

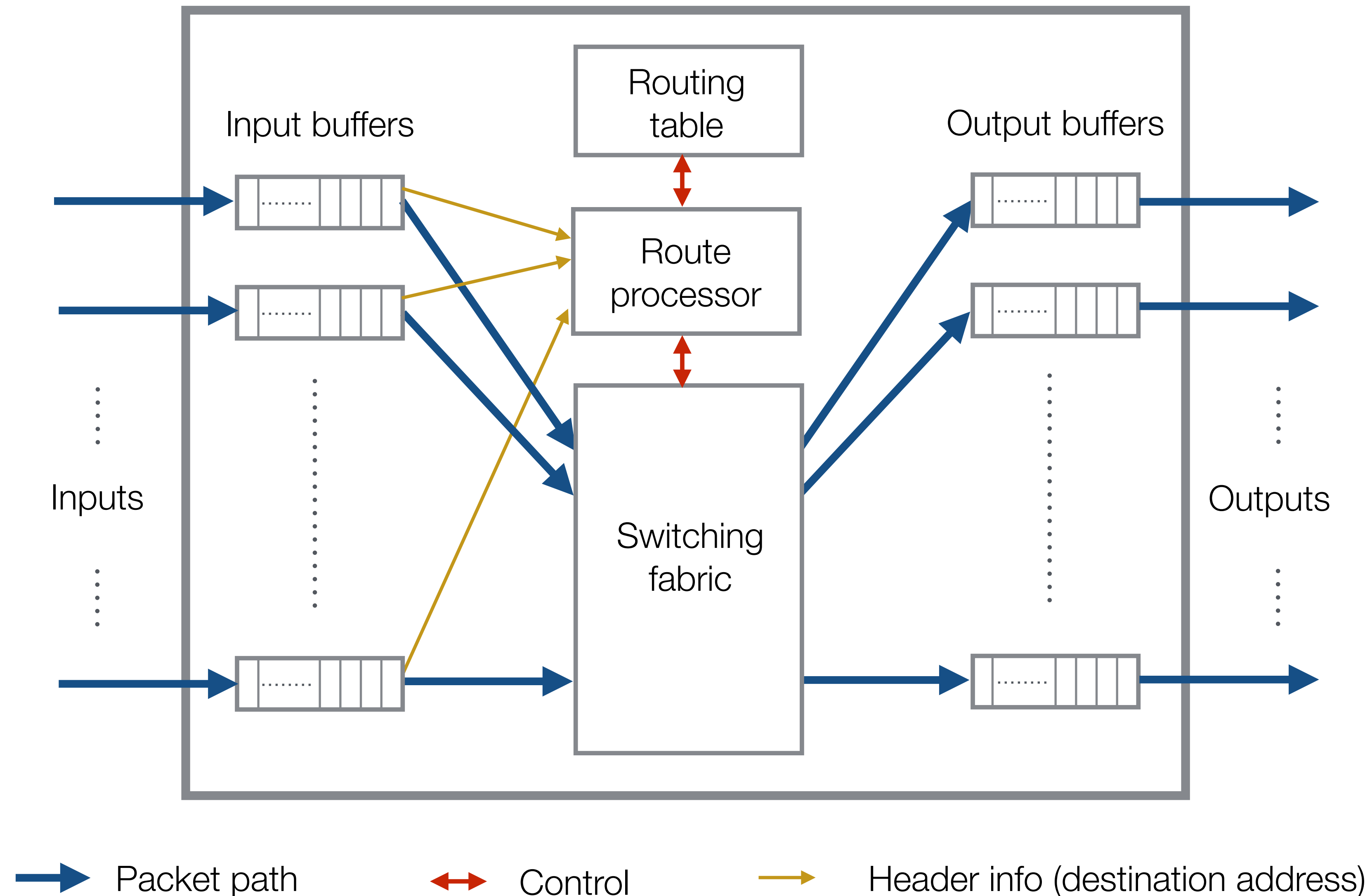
CS 725/825 & IT 725

Lecture 4

Networking Fundamentals

September 16, 2026

Anatomy of a router/switch

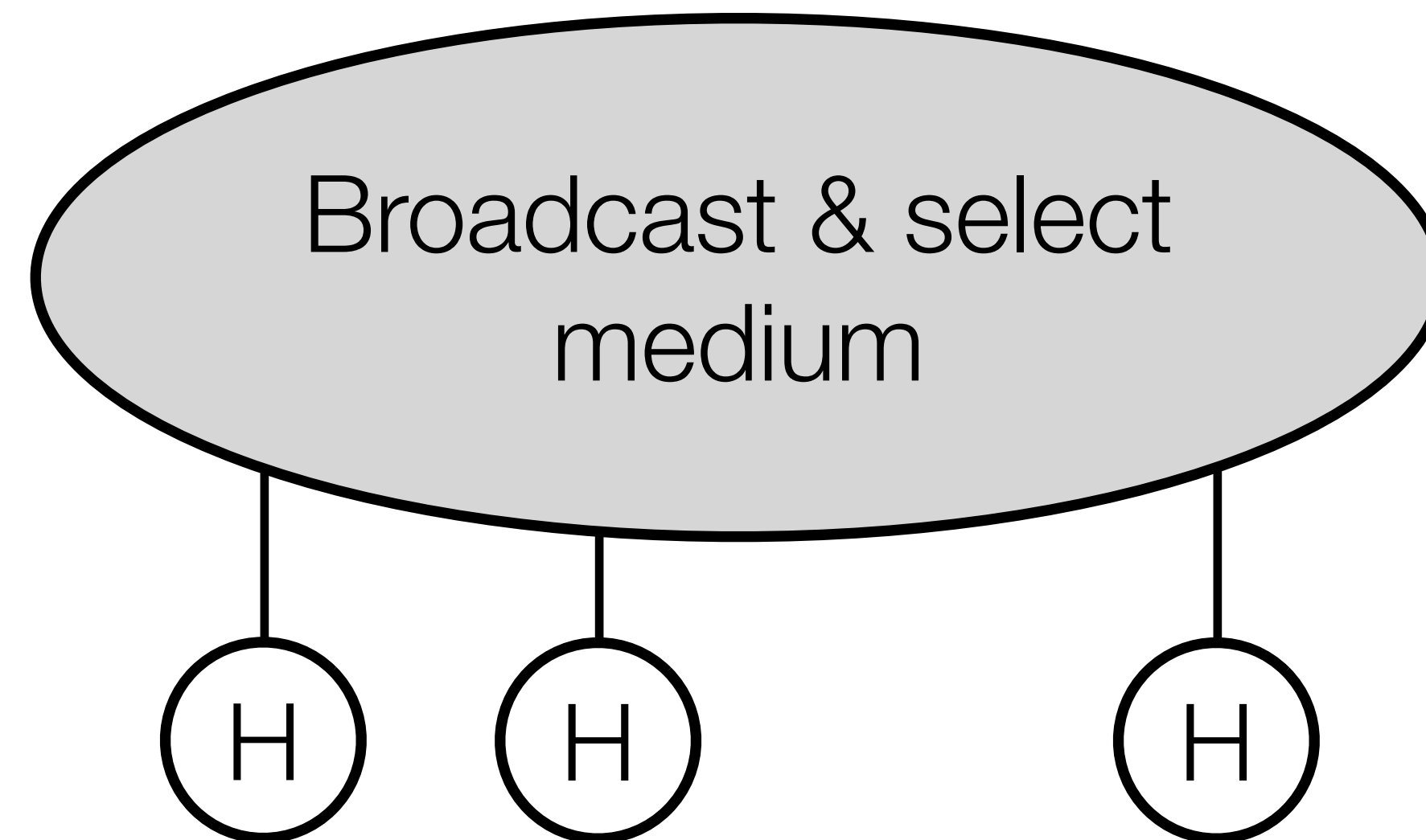


Store and Forward

- ▶ Intermediate nodes **receive**, **store**, and **forward** packets
 - storing and retransmission adds **fixed delay**
- ▶ **Output conflict** - multiple packets waiting to be forwarded on the same output
 - queues/buffers used to store packets waiting transmission
 - queuing adds **variable delay**
 - potential for **packet loss** due to buffer overflow

A bit of history...

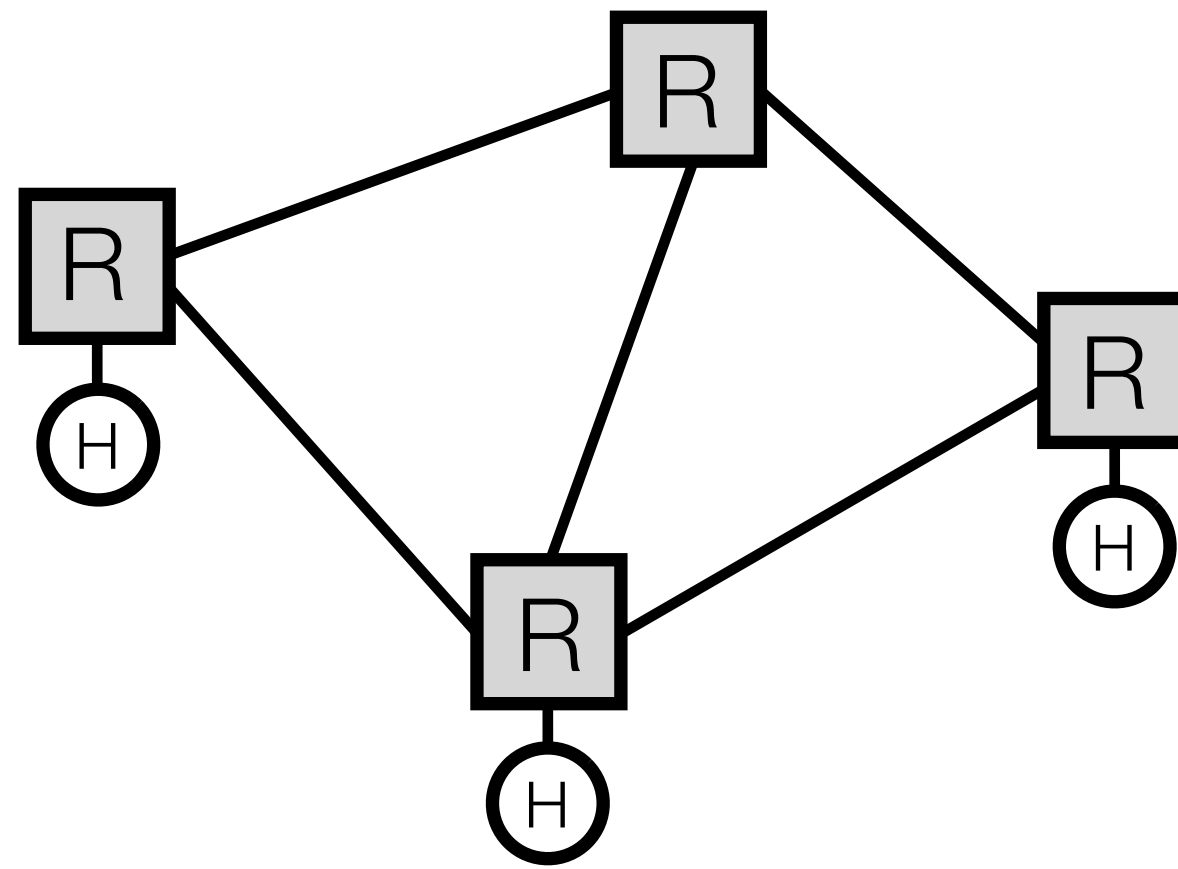
- ▶ **Local area networks** (late 80's, early 90's)
 - (then) based on broadcast & select medium



- (today) a network of Ethernet (L2) switches

Comparison

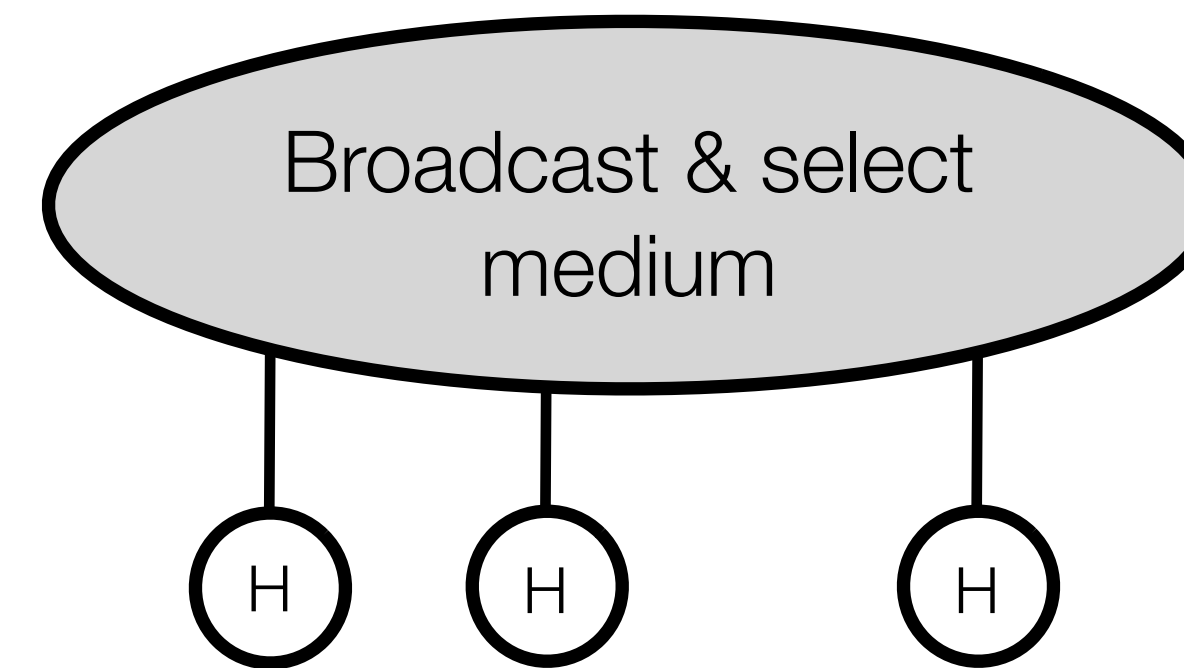
► Routed networks



- topology driven by geography
- long distances (high latency)
- need for scalability
- location-related addresses
- routing

➡ **Network Layer (L3)**

► Broadcast & select

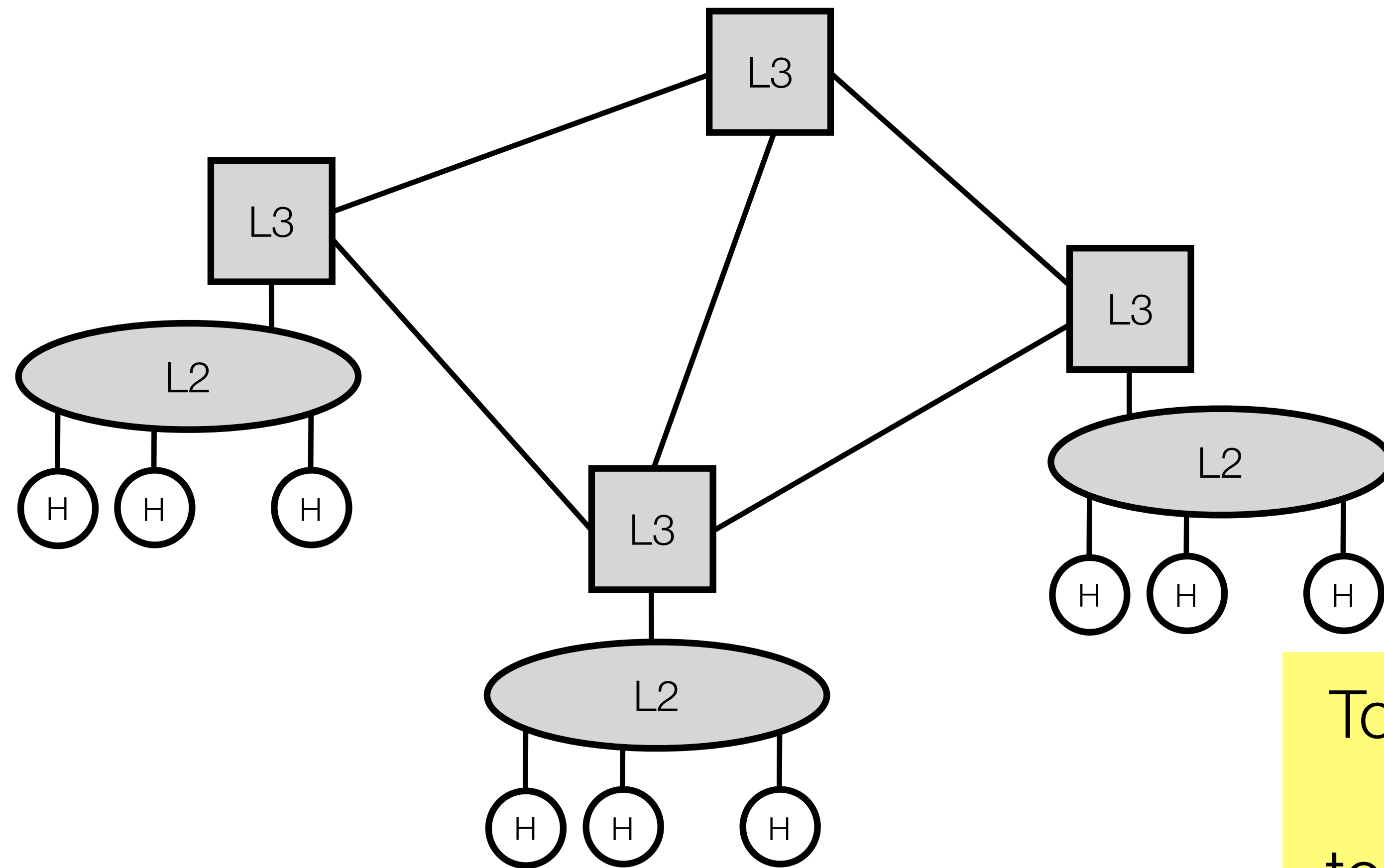


- everyone connected to everyone
- short distances (low latency)
- lesser need for scalability
- arbitrary addresses
- address discovery

➡ **Link Layer (L2)**

Today

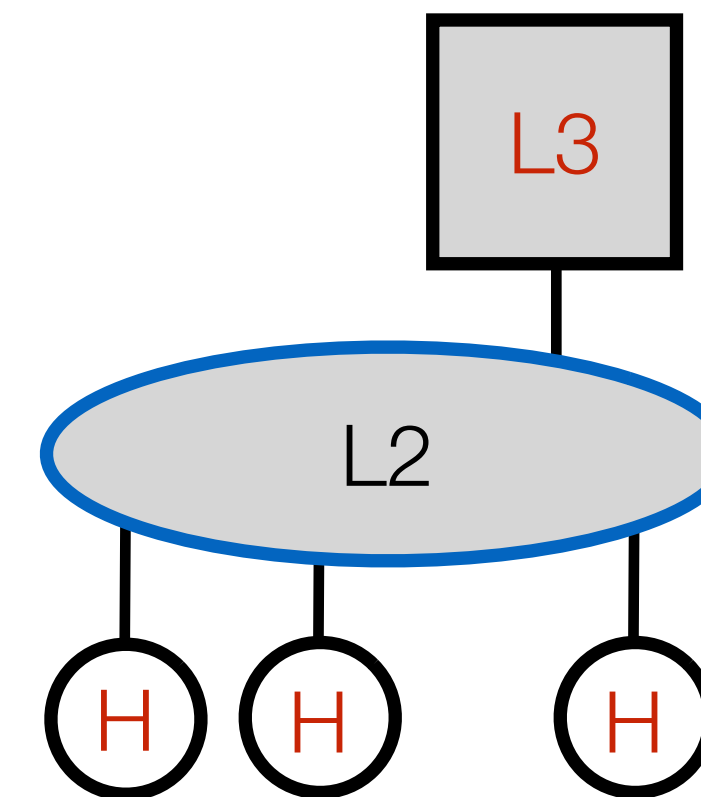
Internet - a network to **INTER**connect **NET**works



Today, L2 switching and L3 routing are often mixed together in devices capable of processing multiple layers

Networking Basics

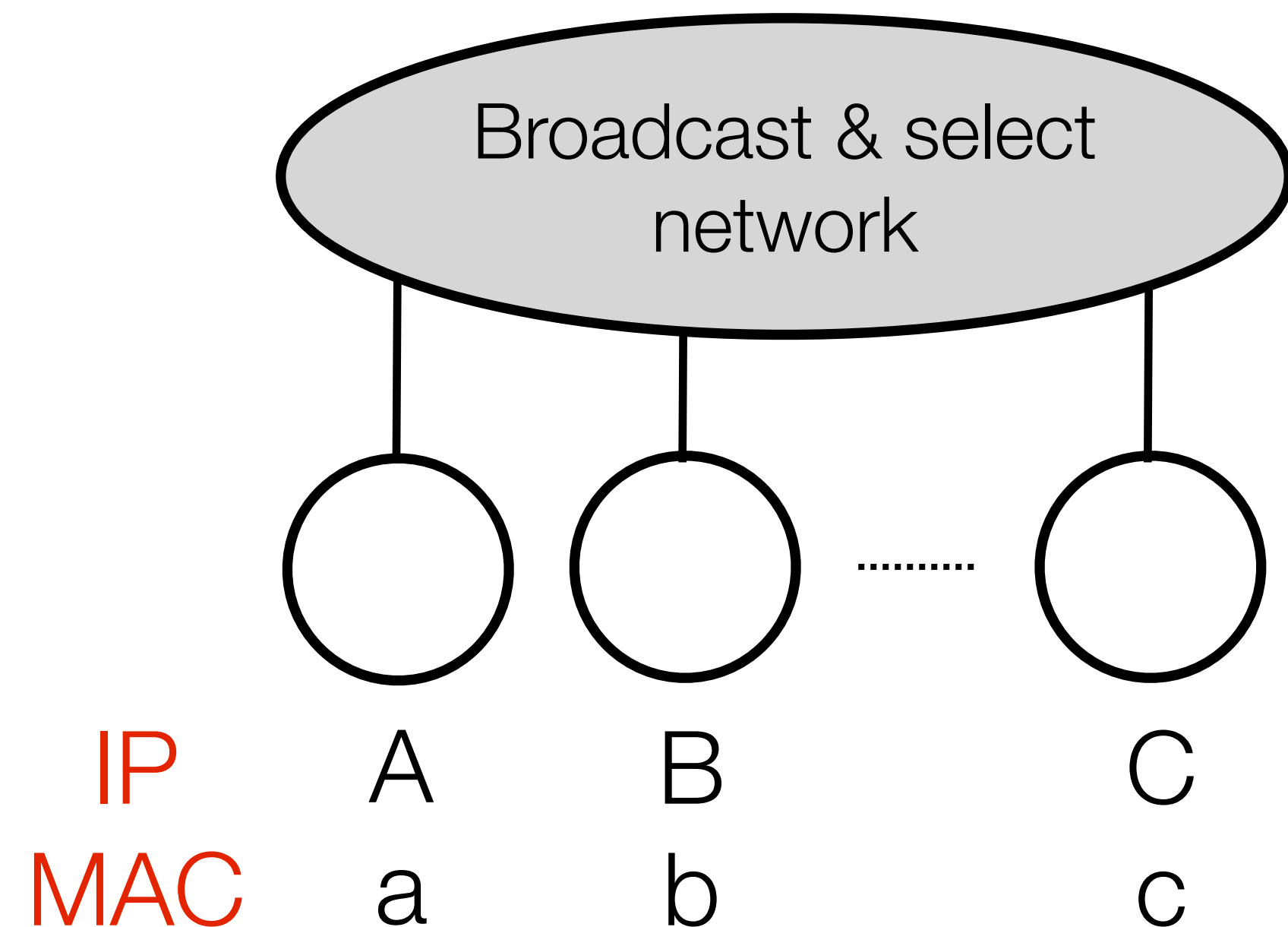
- ▶ **Goals:** IP/MAC addresses, fundamental protocols, subnetting, basics of routing/switching
- ▶ **Assumptions:**
 - packet switched network
 - nodes attached to a **L2 broadcast-and-select network**
 - each **node** “has” a 6-byte MAC and a 4-byte IP addresses



Address Resolution

- **Problem:** Find MAC address of a node with a given IP address

A has a packet with IP destination address B, A needs B's MAC address to deliver the packet



- **Solution:** ARP - Address Resolution Protocol

ARP

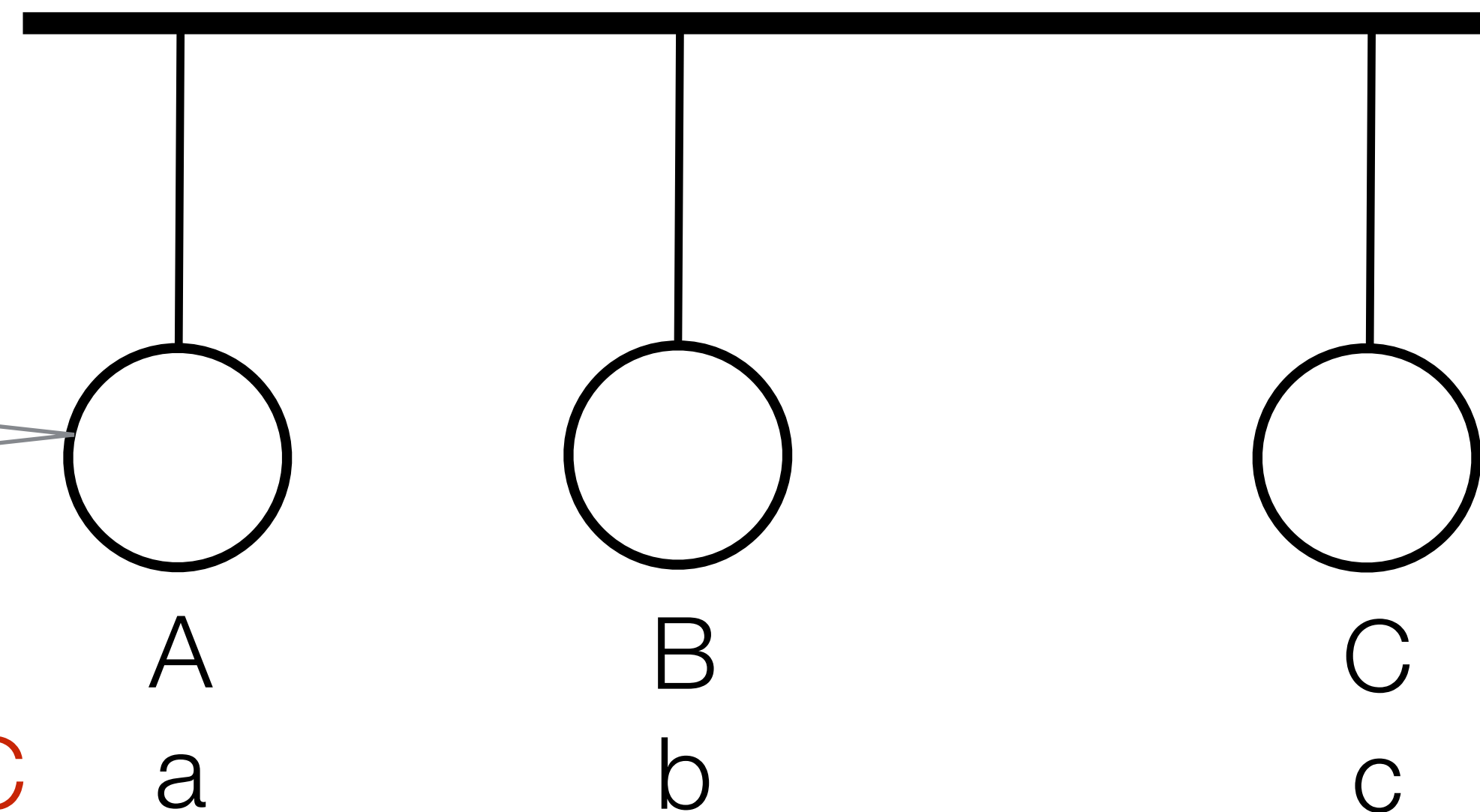
A has a packet with IP destination address B, A needs B's MAC address to deliver the packet

Broadcast and Select medium

Who has IP = B?

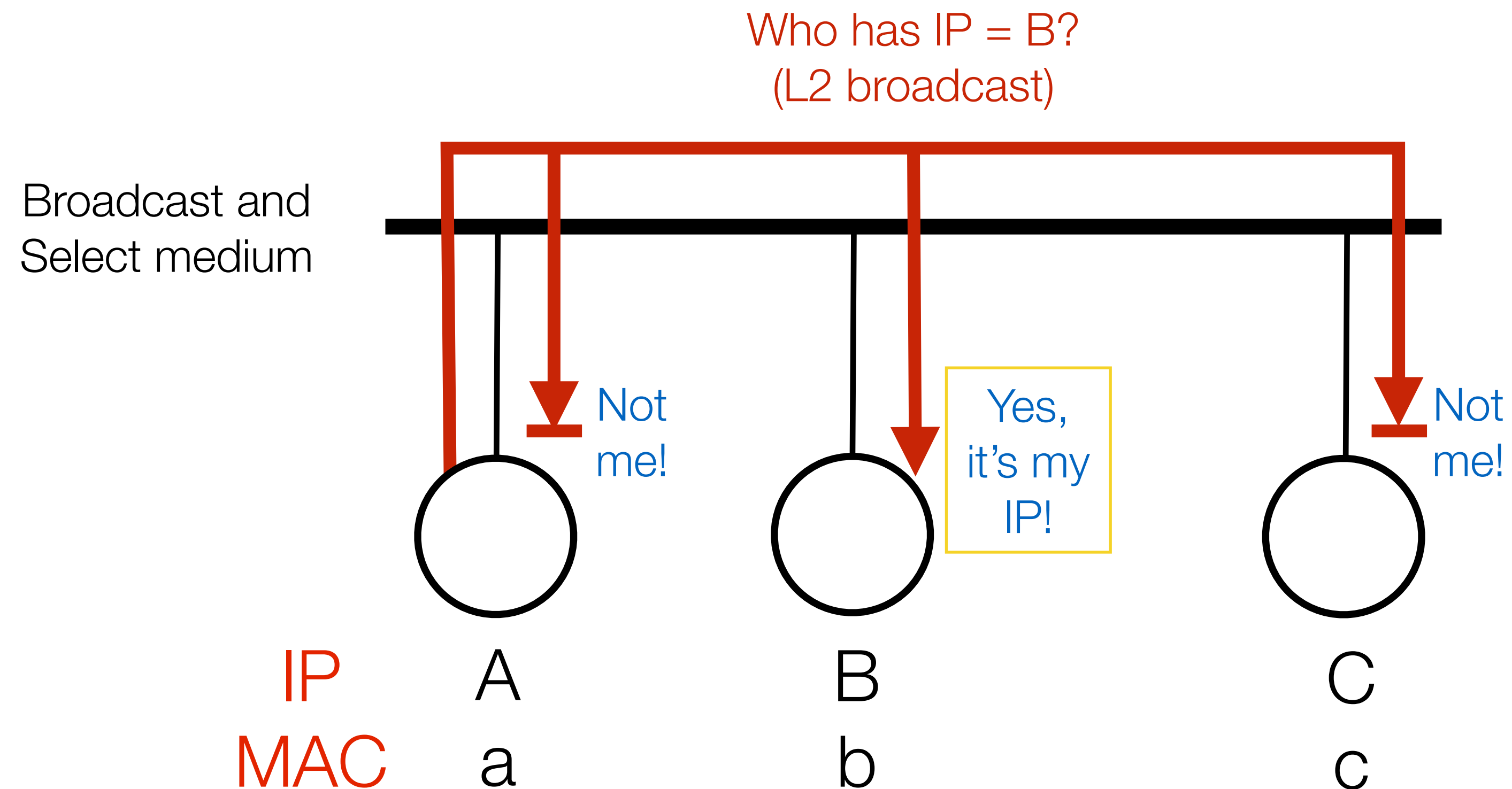
	MAC	IP	
SRC	a	A	
DST	?	B	

IP
MAC

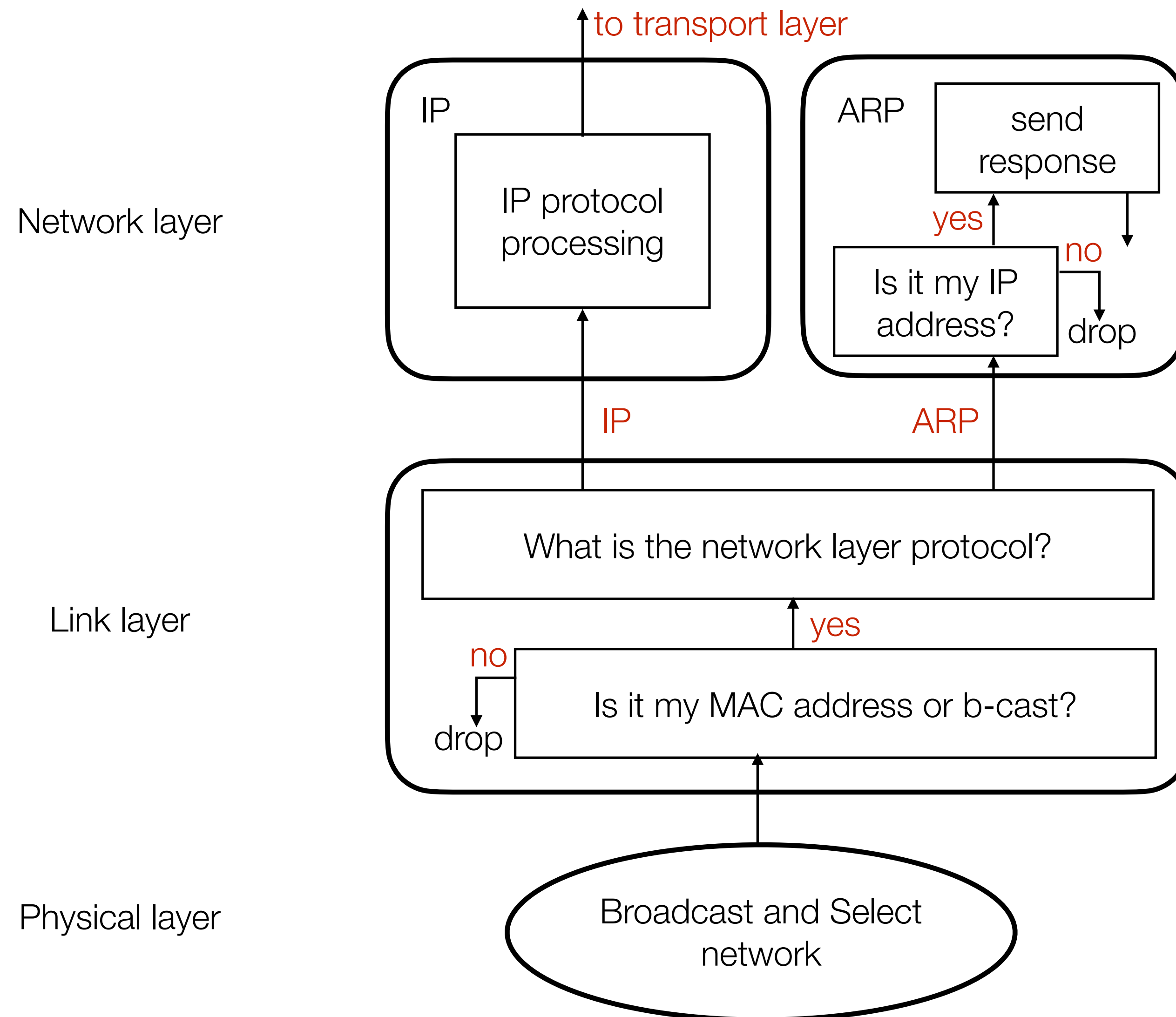


ARP

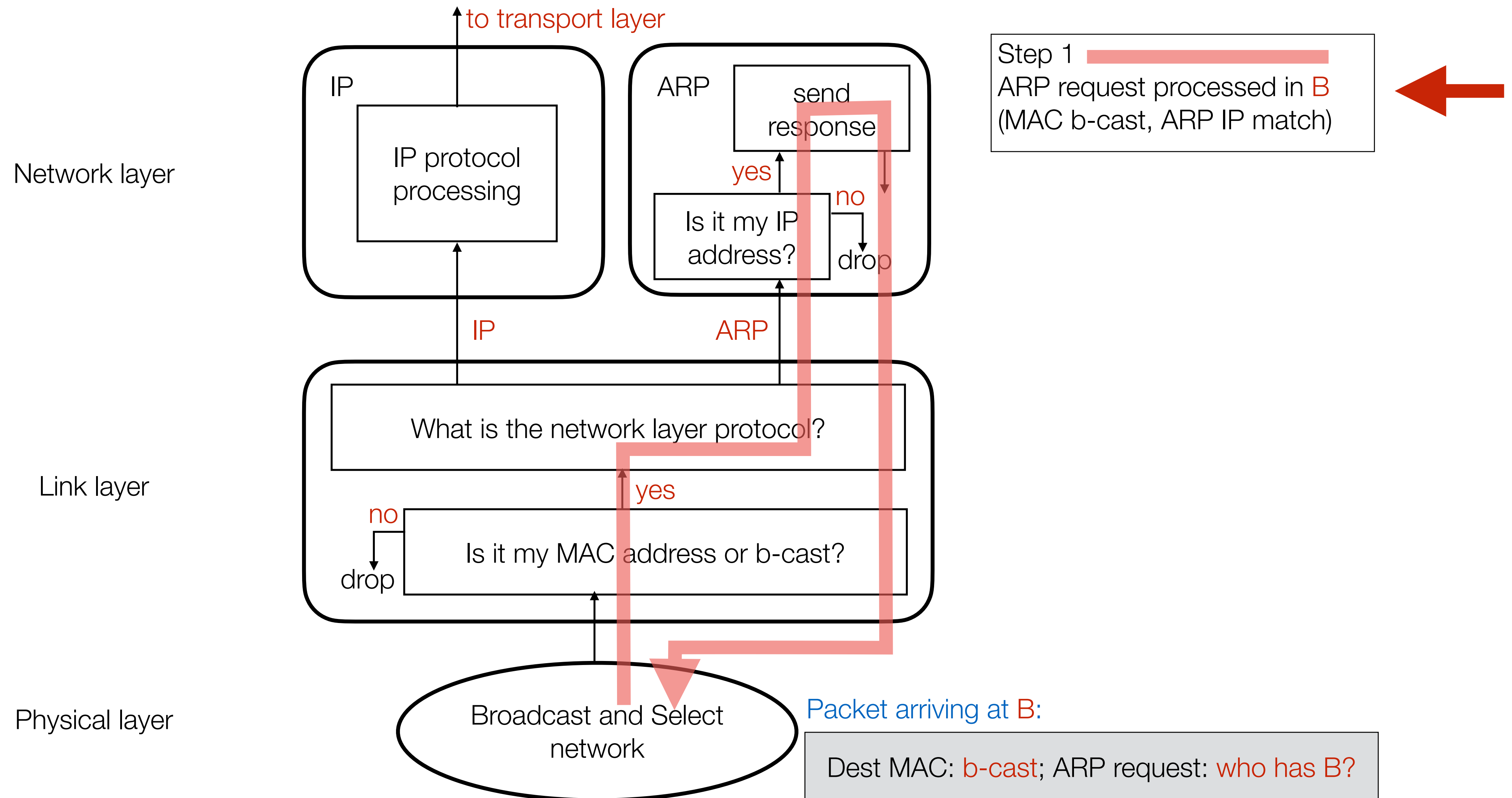
- **Step 1:** “Who has ...” **broadcasted** to everyone by A



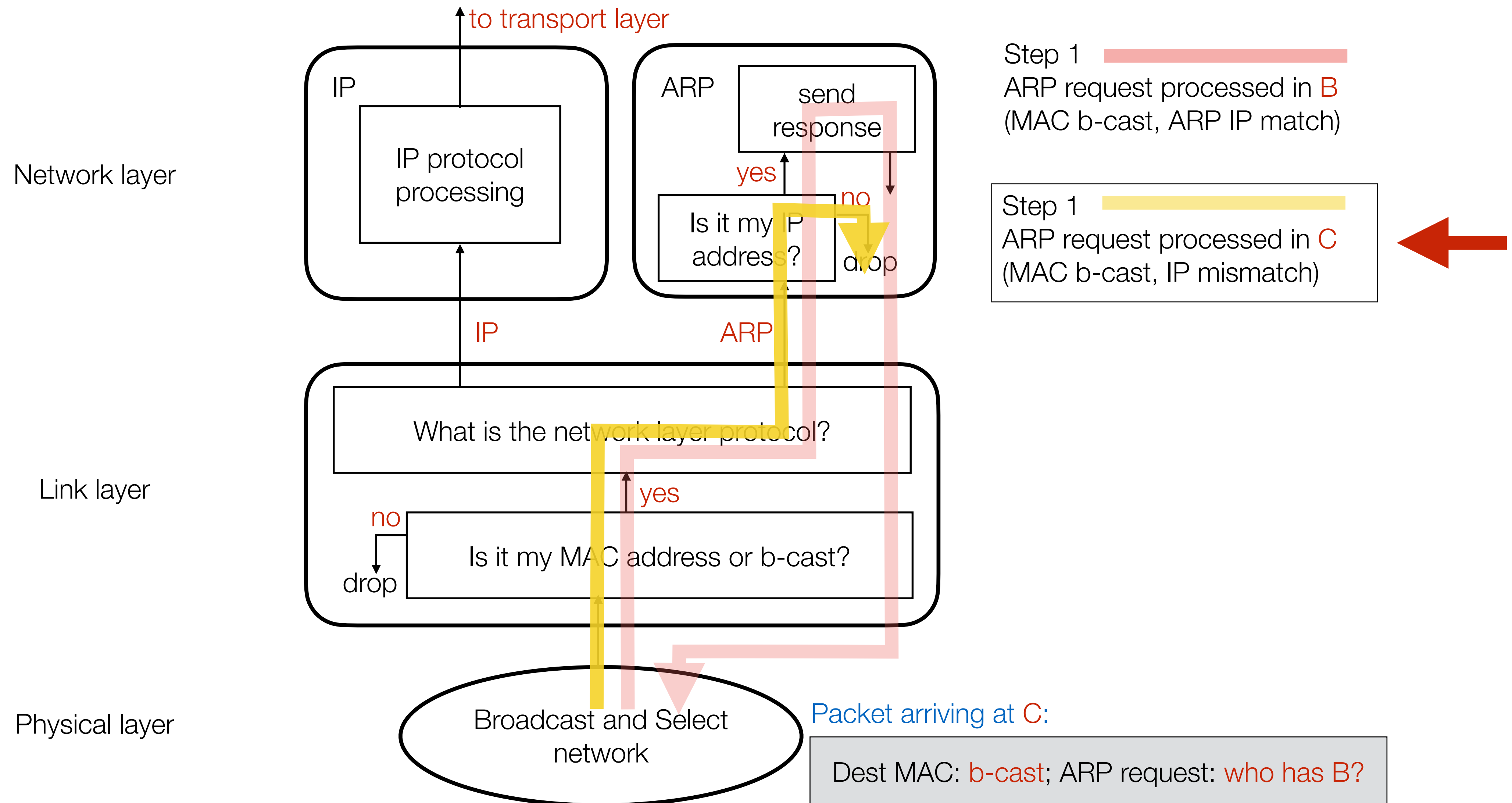
ARP packet processing



ARP packet processing

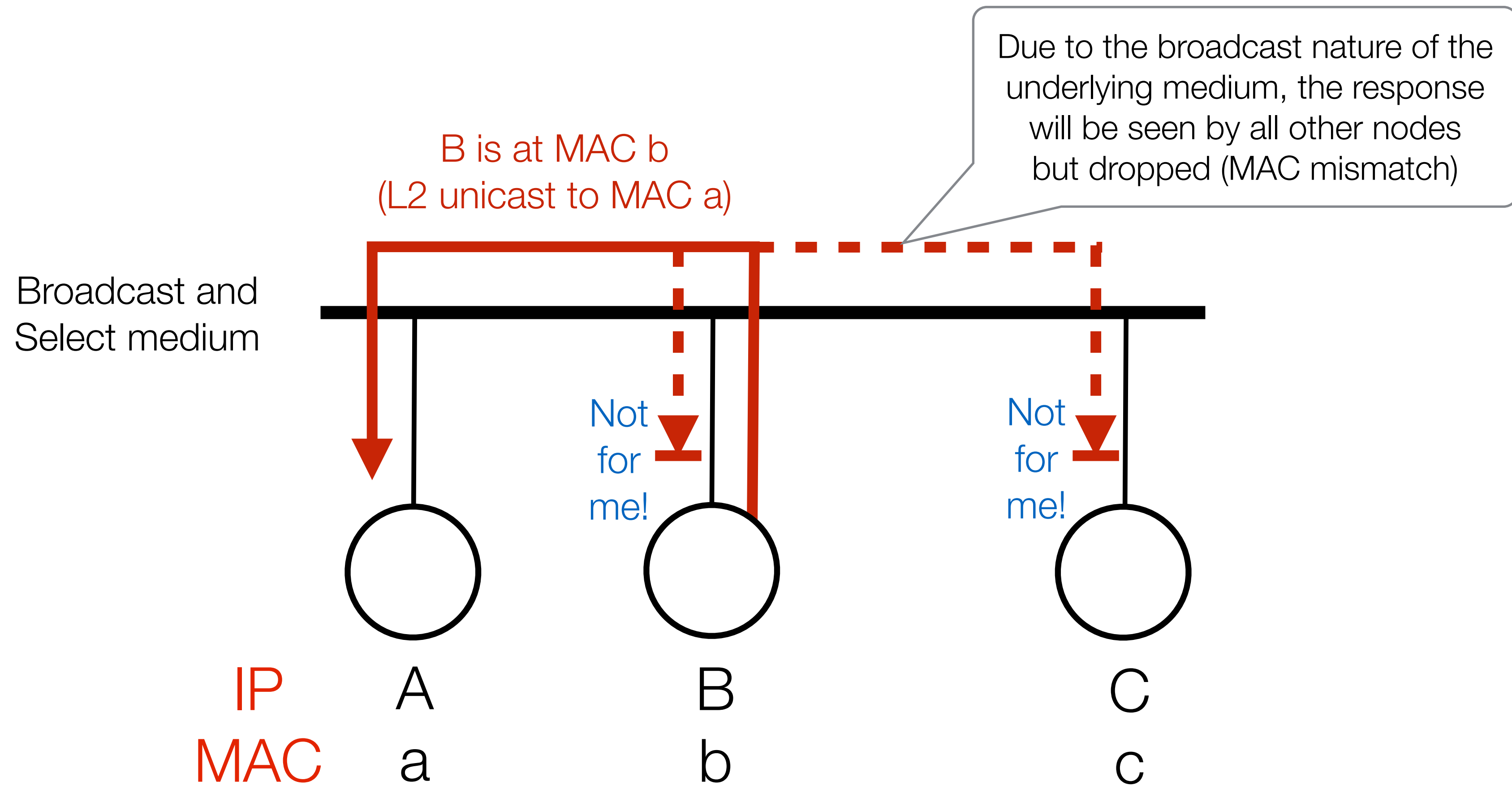


ARP packet processing

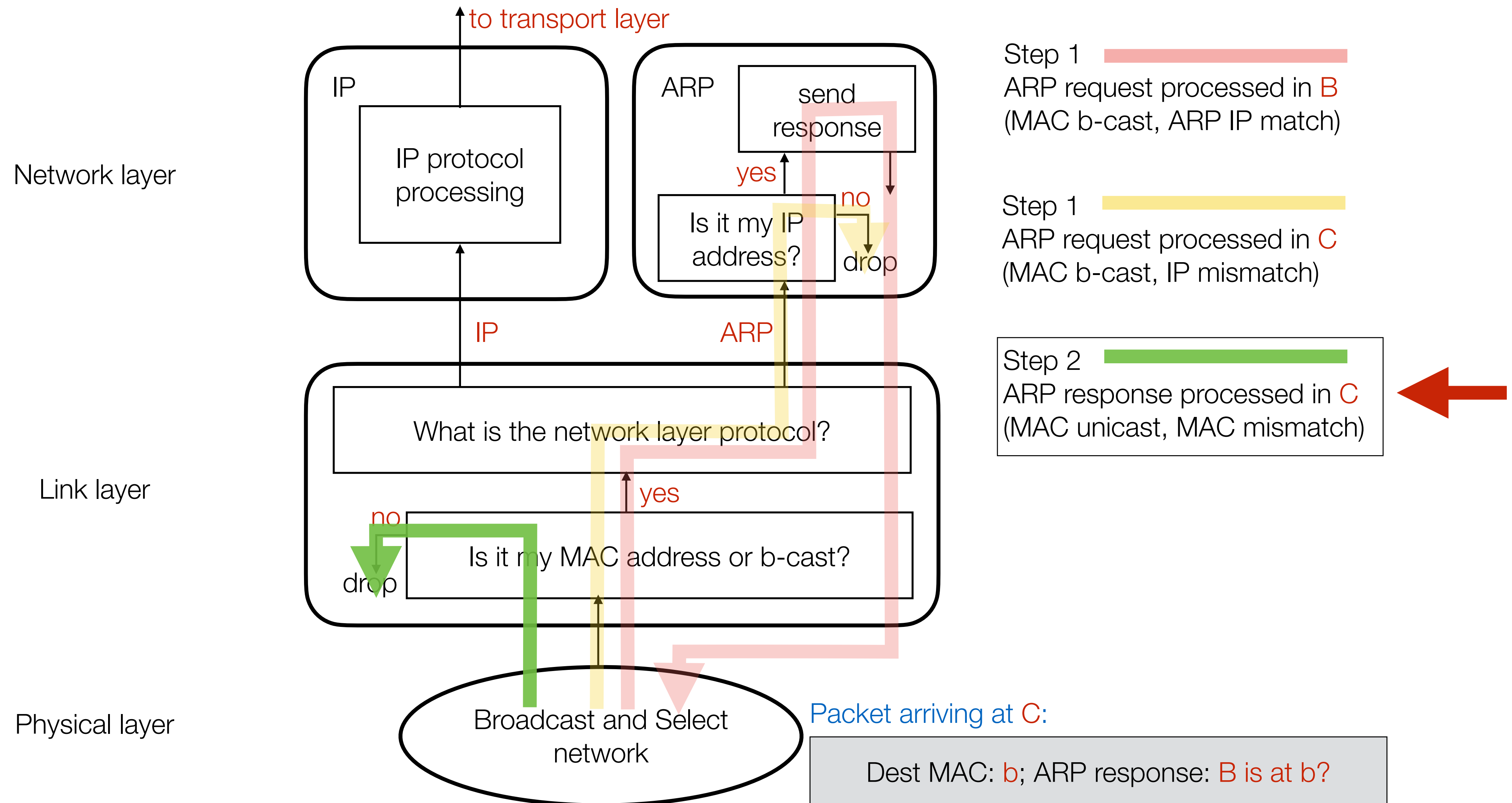


ARP

- Step 2: B sends L2 unicast response to A (MAC a)

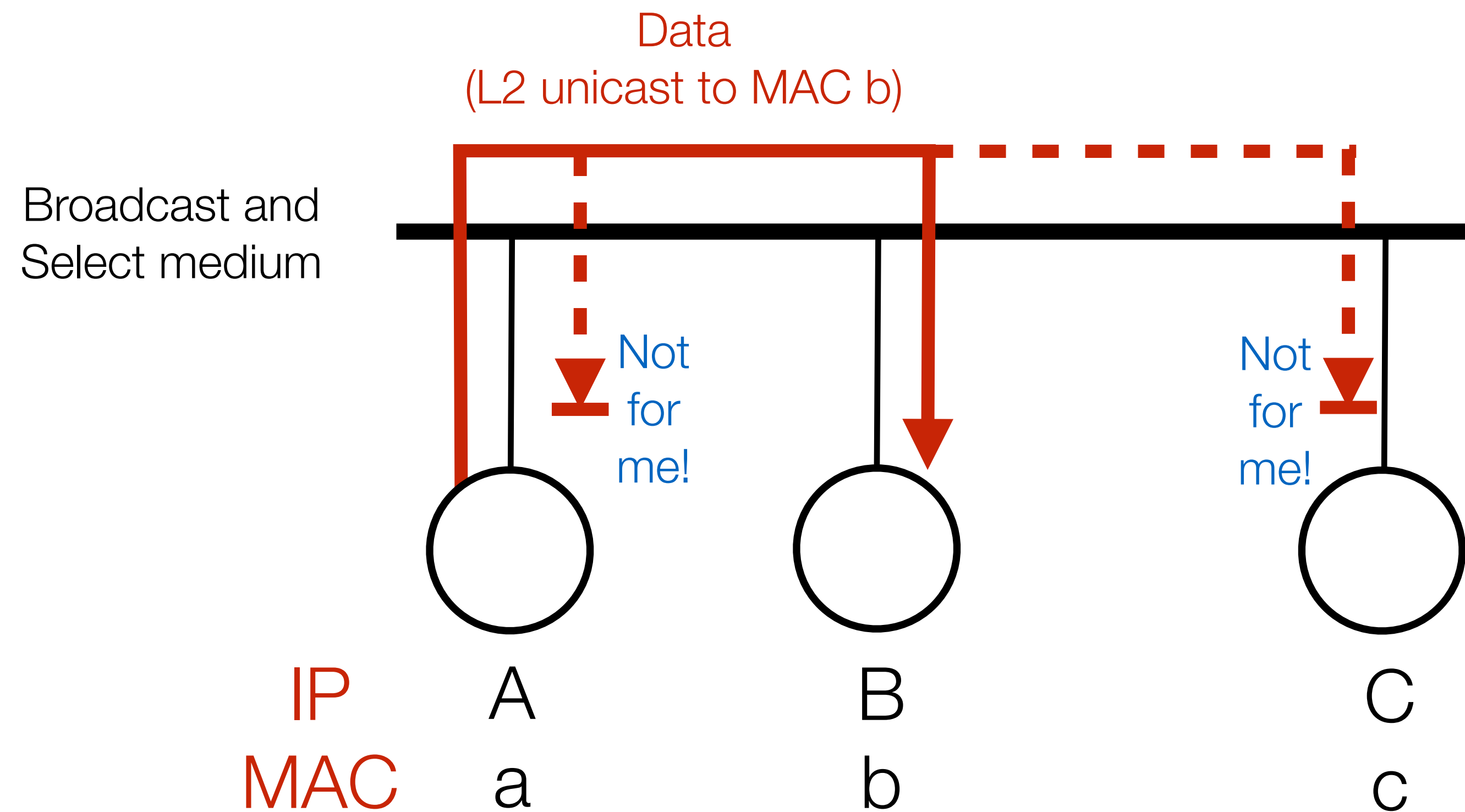


ARP packet processing



ARP

- Step 3: A sends data using L2 unicast to MAC b



ARP packet processing

