James Bond Meets The 7 Layer OSI Model

The modular networking architecture of Windows 95 is based on two industry standard models for a layered networking architecture, namely the International Organization for Standardization (ISO) model for computer networking, called the Open Systems Interconnect (OSI) Reference Model, and the Institute of Electrical and Electronic Engineers (IEEE) 802 model. Windows NT and Windows for Workgroups are also designed according to these standard models. The ISO OSI and IEEE 802 models define a modular approach to networking, with each layer responsible for some discrete aspect of the networking process.

The OSI model describes the flow of data in a network, from the lowest layer (the physical connections) up to the layer containing the user's applications. Data going to and from the network is passed layer to layer. Each layer is able to communicate with the layer immediately above it and the layer immediately below it. This way, each layer is written as an efficient, streamlined software component. When a layer receives a packet of information, it checks the destination address, and if its own address is not there, it passes the packet to the next layer.

When two computers communicate on a network, the software at each layer on one computer assumes it is communicating with the same layer on the other computer. For example, the Transport layer of one computer communicates with the Transport layer on the other computer. The Transport layer on the first computer has no regard for how the communication actually passes through the lower layers of the first computer, across the physical media, and then up through the lower layers of the second computer.

The OSI Reference Model includes seven layers:

- ☐ **Application**
- ☐ **Presentation**
- ☐ **Session**
- ☐ **Transport**
- ☐ **Network**
- ☐ **Data-Link**
- ☐ **Physical**

James Bond meets Number One on the 7th floor of the spy headquarters building. Number One gives Bond a secret message that must get through to the US Embassy across town. Bond proceeds to the 6th floor where the message is translated into an intermediary language, encrypted and miniaturized. Bond takes the elevator to the 5th floor 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. On the 4th floor the message is analyzed to see if it can be combined with some other small messages that need to go to the US end. Also if the message was very large it might be broken into several small packages so other spies can take it and have it reassembled on the other end. The 3rd floor personnel check the address on the message and determine who the addressee is and advising Bond of the fastest route to the Embassy. On the 2nd floor 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. Bond proceeds to the 1st floor 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".

- The *Application layer* represents the level at which applications access network services. This layer represents the services that directly support applications such as software for file transfers, database access, and electronic mail.

- The *Presentation layer* translates data from the Application layer into an intermediary format. This layer also manages security issues by providing services such as data encryption, and compresses data so that fewer bits need to be transferred on the network.

- The *Session layer* allows two applications on different computers to establish, use, and end a session. This layer establishes dialog control between the two computers in a session, regulating which side transmits, plus when and how long it transmits.

- The *Transport layer* handles error recognition and recovery. It also repackages long messages when necessary into small packets for transmission and, at the receiving end, rebuilds packets into the original message. The receiving Transport layer also sends receipt acknowledgments.

- The *Network layer* addresses messages and translates logical addresses and names into physical addresses. It also determines the route from the source to the destination computer and manages traffic problems, such as switching, routing, and controlling the congestion of data packets.

- The *Data Link layer* packages raw bits from the Physical layer into frames (logical, structured packets for data). This layer is responsible for transferring frames from one computer to another, without errors. After sending a frame, it waits for an acknowledgment from the receiving computer.

- The *Physical layer* transmits bits from one computer to another and regulates the transmission of a stream of bits over a physical medium. This layer defines how the cable is attached to the network adapter and what transmission technique is used to send data over the cable.

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THE OSI REFERENCE MODEL

ALL PEOPLE SEEM TO NEED DATA PROCESSING

7 6 5 4 3 2 1

Print This Page

LAYER	WHAT THE LAYER IS RESPONSIBLE FOR/SERVICES ETC.	CORRESPONDING DEVICES	CORRESPONDING PROTOCOLS
Application 7	1. Interface between the user & the computer (applications & Gateways). Provides services that directly support user applications, such as the **USER INTERFACE, E-MAIL, FILE TRANSFER, TERMINAL EMULATION, DATABASE ACCESS,** etc. 2. API incorporated in this layer 3. Allows applications to use the network. 4. Handles Network access, flow control & error recovery. 5. Messages are sent between layers.	Gateways **(can work at all layers)**	· SNMP · FTP · TELNET · WWW · HTTP · SMB · NCP · TCP · TFTP · NFS · SMTP
Presentation 6	1. Translation of data into understandable format for transmission (into a form usable by the application layer i.e. translates data between the formats the network requires and the computer expects). 2. Handles character encoding, bit order and byte order issues. Encodes and decodes data. 3. Data compression and encryption takes place at this layer. 4. Generally determines the structure of data 5. The redirector works at this layer. 6. Responsible for protocol conversion 7. Messages are sent between layers 8. Communicates through GATEWAYS and APPLICATION INTERFACES 9. SERVICES: Telnet, FTP use TCP, TFTP, NFS, SNMP, SMTP use TCP	Gateways	· JPEG · MIDI · MPEG · All kinds of music, pictures & movie formats · NCP
Session 5	1. Responsible for opening, using and closing session. That is. It allows applications on connecting systems to establish a session (Establishes and maintains a connection). 2. Provides synchronization between communicating computers (nodes), messages are sent between layers (i.e. Manages upper layer errors). 3. Also places checkpoints in the data flow, so that if transmission fails, only the data after the last checkpoint needs to be retransmitted. 4. Handles remote procedure calls. 5. Communicates through Gateways & application interfaces. 6. SERVICES: Telnet, FTP use TCP, TFTP, NFS, SNMP, SMTP use TCP	Gateways	· Network File System (NFS) · SQL · RPC
	1. Responsible for PACKET HANDLING. Ensures		

Transport **4**	error free delivery. Repackages messages, divides messages into smaller packets (Fragments and reassembles data), and handles error handling 2. Ensures proper sequencing and without loss and duplication. 3. Takes action to correct faulty transmissions 4. Controls flow of data 5. Acknowledges successful receipt of data 6. Sliding window is at this Layer -segments of message fragments are sent between layers 7. TCP/SPX - connection oriented communication for applications to ensure error free delivery. 8. UDP - connectionless communications and does not guarantee packet delivery between transfer points 9. Communicates through Gateway Services, routers & brouters.	Gateways	· TCP · UDP · SPX · NetBEUI
Network **3**	1. Logical addressing - software addresses to hardware addresses are resolved (ARP/RARP). 2. Routing of message (Packets) between hosts & networks (IP/IPX). 3. Determining the best route (Makes routing decisions & forwards packets (a.k.a. DATAGRAMS) for devices that could be farther away than a single link. 4. Moves information to the correct address. 5. Sends messages and reports errors regarding packet delivery (ICMP) 6. Reports host group membership to local multicast routers (IGMP) 7. Communicates through GATEWAY SERVICES, ROUTERS & BROUTERS	· Routers · Brouters	· IP · IPX · RIP · ICMP · ARP · RARP · OSPF · EGP · IGMP · NetBEUI · DLC · DecNET
Data Link **2**	1. Provides for flow of data over a single link from one device to another 2. Controls access to communication channel 3. Controls flow of data 4. Packets placed into frames at this layer (i.e. Organizes data into logical frames - logical units of information). 5. Identifies the specific computer on the network 6. CRC is added at this Layer (Error detection). 7. If CRC fails at the receiving computer, this layer will request re-transmission. 8. MAC addresses are resolved at this Layer (switches, brouters and bridges function on this layer using the MAC sub layer) 9. Sends data from network layer to physical layer. 10. Manages physical layer communications between connecting systems. 11. Data frames are sent between layers. 12. Ethernet, Token Ring & other communications occur here via frames. LLC -(802.2) manages link control & defines SAP'S (Service Access Points). MAC- (802.3, 802.4, 802.5, 802.12) communicates with adapter card. 13. Communicates through: SWITCHES, BRIDGES & INTELLIGENT HUBS	· Brouters · Bridges · Switches	· HDLC (High-level Data Link Control) - Supports asynchronous & synchronous transmissions. Uses LLC flow control. · SLIP · PPP

	NOTE: The Data Link Layer contains two SUB-LAYERS . LLC (Logical Link Control) - The upper sub-layer, which establishes and maintains links between communicating devices. Also responsible for frame error correction and hardware addresses . MAC (Media Access Control) - The lower sub-layer, which controls how devices share a media channel. Either through CONTENTION or TOKEN PASSING		
Physical **1**	**1.** Data (BITS) is sent across physical media like wires and hubs. **2.** Responsible for encoding scheme (like Manchester encoding) **3.** Defines cables, cards and physical aspects. **4.** Provides electrical and mechanical interfaces for a network. **5.** Specifies how signals are transmitted on network **6.** Communicates through: REPEATERS, HUBS, SWITCHES, CABLES, CONNECTORS, TRANSMITTERS, RECEIVERS, MULTIPLEXERS	· Hubs · Repeaters · Amplifiers · Transceivers · Multiplexers · Receivers · Transmitters · Connectors · Cables · Switches	None