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Paragon Alignment Tool

Version for Toshiba Advanced Format Disk Drives

User Manual

Contents

Introducing the Paragon Alignment Tool

This chapter will present general information on the Paragon Alignment Tool (PAT).

What is PAT?

The Paragon Alignment Tool is a software utility for both physical and virtual systems. It is intended to check and solve misalignment issues on 4K physical sector size Advanced Format Drives (AF Drives) and Solid State Drives (SSDs), as well as Redundant Array of Independent Disks (RAID). Using PAT to check and properly realign partitions will assure maximum system and RAID performance, and in the case of SSDs also assure their maximum longevity.

Product Components

PAT features several components for checking and aligning drives, and protecting user data:

- **Windows™-based utility** – the primary tool for checking and aligning partitions from within Windows.
- **Blue Screen utility** – aligns "locked" partitions, such as a system partition or volumes with open files.
- **Universal Recovery CD (RCD)** – a multi-platform, bootable utility that runs under Linux™ from a CD, DVD, or external storage device connected via USB or FireWire (IEEE 1394). The user-friendly "Windows-like" Linux environment requires no installation, and is designed to be used when the operating system (OS) won't boot in order to continue a previously interrupted alignment operation.

Key Features

- **Partition Alignment without Reboot** – Unlocked partitions can be aligned directly from Windows.
- **Alignment in Blue Screen Mode** – Reboot the system into this Blue Screen mode to align system partitions or volumes with open files.
- **Universal Recovery CD (RCD) –** Boot up your system when Windows won't, or check and align drives without installing PAT.
- **Total Data Protection –** Data will be protected even if the alignment process was unexpectedly interrupted (e.g. due to power outage).

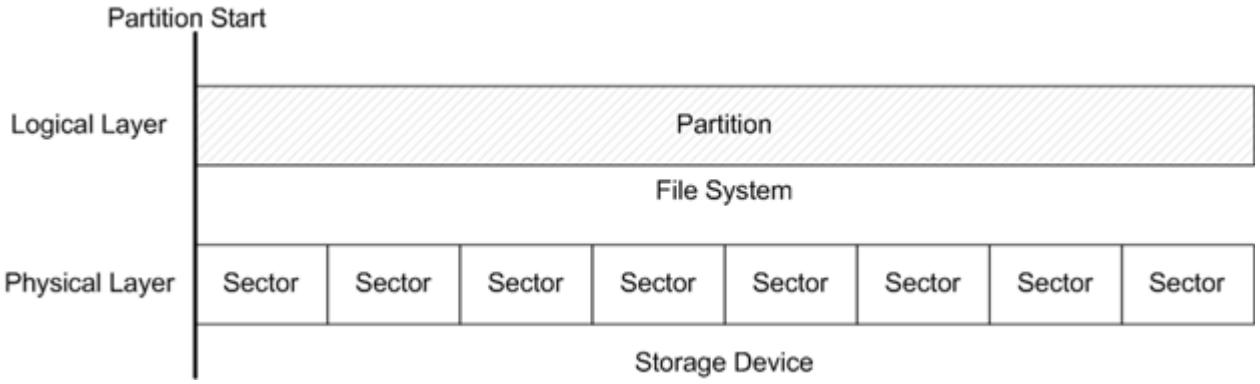
About Partition Alignment

What is Partition Alignment?

To understand what partition alignment is we should first see how data is stored on a drive.

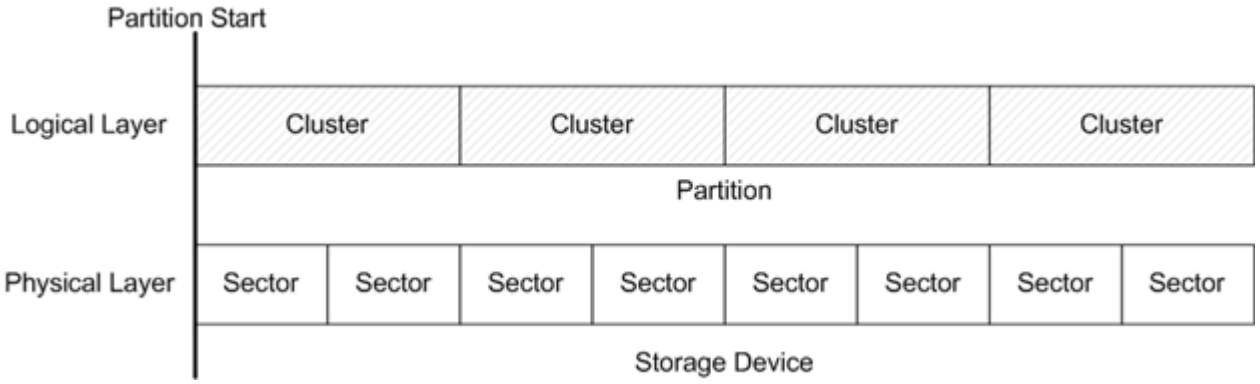
A standard hard disk drive is divided into physical sectors, where each sector is 512 bytes in size. On the Diagram 1 you can see a simplified partitioning scheme, where one partition consumes all drive space and sectors. In this case it is shown properly aligned with the first physical sector; that is, the partition start position corresponds with the first sector start position:

Diagram 1



The partition consists of logical units, called clusters. In this simplified partitioning example (Diagram 2), one logical cluster corresponds to two physical sectors:

Diagram 2



So in this example, when data is read from one logical cluster, for example a small text file, the storage device is actually reading data from two physical sectors. Here again the partition is shown properly aligned; that is, the partition start position and the first sector start position correspond to each other – so all clusters are aligned with all sectors, and thus drive operations are as fast as possible.

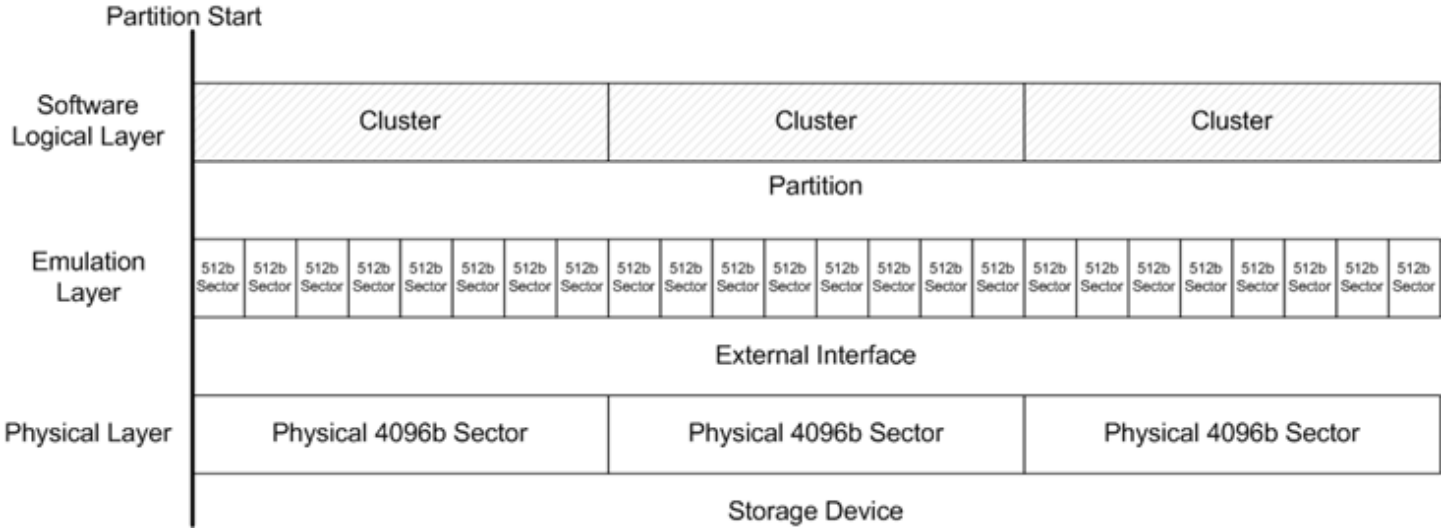
Why are Misaligned Partitions a Problem for Hard Disk Drives?

The next generation of hard disk drives, known as Advanced Format Drives (AF Drives) or “4K”, will have physical sectors that are 4,096 bytes in size (instead of 512 bytes) –because a larger sector size reduces the amount of Error Correction

Code (ECC) and head positioning (servo code) data on the drive, resulting in superior read/write performance and increased hard drive capacity.

But for drives including IDE and SATA, the sector size must be “emulated” at 512 bytes because OSs are designed to work only with sectors of 512 bytes, even though the physical sectors of internal AF Drives are actually 4K (4,096 bytes) in size:

Diagram 3

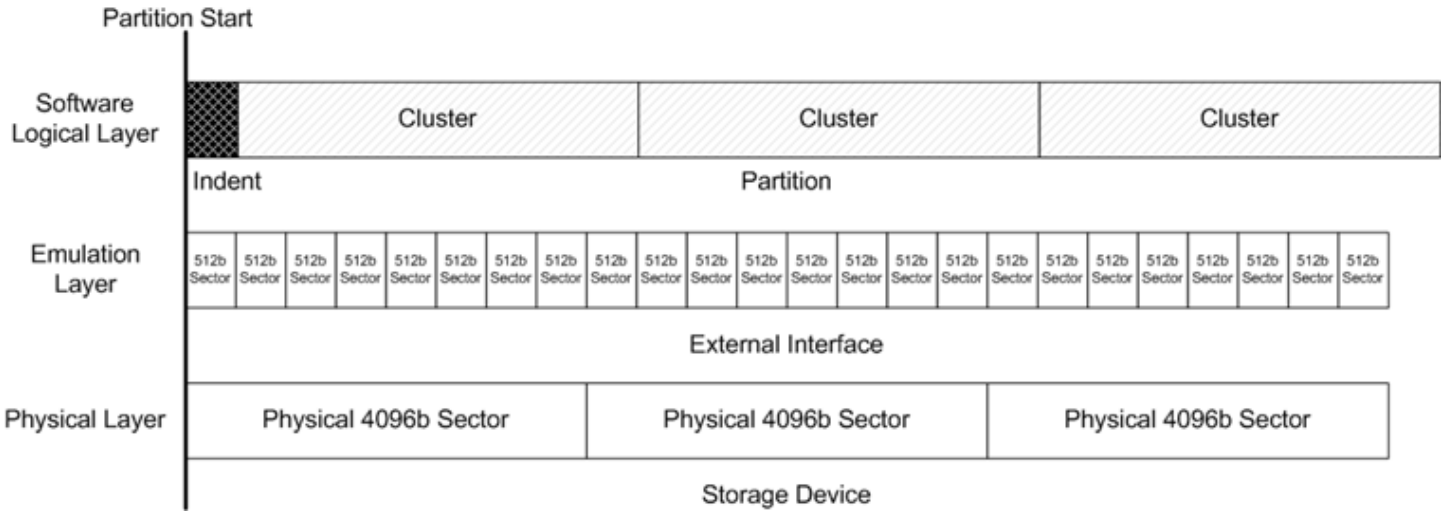


On the Diagram 3 you can see the three layers of an AF Drive: the bottom physical layer is divided into physical sectors that are 4K in size. The second emulation layer is divided into 512 byte sectors. And the top layer is the actual file system partition; here it is divided into 4K clusters, so 1 cluster = 8 emulated sectors = 1 actual physical sector.

Also notice that in this case all three layers are aligned in relation to each other and disk start position. So when you read or write data from one cluster, it will be actualized in four 512 byte emulated sectors and one 4K physical sector. The amount of required read/write operations is minimized; all disk operations are at maximum performance.

But look on the Diagram #4 what happens when logical clusters are shifted (misaligned) relative to all underlying layers:

Diagram 4



On the Diagram 4 you can see that the partition is shifted from the disk start position by 1 512 byte sector. As a result, all logical clusters are now linked (overlapping) with two actual physical 4K sectors, and all read/write operations will be doubled. In this case the performance of the entire system will decrease, because for each cluster of data, the drive has to perform two operations with two sectors –instead of just one if the partition was properly aligned.

What causes this shift? All Windows versions before Vista™ use a factor of 512 bytes to create volume clusters, meaning that the partition start position is aligned to 512 byte sectors and not to 4K sectors, where the partition start position is indented by one 512 byte sector as shown. It is also possible under certain circumstances for any version of Windows to create secondary partitions that are misaligned, and any third-party software which is not "4K-ready" can also misalign partitions.

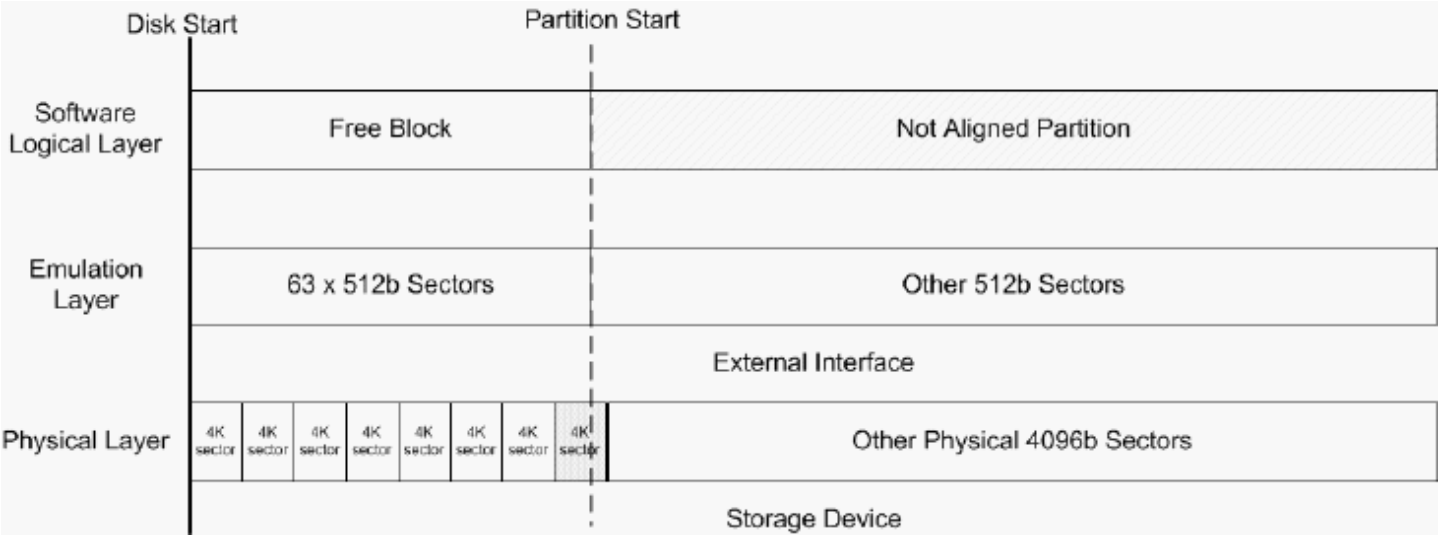
The partition start position is usually indented by 63 sectors because it's an old measure of disk "cylinder", and older versions of Windows (and DOS) require that the partition has to be aligned to the "cylinder" for correct sector addressing and access. This Cylinder/Head/Sector (CHS) addressing scheme is an old compatibility issue which modern operating systems do not use. Instead, they use a Logical Block Addressing (LBA) scheme where there are no "cylinders" or "heads"; sectors are addressed continuously over a whole disk drive. But for legacy reasons all Windows versions before Vista create partitions accordingly to the "cylinder alignment" rule.

There was no problem with this rule and partition alignment until "4K" (4,096 byte) AF Drives became mainstream. Partitions aligned to 63 sectors start position are not aligned with 4K sectors by default. This is a matter of simple math Formula 1:

$$\frac{\mathbf{63\ sectors} \times 512\ bytes}{1\ sector \times 4096\ bytes} = 7{,}875$$ Formula 1

As you can see, 63 sectors multiplied by 512 bytes does not equal a whole number of 4K sectors, thus this partition and as well as all other subsequent partitions on the disk are misaligned (Diagram 5):

Diagram 5



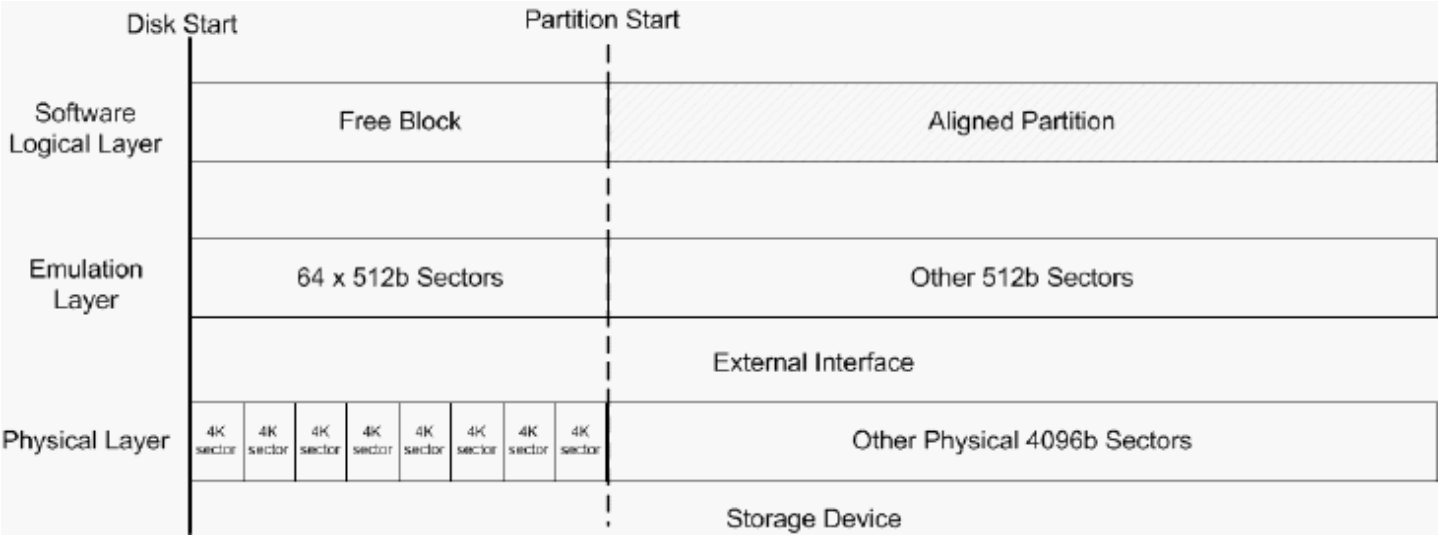
How can the Paragon Alignment Tool help?

PAT realigns all partitions that are misaligned by moving them the required number of 512 byte sectors so that all volumes become aligned. In this example (Formula 2), PAT will move the misaligned partition forward by one 512 byte sector to properly align it:

$$\frac{\mathbf{64\ sectors} \times 512\ bytes}{1\ sector \times 4096\ bytes} = \mathbf{8}$$ Formula 2

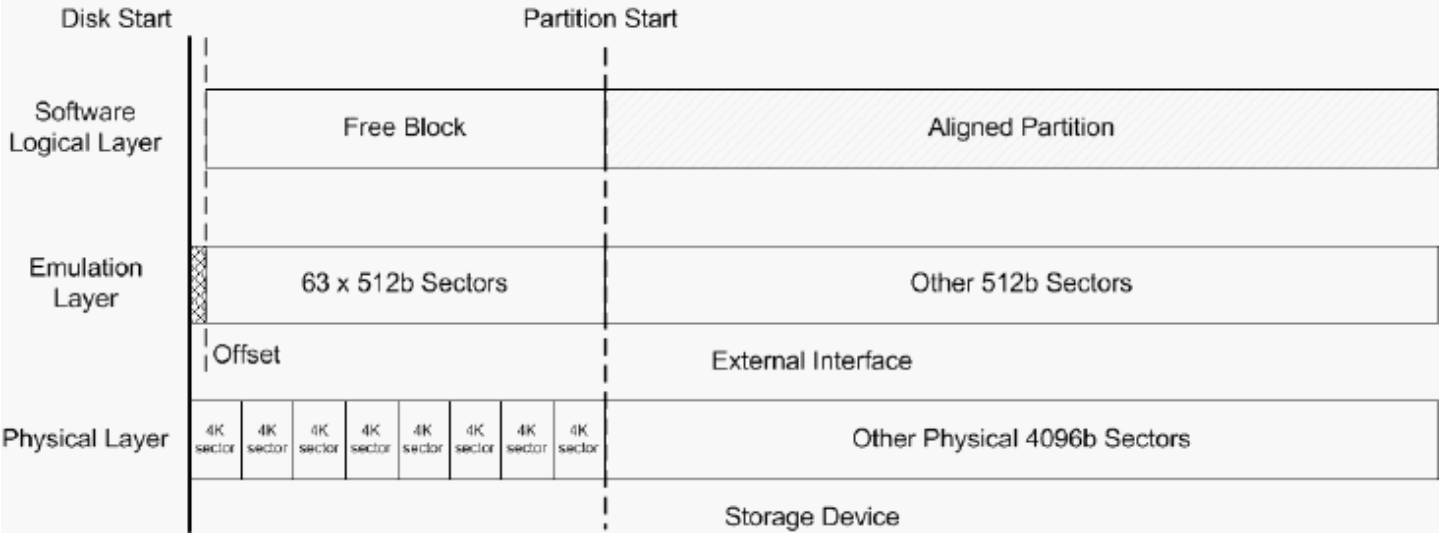
Now the partition start position corresponds to the 4K sector start position, so this partition as well as all other subsequent partitions on the hard drive are properly aligned (Diagram 6):

Diagram 6



There is also one other important issue: Some AF Drives have a trigger to address partition alignment issues. Their internal controllers can be adjusted to shift the emulation layer addressing to an offset of one 512 byte sector. Thus sector #63 becomes sector #64 so that all partitions will be aligned (Diagram 7):

Diagram 7



Most software will not detect a shifted volume such as this because all logical partitions are aligned, so applications which are not “4K offset-aware” will actually create misaligned partitions in this case. However, PAT is “4K offset-aware”, and is able to recognize a shifted volume such as in this example and will skip alignment of partitions on this type of AF Drive.

Getting Started with the Paragon Alignment Tool

In this chapter you will find all the information necessary to get the product ready to use.

System Requirements

Windows-based Utility

To use PAT, it must first be installed. Please make sure your computer meets the following minimum system requirements:

- Supported Operating Systems:
  - Windows XP (32 and 64 bit)
  - Windows 2003 (32 and 64 bit)
  - Windows Vista (32 and 64 bit)
  - Windows 2008 (32 and 64 bit)
  - Windows 7 (32 and 64 bit)
  - Windows 2008 R2 (64 bit only)
- Supported File Systems
  - FAT12
  - FAT16
  - FAT32
  - NTFS
- Internet Explorer 5.0 or higher
- Intel Pentium CPU or equivalent, with 300 MHz processor clock speed
- 128 MB of RAM (256+MB recommended)
- Hard disk drive with 100 MB of available space
- SVGA video adapter and monitor
- Mouse

Linux Based Environment

To use the PAT Universal Recovery CD, which utilizes a Linux based environment, on your computer it doesn't matter what operating system you have installed. Please make sure that your computer meets the following minimum system requirements:

- IBM AT compatible computer with i486 or higher CPU
- 256 MB of RAM

- SVGA-compatible monitor
- Mouse (recommended)

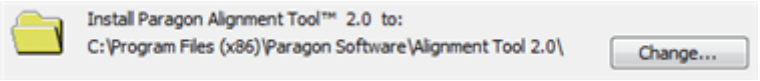
Additional Requirements

- Recordable CD/DVD drive to burn data to compact discs

Installation

Before installation, please make sure your platform meets the minimum system requirements. If your computer meets these requirements, please do the following to install PAT Windows installation package (How to setup Recovery CD you can find in section "Obtaining and burning the Universal Recovery CD"):

1. Click on the setup file to initiate the installation.
2. The Welcome page will inform that the application is being installed. Click **Next** to continue.
3. Please read the Paragon License Agreement carefully and then select the appropriate option to accept it. By not accepting the Paragon License Agreement you won't be able to proceed with the installation. By clicking the **Print** button, the license agreement may also be printed out.
4. **Provide Registration Information**. On the Registration page you are to provide your product key and serial number, if applicable.
5. **Provide Customer Information**. On the Customer Information page you are to provide standard information, i.e. a user name and an organization. You must also decide whether to make the program available for all users of this computer (if applicable) or only for the current user.
6. **Default Installation Path.** Click **Change** to install the utility to a different location (by default **C:\Program Files(x86)\ Paragon Software\Alignment Tool 2.0**). Otherwise, click **Next** to continue using the default path.



7. **Install PAT.** On the Ready to Install the Program page click **Install** to start the installation or click **Back** to return to any of the previous pages to review or modify the installation settings.
8. **Installation Complete.** The Final page reports the end of the setup process. Click **Finish** to complete the wizard.

First Start

To start the Paragon Alignment Tool, please double-click the Paragon Alignment Tool™ 2.0 desktop icon, or click the Windows Start button and then select **Programs > Paragon Alignment Tool™ 2.0> Paragon Alignment Tool 2.0**

Obtaining and burning the Universal Recovery CD

The Universal Recovery CD image is delivered as a separate download from the PAT installation package. The Universal Recovery CD is provided to assist in emergency situations only; when you encounter an interrupted alignment operation.

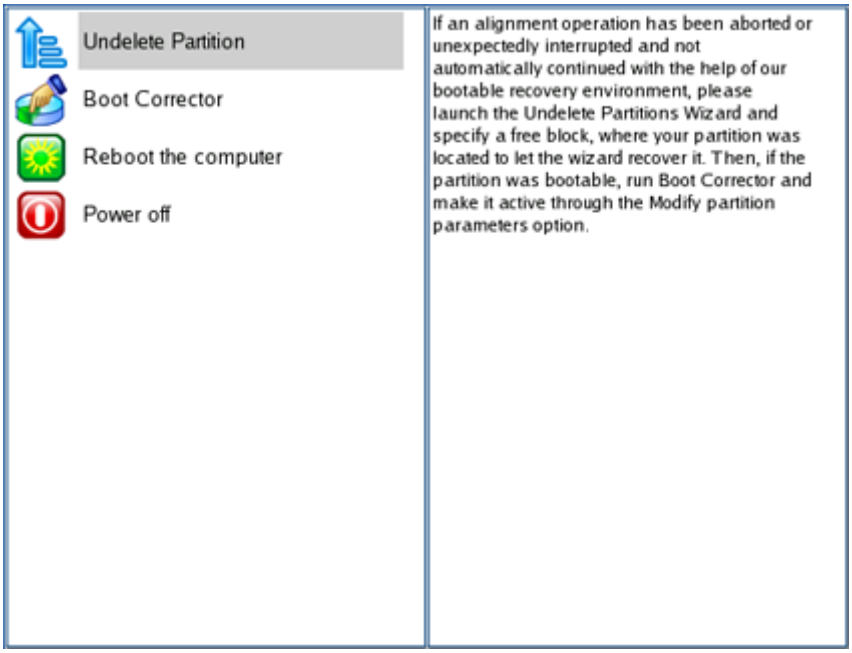
Your Universal Recovery CD can be downloaded separately from the web site. It is packaged within Paragon's Unpack and Burn Wizard. This wizard allows you to author PAT Recovery CDs or DVDs, creating bootable recovery media. The wizard will also allow you to extract the PAT Recovery CD ISO file to your hard drive. Using the Unpack and Burn Wizard will prevent the need of using third-party authoring tools to create PAT recovery media.

If you extract the PAT Recovery CD ISO file from the Unpack and Burn Wizard, use a third-party authoring utility of your choice, to burn the ISO image of the Paragon Alignment Tool Universal Recovery CD to a CD or /DVD.

Emergency Booting from the Universal Recovery CD

This Linux-based recovery CD can be used to boot your computer into PAT's recovery environment to get access to your hard disk for recovery purposes. If an alignment operation has been aborted or unexpectedly interrupted, you can continue the alignment.

To resume an alignment operation, please start the computer and boot from the PAT Universal Recovery CD.



Contacts

If you need technical assistance with the product, or want information on additional Paragon products, please use the following links:

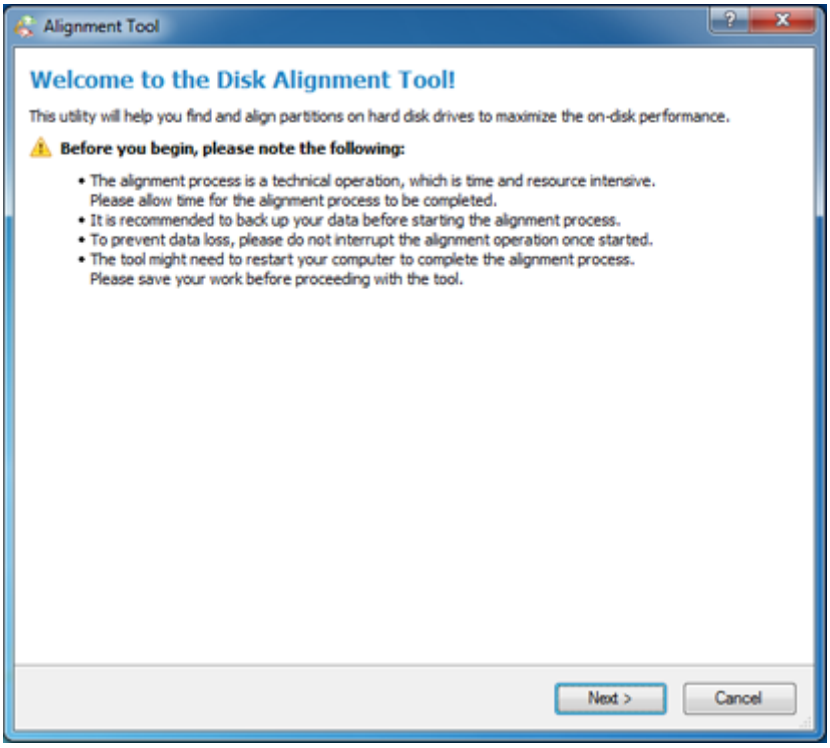
Service	Contact
Technical Support	www.toshibastorage.com/globalsupport
Visit Paragon's Website	www.paragon-software.com

Using the Paragon Alignment Tool

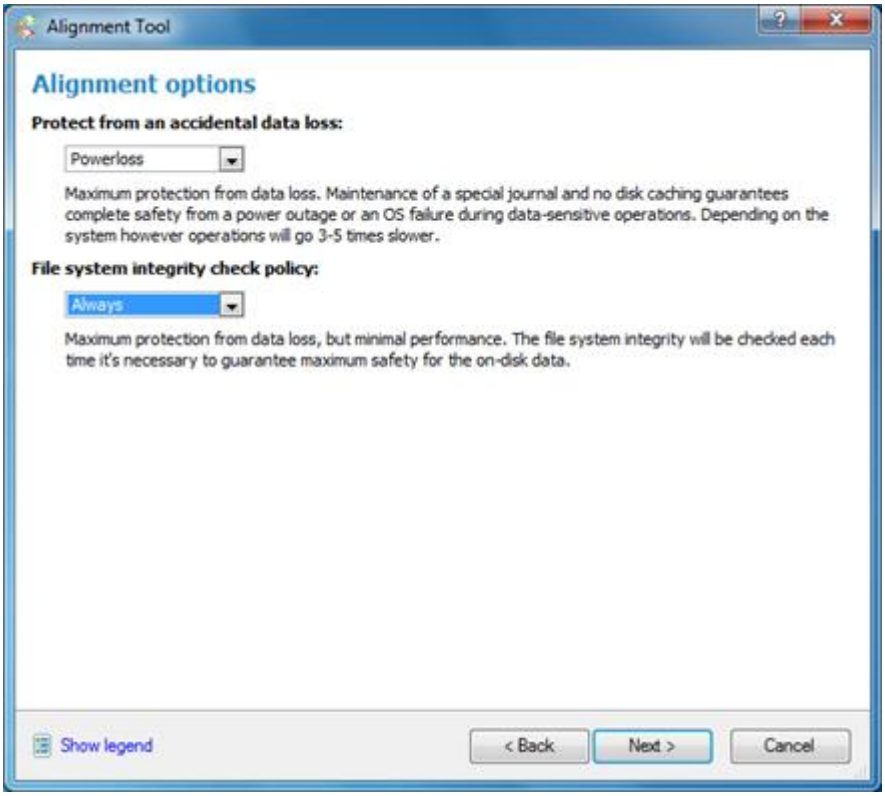
This chapter describes how the Paragon Alignment Tool is used for partition alignment.

1. Launch the program. Select **Programs > Paragon Alignment Tool™ 2.0> Paragon Alignment Tool 2.0** or click the corresponding shortcut on the Desktop.

2. Read the information on the Welcome screen, then click **Next** to continue:



3. The Alignment Options page is where you can choose how you would like the alignment process to be performed:



Default options are set for maximum data protection. This will take more time to complete alignments, but you will be protected from:

- File system errors on partitions to be aligned
- Power failure or other system interruption

To proceed in the fastest alignment mode, simply set the corresponding data protection settings to "**None**" and "**Never**" respectively, then click on the "**I understand the risks and want to proceed further**" check box.

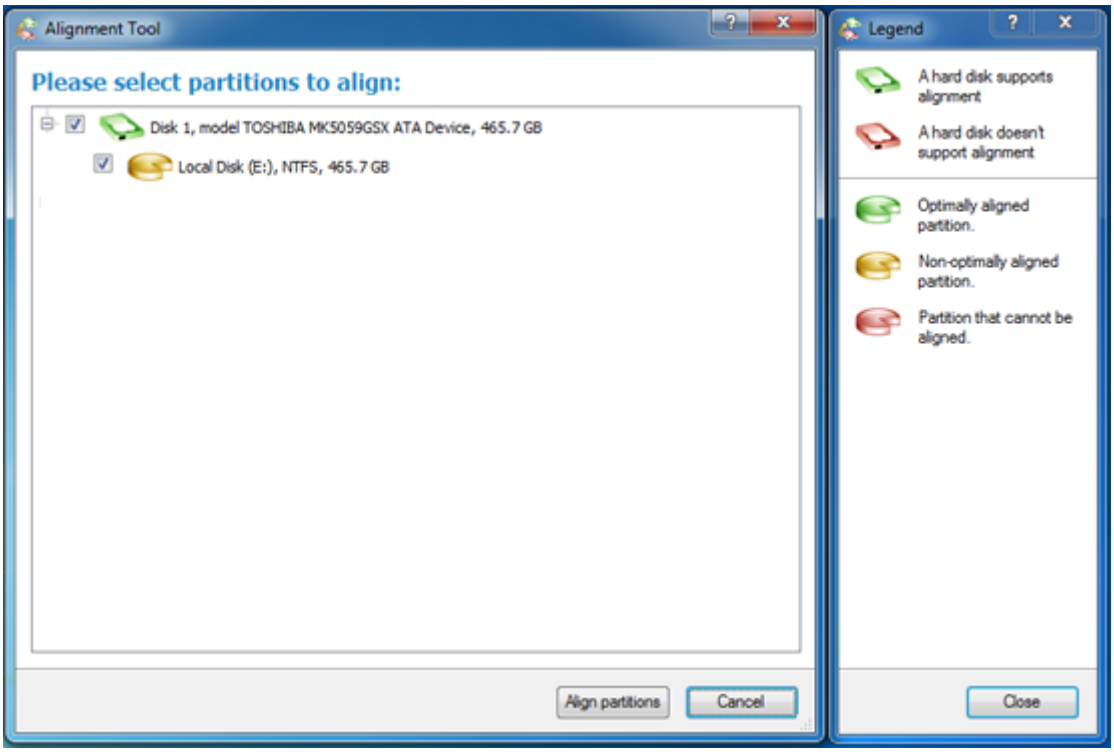
If you are concerned about potential power loss or other system interruptions during alignment, then one of the following options in the "Protect from accidental data loss" section can be selected:

- **No protection:** Protection disabled
- **Reset:** Protects from accidentally pressing the Reset button
- **Power loss:** Protects from complete system power interruption (default)

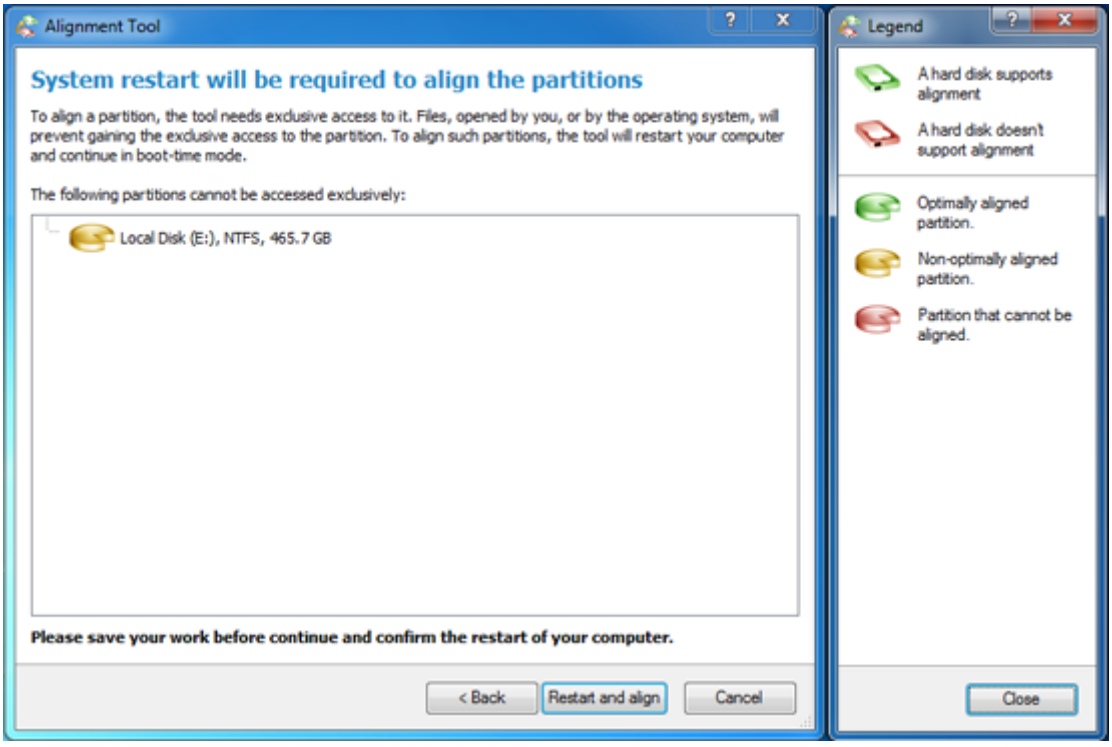
If you are concerned about the file system consistency of partitions (for example, "chkdsk /f" has never or rarely been performed), then one of the following options in the "File system integrity check policy" can be selected:

- **Never:** Do not check file systems
- **Once:** Check file systems once for each partition before alignment
- **Always:** Check file systems for each partition before & after alignment (default)

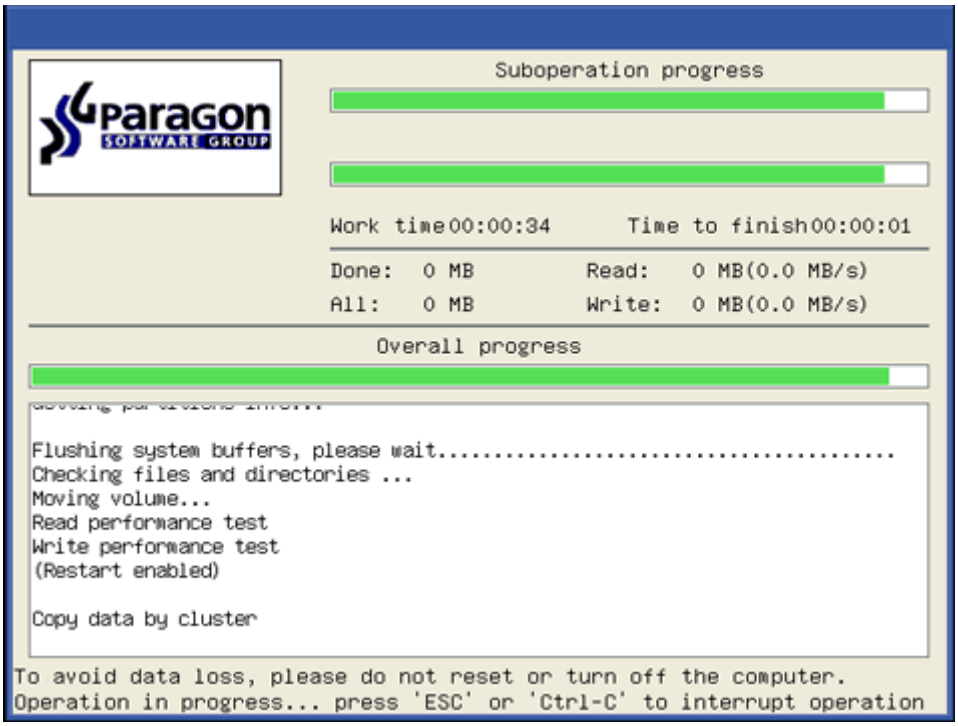
4. On the next screen is a display of all drives and partitions in the system on the left side, and a disk map legend on the right side. Select the partition(s) you want to align:



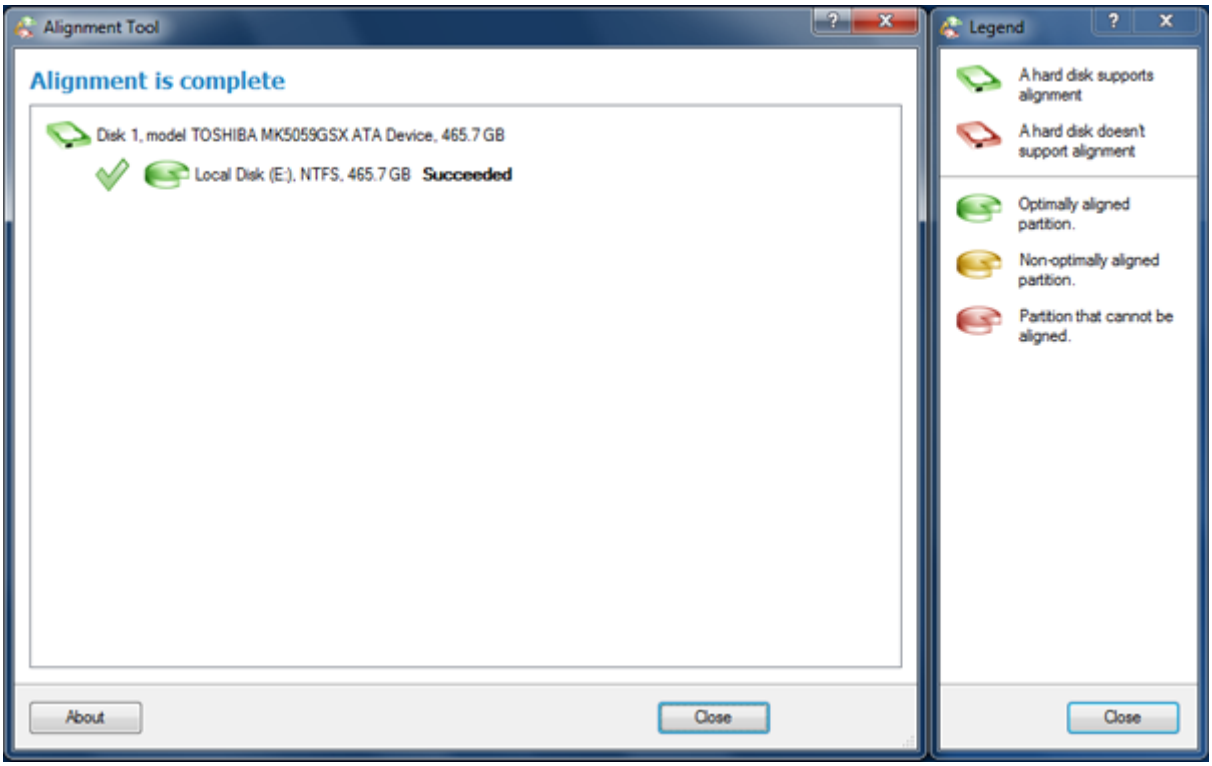
5. Click the **Align partitions** button and start the operation. **NOTE:** If there are any opened or used files on the partition, the program will prompt to restart the computer. The computer will restart and enter Blue Screen mode, where all operations will be safely performed.



6. The system will reboot.



7. It may take several minutes before the alignment operation completes. The amount of time needed depends on the amount of data in the partition. After alignment completes in Blue Screen Mode, your system will restart and return to Windows. Upon returning to Windows, PAT will be automatically re-launch and provide an alignment status update.



Recovery after Interrupted Alignment with the PAT Universal Recovery CD

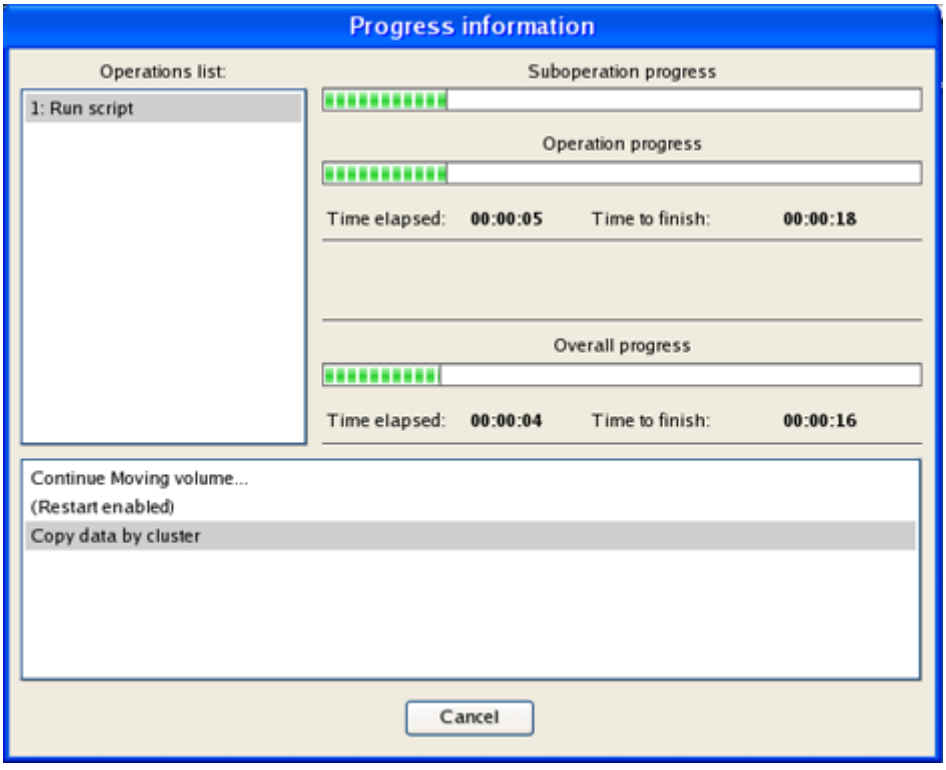
The PAT recovery environment is intended to help you successfully finish any unintentionally interrupted alignment operation. For example, a sudden power outage caused a computer shutdown, or an accidental button push caused a

reboot during alignment of the system partition and you can no longer boot to your operating system. Simply reboot your computer with the PAT Universal Recovery CD and continue the alignment operation.

1. Start your computer and boot from the PAT Universal Recovery CD.

2. A warning message will appear, prompting that an interrupted alignment operation was detected.

3. Click the **Yes** button to continue the interrupted alignment operation.



4. After the alignment operation completes, restart your computer.

Additional Options

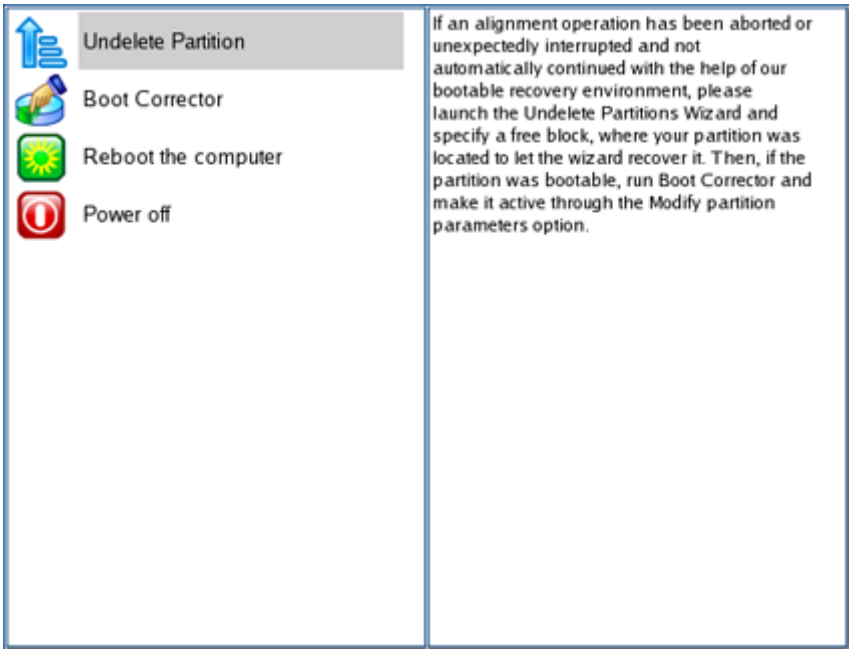
Undelete Partition

The program provides the ability to find and recover deleted partitions. This function is usually known as "undelete".

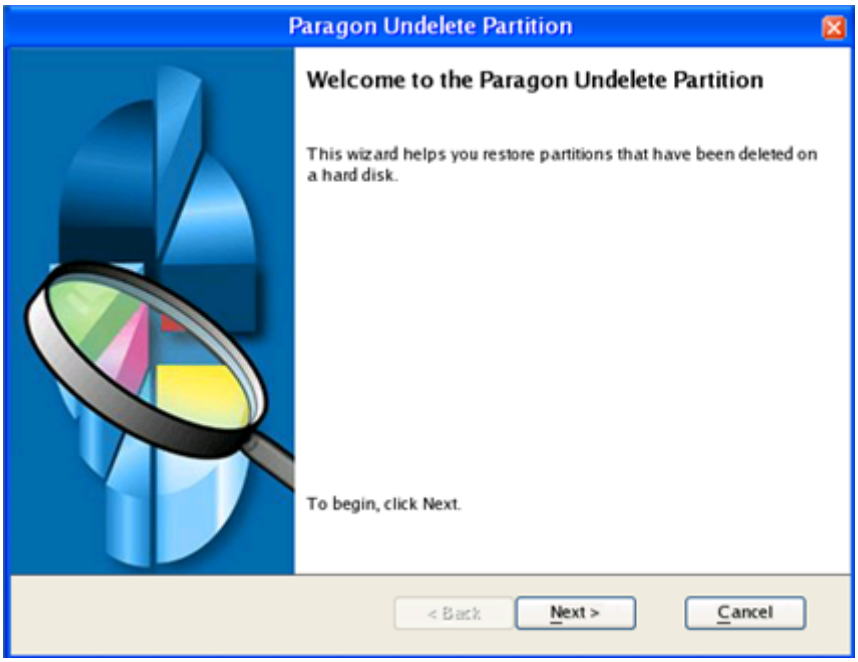
When PAT aligns a partition it deletes the partition from the Partition Table. In the event of a power outage during this stage all data remains untouched, but the computer no longer finds this partition. However, a previously deleted partition can still be recovered.

A restored partition will be fully functional, as long as other partitions were not created, moved or have not exceeded the disk space occupied by the partition before any undelete attempts. That is why the program enables the Undelete Partition function only for blocks of free space.

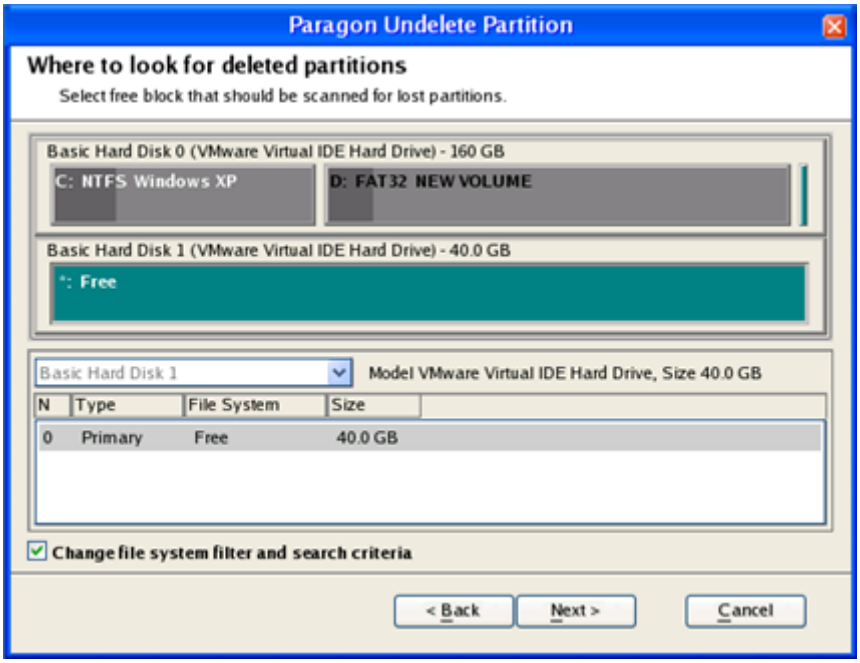
1. Start the computer and boot from the PAT Universal Recovery CD.
2. Select the **Undelete Partition** item from the PAT start menu.



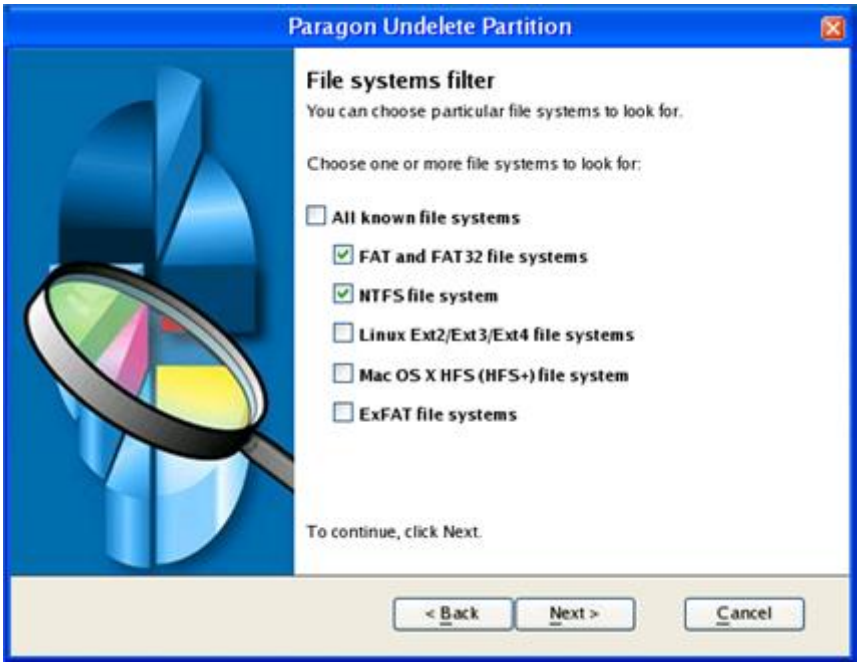
3. Click **Next** on the Welcome screen.



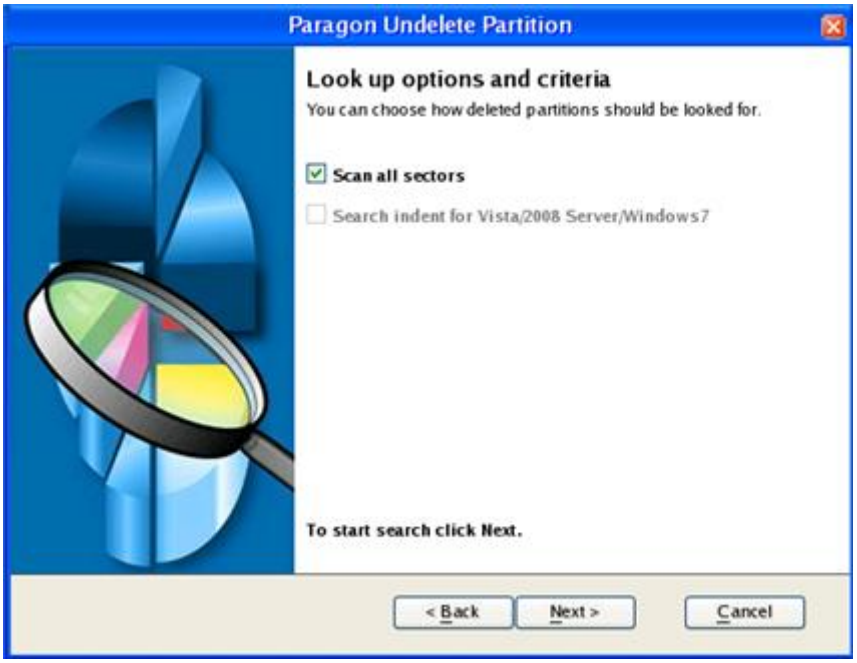
4. Select the free block that will be scanned for lost partitions.



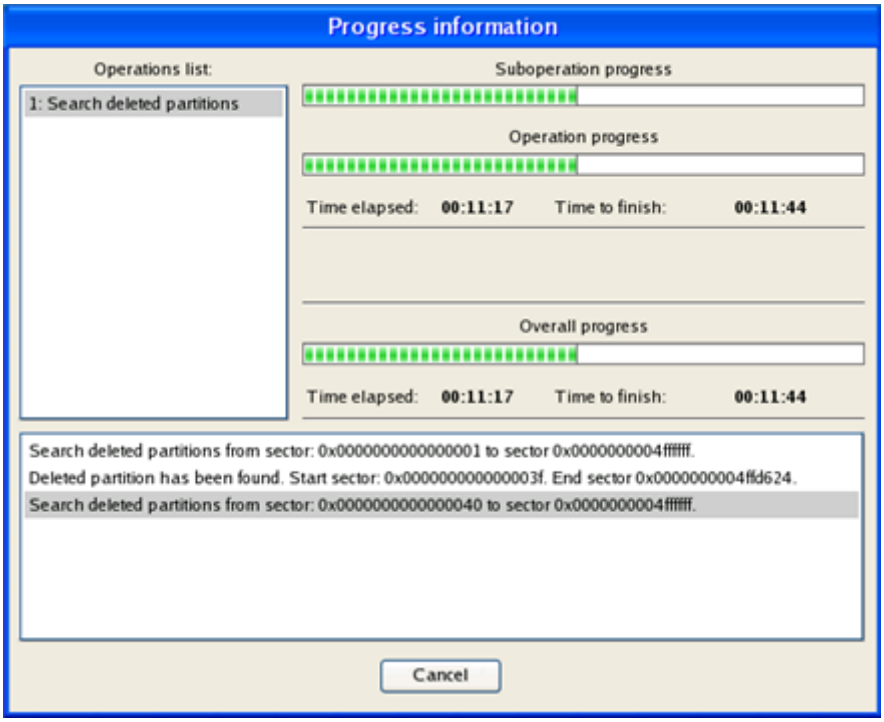
5. Optionally, choose specific file systems to search for.



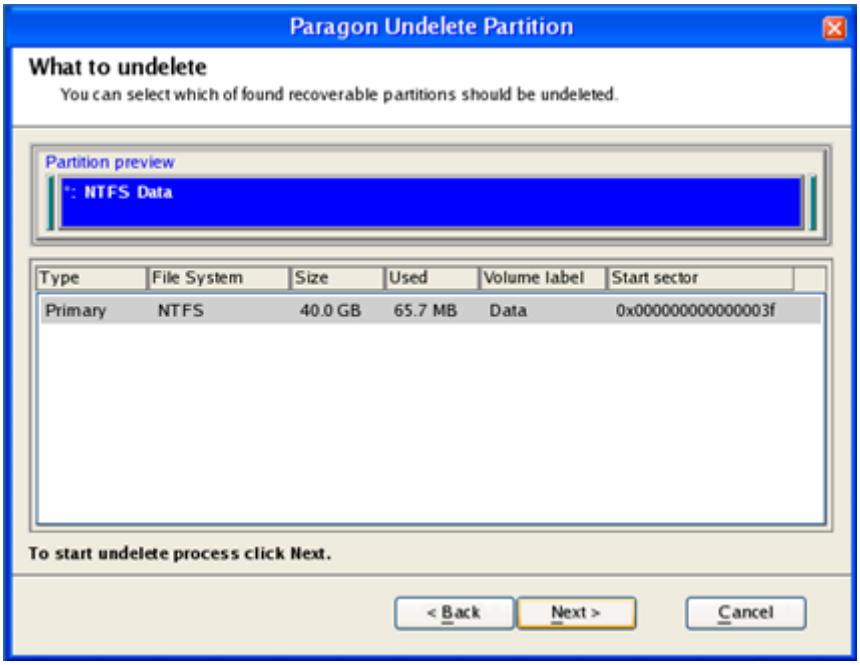
6. You can define how lost partitions should be searched: scan all sectors or only scan where Vista/Windows 7 creates volumes. Click **Next** to start the search.



7. The search progress will be shown.



8. After the search process finishes you will see whether any partitions were found. Here you can select which discovered partition(s) you need to recover.



9. Click **Next** to recover the partition.

Fixing the Master Boot Record (MBR) with Boot Corrector

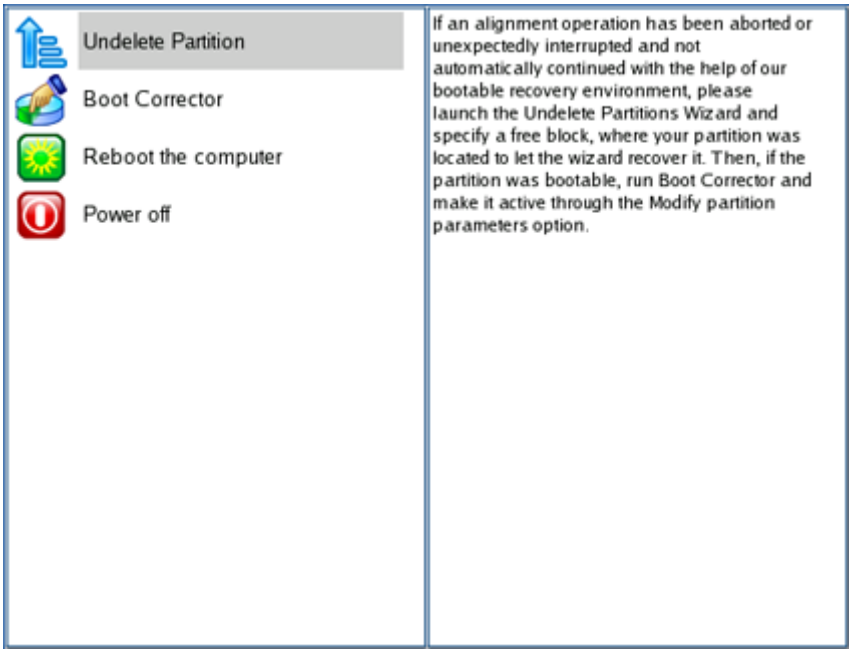
Boot Corrector is a system utility designed to tackle most of the system boot problems that can typically be a result of human error, program error, or boot virus activity. Boot Corrector is located on the Universal Recovery CD. The program is able to fix most of the common boot problems for Windows 2000/XP/Server 2003/Vista/Windows 7/Server 2008.

The crucial thing about Boot Corrector is that it provides the possibility to correct the Windows System Registry without Windows being loaded. It can be of help with other operating systems, for instance, when a boot virus has corrupted the MBR.

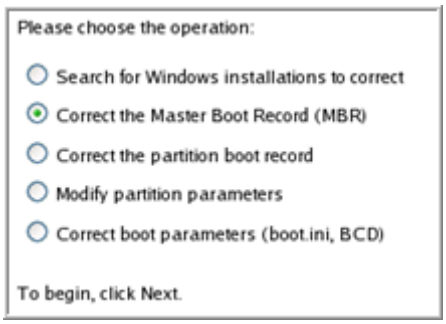
Let’s assume that the MBR of your hard disk has been corrupted, thus your system fails to boot.

To fix the MBR of your hard disk, please do the following:

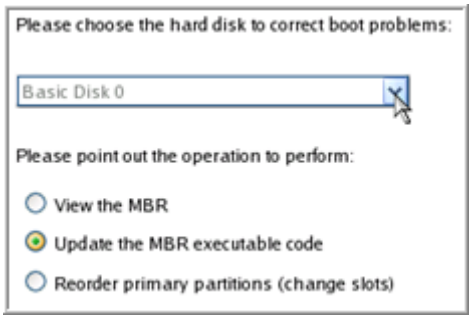
1. Start up the computer from the PAT Universal Recovery CD.
2. Select **Boot Corrector** from the PAT start menu.



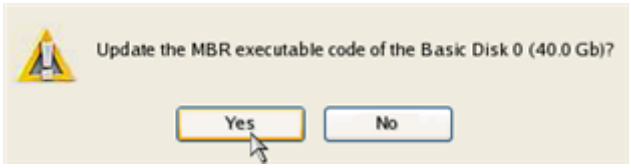
3. On the Welcome page, select the **Correct the Master Boot Record (MBR)** option.



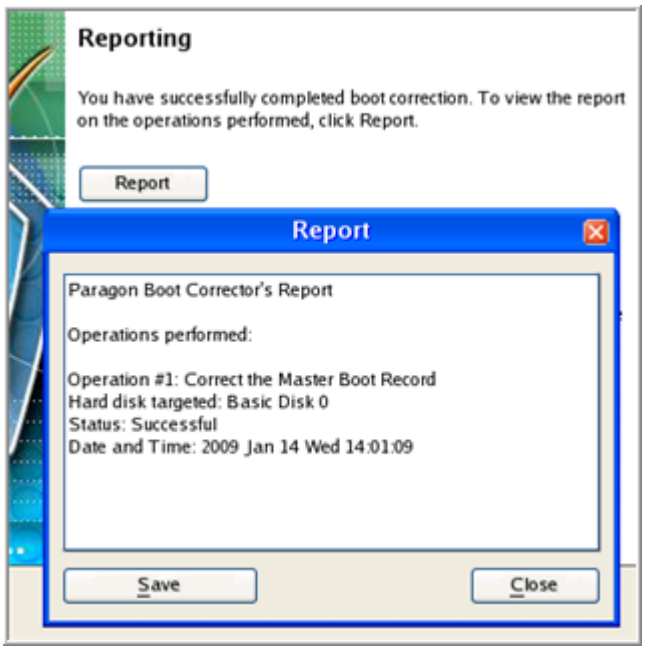
4. On the next page choose the required hard disk from the drop-down list (if applicable) and then select the **Update the MBR executable code** option.



5. Confirm the operation by clicking the **Yes** button.



6. After the operation is complete, click the **Report** button to see an informative summary. The program also enables you to store this report. To do so, just press the **Save** button and choose the destination.



7. Click the **Finish** button to close **Boot Corrector**.

8. Restart the computer.

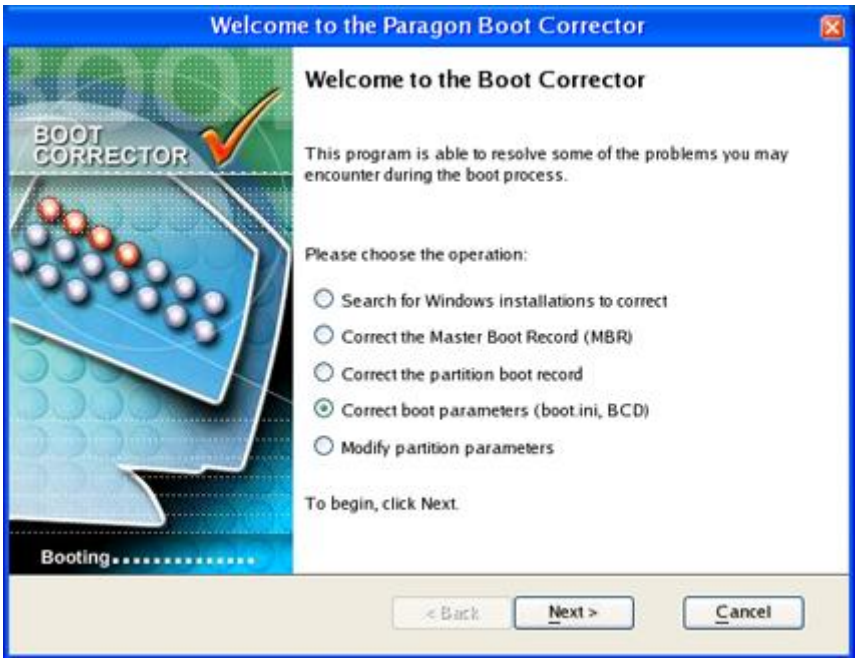
Correcting the Boot Configuration Data (BCD)

To automatically correct the BCD of a Windows 2000+ system, please do the following:

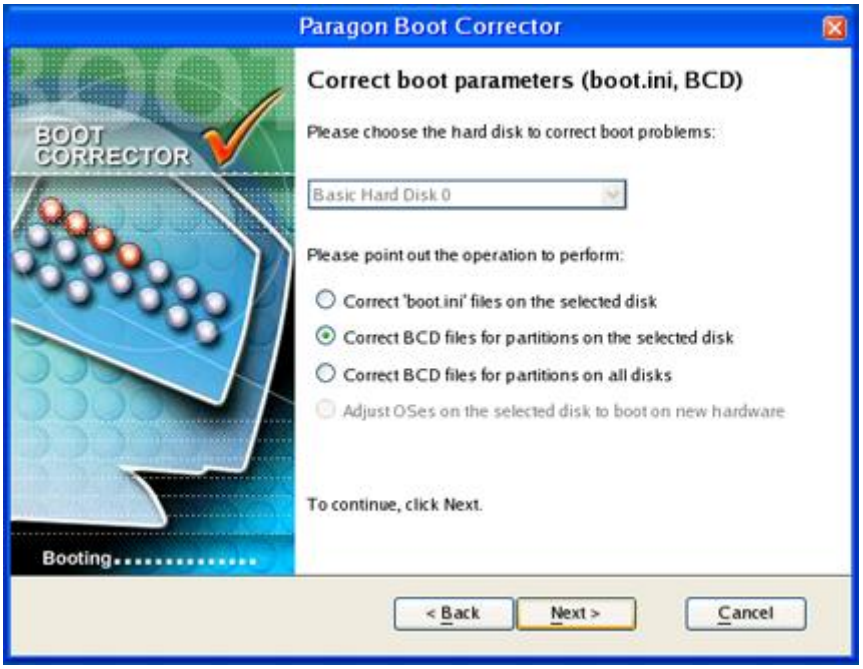
1. Start up the computer from the PAT Universal Recovery CD.

2. Launch **Boot Corrector**.

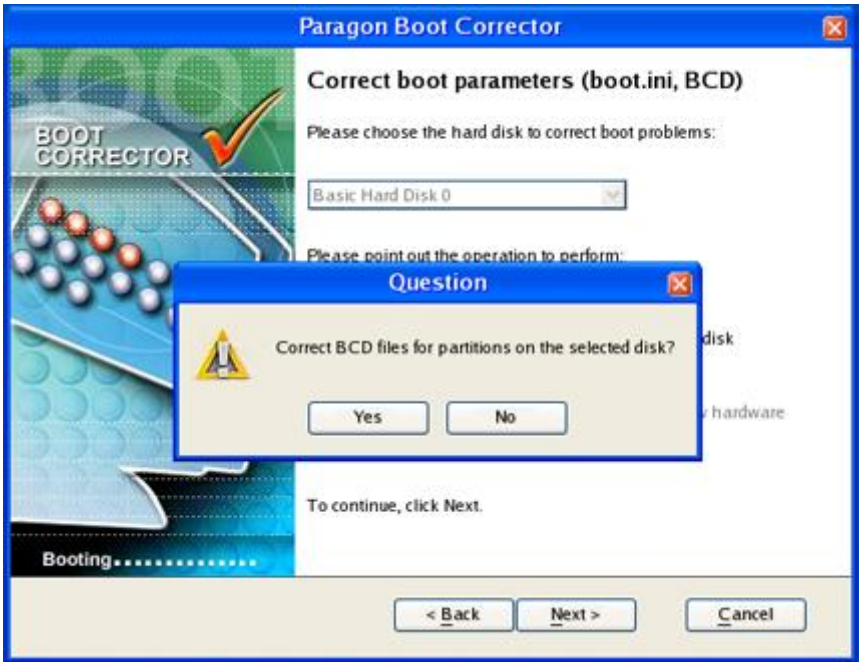
3. Select **Correct boot parameters…** to let the wizard fix the BCD in all recognized Windows 2000+ installations.



4. Select the option to **Correct BCD files for partitions on the selected disk**.



5. The wizard will ask you to confirm the operation. Click the **Yes** button to confirm the operation.

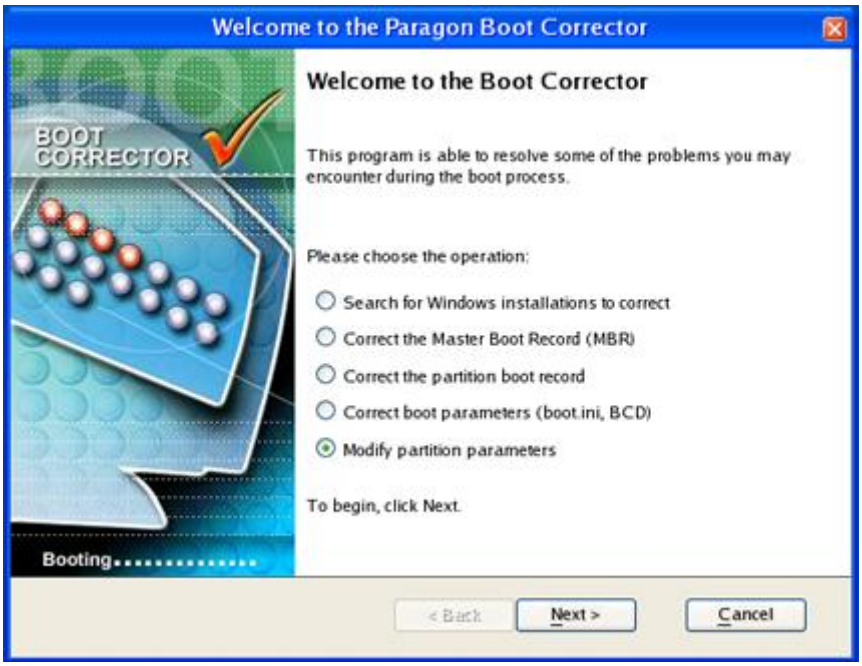


After completing the operation close the wizard, and then reboot the computer.

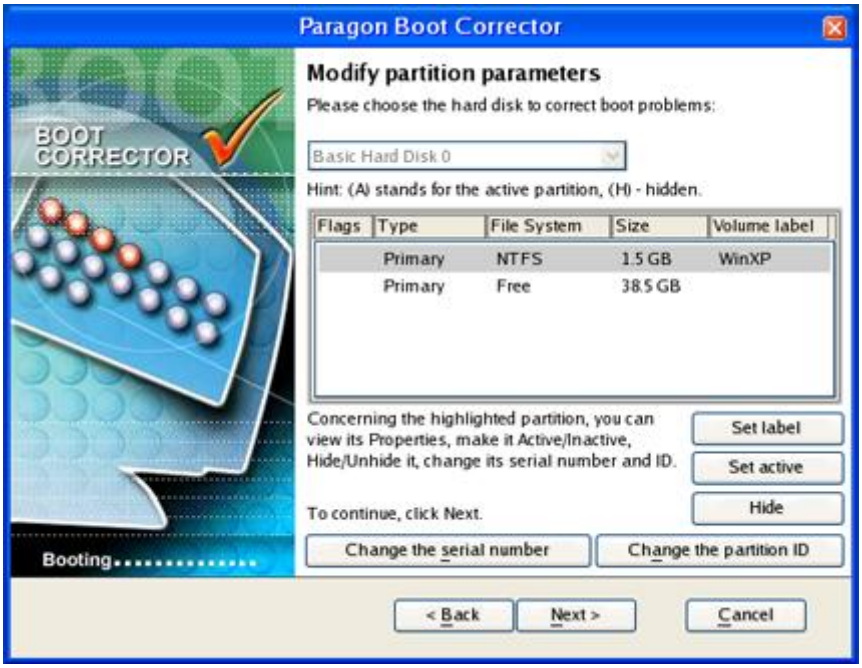
Marking Partitions Active

To mark a partition of a Windows 2000+ system as Active, please do the following:

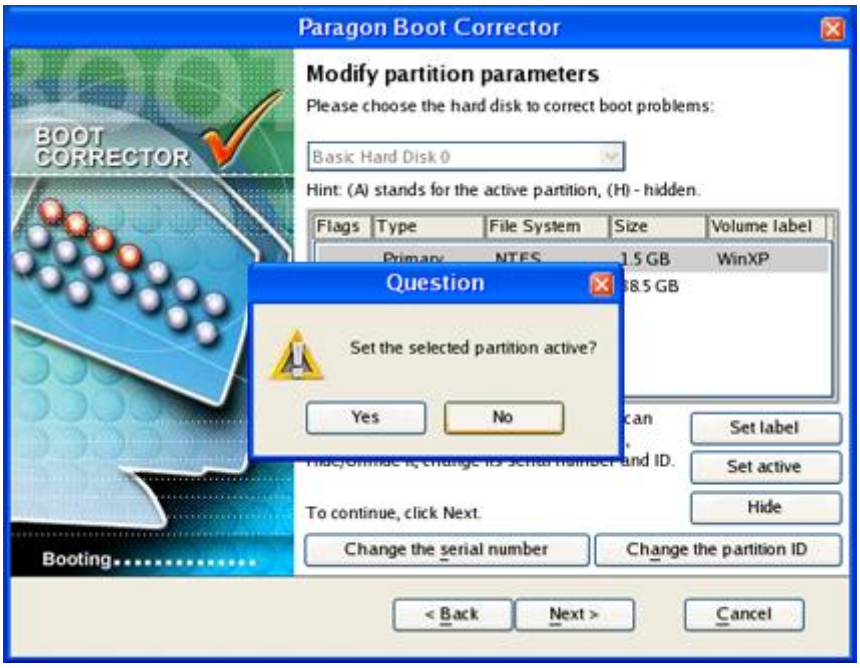
1. Start the computer from the PAT Universal Recovery CD.
2. Launch **Boot Corrector**.
3. On the Wizard's Welcome page, select **Modify partition parameters**.



4. Choose the partition to modify and click **Set active**.



5. The wizard will ask you to confirm the operation. Click the **Yes** button to confirm the operation.



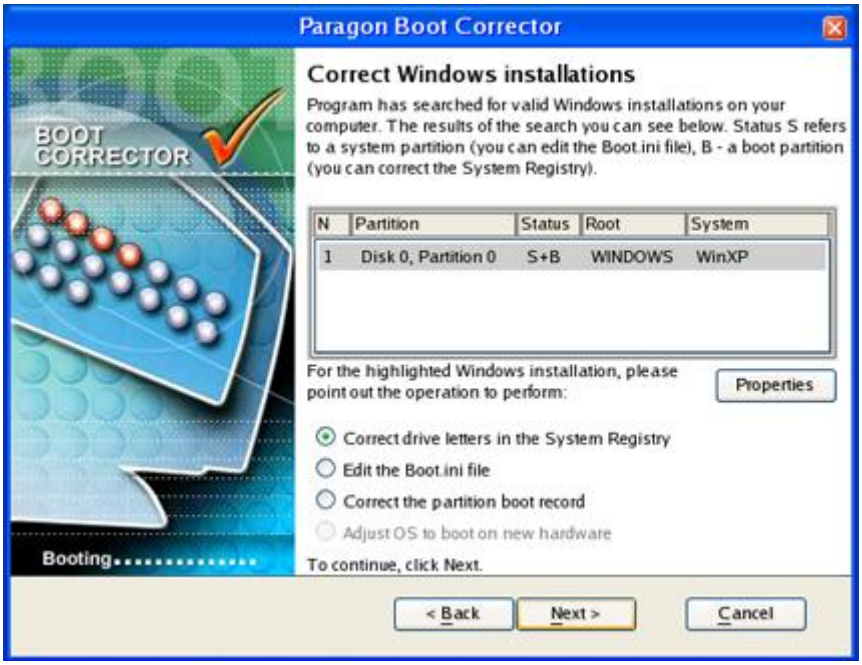
After completing the operation close the wizard, and then reboot the computer.

Changing Drive Letters

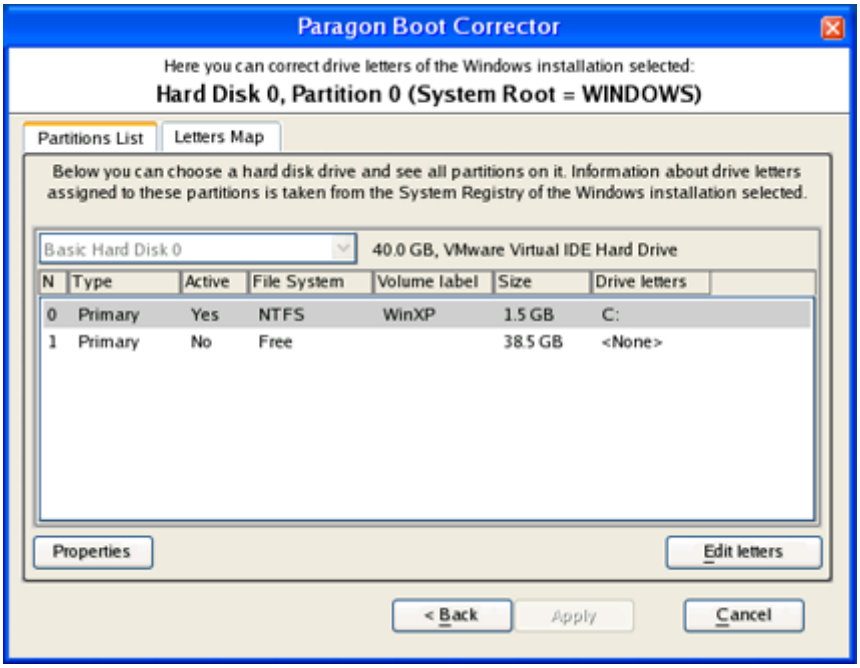
To change a partition drive letter, please do the following:

1. Start the computer from the PAT Universal Recovery CD.
2. Launch **Boot Corrector**.
3. On the Wizard's Welcome page, select **Search for Windows installations to correct**.

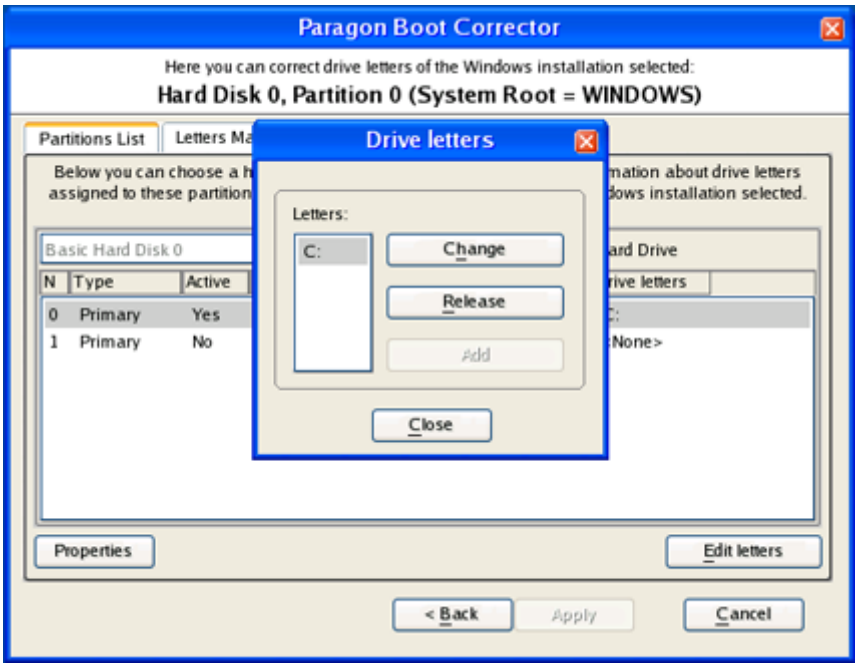
4. Select the detected Windows installation you desire and select the **Correct drive letter in the System Registry** option.



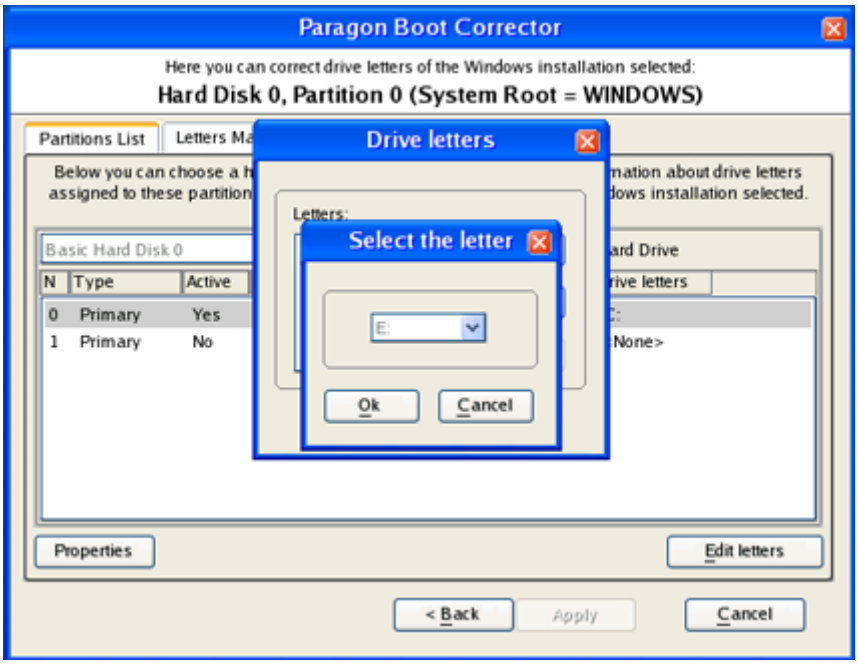
5. Select the system volume and click the **Edit letters** button.



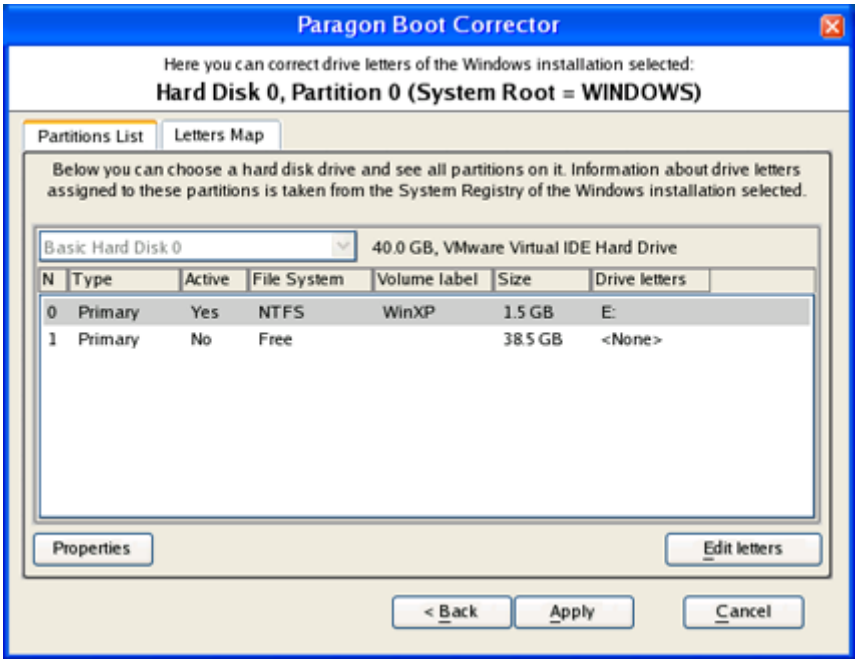
6. A window will appear where you will see the letter you chose. Click **Change**.



7. Select a new drive letter and click **OK**.



8. The wizard will then commit the drive letter change.



After completing the operation close the wizard, and then reboot the computer.