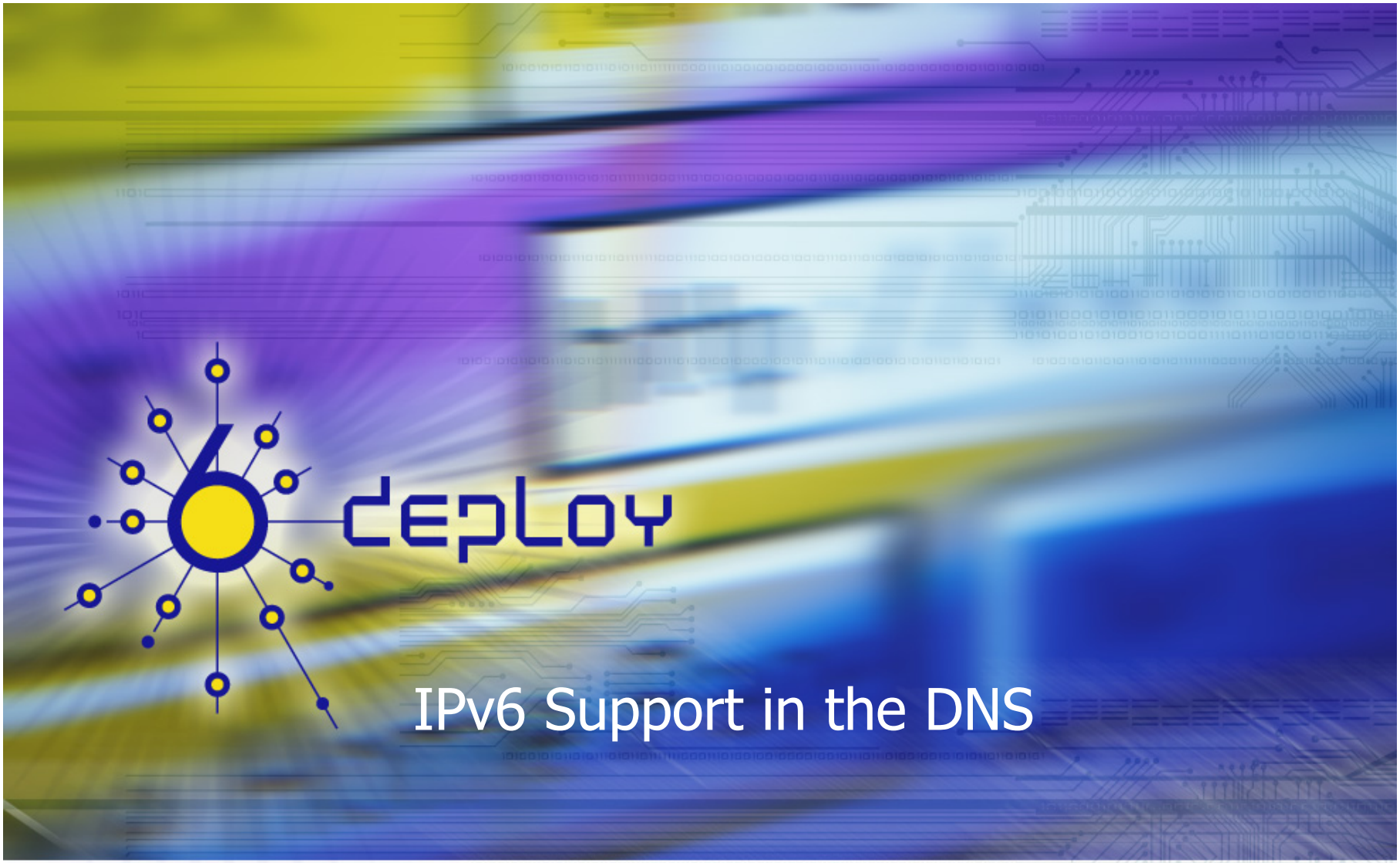

IPv6 Support in the DNS

Workshop Name

Workshop Location, Date

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Agenda

How important is the DNS?

DNS Resource Lookup

DNS Extensions for IPv6

Lookups in an IPv6-aware DNS Tree

About Required IPv6 Glue in DNS Zones

The Two Approaches to the DNS

DNS IPv6-capable software

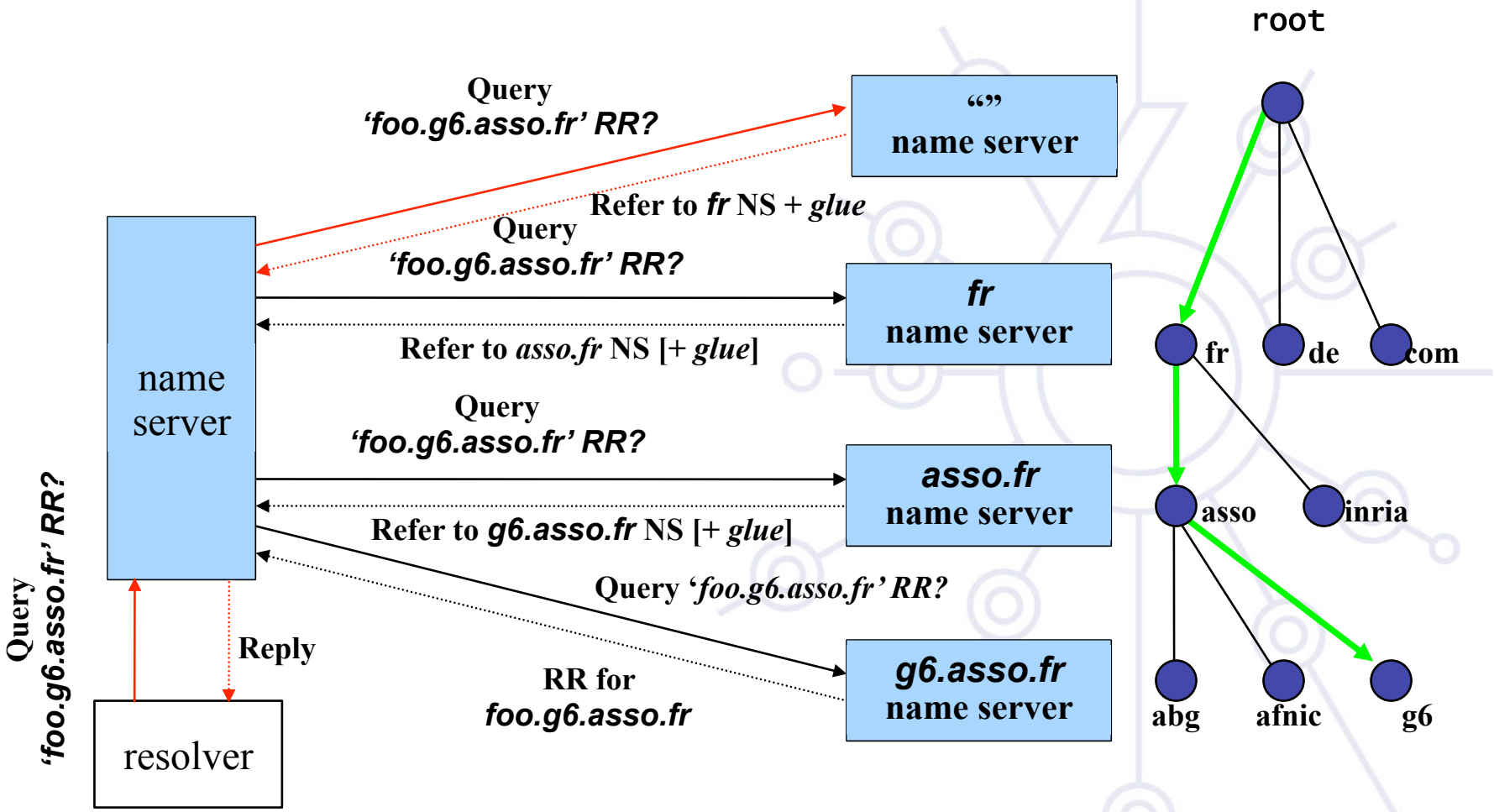
IPv6 DNS and root servers

DNSv6 Operational Requirements & Recommendations

How important is the DNS?

- Getting the IP address of the remote endpoint is necessary for every communication between TCP/IP applications
- Humans are unable to memorize millions of IP addresses (specially IPv6 addresses)
- To a larger extent : the Domain Name System provides applications with several types of resources (domain name servers, mail exchangers, reverse lookups, …
- They need
  - Hierarchy
  - Distribution
  - Redundancy

DNS Lookup


Query
'foo.g6.asso.fr' RR?
"" name server
Refer to fr NS + glue
Query
'foo.g6.asso.fr' RR?
fr name server
Refer to asso.fr NS [+ glue]
Query
'foo.g6.asso.fr' RR?
asso.fr name server
Refer to g6.asso.fr NS [+ glue]
Query 'foo.g6.asso.fr' RR?
g6.asso.fr name server
RR for
foo.g6.asso.fr
name server
Query
'foo.g6.asso.fr' RR?
Reply
resolver
root
fr
de
com
asso
inria
abg
afnic
g6

DNS Extensions for IPv6

RFC 1886 → RFC 3596

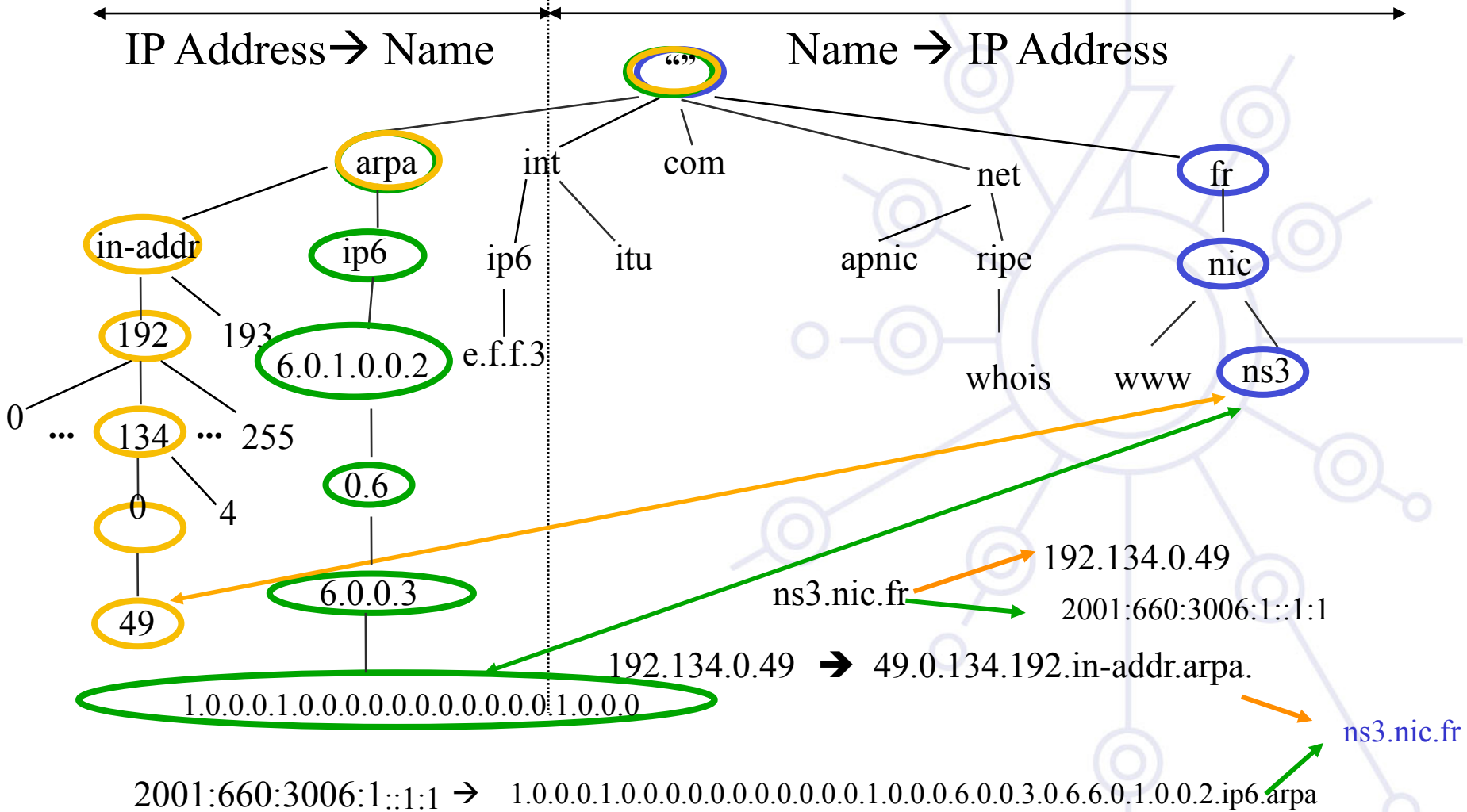
AAAA : forward lookup ('Name →IPv6 Address'):
Equivalent to 'A' record
Example:

ns3.nic.fr.	IN	A	192.134.0.49
	IN	AAAA	2001:660:3006:1::1:1

PTR : reverse lookup ('IPv6 Address → Name'):
Reverse tree equivalent to in-addr.arpa
Main tree: ip6.arpa
Former tree: ip6.int (deprecated)

Example:
$ORIGIN 1.**0.0.0**.6.0.0.3.0.6.6.**0**.1.0.0.2.**ip6.arpa**.
1.**0.0.0**.1.**0.0.0.0.0.0.0.0.0.0.0.0** **PTR** ns3.nic.fr.

Lookups in an IPv6-aware DNS Tree



About Required IPv6 Glue in DNS Zones

When the DNS zone is delegated to a DNS server (among others) contained in the zone itself

Example: In zone file rennes.enst-bretagne.fr

```
@                       IN      SOA     rsm.rennes.enst-bretagne.fr. fradin.rennes.enst-bretagne.fr.
                                        (2005040201 ;serial
                                        86400       ;refresh
                                        3600        ;retry
                                        3600000     ;expire}

                                IN      NS      rsm
                                IN      NS      univers.enst-bretagne.fr.
[...]
ipv6                    IN      NS      rhadamanthe.ipv6
                        IN      NS      ns3.nic.fr.
                        IN      NS      rsm
;
rhadamanthe.ipv6                        IN      A       192.108.119.134
                                        IN      AAAA    2001:660:7301:1::1
[...]
```

IPv4 glue (A 192.108.119.134) is required to reach rhadamanthe over IPv4 transport

IPv6 glue (AAAA 2001:660:7301:1::1) is required to reach rhadamanthe over IPv6 transport

IPv6 DNS and root servers

DNS root servers are critical resources

- **13 roots** « around » the world (#10 in the US)
  - As of June/2011, 9 root servers are IPv6 enabled and reachable via IPv6 networks: **A, D, F, H, I, J, K, L & M**
  - http://www.root-servers.org
  - 102 out of 252 country code TLD (ccTLDs) with at least one IPv6enabled DNS server) – April 2008
  - 261 out 310 tol level domain names has IPv6 record – July 2011
  -
- Need for mirror-like function for the root name servers
  - To be installed in other locations (EU, Asia, Africa, …)

IPv6 DNS and root servers /2

New technique : anycast DNS server

- To build a clone from the primary master
- Containing the same information (files)
- Using the same IP address(es)

Such anycast servers have proved a successful strategy and a lot of them are already installed :

- F root server: Ottawa, Paris(Renater), Hongkong, Lisbon (FCCN)…
- M root server: Tokyo, Paris (Renater), Seoul
- Look at http://www.root-servers.org for the complete and updated list.

```
.                       3600000  IN  NS    A.ROOT-SERVERS.NET.
A.ROOT-SERVERS.NET.     3600000      A     198.41.0.4
A.ROOT-SERVERS.NET.     3600000      AAAA  2001:503:BA3E::2:30
.                       3600000      NS    D.ROOT-SERVERS.NET.
D.ROOT-SERVERS.NET.     3600000      A     128.8.10.90
D.ROOT-SERVERS.NET.     3600000      AAAA  2001:500:2D::D
.                       3600000      NS    F.ROOT-SERVERS.NET.
F.ROOT-SERVERS.NET.     3600000      A     192.5.5.241
F.ROOT-SERVERS.NET.     3600000      AAAA  2001:500:2F::F
.                       3600000      NS    H.ROOT-SERVERS.NET.
H.ROOT-SERVERS.NET.     3600000      A     128.63.2.53
H.ROOT-SERVERS.NET.     3600000      AAAA  2001:500:1::803F:235
.                       3600000      NS    I.ROOT-SERVERS.NET.
I.ROOT-SERVERS.NET.     3600000      A     192.36.148.17
I.ROOT-SERVERS.NET.     3600000      AAAA  2001:7FE::53
.                       3600000      NS    J.ROOT-SERVERS.NET.
J.ROOT-SERVERS.NET.     3600000      A     192.58.128.30
J.ROOT-SERVERS.NET.     3600000      AAAA  2001:503:C27::2:30
.                       3600000      NS    K.ROOT-SERVERS.NET.
K.ROOT-SERVERS.NET.     3600000      A     193.0.14.129
K.ROOT-SERVERS.NET.     3600000      AAAA  2001:7FD::1
.                       3600000      NS    L.ROOT-SERVERS.NET.
L.ROOT-SERVERS.NET.     3600000      A     199.7.83.42
L.ROOT-SERVERS.NET.     3600000      AAAA  2001:500:3::42
.                       3600000      NS    M.ROOT-SERVERS.NET.
M.ROOT-SERVERS.NET.     3600000      A     202.12.27.33
M.ROOT-SERVERS.NET.     3600000      AAAA  2001:DC3::35
```

The Two Approaches to the DNS

The DNS seen as a database

- Stores different types of Resource Records (RRs)
  - SOA, NS, A, AAAA, MX, PTR, …

⇒ DNS data is independent of the IP version (v4/v6) the DNS server is running on

The DNS seen as a TCP/IP application

- The service is accessible in either transport modes (UDP/TCP)
- and over either IP versions (v4/v6)

⇒ Information given over both IP versions must be consistent

DNS IPv6-capable software (1)

BIND (Resolver & Server)

- http://www.isc.org/products/BIND/
- BIND 9,10 (avoid older versions)

On Unix distributions

- Resolver Library (+ (adapted) BIND)

NSD (authoritative server only)

- http://www.nlnetlabs.nl/nsd/

DNS IPv6-capable software (2)

Microsoft Windows (Resolver & Server)

- It has been reported that Windows XP resolver cannot interact with DNS servers over an IPv6 transport.
- It needs an IPv4 network to query a DNS server.

=> This is no more an issue for Windows Vista/Win7 users.

Microsoft Windows XP default resolver only queries over IPv4 transport:

- Install BIND 9 for Windows XP and uses BINDs resolver; or
- Have a local dual stack DNS server.
  - Via DHCP, assign IPv4 address
  - advertise the DNS server IPv4 address to XP users.

DNSv6 Operational Requirements & Recommendations

The target today is not **the transition from an IPv4-only to an IPv6-only environment**

How to get there?

- Start by testing DNSv6 on a small network and get your own conclusion that DNSv6 is harmless, but remember:
  - **The server (host) must support IPv6**
  - **And DNS server software must support IPv6**
- Deploy DNSv6 in an incremental fashion on existing networks
- DO NOT BREAK something that works fine (production IPv4 DNS)!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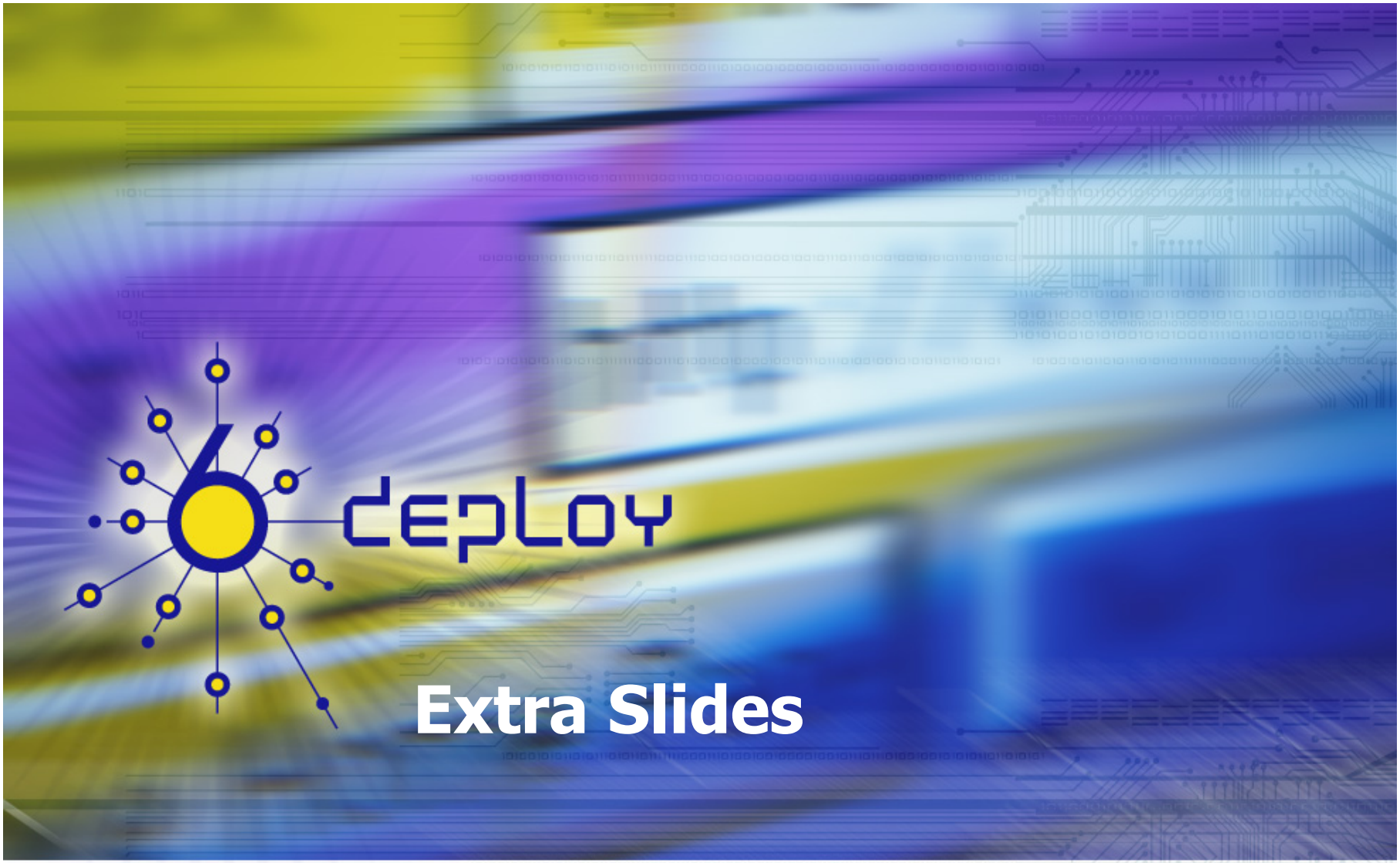
Questions …

Some Global Statistics

Global progress reports

http://bgp.he.net/ipv6-progress-report.cgi

TLD	domains	A	AAAA	A-glue	AAAA-glue
com	95984631	85823899	804158	1863906	1786
net	14005278	11986741	171721	422071	2208
de	13155766	11061106	2121080	398186	114
org	9277396	8136495	105082	283155	1127
info	7908835	6506891	108850	361232	488
biz	2107587	1779544	36624	21918	41
us	1679348	1460238	5074	15617	81
ca	1420247	1067890	2731	16053	17
mobi	1042807	795200	8732	4882	56
no	422532	276159	415	1383	3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Extra Slides

TLDs and IPv6 (1)

One of IANA's functions is the DNS top-level delegations

Changes in TLDs (e.g ccTLDs) has to be approved and activated by IANA

Introduction of IPv6-capable nameservers at ccTLDs level has to be made through IANA

TLDs and IPv6 (2)

How many servers supporting a domain should carry resource records information ?

- Usually conservative approaches
- Preferably two name servers

=> located in geographically different areas

Don't use long server names.

⇒ 1024 bytes limit in DNS response datagrams

- Some ccTLDs had to renamed their servers
- same philosophy used by root servers

TLDs and IPv6 (3)

As of April 14th 2008

- 13 out of 21 TLDs
  - with at least one IPv6 enabled DNS server (glued)
- 102 out of 252 ccTLDs
  - with at least one IPv6 enabled DNS server (glued)

Servers: 124 different ones, worldwide