



Chapter 10

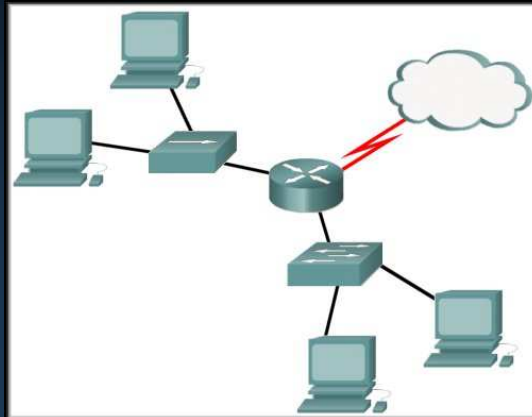
Planning and Cabling Networks

Note for Instructors

- These presentations are the result of a collaboration among the instructors at St. Clair College in Windsor, Ontario.
- Thanks must go out to Rick Graziani of Cabrillo College. His material and additional information was used as a reference in their creation.
- If anyone finds any errors or omissions, please let me know at:
 - tdame@stclaircollege.ca.

Planning and Cabling Networks

LANs: Making the Physical Connection

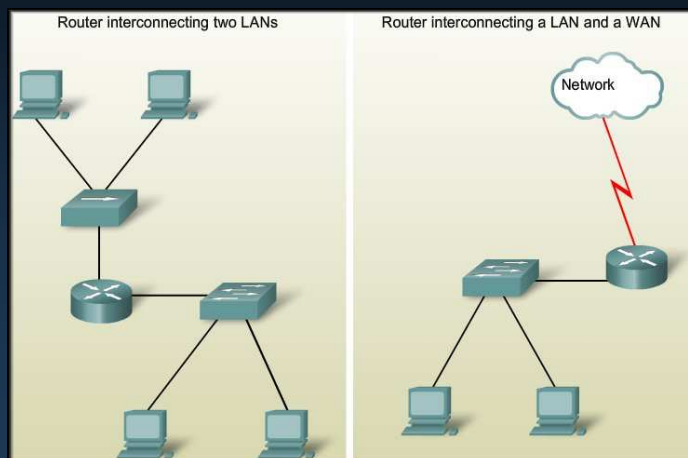


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Choosing the Appropriate LAN Device

- Routers are the primary **internetwork devices** used to interconnect LANs.

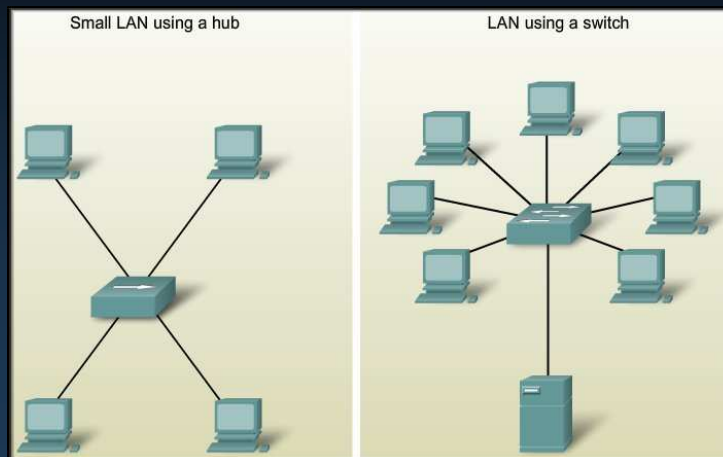


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Chapter 10

Choosing the Appropriate LAN Device

- Hubs and switches are the most common **intranetwork** devices.

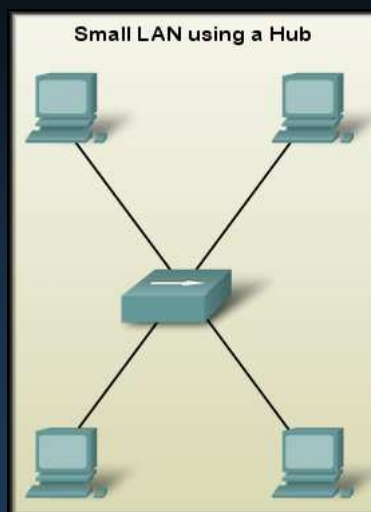


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Choosing the Appropriate LAN Device

- **Hub:**
 - Regenerates all signals over all ports except the incoming port.
 - All devices share bandwidth.
 - Single collision domain.
 - Less expensive than switches.
 - Performance poorer than switches due to collisions and recovery.
 - Can extend the length of a cable run.

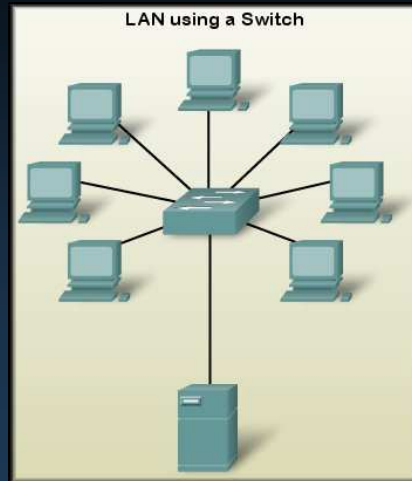


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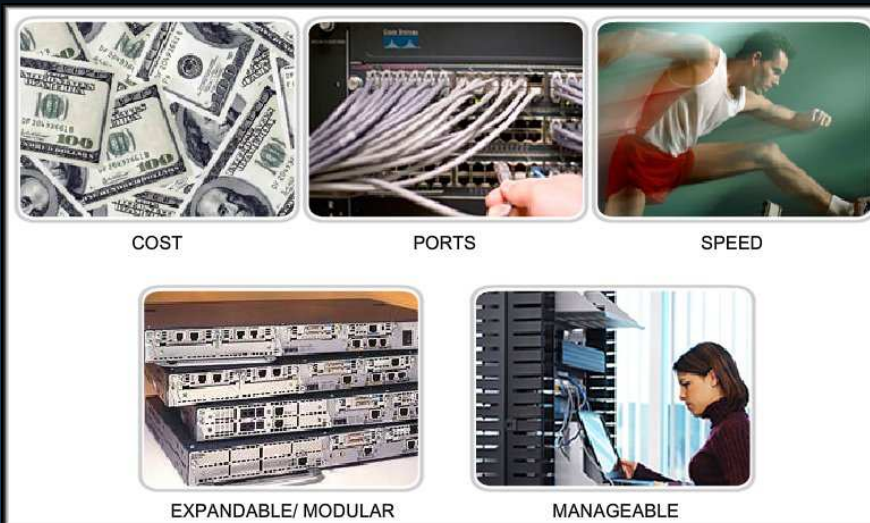
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Choosing the Appropriate LAN Device

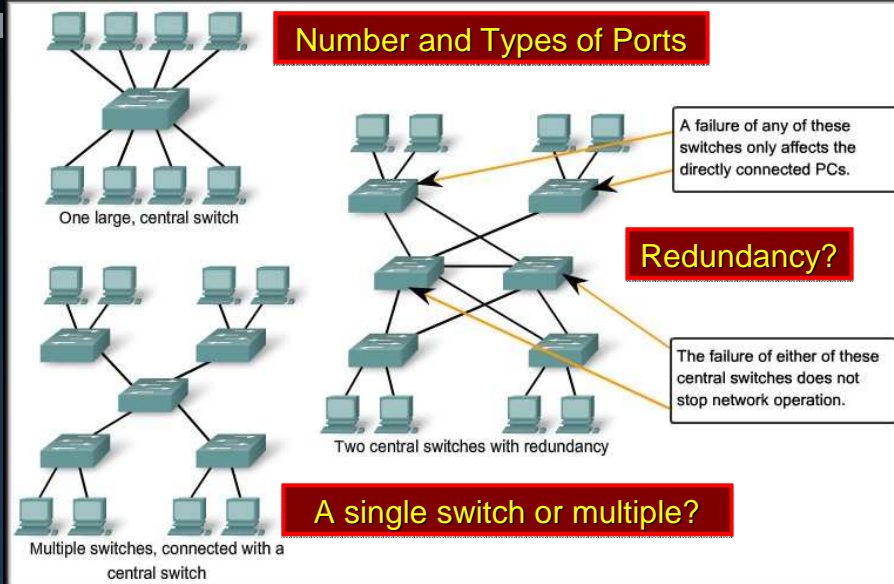
- **Switch:**
 - Sends the frame to the correct destination port.
 - Dedicated bandwidth on all ports.
 - Segments a network into multiple collision domains.
 - More expensive than a hub.
 - Enhanced reliability and performance.



Device Selection Factors



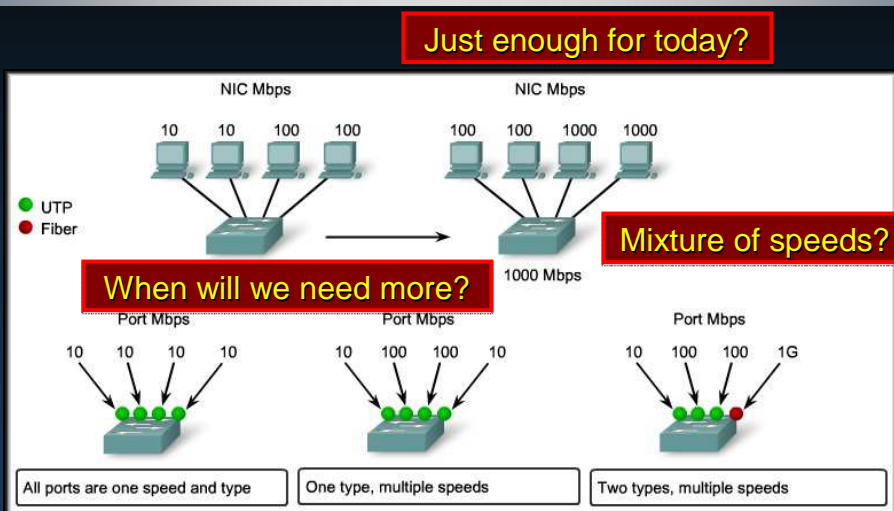
Choosing a Switch - Cost



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Choosing a Switch – Ports/Interfaces



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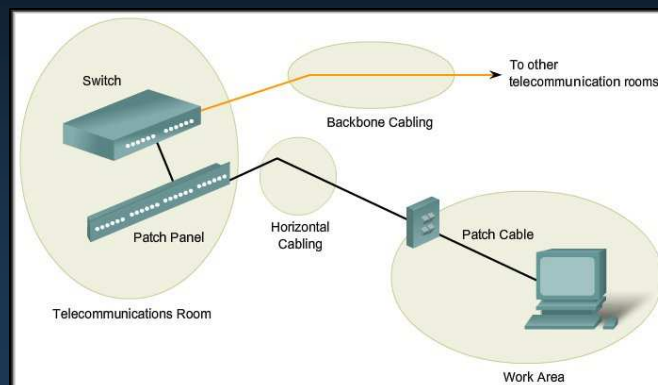
Choosing a Router

- **Router:**
 - Match the router to its purpose.
 - Expandability
 - Media
 - Operating system features
 - Security
 - Quality of Service (QoS)
 - Voice over IP (VoIP)
 - Multiple Protocols
 - Services (NAT / DHCP)



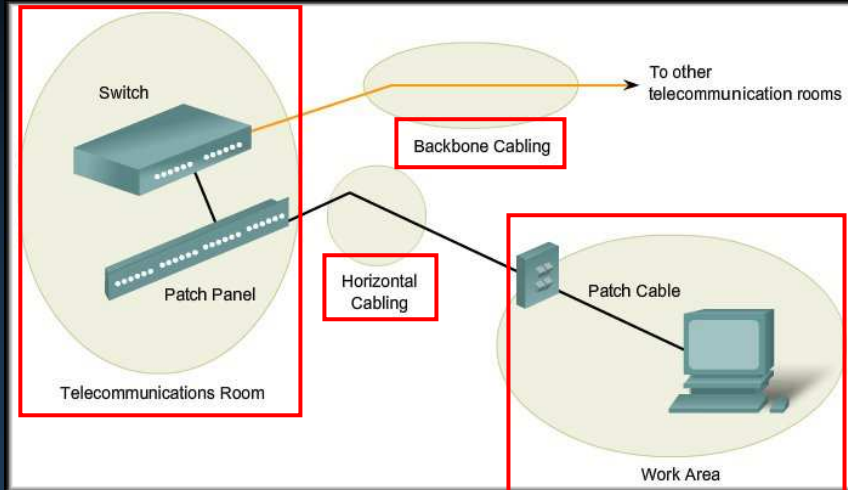
Planning and Cabling Networks

Device Interconnections



LAN and WAN: Getting Connected

- Four Physical Areas:

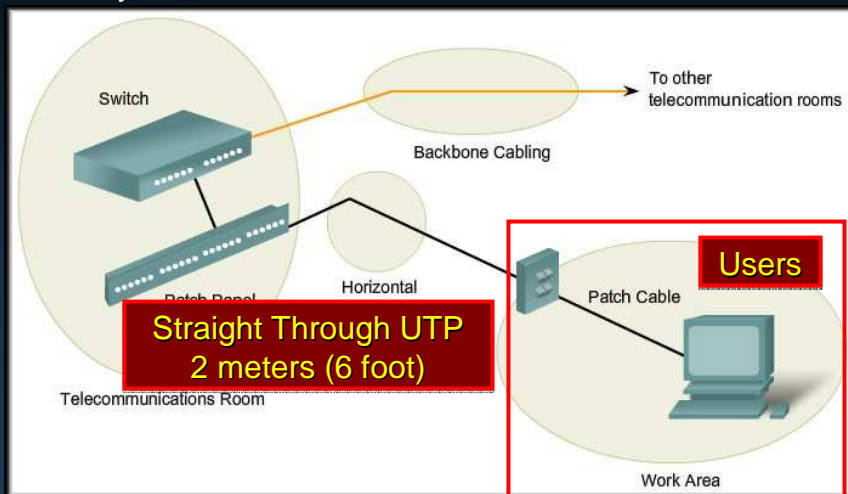


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LAN and WAN: Getting Connected

- Four Physical Areas:

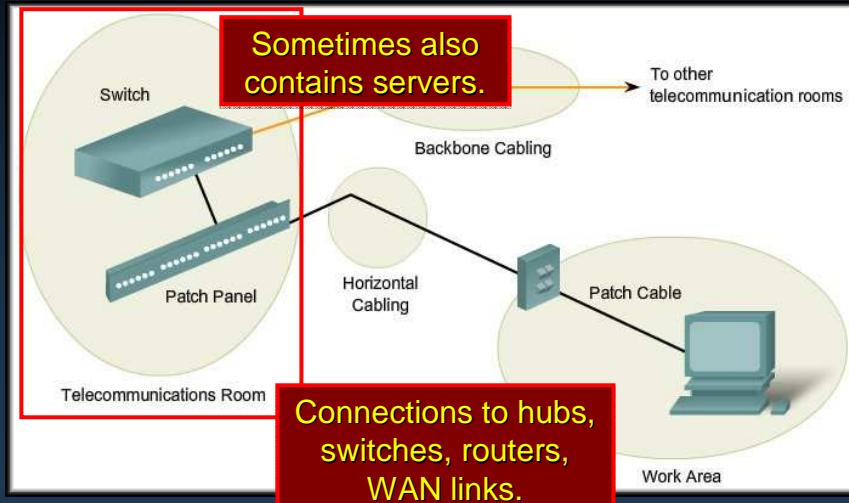


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LAN and WAN: Getting Connected

- Four Physical Areas:

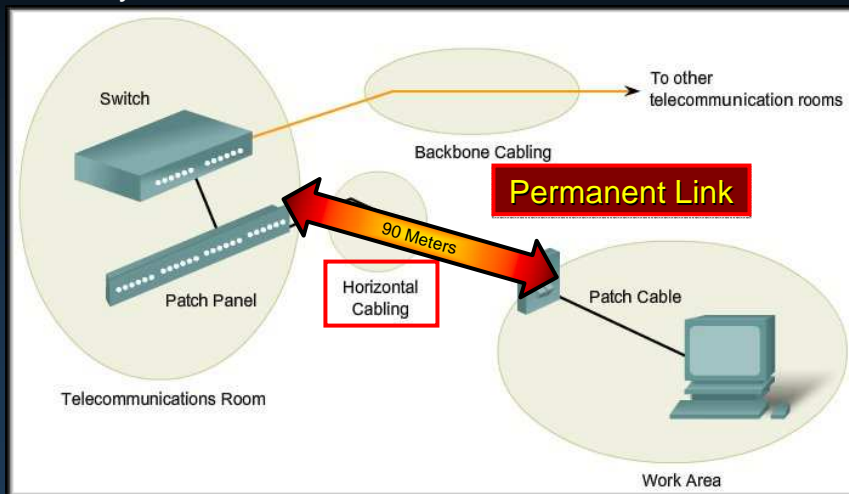


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LAN and WAN: Getting Connected

- Four Physical Areas:

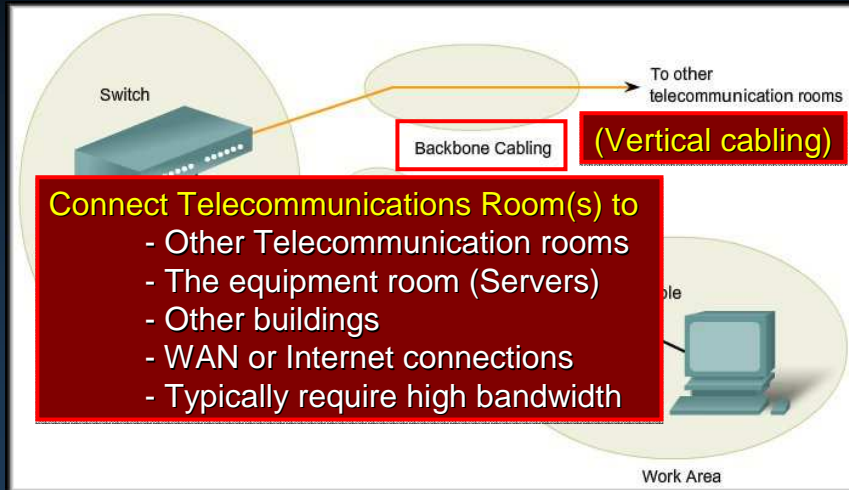


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LAN and WAN: Getting Connected

- **Four Physical Areas:**



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Types of Media



- **Each type have their own advantages and disadvantages.**

- Cable Length
- Cost
- Bandwidth
- Ease of Installation
- Susceptible to EMI or RFI



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Cable Length

- The total length of cable to connect a device includes all cables from the end device in the work area to the intermediary device in the telecommunications room.

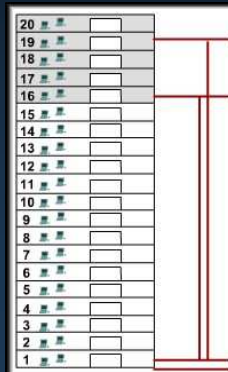
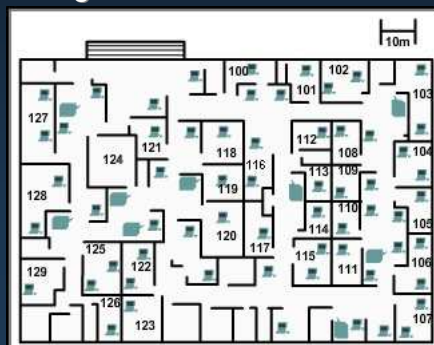
Ethernet Type	Bandwidth	Cable Type	Maximum Distance
10Base-T	10Mbps	Cat3/Cat5 UTP	100m
100Base-TX	100Mbps	Cat5 UTP	100m
100Base-TX	200Mbps	Cat5 UTP	100m
100Base-FX	100Mbps	Multi-Mode Fiber	400m
100Base-FX	200Mbps	Multi-Mode Fiber	2Km
1000Base-T	1Gbps	Cat5e UTP	100m
1000Base-TX	1Gbps	Cat6 UTP	100m
1000Base-LX	1Gbps	Single Mode Fiber	2Km
10GBASE-T	10Gbps	Cat6a/Cat7 UTP	100m
10GBASE-LX4	10Gbps	Multi-Mode Fiber	100m
10GBASE-LX4	10Gbps	Single Mode Fiber	10Km

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Cable Length

- Attenuation:**
 - The reduction of the strength of the signal as it moves down a medium.
 - The longer the medium the more affect attenuation has on the signal.



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Cost

- Can vary from media type to media type.
 - In a perfect setting, the budget would allow for fiber-optic cabling to every device in the LAN.
 - Provides greater bandwidth than UTP
 - Material and installation costs are significantly higher.
- Match the performance needs of the users with the cost of the equipment.

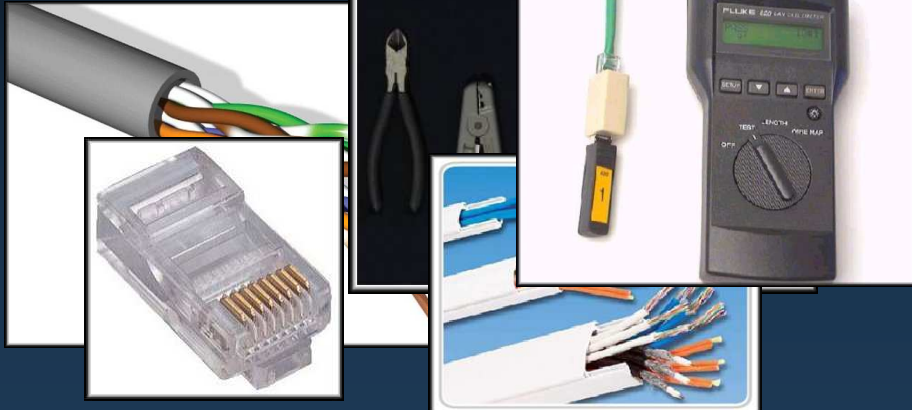
Bandwidth

- The devices in a network have different bandwidth requirements.
 - For example, a server generally has a need for more bandwidth than a computer dedicated to a single user.

Ethernet Type	Bandwidth	Cable Type	Maximum Distance
10Base-T	10Mbps	Cat3/Cat5 UTP	100m
100Base-TX	100Mbps	Cat5 UTP	100m
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1000Base-TX	1Gbps	Cat6 UTP	100m
1000Base-LX	1Gbps	Single Mode Fiber	2Km
10GBASE-T	10Gbps	Cat6a/Cat7 UTP	100m
10GBASE-LX4	10Gbps	Multi-Mode Fiber	100m
10GBASE-LX4	10Gbps	Single Mode Fiber	10Km

Ease of Installation

- The ease of cable installation varies according to cable types and building architecture.
- **Cat5 UTP:**



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Ease of Installation

- The ease of cable installation varies according to cable types and building architecture.
- **Optical Fiber:**



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EMI / RFI

- Electromagnetic Interference (**EMI**) and Radio Frequency Interference (**RFI**) must be taken into consideration when choosing a media type for a LAN.
 - Can significantly impact data transfer
 - Electrical machines
 - Lightning
 - Other communication devices
 - Power cables
 - Distance between buildings
 - Wireless security systems
 - Radio / microwave systems

Making LAN Connections

- Devices use one of two types of UTP interfaces:
 - Media-Dependent Interface (**MDI**)
 - Media-Dependent Interface Crossover (**MDIX**)
 - **MDI:**
 - Transmit: **Pins 1 and 2** Receive: **Pins 3 and 6**
 - *Computers, Servers, Routers*
 - **MDIX:**
 - Switch the transmit and receive pairs internally
 - Allows use of a straight through cable
 - *Hubs and Switches*
 - Many devices will now automatically detect the cable type and will configure the interfaces accordingly.

Making LAN Connections

- Rule of Thumb:

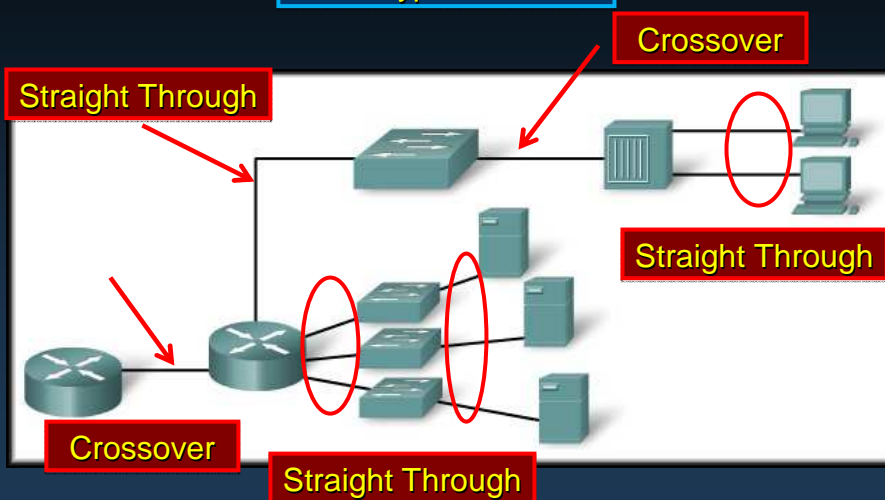


When connecting **different types** of devices, use a **straight through cable**.

When connecting the **same type** of device, use a **crossover cable**.

Making LAN Connections

What type of cable?



Making WAN Connections

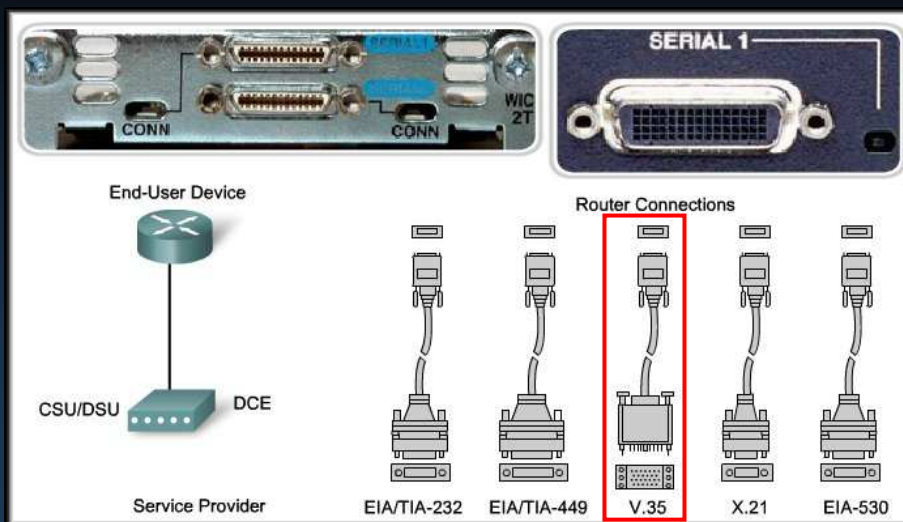
- Wide area connections take a number of forms, including:
 - Telephone line RJ11 connectors
 - Dialup
 - Digital Subscriber Line (DSL)
 - 60 pin Serial connections

Cisco HDLC	PPP	Frame Relay	DSL Modem	Cable Modem
EIA/TIA-232 EIA/TIA-449 X.21V.24 V.35 High Speed Serial Interface (HSSI)			RJ-11 Note: Works over telephone line	F Note: Works over Cable TV line

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Making WAN Connections

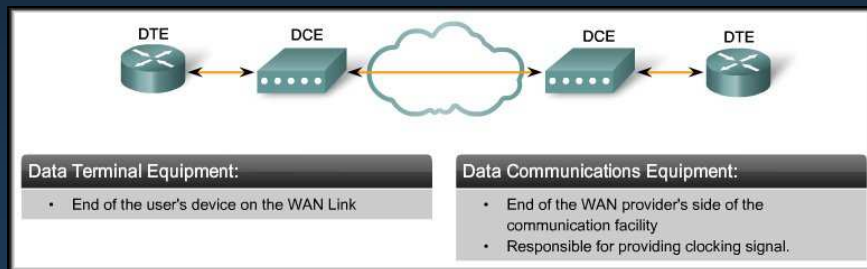


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Making WAN Connections

- Data Communications Equipment (**DCE**):
 - A device that supplies the clocking (timing) services to another device.
- Data Terminal Equipment (**DTE**):
 - A device that receives clocking (timing) services from another device and adjusts accordingly.

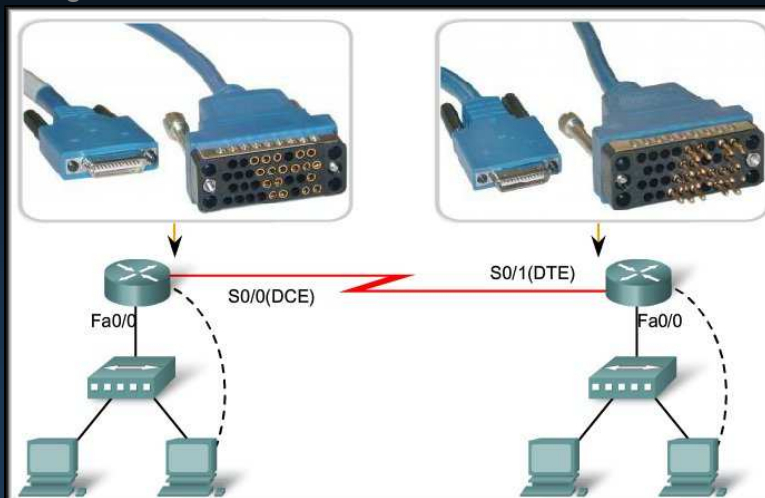


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Making WAN Connections

- Making WAN connections in the lab:



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Planning and Cabling Networks

Developing an Addressing Scheme

Subnet Number	Subnet Address	Subnet Number	Subnet Address
Subnet 0	192.168.20.0/27	Subnet 0	192.168.20.192/30
Subnet 1	192.168.20.32/27	Subnet 1	192.168.20.196/30
Subnet 2	192.168.20.64/27	Subnet 2	192.168.20.200/30
Subnet 3	192.168.20.96/27	Subnet 3	192.168.20.204/30
Subnet 4	192.168.20.128/27	Subnet 4	192.168.20.208/30
Subnet 5	192.168.20.160/27	Subnet 5	192.168.20.212/30
Subnet 6	192.168.20.192/27	Subnet 6	192.168.20.216/30
Subnet 7	192.168.20.224/27	Subnet 7	192.168.20.220/30

How Many Hosts in the Network?

- Start by determining the **total number** of hosts.

Router Interfaces
Count the number of interfaces, and not the number of routers

Printers

IP Phones
Count other specialty IP devices as well

Switch Management Addresses

Administration Users

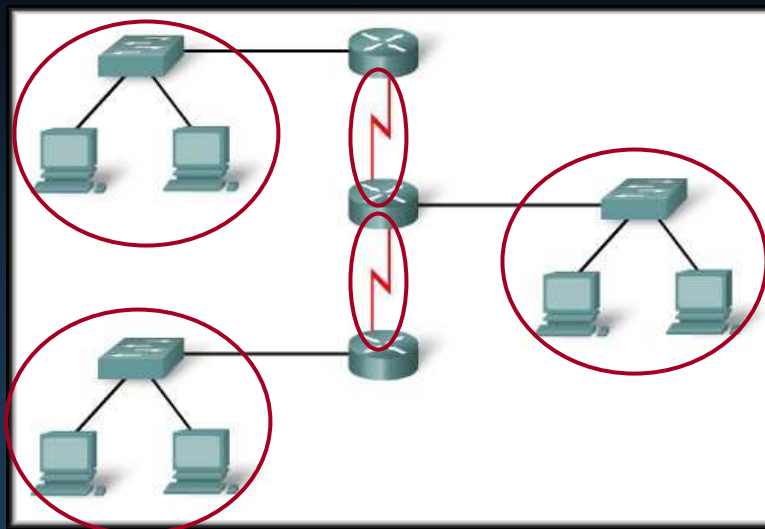
General Users

Servers

How Many Networks?

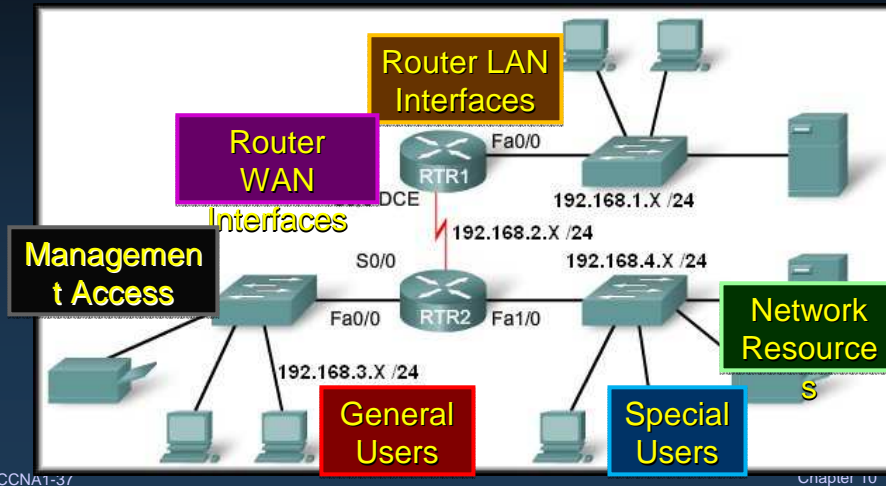
- **Dividing a network into subnets:**
 - Manage broadcast traffic
 - Different network requirements
 - Security
 - Remember the formula $2^n - 2$
- **Counting the subnets:**
 - Each subnet will require some type of router interface as a gateway for that subnet (physical segment).
 - Each WAN connection is a separate subnet.
- **Subnet Masks:**
 - A unique subnet, subnet mask and range of host addresses for each physical segment

How Many Networks?

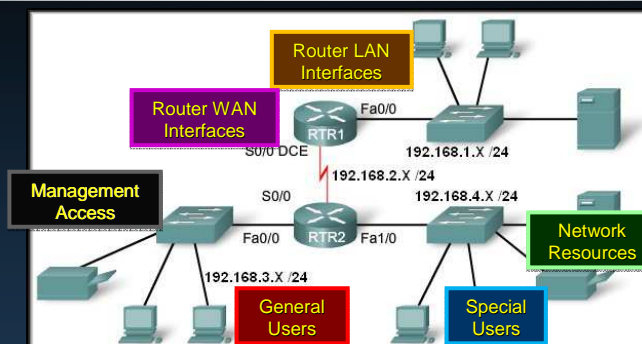


Designing the Address Standard

- Group devices according to types and allocate a logical block of addresses within the address range of the network.



Designing the Address Standard



There is NO specific answer to designing the address standard.

Just make sure it is followed on every subnet.

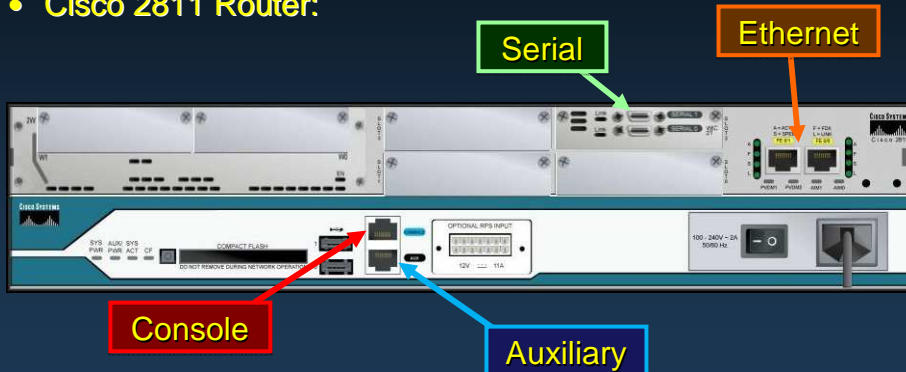
Planning and Cabling Networks

Device Interconnections

Subnet Number	Subnet Address	Subnet Number	Subnet Address
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Subnet 2	192.168.20.64/27	Subnet 2	192.168.20.200/30
Subnet 3	192.168.20.96/27	Subnet 3	192.168.20.204/30
Subnet 4	192.168.20.128/27	Subnet 4	192.168.20.208/30
Subnet 5	192.168.20.160/27	Subnet 5	192.168.20.212/30
Subnet 6	192.168.20.192/27	Subnet 6	192.168.20.216/30
Subnet 7	192.168.20.224/27	Subnet 7	192.168.20.220/30

Device Interfaces

- Cisco devices (routers and switches) have several types of interfaces associated with them.
- **Cisco 2811 Router:**



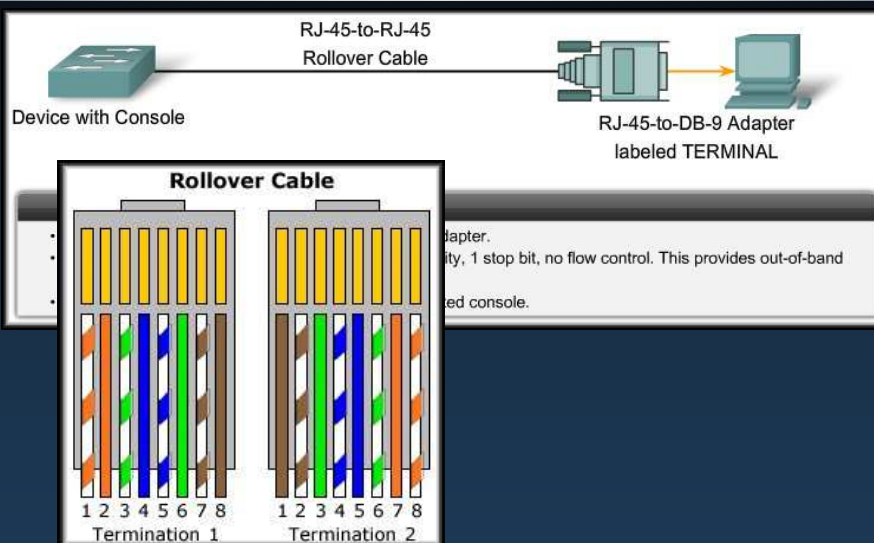
Making the Device Management Connection

- Typically, networking devices do not have their own displays, keyboards, or input devices.
 - Accessing a network device for configuration, verification, or troubleshooting is made via a connection between the **device console interface and a computer**.
 - To enable this connection:
 - The computer is physically connected to the console port of the device.
 - The computer runs a program called a terminal emulator (**HyperTerminal**).

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Making the Device Management Connection



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Making the Device Management Connection

HyperTerminal

Connection Description

New Connection

Enter a name and choose an icon

Name: Router

Icon: [Icons]

Connect To

router

Enter details for the phone number

Country/region: United States

Area code: 519

Phone number:

Connect using: COM1

COM1 Properties

Port Settings

Bits per second: 9600

Data bits: 8

Parity: None

Stop bits: 1

Flow control: Hardware

Restore Defaults

OK Cancel Apply