Glue Protocols

22 January 2025
Lecture 11

Some slides adapted from Kurose and Ross

Topics for Today

- TCP and Threads
- Glue Protocols

Source:

- ARP: PD 3.2.6
- DHCP: PD 3.2.7

TCP and Threads

- We'll write the Sentence Server tool in class.

ARP - Address Resolution Protocol

Problem

- Need mapping between IP and link layer addresses.
- `10.0.10.10` → `ab:cd:ef:12:34:56`

Solution

- ARP
- Every host maintains IP–Link layer mapping table (cache)
- Timeout associated with cached info (15 min.)

Imagine a mail room

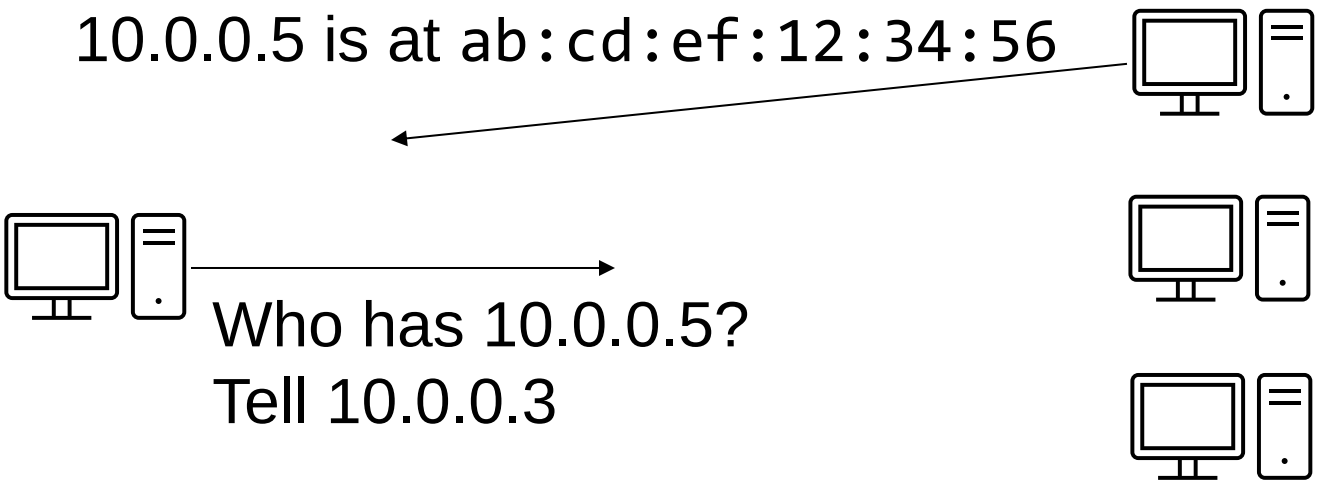
ARP - Address Resolution Protocol

Sender

- Broadcasts "Who is IP address X?"
- Broadcast message includes sender's IP & Link Layer address

Receivers

- Any host with sender in cache "refreshes" time-out
- Host with IP address X replies "IP X is Link Layer Y"
- Target host adds sender (if not already in cache)



ARP Sample Trace

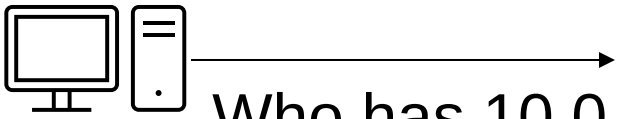
No.	Time	Source	Destination	Protocol	Length	Info
12896	272.707828000	QuantaCo_	Broadcast	ARP	60	Who has 10.0.0.5? Tell 0.0.0.0
12916	273.706199000	QuantaCo_	Broadcast	ARP	60	Gratuitous ARP for 10.0.0.5 (Request)
12956	277.144084000	QuantaCo_	Broadcast	ARP	60	Who has 10.0.0.3? Tell 10.0.0.5
12958	277.144101000	Dell_	QuantaCo_	ARP	42	10.0.0.3 is at 44:

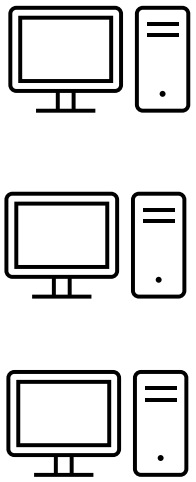
```
⊞ Frame 12956: 60 bytes on wire (480 bits), 60 bytes captured (480 bits) on interface 0
⊞ Ethernet II, Src: QuantaCo_         (60:              ), Dst: Broadcast (ff:ff:ff:ff:ff:ff)
⊟ Address Resolution Protocol (request)
    Hardware type: Ethernet (1)
    Protocol type: IP (0x0800)
    Hardware size: 6
    Protocol size: 4
    Opcode: request (1)
    Sender MAC address: QuantaCo_          (60:              )
    Sender IP address: 10.0.0.5 (10.0.0.5)
    Target MAC address: 00:00:00_00:00:00 (00:00:00:00:00:00)
    Target IP address: 10.0.0.3 (10.0.0.3)
```

ARP - Address Resolution Protocol

- Gratuitous ARP: Check if someone else has your IP address

```
> Frame 2213: 90 bytes on wire (720 bits), 90 bytes captured (720 bits)
> Radiotap Header v0, Length 24
> 802.11 radio information
> IEEE 802.11 QoS Data, Flags: .......TC
> Logical-Link Control
v Address Resolution Protocol (ARP Announcement)
    Hardware type: Ethernet (1)
    Protocol type: IPv4 (0x0800)
    Hardware size: 6
    Protocol size: 4
    Opcode: request (1)
    [Is gratuitous: True]
    [Is announcement: True]
    Sender MAC address: Intel_d1:b6:4f (00:13:02:d1:b6:4f)
    Sender IP address: 192.168.1.109
    Target MAC address: 00:00:00_00:00:00 (00:00:00:00:00:00)
    Target IP address: 192.168.1.109
```





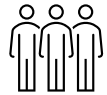
ARP - Address Resolution Protocol

- Gratuitous ARP: Check if someone else has your IP address
- Why?

Tell everyone your MAC address

Detect computers with identical IP addresses

- If there's an answer, there's a problem



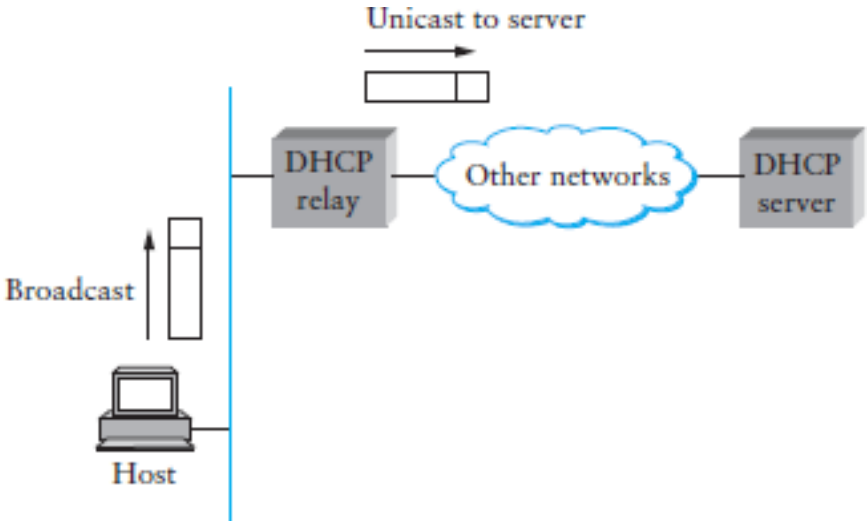
Dynamic Host Configuration Protocol (DHCP)

Goal: Enable computers to get IP addresses dynamically

– For a limited time

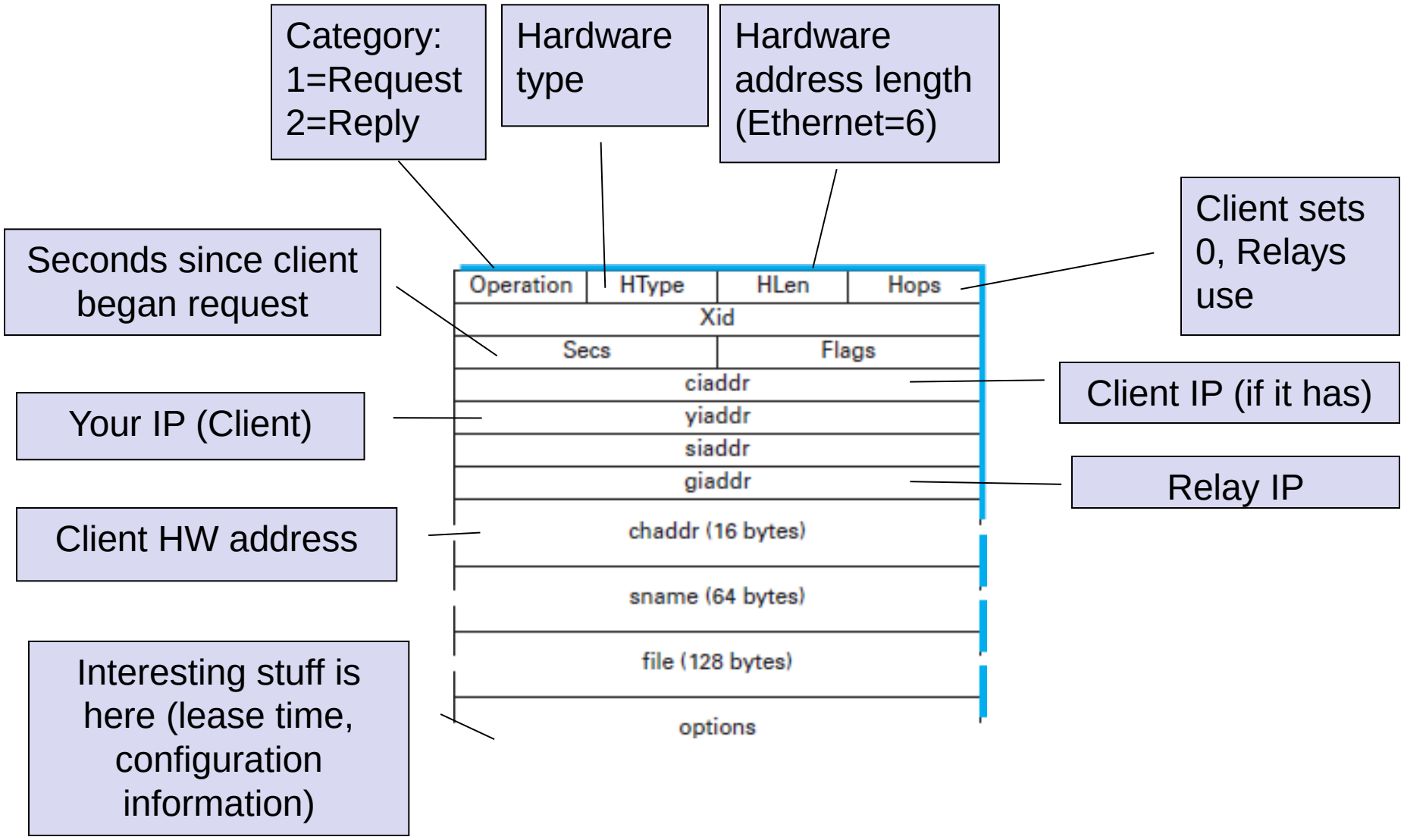
Steps:

1. Client broadcasts DHCP Discover message
2. Servers respond DHCP Offer messages
3. Client sends one DHCP Request (chooses)
4. Chosen DHCP server sends DHCP ACK
5. Work.
6. Client sends DHCP Release
7. Server forgets client



To request an old address, skip 1-2

DHCP Fields


Category: 1=Request 2=Reply
Hardware type
Hardware address length (Ethernet=6)
Client sets 0, Relays use
Seconds since client began request
Client IP (if it has)
Your IP (Client)
Relay IP
Client HW address
Interesting stuff is here (lease time, configuration information)
Operation
HType
HLen
Hops
Xid
Secs
Flags
ciaddr
yiaddr
siaddr
giaddr
chaddr (16 bytes)
sname (64 bytes)
file (128 bytes)
options

DHCP Sample Trace

No.	Time	Source	Destination	Protocol	Length	Info
3	4.357459000	10.0.0.12	10.0.0.138	DHCP	342	DHCP Release - Transaction ID 0xb61cd97f
4	7.490334000	0.0.0.0	255.255.255.255	DHCP	342	DHCP Discover - Transaction ID 0x7983fd04
5	7.506559000	10.0.0.138	10.0.0.12	DHCP	316	DHCP Offer - Transaction ID 0x7983fd04
6	7.506973000	0.0.0.0	255.255.255.255	DHCP	344	DHCP Request - Transaction ID 0x7983fd04
7	7.532959000	10.0.0.138	10.0.0.12	DHCP	316	DHCP ACK - Transaction ID 0x7983fd04

```
⊞ User Datagram Protocol, Src Port: 67 (67), Dst Port: 68 (68)
⊟ Bootstrap Protocol (Offer)
    Message type: Boot Reply (2)
    Hardware type: Ethernet (0x01)
    Hardware address length: 6
    Hops: 0
    Transaction ID: 0x7983fd04
    Seconds elapsed: 0
  ⊞ Bootp flags: 0x0000 (Unicast)
    Client IP address: 0.0.0.0 (0.0.0.0)
    Your (client) IP address: 10.0.0.12 (10.0.0.12)
    Next server IP address: 0.0.0.0 (0.0.0.0)
    Relay agent IP address: 0.0.0.0 (0.0.0.0)
    Client MAC address: Dell_         (44:              )
    Client hardware address padding: 00000000000000000000
    Server host name not given
    Boot file name not given
    Magic cookie: DHCP
  ⊞ Option: (53) DHCP Message Type (Offer)
  ⊞ Option: (54) DHCP Server Identifier
  ⊟ Option: (51) IP Address Lease Time
      Length: 4
      IP Address Lease Time: (3600s) 1 hour
  ⊟ Option: (1) Subnet Mask
      Length: 4
      Subnet Mask: 255.255.255.0 (255.255.255.0)
  ⊟ Option: (3) Router
      Length: 4
      Router: 10.0.0.138 (10.0.0.138)
  ⊟ Option: (6) Domain Name Server
      Length: 4
      Domain Name Server: 10.0.0.138 (10.0.0.138)
  ⊞ Option: (255) End
```

Conclusion

- Glue Protocols