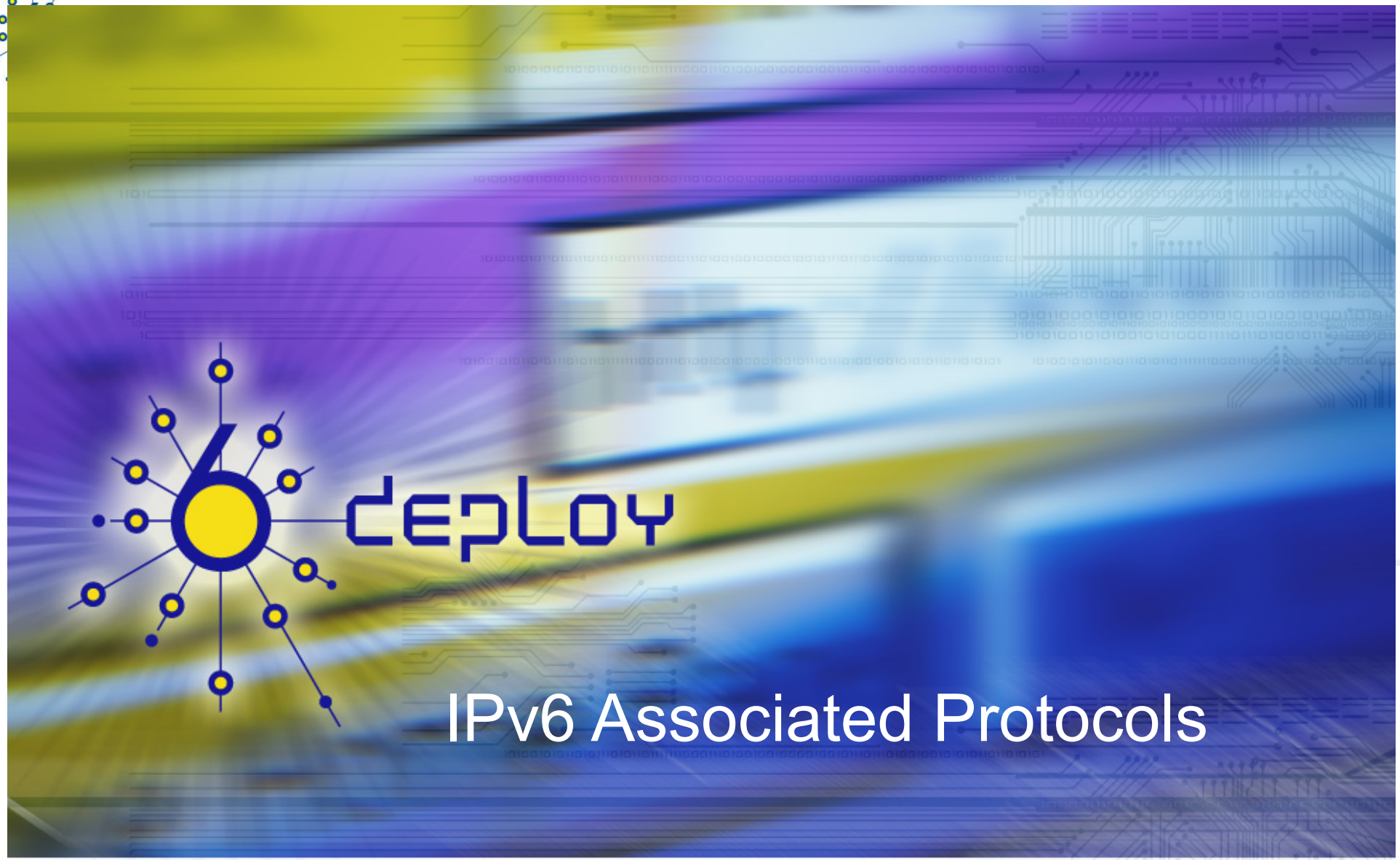


IPv6 Associated Protocols

Workshop IPv6

Zonamerica TechDay II, 30-31 de agosto 2011

Copy …Rights

This slide set is the ownership of the 6DISS project via its partners

The Powerpoint version of this material may be reused and modified only with written authorization

Using part of this material must mention 6DISS courtesy

PDF files are available from www.6diss.org

Looking for a contact ?

- ***Mail to : martin.potts@martel-consulting.ch***
- ***Or bernard.tuy@renater.fr***

Droits d'auteur …

L'ensemble des présentations utilisées dans le cadre de cet atelier est la propriété de 6DISS, représenté par ses différents partenaires.

La version Powerpoint des présentations peut être réutilisée et modifiée après qu'une autorisation écrite ait été obtenue

L'usage de tout ou partie de ce matériel doit mentionné que sa source est le projet 6DISS

La version PDF des présentations est disponible sur www.6diss.org

Pour tout contact :

- ***Mail à Martin.Potts@martel-consulting.ch***
- ***Ou Bernard.Tuy@renater.fr***

Contribs & updates

Bernard Tuy, RENATER	04/2009 : update slide #10
	11/2008 : style, layout …
Laurent Toutain, Telecom B.	09/2008

New Protocols (1)

New features are specified in IPv6 Protocol -*RFC 2460 DS*

Neighbor Discovery (NDP) -*RFC 4861 DS*

Auto-configuration :

- Stateless Address Auto-configuration -*RFC 4862 DS*
- DHCPv6: Dynamic Host Configuration Protocol for IPv6 -*RFC 4361 PS*
- Path MTU discovery (pMTU) -*RFC1981 DS*

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 4443 DS) **"Super" Protocol that :**

- Covers ICMP (v4) features (Error control, Administration, …)
- Transports ND messages
- Transports MLD messages (Queries, Reports, …)

Neighbor Discovery for IP version 6 (1)

- **IPv6 nodes** (hosts and routers) on the same physical medium (link) **use Neighbor Discovery** (NDP) to:
  - discover their mutual presence
  - determine link-layer addresses of their neighbors
  - find neighboring routers that are willing to forward packets on their behalf
  - maintain neighbors' reachability information (NUD)
  - not directly applicable to NBMA (Non Broadcast Multi Access) networks

    ➔ NDP uses link-layer multicast for some of its services.

NDP for IPv6 (2)

Protocol features:

- Router Discovery
- Prefix(es) Discovery
- Parameters Discovery (link MTU, Max Hop Limit, ...)
- Address Autoconfiguration
- Address Resolution
- Next Hop Determination
- Neighbor Unreachability Detection
- Duplicate Address Detection
- Redirect

NDP (3) : comparison with IPv4

The IPv6 Neighbor Discovery protocol corresponds to a combination of the IPv4 protocols:

- Address Resolution Protocol (ARP)
- ICMP Router Discovery (RDISC)
- ICMP Redirect (ICMPv4)

Improvements over the IPv4 set of protocols:

- Router Discovery is part of the base protocol set
- Router Advertisements carry link-layer addresses and prefixes for a link, and enable Address Autoconfiguration
- Multiple prefixes can be associated with the same link.
- Neighbor Unreachability Detection is part of the base protocol set
- Detects half-link failures and avoids sending traffic to neighbors with which two-way connectivity is absent
- By setting the Hop Limit to 255, Neighbor Discovery is immune to off-link senders that accidentally or intentionally send ND messages.

NDP (4)

NDP specifies 5 types of ICMP packets :

- **Router Advertisement** (RA) :
  - ICMP type = 134, code 0
  - periodic advertisement or response to RS message (of the availability of a router) which contains:
    - list of prefixes used on the link (autoconf)
    - Flags for address configuration mechanism (M & O)
    - a possible value for Max Hop Limit (TTL of IPv4)
    - value of MTU
- **Router Solicitation** (RS) :
  - the host needs RA immediately (at boot time)

NDP (5)

- **Neighbor Solicitation** (NS):
  - to determine the link-layer @ of a neighbor
  - or to check a neighbor is still reachable via a cached L2 @
  - also used to detect duplicate addresses (DAD)
- **Neighbor Advertisement** (NA):
  - answer to a NS message
  - to advertise the change of physical address
- **Redirect** :
  - Used by routers to inform hosts of a better first hop for a destination

Address resolution

Address resolution is the process through which a node determines the link-layer address of a neighbor given only its IP address.

Find the mapping:

Dst IP @ → Link-Layer (MAC) @

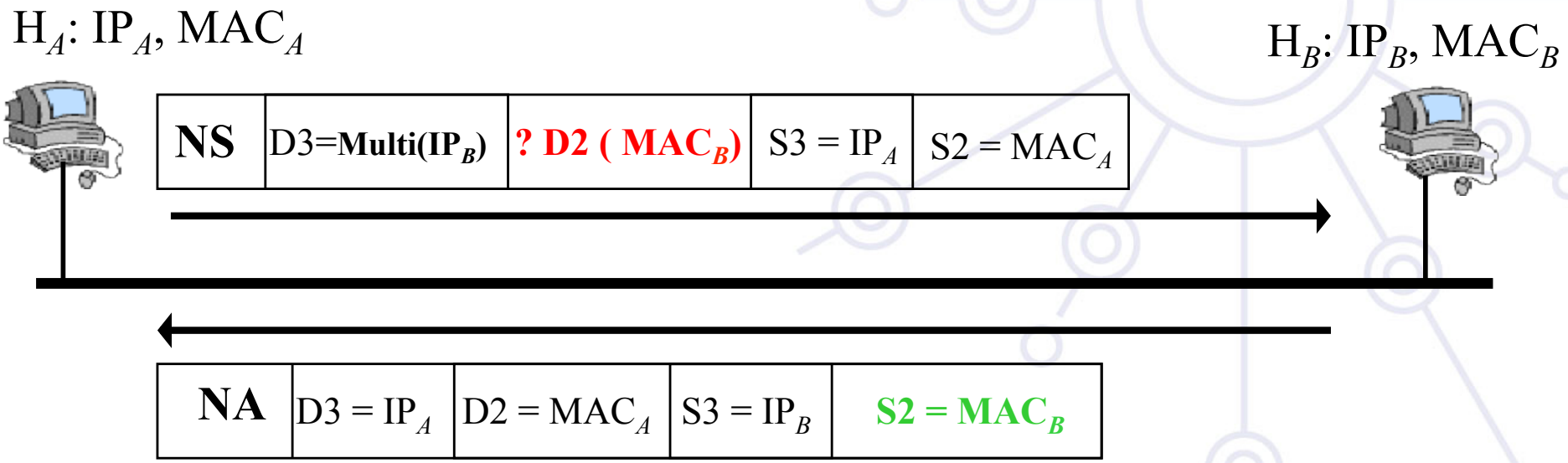
Recalling IPv4 & ARP

- 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) with NDP

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) : multicast solicited 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:FE24:87c1

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

Ethernet: 33-33-FF-24-87-c1

Path MTU discovery (RFC 1981)

Derived from RFC1191 (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


deploy
Questions …