

Wired Connections Types	
<b>Dedicated Leased Lines</b>	direct connection point to point
<b>Circuit-Switched</b>	using data through dial phone connection (ISDN)
<b>Packet-Switched Connections</b>	idem but multiple users using the same line.
<b>Copper</b>	UTP, STP : Dial-up, ISDN, E1, T1 Coax : Cable modem
<b>Fiber</b>	
<b>Electricity</b>	Broadband over Power Lines (BPL)

Wireless Connections	
<b>Cellular</b>	
<b>3G</b>	144Kbps-2Mbps   HSPA(+)
<b>4G</b>	100Mbps-1Gbps   LTE, LTE-A Low-band   30-250Mbps (long range)
<b>5G</b>	Mid-band   100-900Mbps (mid range) High-band   +Gbps (short range)
<b>GSM technology</b>	widely used - converts voice into data
<b>CDMA technology</b>	USA - encryption system
<b>Microwave</b>	
<b>UHF, SHF, EHF</b>	Ultra, Super, Extreme High Frequencies
	point-to-point connection, fast (1Gbps) but direct line of sight. max 40NM WiMAX, antenna on top of buildings
<b>Satellite</b>	over-the-world coverage slow, expensive, high latency
<b>ex: starlink</b>	low orbit -> latency down to 35ms
<b>HF radios</b>	for text only, <10Kbps

WAN Technologies	
<b>Dedicated Leased Lines</b>	E1-E3 (Europe), T1-T4 : use CSU/DSU
<b>Metro Ethernet</b>	use ethernet protocols on fiber cabling
<b>PPP</b>	Point-to-Point
<b>PAP</b>	<i>Password Authentication Protocol</i>   password sent in clear!

WAN Technologies (cont)	
<b>CHAP</b>	<i>Challenge-Handshake Authentication Protocol</i>
<b>MS-CHAP</b>	both sent hashed credentials, security+
<b>PPPoE</b>	encapsulates PPP frames inside Ethernet frames
<b>DSL</b>	
<b>ADSL   5.5km</b>	Dwn: 8Mbps, Up:1.5Mbps
<b>SDSL   3.3km</b>	Dwn & Up : 1.17Mbps
<b>VDSL   1.3km</b>	Dwn : 52Mbps, Up:12Mbps
<b>Cable Modems</b>	use HFC (Hybrid Fiber-Coax) TV infrastructure
<b>protocol</b>	DOCSIS
<b>Satellite Modem</b>	limited, expensive, wx sensitive, echo
<b>POTS</b>	analog connection, PSTN
<b>ISDN</b>	carry voice, video or data over B/D channels
<b>Frame Relay (FR)</b>	use virtual circuits (VC)
<b>SONET</b>	20-250km, til 10Gbits, FDDI (fiber)
<b>ATM</b>	cell-based of fixed 53bytes, use VC
<b>MPLS</b>	used by service providers on backbone
<b>DMVPN</b>	use VPN tunnel to secure WAN connections
<b>Connection speed order</b>	FR, T1, E1, T3, E3, ATM, SONET
<b>mGRE</b>	<i>multipoint generic routing encapsulation</i>

