Topic 2A: Install and Configure Power Supplies and Cooling:

Imagine you're playing a game, and your computer suddenly shuts down. This can happen if the power supply isn't strong enough for all the parts. Now, picture your computer getting too hot because it doesn't have enough cooling. This heat can slow it down or even break it. To keep your computer working well, you need the right power supply and good cooling.

Power Supply Units:

Auto-switching PSU. (Image © 123RF.com)

PSU is responsible for delivering power to all other components in the computers. It basically converts AC current to DC current to transfer power. It converts **AC power** (from a building) to **DC power** using:

- A **rectifier** (converts AC to DC).
- **Transformers** (reduce voltage to lower levels).
- **Filters and regulators** (ensure stable output).

One of the key component of the Power Supply Unit is **Fan.** It removes the heat produced during power conversion. **Form factors** determines its compatibility with **Motherboards** and **system case.** A PSU is connected to the wall socket or electrical outlet via **power cord.** The voltage compatibility must be matched like for **North America**, the voltage current that comes in the wall socket is **120VAC** and for **UK/Europe and Asia** is **230VAC**. Hence suitable, power must be used that aligns with these things.

We have different voltage regulators in the market.

1. **Dual Voltage PSUs**:
   - Automatically switch between low-line and high-line voltages.
2. **Manual Switch PSUs**:
   - Require manual adjustment for the correct voltage.
3. **Fixed Voltage PSUs**:
   - Only work with either low-line or high-line voltage.

Voltage Ranges:

- **Low-line**: 100-127 VAC.
- **High-line**: 220-240 VAC.

Wattage Ratings:

The wattage rating of a PSU determines how much power it can provide to all components in a PC. Basically, **Power (W)** = **Voltage (V)** × **Current (I).** The PSU's output capability is measured as **its wattage rating**. The standard desktop PCs is typically rated at 200 – 300 watts. Enterprise and workstation servers are rated at 300W or more. And finally, Gaming PCs might require 500W or higher PSU ratings.

Different components inside the motherboard required different levels of power. For example, CPU typically requires 17W to 100W power, depending on the model. We can calculate the actual power required for a computer from the website **"Outer Vision Power Supply Calculator"** or **"Cooler Master Power Supply Calculator".**

A PSU is **not 100% efficient** because extra energy is lost as **heat**.

If we want to install a PSU with high power requirements, we need to pay attention to assess the power distribution for its **output voltages** like **(3.3VDC, 5VDC, and 12 VDC).** There are different wires connected to supply the power to other components. These wires are called **rails**.

+12V rail is most important for **modern** PCs.
+3.3V and +**5V** rails share a combined power limit.

GPUs heavily rely on **+12V rails** because it needs high power right.

Power Supply Connectors:

There are several power connectors attached to PSU. Some of them are for motherboards, some are for optical devices, etc. The motherboard's power port is referred to as **the P1 connector**.

- **20pin to 24pin Motherboard Adapter:**
  In original ATX specifications, the P1 connector is 20-pin (2 x 10). Black wire => ground, Yellow => +12V, Red=> +5V and Orange => +3.3V.

  But in the current specification, the P1 connector is 24-pin (2 x 12). Some PSUs have 20 + 4-pin adapter cable for compatibility with older motherboards with 20pin input.

Modular Power Supplies:

A modular PSU has power connector cables that are **detachable** from the unit. Means if we don't need some power cables, we can remove it so that it minimizes clutter with chassis that improves air flow and cooling. For example, a non-modular PSUs might have unused cables that are taking space. A modular PSU lets you remove unnecessary cables, keeping things tidy.

Redundant Power Supplies:

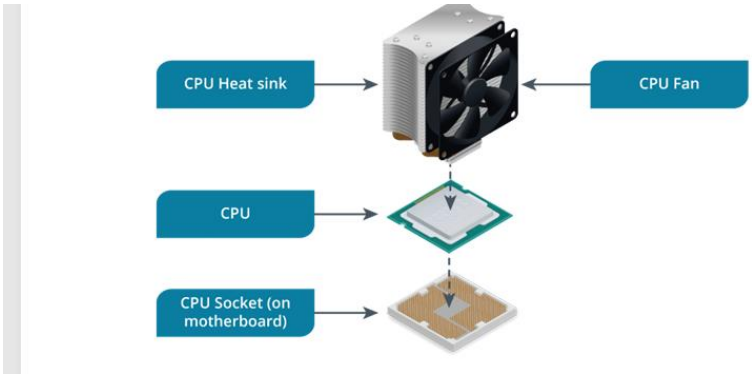
A system with **two PSUs** where one is active and other acts as a **backup.** If the main PSU fails, the backup immediately acts. It is most common in servers. Servers typically have **hot-swappable** PSUs, which means that a faulty PSU can be replaced without shutting down the system.

Fan Cooling Systems:

Computer components often emit heat because of continuous processing. Hence some kind of cooling system must be used to dissipate heat. Components like CPUs, memory cards, graphics cards, and SSDs requires cooling solutions.

Heat Sinks and Fans:

A **heat sink** is made of metal (like copper or aluminum) with fins to cool the computer by spreading heat into the air. **Thermal paste** or a **thermal pad** is used between the heat sink and the chip to help transfer heat better. Thermal paste works better, but thermal pads are easier to use. The heat sink is attached to the motherboard using clips or push pins, which can be adjusted with a screwdriver.



Fan Cooling Systems:

A **heat sink** cools without using electricity, so good airflow is important. **Fans** improve cooling by moving air through the PC. Cool air is drawn in from the front, and warm air is pushed out the back. Most heat sinks have fans to boost performance, and fans must be connected to the motherboard. **Thermometer sensors** adjust fan speed and detect failures. Some PCs use plastic covers (shrouds) to guide airflow. Dust reduces cooling, so fans, heat sinks, and vents should be cleaned regularly with a soft brush, compressed air, or a PC-safe vacuum.

Liquid Cooling Systems:

Liquid cooling systems are used in high-performance PCs, like gaming PCs, to manage heat better than fans. These systems use **water** to cool the components because it's more effective than air.

Two Types:

1. **Open-loop**:
    - Uses tubes, a pump, and a reservoir to circulate water.
    - Water blocks remove heat from parts like the CPU/GPU.
    - Radiators and fans remove heat from the water.
2. **Closed-loop**:
    - Pre-made systems for cooling just one part (CPU or GPU).

Maintenance:

- **Open-loop systems** need regular cleaning, refilling, and draining, especially before moving the PC.
- Keep **fans and radiators dust-free** to ensure proper cooling.

Some Questions and Answers from this lesson:

1. What is the significance of a PSU's wattage rating when you are designing a custom-build PC?

- The wattage rating determines if the PSU can provide enough power for all the components in the PC. A PSU must handle the combined power needs of the CPU, GPU, RAM, storage, and other components. Insufficient wattage can cause instability or prevent the system from working.

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2. Your company has recently closed a foreign branch office, and you are repurposing some PCs that were shipped from the old location. What feature of the PSUs must you check before powering the systems on?

- You must check the **voltage compatibility** of the PSUs. Ensure they are compatible with the local input voltage (e.g., 120 VAC in North America or 230 VAC in Europe). If the PSU is not dual voltage or auto-switching, you may need to adjust a manual switch or replace the PSU.

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3. One of the PCs has a faulty CPU, and one has a faulty power supply. You can use the CPU from one machine in the other. You have opened the case and taken antistatic precautions. What steps must you perform to access the CPU?

1. Disconnect the power and unplug the PC.
2. Remove the heat sink and fan assembly from the CPU.
3. Release the CPU retention mechanism (e.g., lift the lever or unlock the socket).
4. Carefully remove the CPU.
5. Insert the replacement CPU, ensuring proper alignment.
6. Lock the retention mechanism, reattach the heat sink with thermal paste, and reconnect the fan.

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4. The repurposed PC is put into service, but later that day the PC's user contacts you to say that the system has been displaying numerous alerts about high temperature. What do you think might be the cause?

- Possible causes include:
    - Dust buildup in the **heat sink, fan, or air vents**, reducing cooling efficiency.
    - Improper installation of the **CPU heat sink** or insufficient thermal paste.
    - A non-functional **fan** or inadequate airflow within the case due to cable clutter.
    - A liquid cooling system (if present) might need maintenance, such as refilling or cleaning.