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Configuration Guide

Configuring DHCPv6 in AOS

This configuration describes the functionality and configuration of Dynamic Host Configuration Protocol (DHCP) for Internet Protocol version 6 (IPv6), known as DHCPv6 on ADTRAN Operating System (AOS) products. Included in this guide are an overview of DHCPv6 and its components, configuration steps and commands for the command line interface (CLI), and troubleshooting information.

This guide contains the following sections:

DHCPv6 Overview

IPv6 supports an updated version of DHCP called DHCPv6. DHCPv6, like DHCP in IPv4, is used in IP networks to supply hosts with IP addresses and other networking information. There are three main components of DHCPv6, just as there are with DHCPv4. These components are the client, the server, and the relay agent. The three components of DHCPv6 work together to exchange IP address, server, and networking information for each node on the network.

In DHCPv6, clients and servers exchange DHCP messages using User Datagram Protocol (UDP). Clients listen for DHCP messages on UDP port 546, and servers and relay agents listen for DHCP messages on UDP port 547. The DHCPv6 client typically uses a link-local address for transmitting and receiving DHCP messages. This address is the All DHCP Relay Agents and Servers multicast address, designated as **FF02::1:2**. DHCPv6 clients transmit most messages to this reserved multicast address so that the client does not have to be configured with the addresses of DHCPv6 servers. Once clients determine the address of a DHCPv6 server, they can begin to send messages directly to the server using unicast messaging when explicitly permitted by the server (which should only occur when no relay agents are being used).

DHCPv6 also differs in the way it identifies a client to a server. In DHCPv4, the device's hardware address (a combination of the hardware type and the interface's 48-bit MAC address) were typically used as the identifier of a client to a server. In DHCPv6, a new value, called the DHCP Unique Identifier (DUID), is used to identify the entire client device independent of its interfaces and hardware. Every DHCP client and server has a DUID. DUIDs are designed to be unique across all DHCPv6 devices, and should not change over time. DHCPv6 servers use DUIDs to identify clients for the selection of configuration parameters and in the association of identity associations (IAs) with clients. Servers include their DUID in the Server Identifier field, and clients include their DUID in the Client Identifier field. DUIDs can be viewed by issuing a command (**show ipv6 dhcp**) on the DHCPv6 device, and when DUIDs are paired with identity association identifiers (IAIDs), the client instance is identified. A device can have more than one interface request information from a DHCPv6 server using a IPv6 client, and in that case, all interfaces will use the same DUID, but have different IAIDs.

Another difference between DHCPv4 and DHCPv6 is the way that DHCPv6 hosts receive their IPv6 addresses. In DHCPv4, most hosts are manually configured to either use a static IPv4 address or to request an address through DHCP. In DHCPv6, however, when a host is initialized, it can generate a link-local address and then work through the following process to determine if additional IPv6 addresses should be acquired:

1. Uses a part of the Neighbor Discovery (ND) protocol, in particular router discovery, to detect the presence of routers on the link.
2. If the router discovery finds a router on the link, the router typically sends a router advertisement message to the DHCPv6 host.
3. The router advertisement message received by the host can include one or more IPv6 prefixes with the autonomous bit (A-bit) set, indicating that the client should use Stateless Address Autoconfiguration (SLAAC) to generate an IPv6 address from the prefix.
4. The router advertisement message can also include either a managed address configuration bit (M-bit), or an other configuration bit (O-bit). If the M-bit is set, the host uses stateful DHCPv6 to request address configuration. If the O-bit is set, the host uses stateless DHCPv6 to request non-address configuration information.

5. If no router is discovered on the link, the host can attempt to get an IPv6 address using DHCPv6.

> *The DHCPv6 client can also be configured manually to request an address no matter what the ND protocol indicates. The ND protocol is used with most IPv6 features, including DHCPv6. This protocol is not, however, detailed in this guide. For more information about the functionality and uses of ND, refer to the configuration guide Configuring IPv6 in AOS, available online at https://supportforums.adtran.com.*

Other differences between DHCPv4 and DHCPv6 include new DHCP message types for both clients and relay agents, and the fact that DHCPv6 does not convey default router information to clients as DHCPv4 does. In DHCPv6, default router selection is part of the router discovery process using the ND protocol, as described previously. New client and relay agent messaging and the behavior of DHCPv6 servers, clients, and relay agents are described in the following sections. *Table 1* outlines the differences between DHCPv4 and DHCPv6 messaging.

Table 1. Comparison of DHCPv4 and DHCPv6 Message Types

DHCPv4 Message Types	DHCPv6 Message Types
DHCPDISCOVER	SOLICIT (1)
DHCPOFFER	ADVERTISE (2)
DHCPREQUEST	REQUEST (3), RENEW (5), REBIND (6)
DHCPACK/DHCPNAK	REPLY (7)
DHCPRELEASE	RELEASE (8)
DHCPINFORM	INFORMATION-REQUEST (11)
DHCPDECLINE	DECLINE (9)
N/A	CONFIRM (4)
DHCPFORCERENEW	RECONFIGURE (10)
N/A	RELAY-FORWARD (12), RELAY-REPLY (13)

DHCPv6 IPv6 Prefix Delegation

DHCPv6 also provides IPv6 prefix delegation, which allows a delegating router (router that acts as DHCPv6 server) to delegate prefixes to a requesting router across the network. Prefix delegation is a feature of DHCPv6 where a delegating router assigns complete subnets and other network information to requesting routers. Once requesting clients receive the information, they dynamically assign any valid IPv6 addresses within the valid IPv6 address space to any IPv6-enabled interfaces.

When the feature is used, the delegating router configures a list of prefixes and associated preferred and valid lifetimes for the prefix of a client. Clients are identified by their DUID. The delegating router allows selection of prefixes by either static assignment (for DHCPv6 hosts) or dynamic assignment (using the DHCPv6 server pool).

The prefix delegation process begins when the delegating router responds to a client's solicit message. The solicit message contains the prefix delegation option (when configured), and the delegating router responds with an advertise message, which contains the prefix delegation option and a valid prefix. The requesting client's solicit message contains hints that the delegating router uses to provide the best prefix assignment. If the delegating router cannot respond with an appropriate prefix in the advertise message, it responds with the status code NO_PREFIX_AVAIL.

The prefixes delegated by the delegating router are stored in the DHCPv6 binding table. This table is updated with the prefix and DUID information of the requesting client. If the requesting client fails to respond within 1 minute to the advertise response message from the delegating router, the information is removed from the table. If the delegating router sends a reply message to the requesting router, the prefix delegation information is stored in the binding table for the duration of the assignment. When the valid lifetime for the prefix expires, the prefix is removed from the binding table.

Prefix delegation is configured in the DHCPv6 server pool, and enabled on a DHCPv6 client by enabling autoconfiguration on the client interface. Both IPv6 prefixes and named prefixes can be delegated. When a named prefix is changed, the delegating router updates its prefix assignment to match the new prefix. When configuring prefix delegation, remember that preferred prefix lifetimes cannot exceed valid prefix lifetimes. In addition, the sub-length of a prefix or the sub-bits of a named prefix must be equal to or larger than the prefix or named prefix length. Refer to *DHCPv6 Named Prefixes on page 11* for more information about the delegation of named prefixes.

Prefix delegation can also be used with the rapid commit feature. If the requesting router uses rapid commit, and the delegating router supports it, prefixes are assigned with a two message exchange (solicit and reply messages).

DHCPv6 Clients

DHCPv6 clients are nodes that initiate requests on a link to obtain configuration parameters from one or more DHCP servers. The following sections outline how clients function using DHCPv6.

DHCPv6 Client Messages

Several new client message types were implemented in DHCPv6. These new message types allow clients more flexibility in the actions they invoke. In several cases, functions in DHCPv4 that shared the use of a message type have a message specific to their function in DHCPv6. In addition, negative acknowledgement (NAK) messages are not used in DHCPv6. Rather, their function is carried in the REPLY message. The following are the new client message types in DHCPv6:

- Confirm: messages that are sent by the client to any available server to determine whether the addresses it was assigned are still appropriate to the link to which the client is connected.
- Renew: messages that are sent by the client to the server that originally provided the client's addresses and configuration parameters regarding the extension of lifetimes on the addresses assigned to the client. These messages are also used to update other configuration parameters.
- Rebind: messages that are sent to any available server to extend the lifetimes on the addresses assigned to the client and to update other configuration parameters. This message is sent after a client receives no response to a Renew message.

DHCPv4 and DHCPv6 client message types are outlined in *Table 1 on page 3*.

DHCPv6 Clients in the AOS Router

DHCPv6 clients can be used to request three categories of IPv6 information (separately or combined): IPv6 address, prefix, and other configuration information. The following sections describe how this information is obtained, as well as how the DHCPv6 client generally functions.

DHCPv6 Client Addresses

An IPv6 interface can have multiple addresses. The mandatory link-local address is generated internally at the interface, and other addresses can be acquired by manual configuration, SLAAC, or DHCPv6. DHCPv6 address acquisition and prefix acquisition use the stateful exchange. In this process, the server assigning an address maintains state information about which address was assigned to whom and for how long. A four message process (Solicit, Advertise, Request, and Reply) is used by default. A two message exchange process can be used if the rapid commit feature (allows an address to be assigned using only a Solicit/Reply message exchange) is enabled on both the client and server. During the address or prefix message exchange process, the client can also request other configuration information such as server addresses, domain names, etc. within the same exchange. The client is NOT required to separately perform a stateless exchange to acquire non-address information. When requesting address or prefix information, the DHCPv6 server provides an address for the client from its best matching pool. The client performs duplicate address detection and if the address is unique, assigns it to an interface.

In IPv6, a DHCP capable interface on a host creates its link-local address and then solicits router advertisement messages to determine if the M-bit is set (indicating that DHCP service is available on the link for obtaining IPv6 addresses). Router interfaces that use a DHCPv6 client to acquire an address have a slightly different process. When configured to acquire an address via DHCPv6, the router's client attempts DHCP regardless of the M-bit setting in router advertisement messages. A new option, IPv6 address autoconfiguration, allows the interface to request an address using DHCPv6 if the M-bit is set in router advertisements. As with other IPv6 host-like functions on the AOS router, this function exists to help the interface with automatic configuration in certain applications. A manual configuration option is also provided by AOS to force DHCPv6 client functionality on an interface, independent of the ND protocol.

DHCPv6 clients also honor the Preferred and Valid lifetime values of an assigned IPv6 address just as in SLAAC. To extend the use of an address before its lifetime expires, a client enters the Renew or Rebind state at the expiration of the T1/T2 timer respectively to renew or re-establish its address.

DHCPv6 does not provide a prefix length when an address is assigned. Rather, the client installs a prefix and a route with length /128. The prefix associated with the address can be obtained through router advertisements, and is not assumed from the IA non-temporary address.

DHCPv6 Client Address Prefixes

Prefix information conveyed by DHCPv6 allows a delegating router to assign a prefix to a requesting router for use on the local network. For example, assigning prefixes to local interfaces and then advertising them through router advertisement messages so local hosts can use SLAAC to configure their addresses. Prefixes are assigned in a manner similar to addresses. Prefix requests and address requests are entirely separate, and can exist together or alone. DHCPv6 prefix acquisition uses the stateful exchange, meaning the DHCPv6 server maintains state information about which prefix was assigned to whom and for how long; either four or two message exchange can be used, and non-address or prefix information can be requested by the client at the same time address or prefix information is requested. As with addresses, a DHCPv6 client on a router interface requests a prefix if so configured, without regard to M- and O-bit settings in received advertisement messages.

The DHCPv6 client can be configured to request prefixes from the DHCPv6 server. Assigned prefixes are stored to a named prefix which can then be used by other mechanisms on the router, such as being applied to other interfaces or further delegated to other requesters.

The DHCPv6 client can also be configured using prefix delegation. When prefix delegation is used, a delegating router assigns complete subnets and other network information to requesting clients. Once the client receives the information, it dynamically assigns any valid IPv6 addresses within the valid address space to any IPv6 enabled interfaces.

DHCPv6 Client Non-Address/Prefix Information

In addition to IPv6 address and prefix assignment, DHCPv6 servers can provide the client with other useful information that can be used when configuring a device for operation on the network. Such information is often requested and provided in the exchanges used to acquire an IPv6 address or prefix in DHCPv6. When using a stateful exchange, clients can list other desired information in the Option Request Option and the server responds with the information it is able to provide. However, if a method other than DHCPv6 is used to assign IPv6 addresses or prefixes, this information must be obtained in another way.

Stateless DHCPv6 exchange is used when IPv6 addresses or prefixes were not assigned using DHCPv6. This exchange uses two messages: Information-Request and Reply. The client includes a list of non-address information it requires in the Option Request Option, and the server responds with the additional information it has. Stateless exchange means the DHCPv6 server blindly responds to the request and does not keep track of what information was sent to which client. Since no lifetimes or timers are included with the information conveyed, the Information Refresh Time option was added in DHCPv6 in AOS. This option allows the server to inform the client when it should refresh the other configuration data as needed. A client requests this option in the Options Request when sending Information-Request messages to the DHCPv6 server. By default, the client refreshes the information every 24 hours.

DHCPv6 Client General Functionality

The DHCPv6 client has the ability for multicast addressing. The client sends all DHCPv6 messages to the All DHCP Relay Agents and Servers address (**FF02::1:2**). This ensures that any relay agents in use see all exchanges and keep necessary information up-to-date regarding their part in the client/server exchange. A client can still reach a single server when using the multicast address. An individual server is indicated by specifying that server's DUID in a Server Identifier option in the client's message. All servers receive this message, but only the indicated server responds. In addition, the client can send unicast packets to a server if the server sends the Unicast Option. The client must revert to using multicast, however, if the server responds with a UseMcast Status code.

The DHCPv6 client also performs duplicate address detection on each of the addresses in any IA it receives in a Reply message before it uses that address for traffic. If any of the addresses on the link are found to be in use, the client sends a Decline message to the server. Refer to the configuration guide *Configuring IPv6 in AOS*, available online at https://supportforums.adtran.com, for more information about duplicate address detection.

After the client sends a Solicit message to initiate DHCPv6 exchange, the client then assembles a list of the servers that respond. The client then selects one server from which it will accept assignments. Servers are selected by server preference, the degree to which the clients Option Request is satisfied, and the order in which the server response was received.

When sending Solicit or Request messages, the DHCPv6 client can use the following options:

- V4 PRL indicates the option is listed in the parameter request list of DHCPv4 client messages.
- V6 ORO indicates the option is listed in the Options Request option of DHCPv6 client messages.
- V4 Option indicates the option is included in DHCPv4 client messages.
- V6 Option indicates the option is included in DHCPv6 client messages.

Some DHCPv6 information can be removed from the interface on the DHCPv6 client. When an interface with a DHCPv6-assigned IPv6 address is shut down, any DHCP-assigned addresses remain valid, but a confirm sequence is enabled to ensure that the addresses are still valid when the link reactivates. If a server does not respond to the confirm sequence, or it responds with a success code, the addresses remain in use. If the server responds with an error, the addresses are not used and a new solicit sequence begins. Any other information (in addition to addresses and prefixes) delegated to the router through the interface's DHCPv6 client are not distributed, but are reacquired when the interface is returned to service. In addition, if the interface's DHCPv6 client is cleared by issuing a command, all information to that client is removed and must be reacquired.

DHCPv6 Servers

DHCPv6 severs are similar to DHCPv4 servers, and are used to respond to DHCP client requests for networking information and to assign IP addresses to devices. This information, when in stateful mode, uses an exchange of four or more messages: Solicit, Advertise, Request, and Reply messages. This information is maintained by the DHCPv6 server for each client. When in stateless mode, the mode most often used for information that does not require a stateful exchange like IP addresses or prefixes, the server does not maintain the information for each client as it does when in stateful mode. Stateless information usually includes domain names and addresses of domain naming server (DNS), Session Initiation Protocol (SIP), Network Time Protocol (NTP), etc. servers. This non-address information is conveyed with a basic two message exchange: Information-Request and Reply.

DHCPv6 server capability in an AOS router provides the following advantages: it allows a small network to have a simple local DHCPv6 infrastructure, it provides a local DHCPv6 infrastructure for disseminating non-address (stateless) information without relying on additional local servers in environments using SLAAC for host addressing, and as with DHCPv4, the router-based server typically contains the key functions needed in a small- to medium-sized network. Although the DHCPv6 server functionality in the AOS router is very similar to DHCPv4 server functionality, there are a few exceptions and additions.

The DHCPv6 server uses a new concept called identity associations (IAs) to assign and manage multiple addresses per client. An IA is a collection of addresses assigned to a client. Each IA has an associated IA identifier (IAID) that is chosen by the client. A client can be assigned more than one IA. For example, a different IA can be assigned to each client interface. Each IA holds one type of address: an IA_TA (temporary address), an IA_NA (non-temporary address), or an IA_PD (prefixes assigned to the requesting router). The AOS DHCPv6 server only supports assigning IA_NAs.

When the DHCPv6 server is enabled, the server function is configured globally on the AOS unit, but it is enabled individually at each interface. This differs from DHCPv4, where the server is configured globally and implicitly enabled on all Layer 3 interfaces. In addition, when DHCPv6 is enabled at the interface, a pool can be specified. Server pool selection can be accomplished manually by statically specifying a pool at the interface where the server is enabled, or it can be automatically created using a pool selection algorithm. However, automatic pool selection can be difficult to manage because each interface can have

multiple IPv6 addresses and varying scopes. To limit the difficulty in automatic pool selection, pools are created globally and the following configuration parameters are matched in the following order: the host client identifier, the client identifier, the IPv6 address, and the link address. Matching begins with the first pool in the configuration and works through each subsequent pool by using the following matching rules:

1. The prefixes specified by the link address, and then subsequent addresses, are used in a longest bit match algorithm similar to source address selection, where the prefix and address command values must at least match the specified prefix length. The address used for this longest bit match is based on the link address of the interface on which the DHCPv6 Solicit/Request was received, or the link address field within the DHCPv6 relay-forward packet. The pool with the longest bit match is selected to be used to service a request. Prefixes based on the address commands that include the IPv6 prefix are preferred over prefixes in the **link-address** command.
2. The **client-identifier** command specifies a particular DHCPv6 client identifier to match for a given pool. The client identifier is matched and prioritized first over the IPv6 address and link-address configuration. If the client identifier specifies the IAID value, then the specified IAID must match the requester's IAID in the DHCPv6 Solicit and Request messages. If the client identifier is specified without an IAID, then the match is a lower priority to a client identifier and IAID match. Any number of **client-identifier** commands can be specified for a single pool, which allows that pool to be used by multiple client identifiers. Only one pool can have a specific client identifier and IAID pair.

In DHCPv6, a binding on the server is made up of the assigned IPv6 address associated with an IA and a client identifier. The client identifier (the device's DUID) uniquely identifies the client device, and the IA identifies a specific set of addresses for the device. For instance, if the device had more than one interface that is using DHCPv6 client, both interfaces would have the same client ID, but would use different IAs. This method of binding is different from that in DHCPv4, where a binding on the server is made up of the assigned IPv4 address associated with the client identifier.

Addresses assigned to the DHCPv6 server are constructed differently than in DHCPv4. In DHCPv6, server addresses are constructed from the DHCPv6 server pool that was selected for the client's request. The most significant bits of the address are set to the value defined in, and up to the length specified by, the selected address and prefix command. The remaining bits are set to a random value determined by the DHCPv6 server. These bits have no particular context and carry no information (as with an EUI-64 address). The server verifies that the same host bits are unique to addresses assigned from the same prefix. When a DHCPv6 server assigns an address, it does not include a prefix length and therefore conveys no information about a prefix to the client. Clients accepting the address typically enter a host route for the address and do not enter information about a prefix into route or prefix tables. Prefix information is conveyed to the host through neighbor discovery.

The timers in DHCPv6 also function differently than in DHCPv4. In DHCPv4, the lease time determines how long an assigned address can be considered in use. If the lease expires, the client stops using the address and the server is free to reassign the address to another device. In DHCPv6, however, there is no entity called a lease. IPv6 addresses assigned by DHCPv6 use the same preferred and valid lifetimes defined by SLAAC. When the preferred lifetime expires, the device continues with existing conversations but does not begin new conversations using that address. When the valid lifetime of an address expires, it ceases to exist and can be reassigned by the server. An IA can be considered expired when the valid lifetime of all addresses in that IA have expired. T1 and T2 timers function similarly in DHCPv6 as in DHCPv4, in that they trigger renew and rebind states (respectively) to extend the use of an address. Even if the client fails to release assigned addresses, each address assigned to the IA is reclaimed by the server when the valid lifetime of that address expires.

In addition, DHCPv6 in AOS provides the ability to exclude specific addresses from a range of addresses defined for host assignment. This feature is useful when certain addresses within a range configured for assignment are manually configured on certain devices. The server does not attempt to serve excluded addresses. If exclusion is not configured, the system relies solely on address testing (ping) to determine if an address is used; however, such a test will not function if the device assigned the address is not currently communicating on the network. If an address is excluded, and the same address is configured for a host in a DHCPv6 pool, a DHCPv6 debug message is generated that states the server was unable to assign an address to the host. The exclusion nullifies the host assignment in the pool selection logic.

Another difference between DHCPv6 and DHCPv4 is the use of client fully qualified domain names (FQDNs) in DHCPv6, rather than the host name used in DHCPv4.

An addition to server functionality in DHCPv6 is the rapid commit feature. This feature allows for a two message exchange (using Solicit and Reply messages) between the client and server for assigning IPv6 addresses to devices. Care should be exercised when using this feature, however, because if multiple servers receive and respond to a client's Solicit message, each server can create state information about this address, believing they have assigned an address to the client.

Other additions to the DHCPv6 server include the ability to inform a client that it is permitted to use unicast messaging when no relay agents are being used, the ability for vendors to create custom options under their own enterprise space, and the ability for servers to include an option in DHCP Advertise messages indicating a numerical priority. This feature allows clients to select the server to use based on priority.

DHCPv6 Relay Agents

DHCPv6, like DHCPv4, is used in IP networks to supply hosts with IP addresses and other networking information. DHCPv6, however, functions slightly differently than DHCPv4 by providing relay agents with the ability to send Relay-Forward and Relay-Reply messages. In addition, in DHCPv4, when DHCP messages are sent to a DHCP server whose address is not known, the IPv4 client uses the broadcast address. In DHCPv6, the IPv6 client sends messages using a link-scoped mulitcast address. This address is the All DHCP Relay Agents and Servers multicast address, designated as **FF02::1:2**.

In AOS, DHCPv6 relay agents are used when the DHCPv6 server is not on the same link as the DHCPv6 client. The relay is typically a router on the same link as the client, which acts as an intermediary to help the client's DHCPv6 messages reach the DHCPv6 server. DHCPv6 relay agents operate transparently to the DHCPv6 client, and can be configured in chains, meaning that information about each agent encountered is encapsulated into the relay message. Relay agents add fields to the DHCPv6 message as they send these messages to the server, thus providing a method to properly manage and respond to the DHCPv6 client.

DHCPv6 Relay Functionality in AOS

In AOS, DHCPv6 relay functionality is very similar to that of DHCPv4. As previously stated, DHCPv6 clients send messages using the link-scoped multicast address **FF02::1:2**, rather than the broadcast address used by DHCPv4. When the DHCPv6 relay mode is enabled in the AOS product, AOS enables the interface hardware to listen for the multicast MAC address (when applicable) associated with the All DHCPv6 Relay Agents and Servers address (**FF02::1:2**), adds a multicast route to the route table to enable listening for this address, and listens on UDP port 547 to identity DHCPv6 client requests. In addition,

AOS product interfaces with DHCPv6 relay enabled will accept and relay DHCPv6 client messages received on any IPv6 address for which it currently listens. The relay is defined at the interface that receives messages from the DHCPv6 client. The relay can be configured to send messages to multiple servers. By default, Relay-Forward messages are sent using the IPv6 address of the egress interface.

The DHCPv6 relay agent can relay client DHCPv6 messages to unicast or multicast destinations on a linked scope (with a specified interface) or a global scope destination (global unicast address (GUA) or unique local address (ULA)). By default, the DHCPv6 client uses the All DHCPv6 Relay Agents and Servers multicast address to communicate with the DHCPv6 server through the relay. The client is typically identified by its link-local address.

The DHCPv6 relay message path is slightly different than the DHCPv4 relay message path. In IPv4, the IP address of the relay's interface that receives client messages is added to the DHCPv4 packet, and the IP header is modified to be unicast to the server from the relay. In addition, the server sends unicast replies to the relay, which then forwards the messages back to the client based on the broadcast flag in the server message. In DHCPv6, however, the dedicated message types (Relay-Forward and Relay-Reply) provide headers for relay-specific information options. Details of original DHCPv6 client messages are encapsulated inside the relay messages and sent using unicast to the server. When multiple DHCPv6 relays are used, each relay adds its own relay header and encapsulates the previous message, creating a train of encapsulated messages. When the server sends a DHCPv6 Relay-Reply message, it formats the reply to be processed by each relay on the return path. Since all IPv6 nodes have link-local addresses, the messages can be sent using unicast from the relay to the client using the link-local addresses.

DHCPv6 Relay Agent Messages

In DHCPv4, relay agents simply filled certain fields of the DHCPv4 header and forwarded messages to the DHCPv4 server. In DHCPv6, however, relay agents have their own message types: Relay-Forward (**R-Fwd**) and Relay-Reply (**R-Rply**) messages.

Relay-Forward messages are messages sent to the DHCPv6 server from the relay agent, and can either go directly to the server, or go through multiple DHCPv6 relay agents to the server. The received message, either a client message or a Relay-Forward message from another relay agent, is encapsulated in an option in the Relay-Forward message. This option appears as **R-Fwd** when the option is added by the DHCPv6 relay agent in packets sent towards the DHCPv6 server.

Relay-Reply messages are sent by the DHCPv6 server to a relay agent, and these messages contain a message for the relay agent to deliver to the DHCPv6 client. When the the Relay-Reply message is sent from the DHCPv6 server, it is created with the same number and order of **R-Rply** options as the Relay-Forward message received by the server. This ensures that the Relay-Reply message follows the same path back to the DHCPv6 client as taken by the Relay-Forward message. Each DHCPv6 relay agent, upon receiving a Relay-Reply message, removes one **R-Rply** option from the message and forwards the encapsulated DHCPv6 message to the next DHCPv6 relay (or the DHCPv6 client if there are no more **R-Rply** options).

The DHCPv6 relay agent can add an Interface ID option to the Relay-Forward message to identify the specific interface on which the Relay-Forward or client DHCPv6 message was received. This Interface ID option does not have any external significance and is only used by the DHCPv6 relay agent when it receives a Relay-Reply message from the DHCPv6 server.

DHCPv6 Named Prefixes

In DHCPv6, named prefixes can be used to automatically delegate IPv6 prefixes using DHCP. Addresses delegated using this method are long-lived prefixes from a delegating router to a requesting router across an administrative boundary, where the delegating router does not require knowledge about the topology of the links in the network to which the prefixes are assigned. For example, the provider, acting as a delegating router, can assign IPv6 addresses to the subscriber, acting as the requesting router, across the boundary between the provider and subscriber networks.

Prefix delegation relies heavily upon the use of named prefixes on the subscriber (requesting) router. A named prefix is a user-defined label that represents a prefix after it has been delegated to the requesting router. It typically holds the provider's portion of a prefix which resides in the most significant bits of an address. Once the requesting router has been delegated a prefix, it stores the value under the specified label (for example, PREFIX1).

The locally specified components of the prefix or address are the sub-bits, which fill out the remainder of the prefix portion of an address and create the prefix as it will exist on the interface. This allows an administrator to define a subnetting scheme for the local network which remains constant even if the provider changes its portion of the prefix. The interface ID is then added to the bits to complete an individual address.

The named prefix from the provider can be added to multiple interfaces using different sub-bits. The prefix can also be locally assigned by removing it from the DHCP client and assigning a value to the label by a local command. Multiple prefixes can be used.

In addition to delegated prefixes from the provider, named prefixes can also be manually configured on the local network. Prefixes for use with DHCPv6 can be defined by delegation or manually, but the same variable cannot be defined both ways simultaneously.

Prefix Timers

Delegated prefixes have preferred and valid lifetimes assigned by the server. The requesting router must maintain local timers in order to properly age the values after they are assigned. When using a delegated prefix to further advertise prefixes in RAs, the router advertises the current value of the relative timers. Relative timer support is also available on manually created prefixes by specifying an expiration date.

If a delegated prefix changes, for example when a current prefix is replaced with a new prefix without any overlapping period, the router immediately advertises the old prefix with a preferred lifetime of 0 and a valid lifetime of 2 hours that is decremented in real time in RA messages. A manually defined prefix is valid as long as it is defined. When the definition is removed, the prefix becomes invalid. In addition, any features that use the named prefix are only valid while the prefix is valid.

Named Prefix Functionality

A named prefix typically has three parts:

- the base prefix and its length, as contained in the prefix name variable defined manually or by delegation
- the sub-bits and their length, as defined by a prefix command
- the host bits (typically included after the sub-bits length)

The following illustrates the parts of a named prefix when it is created with the **ipv6 address** command:

- A:B:C::/56, the named prefix value and length as assigned to the variable
- 0:0:0:D::1/64, the sub-bits and length and the host bits
- A:B:C:D::1/64, the resulting combined value

When a prefix is created and put into use, any error in the command entry is detected, reported, and the command is rejected. If the prefix name is not valid when the command is entered, no conflict can be detected, so the command is accepted. When the prefix name becomes valid, however, any conflict in the command is detected, reported, and the resulting prefix is not used.

If a delegated prefix is applied locally with a mask that is longer than the delegated mask, the delegated route is an aggregate. If the more specific routes applied to interfaces do not span the entire aggregate, it is possible to have packets that match the aggregate but not specific routers in the route table. This can cause packets to take another route even when that is not desired. To overcome this, in AOS a static route is automatically added to a delegated prefix value with a next hop of null 0. The route has a default administrative distance of 1, and the user can apply a tag. The route can be redistributed to other protocols and removed if the prefix becomes undefined. This action happens only with delegated prefix names, and not manually configured prefix names.

Some named prefix uses are configuration and timing dependent. Named prefixes can generate either addresses or prefixes for use with other features, some of which may or may not be valid at the time the other feature attempts to add them. Because of this, named prefixes refresh periodically, and all features using a named prefix are renotified of all possible prefixes or addresses generated by the named prefix. Whenever a change is made to the configuration that can potentially affect named prefix addresses or prefixes, a refresh action is triggered.

Hardware and Software Requirements and Limitations

IPv6 is only supported in specific AOS devices using firmware 18.1.00 or later. For a complete listing of products that support IPv6, refer to the *Product Feature Matrix*.

AOS implements a dual IP stack method for supporting IPv4 and IPv6. Not all AOS features are compatible with IPv6. Refer to the *Product Feature Matrix* for more information about the supported IPv6 features in AOS.

DHCPv6 cannot be carried over IPv4. IPv6 is required for DHCPv6 because it is strictly a Layer 3 protocol.

A basic understanding of IPv6 functionality, configuration, and addressing is necessary to use DHCPv6. Refer to the configuration guide *Configuring IPv6 in AOS*, available online at https://supportforums.adtran.com for more IPv6 information. Additional information about IPv6 concepts and usage is outlined in *Additional Resources on page 56*.

DHCPv6 clients are supported on Windows 7 and Windows Vista, but not on MAC OS or Windows XP.

IPv6 prefix delegation is supported in AOS firmware release R11.1.0 and later for the products as outlined in the *Product Feature Matrix.*

General DHCPv6 Limitations and Requirements

DHCPv6 has specific requirements based upon the mode of the AOS device. The following sections outline DHCPv6 limitations and requirements based upon server, client, or relay DHCPv6 modes.

DHCPv6 Server Requirements

The DHCPv6 server is configured globally and enabled individually on each interface that is to receive server DHCPv6 information. If DHCPv6 is not enabled on an interface, DHCP packets received on that interface are not processed.

Before assigning an address, the DHCPv6 server sends a ping packet to try to detect if the IPv6 address is already in use but not locally recorded. The number of attempted pings can be configured.

DHCP server, client, and relay functions are mutually exclusive at each interface. Any existing mode must be removed before a different mode can be applied. Only one DHCPv6 function can be enabled on an interface at a time.

Every Layer 3 interface can be enabled as a DHCPv6 server, client, or relay, with the exception of the loopback interface.

DHCPv6 Client Requirements

An interface that is to operate as a DHCPv6 client must have an active link-local address before DHCPv6 functionality can take place on the interface.

Interfaces perform duplicate address detection (DAD) on an IPv6 address acquired using DHCPv6 before applying that address to the interface.

Configuring DHCPv6 Using the CLI

The following sections outline the commands used to configure DHCPv6 on an AOS product using the CLI. The basic configuration steps for DHCPv6 configuration include the following:

- *Step 1: Accessing the CLI on page 13*
- *Step 2: Configuring DHCPv6 Global Parameters on page 14*
- *Step 3: Configuring the DHCPv6 Server Pool on page 17*
- *Step 4: Enabling IPv6 on an Interface on page 25*
- *Step 5: Configuring DHCPv6 on the Interface on page 26*

Step 1: Accessing the CLI

To access the CLI on your AOS unit, follow these steps:

1. Boot up the unit.
2. Telnet to the unit (**telnet** <*ip address*>), for example:
   telnet 10.10.10.1.

If during the unit's setup process you have changed the default IP address (10.10.10.1), use the configured IP address.

3. Enter your user name and password at the prompt.

> *The AOS default user name is **admin** and the default password is **password**. If your product no longer has the default user name and password, contact your system administrator for the appropriate user name and password.*

4. Enable your unit by entering **enable** at the prompt as follows:

   >enable

5. If configured, enter your Enable mode password at the prompt.
6. Enter the unit's Global Configuration mode as follows:

   #configure terminal
   (config)#

Step 2: Configuring DHCPv6 Global Parameters

Some DHCPv6 features are configured from the Global Configuration mode and applied to DHCPv6 operation across the AOS product. These features include the DHCPv6 database settings, address and prefix configurations, domain settings, and ping functionality. Other DHCPv6 configurations are specific to the interface on which DHCPv6 operates. The globally configured parameters of DHCPv6 are described in the following sections.

Configuring the DHCPv6 Database

The DHCPv6 database stores local DHCPv6 bindings, allowing addresses assigned by the DHCPv6 server to be stored in non-volatile random access memory (NVRAM) and thus be preserved across a reboot of the AOS unit. To configure the DHCPv6 database, enter the **ipv6 dhcp database local** command from the Global Configuration mode prompt. By default, the database is disabled. Entering the command enables the local database to begin storing DHCPv6 information, and using the **no** form of this command disables the database. Enter the command as follows:

(config)**#ipv6 dhcp database local**

Configuring DHCPv6 Addresses and Prefixes

To specify IPv6 addresses to exclude from any DHCPv6 server pool, enter the **ipv6 dhcp excluded-address [vrf** <*name*>**]** <*beginning ipv6 address*> <*ending ipv6 address*> from the Global Configuration mode. These addresses are excluded from the DHCPv6 server pool, and cannot be assigned to DHCP clients by the server of these devices. By default, no IPv6 addresses are excluded. The optional **vrf** <*name*> parameter specifies a nondefault virtual routing and forwarding (VRF) instance on which to the exclude the IPv6 addresses. The <*beginning ipv6 address*> parameter specifies the lowest IPv6 address in the range of addresses to exclude (or a single IP address to be excluded), and the <*ending ipv6 address*> parameter specifies the highest IPv6 address in the range (not required if only a single address is excluded). IPv6 addresses should be expressed in colon hexadecimal format (**X:X:X:X::X**), for example, **2001:DB8:1::1**. Using the **no** form of this command removes the exclusion and makes the addresses available for use by the DHCPv6 server. To exclude IPv6 address from DHCPv6 operation on the default VRF, enter the command as follows:

(config)**#ipv6 dhcp excluded-address 2001:DB8:1::1 2001:DB8:1::5**

To specify the maximum number of addresses that can be assigned by the DHCPv6 server, enter the **ipv6 dhcp address limit** <*number*> command from the Global Configuration mode. This command limits the number of addresses assigned by the DHCPv6 server to ensure that the AOS unit does not run out of memory. The <*number*> parameter specifies the number of IPv6 addresses that can be assigned. Valid range is **1** to **10000**. This maximum number is product-specific, and is equivalent to the default value on the product. By default, only a certain number of addresses can be assigned by the DHCPv6 server. This number varies by AOS product. Use the **no** form of this command to reset the count to the default value. To change the number of addresses assigned by the DHCPv6 server, enter the command as follows:

(config)**#ipv6 dhcp address limit 2000**

To specify the maximum number of conflicting IPv6 addresses that can be stored by the DHCPv6 server, enter the **ipv6 dhcp address conflict limit** <*number*> command from the Global Configuration mode. This command limits the number of conflicting addresses stored by the DHCPv6 server to ensure the AOS unit does not run out of memory. The <*number*> parameter specifies the maximum number of conflicting IPv6 addresses that can be stored by the server. Valid range is **1** to **10000** addresses. This maximum number is product-specific and is equivalent to the default value on the product. By default, only a certain number of conflicting IPv6 address can be stored. This number varies by AOS product. Use the **no** form of this command to reset the count to the default value. To change the number of conflicting addresses stored by the DHCPv6 server, enter the command as follows:

(config)**#ipv6 dhcp address conflict limit 3500**

To specify the maximum number of addresses assigned per client by the DHCPv6 server, enter the **ipv6 dhcp address client limit** <*number*> command from the Global Configuration mode. The <*number*> parameter is the maximum number of addresses that can be assigned to a single client. Valid range is **0** to **500**, with a default value of **50**. Setting the number to **0** returns the number to the default value. Using the **no** form of this command also returns the maximum number of assigned addresses to the default value. To change the maximum number of addresses assigned to a single client, enter the command as follows:

(config)**#ipv6 dhcp address client limit 75**

To manually assign a value to a named prefix, enter the **ipv6 named-prefix** <*prefix name*> <*ipv6 prefix/prefix-length*> **[expiration-date** <*date*> <*time*>**]** command from the Global Configuration mode. A named prefix is useful when the upper part of the prefix could change over time (such as when using provider-dependent addresses). By creating a named prefix, the variable holding the value of the prefix is defined once, and then applied in various ways without having to manually enter the prefix value at each use. The <*prefix name*> parameter specifies the name of the variable that holds the service provider assigned value for the prefix. The <*ipv6 prefix/prefix-length*> parameter is the numerical value and length of the prefix. The prefix value is specified in colon hexadecimal format (**X:X::X/<Z>**), for example: **2001:DB8:1::/64**. The prefix length (**<Z>**) is an integer with a value between **0** and **128**. The IPv6 prefix cannot be a link-local address. The optional **expiration-date** <*date*> <*time*> parameter specifies the time at which the prefix will expire. Enter future expiration <*date*> value in the MM/DD/YY format, and the <*time*> parameter in the HH:MM or HH:MM:SS format. Changes made to the named prefix are automatically applied at each interface using the named prefix form of the IPv6 address command. Using the **no** form of this command will remove one prefix from within a named prefix if the prefix and prefix length are specified, or it will remove all prefixes from within a named prefix if entered with only the prefix name. By default, no named prefixes exist. To assign a value to a previously named prefix, enter the command as follows:

(config)**#ipv6 named-prefix PREFIX1 2001:DB8:1::/64**

Once you have created a named prefix, you can also specify that a route is created using the named prefix by entering the **ipv6 route [vrf** <*name*>**] named-prefix** <*prefix name*> <*ipv6 prefix/prefix-length*> **[**<*interface*>**] [tag** <*tag*>**]** command from the Global Configuration mode. When this command is entered, a route is constructed using the prefix bits from a named prefix. The route is inserted into the route table when the command is used and the prefix is populated without an error. The optional **vrf** <*name*> parameter specifies a nondefault VRF instance on which to create the route. If no VRF is specified, the route is created on the default VRF. The <*prefix name*> parameter of the command specifies the name of the previously created named prefix. The <*ipv6 prefix/prefix-length*> parameter is the numerical value and length of the prefix. The prefix value is specified in colon hexadecimal format (**X:X::X/<Z>**), for example: **0:0:0:5::/64**, where the leading zeros are the bits the named prefix will overwrite. The prefix length (**<Z>**) is an integer with a value between **0** and **128**. The IPv6 prefix cannot be a link-local address. This command remains in effect for as long as the named prefix is valid. The optional <*interface*> parameter specifies the interface to which the route is assigned. The optional **tag** <*value*> parameter specifies a number to use as a tag for labeling and filtering routes when they are dynamically redistributed into a routing protocol such as Routing Information Protocol (RIP), Open Shortest Path First (OSPF), or Border Gateway Protocol (BGP). Valid tag range is **1** to **65535**. Using the **no** form of this command removes the static route entry. By default, no static routes exist. To create a static IPv6 route using a named prefix, enter the command as follows:

(config)**#ipv6 route named-prefix PREFIX1 0:0:0:5::/64**

To specify the DHCPv6 prefix delegation prefix limit, enter the **ipv6 dhcp prefix [client] limit** <*limit*> command from the Global Configuration mode prompt. When prefix delegation is enabled in the DHCPv6 pool, a list of prefixes and associated preferred and valid lifetimes are created for the delegating router to assign to requesting clients. The **limit** <*limit*> parameter specifies the limit of prefixes assigned. Valid range is **0** to **164352**. When set to **0**, the limit is removed. The optional **client** parameter specifies the limit is applied to requesting clients. Use the **no** form of this command to remove the prefix limit. To configure the prefix limit for DHCPv6 prefix delegation, enter the command as follows:

(config)**#ipv6 dhcp prefix limit 1000**

Configuring DHCPv6 Domain Settings

DHCPv6 domain list entries can be created using the **domain-list [vrf** <*name*>**]** <*domain*> command from the Global Configuration mode. This command creates an entry that is added to the domain list, which allows DNS to append a series of domains to a host name when attempting to resolve it. The optional **vrf** <*name*> parameter specifies a nondefault VRF instance on which to create the domain list entry. If no VRF is specified, the domain list entry is created on the default VRF. The <*domain*> parameter specifies the domain on which to create the domain list entry. Using the **no** form of this command removes the domain list entry. By default, no domain list entries exist. To create a domain list entry, enter the command as follows:

(config)**#domain-list DOMAIN1**

Configuring DHCPv6 Ping Settings

DHCPv6 ping utility settings are configured from the Global Configuration mode prompt. You can configure the ping timeout interval and the number of ping packets that are transmitted by the DHCPv6 server.

To configure the number of ping packets transmitted by the DHCPv6 server when testing an IPv6 address before it is assigned to a client, enter the **ipv6 dhcp ping packets** <*number*> command from the Global Configuration mode prompt. Transmitting ping packets verifies that no other hosts on the network are currently configured with the IPv6 address being tested. Use the **no** form of this command to prevent the DHCPv6 server from using ping packets as part of the IPv6 address assignment process. The <*number*> parameter is the number of DHCPv6 ping packets sent on the network before assigning the IPv6 address to a requesting DHCPv6 client. Valid range is **0** to **100** packets, and the default value is **2** packets. To change the number of transmitted ping packets, enter the command as follows:

```
(config)#ipv6 dhcp ping packets 20
```

To configure the ping timeout interval (in milliseconds), enter the **ipv6 dhcp ping timeout** <*value*> parameter from the Global Configuration mode. This command specifies the interval the DHCPv6 server waits for a response to a transmitted DHCPv6 ping packet when testing an IPv6 address. The <*value*> parameter specifies the number of milliseconds the DHCPv6 server waits for a response. Valid range is **10** to **1000** ms. By default, the DHCPv6 server waits **500** ms for a ping response when testing an IPv6 address. Using the **no** form of this command returns the timeout period to the default value. To change the ping timeout interval, enter the command as follows:

```
(config)#ipv6 dhcp ping timeout 300
```

Step 3: Configuring the DHCPv6 Server Pool

The DHCPv6 sever pool is created using the **ipv6 dhcp pool** <*name*> command from the Global Configuration mode. This command creates the DHCPv6 pool and enters the pool's configuration mode. The server pool is used to define the information to be assigned to clients by the DHCPv6 server. The server pool chosen to serve a specific client's request is determined by the current pool selection algorithm (same functionality as in DHCPv4). By default, no DHCPv6 server pools are configured. The **no** form of this command removes the DHCPv6 server pool. To create a DHCPv6 server pool, and enter the pool's configuration mode, enter the command as follows:

```
(config)#ipv6 dhcp pool POOL1
(config-dhcpv6)#
```

Once you have created the DHCPv6 server pool, and entered the pool's configuration mode, you can configure several options to control the pool's behavior. These options are discussed in the following paragraphs.

To specify the DHCPv6 client ID (the DUID) that represents a single client and, together with the IAID, identifies a single interface on a single client, enter the **client-identifier** <*client DUID*> **[**<*IAID*>**]** command from the DHCPv6 Pool Configuration mode. The value specified by this command is used to allow a single device, or interface, to match the server pool and is used as part of the automatic pool selection algorithm that matches client requests to the best server pool from which to assign information to the client. When specifying this command, you should remember that a specified DUID can be present in one DHCPv6 server pool only. You can, however, create multiple DUIDs by using multiple instances of the command. Each ID is created and deleted individually. Up to **50** DUIDs can be created on a single DHCPv6 server pool. The <*client DUID*> parameter specifies the DUID of the client to be matched. The DUID is expressed as a hexadecimal value. The optional <*IAID*> parameter is the hexadecimal value that

represents the IAID expected in the client request. This option is useful if the client has more than one interface requesting DHCPv6 information, and specific information is required for each interface. By default, no client ID is specified. Using the **no** form of this command removes the client ID from the pool. To create a client ID (the DUID), enter the command as follows:

(config)**#ipv6 dhcp pool POOL1**
(config)**#client-identifier F2A4C9**

In DHCPv4, the Trivial File Transfer Protocol (TFTP) protocol is used, in conjunction with a name in a directory path, to specify which boot file should be used by requesting DHCP clients. In DHCPv6, however, a URL is used to specify a file location and transfer protocol for the boot file used by DHCPv6 clients. To configure the DHCPv6 server pool's boot file options, enter the **bootfile** <*url*> command from the DHCPv6 Pool Configuration mode. This command specifies a boot file URL (conveyed in the Bootfile URL option 59) that will be supplied to requesting clients served by this DHCPv6 server pool. The requesting client can use the URL to load a boot file. The <*url*> parameter is a valid string (up to **512** characters) that specifies the transfer protocol, the location, and the name of the file to be transferred to the client. File URLs are specified in the format: **protocol://path/filename.ext**. By default, no boot file URL is specified or sent to requesting DHCPv6 clients. Using the **no** form of this command removes the URL from the pool. To specify a boot file URL, enter the command as follows:

(config)**#ipv6 dhcp pool POOL1**
(config-dhcpv6)**#bootfile FTP://hostname/ftpshared/folder/filename1.ext**

To specify the IPv6 address of a DNS server supplied to the DHCPv6 requesting clients for this DHCPv6 server pool, enter the **dns-server** <*ipv6 address*> command from the DHCPv6 Pool Configuration mode. IPv6 addresses should be expressed in colon hexadecimal format (**X:X:X:X::X**), for example, **2001:DB8:1::1**. By default, no DNS server address is specified or sent to the requesting DHCPv6 client. The **no** version of this command removes the DNS server address from the pool. If the **no** version of this command is entered without specifying an IPv6 address, all DNS server addresses are removed from the pool. Multiple DNS server addresses can be entered using multiple instances of this command. Each address is added or deleted individually. Up to **50** DNS server addresses can be entered. These addresses are assigned in the order they are entered. To add a DNS server address to the DHCPv6 pool, enter the command as follows:

(config)**#ipv6 dhcp pool POOL1**
(config-dhcpv6)**#dns-server 2001:DB8:1::1**

To specify a domain name suffix supplied to requesting DHCPv6 clients served by this DHCPv6 server pool, enter the **domain-name** <*name*> command from the DHCPv6 Pool Configuration mode. The <*name*> parameter is the domain name suffix in ASCII text (up to **245** characters), and is typically a domain name suffix the client uses to fully qualify host names. By default, no domain names are specified or sent to the requesting client. The **no** version of this command removes the domain name from the pool. If the **no** version of this command is entered without specifying a domain name, all domain names are removed from the pool. Multiple domain names can be entered using multiple instances of this command. Each name is added or deleted individually. Up to **50** domain names can be entered. These names are assigned in the order they are entered. To add a domain name to the DHCPv6 pool, enter the command as follows:

(config)**#ipv6 dhcp pool POOL1**
(config-dhcpv6)**#domain-name NAME1**

To instruct the DHCPv6 server to import the values of certain information from the global information pool when serving a DHCPv6 client request, enter the **import [dns-server | domain-name | information refresh | ntp [address | domain-name] | sntp-server | timezone]** command from the DHCPv6 Pool Configuration mode. These parameters are served to clients using this server pool as if their values had been configured locally in the pool. If the imported values do not exist in the global information pool, the respective value in the importing pool behaves as if it is not configured. Once a value exists in the global configuration, the respective value in the importing pool is initialized and can be used. The **dns-server** parameter of this command specifies that DNS server options are imported, **domain-name** specifies that domain name options are imported, **information refresh** specifies the information refresh option values learned through the DHCPv6 client are imported, **ntp** specifies that NTP options are imported (either **address** or **domain-name**), **sntp-server** specifies that DNS server addresses (from the Simple Network Time Protocol (SNTP) server as defined by the **sntp server** <*address*> command) are imported, and **timezone** specifies that time zone database information is imported. These options can also be configured locally. This command can be issued multiple times to import a separate parameter each time. By default, no information is imported to the pool. Using the **no** form of this command disables the importation of the specified information. If no parameters are specified when the **no** version of the command is issued, then all imported parameters are removed from the server pool's configuration. To enable the importation of information (in this example, DNS server information), enter the command as follows:

```
(config)#ipv6 dhcp pool POOL1
(config-dhcpv6)#import dns-server
```

To enable the DHCPv6 server to send the information refresh value to requesting clients served by this DHCPv6 pool when using the stateless exchange option for configuration information, and to specify that refresh value, enter the **information refresh [infinite |** <*days*> **[**<*hours*>**] [**<*minutes*>**]]** command from the DHCPv6 Pool Configuration mode. The **infinite** parameter specifies that there is an infinite refresh time. The <*days*> parameter specifies the number of days to wait before refreshing the assigned information. Valid <*days*> range is **0** to **365**. In addition, when specifying the number of days, you can optionally specify the number of hours to wait (<*hours*> parameter) or the number of minutes to wait (<*minutes*> parameter). Valid hour range is **0** to **23**, and valid minute range is **0** to **59**. By default, no information refresh time is set, and the client should refresh every **24** hours. To change the information refresh rate for clients using stateless DHCPv6 to acquire configuration information, for example, to every **4** days, enter the command as follows:

```
(config)#ipv6 dhcp pool POOL1
(config-dhcpv6)#information refresh 4
```

To specify a prefix that the DHCPv6 server can use to match a received interface or relay-forwarded client request to the server pool, enter the **link-address** <*ipv6 prefix/prefix-length*> command from the DHCPv6 Pool Configuration mode. This value is only used as part of the automatic pool selection that matches client requests to the server pool from which to assign information to the client, and is typically the prefix of the DHCPv6 relay agent's interface. The command can be entered multiple times, once for each link address. Up to **50** IPv6 prefixes can be entered. The prefix value is specified in colon hexadecimal format (**X:X::X/<Z>**), for example: **2001:DB8:3F::/64**. The prefix length (<**Z**>) is an integer with a value between **0** and **128**. By default, no link addresses are specified in the server pool. Using the **no** version of this command removes the link address from the server pool, and if the **no** version of the command is entered without specifying an IPv6 prefix, all link address prefixes are removed from the pool. To add an IPv6 link address prefix to the DHCPv6 pool, enter the command as follows:

```
(config)#ipv6 dhcp pool POOL1
(config-dhcpv6)#link-address 2001:DB8:3F::/64
```


To specify an address prefix from which the DHCPv6 server assigns addresses to requesting clients served by this server pool, enter the **address prefix [**<*ipv6 prefix/prefix-length*> | **named-prefix** <*prefix name*><*ipv6 prefix/prefix-length*>**] lifetime [**<*valid lifetime*> | **infinite] [**<*preferred lifetime*> | **infinite]** command from the DHCPv6 Pool Configuration mode. The command can be entered multiple times, once for each link address. Up to **50** IPv6 prefixes can be entered. The <*ipv6 prefix/prefix-length*> parameter is the numerical value and length of the prefix. The prefix value is specified in colon hexadecimal format (**X:X::X/<Z>**), for example: **2001:DB8:1::/64**. The prefix length (<**Z**>) is an integer with a value between **0** and **128**. The **named-prefix** <*prefix name*> parameter specifies the name of the variable that holds the service provider assigned value for the prefix. The IPv6 prefix cannot be a link-local address. The <*ipv6 prefix/prefix-length*> associated with the **named-prefix** indicates the sub-bits that will be added to the named prefix value stored in the system. These prefixes are specified in colon hexadecimal format (**X:X::X/<Z>**), for example: **0:0:0:5::/64**, where the leading zeros are the bits the named prefix will overwrite. The <*valid lifetime*> parameter specifies the valid lifetime for the IPv6 address. The value must be greater than the preferred lifetime. Valid lifetime range is **0** to **4294967295** seconds, with a default lifetime of **2592000** seconds. If you are using a named prefix in this command, the default value is the value assigned by the delegating server. The **infinite** option specifies that the prefix does not age, and can be used instead of a specified valid lifetime. The <*preferred lifetime*> parameter specifies the preferred lifetime for the IPv6 address. The value must be less than the valid lifetime. Valid preferred lifetime range is **0** to **4294967295** seconds, with a default value of **604800** seconds. Using the **no** form of this command removes the IPv6 address prefix. By default, no IPv6 address prefixes are specified or sent to the client. To specify an IPv6 address prefix, enter the command as follows:

```
(config)#ipv6 dhcp pool POOL1
(config-dhcpv6)#address prefix 2001:DB8:1::/64 infinite infinite
```

To enable prefix delegation on the pool, enter the **prefix-delegation [**<*ipv6 prefix/prefix-length*> | **named-prefix** <*prefix name*><*ipv6 prefix/prefix-length*>**] lifetime [**<*valid lifetime*> | **infinite] [**<*preferred lifetime*> | **infinite]** command from the DHCPv6 Pool Configuration mode. The <*ipv6 prefix/prefix-length*> parameter is the numerical value and length of the prefix. The prefix value is specified in colon hexadecimal format (**X:X::X/<Z>**), for example: **2001:DB8:1::/64**. The prefix length (<**Z**>) is an integer with a value between **0** and **128**. The **named-prefix** <*prefix name*> parameter specifies the name of the variable that holds the service provider assigned value for the prefix. The IPv6 prefix cannot be a link-local address. The <*ipv6 prefix/prefix-length*> associated with the **named-prefix** indicates the sub-bits that will be added to the named prefix value stored in the system. These prefixes are specified in colon hexadecimal format (**X:X::X/<Z>**), for example: **0:0:0:5::/64**, where the leading zeros are the bits the named prefix will overwrite. The <*valid lifetime*> parameter specifies the valid lifetime for the IPv6 address. The valid lifetime value must be greater than the preferred lifetime. Valid lifetime range is **0** to **4294967295** seconds, with a default lifetime of **2592000** seconds. If you are using a named prefix in this command, the default value is the value assigned by the delegating server. The **infinite** option specifies that the prefix does not age, and can be used instead of a specified valid lifetime. The <*preferred lifetime*> parameter specifies the preferred lifetime for the IPv6 address. The preferred lifetime value must be less than the valid lifetime. Valid preferred lifetime range is **0** to **4294967295** seconds, with a default value of **604800** seconds. Using the **no** form of this command disables prefix delegation on the pool. By default, no IPv6 address prefixes are specified or sent to the client. To enable prefix delegation, enter the command as follows:

```
(config)#ipv6 dhcp pool POOL1
(config-dhcpv6)#prefix-delegation 2001:DB8:1::/64 infinite infinite
```


To specify the unicast IPv6 address of a SNTP server to be supplied to requesting DHCPv6 clients served by this pool, enter the **sntp-server** <*ipv6 address*> command from the DHCPv6 Pool Configuration mode. IPv6 addresses should be expressed in colon hexadecimal format (**X:X:X:X::X**), for example, **2001:DB8:1::1**. Multiple SNTP server addresses can be entered by using multiple instances of this command. Up to **50** addresses can be entered, and they are assigned in the order they are entered. By default, no SNTP information is specified or sent to the client. Using the **no** form of this command removes the server address from the pool. If no server address is specified when using the **no** form of this command, all SNTP server addresses are removed from the pool. To add an SNTP server address to the DHCPv6 server pool, enter the command as follows:

```
(config)#ipv6 dhcp pool POOL1
(config-dhcpv6)#sntp-server 2001:DB8:1::1
```

To specify the unicast IPv6 address or a multicast group address of an NTP server to be supplied to requesting DHCPv6 clients served by this pool, enter the **ntp address** <*ipv6 address*> command from the DHCPv6 Pool Configuration mode. IPv6 addresses should be expressed in colon hexadecimal format (**X:X:X:X::X**), for example, **2001:DB8:1::1**. Multiple NTP server addresses can be entered by using multiple instances of this command. Up to **50** addresses can be entered, and they are assigned in the order they are entered. By default, no NTP information is specified or sent to the client. Using the **no** form of this command removes the server address from the pool. If no server address is specified when using the **no** form of this command, all NTP server addresses are removed from the pool. To add an NTP server address to the DHCPv6 server pool, enter the command as follows:

```
(config)#ipv6 dhcp pool POOL1
(config-dhcpv6)#ntp address 2001:DB8:1::1
```

To specify the domain name of an NTP server to be supplied to requesting DHCPv6 clients served by this pool, enter the **ntp domain-name** <*name*> command from the DHCPv6 Pool Configuration mode. The <*name*> parameter is the fully qualified domain name of an IPv6 NTP server. Multiple NTP server domain names can be entered by using multiple instances of this command. Up to **50** domain names can be entered, and they are assigned in the order they are entered. By default, no NTP information is specified or sent to the client. Using the **no** form of this command removes the server domain name from the pool. If no server domain name is specified when using the **no** form of this command, all NTP server domain names are removed from the pool. To add an NTP server domain name to the DHCPv6 server pool, enter the command as follows:

```
(config)#ipv6 dhcp pool POOL1
(config-dhcpv6)#ntp domain-name NAME1
```

To specify a generic DHCPv6 option to assign to clients using this pool, enter the **option** <*number*> **[ascii** <*string*> | **hex** <*hexbytes*> | **address** <*ipv6 address*>**]** command from the DHCPv6 Pool Configuration mode. Any number of generic options can be assigned. The <*number*> parameter specifies the DHCPv6 option number. Valid range is **0** to **65535**. The **ascii** <*string*> parameter specifies the option value in simple text (ASCII) with a string of up to **256** characters. The **hex** <*hexbytes*> parameter specifies the option value as a hexadecimal number with up to **512** digits. The **address** <*ipv6 address*> parameter specifies the option value as an IPv6 address. IPv6 addresses should be expressed in colon hexadecimal format (**X:X:X:X::X**), for example, **2001:DB8:1::1**. By default, no options are configured. Using the **no** form of this command removes the option from the DHCPv6 server pool. To specify a generic DHCPv6 option for clients using this pool, enter the command as follows:

```
(config)#ipv6 dhcp pool POOL1
(config-dhcpv6)#option 35 address 2001:DB8:1::1
```


To specify the IPv6 address of a SIP server that is supplied to requesting DHCPv6 clients served by this pool, enter the **sip address** <*ipv6 address*> command from the DHCPv6 Pool Configuration mode. IPv6 addresses should be expressed in colon hexadecimal format (**X:X:X:X::X**), for example, **2001:DB8:1::1**. By default, no SIP server is specified or sent to the requesting client. Multiple SIP server addresses can be added to the pool by entering the command multiple times. Each address is added or deleted individually. Up to **50** addresses can be added to the pool, but addresses are assigned in the order in which they are entered. Using the **no** form of this command removes the SIP server address from the pool. If no SIP server address is specified when using the **no** form of this command, all SIP server addresses are removed from the pool. To add a SIP server address to the DHCPv6 server pool, enter the command as follows:

(config)**#ipv6 dhcp pool POOL1**
(config-dhcpv6)**#sip address 2001:DB8:1::1**

To specify a SIP server domain name that is supplied to requesting DHCPv6 clients served by this pool, enter the **sip domain-name** <*name*> command from the DHCPv6 Pool Configuration mode. The <*name*> parameter is the FQDN of an IPv6 SIP server, entered in ASCII text of up to **256** characters. Typically, the SIP server domain name is the domain name of the SIP outbound proxy server for the DHCPv6 client to use. Multiple SIP server domain names can be entered by using multiple instances of this command. Up to **50** domain names can be entered, and they are assigned in the order they are entered. By default, no SIP server information is specified or sent to the client.

Using the **no** form of this command removes the server domain name from the pool. If no server domain name is specified when using the **no** form of this command, all SIP server domain names are removed from the pool. To add a SIP server domain name to the DHCPv6 server pool, enter the command as follows:

(config)**#ipv6 dhcp pool POOL1**
(config-dhcpv6)**#sip domain-name NAME2**

To specify the time zone information (in POSIX form) that is supplied to requesting DHCPv6 clients served by this pool, enter the **timezone posix** <*string*> command from the DHCPv6 Pool Configuration mode. The <*string*> parameter is a time zone POSIX string, entered in the following format: **EST5EDT4,M3.2.0/02:00,M11.1.0/02:00**. By default, no time zone POSIX information is specified. Using the **no** form of this command removes the time zone information. To enter time zone POSIX information, enter the command as follows:

(config)**#ipv6 dhcp pool POOL1**
(config-dhcpv6)**#timezone posix EST5EDT4,M3.2.0/02:00,M11.1.0/02:00**

To specify the time zone information (in standard time zone database (TZDB) format) that is supplied to requesting DHCPv6 clients served by this pool, enter the **timezone** <*timezone* | *tzdb string*> from the DHCPv6 Pool Configuration mode. The <*timezone*> parameter is a predefined value that indicates the desired time zone. Enter **timezone ?** to display the available time zones and their associated cities. The <*tzdb string*> parameter specifies a time zone string in TZDB format (as defined in RFC 4833), and is limited to **256** characters, for example, **America\Chicago**. By default, no time zone information is specified. Using the **no** form of this command removes the time zone information. To enter time zone information, enter the command as follows:

(config)**#ipv6 dhcp pool POOL1**
(config-dhcpv6)**#timezone America\Chicago**

Any configuration done to the DHCPv6 server pool typically occurs on the default VRF. If you want to associate the DHCPv6 server pool with a nondefault VRF, enter the **vrf** <*name*> command from the DHCPv6 Pool Configuration mode. The <*name*> parameter is the nondefault VRF with which you want to associate the pool. By default, the DHCPv6 server pool is associated with the default (unnamed) VRF. Using the **no** form of this command removes the nondefault VRF association and associates the server pool with the default VRF. To associate the server pool with a nondefault VRF (**RED**), enter the command as follows:

```
(config)#ipv6 dhcp pool POOL1
(config-dhcpv6)#vrf RED
```

Configuring DHCPv6 Hosts from the DHCPv6 Server Pool

You can create a DHCPv6 host entry within the DHCPv6 server pool from the DHCPv6 Pool Configuration mode. This command creates a host entry in the server pool, and enters the DHCPv6 Pool Host Configuration mode where you can specify IPv6 address and host name bindings for a single client.

To specify the manual binding of a set of information to a single client as identified by a client ID (DUID), and enter the host configuration mode, enter the **host client-identifier** <*client DUID*> **[**<*IAID*>**]** command from the DHCPv6 Pool Host Configuration mode. The value specified by this command is used to allow a single device, or interface, to match the pool and is used as part of the automatic pool selection algorithm that matches client requests to the best pool from which to assign information to the client. The <*client DUID*> parameter specifies the DUID of the client to be matched as a DHCPv6 host. The DUID is expressed as a hexadecimal value. The optional <*IAID*> parameter is the hexadecimal value that represents the IAID expected in the client request. By default, no host client ID is specified. Using the **no** form of this command removes the host client ID (DUID) from the pool. To create a host client ID (the DUID), enter the command as follows:

```
(config-dhcpv6)#host client-identifier F2A4C9
```

To specify an IPv6 address is manually bound to a single client identified by its client ID (DUID), enter the **address** <*ipv6 address*> **lifetime [**<*valid lifetime*> | **infinite] [**<*preferred lifetime*> | **infinite]** command from the DHCPv6 Pool Host Configuration mode. The <*ipv6 address*> parameter specifies the IPv6 address to assign to the single client. There is no associated prefix length with this address. IPv6 addresses should be expressed in colon hexadecimal format (**X:X:X:X::X**), for example, **2001:DB8:1::1**. The <*valid lifetime*> parameter specifies the valid lifetime for the IPv6 address. The value must be greater than the preferred lifetime. Valid lifetime range is **0** to **4294967295** seconds, with a default lifetime of **2592000** seconds. The **infinite** option specifies that the prefix does not age, and can be used instead of a specified valid lifetime. The <*preferred lifetime*> parameter specifies the preferred lifetime for the IPv6 address. The value must be less than the valid lifetime. Valid preferred lifetime range is **0** to **4294967295** seconds, with a default value of **604800** seconds. The **infinite** option specifies that the prefix does not age, and can be used instead of a specified preferred lifetime.

Using the **no** form of this command removes the IPv6 address. Multiple addresses (up to **50**) can be entered for a single DUID using multiple instances of this command. To specify an IPv6 address bound to the client, enter the command as follows:

```
(config-dhcpv6)#host client-identifier F2A4C9
(config-dhcpv6-host)#address 2001:DB8::1 lifetime infinite infinite
```


You can also specify an IPv6 prefix to be bound to the client by entering the **address named-prefix** <*prefix-name*> <*ipv6 prefix/prefix-length*> **lifetime [**<*valid lifetime*> | **infinite] [**<*preferred lifetime*> | **infinite]** command from the DHCPv6 Pool Host Configuration mode. The <*prefix-name*> parameter specifies the named prefix to bind to the client. The <*ipv6 prefix/prefix-length*> parameter specifies the address portion appended to the named prefix to create a 128-bit host address. IPv6 named prefixes should be expressed in colon hexadecimal format (**X:X::X/<Z>**), for example, **0:0:0:5::/64**, where the leading zeros are the bits the named prefix will overwrite. The prefix length (**<Z>**) is an integer with a value between **0** and **128**. The <*valid lifetime*> parameter specifies the valid lifetime for the IPv6 address. The value must be greater than the preferred lifetime. Valid lifetime range is **0** to **4294967295** seconds, with a default lifetime of **2592000** seconds. The **infinite** option specifies that the prefix does not age, and can be used instead of a specified valid lifetime. The <*preferred lifetime*> parameter specifies the preferred lifetime for the IPv6 address. The value must be less than the valid lifetime. Valid preferred lifetime range is **0** to **4294967295** seconds, with a default value of **604800** seconds. The **infinite** option specifies that the prefix does not age, and can be used instead of a specified preferred lifetime. By default, no IPv6 host addresses are specified. Using the **no** form of this command removes the IPv6 address. Multiple addresses (up to **50**) can be entered for a single client ID using multiple instances of this command. To specify an IPv6 address bound to the client, enter the command as follows:

```
(config-dhcpv6)#host client-identifier F2A4C9
(config-dhcpv6-host)#address named-prefix PREFIX1 0:0:0:5::/64 lifetime infinite infinite
```

To specify the manual binding of a host name or FQDN to the specified client, enter the **hostname [**<*partial fqdn*> | **fqdn** <*fqdn*>**]** command from the DHCPv6 Pool Host Configuration mode. The **hostname** command specifies a host name for the client, and the <*partial fqdn*> parameter specifies the client's host portion of its FQDN without a specified zone. The **fqdn** <*fqdn*> parameter specifies the client's entire FQDN. By default, no host names are specified. Using the **no** form of this command removes the host name or FQDN from the client. To specify an FQDN for the client, enter the command as follows:

```
(config-dhcpv6)#host client-identifier F2A4C9
(config-dhcpv6-host)#fqdn host.company.com
```

To enable prefix delegation for a specific client, enter the **prefix-delegation [**<*ipv6 prefix/prefix-length*> | **named-prefix** <*prefix name*><*ipv6 prefix/prefix-length*>**] lifetime [**<*valid lifetime*> | **infinite] [**<*preferred lifetime*> | **infinite]** command from the DHCPv6 Pool Host Configuration mode. The <*ipv6 prefix/prefix-length*> parameter is the numerical value and length of the prefix. The prefix value is specified in colon hexadecimal format (**X:X::X/<Z>**), for example: **2001:DB8:1::/64**. The prefix length (<**Z**>) is an integer with a value between **0** and **128**. The **named-prefix** <*prefix name*> parameter specifies the name of the variable that holds the service provider assigned value for the prefix. The IPv6 prefix cannot be a link-local address. The <*ipv6 prefix/prefix-length*> associated with the **named-prefix** indicates the sub-bits that will be added to the named prefix value stored in the system. These prefixes are specified in colon hexadecimal format (**X:X::X/<Z>**), for example: **0:0:0:5::/64**, where the leading zeros are the bits the named prefix will overwrite. The <*valid lifetime*> parameter specifies the valid lifetime for the IPv6 address. The valid lifetime value must be greater than the preferred lifetime. Valid lifetime range is **0** to **4294967295** seconds, with a default lifetime of **2592000** seconds. If you are using a named prefix in this command, the default value is the value assigned by the delegating server. The **infinite** option specifies that the prefix does not age, and can be used instead of a specified valid lifetime. The <*preferred lifetime*> parameter specifies the preferred lifetime for the IPv6 address. The preferred lifetime value must be less

than the valid lifetime. Valid preferred lifetime range is **0** to **4294967295** seconds, with a default value of **604800** seconds. Using the **no** form of this command disables prefix delegation on the pool. By default, no IPv6 address prefixes are specified or sent to the client. To enable prefix delegation, enter the command as follows:

```
(config-dhcpv6)#host client-identifier F2A4C9
(config-dhcpv6-host)#prefix-delegation 2001:DB8:1::/64 infinite infinite
```

Configuring Vendor-Specific DHCPv6 Server Pools

In addition to configuring the general DHCPv6 server pool options, you can optionally configure the DHCPv6 server pool to operate according to a specific vendor. To specify a vendor-specific option, and enter the vendor-specific configuration mode, enter the **vendor-specific** <*number*> command from the DHCPv6 Pool Configuration mode. The <*number*> parameter of the command is the enterprise identifier of the vendor information you are entering. Range is **1** to **4294967295**. By default, no vendor-specific options are configured. Using the **no** form of this command removes the vendor-specific option from the pool. To add a vendor-specific option to the DHCPv6 server pool, and enter the Vendor-Specific Configuration mode, enter the command as follows:

```
(config)#ipv6 dhcp pool POOL1
(config-dhcpv6)#vendor-specific 5
(config-dhcpv6-vs)#
```

Once you have entered the Vendor-Specific Configuration mode for the DHCPv6 server pool, you can specify a vendor-specific suboption to assign to clients that use this pool. Any number of suboptions can be assigned. Use the **suboption** <*number*> **[ascii** <*string*> | **hex** <*hexbytes*> | **address** <*ipv6 address*>**]** command from the vendor-specific configuration mode to specify a suboption. The <*number*> parameter is the vendor-specific option number for the suboption. Valid range is **0** to **65535**. The **ascii** <*string*> parameter specifies that the suboption is expressed as a ASCII text string of up to **256** characters. The **hex** <*hexbytes*> parameter specifies that the suboption is expressed as a hexadecimal number of up to **512** digits. The **address** <*ipv6 address*> parameter specifies that the suboption value is an IPv6 address. IPv6 addresses should be expressed in colon hexadecimal format (**X:X:X:X::X**), for example, **2001:DB8:1::1**. By default, no suboptions are configured. Using the **no** form of this command removes the suboption from the vendor-specific entry. To add a suboption to the vendor-specific entry, enter the command as follows:

```
(config)#ipv6 dhcp pool POOL1
(config-dhcpv6)#vendor-specific 5
(config-dhcpv6-vs)#suboption 6 address 2001:DB8:1::1
```

Step 4: Enabling IPv6 on an Interface

Because AOS uses the dual stack for IPv6 implementation, the IPv6 stack must be enabled for the supported IPv6 features to be used. Enabling IPv6 on an interface in AOS is completed by using an IPv6 address or using the **ipv6** keyword with specific commands. For example, to enable IPv6 on an interface and cause the interface to join the link-scoped all-nodes and all-routers multicast group, enter an IPv6 address from the interface's configuration mode as follows:

```
(config)#interface ethernet 0/1
(config-eth 0/1)#ipv6 address 2001:DB8::1
```


Step 5: Configuring DHCPv6 on the Interface

After configuring the global parameters for DHCPv6, and enabling IPv6 on an interface, you can configure the interface to operate as a DHCPv6 relay, server, or client. These configurations, as well as named prefix use, are discussed in the following sections.

Configuring an IPv6 Address on the Interface Using a Named Prefix

To create an IPv6 address on the interface using a named prefix, enter the **ipv6 address named-prefix** <*prefix name*> <*ipv6 prefix/prefix-length*> **[eui-64]** command from the interface's configuration mode. This command allows the interface address to be created using a named prefix. The <*prefix name*> parameter of the command specifies the name of the previously created named prefix. The <*ipv6 prefix/prefix-length*> parameter is the numerical value and length of the prefix. The named prefix value is specified in colon hexadecimal format (**X:X::X/<Z>**), for example: **0:0:0:5::/64**, where the leading zeros are the bits the named prefix will overwrite. The prefix length (**<Z>**) is an integer with a value between **0** and **128**. The IPv6 prefix cannot be a link-local address. The optional **eui-64** parameter specifies that the interface ID is placed in the lower 64 bits of the address. Use the **no** form of this command to remove the IPv6 address. By default, no IPv6 address is configured on the interface. To create an IPv6 address on the interface using a named prefix, enter the command as follows:

```
(config)#interface ethernet 0/1
(config-eth 0/1)#ipv6 address named-prefix PREFIX1 0:0:0:5::/64
```

Configuring the ND Settings on the Interface Using a Named Prefix

ND settings on the interface are specified using the **ipv6 nd prefix [**<*ipv6 address/prefix-length*> | **named-prefix** <*prefix name*> <*ipv6 address/prefix-length*>**] [**<*valid lifetime*> | **infinite] [**<*preferred lifetime*> | **infinite] [off-link] [no-rtr-address] [no autoconfig] [no-advertise] [no onlink]** command from the interface's configuration mode. The <*ipv6 prefix/prefix-length*> parameter is the numerical value and length of the prefix. The prefix value is specified in colon hexadecimal format (**X:X::X/<Z>**), for example: **2001:DB8:1::/64**. The prefix length (**<Z>**) is an integer with a value between **0** and **128**. The IPv6 prefix cannot be a link-local address. The **named-prefix** option specifies that a named prefix value is used in the creation of the ND prefix. The <*prefix name*> parameter of the command specifies the name of the previously created named prefix. The <*ipv6 prefix/prefix-length*> associated with the **named-prefix** parameter indicates the sub-bits that will be added to the named prefix value stored in the system. These prefixes are specified in colon hexadecimal format (**X:X::X/<Z>**), for example: **0:0:0:5::/64**, where the leading zeros are the bits the named prefix will overwrite. The <*valid lifetime*> parameter specifies the valid lifetime for the IPv6 address. The value must be greater than the preferred lifetime. Valid lifetime range is **0** to **4294967295** seconds, with a default lifetime of **2592000** seconds. If you are using a named prefix in this command, the default value is the value assigned by the delegating server. The <*preferred lifetime*> parameter specifies the preferred lifetime for the IPv6 address. The value must be less than the valid lifetime. Valid preferred lifetime range is **0** to **4294967295** seconds, with a default value of **604800** seconds. The **infinite** option specifies that the prefix does not age, and can be used instead of a specified valid or preferred lifetime. The optional **off-link** parameter specifies that the prefix is off link, the optional **no-rtr-address** parameter specifies that the full router address is not sent in prefix advertisements, the optional **no autoconfig** parameter specifies that the prefix is not used for autoconfiguration, the optional **no-advertise** parameter specifies that the prefix is not advertised, and the optional **no onlink** parameter specifies that the prefix is not used for onlink determination. The **no** version of this command to remove the prefix. By default, no prefixes are configured. To create an ND prefix, enter the command as follows:

(config)**#interface ethernet 0/1**
(config-eth 0/1)**#ipv6 nd prefix named-prefix PREFIX1 0:0:0:5::/64 infinite infinite no autoconfig**

Placing the Interface in Host Mode

Use the **ipv6 mode host unicast** command from the interface's configuration mode to place the interface in host mode using an IPv6 unicast address. Enter the command as follows:

(config)**#interface ethernet 0/1**
(config-eth 0/1)**#ipv6 mode host unicast**

> *When this command is configured on an interface, the MTU value is learned from received router advertisements. Link MTU value is learned in host mode from the following locations (in decreasing order of priority): the provisioned MTU value in the interface configuration, the router advertisements received on the interface, and the default MTU value (1500).*

Configuring DHCPv6 Relay on an Interface

DHCPv6 relay is configured on a per-interface basis, just as with DHCPv4. To configure an interface to function as a DHCPv6 relay agent, you must enable IPv6 on the interface (using the **ipv6** command) and set the destination for DHCPv6 Relay-Forward messages (using the **ipv6 dhcp relay destination** command).

> *Enabling the interface as a DHCPv6 server using the **ipv6 dhcp server** command places the interface into DHCPv6 server mode. DHCPv6 modes (client, server, relay) are mutually exclusive at the interface. Any existing mode must be removed before a different mode can be applied. For example, if the interface is configured as a DHCPv6 relay agent, you must first disable the relay mode before you can specify the interface is in server mode.*

Enter the **ipv6 dhcp relay destination** <*ipv6 address*> **[**<*interface*>**]** command from the interface's configuration mode. The **destination** <*ipv6 address*> parameter specifies the IPv6 address of the next DHCPv6 relay agent or the DHCPv6 server. IPv6 addresses should be expressed in colon hexadecimal format (**X:X:X:X::X**), for example, **2001:DB8:1::1**. Optionally, the <*interface*> parameter specifies an output interface to use when the destination address is a link-scoped address. Using the **no** form of this command disables the relay functionality for the specified destination. When all destinations are removed, DHCPv6 relay functionality is disabled on the interface. By default, no DHCPv6 relay agent destinations are configured and the relay agent mode is disabled. Enter the commands from the interface's configuration mode as follows:

(config)**#interface ethernet 0/1**
(config-eth 0/1)**#ipv6 address 2001:DB8:1::1/64**
(config-eth 0/1)**#ipv6 dhcp relay destination 2001:DB8:2::1**

Configuring the DHCPv6 Server on an Interface

You can also configure an interface to operate as a DHCPv6 server. To do so, you must enable IPv6 on the interface (using the **ipv6** command), and then enable the DHCPv6 server on the interface using the **ipv6 dhcp server [**<*pool name*> | **automatic] [allow-hint | preference** <*number*> **| rapid-commit]** command from the interface's configuration mode. The **ipv6 dhcp server** command not only enables the DHCPv6 server on the interface, it also configures specific parameters of the DHCPv6 server. Hence, the parameters of this command can be entered multiple times and in any order.

*Enabling the interface as a DHCPv6 server using the **ipv6 dhcp server** command places the interface into DHCPv6 server mode. DHCPv6 modes (client, server, relay) are mutually exclusive at the interface. Any existing mode must be removed before a different mode can be applied. For example, if the interface is configured as a DHCPv6 relay agent, you must first disable the relay mode before you can specify the interface is in server mode.*

The <*pool name*> parameter specifies the DHCPv6 server pool that services this interface. All DHCPv6 requests received on this interface are serviced from this pool. If a pool name is not specified, the server pool is selected automatically. You must specify the pool selection method before configuring the other options for this command.

The **automatic** parameter enables automatic selection of the DHCPv6 server pool based on information extracted from the DHCPv6 client's request. You must specify the pool selection method before configuring the other options for this command.

The **allow-hint** parameter specifies that the server attempts to honor the DHCPv6 client's request for specific values as hinted in the client's request (if they are valid and not already assigned). If this option is not specified, any hints from the DHCPv6 client are ignored.

The **preference** <*number*> parameter specifies the preference value advertised by the server. Valid range is **0** to **255**, with a default value of **0**. The preference option is sent by the server to a client to influence the selection of a server when there are multiple servers from which to choose. When the preference is set to a non-zero value, the server includes a preference option containing the value. If the preference value is not set, or is set to 0, the option is omitted and the client assumes the value is 0.

The **rapid-commit** parameter allows the client to request the use of a two message address exchange instead of the normal four message exchange. This option should not be used if more than one DHCPv6 server is available to clients on the network being served. Since a single server is not selected in a two message exchange, it is possible that more than one server might interact with the client. Use of rapid commit must be employed by both the DHCPv6 client and server; so, even if rapid commit is set for the server with this command, the client may not request it.

By default, DHCPv6 server mode is not enabled on the interface. Using the **no** form of this command disables the DHCPv6 server on the interface.

To enable an interface as a DHCPv6 server, and specify the DHCPv6 server pool name associated with the interface, enter the command from the interface's configuration mode as follows:

```
config)#interface ethernet 0/1
(config-eth 0/1)#ipv6 address 2001:DB8:1::1/64
(config-eth 0/1)#ipv6 dhcp server POOL1
```


Configuring the DHCPv6 Client on the Interface

You can also configure an interface to operate as a DHCPv6 client. To do so, you must enable IPv6 on the interface (using the **ipv6** command), and then enable the DHCPv6 client on the interface. The first method to enable the DHCPv6 client is by using the **ipv6 address dhcp [hostname** <*partial fqdn*> **| fqdn** <*fqdn*>**] [no-domain-name] [no-nameservers] [no-information-refresh] [no-sip-address] [no-sip-domain-name] [no-ntp] [no-timezone] [iaid** <*iaid*>**] [rapid-commit]** command from the interface's configuration mode. The **ipv6 address dhcp** command not only enables the DHCPv6 client on the interface, it also configures the specific addressing parameters of the DHCPv6 client.

*Enabling the interface as a DHCPv6 client using the **ipv6 address dhcp** command places the interface into DHCPv6 client mode. DHCPv6 modes (client, server, relay) are mutually exclusive at the interface. Any existing mode must be removed before a different mode can be applied. For example, if the interface is configured as a DHCPv6 relay agent, you must first disable the relay mode before you can specify the interface is in client mode.*

The optional **hostname** <*partial fqdn*> parameter specifies the name to be sent to the DHCPv6 server as the host portion of its FQDN. FQDNs are expressed in ASCII text of up to **254** characters. The string can be enclosed in quotation marks.

The optional **fqdn** <*fqdn*> parameter specifies a name to be sent to the DHCPv6 server as the system's FQDN. FQDNs are expressed in ASCII text of up to **254** characters. The string can be enclosed in quotation marks.

The optional **no-domain-name** parameter specifies that no domain names are obtained using this DHCPv6 client.

The optional **no-nameservers** parameter specifies that no DNS server addresses are obtained through DHCPv6.

The optional **no-information-refresh** parameter specifies that no information refresh setting is obtained through this DHCPv6 client.

The optional **no-sip-address** parameter specifies that no SIP addresses are obtained through this DHCPv6 client.

The optional **no-sip-domain-name** parameter specifies that no SIP domain names are obtained through this DHCPv6 client.

The optional **no-ntp** parameter specifies that no NTP server values are obtained through this DHCPv6 client.

The optional **no-timezone** parameter specifies the no timezone information is obtained through this DHCPv6 client.

The optional **iaid** <*iaid*> parameter manually specifies an IAID to be used for this client. This option is helpful when the DHCPv6 server is maintaining manual bindings for more than one interface on the same client, which is not uniquely identified by DUID alone. By default, the AIAD is automatically given the value generated by the system for the interface. The <*iaid*> is specified in a 32-bit hexadecimal number.

The optional **rapid-commit** parameter enables rapid commit on the DHCPv6 client. When rapid commit is enabled on the both the server and the client, the DHCPv6 message exchange is reduced to a two message exchange (using only the Solicit and Reply messages). This feature is disabled by default.

By default, DHCPv6 client mode is not enabled on the interface. Using the **no** form of this command disables the DHCPv6 client on the interface. To enable an interface as a DHCPv6 client, and specify the host name associated with the client, enter the command from the interface's configuration mode as follows:

```
(config)#interface ethernet 0/1
(config-eth 0/1)#ipv6 address 2001:DB8:1::1/64
(config-eth 0/1)#ipv6 address dhcp fqdn clientpc.company.com no-sip-address
    no-sip-domain-name
```

To enable the DHCPv6 client on the interface and specify that the interface acquires an IPv6 prefix for the DHCPv6 client, enter the **ipv6 dhcp client pd** <*prefix name*> **[no-aggregate-route] [**<*distance*> **[tag** <*value*>**]] [iaid** <*iaid*>**]** command from the interface's configuration mode. Using this command enables prefix delegation for the client on the interface. Prefix delegation allows the DHCPv6 client to request a prefix from the server, which is then stored as a variable on the client system. The <*prefix name*> parameter of this command specifies the variable of the prefix stored on the system. Variables are expressed in ASCII text up to **80** characters. This prefix variable cannot be the same prefix specified by the **ipv6 named-prefix** command. The optional **no-aggregate-route** parameter specifies that a route to the null 0 interface is not injected into the route table for the prefixes assigned. By default, a route to the null 0 interface is injected into the route table for the assigned prefixes. The optional <*distance*> parameter specifies the administrative distance to assign to the injected route. Valid distance range is **1** to **255**, with a default value of **1**. The optional **tag** <*value*> parameter specifies a number to use as a tag for labeling and filtering routes when they are dynamically redistributed into a routing protocol such as RIP, OSPF, or BGP. Valid tag range is **1** to **65535**. The optional **iaid** <*iaid*> parameter manually specifies an IAID to be used for this client. This option is helpful when the DHCPv6 server is maintaining manual bindings for more than one interface on the same client, which is not uniquely identified by DUID alone. By default, the AIAD is automatically given the value generated by the system for the interface. The <*iaid*> is specified in a 32-bit hexadecimal number. By default, the DHCPv6 client mode is not enabled on the interface. Using the **no** form of this command disables the use of the DHCPv6 client on the interface. To enable the DHCPv6 client, and specify that the interface acquires an IPv6 prefix, enter the command as follows:

```
(config)#interface ethernet 0/1
(config-eth 0/1)#ipv6 address 2001:DB8:1::1/64
(config-eth 0/1)#ipv6 dhcp client pd name3
```

To specify the minimum value the DCHPv6 client on this interface accepts as its information refresh timer, enter the **ipv6 dhcp client information refresh minimum** <*seconds*> command from the interface's configuration mode. The DHCPv6 client uses this specified value, or the value assigned by the server, based on which is greater. This timer is used for information acquired by the DHCPv6 client on the interface using stateless DHCPv6 exchange. By default, the minimum refresh timer is set to **600** seconds, with a range of **600** to **3600** seconds. Using the **no** form of this command returns the refresh timer to the default value. To change the information refresh timer for the client, enter the command as follows:

```
(config)#interface ethernet 0/1
(config-eth 0/1)#ipv6 address 2001:DB8:1::1/64
(config-eth 0/1)#ipv6 dhcp client information refresh minimum 2000
```


To enable DHCPv6 prefix delegation on the interface, enter the **ipv6 dhcp client pd** <*prefix name*> **[**<*distance*> **| no-aggregate-route | rapid-commit]** command from the interface's configuration mode. The <*prefix name*> parameter of this command specifies the variable of the prefix stored on the system. Variables are expressed in ASCII text up to **80** characters. The optional <*distance*> parameter specifies the administrative distance to assign to the injected route. Valid distance range is **1** to **255**, with a default value of **1**. The optional **no-aggregate-route** parameter specifies that a route to the null 0 interface is not injected into the route table for the prefixes assigned. By default, a route to the null 0 interface is injected into the route table for the assigned prefixes. The optional **rapid-commit** parameter specifies that two message DHCPv6 exchanges are enabled for prefixes assigned at the interface. To enable prefix delegation on the interface, and enable rapid commit, enter the command as follows:

```
(config)#interface ethernet 0/1
(config-eth 0/1)#ipv6 address 2001:DB8:1::1/64
(config-eth 0/1)#ipv6 dhcp client pd PREFIX1 rapid-commit
```

DHCPv6 Configuration Examples

The example scenarios contained in this section are designed to enhance understanding of DHCPv6 configurations on AOS products. The examples describe some of the common real-world applications of DHCPv6. All configurations provided in this section use the command line interface (CLI).

> NOTE
>
> *The configuration parameters entered in these examples are sample configurations only. These applications should be configured in a manner consistent with the needs of your particular network. CLI prompts have been removed from the configuration examples to provide a method of copying and pasting configurations directly from this configuration guide into the CLI. These configurations should not be copied without first making the necessary adjustments to ensure they will function properly in your network.*

Example 1: Local Network Management Using DHCPv6

In the following example, the IPv6 addressing of the main customer site is managed locally. The AOS device is statically configured on the local side of the network, and DHCPv6 hosts get their addresses and other configuration information using DHCPv6, which serves them locally. In this scenario, the following steps occur:

1. The AOS router at the customer edge of the network has a provider-side interface (**Eth 0/2**), with an IPv6 address that is configured using any available method (manual, DHCPv6, SLAAC, etc.).
2. The AOS router, functioning as a DHCPv6 server, advertises to the DHCPv6 client on the subscriber side of the network using a router advertisement message from the **Eth 0/1** interface. The message does not contain a prefix since the host does not use SLAAC and does not need to learn the prefix from the message because it is assigned an address on the same prefix as the router. The message does have the M-bit set, indicating that clients should use DHCPv6 to acquire address and other configuration information.
3. Per M-bit, the DHCPv6 clients use DHCPv6 stateful exchange to request address and other information.
4. The AOS router's local DHCPv6 server responds to the clients and assigns the appropriate information.

Figure 1 on page 32 illustrates the topology of this network scenario.

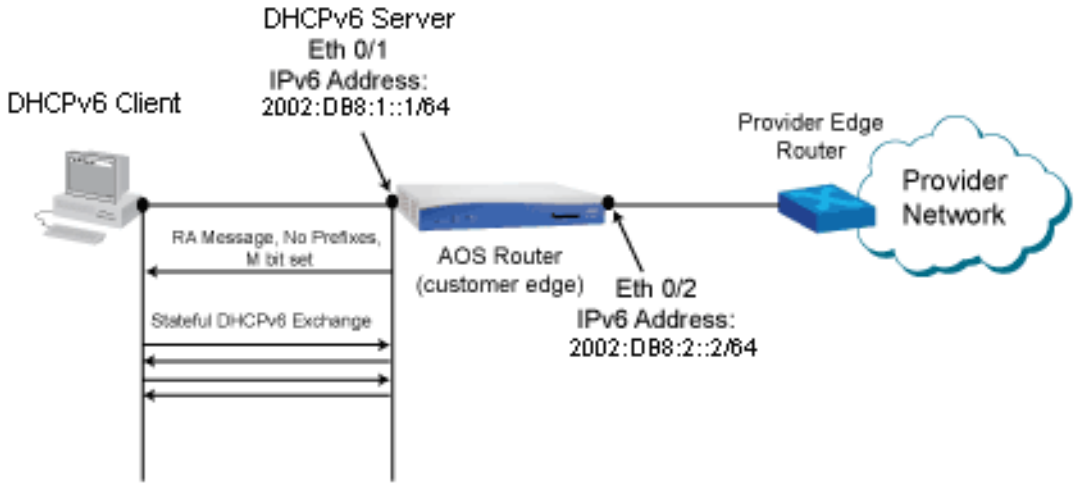

Figure 1. Local Network Management Using DHCPv6

The configuration of the AOS device for this scenario is as follows:

```
!
ipv6 dhcp pool SUBNET1
    address prefix 2002:DB8:1::/64
    dns-server 2002:DB8:1::1
    domain-name cust1.com
!
interface eth 0/1
    ipv6
    ipv6 address 2002:DB8:1::1/64
    ipv6 nd prefix 2002:DB8:1::/64 infinite infinite no-advertise
    ipv6 nd managed-config-flag
    ipv6 dhcp server SUBNET1
!
interface eth 0/2
    ipv6
    ipv6 address 2002:DB8:2::2/64
!
```

Example 2: Central Network Management Using DHCPv6 Relay

In the following example, the IPv6 addressing of the network site (including the AOS device and other hosts) is managed from a central location. The AOS device is dynamically configured on the upstream interface (**eth 0/2**), and acts as a DHCPv6 relay for local hosts who get their addresses and other configuration information using DHCPv6 from a distant DHCPv6 server. In this scenario, the following steps occur:

1. The AOS device uses DHCPv6 stateful exchange to request an address and other configuration information for its upstream interface, **eth 0/2**.
2. The AOS device then advertises to the subscriber-side interface (**eth 0/1**) with no prefix information and a set M-bit.
3. Per M-bit, the DHCPv6 clients use DHCPv6 stateful exchange to request IPv6 address and other information.
4. The AOS device acts as a DHCPv6 relay, and forwards the messages between the DHCPv6 clients and the distant DHCPv6 server.
5. The DHCPv6 server responds and assigns the information.

Figure 2 illustrates the topology of this network scenario.

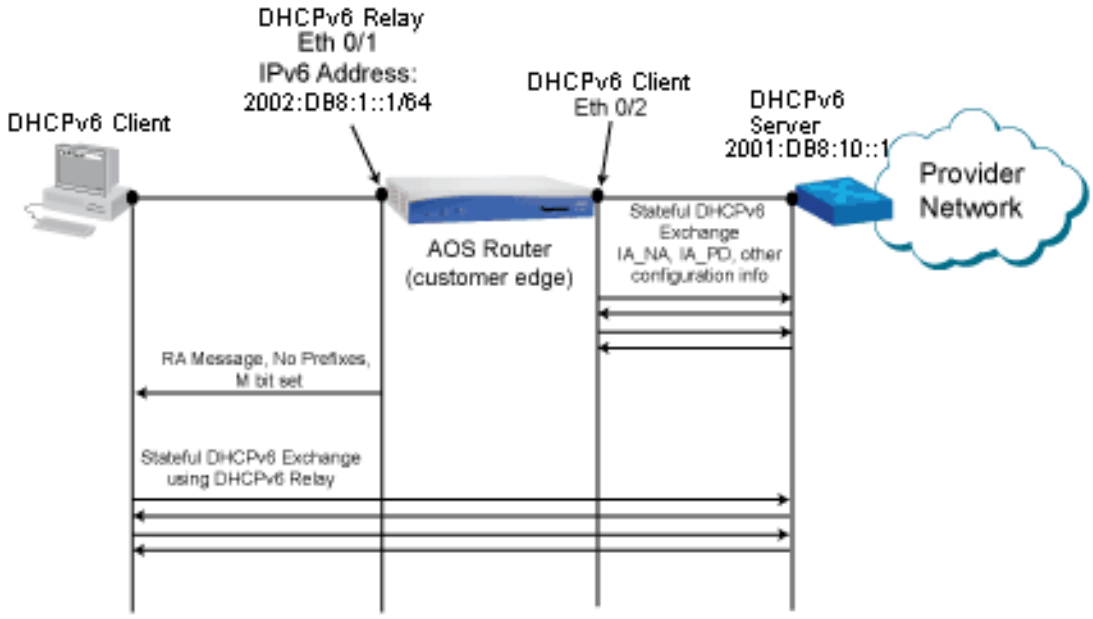

Figure 2. Central Network Management Using DHCPv6 Relay

The AOS device DHCPv6 configuration for this scenario is as follows:

```
!
interface eth 0/1
    ipv6
    ipv6 address 2002:DB8:1::1/64
    ipv6 nd prefix 2002:DB8:1::/64 infinite infinite no-advertise
    ipv6 nd managed-config-flag
    ipv6 dhcp relay destination 2001:DB8:10::1
!
```



```
interface eth 0/2
    ipv6
    ipv6 address dhcp
!
```

Example 3: Central Managed Network with Prefix Delegation, Information Import, and SLAAC

In this scenario, the IPv6 addresses of the site are managed from a central location. The AOS device is dynamically configured and information acquired by the device is transferred internally for use by hosts. Hosts get their addresses and other configuration using SLAAC and DHCPv6 from the local router. In this scenario, the following events occur:

1. Per configuration, the AOS device uses DHCPv6 stateful exchange to request an address for its upstream interface, a prefix to use elsewhere, and other configuration information from a server.
2. The local device assigns the address to its upstream interface, assigns the prefix to the named prefix variable PREFIX1, and imports other configuration information to the DHCPv6 server pool named INFO1.
3. The local device combines PREFIX1 with sub-bits to form a locally structured subnet and uses host bits to create a complete interface address for the downstream interface.
4. The local device advertises to the subscriber-side interface (downstream), including the prefix of its IPv6 address (PREFIX1 plus the sub-bits /64) with an A-bit set and the O-bit set to indicate that hosts should use DHCPv6 to acquire non-address information. Per A-bit, hosts use SLAAC and generate an address from the prefix and then perform DAD. Per O-bit, hosts use DHCPv6 stateless exchange to request non-address information.
5. The device's local DHCPv6 server responds and assigns the information that it imported from the upstream interface's DHCPv6 client.

Figure 3 on page 35 illustrates the network topology for this scenario.

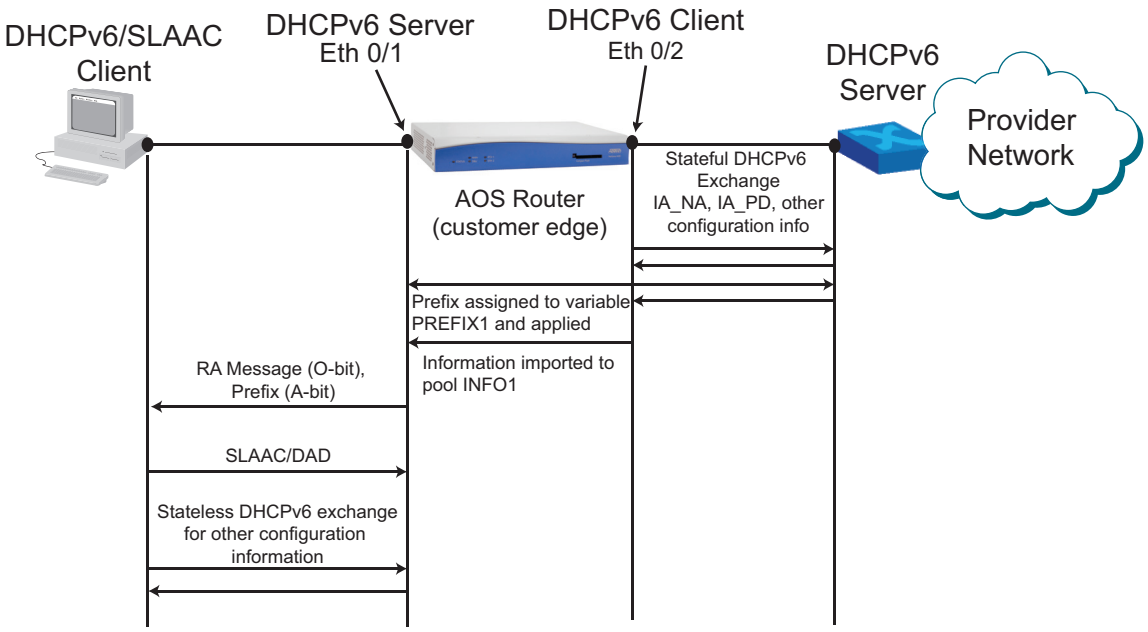

Figure 3. Centrally Managed Network with Prefix Delegation, Information Import, and SLAAC

The AOS device DHCPv6 configuration for this scenario is as follows:

```
!
ipv6 dhcp pool INFO1
    import dns-server
    import domain-name
!
interface ethernet 0/1
    ipv6 address named-prefix PREFIX1 ::1:0:0:1/64
    ipv6 nd other-config-flag
    ipv6 dhcp server INFO1
!
interface ethernet 0/2
    ipv6
    ipv6 address dhcp
    ipv6 dhcp client pd PREFIX1
!
```


DHCPv6 Configuration Command Summary

The following tables summarize the configuration commands associated with DHCPv6.

Table 2. DHCPv6 Global Commands

Prompt	Command	Description
(config)#	**ipv6 dhcp database local**	Enables the DHCPv6 local database, which stores the IPv6 addresses assigned by the DHCPv6 server. By default, the local database is disabled.
(config)#	**ipv6 dhcp excluded-address [vrf** *<name>***]** *<beginning ipv6 address>* *<ending ipv6 address>*	Specifies IPv6 addresses to exclude from any DHCPv6 server pool. By default, no IPv6 addresses are excluded. The optional **vrf** parameter specifies a nondefault VRF instance on which to exclude the addresses. The *<beginning ipv6 address>* parameter specifies the lowest IPv6 address in the range of addresses to exclude, and the *<ending ipv6 address>* parameter specifies the highest IPv6 address in the range. IPv6 addresses should be expressed in colon hexadecimal format (**X:X:X:X::X**).
(config)#	**ipv6 dhcp address limit** *<number>*	Specifies the maximum number of IPv6 addresses that can be assigned by the DHCPv6 server. The *<number>* parameter specifies the number of IPv6 addresses that can be assigned. Valid range is **1** to **10000**. This maximum number is product-specific, and is equivalent to the default value on the product. By default, only a certain number of IPv6 addresses can be assigned. This number varies by AOS product.
(config)#	**ipv6 dhcp address conflict limit** *<number>*	Specifies the maximum number of conflicting IPv6 addresses that can be stored by the DHCPv6 server. The *<number>* parameter specifies the number of conflicting addresses that can be stored. Valid range is **1** to **10000**. This maximum number is product-specific, and is equivalent to the default value on the product. By default, only a certain number of conflicting IPv6 addresses can be stored. This number varies by AOS product.
(config)#	**ipv6 dhcp address client limit** *<number>*	Specifies the maximum number of addresses that can be assigned to a single client. The *<number>* parameter specifies the maximum number of assigned addresses. Valid range is **0** to **500**. By default, only **50** addresses can be assigned to a single client. Specifying the number as **0**, or using the **no** form of this command, returns the number to the default value.

Table 2. DHCPv6 Global Commands *(Continued)*

Prompt	Command	Description
(config)#	**ipv6 named-prefix** <*prefix name*> <*ipv6 prefix/prefix-length*> **[expiration-date** <*date*> <*time*>**]**	Manually assigns a value to a named prefix variable. The <*prefix name*> parameter specifies the prefix variable name, and the <*ipv6 prefix/prefix-length*> parameter is the numerical value and length of the prefix. The named prefix value is specified in colon hexadecimal format (**X:X::X/<Z>**), for example: **2001:DB8:1::/64**. The prefix length (**<Z>**) is an integer with a value between **0** and **128**. By default, no general prefixes exist. The optional **expiration-date** parameter specifies the time at which the prefix will expire.
(config)#	**ipv6 dhcp prefix [client] limit** <*limit*>	Specifies the prefix limit for DHCPv6 prefix delegation. Valid range is **0** to **164352**. The limit is removed if this value is set to **0**.
(config)#	**ipv6 route [vrf** <*name*>**] named-prefix** <*prefix name*> <*ipv6 prefix/prefix-length*> **[**<*interface*>**] [tag** <*tag*>**]**	Specifies a route is created using a named prefix. The <*prefix name*> parameter specifies the prefix variable name, and the <*ipv6 prefix/prefix-length*> parameter is the numerical value and length of the prefix. The named prefix value is specified in colon hexadecimal format (**X:X::X/<Z>**), for example: **0:0:0:5::/64**, where the leading zeros are the bits the named prefix will overwrite. The prefix length (**<Z>**) is an integer with a value between **0** and **128**. By default, no static route entries exist. The optional **vrf** <*name*> parameter specifies a nondefault VRF on which to create the prefix. The <*interface*> parameter specifies the interface to which the route is assigned. The optional **tag** <*tag*> parameter specifies a number to use as a tag for labeling and filtering routes. Valid tag range is **1** to **65535**.
(config)#	**domain-list [vrf** <*name*>**]** <*domain*>	Specifies a domain entry to add to the domain list. This feature of DNS allows a series of domains to be appended to a host name when it is resolved. The <*domain*> parameter is the domain list to append to the host name, and the optional **vrf** <*name*> parameter specifies a nondefault VRF on which this domain list entry is available.
(config)#	**ipv6 dhcp ping packets** <*number*>	Specifies the number of ping packets transmitted by the DHCPv6 server when testing an IPv6 address before it is assigned to a client. The <*number*> parameter is the number of packets sent before the IPv6 address is assigned. Valid range is **0** to **100** packets, with a default value of **2** packets.

Table 2. DHCPv6 Global Commands *(Continued)*

Prompt	Command	Description
(config)#	**ipv6 dhcp ping timeout** <*value*>	Specifies the ping timeout interval (in milliseconds) for DHCPv6 address pings. The <*value*> parameter specifies the number of milliseconds the DHCPv6 server waits for a response to a transmitted DHCPv6 ping packet. Valid range is **10** to **1000** ms, with a default value of **500** ms.

Table 3. DHCPv6 Server Pool Commands

Prompt	Command	Description
(config)#	**ipv6 dhcp pool** <*name*>	Creates a DHCPv6 server pool and enters the pool's configuration mode.
(config-dhcpv6)#	**client-identifier** <*client DUID*> **[**<*IAID*>**]**	Specifies the DHCPv6 client ID that represents a single client in the DHCPv6 pool. The <*client DUID*> parameter specifies the DUID of the client to be matched. DUIDs are expressed as hexadecimal values. The optional <*IAID*> parameter is the hexadecimal value that represents the IAID expected in the client request. Up to **50** IDs can be created on a single DHCPv6 server pool. By default, no client ID is specified.
(config-dhcpv6)#	**bootfile** <*url*>	Specifies the file location and transfer protocol for the boot file used by DHCPv6 clients. The <*url*> parameter is a valid string of up to **512** characters that specifies the transfer protocol, the location, and the name of the file to be transferred to the client. File URLs are specified in the format: **protocol://path/filename.ext**. By default, no boot file URL is specified.
(config-dhcpv6)#	**dns-server** <*ipv6 address*>	Specifies the IPv6 address of a DNS server supplied to requesting DHCPv6 clients for this server pool. IPv6 addresses should be expressed in colon hexadecimal format (**X:X:X:X::X**), for example, **2001:DB8:1::1**. By default no DNS server address is specified. Up to **50** DNS server addresses can be entered.
(config-dhcpv6)#	**domain-name** <*name*>	Specifies a domain name suffix supplied to requesting DHCPv6 clients for this server pool. The <*name*> parameter is the domain name suffix in ASCII text of up to **245** characters. By default, no domain names are specifies. Up to **50** domain names can be entered.

Table 3. DHCPv6 Server Pool Commands *(Continued)*

Prompt	Command	Description
(config-dhcpv6)#	**import [dns-server | domain-name | information refresh | ntp [address | domain-name] | sntp-server | timezone]**	Instructs the DHCPv6 server to import the values of certain information from the global information pool when serving a DHCPv6 client request. DNS server options (**dns-server**), domain names (**domain-name**), information refresh option values (**information refresh**), NTP address (**ntp address**), NTP domain names (**ntp domain-name**), DNS server addresses (**sntp-server**), and timezone database information (**timezone**) can all be imported. By default, no information is imported into the pool.
(config-dhcpv6)#	**information refresh [infinite |** <*days*> **[**<*hours*>**] [**<*minutes*>**]]**	Enables the DHCPv6 server to send information refresh values to requesting DHCPv6 clients served by this pool. The **infinite** parameter specifies that there is an infinite refresh time. The <*days*> parameter specifies the number of days to wait before refreshing the assigned information. Valid range is **0** to **365**. The optional <*hours*> parameter specifies the number of hours to wait, and the optional <*minutes*> parameter specifies the number of minutes to wait. Valid hour range is **0** to **23**, and valid minute range is **0** to **59**. By default, no information refresh time is set and the client should refresh every **24** hours.
(config-dhcpv6)#	**link-address** <*ipv6 prefix/prefix-length*>	Specifies an IPv6 prefix the DHCPv6 server can use to match a received interface or relay-forwarded client request to the server pool. The <*ipv6 prefix/prefix-length*> parameter is the numerical value and length of the prefix. The prefix value is specified in colon hexadecimal format (**X:X::X/<Z>**), for example: **2001:DB8:3F::/64**. The prefix length (**<Z>**) is an integer with a value between **0** and **128**. By default, no link addresses are specified in the pool. Up to **50** IPv6 prefixes can be entered.

Table 3. DHCPv6 Server Pool Commands *(Continued)*

Prompt	Command	Description
(config-dhcpv6)#	**address prefix [**<*ipv6 prefix/prefix-length*> | **named-prefix** <*prefix name*> <*ipv6 prefix/prefix-length*>**] [lifetime [**<*valid lifetime*> **| infinite] [**<*preferred lifetime*> **| infinite]]**	Specifies an IPv6 address prefix from which the DHCPv6 server assigns addresses to requesting clients served by this server pool. Up to **50** IPv6 prefixes can be entered. The <*ipv6 prefix/prefix-length*> parameter is the numerical value and length of the prefix. The prefix value is specified in colon hexadecimal format (**X:X::X/<Z>**), for example: **2001:DB8:1::/64**. The prefix length (**<Z>**) is an integer with a value between **0** and **128**. The optional **named-prefix** <*prefix name*> parameter specifies that the address is constructed using the value defined in the named prefix. If a named prefix is used, the lifetime values are determined by the named prefix's configuration and do not need to be specified with this command. The <*ipv6 prefix/prefix-length*> associated with the **named-prefix** indicates the sub-bits that will be added to the named prefix value stored in the system. These prefixes are specified in colon hexadecimal format (**X:X::X/<Z>**), for example: **0:0:0:5::/64**, where the leading zeros are the bits the named prefix will overwrite.The <*valid lifetime*> parameter specifies the valid lifetime for the IPv6 address if not using a named prefix. The value must be greater than the preferred lifetime. Valid range is **0** to **4294967295** seconds, with a default lifetime of **2592000** seconds. The <*preferred lifetime*> parameter specifies the preferred lifetime for the IPv6 address if not using a named prefix. The value must be less than the valid lifetime value. Valid range is **0** to **4294967295** seconds, with a default value of **604800** seconds. The **infinite** option specifies the prefix does not age and can be used instead of a specified valid or preferred lifetime. By default, no IPv6 address prefixes are specified.

Table 3. DHCPv6 Server Pool Commands *(Continued)*

Prompt	Command	Description
(config-dhcpv6)#	**prefix-delegation [**<*ipv6 prefix/prefix-length*> | **named-prefix** <*prefix name*> <*ipv6 prefix/prefix-length*>**] [lifetime [**<*valid lifetime*> **| infinite] [**<*preferred lifetime*> **| infinite]]**	Enables prefix delegation for the DHCPv6 server to use when assigning addresses to requesting clients served by this server pool. The <*ipv6 prefix/prefix-length*> parameter is the numerical value and length of the prefix. The prefix value is specified in colon hexadecimal format (**X:X::X/<Z>**), for example: **2001:DB8:1::/64**. The prefix length (**<Z>**) is an integer with a value between **0** and **128**. The optional **named-prefix** <*prefix name*> parameter specifies that the address is constructed using the value defined in the named prefix. If a named prefix is used, the lifetime values are determined by the named prefix's configuration and do not need to be specified with this command. The <*ipv6 prefix/prefix-length*> associated with the **named-prefix** indicates the sub-bits that will be added to the named prefix value stored in the system. These prefixes are specified in colon hexadecimal format (**X:X::X/<Z>**), for example: **0:0:0:5::/64**, where the leading zeros are the bits the named prefix will overwrite.The <*valid lifetime*> parameter specifies the valid lifetime for the IPv6 address if not using a named prefix. The valid lifetime value must be greater than the preferred lifetime. Valid range is **0** to **4294967295** seconds, with a default lifetime of **2592000** seconds. The <*preferred lifetime*> parameter specifies the preferred lifetime for the IPv6 address if not using a named prefix. The preferred lifetime value must be less than the valid lifetime value. Valid range is **0** to **4294967295** seconds, with a default value of **604800** seconds. The **infinite** option specifies the prefix does not age and can be used instead of a specified valid or preferred lifetime. By default, no IPv6 address prefixes are specified and prefix delegation is not enabled.
(config-dhcpv6)#	**sntp-server** <*ipv6 address*>	Specifies the unicast IPv6 address of a SNTP server to be supplied to requesting DHCPv6 clients served by this pool. IPv6 addresses should be expressed in colon hexadecimal format (**X:X:X:X::X**), for example, **2001:DB8:1::1**. Up to **50** addresses can be entered. By default, no SNTP information is specified.

Table 3. DHCPv6 Server Pool Commands *(Continued)*

Prompt	Command	Description
(config-dhcpv6)#	**ntp address** <*ipv6 address*>	Specifies the unicast IPv6 address or multicast group address of an NTP server to be supplied to requesting DHCPv6 clients served by this pool. IPv6 addresses should be expressed in colon hexadecimal format (**X:X:X:X::X**). For example, **2001:DB8:1::1**. Up to **50** addresses can be entered. By default, no NTP information is specified.
(config-dhcpv6)#	**ntp domain-name** <*name*>	Specifies the domain name of an NTP server to be supplied to requesting DHCPv6 clients served by this pool. The <*name*> parameter is the FQDN of an IPv6 NTP server. Up to **50** domain names can be entered. They are assigned in the order they are entered. By default, no NTP information is specified.
(config-dhcpv6)#	**option** <*number*> **[ascii** <*string*> **| hex** <*hexbytes*> **| address** <*ipv6 address*>**]**	Specifies a generic DHCPv6 option to assign clients that use this pool. The <*number*> parameter specifies the DHCPv6 option number. Valid range is **0** to **65535**. The **ascii** <*string*> parameter specifies the option value in ASCII text string of up to 256 characters. The **hex** <*hexbytes*> parameter specifies the option value as a hexadecimal number of up to **512** digits. The address parameter specifies the option value as an IPv6 address. IPv6 addresses should be expressed in colon hexadecimal format (**X:X:X:X::X**), for example, **2001:DB8:1::1**. By default, no options are configured.
(config-dhcpv6)#	**sip address** <*ipv6 address*>	Specifies the IPv6 address of a SIP server that is supplied to requesting DHCPv6 clients served by this pool. IPv6 addresses should be expressed in colon hexadecimal format (**X:X:X:X::X**), for example, **2001:DB8:1::1**. Up to 50 addresses can be entered. By default, no SIP servers are specified.
(config-dhcpv6)#	**sip domain-name** <*name*>	Specifies a SIP server domain name that is supplied to requesting DHCPv6 clients served by this pool. The <*name*> parameter is the FQDN of an IPv6 SIP server, entered in ASACII text of up to **256** characters. Up to **50** domain names can be entered. By default, no SIP servers are specified.

Table 3. DHCPv6 Server Pool Commands *(Continued)*

Prompt	Command	Description
(config-dhcpv6)#	**timezone posix** <*string*>	Specifies time zone information in POSIX form that is supplied to requesting DHCPv6 clients served by this pool. The <*string*> parameter is a time zone POSIX string, entered in the following format: **EST5EDT4,M3.2.0/02:00,M11.1.0/02:00**. By default, no time zone POSIX information is specified.
(config-dhcpv6)#	**timezone** <*timezone* | *tzdb string*>	Specifies the time zone information in standard time zone database (TZDB) format for requesting DHCPv6 clients served by this pool. The <*timezone*> parameter is a predefined value that indicates the desired timezone. Enter **timezone ?** to display available time zones. The <*tzdb string*> parameter specifies a time zone string in TZDB format and is limited to **256** characters. By default, no time zone information is specified.
(config-dhcpv6)#	**vrf** <*name*>	Specifies the DHCPv6 server pool is associated with a nondefault VRF instance. By default, server pools are created on the default VRF instance.
(config-dhcpv6)#	**host client-identifier** <*client DUID*> **[**<*IAID*>**]**	Specifies the manual binding of a set of information to a single client served by this pool, and enters the host's configuration mode. The <*client DUID*> parameter specifies the DUID of the client to be matched. DUIDs are expressed as hexadecimal values. The optional <*IAID*> parameter is the hexadecimal value that represents the IAID expected in the client request. By default, no host client ID is specified.

Table 3. DHCPv6 Server Pool Commands *(Continued)*

Prompt	Command	Description
(config-dhcpv6-host)#	**address** <*ipv6 address*> **lifetime [**<*valid lifetime*> **| infinite] [**<*preferred lifetime*> **| infinite]**	Specifies an IPv6 address is manually bound to a single client identified by its DUID. The <*ipv6 address*> parameter specifies the IPv6 address to assign to the single client. There is no associated prefix length with this address. IPv6 addresses should be expressed in colon hexadecimal format (**X:X:X:X::X**), for example, **2001:DB8:1::1**.The <*valid lifetime*> parameter specifies the valid lifetime for the IPv6 address. The value must be greater than the preferred lifetime. Valid range is **0** to **4294967295** seconds, with a default lifetime of **2592000** seconds. The <*preferred lifetime*> parameter specifies the preferred lifetime for the IPv6 address. The value must be less than the valid lifetime value. Valid range is **0** to **4294967295** seconds, with a default value of **604800** seconds. The infinite option specifies the address does not age and can be used instead of a specified valid or preferred lifetime.
(config-dhcpv6-host)#	**address named-prefix** <*prefix name*> <*ipv6 address*> **lifetime [**<*valid lifetime*> **| infinite] [**<*preferred lifetime*> **| infinite]**	Specifies an IPv6 prefix is bound to the specific client. The <*prefix name*> parameter specifies the named prefix to bind to the client. The <*ipv6 address*> parameter specifies the address portion appended to the named prefix to create a 128-bit host address. IPv6 addresses should be expressed in colon hexadecimal format (**X:X:X:X::X**). For example, **::55:44:22:1**. Up to **50** IPv6 addresses can be entered for a single client. By default, no IPv6 host address are specified. The <*valid lifetime*> parameter specifies the valid lifetime for the IPv6 address. The valid lifetime value must be greater than the preferred lifetime. Valid range is **0** to **4294967295** seconds, with a default lifetime of **2592000** seconds. The <*preferred lifetime*> parameter specifies the preferred lifetime for the IPv6 address. The preferred lifetime value must be less than the valid lifetime value. Valid range is **0** to **4294967295** seconds, with a default value of **604800** seconds. The infinite option specifies the address does not age and can be used instead of a specified valid or preferred lifetime.

Table 3. DHCPv6 Server Pool Commands *(Continued)*

Prompt	Command	Description
(config-dhcpv6-host)#	**hostname [fqdn** <*fqdn*> | <*partial fqdn*>**]**	Specifies the manual binding of a host name to the specified client. The **fqdn** <*fqdn*> parameter specifies the client's entire FQDN. The <*partial fqdn*> parameter specifies the client's host portion of the FQDN without a specified zone. By default, no host names are specified/
(config-dhcpv6-host)#	**prefix-delegation [**<*ipv6 prefix/prefix-length*> | **named-prefix** <*prefix name*> <*ipv6 prefix/prefix-length*>**] [lifetime [**<*valid lifetime*> **| infinite] [**<*preferred lifetime*> **| infinite]]**	Enables prefix delegation for a specific client. The <*ipv6 prefix/prefix-length*> parameter is the numerical value and length of the prefix. The prefix value is specified in colon hexadecimal format (**X:X::X/<Z>**), for example: **2001:DB8:1::/64**. The prefix length (**<Z>**) is an integer with a value between **0** and **128**. The optional **named-prefix** <*prefix name*> parameter specifies that the address is constructed using the value defined in the named prefix. If a named prefix is used, the lifetime values are determined by the named prefix's configuration and do not need to be specified with this command. The <*ipv6 prefix/prefix-length*> associated with the **named-prefix** indicates the sub-bits that will be added to the named prefix value stored in the system. These prefixes are specified in colon hexadecimal format (**X:X::X/<Z>**), for example: **0:0:0:5::/64**, where the leading zeros are the bits the named prefix will overwrite.The <*valid lifetime*> parameter specifies the valid lifetime for the IPv6 address if not using a named prefix. The value must be greater than the preferred lifetime. Valid range is **0** to **4294967295** seconds, with a default lifetime of **2592000** seconds. The <*preferred lifetime*> parameter specifies the preferred lifetime for the IPv6 address if not using a named prefix. The value must be less than the valid lifetime value. Valid range is **0** to **4294967295** seconds, with a default value of **604800** seconds. The **infinite** option specifies the prefix does not age and can be used instead of a specified valid or preferred lifetime. By default, no IPv6 address prefixes are specified and prefix delegation is not enabled.
(config-dhcpv6)#	**vendor-specific** <*number*>	Specifies a specific vendor option for the DHCPv6 server pool, and enters the vendor-specific configuration mode. The <*number*> parameter is the enterprise ID of the vendor information you are entering. Valid range is **1** to **4294967295**. By default, no vendor-specific options are configured.

Table 3. DHCPv6 Server Pool Commands *(Continued)*

Prompt	Command	Description
(config-dhcpv6-vs)#	**suboption** <*number*> **[ascii** <*string*> **| hex** <*hexbytes*> **| address** <*ipv6 address*>**]**	Specifies a vendor-specific suboption to assign to DHCPv6 clients that use this server pool. The <*number*> parameter specifies the vendor-specific suboption. Valid range is **0** to **65535**. The **ascii** <*string*> parameter specifies that the suboption is expressed as an ASCII text string of up to **256** characters. The **hex** <*hexbytes*> parameter specifies that the suboption is expressed as a hexadecimal number of up to **512** digits. The address parameter specifies the suboption value is an IPv6 address. IPv6 addresses should be expressed in colon hexadecimal format (**X:X:X:X::X**), for example, **2001:DB8:1::1**. By default, no suboptions are configured.

Table 4. DHCPv6 Interface Commands

Prompt	Command	Description
(config-interface)#	**ipv6 address named-prefix** <*prefix name*> <*ipv6 address/prefix-length*> **[eui-64]**	Specifies an interface IPv6 address is created using a named prefix. The <*prefix name*> parameter specifies the named prefix to use to create the address. The named prefix <*ipv6 address/prefix-length*> parameter specifies the address portion appended to the named prefix to create a 128-bit host address. The prefix value is specified in colon hexadecimal format (**X:X::X/<Z>**), for example: **0:0:0:5::/64**, where the leading zeros are the bits the named prefix will overwrite. The prefix length (**<Z>**) is an integer with a value between **0** and **128**.The optional **eui-64** parameter indicates that the interface ID is to be placed in the lower 64 bits of the address. By default, no IPv6 addresses are specified.

Table 4. DHCPv6 Interface Commands *(Continued)*

Prompt	Command	Description
(config-interface)#	**ipv6 nd prefix [**<*prefix-name*> <*ipv6 address/prefix-length*> | **named-prefix** <*prefix name*> <*ipv6 address/prefix-length*>**] [**<*valid lifetime*> | **infinite] [**<*preferred lifetime*> | **infinite] [off-link] [no-rtr-address] [no-autoconfig] [no-advertise] [no onlink]**	Specifies that ND messages can use a general or previously created prefix. These prefixes can be inserted by the RA or can augment the default settings of an IPv6 address created from a named prefix. The **named-prefix** parameter specifies that a named prefix value is used in the creation of the ND prefix. The <*prefix name*> parameter specifies the named prefix to use to create the address. The <*ipv6 address/prefix-length*> parameter specifies the address portion appended to the named prefix to create a 128-bit host address. The prefix value is specified in colon hexadecimal format (**X:X::X/<Z>**), for example: **2001:DB8:1::/64**. The prefix length (**<Z>**) is an integer with a value between **0** and **128**. The <*ipv6 prefix/prefix-length*> associated with the **named-prefix** indicates the sub-bits that will be added to the named prefix value stored in the system. These prefixes are specified in colon hexadecimal format (**X:X::X/<Z>**), for example: **0:0:0:5::/64**, where the leading zeros are the bits the named prefix will overwrite.The <*valid lifetime*> parameter specifies the valid lifetime for the IPv6 address. The value must be greater than the preferred lifetime. Valid lifetime range is **0** to **4294967295** seconds with a default lifetime of **2592000** seconds. If you are using a named prefix, the default value is the value assigned by the delegating server. The <*preferred lifetime*> parameter specifies the preferred lifetime for the IPv6 address. The value must be less than the valid lifetime value. Valid range is **0** to **4294967295** seconds, with a default value of **604800** seconds. The infinite option specifies the address does not age and can be used instead of a specified valid or preferred lifetime. The optional **off-link** parameter specifies the prefix is off link, the optional **no-rtr-address** parameter specifies that the full router address is not send in prefix advertisements, the optional **no-autoconfig** parameter specifies that the prefix is not used in autoconfiguration, the **no-advertise** parameter specifies that the prefix is not advertised, and the optional **no onlink** parameter specifies that the prefix is not used for onlink determination.
(config-interface)#	**ipv6 mode host unicast**	Specifies that the interface is in host mode using an IPv6 unicast address.

Table 4. DHCPv6 Interface Commands *(Continued)*

Prompt	Command	Description
(config-interface)#	**ipv6 dhcp relay destination** <*ipv6 address*> **[**<*interface*>**]**	Specifies the interface is functioning as a DHCPv6 relay agent, and sets the relay destination. The <*ipv6 address*> parameter is the IPv6 address of the next DHCPv6 relay agent or the DHCPv6 server. IPv6 addresses should be expressed in colon hexadecimal format (**X:X:X:X::X**), for example, **2001:DB8:1::1**. The optional <*interface*> parameter specifies an output interface to use when the destination address is a link-scoped address. By default, no DHCPv6 relay agents are configured, and the relay agent mode is disabled.
(config-interface)#	**ipv6 dhcp server [automatic |** <*pool name*>**] [allow-hint | preference** <*number*> **| rapid-commit]**	Specifies the interface is functioning as a DHCPv6 server. The **automatic** parameter enables automatic selection of the DHCPv6 server pool. The <*pool name*> parameter specifies the DHCPv6 server pool that services this interface. The pool selection method must be specified before configuring the other parameters of this command. The remaining parameters of this command can be entered multiple times and in any order. The **allow-hint** parameter specifies that the server attempts to honor the DHCPv6 client's request for specific values as hinted in the client's request. The **preference** <*number*> parameter specifies the preference value advertised by the server. Valid range is **0** to **255**, with a default value of **0**. The **rapid-commit** parameter allows the client to request the user of a two-message address exchange instead of the normal four-message exchange. By default, the DHCPv6 server mode is not enabled on the interface.

Table 4. DHCPv6 Interface Commands *(Continued)*

Prompt	Command	Description
(config-interface)#	**ipv6 address dhcp [hostname** <*partial fqdn*> **| fqdn** <*fqdn*>**] [no-domain-name] [no-nameservers] [no-information-refresh] [no-sip-address] [no-sip-domain-name] [no-ntp] [no-timezone] [iaid** <*iaid*>**] [rapid-commit]**	Specifies the interface is functioning as a DHCPv6 client. The optional **hostname** <*partial fqdn*> parameter specifies the name to be sent to the DHCPv6 server as the host portion of its FQDN, expressed in ASCII text of up to **254** characters. The optional **fqdn** <*fqdn*> parameter specifies a name to be sent to the DHCPv6 server as the system's FQDN, expressed in ASCII text of up to **254** characters. The optional **no-domain-name** parameter specifies that no domain names are obtained using this client. The optional **no-nameservers** parameter specifies that no DNS server addresses are obtained through DHCPv6. The optional **no-information-refresh** parameter specifies that no information refresh setting is obtained through this client. The optional **no-sip-address** parameter specifies that no SIP addresses are obtained through this client. The optional **no-sip-domain-name** parameter specifies that no SIP domain names are obtained through this client. The optional **no-ntp** parameter specifies that no NTP server values are obtained through this client. The optional **no-timezone** parameter specifies that no timezone information is obtained through this client. The optional **iaid** <*iaid*> parameter manually specifies an IAID to be used for this client. The <*iaid*> is specified in a 32-bit hexadecimal number. By default, the IAID is automatically given the value generated by the system for this interface. The optional **rapid-commit** parameter enables two message DHCPv6 exchanges between the client and the server. By default, DHCPv6 client mode is not enabled on an interface.

Table 4. DHCPv6 Interface Commands *(Continued)*

Prompt	Command	Description
(config-interface)#	**ipv6 dhcp client pd** <*prefix name*> **[no-aggregate-route] [distance** <*distance*> **[tag** <*value*>**]] [iaid** <*iaid*>**]**	Enables the DHCPv6 client on the interface and specifies that the interface acquires an IPv6 prefix for the DHCPv6 client. The <*prefix name*> parameter specifies the variable of the prefixes stored on the system. Variables are expressed in ASCII text up to **80** characters. The optional **no-aggregate-route** parameter specifies that a route to the null 0 interface is not injected into the route table for the prefixes assigned. The optional <*distance*> parameter specifies the administrative distance to assign to the injected router. Valid distance range is **1** to **255**, with a default value of **1**. The optional **tag** <*value*> parameter specifies a number to use as a tag for labeling and filtering routes. Valid tag range is **1** to **65535**. The optional **iaid** <*iaid*> parameter manually specifies an IAID to be used for the client. IAIDs are specified in a 32-bit hexadecimal number. By default, the DHCPv6 client mode is not enabled on the interface.
(config-interface)#	**ipv6 dhcp client information refresh minimum** <*seconds*>	Specifies the minimum value the DHCPv6 client on this interface accepts as its information refresh timer. By default, the minimum refresh timer is set to **600** seconds, with a range of **600** to **3600**.
(config-interface)#	**ipv6 dhcp client pd** <*prefix name*> **[**<*distance*> **| no-aggregate-route | rapid-commit]**	Enables prefix delegation on the DHCPv6 client on the interface. The <*prefix name*> parameter specifies the variable of the prefixes stored on the system. Variables are expressed in ASCII text up to **80** characters. The optional <*distance*> parameter specifies the administrative distance to assign to the injected router. Valid distance range is **1** to **255**, with a default value of **1**. The optional **no-aggregate-route** parameter specifies that a route to the null 0 interface is not injected into the route table for the prefixes assigned. The optional **rapid-commit** parameter enables two message DHCPv6 exchanges on the client.

Troubleshooting

After configuring DHCPv6, several commands can be issued from Enable mode in the CLI to assist in troubleshooting. The following sections contain troubleshooting commands, including the **clear**, **show**, and **debug** commands, that are implemented specifically for DHCPv6.

Release and Renew DHCPv6 Values

Sometimes it can be useful to release and renew DHCPv6 values manually when you are troubleshooting DHCPv6 configuration and can be used to manually refresh the information prior to the normal mechanisms, such as lifetimes, T1/T2 timers, etc. Manual release or renew instructions are given by entering the **ipv6 dhcp release [address [**<*interface*>**] | prefix [**<*interface*>**] | information [**<*interface*>**]**

| all [<*interface*>**]]** or **ipv6 dhcp renew [address [**<*interface*>**] | prefix [**<*interface*>**] | information [**<*interface*>**] | all [**<*interface*>**]]** commands from the Enable mode. By default, only the client function that acquires IPv6 address information is affected. The **release** parameter of this command specifies that the DHCPv6 client stops using information assigned by the DHCPv6 server, and releases that information. If addresses or prefixes have been assigned to the client, the client sends a Release message to the server so that it releases the state for those resources. If prefixes are released, the prefix is removed from any commands that use the prefix. In addition, if any other configuration information is released, any DHCPv6 pools that import that information lose those values. The **renew** parameter of this command instructs the DHCPv6 client to rerequest information. If the client had no previous assignments from the DHCPv6 server, the client performs this action as if it is initializing for the first time. If the client had previous assignments from the DHCPv6 server, it performs the same actions as in the **release** command, and then performs as if it were just initializing. The optional **address** parameter specifies that only the IA_NA is released or renewed, the optional **prefix** parameter specifies that only the IA_PD is released or renewed, the optional **info** parameter specifies that only other configuration information is released or renewed (with no Release message sent by the client), and the optional **all** parameter specifies that all DHCPv6 assigned values are released or renewed. By default, if the **ipv6 address dhcp** command has been configured, then the IA_NA is released or renewed, and if the **ipv6 address dhcp** command has NOT been configured, then only other configuration information is released or renewed.

For example, to specify that only non-address/prefix information is manually renewed, enter the command as follows:

```
>enable
#ipv6 dhcp renew information
```

Clear Commands

The following **clear** commands can be used from the Enable mode to clear statistics and configuration information for DHCPv6.

Use the **clear ipv6 dhcp binding [vrf** <*name*>**] [* | addresses |** <*ipv6 address*> **| client-identifier** <*client DUID*>**| prefixes |** <*prefix*>**]** command to remove one or all of the DHCPv6 server binding entries. The optional **vrf** <*name*> parameter specifies a nondefault VRF instance from which to remove the entries. If a VRF instance is not specified, the binding entries are cleared on the default VRF instance. The ***** parameter of the command specifies that all automatic IPv6 address bindings are cleared, the <*ipv6 address*> parameter specifies the bindings for a single IPv6 address are cleared, and the **addresses** parameter specifies that all IPv6 address bindings are cleared. The **client-identifier** <*client DUID*> parameter specifies the bindings for a single client identifier are cleared. IPv6 addresses should be expressed in colon hexadecimal format (**X:X:X:X::X**), for example, **2001:DB8:1::1**. The <*client DUID*> parameter of the command specifies the DUID of the client to be matched. The DUID is expressed as a hexadecimal value. The **prefixes** parameter clears the bindings for all prefixes, and the <*prefix*> parameter clears the bindings for a specific prefix. Prefixes are expressed in colon hexadecimal format (**X:X::X/<Z>**), for example: **0:0:0:5::/64**. For example, to specify that the DHCPv6 server bindings on the default VRF instance for all IPv6 addresses are cleared, enter the command as follows:

```
>enable
#clear ipv6 dhcp binding *
```


Use the **clear ipv6 dhcp conflict [vrf** <*name*>**] [*** | <*ipv6 address*>**]** command to remove one or all of the DHCPv6 server conflict addresses. The optional **vrf** <*name*> parameter specifies a nondefault VRF instance from which to remove the entries. If a VRF instance is not specified, the conflicting entries are cleared on the default VRF instance. The ***** parameter of the command specifies that all IPv6 address conflicts are cleared, and the <*ipv6 address*> parameter specifies the conflicts for a single IPv6 address are cleared. IPv6 addresses should be expressed in colon hexadecimal format (**X:X:X:X::X**), for example, **2001:DB8:1::1**. For example, to specify that the DHCPv6 server conflict addresses on the default VRF instance for all IPv6 addresses are cleared, enter the command as follows:

```
>enable
#clear ipv6 dhcp conflict *
```

Use the **clear ipv6 dhcp client** <*interface*> command to reinitialize the entire DHCPv6 client on the specified interface. Using this command releases and renews ALL parameters requested or assigned using DHCPv6 to this client. This includes addresses, prefixes, and any other configuration information. The <*interface*> parameter specifies the client interface on which to reinitialize the DHCPv6 information. Interfaces are specified in the format <*interface type [slot/port | slot/port.subinterface id | interface id | interface id.subinterface id*>. For example, for an Ethernet interface, use **eth 0/1**; for a PPP interface, use **ppp 1**; and for an ATM subinterface, use **atm 1.1**. Enter **clear ipv6 dhcp client ?** for a complete list of valid interfaces. For example, to reinitialize the entire client (and all its associated information) on the **eth 0/1** interface, enter the command as follows:

```
>enable
#clear ipv6 dhcp client eth 0/1
```

Show Commands

The following **show** commands are used to display DHCPv6 statistics and configuration information.

Use the **show ipv6 dhcp** command to display the DHCPv6 DUID of the AOS device, and the IAIDs of each interface on the AOS device. Enter the command from the Enable mode as follows:

```
>enable
#show ipv6 dhcp
0----------1----------2----------3----------4----------5----------6----------7----------8
12345678901234567890123456789012345678901234567890123456789012345678901234567890

The DHCPv6 unique identifier (DUID) of this device is: 00030001000F352E2AB9
```

Use the **show ipv6 dhcp binding [vrf** <*name*>**] [**<*ipv6 address*>**]** command to display detailed information about stateful information assigned and bound to individual clients as maintained by the DHCPv6 server. The optional **vrf** <*name*> parameter limits output to a nondefault VRF instance, and the optional <*ipv6 address*> parameter limits output to a single client IPv6 address. IPv6 addresses should be expressed in colon hexadecimal format (**X:X:X:X::X**), for example, **2001:DB8:1::1**. For example, to display all DHCPv6 binding information, enter the command from the Enable mode as follows:

```
>enable
#show ipv6 dhcp binding
0----------1----------2----------3----------4----------5----------6----------7----------8
12345678901234567890123456789012345678901234567890123456789012345678901234567890

Client: FE80::20F:35FF:FE2E:2AB9 eth 0/2
```



```
DUID: 00030001000F352E2AB9
Hostname: <unassigned>
IA PD: IA ID 0x001A0001, T1 302400, T2 483840
    Prefix: 55:44:33:22::/64
        preferred lifetime 604800, valid lifetime 2592000
        expires as 2011/11/23 AD at 13:05:40 CST (56 seconds)
    Prefix: 44:33:22:11::/64
        preferred lifetime 604800, valid lifetime 2592000
        expires at 2011.11.23 AD at 13:05:40 CST (56 seconds)
IA NA: IA ID 0x00000001, T1 43200, T2 69120
    Address: 2000:3::790D:DC94:6C36:9562 from pool MYPOOL
        preferred lifetime 86400, valid lifetime 172800
        expires at 2011.11.23 AD at 13:05:40 CST (56 seconds)
IA NA: IA ID 0x00000002, T1 43200, T2 69120
    Address: 2000:3::4469:960:7C0E:EE6F
        preferred lifetime 86400, valid lifetime 172800
        expires at 2011.11.23 AD at 13:05:40 CST (56 seconds)
```

Use the **show ipv6 dhcp conflict [vrf** <*name*>**]** command to display detailed information about any addresses deemed as conflicting by a DHCPv6 client or by the server when the client is pinged. The optional **vrf** <*name*> parameter limits the output to a nondefault VRF instance. For example, to display all conflicting IPv6 addresses, enter the command as follows:

```
>enable
#show ipv6 dhcp conflict
0----------1----------2----------3----------4----------5----------6----------7----------8
12345678901234567890123456789012345678901234567890123456789012345678901234567890

Address/Prefix                          Reason      TTL (seconds)
1111:2222:3333:4444:5555:6666:7777/128  PING        44
1111:2222:3333:4444:5555:6666:7777/128  DECL        56
```

Use the **show ipv6 dhcp pool [**<*name*>**]** command to display the information served by each configured DHCPv6 pool and the general statistics of the current pool assignments. The optional <*name*> parameter limits the command output to only the statistics for the specified server pool. For example, to display the configuration of all DHCPv6 pools, enter the command as follows:

```
>enable
#show ipv6 dhcp pool
0----------1----------2----------3----------4----------5----------6----------7----------8
12345678901234567890123456789012345678901234567890123456789012345678901234567890

Pool POOL
    Link Addresses:
        22::/64
        22::/96
    Client Identifiers:
        112233445566 2
        112233445566
```



```
    Address Prefixes:
        22::/64 lifetime 60 30
    Host client-identifier AABBCCDD
        Hostname: server1
    Host client-identifier AABBCCDD1122
        Hostname: AACCDDBB
        Address: 22::99
Client: FE80::204:E2FF:FE3E:C786 eth 0/2
    DUID: 000000000000000000000000000DF
    Hostname: winxp
    IA NA: IA ID 0x00000001, T1 15, T2 24
        Address: 22::19C1:AC2:8277:CB39 from pool POOL
            preferred lifetime 30, valid lifetime 60
            expires at 2011.11.23 AD at 13:33:05 CST (47 seconds)
Client: FE80::B098:1B0E:27CA:A8AB eth 0/2
    DUID: 000100010D86F190019B9324A8E
    Hostname: <unassigned>
    IA NA: IA ID 0x0E000475, T1 15, T2 24
        Address: 22::4CC2:9F4E:3C68:1E55 from pool POOL
            preferred lifetime 30, valid lifetime 60
            expires at 2011.11.23 AD at 13:33:04 CST (46 seconds)
```

Use the **show ipv6 dhcp interface** <*interface*> command to display the DHCPv6 mode and settings for interfaces configured for DHCPv6. Specify interfaces in the format <*interface type [slot/port | slot/port.subinterface id | interface id | interface id.subinterface id*>, for example, for an Ethernet interface, use **eth 0/1**; for a PPP interface, use **ppp 1**; and for an ATM subinterface, use **atm 1.1**. Enter **show ipv6 dhcp interface ?** for a complete list of valid interfaces. For example, to display the DHCPv6 mode and settings for the **eth 0/1** interface, enter the command as follows:

```
>enable
#show ipv6 dhcp interface eth 0/1
!
eth 0/1 is in client mode
    Client State is SOLICITING
Server:
    DUID 00030001
```

Use the **show ipv6 named-prefix** command to display information about the prefixes configured on the router. Information displayed includes which prefixes are assigned, how they are configured and delegated, and which interfaces are configured to be addressed using the named prefix. To display named prefix information, enter the command as follows:

```
>enable
#show ipv6 named-prefix
IPv6 Prefix NAME, acquired via Static Configuration
  1::/64
    Preferred Lifetime: Infinite, Valid Lifetime: Infinite
IPv6 Prefix NAME2, acquired via Static Configuration
  3::/64
    Preferred Lifetime: Infinite, Valid Lifetime: Infinite
```


Use the **show ipv6 route named-prefix** command to display all routes generated by a named prefix. To display this information, enter the command as follows:

```
>enable
#show ipv6 route named-prefix
Codes: C-connected, S-static, O-OSPF, B-BGP
       E1-OSPF external type 1, E2-OSPF external type 2
       I-OSPF inter area, NP-named prefix, D-DHCPv6 PD

Gateway of last resort is not set

C   1::/64
    is directly connected, eth 0/1

NP      1::1:0:0:0/80
    (1/0/0) via 1::1, Loopback
```

Debug Commands

The following commands are used to enable **debug** messaging for DHCPv6 events.

Turning on a large amount of debug information can adversely affect the performance of your unit.

Use the **debug ipv6 dhcp [detail | relay | server | client [**<*interface*>**]]** command to enable debug messages for DHCPv6 events. The **no** form of this command disables debug messages for DHCPv6 events. The optional **detail** parameter specifies that IPv6 DHCP packet content and any prefix delegation information is displayed. The optional **relay** parameter specifies that IPv6 DHCPv6 relay debug messages are enabled. The optional **server** parameter specifies that IPv6 DHCPv6 server debug messages are enabled. Enter this command as follows:

```
>enable
#debug ipv6 dhcp server
```


Additional Resources

The following tables list additional resources for IPv6 information. This information is provided by the Internet Engineering Task Force (IETF) and other AOS resources.

Table 5. IETF IPv6 Resources

Subject	Request For Comment (RFC) Article
IPv6 Addressing	RFC 4291
IPv6 Temporary Address/Interface IDs	RFC 4941
IPv6 Packet Headers	RFC 6397
IPv6 Global Unicast Addresses	RFC 3587
IPv6 Site-Local Address Replacement	RFC 1918
IPv6 Neighbor Discovery	RFC 4861
IPv6 Packets over Ethernet	RFC 2464
ICMPv6	RFC 4443
DHCPv6	RFC 3315, 4477
DHCPv6 Prefix Delegation	RFC 3633
DNS Enhancements for IPv6	RFC 3596

Table 6. Additional AOS IPv6 Documentation

Subject	AOS Document
IPv6 in AOS	*Configuring IPv6 in AOS*, configuration guide. Available online at https://supportforums.adtran.com.
IPv6 BGP in AOS	*Configuring IPv6 BGP in AOS*, configuration guide. Available online at https://supportforums.adtran.com.
IPv6 QoS in AOS	*Configuring QoS in AOS*, configuration guide. Available online at https://supportforums.adtran.com.