

Fundamentals	
Basic elements	Layer 1, contention-based (unorderly transmission)
CSMA/CD	Carrier Sense Multiple Access / Collision Detect
<i>Carrier Sense</i>	Listen to the wire, verify if busy
<i>Multiple Access</i>	all devices have access at any time
<i>Collision Detect</i>	if collision occurs, wait random time, try again
Collision Domain /CDO	all devices on an internet segment (same cable or hub)
	half duplex, operates CSMA/CD
Switches	creates multiple CDOs, 1port=1CDO
	-> no chance of collision, full-duplex capability

Limitations	
SPEED	
Ethernet	10Mbps
Fast Ethernet	100Mbps
Gigabit Ethernet	1000Mbps / 1Gbps
10-Gigabit Ethernet	10Gbps
100-Gigabit Ethernet	100Gbps
DISTANCE (memo)	
Copper	100m
CAT6	100m@1Gbps / 55m@10Gbps
CAT8	30m
MMF (T, TX,FX, SR, SX)	short range (200-500m)
SMF (LX, LR, ZX)	long range (in km)

Infrastructure devices	
Collision domain /CD	network segment where packets collide. Collision detection/avoidance can be set
Broadcast domain /BD	domain where broadcast packets are diffused. The smaller the better
Hub	multiport repeater with or without amplification (passive/active/smart)

Infrastructure devices (cont)	
Bridge	analyse source MAC adr & populates table. Separates collision domains
Switch	combination of hub and bridge
- layer 2	all ports belong to broadcast domain
- layer 3	creates one <i>BD</i> per port. Makes routing decisions, interconnect entire NW
Router	connects NW together, makes <i>fw</i> decisions. Separates <i>CD</i> and <i>BD</i>

Other Features		
Link Aggregation	802.3ad	combines multiple connect° into a single logical connect°
		increased bandwidth, congestion lowered
PoE, PoE+	802.3af/at	electrical power over Ethernet, Cat5 mini, 15.4W/25.5W
Port monitoring		network sniffer plugged on a hub - analyse purpose
Port mirroring		copy all traffic to another port
User Auth.	802.1x	once auth., a key is generated and shared
Management		SSH for remote access, console port for local admin.
Out-of-Band		NW conf. devices on a separate NW
First-Hop Redundancy		creates a stand-by router in case the active router fails
MAC Filtering		filters connect° based on MAC adr
Traffic Filtering		filters connect° based on IP adr
QoS		forwards traffic according to priority markings

Spanning Tree Protocol STP 802.1D

Role redundant links btw switches, prevent traffic loops.
Without STP, MAC table can be corrupted

Broadcast Storms

when a switches broadcasts btw each other in loop. Multiple copies are forwarded in loop. NW becomes saturated

Root Bridge reference bridge for spanning tree. defined with BID (lower BID) - made of *priority value* and MAC adr.

Non-Root Bridge all other switches

Root Port on N-RB, closest port to the RB

Designated Port port with the lowest cost index to route to the RB. RB has only designated ports

Non-Des. Port all other ports. Block traffic to avoid loops

Port states

- *Blocking* BPDU recieved but not forwarded

- *Listening* idem+ but populates MAC adr table

- *Learning* process BPDU, switch tries to determine its role

- *Forwarding* full ops

Link Costs speed of a link. Lower the speed, higher the cost

ex: Fast Ethernet :19, GB Ethernet : 4

Long STP from 2.000.000 to 2.

Virtual LAN (VLAN)

Principle allows different logical NWs with a single hardware.

How ? use certain ports to separate broadcast domains

VLAN Trunking multiple VLAN using same phy. cable

TPI Tag Protocol Identifier

TCI Tag Control Identifier

VLAN 0 Native VLAN left untagged

Specialized Equipment

VPN virtual tunnel over untrusted NW/Internet

VPN concentrator tunnel traffic to a single location

VPN headend

Firewalls softw or hardw, allows some outcome traffic, blocks some inbound traffic

NGFW packet inspection at layer 7 (App lvl). much more powerful

IDS/IPS *Intrusion Detection/Prevention System*
recognizes attacks and can respond

Proxy content filter server

Content/Caching Engine caching service for a proxy

Load Balancer distributes request across a server farm

