Link Layer Goal

- Get from one node to it's adjacent neighbor.
- Abstract the details of the underlying network technology from the protocols above it (IP).
- Lots of media with different characteristics:
  - Copper cable
  - Fiber optic cable
  - Radio/electromagnetic broadcast
  - Satellite

Challenges

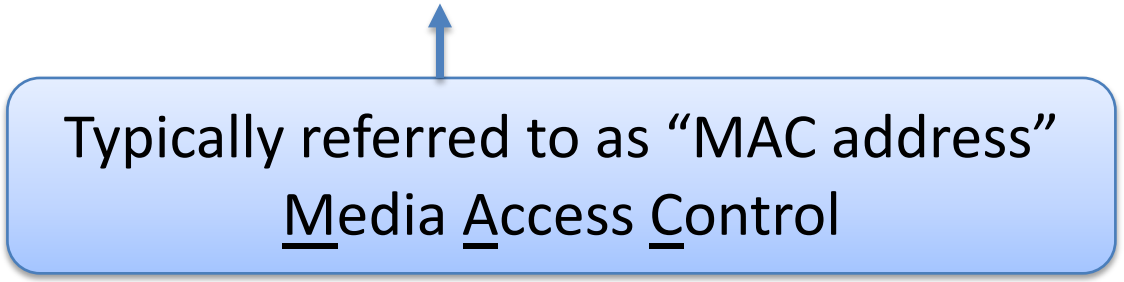
- Even with one medium:
  - Potentially many ways to format & signal data.
  - Multiple users may contend to transmit.
  - How do we address endpoints?
  - How do we locate destinations?

Link Layer Functions

1. Addressing: identifying endpoints

- Must be able to uniquely identify each host on the network. Can't assume IP.

- Implication: each host on the Internet will have **two** addresses: IP & link-layer



Addressing

- Typically, humans deal in IP addresses (or DNS names that resolve to them)

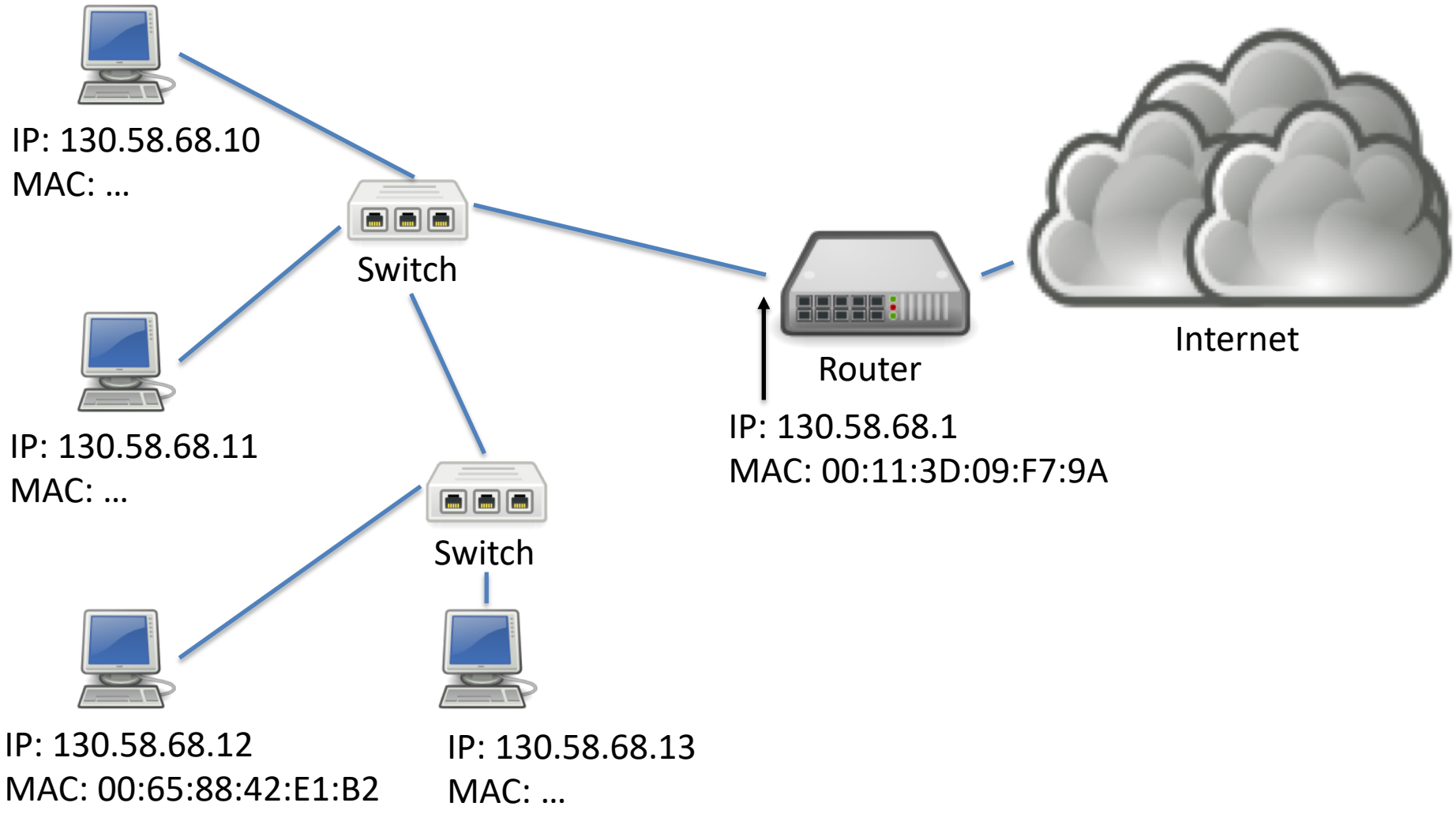
- Network needs a mechanism to determine corresponding MAC address for local sending

ARP: Address Resolution Protocol

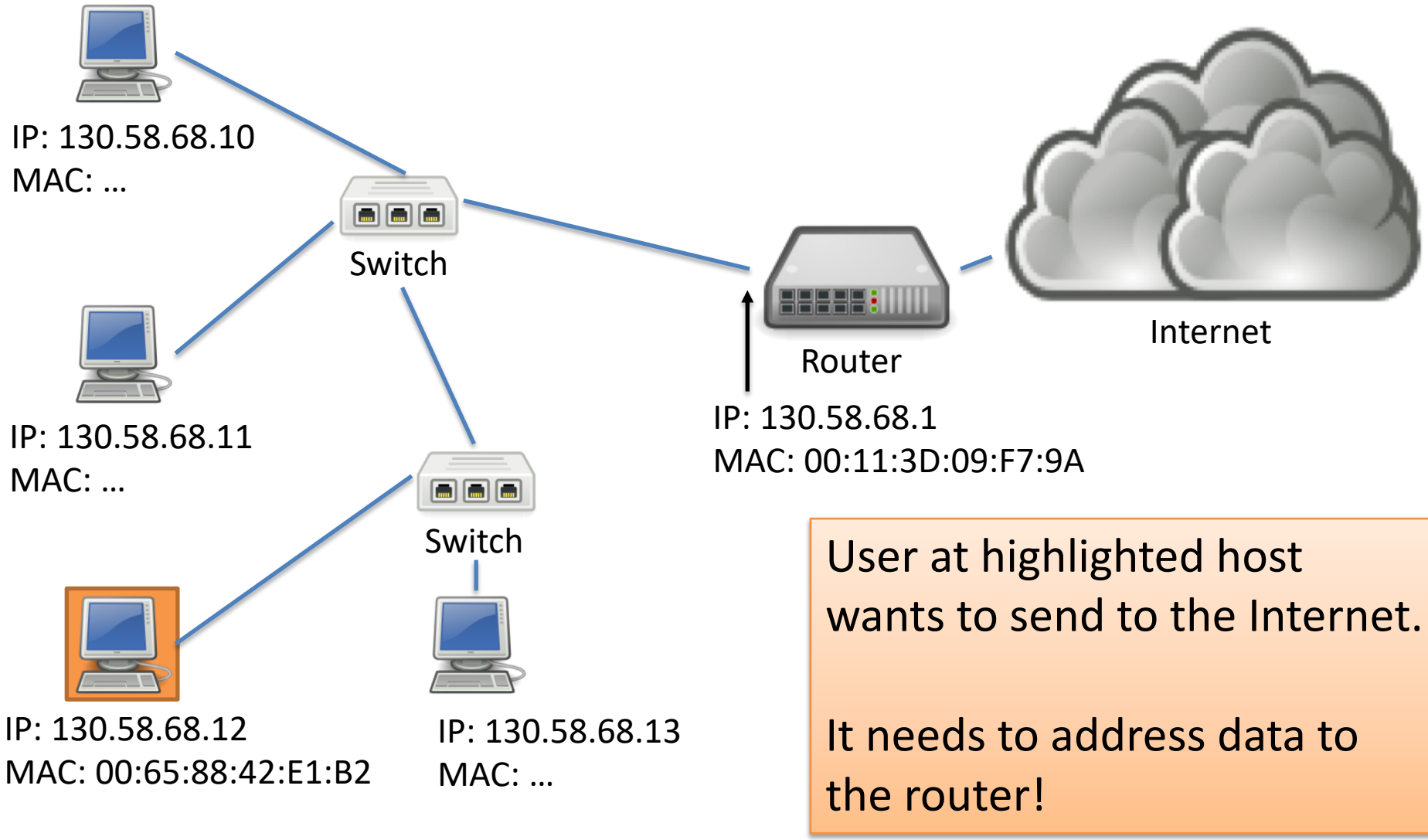
- Common in networks you use: Ethernet, WiFi
- Broadcast to entire local network:
  - "I'm looking for the MAC address of the host with IP address A.B.C.D. If you're out there, please respond to me!"

- You will implement this in lab 7!

ARP Example


IP: 130.58.68.10
MAC: …
Switch
IP: 130.58.68.11
MAC: …
Switch
Router
IP: 130.58.68.1
MAC: 00:11:3D:09:F7:9A
Internet
IP: 130.58.68.12
MAC: 00:65:88:42:E1:B2
IP: 130.58.68.13
MAC: …

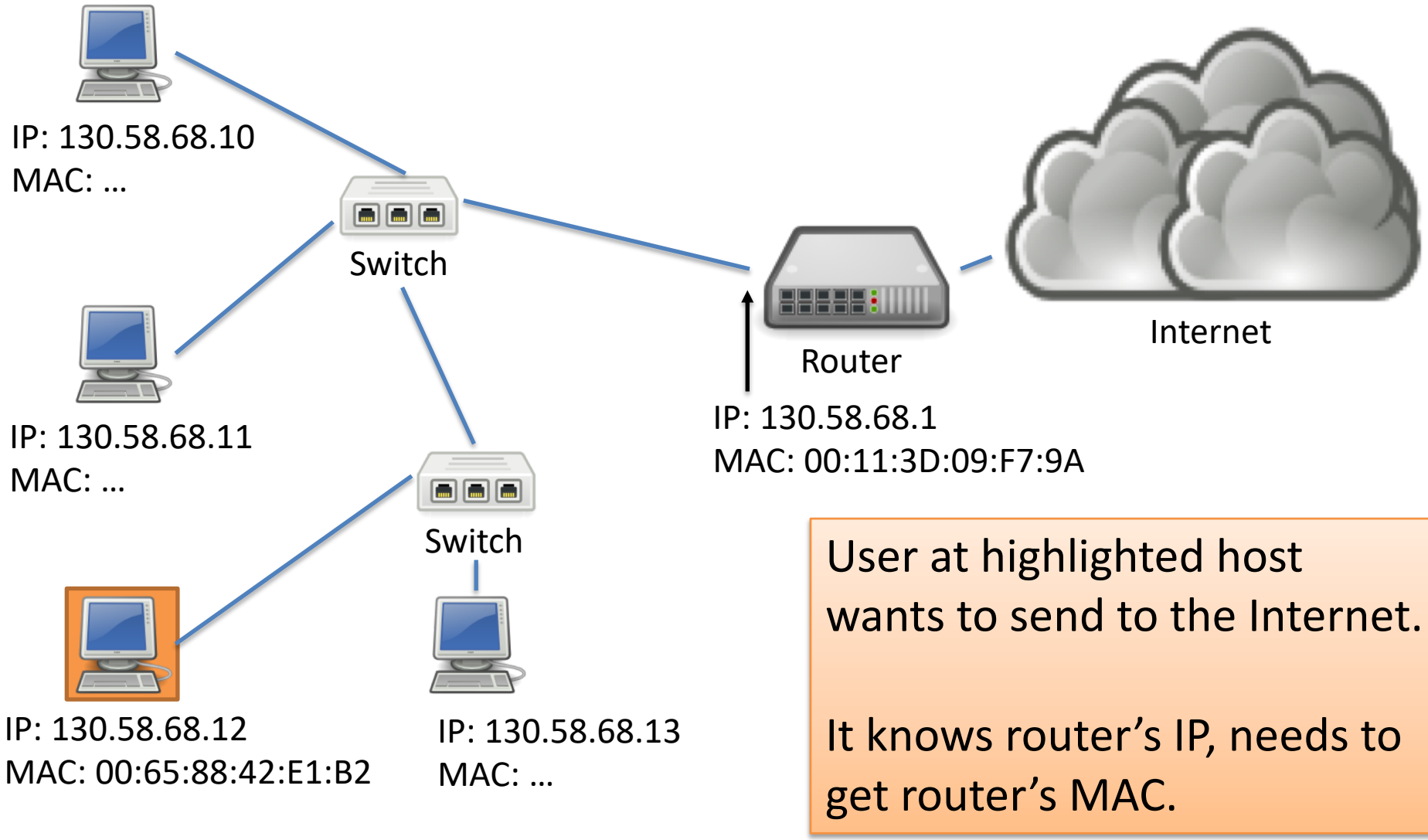
ARP Example



User at highlighted host wants to send to the Internet.

It needs to address data to the router!

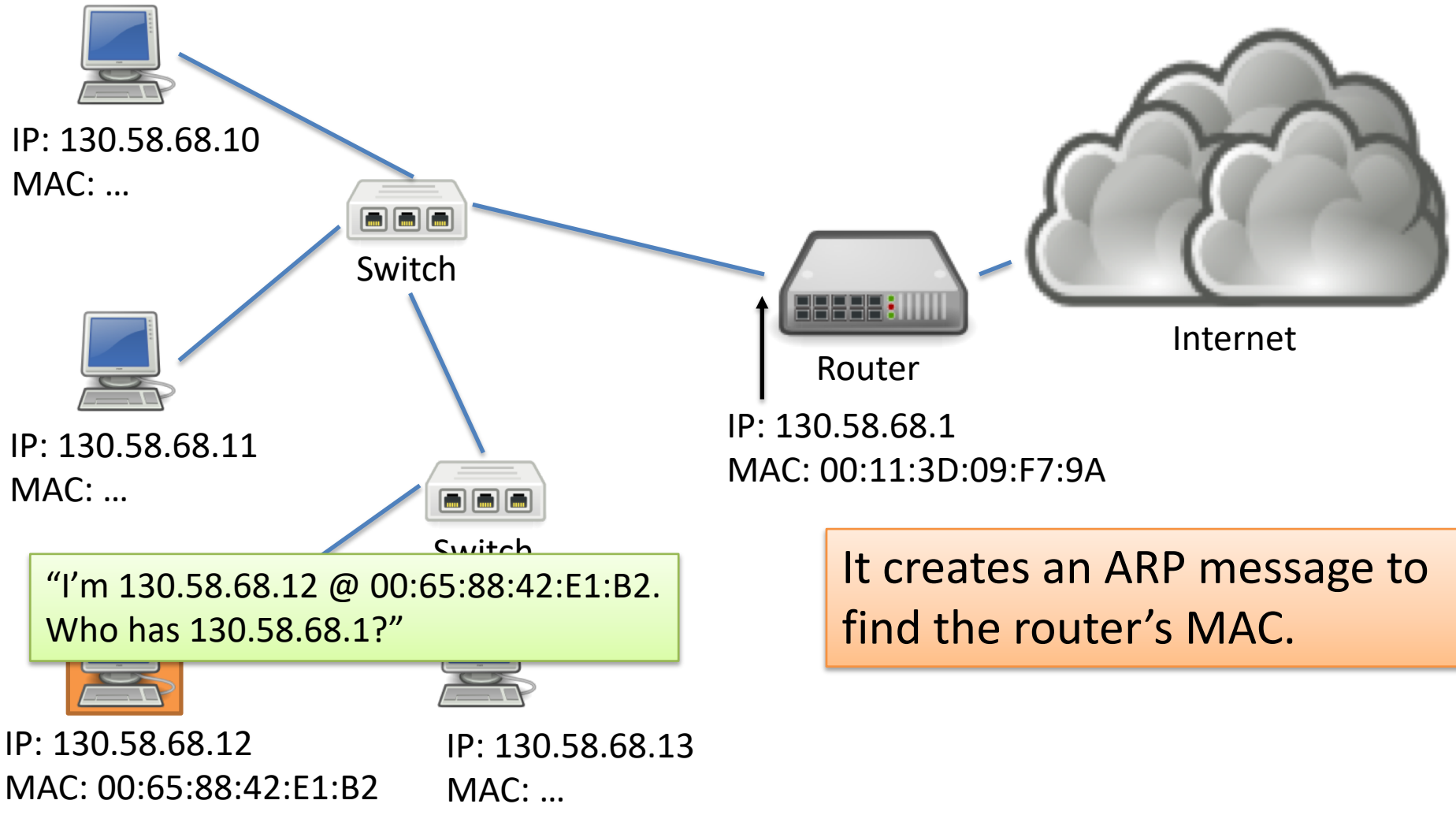
ARP Example



User at highlighted host wants to send to the Internet.

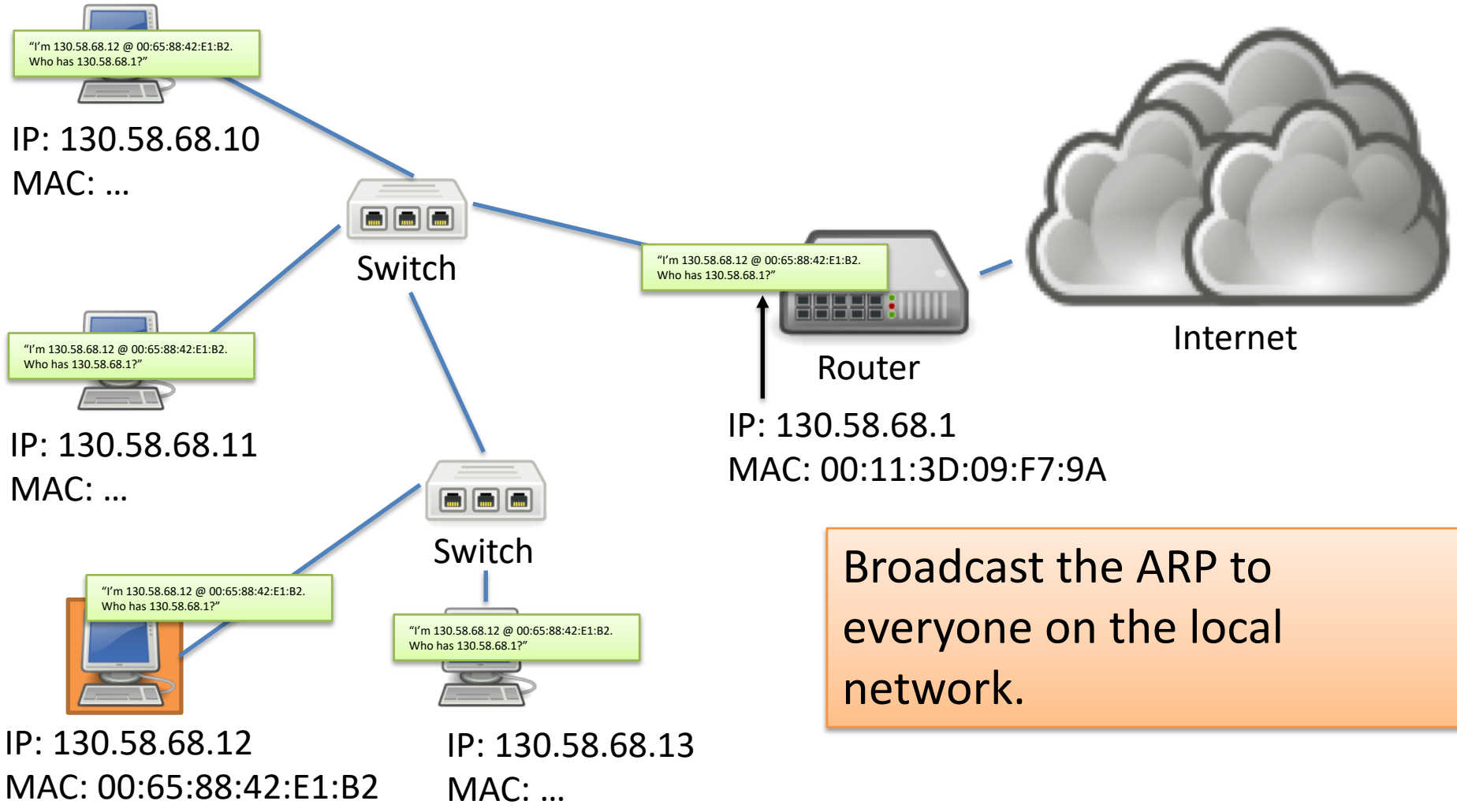
It knows router's IP, needs to get router's MAC.

ARP Example



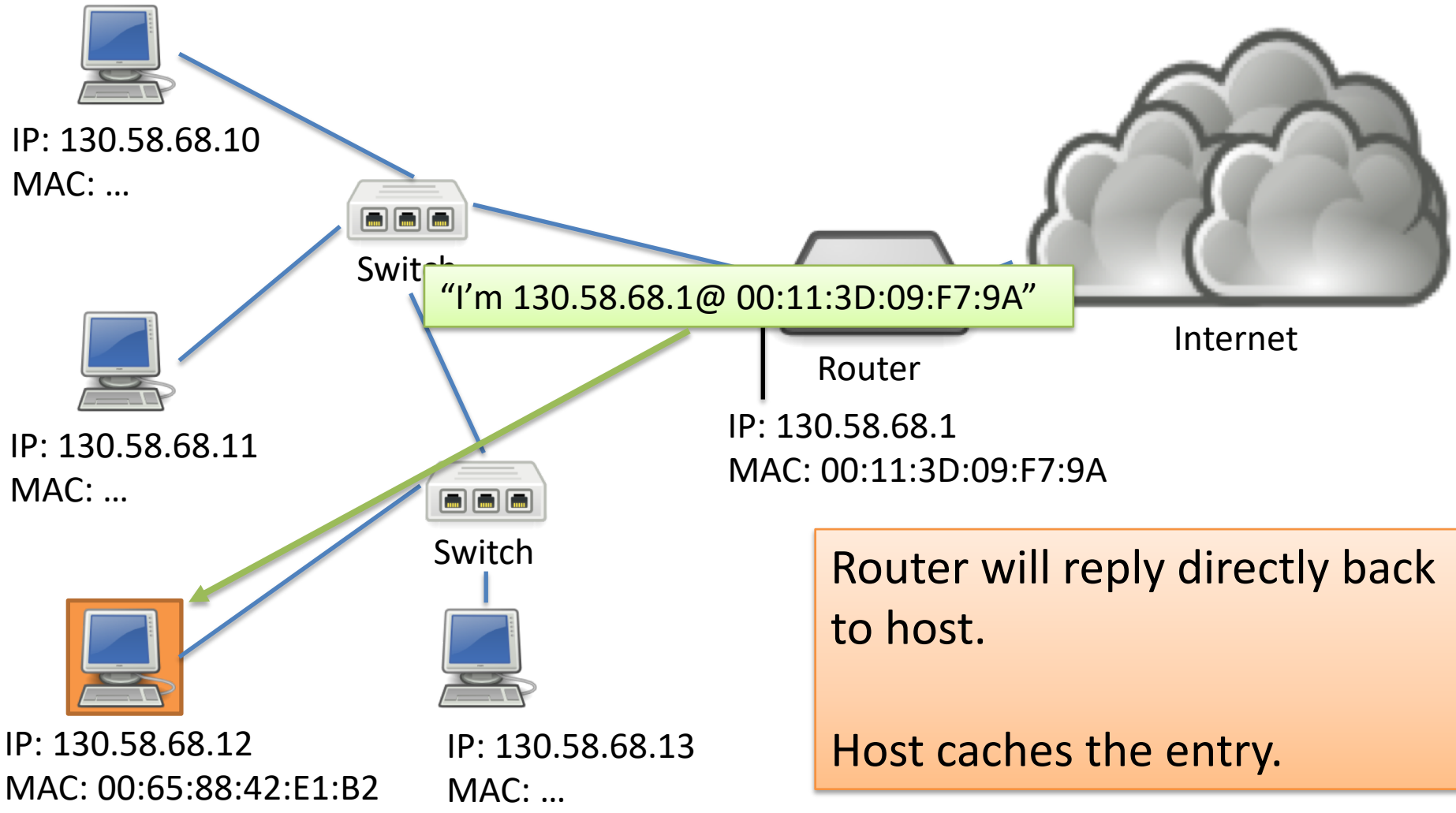
It creates an ARP message to find the router's MAC.

ARP Example



Broadcast the ARP to everyone on the local network.

ARP Example



Router will reply directly back to host.

Host caches the entry.

Link Layer Functions

1. Addressing: identifying endpoints

2. Framing: Dividing data into pieces that are sized for the network to handle.

- Data pieces:
  - Transport: Segments
  - Network: Datagrams (or packets)
  - Link: Frames
  - Physical: Bits

Link Layer Functions

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"Big freaking deal, Sherlock!"