Raw (sd0, sd1, sd2), Datacopy (img), Degas & Degas Elite (pi1, pc1, pi2, pc2, pi3, pc3, pi4, pi5, pi6), Deluxe Paint, Electronic Arts (lbm, ilbm), Dicom (dcm, acr, dic, dicom, dc3), Digital F/X (tdim), Digital Research(GEM Paint) (img, gem), Direct Draw Surface (dds), Discorp CMP Image (cmp), DjVu (djvu, djv, iw4), DolphinEd (dol), Doodle Atari (doo), Doodle C64 (dd), Doodle C64(Compressed) (jj), Dr Halo (cut), Draz Paint (drz), EA Sports FSH (fsh), EPS Interchange Format (epi, ept), ERI-chan(Entis Rasterized Image) (eri), ESM Software Pix (pix), Ecchi (ecc), Eclipse (tile), Edmics (c4), Egg Paint (trp), Electric Image (ei, eidi), Embroidery (bmc), Encapsulated Postscript (ps, eps), Encapsulated Postscript (Preview) (eps), Enhance Simplex (esm), Enhanced Compressed Wavelet (ecw), Epson RAW (erf), Eroiica (eif), Everex Everfax (efx, ef3), Explore(TDI) & Maya (iff, tdi), FIF(Iterated System) (fif), FIT (fit), Face Painter (fpt), Fast Piecewise-constant (pwc), Fax Group 3 (g3, fax), Fax man (fmf), Faxable PCX (fcx), Faxable TIFF (ftf), Fenix Map (map), Fenix Multi Map (fpg), FileMagic (mag), Flash Image (fi), FlashCam Frame (ncy), FlashPix Format (fpx), Flexible Image Transport System (fts, fits, fit), Foculus RAW (bay, raw), Fontasy Grafik (bsg), Fremont Fax96 (f96), Fugawi Map (fx3), Fuji S2 RAW (raf), Fun Painter II (fp2, fun), Fun Photor (fpr), Fuzzy bitmap

(fbm, cbm), GRS16 (g16), Gamma Fax (gmf), GeoPaint (geo), Gfa Raytrace (sul), GigaPaint Hi-res (gih), GigaPaint Multi (gig), Gimp Bitmap (xcf), Gimp Brush (gbr), Gimp Icon (ico), Gimp Pattern (pat), GoDot (4bt, 4bit, clp), GunPaint (gun, ifl), HD Photo (wdp, hdp), HDRI (hdr, hdri), HF (hf), HP-48/49 GROB (gro, grb), HP-49 OpenFire (gro2, gro4), HPGL-2 (hp, hpg, hgl, plt, hpgl, hpgl2, gl2, prn, prt, spl), HRU (hru), HSI Raw (raw), Half-Life Model (mdl), Hasselblad RAW (3fr), Hayes JTFax (jtf), Hemera Photo Image (hpi), Hemera Thumbs (hta), Heretic II MipMap (m8), Hi-Eddi (hed), Hires C64 (hir, hbm), Homeworld Texture (lif), IBM Kips (kps), IBM Printer Page Segment (pse), IM5(Visilog) (im5), IMNET Image (imt), IOCA (ica, ioca, mod), IPLab (ipl), IPod thumb (ithmb), ISS (iss), IcoFX (ifx), Icon Library (icl), Imacon/Hasselblad RAW (fff), Image Capture Board (icb), Image Magick file (mif, miff), Image Speeder (ish), Image System(Hires) (ish), Image System(Multicolor) (ism), Image Systems RLC2 Graphic (rlc), ImageLab (b&w, b_w), ImagePro Sequence (seq), Imaging Fax (g3n), Imaging Technology (img), Img Software Set (img), Inshape (iim), InterPaint(Hires) (iph), InterPaint(Multicolor) (ipt), Intergraph Format (itg, cit, rle), Interleaf (iimg), Iris CT (ct), Iris Graphics (iris), J Wavelet Image Codec (wic), JBIG (jbg, bie, jbig), JBIG-2 (jb2), JFIF based file (jb2), JPEG / JFIF (jpg, jpeg, jif, jfif, J, jpe), JPEG 8BIM header(Mac) (jpg, jpeg, jif, jfif, J, jpe), JPEG XR (jxr), JPEG-2000 Code Stream (jpc), JPEG-2000 JP2 File Format (jp2, j2k, jpx, jpf), JPEG-LS (jls), Jeff's Image Format (jif), Jigsaw (jig), Jovian VI (vi), Jpeg Network Graphics (jng), JustButtons animated bitmap (btn), KONTRON (img), Khoros Visualization Image file (vif, viff, xv), KinuPix Skin (thb), Kiss Cel (cel), Koala Paint (koa, kla), Koala Paint(Compressed) (gg), Kodak Cineon (cin), Kodak DC120 Digital Camera (kdc), Kodak DC25 Camera (k25), Kodak Photo CD (pcd), Kodak Pro Digital RAW (dcr), Kofax Group 4 (kfx), Kolor Raw Format (kro), Konica Camera File (kqp), LSS16 (lss, 16), LView Pro (lvp), LaserData (lda), Leaf RAW (mos), Leica RAW (bay, raw), Light Work Image (lwi), LucasFilm Format (lff), Lumena CEL (cel), LuraDocument Format (ldf), LuraDocument.jpm Format (jpm), LuraWave Format (lwf), LuraWave JPEG-2000 Code Stream (jpc), LuraWave JPEG-2000 Format (jp2, j2k, jpx, jpf), MAKIchan Graphics (mag), MGI Photosuite Project(images) (pzp), MGR bitmap (mgr), MRC(Medical Research Council) (mrc), MTV Ray-Tracer (mtv), Mac Paint (mac, mpnt, macp, pntg, pnt, paint), Mac icon (icns), Macintosh Quickdraw/Pict (pic, pict, pict2, pct), Mac OSX Resource (rsc, rsrc), Maggi Hairstyles & Cosmetics (fff), Male MRI (pd, t1, t2), Male Normal CT (fre), Mamiya RAW (mef), Marks Russel File (mrf), Mavica (411), Maw-Ware Textures (mtx), Mayura Draw (pdx), MegaPaint (bld), Megalux Frame (frm), Micro Dynamics MARS (pbt), Micro Illustrator Uncompressed (mil), Micrografx Picture Publisher 4.0 (pp4), Micrografx Picture Publisher 5.0 (pp5), Micron RAW (bay, raw), Microsoft Image Composer (mic), Microsoft Paint (msp), Microtek Eyestar (img), Mindjongg Format (ipg), Minolta DiMAGE RAW (mrw), Mobile FAX (rfa), MonkeyCard (pdb), MonkeyLogo (pdb), MonkeyPhoto (mph), MrSid (sid), Msx 2 Screen (sc2), Multiple Network Graphics (mng), NCR Image (ncr), NIST ihdr (pct), National Imagery Transmission F. (ntf, nitf), NeoBook Cartoon (car), Neochrome(ST & TT) (neo), Neopaint Mask (npm), Neopaint Stamp (stw), NewsRoom (nsr, ph, bn), Nifti (img), Nikon RAW (nef), Nokia Group Graphics (ngg), Nokia Logo File (nlm), Nokia OTA bitmap (otb), Nokia Operator Logo (nol), OAZ Fax (oaz, xfx), OS/2 Bitmap (bmp, bga), Olicom Fax (ofx), Olympus RAW (orf), Open Image Library Format (oil), OpenEXR (exr), Optigraphics (ctf), Optigraphics Tiled (ttf), Optocat (abs), Oric Hires (hir), Oric TAP (tap), Os/2 Warp (bga), PABX background (pix), PAX (pax), PC Paint / Pictor Page (pic, clp), PCO (b16), PM (pm), Page Control Language (pcl), Paint Magic (pmg), PaintShopPro Browser Cache File (jbf), PaintShopPro Brush (pspbrush), PaintShopPro Brush (jbr), PaintShopPro Frame (pfr, pspframe), PaintShopPro Image (psp, pspimage), PaintShopPro Mask (pspmask), PaintShopPro Mask (msk), PaintShopPro Pattern (pat), PaintShopPro Picture Tube (tub, psptube), PaintShopPro Texture (tex), Palm

Pilot (pdb), Panasonic DMC-LC1 RAW (srf), Panasonic LX3 RAW (rw2), Panasonic RAW (bay, raw), Pegs (pxs, pxa), Pentax *ist D (pef), Pfs Art Publisher (art), Photo Deluxe (pdd, pdb), Photo Filtre Studio (pfi), PhotoFantasy Image (fsy), PhotoFrame (frm), PhotoStudio File (psf), PhotoStudio Stamp (stm), Photomatrix (cat), Pic2 (p2), Picasso 64 (p64), Picture Gear Pocket (prc), Picture It! (mix), Pixar picture file (pic, pxr, picio, pixar), Pixel Power Collage (ib7, i17, i18, if9), Pixia (pxa), Pixibox (pxb), Planetary Data System (pds, img), Playback Bitmap Sequence (bms), Pocket PC Bitmap (2bp), Pocket PC Themes(images) (tsk), Polychrome Recursive Format (prf), Portable Bitmap (pbm, rpbm, ppma), Portable Document Format (pdf), Portable Greyscale (pgm, rpgm), Portable Image (pnm, rpnm, pbm, rpbm, pgm, rpgm, ppm, rppm), Portable Network Graphics (png, apng), Portable Pixmap (ppm, rppm), Portfolio Graphics (pgf), Portfolio Graphics Compressed (pgc), Portrait (cvp), Poser Bump (bum), Postscript (ps, ps1, ps2, ps3, eps, prn), PowerCard maker (crd), PowerPoint(images) (pps), PowerPoint Presentation(images) (ppt), Print Master (pm), Print Shop (psa, psb), Printfox/Pagefox (bs, pg, gb), Prism (cpa), Prisms (pri), Psion Series 3 Bitmap (pic), Psion Series 5 Bitmap (mbm), Punk Productions Picture (ppp), Puzzle (pzl), Q0 (q0, rgb), Qdv(Random Dot Software) (qdv), Qrt Ray-Tracer (qrt), Quake Texture (wal), Quantel VPB (vpb), QuickTime Image Format (qtif, qti), RAW DVR (raw), RIPTerm Image (icn), Radiance (rad, img, pic), Rainbow Painter (rp), Raw (raw, gry, grey), Rawzor (rwz), Rayshade (pic), Red Storm File Format (rsb), Ricoh Digital Camera (j6i), Ricoh Fax (001, ric), Ricoh IS30 (pig), Rm2K XYZ (xyz), Rollei RAW (rdc, ia), RoverShot RAW (bay, raw), RunPaint(Multicolor) (rpm), Saracen Paint (sar), SBIG CCD camera ST-4 (st4), SBIG CCD camera ST-X (stx, st4, st5, st6, st7, st8), SciFax (sci), SciTex Continuous Tone (sct, ct, ch), Seattle Film Works (sfw), Seattle Film Works multi-image (pwp, sfw), SecretPhotos puzzle (xp0), Sega SJ-1 DIGIO (sj1), Sharp GPB (img), Siemens Mobile (bmx), SIF MICHEL-Soft (sif), Sigma RAW (x3f), Silicon Graphics RGB (rgb, rgba, bw, iris, sgi, int, inta), Sinar RAW (cs1, sti), Skantek (skn), Slow Scan Television (hrz), SmartDraw 6 template (sdt), SmartFax (1), SmoothMove Pan Viewer (pan), Softimage (pic, si), Solitaire Image Recorder (sir), Sony DSC-F1 Cyber-shot (pmp), Sony DSC-F828 RAW (srf), Sony PS2 TIM (tm2), Sony Playstation TIM (tim), Sony RAW (sr2, arw), Spectrum 512 (spu), Spectrum 512(Compressed) (spc), Spectrum 512(Smooshed) (sps), SPOT (dat), SriSun (ssi), Stad (pic, pac, seq), Star Office Gallery (sdg), Starbase (img), Stardent AVS X (x, avs, mbfs, mbfavs), Starlight Xpress SX (RAW), Stereo Image (jps), ST Micro RAW (bay, raw), Structured Fax Format (sff), Sun Icon/Cursor (icon, cursor, ico, pr), Sun Rasterfile (ras, rast, sun, sr, scr, rs), Sun TAAC file (iff, vff, suniff, taac), Syberia texture (syj), Synthetic Universe (syn, synu), SVG (svg), TG4 (tg4), TI Bitmap (92i, 73i, 82i, 83i, 85i, 86i, 89i), TIFF Revision 6 (tif, tim, tiff), TMSat image (imi), TRS 80 (hr), TealPaint (pdb), Teli Fax (mh), Thumbnail (tnl), TilePic (tjp), Tiny (tny, tn1, tn2, tn3), TopDesign Thumbnail (b3d, b2d), Total Annihilation (gaf), Truevision Targa (tga, targa, pix, bpx, ivb), Ulead Pattern (pst), Ulead PhotoImpact (upi), Ulead Texture(images) (pe4), Usenix FaceServer (fac, face), Utah raster image (rle, urt), VIPS Image (v), VITec (vit), VRML2 (wrl), Venta Fax (vfx), Verity (vif), Vicar (vic, vicar, img), Vidcom 64 (vid), Video Display Adapter (vda), Vista (vst), Vivid Ray-Tracer (img), Vort (pix), Vue d'esprit (vob), WAD(Half life) (wad), WSQ (wsq), WaveL (iwc), Wavefront Raster file (rla, rlb, rpf), WebShots(images) (wb1, wbc, wbp, wbz), Weekly Puzzle (jig), WebP (webp, wep), Whypic (ypc), WinFAX (fxs, fxo, wfx, fxr, fxd, fxm), WinMIPS (pic), Windows & Aldus Metafile (wmf), Windows Animated Cursor (ani), Windows Bitmap (bmp, rle, vga, rl4, rl8, sys), Windows Clipboard (clp), Windows Comp. Enhanced Metafile (emz), Windows Compressed Metafile (wmz), Windows Cursor (cur), Windows DIB (dib), Windows Enhanced Metafile (emf), Windows Icon (ico), Winzle Puzzle (wzl), Wireless Bitmap(level 0) (wbmp, wbm, wap), Word Perfect Graphics(images) (wpg), Worldport Fax (wfx), X Windows System dump (xwd, x11), X11 Bitmap (xbm, bm), X11 Pixmap (xpm,

pm), XV Visual Schnauzer (p7), Xara(images) (xar), Xerox DIFF (xif), Ximage (xim), Xionics SMP (smp), YUV 16Bits (yuv, qtl, uyvy), YUV 16Bits Interleaved (yuv, qtl, uyvy), YUV 4:1:1 (yuv, qtl), YUV 4:2:2 (yuv, qtl), YUV 4:4:4 (yuv, qtl), ZX Spectrum Hobetta ($s, $c, !s), ZX Spectrum Snapshot(sna), ZX Spectrum standard (screen scr), ZZ Rough (rgh), Zeiss BIVAS (dta), Zeiss LSM (lsm), Zoner Callisto Metafile(zmf), Zoner Zebra Metafile (zbr), Zsoft Multi-page Paintbrush (dcx), Zsoft Publisher's Paintbrush (pcx, pcc, dcx), byLight (bif)

2.1.5 File Masks

R-Studio shows only those files/folders that match the specified file mask. File mask affects files/folders that are processed by the **Recover** and **Find** commands.

To specify a file mask,

1 **Click the File Mask button**

Other ways to specify the file mask

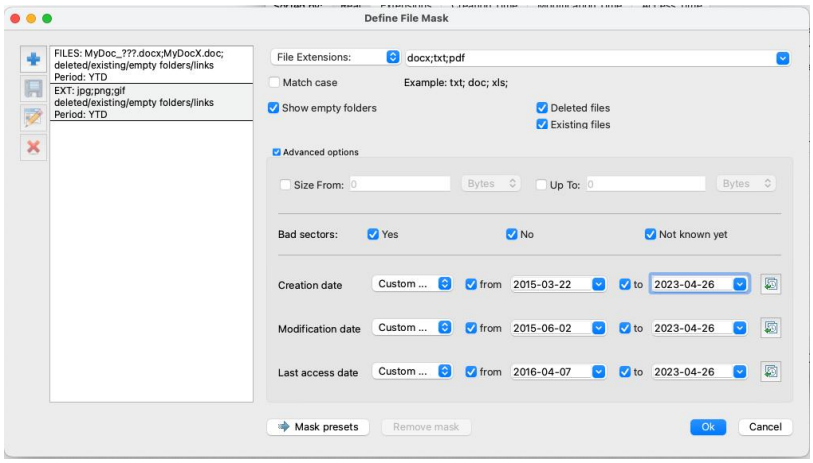
- Control-click a folder and select **File Mask** on the contextual menu

or

- Select the folder and select **File Mask** on the **Tools** menu

2 **Specify the file mask on the** File mask **dialog box and click the OK button**

Mask **dialog box**



File mask options

You may specify options for All Files, File Extensions, Files, and Regular Expressions	
Match case	If this check box is selected, **R-Studio** makes a case-sensitive search.
Show empty folders	If this check box is selected, **R-Studio** will show folders with no files in them.
Deleted files	If this check box is selected, **R-Studio** makes a search among deleted files/folders.
Existing files	If this check box is selected, **R-Studio** makes a search among existing files/folders.
Hide symbolic links	If this check box is selected, **R-Studio** hides all symbolic links. It may be selected by default if the Don't show symbolic links by default option is selected on the **Settings** dialog box.
Use advanced options	If this check box is selected, **R-Studio** will use the advanced options, even when they are hidden.

Advanced Options	
Size from/up to	Specifies file size limits. See the **Data Formats and Multipliers** topic for more details on data formats.
Date	Specifies file date boundaries. Dates for Modified, Created, and Last Accessed timestamps may be set separately.
	The **Set for all** button sets the specified data for all fields.

> **R-Studio will show only those files that match the specified file masks**

Mask presets

You may set various presets with different file masks. Just click on the Plus button to add the data from the dialog box to the presets. You may also give presets names, delete them, and store them permanently.

2.1.6 Regular Expressions

Regular expression is a notation for patterns of text, as opposed to exact strings of characters. The notation uses literal characters and metacharacters. Every character which does not have special meaning in the regular-expression syntax is a literal character and matches an occurrence of that character. For example, letters and numbers are literal characters. A metacharacter is a symbol with special meaning (an operator or delimiter) in the regular-expression syntax.

.	Wildcard: any character
*	Repeat: zero or more occurrences of previous character or class
^	Line position: beginning of line
$	Line position: end of line
[class]	Character class: any character in the set
[^class]	Inverse class: any character not in the set
[x-y]	Range: any characters within the specified range
\x	Escape: literal use of metacharacter x
\<xyz	Word position: beginning of the word
xyz\>	Word position: end of the word

For example, the following regular expression **.*** matches any string of characters, **^a** matches any string beginning with character a.

2.1.7 Event Log

R-Studio logs and displays events in the Log panel. You may set a **Log filter** to display only needed information and to write it to a log file. You may specify the log settings on the Settings dialog box.

You may clear or save the log.

R-Studio logs and displays events in the Log panel. You may set a **Log filter** to display only needed information and to write it to a log file. You may specify the log settings on the Settings dialog box.

You may clear or save the log

To clear the log,

* **Control-click the Log panel and select Clear Log on the contextual menu.**

To save the log to a file,

* **Control-click the** Log **panel and select Save Log to File on the contextual menu.**

2.2 Advanced Data Recovery

This chapter explains how to perform advanced data recovery operations.

- **Disk Scan**
- **Fast-Search-for-Lost-Partition**
- **Customizing File Types**
- **Customizing File Types-I**
- **Customizing File Types-II**
- **Regions**
- **Exclusive Regions**
- **Images**
- **Wiping Objects**

2.2.1 Disk Scan

In order to completely analyze data structure on an object, it must be scanned. Any object on the Drives panel can be scanned. In addition, you may create a ***region*** to scan only a part of an object. The **Regions** topic explains how to create and work with ***regions.*** Scan is also greatly improves estimations for chances of successful file recovery.

You may select scan area and some other scan parameters. Scan information may be saved to a file and later this file may be opened.

You may save scan information on the remote computer if necessary.

Attention: Scanning large areas may be a very lengthy process!

NEVER TRY TO SAVE SCAN INFORMATION TO THE OBJECT BEING SCANNED!!!
Or you may obtain unpredictable results and lose all of your data.

To scan an object

1 **Select an object on the R-Studio's** Drives **panel**

2 **Click the Scan button**

Other ways to start scan

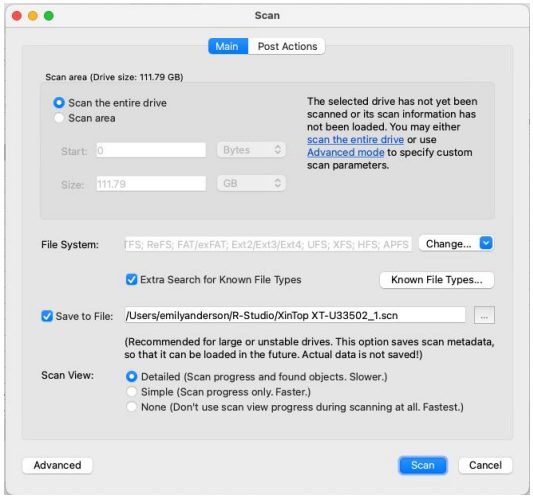
- Control-click the selected disk and select **Scan** on the contextual menu,

or

- Select **Scan** on the **Drive** menu

3 Specify the required parameters on the Scan dialog box and click the Scan button

Scan **dialog box**

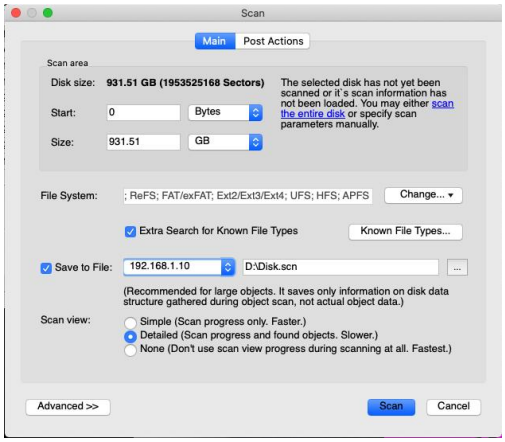


Scan options

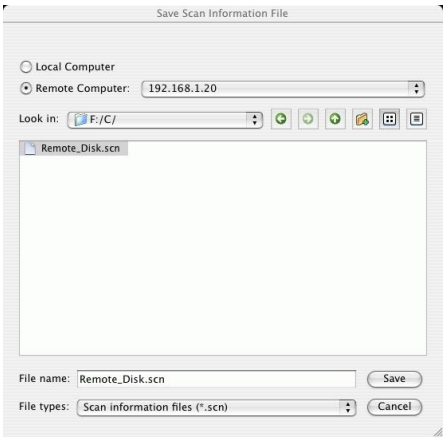
Disk Size:	Shows the size of the object to be scanned
Start:	Sets the start point of the area to be scanned.
Size:	Sets the size of the area to be scanned.
Numbers in these fields can be in bytes or sectors. See the **Data Formats and Multipliers** topic for more details on data formats.	
File Systems:	Specifies the file systems which objects are to be searched for. Current version supports: FAT, NTFS, exFAT, ReFS, Ext2/3/4FS, XFS, HFS,+ APFS, and UFS1/UFS2 file systems. Please note that if you need to scan an HFS, HFS+, or HFSX disk, always enable the Extra search for Known File Types option. This is very important because when files are being deleted on the HFS, HFS+, HFSX file systems, the computer completely removes all system information on them, and there is no way to recover the deleted files except by using the Extra Search for Known File Types option.
Extra search for Known File Types	Enables search for Known File Types.
Save scan Info to File:	If this checkbox is selected, **R-Studio** will save scan information to a specified file. Later this file may be opened. Please note, that this option does not save actual disk data, only information on disk data structure gathered during disk scan.
Simple view	If this option is selected, **R-Studio** will show only scan progress.
Detailed view	If this option is selected, **R-Studio** will show graphic representation on objects found during scan.
None	If this option is selected, **R-Studio** will not show the Scan Information tab during scan.
Buttons	
Scan	Starts scanning

Advanced	Activates advanced scan options
Known File Types…	Selects file types that **R-Studio** will recognize during the disk scan.
Cancel	Closes the dialog box
NEVER TRY TO SAVE SCAN INFORMATION TO THE OBJECT BEING SCANNED!!! Or you may obtain unpredictable results and lose all of your data.	

If a remote computer is connected for **Data Recovery over Network**, the Scan dialog box will have a different look

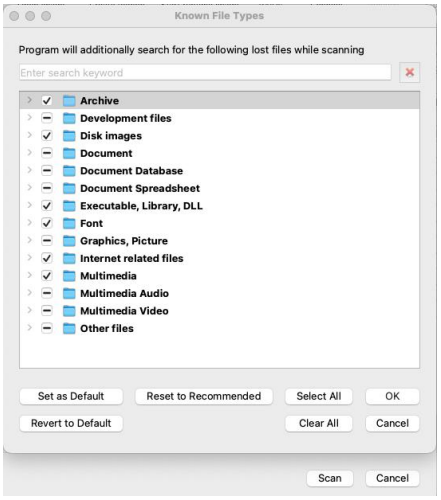


and the Save Scan Information File dialog box will appear when you select a place to store scan info. You may save it to the local or remote computer.



Known File Types: While scanning, **R-Studio** can recognize the data's particular file type. Using such information, **R-Studio** can obtain more information about data/file structure on the object being scanned. By default, **R-Studio** tries to recognize the default list of supported file types specified on the Known File Types tab of the Settings panel, greatly increasing time required for the scan. You may reduce it by selecting only those file types that you need. Click the **Known File Types...** button and select the required file types on the File Types dialog box. These selections will be applied to that scan session only.

File Types **dialog box**



Known File Types

Set as Default	Click this button to set the current list of selected file types as default values.
Revert to Default	Click this button to revert the default settings specified on the Known File Types tab of the Settings panel.
Reset to Recommended	Click this button to revert to factory-preset default settings.
Select All	Click this button to select all file types in the list.
Clear All	Click this button to clear all file types in the list except some predefined ones.

List of known file types

Document			
AbiWord Document: `.abw`	Adobe InDesign File: `.indd`	Adobe PDF document: `.pdf`	Apple iWork Keynote document: `.key`
Apple iWork Pages document: `.pages`	Apple iWork document	Capella document: `.cap`	Final Draft Document: `.fdr`
FrameMaker Document: `.fm`	GNU Info Document: `.info`	Garmin MapSource data: `.mps`	Lotus AMI Pro Document: `.sam`
Lotus Organizer: `.or5`	Lotus Word Pro Document: `.lwp`	Microsoft Office Open XML Document	Microsoft OneNote section file: `.one`
Microsoft Pocket Streets Map File: `.mps`	Microsoft PowerPoint 2007 XML Document: `.pptx`	Microsoft PowerPoint Document: `.ppt`	Microsoft Visio document: `.vsd`
Microsoft Word 2007 XML Document: `.docx`	Microsoft Word Document: `.doc`	Word for Macintosh Document: `.mcw`	Microsoft Word2 Document: `.doc`
Microsoft Works document: `.wps`	OLE Storage	OpenOffice Writer document: `.odt`	OpenOffice document: `.ods`

PageMaker Document: .p65	PostScript document:. ps	QuarkXPress file: .qxd	QuarkXpress project: .qxp
Rich Text Document: .rtf	TEX document: .tex	Text document: .txt	Unicode document: .txt
WordPerfect Document: .doc			
Document: E-book			
Chaoxing SSReader eBook: .pdg	EPUB eBook: .epub	FB2 eBook: .fb2	MOBI eBook: .mobi Microsoft Money Data: .mny
Microsoft Reader eBook: .lit	Microsoft Reader eBook annotations: .ebo		
Document: Spreadsheet			
Apple iWork Numbers document: .numbers	Lotus 1-2-3 v1 worksheet: .wk3	Lotus 1-2-3 v2 workshee: .wk1, .fmt	Lotus 1-2-3 v3 worksheet: .wk3, .fm 3
Lotus 1-2-3 v4 worksheet: .wk4	Lotus 1-2-3 workbook: .123	Microsoft Excel 2/3/4 worksheet: .xls	Microsoft Excel 2007 XML Document: .xlsx
Microsoft Excel 4 Spreadsheet: .xls	Microsoft Excel Spreadsheet: .xls	Quattro Pro Spreadsheet: .wq1	
Document: Database			
Cathy database: .caf	Data Interchange Format file: .dif	GDSII database: .gds	Microsoft Access 2007 XML Document: .accdt
Microsoft Access 2007 Database: .accdb	Microsoft Access Database: .mdb	Microsoft SQL Log: .ldf	Microsoft SQL Database: .mdf
MySQL Database Dictionary: .frm	MySQL database: .myi	Omnis Studio Library: .lbs	Omnis Studio Database: .df1
OpenOffice Base document: .odb	dBase III Database: .dbf		
Document: Financial			
Microsoft Money Data: .mny	QuickBooks Backup File: .qbb	QuickBooks Primary Data File: .qbw	Quicken Data: .qdf
TurboTax return file: .tax			
Internet-related files			
Compiled HTML file: .chm	Internet shortcut: .url	Microsoft OutLook Personal Folder: .pst	Microsoft Outlook/Inbox offline

			folder: .ost
Mozilla Firefox browser extension: .xpi	Mozilla Mail Summary file: .msf	Outlook Express Messages: .dbx	The Bat! Address book: .abd
The Bat! Message Base: .tbb	The Bat! Message Index: .tbi	Windows Address Book: .wab	XML document (Unicode): .xml
Email			
E-Mail Message: .eml	Microsoft OutLook Personal Folder: .pst	Microsoft Outlook Inbox offline folder: .ost	Mozilla Mail Summary file: .msf
Outlook Express Messages: .dbx	The Bat! Address book: .abd	The Bat! Message Base: .tbb	The Bat! Message Index: .tbi
Windows Address Book: .wab			
Font			
Adobe PostScript Font: .pfb	Adobe Printer Font: .pfm	BDF Unix font: .bdf	BGI font: .chr
CPI DOS font: .cpi	OpenType font: .otf	TrueType Font: .ttf	Windows System Font: .fon
Graphics/Picture			
AVHRR Satellite image: .sst	Adobe Lightroom preview: .lrprev	Adobe Photoshop image: .psd	Agfa/Matrix Scodl Image: .scd
Alias Wavefront Raster Image: .rla	Amiga icon: .info	ArcView Shape:. shp	AutoCAD Binary Image: .dxf
AutoCAD Drawing: .dwg	AutoCAD Image: .dxf	Autodesc Animator Pro color palette: .col	Autodesc Animator Pro Image: .pic
Autodesc Animator Image: .pic	Autologic Image: .gm	BMF image: .bmf	Bentley MicroStation CAD Drawing: .dgn
Canon (CR2) RAW graphics file: .cr2	Canon (CRW) RAW graphics file: .crw	ColoRIX Image: .rix	Computer Graphics Metafile image: .cg
ComputerEyes Raw Image: .ce1, .ce1	Continous Edge Graphic Image: .ceg	Corel Texture Image: .tex	CorelDraw CMX Image: .cmx
CorelDraw Image: .cdr	Cubicomp Picture Maker Image .r8, .g8, .b8	DICOM medical image: .dcm	Digital Negative image: .dbg
Dr. Halo palette: .pal	Enhanced MetaFile Image: .emf	Epson RAW image: .erf	Epson Stylus Image: .prn
Erdas LAN/GIS Image: .lan, .gis	Fractal Image Format: .fif	Freehand (MX) Database: .fh10	Fuji RAW image: .raf

GEM Raster Image: .img	GEM VDI Image: .gdi	CompuServe GIF Image: .gif	Garmin Mapsource image: .img
Graphics Workshop for Windows Thumbnail: .thn	Gridded Binary Image: .grb	HP Command Language Image: .pcl	HP Raster Image: .rtl
HSI JPEG Image: .hsi	Hemera Photo-Object Image: .hpi	Hitachi Raster Image: .hrf	Hotspot Image: .shg
IBM Picture Maker Image: .pic	JPEG 2000: .jp2	JPEG Digital Camera: .jpg	JPEG Image: .jpg
Jovian Logic Image: .vi	Kodak PhotoCD Image: .pcd	Kodak RAW image: .dng	LBM/IFF Image: .lbm
Leica RAW image: .dng	Lightwave Object: .lwo	Lotus PIC Image: .pic	Macintosh PICT Image: .pct, .pic
Macintosh Paint Image: .mac	Mamiya RAW image: .mef	McIDAS Satellite Image: .goe	Microsoft Paint Image: .msp
Minolta RAW image: .mrw	Nikon RAW image: .nef	OS/2 Icon: .ico	Olympus RAW image: .orf
PBM Image: .pbm	PGM Image: .pgm	PIX Image: .pix	PM Image: .pm
PNG Image: .png	PPM Image: .ppm	PaintShop Pro Image: .psp	Panasonic RAW image: .rw2
PaperPort Image: .max	Pentax RAW image: .pef	Pictor PC Paint Image: .pic	Print Shop Image: .pds
Quick Link II fax Image: .qfx	QuickDraw 3D Metafile: .3dmf	RAW Digital Camera image: .dng	RenderMan Image: .rib
Ricoh RAW image: .dng	SGI Image: .sgi	STAD Image: .pac	Samsung RAW image: .dng
Seattle FilmWorks / PhotoWorks image: .pwm	Sigma RAW image: .x3f	Sketch Image: .sk	SmartDraw file: .sdr
Sony RAW image: .arw	Sun Raster Image: .sun	SymbianOS Image: .mbm	TI Image: .92i
Tagged Image Format File: .tif	TargetExpress image: .mte	Utah Raster Toolkit Image: .rle	VITec Image: .vit
Webshots Image: .wb1	Weresc CADE drawing: .dtc	Windows Animated cursor: .ani	Windows Bitmap Image: .bmp
Windows Color Palette: .pal	Windows Fax Cover Image: .cpe	Windows MetaFile Image: .wmf	Windows cursor: .cur
Windows icon: .ico	WordPerfect Graphics Image: .wpg	X PixMap Image: .xpm	X Window Dump Image: .xwd

Xara Drawing: .xar	ZSoft PCX Image: .pcx	iPhoto Image: .attr	
Multimedia: Audio Files			
AIFF Sound: .aif	AVR Sound: .avr	AY Chip music: .ay	AdLib Tracker 2 module: .a2m
Advanced Streaming Format file: .asf	Audacity audio: .au	AudioCD file: .cda	Battery 3 sample: .nov
CMF music: .cmf	Common Loudspeaker Binary: .cf1	Creative voice file: .voc	DiamondWare sound: .dwd
Digital Speech File: .dss	Digital voice file: .dvf	EA ASF/MUS audio file: .asf	Extended M3U playlist: .m3u
FLAC audio file: .fla, .flac	KaraBox sound: .mkf	La Lossless audio file: .la	Liquid Audio File: .la1
MIDI Instrument definition: .idf	MIDI music: .mid	MIDI stream: .mds	MPEG Layer I audio file: .mpg
MPEG Layer II audio file: .mp2	MPEG Layer III audio file: .mp3	MUS music: .mus	Monkeys audio file: .ape
Musepack audio file: .mpc	Next/Sun uLaw sound: .au	Nitro Composer sound: .minincs	Nord Modular G2 Patch: .pch2
Ogg Vorbis audio file: .ogg	OptimFROG audio file: .ofr	Portable Sound Format: .psf	RIFF MIDI music: .rmi
RK Audio sound: .rka	Sierra AUD sound: .aud	Sony OpenMG audio file: .oma	Super NES audio file: .spc
TTA audio file: .tta	VQF sound: .vqf	WavPack audio file: .wv	Westwood AUD sound: .aud
Windows Media Audio File: .wma	Windows WAVE sound: .wav	X-MIDI music: .xmi	ZyXEL sound: .zyx
aPac audio file: .apc			
Multimedia: Video Files			
3GPP multimedia audio/video: .3gp	3GPP2 multimedia audio/video: .3g2	4X Movie Video: .4xm	Adobe Filmstrip Animation: .fsf
AMV Video: .amv	ARMovie video: .rpl	Adobe Filmstrip animation: .fsf	Autodesk Animator: .fli
BINK Video: .bik	BluffTitler video: .bt	DVM video: .dvm	DeluxePaint animation: .anm
Director video: .dcr	DriveCam video: .dce	Eyemail video: .eye	Flash Video: .flv
Intel DVI Video: .dvi	Intel Indeo Video File: .ivf	Interplay MVE Video: .mve	LZA animation: .lza

LZA Animation: .lza	Lotus ScreenCam video: .scm	MPEG Transport Stream video: .mts	MPEG video: .mpg
MPEG-2 Transport Stream video: .m2ts	Matroska video: .mkv	MythTV video: .nuv	NEOchrome animation: .ani
Nancy Codec video: .noa	Nullsoft Video: .nsv	QV-10 video: .cam	QuickTime video: .mov
SGI movie format: .mv	SMJPEG Video: .mjpg	Sega FILM/CPK video: .cpk	Shockwave video: .swf
Smacker video: .smk	Sony Movie Player video: .mqv	VOB video files: .vob	VP6 encoded Video: .vp6
VideoCD video: .vcd	Vivo streaming video: .viv	Windows AVI Video: .avi	Windows Media Video: .wmv
Multimedia Files			
MP4 file: .mp4	Material Exchange File: .mxf	RIFF Multimedia File	Real Networks audio/video: .rm
Archive Files			
7-Zip archive: .7z	ACE archive: .ace	AIN archive: .ain	ARJ archive: .arj
ARX archive: .arx	Android Package: .apk	BAG archive: .bag	BIX archive: .bix
BOA archive: .b58, .boa	BZip2 archive: .bz2	BlackHole archive: .bh	Blink archive: .bli
CPIO archive: .cpio	ChArc archive: .chz	Compress archive: .z	Crush archive: .cru
DEB archive: .deb	FOXSQZ archive: .sqz	GZip archive: .gz	HA archive: .ha
HAP archive: .hap	HPack archive: .hpk	Hyper archive: .hyp	InstallShield CAB archive: .cab
InstallShield Z archive: .z	InstallShield compressed file	JAR archive: .jar	JRC archive: .jrc
LHA/LZARK archive: .lzh	LZA archive: .lza, .lzz	LZOParchive: .lzo, .lzop	LZX archive: .lzx
LIMIT archive: .lim	Microsoft Cabinet archive: .cab	Microsoft Compress compressed file	PAKLEO archive: .pll
QFC archive: .qfc	Quantum archive: .q, .pak	Quark archive: .ark	RAR archive: .rar
RPM archive: .rpm	ReSOF archive: .sof	SAR archive: .sar	SBC archive: .sbc
SQZ archive: .sqz	SZip archive	StuffIt archive: .sit	TAR archive: .tar
UFA archive: .ufa	UHArc archive: .uha	UltraCompressor 2 archive: .uc2	WRAptor archive: .wra
WinImp archive: .imp	Windows Installer Merge Module: .msm	Windows Installer Package: .msi	indows Installer Patch: .msp

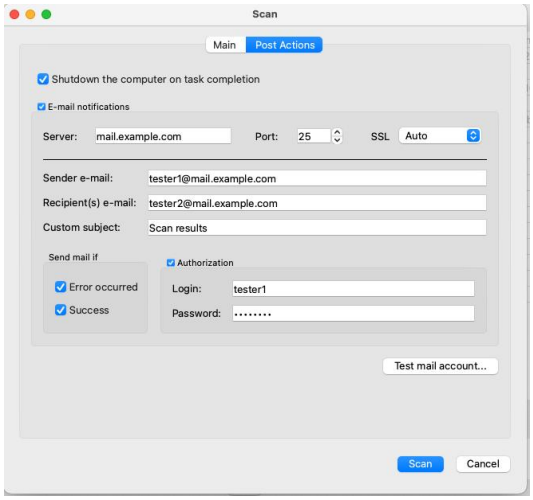
Windows Installer Patch Creation File: .pcp	Windows Installer Validation Module: .cub	YAC archive: .yc	YBS archive: .ybs
ZIP archive: .zip	ZOO archive: .zoo	ZZip archive: .zz	iOS Package: .ipa
xz archive: .xz			
Executable/Library/DLL			
DOS Style Executable: .exe	ELF Executable (UNIX)	ELF Library (UNIX)	ELF Module (UNIX)
Java Bytecode: .class	KolibriOS Executable	NetWare Loadable Module: .nlm	Shell Script
UEFI Executable .efi	Windows DLL: .dll	Windows Executable: .exe	Windows 9x Device Driver: .vxd
Windows Device Driver: .sys	Windows OCX File: .ocx		
Development files			
ACUCOBOL object	Borland Delphi Compiled Unit: .dcu	Borland Turbo Pascal compiled Unit: .tpu	C/C++ Source Code: .c
COM Type Library: .tlb	GUI Design Studio project: .gui	LUA Script: .lua	Library: .lib
Microsoft .NET XML Resource template: .resx	Microsoft ClassWizard file: .clw	Microsoft Linker database .ilk	Microsoft Precompiled header: .pch
Microsoft Program database: .pdb	Microsoft Visual C++ project: .mdp	Microsoft Visual Studio Solution: .sln	Microsoft Visual Studio project: .dsp
Microsoft Visual Studio workspace: .dsw	OMF Object library: .lib	PolySpace results: .chk	RDOFF Object File: .rdf
Resource Compiler Script File: .rc	Visual Studio Solution User Options: .suo	Visual Studio Widget File: .wid	Visual Studio Workspace Options file: .opt
VisualBasic Project: .vbp	WinDev Window: .wdw	Windows Compiled resource (32bit) : .res	XPCOM Type Library: .xpt
Xcode Project: .pbxproj			
Disk images			
Hyper-V virtual disk: .vhdx	JAM compressed disk: .jam	Norton Ghost disk image: .ghs	QEMU virtual disk: .qcow2
R-Drive Image disk image: .rdr	VMware virtual disk: .vmdk	Virtual PC virtual disk: .vhd	VirtualBox virtual disk: .vdi
Other file types			

ABBYY Lingvo dictionary: `.lsd`	AIX Backup File: `.bff`	ArtMoney Table file: `.amt`	CrystalMaker Data File: `.cmdf, .cmmf`
Dwarf Fortress save data: `.dat`	EasyCrypto file: `.encrypted`	Fallout 3 save game: `.fos`	Java Applet cache index: `.idx`
Kaspersky Anti-Virus data base: `.avc`	Kaspersky Anti-Virus report: `.rpt`	Kaspersky Anti-Virus signature bas: `.kdc`	Magic 3D Easy View object: `.x`
Microsoft Security Catalog: `.cat`	NHTSA UDS-1992 crash test result: `.uds`	NOD32 Antivirus Update file: `.nup`	ORTIMZeit project: `.ozv`
OziExplorer Map data: `.map`	PRO100 project: `.sto`	PlayStation 3 Theme: `.p3t`	RegEdit file: `.reg`
RegEdit file (UNICODE): `.reg`	Source Game Engine Compiled AI Nodegraph: `.ain`	Unreal Package	Valve Texture File: `.vtf`
WinHelp: `.hlp`	WinHelp Contents: `.cnt`	WinXP Prefetch file: `.pf`	Windows Backup File: `.bkf`
Windows Clipboard file: `.clp`	Windows Color Profile: `.icm`	Windows Minidump: `.dmp, .mdmp`	Windows National locale: `.nls`
Windows Password file: `.pwl`	Windows Registry hive: `.dat, .hiv`	Windows Thumbnail cache: `.db`	Windows User Interface Module: `.wim`
Windows shortcut: `.lnk`	X-Plane Scenery: `.dsf`	XNA Game Data: `.xnb`	

Note: Using scan for Known File Types, **R-Studio** can successfully recover only un-fragmented files. You may also specify your own file types for scanning. See **Customizing File Types** for details. User-defined file types precede over built-in ones, if their definitions overlap.
You may set the defaults for known file types on the **R-Studio Settings**.

R-Studio Technician/T80+

Scan (Post Actions) **dialog box**

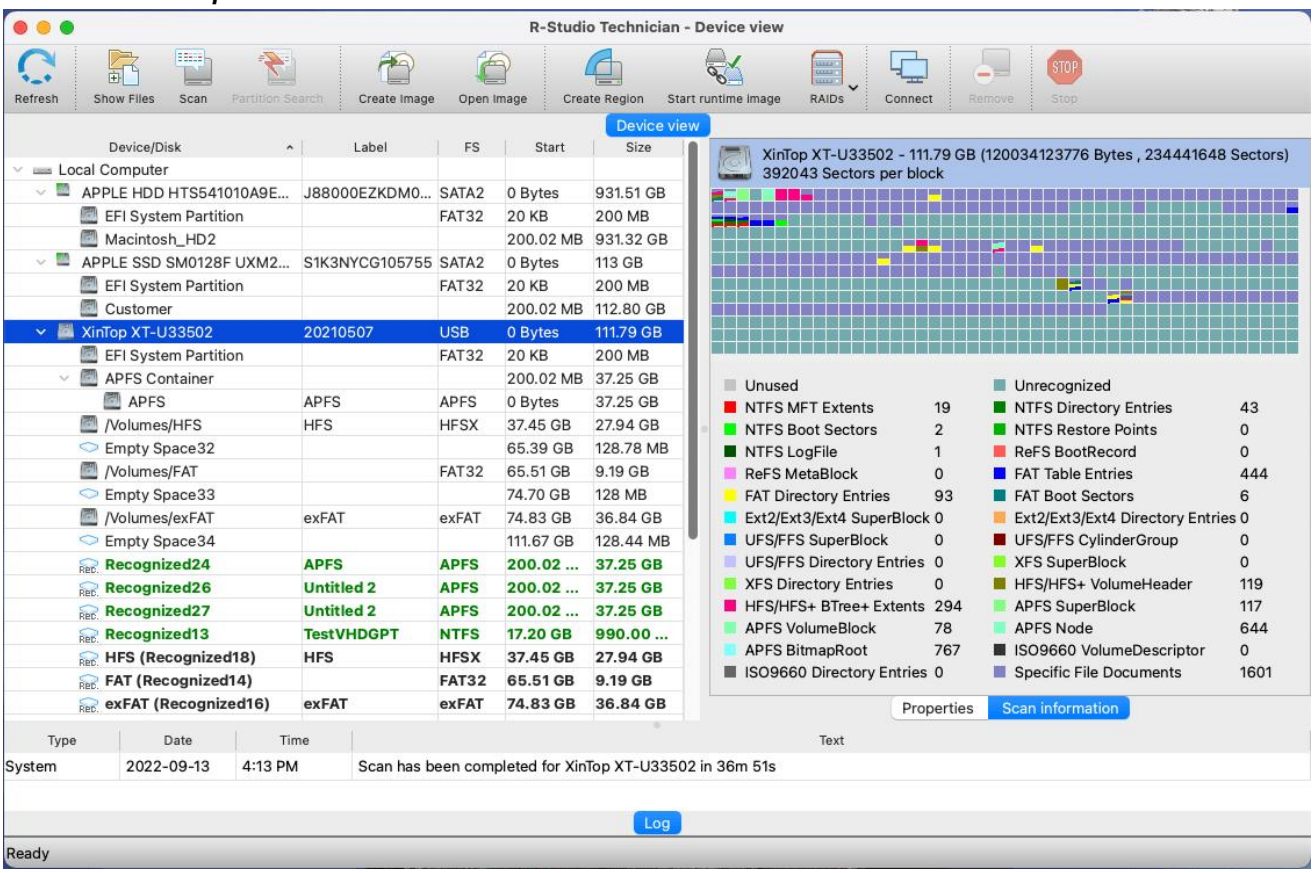


Post Actions Options

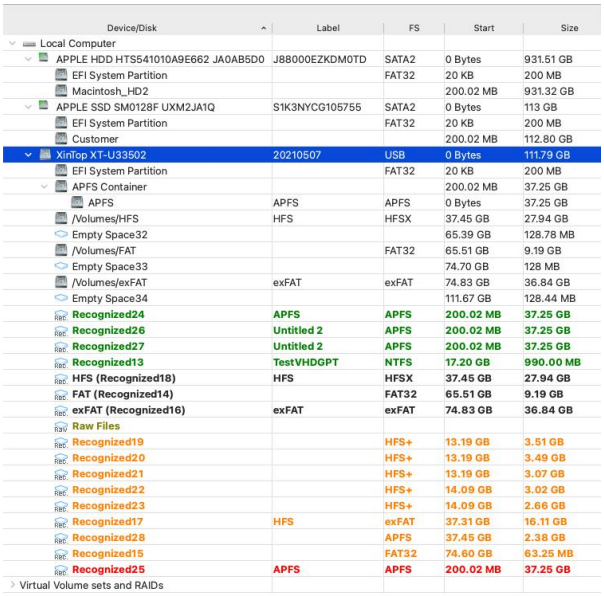
Shutdown the computer on task completion	If this check box is selected, **R-Studio** will shut down your computer when scan has been completed. You should select the Save to file checkbox and specify a place to save scan info to activate this option.
E-Mail notifications	If this check box is selected, **R-Studio** will inform you about the outcome of the operation via email.

4 R-Studio starts scanning the object, and its panel will show information about new found objects:

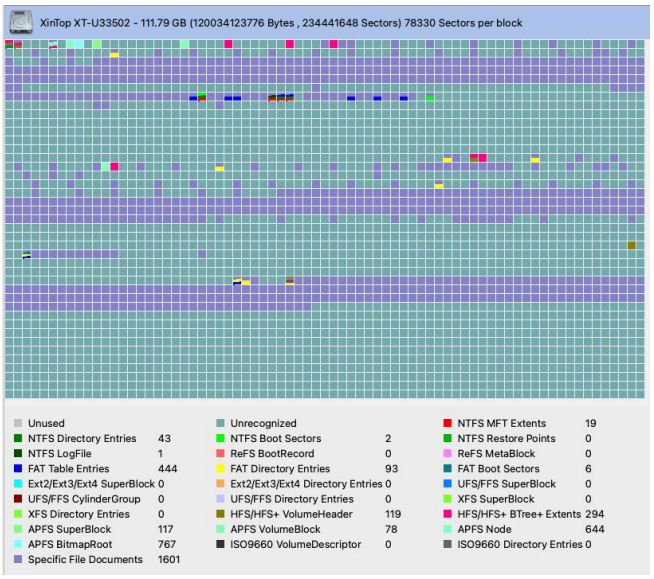
R-Studio Main panel



Drives panel after scanning:
You can select an object by clicking on it

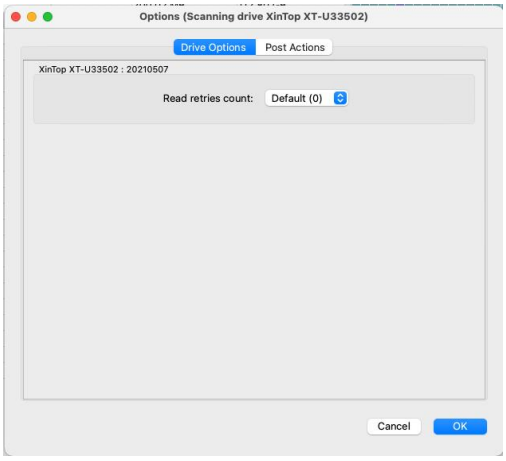


Device/Disk	Label	FS	Start	Size
Local Computer				
APPLE HDD HTS541010A9E662 JA0AB5D0	J88000EZKDM0TD	SATA2	0 Bytes	931.51 GB
EFI System Partition		FAT32	20 KB	200 MB
Macintosh_HD2			200.02 MB	931.32 GB
APPLE SSD SM0128F UXM2JA1Q	S1K3NYCG105755	SATA2	0 Bytes	113 GB
EFI System Partition		FAT32	20 KB	200 MB
Customer			200.02 MB	112.80 GB
XinTop XT-U33502	20210507	USB	0 Bytes	111.79 GB
EFI System Partition		FAT32	20 KB	200 MB
APFS Container			200.02 MB	37.25 GB
APFS	APFS	APFS	0 Bytes	37.25 GB
/Volumes/HFS	HFS	HFSX	37.45 GB	27.94 GB
Empty Space32			65.39 GB	128.78 MB
/Volumes/FAT		FAT32	65.51 GB	9.19 GB
Empty Space33			74.70 GB	128 MB
/Volumes/exFAT	exFAT	exFAT	74.83 GB	36.84 GB
Empty Space34			111.67 GB	128.44 MB
Recognized24	**APFS**	**APFS**	**200.02 MB**	**37.25 GB**
Recognized26	**Untitled 2**	**APFS**	**200.02 MB**	**37.25 GB**
Recognized27	**Untitled 2**	**APFS**	**200.02 MB**	**37.25 GB**
Recognized13	**TestVHDGPT**	**NTFS**	**17.20 GB**	**990.00 MB**
HFS (Recognized18)	**HFS**	**HFSX**	**37.45 GB**	**27.94 GB**
FAT (Recognized14)		**FAT32**	**65.51 GB**	**9.19 GB**
exFAT (Recognized16)	**exFAT**	**exFAT**	**74.83 GB**	**36.84 GB**
Raw Files				
Recognized19		**HFS+**	**13.19 GB**	**3.51 GB**
Recognized20		**HFS+**	**13.19 GB**	**3.49 GB**
Recognized21		**HFS+**	**13.19 GB**	**3.07 GB**
Recognized22		**HFS+**	**14.09 GB**	**3.02 GB**
Recognized23		**HFS+**	**14.09 GB**	**2.66 GB**
Recognized17	**HFS**	**exFAT**	**37.31 GB**	**16.11 GB**
Recognized28		**APFS**	**37.45 GB**	**2.38 GB**
Recognized15		**FAT32**	**74.60 GB**	**63.25 MB**
Recognized25	**APFS**	**APFS**	**200.02 MB**	**37.25 GB**
Virtual Volume sets and RAIDs				

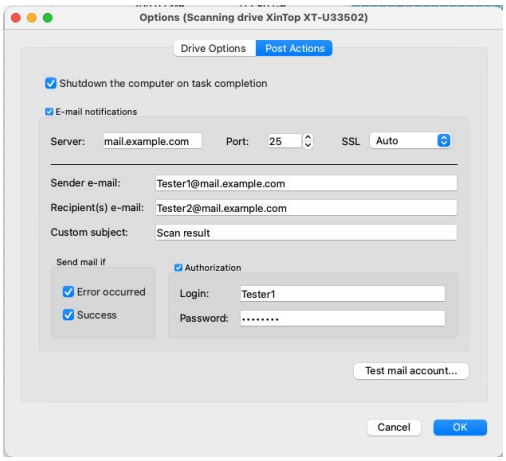


The Log pane will show scan progress. Scan may be stopped by clicking the **Stop** button on the toolbar. Later the scan process may be resumed with different scan parameters. Some scan parameters may also be changed during the scan process. Click the Options button and change them on the Scanning dialog box.

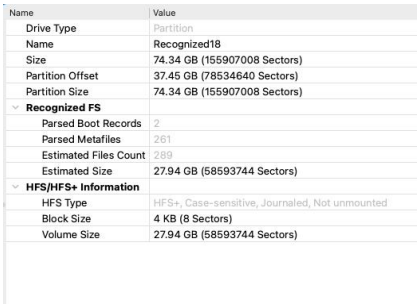
You may change some options during the scan process



Only in the Technician version



To see the information about a newly found object, simply click it on the Drives panel. Click this link to see the information about the object Recognized18.



When an object is scanned, a number of Recognized partitions will appear. **R-Studio** shows them in different colors depending on which elements of the partition have been found.

/Volumes/exFAT	An existing partition
HFS (Recognized)	An existing partition after drive scan
Recognized	A recognized partition. Both boot records and file entries are found for this partition
Recognized	A recognized partition. Only file entries are found for this partition
Recognized	A recognized partition. Only boot records are found for this partition
Recognized	A fast found partition

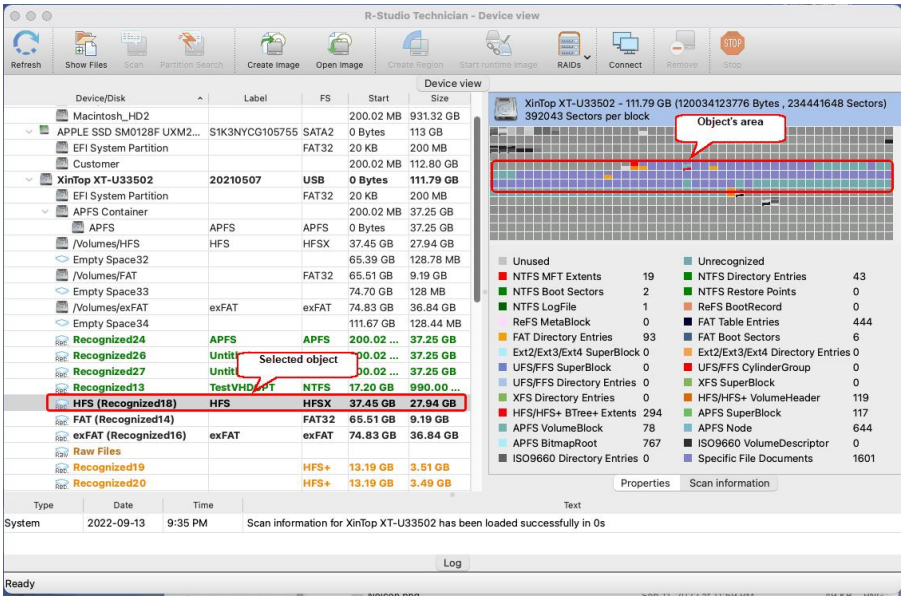
Empty Space	Empty space on the object
DeletedPart	A deleted partition
Raw Files	Files that have been found using scan for known file types (raw file search).

Although such recognized partitions are virtual objects, files can be searched for and recovered from recognized partitions as from real logical disks using Basic File Recovery.

All scanned information may be deleted on the contextual menu for a scanned object.

When an object in the scanned drive is selected, **R-Studio** shows the scanned area of the object.

Object's scanned area



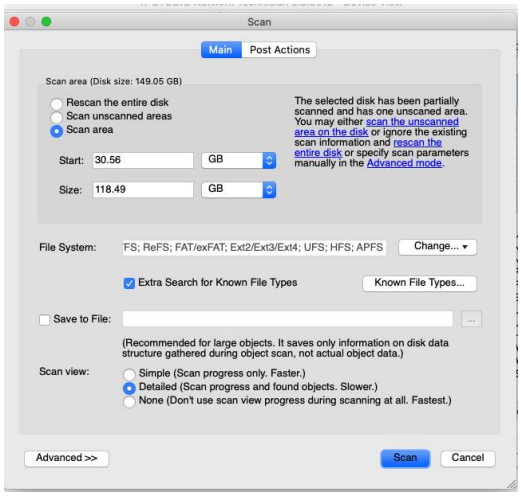
All scanned information may be deleted on the contextual menu for a scanned object.

Scan information may be saved in a file. Previously saved scan information may be loaded. This can be done on the **Drive** or contextual menu for a selected object.

Resuming incomplete scans or scanning the object with different parameters

You may resume the scan of an incompletely scanned object or rescan the already scanned object with different parameters. The Scan dialog will be a little bit different in this case.

Scan **dialog box for incomplete scans**

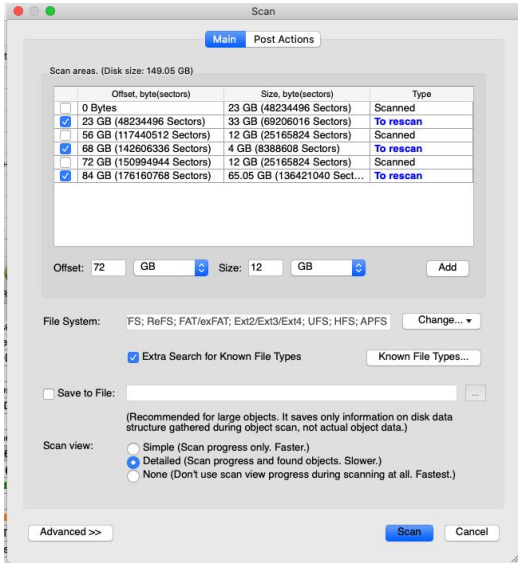


You may rescan the entire disk, scan unscanned areas, or scan an explicitly specified area.

Scan of multiple areas

You may simultaneously scan several successive or overlapping areas. Click the **Advanced** button, specify an offset and size for a new area to scan on the Advanced Scan dialog box and click the **Add** button. You may specify and add several scan areas. You may select which areas should be scanned. Selected scan areas can be merged. Control-click a necessary area and select either **Merge Down**, **Merge Down All**, and **Merge Selected**. You may also select/unselect unscanned areas.

Advanced Scan **dialog box**



R-Studio accumulates the information from successive scans and keeps track of changes in this information obtained from different scans.

You may manage the areas

Managing scan information

Scan information may be saved to a file. Previously saved scan information may be loaded.

To save scan information

1 **Select an object on the R-Studio** Drives **panel**

2 **Select Save Scan Information on the Drive or contextual menu and save the scan information in a file**

The default file extension is `*.scn`.

If a remote computer is connected for **Data Recovery over Network**, the Save Scan Information File dialog box will appear when you select a place to store scan info. You may save it to the local or remote computer.

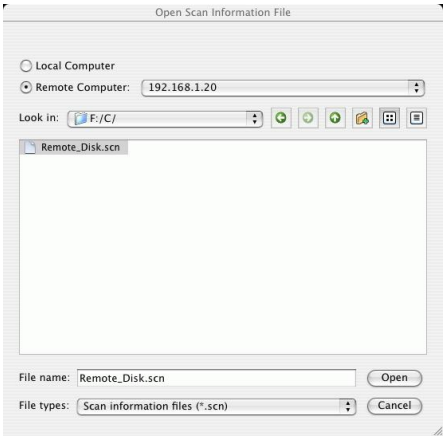
To load scan information

1 **Select an object on the R-Studio** Drives **panel**

2 **Select Open Scan Information on the Drive or contextual menu and select the required file with the scan information**

The default file extension is `*.scn`.

If a remote computer is connected for **Data Recovery over Network**, the Open Scan Information File dialog box will appear when you select a place to load scan info from. You may load it from the local or remote computer.



> **The scan information will appear in the** Drives **panel**

To remove scan information

1 **Select an object on the R-Studio** Drives **panel**

2 **Select Remove Scan Information on the Drive or contextual menu**

> **The scan information will disappear from the** Drives **panel**

NEVER TRY TO SAVE SCAN INFORMATION ON THE OBJECT BEING SCANNED!!!
Or you may obtain unpredictable results and lose all your data.

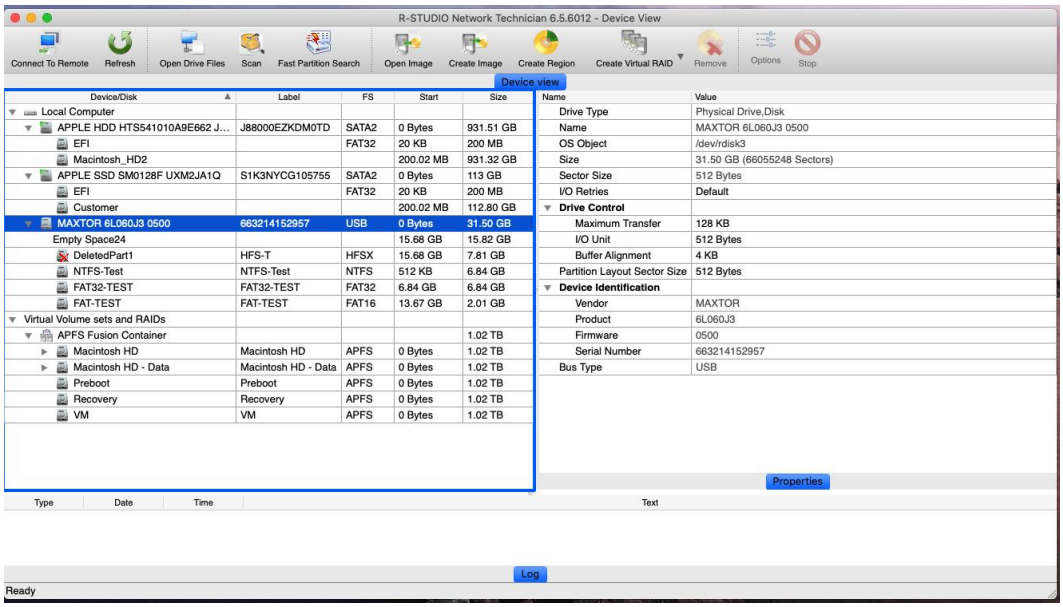
2.2.2 Fast Search for Lost Partitions

Drive scan gives very detailed and accurate results but takes long time. If you want to find only partitions previously existed on the disk you may use fast search for lost partitions which is much faster.

To perform fast search for lost partitions,

1 **Select an object on the R-Studio's** Drives **panel**

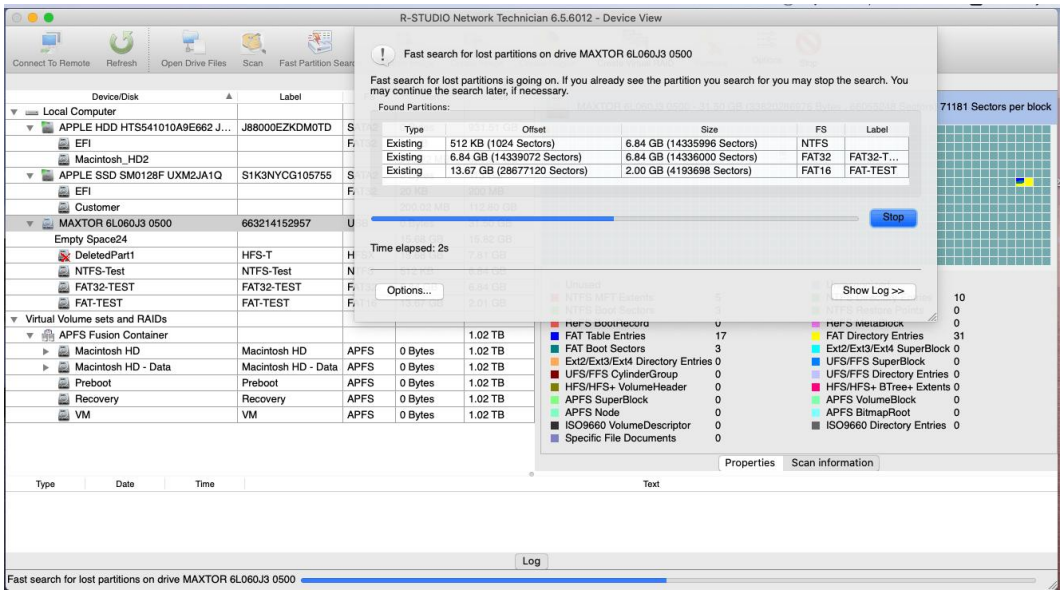
Fast search for lost partitions



2 Click the Fast Partition Search button

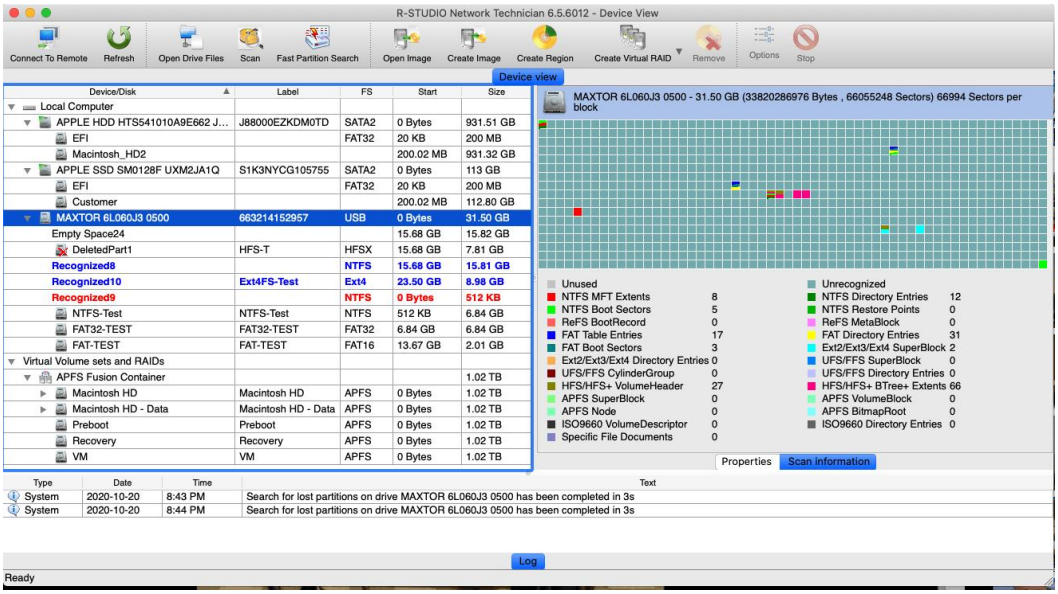
R-Studio will start searching for lost partitions showing its progress.

Fast search for lost partitions



> **R-Studio** will show fast found partitions in blue.

Fast search for lost partitions



You may control-click the partition and select Complete scan to scan the entire disk.

2.2.3 Customizing File Types

You may create your own known file types and add their file signatures for scanning in Known File Types. They will appear in their respective folders on the File Types dialog box.

You can do that either by using the **R-Studio's** graphic interface or by direct editing the known file description file specified on the **R-Studio** Main settings dialog box.

Creating a Known File Types using a Graphic User's Interface

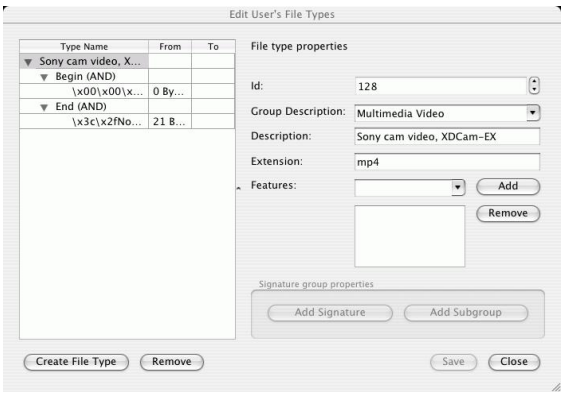
The easiest way to add your own is to use the **R-Studio's** graphic interface.

To create a Known File Type,

1 **On the** Known File Types **settings dialog box, click the Edit User's File Types... button**

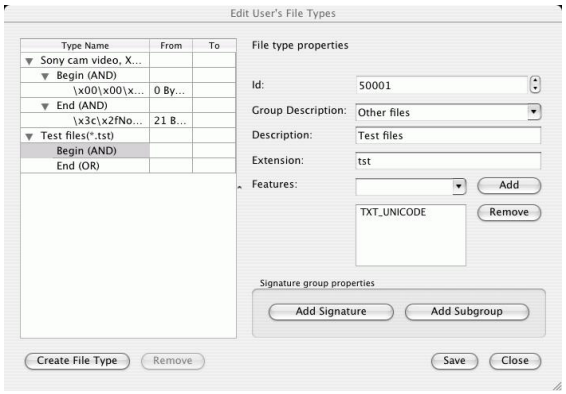
> **The** Edit User's File Types **dialog box will appear**

Edit User's File Types **dialog box**



2 Click the Create File Types button and specify File type properties

Edit User's File Types **dialog box**



File Types properties

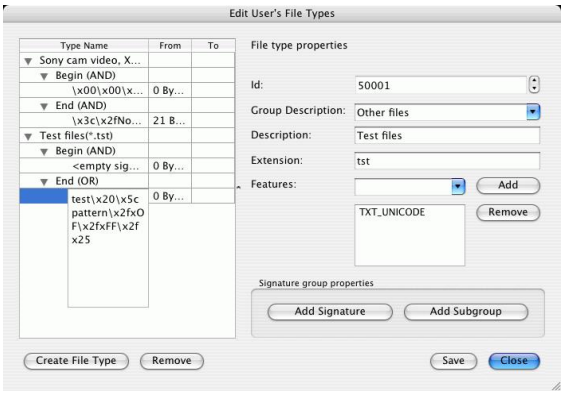
`id`	`digit`	Required	Digital file type identifier. Should be unique for each custom file type.
`group`	`string`	Optional	Specifies a file type group in which found files will appear. You may specify either your own groups or select those predefined on the File Types dialog box.
`description`	`string`	Optional	Brief file description

`features`	`NO_SCAN`
	`TXT_ANSI`
	`TXT_UNICODE`
		Optional	Additional properties of the file type. If you want to specify several properties, they should be separated by a space.
			`NO_SCAN`: Not to be scanned for. If this flag is used, **R-Studio** will not search for such file type. Such files will be shown when sorting files by their extensions.
			`TXT_ANSI`: The file can be viewed as ANSI text. If this flag is specified, the file can be correctly represented as an ANSI text. When previewing, this file will be immediately sent to **Text/hexadecimal editor**.
			`TXT_UNICODE`: The file can be viewed as UNICODE text. If this flag is specified, the file can be correctly represented as a UNICODE text. When previewing, this file will be immediately sent to **Text/hexadecimal editor**.

`extension`	`<string>`	Optional	File extension.

3 Click the Add Signature button, specify the signature parameters, and click the Save button

Edit User's File Types **dialog box**



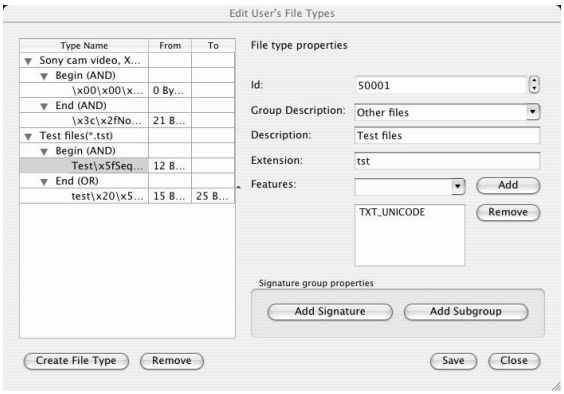
File signature properties

`Begin` `End`	Specifies from where the signature begins. If `End`, the offset is from the end of file to the first byte of the signature. That is, if the signature is two bytes long, the offset value should be `2`.
`AND` `OR`	Shows the order of the logical operation (union or intersection)
`From`	A decimal number specifying the leftmost possible offset for the file signature.
`To`	A decimal number specifying the rightmost possible offset for the file signature.

You may specify as many signatures as you need. Moreover, you may specify subgroups within a signature using the **Add Subgroup** button. The structure of such possible subgroups is described on the Customizing File Types-II help page.

> The newly specified file type will appear on the Edit User's File Types **dialog box and the** File Types **dialog box**

Edit User's File Types **dialog box**



2.2.4 Customizing File Types-I

The syntax of signature description is similar to that of the XML language. They are stored in an `.xml` file the path to which is specified on the **Setting** dialog box.

More advanced features are described in **Customizing File Types-II**.

Signature file example

```
<?xml version="1.0" encoding="utf-8"?>
<FileTypeList>
   <!-- Search for NTFS MFT -->
   <FileType id="5626" group="System Files" description="MFT" features="TXT_ANSI TXT_UNICODE">
      <Signature offset="0" from="begin" count="1">FILE</Signature>
      <Signature offset="7" from="end" count="1">$\x00M\x00F\x00T</Signature>
   </FileType>
</FileTypeList>
```

File structure

File header

The file starts with a standard XML header

```
<?xml version="1.0" encoding="utf-8"?>
```

Section `FileTypeList`

```
<FileTypeList>
```

It requires a closing element `</FileTypeList>`.

Section `FileType`

This is a description of each file signature.

Attributes:

`id`	`<u32>`	Required	Digital file type identifier. Should be unique for each file type.	
`group`	`<string>`	Optional	Specifies a file type group in which found files will appear. You may specify either your own groups or those predefined on the File Types dialog box.	Default: `unknown`
`description`	`<string>`	Optional	Brief file description	Default: `null` (no description)

`features`	`NO_SCAN`
	`TXT_ANSI`
	`TXT_UNICODE`
		Optional	Additional properties of the file type. If you want to specify several properties, they should be separated by a space.	Default: `0`

`extension`	`<string>`	Optional	File extension.	Default: `null` (no extension)

File type properties flags

`NO_SCAN`	Not to be scanned for. If this flag is used, **R-Studio** will not search for such file type. Such files will be shown when sorting files by their extensions.
`TXT_ANSI`	The file can viewed as ANSI text. If this flag is specified, the file can be correctly represented as an ANSI text. When previewing, this file will be immediately sent to **Text/Hexadecimal Editor**.
`TXT_UNICODE`	File can viewed as UNICODE text. If this flag is specified, the file can be correctly represented as a UNICODE text. When previewing, this file will be immediately sent to

	Text/Hexadecimal Editor.

This section can contain an unlimited number of the `Signature` elements.If there are several `Signature` elements, that means that all those signatures are simultaneously present in the file. Such signatures should have different `offset` attributes and they should not overlap.

Element `Signature`

The element contains a string value of the file signature consisting of ASCII characters and hex bytes in the `\xhh` format, where `hh` is a hexadecimal byte code. If there is not a hexadecimal number after `\x` , `\x` are treated as a part of the string section of the signature

Attributes:

`offset`	`<u16>`	Optional	Decimal offset for the signature	Default: `0`
`count`	`<u16>`	Optional	Decimal number specifying the number of signatures of the same length. Used when several signatures of the same length starting with the same offset can be present in a file. In this case they should be sequentially written in the element, and the `size` attribute specifies the length of signature. `count*size` should be equal to the number of bytes in the element. If only one signature can be on this offset, `count` should be equal `"1"`, and `size` should be equal to the length (the number of bytes) of the signature.	Default: `1`
`size`	`<u16>`	Optional	Decimal number specifying the number of bytes in the signature.	Default: the number of bytes written in the element.
`from`	`begin` `end`	Optional	Specifies from where the `offset` is calculated. If `end`, the `offset` is from the end of file to the first byte of the signature. That is, if the signature is two bytes long, the `offset` value should be `2`.	Default: `begin`

Comments

```
<!-- Comment string -->
```

An XML standard string for a comment.

2.2.5 Customizing File Types-II

Currently **R-Studio** supports two versions of file type descriptions. Version 2 extends legacy Version 1 by adding variable signature offsets and `AND/OR` combination of several signatures in one file type. The version of

file type description is specified by the version attribute of the `FileTypeList` section . Version 1 is the default option.

File structure

Elements common to Versions 1 and 2 of file type description

File header

The file starts with a standard XML header

```
<?xml version="1.0" encoding="utf-8"?>
```

Section `FileTypeList`

```
<FileTypeList>
```

Attributes:

`version`	`1.0` `2.0`	Optional	Version of file type description	Default: `1.0`

It requires a closing element `<FileTypeList>`.

Comments

```
<!-- Comment string -->
```

An XML-standard string for a comment.

Version 1 of file type description

Signature file example

```
  <FileTypeList>
    <FileType id="2" group="archive" description="ARJ Archive" extension="arj">
      <Signature offset="3" count="1">Abc\x5c\x00\x04</Signature>
      <Signature offset="9" count="2">\x23\x01\xf4</Signature>
    </FileType>
  </FileTypeList>
```

Section `FileType`

This is a description of each file signature.

Attributes:

`id`	`<u32>`	Required	Digital file type identifier. Should be unique for each file type.	
`group`	`<string>`	Optional	Specifies a file type group in which found files will appear. You may specify either your own groups or those predefined on the File Types dialog box. See the table below.	Default: `unknown`
`description`	`<string>`	Optional	Brief file description	Default: `null` (no description)

`features`	`NO_SCAN`
	`TXT_ANSI`
	`TXT_UNICODE`
		Optional	Additional properties of the file type. If you want to specify several properties, they should be separated by a space.	Default: `0`

extension	<string>	Optional	File extension.	Default: null (no extension)

File type properties flags

NO_SCAN	Not to be scanned for. If this flag is used, **R-Studio** will not search for such file type. Such files will be shown when sorting files by their extensions.
TXT_ANSI	The file can be viewed as ANSI text. If this flag is specified, the file can be correctly represented as an ANSI text. When previewing, this file will be immediately sent to **Text/hexadecimal editor**.
TXT_UNICODE	The file can be viewed as UNICODE text. If this flag is specified, the file can be correctly represented as a UNICODE text. When previewing, this file will be immediately sent to **Text/hexadecimal editor**.

List of predefined file type groups

Group	Name on the File Types dialog box.
archive	Archive Files
graphics	Graphics/Picture
internet	Internet-related files
multimedia	Multimedia Files
audio	Multimedia: Audio Files
video	Multimedia: Video Files
font	Font
document	Document
doc_database	Document: Database
doc_sheet	Document: Spreadsheet
exe	Executable/Library/DLL
unknown	Other file types

This section can contain an unlimited number of the Signature elements.If there are several Signature elements, that means that all those signatures are simultaneously present in the file. Such signatures should have different offset attributes and they should not overlap.

Element Signature

The element contains a string value of the file signature consisting of ASCII characters and hex bytes in the \xhh format, where hh is a hexadecimal byte code. If that is not a hexadecimal number after \x, \x are treated as a part of the string section of the signature

Attributes:

offset	<u16>	Optional	Decimal offset for the signature	Default: 0
count	<u16>	Optional	Decimal number specifying the number of signatures of the same length. Used when several signatures of the same length starting with the same offset can be present in a file. In this case they should be sequentially written in the element, and the size attribute specifies the length of signature. count*size should be	Default: 1

			equal to the number of bytes in the element. If only one signature can be on this offset, count should be equal to "1", and size should be equal to the length (the number of bytes) of the signature.	
size	<u16>	Optional	Decimal number specifying the number of bytes in the signature.	Default: the number of bytes written in the element.
from	begin end	Optional	Specifies from where the offset is calculated. If end, the offset is from the end of file to the first byte of the signature. That is, if the signature is two bytes long, the offset value should be 2.	Default: begin

Version 2 of file type description

Signature file example

```
<?xml version="1.0" encoding="utf-8"?>
<FileTypeList version="2.0">
  <FileType id="5626" group="_Test" description="Test file" extension="tst">
    <Begin combine="and">
      <Signature from="0" to="20">ABC</Signature>
      <Signature offset="1">CDEFG</Signature>
      <AND>
        <Signature offset="0">DE</Signature>
        <Signature offset="0">RTD</Signature>
        <OR>
          <Signature offset="12">CP</Signature>
          <Signature offset="16">RTD</Signature>
        </OR>
      </AND>
    </Begin>
    <End combine="or">
      <Signature from="3" to="20">ABC</Signature>
      <Signature offset="5">CDEFG</Signature>
      <AND>
        <Signature offset="2">DE</Signature>
        <Signature offset="3">RTD</Signature>
        <OR>
          <Signature offset="12">CP</Signature>
          <Signature offset="16">RTD</Signature>
        </OR>
      </AND>
    </End>
  </FileType>
</FileTypeList>
```

Section `FileType`

This is a description of each file signature.

Attributes:

Similar to those in Version 1.

The section can contain one element `Begin` and one `End`. It should contain at least one of them.

Example

```
<FileTypeList version="2.0">
   <FileType id="2" group="archive" description="ARJ Archive" extension="arj">
     <Begin [attributes]>
       ...
     </Begin>
     <End [attributes]>
       ...
     </End>
   </FileType>
 </FileTypeList>
```

Sections `Begin` and `End`

Specify the positions of file type signatures in the file.

Attributes

`combine`	`and` `or`	Optional	Shows the order of the logical operation (union or intersection)	Default: `and`

These sections can contain one of several elements `Signature`. And one or several elements `OR` or `AND`. If there are several elements inside the section they are combined according to the attribute `combine`.

Example:

```
<FileTypeList version="2.0">
  <FileType id="2" group="archive" description="ARJ Archive" extension="arj">
    <Begin combine="or">
      <Signature [attributes]> ... </Signature>
      ...
      <Signature [attributes]> ... </Signature>
      <AND>
        ...
      </AND>
      <OR>
        ...
      </OR>
    </Begin>
    <End>
      <OR>
        ...
      </OR>
      <Signature [attributes]> ... </Signature>
      ...
      <Signature [attributes]> ... </Signature>
    </End>
  </FileType>
</FileTypeList>
```

Sections AND and OR

These sections can contain one of several elements Signature. And one or several elements OR or AND. If there are several elements inside the section they are combined according to the section type (logical AND or OR).

Example:

```
<FileTypeList version="2.0">
  <FileType id="2" group="archive" description="ARJ Archive" extension="arj">
    <Begin>
      <Signature [attributes]> ... </Signature>
      ...
      <Signature [attributes]> ... </Signature>
      <AND>
        <Signature [attributes]> ... </Signature>
        <OR>
          <Signature [attributes]> ... </Signature>
          <AND>
            <Signature [attributes]> ... </Signature>
            <Signature [attributes]> ... </Signature>
          </AND>
          <OR>
            <Signature [attributes]> ... </Signature>
            <Signature [attributes]> ... </Signature>
          </OR>
        </OR>
        <Signature [attributes]> ... </Signature>
      </AND>
    </Begin>
  </FileType>
</FileTypeList>
```

Element Signature

The element contains a string value of the file signature consisting of ASCII characters and hex bytes in the \xhh format, where hh is a hexadecimal byte code. If that is not a hexadecimal number after \x, \x are treated as a part of the string section of the signature

Attributes:

offset	<u16>	Optional	Decimal offset for the signature	Default: 0
from	<u16>	Optional	Decimal number specifying the leftmost possible offset for the file signature. Ignored if the offset attribute is specified.	Default: undefined
to	<u16>	Optional	Decimal number specifying the rightmost possible offset for the file signature. Ignored if the offset attribute is specified.	Default: undefined
size	<u16>	Optional	Decimal number specifying the number of bytes in the signature.	Default: the number of bytes written in the element.

Example:

```
<FileTypeList version="2.0">
  <FileType id="2" group="archive" description="ARJ Archive" extension="arj">
    <Begin>
      <Signature offset="3">Abc\x5c\x00\x04</Signature>
      <Signature from="9" to="15">\x23\x01\xf4</Signature>
    </Begin>
  </FileType>
</FileTypeList>
```

2.2.6 Regions

Scanning large objects may take a long time. Sometimes, only smaller area of a disk needs to be scanned or searched for files. Such area is called a *region*. A region can be created on any object in the **R-Studio**'s Drives panel.

Created regions can be scanned, and files on them can be recovered in the same way as from hard drives or logical disks.

Created regions can be deleted.

Note: R-Studio does not create anything real on the disk. Regions are virtual objects that do not affect actual data on the disk.

To create a *region*

1 Select an object on the R-Studio's Drives panel and click the Create Region button

Other ways to create the region

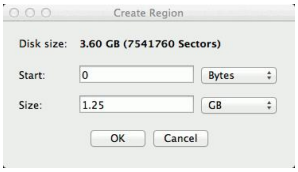
- Control-click the selected object and select **Create Region** on the contextual menu

or

- Select the object and select **Create Region** on the **Create** menu

2 Specify required parameters on the Create region dialog box and click the Create button

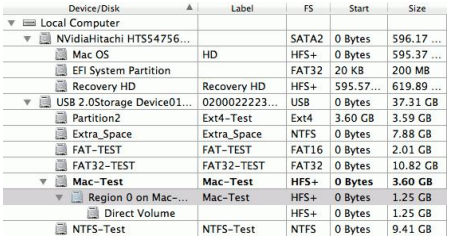
Create region **dialog box**



Region options

Disk size:	Shows size of the object where the region is to be created. The region cannot be larger than this size.
Start:	Start point of the region
Size:	Size of the region. Cannot be larger than Disk size.
Numbers in these fields can be in bytes or sectors. See the **Data Formats and Multipliers** topic for more details on data formats.	

> A Region object will appear on the Drives panel.



To change the size of a region

* **Control-click the Region on the R-Studio** Drives **panel, select Edit on the contextual menu, and enter a new size on the** Edit Region **dialog box.**

To convert a region into an exclusive one

* **Control-click the Region on the R-Studio** Drives **panel and select Exclude area on the contextual menu**

To remove a region

* **Select a Region on the R-Studio's** Drives **panel and click the Remove button**, or
  Control-click the selected region and select **Remove Region** on the contextual menu.

2.2.7 Exclusive Regions

Exclusive regions are areas on any object visible on the **R-Studio**'s Drives panel that are excluded from disk operations. **R-Studio** never tries to read/write data from/to such area. Exclusive regions are necessary when, for example, there are areas with bad sectors on a hard drive, and it is necessary to avoid any disk operations with such areas to not inflict further damage to such drive and to speed work with it.

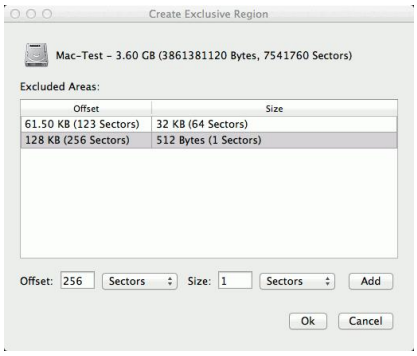
Note: R-Studio does not create anything real on the disk. Exclusive regions are virtual objects that do not affect actual data on the disk.

To create an *exclusive region*

1 **Control-click an object on the R-Studio's** Drives **panel and select Create Exclusive Region on the contextual menu**, or
  Select the object and select **Create Exclusive Region** on the **Create** menu

2 **Specify required parameters on the** Create Exclusive Region **dialog box and click the Add button**

Create exclusive region **dialog box**

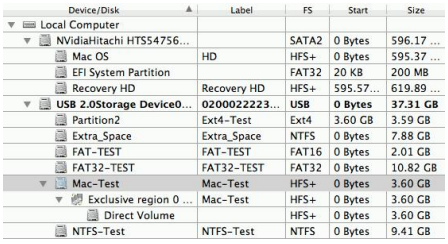


Exclusive Region options

Offset:	Start point of the exclusive region
Size:	Size of the exclusive region. Cannot be larger than Disk size.

Numbers in these fields can be in bytes or sectors. See the **Data Formats and Multipliers** topic for more details on data formats.

> **An Exclusive Region object will appear on the** Drives **panel.**



Device/Disk	Label	FS	Start	Size
Local Computer				
NVidiaHitachi HTS54756...		SATA2	0 Bytes	596.17 ...
Mac OS	HD	HFS+	0 Bytes	595.37 ...
EFI System Partition		FAT32	20 KB	200 MB
Recovery HD	Recovery HD	HFS+	595.57...	619.89 ...
USB 2.0Storage Device0...	**0200022223...**	**USB**	**0 Bytes**	**37.31 GB**
Partition2	Ext4-Test	Ext4	3.60 GB	3.59 GB
Extra_Space	Extra_Space	NTFS	0 Bytes	7.88 GB
FAT-TEST	FAT-TEST	FAT16	0 Bytes	2.01 GB
FAT32-TEST	FAT32-TEST	FAT32	0 Bytes	10.82 GB
Mac-Test	Mac-Test	HFS+	0 Bytes	3.60 GB
Exclusive region 0 ...	Mac-Test	HFS+	0 Bytes	3.60 GB
Direct Volume		HFS+	0 Bytes	3.60 GB
NTFS-Test	NTFS-Test	NTFS	0 Bytes	9.41 GB

Its properties can be seen on the Excluded Areas tab.

Excluded Areas	Start	Size
Excluded area 0	61.50 KB	32 KB
Excluded area 1	128 KB	512 Bytes

To delete an exclusive region

* **Select an Exclusive Region on the R-Studio** Drives **panel and click the Delete button, or**

Control-click the selected region and select **Remove Region** on the contextual menu.

To change the size of an exclusive region

* **Control-click an Exclusive Region on the R-Studio** Drives **panel, select Edit on the contextual menu, and add/delete excluded areas on the Edit**e Exclusive Region **dialog box.**

You may delete an excluded area by control-clicking it and selecting **Remove** on the contextual menu.

2.2.8 Images

An *image* is an exact, byte by byte, copy of any object on the Drives panel. When created, images can be processed like their original objects.

Images are very useful if there is a risk of total data loss due to hardware malfunction. If bad blocks are constantly appearing on a hard drive, you must immediately create an image of this drive. All data search, scan and restoring can be done from this image.

While creating images, **R-Studio** can simultaneously perform disk scan and save scan information to lessen time necessary to process the disk.

The image can be saved on the remote computer if it is created via network. **R-Studio** can also load and process images created with the **DeepSpar Disk Imager™**.

To create an *image*,

1 **Select an object on the R-Studio's** Drives **panel and click the Create Image button**

Other ways to create the image

- Select the object and select **Create Image** on the **Drive** menu

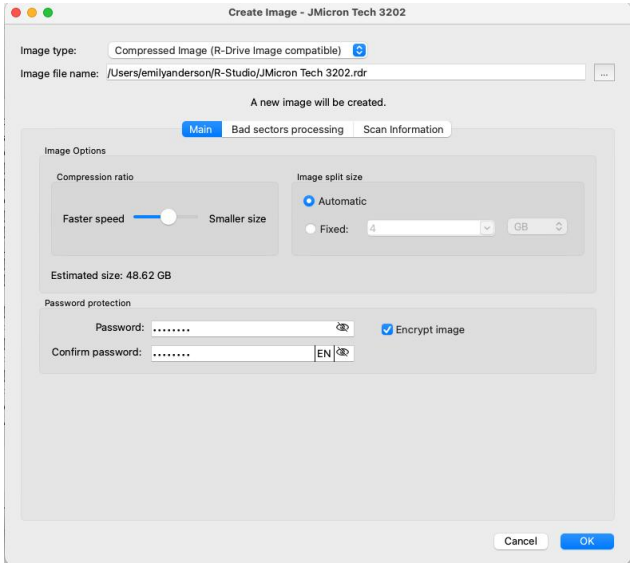
or

- Control-click the selected object and select **Create Image File** on the contextual menu

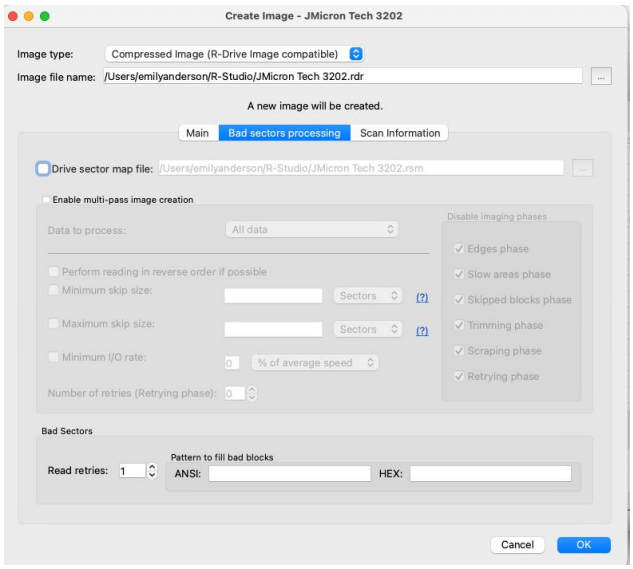
2 **Specify image options, a file name, and destination for the *image* on the Drive Image Wizard**

Note: To store an image file, you need a free space equal to at least the object size.

Create Image (Main) **dialog box**



Create Image (Bad sector processing) **dialog box**



Create Image (Scan Information) **dialog box**

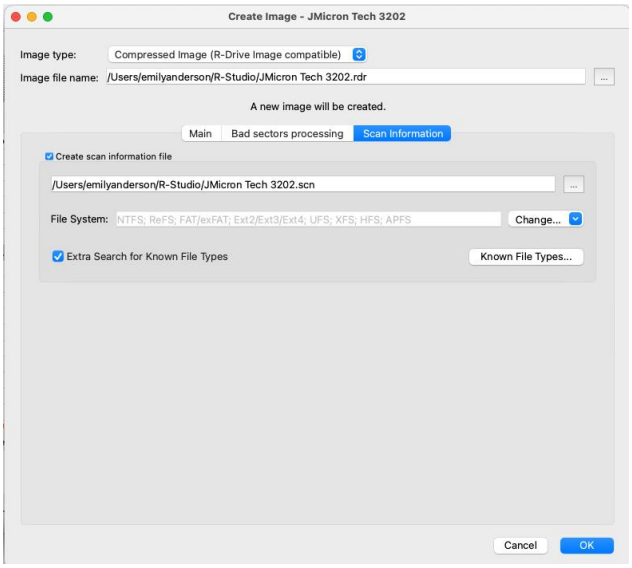
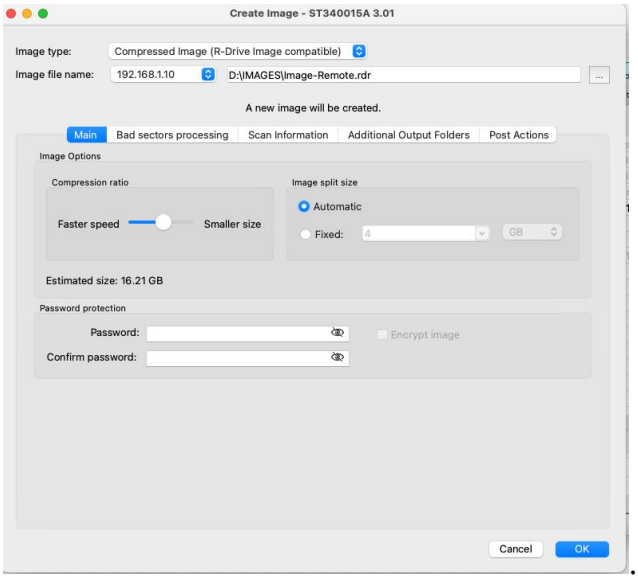


Image Options (Main)

Image filename	Specifies the name and path for the image file
Image type:	Compressed image (R-Drive Image compatible): If this option is selected, **R-Studio** will create an image file which can be compressed, split into several parts, and password-protected. This image file is fully compatible with the images created by **R-Drive Image**, but incompatible with the previous versions of **R-Studio**. Byte by byte image to a file: If this option is selected, **R-Studio** will create a simple exact copy of the object. VMDK (ViMware Virtual Machine Disk) image: If this option is selected, **R-Studio** will create an image of the VMware virtual disk type. Available in the Corporate, Technician, and T80+ license. Byte to byte image to a physical disk: **R-Studio** will create an exact copy of the disk on another hard drive. Data on the target drive will be overwritten. Available in the Corporate, Technician, and T80+ license. Some other image formats are also available in the Technician, and T80+ licenses. You may read more about these formats in the Supported Virtual Disk and Disk Image Formats page.
Image compression ratio	You may compress the data in the image to save space. Active only if the Compressed image (R-Drive Image compatible) is selected.
Estimated size	Shows the estimated size of the image file. An actual image size depends on how much empty space is on the selected partition and what file types are there. Active only if the Compressed image (R-Drive Image compatible) is selected.
Image split size	You may set this option to Automatic and let Windows decide how to split the image file. This mostly depends on the file system on the destination drive. You may also either explicitly specify the split size, or choose a preset for various devices with removable storage. Select Fixed size for that. Active only if the Compressed image (R-Drive Image compatible) is selected.

Password Encrypt image	You may protect your image file with a password. **Note:** If you leave the Encrypt image option clear this feature will provide a relatively moderate protection against conventional unauthorized access. If this option is selected, **R-Studio** will encrypt the image using the AES-XTS algorithm. **Note:** Only files in the RDR format can be password protected and encrypted.
Create scan information file	If this option is selected, **R-Studio** will perform drive scan simultaneously with image creation. See the **Drive Scan** help page to learn scan options.
Read retries	Specifies a value for I/O Tries, or how many times **R-Studio** will try to read a bad sector. **R-Studio** treats bad sectors in the following way: It reads a certain part of drive (predefined by Windows) and • If Default read attempts is set to 0, the entire part with bad sectors will be filled with the specified pattern. • If Default read attempts is set to a non-zero value, **R-Studio** reads again that part sector by sector, repeating the attempts the specified number of times. If **R-Studio** still cannot read a bad sector, it fills the sectors with the specified pattern. In this case only the bad sectors will be filled with the pattern, but that extremely slows the drive read process. For example, if you set Default read retries to 1, a bad sector will be read 2 times.
Pattern to fill bad blocks	Specifies a pattern **R-Studio** will use to fill bad sectors in this image. You may specify the pattern either in the ANSI or Hex data format. **Note: R-Studio** will never ever try to write anything on the drive from which data is to recover or an image is to create. This pattern fills bad sectors only in the image.
Drive sector map file Enable multi-pass image creation	These options are available only in the **Technician/T80+** versions. Read more about these options in the **I/O Monitor and Sector Map files** and **Multi-pass imaging** help page.

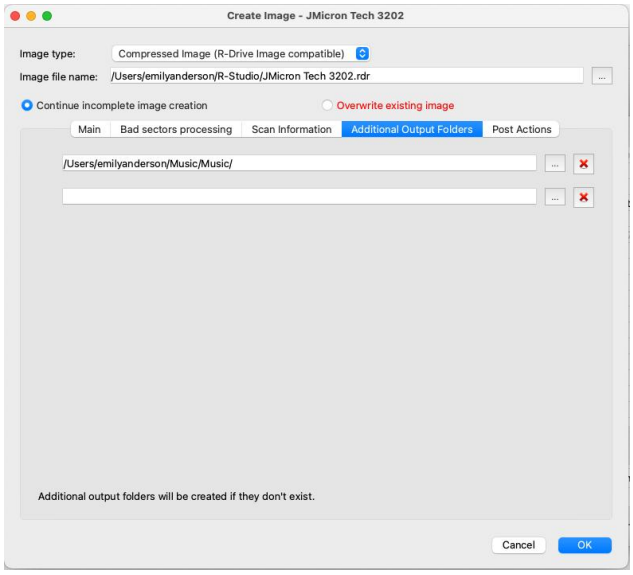
If a remote computer is connected for Data Recovery over Network, the Save Image File dialog box will appear when you select a place to store the image. You may save it to the local or remote computer.



R-Studio Technician/T80+

Create Image (Additional output folders) **dialog box**

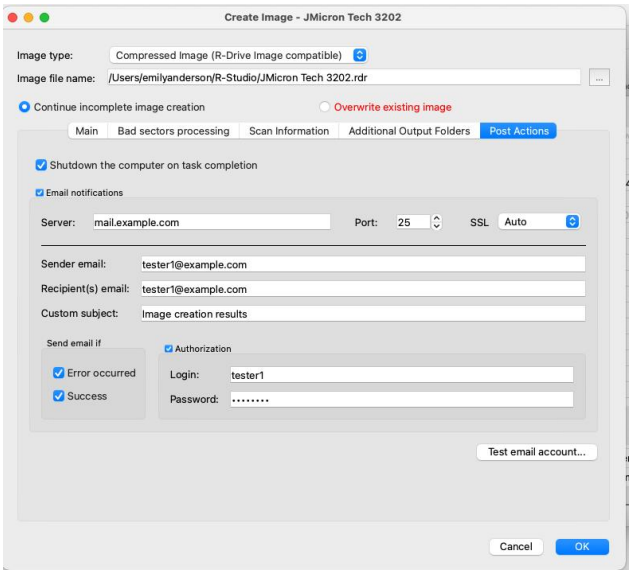
These options are available only in the **Technician/T80+** versions.



Additional output folders

Additional output folders	Additional output folders where image files will be stored when **R-Studio** runs out of space.

Create Image (Post Actions) **dialog box**



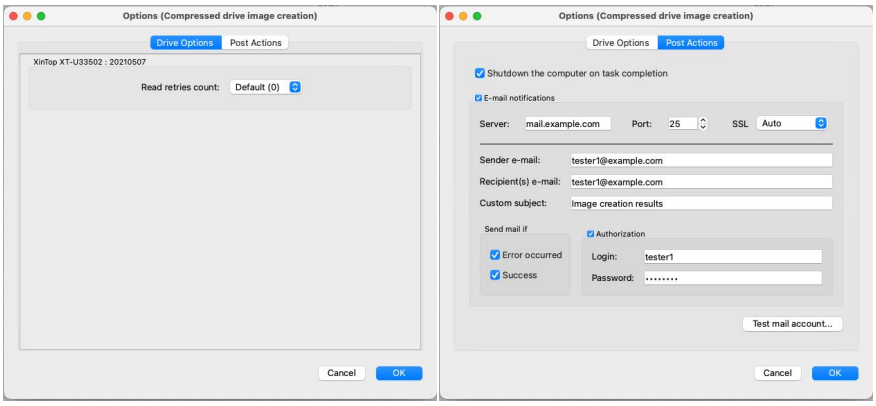
Post Actions Options

Shutdown the computer on task completion	If this check box is selected, **R-Studio** will shut down your computer when image creation has been completed.
E-Mail notifications	If this check box is selected, **R-Studio** will inform you about the outcome of the operation via email.

> **R-Studio will start creating the image, the Progress message showing the progress.**

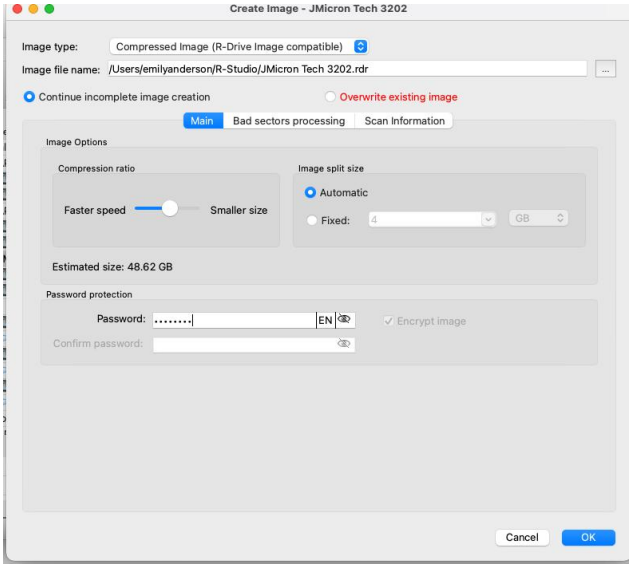
You may change some options during the imaging process. Click the **Options** button and change them as necessary/

You may stop the imaging process and then resume it later on. Click the **Stop** button and the Cancel drive operation dialog box will appear. Select **Stop** if yo want to keep the partially created image or **Discard** if you don't need this image file.



To resume the creation of the image for the same object, select the same file name for the image. You'll be able to create a new image file or continue to create the image for the object.

Resuming image creation



R-Studio will create a new file for every new start of imaging for the `.rdi` and `.vmdk` file types.

To process an already created *Image*, the image file should be opened.

To open an image

1 **Click the Open Image button**, or

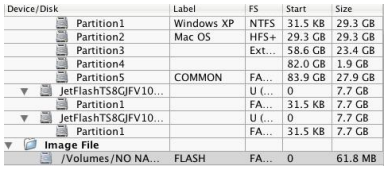
Select **Open Image File** on the **Drive** menu

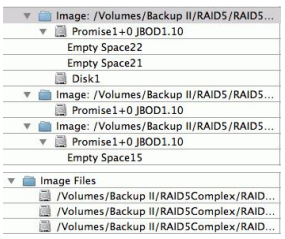
If a remote computer is connected for **Data Recovery over Network**, the Open Image File dialog box will appear when you select a place to load the image file from. You may load it from the local or remote computer.

2 **Select the required image file**

> **An *Image* object will appear on the** Drives **panel**

You may perform all data search, scan, and recovery from this image as it were a regular drive/disk object.





Compressed (**R-Drive Image** compatible) images

Byte-to-byte images

To close an image

* **Select the image and click the Close Image button,**
  - or control-click the image and select **Close Image** on the contextual menu
  - or select the image and press the **F8** key.

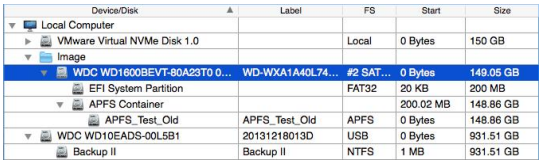
To close all image

* **Select Close All Images on the Tools menu**

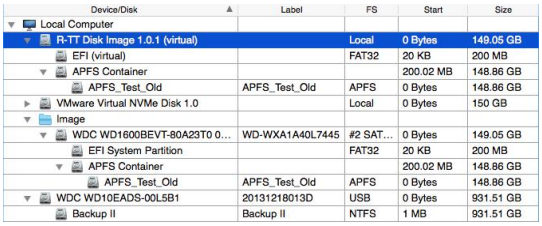
A disk (or disks) containing in an image can be connected to the operating system as a device which makes its content accessible to any program including any other data recovery software.

To connect a disk in an image

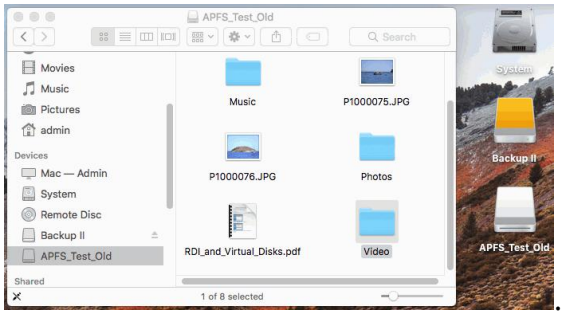
1 **Control-click the disk in the image on the** Drives **panel and select Mount on the contextual menu**



> **A *Virtual disk* object will appear on the** Drives **panel**



and this virtual disk will be available to system in the read-only mode



To disconnect a virtual disk from the system

1 **Control-click the virtual disk in the image on the** Drives **panel and select Unmount on the contextual menu.**

2.2.9 Wiping Objects

Disk objects can be wiped in order to completely destroy its data.

Supported Wipe Algorithms

File wiping is necessary only for files stored on conventional hard drives. Files stored on new SSD storage devices cannot be effectively wiped out due to the principles of operation of these devices.

Currently **R-Studio** supports 6 wiping algorithms:

Zeroes	The disk object or file is filled with zeroes through 1 pass. The fastest but the least secure algorithm. Also it does not conceal the fact that the disk or file has been wiped.
Pseudo-random numbers	The disk object or file is filled with pseudo-random numbers through 1 pass. A slower but little bit more secure algorithm than the **Zeroes** algorithm and it also conceals to some degree the fact that the disk or file has been wiped.
DoD 5220.22-M(3)	The disk object or file is wiped using Department of Defense standard 5220.22-M(3). Provides high-grade data wiping filling the unused space or file with a special digital pattern through 3 passes This algorithm is very secure, but slow.
DoD 5200.28-STD(7)	The disk object or file is wiped using Department of Defense standard 5200.28-STD(7). Provides high-grade data wiping filling the unused space or file with a special digital pattern through 7 passes. This algorithm is very secure, but very slow.
Bruce Schneier(7)	The disk object or file is wiped using the Bruce Schneier(7) algorithm. The first pass overwrites the drive with the bit pattern "00", the second with "11", and the next five with a randomly generated bit pattern. This algorithm is very secure, but very slow.
Peter Gutmann (35)	The disk object or file is wiped using the Peter Gutmann's algorithm. Provides high-grade data wiping filling the unused space or file with a special digital pattern through 35 passes. This algorithm is military-level secure, but horribly slow.

What algorithm is to choose, depends on your specific needs. All of these wiping algorithms make recovery of wiped data with any software-based data recover utility impossible. So if you want to protect your information from a casual snooper, you may safely choose either the **Zeroes** or **Pseudo-random numbers** algorithm. The latter also conceals the fact that you wiped the data.

If you want more security, you need to know the following:

There are some techniques for recovery of wiped data. These techniques are based on the fact that magnetic medium on the hard drive's platters "store" some information about previously written data. Such information cannot be completely removed. Wiped data may be recovered even from mechanically damaged platters. So the only safe way to completely remove data from a hard drive is to mechanically grind the magnetic medium off the drive platters or dissolve them in special chemical solvents.

But in order to recover the wiped data using one of these techniques, a hard drive must be disassembled, its platters placed in a precise magnetic field measurement system, and the results of such measurement statistically

processed. All that is very expensive and requires a very qualified and experienced personnel and a specially developed equipment. Only a very advanced organization such as a law enforcement or intelligence agency of a developed nation, or a special high-tech firm can afford this. Moreover, each successive wiping pass makes such data recovery much and much harder. So, the **DoD 5220.22-M(3)** clearing and sanitizing standard overwriting the data with a special pattern through 3 passes is a rather reliable and safe choice for this case.

If you need the ultimate security, use the **DoD 5220.22-M(7)** clearing and sanitizing standard, the **Bruce Schneier(7)**, or even the **Peter Gutmann (35)** wiping algorithms. They render data almost unrecoverable, but they are extremely slow.

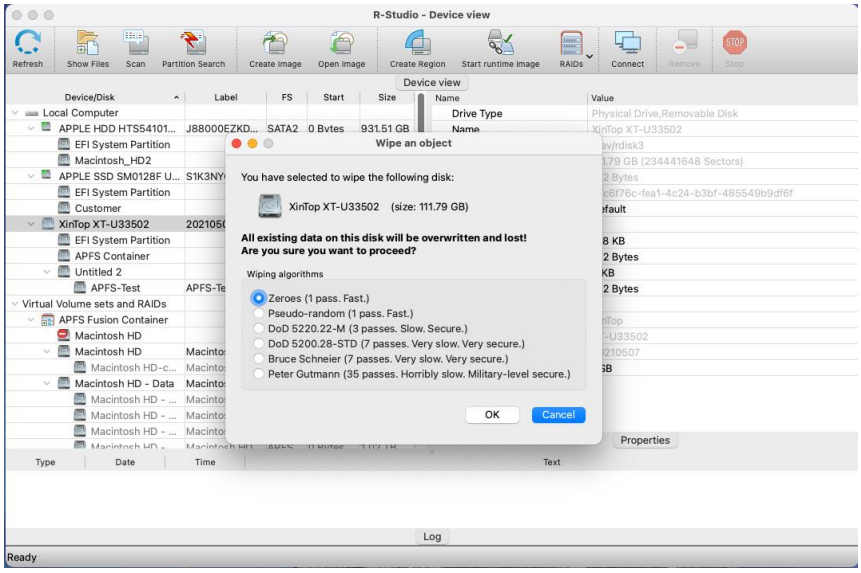
Wiping Disk Objects:

To wipe a disk object,

1 **Control-click the disk object in the Device view pane and select Wipe...**

> **The** Wipe an object **dialog box will appear.**

Wiping Disk Objects



2 **Select the desired wiping algorithms and click the OK button.**

> **R-Studio will start wiping the object.**

2.3 Mass File Recovery

Recovery of multiple files

If you need to recover multiple files you may do it through the following steps:

1 **Find and mark all the necessary files**
Go to the Find and Mark Multiple Files topic for more information

2 **Recover all marked files in a single file recovery step**
Go to the Recover Multiple Files for more information

3 **Create file recovery lists to manually edit the list of files to recovery**
Go to the File Recovery Lists topic for more information

Memory considerations

R-Studio stores information about found files in computer memory. If there are too many files, **R-Studio** may run out of it. To avoid this, you have two options:

Recover all files

If you want to recover data from an entire file system object (a logical disk, partition, partition image, etc.), you may use the **Recover All Files** command from the **Drive** or contextual menu. Right click the object in the Drives panel to access the contextual menu. A Recover dialog box will appear. Select required restore settings, including file mask. This command restores unlimited number of files without memory restrictions.

View file information in steps

As soon as **R-Studio** nearly runs out of memory, a Too many files... message appears. You may temporally stop file listing and browse through found files. Then you can resume file listing. You also may skip this file section and continue file listing.

In all cases, **R-Studio** keeps information about the entire file structure.

- **Find and Mark Multiple Files**
- **Recover Multiple Files**

2.3.1 Find and Mark Multiple Files

If you need to find and mark many files at once, you may do that in the following ways:

By sorting them by their extensions or creation/modification/accessed time

To sort files by their extensions or creation/modification/accessed time,

* **On the** Folders **panel select the tab**

Real File structure	to display the real file structure of the files/folders
Extensions	to sort the files by their extensions
Creation Time	to sort the files by their creation time
Modification Time	to sort the files by their modification time
Accessed Time	to sort the files by their accessed time

Other ways to sort files by their extensions or creation/modification/accessed time

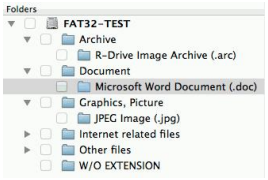
- Select the disk on Drives panel, select **Open Drive Files Sorted By** on the **Drive** menu, and select the respective option,

or

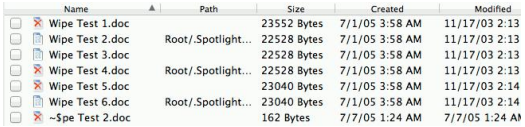
- On the Folders panel, control-click the disk letter and select **Show Files Sorted By** on the contextual menu and select the respective option,

> **R-Studio will show the sorted files in the** Folders **and** Content **panels, showing the path to each file:**

Folders panel for files sorted by their extensions



Content panel with files/folders sorted by their extensions



To return to the conventional view,

* **On the** Drives **panel, control-click the logical disk, select Open Drive Files Sorted By on the contextual menu, and select Real File System Structure,**

  or

  On the Folders panel, select **Show Files Sorted By** on the **Drive** menu and select **Real File System Structure**

  or

  Click the **Real** tab

By finding and marking multiple files using the Find/Mark ***dialog box***

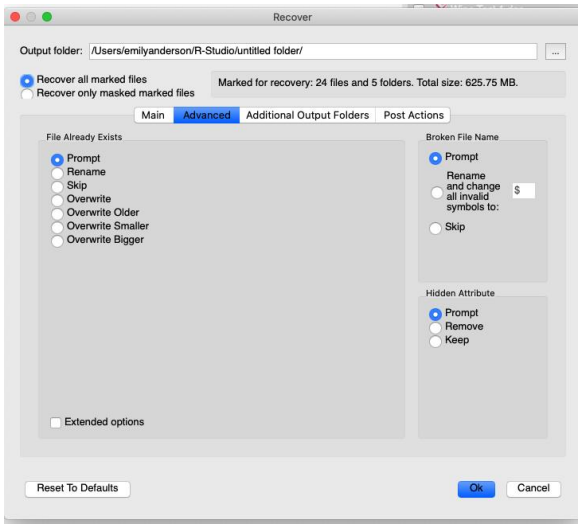
You may find and mark all the files on the entire disk by using Mark matched files in the Find/Mark mode option. You may specify all the necessary search options and mark all the found files. Please note that each find and mark/unmark operation is independent from previous ones. That is, if a file matches the search criteria, it will be marked/unmarked regardless of its previous marked/unmarked state.

For example, if you first mark all `doc` files, and then all `txt` files, all `doc` files remain marked, too. If you then decide to unmark all files smaller than 2 kB, all `doc` and `txt` files will stay marked except those that less than 2 kB.

2.3.2 Recover Multiple Files

If **R-Studio** while recovering files encounters either an already existing file or file with a broken name, normally it will stop working and ask you what to do with the file. If you recover multiple files, that may require you answer a lot of the same questions. You may use Mass File Recovery Options on the Recover dialog box to instruct **R-Studio** what to do in those cases for all files.

Recover (Advanced) **dialog box**



Mass FIle Recovery Options

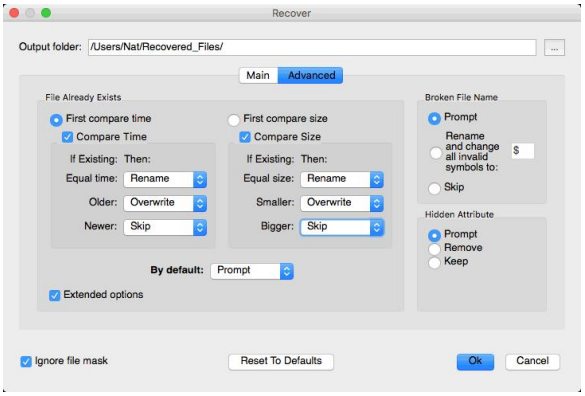
File Already Exists	These options instruct **R-Studio** what to do if there already exists a file with the same name.
Extended options	If this option is selected, more advanced options become accessible to process multiple duplicates of the file.
Prompt	If this option is selected, **R-Studio** asks the user what to do for each such file. It stops file recovery until it receives the answer.
Rename	If this option is selected, **R-Studio** adds a File ID to the file name. If a file already exists with the same name and that file ID, a number will be added to th file name and file ID.
Skip	If this option is selected, **R-Studio** skips all new files with the same name.
Overwrite	If this option is selected, **R-Studio** overwrites the existing file with the new one.
Overwrite Older	If this option is selected, **R-Studio** overwrites the existing file with the new one if the existing file is older than the new file. The time stamp used is Modified.
Overwrite Smaller	If this option is selected, **R-Studio** overwrites the existing file with the new one if the existing file is smaller than the new file. The time stamp used is Modified.
Overwrite Bigger	If this option is selected, **R-Studio** overwrites the existing file with the new one if the existing file is bigger than the new file. The time stamp used is Modified.
Broken File Name	These options instruct **R-Studio** what to do if a file to be recovered appears to have an invalid name.
Prompt	If this option is selected, **R-Studio** shows the standard Broken File Name dialog box for each file with a broken file name. It stops file recovery until it receives the answer.
Rename and change all invalid symbols to:	If this option is selected, **R-Studio** changes all invalid characters to the character specified.

Skip	If this option is selected, **R-Studio** skips all files with broken file names.
Hidden Attribute	These options instruct **R-Studio** what to do if a file to be recovered appears to have the Hidden attribute.
Prompt	If this option is selected, **R-Studio** asks the user what to do with the attribute. It stops file recovery until it receives the answer.
Remove	If this option is selected, **R-Studio** removes the Hidden attribute from all files.
Keep	If this option is selected, **R-Studio** keeps the Hidden attribute for all files.

Extended options

These options give you more flexible ways to process multiple files with the same name. You may compare files by time (Modified) and size, and decide what **R-Studio** should do with those duplicates. If any of the files has an invalid time, the comparison by time is skipped. In this case, if comparison by size is not active, **R-Studio** goes to the default action..

Recover (Advanced - Extended options) **dialog box**



Extended advanced file recovery options

First compare time First compare size	These options instruct **R-Studio** which condition to use first, file time or size.
Compare time Compare size	These options instruct **R-Studio** to enable comparison by time and size..
Actions	These selectable actions instruct **R-Studio** what to do if the condition is met.
Empty field	If this option is selected, **R-Studio** skips the condition.
Prompt	If this option is selected, **R-Studio** asks the user what to do for each such file. It stops file recovery until it receives the answer.
Rename	If this option is selected, **R-Studio** adds a File ID to the file name. If a file already exists with the same name and that file ID, a number will be added to th file name and file ID.
Skip	If this option is selected, **R-Studio** skips all new files with the same name.
Overwrite	If this option is selected, **R-Studio** overwrites the existing file with the new one.

Time conditions	If the Modified time stamp is invalid, **R-Studio** will skip the comparison.
Equal time	Two time stamps are the same.
Older	The existing file is older than the new one.i
Newer	The existing file is newer than the new one.i
Size conditions	
Equal size	Two files have the same size.
Smaller	The existing file is smaller than the new one.i
Bigger	The existing file is bigger than the new one.i
By default	The action **R-Studio** takes when none of the comparison conditions have been met. That may happen when the comparison by size is not enabled.

2.3.3 File Recovery Lists

You may create a file containing a list of files and folder found on a disk/partition. Then such file may be manually edited to specify files to recover and then loaded back into **R-Studio**. **R-Studio** will automatically mark the files in this list for recovery. Such file lists recovery are very useful, for example, when it is necessary to have such file lists approved for recovery by someone else who is far away from the computer where **R-Studio** is running.

You may create file recovery lists for the entire disk or for specific folders. Moreover, you may create a file recovery list for all files within the disk/folder, or for marked files/folders only.

All versions of **R-Studio** can create recovery lists in the plain text format with basic functionality. **R-Studio Technician/T80+** can create custom recovery lists in other formats with more advanced options

Creating a simple recovery list

To create a recovery list

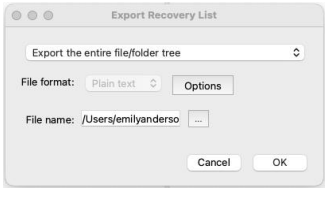
1 **For an entire disk, Select Export Recovery List on the File menu, or**

Right-click the uppermost folder (higher than **Root**, usually the letter or the name of the disk) and select **Export Recovery List** on the shortcut menu.

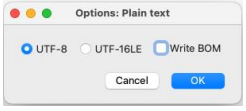
For a specific folder, right-click the folder and select Export Recovery List on the shortcut menu.

2 **Specify the place to save the recovery list and other necessary options on the** Export Recovery List **dialog box**

Export Recovery List **dialog box**



Options **dialog box**



Export Recovery List options

Export the entire folder/file tree Export marked file/folder names Export file/folder names	Specifies which file and folder names will be exported.
File format:	A file format for the recovery list. Only text format is available for the standalone and corporate versions. **R-Studio Technician/T80+** can create custom recovery lists in other formats with more advanced options The following formats are available for **R-Studio Technician/T80+** version: Plain Text HTML XML JSON CSV
File name:	Specifies a file name of the recovery list.

Editing the file recovery list

All files without any marks in the recovery list will be marked when the list is loaded into **R-Studio**. So, if you have some files in the recovery list that don't need to be recovered, just delete them from the list. In addition, you may use the following marks to specify some options

`:+` Mark the file, or the folder, all its files, and subfolders within the folder.

`:*` Mark the file, or the folder and its files, don't mark subfolders in the folder.

`:-` Unmark the file, or the folder, its files, and subfolders in the folder.

`:=` Unmark the file or the folder and its files, dont unmark subfolders in the folder.

`:!` Provide the information on the file. (**R-Studio Technician/T80+** only)

R-Studio for Linux processes records in the list consequently. That is, if there are the following lines in the file,

```
:+Files_to_Recover\
:-Files_to_Delete\File_2.jpg
```

the file `File_2.jpg` won't be marked for recovery, while for the lines

```
:-Files_to_Recover\File_2.jpg
:+Files_to_Recover\
```

file `File_2.jpg` will be.

Loading the edited recovery list

To load a recovery list into R-Studio for Linux,

* **Select Import Recovery List from the File menu and select the file, or**

Right-click the uppermost folder (higher than **Root**, usually the letter or the name of the disk) and select **Import Recovery List** on the shortcut menu.

> **R-Studio for Linux will load the file and mark the files accordingly.**

An example of a simple recovery list

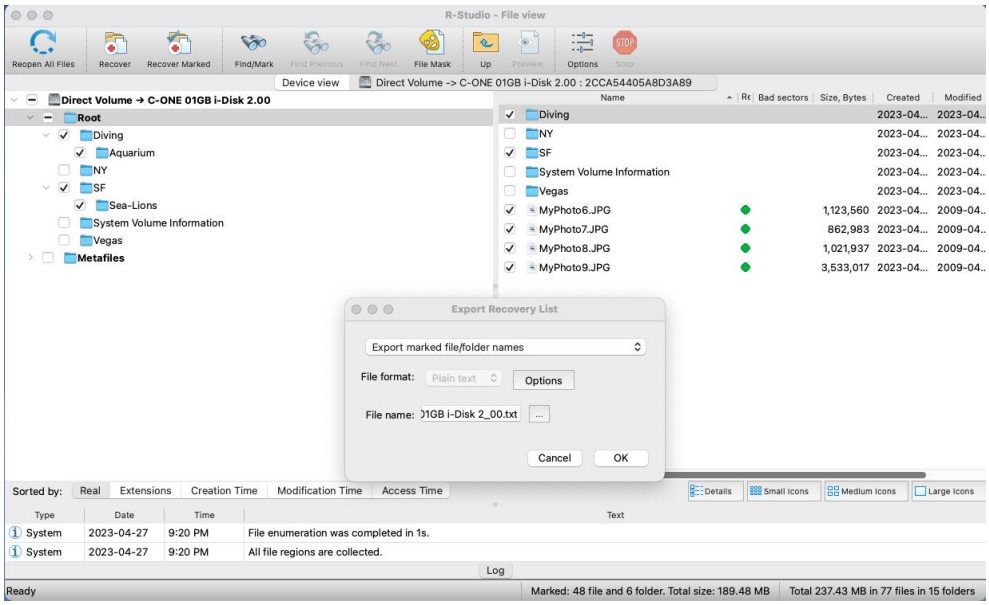
As an example, we'll create a simple recovery list, edit it to mark only those files that are to be recovered, and load it back to mark those files.

To create such recovery list

* **Mark the necessary folders, right-click the Root folder, and select Export Recovery List on the shortcut menu.**

  Right-click the uppermost folder (higher than **Root**, usually the letter or the name of the disk) and select **Export Recovery List** on the shortcut menu.

  Export Recovery List



  Specify the necessary options and click the **OK** button.

> **R-Studio will save the file.**

Structure of a simple recovery list file created by R-Studio

```
:# Version = 1
:# Sort = by real
:# PathDelim = /
:# CaseSensitive
:# Drive = type:"Volume"; size:"1048576000"; label:"ntfs test"; fs:"NTFS";
:# Parent = type:"Drive"; size:"1048576000"; serial:"2cca54405a8d3a89"; firmware:"2.00"; pr
Diving/
Diving/Aquarium/
Diving/Aquarium/20190822_100644.jpg
Diving/Aquarium/20190822_101620.jpg
Diving/Aquarium/20190822_102526.jpg
Diving/Aquarium/20190822_103830.jpg
Diving/Aquarium/20190822_104333.jpg
Diving/MyPhoto1.jpg
Diving/MyPhoto2.jpg
Diving/MyPhoto3.jpg
Diving/MyPhoto4.JPG
Diving/MyPhoto5.jpg
SF/
SF/Sea-Lions/
SF/Sea-Lions/IMG_3493.JPG
SF/Sea-Lions/IMG_3535.JPG
```

```
SF/Sea-Lions/IMG_3542.JPG
SF/Sea-Lions/IMG_3579.JPG
SF/Sea-Lions/IMG_3580.JPG
SF/Sea-Lions/IMG_3581.JPG
SF/Sea-Lions/IMG_3589.JPG
SF/IMG_0869.JPG
SF/IMG_0873.JPG
SF/IMG_0890.JPG
SF/IMG_1739.JPG
SF/IMG_3460.JPG
SF/IMG_3461.JPG
SF/IMG_3476.JPG
SF/IMG_3478.JPG
SF/IMG_3479.JPG
SF/IMG_3480.JPG
SF/IMG_3481.JPG
SF/IMG_3493.JPG
SF/IMG_3535.JPG
SF/IMG_3542.JPG
SF/IMG_3579.JPG
SF/IMG_3580.JPG
SF/IMG_3581.JPG
SF/IMG_3589.JPG
SF/IMG_3590.JPG
SF/IMG_3591.JPG
SF/IMG_3592.JPG
SF/IMG_3593.JPG
SF/IMG_3594.JPG
SF/IMG_3595.JPG
SF/IMG_3596.JPG
SF/IMG_3608.JPG
SF/IMG_3627.JPG
MyPhoto6.JPG
MyPhoto7.JPG
MyPhoto8.JPG
MyPhoto9.JPG
```

If such recovery list is created from an entire logical disk/partition, it will contain several virtual folders. For example, they'll have the following structure for an NTFS partition.

```
System Volume Information/
System Volume Information/IndexerVolumeGuid
System Volume Information/WPSettings.dat
Vegas/
MyPhoto6.JPG
MyPhoto7.JPG
MyPhoto8.JPG
MyPhoto9.JPG
///m/$Extend/
///m/$Extend/$Deleted/
///m/$Extend/$RmMetadata/
///m/$Extend/$RmMetadata/$Txf/
///m/$Extend/$RmMetadata/$TxfLog/
///m/$Extend/$RmMetadata/$TxfLog/$Tops
```

```
///m/$Extend/$RmMetadata/$TxfLog/$TxfLog.blf
///m/$Extend/$RmMetadata/$TxfLog/$TxfLogContainer00000000000000000001
///m/$Extend/$RmMetadata/$TxfLog/$TxfLogContainer00000000000000000002
///m/$Extend/$RmMetadata/$Repair
///m/$Extend/$ObjId
///m/$Extend/$Quota
///m/$Extend/$Reparse
///m/$AttrDef
///m/$BadClus
///m/$Bitmap
///m/$Boot
///m/$LogFile
///m/$MFT
///m/$MFTMirr
///m/$Secure
///m/$UpCase
///m/$Volume
```

Now we need to edit this file to mark for recovery the following folders/files:

1. All files in the root folder;
2. Two files `MyPhoto1.jpg` and `MyPhoto3.jpg` in the `Diving` subfolder;
3. All files in the `Diving/Aquarium/` folder;
4. All files in the SF/ folder except the `SF/Sea-Lions/` subfolder.

The edited simple recovery list

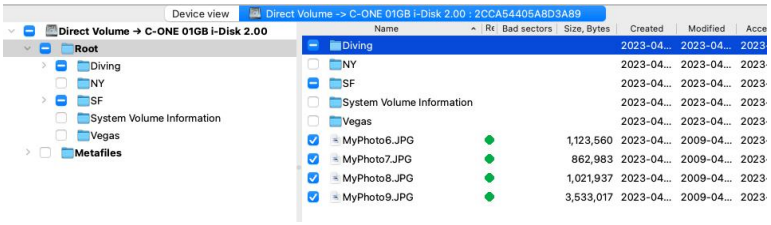
The final simple recovery list will be the following:

```
:# Version = 1
:# Sort = by real
:# PathDelim = /
:# CaseSensitive
:# Drive = type:"Volume"; size:"1048576000"; label:"ntfs test"; fs:"NTFS";
:# Parent = type:"Drive"; size:"1048576000"; serial:"2cca54405a8d3a89"; firmware:"2.00"; pr
:= Diving/
:+ Diving/Aquarium/
:+ Diving/MyPhoto1.jpg
:+ Diving/MyPhoto3.jpg
:+ SF/
:- SF/Sea-Lions/
MyPhoto6.JPG
MyPhoto7.JPG
MyPhoto8.JPG
MyPhoto9.JPG
```

Loading the edited recovery list

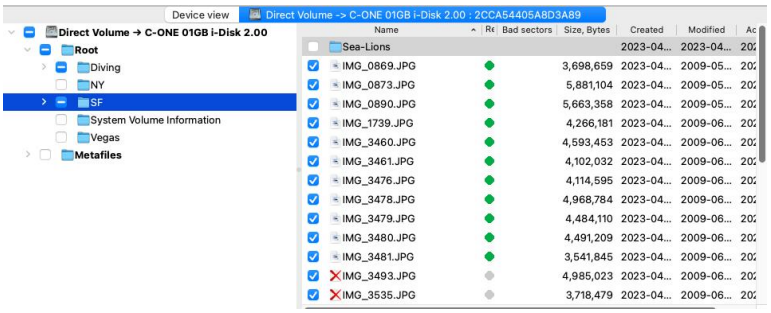
When we load this recovery list into **R-Studio for Linux**, will see the following results;

The root folder



The Diving folder

The SF folder



2.4 Volume Sets and RAIDs

R-Studio detects and processes valid hardware volume sets and RAIDs like regular drives/volumes.

R-Studio can analyze and recover data from software volume sets and RAIDs. If a software volume set or RAID is present in your system, **R-Studio** detects it, and a ***Volume sets and RAIDs*** object appears on the Drives panel. This object can be searched for files, scanned, and files found on it can be recovered the same way as from normal drives/volumes.

If, due to hardware failure, a hardware volume set or RAID cannot be accessed, or due to data loss your system does not recognize a software volume set or RAID, and you know what hard drives were in it, you may create a ***Virtual volume set*** or ***RAID*** and process it like a real software volume set or RAID or hardware volume set or RAID.

You may find more information on RAID types in our article What is Hardware RAID.

- **Volume Sets, Stripe Sets, and Mirrors**
- **Basic RAID 4 and RAID 5 Operations**
- **Working with RAID 6 Presets**
- **Working with RAID6 (Double Xor)**
- **Working with RAIDs with Parity Delays**
- **Working with Advanced RAID Layouts**
- **Nested and Non-Standard RAID Levels**
- **Finding RAID Parameters**
- **Checking RAID Consistency**
- **Syntax of a Description File for RAID Configurations**

- **Description Files for RAID Configurations**
- **Reverse RAIDs**
- **Various Disk and Volume Managers**
- **Connecting Virtual Objects to the System**

Creating and saving your own RAID configuration

You may create and save your own RAID configurations for non-standard RAIDs. You may specify Offset, Block order/size and Row count. See **Working with Advanced RAID Layouts** for details.

To save your own RAID configuration

1 Select <New> in the Blocks order drop-down list

2 Specify the name for the configuration on the Preset name **dialog box.**

Preset name **dialog box**

> The new RAID configuration will be saved

The configurations are stored in the user's RAID layout file. The path and name for this file is specified on the R-Studio Settings dialog box. If no file is specified, **R-Studio** will ask you to enter the name.

Loading your RAID configuration

If there're objects in the Parents tab, the preset will be applied to them. If the Parents tab is empty, **R-Studio** will search the disks listed in the Drives tab for the parents in the user's RAID layout file. If the search fails, **R-Studio** will show the Reference Parents not found message.

To load your RAID configuration

*** Select your configuration in the Blocks order drop-down list**

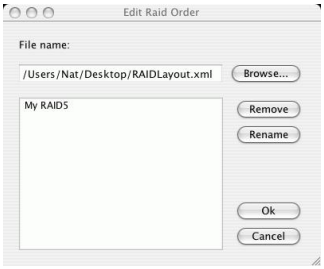
> The new RAID configuration will be loaded

To edit your own RAID configuration

1 Select <Edit> in the Blocks order drop-down list

2 Select the required configuration on the Edit Block RAID Layout Presets **dialog box.**

Edit Block RAID Layout Presets **dialog box**



3 Edit the parameters of the configuration and save it

> The new configuration parameters will be saved.

Turning Disks On-Line and Off-Line on-the-fly

You may turn the objects in the virtual RAID or volume set on-line and off-line by selecting/clearing the checkbox on the Parents tab. It may be useful, for example, if you need to see which disk is non-actual in a RAID5.

Actually, when you turn an object off-line, **R-Studio** substitutes it with a ***Missing Disk*** or ***Empty Space*** object.

Missing Disks

If one partition from a hardware volume set or RAID or software volume set or RAID is absent, due to hardware failure, for example, you need to add a virtual missing disk in order to correctly re-construct the hardware volume set or RAID or software volume set or RAID structure. The missing disk should be placed in the same place as the missing partition.

Note: R-Studio does not write anything real on the disk. Missing disks are virtual objects that do not affect actual data on the drive.

To add an *Missing disk* object

1 **Select a *Volume sets and RAIDs* object on the R-Studio's Drives panel**

2 **Control-click in the** Parents **tab in the right pane and select Add Missing Disk on the contextual menu or select Add Missing Disk in the Create menu**

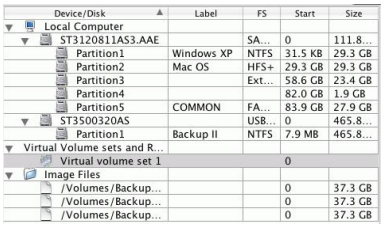
> **A *Missing Disk* object will appear in the** Parents **tab**

2.4.1 Volume Sets, Stripe Sets, and Mirrors

To create a Volume set object

1 **Click the Create Virtual RAID button and select Create Virtual Volume set**
or select the **Create Virtual Volume set** on the **Create** menu

> **A Virtual Volume set object will appear on the** Drives **panel**



2 **Drag the required partitions from the** Drives **panel to the** Parents **tab**

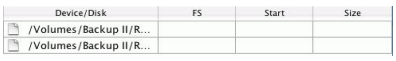
Other ways to add objects

- Control-click the Parents tab and select the required partition from the contextual menu,

or

- Control-click the partition on the Drives panel, select **Add to RAID** on the contextual menu, and select the RAID object you want to add the partition to.

Note: Objects should be placed in the same order as they were in the original volume set. If this order is incorrect, you must change it by dragging the parents to place them in the correct order.



> **The *Virtual volume set or RAIDs* object can now be processed like regular drives/volumes**

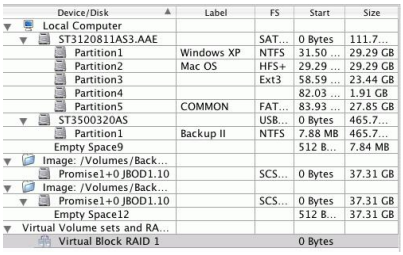
If **R-Studio** detects a valid file system on the newly created RAID object, a partition object will appear on the Drives panel.

To create a Stripe set object (RAID 0)

1 **Click the Create Virtual RAID button and select Create Virtual Block RAID**

or select the **Create Virtual Block RAID** on the **Create** menu

> **A Virtual Block RAID object will appear on the** Drives **panel**



2 **Select RAID 0 (Stripe set) on the RAID type**

3 **Drag the required partitions from the** Drives **panel to the** Parents **tab**

Other ways to add objects

- Control-click the Parents tab and select the required partition from the contextual menu,

or

- Control-click the partition on the Drives panel, select **Add to RAID** on the contextual menu, and select the RAID object you want to add the partition to.

You may either make **R-Studio** to process your changes immediately or wait until you finish editing the RAID layout. Select or clear the Apply changes immediately checkbox on the Parents tab. Click the **Apply** button to apply the changes when are you through.

Note: Objects should be placed in the same order as they were in the original volume set. If this order is incorrect, you must change it by dragging the parents to place them in the correct order.

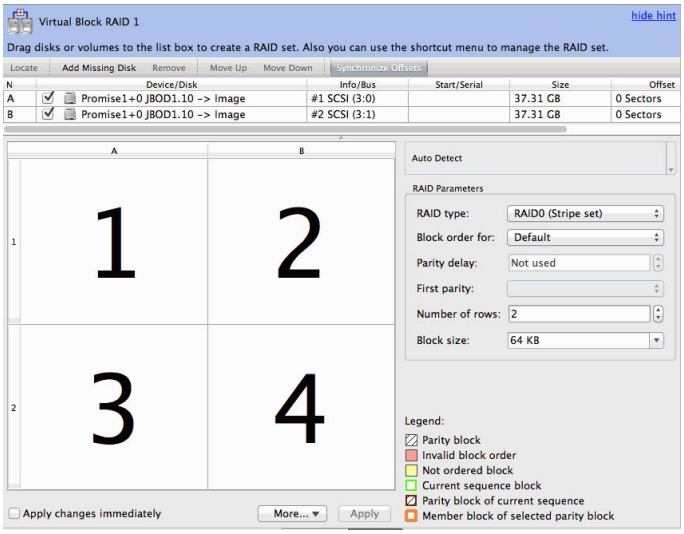
Object control buttons

Locate	Click this button to locate the selected object in the Drives panel.
Add Empty Space/Add Missing Disk	Click this button to add an empty space or missing disk object to the RAID
Remove	Click this button to remove the selected object from the RAID
Move Up	Click this button to move up the selected object in the RAID
Move Down	Click this button to move down the selected object in the RAID
Synchronize Offsets	Click this button to make the offsets the same for all objects in the RAID
Reset changes	Click this button to return the configuration to the initial state (after clicking the Apply button or immediately after loading)

The Block size and Offset (in sectors) parameters must be set the same as for the original volume set.

You also need to specify Block order. You may select it on the Block order drop-down or contextual menu.

If the those parameters are not correct, data on the parents will not be damaged, but they cannot be recovered.



> **The Virtual Block RAID object can now be processed like regular drives/volumes**

If **R-Studio** detects a valid file system on the newly created RAID object, a partition object will appear on the Drives panel.

The **Description Files for RAID Configurations** topic shows the RAID description file for this RAID configuration.

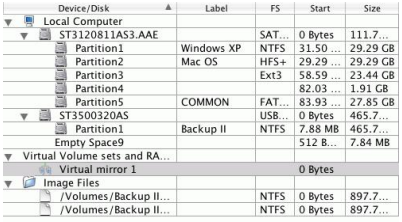
You also may check the RAID consistency, if necessary. See the **Checking RAID Consistency** help page for details.

To create a Mirror set object (RAID 1)

1 **Click the Create Virtual RAID button and select Create Virtual Mirror**

or select the **Create Virtual Mirror** on the **Create** menu

> **A Virtual Mirror object will appear on the** Drives **panel**



2 **Drag the required partitions from the** Drives **panel to the** Parents **tab**

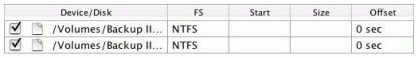
Other ways to add objects

- Control-click the Parents tab and select the required partition from the contextual menu,

or

- Control-click the partition on the Drives panel, select **Add to RAID** on the contextual menu, and select the RAID object you want to add the partition to.

Note: Objects should be placed in the same order as they were in the original volume set. If this order is incorrect, you must change it by dragging the parents to place them in the correct order.



> **The Virtual Mirror object can now be processed like regular drives/volumes**

If **R-Studio** detects a valid file system on the newly created RAID object, a partition object will appear on the Drives panel.

2.4.2 Basic RAID 4 and RAID 5 Operations

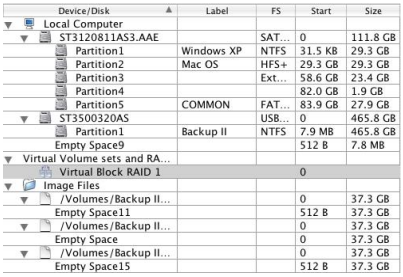
RAID 4 and RAID 5 are much similar. You may create and edit a RAID 4 object the same way as a RAID 5 one.

To create a RAID 5 object

1 **Click the Create Virtual RAID button and select Create Virtual Block RAID**

or select the **Create Virtual Block RAID** on the **Create** menu

> **A Virtual Block RAID object will appear on the** Drives **panel**



2 **Select RAID 5 on the RAID type**

3 **Drag the required partitions from the** Drives **panel to the** Parents **tab**

Other ways to add objects

- Control-click the Parents tab and select the required partition from the contextual menu,

or

- Control-click the partition on the Drives panel, select **Add to RAID** on the contextual menu, and select the RAID object you want to add the partition to.

You may either make **R-Studio** to process your changes immediately or wait until you finish editing the RAID layout. Select or clear the Apply changes immediately checkbox on the Parents tab. Click the **Apply** button to apply the changes when are you through.

Note: Objects should be placed in the same order as they were in the original RAID 5. If this order is incorrect, you must change it by dragging the parents to place them in the correct order.

Object control buttons

Locate	Click this button to locate the selected object in the Drives panel.
Add Empty Space/Add Missing Disk	Click this button to add an empty space or missing disk object to the RAID
Remove	Click this button to remove the selected object from the RAID
Move Up	Click this button to move up the selected object in the RAID
Move Down	Click this button to move down the selected object in the RAID

Synchronize Offsets	Click this button to make the offsets the same for all objects in the RAID
Reset changes	Click this button to return the configuration to the initial state (after clicking the Apply button or immediately after loading)

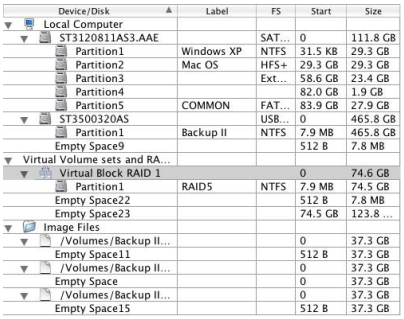
The RAID block size and Offset (in sectors) parameters must be set the same as for the original RAID 5

You also need to specify Block order for virtual RAID 5. You may select it on the Block order drop-down or contextual menu.

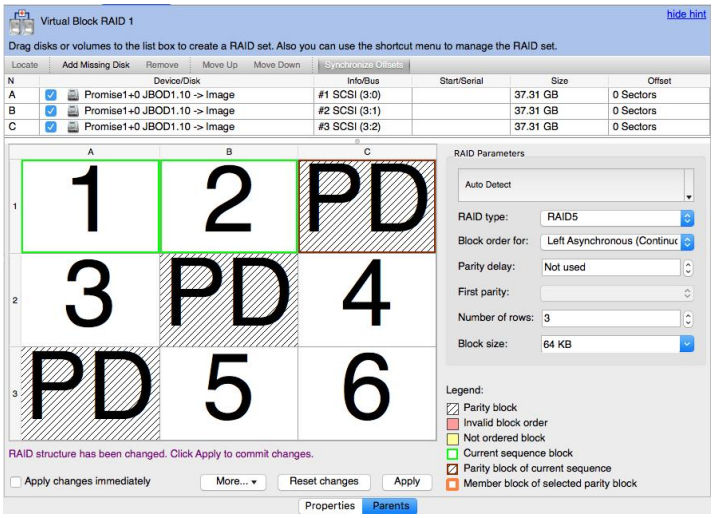
If the those parameters are not correct, data on the parents will not be damaged, but files from the RAID 5 cannot be recovered.

Note: You may check how correctly you have reconstructed the original RAID 5. Find a file and preview it. If the file appears correct, you have created a correct RAID 5 layout.

If your RAID 5 has an unusual configuration, you may create them manually. See **Working with Advanced RAID Layouts** for details.



Parents **tab**



> **The *RAID 5* object can now be processed like regular drives/volumes**

If **R-Studio** detects a valid file system on the newly created RAID object, a partition object will appear on the Drives panel.

The **Description Files for RAID Configurations** topic shows the RAID description file for this RAID configuration.

You also may check the RAID consistency, if necessary. See the **Checking RAID Consistency** help page for details.

Creating and saving your own RAID 5 configuration

You may create and save your own RAID configurations for non-standard RAIDs. You may specify Offset, Block order/size and Row count. See **Working with Advanced RAID Layouts** for details.

2.4.3 Working with RAID6 Presets

R-Studio allows you to create and process RAID 6 layouts. You may use either presets for several RAID 6 layouts, or use your own custom ones.

R-Studio provides presets for the following RAID 6 layouts::

Reed-Solomon

Left Synchronous (standard), Left Asynchronous (continuous), Right Synchronous Right Asynchronous

In addition you may create your own RAID 6 configurations.

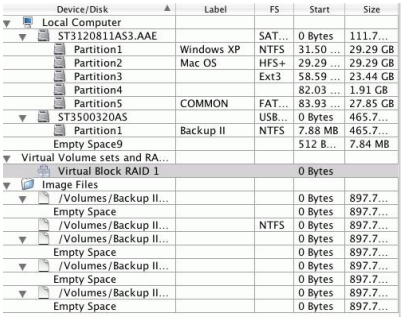
Creating a RAID 6 object from a preset:

We will use the Reed-Solomon (Left Synchronous (standard)) preset as an example.

To create a RAID 6 object

1 **Click the Create Virtual RAID button and select Create Virtual Block RAID**
or select the **Create Virtual Block RAID** on the **Create** menu

> **A Virtual Block RAID object will appear on the** Drives **panel**



2 **Select RAID 6/Reed-Solomon on the RAID type**

3 **Drag the required partitions from the** Drives **panel to the** Parents **tab**

Other ways to add objects

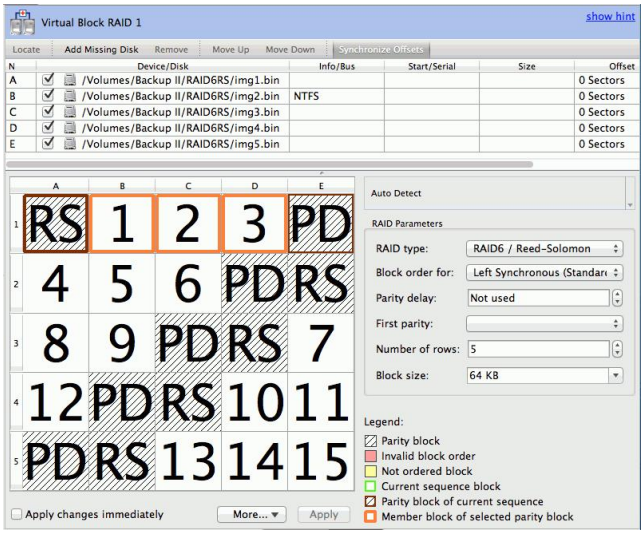
- Control-click the Parents tab and select the required partition from the contextual menu,

or

- Control-click the partition on the Drives panel, select **Add to RAID** on the contextual menu, and select the RAID object you want to add the partition to.

You may either make **R-Studio** to process your changes immediately or wait until you finish editing the RAID layout. Select or clear the Apply changes immediately checkbox on the Parents tab. Click the **Apply** button to apply the changes when are you through.

Parents **tab**



Note: Objects should be placed in the same order as they were in the original volume set. If this order is incorrect, you must change it by dragging the parents to place them in the correct order.

Object control buttons

Locate	Click this button to locate the selected object in the Drives panel.
Add Empty Space/Add Missing Disk	Click this button to add an empty space or missing disk object to the RAID
Remove	Click this button to remove the selected object from the RAID
Move Up	Click this button to move up the selected object in the RAID
Move Down	Click this button to move down the selected object in the RAID
Synchronize Offsets	Click this button to make the offsets the same for all objects in the RAID
Reset changes	Click this button to return the configuration to the initial state (after clicking the Apply button or immediately after loading)

The RAID block size and Offset (in sectors) parameters must be set the same as for the original volume set.

You also need to specify Blocks order (Left Synchronous (standard) for our case) for virtual RAID 6. You may select it on the Blocks order drop-down or contextual menu.

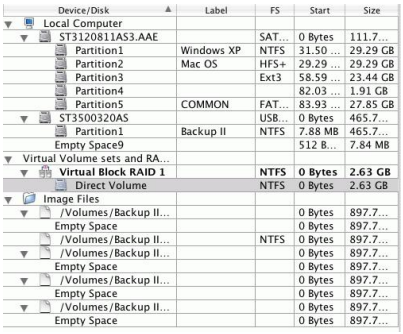
If the those parameters are not correct, data on the parents will not be damaged, but it cannot be recovered.

Note: You may check how correctly you have reconstructed the original volume set or RAID. Find a file and preview it. If the file appears correct, you have created a correct RAID layout.

> **The Virtual Block RAID object can now be processed like regular drives/volumes**

If **R-Studio** detects a valid file system on the newly created RAID object, a partition object will appear on the Drives panel.

The **Description Files for RAID Configurations** topic shows the RAID description file for this RAID configuration.



.

You also may check the RAID consistency, if necessary. See the **Checking RAID Consistency** help page for details.

2.4.4 Working with RAID6 (Double Xor) Presets

R-Studio allows you to create and process RAID 6 Double Xor layouts with the following presets:
EVENODD RAID DP X-Code(2) Adaptec 3805
In addition you may create your own RAID 6 configurations.

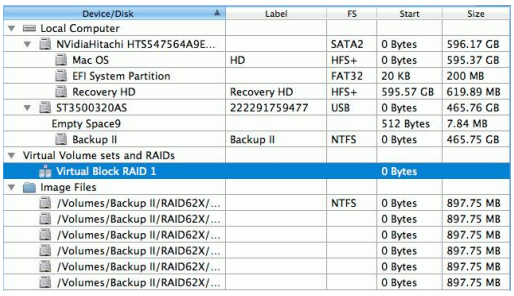
Creating a RAID 6 (Double Xor) object from a preset:

We will use the EVENODD preset as an example.

To create a RAID 6 (Double Xor) object

1 **Click the Create Virtual RAID button and select Create Virtual Block RAID**
or select the **Create Virtual Block RAID** on the **Create** menu

> **A Virtual Block RAID object will appear on the** Drives **panel**



2 **Select RAID 6 / Double Xor on the RAID type**

3 **Drag the required partitions from the** Drives **panel to the** Parents **tab**

Other ways to add objects

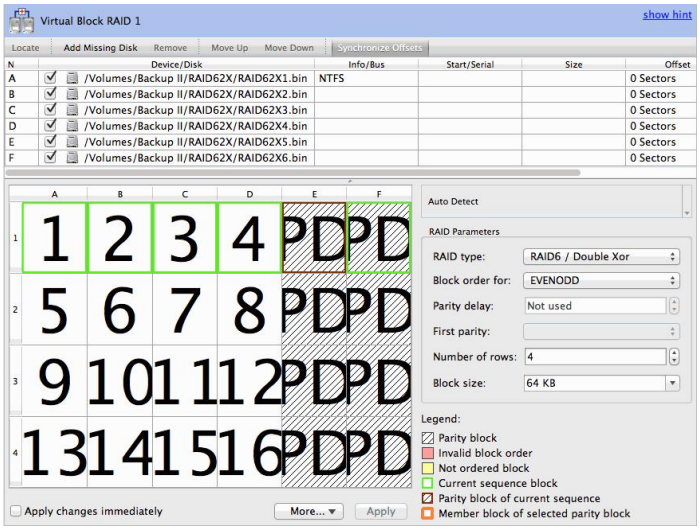
- Control-click the Parents tab and select the required partition from the contextual menu,

or

- Control-click the partition on the Drives panel, select **Add to RAID** on the contextual menu, and select the RAID object you want to add the partition to.

You may either make **R-Studio** to process your changes immediately or wait until you finish editing the RAID layout. Select or clear the Apply changes immediately checkbox on the Parents tab. Click the **Apply** button to apply the changes when are you through.

Parents **tab**



Note: Objects should be placed in the same order as they were in the original volume set. If this order is incorrect, you must change it by dragging the parents to place them in the correct order.

Object control buttons

Locate	Click this button to locate the selected object in the Drives panel.
Add Empty Space/Add Missing Disk	Click this button to add an empty space or missing disk object to the RAID
Remove	Click this button to remove the selected object from the RAID
Move Up	Click this button to move up the selected object in the RAID
Move Down	Click this button to move down the selected object in the RAID
Synchronize Offsets	Click this button to make the offsets the same for all objects in the RAID
Reset changes	Click this button to return the configuration to the initial state (after clicking the Apply button or immediately after loading)

The RAID block size and Offset (in sectors) parameters must be set the same as for the original volume set.

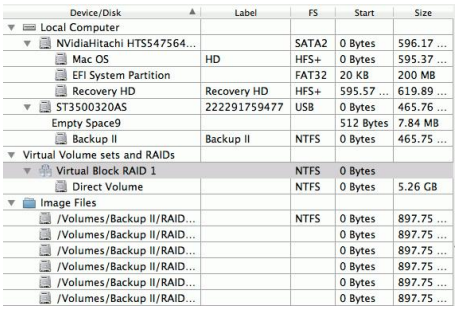
You also need to specify Blocks order (EVENODD for our case) for virtual RAID 6 (Double Xor). You may select it on the Blocks order drop-down or contextual menu.

If the those parameters are not correct, data on the parents will not be damaged, but they cannot be recovered.

Note: You may check how correctly you have reconstructed the original volume set or RAID. Find a file and preview it. If the file appears correct, you have created a correct RAID layout.

> **The Virtual Block RAID object can now be processed like regular drives/volumes**

If **R-Studio** detects a valid file system on the newly created RAID object, a partition object will appear on the Drives panel. The **Description Files for RAID Configurations** topic shows the RAID description file for this RAID configuration.



Device/Disk	Label	FS	Start	Size
Local Computer				
NVidiaHitachi HTS547564...		SATA2	0 Bytes	596.17 ...
Mac OS	HD	HFS+	0 Bytes	595.37 ...
EFI System Partition		FAT32	20 KB	200 MB
Recovery HD	Recovery HD	HFS+	595.57 ...	619.89 ...
ST3500320AS	222291759477	USB	0 Bytes	465.76 ...
Empty Space9			512 Bytes	7.84 MB
Backup II	Backup II	NTFS	0 Bytes	465.75 ...
Virtual Volume sets and RAIDs				
Virtual Block RAID 1		NTFS	0 Bytes	
Direct Volume		NTFS	0 Bytes	5.26 GB
Image Files				
/Volumes/Backup II/RAID...		NTFS	0 Bytes	897.75 ...
/Volumes/Backup II/RAID...			0 Bytes	897.75 ...
/Volumes/Backup II/RAID...			0 Bytes	897.75 ...
/Volumes/Backup II/RAID...			0 Bytes	897.75 ...
/Volumes/Backup II/RAID...			0 Bytes	897.75 ...
/Volumes/Backup II/RAID...			0 Bytes	897.75 ...

You also may check the RAID consistency, if necessary. See the **Checking RAID Consistency** help page for details.

2.4.5 Working with RAIDs with Parity Delays

R-Studio allows you to create RAIDs with parity delays (any level that allows that). For example, let us create a RAID 5 the parity delays with the following layout:

- Three disks,
- Delay=16
- Block size: 16 KB
- Offset: 1088 sectors (544 KB)
- Block order: Left Asynchronous (Continuous)

Block order table:

	A	B	C	
1	1	2	PD	
2	3	4	PD	
3	5	6	PD	
4	7	8	PD	
5	9	10	PD	
6	11	12	PD	
7	13	14	PD	
8	15	16	PD	Delay=16
9	17	18	PD	
10	19	20	PD	
11	21	22	PD	
12	23	24	PD	
13	25	26	PD	
14	27	28	PD	
15	29	30	PD	
16	31	32	PD	
17	33	PD	34	
18	35	PD	36	Delay=16
19	37	PD	38	
20	39	PD	40	

21	41	PD	42	
22	43	PD	44	
23	45	PD	46	
24	47	PD	48	
25	49	PD	50	
26	51	PD	52	
27	53	PD	54	
28	55	PD	56	
29	57	PD	58	
30	59	PD	60	
31	61	PD	62	
32	63	PD	64	
33	PD	65	66	Delay=16
34	PD	67	68	
35	PD	69	70	
36	PD	71	72	
37	PD	73	74	
38	PD	75	76	
39	PD	77	78	
40	PD	79	80	
41	PD	81	82	
42	PD	83	84	
43	PD	85	86	
44	PD	87	88	
45	PD	89	90	
46	PD	91	92	
47	PD	93	94	
48	PD	95	96	

To create such RAID 5,

1 **Click the Create virtual volume sets or RAIDs button and select Create Virtual Block RAID & Autodetect** or select **Create Virtual Block RAID & Autodetect** on the **Create** menu

Check that the Apply changes immediately check box is clear on the Parents tab. This will prevent **R-Studio** from trying to start processing the RAID configuration until you specify it completely.

2 **Drug the required objects from the** Drives **pane to the** Parents **tab and select RAID 5 on the RAID type**

Other ways to add objects

- Control-click the Parents tab and select the required partition from the contextual menu,

or

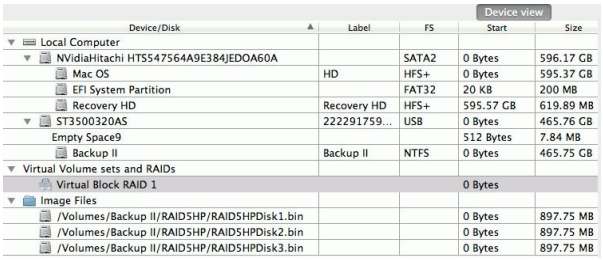
- Control-click the partition on the Drives panel, select **Add to RAID** on the contextual menu, and select the RAID object you want to add the partition to.

These objects may be hard drives, logical disks, or images. Check that the objects are correctly placed.

Note: Objects should be placed in the same order as they were in the original RAID 5. If this order is incorrect, you must change it by dragging the parents to place them in the correct order.

Object control buttons

Locate	Click this button to locate the selected object in the Drives panel.
Add Empty Space/Add Missing Disk	Click this button to add an empty space or missing disk object to the RAID
Remove	Click this button to remove the selected object from the RAID
Move Up	Click this button to move up the selected object in the RAID
Move Down	Click this button to move down the selected object in the RAID
Synchronize Offsets	Click this button to make the offsets the same for all objects in the RAID
Reset changes	Click this button to return the configuration to the initial state (after clicking the Apply button or immediately after loading)



3 Specify the Block size and Offset parameters on the Parents tab

Disregard the Block order field.

4 Specify the parity delay number in the Parity delay control on the Parents tab.

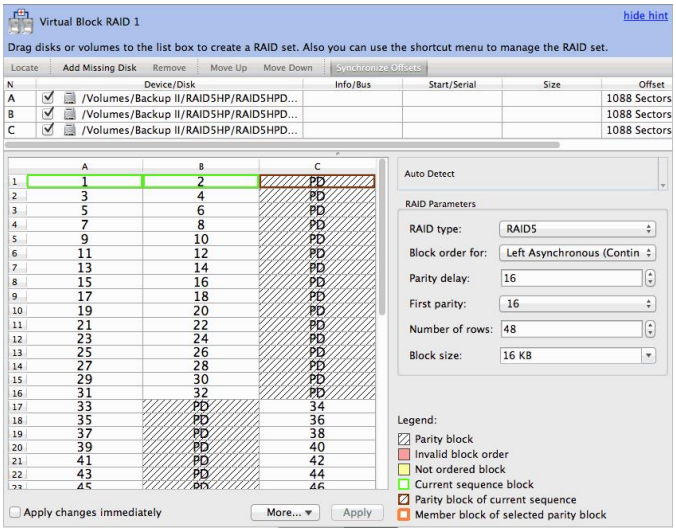
The number of rows will change to 48.

- If necessary, adjust the First parity parameter

By default, this parameter is set equal to Parity delay. By changing it, you may "shift" the block order table. For example, when the First parity parameter is set as 1 for the RAID 5 of 3 disks with Parity delay of 3., the block order table will be the following:**First parity parameter**

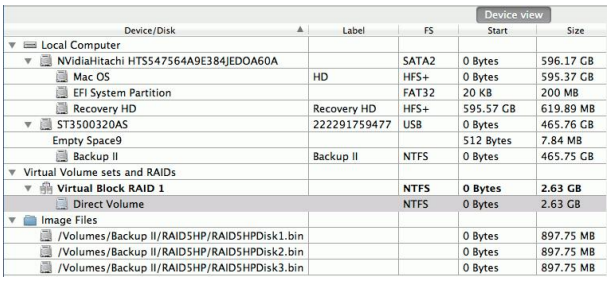
	A	B	C
1	1	2	PD
2	3	PD	4
3	5	PD	6
4	7	PD	8
5	PD	9	10
6	PD	11	12
7	PD	13	14
8	15	16	PD
9	17	18	PD

5 **Select Left Asynchronous (Continuous) on the Block Order Field and click the Apply button on the** Parents **tab**



> **The created Virtual Block RAID 1 object can now be processed like regular drives/volumes**

If **R-Studio** detects a valid file system on this RAID object, a partition object will appear on the Drives panel.



The **Description Files for RAID Configurations** topic shows the RAID description file for this RAID configuration.

You also may check the RAID consistency, if necessary. See the **Checking RAID Consistency** help page for details.

2.4.6 Working with Advanced RAID Layouts

R-Studio allows you to create and process very complex custom RAID layouts.

Advanced RAID 5

For example, let us create a RAID 5 with the following layout:

- Three disks,
- Block size: 4 KB
- Offset: 32768 sectors (64 KB)
- Block order:

	A	B	C
1	PD	1	2
2	PD	3	4

3	PD	5	6
4	7	PD	8
5	9	PD	10
6	11	PD	12
7	13	14	PD
8	15	16	PD
9	17	18	PD

To create such RAID 5,

1 **Click the Create virtual volume sets or RAIDs button and select Create Virtual Block RAID**

or select **Create Virtual Block RAID** on the **Create** menu

Check that the Apply changes immediately check box is clear on the Parents tab. This will prevent **R-Studio** from trying to start processing the RAID configuration until you specify it completely.

2 **Drug the required objects from the** Drives **pane to the** Parents **tab and select RAID 5 on the RAID type**

Other ways to add objects

- Control-click the Parents tab and select the required partition from the contextual menu,

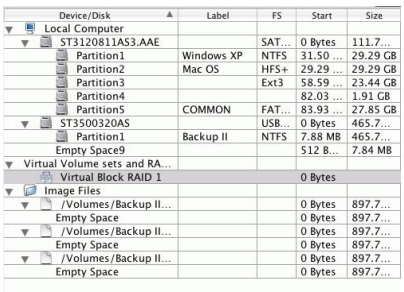
or

- Control-click the partition on the Drives panel, select **Add to RAID** on the contextual menu, and select the RAID object you want to add the partition to.

These objects may be hard drives, logical disks, or images. Check that the objects are correctly placed.

Object control buttons

Locate	Click this button to locate the selected object in the Drives panel.
Add Empty Space/Add Missing Disk	Click this button to add an empty space or missing disk object to the RAID
Remove	Click this button to remove the selected object from the RAID
Move Up	Click this button to move up the selected object in the RAID
Move Down	Click this button to move down the selected object in the RAID
Synchronize Offsets	Click this button to make the offsets the same for all objects in the RAID
Reset changes	Click this button to return the configuration to the initial state (after clicking the Apply button or immediately after loading)



3 **Specify the Block size and Offset parameters on the** Parents **tab**

Disregard the Block order field.

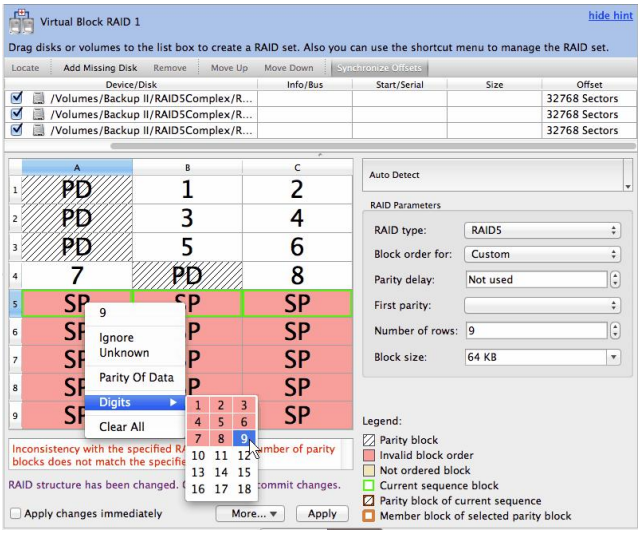
4 Manually enter 9 to Number of rows on the Parents **tab**

5 Enter the block order in the table on the Parents **tab**

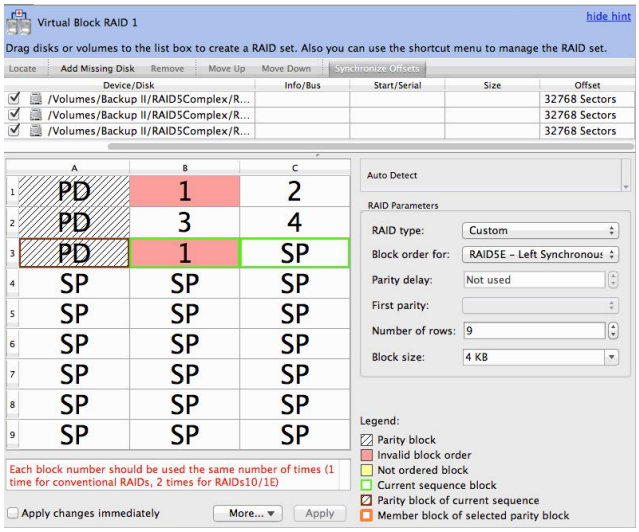
Use the RAID sequence window to move from one row to another.

Using the keyboard: arrow keys to navigate, digit and p keys to enter the block order.

Using the mouse: control-click the cell and select the number or parity from the contextual menu. If the block table is too large, you better use the keyboard to enter the digits.

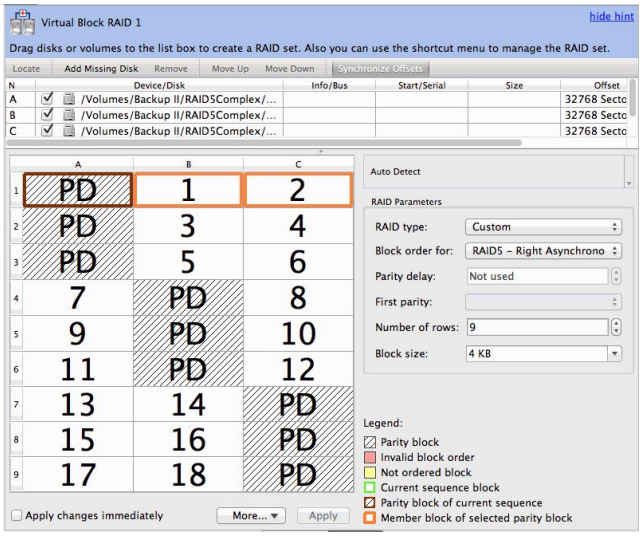


Corrections: **R-Studio** will tell you if some digits are not correct. Navigate to the required cell and enter the correct value. Use the **Delete** key to clear a cell.



Clear the table: Control-click the table and select **Clear all** on the contextual menu.

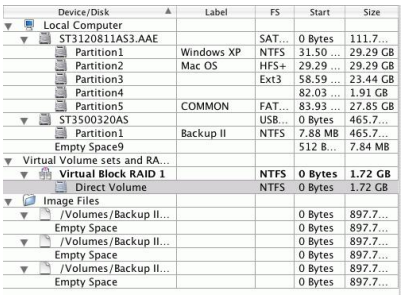
6 When you finishes entering the information, click the Apply button on the Parents **tab**



> **The created Virtual Block RAID 1 object can now be processed like regular drives/volumes**

If **R-Studio** detects a valid file system on this RAID object, a partition object will appear on the Drives panel.

The **Description Files for RAID Configurations** topic shows the RAID description file for this RAID configuration.



You also may check the RAID consistency, if necessary. See the **Checking RAID Consistency** help page for details.

Advanced RAID 5

Another example is a RAID with the following layout, similar to that used in Mac Pro internal RAID cards with 4 hard drives.

- Four disks,
- Block size: 512 KB (1024 sectors)
- Offset: 32768 sectors (64 KB)
- Block order:

A	B	C	D	A	B	C	D	A	B	C	D
PD	1	2	PD	3	4	PD	5	6	PD	7	8

As you see, this layout cannot be fit directly into a standard 2D block order table. Still, it's possible to create such RAID layout using the RAID Sequence window.

To create such RAID,

1 **Click the Create virtual volume sets or RAIDs button and select Create Virtual Block RAID & Autodetect** or select **Create Virtual Block RAID & Autodetect** on the **Create** menu

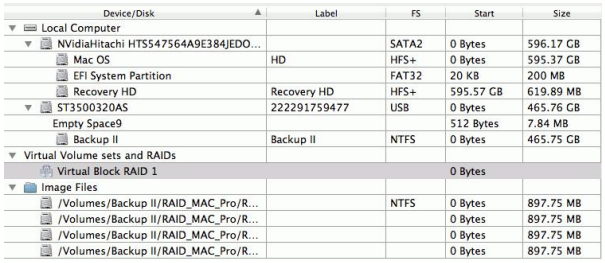
Check that the Apply changes immediately check box is clear on the Parents tab. This will prevent **R-Studio** from trying to start processing the RAID configuration until you specify it completely.

2 **Drug the required objects from the** Drives **pane to the** Parents **tab and select RAID 5 on the RAID type**

These objects may be hard drives, logical disks, or images. Check that the objects are correctly placed.

Object control buttons

Locate	Click this button to locate the selected object in the Drives panel.
Add Empty Space/Add Missing Disk	Click this button to add an empty space or missing disk object to the RAID
Remove	Click this button to remove the selected object from the RAID
Move Up	Click this button to move up the selected object in the RAID
Move Down	Click this button to move down the selected object in the RAID
Synchronize Offsets	Click this button to make the offsets the same for all objects in the RAID
Reset changes	Click this button to return the configuration to the initial state (after clicking the Apply button or immediately after loading)



Device/Disk	Label	FS	Start	Size
Local Computer				
NVidiaHitachi HTS547564A9E384JEDO...		SATA2	0 Bytes	596.17 GB
Mac OS	HD	HFS+	0 Bytes	595.37 GB
EFI System Partition		FAT32	20 KB	200 MB
Recovery HD	Recovery HD	HFS+	595.57 GB	619.89 MB
ST3500320AS	222291759477	USB	0 Bytes	465.76 GB
Empty Space9			512 Bytes	7.84 MB
Backup II	Backup II	NTFS	0 Bytes	465.75 GB
Virtual Volume sets and RAIDs				
Virtual Block RAID 1			0 Bytes	
Image Files				
/Volumes/Backup II/RAID_MAC_Pro/R...		NTFS	0 Bytes	897.75 MB
/Volumes/Backup II/RAID_MAC_Pro/R...			0 Bytes	897.75 MB
/Volumes/Backup II/RAID_MAC_Pro/R...			0 Bytes	897.75 MB
/Volumes/Backup II/RAID_MAC_Pro/R...			0 Bytes	897.75 MB

3 **Specify the Block size and Offset parameters on the** Parents **tab**

Disregard the Block order field.

4 **Manually enter 3 to Number of rows on the** Parents **tab and change Block order to Custom**

5 **Control-click the** RAID Sequence **window and select Remove All. Manually enter 3 to Number of rows on the** Parents **tab and change Block order to Custom**

6 **Control-click Cell 1 in the block order table and select Create New Sequence.**

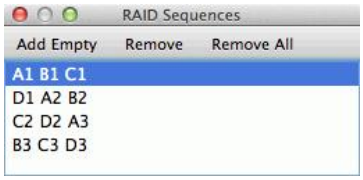
7 **Control-click Cell 2 in the block order table and select Add to Sequence, do that for Cell 3, too.**

8 **Control-click Cell 4 in the block order table and select Create New Sequence.**

9 **Control-click Cell 5 in the block order table and select Add to Sequence, do that for Cell 6, too.**

Continue those steps for the rest of the table until the RAID Sequence window will have 4 sequences of 3 disks:

Sequences **window**



10 **Select the first line in the** RAID Sequence **window, control-click Cell 1 in the block order table, and select Parity of Data.**

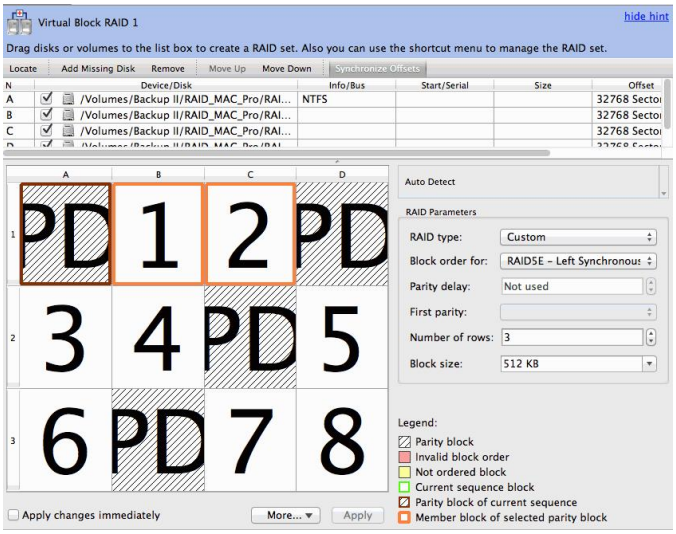
If any unnecessary sequences appear, control-click them in the RAID Sequence window, and select Remove.

11 **Control-click Cell 2 in the block order table and select 1, do that for Cell 3 selecting 2.**

If any unnecessary sequences appear, control-click them in the RAID Sequence window, and select Remove.

12 **Move to the next sequence in the** RAID Sequence **window and repeat the procedure for cells 4, 5, and 6.**

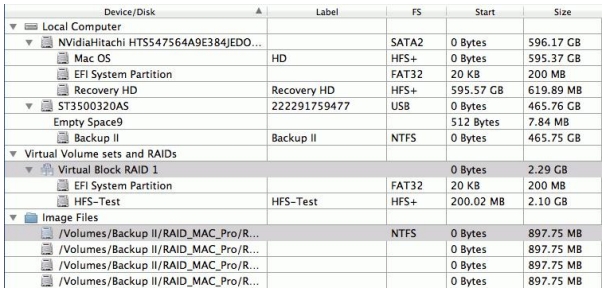
Do that for the rest of the sequences until you fill all cells in the block order table in the Parents **tab.**



> **The created Virtual Block RAID 1 object can now be processed like regular drives/volumes**

If **R-Studio** detects a valid file system on this RAID object, a partition object will appear on the Drives panel.

The **Description Files for RAID Configurations** topic shows the RAID description file for this RAID configuration.



Device/Disk	Label	FS	Start	Size
Local Computer				
NVidiaHitachi HTS547564A9E384JEDO...		SATA2	0 Bytes	596.17 GB
Mac OS	HD	HFS+	0 Bytes	595.37 GB
EFI System Partition		FAT32	20 KB	200 MB
Recovery HD	Recovery HD	HFS+	595.57 GB	619.89 MB
ST3500320AS	222291759477	USB	0 Bytes	465.76 GB
Empty Space9			512 Bytes	7.84 MB
Backup II	Backup II	NTFS	0 Bytes	465.75 GB
Virtual Volume sets and RAIDs				
Virtual Block RAID 1			0 Bytes	2.29 GB
EFI System Partition		FAT32	20 KB	200 MB
HFS-Test	HFS-Test	HFS+	200.02 MB	2.10 GB
Image Files				
/Volumes/Backup II/RAID_MAC_Pro/R...		NTFS	0 Bytes	897.75 MB
/Volumes/Backup II/RAID_MAC_Pro/R...			0 Bytes	897.75 MB
/Volumes/Backup II/RAID_MAC_Pro/R...			0 Bytes	897.75 MB
/Volumes/Backup II/RAID_MAC_Pro/R...			0 Bytes	897.75 MB

You also may check the RAID consistency, if necessary. See the **Checking RAID Consistency** help page for details.

Advanced RAID 6 Layout

For example, let us create a RAID 6 with the following layout:

- Five disks,
- Block size: 64 KB
- Offset: 0
- Block order:

	A	B	C	D	E
1	RS	1	2	3	PD
2	4	5	6	PD	RS
3	8	9	PD	RS	7
4	12	PD	RS	10	11
5	PD	RS	13	14	15
6	PA	PA	PA	PA	PA

where

PD is parity of data;
PA is parity of all;
RS is Reed-Solomon;

Rows from 1 to 5 use two types of error correction: parity of data (xor) and Reed-Solomon. That is, row 1 uses blocks A1 and E1, row 2 uses blocks D2 and E2, and so on.

Row 6 is used for error correction for columns. That is, column A uses block A6, column B uses B6, and so on. Parity of all is used for error correction.

1 **Click the Create virtual volume sets or RAIDs button and select Create Virtual Block RAID**

or select **Create Virtual Block RAID** on the **Create** menu

Check that the Apply changes immediately check box is clear on the Parents tab. This will prevent **R-Studio** from trying to start processing the RAID configuration until you specify it completely.

2 **Drug the required objects from the** Drives **pane to the** Parents **tab and select Custom on the RAID type**

Other ways to add objects

- Control-click the Parents tab and select the required partition from the contextual menu,

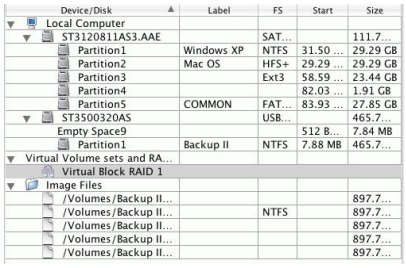
or

- Control-click the partition on the Drives panel, select **Add to RAID** on the contextual menu, and select the RAID object you want to add the partition to.

These objects may be hard drives, logical disks, or images. Check that the objects are correctly placed.

Object control buttons

Locate	Click this button to locate the selected object in the Drives panel.
Add Empty Space/Add Missing Disk	Click this button to add an empty space or missing disk object to the RAID
Remove	Click this button to remove the selected object from the RAID
Move Up	Click this button to move up the selected object in the RAID
Move Down	Click this button to move down the selected object in the RAID
Synchronize Offsets	Click this button to make the offsets the same for all objects in the RAID
Reset changes	Click this button to return the configuration to the initial state (after clicking the Apply button or immediately after loading)



3 Specify the Block size and Offset parameters on the Parents **tab**

Disregard the Block order parameter.

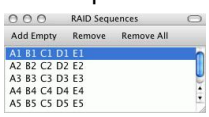
4 Manually enter 6 to Number of rows on the Parents **tab**

5 Enter the block order in the table on the Parents **tab**

You may enter either a block number, or an error correction block of the following types:

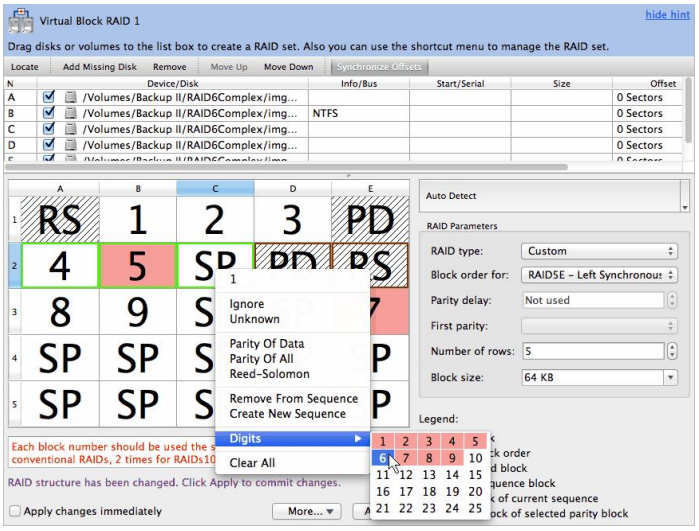
PD	Parity of data
PA	Parity of all
RS	Reed-Solomon
U	Unknown
I	Ignore

Note: You should specify an error correction block only when the correct sequence is selected on the RAID Sequences window.



Using the keyboard: arrow keys to navigate, digit, and rs, pd, pa, u, i keys to enter the block order.

Using the mouse: control-click the cell and select the number or parity from the contextual menu. If the block table is too large, you better use the keyboard to enter the digits.



For the rows:

Select the required row sequence on the RAID Sequences window, select the cell on the RAID table, and enter the required value. **R-Studio** automatically generates those sequences when you add RAID parents.

For the columns and arbitrary sequences:

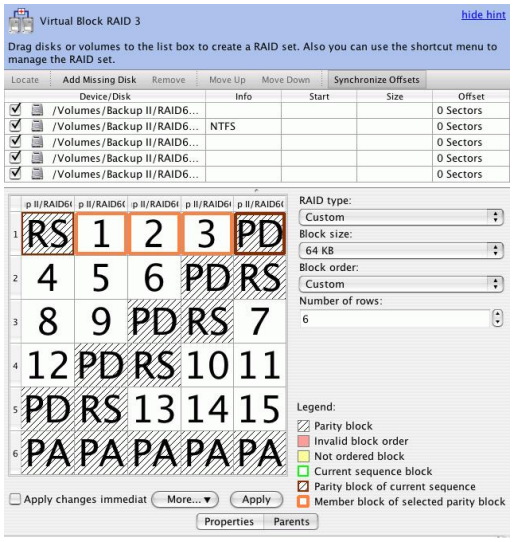
You need to create those sequences and add the respective blocks to it manually.

To create a sequence: Click **Add empty** on the RAID Sequences window or select **Create New Sequence** on the contextual menu on the Parents tab.

To add a block to a sequence: Control-click the respective cell and select **Add To Sequence** on the contextual menu on the Parents tab.

To remove a block to a sequence: Control-click the respective cell and select **Remove From Sequence** on the contextual menu on the Parents tab.

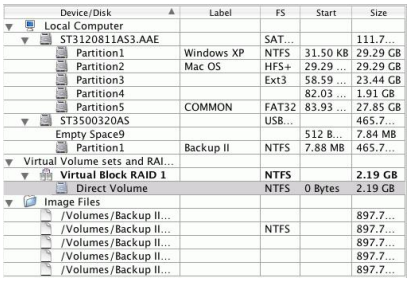
6 When you finishes entering the information, click the Apply button on the Parents tab



> The created Virtual Block RAID 1 object can now be processed like regular drives/volumes

If **R-Studio** detects a valid file system on this RAID object, a partition object will appear on the Drives panel.

The **Description Files for RAID Configurations** topic shows the RAID description file for this RAID configuration.



You also may check the RAID consistency, if necessary. See the **Checking RAID Consistency** help page for details.

2.4.7 Nested and Non-Standard RAID Levels

R-Studio can work with various nested and non-standard RAID levels. Currently, the following RAID levels are supported:

- **RAID10 (1+0)**
- **RAID1E**
- **RAID5E**
- **RAID5EE**
- **RAID6E**

2.4.7.1 RAID10 (1+0)

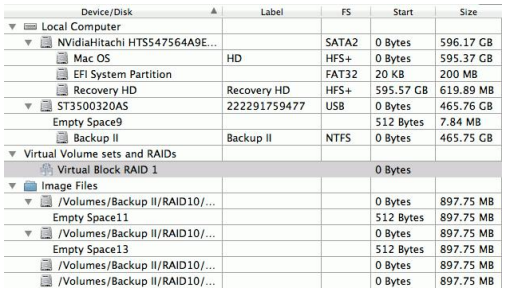
A RAID 10 (or 1+0) is a stripe of mirrors. Its block order can be represented as:

	A	B	C	D
1	1	1	2	2

To create a RAID 10 object

1 **Click the Create Virtual RAID button and select Create Virtual Block RAID**
or select the **Create Virtual Block RAID** on the **Create** menu

> **A Virtual Block RAID object will appear on the** Drives **panel**



2 **Drag the required partitions from the** Drives **panel to the** Parents **tab**

Other ways to add objects

- Control-click the Parents tab and select the required partition from the contextual menu,

or

- Control-click the partition on the Drives panel, select **Add to RAID** on the contextual menu, and select the RAID object you want to add the partition to.

3 Select RAID 10 on the RAID type

You may either make **R-Studio** to process your changes immediately or wait until you finish editing the RAID layout. Select or clear the Apply changes immediately checkbox on the Parents tab. Click the **Apply** button to apply the changes when are you through.

Note: Objects should be placed in the same order as they were in the original RAID 10. If this order is incorrect, you must change it by dragging the parents to place them in the correct order.

Object control buttons

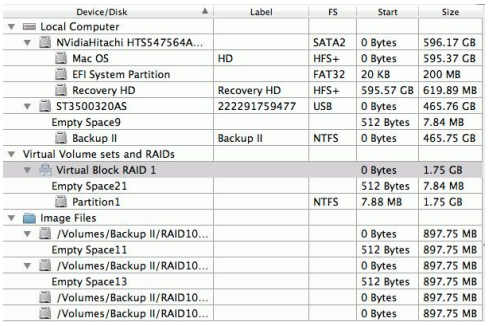
Locate	Click this button to locate the selected object in the Drives panel.
Add Empty Space/Add Missing Disk	Click this button to add an empty space or missing disk object to the RAID
Remove	Click this button to remove the selected object from the RAID
Move Up	Click this button to move up the selected object in the RAID
Move Down	Click this button to move down the selected object in the RAID
Synchronize Offsets	Click this button to make the offsets the same for all objects in the RAID
Reset changes	Click this button to return the configuration to the initial state (after clicking the Apply button or immediately after loading)

The RAID block size and Offset (in sectors) parameters must be set the same as for the original RAID 10.

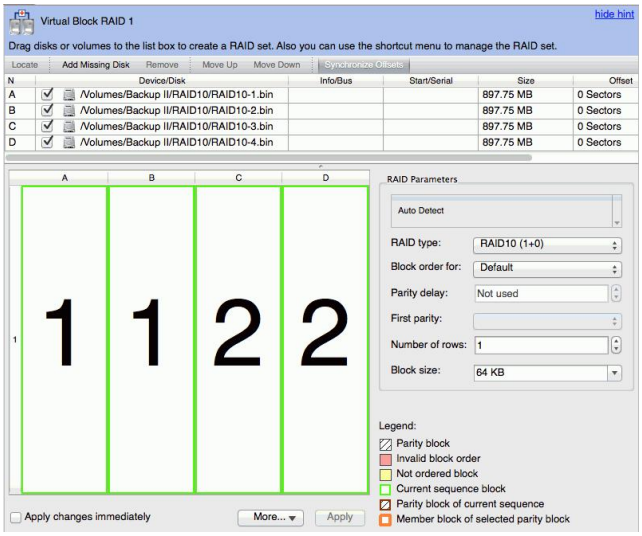
You also need to specify Block order for virtual RAID 10. You may select it on the Block order drop-down or contextual menu.

If the those parameters are not correct, data on the parents will not be damaged, but files from the RAID 10 cannot be recovered.

Note: You may check how correctly you have reconstructed the original RAID 10. Find a file and preview it. If the file appears correct, you have created a correct RAID 10 layout.



Parents **tab**



> **The *RAID 10* object can now be processed like regular drives/volumes**

If **R-Studio** detects a valid file system on the newly created RAID object, a partition object will appear on the Drives panel.

The **Description Files for RAID Configurations** topic shows the RAID description file for this RAID configuration.

You also may check the RAID consistency, if necessary. See the **Checking RAID Consistency** help page for details.

2.4.7.2 RAID1E

RAID 1E is utilizes both the mirroring and striping: data is striped across all drives, as in RAID 0. Additionally, a copy of each stripe is stored on a different drive, as in RAID 1. Its block order can be represented as:

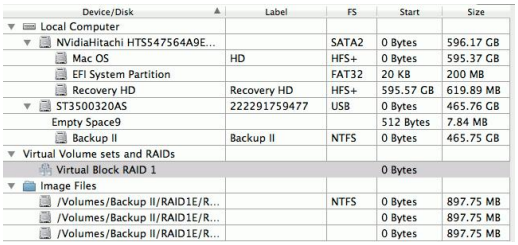
	A	B	C
1	1	1	2
2	2	3	3

To create a RAID 1E object

1 Click the Create Virtual RAID button and select Create Virtual Block RAID

or select the **Create Virtual Block RAID** on the **Create** menu

> **A Virtual Block RAID object will appear on the Drives panel**



2 Drag the required partitions from the Drives panel to the Parents tab

Other ways to add objects

- Control-click the Parents tab and select the required partition from the contextual menu,

or

- Control-click the partition on the Drives panel, select **Add to RAID** on the contextual menu, and select

the RAID object you want to add the partition to.

3 Select RAID 1E on the RAID type

You may either make **R-Studio** to process your changes immediately or wait until you finish editing the RAID layout. Select or clear the Apply changes immediately checkbox on the Parents tab. Click the **Apply** button to apply the changes when are you through.

Note: Objects should be placed in the same order as they were in the original RAID 1E. If this order is incorrect, you must change it by dragging the parents to place them in the correct order.

Object control buttons

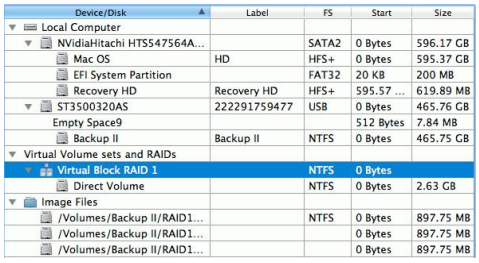
Locate	Click this button to locate the selected object in the Drives panel.
Add Empty Space/Add Missing Disk	Click this button to add an empty space or missing disk object to the RAID
Remove	Click this button to remove the selected object from the RAID
Move Up	Click this button to move up the selected object in the RAID
Move Down	Click this button to move down the selected object in the RAID
Synchronize Offsets	Click this button to make the offsets the same for all objects in the RAID
Reset changes	Click this button to return the configuration to the initial state (after clicking the Apply button or immediately after loading)

The RAID block size and Offset (in sectors) parameters must be set the same as for the original RAID 1E.

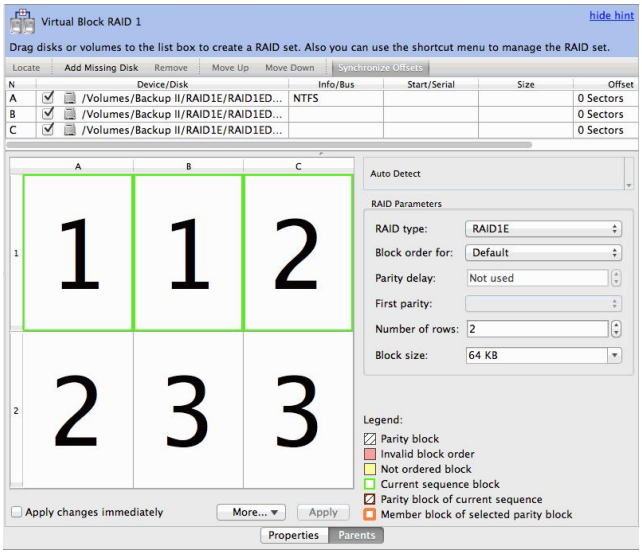
You also need to specify Block order for virtual RAID 1E You may select it on the Block order drop-down or contextual menu.

If the those parameters are not correct, data on the parents will not be damaged, but files from the RAID 1E cannot be recovered.

Note: You may check how correctly you have reconstructed the original RAID 1E. Find a file and preview it. If the file appears correct, you have created a correct RAID 1E layout.



Parents **tab**



> **The *RAID 1E* object can now be processed like regular drives/volumes**

If **R-Studio** detects a valid file system on the newly created RAID object, a partition object will appear on the Drives panel.

The **Description Files for RAID Configurations** topic shows the RAID description file for this RAID configuration.

You also may check the RAID consistency, if necessary. See the **Checking RAID Consistency** help page for details.

2.4.7.3 RAID5E

RAID 5E (where E stands for Enhanced) is a RAID 5 layout with an integrated hot-spare drive, where the spare drive is an active part of the block rotation scheme. An example of such RAID layout is in the table below:

	A	B	C	D
1	1	2	3	PD
2	5	6	PD	4
3	9	PD	7	8
4	PD	10	11	12
5	SP	SP	SP	SP

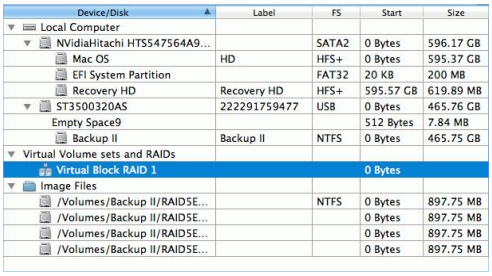
where PD and SP stand for Parity of Data and Spare Part.

To create a RAID 5E object

1 **Click the Create Virtual RAID button and select Create Virtual Block RAID**

or select the **Create Virtual Block RAID** on the **Create** menu

> **A Virtual Block RAID object will appear on the** Drives **panel**



2 Drag the required partitions from the Drives **panel to the** Parents **tab**

Other ways to add objects

- Control-click the Parents tab and select the required partition from the contextual menu,

or

- Control-click the partition on the Drives panel, select **Add to RAID** on the contextual menu, and select the RAID object you want to add the partition to.

3 Select RAID 5E on the RAID type

You may either make **R-Studio** to process your changes immediately or wait until you finish editing the RAID layout. Select or clear the Apply changes immediately checkbox on the Parents tab. Click the **Apply** button to apply the changes when are you through.

Note: Objects should be placed in the same order as they were in the original RAID 5E. If this order is incorrect, you must change it by dragging the parents to place them in the correct order.

Object control buttons

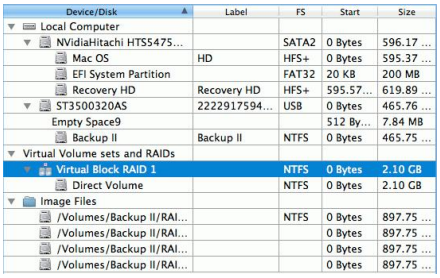
Locate	Click this button to locate the selected object in the Drives panel.
Add Empty Space/Add Missing Disk	Click this button to add an empty space or missing disk object to the RAID
Remove	Click this button to remove the selected object from the RAID
Move Up	Click this button to move up the selected object in the RAID
Move Down	Click this button to move down the selected object in the RAID
Synchronize Offsets	Click this button to make the offsets the same for all objects in the RAID
Reset changes	Click this button to return the configuration to the initial state (after clicking the Apply button or immediately after loading)

The RAID block size and Offset (in sectors) parameters must be set the same as for the original RAID 5E.

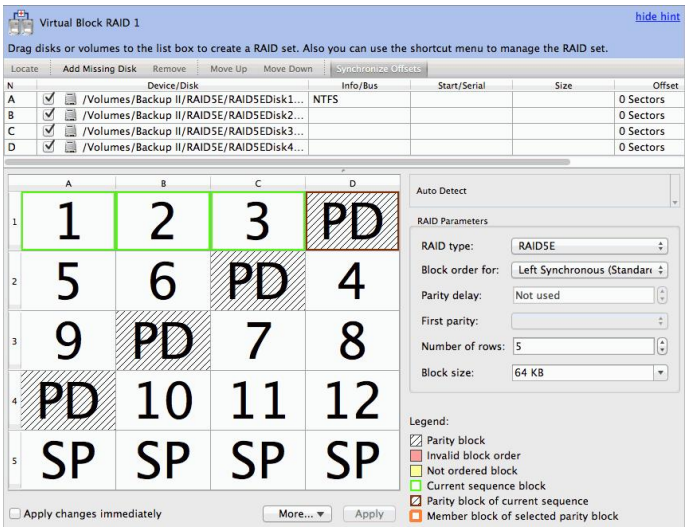
You also need to specify Block order for virtual RAID 5E You may select it on the Block order drop-down or contextual menu.

If the those parameters are not correct, data on the parents will not be damaged, but files from the RAID 5E cannot be recovered.

Note: You may check how correctly you have reconstructed the original RAID 5E. Find a file and preview it. If the file appears correct, you have created a correct RAID 5E layout.



Parents **tab**



> The *RAID 5E* object can now be processed like regular drives/volumes

If **R-Studio** detects a valid file system on the newly created RAID object, a partition object will appear on the Drives panel.

The **Description Files for RAID Configurations** topic shows the RAID description file for this RAID configuration.

You also may check the RAID consistency, if necessary. See the **Checking RAID Consistency** help page for details.

2.4.7.4 RAID5EE

RAID 5EE (where E stands for Enhanced) is a RAID 5 layout with an integrated hot-spare drive, where the spare drive is an active part of the block rotation scheme. An example of such RAID layout is in the table below:

	A	B	C	D
1	1	2	SP	PD
2	4	SP	PD	3
3	SP	PD	5	6
4	PD	7	8	SP

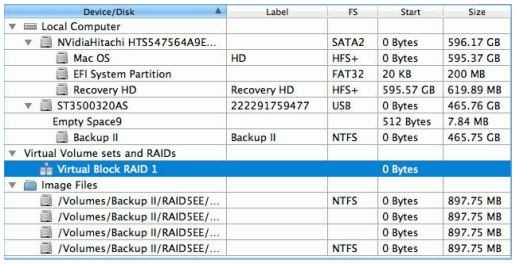
where PD and SP stand for Parity of Data and Spare Part.

To create a RAID 5EE object

1 Click the Create Virtual RAID button and select Create Virtual Block RAID

or select the **Create Virtual Block RAID** on the **Create** menu

> **A Virtual Block RAID object will appear on the** Drives **panel**



Device/Disk	Label	FS	Start	Size
Local Computer				
NVidiaHitachi HTS547564A9E...		SATA2	0 Bytes	596.17 GB
Mac OS	HD	HFS+	0 Bytes	595.37 GB
EFI System Partition		FAT32	20 KB	200 MB
Recovery HD	Recovery HD	HFS+	595.57 GB	619.89 MB
ST3500320AS	222291759477	USB	0 Bytes	465.76 GB
Empty Space9			512 Bytes	7.84 MB
Backup II	Backup II	NTFS	0 Bytes	465.75 GB
Virtual Volume sets and RAIDs				
Virtual Block RAID 1			0 Bytes	
Image Files				
/Volumes/Backup II/RAID5EE/...		NTFS	0 Bytes	897.75 MB
/Volumes/Backup II/RAID5EE/...			0 Bytes	897.75 MB
/Volumes/Backup II/RAID5EE/...			0 Bytes	897.75 MB
/Volumes/Backup II/RAID5EE/...		NTFS	0 Bytes	897.75 MB

2 Drag the required partitions from the Drives **panel to the** Parents **tab**

Other ways to add objects

- Control-click the Parents tab and select the required partition from the contextual menu,

or

- Control-click the partition on the Drives panel, select **Add to RAID** on the contextual menu, and select the RAID object you want to add the partition to.

3 Select RAID 5EE on the RAID type

You may either make **R-Studio** to process your changes immediately or wait until you finish editing the RAID layout. Select or clear the Apply changes immediately checkbox on the Parents tab. Click the **Apply** button to apply the changes when are you through.

Note: Objects should be placed in the same order as they were in the original RAID 5EE. If this order is incorrect, you must change it by dragging the parents to place them in the correct order.

Object control buttons

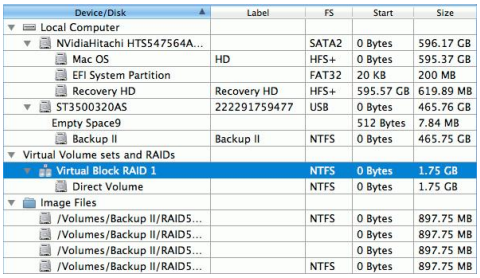
Locate	Click this button to locate the selected object in the Drives panel.
Add Empty Space/Add Missing Disk	Click this button to add an empty space or missing disk object to the RAID
Remove	Click this button to remove the selected object from the RAID
Move Up	Click this button to move up the selected object in the RAID
Move Down	Click this button to move down the selected object in the RAID
Synchronize Offsets	Click this button to make the offsets the same for all objects in the RAID
Reset changes	Click this button to return the configuration to the initial state (after clicking the Apply button or immediately after loading)

The RAID block size and Offset (in sectors) parameters must be set the same as for the original RAID 5EE.

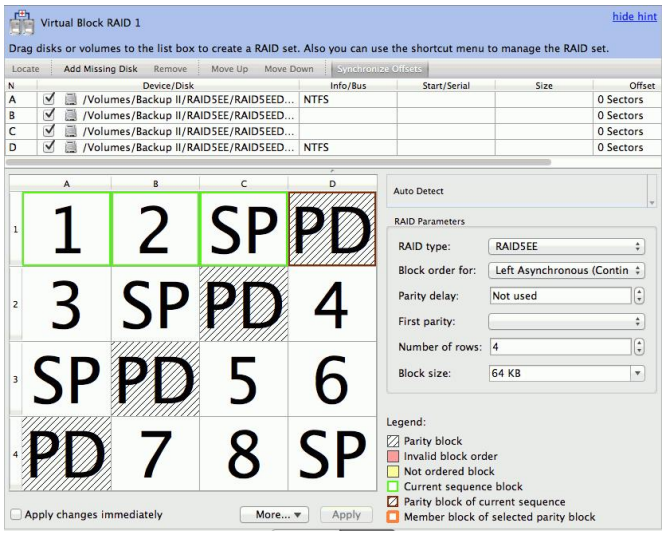
You also need to specify Block order for virtual RAID 5EE You may select it on the Block order drop-down or contextual menu.

If the those parameters are not correct, data on the parents will not be damaged, but files from the RAID 5EE cannot be recovered.

Note: You may check how correctly you have reconstructed the original RAID 5EE. Find a file and preview it. If the file appears correct, you have created a correct RAID 5EE layout.



Parents **tab**



> **The *RAID 5EE* object can now be processed like regular drives/volumes**

If **R-Studio** detects a valid file system on the newly created RAID object, a partition object will appear on the Drives panel.

The **Description Files for RAID Configurations** topic shows the RAID description file for this RAID configuration.

You also may check the RAID consistency, if necessary. See the **Checking RAID Consistency** help page for details.

2.4.7.5 RAID6E

RAID 6E (where E stands for Enhanced) is a RAID 6 layout with an integrated hot-spare drive, where the spare drive is an active part of the block rotation scheme. An example of such RAID layout is in the table below:

	A	B	C	D	E	F
1	RS	1	2	3	4	PD
2	5	6	7	8	PD	RS
3	10	11	12	PD	RS	9
4	15	16	PD	RS	13	14
5	20	PD	RS	17	18	19
6	PD	RS	21	22	23	24
7	SP	SP	SP	SP	SP	SP

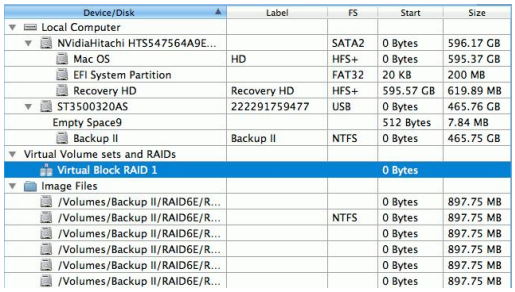
where RS, PD and SP stand for Reed-Solomon, Parity of Data, and Spare Part, respectively.

To create a RAID 6E object

1 **Click the Create Virtual RAID button and select Create Virtual Block RAID**

or select the **Create Virtual Block RAID** on the **Create** menu

> **A Virtual Block RAID object will appear on the** Drives **panel**



Device/Disk	Label	FS	Start	Size
Local Computer				
NVidiaHitachi HTS547564A9E...		SATA2	0 Bytes	596.17 GB
Mac OS	HD	HFS+	0 Bytes	595.37 GB
EFI System Partition		FAT32	20 KB	200 MB
Recovery HD	Recovery HD	HFS+	595.57 GB	619.89 MB
ST3500320AS	222291759477	USB	0 Bytes	465.76 GB
Empty Space9			512 Bytes	7.84 MB
Backup II	Backup II	NTFS	0 Bytes	465.75 GB
Virtual Volume sets and RAIDs				
Virtual Block RAID 1			0 Bytes	
Image Files				
/Volumes/Backup II/RAID6E/R...			0 Bytes	897.75 MB
/Volumes/Backup II/RAID6E/R...		NTFS	0 Bytes	897.75 MB
/Volumes/Backup II/RAID6E/R...			0 Bytes	897.75 MB
/Volumes/Backup II/RAID6E/R...			0 Bytes	897.75 MB
/Volumes/Backup II/RAID6E/R...			0 Bytes	897.75 MB
/Volumes/Backup II/RAID6E/R...			0 Bytes	897.75 MB

2 **Drag the required partitions from the** Drives **panel to the** Parents **tab**

Other ways to add objects

- Control-click the Parents tab and select the required partition from the contextual menu,

or

- Control-click the partition on the Drives panel, select **Add to RAID** on the contextual menu, and select the RAID object you want to add the partition to.

3 **Select RAID 6E on the RAID type**

You may either make **R-Studio** to process your changes immediately or wait until you finish editing the RAID layout. Select or clear the Apply changes immediately checkbox on the Parents tab. Click the **Apply** button to apply the changes when are you through.

Note: Objects should be placed in the same order as they were in the original RAID 6E. If this order is incorrect, you must change it by dragging the parents to place them in the correct order.

Object control buttons

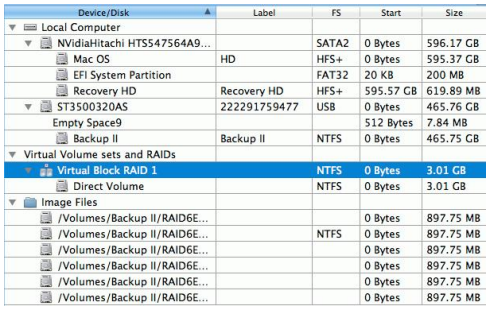
Locate	Click this button to locate the selected object in the Drives panel.
Add Empty Space/Add Missing Disk	Click this button to add an empty space or missing disk object to the RAID
Remove	Click this button to remove the selected object from the RAID
Move Up	Click this button to move up the selected object in the RAID
Move Down	Click this button to move down the selected object in the RAID
Synchronize Offsets	Click this button to make the offsets the same for all objects in the RAID
Reset changes	Click this button to return the configuration to the initial state (after clicking the Apply button or immediately after loading)

The RAID block size and Offset (in sectors) parameters must be set the same as for the original RAID 6E.

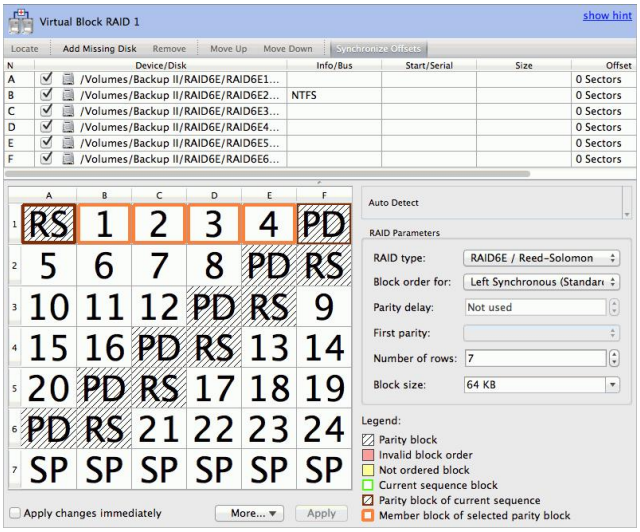
You also need to specify Block order for virtual RAID 6E You may select it on the Block order drop-down or contextual menu.

If the those parameters are not correct, data on the parents will not be damaged, but files from the RAID 6E cannot be recovered.

Note: You may check how correctly you have reconstructed the original RAID 6E. Find a file and preview it. If the file appears correct, you have created a correct RAID 6E layout.



Parents **tab**



> The *RAID 6E* object can now be processed like regular drives/volumes

If **R-Studio** detects a valid file system on the newly created RAID object, a partition object will appear on the Drives panel.

The **Description Files for RAID Configurations** topic shows the RAID description file for this RAID configuration.

You also may check the RAID consistency, if necessary. See the **Checking RAID Consistency** help page for details.

2.4.8 Finding RAID Parameters

R-Studio can find parameters for RAID 5 and 6. RAID parameters can be found automatically or manually.

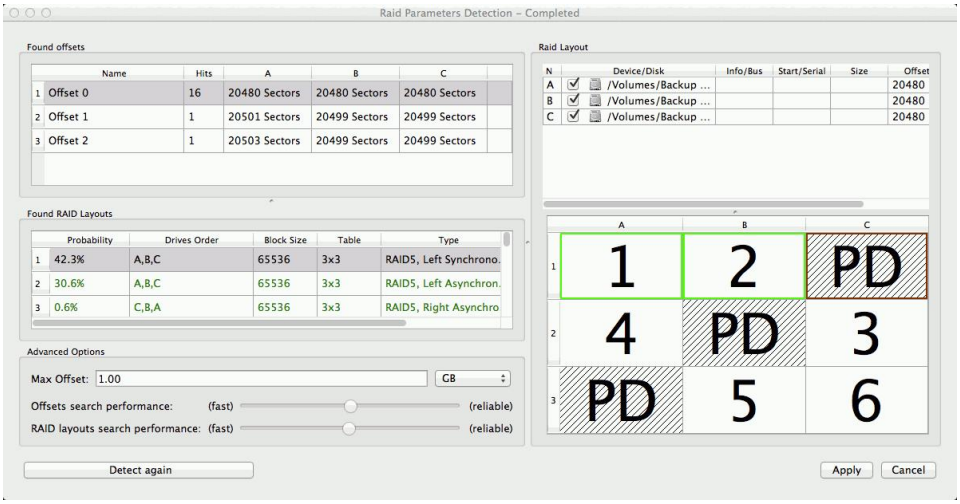
The number of disks in the RAID should be between 3 and 32. RAID parameters can be found only when all original disks (or their images) are present. Even one substitute object in a RAID (like a missing disk) makes finding RAID parameters impossible.

To find RAID parameters automatically,

1 Click the Auto Detect button on the Parents tab

> **R-Studio will start searching for the RAID parameters and show the most probable one on the** RAID Parameter Detection **dialog box**

RAID Parameter Detection **dialog box**



2 **Click the Apply button and R-Studio will change the RAID layout to the selected one on the** Parents **tab.**

3 **Click the Apply button on the** Parents **tab**

> **R-Studio will use the found parameters for the RAID.**

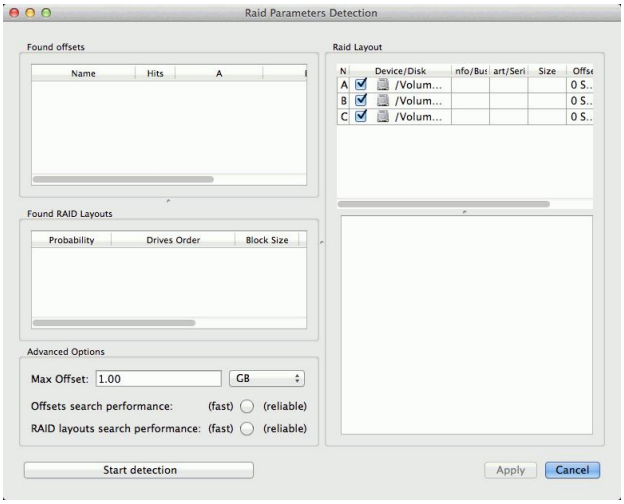
If necessary, you may return to the RAID Parameter Detection dialog box by clicking the **Choose Variants** button, and select another RAID layout.

To find RAID parameters manually,

1 **Click the drop-down Auto Detect list on the** Parents **tab and select Advanced Detection.**

2 **Specify the necessary detection parameters on the** RAID Parameter Detection **dialog box and click the Start detection button**

Raid Parameters Detection **dialog box**



You may change the disk order, offset for disk(s), and enable /disable disks.

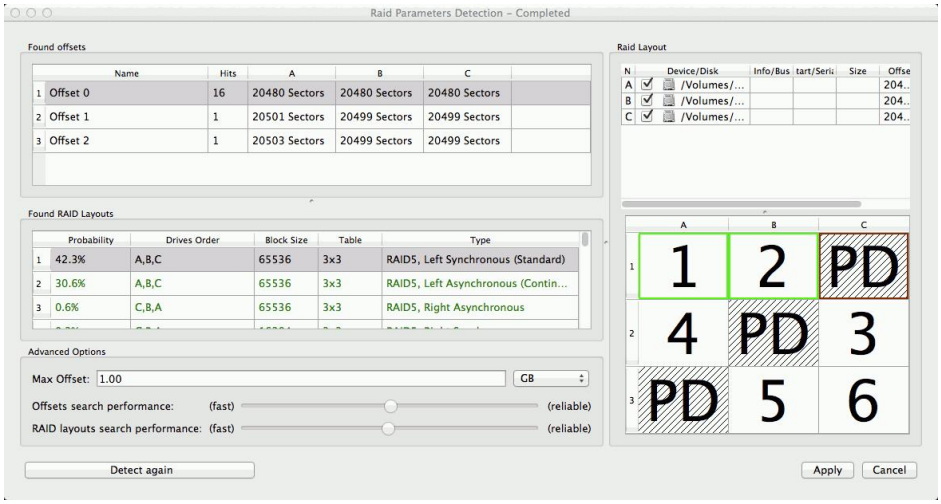
Advanced Parameters

Max offset:	The area on the disk to find RAID parameters in.

Offset search performance RAID layouts search performance	Cumulative parameters that estimates the probability of certain found RAID parameters. Moving it to the right increases accuracy but slows the process. Moving it to the left reduces the accuracy but makes the process faster.

3 **Select an offset and click the Click here to find RAID Layouts button on the** Raid Parameters Detection **dialog box**

RA ID Parameters Detection **dialog box**



You may add your own RAID offsets. Control-click empty space on the **Found offsets** pane and select **Add Custom offset** on the contextual menu and specify the offset individually for every disk.

4 **Select a RAID variant on the Found RAID layouts pane and click the Apply button**

5 **Click the Apply button on the Parents tab**

> **R-Studio will use the found parameters for the RAID.**

If necessary, you may return to the RA ID Parameter Detection dialog box by clicking the **Choose Variants** button, and select another RAID layout.

2.4.9 Checking RAID consistency

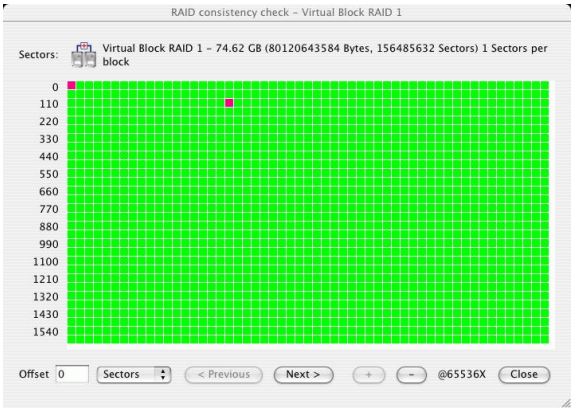
You may check RAID consistency (whether the data parity values are valid) for RAID layouts with parity blocks.

To check RAID consistency,

* **Control-click the RAID and select Check RAID consistency... on the contextual menu**

> **The RAID consistency check window will appear showing the progress.**

RAID consistency check **window**



When the check is finished, you may inspect the results.

Block color	
Green	Data parity values are valid.
Red	Data parity values are not valid.
White	0's

When a mouse pointer hovers over a block, a tooltip will show the sector range within the block and number of consistent and inconsistent sectors. Double-clicking the block moves it to the upper-leftmost corner and zooms in the data by 2.

RAID consistency check controls

Sectors	The number of the first sector in the row.
Offset	Offset in the data. Enter the address you want to jump to and press the **Enter** key.
Sectors/Bytes/KB...	Specifies the dimension of the data in the **Offset** field.
Previous/Next	Moves to the previous/next part of the data.
+/-	Zooms into/out of, the data.

2.4.10 Syntax of a Description File for RAID Configurations

You may create and store your own RAID configurations The syntax of those files is similar to that of the XML language. They are stored in an `.xml` file specified on the **R-Studio Settings**.

A number of file examples are shown on the **Description Files for RAID Configurations** topic.

There are two types of such description files: for RAID presets and custom-created RAID layouts.

RAID preset configuration file

```
<?xml version="1.0" encoding="UTF-8"?>
<RAIDList version="1">
    <RAID blockSize="65536" name="RAID5" rows="3" type="5" order="2" parityDelay="1">
        <Parents>
            <Parent comp="RAID5Disk1.dsk" name="Promise1+0 JBOD1.10" size="40060321792" order="1
            <Parent comp="RAID5Disk2.dsk" name="Promise1+0 JBOD1.10" size="40060321792" order="2
            <Parent comp="RAID5Disk3.dsk" name="Promise1+0 JBOD1.10" size="40060321792" order="3
        </Parents>
    </RAID>
</RAIDList>
```

Custom-created RAID configuration file example

```
<?xml version="1.0" encoding="UTF-8"?>
<RAIDList version="1">
    <RAID blockSize="65536" name="RAID6Complex" rows="6" type="256">
        <Parents>
            <Parent name="img1.bin" size="941359104" order="1"/>
            <Parent name="img2.bin" fs="NTFS" size="941359104" order="2"/>
            <Parent name="img3.bin" size="941359104" order="3"/>
            <Parent name="img4.bin" size="941359104" order="4"/>
            <Parent name="img5.bin" size="941359104" order="5"/>
        </Parents>
        <Table>
            <Block id="A1">ReedSolomon</Block>
            <Block id="B1">1</Block>
            <Block id="C1">2</Block>
            <Block id="D1">3</Block>
            <Block id="E1">XorOfData</Block>
            <Block id="A2">4</Block>
            <Block id="B2">5</Block>
            <Block id="C2">6</Block>
            <Block id="D2">XorOfData</Block>
            <Block id="E2">ReedSolomon</Block>
            <Block id="A3">8</Block>
            <Block id="B3">9</Block>
            <Block id="C3">XorOfData</Block>
            <Block id="D3">ReedSolomon</Block>
            <Block id="E3">7</Block>
            <Block id="A4">12</Block>
            <Block id="B4">XorOfData</Block>
            <Block id="C4">ReedSolomon</Block>
            <Block id="D4">10</Block>
            <Block id="E4">11</Block>
            <Block id="A5">XorOfData</Block>
            <Block id="B5">ReedSolomon</Block>
            <Block id="C5">13</Block>
            <Block id="D5">14</Block>
            <Block id="E5">15</Block>
            <Block id="A6" sequence="1">XorOfAll</Block>
            <Block id="B6" sequence="2">XorOfAll</Block>
            <Block id="C6" sequence="3">XorOfAll</Block>
            <Block id="D6" sequence="4">XorOfAll</Block>
            <Block id="E6" sequence="5">XorOfAll</Block>
        </Table>
        <Sequences>
            <Sequence id="1">A1 A2 A3 A4 A5 A6</Sequence>
            <Sequence id="2">B1 B2 B3 B4 B5 B6</Sequence>
            <Sequence id="3">C1 C2 C3 C4 C5 C6</Sequence>
            <Sequence id="4">D1 D2 D3 D4 D5 D6</Sequence>
            <Sequence id="5">E1 E2 E3 E4 E5 E6</Sequence>
        </Sequences>
    </RAID>
</RAIDList>
```

File structure

File header

The file starts with a standard XML header:

```
<?xml version="1.0" encoding="utf-8"?>
```

Section `RAIDList`

```
<RAIDList>
```

It can contain any number of the `<RAID>` sections and requires a closing element `</FileTypeList>`.

Section structure example:

```
  <RAIDList>
    <RAID [attributes]>
      ...
    </RAID>
    ...
    <RAID [attributes]>
      ...
    </RAID>
```

Section `RAID`

This section describes each RAID layout.

It must contain at least one `<Table>` and `<Parents>` sections and can contain one block `<Sequences>`..

```
<RAIDList version="1">
    <RAID blockSize="65536" name="RAID5" rows="3" type="5" order="2" parityDelay="1">
        <Parents>

        </Parents>
        <Table>

        </Table>
        <Sequences>

        </Sequences>
    </RAID>
</RAIDList>
```

Attributes:

`blocksize`	`<u32>`	Required	The block size of the RAID in bytes
`name`	`<string>`	Optional	The name of the RAID layout
`rows`	`<u16>`	Required	The number of rows in the RAID layout table.
`type`	`<u16>`	Required	The type of the RAID preset. The following types are supported: 1: RAID0 (Stripe set) 2: RAID10 3: RAID1E 4: RAID4 5: RAID5 6: RAID5E 7: RAID5EE 8: RAID6 / Reed-Solomon Encoding

			9: RAID6E / Reed-Solomon Encoding 10: RAID6 / Vertical Xor Encoding 256: Custom Raid Table If the RAID type parameter contradicts to the RAID table, the RAID table always prevails.
order	<u16>	Required/Optional	The RAID sub-type. For example, order="2" means Left Asynchronous for RAID5 layouts. Any value for the custom RAID layouts will be ignored.
parityDelay	<u16>	Required	The Parity delay parameter.

Section structure example:

```
<RAID blockSize="65536" rows="6" type="256">
        <Parents>

        </Parents>

        <Table>

        </Table>
        <Sequences>

        </Sequences>
    </RAID>
```

Section Parents

This section describes the RAID parents. It contains the <Parent> elements of the RAID.

Section structure example:

```
        <Parents>
            <Parent comp="RAID5Disk1.dsk" name="Promise1+0 JBOD1.10" size="40060321792" ord
            <Parent comp="RAID5Disk2.dsk" name="Promise1+0 JBOD1.10" size="40060321792" ord
            <Parent comp="RAID5Disk3.dsk" name="Promise1+0 JBOD1.10" size="40060321792" ord
        </Parents>
```

Element Parent

The element specifies the parent of the RAID.

Attributes:

comp	<string>	Required/Optional	The file-container with the parent object.
name	<string>	Required	The object name of the RAID parent.
offset	<u16>	Required is not 0	The offset value in bytes
size=	<u16>	Required	The object size in bytes
order	<u16>	Required	The order of the RAID object

Section Table

This section describes the RAID layout table. It contains the <Block> elements which number is a product of two attributes in the <RAID> section: <parents> x <rows>.

Section structure example:

```
<RAIDList>
  <RAID name="example" parents="2" rows="2" blocksize="16777216">
    <Table>
      <Block [attributes]> ... </Block>
      <Block [attributes]> ... </Block>
      <Block [attributes]> ... </Block>
      <Block [attributes]> ... </Block>
    </Table>
  </RAID>
</RAIDList>
```

Element `Block`

The element specifies the block number in the RAID layout table (a positive integer number) or an error correction block of the following types:

- `PD` or `ParityOfData`
- `PA` or `ParityOfAll`
- `RS` or `ReedSolomon`
- `U` or `Unknown`
- `I` or `Ignore`

Any other value is treated as `Unknown`.

Attributes:

`id`	`<string>`	Required	The alpha-numerical identifier of the block in the RAID layout table. The element in the 3-rd column of the 2-nd line is designated as `C2`. `AA` is used after letter `Z`, and so on.
`sequence`	`<string>`	Optional	The numerical identifier for non-default sequences.

Section `Sequences`

This section describes the non-default data checksum sequences used to preserve data integrity. It is not necessary to explicitly list default sequences (the table rows). Sequences can contain any number of the `<Sequence>` elements.

Section structure example:

```
<RAIDList>
  <RAID name="example" parents="4" rows="4" blocksize="16777216">
   <Parents>

   </Parents>
    <Table>
      ...
    </Table>
    <Sequences>
      <Sequence [attributes]> ... </Sequence>
      ...
      <Sequence [attributes]> ... </Sequence>
    </Sequences>
  </RAID>
</RAIDList>
```

Element `Sequence`

The element contains the list of the RAID blocks belonging to that sequence. The elements are separated by a space .

Attributes:

`id`	`<u16>`	Required	The sequence identifier.

Element example:

See the **RAID configuration file example**.

Comments

```
<!-- Comment string -->
```

An XML standard string for a comment.

2.4.11 Description Files for RAID Configurations

Below are description files for RAID examples described in the **Volume Sets and RAIDs** chapter. The syntax of them is described in the **Syntax of a Description File for RAID Configurations** topic.

StripeSet

The stripe set layout is described in the **Volume Sets, Stripe Sets, and Mirrors** topic.

```
<?xml version="1.0" encoding="UTF-8"?>
<RAIDList version="1">
    <RAID blockSize="65536" name="StripeSet" rows="2" type="1" order="7" parityDelay="1">
        <Parents>
            <Parent comp="RAID0Disk1.dsk" name="Promise1+0 JBOD1.10" size="40060321792" ord
            <Parent comp="RAID0Disk2.dsk" name="Promise1+0 JBOD1.10" size="40060321792" ord
        </Parents>
    </RAID>
</RAIDList>
```

Basic RAID 5

The RAID layout is described in the **Working with Basic RAID 4 and RAID 5 Operations** topic.

```
<?xml version="1.0" encoding="UTF-8"?>
<RAIDList version="1">
    <RAID blockSize="65536" name="RAID5" rows="3" type="5" order="2" parityDelay="1">
        <Parents>
            <Parent comp="RAID5Disk1.dsk" name="Promise1+0 JBOD1.10" size="40060321792" ord
            <Parent comp="RAID5Disk2.dsk" name="Promise1+0 JBOD1.10" size="40060321792" ord
            <Parent comp="RAID5Disk3.dsk" name="Promise1+0 JBOD1.10" size="40060321792" ord
        </Parents>
    </RAID>
</RAIDList>
```

RAID 5 with parity delays

The RAID layout is described in the **RAID5 with Parity Delays Operations** topic.

```
<?xml version="1.0" encoding="UTF-8"?>
<RAIDList version="1">
    <RAID blockSize="16384" name="RAID5HP" rows="48" type="5" order="2" parityDelay="16" fi
        <Parents>
            <Parent name="RAID5HPDisk1.bin" offset="557056" size="941359104" order="1"/>
            <Parent name="RAID5HPDisk2.bin" offset="557056" size="941359104" order="2"/>
```

```
            <Parent name="RAID5HPDisk3.bin" offset="557056" size="941359104" order="3"/>
        </Parents>
    </RAID>
</RAIDList>
```

Advanced RAID 5

The RAID layout is described in the **Working with Advanced RAID Layouts** topic.

```
<?xml version="1.0" encoding="UTF-8"?>
<RAIDList version="1">
    <RAID blockSize="4096" name="RAID5Complex" rows="9" type="256">
        <Parents>
            <Parent name="RAID5CDisk1.bin" offset="16777216" size="941359104" order="1"/>
            <Parent name="RAID5CDisk2.bin" offset="16777216" size="941359104" order="2"/>
            <Parent name="RAID5CDisk3.bin" offset="16777216" size="941359104" order="3"/>
        </Parents>
        <Table>
            <Block id="A1">XorOfData</Block>
            <Block id="B1">1</Block>
            <Block id="C1">2</Block>
            <Block id="A2">XorOfData</Block>
            <Block id="B2">3</Block>
            <Block id="C2">4</Block>
            <Block id="A3">XorOfData</Block>
            <Block id="B3">5</Block>
            <Block id="C3">6</Block>
            <Block id="A4">7</Block>
            <Block id="B4">XorOfData</Block>
            <Block id="C4">8</Block>
            <Block id="A5">9</Block>
            <Block id="B5">XorOfData</Block>
            <Block id="C5">10</Block>
            <Block id="A6">11</Block>
            <Block id="B6">XorOfData</Block>
            <Block id="C6">12</Block>
            <Block id="A7">13</Block>
            <Block id="B7">14</Block>
            <Block id="C7">XorOfData</Block>
            <Block id="A8">15</Block>
            <Block id="B8">16</Block>
            <Block id="C8">XorOfData</Block>
            <Block id="A9">17</Block>
            <Block id="B9">18</Block>
            <Block id="C9">XorOfData</Block>
        </Table>
    </RAID>
</RAIDList>
```

Advanced RAID 5

The RAID layout is described in the **Working with Advanced RAID Layouts** topic.

```
<?xml version="1.0" encoding="UTF-8"?>
<RAIDList version="1">
    <RAID blockSize="524288" name="RAID_MacPro" rows="3" type="256">
        <Parents>
            <Parent name="RAID_MAC_ProDisk1.bin" fs="NTFS" offset="16777216" size="941359104" o
```

```
            <Parent name="RAID_MAC_ProDisk2.bin" offset="16777216" size="941359104" order='
            <Parent name="RAID_MAC_ProDisk3.bin" offset="16777216" size="941359104" order='
            <Parent name="RAID_MAC_ProDisk4.bin" offset="16777216" size="941359104" order='
        </Parents>
        <Table>
            <Block id="A1" sequence="1">XorOfData</Block>
            <Block id="B1">1</Block>
            <Block id="C1">2</Block>
            <Block id="D1" sequence="2">XorOfData</Block>
            <Block id="A2">3</Block>
            <Block id="B2">4</Block>
            <Block id="C2" sequence="3">XorOfData</Block>
            <Block id="D2">5</Block>
            <Block id="A3">6</Block>
            <Block id="B3" sequence="4">XorOfData</Block>
            <Block id="C3">7</Block>
            <Block id="D3">8</Block>
        </Table>
        <Sequences>
            <Sequence id="1">A1 B1 C1</Sequence>
            <Sequence id="2">D1 A2 B2</Sequence>
            <Sequence id="3">C2 D2 A3</Sequence>
            <Sequence id="4">B3 C3 D3</Sequence>
        </Sequences>
    </RAID>
</RAIDList>
```

RAID 6 Reed-Solomon (Left Synchronous (Standard)) Preset

The RAID layout is described in the **Working with RAID 6 Presets** topic.

```
<?xml version="1.0" encoding="UTF-8"?>
<RAIDList version="1">
    <RAID blockSize="65536" name="RAID6RS" rows="5" type="8" order="1" parityDelay="1">
        <Parents>
            <Parent name="img1.bin" size="941359104" order="1"/>
            <Parent name="img2.bin" fs="NTFS" size="941359104" order="2"/>
            <Parent name="img3.bin" size="941359104" order="3"/>
            <Parent name="img4.bin" size="941359104" order="4"/>
            <Parent name="img5.bin" size="941359104" order="5"/>
        </Parents>
    </RAID>
</RAIDList>
```

RAID6 (Double Xor) Preset

The RAID layout is described in the **Working with RAID 6 Presets** topic.

```
<?xml version="1.0" encoding="UTF-8"?>
<RAIDList version="1">
    <RAID blockSize="65536" name="RAID62X" rows="4" type="10" order="1" parityDelay="1">
        <Parents>
            <Parent name="RAID62X1.bin" fs="NTFS" size="941359104" order="1"/>
            <Parent name="RAID62X2.bin" size="941359104" order="2"/>
            <Parent name="RAID62X3.bin" size="941359104" order="3"/>
            <Parent name="RAID62X4.bin" size="941359104" order="4"/>
            <Parent name="RAID62X5.bin" size="941359104" order="5"/>
            <Parent name="RAID62X6.bin" size="941359104" order="6"/>
```

```
        </Parents>
    </RAID>
</RAIDList>
```

Advanced RAID 6

The RAID layout is described in the **Working with Advanced RAID Layouts** topic.

```
<?xml version="1.0" encoding="UTF-8"?>
<RAIDList version="1">
    <RAID blockSize="65536" name="RAID6Complex" rows="6" type="256">
        <Parents>
            <Parent name="img1.bin" size="941359104" order="1"/>
            <Parent name="img2.bin" fs="NTFS" size="941359104" order="2"/>
            <Parent name="img3.bin" size="941359104" order="3"/>
            <Parent name="img4.bin" size="941359104" order="4"/>
            <Parent name="img5.bin" size="941359104" order="5"/>
        </Parents>
        <Table>
            <Block id="A1">ReedSolomon</Block>
            <Block id="B1">1</Block>
            <Block id="C1">2</Block>
            <Block id="D1">3</Block>
            <Block id="E1">XorOfData</Block>
            <Block id="A2">4</Block>
            <Block id="B2">5</Block>
            <Block id="C2">6</Block>
            <Block id="D2">XorOfData</Block>
            <Block id="E2">ReedSolomon</Block>
            <Block id="A3">8</Block>
            <Block id="B3">9</Block>
            <Block id="C3">XorOfData</Block>
            <Block id="D3">ReedSolomon</Block>
            <Block id="E3">7</Block>
            <Block id="A4">12</Block>
            <Block id="B4">XorOfData</Block>
            <Block id="C4">ReedSolomon</Block>
            <Block id="D4">10</Block>
            <Block id="E4">11</Block>
            <Block id="A5">XorOfData</Block>
            <Block id="B5">ReedSolomon</Block>
            <Block id="C5">13</Block>
            <Block id="D5">14</Block>
            <Block id="E5">15</Block>
            <Block id="A6" sequence="1">XorOfAll</Block>
            <Block id="B6" sequence="2">XorOfAll</Block>
            <Block id="C6" sequence="3">XorOfAll</Block>
            <Block id="D6" sequence="4">XorOfAll</Block>
            <Block id="E6" sequence="5">XorOfAll</Block>
        </Table>
        <Sequences>
            <Sequence id="1">A1 A2 A3 A4 A5 A6</Sequence>
            <Sequence id="2">B1 B2 B3 B4 B5 B6</Sequence>
            <Sequence id="3">C1 C2 C3 C4 C5 C6</Sequence>
            <Sequence id="4">D1 D2 D3 D4 D5 D6</Sequence>
```

```
            <Sequence id="5">E1 E2 E3 E4 E5 E6</Sequence>
        </Sequences>
    </RAID>
</RAIDList>
```

RAID10 (1+0)

The RAID layout is described in the **RAID10 (1+0)** topic.

```
<?xml version="1.0" encoding="UTF-8"?>
<RAIDList version="1">
    <RAID blockSize="65536" name="RAID10" rows="1" type="2" order="7" parityDelay="1">
        <Parents>
            <Parent name="RAID10-1.bin" size="941359104" order="1"/>
            <Parent name="RAID10-2.bin" size="941359104" order="2"/>
            <Parent name="RAID10-3.bin" size="941359104" order="3"/>
            <Parent name="RAID10-4.bin" size="941359104" order="4"/>
        </Parents>
    </RAID>
</RAIDList>
```

RAID1E

The RAID layout is described in the **RAID1E** topic.

```
<?xml version="1.0" encoding="UTF-8"?>
<RAIDList version="1">
    <RAID blockSize="65536" name="RAID1E" rows="2" type="3" order="1" parityDelay="1">
        <Parents>
            <Parent name="RAID1EDisk1.bin" fs="NTFS" size="941359104" order="1"/>
            <Parent name="RAID1EDisk2.bin" size="941359104" order="2"/>
            <Parent name="RAID1EDisk3.bin" size="941359104" order="3"/>
        </Parents>
    </RAID>
</RAIDList>
```

RAID5E

The RAID layout is described in the **RAID5E** topic.

```
<?xml version="1.0" encoding="UTF-8"?>
<RAIDList version="1">
    <RAID blockSize="65536" name="RAID5E" rows="5" type="6" order="1" parityDelay="1">
        <Parents>
            <Parent name="RAID5EDisk1.bin" fs="NTFS" size="941359104" order="1"/>
            <Parent name="RAID5EDisk2.bin" size="941359104" order="2"/>
            <Parent name="RAID5EDisk3.bin" size="941359104" order="3"/>
            <Parent name="RAID5EDisk4.bin" size="941359104" order="4"/>
        </Parents>
    </RAID>
</RAIDList>
```

RAID5EE

The RAID layout is described in the **RAID5EE** topic.

```
<?xml version="1.0" encoding="UTF-8"?>
<RAIDList version="1">
    <RAID blockSize="65536" name="RAID5EE" rows="4" type="7" order="1" parityDelay="1">
        <Parents>
            <Parent name="RAID5EEDisk1.bin" fs="NTFS" size="941359104" order="1"/>
            <Parent name="RAID5EEDisk2.bin" size="941359104" order="2"/>
```

```
            <Parent name="RAID5EEDisk3.bin" size="941359104" order="3"/>
            <Parent name="RAID5EEDisk4.bin" fs="NTFS" size="941359104" order="4"/>
        </Parents>
    </RAID>
</RAIDList>
```

RAID6E

The RAID layout is described in the **RAID6E** topic.

```
<?xml version="1.0" encoding="UTF-8"?>
<RAIDList version="1">
    <RAID blockSize="65536" name="RAID6E" rows="7" type="9" order="1" parityDelay="1">
        <Parents>
            <Parent name="RAID6E1.bin" size="941359104" order="1"/>
            <Parent name="RAID6E2.bin" fs="NTFS" size="941359104" order="2"/>
            <Parent name="RAID6E3.bin" size="941359104" order="3"/>
            <Parent name="RAID6E4.bin" size="941359104" order="4"/>
            <Parent name="RAID6E5.bin" size="941359104" order="5"/>
            <Parent name="RAID6E6.bin" size="941359104" order="6"/>
        </Parents>
    </RAID>
</RAIDList>
```

2.4.12 Various Disk and Volume Managers

R-Studio can work with objects created by various disk and volume managers. Currently, the following managers are supported:

- **BitLocker Drive Encryption**
- **Windows Dynamic Disks**
- **Windows Storage Spaces**
- **Apple RAIDs**
- **Apple CoreStorage/FileVault/Fusion Drive Volumes**
- **Linux mdadm RAIDs**
- **Logical Volume Manager (LVM and LVM2)**

R-Studio can automatically recognize and add their physical components, component images, or the user can manually add the components when their data is damaged so severely that **R-Studio** cannot recognize them.

In addition, **R-Studio** can work with various virtual disk and disk image formats.

2.4.12.1 BitLocker Drive Encryption

BitLocker Drive Encryption, or **BitLocker**, is a data protection feature introduced by Microsoft since Windows Vista. It implements some hard/software measures to encrypt either USB external flash drives or internal system SSD/HDD devices. You may read more about **BitLocker Drive Encryption** on the Microsoft site or Wikipedia.

There are following encryption methods (protectors in the Microsoft terms) that can be utilized in the **BitLocker** protection:

- A TPM/TPM+PIN chip
- A USB key (a flash drive containing a .bek file)

- A user's password (not to confuse with a user's logon password) / recovery key

These methods can be used either individually or as a combination thereof. If they are used as a combination, knowing the decryption information for only one method is enough to unlock the device.

R-Studio can unlock devices encrypted with **BitLocker** provided that all the necessary information is known.

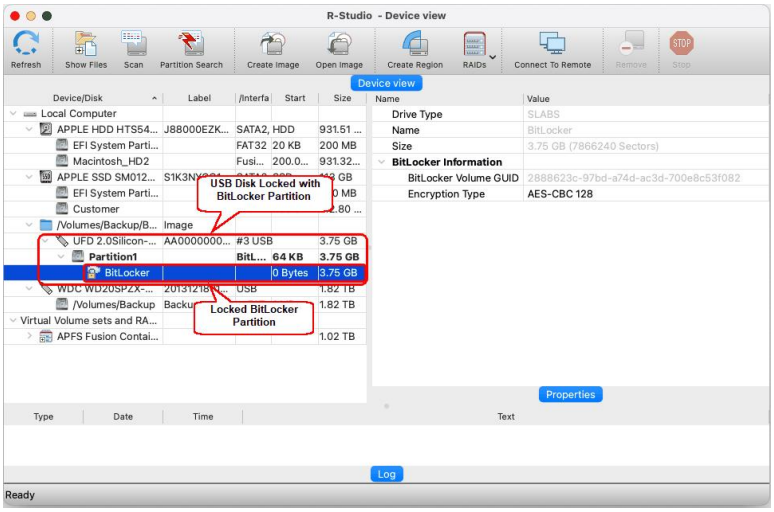
BitLocker ToGo

This is the method used to lock external removable devices. The password or a recovery key is necessary to know to unlock the device. A recovery key may be in the printed form or contained in a file. A name of such a file has the following pattern: `BitLocker Recovery Key 600397A9-48AA-4DE4-B775-C71EB130EA1B.txt`, where the last characters is the **BitLocker** volume identifier. That file contains the **BitLocker** volume identifier and a recovery key.

To unlock a BitLocker ToGo device,

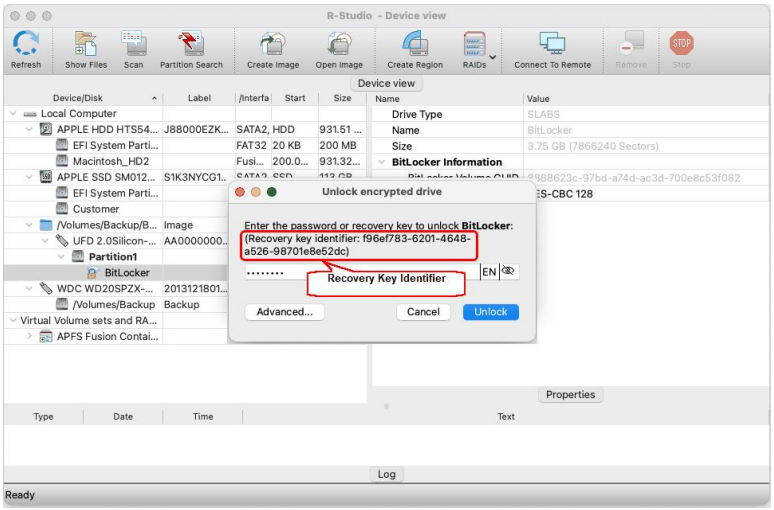
1 **Locate the device and double-click the BitLocker partition.**

BitLocker ToGo



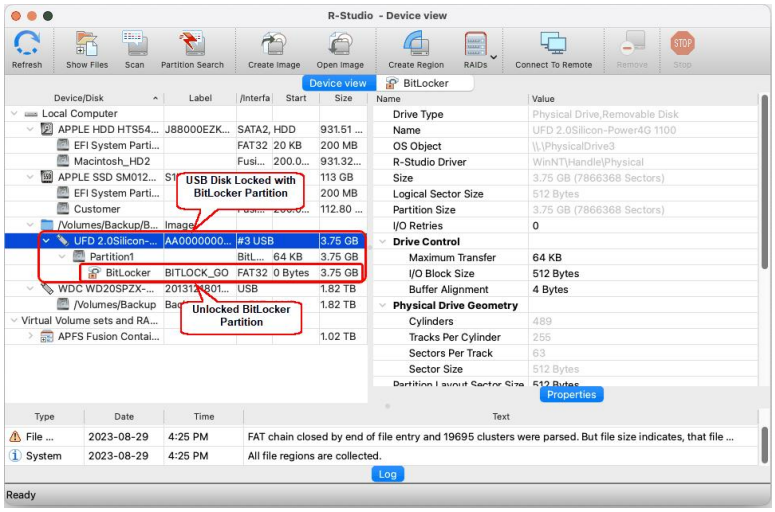
2 **Enter the password or recovery key and click the Unlock button.**

BitLocker ToGo



> **R-Studio will unlock the volume**

BitLocker ToGo



BitLocker System Drive Encryption

This is the method used to lock internal system drives.

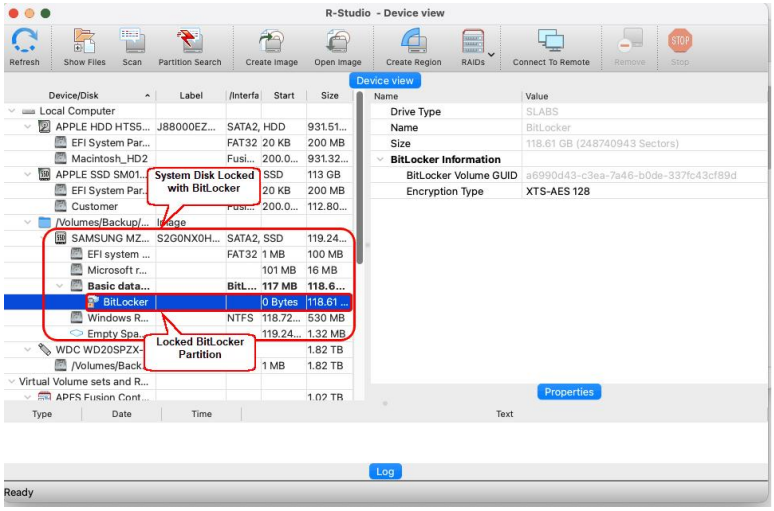
Depending on what methods are used, the following information is necessary to know to unlock the drive.

- A recovery key in the printed form or in a file. A name of such a file has the following pattern: `BitLocker Recovery Key FDA7B96C-635E-45AA-BE63-00C3DB3771EE.txt` , where the last characters is the **BitLocker** volume identifier. That file contains the **BitLocker** volume identifier and a recovery key.
- A password used to start the preboot process. It shouldn't be confused with the password for the user's logon.
- An external USB flash drive containing its `.bek` file. Note that Windows sets `System` and `Hidden` attributes for such files and Windows doesn't show such files by default.

To unlock a system drive with a BitLocker partition,

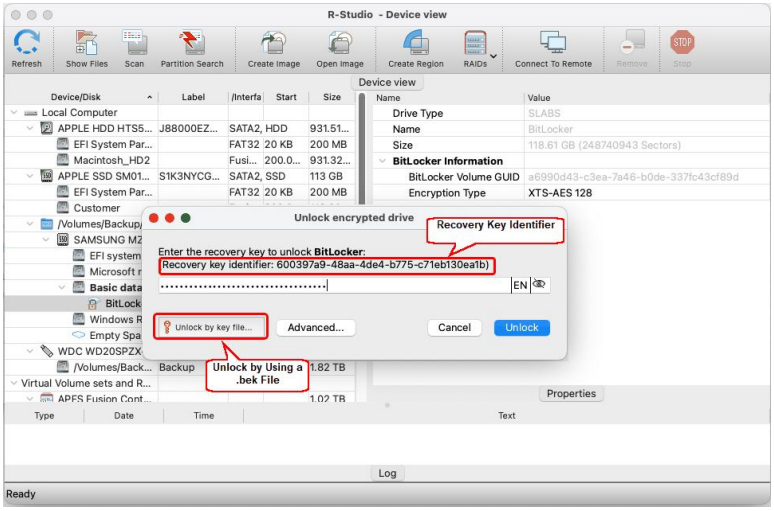
1 **Locate the device and double-click the BitLocker partition.**

BitLocker System Drive Encryption



2 **Enter the password or recovery key and click the Unlock button.**

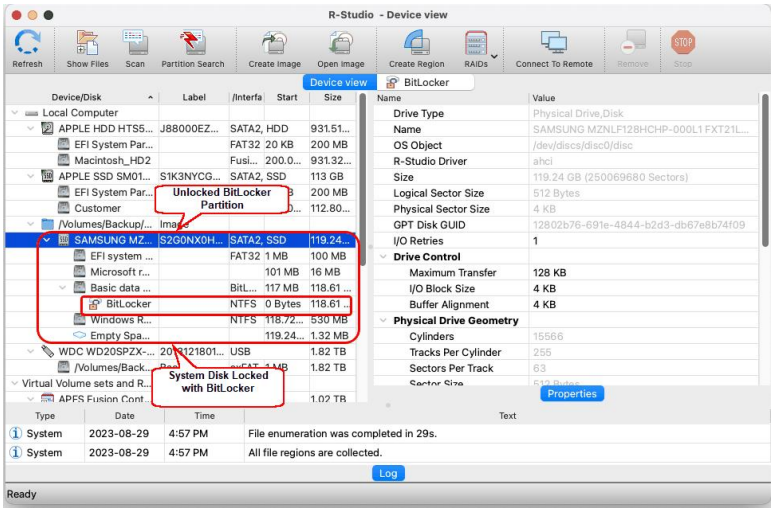
BitLocker System Drive Encryption



If you have the `.bec` file, click the **Unlock by key file** button and load the file.

> **R-Studio will unlock the volume**

BitLocker System Drive Encryption



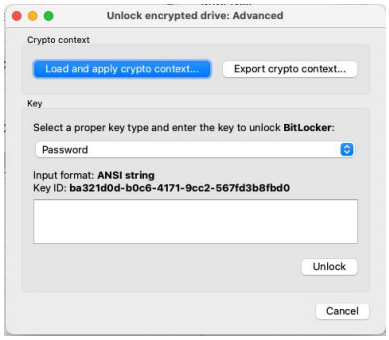
TPM/TPM+PIN modes

Only in registered **R-Studio Technician/T80+** versions.

If only the TPM/TPM+PIN hardware was used to encrypt the partition, you must have either the FVEK (Full Volume Encryption Key) or VMK (Volume Master Key) data. Obtaining these keys is a very hard task, only quite advanced forensic professionals can do that using specialized hardware. Sometimes it may be possible to extract a FVEK from memory dumps and/or hibernation files, but this is still not a trivial process.

If you have FVEK or VMK data, click the **Advanced** button, select the key type of the data, enter the key or load a file with the key.

BitLocker TPM/TPM+PIN modes



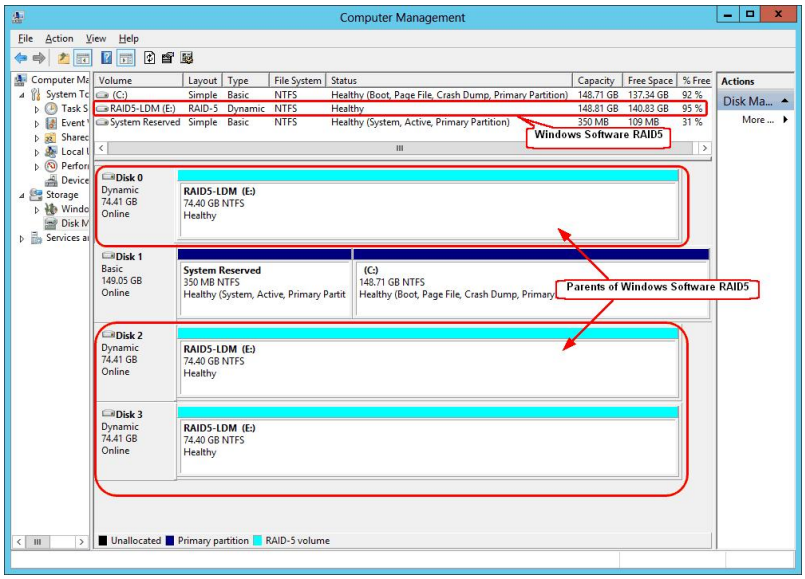
R-Studio will unlock the volume.

You may also save and load encryption information from a BitLocker Encryption volume.

2.4.12.2 Windows Dynamic Disks

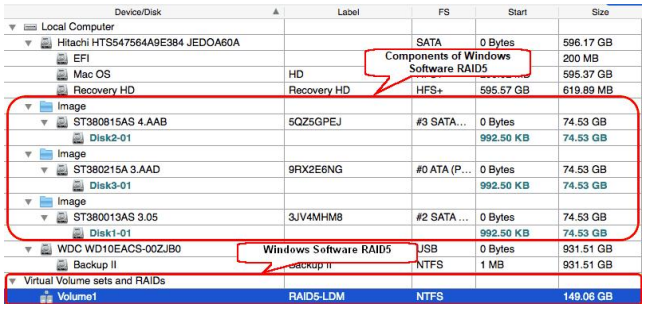
R-Studio supports dynamic disks, including Windows software RAIDs, mirrors, and spanned volumes. When **R-Studio** detects components from such dynamic disks, it assembles them accordingly.

Windows dynamic disks (RAID5)



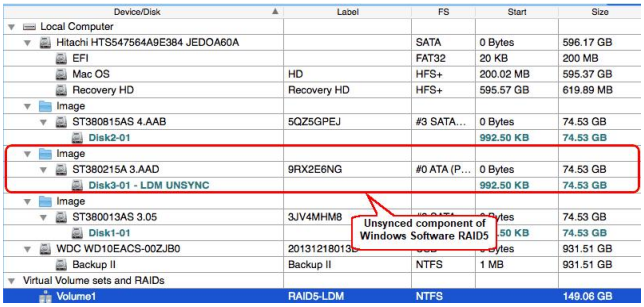
R-Studio automatically detects components form dynamic disks and creates those dynamic disks automatically. At the same time, **R-Studio** gives access to the parents of the dynamic disks (hard drives and images).

Windows dynamic disks (RAID5) in R-Studio for Mac



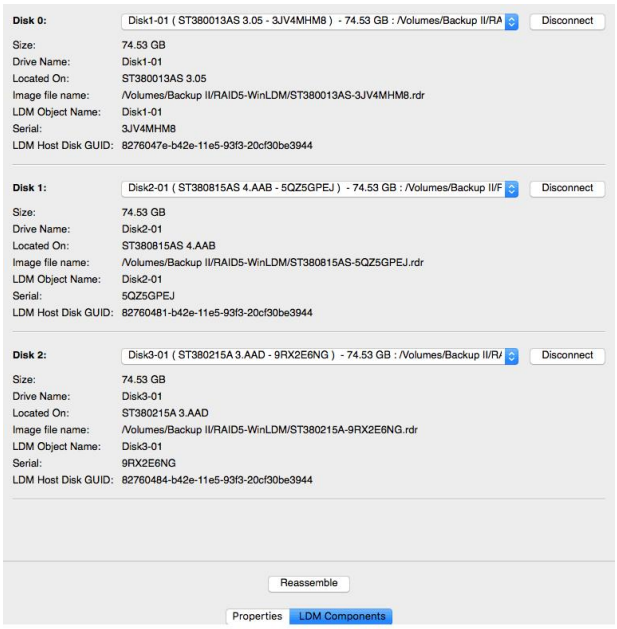
Also, **R-Studio** automatically detects inconsistent components of dynamic disks and marks them accordingly.

Windows dynamic disks (RAID5) with unsynced parent



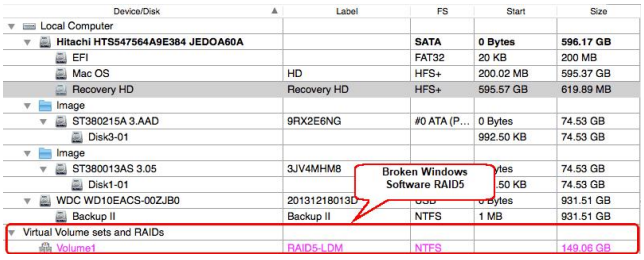
R-Studio shows the components of the selected dynamic disk on its LDM Components tab.

LDM Components **tab**



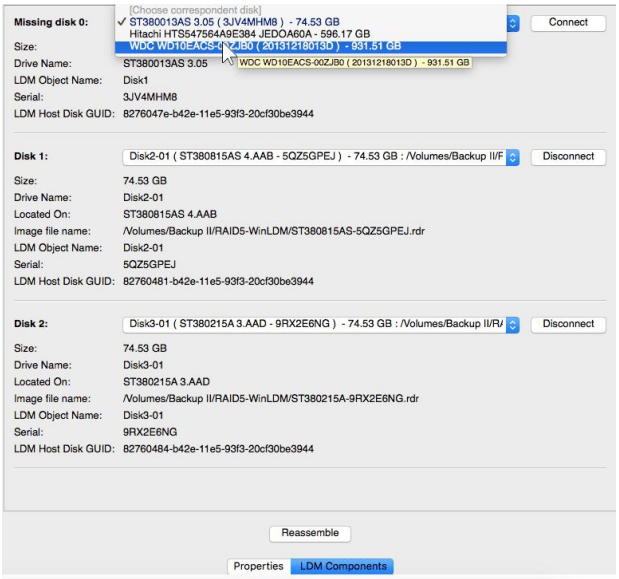
R-Studio shows broken dynamic disks in pink.

Broken dynamic disks in R-Studio



The LDM Components tab also allows you to manually disconnect or connect the components, for example, if they are such damaged that **R-Studio** cannot recognize them as parts of a broken dynamic disk. Select the object from the drop-down box and click the **Connect** button. **R-Studio** displays the objects it recognizes as the components of the dynamic disk in blue.

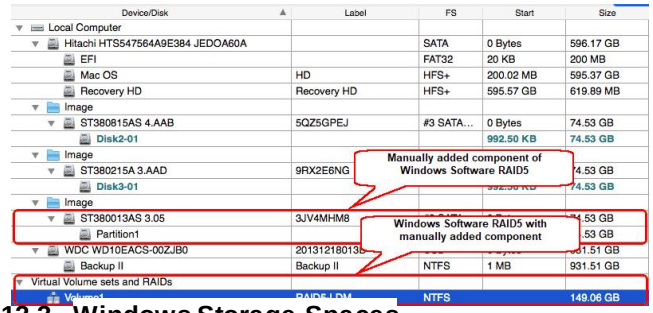
Adding a component manually



You may immediately switch to the dynamic disk configuration that **R-Studio** believes most probable by clicking the **Reassemble** button.

R-Studio shows dynamic disks with manually added components in blue:

Dynamic disks with added components in R-Studio



2.4.12.3 Windows Storage Spaces

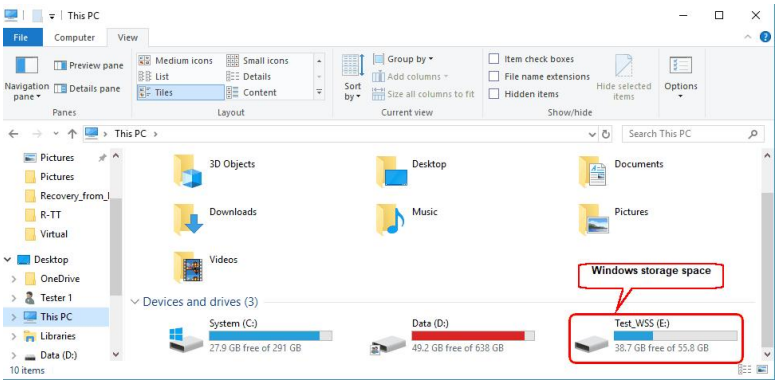
Windows storage spaces is a new storage technology, introduced in Windows 8 and Windows Server 2012, that allows the user to combine various (not always similar) hard drives into a kind of a RAID or compound volume. First, the hard drives are combined into a storage pool, then several storage spaces with striping (similar to RAID0), mirroring (similar to RAID1), and parity (similar to RAID5) can be created in that storage pool. You may read more about storage pools and spaces in the Microsoft's Storage Spaces: FAQ

When drives from a storage pool are connected to a Windows computer, it automatically detects them and assembles storage spaces accordingly.

R-Studio supports Windows Storage Spaces created by Windows 8/8.1 and Windows 10/Threshold 2/Anniversary/Fall Creators updates.

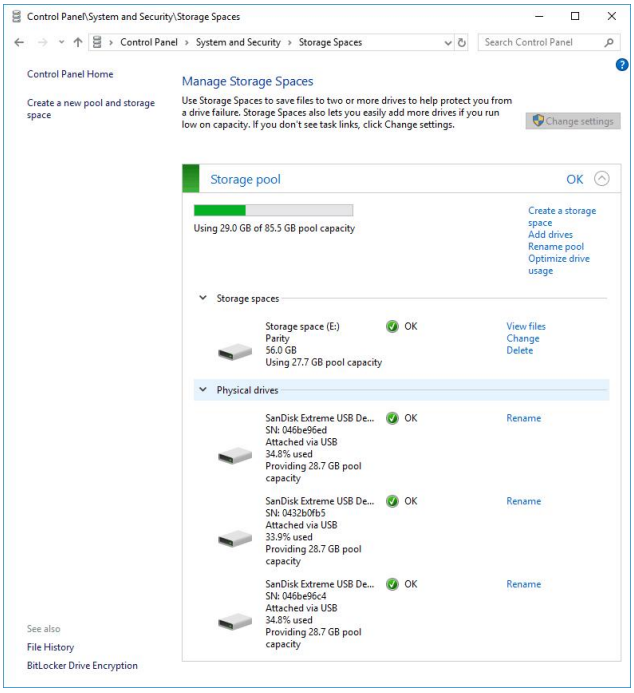
When Windows storage spaces use caching, **R-Studio** can process both the cache and the storage space itself simultaneously greatly increasing chances for successful recovery of deleted files. For SSD (Solid State Device) media, bypassing the cache may be the only available option to recover lost files.

Storage spaces in Windows



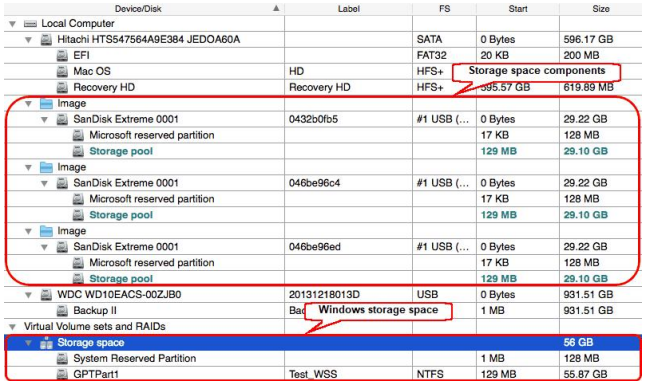
Storage pools and spaces can be managed using the **Storage Spaces** item in the **Windows Control Panel**.

Storage spaces in Windows



R-Studio detects disks (or their images) from storage pools and creates storage pools and spaces automatically. At the same time, **R-Studio** gives access to the parents of the storage spaces (hard drives and images)

Storage spaces in R-Studio

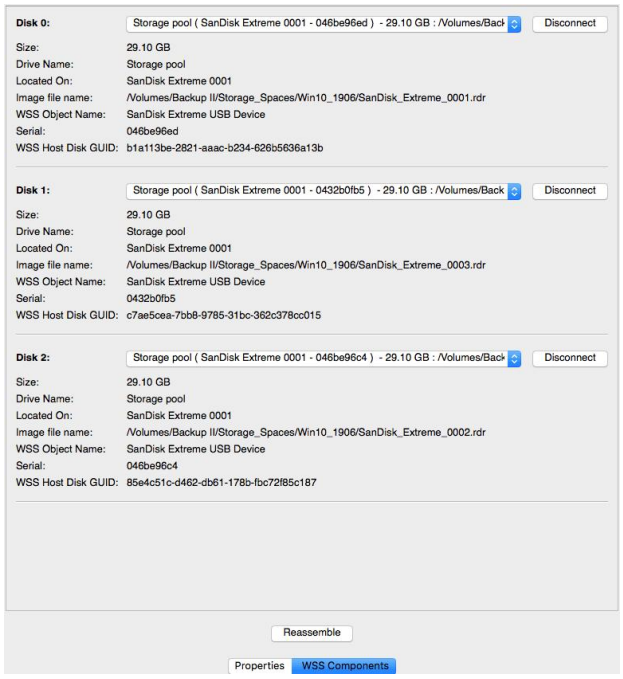


If recognized parents of a storage space, including disk images, are added to **R-Studio** later, it automatically adds them to their respective storage space.

When an automatically created storage space is selected, **R-Studio** highlights its components.

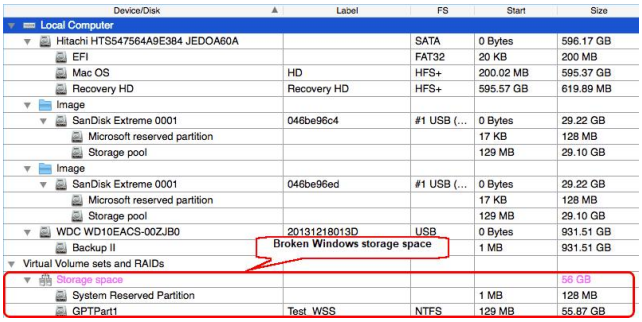
R-Studio shows the components of the selected storage space on its WSS Components tab.

WSS Components **tab**



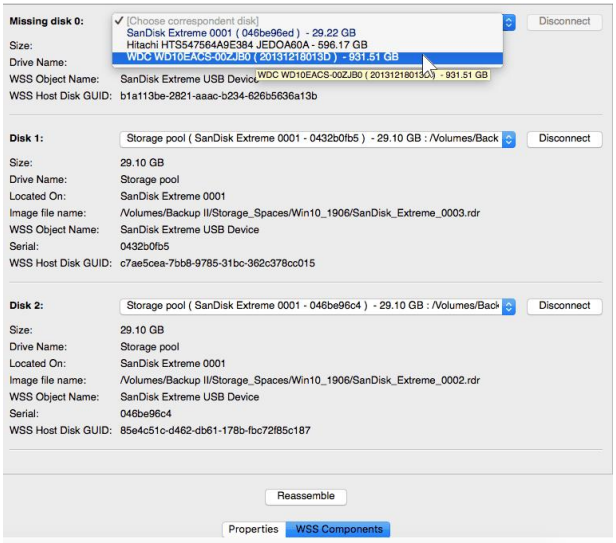
R-Studio shows broken storage spaces in pink.

Broken storage spaces in R-Studio



The WSS Components tab also allows you to manually disconnect or connect the components, for example, if they are such damaged that **R-Studio** cannot recognize them as parts of a broken storage space. Select the object from the drop-down box and click the **Connect** button. **R-Studio** displays the objects it recognizes as the components of the storage space in blue.

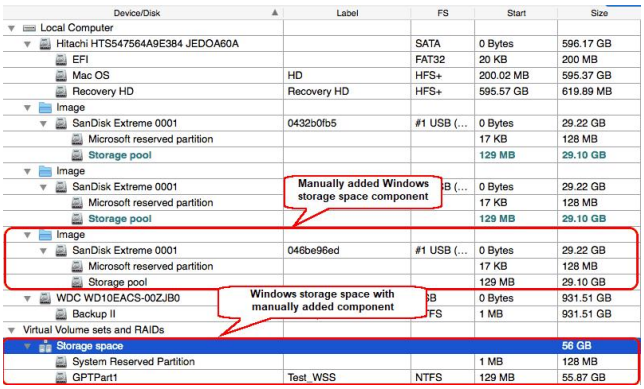
Adding a component manually



You may immediately switch to the storage space configuration that **R-Studio** believes most probable by clicking the **Reassemble** button.

R-Studio shows such storage spaces in blue:

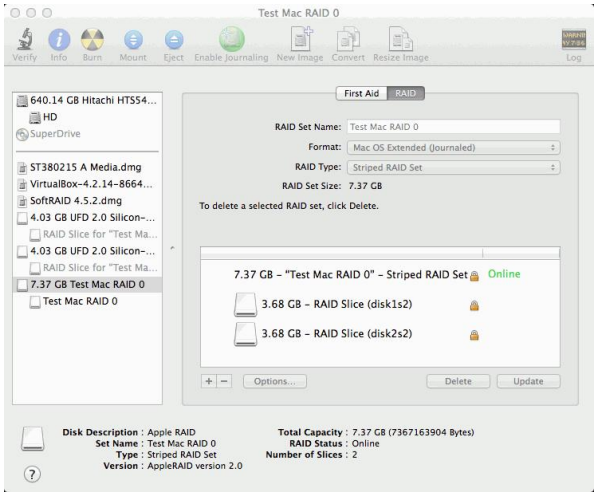
Storage spaces with added parents in R-Studio



2.4.12.4 Apple RAIDs

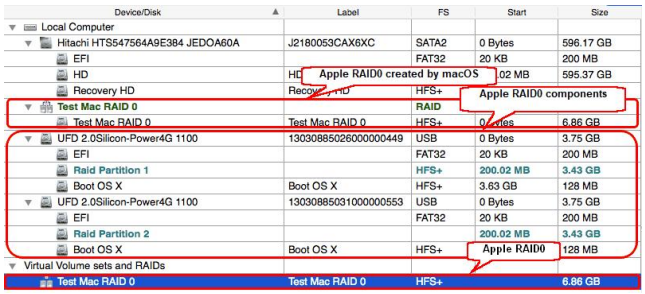
macOS can create several software RAIDs from disks connected to a Mac computer: RAID1 (Mirror set), RAID0 (Stripe set), and Concatenated disk set.

Apple RAID0 example



R-Studio detects components of Apple RAID sets and creates their virtual RAIDs automatically. At the same time, **R-Studio** gives access to the individual components of the Apple RAID sets (hard drives and images).

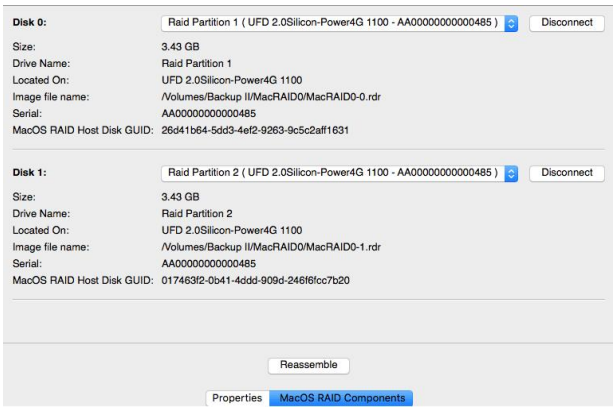
Apple RAIDs in R-Studio



When an automatically created Apple RAID is selected, **R-Studio** highlights its components. It also highlights the Apple RAID that macOS may itself create from the same components.

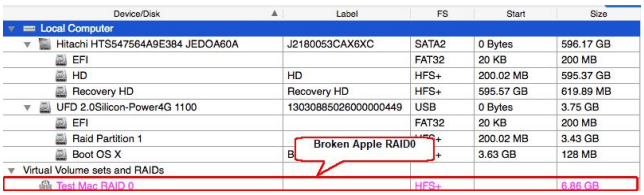
R-Studio shows the components of the Apple RAID on its MacOS Components tab.

MacOS Components **tab**



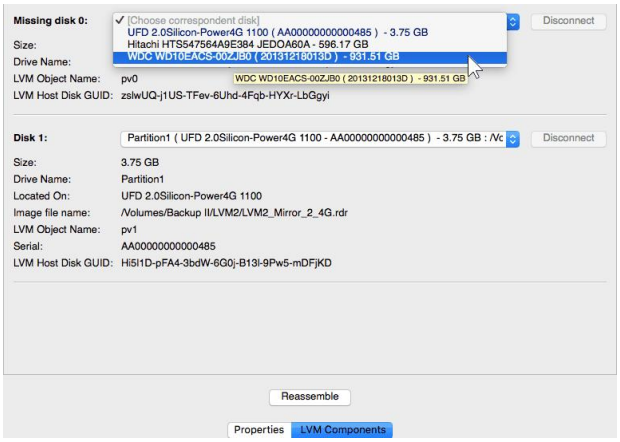
R-Studio shows broken Apple RAIDs in pink.

Broken Apple RAIDs in R-Studio



The MacOS Components tab also allows you to manually disconnect or connect the components, for example, if they are such damaged that **R-Studio** cannot recognize them as parts of a broken Apple RAID. Select the object from the drop-down box and click the **Connect** button. **R-Studio** displays the objects it recognizes as the components of the Apple RAID in blue.

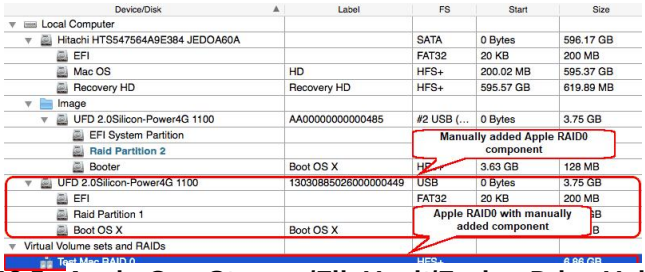
Adding a component manually



You may immediately switch to the Apple RAID configuration that **R-Studio** believes most probable by clicking the **Reassemble** button.

R-Studio shows Apple RAIDs with manually added components in blue:

Apple RAIDs with added members in R-Studio



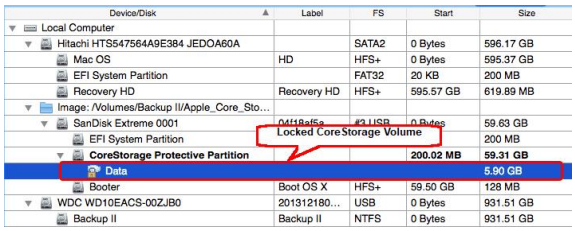
2.4.12.5 Apple CoreStorage/FileVault/Fusion Drive Volumes

The macOS operating system has the following disk management systems:
FileVault, is a disk encrypted utility;
Fusion Drive is an Apple's hybrid drive technology;
CoreStorage is a logical volume management system.

R-Studio supports all these technologies and can unlock their encrypted volumes (hard drives and images) using either their passwords or recovery keys.

CoreStorage/FileVault

Locked CoreStorage Volume in R-Studio

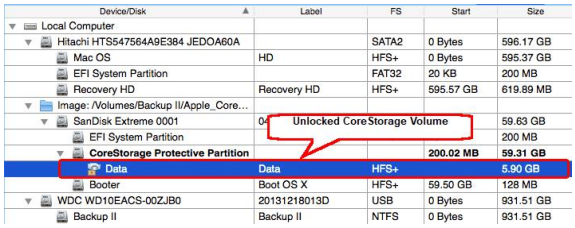


To unlock the volume

1. **Control-click the encrypted volume and select Unlock encrypted drive on the contextual menu.**
2. **Enter the password/recovery key on the Unlock encrypted drive dialog box**

> **R-Studio will unlock the volume**

Unlocked CoreStorage Volume in R-Studio



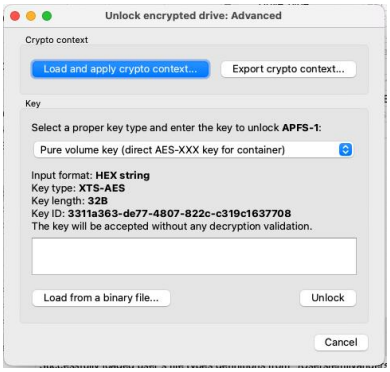
If the volume is partially encrypted, **R-Studio** can recognize which part is encrypted and which isn't. It will provide a correct access to the unencrypted and encrypted parts of the volume, provided that the correct password is entered.

Partially encrypted volume

R-Studio Technician/T80+

In addition to the password, it's possible to enter other decryption data. Click the **Advanced...** button and enter available data.

Unlock encrypted drive: Advanced



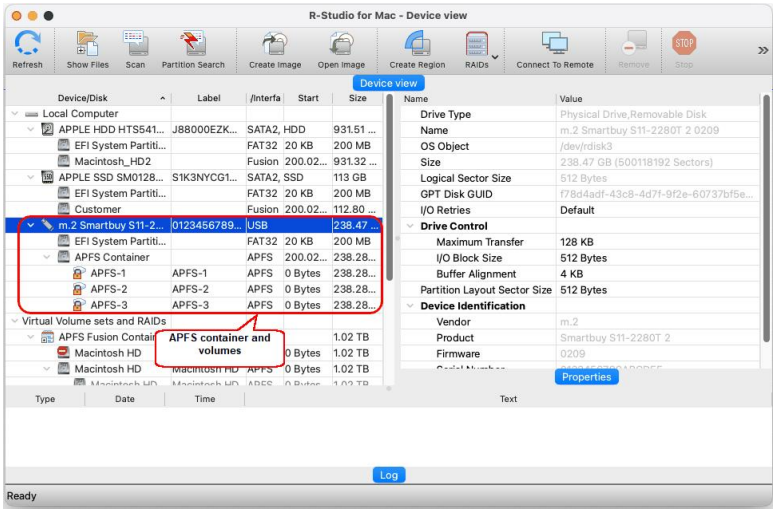
This data is usually very hard to obtain and only very advanced institutions can recover it from actual hardware.

Data recovery from deleted or damaged APFS volumes

When macos deletes an APFS volumes, it also wipes out all decryption information from its APFS container. In this case even knowing the password won't help. Still, there's a trick that may help to open a deleted or damaged encrypted volume.

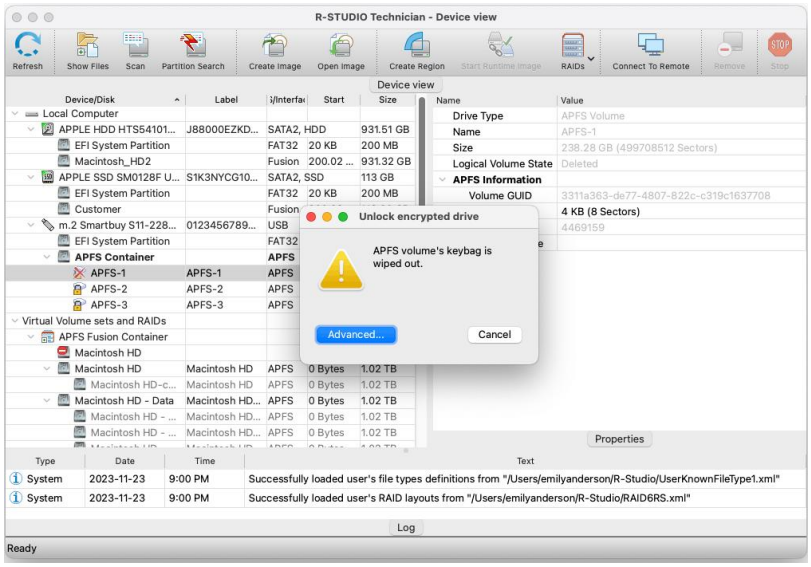
Let's us have a hard drive with an APFS container with 3 APFS volumes:

APFS container and its volumes



One of them has been deleted and **R-Studio** cannot unlock (decrypt) it:

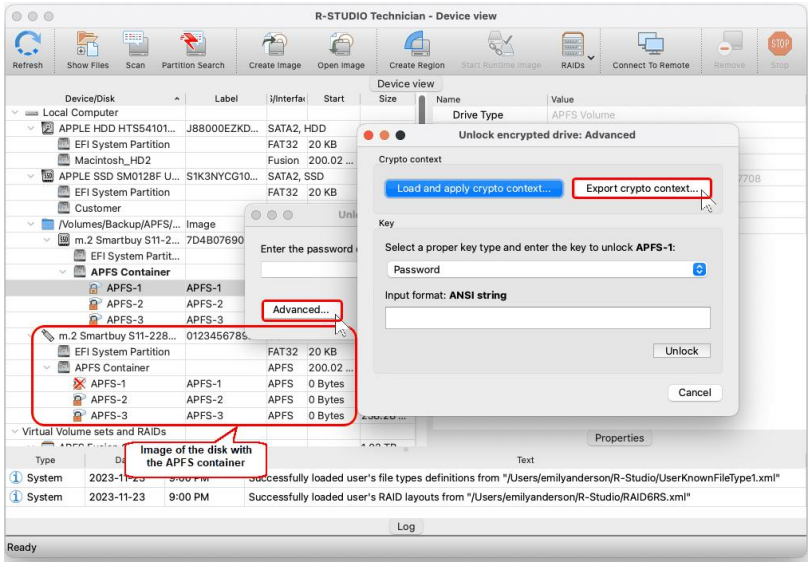
APFS container with a deleted APFS volume



But if we have an image of the disk's previous state, we can extract the necessary encryption information from that image.

Load the image and double-click the existing volume. Click the **Advanced...** button instead of entering its password.

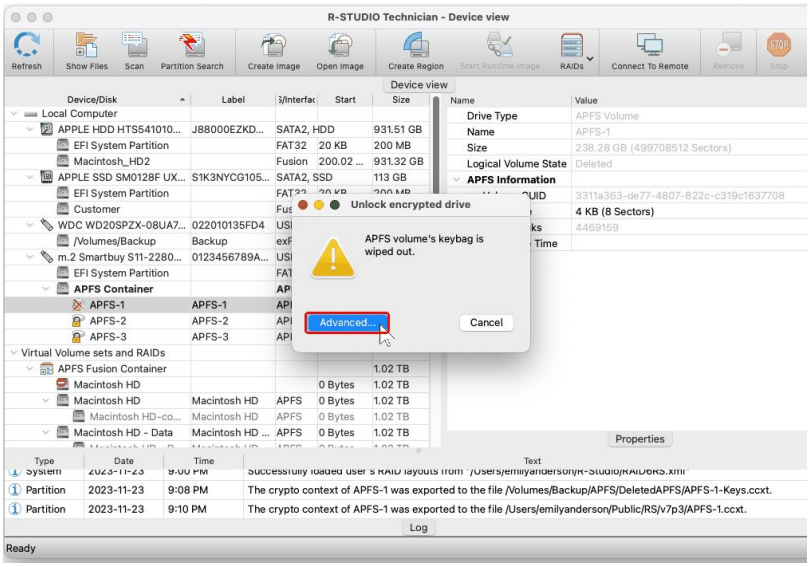
Export of encryption information



Click the **Export crypto context...** button and save a file with this information. Then click the **Close Image** button to unload the image.

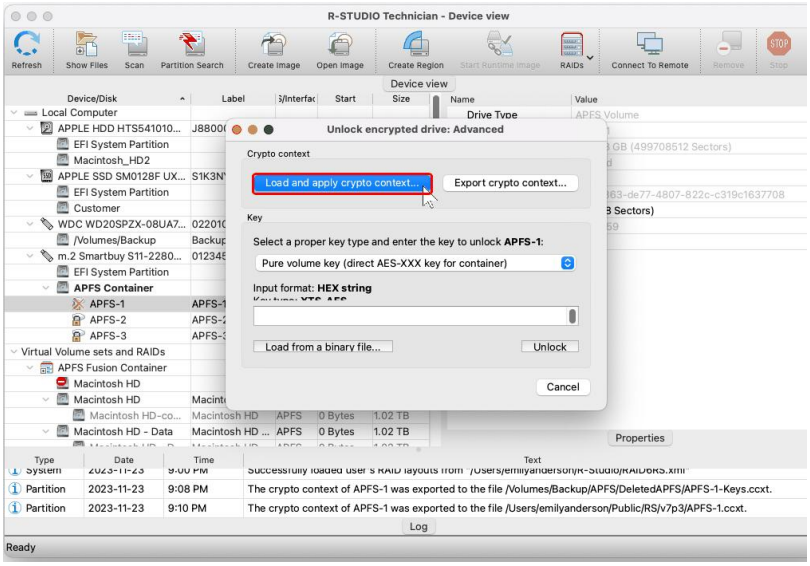
Then double-click the APFS-1 volume and click the **Advanced** button.

APFS container with a deleted APFS volume



Click the **Load and apply crypto context...** button

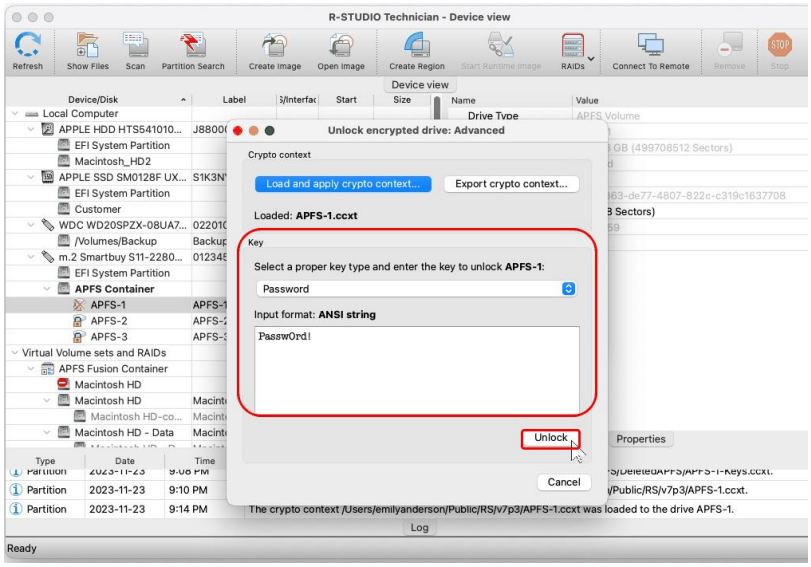
Loading the encryption information



and load the file generated from the image.

Select the required information type (a password for our case), enter the data, and click the **Unlock** button.

Unlocking the APFS volume



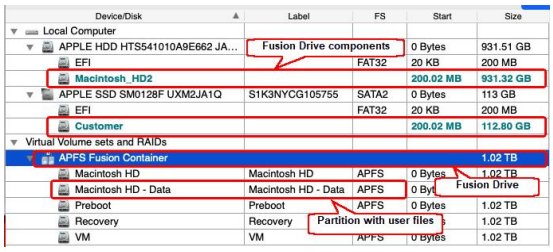
Note that the password will be explicitly shown.

R-Studio will open files on the volume.

Apple Fusion Drive (with installed macOS)

R-Studio detects components of Apple Fusion Drive and creates virtual Fusion Drives automatically. At the same time, **R-Studio** gives access to the individual components of the Fusion Drives (hard drives and images).

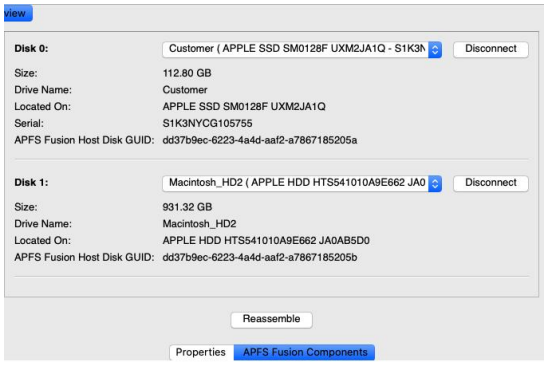
Fusion Drive in R-Studio



When an automatically created Fusion Drive is selected, **R-Studio** highlights its components.

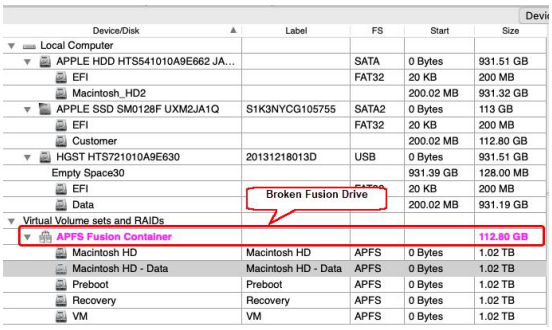
R-Studio shows the components of the Fusion Drive on its APFS Fusion Components tab.

Fusion Drive Components **tab**



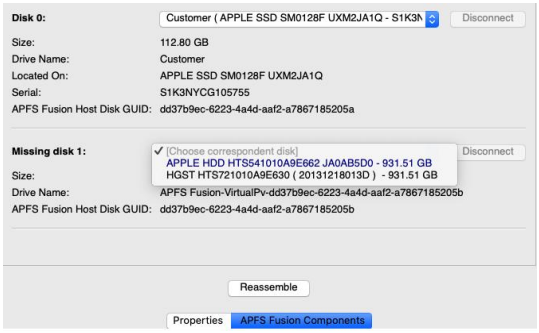
R-Studio shows broken Fusion Drive s in pink.

Broken Fusion Drive in R-Studio



The Fusion Drive Components tab also allows you to manually disconnect or connect the components, for example, if they are such damaged that **R-Studio** cannot recognize them as parts of a broken Fusion Drive. Select the object from the drop-down box and click the **Connect** button. **R-Studio** displays the objects it recognizes as the components of the Fusion Drive in blue.

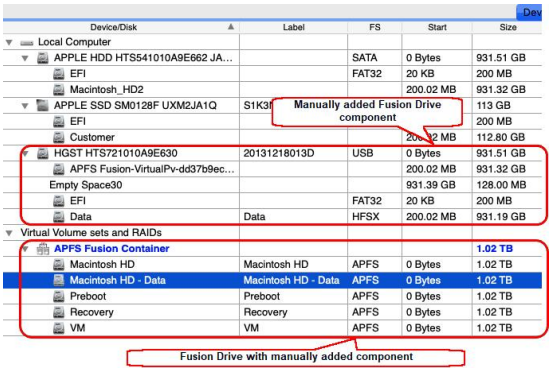
Adding a component manually



You may immediately switch to the Fusion Drive configuration that **R-Studio** believes most probable by clicking the **Reassemble** button.

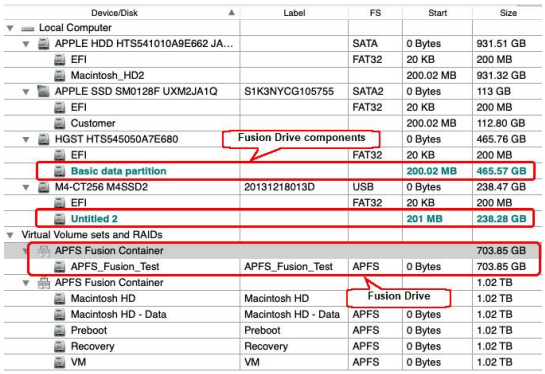
R-Studio shows Fusion Drive with manually added components in blue:

Fusion Drive with added members in R-Studio



Apple Fusion Drive (without installed macOS)

Fusion Drive in R-Studio



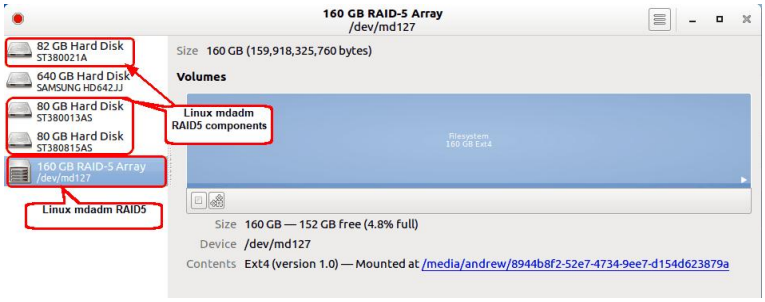
When an automatically created Fusion Drive is selected, **R-Studio** highlights its components.

2.4.12.6 Linux mdadm RAIDs

mdadm is a Linux utility used to manage and monitor software RAID devices.

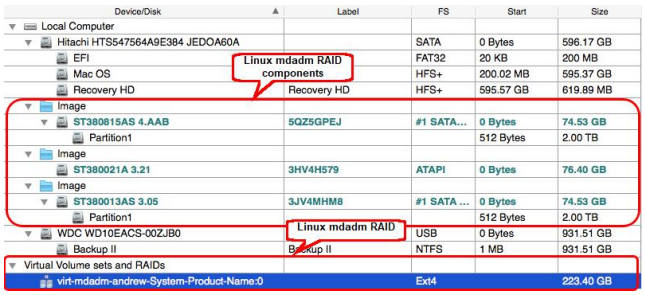
R-Studio supports such devices and when drives from a mdadm RAID are connected to a Mac computer, it automatically detects them and assembles mdadm RAIDs accordingly.

Linux mdadm RAIDs



R-Studio detects components from mdadm RAIDs and creates those RAIDs automatically. At the same time, **R-Studio** gives access to the components of those RAIDs (hard drives and images).

mdadm RAIDs in R-Studio

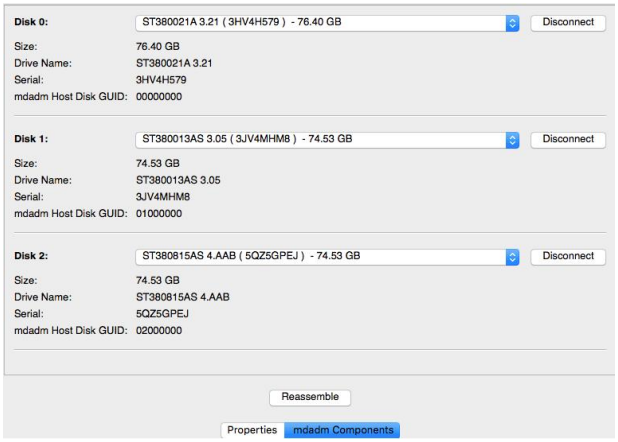


If recognized components of a mdadm RAID, including disk images, are added to **R-Studio** later, it automatically adds them to their respective mdadm RAID.

When an automatically created mdadm RAID is selected, **R-Studio** highlights its components.

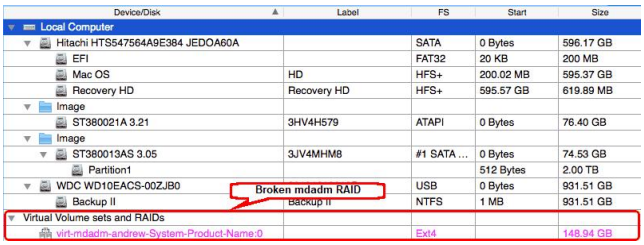
R-Studio shows the components of the mdadm RAIDs on its mdadm Components tab.

mdadm Components **tab**



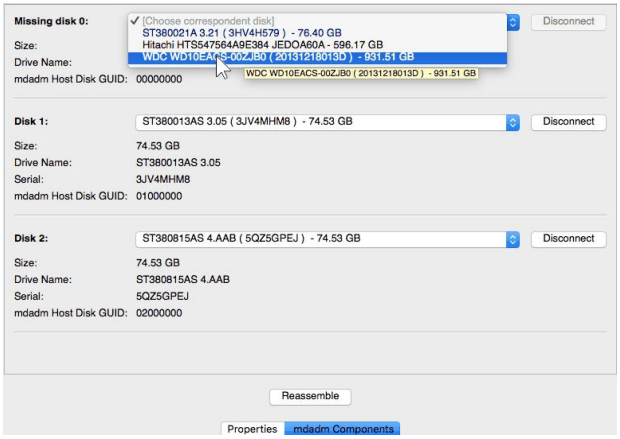
R-Studio shows broken mdadm RAIDs in pink.

Broken mdamd RAIDs in R-Studio



The mdadm Components tab also allows you to manually disconnect or connect the components, for example, if they are such damaged that **R-Studio** cannot recognize them as parts of a broken mdadm RAID. Select the object from the drop-down box and click the **Connect** button. **R-Studio** displays the objects it recognizes as the components of the mdadm RAID in blue.

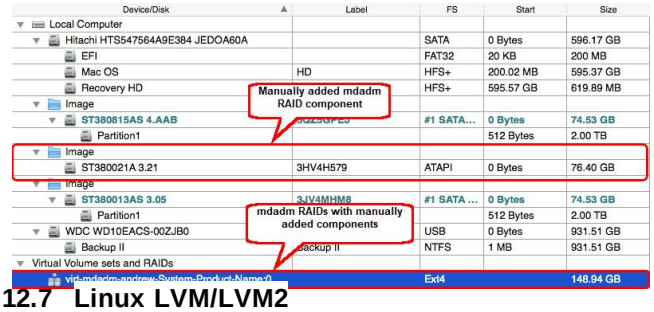
Adding a component manually



You may immediately switch to the mdadm RAID configuration that **R-Studio** believes most probable by clicking the **Reassemble** button.

R-Studio shows such mdadm RAIDs in blue:

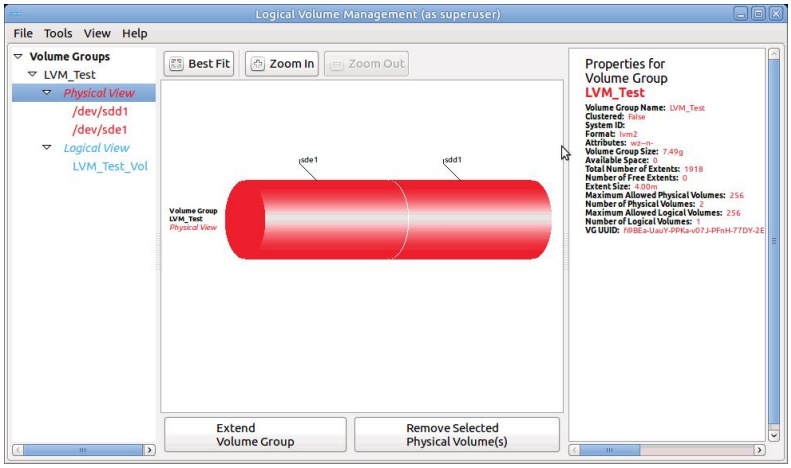
mdadm RAIDs with added components in R-Studio



2.4.12.7 Linux LVM/LVM2

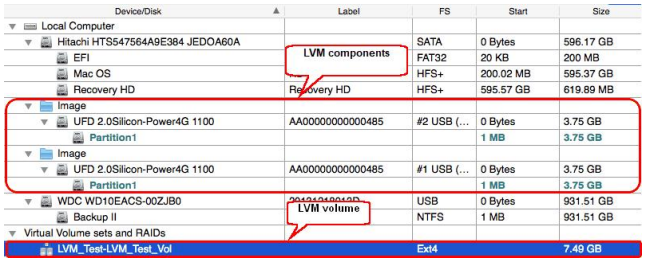
Linux LVM is a logical volume manager for the Linux OS that manages disk drives and other data storage devices. Using it, It is possible to create single logical volumes on several physical disks, add and replace them in a running system, resize logical volumes, create various RAID configuration, and so on. You may read more about Linux LVM in our article: What is Logical Volume Manager (LVM).

LVM volume example



R-Studio automatically detects disks from LVMs and creates their virtual volumes automatically. At the same time, **R-Studio** gives access to the components of the virtual LVM volumes (hard drives and images).

LVM Volumes in R-Studio

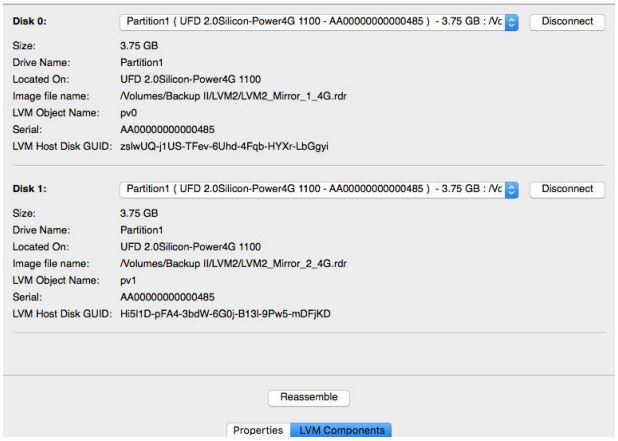


If recognized components of an LVM volume, including disk images, are added to **R-Studio** later, it automatically adds them to their respective LVM volume.

When an automatically created LVM volume is selected, **R-Studio** highlights its components.

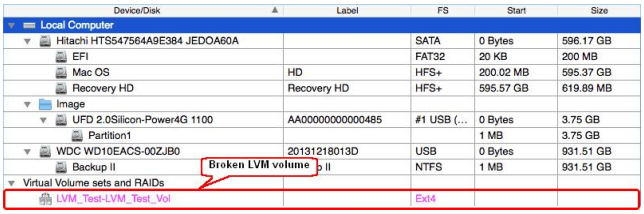
R-Studio shows the components of the LVM volume on its LVM Components tab.

LVM Components **tab**



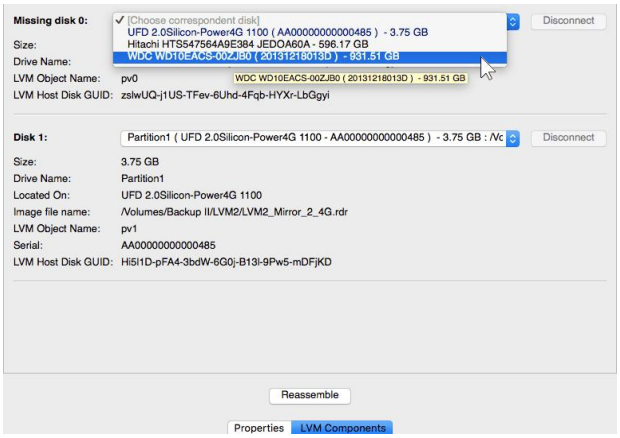
R-Studio shows broken virtual LVM volumes in pink.

Broken LVM volumes in R-Studio



The LVM Components tab also allows you to manually disconnect or connect the components, for example, if they are such damaged that **R-Studio** cannot recognize them as parts of a broken LVM volume. Select the object from the drop-down box and click the **Connect** button. **R-Studio** displays the objects it recognizes as the components of the LVM volume in blue.

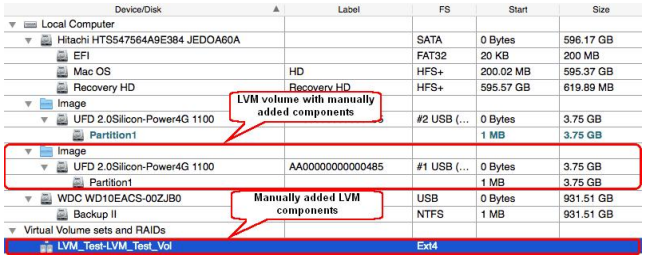
Adding a component manually



You may immediately switch to the LVM volume configuration that **R-Studio** believes most probable by clicking the **Reassemble** button.

R-Studio shows such virtual LVM volumes in blue:

LVM volumes with added components in R-Studio



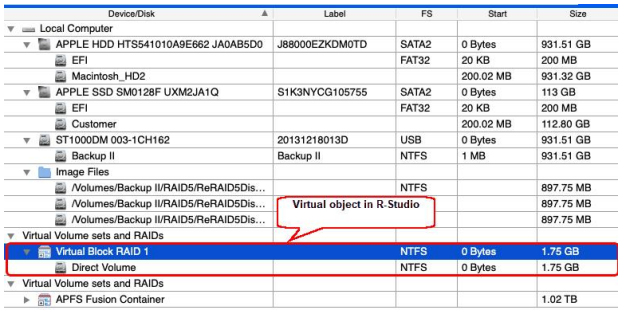
2.4.13 Connecting Virtual Objects to the System as Virtual Drives

Technician version only.

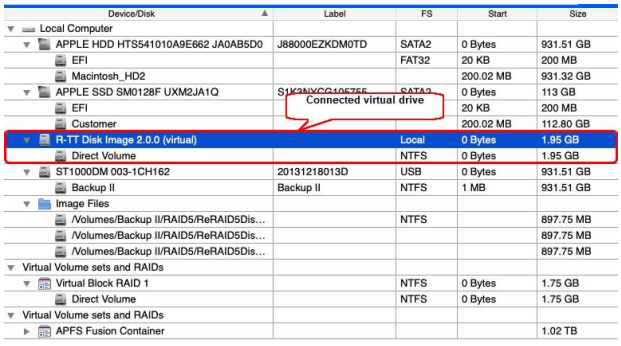
Virtual objects created in the Device view pane of **R-Studio** can be connected to the system as read-only virtual drives. Such virtual drives become accessible to the system and to other programs. Moreover, such virtual drives remain connected after **R-Studio** has been closed.

To connect a virtual object as a read-only virtual drive to the system

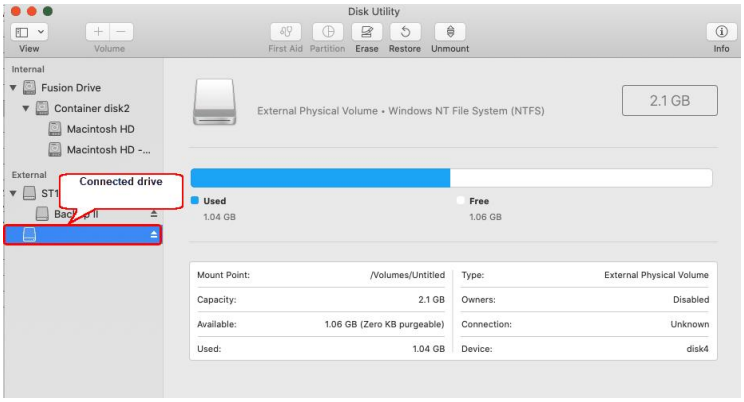
1 Control-click the virtual object and select Mount on the contextual menu.



> A read-only virtual drive will appear on the Drives **panel**



And in the system (Disk Utility) as a physical drive



And this virtual disk becomes accessible to the system and other programs.

To disconnect a virtual drive

1 Control-click the virtual drive on the Drives **panel and select Unmount on the contextual menu.**

2.5 Data Recovery over Network

This chapter explains how to perform data recovery operations over network.

R-Studio has network capabilities that allow the system administrator, using its computer, to recover files on any computers accessible over network.

R-Studio supports the TCP/IP protocol and any protocol supported in Microsoft Network.

R-Studio Agent must be installed on computers where files are to be recovered. This free service program gives **R-Studio** access to local disks on remote computers over network.

You should always disable a firewall and/or antivirus software on the both computers. As an alternative, advanced users may tune them to allow **R-Studio** and ***R-Studio Agent*** to communicate via network.

All data transmitted over network are encrypted with a strong algorithm for data security. Restoring data over network is very much the same as that on a local computer.

- **R-Studio Agent**
- **Data Recovery over Network**
- **Connecting over the Internet**

2.5.1 R-Studio Agent

R-Studio Agent is a program that provides **R-Studio** with an access to the drives of a network computer. It should be installed and properly registered on the computer which drives are to be accessed. ***R-Studio Agent*** has versions for the following PC operating systems:

- **Mac OS**
- **Windows**
- **Linux**

and there is **R-Studio Agent Emergency** that can be used to start a computer from which you are going to recover data that cannot start other way due to a file system crash, for example. Please, note that you need to use **R-Studio Emergency** as an emergency agent if you want to start a Mac computer.

R-Studio can work equally with all versions of ***R-Studio Agent*** and access computers run under Windows, Mac OS, and Linux.

You must have enough rights on the remote computer to install and run ***R-Studio Agent***.

2.5.1.1 R-Studio Agent for Mac

You need to have an administrative account on the Mac computer to start **R-Studio Agent for Mac**.

R-Studio Agent should be installed on a network computer to enable **R-Studio** access to its drives. **R-Studio Agent** should be registered.

If, due to file system crash, the network computer where you are going to recover your data cannot start, you may use **R-Studio Agent Emergency** to start the computer.

To start the R-Studio Agent for Mac and access its main panel,

1 **Go to the Application folder, double-click R-Studio Agent for Mac, and enter the account password**

> **The main panel will appear. You may view its log**

R-Studio Agent for Mac main panel

To configure R-Studio Agent,

1 **Select Preferences on the R-Studio Agent menu**

2 **Specify required parameters on the** R-Studio Agent Preferences **dialog box and click the OK button**

R-Studio Agent Preferences **dialog box**

R-Studio Agent Preferences

Password:	Enter a password to obtain access to this computer from a network.
Re-Enter:	Re-enter the password.
Incoming connection preferences	
Enable incoming connections	If this option is selected, **R-Studio Agent** will accept incoming connections.
Port	port for incoming connections
Accepted IP Addresses	
IP Address	specifies addresses from which this computer can be accessed.
Subnet Mask	specifies subnet mask of the network from which this computer can be accessed.

> **R-Studio Agent will now run with the specified parameters**

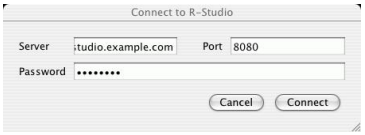
Connecting from R-Studio Agent for Mac to R-Studio.

To establish a connection from R-Studio Agent for Mac to R-Studio,

1 **Run the R-Studio Agent for Mac and select Connect from the Tools menu**

2 **Enter the necessary information on the** Connect to R-Studio **dialog box and click the Connect button.**

Connect to R-Studio **dialog box**



Connect to R-Studio settings

Server	Specify the DNS name or IP address of the host where **R-Studio** is running.
Port	Specify the port set on the **R-Studio** Connect to Remote Computer dialog box.
Password	Specify the password set on the **R-Studio** Connect to Remote Computer dialog box.

> **R-Studio Agent for Mac will connect to the computer where R-Studio is running and it will show the hard drive and logical disk structure of the remote computer.**way as that on a local computer.

2.5.1.2 R-Studio Agent for Windows

Attention Windows NT/2000/XP/2003/Vista/2008/7/8/8.1/10 users: R-Studio Agent should be installed under an administrator account.

When installed, ***R-Studio Agent*** starts automatically and runs as a service. To configure it, ***R-Studio Agent*** should be started again manually.

The following switches are available:

-?	evokes a help screen;
-install	installs ***R-Studio Agent*** as a service
-remove	removes ***R-Studio Agent*** services
-console	starts ***R-Studio Agent*** as a console application

Started without a switch, ***R-Studio Agent*** runs as a GUI application and its icon appears on the taskbar tray. In this mode, it can be configured and its log may be viewed.

Simply connect to the remote computer providing a desired password for ***R-Studio Agent*** in the Connect to Remote Computer dialog box. **R-Studio** checks if there is ***R-Studio Agent*** running on this computer. If not, a Can't connect... message will appear.

Click the **Yes** button, and **R-Studio** will remotely install ***R-Studio Agent***.

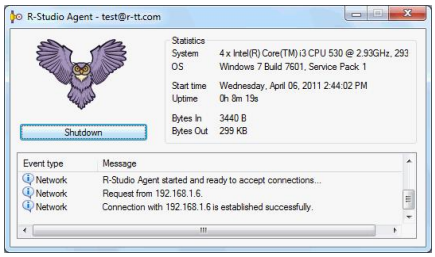
Attention Windows NT/2000/XP/2003/Vista/2008/7/8/8.1/10 users: R-Studio Agent may be remotely installed over a network from a computer running Windows NT/2000/XP/2003/Vista/2008/7/8/8.1/10 to another computer running Windows NT/2000/XP/2003/Vista/2008/7/8/8.1/10. To do so, you must have administrator accounts on both computers.

To access the R-Studio Agent main panel,

1 **Click its tray icon**

> **The main panel will appear. You may view its log**

R-Studio Agent main panel

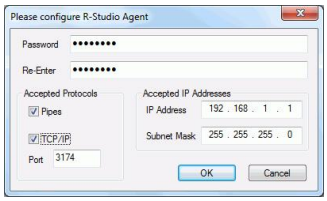


To configure *R-Studio Agent*,

1 **Right-click its tray icon and select Configure**

2 **Specify required parameters on the** Please configure R-Studio Agent **dialog box and click the OK button**

Please configure R-Studio Agent **dialog box**



R-Studio Agent Options

Password:	Enter a password to obtain access to this computer from a network.
Re-Enter:	Re-enter the password.
Accepted Protocols	
Pipes	supported by Windows NT/2000/XP/2003/Vista/2008/7/8/8.1/10 only. To improve security, this option should be disabled.
TCP/IP	supported by any network OS.
Port	port for incoming connections
Accepted IP Addresses	
IP Address	specifies addresses from which this computer can be accessed.
Subnet Mask	specifies a subnet mask of the network from which this computer can be accessed.

> ***R-Studio Agent* will now run with the specified parameters**

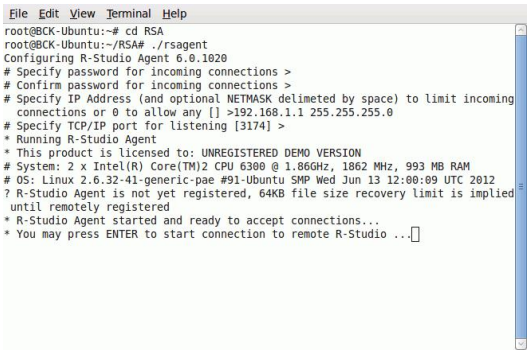
2.5.1.3 R-Studio Agent for Linux

You need to have the root privileges to run **R-Studio Agent for Linux.**

Unlike R-Studio Agent for Windows and R-Studio Agent for Mac, **R-Studio Agent for Linux** is a console application and should be run in the Terminal. You also need to mark it as an executable before start.

When it is started for the first time, **R-Studio Agent for Linux** asks for its configuration.

R-Studio Agent for Linux Configuration **dialog box**



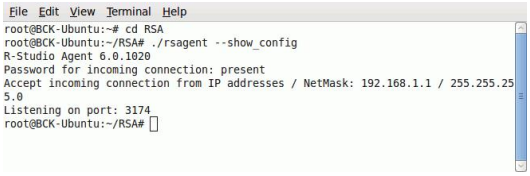
R-Studio Agent for Linux Options

Specify password for incoming connection	Enter a password to obtain access to this computer from a network.
Confirm password for incoming connection	Re-enter the password for confirmation.
Specify IP address...	Specifies addresses and a subnet mask from which this computer can be accessed. Enter 0 to allow connections from any address.
Specify TCP/IP Port for listening	A TCP/IP port for incoming connections. Press Enter for the default one [3174].

Don't pay much attention to the warning about "unregistered demo version". If necessary, you'll be able to register **R-Studio Agent for Linux** through **R-Studio**.

You may see the current configuration by starting **R-Studio Agent for Linux** with the command `rsagent --show_config`.

R-Studio Agent for Linux Configuration **dialog box**



You may change the current configuration by starting **R-Studio Agent for Linux** with the command `rsagent --configure`.

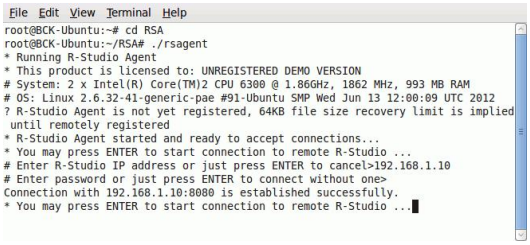
Connecting from R-Studio Agent for Linux to R-Studio.

To establish a connection from R-Studio Agent for Linux to R-Studio,

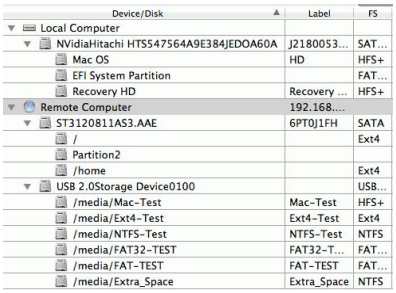
1 **Run the R-Studio Agent for Linux and press Enter**

2 Enter the necessary information

Connect to R-Studio **dialog box**



> **R-Studio Agent for Linux will connect to the computer where R-Studio is running and it will show the hard drive and logical disk structure of the remote computer.**



It can be processed the same way as that on a local computer.

2.5.2 Data Recovery over Network

Generally, data restoring over network is very much the same as that on a local computer.

R-Studio Agent should be running on the network computer where data are to be recovered.

Read the **Connecting over the Internet** topic to learn how to establish connection between **R-Studio** and **R-Studio Agent** over the Internet.

To connect to a remote computer

1 Click the Connect to Remote button, or

Select **Connect To Remote** on the **Drive** menu

2 Specify the name or IP address of the remote computer where data are to be recovered in the Computer: field

Connect to Remote Computer **dialog box**

The Port should coincide with the port specified for the **R-Studio Agent**.

The Password: field is for the password of ***R-Studio Agent*** running on the remote computer. If you want to see the entered password, control-click the field and select **Show password** on the contextual menu.

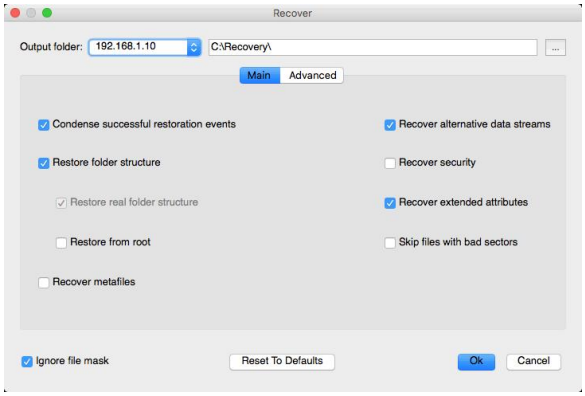
Note: If the remote computer is started with **R-Studio Agent Emergency**, leave this field blank.

> **R-Studio will connect to the remote computer and show its hard drive and logical disk structure of the remote computer below the device/disk structure of your local computer**

It can be processed the same way as that on a local computer.

When **R-Studio** connects to the remote computer, it check if ***R-Studio Agent*** is present and its password. If there is no ***R-Studio Agent*** installed, **R-Studio** may try to remotely install it. See the **R-Studio Agent** topic for details.

Recover **dialog box**



When the Recover dialog box appears, you may select whether you want to save recovered files on the local or remote computer. Saving recovered files on a remote computer may be useful when the remote computer has a healthy disk because you do not have to transfer files over network. It may be an external USB hard drive, for example.

When **R-Studio** connects to the remote computer, it check if ***R-Studio Agent*** is present and its password. If there is no ***R-Studio Agent*** installed, **R-Studio** may try to remotely install it. See the **R-Studio Agent** topic for details.

2.5.3 Connecting over the Internet

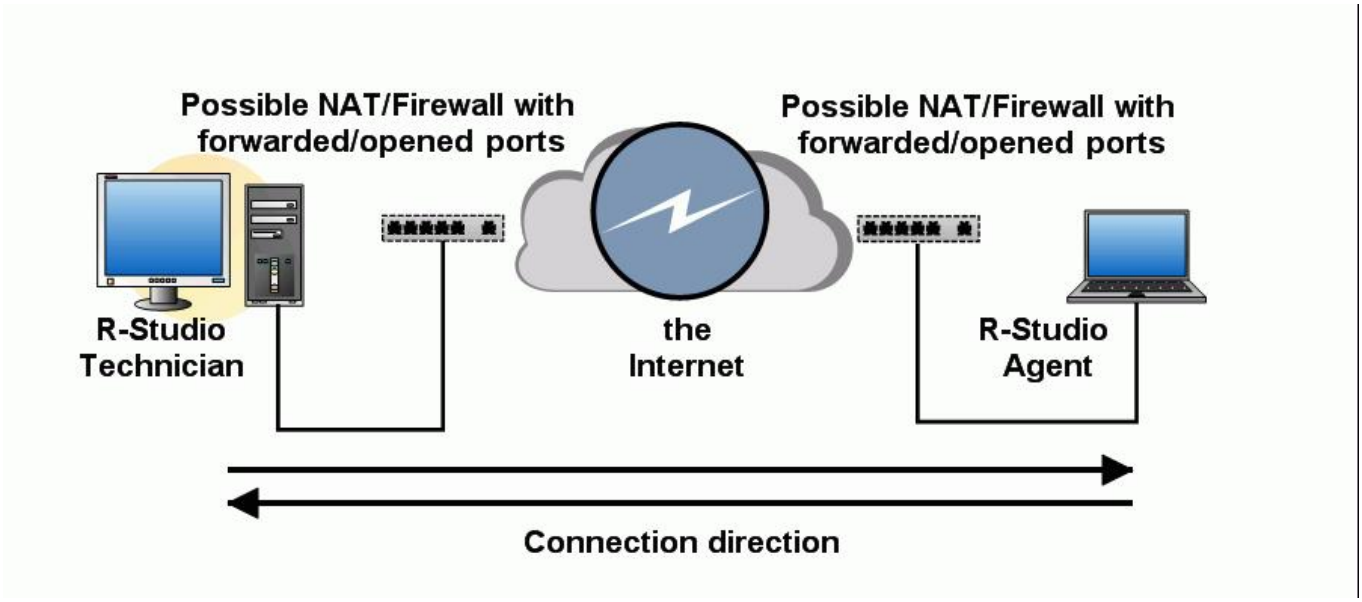
R-Studio and **R-Studio Agent** can be connected over the Internet. The connection can be made either using IP addresses or DNS names.

If hosts where **R-Studio** and **R-Studio Agent** are running have public IP addresses the connection can be made the same way as for the local network, except that the IP address or DNS name should be explicitly specified in the Computer filed the Connect to Remote Computer dialog box

If either (or both) of the hosts are on private networks behind NATs and firewalls and do not have public IP addresses, the corresponding ports should be opened or forwarded. In addition, connection should be made either only from **R-Studio** or from **R-Studio Agent**.

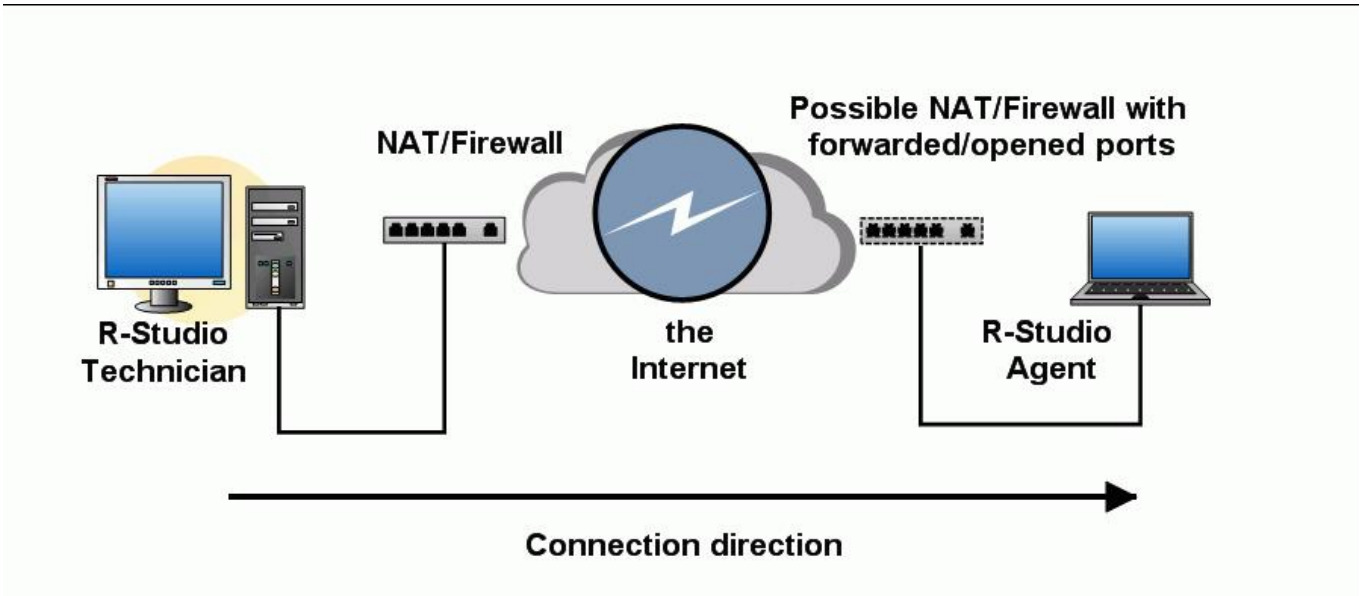
Connection directions

*** Both R-Studio and R-Studio Agent have public IP addresses (no NAT/firewall) or the ports on the NAT/firewall are forwarded/opened.**



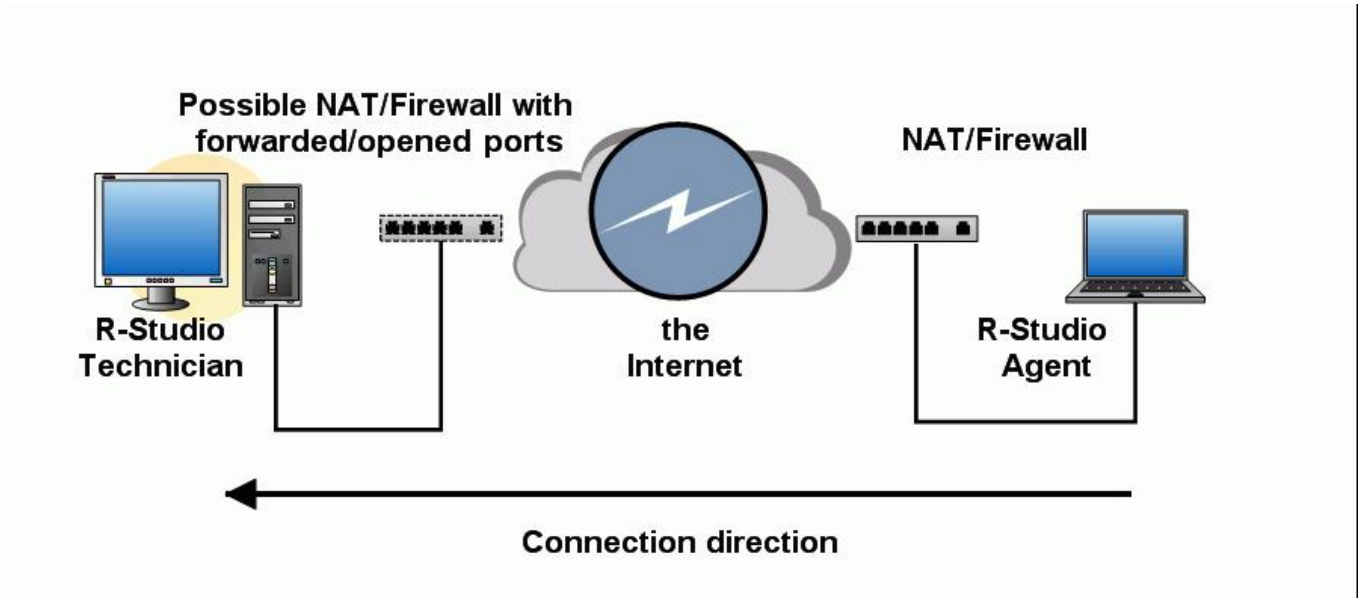
A connection can be made either from **R-Studio** or from **R-Studio Agent**.

*** R-Studio is behind a NAT and R-Studio Agent has a public IP address or the ports on its NAT/firewall are forwarded/opened.**



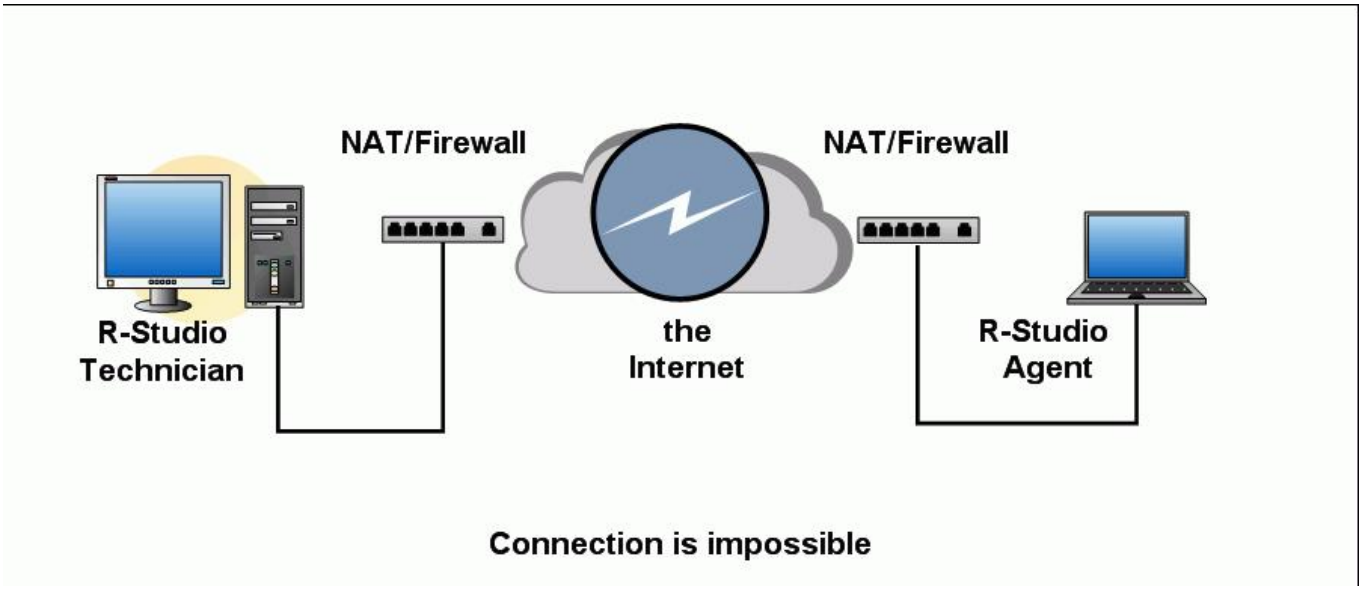
A connection should be made from **R-Studio**.

*** R-Studio has a public IP address or the ports on its NAT/firewall are forwarded/opened and R-Studio Agent is behind a NAT.**



A connection should be made from **R-Studio Agent**.

*** Both R-Studio and R-Studio Agent are behind NATs/firewalls.**



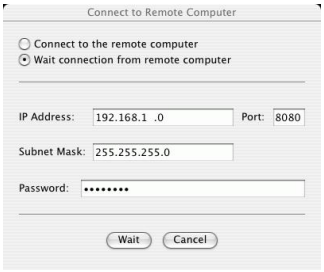
No connections are possible.

Connection from R-Studio Agent to R-Studio

R-Studio settings

If a connection is to be made from **R-Studio Agent** to **R-Studio**, **R-Studio** should be set to accept connection on the Connect to Remote Computer dialog box.

Connect to Remote Computer **dialog box**



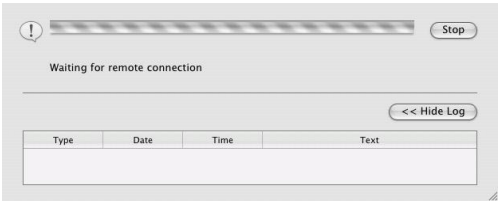
Select **Wait connection from remote computer**, and specify options for incoming connections.

R-Studio Incoming Connection Options

Password:	Enter a password to obtain access to this computer from a network.
IP Address	specifies addresses from which this computer can be accessed.
Subnet Mask	specifies subnet mask of the network from which this computer can be accessed.
Port	port for incoming connections.

R-Studio will wait for an incoming connection.

Waiting for remote connection **dialog box**



Connecting from R-Studio Agent to R-Studio.

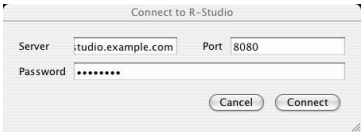
(See the **R-Studio Agent for Mac** or **R-Studio Agent for Linux** help page to learn how to establish connections from those **R-Studio Agent** versions).

To establish a connection from R-Studio Agent to R-Studio,

1 **Select Connect to on the Tools menu.**

2 **Enter the necessary information on the** Connect to R-Studio **dialog box and click the Connect button.**

Connect to R-Studio **dialog box**



Connect to R-Studio settings

Server	Specify the DNS name or IP address of the host where **R-Studio** is running.
Port	Specify the port set on the **R-Studio** Connect to Remote Computer dialog box.
Password	Specify the password set on the **R-Studio** Connect to Remote Computer dialog box.

> **R-Studio Agent will connect to the computer where R-Studio is running and it will show the hard drive and logical disk structure of the remote computer.**

It can be processed the same way as that on a local computer.

III R-Studio Technician/T80+

R-Studio Technician/T80+ Demo can perform all data recovery actions except saving recovered files greater than 256 KB and multi-pass imaging.

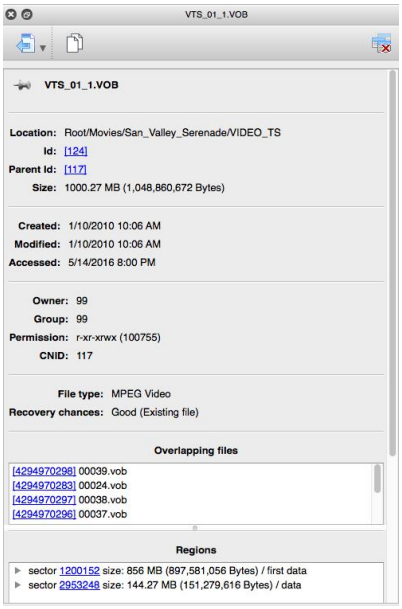
The **R-Studio T80+** version requires an active internet connection to run and register. You may read more about **R-Studio T80+** in our article R-Studio T80+ - A Professional Data Recovery and Forensic Solution for Small Business and Individuals Just for US$1/day.

This chapter covers features that available only in the **R-Studio Technician/T80+** versions.

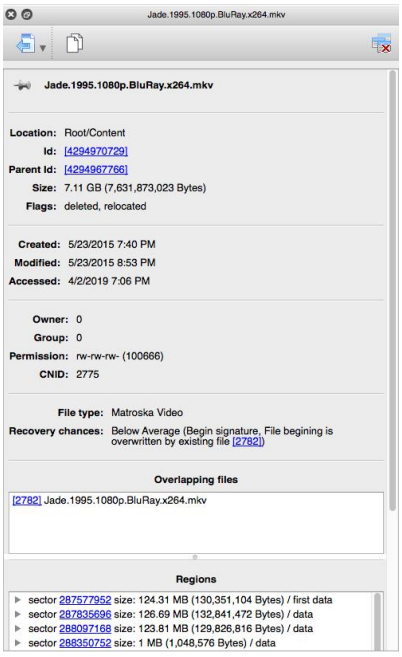
3.1 File Information

R-Studio Technician shows much more information about files than **R-Studio** does.

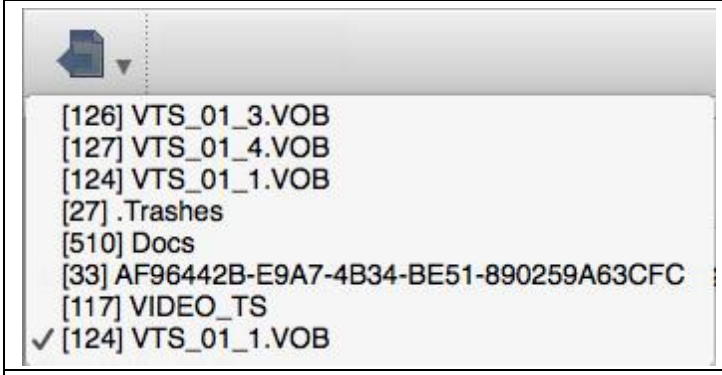
Info about a file with good chances for recovery



Info for a file with below average recovery chances

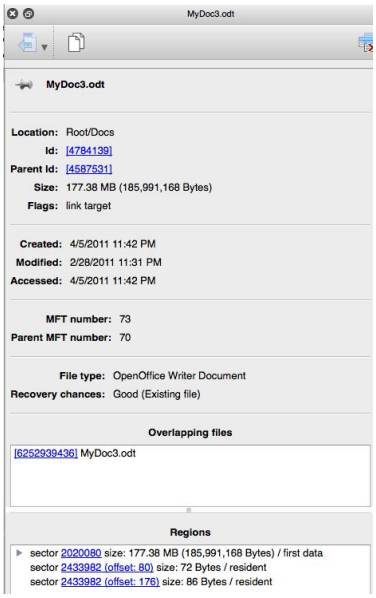


More information

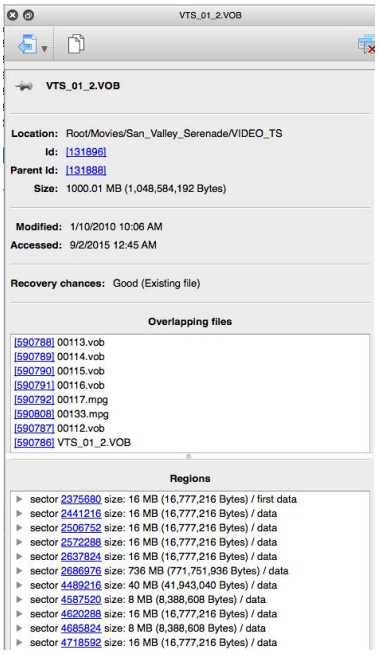
	Click this button to pin the file information. This panel will show the information about the "pinned" file regardless of the current selected file.
	Click this button to copy all this information
	Click this button to select the file you want to go to.
	Click this button to close all the information.
Overlapping files	Shows the list or files that may occupy the same disk sectors. You may click the file id to see information about this file.
Regions	Shows the list of sectors occupied by the file and corresponding overlapping files. You may click a sector number open the sector in the built-in Hexadecimal editor.

Examples of file information on other file systems

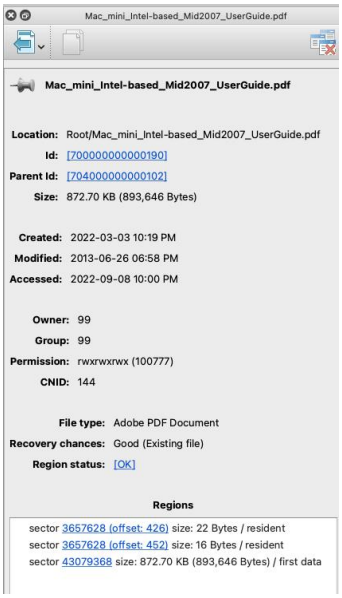
File info on an NTFS file system



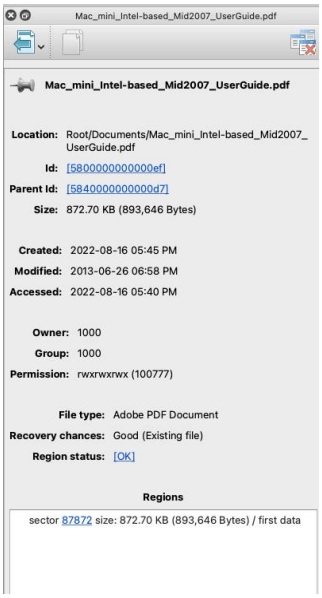
Info for a file on an Ext file system



File info on an APFS file system



Info for a file on an XFS file system



3.2 Custom Recovery Lists

The **R-Studio Technician/T80+** versions can create more advanced recovery lists.

Export Recovery List options

Export the entire folder/file tree Export marked file/folder names Export file/folder names	Specifies which file and folder names will be exported.
File format:	A file format for the recovery list.

	Only text format is available for the standalone and corporate versions. **R-Studio Technician/T80+** can create custom recovery lists in other formats with more advanced options The following formats are available for **R-Studio Technician/T80+** version: Plain Text HTML XML JSON CSV
File name:	Specifies a file name of the recovery list.

Editing the file recovery list

All files without any marks in the recovery list will be marked when the list is loaded into **R-Studio**. So, if you have some files in the recovery list that don't need to be recovered, just delete them from the list. In addition, you may use the following marks to specify some options

- `:+` Mark the file, or the folder, all its files, and subfolders within the folder.
- `:*` Mark the file, or the folder and its files, don't mark subfolders in the folder.
- `:-` Unmark the file, or the folder, its files, and subfolders in the folder.
- `:=` Unmark the file or the folder and its files, dont unmark subfolders in the folder.
- `:!` Provide the information on the file. (**R-Studio Technician/T80+** only)

R-Studio for Linux processes records in the list consequently. That is, if there are the following lines in the file,

```
:+Files_to_Recover\
:-Files_to_Delete\File_2.jpg
```

the file `File_2.jpg` won't be marked for recovery, while for the lines

```
:-Files_to_Recover\File_2.jpg
:+Files_to_Recover\
```

file `File_2.jpg` will be.

A simple recovery list for reference

Structure of a simple recovery list file created by R-Studio

```
:# Version = 1
:# Sort = by real
:# PathDelim = /
:# CaseSensitive
:# Drive = type:"Volume"; size:"1048576000"; label:"ntfs test"; fs:"NTFS";
:# Parent = type:"Drive"; size:"1048576000"; serial:"2cca54405a8d3a89"; firmware:"
Diving/
Diving/Aquarium/
Diving/Aquarium/20190822_100644.jpg
Diving/Aquarium/20190822_101620.jpg
Diving/Aquarium/20190822_102526.jpg
Diving/Aquarium/20190822_103830.jpg
Diving/Aquarium/20190822_104333.jpg
Diving/MyPhoto1.jpg
Diving/MyPhoto2.jpg
Diving/MyPhoto3.jpg
```

```
Diving/MyPhoto4.JPG
Diving/MyPhoto5.jpg
SF/
SF/Sea-Lions/
SF/Sea-Lions/IMG_3493.JPG
SF/Sea-Lions/IMG_3535.JPG
SF/Sea-Lions/IMG_3542.JPG
SF/Sea-Lions/IMG_3579.JPG
SF/Sea-Lions/IMG_3580.JPG
SF/Sea-Lions/IMG_3581.JPG
SF/Sea-Lions/IMG_3589.JPG
SF/IMG_0869.JPG
SF/IMG_0873.JPG
SF/IMG_0890.JPG
SF/IMG_1739.JPG
SF/IMG_3460.JPG
SF/IMG_3461.JPG
SF/IMG_3476.JPG
SF/IMG_3478.JPG
SF/IMG_3479.JPG
SF/IMG_3480.JPG
SF/IMG_3481.JPG
SF/IMG_3493.JPG
SF/IMG_3535.JPG
SF/IMG_3542.JPG
SF/IMG_3579.JPG
SF/IMG_3580.JPG
SF/IMG_3581.JPG
SF/IMG_3589.JPG
SF/IMG_3590.JPG
SF/IMG_3591.JPG
SF/IMG_3592.JPG
SF/IMG_3593.JPG
SF/IMG_3594.JPG
SF/IMG_3595.JPG
SF/IMG_3596.JPG
SF/IMG_3608.JPG
SF/IMG_3627.JPG
MyPhoto6.JPG
MyPhoto7.JPG
MyPhoto8.JPG
MyPhoto9.JPG
```

If such recovery list is created from an entire logical disk/partition, it will contain several virtual folders. For example, they'll have the following structure for an NTFS partition.

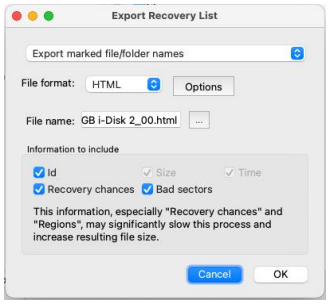
```
System Volume Information/
System Volume Information/IndexerVolumeGuid
System Volume Information/WPSettings.dat
Vegas/
MyPhoto6.JPG
MyPhoto7.JPG
MyPhoto8.JPG
```

```
MyPhoto9.JPG
///m/$Extend/
///m/$Extend/$Deleted/
///m/$Extend/$RmMetadata/
///m/$Extend/$RmMetadata/$Txf/
///m/$Extend/$RmMetadata/$TxfLog/
///m/$Extend/$RmMetadata/$TxfLog/$Tops
///m/$Extend/$RmMetadata/$TxfLog/$TxfLog.blf
///m/$Extend/$RmMetadata/$TxfLog/$TxfLogContainer00000000000000000001
///m/$Extend/$RmMetadata/$TxfLog/$TxfLogContainer00000000000000000002
///m/$Extend/$RmMetadata/$Repair
///m/$Extend/$ObjId
///m/$Extend/$Quota
///m/$Extend/$Reparse
///m/$AttrDef
///m/$BadClus
///m/$Bitmap
///m/$Boot
///m/$LogFile
///m/$MFT
///m/$MFTMirr
///m/$Secure
///m/$UpCase
///m/$Volume
```

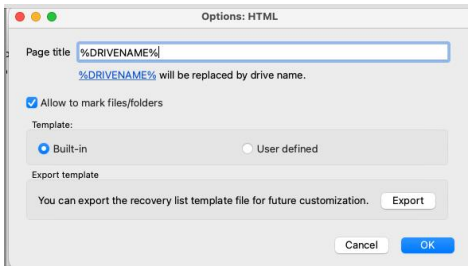
HTML format

This is a default format of recovery lists for the **R-Studio Technician/T80+** version. It allows its users to supply their customers with the recovery lists with the easiest way to edit.

Export Recovery List dialog box for the HTML format



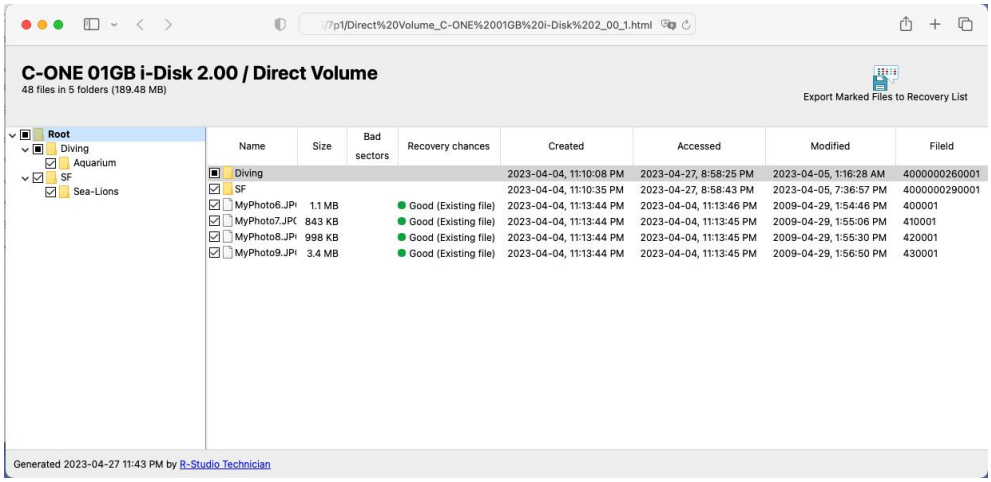
HTML Options dialog box



You may export the default HTML template and edit it to adapt it for your own purposes.

When the customer loads an HTML recovery list in their browser, they can mark files they want to recover, and export their names into the final recovery list in the plain text format.

HTML Recovery list in a browser



You may compare this list with the edited simple recovery list.

An exported recovery list

```
:# Version = 1
:# Sort = by real
:# PathDelim = /
:# CaseSensitive
:# Drive = type:"Volume"; size:"1048576000"; label:"ntfs test"; fs:"NTFS";
:# Parent = type:"Drive"; size:"1048576000"; serial:"2cca54405a8d3a89"; firmware:"2.0
Diving/Aquarium/20190822_100644.jpg
:! Id=3866625
Diving/Aquarium/20190822_101620.jpg
:! Id=3932161
Diving/Aquarium/20190822_102526.jpg
:! Id=3997697
Diving/Aquarium/20190822_103830.jpg
:! Id=4063233
Diving/Aquarium/20190822_104333.jpg
:! Id=4128769
Diving/MyPhoto1.jpg
:! Id=2883585
Diving/MyPhoto3.jpg
:! Id=3014657
SF/IMG_0869.JPG
:! Id=4915201
SF/IMG_0873.JPG
:! Id=4980737
SF/IMG_0890.JPG
:! Id=5046273
SF/IMG_1739.JPG
:! Id=5111809
SF/IMG_3460.JPG
:! Id=5177345
SF/IMG_3461.JPG
:! Id=5242881
SF/IMG_3476.JPG
:! Id=5308417
```

```
SF/IMG_3478.JPG
:! Id=5373953
SF/IMG_3479.JPG
:! Id=5439489
SF/IMG_3480.JPG
:! Id=5505025
SF/IMG_3481.JPG
:! Id=5570561
SF/IMG_3493.JPG
:! Id=5636097
SF/IMG_3535.JPG
:! Id=5701633
SF/IMG_3542.JPG
:! Id=5767169
SF/IMG_3579.JPG
:! Id=5832705
SF/IMG_3580.JPG
:! Id=5898241
SF/IMG_3581.JPG
:! Id=5963777
SF/IMG_3589.JPG
:! Id=6029313
SF/IMG_3590.JPG
:! Id=6094849
SF/IMG_3591.JPG
:! Id=6160385
SF/IMG_3592.JPG
:! Id=6225921
SF/IMG_3593.JPG
:! Id=6291457
SF/IMG_3594.JPG
:! Id=6356993
SF/IMG_3595.JPG
:! Id=6422529
SF/IMG_3596.JPG
:! Id=6488065
SF/IMG_3608.JPG
:! Id=6553601
SF/IMG_3627.JPG
:! Id=6619137
MyPhoto6.JPG
:! Id=4194305
MyPhoto7.JPG
:! Id=4259841
MyPhoto8.JPG
:! Id=4325377
MyPhoto9.JPG
:! Id=4390913
```

A manually edited plain text recovery list

The edited simple recovery list

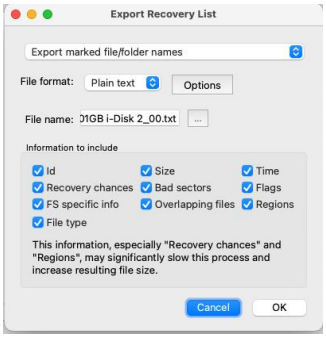
The final simple recovery list will be the following:

```
:# Version = 1
:# Sort = by real
:# PathDelim = /
:# CaseSensitive
:# Drive = type:"Volume"; size:"1048576000"; label:"ntfs test"; fs:"NTFS";
:# Parent = type:"Drive"; size:"1048576000"; serial:"2cca54405a8d3a89"; firmware:"2.
:= Diving/
:+ Diving/Aquarium/
:+ Diving/MyPhoto1.jpg
:+ Diving/MyPhoto3.jpg
:+ SF/
:- SF/Sea-Lions/
MyPhoto6.JPG
MyPhoto7.JPG
MyPhoto8.JPG
MyPhoto9.JPG
```

Plain text format

Custom recovery lists in the text format contains more information about files than simple recovery lists.

Export Recovery List dialog box for the plain text format



You may compare two versions of the same plain text recovery list:

An advanced text recovery list

This is an advanced version of the recovery list described on the Recovery List page.

```
:# Version = 1
:# Sort = by real
:# PathDelim = /
:# CaseSensitive
:# Drive = type:"Volume"; size:"1048576000"; label:"ntfs test"; fs:"NTFS";
:# Parent = type:"Drive"; size:"1048576000"; serial:"2cca54405a8d3a89"; firmware:"
Diving/
:! Id=4000000260001
:! Flags=directory
:! Created=2023-04-04 11:10 PM
:! Modified=2023-04-05 01:16 AM
:! Accessed=2023-04-27 08:58 PM
:! MFT number=38
:! Parent MFT number=5
```

```
Diving/Aquarium/
:! Id=4000000270001
:! Flags=directory
:! Created=2023-04-04 11:10 PM
:! Modified=2023-04-05 08:31 PM
:! Accessed=2023-04-27 08:58 PM
:! MFT number=39
:! Parent MFT number=38

Diving/Aquarium/20190822_100644.jpg
:! Id=3b0001
:! Size=5.49 MB (5,760,305 Bytes)
:! Created=2023-04-05 08:27 PM
:! Modified=2020-08-05 08:34 PM
:! Accessed=2023-04-05 08:27 PM
:! File type=JPEG Digital Camera
:! Recovery chances=Good (Existing file)
:! Regions (sector size=512B):
:! sector 682782 (offset: 80 ) size: 72 Bytes / resident
    :! other files:  [500000000410001] MyPhoto7.JPG
:! sector 682782 (offset: 176 ) size: 104 Bytes / resident
    :! other files:  [500000000420001] MyPhoto8.JPG
:! sector 1282304 size: 5.49 MB (5,760,305 Bytes) / first data
    :! other files:  [500000000410001] MyPhoto7.JPG
:! MFT number=59
:! Parent MFT number=39

Diving/Aquarium/20190822_101620.jpg
:! Id=3c0001
:! Size=5.75 MB (6,030,395 Bytes)
:! Created=2023-04-05 08:27 PM
:! Modified=2020-08-05 08:47 PM
:! Accessed=2023-04-05 08:27 PM
:! File type=JPEG Digital Camera
:! Recovery chances=Good (Existing file)
:! Regions (sector size=512B):
:! sector 682784 (offset: 80 ) size: 72 Bytes / resident
    :! other files:  [500000000420001] MyPhoto8.JPG
:! sector 682784 (offset: 176 ) size: 104 Bytes / resident
    :! other files:  [500000000430001] MyPhoto9.JPG
:! sector 1293560 size: 5.75 MB (6,030,395 Bytes) / first data
    :! other files:  [500000000420001] MyPhoto8.JPG
:! MFT number=60
:! Parent MFT number=39

Diving/Aquarium/20190822_102526.jpg
:! Id=3d0001
:! Size=4.92 MB (5,163,217 Bytes)
:! Created=2023-04-05 08:27 PM
:! Modified=2020-08-06 04:10 AM
:! Accessed=2023-04-05 08:27 PM
:! File type=JPEG Digital Camera
:! Recovery chances=Good (Existing file)
```

```
:! Regions (sector size=512B):
:! sector 682786 (offset: 80 ) size: 72 Bytes / resident
    :! other files:  [500000000430001] MyPhoto9.JPG
:! sector 682786 (offset: 176 ) size: 104 Bytes / resident
    :! other files:  [500000000440001] IMG_3493.JPG
:! sector 1478800 size: 4.92 MB (5,163,217 Bytes) / first data
    :! other files:  [500000000430001] MyPhoto9.JPG
:! MFT number=61
:! Parent MFT number=39

Diving/Aquarium/20190822_103830.jpg
:! Id=3e0001
:! Size=5.41 MB (5,674,169 Bytes)
:! Created=2023-04-05 08:27 PM
:! Modified=2020-08-06 04:10 AM
:! Accessed=2023-04-05 08:27 PM
:! File type=JPEG Digital Camera
:! Recovery chances=Good (Existing file)
:! Regions (sector size=512B):
:! sector 682788 (offset: 80 ) size: 72 Bytes / resident
    :! other files:  [500000000440001] IMG_3493.JPG
:! sector 682788 (offset: 176 ) size: 104 Bytes / resident
    :! other files:  [500000000450001] IMG_3535.JPG
:! sector 1488888 size: 5.41 MB (5,674,169 Bytes) / first data
    :! other files:  [500000000440001] IMG_3493.JPG
:! MFT number=62
:! Parent MFT number=39

Diving/Aquarium/20190822_104333.jpg
:! Id=3f0001
:! Size=6.36 MB (6,673,935 Bytes)
:! Created=2023-04-05 08:27 PM
:! Modified=2020-08-06 04:13 AM
:! Accessed=2023-04-05 08:27 PM
:! File type=JPEG Digital Camera
:! Recovery chances=Good (Existing file)
:! Regions (sector size=512B):
:! sector 682790 (offset: 80 ) size: 72 Bytes / resident
    :! other files:  [500000000450001] IMG_3535.JPG
:! sector 682790 (offset: 176 ) size: 104 Bytes / resident
    :! other files:  [500000000460001] IMG_3542.JPG
:! sector 1642440 size: 6.36 MB (6,673,935 Bytes) / first data
    :! other files:  [500000000450001] IMG_3535.JPG
:! MFT number=63
:! Parent MFT number=39

Diving/MyPhoto1.jpg
:! Id=2c0001
:! Size=2.56 MB (2,682,000 Bytes)
:! Created=2023-04-05 01:16 AM
:! Modified=2009-04-29 01:52 PM
:! Accessed=2023-04-05 01:16 AM
:! File type=JPEG Digital Camera
```

```
:! Recovery chances=Good (Existing file)
:! Regions (sector size=512B):
:! sector 682752 (offset: 80 ) size: 72 Bytes / resident
:! sector 682752 (offset: 176 ) size: 90 Bytes / resident
    :! other files:  [5000000002d0001] MyPhoto2.jpg
:! sector 2036600 size: 2.56 MB (2,682,000 Bytes) / first data
:! MFT number=44
:! Parent MFT number=38

Diving/MyPhoto2.jpg
:! Id=2d0001
:! Size=1.75 MB (1,830,252 Bytes)
:! Created=2023-04-05 01:16 AM
:! Modified=2009-04-29 01:53 PM
:! Accessed=2023-04-05 01:16 AM
:! File type=JPEG Digital Camera
:! Recovery chances=Good (Existing file)
:! Regions (sector size=512B):
:! sector 682754 (offset: 80 ) size: 72 Bytes / resident
    :! other files:  [5000000002e0001] MyPhoto3.jpg
:! sector 682754 (offset: 176 ) size: 90 Bytes / resident
    :! other files:  [5000000002e0001] MyPhoto3.jpg
:! sector 2041840 size: 1.75 MB (1,830,252 Bytes) / first data
:! MFT number=45
:! Parent MFT number=38

Diving/MyPhoto3.jpg
:! Id=2e0001
:! Size=1.73 MB (1,816,964 Bytes)
:! Created=2023-04-05 01:16 AM
:! Modified=2009-04-29 01:53 PM
:! Accessed=2023-04-05 01:16 AM
:! File type=JPEG Digital Camera
:! Recovery chances=Good (Existing file)
:! Regions (sector size=512B):
:! sector 682756 (offset: 80 ) size: 72 Bytes / resident
    :! other files:  [5000000002f0001] MyPhoto4.JPG
:! sector 682756 (offset: 176 ) size: 90 Bytes / resident
    :! other files:  [500000000300001] MyPhoto5.jpg
:! sector 1683624 size: 1.73 MB (1,816,964 Bytes) / first data
    :! other files:  [5000000002f0001] MyPhoto4.JPG
:! MFT number=46
:! Parent MFT number=38

Diving/MyPhoto4.JPG
:! Id=2f0001
:! Size=880.15 KB (901,269 Bytes)
:! Created=2023-04-05 01:16 AM
:! Modified=2009-04-29 01:54 PM
:! Accessed=2023-04-05 01:16 AM
:! File type=JPEG Digital Camera
:! Recovery chances=Good (Existing file)
:! Regions (sector size=512B):
```

```
:! sector 682758 (offset: 80 ) size: 72 Bytes / resident
    :! other files:  [500000000310001] IndexerVolumeGuid
:! sector 682758 (offset: 176 ) size: 90 Bytes / resident
    :! other files:  [500000000310001] IndexerVolumeGuid
:! sector 2045416 size: 880.15 KB (901,269 Bytes) / first data
    :! other files:  [500000000300001] MyPhoto5.jpg
:! MFT number=47
:! Parent MFT number=38

Diving/MyPhoto5.jpg
:! Id=300001
:! Size=3.13 MB (3,286,883 Bytes)
:! Created=2023-04-05 01:16 AM
:! Modified=2009-04-29 02:13 PM
:! Accessed=2023-04-05 01:16 AM
:! File type=JPEG Digital Camera
:! Recovery chances=Good (Existing file)
:! Regions (sector size=512B):
:! sector 682760 (offset: 80 ) size: 72 Bytes / resident
    :! other files:  [500000000320001] IMG_0201.JPG
:! sector 682760 (offset: 176 ) size: 90 Bytes / resident
    :! other files:  [500000000320001] IMG_0201.JPG
:! sector 1687176 size: 3.13 MB (3,286,883 Bytes) / first data
    :! other files:  [500000000310001] IndexerVolumeGuid
:! MFT number=48
:! Parent MFT number=38

SF/
:! Id=4000000290001
:! Flags=directory
:! Created=2023-04-04 11:10 PM
:! Modified=2023-04-05 07:36 PM
:! Accessed=2023-04-27 08:58 PM
:! MFT number=41
:! Parent MFT number=5

SF/Sea-Lions/
:! Id=40000002a0001
:! Flags=directory
:! Created=2023-04-04 11:10 PM
:! Modified=2023-04-05 12:03 AM
:! Accessed=2023-04-27 08:58 PM
:! MFT number=42
:! Parent MFT number=41

SF/Sea-Lions/IMG_3493.JPG
:! Id=440001
:! Size=4.75 MB (4,985,023 Bytes)
:! Created=2023-04-05 12:02 AM
:! Modified=2009-06-06 05:50 AM
:! Accessed=2023-04-05 12:02 AM
:! File type=JPEG Digital Camera
:! Recovery chances=Good (Existing file)
```

```
:! Regions (sector size=512B):
:! sector 682800 (offset: 80 ) size: 48 Bytes / resident
    :! other files:  [5000000004c0001] IMG_0873.JPG
:! sector 682800 (offset: 152 ) size: 90 Bytes / resident
    :! other files:  [5000000004c0001] IMG_0873.JPG
:! sector 682800 (offset: 272 ) size: 80 Bytes / resident
    :! other files:  [5000000004c0001] IMG_0873.JPG
:! sector 1043832 size: 4.75 MB (4,985,023 Bytes) / first data
    :! other files:  [5000000004b0001] IMG_0869.JPG
:! MFT number=68
:! Parent MFT number=42

SF/Sea-Lions/IMG_3535.JPG
:! Id=450001
:! Size=3.55 MB (3,718,479 Bytes)
:! Created=2023-04-05 12:02 AM
:! Modified=2009-06-06 05:55 AM
:! Accessed=2023-04-05 12:02 AM
:! File type=JPEG Digital Camera
:! Recovery chances=Good (Existing file)
:! Regions (sector size=512B):
:! sector 682802 (offset: 80 ) size: 48 Bytes / resident
    :! other files:  [5000000004d0001] IMG_0890.JPG
:! sector 682802 (offset: 152 ) size: 90 Bytes / resident
    :! other files:  [5000000004d0001] IMG_0890.JPG
:! sector 682802 (offset: 272 ) size: 80 Bytes / resident
    :! other files:  [5000000004d0001] IMG_0890.JPG
:! sector 1076608 size: 3.55 MB (3,718,479 Bytes) / first data
    :! other files:  [5000000004c0001] IMG_0873.JPG
:! MFT number=69
:! Parent MFT number=42

SF/Sea-Lions/IMG_3542.JPG
:! Id=460001
:! Size=3.92 MB (4,110,749 Bytes)
:! Created=2023-04-05 12:02 AM
:! Modified=2009-06-06 05:57 AM
:! Accessed=2023-04-05 12:02 AM
:! File type=JPEG Digital Camera
:! Recovery chances=Good (Existing file)
:! Regions (sector size=512B):
:! sector 682804 (offset: 80 ) size: 48 Bytes / resident
    :! other files:  [5000000004e0001] IMG_1739.JPG
:! sector 682804 (offset: 152 ) size: 90 Bytes / resident
    :! other files:  [5000000004e0001] IMG_1739.JPG
:! sector 682804 (offset: 272 ) size: 80 Bytes / resident
    :! other files:  [5000000004f0001] IMG_3460.JPG
:! sector 1109376 size: 3.92 MB (4,110,749 Bytes) / first data
    :! other files:  [5000000004e0001] IMG_1739.JPG
:! MFT number=70
:! Parent MFT number=42

SF/Sea-Lions/IMG_3579.JPG
```

```
:! Id=470001
:! Size=3.92 MB (4,109,345 Bytes)
:! Created=2023-04-05 12:02 AM
:! Modified=2009-06-06 05:59 AM
:! Accessed=2023-04-05 12:02 AM
:! File type=JPEG Digital Camera
:! Recovery chances=Good (Existing file)
:! Regions (sector size=512B):
:! sector 682806 (offset: 80 ) size: 48 Bytes / resident
    :! other files:  [5000000004f0001] IMG_3460.JPG
:! sector 682806 (offset: 152 ) size: 90 Bytes / resident
    :! other files:  [500000000500001] IMG_3461.JPG
:! sector 682806 (offset: 272 ) size: 80 Bytes / resident
    :! other files:  [500000000500001] IMG_3461.JPG
:! sector 1142144 size: 3.92 MB (4,109,345 Bytes) / first data
    :! other files:  [5000000004f0001] IMG_3460.JPG
:! MFT number=71
:! Parent MFT number=42

SF/Sea-Lions/IMG_3580.JPG
:! Id=480001
:! Size=3.35 MB (3,510,477 Bytes)
:! Created=2023-04-05 12:03 AM
:! Modified=2009-06-06 05:59 AM
:! Accessed=2023-04-05 12:03 AM
:! File type=JPEG Digital Camera
:! Recovery chances=Good (Existing file)
:! Regions (sector size=512B):
:! sector 682808 (offset: 80 ) size: 48 Bytes / resident
    :! other files:  [500000000510001] IMG_3476.JPG
:! sector 682808 (offset: 152 ) size: 90 Bytes / resident
    :! other files:  [500000000510001] IMG_3476.JPG
:! sector 682808 (offset: 272 ) size: 80 Bytes / resident
    :! other files:  [500000000510001] IMG_3476.JPG
:! sector 1207680 size: 3.35 MB (3,510,477 Bytes) / first data
    :! other files:  [500000000500001] IMG_3461.JPG
:! MFT number=72
:! Parent MFT number=42

SF/Sea-Lions/IMG_3581.JPG
:! Id=490001
:! Size=4.09 MB (4,285,353 Bytes)
:! Created=2023-04-05 12:03 AM
:! Modified=2009-06-06 05:59 AM
:! Accessed=2023-04-05 12:03 AM
:! File type=JPEG Digital Camera
:! Recovery chances=Good (Existing file)
:! Regions (sector size=512B):
:! sector 682810 (offset: 80 ) size: 48 Bytes / resident
    :! other files:  [500000000520001] IMG_3478.JPG
:! sector 682810 (offset: 152 ) size: 90 Bytes / resident
    :! other files:  [500000000520001] IMG_3478.JPG
:! sector 682810 (offset: 272 ) size: 80 Bytes / resident
```

```
    :! other files:  [500000000530001] IMG_3479.JPG
:! sector 1240448 size: 4.09 MB (4,285,353 Bytes) / first data
    :! other files:  [500000000520001] IMG_3478.JPG
:! MFT number=73
:! Parent MFT number=42

SF/Sea-Lions/IMG_3589.JPG
:! Id=4a0001
:! Size=4.44 MB (4,651,043 Bytes)
:! Created=2023-04-05 12:03 AM
:! Modified=2009-06-06 06:00 AM
:! Accessed=2023-04-05 12:03 AM
:! File type=JPEG Digital Camera
:! Recovery chances=Good (Existing file)
:! Regions (sector size=512B):
:! sector 682812 (offset: 80 ) size: 48 Bytes / resident
    :! other files:  [500000000530001] IMG_3479.JPG
:! sector 682812 (offset: 152 ) size: 90 Bytes / resident
    :! other files:  [500000000540001] IMG_3480.JPG
:! sector 682812 (offset: 272 ) size: 80 Bytes / resident
    :! other files:  [500000000540001] IMG_3480.JPG
:! sector 1273216 size: 4.44 MB (4,651,043 Bytes) / first data
    :! other files:  [500000000530001] IMG_3479.JPG
:! MFT number=74
:! Parent MFT number=42

SF/IMG_0869.JPG
:! Id=4b0001
:! Size=3.53 MB (3,698,659 Bytes)
:! Created=2023-04-05 12:05 AM
:! Modified=2009-05-30 09:13 PM
:! Accessed=2023-04-05 12:05 AM
:! File type=JPEG Digital Camera
:! Recovery chances=Good (Existing file)
:! Regions (sector size=512B):
:! sector 682814 (offset: 80 ) size: 48 Bytes / resident
    :! other files:  [500000000550001] IMG_3481.JPG
:! sector 682814 (offset: 152 ) size: 90 Bytes / resident
    :! other files:  [500000000550001] IMG_3481.JPG
:! sector 682814 (offset: 272 ) size: 80 Bytes / resident
    :! other files:  [500000000550001] IMG_3481.JPG
:! sector 1305984 size: 3.53 MB (3,698,659 Bytes) / first data
    :! other files:  [500000000540001] IMG_3480.JPG
:! MFT number=75
:! Parent MFT number=41

SF/IMG_0873.JPG
:! Id=4c0001
:! Size=5.61 MB (5,881,104 Bytes)
:! Created=2023-04-05 12:05 AM
:! Modified=2009-05-30 09:15 PM
:! Accessed=2023-04-05 07:35 PM
:! File type=JPEG Digital Camera
```

```
:! Recovery chances=Good (Existing file)
:! Regions (sector size=512B):
:! sector 682816 (offset: 80 ) size: 48 Bytes / resident
    :! other files:  [500000000560001] IMG_3493.JPG
:! sector 682816 (offset: 152 ) size: 90 Bytes / resident
    :! other files:  [500000000560001] IMG_3493.JPG
:! sector 682816 (offset: 272 ) size: 16 Bytes / resident
    :! other files:  [500000000570001] IMG_3535.JPG
:! sector 682816 (offset: 312 ) size: 80 Bytes / resident
    :! other files:  [500000000570001] IMG_3535.JPG
:! sector 1338752 size: 5.61 MB (5,881,104 Bytes) / first data
    :! other files:  [500000000560001] IMG_3493.JPG
:! MFT number=76
:! Parent MFT number=41

SF/IMG_0890.JPG
:! Id=4d0001
:! Size=5.40 MB (5,663,358 Bytes)
:! Created=2023-04-05 12:05 AM
:! Modified=2009-05-30 09:47 PM
:! Accessed=2023-04-05 12:05 AM
:! File type=JPEG Digital Camera
:! Recovery chances=Good (Existing file)
:! Regions (sector size=512B):
:! sector 682818 (offset: 80 ) size: 48 Bytes / resident
    :! other files:  [500000000580001] IMG_3542.JPG
:! sector 682818 (offset: 152 ) size: 90 Bytes / resident
    :! other files:  [500000000580001] IMG_3542.JPG
:! sector 682818 (offset: 272 ) size: 80 Bytes / resident
    :! other files:  [500000000580001] IMG_3542.JPG
:! sector 1371520 size: 5.40 MB (5,663,358 Bytes) / first data
    :! other files:  [500000000570001] IMG_3535.JPG
:! MFT number=77
:! Parent MFT number=41

SF/IMG_1739.JPG
:! Id=4e0001
:! Size=4.07 MB (4,266,181 Bytes)
:! Created=2023-04-05 12:05 AM
:! Modified=2009-06-03 08:59 PM
:! Accessed=2023-04-05 12:05 AM
:! File type=JPEG Digital Camera
:! Recovery chances=Good (Existing file)
:! Regions (sector size=512B):
:! sector 682820 (offset: 80 ) size: 48 Bytes / resident
    :! other files:  [500000000590001] IMG_3579.JPG
:! sector 682820 (offset: 152 ) size: 90 Bytes / resident
    :! other files:  [500000000590001] IMG_3579.JPG
:! sector 682820 (offset: 272 ) size: 80 Bytes / resident
    :! other files:  [5000000005a0001] IMG_3580.JPG
:! sector 1404288 size: 4.07 MB (4,266,181 Bytes) / first data
    :! other files:  [500000000590001] IMG_3579.JPG
:! MFT number=78
```

```
:! Parent MFT number=41

SF/IMG_3460.JPG
:! Id=4f0001
:! Size=4.38 MB (4,593,453 Bytes)
:! Created=2023-04-05 12:05 AM
:! Modified=2009-06-06 03:58 AM
:! Accessed=2023-04-05 12:05 AM
:! File type=JPEG Digital Camera
:! Recovery chances=Good (Existing file)
:! Regions (sector size=512B):
:! sector 682822 (offset: 80 ) size: 48 Bytes / resident
    :! other files:  [5000000005a0001] IMG_3580.JPG
:! sector 682822 (offset: 152 ) size: 90 Bytes / resident
    :! other files:  [5000000005b0001] IMG_3581.JPG
:! sector 682822 (offset: 272 ) size: 80 Bytes / resident
    :! other files:  [5000000005b0001] IMG_3581.JPG
:! sector 1469824 size: 4.38 MB (4,593,453 Bytes) / first data
    :! other files:  [5000000005a0001] IMG_3580.JPG
:! MFT number=79
:! Parent MFT number=41

SF/IMG_3461.JPG
:! Id=500001
:! Size=3.91 MB (4,102,032 Bytes)
:! Created=2023-04-05 12:05 AM
:! Modified=2009-06-06 03:58 AM
:! Accessed=2023-04-05 12:05 AM
:! File type=JPEG Digital Camera
:! Recovery chances=Good (Existing file)
:! Regions (sector size=512B):
:! sector 682824 (offset: 80 ) size: 48 Bytes / resident
    :! other files:  [5000000005c0001] IMG_3589.JPG
:! sector 682824 (offset: 152 ) size: 90 Bytes / resident
    :! other files:  [5000000005c0001] IMG_3589.JPG
:! sector 682824 (offset: 272 ) size: 80 Bytes / resident
    :! other files:  [5000000005c0001] IMG_3589.JPG
:! sector 1502592 size: 3.91 MB (4,102,032 Bytes) / first data
    :! other files:  [5000000005b0001] IMG_3581.JPG
:! MFT number=80
:! Parent MFT number=41

SF/IMG_3476.JPG
:! Id=510001
:! Size=3.92 MB (4,114,595 Bytes)
:! Created=2023-04-05 12:05 AM
:! Modified=2009-06-06 04:02 AM
:! Accessed=2023-04-05 12:05 AM
:! File type=JPEG Digital Camera
:! Recovery chances=Good (Existing file)
:! Regions (sector size=512B):
:! sector 682826 (offset: 80 ) size: 48 Bytes / resident
    :! other files:  [5000000005d0001] IMG_3590.JPG
```

```
:! sector 682826 (offset: 152 ) size: 90 Bytes / resident
    :! other files:  [5000000005d0001] IMG_3590.JPG
:! sector 682826 (offset: 272 ) size: 80 Bytes / resident
    :! other files:  [5000000005e0001] IMG_3591.JPG
:! sector 1535360 size: 3.92 MB (4,114,595 Bytes) / first data
    :! other files:  [5000000005d0001] IMG_3590.JPG
:! MFT number=81
:! Parent MFT number=41

SF/IMG_3478.JPG
:! Id=520001
:! Size=4.74 MB (4,968,784 Bytes)
:! Created=2023-04-05 12:05 AM
:! Modified=2009-06-06 04:03 AM
:! Accessed=2023-04-05 07:35 PM
:! File type=JPEG Digital Camera
:! Recovery chances=Good (Existing file)
:! Regions (sector size=512B):
:! sector 682828 (offset: 80 ) size: 48 Bytes / resident
    :! other files:  [5000000005e0001] IMG_3591.JPG
:! sector 682828 (offset: 152 ) size: 90 Bytes / resident
    :! other files:  [5000000005f0001] IMG_3592.JPG
:! sector 682828 (offset: 272 ) size: 80 Bytes / resident
    :! other files:  [5000000005f0001] IMG_3592.JPG
:! sector 1568128 size: 4.74 MB (4,968,784 Bytes) / first data
    :! other files:  [5000000005e0001] IMG_3591.JPG
:! MFT number=82
:! Parent MFT number=41

SF/IMG_3479.JPG
:! Id=530001
:! Size=4.28 MB (4,484,110 Bytes)
:! Created=2023-04-05 12:05 AM
:! Modified=2009-06-06 04:03 AM
:! Accessed=2023-04-05 12:05 AM
:! File type=JPEG Digital Camera
:! Recovery chances=Good (Existing file)
:! Regions (sector size=512B):
:! sector 682830 (offset: 80 ) size: 48 Bytes / resident
    :! other files:  [500000000600001] IMG_3593.JPG
:! sector 682830 (offset: 152 ) size: 90 Bytes / resident
    :! other files:  [500000000600001] IMG_3593.JPG
:! sector 682830 (offset: 272 ) size: 80 Bytes / resident
    :! other files:  [500000000600001] IMG_3593.JPG
:! sector 1600896 size: 4.28 MB (4,484,110 Bytes) / first data
    :! other files:  [5000000005f0001] IMG_3592.JPG
:! MFT number=83
:! Parent MFT number=41

SF/IMG_3480.JPG
:! Id=540001
:! Size=4.28 MB (4,491,209 Bytes)
:! Created=2023-04-05 12:05 AM
```

```
:! Modified=2009-06-06 04:03 AM
:! Accessed=2023-04-05 12:05 AM
:! File type=JPEG Digital Camera
:! Recovery chances=Good (Existing file)
:! Regions (sector size=512B):
:! sector 682832 (offset: 80 ) size: 48 Bytes / resident
    :! other files:  [500000000610001] IMG_3594.JPG
:! sector 682832 (offset: 152 ) size: 90 Bytes / resident
    :! other files:  [500000000610001] IMG_3594.JPG
:! sector 682832 (offset: 272 ) size: 80 Bytes / resident
    :! other files:  [500000000620001] IMG_3595.JPG
:! sector 1633664 size: 4.28 MB (4,491,209 Bytes) / first data
    :! other files:  [500000000610001] IMG_3594.JPG
:! MFT number=84
:! Parent MFT number=41

SF/IMG_3481.JPG
:! Id=550001
:! Size=3.38 MB (3,541,845 Bytes)
:! Created=2023-04-05 12:05 AM
:! Modified=2009-06-20 10:00 PM
:! Accessed=2023-04-05 12:05 AM
:! File type=JPEG Digital Camera
:! Recovery chances=Good (Existing file)
:! Regions (sector size=512B):
:! sector 682834 (offset: 80 ) size: 48 Bytes / resident
    :! other files:  [500000000620001] IMG_3595.JPG
:! sector 682834 (offset: 152 ) size: 90 Bytes / resident
    :! other files:  [500000000630001] IMG_3596.JPG
:! sector 682834 (offset: 272 ) size: 80 Bytes / resident
    :! other files:  [500000000630001] IMG_3596.JPG
:! sector 1666432 size: 3.38 MB (3,541,845 Bytes) / first data
    :! other files:  [500000000620001] IMG_3595.JPG
:! MFT number=85
:! Parent MFT number=41

SF/IMG_3493.JPG
:! Id=560001
:! Size=4.75 MB (4,985,023 Bytes)
:! Flags=deleted
:! Created=2023-04-05 12:05 AM
:! Modified=2009-06-06 05:50 AM
:! Accessed=2023-04-05 12:05 AM
:! File type=JPEG Digital Camera
:! Recovery chances=Good (Integrity OK, Unfragmented)
:! Regions (sector size=512B):
:! sector 682836 (offset: 80 ) size: 48 Bytes / resident
    :! other files:  [500000000640001] IMG_3608.JPG
:! sector 682836 (offset: 152 ) size: 90 Bytes / resident
    :! other files:  [500000000640001] IMG_3608.JPG
:! sector 682836 (offset: 272 ) size: 80 Bytes / resident
    :! other files:  [500000000640001] IMG_3608.JPG
:! sector 1699200 size: 4.75 MB (4,985,023 Bytes) / first data
```

```
    :! other files:  [500000000630001] IMG_3596.JPG
:! MFT number=86
:! Parent MFT number=41

SF/IMG_3535.JPG
:! Id=570001
:! Size=3.55 MB (3,718,479 Bytes)
:! Flags=deleted
:! Created=2023-04-05 12:05 AM
:! Modified=2009-06-06 05:55 AM
:! Accessed=2023-04-05 12:05 AM
:! File type=JPEG Digital Camera
:! Recovery chances=Good (Integrity OK, Unfragmented)
:! Regions (sector size=512B):
:! sector 682838 (offset: 80 ) size: 48 Bytes / resident
    :! other files:  [500000000650001] IMG_3627.JPG
:! sector 682838 (offset: 152 ) size: 90 Bytes / resident
    :! other files:  [500000000650001] IMG_3627.JPG
:! sector 682838 (offset: 272 ) size: 80 Bytes / resident
    :! other files:  [500000000400001] MyPhoto6.JPG
:! sector 1731968 size: 3.55 MB (3,718,479 Bytes) / first data
    :! other files:  [500000000650001] IMG_3627.JPG
:! MFT number=87
:! Parent MFT number=41

SF/IMG_3542.JPG
:! Id=580001
:! Size=3.92 MB (4,110,749 Bytes)
:! Flags=deleted
:! Created=2023-04-05 12:05 AM
:! Modified=2009-06-06 05:57 AM
:! Accessed=2023-04-05 12:05 AM
:! File type=JPEG Digital Camera
:! Recovery chances=Good (Integrity OK, Unfragmented)
:! Regions (sector size=512B):
:! sector 682840 (offset: 80 ) size: 48 Bytes / resident
    :! other files:  [500000000610001] IMG_3594.JPG
:! sector 682840 (offset: 152 ) size: 90 Bytes / resident
    :! other files:  [500000000420001] MyPhoto8.JPG
:! sector 682840 (offset: 272 ) size: 80 Bytes / resident
    :! other files:  [500000000430001] MyPhoto9.JPG
:! sector 1764736 size: 3.92 MB (4,110,749 Bytes) / first data
    :! other files:  [500000000410001] MyPhoto7.JPG
:! MFT number=88
:! Parent MFT number=41

SF/IMG_3579.JPG
:! Id=590001
:! Size=3.92 MB (4,109,345 Bytes)
:! Flags=deleted
:! Created=2023-04-05 12:05 AM
:! Modified=2009-06-06 05:59 AM
:! Accessed=2023-04-05 12:05 AM
```

```
:! File type=JPEG Digital Camera
:! Recovery chances=Good (Integrity OK, Unfragmented)
:! Regions (sector size=512B):
:! sector 682842 (offset: 80 ) size: 48 Bytes / resident
    :! other files:  [500000000370001] IMG_0390.JPG
:! sector 682842 (offset: 152 ) size: 90 Bytes / resident
    :! other files:  [500000000380001] IMG_0391.JPG
:! sector 682842 (offset: 272 ) size: 80 Bytes / resident
    :! other files:  [500000000450001] IMG_3535.JPG
:! sector 1797504 size: 3.92 MB (4,109,345 Bytes) / first data
    :! other files:  [500000000440001] IMG_3493.JPG
:! MFT number=89
:! Parent MFT number=41

SF/IMG_3580.JPG
:! Id=5a0001
:! Size=3.35 MB (3,510,477 Bytes)
:! Flags=deleted
:! Created=2023-04-05 12:05 AM
:! Modified=2009-06-06 05:59 AM
:! Accessed=2023-04-05 12:05 AM
:! File type=JPEG Digital Camera
:! Recovery chances=Good (Integrity OK, Unfragmented)
:! Regions (sector size=512B):
:! sector 682844 (offset: 80 ) size: 48 Bytes / resident
    :! other files:  [500000000470001] IMG_3579.JPG
:! sector 682844 (offset: 152 ) size: 90 Bytes / resident
    :! other files:  [500000000620001] IMG_3595.JPG
:! sector 682844 (offset: 272 ) size: 80 Bytes / resident
    :! other files:  [500000000480001] IMG_3580.JPG
:! sector 1830272 size: 3.35 MB (3,510,477 Bytes) / first data
    :! other files:  [500000000460001] IMG_3542.JPG
:! MFT number=90
:! Parent MFT number=41

SF/IMG_3581.JPG
:! Id=5b0001
:! Size=4.09 MB (4,285,353 Bytes)
:! Flags=deleted
:! Created=2023-04-05 12:05 AM
:! Modified=2009-06-06 05:59 AM
:! Accessed=2023-04-05 12:05 AM
:! File type=JPEG Digital Camera
:! Recovery chances=Good (Integrity OK, Unfragmented)
:! Regions (sector size=512B):
:! sector 682846 (offset: 80 ) size: 48 Bytes / resident
    :! other files:  [5000000004a0001] IMG_3589.JPG
:! sector 682846 (offset: 152 ) size: 90 Bytes / resident
    :! other files:  [5000000003b0001] 20190822_100644.jpg
:! sector 682846 (offset: 272 ) size: 80 Bytes / resident
    :! other files:  [5000000003c0001] 20190822_101620.jpg
:! sector 1863040 size: 4.09 MB (4,285,353 Bytes) / first data
    :! other files:  [500000000490001] IMG_3581.JPG
```

```
:! MFT number=91
:! Parent MFT number=41

SF/IMG_3589.JPG
:! Id=5c0001
:! Size=4.44 MB (4,651,043 Bytes)
:! Flags=deleted
:! Created=2023-04-05 12:05 AM
:! Modified=2009-06-06 06:00 AM
:! Accessed=2023-04-05 12:05 AM
:! File type=JPEG Digital Camera
:! Recovery chances=Good (Integrity OK, Unfragmented)
:! Regions (sector size=512B):
:! sector 682848 (offset: 80 ) size: 48 Bytes / resident
    :! other files:  [5000000004c0001] IMG_0873.JPG
:! sector 682848 (offset: 152 ) size: 90 Bytes / resident
    :! other files:  [500000000330001] IMG_0211.JPG
:! sector 682848 (offset: 272 ) size: 80 Bytes / resident
    :! other files:  [500000000340001] IMG_0250.JPG
:! sector 1895808 size: 4.44 MB (4,651,043 Bytes) / first data
    :! other files:  [5000000004b0001] IMG_0869.JPG
:! MFT number=92
:! Parent MFT number=41

SF/IMG_3590.JPG
:! Id=5d0001
:! Size=4.67 MB (4,899,941 Bytes)
:! Flags=deleted
:! Created=2023-04-05 12:05 AM
:! Modified=2009-06-06 06:00 AM
:! Accessed=2023-04-05 07:35 PM
:! File type=JPEG Digital Camera
:! Recovery chances=Good (Integrity OK, Unfragmented)
:! Regions (sector size=512B):
:! sector 682850 (offset: 80 ) size: 48 Bytes / resident
    :! other files:  [500000000350001] IMG_0283.JPG
:! sector 682850 (offset: 152 ) size: 90 Bytes / resident
    :! other files:  [500000000360001] IMG_0389.JPG
:! sector 682850 (offset: 272 ) size: 80 Bytes / resident
    :! other files:  [5000000004e0001] IMG_1739.JPG
:! sector 1928576 size: 4.67 MB (4,899,941 Bytes) / first data
    :! other files:  [5000000004d0001] IMG_0890.JPG
:! MFT number=93
:! Parent MFT number=41

SF/IMG_3591.JPG
:! Id=5e0001
:! Size=4.08 MB (4,280,042 Bytes)
:! Flags=deleted
:! Created=2023-04-05 12:05 AM
:! Modified=2009-06-06 06:00 AM
:! Accessed=2023-04-05 12:05 AM
:! File type=JPEG Digital Camera
```

```
:! Recovery chances=Good (Integrity OK, Unfragmented)
:! Regions (sector size=512B):
:! sector 682852 (offset: 80 ) size: 48 Bytes / resident
    :! other files:  [5000000004f0001] IMG_3460.JPG
:! sector 682852 (offset: 152 ) size: 90 Bytes / resident
    :! other files:  [5000000003d0001] 20190822_102526.jpg
:! sector 682852 (offset: 272 ) size: 80 Bytes / resident
    :! other files:  [5000000003e0001] 20190822_103830.jpg
:! sector 1961344 size: 4.08 MB (4,280,042 Bytes) / first data
    :! other files:  [500000000630001] IMG_3596.JPG
:! MFT number=94
:! Parent MFT number=41

SF/IMG_3592.JPG
:! Id=5f0001
:! Size=5.04 MB (5,285,211 Bytes)
:! Flags=deleted
:! Created=2023-04-05 12:05 AM
:! Modified=2009-06-06 06:00 AM
:! Accessed=2023-04-05 12:05 AM
:! File type=JPEG Digital Camera
:! Recovery chances=Good (Integrity OK, Unfragmented)
:! Regions (sector size=512B):
:! sector 682854 (offset: 80 ) size: 48 Bytes / resident
    :! other files:  [500000000510001] IMG_3476.JPG
:! sector 682854 (offset: 152 ) size: 90 Bytes / resident
    :! other files:  [500000000520001] IMG_3478.JPG
:! sector 682854 (offset: 272 ) size: 80 Bytes / resident
    :! other files:  [500000000390001] IMG_3694.JPG
:! sector 1994112 size: 5.04 MB (5,285,211 Bytes) / first data
    :! other files:  [500000000500001] IMG_3461.JPG
:! MFT number=95
:! Parent MFT number=41

SF/IMG_3593.JPG
:! Id=600001
:! Size=4.74 MB (4,969,442 Bytes)
:! Flags=deleted
:! Created=2023-04-05 12:05 AM
:! Modified=2009-06-06 06:00 AM
:! Accessed=2023-04-05 12:05 AM
:! File type=JPEG Digital Camera
:! Recovery chances=Good (Integrity OK, Unfragmented)
:! Regions (sector size=512B):
:! sector 682856 (offset: 80 ) size: 48 Bytes / resident
    :! other files:  [500000000530001] IMG_3479.JPG
:! sector 682856 (offset: 152 ) size: 90 Bytes / resident
    :! other files:  [500000000540001] IMG_3480.JPG
:! sector 682856 (offset: 272 ) size: 80 Bytes / resident
    :! other files:  [5000000003f0001] 20190822_104333.jpg
:! sector 2026880 size: 4.74 MB (4,969,442 Bytes) / first data
    :! other files:  [5000000003a0001] IMG_3699.JPG
:! MFT number=96
```

```
:! Parent MFT number=41

SF/IMG_3594.JPG
:! Id=610001
:! Size=4.69 MB (4,917,237 Bytes)
:! Flags=deleted
:! Created=2023-04-05 12:05 AM
:! Modified=2009-06-06 06:00 AM
:! Accessed=2023-04-05 12:05 AM
:! File type=JPEG Digital Camera
:! Recovery chances=Good (Integrity OK, Unfragmented)
:! Regions (sector size=512B):
:! sector 682858 (offset: 80 ) size: 48 Bytes / resident
    :! other files:  [500000000640001] IMG_3608.JPG, [500000000320001] IMG_0201.JP
:! sector 682858 (offset: 152 ) size: 90 Bytes / resident
    :! other files:  [500000000640001] IMG_3608.JPG, [500000000320001] IMG_0201.JP
:! sector 682858 (offset: 272 ) size: 80 Bytes / resident
    :! other files:  [5000000002e0001] MyPhoto3.jpg
:! sector 973080 size: 4.69 MB (4,917,237 Bytes) / first data
    :! other files:  [500000000550001] IMG_3481.JPG
:! MFT number=97
:! Parent MFT number=41

SF/IMG_3595.JPG
:! Id=620001
:! Size=5.09 MB (5,338,697 Bytes)
:! Flags=deleted
:! Created=2023-04-05 12:05 AM
:! Modified=2009-06-06 06:00 AM
:! Accessed=2023-04-05 12:05 AM
:! File type=JPEG Digital Camera
:! Recovery chances=Good (Integrity OK, Unfragmented)
:! Regions (sector size=512B):
:! sector 682860 (offset: 80 ) size: 48 Bytes / resident
    :! other files:  [500000000560001] IMG_3493.JPG
:! sector 682860 (offset: 152 ) size: 90 Bytes / resident
    :! other files:  [500000000570001] IMG_3535.JPG
:! sector 682860 (offset: 272 ) size: 80 Bytes / resident
    :! other files:  [500000000580001] IMG_3542.JPG
:! sector 1174920 size: 5.09 MB (5,338,697 Bytes) / first data
    :! other files:  [500000000300001] MyPhoto5.jpg
:! MFT number=98
:! Parent MFT number=41

SF/IMG_3596.JPG
:! Id=630001
:! Size=4.93 MB (5,174,072 Bytes)
:! Flags=deleted
:! Created=2023-04-05 12:05 AM
:! Modified=2009-06-06 06:00 AM
:! Accessed=2023-04-05 12:05 AM
:! File type=JPEG Digital Camera
:! Recovery chances=Good (Integrity OK, Unfragmented)
```

```
:! Regions (sector size=512B):
:! sector 682862 (offset: 80 ) size: 48 Bytes / resident
    :! other files:  [5000000005a0001] IMG_3580.JPG
:! sector 682862 (offset: 152 ) size: 90 Bytes / resident
    :! other files:  [500000000650001] IMG_3627.JPG
:! sector 682862 (offset: 272 ) size: 80 Bytes / resident
    :! other files:  [5000000005b0001] IMG_3581.JPG
:! sector 1437064 size: 4.93 MB (5,174,072 Bytes) / first data
    :! other files:  [500000000590001] IMG_3579.JPG
:! MFT number=99
:! Parent MFT number=41

SF/IMG_3608.JPG
:! Id=640001
:! Size=5.01 MB (5,257,021 Bytes)
:! Flags=deleted
:! Created=2023-04-05 12:05 AM
:! Modified=2009-06-06 06:01 AM
:! Accessed=2023-04-05 12:05 AM
:! File type=JPEG Digital Camera
:! Recovery chances=Below Average (Integrity OK, Beginning overwritten by existing
:! Regions (sector size=512B):
:! sector 682864 (offset: 80 ) size: 48 Bytes / resident
    :! other files:  [5000000005d0001] IMG_3590.JPG
:! sector 682864 (offset: 152 ) size: 90 Bytes / resident
    :! other files:  [5000000005e0001] IMG_3591.JPG
:! sector 682864 (offset: 272 ) size: 80 Bytes / resident
    :! other files:  [5000000005f0001] IMG_3592.JPG
:! sector 1673352 size: 5.01 MB (5,257,021 Bytes) / first data
    :! other files:  [5000000005c0001] IMG_3589.JPG
:! Overlapping files=[500000000320001] IMG_0201.JPG
:! MFT number=100
:! Parent MFT number=41

SF/IMG_3627.JPG
:! Id=650001
:! Size=3.48 MB (3,651,691 Bytes)
:! Flags=deleted
:! Created=2023-04-05 12:05 AM
:! Modified=2009-06-06 06:02 AM
:! Accessed=2023-04-05 12:05 AM
:! File type=JPEG Digital Camera
:! Recovery chances=Good (Integrity OK, Unfragmented)
:! Regions (sector size=512B):
:! sector 682866 (offset: 80 ) size: 48 Bytes / resident
    :! other files:  [5000000002c0001] MyPhoto1.jpg
:! sector 682866 (offset: 152 ) size: 90 Bytes / resident
    :! other files:  [5000000002d0001] MyPhoto2.jpg
:! sector 682866 (offset: 272 ) size: 80 Bytes / resident
    :! other files:  [5000000002f0001] MyPhoto4.JPG
:! sector 1837136 size: 3.48 MB (3,651,691 Bytes) / first data
    :! other files:  [500000000600001] IMG_3593.JPG
:! MFT number=101
```

```
:! Parent MFT number=41

MyPhoto6.JPG
:! Id=400001
:! Size=1.07 MB (1,123,560 Bytes)
:! Created=2023-04-04 11:13 PM
:! Modified=2009-04-29 01:54 PM
:! Accessed=2023-04-04 11:13 PM
:! File type=JPEG Digital Camera
:! Recovery chances=Good (Existing file)
:! Regions (sector size=512B):
:! sector 682792 (offset: 80 ) size: 48 Bytes / resident
    :! other files:  [500000000460001] IMG_3542.JPG
:! sector 682792 (offset: 152 ) size: 90 Bytes / resident
    :! other files:  [500000000470001] IMG_3579.JPG
:! sector 682792 (offset: 272 ) size: 80 Bytes / resident
    :! other files:  [500000000470001] IMG_3579.JPG
:! sector 938624 size: 1.07 MB (1,123,560 Bytes) / first data
    :! other files:  [500000000460001] IMG_3542.JPG
:! MFT number=64
:! Parent MFT number=5

MyPhoto7.JPG
:! Id=410001
:! Size=842.76 KB (862,983 Bytes)
:! Created=2023-04-04 11:13 PM
:! Modified=2009-04-29 01:55 PM
:! Accessed=2023-04-04 11:13 PM
:! File type=JPEG Digital Camera
:! Recovery chances=Good (Existing file)
:! Regions (sector size=512B):
:! sector 682794 (offset: 80 ) size: 48 Bytes / resident
    :! other files:  [500000000480001] IMG_3580.JPG
:! sector 682794 (offset: 152 ) size: 90 Bytes / resident
    :! other files:  [500000000480001] IMG_3580.JPG
:! sector 682794 (offset: 272 ) size: 80 Bytes / resident
    :! other files:  [500000000480001] IMG_3580.JPG
:! sector 971392 size: 842.76 KB (862,983 Bytes) / first data
    :! other files:  [500000000470001] IMG_3579.JPG
:! MFT number=65
:! Parent MFT number=5

MyPhoto8.JPG
:! Id=420001
:! Size=997.99 KB (1,021,937 Bytes)
:! Created=2023-04-04 11:13 PM
:! Modified=2009-04-29 01:55 PM
:! Accessed=2023-04-04 11:13 PM
:! File type=JPEG Digital Camera
:! Recovery chances=Good (Existing file)
:! Regions (sector size=512B):
:! sector 682796 (offset: 80 ) size: 48 Bytes / resident
    :! other files:  [500000000490001] IMG_3581.JPG
```

```
:! sector 682796 (offset: 152 ) size: 90 Bytes / resident
    :! other files:  [500000000490001] IMG_3581.JPG
:! sector 682796 (offset: 272 ) size: 80 Bytes / resident
    :! other files:  [5000000004a0001] IMG_3589.JPG
:! sector 1004160 size: 997.99 KB (1,021,937 Bytes) / first data
    :! other files:  [500000000490001] IMG_3581.JPG
:! MFT number=66
:! Parent MFT number=5

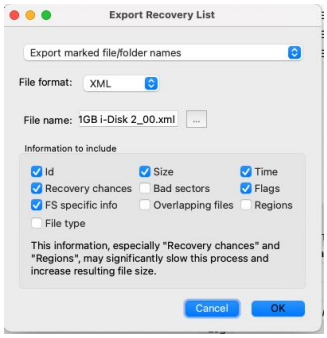
MyPhoto9.JPG
:! Id=430001
:! Size=3.37 MB (3,533,017 Bytes)
:! Created=2023-04-04 11:13 PM
:! Modified=2009-04-29 01:56 PM
:! Accessed=2023-04-04 11:13 PM
:! File type=JPEG Digital Camera
:! Recovery chances=Good (Existing file)
:! Regions (sector size=512B):
:! sector 682798 (offset: 80 ) size: 48 Bytes / resident
    :! other files:  [5000000004a0001] IMG_3589.JPG
:! sector 682798 (offset: 152 ) size: 90 Bytes / resident
    :! other files:  [5000000004b0001] IMG_0869.JPG
:! sector 682798 (offset: 272 ) size: 80 Bytes / resident
    :! other files:  [5000000004b0001] IMG_0869.JPG
:! sector 1036928 size: 3.37 MB (3,533,017 Bytes) / first data
    :! other files:  [5000000004a0001] IMG_3589.JPG
:! MFT number=67
:! Parent MFT number=5
```

Other recovery list formats

You may export recovery lists in the following formats:

XML format

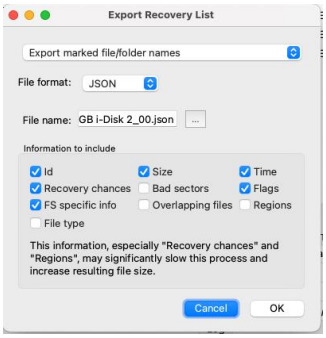
Export Recovery List dialog box for the XML format



JSON format

Custom recovery lists in the text format contains more information about files than simple recovery lists.

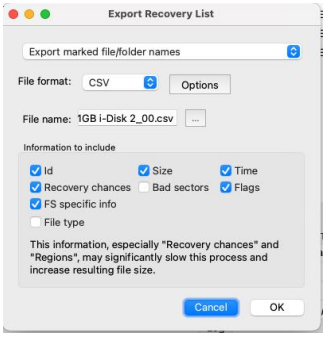
Export Recovery List dialog box for the JSON format



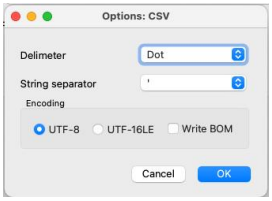
CSV format

Custom recovery lists in the text format contains more information about files than simple recovery lists.

Export Recovery List dialog box for the CSV format



CSV Options dialog box



3.3 Drive Copy Wizard

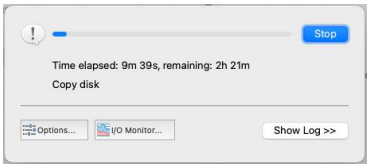
You may copy any object in the Drives panel to any other object, if there is enough space on the target one. Before **Copy object to...** becomes enabled on the **Create** menu, you need to enable writing.

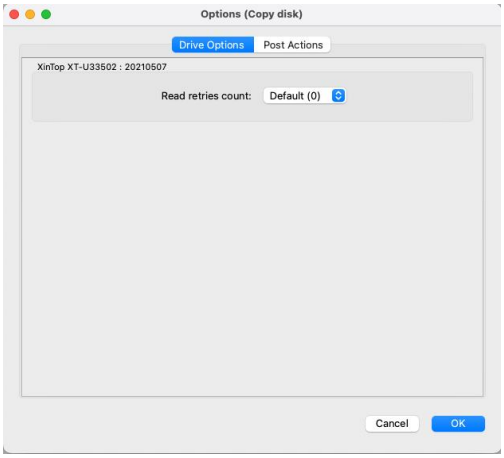
To enable writing,

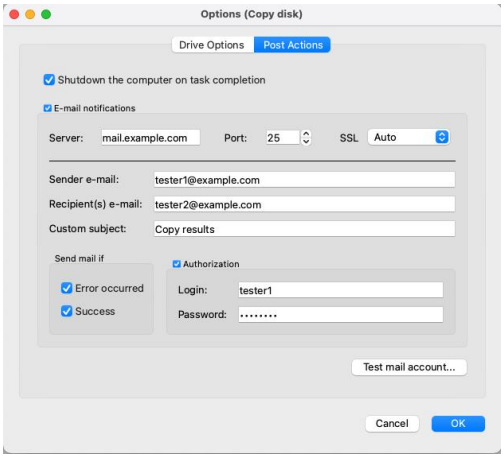
1 **On the R-Studio main panel, select the R-Studio menu, then Preferences, and select Enable Write on the Settings dialog box.**

> **The Copy object to... will be enabled on the Create menu.**
Now objects can be copied.

While the objects are being copied, you may change some parameters and view the I/O monitor on the Object Copy Progress dialog box.







Depending on the objects to copy and your tasks, you may do:

Binary (byte to byte copy)

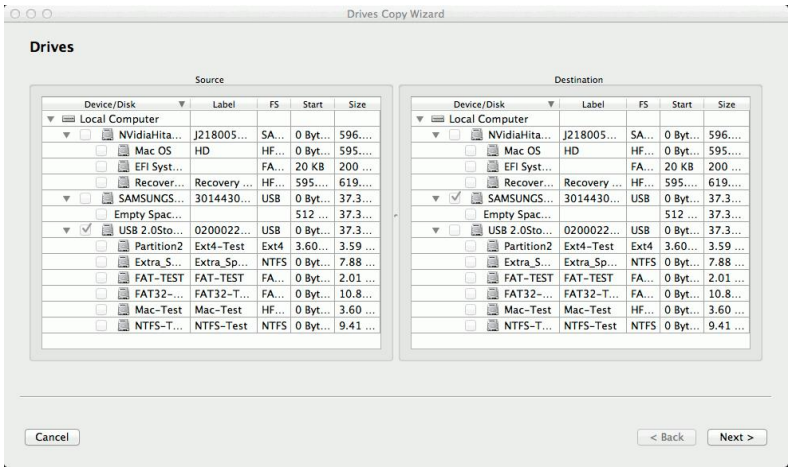
An exact copy of the source object (or a part thereof) to the destination device (from its beginning or a specified offset). Any object may be copied to any object this way.

To perform a binary copy of an object,

1 Select Copy object to... on the Create menu

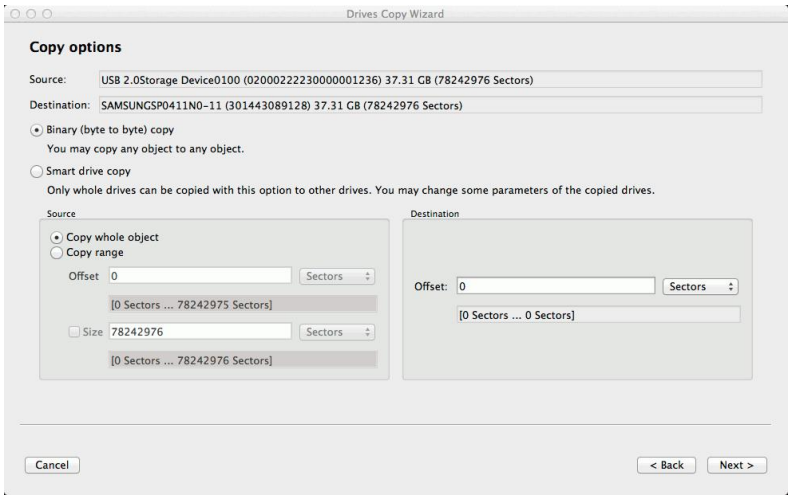
2 Select a source and destination objects on the Drives Copy Wizard **panel and click the Continue button**

Drives Copy Wizard



3 Select Binary (byte to byte) copy **on the** Copy Options **dialog box, specify copy options, and click the Continue button**

Copy options **dialog box**

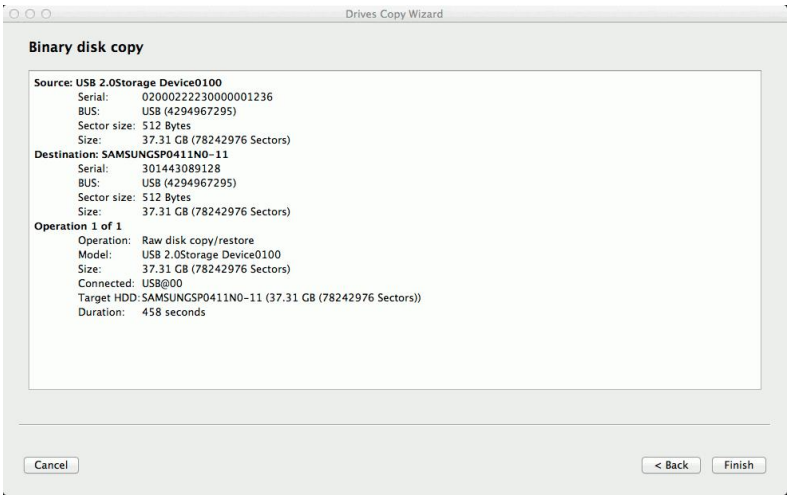


Copy options

Source	
Copy whole object	Select this option if you want to copy the entire source object to the destination one
Copy range	Select this option if you want to copy a part of the source object
Offset	Specify the offset from which the source object data will be copied to the destination object
Size	Specify the size of the source object data which will be copied to the destination object
Destination	
Offset	Specify the offset on the destination object to which the source object data will be copied

3 View the copy task settings on the Drives Copy Wizard **and click the Done button**

Drives Copy Wizard



or click the **Go Back** button to edit the copy parameters

> R-Studio will start copying data from the source object to the destination one.

You may close the wizard by pressing the **Esc** key.

Smart partition copy

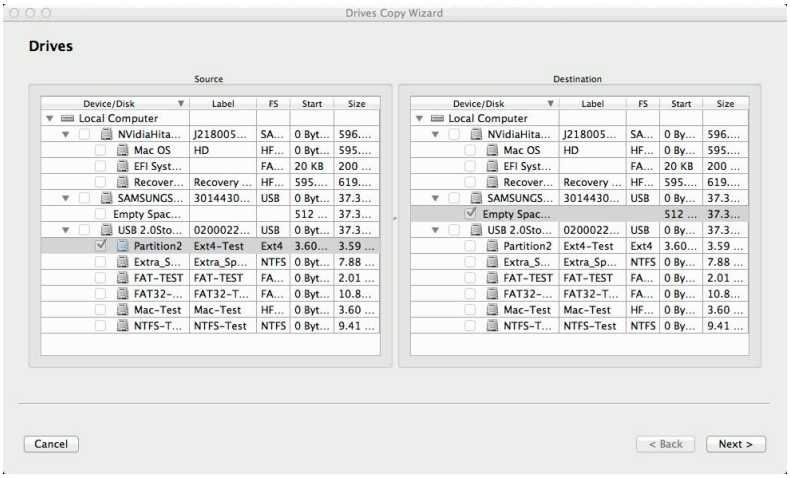
Only partitions can be copied with this option to other partitions or empty spaces. You may change some parameters of the the copied partition(s) on the destination drive.

To perform a smart partition copy of a partition,

1 Select Copy object to... on the Create menu

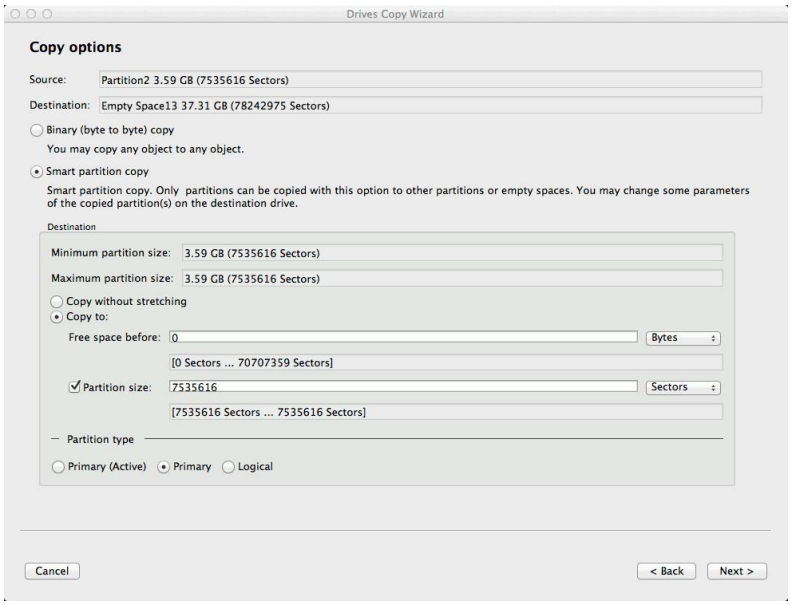
2 Select source and destination partitions on the Drives Copy Wizard **panel and click the Continue button**

Drives Copy Wizard



3 Select Smart partition copy **on the** Copy Options **panel, specify copy options, and click the Continue button**

Copy options **dialog box**

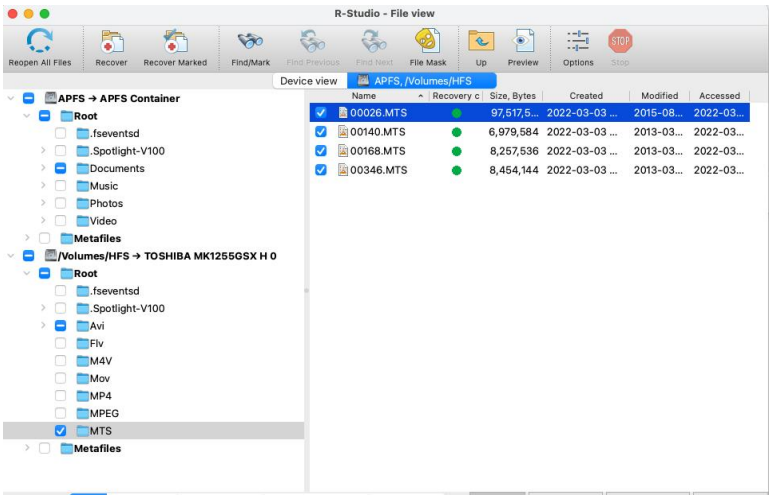


Copy options

Destination	
Copy without stretching	Select this option if you want to copy the partition exactly to the destination place
Copy to:	Select this option if you want to change some parameters of the copied partition on the destination place
Free space before	Specify how much space will be left empty before the start of the copied partition
Partition size	Select this option and specify the new size of the copied partition
Partition type Primary (Active)/ Primary/Logical	Specify the type of the partition to be copied. Do not change this setting unless you have serious reasons to do so.

3 View the copy task settings on the Drives Copy Wizard **and click the Done button**

Drives Copy Wizard



or click the **Go Back** button to edit the copy parameters

> R-Studio will start copying data from the source partition to the destination place.

You may close the wizard by pressing the **Esc** key.

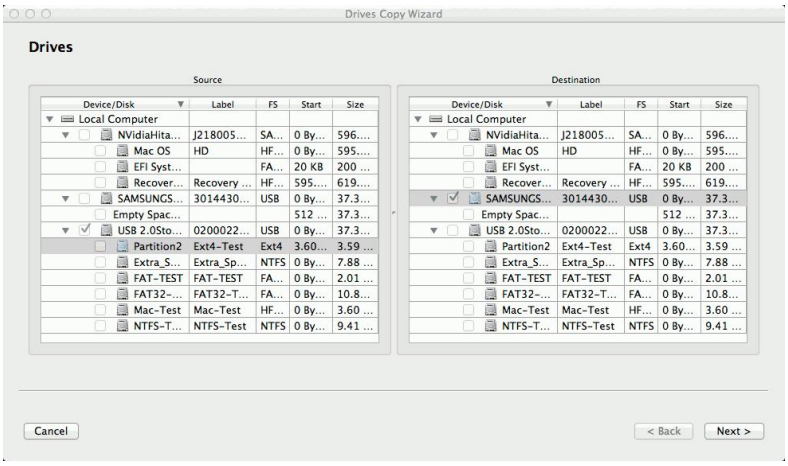
Smart drive copy

Only whole drives can be copied with this option to other drives. You may change some parameters of the copied drives.

1 Select Copy object to... on the Create menu

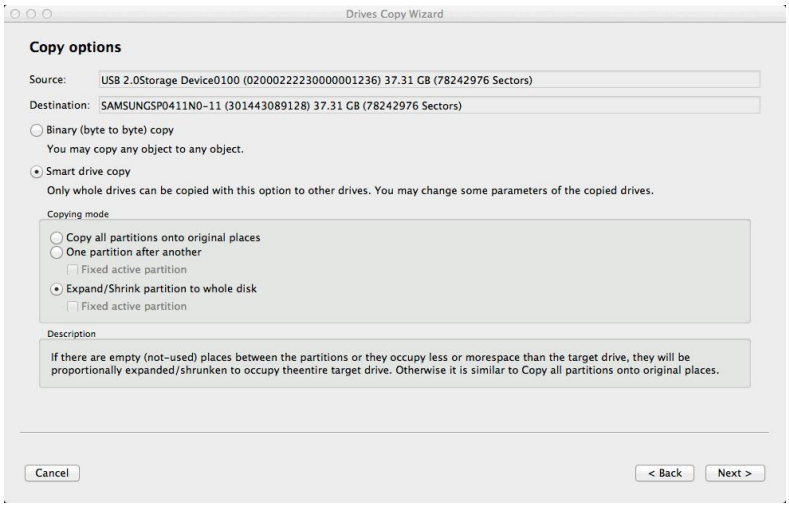
2 Select source and destination hard drives on the Drives Copy Wizard **panel and click the Continue button**

Drives Copy Wizard



3 Select Smart drive copy **on the** Copy Options **panel, specify copy options, and click the Next button**

Copy options **dialog box**

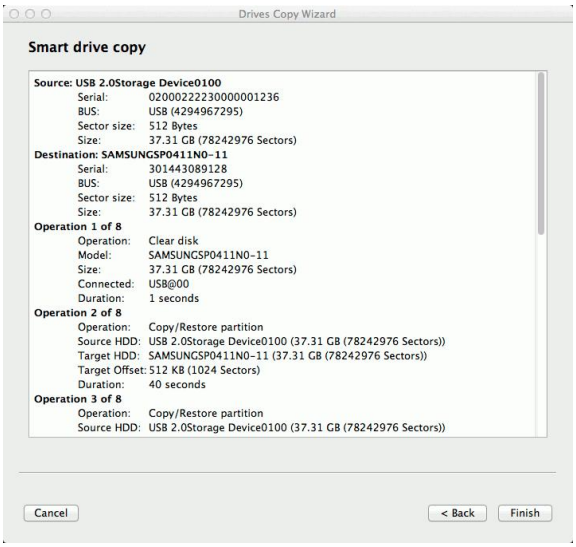


Copy options

Copying mode	
Copy all partitions onto original places	Select this option if you want to copy all partitions to their original places.
One partition after another	Select this option if you want to copy the partitions one after another preserving their space. If there is empty space between the partitions, it will be omitted. Otherwise it is similar to Copy all partitions onto original places. If Fixed active partition is selected, the original offset/size of the active partition will be preserved (in case the loader has links to it).
Expand/Shrink partition to whole disk	Specify this option if you want to proportionally expand/shrink the selected partitions to occupy the entire target drive. If Fixed active partition is selected, the original offset/size of the active partition will be preserved (in case the loader has links to it).

3 View the copy task settings on the Drives Copy Wizard **and click the Finish button**

Drives Copy Wizard



or click the **<Back** button to edit the copy parameters

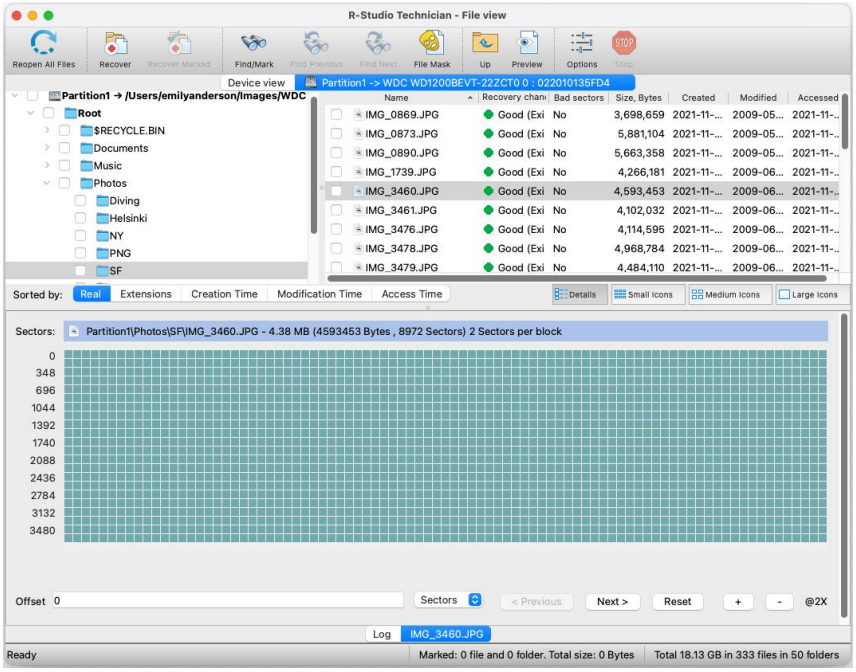
> R-Studio will start copying data from the source hard drive to the destination one

You may close the wizard by pressing the **Esc** key.

3.4 File Maps

R-Studio can show file maps. Control-click the file and select **Map of file** in their contextual menu.

File Map



3.5 I/O Monitor and Sector Map Files

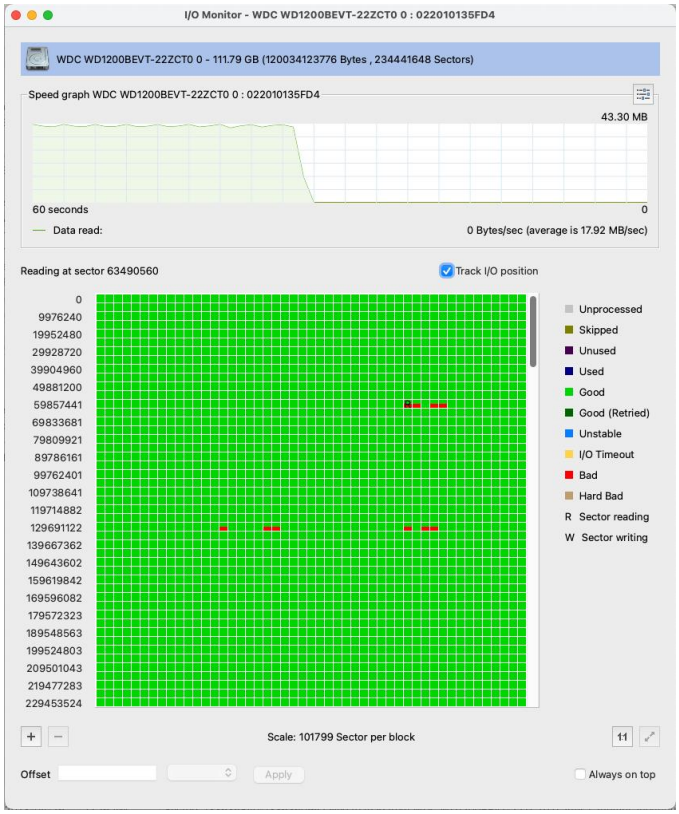
These features greatly improves working with failing drives for **R-Studio**.

I/O Monitor

I/O Monitor allows you to inspect the process of drive input/output operations in real time. When **R-Studio** performs a disk operation the **I/O Monitor button** becomes active.

Click this button, and the **I/O Monitor** will appear.

I/O Monitor



You may also start **I/O Monitor** from the contextual menu and progress dialog boxes during various drive operations.

Sector Map Files

Sector map files are files that contain information about conditions of drive sectors, which may be good, bad, slow, and unstable. **R-Studio** estimates chances for successful file recovery basing on these files and avoiding unnecessary attempts to read bad sectors. Sector map files are crucial for multi-pass imaging.

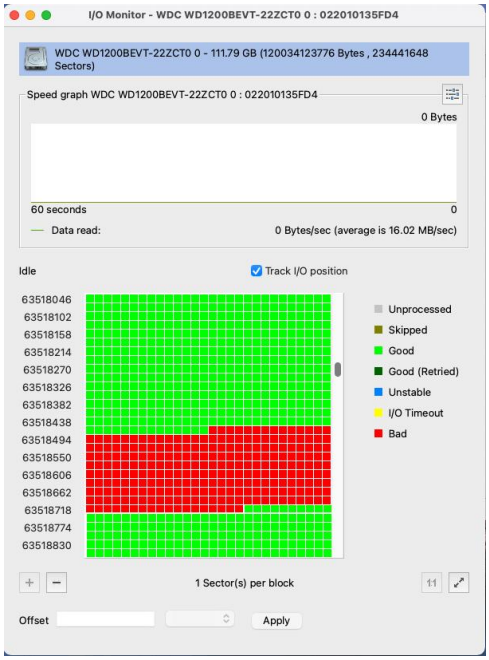
R-Studio creates its own sector map files or can import such files created from other disk imaging programs. Currently **R-Studio** supports sector map files from **HDDSuperClone** and **DDRescue**.

To open, save or clean a sector map file for an object,

* **Control-click the object and select Open Sector Map, Save Sector Map, or Clean Sector Map, respectively, on the contextual menu.**

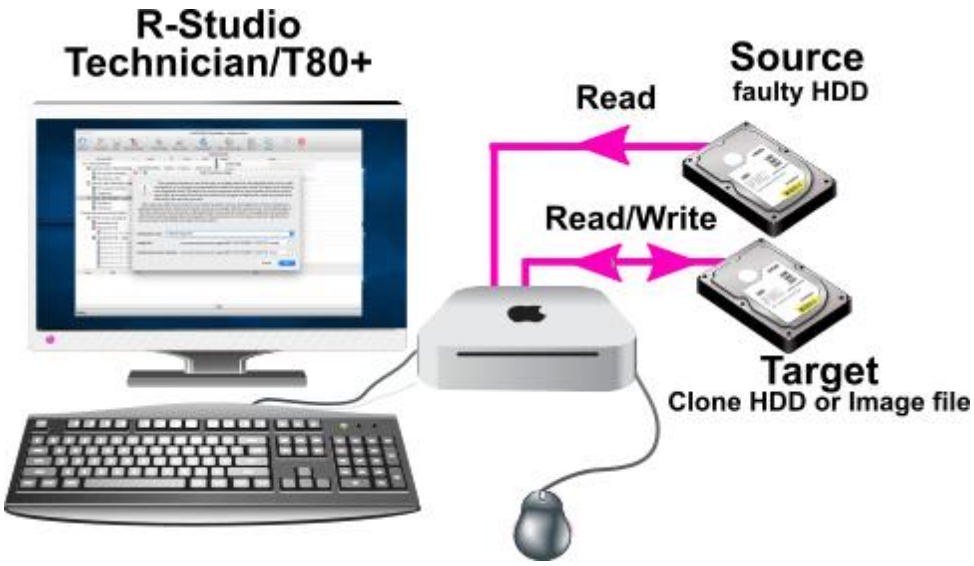
  You may look at the graphical representation of the loaded sector map by starting **I/O Monitor**.

  Sector Map



3.6 Runtime Imaging

Runtime imaging is image creation for a drive object performed simultaneously with other data read operations from this drive. When **R-Studio** reads data from a certain area of the source (a drive, partition, or region), it writes the data to the target which can be either a dedicated drive or an image file. When the data from this area is needed again, **R-Studio** reads it from the target rather than the source thus reducing access to the source. This is very important for faulty or unstable drives which health may be constantly deteriorating during data recovery operations.



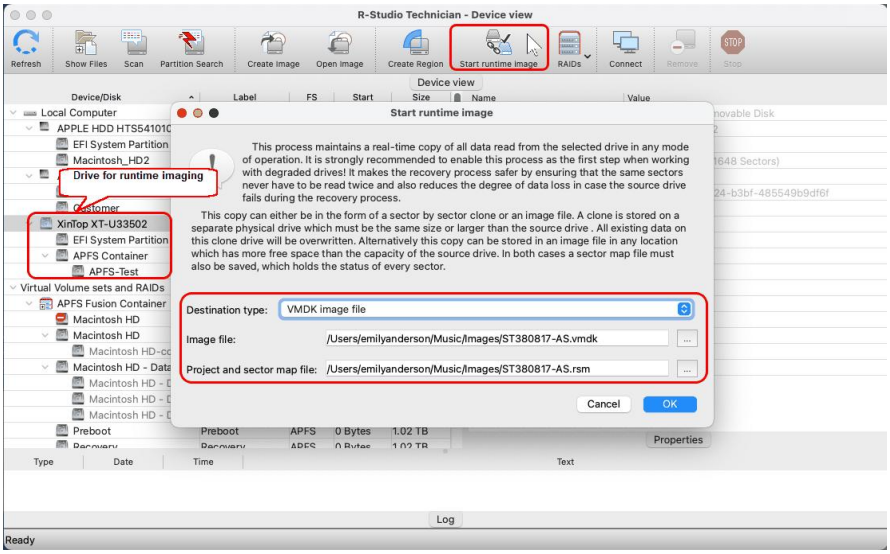
R-Studio also creates a sector map file during runtime imaging.

To start runtime imaging of an object,

using a plain image file

1 **Select a drive object on the R-Studio's** Drives **panel and click the Start Runtime Image button,** or control-click the object and select **Set Runtime Image** on the contextual menu.

Runtime imaging

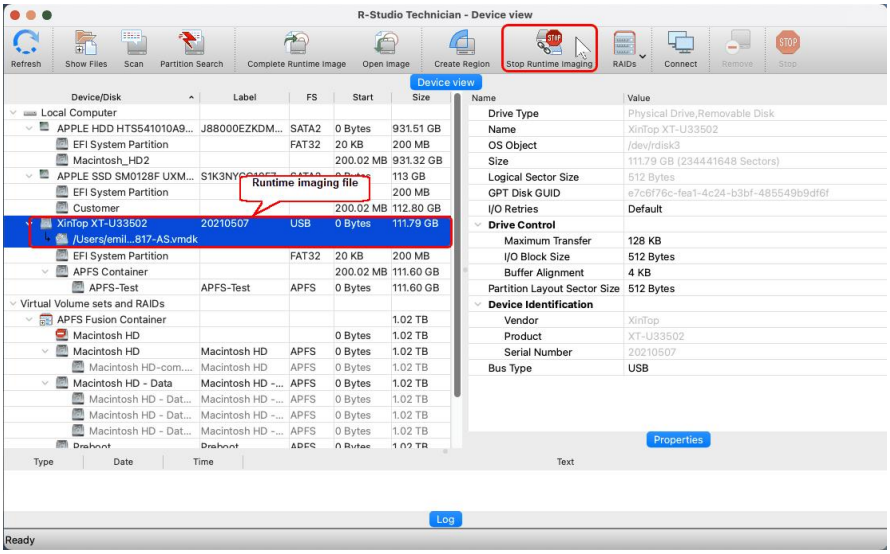


Select **Plain** or another image type in the **Image type** field, specify the file name and path for the image and sector map files, and click the **OK** button. Don't select the **VMDK image file** unless you can disable writing to the drive later. Cloning to a physical drive is not recommended because Windows can write some data to the drive corrupting the imaged data when the image has been completed and runtime imaging is over.

Plain image file requires immediate allocation of disk space equal to the object size, whereas **VMDK image file** is growing gradually upon imaging progress.

> **R-Studio will turn on runtime imaging.**

Runtime imaging

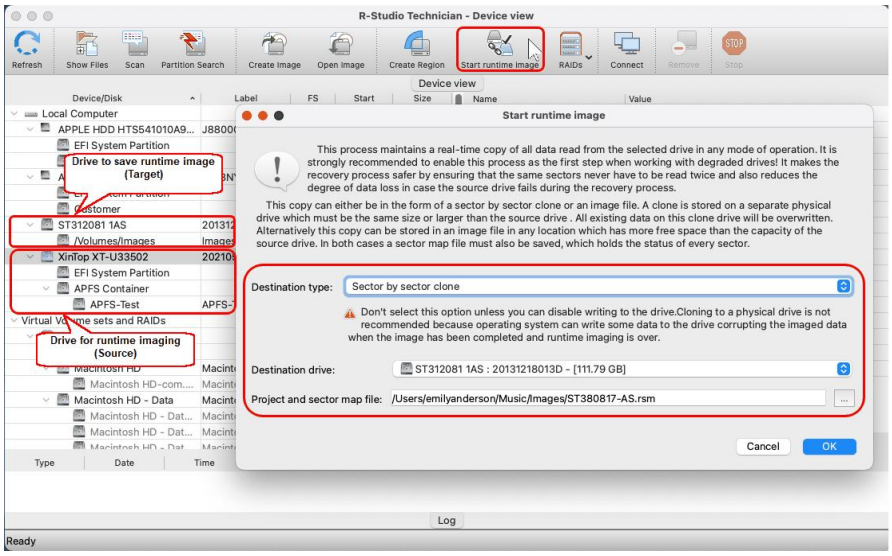


Select the object and click the **Stop Runtime Imaging** button or item in the contextual menu to turn runtime imaging off.

using a physical drive

1 **Select a drive object on the R-Studio's** Drives **panel and click the Start Runtime Image button,** or control-click the object and select **Set Runtime Image** on the contextual menu.

Runtime imaging

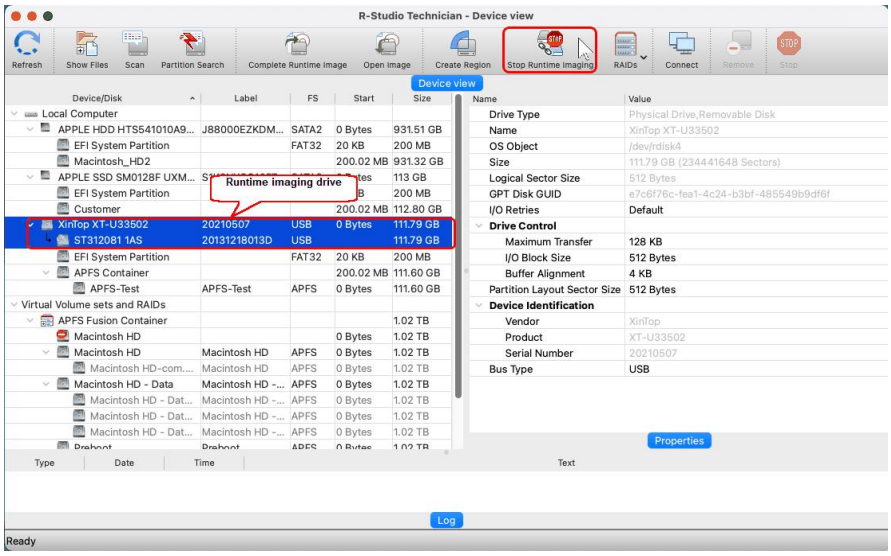


Select **Physical drive** in the **Image type** field, specify the name and path for the sector map file, and click the **OK** button.

Note: all data on the drive will be destroyed.

> R-Studio will turn on runtime imaging.

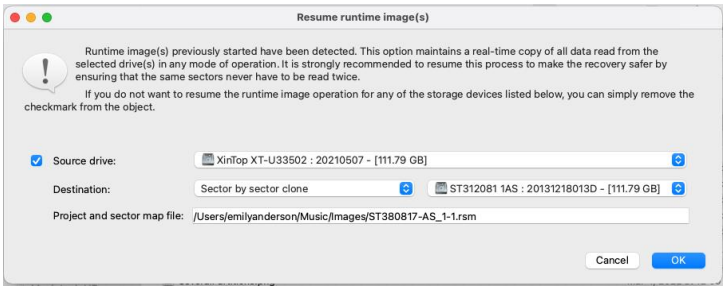
Runtime imaging



Select the object and click the **Stop Runtime Imaging** button or item in the contextual to menu turn runtime imaging off.

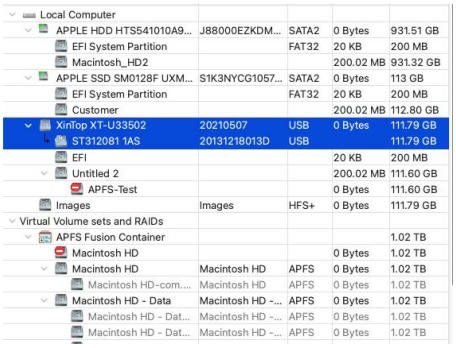
R-Studio stores the information about runtime configurations and asks the users whether they want to keep runtime imaging or discard it during its startup.

Runtime imaging



and this configuration will appear in **R-Studio**.

Runtime imaging



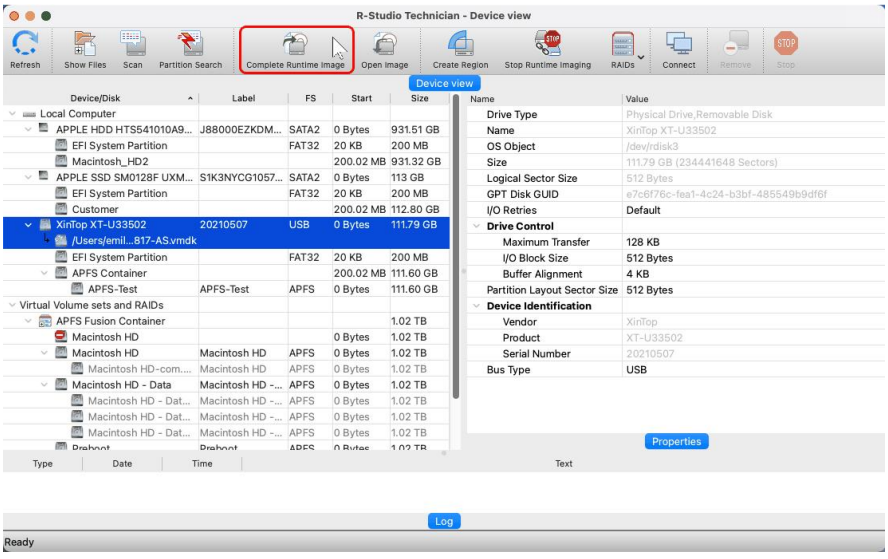
Completing Runtime Image

You may complete the runtime image without browsing through the entire file system on the disk.

1 **Select the object being imaged and click the Complete Runtime Image button,**

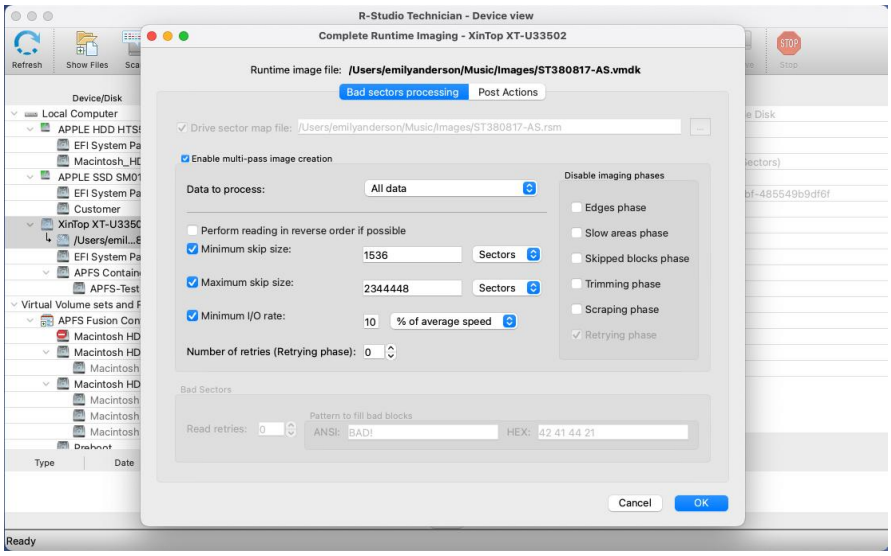
or control-click the object and select **Complete Runtime Image** on the contextual menu.

Runtime imaging



> **The** Complete Runtime Imaging **dialog box will appear.**

Runtime imaging

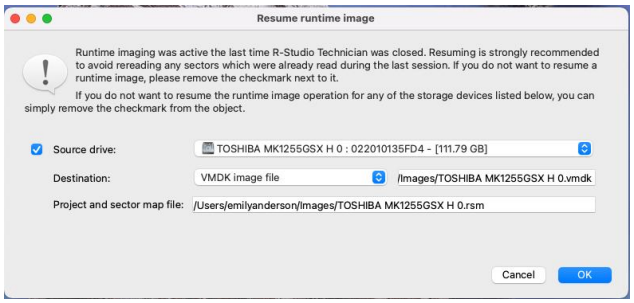


Select the necessary parameters of multi-pass imaging and select the **OK** button.

> **R-Studio will complete the creation of the runtime image.**

If the runtime image has not been completed, you may resume it next time you start runtime imaging.

Runtime imaging



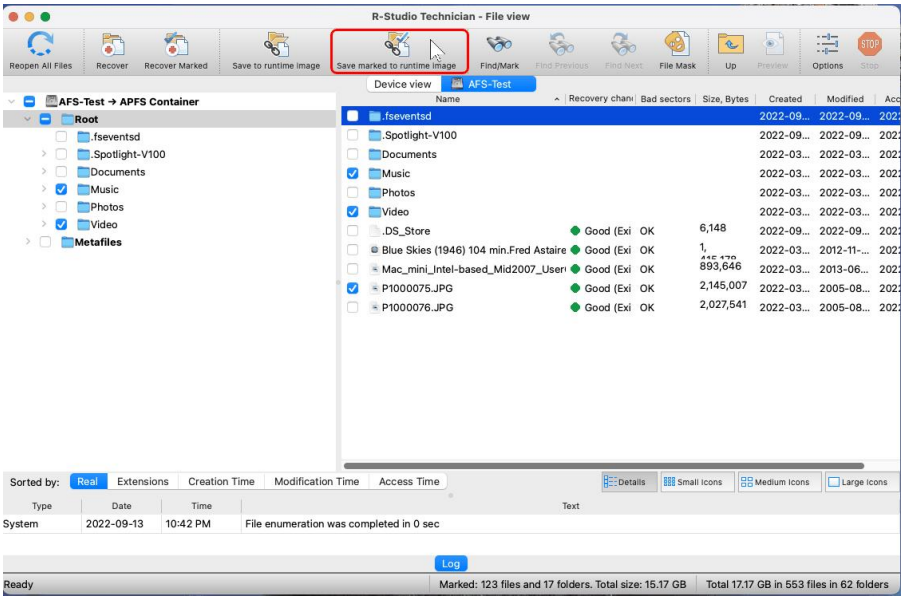
Creating runtime image for individual files

You may create a runtime image containing only individual files rather than all data on the disk.

1 **Open the disk with the files, mark the files, and click the Save marked to runtime image button.**

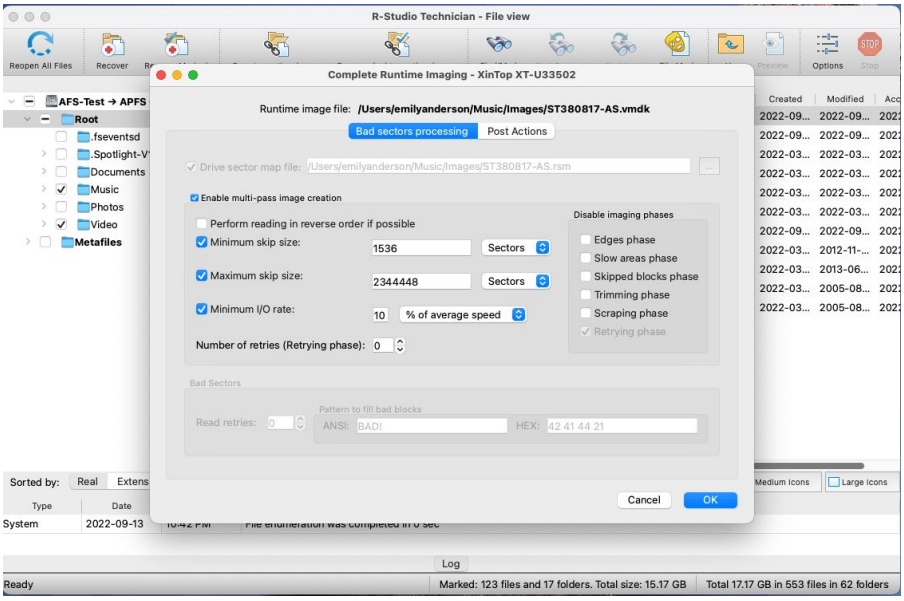
or control-click on the right pane, and select **Complete Runtime Image** on the contextual menu.

Runtime imaging



> **The** Complete Runtime Imaging **dialog box will appear.**

Runtime imaging

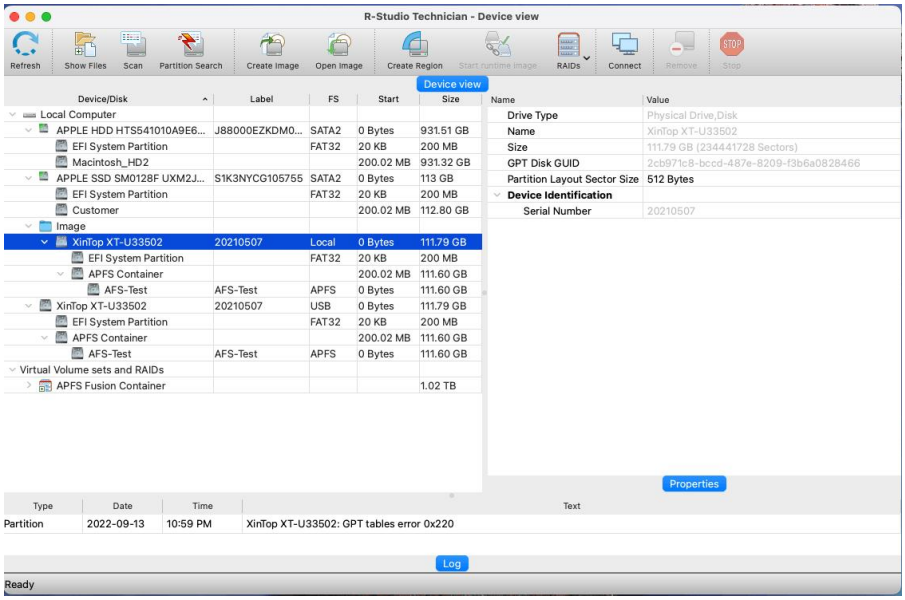


Select the necessary parameters of multi-pass imaging and select the **OK** button.

> **R-Studio will complete the creation of the runtime image.**

You may open such images as regular ones.

Runtime imaging



Such image contains information about the entire file system, but if a non-imaged file is opened, it'll contain only zeros.

3.7 Multi-pass Imaging

Multi-pass imaging is a process of image creation through several passes (phases). Each phase reads data from different areas of a hard drive, starting from areas with good sectors then going to slow sector areas and finishes with bad sector areas. This approach maximizes the amount of data that can be recovered from a failing drive and reduces it chances to fail during this process.

Phase 1. Copying most good data from the drive

In this phase, **R-Studio** reads data from drive by sector blocks, or groups of consecutive drive sectors read in one go. The phase is performed in several steps.

Step 1. **R-Studio** reads data from the drive until it runs into a block with bad or slow sector(s). Then it drops that block and jumps to another area until it finds a block with no bad or slow sectors. Then it continues reading data until it runs into another bad or slow block, and the process repeats. When this step is finished, most good data from the hard drive has been read, and **R-Studio** has detected the front blocks (edges) of bad and slow sector areas.

Step 2. **R-Studio** finds the rear edges of bad sector areas. It reads the skipped area from its rear end backwards until it runs into a block with a bad sector. Then **R-Studio** jumps to another bad sector area and the process is going on until all bad sector areas have been processed. When this step is finished, some good data from the hard drive has been read, and **R-Studio** has detected the rear edges of bad sector areas.

Step 3. **R-Studio** reads data from slow sector areas. It does that much the same way as for bad sector areas. When this step is finished, good data from slow sectors on the hard drive has been read, and **R-Studio** has detected the rear edges of slow sector areas.

Step 4. **R-Studio** finds the rear edges of bad sector areas in slow sector areas. When this step is finished, some new good data from slow sectors on the hard drive has been read, and **R-Studio** has detected the rear edges of all bad sectors within slow sector areas.

Step 5. **R-Studio** tries to read all skipped sector blocks. This is done without skipping bad sector blocks and checking read speed against minimum I/O rate.

When ***Phase 1*** is completed, **R-Studio** has read most of readable data and detected front and rear edges of all bad sector areas.

R-Studio tries to read the rest of data in the next phases, and does that sector by sector (rather than blocks).

Phase 2. Trimming

R-Studio detects the front and rear sectors of bad sector areas. When this step is finished, some new good data from bad sector areas has been read, and **R-Studio** has detected the front and rear sectors of all bad sector areas.

Phase 3. Scraping

R-Studio tries to read data from bad sector areas sector by sector.

Phase 4. Retrying (mostly optional)

R-Studio tries to read data from bad sectors through several attempts.

You may read more about this process in our article Multi-pass imaging in R-Studio

To create an image through multi-pass imaging,

1 **Select an object on the R-Studio's Drives panel and click the Create Image button**

Other ways to create the image

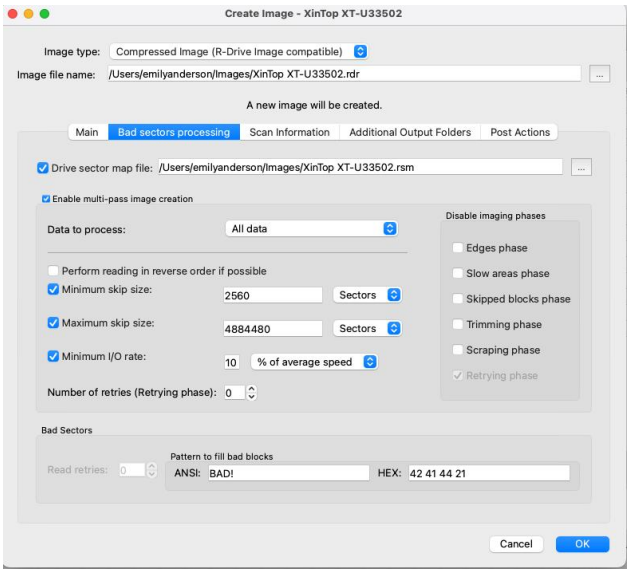
- Select the object and select **Create Image** on the **Drive** menu

or

- Control-click the selected object and select **Create Image File** on the contextual menu

2 Specify image options, a file name, and destination for the *image* on the Create Image **dialog box and click the OK button**

Create Image (Bad sector processing) **dialog box**



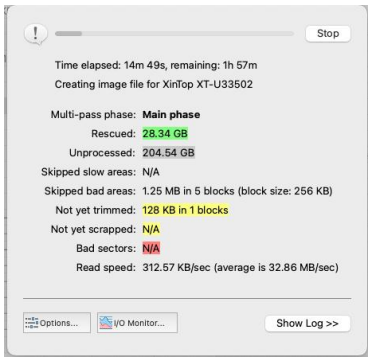
Bad sectors processing options

Image filename	Specifies the name and path for the image file
Image type:	Compressed image (R-Drive Image compatible): If this option is selected, **R-Studio** will create an image file which can be compressed, split into several parts, and password-protected. This image file is fully compatible with the images created by **R-Drive Image**, but incompatible with the previous versions of **R-Studio**. Byte by byte image: If this option is selected, **R-Studio** will create a simple exact copy of the object. VMDK (ViMware Virtual Machine Disk) image: If this option is selected, **R-Studio** will create an image of the VMware virtual disk type. Available in the Corporate, Technician, and T80+ license. Some other image formats are also available in the Technician, and T80+ licenses. You may read more about these formats in the Supported Virtual Disk and Disk Image Formats page.
Drive sector map file	A file with the sector map of the object to image. Optional for the RDI image type, mandatory for the byte-by-byte and VMDK image types.
Enable multi-pass image creation	Turns multi-pass imaging on and off.
Data to process	All data: All data on the disk will be imaged. Existing files only (FS bitmap): Only the disk's area where existing files reside will be imaged. Unused clusters only: Only the disk's free space will be imaged. You may image the existing files first and then unused clusters.

Perform reading in reverse order if possible	Switches the direction of all phases/steps to reverse.
Minimum skip size	Minimum size of drive area to skip when a bad sector is encountered.
Maximum skip size	Maximum size of drive area to skip when a bad sector is encountered.
Number of retries (Retrying phase)	The number of read attempts in the Retrying phase.
Disable imaging phases	Multi-imaging phases that can be skipped.

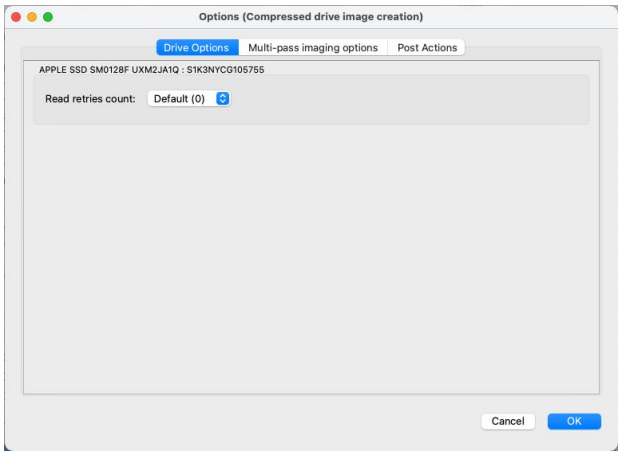
> **R-Studio will start creating the image, the** Progress **message showing the progress.**

Multi-pass imaging progress dialog box

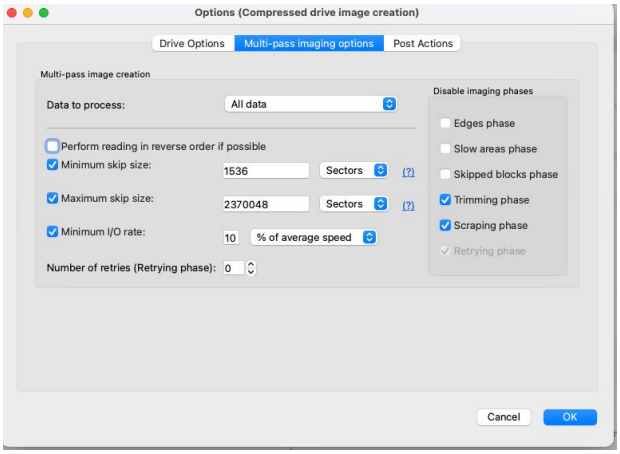


You may change operation parameters during image creation. Click the **Options** button and change them accordingly.

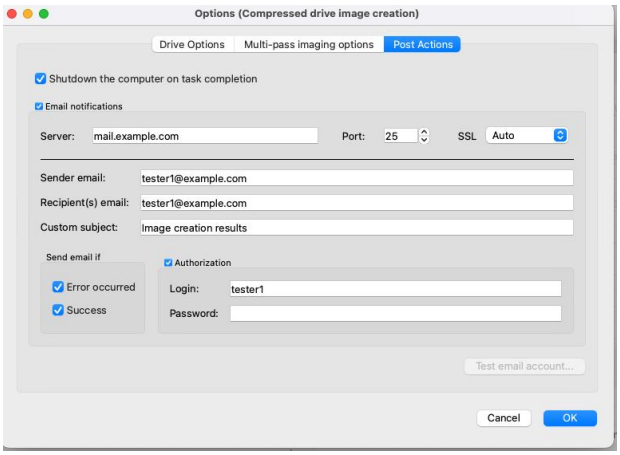
Drive Options tab



Multi-pass imaging options tab



Post Actions tab



3.8 Reverse RAIDs

Reverse RAIDs is a technique that is reverse to creating virtual RAIDs. When creating a reverse RAID, the data from a real object is decomposed into virtual parents.Then data on those virtual parents can be processed like on real objects. They can be viewed, edited, imaged, copied to physical drives, etc.

- **Reverse RAID of an Object**
  This technique can be used to decompose data on a single volume into virtual parents. Then such virtual parents can be processed like on real objects. They can be viewed, edited, imaged, copied to physical drives, etc.
- **Reverse RAID of a RAID**
  This technique can be used to re-construct data on individual RAID disks when data on physical disks is corrupted, but can be recovered using RAID redundancy. A missing disk is an example of this case. Or if there are bad sectors scattered over the physical disks but the overall RAID integrity remains. Then the data can be copied to physical hard drives to create a healthy RAID.

Note: Many controllers write their own metadata to disks to recognize that the disks belong to certains RAIDs. Without that metadata they won't see those RAIDs. You have to write that metadata manually.

3.8.1 Reverse RAID of an Object

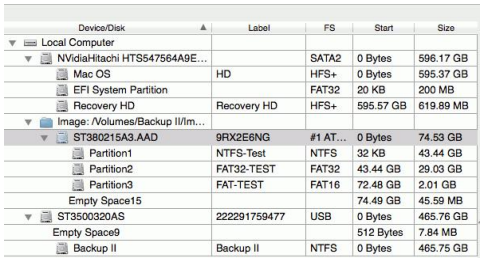
This technique can be used to decompose data on a single object into virtual parents. Then such virtual parents can be processed like on real objects. They can be viewed, edited, imaged, copied to physical drives, etc.

Suppose you have an image of a former RAID 6 (Reed-Solomon) and you wand to re-create data on individual disks from that RAID 6. You can do that by creating a reverse RAID of an image.

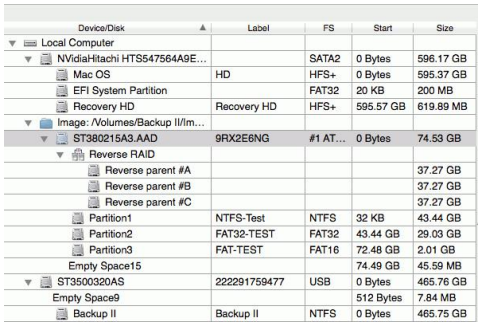
Note: Many controllers write their own metadata to disks to recognize that the disks belong to certains RAIDs. Without that metadata they won't see those RAIDs. You have to write that metadata manually.

To create a reverse RAID of a disk image (or other disk object),

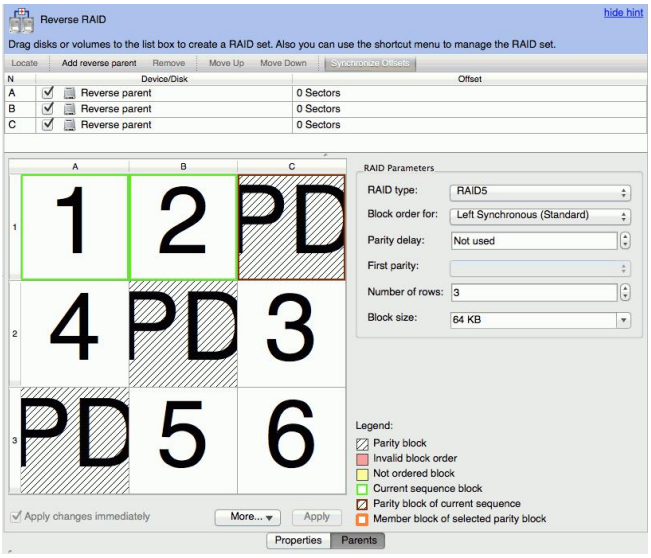
1 **Control-click the disk object on the** Drives **panel and select Create Reverse RAID on the contextual menu.**



> **The Reverse parents will appear on the Drives panel**

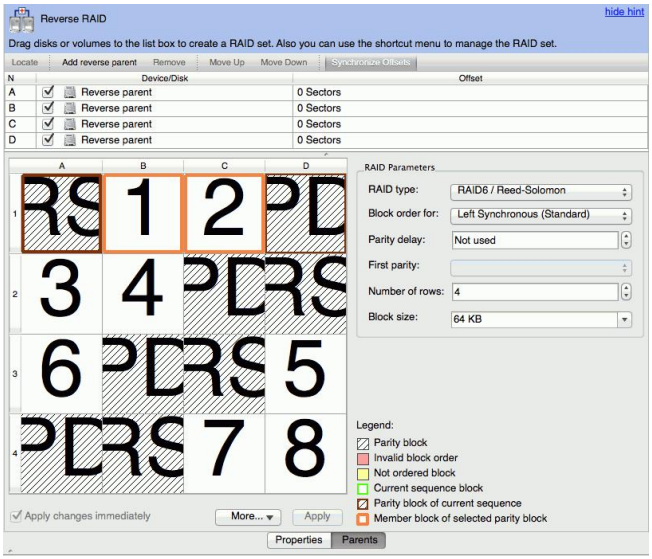


Initially, the reverse RAID is set to its default values as RAID 5 on the Parents tab.



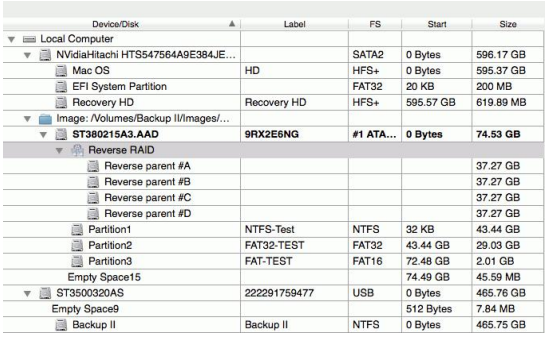
2 **Adjust RAID parameters on the** Parents **tab, as necessary.**

You need to add one reverse parent, change RAID type, and adjust RAID offset .



> **Process the appeared reverse parents on the Drives panel as real objects.**

These parents can be imaged, viewed/edited, etc.



3.8.2 Reverse RAID of a RAID

This technique can be used to re-construct data on individual RAID disks when data on physical disks is corrupted, but can be recovered using RAID redundancy.

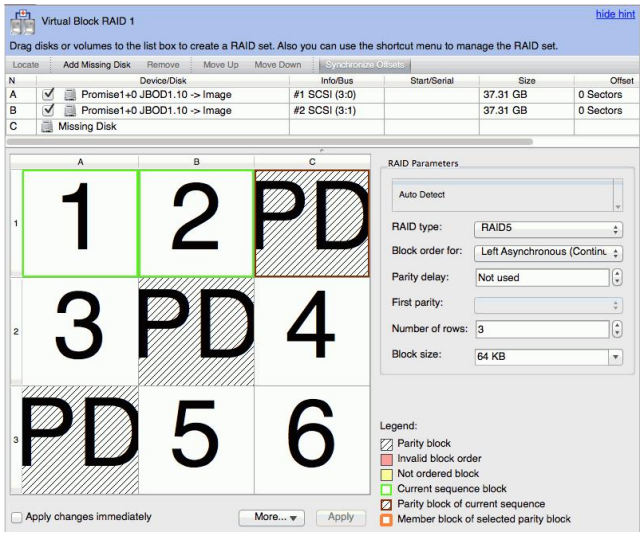
Suppose you have a RAID 5 with one missing hard drive and you need to reconstruct data on that disk. You can do that by creating a reverse RAID for it and then copy data from that missing disk to a real one, or to an image.

Note: Many controllers write their own metadata to disks to recognize that the disks belong to certains RAIDs. Without that metadata they won't see those RAIDs. You have to write that metadata manually.

To create a reverse RAID of a RAID with a missing disk,

1 **Create a virtual RAID 5 of the existing hard drives or their images**

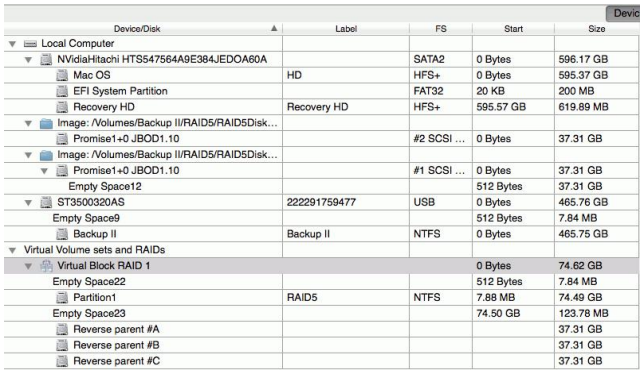
Add a missing disk to the Parents tab.



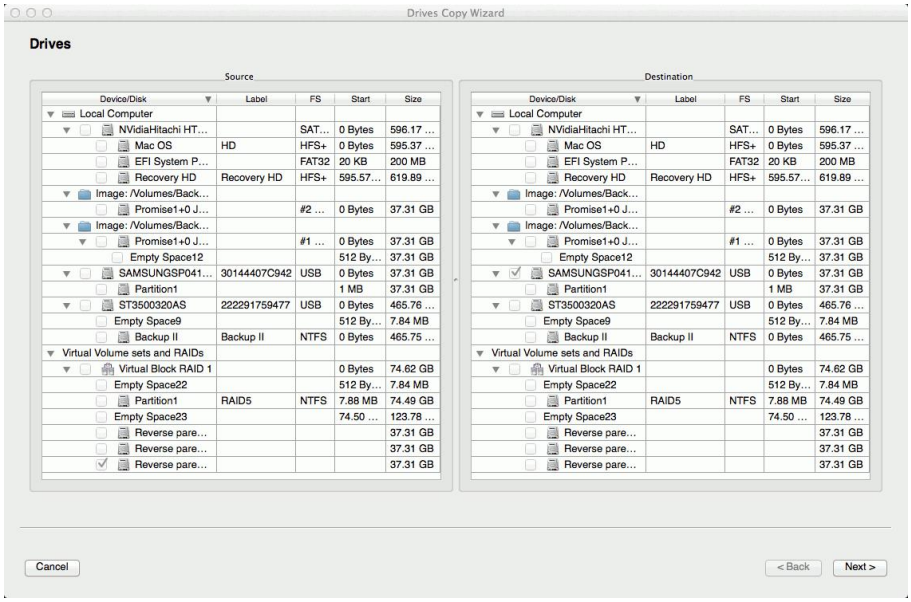
If necessary, read the Basic RAID 4 and RAID 5 Operations and Volumes Sets and RAIDs help pages for details.

2 Control-click the Virtual Block Raid on the Drives **panel and select Create Reverse RAID on the contextual menu.**

> The Reverse parents will appear on the Drives panel



These parents may be processed as real objects, they can be imaged, viewed/edited. For your case the missing disk can be copied to a hard drive in the Drive Copy Wizard.



Note: The reverse parents contain the data that should be on the RAID parents, according to its layout, while RAID parents contain actual data, that may be corrupted.

3.9 Working with the Third-Party Hardware

The Technician version of **R-Studio** can work together with third-party hardware developed for in-depth data recovery. Currently, the following devices are supported:

- **DeepSpar Disk Imager™**

3.9.1 DeepSpar Disk Imager™

Currently only the Windows version of **R-Studio** can work with **DeepSpar Disk Imager™** directly. **R-Studio** versions for Mac and Linux can load and process its images.

DeepSpar Disk Imager™ (**DDI**) is an HDD imaging device specifically built for data recovery from hard drives with hardware issues. It greatly increases imaging speed, accuracy, and integrity of data retrieved from such drives.

The main features that **DDI** provides when working with hard drives are the following:

- Direct low-level access to a hard drive bypassing the computers BIOS.
- Disabling specific drive read/write heads.
- Disable SMART subsystem, Bad Sector Reallocation, and Read Look-Ahead
- Read sector timeout controlled by Software/Hardware/PHY drive reset commands
- Bit level analysis of corrupted data to filter out the read-write channel noise
- Fully customizable multi-pass imaging

And many more others an advanced disk imager must have. You may learn more about **DDI** on its vendor site: **DeepSpar Disk Imager™**.

Viewing the drive map

A drive map shows the conditions for individual disk sectors. You may see which sectors are OK, bad, or unstable.

To view the drive map,

* **Control-click the required hard drive/partition and select Show drive map... on the contextual menu,**

> **The drive map will appear in the right tab.**

Drive map controls

Sectors	The number of the first sector in the row.
Offset	Offset in the data. Enter the address you want to jump to and press the **Enter** key.
Sectors/Bytes/KB...	Specifies the dimension of the data in the **Offset** field.
Previous/Next	Moves to the previous/next part of the data.
+/-	Zooms into/out of, the data.

To see more detailed information about a particular sector range, right click the corresponding rectangle and select **Information** on the contextual menu.

Click the **Open in Hex Editor** button to open the selected block in the **Text/hexadecimal editor**.

Viewing the file map

A file map shows the conditions for individual file sectors. You may see which sectors are OK, bad, or unstable.

To view the file map,

* **Control-click the required file and select Map of file... on the contextual menu,**

> **The file map will appear in the lower pane.**

Drive map controls

Sectors	The number of the first sector in the row.
Offset	Offset in the data. Enter the address you want to jump to and press the **Enter** key.
Sectors/Bytes/KB...	Specifies the dimension of the data in the **Offset** field.
Previous/Next	Moves to the previous/next part of the data.
+/-	Zooms into/out of, the data.

To see more detailed information about a particular sector range, right click the corresponding rectangle and select **Information** on the contextual menu.

Click the **Open in Hex Editor** button to open the selected block in the **Text/hexadecimal editor**.

3.10 Forensic Mode

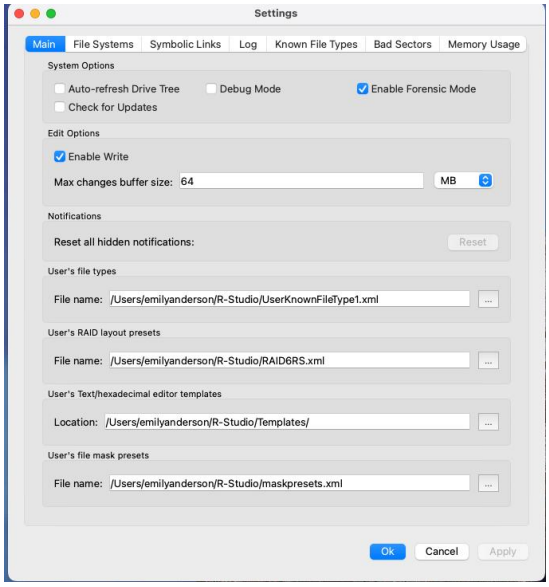
Note: This feature is available for the Technician/T80+ version of **R-Studio** only!

When this mode is enabled, **R-Studio** will generate a forensic data collection audit log that can be presented at court hearings. This log includes information about a hardware configuration on which the forensic data collection takes place and MD5 for recovered files.

Note: A new log will be generated each time the hardware configuration is changed (a drive is connected/? disconnected, an external USB device is connected/disconnected, etc)

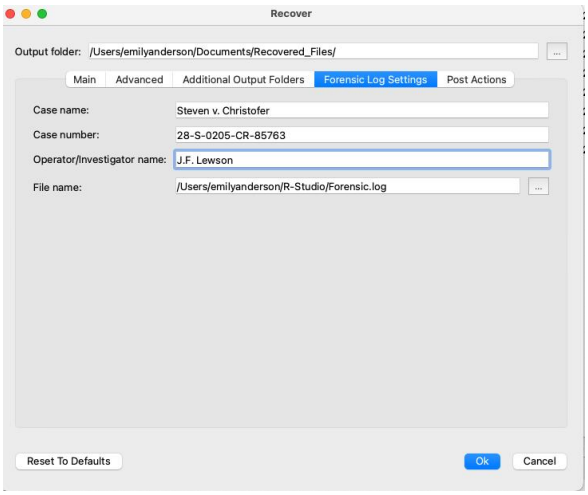
To enable this feature,

* **Select Enable Forensic Mode on the** Main **tab of the** Settings **dialog box.**



The Forensic Log tab will appear on the Recover dialog box.

Forensic Log **tab**



Enter the required information on this tab and then go to the other tabs of the Recovery dialog box.

While file recovery, **R-Studio** will create forensic data collection audit log in the specified folder. Below is an example of such log.

```
****************************** Forensic Data Collection Audit Log ***********************

R-Studio

************************************* Drives Information ****************************

- Drive Number 0 --------------------------------
* Drive Type [256 bytes]: Computer,Local Computer
* Name [30 bytes]: Local Computer
* OS [38 bytes]: macOS 12.5.1 (x64)
```

```
* System [136 bytes]: 4 x Intel(R) Core(TM) i5-4308U CPU @ 2.80GHz, 2800 MHz, 8192 MB RAM

- Drive Number 1 --------------------------------
* Drive Type [256 bytes]: Physical Drive,Disk
* Name [54 bytes]: APPLE SSD SM0128F UXM2JA1Q
* OS Object [24 bytes]: /dev/rdisk0
* R-Studio Driver [12 bytes]: IOKit
* Size [8 bytes]: 113GB (236978176 sec)
* Logical Sector Size [4 bytes]: 512B
* Physical Sector Size [4 bytes]: 4KB
* GPT Disk GUID [74 bytes]: b839dd82-9ebb-4993-b3eb-32cef2e1fbe3
# I/O Retries [4 bytes]: Default
+ Drive Control [8 bytes]:
  # Maximum Transfer [4 bytes]: 131072
  # I/O Block Size [4 bytes]: 4096
  # Buffer Alignment [4 bytes]: 4096
# Partition Layout Sector Size [4 bytes]: 512B
+ Device Identification [8 bytes]:
  * Vendor [32 bytes]: APPLE
  * Product [64 bytes]: SSD SM0128F
  * Firmware [16 bytes]: UXM2JA1Q
  * Serial Number [32 bytes]: S1K3NYCG105755
+ IDE Properties [8 bytes]:
  * Size [44 bytes]: 113GB (236978176 LBA)
  * Logical Sector Size [8 bytes]: 512
  * Physical Sector Size [10 bytes]: 4096
  * Device Type [8 bytes]: SSD
  * Interface [38 bytes]: SATA 3.0, 6.0 Gb/s
  * Interface Speed [18 bytes]: 6.0 Gb/s
  * Standard [18 bytes]: ATA8-ACS
  * Features [70 bytes]: S.M.A.R.T., AAM-, LBA48, NCQ, TRIM
* Bus Type [4 bytes]: SerialATA-II

- Drive Number 2 --------------------------------
* Drive Type [256 bytes]: Physical Drive,Disk
* Name [70 bytes]: APPLE HDD HTS541010A9E662 JA0AB5D0
* OS Object [24 bytes]: /dev/rdisk1
* R-Studio Driver [12 bytes]: IOKit
* Size [8 bytes]: 931.5GB (1953525168 sec)
* Logical Sector Size [4 bytes]: 512B
* Physical Sector Size [4 bytes]: 4KB
* GPT Disk GUID [74 bytes]: 81ac843d-494a-4443-a3e4-c90ecd2dceea
# I/O Retries [4 bytes]: Default
+ Drive Control [8 bytes]:
  # Maximum Transfer [4 bytes]: 131072
  # I/O Block Size [4 bytes]: 4096
  # Buffer Alignment [4 bytes]: 4096
# Partition Layout Sector Size [4 bytes]: 512B
+ Device Identification [8 bytes]:
  * Vendor [32 bytes]: APPLE
  * Product [64 bytes]: HDD HTS541010A9E662
  * Firmware [16 bytes]: JA0AB5D0
  * Serial Number [32 bytes]: J88000EZKDM0TD
```

```
+ IDE Properties [8 bytes]:
  * Size [50 bytes]: 931.5GB (1953525168 LBA)
  * Logical Sector Size [8 bytes]: 512
  * Physical Sector Size [10 bytes]: 4096
  * Device Type [36 bytes]: HDD 2.5" 5400 RPM
  * Interface [38 bytes]: SATA 2.6, 3.0 Gb/s
  * Interface Speed [18 bytes]: 3.0 Gb/s
  * Standard [18 bytes]: ATA8-ACS
  * Features [56 bytes]: S.M.A.R.T., APM, LBA48, NCQ
* Bus Type [4 bytes]: SerialATA-II

- Drive Number 3 --------------------------------
* Drive Type [256 bytes]: Physical Drive,Disk
* Name [40 bytes]: Apple APFSContainer
* OS Object [24 bytes]: /dev/rdisk2
* R-Studio Driver [12 bytes]: IOKit
* Size [8 bytes]: 1.01TB (2189683984 sec)
* Logical Sector Size [4 bytes]: 4KB
# I/O Retries [4 bytes]: Default
+ Drive Control [8 bytes]:
  # Maximum Transfer [4 bytes]: 131072
  # I/O Block Size [4 bytes]: 4096
  # Buffer Alignment [4 bytes]: 4096
+ Device Identification [8 bytes]:
  * Vendor [32 bytes]: Apple
  * Product [64 bytes]: APFSContainer
* Bus Type [4 bytes]: Virtual

- Drive Number 4 --------------------------------
* Drive Type [256 bytes]: Physical Drive,Removable Disk
* Name [34 bytes]: XinTop XT-U33502
* OS Object [24 bytes]: /dev/rdisk3
* Size [8 bytes]: 111.7GB (234441648 sec)
* Logical Sector Size [4 bytes]: 512B
* GPT Disk GUID [74 bytes]: e7c6f76c-fea1-4c24-b3bf-485549b9df6f
# I/O Retries [4 bytes]: Default
+ Drive Control [8 bytes]:
  # Maximum Transfer [4 bytes]: 131072
  # I/O Block Size [4 bytes]: 512
  # Buffer Alignment [4 bytes]: 4096
# Partition Layout Sector Size [4 bytes]: 512B
+ Device Identification [8 bytes]:
  * Vendor [32 bytes]: XinTop
  * Product [64 bytes]: XT-U33502
  * Serial Number [32 bytes]: 20210507
* Bus Type [4 bytes]: USB

- Drive Number 5 --------------------------------
* Drive Type [256 bytes]: Physical Drive,Disk
* Name [40 bytes]: Apple APFSContainer
* OS Object [24 bytes]: /dev/rdisk4
* Size [8 bytes]: 111.5GB (234031968 sec)
* Logical Sector Size [4 bytes]: 4KB
```

```
# I/O Retries [4 bytes]: Default
+ Drive Control [8 bytes]:
  # Maximum Transfer [4 bytes]: 131072
  # I/O Block Size [4 bytes]: 4096
  # Buffer Alignment [4 bytes]: 4096
+ Device Identification [8 bytes]:
  * Vendor [32 bytes]: Apple
  * Product [64 bytes]: APFSContainer
* Bus Type [4 bytes]: Virtual

- Drive Number 6 --------------------------------
* Drive Type [256 bytes]: Volume,Disk
* Name [26 bytes]: Macintosh HD
* Mount Points [4 bytes]: /
* OS Object [32 bytes]: /dev/rdisk2s5s1
* R-Studio Driver [12 bytes]: IOKit
* Size [8 bytes]: 1.01TB (2189683984 sec)
* Logical Sector Size [4 bytes]: 4KB
* Partition Size [8 bytes]: 1.01TB (2189683984 sec)
# I/O Retries [4 bytes]: Default
+ Drive Control [8 bytes]:
  # Maximum Transfer [4 bytes]: 131072
  # I/O Block Size [4 bytes]: 4096
  # Buffer Alignment [4 bytes]: 4096
* Bus Type [4 bytes]: Virtual

- Drive Number 7 --------------------------------
* Drive Type [256 bytes]: Volume,Disk
* Name [6 bytes]: VM
* Mount Points [38 bytes]: /System/Volumes/VM
* OS Object [28 bytes]: /dev/rdisk2s4
* R-Studio Driver [12 bytes]: IOKit
* Size [8 bytes]: 1.01TB (2189683984 sec)
* Logical Sector Size [4 bytes]: 4KB
* Partition Size [8 bytes]: 1.01TB (2189683984 sec)
# I/O Retries [4 bytes]: Default
+ Drive Control [8 bytes]:
  # Maximum Transfer [4 bytes]: 131072
  # I/O Block Size [4 bytes]: 4096
  # Buffer Alignment [4 bytes]: 4096
* Bus Type [4 bytes]: Virtual

- Drive Number 8 --------------------------------
* Drive Type [256 bytes]: Volume,Disk
* Name [16 bytes]: Preboot
* Mount Points [48 bytes]: /System/Volumes/Preboot
* OS Object [28 bytes]: /dev/rdisk2s2
* R-Studio Driver [12 bytes]: IOKit
* Size [8 bytes]: 1.01TB (2189683984 sec)
* Logical Sector Size [4 bytes]: 4KB
* Partition Size [8 bytes]: 1.01TB (2189683984 sec)
# I/O Retries [4 bytes]: Default
+ Drive Control [8 bytes]:
```

```
  # Maximum Transfer [4 bytes]: 131072
  # I/O Block Size [4 bytes]: 4096
  # Buffer Alignment [4 bytes]: 4096
* Bus Type [4 bytes]: Virtual

- Drive Number 9 --------------------------------
* Drive Type [256 bytes]: Volume,Disk
* Name [14 bytes]: Update
* Mount Points [46 bytes]: /System/Volumes/Update
* OS Object [28 bytes]: /dev/rdisk2s6
* R-Studio Driver [12 bytes]: IOKit
* Size [8 bytes]: 1.01TB (2189683984 sec)
* Logical Sector Size [4 bytes]: 4KB
* Partition Size [8 bytes]: 1.01TB (2189683984 sec)
# I/O Retries [4 bytes]: Default
+ Drive Control [8 bytes]:
  # Maximum Transfer [4 bytes]: 131072
  # I/O Block Size [4 bytes]: 4096
  # Buffer Alignment [4 bytes]: 4096
* Bus Type [4 bytes]: Virtual

- Drive Number 10 -------------------------------
* Drive Type [256 bytes]: Volume,Disk
* Name [40 bytes]: Macintosh HD - Data
* Mount Points [42 bytes]: /System/Volumes/Data
* OS Object [28 bytes]: /dev/rdisk2s1
* R-Studio Driver [12 bytes]: IOKit
* Size [8 bytes]: 1.01TB (2189683984 sec)
* Logical Sector Size [4 bytes]: 4KB
* Partition Size [8 bytes]: 1.01TB (2189683984 sec)
# I/O Retries [4 bytes]: Default
+ Drive Control [8 bytes]:
  # Maximum Transfer [4 bytes]: 131072
  # I/O Block Size [4 bytes]: 4096
  # Buffer Alignment [4 bytes]: 4096
* Bus Type [4 bytes]: Virtual

- Drive Number 11 -------------------------------
* Drive Type [256 bytes]: Volume,Disk
* Name [20 bytes]: APFS-Test
* Mount Points [38 bytes]: /Volumes/APFS-Test
* OS Object [28 bytes]: /dev/rdisk4s1
* Size [8 bytes]: 111.5GB (234031968 sec)
* Logical Sector Size [4 bytes]: 4KB
* Partition Size [8 bytes]: 111.5GB (234031968 sec)
# I/O Retries [4 bytes]: Default
+ Drive Control [8 bytes]:
  # Maximum Transfer [4 bytes]: 131072
  # I/O Block Size [4 bytes]: 4096
  # Buffer Alignment [4 bytes]: 4096
* Bus Type [4 bytes]: Virtual

- Drive Number 12 -------------------------------
```

```
* Drive Type [256 bytes]: Volume,Disk
* Name [8 bytes]: EFI
* OS Object [28 bytes]: /dev/rdisk0s1
* Size [8 bytes]: 200MB (409600 sec)
* Logical Sector Size [4 bytes]: 512B
* Partition Offset [8 bytes]: 20KB (40 sec)
* Partition Size [8 bytes]: 200MB (409600 sec)
* GPT Partition GUID [74 bytes]: 8cee8193-135c-4241-8b27-0cd0765bc75f
+ FAT Information [8 bytes]:
  * FAT Bits (12,16,32) [4 bytes]: 32
  * Cluster Size [4 bytes]: 512B (1 sec)
  * First Cluster Offset [8 bytes]: 3.09MB (6332 sec)
  * Root Directory Cluster [4 bytes]: 2
  * First FAT Offset [8 bytes]: 16KB (32 sec)
  * Size of One FAT Table [8 bytes]: 1.53MB (3151 sec)
  * Number of FAT Copies [4 bytes]: 2
  # Active FAT copy [4 bytes]: Auto
  * Sector Size [4 bytes]: 512B
  * Major Version [1 bytes]: 0
  * Minor Version [1 bytes]: 0
  * Volume Size [8 bytes]: 200MB (409600 sec)
# I/O Retries [4 bytes]: Default
+ Drive Control [8 bytes]:
  # Maximum Transfer [4 bytes]: 131072
  # I/O Block Size [4 bytes]: 512
  # Buffer Alignment [4 bytes]: 4096

- Drive Number 13 --------------------------------
* Drive Type [256 bytes]: Volume,Disk
* Name [18 bytes]: Customer
* OS Object [28 bytes]: /dev/rdisk0s2
* R-Studio Driver [12 bytes]: IOKit
* Size [8 bytes]: 112.8GB (236568496 sec)
* Logical Sector Size [4 bytes]: 512B
* Partition Offset [8 bytes]: 200MB (409640 sec)
* Partition Size [8 bytes]: 112.8GB (236568496 sec)
* GPT Partition GUID [74 bytes]: a60a40fb-71e5-4858-aa6b-d3dc7d1e590f
# I/O Retries [4 bytes]: Default
+ Drive Control [8 bytes]:
  # Maximum Transfer [4 bytes]: 131072
  # I/O Block Size [4 bytes]: 512
  # Buffer Alignment [4 bytes]: 4096

- Drive Number 14 --------------------------------
* Drive Type [256 bytes]: Volume,Disk
* Name [8 bytes]: EFI
* OS Object [28 bytes]: /dev/rdisk1s1
* Size [8 bytes]: 200MB (409600 sec)
* Logical Sector Size [4 bytes]: 512B
* Partition Offset [8 bytes]: 20KB (40 sec)
* Partition Size [8 bytes]: 200MB (409600 sec)
* GPT Partition GUID [74 bytes]: d3e176ed-1af0-4b98-9b24-d92be8c9a28d
+ FAT Information [8 bytes]:
```

```
  * FAT Bits (12,16,32) [4 bytes]: 32
  * Cluster Size [4 bytes]: 512B (1 sec)
  * First Cluster Offset [8 bytes]: 3.09MB (6332 sec)
  * Root Directory Cluster [4 bytes]: 2
  * First FAT Offset [8 bytes]: 16KB (32 sec)
  * Size of One FAT Table [8 bytes]: 1.53MB (3151 sec)
  * Number of FAT Copies [4 bytes]: 2
  # Active FAT copy [4 bytes]: Auto
  * Sector Size [4 bytes]: 512B
  * Major Version [1 bytes]: 0
  * Minor Version [1 bytes]: 0
  * Volume Size [8 bytes]: 200MB (409600 sec)
# I/O Retries [4 bytes]: Default
+ Drive Control [8 bytes]:
  # Maximum Transfer [4 bytes]: 131072
  # I/O Block Size [4 bytes]: 512
  # Buffer Alignment [4 bytes]: 4096
* Bus Type [4 bytes]: SerialATA

- Drive Number 15 --------------------------------
* Drive Type [256 bytes]: Volume,Disk
* Name [28 bytes]: Macintosh_HD2
* OS Object [28 bytes]: /dev/rdisk1s2
* R-Studio Driver [12 bytes]: IOKit
* Size [8 bytes]: 931.3GB (1953115488 sec)
* Logical Sector Size [4 bytes]: 512B
* Partition Offset [8 bytes]: 200MB (409640 sec)
* Partition Size [8 bytes]: 931.3GB (1953115488 sec)
* GPT Partition GUID [74 bytes]: 527abab6-d06a-4c4e-a57a-c38fb621f602
# I/O Retries [4 bytes]: Default
+ Drive Control [8 bytes]:
  # Maximum Transfer [4 bytes]: 131072
  # I/O Block Size [4 bytes]: 512
  # Buffer Alignment [4 bytes]: 4096
* Bus Type [4 bytes]: SerialATA

- Drive Number 16 --------------------------------
* Drive Type [256 bytes]: Volume,Disk
* Name [18 bytes]: Recovery
* OS Object [28 bytes]: /dev/rdisk2s3
* R-Studio Driver [12 bytes]: IOKit
* Size [8 bytes]: 1.01TB (2189683984 sec)
* Logical Sector Size [4 bytes]: 4KB
* Partition Size [8 bytes]: 1.01TB (2189683984 sec)
# I/O Retries [4 bytes]: Default
+ Drive Control [8 bytes]:
  # Maximum Transfer [4 bytes]: 131072
  # I/O Block Size [4 bytes]: 4096
  # Buffer Alignment [4 bytes]: 4096
* Bus Type [4 bytes]: Virtual

- Drive Number 17 --------------------------------
* Drive Type [256 bytes]: Volume,Disk
```

```
* Name [26 bytes]: Macintosh HD
* OS Object [28 bytes]: /dev/rdisk2s5
* R-Studio Driver [12 bytes]: IOKit
* Size [8 bytes]: 1.01TB (2189683984 sec)
* Logical Sector Size [4 bytes]: 4KB
* Partition Size [8 bytes]: 1.01TB (2189683984 sec)
# I/O Retries [4 bytes]: Default
+ Drive Control [8 bytes]:
  # Maximum Transfer [4 bytes]: 131072
  # I/O Block Size [4 bytes]: 4096
  # Buffer Alignment [4 bytes]: 4096
* Bus Type [4 bytes]: Virtual

- Drive Number 18 --------------------------------
* Drive Type [256 bytes]: Volume,Removable Disk
* Name [8 bytes]: EFI
* OS Object [28 bytes]: /dev/rdisk3s1
* Size [8 bytes]: 200MB (409600 sec)
* Logical Sector Size [4 bytes]: 512B
* Partition Offset [8 bytes]: 20KB (40 sec)
* Partition Size [8 bytes]: 200MB (409600 sec)
* GPT Partition GUID [74 bytes]: 79730f0b-3579-4ab2-9947-e96892315160
+ FAT Information [8 bytes]:
  * FAT Bits (12,16,32) [4 bytes]: 32
  * Cluster Size [4 bytes]: 512B (1 sec)
  * First Cluster Offset [8 bytes]: 3.09MB (6332 sec)
  * Root Directory Cluster [4 bytes]: 2
  * First FAT Offset [8 bytes]: 16KB (32 sec)
  * Size of One FAT Table [8 bytes]: 1.53MB (3151 sec)
  * Number of FAT Copies [4 bytes]: 2
  # Active FAT copy [4 bytes]: Auto
  * Sector Size [4 bytes]: 512B
  * Major Version [1 bytes]: 0
  * Minor Version [1 bytes]: 0
  * Volume Size [8 bytes]: 200MB (409600 sec)
# I/O Retries [4 bytes]: Default
+ Drive Control [8 bytes]:
  # Maximum Transfer [4 bytes]: 131072
  # I/O Block Size [4 bytes]: 512
  # Buffer Alignment [4 bytes]: 4096
* Bus Type [4 bytes]: USB

- Drive Number 19 --------------------------------
* Drive Type [256 bytes]: Volume,Removable Disk
* Name [22 bytes]: Untitled 2
* OS Object [28 bytes]: /dev/rdisk3s2
* Size [8 bytes]: 111.5GB (234031968 sec)
* Logical Sector Size [4 bytes]: 512B
* Partition Offset [8 bytes]: 200MB (409640 sec)
* Partition Size [8 bytes]: 111.5GB (234031968 sec)
* GPT Partition GUID [74 bytes]: 0c6388f0-1bdb-476f-a1d5-faea580a87af
# I/O Retries [4 bytes]: Default
+ Drive Control [8 bytes]:
```

```
  # Maximum Transfer [4 bytes]: 131072
  # I/O Block Size [4 bytes]: 512
  # Buffer Alignment [4 bytes]: 4096
* Bus Type [4 bytes]: USB

- Drive Number 20 --------------------------------
* Drive Type [256 bytes]: Partition
* Name [42 bytes]: EFI System Partition
* Size [8 bytes]: 200MB (409600 sec)
* Partition Offset [8 bytes]: 20KB (40 sec)
* Partition Size [8 bytes]: 200MB (409600 sec)
* GPT Partition GUID [74 bytes]: 8cee8193-135c-4241-8b27-0cd0765bc75f
* GPT Type GUID [256 bytes]: UEFI System Partition, c12a7328-f81f-11d2-ba4b-00a0c93ec93b
* GPT Partition Name [42 bytes]: EFI System Partition
+ FAT Information [8 bytes]:
  * FAT Bits (12,16,32) [4 bytes]: 32
  * Cluster Size [4 bytes]: 512B (1 sec)
  * First Cluster Offset [8 bytes]: 3.09MB (6332 sec)
  * Root Directory Cluster [4 bytes]: 2
  * First FAT Offset [8 bytes]: 16KB (32 sec)
  * Size of One FAT Table [8 bytes]: 1.53MB (3151 sec)
  * Number of FAT Copies [4 bytes]: 2
  # Active FAT copy [4 bytes]: Auto
  * Sector Size [4 bytes]: 512B
  * Major Version [1 bytes]: 0
  * Minor Version [1 bytes]: 0
  * Volume Size [8 bytes]: 200MB (409600 sec)

- Drive Number 21 --------------------------------
* Drive Type [256 bytes]: Partition
* Name [18 bytes]: Customer
* Size [8 bytes]: 112.8GB (236568496 sec)
* Partition Offset [8 bytes]: 200MB (409640 sec)
* Partition Size [8 bytes]: 112.8GB (236568496 sec)
* GPT Partition GUID [74 bytes]: a60a40fb-71e5-4858-aa6b-d3dc7d1e590f
* GPT Type GUID [256 bytes]: APFS Container, 7c3457ef-0000-11aa-aa11-00306543ecac
* GPT Partition Name [18 bytes]: Customer
# Partition Layout Sector Size [4 bytes]: 512B

- Drive Number 22 --------------------------------
* Drive Type [256 bytes]: Partition
* Name [42 bytes]: EFI System Partition
* Size [8 bytes]: 200MB (409600 sec)
* Partition Offset [8 bytes]: 20KB (40 sec)
* Partition Size [8 bytes]: 200MB (409600 sec)
* GPT Partition GUID [74 bytes]: d3e176ed-1af0-4b98-9b24-d92be8c9a28d
* GPT Type GUID [256 bytes]: UEFI System Partition, c12a7328-f81f-11d2-ba4b-00a0c93ec93b
* GPT Partition Name [42 bytes]: EFI System Partition
+ FAT Information [8 bytes]:
  * FAT Bits (12,16,32) [4 bytes]: 32
  * Cluster Size [4 bytes]: 512B (1 sec)
  * First Cluster Offset [8 bytes]: 3.09MB (6332 sec)
  * Root Directory Cluster [4 bytes]: 2
```

```
  * First FAT Offset [8 bytes]: 16KB (32 sec)
  * Size of One FAT Table [8 bytes]: 1.53MB (3151 sec)
  * Number of FAT Copies [4 bytes]: 2
  # Active FAT copy [4 bytes]: Auto
  * Sector Size [4 bytes]: 512B
  * Major Version [1 bytes]: 0
  * Minor Version [1 bytes]: 0
  * Volume Size [8 bytes]: 200MB (409600 sec)

- Drive Number 23 --------------------------------
* Drive Type [256 bytes]: Partition
* Name [28 bytes]: Macintosh_HD2
* Size [8 bytes]: 931.3GB (1953115488 sec)
* Partition Offset [8 bytes]: 200MB (409640 sec)
* Partition Size [8 bytes]: 931.3GB (1953115488 sec)
* GPT Partition GUID [74 bytes]: 527abab6-d06a-4c4e-a57a-c38fb621f602
* GPT Type GUID [256 bytes]: APFS Container, 7c3457ef-0000-11aa-aa11-00306543ecac
* GPT Partition Name [28 bytes]: Macintosh_HD2
# Partition Layout Sector Size [4 bytes]: 512B

- Drive Number 24 --------------------------------
* Drive Type [256 bytes]: Partition
* Name [42 bytes]: EFI System Partition
* Size [8 bytes]: 200MB (409600 sec)
* Partition Offset [8 bytes]: 20KB (40 sec)
* Partition Size [8 bytes]: 200MB (409600 sec)
* GPT Partition GUID [74 bytes]: 79730f0b-3579-4ab2-9947-e96892315160
* GPT Type GUID [256 bytes]: UEFI System Partition, c12a7328-f81f-11d2-ba4b-00a0c93ec93b
* GPT Partition Name [42 bytes]: EFI System Partition
+ FAT Information [8 bytes]:
  * FAT Bits (12,16,32) [4 bytes]: 32
  * Cluster Size [4 bytes]: 512B (1 sec)
  * First Cluster Offset [8 bytes]: 3.09MB (6332 sec)
  * Root Directory Cluster [4 bytes]: 2
  * First FAT Offset [8 bytes]: 16KB (32 sec)
  * Size of One FAT Table [8 bytes]: 1.53MB (3151 sec)
  * Number of FAT Copies [4 bytes]: 2
  # Active FAT copy [4 bytes]: Auto
  * Sector Size [4 bytes]: 512B
  * Major Version [1 bytes]: 0
  * Minor Version [1 bytes]: 0
  * Volume Size [8 bytes]: 200MB (409600 sec)

- Drive Number 25 --------------------------------
* Drive Type [256 bytes]: Partition
* Name [30 bytes]: APFS Container
* Size [8 bytes]: 111.5GB (234031968 sec)
* Partition Offset [8 bytes]: 200MB (409640 sec)
* Partition Size [8 bytes]: 111.5GB (234031968 sec)
* GPT Partition GUID [74 bytes]: 0c6388f0-1bdb-476f-a1d5-faea580a87af
* GPT Type GUID [256 bytes]: APFS Container, 7c3457ef-0000-11aa-aa11-00306543ecac

- Drive Number 27 --------------------------------
```

```
* Drive Type [256 bytes]: Volume Set
* Name [44 bytes]: APFS Fusion Container
* Size [8 bytes]: 1.01TB (2189683984 sec)

- Drive Number 28 -------------------------------
* Drive Type [256 bytes]: APFS Volume
* Name [20 bytes]: APFS-Test
* Mount Points [38 bytes]: /Volumes/APFS-Test
* Size [8 bytes]: 111.5GB (234031968 sec)
+ APFS Information [8 bytes]:
  * Volume GUID [74 bytes]: c70d7407-cf78-46b6-a905-f3853133c7c8
  * Block Size [4 bytes]: 4KB (8 sec)
  * Used Blocks [8 bytes]: 4469145
  * Last Write Time [8 bytes]: 8.9.2022 21:10:1

- Drive Number 29 -------------------------------
* Drive Type [256 bytes]: APFS Volume
* Name [40 bytes]: Macintosh HD - Data
* Mount Points [42 bytes]: /System/Volumes/Data
* Size [8 bytes]: 1.01TB (2189683984 sec)
+ APFS Information [8 bytes]:
  * Volume Role [10 bytes]: Data
  * Volume GUID [74 bytes]: f5444926-a963-3427-855b-6d02f99de54e
  * Volume Group GUID [74 bytes]: f5444926-a963-3427-855b-6d02f99de54e
  * Block Size [4 bytes]: 4KB (8 sec)
  * Used Blocks [8 bytes]: 116810840
  * Last Write Time [8 bytes]: 8.9.2022 21:10:4

- Drive Number 30 -------------------------------
* Drive Type [256 bytes]: APFS Volume
* Name [132 bytes]: Macintosh HD - Data-com.apple.TimeMachine.2022-09-07-234145.local
* Size [8 bytes]: 1.01TB (2189683984 sec)
+ APFS Information [8 bytes]:
  * Volume Role [10 bytes]: Data
  * Volume GUID [74 bytes]: f5444926-a963-3427-855b-6d02f99de54e
  * Volume Group GUID [74 bytes]: f5444926-a963-3427-855b-6d02f99de54e
  * Block Size [4 bytes]: 4KB (8 sec)
  * Used Blocks [8 bytes]: 116098391
  * Last Write Time [8 bytes]: 7.9.2022 20:41:45

- Drive Number 31 -------------------------------
* Drive Type [256 bytes]: APFS Volume
* Name [132 bytes]: Macintosh HD - Data-com.apple.TimeMachine.2022-09-08-160444.local
* Size [8 bytes]: 1.01TB (2189683984 sec)
+ APFS Information [8 bytes]:
  * Volume Role [10 bytes]: Data
  * Volume GUID [74 bytes]: f5444926-a963-3427-855b-6d02f99de54e
  * Volume Group GUID [74 bytes]: f5444926-a963-3427-855b-6d02f99de54e
  * Block Size [4 bytes]: 4KB (8 sec)
  * Used Blocks [8 bytes]: 116201418
  * Last Write Time [8 bytes]: 8.9.2022 13:4:44

- Drive Number 32 -------------------------------
```

```
* Drive Type [256 bytes]: APFS Volume
* Name [132 bytes]: Macintosh HD - Data-com.apple.TimeMachine.2022-09-08-203916.local
* Size [8 bytes]: 1.01TB (2189683984 sec)
+ APFS Information [8 bytes]:
  * Volume Role [10 bytes]: Data
  * Volume GUID [74 bytes]: f5444926-a963-3427-855b-6d02f99de54e
  * Volume Group GUID [74 bytes]: f5444926-a963-3427-855b-6d02f99de54e
  * Block Size [4 bytes]: 4KB (8 sec)
  * Used Blocks [8 bytes]: 116777113
  * Last Write Time [8 bytes]: 8.9.2022 17:39:16

- Drive Number 33 --------------------------------
* Drive Type [256 bytes]: APFS Volume
* Name [132 bytes]: Macintosh HD - Data-com.apple.TimeMachine.2022-09-08-213917.local
* Size [8 bytes]: 1.01TB (2189683984 sec)
+ APFS Information [8 bytes]:
  * Volume Role [10 bytes]: Data
  * Volume GUID [74 bytes]: f5444926-a963-3427-855b-6d02f99de54e
  * Volume Group GUID [74 bytes]: f5444926-a963-3427-855b-6d02f99de54e
  * Block Size [4 bytes]: 4KB (8 sec)
  * Used Blocks [8 bytes]: 116787894
  * Last Write Time [8 bytes]: 8.9.2022 18:39:18

- Drive Number 34 --------------------------------
* Drive Type [256 bytes]: APFS Volume
* Name [132 bytes]: Macintosh HD - Data-com.apple.TimeMachine.2022-09-08-223922.local
* Size [8 bytes]: 1.01TB (2189683984 sec)
+ APFS Information [8 bytes]:
  * Volume Role [10 bytes]: Data
  * Volume GUID [74 bytes]: f5444926-a963-3427-855b-6d02f99de54e
  * Volume Group GUID [74 bytes]: f5444926-a963-3427-855b-6d02f99de54e
  * Block Size [4 bytes]: 4KB (8 sec)
  * Used Blocks [8 bytes]: 116797931
  * Last Write Time [8 bytes]: 8.9.2022 19:39:22

- Drive Number 35 --------------------------------
* Drive Type [256 bytes]: APFS Volume
* Name [132 bytes]: Macintosh HD - Data-com.apple.TimeMachine.2022-09-08-234107.local
* Size [8 bytes]: 1.01TB (2189683984 sec)
+ APFS Information [8 bytes]:
  * Volume Role [10 bytes]: Data
  * Volume GUID [74 bytes]: f5444926-a963-3427-855b-6d02f99de54e
  * Volume Group GUID [74 bytes]: f5444926-a963-3427-855b-6d02f99de54e
  * Block Size [4 bytes]: 4KB (8 sec)
  * Used Blocks [8 bytes]: 116807413
  * Last Write Time [8 bytes]: 8.9.2022 20:41:7

- Drive Number 36 --------------------------------
* Drive Type [256 bytes]: APFS Volume
* Name [16 bytes]: Preboot
* Mount Points [48 bytes]: /System/Volumes/Preboot
* Size [8 bytes]: 1.01TB (2189683984 sec)
+ APFS Information [8 bytes]:
```

```
  * Volume Role [16 bytes]: Preboot
  * Volume GUID [74 bytes]: 5e853f43-e5ec-4179-bbd3-2f2704b39f0c
  * Block Size [4 bytes]: 4KB (8 sec)
  * Used Blocks [8 bytes]: 190606
  * Last Write Time [8 bytes]: 22.8.2022 21:49:11

- Drive Number 37 --------------------------------
* Drive Type [256 bytes]: APFS Volume
* Name [18 bytes]: Recovery
* Size [8 bytes]: 1.01TB (2189683984 sec)
+ APFS Information [8 bytes]:
  * Volume Role [18 bytes]: Recovery
  * Volume GUID [74 bytes]: 91ae079f-05a4-4502-a04d-fe0e95186448
  * Block Size [4 bytes]: 4KB (8 sec)
  * Used Blocks [8 bytes]: 273581
  * Last Write Time [8 bytes]: 22.8.2022 21:33:59

- Drive Number 38 --------------------------------
* Drive Type [256 bytes]: APFS Volume
* Name [6 bytes]: VM
* Mount Points [38 bytes]: /System/Volumes/VM
* Size [8 bytes]: 1.01TB (2189683984 sec)
+ APFS Information [8 bytes]:
  * Volume Role [6 bytes]: VM
  * Volume GUID [74 bytes]: 0c95f3c3-f381-4547-b503-0a28f03fab4e
  * Block Size [4 bytes]: 4KB (8 sec)
  * Used Blocks [8 bytes]: 524550
  * Last Write Time [8 bytes]: 8.9.2022 17:33:47

- Drive Number 39 --------------------------------
* Drive Type [256 bytes]: APFS Volume
* Name [26 bytes]: Macintosh HD
* Size [8 bytes]: 1.01TB (2189683984 sec)
+ APFS Information [8 bytes]:
  * Volume Role [14 bytes]: System
  * Volume GUID [74 bytes]: cb3e0faf-3835-4536-9538-5fd6ee406e20
  * Volume Group GUID [74 bytes]: f5444926-a963-3427-855b-6d02f99de54e
  * Block Size [4 bytes]: 4KB (8 sec)
  * Used Blocks [8 bytes]: 3764255
  * Last Write Time [8 bytes]: 8.9.2022 17:33:49

- Drive Number 40 --------------------------------
* Drive Type [256 bytes]: APFS Volume
* Name [196 bytes]: Macintosh HD-com.apple.os.update-E64B3CD15985B90FDC72FFBC9FFB352590E652
* Size [8 bytes]: 1.01TB (2189683984 sec)
+ APFS Information [8 bytes]:
  * Volume Role [14 bytes]: System
  * Volume GUID [74 bytes]: cb3e0faf-3835-4536-9538-5fd6ee406e20
  * Volume Group GUID [74 bytes]: f5444926-a963-3427-855b-6d02f99de54e
  * Block Size [4 bytes]: 4KB (8 sec)
  * Used Blocks [8 bytes]: 5345741
  * Last Write Time [8 bytes]: 22.8.2022 21:33:55
```

```
- Drive Number 41 -------------------------------
* Drive Type [256 bytes]: APFS Volume
* Name [14 bytes]: Update
* Mount Points [46 bytes]: /System/Volumes/Update
* Size [8 bytes]: 1.01TB (2189683984 sec)
+ APFS Information [8 bytes]:
  * Volume Role [14 bytes]: Update
  * Volume GUID [74 bytes]: 5337792e-3873-44d4-9550-83d1d26c72ab
  * Block Size [4 bytes]: 4KB (8 sec)
  * Used Blocks [8 bytes]: 2767
  * Last Write Time [8 bytes]: 8.9.2022 17:34:4

********************************************************************************************

----------------------------------------- Session 1 -------------------------------------
START Date / Time of Collection: 2022-09-09 00:16:11

Case Name: Steven v. Christofer
Case Number: 28-S-0205-CR-85763
Operator / Investigator Name: J.F. Lewson

Source drive:Sector    Modification Date       MD5                                    SHA-1
 28                    2022-09-08 22:00:20     Root
 28                    2022-09-08 22:46:03     Root/.fseventsd
 25                    2022-09-08 22:46:03     1af4a4275ce2ce213551464090bb3a2e       14922c
    DATA: DATA (Non-Resident)
         43094336-43094351
 25                    2022-09-08 22:46:03     13936109592cac255892bbe90f2d5d81       cabbcf
    DATA: DATA (Non-Resident)
         43094352-43094359
 25                    2022-09-08 22:46:03     f93b29aa809faae03d1632a519fedc7c       2574e0
    DATA: DATA (Non-Resident)
         7313512-7313519
 28                    2022-09-08 21:58:43     Root/.Spotlight-V100
 28                    2022-09-08 21:58:43     Root/.Spotlight-V100/Store-V2
 28                    2022-09-09 00:09:52     Root/.Spotlight-V100/Store-V2/3FCDA7BE-A427-4EB1
 28                    2022-09-08 22:00:32     Root/.Spotlight-V100/Store-V2/3FCDA7BE-A427-4EB1
 28                    2022-09-08 22:00:32     Root/.Spotlight-V100/Store-V2/3FCDA7BE-A427-4EB1
 28                    2022-09-08 22:00:32     Root/.Spotlight-V100/Store-V2/3FCDA7BE-A427-4EB1
 28                    2022-09-08 22:06:46     Root/.Spotlight-V100/Store-V2/3FCDA7BE-A427-4EB1
 25                    2022-09-08 22:06:46     556c368d59e706d470c957e798ad8b8f       842c63
    com.apple.ResourceFork: MACOS_DATA (Non-Resident)
         43089280-43089319
    com.apple.decmpfs: MACOS_DATA (Resident)
         3659142
    DATA: DATA (Non-Resident)
         0-34
 25                    2022-09-08 22:00:32     2da67d2f5b3f8c181a5e3461f12d2234       4560ac
    com.apple.ResourceFork: MACOS_DATA (Non-Resident)
         8514976-8515039
    com.apple.decmpfs: MACOS_DATA (Resident)
         3660076
    DATA: DATA (Non-Resident)
```

```
      0-35, 36-57
25                  2022-09-08 22:00:32     356319619aee55d6a122363d5188b2cc          a
   DATA: DATA (Non-Resident)
      8514944-8514975
25                  2022-09-08 22:00:32     90ff0d6d9698ebbbddf412e4a6120cc9          2
   com.apple.ResourceFork: MACOS_DATA (Non-Resident)
      8567472-8567495
   com.apple.decmpfs: MACOS_DATA (Resident)
      3660076
   DATA: DATA (Non-Resident)
      0-2, 3-5, 5-7, 8-10, 11-13, 13-15, 16-18, 18-20, 20-22, 22-23
25                  2022-09-08 22:00:32     4af42d4bfc5bf840bb449021f4fddb7c          7
   com.apple.ResourceFork: MACOS_DATA (Non-Resident)
      8515040-8515047
   com.apple.decmpfs: MACOS_DATA (Resident)
      3658893
   DATA: DATA (Non-Resident)
      0-3, 3-5
25                  2022-09-08 22:00:32     ac3a4692d90b01f65a4cf9c74ba6367f          f
   DATA: DATA (Non-Resident)
      8515048-8515071
25                  2022-09-08 22:00:46     abad9948c3fba719ed9755630350b1e3          f
   com.apple.ResourceFork: MACOS_DATA (Non-Resident)
      10141088-10141119
   com.apple.decmpfs: MACOS_DATA (Resident)
      3657014
   DATA: DATA (Non-Resident)
      0-3, 4-7, 7-10, 10-13, 13-16, 17-19, 19-21, 21-23, 24-26, 26-27
25                  2022-09-08 22:00:46     e67c7618bac03e4a14b95cb3a1684c9c          6
   DATA: DATA (Non-Resident)
      10141072-10141087
25                  2022-09-08 22:00:46     c18f56f9da1e49cc56df0c085f691f5d          c
   DATA: DATA (Non-Resident)
      10141048-10141071
25                  2022-09-08 22:00:47     efd79ddcdb8a9ee3ab199e79673087fb          d
   com.apple.ResourceFork: MACOS_DATA (Non-Resident)
      10141144-10141183
   com.apple.decmpfs: MACOS_DATA (Resident)
      3657013
   DATA: DATA (Non-Resident)
      0-35
25                  2022-09-08 22:00:46     262060a3e1367c9ac932cd99fee9fe0a          8
   DATA: DATA (Non-Resident)
      10141120-10141143
25                  2022-09-08 22:00:47     e9c7f33b2c803bf703f2d8729d3504f3          4
   com.apple.ResourceFork: MACOS_DATA (Non-Resident)
      10141184-10141191
   com.apple.decmpfs: MACOS_DATA (Resident)
      3657012
   DATA: DATA (Non-Resident)
      0-2, 2-3
25                  2022-09-08 22:00:46     6922bd5028c11c15e0e7e1e56c5ec18e          5
   DATA: DATA (Non-Resident)
```

```
      10141192-10141207
25                  2022-09-08 22:00:46     c23d6ee6de607a5b122bc932cdcaa981          1e6ba5
   DATA: DATA (Non-Resident)
      10141208-10141231
25                  2022-09-08 22:00:47     b7b098deca62ff106c8886d14764d03e          79b2c0
   DATA: DATA (Non-Resident)
      10141232-10141247
25                  2022-09-08 22:00:47     2cc0171d42663cd68aa458a2330fd317          054023
   DATA: DATA (Non-Resident)
      10141248-10141271
25                  2022-09-08 22:00:48     bc321e21c0bf2cbc674f98c172cd1505          7fff58
   com.apple.ResourceFork: MACOS_DATA (Non-Resident)
      10141272-10141279
   com.apple.decmpfs: MACOS_DATA (Resident)
      3657011
   DATA: DATA (Non-Resident)
      0-2, 2-3
25                  2022-09-08 22:00:47     460142c26d1636f09481f1fbf316102b          ee63ad
   DATA: DATA (Non-Resident)
      10141280-10141303
25                  2022-09-08 22:00:48     3e1da65c9eb5c151d767cf79bbbd5f01          349928
   DATA: DATA (Non-Resident)
      10141312-10141319
25                  2022-09-08 22:00:47     ef107ae30cd2faf7500fdcbcb58ae7fc          65d641
   DATA: DATA (Non-Resident)
      10141304-10141311
25                  2022-09-08 22:00:48     4c3552b2b45c8142fb78230a249788ce          eaef2e
   DATA: DATA (Non-Resident)
      10141320-10141327
25                  2022-09-08 22:00:48     d59410ad642ffe938628813d4229b13d          a9db9e
   DATA: DATA (Non-Resident)
      10141328-10141335
25                  2022-09-08 22:00:48     ac459f514105e4500fd8320425585dc9          981161
   DATA: DATA (Non-Resident)
      10141336-10141343
25                  2022-09-08 22:00:48     dc3a1ddcab841495c42d2ccde2ecb7eb          405cbc
   DATA: DATA (Non-Resident)
      10141344-10141351
25                  2022-09-08 22:00:49     24e341a5d293790b7413c6046ed9cc1e          025d45
   DATA: DATA (Non-Resident)
      10499320-10499327
25                  2022-09-08 22:00:49     acd0b43cd246f085923cf0e62e820042          710db5
   DATA: DATA (Non-Resident)
      10499328-10499335
25                  2022-09-08 22:00:49     b6af99868cbe42e4b77e9860848a2f6a          902d28
   DATA: DATA (Non-Resident)
      10499336-10499343
25                  2022-09-08 22:00:49     40e2c610319e1396ee9dd40cc8c3af2b          1e890a
   DATA: DATA (Non-Resident)
      10499344-10499351
25                  2022-09-08 22:00:49     af479c53a1e532d2e496ed785608eafd          a93ea0
   DATA: DATA (Non-Resident)
      10499352-10499375
```

```
25                    2022-09-08 22:00:50     a726f1b050823eb2f3734e4c3ff0cd30          9
   DATA: DATA (Non-Resident)
        10499376-10499399
25                    2022-09-08 22:00:51     5ccce027044a0df26e27c9bc4b19114b          e
   DATA: DATA (Non-Resident)
        10499440-10499455
25                    2022-09-08 22:00:52     014d7346f8fa99ece5904d993c3b9c51          5
   com.apple.ResourceFork: MACOS_DATA (Non-Resident)
        10499456-10499463
   com.apple.decmpfs: MACOS_DATA (Resident)
        3659775
   DATA: DATA (Non-Resident)
        0-2, 2-3
25                    2022-09-08 22:00:51     c2613cb057383d3beb410d5907072d2f          c
   DATA: DATA (Non-Resident)
        10499400-10499423
25                    2022-09-08 22:00:51     97e8a2c9bdd8cdae7e68068027e27f9e          a
   DATA: DATA (Non-Resident)
        10499424-10499439
25                    2022-09-08 22:00:52     15707949e58cda88fed9e3e8fd0d6d47          c
   com.apple.ResourceFork: MACOS_DATA (Non-Resident)
        10499464-10499471
   com.apple.decmpfs: MACOS_DATA (Resident)
        3659774
   DATA: DATA (Non-Resident)
        0-2, 2-3
25                    2022-09-08 22:00:51     9d18874bd46ad1071f4f417409f81c28          d
   DATA: DATA (Non-Resident)
        10499472-10499495
25                    2022-09-08 22:00:51     7295cdcfb1589d65641f4f2829110fa0          c
   DATA: DATA (Non-Resident)
        10499496-10499503
25                    2022-09-08 22:00:52     82771a9d66d9101d0a3d2ec95745fc13          4
   DATA: DATA (Non-Resident)
        10499504-10499511
25                    2022-09-08 22:00:52     89b7f84c5ce1ba862c25559bfc97ca3f          8
   DATA: DATA (Non-Resident)
        10499512-10499519
25                    2022-09-08 22:00:52     72f9e078858c846f72f317e372d89724          4
   DATA: DATA (Non-Resident)
        10499520-10499527
25                    2022-09-08 22:00:54     556c368d59e706d470c957e798ad8b8f          8
   com.apple.ResourceFork: MACOS_DATA (Non-Resident)
        10857984-10858023
   com.apple.decmpfs: MACOS_DATA (Resident)
        3659772
   DATA: DATA (Non-Resident)
        0-34
25                    2022-09-08 22:00:53     656c8c7ac1dbd4175e05dc484e6c5d62          9
   DATA: DATA (Non-Resident)
        10857976-10857983
28                    2022-09-08 21:58:44     Root/.Spotlight-V100/Store-V2/3FCDA7BE-A427
28                    2022-09-08 21:58:44     Root/.Spotlight-V100/Store-V2/3FCDA7BE-A427
```

```
28                  2022-09-08 21:58:44     Root/.Spotlight-V100/Store-V2/3FCDA7BE-A427-4EB1
28                  2022-09-08 22:00:26     Root/.Spotlight-V100/Store-V2/3FCDA7BE-A427-4EB1
25                  2022-09-08 22:00:26     c4e0d2509011c8ed1dc6b7837395556f          70ec89
   DATA: DATA (Non-Resident)
        7922344-7922351
28                  2022-09-08 21:58:44     Root/.Spotlight-V100/Store-V2/3FCDA7BE-A427-4EB1
28                  2022-09-08 21:58:44     Root/.Spotlight-V100/Store-V2/3FCDA7BE-A427-4EB1
28                  2022-09-08 22:10:49     Root/.Spotlight-V100/Store-V2/3FCDA7BE-A427-4EB1
25                  2022-09-08 22:10:49     c078e4f28252dd21cc095557df7e10ca          cacfa2
   DATA: DATA (Non-Resident)
        43092888-43092895
28                  2022-09-08 22:10:49     Root/.Spotlight-V100/Store-V2/3FCDA7BE-A427-4EB1
25                  2022-09-08 22:10:49     cf8b97ff91a88509dfb71b3e886467e7          3eaa52
   DATA: DATA (Non-Resident)
        43092880-43092887
28                  2022-09-08 21:58:44     Root/.Spotlight-V100/Store-V2/3FCDA7BE-A427-4EB1
28                  2022-09-08 21:58:44     Root/.Spotlight-V100/Store-V2/3FCDA7BE-A427-4EB1
28                  2022-09-09 00:09:42     Root/.Spotlight-V100/Store-V2/3FCDA7BE-A427-4EB1
28                  2022-09-08 21:58:45     Root/.Spotlight-V100/Store-V2/3FCDA7BE-A427-4EB1
25                  2022-09-09 00:09:52     78ecd243884cea622481ee663fc6c286          ed8165
   DATA: DATA (Non-Resident)
        7340896-7340935, 7341208-7341239, 43092904-43092967
25                  2022-09-09 00:09:42     a43c4057656a87b73ecbe45688fa754f          c123ab
   DATA: DATA (Non-Resident)
        7342088-7342215
25                  2022-09-08 22:10:49     05c3f670d5eef252939ecd1c07d91322          21ca9c
   DATA: DATA (Non-Resident)
        7342512-7342519
25                  2022-09-08 21:58:46     8f0f05e65021ccf77960958a9039e4f5          26b769
   DATA: DATA (Non-Resident)
        7341952-7342079, 7342224-7342231
25                  2022-09-08 21:58:45     85c62e3cae77aa28a6f63aaa9e7bcc4c          d28751
   DATA: DATA (Non-Resident)
        7340096-7340103
25                  2022-09-08 21:58:46     7dea362b3fac8e00956a4952a3d4f474          05fe40
   DATA: DATA (Non-Resident)
        7342520-7342527
25                  2022-09-08 21:58:46     a3ce32d674242ae4474c6063f2e348cd          36f9b7
   DATA: DATA (Non-Resident)
        7341928-7341935
25                  2022-09-08 21:58:45     610877ce04dc199237813ad5a7952eef          aa109f
   DATA: DATA (Non-Resident)
        7341816-7341823
25                  2022-09-08 22:10:50     d117ef6fcdf53e87ab58a410a5b62d7b          8074ba
   DATA: DATA (Non-Resident)
        7342504-7342511
25                  2022-09-08 21:58:46     7bea485739dabdca61c3f6f93528dd1c          95f2a5
   DATA: DATA (Non-Resident)
        7340032-7340039
25                  2022-09-08 21:58:46     f1d3ff8443297732862df21dc4e57262          9069ca
   DATA: DATA (Non-Resident)
        7342488-7342495
25                  2022-09-08 21:58:46     c90df404704fefdc5a8f1be1b4340b5f          3732cd
```

```
   DATA: DATA (Non-Resident)
        7342480-7342487
25                    2022-09-08 22:10:49     c4103f122d27677c9db144cae1394a66          1
   DATA: DATA (Non-Resident)
        7341488-7341495
25                    2022-09-08 22:10:49     03024f43cdd1c25630489b3055de4572          b
   DATA: DATA (Non-Resident)
        43093112-43093119
25                    2022-09-08 21:58:46     d2f6a4fd9f5a7b9618ea234f8df12ea7          5
   DATA: DATA (Non-Resident)
        7342496-7342503
28                    2022-09-08 21:58:44     d41d8cd98f00b204e9800998ecf8427e          d
28                    2022-09-09 00:09:42     d41d8cd98f00b204e9800998ecf8427e          d
25                    2022-09-08 21:58:45     52f7ac4bf92074028077df61d1db6826          6
   DATA: DATA (Non-Resident)
        7341176-7341183
25                    2022-09-08 21:58:45     04c0b5d3bebb9dec43f4bc705fa2c901          f
   DATA: DATA (Non-Resident)
        7341160-7341167
25                    2022-09-09 00:09:53     160a021f3205fde79adcaae770c31c43          0
   DATA: DATA (Non-Resident)
        7340856-7340863
25                    2022-09-08 21:58:45     f03f49d651468380cda969fc3c3a99b6          6
   DATA: DATA (Non-Resident)
        7341168-7341175
25                    2022-09-08 22:02:24     02446bd8639cf9d243d4a628412f4392          1
   DATA: DATA (Non-Resident)
        34985712-34985727
25                    2022-09-08 22:01:11     0f6d5d503d0f1684c6c3f5f43033e43e          9
   DATA: DATA (Non-Resident)
        12292128-12292143
25                    2022-09-08 21:58:45     02446bd8639cf9d243d4a628412f4392          1
   DATA: DATA (Non-Resident)
        34985712-34985727
25                    2022-09-08 22:05:33     43164790061f026aa24382195640d651          3
   DATA: DATA (Non-Resident)
        7341184-7341191, 7342552-7342559, 8418768-8418775, 11216160-11216167, 14080400-140
25                    2022-09-08 22:10:50     bdf75e8752c011ccfe0bf6f5188908d7          e
   DATA: DATA (Non-Resident)
        7340864-7340871
25                    2022-09-08 22:05:33     be9fd3f083f292292e5a2cb8049995cf          6
   DATA: DATA (Non-Resident)
        7341192-7341199, 40315328-40315335
28                    2022-09-08 21:58:44     620f0b67a91f7f74151bc5be745b7110          1
   DATA: DATA (Non-Resident)

25                    2022-09-08 21:58:44     afe904447712c4f997a3e54cd9b3a4a7          0
   DATA: DATA (Non-Resident)
        7342544-7342551
25                    2022-09-08 21:58:44     c67d1dfe2d91f38ed0862b00a2671c42          4
   DATA: DATA (Non-Resident)
        7340872-7340879
25                    2022-09-08 21:58:44     620f0b67a91f7f74151bc5be745b7110          1
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   DATA: DATA (Non-Resident)
        7342536-7342543
25                  2022-09-08 21:58:45     31ed29ba96327fe671dd9635266a43e0          7ac6f1
   DATA: DATA (Non-Resident)
        7341776-7341783
25                  2022-09-08 21:58:45     7fb065023cc00671d27540204982a747          db0d0a
   DATA: DATA (Non-Resident)
        7341760-7341767
25                  2022-09-08 22:10:50     edc974b57468b0728883597f36bbc390          4117c9
   DATA: DATA (Non-Resident)
        7340880-7340887
25                  2022-09-08 21:58:45     6e4854f142889c7ee174f25bafae1f7c          e4fadd
   DATA: DATA (Non-Resident)
        7341768-7341775
25                  2022-09-08 21:58:45     e037f4001795f81cb62246033a596cad          67ca01
   DATA: DATA (Non-Resident)
        7341800-7341807
25                  2022-09-08 21:58:45     4a99c9df718acdf59fe4a3232bc135f9          5f7929
   DATA: DATA (Non-Resident)
        7341784-7341791
25                  2022-09-08 22:10:50     a209b2b6921631425d337b3ea80161d0          23bb6f
   DATA: DATA (Non-Resident)
        7340888-7340895
25                  2022-09-08 21:58:45     f95b964328d04de4330df914d271d912          436ef8
   DATA: DATA (Non-Resident)
        7341792-7341799
25                  2022-09-08 22:10:50     cdd79e88bcaeac04808dcddb731fecd7          0da6eb
   DATA: DATA (Non-Resident)
        7313520-7313527
25                  2022-09-08 22:06:15     64712265762f3c6b4230f5241ed72148          520a0c
   DATA: DATA (Non-Resident)
        7342576-7342583
25                  2022-09-09 00:09:53     d8f3a9a3ddff1b219dc49acd90352089          e5a04c
   DATA: DATA (Non-Resident)
        7340064-7340079
28                  2022-09-08 21:58:44     d41d8cd98f00b204e9800998ecf8427e          da39a3
28                  2022-09-08 21:58:44     d41d8cd98f00b204e9800998ecf8427e          da39a3
25                  2022-09-09 00:09:42     1818dac1b16adcdaf4b971bcacc7f018          83ccc3
   DATA: DATA (Non-Resident)
        7340720-7340847
25                  2022-09-08 22:10:49     dde25d3d42da2e43852ca275da5f6cc3          49938c
   DATA: DATA (Non-Resident)
        7341656-7341663
25                  2022-09-09 00:09:42     8e381fe71c2ffc86c6f6e6563d66c5af          9ebd03
   DATA: DATA (Non-Resident)
        7340592-7340719, 43089320-43089575
25                  2022-09-09 00:09:42     b788d18203297bc51d2bf25a91d0deb5          46b3fd
   DATA: DATA (Non-Resident)
        7340504-7340535
25                  2022-09-09 00:09:42     fc197aa19e17dbd16804f4f328504dad          f597b4
   DATA: DATA (Non-Resident)
        7341256-7341263
25                  2022-09-09 00:09:42     30584cfd20e57509a9f7bef35fac93ea          c65ed2
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        7340568-7340591
25                    2022-09-09 00:09:42     88a5672b67fea934af10b134b9068a88         0
   DATA: DATA (Non-Resident)
        7342592-7342599
25                    2022-09-09 00:09:43     734acfe747c61281af75f3d309ec98c4         7
   DATA: DATA (Non-Resident)
        7341264-7341271
25                    2022-09-09 00:09:42     b1984f18d595f76efdec299dae5d9e46         1
   DATA: DATA (Non-Resident)
        7340440-7340503
25                    2022-09-09 00:09:42     374fa3390ab89c531994ca5b1f71b901         4
   DATA: DATA (Non-Resident)
        43092864-43092871, 43090824-43092863
25                    2022-09-09 00:09:42     940ec92fa2c7e996fb44b9b15a1567e3         d
   DATA: DATA (Non-Resident)
        7340552-7340567, 43090072-43090567
25                    2022-09-09 00:09:42     df9ed984babccad049b5e7f7c09add07         c
   DATA: DATA (Non-Resident)
        43090816-43090823, 43090568-43090815
25                    2022-09-09 00:09:42     cc9edfd3f936ae6ed6d779d48896eef1         c
   DATA: DATA (Non-Resident)
        7340536-7340551, 43089576-43090071
28                    2022-09-08 22:10:50     d41d8cd98f00b204e9800998ecf8427e         d
25                    2022-09-08 22:10:49     b80954bd4df2155c1de50d94d6a8c363         4
   DATA: DATA (Non-Resident)
        43092872-43092879
28                    2022-09-08 21:58:45     d41d8cd98f00b204e9800998ecf8427e         d
25                    2022-09-08 22:10:49     8e381fe71c2ffc86c6f6e6563d66c5af         9
   DATA: DATA (Non-Resident)
        7341520-7341655, 43093912-43094159
25                    2022-09-08 22:10:49     7d2d5fca80364273fb07d5820a76fef4         e
   DATA: DATA (Non-Resident)
        43093896-43093903
25                    2022-09-08 21:58:45     69c1753bd5f81501d95132d08af04464         b
   DATA: DATA (Non-Resident)
        7341848-7341855
25                    2022-09-08 22:10:49     f226ecc8234e23c3d02633c5e525e43e         a
   DATA: DATA (Non-Resident)
        43093904-43093911
25                    2022-09-08 21:58:45     d27aea7f3368cbf32422a92d0f172b5d         d
   DATA: DATA (Non-Resident)
        7341856-7341863
25                    2022-09-08 22:10:49     5f43fb76c6ad814e59f1daac8a9fc858         9
   DATA: DATA (Non-Resident)
        7341664-7341671
25                    2022-09-08 22:10:49     9a9d53f24a94ff976e9e9dedbe7010ff         0
   DATA: DATA (Non-Resident)
        43093120-43093127
25                    2022-09-08 21:58:45     04473ed15016a707f941eb37dd4dfb89         4
   DATA: DATA (Non-Resident)
        7341840-7341847
25                    2022-09-08 22:10:49     f55f63cd645c398758dbeadd219f6757         a
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   DATA: DATA (Non-Resident)
        43093512-43093775
25                   2022-09-08 22:10:49     1ba9604adf198eaf1cbe60b8e5970913          7a7a3b
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        43093128-43093391
25                   2022-09-09 00:09:42     342dbe0685b41e0d3f88fa168762bb94          597622
   DATA: DATA (Non-Resident)
        7340968-7341095
25                   2022-09-08 22:10:49     22258f2dd8b18798cc871e8ec82f4e4a          b7a698
   DATA: DATA (Non-Resident)
        7341312-7341319, 43093104-43093111
25                   2022-09-08 22:10:50     25daad3d9e60b45043a70c4ab7d3b1c6          0e356b
   DATA: DATA (Non-Resident)
        43094304-43094311
25                   2022-09-08 21:58:45     25daad3d9e60b45043a70c4ab7d3b1c6          0e356b
   DATA: DATA (Non-Resident)
        7341880-7341887
25                   2022-09-08 22:46:03     38539fe36a3b769e583f408651ef0690          a881eb
   DATA: DATA (Non-Resident)
        43094328-43094335
25                   2022-09-08 22:16:49     a404b479659fec858c4c83ee2dae5af5          6368c4
   DATA: DATA (Non-Resident)
        43094312-43094319
25                   2022-09-08 22:10:49     aeab4da419d2d7d9557a767b69636af5          a8e7a9
   DATA: DATA (Non-Resident)
        43092896-43092903
25                   2022-09-08 21:58:46     36927412bd722b23be608823fd0808df          2aabc3
   DATA: DATA (Non-Resident)
        7341888-7341895
25                   2022-09-08 22:10:50     544f270df3499abdcb1fb81d6222fe67          111073
   DATA: DATA (Non-Resident)
        7340848-7340855, 7340936-7340967, 7341280-7341311, 43093040-43093103
25                   2022-09-08 22:10:50     30a771fb83c2f5000a74d41689f19c76          9508e9
   DATA: DATA (Non-Resident)
        43094296-43094303
25                   2022-09-08 21:58:45     30a771fb83c2f5000a74d41689f19c76          9508e9
   DATA: DATA (Non-Resident)
        7341872-7341879
25                   2022-09-08 21:58:44     f2dd0dedb2c260419ece4a9e03b2e828          0aaf76
   DATA: DATA (Non-Resident)
        7341104-7341111
28                   2022-09-08 21:58:44     d41d8cd98f00b204e9800998ecf8427e          da39a3
28                   2022-09-08 22:10:49     d41d8cd98f00b204e9800998ecf8427e          da39a3
28                   2022-09-08 22:10:49     d41d8cd98f00b204e9800998ecf8427e          da39a3
28                   2022-09-08 21:58:44     d41d8cd98f00b204e9800998ecf8427e          da39a3
25                   2022-09-08 22:10:49     414e154032380933dd36ca56a217ead0          a78f9e
   DATA: DATA (Non-Resident)
        43092968-43093031
25                   2022-09-08 21:58:45     8096b00ef112413d9b90dbfb056fcbae          2fdce9
   DATA: DATA (Non-Resident)
        7341808-7341815
25                   2022-09-09 00:09:52     8fdd6a6bbc1a5aedcea2b12ba7ed679c          018fd3
   DATA: DATA (Non-Resident)
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        7340080-7340087
25                    2022-09-09 00:09:43     174c2f4a5b32d2ea3c0c9b3be912db77          f
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        7340056-7340063
25                    2022-09-08 22:10:49     d49cbad07db828dd49e66c2e61fc323b          2
   DATA: DATA (Non-Resident)
        43093032-43093039
25                    2022-09-08 22:10:49     dd69f94854aac0364ad0eeb2b556ffc2          b
   DATA: DATA (Non-Resident)
        43094288-43094295
25                    2022-09-08 22:00:30     d35452777ea04b7c05777caff473771f          b
   DATA: DATA (Non-Resident)
        8418760-8418767
28                    2022-09-08 21:58:44     d41d8cd98f00b204e9800998ecf8427e          d
25                    2022-09-09 00:09:42     3bff3605f109fae4cd07e26dcc68cc41          2
   DATA: DATA (Non-Resident)
        7340040-7340055
25                    2022-09-08 21:58:44     ac8b6b78551823f4f648b850dc6c4a64          2
   DATA: DATA (Non-Resident)
        7341112-7341127
28                    2022-03-03 22:07:11     Root/Documents
28                    2022-03-03 22:07:13     Root/Documents/OpenOffice-files
28                    2022-03-03 22:07:13     Root/Documents/OpenOffice-files/Calc-files
28                    2022-03-03 22:07:13     Root/Documents/OpenOffice-files/Calc-files/
25                    2020-04-07 02:21:52     b1eb4cc9101bcb86c0042231f898f0ae          8
   DATA: DATA (Non-Resident)
        7441648-7441663
25                    2020-04-07 02:18:30     eab006354c7cf4e1fd3772afd0643672          b
   DATA: DATA (Non-Resident)
        7441616-7441647
25                    2020-04-07 02:20:50     94790aeb545e806ea9cf161f6ae2697f          1
   DATA: DATA (Non-Resident)
        7441696-7441799
25                    2020-04-07 02:19:48     000389561d71032e79411613d73f01f5          3
   DATA: DATA (Non-Resident)
        7441664-7441695
25                    2020-04-07 02:21:44     28aa35b07f4a28f4f001e28f277dd1be          f
   DATA: DATA (Non-Resident)
        7441800-7442175
28                    2022-03-03 22:07:13     Root/Documents/OpenOffice-files/Calc-files/
25                    2020-04-07 02:31:06     c763a032a1999d42934abebc25fc6a83          0
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        7441168-7441183
25                    2020-04-07 02:25:50     f893b7290b96905f0776e0e1cb4b91c4          d
   DATA: DATA (Non-Resident)
        7441600-7441615
25                    2020-04-07 02:30:28     be99eeaa2e2aa77ecb4d7b9eeff44cb4          1
   DATA: DATA (Non-Resident)
        7441184-7441207
25                    2020-04-07 02:30:10     2280cba8bea0ded6bf9c428939f9cb32          4
   DATA: DATA (Non-Resident)
        7441584-7441599
25                    2020-04-07 02:30:42     980e7a175ea67333379753a788d331e5          c
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        7441208-7441583
25                  2020-04-07 02:23:14     db42bc048678d194bda93124fcc1e359          9f7137
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        7441152-7441167
28                  2022-03-03 22:07:13     Root/Documents/OpenOffice-files/Microsoft-files
28                  2022-03-03 22:07:13     Root/Documents/OpenOffice-files/Microsoft-files/
28                  2022-03-03 22:07:13     Root/Documents/OpenOffice-files/Microsoft-files/
25                  2020-04-07 02:13:48     7901a6038143aa293bff65c1dcc564a9          13c30d
   DATA: DATA (Non-Resident)
        7431480-7431495
25                  2018-10-19 21:12:18     01a42d82b4e2e143876cc0afea4883ed          3cc926
   DATA: DATA (Non-Resident)
        7432936-7432975
25                  2018-10-19 21:14:00     efcb6e746de385a6ba15f9e697503f4c          96451e
   DATA: DATA (Non-Resident)
        7431496-7431567
25                  2018-10-19 21:14:56     f9773bf0bd611c8a9107140956b3881f          7a538e
   DATA: DATA (Non-Resident)
        7432976-7433279
25                  2018-10-19 21:13:24     b3df6dd6764416491f51415c4ccf1aaf          eea1be
   DATA: DATA (Non-Resident)
        7431424-7431479
25                  2018-10-19 21:15:24     ecb548b885ec5cf6f6e38ece80fa5f2e          5ddffe
   DATA: DATA (Non-Resident)
        7431568-7432935
28                  2022-03-03 22:07:13     Root/Documents/OpenOffice-files/Microsoft-files/
25                  2020-04-07 02:16:34     8f9765363a3610383bbafb7ed7e8928c          075e8f
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        7430744-7430759
25                  2018-10-19 21:16:16     bd5ec17de931c601b3231fdb4eac6db6          2a647d
   DATA: DATA (Non-Resident)
        7431288-7431311
25                  2018-10-19 21:17:58     43cb8b1c3ede97eaeb779d0bc7d03710          41360a
   DATA: DATA (Non-Resident)
        7431256-7431287
25                  2018-10-19 21:18:46     513e4fac7ff88720001864d1a350ed1c          87e9c3
   DATA: DATA (Non-Resident)
        7431312-7431423
25                  2018-10-19 21:16:44     775654d96ef34c95ce1a60e9606977e9          1954ba
   DATA: DATA (Non-Resident)
        7430760-7430783
25                  2018-10-19 21:19:10     ea38c0c454aa508b5909161bd8260918          e566e8
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        7430784-7431255
25                  2020-04-07 02:31:14     52d71be9d0971685678823c546b72eff          1930f5
   DATA: DATA (Non-Resident)
        7430720-7430743
28                  2022-03-03 22:07:13     Root/Documents/OpenOffice-files/Microsoft-files/
28                  2022-03-03 22:07:13     Root/Documents/OpenOffice-files/Microsoft-files/
25                  2020-04-07 02:12:42     34b20ad44b5d33cc3401b0ca1c9c55ad          236a62
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        7422312-7422327
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25                    2018-10-19 21:10:24     759cbcd3d7c574ec4de97222bc407665          1
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        7423312-7424319
25                    2018-10-19 21:20:26     35176f9b7f521954445100e5df74dee9          5
   DATA: DATA (Non-Resident)
        7424320-7424527
25                    2018-10-19 21:20:00     bb8c0ad499fc64837a45154a27e07734          1
   DATA: DATA (Non-Resident)
        7424528-7426543
25                    2018-10-19 21:21:18     e16fb51cef336edf2c19d065ef49a662          1
   DATA: DATA (Non-Resident)
        7422328-7423311
28                    2022-03-03 22:07:14     Root/Documents/OpenOffice-files/Microsoft-f
25                    2020-04-07 02:12:42     0717f9af8c983c9af7d5fb9d311ab163          0
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        7426792-7426807
25                    2018-10-19 21:11:20     96d043aabc6bdad1046db4c47aa7a3a8          7
   DATA: DATA (Non-Resident)
        7428896-7429583
25                    2018-10-19 21:22:34     0815c2eb26ab3ad59fab1ccba9d18fd0          2
   DATA: DATA (Non-Resident)
        7426544-7426791
25                    2018-10-19 21:21:56     9a1485d3bca8dd88cb67f248c0144d0b          0
   DATA: DATA (Non-Resident)
        7426808-7428895
25                    2018-10-19 21:23:10     183a5dc1a099e3c8c0b54c6aa52d64b7          1
   DATA: DATA (Non-Resident)
        7429584-7430719
25                    2020-04-07 02:44:02     8b1836fc208a9ab78cb95bc0d00b6256          c
   DATA: DATA (Non-Resident)
        7422296-7422311
25                    2020-04-07 02:44:32     b6e071bf10615607b95d544a2022d187          1
   DATA: DATA (Non-Resident)
        7422280-7422295
28                    2022-03-03 22:07:14     Root/Documents/OpenOffice-files/Writer-file
28                    2022-03-03 22:07:14     Root/Documents/OpenOffice-files/Writer-file
25                    2020-04-07 02:33:22     70b4b7f69342042902032114b234fa03          7
   DATA: DATA (Non-Resident)
        7438216-7438359
25                    2020-04-07 02:36:02     e579cd58b1ac23749e4251835bc0f610          e
   DATA: DATA (Non-Resident)
        7439232-7441135
25                    2020-04-07 02:36:58     0a64c077c83153e159aa45906220ff3e          c
   DATA: DATA (Non-Resident)
        7437312-7438215
25                    2020-04-07 02:34:46     f1dbf4f7ad95d39ccc0f877d9b887afa          c
   DATA: DATA (Non-Resident)
        7438360-7439231
28                    2022-03-03 22:07:14     Root/Documents/OpenOffice-files/Writer-file
25                    2020-04-07 02:43:34     d4c494a030d81983196866482a5597fe          4
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        7433296-7433311
25                    2020-04-07 02:40:22     c3e2b9d976977ec25d6347ed02673120          c
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25                  2020-04-07 02:42:34     5f1e8dfdac3fc3133511a75f26001854          7a26c3
   DATA: DATA (Non-Resident)
        7433312-7435407
25                  2020-04-07 02:41:24     324dd4fe1e621090a5dfe7e0c7680050          c070a6
   DATA: DATA (Non-Resident)
        7435408-7436543
25                  2020-04-07 02:43:30     b45be240cb18dda2cd78caee72891837          06bb21
   DATA: DATA (Non-Resident)
        7436792-7437311
25                  2020-04-07 02:37:14     14a0ca21163393f57c739e278f95dfde          cc80e7
   DATA: DATA (Non-Resident)
        7433280-7433295
25                  2020-04-07 02:35:00     229601a0b29ad34773e4891161a14e2b          e0a791
   DATA: DATA (Non-Resident)
        7441136-7441151
28                  2022-03-03 22:07:14     Root/Documents/pdf
25                  2018-10-19 21:31:10     cafaa4fe6206c58f5dec13c3ea9d0371          7ed087
   DATA: DATA (Non-Resident)
        7413144-7413663
25                  2018-10-19 21:28:32     f75c9215162661abdd9cd1aa11d792e6          06dcba
   DATA: DATA (Non-Resident)
        7413664-7416031
25                  2018-10-19 21:30:08     23d2d7627d3edbc66586726cbd4225b1          34d580
   DATA: DATA (Non-Resident)
        7381832-7383247
25                  2018-10-19 22:05:42     2cea8c95dc5f5db6065f704068292867          662885
   DATA: DATA (Non-Resident)
        7383248-7413143
25                  2018-10-19 21:49:28     4bfa34445fe5e92cee0d4be1c4b6afbd          4c166d
   DATA: DATA (Non-Resident)
        7379240-7381831
25                  2018-06-22 21:08:58     b05a97e064cc54b99daba53bde958d58          31249a
   DATA: DATA (Non-Resident)
        7347048-7351519
25                  2013-06-26 19:00:34     0a4ffa384ae31d33a801acc0e1746e65          f09aed
   DATA: DATA (Non-Resident)
        7416032-7422279
25                  2013-06-26 18:58:10     12ab314eb73a4a938bed3d6550da0ff2          22b014
   DATA: DATA (Non-Resident)
        7442176-7443927
25                  2013-06-26 18:56:34     bcb1278d0441dd482bc9aafb57abe8a6          790de8
   DATA: DATA (Non-Resident)
        7342616-7347047
25                  2018-10-19 22:04:44     9bc47b9f8c3ddc76f98b888d29d58dc8          ca2d12
   DATA: DATA (Non-Resident)
        7351520-7379239
25                  2016-08-09 16:43:30     cbe35c8518717402622e37fe748e08b3          028f8e
   DATA: DATA (Non-Resident)
        7443928-7450887
28                  2022-03-03 22:07:16     Root/Music
28                  2022-03-03 22:07:16     Root/Music/Andre_Rieu
```

```
25                    2016-06-05 16:40:10     a44be999d6682d18644da916cc3a5569          5
   DATA: DATA (Non-Resident)
        7861312-7874119
25                    2016-06-05 16:39:14     babfb3a12071e9207803c707f0ea4da9          1
   DATA: DATA (Non-Resident)
        7874120-7882167
25                    2016-06-05 16:39:10     d4d8f39e2b3c8df8c62b363284524e7c          3
   DATA: DATA (Non-Resident)
        8105000-8119791
25                    2016-06-05 16:39:14     0f83a6b9df6c1c8768ff7a5466789eb2          7
   DATA: DATA (Non-Resident)
        8051224-8058271
25                    2016-06-05 16:40:02     e76773c030362550b84955ddb47bc7db          b
   DATA: DATA (Non-Resident)
        7893384-7900703
25                    2016-06-05 16:39:52     36f69d719447f30f50290692ae1ba58a          c
   DATA: DATA (Non-Resident)
        7992168-8006335
25                    2016-06-05 16:39:14     f33002bfcfdff30eca4937b2fa02e7b4          2
   DATA: DATA (Non-Resident)
        8085992-8087519
25                    2016-06-05 16:40:24     afdf9b6627e3ee2a87027fe4037b684a          9
   DATA: DATA (Non-Resident)
        8008776-8017527
25                    2016-06-05 16:39:46     95412d5402c21407a4f1fedf4976a019          a
   DATA: DATA (Non-Resident)
        8170912-8180127
25                    2016-06-05 16:40:08     a0c6ca644336e199bdd47941f90273cb          7
   DATA: DATA (Non-Resident)
        8189504-8217231
25                    2016-06-05 16:39:24     1349bee844c598e63840776a8672c7b9          4
   DATA: DATA (Non-Resident)
        8139184-8151399
25                    2016-06-05 16:39:12     7d8c170fdef0f9be95ebb3eb8ff5c351          8
   DATA: DATA (Non-Resident)
        7851336-7861311
25                    2016-06-05 16:40:14     b2d52b23a778f12d5ecd3dd17cefac21          f
   DATA: DATA (Non-Resident)
        7900704-7922319
25                    2016-06-05 16:39:28     6ed3f80daa58010724c6522a1c8599b8          6
   DATA: DATA (Non-Resident)
        7846848-7851335
25                    2016-06-05 16:39:34     5df7c88018a4a90877e37f5146b64ba4          b
   DATA: DATA (Non-Resident)
        7957336-7968479
25                    2016-06-05 16:39:10     e1469291b0a0383d587c8783a206679b          6
   DATA: DATA (Non-Resident)
        8119792-8129895
25                    2016-06-05 16:39:26     24edae723208ebb53fa9a70c6235d174          7
   DATA: DATA (Non-Resident)
        7882168-7893383
25                    2016-06-05 16:39:16     4214e0582e22356faa3006f593c31521          6
   DATA: DATA (Non-Resident)
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      8045120-8051223
25                  2016-06-05 16:39:30     6f867a4b657fcb11eb1590b93f6121af          2a4451
   DATA: DATA (Non-Resident)
      8006336-8008775
25                  2016-06-05 16:39:12     9da23d67db029b0a2aba65a902977ee7          f4427b
   DATA: DATA (Non-Resident)
      7944504-7957335
25                  2016-06-05 16:40:20     04f2d1fdff801d2ebe6df0f29a18e619          ae5ef6
   DATA: DATA (Non-Resident)
      8038144-8045119
25                  2016-06-05 16:40:20     3a8b983d9b22d2cf58714f94272085a2          d8888d
   DATA: DATA (Non-Resident)
      7980688-7992167
25                  2016-06-05 16:40:06     ed26972ec518840247f114119e032cb9          954750
   DATA: DATA (Non-Resident)
      8129896-8139183
25                  2016-06-05 16:39:44     90d6ced1e8a5012ba917d1049cb86d83          c8563a
   DATA: DATA (Non-Resident)
      8162112-8170911
25                  2016-06-05 16:40:22     16c30e0592019ff78261b8ace757d93c          26c851
   DATA: DATA (Non-Resident)
      8180128-8189503
25                  2016-06-05 16:40:22     16c30e0592019ff78261b8ace757d93c          26c851
   DATA: DATA (Non-Resident)
      8252896-8262271
25                  2016-06-05 16:39:22     9f2fa86941e53af861f58a20fe4ca3a0          048dae
   DATA: DATA (Non-Resident)
      8237728-8252895
25                  2016-06-05 16:39:08     7a4d0e64b2e59713d8372bc8c33a413f          6eb557
   DATA: DATA (Non-Resident)
      8087520-8094615
25                  2016-06-05 16:40:26     85af6129badd4d015270a811c686b5ed          fa8560
   DATA: DATA (Non-Resident)
      8094616-8104999
25                  2016-06-05 16:39:38     d8f4430b58e89bfbca7e04d9c8c1ae85          ed6067
   DATA: DATA (Non-Resident)
      7922352-7944503
25                  2016-06-05 16:39:34     526ac06ad6e99e345c605e8ee5308765          a26404
   DATA: DATA (Non-Resident)
      8217232-8237727
25                  2016-06-05 16:39:42     5e069942912410b0a2b9a07393c5bca8          1d9a97
   DATA: DATA (Non-Resident)
      8151400-8162111
25                  2016-06-05 16:39:30     620bf7a865780b1d6f5357af14d91ad5          7634bc
   DATA: DATA (Non-Resident)
      7968480-7980687
25                  2016-06-05 16:39:16     c9cf9053c04806485687e3cc0c26fef2          56258d
   DATA: DATA (Non-Resident)
      8027992-8038143
25                  2016-06-05 16:39:18     e9f2e7b7ec1b375bf8409bbb63c0c1d3          516710
   DATA: DATA (Non-Resident)
      8017528-8027991
25                  2016-06-05 16:40:02     5f5e765df138f0d8695d567bd6ba7ebf          4a7d04
```

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        8058272-8085991
28                   2022-03-03 22:07:28     Root/Music/Barry_Sisters
25                   2013-10-19 00:58:26     ca8ecbaf0d6dc35e2633236cdd4fd3a3          7
   DATA: DATA (Non-Resident)
        7657816-7663375
25                   2013-10-19 00:25:14     2cac595c471dbc63b18f64d7402e5a47          4
   DATA: DATA (Non-Resident)
        7717624-7724247
25                   2013-10-19 00:14:20     ab3e597a143beb7cca18afabe6b2cf05          0
   DATA: DATA (Non-Resident)
        7694120-7700695
25                   2013-10-19 01:14:54     93faf50fbbb3852820fd0af9304d981e          d
   DATA: DATA (Non-Resident)
        7663376-7669759
25                   2013-10-19 00:51:52     665e256b848c6932d601ba9c7a69d71a          b
   DATA: DATA (Non-Resident)
        7700696-7717623
25                   2013-10-19 00:06:18     ebc7efe7222437cea77bbb756ae20b66          0
   DATA: DATA (Non-Resident)
        7743520-7749727
25                   2013-10-19 01:20:22     d835c7abf97c3739e3ad3a2943e3bbe5          0
   DATA: DATA (Non-Resident)
        7734096-7743519
25                   2013-10-19 00:28:36     d8cdf8cfd4419fbb70c7f5df347f6890          1
   DATA: DATA (Non-Resident)
        7669760-7677639
25                   2013-10-19 00:41:54     675c2e035c953df83bc6dd245966ff8e          3
   DATA: DATA (Non-Resident)
        7650688-7657815
25                   2013-10-19 13:03:04     8cff6cb8a834d5a0e00366853c2ed8bd          4
   DATA: DATA (Non-Resident)
        7724248-7734095
25                   2013-10-19 00:37:44     c928185e9da6fd4bb10b64b5b578552f          3
   DATA: DATA (Non-Resident)
        7677640-7694119
28                   2022-03-03 22:07:31     Root/Music/Electric_Lgcht_Orchestra
28                   2022-03-03 22:07:31     Root/Music/Electric_Lgcht_Orchestra/Time_19
25                   2005-04-07 14:11:40     e56b81d6e95ba198ba13f55a6c94d9d6          1
   DATA: DATA (Non-Resident)
        7531632-7535103
25                   2005-04-07 14:11:40     e183a3f026acbfaf8e4c8c9997c03721          8
   DATA: DATA (Non-Resident)
        7573088-7580687
25                   2005-04-07 14:11:40     e71574ae3bdb6a6d39a777b63f98c261          e
   DATA: DATA (Non-Resident)
        7561264-7573087
25                   2005-04-07 14:11:40     1a5112f377cacd6d35e093d47c52fcc0          7
   DATA: DATA (Non-Resident)
        7499496-7511095
25                   2005-04-07 14:11:40     f9d68c6e0468aed135415687d65e41a6          b
   DATA: DATA (Non-Resident)
        7535104-7548199
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25                    2005-04-07 14:11:40     75d6f8ea67e56aff2c37a7355c311c81          55a5fe
   DATA: DATA (Non-Resident)
        7488808-7499495
25                    2005-04-07 14:11:40     f20ca468c271d565a9cf8a2b5dc00064          ff4c27
   DATA: DATA (Non-Resident)
        7589912-7600911
25                    2005-04-07 14:11:40     9f71d12c63e3c3df2a343ad6f7949e1e          7517b6
   DATA: DATA (Non-Resident)
        7580688-7589911
25                    2005-04-07 14:11:40     13521f054f7d59ba7cab3df7da45257e          ca1760
   DATA: DATA (Non-Resident)
        7521624-7531631
25                    2005-04-07 14:11:40     c05d2969d001899b4a175a4e68c2fecb          9294e2
   DATA: DATA (Non-Resident)
        7511096-7521623
25                    2005-04-07 14:11:40     4a6ac89638420964737bcd597e12f667          ca4fbd
   DATA: DATA (Non-Resident)
        7600912-7612631
25                    2005-04-07 14:11:40     1b3bb20062656046700d2356c66978e6          e985fc
   DATA: DATA (Non-Resident)
        7552512-7561263
25                    2005-04-07 14:11:40     6553cefc73c2eb9c974d65d9e100ce63          a63cf4
   DATA: DATA (Non-Resident)
        7548200-7552511
28                    2022-03-03 22:07:35     Root/Music/Ennio Morricone
25                    2001-08-17 01:00:00     e9d6556f18f45fcc506d99d17ca3010d          885dbd
   DATA: DATA (Non-Resident)
        7792000-7796383
25                    2001-08-17 01:00:00     4b2bcfafa655751e0be9aad58d32df98          a8183f
   DATA: DATA (Non-Resident)
        7824560-7831551
25                    2001-08-17 01:00:00     cc03b5901e0950ed7f6fce239c53f387          97a620
   DATA: DATA (Non-Resident)
        7831552-7839943
25                    2001-08-17 01:00:00     8242372bc075979a755f5ebc64b1c0f0          bd4b07
   DATA: DATA (Non-Resident)
        7816464-7824559
25                    2001-08-17 01:00:00     167926ceb7f39e1707f1514fb44ac9b8          bb942a
   DATA: DATA (Non-Resident)
        7799720-7804655
25                    2001-08-17 01:00:00     9ce646a5049fdd19bee62c84eabebd5a          95d126
   DATA: DATA (Non-Resident)
        7804656-7809287
25                    2001-08-17 01:00:00     6704adff61e44c1f7daa9ce2baabbab0          051a4a
   DATA: DATA (Non-Resident)
        7796384-7799719
25                    2001-08-17 01:00:00     df47b2ebadac3343ef63ba820f567d55          21c4de
   DATA: DATA (Non-Resident)
        7772344-7787271
25                    2001-08-17 01:00:00     dd654b0d7aadbd4ed5aa2f07f601d54d          db453d
   DATA: DATA (Non-Resident)
        7787272-7791999
25                    2001-08-17 01:00:00     f2857800c13a4eb3d2c196093921f56b          bfcc6f
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   DATA: DATA (Non-Resident)
        7809288-7816463
25                    2001-08-17 01:00:00     66ead755183f910d14aeb071b1b0a906          2
   DATA: DATA (Non-Resident)
        7839944-7846847
25                    2001-08-17 01:00:00     f8c04ca99abc731f691dac5d1258c623          5
   DATA: DATA (Non-Resident)
        7766840-7772343
25                    2016-04-29 00:51:04     678be5fa10fd689690b47a63b8091549          8
   DATA: DATA (Non-Resident)
        7470224-7474527
25                    2016-04-29 01:12:34     cb2a01e7a4de030627a8bd11330853a4          5
   DATA: DATA (Non-Resident)
        8275816-8284119
25                    2016-04-29 01:14:02     d09612ad1b02eb2f89ce0f7cb54687b0          7
   DATA: DATA (Non-Resident)
        7612632-7622735
25                    2016-04-29 00:46:58     31cce7cada7d6e1250024562038f851f          d
   DATA: DATA (Non-Resident)
        7474528-7488807
25                    2016-04-29 00:36:44     698ab247141b7ee08376ca4bdc107614          3
   DATA: DATA (Non-Resident)
        7759928-7766839
25                    2016-04-29 00:32:14     24d2f32b70c8720297b4683e45526d53          e
   DATA: DATA (Non-Resident)
        7450888-7458287
25                    2016-04-29 00:38:28     ea34e906ad80d8c007b228d64f43325d          6
   DATA: DATA (Non-Resident)
        7622736-7628615
25                    2016-04-29 00:29:20     012ff60673c13ee257122f7c89ccc8a1          3
   DATA: DATA (Non-Resident)
        8262272-8275815
25                    2016-04-29 00:22:18     59d71c51254e6a34ec2b56bd24215f0e          a
   DATA: DATA (Non-Resident)
        7628616-7635495
25                    2016-04-29 00:35:10     59f3006e9f2f718ab75f7373e92bbd12          b
   DATA: DATA (Non-Resident)
        7458288-7465327
25                    2016-04-29 00:44:04     5286083472934c6997889b1384dd750a          f
   DATA: DATA (Non-Resident)
        7646264-7650687
25                    2016-04-29 00:58:38     aec6b3e9c714bdb1472d21aad613006a          e
   DATA: DATA (Non-Resident)
        7749728-7759927
25                    2016-04-29 00:16:20     85c29de2ac785e0f2453e0b86334ef54          d
   DATA: DATA (Non-Resident)
        7635496-7646263
25                    2016-04-29 00:17:10     6cb3521e4ab602c95a09a61348545cfe          3
   DATA: DATA (Non-Resident)
        7465328-7470223
28                    2022-03-03 22:07:40     Root/Photos
28                    2022-03-03 22:07:40     Root/Photos/Diving
25                    2009-04-29 13:52:42     1be9257a5f5816119a1ee7932f277709          b
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   DATA: DATA (Non-Resident)
        9318464-9323703
25                    2009-04-29 13:53:22     96d4bd523d897cb9b71d81b9703e7361          d4688b
   DATA: DATA (Non-Resident)
        9327256-9330831
25                    2009-04-29 13:53:58     bb6bbeaad2b8ef9c9abe4648de3a5999          cdfcfb
   DATA: DATA (Non-Resident)
        9323704-9327255
25                    2009-04-29 13:54:20     beb944c66d0c83a708fe1c69011a5d42          4a9ebc
   DATA: DATA (Non-Resident)
        9337256-9339023
25                    2009-04-29 14:13:38     55bef019410f8bcd10731a46fa250909          35fa00
   DATA: DATA (Non-Resident)
        9330832-9337255
28                    2022-03-03 22:07:41     Root/Photos/Helsinki
25                    2007-07-25 11:14:30     28b5e80d00c5c1e44547e944319f2fc4          6cffe5
   DATA: DATA (Non-Resident)
        8302592-8304823
25                    2007-07-25 11:14:36     0985e9acf3eed9f6efdc54f6444a890c          8409c0
   DATA: DATA (Non-Resident)
        8308512-8311175
25                    2007-07-25 11:14:38     6c0f93298d0e48ba408f661bfc2236e6          6fa4cc
   DATA: DATA (Non-Resident)
        8378672-8381735
25                    2007-07-25 11:14:40     eb17a6b5efad44800ce7d7d83c69eff6          ea0ca4
   DATA: DATA (Non-Resident)
        8381736-8384447
25                    2007-07-25 11:14:54     52a5aadcbfcaf383d1a0297bac0fb533          7faad9
   DATA: DATA (Non-Resident)
        8299224-8302591
25                    2007-07-25 11:14:56     ff01a8fcc0828e06a441d6da9d971b25          ae1fd2
   DATA: DATA (Non-Resident)
        8295968-8299223
25                    2007-07-25 11:15:00     b7fd46830da4a1c74c0dca5be70fcdfd          b550ec
   DATA: DATA (Non-Resident)
        8293024-8295967
25                    2007-07-25 11:15:14     42cd2c12e0f30c16eaa5e32791ea2865          e6d0da
   DATA: DATA (Non-Resident)
        8373032-8378671
25                    2007-07-25 11:15:56     8364499c7c8615c153efece95eb08384          246530
   DATA: DATA (Non-Resident)
        8370096-8373031
25                    2007-07-25 11:15:58     21f868c3943b06282bb955cd9acf182b          7957e9
   DATA: DATA (Non-Resident)
        8367624-8370095
25                    2007-07-25 11:16:04     5e0825fd4b9ea941bc183b07ee53b30b          10f84b
   DATA: DATA (Non-Resident)
        8304824-8308511
25                    2007-07-25 11:16:26     f60112a20189a34ded555d744fc995cd          2031d9
   DATA: DATA (Non-Resident)
        8353760-8357655
25                    2007-07-25 11:16:54     6bdc1d3560757979d5a8c74499703fca          d3734d
   DATA: DATA (Non-Resident)
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        8336632-8340687
25                      2007-07-25 11:16:58     eab027d27180b03de7e2545824918f50          a
   DATA: DATA (Non-Resident)
        8343480-8348719
25                      2007-07-25 11:17:40     fe959fdcae31e90b0fdb0a3982e59b79          7
   DATA: DATA (Non-Resident)
        8332240-8336631
25                      2007-07-25 11:17:52     048ac817b294fcbd35226d924dd6403e          1
   DATA: DATA (Non-Resident)
        8328816-8332239
25                      2007-07-25 11:17:54     2b62227eb196f862d1cf457a5ddac5cc          3
   DATA: DATA (Non-Resident)
        8325944-8328815
25                      2007-07-25 11:17:56     890e90a5a7abb2d1a27392229808b4c2          5
   DATA: DATA (Non-Resident)
        8311176-8314287
25                      2007-07-25 11:18:02     d39d9a42c01b2108540103ce2f788520          2
   DATA: DATA (Non-Resident)
        8317336-8320623
25                      2007-07-25 11:18:04     8e8492d1199d9009f051056b7e87f6d0          7
   DATA: DATA (Non-Resident)
        8320624-8323535
25                      2007-07-25 11:18:06     883494b431679f7f9d39ea7d1ceb157c          5
   DATA: DATA (Non-Resident)
        8362664-8365231
25                      2007-07-25 11:18:08     f47cd4b931c58d5c6afd085467ceed91          b
   DATA: DATA (Non-Resident)
        8359904-8362663
25                      2007-07-25 11:18:12     6d75cc9c722568437c5e8794412248b6          1
   DATA: DATA (Non-Resident)
        8340688-8343479
25                      2007-07-25 11:18:14     9796e28ed4fa1a498fb0d4a88d54271a          5
   DATA: DATA (Non-Resident)
        8348720-8351495
25                      2007-07-25 11:18:32     4c313faa0ef5e45095fbbfb9df12ba3b          7
   DATA: DATA (Non-Resident)
        8365232-8367623
25                      2007-07-25 11:18:34     2b19644cde41ead9a90607ddefbd9baf          b
   DATA: DATA (Non-Resident)
        8323536-8325943
25                      2007-07-25 11:18:36     726690c9daec4197326eefa1c43aeea9          0
   DATA: DATA (Non-Resident)
        8314288-8317335
25                      2007-07-25 11:18:38     0c72be139e24115e6c158746f68cc331          1
   DATA: DATA (Non-Resident)
        8357656-8359903
25                      2007-07-25 11:18:40     f85c8796fa3172ddb8bdaa6cccb10a53          1
   DATA: DATA (Non-Resident)
        8351496-8353759
28                      2022-03-03 22:07:44     Root/Photos/NY
25                      2009-05-24 18:43:16     77b5b122cd1b05c2af50cd0836f9b985          3
   DATA: DATA (Non-Resident)
        9258792-9265511
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25                    2009-05-24 19:25:48     a09054f3aceefb09a45ca4478b43640e          053117
   DATA: DATA (Non-Resident)
        9265512-9274447
25                    2009-05-24 20:58:56     a343458fad6b045f9d77c6fb646f71ce          dd2bbb
   DATA: DATA (Non-Resident)
        9283136-9292207
25                    2009-05-25 01:21:14     c29ac1f58994cb46c53a56f46fdde5b5           a8f5e6
   DATA: DATA (Non-Resident)
        9274448-9283135
25                    2009-05-25 22:07:46     f8d65215fe542da63bdee82868e0fe9a           f9eaba
   DATA: DATA (Non-Resident)
        9251000-9258791
25                    2009-05-25 22:15:24     f145c400d3ed9e69557851c522320a56          3f56ea
   DATA: DATA (Non-Resident)
        9310720-9318463
25                    2009-05-25 22:15:32     b603d9b3aff85c5f62a9e8091f2dc916           b496ea
   DATA: DATA (Non-Resident)
        9292208-9300535
25                    2009-06-06 23:01:08     94ca44fd6bcad151e18159393fc0e71c           0b9a0d
   DATA: DATA (Non-Resident)
        9239144-9250999
25                    2009-06-06 23:11:32     35df6163f8b1154b535bb185aced2d56          01f1be
   DATA: DATA (Non-Resident)
        9300536-9310719
28                    2022-03-03 22:07:47     Root/Photos/PNG
25                    2016-08-09 16:29:56     0e20c4014a80419756af6b3618d894d4          dfeb14
   DATA: DATA (Non-Resident)
        8699176-8705815
25                    2016-08-09 16:29:56     50a39ae6bdde09570419e04899e861ca          7d9a67
   DATA: DATA (Non-Resident)
        8734136-8738943
25                    2016-08-09 16:29:58     07a975f0d121d5710e9e0678c9f08a5d           d15bea
   DATA: DATA (Non-Resident)
        8705816-8711367
25                    2016-08-09 16:29:58     1cfea16f1e3b86b9d85ec43a1c146405           c78d1c
   DATA: DATA (Non-Resident)
        8656616-8661935
25                    2016-08-09 16:29:58     f39301a4119a7e8b83f8bb9573675cb7           1bd0dc
   DATA: DATA (Non-Resident)
        8688120-8699175
25                    2016-08-09 16:29:58     2b6dd7410024c29335480e4b01ecf6bf           8b76cf
   DATA: DATA (Non-Resident)
        8789800-8795807
25                    2016-08-09 16:29:58     831472853caf70e4279eb9b10fb95502          946d4e
   DATA: DATA (Non-Resident)
        8533056-8539335
25                    2016-08-09 16:30:00     554ec19309cce9e77234673957d843a6          4487af
   DATA: DATA (Non-Resident)
        8580208-8586951
25                    2016-08-09 16:30:00     bbbfa1afbe6caf6d20727636eca423c6          11b598
   DATA: DATA (Non-Resident)
        8649640-8656615
25                    2016-08-09 16:30:00     d6596d9f439081baed836fa0c8a28a8e           15c0b0
```

```
   DATA: DATA (Non-Resident)
        8586952-8594495
25                      2016-08-09 16:30:00     3980b368079e048f6f8eed6d218f1456          9
   DATA: DATA (Non-Resident)
        8635776-8649639
25                      2016-08-09 16:30:00     3af85c982fdaee46f578fcec569f037e          3
   DATA: DATA (Non-Resident)
        8594496-8605119
25                      2016-08-09 16:30:02     c1ac17a6c98f27fbeac401359f14b515          e
   DATA: DATA (Non-Resident)
        8778744-8789799
25                      2016-08-09 16:30:02     03d72084aa58d9ce060595bcfe0257a7          9
   DATA: DATA (Non-Resident)
        8750584-8762567
25                      2016-08-09 16:30:02     a066c510d6c6ae3227d4f675abe5b0f1          b
   DATA: DATA (Non-Resident)
        8738944-8750583
25                      2016-08-09 16:30:04     d5dfe820657d381ad10740edc4536a67          6
   DATA: DATA (Non-Resident)
        8615928-8635775
25                      2016-08-09 16:30:04     9a667f59d860a11fb4a0bda9f6fdf0d6          9
   DATA: DATA (Non-Resident)
        8661936-8665815
25                      2016-08-09 16:30:04     2c08bc733d7461eeac2b1a9af2b9f360          d
   DATA: DATA (Non-Resident)
        8665816-8676391
25                      2016-08-09 16:30:04     0a5e03889a84d667baabdd3094e61025          e
   DATA: DATA (Non-Resident)
        8762568-8772479
25                      2016-08-09 16:30:06     5ee9282489f0903303703bb5d77d439a          d
   DATA: DATA (Non-Resident)
        8676392-8688119
25                      2016-08-09 16:30:06     9e953995ca786148098b427656a60e35          0
   DATA: DATA (Non-Resident)
        8729384-8734135
25                      2016-08-09 16:30:06     cfe7fe275b90861aa58433e1aaada445          8
   DATA: DATA (Non-Resident)
        8711368-8729383
25                      2016-08-09 16:30:08     ca234fe6fa2fc56916c1450e9fcc891a          f
   DATA: DATA (Non-Resident)
        8605120-8615927
25                      2016-08-09 16:30:08     2c386dda664658d66050e7cfd9d869fd          7
   DATA: DATA (Non-Resident)
        8567496-8580207
25                      2016-08-09 16:30:08     b2b1be511998f2e630475d164efa0c3d          1
   DATA: DATA (Non-Resident)
        8772480-8778743
25                      2016-08-09 16:30:10     28c3d52822bcd0eb7123a20f9d0f71a0          0
   DATA: DATA (Non-Resident)
        8539336-8567471
25                      2016-08-09 16:30:12     f5e5a8ad113cf60301cc3038738018df          d
   DATA: DATA (Non-Resident)
        8458312-8480991
```

```
25                    2016-08-09 16:30:12     dbc0c95df4c2b4a16fd5d653a03e3a03          3fde4c
   DATA: DATA (Non-Resident)
        8515072-8533055
25                    2016-08-09 16:30:14     a3df8bed38651d33eac4b21dd6a001e5          20c969
   DATA: DATA (Non-Resident)
        8493088-8514943
25                    2016-08-09 16:30:14     7262d86f98a816ac5aa19d5000fdaa38          ca5a22
   DATA: DATA (Non-Resident)
        8814088-8835751
25                    2016-08-09 16:30:16     20f2266bc91a926c0af8fb8890b39cdd          a3d919
   DATA: DATA (Non-Resident)
        8835752-8857511
25                    2016-08-09 16:30:16     b3943271dec5e1d6f8f98ce41195a573          9fa3da
   DATA: DATA (Non-Resident)
        8892544-8913943
25                    2016-08-09 16:30:18     399f7ca061e54f792c0842ddb75abe08          f70bd2
   DATA: DATA (Non-Resident)
        8857512-8879191
25                    2016-08-09 16:30:18     badbc4166c959a41bc77820f2c1aa5ac          24d11b
   DATA: DATA (Non-Resident)
        8418776-8441343
25                    2016-08-09 16:30:20     3699a09b4d90e3e0466d2e025ac71f38          db77c0
   DATA: DATA (Non-Resident)
        8879192-8892543
25                    2016-08-09 16:30:20     9c8dfa6629ca4056b66ba70df36b6155          3014b4
   DATA: DATA (Non-Resident)
        8795808-8814087
25                    2016-08-09 16:30:22     449a39e60fb73cd06792eb33702e3fd2          7aa345
   DATA: DATA (Non-Resident)
        8441344-8458311
25                    2016-08-09 16:30:22     ee784f441db80e795a4f50a5ed06bc31          f544a5
   DATA: DATA (Non-Resident)
        8384448-8396799
25                    2016-08-09 16:30:24     9b2ee5928e602ec7610cad42538a2ea7          c8a679
   DATA: DATA (Non-Resident)
        8480992-8493087
25                    2016-08-09 16:30:24     1bfbd10558bb2dd12cadfd3032b78572          fec0d4
   DATA: DATA (Non-Resident)
        8396800-8418759
28                    2022-03-03 22:08:01     Root/Photos/SF
25                    2009-05-30 21:13:46     be7dba7a3fff3748f1f438b728b279a4          3cc204
   DATA: DATA (Non-Resident)
        9028816-9036039
25                    2009-05-30 21:15:56     999611c3e27def28c94708e9b6203db8          34b2fd
   DATA: DATA (Non-Resident)
        9109336-9120823
25                    2009-05-30 21:47:26     ca72b6c55f22a45908b24cbd8bf29a56          4a6f4a
   DATA: DATA (Non-Resident)
        9080824-9091887
25                    2009-06-03 20:59:04     bfa7e431bf44e036bd8c6f77179e7543          c501d5
   DATA: DATA (Non-Resident)
        9145856-9154191
25                    2009-06-06 03:58:08     1854c9f44cc66810600f955e7e57bdb1          4f878a
```

```
   DATA: DATA (Non-Resident)
        9120824-9129799
25                    2009-06-06 03:58:26     6f2ac54948b5b30ce16e477c66e111ce         6
   DATA: DATA (Non-Resident)
        9129800-9137815
25                    2009-06-06 04:02:50     2a052e493fbcd7cdd55a850a611cc445         4
   DATA: DATA (Non-Resident)
        9137816-9145855
25                    2009-06-06 04:03:22     44652638deef4f478e07706566550c61         b
   DATA: DATA (Non-Resident)
        8946648-8956359
25                    2009-06-06 04:03:42     3872c8067f88768007a636d612c3650e         d
   DATA: DATA (Non-Resident)
        8956360-8965119
25                    2009-06-06 04:03:48     035c6628e8d5bbed6287bb85cf6022b2         a
   DATA: DATA (Non-Resident)
        8928128-8936903
25                    2009-06-20 22:00:56     e41f63dcb998da55a02dd60fa505bcdc         a
   DATA: DATA (Non-Resident)
        8921208-8928127
25                    2009-06-06 05:50:22     22e77e0803b18803256074b4c252bd88         6
   DATA: DATA (Non-Resident)
        8936904-8946647
25                    2009-06-06 05:55:56     1300d583c82fe612dd57d3ad910a9486         0
   DATA: DATA (Non-Resident)
        8913944-8921207
25                    2009-06-06 05:57:38     8b1353ff9495552a19b0bfeec5394247         1
   DATA: DATA (Non-Resident)
        8983928-8991959
25                    2009-06-06 05:59:32     cefa4e580592809baf1c00cefacd93f0         7
   DATA: DATA (Non-Resident)
        9052888-9060919
25                    2009-06-06 05:59:40     9143872d4928619a667153c4ed3a303c         1
   DATA: DATA (Non-Resident)
        9011840-9018703
25                    2009-06-06 05:59:48     a545a740177ead5214943f35115e2d84         1
   DATA: DATA (Non-Resident)
        8965120-8973495
25                    2009-06-06 06:00:18     74896797a5afc74f9d257c087a2d7637         4
   DATA: DATA (Non-Resident)
        9100248-9109335
25                    2009-06-06 06:00:22     191bf4eac6e4bec6779e857609448a0c         1
   DATA: DATA (Non-Resident)
        9071248-9080823
25                    2009-06-06 06:00:22     d8b25a6d107fa25e67c01fd1691a840a         e
   DATA: DATA (Non-Resident)
        9091888-9100247
25                    2009-06-06 06:00:22     be2a41a0f6c956b0a9105cbc81366a86         6
   DATA: DATA (Non-Resident)
        9060920-9071247
25                    2009-06-06 06:00:26     482bfbc2665903526f3bb328d70bcc68         6
   DATA: DATA (Non-Resident)
        9036040-9045751
```

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25                    2009-06-06 06:00:30     157a7a625ea640ff216ef35c01b20740          69d556
   DATA: DATA (Non-Resident)
        9002232-9011839
25                    2009-06-06 06:00:32     b36d08d7fddeae5a02bf023c82f6ce6a          9e42ca
   DATA: DATA (Non-Resident)
        8973496-8983927
25                    2009-06-06 06:00:34     298393890a37472a688a82e7bbc13ec7          03c15b
   DATA: DATA (Non-Resident)
        9018704-9028815
25                    2009-06-06 06:01:28     af118fa168b1e768805bab011ed79ec3          9b25a5
   DATA: DATA (Non-Resident)
        8991960-9002231
25                    2009-06-06 06:02:36     84013837a9cd3be6cd35dd5afb77099b          946ed1
   DATA: DATA (Non-Resident)
        9045752-9052887
28                    2022-03-03 22:08:08     Root/Photos/Vegas
25                    2009-05-28 07:46:20     0f5cb6b4dc609659f4ce7e5a1c4c01aa          fca842
   DATA: DATA (Non-Resident)
        9154192-9162631
25                    2009-06-20 13:42:42     c5497d040ee9ca74aacb1a627584620b          5b0a9e
   DATA: DATA (Non-Resident)
        9171136-9179655
25                    2009-05-28 07:55:54     be3c022f27e9b50f54fde9ed2926716d          e9b1ad
   DATA: DATA (Non-Resident)
        9179656-9187303
25                    2009-05-28 07:59:50     0d30cbcb374dc62be046953738a90523          df8f55
   DATA: DATA (Non-Resident)
        9162632-9171135
25                    2009-05-28 08:00:44     277f3865011837bc68612c72eb9a2691          b6e63a
   DATA: DATA (Non-Resident)
        9231464-9239143
25                    2009-05-28 08:04:54     77acf0f1d75d65cbb59329f3253e4030          6a4fd9
   DATA: DATA (Non-Resident)
        9223760-9231463
25                    2009-05-28 08:05:02     960983bce3dfa5e34935b215f0e018ce          31a3b1
   DATA: DATA (Non-Resident)
        9216792-9223759
25                    2009-06-20 13:42:24     06ce765c697ea92ab4782b4696174512          f3dcfc
   DATA: DATA (Non-Resident)
        9194360-9202231
25                    2009-06-20 13:42:18     b2f292f1694c9d12f2b100abec8e252d          039efc
   DATA: DATA (Non-Resident)
        9210272-9216791
25                    2009-05-28 08:09:00     f7960866200a1f52ee74a46ebcd9761e          f09b4b
   DATA: DATA (Non-Resident)
        9202232-9210271
25                    2009-05-28 08:09:10     4ac853b049966e9cee7e7cdf9894eb9c          30e71e
   DATA: DATA (Non-Resident)
        9187304-9194359
25                    2009-04-29 13:54:46     3feacbf5dd9afc05143f12a55f0536f0          acf18f
   DATA: DATA (Non-Resident)
        9339024-9341223
25                    2009-04-29 13:55:06     22bf64446fcd3a630ab17bf839de6e7d          6e023a
```

```
   DATA: DATA (Non-Resident)
        9341224-9342911
25                    2009-04-29 13:55:30     cb4bed7e6405a90b65cd80ccbec04928         6
   DATA: DATA (Non-Resident)
        8291024-8293023
25                    2009-04-29 13:56:50     2abc60a295d7e3eaa91cb7ad92efc788         5
   DATA: DATA (Non-Resident)
        8284120-8291023
28                    2022-03-03 22:08:10     Root/Video
28                    2022-03-03 22:08:10     Root/Video/Avi
28                    2022-03-03 22:08:46     Root/Video/Avi/Cops_Season_24_HDTV
25                    2016-06-06 08:18:26     7f0357f25d88e1369c8dc1acd0aed663         3
   DATA: DATA (Non-Resident)
        15153544-15511559
25                    2016-06-06 08:19:24     8dd47bbfb3420f7ff4b0b101e8cad36b         1
   DATA: DATA (Non-Resident)
        14080408-14437799
25                    2016-06-06 08:19:42     e389377f24ca35cc802aa90d821a246d         3
   DATA: DATA (Non-Resident)
        11574840-11932863
25                    2016-06-06 08:12:38     5e828eea4a7d198d5d029eb6a5fd8a97         5
   DATA: DATA (Non-Resident)
        10858024-11216159
25                    2016-06-06 08:17:44     409e0f6332db4c12da861cd3cab5ae14         6
   DATA: DATA (Non-Resident)
        14795712-15153543
25                    2016-06-06 08:18:58     b55ee3db70b62f883db5573a5746e4d1         0
   DATA: DATA (Non-Resident)
        13007272-13364895
25                    2016-06-06 08:17:06     1febb45222f9f114e88c533c36f8f29b         b
   DATA: DATA (Non-Resident)
        12650056-13007271
25                    2016-06-06 08:16:18     0ecf424d46e619cd1d09bce2dae5b570         a
   DATA: DATA (Non-Resident)
        15869552-16227311
25                    2016-06-06 08:17:14     88b3f03a9e20f9b2310dde6cd0296fca         b
   DATA: DATA (Non-Resident)
        10141352-10499319
25                    2016-06-06 08:19:18     de1cf8808dff26c1b4398220a8913dd1         1
   DATA: DATA (Non-Resident)
        12292144-12650055
25                    2016-06-06 08:16:50     216bdd9f74a00a7a9b4383e2e655ef58         4
   DATA: DATA (Non-Resident)
        13364896-13722703
25                    2016-06-06 08:17:34     51bf22c8ed46f23cd1efde24952d305e         a
   DATA: DATA (Non-Resident)
        14437800-14795711
25                    2016-06-06 08:19:32     ac81e8b5472ca54054c8e57b6e69b1b0         b
   DATA: DATA (Non-Resident)
        11216168-11574839
25                    2016-06-06 08:16:28     8d99cfc73a09a48825a276375bfad763         7
   DATA: DATA (Non-Resident)
        11932864-12292127
```

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25                    2016-06-06 08:18:52     6c498108cd539cb1b05c813b8e91893d          843e63
   DATA: DATA (Non-Resident)
        13722704-14080399
25                    2016-06-06 08:18:10     0e418b50264b2bb748f031e1250de762          b6a7ed
   DATA: DATA (Non-Resident)
        15511560-15869551
25                    2016-06-06 08:19:08     65fe333f28d8c5f27d21a2445d95fa91          f6ed23
   DATA: DATA (Non-Resident)
        10499528-10857975
25                    2016-06-06 08:18:18     514b0659f98a3c45202f1cc8a125fe61          1ba856
   DATA: DATA (Non-Resident)
        16616128-16974239
25                    2016-06-06 08:18:12     0e6f2a5dea0e8a1e4dd33ad2c99395cb          9a0b65
   DATA: DATA (Non-Resident)
        9785232-10141047
25                    2016-06-06 08:18:38     f3704970997f2eb8af3fb9dd2691f7d0          580ca4
   DATA: DATA (Non-Resident)
        9426848-9785231
25                    2016-06-06 08:18:48     ba81e0c6597f2e3898535fb78ffa0ccb          7f5372
   DATA: DATA (Non-Resident)
        16974240-17331143
25                    2016-06-06 08:19:38     f61d04146b1f1e8404b1a16e9adfab5e          306eba
   DATA: DATA (Non-Resident)
        16227312-16616127
28                    2022-03-03 22:10:48     Root/Video/Flv
25                    2010-01-06 01:11:42     d2ef7350396693de9389e8b39774b4d7          31920a
   DATA: DATA (Non-Resident)
        17331144-17347239
28                    2022-03-03 22:10:48     Root/Video/M4V
25                    2012-08-22 18:36:44     968139c8f965b32be629b5eddac23382          3d4ab4
   DATA: DATA (Non-Resident)
        34985736-34987727
28                    2022-03-03 22:10:48     Root/Video/Mov
25                    2015-10-11 17:33:14     53bd8bd63f73df2e647b20ac336b5184          384762
   DATA: DATA (Non-Resident)
        37651640-40315327
25                    2015-10-11 17:48:14     4d0737f26d565e7ade41c1eeff0e7cae          9a11b8
   DATA: DATA (Non-Resident)
        34987728-37651639
28                    2022-03-03 22:12:34     Root/Video/MP4
25                    2010-11-30 21:58:20     3e3661d0dc6f16a5d416791614623e9e          3d41e5
   DATA: DATA (Non-Resident)
        17583976-17760279
25                    2015-09-19 03:52:24     f9d18db99b4d4f3d5d8f7ecda07a283a          3f3092
   DATA: DATA (Non-Resident)
        18349760-18554783
25                    2015-09-19 04:00:20     b970ad6b6fc339a639a747d43279fc24          226dd5
   DATA: DATA (Non-Resident)
        17760280-18096719
25                    2015-09-20 18:31:20     050863ea63873886856c1850f89b2872          15e1a4
   DATA: DATA (Non-Resident)
        18096720-18349759
28                    2022-03-03 22:12:53     Root/Video/MPEG
```

```
 25                    2016-08-06 21:50:24     8661e7edc04aa49accced6da2520decc          0
    DATA: DATA (Non-Resident)
         9342912-9426847
 28                    2022-03-03 22:12:55     Root/Video/MTS
 25                    2015-08-05 13:44:42     28264a21f4babe4c26fd9422ecce8066          d
    DATA: DATA (Non-Resident)
         17377000-17567463
 25                    2013-03-20 18:16:48     c8813d64f8e33e4e41c773d188ce6f62          c
    DATA: DATA (Non-Resident)
         17347240-17360871
 25                    2013-03-20 18:16:20     40566a6585ba0440175eed119a32a32a          9
    DATA: DATA (Non-Resident)
         17360872-17376999
 25                    2013-03-20 18:15:22     90b17b9d8b04d14b2a72aa1a7ea2c6c8          1
    DATA: DATA (Non-Resident)
         17567464-17583975
 25                    2016-06-05 19:36:08     d6b0ce497e569371b94e19fea48355cd          3
    DATA: DATA (Non-Resident)
         18554784-34985711
 25                    2022-09-08 22:00:25     878872a0818c4431aa4260f71053236a          3
    DATA: DATA (Non-Resident)
         7922320-7922343
    com.apple.FinderInfo: MACOS_DATA (Resident)
         3659179
 25                    2012-11-03 21:10:08     9565cf6684e2858bda872890a32cc671          d
    DATA: DATA (Non-Resident)
         40315344-43079367
    com.apple.lastuseddate#PS: MACOS_DATA (Resident)
         3660133
 25                    2013-06-26 18:58:10     12ab314eb73a4a938bed3d6550da0ff2          2
    DATA: DATA (Non-Resident)
         43079368-43081119
    com.apple.lastuseddate#PS: MACOS_DATA (Resident)
         3660132
    com.apple.quarantine: MACOS_DATA (Resident)
         3660132
 25                    2005-08-06 17:04:54     59262f761288b9fd5f1306a80aa25ddb          9
    DATA: DATA (Non-Resident)
         43081120-43085311
    com.apple.lastuseddate#PS: MACOS_DATA (Resident)
         3660132
    com.apple.quarantine: MACOS_DATA (Resident)
         3660126
 25                    2005-08-06 17:06:04     33e7439162b60fc39c701fe1d40cdde7          f
    DATA: DATA (Non-Resident)
         43085312-43089279
    com.apple.lastuseddate#PS: MACOS_DATA (Resident)
         3660126
    com.apple.quarantine: MACOS_DATA (Resident)
         3660124

END Date / Time of Collection: 2022-09-09 00:27:44
--------------------------------------------------------------------------------
```

IV Text/Hexadecimal Editor

Any object visible by **R-Studio** can be viewed and edited in the **Text/Hexadecimal Editor**. It is also able to parse the data and represent data according to various data patterns. You may also create your own patterns to parse data.

Note: Data alteration is available on the **Technician/T80+** and **Corporate** versions only.

You may turn numerical indexes for objects to distinguish them better.

4.1 Viewing and Editing Objects

YOU MUST BE ABSOLUTELY SURE OF WHAT AND WHERE YOU ARE WRITING!
Or you may completely lose all your data.

Before you can physically write anything on a disk, you need to enable writing.

To enable writing,

1 **On the R-Studio main panel, select Enable Write on the Tools menu**

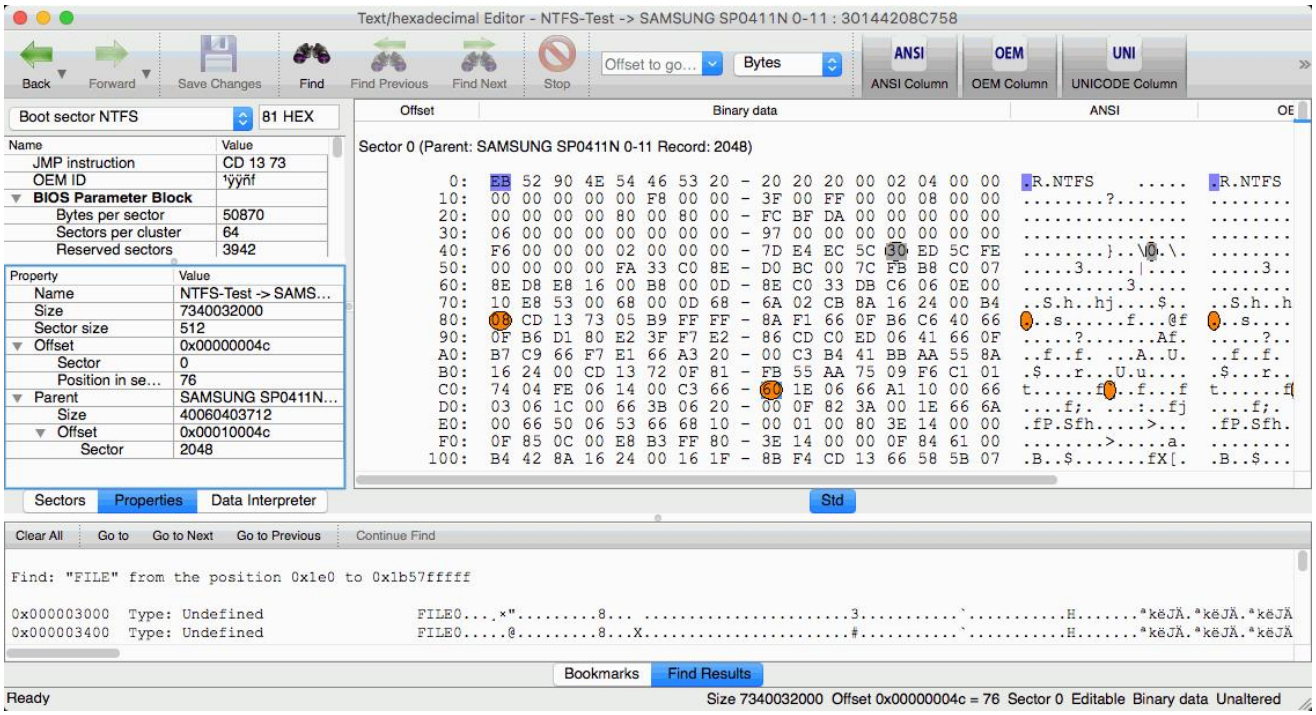
> **The** Editable: **status will change to** Yes **from** Read Only**.**
Now the object can be edited.

To view/edit an object,

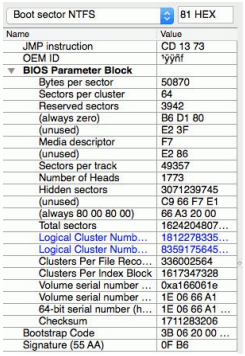
1 **Control-click the object and select View/Edit on the contextual menu,** or
Select the object and select **View/Edit** on the **File** menu

> A **Text/hexadecimal Editor** panel will appear

R-Studio Text/Hexadecimal editor

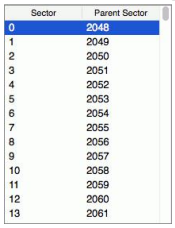


Data Parsed According to the Selected Pattern



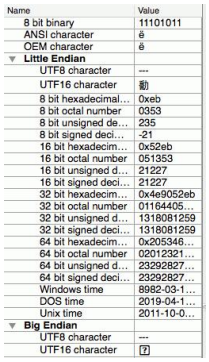
Object Properties

Object Sector Mapping



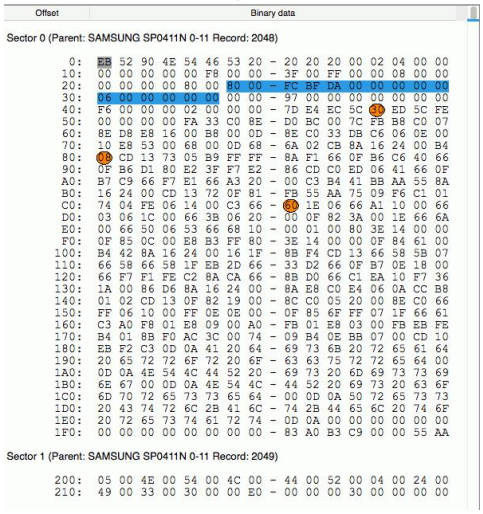
Sector	Parent Sector
0	2048
1	2049
2	2050
3	2051
4	2052
5	2053
6	2054
7	2055
8	2056
9	2057
10	2058
11	2059
12	2060
13	2061

Data Shown as Various Digits



Name	Value
8 bit binary	11101011
ANSI character	ë
OEM character	ë
Little Endian	
UTF8 character	---
UTF16 character	勭
8 bit hexadecimal…	0xeb
8 bit octal number	0353
8 bit unsigned de…	235
8 bit signed deci…	-21
16 bit hexadecim…	0x52eb
16 bit octal number	051353
16 bit unsigned d…	21227
16 bit signed deci…	21227
32 bit hexadecim…	0x4e9052eb
32 bit octal number	01164405…
32 bit unsigned d…	1318081259
32 bit signed deci…	1318081259
64 bit hexadecim…	0x205346…
64 bit octal number	02012321…
64 bit unsigned d…	23292827…
64 bit signed deci…	23292827…
Windows time	8982-03-1…
DOS time	2019-04-1…
Unix time	2011-10-0…
Big Endian	
UTF8 character	---
UTF16 character	퓗

Binary view



Offset | Binary data

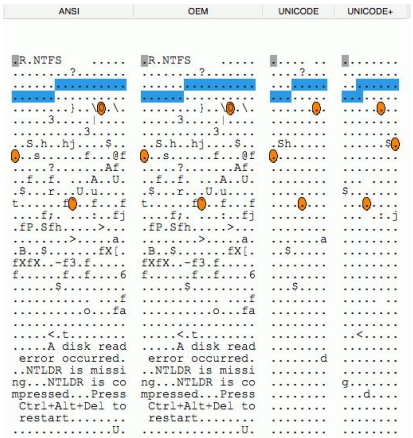
Sector 0 (Parent: SAMSUNG SP0411N 0-11 Record: 2048)

```
       0:  EB 52 90 4E 54 46 53 20 - 20 20 20 00 02 04 00 00
      10:  00 00 00 00 00 F8 00 00 - 3F 00 FF 00 00 08 00 00
      20:  00 00 00 00 80 00 80 00 - FC BF DA 00 00 00 00 00
      30:  06 00 00 00 00 00 00 00 - 00 00 97 00 00 00 00 00
      40:  F6 00 00 00 02 00 00 00 - 7D E4 EC 5C 81 ED 5C FE
      50:  00 00 00 00 FA 33 C0 8E - D0 BC 00 7C FB B8 C0 07
      60:  8E D8 E8 16 00 B8 00 0D - 8E C0 33 DB C6 06 0E 00
      70:  10 E8 53 00 68 00 0D 68 - 6A 02 CB 8A 16 24 00 B4
      80:  19 CD 13 73 05 B9 FF FF - 8A F1 66 0F B6 C6 40 66
      90:  0F B6 D1 80 E2 3F F7 E2 - 86 CD C0 ED 06 41 66 0F
      A0:  B7 C9 66 F7 E1 66 A3 20 - 00 C3 B4 41 BB AA 55 8A
      B0:  16 24 00 CD 13 72 0F 81 - FB 55 AA 75 09 F6 C1 01
      C0:  74 04 FE 06 14 00 C3 66 - 60 1E 06 66 A1 10 00 66
      D0:  03 06 1C 00 66 3B 06 20 - 00 0F 82 3A 00 1E 66 6A
      E0:  00 66 50 06 53 66 68 10 - 00 01 00 80 3E 14 00 00
      F0:  0F 85 0C 00 E8 B3 FF 80 - 3E 14 00 00 0F 84 61 00
     100:  B4 42 8A 16 24 00 16 1F - 8B F4 CD 13 66 58 5B 07
     110:  66 58 66 58 1F EB 2D 66 - 33 D2 66 0F B7 0E 18 00
     120:  66 F7 F1 FE C2 8A CA 66 - 8B D0 66 C1 EA 10 F7 36
     130:  1A 00 86 D6 8A 16 24 00 - 8A E8 C0 E4 06 0A CC B8
     140:  01 02 CD 13 0F 82 19 00 - 8C C0 05 20 00 8E C0 66
     150:  FF 06 10 00 FF 0E 0E 00 - 0F 85 6F FF 07 1F 66 61
     160:  C3 A0 F8 01 E8 09 00 A0 - FB 01 E8 03 00 FB EB FE
     170:  B4 01 8B F0 AC 3C 00 74 - 09 B4 0E BB 07 00 CD 10
     180:  EB F2 C3 0D 0A 41 20 64 - 69 73 6B 20 72 65 61 64
     190:  20 65 72 72 6F 72 20 6F - 63 63 75 72 72 65 64 00
     1A0:  0D 0A 4E 54 4C 44 52 20 - 69 73 20 6D 69 73 73 69
     1B0:  6E 67 00 0D 0A 4E 54 4C - 44 52 20 69 73 20 63 6F
     1C0:  6D 70 72 65 73 73 65 64 - 00 0D 0A 50 72 65 73 73
     1D0:  20 43 74 72 6C 2B 41 6C - 74 2B 44 65 6C 20 74 6F
     1E0:  20 72 65 73 74 61 72 74 - 0D 0A 00 00 00 00 00 00
     1F0:  00 00 00 00 00 00 00 00 - 83 A0 B3 C9 00 00 55 AA
```

Sector 1 (Parent: SAMSUNG SP0411N 0-11 Record: 2049)

```
     200:  05 00 4E 00 54 00 4C 00 - 44 00 52 00 04 00 24 00
     210:  49 00 33 00 30 00 00 E0 - 00 00 00 30 00 00 00 00
```

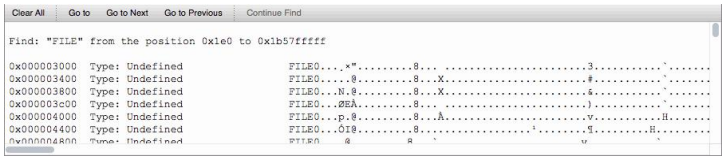
Text view



ANSI | OEM | UNICODE | UNICODE+

```
.R.NTFS    .....  .R.NTFS    .....  .....  .....
.....?.....       .....?.....       .....  .....
......          ......          ...    ...
......          ......          ...    ...
........}..\.\.  ........}..\.\.  .....  .....
.....3....|....  .....3....|....  .....  .....
.....3.....       .....3.....       .....  .....
..S.h..hj....$..  ..S.h..hj....$..  ..Sh...  .....
.s....f...@f      .s....f...@f      .....  .....
.....?.....Af.    .....?.....Af.    .....  .....
..f..f. ...A..U.  ..f..f. ...A..U.  .....  ... ....
.S...r...U.u....  .S...r...U.u....  .....  S......
t.....f..f...f    t.....f..f...f    ....   ....
....f.. ...:..fj  ....f.. ...:..fj  .....  ... ..j
.fP.Sfh.....>...  .fP.Sfh.....>...  .....  .....
.....>.....a.     .....>.....a.     .....a .....
.B..S.....fX[.    .B..S.....fX[.    ..S....  .....
fXfX..-f3.f.....  fXfX..-f3.f.....  .....  .....
f.....f..f....6   f.....f..f....6   .....  .....
.....S.....       .....S.....       ...S...  .....
..... ...f        ..... ...f        .....  ..... ..
.....o...fa       .....o...fa       .....  .....
.....             .....             .....  .....
.....<.t.....     .....<.t.....     .....  ..<.....
.....A disk read  .....A disk read  .....  .....
 error occurred.   error occurred.  .....d .....
..NTLDR is missi  ..NTLDR is missi  .....  .....
ng...NTLDR is co  ng...NTLDR is co  .....  g.....
mpressed...Press  mpressed...Press  .....  ...d....
 Ctrl+Alt+Del to   Ctrl+Alt+Del to  .....  .....
 restart.....      restart.....     .....  .....
.....U.           .....U.          .....  .....
```

Find Results

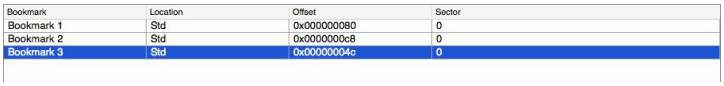


Clear All | Go to | Go to Next | Go to Previous | Continue Find

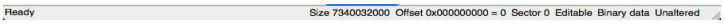
```
Find: "FILE" from the position 0x1e0 to 0x1b57fffff

0x000003000  Type: Undefined    FILE0....x"........8... .....................3..........`.......
0x000003400  Type: Undefined    FILE0.....8........8...X.....................#..........`.......
0x000003800  Type: Undefined    FILE0...N.8........8...X.....................&..........`.......
0x000003c00  Type: Undefined    FILE0...ØEÀ........8... .....................)..........`.......
0x000004000  Type: Undefined    FILE0...p.@........8...À.....................v..........H.......
0x000004400  Type: Undefined    FILE0...ÒI@........8.....................¹.........¶.........H.......
0x000004800  Type: Undefined    FILE0....@........8.....                     v..........`.......
```

List of Bookmarks



Text / hexadecimal Editor status



Previous Pattern
Click this button to go to the previous pattern.

Next Pattern
Click this button to go to the next pattern.

Save Changes
Click this button to save changes.

Code pages
Turns supported code pages on/off.

Autoflow
Click this button to turn autoflow on.

Panel view options

You may set which panels and bars to enable/disable.

To enable/disable:

ANSI data	Select/clear **ANSI** on the **View** menu
OEM data	Select/clear **OEMr** on the **View** menu
UNICODE data	Select/clear **UNICODE** on the **View** menu
UNICODE+ data	Select/clear **UNICODE+** on the **View** menu
Toolbar	Select/clear **Toolbar** on the **View** menu
Toolbar Button Text	Select/clear **Toolbar Button Text** on the **View** menu
Properties View	Select/clear **Properties View** on the **View** menu
Sectors View	Select/clear **Sectors View** on the **View** menu
Data Interpreter View	Select/clear **Data Interpreter View** on the **View** menu
Template View	Select/clear **Template View** on the **View** menu
Bookmarks View	Select/clear **Bookmarks View** on the **View** menu
Find Results View	Select/clear **Find Results View** on the **View** menu

2 View the information and make necessary changes

Select **Enable Write** on the **Tools** menu if you want to save changes.

Viewing

There are up to four tabs showing the data in different representations. Actual number of tabs depends on the object and property being viewed/edited.

Std	Exact attribute data. If the attribute is compressed, **R-Studio** decompresses it prior to showing.
Unlimited	Exact attribute data + free space of last cluster. If the attribute is compressed, **R-Studio** decompresses it prior to showing.
Direct	Actual data written on the disk. If the attribute is not compressed, it coincides with the Std representation.
Allocation	Resident part of the attribute.

You may view data in 4 various code pages: ANSI/OEM/UNICODE/UNICODE+ by s witching on/off the respective code pages in the **Code pages** buttons or select the appropriate code pages on the **View** menu.

Patterns or Templates

You may select a pattern according to which the data will be parsed and shown in the parsed data pane. The Data Interpreter shows the data selected on the Template pane in various representation.

You may find the next or previous data that matches the pattern signature on the disk. Control-click the right pane of the editor and select either **Find Template Signature Next** or **Find Template Signature Previous** on the contextual menu. You may also select these items on the **Edit** menu.

You may also create your own patterns to parse data from various objects.

Navigating

Text/hexadecimal Editor gives you various ways to navigate through an object. See the **Navigating through an Object** for more details.

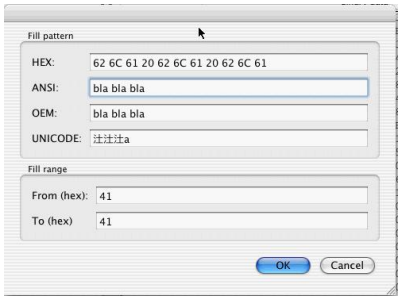
Data Copy

Text/hexadecimal Editor gives you various ways to copy selected data navigate in an object. See the **Data Copy** for more details.

Filling an area with a pattern

To fill an area with a pattern, select **Fill** on the **Edit** menu, and specify the pattern and area on the Fill dialog box.

Fill **dialog box**



Fill options

Fill pattern	
HEX	Field for the pattern to fill the area in the hexadecimal representation
ANSI	Field for the pattern to fill the area in the ANSI encoding
OEM	Field for the pattern to fill the area in the OEM encoding

UNICODE	Field for the pattern to fill the area in the UNICODE encoding
Fill range	
From (hex)	Field for the start position of the area to fill with the pattern
To (hex)	Field for the end position of the area to fill with the pattern

3 **Click the Save Changes button to save the changes**, or

- Select **Save Changes** on the **Edit** menu

> **Viewer/Editor will save the changes on the object**

YOU MUST BE ABSOLUTELY SURE OF WHAT AND WHERE YOU ARE WRITING!
Or you may completely lose all your data.

Selecting and saving an area in the Viewer/Editor

You may select an area in the Viewer / Editor panel and save it as a file.

To select and save an area in the Viewer / Editor **panel**,

1 **Control-click the beginning of the selection and select Select From** on the contextual menu.

2 **Control-click the end of the selection and select Select To** on the contextual menu

Other ways to select an area

- Select **Select...** on the **Tools** menu and specify an area to select on the Select dialog box,

or

- Click the start point of the area and drag the mouse cursor to its end.

If you need to select an entire object, select **Select All** on the **Tools** menu

Select **dialog box**

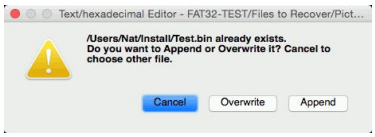
2 **Select an appropriate item in the Tools menu to save the data in a required format and specify its file name**

Select:

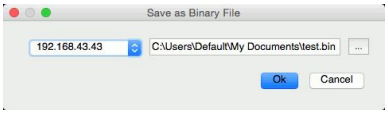
Save to Binary File...	to save the data in the binary format (default extension is `.bin`)
Save to Hexadecimal File	to save the data in the binary format (default extension is `.hex`)

on the **Tools** menu.

If you select an existing file, **R-Studio** will ask you if you want to append or overwrite the file.



If a remote computer is connected for **Data Recovery over Network**, the Save as... dialog box will appear when you select a place to save the data. You may save it to the local or remote computer.



> **Viewer/Editor will save the data in the file**

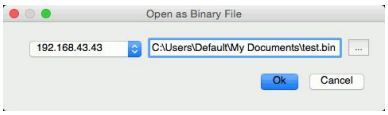
Loading data from an external file

You may load a data from a file and overwrite an area of the object opened in the Viewer/Editor panel.

To load binary data from a file and overwrite an area of the object opened in the Viewer/Editor **panel,**

1 **Select an area to overwrite and select Load from File... on the Tools menu**

If a remote computer is connected for **Data Recovery over Network**, the Open as Binary File dialog box will appear when you select a place to open the data file from. You may open it from the local or remote computer.



2 **Select the necessary file and load the data.**

> **The area in the Viewer/Editor will be overwritten with the new data.**

4.2 Navigating through an Object

Navigating

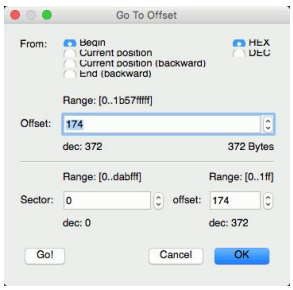
You may quickly move to a particular part of the object. To move to a particular part of the object being viewed/edited, enter the required offset in the **Go to Offset** field between the buttons.

Type an offset to which you want to go. You may select between bytes and sectors. See the **Data Formats and Multipliers** topic for more details on data formats.

If a file is opened in **Text/hexadecimal Editor** , you may select data representation for that file.

You may also use the Go To Offset dialog box to go to a specified place in the object. Click the Offset field on the **Status** bar. You may also use this dialog box to copy the offset.

Go To Offset **dialog box**



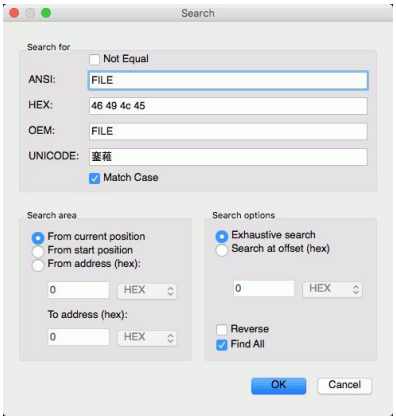
Go To Offset options

From:	Jump / offset direction. For example, if you need to find the offset from the object end for a selected byte, switch to the End (backward) option.
HEX / DEC	Switch between the hexadecimal and decimal data representation.
Range	Range of values that can be entered.
dec / hex:	Alternative data representation.
Offset:	Flat data offset (without separation between the sector and offset in the sector).
Sector / offset	Data offset represented as a sector and offset in the sector.
Go! /OK buttons	The Go! button moves the cursor to the specified positions, but the Go To Offset dialog box remains open. The OK button closes the dialog box after moving the cursor.

Searching

To search for a particular string, click the **Find**, **Find Next**, or **Find Previous** buttons or the same items on the **Edit** menu, and specify the string on the Search dialog box.

Search **dialog box**



Search options

Not Equal	Search for the place which content is not equal to the string. For example, the first byte not equal to 00 or FF.
Search for	
HEX	Field for the string to search for in the hexadecimal representation
ANSI	Field for the string to search for in the ANSI encoding
OEM	Field for the string to search for in the OEM encoding
UNICODE	Field for the string to search for in the UNICODE encoding
Match case	Select this check box to make the search case-sensitive
Search area	
From current position	Select this check box to start search from the current position

From start position	Select this check box to start search from the beginning of the object
From Address	Select this check box and specify the range in which the search is to be carried out
Search position	
Exhaustive search	Select this check box to search the entire object
Search at offset	Select this check box and specify the sector offset from which the search will start
Reverse	Select this check box to start the search in the reverse direction
Find all	Select this check box to search for all instances of the string to search. Search results will be shown in the Find Results pane.

Text/hexadecimal Editor will show the search progress.

Search results are shown on the Find Results pane. You may easily move to the required found item by clicking the item.

Features of the Not Equal option

Suppose we have an object which first 3 consecutive sectors start with:

```
Sector1   FILEAAAAA.....................................................
Sector2   FILEBBBBB.....................................................
Sector3   NOTAFILE......................................................
```

And the search string is `Not Equal FILE`.

If the Exhaustive search option is selected, the **Text/hexadecimal Editor** will stop at the first `A` character in `Sector1`.

If the Search at offset=0 option is selected, the **Text/hexadecimal Editor** will stop at the `N` character in `Sector3`.

Bookmarking

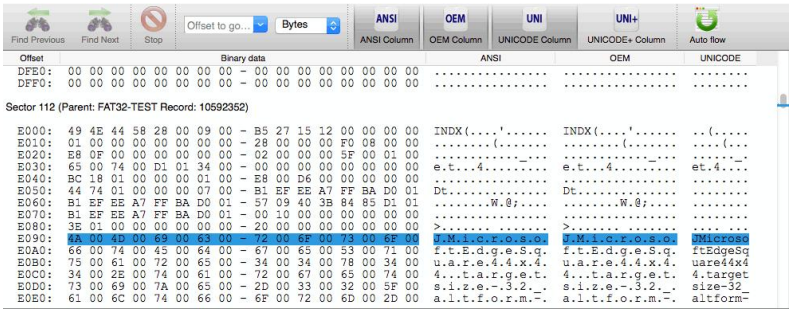
You may create bookmarks to easily move to those places. Control-click the cursor on the place you want to bookmark and select **Toggle Bookmark** on the contextual menu. The list of bookmarks appears in the Bookmark pane. You may easily move to the required bookmark by clicking it in the list.

You may control bookmarks on the **Edit** menu.

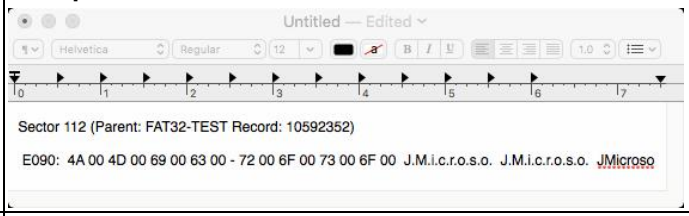
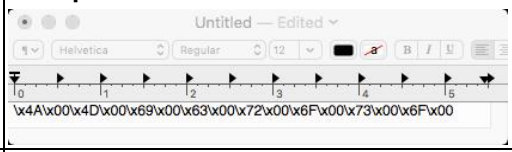
4.3 Data Copy

Text/hexadecimal Editor gives you various ways to copy selected data navigate in an object.

Data selected in Text/hexadecimal editor



Depending on what column you have control-clicked, the following commands are available in the contextual menu:

When control-clicking any column Copy Editor Display	**Data pasted into a text editor** 
When control-clicking any column Copy as File Signature	**Data pasted into a text editor** 
When control-clicking the Binary data column Copy as "Binary data"	**Data pasted into a text editor** 
When control-clicking the ANSI column Copy as "ANSI"	**Data pasted into a text editor** 
When control-clicking the UNICODE column Copy as "UNICODE"	**Data pasted into a text editor**  

4.4 Files and Sectors

You may see which file is written on a particular sector. To do so:

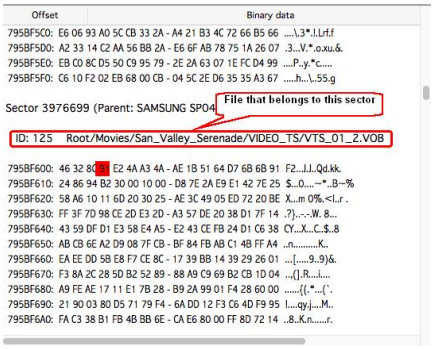
1 **Enumerate files on a logical disk on the** Drives **panel.**

2 **Go to the tab of that logical disk and select Show Files in HexEditor on the Files menu.**

3 **Return to the** Drives **panel and select View/Edit on the contextual menu.**

> **R-Studio will show a file that belongs to a particular section.**

File in a sector



4.5 Creating Custom Patterns

You may create your own patterns yourself.

An example of a commented pattern parsing an AVI file.

The syntax of pattern description is similar to that of the XML language. The folder where the files should be placed is specified on the Main tab of the Settings dialog box.

Pattern structure

Pattern header

Each pattern starts with a standard header

```
<?xml version="1.0" encoding="utf-8"?>
```

Section `template`

Each pattern starts with a section giving to the pattern a name that will be shown in the parsed data pane.

Attributes:

`name`	Specifies the pattern name shown in the parsed data pane

Example:

```
<template name="AVI File LIST">
  ........
</template>
```

Section `signature`

Attributes:

`align <positive`	Specifies if the data structure address is aligned (i.g., by a sector: 512)

This section contains elements `field` with hex-codes of the signature. The attribute `offset` specifies their offset from the start of the record. Field length is equal to the number of hex-codes.

Example:

```
<signature align="1">
   <field offset="0">46 49</field>
   <field offset="2">4c 45</field>
</signature>
```

Section `section`

Such sections contain all expressions and operations needed for the pattern to parse the data. A section name is shown in the parsed data pane. In fact, sections are virtual objects used to group logically connected `fields`. Sections can be nested.

The main section is not shown in the parsed data pane.

Section contain elements `field` which are actual data objects. `field` names are shown in the parsed data pane with their values.

Attributes:

`name`	Specifies the pattern name shown in the parsed data pane

Example:

```
<section name="JUNK">
 ....
</section>
```

List of All Objects in Patterns

Data types (in `field`)

- `integer`
  Sub-types:
  `int8`
  `int16`
  `int32`
  `int64`
  `uint8`
  `uint16`
  `uint32`
  `uint64`
  uintX
  Attributes:

`endian: (be | le`	Optional. Default: `system`.
`base: (decimal |`	Optional. Specifies data representation. Default: `decimal`.
`as-offset: <expre`	Optional. Specifies that this field is an offset and its value should be evaluated using the expression. A special variable `this` returns the value of this field.
`purpose: (offset`	Optional. Specifies the type of the `as-offset` expression result . If this attribute is present, the attribute is necessary if the offset value should differ from the value of this field (variable `this`). `rsector` and `rcluster` are offsets relative to the absolute position of the pattern beginning.
`assigned-template`	Specifies the pattern name linked with this field. Ignored if the `as-offset` or `purpose` attributes are not specified.
`var: <Name>`	Optional. Specifies the name under which the value of this field can be accessed in expressions.

- `binary`
  Attributes:

`display-encoding: (he`	Optional. Default: `hex`.
`size: <bytes>`	Mandatory.

- `char`

Attributes:

`size: <bytes>`	Mandatory.
`codepage: (ansi | oem | utf8 | utf16)`	Optional. Specifies which codepage is used. Default: `ansi`.

- `filetime`
  Shows time in the Win32 format (64 bits)

- `unixtime`
  Shows time in the Unix format (seconds from 01/01/1970)

- `filetime`
  Shows time in the DOS format (date: hiword, time: loword)

- `bits`
  Attributes:

`size: <bytes>`	Mandatory.
`pos: <comma separated`	Mandatory. Specifies bit positions in a data block.

Commands

- `goto`
  Specifies a jump to a specified offset (either absolute or relative one)
  Attributes:

`address: <expression>`	Specifies an absolute address to jump to.
`offset: <expression>`	Specifies a relative offset to jump by.

  One and only one of the attributes should always be specified.

- `if`
  Evaluates a condition specified in the `test` attribute and, if the condition is true, reads fields specified in this tag.
  Attribute:

`test: <expression>`	Sets a condition to test against.

- `repeat`
  Reads the fields specified in the tag until the exit condition is equal to 0 or specified times
  Attributes:

`count: <expression>`	`<expression>` is evaluated one time upon entering the block. Internal elements are read the specified number of times.
`test: <expression>`	`<expression>` is evaluated upon entering the block. Similar to the C++ construction `while(...) {}`.

`test: <expression>`	`<expression>` is evaluated upon exiting the block. Similar to the C++ construction `do {} while(...)`.

- `setvar`
  Sets the value of an internal variable. As an example, this command is convenient to store the current offset. The value of the current offset is stored in a predefined variable `offset`.
  Attributes:

`var: <string>`	Specifies the name of the variable.
`expr: <expression>`	Specifies an expression which result will be assigned to the variable.

Expressions

Expressions in the patterns are arithmetic expressions which syntax is similar to that of the C language, including operation preceding.
The following operations are supported:
`+ - * / & | > < <= >= != == || &&`

Predefined variables

- `offset`
  An offset in bytes from the pattern beginning data is currently read at.

- `start_position`
  An absolute position of the pattern beginning. `offset` + `start_position` = absolute offset.

- `this`
  This variable exists only within the context of the `ass-offset` expression evaluation and is the current value of the data field for which that expression is specified

4.6 Pattern Example I

Below is an example of a commented pattern parsing an AVI file.

```
<?xml version="1.0" encoding="utf-8"?>
<!-- A pattern section. The pattern name is AVI File. -->
<template name="AVI File">
  <!-- A template signature section. Alignment is 1. -->
  <signature align="1">
    <!-- A 4-byte signature at offset 0x00. -->
    <field offset="0x00">52 49 46 46</field> <!-- ANSI: RIFF -->
    <!-- A 4-byte signature at offset 0x08. -->
    <field offset="0x08">41 56 49 20</field> <!-- ANSI: LIST -->
  </signature>

  <!-- A data section. Its name is AVI File. This is the main data section. It is not shown in the parsing tree as a section (its name is ignored). -->
  <section name="AVI File">
```

```
<!-- The first 4 bytes are read and shown as an ANSI  string. -->
<field type="char" size="4" name="Signature: RIFF" var="signature"/>
<!--  The current position is moved to the beginning of the file. -->
<goto offset="-4"/>
<!-- The first 4 bytes in the file are read and shown as an unsigned integer. The internal variable signature gets the value of the field. -->
 <field type="uint32" base="hex" name="Signature RIFF as unsigned integer in hex format" var=

<!-- A test against the condition (signature == RIFF) -->
<if test="signature == 0x46464952"> <!-- ANSI: RIFF -->
  <!-- The next 4 bytes are read and shown as an unsigned integer. The internal variable dataSize gets the value of  the field. -->
   <field type="uint32" name="Size of the data in file" var="dataSize"/>
   <!-- A new internal variable endOfFile is created and the expr field evaluates its value.-->
   <setvar var="endOfFile" expr="offset + dataSize - 8"/>
   <!-- The next 4 bytes is read and shown as an ANSI string. -->
   <field type="char" size="4" name="File type"/>

   <!-- A new section named DATA is created -->
   <section name="DATA">
     <!-- A new internal variable chunksOffset is created, the expr filed evaluating its value. This variable gets the absolute value of template offset. -->
     <setvar var="chunksOffset" expr="start_position"/>

      <!-- A loop is created. Its condition is set in the test field (while the endOfFile variable is greater then the current position.) -->
     <repeat test="endOfFile > offset">
       <!-- 4 bytes are read and shown as an ANSI string. -->
       <field type="char" size="4" name="Signature"/>
       <!-- The current position is moved backwards by 4 bytes. -->
       <goto offset="-4"/>
       <!-- The same 4 bytes are read and shown as an unsigned integer. The internal variable signature gets this value. -->
                    <field type="uint32" name="Signature as unsigned integer" var="signature"/>

       <!-- A test against the condition (signature == LIST) -->
       <if test="signature == 1414744396"> <!-- ANSI: LIST -->
         <!-- The section is shown. Its name is LIST -->
         <section name="LIST">
           <!--  The current position is moved backward by 4 bytes. -->
           <goto offset="-4"/>
```

<!-- The 4 bytes are read and shown as an unsigned hexadecimal integer. This field has the attributes `offset` and `assigned-template`. If the user double-clicks this field, the `AVI File LIST` pattern will be invoked and the current pattern position will be moved to the address specified in `as-offset`.-->

```
<field type="uint32" base="hex" name="Signature LIST as unsigned integer in hex format" as-offset="start_position + offset - 4" assigned-template="AVI File LIST"/>
<!-- The next 4 bytes are read and shown as an unsigned integer. The listSize variable gets its value. -->
<field type="uint32" name="Size of the data in the list" var="listSize"/>
<!-- The 4 bytes are read and shown as an ANSI string. -->
<field type="char" size="4" name="List type"/>
<!-- The current position is moved backward by 4 bytes. -->
<goto offset="-4"/>
<!-- The same 4 bytes are shown as an unsigned hexadecimal integer. The listType variable gets its value.-->
<field type="uint32" base="hex" name="List type as unsigned integer in hex format" var="listType"/>

<!-- A test against condition (type == movi) -->
<if test="listType == 0x69766f6d"> <!-- ANSI: movi -->
  <!-- The chunksOffset variable gets the value evaluated in the expr attribute. -->
  <setvar var="chunksOffset" expr="start_position + offset - 4"/>
 </if>

<!-- The current position is moved to the address evaluated in the address attribute. -->
<goto address="offset + listSize - 4"/>
  </section>
 </if>

<!-- A test against condition (signature == JUNK) -->
<if test="signature == 1263424842"> <!-- ANSI: JUNK -->
  <!-- The section is shown with the JUNK name. -->
  <section name="JUNK">
<!-- The next 4 bytes are read and shown as an unsigned integer. The internal variable junkSize gets its value. -->
<field type="uint32" name="Size of the data of the junk" var="junkSize"/>
<!-- The current position is moved by junkSize bytes forward. -->
<goto offset="junkSize"/>
  </section>
 </if>
```

```
          <!-- A test against condition (signature == idx1) -->
          <if test="signature == 829973609"> <!-- ANSI: idx1 -->
            <!--  The section is shown with the idx1 name. -->
            <section name="idx1">
                  <!-- The next 4 bytes are read and shown as an unsigned integer. The internal variable idxSize gets its value. -->
                        <field type="uint32" name="Size of the data of the idx1" var="idxSize"/>
              <!-- The section is shown with the First AVIINDEXENTRY name. -->
              <section name="First AVIINDEXENTRY">
                <!-- The 4 bytes are read and shown as an ANSI string. -->
                <field type="char" size="4" name="Chunck id"/>
                <!-- The next 4 bytes are read and shown as an unsigned hexadecimal integer. -->
                <field type="uint32" base="hex" name="Flags"/>
                 <!-- The next 4 bytes are read ans shown as an unsigned hexadecimal integer. The offset attribute is evaluated for this field as a sum of  the chunksOffset variable and valued of this field.  -->
                          <field type="uint32" base="hex" name="Chunk offset" as-offset="chunksOffset + this"/>
                <!-- The next 4 bytes are read and shown as an unsigned integer. -->
                <field type="uint32" name="Chunk size"/>
              </section>
              <!-- The current position is moved by idxSiz bytes forward. -->
              <goto offset="idxSize"/>
            </section>
          </if>

          <!-- A test against the condition. &amp;&amp; is a logical AND (&&) -->
               <if test="signature != 1414744396 &amp;&amp; signature != 1263424842 &amp;&amp; signature != 829973609">
            <!-- An empty section is shown. Its name is Unknown signature found -->
            <section name="Unknown signature found">
            </section>
            <!-- The current position is moved to the address set in the endOfFile variable. -->
            <goto address="endOfFile"/>
           </if>
        </repeat>
      </section>
    </if>
  </section>
</template>
```

4.7 Pattern Example II

```
<?xml version="1.0" encoding="utf-8"?>
<!-- A pattern section. The pattern name is AVI File LIST -->
<template name="AVI File LIST">
  <!-- A template signature section. Alignment is 1. -->
  <signature align="1">
    <!-- A 4-byte signature at offset 0x00. -->
    <field offset="0x00">4C 49 53 54</field> <!-- ANSI: LIST -->
  </signature>

  <!-- A data section. Its name is AVI File LIST. This is the main data section. It is not shown in the parsing tree as a section (its name is ignored).-->
  <section name="AVI File LIST">
    <!-- The first 4 bytes are read and shown as an ANSI string. -->
    <field type="char" size="4" name="Signature: LIST"/>
    <!-- The current position is moved to the beginning of the file (4 bytes backward). -->
    <goto offset="-4"/>
    <!-- The first 4 bytes in the file are read and shown as an unsigned integer. The internal variable signature gets the value of the field. -->
    <field type="uint32" name="Signature LIST as unsigned integer" var="signature"/>

    <!-- A test against the condition (signature == LIST) -->
    <if test="signature == 1414744396"> <!-- ANSI: LIST -->
      <!-- The next 4 bytes are read and shown as an unsigned integer. The internal variable listSize gets its value. -->
      <field type="uint32" name="Size of the data in the list" var="listSize"/>
      <setvar var="endOfList" expr="offset + listSize"/>

      <field type="char" size="4" name="List type"/>
      <goto offset="-4"/>
        <field type="uint32" base="hex" name="List type as unsigned integer in hex format" var="listType"/>

      <!-- A test against condition (listType == movi) -->
      <if test="listType == 0x69766f6d"> <!-- ANSI: movi -->
        <!-- This chunk is not to be parsed. The current position is moved to the end of the chunk. -->
        <goto address="endOfList"/>
      </if>

      <setvar var="mediaType" expr="0"/>
      <repeat test="endOfList > offset - 8">
```

```
        <section name="CHUNK">
          <field type="char" size="4" name="Chunk ID"/>
          <goto offset="-4"/>
          <field type="uint32" name="Chunk ID as unsigned integer" var="chunkId"/>
          <if test="chunkId == 1414744396"> <!-- ANSI: LIST -->
            <goto offset="-4"/>
    <field type="uint32" base="hex" name="LIST chunk ID as unsigned integer in hex
format" as-offset="start_position + offset - 4" assigned-template="AVI File LIST"/>
          </if>

                        <field type="uint32" name="Size of the data in the chunk"
var="chunkSize"/>
          <setvar var="endOfChunk" expr="offset + chunkSize"/>

          <!-- Rounding the value of the variable endOfChunk to a number divisible by 2. -->
          <if test="endOfChunk &amp; 1">
            <setvar var="endOfChunk" expr="endOfChunk &amp; 0xFFFFFFFE"/>
            <setvar var="endOfChunk" expr="endOfChunk + 2"/>
          </if>

          <if test="chunkId == 1751742049"> <!-- ANSI: avih -->
            <field type="uint32" name="Number of microseconds between frames"/>
            <field type="uint32" name="Approximate maximum data rate of the file"/>
            <field type="uint32" name="Alignment for data, in bytes"/>
               <field type="uint32" name="Bitwise combination of zero or more of the
flags"/>
            <field type="uint32" name="Total number of frames of data in the file"/>
            <field type="uint32" name="Initial frame for interleaved files"/>
            <field type="uint32" name="Number of streams in the file"/>
            <field type="uint32" name="Suggested buffer size for reading the file"/>
            <field type="uint32" name="Width of the AVI file in pixels"/>
            <field type="uint32" name="Height of the AVI file in pixels"/>
            <field type="binary" size="16" name="Reserved"/>
          </if>

          <if test="chunkId == 1852994675"> <!-- ANSI: strn -->
            <field type="char" size="chunkSize" name="Stream name"/>
          </if>

          <if test="chunkId == 1752331379"> <!-- ANSI: strh -->
            <field type="char" size="4" name="Type"/>
```

```
            <goto offset="-4"/>
               <field type="uint32" base="hex" name="Type as unsigned integer in hex
format" var="type"/>
            <setvar var="mediaType" expr="type"/>
            <field type="char" size="4" name="Handler (codec)"/>
            <field type="uint32" base="hex" name="Flags"/>
             <field type="uint32" name="Number of the first block of the stream that
is present in the file"/>
            <field type="uint32" name="Scale"/>
            <field type="uint32" name="Rate"/>
            <field type="uint32" name="Start time of stream"/>
               <field type="uint32" name="Size of stream in units as defined in Rate
and Scale"/>
              <field type="uint32" name="Size of buffer necessary to store blocks of
that stream"/>
            <field type="uint32" name="Quality"/>
               <field type="uint32" name="Sample size (number of bytes of one stream
atom)"/>
          </if>

          <if test="chunkId == 1718776947"> <!-- ANSI: strf -->
            <if test="mediaType == 0x73646976"> <!-- ANSI: vids -->
              <section name="BITMAPINFOHEADER">
                        <field type="uint32" name="Number of bytes required by the
structure"/>
                <field type="int32" name="Width of the bitmap, in pixels"/>
                <field type="int32" name="Height of the bitmap, in pixels"/>
                <field type="uint16" name="Number of planes for the target device"/>
                <field type="uint16" name="Number of bits-per-pixel"/>
                     <field type="uint32" name="Type of compression for a compressed
bottom-up bitmap"/>
                <field type="uint32" name="Size, in bytes, of the image"/>
                     <field type="int32" name="Horizontal resolution, in pixels-per-
meter, of the target device for the bitmap"/>
                  <field type="int32" name="Vertical resolution, in pixels-per-meter,
of the target device for the bitmap"/>
                    <field type="uint32" name="Number of color indexes in the color
table that are actually used by the bitmap"/>
                 <field type="uint32" name="Number of color indexes that are required
for displaying the bitmap"/>
              </section>
            </if>
```

```
            <if test="mediaType == 0x73647561"> <!-- ANSI: auds -->
              <section name="WAVEFORMATEX">
                <field type="uint16" name="Waveform-audio format type"/>
                  <field type="uint16" name="Number of channels in the waveform-audio
data"/>
                       <field type="uint32" name="Sample rate, in samples per second
(hertz)"/>
                   <field type="uint32" name="Required average data-transfer rate, in
bytes per second, for the format tag"/>
                <field type="uint16" name="Block alignment, in bytes"/>
                   <field type="uint16" name="Bits per sample for the Waveform-audio
format type"/>
                          <field type="uint16" name="Size, in bytes, of extra format
information appended to the end of the WAVEFORMATEX structure"/>
              </section>
            </if>
          </if>

          <goto address="endOfChunk"/>
        </section>
      </repeat>

    </if>

    <if test="signature != 1414744396">
      <section name="Invalid LIST signature found">
      </section>
    </if>

  </section>
</template>
```

V Technical Information and Troubleshooting

This chapter covers various technical issues and troubleshooting.

5.1 IntelligentScan Technology

R-Studio uses a unique ***IntelligentScan*** technology when it tries to recover the data on the area being scanned.

While scanning the selected area, **R-Studio** reads data directly from the disk, analyzes them, and tries to determine a record to which the data belong. The following record types are possible:

- MBR/GPT records
- NTFS Boot Sector, Folder, and MFT records
- FAT/exFAT Boot Sector, folder, and file records
- ReFS Boot sector records and ReFS Meta blocks
- HFS/HFS+ Volume headers and BTree+ nodes
- APFS Super blocks, APFS Volume blocks, and APFS nodes
- Ext2/3/4FS SuperBlocks records
- UFS1/UFS2/FFS SuperBlock records
- Specific file signatures of Known File types for raw file carving

All these record types have different, but known, structure. Knowing valid values of record fields and relations between them for each record type, **R-Studio** determines a record type for the data. If such record type cannot be unambiguously determined, the data are assigned to the most probable record type. The same data can be assigned to several record types, with a certain probability for each assignment. A list of possible files is generated from these records.

R-Studio generates a record list for each record type. This list contains references to records assigned to a record type from the list with their assignment probability. The same data can be included into different record lists. Then **R-Studio** analyzes relations between elements in each list and between different lists, and generates a list of found partition with their parameters, such as partition start point and probable size, file system type, cluster size, and existence probability.

Using the file list and partition list, **R-Studio** reconstructs file systems and files on the found partitions. One file can be attributed to several different partitions.

When the entire disk or its part has been scanned, **R-Studio** shows all found partitions. Then the parameters of the found partitions may be manually corrected, if additional information on them is available.

Using the *IntelligentScan* technology, **R-Studio** can recover files not only on new and existing partitions. It also can find and recover data on partitions that have been deleted or reformatted. If, for example, there was an NTFS partition, which later was reformatted as a FAT partition, **R-Studio** will show two partitions on the same place on the disk, one having the FAT file system, the other the NTFS. Then, found files can be recovered.

The ***IntelligentScan*** technology makes **R-Studio** a very powerful data recovery tool, but it is not omnipotent. As it uses probabilistic approach to data reconstruction, it cannot guarantee 100% correct results. Moreover, even if **R-Studio** has reconstructed data structure correctly, it is impossible to guarantee that all found files will be completely and correctly recovered, as new data may be already written over the old files. See the **Data Recovery Issues** topic for details.

5.2 Data Recovery Issues

NEVER TRY TO SAVE RECOVERED FILES/FOLDERS TO THE SAME LOGICAL DISK WHERE THEY RESIDE!!!

Or you may obtain unpredictable results and lose all of your data.

R-Studio writes directly to a hard drive only when writing recovered data and from its hex editor, if writing is enabled. In all other actions, **R-Studio** only reads data and analyzes them, and never modifies data on the hard drives being analyzed.

Most operating systems use lazy-write. So, there is a time lag between file actions and actual changes on data on a hard drive. **R-Studio** analyzes data on hard drives only. That is why it does not always detect recent changes in data structure.

Most operating systems constantly write their service information on hard drives. Such writing is especially intensive during start-up and shut-down procedures. When an operating system deletes a file/folder, it treats the space where it has resided as empty and may write something in this place. If this happened, the file/folder and its parameters may be detected correctly, but its data may be lost.

Folder names like **$$$Folder58448** on NTFS partitions mean that the folder has not been found on the drive but some references to it have been. For example, folders My documents, Work, Photos have been found and all they have one parent folder, whose description has not actually been found on the disk, so its name is unknown and therefore represented as **$$$Folder58448**. It may happen that the description of such folders was outside of the

scan area, so try to enlarge the region or scan the entire hard drive. If that does not help, most likely that the description of the folder has been overwritten.

Folder names like **$ROOT58448** on FAT partitions mean that some folders have been found, but they cannot be included into the folder structure for this FAT partition. Sometimes, such folders may contain other folder structures.

If you recover a file, and it appears that the file contains wrong data, try to do the following:

- **Scan**:
  the logical disk, if the file has been just deleted.
  the hard drive, if the data structure is damaged more seriously.
- **Search for the file** to be restored on all found partitions and try to recover it from all found partitions. Check each recovered file to ensure that it contains correct data. As soon as you found the partition from which the file is recovered correctly, use this partitions to recover all other deleted files.

If there are several deleted files to be restored, you should use a file larger than 2KB to select the required partition.

FAT file system:

Cross-Linked Folders

Often **R-Studio** finds several FAT folder records that contain the same data. Such folders are called *cross-linked*. **R-Studio** marks such folders with an arrow mark: 

R-Studio attributes the content of cross-linked folders to one folder called a *target folder*. When recovering, **R-Studio** places the content to the target folder.

To view the list of cross-linked folders,

1 **Control-click a cross-linked folder and select Cross Linked Folders on the contextual menu.**

> **A list of cross-linked folders will appear**
  You may go to any folder in this list by clicking it.

To find a target folder,

* **Control-click a cross-linked folder and select Go Target on the contextual menu,** or
  Select the cross-linked folder and select **Goto Target** on the **File** menu
  If **Go Target** is gray, this folder is already the target folder.

To set the target folder manually,

* **Control-click a cross-linked folder and select Set As Default Target on the contextual menu**, or
  Select the cross-linked folder and select **Set As Default Target** on the **File** menu.
  If **Set As Default Target** is gray, this folder is already the target folder.

Questionable Folders

Sometimes, **R-Studio** may find FAT records, which look like folders, but their content is invalid. For example, file names have invalid characters, date, time, and size, or other file attributes may look strange. Please note that **R-Studio** correctly recognizes localized names. **R-Studio** treats such records as folders, but does not analyze their content and structure. You can manually scan such folders, but results may be unpredictable. Usually, such scan reveals garbage.

R-Studio marks such folders with a question mark. 

To re-scan an object,

* **Control-click a questionable folder on the R-Studio's** Folders **panel and select Rescan on the contextual menu**, or

  Select the questionable folder and select **Rescan** on the **File** menu.

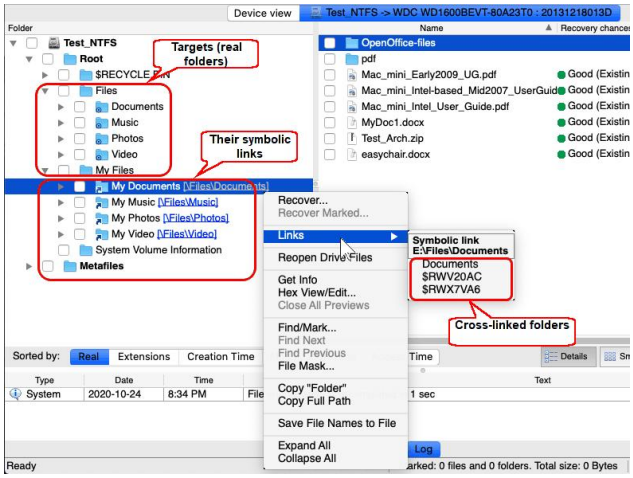
NTFS, APFS, HFS,* XFS*, and ext fs file systems:

Symbolic links (symlinks)

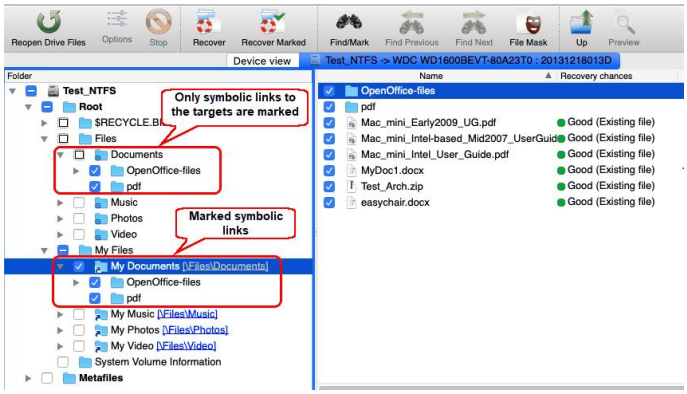
Symbolic links (of symlinks for short) are object that contains references to other files or folders directory in the form of absolute or relative paths and that affect pathname resolution. For example, if a symlink `C:\ProgramData\Documents` points to `D:\Recovered Files\Root\Users\Public\Documents`, entering it will result in entering `D:\Recovered Files\Root\Users\Public\Documents`.

They are present in almost all modern file systems. NTFS, HFS+, APFS, and EXT FS are probably the most popular examples.

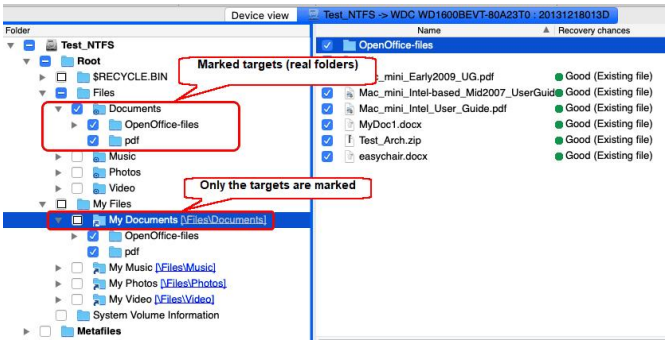
R-Studio shows such symlinks and their targets in the following way:



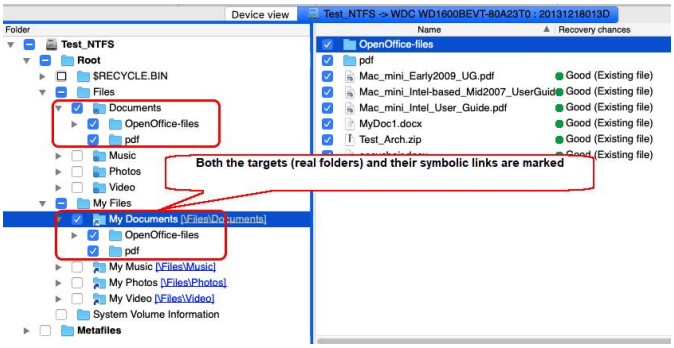
Symlinks can be marked for recovery^



Only symlinks on the picture above are marked for recovery. They will be recovered as real files and folders.



Only targets (real folders) on the picture above are marked for recovery. They will be recovered as real files and folders.



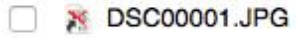
Both targets (real folders) and symlinks on the picture above are marked for recovery. They will be recovered as real files and folders and symlinks.

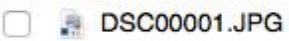
The R-Studio Settings topic gives more details about symlink recovery.

Files:

Hard links

Hard links are file system entries that give file names to files. This term is usually used when files may have several names. **R-Studio** shows hard links using the following icons:

A hard link: 

The target file: 

You may find a target or hard link for a file. Control-click the file and select **Links** on the contextual menu.

5.3 Extended Information Recovery

R-Studio supports recovery of compressed files, alternative data streams, encrypted files, file security and extended file attributes. If the **R-Studio** host OS and the file system of the disk you are going to save file to support any particular extended information, it will be saved with the file, too. Otherwise, the extended information will be saved as separate files with the same name as the restored file and extension showing the type of the extended information. Below is a quick reference for the host OS and file system of the target drive.

Extended Information	Required target disk FS
Encrypted files	NTFS
Alternative data streams	NTFS
File security	NTFS
Extended file attributes	NTFS or FAT

5.4 Data Formats and Multipliers

You may enter data in all numerical fields either in sectors or in bytes. If there is no letters are after the number, **R-Studio** assumes the numbers are in bytes.

Decimal numbers are entered as it is: `2372354`

Hexadecimal numbers are entered as `0x23Fa67` or `23Fa67 hex`.

The following case-insensitive notation is possible:

`b`	1 byte
`kb`	1 kb = 2^10=1024 bytes
`mb`	1 mb = 2^20=104857 bytes
`gb`	1 gb = 2^30=1073741824 bytes
`tb`	1 tb = 2^40=1099511627776 bytes
`eb`	1 eb = 2^50=1125899906842624 bytes
`hex`	A hexadecimal number
`sec (sector)`	A number is in sectors

You may also select the multipliers in the drop-down boxes.

Type an offset to which you want to go. You may select between bytes and sectors. See the **Data Formats and Multipliers** topic for more details on data formats.

If a file is opened in **Text/hexadecimal Editor** , you may select data representation for that file.

When the multiplier has been changed, the data value will be changed according to the specific contextual commands for that field:

Suppose, the initial value is 1 GB, and the sector size of the object is 512 byte. The results will be the following:

Command: No recalculate

Change from GB to MB: 1

Change from GB to Sectors: 1

Command: Always recalculate

Change from GB to MB: 1024

Change from GB to Sectors: 2097152

Command: Units type recalculate

Change from GB to MB: 1

Change from GB to Sectors: 2097152

5.5 Data Recovery on HFS/HFS+ File System

When deleting a file, macOS deletes system BTree+ records describing the file. Therefore, it is hard to recover such file directly. Those records may remain in:

1. The swap file (if the deleted file has been deleted recently).
2. In the journal (if the HFS+ journaling is on, and the deleted file has been CREATED recently)

Actually, if a file has been deleted, chances that the records would be found are small. To greatly increase the chances to recover deleted files successfully , you may actively use scanning with enabled Known Files Types.

Note: All above is correct for intentionally deleted files. In case of a corrupted file system, HFS/HFS+ can be recovered quite successfully.

When saving files with HFS+-specific attributes (resource fork, finder info, etc.) to a non-HFS+ disk, **R-Studio** saves them in the so-called AppleDouble format. When they are copied to an HFS+ disk under macOS, those attributes will be automatically restored.

5.6 Supported Virtual Disk and Disk Image Formats

Along with file formats used for purely disk backup and imaging purposes, there are file formats for virtual disks. Virtual disks are software components that emulates data storage devices in virtual machines. A the same time, virtual disks can be used for disk backup and imaging, too. That is why it's expedient for disk backup and imaging software to support various file formats for virtual disks. This is especially important for system interoperability, when it's necessary to use disk backup/image files on other machines where the disk backup and imaging software isn't installed.

Currently **R-Studio** supports the following virtual disk and disk image formats:

RDR: A proprietary disk image format developed by **R-Tools Technology, Inc (R-TT)**. It is the main format in **R-Drive Image**, **R-Studio**, **R-Linux**, and **R-Undelete**. RDR files are interchangeable, that is, any **R-TT** program may load and process, within its capabilities, any rdr file created in another **R-TT** program.

The following image formats can be created only in the **R-Studio Corporate** and **Technician/T80+** versions:

VHD/VHDX: A virtual disk file format built into Windows. It's a native virtual hard drive for Hyper-V, the Windows virtual machine. You may read more about these file formats in Wikipedia: VHD (file format). **R-Studio** creates a special file with some metadata for the VHD file format, its extension is vhr. The VHDX file format contains this metadata within its main file.

VMDK: A virtual disk file format for the most virtual machines like VMware Workstation, VirtualBox, Parallels Desktop for Mac, etc. You may read more about these file format in our Glossary: What is a VMDK Virtual Disk.

VDI: A virtual disk file format for the VirtualBox virtual machine. **R-Studio** creates a special file with some metadata for the VDI file format, its extension is vdr. You may read more about these file format in Wikipedia: VDI.

R-Studio Standalone can load these image formats.

The main features of these file formats are presented in the table below:

Features	RDR	VHD/VHDX	VMDK	VDI
Compression	Yes	No	Yes	No
Encryption	Yes	No	No	No
Image Split	Yes	No	Yes	No
Native mounting on Windows	No	Yes	No	No
Mounting on Windows	Yes	Yes	Yes	Yes

using R-Studio				

Additional file formats that can be opened "read-only"

Extensions	Description	Licenses
dmg	Apple Disk Image	All
e01/(ewf)	Expert Witness File Format	**Technician/T80+**
aff	Advanced Forensic Format	**Technician/T80+**

5.7 Bad Sectors

Quite often, drives from which the data are to be recovered have bad sectors, or those sectors that are very hard, even impossible, to read, mostly due to hardware problems. **R-Studio** tries to read such sectors several times. The number of tries is specified either on the Settings/Bad Sectors dialog box, or on the Properties tab, the Drive Control section, for each drive separately.

When **R-Studio** encounters such bad sectors while performing various tasks and they appear unreadable, it treats them as follows:

Object images:

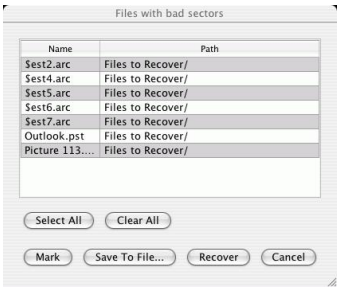
R-Studio fills the space in the image file where the bad sectors should be with the pattern specified in the Pattern to fill bad blocks field on the Settings/Bad Sectors dialog box. Please note that **R-Studio** writes the pattern on the image, not on the source drive.

Files

If Skip files with bad sectors on the Recovery dialog box is cleared, **R-Studio** fills bad sectors in the recovered file with the pattern specified on the the Settings/Bad Sectors dialog box. Information about such files will appear in the Log.

If Skip files with bad sectors on the Recovery dialog box is selected, **R-Studio** skips files with bad sectors and displays their list on the Files with bad sectors dialog box when the recovery has been completed. You may select files to immediately recover them or to mark for later recovery. You may also save this list to a text file.

Files with bad sectors **dialog box**



Files with bad sectors Buttons

Select All	Click this button to select all files in the list.
Clear All	Click this button to unselect all selected files.
Mark	Click this button to mark all selected files in the list.
Save to File	Click this button to save the list of files with bad sectors to a text file.

Recover	Click this button to immediately recover selected files. The bad sectors in the recovered files will be filled with the pattern specified in the Pattern to fill bad blocks field on the Settings/Bad Sectors dialog box.

Objects edited in the Text/hexadecimal editor/viewer

Bad sectors in the objects viewed/edited in the **Text/hexadecimal editor** are shown as filled with the pattern specified in the Pattern to fill bad blocks field on the Settings/Bad Sectors dialog box.

5.8 Memory Usage

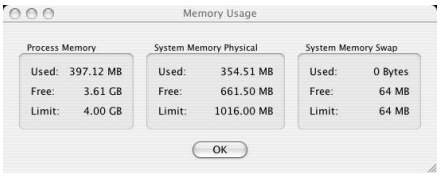
You may see how much memory **R-Studio** uses while performing a data recovery task. This is especially useful when scanning large disks on a computer with limited resources. You may specify memory control options on the Memory usage tab in the **R-Studio Settings**.

To view memory usage,

1 **Select Memory usage on the Tools menu**

> **R-Studio will show the total memory in your computer and how much memory it uses**

Memory usage **dialog box**



Memory usage

Process Memory	Shows how much memory **R-Studio** uses. Limit shows how much memory your system can virtually allocate to **R-Studio**. Actual memory allocation depends also on the RAM and swap file sizes.
System Memory Physical	Shows how much RAM is in your system
System Memory Swap	Shows how much virtual memory is in your system

5.9 R-Studio Command Line Command and Switches

You may start **R-Studio** from the terminal using the following command:

`open a R-Studio [--args -<switch>].`

If there are problems in starting **R-Studio** and while working with it, you may use switches to avoid them.

The following switches are available:

`-all_drives`	Forces **R-Studio** to show all logical disks in the system. Normally **R-Studio** shows only local disks in the system. Some storage devices may pretend that they are not local disks.
`-debug`	Includes additional debug information. When this switch is used, an additional command **Create FS Snapshot** on the context menu appears for an object with a file system. An FS Snapshot contains system data for the file system only (file descriptions without file contents). If a problem appears, this snapshot can be sent to **R-Studio** technical support to identify the problem. This switch greatly slows **R-**

	Studio. You may also turn this mode on by selecting **Debug Mode** on the Settings dialog box.
`-flush`	Flushes the log file after each write to log operations. This switch is helpful when **R-Studio** locks and its log file remains in memory cache unwritten to a disk. This switch greatly slows **R-Studio**.
`-log <filename>`	Started with this switch, **R-Studio** writes its log into the specified file. If **R-Studio** locks and its log file remains in memory cache unwritten to a disk, use the `-flush` switch.
`-mem <size in MB>`	Sets memory usage limit in MB for **R-Studio** to reconstruct the file tree. When it exceeds the limit, a `Too many files...` message appears. You may temporally stop file listing and browse through found files. Then you can resume file listing. You also may skip this file section and continue file listing. Example: `-mem 400` - sets the limit to 400 MB.
`-no_ide_ext`	Turns off the inquiry about extended information on HDDs in Wind9x/ME. This switch may be helpful if **R-Studio** returns information about HDDs incorrectly (detects HDD geometry incorrectly).
`-no_int13`	Turns off the disc access through Int13 in Wind9x/ME. This switch may be helpful if the system operates incorrectly (detects HDD geometry incorrectly or lock the system).
`-no_ios`	Turns off the Wind9x/ME protected-mode I/O system. This switch may be helpful if this system operates incorrectly (detects HDD geometry incorrectly or lock the system).
`-reset`	**R-Studio** resets an HDD controller each time it reads a bad sector. This switch may be helpful if the controller locks after it attempts to read a bad sector, or returns incorrect data.
`-safe`	Disables automatic partition search on a hard drive, file system recognition on partitions, and other potentially problematic operations.

If an unrecognized problem appears, start **R-Studio** with the `-debug` and `-log <filename>` switches, and send the log and screenshot of the **R-Studio** main panel to the **R-Studio** technical support:

R-Studio Technical Support Team is available 24 hours a day, seven days a week, and has an average response time less than 4 hours.

5.10 Properties Tab

Object size units

You may select the units in which the information on object sizes will be displayed. Some parameters can be edited when the Debug mode is turned on on the Main dialog box of the **R-Studio** settings.

To select the units

1. **Select Properties on the View menu**
2. **Select the units in which you want to see object sizes.**

   You may select

   Show as Bytes
   Show as Sectors
   Show as Bytes and Sectors

1.Basic information

This section shows basic information for a disk object.

More information...

Drive Type	Device/disk type and subtype. Current **R-Studio** version supports the following types: Disk, WORM, CDROM, Optical, Changer, Floppy, RAM Disk, LDM Partition, LDM Component, LDM Volume and subtypes: Device, OS File, Physical Drive, Mount Point, Partition, Volume Set, Mirror, Stripe Set, RAID5
Name	Device/disk name
Size	Device/disk size
Bus Type	Device/disk bus type. Can be: IDE/ATA, IDE/ATAPI, SCSI, Floppy, USB, 1394, SSA, FibreChannel, RAID, SMART, ABIOS

2.Information on hard drives and logical disks

This section shows available information on hard drives and logical disks. These properties depend on the drive/disk type and appear only when applicable. Under Windows NT/2000/XP/2003/Vista/2008/7/8/8.1/10, an IDE drive/disk may be represented as a SCSI device, that is why the SCSI Address section appears under these OSes for those drives/disks.

More information...

OS object	Appears for image files. An object name used by OS to access the device/disk.
R-Studio driver	Driver names (both internal and OS) used to access this drive/disk.
Sector Size	Drive/disk sector size
Physical Drive Geometry	This section shows physical geometry for a hard drive. For a logical disk it shows the physical geometry for a hard drive where the logical disk resides
Cylinders	
Tracks Per Cylinder	
Sectors Per Track	
Sector Size	
Device Identification	This section shows vendor information for the drive/disk
Vendor	
Product	
Firmware	
Bus	
SCSI Address	This section shows SCSI information for the drive/disk
Port Number	
Path ID	
Target ID	
Lun	

Windows 9x/ME adds the following properties:	
Int13 Drive Number	128 for the first hard drive accessible through Int13, 129 for the second one, etc. 0...128 for drives and other devices accessible through a Windows 9x/ME protected mode driver, if their Int13 device option is disabled. **R-Studio** can use Int13 disk access, and for some drive types, like SCSI devices, Int13 access is preferable. You may consider enabling the Int13 device option in the Windows Device Manager for such devices.
Int13 Extension Version	Int13 Extension Version Support for hard drives. Extended Int13 support is necessary for large drives. If this property is zero, Extended Int13 is not supported, otherwise, it shows Extended Int13 standard version, the large, the better.

3.Properties controlling access to hard drives and logical disks

This section shows properties that control access (read and write) to hard drives and logical disks. They are set to their optimal values and should be altered only if access problems appear.

More information...

Drive Control	
Maximum transfer	Maximum data size that can be read or written during a single access to the drive. If there are problems with drive access, decrease the value of this property
I/O Unit	Data size read or written during a single access to the drive is a multiple value of this property. If there are problems with drive access, decrease the value of this property
Buffer Alignment	Drive data transfer buffer is positioned at an address multiple value of this property. If there are problems with drive access, increase the value of this property.
These three properties are set by OS drivers. If the drivers set incorrect values, problems may appear during data transfer operations. You can alter them until data transfer becomes stable.	
I/O Tries	Number of read/write tries during access to the drive. If there are bad sectors on the drive, increase the value of this property. This may help to successfully read those sectors. Sometimes, if the I/O Tries parameter is set too large and there are some unreadable sectors on the hard drive, the hard drive-controller pair may refuse to perform any successive read/write operations with the entire hard drive when it fails to read/write such sectors. In this case, set this parameter to zero. The default value is specified on the Settings (Bad Sectors) panel. **R-Studio** treats bad sectors in the following way: It reads a certain part of disk (predefined by Windows) and • If Default read attempts is set to 0, the entire part with bad sectors will be filled with the specified pattern. • If Default read attempts is set to a non-zero value, **R-Studio** reads again that part sector by sector, repeating the attempts the specified number of times. If **R-Studio** still cannot read a bad sector, it fills the sectors with the specified pattern. In this case only the bad sectors will be filled with the pattern, but that extremely slows the disk read process. For example, if you set Default read attempts to 1, a bad sector will be read 2 times.

4.Partition properties

A *partition* is a continuous area on a hard drive, characterized by its offset and size. There are partitions on basic disks, dynamic disks, and recognized volumes and partitions. **R-Studio** treats regions like partitions.

More information...

Partition Offset	Initial offset for the partition.
Partition Size	Size of the partition.
Partition Type	File system type for the partition. If the record in the drive partition table is incorrect, this property may differ from the actual file system type for this partition. Still, **R-Studio** will process this partition correctly, as it does not use this property.
Partition number	Appears under Windows NT/2000/XP/2003/Vista/2008/7/8/8.1/10 only. Shows the number of the partition on the physical drive.
For regions and recognized partitions, Partition Offset and Partition Type properties can be manually corrected.	

5.Compound volume properties

A *compound volume* is a union of several partitions or other disk objects. Each union type has its own rules, unique for each compound volume type. Among compound volumes are: *Volume Sets* (RAIDs Level 0), *Mirrors* (RAIDs Level 1), *RAIDs5* (RAIDs Level 5), both physical and created by the user (*Virtual Volume Sets*, *Virtual Stripe Sets*, *Virtual Mirrors*, *Virtual RAID5*).

More information...

Main properties of compound volumes are *parents* (disk objects from which a compound volume is created) and their order. These properties may be viewed in the Parents tab. For user-created compound volumes these properties may be altered.	
Raid Block Size	Data block size for compound volumes of RAID (Level 0-5) types

6.LDM disks and volumes (Dynamic Disks)

LDM disks and volumes are volumes controlled by Logical Disk Manager (LDM). They are represented on a hard drive as a LDM database rather than partition tables. Under Windows 2000/XP/2003/Vista/2008/7/8/8.1/10, LDM disks are also called *Dynamic Disks*.

More information...

Offset of Logical Disk	Initial offset of a logical disk on a hard drive. For disks, initially formatted by LDM, this value is often **31.5KB**, for converted disks, it may be larger.
Supposed Parents Count	Supposed number of parent partitions for compound LDM volumes. If the LDM database is not damaged, the value of this property must be equal to the number of parent objects in the Parents tab for the disk object.
LDM Host GUID	Global Unique Identifier of a computer system where this LDM disk group has been created.
LDM DiskGroup GUID	Global Unique Identifier of the LDM disk group.
LDM Disk GUID	Global Unique Identifier of the hard drive.
LDM Volume GUID	Global Unique Identifier of the volume.
LDM Disk ID	Local hard drive Identifier, unique within this LDM disk group.

LDM Partition ID	Local partition Identifier, unique within this LDM disk group.
LDM Component ID	Local component Identifier, unique within this LDM disk group.
LDM Volume ID	Local volume Identifier, unique within this LDM disk group.
LDM Disk AltName	Additional Alternative Name given by LDM to the hard drive.
LDM Disk DriveHint	Last name of the volume, under which is has been mounted in the system. May be either a letter (C:, D:, etc.), or a mount point under Windows 2000/XP/2003/Vista/2008/7/8/8.1/10.

7.File System Volume properties

A *File System (FS) volume* is a disk object where a certain, supported by **R-Studio**, file system is present. There are two FS volume types: FS volume on a regular disk object and a recognized volume, found by a scan process. FS volume properties depend on volume's file system and type.

7.1.NTFS Volume properties

These properties are present for all NTFS volumes and represent their main properties. For *recognized volumes*, these values can be altered.

More information...

NTFS Information	Regular volumes
Recognized NTFS	Recognized volumes
Cluster Size	Cluster size for the NTFS volume.
MFT record size	Size of one MFT record describing one file on the NTFS volume. This is an important property of any NTFS volume. Its common value is 1KB. If this property has incorrect value, many files may be incorrectly recovered.
Sector Size	Sector size for the physical drive. This property is read from the boot sector of the NTFS volume and does not affect **R-Studio** operation.
Index Block Size	Index block size for the NTFS volume. This property determines binary trees used to store NTFS folder structure. It does not affect **R-Studio** operation.
MFT position	MFT offset from the start of the NTFS volume.
MFT Mirror Position	Second MFT copy offset from the start of the NTFS volume.
Volume size	Size of the NTFS volume. This property does not affect **R-Studio** operation.

7.2.FAT Volume properties

These properties are present for all FAT volumes and represent their main properties. For *recognized volumes*, these values can be altered.

More information...

FAT Information	Regular volumes
Recognized FAT	Recognized volumes
FAT Bits (12,16,32)	FAT type. 12 for the FAT12, 16 for the FAT16, 32 for the FAT32.
Cluster Size	Cluster size for the FAT volume.
First Cluster Offset	Offset of the first cluster from the start of the FAT volume.

Boot Directory Cluster	(*For FAT32 only.*) Cluster number where the root directory starts on the FAT volume where the logical disk resides.
Root Directory Offset	(*For FAT12 and 16 only.*) Root directory offset from the start of the FAT volume.
Root Directory Length	(*For FAT12 and 16 only.*) Root directory length for the FAT volume.
First FAT Offset	Offset for the first FAT table on the volume. Together with the Size of One Fat Table property, is a most important property for a FAT volume. If this property is incorrect, many files (especially fragmented ones) may be incorrectly recovered.
Size of One FAT Table	Size of one FAT table on the volume.
Sector Size	Sector size of the hard drive. This property is read from the boot sector of the FAT volume and does not affect **R-Studio** operation.
Number of FAT Copies	Number of FAT copies on the FAT volume.
Active FAT copy	Active FAT table number for the FAT volume. Can be set to Disabled, Auto, 1, or 2. If it is Disabled, **R-Studio** processes the volume as there is no FAT table present. This may be useful if the volume has been reformatted and thus a new FAT table is created and the old one is deleted. In this case, it is reasonable to recover files from the previous volume without processing the new and irrelevant FAT table. All files will be recovered as continuous byte chains beginning from their start cluster. Unfragmented files will be recovered successfully. If it is 1 or 2, **R-Studio** uses the first or second FAT table copy, respectively. If it is Auto, **R-Studio** uses both FAT table copies and decides, which FAT table copy should be used for a particular FAT table sector. This may be useful when both FAT tables are partially damaged.
Major version	FAT version.
Minor version	FAT minor version.
Volume size	Size of the volume.

7.3.Ext2/3/4FS Volume properties

These properties are present for all Ext2/3/4FS volumes and represent their main properties. For *recognized volumes*, these values can be altered.

More information...

Ext2/3/4FS Information	Regular volumes
Recognized Ext2FS	Recognized volumes
Block Size	Block size of Ext2FS file system. A block in the Ext2FS file system is similar to a cluster in the FAT file system.
First SuperBlock Offset	Offset of the first SuperBlock from the start of the Ext2FS volume.
Blocks Per Volume	Number of blocks in the Ext2FS volume.
INodes Per Volume	Number of inodes on the Ext2FS volume. An inode is a record describing file's size, attributes, position on an Ext2FS volume - all information about a file, except its name,

	which is stored separately. Therefore, the INodes Per Volume parameter is equal to the maximum number of files on an Ext2FS volume.
Creator OS	The OS that created this Ext2FS volume. May be Linux, Hurd, Masix, FreeBSD, Lites.
Major version	Ext2FS version. Usually 1.
Minor version	Ext2FS minor version. Usually 0.
Last Mount Time	Last mount time for this Ext2FS volume.
Last Write Time	Last write time for this Ext2FS volume.
Last Check Time	Last check time for this Ext2FS volume.
Volume size	Size of the volume.

7.4.Recognized Volume properties

These properties are present for all *recognized volumes*, regardless of their file system type. They estimate how reliable those volumes are recognized. This is useful for fast search for, and selection of, optimally recognized volume to recover.

More information...

Parsed File Entries	Number of files proving that this recognized volume existed. May have any non-negative values. The main property characterizing the reliability of volume recognition. The larger it, the higher probability that this recognized volume has file system properties that have been correctly found.
Parsed Boot Records	Number of boot records proving that this recognized volume existed. May be 0 or 1. This is the second important property characterizing the reliability of volume recognition.
Estimated Size	Estimated size of the recognized FS partition/volume. This property shows the most probable size of the recognized FS partition/volume. Alternatively, Size and Partition Size are set to the highest possible values in order to recover the maximum number of files.

VI R-Studio Emergency

R-Studio Emergency is a tool that allows you to startup a computer with a damaged startup disk and recover data stored on its hard drives. Then restored data can either be saved on its disk or transferred to a working computer via a network.

The R-Studio Emergency version is a part of the R-Studio software package.

You may run this R-Studio Emergency version on a computer for which you have bought an R-Studio license, and you may not transfer the licensed software to another computer.

6.1 Contact Informaiton and Technical Support

To obtain the latest version of **R-Studio Emergency**, go to:

Product Site: http://www.r-tt.com
Sales Department: sales@r-tt.com

R-Studio Technical Support Team is available 24 hours a day, seven days a week, and has an average response time less than 4 hours.

Tech. Support: support@r-tt.com
Send your support request to: http://www.r-tt.com/Support_request.html

6.2 Creating Startup Disks

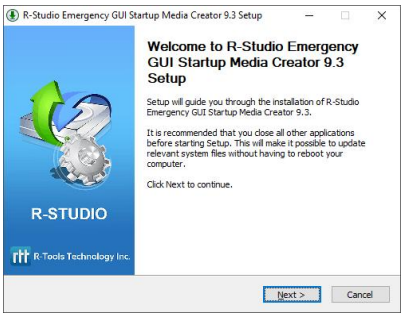
- Installing R-Studio Emergency Startup Media Creator
- Creating Startup Disks Using R-Studio Emergency Startup Media Creator

- Creating Startup Disks for Mac and Linux Computers

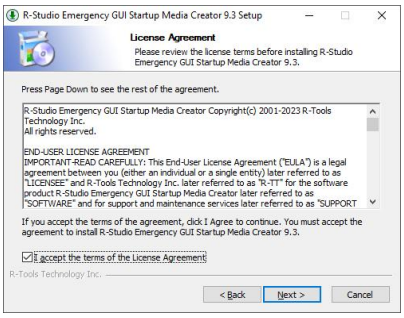
6.2.1 Installing R-Studio Emergency Startup Media Creator

You must have administrative privileges to install R-Studio Emergency Startup Media Creator.
If you are not sure whether you have such privileges, you almost certainly do not have them. Contact your system administrator for assistance.

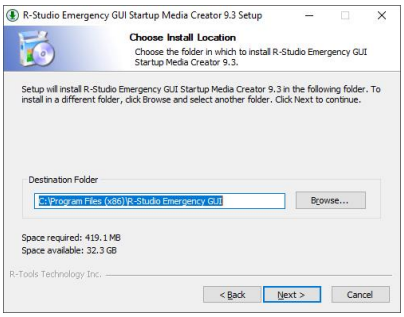
1 Run the setup wizard



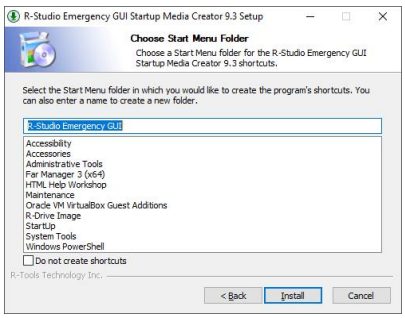
2 Read the License Agreement and accept its conditions.



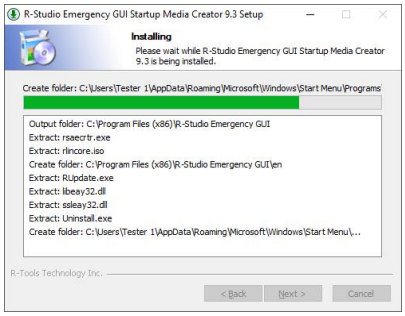
3 Select the installation location



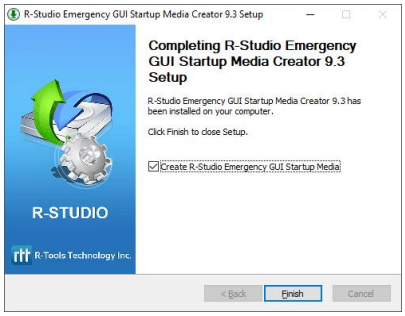
4 Select the Start Menu Folder



5 Wait for the program to install



6 You may start creating R-Studio Emergency immediately upon install completion.



6.2.2 Creating Startup Disks Using R-Studio Emergency Startup Media Creator

You need to create either

- A startup FAT/FAT32 removable device recognized by your system as a bootable one. The total available size of the device should be more than 50 MB. You may use this device to start both UEFI computers (modern Windows/Mac/Linux systems) and old Windows/Mac/Linux machines.
  or
- A startup CD/DVD disc. You may create an ISO image, or write the disc directly from **R-Studio** Emergency Startup Media Creator, if there is a CD/DVD recorder in your system. You may use this disc to start both UEFI computers (modern Windows/Mac/Linux systems) and old Windows/Mac/Linux machines.

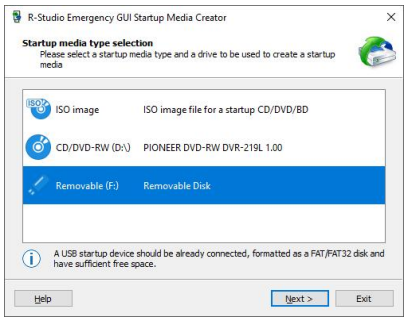
You may create a Linux-based or WinPE based startup disk.

1 Run R-Studio Emergency

Welcome **dialog box**

click the **Next** button to see the list of all devices on which startup disks may be created.

Startup media type selection **dialog box**



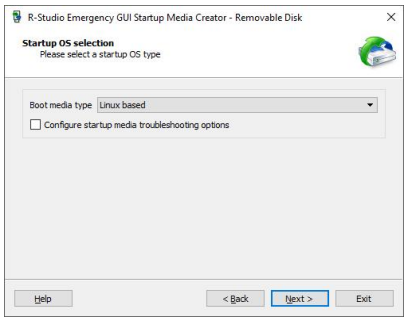
A Linux-based disk

Check the [Hardware Compatibility List](#).

If you have problems with starting you computer up from the **R-Studio** Emergency startup disks, select **Configure startup media troubleshooting options** on the Startup media type selection dialog box. Then the Startup Media Troubleshooting Options dialog box will appear. You may configure these options to eliminate those problems.

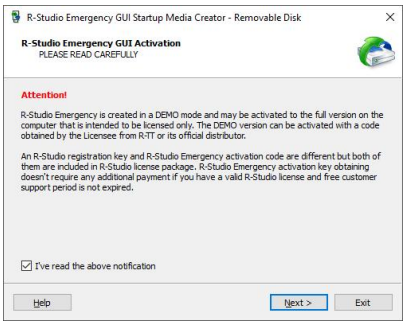
3 Select Linux based on the Startup OS selection and click the Next button.

Startup OS selection **dialog box**



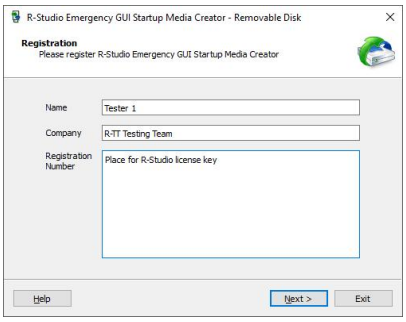
4 Read and accept the Activation terms on the R-Studio Emergency GUI Activation dialog box and click the Next button.

R-Studio Emergency GUI Activation **dialog box**



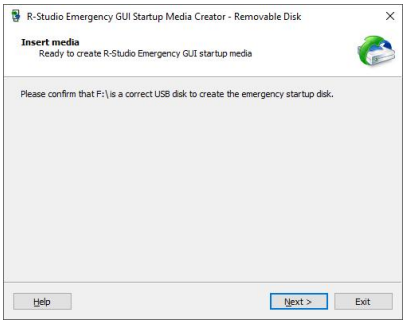
If you create startup disk for **R-Studio Emergency Technician**, you'll need to enter your license key on the Registration dialog box.

Registration **dialog box**



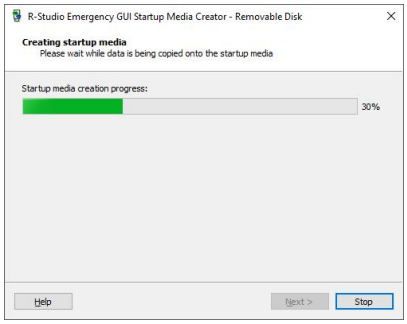
5 Specify the path and name for the ISO file or verify that you've select the correct USB device and click the Next button.

Insert media **dialog box**



> **R-Studio Emergency Startup Media Creator will start creating the startup USB disk showing the progress on the** Creating startup media **dialog box**

Creating startup media **dialog box**

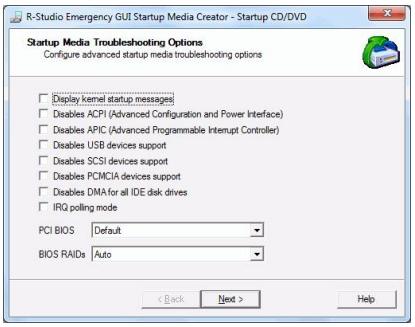


R-Studio Emergency Startup Media Creation is Finished **message**

Startup Media Troubleshooting Options

Those options will help you if you have problems with starting you computer up from the **R-Studio** startup disks. Please, contact the **R-Studio Technical Support Team** for more information.

R-Studio Startup Media Troubleshooting Options **dialog box**



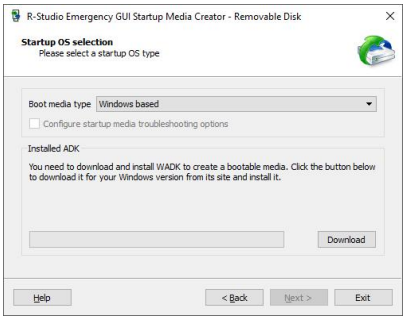
Display kernel startup messages	if this checkbox is enabled, **R-Studio** Emergency displays all startup messages. That may be useful to locate the source of the problem when your system hangs during **R-Studio** Emergency startup.
Disables ACPI Disables APIC	Select these checkboxes when your system detects some hardware incorrectly during **R-Studio** Emergency startup and displays messages like: `hda: lost interrupt`
Disables USB device support	Select this checkbox if your system experiences problems with USB devices during **R-Studio** Emergency startup.

Disables SCSI device support	Select this checkbox if your system experiences problems with SCSI devices during **R-Studio** Emergency startup.
Disables PCMCIA device support	Select this checkbox if your system experiences problems with PCMCIA devices during **R-Studio** Emergency startup.
Disables DMA for all IDE disk drives	Select this checkbox if your system experiences problems with IDE disks during **R-Studio** Emergency startup.
IRQ polling mode	Select this checkbox to enable the IRQ polling mode to prevent locking the system because a device generates too much interrupts for the system to handle.
PCI BIOS	Select an appropriate option if your system experiences problems with PCI cards.
BIOS RAIDS	Select an appropriate option if your system experiences problems with RAIDs built in the system board.

A WindowsPE-based disk

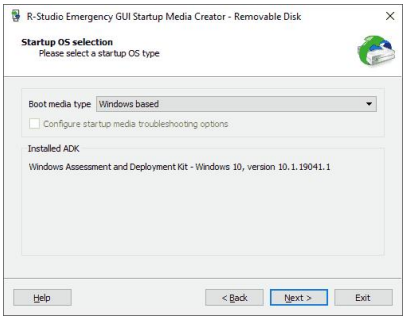
3 Select Windows based on the Startup OS selection and click the Next button.

Startup OS selection **dialog box**



If you select this option for the first time, you'll need to download and install some extra Windows components. Click the Download button and follow the on-screen instructions. When the process is finished, you'll be able to continue creating the startup disk.

Startup OS selection **dialog box**

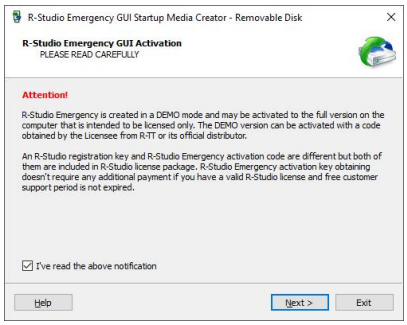


If you select this option for the first time, you'll need to download and install some extra Windows components. Click the Download button and follow the on-screen instructions.

You don't have to perform these steps next times.

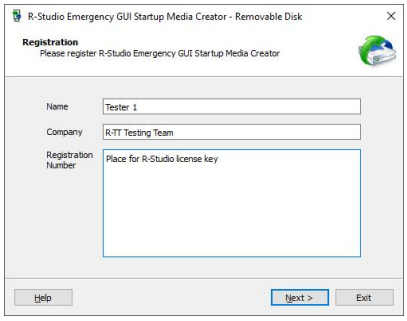
4 Read and accept the Activation terms on the R-Studio Emergency GUI Activation dialog box and click the Next button.

R-Studio Emergency GUI Activation **dialog box**



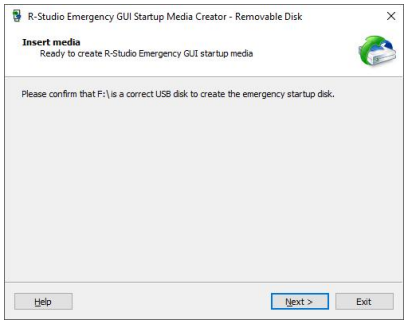
If you create startup disk for **R-Studio Emergency Technician**, you'll need to enter your license key on the Registration dialog box.

Registration **dialog box**



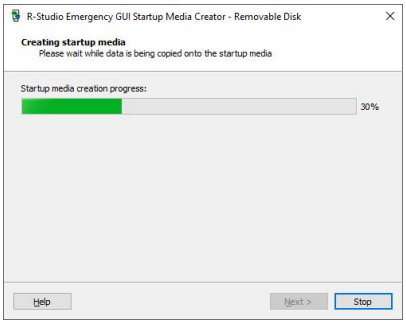
5 Specify the path and name for the ISO file or verify that you've select the correct USB device and click the Next button.

Insert media **dialog box**



> **R-Studio Emergency Startup Media Creator will start creating the startup USB disk showing the progress on the** Creating startup media **dialog box**

Creating startup media **dialog box**



R-Studio Emergency Startup Media Creation is Finished **message**

6.2.3 Creating Startup Disks on Mac and Linux Computers

To start a Mac or a Linux computer, you may use the following devices:

1. A USB device created using the R-Studio Emergency Startup Media Creator for Windows. See the **Creating Startup Disks Using R-Studio Emergency Startup Media Creator** page for more details.

2. A USB device created using a Mac or Linux computer. To create such device, download the ZIP archive of R-Studio Emergency, unzip it, and write files to a FAT32-formatted USB device.

Please note that you cannot use this disk to start non-UEFI computers (old Macs, for example), nor can you just copy those files to a CD/DVD disc to create an R-Studio Emergency startup disc. If you need a CD/DVD disk, burn it using the ISO image.

3. A startup CD/DVD disc. Download the ISO image of that disk and burn it or use the R-Studio Emergency Startup Media Creator for Windows to burn it on a Windows computer.

6.3 R-Studio Emergency Operation

Starting a Computer with the R-Studio Emergency Startup Disks
File Recovery
Searching for a File
Disk Scan
Disk Images

Using R-Studio Emergency as Emergency Agent

6.3.1 Starting a Computer with the R-Studio Emergency Startup Disks

We recommended that you print out this help page and have the hardcopy on hand while you are performing this action.

If there is a non-IDE disk controller in your system, or you plan to use network disks or external hardware devices, first check the Hardware Compatibility List.

If you plan to use any external device, turn it on before starting the system.

If the motherboard in your computer supports the Serial ATA (SATA) devices, but IDE disks are also present, only the SATA devices should be set to the Enhanced Mode in BIOS.

To start the computer with the R-Studio Emergency startup CD/DVD disc or any removable device,

1 **Make sure that the first startup device in the system BIOS is the CD/DVD drive or the removable device**

Disable "Secure boot" in the system BIOS if your computer is certified to run Windows 8. Refer to your system documentation for details.

2 **Insert the R-Studio Emergency startup CD/DVD disc and start your computer**

If you have a Mac computer

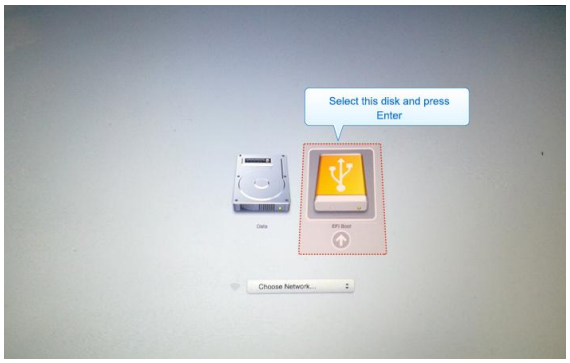
To start a Mac computer with the **R-Studio Emergency** startup disk,

1. Insert a CD/DVD disc or connect a USB disk
2. Switch the Mac on.
3. While loading, press the **Option** key on the Mac keyboard (the **Alt** key if you use a non-Apple keyboard).

The Options key

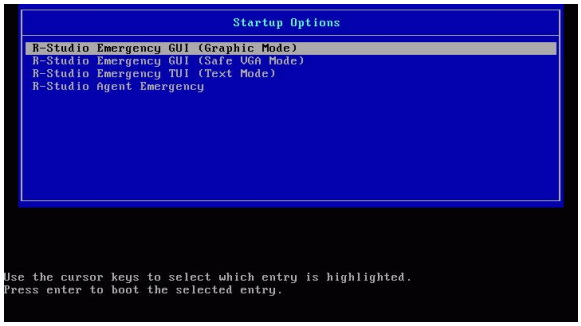
4. Select the **EFI boot** disk and press **Enter**.

The R-Studio Emergency startup disk



R-Studio Emergency will start loading.

Then a startup screen will appear:



Select the **R-Studio Emergency** GUI (Graphic Mode) to run **R-Studio Emergency** in the graphic mode in which its user interface is similar to the Windows version. If **R-Studio Emergency** cannot run in this mode, restart the system in the Safe VGA mode (only VESA-compliant) which is compatible with most video cards and monitors. If it fails too, select the Text mode in which the **R-Studio Emergency** user interface is shown in the pseudo-graphic mode compatible with all video cards. The help describes this pseudo-graphic mode.

> **R-Studio Emergency will start and its** Device / Disk **panel will appear**

To start the computer with the R-Studio Emergency startup floppy disks,

1 **Make sure that the first startup device in the system BIOS is A (Floppy)**
Refer to your system documentation for details.

2 **Insert the first startup floppy disk and start your computer**

> **The following text will appear on the screen:**

```
Loading
Uncompressing ... OK, starting the kernel
VFS: Insert the second boot disk and press ENTER
```

3 **Insert the second disk and press ENTER.**

> **R-Studio Emergency will start and its** Device / Disk **panel will appear**

Secure boot:

It may be impossible to start a Windows 8 certified computer with the R-Studio Emergency startup disk without some additional actions. This happens because any computer should use a so-called "Secure boot" procedure to comply with Windows 8 hardware certification from Microsoft. In brief, this procedure prevents computer from booting into any operating system that isn't digitally signed with an appropriate digital signature. "Secure boot" is claimed to prevent unauthorized modification of the boot sector by bootkits, viruses, trojans, and other malicious software. To the date, only Windows 8, Windows Server 2012, and selected Linux distributions support this feature. As a side effect, it also prevents most LiveCDs, rescue disks (R-Studio and R-Drive Image included), and other OS from running.

Likely enough, the other requirement of Windows 8 hardware certification is to make it possible for the user to disable the Secure boot procedure. Those settings can be done through the system BIOS under the Boot options. Generally, it's enough to enable Legacy support in those options, but sometimes it may require additional actions. Please, refer to your system documentation to learn more about disabling/enabling Secure boot.

When Secure boot is disabled, it should be possible to start the computer with the R-Studio Emergency startup disk.

Please note that you should enable this feature back after using the startup disks because Windows 8 or Server 2012 may not start properly without the Secure boot feature enabled.

6.3.2 File Recovery

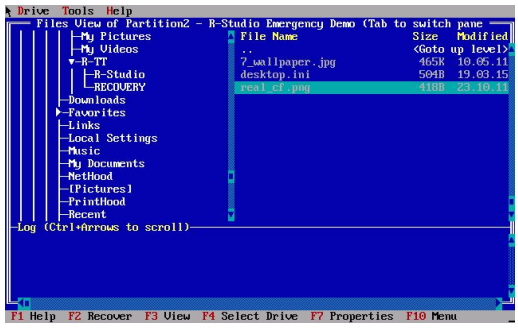
To recover files,

1 **Select a partition on the** Device / Disk **panel on which the files to recover reside and press the Enter key**

> **R-Studio will change its panel showing the disk's folders/files structure**

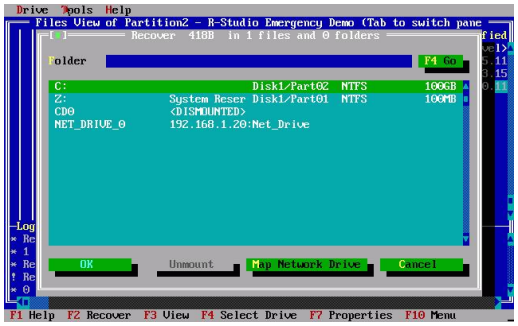
2 **Select the file to recover on the** Files View **panel. Use the** Tab **key to switch between panes**

Files View **panel**



3 Press the F2 key and specify the output folder on the Recover dialog box

Recover **dialog box**



External USB drives with the NTFS file system: **R-Studio Emergency** can save recovered files on such disks if they are properly disconnected in a Windows system using the **Safely Remove Hardware** icon in the system tray or while shutting Windows down.

[Searching for a File]
[Mapping Network Drives]
[Viewing object properties]

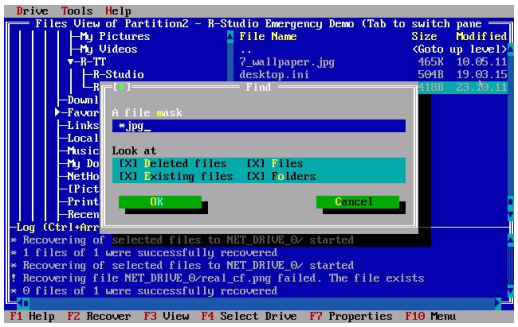
6.3.3 Searching for a File

To search for a file,

1 Select Find on the Tools menu (or press the Alt+F key)

2 Specify a file name or mask

Find **dialog box**



Look at dialog box

Deleted files:	If it is selected, **R-Studio** makes a search among deleted files/folders.

Existing files:	If it is selected, **R-Studio** makes a search among existing files/folders.
Files:	If it is selected, **R-Studio** includes files into a search.
Folders:	If it is selected, **R-Studio** includes folders into a search.

To find the next file corresponding to the specified file mask,

* **Press the Alt+N key**

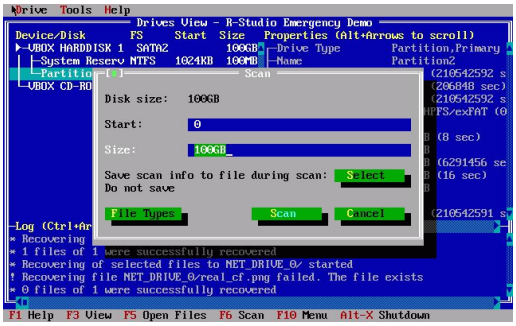
6.3.4 Disk Scan

To scan an object

1 **Select an object on the** Device / Disk **panel and press the F6 key**

2 **Specify the required parameters on the** Scan **dialog box and press the Enter key**

Scan **dialog box**

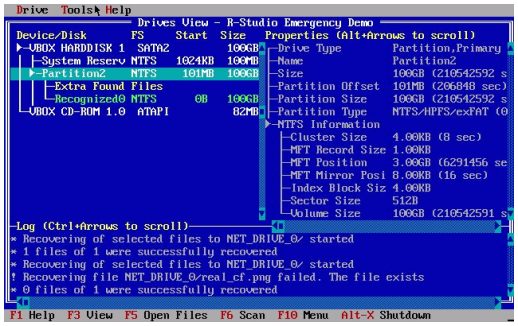


Scan dialog box

Start:	Sets the start point of the area to be scanned.
Size:	Sets the size of the area to be scanned.
Numbers in these fields can be in bytes or sectors. If no letters are after the numbers, **R-Studio**assumes the numbers in bytes. The following case-ignoring notation is possible:	
b	Bytes
kb	Kilobytes
mb	Megabytes
gb	Gigabytes
tb	Terabytes

> **When an object is scanned, it may be searched for files, and found files may be recovered the same way as for a regular object**

Scan **results**



Found objects:

Extra Found Files	Entries of known file types have been found
Recognized1	Records and file entries are found for this partition
Recognized2	Only file entries are found for this partition
Recognized3	Only boot records are found for this partition

To save scan information

1 **Select an object with scan information**

2 **Press the Alt+D key and select Save Scan Information on the Drive menu**

3 **Specify the output folder and file name on the** Save Scan Information **dialog box**

Mapping Network Drives

To open scan information

1 **Select an object to which scan information is to be opened**

2 **Press the Alt+D key and select Open Scan Information on the Drive menu**

3 **Specify the folder and file name with the scan information on the** Open Scan Information **dialog box**

Mapping Network Drives

To delete scan information

1 **Select an object to which scan information is to be deleted**

2 **Press the Alt+D key and select Delete Scan Information on the Drive menu**

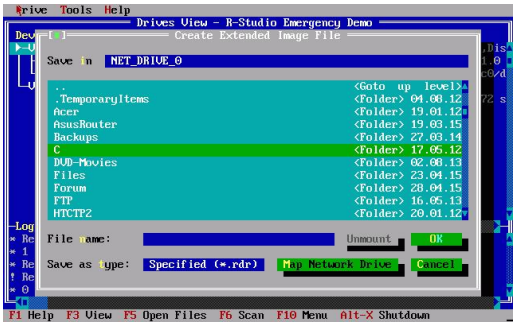
6.3.5 Disk Images

To create an image file

1 **Select an object on the** Device / Disk **panel**

2 **Press the Alt+D key and select Create Plain Image File or Create Compressed Image File on the Drive menu**

Create Image **dialog box**



Plain Image	If this option is selected, **R-Studio** will create a simple exact copy of the object. This image format is compatible with the previous versions of **R-Studio**.
Compressed Image	If this option is selected, **R-Studio** will create an image file compatible with the images created by **R-Drive Image**, but incompatible with the previous versions of **R-Studio**.

3 **Specify the output folder and file name on the** Create Image File **dialog box**

Mapping Network Drives

To load an image file

1 **Press the Alt+D key and select Open Image File on the Drive menu**

2 **Specify the folder and file name with the image on the** Open Image File **dialog box**

Mapping Network Drives

6.4 Using R-Studio Emergency as an Emergency Agent

R-Studio Emergency Linux version can be used as an emergency agent for **R-Studio**. Moreover, if you have a Mac computer, this is the only way to start it with **R-Studio Agent Emergency.**

To start the computer with the R-Studio Emergency/Agent startup CD/DVD disc or any removable device ,

1 **Make sure that the first startup device in the system BIOS is the CD/DVD drive or the removable device**

Disable "Secure boot" in the system BIOS if your computer is certified to run Windows 8. Refer to your system documentation for details.

2 **Insert the R-Studio Emergency startup CD/DVD disc or the removable device and start your computer**

If you have a Mac computer

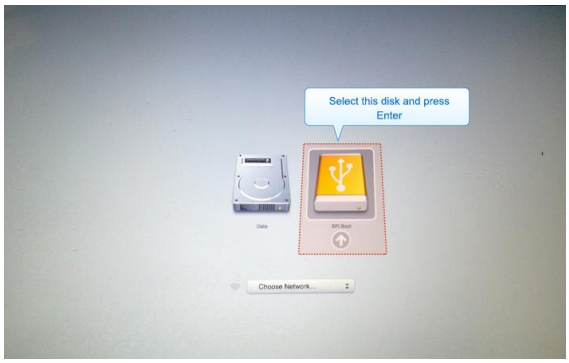
To start a Mac computer with the **R-Studio Emergency** startup disk,

1. Insert a CD/DVD disc or connect a USB disk
2. Switch the Mac on.
3. While loading, press the **Option** key on the Mac keyboard (the **Alt** key if you use a non-Apple keyboard).

The Options key

4. Select the **EFI boot** disk and press **Enter**.

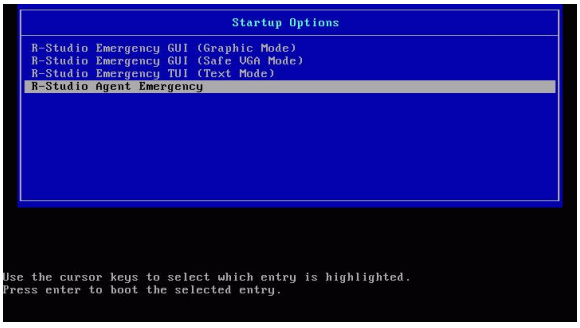
The R-Studio Emergency startup disk



R-Studio Emergency will start loading.

Then a startup screen will appear:

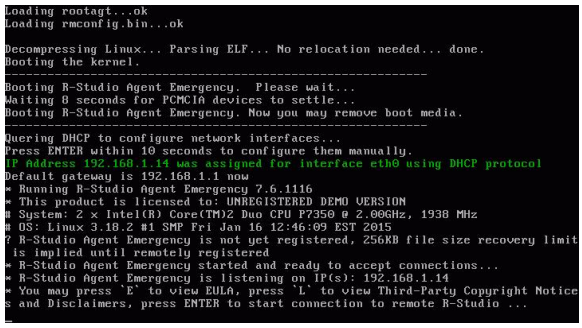
Startup Options



2 Select the R-Studio Agent Emergency to run R-Studio Emergency as an emergency agent.

> R-Studio Agent Emergency will start and its prompt will appear

R-Studio Emergency as an Emergency Agent



If your network has a DHCP server

The computer running R-Studio Agent Emergency will be assigned an IP address automatically

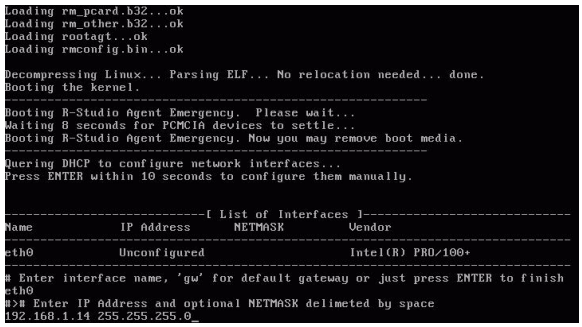
A prompt with a computer address will appear. You need to remember it to access the computer via network.

If your network does not have a DHCP server

You need to configure the interfaces and IP addresses manually.

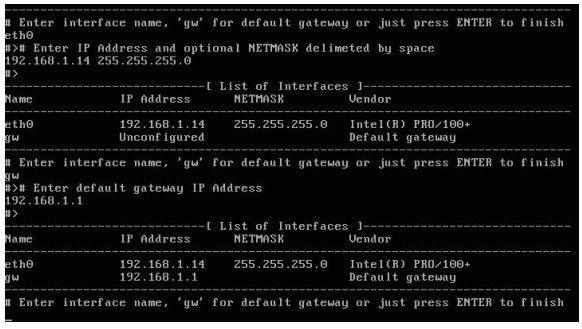
1. Press Enter to start configuring the settings. A prompt to select an interface will appear. Enter the selected interface name and press **Enter**.
2. A prompt to enter its IP address and optional subnet mask will appear. Enter the IP address and optional subnet mask and press **Enter**.

Network Setting Configuration



3. A prompt to configure another interface, gateway, or to finish configuring the interfaces will appear. Enter `gw`, enter the IP address of the gateway, and press **Enter**.

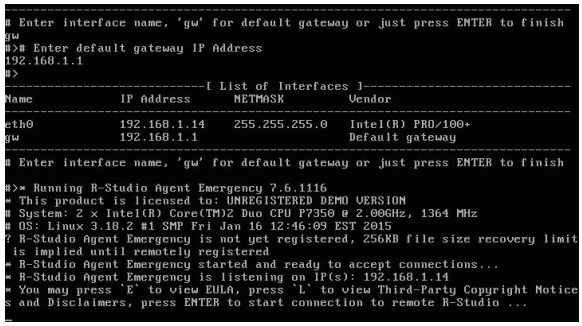
Network Setting Configuration



4. Press **Enter** to finish configuring the interfaces, or enter the name of the next interface to configure.

> **R-Studio Agent Emergency will show a prompt that is ready to accept connections**

R-Studio Emergency as an Emergency Agent



Now the computer may be accessed by **R-Studio** via network.

.

Secure boot:

It may be impossible to start a Windows 8 certified computer with the R-Studio Emergency startup disk without some additional actions. This happens because any computer should use a so-called "Secure boot" procedure to comply with Windows 8 hardware certification from Microsoft. In brief, this procedure prevents computer from booting into any operating system that isn't digitally signed with an appropriate digital signature. "Secure boot" is claimed to prevent unauthorized modification of the boot sector by bootkits, viruses, trojans, and other malicious software. To the date, only Windows 8, Windows Server 2012, and selected Linux distributions support this feature. As a side effect, it also prevents most LiveCDs, rescue disks (R-Studio and R-Drive Image included), and other OS from running.

Likely enough, the other requirement of Windows 8 hardware certification is to make it possible for the user to disable the Secure boot procedure. Those settings can be done through the system BIOS under the Boot options. Generally, it's enough to enable Legacy support in those options, but sometimes it may require additional actions. Please, refer to your system documentation to learn more about disabling/enabling Secure boot.

When Secure boot is disabled, it should be possible to start the computer with the R-Studio Emergency startup disk.

Please note that you should enable this feature back after using the startup disks because Windows 8 or Server 2012 may not start properly without the Secure boot feature enabled.

To connect to R-Studio's computer,

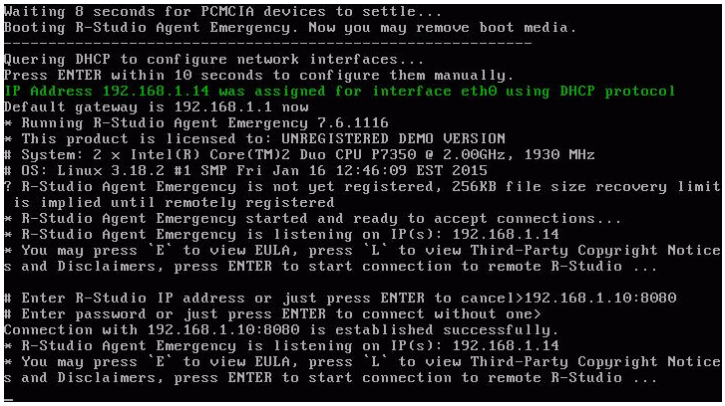
1 **Press the Enter key and enter the IP address of the computer where R-Studio is running as** `IPaddress:port`**.**

The default port is 8080, and you don't have to specify it.

2 Enter the password if required, and press the Enter key.

> When the connection is established successfully, **R-Studio Agent Emergency** will notify you about this.

R-Studio Emergency as an Emergency Agent



6.5 R-Studio Emergency Technical Information

6.5.1 Properties and Text/Hexadecimal Viewer

To view object properties,

1 Select an object

2 Press the F7 key

To view an object

1 **Select an object**

2 **Press the F3 key**

3 Press the **F6** key to view and select file attributes

Press the **Esc** key to close the viewer.

6.5.2 Network Drives

To map a network drive,

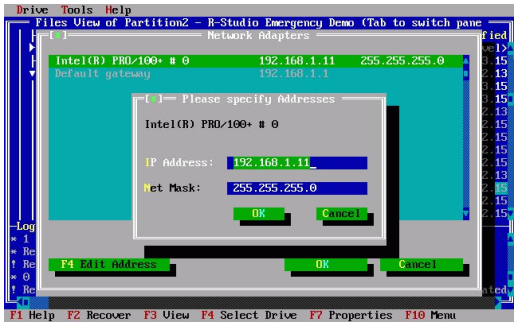
1 **On a dialog box with Map Network Drive, press the Alt+M key**

> **The** Querying DHCP **message will appear**

If the network has a DHCP server, the computer will obtain an IP address automatically. A list of adapters and their IP addresses will appear on the Network Adapters dialog box.

If the network does not have a DHCP server, select a network adapter on the Network Adapters dialog box and press the **F4** key. Enter the IP address and network mask and press the **Enter** button.

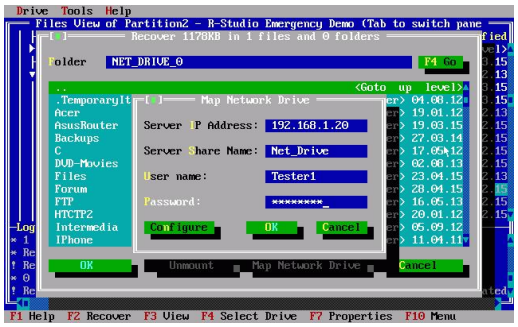
Network Addresses **dialog box**



2 **Select a configured network adapter and press the Enter key**

3 **Enter the required information on the** Map Network Drive **message message**

Map Network **dialog box**



Server IP Address:	IP address of the computer where the network drive is to reside.
Server Share Name:	Name of the shared folder where the network drive is to reside.
Login:	Username of a user on the computer where the network drive is to reside.
Password:	User's password on the computer where the network drive is to reside.

For the network drive's path `//SERVER/Net_Drive`,

Server IP address: The IP address of the SERVER computer (192.168.1.20)

Server share name: Net_Drive.

> The mounted network disk will appear

To disconnect a mounted network drive

1 Select a mounted network drive

2 Switch to the Disconnect button and press the Enter key

6.5.3 Log

To clear log information

*** Select Clear Log on the Tools menu**

To save log information to a file

*** Select Save Log To File on the Tools menu**

6.5.4 Devices to Store Recovered Files

R-Studio Emergency can write recovered files to the following devices:

- FAT devices such as USB sticks, memory cards, and other similar devices. Such devices are inexpensive and easily available, they can be fully accessed by all operating systems, but they have one important drawback: they cannot store files larger that 2GB. So, if you plan to recover large video files, this is not your option.

- exFAT devices such as large USB sticks and memory cards, external hard disks, and other similar devices. They are fully accessed by all operating systems. Unlike FAT devices, they don't have the 2GB file size limit.

- NTFS disks (primarily used in Windows computers).

Access without any third-party software:
Windows computers: full.
Mac computers: read.
Linux computers: full.

- HFS/HFS+ disks (used in Mac computers).

Access without any third-party software:
Windows computers: no.
Mac computers: full. Some access problems may appear for files written by **R-Studio Emergency**.
Linux computers: full. Some access problems may appear for files written by **R-Studio Emergency**.

- Ext2/3/4 disks (used in Linux computers).

Access without any third-party software:
Windows computers: no.
Mac computers: no
Linux computers: full.

- XFS disks (used in Linux computers).

Access without any third-party software:

Windows computers: no.

Mac computers: no

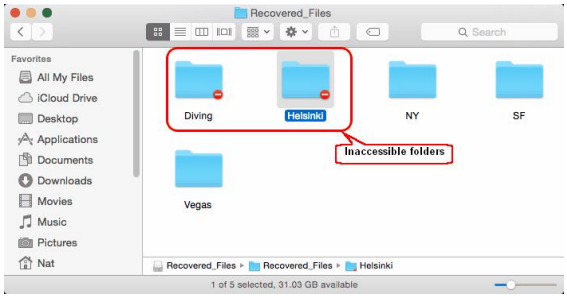
Linux computers: full.

- Network disks. Such disks may be on other network computers or NAS devices. See the **Network Drives** page for more details

How to solve file access problems on Macs

Finder in the OSX system shows such inaccessible folders and files in the following way:

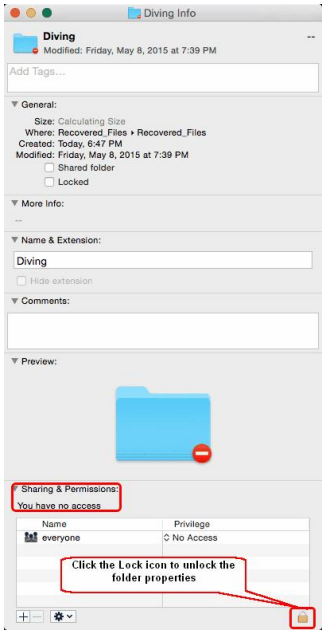
Inaccessible folders in Finder



To get access to such data, do the following:

1. Under an administrator account, right-click the folder and select **Get Info** on the contextual menu.

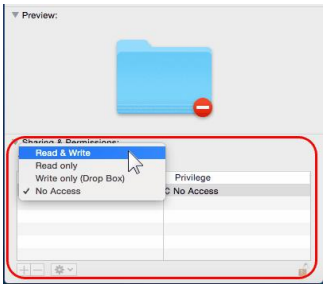
Info of an inaccessible folder



Click the **Lock** icon in the **Sharing & Permissions** section to unlock the folder properties. The system will ask you for the account password.

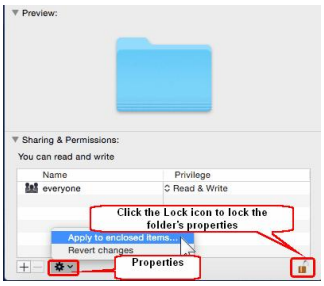
2. Click the **Privilege** column and select **Read & Write** on the contextual menu.

Setting the access rights for the folder



3. If this is a folder with other folders and files, click the **Properties** icon and select **Apply to enclosed items.**

Setting access rights for enclosed items in the folder



Then click the **Lock** icon to lock the properties back.

6.6 R-Studio Emergency Hardware Compatibility List

R-Studio Emergency supports the following hardware devices:

Data Storage Devices

Serial ATA and Parallel ATA drivers

ACPI firmware driver for PATA
AHCI SATA
ALi PATA
AMD/NVidia PATA
ARTOP 6210/6260 PATA
ARTOP/Acard ATP867X PATA
ATI PATA
CMD / Silicon Image 680 PATA
CMD640 PCI PATA
CMD64x PATA
CS5510/5520 PATA
CS5530 PATA
CS5535 PATA

Networking Devices

Ethernet (10 or 100Mbit)

3c501 `EtherLink`
3c503 `EtherLink II`
3c505 `EtherLink Plus`
3c507 `EtherLink 16`
3c509/3c529 (MCA)/3c579 `EtherLink III`
3c515 ISA `Fast EtherLink`
3c590/3c900 series (592/595/597) `Vortex/Boomerang`
3cr990 series `Typhoon`
AMD 8111 (new PCI lance)
AMD LANCE and PCnet (AT1500 and NE2100)
AMD PCnet32 PCI
AT1700/1720

CS5536 PATA
Compaq Triflex PATA
Cypress CY82C693 PATA
EFAR SLC90E66
Generic ATA
HPT 343/363 PATA
HPT 366/368 PATA
HPT 370/370A/371/372/374/302 PATA
HPT 372N/302N PATA
IT8211/2 PATA
IT8213 PATA
Initio 162x SATA
Intel ESB, ICH, PIIX3, PIIX4 PATA/SATA
Intel PATA MPIIX
Intel PATA old PIIX
Intel SCH PATA
JMicron PATA
Legacy ISA PATA
Marvell PATA support via legacy mode
Marvell SATA
NETCELL Revolution RAID
NVIDIA SATA
Nat Semi NS87410 PATA
Nat Semi NS87415 PATA
Ninja32/Delkin Cardbus ATA
OPTI FireStar PATA
OPTI621/6215 PATA
Older Promise PATA controller
PCMCIA PATA
Pacific Digital ADMA
Pacific Digital SATA QStor
Platform AHCI SATA
Promise PATA 2027x
Promise SATA SX4
Promise SATA TX2/TX4
QDI VLB PATA
RADISYS 82600 PATA
RDC PATA
SC1200 PATA
SERVERWORKS OSB4/CSB5/CSB6/HT1000 PATA

Adaptec Starfire/DuraLAN
Ansel Communications EISA 3200
Apricot Xen-II on board Ethernet
Atheros L2 Fast Ethernet
Broadcom 440x/47xx ethernet
CS89x0
Cabletron E21xx
DECchip Tulip (dc2114x) PCI
Dave ethernet support (DNET)
Davicom DM910x/DM980x
Early DECchip Tulip (dc2104x) PCI
EtherExpress 16
EtherExpressPro support/EtherExpress 10 (i82595)
Generic DECchip & DIGITAL EtherWORKS PCI/EISA
HP 10/100VG PCLAN (ISA, EISA, PCI)
HP PCLAN (27245 and other 27xxx series)
HP PCLAN+ (27247B and 27252A)
ICL EtherTeam 16i/32
Intel(R) PRO/100+
LP486E on board Ethernet
Myson MTD-8xx PCI Ethernet
NE2000/NE1000
NI5010
NI5210
NI6510
National Semiconductor DP8381x series PCI Ethernet
OpenCores 10/100 Mbps Ethernet MAC
PCI NE2000 and clones support (see help)
RDC R6040 Fast Ethernet Adapter
RealTek RTL-8129/8130/8139 PCI Fast Ethernet Adapter
RealTek RTL-8139 C+ PCI Fast Ethernet Adapter
SEEQ8005
SMC 9194
SMC EtherPower II
SMC Ultra
SMSC LAN9420 PCI ethernet adapter
SiS 900/7016 PCI Fast Ethernet Adapter
Silan SC92031 PCI Fast Ethernet Adapter driver

ServerWorks Frodo / Apple K2 SATA
SiS 964/965/966/180 SATA
SiS PATA
Silicon Image 3124/3132 SATA
Silicon Image SATA
ULi Electronics SATA
VIA PATA
VIA SATA
VITESSE VSC-7174 / INTEL 31244 SATA
Winbond SL82C105 PATA
Winbond W83759A VLB PATA

SCSI low-level drivers

3ware 5/6/7/8xxx ATA-RAID
3ware 97xx SAS/SATA-RAID
3ware 9xxx SATA-RAID
7000FASST SCSI
ACARD SCSI
ARECA (ARC11xx/12xx/13xx/16xx) SATA/SAS RAID Host Adapter
Adaptec AACRAID
Adaptec AHA152X/2825
Adaptec AHA1542
Adaptec AIC79xx U320
Adaptec AIC7xxx
Adaptec AIC7xxx Fast -> U160
Adaptec AIC94xx SAS/SATA
Adaptec I2O RAID
AdvanSys SCSI
Always IN2000 SCSI
BusLogic SCSI
DMX3191D SCSI
DTC3180/3280 SCSI
EATA ISA/EISA/PCI (DPT and generic EATA/DMA-compliant boards)
Emulex LightPulse Fibre Channel Support
Future Domain 16xx SCSI/AHA-2920A
Generic NCR5380/53c400 SCSI MMIO
Generic NCR5380/53c400 SCSI PIO
HP Smart Array SCSI driver
HighPoint RocketRAID 3xxx/4xxx Controller
Sun Cassini
Sun GEM
Sun Happy Meal 10/100baseT
Sundance Alta
TI ThunderLAN
ULi M526x controller
VIA Rhine
WD80*3
Winbond W89c840 Ethernet
Zenith Z-Note
nForce Ethernet

Ethernet (1000 Mbit)

Alteon AceNIC/3Com 3C985/NetGear GA620 Gigabit
Atheros L1C Gigabit Ethernet
Atheros L1E Gigabit Ethernet
Atheros/Attansic L1 Gigabit Ethernet
Broadcom CNIC
Broadcom NetXtremeII
Broadcom Tigon3
DL2000/TC902x-based Gigabit Ethernet
IP1000 Gigabit Ethernet
Intel(R) 82575/82576 PCI-Express Gigabit Ethernet
Intel(R) 82576 Virtual Function Ethernet
Intel(R) PRO/1000 Gigabit Ethernet
Intel(R) PRO/1000 PCI-Express Gigabit Ethernet
JMicron(R) PCI-Express Gigabit Ethernet
National Semiconductor DP83820
New SysKonnect GigaEthernet
Packet Engines Hamachi GNIC-II
Packet Engines Yellowfin Gigabit-NIC
QLogic QLA3XXX Network Driver Support
Realtek 8169 gigabit ethernet
SiS190/SiS191 gigabit ethernet
SysKonnect Yukon2
VIA Velocity

Ethernet (10000 Mbit)

Broadcom NetXtremeII 10Gb
Chelsio 10Gb Ethernet
Chelsio Communications T3 10Gb Ethernet

IBM Power Linux RAID adapter
IBM ServeRAID
Initio 9100U(W)
Initio INI-A100U2W
Intel/ICP (former GDT SCSI Disk Array) RAID Controller
LSI Logic Legacy MegaRAID Driver
LSI Logic Management Module
LSI Logic MegaRAID Driver
LSI Logic MegaRAID SAS RAID Module
LSI MPT Fusion SAS 2.0 Device Driver
Marvell 88SE64XX/88SE94XX SAS/SATA
NCR53c406a SCSI
PAS16 SCSI
PMC SIERRA Linux MaxRAID adapter
PMC-Sierra SPC 8001 SAS/SATA Based Host Adapter driver
Promise SuperTrak EX Series
QLogic ISP4XXX host adapter family
QLogic QLA2XXX Fibre Channel Support
Qlogic FAS SCSI
Qlogic QLA 1240/1x80/1x160 SCSI
SYM53C8XX Version 2 SCSI
Symbios 53c416 SCSI
Tekram DC390(T) and Am53/79C974 SCSI
Tekram DC395(U/UW/F) and DC315(U) SCSI
Trantor T128/T128F/T228 SCSI
UltraStor 14F/34F
UltraStor SCSI
VMware PVSCSI driver
Workbit NinjaSCSI-32Bi/UDE

USB support

Cypress C67x00 HCD
Datafab Compact Flash Reader
Freecom USB/ATAPI Bridge
ISD-200 USB/ATA Bridge
ISP 1760 HCD
ISP116X HCD
ISP1362 HCD
Lexar Jumpshot Compact Flash Reader
Chelsio Communications T4 Ethernet
Cisco VIC Ethernet NIC Support
Intel(R) 10GbE PCI Express adapters
Intel(R) PRO/10GbE
Mellanox Technologies 10Gbit Ethernet
Myricom Myri-10G Ethernet
NetXen Multi port (1/10) Gigabit Ethernet NIC
Neterion X3100 Series 10GbE PCIe Server Adapter
QLOGIC QLCNIC 1/10Gb Converged Ethernet NIC Support
QLogic QLGE 10Gb Ethernet Driver Support
S2IO 10Gbe XFrame NIC
ServerEngines' 10Gbps NIC - BladeEngine
Solarflare Solarstorm SFC4000/SFC9000-family
Sun Neptune 10Gbit Ethernet
Tehuti Networks 10G Ethernet

Token Ring driver support

3Com 3C359 Token Link Velocity XL adapter
Generic TMS380 PCI
Generic TMS380 Token Ring ISA/PCI adapter
IBM Lanstreamer chipset PCI adapter
IBM Olympic chipset PCI adapter
IBM Tropic chipset based adapter
Madge Smart 16/4 PCI Mk2
Proteon ISA
SMC ISA/MCA adapter
SysKonnect TR4/16 ISA

USB Network Adapters

ASIX AX88xxx Based USB 2.0 Ethernet Adapters
CDC EEM
CDC Ethernet support (smart devices such as cable modems)
Davicom DM9601 based USB 1.1 10/100 ethernet devices
GeneSys GL620USB-A based cables
Host for RNDIS and ActiveSync devices
MosChip MCS7830 based Ethernet adapters
NetChip 1080 based cables (Laplink, ...)
Prolific PL-2301/2302 based cables

OXU210HP HCD
Olympus MAUSB-10/Fuji DPC-R1
R8A66597 HCD
SL811HS HCD
SanDisk SDDR-09 (and other SmartMedia, including DPCM)
SanDisk SDDR-55 SmartMedia
USB 2.0
USB Mass Storage
USB Monitor
USBAT/USBAT02-based storage
xHCI HCD (USB 3.0)

Block devices

Compaq SMART2
Compaq Smart Array 5xxx
Mylex DAC960/DAC1100 PCI RAID Controller
Normal floppy disk
Promise SATA SX8

IEEE 1394 (FireWire) support

Legacy alternative FireWire driver stack
Storage devices (SBP-2 protocol)

PCMCIA network device support

3Com 3c574 PCMCIA
3Com 3c589 PCMCIA
Asix AX88190 PCMCIA
COM20020 ARCnet PCMCIA
Fujitsu FMV-J18x PCMCIA
NE2000 compatible PCMCIA
New Media PCMCIA
SMC 91Cxx PCMCIA
Xircom 16-bit PCMCIA

Other devices

Microsoft Hyper-V Utilities driver
Microsoft Hyper-V client drivers
Microsoft Hyper-V virtual block driver
Microsoft Hyper-V virtual network driver
Microsoft Hyper-V virtual storage driver
SMSC LAN95XX based USB 2.0 10/100 ethernet devices
Sharp Zaurus (stock ROMs) and compatible
Simple USB Network Links (CDC Ethernet subset)
USB CATC NetMate-based Ethernet device
USB KLSI KL5USB101-based ethernet device
USB Pegasus/Pegasus-II based ethernet device
USB RTL8150 based ethernet device

VII R-Studio Agent Emergency

R-Studio Agent Emergency is a tool that allows you to start a network computer with a damaged startup disk and recover data stored on its hard drives. Then restored data can be transferred to a working computer via the network.

It works very simple: Just start the computer with the **R-Studio Agent Emergency** startup disk(s) and, if necessary, manually configure a network interface for **R-Studio Agent Emergency**. When started, the computer and its hard drives can be accessed by **R-Studio** installed on another computer on the network.

7.1 Contact Information and Technical Support

To obtain the latest version of **R-Studio Agent Emergency**, go to:

Product Site: http://www.r-tt.com
Sales Department: sales@r-tt.com

R-Studio Technical Support Team is available 24 hours a day, seven days a week, and has an average response time less than 4 hours.

Tech. Support: support@r-tt.com
Send your support request to: http://www.r-tt.com/Support_request.html

7.2 Installing R-Studio Agent Emergency Startup Media Creator

You must have administrative privileges to install R-Studio Agent Emergency Startup Media Creator.

If you are not sure whether you have such privileges, you almost certainly do not have them. Contact your system administrator for assistance.

1. Run the setup file.
2. Follow the on-screen instructions.

You may create startup disks even before the installation ends.

7.3 Creating Startup Disks

You need to create either

- A startup CD/DVD disc. You may create an ISO image, or write the disc directly from **R-Studio** Emergency Startup Media Creator, if there is a CD/DVD recorder in your system.

  or

- A startup FAT/FAT32 removable device recognized by your system as a bootable one. The total available size of the device should be more than 10 MB.

  or

- 4 formatted floppy disks

Check the Hardware Compatibility List.

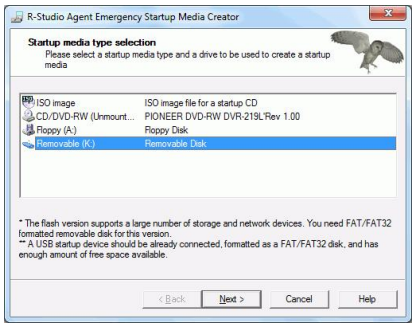
When **R-Studio Agent Emergency Startup Media Creator** starts, its Welcome dialog box appears:

Welcome to **R-Studio Agent** Emergency Startup Media Creator **dialog box**

Welcome **dialog box**

click the **Next** button to see the list of all devices on which startup disks may be created.

Startup media type selection **dialog box**

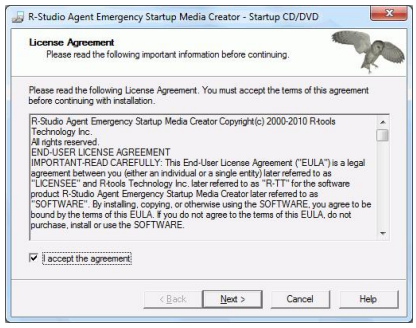


To create a startup CD/DVD disc directly on your CD/DVD writer (if present):

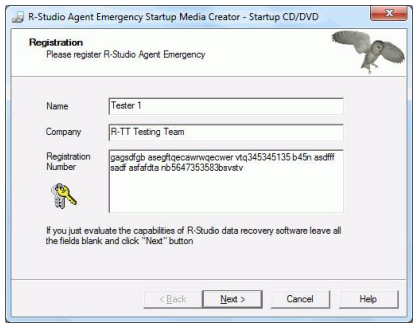
1. **Run R-Studio Agent Emergency**
2. **Select the CD/DVD writer on the** Startup media type selection **dialog box and click the Next button**
3. **Read and accept the License Agreement and enter the R-Studio Agent registration key on the R-Studio** Agent Emergency Activation **dialog box and click the Next button**

   Note: You should enter the registration key of **R-Studio Agent**, not **R-Studio** itself.

R-Studio Agent Emergency License Agreement **dialog box**



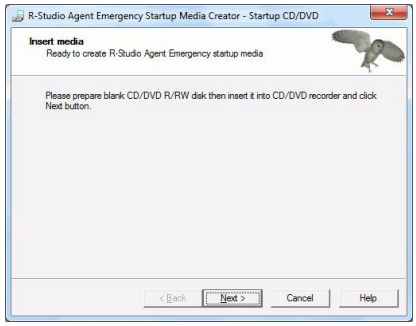
R-Studio Agent Emergency Activation **dialog box**



if you do not enter the registration key, **R-Studio Agent** Emergency will work in the Demo mode. You may enter the key later when **R-Studio Agent** Emergency and **R-Studio** establish a connection

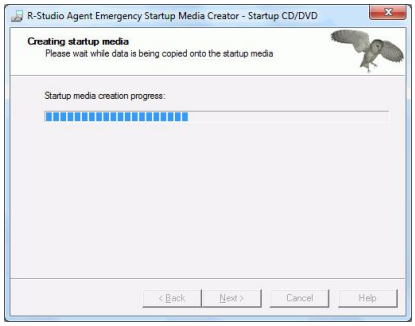
4 Insert a blank CD/DVD disk into the CD/DVD recorder and click the Next button

Insert media disc **dialog box**



> **R-Studio Agent Emergency Startup Media Creator will start creating the startup CD/DVD disc showing the progress on the** Creating startup media **dialog box**

Creating startup media **dialog box**



When R-Studio Agent Emergency Startup Media Creator finishes creating the startup CD/DVD disc, the R-Studio Agent Emergency Startup Media Creation is Finished **message will appear**

You may either exit **R-Studio Emergency Startup Media Creator** by clicking the **Finish** button or create another startup media by clicking the **Back** button.

R-Studio Agent Emergency Startup Media Creation is Finished **message**

To create an ISO image of a startup CD/DVD disc

1 **Run R-Studio Agent Emergency**

2 **Select ISO Image for a startup CD/DVD on the R-Studio** Agent Emergency Startup Media Creator **dialog box and click the Next button**

3 **Read and accept the License Agreement and enter the R-Studio Agent registration key on the R-Studio Agent** Emergency Activation **dialog box and click the Next button**

Note: You should enter the registration key of **R-Studio Agent**, not **R-Studio** itself.

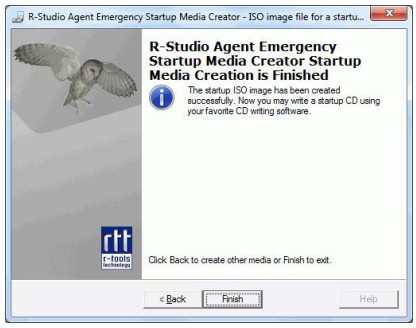
if you do not enter the registration key, **R-Studio Agent** Emergency will work in the Demo mode. You may enter the key later when **R-Studio Agent** Emergency and **R-Studio** establish a connection.

4 **Select a place and file name for the ISO image of the startup CD/DVD and click the Save button**

> **When R-Studio Bootable Startup Media Creator finishes writing the file with the ISO image, the R-Studio** Agent Emergency Startup Media Creation is Finished **message will appear**

You may either exit **R-Studio Bootable Startup Media Creator** by clicking the **Finish** button or create another startup media by clicking the **Back** button.

R-Studio Agent Emergency Startup Media Creation is Finished **dialog box**



5 **Create the startup CD/DVD using your favorite CD/DVD creation software**

Load the created ISO image into the CD/DVD creation software. Consult documentation for the software for details.

To create a startup FAT/FAT32 removable device

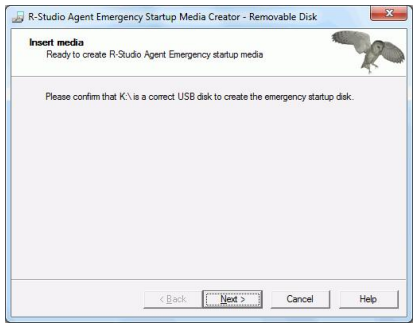
1 **Run R-Studio Agent Emergency**

2 **Select the removable device on the** Startup media type selection **dialog box and click the Next button**

3 **Read and accept the License Agreement and enter the registration key on the R-Studio Agent** Emergency Activation **dialog box and click the Next button**

4 **Check that the correct FAT/FAT32-formatted device is selected and click the Next button**

Confirm device selection **dialog box**

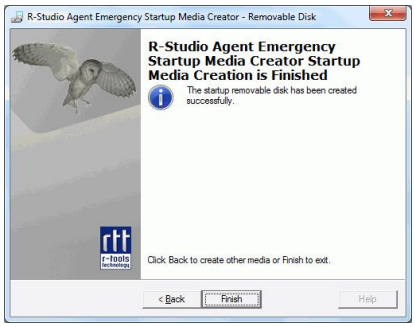


> **R-Studio Agent Emergency Startup Media Creator will start creating the startup USB disk showing the progress on the** Creating startup media **dialog box**

When R-Studio Agent Emergency Startup Media Creator finishes creating the startup device, the R-Studio Agent Emergency Startup Media Creation is Finished **message will appear**

You may either exit **R-Studio Emergency Startup Media Creator** by clicking the **Finish** button or create another startup media by clicking the **Back** button.

R-Studio Agent Emergency Startup Media Creation is Finished **dialog box**



To create floppy disks:

You will need 4 formatted floppy disks.

1 **Run R-Studio Agent Emergency**

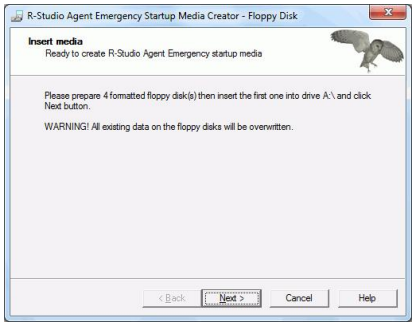
2 **Select Floppy Disk for the startup floppy disk on the R-Studio** Agent Emergency Startup Media Creator **dialog box and click the Next button**

3 **Enter the registration information and number on the** Registration **dialog box and click the Next button**

If you leave all the field blank, **R-Studio Agent Emergency** will work with the **Demo-version limitations**

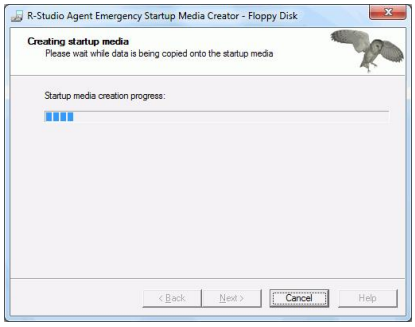
4 **Insert the floppy disk and click the Next button on the** Insert floppy **dialog box**

Insert floppy **dialog box**

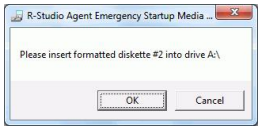


> **R-Studio Agent Emergency Startup Media Creator will start creating the startup floppy disk showing the progress on the** Creating startup media **dialog box**

Creating startup media **dialog box**



5 **Insert the second floppy disk and click the OK button when the** Please insert formatted diskette #2 into drive A: **message will appear**



Do it with the next 2 floppy disks.

> **When R-Studio Startup Media Creator finishes creating the startup floppy disk, the R-Studio** Agent Emergency Startup Media Creation is Finished **message will appear. You may either exit R-Studio Startup Media Creator by clicking the Finish button or create another startup media by clicking the Back button.**

R-Studio Agent Emergency Startup Media Creation is Finished **dialog box**

7.4 Starting a Computer with the R-Studio Agent Emergency Startup Disk

We recommended that you print out this help page and have the hardcopy on hand while you are performing this action.

Before you start the computer you should be aware that your network has a DHCP server or you know the computer's IP address and network mask.

If there is a non-IDE disk controller in your system, or you plan to use network disks or external hardware devices, first check the Hardware Compatibility List.

If you plan to use any external device, turn it on before starting the system.

If the motherboard in your computer supports the Serial ATA (SATA) devices, but IDE disks are also present, only the SATA devices should be set to the Enhanced Mode in BIOS.

To start the computer with the R-Studio Agent Emergency startup disks

1 **Make sure that the first startup device in the system BIOS is the device from which you plan to start your computer (a CD/DVD drive or A (Floppy))**

Disable "Secure boot" in the system BIOS if your computer is certified to run Windows 8. Refer to your system documentation for details. Refer to your system documentation for details.

2 **Insert the R-Studio Agent Emergency startup CD/DVD disc, a removable device, or the first floppy disk and start your computer**

> **R-Studio Agent Emergency will start and its prompt will appear**

If you start your computer with floppy disks, you'll see prompts to insert a next floppy disk.

```
  ----------------------------------------------------------------
  Booting R-Studio Emergency. Please wait...
```

```
Waiting 8 seconds for PCMCIA devices to settle
Booting R-Studio Agent Emergency. Now you may remove floppy.
------------------------------------------------------------------
Querying DHCP to configure network interfaces...
Press ENTER within 10 seconds to configure them manually.
```

If your network has a DHCP server

The computer running R-Studio Agent Emergency will be assigned an IP address automatically

A prompt with a computer address will appear. You need to remember it to access the computer via network.

If your network does not have a DHCP server

You need to configure the interfaces and IP addresses manually.

1. A prompt to select an interface will appear. Enter the selected interface name and press **Enter**.
2. A prompt to enter its IP address and optional subnet mask will appear. Enter the IP address and optional subnet mask and press **Enter**.

```
------------------------[ List of Interfaces ]--------------------------------
Name           IP Address            NETMASK            Vendor
------------------------------------------------------------------------------
re0            Unconfigured                             RealTek 8139C+
------------------------------------------------------------------------------
# Enter interface name, 'gw' for default gateway or just press ENTER to finish
#>re0
# Enter IP address and optional NETMASK delimited by space
#>192.168.0.10 255.255.255.0
```

3. A prompt to configure another interface, gateway, or to finish configuring the interfaces will appear. Enter `gw`, enter the IP address of the gateway, and press **Enter**.

```
------------------------[ List of Interfaces ]--------------------------------
Name           IP Address            NETMASK          Vendor
------------------------------------------------------------------------------
re0            Unconfigured                           RealTek 8139C+
------------------------------------------------------------------------------
# Enter interface name, 'gw' for default gateway or just press ENTER to finish
#>re0
# Enter IP address and optional NETMASK delimited by space
#>192.168.0.10 255.255.255.0

------------------------[ List of Interfaces ]--------------------------------
Name           IP Address            NETMASK            Vendor
------------------------------------------------------------------------------
re0            192.168.0.10          255.255.255.0      RealTek 8139C+
gw             Unconfigured                             Default gateway
------------------------------------------------------------------------------
# Enter interface name, 'gw' for default gateway or just press ENTER to finish
#>gw
# Enter default gateway IP Address
#>192.168.0.1

------------------------[ List of Interfaces ]--------------------------------
Name           IP Address            NETMASK            Vendor
------------------------------------------------------------------------------
re0            192.168.0.10          255.255.255.0      RealTek 8139C+
```

```
gw              192.168.0.1                                  Default gateway
-------------------------------------------------------------------------------
# Enter interface name, 'gw' for default gateway or just press ENTER to finish
#>
```

4. Press **Enter** to finish configuring the interfaces, or enter the name of the next interface to configure.

> **R-Studio Agent Emergency will show a prompt that is ready to accept connections**

```
* R-Studio Agent started and ready to accept connections...
* You may press ENTER to start to remote R-Studio...
```

Now the computer may be accessed by **R-Studio** via network.

Secure boot:

It may be impossible to start a Windows 8 certified computer with the R-Studio Agent Emergency startup disk without some additional actions. This happens because any computer should use a so-called "Secure boot" procedure to comply with Windows 8 hardware certification from Microsoft. In brief, this procedure prevents computer from booting into any operating system that isn't digitally signed with an appropriate digital signature. "Secure boot" is claimed to prevent unauthorized modification of the boot sector by bootkits, viruses, trojans, and other malicious software. To the date, only Windows 8, Windows Server 2012, and selected Linux distributions support this feature. As a side effect, it also prevents most LiveCDs, rescue disks (R-Studio and R-Drive Image included), and other OS from running.

Likely enough, the other requirement of Windows 8 hardware certification is to make it possible for the user to disable the Secure boot procedure. Those settings can be done through the system BIOS under the Boot options. Generally, it's enough to enable Legacy support in those options, but sometimes it may require additional actions. Please, refer to your system documentation to learn more about disabling/enabling Secure boot.

When Secure boot is disabled, it should be possible to start the computer with the R-Studio Agent Emergency startup disk.

Please note that you should enable this feature back after using the startup disks because Windows 8 or Server 2012 may not start properly without the Secure boot feature enabled.

Starting a Connection from R-Studio Agent Emergency

When you need to connect **R-Studio** and **R-Studio Agent Emergency** over the Internet, it may be necessary to start the connection from the computer where **R-Studio Agent Emergency** is running.

To connect to R-Studio's computer,

1 **Press the Enter key and enter the IP address of the computer where R-Studio is running as** `IPaddress:port`**.**

```
* R-Studio Agent started and ready to accept connections...
* You may press ENTER to start connection to remote R-Studio...
# Enter R-Studio IP address or just press ENTER to cancel> 192.168.0.25:80
```

The default port is 8080, and you don't have to specify it.

2 **Enter the password if required, and press the Enter key.**

```
* R-Studio Agent started and ready to accept connections...
* You may press ENTER to start connection to remote R-Studio...
# Enter R-Studio IP address or just press ENTER to cancel> 192.168.0.25:80
# Enter password or just press ENTER to connect without one>PaSsWoRd1234
```

> **When the connection is established successfully, R-Studio Agent Emergency will notify you about this.**

```
* R-Studio Agent started and ready to accept connections...
```

```
 * You may press ENTER to start connection to remote R-Studio...
# Enter R-Studio IP address or just press ENTER to cancel> 192.168.0.25:80
# Enter password or just press ENTER to connect without one>PaSsWoRd1234
Connection with 192.168.0.25:80 is established successfully.
```

7.5 R-Studio Agent Emergency Hardware Compatibility List

7.5.1 Disk Controllers

R-Studio Agent Emergency is based on the **FreeBSD 5.3** kernel and supports devices from the list published at http://www.freebsd.org/releases/5.3R/hardware-i386.html.

*: Supported in the floppy version

Disk controllers

IDE/ATA controllers (ata driver) *

The adapters supported by the aic driver include:

Adaptec AHA-1505 (ISA)
Adaptec AHA-1510A, AHA-1510B (ISA)
Adaptec AHA-1520A, AHA-1520B (ISA)
Adaptec AHA-1522A, AHA-1522B (ISA)
Adaptec AHA-1535 (ISA)
Creative Labs SoundBlaster SCSI host adapter (ISA)
Adaptec AHA-1460, AHA-1460B, AHA-1460C, AHA-1460D (PC Card)
Adaptec AHA-1030B, AHA-1030P (PC98)
NEC PC-9801-100 (PC98)

The aha driver supports the following SCSI host adapters:

Adaptec AHA-154xB
Adaptec AHA-154xC
Adaptec AHA-154xCF
Adaptec AHA-154xCP
Adaptec AHA-1640
Adaptec AHA-174x in 154x emulation mode
DTC 3290 SCSI controller in 1542 emulation mode
Tekram SCSI controllers in 154x emulation mode

The ahb driver supports the following SCSI host adapters:

Adaptec AHA-1740
Adaptec AHA-1742
Adaptec AHA-1740A

Adaptec AHA-1742A

The ahc driver supports the following SCSI host adapter chips and SCSI controller cards:

Adaptec AIC7770 host adapter chip
Adaptec AIC7850 host adapter chip
Adaptec AIC7860 host adapter chip
Adaptec AIC7870 host adapter chip
Adaptec AIC7880 host adapter chip
Adaptec AIC7890 host adapter chip
Adaptec AIC7891 host adapter chip
Adaptec AIC7892 host adapter chip
Adaptec AIC7895 host adapter chip
Adaptec AIC7896 host adapter chip
Adaptec AIC7897 host adapter chip
Adaptec AIC7899 host adapter chip
Adaptec 274X(W)
Adaptec 274X(T)
Adaptec 284X
Adaptec 2910
Adaptec 2915
Adaptec 2920
Adaptec 2930C
Adaptec 2930U2
Adaptec 2940
Adaptec 2940J
Adaptec 2940N
Adaptec 2940U
Adaptec 2940AU
Adaptec 2940UW
Adaptec 2940UW Dual
Adaptec 2940UW Pro
Adaptec 2940U2W
Adaptec 2940U2B
Adaptec 2950U2W
Adaptec 2950U2B
Adaptec 19160B
Adaptec 29160B
Adaptec 29160N
Adaptec 3940
Adaptec 3940U
Adaptec 3940AU
Adaptec 3940UW
Adaptec 3940AUW
Adaptec 3940U2W
Adaptec 3950U2
Adaptec 3960

Adaptec 39160
Adaptec 3985
Adaptec 4944UW
NEC PC-9821Xt13 (PC-98)
NEC RvII26 (PC-98)
NEC PC-9821X-B02L/B09 (PC-98)
NEC SV-98/2-B03 (PC-98)
Many motherboards with on-board SCSI support

The ahd driver supports the following:

Adaptec AIC7901 host adapter chip
Adaptec AIC7901A host adapter chip
Adaptec AIC7902 host adapter chip
Adaptec 29320 host adapter
Adaptec 39320 host adapter
Many motherboards with on-board SCSI support

Controllers supported by the aac driver include:

Adaptec AAC-364
Adaptec SCSI RAID 2120S
Adaptec SCSI RAID 2130S
Adaptec SCSI RAID 2200S
Adaptec SCSI RAID 2410SA
Adaptec SCSI RAID 2810SA
Adaptec SCSI RAID 5400S
Dell CERC SATA RAID 2
Dell PERC 2/Si
Dell PERC 2/QC
Dell PERC 3/Si
Dell PERC 3/Di
Dell PERC 320/DC
HP NetRAID 4M

The adv driver supports the following SCSI controllers:

AdvanSys ABP510/5150
AdvanSys ABP5140
AdvanSys ABP5142
AdvanSys ABP902/3902
AdvanSys ABP3905
AdvanSys ABP915
AdvanSys ABP920
AdvanSys ABP3922
AdvanSys ABP3925
AdvanSys ABP930, ABP930U, ABP930UA
AdvanSys ABP960, ABP960U
AdvanSys ABP542
AdvanSys ABP742
AdvanSys ABP842

AdvanSys ABP940
AdvanSys ABP940UA/3940UA
AdvanSys ABP940U
AdvanSys ABP3960UA
AdvanSys ABP970, ABP970U
AdvanSys ABP752
AdvanSys ABP852
AdvanSys ABP950
AdvanSys ABP980, ABP980U
AdvanSys ABP980UA/3980UA
MELCO IFC-USP (PC-98)
RATOC REX-PCI30 (PC-98)
@Nifty FNECHARD IFC-USUP-TX (PC-98)

The adw driver supports SCSI controllers including:

AdvanSys ABP940UW/ABP3940UW
AdvanSys ABP950UW
AdvanSys ABP970UW
AdvanSys ABP3940U2W
AdvanSys ABP3950U2W

The bt driver supports the following BusLogic MultiMaster ``W'', ``C'', ``S'', and ``A'' series and compatible SCSI host adapters:

BusLogic BT-445C
BusLogic BT-445S
BusLogic BT-540CF
BusLogic BT-542B
BusLogic BT-542B
BusLogic BT-542D
BusLogic BT-545C
BusLogic BT-545S
BusLogic/BusTek BT-640
BusLogic BT-742A
BusLogic BT-742A
BusLogic BT-747C
BusLogic BT-747D
BusLogic BT-747S
BusLogic BT-757C
BusLogic BT-757CD
BusLogic BT-757D
BusLogic BT-757S
BusLogic BT-946C
BusLogic BT-948
BusLogic BT-956C
BusLogic BT-956CD
BusLogic BT-958
BusLogic BT-958D

Storage Dimensions SDC3211B / SDC3211F
AMI FastDisk Host Adapters that are true BusLogic MultiMaster clones are also supported by the bt driver.

The dpt driver provides support for the following RAID adapters:

DPT Smart Cache Plus
Smart Cache II (PM2?2?, PM2022 [EISA], PM2024/PM2124 [PCI]) (Gen2)
Smart RAID II (PM3?2?, PM3021, PM3222)
Smart Cache III (PM2?3?)
Smart RAID III (PM3?3?, PM3332 [EISA], PM3334UW [PCI]) (Gen3)
Smart Cache IV (PM2?4?, PM2042 [EISA], PM2044/PM2144 [PCI]) (Gen4)
Smart RAID IV

The adapters currently supported by the asr driver include the following:

Adaptec Zero-Channel SCSI RAID 2000S, 2005S, 2010S, 2015S
Adaptec SCSI RAID 2100S, 2110S
Adaptec ATA-100 RAID 2400A
Adaptec SCSI RAID 3200S, 3210S
Adaptec SCSI RAID 3400S, 3410S
Adaptec SmartRAID PM1554
Adaptec SmartRAID PM1564
Adaptec SmartRAID PM2554
Adaptec SmartRAID PM2564
Adaptec SmartRAID PM2664
Adaptec SmartRAID PM2754
Adaptec SmartRAID PM2865
Adaptec SmartRAID PM3754
Adaptec SmartRAID PM3755U2B / SmartRAID V Millennium
Adaptec SmartRAID PM3757
DEC KZPCC-AC (LVD 1-ch, 4MB or 16MB cache), DEC KZPCC-CE (LVD 3-ch, 64MB cache), DEC KZPCC-XC (LVD 1-ch, 16MB cache), DEC KZPCC-XE (LVD 3-ch, 64MB cache) -- rebadged SmartRAID V Millennium

The amr driver supports the following:

AMI MegaRAID 320-1
AMI MegaRAID 320-2
AMI MegaRAID 320-4X
AMI MegaRAID Series 418
AMI MegaRAID Enterprise 1200 (Series 428)
AMI MegaRAID Enterprise 1300 (Series 434)
AMI MegaRAID Enterprise 1400 (Series 438)
AMI MegaRAID Enterprise 1500 (Series 467)
AMI MegaRAID Enterprise 1600 (Series 471)
AMI MegaRAID Elite 1500 (Series 467)
AMI MegaRAID Elite 1600 (Series 493)
AMI MegaRAID Elite 1650 (Series 4xx)
AMI MegaRAID Express 100 (Series 466WS)
AMI MegaRAID Express 200 (Series 466)
AMI MegaRAID Express 300 (Series 490)

AMI MegaRAID Express 500 (Series 475)
Dell PERC
Dell PERC 2/SC
Dell PERC 2/DC
Dell PERC 3/DCL
Dell PERC 3/QC
Dell PERC 4/Di
HP NetRAID-1/Si
HP NetRAID-3/Si (D4943A)
HP Embedded NetRAID

Note: Booting from these controllers is supported. EISA adapters are not supported.

Controllers supported by the mlx driver include:

Mylex DAC960P
Mylex DAC960PD / DEC KZPSC (Fast Wide)
Mylex DAC960PDU
Mylex DAC960PL
Mylex DAC960PJ
Mylex DAC960PG
Mylex DAC960PU / DEC PZPAC (Ultra Wide)
Mylex AcceleRAID 150 (DAC960PRL)
Mylex AcceleRAID 250 (DAC960PTL1)
Mylex eXtremeRAID 1100 (DAC1164P)
RAIDarray 230 controllers, aka the Ultra-SCSI DEC KZPAC-AA (1-ch, 4MB cache), KZPAC-CA (3-ch, 4MB), KZPAC-CB (3-ch, 8MB cache)
All major firmware revisions (2.x, 3.x, 4.x and 5.x) are supported, however it is always advisable to upgrade to the most recent firmware available for the controller. Compatible Mylex controllers not listed should work, but have not been verified.

Note: Booting from these controllers is supported. EISA adapters are not supported.

Controllers supported by the mly driver include:

Mylex AcceleRAID 160
Mylex AcceleRAID 170
Mylex AcceleRAID 352
Mylex eXtremeRAID 2000
Mylex eXtremeRAID 3000
Compatible Mylex controllers not listed should work, but have not been verified.

The twe driver supports the following ATA RAID controllers:

AMCC's 3ware 5000 series
AMCC's 3ware 6000 series
AMCC's 3ware 7000-2
AMCC's 3ware 7006-2
AMCC's 3ware 7500-4LP
AMCC's 3ware 7500-8
AMCC's 3ware 7500-12
AMCC's 3ware 7506-4LP
AMCC's 3ware 7506-8

AMCC's 3ware 7506-12
AMCC's 3ware 8006-2LP
AMCC's 3ware 8500-4LP
AMCC's 3ware 8500-8
AMCC's 3ware 8500-12
AMCC's 3ware 8506-4LP
AMCC's 3ware 8506-8
AMCC's 3ware 8506-8MI
AMCC's 3ware 8506-12
AMCC's 3ware 8506-12MI

The twa driver supports the following PATA/SATA RAID controllers:

AMCC's 3ware 9500S-4LP
AMCC's 3ware 9500S-8
AMCC's 3ware 9500S-8MI
AMCC's 3ware 9500S-12
AMCC's 3ware 9500S-12MI

The ncr driver provides support for the following NCR/Symbios SCSI controller chips:

53C810
53C810A
53C815
53C820
53C825A
53C860
53C875
53C875J
53C885
53C895
53C895A
53C896
53C1510D

The following add-on boards are known to be supported:

I-O DATA SC-98/PCI (PC-98)
I-O DATA SC-PCI (PC-98)

The sym driver provides support for the following Symbios/LSI Logic PCI SCSI controllers:

53C810
53C810A
53C815
53C825
53C825A
53C860
53C875
53C876
53C895
53C895A

53C896
53C897
53C1000
53C1000R
53C1010-33
53C1010-66
53C1510D

The SCSI controllers supported by sym can be either embedded on a motherboard, or on one of the following add-on boards:

ASUS SC-200, SC-896
Data Technology DTC3130 (all variants)
DawiControl DC2976UW
Diamond FirePort (all)
I-O DATA SC-UPCI (PC-98)
Logitec LHA-521UA (PC-98)
NCR cards (all)
Symbios cards (all)
Tekram DC390W, 390U, 390F, 390U2B, 390U2W, 390U3D, and 390U3W
Tyan S1365

The following devices are currently supported by the ncv driver:

I-O DATA PCSC-DV
KME KXLC002 (TAXAN ICD-400PN, etc.), KXLC004, and UJDCD450
Macnica Miracle SCSI-II mPS110
Media Intelligent MSC-110, MSC-200
NEC PC-9801N-J03R
New Media Corporation BASICS SCSI
Qlogic Fast SCSI
RATOC REX-9530, REX-5572 (SCSI only)

Controllers supported by the stg driver include:

Adaptec 2920/A
Future Domain SCSI2GO
Future Domain TMC-18XX/3260
IBM SCSI PCMCIA Card
ICM PSC-2401 SCSI
MELCO IFC-SC
RATOC REX-5536, REX-5536AM, REX-5536M, REX-9836A
Note that the Adaptec 2920C is supported by the **ahc** driver.

Cards supported by the isp driver include:

ISP1000
PTI SBS440
ISP1020
ISP1040
PTI SBS450
Qlogic 1240
Qlogic 1020

Qlogic 1040
Qlogic 1080
Qlogic 1280
Qlogic 12160
Qlogic 2100
Qlogic 2102
Qlogic 2200
Qlogic 2202
Qlogic 2204
Qlogic 2300
Qlogic 2312
PTI SBS470
Antares P-0033

Controllers supported by the amd driver include:

MELCO IFC-DP (PC-98)
Tekram DC390
Tekram DC390T

Controllers supported by the nsp driver include:

Alpha-Data AD-PCS201
I-O DATA CBSC16
Adaptec AIC-7110 Parallel to SCSI interfaces (**vpo** driver)

The following controllers are supported by the ida driver:

Compaq SMART Array 221
Compaq Integrated SMART Array Controller
Compaq SMART Array 4200
Compaq SMART Array 4250ES
Compaq SMART 3200 Controller
Compaq SMART 3100ES Controller
Compaq SMART-2/DH Controller
Compaq SMART-2/SL Controller
Compaq SMART-2/P Controller
Compaq SMART-2/E Controller
Compaq SMART Controller

Controllers supported by the ciss driver include:

Compaq Smart Array 5300
Compaq Smart Array 532
Compaq Smart Array 5i
HP Smart Array 5312
HP Smart Array 6i
HP Smart Array 641
HP Smart Array 642
HP Smart Array 6400
HP Smart Array 6400 EM
HP Smart Array 6422

HP Smart Array V100
HP Modular Smart Array 20 (MSA20)
HP Modular Smart Array 500 (MSA500)

Controllers supported by the iir driver include:

Intel RAID Controller SRCMR
Intel Server RAID Controller U3-l (SRCU31a)
Intel Server RAID Controller U3-1L (SRCU31La)
Intel Server RAID Controller U3-2 (SRCU32)
All past and future releases of Intel and ICP RAID Controllers.
Intel RAID Controller SRCU21 (discontinued)
Intel RAID Controller SRCU31 (older revision, not compatible)
Intel RAID Controller SRCU31L (older revision, not compatible)
The SRCU31 and SRCU31L can be updated via a firmware update available from Intel.
Promise SuperTrak ATA RAID controllers (pst driver)

The hptmv driver supports the HighPoint RocketRAID 182x SATA controllers.

Controllers supported by the ips driver include:

IBM ServeRAID 3H
ServeRAID 4L/4M/4H
ServeRAID Series 5
ServeRAID 6i/6M

The following controllers are supported by the mpt driver:

LSI Logic 53c1030 (Dual Ultra320 SCSI)
LSI Logic FC909 (1Gb/s Fibre Channel)
LSI Logic FC909A (Dual 1Gb/s Fibre Channel)
LSI Logic FC919 (2Gb/s Fibre Channel)
LSI Logic FC929 (Dual 2Gb/s Fibre Channel)
The SCSI controller chips supprted by the **mpt** driver can be found onboard on many systems including:
Dell PowerEdge 1750
IBM eServer xSeries 335

SCSI controllers supported by the trm driver include:

Tekram DC-315 PCI Ultra SCSI adapter without BIOS and internal SCSI connector
Tekram DC-315U PCI Ultra SCSI adapter without BIOS
Tekram DC-395F PCI Ultra-Wide SCSI adapter with flash BIOS and 68-pin external SCSI connector
Tekram DC-395U PCI Ultra SCSI adapter with flash BIOS
Tekram DC-395UW PCI Ultra-Wide SCSI adapter with flash BIOS
Tekram DC-395U2W PCI Ultra2-Wide SCSI adapter with flash BIOS
For the Tekram DC-310/U and DC-390F/U/UW/U2B/U2W/U3W PCI SCSI host adapters, use the **sym** driver.

The wds driver supports the WD7000 SCSI controller.

7.5.2 Network Cards

R-Studio Agent Emergency is based on the **FreeBSD 5.3** kernel and supports devices from the list published at http://www.freebsd.org/releases/5.3R/hardware-i386.html.

*: Supported in the floppy version

Ethernet NICs

Adapters supported by the sf driver include:

ANA-62011 64-bit single port 10/100baseTX adapter
ANA-62022 64-bit dual port 10/100baseTX adapter
ANA-62044 64-bit quad port 10/100baseTX adapter
ANA-69011 32-bit single port 10/100baseTX adapter
ANA-62020 64-bit single port 100baseFX adapter

The ti driver supports Gigabit Ethernet adapters based on the Alteon Tigon I and II chips. The ti driver has been tested with the following adapters:

3Com 3c985-SX Gigabit Ethernet adapter (Tigon 1)
3Com 3c985B-SX Gigabit Ethernet adapter (Tigon 2)
Alteon AceNIC V Gigabit Ethernet adapter (1000baseSX)
Alteon AceNIC V Gigabit Ethernet adapter (1000baseT)
Digital EtherWORKS 1000SX PCI Gigabit adapter
Netgear GA620 Gigabit Ethernet adapter (1000baseSX)
Netgear GA620T Gigabit Ethernet adapter (1000baseT)

The following adapters should also be supported but have not yet been tested:

Asante GigaNIX1000T Gigabit Ethernet adapter
Asante PCI 1000BASE-SX Gigabit Ethernet adapter
Farallon PN9000SX Gigabit Ethernet adapter
NEC Gigabit Ethernet
Silicon Graphics PCI Gigabit Ethernet adapter

The pcn driver supports adapters and embedded controllers based on the AMD PCnet/FAST, PCnet/FAST+, PCnet/FAST III, PCnet/PRO and PCnet/Home Fast Ethernet chips:

AMD Am53C974/Am79C970/Am79C974 PCnet-PCI *
AMD Am79C970A PCnet-PCI II *
AMD Am79C971 PCnet-FAST *
AMD Am79C972 PCnet-FAST+ *
AMD Am79C973/Am79C975 PCnet-FAST III *
AMD Am79C976 PCnet-PRO *
AMD PCnet/Home HomePNA
Allied-Telesis LA-PCI
Contec C-NET(98)S (PC-98)
NEC SV-98/2-B05, B06

The lnc driver supports the following adapters:

Novell NE2100 *
Novell NE32-VL *
Isolan AT 4141-0 (16 bit)
Isolan BICC
Isolink 4110 (8 bit)
Diamond HomeFree
Digital DEPCA
Hewlett Packard Vectra 486/66XM
Hewlett Packard Vectra XU

Also supported are adapters working with the **pcn** driver. The **lnc** driver runs these in compatibility mode, thus the **pcn** driver should be preferred.

SMC 83c17x (EPIC)-based Ethernet NICs (**tx** driver)

The ed driver supports the following Ethernet NICs:

3Com 3c503 Etherlink II
AR-P500 Ethernet
Accton EN1644 (old model), EN1646 (old model), EN2203 (old model) (110pin) (flags 0xd00000)
Accton EN2212/EN2216/UE2216
Allied Telesis CentreCOM LA100-PCM_V2
Allied Telesis LA-98 (flags 0x000000) (PC-98)
Allied Telesis SIC-98, SIC-98NOTE (110pin), SIU-98 (flags 0x600000) (PC-98)
Allied Telesis SIU-98-D (flags 0x610000) (PC-98)
AmbiCom 10BaseT card
Bay Networks NETGEAR FA410TXC Fast Ethernet
CNet BC40 adapter
Compex Net-A adapter
Contec C-NET(98), RT-1007(98), C-NET(9N) (110pin) (flags 0xa00000) (PC-98)
Contec C-NET(98)E-A, C-NET(98)L-A, C-NET(98)P (flags 0x300000) (PC-98)
Corega Ether98-T (flags 0x000000) (PC-98)
Corega Ether PCC-T/EtherII PCC-T/FEther PCC-TXF/PCC-TXD
CyQ've ELA-010
DEC EtherWorks DE305
Danpex EN-6200P2
D-Link DE-298, DE-298P (flags 0x500000) (PC-98)
D-Link DE-650/660
D-Link IC-CARD/IC-CARD+ Ethernet
ELECOM LD-98P (flags 0x500000) (PC-98)
ELECOM LD-BDN, LD-NW801G (flags 0x200000) (PC-98)
ELECOM Laneed LD-CDL/TX, LD-CDF, LD-CDS, LD-10/100CD, LD-CDWA (DP83902A)
HP PC Lan+ 27247B and 27252A
IBM Creditcard Ethernet I/II
ICM AD-ET2-T, DT-ET-25, DT-ET-T5, IF-2766ET, IF-2771ET, NB-ET-T (110pin) (flags 0x500000) (PC-98)
I-O DATA LA/T-98, LA/T-98SB, LA2/T-98, ET/T-98 (flags 0x900000) (PC-98)
I-O DATA ET2/T-PCI
I-O DATA PCLATE
Kansai KLA-98C/T (flags 0x900000) (PC-98)
Kingston KNE-PC2, KNE-PCM/x Ethernet
Linksys EC2T/PCMPC100/PCM100, PCMLM56
Linksys EtherFast 10/100 PC Card, Combo PCMCIA Ethernet Card (PCMPC100 V2)
Logitec LAN-98T (flags 0xb00000) (PC-98)
MACNICA Ethernet ME1 for JEIDA
MACNICA ME98 (flags 0x900000) (PC-98)
MACNICA NE2098 (flags 0x400000) (PC-98)
MELCO EGY-98 (flags 0x300000) (PC-98)

MELCO LGH-98, LGY-98, LGY-98-N (110pin), IND-SP, IND-SS (flags 0x400000) (PC-98)
MELCO LGY-PCI-TR
MELCO LPC-T/LPC2-T/LPC2-CLT/LPC2-TX/LPC3-TX/LPC3-CLX
NDC Ethernet Instant-Link
NEC PC-9801-77, PC-9801-78 (flags 0x910000) (PC-98)
NEC PC-9801-107, PC-9801-108 (flags 0x800000) (PC-98)
National Semiconductor InfoMover NE4100
NetGear FA-410TX
NetVin 5000
Network Everywhere Ethernet 10BaseT PC Card
Networld 98X3 (flags 0xd00000) (PC-98)
Networld EC-98X, EP-98X (flags 0xd10000) (PC-98)
Novell NE1000/NE2000/NE2100
PLANEX ENW-8300-T
PLANEX EN-2298-C (flags 0x200000) (PC-98)
PLANEX EN-2298P-T, EN-2298-T (flags 0x500000) (PC-98)
PLANEX FNW-3600-T
RealTek 8029
SMC Elite 16 WD8013
SMC Elite Ultra
SMC EtherEZ98 (flags 0x000000) (PC-98)
SMC WD8003E/WD8003EBT/WD8003S/WD8003SBT/WD8003W/WD8013EBT/WD8013W and clones
Socket LP-E
Surecom EtherPerfect EP-427
Surecom NE-34
TDK LAK-CD031, Grey Cell GCS2000 Ethernet Card
Telecom Device SuperSocket RE450T
VIA VT86C926
Winbond W89C940
C-Bus, ISA, PCI and PC Card devices are supported.

Adapters supported by the rl driver include:

Accton ``Cheetah'' EN1207D (MPX 5030/5038; RealTek 8139 clone)
Allied Telesyn AT2550
Allied Telesyn AT2500TX
Belkin F5D5000
BUFFALO(Melco INC.) LPC-CB-CLX(CardBus)
Compaq HNE-300
CompUSA no-name 10/100 PCI Ethernet NIC
Corega FEther CB-TXD
Corega FEtherII CB-TXD
D-Link DFE-530TX+
D-Link DFE-538TX (same as 530+?)
D-Link DFE-690TXD
Edimax EP-4103DL CardBus

Encore ENL832-TX 10/100 M PCI
Farallon NetLINE 10/100 PCI
Genius GF100TXR,
GigaFast Ethernet EE100-AXP
KTX-9130TX 10/100 Fast Ethernet
LevelOne FPC-0106TX
Longshine LCS-8038TX-R
NDC Communications NE100TX-E
Netronix Inc. EA-1210 NetEther 10/100
Nortel Networks 10/100BaseTX
OvisLink LEF-8129TX
OvisLink LEF-8139TX
Peppercon AG ROL-F
Planex FNW-3800-TX
SMC EZ Card 10/100 PCI 1211-TX
SOHO(PRAGMATIC) UE-1211C

The wb driver supports Winbond W89C840F based Fast Ethernet adapters and embedded controllers including:

Trendware TE100-PCIE *

The vr driver supports VIA Technologies Rhine I, Rhine II, and Rhine III based Fast Ethernet adapters including:

D-Link DFE530-TX
Hawking Technologies PN102TX
AOpen/Acer ALN-320

The sis driver supports Silicon Integrated Systems SiS 900 * and SiS 7016 * based Fast Ethernet adapters and embedded controllers, as well as Fast Ethernet adapters based on the National Semiconductor DP83815 (MacPhyter) chip. Supported adapters include:

@Nifty FNECHARD IFC USUP-TX
MELCO LGY-PCI-TXC
Netgear FA311-TX (DP83815)
Netgear FA312-TX (DP83815)
SiS 630, 635, and 735 motherboard chipsets

The nge driver supports National Semiconductor DP83820 * and DP83821 based Gigabit Ethernet adapters including:

SMC EZ Card 1000 (SMC9462TX)
D-Link DGE-500T
Asante FriendlyNet GigaNIX 1000TA and 1000TPC
Addtron AEG320T
LinkSys EG1032 (32-bit PCI) and EG1064 (64-bit PCI)
Surecom Technology EP-320G-TX
Netgear GA622T
Netgear GA621
Ark PC SOHO-GA2500T (32-bit PCI) and SOHO-GA2000T (64-bit PCI)
Trendware TEG-PCITX (32-bit PCI) and TEG-PCITX2 (64-bit PCI)

The ste driver supports Sundance Technologies ST201 based Fast Ethernet adapters and embedded controllers including:

D-Link DFE-530TXS
D-Link DFE-550TX

Adapters supported by the sk driver include:

3COM 3C940 single port, 1000baseT adapter
Belkin F5D5005 single port, 1000baseT adapter
Linksys EG1032 single port, 1000baseT adapter
SK-9521 SK-NET GE-T single port, 1000baseT adapter
SK-9821 SK-NET GE-T single port, 1000baseT adapter *
SK-9822 SK-NET GE-T dual port, 1000baseT adapter *
SK-9841 SK-NET GE-LX single port, single mode fiber adapter *
SK-9842 SK-NET GE-LX dual port, single mode fiber adapter *
SK-9843 SK-NET GE-SX single port, multimode fiber adapter *
SK-9844 SK-NET GE-SX dual port, multimode fiber adapter *
SMC 9452TX single port, 1000baseT adapter

The tl driver supports Texas Instruments ThunderLAN based Ethernet and Fast Ethernet adapters including a large number of Compaq PCI Ethernet adapters. Also supported are:

Olicom OC-2135/2138 10/100 TX UTP adapter
Olicom OC-2325/OC-2326 10/100 TX UTP adapter
Racore 8148 10baseT/100baseTX/100baseFX adapter
Racore 8165 10/100baseTX adapter

The tl driver also supports the built-in Ethernet adapters of various Compaq Prosignia servers and Compaq Deskpro desktop machines including:

Compaq Netelligent 10
Compaq Netelligent 10 T PCI UTP/Coax
Compaq Netelligent 10/100
Compaq Netelligent 10/100 Dual-Port
Compaq Netelligent 10/100 Proliant
Compaq Netelligent 10/100 TX Embedded UTP
Compaq Netelligent 10/100 TX UTP
Compaq NetFlex 3P
Compaq NetFlex 3P Integrated
Compaq NetFlex 3P w/BNC

The dc driver provides support for the following chipsets: *

DEC/Intel 21143
ADMtek AL981 Comet, AN985 Centaur, ADM9511 Centaur II and ADM9513 Centaur II
ASIX Electronics AX88140A and AX88141
Conexant LANfinity RS7112 (miniPCI)
Davicom DM9009, DM9100, DM9102 and DM9102A
Lite-On 82c168 and 82c169 PNIC
Lite-On/Macronix 82c115 PNIC II
Macronix 98713, 98713A, 98715, 98715A, 98715AEC-C, 98725, 98727 and 98732
Xircom X3201 (cardbus only)

The following NICs are known to work with the dc driver at this time:

3Com OfficeConnect 10/100B (ADMtek AN985 Centaur-P)
Abocom FE2500
Accton EN1217 (98715A)
Accton EN2242 MiniPCI
Adico AE310TX (98715A)
Alfa Inc GFC2204 (ASIX AX88140A)
Built in 10Mbps only Ethernet on Compaq Presario 7900 series desktops (21143, non-MII)
Built in DE500-BA on DEC Alpha workstations (21143, non-MII)
Built in Sun DMFE 10/100 Mbps Ethernet on Sun Netra X1 and Sun Fire V100 (DM9102A, MII)
Built in Ethernet on LinkSys EtherFast 10/100 Instant GigaDrive (DM9102, MII)
CNet Pro110B (ASIX AX88140A)
CNet Pro120A (98715A or 98713A) and CNet Pro120B (98715)
Compex RL100-TX (98713 or 98713A)
D-Link DFE-570TX (21143, MII, quad port)
Digital DE500-BA 10/100 (21143, non-MII)
ELECOM Laneed LD-CBL/TXA (ADMtek AN985)
Hawking CB102 CardBus
IBM EtherJet Cardbus Adapter
Intel PRO/100 Mobile Cardbus (versions that use the X3201 chipset)
Jaton XpressNet (Davicom DM9102)
Kingston KNE100TX (21143, MII)
Kingston KNE110TX (PNIC 82c169)
LinkSys LNE100TX (PNIC 82c168, 82c169)
LinkSys LNE100TX v2.0 (PNIC II 82c115)
LinkSys LNE100TX v4.0/4.1 (ADMtek AN985 Centaur-P)
Matrox FastNIC 10/100 (PNIC 82c168, 82c169)
Melco LGY-PCI-TXL
Microsoft MN-120 10/100 CardBus (ADMTek Centaur-C)
Microsoft MN-130 10/100 PCI (ADMTek Centaur-P)
NDC SOHOware SFA110A (98713A)
NDC SOHOware SFA110A Rev B4 (98715AEC-C)
NetGear FA310-TX Rev. D1, D2 or D3 (PNIC 82c169)
Netgear FA511
PlaneX FNW-3602-T (ADMtek AN985)
SMC EZ Card 10/100 1233A-TX (ADMtek AN985)
SVEC PN102-TX (98713)
Xircom Cardbus Realport
Xircom Cardbus Ethernet 10/100
Xircom Cardbus Ethernet II 10/100

Adapters supported by the aue driver include:

Abocom UFE1000, DSB650TX_NA
Accton USB320-EC, SpeedStream
ADMtek AN986, AN8511
Billionton USB100, USB100LP, USB100EL, USBE100

Corega Ether FEther USB-T, FEther USB-TX, FEther USB-TXS
D-Link DSB-650, DSB-650TX, DSB-650TX-PNA
Elecom LD-USBL/TX
Elsa Microlink USB2Ethernet
HP hn210e
I-O Data USB ETTX
Kingston KNU101TX
LinkSys USB10T adapters that contain the AN986 Pegasus chipset, USB10TA, USB10TX, USB100TX, USB100H1
MELCO LUA-TX, LUA2-TX
Planex UE-200TX
Sandberg USB to Network Link (model number 133-06)
Siemens Speedstream
SmartBridges smartNIC
SMC 2202USB
SOHOware NUB100

The cue driver supports CATC USB-EL1210A based USB Ethernet adapters including:

Belkin F5U011/F5U111
CATC Netmate
CATC Netmate II
SmartBridges SmartLink

The kue driver supports Kawasaki LSI KL5KLUSB101B based USB Ethernet adapters including:

3Com 3c19250
3Com 3c460 HomeConnect Ethernet USB Adapter
ADS Technologies USB-10BT
AOX USB101
ATen UC10T
Abocom URE 450
Corega USB-T
D-Link DSB-650C
Entrega NET-USB-E45, NET-HUB-3U1E
I/O Data USB ETT
Kawasaki DU-H3E
LinkSys USB10T
Netgear EA101
Peracom USB Ethernet Adapter
SMC 2102USB, 2104USB

The axe driver supports ASIX Electronics AX88172 based USB Ethernet adapters including:

Buffalo (Melco Inc.) LUA-U2-KTX
D-Link DUBE100
LinkSys USB200M
Netgear FA120
System TALKS Inc. SGC-X2UL

The rue driver supports RealTek RTL8150 based USB Ethernet adapters including:

Buffalo (Melco Inc.) LUA-KTX
Green House GH-USB100B
LinkSys USB100M
Billionton 10/100 FastEthernet USBKR2

The udav driver supports the following adapters:

Corega FEther USB-TXC

Adapters supported by the de driver include:

Adaptec ANA-6944/TX
Cogent EM100FX and EM440TX
Corega FastEther PCI-TX
D-Link DFE-500TX
DEC DE435, DE425, DEC DE450, and DEC DE500
ELECOM LD-PCI2T, LD-PCITS
I-O DATA LA2/T-PCI
SMC Etherpower 8432, 9332 and 9334
ZNYX ZX3xx

Controllers and cards supported by the fe driver include:

Allied Telesis RE1000, RE1000Plus, ME1500 (110-pin)
CONTEC C-NET(98)P2, C-NET (9N)E (110-pin), C-NET(9N)C (ExtCard)
CONTEC C-NET(PC)C PCMCIA Ethernet
Eiger Labs EPX-10BT
Fujitsu FMV-J182, FMV-J182A
Fujitsu MB86960A, MB86965A
Fujitsu MBH10303, MBH10302 Ethernet PCMCIA
Fujitsu Towa LA501 Ethernet
HITACHI HT-4840-11
NextCom J Link NC5310
RATOC REX-5588, REX-9822, REX-4886, and REX-R280
RATOC REX-9880/9881/9882/9883
TDK LAC-98012, LAC-98013, LAC-98025, LAC-9N011 (110-pin)
TDK LAK-CD021, LAK-CD021A, LAK-CD021BX
Ungermann-Bass Access/PC N98C+(PC85152, PC85142), Access/NOTE N98(PC86132) (110-pin)

Adapters supported by the fxp driver include:

Intel EtherExpress PRO/10
Intel InBusiness 10/100
Intel PRO/100B / EtherExpressPRO/100 B PCI Adapter *
Intel PRO/100+ Management Adapter
Intel PRO/100 VE Desktop Adapter
Intel PRO/100 M Desktop Adapter
Intel PRO/100 S Desktop, Server and Dual-Port Server Adapters
Contec C-NET(PI)-100TX (PC-98)
NEC PC-9821Ra20, Rv20, Xv13, Xv20 internal 100Base-TX (PC-98)
NEC PC-9821X-B06 (PC-98)

Many on-board network interfaces on Intel motherboards

The ex driver supports the following Ethernet adapters:

Intel EtherExpress Pro/10
Intel EtherExpress Pro/10+
The Olicom OC2220

The ie driver provides supports the following 8 and 16bit ISA Ethernet cards that are based on the Intel i82586 chip:

3COM 3C507
AT&T EN100
AT&T Starlan 10
AT&T Starlan Fiber
Intel EtherExpress 16
RACAL Interlan NI5210

The ep driver supports Ethernet adapters based on the 3Com 3C5x9 Etherlink III Parallel Tasking chipset, including:

3Com 3C1 CF
3Com 3C509-TP, 3C509-BNC, 3C509-Combo, 3C509-TPO, 3C509-TPC ISA
3Com 3C509B-TP, 3C509B-BNC, 3C509B-Combo, 3C509B-TPO, 3C509B-TPC ISA
3Com 3C529, 3C529-TP MCA
3Com 3C562/3C563 PCMCIA
3Com 3C569B-J-TPO, 3C569B-J-COMBO CBUS
3Com 3C574-TX, 3CCFE574BT, 3CXFE574BT, 3C3FE574BT PCMCIA
3Com 3C579-TP, 3C579-BNC EISA
3Com 3C589, 3C589B, 3C589C, 3C589D, 3CXE589DT PCMCIA
3Com 3CCFEM556B, 3CCFEM556BI PCMCIA
3Com 3CXE589EC, 3CCE589EC, 3CXE589ET, 3CCE589ET PCMCIA
3Com Megahertz 3CCEM556, 3CXEM556, 3CCEM556B, 3CXEM556B PCMCIA
3Com OfficeConnect 3CXSH572BT, 3CCSH572BT PCMCIA
Farallon EtherMac PCMCIA

The el driver supports the 3Com 3c501 8bit ISA Ethernet card.

The xl driver supports the following hardware:

3Com 3c900-TPO *
3Com 3c900-COMBO *
3Com 3c905-TX *
3Com 3c905-T4 *
3Com 3c900B-TPO *
3Com 3c900B-TPC *
3Com 3c900B-FL *
3Com 3c900B-COMBO *
3Com 3c905B-T4 *
3Com 3c905B-TX *
3Com 3c905B-FX *
3Com 3c905B-COMBO *
3Com 3c905C-TX *
3Com 3c980, 3c980B, and 3c980C server adapters

3Com 3cSOHO100-TX OfficeConnect adapters
3Com 3c450 HomeConnect adapters
3Com 3c555, 3c556 and 3c556B mini-PCI adapters
3Com 3C3SH573BT, 3C575TX, 3CCFE575BT, 3CXFE575BT, 3CCFE575CT, 3CXFE575CT, 3CCFEM656, 3CCFEM656B, and 3CCFEM656C, 3CXFEM656, 3CXFEM656B, and 3CXFEM656C CardBus adapters
3Com 3c905-TX, 3c905B-TX 3c905C-TX, and 3c920B-EMB embedded adapters
Both the 3C656 family of CardBus cards and the 3C556 family of MiniPCI cards have a built-in proprietary modem. Neither the xl driver nor any other driver supports this modem.

The vx driver supports the following cards:

3Com 3c590 EtherLink III PCI *
3Com 3c592 EtherLink III EISA
3Com 3c595 Fast EtherLink III PCI in 10 Mbps mode *
3Com 3c597 Fast EtherLink III EISA in 10 Mbps mode
Crystal Semiconductor CS89x0-based NICs (**cs** driver)

The sn driver supports SMC9xxx based ISA and PCMCIA cards including:

3Com Megahertz X-Jack Ethernet PC-Card CC-10BT

The xe driver supports the following cards:

Xircom CreditCard Ethernet (PS-CE2-10)
Xircom CreditCard Ethernet + Modem 28 (PS-CEM-28)
Xircom CreditCard Ethernet + Modem 33 (CEM33)
Xircom CreditCard 10/100 (CE3, CE3B)
Xircom CreditCard Ethernet 10/100 + Modem 56 (CEM56)
Xircom RealPort Ethernet 10 (RE10)
Xircom RealPort Ethernet 10/100 (RE100)
Xircom RealPort Ethernet 10/100 + Modem 56 (REM56, REM56G)
Accton Fast EtherCard-16 (EN2226)
Compaq Netelligent 10/100 PC Card (CPQ-10/100)
Intel EtherExpress Pro/100 PC Card Mobile Adapter 16 (Pro/100 M16A)
Other similar devices using the same hardware may also be supported.

Adapters supported by the lge driver include:

SMC TigerCard 1000 (SMC9462SX) *
D-Link DGE-500SX *

The txp driver supports the following cards:

3Com 3CR990-TX-95 *
3Com 3CR990-TX-97 *
3Com 3cR990B-TXM *
3Com 3CR990SVR95 *
3Com 3CR990SVR97 *
3Com 3cR990B-SRV *

The bge driver provides support for various NICs based on the Broadcom BCM570x family of Gigabit Ethernet controller chips, including the following:

3Com 3c996-T (10/100/1000baseTX) *
Dell PowerEdge 1750 integrated BCM5704C NIC (10/100/1000baseTX) *

Dell PowerEdge 2550 integrated BCM5700 NIC (10/100/1000baseTX) *
Dell PowerEdge 2650 integrated BCM5703 NIC (10/100/1000baseTX) *
IBM x235 server integrated BCM5703x NIC (10/100/1000baseTX) *
HP ProLiant NC7760 embedded Gigabit NIC (10/100/1000baseTX) *
HP ProLiant NC7770 PCI-X Gigabit NIC (10/100/1000baseTX) *
HP ProLiant NC7781 embedded PCI-X Gigabit NIC (10/100/1000baseTX) *
Netgear GA302T (10/100/1000baseTX) *
SysKonnect SK-9D21 (10/100/1000baseTX) *
SysKonnect SK-9D41 (1000baseSX) *

The em driver supports Gigabit Ethernet adapters based on the Intel 82540, 82541PI, 82542, 82543, 82544, 82546, 82546EB and 82547 controller chips:

Intel PRO/1000 CT Network Connection (82547)
Intel PRO/1000 F Server Adapter (82543)
Intel PRO/1000 Gigabit Server Adapter (82542)*
Intel PRO/1000 GT Desktop Adapter (82541PI)
Intel PRO/1000 MF Dual Port Server Adapter (82546)
Intel PRO/1000 MF Server Adapter (82545)
Intel PRO/1000 MF Server Adapter (LX) (82545)
Intel PRO/1000 MT Desktop Adapter (82540)
Intel PRO/1000 MT Desktop Adapter (82541)
Intel PRO/1000 MT Dual Port Server Adapter (82546)
Intel PRO/1000 MT Quad Port Server Adapter (82546EB)
Intel PRO/1000 MT Server Adapter (82545)
Intel PRO/1000 T Desktop Adapter (82544)
Intel PRO/1000 T Server Adapter (82543)
Intel PRO/1000 XF Server Adapter (82544)
Intel PRO/1000 XT Server Adapter (82544)

The gx driver supports Gigabit Ethernet adapters based on the Intel 82542 and 82543 controller chips:

Intel PRO/1000 Gigabit Server Adapter (82542)
Intel PRO/1000 F Server Adapter (82543)
Intel PRO/1000 T Server Adapter (82543)

The hme driver supports the on-board Ethernet interfaces of many Sun UltraSPARC workstation and server models. Cards supported by the hme driver include:

Sun PCI SunSwift Adapter
Sun SBus SunSwift Adapter ``( hme" and ``SUNW,hme")
Sun PCI Sun100BaseT Adapter 2.0
Sun SBus Sun100BaseT 2.0
Sun PCI Quad FastEthernet Controller
Sun SBus Quad FastEthernet Controller

The my driver provides support for various NICs based on the Myson chipset. Supported models include:

Myson MTD800 PCI Fast Ethernet chip
Myson MTD803 PCI Fast Ethernet chip
Myson MTD89X PCI Gigabit Ethernet chip

Broadcom BCM4401 based Fast Ethernet adapters (bfe driver) *

The re driver supports RealTek RTL8139C+, RTL8169, RTL8169S and RTL8110S based Fast Ethernet and Gigabit Ethernet adapters including:

Alloy Computer Products EtherGOLD 1439E 10/100 (8139C+) *
Compaq Evo N1015v Integrated Ethernet (8139C+) *
Corega CG-LAPCIGT Gigabit Ethernet (8169S) *
Gigabyte 7N400 Pro2 Integrated Gigabit Ethernet (8110S) *
PLANEX COMMUNICATIONS Inc. GN-1200TC (8169S) *
Xterasys XN-152 10/100/1000 NIC (8169) *

The ixgb driver supports the following cards:

Intel PRO/10GbE LR Server Adapter *
Intel PRO/10GbE SR Server Adapter *

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