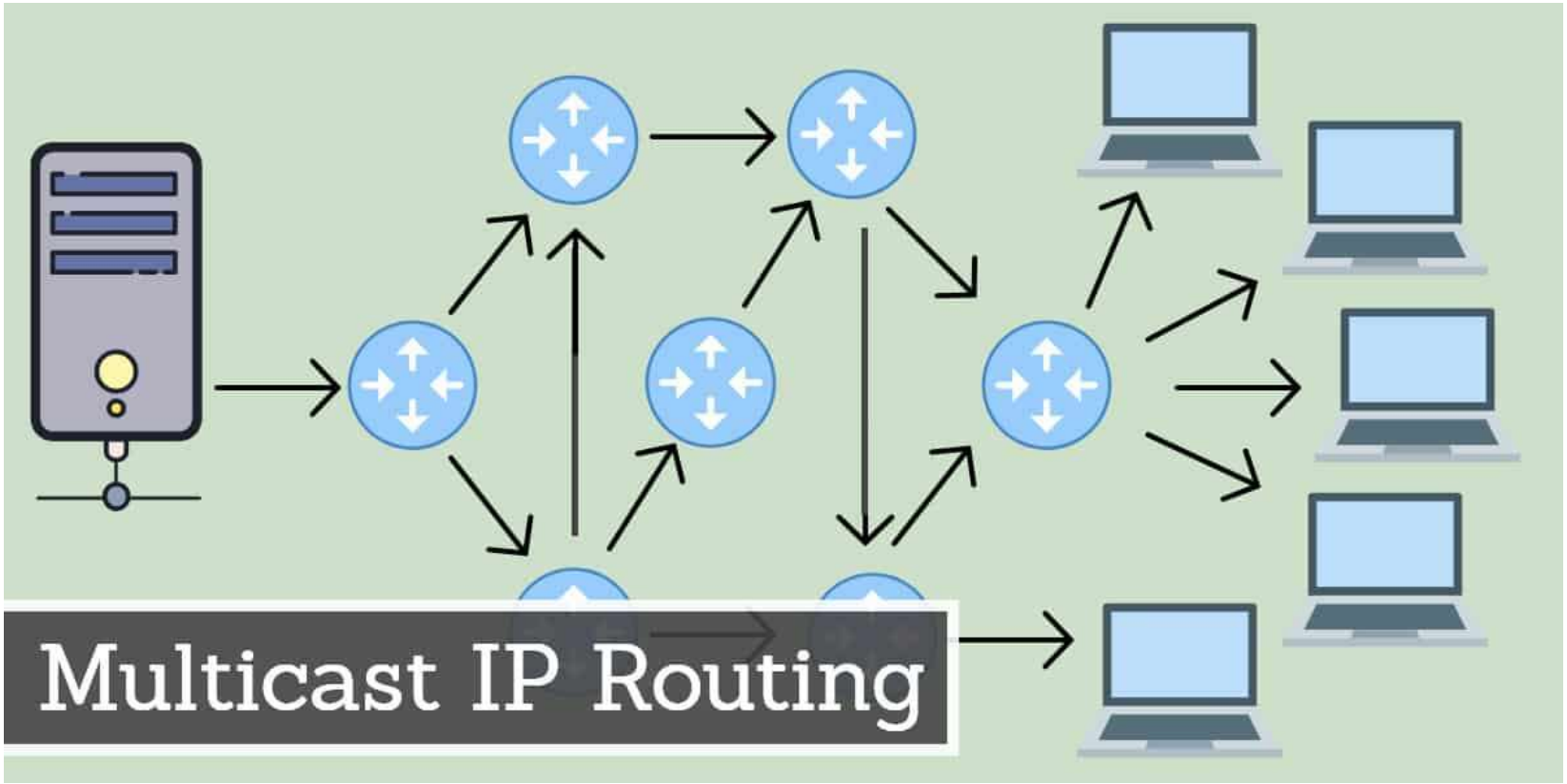
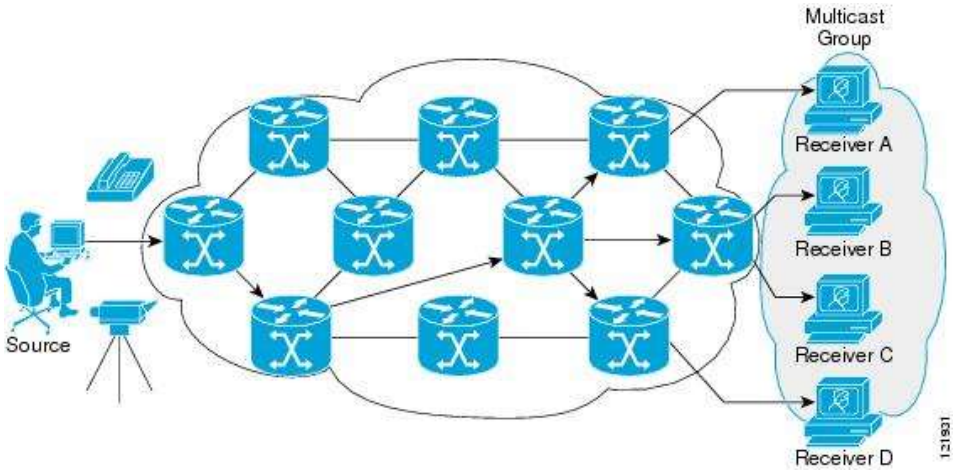
Chapter 21

Multicast Routing



Objective

- Unicasting and multicasting: multicast addresses and forwarding .
- Intradomain multicast routing protocols: DVMRP, MOSPF and PIM.
- Multicast routing protocols: MGBP and IGMP.



Good News for students

- Detail explanations for Multicast algorithms and protocols ……

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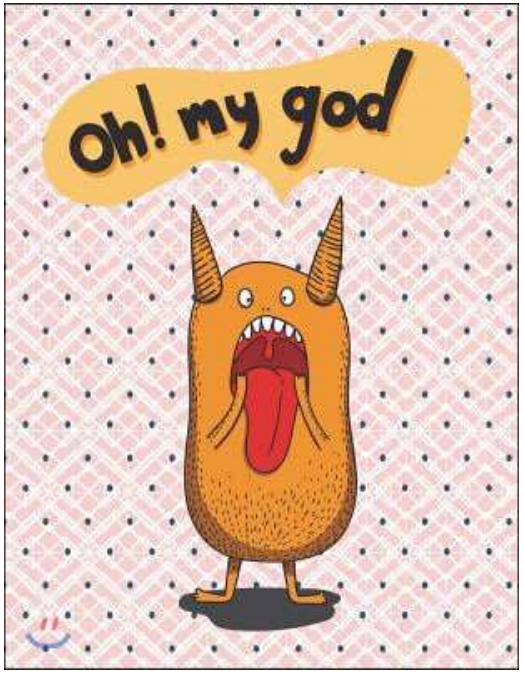
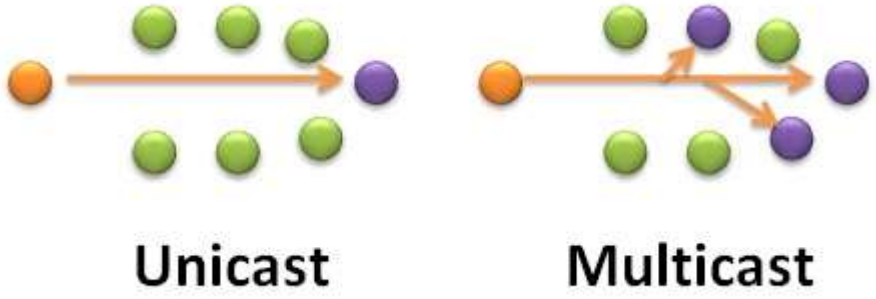


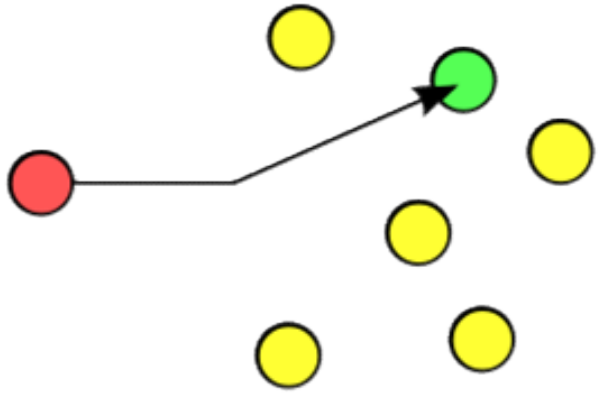
INTRODUCTION

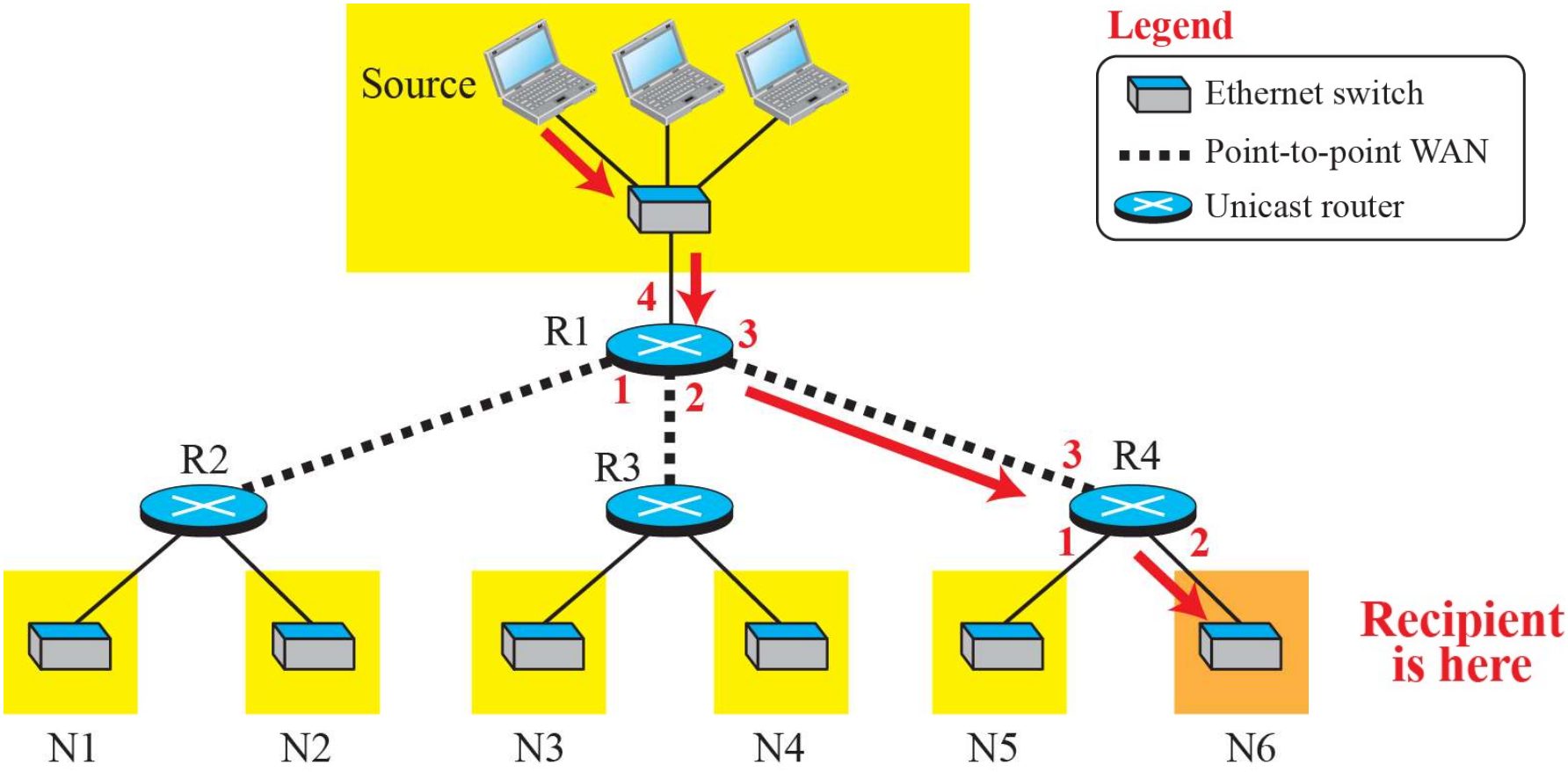
- Communication in the Internet today is not only unicasting; multicasting communication is growing fast.
- Discuss the general ideas behind unicasting, multicasting, and broadcasting. we simply review multicasting routing protocols in the Internet.



Unicasting

- In unicasting, there is one source and one destination network. The relationship between the source and the destination network is one to one.
- Each router in the path of the datagram tries to forward the packet to one and only one of its interfaces.

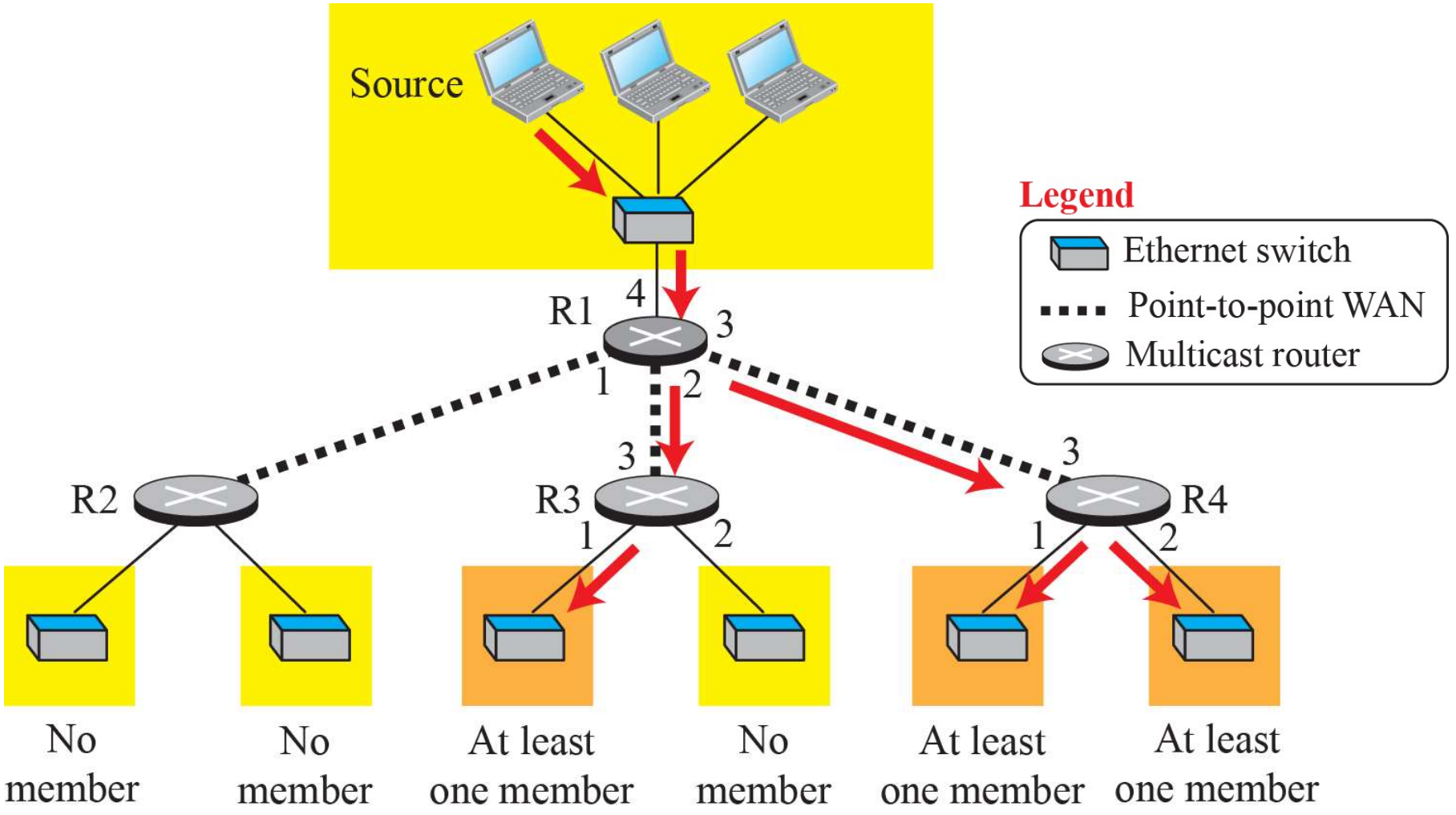



Source
Legend
Ethernet switch
Point-to-point WAN
Unicast router
R1
R2
R3
R4
1
2
3
4
1
2
3
1
2
Recipient is here
N1
N2
N3
N4
N5
N6

Unicasting

Multicasting

- In multicasting, there is one source and a group of destinations. The relationship is one to many.
- In this type of communication, the source address is a unicast address, but the destination address is a group address.
- The group address defines the members of the group.



Multicasting

Broadcasting

- Broadcasting means one-to-all communication: a host sends a packet to all hosts in an internet. Broadcasting in this sense is not provided at the Internet level for the obvious reason that it may create a huge volume of traffic and use a huge amount of bandwidth.

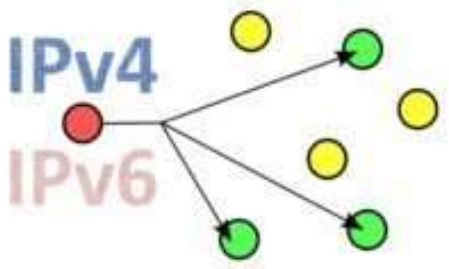
- Partial broadcasting is done in the Internet; some peer-to-peer applications may use broadcasting to access all peers. Controlled broadcasting may also be done in a domain (area or AS) mostly as a step to achieve multicasting.

MULTICAST BASICS

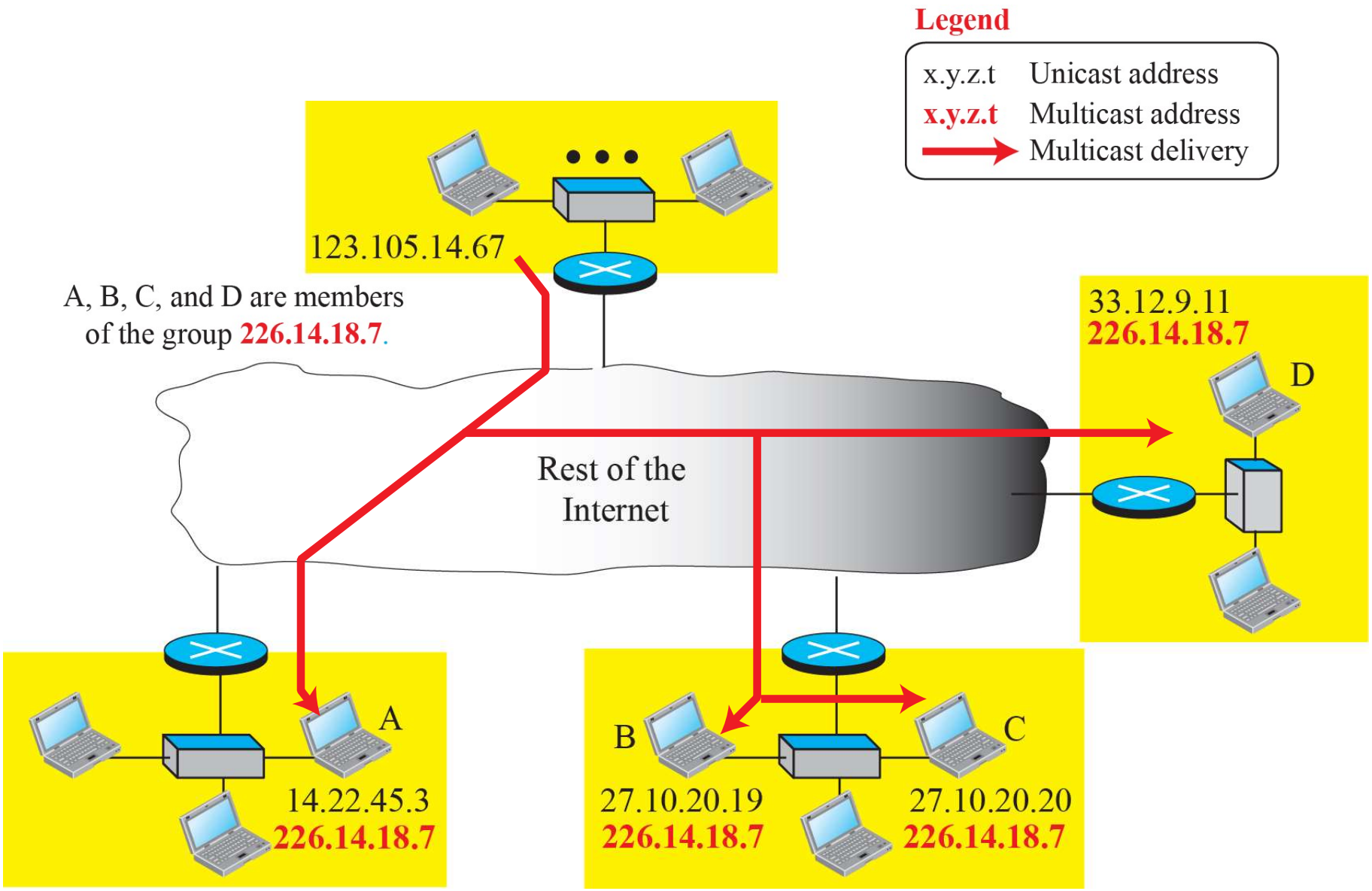
- Some multicasting basics: multicast addressing, collecting information about multicast groups, and multicast optimal trees.
- In multicast communication, the sender is only one, but the receiver is many, sometimes thousands or millions spread all over the world.
- It should be clear that we cannot include the addresses of all recipients in the packet.

Multicast Addresses

- The destination address of a packet, as described in the Internet Protocol (IP) should be only one.
- For this reason, we need multicast addresses. A multicast address defines a group of recipients, not a single one.
- In other words, a multicast address is an identifier for a group.



Multicast

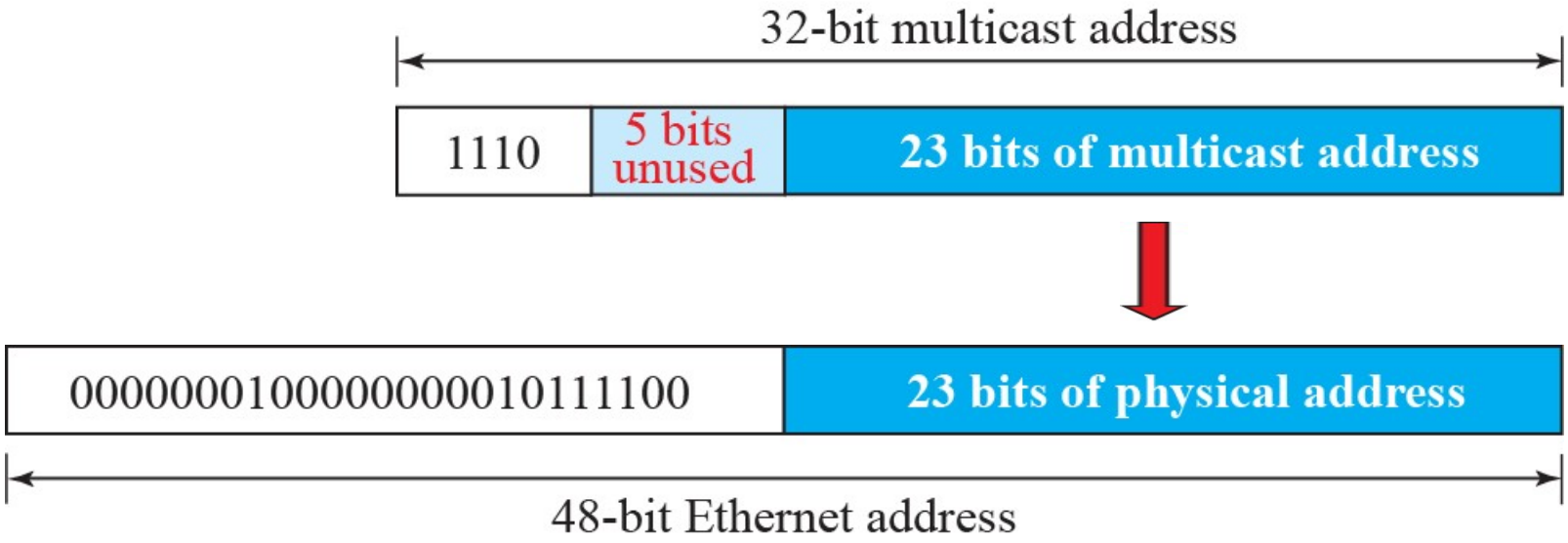


Needs for multicast addresses

Delivery at Data-Link Layer

- In multicasting, the delivery at the Internet level is done using network-layer multicast addresses. However, data-link layer multicast addresses are also needed to deliver a multicast packet encapsulated in a frame.

- In the case of unicasting, this task is done by the ARP protocol, but, because the IP packet has a multicast IP address, the ARP protocol cannot find the corresponding MAC (physical) address to forward a multicast packet at the data-link layer.



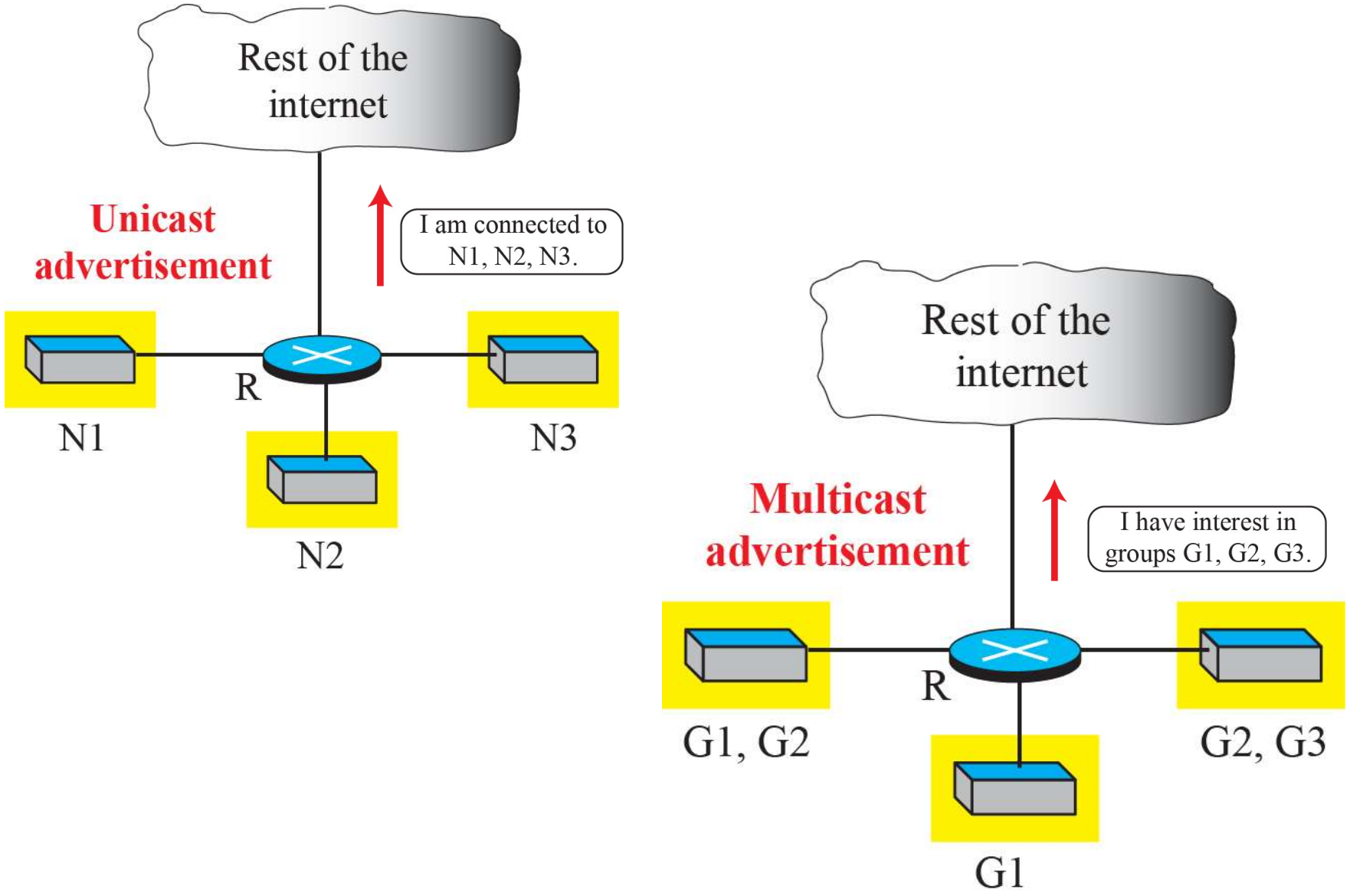
Mapping class D to Ethernet physical address

Collecting Information

- Creation of forwarding tables in both unicast and multicast routing involves two steps:

1. *A router needs to know to which destinations it is connected.*

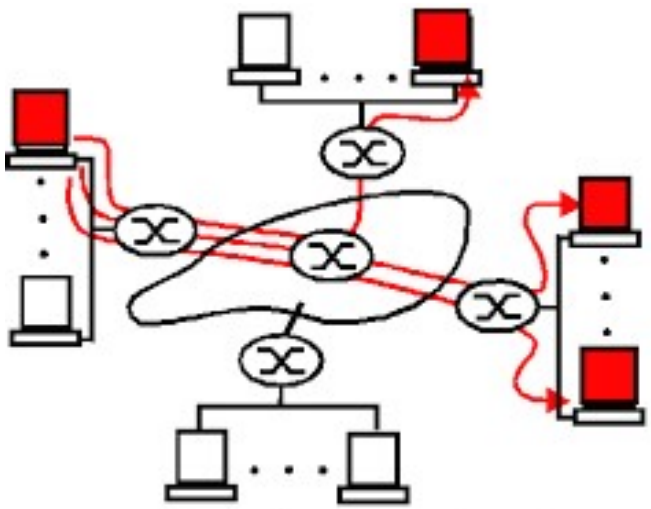
2. *Each router needs to propagate information obtained in the first step to all other routers so that each router knows to which destination each other router is connected.*



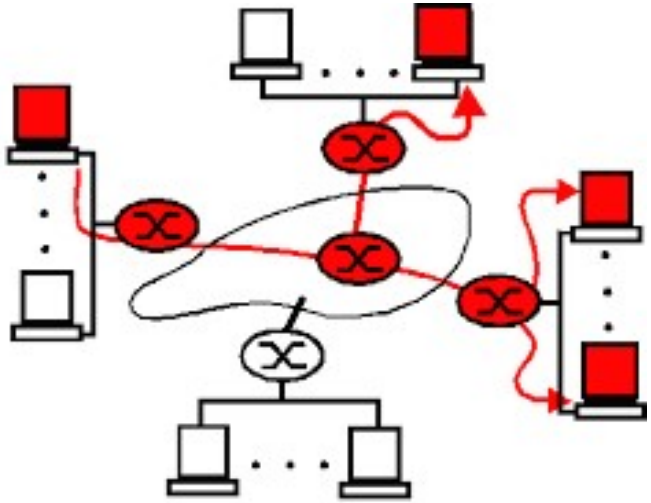
Unicast versus multicast advertisement

Multicast Forwarding

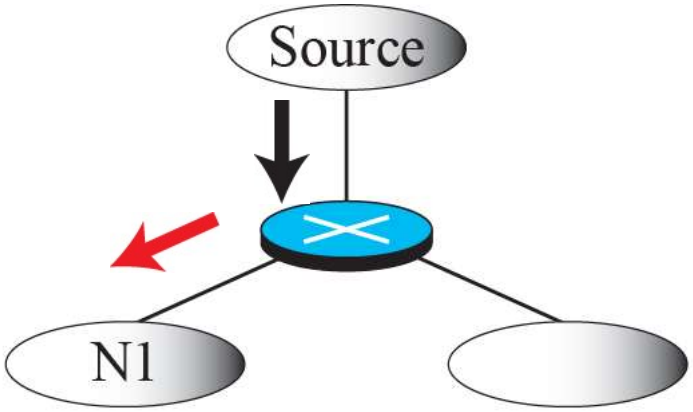
- Another important issue in multicasting is the decision a router needs to make to forward a multicast packet.
- Forwarding in unicast and multicast communication is different.

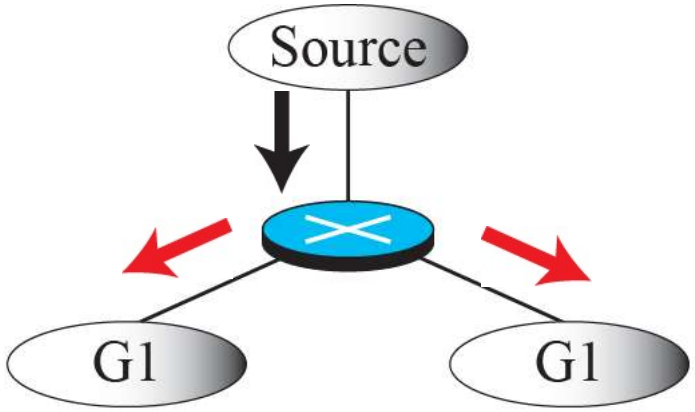


multicast via unicast



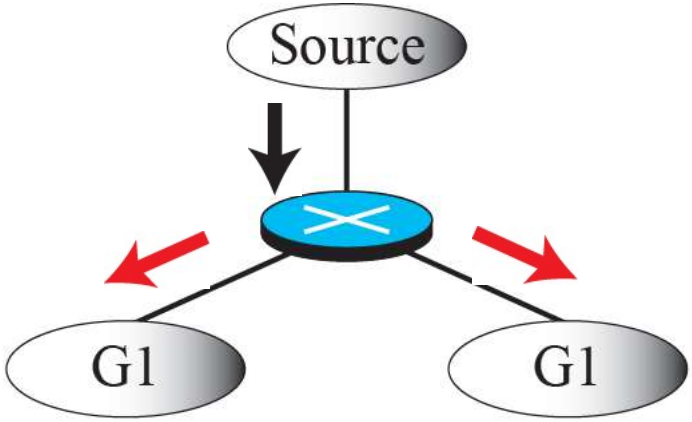
network multicast

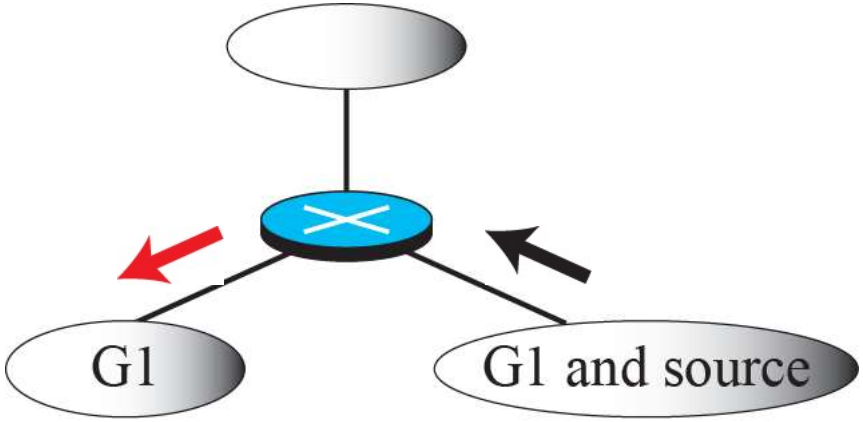




a. Destination in unicasting is one b. Destination in mulicasting is more than one

Destination in unicasting and multicasting



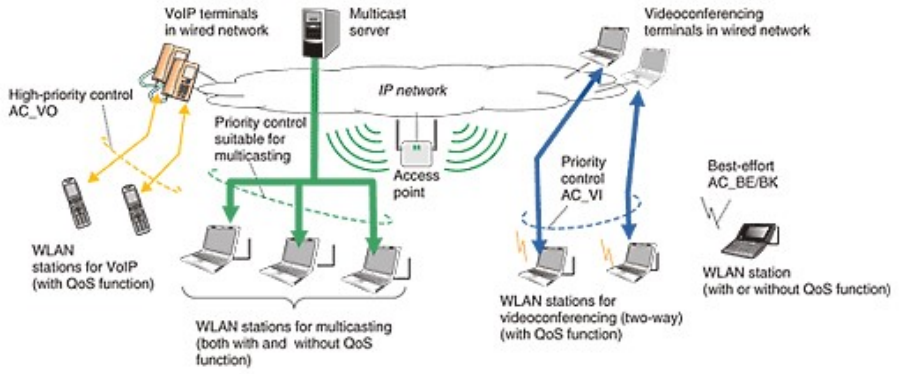


a. Packet sent out of two interfaces b. Packet sent out of one interface

Forwarding depends on the destination and the source

Two Approaches to Multicasting

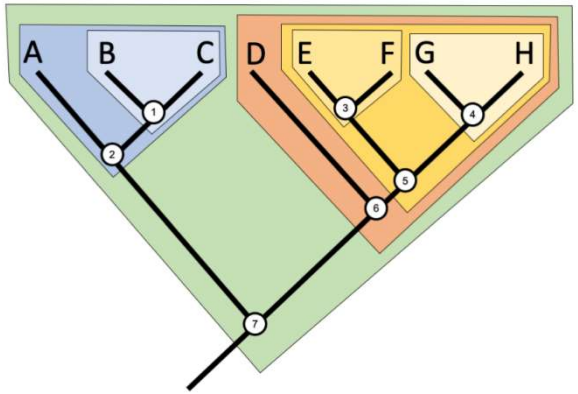
- In multicast routing, we need to create routing trees to optimally route the packets from their source to their destination.
- However, the multicast routing decision at each router depends not only on the destination of the packet, but also on the source of the packet.

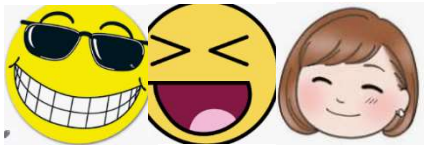


Two Approaches to Multicasting

- The involvement of the source in the routing process makes multicast routing much more difficult than unicast routing.

- For this reason, two different approaches in multicast routing have been developed: routing using source-based trees and routing using group-shared trees, but **SKIP in this class**.





INTRADOMAIN PROTOCOLS

- During the last few decades, several intradomain multicast routing protocols have emerged.

- We discuss three of these protocols. Two are extensions of unicast routing protocols (RIP and OSPF), using the source-based tree approach; the third is an independent protocol which is becoming more and more popular.

DVMRP

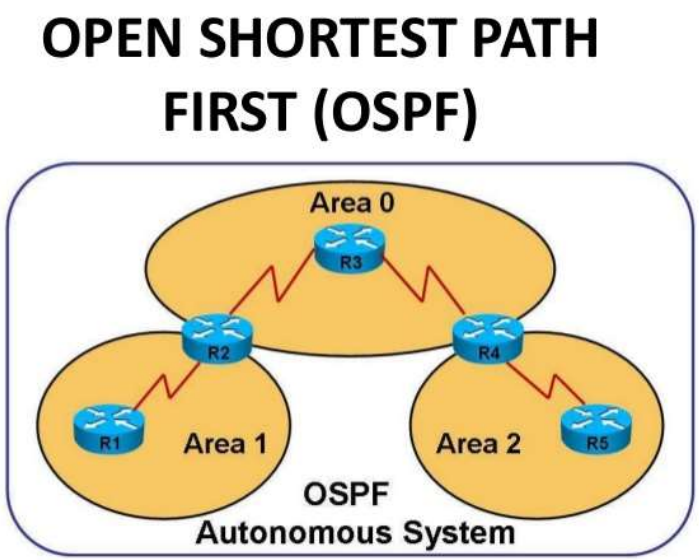
- The Distance Vector Multicast Routing Protocol (DVMRP) is the extension of the Routing Information Protocol (RIP) which is used in unicast routing.

- It uses the source-based tree approach to multicasting. It is worth mentioning that each router in this protocol that receives a multicast packet to be forwarded implicitly creates a source-based multicast tree.

Multicast Link State (MOSPF)

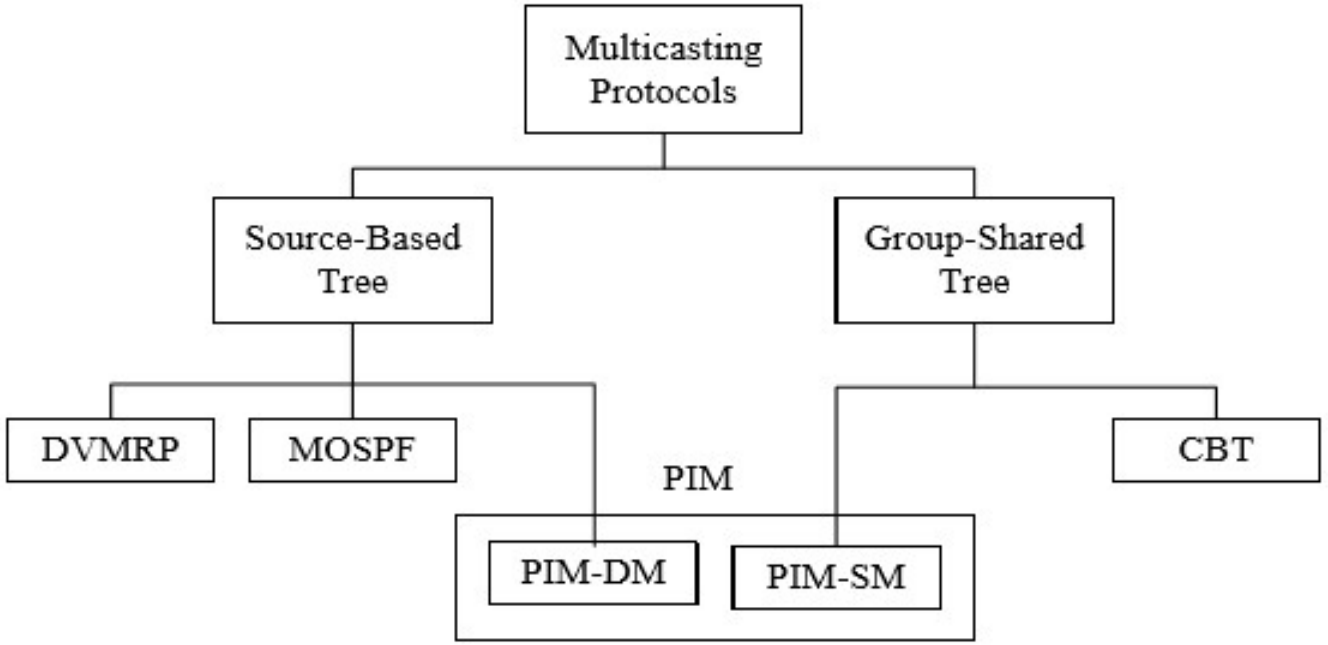
- Multicast Open Shortest Path First (MOSPF) is the extension of the Open Shortest Path First (OSPF) protocol, which is used in unicast routing.

- It also uses the source-based tree approach to multicasting. If the internet is running a unicast link-state routing algorithm, the idea can be extended to provide a multicast link-state routing algorithm.



Multicast Link State (MOSPF)

- To extend unicasting to multicasting, each router needs to have another database to show which interface has an active member in a particular group.



PIM

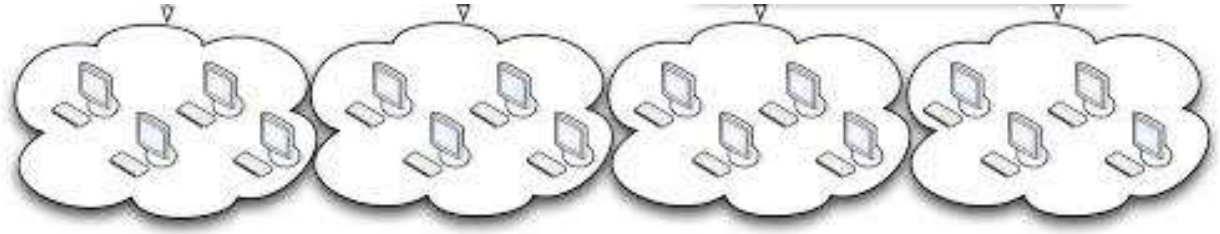
- Protocol Independent Multicast (PIM) is a family of multicast routing protocols for IP networks. It is termed protocol-independent because PIM does not include its own topology discovery mechanism, but instead uses routing information supplied by other routing protocols.

- PIM is not dependent on a specific unicast routing protocol. It can make use of any unicast routing protocol, and does not build its own routing tables, but uses the unicast routing table.

INTERDOMAIN PROTOCOLS

- The three protocols we discussed for multicast routing, DVMRP, MOSPF, and PIM, are designed to provide multicast communication inside an autonomous system.

- When the members of the groups are spread among different domains (ASs), we need an interdomain multicast routing protocol.



BGMP and IGMP

- The Border Gateway Multicast Protocol (BGMP) is a true inter-domain multicast routing protocol.

- The Internet Group Management Protocol (IGMP) is used today for collecting information about group membership. It is a protocol defined at the network layer. IGMP messages are encapsulated in an IP datagram.