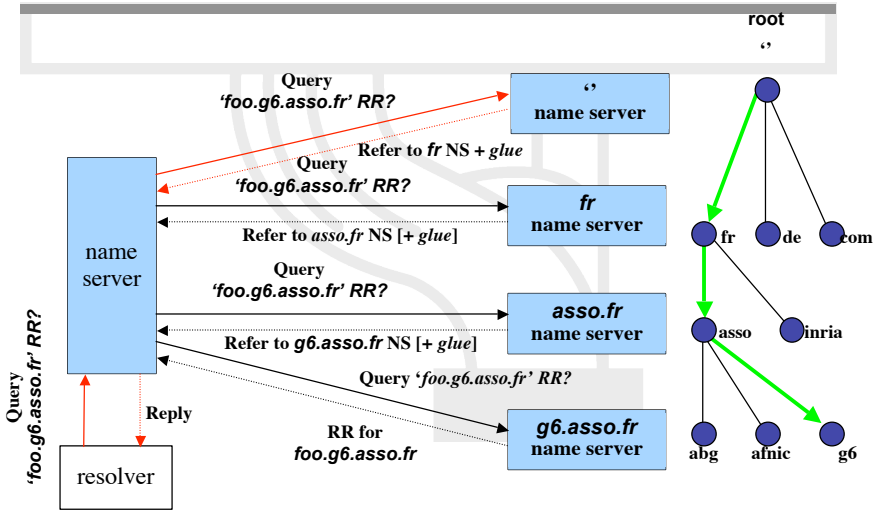
IPv6 support in the DNS

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
  - simplicity

DNS Resource 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** **PTR** ns3.nic.fr.

The Two Approaches to the DNS

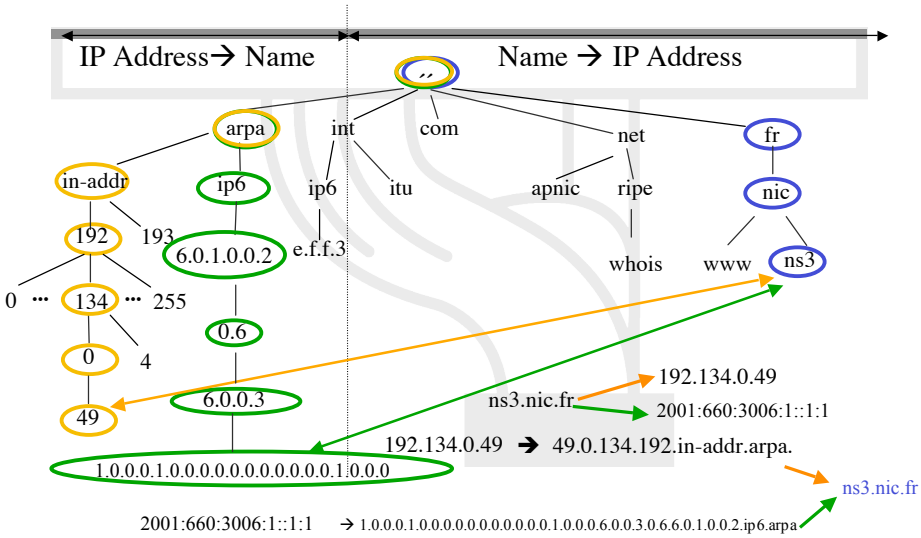
- The DNS seen as a distributed Database
  - Stores different types of Resource Records (RR): SOA, NS, A, AAAA, MX, SRV, PTR, ...

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

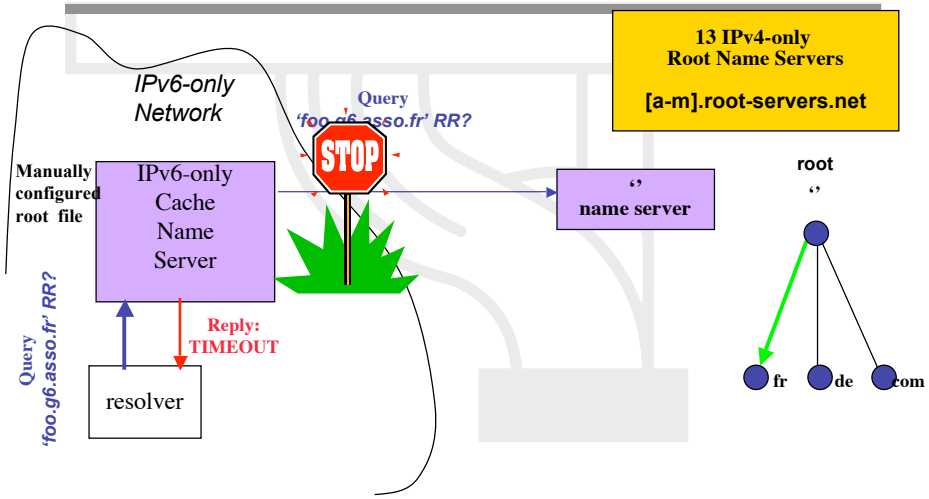
- The DNS seen as a TCP/IP application
  - The service is accessible in either transport modes (UDP/TCP) and over either IP versions (v4/v6)

è Information given over both IP versions MUST BE CONSISTENT!

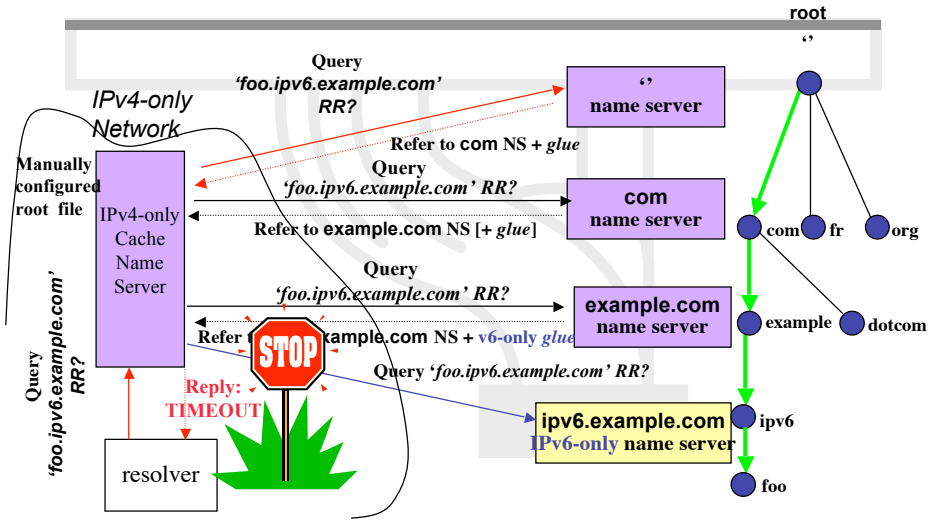
Lookups in an IPv6-aware DNS Tree



DNS Service Continuity through IP Networks



DNS Service Continuity through IP Networks (2)



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 2001:660:73001:1::1) is required to reach rhadamanthe over IPv6 transport

IPv6 Support for the Root Servers

- Why not?
  - No room available for an extra root server IP(v4/v6) address
  - DNS response size limit is 512 bytes unless EDNS.0 is used
  - "IPv6 infrastructure is not mature yet for the operation of the root servers" – not a valid argument!
- Homework done first...
  - RS.NET Testbed: http://www.rs.net/
  - Test and prove that new technologies (IPv6, DNSsec, IDN) are harmless
  - Several TLDs participate in the testbed (FR, JP, SE, ...)
- Who can put AAAA Glue Records in the Root Zone?
  - IANA/ICANN

IPv6 DNS and root servers

- DNS root servers are critical resources!
- 13 roots « around » the world (#10 in the US)
- 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), Dubai, ...
  - K root : London, Amsterdam, ...
  - Look at http://www.root-servers.org for the complete and updated list.

DNS Discovery

- A Stub Resolver needs a Recursive Name Server address for name resolution and a Search Path
- In IPv4 world, the DNS parameters are:
  - Either configured manually in the stub resolver (e.g. /etc/resolv.conf)
  - Or discovered via DHCPv4
- In IPv6 world:
  - Proposals for DNS Discovery:
    - Under discussion IETF ipv6/dnsop WGs
    - Stateless Discovery: RA-Based vs Stateful Discovery: DHCPv6(-light)
    - Well-known address (anycast or unicast): seems to be out of date

DNSv6 Operational Requirements & Recommendations

- The target today IS NOT the transition from an IPv4-only to an IPv6-only environment
- It IS RATHER EASY to get from an IPv4-only to a mixed v4/v6 environment where:
  - Some systems will remain IPv4-only
  - Some systems will be dual-stacked
  - Some systems will be IPv6-only
- 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)!

DNSv6 Operational Requirements & Recommendations #2

- How to get there? (cont.)
  - For new large IPv6-only networks: enable IPv6-only resolvers to query the DNS for IPv4-only resources by (for example):
    - Letting them query dual-stack forwarders
    - Using some DNS ALG
- Bear in mind
  - Any DNS zone SHOULD be served by at least one IPv4 name server
  - All DNS zones (including 'root', yes, yes!) SHOULD be reachable over IPv4 and IPv6

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)

...