

# Internet Technology

04r. Assignment 4 & 2013 Exam 1 Review

Paul Krzyzanowski

Rutgers University

Spring 2016

# Assignment 4 Review

# Question 1

---

Why is it said that FTP sends control information “out-of-band”?

---

**FTP uses two parallel TCP connections:**

1. One connection for sending control information (such as a request to transfer a file)
2. Another connection for actually transferring the file.

**Because the control information is not sent over the same connection that the file is sent over, FTP sends control information out of band.**

## Question 2

---

From a user's perspective, what is the difference between the download-and-delete mode and the download-and-keep mode in POP3?

---

With **download and delete**, after a user retrieves its messages from a POP server, the messages are deleted

- This poses a problem for a user who may want to access the messages from many different machines.

With **download and keep**, messages are not deleted after the user retrieves the messages

- This can also be inconvenient, as each time the user retrieves the stored messages from a new machine, all of non-deleted messages will be transferred to the new machine (including very old messages).

# Question 3

---

Read HTTP cookies explained.

What happens if a cookie is not given an expiration time?

---

Without the **expires** option, a cookie has a lifespan of a single session.

A session is defined as finished when the browser is shut down, so session cookies exist only while the browser remains open.

# Question 4a

---

What company owns the address 66.135.216.190?

---

Enter the address in the "Search WhoisRWS" box on arin.net  
(ARIN = American Registry for Internet Numbers)

66.135.216.190 belongs to eBay, Inc.

## Question 4b

---

What company owns the address 9.8.7.6?

---

Enter the address in the "Search WhoisRWS" box on arin.net  
(ARIN = American Registry for Internet Numbers)

9.8.7.6 belongs to IBM

# Question 5a

---

What are the DNS servers that are responsible for amazon.com?

---

Run `dig +nocmd amazon.com NS +noall +answer`

**Answer:**

pdns6.ultradns.co.uk.

ns2.p31.dynect.net.

ns1.p31.dynect.net.

ns3.p31.dynect.net.

pdns1.ultradns.net.

ns4.p31.dynect.net.



## Question 5b

---

What is the mail server (MX record) for cs.rutgers.edu?

---

Run `dig +nocmd cs.rutgers.edu MX +noall +answer`

Answer:

dragon.rutgers.edu

# Question 5c

---

gmail.com defines five redundant mail servers. What are they?

---

Run `dig +nocmd gmail.com MX +noall +answer`

Answer:

alt4.gmail-smtp-in.l.google.com.

alt3.gmail-smtp-in.l.google.com.

alt2.gmail-smtp-in.l.google.com.

alt1.gmail-smtp-in.l.google.com.

gmail-smtp-in.l.google.com.

# Exam 1 Review

# Question 1

A circuit switched network does not need to use store and forward delivery when going through routers.

Assume that processing delays and propagation delays are negligible and queuing delays nonexistent.

The propagation time per link is  $P$ .

The transmission rate is  $R$  bits per second and the average packet size is  $L$  bits.

What is the end-to-end delay of a circuit-switched communication link where the packet has to pass through  $N$  network links?

# Question 1

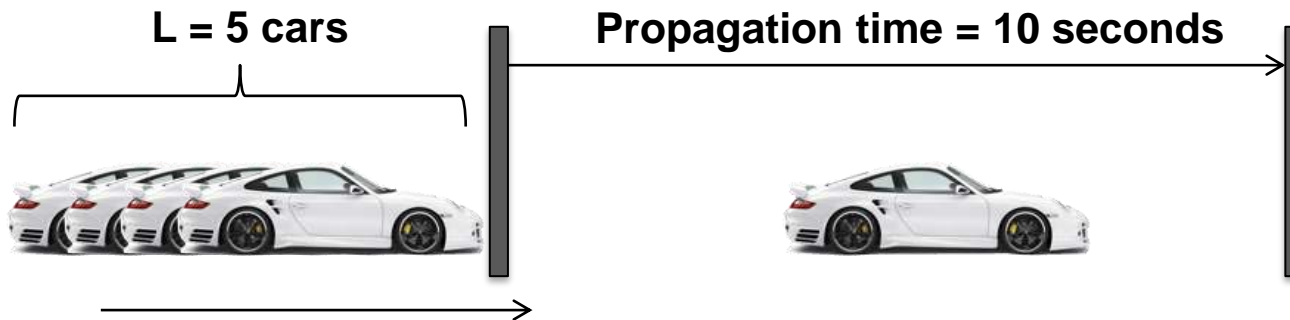
- Transmission rate:  $R$  bits per second
- Packet size:  $L$  bits
- Propagation time:  $P$  seconds

Example (car=packet)

1 car per 30 seconds

5 cars

10 seconds

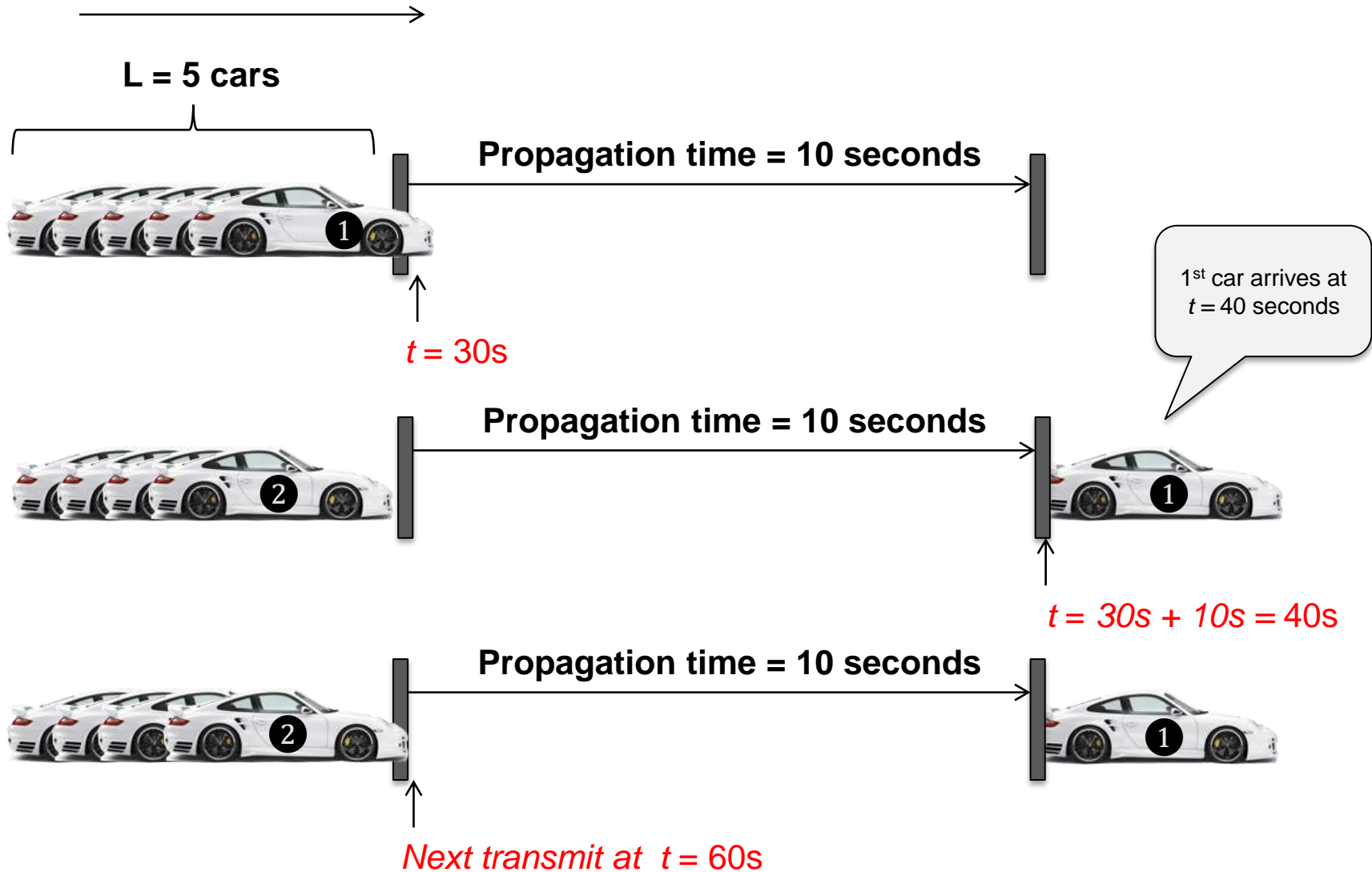


**Transmission rate: 1 car / 30s**

New car goes out:  
1 every 30 seconds  
(*driver gets in,  
fasten seat belt,  
starts the car, ...*)

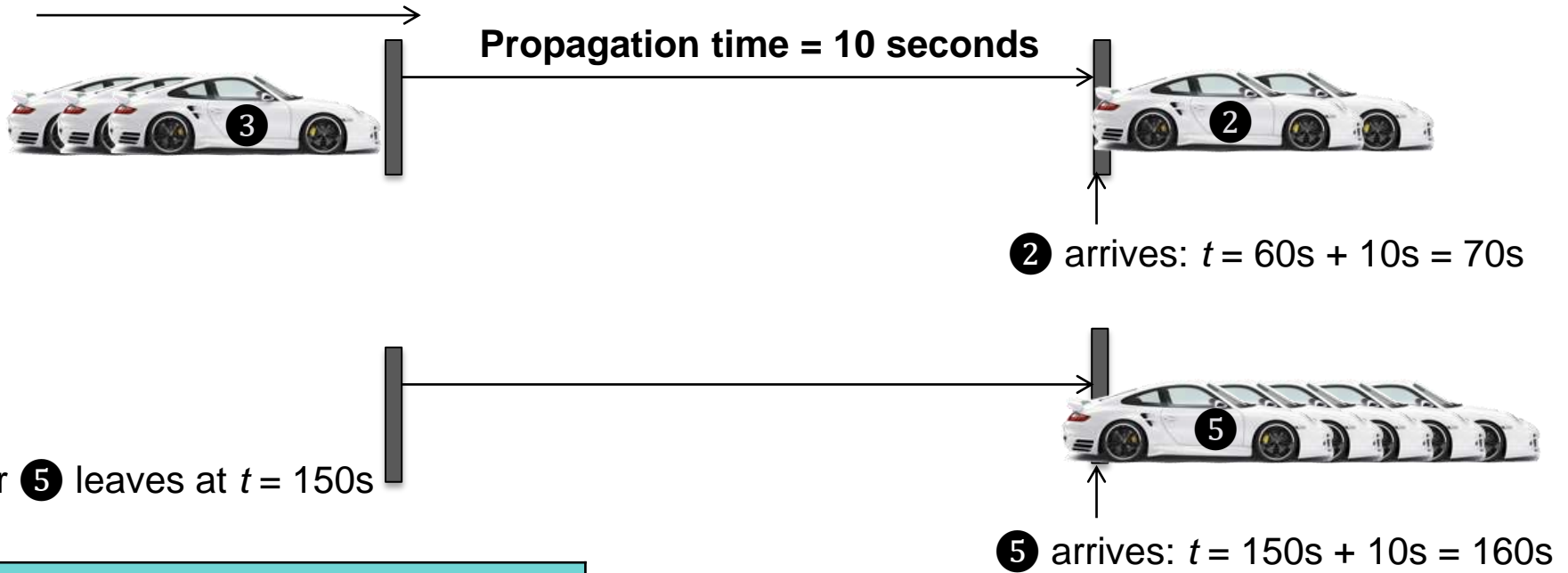
# Question 1

Transmission rate: 1 car / 30s



# Question 1

Transmission rate: 1 car / 30s

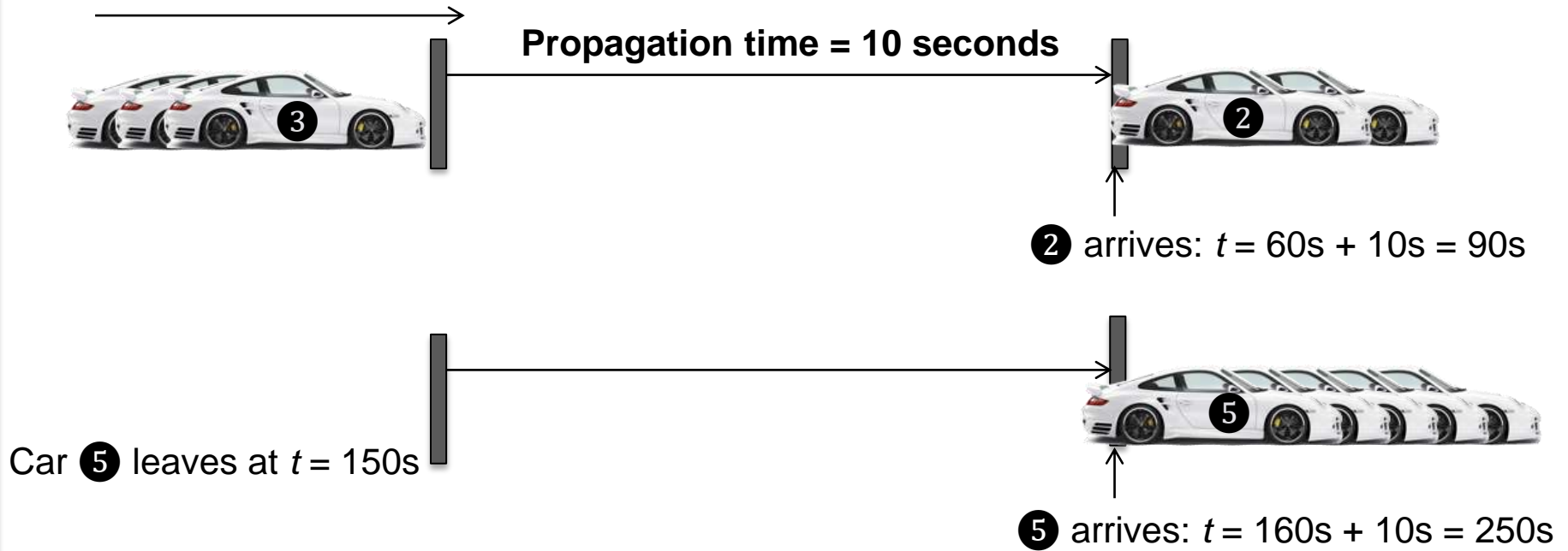


Car	Departure	Arrival
1	30	40
2	60	70
3	90	100
4	120	130
5	150	160

Total latency = (# cars × transmission rate) + propagation time  
**Total latency = ( L / R ) + P**

# Store-and-forward links

Transmission rate: 1 car / 30s



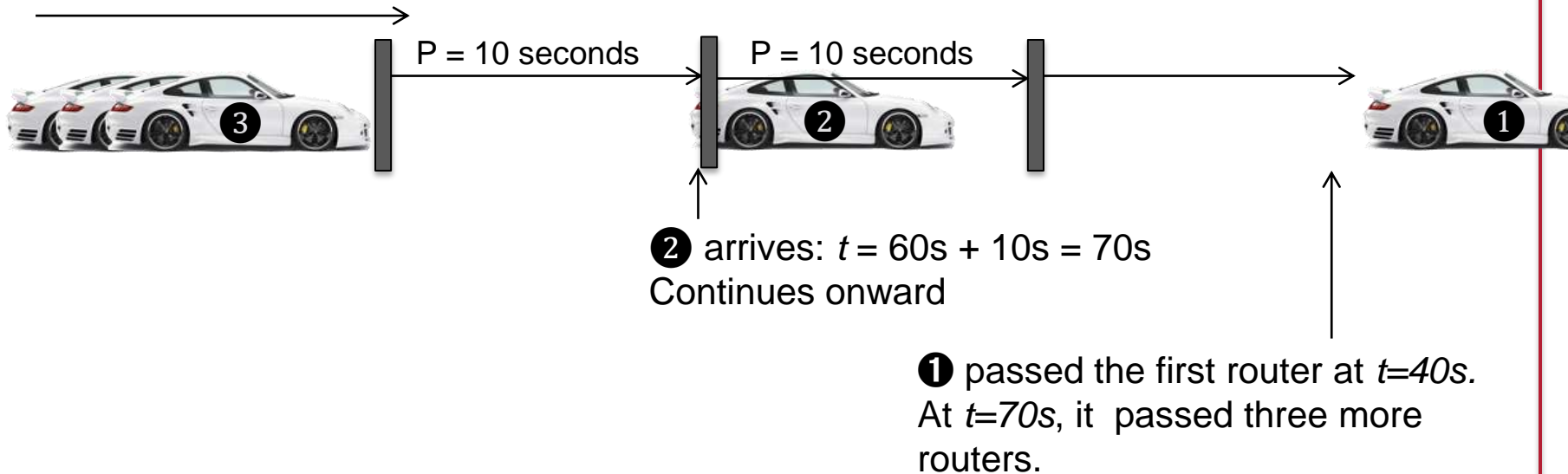
With **store-and-forward** switching, a car cannot continue until all the other cars have arrived. Hence, we have the latency of  $(LR+P)$  for each link.

$$\text{End-to-end latency (N links)} = N((L/R) + P)$$



# Without store-and-forward

Transmission rate: 1 car / 30s



## Without store & forward:

A car does not have to wait for the others to arrive before proceeding

Cars are dispatched at rate  $R$

The last one is dispatched at  $L/R$

It arrives at the final destination at  $L/R + NP$

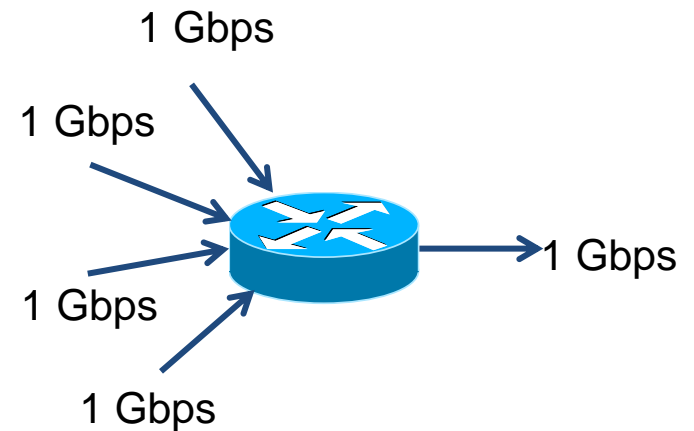
$$\text{End-to-end latency} = L/R + NP$$

## Question 2

Can packet loss occur on a packet-switched network where every single link ensures reliable data transmission? Explain.

Yes. Queue overflow at a router can cause packet loss: packets arrive faster than they can be transmitted.

**No credit without an explanation.**



# Question 3

What information does a root DNS name server provide?

The name servers for each top-level domain (TLD)

*Your answer should explain the specific role of the **root DNS name servers**, not be a generic answer that could apply to any DNS server.*

*Not: provides a list of name servers for lower-level domains*

*Not: provides a name, IP address, TTL, etc.*

# Question 4

---

A unicast message is a message that

- (a) Must be acknowledged upon receipt.
- (b) Is delivered to multiple destinations.
- (c) Is delivered reliably with no retransmissions.
- (d) Is delivered to a single destination.**

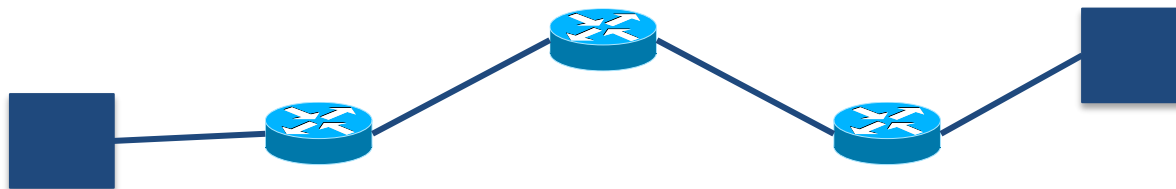
# Question 5

One design for a reliable, in-order packet delivery system is to ensure that a sender does not transmit the next packet until it receives an acknowledgement that the previous packet has been received at the destination.

Assume the sender transmits lots of small packets and that an acknowledgement message is approximately the same size as a data packet.

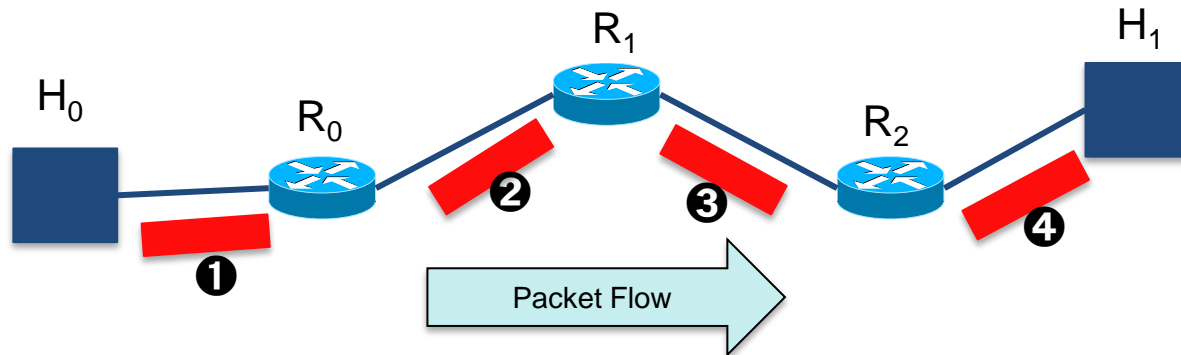
Also assume a packet-based network with packets flowing through three routers.

This technique will make communications slower by approximately a factor of:



# Question 5

Packet transmission with no acknowledgements



Packets ❶, ❷, and ❸ are in transit while ❹ is being delivered to H<sub>1</sub>.  
With end-to-end acknowledgement, we cannot transmit those packets.

The packet takes 4 hops to get to H<sub>1</sub> and 4 hops to send an *ack*

Total hops = 8

Answer: (d) 8

# Questions 6-7

6. Which of the following is not a core design principle of the Internet?

- (a) Support the interconnection of multiple networks.
- (b) Design the system with the assumption that the network is not reliable.
- (c) Routers can be stateless; they should not have to retain information on the flow of previous packets.
- (d) The entire network should be centrally administered for full end-to-end control.**

7. A peering agreement among two Internet Service Providers (ISPs) means

- (a) One ISP can take over for another ISP in case of failure.
- (b) The ISPs share the same set of customers.
- (c) One ISP routes all its data through the other ISP.
- (d) The ISPs route data between their networks without charging each other.**

# Questions 8-9

8. Frequency Division Multiplexing (FDM) means that a communication channel

- (a) Is assigned one specific frequency band.
- (b) Shares a frequency band with other channels and takes turns using it.
- (c) Hops between multiple frequency bands during the course of communication.
- (d) Has full use of the total bandwidth available in the communication medium.

9. Circuit switching is more efficient than packet switching because

- (a) All participating routers figure out the route just once at the start of a communication session.
- (b) It uses the bandwidth of the network more efficiently.
- (c) It is done in hardware instead of software.
- (d) It is a data link versus a network layer protocol.



# Questions 10-11

10. Packet switching is more efficient than circuit switching because

- (a) All participating routers figure out the route just once at the start of a communication session.
- (b) It uses the bandwidth of the network more efficiently.**
- (c) It is done in hardware instead of software.
- (d) It uses store-and-forward packet delivery through routers.

11. Packet switching shares the network by having each transmitter

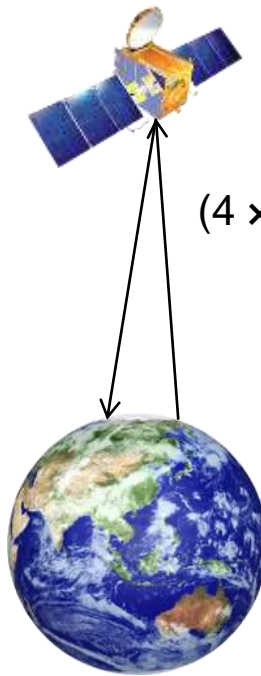
- (a) Take turns and use variable-size time slots.**
- (b) Take turns and use fixed-size time slots.
- (c) Transmit on a specific frequency.
- (d) Split its transmission onto a range of frequencies.

# Question 12

Assume that a satellite in geostationary orbit is approximately 40,000 km away. A signal travels at  $3 \times 10^8$  m/s. The latency of a packet that has to be routed through a geostationary satellite is approximately

- (a) 133 ms
- (b) 267 ms**
- (c) 133  $\mu$ s
- (d) 267  $\mu$ s

$$40,000 \text{ km} = 40,000,000 \text{ m} = 40 \times 10^7 \text{ m}$$



$$\begin{aligned} (4 \times 10^7 \text{ m}) \div (3 \times 10^8 \text{ m/s}) &= (4/3) \times 10^{-1} \text{ s} \\ &= 1.333 \times 10^{-1} \text{ s} = 0.1333 \text{ s} = 133.3 \text{ ms} \\ &\text{in each direction} \end{aligned}$$

*Not to scale*

# Questions 13-14

## 13. Propagation delay is

- (a) The time it takes to transmit a packet out onto the communication link.
- (b) The time it takes a signal to flow from one end of the communication link to the other.**
- (c) The delay that is incurred when a packet has to wait for the communication link to be available.
- (d) The delay of moving a packet from the input port of a router to the outbound link.

## 14. A sustained traffic intensity greater than 1 means

- (a) Some packets may need to be queued for transmission.
- (b) The queue on a router will grow without bound and packet loss will occur.**
- (c) Packets are capable of going out faster than they are coming in.
- (d) Transmission delay will dominate over queuing delay when measuring overall latency.

# Questions 15-16

15. An IP router operates at the

- (a) Transport layer.
- (b) Network layer.**
- (c) Physical layer.
- (d) Data Link layer.

Pick the *best* answer.

Yes, an IP router needs to have physical and data link connectivity but its function is to route packets.

16. Which protocol layer is not implemented in the IP protocol stack and must be handled at the application layer?

- (a) Transport.
- (b) Session.**
- (c) Data link.
- (d) Network.

# Questions 17-18

17. A peer-to-peer application architecture is one that

(a) **Does not use a central server.**

Hybrid architectures, like Napster use a server for some tasks

99% of client-server apps do this

(b) Allows multiple clients to connect to a server at the same time.

(c) Supports loss-tolerant applications.

Desirable but not necessary nor a definition

(d) Relies on computers instead of routers to relay messages.

18. A TCP connection means that

(a) **The application sees a bidirectional communication channel.**

(b) Routers commit to bandwidth guarantees for the connection.

(c) All packets take the same route to their destination.

(d) The network will ensure that all data flowing on the connection has a constant latency.

# Questions 19-20

19. Which system call waits for an incoming TCP connection?

- (a) **accept** ← It's *accept* in Java and Python APIs too!
- (b) listen
- (c) bind
- (d) wait

20. Which of the following is not an advantage of a multithreaded program?

- (a) **Threads have their own protected memory but can send messages to each other.**
- (b) Threads take advantage of multicore processors.
- (c) Threads process multiple requests concurrently.
- (d) Threads make data sharing easy.

# Questions 21-22

21. A race condition occurs when

- (a) The outcome of a program is based on the exact order in which concurrent events execute.
- (b) One thread is blocked by another thread.
- (c) One thread is always scheduled at a higher priority than another thread.
- (d) Two or more threads compete for exclusive access to the same data.

22. A Regional Internet Registry (RIR)

- (a) Keeps track of the database of domain names for a geographic region.
- (b) Allocates IP addresses within a geographic region.
- (c) Provides Internet service to ISPs within a geographic region.
- (d) Is a database of all ISPs in a geographic region.

# Questions 23-24

23. Iterative name resolution means that a name server will

- (a) Contact a top-level name server, which will then contact a lower-level name server; that one will then query one further down the tree.
- (b) Contact a top-level name server, get a referral to a lower-level name server, query that one, get a referral for an even lower-level name server, and continue the process.
- (c) Iterate through a known list of name servers until it finds one that can resolve the name.
- (d) Start at the bottom of the domain tree and work its way up instead of starting at the top.

24. Which protocol does not use a line-oriented, text-based protocol?

- (a) DNS
- (b) FTP
- (c) HTTP
- (d) SMTP



# Questions 25-26

25. How does a DNS resolver decide how long to cache the result of a DNS query?

- (a) The query returns an expiration time, from which the current time is subtracted to get the remaining time to cache.
- (b) The query returns a time to live value, which is the duration of time that the result can be cached.**
- (c) The configuration of the DNS resolver defines cache sizes and duration.
- (d) The DNS resolver will never cache the result of a DNS query.

26. An HTTP persistent connection is useful for

- (a) Not having to authenticate a user each time a new page is visited.
- (b) Downloading a page that has other content associated with it that needs to be downloaded.**
- (c) Enabling access to cached copies of a page.
- (d) Allowing cookies to persist from page to page.

# Questions 27-28

27. Which of the following is a push protocol?

- (a) HTTP
- (b) SMTP**
- (c) IMAP
- (d) POP3

28. Which protocol sends commands and data over two separate communication channels?

- (a) IMAP
- (b) FTP**
- (c) SMTP
- (d) HTTP

# Question 29

---

29. Which operation is not supported in IMAP?

- (a) List messages.
- (b) Send a message.**
- (c) Download a message.
- (d) Move a message to a folder.

SMTP is a mail delivery protocol.

POP & IMAP are mailbox access protocols

## Question 30-32

30. To send an IP packet on an Ethernet link, the IP message has to be encapsulated in an Ethernet packet.

True

False

Ethernet switches and transceivers don't know about IP – they handle Ethernet frames

31. A generic top-level domain (gTLD) is beneath a country code top-level domain (ccTLD) in the DNS hierarchy.

True

False

No, generic names (.org, .net) are also a top-level domain names

32. When you register a .com domain name with GoDaddy, it has to first check with every other other .com domain registrar to see if the domain name is already registered.

True

False

It has to check the registry operator for .com, which holds the master database

# Question 33-34

33. A DNS resolver has to be able to accept a recursive query request from a client

True

False

DNS resolvers are the client-side interfaces to DNS. They ensure that the user's program will not have to perform an iterative query and contact multiple DNS servers – the user's program only needs to contact the resolver.

34. Passive mode FTP avoids the problem of a server having to connect to the client.

True

False

Yes. Without Passive Mode, the server connects to the client to set up the data channel. The socket that the client set up is the *control channel* (for commands).

The end