DHCPv6: DHCP for IP version 6

Charles E. Perkins

Technology Development

Sun Microsystems, Inc.

Menlo Park, CA 94025

cperkins@eng.sun.com

http://www.svrloc.com/~charliep

Jim Bound

Compaq Computer Corporation

Nashua, NH 03062

bound@zk3.dec.com

Outline of Presentation

Motivation and Problem Statement

Terminology and Entity Definition

IPv6

Protocol Overview and Detailed Description

Operational Examples

Internet Engineering Task Force (IETF)

Why DHCP for IPv6?

IPv6 is an advance towards zero-administration, *but* many network administrators want control

- of which nodes get which IP addresses
- of servers assigned to particular clients
- for load balancing
- for record-keeping
- to simplify ancillary network management tasks such as DNS

The Dynamic Host Configuration Protocol (DHCP) offers the accepted protocol model for automatically configuring Internet nodes at boot time.

IP version 6

Reasons for creation:

- Exponential route table expansion (BUT: CIDR has helped)
- Rapid address space exhaustion

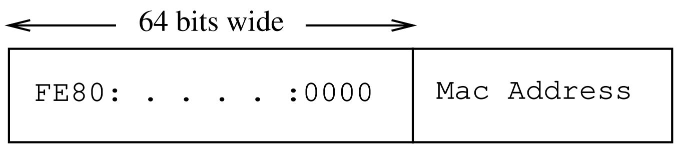
IPv6 Options placed *after* IPv6 header:

- Destination Options
- Hop-by-Hop Options
- Fragmentation
- (source) Routing
- Authentication; Encryption
- Jumbogram length

IP version 6 – major points of difference from IPv4

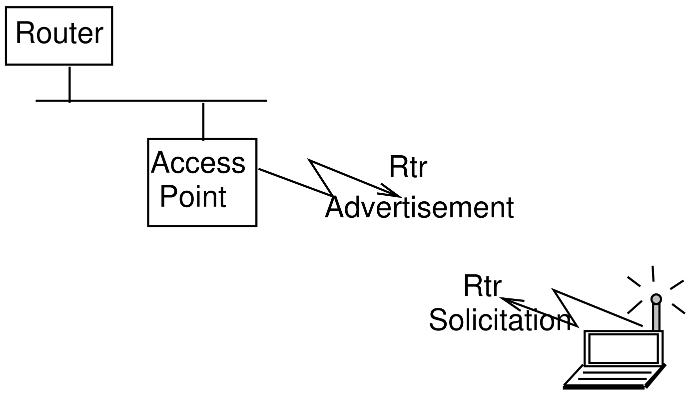
- 128 bit addresses (denoted in format `XXXX:XXXX:....:XXXX`)
- *flow id* field
- Improved option handling
- Authentication services assumed universal
- Source route reversal not required
- Address space for Novell, Appletalk, OSI, ...
- Fragmentation only at endpoints
- No checksum
- Address autoconfiguration
- Some level of multi-homing guaranteed

Establishing the Link – Stateless Address Autoconfiguration (RFC1971)



- Provides means for creating a *unique* link-local address
- Specifies algorithms for *Duplicate Address Detection*(DAD),
- Stateless and idempotent

Router and Neighbor Discovery (RFC1970)



These processes only expect appropriate broadcast behavior on link.

- Provides means for creating a unique globally routable address
- Defines router advertisements, host advertisements, solicitations
- Replaces and improves upon ARP
- Proxy advertisement specified
- 'M' bit allows for stateful autoconfiguration (i.e., DHCPv6)

Protocol Overview

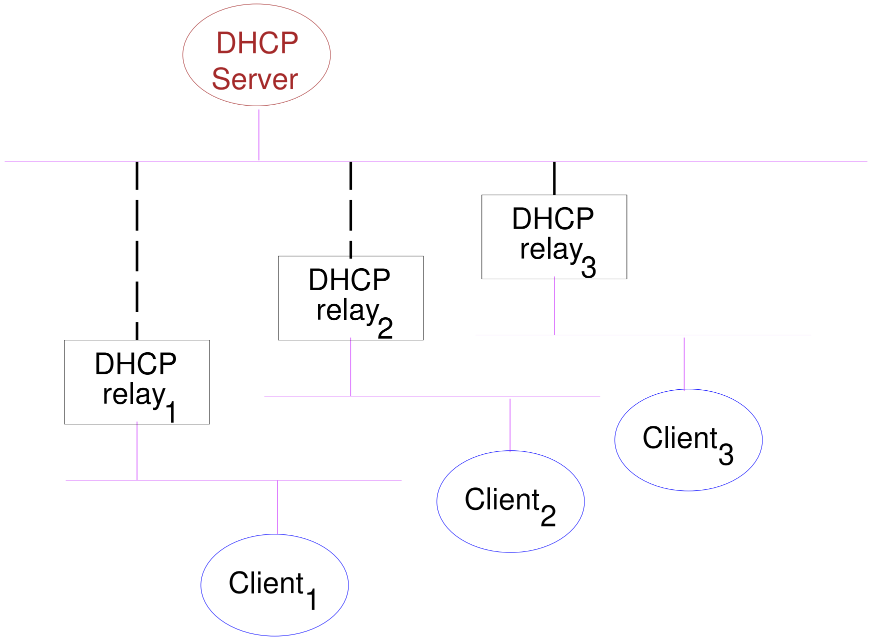
DHCPv6 has the following properties:

- >= administrative convenience of DHCPv4
- Request/Response protocol, with optimistic responders
- Failures remedied by retransmissions from requestors
- Transaction IDs identify retransmitted requests
- Multiple IP addresses available per client
- Simplified reconfiguration upon network renumbering
- Simplified interoperation with DNS
- Multiple DHCP servers possible per client

DHCPv6 entities and terminology

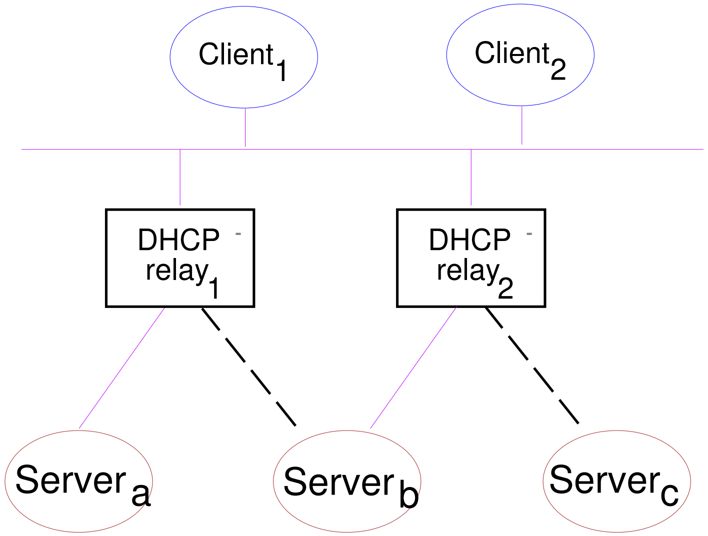
- DHCP client
- DHCP server
- DHCP relay
- Preferred and Valid lifetimes
- transaction-ID
- client binding
- resource-server association

General DHCP model of operation



Multiple clients, multiple servers, multiple relays

Many-Many Operation

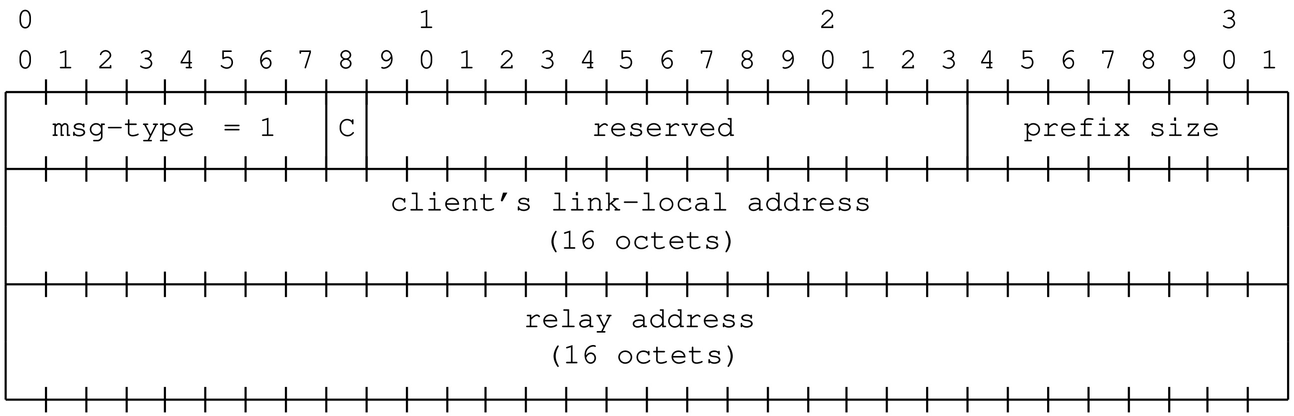


Simple server-server protocol is finally receiving attention

DHCP Message Types

- DHCP Solicit
- DHCP Advertise
- DHCP Request
- DHCP Reply
- DHCP Release
- DHCP Reconfigure

DHCP Solicit Message Format



C	whether the servers receiving the message should deallocate the resources associated with the client.
prefix-size	if nonzero, the size of the relay agent's routing prefix.
client's link-local address	
relay-address	If nonzero, the IP address of the interface on which the relay received the client's DHCP Solicit message

DHCP Advertise Message Format

```
 0                   1                   2                   3
 0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|  msg-type = 2 |S|          reserved           |  preference   |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|                  client's link-local address                  |
|                          (16 octets)                          |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|                         agent address                         |
|                          (16 octets)                          |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|                         server address                        |
|                    (16 octets, if present)                    |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|         extensions (variable number and length) ...
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
```

S	whether the server-address is present.
preference	how eager the server is to serve the client
client's link-local address	
agent-address	The agent's interface address on the client's link.
server-address	If present, the IP address of the DHCP server

This works whether or not the DHCP server is on the same link as the client.

DHCP Request Message Format

```
 0                   1                   2                   3
 0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|  msg-type  = 3  |C|S|R| reserved  |        transaction-ID       |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|                  client's link-local address                    |
|                          (16 octets)                            |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|                         agent address                           |
|                          (16 octets)                            |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|                        server address                           |
|                   (16 octets, if present)                       |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|       extensions (variable number and length)  ...
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
```

C	whether to remove previous client resources
S	whether the server-address is present
R	whether to expunge previous transaction-IDs
transaction-ID	identifies this Request, and is copied into the Reply.
client's link-local address	
agent-address	The IP address of an agent's interface
server-address	If nonzero, a preferred DHCP server

DHCP Reply Message Format

```
 0                   1                   2                   3
 0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|  msg-type = 4 |L|    status   |        transaction-ID         |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|                  client's link-local address                  |
|                   (16 octets, if present)                     |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|        extensions (variable number and length)  ...
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
```

L	whether the client's link-local address is present
transaction-ID	identifies the Reply, copied from the Request.
client's link-local address	

DHCP Reply Status values

One of the following decimal values:

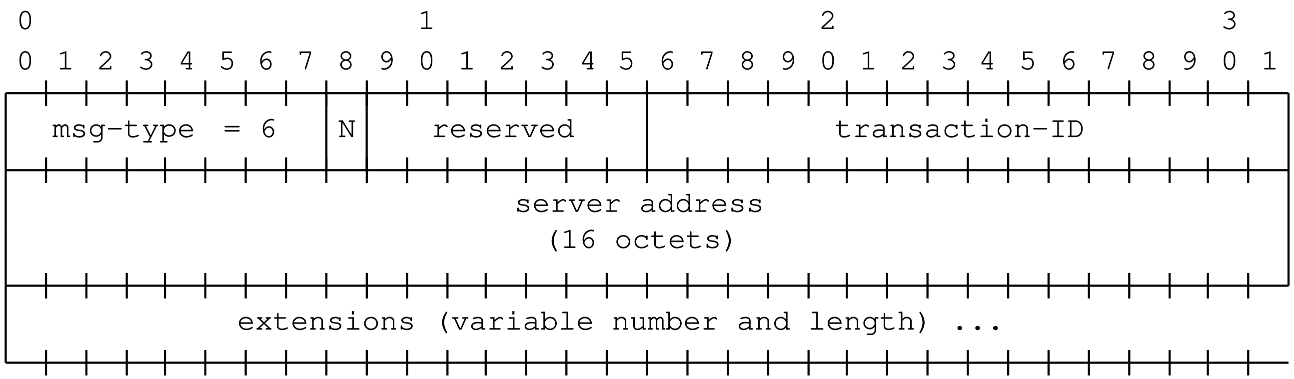
0	Success
16	Failure, reason unspecified
17	Authentication failed or nonexistent
18	Poorly formed Request or Release
19	Resources unavailable
20	Client record unavailable
21	Invalid client IP address in Release
23	Relay cannot find Server Address
64	Server unreachable (ICMP error)

DHCP Release Message Format

```
 0                   1                   2                   3
 0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|  msg-type = 5 |D|  reserved   |        transaction-ID         |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|                 client's link-local address                   |
|                        (16 octets)                            |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|                        agent address                          |
|                        (16 octets)                            |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|                        client address                         |
|                  (16 octets, if present)                      |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|         extensions (variable number and length)  ...
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
```

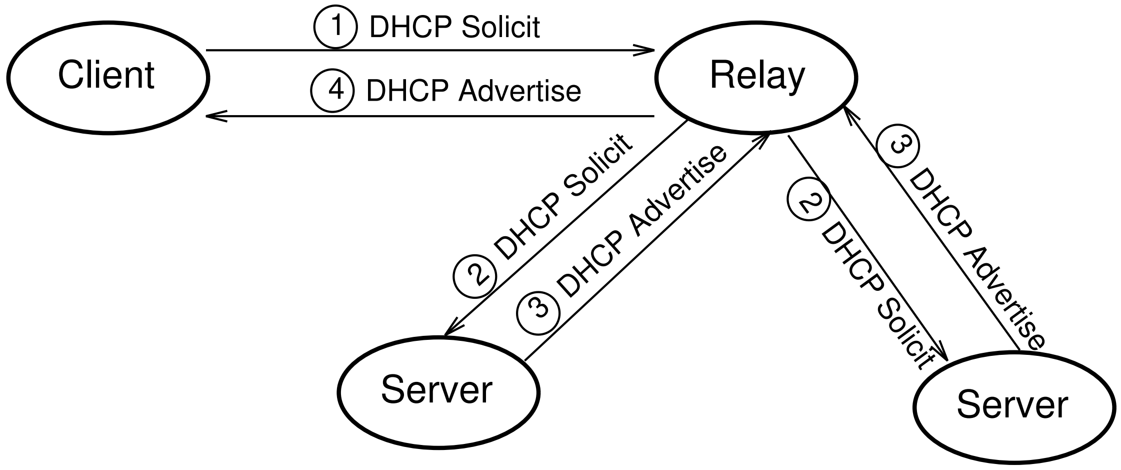
D	whether to send the DHCP Reply to the client's relay
transaction-ID	As with the DHCP Request message
client's link-local address	
agent-address	
client-address	The IP address at which the client expects the Reply

DHCP Reconfigure Message Format



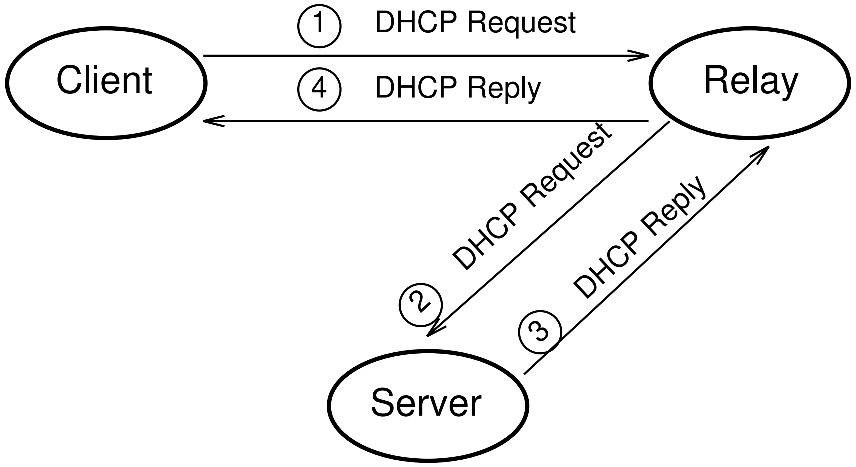
N	whether the client should expect a DHCP Reply
transaction-ID	identifies the Reconfigure message, is copied to the Request.
server-address	

DHCP Solicit/Advertise Message Flow



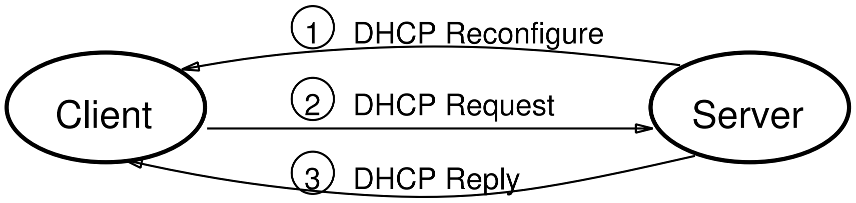
This procedure gets the client one or more DHCP Server addresses

DHCP Request/Reply Message Flow



This procedure allows the client to get configuration information from the chosen server.

DHCP Reconfigure Message Flow



The destination address for the DHCP Reconfigure message can be a multicast address.

Mailing Lists

DHCPv6 discussion:	`dhcp-v6@bucknell.edu`
DHCPv6 Subscribe:	`listserv@bucknell.edu`
	In Body: `subscribe dhcpv6` Your Name
DHCPv4 discussion:	`dhcp-v4@bucknell.edu`
DHCPv4 Subscribe:	`listserv@bucknell.edu`
	In Body: `subscribe dhcpv4` Your Name
IPv6 discussion	`ipng@sunroof.eng.sun.com`
IPv6 Subscribe	`majordomo@sunroof.eng.sun.com`
	In Body: `subscribe ipng`

WWW info

For more information, check out the following relevant home pages:

www.ietf.org

http://www.ietf.org/html.charters/dhc-charter.html

http://www.ietf.org/html.charters/ipngwg-charter.html