**The DHCP Address Allocation Process**

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| **History**  DHCP was first defined as a standards track protocol in [RFC 1531](http://tools.ietf.org/html/rfc1531) in October 1993, as an extension to the Bootstrap Protocol (BOOTP). The motivation for extending BOOTP was that BOOTP required manual intervention to add configuration information for each client, and did not provide a mechanism for reclaiming disused IP addresses.  Many worked to clarify the protocol as it gained popularity, and in 1997 [RFC 2131](http://tools.ietf.org/html/rfc2131) was released, and remains as of 2011 the standard for IPv4 networks. DHCPv6 is documented in [RFC 3315](http://tools.ietf.org/html/rfc3315). [RFC 3633](http://tools.ietf.org/html/rfc3633) added a DHCPv6 mechanism for prefix delegation. DHCPv6 was further extended to provide configuration information to clients configured using stateless address autoconfiguration in [RFC 3736](http://tools.ietf.org/html/rfc3736).  The BOOTP protocol itself was first defined in [RFC 951](http://tools.ietf.org/html/rfc951) as a replacement for the Reverse Address Resolution Protocol RARP. The primary motivation for replacing RARP with BOOTP was that RARP was a data link layer protocol. This made implementation difficult on many server platforms, and required that a server be present on each individual network link. BOOTP introduced the innovation of a relay agent, which allowed the forwarding of BOOTP packets off the local network using standard IP routing, thus one central BOOTP server could serve hosts on many IP subnets.  **Technical overview**  Dynamic Host Configuration Protocol automates network-parameter assignment to network devices from one or more DHCP servers. Even in small networks, DHCP is useful because it makes it easy to add new machines to the network.  When a DHCP-configured client (a computer or any other network-aware device) connects to a network, the DHCP client sends a broadcast query requesting necessary information from a DHCP server. The DHCP server manages a pool of IP addresses and information about client configuration parameters such as default gateway, domain name, the name servers, other servers such as time servers, and so forth. On receiving a valid request, the server assigns the computer an IP address, a lease (length of time the allocation is valid), and other IP configuration parameters, such as the subnet mask and the default gateway. The query is typically initiated immediately after booting, and must complete before the client can initiate IP-based communication with other hosts.  Depending on implementation, the DHCP server may have three methods of allocating IP-addresses:   * **dynamic allocation**: A network administrator assigns a range of IP addresses to DHCP, and each client computer on the LAN is configured to request an IP address from the DHCP server during network initialization. The request-and-grant process uses a lease concept with a controllable time period, allowing the DHCP server to reclaim (and then reallocate) IP addresses that are not renewed. * **automatic allocation**: The DHCP server permanently assigns a free IP address to a requesting client from the range defined by the administrator. This is like dynamic allocation, but the DHCP server keeps a table of past IP address assignments, so that it can preferentially assign to a client the same IP address that the client previously had. * **static allocation**: The DHCP server allocates an IP address based on a table with MAC address/IP address pairs, which are manually filled in (perhaps by a network administrator). Only requesting clients with a MAC address listed in this table will be allocated an IP address. This feature (which is not supported by all DHCP servers) is variously called Static DHCP Assignment (by DD-WRT), fixed-address (by the dhcpd documentation), Address Reservation (by Netgear), DHCP reservation or Static DHCP (by Cisco/Linksys), and IP reservation or MAC/IP binding (by various other router manufacturers).   **Technical details**  **DHCPDiscover**  The initial step has the DHCP client sending a broadcast packet, a *DHCPDiscover* packet, that allow the host to discover where the DHCP servers are.  [DHCP client sending a DHCPDiscover to find a DHCP server](https://sites.google.com/site/royrouwkemaswiki/cisco/ccna-study-material/the-dhcp-address-allocation-process/dhcpdiscover.png?attredirects=0)   |  |  | | --- | --- | | **NOTE** | A DHCP client may receive offers from multiple DHCP servers and can accept any one of the offers; however, the client usually accepts the first offer it receives. Additionally, the offer from the DHCP server is not a guarantee that the IP address will be allocated to the client; however, the server usually reserves the address until the client has had a chance to formally request the address. |   **DHCPOffer**  The DHCP servers that receive that DHCPDiscover packet will respond with a DHCPOffer packet.  This packet contains an IP address, the time the host can keep the address (the "lease"), a default gateway, and other information as configured by the DHCP server admin.  [DHCP server offering an IP address to the client](https://sites.google.com/site/royrouwkemaswiki/cisco/ccna-study-material/the-dhcp-address-allocation-process/dhcpoffer.png?attredirects=0)    **DHCPRequest**  If the host receives DHCPOffer packets from multiple DHCP servers, the first DHCPOffer packet received is the one accepted.  The host accepts this offer with a *DHCPRequest* packet, which is also a broadcast packet.  [DHCP client requesting the offered IP address](https://sites.google.com/site/royrouwkemaswiki/cisco/ccna-study-material/the-dhcp-address-allocation-process/dhcprequest.png?attredirects=0)   |  |  | | --- | --- | | **NOTE** | The formal request for the offered IP address (the DHCPREQUEST message) that is sent by the client is broadcast so that all other DHCP servers that received the DHCPDISCOVER broadcast message from the client can reclaim the IP addresses that they offered to the client. |   **DHCPAck**  All DHCP servers that sent DHCPOffer packets will receive the DHCPRequest packet. If the IP address they offered the client is not seen in the DHCPRequest, that server will return that particular IP address back to the DHCP address pool. The DHCP server whose offered IP address is being accepted sends a unicast DHCPAck (for "acknowledgement") back to the host.  [DHCP server acknowledging the IP request from the DHCP client](https://sites.google.com/site/royrouwkemaswiki/cisco/ccna-study-material/the-dhcp-address-allocation-process/dhcpack.png?attredirects=0)  **DHCP in action**  Here is an example of a Cisco DHCP server in action  \*Mar 1 00:05:03.927: DHCPD: DHCPDISCOVER received from client 0063.6973.636f.2d 63.3430.312e.3033.6363.2e30.3030.302d.4661.302f.30 on interface FastEthernet0/0.  \*Mar 1 00:05:03.931: DHCPD: Allocate an address without class information (10.0.0.0)  \*Mar 1 00:05:05.931: DHCPD: Sending DHCPOFFER to client 0063.6973.636f.2d63.3430.312e.3033.6363.2e30.3030.302d.4661.302f.30 (10.0.0.2).  \*Mar 1 00:05:05.931: DHCPD: broadcasting BOOTREPLY to client c401.03cc.0000.  \*Mar 1 00:05:05.935: DHCPD: DHCPDISCOVER received from client 0063.6973.636f.2d63.3430.312e.3033.6363.2e30.3030.302d.4661.302f.30 on interface FastEthernet0/0.  \*Mar 1 00:05:05.935: DHCPD: Sending DHCPOFFER to client 0063.6973.636f.2d63.3430.312e.3033.6363.2e30.3030.302d.4661.302f.30 (10.0.0.2).  \*Mar 1 00:05:05.939: DHCPD: broadcasting BOOTREPLY to client c401.03cc.0000.  \*Mar 1 00:05:06.215: DHCPD: DHCPREQUEST received from client 0063.6973.636f.2d63.3430.312e.3033.6363.2e30.3030.302d.4661.302f.30.  \*Mar 1 00:05:06.219: DHCPD: No default domain to append - abort update  \*Mar 1 00:05:06.219: DHCPD: Sending DHCPACK to client 0063.6973.636f.2d63.3430.312e.3033.6363.2e30.3030.302d.4661.302f.30 (10.0.0.2).  \*Mar 1 00:05:06.219: DHCPD: broadcasting BOOTREPLY to client c401.03cc.0000.  **Sources**   * Dynamic Host Configuration Protocol, http://en.wikipedia.org/wiki/Dynamic\_Host\_Configuration\_Protocol * Cisco IOS DHCP Server, http://www.cisco.com/en/US/docs/ios/12\_0t/12\_0t1/feature/guide/Easyip2.html * The Bryant Advantage, http://www.thebryantadvantage.com/CCNACCNPCertificationDHCP.htm |