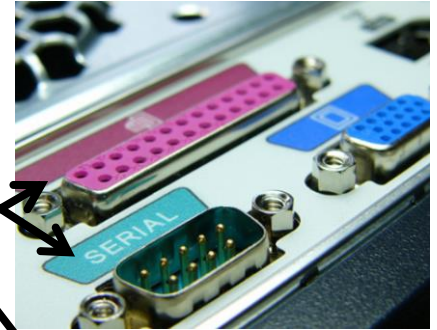


# I/O Connections

# Legacy Ports (parzialmente obsoleti)

- Serial
  - Used for connecting various peripherals such as printers, scanners, modems, and console connections to network devices.
- Parallel
  - Used for connecting to various peripheral devices, commonly printers.
- Game
  - Used for connecting a joystick input
- PS/2
  - Used for connecting a keyboard and mouse. Purple for keyboard and green for the mouse.
- Audio ports
  - Analog ports were used for connecting stereo system, microphone and speakers/headphones.



# Ports, Connectors, and Cables




## Video and Graphic Ports

- VGA (Video Graphics Array)
  - An analog port and commonly the oldest graphics port still used on some PCs.
- DVI (Digital Visual Interface)
  - Provides support for transmitting uncompressed digital video.
  - Includes DVI-A (analog), DVI-D (digital), and DVI-I (integrated).
- HDMI (High Definition Multimedia Interface)
  - Carries the same video information as DVI but is also capable of providing digital audio and control signals..
- DP (Display Port)
  - Designed to replace both DVI and VGA for computer monitors while including high bandwidth video and audio signals.



# Ports, Connectors, and Cables

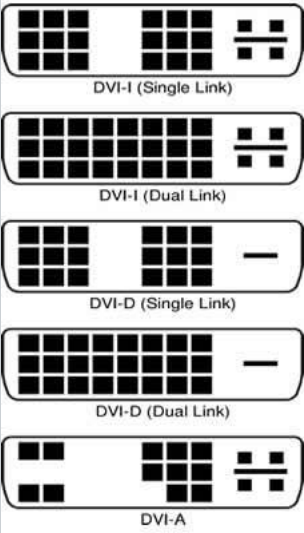

## Video and Graphic Ports

Year - Signal standard name	Connector	Type	Max resolution (Horiz x Vert @ Freq)	Used for	Notes
<b>1977</b> <a href="#">SCART</a> (Syndicat des Constructeurs d'Appareils Radiorécepteurs et Téléviseurs)		Analog	720 × 576i px @ 50 Hz 720 × 480i px @ 60 Hz	<a href="#">Consumer electronics</a> , VHS, Early home computers such as Commodore <a href="#">Amiga</a> , <a href="#">Acorn Archimedes</a> and various <a href="#">video games</a> such as the <a href="#">Sega Megadrive</a> and <a href="#">Super Nintendo</a>	<a href="#">European</a> "unified" A/V interface for bi-directional stereo audio, <a href="#">composite video</a> and <a href="#">s-video</a> , and unidirectional <a href="#">RGBS</a> and data. Composite and s-video can use <a href="#">PAL</a> , <a href="#">NTSC</a> or <a href="#">SECAM</a> color encoding. YP <sub>b</sub> P <sub>r</sub> is also available in some non-standard set-ups via the RGB pins.
<b>1979</b> <a href="#">S-Video</a> (Separate video, Split video, Super-video, and Y/C)		Analog	720 × <a href="#">576i</a> px @ 50 Hz 720 × <a href="#">480i</a> px @ 60 Hz <a href="#">i=interlaced</a>	<a href="#">S-VHS</a> , some <a href="#">laptop</a> computers, analog <a href="#">broadcast video</a> , 1980-1990s <a href="#">home computers</a> including the <a href="#">Commodore 64</a> , <a href="#">C128</a> and <a href="#">Atari 8-bit</a>	The 4-pin mini-DIN that is most common in consumer products today debuted in <a href="#">JVC's</a> 1987 <a href="#">S-VHS</a> . The 7-pin mini-DIN is commonly used on laptops. Used with <a href="#">PAL</a> , <a href="#">NTSC</a> or <a href="#">SECAM</a> color. Where two connectors are used, they are labeled Chroma and Luma.
<b>1987</b> <a href="#">VGA</a> (Video Graphics Array)		Analog	2048 × 1536 px @ 85 Hz	Introduced with <a href="#">IBM</a> x86 machines, but became a universal analog display interface. <a href="#">Display Data Channel</a> was later added to allow monitors to identify themselves to graphic cards, and graphic cards to modify monitor settings.	Successor analog protocols include <a href="#">SVGA</a> , <a href="#">XGA</a> , etc. DVI is a more modern digital alternative. Where BNC is used, available as 3 connectors with Sync on Green, or 5 connector Red / Green / Blue / Horizontal Sync / Vertical sync.



# Ports, Connectors, and Cables

## Video and Graphic Ports

Year - Signal standard name	Connector	Type	Max resolution (Horiz x Vert @ Freq)	Used for	Notes
<p>1999-2000  <a href="#">Digital Visual Interface (DVI)</a></p>	 <p>DVI-I (Single Link)</p> <p>DVI-I (Dual Link)</p> <p>DVI-D (Single Link)</p> <p>DVI-D (Dual Link)</p> <p>DVI-A</p>	Both	<p>2560 × 1600 px @ 60 Hz</p> <p>3840 × 2400 px @ 33 Hz</p>	Recent video cards	<p>Almost a ubiquitous computer display link. Uncompressed video only. <a href="#">High-bandwidth Digital Content Protection</a> (HDCP) encryption is optional.</p>
	<p><a href="#">Apple Display Connector (ADC)</a></p> 	Both	2560 × 1600 px @ 60 Hz	<a href="#">Apple Inc.</a> Macintoshes and monitors	<p><a href="#">Proprietary</a> connector designed to combine DVI-I, USB, and monitor power</p>


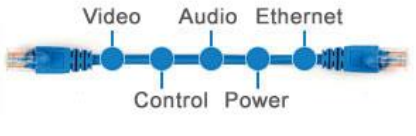
# Ports, Connectors, and Cables

## Video and Graphic Ports

Year - Signal standard name	Connector	Type	Max resolution (Horiz x Vert @ Freq)	Used for	Notes
2003 <a href="#">Serial digital interface (SDI)</a>	 <p>BNC Extension Cables</p> <p>BNC male</p> <p>BNC female</p>	Digital	From 143 Mbit/s to 12 Gbit/s, depending on variant. <a href="#">480i</a> , <a href="#">576i</a> , 480p, 576p, 720p, 1080i, 1080p, UHDTV1, <a href="#">p=progressive</a>	Broadcast video. Variants include SD-SDI, HD-SDI, Dual Link HD-SDI, 3G-SDI, 6G-SDI, 12G-SDI. <a href="#">[B]</a>	
2003 <a href="#">High-Definition Multimedia Interface (HDMI)</a>		<a href="#">Digital</a>	10240 x 4320 px @ 120 Hz	Many A/V systems and video cards (including motherboards with IGP)	<a href="#">High-bandwidth Digital Content Protection</a> (HDCP) encryption is mandatory.
2007 <a href="#">DisplayPort</a>		Digital	2560 x 1600 px @ 75 Hz  8192 x 4320 px @ 60 Hz	Apple Inc. <a href="#">Lenovo</a> , <a href="#">HP</a> , and <a href="#">Dell</a> systems and monitors ATI <a href="#">RV670</a> based graphics cards and NVIDIA <a href="#">G92</a> graphics cards (both as OEM optional implementations)	<a href="#">DisplayPort</a> introduced the 128-bit <a href="#">AES</a> to replace <a href="#">HDCP</a> . DisplayPort version 1.1 added support for <a href="#">HDCP</a> .

# Ports, Connectors, and Cables

## Video and Graphic Ports

Year - Signal standard name	Connector	Type	Max resolution (Horiz x Vert @ Freq)	Used for	Notes
2008 <a href="#">DiiVA</a>		Digital	2560 × 1600 px @ 75 4096 × 2160 px @ 24	A/V systems	<a href="#">High-bandwidth Digital Content Protection</a> (HDCP).
2010 <a href="#">HDBaseT</a>	<p><b>HDBaseT™ Cables</b> One cable, five signals</p> 	Digital	4096 × 2160 px @ 24	A/V systems, data at 10.2 Gbit/s, power up to 100 watts	

# Video Ports and Cables

- A video port connects a monitor to a computer using a cable.
- Video ports and monitor cables transfer analog signals, digital signals, or both.
- Video ports and cables include:
  - Digital Visual Interface (DVI)
  - DisplayPort
  - High-Definition Multimedia Interface (HDMI)
  - Thunderbolt 1 or 2
  - Thunderbolt 3
  - Video Graphics Array (VGA)
  - Radio Corporation of America (RCA)





# USB Cables and Connectors

- Over the years, USB has evolved with various standards. (USB 1.0, USB 2.0, USB 3.0, and USB 3.2)
- USB Type-A
  - The typical rectangular connector found on almost all desktop and laptop computers, TVs, game consoles, and media players.
- Mini-USB
  - A rectangular connector with a small indentation on each side that is being replaced with the micro-USB connector.
- Micro-USB
  - A common connector on smartphones, tablets and other devices.
  - This connector has two corners pushed in at an angle.



# USB Cables and Connectors (Cont.)

### ▪ USB Type-B

- This connector has a square shape with beveled exterior corners and an extra notch at the top.
- Used to connect printers or external hard drives.

### ▪ USB Type-C

- This connector is rectangular with four rounded corners and is the newest USB interface.
- Used as a multipurpose cable to attach different kinds of peripheral devices to a PC.
- The same cable is used for Thunderbolt connectors.

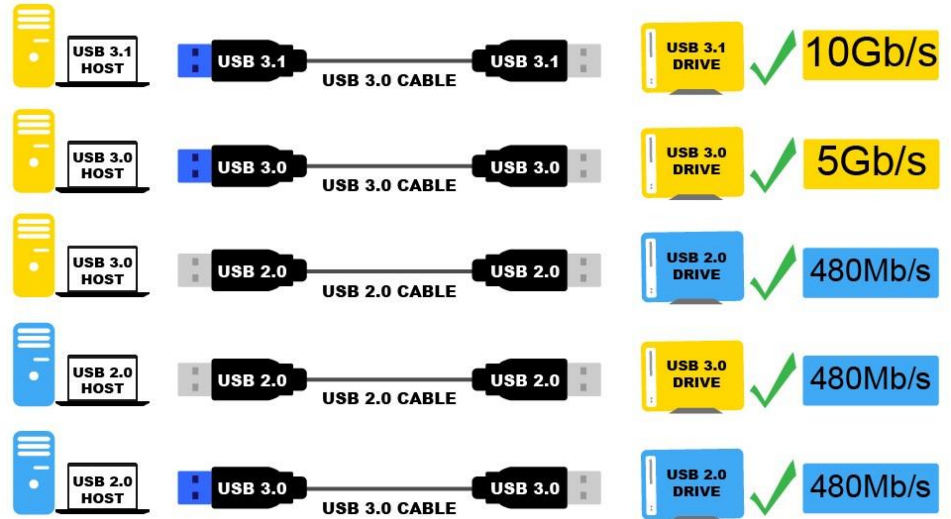
### ▪ Lightning

- This connector is a small proprietary 8-pin connector used by Apple mobile devices such as iPhones, iPads, and iPods for both power and data.



# USB Speed

<b>USB 1.1</b> 12Mbps		 Tipo A Mini-A Micro-A
<b>USB 2.0</b> 480Mbps		 Tipo B Mini-B Micro-B
<b>USB 3.1 Gen1</b> (USB 3.0) 5Gbps		 Tipo-A Tipo-B Mini-B Micro-B
<b>USB 3.1 Gen2</b> 10Gbps		 Tipo-A Tipo-C
<b>USB 3.2</b> 20Gbps		 Tipo-C
<b>Thunderbolt 2</b> 20Gbps		 Mini DisplayPort
<b>Thunderbolt 3</b> 40Gbps		 Tipo-C



# SATA Cables and Connectors

- **SATA Cable (Serial Advanced Technology Attachment)**
  - One end plugs into a SATA port on a motherboard and the other end into the back of an internal storage device.
  - The SATA data cable does not provide power so a SATA power cable is needed in addition to power the internal storage device.
  - SATA data and power cables are keyed so they can only be installed in one way.
- **eSATA Cable (External Serial Advanced Technology Attachment)**
  - This cable is used to connect external SATA drives and is a keyed connector.
- **eSATA Adapter**
  - An expansion card is commonly used to provide eSATA ports.

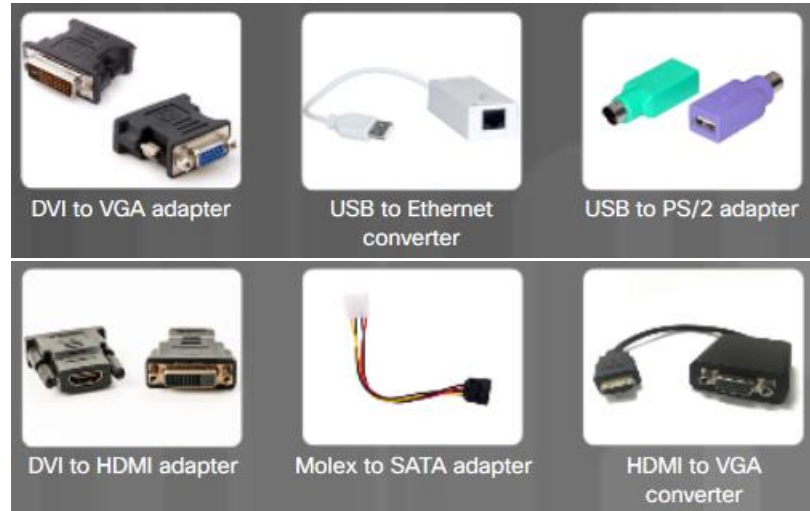


# Adapters and Converters

- There are many connection standards in use today. These components are called adapters and converters:
  - **Converter** – performing the same function as an adapter but also translates the signals from one technology to the other.
  - **Adapter** – physically connecting one technology to another

- Example of adapters include:

- DVI to VGA Adapter
- USB to Ethernet adapter
- USB to PS/2 adapter
- DVI to HDMI adapter
- Molex to SATA adapter
- HDMI to VGA converter



# Twisted Pair Cables and Connectors

- Twisted pair cable is used in wired Ethernet networks and older telephone networks.
- Twisted Pairs
  - Unshielded Twisted Pair (UTP) cabling is the most common form of twisted pair cabling and uses color-coded insulated copper wires.
  - Shielded Twisted Pair (STP) also uses color-coded insulated copper wires but includes foil or braiding as well.
- RJ-45
  - Each end of a UTP cable must be terminated with an RJ-45 connector so it can be plugged into an Ethernet port.
- RJ-11
  - Older telephone networks used a four-wire UTP cable terminated with an RJ-11 connector.



# Coax Cables and Connectors

### ▪ Coax Cable Construction

- Coaxial cable has an inner center conductor surrounded by insulating material.
- The insulating material is surrounded by a foil shield which is used as an outer conductor and also shields against electromagnetic interference (EMI).

### ▪ RG-6

- A heavy gauge cable with insulation and shielding for high-bandwidth, high-frequency applications (Internet, Cable TV, and Satellite TV)

### ▪ RG-59

- A thinner cable similar to RG-6, used for low bandwidth and lower frequency applications (analog video and CCTV)

### ▪ BNC

- An older connector, used with digital or analog audio or video.

