

LE 517

Data Communications and Networks

Week 13:- Wide Area Networks

By

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Wide Area Networks

- Internet Protocol
 - TCP/IP
 - DoD Internet Protocol
 - Internet Control Message Protocol
- Transport Protocols
 - DoD Transmission Control Protocol
 - User Datagram Protocol
 - OSI Transport Protocols

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Internet Protocol

- 1960s, Military began funding for developing communications systems.
- There millions of nodes connect to the internet.
- Every data on the Internet is using packet switching network.

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TCP/IP

- TCP (Transmission control protocol)
- IP (Internet Protocol)

- They are working on both layer 3 and 4.

- Every connecting node can use the same principal.

TCP/IP

- There are specific application protocols for Internet.
- SMTP (Simple Mail Transfer Protocol) - 25
- TELNET - 23
- FTP (File Transfer Protocol) - 21
- DNS (Domain Name Server) - 53

TCP/IP



SMTP Protocol

TCP/IP

Common FTP Commands

| | |
|---------------|---|
| ? | to request help or information about the FTP commands |
| ascii | to set the mode of file transfer to ASCII (this is the default and transmits seven bits per character) |
| binary | to set the mode of file transfer to binary (the binary mode transmits all eight bits per byte and thus provides less chance of a transmission error and must be used to transmit files other than ASCII files) |
| bye | to exit the FTP environment (same as quit) |
| cd | to change directory on the remote machine |
| close | to terminate a connection with another computer |
| close brubeck | closes the current FTP connection with brubeck, but still leaves you within the FTP environment. |
| delete | to delete (remove) a file in the current remote directory (same as rm in UNIX) |
| get | to copy one file from the remote machine to the local machine |
| get ABC DEF | copies file ABC in the current remote directory to (or on top of) a file named DEF in your current local directory. |
| get ABC | copies file ABC in the current remote directory to (or on top of) a file with the same name, ABC, in your current local directory. |
| help | to request a list of all available FTP commands |
| lcd | to change directory on your local machine (same as UNIX cd) |
| ls | to list the names of the files in the current remote directory |
| mkdir | to make a new directory within the current remote directory |
| mget | to copy multiple files from the remote machine to the local machine; you are prompted for a y/n answer before transferring each file |
| mget * | copies all the files in the current remote directory to your current local directory, using the same filenames. Notice the use of the wild card character, *. |
| mput | to copy multiple files from the local machine to the remote machine; you are prompted for a y/n answer before transferring each file |

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DoD Internet Protocol

- Internet Protocol is design to able to route between host with IP.
- Therefore in the middle of network, different type of LAN will able to server the Internet Protocol.
- Internet Datagram will travel along the network and be routed with the IP.

Internet Protocol

| 4 Bits | 8 Bits | 16 Bits | 24 Bits |
|------------------------|----------|-----------------|-----------------|
| Version | IHL | Type of Service | Total Length |
| Identification | | Flags | Fragment Offset |
| Time to Live | Protocol | Header Checksum | |
| Source IP Address | | | |
| Destination IP Address | | | |
| IP Options | | | Padding |
| Data | | | |

Internet Protocol

- **1. Version** - The version is a binary number that is four bits long. It indicates which version of IP is being used. Currently we are using IP version four, although IP version six will soon make an impact on the networking world.
- **2. IHL (Internet Header Length)** - The IHL simply measures the length of the IP header in 32-bit words. The minimum header length is five 32-bit words.
- **3. Type of Service** - This field is for specifying special routing information. This field in particular relates to Quality of Service technologies quite well. Essentially, the purpose of this 8-bit field is to prioritize datagrams that are waiting to pass through a router.
- **4. Total Length** - This 16-bit field includes the length of the IP datagram. This length includes the IP header and also the data itself.

Internet Protocol

- **5. Identification** - This is a 16-bit field that acts as a means of organizing chunks of data. If a message is too large to fit in one data packet, it is split up and all of its child packets are given the same identification number. This is handy to ensure data is rebuilt on the receiving end properly.
- **6. Flags** - This field signifies fragmentation options- such as whether or not fragments are allowed. The Flags field also has capability to tell the receiving source that more fragments are on the way, if enabled. This is done with the MF flag, also known as the more fragments flag.
- **7. Fragment Offset** - This is a 13-bit field that assigns a number value to each fragment. The receiving computer will then use these numbers to reassemble the data correctly. Obviously this is only applicable if fragments are allowed.

Internet Protocol

- **8. Time to Live** - This is often known as TTL. It is a field that indicates how many hops a data packet should go through before it is discarded. Every successful pass through a router, known as a hop, decrements this field by one. When it reaches zero, it is discarded.
- **9. Protocol** - This 8-bit field indicates which protocol should be used to receive the data. Some of the more popular protocols such as TCP and UDP are identified by the numbers 6 and 17 respectively.
- **10. Header Checksum** - This 16-bit field holds a calculated value that is used to verify that the header is still valid. Each time a packet travels through a router this value is recalculated to ensure the header is still indeed valid.

Internet Protocol

- **11. Destination IP Address** - This 32-bit field holds the IP address of the receiving computer. It is used to route the packet and to make sure that only the computer with the IP address in this field obtains the packets.
- **12. Source IP Address** - This 32-bit field holds the IP address of the sending computer. It is used to verify correct delivery, and will also be the return address in case an error occurs.
- **13. IP Options** - This field can hold a fair number of optional settings. These settings are primarily used for testing and security purposes. Although clever settings such as keeping timestamp data from each router hop may seem handy, it will actually degrade speed more often than not.

Internet Protocol

- **14. Padding** - Since the IP options field varies in length depending on the configuration, we need to have this field set to occupy left over bits. This is because the header needs to be ended after a 32-bit word: no more, no less.
- **15. Data** - This is fairly self explanatory- it is simply the data that is being sent.

Internet Protocol

- Additional Feature
 - MTU (Maximum Transfer Units) – Fragmentation control
 - The flag field contains mfb (more fragments bit)
 - There is ***do not fragment bit***.

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Internet Control Message Protocol

- ICMP (Internet Control Message Protocol)
 - Destination unreachable
 - The destination is down
 - Fragment bit set is too large
 - Echo request
 - The check the destination is reachable
 - Echo reply
 - To response the Echo request

Internet Control Message Protocol

- Parameter Problem
- Redirect
 - Send back to host for faster sending
- Source quench
 - To many packet arrived at router
- Time exceeded
- Timestamp request reply
 - To check round trip time

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Transport Protocols

- Transport Protocol:-Establish and end connection
 - Connection Management
 - Handshaking
 - Flow Control
 - Error Detection
 - Response to users' requests
 - Establish both connectionless or connection-oriented communication
 - Reliable communication
 - IP does not guarantee.

Transport Protocols

- DoD designed
 - TCP (Transmission Control Protocol)
 - Connection oriented
 - UDP (User Datagram Protocol)
 - Connection less

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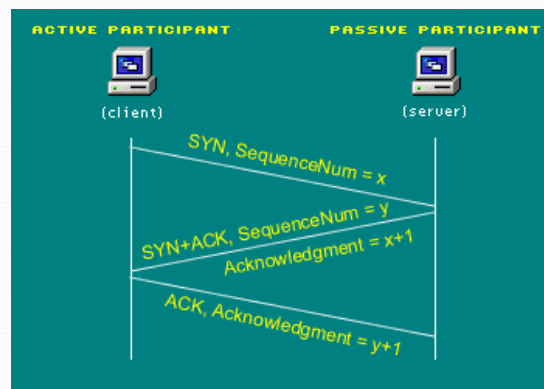
DoD Transmission Control Protocol

| | | | |
|-----------------------------|--------------|-----------------------|-------------|
| Source Port (16) | | Destination Port (16) | |
| Sequence Number (32) | | | |
| Acknowledgement Number (32) | | | |
| Data offset | Reserved (6) | Flags (6) | Window (16) |
| Checksum (16) | | Urgent (16) | |
| Options and Padding | | | |
| Data (Varies) | | | |

DoD Transmission Control Protocol

- Destination Port:- Identify application
- Source Port:- Identify sending application
- Sequence number:- running up + data size
- Acknowledgement number
- Offset:- size of header
- Window:- size of sliding window
- Urgent Pointer:- urgent to deliver to higher layer

DoD Transmission Control Protocol



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User Datagram Protocol

| | |
|-----------------------|----------------------------|
| Source Port (16 bits) | Destination Port (16 bits) |
| Length (16 bits) | Checksum (16 bits) |
| Data | |

User Datagram Protocol

- If there is no error UDP passes to higher layer
- If founded error, discard the data.

Wide Area Networks

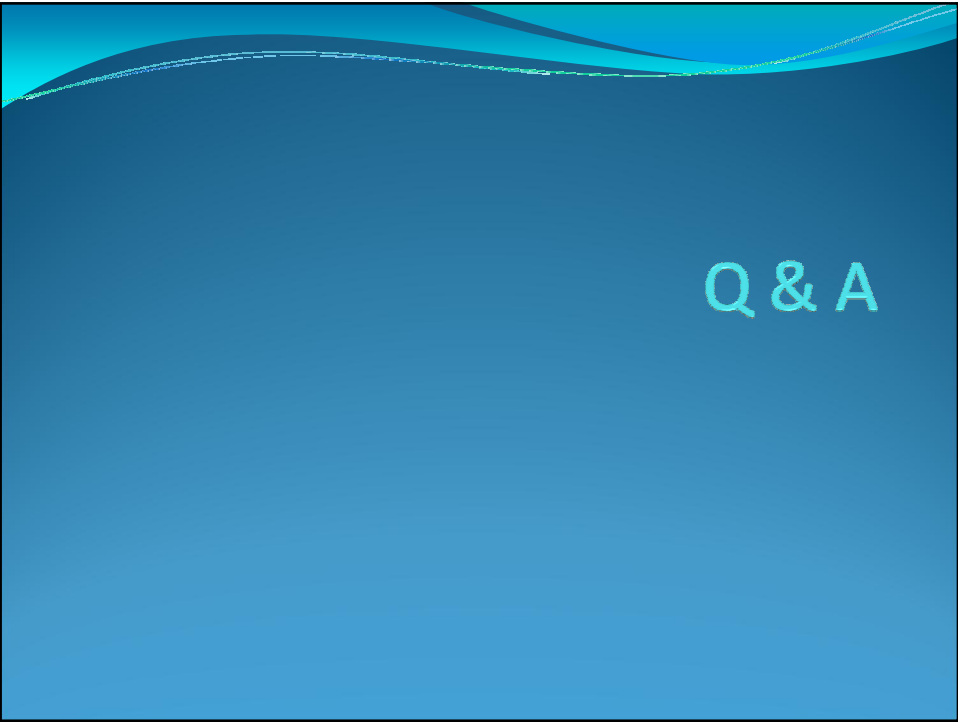
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OSI Transport Protocols

- ISO defines 5 classes in transport protocol standard.
 - TP₀, TP₁, TP₂, TP₃, TP₄
 - TP₄ is designed to run on top of unreliable network.
 - Important data
 - Piggybacked acknowledgements
 - Sequencing
 - Flow Control

Reference

- <http://www.cs.colostate.edu/helpdocs/ftp.html>
- <http://www.yuki-onna.co.uk/email/sntp.html>
- <http://learn-networking.com/tcp-ip/how-the-internet-layer-works/comment-page-1>
- www.proprofs.com/mwiki/images/4/47/TCP-header.GIF
- <http://www.geocities.com/jchakma/TCPIP/ThreeWayHandshake.html>



Q & A