Part 2

NETWORK TECHNOLOGY

Network Technology

- Network comprises
  - Nodes
  - Links
- Topology: How they're configured
  - LAN
  - WLAN
  - WAN

LANs

- Type of LANs
  - Ethernet
  - Fast Ethernet
  - Gigabit Ethernet
  - Half-duplex vs Full-duplex
  - Switched Ethernet
  - VLAN
  - Token ring
  - FDDI
  - ATM / LANE

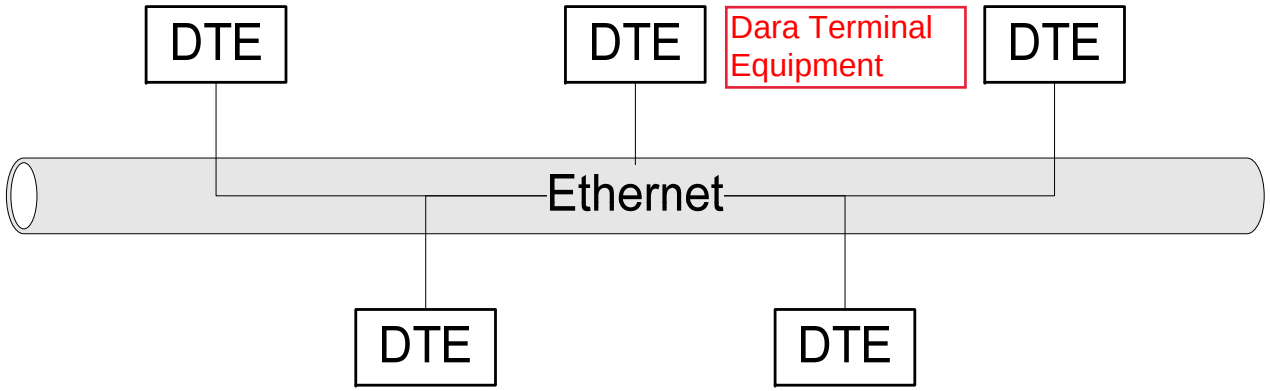
Nodes

- Hubs
- Bridges
- Remote bridges
- Routers
- Gateways
- Half bridge / half router
- Switches

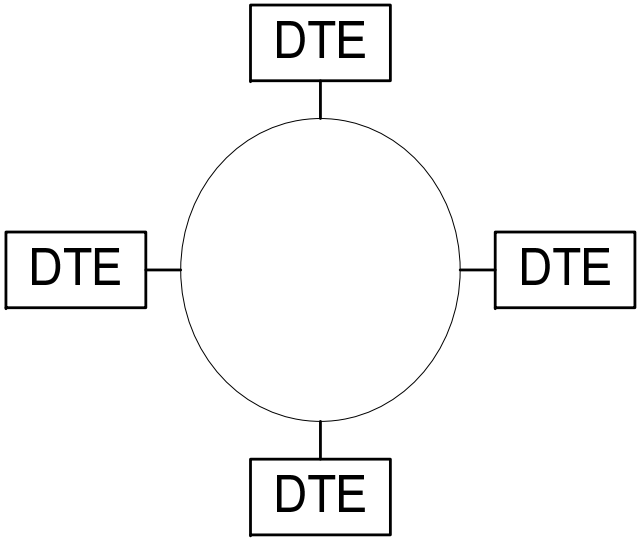
WANs

- Facilities / Media
  - Wired
    - ✓ Copper
    - ✓ Coaxial
    - ✓ Fiber
  - Wireless
    - ✓ Terrestrial
    - ✓ Satellite
- Mode
    - ✓ Digital
    - ✓ Analog
- Services
    - ✓ POTS
    - ✓ ISDN
    - ✓ Broadband

Basic LAN Topologies

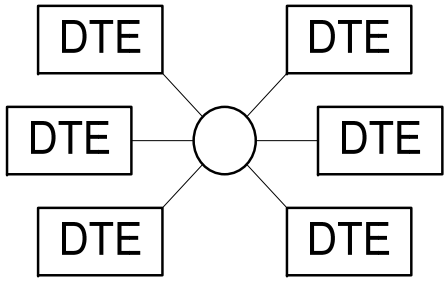


(a) Bus Topology

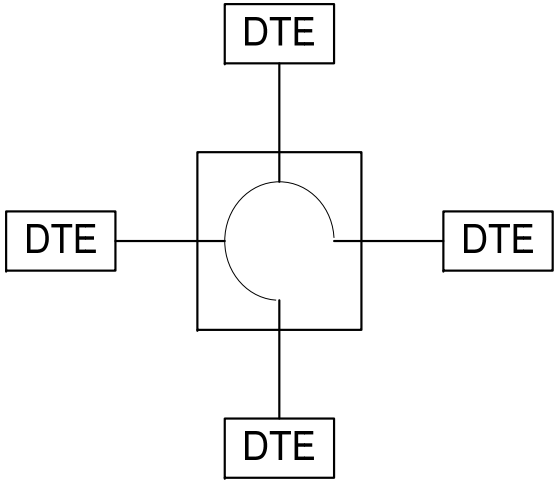


(b) Ring Topology

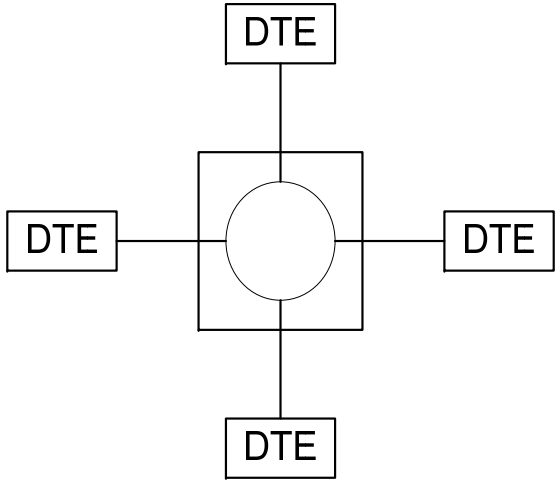
Star & Hybrid LAN Topologies



(c) Star Topology



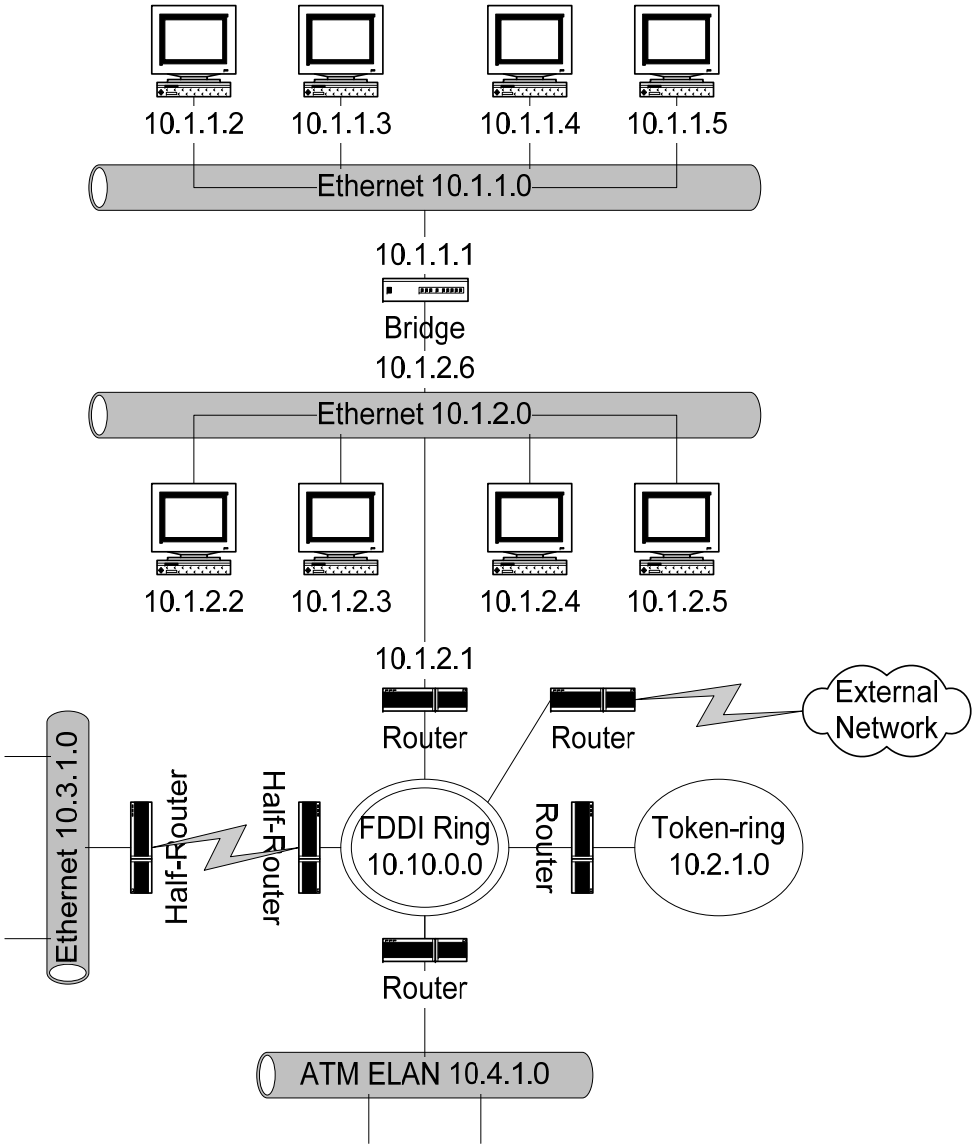
Ethernet Hub



Token Ring Hub

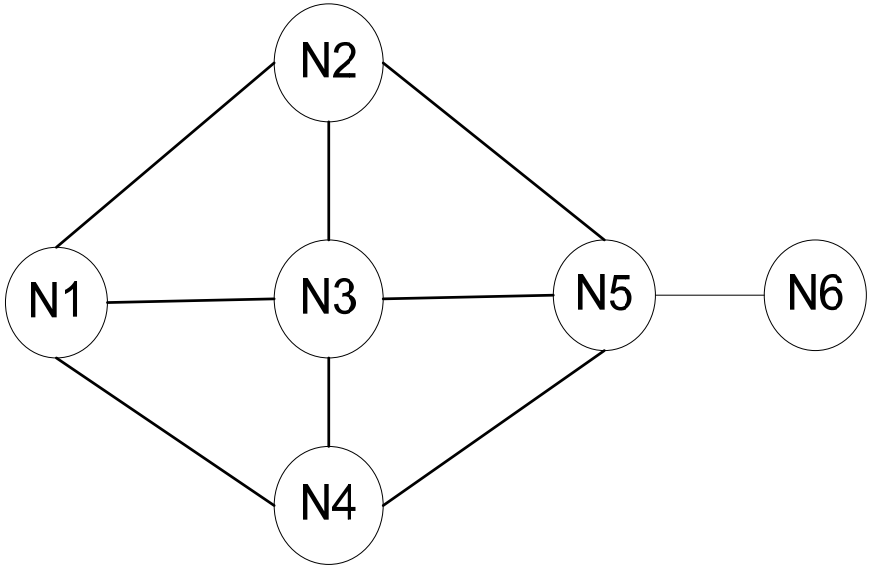
(d) Hub Configurations

A Campus Network

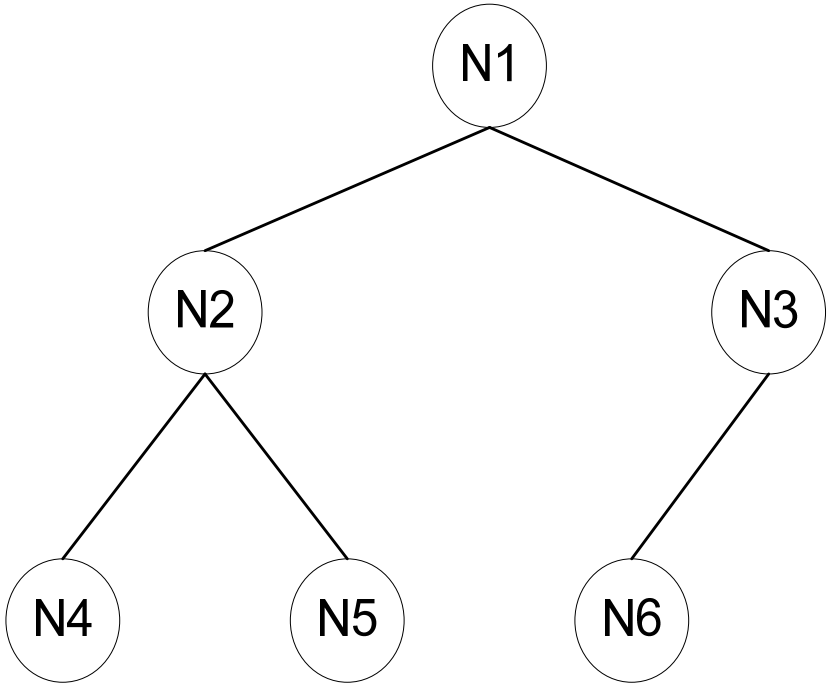


Campus Network of LANs

WAN Topologies



(a) Mesh Topology



(b) Tree Topology

Ethernet

Ethernet LAN Topology Limits

TYPE	DESCRIPTION	SEGMENT LENGTH	DROP CABLE
10Base2	Thin coax (0.25”)	200 meters	Not allowed
10Base5	Thick Coax (0.5”)	500 meters	Twisted pair: 50 meters
10Base-T	Hub topology	N/A	Two twisted pairs: 100 meters
10Base-F	Hub topology		2 km
100BASE-TX	Hub topology		Two twisted pairs: 100m
1000BASE-T	Hub topology		Four twisted pairs: 100m
10GBASE-T	Hub topology	N/A	CAT6e Cable, 100m

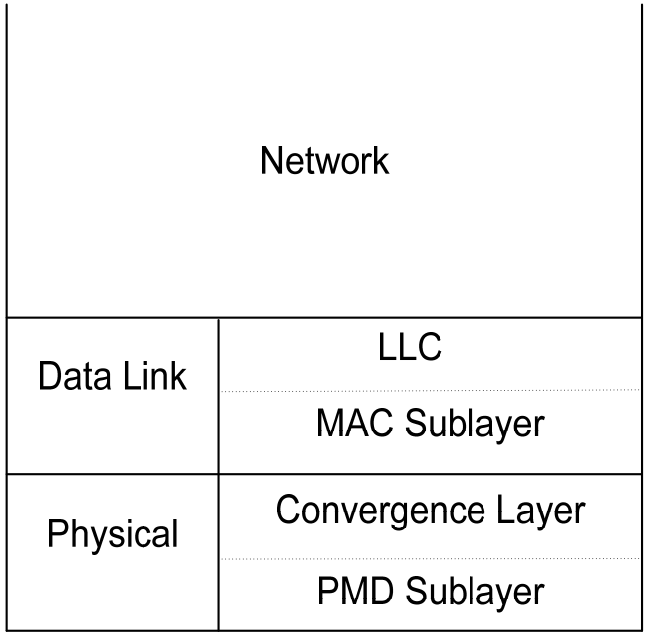
10Base2

- Cheapernet
- 0.25 inch cable
  - More flexible
  - Easier to bring to workstation
  - Cheaper electronics
  - Greater attenuation
  - Lower noise resistance
  - Fewer taps (30)
  - Shorter distance (185m)

10Base5

- Ethernet and 802.3 originally used 0.4 inch diameter cable at 10Mbps
- Max cable length 500m
- Distance between taps a multiple of 2.5m
  - Ensures that reflections from taps do not add in phase
- Max 100 taps
- 10Base5

Fast Ethernet



LLC Logical Link control
MAC Medium Access Control
PMD Physical Medium Dependent

100Base-T Fast Ethernet Protocol Architecture

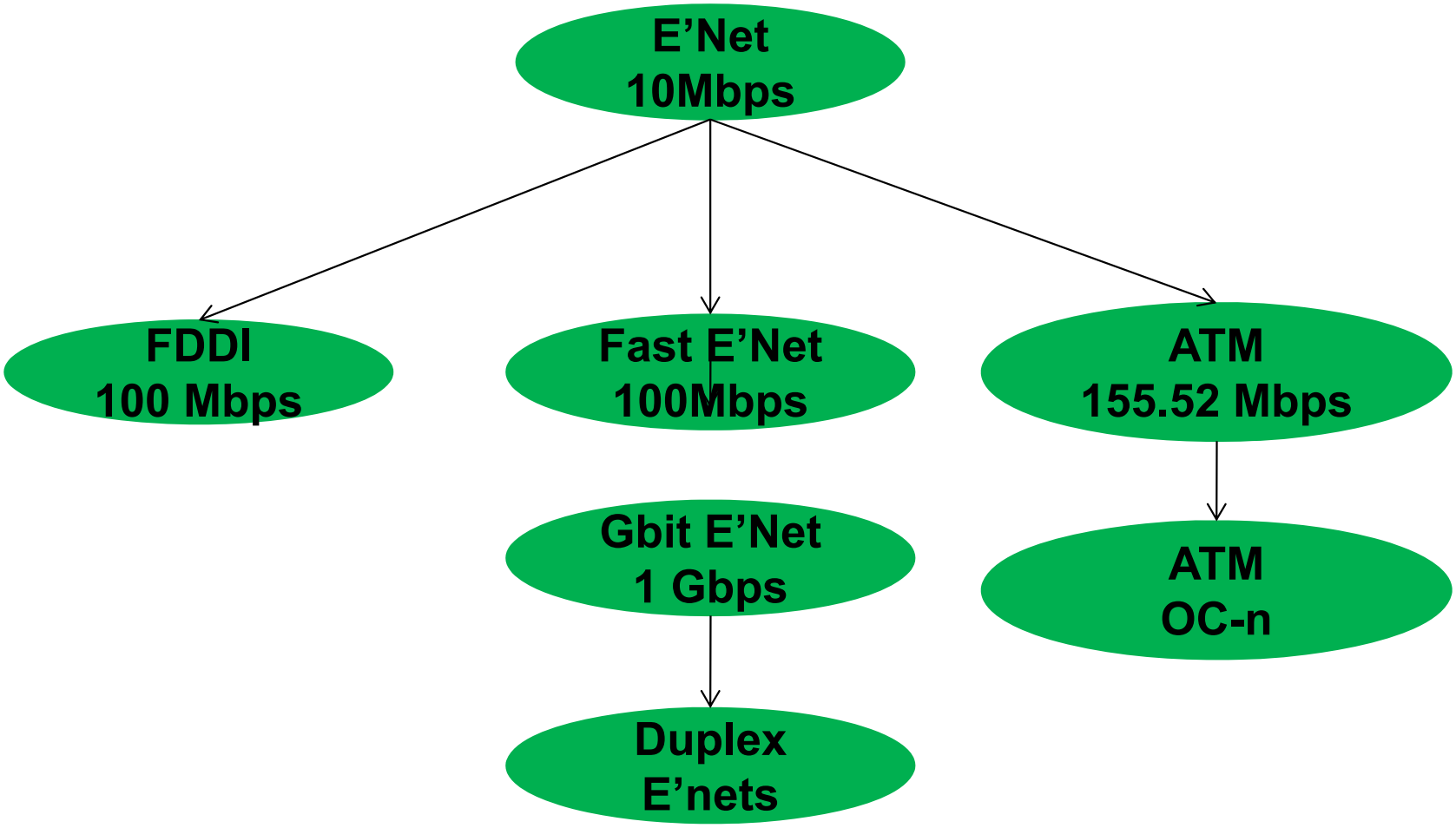
Gigbit Ethernet

Gigabit Ethernet Topology Limits

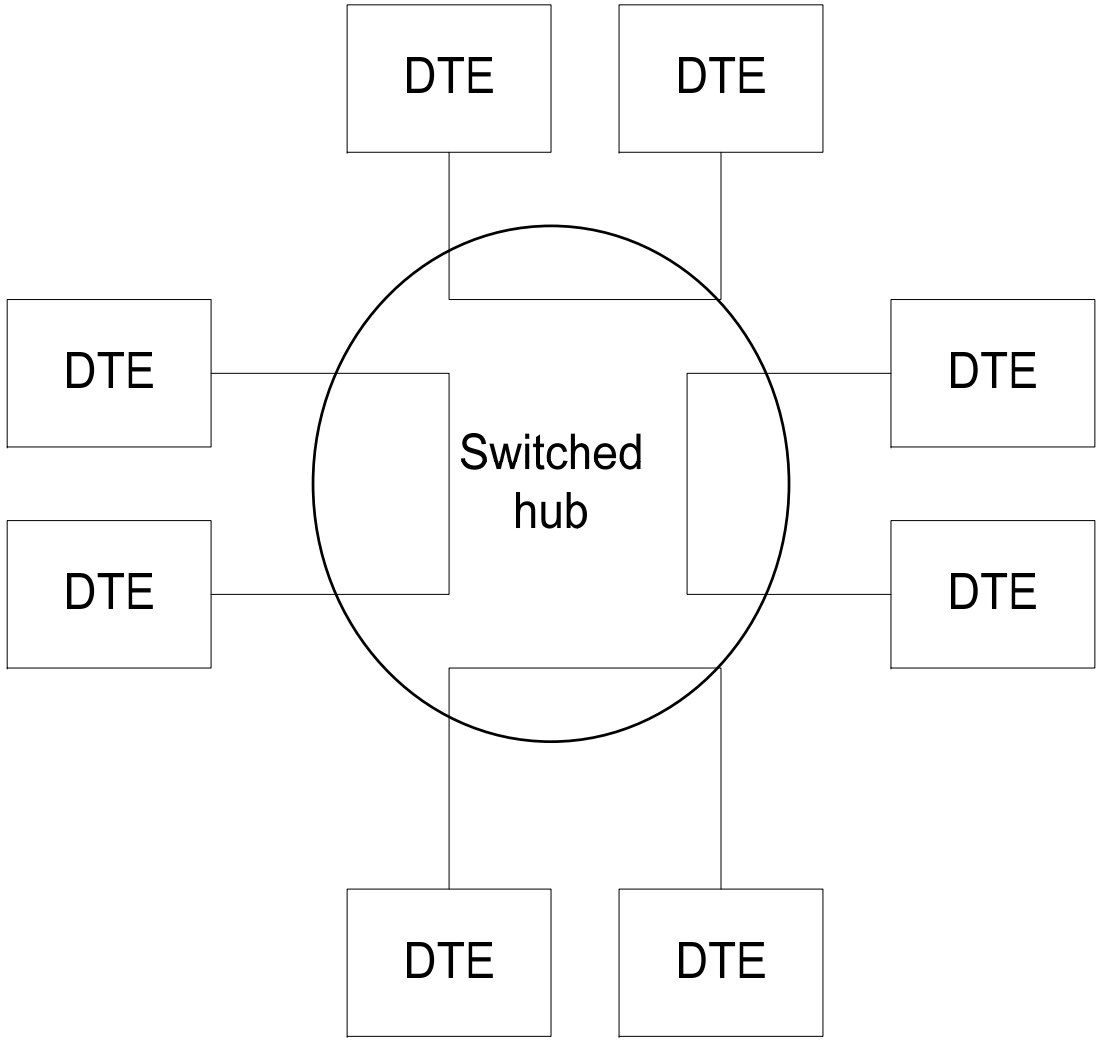
	9 micron Single Mode	50 micron Single Mode	50 micron Multimode	62.5 micron Multimode	Balance Shielded Cable	UTP
1000BASE-LX	10 km	3 km	550 m	440 m	-	-
1000BASE-SX	-		550 m	260 m	-	-
1000BASE-CX	-		-	-	25 m	-
1000BASE-T	-		-	-	-	100 m

1000Base-LX: long-wave laser over single-mode and multi-mode fiber
1000Base-SX: short-wave laser over multi-mode fiber
1000Base-CX: balanced shielded 150 ohm copper cable
1000Base-T: unshielded twisted-pair cable

LAN Data Rate Race

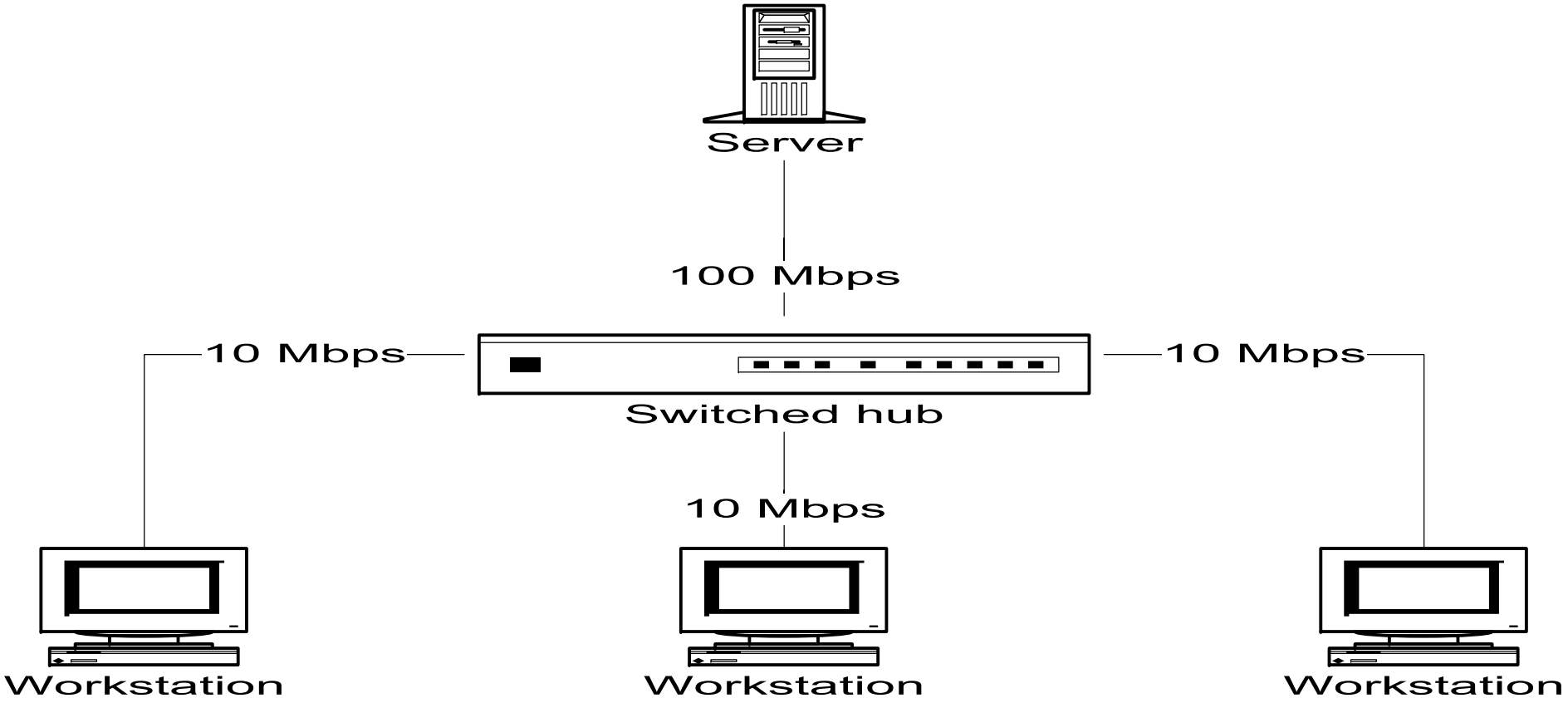


Switched Ethernet



Switched Ethernet Hub

Client/Server Configuration using Switched Hub

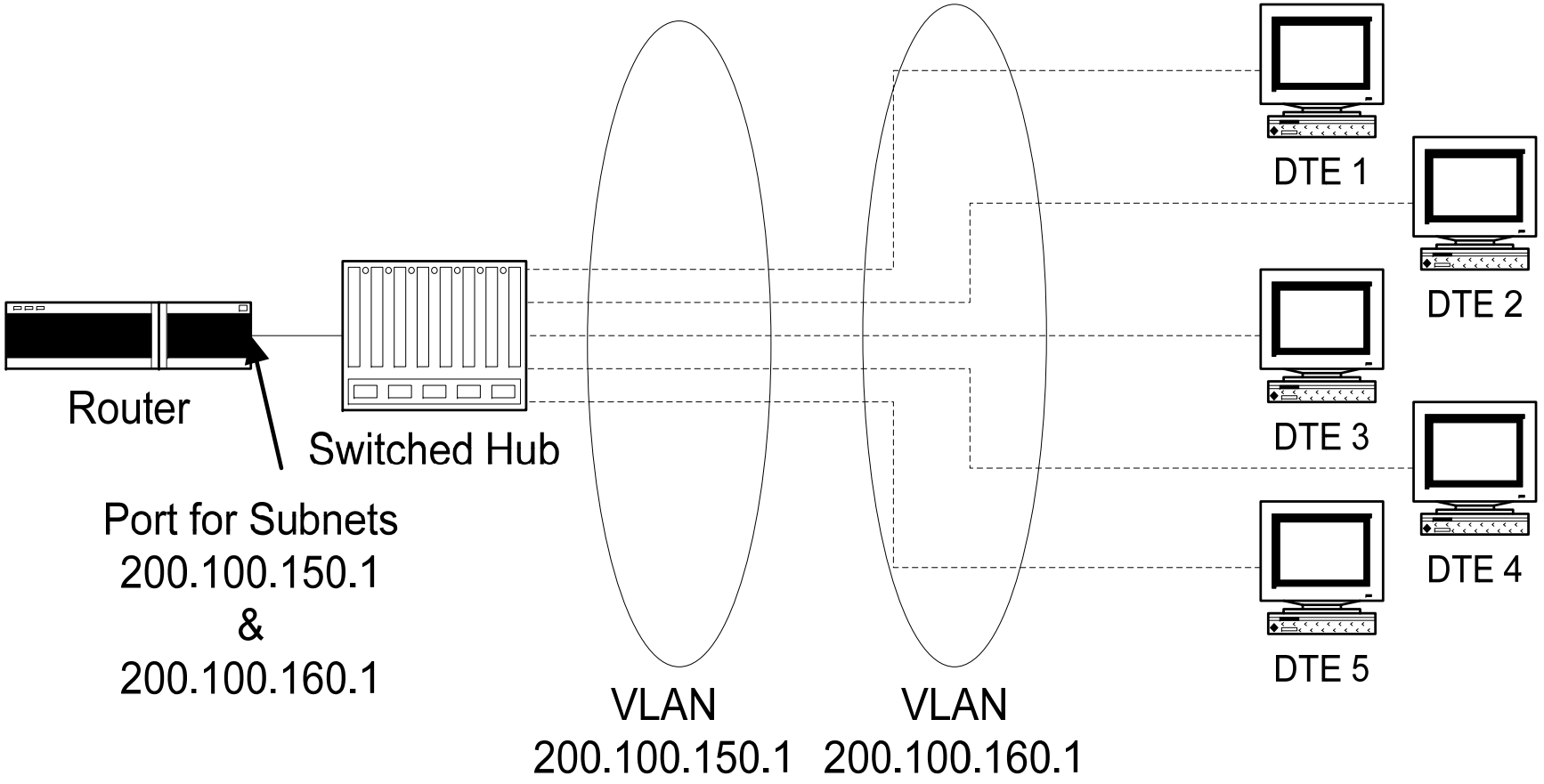


Switched Hub in Client-Server Configuration

Virtual LAN

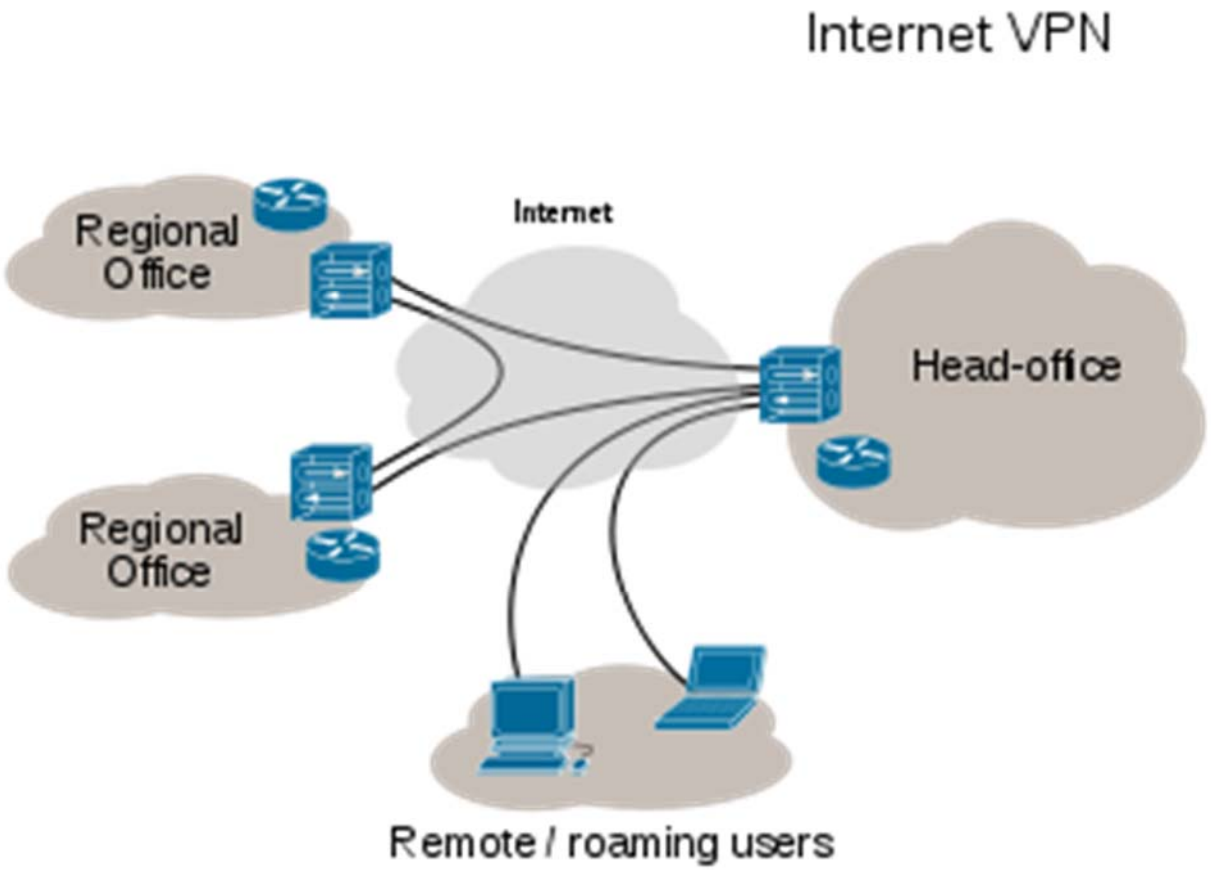
- VLAN: can be viewed as a group of devices on different physical LAN segments which can communicate with each other as if they were all on the same physical LAN segment
- VPN: a computer network that uses a public telecommunication infrastructure such as the Internet to provide remote offices or individual users with secure access to their organization's network

Virtual LAN

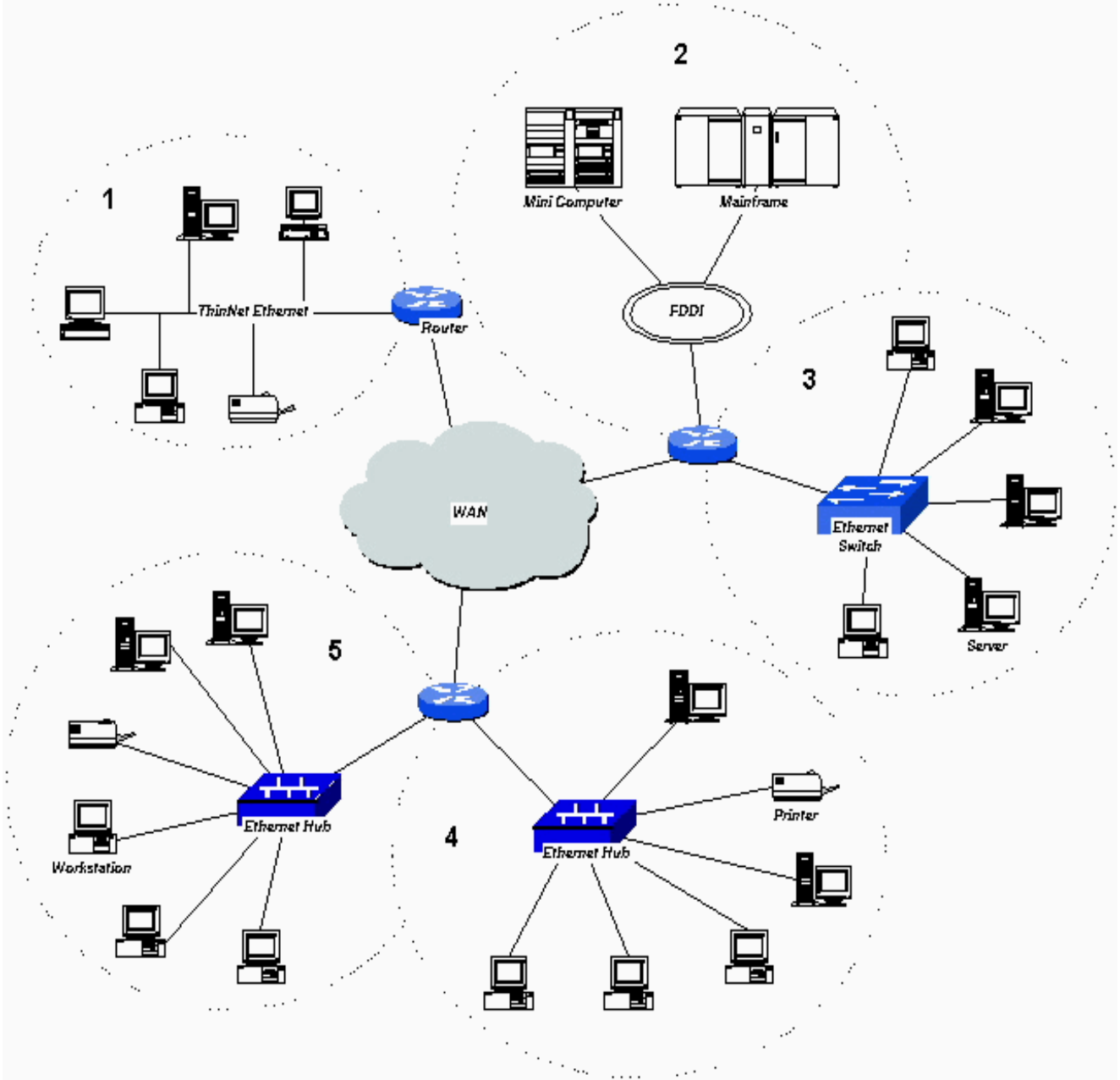


Virtual LANs

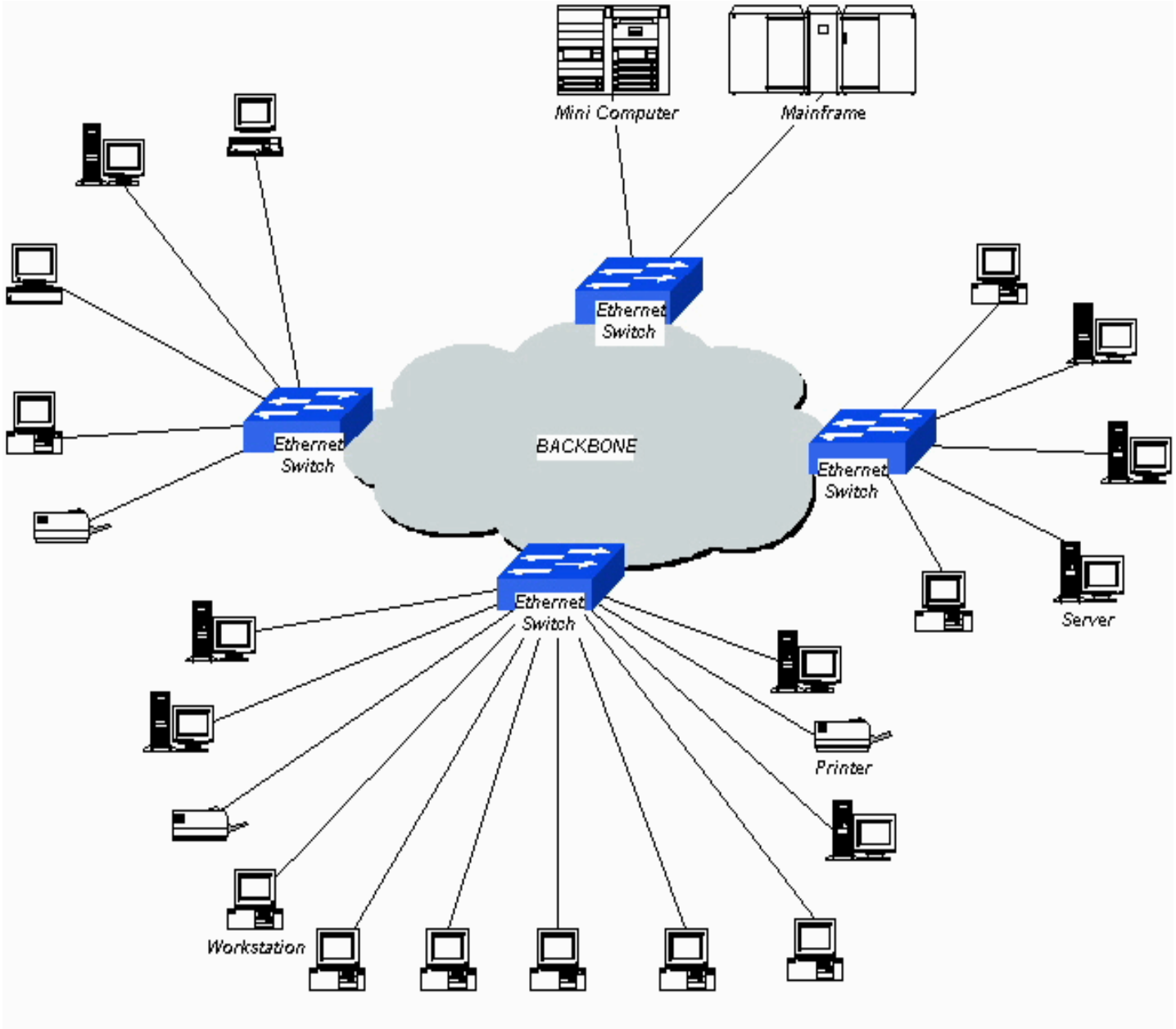
Virtual LAN


Internet VPN
Internet
Regional Office
Regional Office
Head-office
Remote / roaming users

Virtual LAN

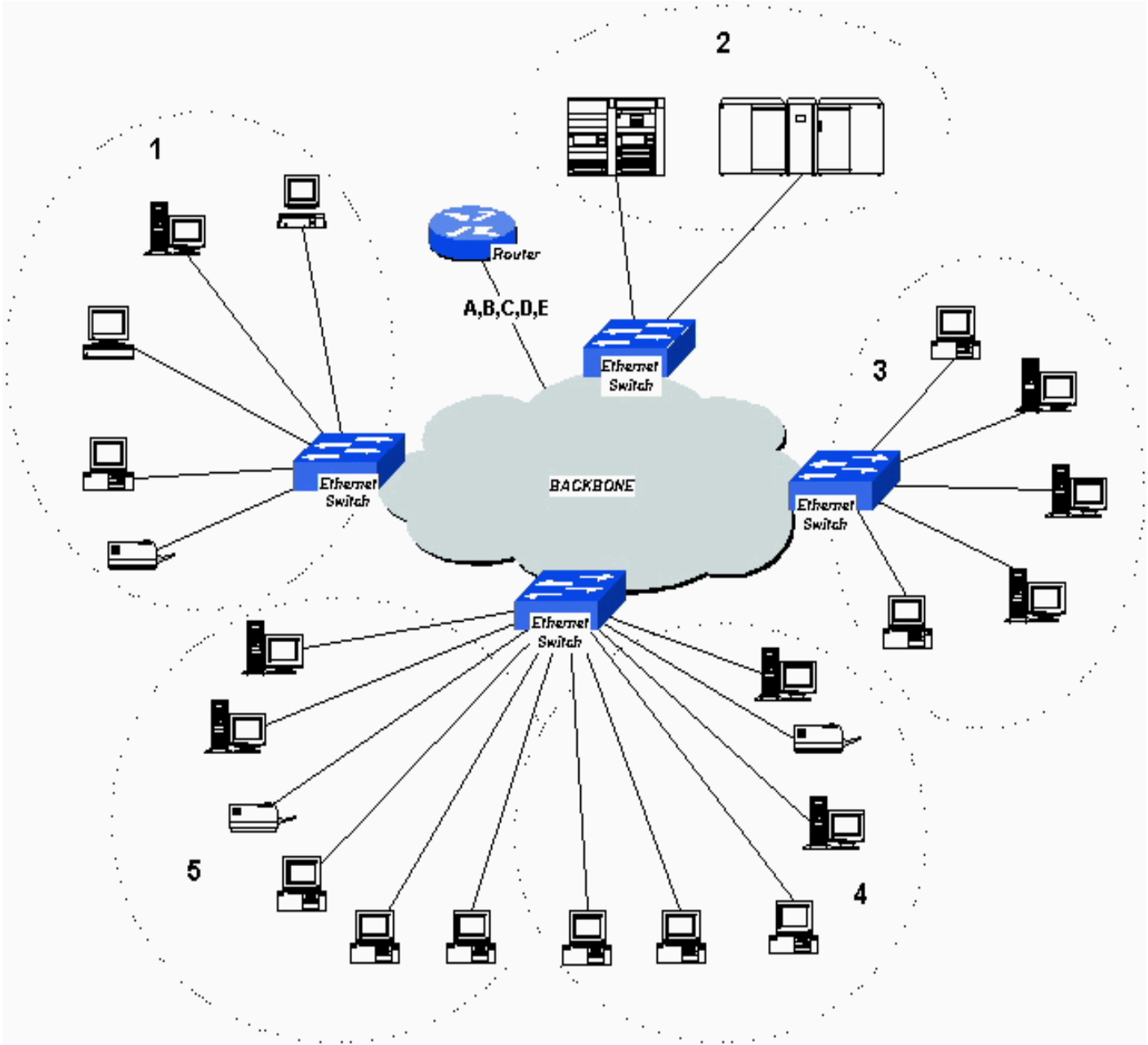

2
Mini Computer
Mainframe
1
ThinNet Ethernet
Router
FDDI
3
WAN
Ethernet
Switch
Server
5
Ethernet Hub
Workstation
4
Ethernet Hub
Printer

Virtual LAN



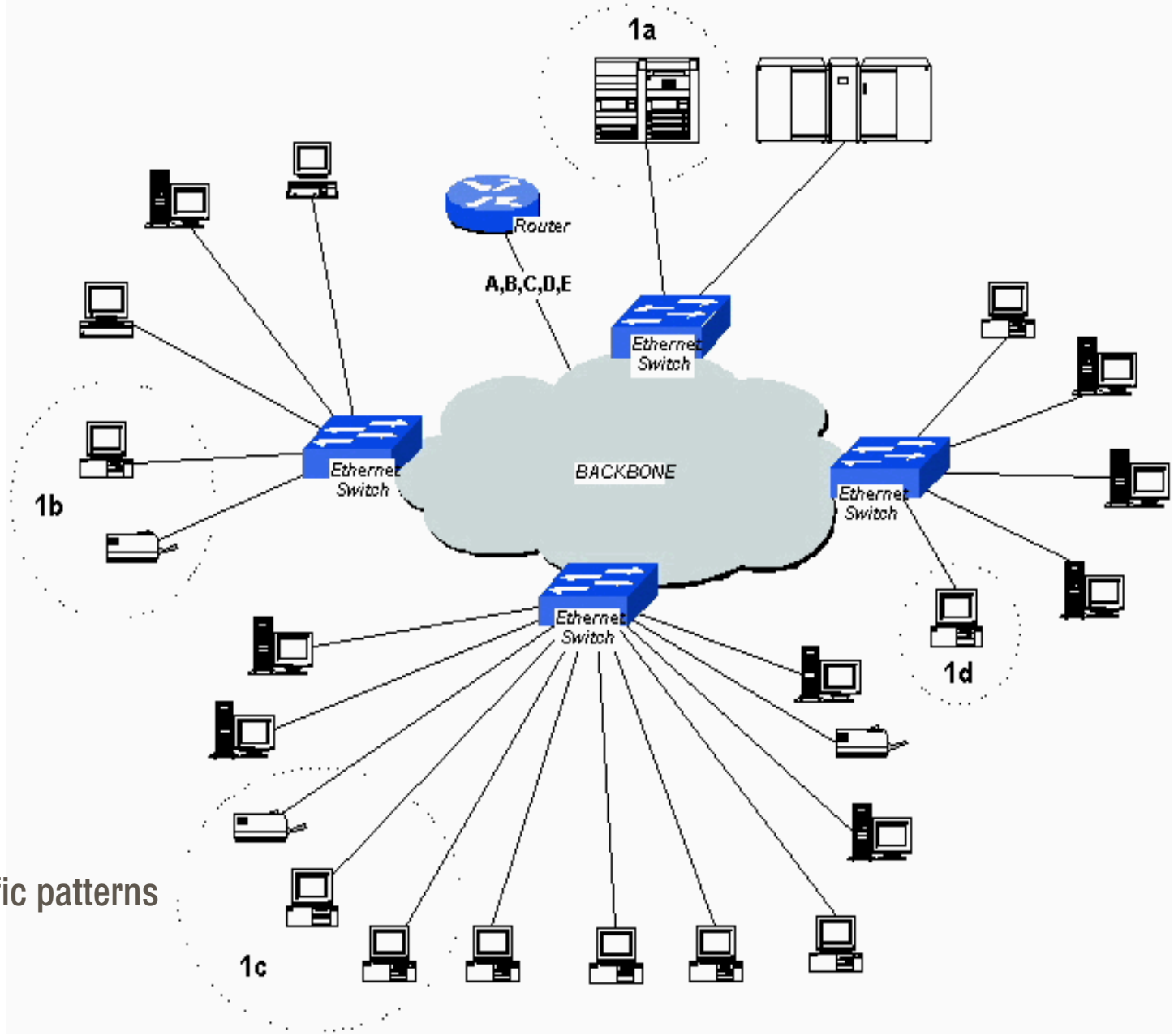
Typical Switched Network

Virtual LAN



Switched Network with VLAN

Virtual LAN



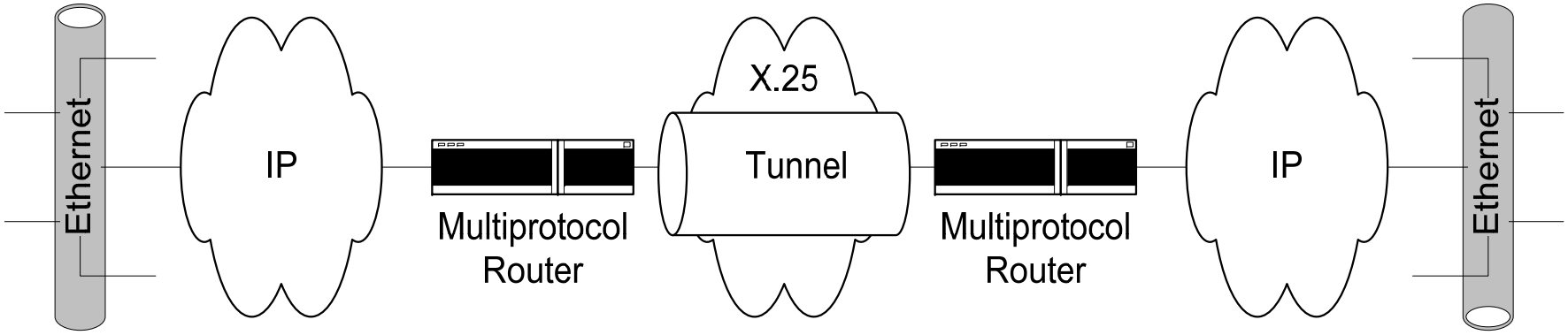
VLAN grouping using traffic patterns

Virtual LAN

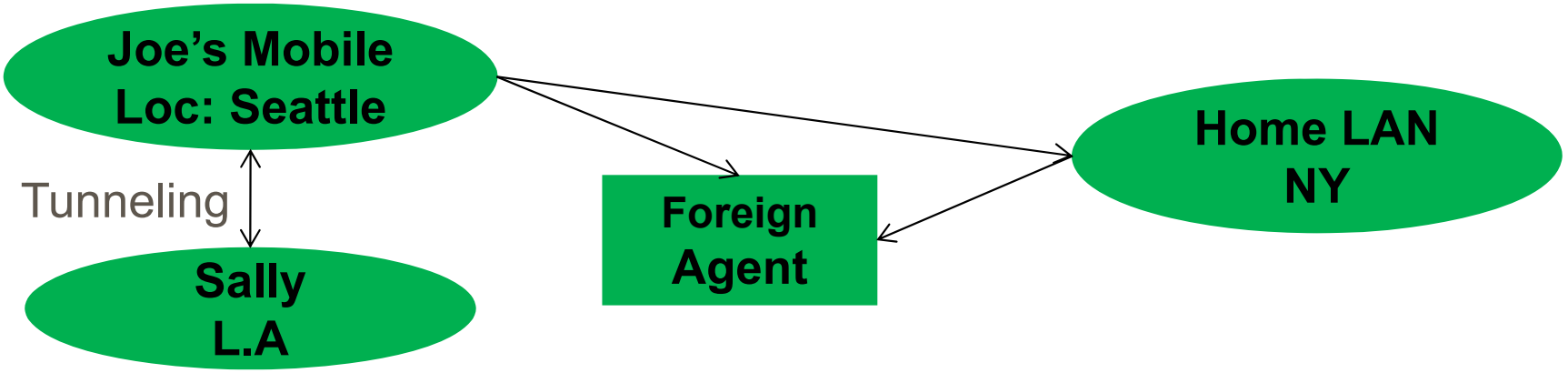
- VLAN benefits:
  - Increased performance
  - Improved manageability
  - Network tuning and simplification of software configurations
  - Physical topology independence
  - Increased security options
    - ✓ Secure VPNs use cryptographic tunneling protocols to provide confidentiality by blocking intercepts and packet sniffing, allowing sender authentication to block identity spoofing, and provide message integrity by preventing message alteration.

intercepts拦截
sniffing **嗅探**

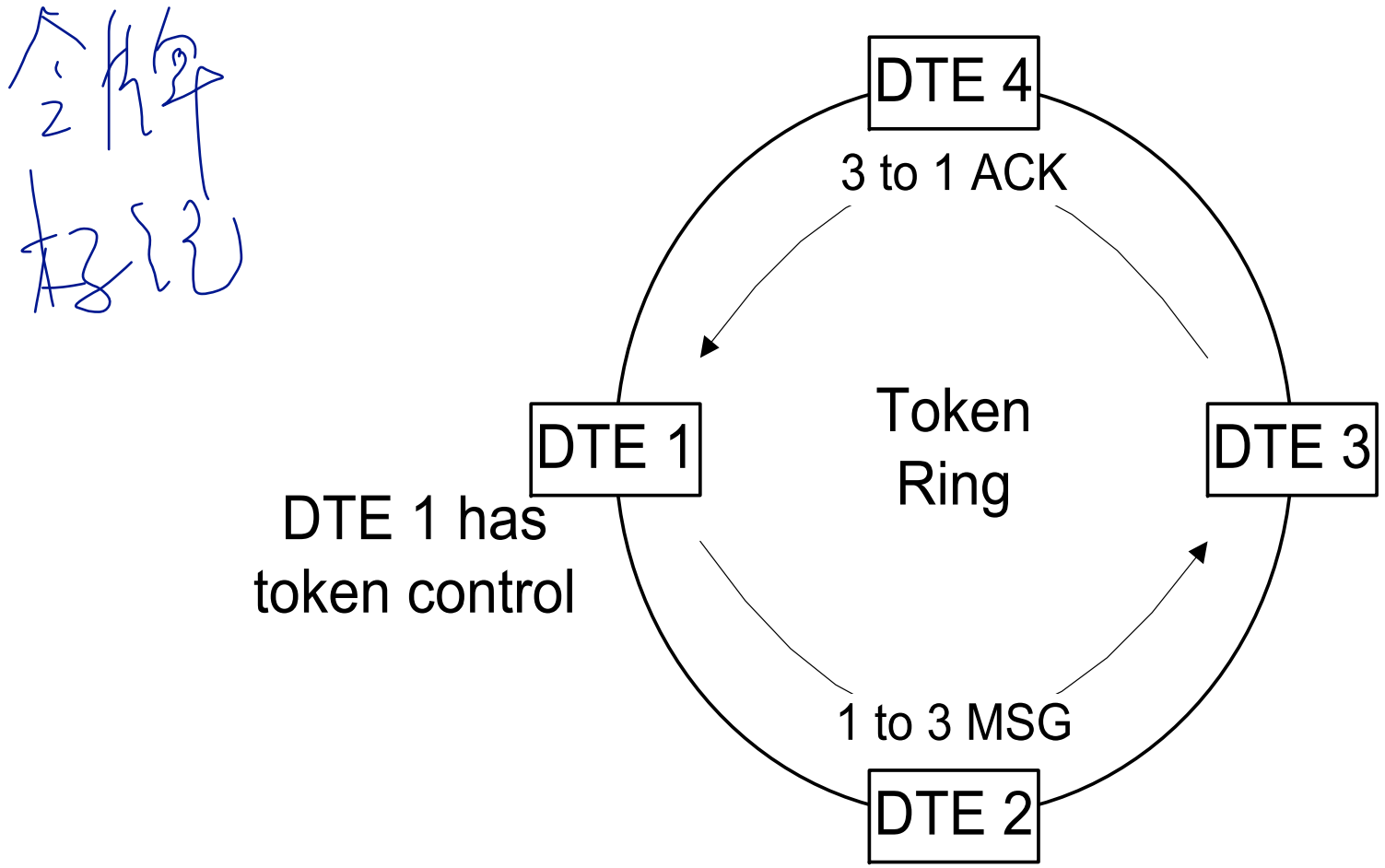
Tunneling



Tunneling Using Multiprotocol Routers

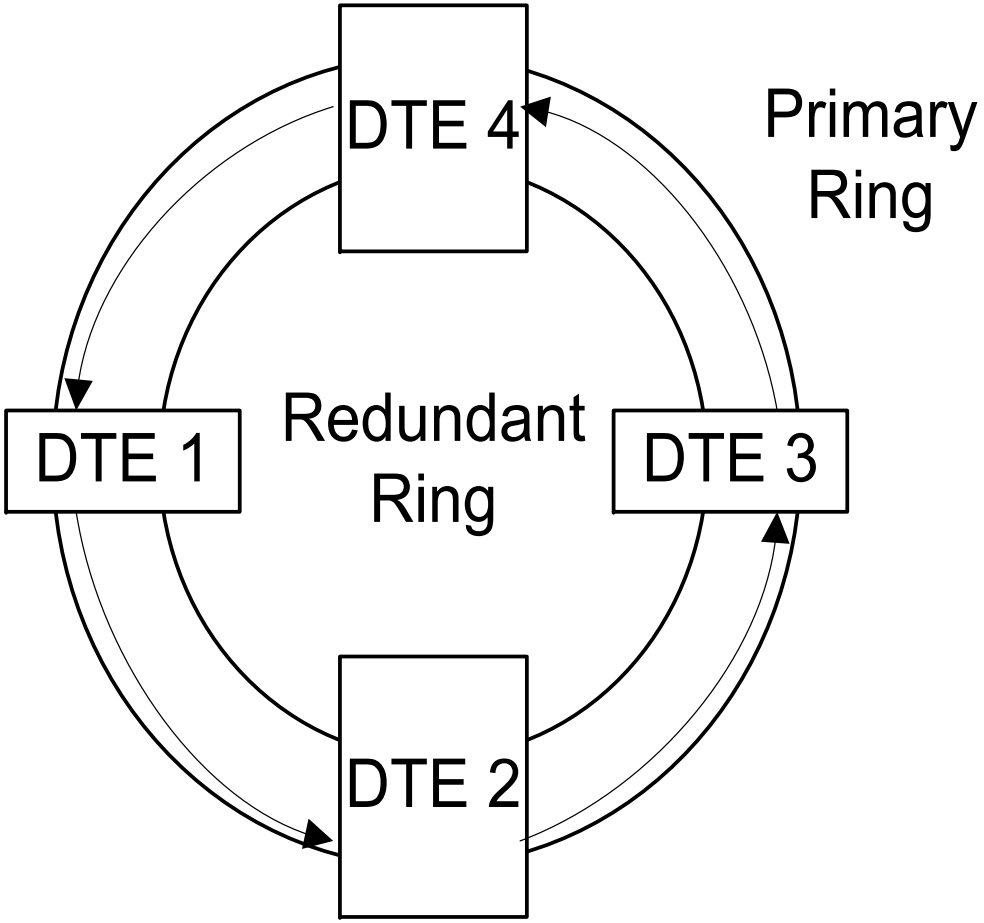


Token Ring



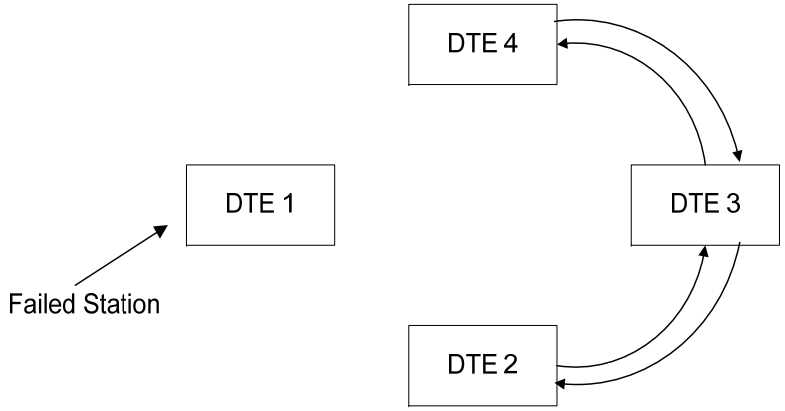
Token Ring LAN

Dual Ring TR LAN

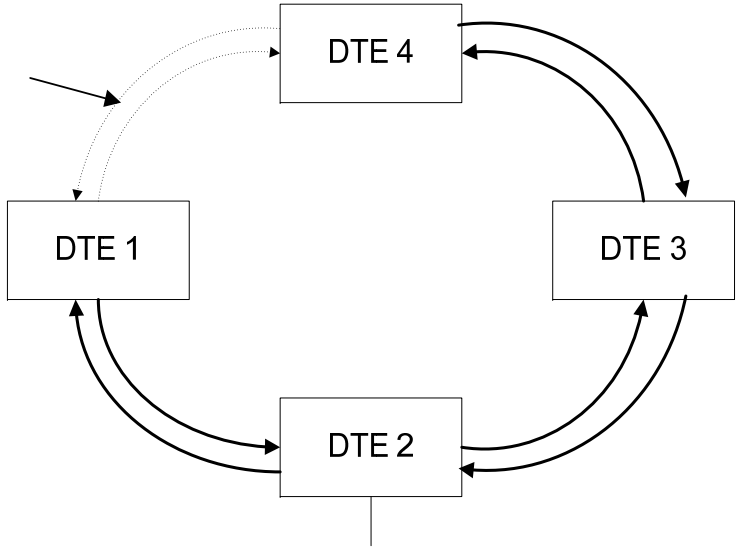


Token Ring Dual Ring Management

Failure Recovery in TR LAN



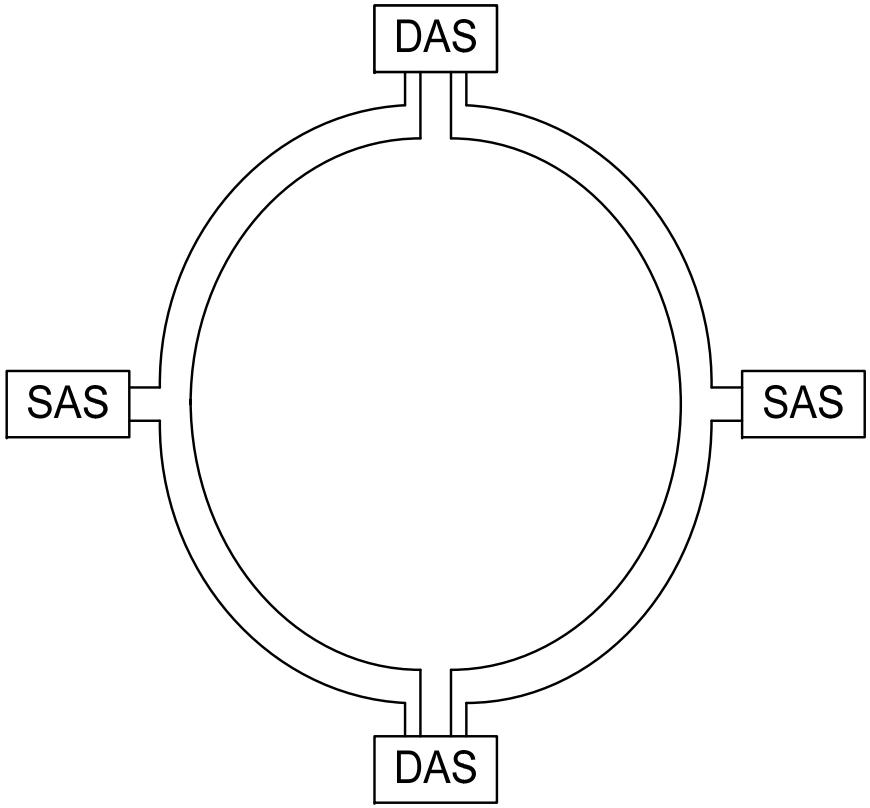
Token Ring DTE Isolation



Token Ring Segment Isolation

Fiber Distributed Data Interface

FDDI LAN



SAS Single Attached Station
DAS Dual Attached Station

(a) Dual Ring FDDI Network Configuration

- Operates at rate of 100Mbps, up to 500DTE
- Single segment up to 100km
- Separation between neighboring on the cable up to 2km
- Low noise interference compared to copper cable, suitable for campus backbone network

Basic Network Nodes

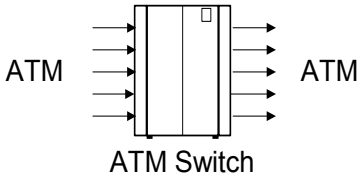


Figure 2.14(a) Switch

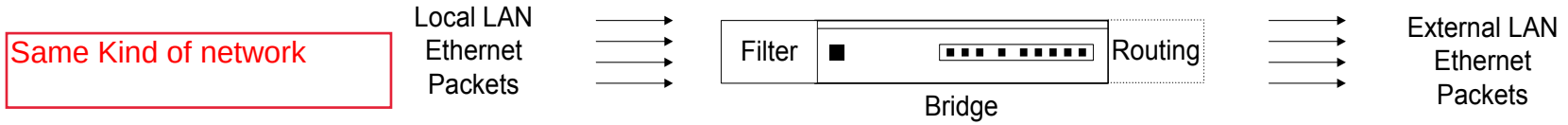


Figure 2.14(b) Bridge

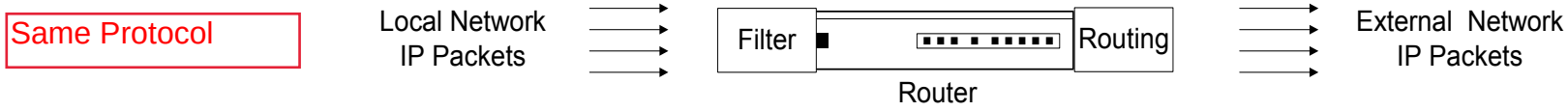


Figure 2.14(c) Router

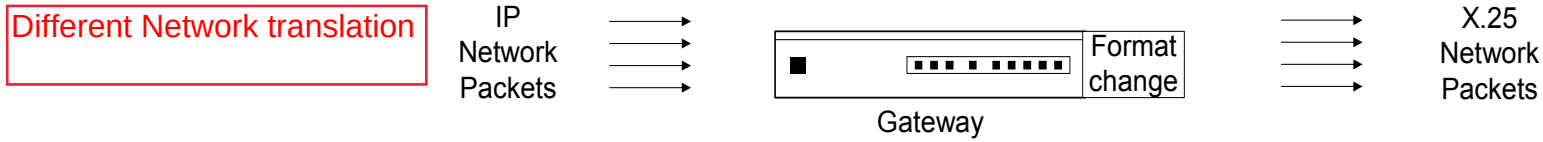
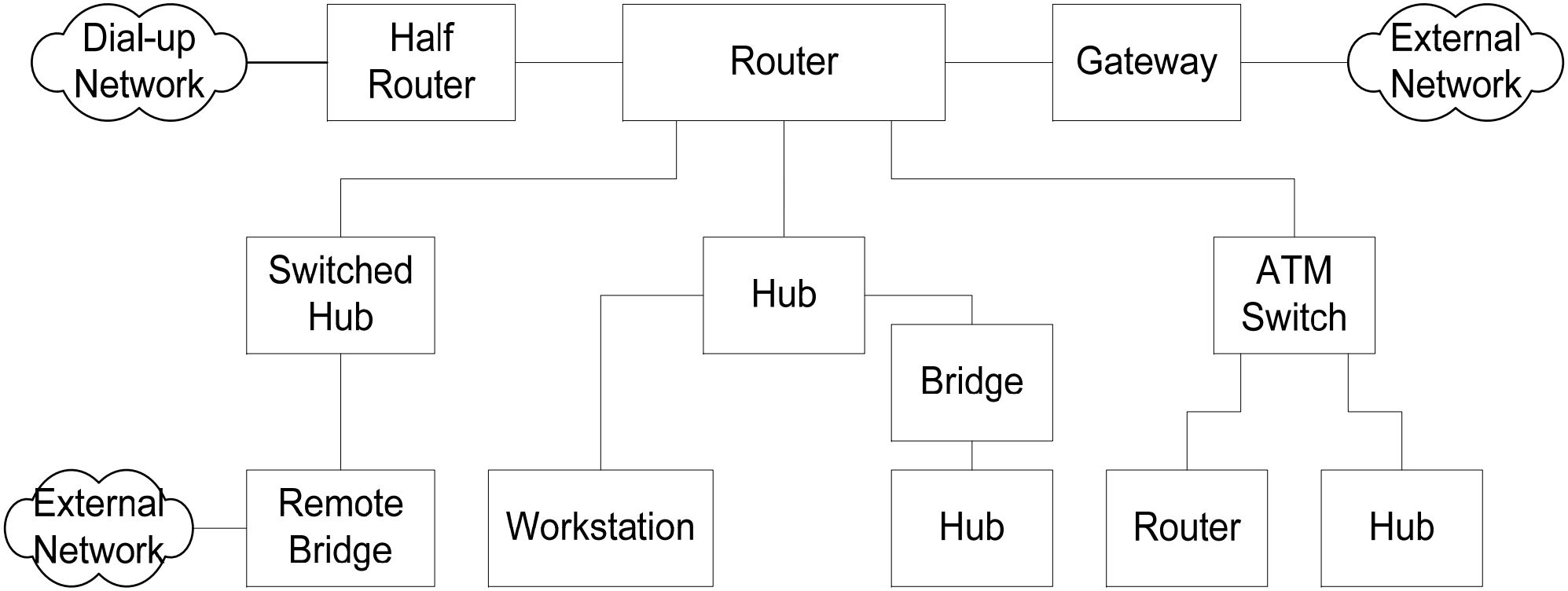


Figure 2.14(d) Gateway

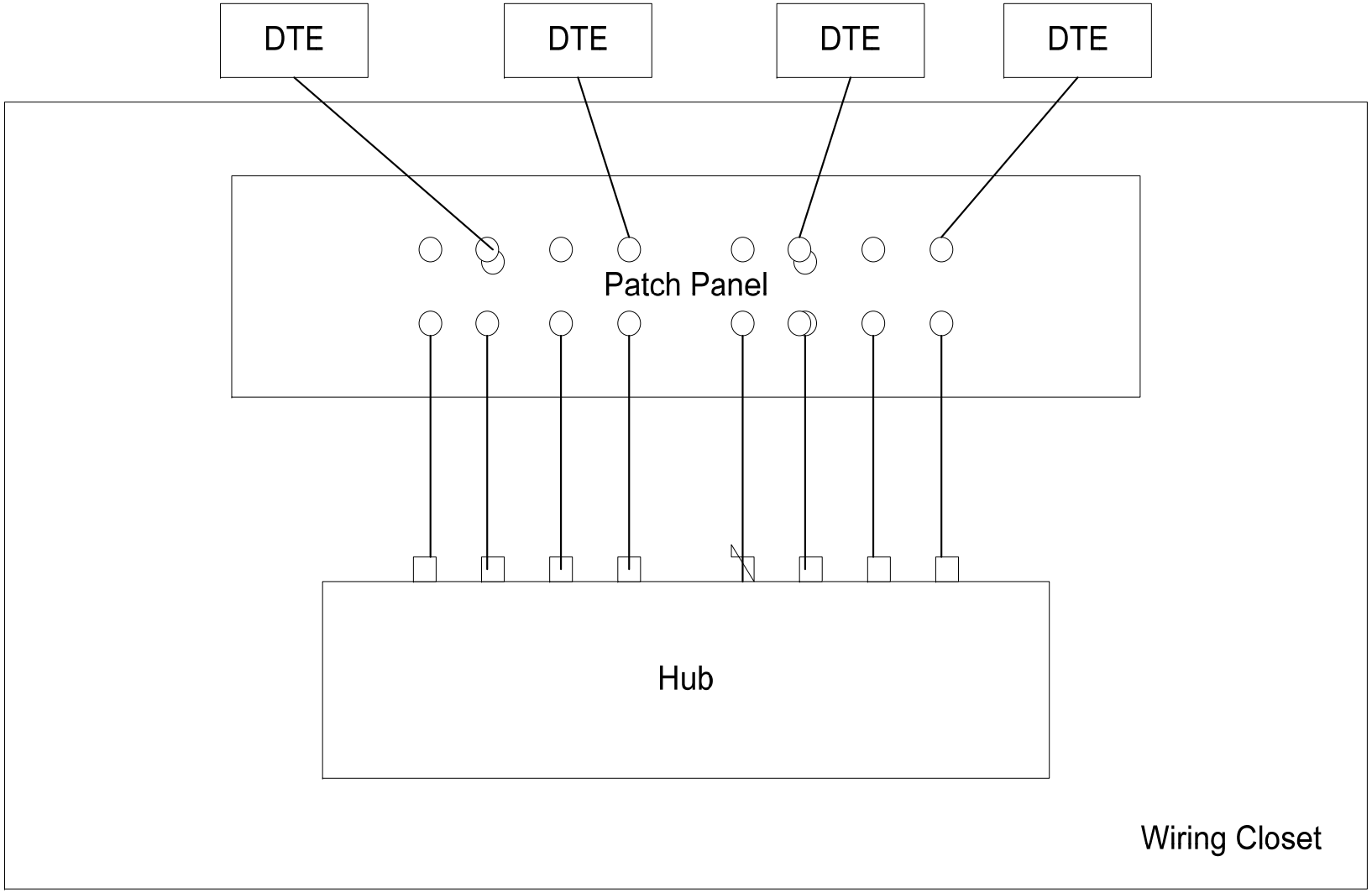
Figure 2.14 Basic Network Node Components

Network Node Components



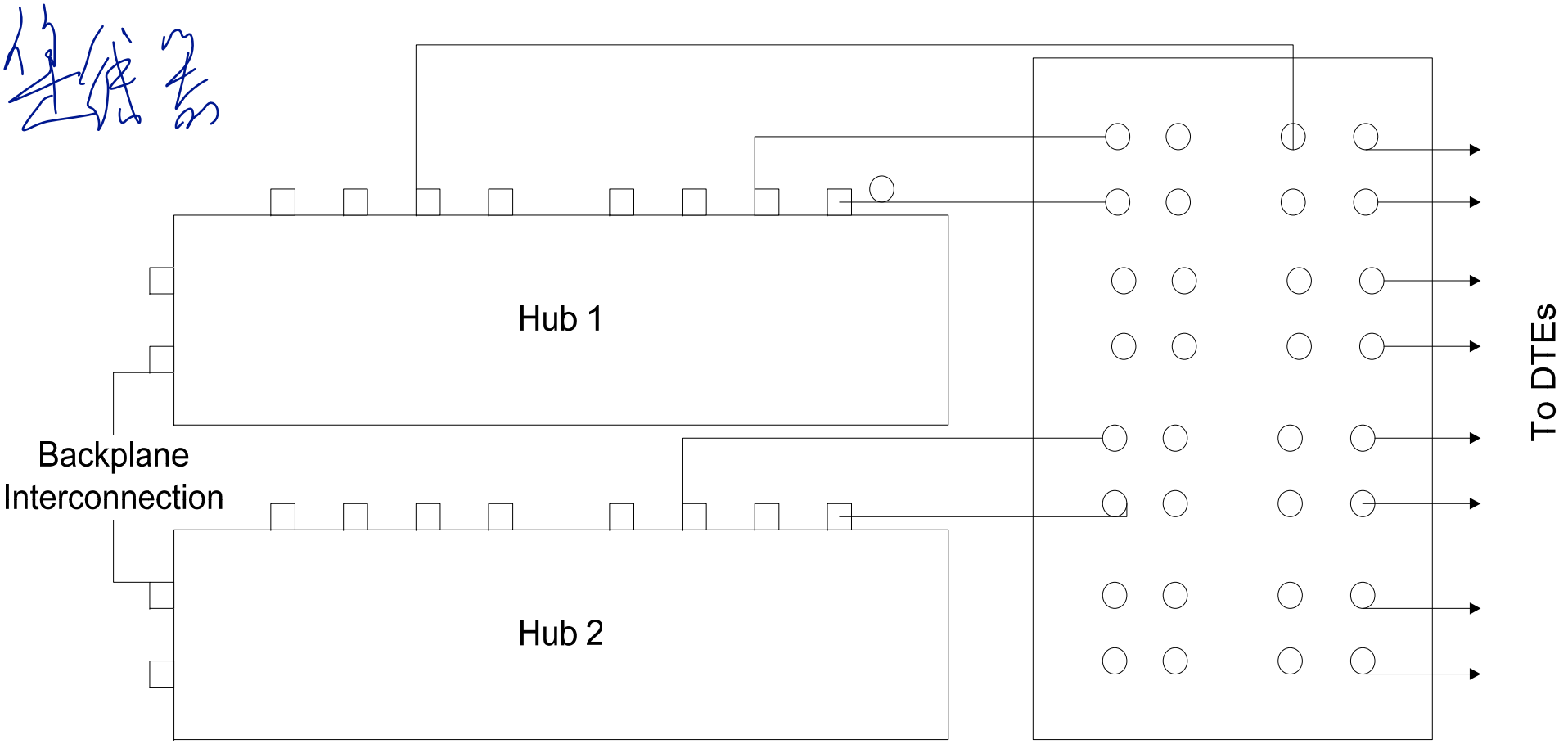
Networked Components

Hubs



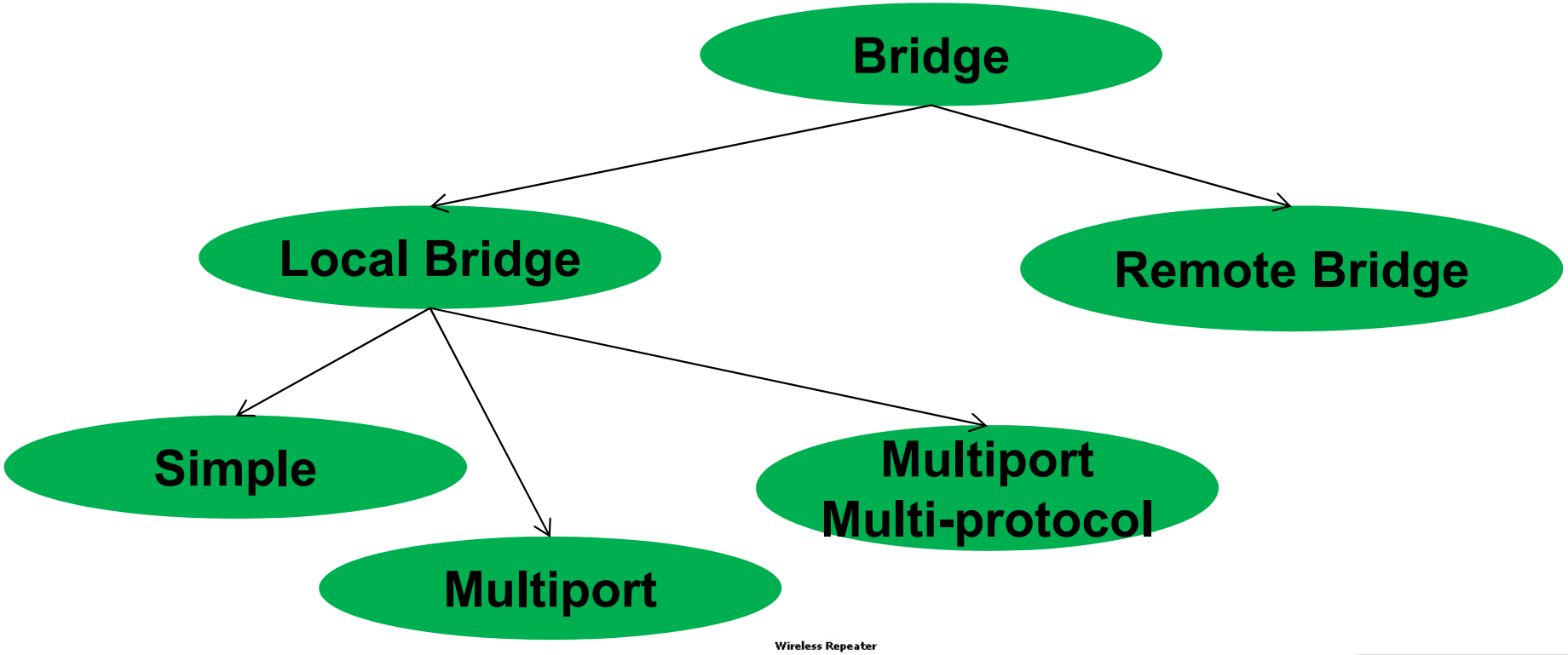
(a) Hub Configuration

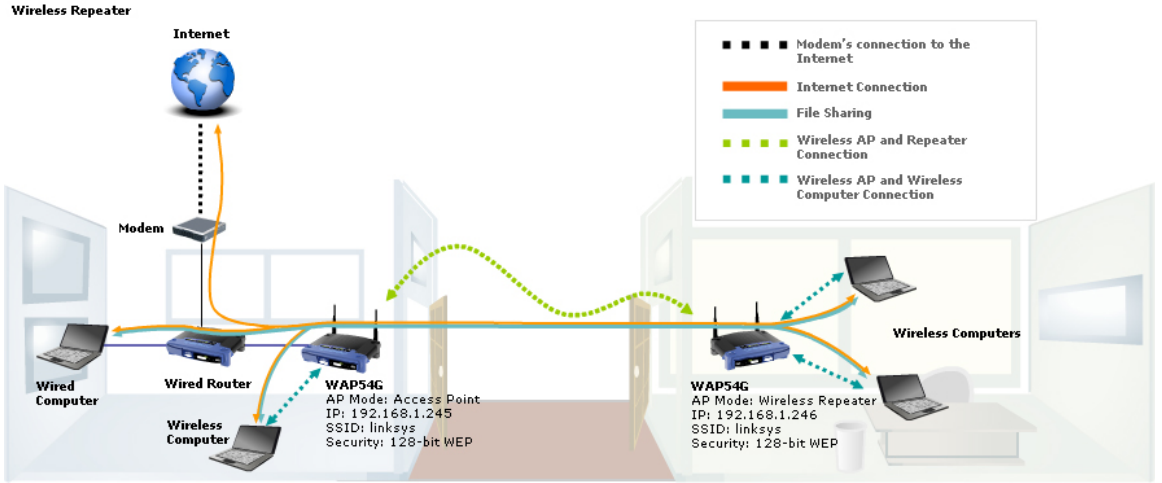
Stacked Hubs



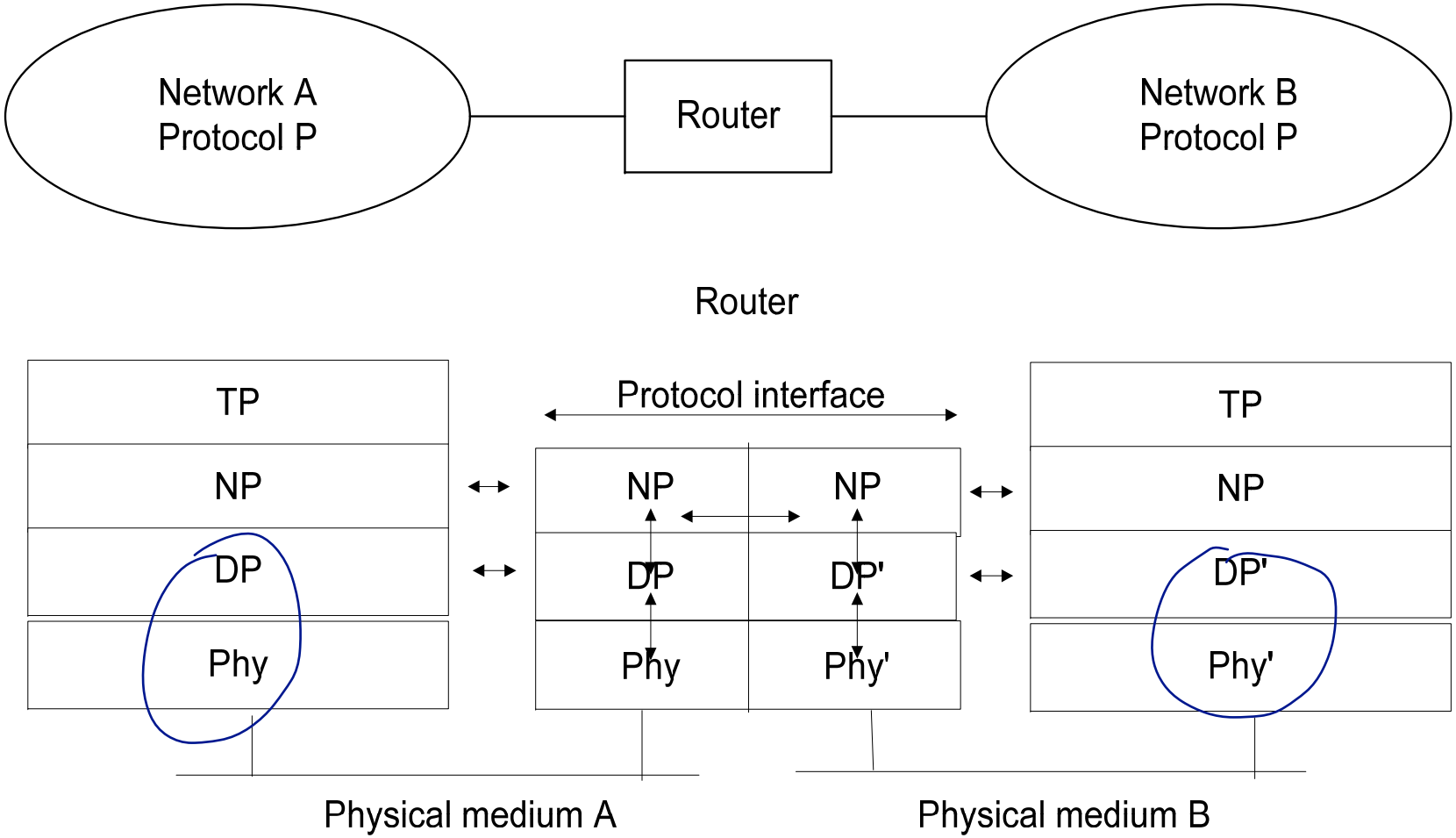
(b) Stacked Hub

Bridges


Bridge
Local Bridge
Remote Bridge
Simple
Multiport
Multiport
Multi-protocol

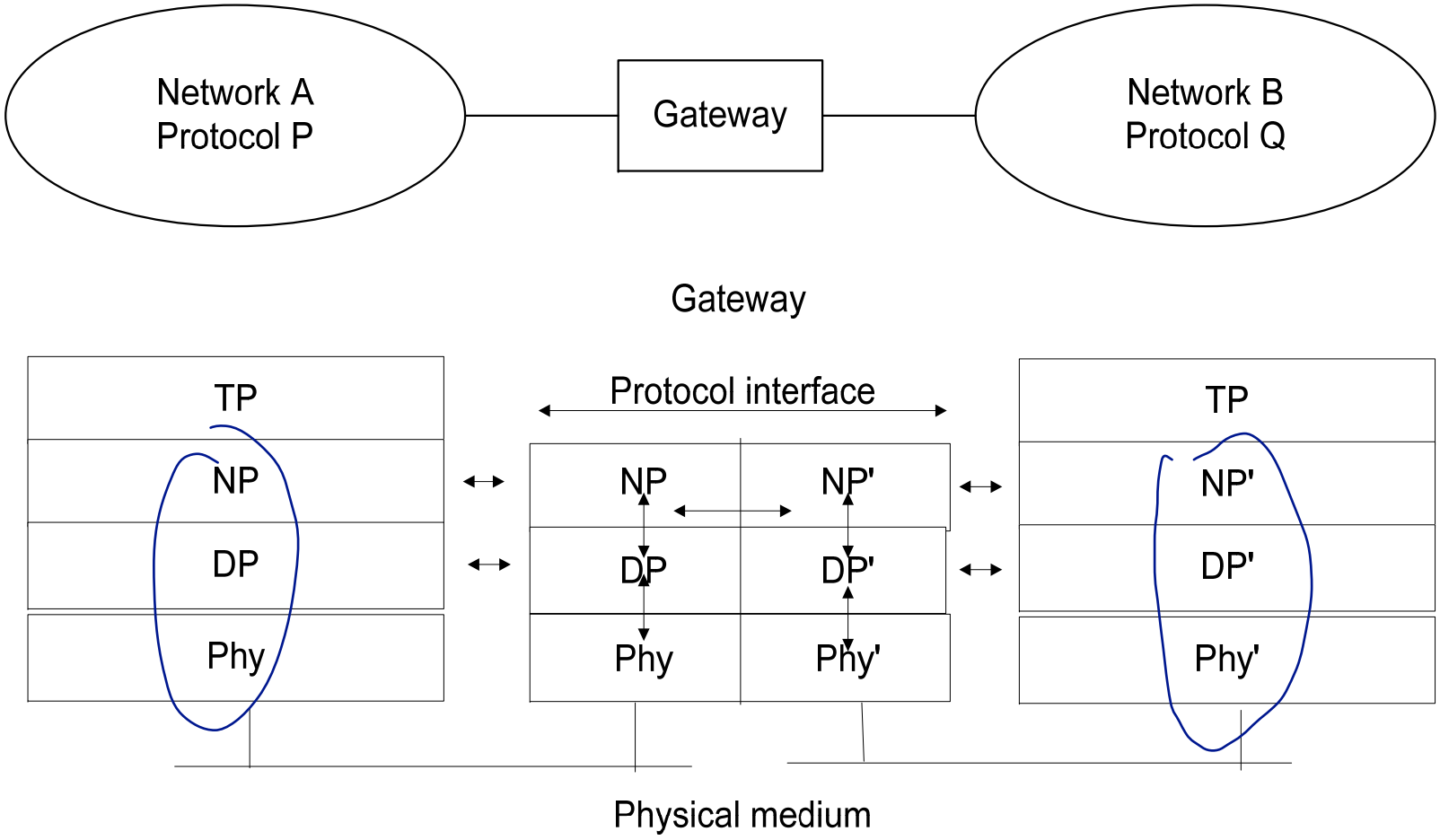

Wireless Repeater
Internet
Modem's connection to the Internet
Internet Connection
File Sharing
Wireless AP and Repeater Connection
Wireless AP and Wireless Computer Connection
Modem
Wired Computer
Wired Router
WAP54G
AP Mode: Access Point
IP: 192.168.1.245
SSID: linksys
Security: 128-bit WEP
Wireless Computer
Wireless Computers
WAP54G
AP Mode: Wireless Repeater
IP: 192.168.1.246
SSID: linksys
Security: 128-bit WEP

Routers



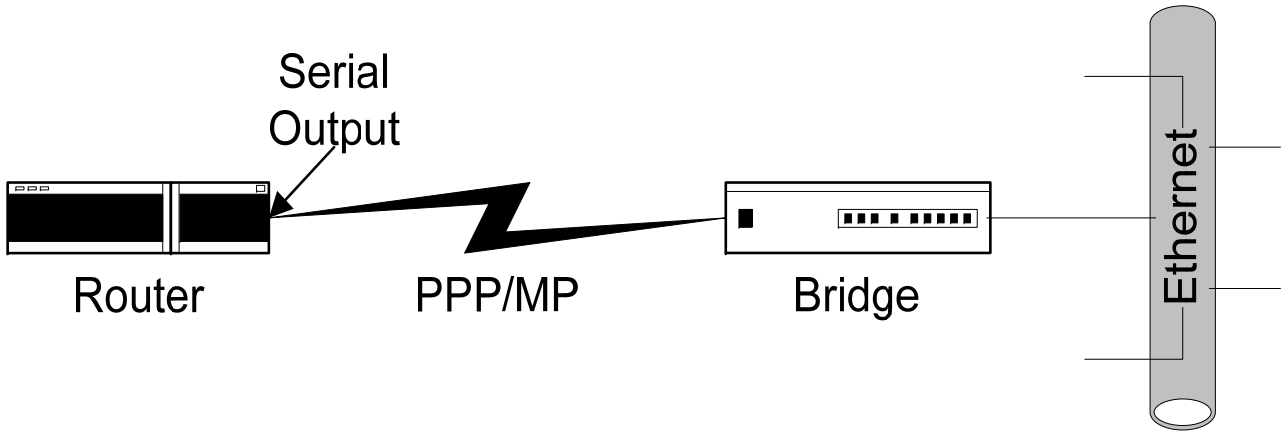
Router Configuration

Gateway



Gateway Configuration

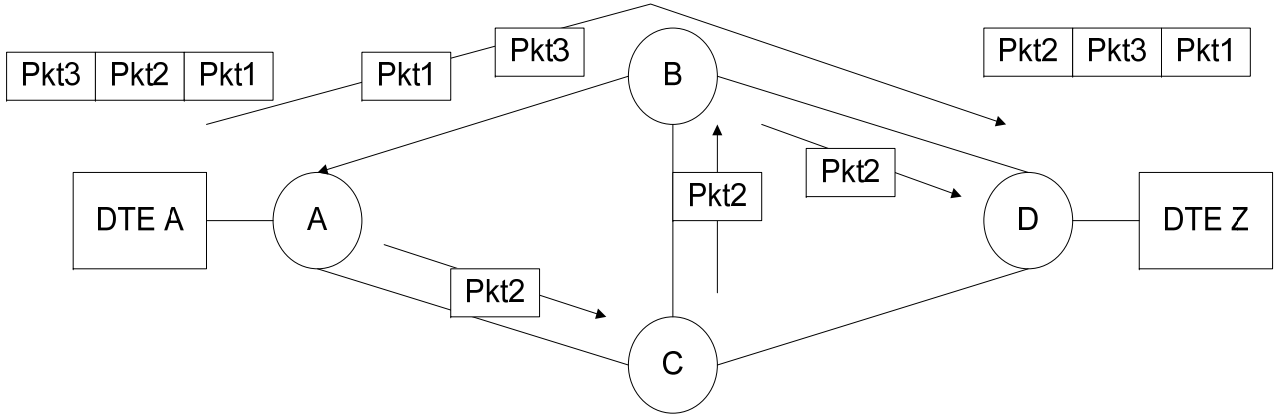
Half-Bridge



Half-Bridge Configuration

- Half-bridge (also referred to as half-router) is point-to-point communication
- Uses Point-to-Point Protocol (PPP)
- Helps low-end users to communicate with ISP on dial-up link saving the expense of dedicated link
- Router encapsulates packets in PPP frames and puts serial outputs to the bridge, and vice-versa

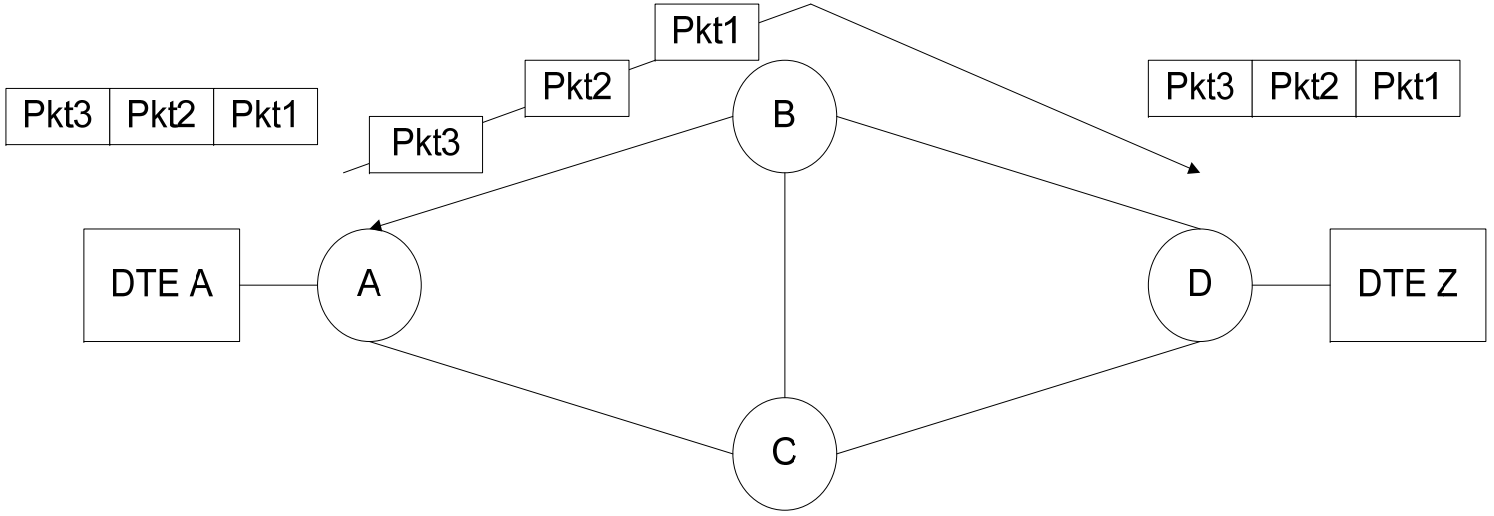
Switched Networks



UDP

Datagram Configuration

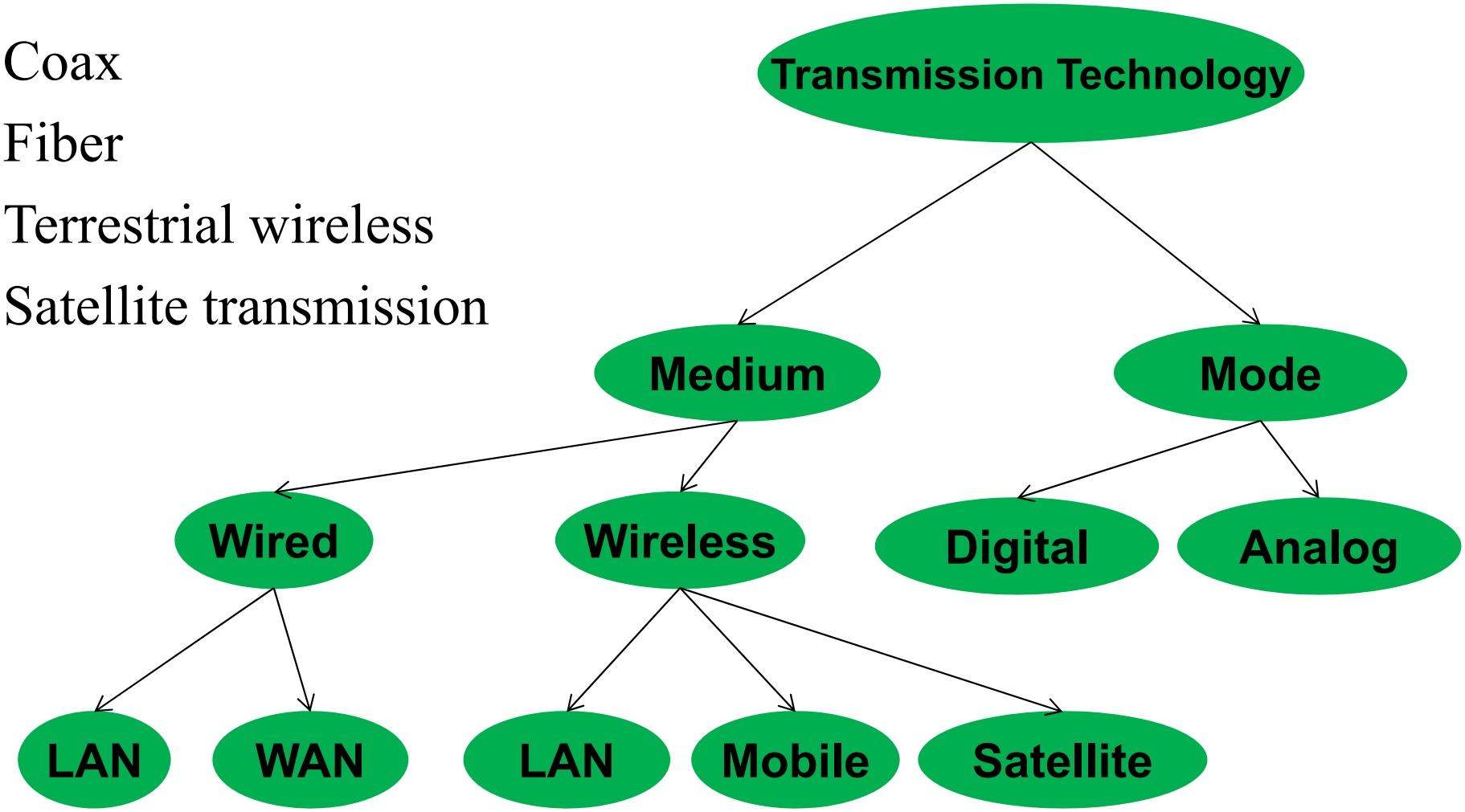
TCP



Virtual Circuit Configuration

Transmission Technology

- Physical transport media
  - UTP
  - Coax
  - Fiber
  - Terrestrial wireless
  - Satellite transmission



Transmission Modes