

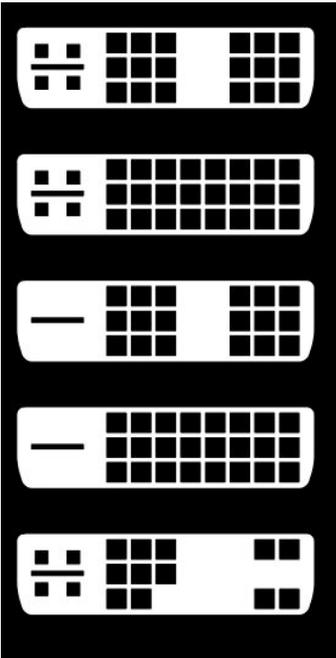
Computer Input/Output Ports and Interfaces

Terms and abbreviations:

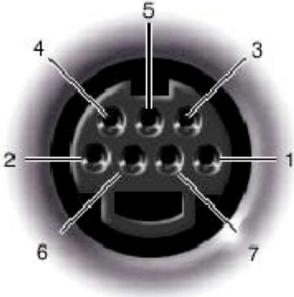
port	an electrical connection using multiple wires to send data typically between a computer and a device
interface	a standardized method of communicating data typically between a computer and a device
bit	a single binary digit (that is, a “0” or a “1”)
byte	8 bits (with $2^8 = 256$ possible binary values, typically enough to encode a single character such as a letter or digit)
bps	bits per second
Bps	bytes per second
Mbps	mega (1,000,000) bits per second
MBps	mega (1,000,000) bytes per second
pixel	picture element (that is, a single dot on a display which may have any color that is available on that display)
kHz	kilohertz (1000 cycles per second)
real time	the speed of real time signals must keep up with physical phenomena such as sound or an electron beam scanning a monitor
serial	transferring a series of data bits one bit at a time, typically using one or two data wires; the opposite of parallel data transfers
parallel	transferring more than one data bit at a time, typically using one or two data wires per bit; the opposite of serial data transfers

Port or interface name	Data width	Data transfer rate	Typical use	Comments	Connector appearance or port icon
Video Graphics Adapter (VGA) or Super-VGA (SVGA)	analog signals including separate red, green, blue, horizontal sync, and vertical sync	real time at resolutions of 320×200 to about 1600×1200 pixels (or even higher resolution for some vendors) at about 50 to 85 frames/second	cathode ray tube (CRT) monitor	VGA was first marketed by IBM in 1987; SVGA was originally 800×600 pixels, but many manufacturers upgraded SVGA many times	 <p>VGA plug (male connector) on a cable above and a 15-pin VGA receptacle (female connector) on a computer or monitor below</p>

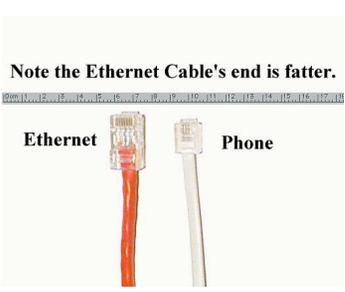
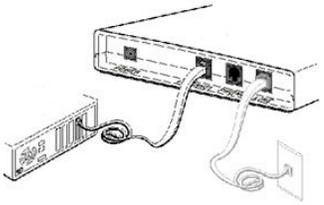
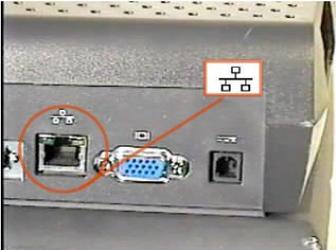
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Digital Visual Interface (DVI)	A single DVI link transmits 4 bits (one bit each for red, blue, green, and the clock) per pixel, sent serially for 24 bits per pixel, plus control signals	real time at resolutions up to 1920×1200 (WUXGA) at 60 frames per second for a single link, and up to 2560×1600 (WQXGA) at 60 frames per second for dual link	liquid crystal display (LCD) monitor	DVI connectors have up to 24 pins for digital signals and may include legacy	 <p>DVI plug (male connector) on cable</p>
				VGA analog (red, green, blue, sync) signals using an additional 5 pins. The second link can be used for more pixels (increasing resolution) or for more bits per pixel (increasing the number of colors).	 <p>pin layout of a plug for DVI-I (Single Link, digital and analog);</p> <p>DVI-I (Dual Link, digital and analog);</p> <p>DVI-D (Single Link; digital only);</p> <p>DVI-D (Dual Link, digital only);</p> <p>DVI-A (analog only)</p>

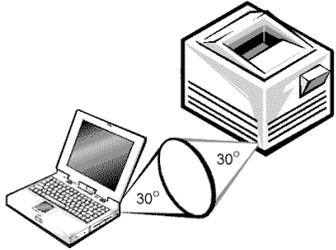
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Port or interface name	Data width	Data transfer rate	Typical use	Comments	Connector appearance or port icon
PC Card Adapter, or Peripheral Component Microchannel Interconnect Architecture (PCMCIA)	16 bits (type I); 16 or 32 bits (types II or III or CardBus)	3.92 MBps to 132 MBps (DWord CardBus burst mode)	modem, Ethernet adapter, portable flash memory	card thickness: 3.3 mm for type I; 5.0 mm for type II; 10.5 mm for type III	 <p>PC card inserted in a port with a cable attached</p>
Audio out	2 analog for stereo	real time	speakers, headphones	about 1 volt RMS	 <p>Audio (speakers or headphones) output on left; microphone input on right</p>
Microphones in	1 or 2 analog signals	real time	microphone	microphones generate millivolts	
Line in	2 analog signals for stereo	real time	audio CD player, radio, home audio/video system	audio amplifiers output about 1 volt RMS	 <p>Mono and stereo 3.5 mm miniature phone plugs (male) on cables; icon for line input connector</p>
S-Video / TV out (S-Video is also called Y/C video)	2 analog signals for S-Video; 1 analog additional signal for optional composite video	real time	television	S-Video has separate wires for intensity (Y; luminance & sync) and color (C; chrominance); composite video has one analog signal	 <p>Computer port with S-Video and composite: Pins 1 & 2: Ground Pin 3: Y (intensity or luminance) Pin 4: C (color or chrominance) Pins 5, 6, 7: nonstandard composite video and maybe sound</p>

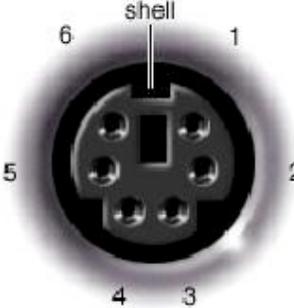
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Modem	1 analog signal over 2 wires (bidirectional half duplex in phone voice band, or separate upstream and downstream ADSL frequency channels)	300 bps to about 56 Kbps for standard modems that use the voice band of a phone line; up to about 8 Mbps for broadband Asymmetric Digital Subscriber Line (ADSL) modems	digital data transfer over a telephone line	phone's RJ11 connector with 2 to 6 pins is smaller than Ethernet's RJ45 connector with 8 pins		Broadband DSL or ADSL modem
					<p>Note the Ethernet Cable's end is fatter.</p> 	 <p>computer to modem to phone line connections</p>
Ethernet	1 bit	10, 100, or 1000 Mbps	networked computers and printers	peer to peer (so any node can initiate sending data) using Carrier Sense Multiple Access with Collision Detection (CSMA/CD)		Cable with an 8-wire RJ45 plug (male connector) on each end
						RJ45 receptacle (8-pin female connector) with its Ethernet icon at the left

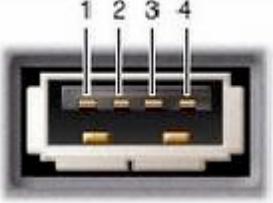
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Infrared (also called an IrDA port for Infrared Data Association)	1 bit	2400 to 115,200 bps for IrDA 1.1; Up to 4 Mbps for new IrDA devices	printer, mouse, keyboard	Similar to a TV/VCR remote, this port allows two computers or a computer and a device to communicate with each other without the use of wires.	 <p>Infrared port (on the right) on a laptop computer</p>
					 <p>Cones showing required alignment of infrared ports between a laptop computer and a printer</p>
Serial RS-232-C (this is a standard for serial binary communication by the Electronic Industries Alliance [EIA], where “RS” is an abbreviation for “RETMA Standard” promulgated in 1969 by RETMA, which was a precursor of the EIA)	1 bit	typically 75 to 128,000 bps, although the RS-232-C standard does not define bit rates for transmission nor protocols for character encoding, error detection, or data compression	modem, printer, mouse, keyboard	bidirectional using one transmit wire and one receive wire; asynchronous (no separate clock wire is included, but there are other control signals so either side can initiate or pause data transfers)	 <p>male 9-pin D-shell RS232C serial connector on a PC</p>
					 <p>a male 25-pin D-shell plug (left) and a female 9-pin D-shell connector (right) on a cable for RS232C serial communication between a PC and a device</p>

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PS/2	1 bit	about 7000 to about 12,000 bps	mouse, keyboard	synchronous data transmission from device to PC with a 10 – 16.7 kHz clock; supplies the device with power of 5 volts at up to 275 mA	 <p>PS/2 mouse or keyboard connector on a PC, typically with an icon for a mouse (cyan) or for a keyboard (magenta)</p>
Parallel (IEEE 1284, where “IEEE” is an abbreviation for the “Institute of Electrical and Electronic Engineers”)	8 bits	360,360 Bps for Centronics or standard mode; about 2 MBps for EPP mode; about 2.5 MBps for ECP mode	printer, scanner, magnetic tape	Centronics or standard mode has 8 bits out of and 4 bits into the computer port; Enhanced Parallel Port (EPP) has 8 bits in/out; Extended Capability Port (ECP) has 8 bits in/out	 <p>25-pin D-shell receptacle (above) on a computer</p>
					 <p>Centronics parallel 36-pin plug (above, to a printer) and a 25-pin D-shell plug (below, to a computer) on a cable</p>

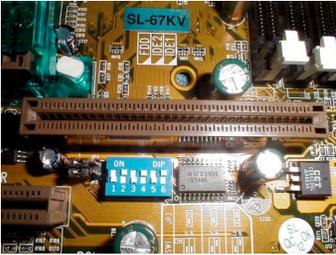
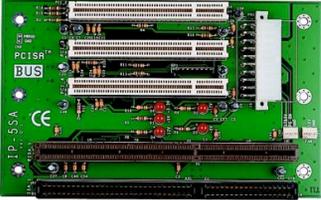
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Universal Serial Bus (USB 1.1 or USB 2.0)	1 bit	1.5 Mbps low speed for USB 1.1 or 2.0; 12 Mbps full speed for USB 1.1 or 2.0; 480 Mbps hi speed for USB 2.0	printer, scanner, modem, mouse, keyboard, portable flash memory, portable media player, external floppy or hard or optical disk, digital still or video camera, PDA	up to 127 devices per host port using hubs; supplies 5 volts at 100 to 500 milliamperes for use by each device; 4 wires in a shielded cable up to 5 meters (16.4 feet) long; devices cannot send data until they are polled by the host; hotpluggable (that is, cable plugs can be inserted into or removed from receptacles while power is on)	 <p>Type A receptacle on a computer host or a hub</p>
					 <p>Type A plug (above) to a host or hub, and a Type B plug (below) to a device on the ends of a typical full-size-connector cable</p>
					 <p>Mini-A plug (left, white) to a computer, and a Mini-B plug (right, black) to a device on the ends of a typical mini-connector cable</p>
					 <p>Symbol for USB (especially USB 1.1)</p>
					 <p>Symbol for USB 2.0 high speed (480 MBps)</p>

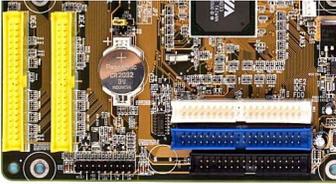
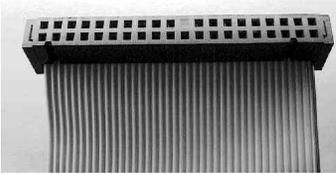
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FireWire 400 (IEEE 1394a, or Sony i.Link with no power to devices); FireWire 800 (IEEE 1394b)	1 bit	100 Mbps, 200 Mbps, or 400 Mbps for FireWire 400; 800 Mbps for FireWire 800	printer, scanner, portable media player, external floppy or hard or optical disk, digital still or video camera	up to 63 daisy-chained devices up to 4.5 meters apart; 30 volts at up to 45 watts (1.5 amperes) per port; peer to peer devices (without using the CPU or system memory); hotpluggable; licensed by Apple	 <p style="text-align: center;">1 2 3 4</p> <p style="text-align: center;">1394</p> <p style="text-align: right;">FireWire 4-pin mini receptacle on a computer</p>
					 <p style="text-align: right;">FireWire 4-pin mini plug (left, to the computer) and FireWire 6-pin standard plug (right, to the device)</p>
Industry Standard Architecture (ISA) bus, or PC bus	8 or 16 bits	4.77 MBps for 8-bit ISA; 8.66 MBps for 16-bit ISA	internal interface cards for most PC peripherals	located on the motherboard; 1 interface card per slot; main bus for the original IBM PC in 1981 and modified for IBM PC/XT in 1983	 <p style="text-align: right;">One 8-bit ISA slot and five 16-bit Extended ISA slots</p>

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Extended Industry Standard Architecture (EISA) bus, or AT bus	32 bits	33 MBps	internal interface cards for most PC peripherals	located on the motherboard; 1 interface card per slot; main bus for IBM PC/AT in 1984; PCI replaced it	 <p>One 8-bit ISA slot and five 16-bit Extended ISA slots</p>
Accelerated Graphics Port (AGP, or Advanced Graphics Port) bus	32 bits (64-bit AGP is also made)	266 MBps for AGP; 533 MBps for AGP 2X; 1066 MBps for AGP 4X; 2133 MBps for AGP 8X	Monitor with high-end graphics for 3D and gaming	located on the motherboard	 <p>AGP connector on a motherboard inside a computer</p>
Peripheral Component Interconnect (PCI) bus	32 bits or 64 bits for variants	133 MBps to 2035 MBps for variants	internal interface cards for most PC peripherals	located on the motherboard	 <p>3 PCI slots (above in white) on a motherboard inside a computer</p>
					 <p>an interface card that plugs into a PCI slot</p>

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Enhanced Integrated Device Electronics (EIDE)	16 bits	133 MBps	internal floppy or hard or optical disk	40 wires	 <p>two EIDE male connectors (right; one white and the other one blue just below it) on a motherboard</p>
					 <p>an EIDE female connector on a ribbon cable</p>
Serial Advanced Technology Attachment (SATA)	1 bit	150 MBps or 300 MBps	hard or optical disk	The SATA serial port was designed to replace the slower EIDE parallel port	 <p>SATA 7-pin edge connector (left) and a SATA 15-pin edge connector (right) on a motherboard</p>
					 <p>SATA 7-pin connector on a cable</p>
					 <p>SATA 15-pin connector on a cable</p>

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Small Computer System Interface (SCSI-1 or SCSI-2); Fast SCSI; Fast-Wide SCSI; Ultra SCSI; Ultra Wide SCSI-3; Ultra2 SCSI; Ultra2 Wide SCSI; Ultra3 SCSI; Ultra320 SCSI	8 bits; 8 bits; 16 bits; 8 bits; 16 bits; 8 bits; 16 bits; 16 bits; 16 bits	5 MBps 10 MBps 20 MBps 20 MBps 40 MBps 40 MBps 80 MBps 160 MBps 320 MBps	hard and optical disks, magnetic tape storage, printers, scanners	up to 7 or 15 devices per host port; peer to peer devices; standardized in 1986; commonly used by Apple Macintosh and Sun Microsystems	 <p>50-pin SCSI-2 connector on an interface card (SCSI-1 uses 25 pins; Wide SCSI uses 68 pins)</p>
					 <p>Centronics 50-pin SCSI-2 connector on a cable</p>
Wireless (Wi-Fi) IEEE 802.11a, 802.11b, 802.11g, and 802.11n	1 bit	max of 25 Mbps at ~50 meters for 802.11a; 11 Mbps at ~100 meters for 802.11b; 54 Mbps at ~100 meters for 802.11g; 200 Mbps at ~250 meters for 802.11n; rates and distances may be reduced when indoors	networking of multiple computers, PDAs, and other devices such as printers or file servers, using radio “access points” instead of wires to interconnect peer-to-peer nodes	802.11a uses the 5 GHz radio frequency band in the USA; 802.11b and 802.11g use 2.4 GHz; 802.11n may use 2.4 or 5 GHz when it becomes standardized in 2007	 <p>typical Wireless 802.11 PC card for use with a laptop</p>
					 <p>typical Wireless 802.11 access point (which in this case also serves as a router to a DSL modem and as a switch between 4 wired Ethernet ports)</p>

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Bluetooth wireless (IEEE 802.15.1)	1 bit	max of 723.1 kbps for Bluetooth 1.1 and 1.2; 3 Mbps for Bluetooth 2.0; the range is up to ~100, ~10, or ~1 meters for power classes 1, 2, or 3 (at 100, 2.5, or 1 milliwatt)	computer, PDA, cell phone, or portable media player (such as an iPod with a Bluetooth adapter) transferring data to or from a device such as a mouse, keyboard, digital camera, printer, scanner, speakers, headphones, or microphone as appropriate	Bluetooth uses the 2.45 GHz ISM radio frequency band in the USA; a Bluetooth “master” can communicate with up to 7 devices playing the role of the “slaves” in a “piconet”; two or more piconets can be connected together to form a “scatternet”	 <p>Bluetooth registered logo</p>
					 <p>Bluetooth hands-free headset with an earphone and a microphone</p>