# Wide-area Network (WAN) Environments & & Open Systems Interconnection



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#### Introduction

- Covers a broad geographic area through networking
- Network protocols are used to communicate between networks
- System of network protocols used varies from network-to-network and is referred to as the network model
- Ex: ISO OSI Network Model with 7 layers, TCP/IP Network Model with 4 Layers



#### Need for a Network Model

- In the Beginning
  - > Only a few companies
  - > They sold complete systems
  - > They took care of all communications
- Growing need for Interoperability
  - > Midi/Mini Computer
  - > Inter Departmental
  - Inter Company
  - > Budget
- Variety of equipment was expanding



### WAN Link Options





#### What is OSI ?

- 7 layers, each specifying particular network functions
- Lower 4 layers flow of data from end to end through the network
- Upper 4 layers orientated more toward services to the applications
- Data is encapsulated with the necessary protocol information as it moves down the layers before network transit



#### What is OSI ?





#### **OSI Model in the Network**





#### Data in the Model





### Layer 7 – Application

Layer 7 -----> Application

User application programs interact and receive services Examples - Hypertext Transfer Protocol (HTTP), File Transfer Protocol (FTP), and Simple Mail Transfer Protocol (SMTP).

• James Bond meets Number One on the 7th floor Application of the spy headquarters building. Number One gives Bond a secret message that must get through to the US Embassy across town.



#### Layer 6 – Session



Ensures reliable session transmission between applications; takes care of differences in data representation Examples :- JPEG, MPEG, ASCII, EBCDIC, HTML.

• Bond proceeds to the 6th floor **Presentation** where the message is translated into an intermediary language, encrypted and miniaturized.



#### Layer 5 – Session



#### Enables two applications to communicate across the network Example – Web conferencing, Live TV programs

- Bond takes the elevator to the 5th floor **Session** where Security checks the message
- to be sure it is all there and puts some checkpoints in the message so his counterpart at the US end can be sure he's got the whole message.



### Layer 4 – Transport



#### Ensures reliable transmission from end-to-end, usually across multiple nodes Examples – TCP, UDP



On the 4th floor, Transport the message is analyzed to see if it can be continued with some other small messages that need to go to the US end. Also if the messages wes very large it might be broken into several small packages so other spies can take it and have it reassembled on the other end.

#### Layer 3 – Network



#### Sets up pathways or end-to-end connections, usually across long distances or multiple nodes Examples – TCP/IP, IPX

The 3rd floor Network personnel check the address on the message and determine who the addressee

is and advising Bond of the fastest route to the Embassy.



#### Layer 2 – Data Link



Puts messages together,

attaches proper headers to be sent out or received, &

ensures messages are delivered between two points

#### Examples – ATM, LAPD, PPP

• On the 2<sup>nd</sup> floor Data Link the message is put into a special courier pouch (packet). It contains the message, the sender and destination ID. It also warns the recipient if other pieces are still coming.





#### Layer 1 - Physical



Concerned with transmitting and receiving bits of data over a physical medium Examples – T1, E1 RS-232, SONET, SDH

Bond proceeds to the 1st floor Physical where Q has prepared the Aston Martin for the trip to the Embassy. Bond departs for the US Embassy with the secret packet in hand.

On the other end the process is reversed. Bond proceeds from floor to floor where the message is decoded. The US Ambassador is very grateful the message got through safely. "Bond, please tell Number One I'll be glad to meet him for dinner tonight".



#### WAN Link Options Review

| Acronym                    | Name                                   | Max. Bandwidth      | Comments                              |  |  |
|----------------------------|--|---------------------|---------------------------------------|--|--|
| Dedicated Digital Services |  |                     |                                       |  |  |
| T1, T3                     | T1, T3                                 | 1.544 & 44.736 Mbps | Widely used telecommunications        |  |  |
| xDSL                       | Digital Subscriber Line                | 384 kbps            | New technology over phone lines       |  |  |
| SONET                      | Synchronous Optical<br>Network         | 9,992 Mbps          | Very fast optical fiber transmission  |  |  |
| Circuit Switched Services  |  |                     |                                       |  |  |
| POTS                       | Plain Old Telephone<br>Service         | 4 kHz Analog        | The Standard for Reliability          |  |  |
| ISDN                       | Integrated Services<br>Digital Network | 128 kbps            | Data and Voice Together               |  |  |
| Packet Switched Services   |  |                     |                                       |  |  |
| X.25                       | X.25                                   |                     | An Old Reliable, Workhorse            |  |  |
| Frame Relay                | Frame Relay                            | up to 44.736 Mbps   | A flexible new workhorse; son of ISDN |  |  |
| Cell Switched Services     |  |                     |                                       |  |  |
| ATM                        | Asynchronous<br>Transfer Mode          | 622 Mbps            | High powered Networks                 |  |  |
| SMDS                       | Switched Multimegabit<br>Data Service  | 1.544 & 44.736 Mbps | MAN variant of ATM                    |  |  |

**Communications** 

## Summary

|              | Data Unit | Layer        | Function                                  |
|--------------|-----------|--------------|---|
| Host Layers  | Data      | Application  | Network process to application            |
|              |           | Presentation | Data representation and encryption        |
|              |           | Session      | Inter-host Communication                  |
|              | Segment   | Transport    | End-to-end connections and reliability    |
| Media Layers | Packet    | Network      | Path determination and logical addressing |
|              | Frame     | Data Link    | Physical Addressing (MAC & LLC)           |
|              | Bit       | Physical     | Media, signal and binary transmission     |



# **Thank You**

