

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

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

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

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

