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DHCPV4/6 STATEFUL/STATELESS CONFIG

DHCPv4: Assigns IP addresses: Dynamic: Dedicated server scalable/easy

- C-routers can be config to provide DHCPv4 w/out dedicated server: Easy IP: Optional: DHCPv4 server via Cisco

3 Diff address allocation mechanisms (flexibility)

Manual	Assigned pre-allocated IP address to client: DHCPv4 coms only IPv4 address to device
Auto	Auto assigned static IP perm to device: Selects from pool • No lease: Address Perm assigned to device
Dynamic	Assigns/leases IP from pool for limited period: Most common: Used til server/client no longer need 1. Clients lease info from server for defined period 2. Lease expires? Client must ask for another address: Typically assigned same one

Operation:

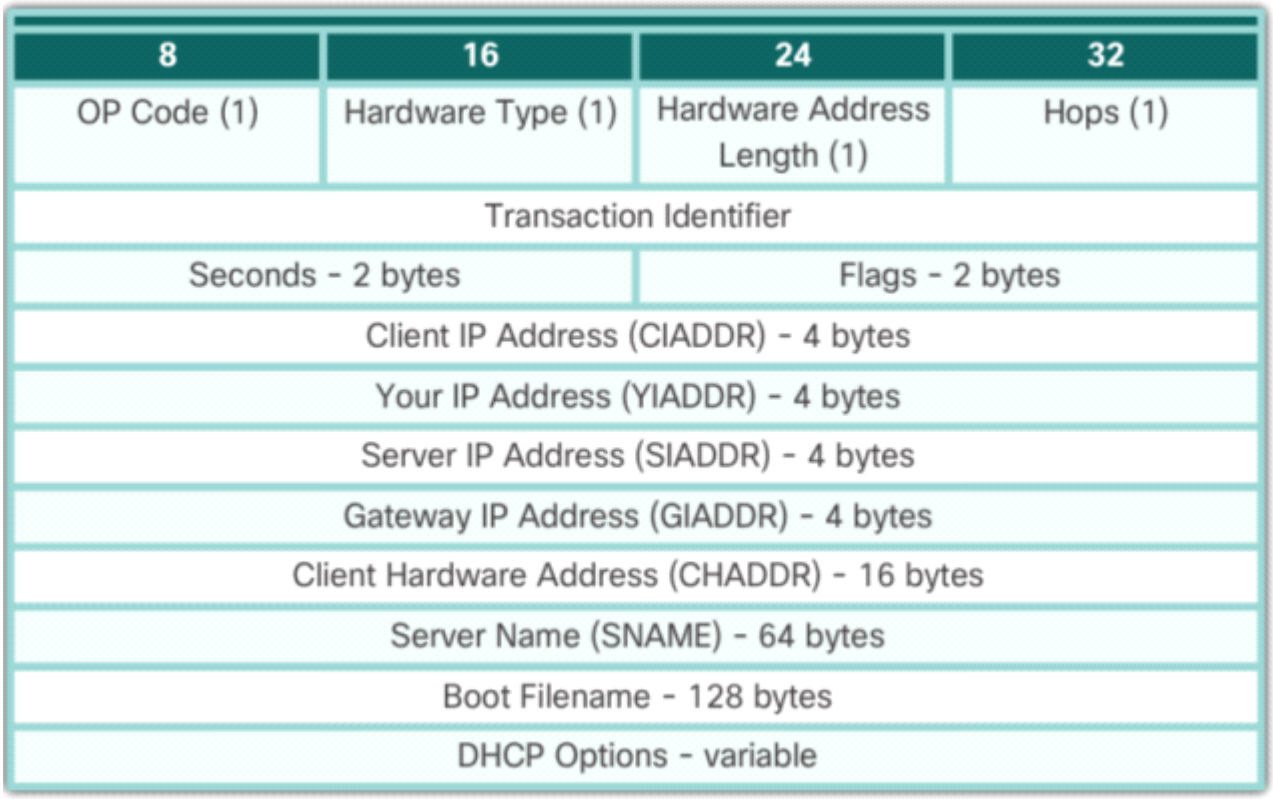
1. Client communicates w/DHCP server: Server assigns/leases address to client
2. Client connects to network until lease expiration: Must contact to maintain
3. Lease expires? DHCP returns address to pool for reallocation

Lease Origination: Client boot: 4 step process to obtain

1. Discover	**DHCPDISCOVER:** Msg finds DHCPv4 servers • Client has no IP info at boot: Uses L2/L3 broadcasts to communicate
2. Offer	**DHCPOFFER**: DHCPv4 server receives DHCPDISCOVER msg then: • Reserves available IPv4 address to lease to client • Server creates ARP entry of: MAC of requesting/leased IPv4 of client • Sends binding DHCPOFFER msg to requesting • Uses unicast L2 MAC of server as source | L2 MAC of client as destination
3. Request	**DHCPREQUEST:** Client receives DHCPOFFER: Sends back DHCPREQUEST • Both lease origination/renewal When lease origination: • Binding acceptance notice to server for params offered • Implicit decline to any others • Broadcast informs approved/other DHCPv4 servers about acceptance
4. Acknowledgment	**DHCPACK**: After DHCPREQUEST: Server validates lease info w/ICMP ping • Ensures not already used • Creates new ARP entry for lease: Replies w/unicast DHCPACK msg • Only msg type field changes between DHCPREQUEST/OFFER • Client receives msg: Logs config info/performs ARP lookup • No reply to ARP? IPv4 valid: Starts using

DHCPv4 Msg Fmt: Used for all transactions: Encapsulated w/in UDP transport

- Msgs sent from client use UDP source:port 68/destination:port 67 (sent from server opposite)



Fields as follows:

Operation (OP) Code	General: 1 = request msg || 2 = 2 reply msg
HW Type	ID's HW used in network Ethernet:1, Frame Relay:15, Serial line: 20 || Same codes used in ARP's
HW Address Length	
Hops	Controls fwding of msgs • Set to 0 by client before transmitting request
Transaction Identifier	Used by client to match request w/replies received from DHCPv4 servers
Seconds	Time elapsed since client began attempting to acquire/renew lease
Flags	Used by client: Doesn't know if it's IPv4 when sending a request • Only 1 of 16bits used, which is the broadcast flag • 1 = tells server/relay agent receiving request reply should be sent as broadcast
Client IP	Used by client during lease renewal when address is valid/usable: Not during acquiring address Client puts own IPv4 in field if/only if has a valid IPv4 while in bound state; otherwise, sets field to 0
Your IP	Used by server to assign an IPv4 to client
Server IP	Used by server to ID address of server that client should use for bootstrap Sending server always includes its own IPv4 in special field [Server ID]
Gateway IP	Routes DHCPv4 msgs when DHCPv4 relay agents involved Gateway facilitates communications of DHCPv4 requests/replies between client/server on diff subnets
Client HW Address	Physical layer of client
Server Name	Used by server sending DHCPOFFER/DHCPACK: May put name in field
Boot Filename	Optionally: Used by client to request particular type of boot file in DHCPDISCOVER Used by server in DHCPOFFER to specify boot file dir/filename

DHCP Options	Options include 7 params required: Variable in length: Both client/server use

Config DHCPv4 Server

1. Exclude IPv4 Addresses
    - Assigns all addresses in pool unless config to exclude specific ones: Some are for static assignments
    - Ranged of addresses can also be excluded

ip dhcp excluded-address Exclude certain IP's
Config DHCP Pool: ip dhcp pool pool-name Creates pool [enters DHCP config]
Config: Addr pool/gateway router must be config
network Defines ranges of available addresses
default-router Define gateway [LAN int closest to client]: Can list up to 8 addresses [multiple gateways]
dns-server DNS server address
domain-name Define..
lease Change lease duration times
netbios-name-server Define NetBIOS WINS server
no service dhcp [global config]
service dhcp
Verify
show run | section dhcp Display DHCP config
show ip dhcp binding Verify DHCP running/settings: Lists all IPv4/MAC bindings provided by DHCP
show ip dhcp server statistics Verify msgs are being received/sent by router: Count info on msgs sent/received

DHCP Relay: Fwd broadcasts w/DHCP between subnets
IOS helper address: Enables router to fwd DHCPv4 broadcasts to DHCP server (acts like a relay agent)
ip helper-address [int config] Setup relay
show ip int Verify config
ip helper-address **fwds 8 UDP services by default:**

Port 37	Time
Port 49	TACACS
Port 53	DNS
Port 67	DHCP/BOOTP client
Port 68	DHCP/BOOTP server
Port 69	TFTP
Port 137	NetBIOS name service
Port 138	NetBIOS datagram service

Troubleshooting

1. Resolve address Conflicts

- A lease can expire on client still connected: If lease not renewed the address can be reassigned.

show ip dhcp conflict Displays all address conflicts recorded by DHCPv4 server

- Server uses ping: Client uses ARP to detect conflicts: If conflict detected: Address removed from pool

2. Check physical
3. Test connectivity using static IP
4. Verify switch port config: Obtain address from DHCP server by manually forcing client to send DHCP request

- If switch between client/server and client can't get DHCP config: switch port config issues possible
- Trunking/channeling, STP/RSTP
- PortFast/edge port configs resolve common DHCPv4 client issues w/cisco switch

5. Test operation on same subnet/VLAN (relay agent possible if issue here)

Verify router config:

1. Verify ip helper-address config on correct int:
    1. Must be present on inbound int of LAN containing DHCPv4 clients
    2. Must be directed to correct DHCPv4 server
    3. show ip int
2. Verify no service dhcp hasn't been config [global config]

debug ip packet Display only DHCPv4 msgs (use acl's as well to help debug)

debug ip dhcp server events Reports server events
- Example: Address/db updates
- Decoding DHCPv4 receptions/transmissions.

SLAAC: Stateless Address Autoconfig
- Like IPv4/v6 global unicast addresses can be config manually/dynamically
- 2 methods IPv6 global unicast can be assigned dynamically

SLAAC: Method where a device can obtain an IPv6 global uni w/out a DHCP server
- At core of SLAAC -> ICMPv6

ICMPv6: Similar to v4 [incl: addition funcs/more robust protocol]
- SLAAC uses ICMPv6 RS/RA (r-advertisements/solicitation) msgs to provide addressing/config info

RS: Router Solicitation:	○ When client config to obtain addressing info automatically via SLAAC… ○ Client sends RS msg to router: RS msg sent to IPv6 all-routers multicast address FF02::2
RA: Router Advertisement:	○ Msgs sent provide addressing info to clients config to obtain IPv6 addresses auto ○ Includes: prefix/prefix length of segment ○ Client uses this info to create own IPv6 global unicast ○ Router sends RA msg periodically/in response to RS msg ○ Default Cisco: Send RA's every 200seconds: Always sent to multicast FF02::1

SLAAC: Stateless: No server that maintains network address info
Operation:
- Router must be enabled IPv6 before sending RA's
- ipv6 unicast-routing

EUI-64: Using the EUI-64 process: IID's created using a 48bit MAC: Rando generated: 64-bit IID can be random #
DAD: Duplicate Address Detections: Part of ICMPv6 Neighbor Discovery (ND)
SLAAC/DHCPv6: 2 flags: 1. Managed Address Config (M) 2. Other Config (O)
no ipv6 nd managed-config-flag
no ipv6 nd other-config-flag
Stateless DHCPv6: O flag set to 1 | M flag default of 0 (O flag 1 used to inform client additional config info available
Modify RA msg sent on int to indicate stateless DHCPv6: ipv6 nd other-config-flag

Stateful DHCPv6 (v6 only)
- RA msg informs client no use info in RA: All addressing/config info must be grabbed from stateful DHCPv6 server
- Known as stateful b/c DHCPv6 server maintains IPv6 state info: Similar to v4 server allocating addresses

M flag: Whether/not to use stateful DHCPv6
O flag: Not involved
Change M flag from 0 to 1 to signify stateful DHCPv6:
ipv6 nd managed-config-flag

DHCPv6 Communications
- When stateless/stateful DHCPv6 indicated by RA: DHCPv6 operation invoked
- Msgs sent over UDP: DHCPv6 msgs from the server to client: UDP dest port 546
- Client sends DHCPv6 msgs to server using UDP dest port 547

Stateless DHCPv6 client	Client sends DHCPv6 INFORMATION-REQUEST to server • Requesting only config params [eg DNS server address] Client generated its own IPv6 address using: • Prefix from RA msg/self-generated int ID
Stateful DHCPv6 client	Client sends DHCPv6 REQUEST to server to obtain IPv6/other config params

Config Router Stateless DHCPv6 Server

1. ipv6 unicast-routing
2. ipv6 dhcp pool pool-name Create a pool name [router config mode]

3. Config Pool Params
- During SLAAC process: Client received info needed to create IPv6 global unicast
- Client also received default gateway info using source IPv6 from RA [link-local of router]
- Stateless DHCPv6 server can be config to provide other info not included in RA [eg DNS/domain name]

4. Config DHCPv6 int
- ipv6 dhcp server pool-name [int config] Binds DHCPv6 pool to int
- Router responds to stateless DHCPv6 requests on int w/info contained in pool
- O flag needs to be changed from 0 to 1
- ipv6 nd other-config-flag
- RA msgs sent on this int indicate additional info available from stateless

ipv6 address autoconfig Enables auto config of IPv6 addressing using SLAAC
- RA then used to inform client router to use stateless

Verify:
show ipv6 dhcp pool Verifies name of DHCPv6 pool/params
- # of active clients is 0 b/c no state being maintained by server

show run

Verifying the Stateless DHCPv6 Client
show ipv6 int Shows global unicast address created using SLAAC; includes prefix in RA
- IID generated using EUI-64

debug ipv6 dhcp detail Shows msgs exchanged between client/server

Config Router as Stateful DHCPv6
1. ipv6 unicast-routing
2. ipv6 dhcp pool pool-name
3. Config Pool Parameters
- With stateful all addressing/config params must be assigned by DHCPv6 server
- Address prefix cmd is used to indicate pool of addresses to be allocated
- lifetime Indicates valid/preferred lease times in seconds
- As with stateless: Client uses source IPv6 from packet that contained RA

4. Int cmds
- ipv6 dhcp server pool-name int Binds DHCPv6 pool to int
- Router responds to stateless requests on this int w/info in pool
- M flag: 1 | ipv6 nd managed-config-flag
- Informs device not to use SLAAC but obtain addressing/config params from stateful

Config DHCPv6 Relay Agent

ipv6 dhcp relay destination Config on int facing DHCPv6 client using address of DHCPv6 server as dest
show ipv6 dhcp int

Troubleshooting
show ipv6 dhcp conflict
show ipv6 int | Check M/O flag settings
ipv6 dhcp relay destination