Installing, Configuring, and Troubleshooting Internal System Components

# Installing, Configuring, and Troubleshooting Internal System Components

- Install and Upgrade CPUs
- Configure and Upgrade BIOS/UEFI
- Install Power Supplies
- Troubleshoot Internal System Components
- Configure a Custom PC

CPU

CPU: (central processing unit) The main chip on the system board, it performs software instructions and mathematical and logical calculations. Also referred to as the microprocessor or processor.

- Controls I/O functions
- Processes simple instructions quickly
- CPU manufacturing process
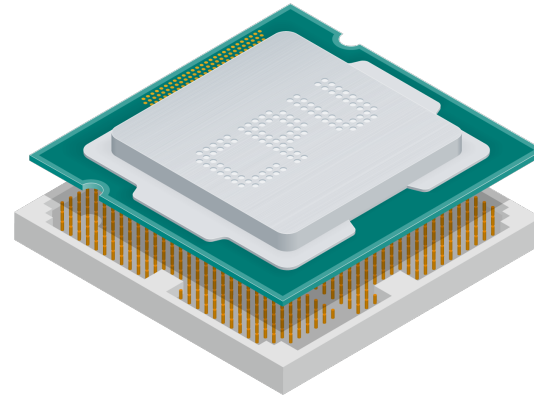
CPU Architectures

Instruction set: The machine language code and commands the CPU can process.

ALU: (arithmetic logic unit) A CPU circuit that performs integer-based calculations and performs bit-wise logical calculations.

FPU: (floating point unit) A math co-processor built into the CPU that performs calculations on floating point numbers.

1. Software is assembled into instructions and loaded into system memory.
2. The control unit fetches instructions in sequence from system memory to the pipeline.
3. The control unit decodes each instruction and either executes it itself or passes it to the ALU or FPU for execution.
4. The result of the executed instruction is written back to a register or to system memory.

CompTIA.

Instruction Sets

GP registers: (general purpose) Registers that store data from a CPU's basic instruction set.

- x86-32 or IA-32
- x64
    - Intel IA-64
    - AMD AMD64
    - Intel EM64T, also known as x86-64 or x64

Addressing

- System bus between CPU and memory consists of:
  - Data bus determines how much data can be transferred per clock cycle.
  - Address bus determines how many memory locations the PC can access.
- On modern PCs, the data bus is 64 bits wide.
- Address bus for 32-bit CPUs is 32 or 36 bits wide.
  - 32-bit bus can access 4 GB of address space.
  - 36-bit bus can access 64 GB of address space.
- Address bus for 64-bit CPUs is usually 48 bits wide.
  - 48-bit bus can access 256 TB of address space.
  - Done to reduce complexity in compatibility with 32-bit software.
  - Theoretically could be 64-bits wide and access 16 Exabytes of address space.

Cache

Cache: A small block of high-speed memory that enhances performance by preloading instructions and data from system RAM that the CPU uses regularly.

- Originally implemented as a second chip on the motherboard.
- Now implemented almost exclusively on-die (on the CPU itself).
- Levels
  - Level 1 cache is closest to CPU and is smallest and fastest.
  - Level 2 cache is a bit larger, and a bit slower than Level 1.
  - Levels 3 and 4 are larger and possibly slower than Level 2.

Hyperthreading

Multitasking: The ability of an operating system to run multiple programs, or tasks, at one time.

Thread: A stream of instructions generated by a software application. Most applications run a single process in a single thread.

- Superpiplining:
  - CPUs process multiple instructions at once.
  - Considered superscalar architecture as multiple execution units are required.
- Multithreading:
  - Also known as SMT, HT, or HTT.
  - Allows multiple threads to run through the CPU at the same time.
  - Duplicates many registers of the CPU.
  - Reduces amount of CPU idle time.
  - The OS thinks more CPUs are installed.
  - Works best with multithreaded software (usually runs on servers).

Multiprocessing and Multicore Processors

SMP: (symmetric multiprocessing) A condition where two or more physical CPUs that share a common OS and memory execute instructions simultaneously.

- Two or more physical processors installed for SMP.
- SMP-aware OS makes efficient use of processing resources.
- Multicore CPUs are multiple processors combined on the same die.
  - Often 2, 4, 8, or more processors.

CompTIA.

Clock Speed

- A key performance indicator.
- Some run slower but provide better performance.
- Core clock speed :
  - Speed at which the CPU runs internal processes and accesses L1 and L2 cache.
- Front Side Bus speed is the speed of the interface between the CPU and system memory.

CompTIA.

Overclocking

Overclocking: Increasing the clock speed over the optimum speed determined by the manufacturer in an effort to increase performance.

- Manufacturer sets optimum clock speed where damage is not likely.
- Overclocking is configured through system setup firmware or by adjusting properties of the CPU Speed or Advanced Chipset Features.
  - Can increase the core clock speed.
  - FSB speed (overclocking the memory chips).
  - Both core and FSB speed.
- Increasing clock speed generates more heat.
  - Requires a suitable power supply and sufficient cooling.
  - Monitor the temperature of the room as well.

Power Management (Throttling)

Throttling: Technology that allows the CPU to slow down if thermal output reaches a critical level or to improve power performance.

- CPUs can implement power management to enter lower power states.
  - Helps conserve energy and reduce heat production.
  - CPUs that run too hot can become unstable or damaged.

Other CPU Features (Slide 1 of 2)

VM: (virtual machine) A guest OS installed on a host computer by using virtualization software (a hypervisor), such as Microsoft Hyper-V or VMware.

Hardware-assisted virtualization: Instruction set extensions that facilitate the operation of VMs.

SLAT: (second level address translation) A feature of virtualization software designed to improve the management of virtual (paged) memory.
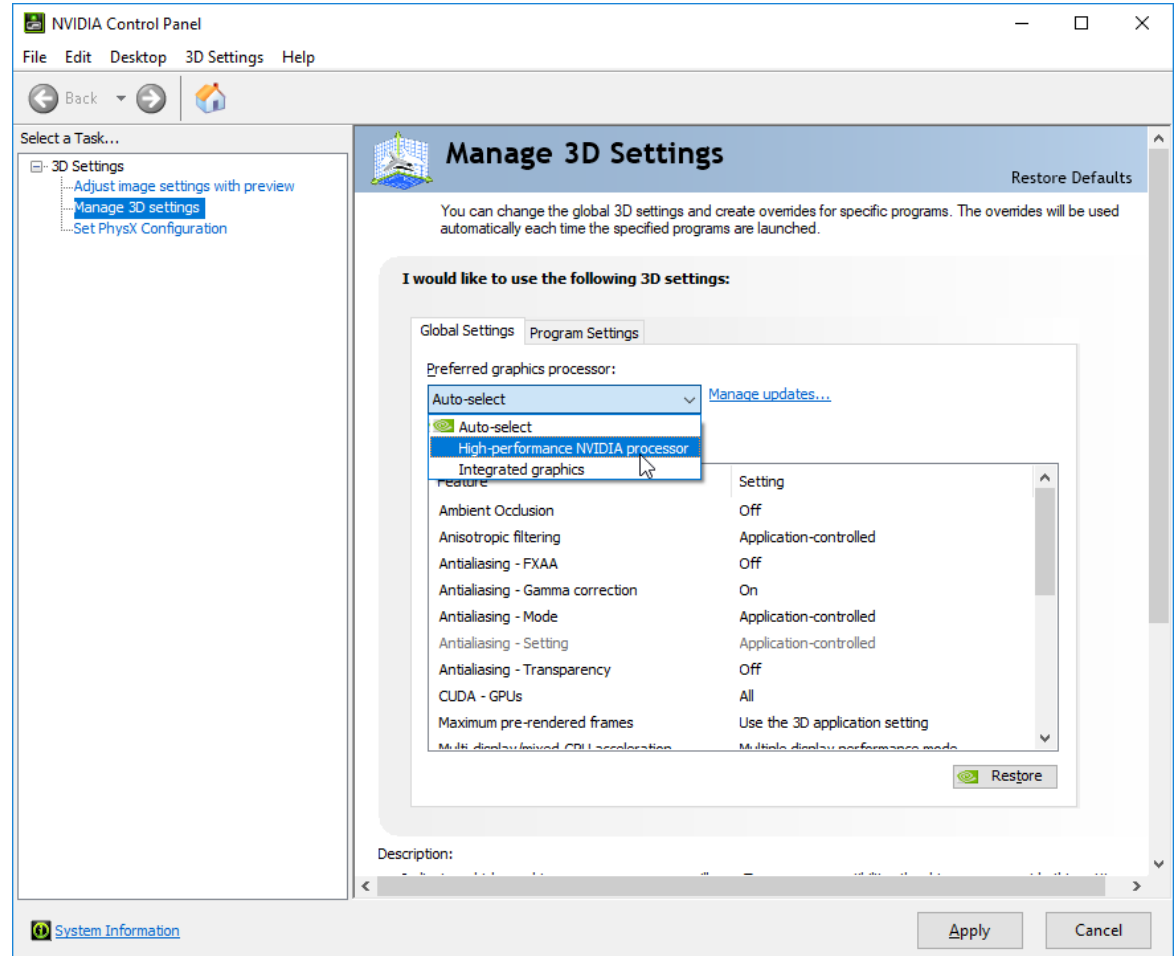
EPT: (extended page table) The term used for SLAT extensions by Intel.

RVI: (rapid virtualization indexing) The term used for SLAT extensions by AMD.

Integrated GPU: A graphics adapter built onto the motherboard or the CPU.

Other CPU Features (Slide 2 of 2)

- Virtualization extensions.
- Integrated GPU.
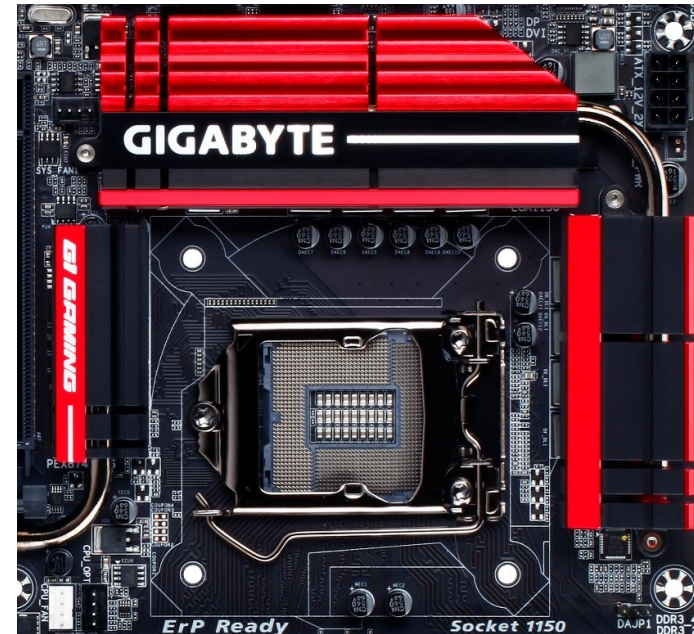
CPU Packaging and Compatibility (Slide 1 of 2)

CPU form factor: CPU packaging and how it connects to the motherboard.

LGA: (Land Grid Array) Intel technology in which pins that connect the CPU and socket are located on the socket.

- Intel CPU ranges:
  - Core (flagship brand, i3-i9)
  - Pentium (32 bit)
  - Celeron (budget)
  - Atom (portable devices)
  - Xeon (Server/Workstation, powerful)
- LGA socket type

Intel Socket 1150

# CPU Packaging and Compatibility (Slide 2 of 2)

PGA: (Pin Grid Array) AMD technology in which pins that connect the CPU and socket are located on the underside of the processor.

ZIF: (Zero Insertion Force) A processor socket type allowing the chip to be placed in the socket with as little risk of damaging the pins on the processor chip as possible.

- AMD CPU ranges:
  - Ryzen/Threadripper
  - Ryzen Mobile
  - Epyc
- PGA socket type

AMD FM2+/FM2 Socket
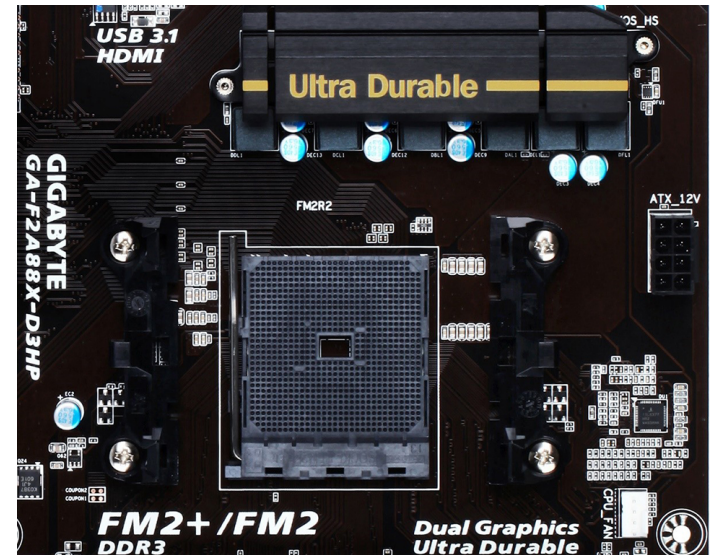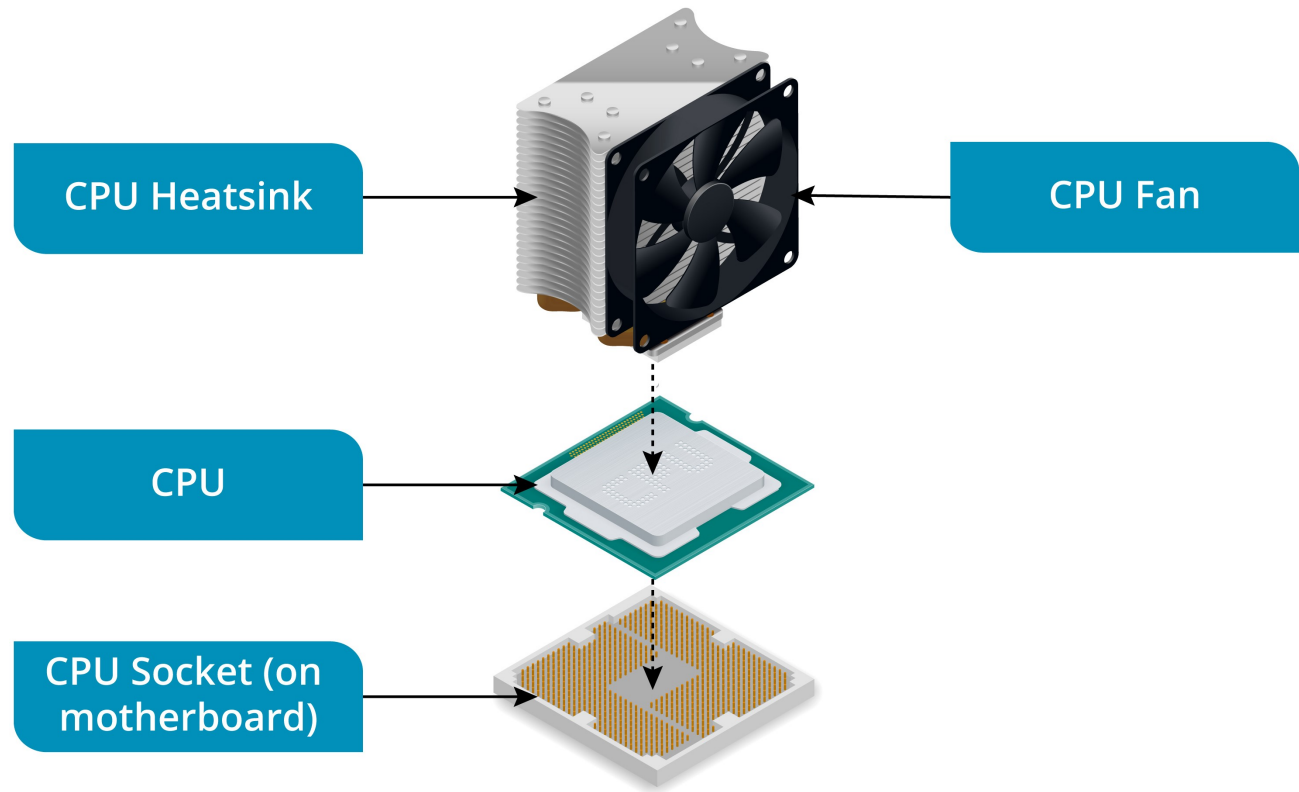
Cooling Mechanisms (Slide 1 of 3)

Heat sink: A passive heat exchanger that dissipates heat from a source such as a CPU and transfers it, normally via an enlarged surface area, to another medium such as air or water.

Thermal paste: A medium used to connect a heat sink to a CPU that fills any gaps between the CPU and the heat sink to permit a more efficient transference of heat from the CPU to the heat sink.

Passive cooling device: Cooling systems that work without electricity.

Cooling Mechanisms (Slide 2 of 3)

- CPU heat sink and fan assembly
- Case fans
- GPU fans

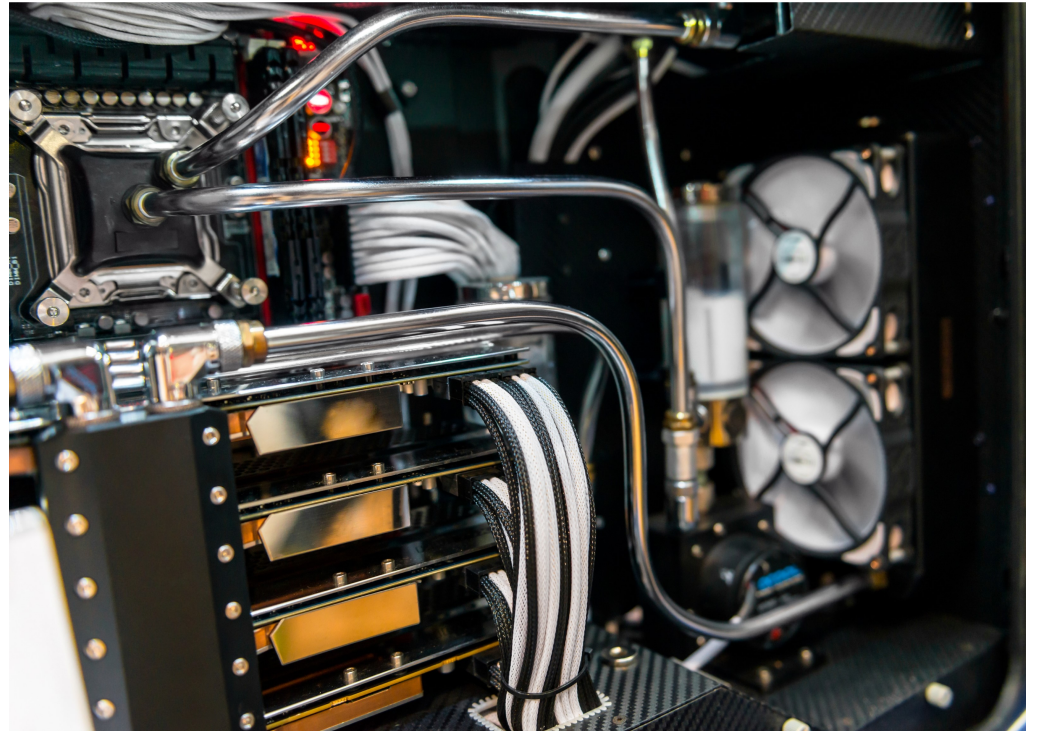CPU Heatsink

CPU Fan

CPU

CPU Socket (on motherboard)

Cooling Mechanisms (Slide 3 of 3)

Heat pipe: A sealed tube containing water or ethanol coolant. **Heat spreader**: Similar to a heat pipe except it is a flat container rather than a pipe.

- Liquid-based cooling systems

CPU Installation Considerations

- Make sure processor matches the type of socket on the system board.
- When upgrading the CPU, check that the new model is supported by the motherboard.
- On a processor, Pin 1 may be indicated with:
  - A beveled corner or a white dot printed in one corner of the processor.
  - A square, rather than round, joint where one of the pins is connected to the underside of the processor.
  - A "spur" on one corner of the gold patch on the underside of the processor.
- On a processor socket, Pin 1 may be indicated with:
  - A difference in the pattern of pin holes in one corner.
  - A "1" printed on the motherboard next to one corner.

Activity

Discussing CPU Upgrades

CPU Swap: https://www.youtube.com/watch?v=FBdzT-hygj0

Activity

Planning for a CPU Upgrade

System Firmware

Firmware: Software stored in memory chips that stores information whether the computer is turned on or not.

System firmware: Provides low-level code that allows computer components to be initialized and load the main OS software.
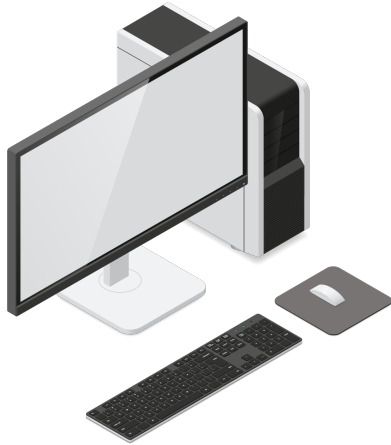
Hardware
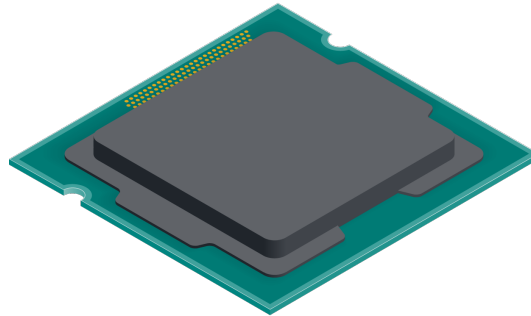
Firmware

Software

BIOS

BIOS: (basic input/output system) A set of instructions that is stored in ROM and that is used to start the most basic services of a computer system.

UEFI

UEFI: (Unified Extensible Firmware Interface) A standard firmware interface for PCs designed to improve software interoperability and address the limitations in BIOSs.

System Firmware Setup Programs


```
          Dell Inc. (www.dell.com) - PowerEdge T310
                    BIOS Version 1.12.0

 Service Tag: C3CVT4J              │ Asset Tag:

 System Time ............................. 13:49:42        ▲
 System Date ............................. Wed Nov 11, 2015

 Memory Settings ......................... <ENTER>
 Processor Settings ...................... <ENTER>

 SATA Settings ........................... <ENTER>

 Boot Settings ........................... <ENTER>

 Integrated Devices ...................... <ENTER>
 PCI IRQ Assignment ...................... <ENTER>

 Serial Communication .................... <ENTER>
 Embedded Server Management .............. <ENTER>

 Power Management ........................ <ENTER>        ▼

 Up,Down Arrow to select │ SPACE,+,- to change │ ESC to exit │ F1=Help
```
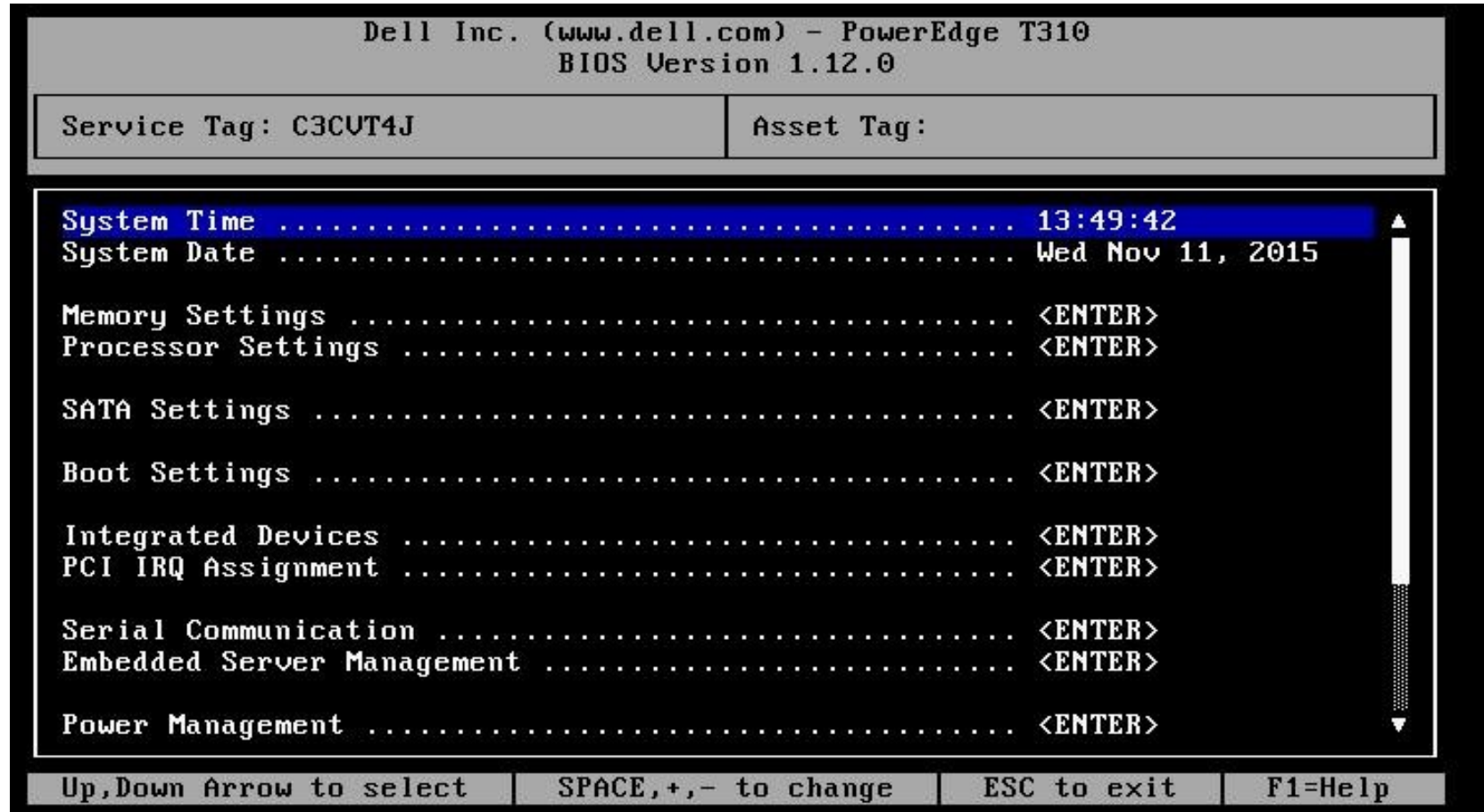
CompTIA.

System Component Settings (Slide 1 of 3)

- CPU features

System Component Settings (Slide 2 of 3)

- RAM

Dell Inc. (www.dell.com) – PowerEdge T310
BIOS Version 1.12.0

Service Tag: C3CVT4J   Asset Tag:

System Time 14:36:00
System Date ..
                System Memory Size .... 8.0 GB
Memory Setting System Memory Type .... ECC DDR3
Processor Sett System Memory Speed .... 1067 MHz
                Video Memory .... 8 MB
SATA Settings   System Memory Testing .... Enabled

Boot Settings .... <ENTER>

Integrated Devices .... <ENTER>
PCI IRQ Assignment .... <ENTER>

Serial Communication .... <ENTER>
Embedded Server Management .... <ENTER>

Power Management .... <ENTER>

Up,Down Arrow to select | SPACE,+,- to change | ESC to exit | F1=Help
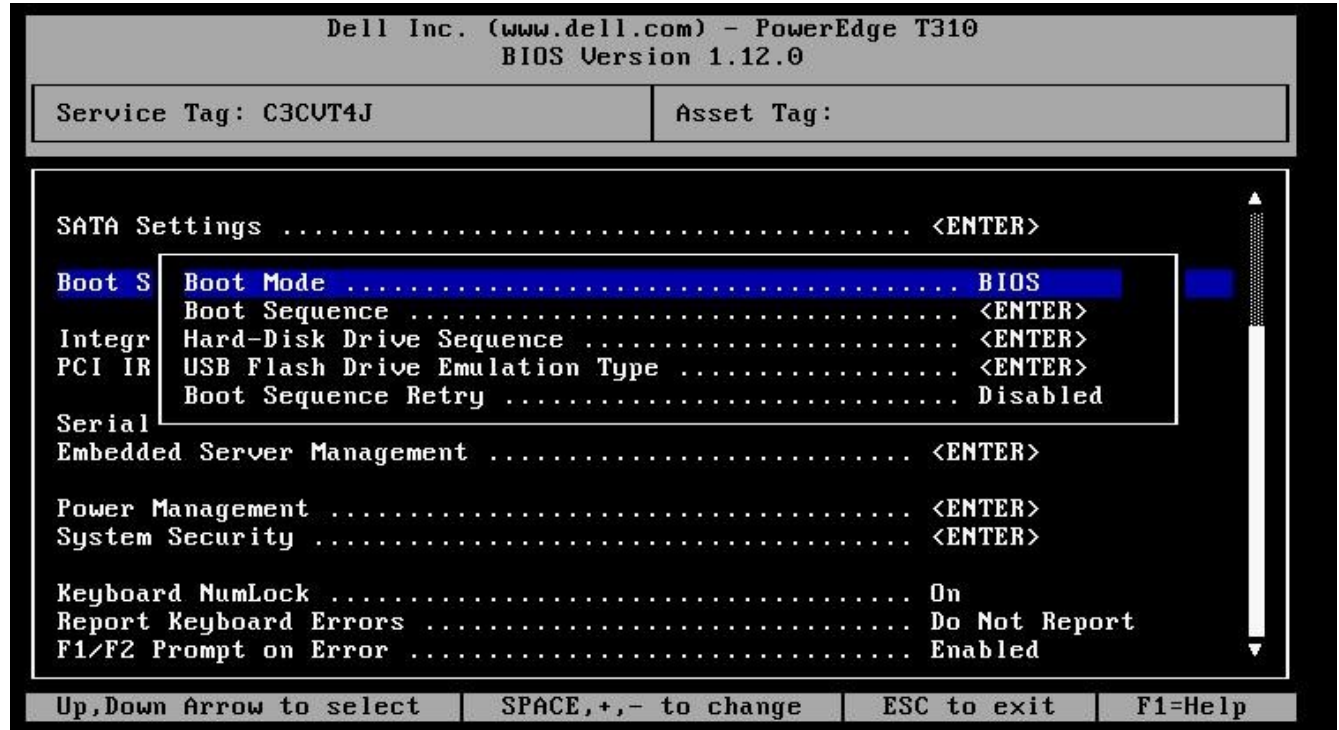
System Component Settings (Slide 3 of 3)

- Power management
- Date, time, and daylight savings
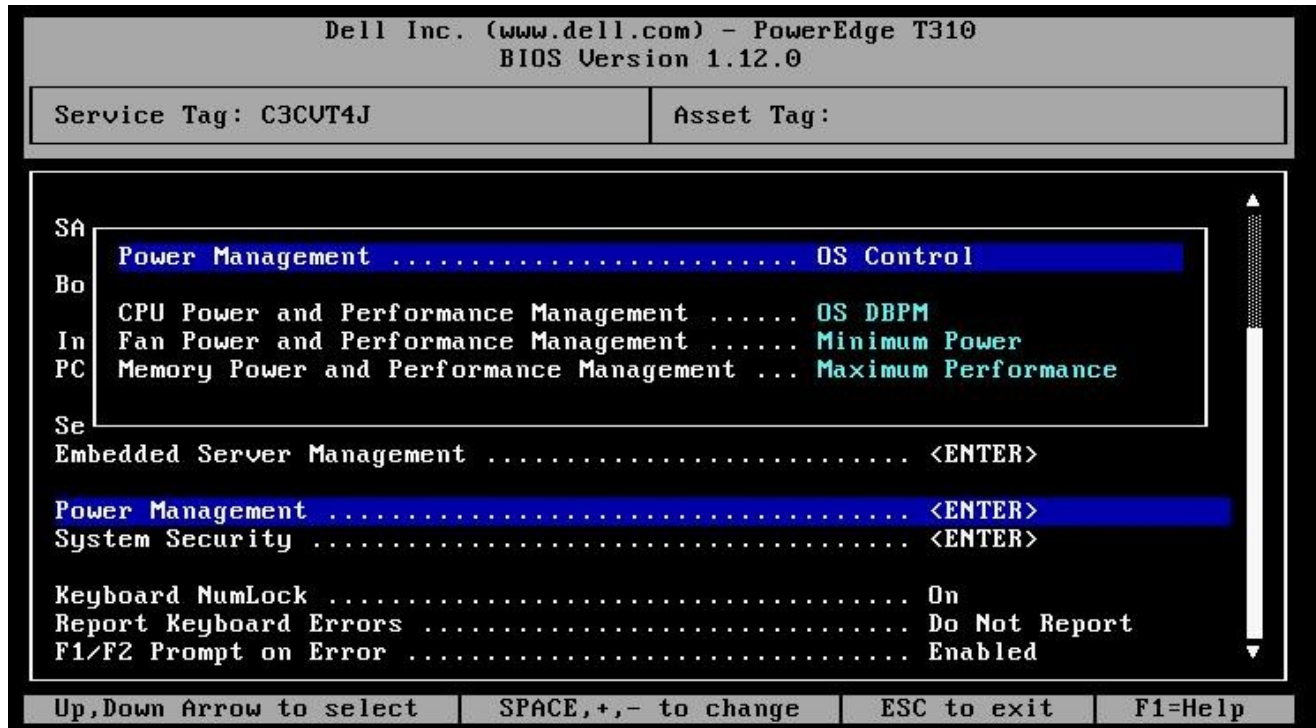
Boot Options (Slide 1 of 2)

- Hard drive
- Floppy drive
- Optical drive
- USB
- Network/PXE

Dell Inc. (www.dell.com) – PowerEdge T310
BIOS Version 1.12.0

Service Tag: C3CVT4J   Asset Tag:

```
SATA Settings ....................................... <ENTER>

Boot S | Boot Mode ................................................ BIOS
       | Boot Sequence ........................................... <ENTER>
Integr | Hard-Disk Drive Sequence .............................. <ENTER>
PCI IR | USB Flash Drive Emulation Type ................... <ENTER>
       | Boot Sequence Retry ............................. Disabled
Serial
Embedded Server Management ........................... <ENTER>

Power Management ..................................... <ENTER>
System Security ...................................... <ENTER>

Keyboard NumLock ..................................... On
Report Keyboard Errors ............................... Do Not Report
F1/F2 Prompt on Error ................................ Enabled
```

| Up,Down Arrow to select | SPACE,+,- to change | ESC to exit | F1=Help |

CompTIA.

Boot Options (Slide 2 of 2)

Interface Configuration Settings

- **Onboard device configuration**
  - **Storage adapters**
  - **USB**
  - **Network adapters**
  - **Graphics adapters**
  - **Sound adapters**


```
              Dell Inc. (www.dell.com) - PowerEdge T310
                        BIOS Version 1.12.0

  Service Tag: C3CVT4J                    Asset Tag:


  SATA S
         User Accessible USB Ports ......... All Ports On
  Boot S Internal USB Port ................. On
         Embedded NIC1 and NIC2 ............ Enabled
  Integr Embedded Gb NIC1 .................. Enabled with PXE
  PCI IR    MAC Address .................... 842B2B19E291
         Embedded Gb NIC2 .................. Enabled
  Serial    MAC Address .................... 842B2B19E292
  Embedd OS Watchdog Timer ................. Disabled
         Embedded Video Controller ......... Enabled
  Power
  System Security .................................. <ENTER>

  Keyboard NumLock ................................. On
  Report Keyboard Errors ........................... Do Not Report
  F1/F2 Prompt on Error ............................ Enabled

  Up,Down Arrow to select │ SPACE,+,- to change │ ESC to exit │ F1=Help
```
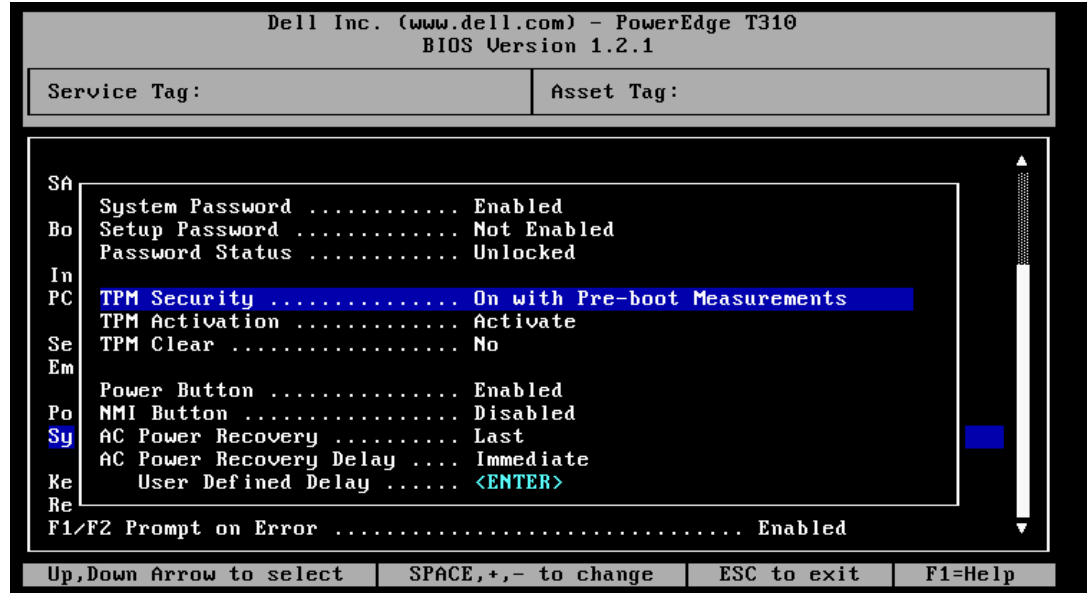
CompTIA.

Security Settings (Slide 1 of 2)

- Authentication:
  - Supervisor/Administrator/Setup
  - User/System
- Drive locks:
  - Password stored in PC firmware
  - Password stored in disk firmware
  - Full Disk Encryption
- Drive encryption
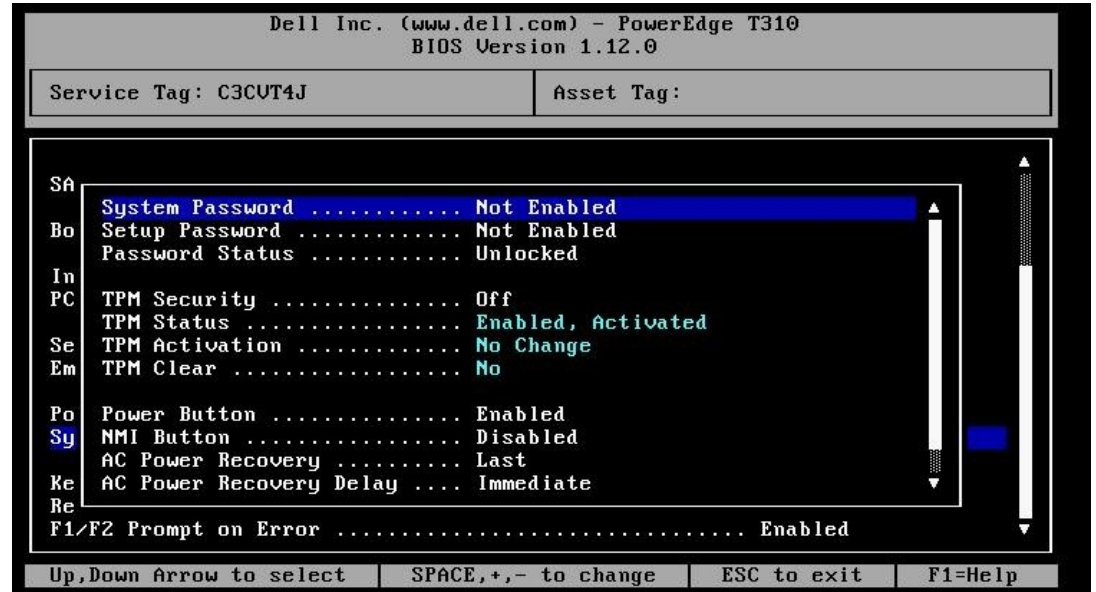
Security Settings (Slide 2 of 2)

- TPM
- LoJack
- Intrusion detection
- Secure boot

Firmware Updates

- Fix bugs.
- Solve incompatibilities.
- Check websites for updates:
  - Only apply to resolve specific issues.
  - Install critical updates.

Activity

Discussing BIOS/UEFI Configuration and Updates

30bird 4.1.3&5

Electrical Circuits (Slide 1 of 3)

Voltage: The potential difference between two points measured in Volts (V).

Current: The actual flow of electrons, measured in Amps (I).

Resistance: A degree of opposition to the current caused by characteristics of the conductor, measured in Ohms (Ω or R).

Power: The rate at which electricity is drawn from the supply by the device using it, measured in Watts.

Energy: The amount of power consumed by a device over time, measured in Kilowatt-hours.

Electrical Circuits (Slide 2 of 3)

DC: (Direct Current) The charge flows in one direction from the positive to negative terminals of the power source at a constant voltage.

AC: (Alternating Current) The current flows in both directions around the circuit and the voltage alternates between low and high values.

Conductor: A material that is good at conducting electricity, such as gold, copper, or tin.

Insulator: A material that does not conduct electricity, such as rubber or plastic.

Semiconductor: A material that can act as both a conductor and an insulator.

Electrical Circuits (Slide 3 of 3)

Resistor: A material that can oppose the flow of current without blocking it completely and is used to manage electronic circuits.

Diode: A valve allowing current to flow in one direction only.

Fuse: A safety device designed to break a wire, breaking the circuit and shutting off the current.

Transistor: A semiconductor switch used to create logic devices.

Capacitor: A device which stores electrical energy and is often used to regulate voltages.

PSU

PSU: (Power Supply Unit) An internal hardware component that delivers Direct Current (DC) low voltage power to the PC components.

- Contains:
    - Transformers
    - Filters
    - Regulators
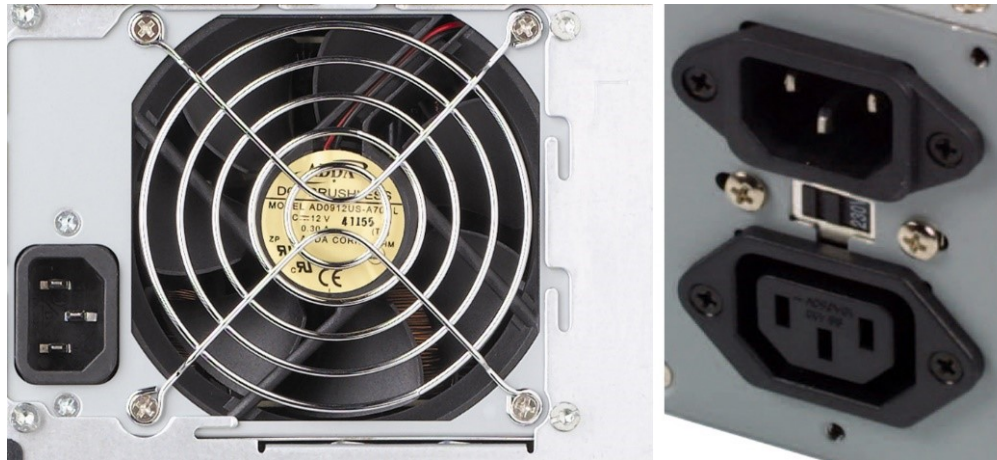   - Fan

CompTIA.

PSU Form Factors

- ATX
  - Most common
- EPS12V
  - Server class
- Micro-ATX
  - SFX12V
  - TFX12V

Input Voltage

Input voltage: A PSU setting to set North American power supplies to 115 V and UK power supplies to 240 V.

PSU Power Ratings

Power rating: The maximum power output available from a PC power supply, measured in watts, calculated as voltage multiplied by current.

- Calculated as V*I
- Desktop PC typically 200-300 W
- Slimline Desktop PC typically 100-200 W
- Tower systems and servers often over 300 W
- Gaming PCs often over 500 W

Output Voltages

OCP: (Overcurrent Protection) A power supply rail safety feature that cuts the circuit if the power exceeds a safe limit.

Output Rail (V)	Maximum Load (A)	Maximum Output (W)
+3.3	20	130
+5	20	130
+12	33	396
-12	0.8	9.6
+5 (standby)	2.5	12.5

CompTIA.

PSU Adapter Types (Slide 1 of 3)

Voltage regulator: A module that ensures the motherboard delivers the voltage required by the CPU.
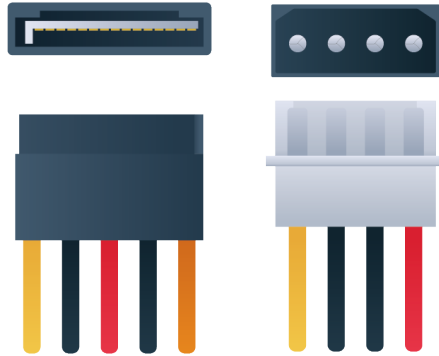
Main connector: The adapter from the power supply that supplies power to the motherboard. (P1 adapter, 3.3v, 5v, 12v)

PSU Adapter Types (Slide 2 of 3)

Molex connector: A power connector that is used to supply power to Parallel Advanced Technology Attachment (PATA) drives, optical drives, and SCSI drives. (5v and 12v)

PSU Adapter Types (Slide 3 of 3)

- PCIe connectors: 6-pin (12v)
- P4 and EPS connectors: 8-pin

# Power Needs Calculation (Slide 1 of 2)

1. List the devices that need to have power served by the PSU. Be sure to include the following:
   - Motherboard
   - CPU
   - RAM
   - Hard drives
   - CD drives
   - DVD drives
   - Floppy drives (if any)
   - Expansion cards

Power Needs Calculation (Slide 2 of 2)

2. Determine the power requirements for each device.
3. Add up the power requirements for the existing total power load.
4. Consider adding a buffer of 20 to 30 percent for future power needs.
5. Examine the details on the PSU currently installed, paying particular attention to the maximum output.
   - If you have not exceeded the power available, you do not need to upgrade the PSU.
   - If you have, you will need to obtain a PSU with a higher output and install it.

Activity

Discussing Power Supply Installation
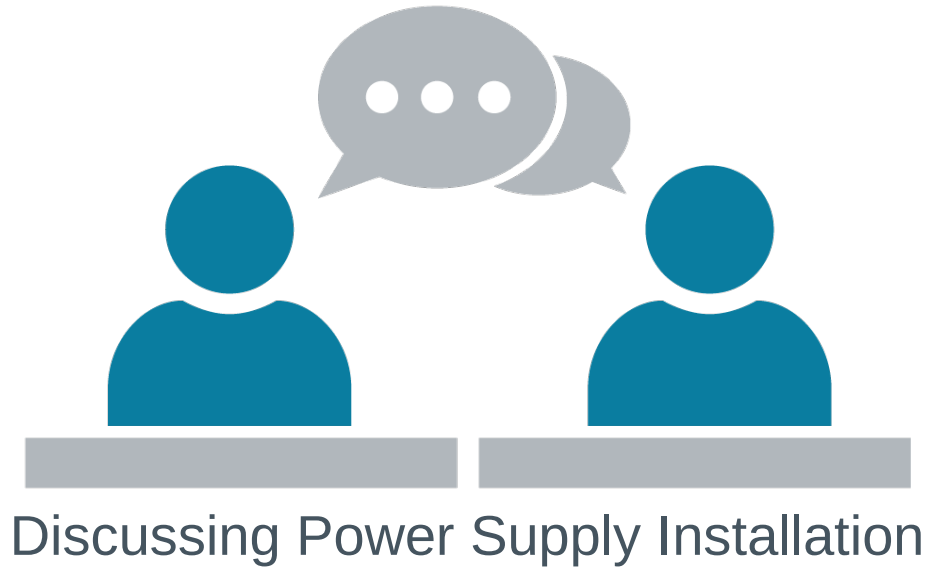
Activity

Calculating Power Requirements and Installing a PSU
Installation: https://www.youtube.com/watch?v=Q_NPF_4Kvc4