

WAN

SONET(America)	Synchronous Optical Network
SDH(Europe)	Synchronous Digital Hierarchy
Physical Trait	OC Standard, Optical Career
Topology	Ring topology, fault tolerable

Bandwidth Throughput Increase

Though the expected bandwidth from a SONET or other WAN is higher, which it doesn't provide, and hence we use some technologies to boost it

BWDM(Bidirectional Wavelength Division Multiplexing)	Multiple direction of light travel, so different wavelength to carry multiple signals
DWDM(Dense Wavelength Division Multiplexing)	Multiple coloured light to carry multiple signals
	CWDM(Coarse WDM) is DWDM for shorter distance

Technologies underlying different WANs

MPLS

The destination where a packet needs to go is decided by the Router. All this is done by the router and the packet has no role in it. But if we tell the router to choose the best path according to the packet's preference, to make the process more efficient. This is done using the technology called **MPLS(Multi-protocol Label Switching)**

MPLS	Multi-Protocol Label Switching
Layer of operation	2.5, since the MPLS labels sits between layer 2 and 3

MPLS Labels

Label	Unique ID used by routers
Exp(Experimental Bits)	Value to prioritize some packets over

	others
S(Labelling Stack)	If a packet has more than one MPLS labels, they are sequenced using this number
TTL	No of hops for the label

Now since most of the routing-preference is handled by the MPLS itself, routers would still be sharing information about the status of their overhead, meaning if they are running above a particular baseline, they would like to get helped by other neighbour routers and reduce costs or any other QOS. This is done by Router's own protocols

LDP(Label Distribution Protocol)	A protocol used by Routers for communication
LER(Label Edge Router)	It is the very first Router which adds MPLS labels)
LSR(Label Switching Router)	MPLS Routers
FEC(Forward Equivalence Class)	A group of packets which always follow the same path

SD-WAN(Software Defined WAN)

This WAN works under the existing internet

Metro Ethernet

Creating a private connection within the city using Fibre Cables. Also called **Metro-Optical** or **Metropolitan Area Network(MAN)**

Last-Mile Technologies

Since we need to access the Internet, we need to tap into some form of WAN, which is eventually what the Internet is

DSL(Digital Subscriber Line)	
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ISDN(Integrated Services Digital Network)	Telephone Line
PSTN(Public Switched Telephone Network)	Telephone Line
ADSL	Different uploading and downloading speeds
SDSL	Same Downloading and Uploading Speed
DSLAM	DSL Access Multiplexer, the device at the ISP office
POTS Filter(Plain Old Telephone Line)	To segregate out telephone and DSL out of the incoming DSL line
Protocol	PPPoE
Broadband Cable	Coax Cable > Cable Modem > PC
Protocol	DOCSIS(Data Over Cable Interface Specifications)
Office Device	Headend
Satellite	one way, two way
Fiber	PON(Passive Optical Network) - Installing one in the neighbourhood and taking into the houses
Cellular Connections	
GSM(Global System For Mobile Communication) 2G	Allowed multiple users to use the same channel at the same time using Time Division Multiple Access(TDMA) . Introduced SIM card. Advanced version of it is called EDGE(Enhanced Data Rates for GSM)
CDMA(Code-Division Multiple Access) 2G	Allowed multiple users but using different

	channels, not compatible with GSM. There was no SIM card but the connection was embedded in the system itself
HSPA(High-Speed Packet Access) 3G	ITA2000 was a document which listed all the shortcomings in the telephony. So basically, HSPA was the technology which fulfilled all the requirements of ITA2000. Like MMS, high speeds etc
LTE(Long Term Evolution) 4G	Started in somewhat 2010

Remote Access

Two ways of Remote Accessing > **Remote Terminal & VPN**

Remote Terminal

It is meant for accessing a particular system remotely

Extranet	Allowing outside users to access our network is called Extranet
ICA(Independent Computing Architecture)	Developed by Citrix to define how the information among terminals will be passed Server-Controlled, Client-Controller
RDP(Remote Desktop Protocol)	Microsoft's version of ICA, the software was RDC(Remote Desktop Connection)
	Current version of Windows runs RDG(Remote Desktop Gateway) , secured using TLS
VNC(Virtual Network Computing)	Terminal Emulator Example, runs on SSH

Virtual Private Networking

It is meant for accessing the entire network remotely

VPN	
Endpoint 1	Virtual NIC
Endpoint 2	VPN Server Endpoint
VPN Tunnel	

VPN Protocols

PPTP(P2P Tunnelling Protocol)	Developed by Microsoft, an advanced version of PPP. The program used on Windows Server side for enabling VPN is called RRAS(Routing and Remote Access Service) . Note that this RRAS is only for Windows. For the rest systems which use PPTP rely on different server-side programs. The encryption mechanism used by PPTP is Microsoft's MPPE (MP2P Encryption)
Client to Network	Host-To-Site VPN
Layer	Layer 2
L2TP	Layer 2 Tunnelling Protocol, it is made up from the Cisco's L2F(Layer 2 Forwarding) and PPTP thus the name L2TP. The only reason it works better than PPTP is that it provides encryption using IPsec Protocol
Server Endpoint	VPN Concentrator or VPN Headend
Site-To-Site	Connecting two VPN Headends, which enables two LANs to act as a single

	network
Host-To-Host	Connecting two clients individually using VPN
Split Tunnel	Only allows VPN Connection to the LAN, and not the rest of the Network
Full Tunnel	Every connection is allowed to go through the requested VPN
Layer	2
SSL/TLS	It is a type of VPN Protocol where there is no dedicated software installed on the user computer but the encryption happens using TLS/SSL over the browser
SSL Portal	After successfully connecting to a VPN, only specific resources are accessible
Tunnel VPN	The access is not limited to a single resource but broad
Layer	7, Application
DTLS	Similar to TLS but once connected, shares the Datagram instead of TCP
DMVPN	Dynamic Multipoint VPN, allows to connect multiple locations irrespective of whether they are interconnected or not
Others	Most of the VPNs use IPsec Technologies , Cisco provides this Generic Routing Encapsulation(GRE) with IPsec
GRE Layer	3