

Computer Networks and Distributed Systems: End Term

1. There are 20 questions.
2. There can be ONE or MORE correct answers.
 - The correct set of answers awards you 5 mark.
 - Leaving a question un-attempted (i.e. empty set) awards you 0.
 - Any subset of the correct set, whose cardinality is one less than the cardinality of the correct set awards 2 marks.

Example: If correct answers to a question are (a), (b) and (d), then encircling (a), (b), (d) awards you 5. Encircling (a)(b) or (a)(d) or (b)(d) awards you 2. Any other answer, including just (a), just (b) or just (d) or any other combination thereof awards you 0.

1

Scalability is one of the central issues in routing. Since the number of nodes in a network like the Internet is in billions, how do you think scalability is usually achieved in the Internet.

- ☒ Hierarchy is used: The infrastructure and the functionality is divided hierarchically. For example, the IP address broken into the network and the host part.
- ☐ Hierarchy may also be seen in the status of Autonomous Systems depending on their global connectivity.
- ☒ The timeout and ACK mechanisms ensure that receiver receives what the sender has sent.
- ☒ Increasing TTL is one of the ways to achieve scalability.

2

Choose the correct statements:

- ☐ Hidden node problem is the cause of exposed node problem
- ☒ Hidden node problem may be completely solved using RTS CTS
- ☐ Wireless 802.11 doesn't use exponential backoff when collisions occur.
- ☒ Collisions are inherent property of a shared media. They will continue to be there until the medium is shared.

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Choose the correct statements:

- ☐ In a switched Ethernet, there is at least one path between any two end nodes in the network
- ☒ In traditional Ethernet, there is exactly one path between any two nodes in the network
- ☒ Collisions don't occur in a switched network as there is no shared media
- ☒ Collisions are property of a network with shared media. Hence, very difficult for wireless networks to get rid of them.

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Choose the correct options:

- ☒ NRZ encoding scheme seems to work well, until in practice it is found that it suffers from problems like baseline wander and clock recovery.
- ☐ Frequent transitions from low to high are required to solve both baseline wander and clock recovery
- ☒ Manchester solves the problem of baseline wander and clock recovery because it makes frequent low to high and high to low transitions
- ☐ The problem with Manchester is that it is only 80% efficient.

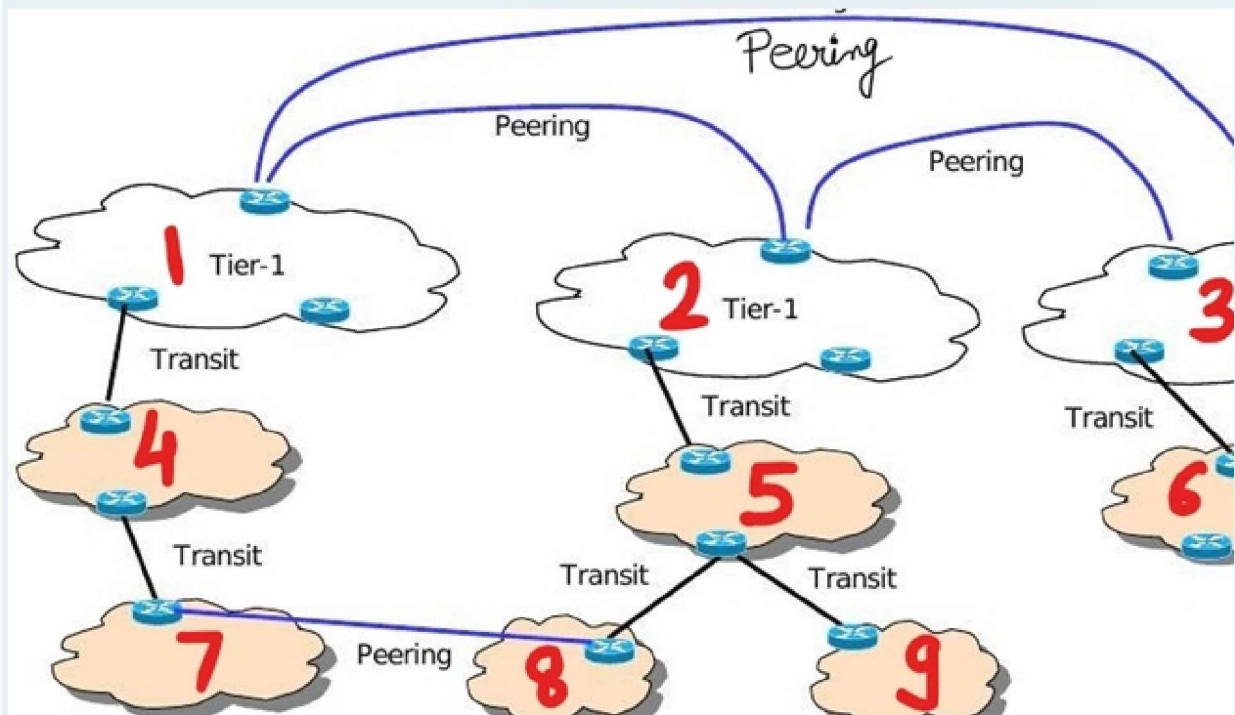
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A message 10101101 is to be sent from a source to destination in a link layer network. Moreover, all the frames exchanged on this network have maximum payload size equal to 12 bits. Both sender and receiver agree to implement Cyclic Redundancy Check (CRC) as a mechanism to detect errors introduced in the message. $C(x)$ is the polynomial that both the sender and receiver have to agree upon. Which of the following hold(s):

- ☒ $C(x) = (2+x)^2$ is a good choice.
- ☒ $(1+x)^{53}$ is a bad choice.
- ☒ Maximum size of payload is 12 bits it does not make sense to use 32 bits for error detection.
- ☐ If $C(x) = x^3 + 1$, then the PAYLOAD size in the frame will be 11 bits.

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Consider the following figure.



- ☐ For a packet destined from 7 to 9, path 7->8->5->9 is the shortest and optimal path according to BGP.
- ☒ For a packet destined from 7 to 9, path 7->4->1->3->2->5->9 may be taken.

- ☒ It is possible that 4 decides to make both 1 and 2 as its provider.
- ☒ 7 will not advertise to 8 that it can reach 4. However, it will advertise all its customer base to 4 and 8.

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Link state based approaches:

- ☒ Do reliable flooding to send control level link state advertisement (LSA) packets to the neighboring routers.
- ☒ result in intra-domain routing protocols with the capability to construct the whole network topology.
- ☐ require periodic exchange of HELLO packets to know if the neighboring nodes/links are functioning or not.
- ☐ Don't update automatically to a new routing table if any faults are observed in the network.

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UDP

- ☒ is one of the simplest possible transport layer protocols
- ☒ works well for applications like video conferencing, online gaming, streaming videos, etc.
- ☐ uses a three way handshake to establish connections between hosts
- ☐ provides an option of using pseudoheader to verify that the message has been delivered between the correct endpoints.

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Assume that an IP packet goes from S->R1->R2->R3->D. S is the source, D is the destination and remaining nodes are the routers.

- ☒ From S to D it gets encapsulated at least 4 times in data link layer frames

- ☒ In path from S to D the TTL field of the IP packet remains unchanged

Assume (for the purpose of this choice only) that the packet was originally bigger than the MTU of the first link layer it encounters. It was fragmented in two and then sent. Also assume that no subsequent MTU is smaller, the packets will be re-assembled at D, not before.

- ☐ Assume that TCP is being used at the transport layer, R2 goes down as the packet was in transition from R1->R2, i.e., R2 goes down, before receiving the packet from R1. Then the packet will never be received by D.

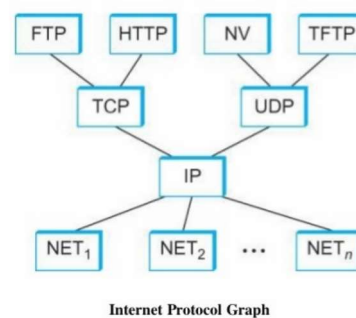
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Distance vector based approaches:

- ☒ take care of routing inside the network of an Autonomous system.
- ☐ may be used to send packets between any two or more Autonomous systems as well.
- ☐ Update the neighboring routers ONLY. If there are other devices like hubs or repeaters next to it, it doesn't send distance vectors to them for routing purposes.
- ☐ always work well and provide a correct routing table at the end

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Network Architecture Contd...



In the characteristics of Internet Architecture, we had mentioned the hourglass nature of protocol graph in which IP is the only protocol at layer 3. It signifies that

- ☐ Internet Architecture was designed such that there would be only one protocol at layer 3 as it is the middle layer in the stack.

- ☒ IP has performed extremely well in achieving its goal of ability to run over anything as it does not depend on the technology used by link layer.
- ☒ There can of course be more protocols at layer 3 but none of them got as famous as IP.
- ☐ There is a limitation on protocol graphs that there can be only one path from application layer to physical layer and that must pass through IP.

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TCP saw tooth pattern

- ☒ is a plot of congestion window with respect to time due to additive increase and multiplicative decrease.
- ☒ forms due to packet drops at the receiver as the receiver may be way slower compared to the sender.
- ☐ forms due to the slow start of TCP in the beginning.
- ☐ is a reflection of how TCP tries to keep the pipe full without over-running the network.

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Choose the correct options:

- ☒ IP does not provide any guarantees, including delivery to the receiver. It is a best effort service which means that IP will not take any actions for recovery even if a packet to the destination is not delivered.
- ☒ IP sends the packet from source to the destination, which, in itself is a mammoth task, as the number of potential networks in the Internet is already huge.
- ☒ Every transport layer must provide at least process to process communication as the IP layer provides only host to host delivery.
- ☐ IP already provides process to process communication. So transport layer must do more, like providing flow control, congestion control, reliability, etc.

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Choose the correct options:

- ☒ DHCP is used to automatically assign IP addresses to the nodes in a network.
- ☒ Routers understand IP addresses only. Human beings are good at memorizing relevant strings. Hence, the mapping of URL to IP is done by the DNS.
- ☒ DNS and DHCP are both application layer protocols.
- ☐ DNS is application layer protocol whereas DHCP is Network layer protocol.

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```

S = {u}
for all nodes v
  if (v is adjacent to u)
    D(v) = c(u,v)
  else D(v) = ∞
add w with smallest D(w) to S
update D(v) for all adjacent v:
  D(v) = min{D(v), D(w) + c(w,v)}
until all nodes are in S
  
```

- ☒ The above algorithm may be used to compute the shortest path from one node to any other node in the network.
- ☐ The above algorithm is just the path computing. How to send the local topology to the nodes is not covered by this.
- ☐ This is bellman ford algorithm
- ☐ None of these

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Choose the correct options:

- ☒ TCP provides end to end reliability but UDP doesn't.

- ☐ The end to end reliability provided by a transport layer protocol is redundant since the data link layer already provides it and no data packet may reach destination without passing through data link layers like the Ethernet.
- ☒ End to end reliability is required because the intermediate nodes and routers may not behave well and may reorder or change the data.
- ☒ Data link layer uses the mechanism of TIME-OUT and ACK to implement reliability which is different from the one deployed by UDP to ensure reliability.

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The following equation may be used to compute distance. Choose the correct options.

$$du(z) = \min \{ c(u,v) + dv(z), c(u,w) + dw(z) \}$$

- ☐ The routing protocol using this equation may suffer from the network updates that may diverge if links/nodes fail.
- ☒ Distance to z from u is computed via two neighbors of u, namely v and w.
- ☐ Equation at w may look like: $dw(z) = \min \{ c(w,v') + dv'(z), c(w,u) + du(z) \}$
- ☐ None of these

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Choose the correct options:

- ☐ In flow control, receiver gives feedback on the congestion window that the sender keeps.
- ☐ In congestion control, intermediate routers will send congestion window to the sender asking to slow down.
- ☒ Flow and congestion control happens in TCP but is available as option in UDP as well.
- ☒ The sender chooses the effective window size as the $\min\{\text{CongestionWindow}, \text{AdvertisedWindow}\}$ with due regards to the buffer sizes.

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BGP

- ☒ is a path vector protocol so that routing loops may be detected.
- ☒ is an interdomain routing protocol unlike RIP and OSPF.
- ☐ finds an optimum, shortest path from the source to the destination.
- ☐ is not run by all the routers in a network.

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TCP does a three way handshake before starting data communication. Select the correct options.

- ☐ The handshake starts with 0, i.e., the sequence numbers that will be used by each side starts at 0.
- ☐ The handshake is a way to agree upon a few parameters such as the IP addresses and the port numbers. This is required if data transfer has to take place.
- ☒ The ACK field actually identifies the sequence number of the next byte expected.
- ☐ None of these

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