DHCPv6

NANOG46

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Assumptions

- An understanding of why DHCP is used in general
- Basic understanding of how DHCPv4 works
- Understanding of basic components of DHCP
  - Client
  - Server
  - Relay Agent

DHCPv6 Standards

- Relevant RFCs include:
  - •RFC3315 - Dynamic Host Configuration Protocol for IPv6 (DHCPv6)
  - •RFC3633 - IPv6 Prefix Options for Dynamic Host Configuration Protocol (DHCP) version 6
  - •RFC3736 - Stateless Dynamic Host Configuration Protocol (DHCP) Service for IPv6
- More information about DHCP standards
  - •IETF dhc WG page (http://www.ietf.org/html.charters/dhc-charter.html)

Overview of DHCPv6 (continued)

- Used to configure nodes with the following:
  - One or more IPv6 addresses, or
  - Configuration information, or
  - One or more IPv6 prefixes
  - Or all of the above
- Offer similar functionality to DHCPv4 but for IPv6

Overview of DHCPv6

- Additional mode of operation in DHCPv6
  - Stateless DHCPv6 where configuration information only is exchanged
  - Stateful is similar to how DHCPv4 traditionally operates
- Requires IPv6 transport
- DHCPv6 is not simply an upgrade to DHCPv4
  - It is a separate and distinct protocol

Fundamentals of DHCPv6 (continued)

- DHCPv6 clients listen on port 546, servers and relays listen on port 547
- Solely layer 3 protocol unlike DHCPv4
- DHCPv6 clients and servers (relays) communicate via link-local multicast addresses
  - All_DHCP_Relay_Agents_and_Servers and All_DHCP_Servers multicast addresses are used
  - Relays may forward DHCPv6 messages to other relays or servers using link-local multicast or global unicast IPv6 addresses

Fundamentals of DHCPv6

- Relay agent “chaining” through DHCPv6 message encapsulation
  - Information about each relay agent between the client and server is encapsulated

- DHCPv6 employs a larger option code space
  - DHCPv6 options are TLV similar to those in DHCPv4
  - 16 bit option type code and length with variable length data
  - Most information carried in options, instead of fixed header fields

DHCPv6 to DHCPv4 Message Comparison

DHCPv6 Message Type	DHCPv4 Message Type
SOLICIT (1)	DHCPDISCOVER
ADVERTISE (2)	DHCPOFFER
REQUEST (3), RENEW (5), REBIND (6)	DHCPREQUEST
REPLY (7)	DHCPACK / DHCPNAK
RELEASE (8)	DHCPRELEASE
INFORMATION-REQUEST (11)	DHCPINFORM
DECLINE (9)	DHCPDECLINE
CONFIRM (4)	none
RECONFIGURE (10)	DHCPFORCERENEW
RELAY-FORW (12), RELAY-REPLY (13)	none

Role of Routers (continued)

- Routers in IPv6 deployments have different roles in the network compared to routers in IPv4 deployments
- IPv6 routers advertise their availability using IPv6 Router Advertisement Messages
  - Unlike in IPv4 deployments hosts are explicitly told where routers are statically, via DHCPv4, etc.
  - Details of IPv6 Router behavior is out of scope

Role of Routers

- IPv6 routers also transmit additional information that is relevant to the links it serves including but not limited to the following:
  - •Prefix information or information about prefixes that are in use or valid for a given link or links
  - •Flags that suggest how DHCPv6 should be used by nodes
    - –Managed bit suggests use of stateful DHCPv6
    - –Other bit suggests use of stateless DHCPv6
  - •Additionally the Autonomous bit indicates that auto-configuration should be used by nodes

DHCPv6 Client Identification

- DHCPv6 DUID (DHCP Unique Identifier) as defined in RFC3315 is used to uniquely identify DHCPv6 clients
  - One DUID per DHCPv6 client

- Three types of DUIDs are defined in RFC3315
  - Link-layer address plus time - generated and stored at startup
  - Link-layer - generally used if network interface is permanent or unchangeable
  - Vendor assigned unique identifier based on enterprise identifier

Stateful DHCPv6 (continued)

- Used when a DHCPv6 client wishes to be allocated one or more IPv6 addresses
- Similar to DHCPv4 today, a DHCPv6 server will allocate one or more IPv6 addresses or prefixes to a DHCPv6 client
  - DHCPv6 may leverage a four message exchange (SOLICIT, ADVERTISE, REQUEST, REPLY), or
  - Rapid Commit may be employed which uses only two message (SOLICIT, REPLY)

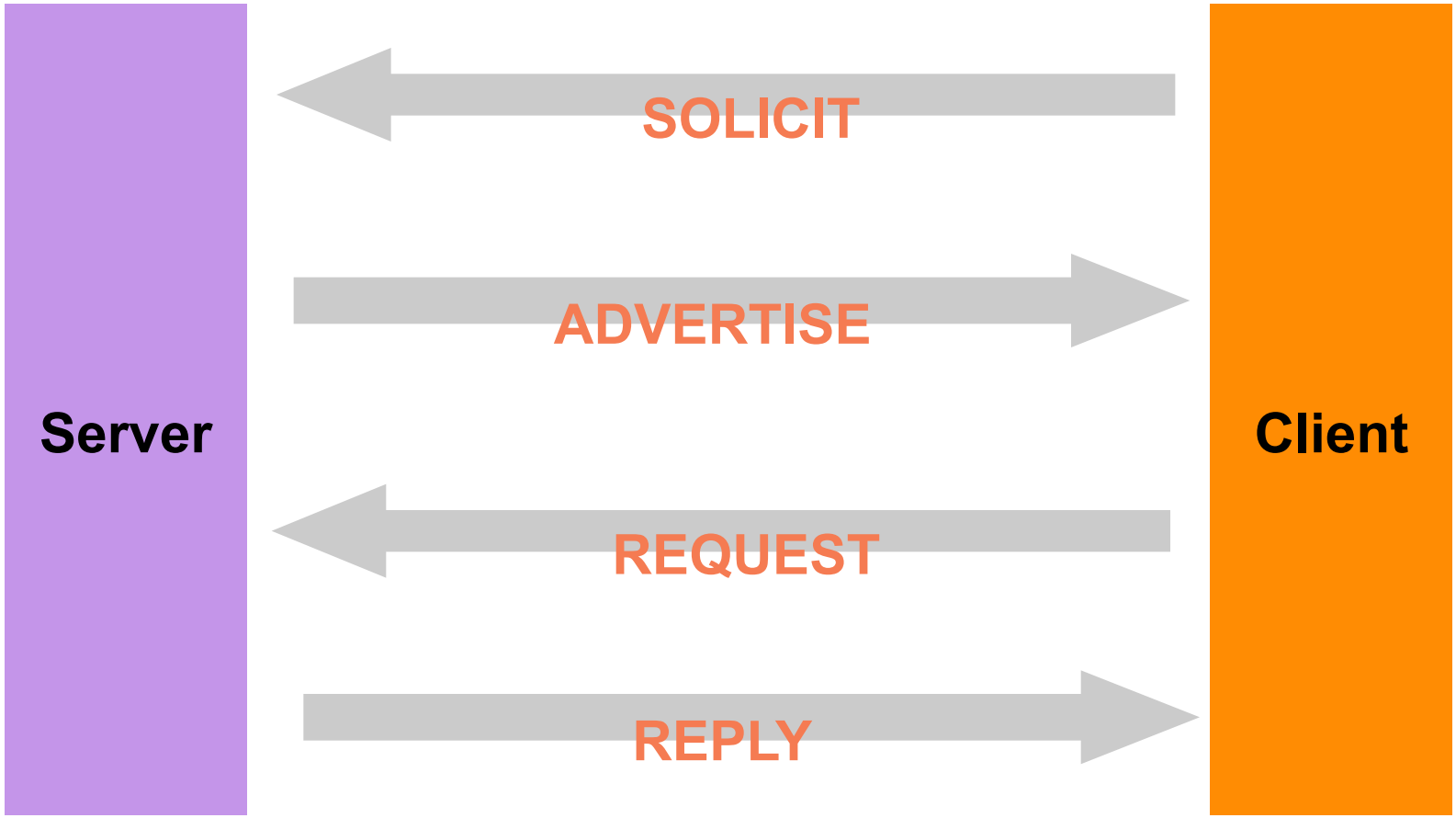
Stateful DHCPv6

- Configuration options like DNS Server IPv6 Addresses (RFC3646) may or may not be requested and offered to the client

    - Note in DHCPv6 adherence to the option request option is more rigidly evaluated and adhered to unlike in DHCPv4 where the parameter request list is more of a hint

- Typically is triggered when “Managed” bit is set in router advertisement

Stateful DHCPv6 Message Exchange



Stateful DHCPv6 Message Exchange Detail (SOLICIT)

DHCPv6
- Message type: Solicit (1)
- Transaction-ID: 0x0095d266
- Client Identifier
  - option type: 1
  - option length: 14
  - DUID type: link-layer address plus time (1)
  - Hardware type: Ethernet (1)
  - Time: 281507745
  - Link-layer address: 00:16:3e:18:88:fe
- Option Request
  - option type: 6
  - option length: 4
  - Requested Option code: DNS recursive name server (23)
  - Requested Option code: Domain Search List (24)
- Elapsed time
  - option type: 8
  - option length: 2
  - elapsed-time: 0 ms

Identity Association for Non-temporary Address
- option type: 3
- option length: 40
- IAID: 1041795326
- T1: 3600
- T2: 5400
- IA Address
  - option type: 5
  - option length: 24
  - IPv6 address: 2001:558:ff10:870:f914:a7c1:42d1:faa1
  - Preferred lifetime: 7200
  - Valid lifetime: 10800

Stateful DHCPv6 Message Exchange Detail (ADVERTISE)

DHCPv6
- Message type: Advertise (2)
- Transaction-ID: 0x0095d266
- Identity Association for Non-temporary Address
  - option type: 3
  - option length: 40
  - IAID: 1041795326
  - T1: 0
  - T2: 0
  - IA Address
    - option type: 5
    - option length: 24
    - IPv6 address: 2001:558:ff10:870:f914:a7c1:42d1:faa1
    - Preferred lifetime: 75
    - Valid lifetime: 120

Client Identifier
- option type: 1
- option length: 14
- DUID type: link-layer address plus time (1)
- Hardware type: Ethernet (1)
- Time: 281507745
- Link-layer address: 00:16:3e:18:88:fe

Server Identifier
- option type: 2
- option length: 14
- DUID type: link-layer address plus time (1)
- Hardware type: Ethernet (1)
- Time: 281498447
- Link-layer address: 00:16:3e:60:6d:5d

Stateful DHCPv6 Message Exchange Detail (REQUEST)

DHCPv6
- Message type: Request (3)
- Transaction-ID: 0x0086a342
- Client Identifier
  - option type: 1
  - option length: 14
  - DUID type: link-layer address plus time (1)
  - Hardware type: Ethernet (1)
  - Time: 281507745
  - Link-layer address: 00:16:3e:18:88:fe
- Server Identifier
  - option type: 2
  - option length: 14
  - DUID type: link-layer address plus time (1)
  - Hardware type: Ethernet (1)
  - Time: 281498447
  - Link-layer address: 00:16:3e:60:6d:5d
- Option Request
  - option type: 6
  - option length: 4
  - Requested Option code: DNS recursive name server (23)
  - Requested Option code: Domain Search List (24)

Elapsed time
- option type: 8
- option length: 2
- elapsed-time: 0 ms

Identity Association for Non-temporary Address
- option type: 3
- option length: 40
- IAID: 1041795326
- T1: 3600
- T2: 5400
- IA Address
  - option type: 5
  - option length: 24
  - IPv6 address: 2001:558:ff10:870:f914:a7c1:42d1:faa1
  - Preferred lifetime: 7200
  - Valid lifetime: 7500

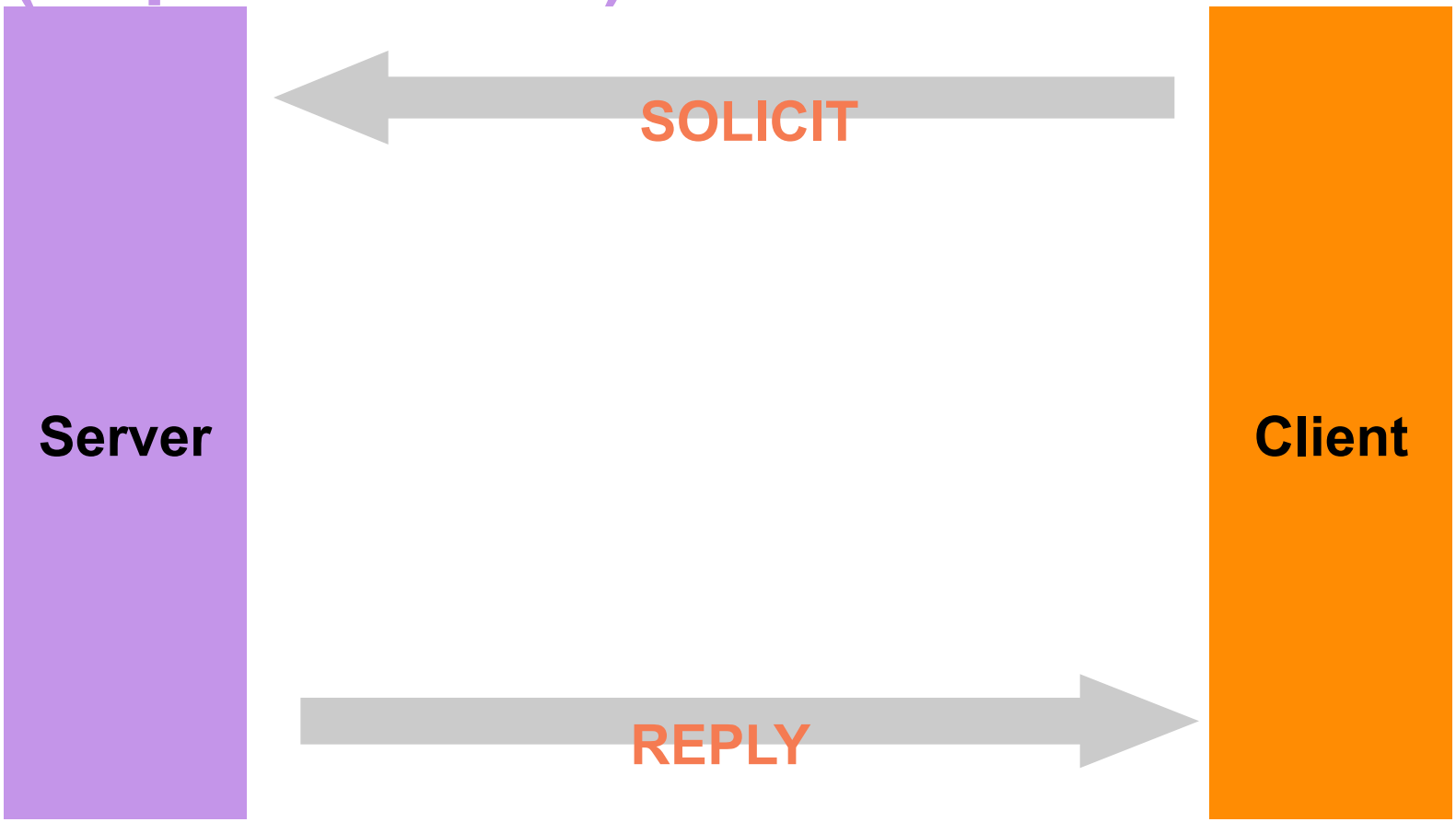
Stateful DHCPv6 Message Exchange Detail (REPLY)

DHCPv6
- Message type: Reply (7)
- Transaction-ID: 0x0086a342
- Identity Association for Non-temporary Address
  - option type: 3
  - option length: 40
  - IAID: 1041795326
  - T1: 0
  - T2: 0
  - IA Address
    - option type: 5
    - option length: 24
    - IPv6 address: 2001:558:ff10:870:f914:a7c1:42d1:faa1
    - Preferred lifetime: 75
    - Valid lifetime: 120

Client Identifier
- option type: 1
- option length: 14
- DUID type: link-layer address plus time (1)
- Hardware type: Ethernet (1)
- Time: 281507745
- Link-layer address: 00:16:3e:18:88:fe

Server Identifier
- option type: 2
- option length: 14
- DUID type: link-layer address plus time (1)
- Hardware type: Ethernet (1)
- Time: 281498447
- Link-layer address: 00:16:3e:60:6d:5d

Stateful DHCPv6 Message Exchange (Rapid Commit)



Stateful DHCPv6 - Rapid Commit Message Exchange Detail (SOLICIT)

DHCPv6
- Message type: Solicit (1)
- Transaction-ID: 0x00d8bf63
- Client Identifier
  - option type: 1
  - option length: 14
  - DUID type: link-layer address plus time (1)
  - Hardware type: Ethernet (1)
  - Time: 281507745
  - Link-layer address: 00:16:3e:18:88:fe
- Option Request
  - option type: 6
  - option length: 4
  - Requested Option code: DNS recursive name server (23)
  - Requested Option code: Domain Search List (24)
- Elapsed time
  - option type: 8
  - option length: 2
  - elapsed-time: 0 ms

Rapid Commit
- option type: 14
- option length: 0

Identity Association for Non-temporary Address
- option type: 3
- option length: 40
- IAID: 1041795326
- T1: 3600
- T2: 5400
- IA Address
  - option type: 5
  - option length: 24
  - IPv6 address: 2001:558:ff10:870:f914:a7c1:42d1:faa1
  - Preferred lifetime: 7200
  - Valid lifetime: 10800

Stateful DHCPv6 - Rapid Commit Message Exchange Detail (REPLY)

DHCPv6
- Message type: Reply (7)
- Transaction-ID: 0x00d8bf63
- Identity Association for Non-temporary Address
  - option type: 3
  - option length: 40
  - IAID: 1041795326
  - T1: 0
  - T2: 0
  - IA Address
    - option type: 5
    - option length: 24
    - IPv6 address: 2001:558:ff10:870:f914:a7c1:42d1:faa1
    - Preferred lifetime: 75
    - Valid lifetime: 120

Client Identifier
- option type: 1
- option length: 14
- DUID type: link-layer address plus time (1)
- Hardware type: Ethernet (1)
- Time: 281507745
- Link-layer address: 00:16:3e:18:88:fe

Server Identifier
- option type: 2
- option length: 14
- DUID type: link-layer address plus time (1)
- Hardware type: Ethernet (1)
- Time: 281498447
- Link-layer address: 00:16:3e:60:6d:5d

Rapid Commit
- option type: 14
- option length: 0

Stateful DHCPv6 Message Exchange (with Relay Agent)

Stateful DHCPv6 Message Exchange Detail with Relay Agent (SOLICIT)

DHCPv6
Message type: Relay-forw (12)
Hop count: 0
Link-address: 2001:470:1f01:3164:192:168::3
Peer-address: fe80::260:8ff:fed1:d51f
Interface-Id
option type: 18
option length: 4
Interface-ID
Relay Message
option type: 9
option length: 80
DHCPv6
Message type: Solicit (1)
Transaction-ID: 0x00c2aab6
Client Identifier
option type: 1
option length: 14
DUID type: link-layer address plus time (1)
Hardware type: Ethernet (1)
Time: 282016307
Link-layer address: 00:60:08:d1:d5:1f
Option Request
option type: 6
option length: 4
Requested Option code: DNS recursive name server (23)
Requested Option code: Domain Search List (24)
Elapsed time
option type: 8
option length: 2
elapsed-time: 0 ms
Identity Association for Non-temporary Address
option type: 3
option length: 40
IAID: 147969311
T1: 3600
T2: 5400
IA Address
option type: 5
option length: 24
IPv6 address: 2001:470:1f01:3164:4916:62de:123e:19b
Preferred lifetime: 7200
Valid lifetime: 10800

Stateful DHCPv6 Message Exchange Detail with Relay Agent (ADVERTISE)

DHCPv6
Message type: Relay-reply (13)
Hop count: 0
Link-address: 2001:470:1f01:3164:192:168::3
Peer-address: fe80::260:8ff:fed1:d51f
Interface-Id
option type: 18
option length: 4
Interface-ID
Relay Message
option type: 9
option length: 84
DHCPv6
Message type: Advertise (2)
Transaction-ID: 0x00c2aab6
Identity Association for Non-temporary Address
option type: 3
option length: 40
IAID: 147969311
T1: 0
T2: 0
IA Address
option type: 5
option length: 24
IPv6 address: 2001:470:1f01:3164:4916:62de:123e:
19b
Preferred lifetime: 75
Valid lifetime: 120

Client Identifier
option type: 1
option length: 14
DUID type: link-layer address plus time (1)
Hardware type: Ethernet (1)
Time: 282016307
Link-layer address: 00:60:08:d1:d5:1f
Server Identifier
option type: 2
option length: 14
DUID type: link-layer address plus time (1)
Hardware type: Ethernet (1)
Time: 282033914
Link-layer address: 00:11:11:69:c7:99

Stateful DHCPv6 Message Exchange Detail with Relay Agent (REQUEST)

DHCPv6
  Message type: Relay-forw (12)
  Hop count: 0
  Link-address: 2001:470:1f01:3164:192:168::3
  Peer-address: fe80::260:8ff:fed1:d51f
  Interface-Id
    option type: 18
    option length: 4
    Interface-ID
  Relay Message
    option type: 9
    option length: 98
    DHCPv6
      Message type: Request (3)
      Transaction-ID: 0x00906783
      Client Identifier
        option type: 1
        option length: 14
        DUID type: link-layer address plus time (1)
        Hardware type: Ethernet (1)
        Time: 282016307
        Link-layer address: 00:60:08:d1:d5:1f
      Server Identifier
        option type: 2
        option length: 14
        DUID type: link-layer address plus time (1)
        Hardware type: Ethernet (1)
        Time: 282033914
        Link-layer address: 00:11:11:69:c7:99
Option Request
        option type: 6
        option length: 4
        Requested Option code: DNS recursive name server (23)
        Requested Option code: Domain Search List (24)
    Elapsed time
        option type: 8
        option length: 2
        elapsed-time: 0 ms
    Identity Association for Non-temporary Address
        option type: 3
        option length: 40
        IAID: 147969311
        T1: 3600
        T2: 5400
        IA Address
          option type: 5
          option length: 24
          IPv6 address: 2001:470:1f01:3164:4916:62de:123e:19b
          Preferred lifetime: 7200
          Valid lifetime: 7500

Stateful DHCPv6 Message Exchange Detail with Relay Agent (REPLY)

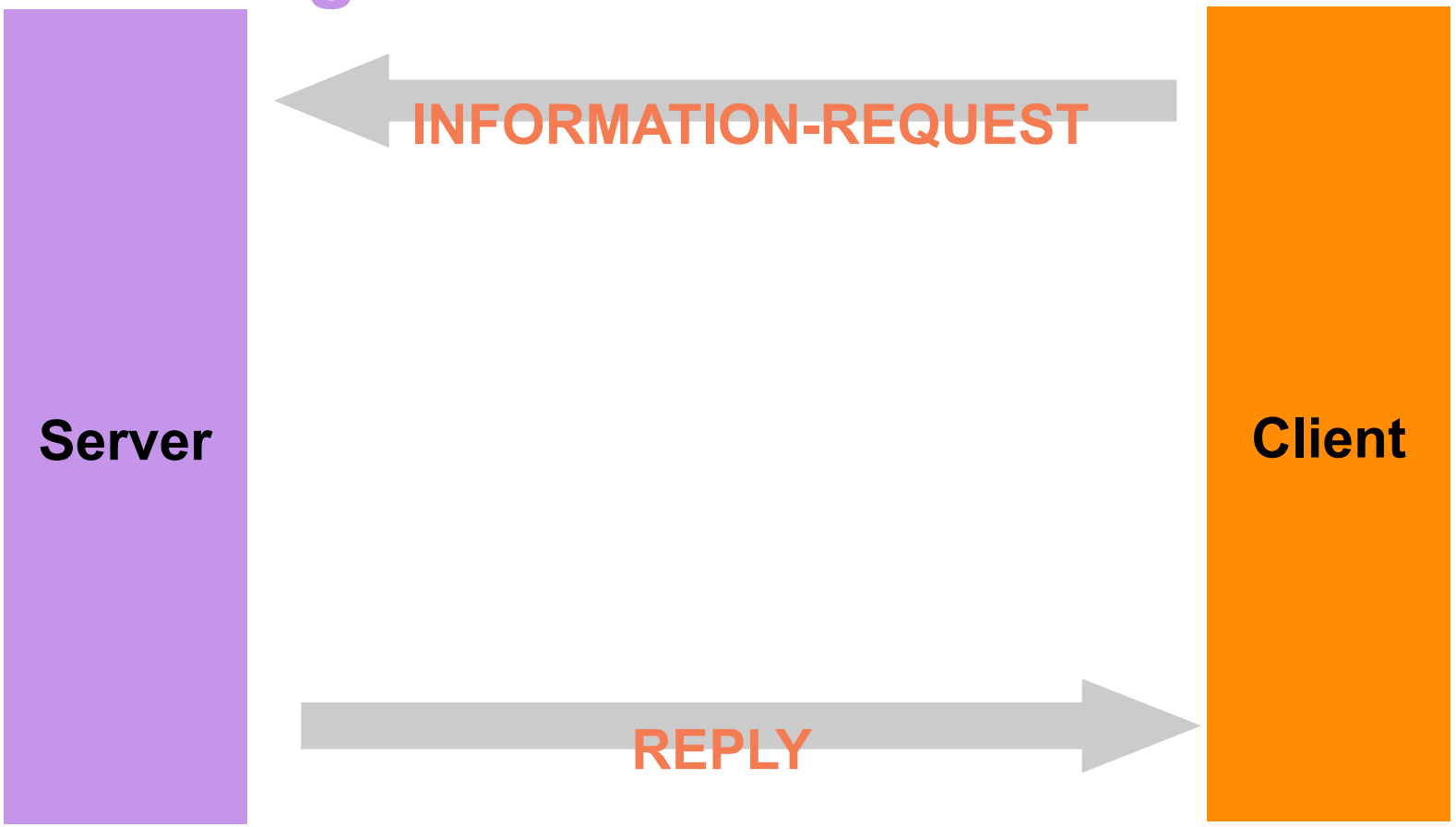
DHCPv6
Message type: Relay-reply (13)
Hop count: 0
Link-address: 2001:470:1f01:3164:192:168::3
Peer-address: fe80::260:8ff:fed1:d51f
Interface-Id
option type: 18
option length: 4
Interface-ID
Relay Message
option type: 9
option length: 84
DHCPv6
Message type: Reply (7)
Transaction-ID: 0x00906783
Identity Association for Non-temporary Address
option type: 3
option length: 40
IAID: 147969311
T1: 0
T2: 0
IA Address
option type: 5
option length: 24
IPv6 address: 2001:470:1f01:3164:4916:62de:123e:
19b
Preferred lifetime: 75
Valid lifetime: 120

Client Identifier
option type: 1
option length: 14
DUID type: link-layer address plus time (1)
Hardware type: Ethernet (1)
Time: 282016307
Link-layer address: 00:60:08:d1:d5:1f
Server Identifier
option type: 2
option length: 14
DUID type: link-layer address plus time (1)
Hardware type: Ethernet (1)
Time: 282033914
Link-layer address: 00:11:11:69:c7:99

Stateless DHCPv6

- Assumes one or more techniques used by a node to acquire one or more IPv6 addresses
  - Static assignment
  - Auto-configuration
- Stateless DHCPv6 is a two message exchange (INFORMATION-REQUEST, REPLY) between a DHCPv6 client and server where configuration information only is provided
- Typically is triggered when “Other” bit is set in router advertisement

Stateless DHCPv6 Message Exchange



Stateless DHCPv6 Message Exchange Detail (INFORMATION-REQUEST)

DHCPv6
- Message type: Information-request (11)
- Transaction-ID: 0x007b23c6
- Client Identifier
  - option type: 1
  - option length: 14
  - DUID type: link-layer address plus time (1)
  - Hardware type: Ethernet (1)
  - Time: 281507745
  - Link-layer address: 00:16:3e:18:88:fe
- Option Request
  - option type: 6
  - option length: 4
  - Requested Option code: DNS recursive name server (23)
  - Requested Option code: Domain Search List (24)
- Elapsed time
  - option type: 8
  - option length: 2
  - elapsed-time: 0 ms

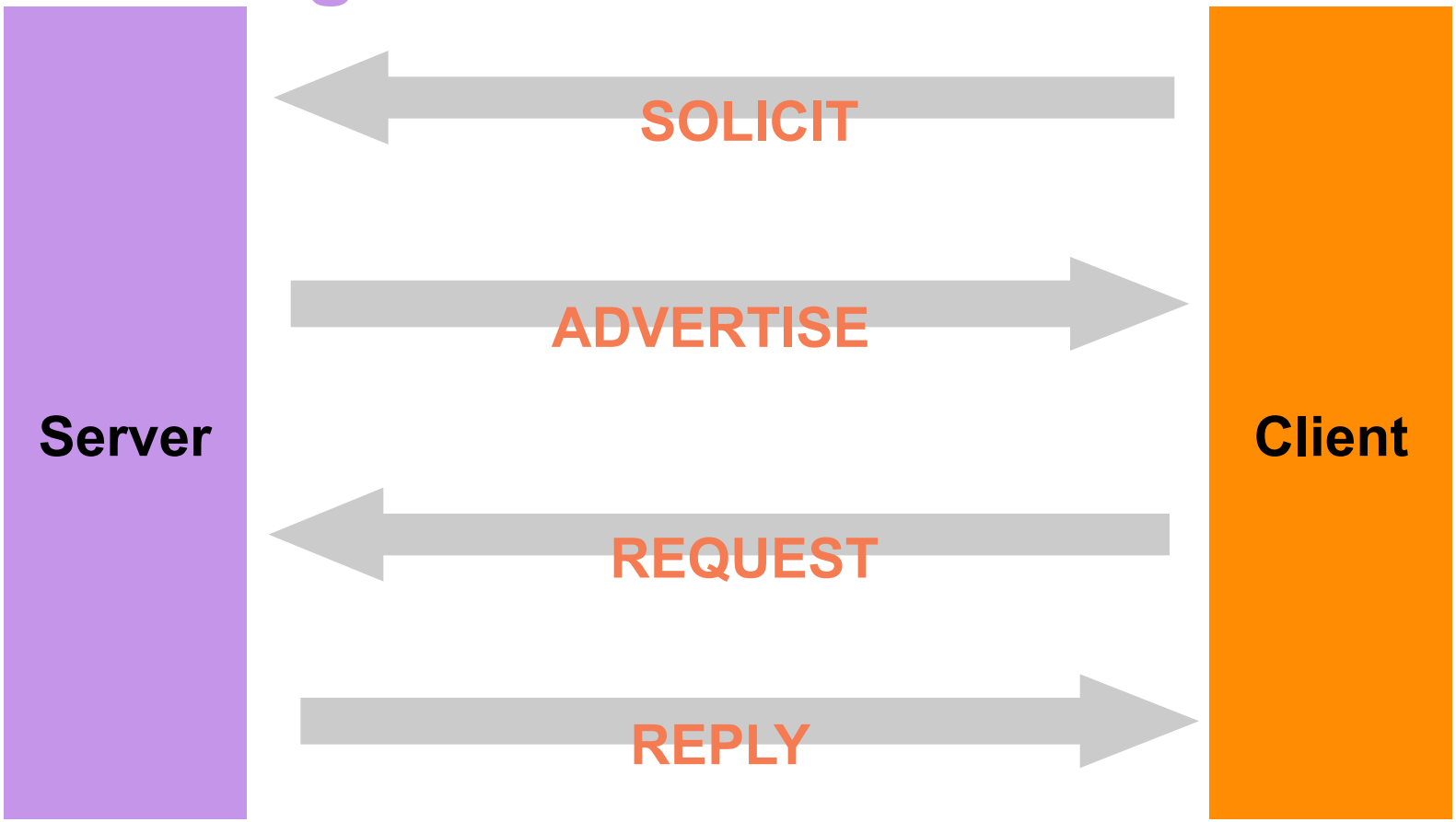
Stateless DHCPv6 Message Exchange Detail (REPLY)

DHCPv6
- Message type: Reply (7)
- Transaction-ID: 0x007b23c6
- Client Identifier
  - option type: 1
  - option length: 14
  - DUID type: link-layer address plus time (1)
  - Hardware type: Ethernet (1)
  - Time: 281507745
  - Link-layer address: 00:16:3e:18:88:fe
- Server Identifier
  - option type: 2
  - option length: 14
  - DUID type: link-layer address plus time (1)
  - Hardware type: Ethernet (1)
  - Time: 281498447
  - Link-layer address: 00:16:3e:60:6d:5d

Prefix Delegation

- Four message DHCPv6 exchange (SOLICIT, ADVERTISE, REQUEST, REPLY) where one or more IPv6 prefixes are requested by a DHCPv6 client
    - Request for one or more IPv6 prefixes can be coupled with a stateful DHCPv6 request

Prefix Delegation Message Exchange



DHCPv6 Prefix Delegation Message Exchange Detail with Relay Agent (SOLICIT)

DHCPv6
Message type: Relay-forw (12)
Hop count: 0
Link-address: 2001:470:1f01:3164:192:168::3
Peer-address: fe80::260:8ff:fed1:d51f
Interface-Id
option type: 18
option length: 4
Interface-ID
Relay Message
option type: 9
option length: 81
DHCPv6
Message type: Solicit (1)
Transaction-ID: 0x007be9f6
Client Identifier
option type: 1
option length: 14
DUID type: link-layer address plus time (1)
Hardware type: Ethernet (1)
Time: 282016307
Link-layer address: 00:60:08:d1:d5:1f
Option Request
option type: 6
option length: 4
Requested Option code: DNS recursive name server (23)
Requested Option code: Domain Search List (24)

Elapsed time
option type: 8
option length: 2
elapsed-time: 0 ms
Identity Association for Prefix Delegation
option type: 25
option length: 41
IAID: 147969311
T1: 3600
T2: 5400
IA Prefix
option type: 26
option length: 25
Preferred lifetime: 7200
Valid lifetime: 10800
Prefix length: 56
Prefix address: 2001:470:1f01::

DHCPv6 Prefix Delegation Message Exchange Detail with Relay Agent (ADVERTISE)

DHCPv6
- Message type: Relay-reply (13)
- Hop count: 0
- Link-address: 2001:470:1f01:3164:192:168::3
- Peer-address: fe80::260:8ff:fed1:d51f
- Interface-Id
  - option type: 18
  - option length: 4
  - Interface-ID
- Relay Message
  - option type: 9
  - option length: 85
  - DHCPv6
    - Message type: Advertise (2)
    - Transaction-ID: 0x007be9f6
    - Identity Association for Prefix Delegation
      - option type: 25
      - option length: 41
      - IAID: 147969311
      - T1: 0
      - T2: 0
      - IA Prefix
        - option type: 26
        - option length: 25
        - Preferred lifetime: 75
        - Valid lifetime: 120
        - Prefix length: 56
        - Prefix address: 2001:470:1f01::

Client Identifier
- option type: 1
- option length: 14
- DUID type: link-layer address plus time (1)
- Hardware type: Ethernet (1)
- Time: 282016307
- Link-layer address: 00:60:08:d1:d5:1f

Server Identifier
- option type: 2
- option length: 14
- DUID type: link-layer address plus time (1)
- Hardware type: Ethernet (1)
- Time: 282033914
- Link-layer address: 00:11:11:69:c7:99

DHCPv6 Prefix Delegation Message Exchange Detail with Relay Agent (REQUEST)

DHCPv6
Message type: Relay-forw (12)
Hop count: 0
Link-address: 2001:470:1f01:3164:192:168::3
Peer-address: fe80::260:8ff:fed1:d51f
Interface-Id
option type: 18
option length: 4
Interface-ID
Relay Message
option type: 9
option length: 99
DHCPv6
Message type: Request (3)
Transaction-ID: 0x00bc2164
Client Identifier
option type: 1
option length: 14
DUID type: link-layer address plus time (1)
Hardware type: Ethernet (1)
Time: 282016307
Link-layer address: 00:60:08:d1:d5:1f
Server Identifier
option type: 2
option length: 14
DUID type: link-layer address plus time (1)
Hardware type: Ethernet (1)
Time: 282033914
Link-layer address: 00:11:11:69:c7:99
Option Request
option type: 6
option length: 4
Requested Option code: DNS recursive name server (23)
Requested Option code: Domain Search List (24)
Elapsed time
option type: 8
option length: 2
elapsed-time: 0 ms
Identity Association for Prefix Delegation
option type: 25
option length: 41
IAID: 147969311
T1: 3600
T2: 5400
IA Prefix
option type: 26
option length: 25
Preferred lifetime: 7200
Valid lifetime: 7500
Prefix length: 56
Prefix address: 2001:470:1f01::

DHCPv6 Prefix Delegation Message Exchange Detail with Relay Agent (REPLY)

DHCPv6
- Message type: Relay-reply (13)
- Hop count: 0
- Link-address: 2001:470:1f01:3164:192:168::3
- Peer-address: fe80::260:8ff:fed1:d51f
- Interface-Id
  - option type: 18
  - option length: 4
  - Interface-ID
- Relay Message
  - option type: 9
  - option length: 85
  - DHCPv6
    - Message type: Reply (7)
    - Transaction-ID: 0x00bc2164
    - Identity Association for Prefix Delegation
      - option type: 25
      - option length: 41
      - IAID: 147969311
      - T1: 0
      - T2: 0
      - IA Prefix
        - option type: 26
        - option length: 25
        - Preferred lifetime: 75
        - Valid lifetime: 120
        - Prefix length: 56
        - Prefix address: 2001:470:1f01::

Client Identifier
- option type: 1
- option length: 14
- DUID type: link-layer address plus time (1)
- Hardware type: Ethernet (1)
- Time: 282016307
- Link-layer address: 00:60:08:d1:d5:1f

Server Identifier
- option type: 2
- option length: 14
- DUID type: link-layer address plus time (1)
- Hardware type: Ethernet (1)
- Time: 282033914
- Link-layer address: 00:11:11:69:c7:99

DHCPv6 IA Address, IA_NA, IA_TA, and IA_PD Options (continued)

- The IA Address Option is used to specify the IPv6 address(es) allocated using DHCPv6
- The IA Address Option is used with the IA_NA and IA_TA options
  - The IA Address option is encapsulated within IA_NA and IA_TA options
  - Additional attributes and parameters are also encapsulated within IA_NA and IA_TA

DHCPv6 IA Address, IA_NA, IA_TA, and IA_PD Options

- IA_NA and IA_TA options represent different types of IPv6 addresses and parameters related to the same accepted by DHCPv6 clients each used in different context by an IPv6 node
  - IA_NA is the Identity Association for Non-temporary Addresses option
  - IA_TA is the Identity Association for Temporary Addresses option

- IA_PD options represent one or more IPv6 prefix and parameters related to the same
  - IA_PD is the Identity Association for Prefix Delegation

DHCPv6 Renewal and Rebinding (continued)

- Independent to one another IA_NA, IA_TA, and IA_PD each have attributes pertaining to lease state and timing
- Timers
  - T1 timer indicates when the 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

DHCPv6 Renewal and Rebinding

- Lifetimes
  - •Preferred Lifetime is aligned with the IPv6 construct of preferred lifetime
    - –At this lifetime IPv6 addresses or prefixes is valid
    - –Nodes must extend the lifetimes or prepare to abandon the use of the same.
  - •Valid Lifetime is aligned with the IPv6 construct of valid lifetime
    - –At this lifetime IPv6 addresses or prefixes must be abandoned and not used further
  - •Issuing lifetime values of zero is an indicator that the IPv6 addresses or prefixes should be abandoned

DHCPv6 Renew Message Exchange Detail with Relay Agent (RENEW)

DHCPv6
Message type: Relay-forw (12)
Hop count: 0
Link-address: 2001:470:1f01:3164:192:168::3
Peer-address: fe80::260:8ff:fed1:d51f
Interface-Id
option type: 18
option length: 4
Interface-ID
Relay Message
option type: 9
option length: 98
DHCPv6
Message type: Renew (5)
Transaction-ID: 0x00185141
Client Identifier
option type: 1
option length: 14
DUID type: link-layer address plus time (1)
Hardware type: Ethernet (1)
Time: 282016307
Link-layer address: 00:60:08:d1:d5:1f
Server Identifier
option type: 2
option length: 14
DUID type: link-layer address plus time (1)
Hardware type: Ethernet (1)
Time: 282033914
Link-layer address: 00:11:11:69:c7:99
Option Request
option type: 6
option length: 4
Requested Option code: DNS recursive name server (23)
Requested Option code: Domain Search List (24)
Elapsed time
option type: 8
option length: 2
elapsed-time: 0 ms
Identity Association for Non-temporary Address
option type: 3
option length: 40
IAID: 147969311
T1: 3600
T2: 5400
IA Address
option type: 5
option length: 24
IPv6 address: 2001:470:1f01:3164:4916:62de:123e:19b
Preferred lifetime: 7200
Valid lifetime: 7500

DHCPv6 Renew Message Exchange Detail with Relay Agent (REPLY)

DHCPv6
Message type: Relay-reply (13)
Hop count: 0
Link-address: 2001:470:1f01:3164:192:168::3
Peer-address: fe80::260:8ff:fed1:d51f
Interface-Id
option type: 18
option length: 4
Interface-ID
Relay Message
option type: 9
option length: 84
DHCPv6
Message type: Reply (7)
Transaction-ID: 0x00185141
Identity Association for Non-temporary Address
option type: 3
option length: 40
IAID: 147969311
T1: 0
T2: 0
IA Address
option type: 5
option length: 24
IPv6 address: 2001:470:1f01:3164:4916:62de:123e:
19b
Preferred lifetime: 75
Valid lifetime: 120
Client Identifier
option type: 1
option length: 14
DUID type: link-layer address plus time (1)
Hardware type: Ethernet (1)
Time: 282016307
Link-layer address: 00:60:08:d1:d5:1f
Server Identifier
option type: 2
option length: 14
DUID type: link-layer address plus time (1)
Hardware type: Ethernet (1)
Time: 282033914
Link-layer address: 00:11:11:69:c7:99

DHCPv6 Rebind Message Exchange Detail (REBIND)

DHCPv6
- Message type: Rebind (6)
- Transaction-ID: 0x004f4842
- Client Identifier
  - option type: 1
  - option length: 14
  - DUID type: link-layer address plus time (1)
  - Hardware type: Ethernet (1)
  - Time: 281507745
  - Link-layer address: 00:16:3e:18:88:fe
- Option Request
  - option type: 6
  - option length: 4
  - Requested Option code: DNS recursive name server (23)
  - Requested Option code: Domain Search List (24)
- Elapsed time
  - option type: 8
  - option length: 2
  - elapsed-time: 0 ms

Identity Association for Non-temporary Address
- option type: 3
- option length: 40
- IAID: 1041795326
- T1: 3600
- T2: 5400
- IA Address
  - option type: 5
  - option length: 24
  - IPv6 address: 2001:558:ff10:870:f914:a7c1:42d1:faa1
  - Preferred lifetime: 7200
  - Valid lifetime: 7500

DHCPv6 Rebind Message Exchange Detail (REPLY)

DHCPv6
Message type: Reply (7)
Transaction-ID: 0x004f4842
Identity Association for Non-temporary Address
option type: 3
option length: 40
IAID: 1041795326
T1: 0
T2: 0
IA Address
option type: 5
option length: 24
IPv6 address:
2001:558:ff10:870:f914:a7c1:42d1:faa1
Preferred lifetime: 75
Valid lifetime: 120

Client Identifier
option type: 1
option length: 14
DUID type: link-layer address plus time (1)
Hardware type: Ethernet (1)
Time: 281507745
Link-layer address: 00:16:3e:18:88:fe
Server Identifier
option type: 2
option length: 14
DUID type: link-layer address plus time (1)
Hardware type: Ethernet (1)
Time: 281498447
Link-layer address: 00:16:3e:60:6d:5d

DHCPv6 Server Preference Option

- Server preference option indicates the preference as configured administratively for a DHCPv6 server
- Per RFC3315 DHCPv6 clients wait a specified amount of time and gather DHCPv6 server responses to its requests
  - If a DHCPv6 server responses contains a preference less than 255
  - No preference indicating a preference of zero
  - Preference of 255 suggest that no further waiting is required, this is the highest preference
- After waiting the specified amount of time a DHCPv6 client must select the best response

DHCPv6 Reconfigure (continued)

- Unlike that of DHCPv4, DHCPv6 Reconfigure offers a more secure technique for DHCPv6 servers to interact with DHCPv6 clients
- The Reconfiguration Key Authentication Protocol, as specified in RFC3315, is the mechanism used to enable this interaction
- DHCPv6 clients must advertise support and willingness to enable Reconfigure
    - DHCPv6 server must obviously be enabled and support this behavior as well

DHCPv6 Reconfigure

- After successfully negotiating willingness to support Reconfigure DHCPv6 servers can be triggered to transmit Reconfigure messages to DHCPv6 clients
  - •Renew, Information-Request, or Rebind can result from the transmission of a Reconfigure message
- Reconfigure Key Authentication Protocol does not imply support for DHCPv6 Authentication as specified in RFC3315

DHCPv6 Vendor Information Options (continued)

- For DHCPv6 these vendor information options are specified as part of RFC3315
  - •Allows for vendor specific options leveraging vendor identifiers or enterprise identifiers to uniquely identify DHCPv6 options
  - •Allow a given vendor or enterprise to define and manage its own DHCPv6 vendor option space
- Clients and servers must support vendor information options

- Vendor information options also apply to relay agents
  - •Vendor information can be specified for relay agents to enable the transmission of vendor information for the same

DHCPv6 Vendor Information Options

- Vendor information options provide additional flexibility
  - Misuse of the same could result in overloaded option space
- Vendor options also help to ensure that core DHCPv6 options are maximized and not overloaded
  - Over the years many DHCPv4 options and fields were overloaded

DHCPv4 and DHCPv6 Co-existence

- Generally DHCPv4 and DHCPv6 transmit information that is applicable to the version of IP being used
  - In some cases this information can intersect or conflict, for example:
    - DNS server IP address, DNS search path
- DHCPv4 and DHCPv6 behavior can be supported by a single process or one process per protocol
  - Pertains to clients, servers, and relays

DHCPv6 Deployment Considerations (continued)

- DHCPv6 is typically used to provide controlled dynamic allocation of IPv6 addresses and prefixes
  - Static addressing as with IPv4 is challenging to scale
  - Auto-configuration in IPv6 does not offer adequate control
- DHCPv6 is at this time the most widely available approach to dynamically distribute configuration information
- DHCPv6 is also the most common approach to facilitate IPv6 prefix delegation

DHCPv6 Deployment Considerations

- Deployment considerations apply when determining how to offer DHCPv4 and DHCPv6 services
  - Consider balance between impact to existing services over IPv4 and manageability
  - Both protocols on the same server, one process
  - Both protocols on the same server, two processes
  - One protocol per server, implies one process

DHCPv6 Redundancy Background (continued)

- There is currently no defined protocol for DHCPv6 redundancy
- Redundancy is required to ensure that DHCPv6 services are highly available
  - Required for both IPv6 address and prefix allocation
  - Used to provide reliability for DHCPv6 clients
  - Used to ensure that other back-office and related systems have reliable access to DHCPv6 data

DHCPv6 Redundancy Background

- Some DHCPv6 deployment models that provide limited redundancy leverage split or overlapping prefix assignments to one or more DHCPv6 servers
  - The notion of ranges to ensure unique pools of addresses are used per DHCPv6 server may be applied
  - DHCPv6 server preference option may be used to prefer one DHCPv6 server over others

DHCPv6 Redundancy Models

- Timer and lifetime values are aligned to reduce service disruption or interruption
  - Typically renewal and rebind timers are nearly equal to preferred and valid lifetimes
- Split ranges
  - Assigns the same prefix with unique ranges to multiple DHCPv6 servers, leveraging DHCPv6 preference to indicate to clients which DHCPv6 server is preferred
- Overlapping ranges
  - Assigns the same prefix and range to one or more DHCPv6 servers, leveraging DHCPv6 preference to indicate to clients which DHCPv6 server is preferred

DHCPv6 Redundancy (Split Ranges Example)

- This example assigns the same prefix with unique ranges assigned to multiple DHCPv6 servers, leveraging DHCPv6 preference to indicate to clients which DHCPv6 server is preferred

```
# server-a
option dhcp6.preference code 7 = unsigned integer 8;
option dhcp6.preference 128;

default-lease-time 120;

ddns-update-style interim;
ddns-domainname "example.com";
authoritative;

subnet6 2001:DB8:FF10:870::/64 {
      # notice the range configuration using a /65
      range6 2001:558:ff10:870:0000:/65;
      # indicates that this server is preferred less
      option dhcp6.preference 128;
}
```

```
#server-b
option dhcp6.preference code 7 = unsigned integer 8;
option dhcp6.preference 128;

default-lease-time 120;

ddns-update-style interim;
ddns-domainname "example.com";
authoritative;

subnet6 2001:DB8:FF10:870::/64 {
      # notice the range configuration using a /65
      range6 2001:558:ff10:870:8000:/65;
      # indicates that this server is more preferred
      option dhcp6.preference 255;
}
```

DHCPv6 Redundancy (Overlapping Ranges Example)

- This example assigns the same prefix and range to one or more DHCPv6 servers, leveraging DHCPv6 preference to indicate to clients which DHCPv6 server is preferred

```
# server-a
option dhcp6.preference code 7 = unsigned integer 8;
option dhcp6.preference 128;

default-lease-time 120;

ddns-update-style interim;
ddns-domainname "example.com";
authoritative;

subnet6 2001:DB8:FF10:870::/64 {
      # notice the range configuration using a /64
      range6 2001:558:ff10:870::/64;
      # indicates that this server is preferred less
      option dhcp6.preference 128;
}
```

```
#server-b
option dhcp6.preference code 7 = unsigned integer 8;
option dhcp6.preference 128;

default-lease-time 120;

ddns-update-style interim;
ddns-domainname "example.com";
authoritative;

subnet6 2001:DB8:FF10:870::/64 {
      # notice the range configuration using a /64
      range6 2001:558:ff10:870::/64;
      # indicates that this server is more preferred
      option dhcp6.preference 255;
}
```

DHCPv6 Resources

- Software resources
  - ISC (www.isc.org)
    - Open source DHCPv6 implementation
  - Dibbler (http://klub.com.pl/dhcpv6)
    - Open source DHCPv6 implementation
- Testing resources
  - TAHI (www.tahi.org)
  - UNH-IOL
    - DHCPv6 Specification Test Suite
    - DHCPv6 Interoperability Test Suite

DHCPv6 Server Configuration Example

Basic server configuration using the ISC DHCPv6 server version 4.1.0rc1:

```
option dhcp6.rapid-commit;              # enables support for Rapid Commit

default-lease-time 120;                 # default lease time
ddns-update-style interim;              # ddns update style
ddns-domainname example.com";           # ddns domain name
authoritative;                          # authoritative

subnet6 2001:0bd8:a814:1::/64 {         # first IPv6 subnet declaration
    range6 2001:470:a814:1::/64;          # the range from within the IPv6 subnet
}

subnet6 2001:0db8:1f01::/48 {                       # second IPv6 subnet declaration
    range6 2001:470:1f01:3164::/64;                   # the range from within the IPv6 subnet
    prefix6 2001:470:1f01:: 2001:470:1f01::/56;       # prefix declaration for DHCPv6 PD (RFC3633)

}
```

Usage:

```
dhcpd -6 -cf /etc/dhcpd.conf eth0                   # starts DHCPv6 server using specific
                                                    # configuration and interface eth0
```

DHCPv6 Client Configuration Example

Basic client configuration using the ISC DHCPv6 client version 4.1.0rc1:

```
    send dhcp6.rapid-commit;        # instructs the client to use rapid commit
```

Usage:

```
    dhclient -6 eth0                # starts the DHCPv6 client on interface eth0

    dhclient -r -6 eth0             # releases the binding associated with the DHCPv6 client

    dhclient -S -6 eth0             # starts the DHCPv6 client on interface eth0 using stateless DHCPv6

    dhclient -P -6 eth0             # starts the DHCPv6 client on interface eth0 using DHCPv6 PD
```

DHCPv6 Relay Configuration Example

Basic relay agent configuration using the ISC DHCPv6 relay agent version 4.1.0rc1:

```
dhcrelay -d -l eth0 -u 2001:0db8:ff10:8a0:10:252:24:82%eth1        # starts the relay up listening for
                                                                   # DHCPv6 on eth0 and
                                                                   # sending on interface eth1
                                                                   # the IPv6 address must be specified
```

DHCPv6 and DOCSIS

Terminology

Standards and References

Overview of DOCSIS

Protocol Overview

Modes of Operation

DOCSIS IPv6 Message Flow

Deployment Considerations

Terminology

CM – Cable Modem

CMTS - Cable Modem Termination System

MTA – Media Terminal Adapter (VoIP device)

STB – Set top Box

eMTA – Embedded MTA (CM-MTA in one device)

eSTB – Embedded STB (CM-STB in one device)

DOCSIS – Data over cable standard Interface specification

PacketCable – Specification to provision and support MTAs behind a CM

Provisioning – Assigning an IP-address, configuration information, and a service tier to CM, MTA, etc.

DHCP - Dynamic Host Configuration Protocol

TFTP - Trivial File Transfer Protocol

TOD - Time of Day

Standards and References

- Cablelabs (www.cablelabs.com)
  - DOCSIS 3.0 Specifications
    - –MAC and Upper Layer Protocols Interface Specification (CM-SP-MULPIv3.0-I08-080522)
    - –CableLabs' Assigned Names and Numbers (CL-SP-CANN-I02-080306)
    - –CableLabs' DHCP Options Registry (CL-SP-CANN-DHCP-Reg-I02-080306)
  - DOCSIS 2.0 + IPv6 Technical Report (CM-TR-DOCSIS2.0-IPv6-V01-080307)
- IETF (www.ietf.org)
  - RFC5007 - DHCPv6 Leasequery

Overview of DOCSIS (continued)

- IP specific requirements are defined as part of the DOCSIS specifications
  - Additional layer two behavior is also specified but is out of scope for this module
  - DOCSIS 3.0 includes definition of IPv6 in DOCSIS
- IPv6 behavior for DOCSIS 2.0 has been defined as part of the DOCSIS 2.0 + IPv6 Technical Report
- Several modes of IP operation are defined as part of DOCSIS

Overview of DOCSIS

- DOCSIS leverages core, well-known protocols including
  - DHCP, TFTP, TOD, SYSLOG, and SNMP for both IPv4 and IPv6
  - Focus here is on how DOCSIS leverages DHCPv6
- Stateful DHCPv6 is required by DOCSIS for IPv6
  - Similarly DHCPv4 is used to support DOCSIS devices operating in IPv4 mode

DOCSIS and DHCPv6 (continued)

- DOCSIS devices in IPv6 mode leverage DHCPv6 to obtain IPv6 address/prefix and configuration information
- CMTS generally acts as the relay agent and MUST too be IPv6 enabled
  - Facilitates router discovery and neighbor discovery
- DOCSIS leverages vendor information options as specified by RFC3315 and defined by CableLabs
  - Enterprise Identification number is 4491

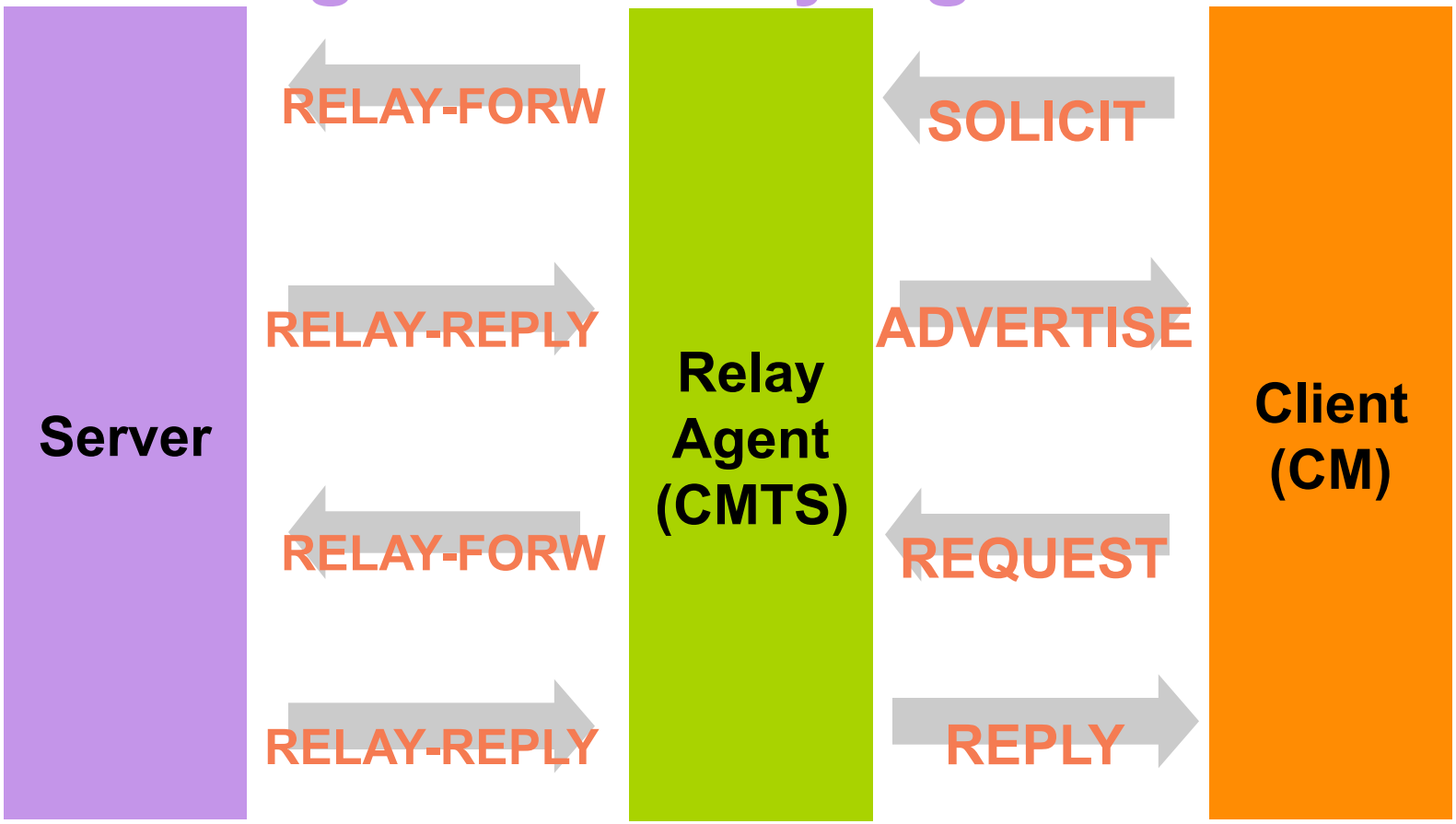
DOCSIS and DHCPv6 (continued)

- Most configuration information is defined under the CableLabs enterprise identification number including but not limited to the following for DHCPv6 clients
  - CableLabs option request option
  - CableLabs TFTP, TOD, SYSLOG server IPv6 addresses
  - CableLabs Configuration File
  - CableLabs Client Configuration options (contains IPv4 addresses)
  - CableLabs Device Identifier
  - CableLabs Modem Capabilities

DOCSIS and DHCPv6

- DHCPv6 vendor information options have also been defined for relay agents (CMTS)
  - CableLabs DOCSIS version
  - CableLabs Cable Modem MAC Address

DOCSIS Stateful DHCPv6 Message Exchange with Relay Agent



DOCSIS Stateful DHCPv6 Message Exchange Detail with Relay Agent (SOLICIT)

```
DHCPv6
   Message type: Relay-forw (12)
   Hop count: 0
   Link-address: 2001:558:ff10:850::1
   Peer-address: fe80::215:a4ff:fea5:a468
   Relay Message
      option type: 9
      option length: 298
      DHCPv6
         Message type: Solicit (1)
         Transaction-ID: 0x00001bc3
         Client Identifier
            option type: 1
            option length: 14
            DUID type: link-layer address plus time (1)
            Hardware type: IEEE 802 (6)
            Time: 1414087501
            Link-layer address: 00:15:a4:a5:a4:68
```

```
Elapsed time
            option type: 8
            option length: 2
            elapsed-time: 0 ms
         Rapid Commit
            option type: 14
            option length: 0
         Vendor Class
            option type: 16
            option length: 15
            enterprise-number: 4491
            vendor-class-data
         Reconfigure Accept
            option type: 20
            option length: 0
(continued)
```

DOCSIS Stateful DHCPv6 Message Exchange Detail with Relay Agent (SOLICIT)

Vendor-specific Information
option type: 17
option length: 213
enterprise-number: 4491
option
option code: 1
option length: 12
option-data
option
option code: 2
option length: 3
option-data
option
option code: 3
option length: 8
option-data
option
option code: 4
option length: 15
option-data
option
option code: 5
option length: 2
option-data
option
option code: 6
option length: 19
option-data
option
option code: 7
option length: 4
option-data
option
option code: 8
option length: 6
option-data
option
option code: 9
option length: 6
option-data
option
option code: 10
option length: 25
option-data
option
option code: 35
option length: 55
option-data
option
option code: 36
option length: 6
option-data
(continued)

DOCSIS Stateful DHCPv6 Message Exchange Detail with Relay Agent (SOLICIT)

Identity Association for Non-temporary Address
option type: 3
option length: 12
IAID: 1418405
T1: 0
T2: 0
Option Request
option type: 6
option length: 6
Requested Option code: Client Identifier (1)
Requested Option code: Server Identifier (2)
Requested Option code: Identity Association for Non-temporary Address (3)

Interface-Id
option type: 18
option length: 19
Interface-ID
Vendor-specific Information
option type: 17
option length: 22
enterprise-number: 4491
option
option code: 1025
option length: 4
option-data
option
option code: 1026
option length: 6
option-data

DOCSIS Stateful DHCPv6 Message Exchange Detail with Relay Agent (ADVERTISE)

DHCPv6
- Message type: Relay-reply (13)
- Hop count: 0
- Link-address: 2001:558:ff10:850::1
- Peer-address: fe80::215:a4ff:fea5:a468
- Interface-Id
  - option type: 18
  - option length: 19
  - Interface-ID
- Relay Message
  - option type: 9
  - option length: 240
  - DHCPv6
    - Message type: Advertise (2)
    - Transaction-ID: 0x00001bc3
    - Client Identifier
      - option type: 1
      - option length: 14
      - DUID type: link-layer address plus time (1)
      - Hardware type: IEEE 802 (6)
      - Time: 1414087501
      - Link-layer address: 00:15:a4:a5:a4:68
    - Server Identifier
      - option type: 2
      - option length: 14
      - DUID type: link-layer address plus time (1)
      - Hardware type: Ethernet (1)
      - Time: 261780576
      - Link-layer address: 00:03:ba:90:fb:61
    - Identity Association for Non-temporary Address
      - option type: 3
      - option length: 40
      - IAID: 1418405
      - T1: 129600
      - T2: 207360
      - IA Address
        - option type: 5
        - option length: 24
        - IPv6 address: 2001:558:ff10:850:215:a4ff:fea5:a468
        - Preferred lifetime: 259200
        - Valid lifetime: 604800

(continued)

DOCSIS Stateful DHCPv6 Message Exchange Detail with Relay Agent (ADVERTISE)

Reconfigure Accept
option type: 20
option length: 0
Authentication
option type: 11
option length: 28
Protocol: 3
Algorithm: 1
RDM: 0
Replay Detection
Authentication Information
Vendor-specific Information
option type: 17
option length: 116
enterprise-number: 4491
option
option code: 34
option length: 16
option-data
option
option code: 38
option length: 4
option-data
option
option code: 33
option length: 20
option-data
option
option code: 37
option length: 16
option-data
option
option code: 32
option length: 16
option-data
option
option code: 2170
option length: 16
option-data

DOCSIS Stateful DHCPv6 Message Exchange Detail with Relay Agent (REQUEST)

DHCPv6
- Message type: Relay-forw (12)
- Hop count: 0
- Link-address: 2001:558:ff10:850::1
- Peer-address: fe80::215:a4ff:fea5:a468
- Relay Message
  - option type: 9
  - option length: 340
  - DHCPv6
    - Message type: Request (3)
    - Transaction-ID: 0x00002078
    - Client Identifier
      - option type: 1
      - option length: 14
      - DUID type: link-layer address plus time (1)
      - Hardware type: IEEE 802 (6)
      - Time: 1414087501
      - Link-layer address: 00:15:a4:a5:a4:68
    - Server Identifier
      - option type: 2
      - option length: 14
      - DUID type: link-layer address plus time (1)
      - Hardware type: Ethernet (1)
      - Time: 261780576
      - Link-layer address: 00:03:ba:90:fb:61
    - Elapsed time
      - option type: 8
      - option length: 2
      - elapsed-time: 0 ms
    - Vendor Class
      - option type: 16
      - option length: 15
      - enterprise-number: 4491
      - vendor-class-data
    - Reconfigure Accept
      - option type: 20
      - option length: 0

(continued)

DOCSIS Stateful DHCPv6 Message Exchange Detail with Relay Agent (REQUEST)

Vendor-specific Information
option type: 17
option length: 213
enterprise-number: 4491
option
option code: 1
option length: 12
option-data
option
option code: 2
option length: 3
option-data
option
option code: 3
option length: 8
option-data
option
option code: 4
option length: 15
option-data
option
option code: 5
option length: 2
option-data
option
option code: 6
option length: 19
option-data
option
option code: 7
option length: 4
option-data
option
option code: 8
option length: 6
option-data
option
option code: 9
option length: 6
option-data
option
option code: 10
option length: 25
option-data
option
option code: 35
option length: 55
option-data
option
option code: 36
option length: 6
option-data
(continued)

DOCSIS Stateful DHCPv6 Message Exchange Detail with Relay Agent (REQUEST)

Identity Association for Non-temporary Address
option type: 3
option length: 40
IAID: 1418405
T1: 0
T2: 0
IA Address
option type: 5
option length: 24
IPv6 address: 2001:558:ff10:850:215:a4ff:fea5:a468
Preferred lifetime: 259200
Valid lifetime: 604800
Option Request
option type: 6
option length: 6
Requested Option code: Client Identifier (1)
Requested Option code: Server Identifier (2)
Requested Option code: Identity Association for Non-temporary Address (3)

Interface-Id
option type: 18
option length: 19
Interface-ID
Vendor-specific Information
option type: 17
option length: 22
enterprise-number: 4491
option
option code: 1025
option length: 4
option-data
option
option code: 1026
option length: 6
option-data

DOCSIS Stateful DHCPv6 Message Exchange Detail with Relay Agent (REPLY)

DHCPv6
- Message type: Relay-reply (13)
- Hop count: 0
- Link-address: 2001:558:ff10:850::1
- Peer-address: fe80::215:a4ff:fea5:a468
- Interface-Id
  - option type: 18
  - option length: 19
  - Interface-ID
- Relay Message
  - option type: 9
  - option length: 240
  - DHCPv6
    - Message type: Reply (7)
    - Transaction-ID: 0x00002078
    - Client Identifier
      - option type: 1
      - option length: 14
      - DUID type: link-layer address plus time (1)
      - Hardware type: IEEE 802 (6)
      - Time: 1414087501
      - Link-layer address: 00:15:a4:a5:a4:68
    - Server Identifier
      - option type: 2
      - option length: 14
      - DUID type: link-layer address plus time (1)
      - Hardware type: Ethernet (1)
      - Time: 261780576
      - Link-layer address: 00:03:ba:90:fb:61
    - Identity Association for Non-temporary Address
      - option type: 3
      - option length: 40
      - IAID: 1418405
      - T1: 129600
      - T2: 207360
      - IA Address
        - option type: 5
        - option length: 24
        - IPv6 address: 2001:558:ff10:850:215:a4ff:fea5:a468
        - Preferred lifetime: 259200
        - Valid lifetime: 604800
    - Reconfigure Accept
      - option type: 20
      - option length: 0

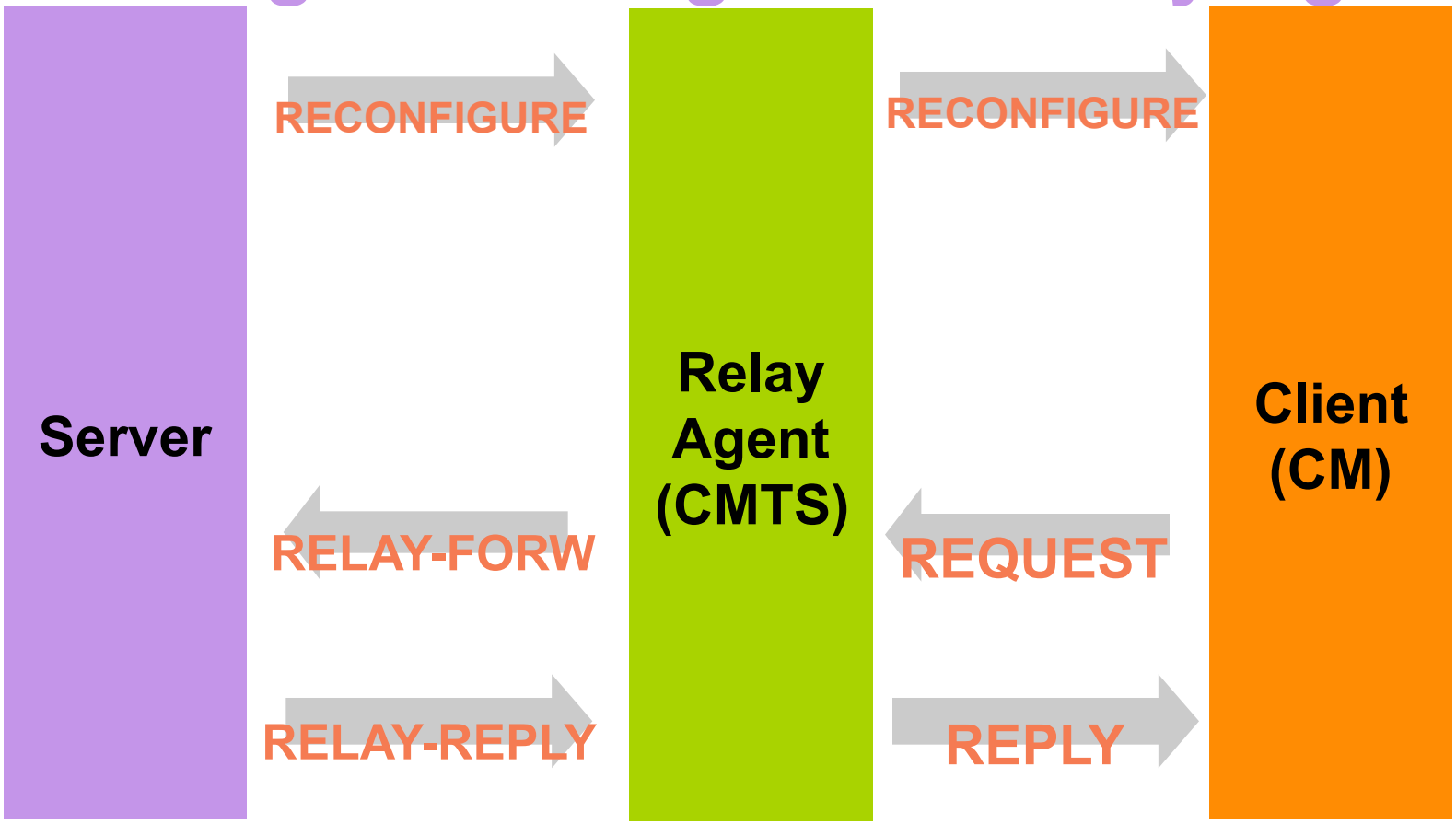
(continued)

DOCSIS Stateful DHCPv6 Message Exchange Detail with Relay Agent (REPLY)

Authentication
option type: 11
option length: 28
Protocol: 3
Algorithm: 1
RDM: 0
Replay Detection
Authentication Information
Vendor-specific Information
option type: 17
option length: 116
enterprise-number: 4491

option
option code: 34
option length: 16
option-data
option
option code: 38
option length: 4
option-data
option
option code: 33
option length: 20
option-data
option
option code: 37
option length: 16
option-data
option
option code: 32
option length: 16
option-data
option
option code: 2170
option length: 16
option-data

DOCSIS DHCPv6 Reconfigure Message Exchange with Relay Agent



DOCSIS DHCPv6 Reconfigure Message Exchange Detail with Relay Agent (RECONFIGURE)

DHCPv6
- Message type: Reconfigure (10)
- Transaction-ID: 0x00000000
- Client Identifier
  - option type: 1
  - option length: 14
  - DUID type: link-layer address plus time (1)
  - Hardware type: IEEE 802 (6)
  - Time: 1414087501
  - Link-layer address: 00:15:a4:a5:a4:68
- Server Identifier
  - option type: 2
  - option length: 14
  - DUID type: link-layer address plus time (1)
  - Hardware type: Ethernet (1)
  - Time: 261780576
  - Link-layer address: 00:03:ba:90:fb:61

Reconfigure Message
- option type: 19
- option length: 1
- Reconfigure-type: Renew

Authentication
- option type: 11
- option length: 28
- Protocol: 3
- Algorithm: 1
- RDM: 0
- Replay Detection
- Authentication Information

DOCSIS DHCPv6 Reconfigure Message Exchange Detail with Relay Agent (REQUEST)

DHCPv6
Message type: Relay-forw (12)
Hop count: 0
Link-address: 2001:558:ff10:850::1
Peer-address: fe80::215:a4ff:fea5:a468
Relay Message
option type: 9
option length: 95
DHCPv6
Message type: Renew (5)
Transaction-ID: 0x00002a16
Client Identifier
option type: 1
option length: 14
DUID type: link-layer address plus time (1)
Hardware type: IEEE 802 (6)
Time: 1414087501
Link-layer address: 00:15:a4:a5:a4:68
Server Identifier
option type: 2
option length: 14
DUID type: link-layer address plus time (1)
Hardware type: Ethernet (1)
Time: 261780576
Link-layer address: 00:03:ba:90:fb:61

Elapsed time
option type: 8
option length: 2
elapsed-time: 0 ms
Vendor Class
option type: 16
option length: 15
enterprise-number: 4491
vendor-class-data
Reconfigure Accept
option type: 20
option length: 0

(continued)

DOCSIS DHCPv6 Reconfigure Message Exchange Detail with Relay Agent (REQUEST)

Identity Association for Non-temporary Address
option type: 3
option length: 12
IAID: 1418405
T1: 129600
T2: 207360
Option Request
option type: 6
option length: 6
Requested Option code: Client Identifier (1)
Requested Option code: Server Identifier (2)
Requested Option code: Identity Association for Non-temporary Address (3)

Interface-Id
option type: 18
option length: 19
Interface-ID
Vendor-specific Information
option type: 17
option length: 22
enterprise-number: 4491
option
option code: 1025
option length: 4
option-data
option
option code: 1026
option length: 6
option-data

DOCSIS DHCPv6 Reconfigure Message Exchange Detail with Relay Agent (REPLY)

DHCPv6
Message type: Relay-reply (13)
Hop count: 0
Link-address: 2001:558:ff10:850::1
Peer-address: fe80::215:a4ff:fea5:a468
Interface-Id
option type: 18
option length: 19
Interface-ID
Relay Message
option type: 9
option length: 240
DHCPv6
Message type: Reply (7)
Transaction-ID: 0x00002a16
Client Identifier
option type: 1
option length: 14
DUID type: link-layer address plus time (1)
Hardware type: IEEE 802 (6)
Time: 1414087501
Link-layer address: 00:15:a4:a5:a4:68
Server Identifier
option type: 2
option length: 14
DUID type: link-layer address plus time (1)
Hardware type: Ethernet (1)
Time: 261780576
Link-layer address: 00:03:ba:90:fb:61
Identity Association for Non-temporary Address
option type: 3
option length: 40
IAID: 1418405
T1: 129600
T2: 207360
IA Address
option type: 5
option length: 24
IPv6 address: 2001:558:ff10:850:215:a4ff:fea5:a468
Preferred lifetime: 259200
Valid lifetime: 604800
Reconfigure Accept
option type: 20
option length: 0

(continued)

DOCSIS DHCPv6 Reconfigure Message Exchange Detail with Relay Agent (REPLY)

Authentication
option type: 11
option length: 28
Protocol: 3
Algorithm: 1
RDM: 0
Replay Detection
Authentication Information
Vendor-specific Information
option type: 17
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enterprise-number: 4491

option
option code: 34
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option
option code: 38
option length: 4
option-data
option
option code: 33
option length: 20
option-data
option
option code: 37
option length: 16
option-data
option
option code: 32
option length: 16
option-data
option
option code: 2170
option length: 16
option-data

Q&A

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