Link Layer Forwarding

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April 23, 2019

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

- 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
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:EB:FF:55, 1200>)
  » TTL: time after which address mapping will be forgotten (typically 20 min)

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

Routing table in A

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 table in router

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