Network Programming

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BOOTP and DHCP

Mapping Physical to Logical Address

Each computer needs the following:

- ✓ *Its IP address*
- ✓ *Its subnet mask*
- ✓ *The IP address of a router*
- ✓ *The IP address of a name server*

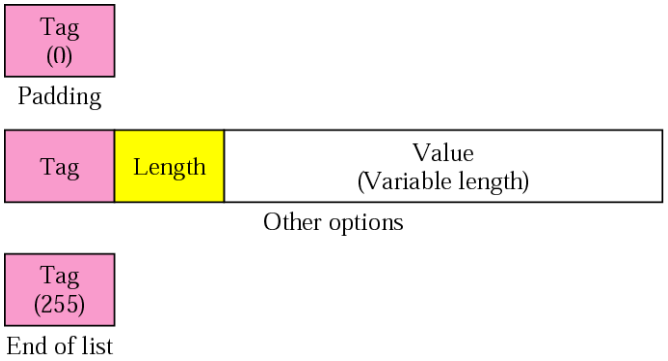
- *RARP (Broadcasting is done at the data link layer)*
- *BOOTP (Application layer processes)*
- *DHCP*

BOOTP

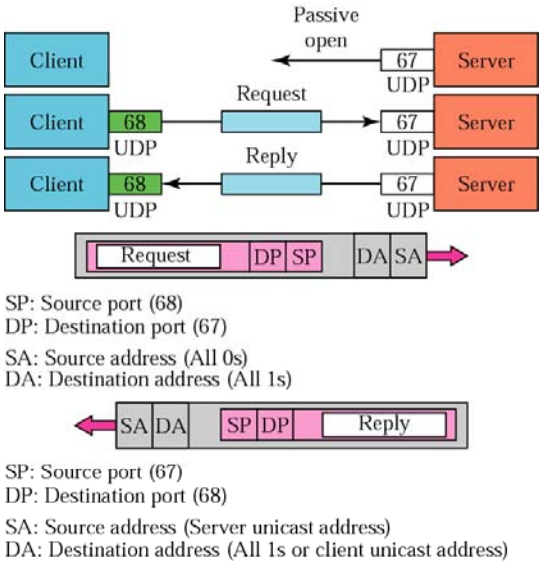
BOOTP packet format

Operation code	Hardware type	Hardware length	Hop count
Transaction ID			
Number of seconds		Unused	
Client IP address			
Your IP address			
Server IP address			
Gateway IP address			
Client hardware address (16 bytes)			
Server name (64 bytes)			
Boot file name (128 bytes)			
Options			

Option format



BOOTP operation



BOOTP Steps

1. *The BOOTP server uses port 67 and waits for a client*
2. *The client sends a BOOTP request message to the server. The message is encapsulated in a UDP user datagram, using the UDP port 68.*
3. *The server replies to the client with either a broadcast or a unicast message using UDP destination port 68.*

BOOTP Notes

- *UDP ports*
- *Using TFTP*
- *Relay Agent*
- *Error control*

DHCP

IP addresses: how to get one?

Q: How does a *host* get IP address?

- hard-coded by system admin in a file
  - Windows: control-panel->network->configuration->tcp/ip->properties
  - UNIX: /etc/rc.config
- DHCP: Dynamic Host Configuration Protocol: dynamically get address from as server
  - "plug-and-play"

BOOTP vs. DHCP

- *The BOOTP is not a dynamic configuration protocol. Client requests IP address → server consults a table that matches the physical address and its IP address (the binding is predetermined)*
- *DHCP is an extension to BOOTP, it provides dynamic configuration (backward compatible)*

BOOTP vs. DHCP (2)

- *DHCP has two databases.*
  - *One static*
  - *One dynamic: DHCP goes to a pool of available (unused) IP addresses*
- *Leasing*

DHCP: Dynamic Host Configuration Protocol

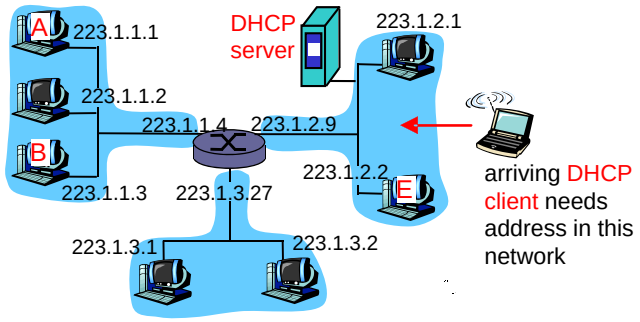
Goal: allow host to *dynamically* obtain its IP address from network server when it joins network

- Can renew its lease on address in use
- Allows reuse of addresses (only hold address while connected an "on")
- Support for mobile users who want to join network (more shortly)

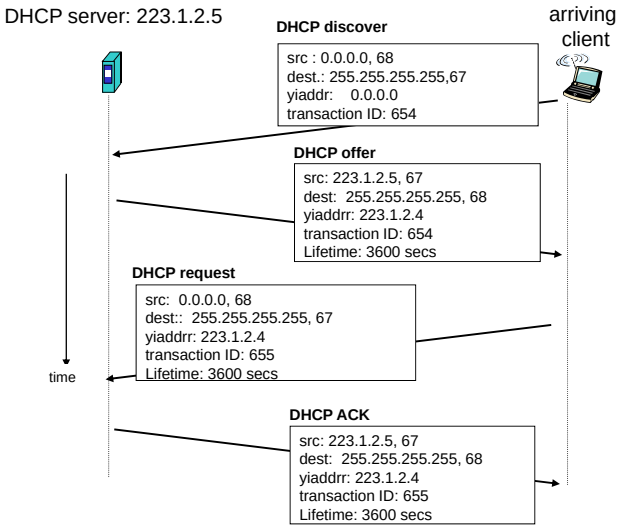
DHCP overview:

- host broadcasts "DHCP discover" msg [optional]
- DHCP server responds with "DHCP offer" msg [optional]
- host requests IP address: "DHCP request" msg
- DHCP server sends address: "DHCP ack" msg

DHCP client-server scenario



DHCP client-server scenario

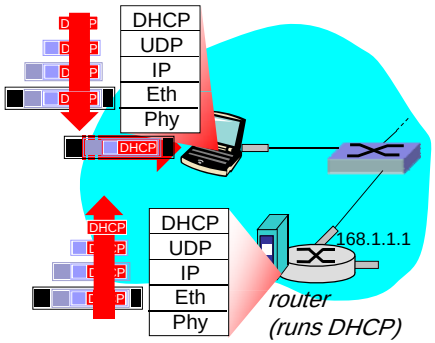


DHCP: more than IP address

DHCP can return more than just allocated IP address on subnet:

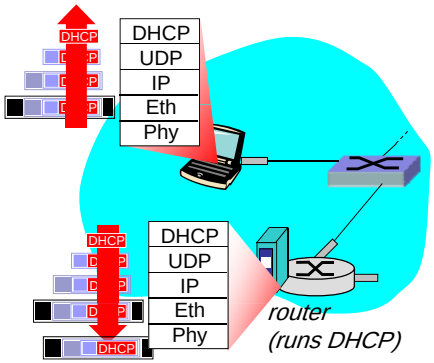
- address of first-hop router for client
- name and IP address of DNS sever
- network mask (indicating network versus host portion of address)

DHCP: example



- connecting laptop needs its IP address, addr of first-hop router, addr of DNS server: use DHCP
- DHCP request encapsulated in UDP, encapsulated in IP, encapsulated in 802.1 Ethernet
- Ethernet frame broadcast (dest: FFFFFFFFFFFF) on LAN, received at router running DHCP server
- Ethernet demux'ed to IP demux'ed, UDP demux'ed to DHCP

DHCP: example



- DCP server formulates DHCP ACK containing client's IP address, IP address of first-hop router for client, name & IP address of DNS server
- encapsulation of DHCP server, frame forwarded to client, demux'ing up to DHCP at client
- client now knows its IP address, name and IP address of DSN server, IP address of its first-hop router

DHCP packet

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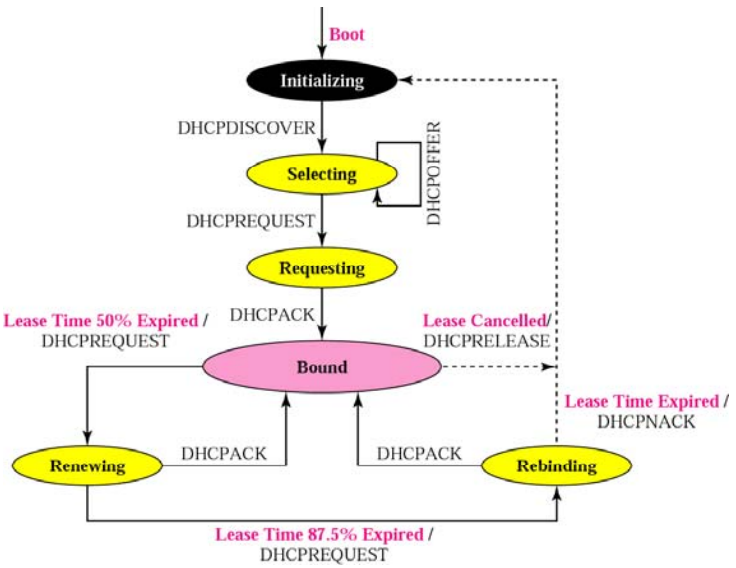
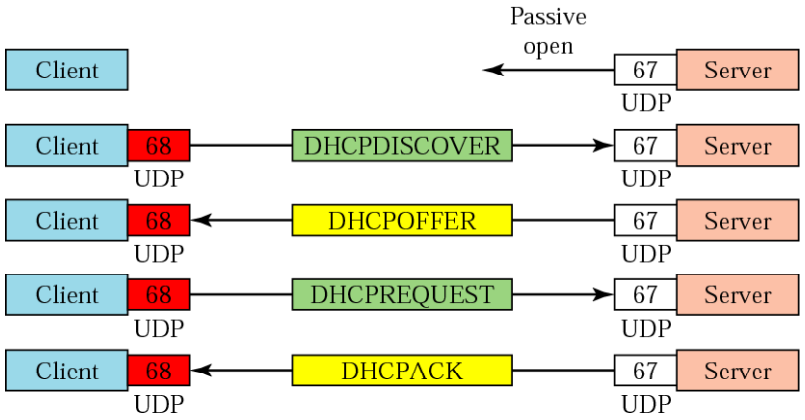
Transaction ID			
Number of seconds	F	Unused	
Client IP address			
Your IP address			
Server IP address			
Gateway IP address			
Client hardware address (16 bytes)			
Server name (64 bytes)			
Boot file name (128 bytes)			
Options (Variable length)			

DHCP transition diagram



Exchanging messages



Exchanging messages