

# Disk Imaging Technologies

## **Backup and Restoration Challenges**

# Topics

- Manufacture Firmware Changes
- File System Landscape
  - UEFI
  - Introduction to GUID Partition Table (GPT)
  - Partitions & Limitations
- Imaging Utilities Windows & Linux
- Full Disk Encryption
- Source Web-Links

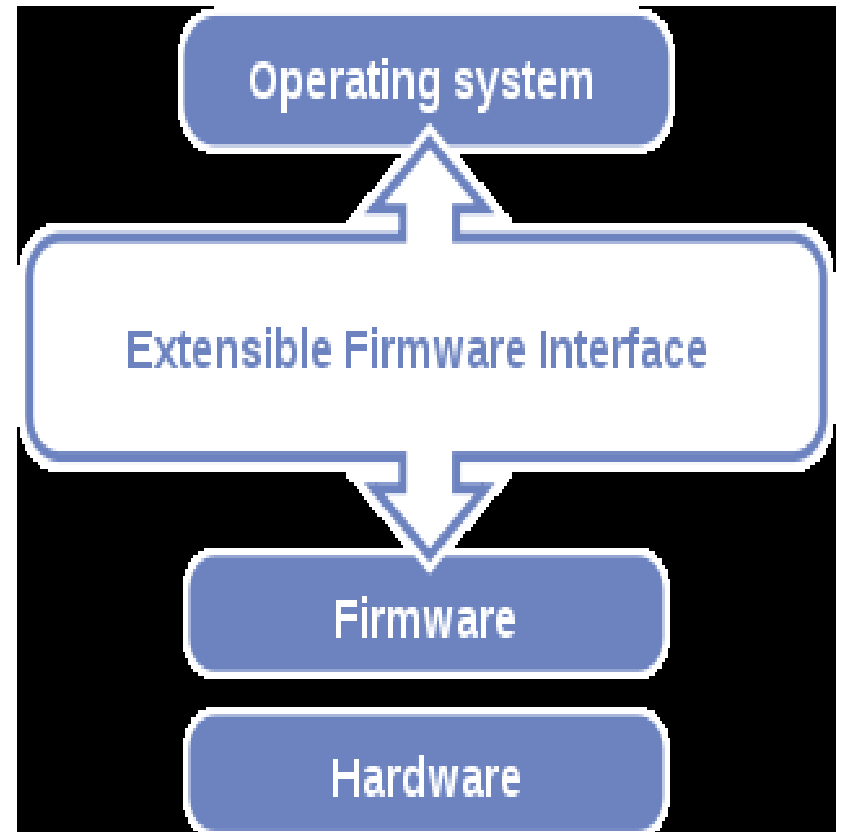
# Manufacture Firmware Changes

- Industry push to a new standard:
  - **BIOS vs. UEFI**
    - UEFI is to replace and extend the old BIOS firmware.
    - UEFI is not a new thing. [Intel](#) has been working in EFI/UEFI since mid 1990s, and there are vendors like HP or Apple that provided EFI machines since a long time ago. But it is when Microsoft announced Windows 8 that UEFI became the required way to boot the new certified machines.
    - Secure boot is an extension of UEFI. One of the key points of UEFI is that it can be extended. UEFI has an internal virtual machine that is independent of the architecture that it is using. The standard accepts special binary files compiled for this virtual machine (EFI binaries) that can be executed inside the environment. These binaries can be device drivers, applications or extensions to the UEFI standard. UEFI, in some sense, is like a small operative system that runs when the machine is powered on and whose main task is to find and load another operating system.

# Unified Extensible Firmware Interface

Unified Extensible Firmware Interface (UEFI) is meant as a replacement for the Basic Input/Output System (BIOS) firmware interface

- Initially (1998) designed by Intel for Itanium processor
- Since 2005 managed by the Unified EFI Forum ([uefi.org](http://uefi.org))



Source: <http://loadays.org/archives/2013/static/slides/Integrating-UEFI-into-rear.pdf>

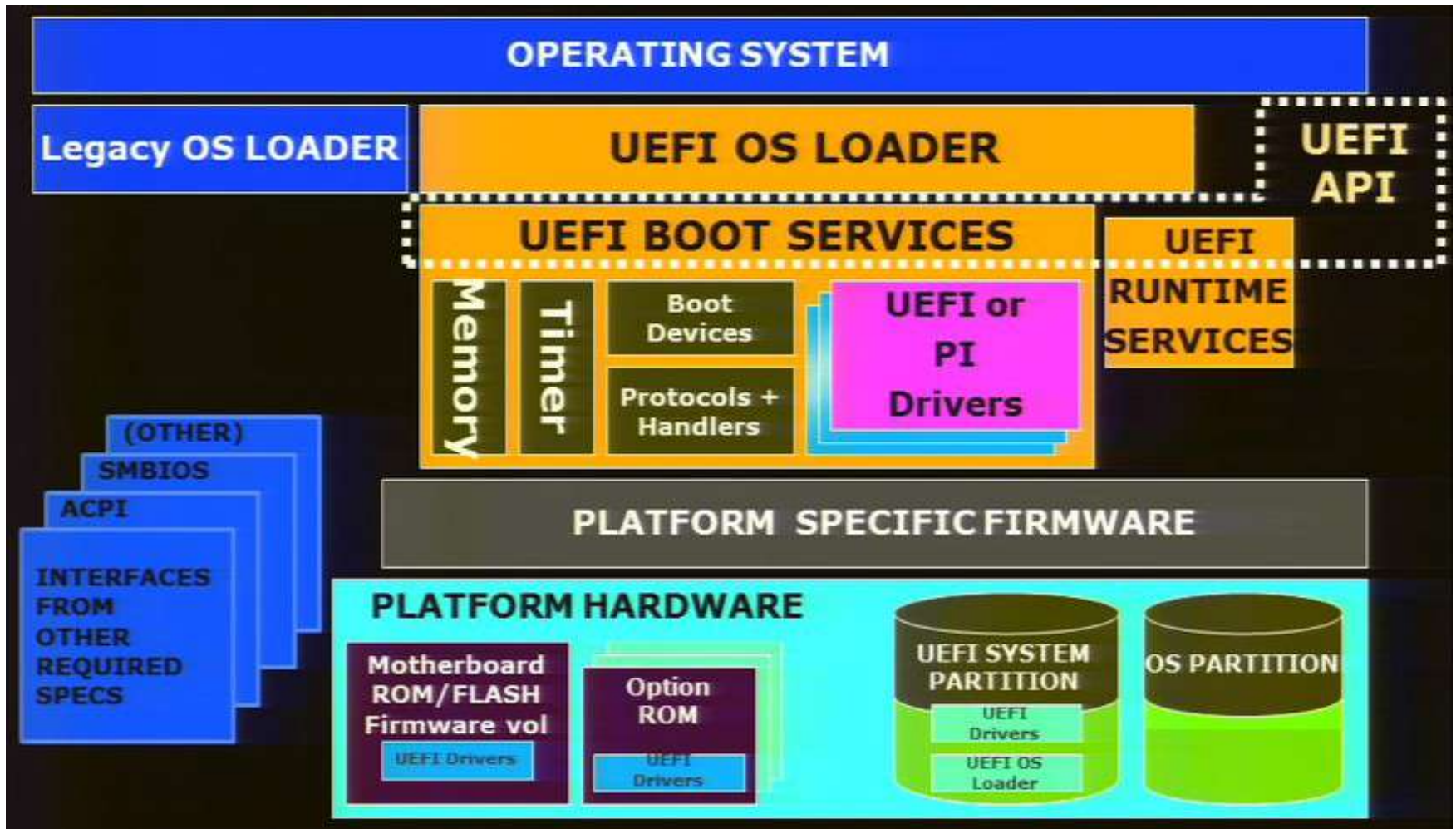
# Why UEFI?

- BIOS has its (aging) limitations
  - 16-bit processes
  - max. 2.2TB
  - 1 MB memory addressing
  - 4 primary partition MBR
- UEFI offers 32-bit and 64-bit mode
  - goes beyond the 2.2TB limit
  - uses Globally Unique IDs (GUID) partition tables (GPT)
  - network authentication
  - cryptography
  - support for extensions stored on non-volatile media
  - an integrated boot manager
  - a shell environment for running other EFI applications
    - diagnostic utilities or flash updates

# UEFI Pro's and Cons

- Pro's of UEFI:
  - Flexible and modular
  - Multiple OS loaders possible (no need to Chainload)
  - Written in C language (and it is free [BSD license])
  - IPv4 and IPv6 support
  - Secure boot is an extension of UEFI (internal VM)
- Pro-Con of UEFI:
  - UEFI can support remote diagnostics and repair of computers, even without another operating system.
- Con's of UEFI:
  - Error prone
  - Lots of code

# UEFI Architecture



# UEFI Services

- ● Two type of services:
  - Boot Services: interaction with the firmware of the motherboard
    - ● Console (text, graphical), block devices and other devices
    - ● Image loading (drivers, applications and OS loaders)
  - Runtime Services: start after the “boot services” and keep on running (while the OS is available)
    - ● Timer, date protocol
    - ● NVRAM access
    - ● Wakeup alarm
    - ● System reset



# UEFI Bricking

- In January 2013, a bug surrounding the UEFI implementation on some [Samsung](#) laptops was publicized, which caused them to be [bricked](#) after installing a Linux distribution in UEFI mode. While potential conflicts with a kernel module designed to access system features on Samsung laptops were initially blamed (also prompting kernel maintainers to disable the module on UEFI systems as a safety measure), Matthew Garrett uncovered that the bug was actually triggered by storing too many UEFI variables to memory, and that the bug could also be triggered under Windows as well under special conditions. In conclusion, he determined that the offending kernel module had caused kernel message dumps to be written to the firmware, thus triggering the bug.

# Changing the File System Landscape

- **MBR vs. GPT**

- Limitations of the Master Boot Record (MBR) scheme:

- The CHS notation is obsolete because of its 24-bit limit which can only address 8GB of disk space. The 32-bit LBA values permits us to address up to 2TB.

- GUID Partition Table scheme, a New Standard:

- The [GUID](#) Partition Table (GPT) is a new standard for the layout of the [partition table](#) on a physical [hard disk](#). It is a part of the [Extensible Firmware Interface](#) (EFI) standard proposed by Intel as a replacement for the [PC BIOS](#). GPT uses the 64 bit disk pointers, which allow for a maximum disk partition size of **9.4 Zeta bytes**, or 9.4 billion Terabytes based on the [UEFI.org](http://www.uefi.org)
- Source: [http://www.uefi.org/sites/default/files/resources/UEFI\\_Drive\\_Partition\\_Limits\\_Fact\\_Sheet.pdf](http://www.uefi.org/sites/default/files/resources/UEFI_Drive_Partition_Limits_Fact_Sheet.pdf)

# GUID Partition Table

- GPT (or GUID Partition Table) is part of UEFI specification
- Maximum 128 partitions per disk; (124 with 4 MBR protective partitions)
- Maximum partition size is 9.4 ZB (assuming 512 byte blocks)
- Each partition has an GUID
- Provides greater reliability due to replication and cyclical redundancy check (CRC) protection of the partition table GPT uses LBA exclusively.
- GPT enables storing a human-readable partition name. You can use this field to name your Linux<sup>®</sup> /home, /usr, /var, and other partitions for easier identification within partitioning software.
- Source: <http://www.ibm.com/developerworks/library/l-gpt/>

# What is a Zebibyte?

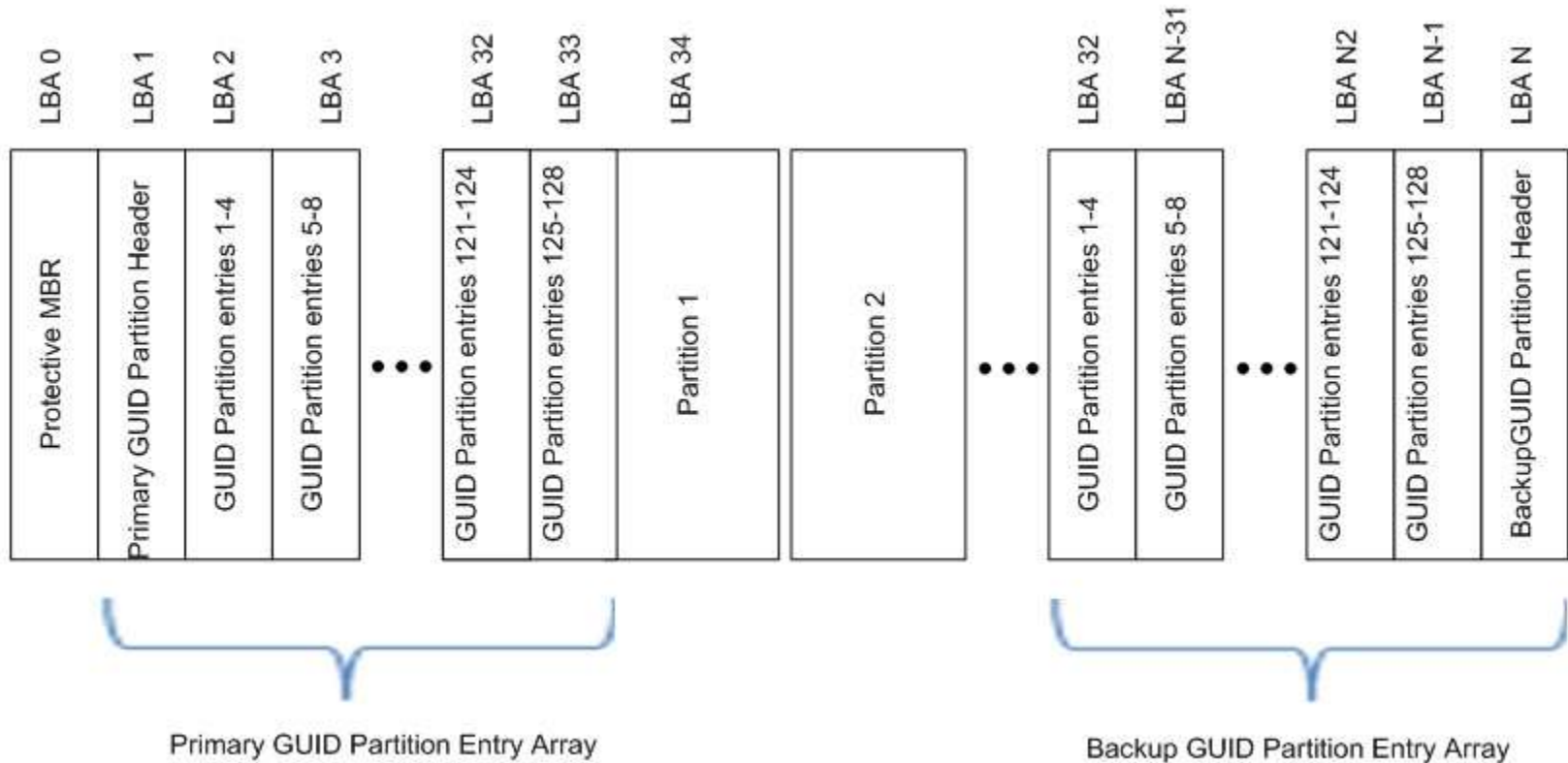
## Multiples of bytes

<u>Decimal</u>			<u>Binary</u>			
Value	<u>Metric</u>		Value	JEDEC		<u>IEC</u>
1000	kB	<a href="#">kilobyte</a>	1024	KB	kilobyte	KiB
1000 <sup>2</sup>	MB	<a href="#">megabyte</a>	1024 <sup>2</sup>	MB	megabyte	MiB
1000 <sup>3</sup>	GB	<a href="#">gigabyte</a>	1024 <sup>3</sup>	GB	gigabyte	GiB
1000 <sup>4</sup>	TB	<a href="#">terabyte</a>	1024 <sup>4</sup>	–	–	TiB
1000 <sup>5</sup>	PB	<a href="#">petabyte</a>	1024 <sup>5</sup>	–	–	PiB
1000 <sup>6</sup>	EB	<a href="#">exabyte</a>	1024 <sup>6</sup>	–	–	EiB
1000 <sup>7</sup>	ZB	<a href="#">zettabyte</a>	1024 <sup>7</sup>	–	–	ZiB
1000 <sup>8</sup>	YB	<a href="#">yottabyte</a>	1024 <sup>8</sup>	–	–	YiB

[binary prefixes](#) defined by the [International Electrotechnical Commission](#) (IEC).

Source: <https://en.wikipedia.org/wiki/ZiB>

# What does GPT FS Looks Like?

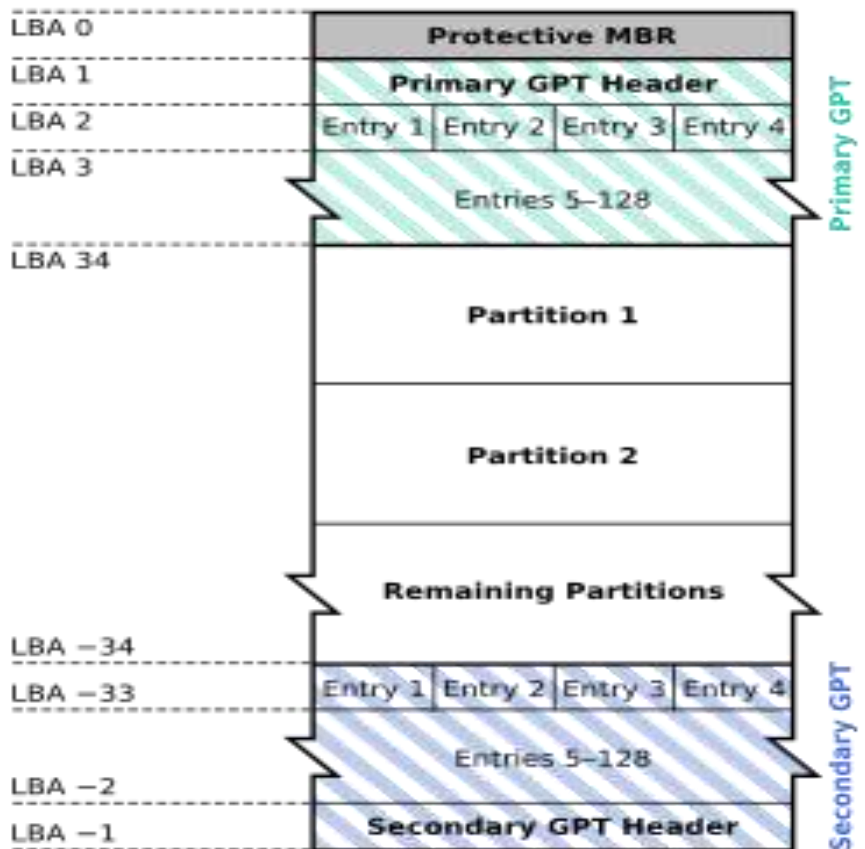


# GPT Another Look

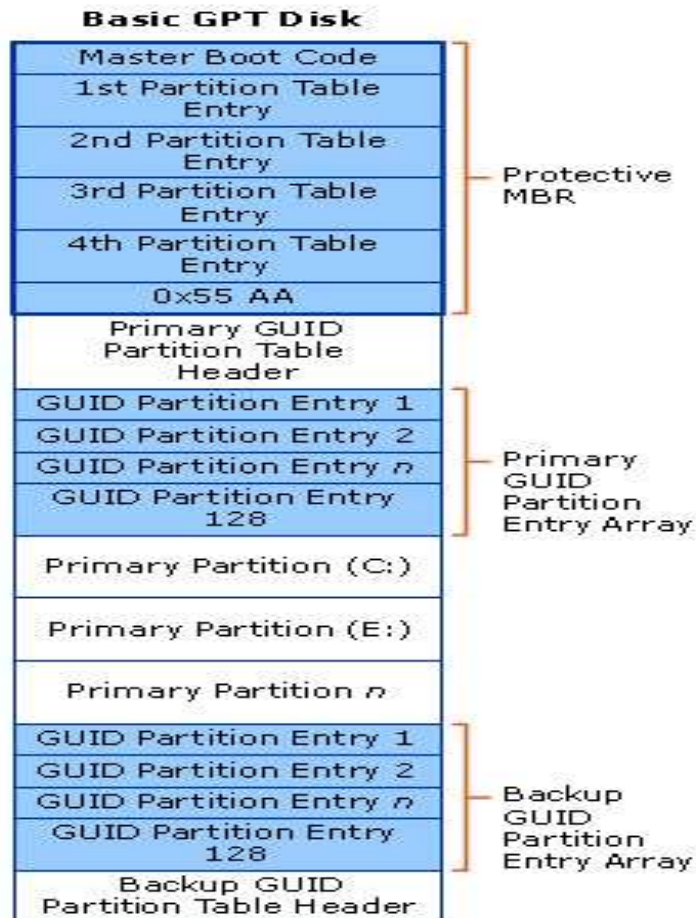
## Windows 8 GPT 6-Partition Layout

Part0-(1024MB)-(None) Windows RE tools  
NTFS Primary  
Part1-(360MB)-(None) System FAT32 (LBA)  
Primary  
Part2-(128MB)-(None)  
Unformatted/System Reserved Partition  
(GPT)  
Part3-(?GB/TB) OS (C:) NTFS Primary  
Part4-(450MB)(None) NTFS Primary  
Part5-(20.24GB) Recovery Image (D:)

## GUID Partition Table Scheme



# GPT Another Look 2



# Windows OS Partition Schemes and Limitations

	MBR Disk	GPT disk
Support in legacy OSes like DOS, Windows 98 etc.	Yes	No
Support for > 2TB (Terabyte)	No	Yes
Support as Data disk in x86 version of OS	Yes	Yes
Support as Data disk in x64 version of OS	Yes	Yes
Support as Boot disk in x86 version of OS	Yes	No
Support as Boot disk in x64 version of OS	Yes	Yes
Support for more than 4 primary partition	No	Yes (Supports up to 128 Partition)
Bootling support through BIOS mode	Yes	No
Imposed File System Limitations (in Total)	2 Terabytes	256 Terabytes

**Note** Windows only supports booting from a GPT disk on systems that contain Unified Extensible Firmware Interface (UEFI) boot firmware. NTFS is currently limited to  $2^{32}-1$  allocation units. This yields a 256TB volume, using 64k clusters.



# NTFS GPT Disk Limitations

- **What is the maximum NTFS volume size supported on a GPT disk?**
- This depends on the cluster size that is selected at the time of formatting. NTFS is currently limited to  $2^{32}-1$  allocation units. This yields a 256TB volume, using 64k clusters. However, this has only been tested to 16TB, or 17,592,186,040,320 bytes, using 4K cluster size. The following chart shows the NTFS limits based on cluster size:

Cluster size	Maximum NTFS Volume Size (bytes RAW)
512	2,199,023,255,040 (2TB)
1,024	4,398,046,510,080 (4TB)
2,048	8,796,093,020,160 (8TB)
4,096	17,592,186,040,320 (16TB)
8,192	35,184,372,080,640 (32TB)
16,384	70,368,744,161,280 (64TB)
32,768	140,737,488,322,560 (128TB)
65,536	281,474,976,645,120 (256TB)

# Windows/Linux OS Partitions

File System	Max File size	Max Partition	Journaling	Notes
Fat16	2 GB	2 GB	No	Legacy
Fat32	4 GB	8 TB	No	Legacy
NTFS	2 TB	256 TB	Yes	(For Windows Compatibility) NTFS-3g is installed by default in Ubuntu, allowing Read/Write support
ext2	2 TB	32 TB	No	Legacy
ext3	2 TB	32 TB	Yes	Standard linux filesystem for many years. Best choice for super-standard installation.
ext4	16 TB	1 EB	Yes	Modern iteration of ext3. Best choice for new installations where super-standard isn't necessary.
ReiserFS	8 TB	16 TB	Yes	No longer well-maintained.
JFS	4PB	32PB	Yes (metadata)	Created by IBM - Not well maintained.
XFS	8 EB	8 EB	Yes (metadata)	Created by SGI. Best choice for a mix of stability and advanced journaling.
Btrfs	16EiB	16EiB	Yes (metadata)	B-tree file system (Under Development)
GPT	16 TB (4K Cluster)	18 EB	Yes (metadata)	Requires UEFI boot firmware. MBR compatible, GPT backup partition entries. (Theoretical Size $2^{64}$ )

GB = Gigabyte (1024 MB) :: TB = Terabyte (1024 GB) :: PB = Petabyte (1024 TB) :: EB = Exabyte (1024 PB)

# Backup Utility Features

Easy to use Interface	Event Logs	Phone Support
File & Folder masks	Email Notification	Image Restore
Priority Job Scheduling	Log Management	File & Folder Level Restore
Versatile Disk imaging	SMS Notification	External Device Support
Reorder & resize partitions	File Synchronization	Park First Backup
Image verification	Separate Folder Time & Date Stamping	Run missed jobs
Archiving Compression	Full, Incremental, Differential Backups	Remote management
Archive verification	Include / Exclude Rules	Support 32 and 64 bit Platforms
Versatile scheduling	Include Subdirectories	Command line & scripting
Pre- & Post-Run Events	File Attribute Logic	Cloud Storage
Create Bootable Backup	Impersonate User	Direct disk cloning
Registry Backup	Domain Authentication	UEFI Support
Volume Shadow Copy	Versioning capabilities	Custom backup plan support
Run As Service	Password & Encryption protection	SSD Trim support

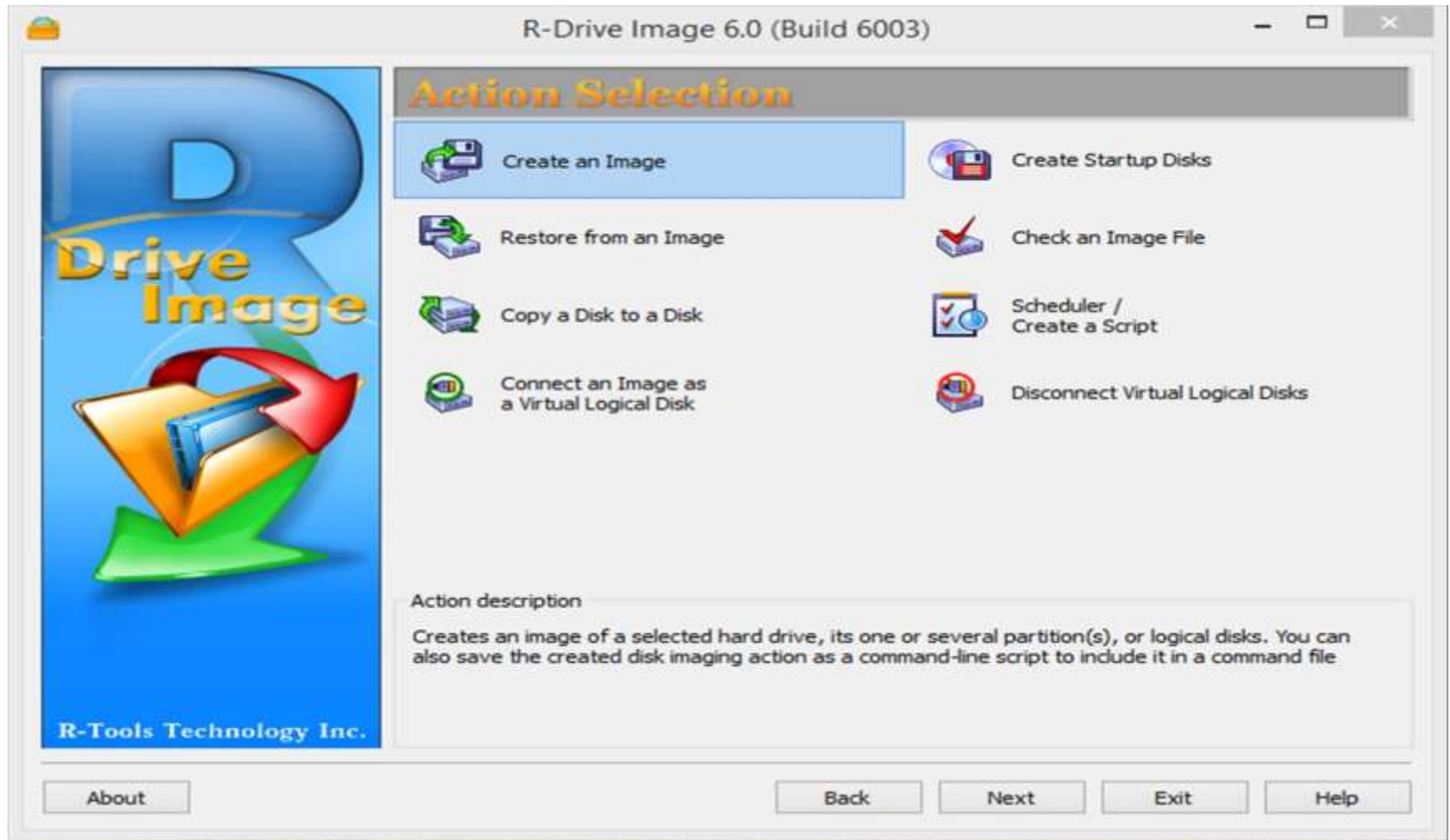
# Windows Utilities

- [Macrium Reflect](#)
- [R-Drive Image](#)
- [EaseUS Todo Backup Workstation](#)
- [Acronis Backup for PC](#)
- [Paragon Backup & Recovery](#)
- [NovaBACKUP](#)

# Differences and Costs

- R-Tools R-Drive (Standalone **\$44.95**)
- Publisher Website: <http://www.drive-image.com/>; <http://www.r-tt.com>
- R-Drive Image Standalone
- license allows Licensee (home user or organization) to serve one computer (workstation or SERVER) for its entire lifetime and can be transferred to another computer when the served computer is decommissioned or replaced. The license may not be transferred between different computers back and forth and be reused on the computer it was transferred from.
- Image file: {.rdr}
- Image type: Proprietary
  
- Macrium Reflect (Home **\$69.95**, Workstation **\$68.00**, Server **\$250.00**, Server EXCH/SQL **\$599.00**)
- **Home User: Free**
- Publisher Website: <http://www.macrium.com/>
- Image file: {.mrimg}
- Image type: Proprietary
- Image companion file (Settings Only): {.xml}
- Image conversion to: VHD
  
- EaseUS Todo Backup Free (Home **\$29**, Workstation **\$39**)
- **Todo Backup Free**

# R-Drive Image Backup



# R-Drive Image Backup

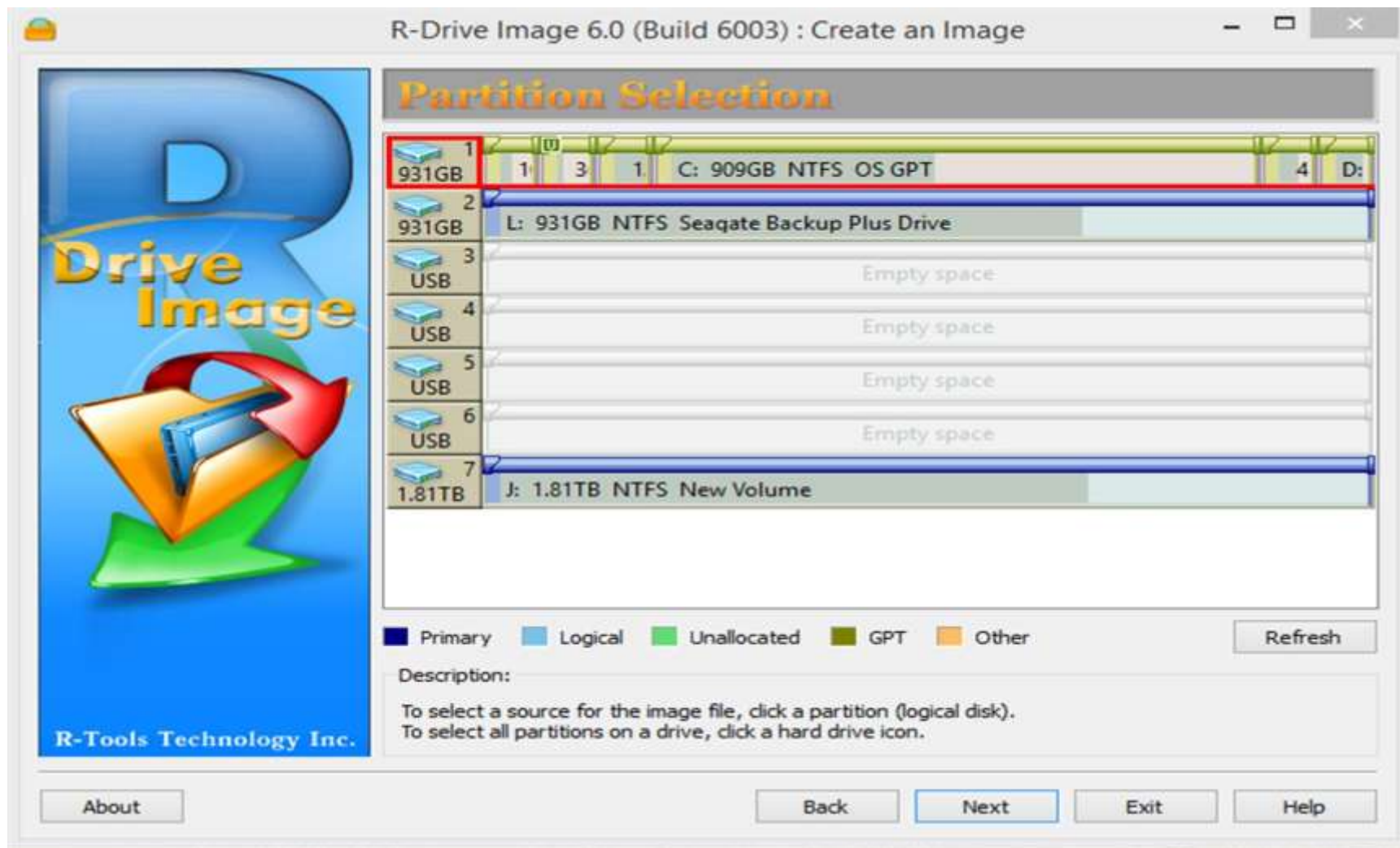
The screenshot shows the 'R-Drive Image 6.0 (Build 6003) : Create an Image' window. On the left is a logo for 'R-Tools Technology Inc.' featuring a large blue 'R' with 'Drive Image' text and a folder icon. The main area is titled 'Partition Selection' and displays a list of partitions:

Icon	Number	Capacity	File System	Volume Label	Partition Type
Hard Drive	1	931GB	NTFS	C: 909GB OS	Primary
Hard Drive	2	931GB	NTFS	L: Seagate Backup Plus Drive	Logical
USB	3			Empty space:	Other
USB	4			Empty space:	Other
USB	5			Empty space:	Other
USB	6			Empty space:	Other
Hard Drive	7	1.81TB	NTFS	J: New Volume	Primary

Below the list is a legend for partition types: Primary (dark blue), Logical (light blue), Unallocated (green), GPT (dark green), and Other (orange). A 'Refresh' button is located to the right of the legend. A 'Description:' section contains the following text: 'To select a source for the image file, click a partition (logical disk). To select all partitions on a drive, click a hard drive icon.'

At the bottom of the window are five buttons: 'About', 'Back', 'Next', 'Exit', and 'Help'.

# R-Drive Image Backup



R-Drive Image 6.0 (Build 6003) : Create an Image

### Partition Selection

Icon	Number	Volume Label	Capacity	File System	Partition Type	Drive Letter
Hard Drive	1	C:	909GB	NTFS	OS GPT	D:
Hard Drive	2	L:	931GB	NTFS	Seagate Backup Plus Drive	
USB	3				Empty space	
USB	4				Empty space	
USB	5				Empty space	
USB	6				Empty space	
Hard Drive	7	J:	1.81TB	NTFS	New Volume	

■ Primary ■ Logical ■ Unallocated ■ GPT ■ Other

Refresh

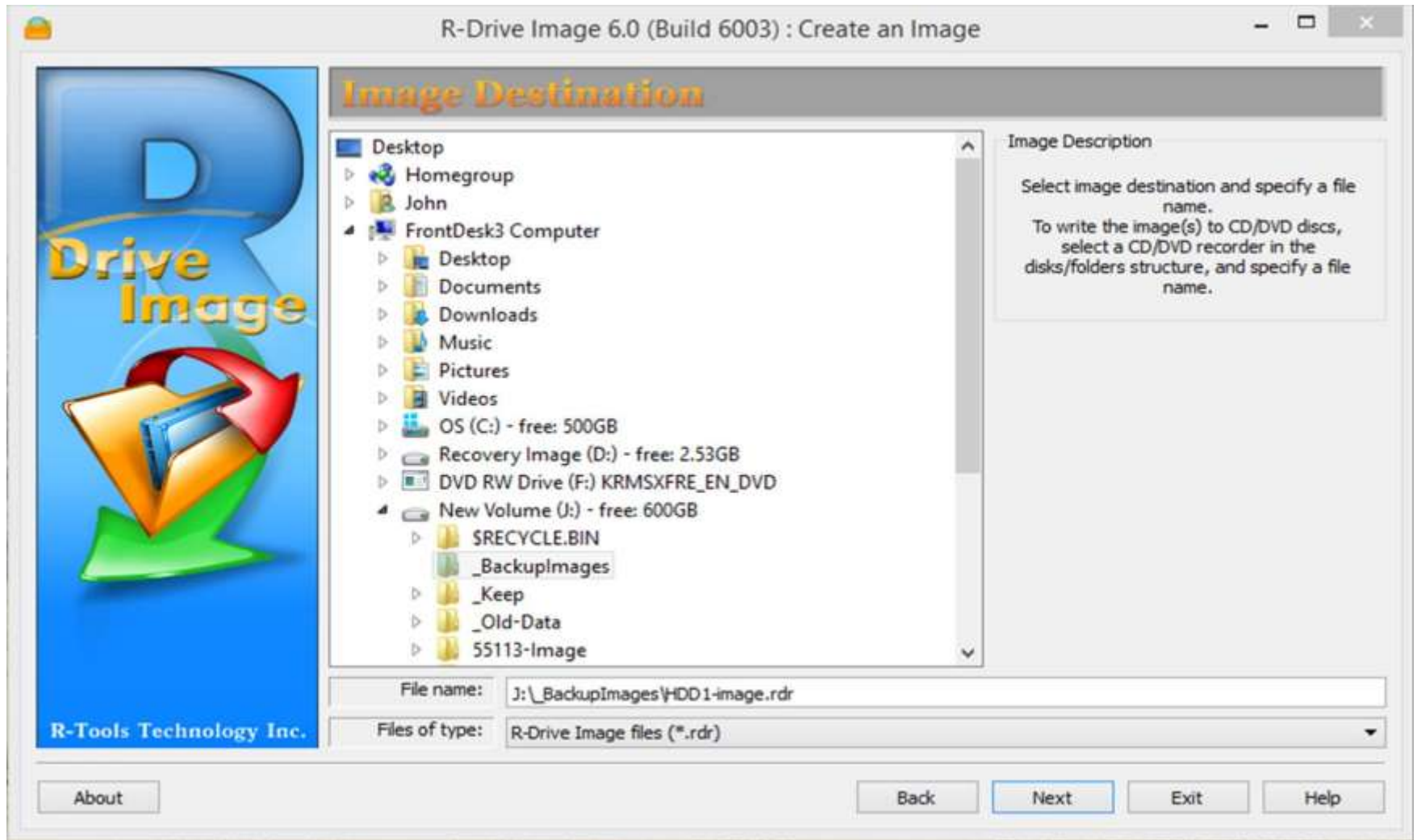
Description:  
To select a source for the image file, click a partition (logical disk).  
To select all partitions on a drive, click a hard drive icon.

About Back Next Exit Help

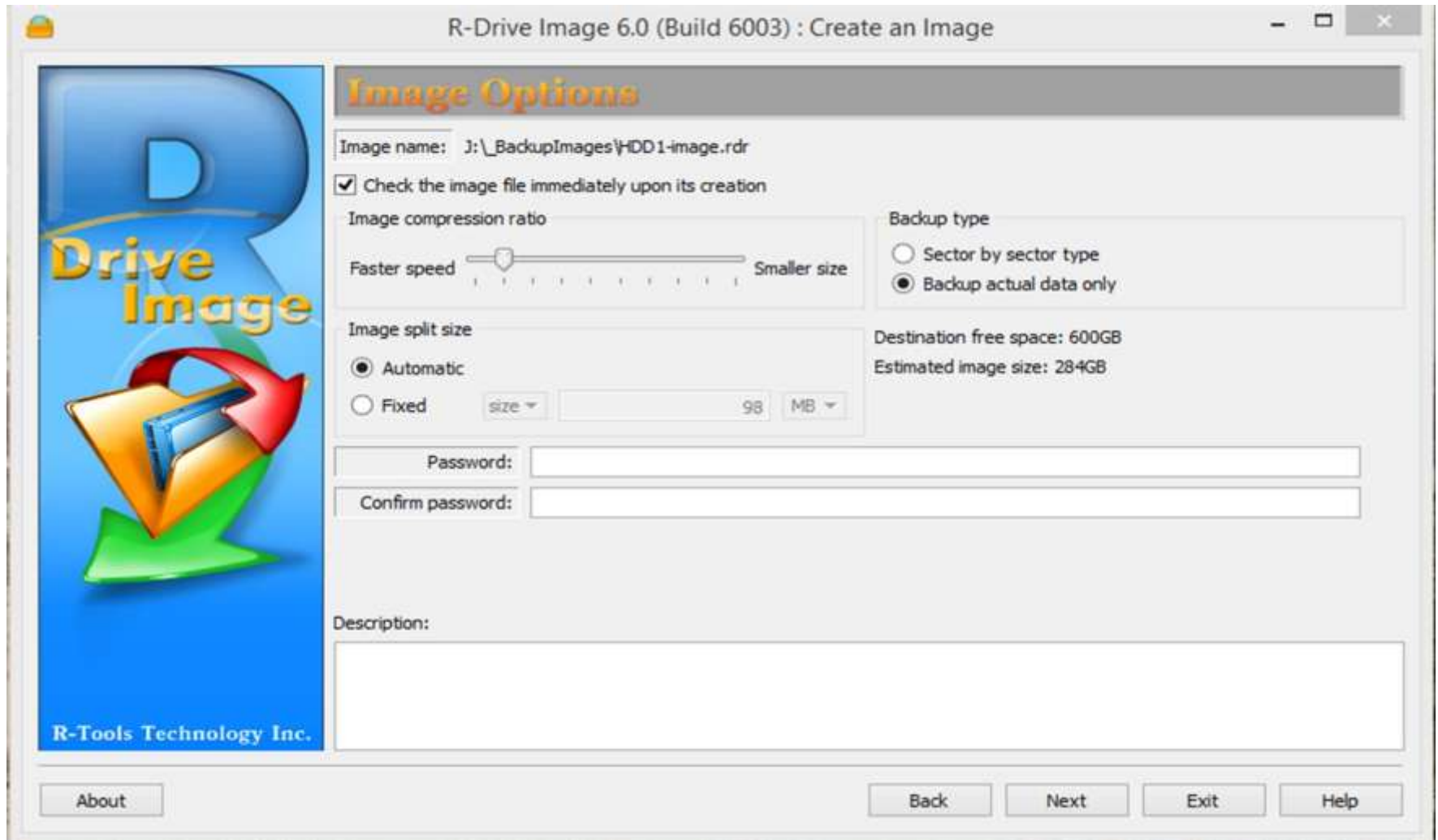
R-Tools Technology Inc.



# R-Drive Image Backup



# R-Drive Image Backup



# R-Drive Image Backup FAQ

- **30. I can't start my Windows 8 computer with the R-Drive Image startup disk. Why?**
- Sometimes, it may be impossible to start a Windows 8 computer with the R-Drive Image startup disk. 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-Drive Image t 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.

# Macrium Reflect Backup

- **Core Features in All Products**

- Disk imaging
- SSD Trim support
- Virtual Image Boot
- File & folder backup
- AES Encryption
- Retention Rules
- Image verification
- Reorder & resize partitions
- Backup destination rotation
- Drag and drop user interface
- ReDeploy
- WinPE 5.0 rescue environment
- UEFI Support
- Direct disk cloning
- Integrated email component
- Backup definitions
- Scheduled backups
- Scripting support
- Compress backups
- Browse backups
- Comment backups

# Macrium Reflect Backup

Macrium Reflect - Free Edition for non-commercial use

File View Backup Restore Other Tasks Help

Disk Image Restore Log

Backup Tasks

- Image all local drives on this computer.
- Create an image of the partition(s) required to backup and restore Windows.

Other Tasks

Details

**Windows RE tools**  
(AB14FF44-63A7-45FA-A147)  
File System: NTFS  
Free Space: 676.4 MB  
Total Size: 1023.0 MB  
Start Sector: 2,048  
End Sector: 2,097,151

Create a Backup Backup Definition Files Scheduled Backups

Refresh

GPT Disk 1 [3579415D-A00B-47AB-8ECE-E12B864A2895] - WDC WD10EZEX-60ZPSA0 80.00A80 <931.51 GB>

Partition	File System	Size	Free Space
1 - Windows RE tools (None) NTFS Primary	None	346.6 MB	1023.0 MB
2 - SYSTEM (None) FAT32 (LBA) Primary	FAT32 (LBA)	32.7 MB	360.0 MB
3 - (None) Unformatted Primary	None	128.0 MB	128.0 MB
4 - OS (C:) NTFS Primary	NTFS	408.46 GB	909.36 GB
5 - (None) NTFS Primary	None	265.4 MB	450.0 MB
6 - Recovery Image (D:) NTFS Primary	None	17.70 GB	20.24 GB

Actions...

Clone this disk... Image this disk...

MBR Disk 2 [E160AC6B] - Seagate Backup+ BK 0412 <931.51 GB>

Partition	File System	Size	Free Space
1 - Seagate Backup Plus Drive NTFS (L:) NTFS Primary	NTFS	623.51 GB	931.51 GB

**Upgrade now and get all the features of Macrium Reflect**

- File and folder backups.
- Incremental and differential images for faster backups.
- Support and forum access.
- Commercial/Business use.
- Enhanced recovery options.
- Unattended system restore.
- Restore to dissimilar hardware with Reflect Pro and Server.
- Windows Server support with the [Server Edition](#).
- [Plus much more...](#)

Business users click [here](#)

Done

CAP NUM SCRL

# Macrium Reflect Backup

Macrium Reflect - Free Edition for non-commercial use

File View Backup Restore Other Tasks Help

Disk Image Restore Log

**Restore Tasks**

- Browse for an image or backup file to restore
- Open an image or backup file in Windows Explorer
- Detach a backup image from Windows explorer

**Other Tasks**

**Details**

ID: 3D0ACEAD3EF3D0C  
Type: Full  
Date: 3/11/2015 10:56 AM

**Image Restore**

Browse for an image file... Refresh Folders to search

GPT Disk 1 [3579415D-A00B-47AB-8ECE-E128864A2895] - WDC WD10EZEK-60ZFA0 80.00A80 <931.51 GB>

Partition	File System	Volume Label	Size	Used Space
1 - Windows RE tools (None)	NTFS Primary		346.6 MB	1023.0 MB
2 - SYSTEM (None)	FAT32 (LBA) Primary		32.7 MB	360.0 MB
3 - (None)	Unformatted Primary		128.0 MB	128.0 MB
4 - OS (C:)	NTFS Primary		376.39 GB	909.36 GB
5 - (None)	NTFS Primary		265.4 MB	450.0 MB
6 - Recovery Image (D:)	NTFS Primary		17.70 GB	30.24 GB

Sort by... Backup Date Location File Name Images that contain drive: All Drives View Load Errors

Image Name	Folder	Type	Date	Image ID	Actions
FD3-20150311-3D0ACEAD3EF3D0C-00-00.mrimg	J:\_BackupImages\	Full	3/11/2015 10:56 AM	3D0ACEAD3EF3D0C	Browse Image, Restore Image, Verify Image, Other Actions...
FD3-20150211-1692EF0570541C3D-00-00.mrin	J:\_BackupImages\	Full	2/11/2015 7:18 PM	1692EF0570541C3D	Date: 02-11-2015, Type: Full, Backup

Ready CAP NUM SCRL

# Macrium Reflect Backup

The screenshot displays the Macrium Reflect - Free Edition for non-commercial use interface. The main window is titled 'Image Restore' and shows a 'Macrium ImgToVHD' dialog box. The dialog box prompts the user to 'Click the browse button and select an image file...'. Below this, there is a table with columns: Drive, Type, Start Sector, End Sector, Capacity, Used Space, Free Space, and File System. The table is currently empty. Below the table, there is a 'VHD File' field with a browse button. There are three checkboxes: 'Remap partition table', 'Reset disk ID', and 'Continue on errors'. At the bottom of the dialog box are 'Convert' and 'Close' buttons. The status bar at the bottom of the dialog box shows 'Image ID: 1692EF0570541C3D'. On the right side of the main window, there are two drive information boxes: '5 - (None) NTFS Primary' with 265.4 MB used and 450.0 MB free, and '6 - Recovery Image (D:) NTFS Primary' with 17.70 GB used and 20.24 GB free. Below these are buttons for 'Browse Image', 'Restore Image', 'Verify Image', and 'Other Actions...'. The status bar at the bottom of the main window shows 'Ready' on the left and 'CAP NUM SCRL' on the right.

Macrium Reflect - Free Edition for non-commercial use

File View Backup Restore Other Tasks Help

Disk Image Restore Log

Restore Tasks

- Browse for an image or backup file to restore
- Open an image or backup file in Windows Explorer
- Detach a backup image from Windows explorer

Other Tasks

Details

ID: 3D0ACEAD3EF3D0C  
Type: Full  
Date: 3/11/2015 10:56 AM

Image Restore

Macrium ImgToVHD

Click the browse button and select an image file...

Drive	Type	Start Sector	End Sector	Capacity	Used Space	Free Space	File System
-------	------	--------------	------------	----------	------------	------------	-------------

VHD File

Remap partition table  Reset disk ID  Continue on errors

Convert Close

Image ID: 1692EF0570541C3D

5 - (None) NTFS Primary  
265.4 MB  
450.0 MB

6 - Recovery Image (D:) NTFS Primary  
17.70 GB  
20.24 GB

[View Load Errors](#)

[Browse Image](#) [Restore Image](#)  
[Verify Image](#) [Other Actions...](#)

Ready CAP NUM SCRL



# Macrium Reflect Backup


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## Product Comparison



Feature/Functionality	Home Edition	Workstation	Server	Server Plus
<b>Backup/Imaging</b>				
Macrium Fast Imaging	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
File and folder backup	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
VSS Support for data integrity	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
Dynamic disk / GPT support	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
Incremental cloning	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
Backup chain consolidation	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
Backup plan templates	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
Backup file management	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
Backup rotation automation	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
SSD Trim support	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
Exchange and MSSQL granular backup	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
<b>Restore</b>				
Macrium ReDeploy	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
Item level recovery	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
Rapid Delta Restore	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
Windows Server supported	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
MS Exchange and MS SQL granular restore	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
<b>Support</b>				
Support period	1 Year	1 Year	1 Year	1 Year
Support Essentials	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Standard Support (Premium Support Available)	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>



# EaseUS Todo Backup

- Key Features
  - System backup: Back up your entire system including applications, configurations and Operating System in one compressed file.
  - Disk imaging: Block-level disk imaging quickly and efficiently backs up the entire disk or volumes.
  - File backup: File-level backup allows you to selectively back up specific files, folders or file types, including network shared files.
  - Migration and clone: Fast, easily and safely migrate system to a SSD or a bigger HDD for disk replacement or upgrade.
  - Browse image file: Browse backup with Windows Explorer and simply copy-paste files/folders.

# EaseUS Todo Backup

The screenshot displays the EaseUS Todo Backup Free 7.0 application window. The title bar reads "EaseUS Todo Backup Free 7.0". The interface features a top navigation bar with icons for "Disk/Partition Backup", "File Backup", "System Backup", "Smart Backup", "Clone", "Logs", and "Tools". Below this, there are search and sort options: "Browse to Recover" and "Sort by".

The main area shows three backup tasks:

- File Backup 2014-09-04 08-42**: Location: N:\My Backups\File Backup 2014-09-04 08-42. Task completed. Includes "Recovery", "Backup", and "Advanced" options.
- System Backup 2014-09-04 08-42**: Location: N:\My Backups\System Backup 2014-09-04 08-42. Task completed. Includes a "Recovery" option.
- Disk Backup 2014-09-04 08-40**: Please wait, backing up... Estimated time remaining 00:12:39. Includes a "Cancel" button.

A context menu is open over the System Backup task, listing the following options:

- Edit Plan
- Image Manager
- Check Image
- Delete Backup

A watermark for "SnapFiles" is visible in the background. At the bottom, a yellow banner contains the text: "Upgrade now to get more powerful edition. [Activate now](#)".

# EaseUS Todo Backup

Disk/Partition Backup

Select the disk or partition

Hard disk 0 (931.51 GB, Basic, GPT)

<input type="checkbox"/> *: (Other) 0 Byte(s) free of 1023.00 MB	<input type="checkbox"/> *: (Other) 0 Byte(s) free of 360.00 MB
<input type="checkbox"/> *: (Other) 0 Byte(s) free of 128.00 MB	<input type="checkbox"/> OS C: (NTFS) 51.60 GB free of 96.65 GB
<input type="checkbox"/> *: (Other) 0 Byte(s) free of 350.00 MB	<input type="checkbox"/> Data N: (NTFS) 670.45 GB free of 813.66 GB

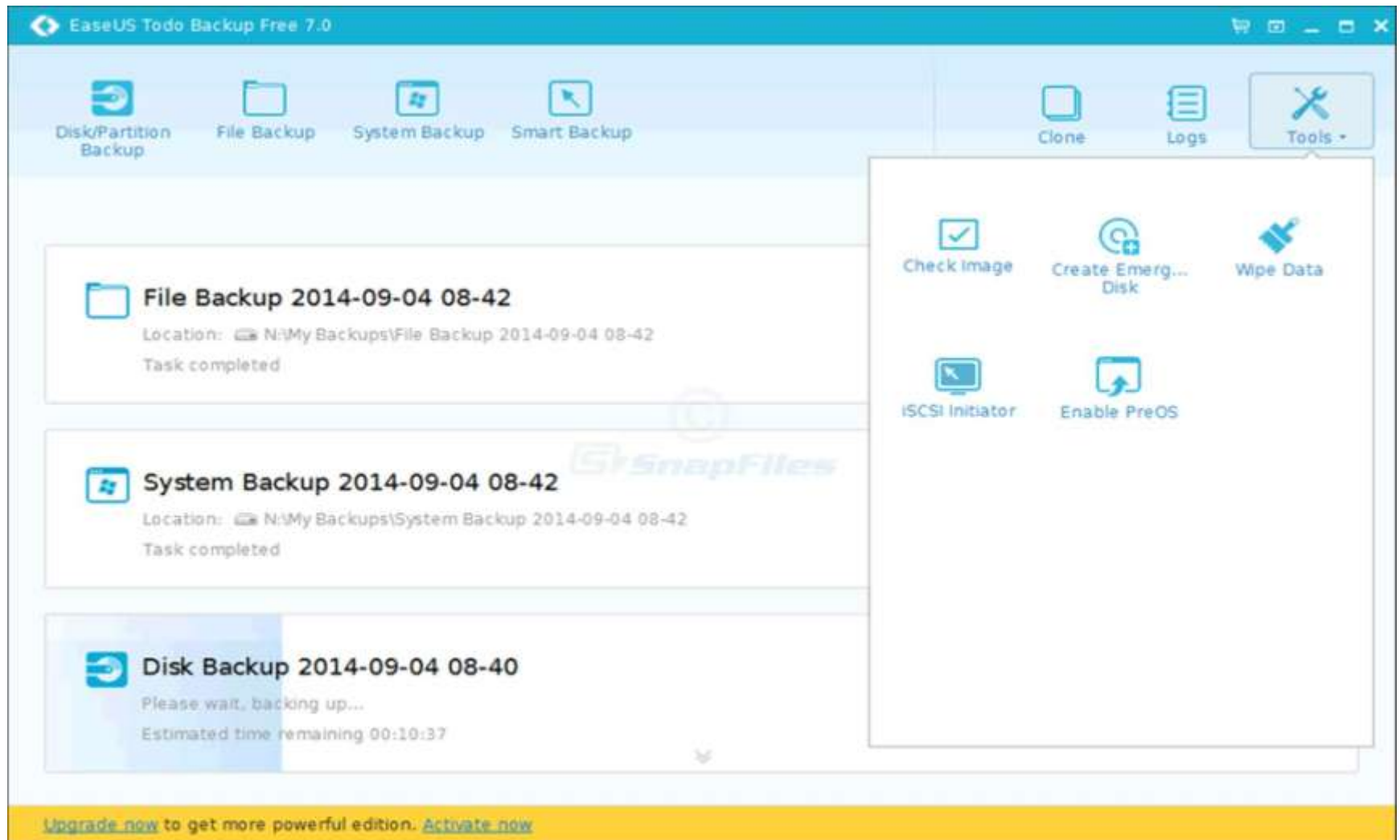
Sector by sector backup

Destination:  670.45 GB Free of 813.66 GB

Plan name:  Description:

Schedule: Off  Backup options  Image-reserve strategy

# EaseUS Todo Backup



# EaseUS Todo Backup

Edition Comparison	Todo Backup Free	Todo Backup Home	Todo Backup Workstation
	<a href="#">Free Download</a>	<b>\$23.20</b> <del>\$29</del> <a href="#">Buy Now</a>	<b>\$31.20</b> <del>\$39</del> <a href="#">Buy Now</a>
Backup & restore speed	Normal	Faster	Faster
Business usage			●
Transfer system to different PC, Virtual PC and VMware			●
Outlook backup and recovery		●	●
Email notification, pre/post-command, backup to FTP Server, event-based schedule backup, exclude files from backup		●	●
Free technical support		●	●
Full/Incremental/Differential/Schedule backup	●	●	●
System/Partition/File backup and recovery	●	●	●
Disk clone, migrate OS to SSD/HDD	●	●	●
Support MBR & GPT disk, hardware RAID, UEFI boot, WinPE bootable disk	●	●	●

# Linux GPT Tools (Manual Configuration)

## Utilities support

- The third area of GPT support is system utilities. Linux provides three main families of partitioning tools, with varying support for GPT:
- **The fdisk family.** These programs (`fdisk`, `cdisk`, and `sfdisk`) are text-mode tools that can handle MBR and some more exotic partition tables, but they can't handle GPT.
- **GNU Parted (`libparted`).** The GNU Parted project provides a library (`libparted`) and a text-mode utility (`parted`) for partitioning. Several graphical user interface (GUI) utilities are built atop `libparted`, as well. The `libparted` library can handle MBR, GPT, and several other partition table types.
- **GPT fdisk.** This family (`gdisk`, `cgdisk`, and `sgdisk`) is modeled after the `fdisk` family but works on GPT disks. (Note that I'm the author of GPT fdisk.) [GPT partitioning advice](#)

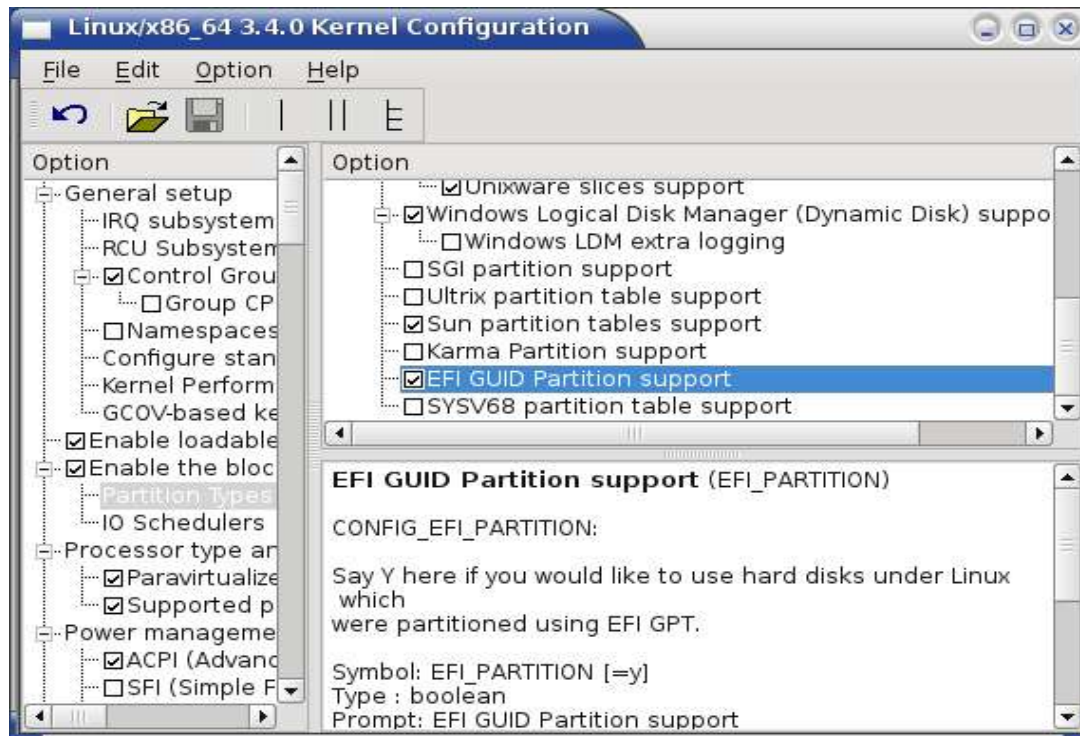
Some special concerns crop up for GPT partitioning, particularly if your computer uses EFI or you run in a multi-boot environment:

- **EFI requires an EFI System Partition (ESP) on any boot disk.**
- Also as noted earlier, you should create a BIOS Boot Partition if you plan to boot from GPT on a BIOS-based computer.
- Many GPT partitioning tools create gaps of about 128MiB after each partition (the ESP is an exception to this rule). The intention is that disk utilities can use this space to help with their jobs.
- **On Mac OS X systems, partitions are created in sizes that are multiples of 4KiB** (typically, eight sectors). This feature relates to limitations of the HFS Plus file system that most modern Macs use.
- You can follow these partitioning rules or ignore them as you see fit. Linux is flexible enough that it won't be bothered by a disregard for these rules, unless your computer requires an ESP or BIOS Boot Partition to boot.
- One other rule isn't GPT specific but is important on most large disks produced since early 2010: These disks use 4KiB physical sectors but 512-byte logical sectors. This discrepancy creates potentially severe performance issues if partitions aren't aligned on physical sector boundaries. Partitioning tools released since late 2010 generally handle this well, but if you're using older tools, be sure to create properly aligned partitions.

# Linux Kernel EFI GUID Partition Support

- **Kernel support**

- The Linux kernel must provide GPT support to provide access to data on the disk's partitions. Fortunately, this support has long been present in Linux. If you compile your own kernel, be sure to select **EFI GUID Partition Support** in the **Partition Types** area of the **Enable the Block Layer** configuration area, as shown in [Figure 1](#). (This item used to be located under **File Systems**, so look there if you've got an older kernel.)
- **Figure 1. The Linux kernel provides GPT support, but it must be enabled when you compile a new kernel**



# Imaging Utilities (Linux)

- **Disaster Recovery / Disk Cloning**
- [Clonezilla](#) Offers similar functionality to Symantec Ghost
- [Mondo Rescue](#) A powerful disaster recovery suite
- [PartImage](#) Backup partitions into a compressed image file
- [PING](#) (Partimage Is Not Ghost) -- Backup and Restore Disk Partitions
- [Redo Backup and Recovery](#) It is the easiest, most complete disaster recovery solution available. It allows *bare-metal restore*.
- [G4L](#) is a free Live CD system to clone hard disk easily image disk and partitions
- [DoClone](#) for creating or restoring GNU/Linux systems images.

• Source: <http://www.linuxlinks.com/article/20090105114152803/Backup.html> (Last Updated Sunday, December 07 2014 @ 05:06 AM EST)



# Clonezilla (free)

- Clonezilla is a partition and disk imaging/cloning program similar to [True Image®](#) or [Norton Ghost®](#). It helps you to do system deployment, bare metal backup and recovery.
- Two types of Clonezilla are available, [Clonezilla live](#) and [Clonezilla SE \(server edition\)](#). Clonezilla live is suitable for single machine backup and restore. While Clonezilla SE is for massive deployment, it can clone many (40 plus!) computers simultaneously. Clonezilla saves and restores only used blocks in the hard disk.
- Supported File Systems:
- Many File systems are supported: (1) ext2, ext3, ext4, reiserfs, reiser4, xfs, jfs, btrfs and f2fs of GNU/Linux, (2) FAT12, FAT16, FAT32, NTFS of MS Windows, (3) HFS+ of Mac OS, (4) UFS of FreeBSD, NetBSD, and OpenBSD, (5) minix of Minix, and (6) VMFS3 and VMFS5 of VMWare ESX. Therefore you can clone GNU/Linux, MS windows, Intel-based Mac OS, FreeBSD, NetBSD, OpenBSD, Minix, VMWare ESX and Chrome OS/Chromium OS, no matter it's 32-bit (x86) or 64-bit (x86-64) OS. For these file systems, only used blocks in partition are saved and restored. For unsupported file system, sector-to-sector copy is done by dd in Clonezilla.
- Both [MBR](#) and [GPT](#) partition formats of hard drive are supported. Clonezilla live also can be booted on a [BIOS](#) or [UEFI](#) machine.
  - Download at <http://clonezilla.org/>

# G4L Disk & Image Cloning (free)

- G4L is a hard disk and partition imaging and cloning tool. The created images are optionally compressed and transferred to an FTP server or cloned locally. CIFS(Windows), SSHFS and NFS support included, and udpcast and fsarchiver options. .

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GPT partition support was added in version 0.41.

Backing up Windows partitions requires the use of a bootable G4L CD or running g4l via grub4dos.

- [Download: http://sourceforge.net/projects/g4l/](http://sourceforge.net/projects/g4l/)

# DoClone (free)

- DoClone is a free project developed in C++ for creating or restoring GNU/Linux systems images. It can also work on a LAN to transfer data within computers. This tool provides an easy way to manage the GNU/Linux installation in offices or schools, including machines with different hardware, e.g., different hard-disk sizes, using only the space required by the data.
- **Supported disk labels** - DoClone works with all the libparted supported disk labels:
  - Aix, Amiga, BSD, Dvh, GPT, Mac, MsDos, Pc98, Sun
- Features:
  - Supports 12 file systems.
  - Supports 9 disk labels.
  - Clones disks or partitions with different sizes.
  - Clones selinux systems.
  - GRUB boot loader restoration.
  - Multiple cloning on a LAN.
  - UUID's and file system labels cloning.
  - Live cloning: a system can make images of itself.
    - [Download: http://doclone.nongnu.org/](http://doclone.nongnu.org/)

# Image Backup Extras

- Whole/Full Disk Encryption
  - Truecrypt
  - Bitlocker
  - CheckPoint
  - Symantec PGP End-Point

# Source Web-Links

- <http://www.drive-image.com/>
- <http://www.macrium.com/>
- <http://www.easeus.com/backup-software/>
  
- <http://www.ibm.com/developerworks/library/l-gpt/>
- [https://en.wikipedia.org/wiki/Master boot record](https://en.wikipedia.org/wiki/Master_boot_record)
- [https://en.wikipedia.org/wiki/GUID Partition Table](https://en.wikipedia.org/wiki/GUID_Partition_Table)
- [https://en.wikipedia.org/wiki/EFI System partition](https://en.wikipedia.org/wiki/EFI_System_partition)
- [https://en.wikipedia.org/wiki/Unified Extensible Firmware Interface](https://en.wikipedia.org/wiki/Unified_Extensible_Firmware_Interface)
- <http://www.uefi.org/>
  
- <http://www.extremetech.com/computing/96985-demystifying-uefi-the-long-overdue-bios-replacement>
- <http://refit.sourceforge.net/>
- <http://sourceforge.net/projects/gptfdisk/?source=directory>

# Source Web-Links

- <http://sourceforge.net/projects/clonezilla/>
- <http://www.diffingo.com/oss/fwbackups/features>
- [http://www.sysresccd.org/SystemRescueCd Homepage](http://www.sysresccd.org/SystemRescueCd)
- <http://doclone.nongnu.org/>
- <http://sourceforge.net/projects/g4l/>

The End

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