COMP 431
Internet Services & Protocols

Link Layer Forwarding

Jasleen Kaur

April 16, 2020

Link-Layer Routing
Ethernet MAC* addresses

IP address:

- *32-bit network-layer* address
- used to get datagram to destination network (recall IP network definition)

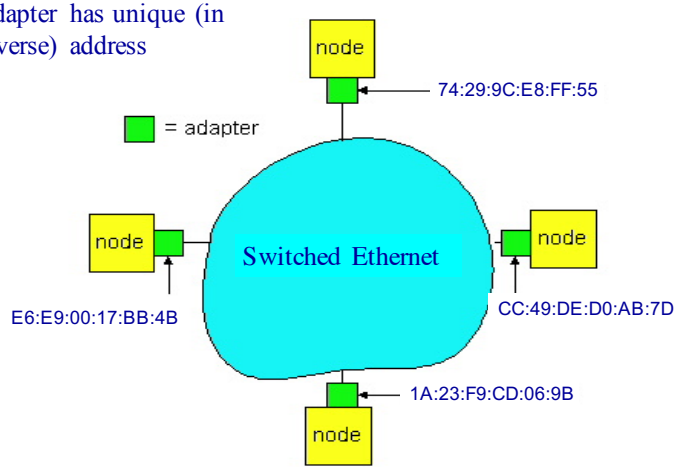
Ethernet (*or MAC or physical*) address:

- used to get datagram from one interface to another physically-connected interface (same network)
- 48 bit MAC address burned in the adapter Read-only Memory

* Medium Access Control

Link-Layer Routing
Ethernet MAC addresses

- Each adapter has unique (in the universe) address

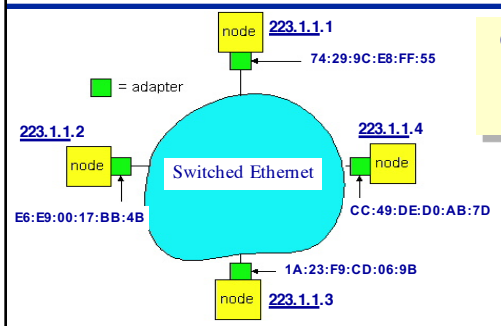


Link-Layer Routing
Ethernet MAC address (more)

- Ethernet MAC address allocation administered by IEEE
  - » Manufacturer buys portion of MAC address space (to assure uniqueness)
- MAC unstructured address => portability
  - » Can move adapter from one Ethernet to another
- IP hierarchical address NOT portable
  - » Depends on network to which one attaches

Link-Layer Routing

ARP: Address Resolution Protocol



Question: how to determine MAC address of B given B's IP address?

- Each IP node (Host, Router) has ARP module & cache
- ARP cache: IP/MAC address mappings **< IP address; MAC address; TTL>**

  (e.g., <223.1.1.1, 74:29:9C:E8:FF:55, 1200>)

  » TTL: time after which address mapping will be forgotten (typically 20 min)

Link-Layer Routing

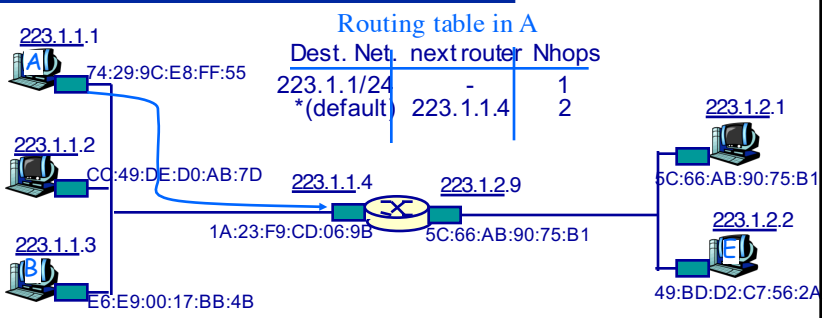
ARP protocol

- Host A knows B's IP address, wants to learn the MAC address of B
- A broadcasts ARP query packet, containing B's IP address
  - » All hosts on Ethernet receive ARP query
- B receives ARP packet, replies to A with its (B's) MAC address
- A caches (saves) IP-to-MAC address pairs until information becomes old (times out)

Routing IP Datagrams

Routing to a remote destination

misc fields	223.1.1.1	223.1.2.2	data

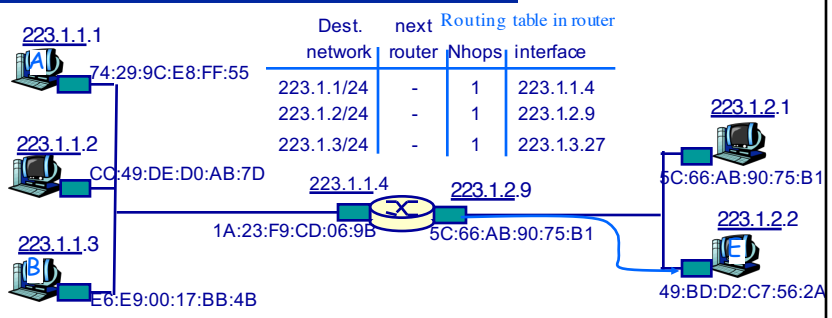


A finds 223.1.1.4 in routing table as default router
A uses ARP to find 1A:23:F9:CD:06:9B as Ethernet address for 223.1.1.4
A creates Ethernet frame with 1A:23:F9:CD:06:9B as destination;
Ethernet frame contains IP datagram in data field
A's link layer (adapter driver) sends Ethernet frame

Routing IP Datagrams

Routing to a remote destination

misc fields	223.1.1.1	223.1.2.2	data



Router finds 223.1.2.9 in routing table as destination network interface
Router uses ARP to find 49:BD:D2:C7:56:2A as Ethernet address for 223.1.2.2
Router creates Ethernet frame with 49:BD:D2:C7:56:2A as destination;
Ethernet frame contains IP datagram in data field
Router's link layer (adapter driver) sends Ethernet frame