Topic 1C: Explain Legacy Cable Types:

DVI and VGA Video Cables Explained Simply

Modern video interfaces like **HDMI** and **DisplayPort** only work with **digital flat-panel displays**. However, older systems like **DVI** and **VGA** were designed when computer screens and projectors were mainly CRT (Cathode Ray Tube) monitors, which worked with **analog signals**.

Before explaining legacy cable types, lets look at the **HDMI** and **DisplayPort cables** as well. We already read it in first lesson 1A but since we are talking about the cables, lets recall them as well.

High-Definition Multimedia Interface (HDMI):

Video cable bandwidth is determined by two main factors:

- **Resolution of the image** like 1920x1200 for HD, and 3840 x 2160 for 4k.
- **Frame Rate:** Speed at which image is redrawn.

HDMI cables transmit high-definition video and audio in a single cable. It also supports remote control and digital content protection. There are different types of HDMI in the market:

- **Standard HDMI (Type A):** Used in TVs, monitors, gaming consoles.
- **Mini HDMI (Type B):** Smaller devices like tablets and cameras.
- **Micro HDMI (Type C):** For very compact devices like GoPro cameras.

HDMI cables are categorized into Standard (Category 1) and (High speed) Category 2. High speed supports refresh rates over 60Hz. HDMI 2.0 and 2.1 supports Premium High Speed (upto 18Gbps) and Ultra High Speed (48Gbps) cable ratings.

DisplayPort:

It is another cable which is high-performance connection for video and audio, mostly used with computers and monitors. Two types of connectors can be found in the market:

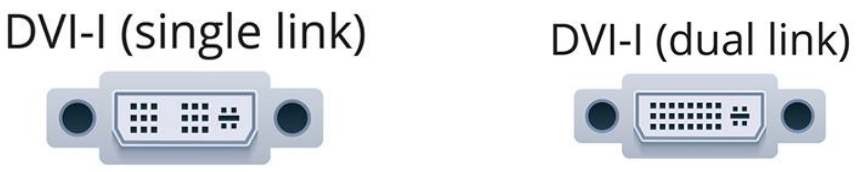
- **Standard DisplayPort:** Found on desktops, laptops, and monitors.
- **Mini DisplayPort:** Used in some laptops like older MacBooks.

The main feature is the support for **Daisy-Chaining.** It is better suited for high-refresh-rate gaming monitors (e.g. 144Hz or higher). It is backwards compatible with HDMI and DVI using adapters as well.

Digital Visual Interface (DVI)

1. DVI cables are used to transmit **video signals** from a source device (like **computer** or gaming consoles) to a display device (like **monitor** or projector). DVI can handle both **analog** and **digital** outputs. DVI is now outdated and mainly found on **older devices** like older monitors and graphics cards. Some versions support **single-link** (standard bandwidth) or **dual-link** (extra bandwidth for higher resolutions).

- **Types of DVI Connectors**:
    1. **DVI-I**: Works with both analog and digital outputs.



    2. **DVI-A**: Works only with analog output.

DVI-A

3. **DVI-D**: Works only with digital output.

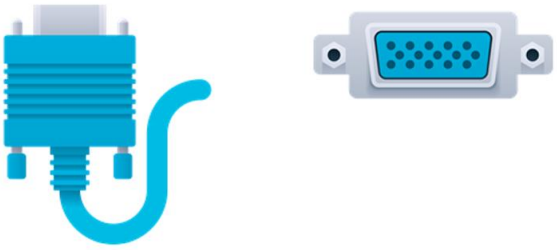
DVI-D (single link)

DVI-D (dual link)

- **Identifying Types**: The type of DVI supported depends on the **pins in the connector**.

Video Graphics Array (VGA)

- **Purpose**: VGA was the go-to analog video interface for PCs for many years.
- **Resolution**: VGA supports resolutions up to **HD (1920x1080)**, but this depends on the quality of the cable.
- **Connector**: The VGA connector is **15-pin**, shaped like a **D**, and has screws to secure it to the port.
- **Current Use**: VGA is also becoming obsolete as newer devices no longer include VGA ports.



A VGA connector and port. (Image ©123RF.com)

Key Comparisons for Exam Prep

Feature	HDMI	DisplayPort	VGA	DVI
Signal Type	Digital (Audio + Video)	Digital (Audio + Video)	Analog (Video Only)	Digital/Analog (Video)
Audio Support	Yes	Yes	No	No
Max Resolution	Up to 8K (HDMI 2.1)	Up to 10K (DisplayPort 2.0)	Up to 1080p	Up to 2560x1600
Typical Use	TVs, Gaming Consoles	High-End Monitors, PCs	Legacy Monitors	PC Monitors
Hot-Swappable	Yes	Yes	No	No

Small Computer System Interface

Modern computer systems use two primary methods to transfer data: **serial communication** and **parallel communication**. In serial communication, data is sent one bit at a time. This may sound slow, but thanks to advancements in technology, modern serial interfaces like **USB** and **Thunderbolt** can achieve extremely high speeds, ranging from **megabits per second (Mbps)** to **gigabits per second (Gbps)**.
Parallel communication, on the other hand, sends multiple bits simultaneously (often 8 bits, or 1 byte). While this approach seemed faster in the past, it required more wires and larger connectors, making parallel interfaces bulkier. One well-known example of a parallel interface is the **Small Computer System Interface (SCSI)**.

SCSI is a popular standard for connecting computers to peripheral devices either input or output both. It allows a single host adapter (SHA) to control multiple devices, such as **internal hard drives** or **external peripherals like printers and scanners.** The host adapter can identify these devices through the **command language.** This SCS is commonly used in hard drives, servers, workstations, and mainframes. This is not used in like embedded systems, personal computers, and desktops.

There are many versions of SCSI. But we are mostly likely to encounter:

- **HD (High-Density) 68-pin connectors**, which required a separate Molex connector for power.
- **SCA (Single Connector Attachment) 80-pin connectors**, which included both data and power in a single connection.

Each device on a SCSI bus needed a unique **ID number**, ranging from **0 to 15** for Wide SCSI. The **host adapter** itself was typically assigned an ID of **7 or 15**, while a bootable hard disk would usually take **ID 0**. SCSI buses also required **termination** to prevent signal reflections that could disrupt data transfer. Termination was mandatory for the **first and last devices** on the bus and could be enabled either internally (via a switch on the device) or by attaching a **terminator pack**.

The Transition to SAS
As technology advanced, parallel SCSI was largely replaced by **Serial Attached SCSI (SAS)**. SAS uses serial communication for faster and more reliable data transfer. It is now the dominant standard for **enterprise-class storage**, particularly in workstations and servers. Even though the physical SCSI interface has mostly disappeared, its **software interface and command set** are still widely used in storage technologies.

Integrated Drive Electronics (IDE) interface:

The **Integrated Drive Electronics (IDE) interface**, also known as **Parallel Advanced Technology Attachment (PATA)**, was a popular standard for connecting storage devices like hard drives and CD/DVD drives to desktop PCs. An improved version of IDE, supporting faster data transfer and larger storage capacities. It uses **16-bit parallel data transfer**.

- A motherboard with IDE support may have:
    - **One IDE channel** (IDE1) or
    - **Two IDE channels** (IDE1 and IDE2), often labeled as:
        - **Primary (PRI IDE)**
        - **Secondary (SEC IDE)**
- **Devices per Channel**: Each IDE channel can connect up to **two devices**:
    - **Device 0 (Master)**: Connected to the **black connector** on the cable (end).
    - **Device 1 (Slave)**: Connected to the **grey connector** (middle).

3. IDE Cable Connectors

- **Color-Coded Connectors**:
  - **Blue**: Connects to the motherboard.
  - **Black (End)**: Connects to the first device (Device 0).
  - **Grey (Middle)**: Connects to the second device (Device 1).
- **Pin 1 Orientation**:
  - Pin 1 on the cable must match Pin 1 on the device or motherboard.
  - A **red stripe** on the cable identifies Pin 1.
  - Connectors are often **keyed** (shaped) to prevent incorrect insertion.

Limitations of IDE

- Only **two devices per channel**.
- Slower data transfer compared to modern interfaces like **SATA (Serial ATA)**.
- Large ribbon cables made airflow within the case more challenging.

Serial Cables:

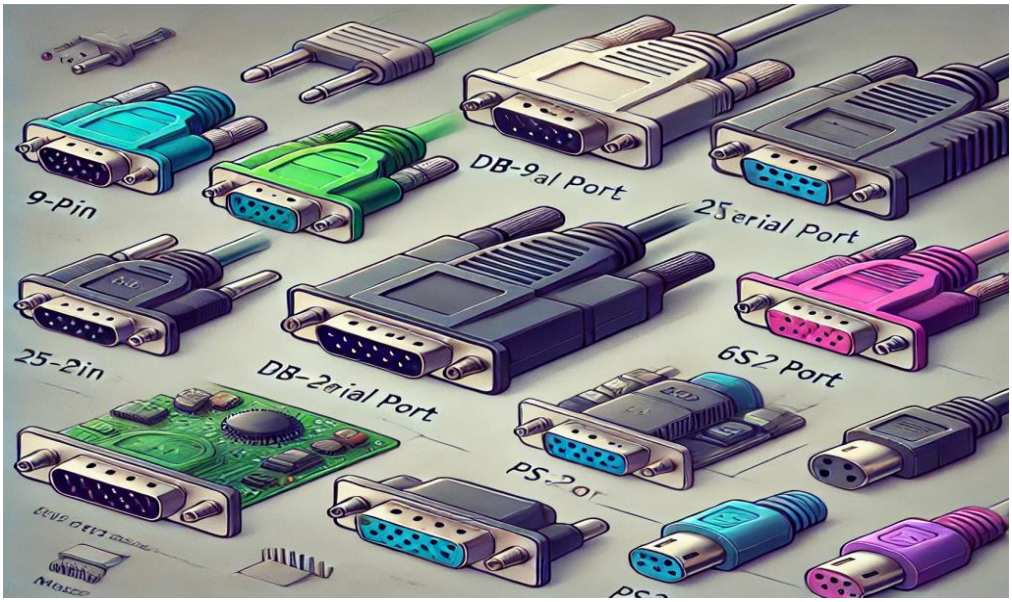
Serial Cables transmit data **one bit at a time** over a single wire, making them slower compared to modern interfaces. Commonly referred to as **RS-232 (Recommended Standard #232)**. Used in legacy systems for connecting peripherals like modems, network equipment, and sometimes mice/keyboards. Uses **start, stop, and parity bits** for formatting and verifying data transmission. Data rate: **Up to 115 Kbps**, much slower than modern interfaces like USB.

Physical Connectors:

- **9-pin (DB-9)** connector: Commonly found on PCs for serial communication.
- **25-pin connector**: Defined by the RS-232 standard but rarely used due to cost.

PS/2 Ports (Mini-DIN)

- Special type of **serial port** used for connecting mice and keyboards.
- **Color-coded**:
  - **Green**: For mice.
  - **Purple**: For keyboards.
- Features a **6-pin design**



Adapter Cables:

Adapter cables solve compatibility issues between different cable types and connectors, allowing devices with different ports to communicate.

1. Video Adapters:
   Convert video signals between different standards or connector types. Like HDMI to VGA, HDMI to DisplayPort, HDMI to DVI.

2. USB Adapters:
   Convert between USB connector types or expand USB connectivity. Like USB-C to USB-A.

3. USB to other outputs:
   Like USB to lightining, USB to HDMI.

Your **smartphone** uses USB-C, but your computer only has USB-A ports. A **USB-C to USB-A adapter** allows you to connect your phone for data transfer or charging. You want to connect your **old VGA projector** to your **modern laptop** with an HDMI output. A **HDMI to VGA active adapter** makes this possible.

Questions:

1. **You are labelling systems for inventory. What two types of display cabling can be connected to this laptop?**

➔ 15-pin VGA, RJ45, HDMI, and USB Type A ports.

2. **Which ports are present on the graphics card shown below?**

Left is DVI interface. DVI-I. Right one is DisplayPort.

3. **Which interfaces does the adapter cable shown below support?**

DVI-I and HDMI.