Quiz 1

This is a preview of the draft version of the quiz

- Due No due date
- Points 24
- Questions 12
- Time Limit 85 Minutes

Instructions

Quiz 1. Answer using your team's submitted program for Q1. Both teammates receive the same questions and submit their own answers.

Selecting "I don't know" in the questions that have the option will gain partial points.

Attempt History

	Attempt	Time	Score
LATEST	Attempt 1	85 minutes	0 out of 24 *

* Some questions not yet graded

Correct answers are hidden.

Score for this quiz: 0 out of 24 *
* Some questions not yet graded
Submitted Sep 29 at 5:02pm
This attempt took 85 minutes.
Unanswered

Question 1
0 / 4 pts

1. How will your submitted program react?

This question is common to all teams. The simulation runs your submitted program on the network

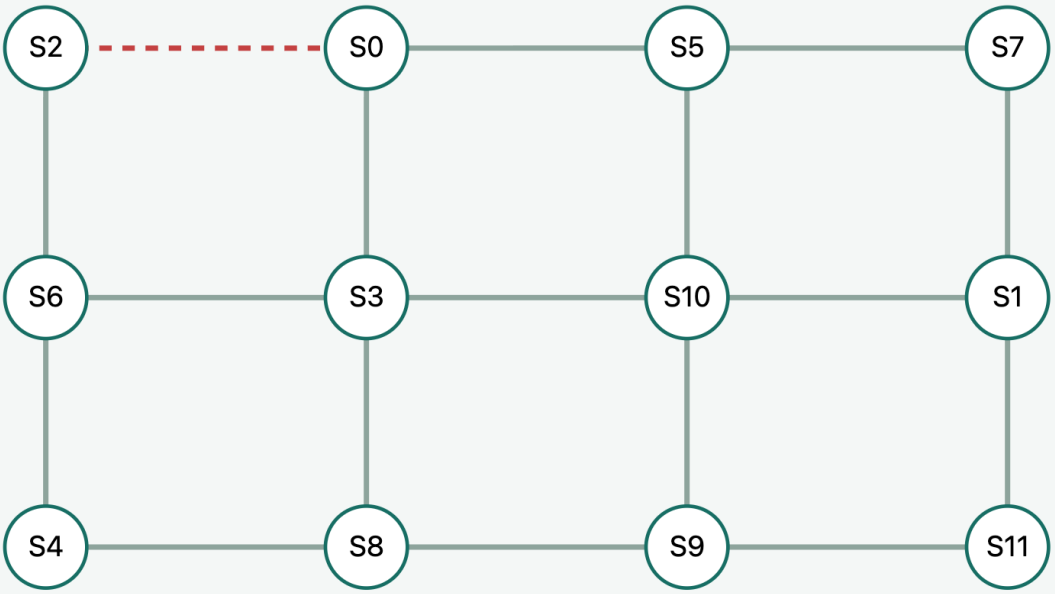
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10.0.205.1 is attached to **S2**. Host links are not shown and remain up.



At simulation time **3,000 ms**, link **S0–S2** fails in both directions and stays down. Routers receive no packets other than what your program sends. Other links remain up. Your program receives no direct link-failure notification. The table records its next hops for **10.0.205.1** immediately before the failure.

Switch	Next hop before failure
S0	S2
S1	S7
S2	A102
S3	S0
S4	S6
S5	S0
S6	S2
S7	S5
S8	S3
S9	S8
S10	S3
S11	S1

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- I don’t know (IDK)
- S0, S1
- S0, S3, S7
- S0, S3
- S0, S1, S3, S7
- S0, S1, S7
- S0, S5, S7, S10
- S0, S5, S8, S9
- S0, S3, S5, S7
- S0, S1, S5

Observed changed switches: S0, S1, S3, S7. See retained before/after evidence. Correct 4; IDK 1 manually; wrong 0.

Unanswered

Question 2
Not yet graded / 4 pts

1. How will your submitted program react?

The simulation runs your submitted program on the network below. Predict its behavior using the routing, failure-detection and update logic you implemented. Answers are checked against this submitted program, even if you would now design it differently.

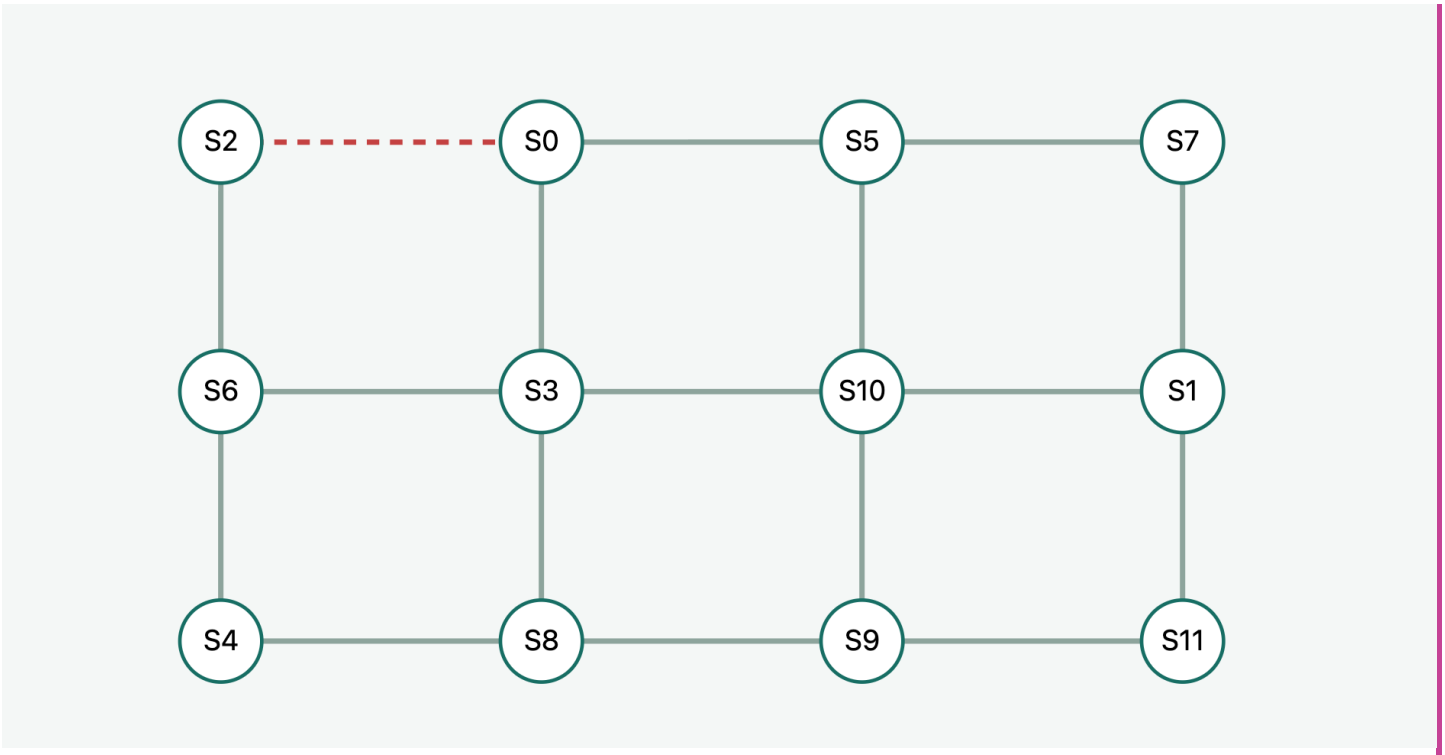
All links are bidirectional. The source host **10.0.148.1** is attached to **S9**; the destination host **10.0.205.1** is attached to **S2**. Host links are not shown and remain up.

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At simulation time **3,000 ms**, link **S0–S2** fails in both directions and stays down. Routers receive no packets other than what your program sends. Other links remain up. Your program receives no direct link-failure notification. The table records its next hops for **10.0.205.1** immediately before the failure.

Switch	Next hop before failure
S0	S2
S1	S7
S2	A102
S3	S0
S4	S6
S5	S0
S6	S2
S7	S5
S8	S3
S9	S8
S10	S3
S11	S1

Based on the timeout checks, timers and routing-update logic you implemented, approximately how

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your controller internally detects the failure.

Enter one number in milliseconds. Your answer will be scored later using the instructor-defined deviation model.

Your Answer:

Measured reference: 150.812576 ms after the failure. Apply the instructor-defined deviation model later. No exact-match grading rule is specified.

Unanswered

Question 3
0 / 2 pts

2. Design a drone network

A disaster has disabled communication across a **10 miles × 10 miles square**. You have **10 drones**. Ground devices and drones support radio links with a **6 miles range at 1 Gbit/s** and millimeter-wave links with a **300-foot range at 100 Gbit/s**. Drones fly at **1 mile per minute** and have unlimited compute, memory and storage. People throughout the area need calls and short messages: this traffic is light compared with 1 Gbit/s, and a one-way delay of **100 ms or less** is sufficient. Two ground locations **6 miles apart** also each generate a **6,000 Gbit file every hour** to send to the other, with a **30-minute delivery deadline**. Bulk transfers use dedicated ground devices, separate from the devices used for calls and messages. Each ground device can use only one wireless link at a time. Each forwarding drone adds **1 ms** of delay. Ignore battery limits, interference, and signal travel time. For bulk files, account for copying time using the stated available data rates.

(a) Considering only calls and short messages, which design meets the requirement?

- I don't know (IDK)
- Place ten stationary drones in one mm-wave chain: this connects people throughout the square.
- Divide the area into four equal squares and place a radio relay at the centre of each square.
- Place all drones at one corner and use radio to reach everyone in the area.
- Radio is unsuitable because its lower bandwidth necessarily makes even light traffic exceed 100 ms.

Answer key & reasoning Key: (a) A. Part (b): sample response below. (a) A — spread out radio relays Each small square is 5 miles × 5 miles. From its centre, reaching any point requires at most 2.5 miles horizontally plus 2.5 miles vertically. The straight-line distance is no greater than this 5

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points 10 miles away without coverage. Ten short-range mm-wave relays cannot cover the area. Lower bandwidth alone does not make light traffic too slow. (b) Sample response — carry the file on a drone Radio takes 6,000 ÷ 1 = 6,000 seconds = 100 minutes, longer than the 30-minute deadline. Ten stationary mm-wave relays provide at most eleven 300-foot links, spanning 3,300 feet (less than one mile), short of 6 miles. Copy onto the drone: 6,000 ÷ 100 = 60 seconds = 1 minute. Fly: 6 miles ÷ 1 mile/minute = 6 minutes. Copy off: 1 minute. Total: 1 + 6 + 1 = 8 minutes. Start one drone at each location to transfer both files within the deadline; they can carry the next hour's files back. Award credit for proposing to store and physically carry the file, using mm-wave for loading and unloading, and showing that the transfer meets the deadline. One drone starting at each location gives simultaneous delivery in both directions. Accept other feasible schedules with justified timing.

Unanswered

Question 4

Not yet graded / 4 pts

2. Design a drone network

The prompt remains the same as for the above question. Answer the questions below

(b) Considering only the file transfers, how would you use the drones and their wireless links to meet the deadline? Describe your design and estimate how long one file takes to arrive.

(c) Can you support both kinds of traffic at the same time using the same 10 drones? Describe your design and explain why both deadlines are met.

Label your written answers (b) and (c). Each part is worth 2 points.

Your Answer:

Answer key & reasoning Key: (a) A. Part (b): sample response below. (a) A — spread out radio relays Each small square is 5 miles × 5 miles. From its centre, reaching any point requires at most 2.5 miles horizontally plus 2.5 miles vertically. The straight-line distance is no greater than this 5 miles total, so it is within the 6 miles radio range. No diagonal calculation is needed. Adjacent relays are 5 miles apart, so they can communicate. A message needs at most three forwarding drones to travel between any two people. Delay is at most 3 × 1 ms = 3 ms, well below the 100 ms target. Further reducing it is unnecessary for the stated requirement. Clustering drones at one corner leaves points 10 miles away without coverage. Ten short-range mm-wave relays cannot cover the area. Lower bandwidth alone does not make light traffic too slow. (b) Sample response — carry the file on

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location to transfer both files within the deadline; they can carry the next hour's files back. Award credit for proposing to store and physically carry the file, using mm-wave for loading and unloading, and showing that the transfer meets the deadline. One drone starting at each location gives simultaneous delivery in both directions. Accept other feasible schedules with justified timing. Yes: four stationary radio relays plus two moving file carriers use six drones. Interactive delay is at most 3 ms (limit 100 ms), and bulk delivery is 8 minutes (limit 30 minutes). Separate bulk devices prevent loading/unloading from interrupting interactive devices. Accept any feasible justified design. Grade (b) out of 1 point and (c) out of 1 point; total 2.

Unanswered

Question 5
0 / 2 pts

3. Recover a missing packet before its deadline

A sender sends a continuous stream of equal-sized, numbered packets to a receiver: 1, 2, 3, and so on. It sends **50 packets every 100 ms**, evenly spaced. The network's round-trip time (RTT) is also **100 ms**.

Suppose one packet is lost. All later packets arrive in order, with the same spacing as they were sent. Recovery by retransmission works as follows:

1. The receiver discovers the loss when the next numbered packet arrives. For example, receiving packet 8 after packet 6 reveals that packet 7 is missing.
2. The receiver immediately asks the sender to resend the missing packet.
3. The request travels back to the sender, and the replacement travels to the receiver. Together, this takes **one RTT (100 ms)**, measured from when the receiver sends the request.

The request and replacement are not lost. Ignore processing and sender waiting time. In both parts, **recovery delay starts when the missing packet would normally have arrived** and ends when the receiver can recover it.

(a) Estimate the recovery delay — choose one

Using this retransmission procedure, which value is closest to the recovery delay?

- 100 ms
- 1,000 ms

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Answer key & reasoning (a) C — about 100 ms Packet spacing is 100 / 50 = 2 ms. The next packet reveals the gap after 2 ms. Request and replacement then take 100 ms. Recovery is approximately 102 ms, so 100 ms is the closest order-of-magnitude choice. (b) C — use the repair scheme The worst case is loss of the first original in a group. The repair packet is ten packet intervals later: 10 × 2 = 20 ms. It can reconstruct the lost original within the 25 ms deadline. Retransmission needs about 102 ms and misses that deadline. The cost is one extra packet per ten originals (10% overhead). Since the total packet rate stays fixed, original-data throughput becomes 10/11 of the available packet rate. The design trades some useful throughput for recovery before the deadline.

Unanswered

Question 6
0 / 2 pts

3. Recover a missing packet before its deadline

A sender sends a continuous stream of equal-sized, numbered packets to a receiver: 1, 2, 3, and so on. It sends **50 packets every 100 ms**, evenly spaced. The network's round-trip time (RTT) is also **100 ms**.

Suppose one packet is lost. All later packets arrive in order, with the same spacing as they were sent. Recovery by retransmission works as follows:

1. The receiver discovers the loss when the next numbered packet arrives. For example, receiving packet 8 after packet 6 reveals that packet 7 is missing.
2. The receiver immediately asks the sender to resend the missing packet.
3. The request travels back to the sender, and the replacement travels to the receiver. Together, this takes **one RTT (100 ms)**, measured from when the receiver sends the request.

The request and replacement are not lost. Ignore processing and sender waiting time. In both parts, **recovery delay starts when the missing packet would normally have arrived** and ends when the receiver can recover it.

(b) Choose a recovery design — choose one

The application needs a missing packet recovered within 25 ms of when it should have arrived. Consider replacing retransmission with this scheme:

The sender repeatedly sends 10 original packets, then 1 repair packet. The repair packet contains

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The total sending rate remains 50 packets every 100 ms, evenly spaced. A repair packet uses one of those transmission slots, just like an original packet. Assume reconstruction takes no time. Which assessment is correct?

- Choose retransmission: its roughly 102 ms recovery meets the deadline.
- Choose retransmission: recovery takes about 2 ms and needs no repair traffic.
- Choose the repair scheme: worst-case recovery is 20 ms, at a cost of one extra packet per ten originals.
- I don't know (IDK)
- Neither works: the repair scheme needs at least one RTT to recover a missing packet.

Answer key & reasoning (a) C — about 100 ms Packet spacing is 100 / 50 = 2 ms. The next packet reveals the gap after 2 ms. Request and replacement then take 100 ms. Recovery is approximately 102 ms, so 100 ms is the closest order-of-magnitude choice. (b) C — use the repair scheme The worst case is loss of the first original in a group. The repair packet is ten packet intervals later: 10 × 2 = 20 ms. It can reconstruct the lost original within the 25 ms deadline. Retransmission needs about 102 ms and misses that deadline. The cost is one extra packet per ten originals (10% overhead). Since the total packet rate stays fixed, original-data throughput becomes 10/11 of the available packet rate. The design trades some useful throughput for recovery before the deadline.

Unanswered

Question 7
0 / 1 pts

6. Judge three routing decisions

An ISP carries Netflix video to its subscribers. Netflix can buffer video before playback, so some network delay is acceptable as long as enough video arrives to keep playback smooth. **For this question, assume** the ISP must guarantee a **maximum one-way network delay of 100 ms** for this Netflix traffic. Its design goal is to meet that deadline at the lowest cost; extra speed has no additional benefit. These are simplified requirements for this question, not measured Netflix service requirements.

At the planned traffic load, including this service, the cheaper Route A guarantees at most **80 ms** and the more expensive Route B guarantees at most **30 ms**. Both guarantees include propagation, forwarding and queueing. Both routes have enough capacity and the same reliability at this load.

Judge each statement independently. Only the condition explicitly changed in that part is different.

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is faster.

- False
- I don't know (IDK)
- True

Answer key & reasoning Keys: (a) True · (b) False · (c) True. (a) True 80 ms is below 100 ms. Both routes meet the deadline, so the cheaper route meets the stated objective. (b) False An 80 ms bound does not guarantee delivery within 50 ms. Route B's 30 ms bound does. A lower price cannot compensate for an unmet delivery requirement. This does not mean every packet on Route A takes 80 ms; it means the supplied guarantee is insufficient. (c) True The bound applies only at the specified load. More traffic can increase queueing or exceed capacity. The designer needs a delay guarantee or evaluation at the higher load; the original figure does not establish whether the deadline will still be met.

Unanswered

Question 8
0 / 1 pts

6. Judge three routing decisions

An ISP carries Netflix video to its subscribers. Netflix can buffer video before playback, so some network delay is acceptable as long as enough video arrives to keep playback smooth. **For this question, assume** the ISP must guarantee a **maximum one-way network delay of 100 ms** for this Netflix traffic. Its design goal is to meet that deadline at the lowest cost; extra speed has no additional benefit. These are simplified requirements for this question, not measured Netflix service requirements.

At the planned traffic load, including this service, the cheaper Route A guarantees at most **80 ms** and the more expensive Route B guarantees at most **30 ms**. Both guarantees include propagation, forwarding and queueing. Both routes have enough capacity and the same reliability at this load.

Judge each statement independently. Only the condition explicitly changed in that part is different.

(b) True or false

Now consider GameNow, a fictional low-latency cloud-gaming service: each player's input affects the next game image, so long delays make the controls feel unresponsive. Suppose it replaces the

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- True
- False

Answer key & reasoning Keys: (a) True · (b) False · (c) True. (a) True 80 ms is below 100 ms. Both routes meet the deadline, so the cheaper route meets the stated objective. (b) False An 80 ms bound does not guarantee delivery within 50 ms. Route B's 30 ms bound does. A lower price cannot compensate for an unmet delivery requirement. This does not mean every packet on Route A takes 80 ms; it means the supplied guarantee is insufficient. (c) True The bound applies only at the specified load. More traffic can increase queueing or exceed capacity. The designer needs a delay guarantee or evaluation at the higher load; the original figure does not establish whether the deadline will still be met.

Unanswered

Question 9
0 / 1 pts

6. Judge three routing decisions

An ISP carries Netflix video to its subscribers. Netflix can buffer video before playback, so some network delay is acceptable as long as enough video arrives to keep playback smooth. **For this question, assume** the ISP must guarantee a **maximum one-way network delay of 100 ms** for this Netflix traffic. Its design goal is to meet that deadline at the lowest cost; extra speed has no additional benefit. These are simplified requirements for this question, not measured Netflix service requirements.

At the planned traffic load, including this service, the cheaper Route A guarantees at most **80 ms** and the more expensive Route B guarantees at most **30 ms**. Both guarantees include propagation, forwarding and queueing. Both routes have enough capacity and the same reliability at this load.

Judge each statement independently. Only the condition explicitly changed in that part is different.

(c) True or false

Return to Netflix and its 100 ms deadline. If more subscribers start watching and traffic rises beyond the load covered by these guarantees, the original 80 ms figure alone is not enough to conclude that Route A will still meet the 100 ms deadline.

- False

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routes meet the deadline, so the cheaper route meets the stated objective. (b) False An 80 ms bound does not guarantee delivery within 50 ms. Route B's 30 ms bound does. A lower price cannot compensate for an unmet delivery requirement. This does not mean every packet on Route A takes 80 ms; it means the supplied guarantee is insufficient. (c) True The bound applies only at the specified load. More traffic can increase queueing or exceed capacity. The designer needs a delay guarantee or evaluation at the higher load; the original figure does not establish whether the deadline will still be met.

Unanswered

Question 10
0 / 1 pts

7. Allocate traffic to meet deadlines at the lowest cost

An ISP delivers two services to subscribers in the same destination access network: **GameNow**, a fictional low-latency cloud-gaming service, and **Netflix** video streaming. GameNow sends game images in response to player input, so delays make the controls feel unresponsive. Netflix downloads video ahead of playback into a buffer, so it can tolerate more network delay.

For this question, assume GameNow needs **1 Gbit/s of interactive gaming traffic** with a maximum one-way network delay of **30 ms**. Netflix needs **2 Gbit/s of buffered video traffic** with a maximum one-way network delay of **100 ms**. These rates are the total traffic across all subscribers, not per-user rates. The deadlines are simplified quiz requirements, not measured service requirements. Both routes below can deliver either service to this destination network. Return traffic is outside the scope of this question.

Two routes are available. Their spare capacities are independent. The delay bounds below include queueing and hold as long as a route's total assigned traffic does not exceed its spare capacity.

Route	Spare capacity	Maximum one-way delay	Additional monthly cost
Customer route	2 Gbit/s	80 ms	Free
Provider route	2 Gbit/s	20 ms	$50 per Gbit/s assigned

Traffic consists of many small flows that may be divided between the routes. Each flow must meet its own deadline; averaging delays across routes does not satisfy a deadline. Ignore other costs.

Choose one — choose one

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Customer: all GameNow gaming traffic and 1 Gbit/s of Netflix video. Provider: the remaining 1 Gbit/s of Netflix video. Cost: $50.

Customer: 1 Gbit/s of Netflix video. Provider: all GameNow gaming traffic and the remaining 1 Gbit/s of Netflix video. Cost: $100.

Customer: all 2 Gbit/s of Netflix video. Provider: all 1 Gbit/s of GameNow gaming traffic. Cost: $50.

Provider: all 3 Gbit/s of traffic. Cost: $150.

I don't know (IDK)

Answer key & reasoning Answer: B. GameNow gaming traffic needs a 30 ms guarantee. The customer route's 80 ms bound is insufficient, so all 1 Gbit/s of GameNow gaming traffic must use the provider route, whose bound is 20 ms. Netflix video traffic tolerates 100 ms, so it can use either route. Put its full 2 Gbit/s on the free customer route, exactly filling that route's available capacity. The provider carries just 1 Gbit/s, below its 2 Gbit/s capacity. Cost: 1 × $50 = $50 per month. This is the lowest possible cost because at least that much GameNow gaming traffic must use the paid route. Why the others fail: A has the same price and fits the capacities, but cannot guarantee the interactive deadline. C meets all requirements but unnecessarily pays to carry Netflix video traffic. D exceeds the provider route's 2 Gbit/s spare capacity, so its delay guarantee no longer applies.

Unanswered

Question 11
0 / 1 pts

8. A forwarding loop in a triangle

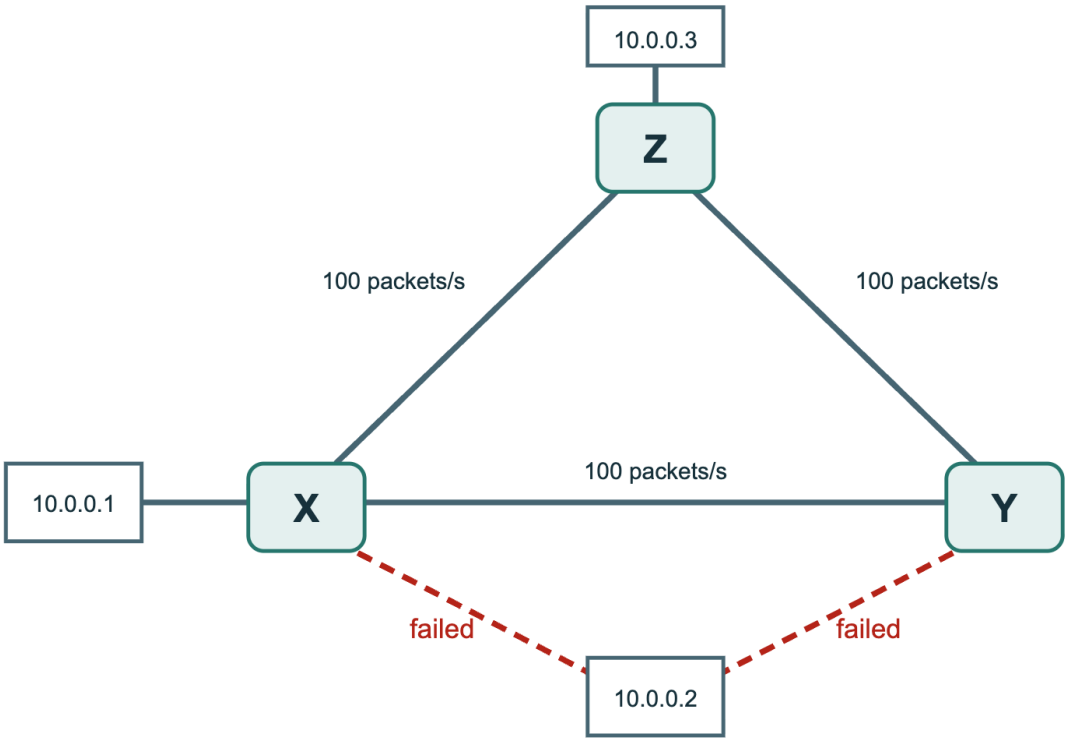
Switches X, Y and Z form a triangle. Host 10.0.0.1 connects to X, host 10.0.0.3 connects to Z, and host 10.0.0.2 has a connection to **both X and Y**. Each switch-to-switch link can carry **100 equal-sized packets/s in each direction independently**. Host connections are not a bottleneck.

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Each switch link: 100 packets/s in each direction

Both links to 10.0.0.2 have just failed. X knows its own link to 10.0.0.2 failed but still believes Y's link to 10.0.0.2 works. Y knows its own link failed but still believes X's link works. Each therefore tries to reach 10.0.0.2 through the other switch.

For this question, hold the forwarding entries below unchanged. 10.0.0.3 sends packets to 10.0.0.2 at **10 packets/s**. The header is shown as a packet enters Z, before Z processes it; all 10.0.0.2-bound packets have the same forwarding-relevant values. Use standard IP forwarding behavior.

Use steady average rates, ignore brief bursts, and count every crossing against that link direction's capacity. A sustainable rate must not require a growing queue or packet loss.

Switch	To 10.0.0.1	To 10.0.0.2
X	Deliver	Y
Y	X	X
Z	X	Y

Header field	Value
Source	10.0.0.3
Destination	10.0.0.2
Source port	41000

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(a) Numerical answer

At what rate does 10.0.0.2 receive packets from 10.0.0.3?

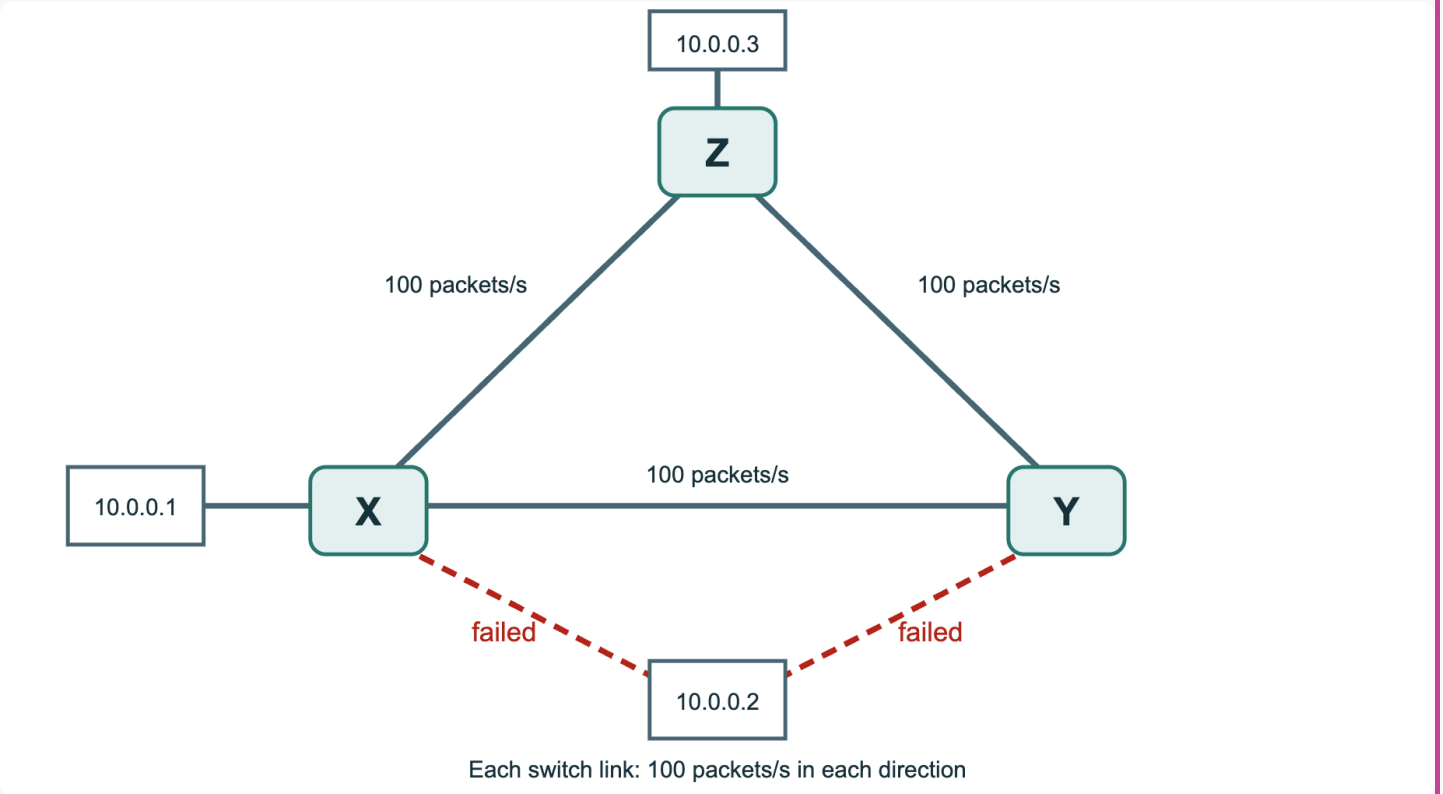
Enter a number only (packets/s).

Unanswered

Question 12
0 / 1 pts

8. A forwarding loop in a triangle

Switches X, Y and Z form a triangle. Host 10.0.0.1 connects to X, host 10.0.0.3 connects to Z, and host 10.0.0.2 has a connection to **both X and Y**. Each switch-to-switch link can carry **100 equal-sized packets/s in each direction independently**. Host connections are not a bottleneck.



Both links to 10.0.0.2 have just failed. X knows its own link to 10.0.0.2 failed but still believes Y's link to 10.0.0.2 works. Y knows its own link failed but still believes X's link works. Each therefore tries

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packets have the same forwarding-relevant values. Use standard IP forwarding behavior.

Use steady average rates, ignore brief bursts, and count every crossing against that link direction's capacity. A sustainable rate must not require a growing queue or packet loss.

Switch	To 10.0.0.1	To 10.0.0.2
X	Deliver	Y
Y	X	X
Z	X	Y

Header field	Value
Source	10.0.0.3
Destination	10.0.0.2
Source port	41000
Destination port	9000
Protocol	UDP
TTL	15

(b) Numerical answer

10.0.0.3 continues sending to 10.0.0.2 at 10 packets/s. What is the maximum additional rate at which 10.0.0.3 can send packets to 10.0.0.1 such that 10.0.0.1 receives them at the same rate, without overloading any direction? Packets addressed to 10.0.0.1 have enough lifetime to reach it.

Enter a number only (packets/s).

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* Some questions not yet graded

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