

NETWORK DESIGN

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Lecture Outline

2

- Network Design issues
- Network Design Principles
- IP Issues
- IP Addressing
- Routing Issues

Network Design Issues

3

- ❑ Physical Infrastructure
- ❑ Protocols
- ❑ Software
- ❑ Services or applications
- ❑ Standards
- ❑ Security etc.

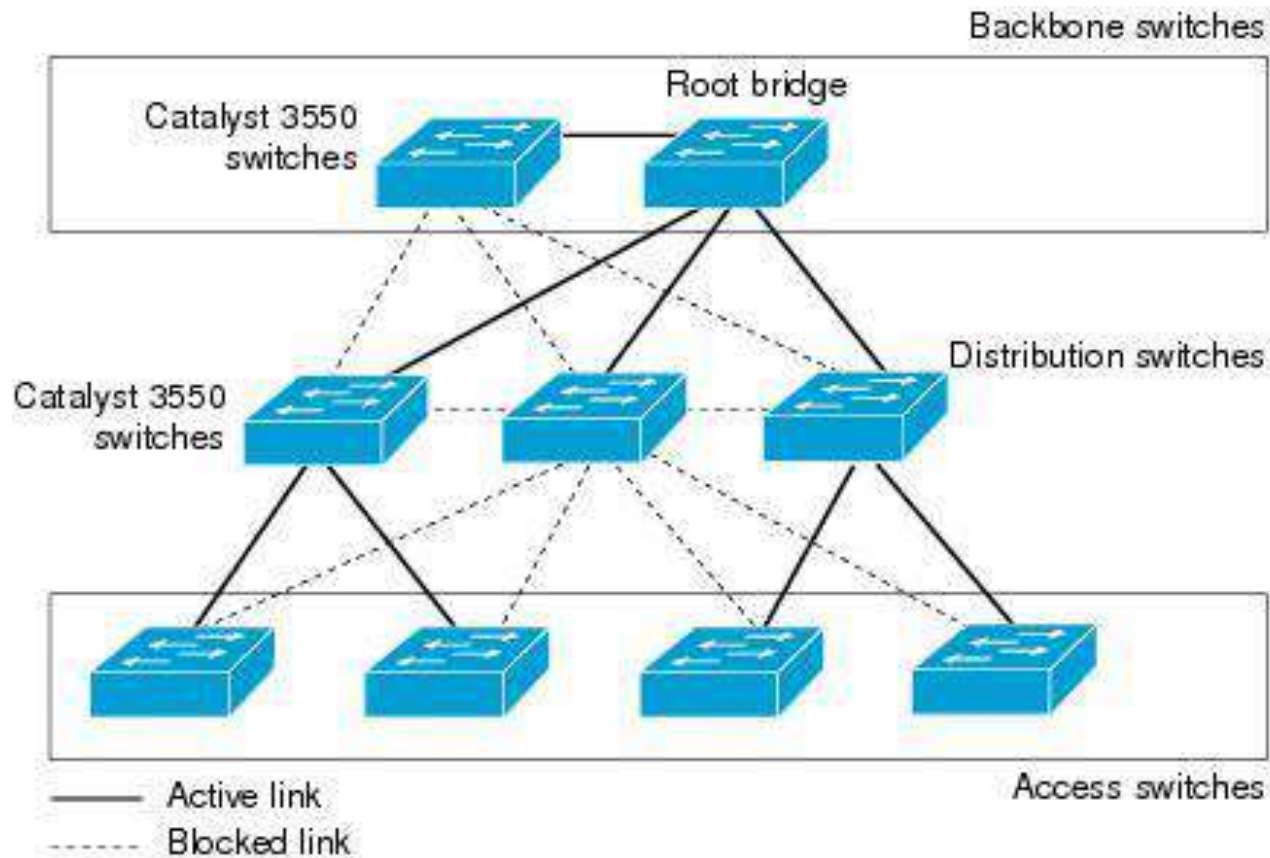
Physical Infrastructure

4

- Topology
 - ▣ Star, Bus, Ring, Mesh etc.
- Office floor layout
 - ▣ Historical building
 - ▣ False ceiling and floor
- Wireless provision / Extension

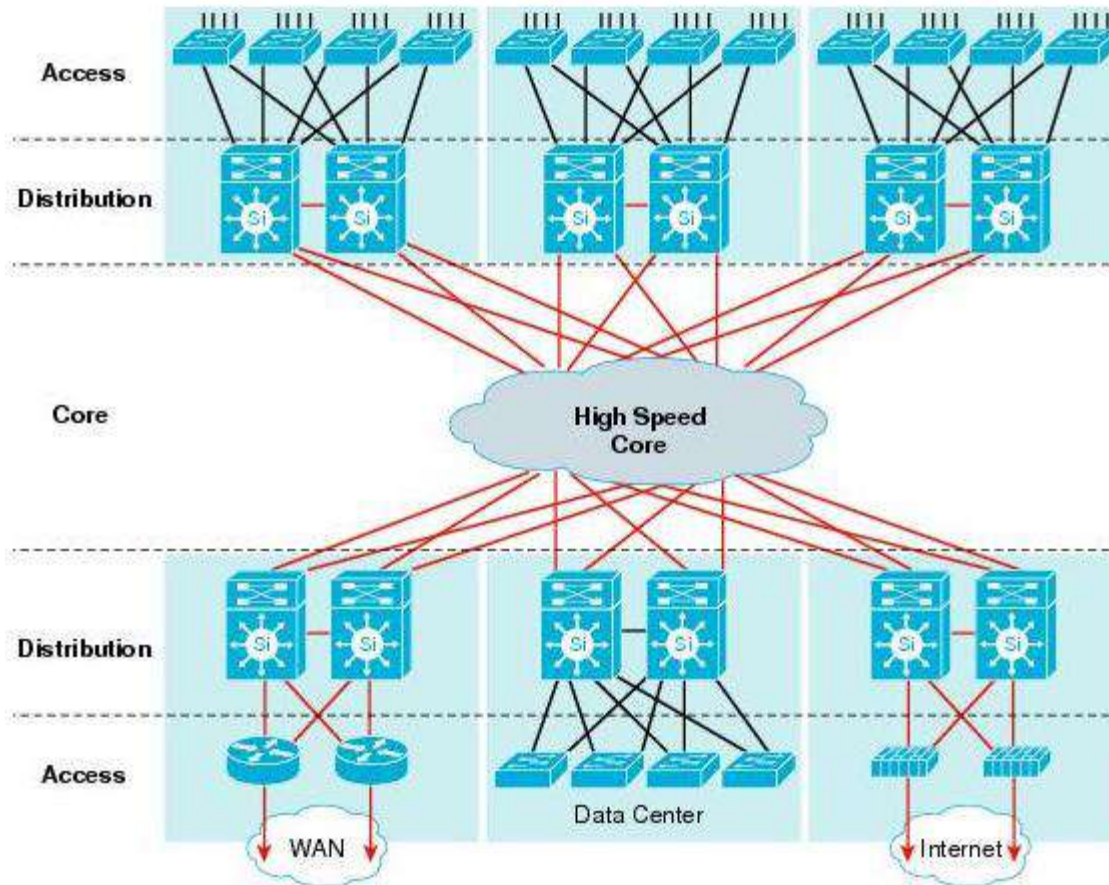
Physical Topology - Hierarchical Network Design

5



Hierarchical Network Design

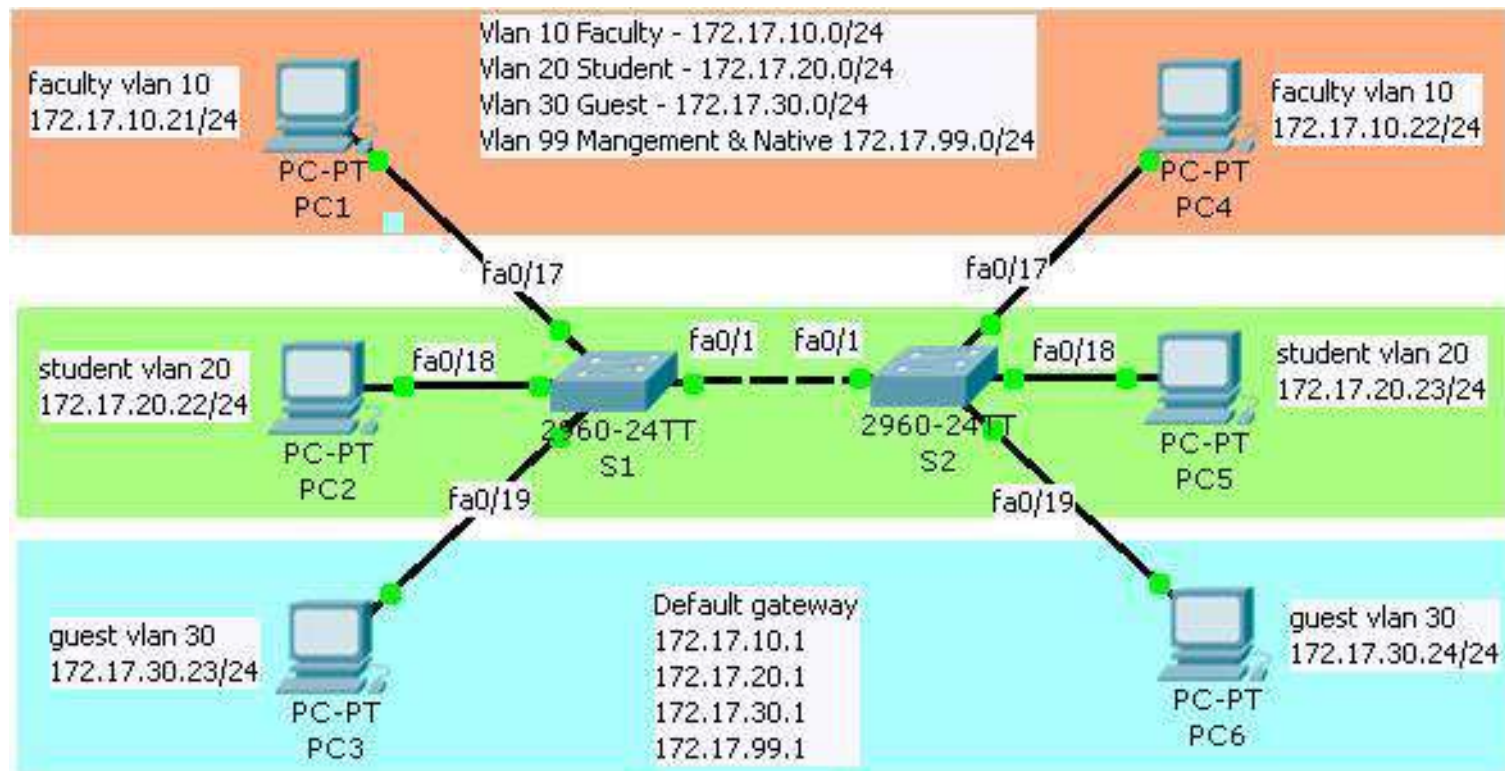
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Network Design

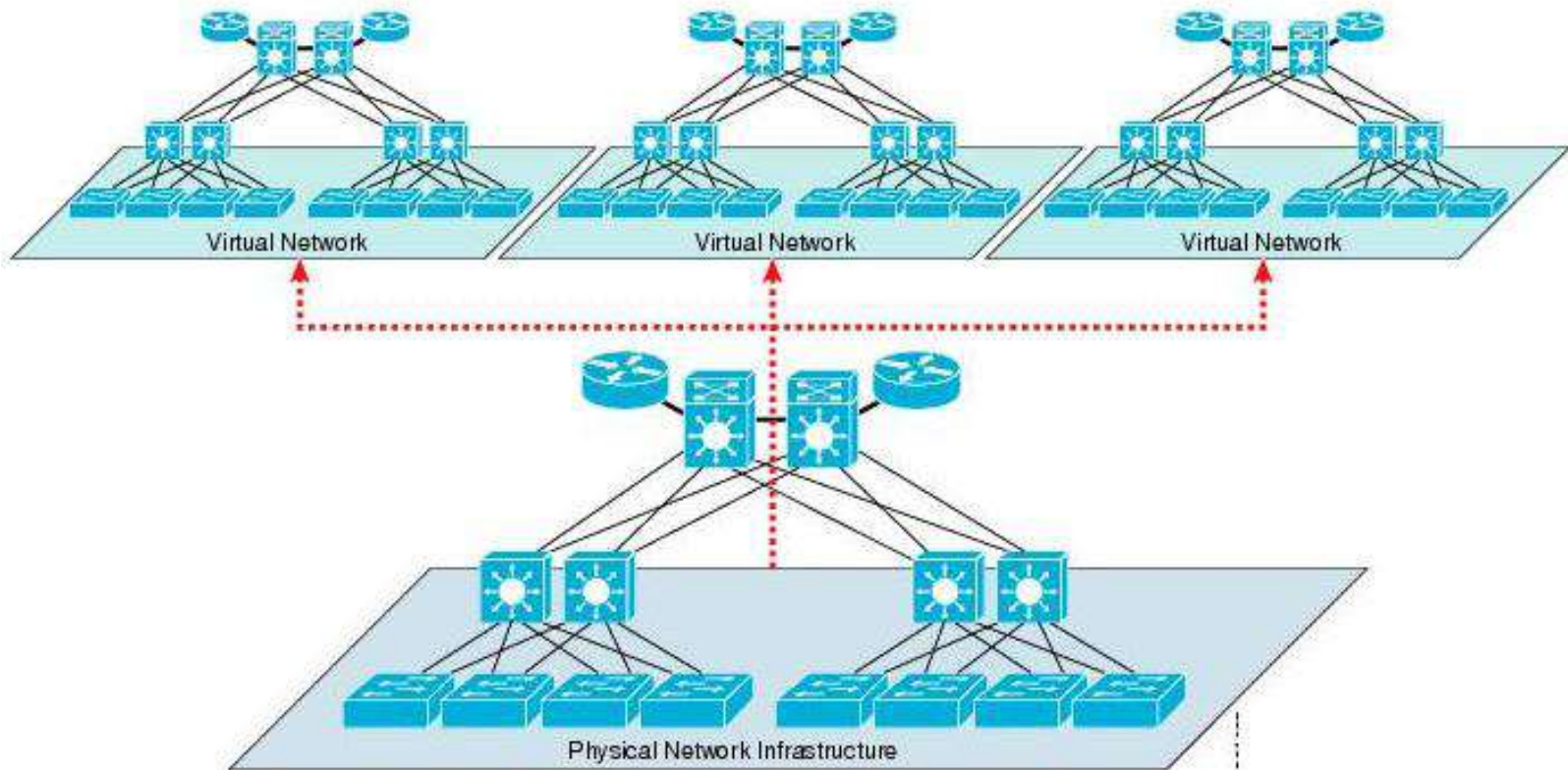
Physical Topology vs. Virtual LAN (VLAN)

7



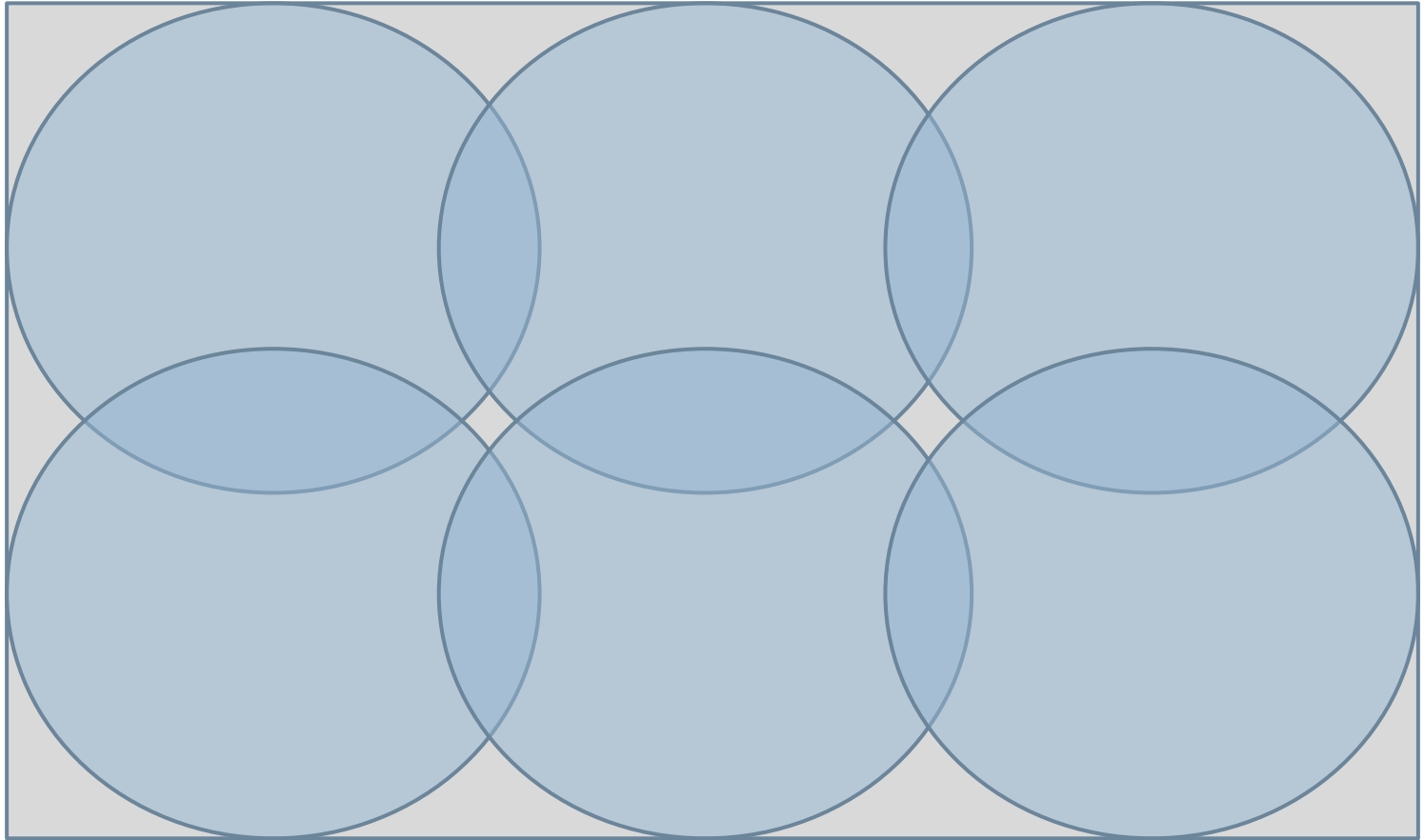
Physical Infrastructure vs. Virtual Network

8



Wireless Provision / Extension

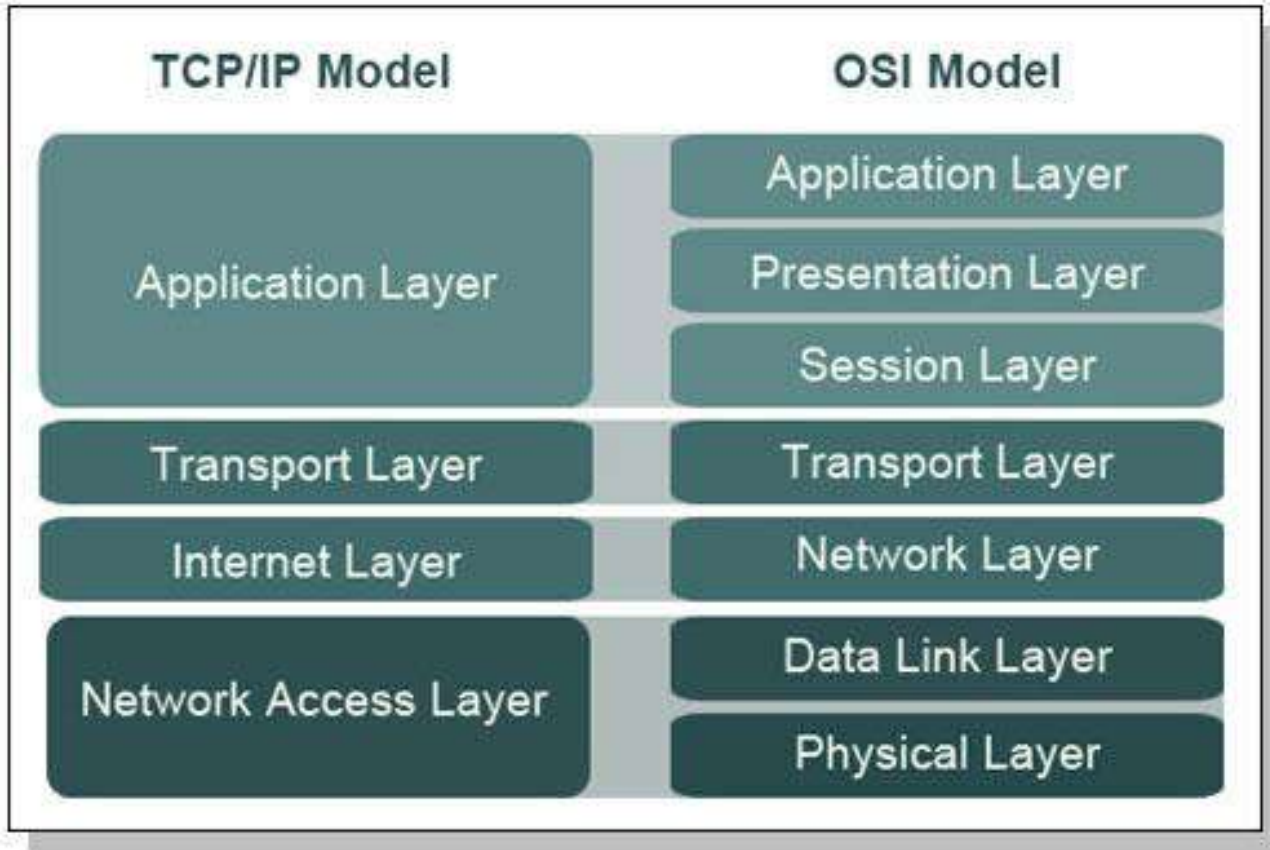
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Network Design

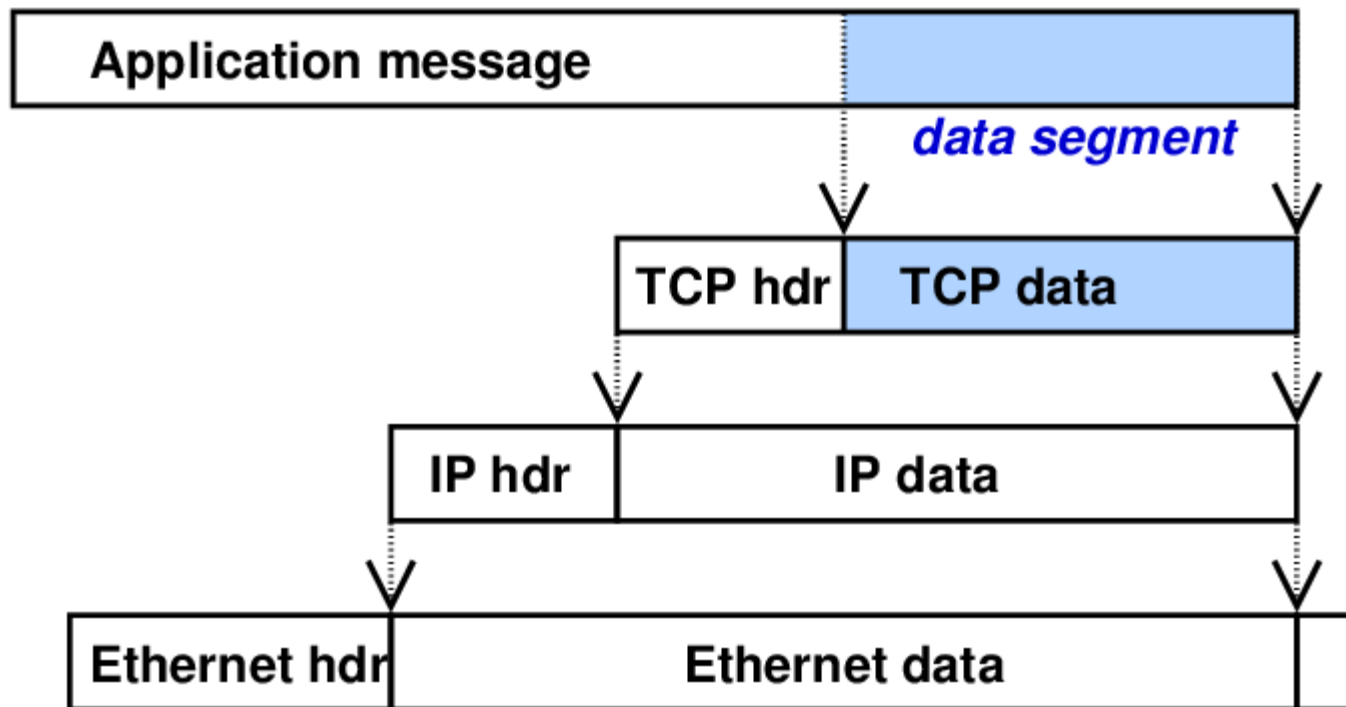
Protocols – OSI Model vs. TCP/IP

10



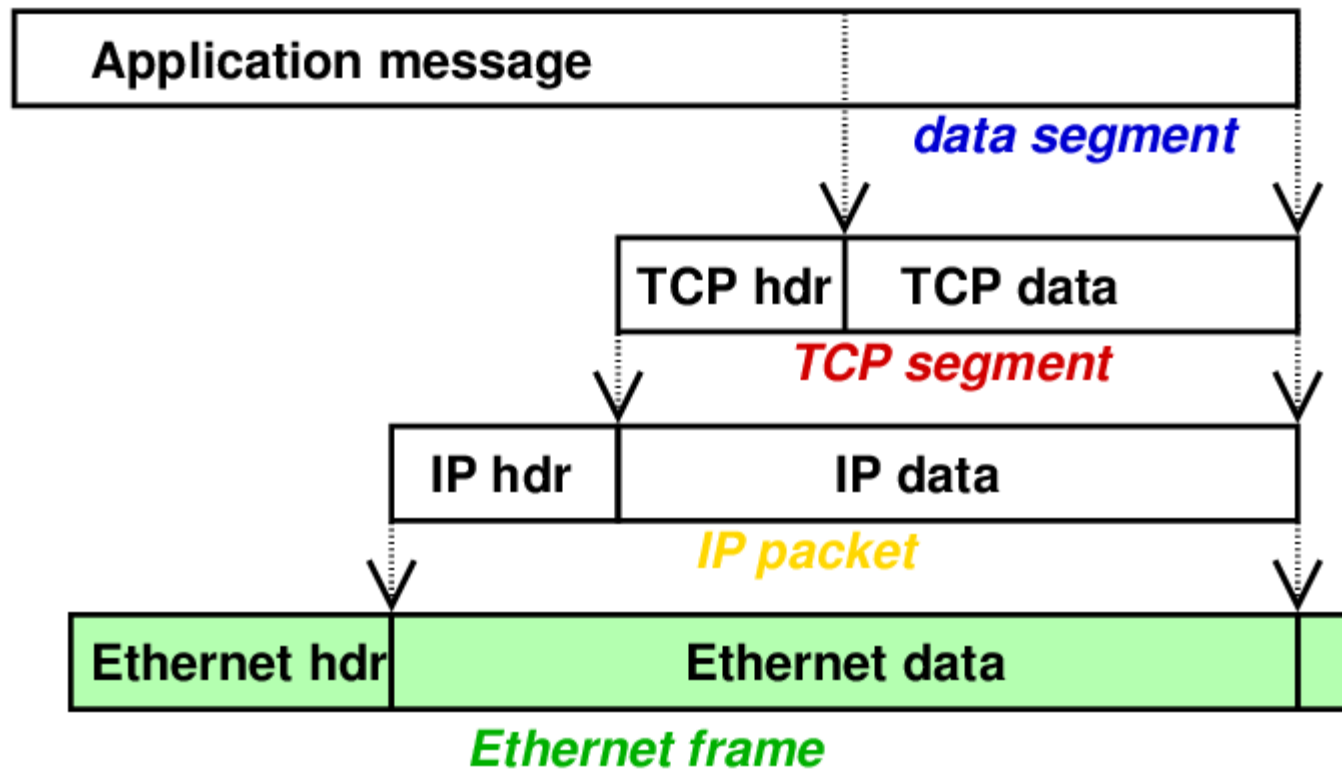
Encapsulation

11



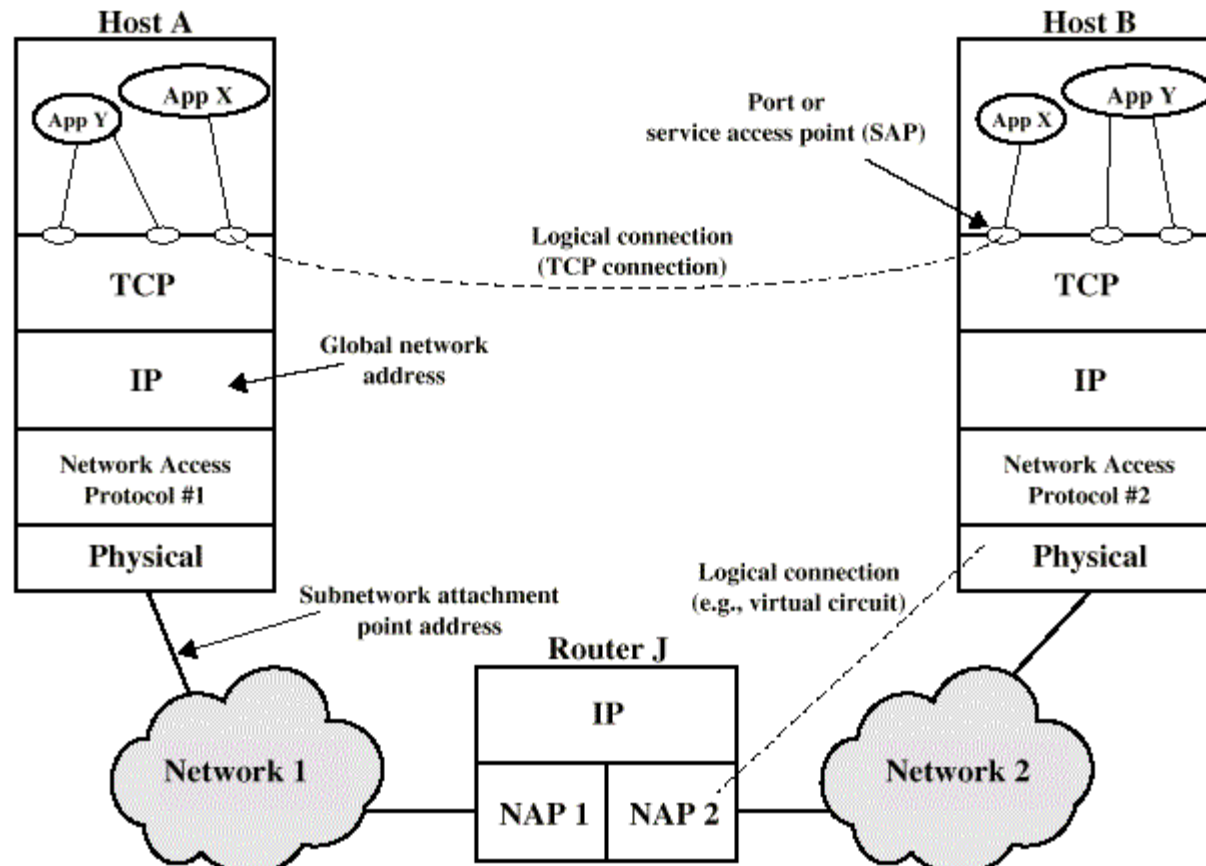
Encapsulation

12



TCP/IP Operation

13



Software

14

- End device / host operating Systems
 - ▣ Windows, Android, Linux etc.
- Network device operating Systems
 - ▣ Internetworking Operating System (IOS)
- Application Software
 - ▣ Email client, browser etc.

Services and Applications

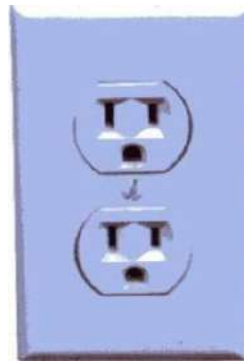
15

- Real Time Applications
 - ▣ Voice, Video conferencing, Video on Demand etc.
- Interactive applications
 - ▣ Browsing, telnet etc.
- Background
 - ▣ Email, File Transfer etc.

The Need for Standards

16

- Google Android
 - ▣ Multiple versions / implementations
- Protocol standardisation
 - ▣ Different physical layers



Network Standard Bodies

17

- IETF
 - ▣ Internet Engineering Task Force
- IEEE
 - ▣ Institution of Electrical and Electronic Engineering
 - ▣ E.g. IEEE 802.11n
- IANA
 - ▣ Internet Assigned Number Authority
- ITU-T
 - ▣ International Telecommunications Union
- W3C
 - ▣ World Wide Web (WWW) standards
- OSI
 - ▣ Open Systems Interconnection

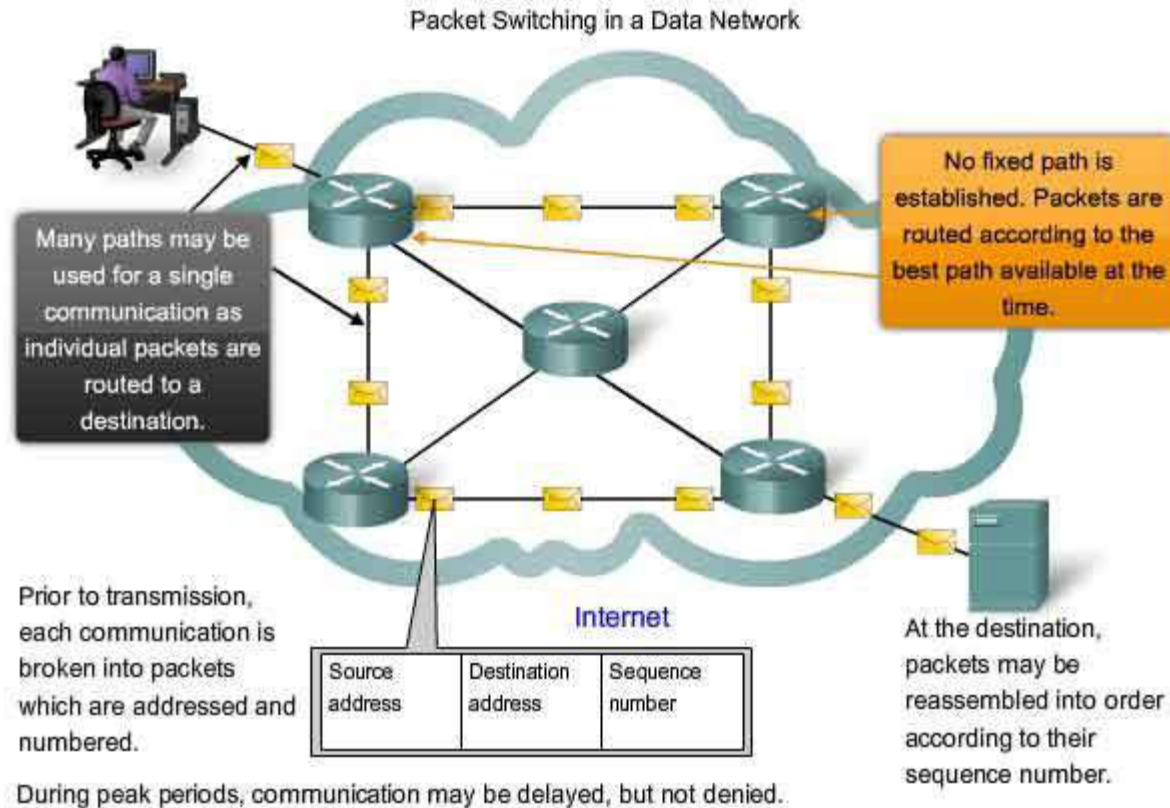
Network Design Principles

18

- Packet switched rather Circuit switched
 - ▣ Release resource once the exchange is complete
 - ▣ Do NOT reserve resources e.g. bandwidth
- Layered Model
 - ▣ Simplicity, modularity and easy upgrade
 - ▣ Follow OSI or TCP/IP model
- Control Mechanism
 - ▣ Distributed instead of Central
- Deployment
 - ▣ Incremental deployment, scalability, heterogeneity
- Generic Issue
 - ▣ Simplicity, modularity, performance etc.

Packet Switched vs. Circuit Switched

19

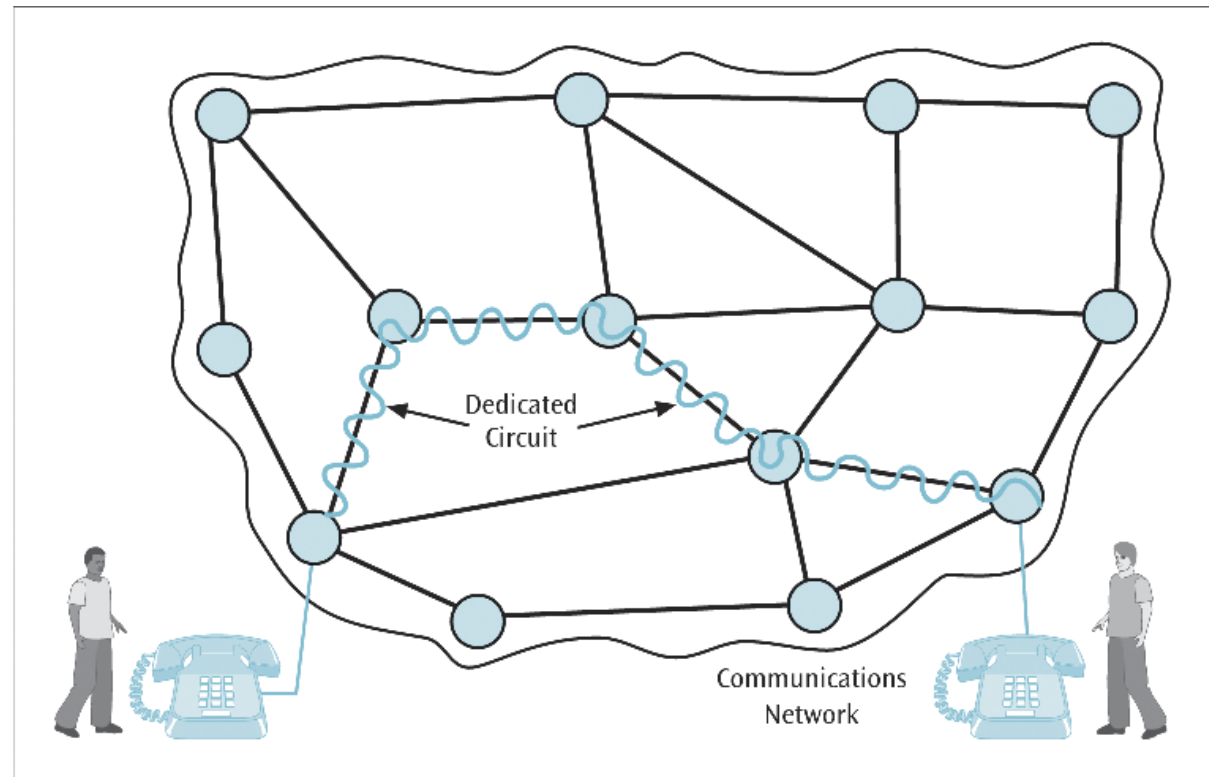


Packet Switched vs. Circuit Switched

20

Figure 10-6

Two people carrying on a telephone conversation using a circuit-switched network



Layered Model – OSI and TCP/IP

21

OSI Model

Layer	Function	Examples
Application (Layer 7)	User interface	Telnet, HTTP
Presentation (Layer 6)	Handles encryption & changes to syntax	ASCII/EBCDIC, JPEG/MP3
Session (Layer 5)	Manages multiple applications and maintains synchronisation points	Operating systems, scheduling
Transport (Layer 4)	Provides reliable or best-effort delivery and (optional) error and flow control	TCP, UDP
Network (Layer 3)	Provides logical end-to-end addressing used by routers and hosts	IP
Data Link (Layer 2)	Creates frames from data bits, uses MAC addresses to access endpoints, and provides error detection but no correction	802.3, 802.2, HDLC, Frame Relay
Physical (Layer 1)	Specifies voltage, wire speed, and cable pin-outs	EIA/TIA, V.35

Deployment

22

- Scalability
 - ▣ Size $\leq 1\text{m}$ and $\geq 10000\text{ Km}$
 - ▣ Number of hosts from 1 to 10000000000
 - ▣ Link speed from 96 Kbps to 40 Gbps
- Incremental deployment
 - ▣ Constant change in the network
 - ▣ Support for the legacy components
- Heterogeneity
 - ▣ Different devices e.g. laptop, desktop, switch, routers etc.
 - ▣ Different technologies e.g. WLAN, Fast Ethernet etc.
 - ▣ Different applications e.g. real time voice, email, etc.

Network Scale

23

- Geographic scale
 - ▣ LAN – Local Area Network e.g. one building
 - ▣ CAN – Campus Area Network e.g. one campus
 - ▣ MAN – Metropolitan Area Network e.g. one city or town
 - ▣ WAN – Wide Area Network e.g. bigger than one city
- Scale based on number of routers or switches
 - ▣ Small < 10
 - ▣ Medium from 10 to 100
 - ▣ Large > 100

IP Issues

24

□ Billing

- Circuits are easy to bill
- Most packet switched network is flat rate billing

□ Security

- Authentication, Encryption etc.
- DoS, DDoS, Man-in-the-middle etc. are hard to mitigate

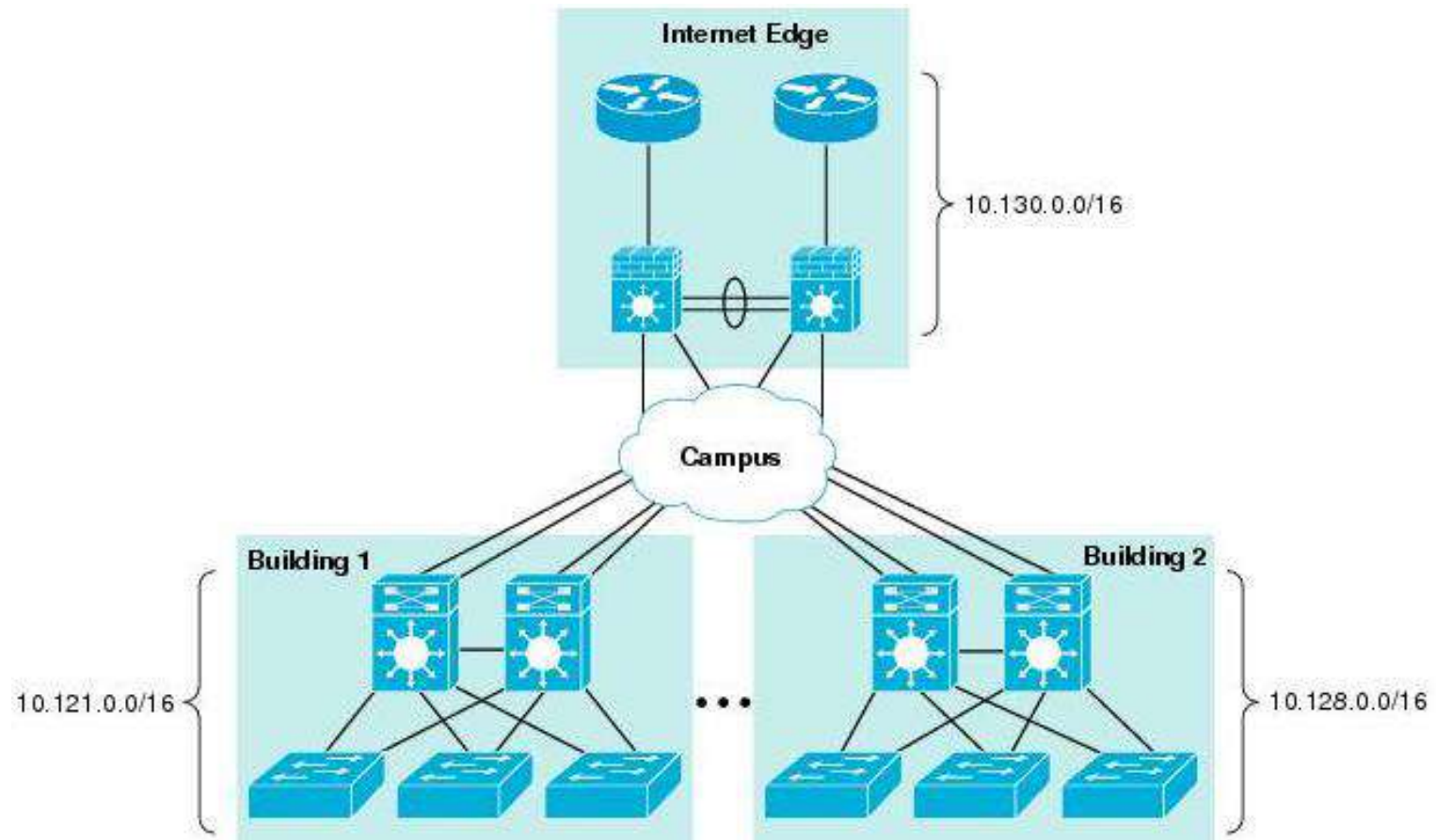
IP Addressing

25

- Variable Length Subnet Masking (VLSM)
 - ▣ Future expansion or scope for more devices in future
- Private IP addresses
 - ▣ 10.0.0.0 - 10.255.255.255 allows 16,777,216 addresses
 - ▣ 172.16.0.0 - 172.31.255.255 allows 1,048,576 address
 - ▣ 192.168.0.0 - 192.168.255.255 allows 65536 addresses
- IPv4 vs. IPv6 address
 - ▣ 32 bit vs. 128 bit

IP Addressing in Campus Network

26



Network Design

Routing Issues

27

- Distance Vector
 - ▣ RIPv1, IGRP, RIPv2, EIGRP etc.
- Link State
 - ▣ OSPF, IS-IS etc.
- Convergence time
- Network size
- Hardware requirement