

DHCP for IPv6 (DHCPv6)

Feature Overview and Configuration Guide

Introduction

This guide describes the Dynamic Host Configuration Protocol for IPv6 (DHCPv6), including Prefix Delegation (PD) support, provided by your device. It includes sample configurations to configure your device:

- as a DHCPv6 Server, to pass configuration information to IPv6 clients
- as a DHCPv6 Client, to request IPv6 addresses from a DHCPv6 Server
- for DHCPv6 Prefix Delegation
- as a DHCPv6 Relay Agent.

See "[DHCPv6 messages](#)" on [page 6](#) for the sequence of messages sent and received between DHCPv6 Servers and DHCPv6 Clients and brief descriptions of the messages.

Note: The IPv6 addresses shown in this guide use the address space 2001:0db8::/32, defined in RFC 3849 for documentation purposes. These addresses should not be used for practical networks (other than for testing purposes), nor should they appear on any public network.

Products and software version that apply to this guide

This guide applies to AlliedWare Plus™ products that support DHCPv6 client, server and/or relay, running version 5.4.6-2.1 or later.

To see whether your product supports DHCPv6 client, server and/or relay, see the following documents:

- The [product's Datasheet](#)
- The product's [Command Reference](#)

These documents are available from the above links on our website at alliedtelesis.com.



Feature support may change in later software versions. For the latest information, see the above documents.

Related documents

For the syntax, parameters, descriptions, defaults, and examples for all of the commands used in these sample DHCPv6 configurations, refer to the DHCP for IPv6 (DHCPv6) Commands chapter in your product's [Command Reference](#).

For information about DHCP for IPv4, see the [Dynamic Host Configuration Protocol \(DHCP\) Feature Overview and Configuration Guide](#).

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DHCPv6 for IPv6

DHCPv6 is used to delegate IPv6 prefixes and to allocate IPv6 addresses. It offers stateful address autoconfiguration, and complements Stateless Address Autoconfiguration (SLAAC) described in RFC 2462, IPv6 Stateless Address Autoconfiguration. Stateless Address Autoconfiguration (SLAAC) allows an IPv6-aware device to be plugged into a network, and given an IPv6 address prefix without manual configuration.

- DHCPv6 Clients first use Router Advertisement (RA) messages to auto-configure themselves with any default IPv6 route(s) via gateway router(s).
- A DHCPv6 Client can then initiate DHCPv6 Prefix Delegation by including an IAPD (Identity Association for Prefix Delegation) option along with an ID in its solicit messages.
- Interface addresses can also be automatically configured that are derived from delegated prefix information.
- A DHCPv6 Server can be configured to set optional M and/or O flags in RA messages that it sends.
- A DHCPv6 Server can be configured to notify clients that they can use a stateful address configuration protocol (for example, DHCPv6 IANA) to obtain an address by setting the single bit Managed Address Configuration (M) flag to 1 in RA messages
- A DHCPv6 Server can be configured to notify clients that they can use a stateful address configuration protocol (for example, DHCPv6) to obtain non-address configuration information such as optional DNS information plus SNTP information by setting the single bit Other Stateful Configuration (O) flag to 1 in RA messages.
- IAPD or IANA delegation pools are configured in a DHCPv6 PD (Prefix Delegation) Server. Prefixes or addresses to be allocated are stored in these delegation pools.

See the section "[DHCPv6 Server and Client Identification](#)" on page 15 for IAPD information. See the section "[DHCPv6 messages](#)" on page 6 for solicit message information.

When the device is configured as a DHCPv6 Server, it can:

- **delegate prefixes to IPv6 subnets.** Prefixes allow subnets to be selected, rather than a single node. Like IPv4 addresses, a proportion of the left most bits of the address can be used to indicate the subnet (e.g. using slash notation 2001:0db8:1234::/64). EUI64 suffix information can then be appended to form an IPv6 address on an interface.
- **assign normal and temporary IPv6 addresses to devices.** Normal addresses are renewed by the server for as long as the device requires an address. Temporary addresses are assigned for a limited time (lease time) and are usually allocated for privacy reasons, as outlined in RFC 3041 "Privacy Extensions for Stateless Address Autoconfiguration in IPv6".

DHCPv6 Prefix Delegation

DHCPv6 Prefix Delegation automates IPv6 prefix assignment in an IPv6 network, and enables user devices to automatically append their own device component for the user device portion of the IPv6 address. This gives you the ability to centrally control IPv6 addressing used in remote sites where the IPv6 prefix information is the equivalent of the network portion of an IPv4 address.

DHCPv6 Relay is often used between PE (Provider Edge) devices and CPE (Customer Premises Equipment) devices with DHCPv6 Prefix Delegation. Once a provider delegates prefixes to its customers, the customers can then subnet and assign the prefixes to their internal links.

Providers use the DHCPv6 feature to manage site addressing, subnet, and link updates.

- **Stateless DHCPv6** does not require a DHCPv6 Server to maintain any dynamic state for clients, such as Domain Name System (DNS) Server addresses. Note that only configuration information is exchanged with stateless Prefix Delegation.
- **Stateful DHCPv6** uses a DHCPv6 Server to centrally manage IPv6 address and prefix assignment. DHCPv6 Clients get IPv6 address or prefix information from the DHCPv6 Server. DHCPv6 Clients can obtain configuration information that is not available from other protocols, such as DNS.

DHCPv6 RFCs

See the following list of DHCPv6 related RFCs:

- RFC 3315 Dynamic Host Configuration Protocol for IPv6 (DHCPv6)
- RFC 3769 Requirements for IPv6 Prefix Delegation
- RFC 3633 IPv6 Prefix Options for DHCPv6
- RFC 6276 DHCPv6 Prefix Delegation for Network Mobility (NEMO). This specifies DHCPv6 Prefix Delegation use with a mobile router for network mobility.
- RFC 3646 DNS Configuration Options for DHCPv6.
- RFC 3736 Stateless Dynamic Host Configuration Protocol (DHCP) Service for IPv6 Stateless DHCPv6. This is a combination of IPv6 Stateless Address Autoconfiguration (RFC 4862) and Dynamic Host Control Protocol for IPv6 (RFC 3315). It is a counterpart to IPv6 Stateless Address Autoconfiguration, and can be used with or without IPv6 Stateless Address Autoconfiguration to obtain configuration parameters.
- RFC 4649 Dynamic Host Configuration Protocol for IPv6 (DHCPv6) Relay Agent Remote-ID Option.
- RFC 4841 Neighbor Discovery for IP version 6 (IPv6).
- RFC 4862 IPv6 Stateless Address Autoconfiguration.
- RFC 5007 DHCPv6 Leasequery.

DHCPv6 messages

DHCPv6 uses multicast and unicast addresses for communication. A multicast address provides the equivalent functionality to an IPv4 broadcast address. It identifies a group of interfaces, and packets are sent to all interfaces in that group.

Addresses reserved for DHCPv6 messages are:

- ff02::1:2. This link-scope multicast address is used by clients to communicate with DHCPv6 servers. When the DHCPv6 module is enabled the device listens to this address.
- ff05::1:3. This site-scope multicast address is used by clients to communicate with DHCPv6 servers. When the DHCPv6 module is enabled the device listens to this address.

A normal DHCPv6 message exchange involves the following messages:

1. **Solicit** - sent by a DHCPv6 Client to locate DHCPv6 Servers.
2. **Advertise** - sent by a DHCPv6 server to a DHCPv6 Client in answer to the solicit message as an affirmative message that DHCPv6 Server services are available to a DHCPv6 Client.
3. **Request** - sent by a DHCPv6 Client to a DHCPv6 Server to request configuration parameters.
4. **Reply** - sent by a DHCPv6 Server to a DHCPv6 Client with configuration information.
5. **Renew** - sent by a DHCPv6 Client to a DHCPv6 Server requesting an extension to the address lifetime.

An IPv6 address may be assigned to the DHCPv6 Client for a limited or unlimited time. If the address lifetime is limited, it has a preferred lifetime and a (generally longer) valid lifetime.

Preferred IPv6 addresses or prefixes are available to interfaces for unrestricted use and are deprecated when the preferred timer expires.

An IPv6 address or prefix becomes invalid and is not available to an interface when the valid lifetime timer expires. Invalid addresses or prefixes should not appear as the source or destination for a packet.

Once half the time between address assignment and the preferred lifetime has passed (the T1 time), the client sends a **Renew** message to the server, requesting an extension to the address lifetime.

If the client has not received a reply after 80% of the valid lifetime has passed (the T2 time), it sends a multicast **Rebind** message to discover another DHCPv6 Server

DHCPv6 Client/Server/Relay Agent messages are exchanged over UDP ports 546 and 547. DHCPv6 Clients listen for DHCPv6 messages on UDP port 546, while DHCPv6 Servers and DHCPv6 Relay Agents listen for DHCPv6 messages on UDP port 547.

In a DHCPv6 Client/DHCPv6 Server environment, DHCPv6 messages are sent from the DHCPv6 Clients to DHCPv6 Server destination UDP port 547. DHCPv6 Servers respond to DHCPv6 Client destination UDP port 546.

In a DHCPv6 Client/DHCPv6 Relay Agent/DHCPv6 Server environment, DHCPv6 messages are sent from DHCPv6 Clients to DHCPv6 Relay Agent and DHCPv6 Server destination UDP port 547. DHCPv6 Servers respond to DHCPv6 Relay Agents via destination UDP port 547. DHCPv6 Relay Agents respond to DHCPv6 Client destination UDP port 546.

DHCPv6 message types

The following DHCPv6 Message Types are supported in AlliedWare Plus:

- **SOLICIT:**

A DHCPv6 Client sends a **SOLICIT** message to locate DHCPv6 Servers.

- **ADVERTISE:**

A DHCPv6 Server sends an **ADVERTISE** message to indicate that it is available for DHCPv6 service in response to a SOLICIT message received from a DHCPv6 Client.

- **REQUEST:**

A DHCPv6 Client sends a **REQUEST** message to request configuration parameters, including IPv6 addresses.

- **CONFIRM:**

A DHCPv6 Client sends a **CONFIRM** message to any available DHCPv6 Server to determine whether the IPv6 addresses it was assigned is still appropriate to the link to which the DHCPv6 Client is connected. This can happen when the DHCPv6 Client detects either a link-layer connectivity change, or if it is powered on and one or more leases are still valid. The **CONFIRM** message is used to confirm whether the DHCPv6 Client is still on the same link or whether it has been moved. The actual lease(s) are not validated; just the prefix portion of the delegated IPv6 addresses or IPv6 prefixes.

- **RENEW:**

A DHCPv6 Client sends a **RENEW** message to the DHCPv6 Server that originally provided the DHCPv6 Client's addresses and configuration parameters, to extend the lifetimes on the IPv6 addresses assigned to the DHCPv6 Client and to update other configuration parameters.

- **REBIND:**

A DHCPv6 Client sends a REBIND message to any available DHCPv6 Server to extend the lifetimes of the IPv6 addresses assigned to the DHCPv6 Client, and to update other configuration parameters. This message is sent after a DHCPv6 Client receives no response to a RENEW message.

- **REPLY:**

A DHCPv6 Server sends a **REPLY** message containing assigned IPv6 addresses and configuration parameters in response to a **SOLICIT**, **REQUEST**, **RENEW**, and **REBIND** message received from a DHCPv6 Client. A DHCPv6 Server sends a **REPLY** message containing configuration parameters in response to an **INFORMATION-REQUEST** message. A DHCPv6 Server sends a **REPLY** message in response to a **CONFIRM** message confirming or denying that the IPv6 addresses assigned to the DHCPv6 Client are appropriate to the link to which the DHCPv6 Client is connected. A DHCPv6 Server sends a **REPLY** message to acknowledge receipt of a **RELEASE** or **DECLINE** message.

- **RELEASE:**

A DHCPv6 Client sends a **RELEASE** message to the DHCPv6 Server to inform it that the DHCPv6 Client will no longer use one or more of the assigned IPv6 addresses.

- **DECLINE:**

A DHCPv6 Client sends a **DECLINE** message to a DHCPv6 Server to indicate that the DHCPv6 Client has determined that one or more IPv6 addresses assigned by the DHCPv6 Server are already in use on the link to which the DHCPv6 Client is connected.

- **RECONFIGURE:**

A DHCPv6 Server sends a **RECONFIGURE** message to a DHCPv6 Client to inform the DHCPv6 Client that the DHCPv6 Server has new or updated configuration parameters. The DHCPv6 Client is to initiate a **RENEW/REPLY** or an **INFORMATION-REQUEST/REPLY** transaction with the DHCPv6 Server to receive updated information.

- **INFORMATION-REQUEST:**

A DHCPv6 Client sends an **INFORMATION-REQUEST** message to a DHCPv6 Server to request configuration parameters without the assignment of any IPv6 addresses to the DHCPv6 Client.

- **RELAY-FORW:**

A DHCPv6 Relay Agent sends a **RELAY-FORW** message to relay messages to DHCPv6 Servers, either directly or through another DHCPv6 Relay Agent. The received message, either a DHCPv6 Client message or a **RELAY-FORW** message from another DHCPv6 Relay Agent, is encapsulated in an option in the **RELAY-FORW** message.

- **RELAY-REPL:**

A DHCPv6 Server sends a **RELAY-REPL** message to a DHCPv6 Relay Agent containing a message that the DHCPv6 Relay Agent delivers to a DHCPv6 Client. The **RELAY-REPL** message may be relayed by other DHCPv6 Relay Agents for delivery to the destination DHCPv6 Relay Agent. The DHCPv6 Server encapsulates the DHCPv6 Client message as an option in the **RELAY-REPL** message, which the DHCPv6 Relay Agent extracts and relays to the DHCPv6 Client.

DHCPv6 Client to DHCPv6 Server messages

The following DHCPv6 Messages are sent from a DHCPv6 Client to a DHCPv6 Server:

- **SOLICIT**
- **REQUEST**
- **CONFIRM**
- **RENEW**
- **REBIND**
- **RELEASE**
- **DECLINE**
- **INFORMATION-REQUEST**

DHCPv6 Server to DHCPv6 Client messages

The following DHCPv6 Messages are sent from a DHCPv6 Server to a DHCPv6 Client:

- **ADVERTISE**
- **REPLY**
- **RECONFIGURE**

DHCPv6 Relay to DHCPv6 Relay/Server messages

The following DHCPv6 Message is sent from a DHCPv6 Relay to a DHCPv6 Relay/Server:

- **RELAY-FORW**

DHCPv6 Relay/Server to DHCPv6 Relay messages

The following DHCPv6 Message is sent from a DHCPv6 Relay/Server to a DHCPv6 Relay:

- **RELAY-REPL**

DHCPv6 Renewal and Rebinding

DHCPv6 Renewal and Rebinding terminology:

- **T1 Timer:**

Indicates when a DHCPv6 Client must attempt to renew IPv6 addresses or prefixes.

- **T2 Timer:**

Indicates when a DHCPv6 Client must attempt to rebind IPv6 addresses or prefixes.

- **Preferred Lifetime:**

Indicates when preferred IPv6 addresses or prefixes are available to interfaces for unrestricted use and are deprecated when the preferred timer expires. Deprecated addresses and prefixes are available for use and are discouraged but not forbidden. A deprecated address or prefix should not be used as a source address or prefix, but packets sent from deprecated addresses or prefixes are delivered as expected.

- **Valid Lifetime:**

Indicates when IPv6 addresses or prefixes must be abandoned. An IPv6 address or prefix becomes invalid and is not available to an interface when the valid lifetime timer expires. Invalid addresses or prefixes should not appear as the source or destination for a packet.

- **Client States:**

- **Bound:** Normal operation.
- **Renewing:** Renewing lease.
- **Rebinding:** Occurs when no reply has been received from the DHCPv6 Server.
- **Bound:** Receive, process, and finalize new lease.

- **Renewal Process:**

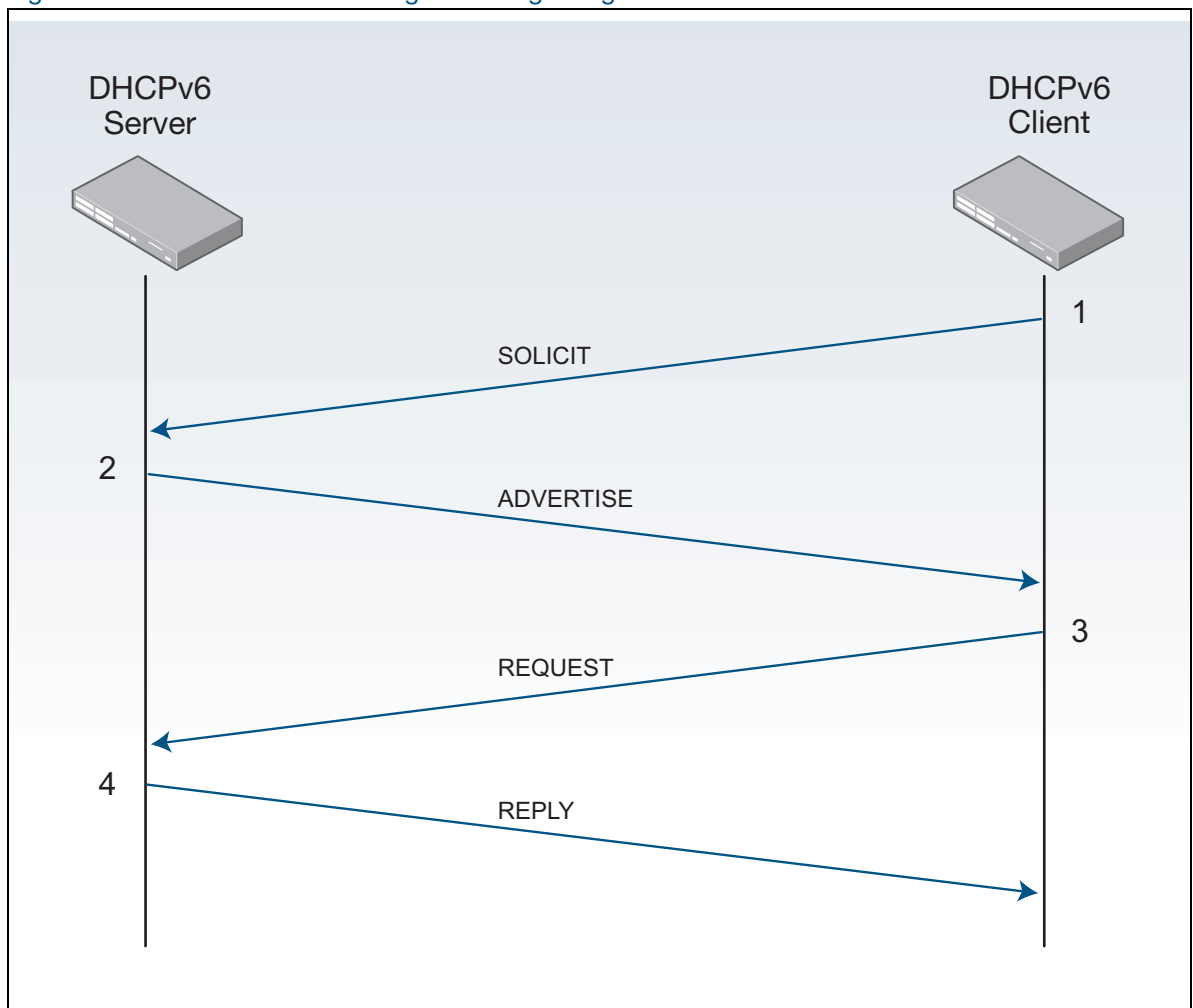
- Renewal T1 Timer expires (the default T1 Timer period is 50% of the lease length)
- DHCPv6 Client transitions from Bound to Renewing state.
- DHCPv6 Client sends DHCPv6 Request/Renew messages (**REQUEST/RENEW** message types)
- DHCPv6 Client transitions to Rebinding state (if no reply from DHCPv6 Server and the T2 Timer expires).
- DHCPv6 Client transitions to Bound state (when DHCPv6 Client receives a reply from DHCPv6 Server).

Stateful DHCPv6 message exchange

The sequence for stateful DHCPv6 message exchange between a DHCPv6 Client and a DHCPv6 Server is shown below in Figure 1.

1. The Client starts by sending a **SOLICIT** message to the Server.
2. The Server sends an **ADVERTISE** message back to the Client.
3. The Client sends a **REQUEST** message to the Server.
4. The Server sends a **REPLY** message back to the Client to finish.

Figure 1: Stateful DHCPv6 message exchange diagram



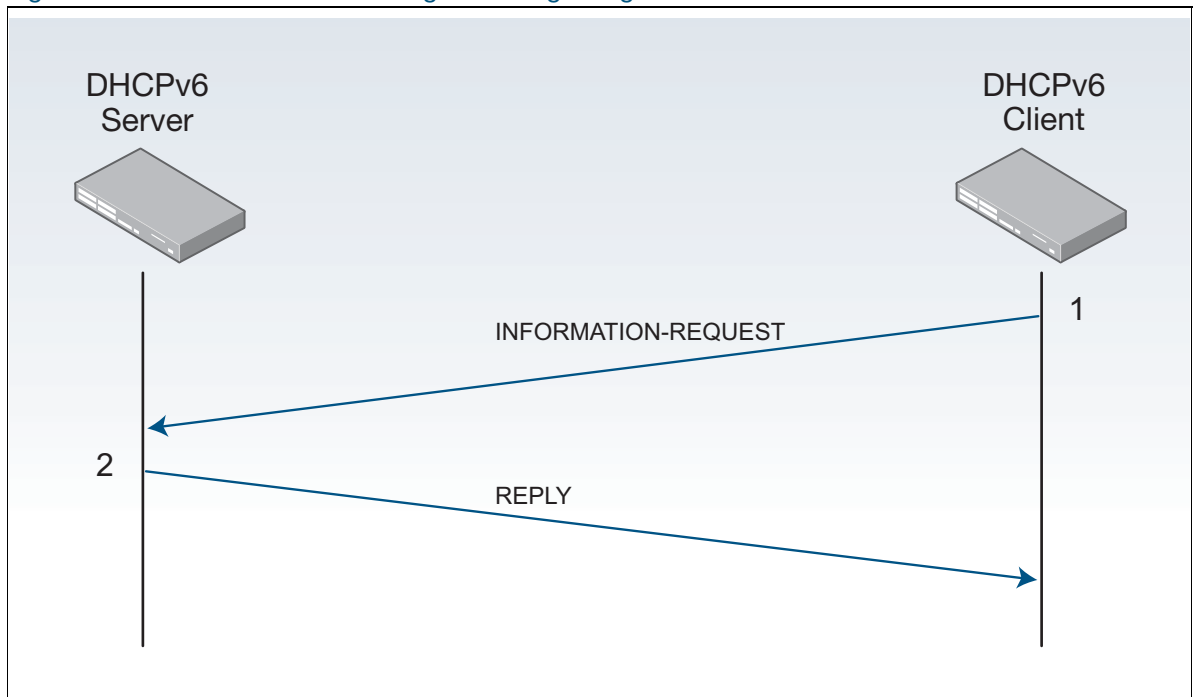
See the section "[DHCPv6 messages](#)" on [page 6](#) for descriptions of all DHCPv6 messages.

Stateless DHCPv6 message exchange

The sequence for stateless DHCPv6 message exchange between a DHCPv6 Client and a DHCPv6 Server is shown below in Figure 2.

1. The Client starts by sending an **INFORMATION-REQUEST** message to the Server. This request specifically excludes the assignment of any IPv6 address.
2. The Server sends a **REPLY** message back to the Client to finish.

Figure 2: Stateless DHCPv6 message exchange diagram



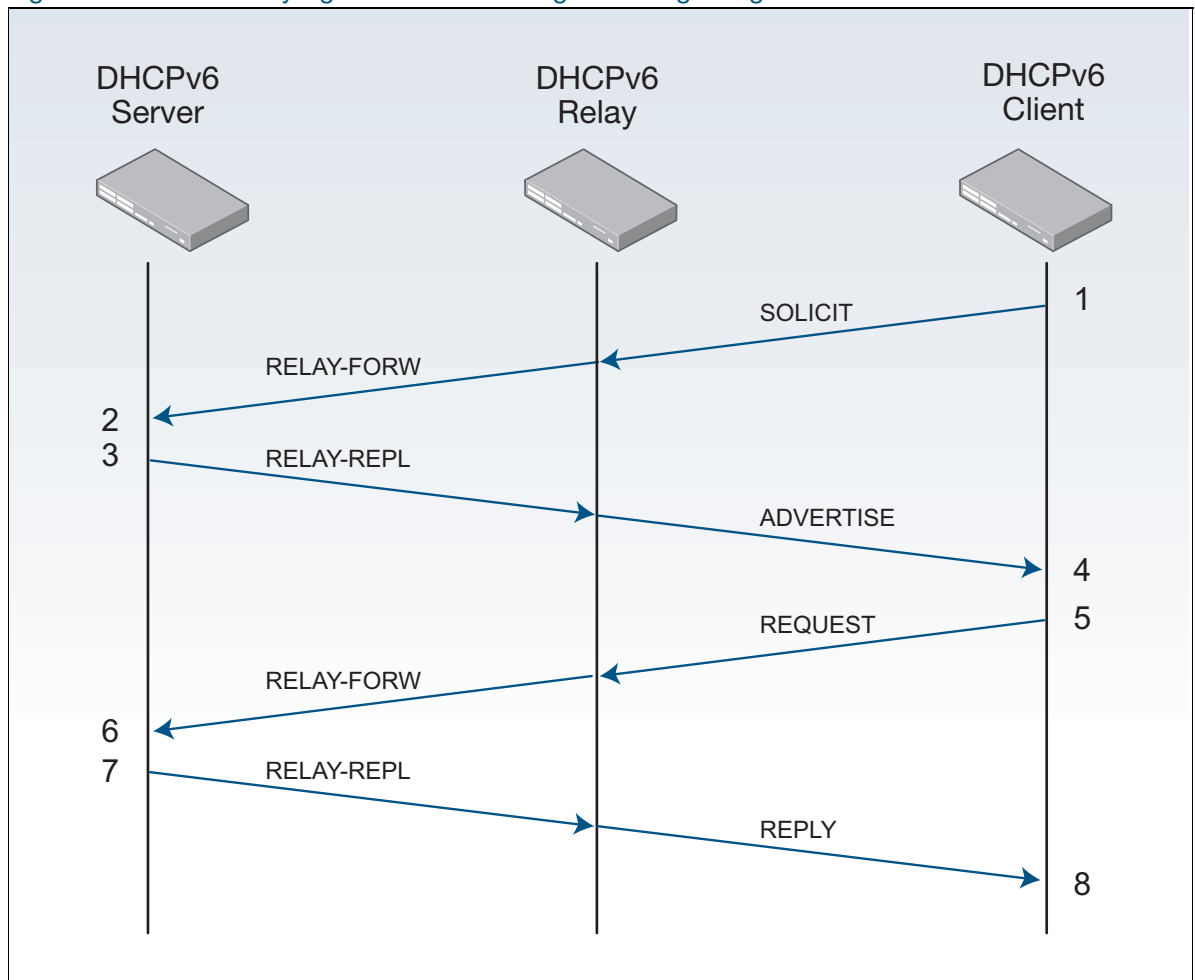
See section "[DHCPv6 messages](#)" on page 6 for descriptions of all DHCPv6 messages.

DHCPv6 Relay Agent stateful message exchange

The sequence for a stateful DHCPv6 message exchange between a DHCPv6 Client, a DHCPv6 Relay, and a DHCPv6 Server is shown below in Figure 3.

1. The Client starts by sending a **SOLICIT** message to the Relay.
2. The Server receives a **RELAY-FORW** message sent from the Relay.
3. The Server sends a **RELAY-REPL** message back to the Relay.
4. The Client receives an **ADVERTISE** message sent from the Relay.
5. The Client sends a **REQUEST** message to the Relay.
6. The Server receives a **RELAY-FORW** message sent from the Relay.
7. The Server sends a **RELAY-REPL** message back to the Relay.
8. The Client receives a **REPLY** message sent from the Relay to finish.

Figure 3: DHCPv6 Relay Agent stateful message exchange diagram



See section "DHCPv6 messages" on page 6 for message descriptions.

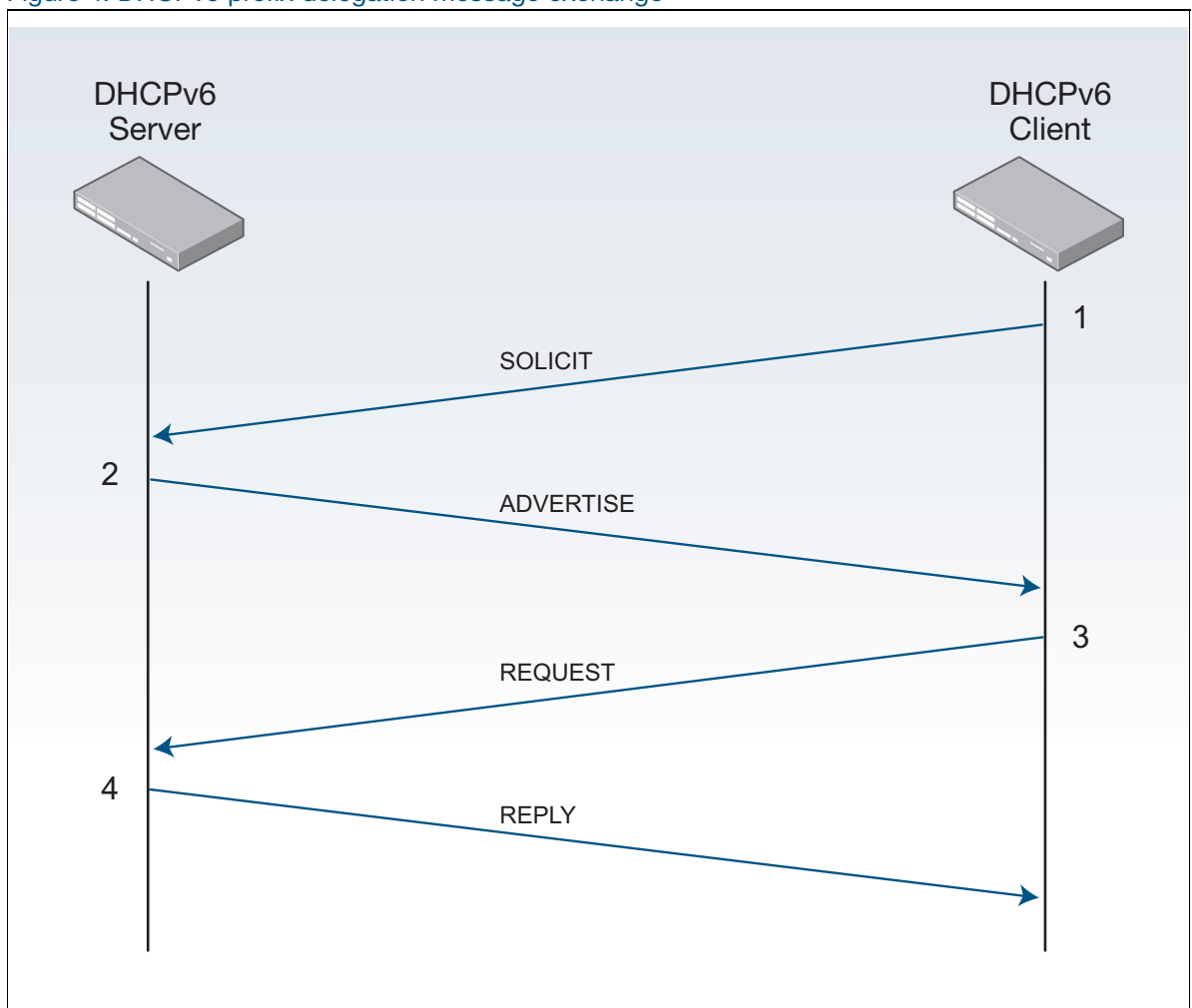
DHCPv6 Prefix Delegation message exchange

The sequence for stateful DHCPv6 message exchange between a DHCPv6 Client and a DHCPv6 Server configured for DHCPv6 Prefix Delegation is shown below in Figure 4.

The DHCPv6:

1. The Client starts by sending a **SOLICIT** message to the Server.
2. The Server sends an **ADVERTISE** message back to the Client.
3. The Client sends a **REQUEST** message to the Server.
4. The Server sends a **REPLY** message back to the Client to finish.

Figure 4: DHCPv6 prefix delegation message exchange



See section "DHCPv6 messages" on page 6 for descriptions of all DHCPv6 messages.

DHCPv6 Server and Client Identification

DHCPv6 Clients and Servers are identified by a DHCPv6 Unique Identifier (DUID). The DUID consists of a number, followed by a hexadecimal string that identifies the hardware type of the client and the link-layer address of the client.

DHCPv6 Unique Identifier (DUID)

A DUID identifies each DHCPv6 Client and Server, where Client and Server identifier options contain the DUID. The DUID is unique for DHCPv6 Clients and Servers. DHCPv6 uses DUIDs with link-layer addresses for client and server identifiers. The device uses the MAC address from the lowest-numbered interface to determine a DUID.

Prefixes are considered to be for different clients when a DHCPv6 Client requests two prefixes with the same DUID and with different IAIDs on different network interfaces.

Identity associations (IAPD, IAID, and IANA)

DHCPv6 Clients use identity associations to identify each interface that is configured by DHCPv6. An interface's identity association contains the configuration settings of the interface and an Identity Association Identifier (IAID). When the client requests settings from the server for a particular interface, it includes the IAID, to identify the interface.

An Identity Association for Prefix Delegation (IAPD) is a set of IPv6 prefixes assigned to a requesting device. A requesting device may have more than one IAPD where an IAPD is assigned per interface and the device has multiple interfaces.

IAPDs are identified by IAIDs. IAIDs are chosen by requesting devices and are unique among IAPD IAIDs on requesting devices. IAIDs are consistent after reloading using information from the associated interface that is permanently attached to the device.

IAPD, IAID, and IANA use with Prefix Delegation

For subscriber LAN addressing, you can use DHCPv6 address and/or Prefix Delegation to provision global IPv6 addresses to subscribers on the LAN.

IAPD or IANA (Identity Association for Non-temporary Addresses) delegation pools are configured in a PD Server. Prefixes or addresses to be allocated are stored in delegation pools. RA messages are first used by stateful client(s) to auto-configure themselves with any default IPv6 route(s) via gateway router(s).

When IAPD is specified, a DHCPv6 client can then initiate Prefix Delegation as a requesting device by including an IAPD option with the specified ID in **solicit** messages. Interface addresses can be automatically derived from delegated prefix information.

See the section "[DHCPv6 messages](#)" on page 6 for the sequence of messages sent and received between DHCPv6 Servers and DHCPv6 Clients and brief descriptions of the messages.

DHCPv6 Server and Client Functionality

DHCPv6 Server and Client functionality is mutually exclusive on an interface. When one of these functions is enabled and a user tries to configure a DHCPv6 Client or Server on the same interface, a message is shown to indicate whenever an interface already configured.

DHCPv6 Server functionality

Configuration parameters for DHCPv6 Clients are configured in DHCPv6 configuration pools. A configuration pool is associated with a particular DHCPv6 Server on an interface. Prefixes that are delegated to DHCPv6 Clients can be specified as a list of assigned IPv6 prefixes for a given DHCPv6 Client or as IPv6 local prefix pools. The list of configured IPv6 prefixes or IPv6 local prefix pools are referenced and used by DHCPv6 configuration pools.

The DHCPv6 Server can provide configuration parameters that do not require the server to maintain any dynamic state for individual clients, such as DNS Server addresses and domain search list options. The DHCPv6 Server can be configured for prefix delegation. DHCPv6 Server functionality can be enabled on individual IPv6-enabled VLAN interfaces.

The DHCPv6 Server maintains an automatic binding table in memory to track the assignment of some configuration parameters, such as prefixes between the server and its clients. Automatic bindings can be stored semi-permanently in non-volatile memory.

RA suppression is turned off in the DHCPv6 Server to facilitate neighbor discovery and allow clients via router solicitation to discover gateway routers on the LAN.

DHCPv6 Server prefix delegation pool

A DHCPv6 Server prefix delegation pool is named and includes information about the configuration parameters that control assignment of prefixes to clients from the pool. A prefix delegation pool is configured independently and is associated with the DHCPv6 Server by entering the relevant commands at the console. Each DHCPv6 prefix delegation pool can contain the following configuration parameters and information:

- SNTP Server IPv6 addresses.
- DNS Server IPv6 addresses.
- DHCPv6 prefix delegation information, including a DHCPv6 prefix pool name and available IPv6 prefixes, both with their configured preferred and valid lifetimes.

See the section "[Configuring the DHCPv6 Server delegation pool](#)" on page 20 for the sequence of commands issued together with command modes, command syntaxes, and brief descriptions.

IPv6 prefix assignment

A DHCPv6 Server selects prefixes for assignment following a request from a DHCPv6 Client. The DHCPv6 Server selects prefixes for a DHCPv6 Client statically or dynamically. You can statically configure IPv6 prefixes, plus preferred and valid lifetimes for an IAPD, of a DHCPv6 Client as identified by its DUID.

When the delegating DHCPv6 Server receives a request from a DHCPv6 Client, it checks if there is a static binding configured for the IAPD in the message from the DHCPv6 Client. If a static binding is present, prefixes in the binding are returned to the DHCPv6 client. If no binding is found, the DHCPv6 Server can assign prefixes for the DHCPv6 client from DNS.

The DHCPv6 Server assigns prefixes dynamically from an IPv6 local prefix pool. When the DHCPv6 Server receives a prefix request from a DHCPv6 Client, it attempts to obtain unassigned prefixes from the IPv6 local prefix pool. After the DHCPv6 Client releases the previously assigned IPv6 prefixes, the DHCPv6 Server returns them to the pool for reassignment.

Automatic binding table

Each DHCPv6 configuration pool has a linked automatic binding table. The automatic binding table records all IPv6 prefixes in the configuration pool that are delegated to DHCPv6 Clients. Each permanent storage to which the binding database is saved is called the database agent. Database agent binding information is stored in NVRAM so configuration information, including prefixes for DHCPv6 Clients from a DHCPv6 Server, is retained after a reload. Each binding table entry contains the following information:

- DHCPv6 Server network interface for the DHCPv6 configuration pool.
- Configuration pool for the binding table.
- Preferred and valid lifetimes per prefix.
- Prefixes delegated to each IAPD.
- IAPDs associated with the client.
- Client IPv6 address.
- Client DUID.

DHCPv6 Server creates a binding table entry when a prefix is delegated to a DHCPv6 Client from the configuration pool, and the entry is updated when the DHCPv6 Client renews, rebinds, or confirms the prefix delegation.

A binding table entry is deleted when the DHCPv6 Client releases all prefixes in the binding, all valid lifetimes expire, or when you run the **clear ipv6 dhcp binding** command. Use the **show ipv6 dhcp binding** command to see binding details.

The DHCPv6 Server assigns prefixes dynamically from an IPv6 local prefix pool. When the DHCPv6 Server receives a prefix request from a DHCPv6 Client, then the DHCPv6 Server gets unassigned prefixes from the DHCPv6 configuration pool. Once the DHCPv6 client releases assigned prefixes, the DHCPv6 Server returns prefixes to the configuration pool.

SNTP Server functionality

The SNTP Server Functionality gives a list of IPv6 addresses for SNTP Servers that the DHCPv6 Client can use to synchronize system time to a standard time server. The DHCPv6 Server lists the SNTP Servers for the DHCPv6 Clients to select from to synchronize timing.

Use the **sntp-address <ipv6-address>** command to specify an SNTP server.

DHCPv6 Server and DNS for IPv6 address assignment

Additional options, such as the default domain name and DNS name-server address, can be passed back to the DHCPv6 Client. Address pools can be assigned for use on a specific interface, or the DHCPv6 Server can automatically find the appropriate pool.

To specify the DNS name-server address, use the **dns-server <ipv6-address>** command. To specify the domain name, use the **domain-name** command.

DHCPv6 Client functionality

DHCPv6 Clients can request the delegation of prefixes from a DHCPv6 Server. The IPv6 prefixes acquired from a delegating DHCPv6 Server are stored in an IPv6 prefix pool. The prefixes in the IPv6 prefix pool can be used to number downstream device interfaces.

A DHCPv6 Client is enabled on an individual IPv6-enabled VLAN interface, and can also request and accept those configuration parameters that do not require a DHCPv6 Server to maintain any dynamic state for individual clients, such as DNS Server addresses.

See the section "[Configuring the DHCPv6 Client for prefix delegation](#)" on page 21 for the sequence of commands issued together with command modes, command syntaxes, and brief descriptions.

DHCPv6 Server selection by a DHCPv6 Client

A DHCPv6 Client builds a list of DHCPv6 servers by sending a **solicit** message and by receiving **advertisement** replies from DHCPv6 Servers. The replies are ranked by the DHCPv6 Client based on preference value, when DHCPv6 Servers add a preference value to their advertisement messages. For DHCPv6 Clients to obtain IPv6 prefixes from DHCPv6 Servers, only DHCPv6 Servers that advertise prefixes are considered by DHCPv6 Clients.

See the section "[DHCPv6 messages](#)" on page 6 for the sequence of messages sent and received between DHCPv6 Servers and DHCPv6 Clients and brief descriptions of the messages.

Note: The IPv6 addresses shown use the address space 2001:0db8::/32, defined in RFC 3849 for documentation purposes. These addresses should not be used for practical networks (other than for testing purposes) nor should they appear on any public network.

See the section "[Configuring DHCPv6 Prefix Delegation](#)" on page 20 for the sequence of commands issued together with command modes, command syntaxes, and brief descriptions.

See the section "[Example: Prefix Delegation Subdelegation System](#)" on page 47 for an example network topology and configuration output to adapt for your own network configuration.

For the syntax, parameters, descriptions, defaults, and examples for all of the commands used in the following DHCPv6 configurations, refer to the DHCP for IPv6 (DHCPv6) Commands chapter of your product's [Command Reference](#).

Configuring DHCPv6 Prefix Delegation

This section contains step-by-step instructions for configuring a DHCPv6 server delegation pool and a DHCPv6 client.

Configuring the DHCPv6 Server delegation pool

Perform this sequence of command entries to create and configure the DHCPv6 configuration pool and associate it with a DHCPv6 Server on a VLAN interface.

1.	<code>awplus>enable</code>	Enter Privileged Exec mode.
2.	<code>awplus#configure terminal</code>	Enter Global Configuration mode.
3.	<code>awplus(config)#ipv6 local pool <dhcpv6-poolname> <ipv6-prefix/ prefix-length></code>	Configure a DHCPv6 local prefix pool to be delegated by the DHCPv6 server.
4.	<code>awplus(config)#ipv6 dhcp pool <dhcpv6-poolname></code>	Configure a DHCPv6 configuration information pool and enter DHCPv6 configuration mode.
5.	<code>awplus(config-dhcp6)#domain-name <domain-name></code>	Configure a domain name for a DHCPv6 client.
6.	<code>awplus(config-dhcp6)#dns-server {<ipv6-address> interface <server- interface>}</code>	Specify the DNS IPv6 servers available to a DHCPv6 client.
7.	<code>awplus(config-dhcp6)#prefix- delegation pool <poolname> [lifetime {<valid-time> infinite} {<preferred-time> infinite}]</code>	Specify a named IPv6 prefix pool from which prefixes are delegated to DHCPv6 clients. If desired, specify the lifetime, which determines the time period for which the hosts remember RAs.
8.	<code>awplus(config-dhcp6)#exit</code>	Exit DHCPv6 configuration mode, and return the device to Global Configuration mode.
9.	<code>awplus(config)#interface <interface- list></code>	Specify a VLAN interface, and enter Interface Configuration mode.
10.	<code>awplus(config-if)#ipv6 dhcp-server [<dhcpv6-poolname>]</code>	Enable DHCPv6 on the specified VLAN interface.
11.	<code>awplus(config-if)#exit</code>	Return to Global Configuration mode.

Configuring the DHCPv6 Client for prefix delegation

General prefixes can be defined dynamically from a prefix received by a DHCPv6 prefix delegation client via IAPD. The delegated prefix is stored in a general prefix:

1.	<code>awplus>enable</code>	Enter Privileged Exec mode.
2.	<code>awplus#configure terminal</code>	Enter Global Configuration mode.
3.	<code>awplus(config)#interface <interface-list></code>	Specify a VLAN interface, and enter Interface Configuration mode.
4.	<code>awplus(config-if)#ipv6 dhcp client pd [<prefix-name>]</code>	Enable the DHCPv6 client process and enable a request for prefix delegation through the specified VLAN interface.
5.	<code>awplus(config-if)#exit</code>	Return to Global Configuration mode.

Note that devices can be optionally configured to advertise connected routing information associated with delegated prefixes to other devices within the domain via dynamic routing protocols.

Note the following configuration examples build from a simple two-device system up to a complex sub-delegation system involving multiple devices and multiple delegation pools.

Examples: DHCPv6 Prefix Delegation

This section contains short examples for a variety of configurations.

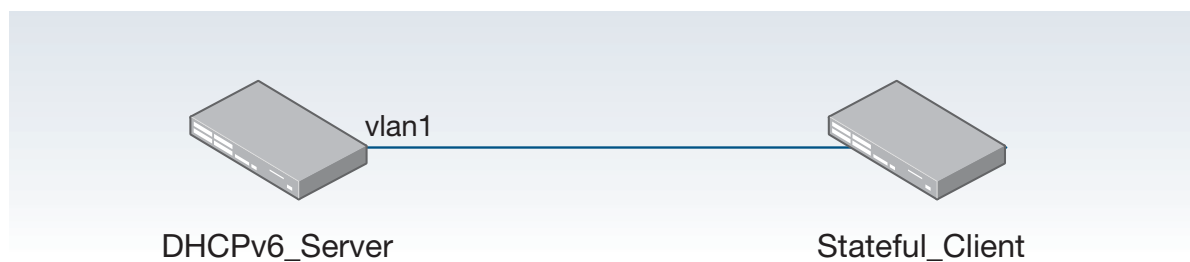
Configuring DHCPv6 Server/Stateful Client (prefix)

In this example, a stateful client can obtain its interface address (via DHCPv6 IANA) and other information (such as DNS, SNTP) configured in the DHCP Server delegation pool.

- The client is allocated an address from the address prefix configured in the DHCP Server pool. A stateful client can automatically learn about any gateway router(s) on the LAN and dynamically add associated default route(s) into its routing table via next-hop link-local address of the gateway router via router advertisements.
- RA suppression is turned off in the DHCPv6 Server to facilitate neighbor discovery.

Note the default VLAN interface vlan1 is applied to all ports on a device.

Figure 5: DHCPv6 Server / Stateful Client configuration topology:



DHCPv6_Server configuration (prefix)

See the following configuration for a device with the hostname “DHCPv6_Server”:

```
hostname DHCPv6_Server
!
ipv6 dhcp pool pool1
address prefix 2001:db8:10::/64
dns-server 2001:db8:10::10
domain-name example.com
sntp address 2001:db8:10::20
!
interface vlan1
description to_Stateful_Client
ipv6 address 2001:db8:10::1/64
ipv6 enable
no ipv6 nd suppress-ra
ipv6 nd managed-config-flag
ipv6 nd other-config-flag
ipv6 dhcp server pool1
!
ipv6 forwarding
```

Stateful_Client configuration (IANA)

See the following configuration for a device with the hostname “Stateful_Client”:

```
hostname Stateful_Client
!  
interface vlan1  
  ipv6 address dhcp
```

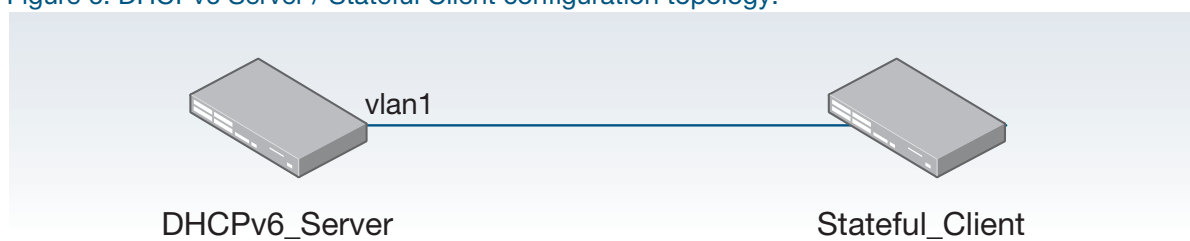
Configuring DHCPv6 Server/Stateful Client (Range)

In this example, a stateful client can obtain its interface address (via DHCPv6 IANA) and other information (such as DNS, SNTP) configured in the DHCP Server delegation pool.

- The client is allocated an address from the address range configured in the DHCP Server pool. A stateful client can automatically learn about any gateway router(s) on the LAN and dynamically add associated default route(s) into its routing table via the next-hop link-local address of the gateway router via router advertisements.
- RA suppression is turned off in the DHCPv6 Server to facilitate neighbor discovery.

Note the default VLAN interface vlan1 is applied to all ports on a device.

Figure 6: DHCPv6 Server / Stateful Client configuration topology:



DHCPv6_Server configuration (range)

See the following configuration for a device with the hostname “DHCPv6_Server”:

```
hostname DHCPv6_Server
!
ipv6 dhcp pool pool1
address range 2001:db8:10::2 2001:db8:10::100
dns-server 2001:db8:10::10
domain-name example.com
sntp address 2001:db8:10::20
!
interface vlan1
description to_Stateful_Client
ipv6 address 2001:db8:10::1/64
ipv6 enable
no ipv6 nd suppress-ra
ipv6 nd managed-config-flag
ipv6 nd other-config-flag
ipv6 dhcp server pool1
!
ipv6 forwarding
```

Note: Only the configuration lines in bold are required to support a Stateless Client configuration when the DHCP server is acting as the IPv6 gateway router for the network to which the Stateless Client is attached.

Stateful_Client configuration (IANA)

See the following configuration for a device with the hostname “Stateful_Client”:

```
hostname Stateful_Client
!  
interface vlan1  
  ipv6 address dhcp
```

Configuring DHCPv6 Server/Stateless Client

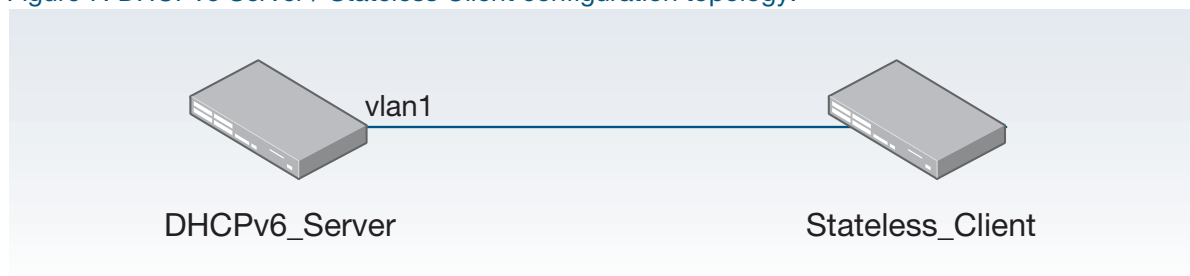
The Stateless Client can automatically learn about any gateway router(s) on the LAN via router solicitation. It can then dynamically add associated default route(s) into its routing table via the next-hop link-local address of the gateway router.

From RFC 4864, section 5.5.3: If the sum of the prefix length and interface identifier length does not equal 128 bits, the Prefix Information option must be ignored.

The effect is that prefix information received in an RA will not be applied to form an IPv6 address via SLAAC if the prefix is greater or less than 64. Since EUI is 64 bits in length the IPv6 Prefix of the advertising device must be 64 bits as well.

Note the default VLAN interface vlan1 is applied to all ports on a device.

Figure 7: DHCPv6 Server / Stateless Client configuration topology:



DHCPv6_Server configuration (prefix)

See the following alternative configuration for a device with the hostname "DHCPv6_Server":

```
hostname DHCPv6_Server
!
ipv6 dhcp pool pool1
 address prefix 2001:db8:10::/64
 dns-server 2001:db8:10::10
 domain-name example.com
 sntp address 2001:db8:10::20
!
interface vlan1
 description to_Stateless_Client
 ipv6 address 2001:db8:10::1/64
 ipv6 enable
 no ipv6 nd suppress-ra
 ipv6 nd managed-config-flag
 ipv6 nd other-config-flag
 ipv6 dhcp server pool1
!
ipv6 forwarding
```

Stateless_Client configuration (SLAAC)

See the following configuration for a device with the hostname “Stateless_Client”:

```
hostname Stateless_Client
!  
interface vlan1  
  ipv6 enable
```

Note: Some clients, when configured for SLAAC, will initiate a stateless DHCPv6 information request if they receive an RA with the “other-config” flag set. This DHCPv6 information request allows them to retrieve additional information such as DNS server addresses, Domain Name information, and SNTP server addresses from the DHCPv6 server. AlliedWare Plus devices behave like this when SLAAC is configured on an Ethernet interface.

Configuring DHCPv6 Relay / Server / Client

In this example, a stateful client device (via IANA) obtains its interface address from a DHCPv6 Server pool. In this example, the DHCPv6 Client resides in a network that is remote from the DHCPv6 Server and communicates via an intermediate DHCPv6 Relay. Diagnostics command output is shown following the configuration output.

The DHCPv6 Server needs a route to the remote LAN, where the client request originates from via the appropriate next-hop. In this example, the next-hop address is the link-local address of the DHCPv6 Relay. The route could be statically configured as in this example, or dynamically learned via an IPv6 routing protocol.

Link addresses are configured in DHCPv6 Server address pools when there are remote clients that communicate via intermediate relay(s).

When a DHCPv6 Relay receives a request from the DHCPv6 Client, it sends a **relay-forward** message toward the DHCPv6 Server. The DHCPv6 Relay message includes an address from the client-facing interface in the link-address field of the **relay-forward** message. The address of the server-facing interface is used as the IPv6 source of the relay message, and the server will send any reply to that address.

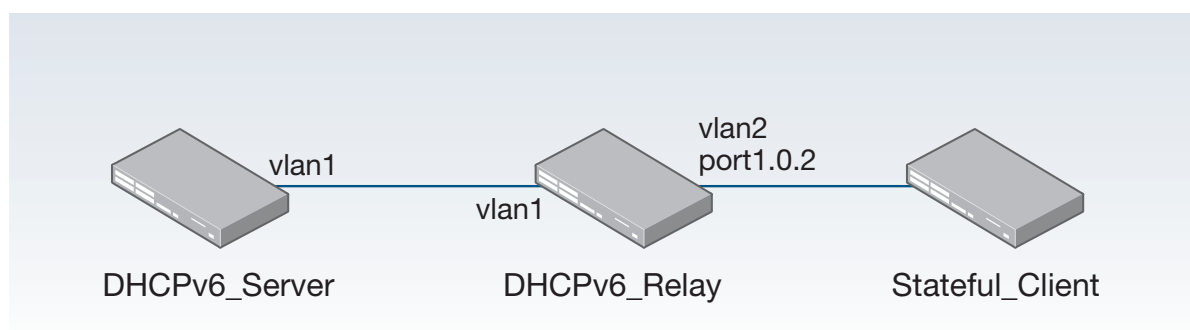
The DHCPv6 Relay automatically adds a route for the delegated prefix into its routing table for the duration of the valid lease, via the interface where the PD client device resides.

When an address on the incoming interface of the DHCPv6 Server or a link address set in the incoming delegation request packet matches the link-address prefix configured in the delegation pool, the server is able to match and use the appropriate delegation pool for relayed delegation request messages.

Active bindings are stored in non-volatile memory, and are retained over a device reboot.

Note the default VLAN interface vlan1 is applied to all ports on a device.

Figure 8: DHCPv6 server / relay / stateful client configuration topology



DHCPv6_Server configuration

See the following configuration for a device with the hostname "DHCPv6_Server":

```
hostname DHCPv6_Server
!
ipv6 dhcp pool pool1
  address prefix 2001:db8:20::/64
  link-address 2001:db8:20::/64
  dns-server 2001:db8:10::10
  domain-name example.com
  sntp address 2001:db8:10::20
!
interface vlan1
  description to_DHCPv6_Relay
  ipv6 address 2001:db8:10::1/64
  ipv6 enable
  no ipv6 nd suppress-ra
  ipv6 nd managed-config-flag
  ipv6 nd other-config-flag
  ipv6 dhcp server pool1
!
ipv6 forwarding
!
ipv6 route 2001:db8:20::/64 fe80::200:cdff:fe29:a65f vlan1
```

DHCPv6_Server diagnostic output

See the DHCPv6_Server diagnostic output after entering the command to clear bindings:

```
DHCPv6_Server#clear ipv6 dhcp bind all
DHCPv6_Server#show ipv6 interface
Interface      IPv6-Address      Status      Protocol
lo             unassigned        admin up    running
vlan1          2001:db8:10::1/64  admin up    running
                fe80::eecd:6dff:fe5a:b864/64
```

When the DHCPv6 Client connects, see the binding and associated counters as below:

```
DHCPv6_Server#show ipv6 dhcp binding
Pool pool1
  Address 2001:db8:20:0:e2e3:7b54:6d72:28b4
         client IAID 77c973a3, DUID 00010001182323a8001577c973a3
         preferred lifetime 604800, valid lifetime 2592000
         starts at 30 Oct 2012 23:50:01
         expires at 29 Nov 2012 23:50:01
DHCPv6_Server#show counter ipv6 dhcp-server
DHCPv6 server counters
SOLICIT in          ..... 3
ADVERTISE out       ..... 3
REQUEST in          ..... 2
CONFIRM in          ..... 1
RENEW in            ..... 0
REBIND in           ..... 0
REPLY out           ..... 2
RELEASE in          ..... 0
DECLINE in          ..... 0
INFORMATION-REQUEST in ..... 0
```

Stateful_Client configuration

See the following configuration for a device with the hostname "Stateful_Client":

```
hostname Stateful_Client
!
interface vlan1
  ipv6 address dhcp
```

Stateful_Client diagnostic output

See the Stateful Client device diagnostic output after entering the command to clear bindings:

```
Stateful_Client#clear ipv6 dhcp client vlan1
Stateful_Client#show ipv6 interface
Interface      IPv6-Address      Status      Protocol
lo             unassigned        admin up    running
vlan1          fe80::215:77ff:fec9:73a3/64  admin up    running
```

Once the client has an address delegated, see the binding and associated counters below:

```
Stateful_Client#show ipv6 interface
Interface      IPv6-Address      Status      Protocol
lo             unassigned        admin up    running
vlan1          2001:db8:20:0:e2e3:7b54:6d72:28b4/64  admin up    running
                fe80::215:77ff:fec9:73a3/64
Stateful_Client#show count ipv6 dhcp-client
DHCPv6 client counters
SOLICIT out           ..... 3
ADVERTISE in          ..... 1
REQUEST out           ..... 1
CONFIRM out           ..... 0
RENEW out             ..... 0
REBIND out            ..... 0
REPLY in              ..... 1
RELEASE out           ..... 0
DECLINE out           ..... 0
INFORMATION-REQUEST out ..... 0
```

DHCPv6_Relay configuration

See the following configuration for a device with the hostname “DHCPv6_Relay”:

```
hostname DHCPv6_Relay
!
vlan database
  vlan 2 state enable
!
interface port1.0.2
  switchport access vlan 2
!
interface vlan1
  description to_DHCPv6_Server
  ipv6 address 2001:db8:10::2/64
  ipv6 enable
!
interface vlan2
  description to_Stateful_Client
  ipv6 address 2001:db8:20::1/64
  ipv6 enable
  no ipv6 nd suppress-ra
  ipv6 nd managed-config-flag
  ipv6 nd other-config-flag
  ip dhcp-relay server-address 2001:db8:10::1 vlan1
!
ipv6 forwarding
```

DHCPv6_Relay diagnostic output

See the DHCPv6_Relay device diagnostic output after entering the command to clear bindings:

```
DHCPv6_Relay#show ipv6 interface
Interface      IPv6-Address      Status      Protocol
eth0           unassigned        admin up    running
lo             unassigned        admin up    running
vlan1          2001:db8:10::2/64
                fe80::200:cdff:fe29:a65f/64
                admin up    running
vlan2          2001:db8:20::1/64
                fe80::200:cdff:fe29:a65f/64
                admin up    running
DHCPv6_Relay#show counter dhcp-relay
DHCP relay counters
Requests In           ..... 0
Replies In            ..... 0
Relayed To Server     ..... 0
Relayed To Client     ..... 0
Out To Server Failed  ..... 0
Out To Client Failed  ..... 0
Invalid hlen          ..... 0
Bogus giaddr          ..... 0
Corrupt Agent Option  ..... 0
Missing Agent Option  ..... 0
Bad Circuit ID        ..... 0
Missing Circuit ID    ..... 0
Bad Remote ID         ..... 0
Missing Remote ID     ..... 0
Option Insert Failed  ..... 0
DHCPv6 Requests In   ..... 5
DHCPv6 Replies In    ..... 3
DHCPv6 Relayed To Server .....5
DHCPv6 Relayed To Client .....3
```

Use the **show log** command to view additional useful information on the system log. Real time protocol messages for diagnostic purposes can be viewed via verbose **tcpdump** for traffic traversing a VLAN, for example:

```
awplus#tcpdump -vvvni vlan1
```

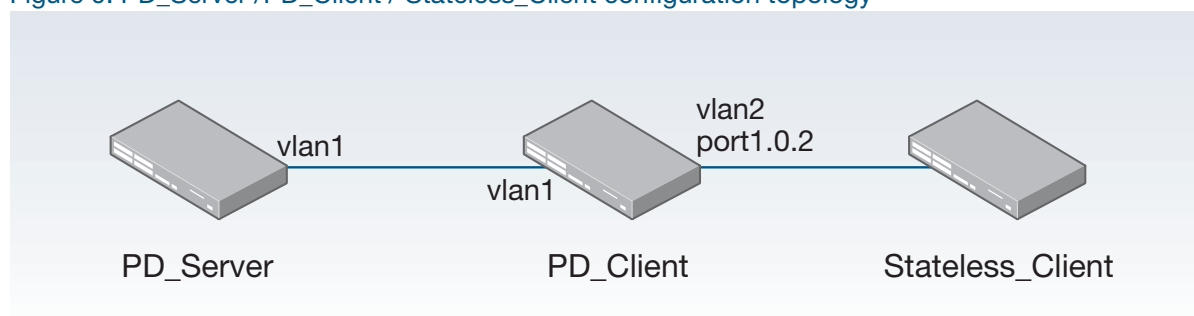

Configuring PD Server / PD Client / Stateless Client

In this example, the PD Client is assigned a prefix from the PD Server via IAPD.

- PD_Client auto-configures an upstream VLAN interface vlan1 address via SLAAC.
- PD_Client is assigned a prefix from PD_Server via IAPD.
- PD_Client auto-configures its downstream VLAN interface vlan2 address derived from a combination the delegated prefix and eui64 suffix.
- Stateless_Client auto configures its VLAN interface address using SLAAC.

Note the default VLAN interface vlan1 is applied to all ports on a device.

Figure 9: PD_Server /PD_Client / Stateless_Client configuration topology



PD_Server configuration (IAPD)

See the following configuration for a device with the hostname PD_Server:

```
hostname PD_server
!
ipv6 local pool pd_vlan1 2001:db8:20::/48 56
!
ipv6 dhcp pool pool1
  prefix-delegation pool pd_vlan1
!
interface vlan1
  description to_PD_Client
  ipv6 address 2001:db8:10::1/64
  ipv6 enable
  no ipv6 nd suppress-ra
  ipv6 dhcp server pool1
!
ipv6 forwarding
```

Stateless_Client configuration

See the following configuration for a device with the hostname Stateless_Client:

```
hostname Stateless_Client
!
interface vlan1
  ipv6 enable
```

PD_Client configuration

See the following configuration for a device with the hostname PD_Client:

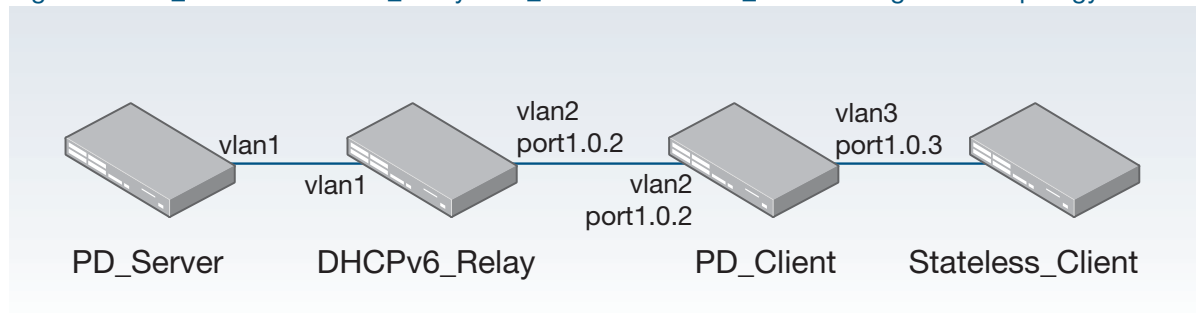
```
hostname PD_Client
!
vlan database
  vlan 2 state enable
!
interface port1.0.2
  switchport access vlan 2
!
interface vlan1
  description to_PD_Server
  ipv6 enable
  ipv6 dhcp client pd pool1
!
interface vlan2
  description to_Stateless_Client
  ipv6 enable
  no ipv6 nd suppress-ra
  ipv6 address pool1 ::/64 eui64
!
ipv6 forwarding
```

Configuring PD via DHCPv6 Relay

This example includes Prefix Delegation (IAPD) via an intermediate DHCPv6 relay. The DHCPv6 Server requires a route to the remote IPv6 subnet of the DHCPv6 relay, where the source of the IAPD request originates from via the link-local address of the DHCPv6 Relay.

Note the default VLAN interface vlan1 is applied to all ports on a device.

Figure 10: PD_Server / DHCPv6_Relay / PD_Client / Stateless_Client configuration topology



PD_Server configuration

See the following configuration for a device with the hostname “PD_Server”:

```

hostname PD_Server
!
ipv6 local pool pd_vlan1_relay 2001:db8:20::/48 56
!
ipv6 dhcp pool pool1
  link-address 2001:db8:20::/64
  prefix-delegation pool pd_vlan1_relay
!
interface vlan1
  description to_DHCPv6_Relay
  ipv6 address 2001:db8:10::1/64
  ipv6 enable
  no ipv6 nd suppress-ra
  ipv6 dhcp server pool1
!
ipv6 forwarding
!
ipv6 route 2001:db8:20::/64 fe80::200:cdff:fe29:a65f vlan1
  
```

DHCPv6_Relay configuration

See the following configuration for a device with the hostname “DHCPv6_Relay”:

```
hostname DHCPv6_Relay
!
vlan database
  vlan 2 state enable
!
interface port1.0.2
  switchport access vlan 2
!
interface vlan1
  description to_PD_Server
  ipv6 address 2001:db8:10::2/64
  ipv6 enable
!
interface vlan2
  description to_PD_Client
  ipv6 address 2001:db8:20::1/64
  ipv6 enable
  no ipv6 nd suppress-ra
  ip dhcp-relay server-address 2001:db8:10::1 vlan1
!
ipv6 forwarding
```

PD_Client configuration

See the following configuration for a device with the hostname “PD_Client”:

```
hostname PD_Client
!
vlan database
  vlan 2,3 state enable
!
interface port1.0.2
  switchport access vlan 2
!
interface port1.0.3
  switchport access vlan 3
!
interface vlan2
  description to_DHCPv6_Relay
  ipv6 enable
  ipv6 dhcp client pd pool1
!
interface vlan3
  description to_Stateless_Client
  ipv6 enable
  no ipv6 nd suppress-ra
  ipv6 address pool1 ::/64 eui64
!
ipv6 forwarding
!
```

Stateless_Client configuration

See the following configuration for a device with the hostname "Stateless_Client":

```
hostname Stateless_Client
!  
interface vlan1  
  ipv6 enable  
!
```

Configuring PD subdelegation with SLAAC

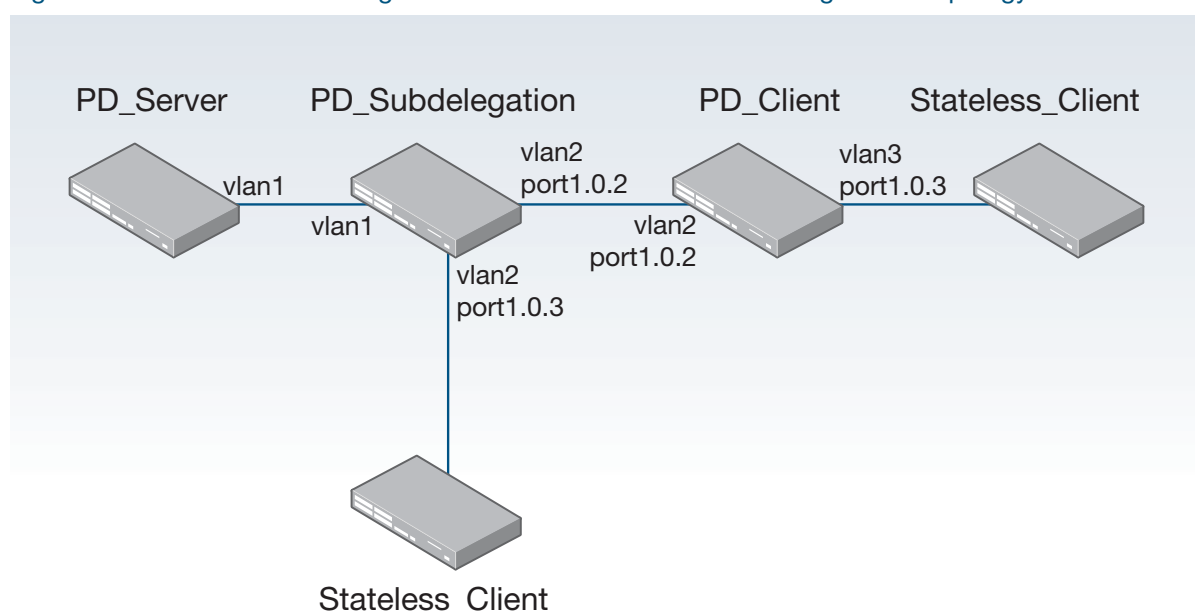
In this example, the PD subdelegation device acts as both a PD client on its upstream interface facing the PD Server, and also recursively acts as a PD Server, to sub-delegate prefixes to a downstream PD client. The PD subdelegation device also supports router solicitation on downstream interfaces to allow stateless client devices to auto configure themselves via SLAAC (Stateless Address Auto Configuration).

For this example, a longer prefix mask is used for each subdelegated prefix.

- The PD subdelegation device auto configures its upstream interface facing the PD Server via SLAAC.
- The PD Server device advertises its prefix to the PD subdelegation device. This is stored in the local address pool in the PD subdelegation device.
- The PD subdelegation device then auto configures its downstream interface based on a combination of the advertised prefix and EUI64 suffix, and advertises Router Advertisements (RAs).
- The PD subdelegation device then recursively advertises prefixes stored in its local address pool out its downstream interface to the PD client device.
- The PD client device uses SLAAC to configure its upstream vlan2 interface. The PD client device configures its downstream vlan3 interface based on recursively delegated prefix, and advertises RAs via vlan3 to the attached Stateless_Client device.
- Stateless_Client devices auto configure their address and gateway router information, using SLAAC, via router solicitation and router advertisements.

Note the default VLAN interface vlan1 is applied to all ports on a device.

Figure 11: PD Server / Subdelegation / Client / Stateless Client configuration topology:



PD_Server configuration

See the following configuration for a device with the hostname “PD_Server”:

```
hostname PD_Server
!
ipv6 local pool pd_vlan1 2001:db8:20::/48 56
!
ipv6 dhcp pool pool1
  prefix-delegation pool pd_vlan1
!
interface vlan1
  description to_PD_Subdelegation
  ipv6 address 2001:db8:10::1/64
  ipv6 enable
  no ipv6 nd suppress-ra
  ipv6 dhcp server pool1
!
ipv6 forwarding
!
```

PD_Subdelegation configuration

See the following configuration for a device with the hostname “PD_Subdelegation”:

```
hostname PD_Subdelegation
!
ipv6 local pool pdpool1 pool1 ::/56 64
!
ipv6 dhcp pool pool1
  prefix-delegation pool pdpool1
!
vlan database
  vlan 2 state enable
!
interface port1.0.2-port1.0.3
  switchport access vlan 2
!
interface vlan1
  description to_PD_Server
  ipv6 enable
  ipv6 dhcp client pd pool1
!
interface vlan2
  description to_PD_Client
  ipv6 enable
  no ipv6 nd suppress-ra
  ipv6 address pool1 ::/64 eui64
  ipv6 dhcp server pool1
!
ipv6 forwarding
!
```

PD_Subdelegation diagnostic output

See the following “PD_Subdelegation” device diagnostic output to validate PD configuration:

```
PD_Subdelegation#show ipv6 dhcp interface
vlan1 is in client (Prefix-Delegation) mode
  Prefix name pool1
    prefix 2001:db8:20:fe00::/56
    preferred lifetime 604800, valid lifetime 2592000
    starts at 8 Nov 2012 14:23:12
    expires at 8 Dec 2012 14:23:12
vlan2 is in server mode
Using pool : pool1
Preference : 0
```

Stateless_Client configuration

See the following configuration for a device with the hostname “Stateless_Client”:

```
hostname Stateless_Client
!
interface vlan1
  ipv6 enable
```

PD_Client configuration

See the following configuration for a device with the hostname “PD_Client”:

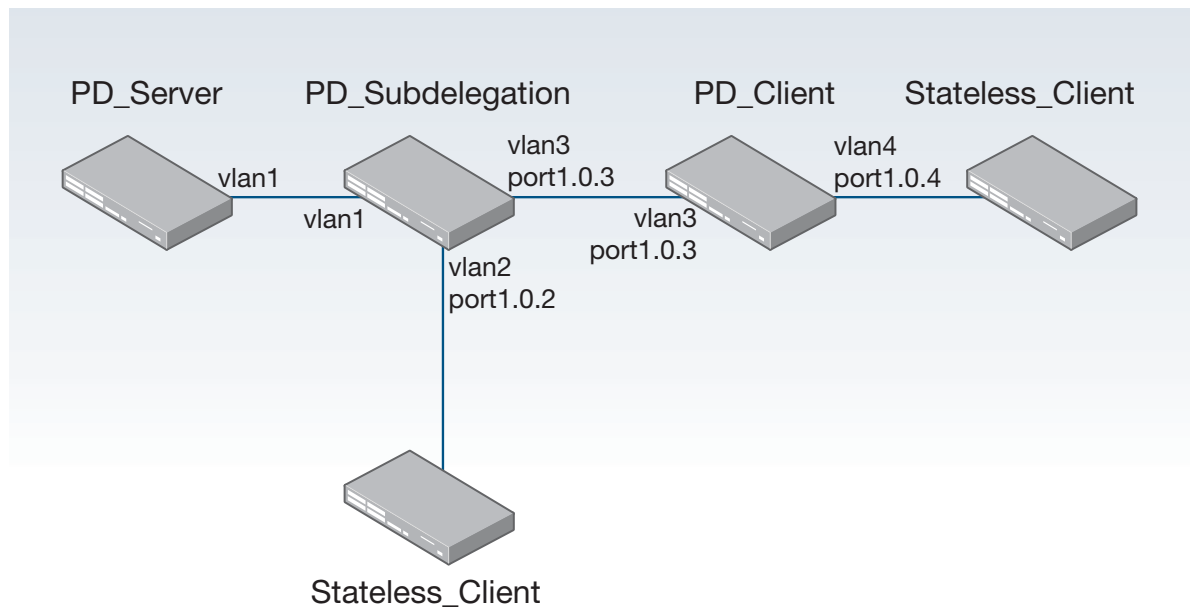
```
hostname PD_Client
!
vlan database
  vlan 2,3 state enable
!
interface port1.0.2
  switchport access vlan 2
!
interface port1.0.3
  switchport access vlan 3
!
interface vlan2
  description to_PD_Subdelegation
  ipv6 enable
  ipv6 dhcp client pd pool1
!
interface vlan3
  description to_Stateless_Client
  ipv6 enable
  no ipv6 nd suppress-ra
  ipv6 address pool1 ::/64 eui64
!
ipv6 forwarding
```


Configuring PD subdelegation for multiple VLANs

This example is similar to the previous example, "Configuring PD subdelegation with SLAAC" on page 38, with the difference being that the PD subdelegation device has two downstream VLANs (vlan2 and vlan3) instead of one downstream VLAN (vlan2) as shown previously.

Note the default VLAN interface vlan1 is applied to all ports on a device.

Figure 12: PD Server / Subdelegation / Client / Stateless Client (multiple VLANs) configuration topology



PD_Server configuration

See the following configuration for a device with the hostname "PD_Server":

```

hostname PD_Server
!
ipv6 local pool pd_vlan1 2001:db8:20::/48 56
!
ipv6 dhcp pool pool1
  prefix-delegation pool pd_vlan1
!
interface vlan1
  description to_PD_Subdelegation
  ipv6 address 2001:db8:10::1/64
  ipv6 enable
  no ipv6 nd suppress-ra
  ipv6 dhcp server pool1
!
ipv6 forwarding
  
```

PD_Subdelegation configuration

See the following configuration for a device with the hostname "PD_Subdelegation":

```
hostname PD_Subdelegation
!
ipv6 local pool pdpool1 pool1 ::/56 64
!
ipv6 dhcp pool pool1
  prefix-delegation pool pdpool1

vlan database
  vlan 2,3 state enable
!
interface port1.0.2
  switchport access vlan 2
!
interface port1.0.3
  switchport access vlan 3
!
interface vlan1
  description to_PD_Server
  ipv6 enable
  ipv6 dhcp client pd pool1
!
interface vlan2
  description to_Stateless_Client
  ipv6 enable
  no ipv6 nd suppress-ra
  ipv6 address pool1 ::/64 eui64
!
interface vlan3
  description to_PD_Client
  ipv6 enable
  no ipv6 nd suppress-ra
  ipv6 address pool1 ::11:0:0:0:0/64 eui64
  ipv6 dhcp server pool1
!
ipv6 forwarding
```

PD_Client configuration

See the following configuration for a device with the hostname “PD_Client”:

```
hostname PD_client
!
vlan database
  vlan 3,4 state enable
!
interface port1.0.3
  switchport access vlan 3
!
interface port1.0.4
  switchport access vlan 4
!
interface vlan3
  description to_PD_Subdelegation
  ipv6 enable
  ipv6 dhcp client pd pool1
!
interface vlan4
  description to_Stateless_Client
  ipv6 enable
  no ipv6 nd suppress-ra
  ipv6 address pool1 ::/64 eui64
!
ipv6 forwarding
```

Stateless_Client configuration

See the following configuration for a device with the hostname “Stateless_Client”:

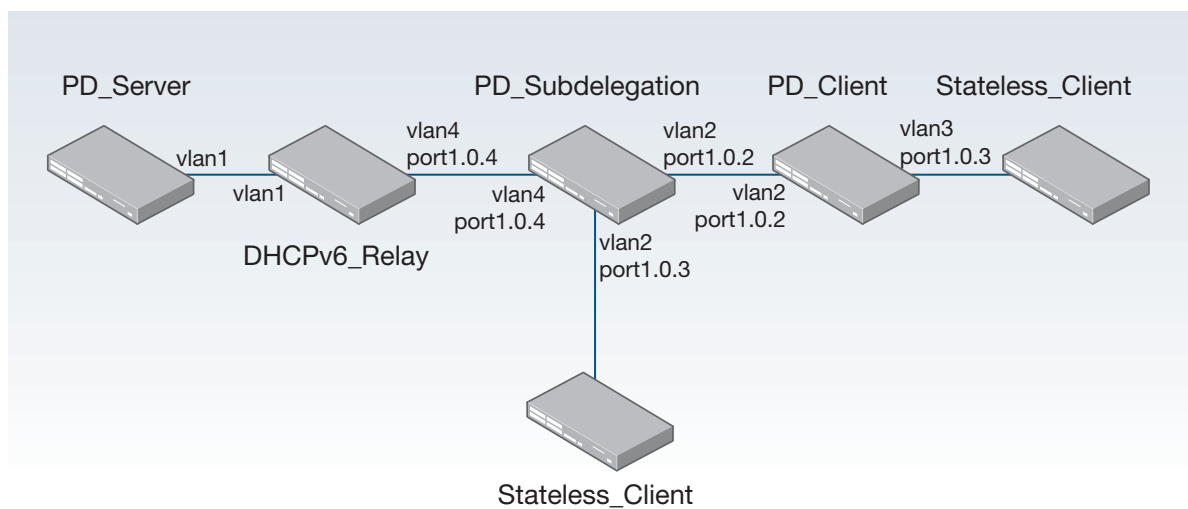
```
hostname Stateless_Client
!
interface vlan1
  ipv6 enable
```

Configuring DHCPv6 Relay with Recursive PD Subdelegation

This example is similar to the previous example, "Configuring PD subdelegation with SLAAC" on page 38, with the difference being that there is a DHCPv6 Relay device between the DHCPv6 PD Server device and the DHCPv6 PD subdelegation device.

Note the default VLAN interface vlan1 is applied to all ports on a device.

Figure 13: DHCPv6 Server / Stateful Client configuration topology



PD_Server configuration

See the following configuration for a device with the hostname "PD_Server":

```
hostname PD_Server
!
ipv6 local pool pd_vlan2_relay 2001:db8:20::/48 56
!
ipv6 dhcp pool pool1
 prefix-delegation pool pd_vlan2_relay
 link-address 2001:db8:40::/64
!
interface vlan1
 description to_DHCPv6_Relay
 ipv6 address 2001:db8:10::1/64
 ipv6 enable
 no ipv6 nd suppress-ra
 ipv6 dhcp server pool1
!
ipv6 forwarding
!
ipv6 route 2001:db8:40::/64 fe80::200:cdf:fe29:a65f vlan1
```

DHCPv6_Relay configuration

See the following configuration for a device with the hostname "DHCPv6_Relay":

```
hostname DHCPv6_Relay
!
vlan database
  vlan 4 state enable
!
interface port1.1.4
  switchport access vlan 4
!
interface vlan1
  description to_PD_Server
  ipv6 address 2001:db8:20::2/64
  ipv6 enable
!
interface vlan4
  description to_PD_Subdelegation
  ipv6 address 2001:db8:40::1/64
  ipv6 enable
  no ipv6 nd suppress-ra
  ip dhcp-relay server-address 2001:db8:10::1 vlan1
!
ipv6 forwarding
```

PD_Subdelegation configuration

See the following configuration for a device with the hostname "PD_Subdelegation":

```
hostname PD_Subdelegation
!
ipv6 local pool pdpool1 pool1 ::/56 64
!
ipv6 dhcp pool pool1
  prefix-delegation pool pdpool1
!
vlan database
  vlan 2,4 state enable
!
interface port1.0.2-port1.0.3
  switchport access vlan 2
!
interface port1.0.4
  switchport access vlan 4
!
interface vlan4
  description to_DHCPv6_Relay
  ipv6 enable
  ipv6 dhcp client pd pool1
!
interface vlan2
  description to_PD_Client
  ipv6 enable
  no ipv6 nd suppress-ra
  ipv6 address pool1 ::/64 eui64
  ipv6 dhcp server pool1
!
ipv6 forwarding
```

PD_Client configuration

See the following configuration for a device with the hostname "PD_Client":

```
hostname PD_Client
!
vlan database
  vlan 2,3 state enable
!
interface port1.0.2
  switchport access vlan 2
!
interface port1.0.3
  switchport access vlan 3
!
interface vlan2
  description to_PD_Subdelegation
  ipv6 enable
  ipv6 dhcp client pd pool1
!
interface vlan3
  description to_Stateless_Client
  ipv6 enable
  no ipv6 nd suppress-ra
  ipv6 address pool1 ::/64 eui64
!
ipv6 forwarding
!
```

Stateless_Client configuration

See the following configuration for a device with the hostname "Stateless_Client":

```
hostname Stateless_Client1
!
interface vlan1
  ipv6 enable
```

Example: Prefix Delegation Subdelegation System

This section provides an example of a DHCPv6 PD sub-delegating system, involving multiple delegation pools, with device configuration output listed for each of the devices configured for PD sub-delegation:

- "Stateful_Client configuration" on page 49
- "Stateless_Client configuration" on page 49
- "PD_Client configuration" on page 49
- "DHCPv6_Relay configuration" on page 50
- "PD_Subdelegation configuration" on page 51
- "PD_Server1 configuration" on page 52
- "PD_Server2 configuration" on page 53

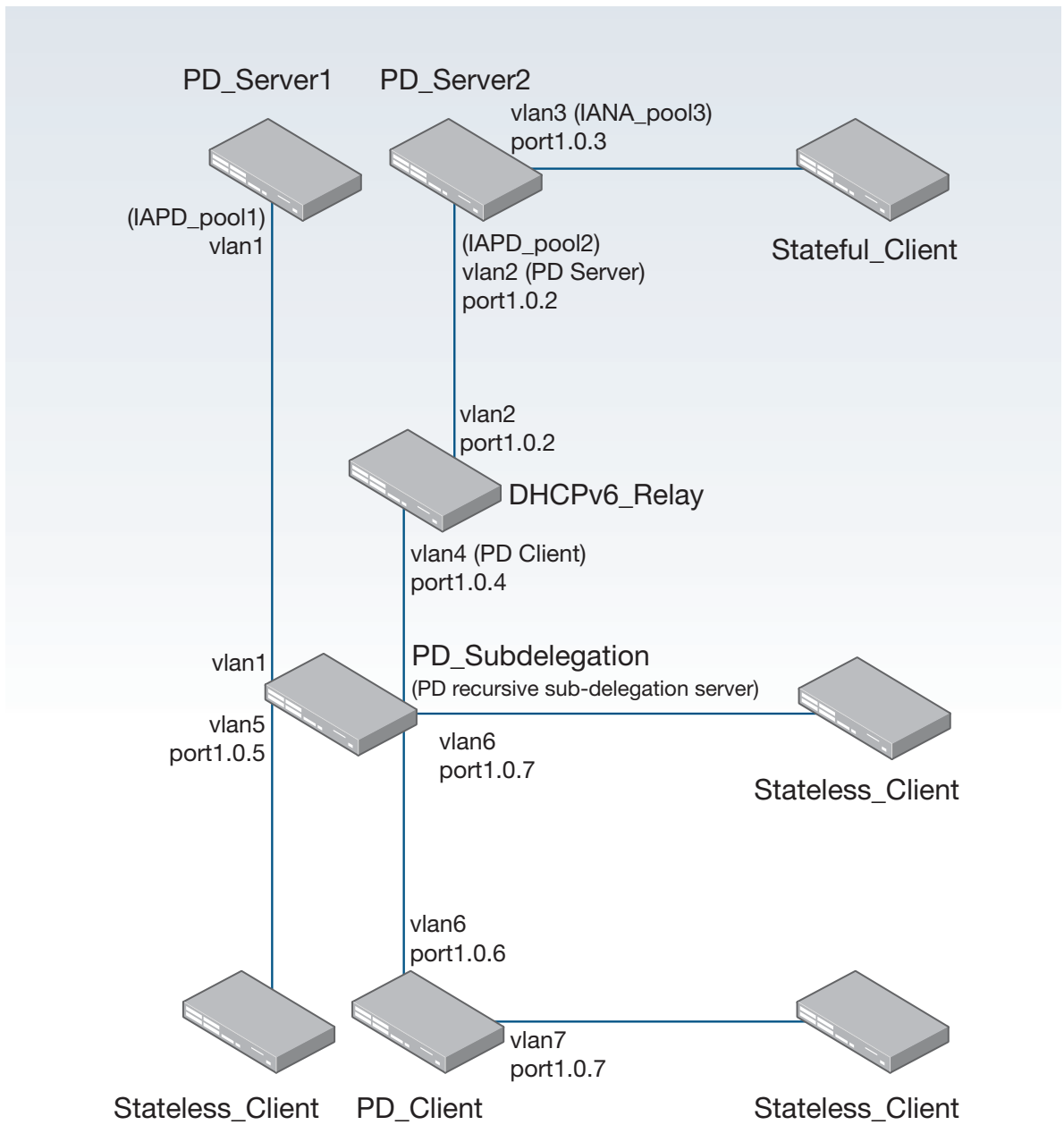
Note the functionality for configured devices in this multiple delegation pool system:

- **PD_Server1** is configured with a single IAPD delegation pool, **IAPD_pool1**.
- **PD_Server2** is configured with two pools; **IAPD_pool2** is used to delegate prefix information via intermediate **DHCPv6_Relay** to the subdelegation device via **vlan2**, and **IANA_pool3** is used to delegate address information to **Stateful_Client** via vlan3.
- **PD_Subdelegation** uses SLAAC to configure its upstream interfaces and acts as PD client on its upstream interfaces (vlan1 and vlan4) that face each PD Server.
- **PD_Subdelegation** downstream interface vlan5 is configured based on the prefix delegated via the upstream interface vlan1.
- **PD_Subdelegation** downstream interface vlan6 is configured based on the prefix delegated via upstream interface vlan4.
- Prefix information delegated via **PD_Client** interface vlan4 is recursively sub-delegated via the downstream interface vlan6 to **PD_Client**.
- Stateless clients auto configure themselves based on RAs.

Note the default VLAN interface vlan1 is applied to all ports on a device.

For the syntax, parameters, descriptions, defaults, and examples for all of the commands used in the following DHCPv6 configurations, refer to the DHCP for IPv6 (DHCPv6) Commands chapter of your product's [Command Reference](#).

Figure 14: PD sub-delegation system configuration example topology



Stateful_Client configuration

See the following configuration for a device with the hostname “Stateful_Client”:

```
hostname Stateful_Client
!
interface vlan1
  ipv6 address dhcp
```

Stateless_Client configuration

See the following configuration for a device with the hostname “Stateless_Client”:

```
hostname Stateless_Client
!
interface vlan1
  ipv6 enable
```

PD_Client configuration

See the following configuration for a device with the hostname “PD_Client”:

```
hostname PD_Client
!
vlan database
  vlan 6,7 state enable
!
interface port1.0.6
  switchport access vlan 6
!
interface port1.0.7
  switchport access vlan 7
!
interface vlan6
  description to_PD_Subdelegation
  ipv6 enable
  ipv6 dhcp client pd pool1
!
interface vlan7
  description to_Stateless_Client
  ipv6 enable
  no ipv6 nd suppress-ra
  ipv6 address pool1 ::/64 eui64
!
ipv6 forwarding
```

DHCPv6_Relay configuration

See the following configuration for the device with the hostname “DHCPv6_Relay”:

```
hostname DHCPv6_Relay
!
vlan database
  vlan 2,4 state enable
!
interface port1.0.2
  switchport access vlan 2
!
interface port1.0.4
  switchport access vlan 4
!
interface vlan2
  description to_PD_Server2
  ipv6 address 2001:db8:20::2/64
  ipv6 enable
  no ipv6 nd suppress-ra
!
interface vlan4
  description to_PD_Subdelegation
  ipv6 address 2001:db8:40::1/64
  ipv6 enable
  no ipv6 nd suppress-ra
  ip dhcp-relay server-address 2001:db8:20::1 vlan2
!
ipv6 forwarding
```

PD_Subdelegation configuration

See the following configuration for a device with the hostname "PD_Subdelegation":

```

hostname PD_Subdelegation
!
ipv6 local pool pdpool1 pool1 ::/56 64
ipv6 local pool pdpool2 pool2 ::/56 64
!
ipv6 dhcp pool pool1
  prefix-delegation pool pdpool1
!
ipv6 dhcp pool pool2
  prefix-delegation pool pdpool2
!
vlan database
  vlan 4,5,6 state enable
!
interface port1.0.4
  switchport access vlan 4
!
interface port1.0.5
  switchport access vlan 5
!
interface port1.0.6
  switchport access vlan 6
!
interface vlan1
  description to_PD_Server1
  ipv6 address auto
  ipv6 dhcp client pd pool1
!
interface vlan4
  description to_DHCPv6_Relay
  ipv6 address auto
  ipv6 dhcp client pd pool2
!
interface vlan5
  description to_Stateless_Client
  ipv6 enable
  no ipv6 nd suppress-ra
  ipv6 address pool1 ::1:0:0:0/64 eui64
  ipv6 nd prefix pool1 ::1:0:0:0/64
!
interface vlan6
  description to_PD_Client
  ipv6 enable
  no ipv6 nd suppress-ra
  ipv6 address pool2 ::1/64
  ipv6 dhcp server pool2
!
ipv6 forwarding

```

PD_Server1 configuration

See the following configuration for the device with the hostname “PD_Server1”:

```
hostname PD_Server1
!
ipv6 local pool pd_direct_vlan1 2001:db8:50::/48 56
!
ipv6 dhcp pool pool1
  prefix-delegation pool pd_direct_vlan1
!
interface vlan1
  description to_PD_Subdelegation
  ipv6 address 2001:db8:10::1/64
  ipv6 enable
  no ipv6 nd suppress-ra
  ipv6 dhcp server pool1
!
ipv6 forwarding
!
```

PD_Server2 configuration

See the following configuration for the device with the hostname "PD_Server2":

```
hostname PD_Server2
!
ipv6 local pool pd_relay_vlan2 2001:db8:60::/48 56
!
ipv6 dhcp pool pool2
  link-address 2001:db8:40::/64
  prefix-delegation pool pd_relay_vlan2
!
ipv6 dhcp pool pool3
  address prefix 2001:db8:30::/64
!
vlan database
  vlan 2,3 state enable
!
interface port1.0.2
  switchport access vlan 2
!
interface port1.0.3
  switchport access vlan 3
!
interface vlan2
  description to_DHCPv6_Relay
  ipv6 address 2001:db8:20::1/64
  ipv6 enable
  no ipv6 nd suppress-ra
  ipv6 dhcp server pool2
!
interface vlan3
  description to_Stateful_Client
  ipv6 address 2001:db8:30::1/64
  ipv6 enable
  no ipv6 nd suppress-ra
  ipv6 dhcp server pool3
!
ipv6 forwarding
!
ipv6 route 2001:db8:40::/64 fe80::200:cdf:fe29:a65f vlan2
!
```

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