Computer Network

Lecture-34

Dharmendra Kumar (Associate Professor)
Department of Computer Science and Engineering
United College of Engineering and Research, Prayagraj

Delivery, Forwarding, and Routing

Delivery, Forwarding, and Routing

- Delivery refers to the way a packet is handled by the underlying networks under the control of the network layer.
- Forwarding refers to the way a packet is delivered to the next station.
- Routing refers to the way routing tables are created to help in forwarding. Routing protocols are used to continuously update the routing tables that are consulted for forwarding and routing.

Delivery, Forwarding, and Routing

Delivery

The delivery of a packet to its final destination is accomplished by using two different methods of delivery, direct and indirect.

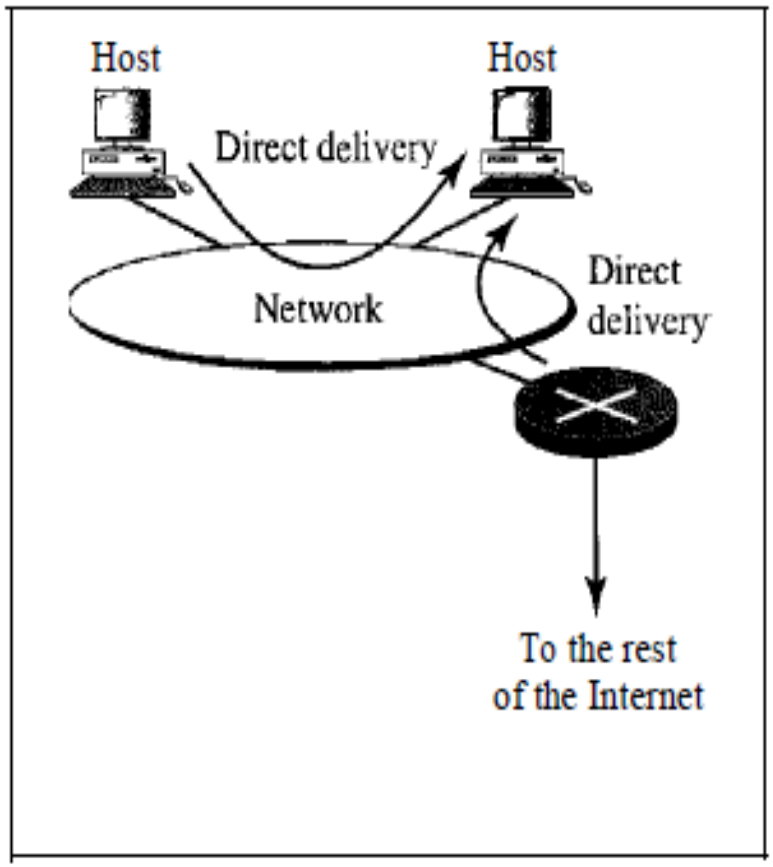
Direct Delivery

- In a direct delivery, the final destination of the packet is a host connected to the same physical network as the deliverer.
- Direct delivery occurs when the source and destination of the packet are located on the same physical network or when the delivery is between the last router and the destination host.

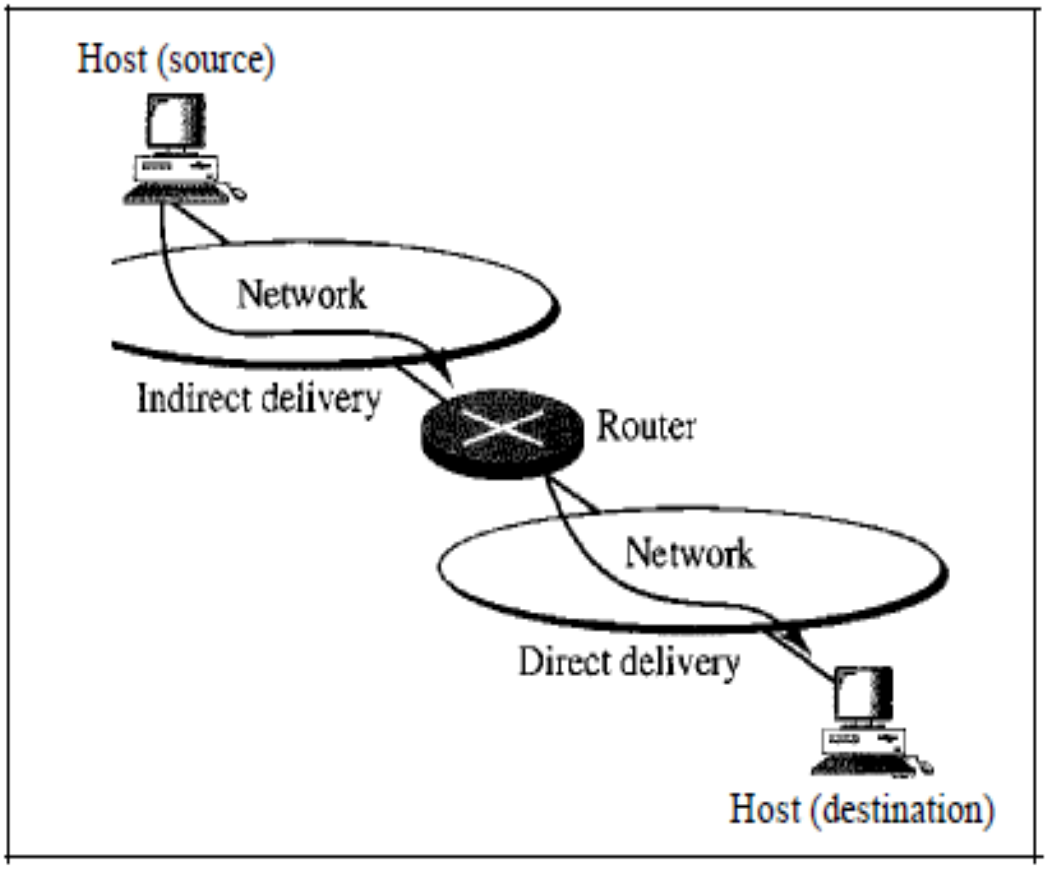
Indirect Delivery

- If the destination host is not on the same network as the deliverer, the packet is delivered indirectly.
- In an indirect delivery, the packet goes from router to router until it reaches the one connected to the same physical network as its final destination.

Delivery, Forwarding, and Routing



a. Direct delivery



b. Indirect and direct delivery

Note: (1) A delivery always involves one direct delivery but zero or more indirect deliveries.

(2) The last delivery is always a direct delivery.

Delivery, Forwarding, and Routing

Forwarding

Forwarding means to place the packet in its route to its destination. Forwarding requires a host or a router to have a routing table. When a host has a packet to send or when a router has received a packet to be forwarded, it looks at this table to find the route to the final destination.

There are following methods of forwarding:-

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Next-Hop Method Versus Route Method

One technique to reduce the contents of a routing table is called the next-hop method. In this technique, the routing table holds only the address of the next hop instead of information about the complete route (route method).

a. Routing tables based on route

Routing table for host A

Destination	Route
HostB	R1, R2, host B

Routing table for R1

Destination	Route
HostB	R2, host B

Routing table for R2

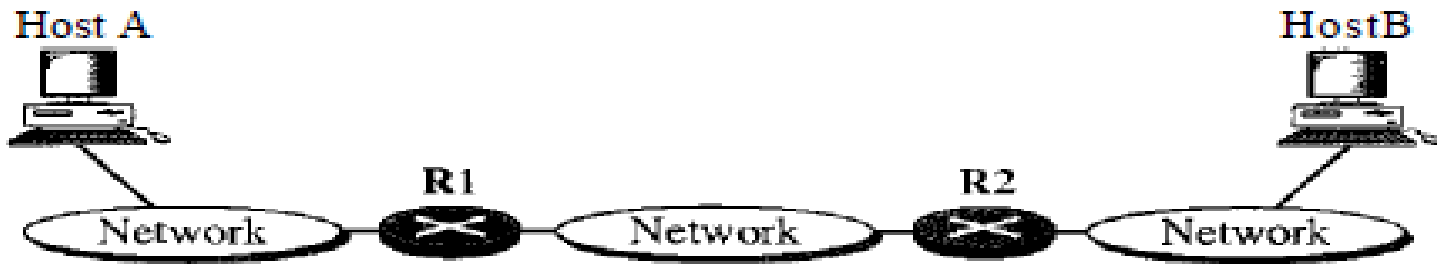
Destination	Route
HostB	HostB

b. Routing tables based on next hop

Destination	Next hop
Host B	R1

Destination	Next hop
HostB	R2

Destination	Next hop
Host B	



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Network-Specific Method Versus Host-Specific Method

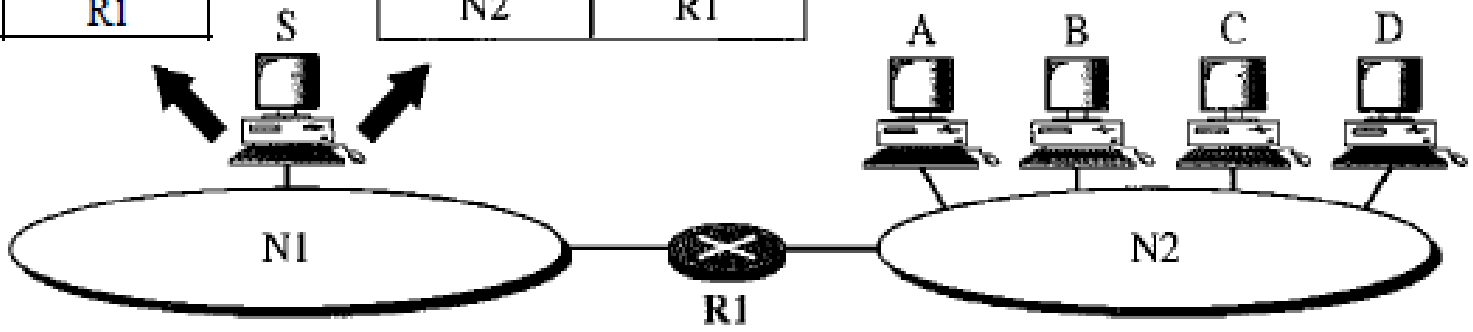
A second technique to reduce the routing table and simplify the searching process is called the network-specific method. Here, instead of having an entry for every destination host connected to the same physical network (host-specific method), we have only one entry that defines the address of the destination network itself. In other words, we treat all hosts connected to the same network as one single entity.

Routing table for host S based on host-specific method

Destination	Next hop
A	R1
B	R1
C	R1
D	R1

Routing table for host S based on network-specific method

Destination	Next hop
N2	R1



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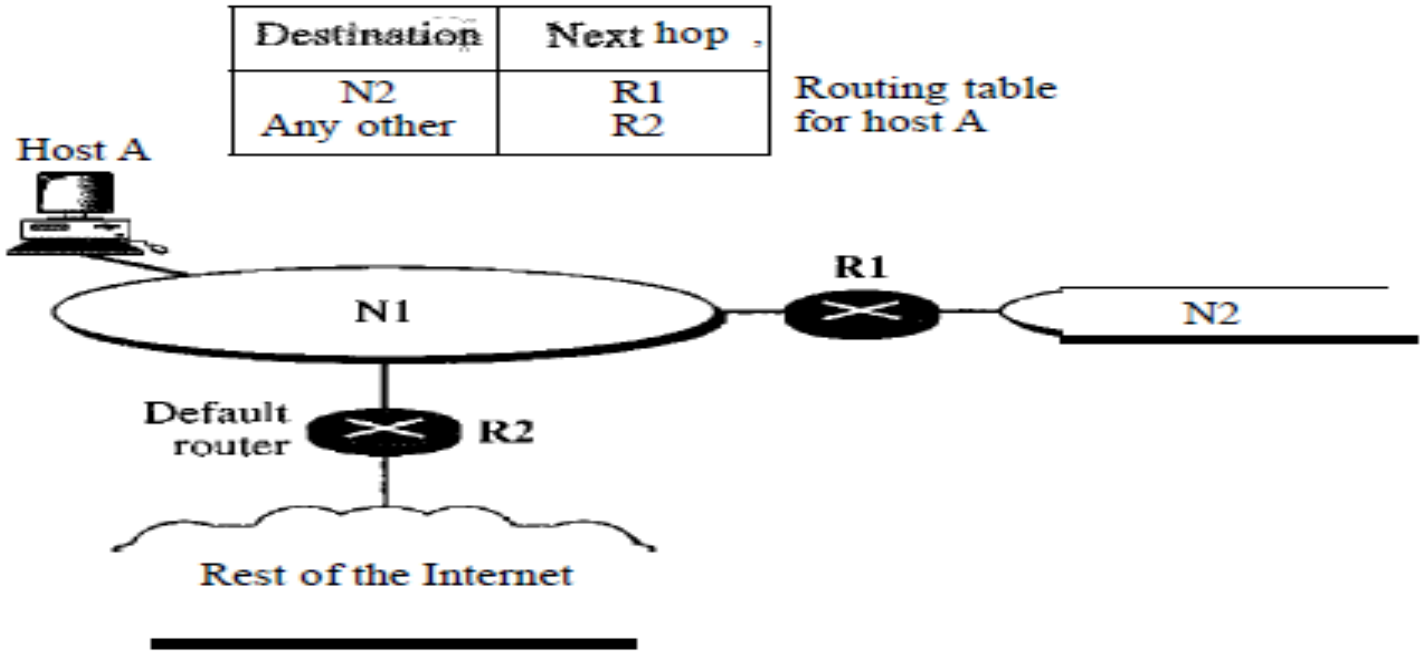
Default Method



In this figure, host A is connected to a network with two routers. Router R1 routes the packets to hosts connected to network N2. However, for the rest of the Internet, router R2 is used. So instead of listing all networks in the entire Internet, host A can just have one entry called the **default (normally defined as network address)**.

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Structure of Routing Table

In classless addressing, we need at least four columns in a routing table.

Mask *(/n)*	Network address	Next-hop address	Interface

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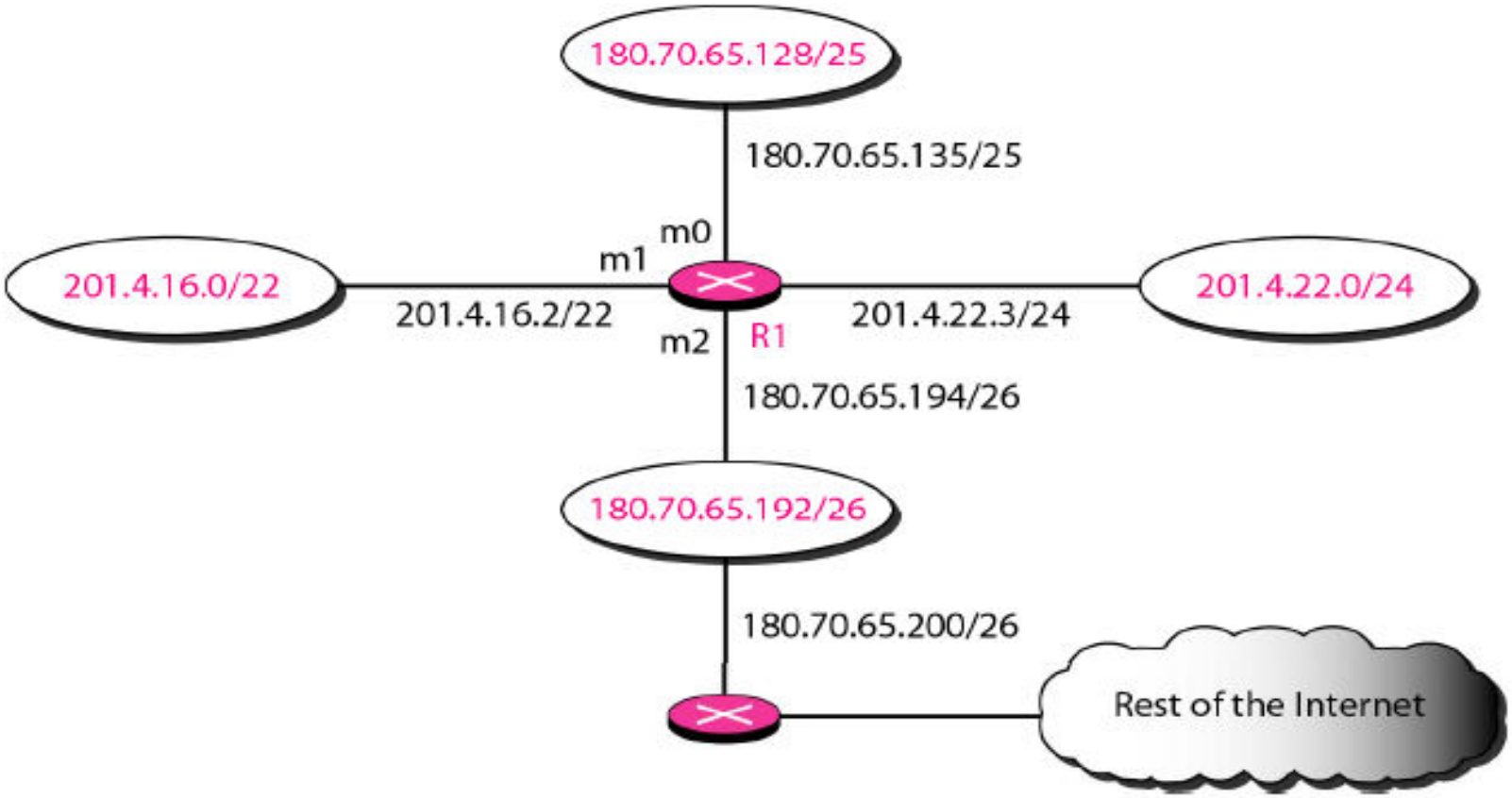
Example

Make a routing table for router R1, using the configuration in shown in following figure:-



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Solution: Routing table corresponding to router R1 is shown in the following figure:-

Mask	*Network Address*	*Next Hop*	*Interface*
/26	180.70.65.192	—	m2
/25	180.70.65.128	—	m0
/24	201.4.22.0	—	m3
/22	201.4.16.0	....	m1
Any	Any	180.70.65.200	m2

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Example

Show the forwarding process if a packet arrives at R1 in previous example with the destination address 180.70.65.140.

Solution

The router performs the following steps:

1. The first mask (/26) is applied to the destination address. The result is 180.70.65.128, which does not match the corresponding network address.

2. The second mask (/25) is applied to the destination address. The result is 180.70.65.128, which matches the corresponding network address. Therefore, router forwards the packet at the interface number m0.

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Example

Show the forwarding process if a packet arrives at R1 in previous example with the destination address 201.4.22.35.

Solution

The router performs the following steps:

1. The first mask (/26) is applied to the destination address. The result is 201.4.22.0, which does not match the corresponding network address (row 1).

2. The second mask (/25) is applied to the destination address. The result is 201.4.22.0, which does not match the corresponding network address (row 2).

3. The third mask (/24) is applied to the destination address. The result is 201.4.22.0, which matches the corresponding network address. The destination address of the packet and the interface number m3 are passed to ARP.

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Example

Show the forwarding process if a packet arrives at R1 in previous example with the destination address 18.24.32.78.

Solution

This time all masks are applied, one by one, to the destination address, but no matching network address is found. When it reaches the end of the table, the module gives the next-hop address 180.70.65.200 and interface number m2 to ARP. This is probably an outgoing package that needs to be sent, via the default router, to someplace else in the Internet.