1

WELCOME TO THE CLOUD

NETFLIX DIVES INTO THE AMAZON

Test Your Understanding

1. a) Why is the Internet usually depicted as a cloud?

   It symbolizes that users should not have to know how it works, just as you do not have to know how the electrical system works when you turn on a light.

   b) What is the significance of this depiction for users?

   The operation of the Internet should be hidden from them.

Hosts, Messages, and Addresses

Test Your Understanding

2. a) What is the term we use in networking for any computer attached to a network?

   Host

   b) Is your smartphone a host when you use it to surf the 'Web?

   Yes. By definition.

   c) Are you as a person a host when you use a network?

   No. You are not a computer! Always go back to the definition.

   d) How do application programs on different hosts communicate?

   They send messages to each other

3. a) What kind of addresses do hosts have on the Internet?

   Internet Protocol (IP addresses)

b) What kind of address is 128.171.17.13?

IPv4

c) What name do we use for the format 128.171.17.13?

Dotted decimal notation

d) Who uses this format—humans or computers?

Humans

e) Convert the following 32-bit binary IP address into DDN (spaces are added for easier reading): 10000000 10101011 00010001 00001101. (Check Figure: 10000000 = 128. In the first printing, this was erroneously printed as 127.)

128.171.17.13

f) Convert 5.6.7.138 into a 32-bit IP address. (Check Figure: 5 = 00000101) Show a space between each 8-bit segment.

00000101 00000110 00000111 00001100

g) What type of IP addresses is 32 bits long?

IPv4

h) What other type of IP address exists, and how long is its addresses?

IPv6, 128 bits

The Internet

Test Your Understanding

4. a) Is the Internet a single network? Explain.

   The Internet is not a single network. It is a collection of single networks and smaller internets.

   b) What is the role of ISPs?

   ISPs collectively form the core of the Internet, which is also called the Internet's backbone.

   c) Who controls the Internet?

   No one.

   d) Who funds the Internet?

   Users—both individual and corporate

Netflix Dives into the Amazon

Test Your Understanding

5. a) List Netflix's content delivery requirements.

Users will not tolerate delay or unreliability

b) What is transcoding?

Changing a movie or other video into a form that can be delivered to consumers by Netflix or another streaming services.

c) Why does Netflix make many transcoded versions of each movie?

To serve the particular needs of specific user equipment and network conditions.

d) How does Netflix use AWS?

For transcoding, selecting the best transcoded version for a particular user and set of network conditions, and personalized recommendations.

e) How do content delivery networks reduce streaming delays to customers?

They place a local content server near the user. Either near the user's ISP or within the user's ISP's premises.

Virtualization and Agility

6. a) Distinguish between physical servers and virtual machines.

Physical servers are real computers. Virtual machines are parts of a server that act like computers but are not. A physical server may have many virtual machines. VMs can be quickly spun up, spun down, or moved to different physical servers.

b) What can be done with virtual machines that would be difficult to do with physical servers?

Nearly instantaneous setup, tear-down, and movement to another machine.

c) What is VM instantiation?

Creating a new VM.

d) How does Netflix use the agility offered by Amazon Web Services?

It spins up additional VMs during peak viewing time and tears them down in low viewing periods.

Infrastructure as a Service (IaaS) and Software as a Service (SaaS)

7. a) What is a CSP? (Do not just spell out the acronym).

A cloud service provider that provides a service opaquely so that customers do not have to worry about the details.

b) Distinguish between IaaS CSPs and SaaS CSPs.

IaaSs provide VMs with operating systems but no application software.

SaaSs provide VMs complete with specific application software.

c) Is AWS an IaaS or a SaaS for Netflix?

AWS is an IaaS provider

d) Is Google an IaaS or a SaaS for Netflix?

Google is a SaaS provider

e) Who owns and manages the servers in IaaSs and SaaSs?

The cloud service provider in both

f) Who owns and manages the applications in IaaSs and SaaSs?

The cloud server provider in SaaS; the customer in IaaS.

g) In AWS, what does Netflix manage and not manage?

It does not manage the servers except in the sense of creating, deleting, or moving them.

It does manage the applications.

Clients Move into the Cloud

8. a) When a cloud virtual client is used, describe what happens when a user moves from one physical client device to another.

   All data files, applications, and application program personalizations are available to them.

   b) How does the use of virtual clients facilitate file sharing among customers of the system?

   Virtual clients can share files with other virtual clients easily.

   c) What are the advantages of using cloud application programs as a service, compared to traditional application purchasing?

   It avoids large one-time expenses in buying software and replaces it with smaller monthly expenses to pay for the service.

   At least some of the management work is outsourced to the CSP.

Rain Clouds: Security

9. What concerns do customers have about cloud security?

   That critical corporate data in the cloud may be hacked, that the government may be secretly looking at their data

Networks and the Cloud

10. Describe the relationship between cloud computing and networking.

    The explosive growth of cloud computing is putting a strain on network capacity.

Service Level Agreements (SLAs): Speed

11. a) What are service level agreements?

Service level agreements (SLAs) are guarantees that the CSP will meet specified service parameters or pay a penalty.

b) What happens if a service provider fails to meet its SLA?

It must pay a penalty

c) Is network speed usually measured in bytes per second (Bps) or bits per second (bps)?

bits per second (bps)

d) How many bits per second is 56 kbps without a metric prefix. (In other words, how many bits per second is it?)

56,000 bps

e) Express 47,303,000 bps with a metric prefix.

47.303 Mbps

f) Why do you need to know what application you are using to know what connection speed you need?

Some applications, such as e-mail, do not need fast connection speeds to be effective. Others, such as video streaming and data backup, do.

g) Distinguish between speed to individuals and corporate network speeds.

Speed to individuals is what individual employees experience. Corporate network speeds must be high enough for the aggregate speeds of individual employees.

WRITING SPEEDS IN METRIC NOTATION

12. a) How would you write four thousand bits per second in metric notation?

4 kbps

b) How would you write 45,250,000 bps in metric notation?

45.25 Mbps

c) How would you write 23.78 Mbps without a metric prefix?

23,780,000 bps

d) How would you write 0.047 Mbps without a metric prefix?

47,000 bps

13. a) Write 45.6355 kbps properly.

It is written properly.

b) Write 37,400 Mbps properly.

37.4 Gbps

c) Write 0.032 Mbps properly.

32 kbps

d) Write 37kbps properly.

37 kbps (needed a space)

e) Write 89k bps properly.

89 kbps (needed a space and bps)

MESSAGES

Application Messages

Message Fragmentation, Frames, and Packets

14. a) What is fragmentation?

Dividing an (application) message into many smaller parts that will each be sent in a packet or frame.

b) What are frames or packets?

They are small messages that carry application message segments. They travel across an internet (packet) or a single network (frame).

c) How does fragmentation improve error handling?

If there is a transmission error, only a single frame or packet is resent—not the entire applications message, which can be very long.

d) What is multiplexing?

Having the packets or frames of multiple users share a physical transmission line.

e) How does fragmentation reduce transmission cost through multiplexing?

Individual users do not have to pay for an entire line; they only pay for the capacity they actually use.

SINGLE NETWORKS

Test Your Understanding

15. What are the three defining characteristics of single networks?

A single networks uses a single technology for transmission. All devices must comply with that technology's standards.

There is a controlled address space such that each host address is unique, like a telephone number.

Messages in single networks are called frames, not packets.

Single-Network Host Addresses

16. a) What is the most widely used single-network address?

EUI-48

b) What else is it called?

MAC address

c) Why is the following NOT an EUI-48 address: A9-00-FF-93-BD?

There are only five symbol pairs, not six.

d) Are all single-network addresses EUI-48 addresses?

No.

Point-to-Point Single Networks, Physical Links, and Data links

17. a) In what type of single-network technology is the Point-to-Point (PPP) protocol used?

Point-to-point

b) What do physical layer standards govern?

Connectors and physical transmission.

c) What do data link layer (DLL) standards govern?

Frames and switch operation.

d) At what layer do you find EUI-addresses? (The answer is not directly in the text. It requires you to integrate the information you have learned.)

Data link layer

e) At what layer are frames defined?

Data link layer

18. a) Why is layering important for creating standards?

It breaks the standardization job into smaller pieces that can be worked on by specialists in that area.

b) What is the name and number of the lowest network standards layer?

Physical layer, Layer 1

c) What is the name and number of the second-lowest network standards layer?

Data link layer, Layer 2

d) At which layers are standards defined for single-network technologies?

Layers 1 and 2

e) At what layer or layers is PPP a standard?

Layer 2 because it defines frame organization.

Wireless Single Networks

19. a) In 802.11 Wi-Fi networks, what device relays frames between the source and destination hosts?

Wireless access point.

b) What two things do 802.11 data link layer standards govern?

Frame organization and access point operation

c) Is there always a single data link for a frame in a single network?

Yes

Switched Single Networks

20. a) What decision do switches have to make when a frame arrives?

Where to send it next

b) What is this decision called?

The switching decision

c) How do they make this decision?

Their switching table specifies where to send the frame next, based on the frame's destination address.

d) Does an individual switch know the frame's entire path through a switched single network?

No. Only the next hop.

e) Are frames addressed to the DLL addresses of a switch or the DLL addresses of a destination host? (The answer is not in the text.)

Destination hosts. Switches merely read the DLL address in the frame in order to pass it on to the destination host with the destination DLL address.

Hybrid Switched/Wireless Single Networks

21. a) Can you have a mixed wired and wireless network?

    Yes

    b) In a hybrid single-switched network, why do wireless clients need to connect to the wired network?

    This is where resources are that then need, including servers and the firm's Internet access router.

    c) What role do access points have in hybrid switched/wireless networks?

    They translate between wireless client frames and wired network frames.

INTERNET TRANSMISSION

Hosts on Different Single Networks

22. If two hosts are on two different single networks, what three problems must be overcome if they are to be able to communicate?

    First, the single networks may have different standards. They would not be able to make sense of each other's frames.

    Second, even if the two networks follow the same standard, this does not mean that they can interoperate. Most fundamentally, a host on one network may have the same DLL address as a host on the other network.

    Third, how would you link the two networks together? If the link used the standards of one network, it would not connect to the other network for the first two reasons.

Creating the Internet

23. a) What device connects different single networks together into an internet?

    A router

    b) Do single networks know that they are delivering frames to a router?

    No

    c) To what type of device do single networks think they are delivering frames?

    A destination host

    d) What devices understand what is really happening?

    The router and the source and destination host

24. Why was a new type of address needed for the Internet?

There needed to be an address that would be unique worldwide, unlike data link layer addresses.

25. a) On the Internet, what new type of message travels between the source and destination host?

The Internet Protocol (IP) packet

b) How are these messages carried in single networks?

Inside frames.

c) Describe what happens to a packet between the source and destination host.

The source host places the packet in a frame for the network to the first router

Each router along the route receives a frame, removes the packet, and places it into a frame for the next-hop-router

The final router delivers the frame to the destination host. The destination host removes the packet from the frame.

d) Draw a frame in terms of encapsulation, assuming that the frame comes from a contemporary host.

There will be a frame header, followed by the packet, perhaps followed by a frame trailer.

Routes and Layer 3

26. a) What is a route?

The path that a packet takes across an internet from the source host to the destination host.

b) Distinguish between a data link and a route.

A data link is a path a frame takes through a single network

A route is the path a packet takes through an internet from the source host to the destination host

c) When a packet travels through an internet, are there usually more data links or routes along the way?

Data links

d) How many routes are there when a packet is transmitted?

One

e) When a packet is transmitted from a source host to a destination host separated by four single networks, how many packets will there be? (Answer: 1)

1

f) How many frames will there be? (Answer: 4)

4

g) When a packet is transmitted from a source host to a destination host separated by 17 single networks, how many packets will there be?

1

h) How many frames will there be?

17

27. a) Distinguish between physical links, data links, and routes.

Physical links are connections between adjacent devices on the transmission path.

A data link is a path a frame takes through a single network

A route is the path a packet takes through an internet from the source host to the destination host

b) When Host A in Figure 1-26 transmits a packet to Host D, how many physical links, data links, and routes will there be?

7

c) How many packets will there be?

3

d) How many frames? (Answers: 7 physical links, 3 data links, 1 route, 1 packet, 3 frames.)

1

28. a) When Host A in Figure 1-26 transmits a packet to Host C, how many physical links, data links, and routes will there be?

3-4 physical links, depending on the data link

1 data link

1 route

b) How many nodes will there be along the route?

2 or 3 depending on the data link

c) How many packets will there be?

1

d) How many frames?

1

29. a) At what layer do you find: a) IP addresses,

Layer 3 (internet)

b) EUI-48 addresses,

Layer 2 (data link)

c) packets,

Layer 3 (internet)

d) frames,

Layer 2 (data link)

e) wireless connections,

Layers 1 and 2

f) wire connections,

Layer 1

g) switches, and

Layer 2

h) routers?

Layer 3

"PACKET SWITCHING"

30. Both single switched networks and routed networks are said to use packet switching. Why is this term confusing?

Packets are always routed

Frames are always switched

Packets are never switched

STANDARDS LAYERS

Five Layers

Layers 1 through 3 (Physical, Data Link, and Internet Layers)

Layers 4 and 5 (Transport and Application Layers)

Test Your Understanding

31. a) What is required for competition among vendors?

Standards

b) What benefits do standards bring?

Competition to lower prices

Innovation by vendors to avoid being commodity suppliers

Protection in case your product vendor falls behind or even fails

c) Name the five layers from bottom to top.

Application

Transport

Internet

Data Link

Physical

d) Give the number for each layer name.

Application (5)

Transport (4)

Internet (3)

Data Link (2)

Physical (1)

e) What does Layer 1 standardize?

Physical link standards describe transmission media and signaling.

f) Layer 2?

Data link layer standards describe the structure of frames, DLL addresses, and how to deliver frames across a single network.

g) Layer 3?

Internet layer standards describe the structure of IP packets, IP addresses, and how to deliver packets across a series of routers in an internet.

h) Layer 4?

The transport layer does fragmentation on the source host, as we saw in Figure 1-12. The transport layer also does reassembly on the destination host.

i) Layer 5?

The application layer standardizes communication between application programs. This includes application messages.

Standards Agencies and Architectures

32. a) Distinguish among ISO, OSI, and ITU-T.

OSI is the standards architecture

ISO and ITU-T are OSI's standards agencies

b) In what two layers do OSI standards dominate?

Physical and data link

c) What is the standards agency for the Internet?

The Internet Engineering Task Force (IETF)

d) In what two layers do its standards dominate?

Layers 3 and 4

e) What is the standards agency for the World Wide Web?

The book says the W3C consortium, but the IETF has taken on the job of creating new HTTP standards for the World Wide Web.

TCP/IP Supervisory Applications: The Domain Name System (DNS)

33. a) To send packets to a target host, what must the source host know?

The IP address of the target host.

b) If the source host knows the host name of the target host, how can it get the target host's IP address?

It can send the host name to a Domain Name System server and request the corresponding IP address. The DNS server will return this information. The source host can now send packets to the IP address of the target host.

CONCLUSION

End-of-Chapter Questions

Thought Questions

1-1. a) When Host D in Figure 1-26 transmits a packet to Host C, how many physical links, data links, and routes will there be?

7, 3, 1

b) How many packets will there be?

1

c) How many frames? (Check answers are 7, 3, 1, 1, and 3).

3

1-2. a) When Host A in Figure 1-26 transmits a packet to Host C, how many physical links, data links, and routes will there be?

3 or 4, 1, 1

b) How many packets will there be?

1

c) How many frames?

1

1-3. A frame is addressed to the data link layer (DLL) address of the device at the end of the frame's data link. The packet is addressed to the IP address of the host at the end of the packet's route. a) When Host C in Figure 1-26 transmits a packet to Host D, to which address is the first frame addressed (be specific)? (Hint. It is the DLL address of the interface (port) on Router R1 that receives the frame.)

The DLL address of the interface on Router R1 that receives the frame.

b) To which address is the packet addressed?

The IP address of the destination host

c) When router R1 sends the packet along in a Frame to Router R2, to which address is the frame addressed?

The DLL of the interface on Router R2 that receives the frame.

d) To which address is the packet addressed?

To the IP address of the destination host.

1-4. a) What type of single network is Network X in Figure 1-26?

Switched

b) What type of single network is Network Y?

Point-to-point

c) What protocol does Network Y follow at the data link layer?

Presumably the Point-to-Point Protocol (PPP)

~~1-5. a) Both DHCP servers and DNS servers send a host an IP address.~~

This question part was in the first printing. It pertained to material that was deleted from the chapter.

~~b) These are the IP addresses of which hosts?~~

This question part was in the first printing. It pertained to material that was deleted from the chapter.

1-6. What is the difference between the Internet and the World Wide Web? The answer is not in the text.

The Internet delivers packets to hosts

The WWW is an application that uses the Internet delivery system

1-7. Use Excel's dec2bin() function to convert from dotted decimal notation to binary. The IP address in dotted decimal notation is 128.171.17.13.

10000000 10101011 00010001 00001101

1-8. Use the Excel bin2dec() function to convert 32-bit IP addresses into dotted decimal notation.

Huh?

Troubleshooting Questions

Troubleshooting is an important skill to have when networks go wrong. The job is to find the root cause of the problem from observed symptoms through logical and empirical tests.

- First, understand the symptoms in detail. Often, a small point is the key to identifying the problem.
- Second, know all the system's components and decide analytically which ones might be the cause of the problem. This almost always requires you to draw the network just to identify the elements that need to be considered.
- Third, list all of the possible causes of the problem. You do not start testing them one at a time. To think of one thing and consider it, then do this again and again, is chaotic, unprofessional, and usually futile. Use this approach to answer the following troubleshooting questions.
- Fourth, exclude as many possibilities as possible logically because they do not fit the details of the situation.

- Fifth and last, prioritize the alternatives you cannot eliminate logically. Begin with the most likely ones and perhaps the easiest to test.

1-9. A server that you use daily is unusually slow. So are other servers you try. Troubleshoot the problem using the five-step method described above. List the steps in order. Draw the picture.

List Symptoms

You use the server daily. It is not a new server to you

It is slow; so are other servers you try

Second, know all the system's components and decide analytically which ones might be the cause of the problem

Your computer

Your local network

Your ISP

The internet core

The host's ISP

The host network and computer

List Possible causes

Any might be slow

Exclude as many causes as possible logically

The problem exists for all the servers you try, so one can probably exclude the host's ISP, its network, and its computer.

Prioritize other alternatives you will look at (and say how you will test them)

Your computer. Ask others if they are having the same problem. Try a different computer.

Your local network and ISP. Ask others if they are having problems. If they are, call your networking department to see if there is a known problem.

1-10. You type a URL, and your browser tells you that the host you are trying to reach does not exist. This message probably comes from a DNS server. Troubleshoot the problem using the five-step method described above. List the steps in order. Be sure to draw a picture of the situation.

List Symptoms

Do you use the server daily? Don't assume that you do.

You get a message telling you that the host does not exist

Second, know all the system's components and decide analytically which ones might be the cause of the problem

You

Your computer

Your local network

Your local DNS server

The Internet

List Possible causes

You may have mistyped the URL

Your computer may have glitched

Your local network may have errors

The DNS server may be down

The internet may be performing badly

Exclude as many causes as possible logically

Your computer is working with the DNS server, so it is probably not the problem.

Your DNS server is not down. It sent you a message

Similarly, your local network probably has not glitched. It must be working to get you the server's message. This appears to be a DNS problem.

The DNS server is on your network, so the Internet is not likely to be at fault.

Prioritize other alternatives you will look at (and say how you will test them)

The most likely cause is that you typed the host name in the URL incorrectly. Try typing it again. If that does not work, be sure you have the correct host name and try again.

Is the DNS server wonky? Try URLs with other host names to see if it works with them. If not, call the networking department. It is out of your hands.

Perspective Questions

1-11. What was the most surprising thing you learned in this chapter?

Student answers will vary

1-12. What was the most difficult material for you in this chapter?

Student answers will vary