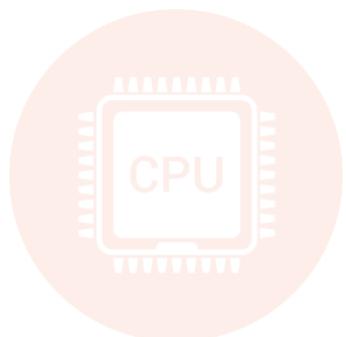


Minimum Hardware



1 CPU Sockets with 6 cores



64 GB of RAM



1 Gbps Networking



512 GB Storage

Recommended Hardware

2 CPU Sockets with 12 cores each

256 GB of RAM

10 Gbps Networking

3 TB Storage

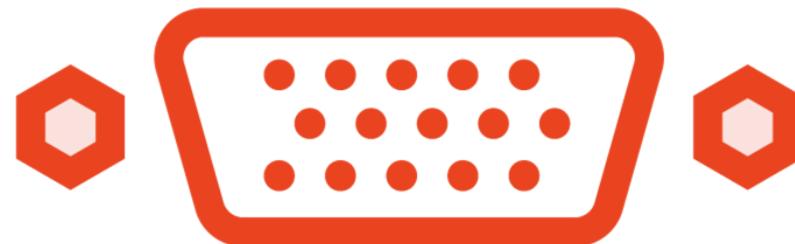


Decision Points

Are the Built-in Components Sufficient?

Most system boards have integrated display, storage, and network adapters

These devices may not be powerful enough for your needs

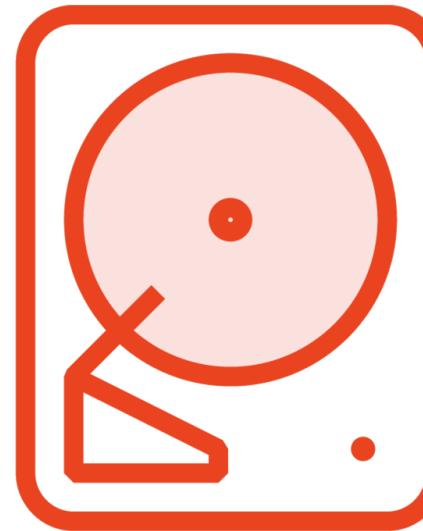


VGA

Graphics Card

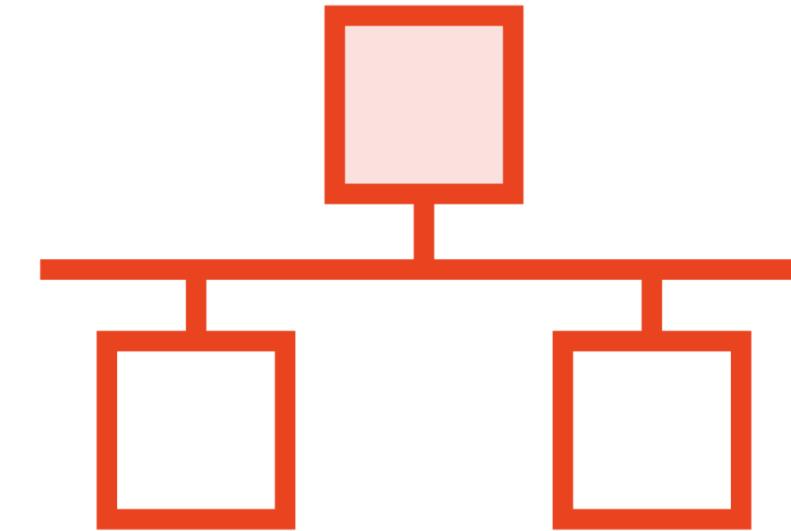
Is VGA acceptable or do you require HDMI?

Do you need GPUs?



Storage Adapter

Is SATA sufficient, or do you need another storage type?



Network Adapter

Is the 1Gbps or 10 Gbps adapter sufficient, or do you require higher speeds?

What Type of PCIe Slots Do You Need?

Do you intend to add PCIe cards now or in the future?

How much bandwidth will the cards require?

PCI
Version

Lanes

Slots

PCIe v4.0 or 5.0?

This is represented as x1, x4, x8, and x16

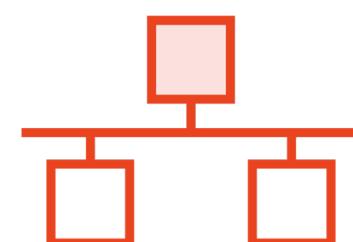
How many cards will you add now and in the future?



Globomantics does not need any GPUs or an HDMI display.

They have not decided upon their storage needs yet.

The built-in 10 Gbps network adapter is sufficient today.



Use the built-in VGA port

Plan for a PCIe storage adapter

Plan for future upgrade to a 40 Gbps network adapter

Server Maintenance



Storyline

LOBOMANTICS

Globomantics is finalizing the hardware plans for their new server

Just a few more questions remain unanswered



How much downtime can they experience?



How difficult will it be to replace failed hardware components?



Should they have spare parts on hand?



Globomantics only plan to purchase a single server, therefore it must be redundant



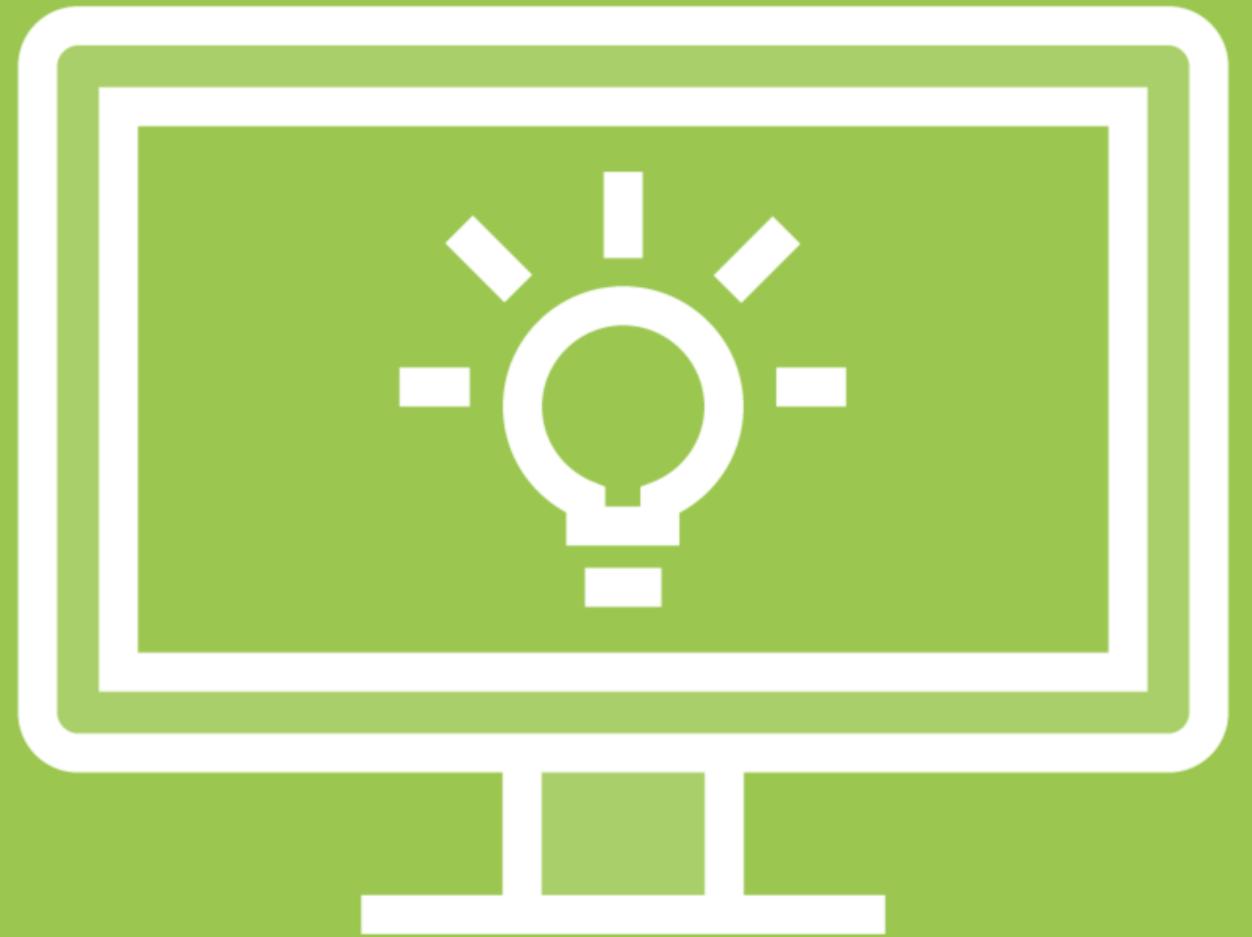
The server will run Microsoft Server 2019 or later, which is a 64-bit operating system



They will use hot swap power supplies, PCIe cards, fans, and hard drives

The server will boot UEFI

Now, let's learn about the choices



Tech Point
Hot Swap
Components

Hot Swap



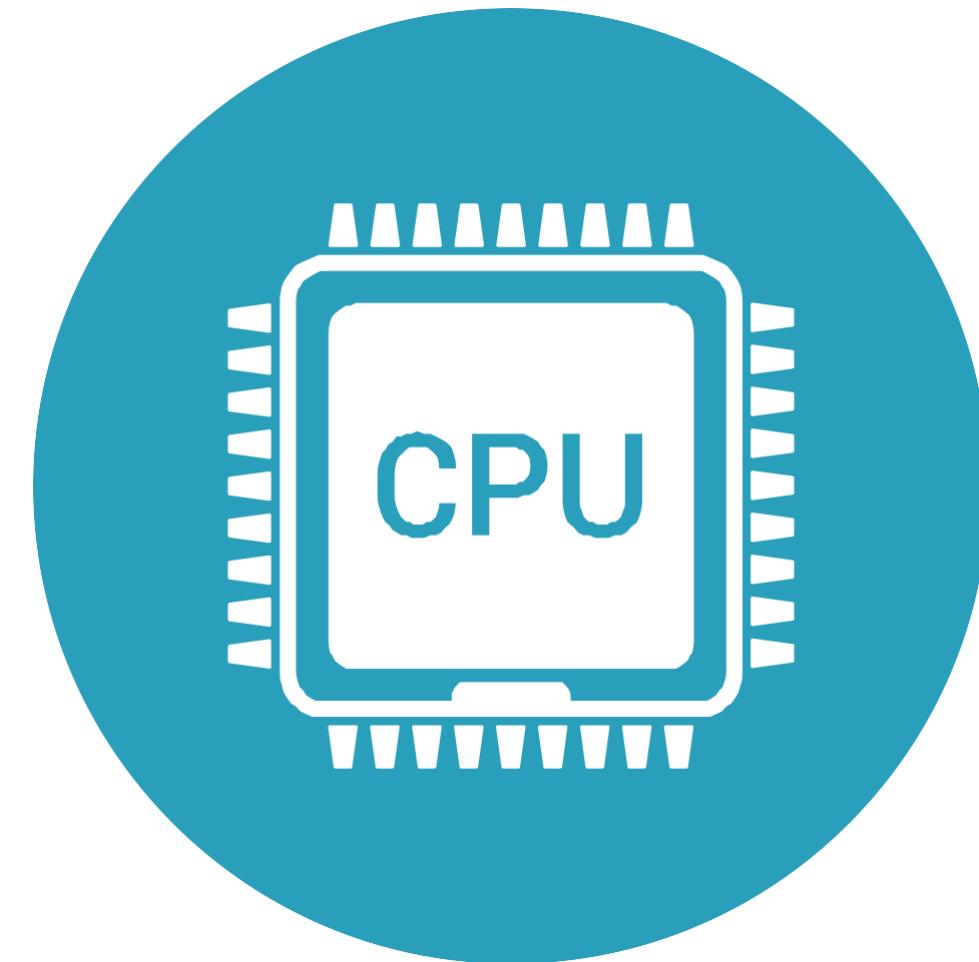
Hot Swap (aka Hot Plug) devices can be added/removed while the device is running

- Hot Swap usually denotes replacing devices (ex. when it fails)
- Hot Plug usually denotes adding functionality (ex. plugging in a USB device)

Non-hot Swap

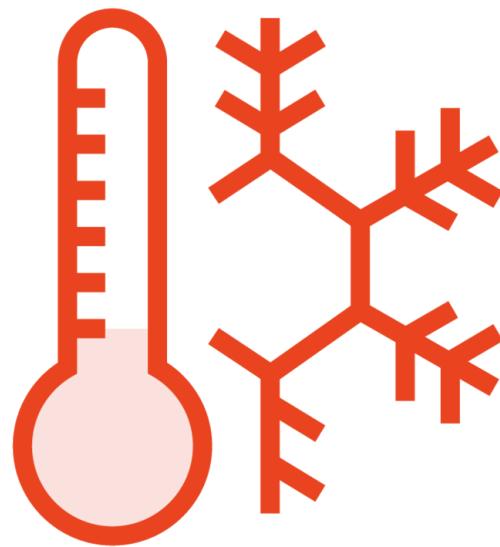
Cold Plug / Swap

- Also known as non-hot swappable
- The computer is powered off

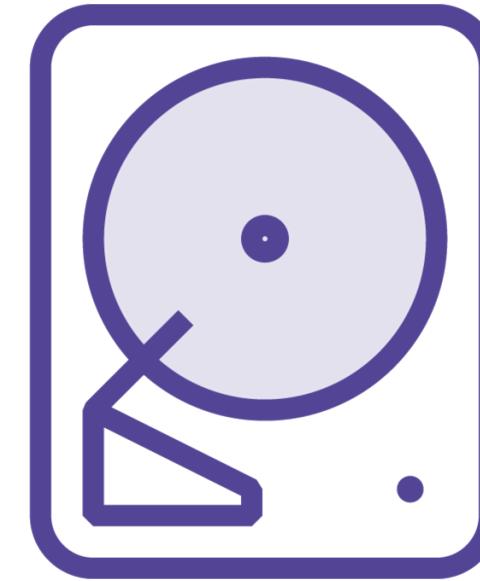


Common Hot Swappable Components

Components that can often be hot swapped in servers:



Fans

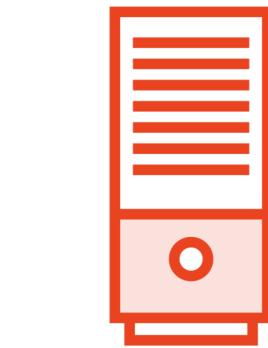


Hard drives



Power supplies

Hot Swap Fans



Located inside the server chassis



Typically encased in a plastic assembly with a plug (as shown)



Often you can install additional fans for redundancy

Hot Swap Hard Drives



May be located inside or outside the server chassis



Be sure to insert the drive fully and lock it in place



Fill all empty spaces with the provided baffles



Power Supplies

Tower, vs. rack, vs. blade

Same function, different power draw

We need to understand:

- Power draw per server, per rack, per row, for the entire data center
- Redundancy needs

Other Hot Swappable Components

**High-end servers
may also support
hot-add of CPU
and RAM**

- Often these systems do not support hot-remove

In most servers,
CPU/Memory are
NOT hot pluggable

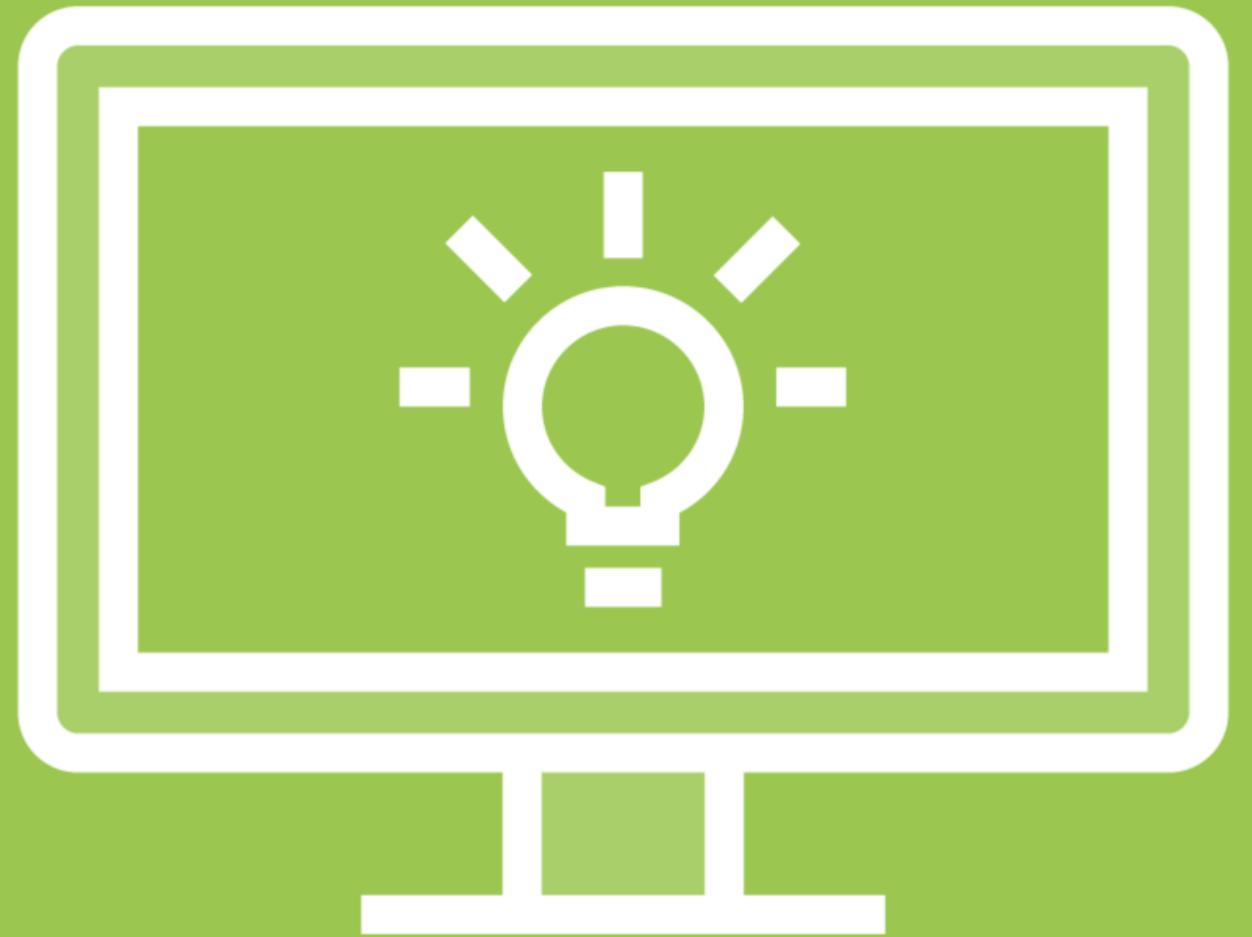
**Hot swap requires
hardware and OS
support**

Hot Swappable Components Color Coding / Icons

No industry standard

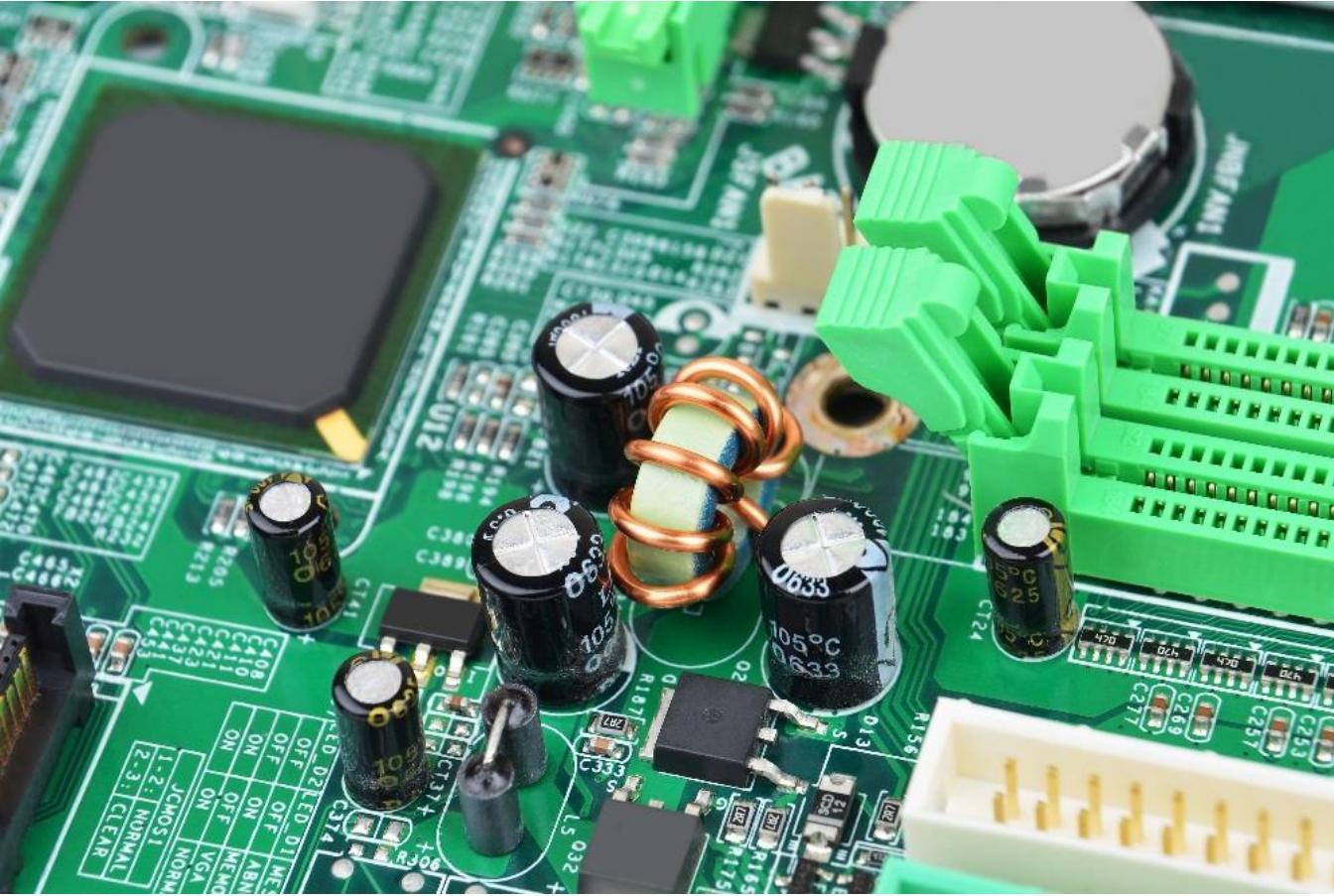
Defined by the manufacturer

Usually documented on the system cover



Tech Point
UEFI and BIOS

Visual Anchor



BIOS

Basic Input/Output System (BIOS) has been used since the dawn of PCs

Very first code loaded and run when a computer is powered on

Purposes:

- Set and use configuration of options (for example date & time or boot device)
- Initialize and test components (for example memory)
- Load bootloader code from boot device (which loads OS)

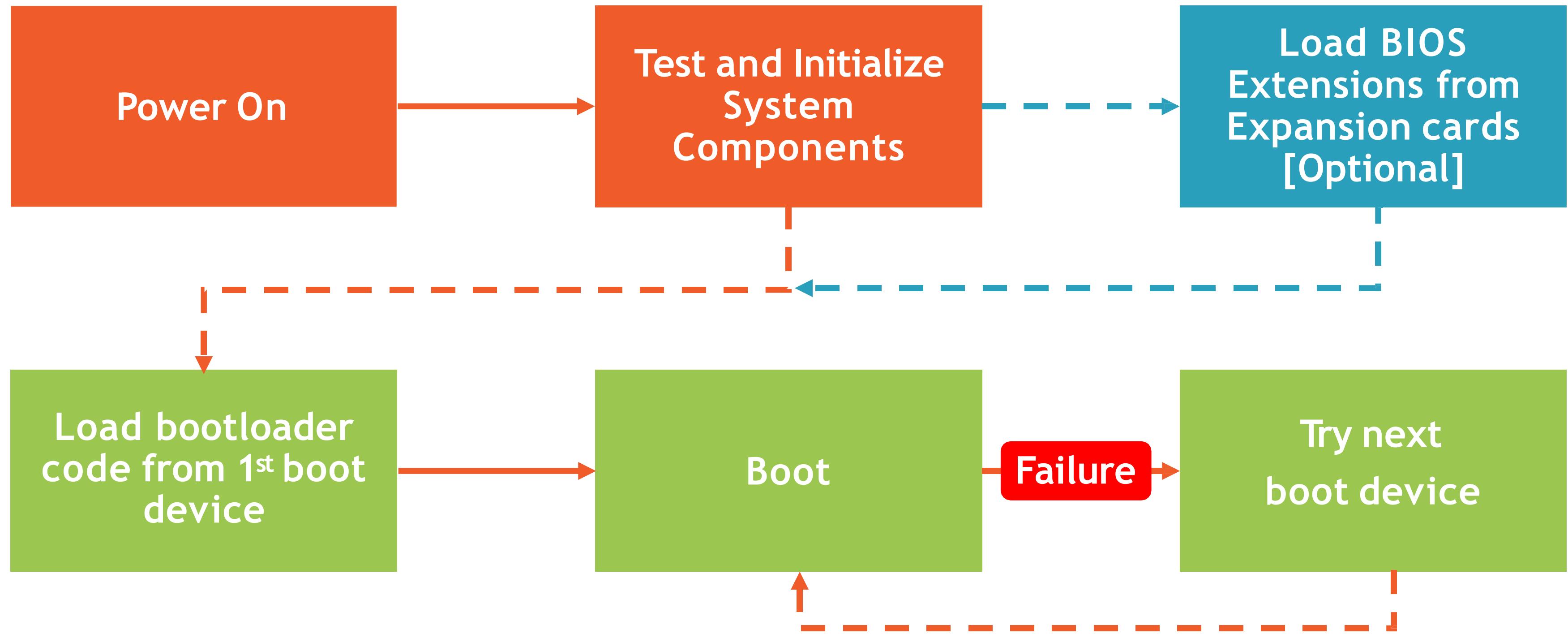
BIOS

Stored in semi-permanent flash memory

- Retains content without power indefinitely
- Can be upgraded via software as bug fixes and improvements are made by the computer manufacturer

Can be extended by cards installed in the system with their own BIOS extensions

BIOS Boot Process



UEFI

UEFI (Unified Extensible Firmware Interface) is successor to BIOS

- Provides BIOS services to OS for backwards compatibility

Can be securely booted

- Cryptography
- Linked to TPM (Trusted Platform Module) in servers

Used in all recent computers

Can be virtualized by VMware, Hyper-V, etc. like BIOS

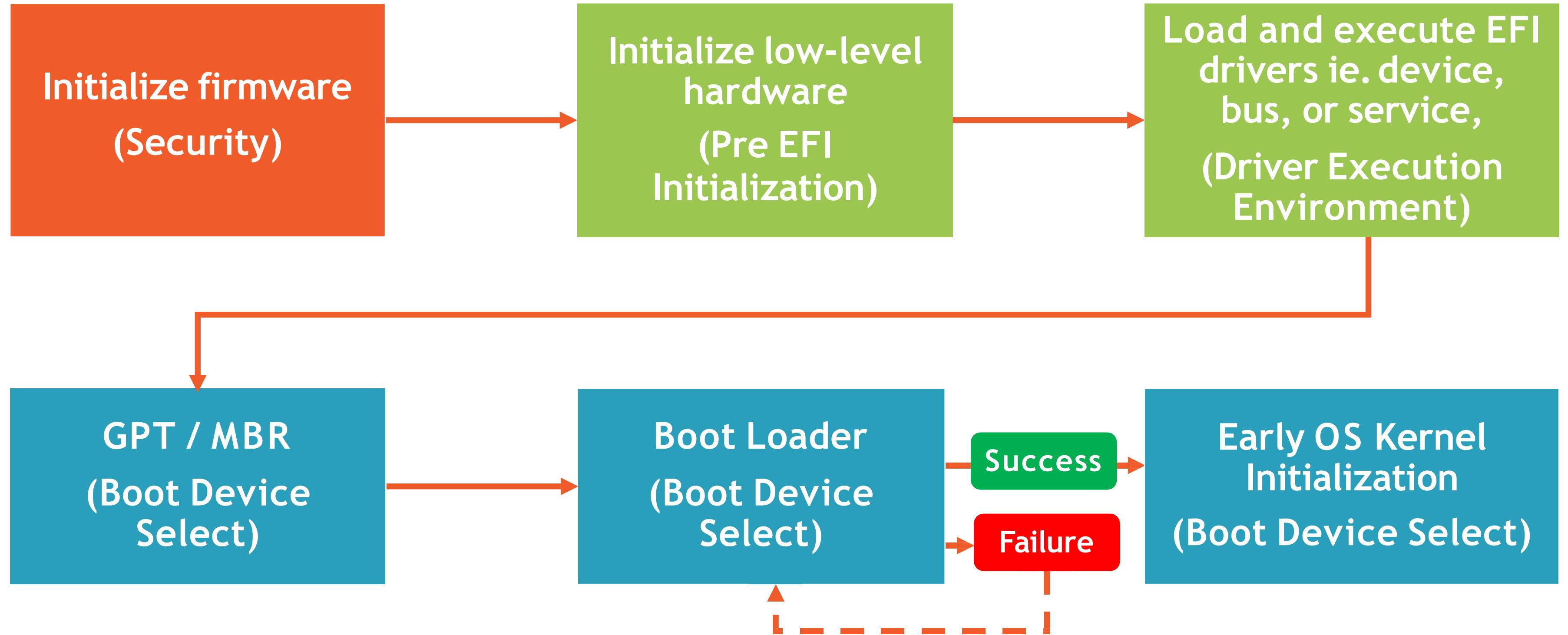
- Can have a VM with BIOS or UEFI boot on a system with either

UEFI OS Support

The operating system must support UEFI, or the system board must support BIOS compatibility mode

All major operating systems have supported UEFI since 2010, many were earlier than this

UEFI Boot Process



Differences between BIOS and UEFI

| Characteristic | BIOS | UEFI |
|--|--------------------------------------|-------------------------|
| # bits | 16 (1 MB addressable space) | 32 or 64 |
| Max disk size | 2 TB (MBR) | > 2 TB (MBR or GPT) |
| CPU-independent architecture and drivers | x86 (x64) only | x86 (x64), ARM, Itanium |
| Modular design | No | Yes |
| Support for time zones & daylight savings time | No | Yes |
| Support for boot from SAN & network | via BIOS extensions on adapter cards | Native |

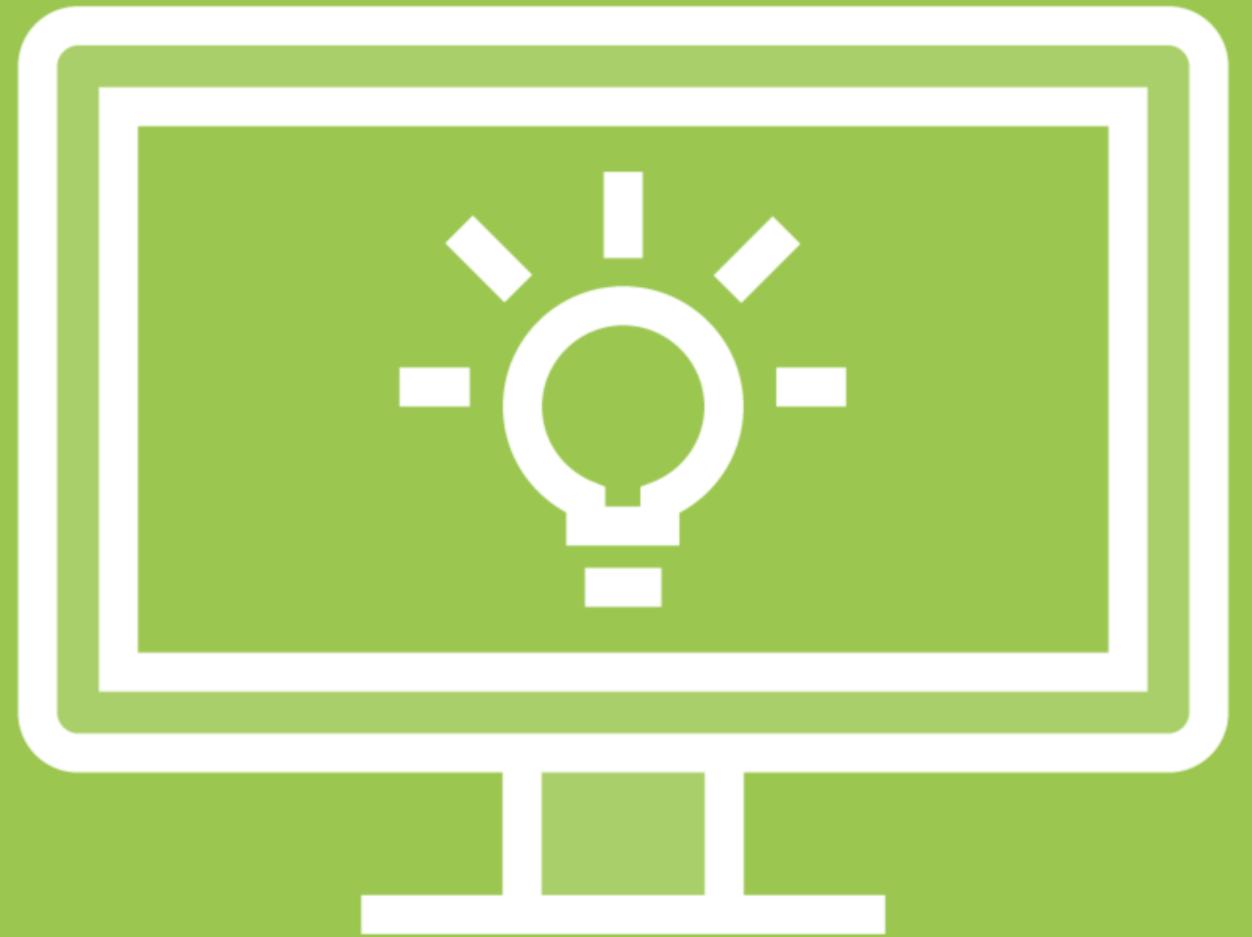
CMOS Batteries

Keeps the clock accurate (relatively speaking) when the server is off



Battery typically lasts 2 - 10 years

- Usually on the longer side with servers as power is typically off infrequently
- Usually a coin cell battery



Tech Point
Firmware

Firmware

Low-level code to run basic functions of a device

Examples:

BIOS for booting
(then OS does
most of the work)

Code on an
expansion card
(like a storage
controller)

External devices
such as scanners
and printers use it
for all functionality
it offers

Firmware

**Stored in non-volatile memory
(like the BIOS, which is a type
of firmware)**

**Updateable in computers and
associated devices**

- Used to add features, fix bugs, etc.
- Original code is stored in addition to the update in case the update fails

Firmware vs. BIOS/UEFI

Firmware

Generic term

Used by many devices

Updated less frequently than
BIOS/UEFI

Example:

Firmware on a hard drive is rarely, if ever, updated

BIOS / UEFI

BIOS/UEFI is specialized firmware

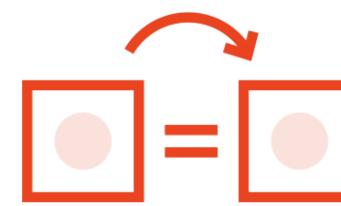
Handles the pre-boot processes

Updated several times during the lifespan of the server

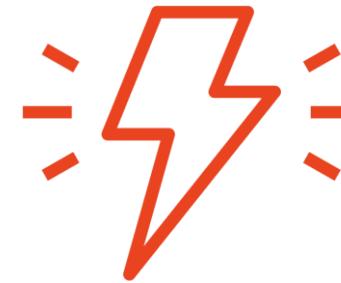
May be hacked

Updating Firmware

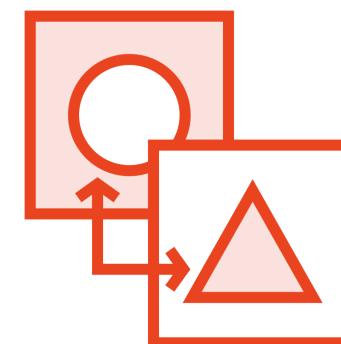
Risks and considerations for updating component firmware



Backup the current firmware



Do not power off the device during the update process



Know how to restore the old firmware before beginning the upgrade



Hindsight



LOBOMANTICS

Globomantics is finalizing the hardware plans for their new server

Just a few more questions remain unanswered



How much downtime can they experience?



How difficult will it be to replace failed hardware components?



Should they have spare parts on hand?



Decision Points

How Critical Is the Server?

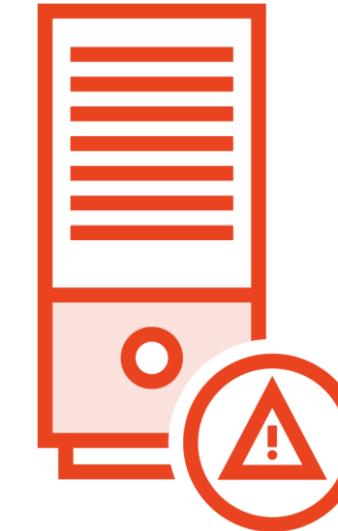
If server downtime will cause lost business or opportunities the server may be Mission Critical to the company, even if the company is small.

When lives are on the line, redundancy is imperative.



Standard Server

Standard Non-Hot Plug Components



Mission Critical

Hot-Plug Components



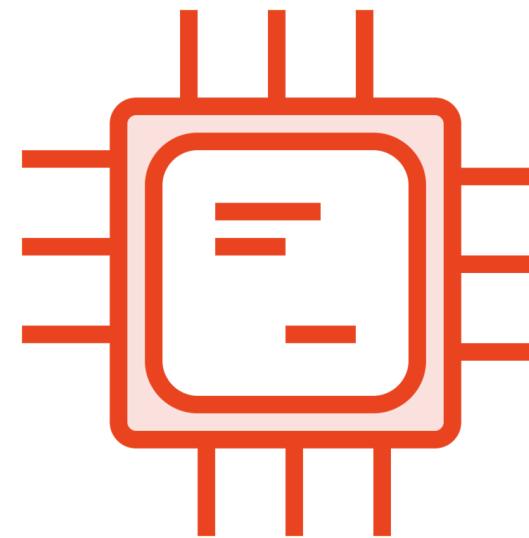
Lives depend upon it

Hot-Plug Components

Have spare components on hand

Will the Server Run a 64-bit Operating System?

32-bit operating systems typically do not support UEFI



BIOS

Stored in a chip located on the system board

Primarily used in older systems



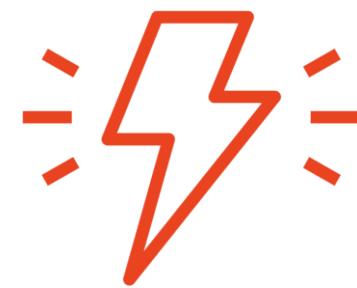
UEFI

Stored in NVRAM or in files on the hard drive

Much more extensible than BIOS



Globomantics only plan to purchase a single server, therefore it must be redundant



The server will run Microsoft Server 2019 or later, which is a 64-bit operating system



They will use hot swap power supplies, PCIe cards, fans, and hard drives

The server will boot UEFI



Module Summary

Review



Server Form Factors

The Hardware Compatibility List (HCL)

CPU Cores vs. Clock Speed

Memory Type and Placement

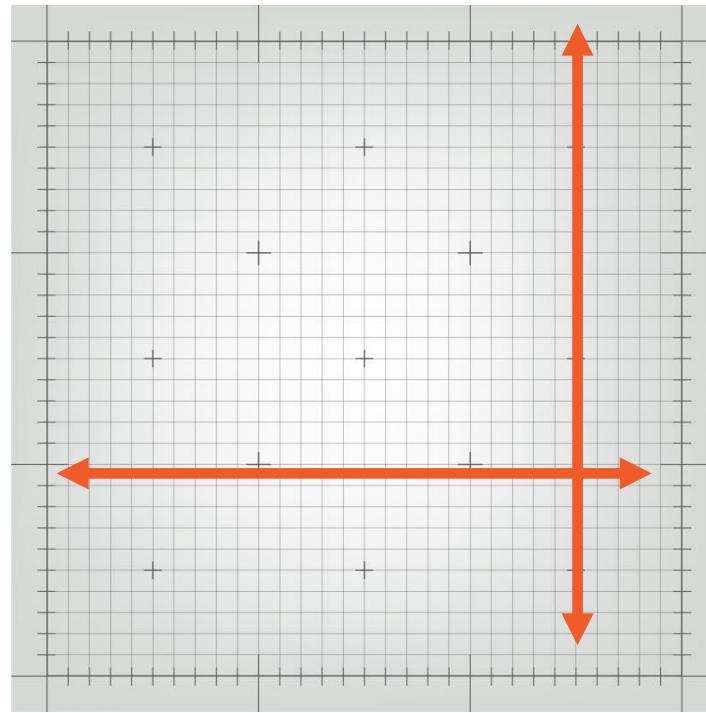
PCIe Version and Slot Type

GPU Considerations

Hot Swappable Hardware

Firmware vs. UEFI/BIOS

Why Does the Form Factor Matter?

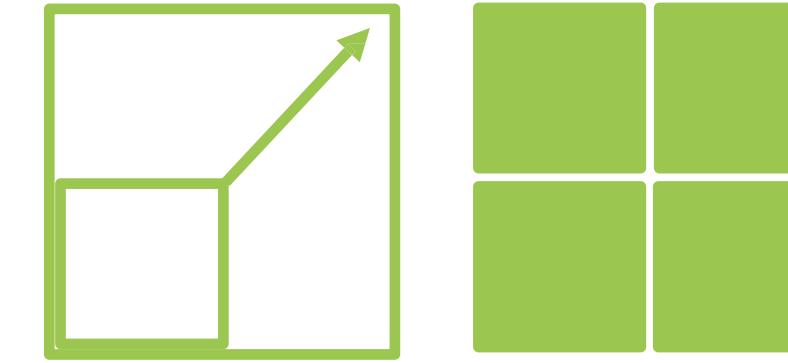


Physical size

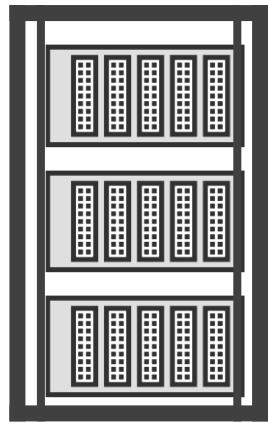


120V
208V
240V

Power input
type



Expansion vs.
density

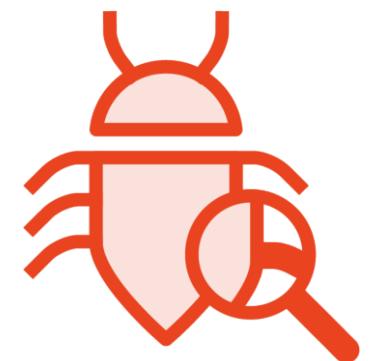


Free-standing
vs. fixed
mounted

What Is the Purpose of an HCL?



You can feel confident that your hardware has been tested and confirmed to be stable with the vendor's application



The vendor can rule out hardware compatibility issues, making support easier



Some software vendors will not provide support if you do not follow the HCL

Speed vs. Parallel Processing

Do you require extreme speed for a single process or are you planning to run a highly parallel workload?

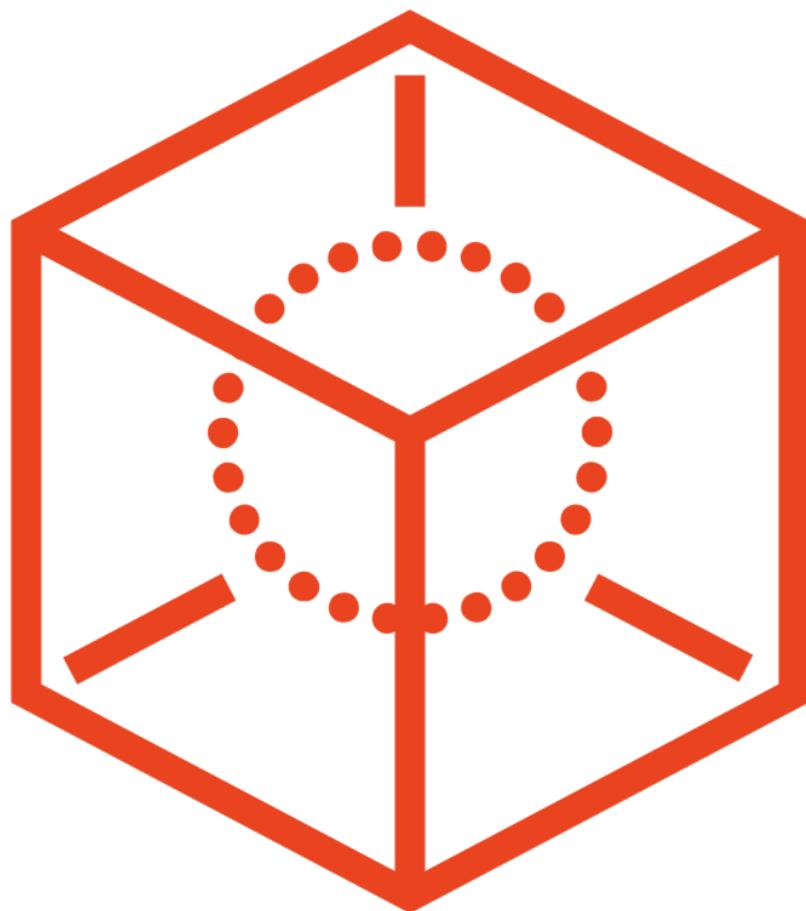


**Single-thread
Performance**
Choose a system with
fewer cores, where each
core has a high clock
speed



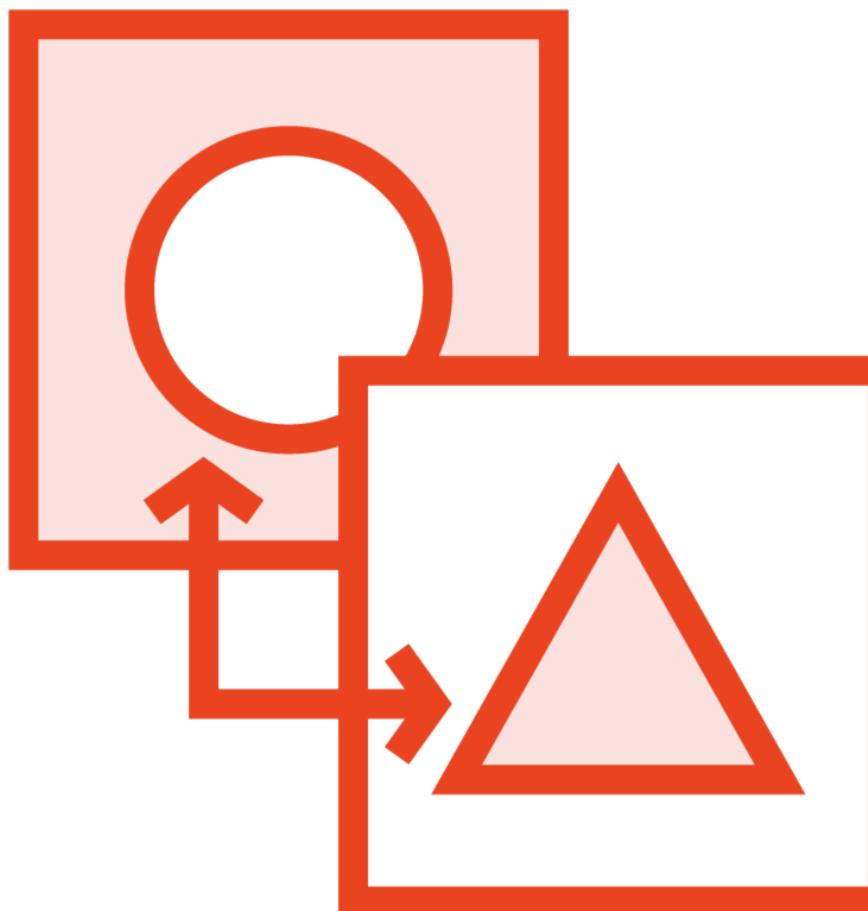
**Highly Parallel
Processing**
Choose a system with
more cores, but each core
will have a lower clock
speed

With RAM, What Matters Most?

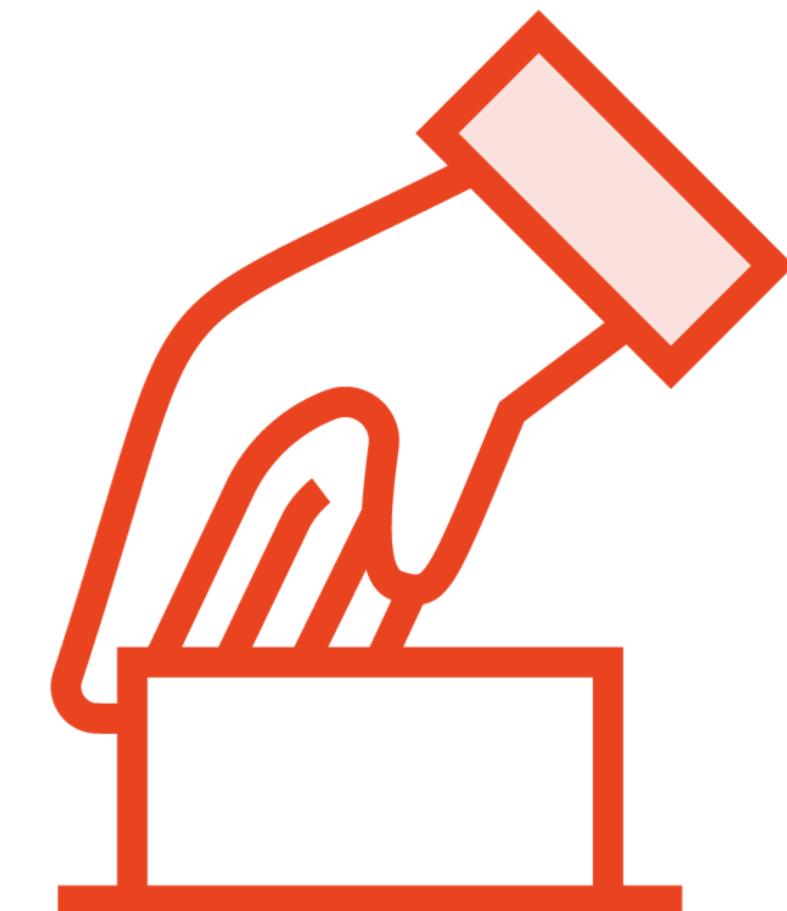


The total RAM
capacity

64GB, 256GB, 1TB



The type of RAM
ECC, DDR4, etc.

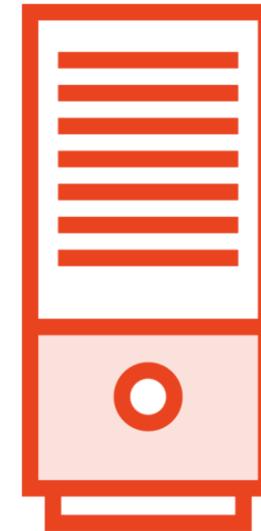


Where you install it
Bank 0, Bank 1

How Critical Is the Server?

If server downtime will cause lost business or opportunities the server may be Mission Critical to the company, even if the company is small.

When lives are on the line, redundancy is imperative.



Standard Server

Non-ECC Memory



Mission Critical

ECC memory required

Memory spares if available



Lives depend upon it

Memory Mirroring
Required

Memory Spares Required

Why Does the PCIe Version and Slot Type Matter?

Suppose you want to add a **40 Gbps network card** to a server.

What do you need to know about the system board?

What is the PCIe bus version?

What type of PCIe slots are available?



This tells you the available bandwidth

For this example, assume the bus (and card) is PCIe 4.0

How many PCIe lanes (the PCIe slot type) would you need to support a **40 Gbps card**?

Why Does the PCIe Version and Slot Type Matter?

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What do you need to know about the system board?

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PCIe 4.0

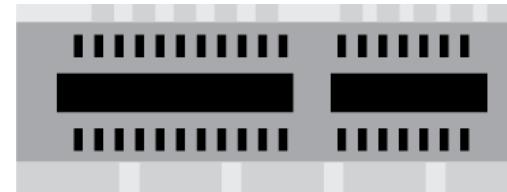
What types of PCIe slots are available?

x1, x4, and x16

Solution:
PCIe 4.0
Using one x4 slot



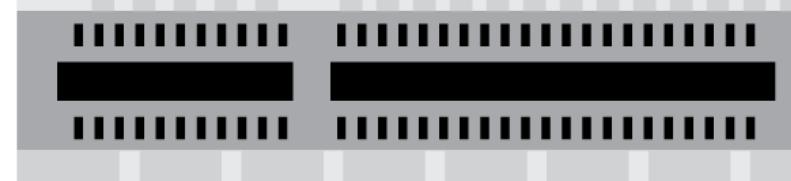
x1 Slot



PCIe 4.0 with 1 lane = 15.76 Gbps (insufficient)



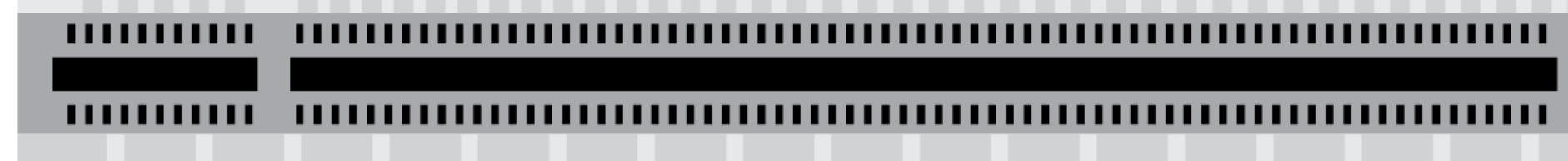
x4 Slot



PCIe 4.0 with 4 lanes = 63.02 Gbps (perfect)

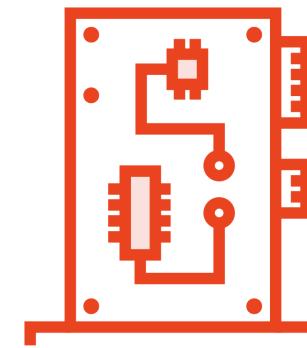


x16 Slot



(overkill)

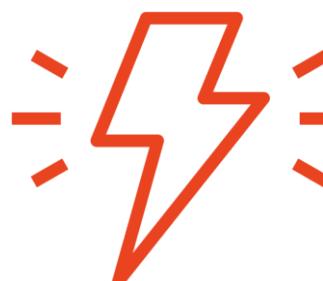
What Do You Need to Consider About GPUs?



How many cards do you need?



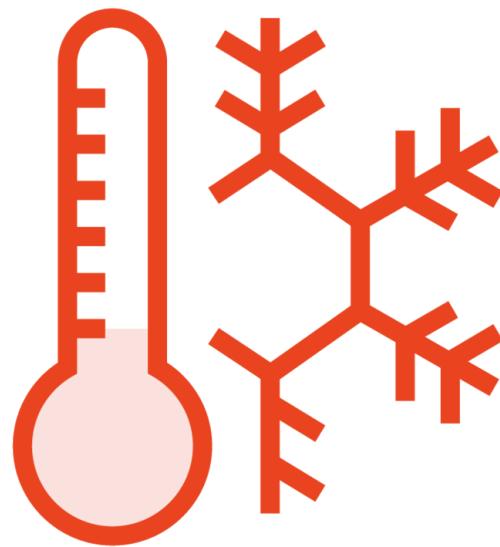
Bus type of the card



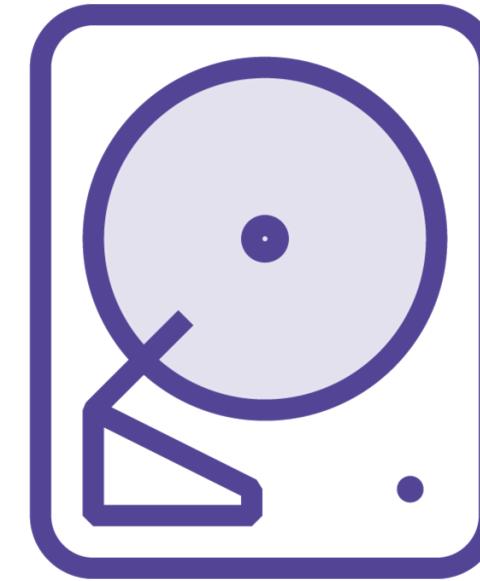
Power draw of the cards

Common Hot Swappable Components

Components that can often be hot swapped in servers:



Fans



Hard drives



Power supplies

Firmware vs. BIOS/UEFI

Firmware

Generic term

Used by many devices

Updated less frequently than
BIOS/UEFI

Example:

Firmware on a hard drive is rarely, if ever, updated

BIOS / UEFI

BIOS/UEFI is specialized firmware

Handles the pre-boot processes

Updated several times during the lifespan of the server

May be hacked

Up

Next:

—~~Storage~~
