Planning and cabling

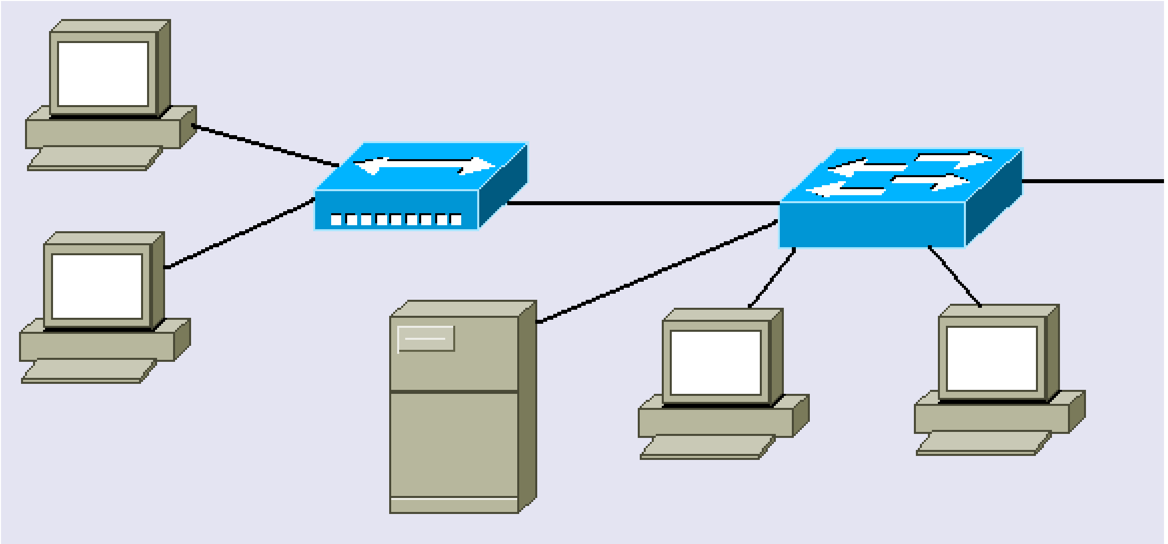
CCNA Exploration Semester 1 – Chapter 10

Chapter 10 topics

- Identify media for a LAN.
- Identify cables, connections and standards for a LAN.
- Compare straight through and crossover UTP cables
- Identify cables, connections and standards for a WAN.
- Make and use a console connection to a Cisco device.
- Design an addressing scheme for an internetwork.
- Compare and contrast network designs.

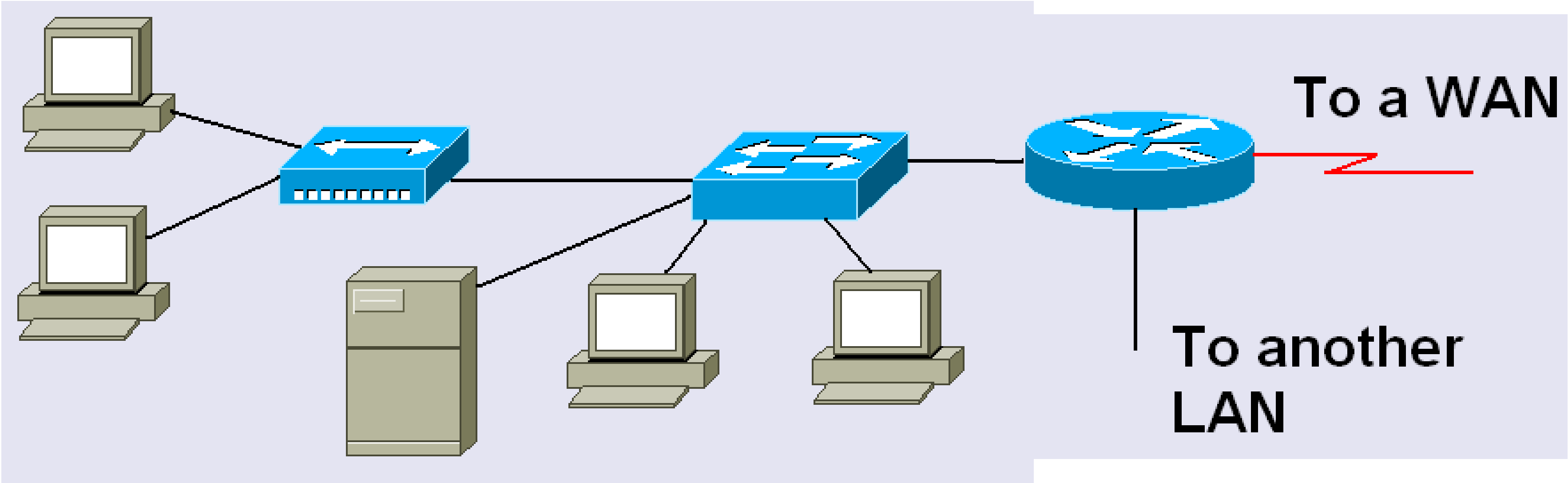
Within a LAN

- Hubs and switches link hosts



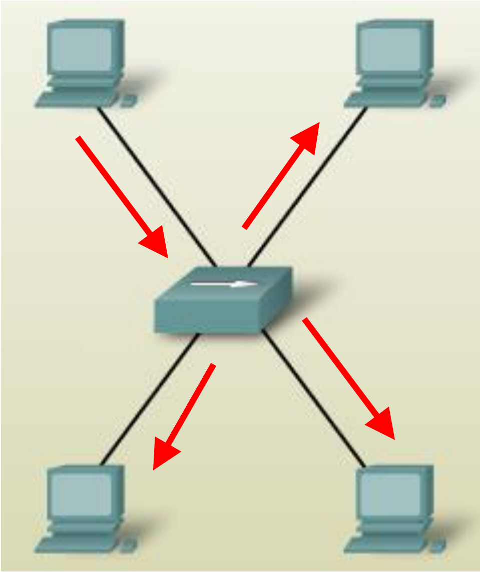
Between networks

- Routers link networks together and act as gateways between them.



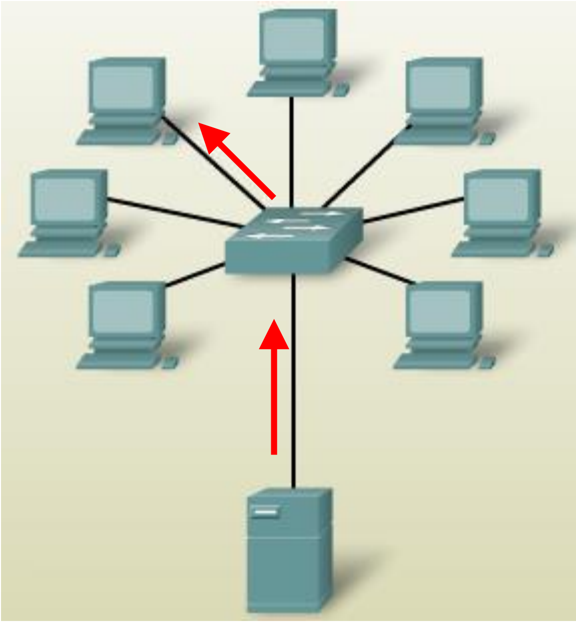
Hub

- Frame comes in. Hub regenerates it and forwards it through all ports except incoming port.
- Shared medium, shared bandwidth. Hosts are in the same collision domain.
- Cheap.
- For small LANs only.

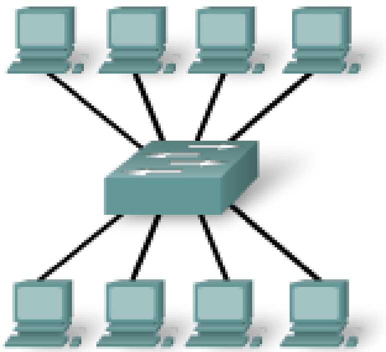


Switch

- Frame comes in. Switch regenerates it and forwards it to destination only.
- Segments network into separate collision domains.
- More expensive but better performance than hub

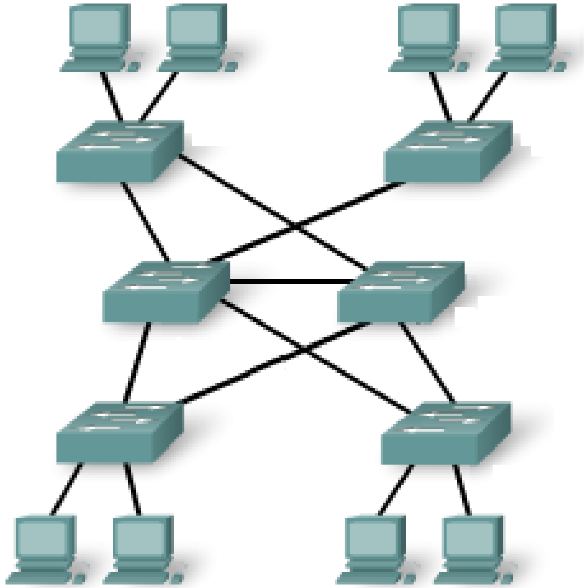


Arranging switches



Star for small networks

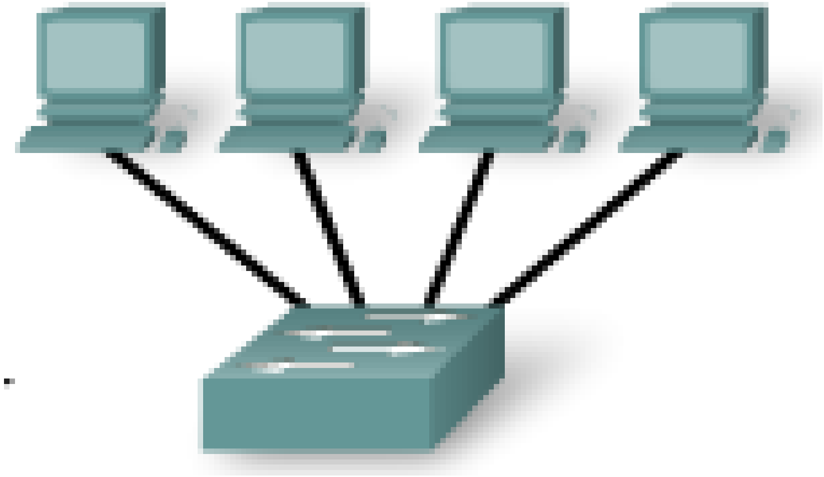
Extended Star for larger networks, perhaps on several floors



Mesh to give redundancy – fault tolerance.

Choice of switch ports

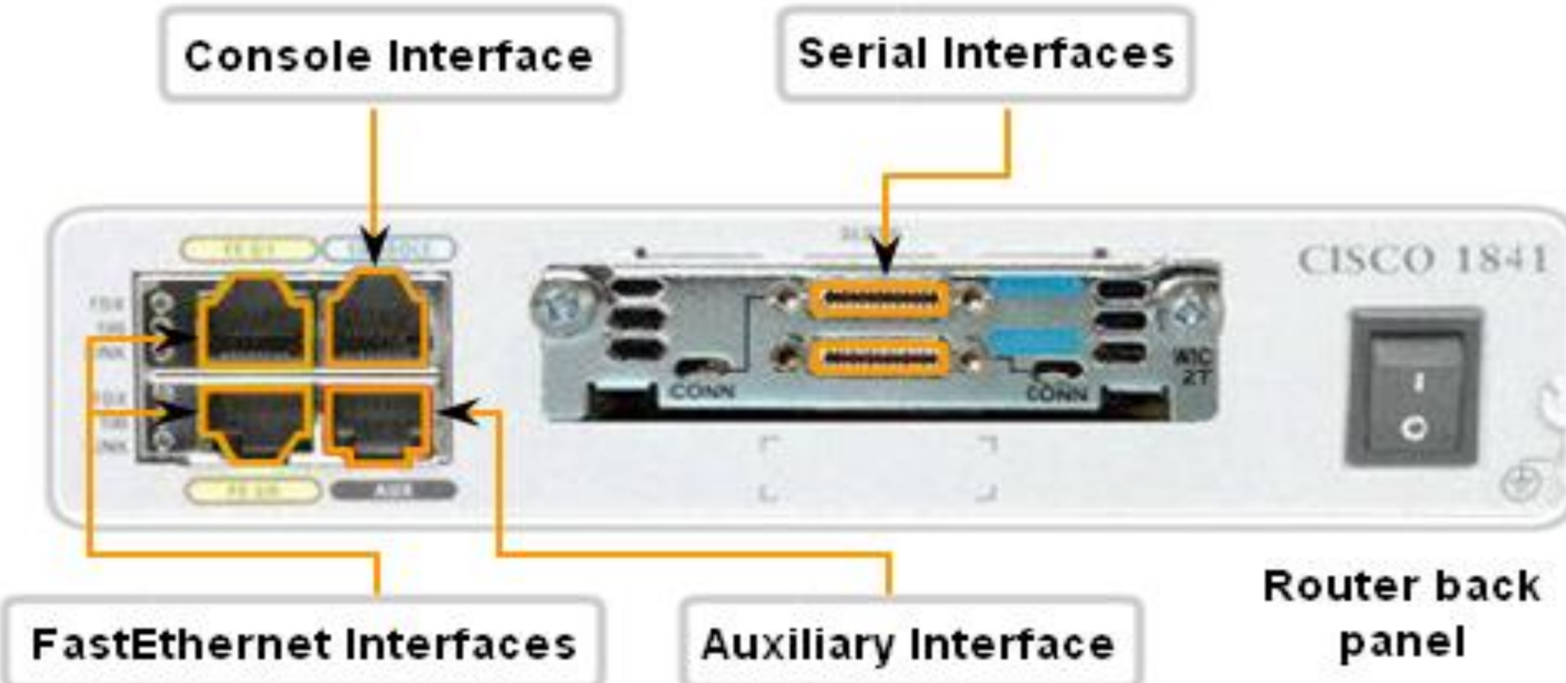
- 10 Mbps?
- 100 Mbps?
- 10/100 Mbps?
- 1Gbps?
- UTP or fibre optic?
- Allow for growth.
- Modular switch?
- What have our switches got?



Choice of router

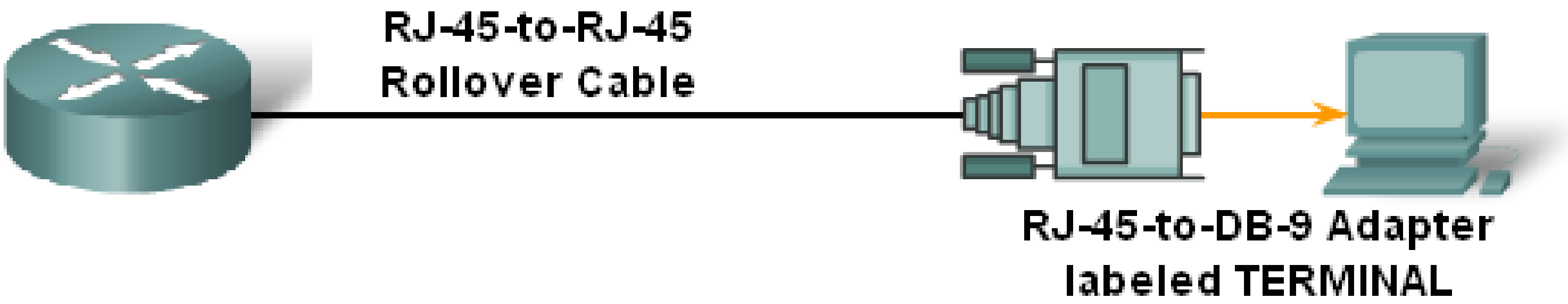
- Expandability – will you want to add extra modules?
- Media – serial ports, Ethernet ports, UTP or fibre optic, how many of each?
- Operating System Features – what do you want the router to do? Will you have enough memory to upgrade the operating system?
- What ports have our routers got?

Router interfaces



 Cisco Public

Rollover cable - console



- Our rollover cables a DB9 connector at one end and do not need an adaptor.
- Rollover cables with RJ45 connectors both ends need an adaptor.

Hyperterminal

- You run a terminal emulator program such as Hyperterminal on the PC in order to configure the router.
- Windows has a built in Hyperterminal program.
- We usually use Hilgraeve Hyperterminal.

Hyperterminal

- You set up the PC's serial port as follows:

  Bits per second: 9600 bps

  Data bits: 8

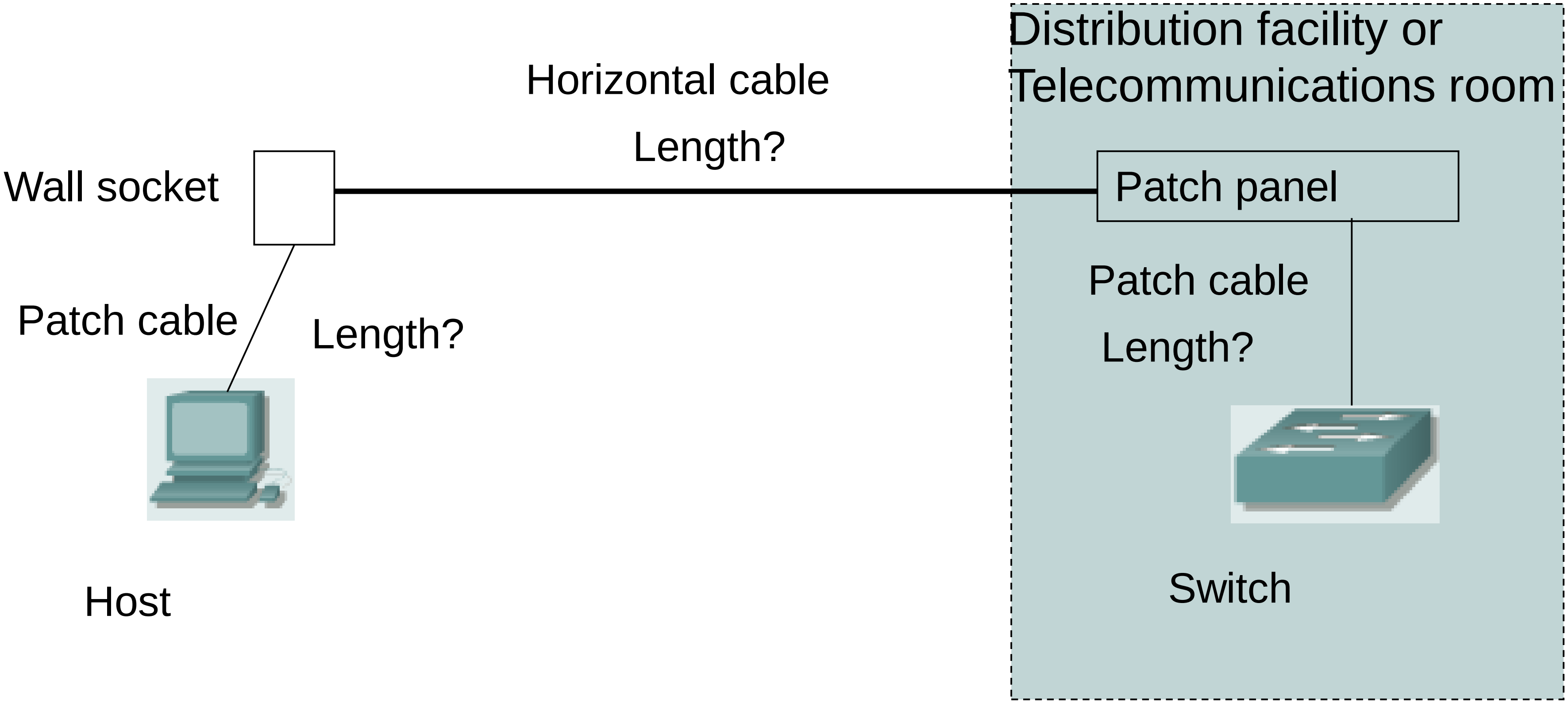
  Parity: None

  Stop bits: 1

  Flow control: None

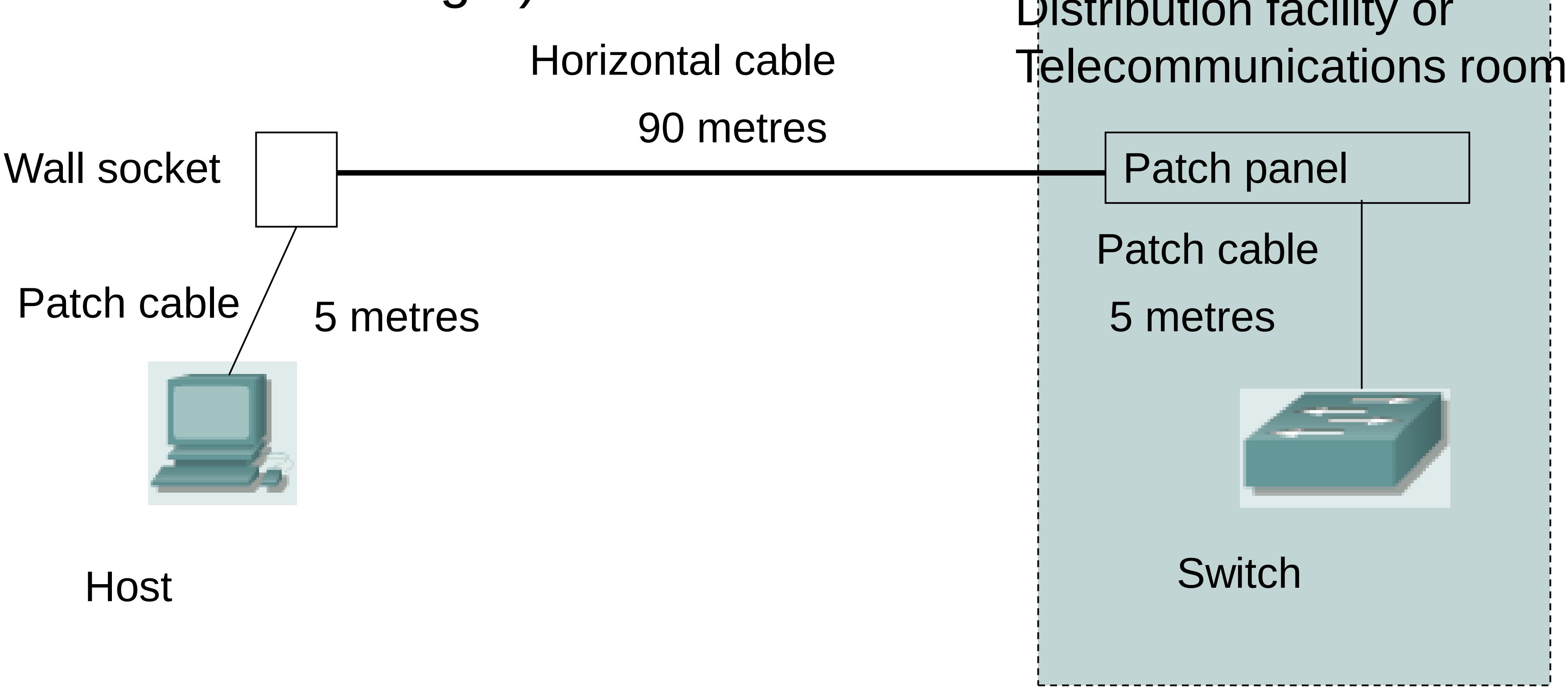
Total length of cable allowed for UTP connection?

Distance to allow between host and switch or hub?

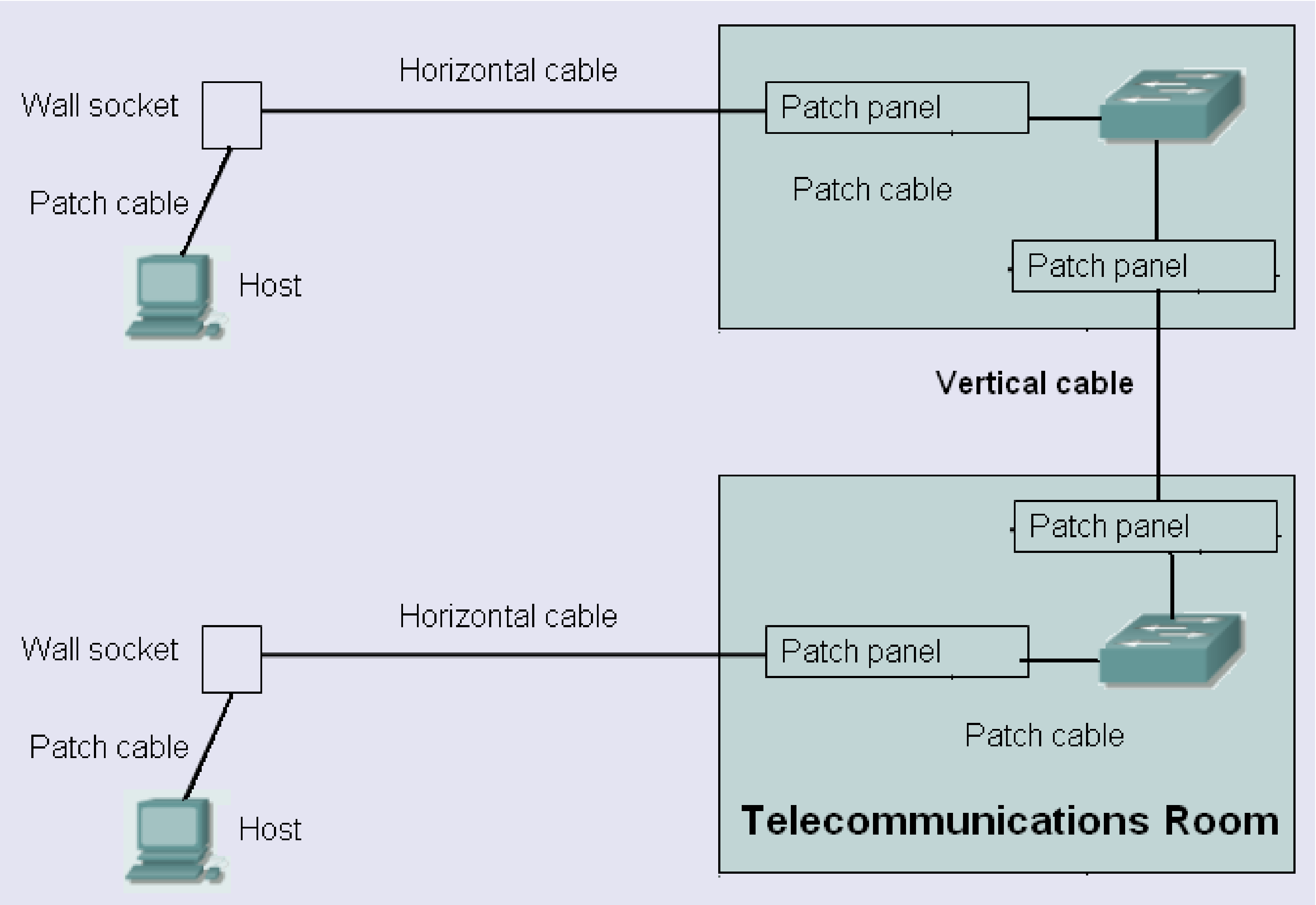


Total length of cable allowed for UTP connection? 100 metres

Distance to allow between host and switch or hub? 50 metres (cable runs are not straight)



Horizontal and vertical cable



Which cable?

- Length: UTP up to 100m, fibre optic longer
- UTP inside building. Fibre optic in or out.
- Cost: UTP cheaper than fibre optic
- Bandwidth: is it enough to meet requirements?
- Ease of installation: UTP is easier.
- EMI/RFI noise: may need fibre optic.
- High capacity link: may need fibre optic.

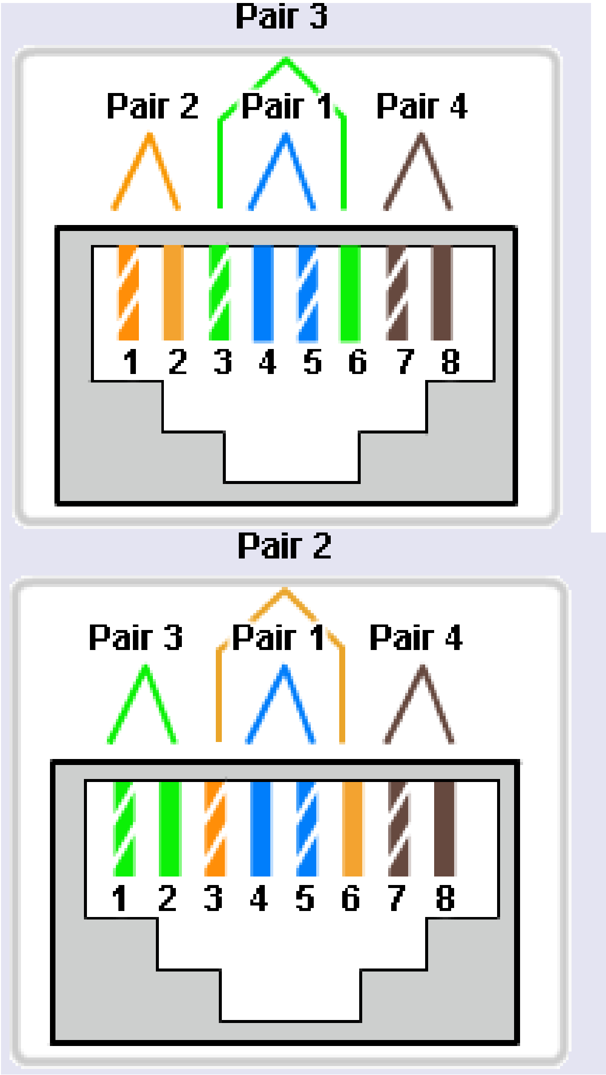
Attenuation

- As a signal propagates (travels) it becomes weaker. This is attenuation
- If a signal becomes too weak then the receiving host cannot tell if it is meant to be a 0 or a 1.
- This limits cable length.

UTP cable reminder

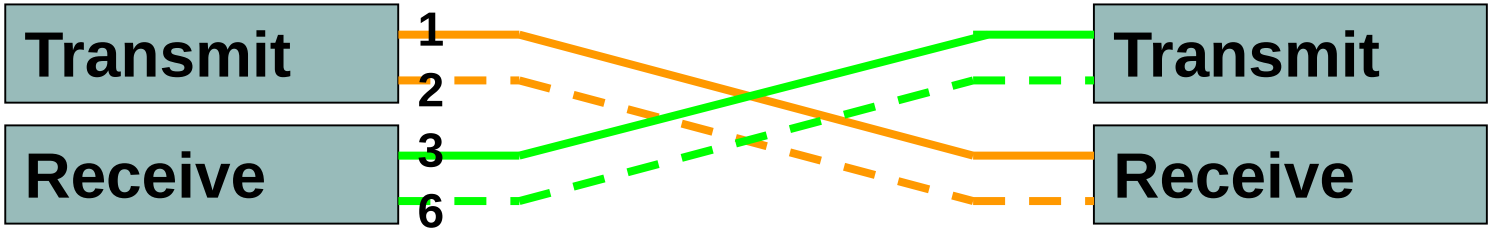
- Straight through cable – same both ends

- Crossover cable – 1 swaps with 3, 2 swaps with 6



Why cross over?

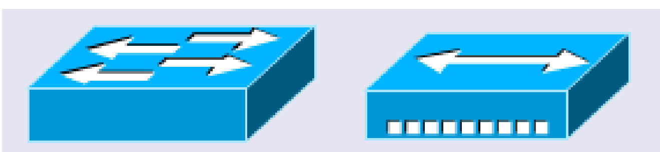
- Transmit needs to connect to receive

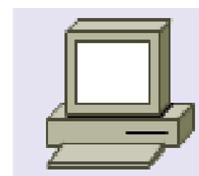


- The crossing over can happen in the cable or inside a device.

Where is the cross over?

- Switches and hubs have ports that manage the cross over inside
- PCs and routers have ports where there is no crossover inside





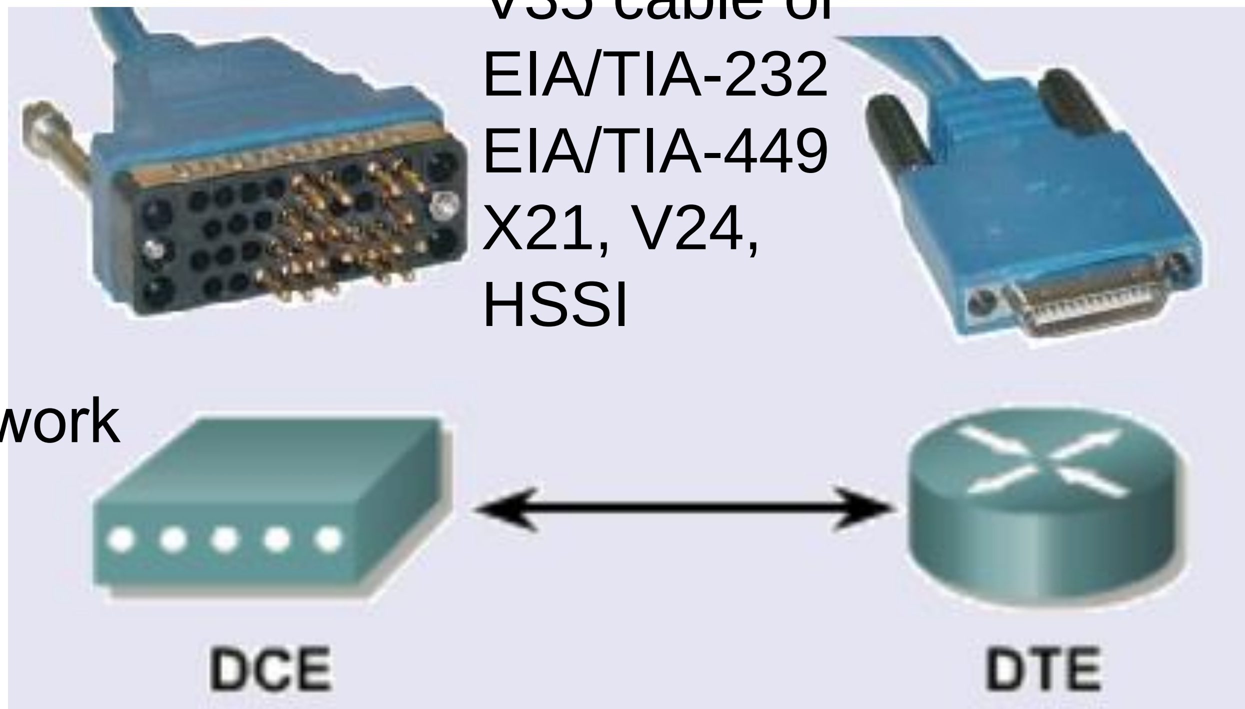
- Straight through cable needed if you link a device in one group to a device in the other group
- Crossover cable needed if you link devices in the same group

Switch ports

- Most switch ports are normally the MDIX type. They manage the crossing over internally.
- Some switch ports can be changed between MDI and MDIX either with a switch or in the configuration.
- Some switches can detect which sort of port is needed and change automatically.

WAN connection

V35 cable or
EIA/TIA-232
EIA/TIA-449
X21, V24,
HSSI

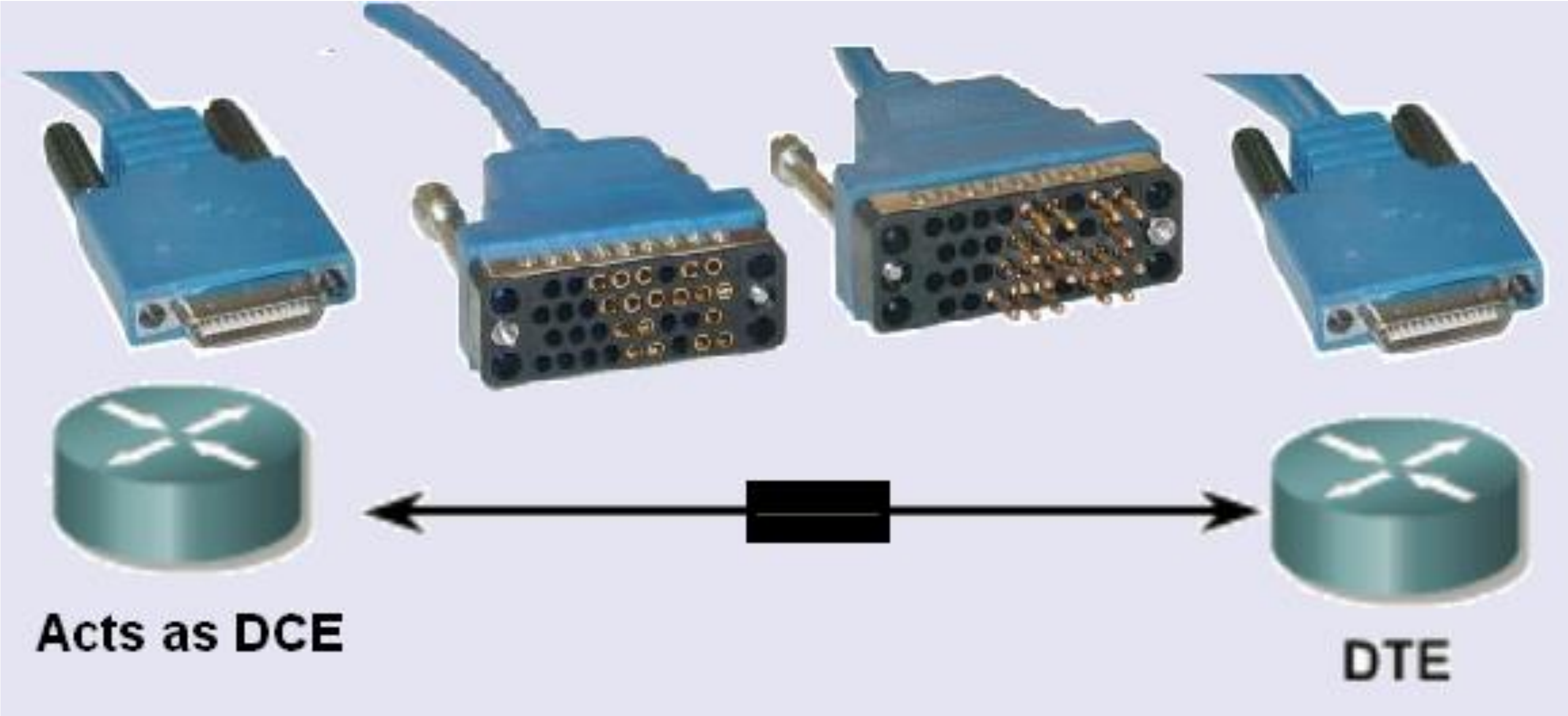


Supplier's network

Supplier's device on customer's premises provides clocking

Customer's router

Simulating WAN in the lab



Split network into subnets

- To cut down the number of broadcasts. Splitting the network into subnets also splits it into separate broadcast domains.
- To provide different facilities for different groups of users.
- For security. Traffic between subnets can be controlled.

Addressing the network(s) 1

- Start with a topology diagram.
- All on one network, or will it be split into subnets?
- How many subnets?
- How many network bits do we need?
- n bits can provide 2^n addresses
- How many bits are left for hosts?

Addressing the network(s) 2

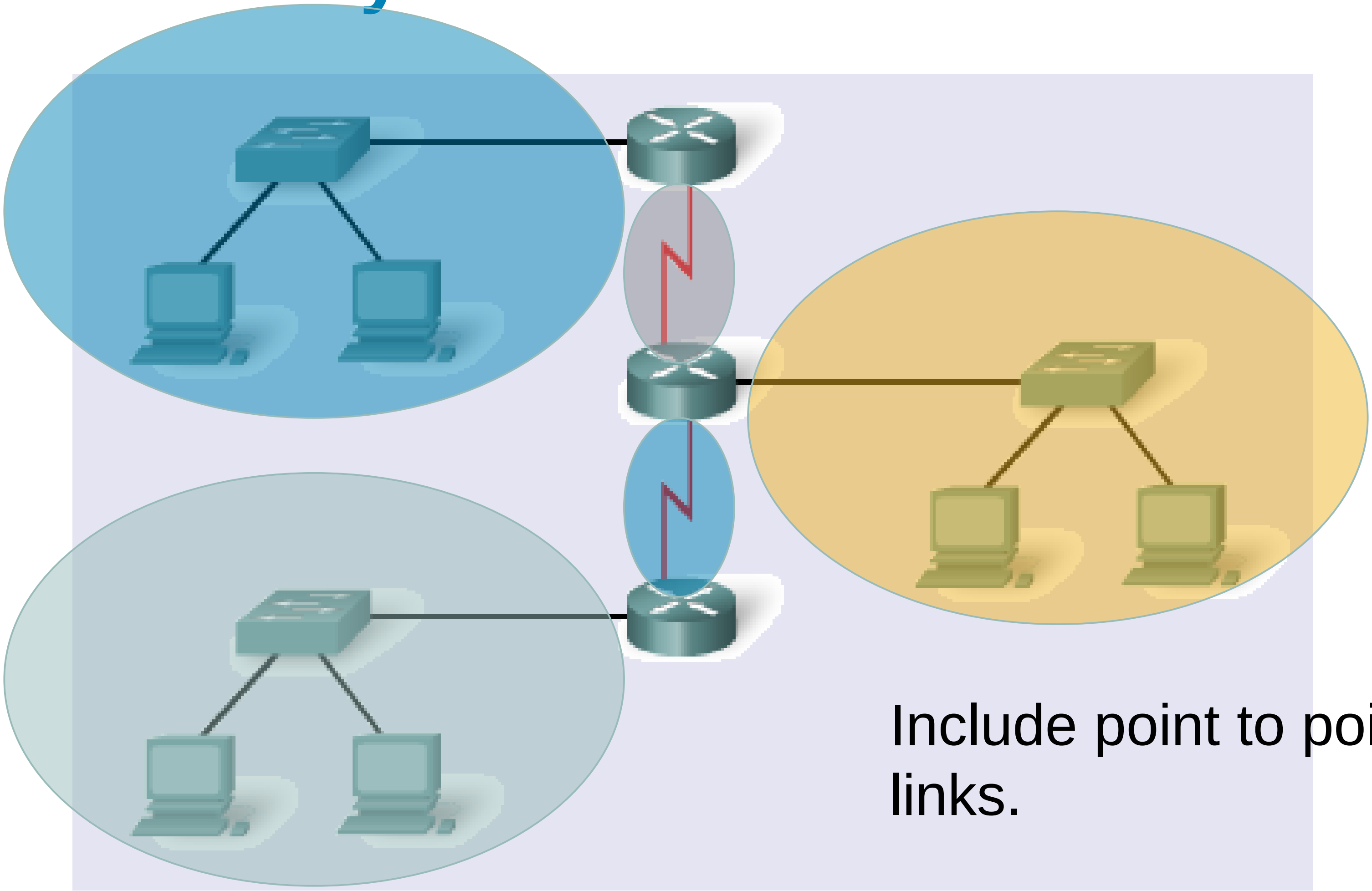
On each subnet, count the number of:

- Router interfaces
- Switches
- Servers
- Admin workstations
- General workstations
- Printers
- IP phones

Addressing the network(s) 2

- How many host bits do we need?
- n bits can provide 2^n addresses
- One for network, one for broadcast
- So $2^n - 2$ host addresses.
- $2^n - 2$ could be 2, 6, 14, 30, 62, 126, 254, 510, 1022, 2046 and so on.
- Go for a number big enough to give us enough addresses.

How many subnets?



Include point to point links.

Bits to borrow

- n bits borrowed for subnetting gives you 2^n subnets.
- So 1 bit gives 2 subnets, 2 bits give 4 subnets, 3 bits give 8 subnets and so on.
- If you need 5 subnets, how many bits do you borrow?
- If you need 10 subnets, how many bits do you borrow?

3

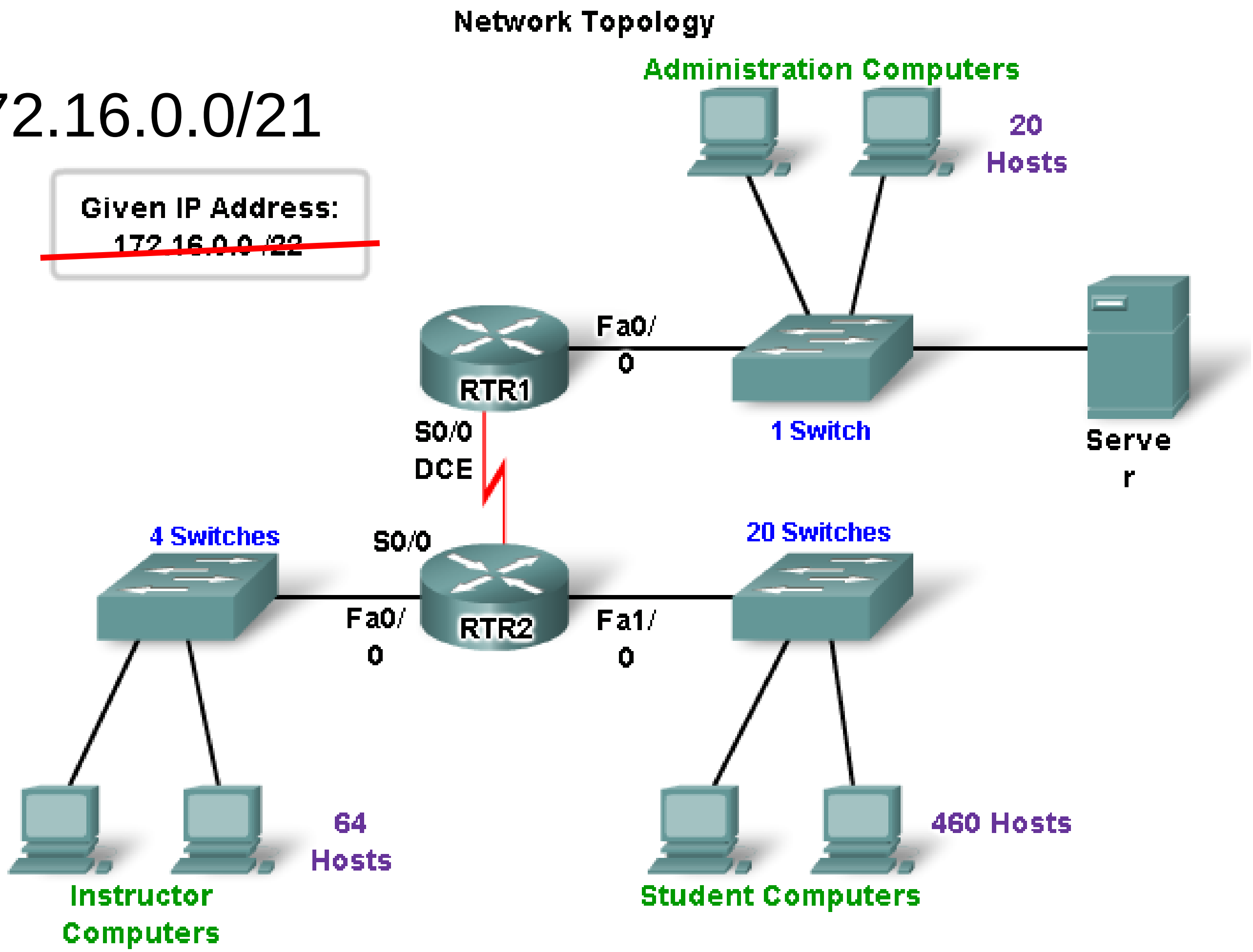
4

Addressing example

- The example given in the curriculum shows subnetting without VLSM using 172.16.0.0/22. (172.16.0.0 – 172.16.3.255)
- They produce 4 subnets each with 510 addresses.
- This is **impossible**. It will be corrected.
- You can do it if you start with 172.16.0.0/21 (172.16.0.0 – 172.16.7.255)

Addressing example no VLSM

172.16.0.0/21



What we have and need

- Given IP address 172.16.0.0/21
- That's 172.16.0.0 to 172.16.7.255
- 4 subnets needed:

  Student LAN has 481 hosts

  Instructor LAN has 69 hosts

  Administrator LAN has 23 hosts

  WAN has 2 hosts

Without VLSM – same size subnets

- Biggest subnet has 481 hosts.
- Formula for hosts is $2^n – 2$
- n = 9 gives 510 hosts (n = 8 gives only 254)
- So 9 host bits needed.
- That means 32 – 9 = 23 network bits
- /23 or subnet mask 255.255.254.0

Network addresses

- /23 so subnet mask in binary is
- 11111111 11111111 11111110.00000000
- Octet 3 is the interesting one.
- Value of last network bit in octet 3 is 2
- So network numbers go up in 2s

    172.16.0.0

    172.16.2.0

    172.16.4.0

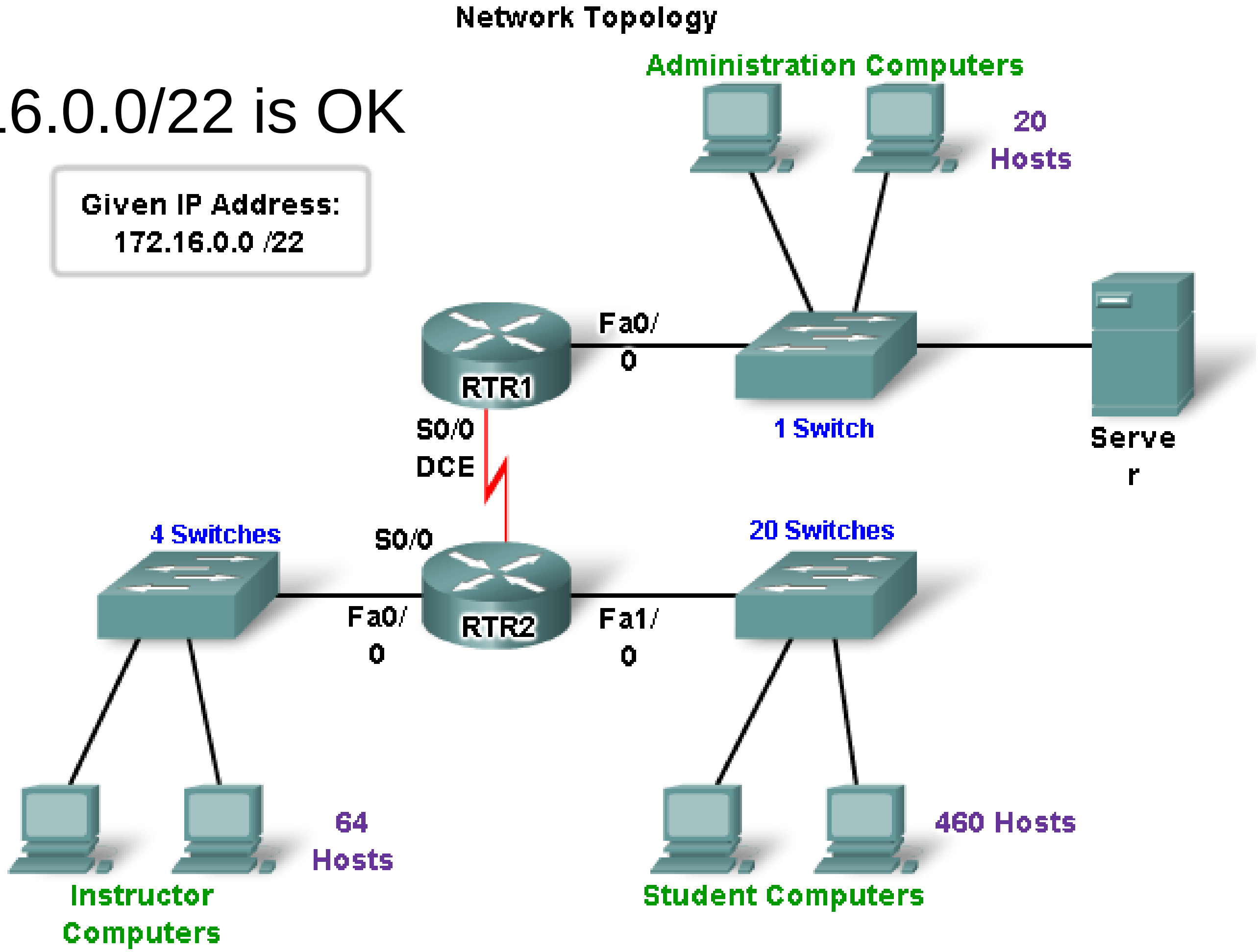
    172.16.6.0

Subnet with no VLSM

Network	Subnet address	Host range	Broadcast address
Student	172.16.0.0/23	172.16.0.1 - 172.16.1.254	172.16.1.255
Instructor	172.16.2.0/23	172.16.2.1 - 172.16.3.254	172.16.3.255
Admin	172.16.4.0/23	172.16.4.1 - 172.16.5.254	172.16.5.255
WAN	172.16.6.0/23	172.16.6.1 - 172.16.7.254	172.16.7.255

Addressing example with VLSM

172.16.0.0/22 is OK



What we have and need

- Given IP address 172.16.0.0/22
- That’s 172.16.0.0 to 172.16.3.255
- 4 subnets needed:

  Student LAN has 481 hosts

  Instructor LAN has 69 hosts

  Administrator LAN has 23 hosts

  WAN has 2 hosts

With VLSM

- Student subnet has 481 hosts.
- Formula for hosts is $2^n - 2$
- n = 9 gives 510 hosts (n = 8 gives only 254)
- So 9 host bits needed.
- That means 32 – 9 = 23 network bits
- /23 or subnet mask 255.255.254.0
- Network address 172.16.0.0
- Broadcast address 172.16.1.255

With VLSM

- Instructor subnet has 69 hosts.
- Formula for hosts is $2^n – 2$
- n = 7 gives 126 hosts (n = 6 gives only 62)
- So 7 host bits needed.
- That means 32 – 7 = 25 network bits
- /25 or subnet mask 255.255.255.128
- Network address 172.16.2.0
- Broadcast address 172.16.2.127

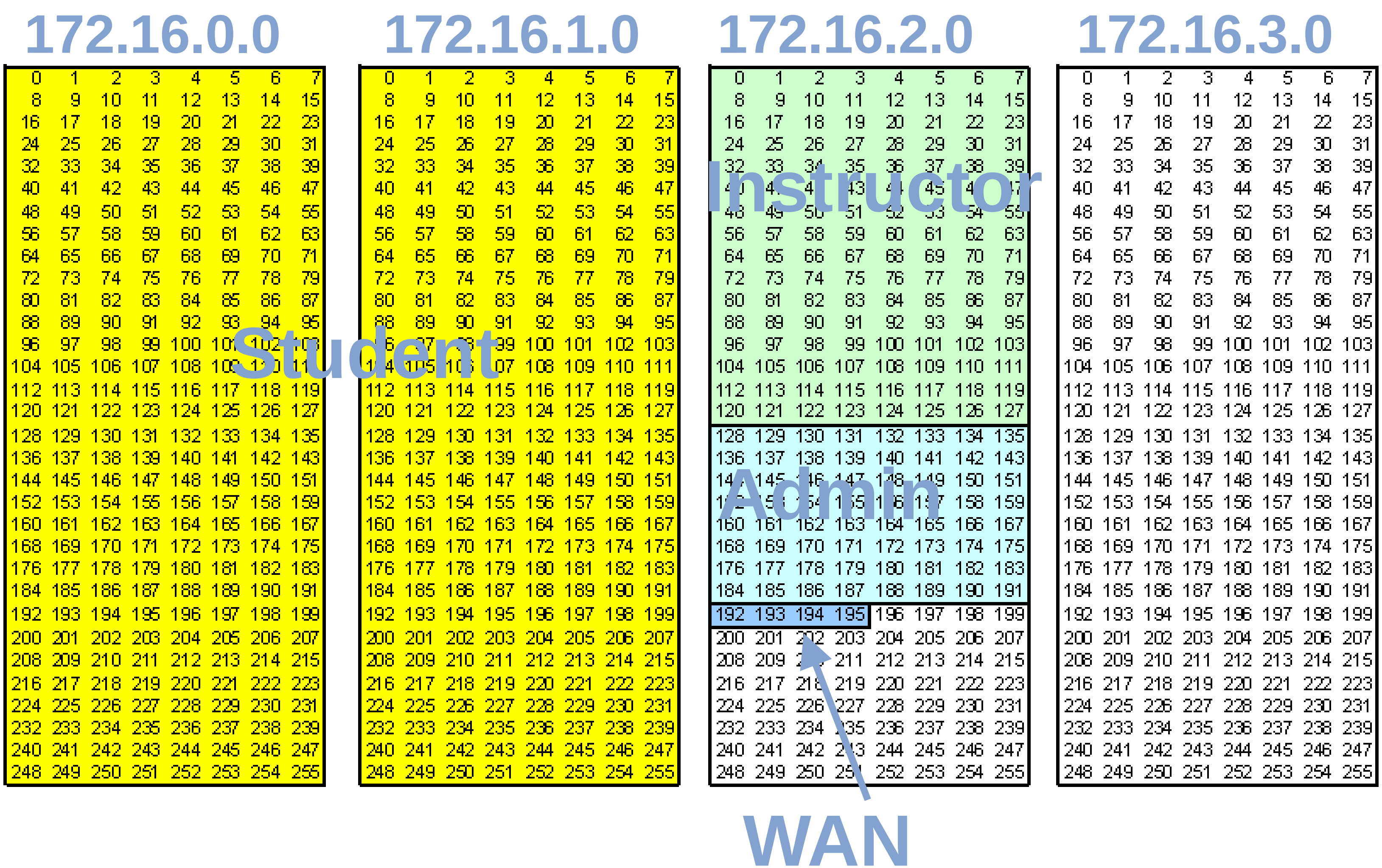
With VLSM

- Admin subnet has 23 hosts.
- Formula for hosts is $2^n - 2$
- n = 5 gives 30 hosts (n = 4 gives only 14)
- So 5 host bits needed.
- That means 32 – 5 = 27 network bits
- /27 or subnet mask 255.255.255.224
- Network address 172.16.2.128
- Broadcast address 172.16.2.159

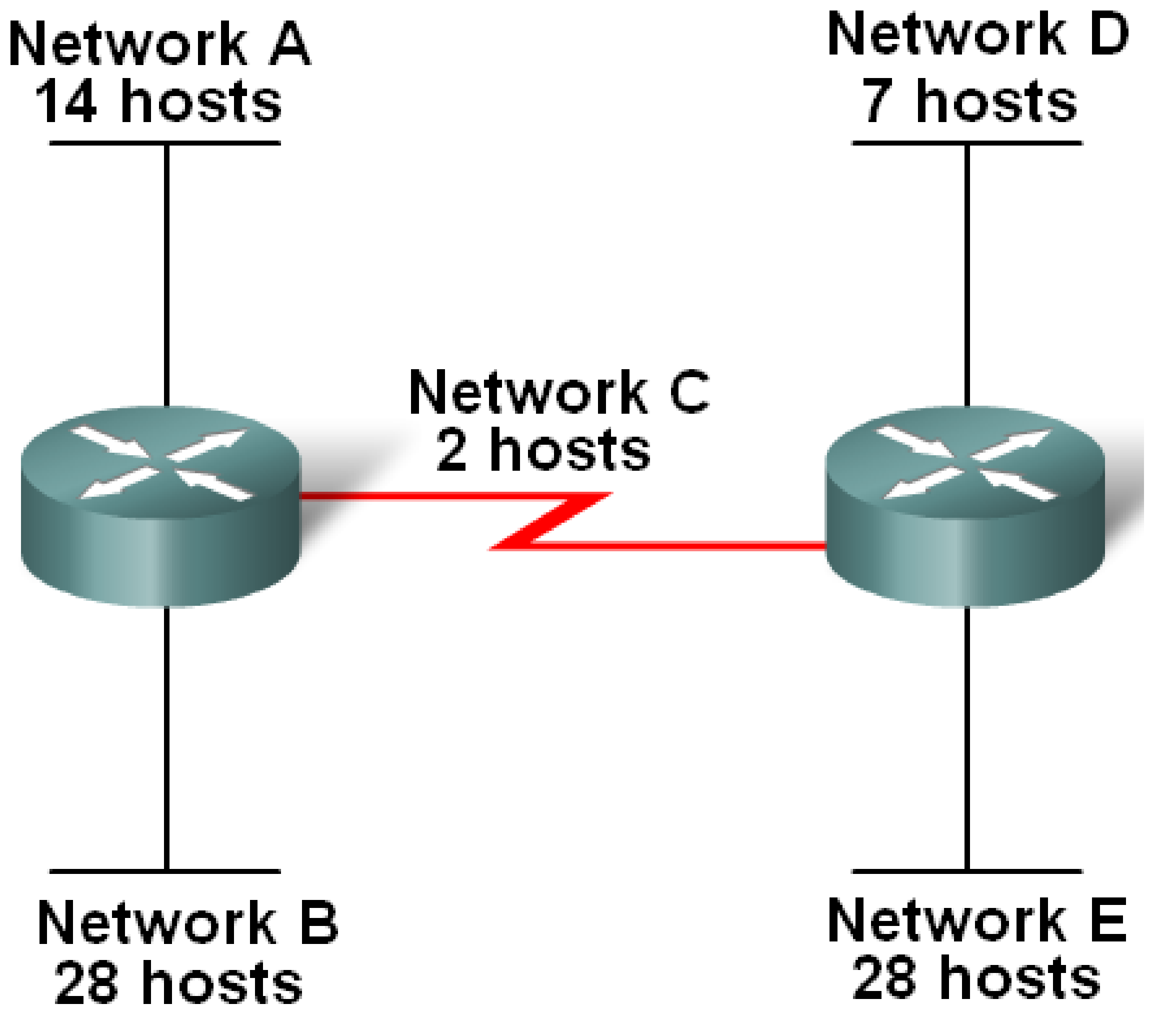
With VLSM

- WAN subnet has 2 hosts.
- Formula for hosts is $2^n - 2$
- n = 2 gives 2 hosts
- So 2 host bits needed.
- That means 32 – 2 = 30 network bits
- /30 or subnet mask 255.255.255.252
- Network address 172.16.2.160
- Broadcast address 172.16.2.163

Visually with VLSM



Case 2. Given 192.168.1.0/24



Subnet 192.168.1.0/24

- 2 subnets with 28 hosts each (largest)
- 5 host bits $2^5 - 2 = 30$ would be just enough
- But allow for expansion: 6 host bits give 62
- Network bits $32 - 6 = 26$
- so /26 or subnet mask 255.255.255.192

Network	Subnet address	Host range	Broadcast address
B	192.168.1.0/26	192.168.1.1 - 192.168.1.62	192.168.1.63
E	192.168.1.64/26	192.168.1.65 - 192.168.1.126	192.168.1.127

Subnet 192.168.1.1/24

- 1 subnets with 14 hosts
- 4 host bits $2^4 - 2 = 14$ would be just enough
- But allow for expansion: 5 host bits give 30
- Network bits 32 - 5 = 27
- so /27 or subnet mask 255.255.255.224
- 0-127 range already used

Network	Subnet address	Host range	Broadcast address
A	192.168.1.128/27	192.168.1.129 - 192.168.1.158	192.168.1.159

Subnet 192.168.1.1/24

- 1 subnets with 7 hosts
- 4 host bits $2^4 - 2 = 14$ is enough
- Network bits $32 - 4 = 28$
- so /28 or subnet mask 255.255.255.240
- 0-159 range already used

Network	Subnet address	Host range	Broadcast address
D	192.168.1.160/28	192.168.1.161 - 192.168.1.174	192.168.1.175

Subnet 192.168.1.1/24

- 1 subnets with 2 hosts
- 2 host bits 2^2 - 2 = 2 is enough
- Network bits 32 - 2 = 30
- so /30 or subnet mask 255.255.255.252
- 0-175 range already used

Network	Subnet address	Host range	Broadcast address
C	192.168.1.176/30	192.168.1.177 - 192.168.1.178	192.168.1.179

Subnet plan with VLSM

Network	Subnet address	Host range	Broadcast address
B	192.168.1.0/26	192.168.1.1 - 192.168.1.62	192.168.1.63
E	192.168.1.64/26	192.168.1.65 - 192.168.1.126	192.168.1.127
A	192.168.1.128/27	192.168.1.129 - 192.168.1.158	192.168.1.159
D	192.168.1.160/28	192.168.1.161 - 192.168.1.174	192.168.1.175
C	192.168.1.176/30	192.168.1.177 - 192.168.1.178	192.168.1.179

Visual

One octet available

0	1	2	3	4	5	6	7	
8	9	10	11	12	13	14	15	
16	17	18	19	20	21	22	23	
24	25	26	27	28	29	30	31	B
32	33	34	35	36	37	38	39	
40	41	42	43	44	45	46	47	
48	49	50	51	52	53	54	55	
56	57	58	59	60	61	62	63	
64	65	66	67	68	69	70	71	
72	73	74	75	76	77	78	79	
80	81	82	83	84	85	86	87	
88	89	90	91	92	93	94	95	E
96	97	98	99	100	101	102	103	
104	105	106	107	108	109	110	111	
112	113	114	115	116	117	118	119	
120	121	122	123	124	125	126	127	
128	129	130	131	132	133	134	135	
136	137	138	139	140	141	142	143	
144	145	146	147	148	149	150	151	A
152	153	154	155	156	157	158	159	
160	161	162	163	164	165	166	167	
168	169	170	171	172	173	174	175	D
176	177	178	179	180	181	182	183	
184	185	186	187	188	189	190	191	
192	193	194	195	196	197	198	199	
200	201	202	203	204	205	206	207	C
208	209	210	211	212	213	214	215	
216	217	218	219	220	221	222	223	
224	225	226	227	228	229	230	231	
232	233	234	235	236	237	238	239	
240	241	242	243	244	245	246	247	
248	249	250	251	252	253	254	255	

Summary

- Hierarchical Design model addresses performance, scalability, maintainability & manageability issues.
- Traffic Analysis is used to monitor network performance.
- Hierarchical Design Model is composed of 3 layers:
  - Access
  - Distribution
  - Core
- Switches selected for each layer must meet the needs of each hierarchical layer as well as the needs of the business.