Overview

Do you need a direct attached or shared storage solution within your BladeSystem enclosure?
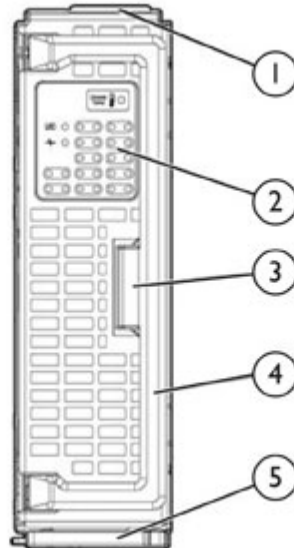
Direct attached storage
The D2200sb Storage Blade delivers direct attached storage for c-Class servers, with support for up to twelve hot plug small form factor (SFF) SAS hard disk drives or SAS/SATA SSDs or SATA Midline hard disk drives. The enclosure backplane provides a PCI Express connection to the adjacent c-Class server blade and enables high performance storage access without any additional cables. The D2200sb Storage Blade features an onboard Smart Array P410i controller with 1 GB flash-backed write cache (FBWC), for increased performance and data protection.

Two ways to create shared storage with the D2200sb
Use HP StoreVirtual VSA software to turn the D2200sb into an iSCSI SAN for use by all servers in the enclosure and any server on the network. HP StoreVirtual VSA software is installed in a virtual machine on a VMware ESX host server adjacent to the D2200sb. HP StoreVirtual VSA turns the D2200sb into a scalable and robust iSCSI SAN, featuring storage clustering for scalability, Network RAID for storage failover, thin provisioning, snapshots, remote replication, and cloning. Expand capacity within the same enclosure or to other BladeSystem enclosures by adding additional D2200sb Storage Blades and HP VSA licenses. A cost effective bundle of the D2200sb Storage Blade and a HP StoreVirtual VSA license makes purchasing convenient. If storage needs increase, add HP P4300 or P4500 systems externally and manage everything via a single pane of glass.

The HP X1800sb Network Storage Blade is a flexible storage server solution for BladeSystem environments. Combine the X1800sb with the D2200sb Storage Blade to enable file serving and iSCSI shared storage inside the BladeSystem enclosure.

1. Product information tag
2. LED panel
3. Hard drive drawer release latch

4. Hard drive drawer handle
5. Storage blade locking lever*
   * Removing the storage blade from the enclosure removes power from the hard drives.

What's New

- Support for BL460c Gen8, BL BL420c Gen8, BL465c Gen8 , BL660c Gen8 and WS460c Gen8

QuickSpecs

Product Highlights

Key Features	**Features of the D2200sb include:**
	SFF (SAS/SAS SSD/SATA SSD) support - Delivering data transfer rates up to 6 Gb/s for SAS and SAS SSD and 3Gb/s for SATA SSD and SATA MDL HDD
	• Support for up to twelve (12) hot plug SFF SAS or SAS/SATA/Solid State or SATA Midline hard disk drives in a half-height blade
	• Internal Smart Array P410i with 1 GB flash-backed write cache
	• Simple configuration and setup with HP's Array Configuration Utility (ACU - for G7 server blades) and HP Smart Storage Administrator (HP SSA - for Gen8 server blades)
	• Easy to maintain and troubleshoot with industry standard management tools including HP System Insight Manager
	• Use with HP StoreVirtual VSA software to create a robust shared storage environment inside BladeSystem enclosures
	• Protected by HP Services and a worldwide network of HP Authorized Channel Partners. Three-year parts limited global warranty. Certain restrictions and exclusions apply.
Mix and Match of Hard Drive Types	D2200sb supports mixing of different drive types (SAS/SATA, SSD/HDD) in a single enclosure. However, please note also that an array can be created across only one drive type.
Universal hot plug Hard Drive	Form factor is for use across multiple HP ProLiant servers, disk enclosures and storage systems. With compatibility across many enterprise platforms, you are free to deploy and re-deploy these drives to quickly deliver increased storage capacity, migrate data between systems, and easily manage spare drives.
LED Indicators	Front panel LEDs indicate drive activity and system health status.
Density	The D2200sb fits into a half height bay on the BladeSystem c3000 and c7000 Enclosure.
Fault Tolerance	Using the internal Smart Array P410i controller with1 GB flash-backed write cache, the D2200sb can be configured for RAID levels 0, 1, 1 + 0, 5, and 6 (RAID ADG)
	NOTE: RAID 6 and RAID 60 support requires purchase of Smart Array Advanced Pack (SAAP) license. Please visit www.hp.com/go/SAAP
Manageability	All Smart Array products utilize a standard set of management and utility software. These tools minimize Total Cost of Ownership (TCO) by reducing training requirements and technical expertise necessary to install and maintain the HP server storage.

Product Highlights

Fault Prevention

The following features offer detection of possible failures before they occur, allowing preventive action to be taken:

- S.M.A.R.T.: Self Monitoring Analysis and Reporting Technology first developed at HP detects possible hard disk failure before it occurs, allowing replacement of the component before failure occurs.
- Drive Parameter Tracking monitors drive operational parameters, predicting failure and notifying the administrator.
- Dynamic Sector Repairing continually performs background surface scans on the hard disk drives during inactive periods and automatically remaps bad sectors, ensuring data integrity.
- Smart Array Cache Tracking monitors integrity of controller cache, allowing pre-failure preventative maintenance.
- Environment Tracking for External Storage System: Monitors fan speed and cabinet temperature of ProLiant Storage System and newer HP storage enclosures.

D2200sb Blade server support matrix

Supported Servers	Server: Full Height or Half Height	No of D2200sb Storage blades Supported	Pass Thru Card Required	Mezz slot to support 1st Pass Thru Card	Mezz slot to support 2nd Pass Thru Card
X86 server blades					
BL280c G6	Half	1	No	n/a	n/a
BL460c G6	Half	1	No	n/a	n/a
BL460c G7	Half	1	No	n/a	n/a
BL460c Gen8	Half	1	No	n/a	n/a
WS460c Gen8	Half	1	No	n/a	n/a
BL490c G6	Half	1	No	n/a	n/a
BL490c G7	Half	1	No	n/a	n/a
BL465c G6	Half	1	No	n/a	n/a
BL465c G7	Half	1	No	n/a	n/a
BL495c G6	Half	1	No	n/a	n/a
BL620c G7	Full	2	Yes	3	2
BL685c G6	Full	2	No	n/a	n/a
BL685c G7	Full	2	No	n/a	n/a
BL680c G7	Full	Not supported	n/a	n/a	n/a
BL420c Gen8	Half	1	No	n/a	n/a
BL465c Gen8	Half	1	No	n/a	n/a
BL660c Gen8	Full	2	No	n/a	n/a
Integrity server blades					
BL860c i2	Full	1	No	n/a	n/a
BL860c	Full	1	Yes	3	n/a
BL870c	Full	Not supported	n/a	n/a	n/a
BL870ci2	Full	1	No	n/a	n/a

Product Highlights

BL890ci2	Full	Not supported	n/a	n/a	n/a

Operating Systems

Windows Server: 2003, 2008
Red Hat Enterprise: RHEL5, RHEL6
SLES (x86): SLES10, SLES11
VMware ESX: 3.5, 4.0, ESXi 5.0
HP-UX

NOTE: For more information on HP's Certified and Supported ProLiant Servers for OS and Virtualization Software and latest listing of software drivers available for your server, please visit our Support Matrix at: http://www.hp.com/go/supportos.

Software Suite

Systems Insight Manager

- Powerful server and server options/storage manager tool
- Monitors over 1,200 system wide parameters
- Configuration/Diagnostic Utilities

HP Array Configuration Utility (ACU - for G7 server blades) **and HP Smart Storage Administrator** (HP SSA - for Gen8 server blades)

- Powerful Web based configuration utility for all Smart Array controllers
- Provides a graphical view of HP drive array configurations
- Allows for management of multiple arrays over a secure internet connection from anywhere in the world
- Easy to use Wizards for configuration
- Runs offline for all supported Operating Systems and runs online for Windows and Linux. For online configuration of NetWare, use CPQONLIN

HP Option ROM Configuration for Arrays (ORCA)

- A simple method for managing logical drives during system power up by pressing F8 during POST
- Allows the ability to create arrays, logical drives, and assign an online spare drive
- Allows the ability to view and delete logical drives
- Allows the ability to select the boot controller or advanced array configurations use ACU/HP SSA

HP Array Diagnostic Utility (ADU)

- In depth diagnostic and reporting utility for all Smart Array controllers
- Runs offline for all supported Operating Systems, and runs online for Windows and Linux

HP Smart Array Advanced Pack (SAAP)

Group of firmware that provides additional and advanced feature functionality within the Smart Array Controllers that requires a license key for activation. These licensed features provides an easy key activation to enable features such as added RAID protection, drive erase and performance optimization and more. For more information visit the following URL: www.hp.com/go/saap.

Service and Support, HP Care Pack, and Warranty Information

Warranty	Protected by HP Services and a worldwide network of HP Authorized Channel Partners. Three-year parts limited global warranty. Certain restrictions and exclusions apply.
	Hard drive Pre-Failure Warranty: When used with any one of the Smart Array Family controllers and monitored under HP Systems Insight Manager (v4.20 or later), HP hard drives are supported by a Pre-Failure (replacement) Warranty. Hard drives have a one year warranty.

HP Care Pack Services: Packaged server and storage services for increased uptime, productivity and ROI

When you buy HP server and storage products and solutions, it's also a good time to think about what levels of support you may need. Our portfolio of service options reduce deployment and management worries while helping you get the most out of your server and storage investments. We take a holistic approach to your environment, bridging servers, blades, storage, software and network infrastructures with our packaged HP Care Pack Services for servers and storage.

Protect your business beyond warranty

When it comes to robustness and reliability, standard computing equipment warranties have matured along with technology. Good news that can also create problems stemming from depending on standard warranties designed to only protect against product defects and some downtime causes. Using a standard approach to warranty uplifts, such as HP Care Pack Services, helps reduce downtime risks and provides operational consistency for mission-critical and standard business computing.

HP Care Pack Services: Upgrading or extending standard server and storage warranties cost effectively

HP Care Pack Services offer a standard reactive hardware and software support services suite sold separately, or combined with our Support Plus and Support Plus 24 services. The portfolio also provides a combination of integrated proactive and reactive services, such as Proactive 24 Service and Critical Service. In addition with HP Proactive Select, you can acquire the specific proactive constancy and technical services. HP Proactive Select menu offers a broad set of service options that you can mix and match depending on your specific requirements. Proactive service options include offers for server, storage, network, SAN device, software, environment and education services.

HP server and storage lifecycle support services offers a full spectrum of customer care-from technology support to complex migrations to complete managed services. HP Factory Express provides customization, integration and deployment services for turnkey solutions. HP Education Services offer flexible, comprehensive training on to help your IT staff get the most out of your server and storage investments. HP Financial solutions extend innovative financing and cost-effective asset management programs-from purchase to equipment retirement.
Learn more: www.hp.com/services/servers and www.hp.com/services/storage

NOTE: Care Pack Services availability may vary by product and country.
HP Care Pack Services are sold by HP and HP Authorized Service Partners:

- Services for customers purchasing from HP or an enterprise reseller are quoted using HP order configuration tools.
- Customers purchasing from a commercial reseller can find HP Care Pack Services at http://www.hp.com/go/lookuptool

Service and Support, HP Care Pack, and Warranty Information

Recommended HP Care Pack Services for optimal satisfaction with your HP product.

| **3-Year HP Support Plus 24** | For a higher return on your server and storage investment, HP Support Plus 24 provides integrated hardware and software support services designed specifically for your technology. Available 24x7, this 3-year combined reactive support option delivers onsite hardware support and over-the-phone software support around-the-clock. Leverage the full strength of HP Technology Services - customers can trust the services professionals at HP to work collaboratively with them, putting our strategic and technical know-how to work across their entire infrastructure. |

- Improve uptime with responsive hardware and software services
- Enjoy consistent service coverage across geographically dispersed sites
- Update HP software at a predictable cost
- Increase customer satisfaction-with no interoperability gaps

http://h20195.www2.hp.com/V2/GetPDF.aspx/5981-6638EEE

| **HP Install Storage Blade Service** | For smooth startup and better business outcomes, HP Install Storage Blade Service- this service provides initial hardware installation of your HP Storage Blade (system configuration is not included). In today's new era of business technology- customers can trust the services professionals at HP to work collaboratively with them, putting our strategic and technical know-how to work across their entire infrastructure. |

- Allows your IT resources to stay focused on their core tasks and priorities
- Reduces implementation time, impact and risk to your storage environment

http://h71028.www7.hp.com/ERC/downloads/5981-9356EN.pdf

| **HP Proactive Select Service** | HP Proactive Select Service improves your IT performance and manageability through the use of cost effective flexible services. HP provides technical expertise and best practices to accelerate ROI of your technology investment. Selectable proactive services span a wide range of technology and process services - a flexible way to purchase proactive services that fit your particular environment and situation. |

HP Proactive Select Service is technology agnostic and purchased in addition to your choice of underlying reactive support.

- Access to a list of flexible and customizable proactive service activities
- Enhance customers' in-house IT team with complementary assistance from HP
- Improved time to solution
- Reduce business risk and project costs by accessing HP specialists
- Simplify IT operational procedures by leveraging HP best practices

http://h20195.www2.hp.com/v2/GetPDF.aspx/4AA2-3842ENN.pdf

Service and Support, HP Care Pack, and Warranty Information

Optional HP Care Pack Services that will enhance your HP product experience.

HP BladeSystem c3000 Infrastructure (ICE + OS) Installation & Startup	For customers who need professionally integrated hardware and software BladeSystem implementation:

The HP Installation and Startup Service for HP BladeSystem c-Class Infrastructure provides for the installation of an HP BladeSystem c-Class enclosure, c-Class ProLiant and Integrity server blades, storage blades, SAN switch blades, Virtual Connect modules (Ethernet and Fibre Channel), Ethernet network interconnects, and Infiniband, as well as deployment and basic configuration of HP Insight Control Environment for HP BladeSystem software.

Service benefits

- Efficient and effective HP BladeSystem c-Class infrastructure setup, server deployment, and management
- Delivery of the service at a mutually scheduled time convenient to your organization
  - Expedited installation, provided all service prerequisites are met prior to commencement of service
- Verification prior to installation that all service prerequisites are met
- Reduced implementation time and cost
- More effective IT resource planning
- Increased data-center efficiency through reduction of manually intensive tasks
- Allows IT resources to stay focused on their core tasks and priorities
- Helps improve IT infrastructure uptime
- Automated diagnosis and remote support for hardware problems (via HP Service Essentials Remote Support Pack)

http://h20195.www2.hp.com/V2/GetPDF.aspx/4AA0-5964ENW

HP Entry Storage Data Migration Service for Windows	For customers who need to safely migrate Windows data within their TCP/IP networks with minimal impact to their operations:

You have a need to migrate data between Windows servers within your TCP/IP network. Or you have a need to migrate storage for your Windows servers. Or both. And you need to accomplish these migrations efficiently while minimizing risk at the same time.

HP Entry Storage Data Migration Service for Windows offers you a cost competitive and convenient way to accommodate data migration triggered by a need to refresh or consolidate storage, or to create different storage tiers. This service offers a migration cost in line with the costs of storage products in small and medium-sized storage environments. The service is delivered via a skilled HP service specialist with special consideration for data availability, integrity, and ongoing operational performance during the transfer process.

http://h20195.www2.hp.com/v2/GetPDF.aspx/4AA2-4734ENW.pdf

Service and Support, HP Care Pack, and Warranty Information

eSupport

HP eSupport is a portfolio of technology-based services that assist you with managing your business environment - from the desktop to the data center.

Support Portal
The HP support portal provides one-stop access to the information, tools and services you need to manage the daily operations of your IT environment.

Features include:

- Access to self-solve tools (including search technical knowledge base)
- Efficient logging and tracking of support cases
- Collaboration with other business and IT professionals
- Download of patches and drivers
- Access to diagnostic tools
- Proactive notification of relevant information

Access to certain features of the support portal requires an HP service agreement. To access the support portal, visit: http://www.hp.com/support

HP Insight Remote Support software delivers secure remote monitoring and support for your HP Servers and Storage, 24 X 7, so you can spend less time solving problems and more time focused on your business. You can have your systems remotely monitored for hardware failure using secure technology that's been proven at thousands of companies around the world. In many cases, you can avoid problems before they occur.

Customer Technical Training

HP Education Services
In today's cost-conscious business environment, IT professionals, developers, consultants and users face an interesting challenge: how to keep up with the latest technologies and expand important skills while delivering profitable results on current projects. To help address this challenge, HP offers innovative training solutions that help keep you up-to-date on virtualization, server, storage, Insight Control, Citrix, Microsoft® and open source/Linux-related topics-while spending less time away from business-critical activities.

HP Services Awards

HP Technology Services continues to be recognized for service and support excellence by customers, partners, industry organizations and publications around the world. Recent honors and award reflect our services team's dedications, technical expertise, professionalism and uncompromising commitment to customer satisfaction.

Additional Services Information

To learn more on HP ProLiant servers, HP BladeSystem servers and HP storage products, please contact your HP sales representative or HP Authorized Channel Partner. Or visit www.hp.com/services/proliant or www.hp.com/services/bladesystem or http://www.hp.com/services/storage

Configuration Information - Factory Integrated Models (North America Only)

Step 1: D2200sb Storage Blade Configuration

Models	HP D2200sb Storage Blade	AP880A
	HP D2200sb Storage Blade Bundle with SAAP License	BK781A
	NOTE: Includes the D2200sb Storage Blade, A Smart Array Advanced Pack (SAAP) single server License (Part number 516471-B21)	
	HP D2200sb PCIe Storage Blade with (12) 600GB 6G SAS HDD bundle	AP882A
	HP D2200sb PCIe and HP StoreVirtual VSA Bundle with SAAP License	AP881A

NOTE: Includes the D2200sb Storage Blade, a Smart Array Advanced Pack (SAAP) single server License (Part number 516471-B21) and a single HP StoreVirtual VSA license. VSA software is installed in a virtual machine on a VMware ESX/ESXi & Microsoft Hyper-V host server adjacent to the D2200sb.

NOTE: Includes 3yr 9x5 software support for HP StoreVirtual VSA software.

For detailed deployment information, see the HP StoreVirtual VSA in an HP BladeSystem environment solution guide:

NOTE: HP StoreVirtual VSA is supported on VMware ESX/ESXi & Microsoft Hyper-V

http://bizsupport1.austin.hp.com/bc/docs/support/SupportManual/c01729139/c01729139.pdf

Options

c-Class Mezzanines	HP PCI Express Mezzanine pass-thru card for HP BladeSystem	431643-B21
	NOTE: Required to support the HP D2200sb Storage Blade with HP c-Class BladeSystem full-height server blades	

HP Hard Drives	**SAS Hot Plug SFF Enterprise (ENT) Drives**	
	HP 72GB 6G SAS 15K rpm SFF (2.5-inch) Dual Port Enterprise 3yr Warranty Hard Drive	512545-B21
	HP 146GB 6G SAS 15K rpm SFF (2.5-inch) Dual Port Enterprise 3yr Warranty Hard Drive	512547-B21
	HP 146GB 6G SAS 10K rpm SFF (2.5-inch) Dual Port Enterprise 3yr Warranty Hard Drive	507125-B21
	HP 300GB 6G SAS 10K rpm SFF (2.5-inch) Dual Port Enterprise 3yr Warranty Hard Drive	507127-B21
	HP 300GB 6G SAS 15K rpm SFF (2.5-inch) Dual Port Enterprise 3yr Warranty Hard Drive	627117-B21
	HP 450GB 6G SAS 10K rpm SFF (2.5-inch) Dual Port Enterprise 3yr Warranty Hard Drive	581284-B21
	HP 600GB 6G SAS 10K rpm SFF (2.5-inch) Dual Port Enterprise 3yr Warranty Hard Drive	581286-B21
	HP 900GB 6G SAS 10K rpm SFF (2.5-inch) Dual Port Enterprise 3yr Warranty Hard Drive	619291-B21
	HP 1.2TB 6G SAS 10K rpm SFF (2.5-inch) Dual Port Enterprise 3yr Warranty Hard Drive	718160-B21

NOTE: SAS drives have a 3 year warranty.

NOTE: Please see the for Technical Specifications and additional information: http://h18000.www1.hp.com/products/quickspecs/12244_div/12244_div.html (Worldwide)

NOTE: Go to the HP Hard Drive Compatibility table for complete drive compatibility information (http://www.hp.com/products/harddiskdrives). Using hard drives in unsupported configurations will result in voiding the warranty and could result in damage to the drive and/or loss of data.

SATA Hot Plug Enterprise Mainstream Solid State Drives	
HP 400GB 3G SATA MLC SFF SSD	636597-B21
HP 200GB 3G SATA MLC SFF SSD	636595-B21
HP 100GB 3G SATA MLC SFF SSD	636593-B21

NOTE: SATA MLC SSD drives have 3 year warranty

SATA Hot Plug Midline (MDL) Solid State Drives	
HP 60GB 3G SATA SFF MDL SSD	572071-B21
HP 120GB 3G SATA SFF MDL SSD	572073-B21

NOTE: SATA MDL SSD drives have a 1 year warranty**.**

NOTE: Customers can use SATA MDL SSD if they update D2200sb to Smart Array FW 5.06 available through notices on HP.com

6G SAS Hot Plug Enterprise Performance Solid State Drives	
HP 400GB 6G SAS SLC SFF SSD	632494-B21
HP 200GB 6G SAS SLC SFF SSD	632492-B21

NOTE: SAS SSD drives have a 3 year warranty.

6G SAS Hot Plug Mainstream Endurance Solid State Drives	
HP 800GB 6G SAS MLC SFF SSD	690823-B21
HP 400GB 6G SAS MLC SFF SSD	690821-B21

Options

HP 200GB 6G SAS MLC SFF SSD	690819-B21

NOTE: SAS SSD drives have a 3 year warranty.

SATA Hot Plug SFF (2.5-inch) Midline (MDL) Drives

HP 1TB 3G SATA 7.2K SFF	625609-B21
HP 500GB 3G SATA 7.2K SFF	507750-B21

NOTE: SATA MDL HDD drives have a 1 year warranty.

NOTE: In order to support SATA MDL HDD/ SATA SSDs in a D2200sb, the Smart Array Firmware has to be upgraded to version 5.06.

Storage

Top view of the D2200sb, with the drive drawer opened

Hard Drives

SAS Hot Plug SFF Enterprise (ENT) Drives

Quantity Supported	Position Supported	Controller
12	1-12	Smart Array P410i Controller

Technical Specifications

HP D2200sb Storage Blade			
Dimensions (HxWxD)	5.316cm x 18.070cm x 51.565cm (2.093" x7.114" x 20.301")		
Weight (unloaded)	3.9KG (8.58 lbs)		
Weight (loaded)	7.19KG (15.8 lbs)		
Protocol Support	6Gb/s SAS		
O/S Support	Defined by specific HP array controller or SAS/ adapter used; please refer to the QuickSpecs and/or User Guide of the specific array controller or adapter		
LED Indicators	UID		
	System Health LED		
Drive LED Indicators (on drive trays)	Drive LED (top) - On-line/Activity		
	Drive Failure LED (bottom) - Drive Fault/Locate		
Relative Humidity (non-condensing)	Operating	20% to 80%	
	Shipping	5% to 95%	
Temperature Range	Operating	50° to 95° F (10° to 35° C°)	
	Shipping	-22° to 140° F (-30° to 60° C)	

NOTE: To maintain proper cooling and airflow, a drive blank or drive must occupy all bays during operation.

Power Consumption	12V/11A	

Smart Array P410i Controller		
Disk Drive and Enclosure Interface	6G SAS (Serial Attached SCSI)	
SAS Connectors	2 internal (SFF8484) x4 wide port connectors	
Cache Memory Speed	DDR2-533MHz with provides up to 4.2 GB/s maximum bandwidth.	
SAS Speed	x8 6G SAS	
Cache Memory	1 GB flash-backed write cache; ECC protection, battery-backed, and transportable	
Logical Drives Supported	Up to 32 logical drives	
Maximum Logical Drive Capacity	10.8TB SAS or 12TB SATA	
Host Memory Addressing	64-bit, supporting greater than 4GB server memory space	
RAID Support	RAID 6 with ADG (Advanced Data Guarding)	
	RAID 5 (Distributed Data Guarding)	
	RAID 1+0 (Striping & Mirroring)	
	RAID 0 (Striping)	
Upgradeable Firmware	Upgradeable Firmware with recovery ROM feature	

Technical Specifications

Environment-friendly Products and Approach	End-of-life Management and Recycling	
		Hewlett-Packard offers end-of-life HP product return, trade-in, and recycling programs in many geographic areas. For trade-in information, please go to http://www.hp.com/go/green. To recycle your product, please go to: http://www.hp.com/go/green or contact your nearest HP sales office. Products returned to HP will be recycled, recovered or disposed of in a responsible manner.
		The EU WEEE directive (2002/95/EC) requires manufacturers to provide treatment information for each product type for use by treatment facilities. This information (product disassembly instructions) is posted on the Hewlett Packard web site at: http://www.hp.com/go/green. These instructions may be used by recyclers and other WEEE treatment facilities as well as HP OEM customers who integrate and re-sell HP equipment.

For hard drives, 1GB = 1 billion bytes. Actual formatted capacity is less.