IPv6 Support in the DNS

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6DEPLOY IPv6 Training, Skopje, June 2011

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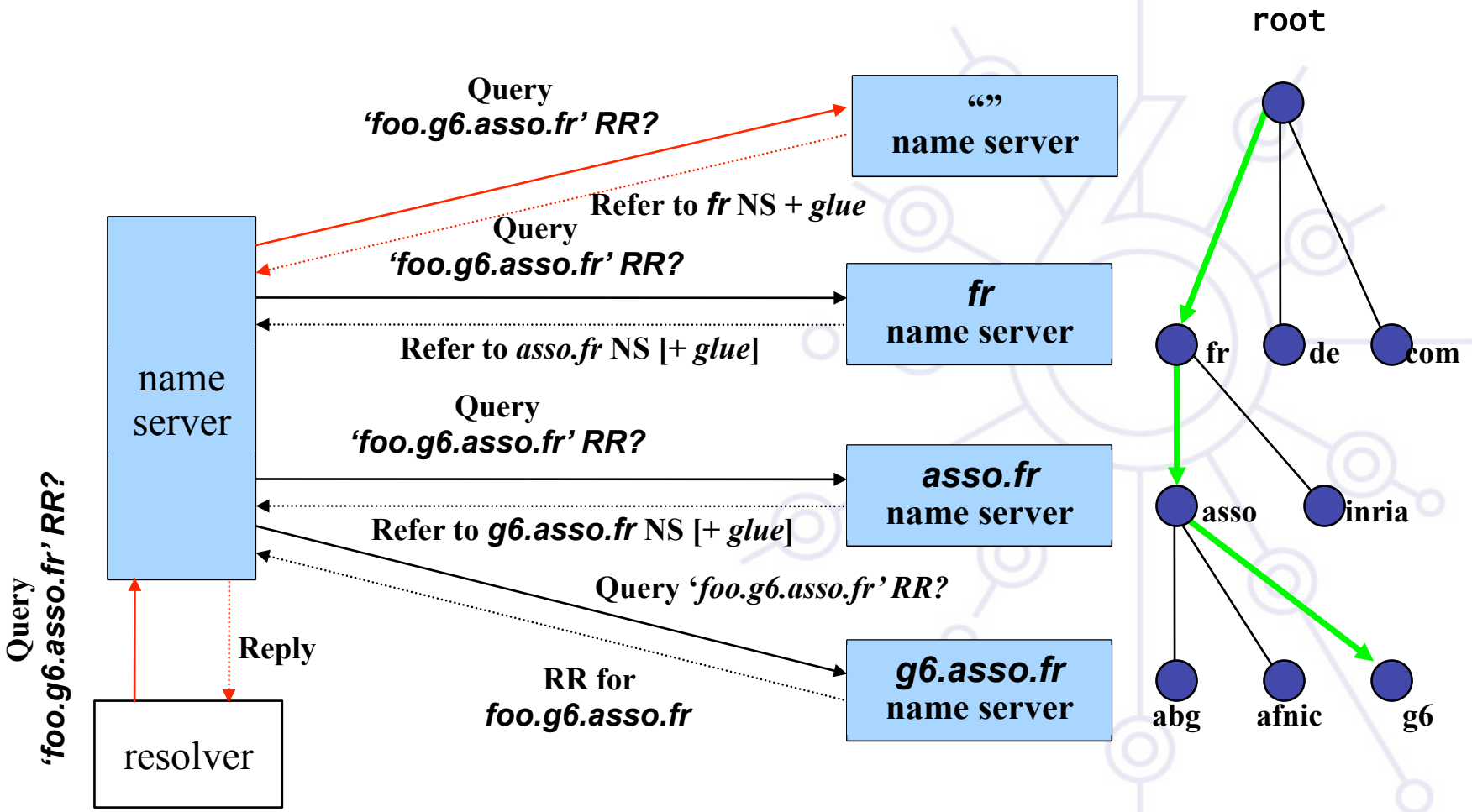
Agenda

- 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**

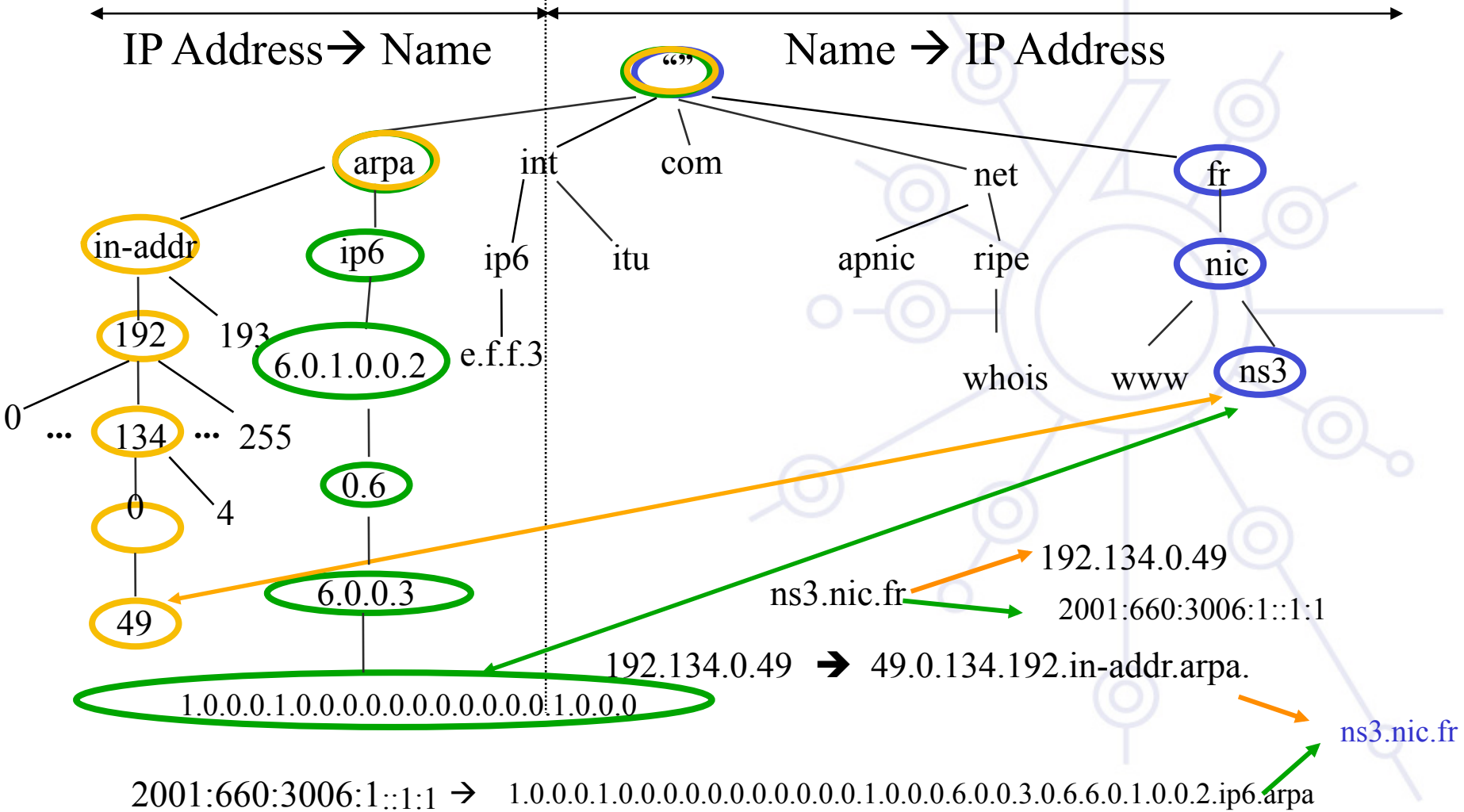
AAAA : forward lookup ('Name →IPv6 Address'):
Equivalent to 'A' record
Example:

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 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, e.g. **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 IPv6 enabled DNS server) – April 2008

- Need for mirror-like function for the root name servers
  - To be installed in other locations (EU, Asia, Africa, …)

```
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
```

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.

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 (avoid older versions)

On Unix distributions

- Resolver Library (+ (adapted) BIND)

Name Server Daemon (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 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)!


deploy
Questions?

Some Global Statistics

Global IPv6 Progress Report

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

TLD	domains	A	AAAA	A-glue	AAAA-glue
com	95689170	85595028	678915	1847135	1744
net	13987112	11976420	140170	419545	2163
de	13155766	11091346	1747046	398186	114
org	9248100	8111565	87137	281685	1118
info	7865497	6457222	86635	370153	476
biz	2102578	1775952	29656	21887	43
us	1680259	1460301	5091	15555	80
ca	1420247	1074210	2548	16053	17
mobi	1018228	791295	8306	4825	54