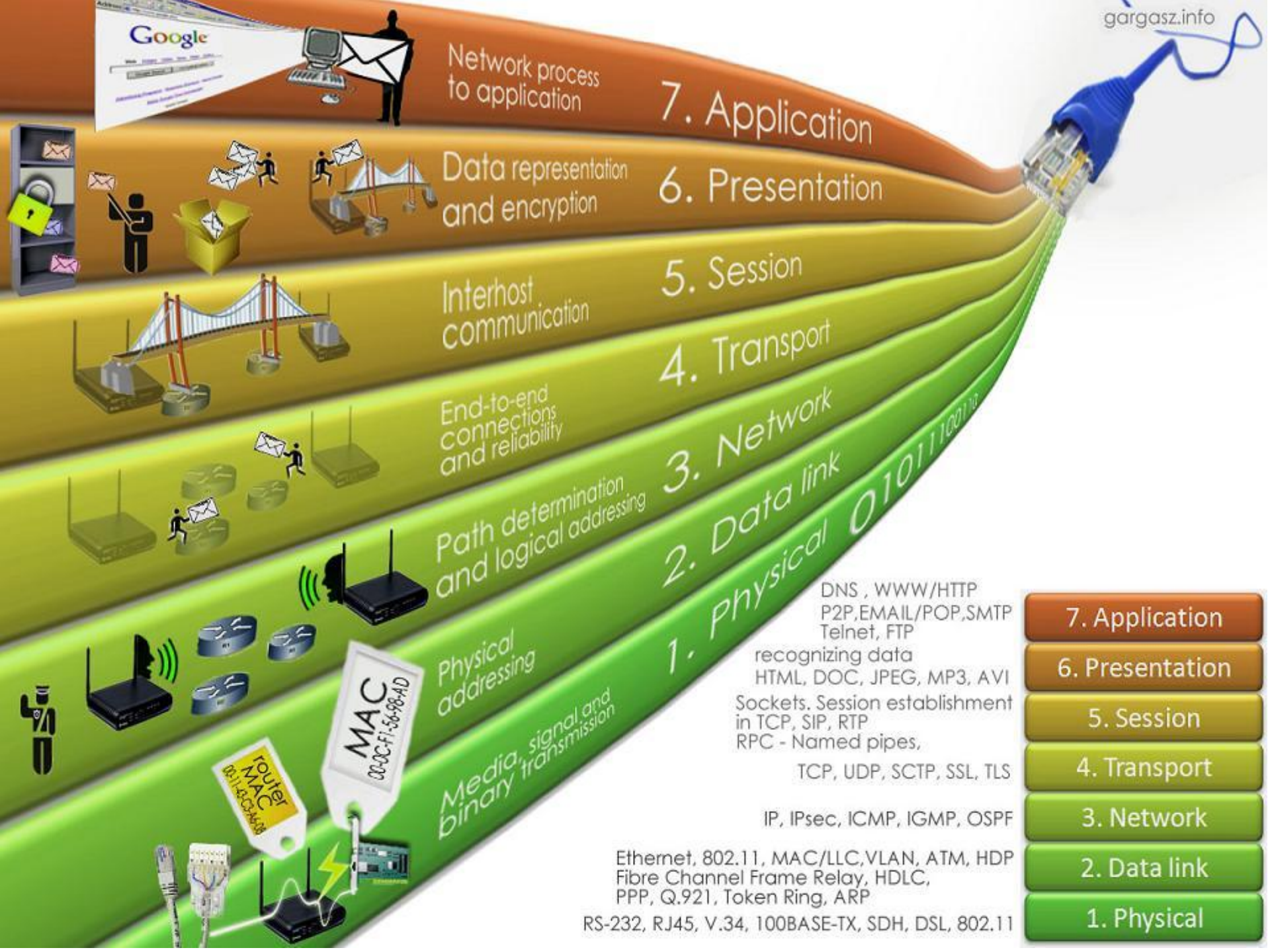


Introduction to Networks

Lecture 4:

OSI Model Layers Protocols

Lecturer :Dr. Suad A. Alasadi



Network process to application

7. Application

Data representation and encryption

6. Presentation

Interhost communication

5. Session

End-to-end connections and reliability

4. Transport

Path determination and logical addressing

3. Network

Physical addressing

2. Data link

Media, signal and binary transmission

1. Physical

DNS , WWW/HTTP
P2P,EMAIL/POP,SMTP
Telnet, FTP

7. Application

recognizing data
HTML, DOC, JPEG, MP3, AVI
Sockets. Session establishment
in TCP, SIP, RTP
RPC - Named pipes,

6. Presentation

TCP, UDP, SCTP, SSL, TLS

5. Session

IP, IPsec, ICMP, IGMP, OSPF

4. Transport

Ethernet, 802.11, MAC/LLC,VLAN, ATM, HDP
Fibre Channel Frame Relay, HDLC,
PPP, Q.921, Token Ring, ARP

3. Network

RS-232, RJ45, V.34, 100BASE-TX, SDH, DSL, 802.11

2. Data link

1. Physical

Google

MAC
00-0C-F1-56-98-AD

Router
MAC
00-14-3C-34-68

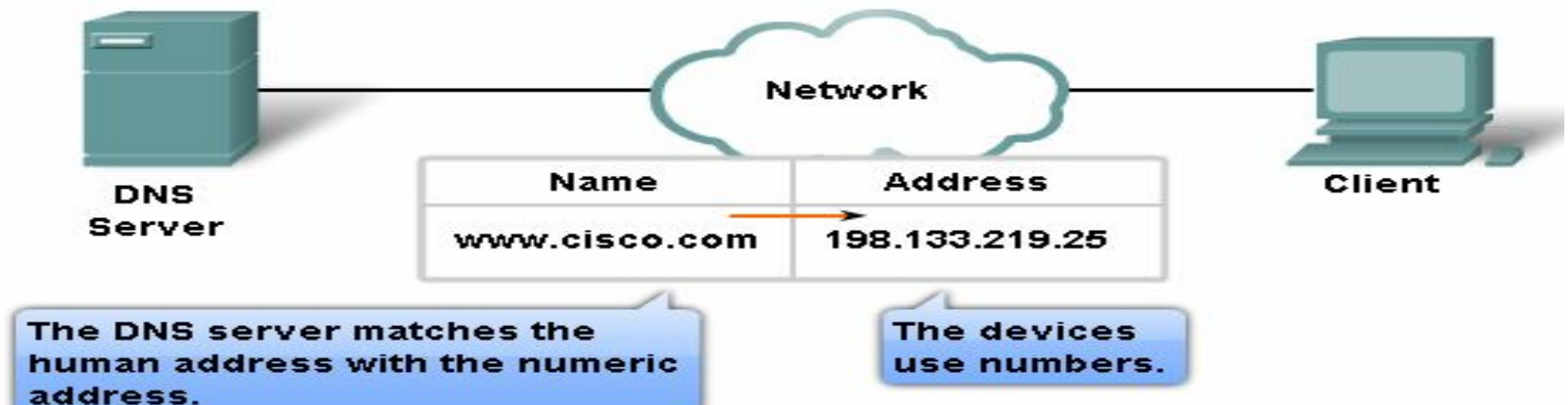
Protocols

- A *protocol* is a set of rules. The OSI model provides a framework for the *communication protocols* used between computers. Just as we need rules of the road—for example, so that we know that a red light means stop and a green light means go—computers also need to agree on a set of rules to successfully communicate.
- Two computers must use the same protocol to communicate. Computers that try to use different protocols would be analogous to speaking in Italian to someone who understands only English—it would not work.
- Many *protocol suites* define various protocols that correspond to the functions defined in the seven OSI layers, including routed protocols, a selection of routing protocols, applications, and so forth. Protocol suites are also known as *protocol stacks*.
- The most widely used network protocol suite today is the TCP/IP suite.

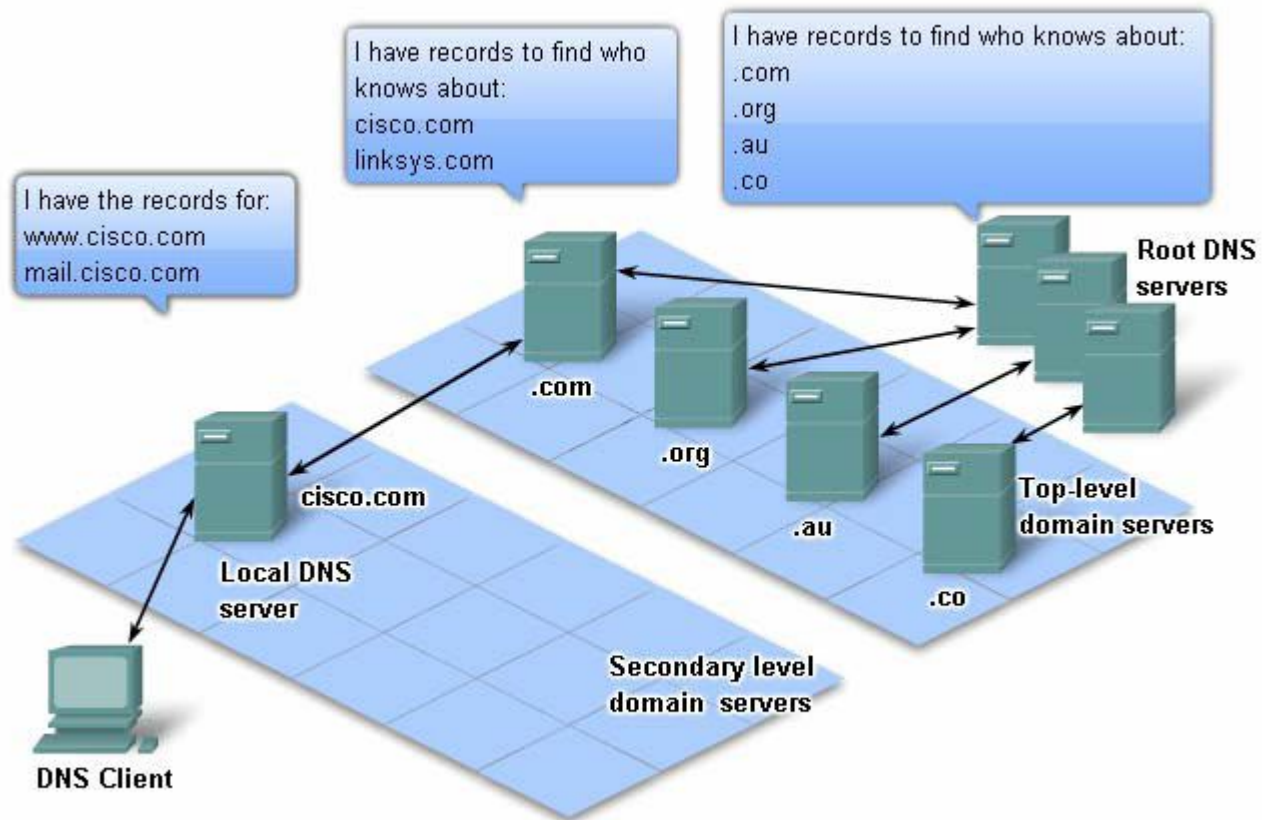
Application layer Protocols

- Application layer examples include:
- **Domain Name Service (DNS)** :DNS protocol is used to resolve Internet names to IP addresses.

Resolving DNS Addresses



Application layer protocols



A hierarchy of DNS servers contains the resource records that match names with addresses.

Application layer protocols

- **Application layer examples include:**
- **Dynamic Host Configuration Protocol (DHCP)** :Enables devices on a network to obtain IP addresses and other information from a DHCP server. DHCP allows a host to obtain an IP address dynamically when it connects to the network.
- **File Transfer Protocol (FTP)** : FTP was developed to allow for file transfers between a client and a server . (FTP) Protocol is used for interactive file transfer between systems.
- **Simple Mail Transfer Protocol (SMTP)** : is used for the transfer of mail messages and attachments.
- **Terminal Emulation Protocol (Telnet)**: is used to provide remote access to servers and networking devices.

Application layer protocols

- **Application layer examples include:**

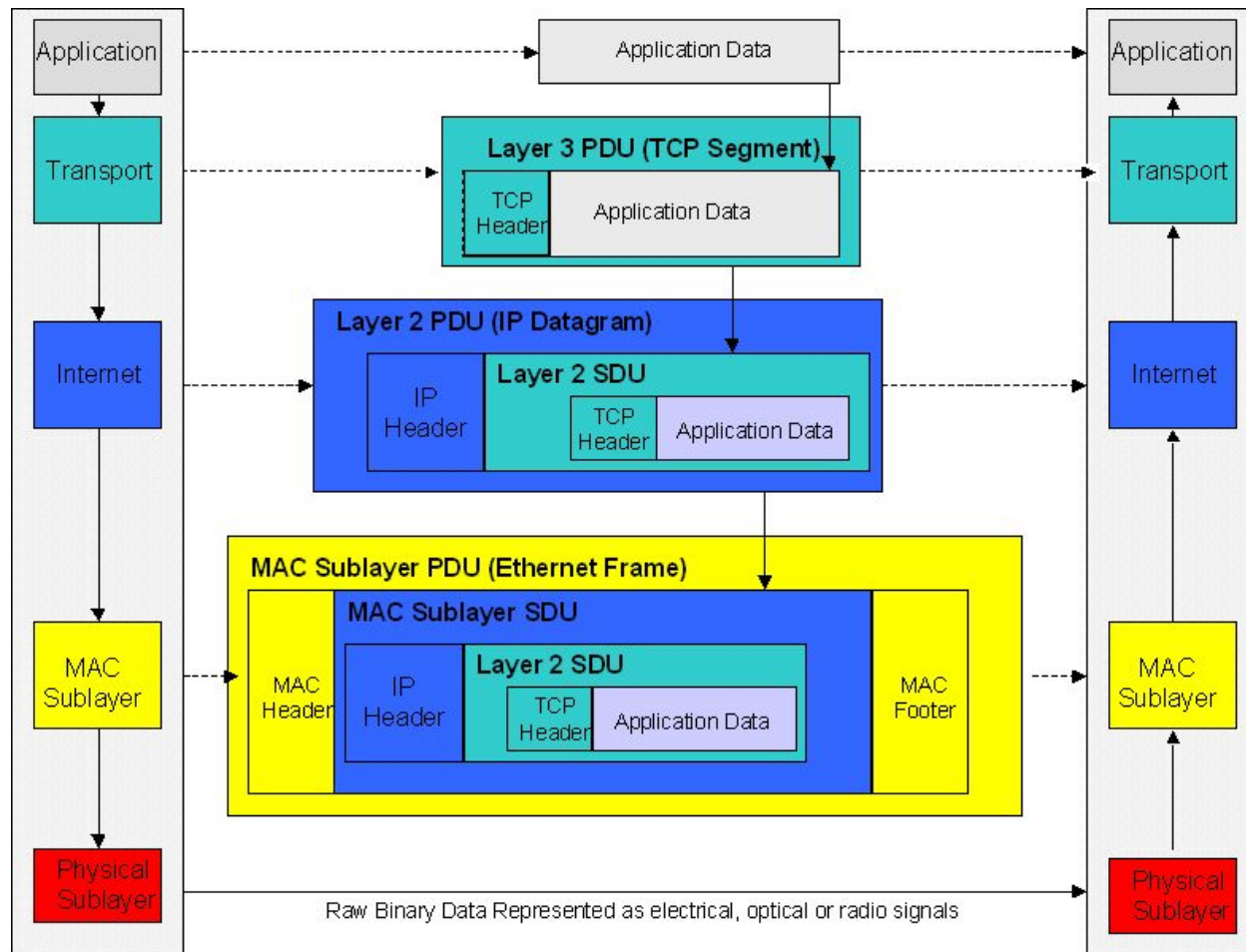
- **Hypertext Transfer Protocol (HTTP)** :The (HTTP) is one of the protocols in the TCP/IP suite, was originally developed to publish and retrieve HTML pages and is now used for distributed, collaborative information systems. HTTP is used across the WWW for data transfer and is one of the most used application protocols. (HTTP) is used to transfer files that make up the Web pages of the World Wide Web.

- **Uniform Resource Locator (URL)** : When a web address (or URL) is typed into a web browser, the web browser establishes a connection to the web service running on the server using the HTTP protocol. URLs (or Uniform Resource Locator) and URIs (Uniform Resource Identifier) are the names most people associate with web addresses.

Application layer protocols

- **Application layer examples include:**
- Post Office Protocol (POP).
- Internet Message Access Protocol (IMAP).
- Internet Relay Chat (IRC).
- Simple Network Management Protocol (SNMP)

Transport Layer protocols



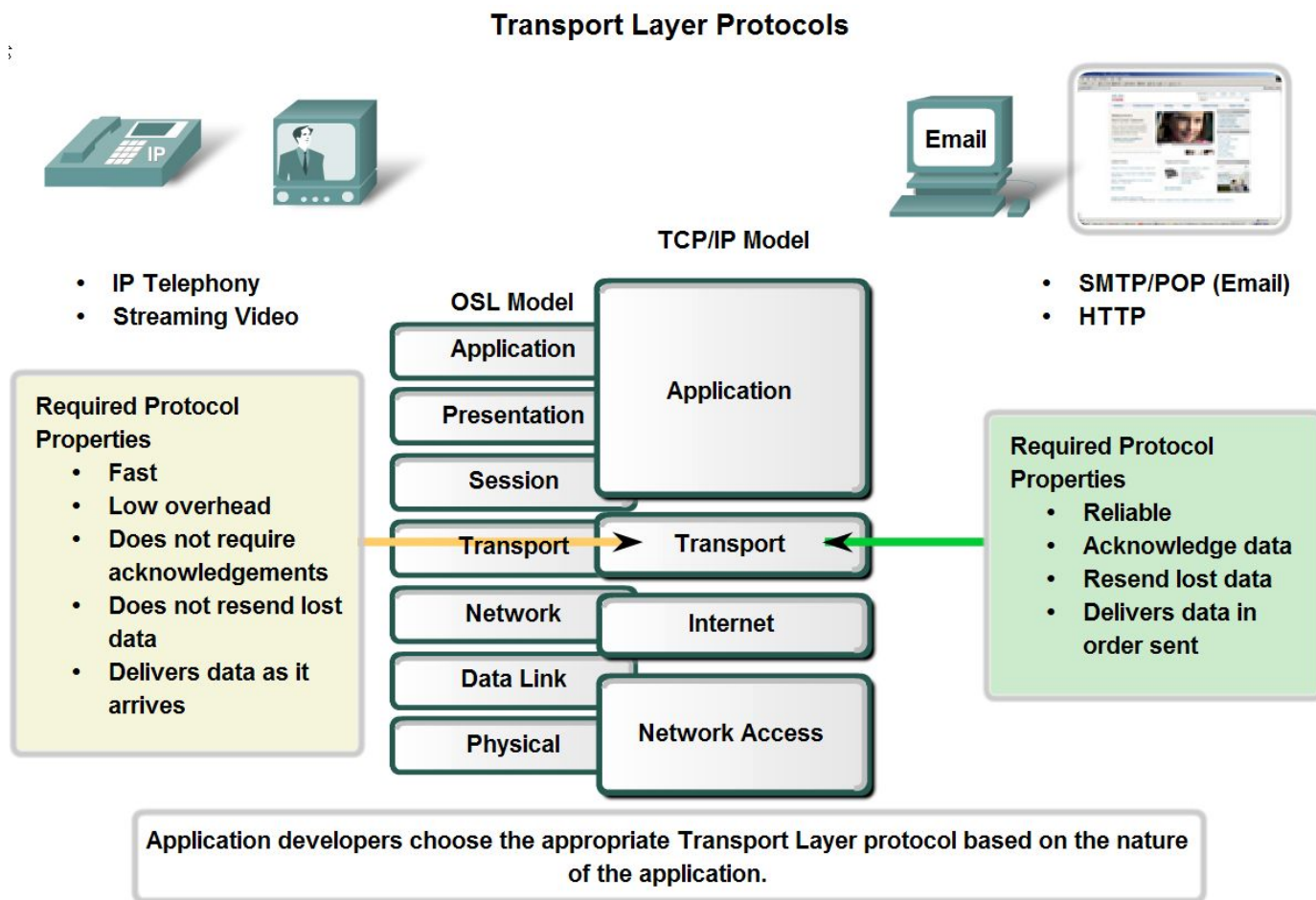
Transport Layer protocols

- The Transport layer provides for the **segmentation of data** and the **control necessary** to reassemble these pieces into the various communication streams. Its primary responsibilities to accomplish this are:
 - **Segmenting data and managing each piece.**
 - **Reassembling the segments into streams of application data**
 - **Identifying the different applications.**

Transport Layer protocols

UDP Protocol

TCP Protocol



Transport Layer Header

TCP and UDP Headers

TCP SEGMENT & HEADER FIELDS



UDP SEGMENT & HEADER FIELDS



TCP Connection Establishment and Termination

- Three way handshake
- **Step 1**
- A TCP client begins the three-way handshake by sending a segment with the SYN (Synchronize Sequence Number) control flag set, indicating an initial value in the sequence number field in the header. This initial value for the sequence number, known as the Initial Sequence Number (ISN), is **randomly chosen** and is used to begin tracking the flow of data from the client to the server for this session. The ISN in the header of each segment is increased by one for each byte of data sent from the client to the server as the data conversation continues

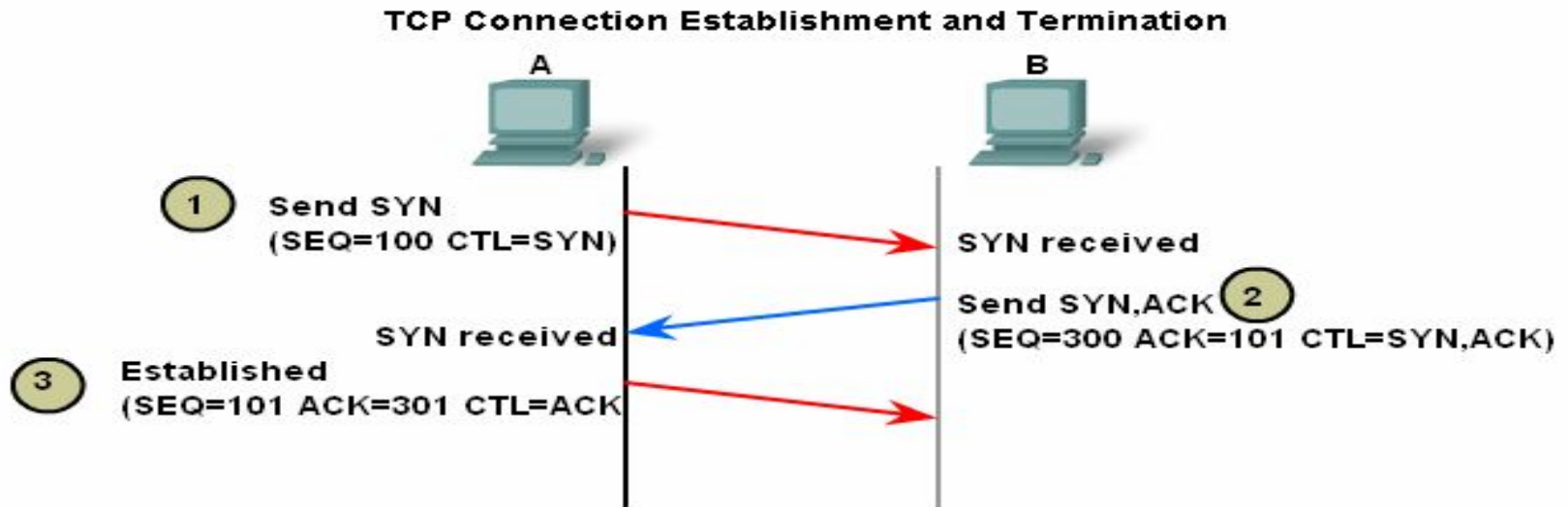
TCP Connection Establishment and Termination

- **Step 2**
- The TCP server needs to acknowledge the receipt of the SYN segment from the client to establish the session from the client to the server. To do so, the server sends a segment back to the client with the ACK flag set indicating that the Acknowledgment number is significant. With this flag set in the segment, the client recognizes this as an acknowledgement that the server received the SYN from the TCP client.
- The value of the acknowledgment number field is equal to the client initial sequence number plus 1.

TCP Connection Establishment and Termination

- **Step 3**
- Finally, the TCP client responds with a segment containing an ACK that is the response to the TCP SYN sent by the server. There is no user data in this segment.

TCP Connection Establishment and Termination



ctl = Which control bits in the TCP header are set to

¹
A sends ACK response to B.

Reset SYN ACK 1 2 3

FIN ACK 1 2 3 4 End

Click to see the steps.

The Transport Layer applications port numbers

- **Transport Layer Role and Services**

TCP and UDP Headers

TCP SEGMENT & HEADER FIELDS



UDP SEGMENT & HEADER FIELDS



(The Transport Layer(Cont.

Port Addressing

The Internet Assigned Numbers Authority (IANA) assigns port numbers. IANA is a standards body that is responsible for assigning various addressing standards.

There are different types of port numbers:

1- Well Known Ports (Numbers 0 to 1023) - These numbers are reserved for services and applications.

2- Registered Ports (Numbers 1024 to 49151) - These port numbers are assigned to user processes or applications. These processes are primarily individual applications that a user has chosen to install rather than common applications that would receive a Well Known Port. When not used for a server resource, these ports may also be used dynamically selected by a client as its source port.

3- Dynamic or Private Ports (Numbers 49152 to 65535) - Also known as Ephemeral Ports, these are usually assigned dynamically to client applications when initiating a connection.

The Transport Layer(Cont.)

Port Numbers

Port Number Range	Port Group
0 to 1023	Well Known (Contact) Ports
1024 to 49151	Registered Ports
49152 to 65535	Private and/or Dynamic Ports

Registered TCP Ports:

1863 MSN Messenger
8008 Alternate HTTP
8080 Alternate HTTP

Well Known TCP Ports

21 FTP
23 Telnet
25 SMTP
80 HTTP
110 POP3
194 Internet Relay Chat (IRC)
443 Secure HTTP (HTTPS)

Reset

TCP Ports

UDP Ports

TCP/UDP Common Ports

Click to see the example ports numbers.

The Transport Layer(Cont.)

Port Numbers

Port Number Range	Port Group
0 to 1023	Well Known (Contact) Ports
1024 to 49151	Registered Ports
49152 to 65535	Private and/or Dynamic Ports

Registered UDP Ports:

1812 RADIUS Authentication Protocol
2000 Cisco SCCP (VoIP)
5004 RTP (Voice and Video Transport Protocol)
5060 SIP (VoIP)

Well Known UDP Ports:

69 TFTP
520 RIP

Reset

TCP Ports

UDP Ports

TCP/UDP Common Ports

Click to see the example ports numbers.

The Transport Layer(Cont.)

Port Numbers

Port Number Range	Port Group
0 to 1023	Well Known (Contact) Ports
1024 to 49151	Registered Ports
49152 to 65535	Private and/or Dynamic Ports

Registered TCP/UDP Common Ports: 1433 MS SQL 2948 WAP (MMS)	Well Known TCP/UDP Common Ports: 53 DNS 161 SNMP 531 AOL Instant Messenger, IRC
--	---

The diagram illustrates the classification of port numbers into three groups: Well Known (Contact) Ports (0-1023), Registered Ports (1024-49151), and Private and/or Dynamic Ports (49152-65535). Below the table, two boxes provide examples of common ports. The 'Registered TCP/UDP Common Ports' box lists 1433 for MS SQL and 2948 for WAP (MMS). The 'Well Known TCP/UDP Common Ports' box lists 53 for DNS, 161 for SNMP, and 531 for AOL Instant Messenger and IRC. Arrows point from these boxes to their respective ranges in the table.

[Reset](#) [TCP Ports](#) [UDP Ports](#) [TCP/UDP Common Ports](#)

Click to see the example ports numbers.

The Transport Layer(Cont.)

- **Domain Name Service (DNS):** TCP/UDP port 53
- **HTTP:** TCP port 80
- **Simple Mail Transfer Protocol (SMTP):** TCP port 25
- **Post Office Protocol (POP):** UDP port 110
- **Telnet:** TCP port 23
- **DHCP:** UDP port 67
- **FTP:** TCP ports 20 and 21

Thank You