IPv6 support in the DNS

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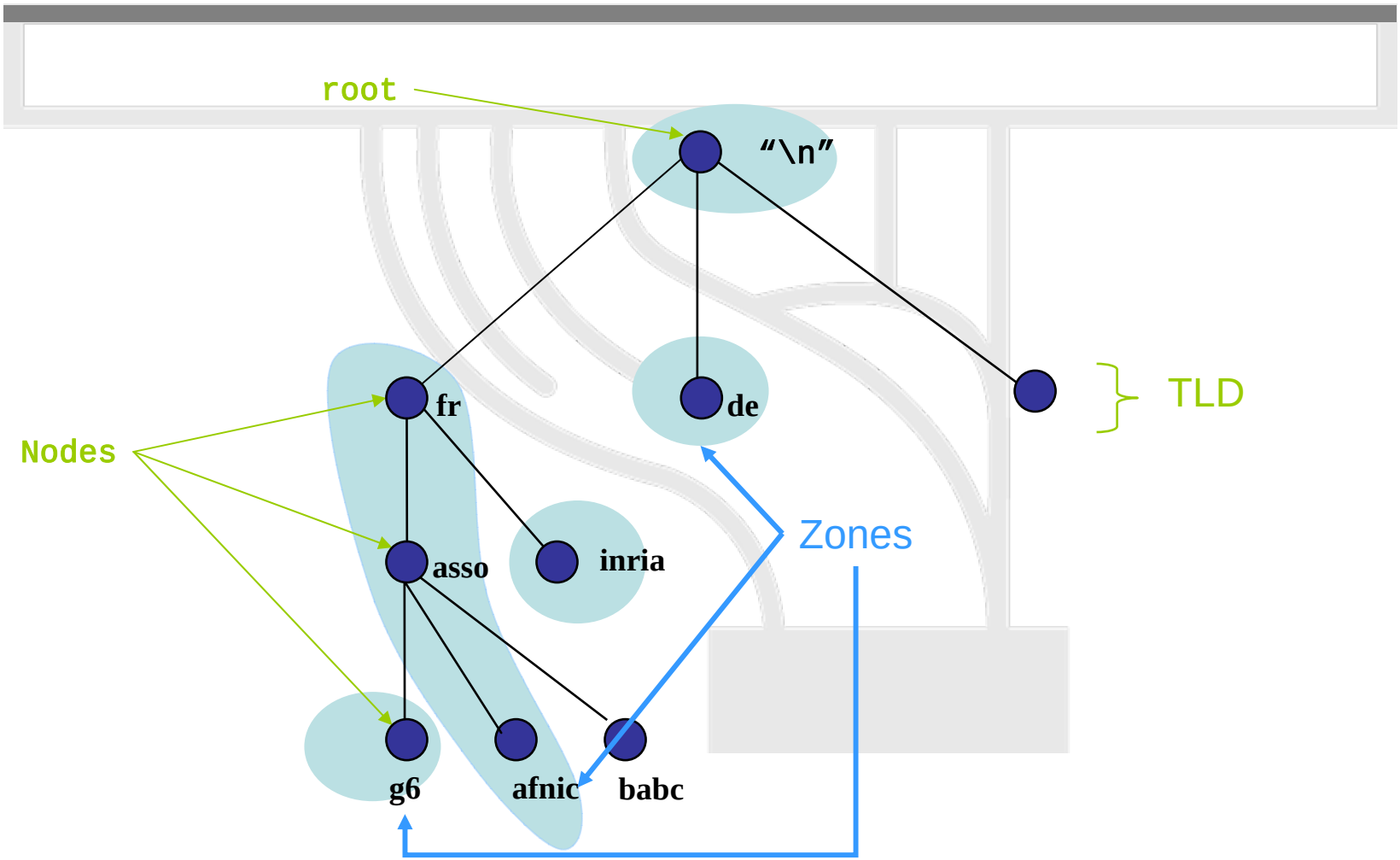
Agenda

- 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

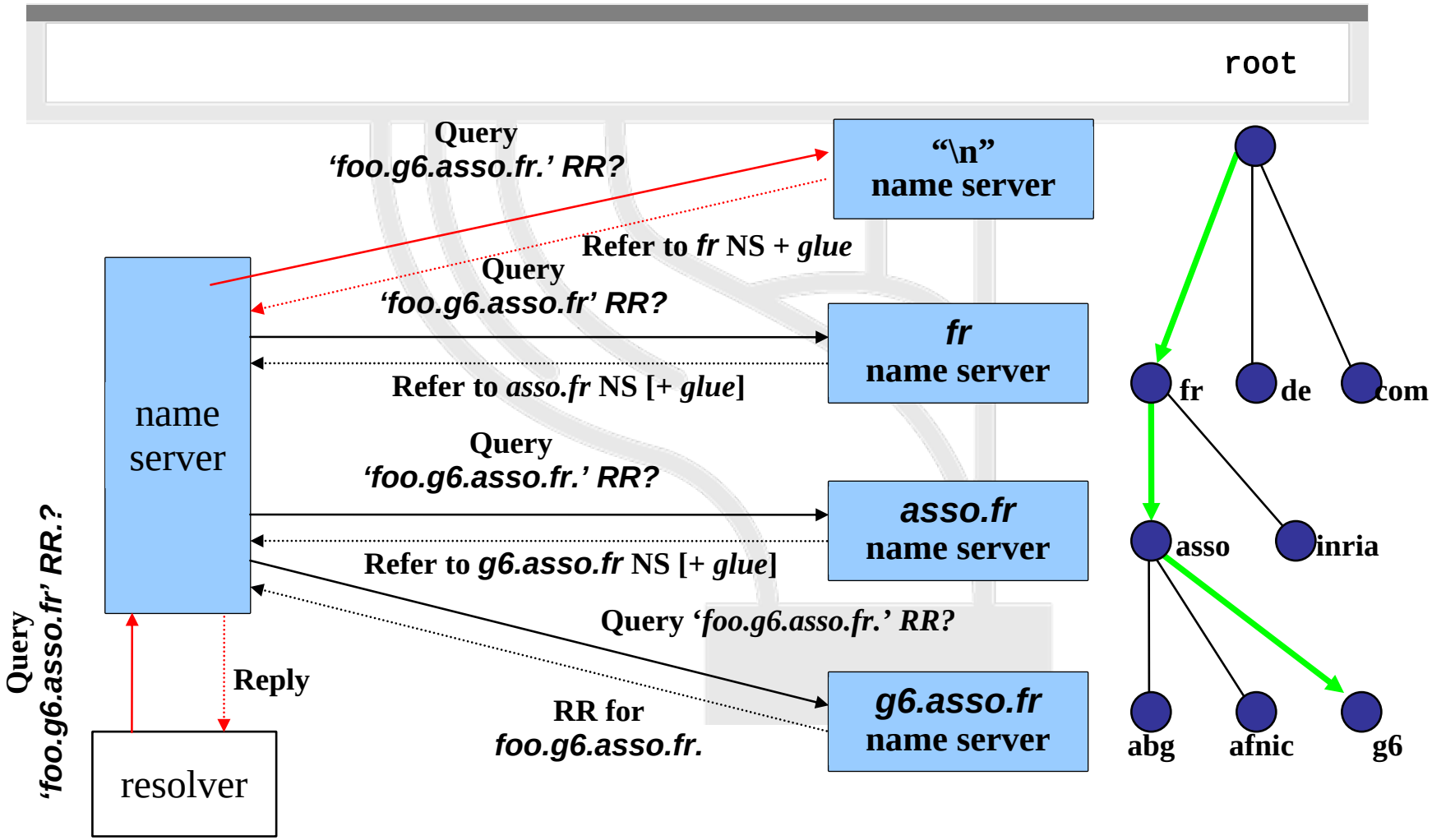
How important is the DNS?

- 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 (DNS) provides applications with several types of resources (domain name servers, mail exchangers, reverse lookups, …) they need
- DNS design
  - hierarchy
  - distribution
  - redundancy

DNS tree



DNS Lookup


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

DNS Extensions for IPv6

RFC 1886 → RFC 3596 (upon successful interoperability tests)

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

New tree: **ip6.arpa** (under deployment)

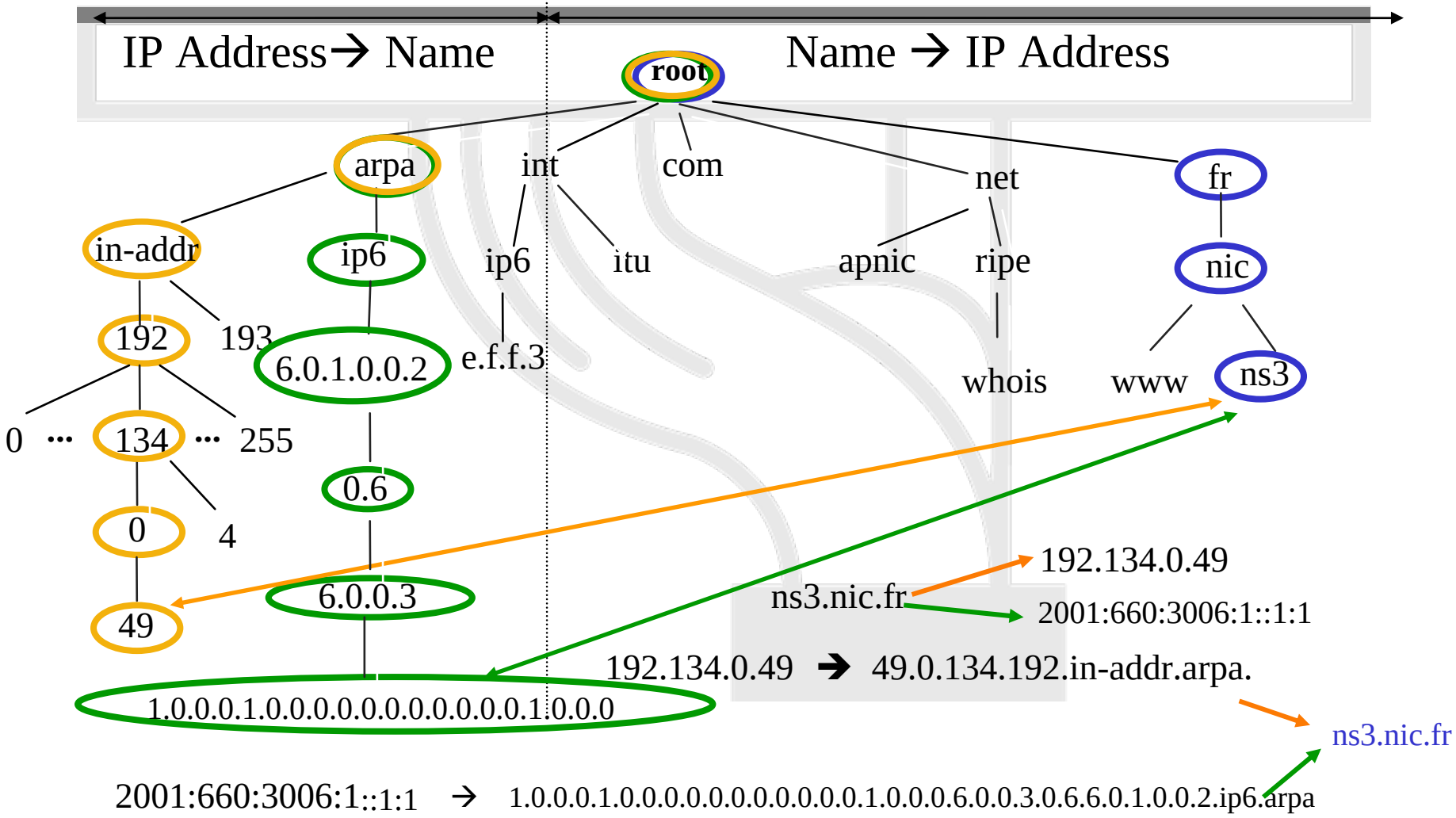
Former tree: **ip6.int** (deprecated)

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** **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)
- Not all the 13 servers already have IPv6 enabled and globally reachable via IPv6.
- Need for (mirror) root servers to be installed in other locations (EU, Asia, Africa, …)
- New technique : anycast DNS server
  - To build a clone from the master/primary server
  - Containing the same information (files)
  - Using the same IP address
- Such anycast servers have already begun to be installed :
  - F root server: Ottawa, Paris(Renater), Hongkong, Lisbon (FCCN)…
  - 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 (RR): SOA, NS, A, AAAA, MX, SRV, 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

- BIND (Resolver & Server)
  - http://www.isc.org/products/BIND/
  - BIND 9 (avoid older versions)
- On Unix distributions
  - Resolver Library (+ (adapted) BIND)
- NSD (authoritative server only)
  - http://www.nlnetlabs.nl/nsd/
- Microsoft Windows (Resolver & Server)

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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)!

Questions?

EXTRA SLIDES

TLDs and IPv6

- 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 AAAA records?

- Usually conservative approaches
- One or two servers

- Don’t use long server names. 1024 bytes limit in DNS responses
  - Some ccTLDs had to renamed their servers (same philosophy used by root servers)

TLDs and IPv6 #3

- 17/04/2005
  - 4 TLDs (.AEROS, .NET, .COM, .INT)
  - 42 ccTLDs
- European: About half already glued
- Servers: 35 different ones, worldwide