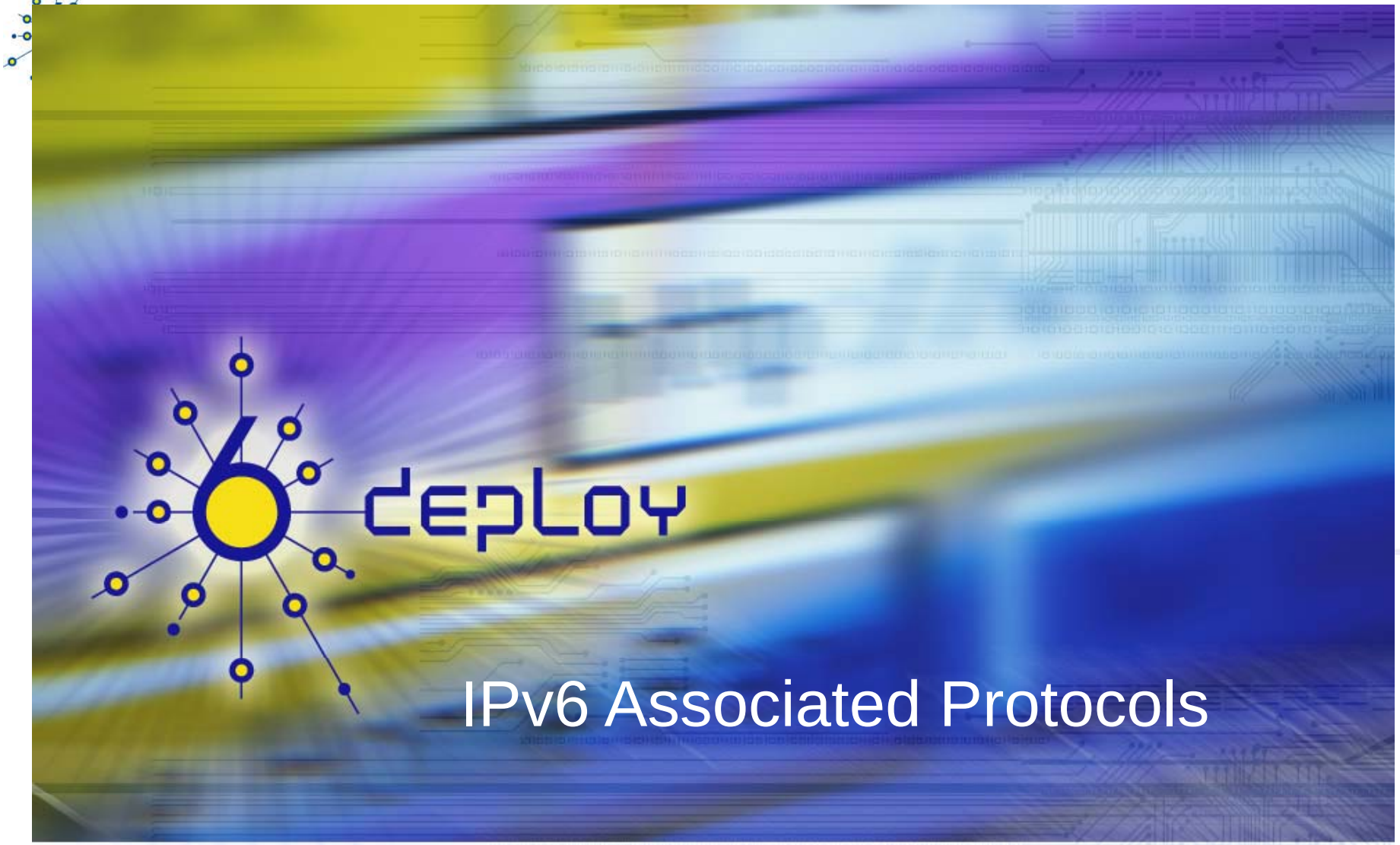

IPv6 Associated Protocols

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PDF files are available from www.6diss.org

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Droits d'auteur ...

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

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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) @

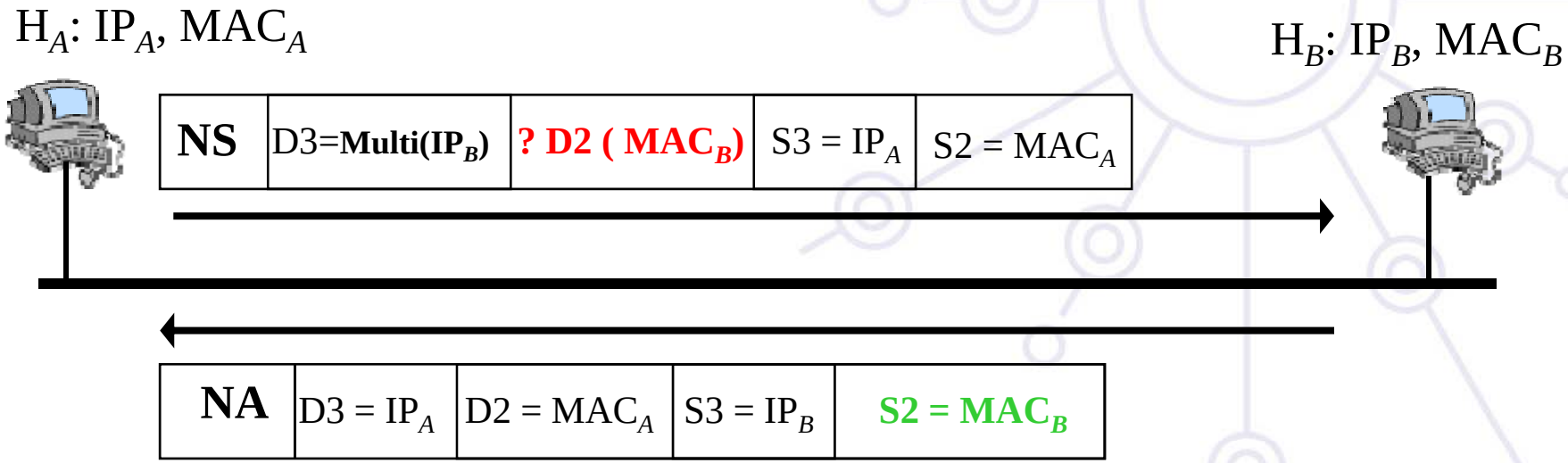
Recalling IPv4 & ARP

- 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 ...