IPv6 associated protocols

Address auto-configuration in IPv6

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Agenda

- Associated protocols in IPv6
- Neighbor Discovery Protocol
- Path MTU protocol
- Address auto-configuration in IPv6

New Protocols

- New features specified in IPv6 Protocol (RFC 2460 DS)
- Neighbor Discovery (ND) (RFC 2461 DS)
- Auto-configuration:
  - Stateless Address Auto-configuration (RFC 2462 DS)
  - DHCPv6:
    - Dynamic Host Configuration Protocol for IPv6 (RFC 3315 PS)
  - Path MTU discovery (pMTU) (RFC 1981 PS)

New Protocols (2)

- MLD (Multicast Listener Discovery) (RFC 2710 PS)
  - Multicast group management over an IPv6 link
  - Based on IGMPv2
  - MLDv2 (equivalent to IGMPv3 in IPv4)
- ICMPv6 (RFC 2463 DS) "Super" Protocol that :
  - Covers ICMP (v4) features (Error control, Administration, …)
  - Transports ND messages
  - Transports MLD messages (Queries, Reports, …)

Neighbor Discovery

IPv6 nodes which share the same physical medium (link) use Neighbor Discovery (NDP) to:

- discover their mutual presence
- determine link-layer addresses of their neighbors
- find routers
- maintain neighbors' reachability information (NUD)

➢ *not directly applicable to NBMA (Non Broadcast Multi Access) networks : ND uses multicast for certain services.*

Neighbor Discovery (2)

- Protocol features:
  - Router discovery
  - Prefix(es) discovery
  - Parameters discovery (link MTU, Max Hop Limit, ...)
  - Address auto-configuration
  - Address resolution
  - Next Hop determination
  - Neighbor Unreachability Detection
  - Duplicate Address Detection
  - Redirect

Neighbor Discovery (3): Comparison with IPv4

- It is the synthesis of:
  - ARP
  - R-Disc
  - ICMP redirect
  - ...

Neighbor Discovery (4)

- ND specifies 5 types of ICMP packets :
  - Router Advertisement **(RA)** :
    - **periodic advertisement (of the availability of a router) which contains:**
      - » **list of prefixes used on the link (autoconf)**
      - » **a possible value for Max Hop Limit (TTL of IPv4)**
      - » **value of MTU**
  - Router Solicitation **(RS)** :
    - **the host needs RA immediately (at boot time)**

Neighbor Discovery (5)

- Neighbor Solicitation **(NS):**
  - **to determine the link-layer @ of a neighbor**
  - **or to check its impeachability**
  - **also used to detect duplicate addresses (DAD)**
- Neighbor Advertisement **(NA):**
  - **answer to a NS packet**
  - **to advertise the change of physical address**
- Redirect **:**
  - **Used by a router to inform a host of a better route to a given destination**

Address Resolution

- **Find the mapping: Dst IP @ ➔ Link-Layer (MAC) @**

- **Recalling IPv4 & ARP**
  - **ARP Request is broadcasted**
    - **e.g. `ethernet @: FF-FF-FF-FF-FF-FF`**
    - **Btw, it contains the Src's LL @**
  - **ARP Reply is sent in unicast to the Src**
    - **It contains the Dst's LL @**

Address Resolution (2)
IPv6 with Neighbor Discovery

At boot time, every IPv6 node has to join 2 special multicast groups for each network interface:

- **All-nodes multicast group:** `ff02::1`
- **Solicited-node multicast group:** `ff02:1:ffxx:xxxx` **(derived from the lower 24 bits of the node's address)**

Address Resolution (3)
Solicited Multicast Address

- Concatenation **of the prefix `FF02::1:FF00:0/104` with the last 24 bits of the IPv6 address**

Example:

- Dst IPv6 @: **`2001:0660:010a:4002:4421:21FF:FE`**`24:87c1`

↓

- Sol. Mcast @: `FF02:0000:0000:0000:0000:0001:FF24:87c1`

↓

- ethernet: `33-33-FF-24-87-c1`

Path MTU discovery (RFC 1981)

- Derived from RFC 1191, (IPv4 version of the protocol)
- Path : set of links followed by an IPv6 packet between source and destination
- link MTU : maximum packet length (bytes) that can be transmitted on a given link without fragmentation
- Path MTU (or pMTU) = min { link MTUs } for a given path
- Path MTU Discovery = automatic pMTU discovery for a given path

Path MTU discovery (2)

- Protocol operation
  - makes assumption that pMTU = link MTU to reach a neighbor (first hop)
  - if there is an intermediate router such that link MTU < pMTU ➔ it sends an ICMPv6 message: "Packet size Too Large"
  - source reduces pMTU by using information found in the ICMPv6 message

  => Intermediate network element aren't allowed to perform packet fragmentation

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Questions?