HP ProLiant blade systems

The business case for adopting blade systems in the data center

change + hp

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Solutions for the adaptive enterprise.

hp invent

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Blade systems represent a new approach to infrastructure that can accelerate the integration and transformation of your data center.

Introduction

Blades are widely viewed as compact and efficient servers that primarily save space and power. However, the full story behind blades is about much more than this and goes far beyond considerations of the individual server. When making a purchase decision, blades should be considered as an integrated, consolidated infrastructure—or a complete system—that includes servers, storage, networking and power; all virtualized, controlled and automated through a common management framework that is optimized to scale. Such a modular system design simplifies the construction, maintenance and expansion of scale-out infrastructures. Based on experience gained across the award-winning HP enterprise portfolio, and built from the ground up for tomorrow's IT demands, HP blade systems represent a new approach to infrastructure that can accelerate the integration and transformation of your data center.

This paper first examines how the unique design and integration of blade systems drives cost savings and efficiencies. Next, it will highlight ideal adoption scenarios of blade systems for a variety of environments and IT strategies. Finally, the paper will show, with quantified evidence, how IT organizations can dramatically reduce cost, increase efficiency, and enhance business agility immediately with the deployment of blade systems.

In addition, this paper will demonstrate that acquisition costs of HP blade systems are significantly lower than rack-mount infrastructures in the majority of scenarios. Even in the few instances where blade systems are approximately equal in initial cost, the total operational savings that result from their increased efficiency yield long-term business value that justifies adoption.

With this paper, a compelling business case can be made for adopting blade systems as a shortcut toward building an infrastructure optimized for the Adaptive Enterprise—the HP strategy for building an organization in which business and IT are synchronized to capitalize on change. The fact is, when it comes to increased business agility, greater data center efficiency, and immediate return on investment, blade systems are the logical choice for any new application or service deployment in scale-out environments.

Reductions in cable complexity: Reduce cabling by 87% and save USD$100 to $350 per 10/100 network port. Also eliminate the need for KVM switches and cables through integrated Lights-Out management (iLO) capability over IP; saving an additional USD$25,000 for each rack.

Operational cost savings: Double the number of resources (servers, switches, and storage) managed per administrator from an average of 15:1 for traditional rack-mount environments to more than 30:1 in blade environments. The more efficient use of IT personnel can save as much as USD $3M annually.

Data center space savings: Reduce the amount of space required in the data center by up to 24%, supporting as many as 48 blades in the same space as 30 or fewer rack-mounted servers.

Lower acquisition costs: With as few as 8 blade servers, HP blade systems with a SAN configuration are 4-16% less expensive than comparable rack-mount infrastructures. In non-SAN environments, the up-front costs are approximately equal to 11% less expensive dependent on networking choices.

Improved high availability: N+1 redundancy built-in across the system eliminates the need for idle, duplicate spares and 1+1 redundancy schemes; reducing HA costs by nearly 100%. Increase uptime with simplified maintenance and reduce hardware and software errors that lead to downtime.

More efficient power usage: Save over USD$6000 per rack of 32 servers through reduced power consumption and lower power distribution costs.

Integrated blade system architecture

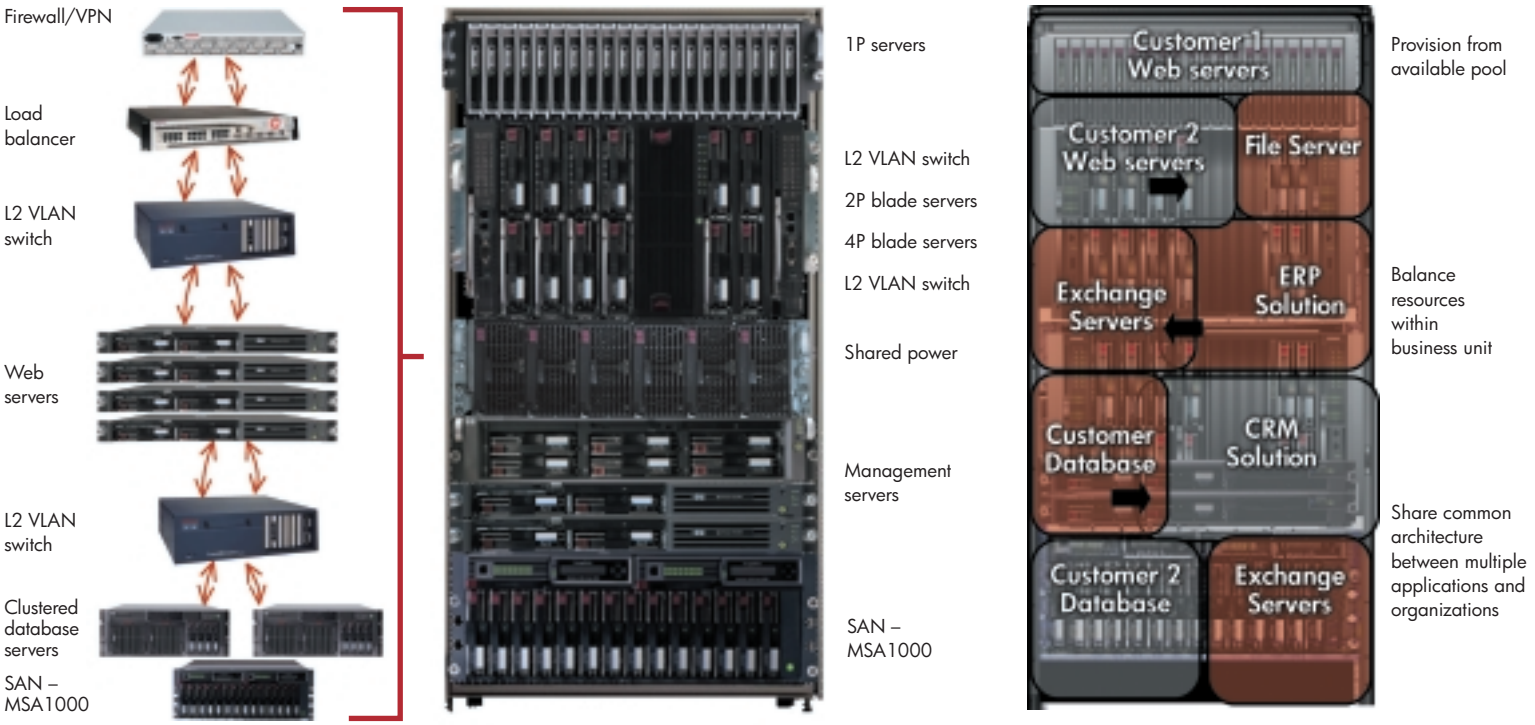
The HP Adaptive Enterprise is not a product you can buy; it is a state of enterprise fitness that must be built step by step. The first step in the transformation begins by optimizing the IT infrastructure to improve agility, simplicity, and value.

To achieve this goal, HP blade systems employ an integrated, modular design that consolidates servers, storage, power, and networking controlled by a common management framework. Multiple resources are pooled, virtualized and automated to scale for growth—to support more efficiently any workload or IT service the business demands. Standard and advanced administrative and maintenance tasks can occur automatically and be achieved remotely. A modular approach also makes it easy for enterprises to repurpose and expand resources, allowing blades to be introduced incrementally for new application and service deployments where the cost and efficiency improvements make the biggest impact on the bottom line. Any combination of modular resources can be created to support nearly any multi-tiered application, deliver consolidation, migrate proprietary SMP systems, or construct GRID and HPC environments. Finally, blade systems easily integrate with existing environments and introduce more effective processes and strategies for growth, management, and high availability across the entire environment.

To understand how the consolidated design delivers better total cost of ownership (TCO) than traditional rack-mount environments, this paper will examine the key features of the HP blade system in three sections: the intelligent rack infrastructure, the modular system components, and the blade management environment.

- The consolidated design of the intelligent rack infrastructure connects all system resources. It helps reduce cables by up to 87% and provides more cost-effective scaling and business continuity through shared redundant resources that eliminate any single point of failure. To protect current investments in HP rack-mount infrastructure and to ensure compatibility with future blade components, the intelligent rack infrastructure delivers consistency with existing HP devices and interfaces, as well as a better solution to meet future demands of power, cooling, performance and availability. Once in place, it becomes a foundation for simplified planning, growth, and more efficient administration.
- By combining standardized, modular components, blade systems are scalable to nearly any IT application or service. By pooling and virtualizing individual resources in an integrated way within the intelligent rack infrastructure—storage, server, network and power—the overall system can be divided or combined to support a wide range of workloads. For example, blade systems enable the use of multiple servers to create a virtual 24-processor SMP machine image across 12 two-processor server blades; or consolidate multiple applications on a single server sharing other resources. HP offers the broadest choice of standards-based server blades, as well as the widest support for HP and third-party SAN and storage array solutions.

Fig 1. Simplified integration



Blade systems are a consolidation of traditional rack-mount components that simplifies the building, integration and management of scale-out infrastructures. Combined with an adaptive management framework, multiple resources are virtualized to facilitate pooling and sharing of resources across any combination of workloads. Basic and advanced management tasks are then automated to improve efficiency.

- The blade management environment leverages HP Systems Insight Manager, HP ProLiant Essentials, HP OpenView, and partner software products to enable administrators to manage the blade system more efficiently than traditional environments. The management tools are designed to work together to remotely manage multiple components through a common interface. The software tools are modular and can create an environment with capabilities tailored to address the sources of cost and inefficiency unique to every data center. With the combination of virtualized resources and automated application monitoring, software provisioning, and dynamic scaling capabilities, enterprises are able to significantly improve productivity and efficiency in managing a large scale-out environment with less manual intervention.

Intelligent rack infrastructure

The intelligent rack infrastructure of HP blade systems provides integrated connectivity and shared redundancy, optimized for the management, reliability and virtualization of servers, storage, power, and networking. The infrastructure is racked and wired only once, greatly simplifying cabling and reducing connectivity costs. With built-in redundancy, the intelligent infrastructure facilitates the sharing of resources such as power and networking for more cost-effective high-availability strategies. The intelligence provided by HP management software enables the infrastructure to connect and identify the physical resource location and status within the rack and provide built-in management interfaces to each one for improved control. This is a unique design feature to blade systems necessary to simplify the virtualization of physical resources.

The primary components of the infrastructure include the blade server enclosure, the power distribution system, and network interconnections.

- Blade server enclosures enable wire-once connectivity of blade servers to VLANs, storage, and power. Each enclosure includes a built-in management module that reports thermal, power, and protection fuse events and provides asset and inventory information. The management module and interconnects extend scalability beyond the enclosure allowing each server blade to communicate with other server blade enclosures. Distinct from other blade choices, HP blade enclosures ensure investment protection by accommodating future server and network designs.
- The blade power distribution system provides N+N redundancy and eliminates the need for power supplies in each system component. This unique design enables HP blade systems to reduce cost, heat, and power usage. To provide power redundancy, power is distributed from the modular power enclosure to the blade server enclosures using scalable bus bars attached to the back of the rack. In addition, a power management module determines if adequate power is available for new server blades during the power-up sequence. The HP power solution is superior to other choices based on its ability to expand to future power demands. Not limited to one bank of servers, the power subsystem in HP blade systems provides more headroom without a complete overhaul of the power subsystem and distribution scheme as the environment grows.
- All network signals from the server bays are routed to the interconnect bays. Advanced network interconnect options allow the creation of virtual LANs (VLANs) that separate available network bandwidth into multiple independent and secure channels. Without visibility to the actual path, devices can be assigned network resources dynamically and transparently. These virtual network channels enable efficient, available, and secure communications across the blade system. To extend the efficient, integrated design of HP blade systems, network and switch options share the same enclosures as the server blade. HP offers one of the broadest selections of network and switch options in the industry to support advanced network and SAN connectivity.

Modular system components

Server modules—Designed for flexibility, the ProLiant BL portfolio of server blades supports the widest range of application requirements in scale-out architectures. HP offers 1P, 2P, and 4P server blades, including a range of performance and form factors that includes the most processing density of any other blade portfolio. Each HP ProLiant server blade is based on and consistent with traditional ProLiant rack-mount server design. They include many of the same winning innovations and features found in trusted ProLiant servers. Those familiar with renowned ProLiant server management, reliability, and performance will find the same consistency and ease of use with ProLiant BL server blades, extended to take advantage of the unique design of HP blade systems.

- **ProLiant BL10e**—This one-processor blade features maximum density, ideal for front-end web and infrastructure applications, or as a node in computational clusters.
- **ProLiant BL20p**—Designed with enterprise availability, this two-processor blade has the performance needed for databases, mid-tier applications such as web hosting or streaming media, and is ideal for server farms, or as a node in high-availability scale-out clusters.
- **ProLiant BL30p**—Ideal for high-performance computing environments, this two-processor blade is optimized for maximum processor density and ideal for a variety of mid-tier applications. These servers are also best-suited for a SAN-centric (boot from SAN), stateless computing environments.
- **ProLiant BL40p**—When it comes to mission-critical applications, this four-processor blade delivers the high performance needed as a database server, mail/messaging server, or enterprise application server.

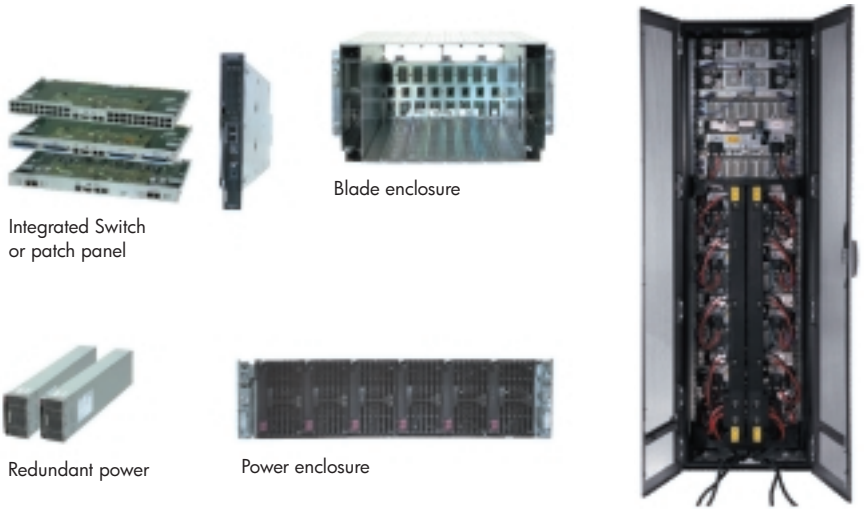
Storage modules—The ProLiant BL20p G2, ProLiant BL30p, and ProLiant BL40p server blades provide dual 2 GB Fibre Channel ports for redundant SAN interconnects. These server blades are optimized for HP StorageWorks MSA1000, EVA, EMA/MA, and XP arrays and can attach to select third-party SAN solutions. With this choice of storage options, you can select the right storage solution for your needs—from high-performance direct-attached storage options, to the simplicity of NAS or the scalability of SAN storage solutions. HP blade systems fully support boot-from-SAN capabilities to maximize storage consolidation and efficiency of overall system deployment. In addition, the server blades can integrate with "fused" NAS and SAN configurations, providing the ability to work in file and block environments seamlessly, and support multiple types of clustered configurations. Various HP back-up solutions can also be employed for improved information lifecycle management.

Interconnect networking modules—Two general categories of interconnect options are available. Patch Panel interconnects allow the collection of Ethernet signals to LAN and SAN infrastructure components and are very economical, completely passive, and require no software or management. The second option, Interconnect Switches, consolidate

Fig 2. Server portfolio
Wide portfolio of blade server choices to meet unique needs for performance and density.

HP ProLiant BL10e | HP ProLiant BL20p | HP ProLiant BL30p | HP ProLiant BL40p

Fig 3. Simplified, consolidated infrastructure provides essential integration and connectivity across shared, pooled components.



the Ethernet signals from the server blades to a smaller set of external copper-based or fiber-based uplink ports. Fully VLAN-capable Interconnect Switches provide up to 32-to-1 network cable reduction per server blade enclosure.

- The RJ-45 Patch Panel Kit provides Ethernet signal pass-through only.
- The RJ-45 Patch Panel 2 Kit provides both Ethernet and BL20p G2 Fibre Channel signal pass-through.
- The GbE Interconnect Kit consolidates 100 Mbps Fast Ethernet NIC signals.
- The GbE2 Interconnect Kit provides consolidation of 1000 Mbps Gigabit Ethernet NIC signals, advanced network capabilities, and BL20p G2 Fibre Channel signal pass-through.

Power modules—The hot-plug, redundant power supplies for HP blade systems are housed in a 3U ProLiant BL p-Class power enclosure. The power supplies are front-accessible, hot-pluggable, and can be configured redundantly. Mounted at the bottom of the rack for lower thermals, the power enclosures are available in two models depending on the number of server blades deployed:

- Single-phase power enclosure—holds a maximum of four hot-plug power supplies.
- Three-phase power enclosure—holds a maximum of six hot-plug power supplies, supports more server blades and interconnect switches, and is recommended for the ProLiant BL p-Class system.

Blade management environment

HP provides an industry-leading portfolio of intelligent management solutions designed specifically to maximize the potential of blade systems. The blade management environment includes HP Systems Insight Manager, HP ProLiant Essentials, HP OpenView, and partner software to enable the management of the system with the flexibility and cost-effectiveness of a decentralized infrastructure and the power and control of a centralized one. The HP management portfolio also includes tools for infrastructure and application monitoring, initial bare metal provisioning, change and patch management, automated workflow provisioning, and remote management. A key function of the blade management environment is that it understands where all physical resources are located within the rack infrastructure. With this intuitive understanding of physical location, the HP portfolio of management tools enables more automated, self-directing capabilities that simplify administrative tasks.

Blade management begins with Systems Insight Manager to provide a consolidated view of all physical resources of the blade system, including detailed fault and performance information. Systems administrators familiar with Insight Manager 7 will be able to take advantage of the same features used to manage traditional HP servers, with extended capabilities optimized to take full advantage of the unique design of HP blade systems.

The management tools interact with the integrated rack infrastructure to present a virtualized view of all components, enabling change regardless of the location within the rack. This facilitates various levels of workflow-based automation without physically reconfiguring the resources. Through a single console, administrators can quickly create and deploy application environments, assigning server, network, and storage resources based on the needs of the business.

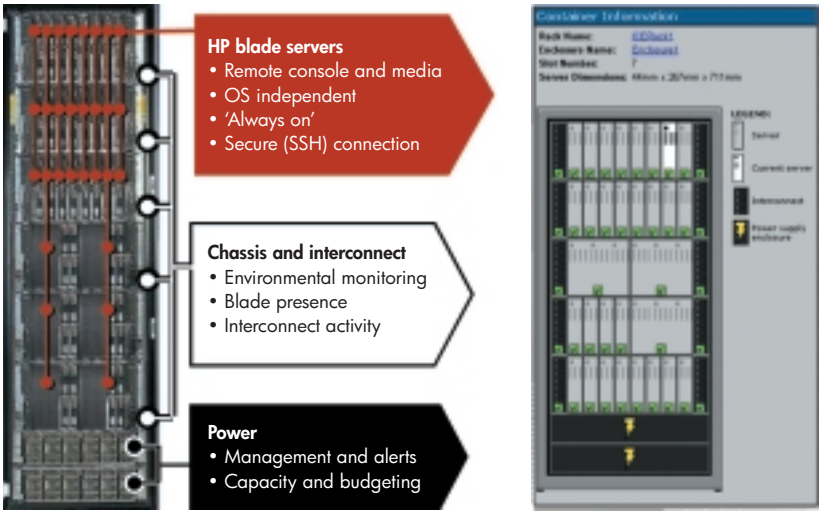
Additional software (ProLiant Essentials, OpenView, and HP StorageWorks SAN Management) takes full advantage of this built-in intelligence to enable self-directed control and automation of rapid deployment, hardware configuration, switch and SAN provisioning, as well as performance optimization, workload management, and rapid recovery.

System monitoring and control—To maximize control at a component level, each blade system module provides unique management interfaces for greater detail and flexibility. The interconnection and system-wide management helps create a large resource pool that can allocate compute power and other resources to applications and services based on fluctuating demand.

- Attached to the back of each server blade enclosure is a server blade management module that polls server blades in the enclosure for one-click access through the HP Integrated Lights-Out (iLO) ASIC on each blade. It also reports thermal, power, and protection fuse events to all server blades in the server blade enclosure; provides asset and inventory information; and enables each enclosed server blade to communicate with other server blade enclosures. The blade system also correlates events generated by shared infrastructure components, ensuring that administrators receive a single event from each affected enclosure as opposed to a single event from each affected component. This integration extends and improves pre-failure alerting, version control, and remote update capabilities to the server blade environment.
- Integrated "lights out" management capabilities are built into each server blade, enabling proactive remote monitoring and control to ensure maximum uptime. Lights-out features also communicate with infrastructure management controllers in the enclosures and expose infrastructure and environmental alerts.
- For greater power efficiency and availability, each power enclosure includes a self-contained controller that monitors the power supplies and the power enclosure. The power management module is responsible for determining if adequate power is available for new server blades during the power-up sequence. The power management module can be connected to the server blade enclosure management modules to communicate management information, such as power supply budget and status.
- To better utilize storage resources, the HP StorageWorks management portfolio of tools provide SAN and NAS provisioning and setup, data replication and protection, and other storage management capabilities.
- The interconnect switches include a web-based interface, a menu driven console, and a scriptable command line interface to configure, manage, and monitor the network. Telnet, SNMP, and RMON are also supported. As a result, an administrator can monitor the interconnect switch remotely from an RMON-based network management console or an SNMP-based management tool such as HP Systems Insight Manager or HP OpenView. In addition, OpenView Network manager provides network monitoring and alerting capabilities.

Advanced blade management—To extend and complement the control enabled by Systems Insight Manger, HP offers additional tools through HP OpenView and HP ISV partners for virtualization, application management, automated provisioning, and change/patch management.

Fig 4. HP blade management



HP Systems Insight Manager visualization and control

- Initial server setup—HP ProLiant Essentials Rapid Deployment Pack provides software deployment and bare-metal server provisioning
- Auto-provisioning and workflow automation—OpenView Service Delivery tools provide object-based workflow automation of OS, network, storage, and application configuration/set-up.
- Change and patch management—Systems Insight Manager provides configuration and change management of ProLiant system software, drivers, and updates. Novadigm, recently acquired by HP, will provide policy-based change and configuration management of OS and application software.

HP partners with several leading ISVs to provide valuable middleware for blade systems, such as:

- Virtual server technology—VMware and Microsoft® enable server consolidation.
- Load balancing and traffic management—F5 Networks virtualizes and load balances IP traffic within and across the blade system network. This is often used for web-based applications.
- Clustered file systems for scale-out, multi-node application scaling—PolyServe and Red Hat Sistina are ideal for creating complete virtualized SMP systems with a scale-out blade infrastructure. This technology is ideal for migrating large UNIX® SMP applications to Linux® blade clusters.
- Scale-out database clusters—Oracle9*i* RAC and Oracle 10g can be used to migrate large UNIX SMP database applications to scale-out Linux blade clusters.
- Grid enabling middleware—Platform Computing, Data Synapse, Axceleon, Scali, and others can be used for high-performance computing applications.

Blade system adoption scenarios

There are many ideal scenarios where enterprises can take advantage of blade systems for immediate return on investment.

Blade systems should be the first platform considered for new deployments of applications and services due to the underlying advantages of costs and efficiency that they can deliver to any workload in scale-out architectures. A conservative approach would be to introduce blade systems incrementally over time. In many cases, customers adopt blade systems for IT consolidation and multi-tier enterprise applications. Compared with traditional rack-mounted server infrastructures, use of blade systems for these solutions provides valuable opportunities to reduce operational costs, improve service management, and increase business agility. The main benefits to enterprises using this approach primarily include large gains in efficiency of personnel and improved processes.

Other, more aggressive adoption scenarios focus on replacing proprietary UNIX SMP systems with industry standard servers or creating grid clusters. These enterprises find blade systems to provide the advantages of centralized control, as well as decentralized flexibility and lower cost platforms due to the volume economics of industry standards. Usage scenarios include migrating from large, proprietary UNIX SMP systems to Linux-based blade systems, or employing blade systems for high-performance computing (HPC). Both can provide dramatic savings in acquisition costs over proprietary RISC systems and improve TCO and data center efficiency by an order of magnitude or greater. Often in these scenarios, the business decision of blade systems can be justified based on hardware and software acquisition costs alone.

Below, each adoption scenario is examined in more depth.

IT consolidation

Beyond lower platform costs, the key advantage to IT consolidation on any platform is primarily improved management efficiency. The integrated blade system simply magnifies the management benefits of consolidation. By taking advantage of the pooling and virtualization capabilities of blade systems, enterprises can consolidate multiple, under-utilized, special-purpose servers onto a compact and highly versatile blade system—not only saving space, but reducing long-term operational costs significantly. Working with a variety of software partners, HP enables an average consolidation onto virtual server partitions of at least 4:1. However, blade systems also consolidate storage, network, and power; reducing complexity of cabling and driving greater utilization of resources.

Ideal candidates for IT consolidation include:

- Web and e-commerce applications
- Mail and messaging applications
- Microsoft Windows® applications
- Thin client/terminal services
- Infrastructure applications

Table 1. IT consolidation

Customer scenario: IT consolidation
A large cellular communications company needed an efficient and scalable IT infrastructure for its high-growth business. The company's goals were to conserve data center space and improve server utilization, while reducing the administrative overhead associated with managing hundreds of servers.
Solution: ProLiant BL p-Class server farm running VMware ESX, with an HP StorageWorks Enterprise Virtual Array storage area network (SAN) and HP blade management software.
Results: improved server utilization of 35 – 50 percent, with average application consolidation of 13:1

Multi-tiered applications

With multiple data center resources networked together, blade systems are a natural fit for multi-tier applications. In these environments, blades become a catalyst for change, driving integration and the adoption of next-generation tools and processes at lower costs. Access to virtual storage and networking, along with integrated management, provide a powerful solution for increasing efficiency and enhancing flexibility. Enterprises no longer have to dedicate a fixed set of web, application, and database servers to multi-tier applications.

Beyond greater management efficiency, a primary advantage of blade systems in this usage scenario is to improve utilization of multiple applications in the environment through virtualization and load balancing across the blade system server farms. Because blade systems provide higher availability through shared redundancy of all components, enterprises can also simplify planning and lower costs associated with business continuity strategies that today require duplicate, stand-by systems.

Ideal candidates for multi-tier applications include:

- Web and e-commerce applications
- Streaming media
- Mail and messaging
- Small and medium databases
- Enterprise applications such as ERP and CRM

Table 2. Multi-tiered applications

Customer scenario: multi-tiered applications
A major commercial and retail banking and financial services company wanted to brings its web hosting center in-house. The company's goals: reduce total cost of ownership over an external web hosting service provider.
Solution: 800 ProLiant BL p-Class server farm running Windows 2000, with connectivity to Hitachi storage area networks (SANs) and HP blade management software.
Results: reduced costs while gaining a flexible platform for increased performance and customer satisfaction

SMP-to-Linux migration

Migrating from large UNIX SMP systems to highly efficient Linux blade clusters can reduce platform costs 50 – 70 percent and result in significant long-term savings as a result of increased data center efficiency and simplified management. By leveraging virtual storage, cluster file systems, and scale-out multi-node database environments, along with the scale-out flexibility of the blade system architecture, enterprises have the opportunity to improve storage utilization and increase performance and availability—all at lower cost than UNIX-based SMP servers. Blade systems based on industry standards also deliver lower annual support costs, lower costs to achieve high availability, and provide more control and flexibility.

Ideal candidates for SMP-to-Linux migration include:

- Custom (homegrown) applications (file based and relational database based)
- Enterprise applications such as large scale-out databases, ERP, and CRM requiring numerous CPUs

Table 3. SMP migration to Linux

Customer scenario: SMP migration to Linux
A large North American bank sought to dramatically improve the price/performance of its server platform for a back-office banking application. The company saw migrating from a SMP UNIX platform to Linux as a cost-effective way to meet this objective.
Solution: ProLiant BL p-Class server farm running Linux, with an HP StorageWorks Enterprise Virtual Array storage area network (SAN) and HP blade management software.
Results: 25% improvement in application performance, while reducing platform costs by 70%

High-performance computing

Blade systems are well-suited for high-performance computing applications primarily due to lower infrastructure and platform costs, as well as their ability to more easily take advantage of spare computing cycles. By capitalizing on the density, power efficiency, and integrated technologies of HP blade systems, enterprises can build large compute clusters, in conjunction with grid middleware, to handle the most intense HPC requirements.

Ideal candidates for high-performance computing include:

- Technical computation clusters for life sciences, CAE, etc.
- 'Visualization' clusters for entertainment or oil/gas
- Financial and portfolio analysis: computation clusters

Table 4. HPC

Customer scenario: HPC
A major biotechnology company needed a cost-effective, flexible IT environment for research and business applications. The company's goals were to manage its IT servers more efficiently and to gain the agility to provision and re-provision applications based on demand.
Solution: ProLiant BL p-Class server farm running Linux, with a 5 TB HP StorageWorks SAN and HP blade management software.
Results: Increased performance over previous compute node cluster/grid at lower platform cost, while gaining an adaptable infrastructure for its research community.

Quantifying the benefits of blade systems

After understanding how blades can be applied within the enterprise to achieve both immediate and long-range benefits, the final step before purchase is to build a solid business case for deploying blades by translating the benefits into quantified savings.

This section of the paper provides a closer examination of how blade systems improve efficiency and reduce total cost of ownership in the data center. For each unique environment, any one of these dimensions of TCO savings could provide the justification for future blade system deployments:

- Reducing data center space utilization
- Improving power and cooling efficiency
- Increasing system availability and redundancy
- Simplifying cabling and reducing network connectivity costs
- Reducing system acquisition costs (in comparison to rack-mounted servers)
- Reducing data center management costs

Reducing data center space utilization

As information demands grow, so does the physical data center. In a data center environment in which individual applications are tied to specialized architectures, data center space can be filled very quickly. And when clusters are involved, floor space usage and cost can double to accommodate an idle spare.

Blade systems reduce the amount of space required in the data center by up to 24 percent, supporting as many as 48 blades in the same space as 30 or fewer rack-mounted servers (with switches). The new ProLiant BL30p server blade packs up to 192 processors per rack, building on HP leadership in processor density and space savings. By building in reliability across the system and by replacing duplicate spare systems, the floor space savings more than double. In areas where the price of real estate has soared in recent years, the impact can be significant. For example, in New York City, where floor space can be as high as USD$5,000 per square foot, a 24 percent reduction can translate to millions in savings. Often, blade systems can be justified purely on the basis of space savings alone.

Improving power and cooling efficiency

Today, many data centers are not equipped to supply adequate power to a large farm of servers. This is a reality of the future that every enterprise will face and must plan for, regardless of whether a blade or traditional rack-mount architecture is employed. Power consumption in the data center is also increasing due to higher performance and speed of next-generation processors. Given these circumstances, HP blade systems were designed specifically to scale to meet future power demands, and offer the best short and long-term power advantages over competitors.

Blade systems are proven to reduce power requirements significantly, which in turn reduces heat and A/C requirements. Unlike standard rack-mounted servers or other blade server designs, which have dual power supplies in each server or blade enclosure, HP blade systems incorporate a centralized power subsystem at the bottom of the rack, which provides better power efficiency, monitoring and reliability. In addition, this design reduces the cooling requirements compared to rack-mounted servers, where individual server power supplies demand more cooling capacity top to bottom of the rack. Instead, the bottom-based power subsystem (along with the reduction of cables throughout the rack) enables better air flow through the rack, and contains the heat of the power supplies at the bottom of the rack where cooler air generally resides in a data center.

Consider the following comparison:

Table 5. Power consumption

	Power/ hour with 32 servers in a rack	**Input power per server**
Rack-mounted	13.3 kW	389 W
Blade system	9.7 kW	307 W

With their increased efficiency, blade systems can provide up to 27 percent improvement in power consumption compared to rack systems. Considering a savings of 3.6kW, with an average North America cost of USD$.09/kW hour, each rack of 32 blades can save USD$2800 to $3200 per year depending on region-specific costs.

The consolidated power subsystem of blade systems also reduces power distribution costs by eliminating the need for PDUs in the enclosure, and by minimizing the need for multiple power feeds in each enclosure, which alone can save up to an additional USD$3000 per rack.

But, the power advantages of blade systems go even further. The power design of HP blade systems is unique and ensures that power demands are met well into the future with the same modules and distribution system. HP blade systems offer higher power availability through redundancy, reducing the number of power supplies per system. Pooled power also improves flexibility and scalability. And with intelligent power management, blade systems ensure that the right amount of power is delivered where and when it is needed.

Increasing system availability

In traditional rack-mounted server architectures, increasing availability requires additional hardware for redundancy, as well as all the connections and external networking components to support the systems—all extra costs.

In blade systems, redundancy—and therefore availability—is built into the system. HP blade systems incorporate dual VLAN switches, redundant power sub-systems, redundant backplane data paths, redundant storage and storage inter-connects, redundant fans for cooling, and hot-swap blade replacement that provides high availability and simplifies maintenance.

The fact is, high availability is built in with blade systems, while with rack-mounted servers, redundant components must be planned for and purchased separately to achieve high availability.

Simplifying cabling and network connectivity

According to the Giga Group, up to 25 percent of a system administrator's time is spent on cable management. To make matters worse, cable failures are a prime cause of downtime.

HP blade systems greatly simplify cabling and reduce connectivity costs. Through the use of integrated blade VLAN switches, multiple Ethernet cables are consolidated down to a few uplink cables per enclosure. Blade systems are also wired once and can be reconfigured through software, eliminating the need to re-configure the physical cables.

HP blade systems also eliminate the need for KVM switches and cables by providing an Integrated Lights-Out Management (iLO) capability over IP. This feature can save as much as USD$25,000 for each rack of 1U rack-mounted servers.

Blade systems often offer significant direct savings in network connectivity costs (cost per switch port), as illustrated in the table below.

Table 6. Network connectivity cost savings

	8 rack-mounted servers	**8 ProLiant server blades**
Cabling	16 – 32 cables to the servers blades	2 – 4 from the switch blades
10/100 Ethernet downlinks USD$	$40 – $150 (copper)	
	$65 – $385 (fibre per port)	$54 per switch port (copper or fibre)
Gigabit Ethernet downlinks USD$	$180 – $1,060 per switch port	$92 per switch port (copper or fibre

As the table above shows, the use of integrated blade switches will save port costs over time within the network environment, and the reduced cabling and simplified cable installation of blade systems offer significantly more cost savings.

Reducing system acquisition costs

When looking at acquisition costs, it is natural to think in terms of server-to-server comparisons. In a data center environment, however, there is always much more to the true cost of acquisition than just the server. Storage, power, networking, KVM, cabling—all must be taken into consideration. While on a pure, server-to-server basis, blades may have a unit cost equal to, or slightly higher than 1U rack servers, when all the associated components are calculated, a more accurate measure of true acquisition costs is revealed. The two acquisition profiles below illustrate this point.

Profile 1—small blade configuration (8 server blades) without SAN connectivity and Gigabit Ethernet networking:

Table 7. Small blade configuration without SAN connectivity and GbE

	HP blade system	1U rack-mounted servers
Total cost USD$	$48,534	$56,637
Servers	$37,952	$33,312
Infrastructure	$6,166	$2,231
Switching (GbE network)	$4,416	$21,094

Profile 2—small blade configuration (8 server blades) with SAN connectivity and Gigabit Ethernet networking:

Table 8. Small blade configuration with SAN connectivity and GbE

	HP blade system	1U rack-mounted servers
Total cost USD$	$87,584	$104,388
Servers	$45,944	$51,704
Infrastructure	$7,525	$3,590
Switching (GbE network)	$34,115	$49,094

As the numbers above indicate, when viewed as total systems, the up-front acquisition costs for blades is generally lower than rack servers due to savings in network switching—especially when the blades are connected with a SAN and when the environment requires Gigabit Ethernet networking.

The table below summarizes this comparison, based on a complete blade system with 8 or more servers:

Table 9. Acquisition cost summary

	SAN-connected	No SAN connectivity
10/100 Ethernet network	blade systems are ~7% less expensive	Blade systems are ~1% more expensive
Gigabit Ethernet network	Blade systems are ~19% less expensive	Blade systems are ~17% less expensive

In all of the above instances, blade systems are approximately equal to or less costly than 1U rack-mounted servers. Therefore, a strong business case can be made for blade systems purely based on acquisition costs. Even if a configuration with 10/100 Ethernet networking and no SAN connectivity is employed, the long-term operational savings in space, power and cooling, networking, and administrative costs, as described earlier in this paper, provide a strong justification for moving to blades as the data center architecture of choice.

Table 10. Comparison components

Server components used for acquisition cost comparison	
• Server (2p Xeon 3.06 GhZ)	
• 2 internal disk drives	
• Fibre Channel interface cards	
Infrastructure components used for comparison	
• ProLiant blade systems: – blade enclosures – power subsystems – rack	• 1U rack-mounted servers – rack – PDUs – KVM systems
Switching components used for comparison	
• ProLiant blade systems: – internal blade switch interconnects – Fibre Channel interconnect kits – cables – Fibre Channel switch (external)	• 1U rack-mounted servers – External GbE VLAN switches – KVM infrastructure – cables – Fibre Channel switch (external)

Reducing data center management costs

HP blade systems are a catalyst for improving efficiency at every point in the data center and for adopting next-generation tools to manage the data center. The positive impact of blade system efficiency can be greater on people and processes than it is on technology. With management capabilities for the Adaptive Enterprise built in, HP blade systems facilitate adoption of advanced management tools that can automate and streamline numerous administrative tasks. By virtualizing the network, servers, and shared storage, and by using intelligent management technologies, blade systems reduce the need to physically touch every device in the data center at every change. More important, blade systems improve management efficiency by merging separate management domains, such as servers, storage, and networking. This level of efficiency can also open opportunities to centralize management of multiple data centers to further simplify administration and reduce costs.

To achieve greater efficiency with people and processes, a key objective is to manage many more resources (servers, network, and storage devices) with the same number of or fewer administrators. Improving this ratio can result in an order of magnitude improvement in efficiency.

The table below illustrates the cost impact of this increase in efficiency:

Table 11. Management efficiency of blade systems; an environment of 100 – 1000's of resources managed by IT administration salaries of ~UDS $125,000/year

Data center environment	Devices managed per administrator	Annual cost
Rack mounted without adaptive management	15:1 (average)	USD$6 million
Blade systems with adaptive management	30:1 (average)	USD$3 million

To understand how these ratios were achieved, consider one example of how automation can cut management costs. An administrator can build a provisioning script/image (often called a server profile) assigned to a specific blade, and save the profile on a management server. When a server blade is installed into bay 4, the server blade seeks out the management server, downloads the pre-assigned script/image, configures the VLAN in the blade system, configures/attaches the appropriate storage, and starts the application.

The application then begins working immediately, all without expensive manual intervention. If that server blade requires replacement, the new server blade automatically seeks out the management server and downloads the pre-assigned script to configure itself identically. The same automated process can be used to dynamically scale the capacity of a blade system application. This is just one example of how new automated provisioning, change management, and dynamic scaling tools can improve data center efficiency and operations.

Calculating the TCO savings

To enable individual IT organizations to measure the TCO savings for their unique environments, HP provides a TCO tool that is available from local HP sales representatives. This should be the first step toward a blade system purchase. The HP blade TCO model creates a three-year total cost of ownership for two-processor server blades and a comparative value for 1U rack-mounted servers. It uses user-specific data (labor rates, pricing, power costs, etc.) combined with rack configuration rules to produce results that are specific to each organization.

This valuable tool allows the user to walk through "what if" scenarios, providing a compelling aid in the decision-making process. The tool is revised on a regular basis to reflect changes in variables and to incorporate new blade system functionality as it becomes available. After this assessment, businesses will be armed with a powerful, compelling business case to justify blades in their next deployment.

Added value of HP services

Maximizing the success of any data center implementation requires thorough planning, expert implementation, and committed support. HP offers a full portfolio of services to ensure the successful planning and implementation of HP blade systems—and HP is committed to providing responsive support to ensure the long-term value of customers' IT investments.

One of the most critical aspects of adopting blade systems is ensuring data center readiness. HP offers a complete data center assessment service, covering security issues, hardware and software support requirements, enterprise management, mission-critical support, and more.

As described above, power and cooling are central issues in the data center, regardless of the architecture being adopted. To ensure adequate power and cooling for HP blade systems, HP employs power calculator tools and offers a complete Smart Cooling Service. And HP provides the proven expertise to implement power and cooling solutions that meet specific requirements.

Also available, the ProLiant BL p-Class Sizing Utility tool provides valuable information necessary to help plan and prepare a site for delivery and installation. Site planning information, such as power distribution requirements and environmental specifications, is generated based on entered system configuration criteria. Simply configure each server blade with appropriate options, choose interconnects for each server blade enclosure, and enter data center power

information. Once the valid information is entered, the tool calculates power specifications, overall equipment list, system weight, number of power supplies and enclosures needed and a summary table of blade components in the rack (server blades, memory, processor, etc.)

Blade systems can also become a foundation for a utility computing model through the HP Instant Capacity on Demand (iCOD) program. The iCOD program automates and streamlines acquisition, deployment and billing. Servers blades are delivered and activated only when needed. By placing pre-configured server blades and other components on-site, resources are available for deployment within minutes, versus days. When a blade is activated, the business is invoiced for that server plus only a corresponding percentage of the infrastructure. Alternatively, the infrastructure can be purchased up front. Businesses can optionally bill user departments for the amount of capacity they use, aligning IT costs with business usage. HP Services will work with customers to determine computing needs, assessing the environment and helping to define the appropriate inventory levels.

To simplify the ordering, configuration and deployment of complete HP blade system solutions, customers may choose HP Factory Express services. HP's factory-direct capabilities speed project implementation, delivering plug-and-play blade solutions completely integrated and shipped in a fully configured rack. HP Factory Express provides customers with unique capabilities like fully integrated blade rack solutions built and configured to the customer's specifications that are pre-loaded, wired, racked, tested and ready to deploy within 6 to 10 days of an order. To ensure reliability and protect the customer investment, each solution is fully tested and validated in an ISO 9002 environment prior to shipment.

To support individual business goals, HP provides a complete lifecycle services methodology for IT consolidation—from consolidation assessment and planning services to implementation and start-up services, to availability assessment and support services. HP also offers optional services to provide an extra level of support beyond standard warranty coverage, including 24 x 7 technical support, high-availability services, and proactive remote services that alert administrators to faulty conditions before they affect customers.

In addition, for those customers migrating from proprietary RISC/SMP systems to Linux-based blade systems, HP offers comprehensive porting and migration services, including needs analysis, application baselining, code analysis, and migration planning and implementation.

With 65,000 service professionals in 170 countries, HP provides the largest IT customer support organization in the world. Moreover, with our in-depth technology expertise, global strategic partnerships, and more than 60 years of IT experience, IT organizations are assured of getting a quality solution that delivers the highest levels of performance and flexibility at the lowest possible cost.

Conclusion

The HP blade systems architecture provides a shortcut toward building a simplified infrastructure optimized for the Adaptive Enterprise; offering a highly flexible and scalable environment that enables enterprises to embrace change, while dramatically reducing total cost of ownership. The pooling and virtualization capabilities of blade systems are key, empowering IT organizations to automatically respond with agility to fluctuating business requirements by using software to allocate and re-allocate resources on demand without manual intervention. In addition, the consolidation and built-in intelligence of these systems supports advanced management tools that automate and simplify a wide range of administrative and advanced IT tasks.

With the evidence presented in this paper, it is also clear that acquisition costs of HP blade systems are significantly lower than rack-mounted servers in the majority of scenarios. Even in the few instances where blade systems are slightly more costly, the long term operational savings that result from their increased efficiency yield long-term business value that justifies adoption.

The combination of lower acquisition costs and dramatically improved data center efficiency make a strong business case for adopting blade systems as the architectural foundation to transform the future of the data center. The fact is, when it comes to increased business agility, greater data center efficiency, and higher long-term IT value, HP blade systems are simply the best choice.

For more information

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5982-6701EN, 06/2004