LONGEST PREFIX MATCHING

LONGEST PREFIX MATCHING

Consider a datagram network using 8-bit host addresses.
Suppose a router uses longest-prefix matching, and has the following forwarding table:

Prefix Match	Interface
10	1
11	2
101	3
110	4
010	5
otherwise	6

1. QUESTION 1 OF 3

Suppose a datagram arrives at the router, with destination address 11001011. To which interface will this datagram be forwarded using longest-prefix matching?

Answer 4

11001011

2 QUESTION 2 OF 3

Suppose a datagram arrives at the router, with destination address 01011001. To which interface will this datagram be forwarded using longest-prefix matching?

Answer 5

01011001

3. QUESTION 3 OF 3

Suppose a datagram arrives at the router, with destination address 11011101. To which interface will this datagram be forwarded using longest-prefix matching?

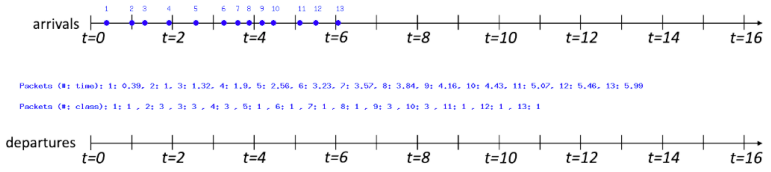
Answer 4

11011101

PACKET SCHEDULING

PACKET SCHEDULING

Consider the arrival of 13 packets to an output link at a router in the interval of time [0, 5], as indicated by the figure below. We'll consider time to be "slotted", with a slot beginning at t = 0, 1, 2, 3, etc. Packets can arrive at any time during a slot, and multiple packets can arrive during a slot. At the beginning of each time slot, the packet scheduler will choose one packet, among those queued (if any), for transmission according to the packet scheduling discipline (that you will select below). Each packet requires exactly one slot time to transmit, and so a packet selected for transmission at time t, will complete its transmission at t+1, at which time another packet will be selected for transmission, among those queued. You might want to review section 4.2.5 in the 8th edition of our textbook, on packet scheduling.



Packets (#: time): 1: 0.39, 2: 1, 3: 1.32, 4: 1.9, 5: 2.56, 6: 3.23, 7: 3.57, 8: 3.84, 9: 4.16, 10: 4.43, 11: 5.07, 12: 5.46, 13: 5.99

Packets (#: class): 1: 1 , 2: 3 , 3: 3 , 4: 3 , 5: 1 , 6: 1 , 7: 1 , 8: 1 , 9: 3 , 10: 3 , 11: 1 , 12: 1 , 13: 1

Choose a specific packet scheduling discipline (FCFS, Priority, RR, and WFQ) from the list below. In the case of Priority, RR, and WFQ there will be three classes of traffic (1, 2, 3), with lower class numbers having higher priority in the case of priority schedule, or beginning earlier in the case of RR and WFQ. In the case of WFQ, scheduling weights are 0.5, 0.3, and 0.2.

Con priority

1. QUESTION 1 OF 13

At t=1, which packet is sent out? Give the packet # or 'n/a' if applicable

Answer

t=1 [1,2] => 1
1 3

2. QUESTION 2 OF 13

At t=2, which packet is sent out? Give the packet # or 'n/a' if applicable

Answer

t=1 [~~1~~,2] => 2
1 3

3. QUESTION 3 OF 13

At t=3, which packet is sent out? Give the packet # or 'n/a' if applicable

Answer

t=3 [3,4,5] => 5
3 3 1

4. QUESTION 4 OF 13

At t=4, which packet is sent out? Give the packet # or 'n/a' if applicable

Answer

t=4 [3,4,6,7,8] => 6
3 3 1 1 1

5. QUESTION 5 OF 13

At t=5, which packet is sent out? Give the packet # or 'n/a' if applicable

Answer

t=5 [3,4,7,8,9,10] = 7
3 3 1 1 3 3

6. QUESTION 6 OF 13

At t=6, which packet is sent out? Give the packet # or 'n/a' if applicable

Answer

t=6 [3, 4, 8, 9, 10, 11, 12] => 8
3 3 1 3 3 1 1

7. QUESTION 7 OF 13

At t=7, which packet is sent out? Give the packet # or 'n/a' if applicable

Answer

t=7 [3, 4, 8, 9, 10, 11, 12, 13] => 11
3 3 1 3 3 1 1 1

8. QUESTION 8 OF 13

At t=8, which packet is sent out? Give the packet # or 'n/a' if applicable

Answer

t=8 [3, 4, 9, 10, 12, 13] => 12
3 3 3 3 1 1

9 QUESTION 9 OF 13

At t=9, which packet is sent out? Give the packet # or 'n/a' if applicable

Answer

t=9 [3, 4, 9, 10, , 13] => 13
3 3 3 3 1

10 QUESTION 10 OF 13

At t=10, which packet is sent out? Give the packet # or 'n/a' if applicable

Answer

t=10 [3, 4, 9, 10, ,] => 3
3 3 3 3

11 QUESTION 11 OF 13

At t=11, which packet is sent out? Give the packet # or 'n/a' if applicable

4

12 QUESTION 12 OF 13

At t=12, which packet is sent out? Give the packet # or 'n/a' if applicable

9

13 QUESTION 13 OF 13

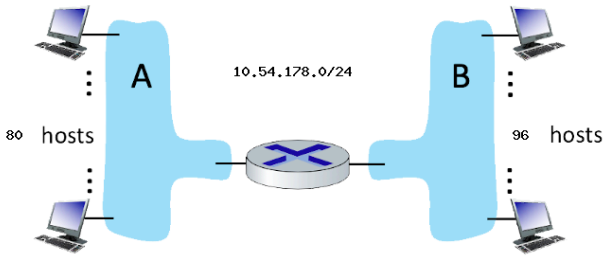
At t=13, which packet is sent out? Give the packet # or 'n/a' if applicable

Answer 10

SUBNET ADDRESSING

SUBNET ADDRESSING

Consider the router and the two attached subnets below (A and B). The number of hosts is also shown below. The subnets share the 24 high-order bits of the address space: 10.54.178.0/24



Assign subnet addresses to each of the subnets (A and B) so that the amount of address space assigned is minimal, and at the same time leaving the largest possible contiguous address space available for assignment if a new subnet were to be added. Then answer the questions below.

0 1 2 3 4 5
1 2 4 8 16 32
6 7 8
64 128 256

- /24 → $2^{32-24} = 2^8 - 2 = 254$ host assegnabili
- /$2^{32-x} = 2^7 - 2 = 126$ host per rete $x = 32-7 = 25$
  = /25 =

1) S.M = 11111111 11111111 11111111 1000..
net
1) 10 10.00110110.10110010.00000000
7 6 5 4 3 2 1 0
.1

→ 10.54.178.0 /25 → 128 SM: 255.255.255.128
10.54.178.128 /25 : //

1. QUESTION 1 OF 10

Is the address space public or private?

Answer

private: 10/8, 172.16/12, ...

2. QUESTION 2 OF 10

How many hosts can there be in this address space?

254

3. QUESTION 3 OF 10

What is the subnet address of subnet A? (CIDR notation)

10.54.178.128/25

4. QUESTION 4 OF 10

What is the broadcast address of subnet A?

10.54.178.255

5. **QUESTION 5 OF 10**

What is the starting address of subnet A?

10.54.178.129

6. **QUESTION 6 OF 10**

What is the ending address of subnet A?

10.54.178.254

7. **QUESTION 7 OF 10**

What is the subnet address of subnet B? (CIDR notation)

10.54.178.0/25

8. **QUESTION 8 OF 10**

What is the broadcast address of subnet B?

10.54.178.127

9. **QUESTION 9 OF 10**

What is the starting address of subnet B?

10.54.178.1

10. **QUESTION 10 OF 10**

What is the ending address of subnet B?

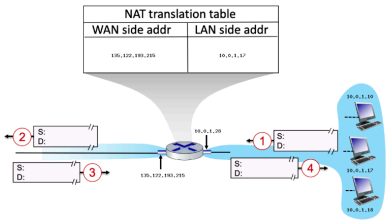
10.54.178.126

NETWORK ADDRESS TRANSLATION

NETWORK ADDRESS TRANSLATION

Consider the scenario below in which three hosts, with private IP addresses 10.0.1.10, 10.0.1.17, 10.0.1.18 are in a local network behind a NAT'd router that sits between these three hosts and the larger Internet. IP datagrams being sent from, or destined to, these three hosts must pass through this NAT router. The router's interface on the LAN side has IP address 10.0.1.28, while the router's address on the Internet side has IP address 135.122.193.215

Before doing this problem, you might want to reread the section on the NAT protocol in section 4.3.4 in the text.



Suppose that the host with IP address 10.0.1.17 sends an IP datagram destined to host 128.119.177.189. The source port is 3374, and the destination port is 80.

1

QUESTION 1 OF 10

Consider the datagram at step 1, after it has been sent by the host but before it has reached the router. What is the source IP address for this datagram?

10.0.1.17 ✓

2.

QUESTION 2 OF 10

At step 1, what is the destination IP address?

128.119.177.189 ✓

3.

QUESTION 3 OF 10

Now consider the datagram at step 2, after it has been transmitted by the router. What is the source IP address for this datagram?

135.122.193.215 ✓

4.

QUESTION 4 OF 10

At step 2, what is the destination IP address for this datagram?

128.119.177.189 ✓

5

QUESTION 5 OF 10

Will the source port have changed? Yes or No.

Yes ✓

6.

QUESTION 6 OF 10

Now consider the datagram at step 3, just before it is received by the router. What is the source IP address for this datagram?

128.119.177.189 ✓

7.

QUESTION 7 OF 10

At step 3, what is the destination IP address for this datagram?

135.122.193.215 ✓

8.

QUESTION 8 OF 10

Last, consider the datagram at step 4, after it has been transmitted by the router but before it has been received by the host. What is the source IP address for this datagram?

128.119.177.189 ✓

9. ## QUESTION 9 OF 10

At step 4, what is the destination IP address for this datagram

10.0.1.17

10 ## QUESTION 10 OF 10

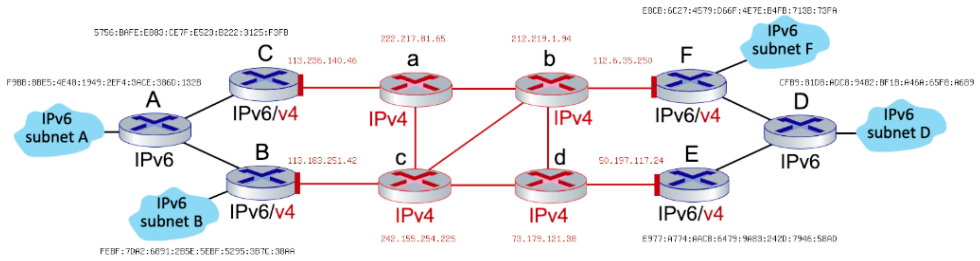
Has a new entry been made in the router's NAT table? Yes or No.

No

IPV6 TUNNELING & ENCAPSULATION

IPV6 TUNNELING AND ENCAPSULATION

Consider the network shown below which contains four IPv6 subnets, connected by a mix of IPv6-only routers(shaded blue), IPv4-only routers (shaded red) and dual-capable IPv6/IPv4 routers (shaded blue with red interfaces to IPv4 routers). You might want to review Section 4.3.4 in the textbook before doing this problem.



Suppose that a host of subnet F wants to send an IPv6 datagram to a host on subnet A. Assume that the forwarding between these two hosts goes along the path: F --> b --> c --> a --> C --> A

QUESTION 1 OF 31

Is the datagram being forwarded from F to b an IPv4 or IPv6 datagram?

IPv4

QUESTION 2 OF 31

What is the source address of this F to b datagram?

112.6.35.250

QUESTION 3 OF 31

What is the destination address of this F to b datagram?

113.236.140.46

QUESTION 4 OF 31

Is this F to b datagram encapsulating another datagram? Yes or No.

Yes

QUESTION 5 OF 31

What is the source address of this encapsulated datagram?

E8CB:6C27:4579:D66F:4E7E:B4FB:713B:73FA

QUESTION 6 OF 31

What is the destination address of this encapsulated datagram?

F9BB:BBE5:4E48:1949:2EF4:3ACE:386D:132B

QUESTION 7 OF 31

Is the datagram being forwarded from b to c an IPv4 or IPv6 datagram?

IPv4

QUESTION 8 OF 31

What is the source address of this b to c datagram?

112.6.35.250

QUESTION 9 OF 31

What is the destination address of this b to c datagram?

113.236.140.46

QUESTION 10 OF 31

Is this b to c datagram encapsulating another datagram? Yes or No.

Yes

QUESTION 11 OF 31

What is the source address of this encapsulated datagram?

E8CB:6C27:4579:D66F:4E7E:B4FB:713B:73FA

QUESTION 12 OF 31

What is the destination address of this encapsulated datagram?

F9BB:BBE5:4E48:1949:2EF4:3ACE:386D:132B

QUESTION 14 OF 31

What is the source address of this c to a datagram?

112.6.35.250

QUESTION 15 OF 31

What is the destination address of this c to a datagram?

113.236.140.46

QUESTION 16 OF 31

Is this c to a datagram encapsulating another datagram? Yes or No.

Yes

QUESTION 17 OF 31

What is the source address of this encapsulated datagram?

E8CB:6C27:4579:D66F:4E7E:B4FB:713B:73FA

QUESTION 18 OF 31

What is the destination address of this encapsulated datagram?

F9BB:BBE5:4E48:1949:2EF4:3ACE:386D:132B

QUESTION 19 OF 31

Is the datagram being forwarded from a to C an IPv4 or IPv6 datagram?

IPv4

QUESTION 25 OF 31

Is the datagram being forwarded from C to A an IPv4 or IPv6 datagram?

IPv6

QUESTION 26 OF 31

What is the source address of this C to A datagram?

E8CB:6C27:4579:D66F:4E7E:B4FB:713B:73FA

QUESTION 27 OF 31

What is the destination address of this C to A datagram?

F9BB:BBE5:4E48:1949:2EF4:3ACE:386D:132B

QUESTION 28 OF 31

Is this C to A datagram encapsulating another datagram? Yes or No.

No

QUESTION 29 OF 31

What router is the 'tunnel entrance'? Give the router's letter

F

QUESTION 30 OF 31

What router is the 'tunnel exit'? Give the router's letter

C

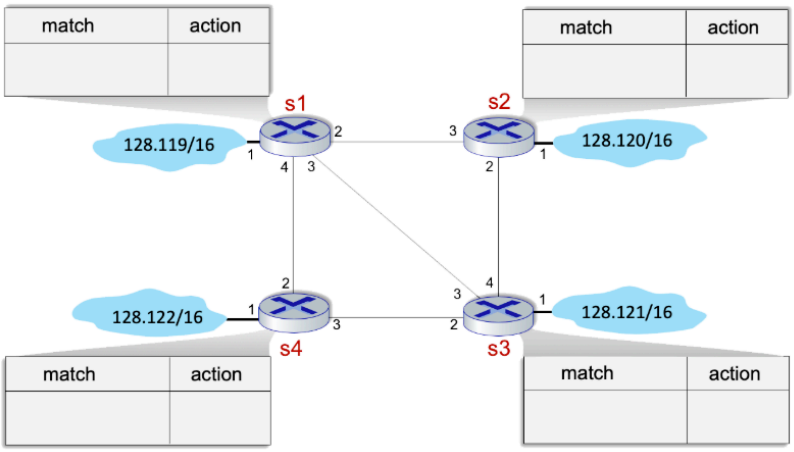
QUESTION 31 OF 31

Which protocol encapsulates the other, IPv4 or IPv6?

IPv4

OPENFLOW FLOW TABLES

Consider the 4-router network shown below, where packet forwarding is controlled by flow tables (e.g., configured via OpenFlow in an SDN controller), rather than by a forwarding table computed by a routing algorithm. The addresses of networks attached to each of the router is also shown. The interfaces at each of the routers are also as indicated.



Suppose we want the following forwarding behavior of packets to be implemented:

- Packets coming from the source network attached to s2 and destined to the network attached to s3 should be forwarded along the path: s2 -> s1 -> s3.

Complete the match-plus-action tables in each of the routers, s1, s2, s3, and s4, that implement these forwarding behaviors. Your rules should be as strict as possible (should only allow these behaviors, and no other forwarding behaviors). You can assume that any packet arriving at a router that does not match a rule in that table will be dropped.

QUESTION 1 OF 21

For router s1, what should the value of the 'IP Src' be? Pick either a specific address (including CIDR), any, or none

128.120/16

QUESTION 2 OF 21

For router s1, what should the value of the 'IP Dst' be? Pick either a specific address (including CIDR), any, or none

128.121/16

QUESTION 3 OF 21

For router s1, what should the value of the 'Src Port' be? Pick either a specific port, or any

any

QUESTION 4 OF 21

For router s1, what should the value of the 'Dst Port' be? Pick either a specific port, or any

any

QUESTION 5 OF 21

For router s1, what should the value of the 'IP Proto' be? Pick either TCP, UDP, or any

any

QUESTION 6 OF 21

For router s1, what should the action of the rule be? Some examples include forward, allow, deny, etc

forward

QUESTION 7 OF 21

For router s1, what interface should the packets be forwarded to?

3

QUESTION 8 OF 21

For router s2, what should the value of the 'IP Src' be? Pick either a specific address (including CIDR), any, or none

128.120/16

QUESTION 9 OF 21

For router s2, what should the value of the 'IP Dst' be? Pick either a specific address (including CIDR), any, or none

128.121/16

QUESTION 10 OF 21

For router s2, what should the value of the 'Src Port' be? Pick either a specific port, or any

any

QUESTION 11 OF 21

For router s2, what should the value of the 'Dst Port' be? Pick either a specific port, or any

any

QUESTION 12 OF 21

For router s2, what should the value of the 'IP Proto' be? Pick either TCP, UDP, or any

any

QUESTION 13 OF 21

For router s2, what should the action of the rule be? Some examples include forward, allow, deny, etc

forward

QUESTION 14 OF 21

For router s2, what interface should the packets be forwarded to?

3

QUESTION 15 OF 21

For router s3, what should the value of the 'IP Src' be? Pick either a specific address (including CIDR), any, or none

128.120/16

QUESTION 16 OF 21

For router s3, what should the value of the 'IP Dst' be? Pick either a specific address (including CIDR), any, or none

128.121/16

QUESTION 17 OF 21

For router s3, what should the value of the 'Src Port' be? Pick either a specific port, or any

any

QUESTION 18 OF 21

For router s3, what should the value of the 'Dst Port' be? Pick either a specific port, or any

any

QUESTION 19 OF 21

For router s3, what should the value of the 'IP Proto' be? Pick either TCP, UDP, or any

any

QUESTION 20 OF 21

For router s3, what should the action of the rule be? Some examples include forward, allow, deny, etc

forward

QUESTION 21 OF 21

For router s3, what interface should the packets be forwarded to?

1