Topic 2: Networks

2.1.3
Dynamic Host Configuration Protocol (DHCP)

Lecture Contents

- References
- Assignment of IP Addresses to Devices
- Dynamic Host Configuration Protocol (DHCP)

References

- DHCP is defined in RFC-2131 (45 pages)

  https://datatracker.ietf.org/doc/html/rfc2131

- Additional DHCP and BOOTP Vendor Extensions (RFC-2132)

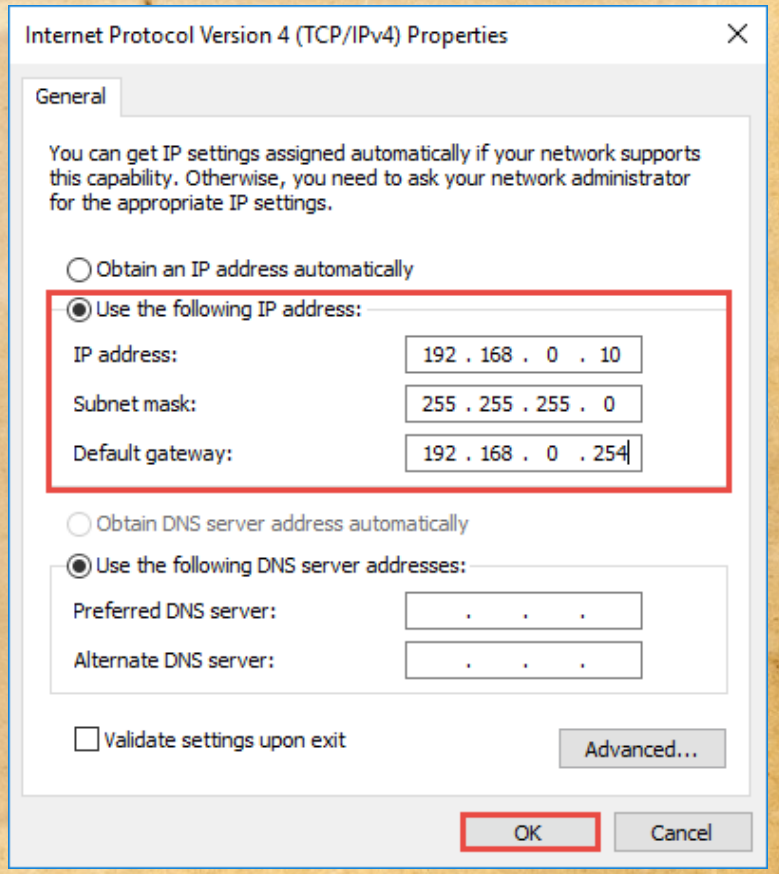
  https://datatracker.ietf.org/doc/html/rfc2132

- DHCP Relay Agent Information Option (RFC-3046)

  https://datatracker.ietf.org/doc/html/rfc3046

Assignment of IP Addresses to Devices

- Static IP Addresses
  - Original method
  - IT personnel enters a unique IP address into each computer.
  - Computers confused if there is a conflict
    - Network access corrupted
  - Also needed to specify gateway, mask, DNS
- Dynamic IP Addresses
  - DHCP



Dynamic Host Configuration Protocol (DHCP)

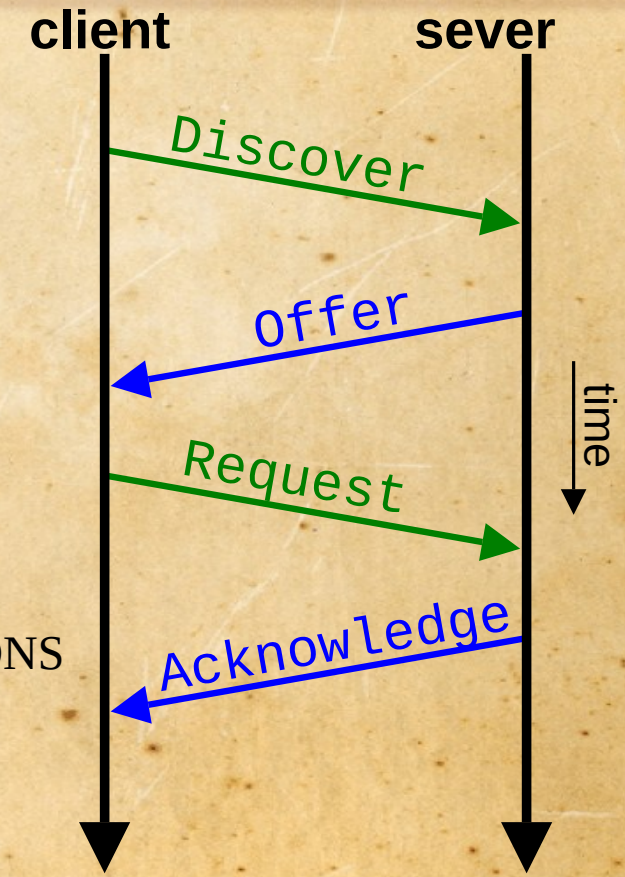
- Client-Server Model
- Functions
  - Assign a **unique IP addresses** to each host on the network
  - Also required: Subnet Mask, Default Gateway, DNS Server Address
  - Other useful things that may be configured:
    - Time offset, Network Time Protocol Server, interface MTU

DHCP Server

- DHCP Servers are typically run on
  - Home-based Router
  - Larger networks may have the DHCP server run on a computer

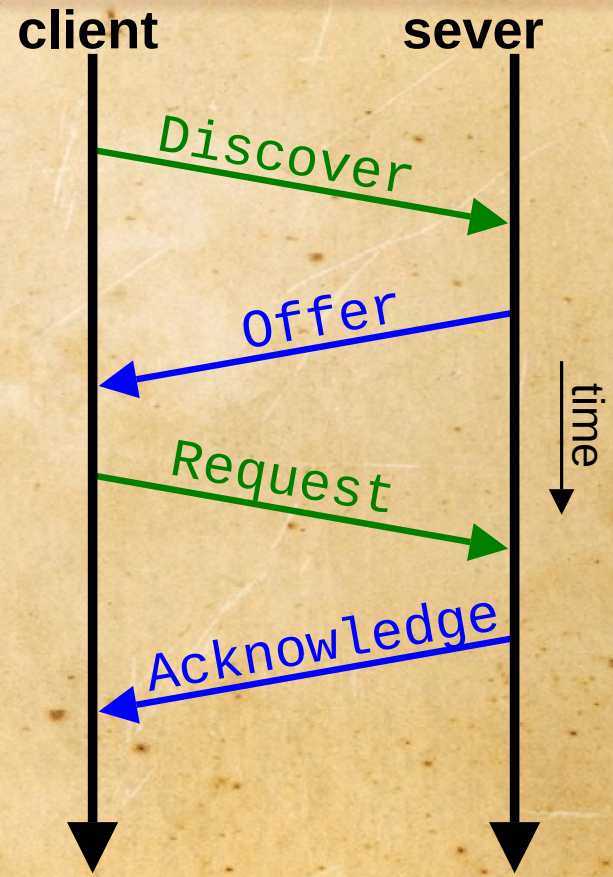
DHCP Server

- DHCP Sequence Diagram
  - Client *broadcasts* a **discover** message
    - Message dropped (ignored) if not a DHCP server
  - DHCP server **offers** an IP address to client
    - Client takes first offer if multiple received
  - Client sends **request** to DHCP server
  - DHCP server **acknowledges**
    - Also gives subnet mask, default gateway, default DNS



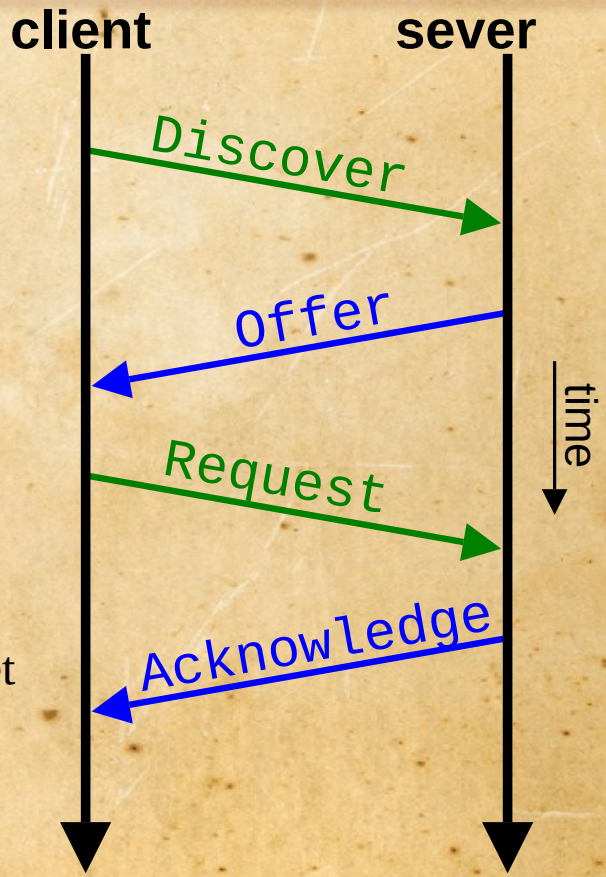
DHCP Server

- DHCP Sequence Diagram
  - Client *broadcasts* a **discover** message
    - UDP Packet (source port 68, destination port 67)
    - Source IP Address: `0.0.0.0`
      - Source doesn't know what IP Address it should use!
    - Destination IP Address: `255.255.255.255`
      - This is the *broadcast* address
    - Client MAC Address provided for unique identifier
    - May request a previously-used address
    - Message dropped (ignored) if not a DHCP server



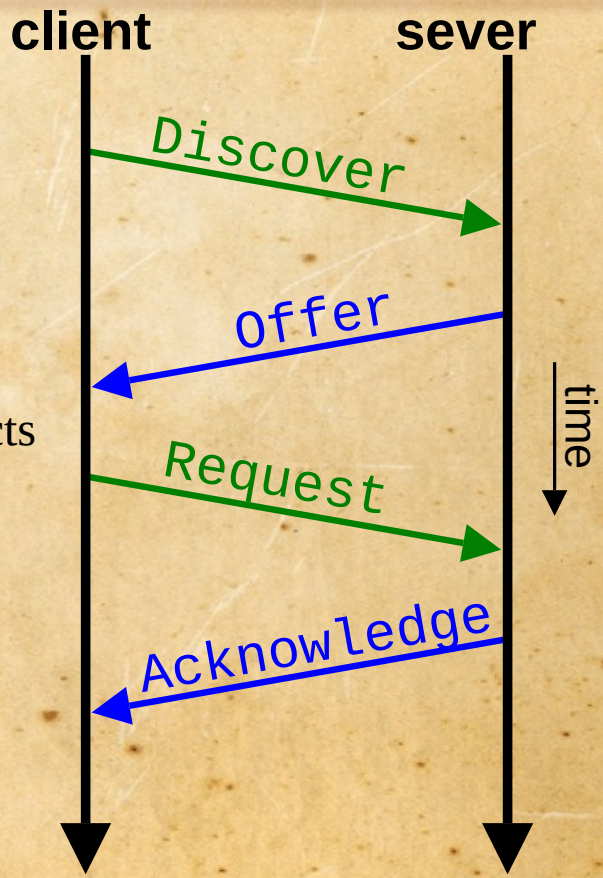
DHCP Server

- DHCP Sequence Diagram
  - Client *broadcasts* a **discover** message
  - DHCP server **offers** an IP address to client
    - UDP Packet (ports swapped 67 → 68)
    - Source IP Address: address of DHCP server
    - Destination IP Address: address offered to client
    - Client MAC Address provided for unique identifier
      - Message also sends back a “transaction identifier”
    - Also other parameters in message: lease time, subnet mask, DNS, Domain name, etc.
      - May not give all requested info



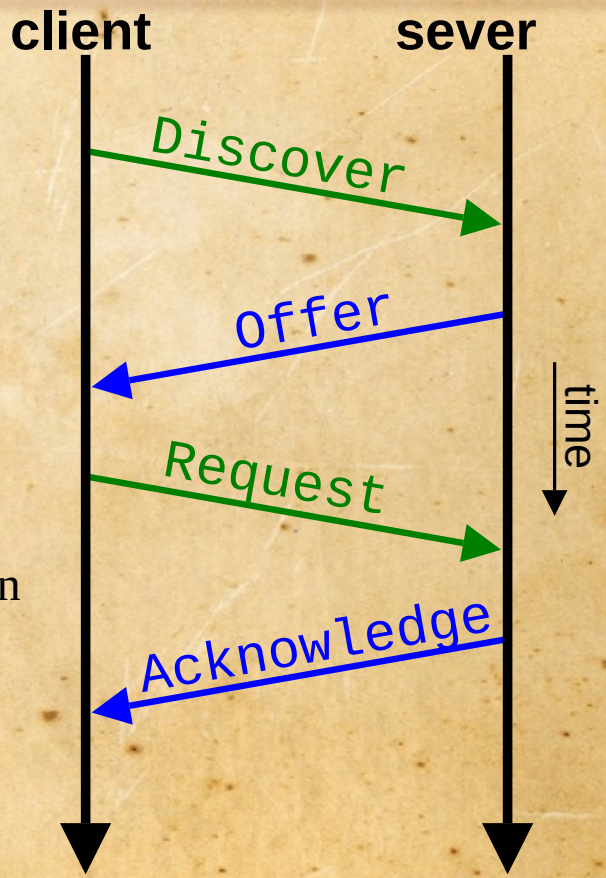
DHCP Server

- DHCP Sequence Diagram
  - Client *broadcasts* a **discover** message
  - DHCP server **offers** an IP address to client
  - Client sends **request** to DHCP server
    - If multiple requests (multiple DHCP servers?), selects one to respond to (first received?)
    - Broadcast (again); specifies which DHCP server it accepted / formally requests



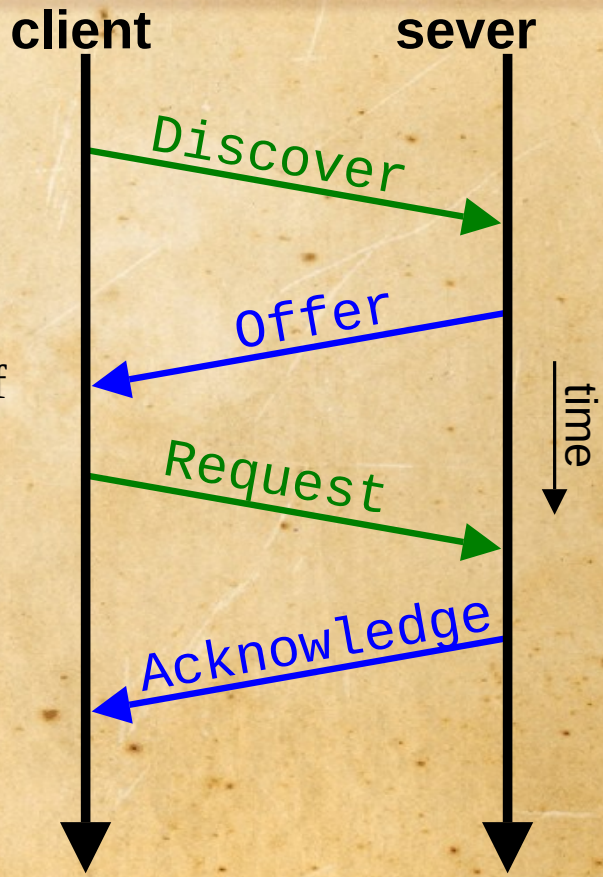
DHCP Server

- DHCP Sequence Diagram
  - Client *broadcasts* a **discover** message
  - DHCP server **offers** an IP address to client
  - Client sends **request** to DHCP server
  - DHCP server **acknowledges**
    - Unicast (to requested IP address)
    - Repeats info: lease time, subnet mask, DNS, Domain name, etc.
      - May give additional info not provided in offer



DHCP Server

- DHCP Expiration
  - IP addresses are *leased*
    - Client must renew address, or it will be returned to the pool of addresses to be distributed
    - Ensures unused addresses are returned to the pool of addresses (for example, if a computer is removed)
    - DHCP lease time is number of seconds and represented by a 32-bit value
      - Maximum lease: ~136 years
      - Typical lease: 24 hours
      - Public wifi may wish to set lease time to an hour or two
      - Infinite lease time for `0xFFFF_FFFF`



DHCP Address Reservation

- Same IP address for a given MAC address
  - Generally for network printers, servers, routers (not user computers)

DHCP Further Details

- DHCP Clients may release an address with a DHCP Release message
- UDP client uses port 68, Server uses port 67
- DHCP Server setting “scope” gives the range of IP Addresses that may be assigned, for example
  - 192.168.0.1 – 192.168.0.100

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