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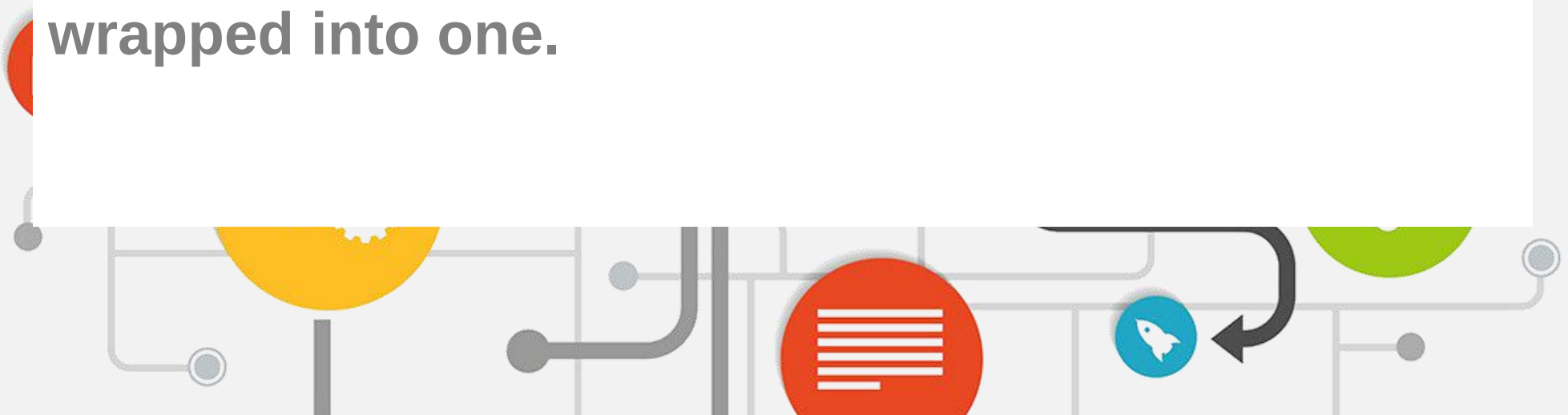
The Ultimate Server Hardware Cheat-Sheet

Pros, cons, and purchasing considerations, all wrapped into one.



In this e-guide

- Learn the major types of server hardware and their pros and cons
- Buy server hardware with these key functions in mind

In this e-guide:

While other components of IT technology come and go with the wind, servers have remained a data center mainstay for decades. But that doesn't mean servers are ubiquitous – there's several distinctions that set some types of servers apart from others, and as a result, ideal use cases for each.

Inside this e-guide, learn about the major types of server hardware, including pros, cons, and the purchasing considerations to make of each.

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Learn the major types of server hardware and their pros and cons

Robert Sheldon, Contributor

Servers host applications, manage files, process emails, stream media and perform analytics. Any organization can benefit from the power and versatility that servers provide, but it can be difficult to know which types of server hardware to choose.

Today's servers are primarily available in three forms: racks, blades and mainframes. The majority of IT teams turn to rack and blade servers to meet their server requirements. Some teams opt for mainframe computers to handle their workloads, although not nearly to the extent of rack and blade servers.

Rack, blade and mainframe servers all have their advantages and disadvantages, and buyers should carefully weigh these different types of server hardware before deciding on a product. Buyers do not need to limit their selection to any one type, however. Organizations can choose what's best for the workloads they need to support with an eye on budget and space constraints.

What is a server?

A server is a type of computer that provides processing and memory resources for different workloads. The term *server* can refer to the computer itself or to a program that delivers a service, such as an email management system. Most hardware-related references concern the physical machine. The server operating system (OS) is designed to process large

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workloads, deliver services and support network-based operations. Common server OSes include Linux, Unix and Windows Server.

Servers are usually set up to provide one or more specific services. Servers are commonly used to manage network resources and make them available to client devices. A server is often referenced to based on the purpose it serves. For example, a print server provides network users with access to shared printers, and a media server streams video and audio content to network users.

A server's physical configuration is usually specific to the types of services it provides. For example, a database server might include more processing or memory resources to handle the influx of concurrent transactions. Many data centers also implement server virtualization to deliver services more efficiently. Server virtualization can help better utilize the server's physical resources, while also increasing flexibility and security and reducing energy consumption.

Editor's note

With extensive research into the server market, TechTarget editors have focused this series of articles on server vendors with considerable market presence and that offer at least one product among blade, rack and mainframe types. Our research included Gartner, Forrester and TechTarget surveys.

Why purchase a server?

Any organization that supports more than a handful of users can benefit from different types of server hardware. For most organizations, servers are essential to carrying out business and protecting sensitive resources. Organizations might need to purchase servers when they

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set up new data centers, expand or update existing ones, open satellite offices, or spin up development projects.

Although servers add to the number of computers that an organization must support, they can also help consolidate resources; different types of server hardware make it possible to share printers, disk drives and applications with network users. Although users can share resources across peer-to-peer networks, a server is much better equipped to manage those resources and deliver them securely across the network, especially with a large number of users.

This use of servers can also lead to greater productivity because resources are centralized, which allows workers to easily share data with their colleagues. Users can access the resources they need when they need them without worrying about managing them. For example, they do not have to keep a copy of the data on their own systems, implement and maintain a backup, or manage multiple copies of the same data.

Any organization that supports more than a handful of users can benefit from different types of server hardware.

In addition, servers enable users to access the applications and data they need from remote locations, which makes it easier for workers to stay productive when they travel or work remotely.

Servers also add business value via data protection, providing the structure necessary for admins to control which users can access files, applications, peripherals and other resources. In addition, admins can control the security mechanisms that they implement on the servers, as well as centrally monitor systems for issues related to security and compliance.

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Different types of server hardware also make it easier to back up system and user data and implement disaster recovery strategies. Admins can also more easily ensure the reliability and availability of data, whether by clustering servers or building redundancies into system components. In addition, the consolidated model makes it possible to centralize other management operations, such as maintaining workstations, controlling domains and monitoring software.

Because servers can consolidate resources, streamline management and increase productivity, they can ultimately reduce costs. In addition, their centralized management capabilities make it easier to track application usage to better control licensing costs and avoid expensive software audits.

Because servers better protect the data, it is less likely to be compromised, helping to avoid costly fines, tarnished reputations and the lost business that comes with both of these.

Rack servers

A rack server, also known as a rack-mounted server, is a standard-size computer designed to be mounted in a server rack along with other rack servers or standard-size components, such as network or storage area network devices. A rack server is considered to be a general-purpose machine that can support a wide range of workloads.

Rack servers take up a lot less space than tower servers because they're not encased in bulky cabinets and users can stack them in a single rack along with the other components. In addition, because providers have standardized the size of racks and rack servers, admins can easily add or replace servers if one should malfunction. The design also makes it simple to add components gradually to accommodate growing workloads. Best of all, the servers in the same rack don't have to be the same model or come from the same vendor.

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One of the biggest challenges with rack servers is managing all the cabling that ties the components together. Rack servers require cables for power, networking, management and storage, all of which hang off of the back of the stacked components, making it difficult to manage the cables and servers. The cables can also affect cooling, which is already challenging with rack servers because of their proximity to each other.

Blade servers

A blade server is a modular component -- blade -- that fits into a server chassis along with other blades. Each blade has its own processors, memory and integrated network controllers. The blade might also include a Fibre Channel host bus adapter, as well as other I/O ports. Blade servers offer more processing power in a smaller space than rack servers while providing a simplified cabling structure.

Because blades are so tightly configured within the chassis, the chassis itself is sometimes referred to as the blade server and the individual blades are called modular motherboards or circuit boards even though they're servers in their own right. This is because the chassis provides consolidated resources such as power, cooling and networking, which are shared across all the blades within the chassis. Admins can also mount the chassis on a standard-size server rack.

One of the biggest advantages of a blade server compared to a rack server is its ability to provide greater processing density within a smaller space. This can result in a price-to-performance advantage even though blade servers are themselves more expensive than rack servers. This efficient use of space can increase redundancy to better ensure the reliability and availability of applications and data.

In addition, the blades and chassis components are hot-swappable, including the cooling system, controllers and switches. Plus, because of the chassis structure, cabling is simpler

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when compared to the rack server. The blade system also provides a centralized management console to control and monitor the system's components.

Although blade servers offer state-of-the-art computing capabilities, they also come with a few drawbacks. For example, the server chassis and blade architecture are proprietary, which makes vendor lock-in a strong possibility. This proprietary nature can also limit upgrade options if the vendor does not release new or updated components in a timely manner.

Although blade servers are more expensive than rack servers, savings in space, power and management can offset expenses under the right circumstances. However, the rack server provides a lower entry cost, which can be an advantage to an organization that wants to start out small and work its way up gradually. Also, with blade servers, an organization might need to update its data center to accommodate power and cooling needs.

Despite these concerns, a blade server can be a good fit in a number of circumstances, particularly for data centers with high-density server rooms in which space is limited. Blade servers are well-suited to a single task that requires clustered servers, such as file sharing, web hosting, video streaming, database management or virtual desktop infrastructure.

Mainframe servers

A mainframe server is an extremely powerful computer; it's about the size of a large refrigerator. Unlike its predecessors, which could take up an entire room, today's mainframes are much more compact and powerful and include sophisticated encryption capabilities, as well as multiple layers of redundancy. Mainframes are still much bigger and bulkier than rack or blade servers, as well as a lot more expensive. However, mainframes are also much more powerful and reliable than anything else out there.

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A mainframe is designed for high throughput; it can support a large number of simultaneous transactions and heavy I/O loads without affecting performance. IBM leads the way in the mainframe market, producing systems that can perform 12 billion encrypted transactions per day.

In addition to its massive transaction processing capabilities, a mainframe is extremely configurable, supports dynamic reconfigurations and provides hot-swappable hardware components. A mainframe normally runs its own OS, such as IBM's z/OS, but recent models also support Linux, running on bare metal or in virtual machines, considerably increasing the mainframe's capabilities.

Mainframes have a reputation for being resilient, reliable and secure, incorporating some of the most advanced hardware technologies available. Multiple layers of redundancy exist throughout the system to ensure continuous reliability and availability. In addition, admins can cluster mainframes to deliver even greater reliability and availability, especially if the cluster is geographically dispersed, which can help protect against a disaster in any one location.

Mainframes are primarily suited for high-volume, data-intensive workloads with many concurrent, real-time transactions, such as the transactions of banks or other financial institutions. Industries such as utility companies, government agencies and health care systems can also benefit from the power a mainframe computer can offer.

However, a mainframe's high price tag also means that it's not a system for organizations that are simply testing the waters or implementing types of server hardware incrementally. A mainframe might be more cost-effective in the long term depending on the supported workloads, but the initial capital outlay could be too much for many businesses.

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Mainframes also require skilled technicians to implement and operate -- a type of admin getting harder to find as much of the attention turns to rack and blade servers. For many organizations, a mainframe comes with a learning curve that might be too steep to take on.

Hyper-converged infrastructure

Organizations in the market for data center servers might also consider hyper-converged infrastructure (HCI), a software-centric system for delivering compute, storage and networking resources in a tightly integrated system. Vendors offer HCI platforms as self-contained appliances, software-only packages or reference architectures.

An HCI platform typically consists of multiple server nodes, a hypervisor for virtualizing resources on each node, and an intelligent software layer that manages and orchestrates resources across the server nodes. In addition, HCI systems usually include built-in data protections, such as mirroring, replication or erasure coding, as well as backup, redundancy and other disaster recovery capabilities.

The compute nodes that make up an HCI platform can be standard, off-the-shelf servers. In addition to the processing and memory resources, each server also includes its own direct-attached storage. Most HCI appliances include at least three nodes, with the ability to add nodes to accommodate growing workloads.

The intelligent software consolidates the resources from each server into a shared resource pool, delivering a high degree of flexibility while also simplifying management. Scaling the system is merely a matter of adding another server node. However, the server nodes must be identical, so adding a node can sometimes mean purchasing resources that are not always necessary in order to boost the compute resources.

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Buy server hardware with these key functions in mind

Robert Sheldon, Contributor

When the time comes to buy server hardware, there are a lot of factors to consider, such as the number of processors, the available memory and the total storage capacity. Buyers should closely evaluate eight important features when comparing the servers available from the leading vendors.

These eight features cover the basic components to look for to buy server hardware, but they don't represent all the features that buyers should consider. Decision-makers at every organization must determine exactly what they need to support their existing and future workloads, keeping in mind the differences between rack, blade and mainframe computers.

Companies should view these eight features as the starting point to identify their requirements and evaluate the available products and should expand their research as necessary to ensure they're addressing every concern.

Processors

One of the most important components to consider when buying server hardware is the processor that carries out the data computations. Also referred to the central processing unit (CPU), the processor does all the heavy lifting when it comes to running programs and sifting through data. Most servers run multiple processors, usually with one per socket. However, a processor can also be made up of multiple cores to support multiprocessing capabilities.

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Multiple cores usually translate to better performance, but the number of cores is not the only factor to consider. Buyers should also consider the processor speed -- CPU clock speed -- and available cache, as well as the total number of sockets, as these can differ significantly from one processor to the next.

For example, the NEC Express5800/D120h blade server supports up to two processors from the Intel Xeon Scalable product family. One of the most robust of these processors offers 26 cores, 35.75 MB of cache and a 2.0 GHz clock speed.

Compare that to the Dell PowerEdge M830 blade server, which uses Xeon E5-4600 v4 processors. The most robust of these offers 22 cores, 55 MB of cache and a 2.20 GHz clock speed. The Dell server also supports up to four processors rather than two.

Editor's note

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Memory

Adequate server memory is essential to a high-performing system, and the more memory that is available, the better the workloads are likely to perform. However, other factors can also contribute to performance, such as the memory's speed and quality. Most server memory is made up of dual in-line memory module integrated circuit boards with some type of random-access memory.

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Server memory might also include fault-tolerant capabilities or other features that enhance reliability. One of the most common capabilities is error-correcting code (ECC), a method to detect and correct common single-bit errors. When evaluating server hardware memory, you should look at the entire offering, keeping in mind the types of workloads and applications you run.

Companies should view these eight features as the starting point to identify their requirements and evaluate the available products and should expand their research as necessary to ensure they're addressing every concern.

For example, Fujitsu's mainframe computers in the BS2000 SE series support up to 1.5 TB of memory. However, IBM's ZR1 mainframe, which is part of the z14 family, supports up to 8 TB of memory. The ZR1 also provides up to 8 TB of available redundant array of independent memory to improve transaction response times, a pre-emptive dynamic RAM feature to isolate and recover from failures quickly, and ECC technologies to detect and correct bit errors.

Storage

Servers vary greatly in the amount and types of internal storage that they support, in part because workflows and applications also vary. For example, a server hosting a relational database management system will have different requirements than one hosting a web application. In addition, the use of external storage, such as storage area networks (SANs), can also impact internal storage requirements.

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When you buy server hardware, be sure to evaluate each prospective server to ensure it can meet your storage needs. Today, most servers support both solid-state drives (SSDs) and hard disk drives (HDDs). But buyers should certainly verify this support, as well as the server's supported drive technologies, such as Serial-Attached SCSI (SAS), Serial Advanced Technology Attachment (SATA) or non-volatile memory express (NVMe). Other considerations should include drive speeds, capacities, endurance and support for redundant array of independent disks (RAID).

For example, Oracle's X7-2 rack server can support up to eight 2.5-inch HDDs or SSDs, either SAS or NVMe, and multiple RAID configurations. Compare that to the Inspur TS860G3 rack server, which can handle up to 16 drives, either SSDs or HDDs, and support both SAS and SATA. However, the Inspur server does not support NVMe, which means the SSDs might not perform as well.

Connectivity

A server's ability to connect to networks, peripherals, storage and other components is essential to its effectiveness within the data center. The server needs the necessary connectors and drivers to ensure that it can properly communicate with other entities and process various workloads. Buyers need to determine exactly what type of connectivity is necessary and, from there, examine the server's specs to verify whether it will meet those requirements.

Servers differ widely in this regard, so buyers should look for specifics such as the number and speed of the Ethernet connectors, the number and type of USB ports, the availability of management interfaces, the types of protocols available, support for SANs and other storage systems, as well as whatever other components are necessary to facilitate connectivity.

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Acer's rack server Altos R380 F3 is a good example of what connectivity features to look for when you buy server hardware. It includes two Ethernet ports, either 1 GB or 10 GB, an RJ-45 management port, three USB 3.0 ports, one USB 2.0 port, and a video port. In addition, the server offers up to seven Peripheral Component Interconnect Express (PCIe) 3.0 slots and one PCIe 1.0 slot.

Hot swapping

Servers offer hot swapping capabilities to varying degrees. Hot swapping refers to the ability to replace or add a component without needing to shut down the system.

The term hot plugging sometimes refers to hot swapping, although, in theory, hot plugging capabilities are limited to being able to add components but not replace them without shutting down the system. Because of the confusion around these terms, it is best to verify how each vendor uses them.

One of the most common hot swappable components is the disk drive. For example, the Cisco UCS B480 M5 blade server supports hot swappable drives, as does the Huawei FusionServer CH242 V5 blade server and the Intel R2224WFQZS rack server.

With blade systems, the hot swapping capabilities are often within the chassis itself. One example is the chassis used for the Lenovo ThinkSystem SN850 blade server, which provides hot swapping capabilities for the fans and power supplies, in addition to the server's disk drives. However, these types of capabilities are not limited to blade servers. The Acer Altos R380 F3 system also supports hot swappable fans and power supplies even though it is a rack server.

Redundancy

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Redundancy is important to ensure a server's continued operation in the event of a component failure. Most servers provide some level of redundancy, often for the hard drives, power supplies and fans. The Asus RS720-E9-RS12-E rack server, for example, offers redundant power supplies and the HPE ProLiant DL380 Gen10 rack server offers redundant fans.

As with its hot swapping capabilities, the redundancy available to blade servers is often located within the chassis. For instance, the chassis that support the Dell PowerEdge M830 blade server and Supermicro SBI-6129P-T3N blade server both provide redundant power supplies.

However, the Dell chassis also offers redundant cooling components, and the server itself provides redundant embedded hypervisors.

Manageability

Admins must manage a server effectively to ensure its continued operation while delivering optimal performance. Most servers provide at least some management capabilities.

For example, many servers support the Intelligent Platform Management Interface (IPMI), a specification developed by Dell, Hewlett Packard, Intel and NEC to monitor and manage server systems. Not surprisingly, the servers offered by these companies, such as the Dell PowerEdge M830, HPE ProLiant DL380 Gen10, Intel Server System R2224WFQZS and NEC Express5800/B120g-h, are IPMI-compliant.

But servers are certainly not limited to IPMI capabilities. For example, the Acer Altos R380 F3 rack server comes with the Acer Smart Server Manager; the Asus RS720-E9-RS12-E rack server comes with the ASUS Control Center; and the Cisco Unified Computing System (UCS)

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B480 M5 blade server comes with Cisco Intersight, Cisco UCS Manager, Cisco UCS Central Software, Cisco UCS Director and Cisco UCS Performance Manager.

Blade systems usually provide some type of module to manage the individual blades. For instance, Huawei's FusionServer CH242 V5 blade system includes the Intelligent Baseboard Management System module to monitor the compute node's operating status and support remote management.

Not surprisingly, systems such as Fujitsu's BS2000 mainframes provide a variety of management capabilities. For example, each BS2000 system includes a management unit that works in conjunction with the SE Manager to offer a centralized interface from which to administer the entire server environment. And IBM's ZR1 mainframe includes the IBM Hardware Management Console (HMC) 2.14, the IBM Dynamic Partition Manager and an optimized z/OS platform for IBM Open Data Analytics.

Security

Another important factor to consider is the server's security features. As with other features, servers can vary significantly in what they offer, with each vendor taking a different approach to securing their systems.

For example, the Lenovo ThinkSystem SN850 blade server provides an integrated Trusted Platform Module 2.0 chip to store the RSA encryption keys used for hardware authentication. The server also supports Secure Boot, Intel Execute Disable Bit (EDB) functionality and Intel Trusted Execution Technology.

Another example is the Oracle Server X7-2 rack server, which comes with the Oracle Integrated Lights Out Manager 4.x, a cloud-ready service processor for monitoring and managing system and chassis functions. On the other hand, the Huawei FusionServer CH242

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V5 blade server supports the Advanced Encryption Standard -- New Instructions, as well as Intel's EDB feature and Trusted Execution Technology.

IBM's ZR1 mainframe is also strong when it comes to security. The server includes on-chip cryptographic coprocessors and the Central Processor Assist for Cryptographic Function (CPACF), which includes the new Crypto Express6S feature to enable pervasive encryption and support a secure cloud strategy. The CPACF is standard on every core. The platform also includes IBM Secure Service Containers to securely deploy container-based applications.