

DHCP -- Dynamic Host Configuration Protocol

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Background

Whether connecting through an ISP or to a corporate WAN, most users obtain their IP Address and critical network resource information via Dynamic Host Configuration Protocol (DHCP). DHCP not only provides the station IP address and default gateway, but also provides how long you may keep the “leased” DHCP address, the DNS search list, default domain, WINS information, as well as other

Routers are used to forward DHCP Lease requests directly to the DHCP servers configured for the subnet.

DHCP Scopes and Templates

Fundamentally, a DHCP Scope is a group of IP Addresses in the same subnet to be allocated to client workstations using the DHCP protocol. Multiple scopes can be assigned to a subnet, however, for the best performance and least confusion, a single scope is recommended and desired.

A DHCP Template is used to assign common network resource information to multiple DHCP scopes. The DHCP Template provides information like DNS and WINSs server addresses, IP Domain, and lease duration.

Router Configuration

DHCP forwarding is provided by the router(s). On Cisco routers, this is the IP Helper-Address configured on the IP Interface (or sub interface in the case of VLANs). Several IP-Helper addresses may be configured on each router interface supporting DHCP: The primary DHCP server for the subnet, an alternate server in that network region, and the fail-over DHCP server(s). This configuration provides maximum flexibility when building and supporting DHCP subnet scopes without having to implement special router IP-Helper changes. In general all routers within each region should use the same IP-Helpers regardless of other changes that may be required in the regional DHCP infrastructure.

DHCP Lease Process

For any given subnet (using DHCP) one DHCP server "owns" the entire scope for that subnet. In other words, no scopes are (or should be) split across multiple DHCP servers.

New Lease

When an IP client workstation requests a lease for the first time, the workstation sends a DHCP broadcast. The router picks up the broadcast and forwards it directly to ALL of the helper-addresses configured for that subnet interface. Depending on the DHCP server software used, the servers receiving these requests check the subnet of the request and determine if they support

a scope for that subnet. If no scope is defined for that subnet the server will either ignore the request or could possibly send a lease rejection or NAK back to the router (and ultimately to the workstation). If a scope does exist, the server will check the MAC address for the workstation and determine if that workstation has ever had a lease on that subnet or if any other lease exists for that MAC address on the enterprise server. If a lease previously existed for that MAC address on the same subnet, the server will re-assign the same IP address. If no lease previously existed, the server will assign the next available IP address from the scope. Before actually using this IP address, however, the server will try to ping the address to make sure that the address is in fact truly available (and no one has statically assigned that IP address). If the MAC address existed on another subnet in the enterprise, the lease information for the other location will be deleted from the enterprise database. In the event that no more IP addresses are available in the DHCP scope, the server will return a lease rejection (or NAK) to the client.

Lease Renewal

DHCP templates are configured with a lease time. The time to renew the lease is also configurable. 50% of the lease is typical. This means that if the IP Address assigned to a DHCP client is reserved for 15 days. After 7 days, the client will start requesting a lease renewal directly (unicast) from the server that assigned the address. If the client is unable to renew the lease, it will continue to use the assigned address for the duration of the lease period while occasionally trying to renew the lease directly from the server that assigned the address. If a renewal cannot be obtained by 80% of the lease (approx. 12 days), the client will begin broadcasting for a lease renewal. The router will forward these broadcasts to all servers currently defined in the IP Helper list. If the primary server is unavailable or the scope has been moved to a different IP address, the new server will respond to renewal request.

DHCP Fail-Over

In the event that a primary DHCP server is unavailable to assign (or renew) leases, a DHCP fail-over server may be available. If used, each Primary DHCP server is assigned to one fail-over servers. The fail-over server(s) can provide fail-over services for multiple DHCP servers. The fail-over server maintains a copy of the same DHCP scopes and templates used on the primary servers and receive lease information as it is assigned to clients.

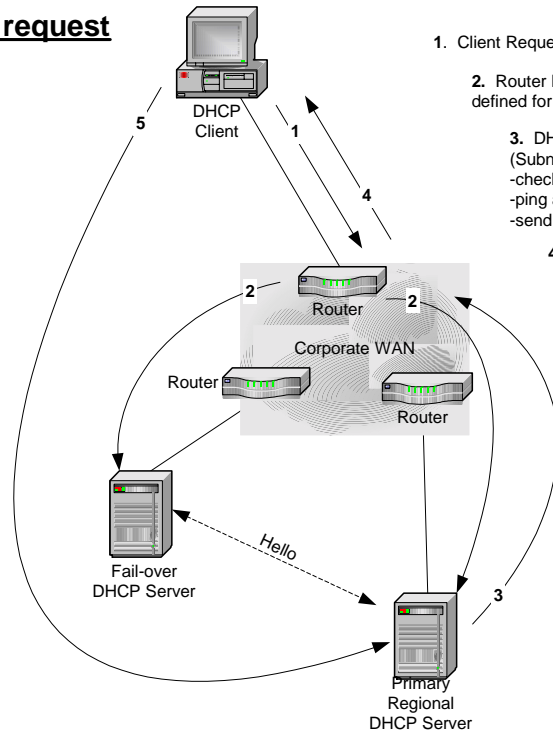
Under normal circumstances, the fail-over server will ignore lease requests from clients until it determines that the primary server for those requests is unavailable. The fail-over server sends periodic “hello” queries to the DHCP servers for which it is providing fail-over services. If three hello queries go unacknowledged the fail-over server assumes that the server is no longer available and will begin serving leases for ALL of the subnets from the primary server.

As discussed previously, the client will unicast renewal requests to the IP Address of the assigning server until 80% of the lease period has passed. After that, the client will broadcast for renewal and the router will forward the request to all servers in the helper list. With this in mind the only time a fail-over server would actually provide a client an IP address is when the primary server is unavailable AND the client issues a broadcast for a new lease or lease renewal. Note that once a client receives a lease from a fail-over server, it will try to renew that lease directly with the fail-over server – even after the primary server has returned to service – until 80% of the lease has expired at which time the client will issue a broadcast to find another server renewal the lease.

DHCP Process Diagrams

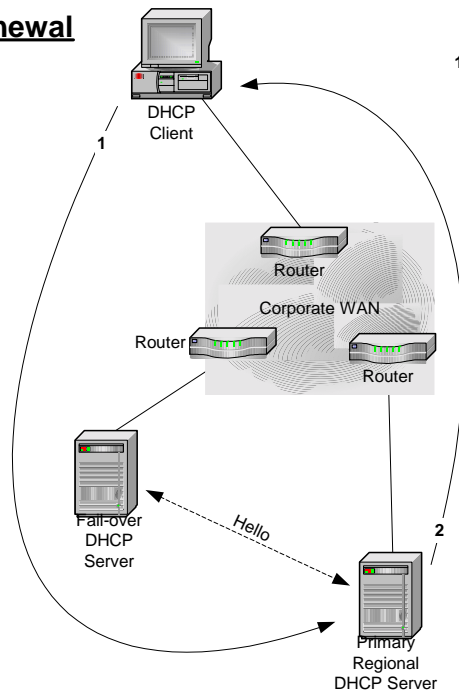
Normal DHCP Lease request / Renewal Process

New DHCP Lease request



1. Client Requests NEW lease IP-0.0.0.0
2. Router Forwards Request to ALL IP Helper-Addresses defined for interface on which request was received.
3. DHCP Server with scope for requesting device (Subnet) will
 - check for available address,
 - ping address to verify availability,
 - send an address "offer" back to router.
4. Router Forwards lease "offer" to client.
5. Client accepts lease offer and sends Acknowledgement directly back to Server.

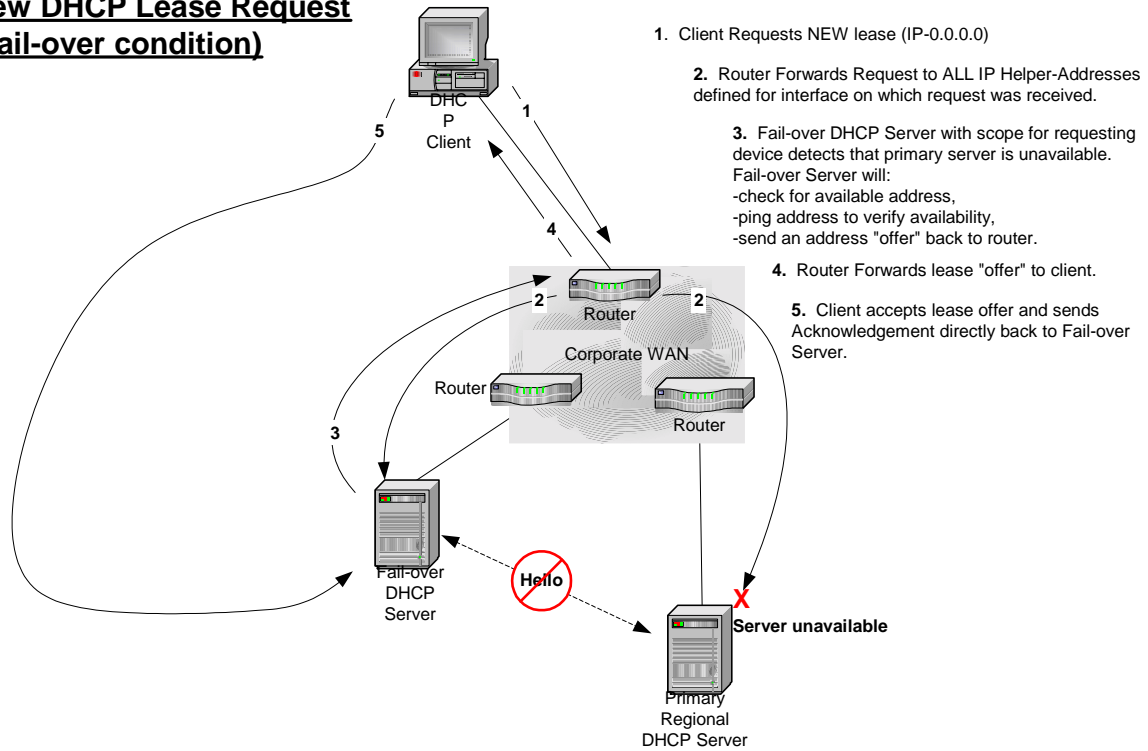
DHCP Lease Renewal



1. Client requests Lease Renewal
2. Server updates and Acknowledges lease renewal.

DHCP Fail-Over Process

New DHCP Lease Request (Fail-over condition)



DHCP Lease Renewal (Fail-over condition)

