

Preparing Advanced Format Hard Drives for Installing Microsoft Windows^Æ on HP Business Notebook and Desktop PCs

Technical white paper

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Executive Summary

This white paper is designed for both consumers and SMB/enterprise and provides instructions for preparing an Advanced Format hard drive for installing Microsoft Windows[®] 7, Microsoft Windows XP, Microsoft Windows Vista[®], and Linux (SuSE and RedFlag) operating systems on HP business notebook and desktop PCs.

Hard Disk Drives (HDD) have used 512 byte sectors for a very long time and the industry has reached the limit for drive capacity for a given physical drive size. To address these limitations, the industry is moving to 4096-byte sectors (4kB sectors), which are sectors 8 times bigger than current drive technology. This change creates a drive that has less wasted space on the physical drive platter, is easier to manufacture and gives room to have larger-capacity drives. The initial generation 4kB sector drives remain backwards compatible with current computers by using standard 512-byte sector SATA communications. These drives — also known as 512e drives — operate internally at 4096 bytes and externally at 512 bytes. Because they are backwards compatible, any PC using a SATA interface can use these drives, but there are some extra steps required depending on operating system.

Operating System Readiness

As Table 1 highlights, newer operating systems — starting with Microsoft Windows Vista Service Pack 1 and continuing with Microsoft Windows 7 — will detect and have no problem with the 4kB-sector alignment. However, operating systems that are Advanced Format aware may require updates to improve performance, as noted in the Hard Drive Performance section.

Table 1: Advanced Format aware operating systems

Operating System	Advanced Format aware?
Microsoft Windows 7	Yes
Microsoft Windows Vista	Yes — Service Pack 1 or higher
Microsoft Windows XP	No (Requires Alignment)
Microsoft Windows 2000	No (Requires Alignment)
SuSE Linux	Yes — Linux kernel in SLE11-SP1 or higher
RedFlag Linux	Yes — kernel version v2.6.31 or higher
Microsoft Windows PE	Yes — 2.1 and higher
MS-DOS	No

Operating systems listed in the table above that are Advanced Format aware can still suffer alignment issues when using third-party deployment tools. Contact the vendor of your deployment tools for requirements for using Advanced Format hard drives.

Hard Drive Performance

Extra steps are required to get optimal performance from your new hard drive. Refer to Table 2 for required and suggested optimization steps.

Table 2: Software for Advanced Format hard drives

Operating System	Importance	Software for Advanced Format hard drives
Windows 7	Suggested Suggested	SP50624 Intel RST 9.6 or higher — for Intel chipsets only SP49457 Essential system updates 1.1.F, 1 or later
Windows Vista	Suggested	SP50624 Intel RST 9.6 or higher — for Intel chipsets only
Windows XP	Required Suggested Suggested	SP51013 Partition Alignment Utility SP50624 Intel RST 9.6 or higher — for Intel chipsets only SP50304 AMD Storage Driver — for AMD chipsets only
	Required Required	For HP desktop PCs only SP51011 Partition Alignment Utility SP51017 Partition Alignment Utility — bootable CD
Windows 2000	Required	SP51015 Partition Alignment Utility — bootable CD
Windows PE 2.1	Suggested	KB982018 Microsoft Windows PE Hotfix

All software listed can be downloaded from www.hp.com, with the exception of the Microsoft Windows PE hotfix, which can be downloaded at:

<http://support.microsoft.com/hotfix/KBHotfix.aspx?kbnun=982018&kbln=en-us>

Validating Partition Alignment

Using MSINFO32 utility

1. After operating system installed, Run `msinfo32` in windows command line.
2. Go to Component ->Storage -> Disks.
3. Divide each partition's `Partition Starting Offset` number by 4096. If divisible, the partition is aligned.

Using WMIC utility

1. After operating system installed, Run `wmic` in windows command line.
2. Type `partition` at the prompt to show all partitions information in the system.
3. Divide each partition's `Partition Starting Offset` number by 4096. If divisible, the partition is aligned.

Using DISKPART utility

1. Boot with bootable Microsoft Windows PE RAM media.
2. Executing the diskpart utility to get the hard disk partition info. For example, the following script is to find the partition-1 information of the disk 0.

```
diskpart
select disk 0
select partition 1
detail partition
```

3. Divide each partition's `Offset in Bytes` number by 4096. If divisible, the partition is aligned.

Table 3: Sample script output

```
Partition 1
Type : 07
Hidden: No
Active: No
Offset in Bytes:1048576
```

Volume ###	Ltr	Label	Fs	Type	Size	Status	Info
* Volume 1			NTFS	Partition	9 GB	Healthy	

Example for calculations

As illustrated in Table 4, the drive partition size and starting offset should be in multiple of 4kB.

Table 4: Partition size and starting offset

Partition #	Partition size	Starting offset
Partition #0	208666624 ($208666624/4096=50944$)	1048576 ($1024 \times 1024 =$ $1048576/4096 = 256$)
Partition #1	732388392960 (=178805760)	209715200 (=51200)
Partition #2	17449353216 (=4260096)	732598108160 (=178856960)
Partition #3	107864064 (=26334)	750047461376 (=183117056)

Clean Installation of the Operating System or Image for Advanced Format Hard Drive Support and Deployment

System requirements and preparation

Information regarding minimum hardware requirements for the installation of Microsoft Windows is available at <http://www.microsoft.com>.

You need the following items to help you install Windows:

- A supported HP business notebook or desktop PC model with an Advanced Format hard drive installed.
- Microsoft Windows 7 (preferred) or Microsoft Windows Vista Service Pack 1 or later operating system — even if installing Microsoft Windows XP.

WARNING: Before proceeding with the installation of Microsoft Windows, you should back up all personal data, such as files and images. If it is not backed up, your personal data will be lost.

Creating a 4kB-aligned partition on an existing Microsoft Windows XP or Microsoft Windows 2000 installation

1. Boot the system.
2. Run Partition alignment tool referred to in Table 2.
3. If Partition alignment tool indicates the operating system is not supported, go to Step 6 below.
4. Reboot the system.
5. Go to Validating partition alignment section on page 5.
6. Burn a CD/DVD/flash drive with the Partition Alignment Tool ISO bootable image referenced in Table 2.
7. Boot the system with the ISO bootable CD/DVD/flash drive you just created.
8. Run the Partition alignment tool.
9. Reboot the system normally.
10. Go to Validating partition alignment section on page 5.

Creating a new 4kB-aligned partition prior to installing Microsoft Windows XP or Microsoft Windows 2000

1. Boot the target notebook or desktop PC with Microsoft Windows 7 OS media or Microsoft Windows Vista (SP1 or later) OS media — even if you plan on installing Microsoft Windows XP or Microsoft Windows 2000. You're just going to use Win 7 or Vista to partition the hard drive, and once you partition it you can run XP, 2000, or another OS that's not 4K-alignment aware.
2. Instead of choosing Install, choose Repair An Installation.
3. Select Advanced from the available options.
4. Select Command Prompt to launch the Command Prompt window.

5. Format the hard drive by using diskpart utility at the prompt. Again, you should back up all personal data, such as files and images, because this process will erase the hard drive that is Disk 0 and all existing data on it will be lost.

```
diskpart
select disk 0
clean
create partition primary
select partition 1
exit
```

Further detail can be found under <http://technet.microsoft.com/en-us/library/bb490893.aspx>.

6. Reboot the target system and start the installation process.

Enterprise deployment and imaging for Microsoft Windows 2000, Microsoft Windows XP, Microsoft Windows Vista SP1, and Microsoft Windows 7

Enterprise Deployment is intended for the IT professional. Using non-Microsoft third-party utilities may negate the following steps and result in an unaligned drive.

HP suggests adding the Microsoft Windows PE Hotfix KB982018 to the source image to improve ImageX performance. To do so:

1. Download the Microsoft Windows PE HotFix under <http://support.microsoft.com/hotfix/KBHotfix.aspx?kbnm=982018&kbln=en-us> to c:.
2. Unzip the download file to c: by double clicking on it.
3. The `Windows6.1-KB982018-x86.MSU` should appear in c:. Please Expand the file by:
 - a. Launching command prompt with Administrator rights
 - b. At the prompt, enter the following:
`expand.exe c:\Windows6.1-KB982018-x86.MSU -f:*.* c:\`
4. Click Start, point to All Programs, point to Windows OPK or Windows AIK, right-click Deployment Tools Command Prompt, and then select Run as administrator.
5. At the prompt, expanding the WinPE image by mounting `iboot.wim` to be updated into a location by entering:
`ImageX.exe /mount /w c:\winpe_x86\ISO\sources\boot.wim 1 c:\winpe_x86\mount`
6. Create a scratch directory entering following at the prompt:
`mkdir c:\winpe_x86\sandbox`
7. At the prompt, applying the KB982018 update to your boot.wim image by entering:
`Dism.exe /image=c:\winpe_x86\mount /ScratchDir=c:\winpe_x86\sandbox /Apply-Unattend=c:\Windows6.1-KB982018-x86.xml`
8. At the prompt, committing the WinPE image by un-mounting `iboot.wim` to be updated into a location by entering:
`ImageX.exe /unmount /commit c:\winpe_x86\mount`

Frequently Asked Questions

What should I do if I'm not sure I have an Advanced Format hard drive?

If you're not sure, follow these steps anyway. Changing your installation methods for 4kB-sector alignment won't negatively impact a 512-byte drive.

If my OS is Advanced Format aware but I don't have a 512e drive, do I need to do anything?

No changes are required to support 4kB-sector alignment in 512-byte hard drives.

What happens if I don't align my partitions?

Your Advanced Format hard drives will work, but you may see failures in applications because of the unexpected slowdown.

What impact does this have on Linux users?

When creating partitions, do not create MS-DOS-compatible partitions and use kernel version 2.6.33 or higher. Refer to Appendix D for details regarding SuSE Linux. Regarding RedFlag Linux, kernel version 2.6.31 and higher ship from HP read for new HDD technology.

What impact does this have on FreeDOS users?

Refer to table 2 for the operating system being installed. FreeDOS itself has no requirements for the new HDD technology.

What if I'm running older operating systems or if I have 512-byte drives or a mixed environment?

There are no issues in making these modifications for 512-byte drives or in mixed environment. And it doesn't matter if you're running or plan to run Microsoft Windows XP or Microsoft Windows 2000 or something else — you're just using Microsoft Windows 7 or Microsoft Windows Vista to partition the hard drive.

Are there any differences in Advanced Format hard drives?

With certain drive models, there is noticeably superior performance with a slight increased potential for data loss. While many vendors are switching to the new drives without making any other changes, some vendors have made the transition more transparent to users and optimized the performance of their software by delaying the writes. While these sequential writes improve performance, they keep data in the cache longer. If you fail to align one of these write-optimized drives, there is a higher than normal risk of data loss.

Why not just go to 4096 native physical?

This is a good question and HP clients did consider this. The existing system infrastructure was designed around a logical 512 bytes (especially the hard disk boot device) and the resources required for this task would have been vast. In addition there would have been older applications and games that just never could have been used again. Add to that there would have been no performance advantage for a customer, HP elected to not pursue this approach at this time.

What other tools will I need for advanced deployment techniques?

- A technician computer with Microsoft Windows 7 or Microsoft Windows Server 2008 installed.
- Microsoft Windows Automated Installation Kit.
- Microsoft Windows PE Hotfix KB Article Number(s): 982018.
- A USB Flash drive.
- A blank CD-ROM and CD-ROM-burning software — if you chose to create a Microsoft Windows PE CD.

References

Microsoft support information

- <http://support.microsoft.com/kb/982018>

Microsoft Windows Automated Installation Kit (AIK) Download

- <http://www.microsoft.com/downloads/en/details.aspx?FamilyID=696dd665-9f76-4177-a811-39c26d3b3b34&displaylang=en>

Microsoft Windows Automated Installation Kit Information

- [http://technet.microsoft.com/en-us/library/dd349343\(WS.10\).aspx](http://technet.microsoft.com/en-us/library/dd349343(WS.10).aspx)

Walkthrough: Create a Bootable Microsoft Windows PE RAM Disk on CD-ROM

- [http://technet.microsoft.com/en-us/library/dd799303\(WS.10\).aspx](http://technet.microsoft.com/en-us/library/dd799303(WS.10).aspx)

Walkthrough: Create a Bootable Microsoft Windows PE RAM Disk on a USB Flash Disk

- [http://technet.microsoft.com/en-us/library/dd744530\(WS.10\).aspx](http://technet.microsoft.com/en-us/library/dd744530(WS.10).aspx)

Walkthrough: Create a Bootable Microsoft Windows PE RAM Disk on a Hard Disk

- [http://technet.microsoft.com/en-us/library/dd744359\(WS.10\).aspx](http://technet.microsoft.com/en-us/library/dd744359(WS.10).aspx)

Diskpart utility information

- <http://technet.microsoft.com/en-us/library/bb490893.aspx>

Partition alignment for SuSE Linux

- Go to www.novell.com and search for further information.

Appendix A: Technical Background

Industry standard computer Hard Disk Drives (HDD) have used 512 byte sectors on their internal disc platters since initial HDD standards were created in 1956. This sector size places a limit on HDD storage capacity and has also caused HDD manufacturing capabilities to reach a limit.

Under sponsorship and support of the International Disk Drive Equipment and Materials Association (IDEMA), manufacturers of industry standard HDDs are transitioning from 512 byte (512B) sectors to 4,096 byte (4KB) sectors on HDDs with Serial ATA (SATA) interfaces. HDDs with 4KB sector platters will offer increased storage space utilization through less wasted space and can be more easily manufactured. Some HDD manufacturers refer to these HDDs as supporting iAdvanced Format media.î

HDD manufacturers began shipping HDDs with 4KB sector platters in calendar 4Q 2010 on newly announced HDD models. HDD manufacturers have communicated that previously announced and currently shipping HDD models will not transition to 4KB sector platters.

The initial generation of HDDs with 4KB sector platters will be backward compatible with current computers by using the current standard 512-byte sector Serial ATA (SATA) communications. These HDDs are referred to as 512e, meaning the internal drive operation is at 4KB and the external operation is at 512B. Some may also refer to these HDDs as îtranslated.î

Partition Alignment

Modern operating systems use a 4096 byte sector in the file system when formatting a partition. Because the physical platter and OS file system are both 4096 byte sectors and the computer interface is 512 bytes a misalignment can occur. Misalignment occurs when the file system sectors crosses physical sectors boundaries. When a partition is created unaligned it impacts write performance.

With 512e or îtranslatedî HDDs, the drive emulates the logical 512 interface and takes care of the physical manipulation in the background, maintaining backwards compatibility with the emulation so there are no functional failure points. However, this can affect performance with older operating systems such as Microsoft Windows XP. This can be fixed by either reinstalling the operating system with newer install tools that are 4K alignment aware or using a utility that will align the partitions and data on the drive properly afterwards.

The reason that a 512e drive's data needs to be aligned has to do with write accesses that are either less than 4096 bytes or if the logical address being written to is not at the beginning of a physical address. A write that is not aligned or less than 4096 bytes will cause the drive to read the data from the media, modify the old data with to the new data and then rewrite the new data to the media. Depending on the hard drive's RPM, this could add an additional 16-22 milliseconds to complete the write at the drive level. Reads are not a problem because the drive will just read the whole 4096 bytes into drive memory and send out only the data sector(s) needed.

Most accesses to a drive are 4096 bytes or greater. If the host writes anything smaller than 4096 bytes, then all 4096 bytes on the media has to be read, the old data modified with the new data and then written back to the media as one 4096 byte physical sector. For a normal user the smaller accesses typically are rare.

The other issue is when a data write spans across a physical sector at either end. What happens in this case is the drive will need to read both physical sectors in to the drive memory, modify both data sets and then rewrite the new data out to media.

Why Alignment Helps

The problem with older operating systems such as Microsoft Windows XP has to do with where the partitions start. In XP, the partition boot sector is located at logical block address 63. This is not divisible by 8 and so the rest of the partition information, directories and files, are not aligned to the physical addresses on the disk drive.

This is where alignment can help. If the logical write is aligned to the physical sectors and the write length is a multiple of 4096 bytes, then the new data is completely replacing the old data and the drive does not have to do any extra steps for the write.

Newer operating systems like Microsoft Windows Vista and Microsoft Windows 7 start the partition on logical block address 2048, which is divisible by 8. In addition there have been changes in the operating system to reduce the amount of writes less than 4096 bytes.

Appendix B: Information about the Microsoft Windows PE Hotfix KB982018

Contained in Essential system updates for Microsoft Windows 7 1.1.F.1

Issues this hotfix rollup package fixes:

1. An updated Esent.sys binary that eases the effects of changes in the reported sector size is included with this hotfix.
2. This hotfix introduces behavior to NTFS which makes sure that buffered writes at the end of the file are padded to the reported physical sector size of the disk. This issue can manifest itself with everyday applications on an Advanced Format disk. However, this issue occurs most frequently when you perform many small writes, such as using the ImageX command-line tool in Microsoft Windows 7 or in Microsoft Windows Server 2008 R2 to apply a Microsoft Windows Image (.wim file) to a Advanced Format disk. Without the hotfix, ImageX takes significantly longer to complete the operation than if you were to apply the same operation to a traditional hard disk.
3. Without this hotfix, applications cannot query the physical sector size of the external storage device. (hence external USB). An updated USBStor driver (Usbstor.sys) that supports the **IOCTL_STORAGE_QUERY_PROPERTY** request, together with the **STORAGE_ACCESS_ALGINMENT_DESCRIPTOR** structure, is included in this hotfix.
4. Without this hotfix, applications cannot query the physical sector size of the storage device. An updated Storport driver (Storport .sys) that supports the **IOCTL_STORAGE_QUERY_PROPERTY** request, together with the **STORAGE_ACCESS_ALGINMENT_DESCRIPTOR** structure, is included in this hotfix.
5. Many storage drivers do not support correct sector size reporting for Advanced Format disks. Updates to the following drivers are included in this hotfix:
 - laStorV.sys
 - Amdsata.sys
 - Nvraid.sys
 - Nvsata.sys

Appendix C: Deployment Tools Reference

There are various methods exist for mass deployments. An example can be found with the Microsoft Windows Deployment Services. The detail information can be found in:

Microsoft Windows Deployment Services Getting Started Guide

- [http://technet.microsoft.com/en-us/library/cc771670\(WS.10\).aspx](http://technet.microsoft.com/en-us/library/cc771670(WS.10).aspx)

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