What Every Mainframer Needs to Know About Networking (Session 13294)

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Session Number   **(13294)**

SHARE in Boston

What was your first
Network Computing Experience?

- Mine was 1985 installing a NBI Word Processing and ISS Unix servers via thick Ethernet 802.3 10base 5.

- Kevin, what was yours ?

- Class "What was yours" ?

- What is (Computer) Networking?

Answer: In the world of computers, networking is the practice of linking two or more computing devices together for the purpose of sharing data. Networks are built with a mix of computer hardware / computer software and Networking Routers / Switches with all types of Media attachments: Fiber, Copper, Serial to name a few.

IBM
Leading the Way to where we are Today!!!

For you old IBM'ers do you remember this ????
In September 1956 IBM launched the 305 RAMAC, the first 'SUPER' computer with a hard disk drive (HDD).
The HDD weighed over a ton and stored 5 MB of data.'

**This is what a 5MB hard drive looked like in 1956 (note: required a forklift).**

Network Topologies?

Area Networks

- Networks can be categorized in several different ways. One approach defines the type of network according to the geographic area it spans. Local area networks (LANs), for example, typically span a single home, school, or small office building, whereas wide area networks (WANs), reach across cities, states, or even across the world. The Internet is the world's largest public WAN.

Network Design

- Computer networks also differ in their design. The two basic forms of network design are called **client/server and peer-to-peer.** Client-server networks feature centralized server computers that store email, Web pages, files and or applications. On a peer-to-peer network, conversely, all computers tend to support the same functions. Client-server networks are much more common in business and peer-to-peer networks much more common in homes.

- **Network topology** represents its layout or structure from the point of view of data flow. In so-called bus networks, for example, all of the computers share and communicate across one common conduit, whereas in a star network, all data flows through one centralized device. Common types of network topologies include bus, star, ring networks and mesh networks.
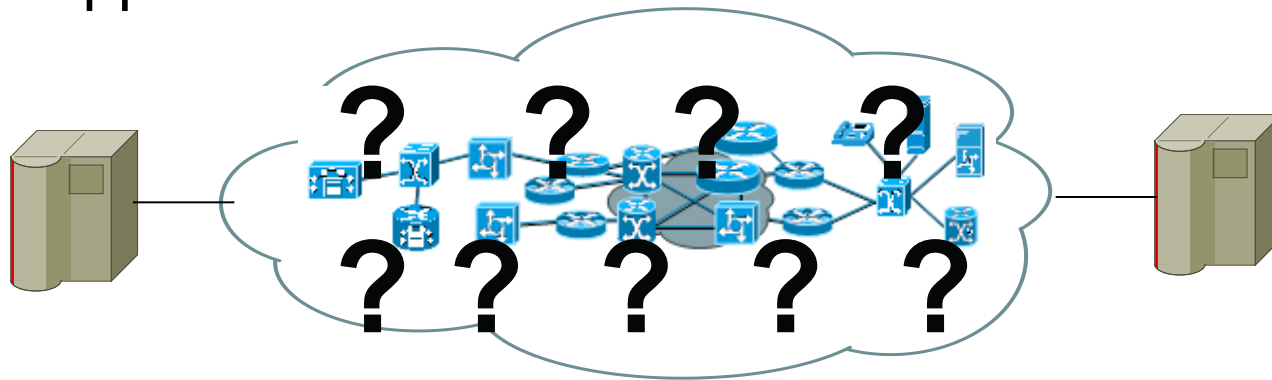

Bus Network Topology — Ring Network Topology — Star Network Topology — Mesh Network Topology — Tree Network Topology
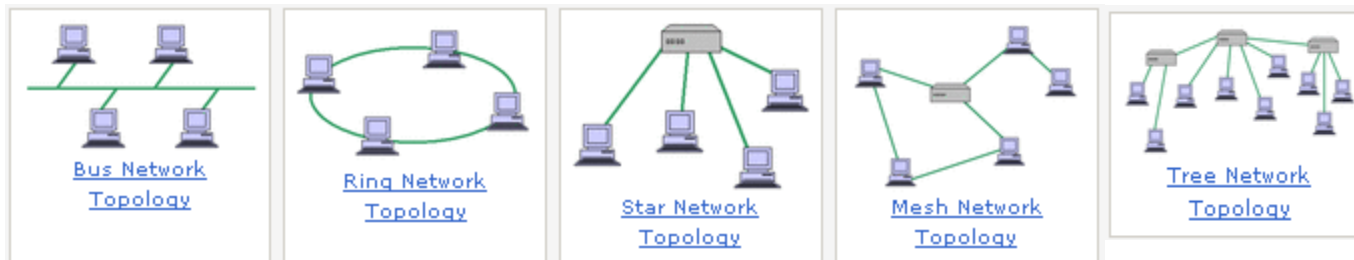
Main Frame IP Connectivity Evolution

3172

CIP/CPA

OSA
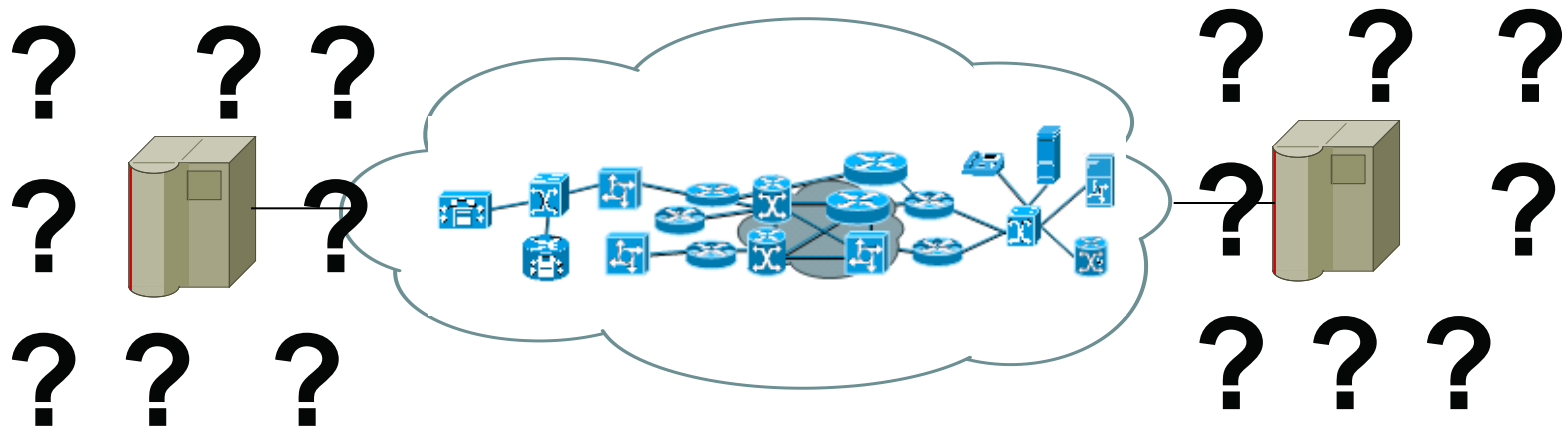
OSA Express

10 Gig OSA
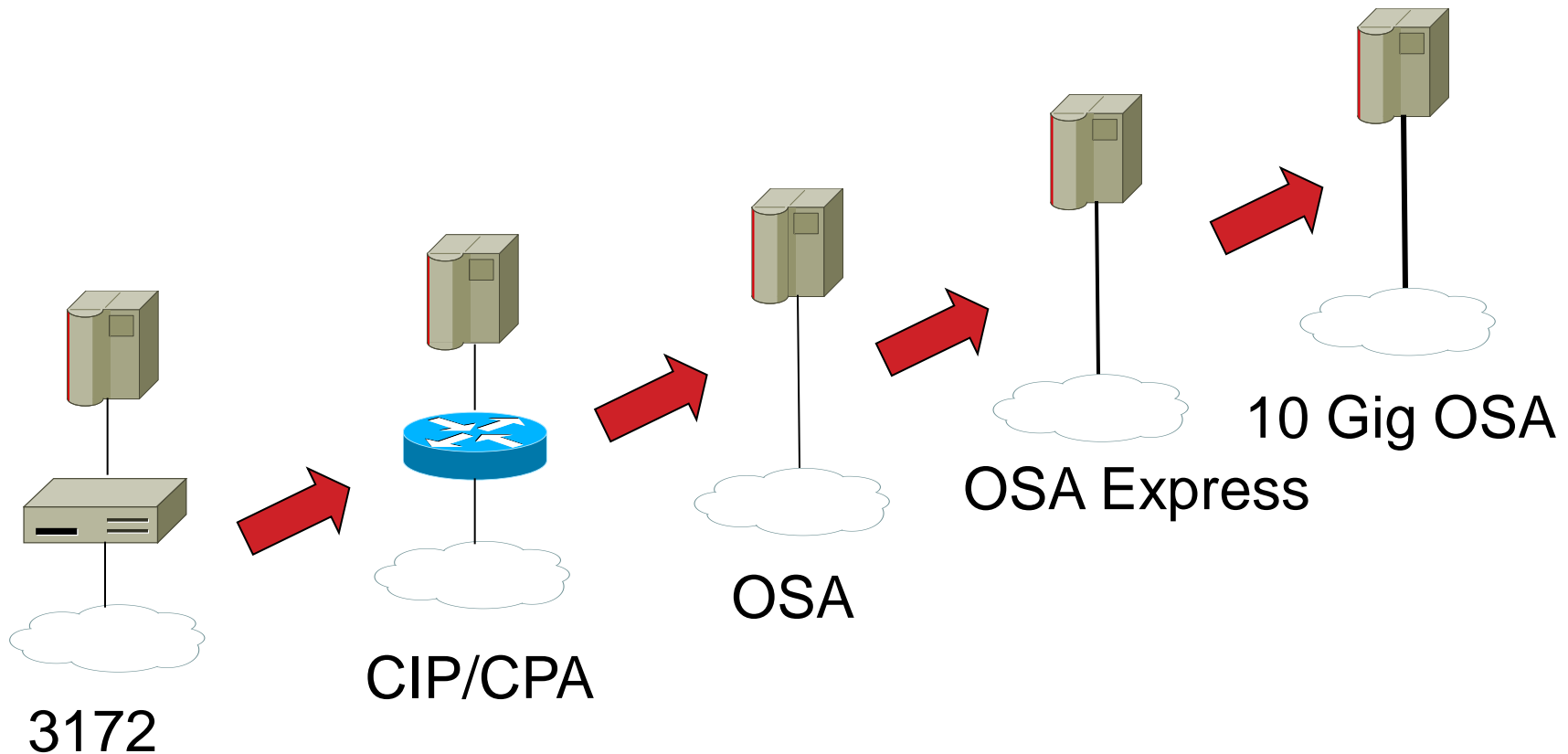
Mainframe view of the Network

- The network is just a big cloud
- Stuff is inside
- Stuff happens

Network view of the Mainframe

- The MF lives, but you have to be 60 years old to understand it.

- Not sure **who, what or how** Stuff happens it just does????

- Sysplex – isn't that a big movie theater?
- VIPA – that's a poisonous snake, right?
- LPAR – is that a golf term for loosers ?

Network Model

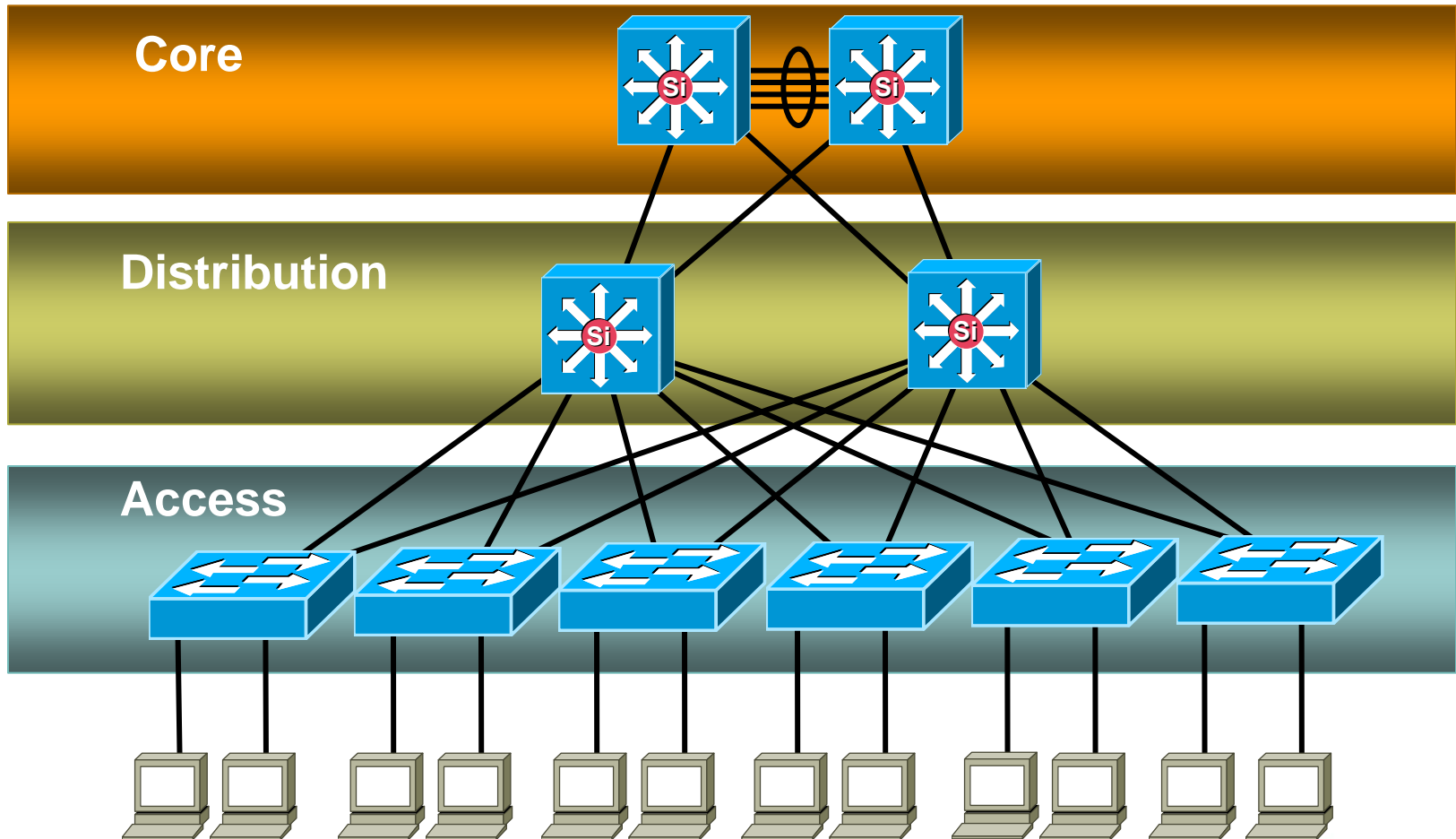- Ideally, the network between data centers would look like this:

The Old Days

- Unfortunately, nothing is ever quite that straightforward….

3 Layer Hierarchical Model ???

Who knows what they are called?

Core

Distribution

Access

Network's -- The Bigger Picture

ISP / Internet connected to Distribution

WAN Core / Distribuiton / Remote Sites / DC-2-DC Links

ISP / Internet connected to Distribution

Data Center MF and Server Farm connected to Access
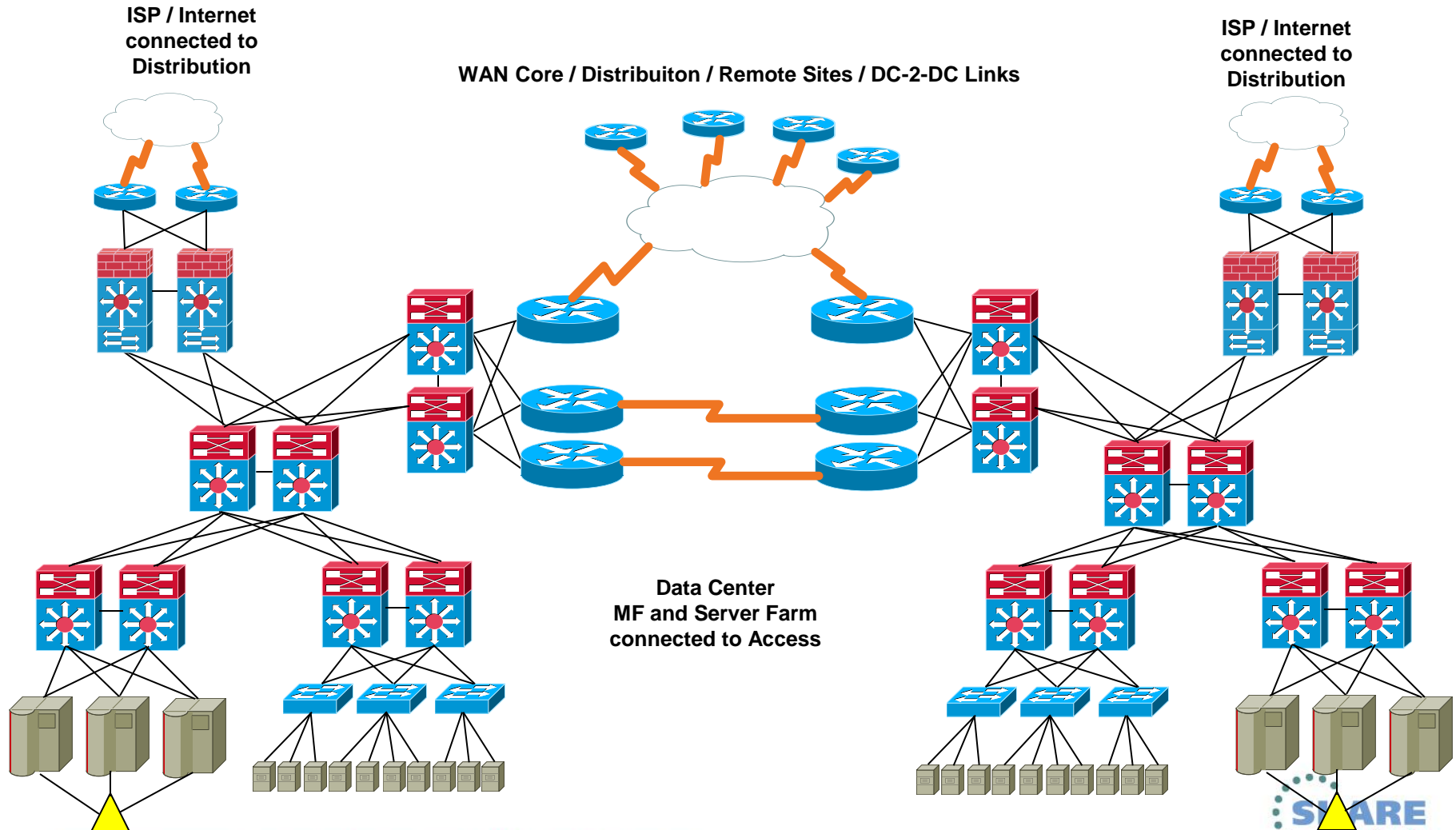
Open Systems Interconnection (OSI)

Definition: The **OSI model** defines internetworking in terms of a vertical stack of seven layers.

The **upper layers** of the OSI model represent software that implements network services like encryption and connection management.

The **lower layers** of the OSI model implement more primitive, hardware-oriented functions like routing, addressing, and flow control.
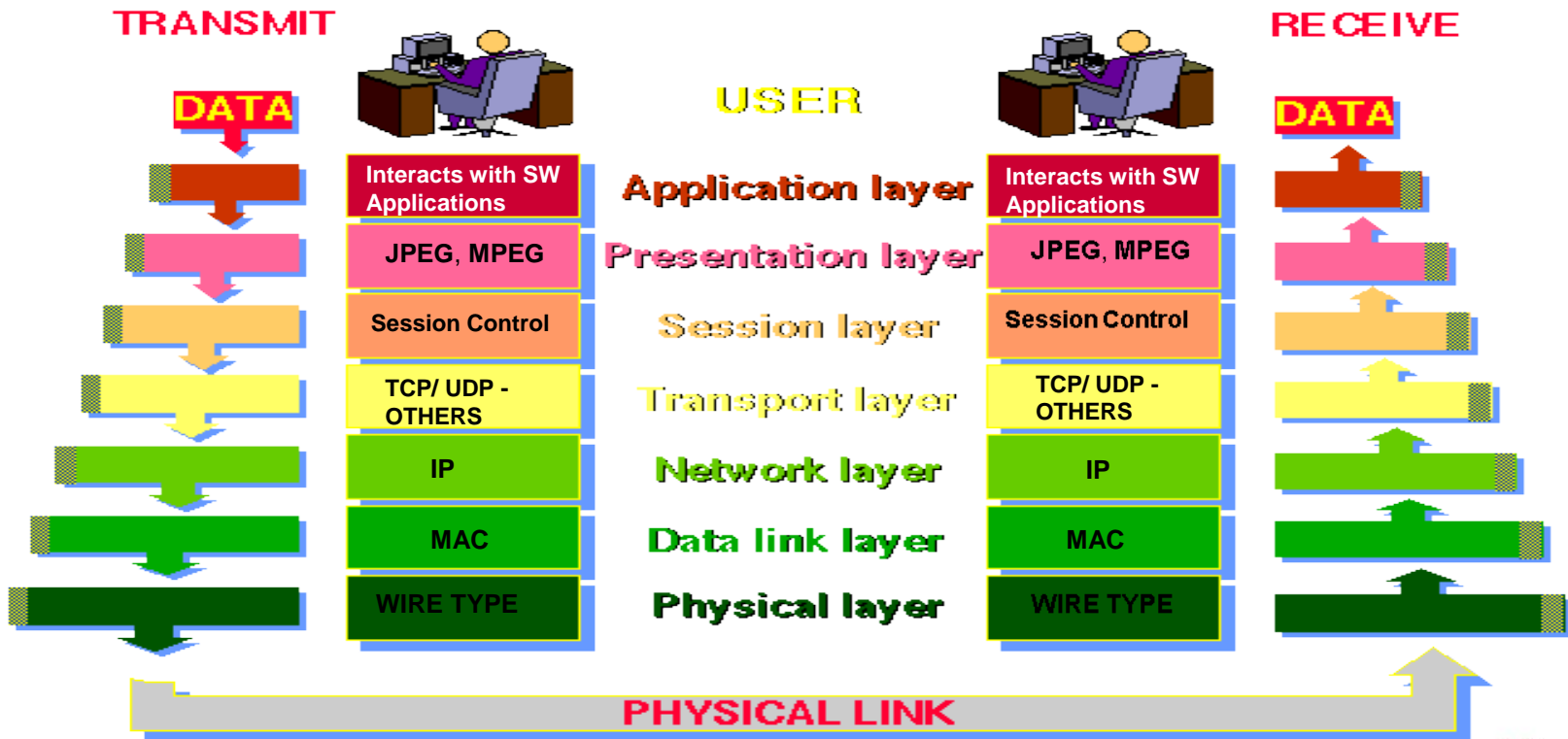
In the **OSI model**, data communication starts with the top layer at the sending side, travels down the OSI model stack to the bottom layer, then traverses the network connection to the bottom layer on the receiving side, and up its OSI model stack.

The **OSI model** was introduced in 1984. Although it was designed to be an abstract model, the OSI model remains a practical framework for today's key network technologies like Ethernet and protocols like IP.
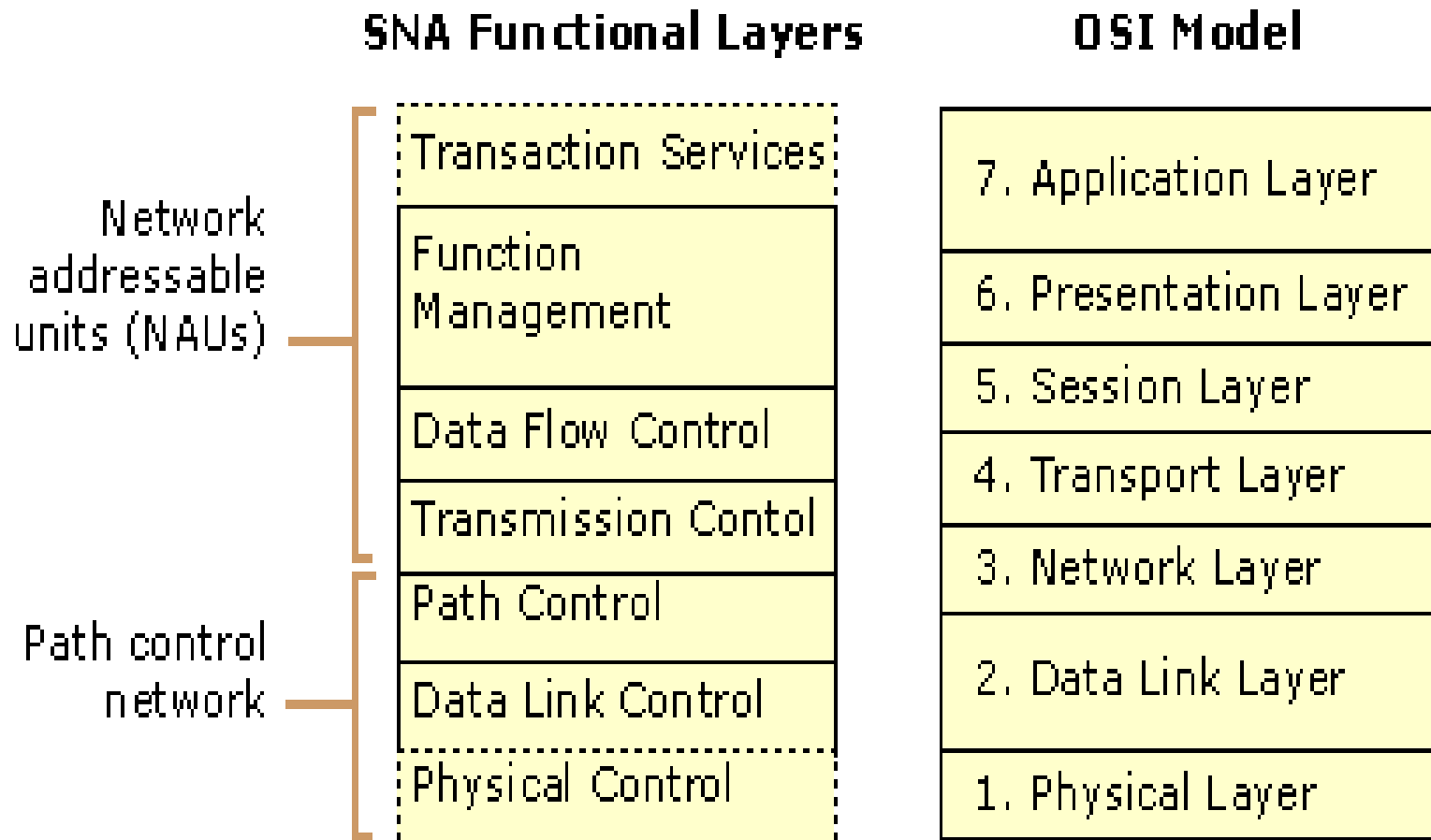
Network Quiz ???

- What or Who can tell us what the 7 layers are and what the "special" 8th Layer is ?:

THE 7 LAYERS OF OSI

TRANSMIT		USER		RECEIVE
DATA				DATA
	Interacts with SW Applications	Application layer	Interacts with SW Applications	
	JPEG, MPEG	Presentation layer	JPEG, MPEG	
	Session Control	Session layer	Session Control	
	TCP/ UDP - OTHERS	Transport layer	TCP/ UDP - OTHERS	
	IP	Network layer	IP	
	MAC	Data link layer	MAC	
	WIRE TYPE	Physical layer	WIRE TYPE	

PHYSICAL LINK

SNA to OSI Comparison

SNA Functional Layers

OSI Model

SNA Functional Layers	OSI Model
Transaction Services	7. Application Layer
Function Management	6. Presentation Layer
	5. Session Layer
Data Flow Control	4. Transport Layer
Transmission Contol	
Path Control	3. Network Layer
Data Link Control	2. Data Link Layer
Physical Control	1. Physical Layer

Network addressable units (NAUs)

Path control network
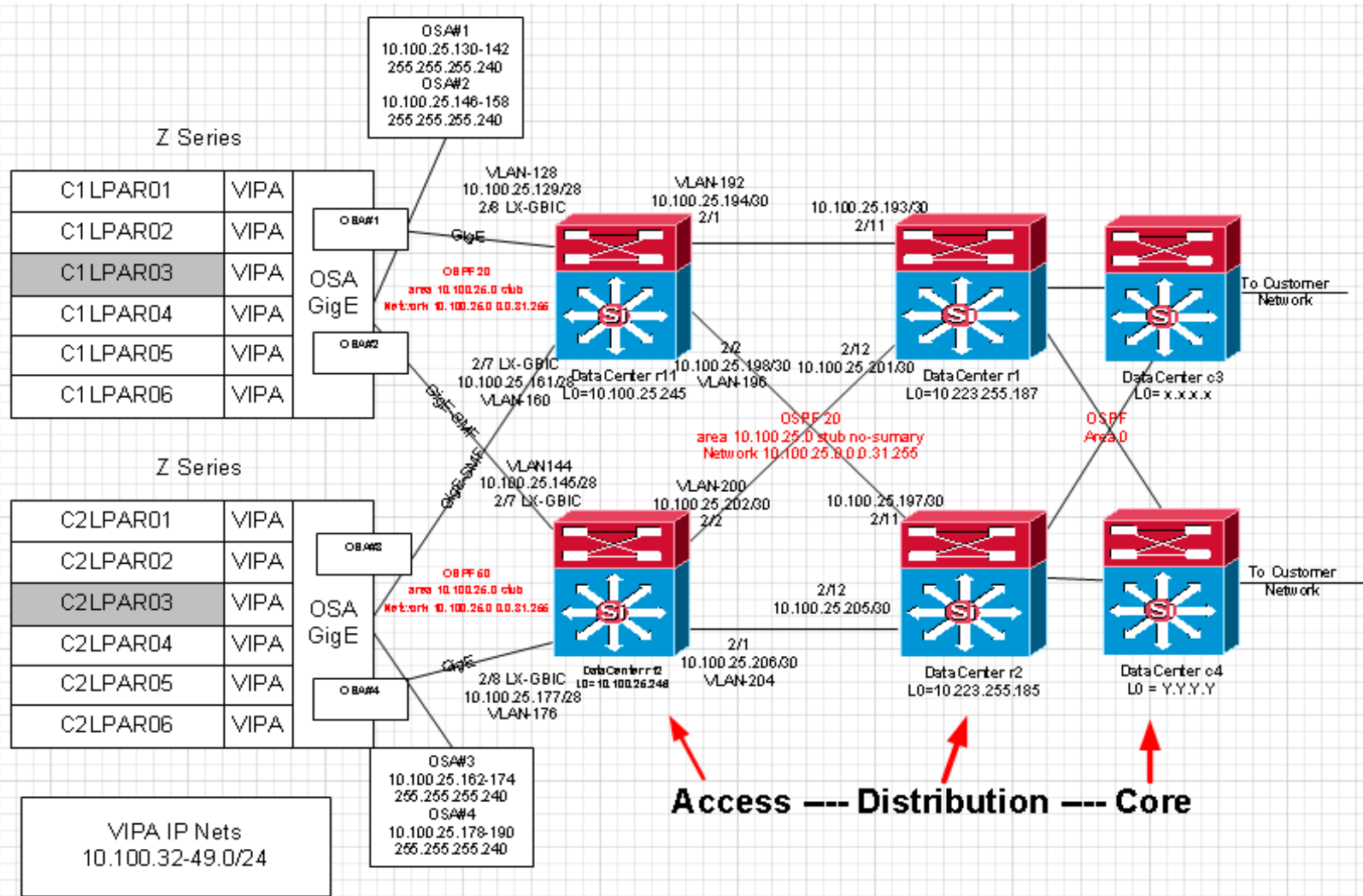
Figure A.4 SNA Functional Layers Mapped to the OSI Model

MF / OSA / Network Connectivity Example

Network Quiz ???

Is "IP" a Routing Protocol ?

No – it is a routable protocol

What are the Routing Protocols used in today's networks for IP ?

RIP / RIPv2 / RIPNG-for IPv6

OSPF v2 / OSPF-v3 for IPv6

EIGRP / EIGRP v6

ISIS

BGP

Networking Terms

VLANs:
- Group stations by function regardless of switch location.
- Limit size of broadcast domain by organizing functionally.
- IEEE standard 802.1Q

ARP: IPv4
- **Address Resolution Protocol** (**ARP**) is a telecommunications protocol used for resolution of network layer addresses into link layer addresses.,

Neighbor Discovery: IPv6
- In Internet Protocol Version 6 (IPv6) networks, the functionality of ARP is provided by the Neighbor Discovery Protocol (NDP).

Virtual Private Network (VPN):
- A data network that uses the public telecommunications infrastructure, but maintains privacy through the use of a tunneling protocol and security procedures.

Multiprotocol Label Switching:
- MPLS is a scalable, protocol-independent transport. In an MPLS network, data packets are assigned labels. Packet-forwarding decisions are made solely on the contents of this label, without the need to examine the packet itself. This allows one to create end-to-end circuits across any type of transport medium, using any protocol. The primary benefit is to eliminate dependence on a particular OSI model data link layer technology. MPLS operates at a layer that is generally considered to lie between traditional definitions of layer 2 (data link layer) and layer 3 (network layer), and thus is often referred to as a "layer 2.5" protocol.

IP Network Troubleshooting
Troubleshooting TCP/IP
TCP/IP Introduction

The Network Layer
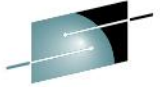
       Addressing
       Internet Routing
       ICMP

The Transport Layer

       TCP
       UDP

Upper-Layer Protocols

       Domain Name System

IP Network Troubleshooting

Tools for Troubleshooting IP Problems	
	ping
	traceroute
	Packet Debugging
General IP Troubleshooting Suggestions	
Narrowing Down the Problem Domain	
Troubleshooting Local Connectivity Problems	
	Check for Configuration Problems
	Check for Local Connectivity
	Ruling Out Duplicate IP Addresses
Troubleshooting Physical Connectivity Problems	
	Rule Out a Configuration Problem
	Check Cable Connections
	Check the Configuration
	Check the Network Interface
Troubleshooting IP Connectivity and Routing Problems	
	Determining Where to Start
	Check for Resources
	Check for Connectivity
	Check for ACLs
	Check for Network Address Translation
Troubleshooting Upper-Layer Problems	
	Generic
	Hypertext Transport Protocol
	FTP
	MAIL (IMAP, POP, and SMTP)
	Telnet

IP Network Troubleshooting Tools Ping and Pathping

```
C:\Users\jrsadler>ping 10.131.24.1

Pinging 10.131.24.1 with 32 bytes of data:
Reply from 10.131.24.1: bytes=32 time=10ms TTL=255
Reply from 10.131.24.1: bytes=32 time=3ms TTL=255

Ping statistics for 10.131.24.1:
    Packets: Sent = 2, Received = 2, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 3ms, Maximum = 10ms, Average = 6ms
```

C:\Users\jrsadler>pathping www.bankofamerica.com
Tracing route to wwwui.ecglb.bac.com [171.161.199.100]
over a maximum of 30 hops:
```
 0  JRSADLER-WS01.cisco.com [10.131.24.34]
 1  nyc1-bb-gw1-vla250.cisco.com [10.131.24.2]
 2  nyc1-wan-gw2-gig1-1.cisco.com [161.44.60.166]
 3  nycidc-wag-gw2-pos2-3-0.cisco.com [161.44.60.181]
 4  nycidc-wbb-gw2-ten3-2.cisco.com [10.87.127.30]
 5  nycidc-gb2-ten0-1-0.cisco.com [10.112.3.250]
 6  capnet-rtp5-nycidc-oc48.cisco.com [10.112.2.174]
 7  rtp5-rbb-gw1-ten4-2.cisco.com [10.112.3.58]
 8  rtp10-corp-gw1-ten0-2-0.cisco.com [10.81.255.114]
 9  rtp10-dmzbb-gw1-vla777.cisco.com [64.102.241.141]
10  rtp10-isp-gw1-ten1-0-0.cisco.com [64.102.254.193]
11  rtp5-isp-ssw1-ten3-2.cisco.com [64.102.254.166]
12  rtp5-isp-ssw1-vla151.cisco.com [64.102.254.250]
13  rtp10-isp-gw1-ten1-3-0.cisco.com [64.102.254.165]
14  gige-g3-16.core1.ash1.he.net [209.51.171.13]
15    *    *    *
```

:\Users\jrsadler>pathping -n www.bankofamerica.com
Tracing route to wwwui.ecglb.bac.com [171.161.207.100]
```
 0  10.131.24.34
 1  10.131.24.2
 2  161.44.60.162
 3  161.44.60.177
 4  10.87.127.18
 5  10.112.3.242
 6  10.112.2.174
 7  10.112.3.58
 8  10.81.255.114
 9  64.102.241.140
10  64.102.254.229
11  64.102.244.34
12  64.102.254.250
13  64.102.254.165
14  209.51.171.13
15  ^C
```

IP Network Troubleshooting Tools

Trace Route
tracert

C:\Users\jrsadler>tracert www.bankofamerica.com

Tracing route to wwwui.ecglb.bac.com [171.161.199.100]
over a maximum of 30 hops:

```
 1   21 ms    6 ms    4 ms  nyc1-bb-gw1-vla250.cisco.com [10.131.24.2]
 2    2 ms    1 ms    4 ms  nyc1-wan-gw2-gig1-1.cisco.com [161.44.60.166]
 3    2 ms    1 ms    2 ms  nycidc-wag-gw2-pos2-3-0.cisco.com [161.44.60.181
 4    2 ms    1 ms    1 ms  nycidc-wbb-gw2-ten3-2.cisco.com [10.87.127.30]
 5    2 ms   11 ms    2 ms  nycidc-gb2-ten0-1-0.cisco.com [10.112.3.250]
 6   15 ms   17 ms   17 ms  capnet-rtp5-nycidc-oc48.cisco.com [10.112.2.174]
 7   16 ms   15 ms   21 ms  rtp5-rbb-gw1-ten4-2.cisco.com [10.112.3.58]
 8   18 ms   18 ms   15 ms  rtp10-corp-gw1-ten0-2-0.cisco.com [10.81.255.114
 9   16 ms   16 ms   15 ms  rtp10-dmzbb-gw1-vla777.cisco.com [64.102.241.141
10   18 ms   17 ms   16 ms  rtp10-isp-gw1-ten1-0-0.cisco.com [64.102.254.193
11   17 ms   33 ms   17 ms  rtp5-isp-ssw1-ten3-2.cisco.com [64.102.254.166]
12   37 ms   17 ms   18 ms  rtp5-isp-ssw1-vla151.cisco.com [64.102.254.250]
13   25 ms   24 ms   17 ms  rtp10-isp-gw1-ten1-3-0.cisco.com [64.102.254.165
14   25 ms   26 ms   26 ms  gige-g3-16.core1.ash1.he.net [209.51.171.13]
15    *    ^C
C:\Users\jrsadler>
```

Q and A

SHARE in Boston