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**Chapter 5 questions**

**Question 3: What are the parts of TCP/IP and what do they do? Who is the primary user of TCP/IP?**

The parts of TCP/IP are TCP, which is the transport layer protocol, and IP, which is the network layer protocol.

The transport layer protocol “links the application layer to the network layer” (FitzGerald, J. p. 116). On top of connecting the application layer to the network layer, the transport layer protocol segments data, which means that it breaks down the data into smaller PDUs. After breaking down the data/segmenting it, it then numbers the segments and makes sure that they are properly delivered and in order for the receiving destination (FitzGerald, J. p. 116).

The network layer protocol “performs addressing and routing” (FitzGerald, J. p. 116). Specifying into addressing and routing, the network layer protocol uses software on both the sending and receiving sides of the message in order to properly route the data/tell it where it’s going to (FitzGerald, J. p. 116).

The primary user of TCP/IP is the United States Department of Defense’s Advanced Research Project Agency network, which is also known as ARPANET, and was developed for them by Vinton Cerf and Bob Kahn. However, nowadays TCP/IP is used on almost every backbone network (BN) and wide area network (WAN) (FitzGerald, J. p. 116).

**Question 4: Compare and contrast the three types of addresses used in a network.**

The three types of addresses used in a network are the application layer address, network layer address, and the data link layer address (FitzGerald, J. p. 123 - 124).

Application layer address – Often times when you are using software which is an application it is considered to be using the application layer. The application layer address is also referred to as the server’s name. The application layer address also passes what the user types in a URL from a web browser as an application layer packet to the network layer (FitzGerald, J. p. 123).

Network layer address – The network layer address translates the web address into a 4-byte long IP address, if using IPv4. The network layer then determines the best route to be taken through the network to its receiver/final destination (FitzGerald, J. p. 124). The network layer address then, based upon its route, then determines the data link address of the computer which the message is to be sent to (FitzGerald, J. p. 124).

Data link layer address – The data link layer address is the physical or MAC address of the network card within a machine (FitzGerald, J. p. 124).

**Question 5: How is TCP different from UDP?**

TCP –

* TCP usually has a 192-bit header, simplified to 24 bytes (FitzGerald, J. p. 116)
* TCP also contains the source and destination port (FitzGerald, J. p. 116)
* Checks for lost messages (FitzGerald, J. p. 117)

UDP –

* TCP only has 4 fields and has 8-bytes of overheads (FitzGerald, J. p. 117)
* UDP is typically used when the sender needs to send a single, small packet (FitzGerald, J. p. 117)
* Does not check for lost messages (FitzGerald, J. p. 117)

This shows that TCP uses a 192-bit header and is simplified to 24 bytes, UDP uses 8-bytes. TCP checks for lost messages, and UDP does not. TCP contains the source destination and port while UDP may not necessarily contain it all, as well as UDP is often used for when they need to send a single, small packet, while TCP may be used for larger and multiple packets.

**Question 7: What is a subnet and why do networks need them?**

A subnet, also referred to as a subnetwork, divides networks into smaller, more logical pieces to allow people to be able to know what network the device is on, and to help assist in efficiency in assigning IPs (FitzGerald, J. p. 127).

**Question 8: What is a subnet mask?**

A subnet mask allows us to be able to designate any IP as if it were apart of a subnet. Subnet masks help determine if a computer within a network is on the same subnet as another computer. It is important for computers to be able to know which other devices are on the same subnet as it, to help with routing of messages (FitzGerald, J. p. 128).

**Question 10: What benefits and problems does dynamic addressing provide?**

Some of the benefits of dynamic addressing are that it saves a lot of time by preventing having the need of having someone go to each computer and edit files, as well it can be more accurate than a human if they were typing all the addresses in files. (FitzGerald, J. p. 128). One of the downsides of dynamic addressing is that if using DHCP (the most common standard) is that in order to connect to the network it must first talk with a DHCP server. This means, if the DHCP server is slow or offline that it may have a slow connection to the network or even no connection at all (FitzGerald, J. p. 129).

**Question 12: How does TCP/IP perform address resolution from URLs into network layer addresses?**

TCP/IP uses two different approaches in order to perform address resolution from URLs into network layer addresses. The first approach is for resolving application layer addresses into IP addresses, and the second approach which TCP/IP has is to resolve IP addresses into data link layer addresses (FitzGerald, J. p. 129).

For the first approach, we use server name resolution, which simply stands for the translation of application layer addresses into network layer addresses. This is typically done using DNS, or a Domain Name Service. There are tons of servers on the Internet which are used as name servers, which provide the DNS service. These name servers are what stores Internet addresses/domains, and their matching IP address. For TCP/IP to be able to perform the address resolution, it sends a message to a DNS server and the DNS server sends a response back with the IP address, that is, if the server has a matching address (FitzGerald, J. p. 129-130).

**Question 13: How does TCP/IP perform address resolution from IP addresses into data link layer addresses?**

The second approach for TCP/IP to perform address resolution is through the use of data link layer address resolution. For a computer to send a message to another computer ion a subnet it must know there it is sending the message to, which requires knowing the correct data link layer address. Using TCP/IP software, a computer will send a broadcast message to all computers on a subnet. The broadcast message is usually formatted using ARP, also known as the Address Resolution Protocol. It tells the computers receiving the broadcast on the subnet to respond back using its format to the sender of the broadcast message. This allows the broadcaster to then communicate with that computer, as it would have send its data link layer address in the message (FitzGerald, J. p. 131).

**Question 15: How does decentralized routing differ from centralized routing?**

Centralized routing –

* All decisions for routing are made through a centralized computer or router (FitzGerald, J. p. 133)
* Most commonly used in host-based networks (FitzGerald, J. p. 133)
* Usually, routing decisions are simple (FitzGerald, J. p. 133)
* Since all computers are connected to the central computer, any message needing to be routed is sent through the central computer and is then sent to the correct circuit for its destination (FitzGerald, J. p. 133)

Decentralized routing –

* Also known as static routing (FitzGerald, J. p. 133)
* All computers or routers within the network make their own routing decisions (FitzGerald, J. p. 133)
  + Using a formal routing protocol (FitzGerald, J. p. 133).
* Self-adjusting (FitzGerald, J. p. 133)
  + Automatically update/adjust to changes within a network configuration (FitzGerald, J. p. 133)
* Has a routing table developed by either network manager, an individual, or committee (FitzGerald, J. p. 133)
* Most commonly used in networks which have limited routing options that rarely change

This shows that centralized routing all goes through a single computer which performs the routing, decentralized all computers perform their own routing using a protocol. Centralized routing is most commonly used in a host-based network while decentralized is for a network with limited routing options that do not often change. Decentralized routing is also self-adjusting and uses a routing table. However, there are also other forms of decentralized routing such as dynamic routing, also known as adaptive routing, which is a form of decentralized routing. (FitzGerald, J. p. 133).

**Question 21: Explain how the client computer in Figure 5-16 (128.192.98.xx) would obtain the data link layer address of its subnet router.**

In this example, a client computer would know the IP address of its subnet’s gateway. This is usually done by having a network manager setup a configuration file or through a DHCP server (FitzGerald, J. p. 137-138). Despite this, the client computer will not know the Ethernet address, also known as the data link layer address, of its subnet router. As a result of this, the client computer will likely send out an ARP request/broadcast throughout the computers on its subnet, which is requesting the data link layer address of the computer at 128.192.98.1, as shown on the figure (FitzGerald, J. p. 139). The subnet gateway would then respond to the broadcast with the proper format of its data link layer address. The client computer, then, ideally will store this address within its stored table.

**Question 22: How does HTTP use TCP and DNS use UDP?**

HTTP, specifically at the application layer, uses TCP by sending its message through it to the transport layer. This message must contain the internet address of which the message is being sent to. TCP then performs its functions and sends the message to the network layer. (FitzGerald, J. p. 116-117.

DNS uses UDP by sending a domain name or an IP address to it. Which is sent through the transport layer to the network layer. The problem with this, however, is sometimes the message is lost because it doesn’t check for lost messages. (FitzGerald, J. p. 117).

**Question 23: How does static routing differ from dynamic routing? When would you use static routing? When would you use dynamic routing?**

Static routing –

* Is decentralized (FitzGerald, J. p. 133)
* All computers or routers within the network make their own routing decisions through the use of a formal routing protocol (FitzGerald, J. p. 133)
* Self-adjusting, meaning it automatically updates/adjusts to changes within a network (FitzGerald, J. p. 133)
* Has a routing table developed by either network manager, an individual, or committee (FitzGerald, J. p. 133)
* Most commonly used in networks which have limited routing options that rarely change

Dynamic routing –

* Also known as adaptive routing (FitzGerald, J. p. 133)
* Decentralized (FitzGerald, J. p. 133)
  + Routing decisions made by individual computers (FitzGerald, J. p. 133)
* Multiple routes through a network (FitzGerald, J. p. 133)
  + Important to select best route (FitzGerald, J. p. 133)
* Tries to improve network performance, this is done by trying to route through the fastest route
* Uses an initial routing table but is updated by the computers/self-adjusting (FitzGerald, J. p. 133)
* Has distance vector dynamic routing or link state dynamic routing (FitzGerald, J. p. 133)
  + Distance vector dynamic routing
    - This counts the number of hops/jumps along a specific route, a single hop is one circuit (FitzGerald, J. p. 133)
  + Link state dynamic routing
    - Computers tracks number of hops and speed of circuits in each route, as well as how busy each route is

This shows that static routing and dynamic routing’s largest difference is the type of routing it specifically performs and what it values, for example speed/improving network performance. I would use static routing over dynamic routing when in a little bit of a smaller network when there’s not too many options, this would mean that dynamic routing wouldn’t really make a difference and may be a more simple option. I would use dynamic routing when in a larger network with lots of routes and it’s important to get the best possible network performance.

**Question 24: What type of routing does a TCP/IP client use? What type of routing does a TCP/IP gateway use? Explain.**

A TCP/IP client uses static routing. This is since the client must go to/point to a single gateway/router. A TCP/IP gateway uses dynamic routing because it will be handling multiple requests which may be outside of/beyond the segment which it is a part of (FitzGerald, J. p. 139).

**Question 25: What is the transmission efficiency of a 10-byte Web request sent using HTTP, TCP/IP, and Ethernet? Assume that the HTTP packet has 100 bytes in addition to the 10-byte URL. Hint: Remember from Chapter 4 that efficiency = user data/total transmission size.**

User data: 10 bytes

Transmission size (this is if each TCP and IP includes user data, I wasn’t sure if each of them includes it or not, so I included calculations for both)

TCP:

16 + 16 + 32 + 32 + 4 + 3 + 9 + 16 + 16 + 16 + 32 + 80

= 272

= 34 bytes

IPv4:

4 + 4 + 8 + 16 + 16 + 3 + 13 + 8 + 8 + 16 + 32 + 32 + 32 + 80

= 272

= 34 bytes

Ethernet II:

7 + 1 + 6 + 6 + 2 + (userdata?) + 4

= 26 bytes

Additional overhead

10 bytes

100 + 10 + 34 + 34 + 26 = 204 bytes

10 / 204 = 0.0490196

0.0490196 \* 100 = 4.90196%

(FitzGerald, J. p. 103-105 & 116-117)

User data: 10 bytes

Transmission size (this is if I don’t include user data in TCP/IPv4)

TCP:

16 + 16 + 32 + 32 + 4 + 3 + 9 + 16 + 16 + 16 + 32

= 192 bits

= 24 bytes

IPv4:

4 + 4 + 8 + 16 + 16 + 3 + 13 + 8 + 8 + 16 + 32 + 32 + 32

= 192 bits

= 24 bytes

Ethernet II:

7 + 1 + 6 + 6 + 2 + (userdata?) + 4

= 26 bytes

Additional overhead

10 bytes

100 + 10 + 24 + 24 + 26 = 184 bytes

10 / 184 = 0.054347

0.054347 \* 100 = 5.4347%

(FitzGerald, J. p. 103-105 & 116-117)

**Question 27: What is the transmission efficiency of a 5,000-byte file sent in response to a Web request HTTP, TCP/IP, and Ethernet? Assume that the HTTP packet has 100 bytes in addition to the 5,000-byte file. Assume that the maximum packet size is 1,200 bytes. Hint: Remember from Chapter 4 that efficiency = user data/total transmission size.**

User data: 5,000 bytes

Total transmission size:

TCP: 24 bytes

IP: 24 bytes

Ethernet: 33 bytes

How many overheads:

Max packet size = 1,200 bytes

5,000 + 100 = 5,100 bytes

5,100 / 4 = 1,275 = too big for max packet size

5,100 / 5 = 1,020 = within range of max packet size, optimal

5,100 / 6 = 856 = within range of max packet size, but not optimal

First overhead:

100 + 24 + 24 + 33 = 181 bytes

Second overhead:

24 + 24 + 33 = 81

Third overhead:

24 + 24 + 33 = 81

Fourth overhead:

24 + 24 + 33 = 81

Fifth overhead:

24 + 24 + 33 = 81

5,000 / 5,000+(181+81+81+81+81)

5,000 + 181 + 81 + 81 + 81 + 81 = 5,505

5,000 / 5,505 = 0.908265

0.908265 \* 100 = 90.8265%

(FitzGerald, J. p. 103-105 & 116-117)

References:

Gwarzo, Z. (2022) *Business Data Communications*. <https://lawrencetech.instructure.com/courses/10753/files/2713884?wrap=1>

FitzGerald, J., Dennis, A., & Durcikova, A. (2021). Business data communications and networking (Fourteenth). Wiley.

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