Plug & Play
ICMPv6 & Neighbor Discovery

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Plug & Play

- It is one major feature of IPv6
- It reduces IP support and maintenance costs for enterprises
- Essential for areas of IP growth:
  - mobile systems
  - home networks
- It is zero configuration networking and automatic device and service discovery
Autoconfiguration

- Neighbor Discovery
  - Obtain a new usable IP address
  - Find and use a new router
    - Switch automatically from one router to another
  - Addresses with lifetime
- Complete autoconfiguration
  - Announce its name: Dynamic DNS updates
  - Advertise its capabilities when requested
  - Learn about the presence and capabilities of other devices
  - Server / Service discovery
Neighbor discovery services

1. First time plugging
2. Address resolution
3. Advanced features
1. First time plugging

- New (or initial) Home Subnet
- Store new home address
- Finding neighboring routers
  - Keeping track of routers
- Get forward & reverse DNS entries installed
  - subsequent times on current home network, verify DNS entries
  - (note that “stateless autoconfig” is stateless for the network, not necessarily for the host)
- Determining whether a neighbor has become unreachable
Autoconfiguration

- **Stateless** autoconfiguration
  - Creation of global and site-local addresses
  - Based on ICMPv6
  - Creation of link-local addresses
    - Assumes that each interface can provide a unique identifier
    - With duplicate address detection
  - Security to disable hackers plug and play

- **Stateful** autoconfiguration
  - Obtain network information from a server
  - Use DHCPv6
  - Servers maintain a database with
    - Hosts addresses
    - Other configuration information
IPv6 nodes have multiple addresses

- Link-local addresses
  - Valid only on a specific link (LAN)
  - To communicate among nodes of the same link

- Site-local addresses
  - Valid only within a particular organization

- Global scope addresses
  - Globally unique
  - Can be used anywhere
Autoconfiguration process

a. Assign link-local address
   - Duplicate detection
b. IF fails THEN
   Autoconfiguration stops
c. Find routers
   - Wait periodic RA
     (from few seconds to 30 minutes)
   - Send RS
d. IF no receive any RA
   THEN Isolated network
e. Finish autoconfiguration
a. Obtain a Link Local Address

- Used only for communication among nodes attached to the same link.
- Definition using only information local to the node
  - Fixed 64-bit address prefix
  - 64-bit host address based on interface identifier
    - Use the MAC address
- The exact details of how an interface identifier are formed depend on the specific type of interface
IPv6 over Ethernet: EUI-64

**MAC address**

**EUI-48 address**

**EUI-64 address**

IPv6 host identifier: 36ED:84FF:FE32:5476
b. Duplicate detection

Device 64-bit interface identifier

Source:
FE80:0000:0000:0000:36ED:84FF:FE32:5476

Destination:
FF02:0000:0000:0000:0000:0000:0001:FF32:5476

Solicited-node link-local multicast prefix
FF02:0:0:0:0:1:FF00:0/104

24-bit interface identifier

Link-local prefix
FE80::/64

Device 64-bit interface identifier
34-ED-84-32-54-76

Target multicast address

Options

Reserved

Checksum

Type = 135
Code

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ICMPv6 & Neighbor Discovery
c. ICMP Router Advertisement

- Time (ms) that node assumes a neighbor is reachable
  - 0 = unspecified

- Time (ms) between neighbor solicitations

- Complete configuration with DHCP
  - M = obtain more addresses
  - O = Servers addresses

- Default router lifetime
  - 0 = no default router
  - few seconds
  - 18.2 hours

- Prefix Information options
  - Subnet number and mask
  - Node Subnets addresses

- Link MTU definition

Router Advertisement

Source
- Router address

Destination
- link-local multicast
- or
- node link-local

Options

Reachable Time

Retrans Timer
Neighbor discovery services

1. First time plugging
2. Address resolution
3. Advanced features
2. Address resolution

1) Source : 2001:0720:1500::2
   Destination : 2001:4200:3004::2

2) Routing
   It is not a local address
   Which router should be used? = 2001:0720:1500::1

3) Address resolution
   How to obtain the router MAC address?
The basic algorithm

Destination
2001:4200:3004::2

is local?

Prefixes list
2001:0720:1500::/64

has been recently used?

Prefixes list
2001:0720:1500::/64

where to send it?

Destinations cache
2001:4200:3004::7 -- 2001:0720:1500::1 - C
2001:8888:4444::3 -- 2001:0720:1500::1 - I

Neighbors cache
2001:0720:1500::1 - R
2001:0720:1500::3 - CC-49-23-50-A8-70- H

Routers list
2001:0720:1500::1

If unknown then
Address resolution

Neighbor Solicitation

Neighbor Advertisement

updates database
Redirects

- Sometimes hosts will pick the wrong next hop
  - there are several routers
  - Send to a router although destination is connected to the same link
- The router that receives the packet
  - will retransmit to the correct hop
  - send a Redirect Message
- Next message send to that destination travels only once to the correct router
Neighbor discovery services

1. First time plugging

2. Address resolution

3. Advanced features
Point to point connections

- Networks with no multicast communication
  - They will not able to send NS messages
  - Require some manual configuration
- Serial links have only two stations
  - Whenever they must contact a new destination consider the next hop is always the router
- NonBroadcast Multiple Access (NBMA) network
  - Send all messages to the router
  - If destination is directly connected
    - The router will send back a redirect message
Anycast servers

- An anycast address may be served by several stations connected to the same link

1. Send a NS to an Anycast Address
2. All stations served anycast reply a NA
   - use regular address not anycast address
3. The solicitor will receive several NA
   - The first will be used to complete the cache
   - The rest will be ignored

- In theory the first is the nearest and fastest
Multi-homed hosts

- Hosts connected to the network by several interfaces
  - Multi-homed hosts are not routers
  - Multiple connections are used for better performance
  - Host connected to several providers

- To transmit a message
  - Select an outgoing interface
  - It can use prefix information on various interfaces
    - The best matching prefix result the best performance
References