Ex. 1

- A router has the following routing table and the following interfaces

network	netmask	first hop
131.175.21.0	255.255.255.0	131.17.123.254
131.175.16.0	255.255.255.0	131.17.78.254
131.56.0.0	255.255.0.0	131.17.15.254
131.155.0.0	255.255.0.0	131.17.15.254
0.0.0.0	0.0.0.0	131.17.123.254

interface eth0	
IP address	131.17.123.1
netmask	255.255.255.0

interface eth1	
IP address	131.17.78.1
netmask	255.255.255.0

interface eth2	
IP address	131.17.15.12
netmask	255.255.255.0

- How does the router manages the IP packets with the following IP destination addresses? :
  - 131.17.123.88
  - 131.56.78.4
  - 190.78.90.2

Ex. 1 - Solution

network	netmask	first hop
131.175.21.0	255.255.255.0	131.17.123.254
131.175.16.0	255.255.255.0	131.17.78.254
131.56.0.0	255.255.0.0	131.17.15.254
131.155.0.0	255.255.0.0	131.17.15.254
0.0.0.0	0.0.0.0	131.17.123.254

interface eth0	
IP address	131.17.123.1
netmask	255.255.255.0

interface eth1	
IP address	131.17.78.1
netmask	255.255.255.0

interface eth2	
IP address	131.17.15.12
netmask	255.255.255.0

□ 131.17.123.88

 □ Forwarded through interface eth0

□ 131.56.78.4

 □ Forwarded to the next hop 131.17.15.254

□ 190.78.90.2

 □ Forwarded to the gateway 131.175.123.254

Ex. 2

- A router has the following routing table and interfaces configuration.

- eth0
  192.170.123.4
  255.255.255.0
- eth1
  192.170.124.4
  255.255.255.0

Network	Netmask	Next Hop
191.138.112.0	255.255.240.0	192.170.123.1
191.138.96.0	255.255.224.0	192.170.124.1
191.138.0.0	255.255.0.0	192.170.123.2
191.138.160.0	255.255.224.0	192.170.124.2
0.0.0.0	0.0.0.0	192.170.123.3

- The router receives packets with the following IP destination addresses:
  1. 191.138.163.13
  2. 191.138.113.32
  3. 131.175.123.244
  4. 255.255.255.255
  5. 192.170.123.255 from eth1
  6. 0.0.0.3 from eth0
- Specify the behavior of the router for each packet.
  - What kind of forwarding is implemented (direct, indirect)?
  - Which is the *next hop*
  - Which the line of the routing table used to decide the *next hop*?

Ex. 2 – Solution

191.138.163.13 AND
1. /20 = 191.138.160.0
2. /19 = 191.138.160.0
3. /16 = 191.138.0.0 — **OK**
4. /19 = 191.138.160.0 — **OK**
5. /0 = 0.0.0.0 — **OK**

OK

	Network	Netmask	Next Hop
1	191.138.112.0	255.255.240.0	192.170.123.1
2	191.138.96.0	255.255.224.0	192.170.124.1
3	191.138.0.0	255.255.0.0	192.170.123.2
4	191.138.160.0	255.255.224.0	192.170.124.2
5	0.0.0.0	0.0.0.0	192.170.123.3

Indirect Forwarding
    192.170.124.2

Ex. 2 – Solution

191.138.113.32 AND

1. /20 = 191.138.112.0
2. /19 = 191.138.96.0
3. /16 = 191.138.0.0
4. /19 = 191.138.112.0
5. /0 = 0.0.0.0

	Network	Netmask	Next Hop
1	191.138.112.0	255.255.240.0	192.170.123.1
2	191.138.96.0	255.255.224.0	192.170.124.1
3	191.138.0.0	255.255.0.0	192.170.123.2
4	191.138.160.0	255.255.224.0	192.170.124.2
5	0.0.0.0	0.0.0.0	192.170.123.3

OK
OK
OK
OK

Indirect Forwarding
   192.170.123.1

Ex. 2 - Solution

131.175.123.244 AND

1. /20 No match
2. /19 No match
3. /16 No match
4. /19 No match
5. /0 = 0.0.0.0 ——— **OK** ——→

Indirect Forwarding
192.170.123.3

	Network	Netmask	Next Hop
1	191.138.112.0	255.255.240.0	192.170.123.1
2	191.138.96.0	255.255.224.0	192.170.124.1
3	191.138.0.0	255.255.0.0	192.170.123.2
4	191.138.160.0	255.255.224.0	192.170.124.2
5	0.0.0.0	0.0.0.0	192.170.123.3

Ex. 2 - Solution

- eth0
  192.170.123.4
  255.255.255.0
- eth1
  192.170.124.4
  255.255.255.0

	Network	Netmask	Next Hop
1	191.138.112.0	255.255.240.0	192.170.123.1
2	191.138.96.0	255.255.224.0	192.170.124.1
3	191.138.0.0	255.255.0.0	192.170.123.2
4	191.138.160.0	255.255.224.0	192.170.124.2
5	0.0.0.0	0.0.0.0	192.170.123.3

- 255.255.255.255
  - Limited broadcast, router drops the packet

- 192.170.123.255 from eth1
  - Direct broadcast to subnet 192.170.123.0, router forwards the packet through eth0

- 0.0.0.3 from eth0
  - Limited unicast, router drops the packet

Ex. 3

A router has the following routing table and the following interfaces.
The router receives 8 packets whose destination IP addresses and
incoming interfaces are reported below. Indicate what is the
behavior of the router per each packet indicating:

- If the packet is forwarded or not
- In the case the packet is forwarded,
  - the next hop (IP address)
  - whether the forwarding is direct or indirect
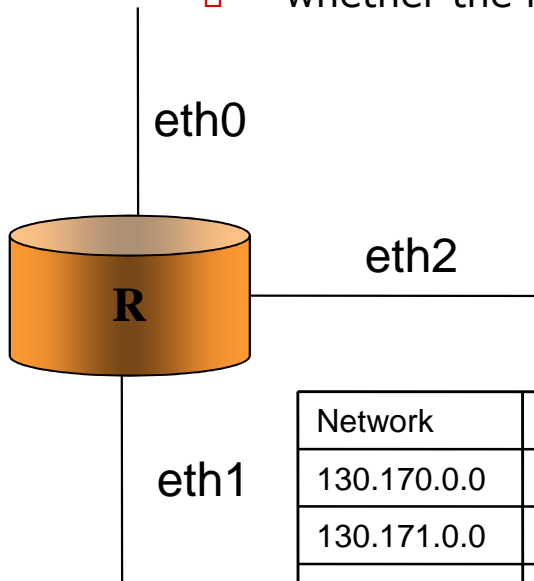
eth0

eth2

R

eth1

Interface	IP Address	Netmask
Eth0	131.175.123.235	255.255.255.0
Eth1	131.175.123.129	255.255.255.128
Eth2	131.175.122.1	255.255.255.0

Network	Netmask	Next Hop
130.170.0.0	255.255.0.0	131.175.123.1
130.171.0.0	255.255.0.0	131.175.123.132
130.171.4.0	255.255.252.0	131.175.122.2
130.170.10.0	255.255.254.0	131.175.122.3
0.0.0.0	0.0.0.0	131.175.123.3

RECEIVED PACKETS

A. 131.175.123.64 from eth2
B. 131.175.123.255 from eth0
C. 131.175.123.132 from eth2
D. 130.170.132.240 from eth1
E. 130.170.11.64 from eth1
F. 130.171.5.125 from eth1
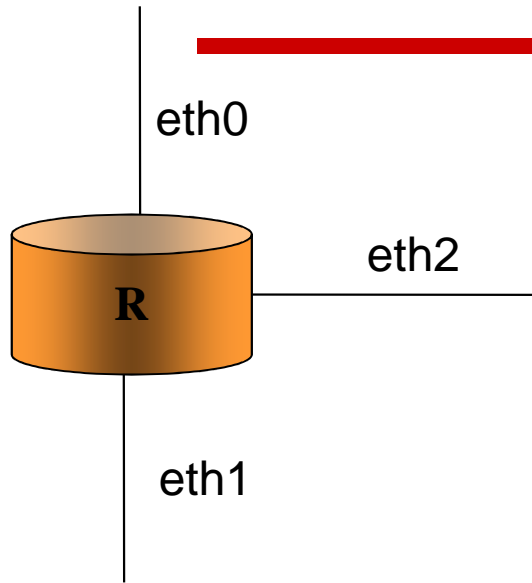G. 156.198.34.14 from eth0
H. 0.0.0.132 from eth1

Ex. 3 - Solution
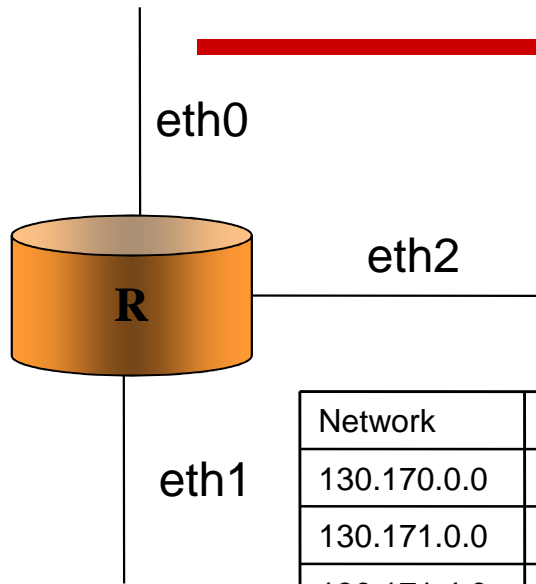
eth0

eth2

eth1

R

Interface	IP Address	Netmask
Eth0	131.175.123.235	255.255.255.0
Eth1	131.175.123.129	255.255.255.128
Eth2	131.175.122.1	255.255.255.0

Network	Netmask	Next Hop
130.170.0.0	255.255.0.0	131.175.123.1
130.171.0.0	255.255.0.0	131.175.123.132
130.171.4.0	255.255.252.0	131.175.122.2
130.170.10.0	255.255.254.0	131.175.122.3
0.0.0.0	0.0.0.0	131.175.123.3

A. 131.175.123.64 from eth2
   direct forwarding through eth0

B. 131.175.123.255
   broadcast address: not forwarded

C. 131.175.123.132
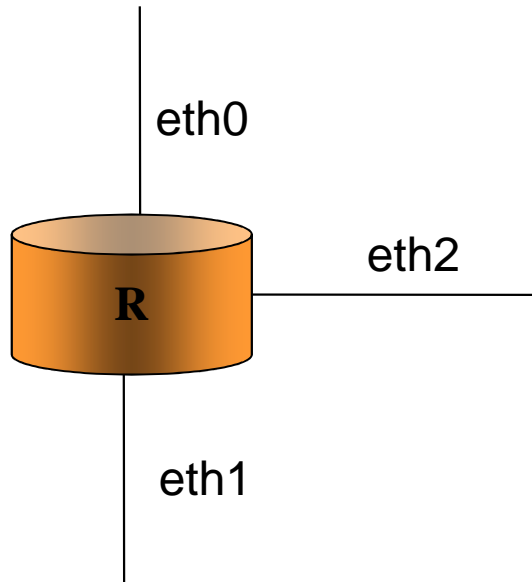   direct forwarding through eth1

Ex. 3 - Solution

eth0

eth2

R

eth1

Interface	IP Address	Netmask
Eth0	131.175.123.235	255.255.255.0
Eth1	131.175.123.129	255.255.255.128
Eth2	131.175.122.1	255.255.255.0

Network	Netmask	Next Hop
130.170.0.0	255.255.0.0	131.175.123.1
130.171.0.0	255.255.0.0	131.175.123.132
130.171.4.0	255.255.252.0	131.175.122.2
130.170.10.0	255.255.254.0	131.175.122.3
0.0.0.0	0.0.0.0	131.175.123.3

D. 130.170.132.240 from eth1
Indirect forwarding, first line routing table,
NH: 131.175.123.1

E. 130.170.11.64 from eth1
Indirect forwarding, fourth line routing table,
NH: 131.175.122.3

F. 130.171.5.125 from eth1
Indirect forwarding, third line routing table,
NH: 131.175.122.2

Ex. 3 - Solution

Interface	IP Address	Netmask
Eth0	131.175.123.235	255.255.255.0
Eth1	131.175.123.129	255.255.255.128
Eth2	131.175.122.0	255.255.255.0

Network	Netmask	Next Hop
130.170.0.0	255.255.0.0	131.175.123.1
130.171.0.0	255.255.0.0	131.175.123.132
130.171.4.0	255.255.252.0	131.175.122.2
130.170.10.0	255.255.254.0	131.175.122.3
0.0.0.0	0.0.0.0	131.175.123.3

G. 156.198.34.14 from eth0
Indirect forwarding, last line routing table,
NH: 131.175.123.3

H. 0.0.0.132 from eth1

special address, only source, not processed