IPv6 support in the DNS

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IPv6DISSemination and Exploitation

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

IPv6DISSemination and Exploitation

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 Lookup
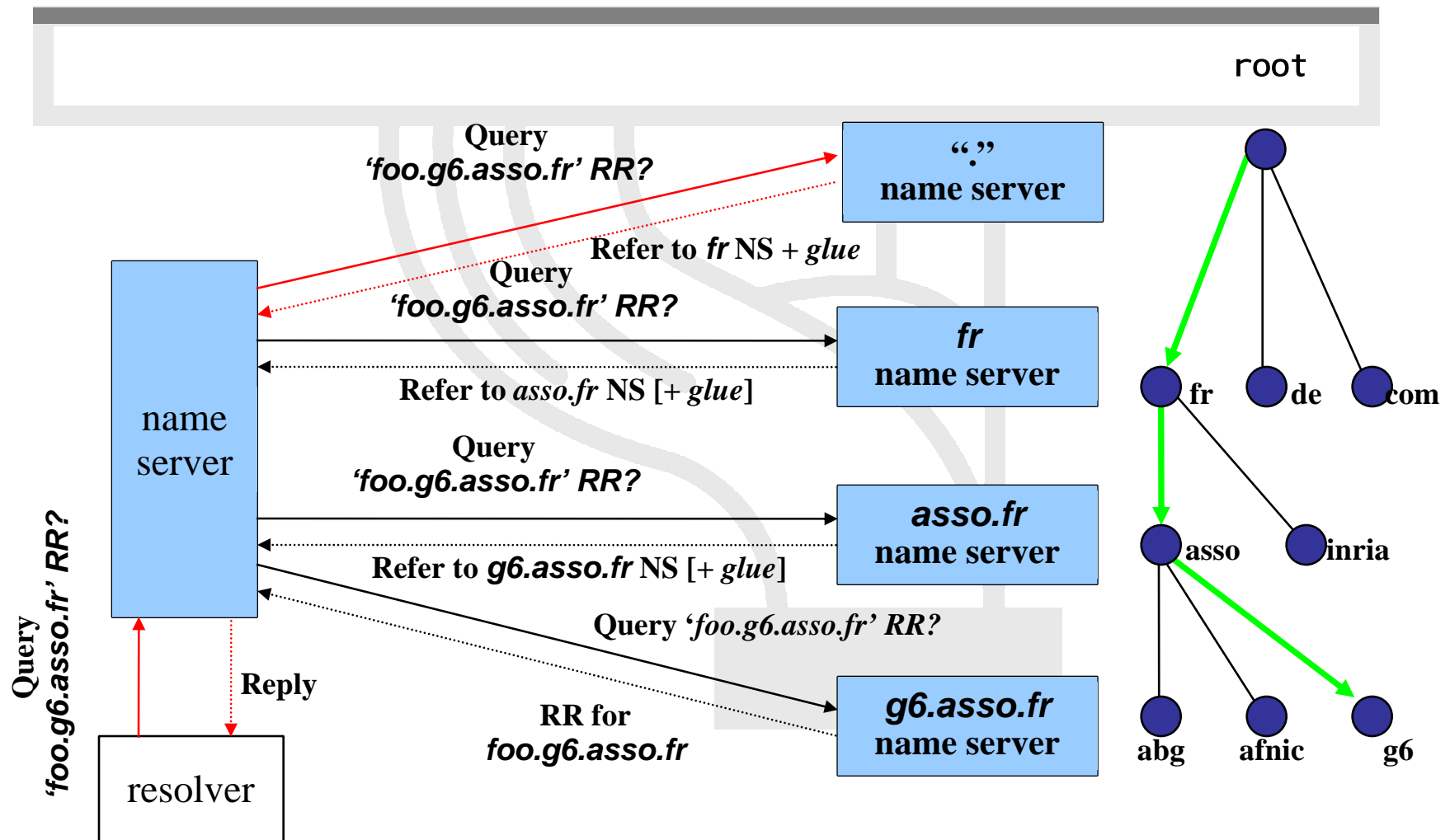
DNS Extensions for IPv6

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
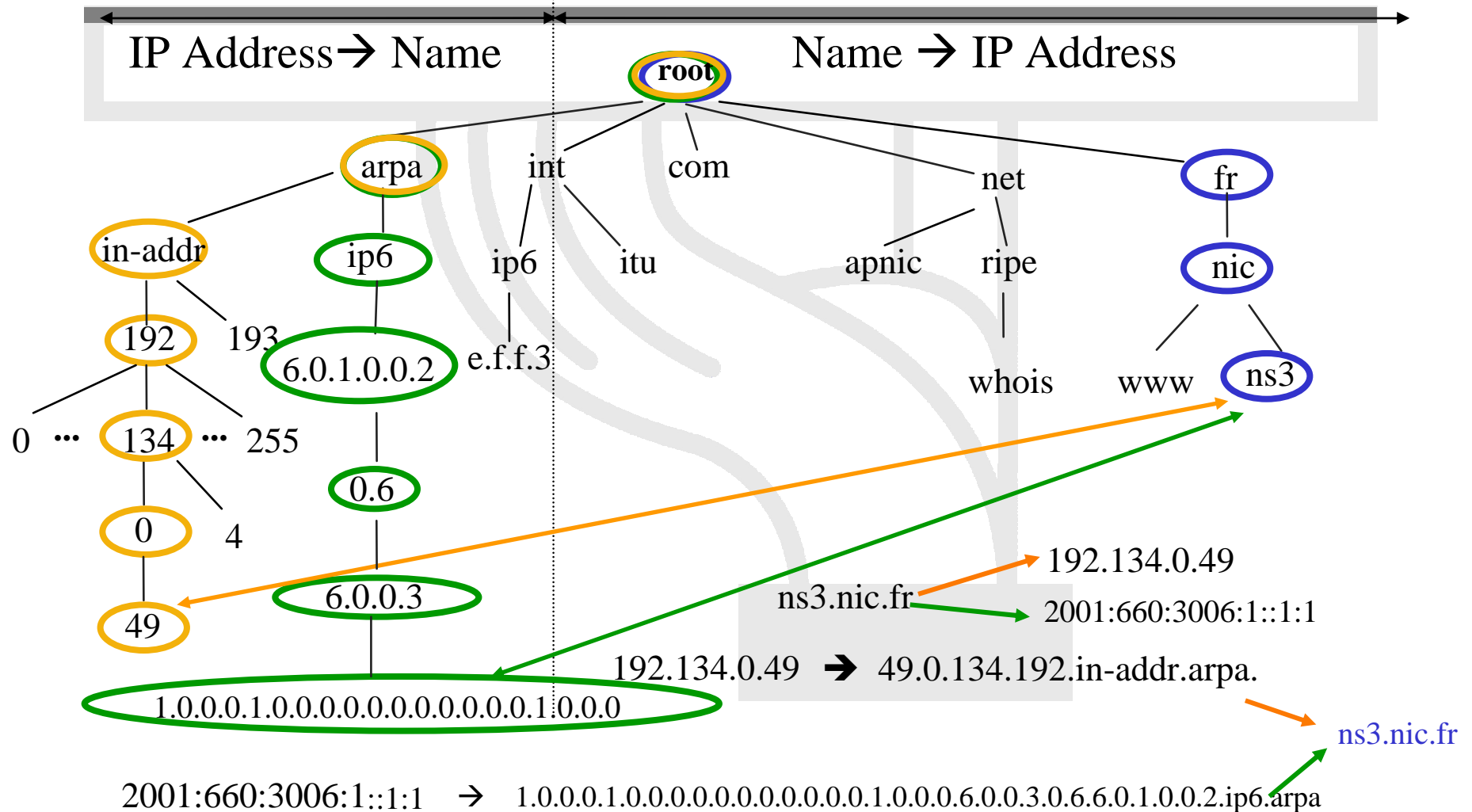   New tree: **ip6.arpa** (under deployment)
        Former tree: **ip6.int**   (deprecated)

    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.**0.0.0.0.0.0.0.0.0.0.0**   **PTR**   ns3.nic.fr.

Lookups in an IPv6-aware DNS Tree

IP Address → Name

Name → IP Address

root

arpa   int   com   net   fr

in-addr   ip6   ip6   itu   apnic   ripe   nic

192   193   6.0.1.0.0.2   e.f.f.3

0 ••• 134 ••• 255   whois   www   ns3

0   4   0.6

49   6.0.0.3

1.0.0.0.1.0.0.0.0.0.0.0.0.0.0.0.1.0.0.0

192.134.0.49

ns3.nic.fr → 192.134.0.49

ns3.nic.fr → 2001:660:3006:1::1:1

192.134.0.49 → 49.0.134.192.in-addr.arpa.

ns3.nic.fr

2001:660:3006:1::1:1 → 1.0.0.0.1.0.0.0.0.0.0.0.0.0.0.0.1.0.0.0.6.0.0.3.0.6.6.0.1.0.0.2.ip6.arpa

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.

NEWS

Date	Subject
2004-01-29	New IP address for b.root-servers.net. (192.228.79.201)
2004-01-26	New AS number for i.root-servers.net.

PRESENTATIONS

Date	Occasion
2003-03-24	GAC meeting during ICANN meeting in Rio de Janeiro (PDF)
2003-12-09	WSIS meeting in Geneva (PDF)
ALL	Complete list of presentations

SERVERS

Server	Operator	Locations	IP Addr	Home ASN
A	VeriSign Naming and Directory Services	Dulles VA	198.41.0.4	19836
B	Information Sciences Institute	Marina Del Rey CA	IPv4: 192.228.79.201 IPv6: 2001:478:65::53	tba
C	Cogent Communications	Herndon VA; Los Angeles; New York City; Chicago	192.33.4.12	2149
D	University of Maryland	College Park MD	128.8.10.90	27
E	NASA Ames Research Center	Mountain View CA	192.203.230.10	297
F	Internet Systems Consortium, Inc.	**40 sites:** Ottawa; Palo Alto; San Jose CA; New York City; San Francisco; Madrid; Hong Kong; Los Angeles; Rome; Auckland; Sao Paulo; Beijing; Seoul; Moscow; Taipei; Dubai; Paris; Singapore; Brisbane; Toronto; Monterrey; Lisbon; Johannesburg; Tel Aviv; Jakarta; Munich; Osaka; Prague; Amsterdam; Barcelona; Nairobi;	IPv4: 192.5.5.241 IPv6: 2001:500::1035	3557

Done   McAfee SiteAdvisor ▾   0:2

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)

...

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?