



Multicast

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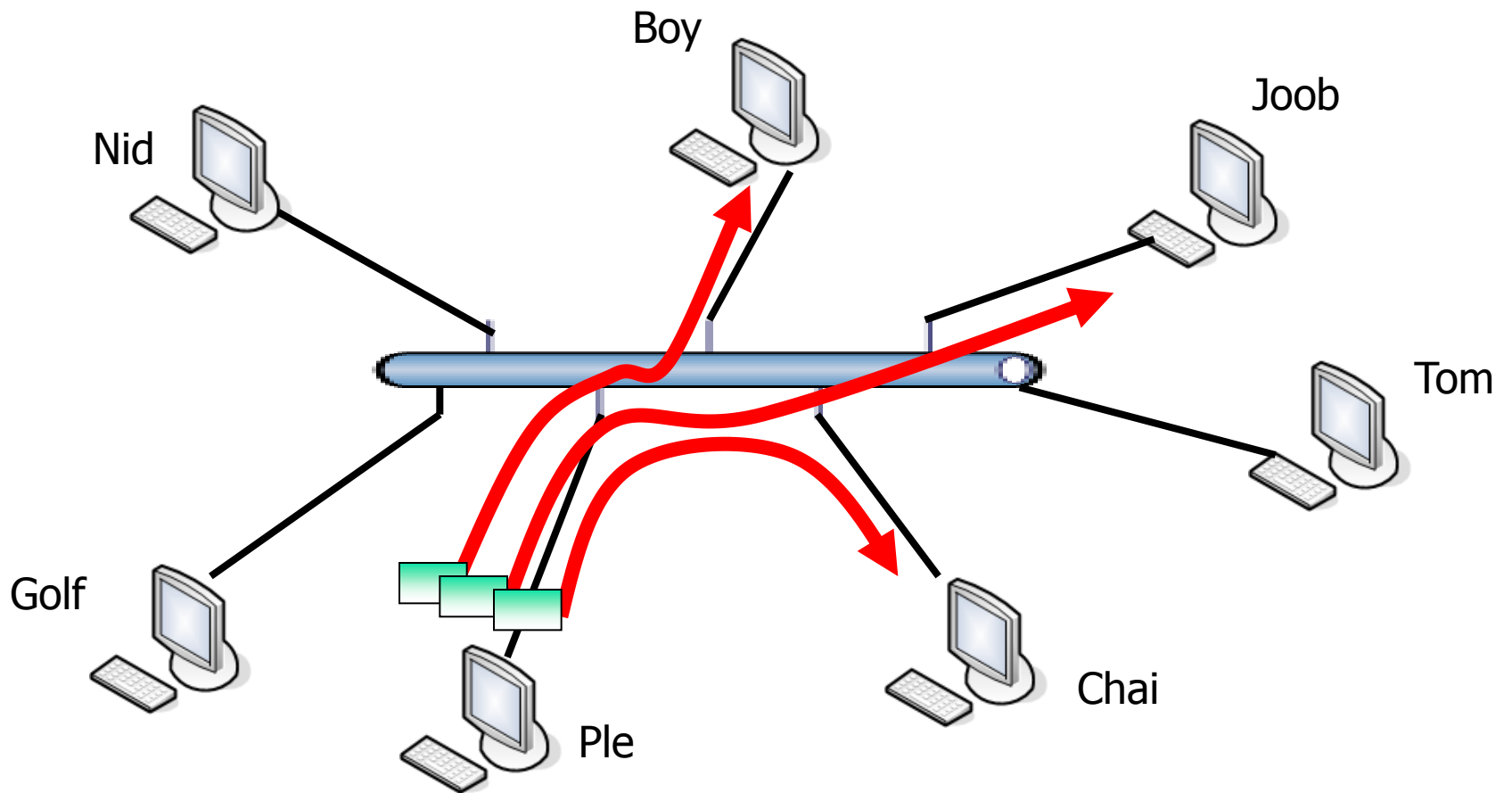
Kasetsart University, Bangkok, Thailand



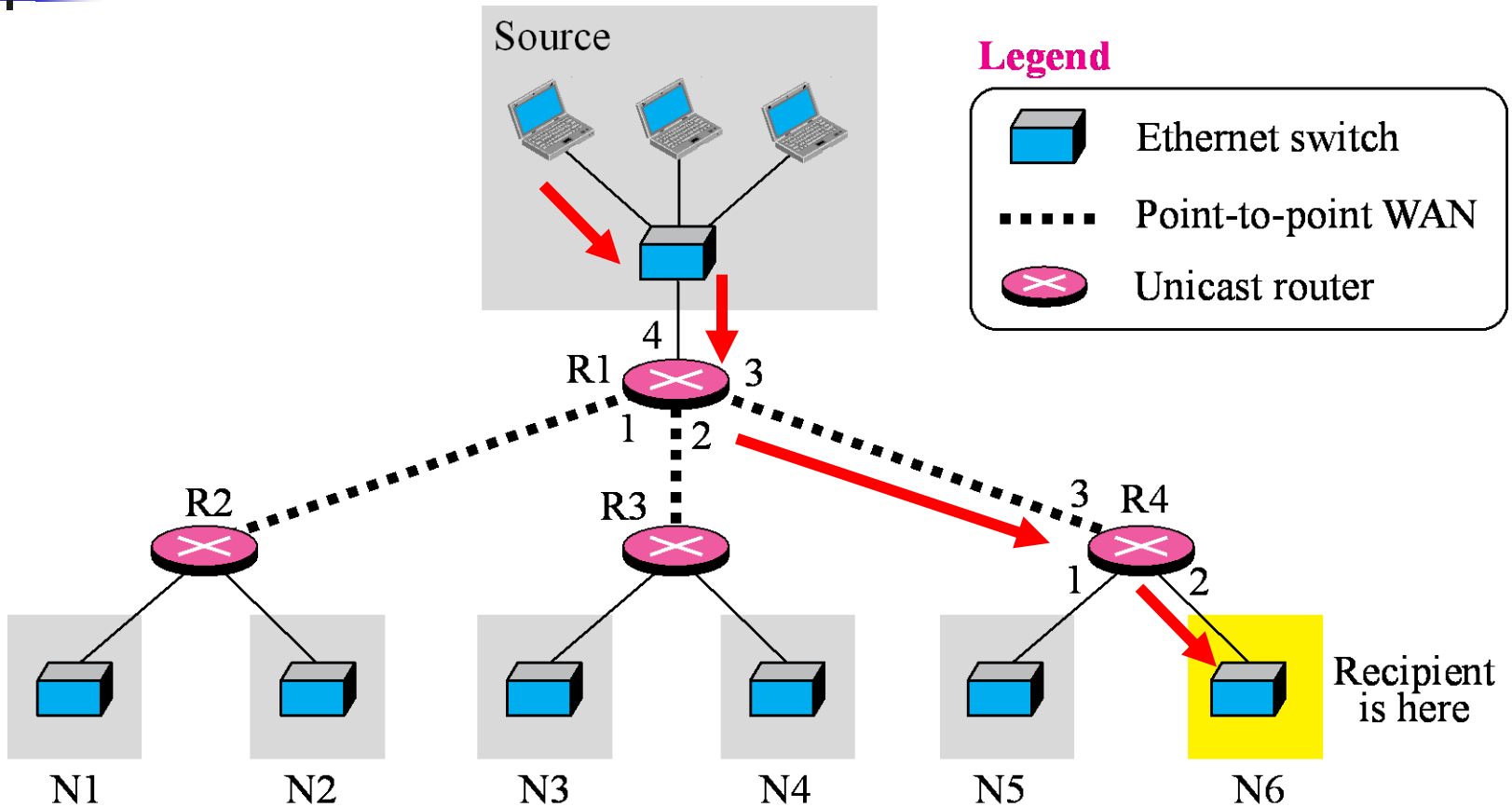
IP Datagram delivery

- Unicast
- Broadcast
- Multicast

Unicast



Unicast

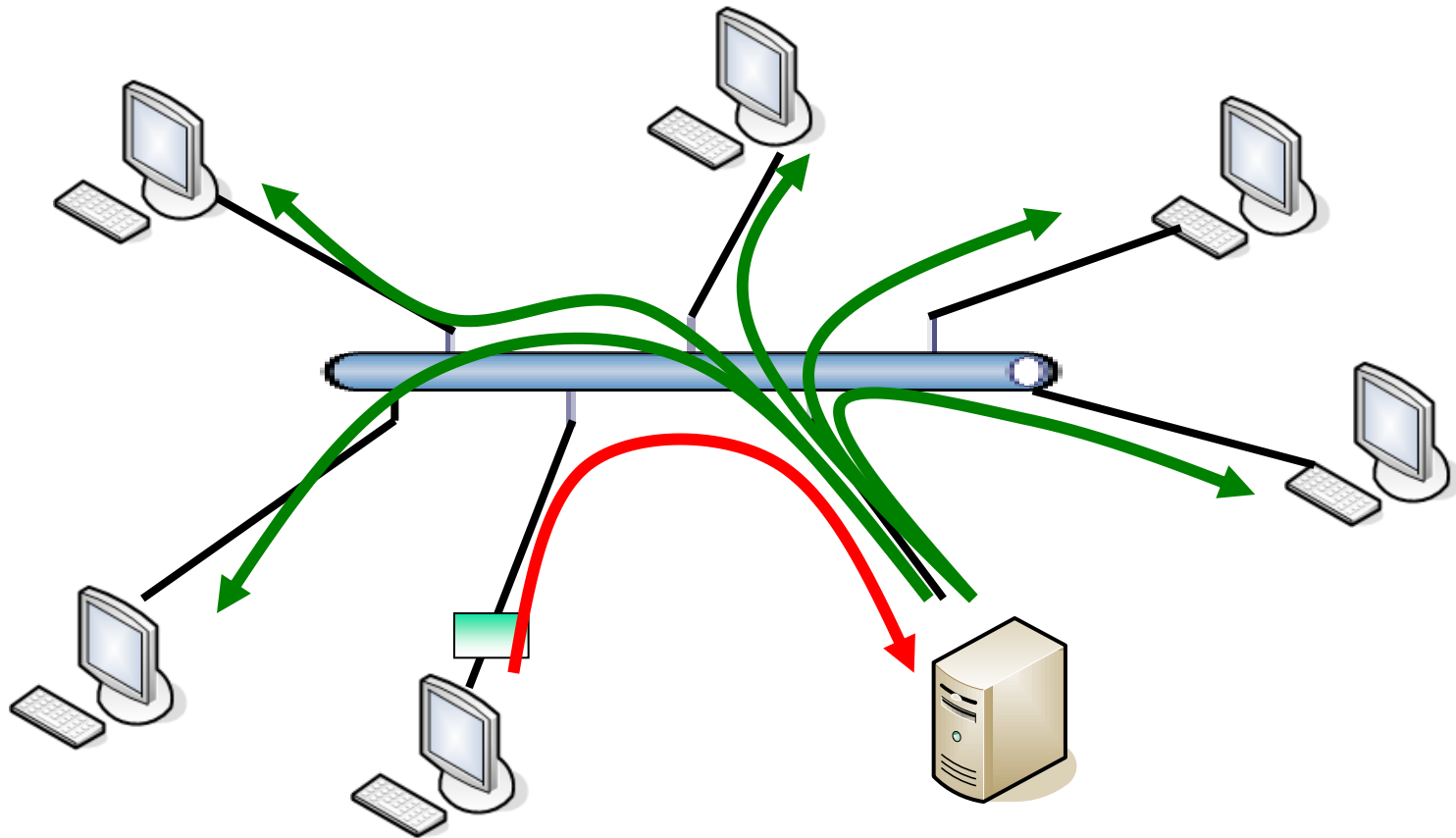




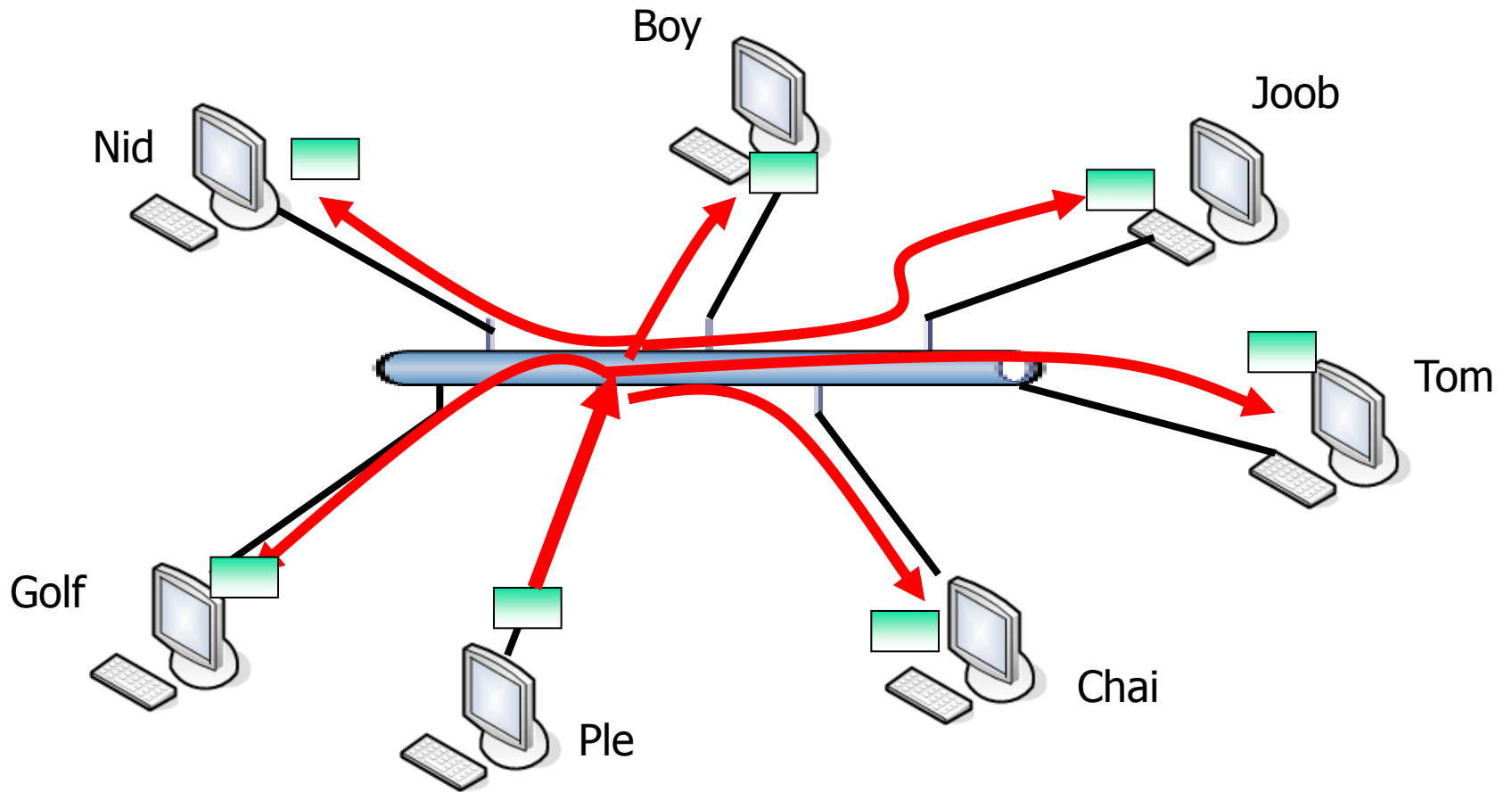
Unicast

- One-to-one delivery
- Each datagram to single destination
- Need additional buffer
- Large amount of data traffic
- Secure (Only to specified destination)

Conference Server



Broadcast





Broadcast

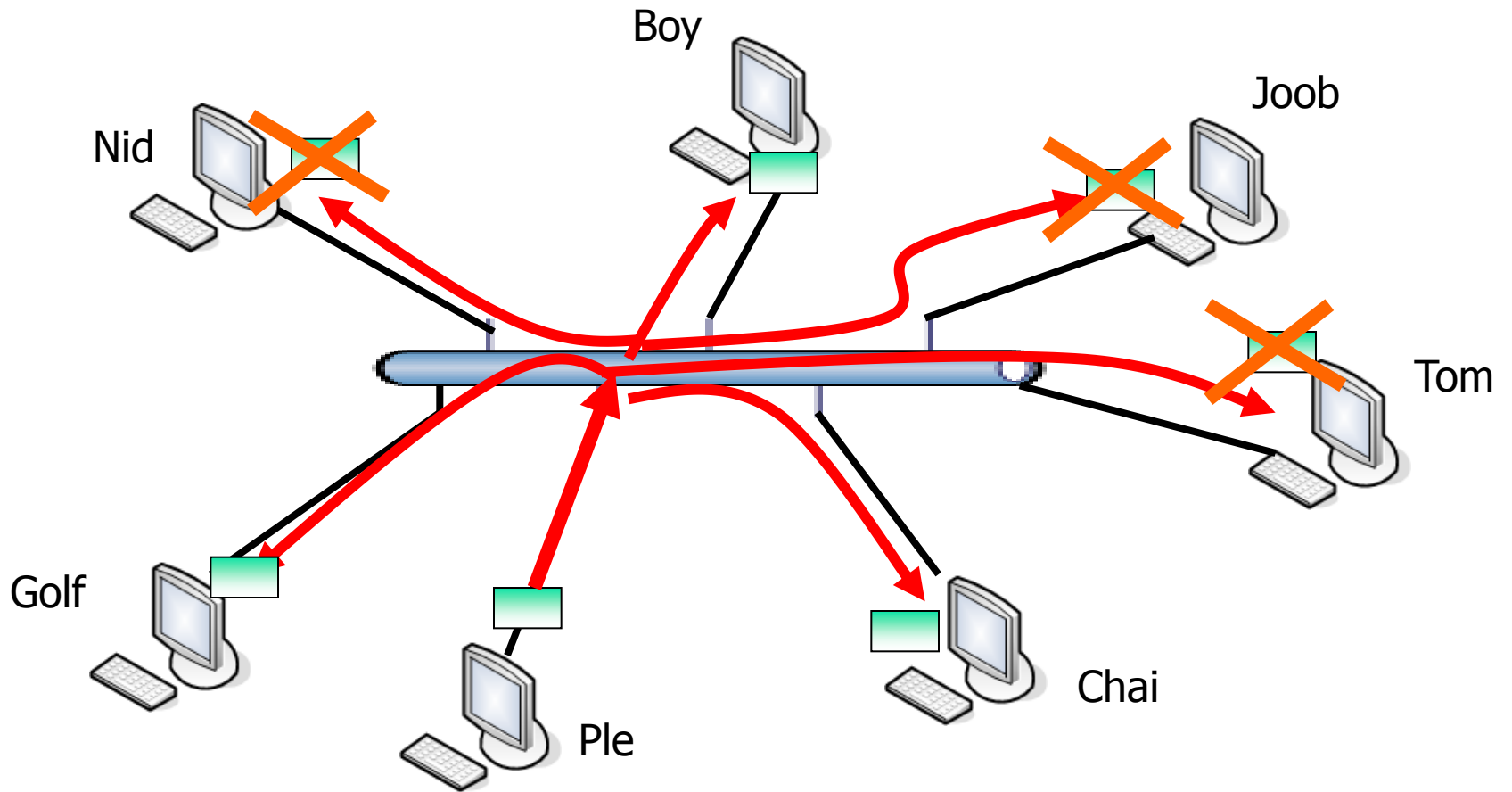
- One-to-all
- Data-Link implementation
 - Broadcast Add. FF-FF-FF-FF-FF-FF
- Each Frame to all nodes
 - Less Data Traffic



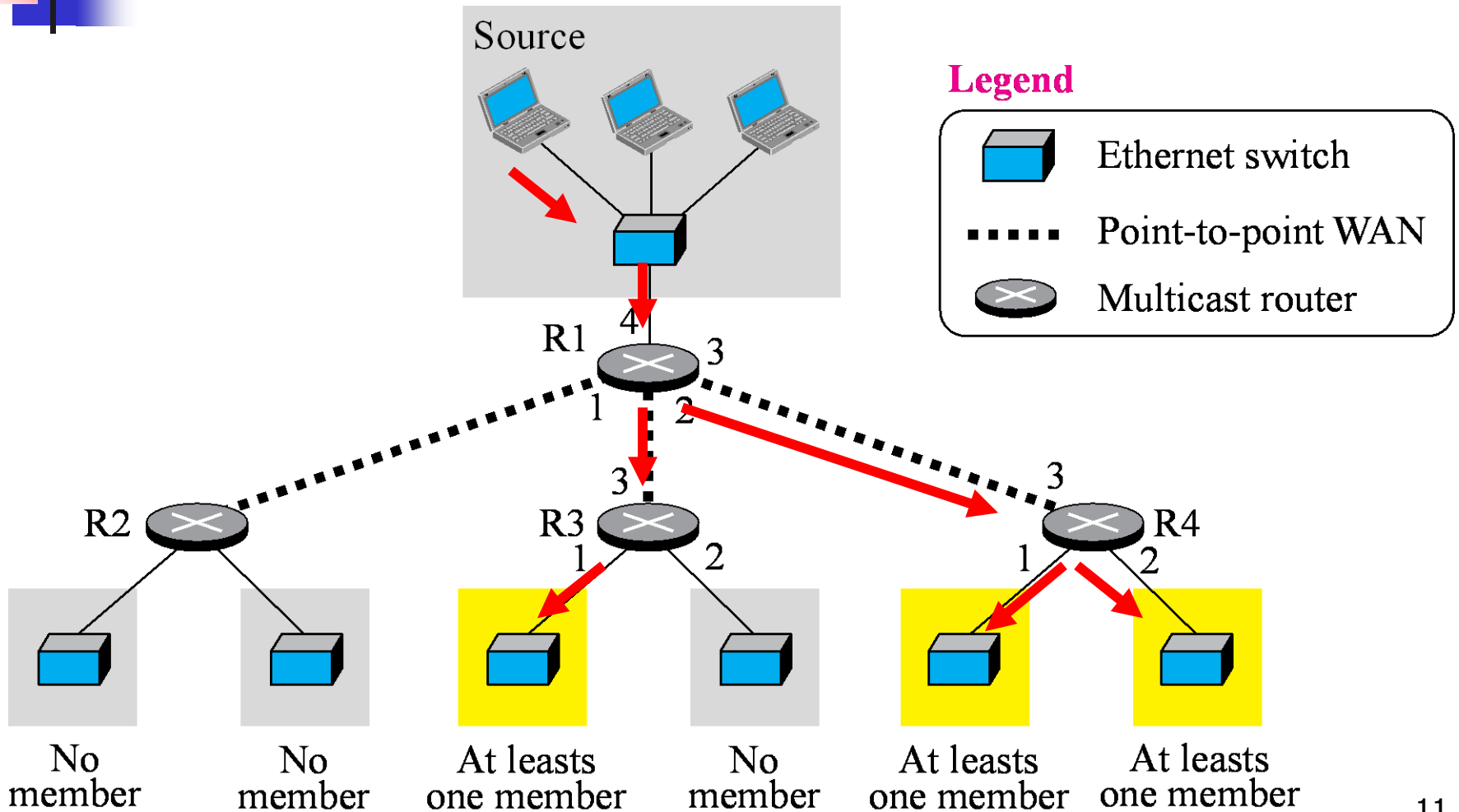
Broadcast Problem

- If not all nodes want the data
 - Higher Layer needs to be involved
 - Unacceptable processing overhead
 - Security vulnerability

Multicast



Multicast





Multicast

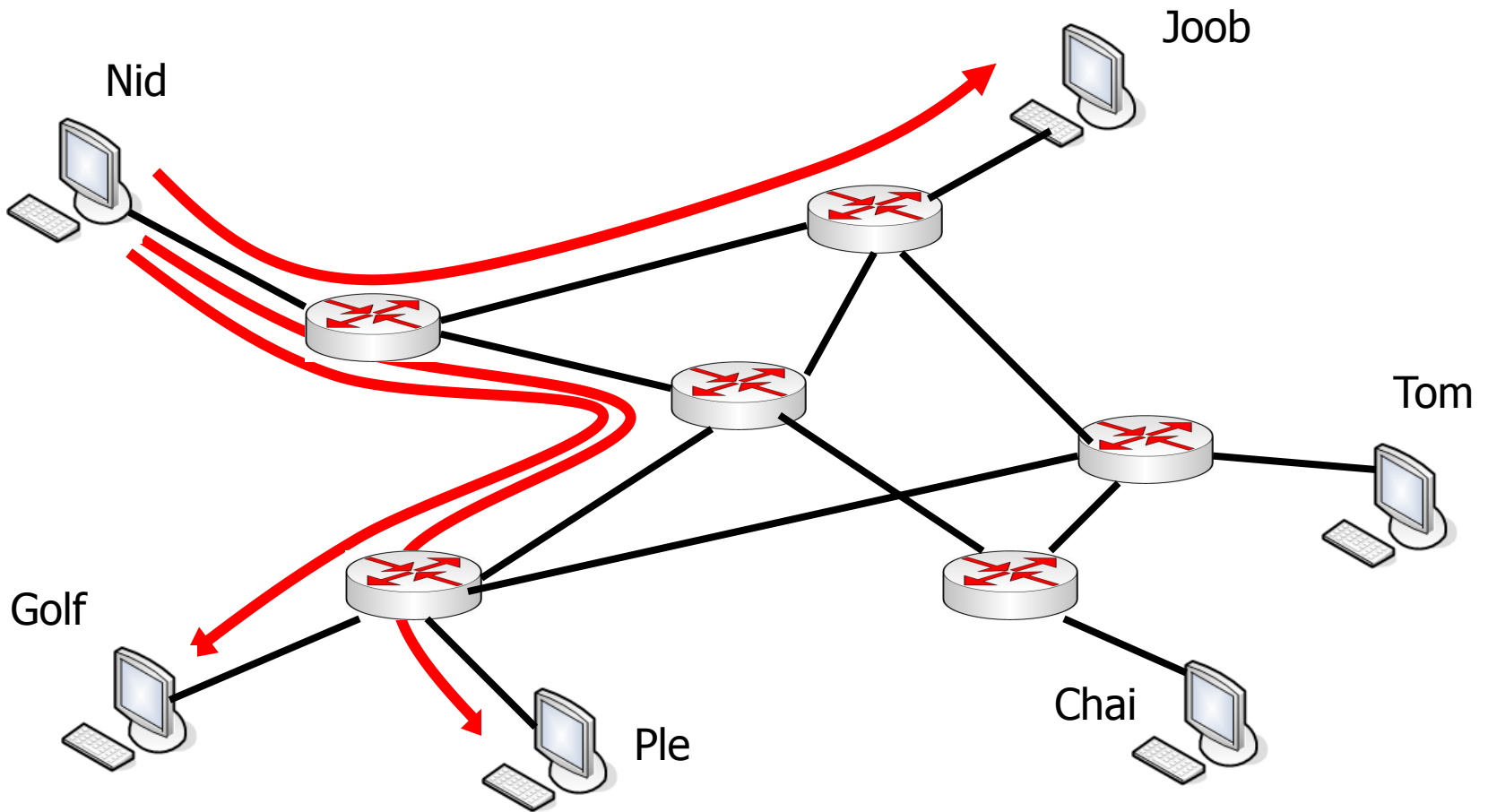
- One-to-many (Not to all)
- Need special address for the group
- Actually broadcast
 - Still have processing overhead
 - Non-participate stations only look and throw away
→ Less overhead
- Can Reduces more ?
 - Possible to map IP multicast to MAC multicast



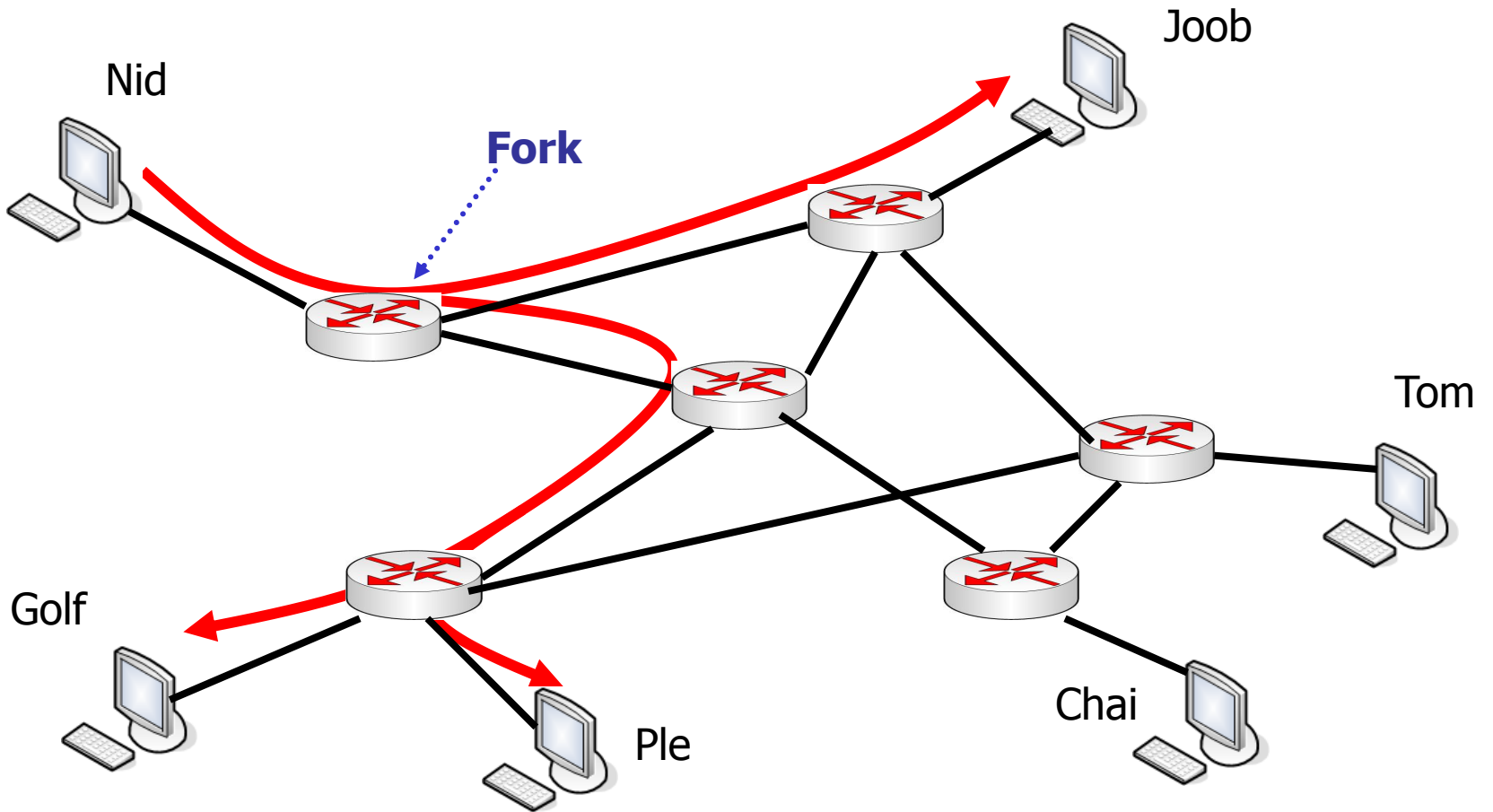
Multicast

- Data-Link Layer broadcast frames are not forwarded across routers
- IP Broadcast packets are also not forwarded across routers
- Multiple copies

Data Across the Internet



IP Multicast





IP Multicast Challenge

- Determine joined stations
- Locations to fan-out the traffic



IP Multicast

- Additional overhead
 - Control / Join / Leave
- Special routing protocol
- Scalability
- Security concerns
- Retransmission process

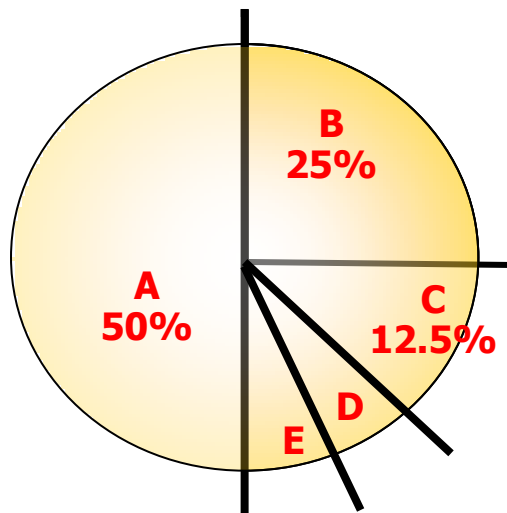


Multicast Applications

- Chain Store
 - Stock distribution / update
- Data Streaming
 - Trader / exchange rate update
 - Video / Audio streaming
 - Multimedia conferences

IP Multicast Address

- Class D
- 224.0.0.0 – 239.255.255.255
- Each for Multicast Group



Class A	0	Netid
Class B	1 0	Netid
Class C	1 1 0	
Class D	1 1 1 0	
Class E	1 1 1 1	



IP Multicast Ranges

Address Range	Usage
224.0.0.1	All Systems (host + router)
224.0.0.2	All Routers
224.0.0.5 – 224.0.0.6	OSPF routing protocol
224.0.0.1 – 224.0.0.255	Local segment (not across router)
239.192.0.0 – 239.195.255.255	Admin. scope for organizations

netstat -r

```
C:\WINDOWS\system32\cmd.exe

C:\Documents and Settings\anan>netstat -r

Route Table
=====
Interface List
0x1 ..... MS TCP Loopback interface
0x2 ...08 00 27 52 47 10 ..... AMD PCNET Family Ethernet Adapter (PCI) - Packet
Scheduler Miniport
=====

Active Routes:
Network Destination    Netmask          Gateway          Interface        Metric
0.0.0.0                0.0.0.0          10.0.2.2         10.0.2.15        20
10.0.2.0               255.255.255.0   10.0.2.15       10.0.2.15        20
10.0.2.15              255.255.255.255 127.0.0.1       127.0.0.1        20
10.255.255.255        255.255.255.255 10.0.2.15       10.0.2.15        20
127.0.0.0              255.0.0.0       127.0.0.1       127.0.0.1        1
224.0.0.0              240.0.0.0       10.0.2.15       10.0.2.15        20
255.255.255.255      255.255.255.255 10.0.2.15       10.0.2.15        1
Default Gateway:      10.0.2.2
=====

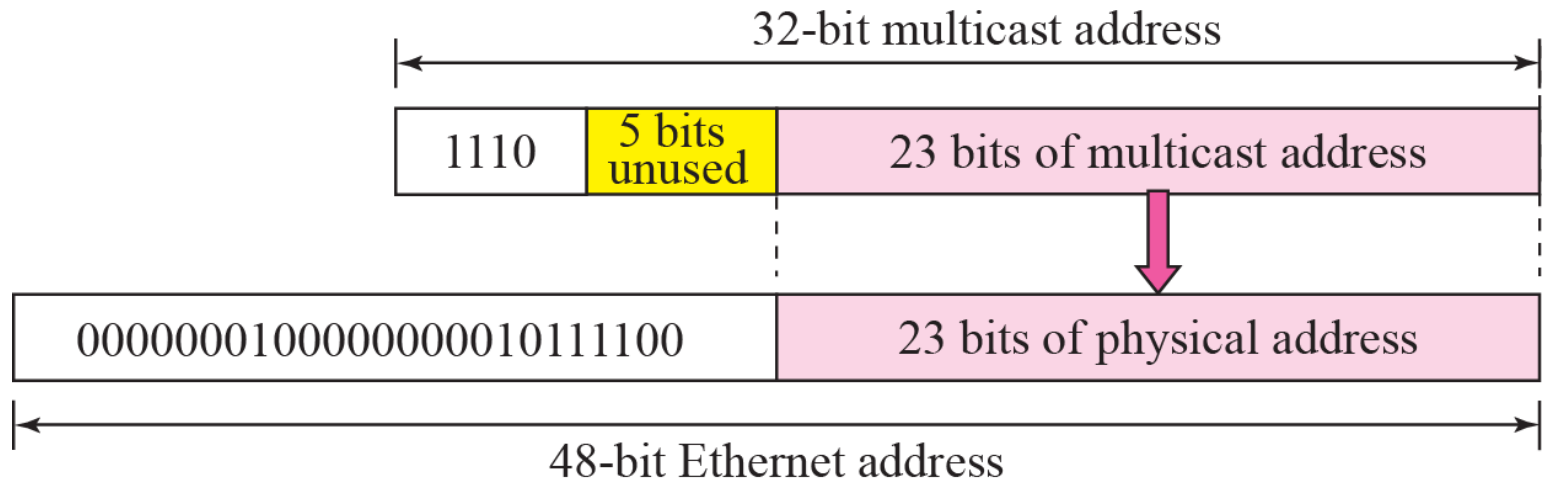
Persistent Routes:
None

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```



Mapping

Multiclass IP Add → Physical Ethernet Add



01:00:5E:00:00:00 - 01:00:5E:7F:FF:FF

Mapping

Multicast IP Add → Physical Ethernet Add

Multicast IP Add: 232.196.28.3



E8.C4.1C.3



C4 → 1101 0100

Physical Ethernet Add: 01:00:5E:C4:1C:3



01:00:5E:44:1C:3

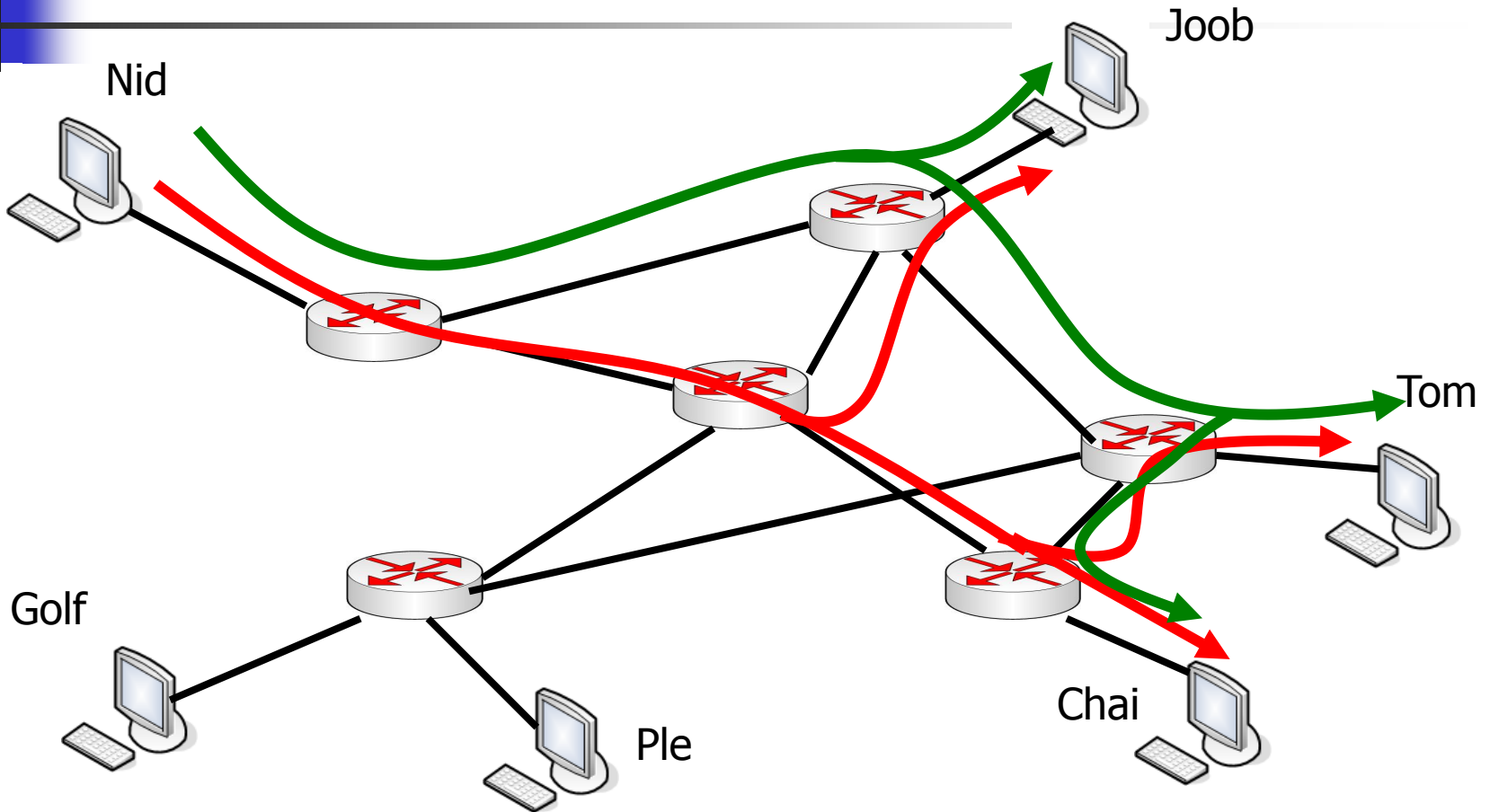




Multicast Forwarding

- Build a **logical tree** structure
- Packet flows from
root → trunk → branch → leave (destination)
- Objective to reduce
 - the **travel length**
 - or **amount of data**
- Can be multiple data sources

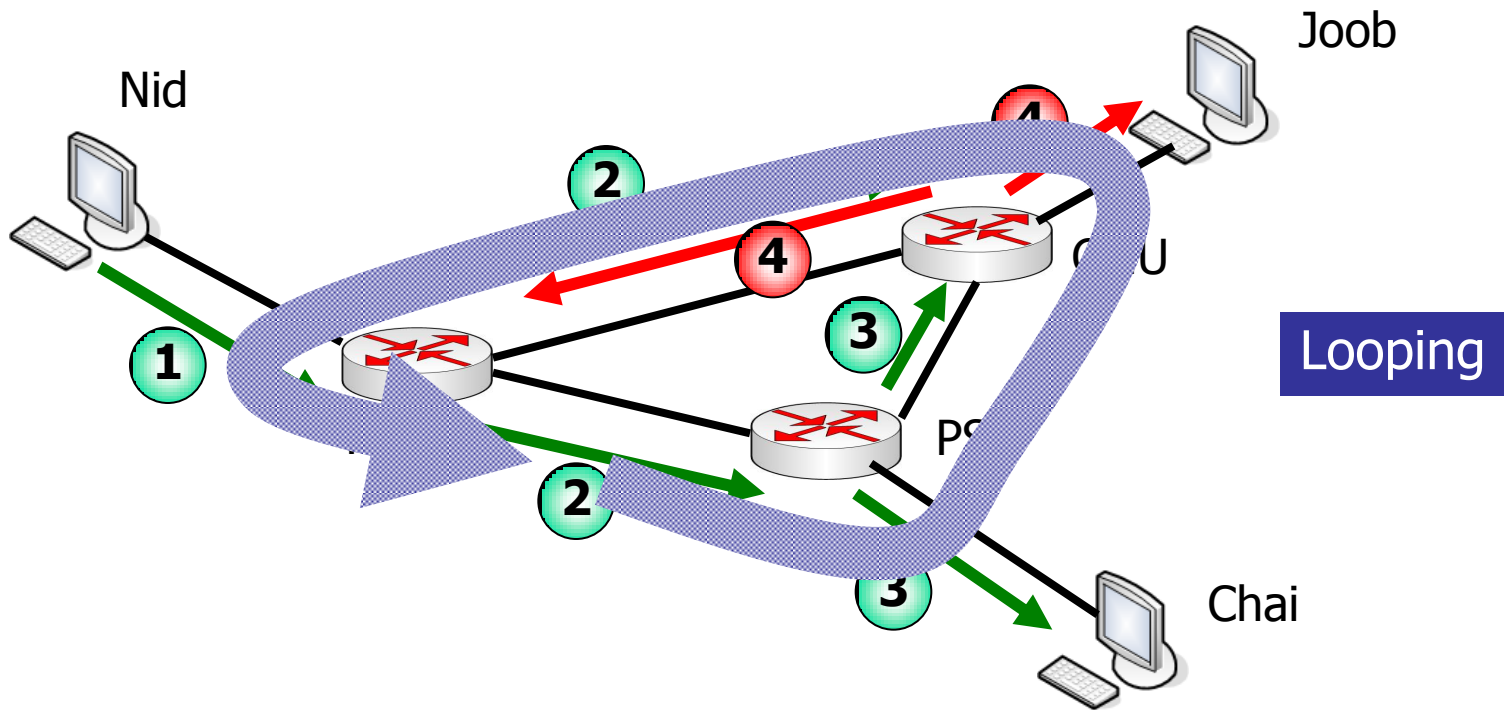
Multicast paths



For red path: Job(4 hops), Tom(5 hops), Chai(4 hops) : Total packet (8 hops)

For green path: Job(3 hops), Tom(4 hops), Chai(5 hops) : Total packet (7 hops)₂₅

Multicast Scenario

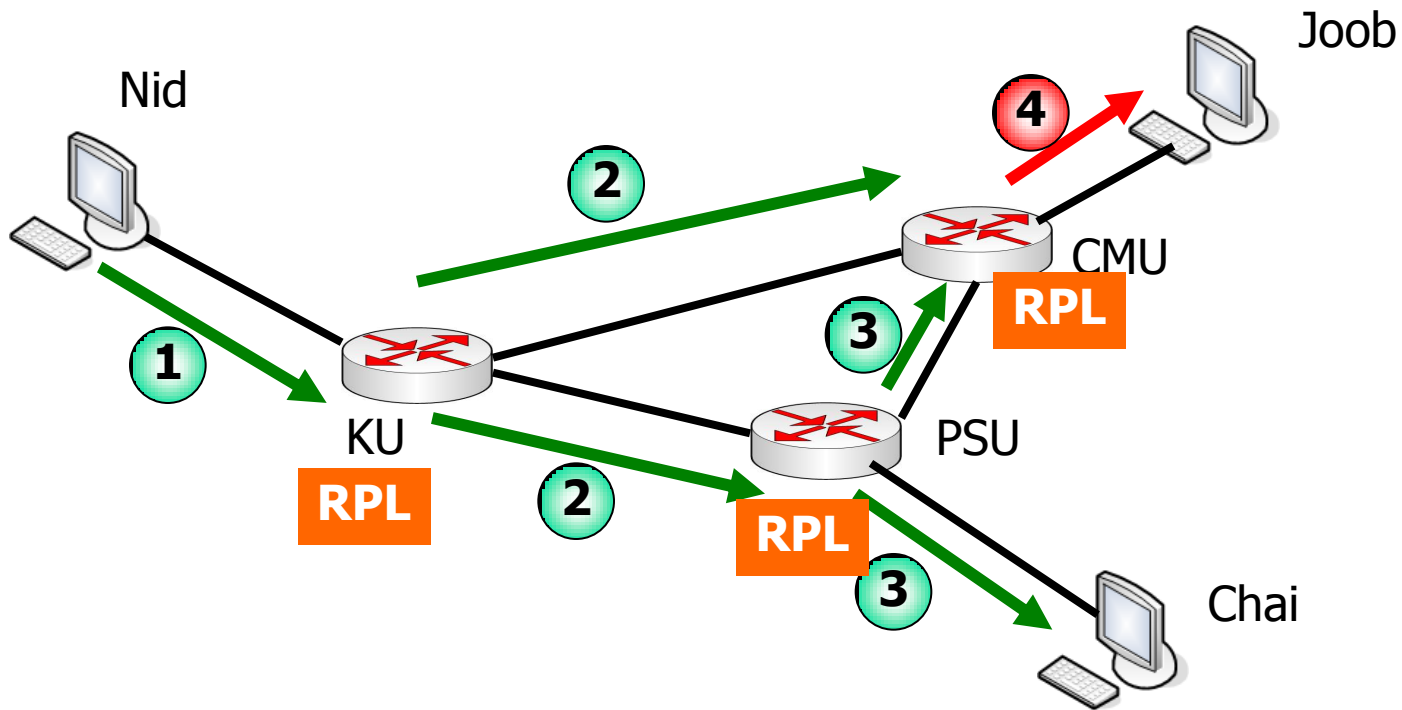




Reverse Path Lookup (RPL)

- Determine to forward / not forward
- Based on algorithm
 - e.g. shortest path

RPL

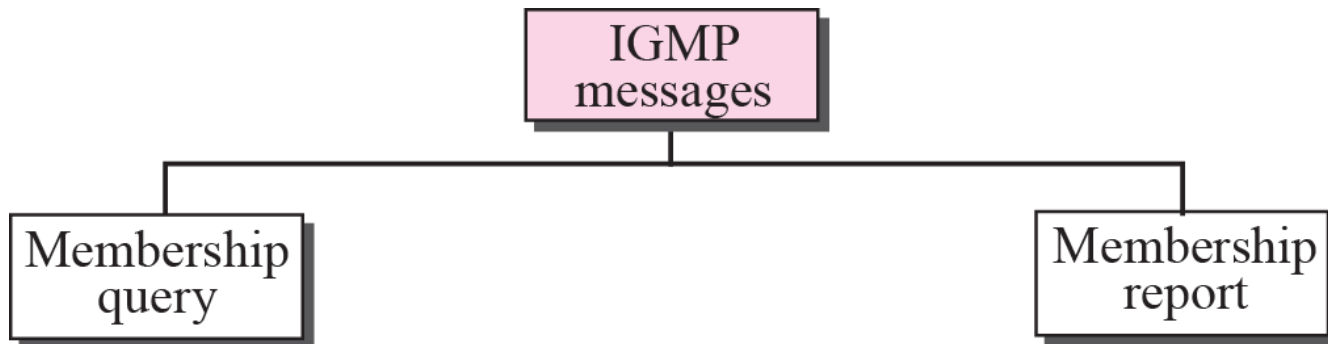




IGMP

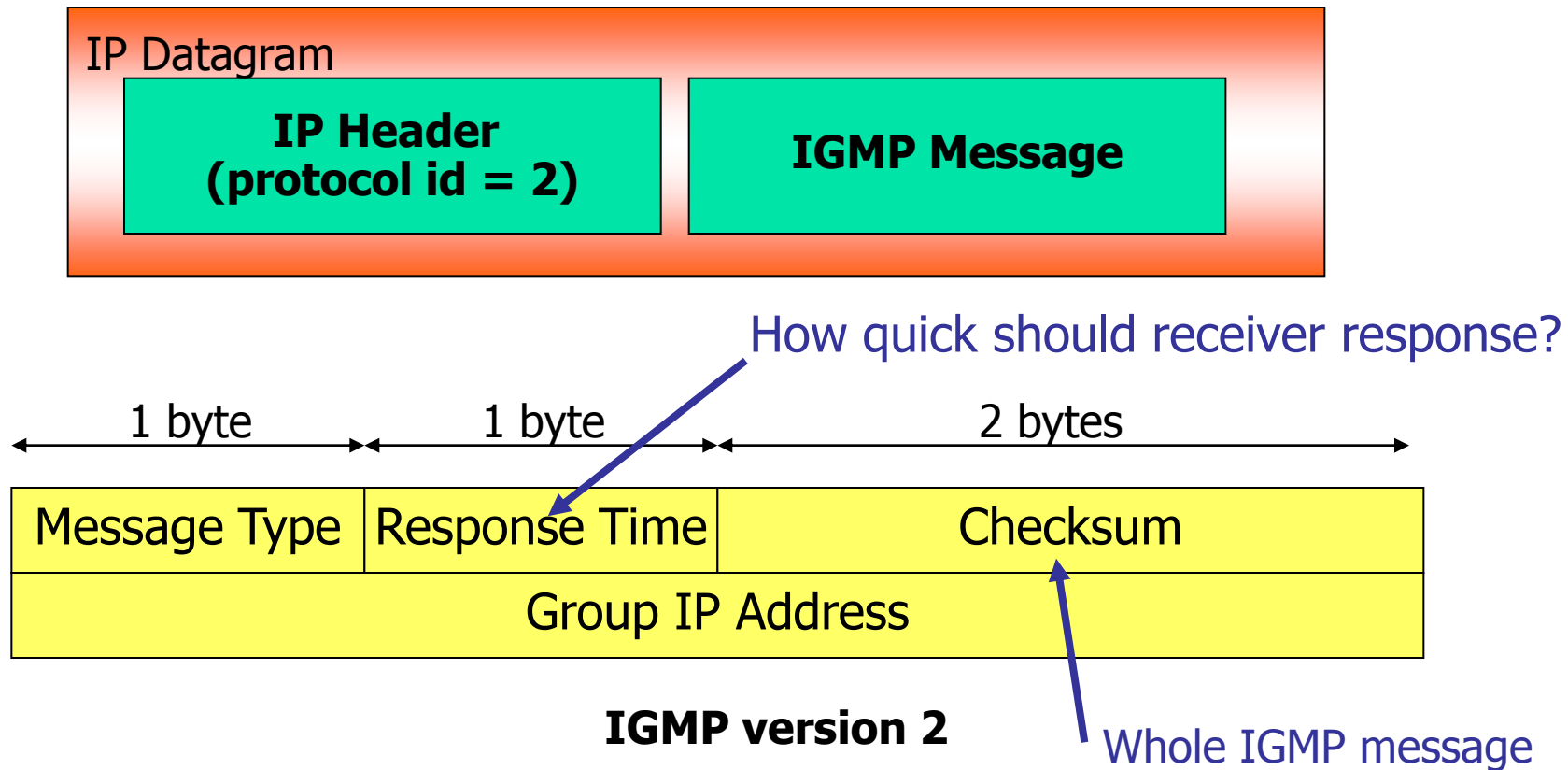
- Internet Group Management Protocol
- Multicast Group
 - Collection of hosts/routers wish to receive same packets
- Determine
 - station to register / withdraw
 - other hosts in group

IGMP



- General
- Group-specific
- Group-and-source-specific

IGMP Format



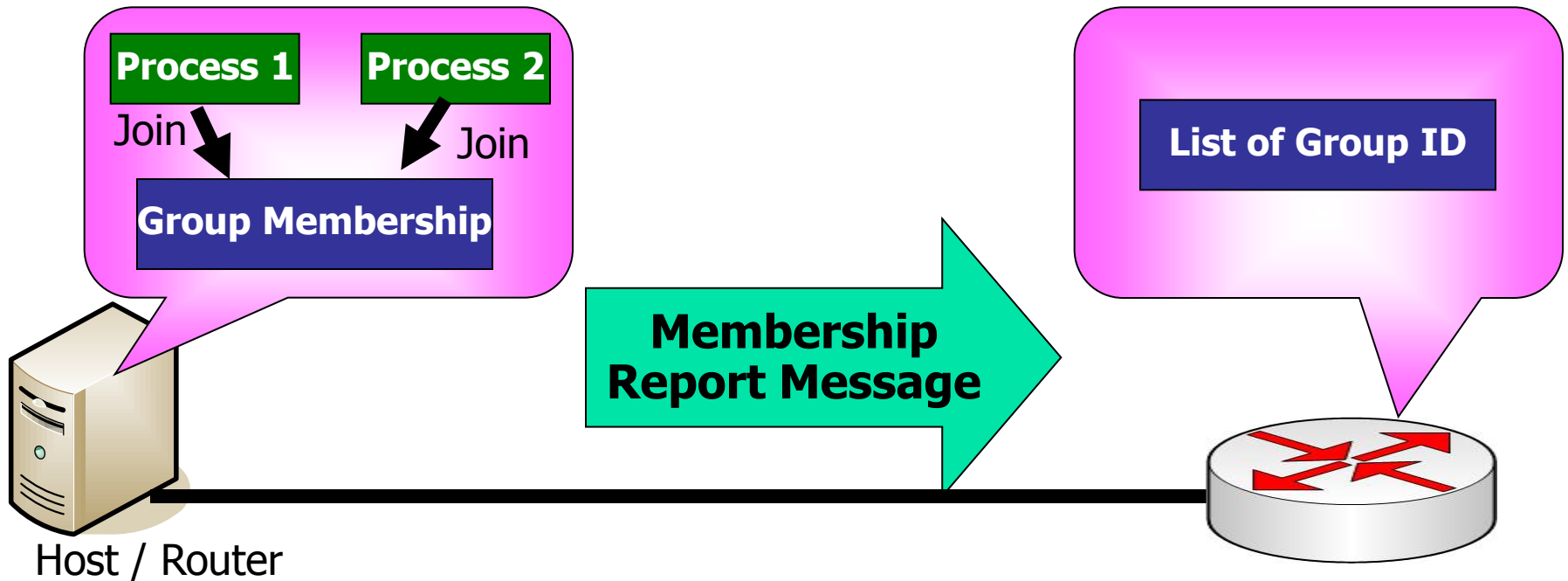
IGMP Message Types

Message Type		Meaning
Ver.1	Ver.2	
1	17	Group membership query
2	18	Response to Group query
6	22	Response to Group query
7	23	Announcement leaving a group

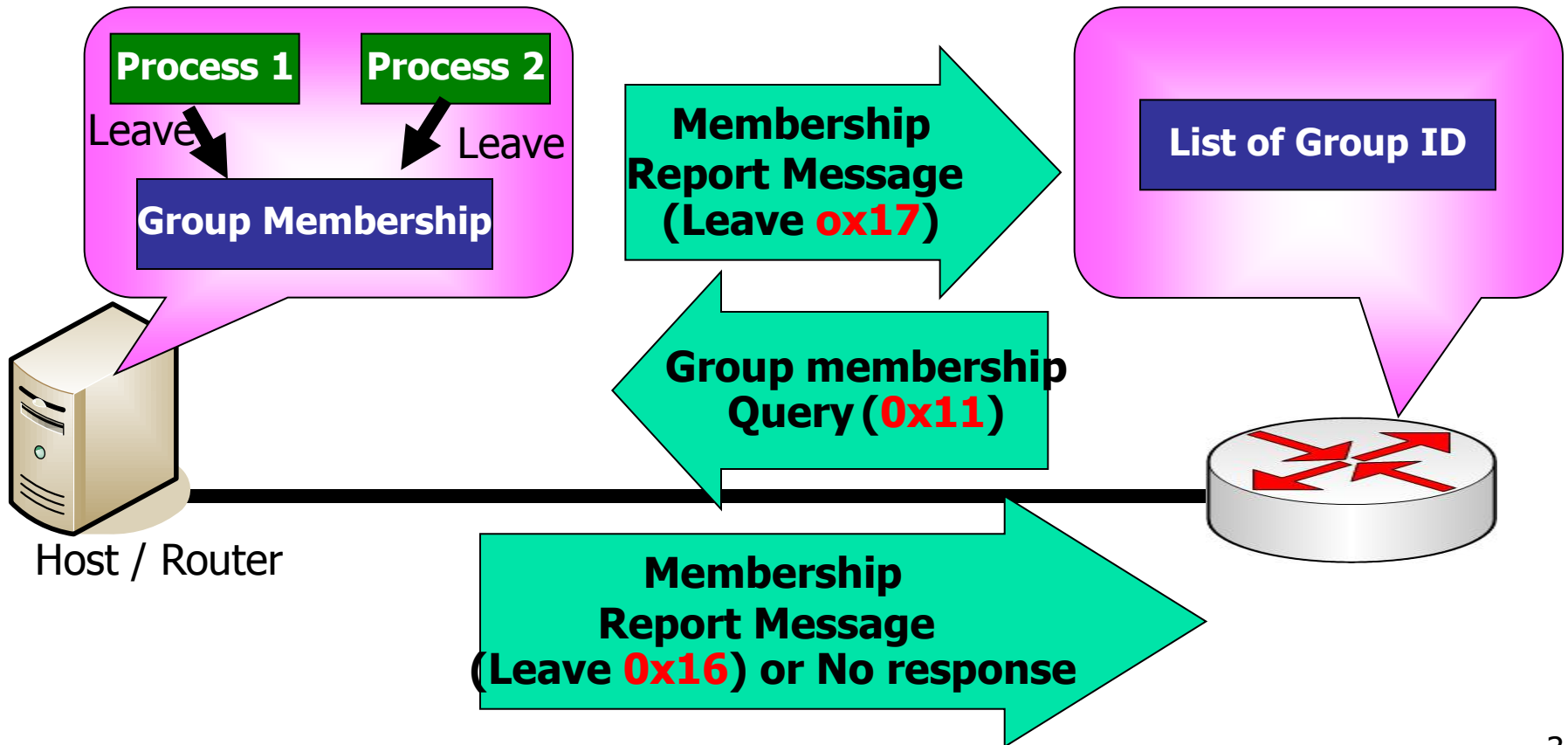
Protocol version

Message Type

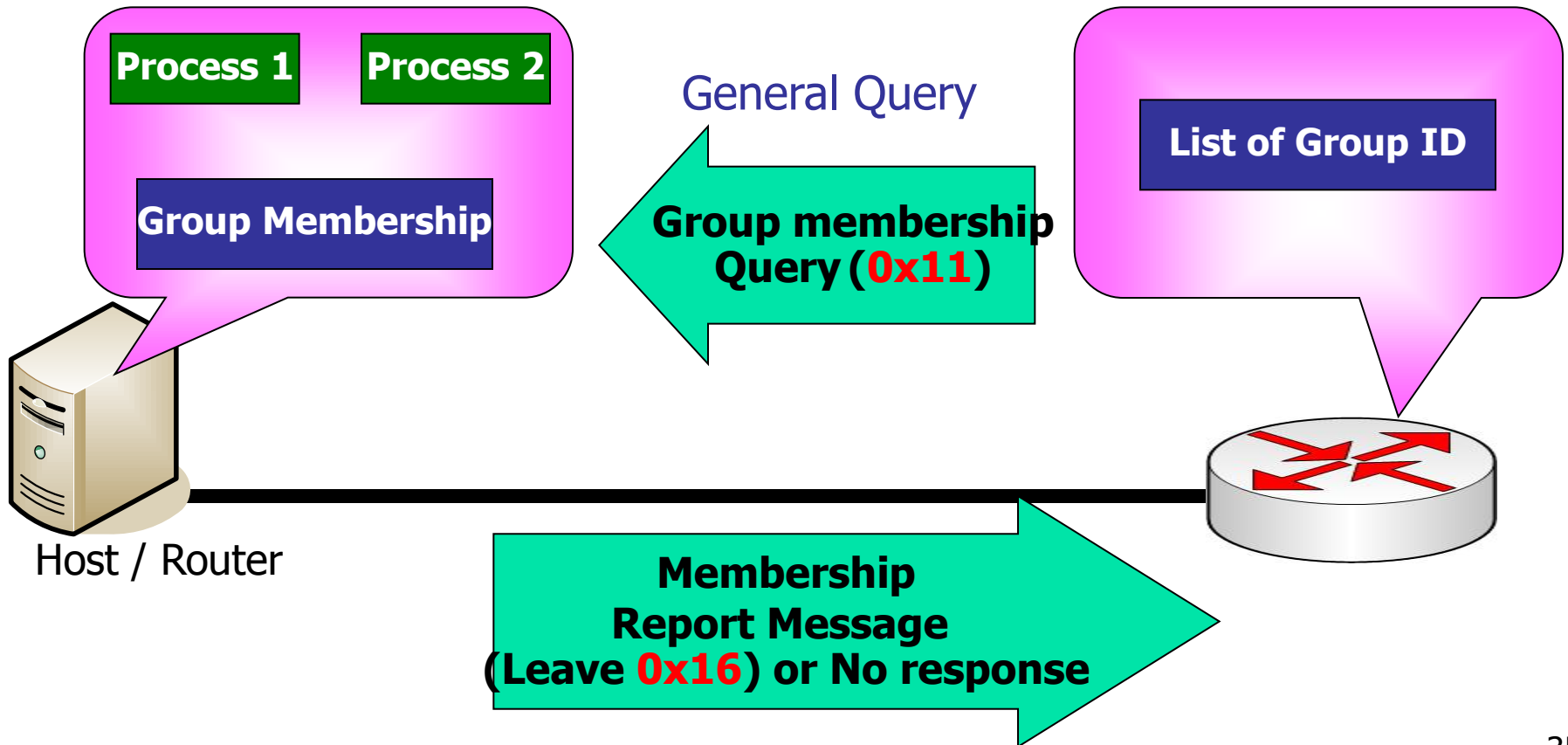
Joining a group



Leaving a group



Membership Monitoring





Multicast Routing

- Protocol Independent Multicast
 - Dense Mode (PIM-DM)
 - Sparse Mode (PIM-SM)



Multicast Routing

- Dense mode protocols
 - assumes dense group membership
 - Source distribution tree and NACK type
 - DVMRP (Distance Vector Multicast Routing Protocol)
 - PIM-DM (Protocol Independent Multicast, Dense Mode)
 - Example: Company-wide announcement



Multicast Routing

- Sparse mode protocol
 - assumes sparse group membership
 - Shared distribution tree and ACK type
 - PIM-SM (Protocol Independent Multicast, Sparse Mode)
 - Examples: a Shuttle Launch



Why deploy Multicast Service?

- Emerging IP-based applications best served by multicast
 - Electronic software/data distribution
 - Distance learning
 - Corporate announcements, communications across multiple locations
 - Audio/video conferencing
 - Webcasting



Management Concerns

- New service needs to be reliable
 - predeployment analysis, experiments, pilots
 - rapid fault diagnosis & repair
 - capacity planning



Management Concerns

- Fear effects of multicast on existing network
 - router misconfiguration, defects, CPU load
 - increased traffic
- Control and security

Ongoing monitoring helps alleviate all these concerns

Multicast Management

...like ordinary network management

Operations

Capacity Planning



Customer Support



At a high level, the same business roles need to be supported

Low level details are different for multicast



Multicast Mgmt Requirements Survey Findings

- Few people understand multicast technology
- Public domain tools require protocol knowledge
- No commercial monitoring facilities available



Operational Management Requirements (continued)

- Traffic control
- Accounting
- Performance, QoS assessment