DHCP Basics

What is DHCP

- “Dynamic Host Configuration Protocol” (RFC 2131)
- Automatically assigns IP addresses to devices (I.e. hosts) on your network
  - Prevents having to manually enter data
  - Prevents typos that can cause connectivity problems or disrupt the network (e.g., exchanging IP address and gateway address)

DHCP Conversation

- Four step process between client (UDP port 68) and servers (UDP port 67)
  - Client sends *Discover* “Someone send me an address”. This is a broadcast.
  - Servers *Offer* “Use this address”.
  - Client *Requests* “I’ll use this one”. (broadcast)
  - Servers *Acknowledge* “OK or No Way!” (ACK/NAK)

DHCP Results

- Servers should provide address, net mask, DNS servers, domain, and gateway (and perhaps other stuff, e.g., WINS)
- Client will be allowed to use the address for a period of time called a *Lease*
  - Normal campus addresses: 2 day lease
  - Roaming addresses: 42 minutes

Lease Renewal

- Halfway through lease period, client asks its current server to continue using the address.
  - Client sends *Request* (unicast).
  - Server sends *Acknowledge.*
- If current server isn’t available, client will broadcast request. This may cause it to change servers.
- If lease expires, client must stop using the address and start the process from scratch.

DHCP Details

Purpose of DHCP

- From RFC2131: The Dynamic Host Configuration Protocol (DHCP) provides a framework for passing configuration information to hosts on a TCP/IP network. DHCP consists of two components: a protocol for delivering host-specific configuration parameters from a DHCP server to a host and a mechanism for allocation of network addresses to hosts.

DHCP functional goals

- A host without a valid IP address locates and communicates with a DHCP server
- A DHCP server passes configuration parameters, including an IP address, to the host
- The DHCP server may dynamically allocate addresses to hosts and reuse addresses

DHCP functional goals

- Hosts can detect when they require a new IP address
- Unavailability of DHCP server has minimal effect on operation of hosts

What does DHCP do?

- Provides protocol stack, application and other configuration parameters to hosts
- Eliminates need for individual, manual configuration for hosts
- Includes administrative controls for network administrators

What does DHCP do?

- Backward compatible packet format for BOOTP interoperation (RFC 1542)
- Can coexist with hosts that have pre-assigned IP addresses and hosts that do not participate in DHCP

Design Goals

- Eliminate manual configuration of hosts
- Prevent use of any IP address by more than one host
- Should not require a server on every subnet
- Allow for multiple servers

Design Goals

- Provide a mechanism, not a policy
- Provide same configuration - including IP address - to a host whenever possible

What can you do with DHCP

- Plug-and-play
- Move desktop PCs between offices
- Renumber
- Other restructuring - change subnet masks
- Mobile IP - laptops
- Moving equipment - cartable

Server manages client configurations

- Provide a variety of mechanisms for controlled configuration
- Can override default parameters from Host Requirements

Address allocation

- Static (BOOTP): client must be pre-configured into database
- Dynamic: server can allocate and reuse addresses

Leases

- Dynamic addresses are allocated for a period of time known as the lease
- Client is allowed to use the address until the lease expires

Leases

- Client MUST NOT use the address after the lease expires, even if there are active connections using the address
- Server MUST NOT reuse the address before the lease expires

Motivation for leases

- An IP internet may not always be completely operational; there may not always be connectivity between any two hosts, so:
  - Can’t use distributed (client-based) assignment of addresses
  - Can’t use “address defense” before server reuse of addresses

Motivation for leases

- Leases guarantee an agreement as to when an address may be safely reused even if the server can’t contact the client

Address reuse

- Server MAY choose to reuse an address by reassigning it to a different client after the lease has expired
- Server can check using ICMP echo to see if the address is still in use (but no response is not a definitive answer!)

Address reuse

- Allows address sharing
  - From old computers replaced by new ones
  - Among a pool of computers not always using TCP/IP
  - For transient hosts like laptops

Address allocation details

- Clients check on address validity at reboot time (renumbering)
- Clients can extend the lease on an address at startup time

Address allocation details

- Clients can extend the lease on an address as expiration time approaches (without closing and restarting existing connections)
- Clients with addresses that have been configured manually can use DHCP to obtain other configuration parameters

Four ways a client uses DHCP

- INIT - acquire an IP address and configuration information
- INIT-REBOOT - confirm validity of previously acquired address and configuration
- RENEWING - extend a lease from the original server
- REBINDING - extend a lease from any server

Obtaining an initial address

- Client broadcasts DISCOVER to locate servers
- Server chooses address and replies
- Client selects a server and sends REQUEST for address
- Server commits allocation and returns ACK

Rebooting client

- Client puts address in REQUEST and broadcasts
- Server checks validity and returns ACK with parameters
- If client address is invalid – e.g., client is attached to a new network – server replies with NAK and client restarts

Extending a lease

- Client puts requested lease extension in REQUEST and sends to server
- Server commits extension and returns ACK with parameters

DHCP options

- Options carry additional configuration information to client
  - DHCP message type
  - Subnet mask, default routers, DNS server
  - Many others …
- Carried as fields in DHCP message

Configuration with options

- Network architect configures server to select and return options and values
- Client can explicitly request specific options

Relay agents

- Using hardware and IP broadcast still limits DHCP message from client to single physical network
- Relay agent, on same subnet as client, forwards DHCP messages between clients and servers

Relay agents

- Relay agent and server exchange messages using unicast UDP
  - Servers can be located anywhere on intranet
  - Servers can be centrally located for ease of administration
- Very simple in function, implementation
- Usually, but not necessarily, located in routers

Outline

- DHCP purpose and goals
- Background and history of DHCP
- Case Study
- Operational details
- Using DHCP

Using multiple servers

- Clients must be implemented for multiple servers; e.g., receiving multiple OFFER messages
- Using multiple servers can provide increased reliability through redundancy

Using multiple servers

- All coordination must be managed by DHCP administrator
  - Distributed database
  - Off-line batch updates
  - Manually

Strategies for using multiple servers

- Split address pool for each subnet among servers
- Coordinate leases off-line
- Reallocate addresses when needed

Lease times and strategies

- Choice of lease times made by DHCP administrator
- Long lease times decrease traffic and server load, short lease times increase flexibility

Lease times and strategies

- Should choose lease time allow for server unavailability
  - Allows clients to use old addresses
  - For example, long enough to span weekends
- Can assign different leases to desktop computers, cartable systems and laptops

Changing other configuration parameters

- Other configuration parameters such as print servers may change
- Reconfigure DHCP server with new parameters
- At next reconfirmation, clients will get new addresses

Moving a client to a new location

- User may get moved to a new location on a different subnet
- User may arrange to move computer system without contacting network administrator
- DHCP will allocate address for new location

Moving a client to a new location

- What about old lease?
  - New server can notify network administrator about address allocation
  - Client can issue RELEASE before moving from old location
- Or, might be appropriate to leave old lease in place…

Replacing a system

- User may get new computer on desktop
- Network administrator wants to allocate same IP address to the new computer – but, new computer will have different hardware address
- Use client id as system identifier and transfer to new system