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a. An IPv6 address is represented as eight groups of four hexadecimal digits, each group representing 16 bits. colons separate the groups (:). for example 2001:0db8:85a3:0000:0000:8a2e:0370:7334 is used to identify and locate a network interface of a computer or a network node participating in a computer network using IPv6. IP addresses are included in the packet header to indicate the source and the destination of each packet. The IP address of the destination is used to make decisions about routing IP packets to other networks.

b.

IPv4	IPv6
ARP Request	Neighbor Solicitation
ARP Reply	Neighbor Advertisement
Router Solicitation (elective)	Router Solicitation (mandatory)
Router Advertisement (elective)	Router Advertisement e (mandatory)
Redirect	Redirect
ARP cache	Neighbor cache
Gratuitous ARP	DAD

c. Another scenario occasionally suggested is one where the Internet address registries begin to run out of IPv6 prefix space, such that operators can no longer assign proper prefixes to users following, such as [RFC6177]. It is sometimes suggested that assigning a prefix such as /48 or /56 to every user site (including the smallest) recommended by [RFC6177]. In fact, the currently released unicast address space, 2000::/3, contains 35 trillion /48 prefixes ((2**45 = 35,184,372,088,832), of which only a small fraction have been allocated. Allowing for a conservative estimate of allocation efficiency, i.e., an HD-ratio of 0.94 [RFC4692], approximately 5 trillion /48 prefixes can be allocated. Even with a relaxed HD-ratio of 0.89, approximately one trillion /48 prefixes can be allocated. Furthermore, with only 2000::/3 currently committed for unicast addressing, we still have approximately 85% of the address space in reserve. Thus, there is no objective risk of prefix depletion by assigning /48 or /56 prefixes even to the smallest sites.

d. Stateful autoconfiguration of IPv6 is equivalent to the use of DHCP in IPv4. It requires a DHCPv6 service to provide the IPv6 address to the client device and that both client device and server maintain the "state" of that address (i.e., lease time, etc.).
Stateless autoconfiguration of IPv6 allows the client device to self-configure its IPv6 address and routing based on the router advertisements.

A network can use both stateful and stateless autoconfiguration simultaneously; they are not mutually exclusive.

e. The autoconfiguration process includes generating a link-local address, generating global addresses via stateless address autoconfiguration, and the

Duplicate Address Detection procedure to verify the addresses' uniqueness link.

The IPv6 stateless autoconfiguration mechanism requires no manual configuration of hosts, minimal (if any) configuration of routers, and no additional servers. The stateless mechanism allows a host to generate its addresses using locally available information and information advertised by routers. Routers advertise prefixes that identify the subnet(s) associated with a link, while hosts generate an "interface identifier" that uniquely identifies an interface on a subnet. An address is formed by combining the two. In the absence of routers, a host can only generate link-local addresses. However, link-local addresses are sufficient for allowing communication among nodes attached to the same link.

f. A Solicited-Node multicast address is an IPv6 multicast address used by the Neighbor Discovery Protocol to verify whether a given IPv6 address is already in use in the local-link or not, through a process called DAD (Duplicate Address Detection). This allows NDP to assign IPv6 addresses to hosts using SLAAC (IPv6 Stateless Address Autoconfiguration) without the risk of assigning addresses already in use. The Solicited-Node multicast addresses are generated from the host's IPv6 unicast or anycast address, and each interface must have a Solicited-Node multicast address associated with it.

NDP sends out a Neighbor Solicitation message (ICMPv6 Type 135) to the Solicited-Node multicast address of the IPv6 unicast or anycast address it plans to assign using SLAAC. If a host is present in that group, it will respond with a Neighbor Advertisement message (ICMPv6 Type 136), and NDP will know that the IPv6 unicast or anycast address it is trying to assign is already in use.

A Solicited-Node address is created by taking the least-significant 24 bits of a unicast or anycast address and appending them to the prefix ff02::1:ff00:0/104

Example: Assume a host with a unicast/anycast IPv6 address of fe80::2aa:ff:fe28:9c5a. Its Solicited-Node multicast address will be ff02::1:ff28:9c5a.

```
fe80::2aa:ff:fe28:9c5a                        IPv6 unicast/anycast address (compressed notation)
fe80:0000:0000:0000:02aa:00ff:fe28:9c5a       IPv6 unicast/anycast address (uncompressed notation)
                                -- ----       the least-significant 24-bits
ff02::1:ff00:0/104                            Solicited-Node multicast address prefix
ff02:0000:0000:0000:0000:0001:ff00:0000/104   (uncompressed)
---- ---- ---- ---- ---- ---- --              The first 104 bits
ff02:0000:0000:0000:0000:0001:ff28:9c5a       Solicited-Node multicast address (uncompressed
notation)
ff02::1:ff28:9c5a                             Solicited-Node multicast address (compressed
notation)
```

g. DHCPv6 and DHCP for IPv4

One of the more subtle differences between IPv4 and IPv6 are how these two distinct network protocols use DHCP. The recognizable fact is that DHCP for IPv4 (RFC 2132) is a separate protocol from DHCPv6 for IPv6 (RFC 3315). However, these protocols share some characteristics because, frankly, DHCP helped pave the way for DHCPv6. The following is a list of similarities between DHCP for IPv4 and DHCPv6.