



IPv6 & DNS: DNSv6



Overview

- How important is the DNS?
- DNS Extensions for IPv6
- DNS Resource Lookup
- Recursive Name Servers Information Discovery
- DNS Service Continuity through IP Networks
- Operational Requirements, Recommendations & Issues
- About IPv6 AAAA *glue* Records in DNS Zones
- IPv6-capable DNS Software



How important is the DNS?

- Need for **Name Resolution (Lookup)**
 - Name resolution **needed** prior to a TCP/IP communication
 - With Internet **exponential growth**, it became:
 - **impossible to memorize** millions of IP addresses;
 - **impossible to maintain** them in a **centralized flat file** (aka '/etc/hosts') ☹

 - **2 Approaches** to the DNS : [RFC 1034](#) / [RFC 1035](#)
 - **A Database:** Stores different types of **Resource Records (RR)**:
 - **Mainly** IP address(es) **but** other types (NS, MX, PTR, ...)
 - **A TCP/IP Protocol and a Client/server Application:**
 - IPv4 and IPv6; UDP & TCP; port 53
 - **Query** (for a RR) → **lookup** in the DNS **database** → **Response**
- Data returned to DNS clients **SHOULD NOT** depend on the underlying IP version



DNS Extensions for IPv6 Support

RFC 3596 (DS)

❖ *Forward lookup* ('Name → IPv6 Address'):

➤ A **new** Resource Record (RR) : '**AAAA**'

➤ The '**AAAA**' RR is for IPv6 what the '**A**' RR 'is for IPv4

➤ Example:

www.afnic.fr.	IN	A	192.134.4.20
	IN	AAAA	2001:660:3003:2::4:20

❖ *Reverse lookup* ('IPv6 Address → Name'):

➤ **PTR** RR (pointer) applied to the **new** reverse tree: **ip6.arpa**

➤ A dedicated tree with *nibble* (4 bits) *boundaries*

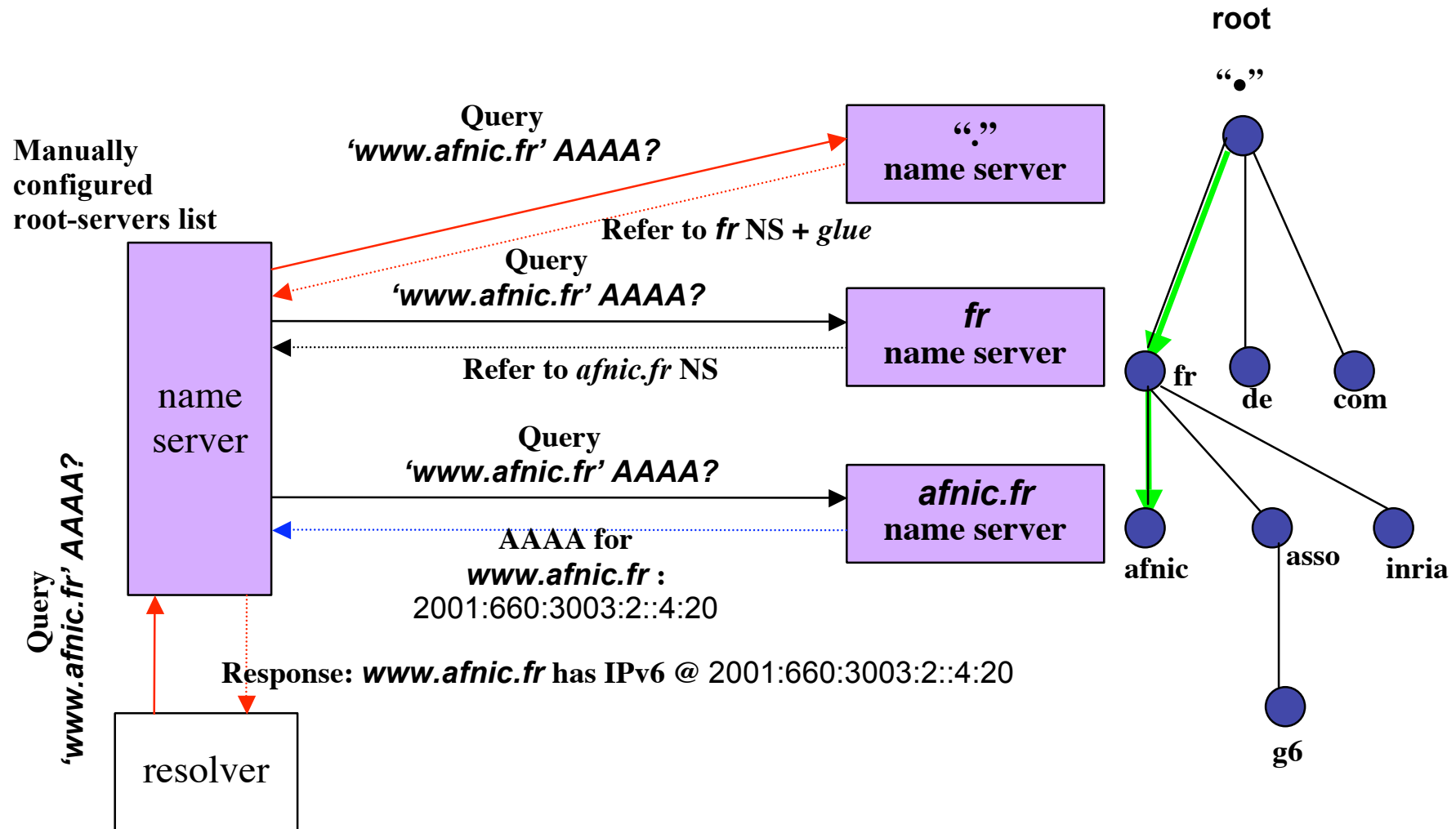
➤ ip6.arpa tree is for IPv6 what the in-addr.arpa tree is for IPv4

➤ 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.
```

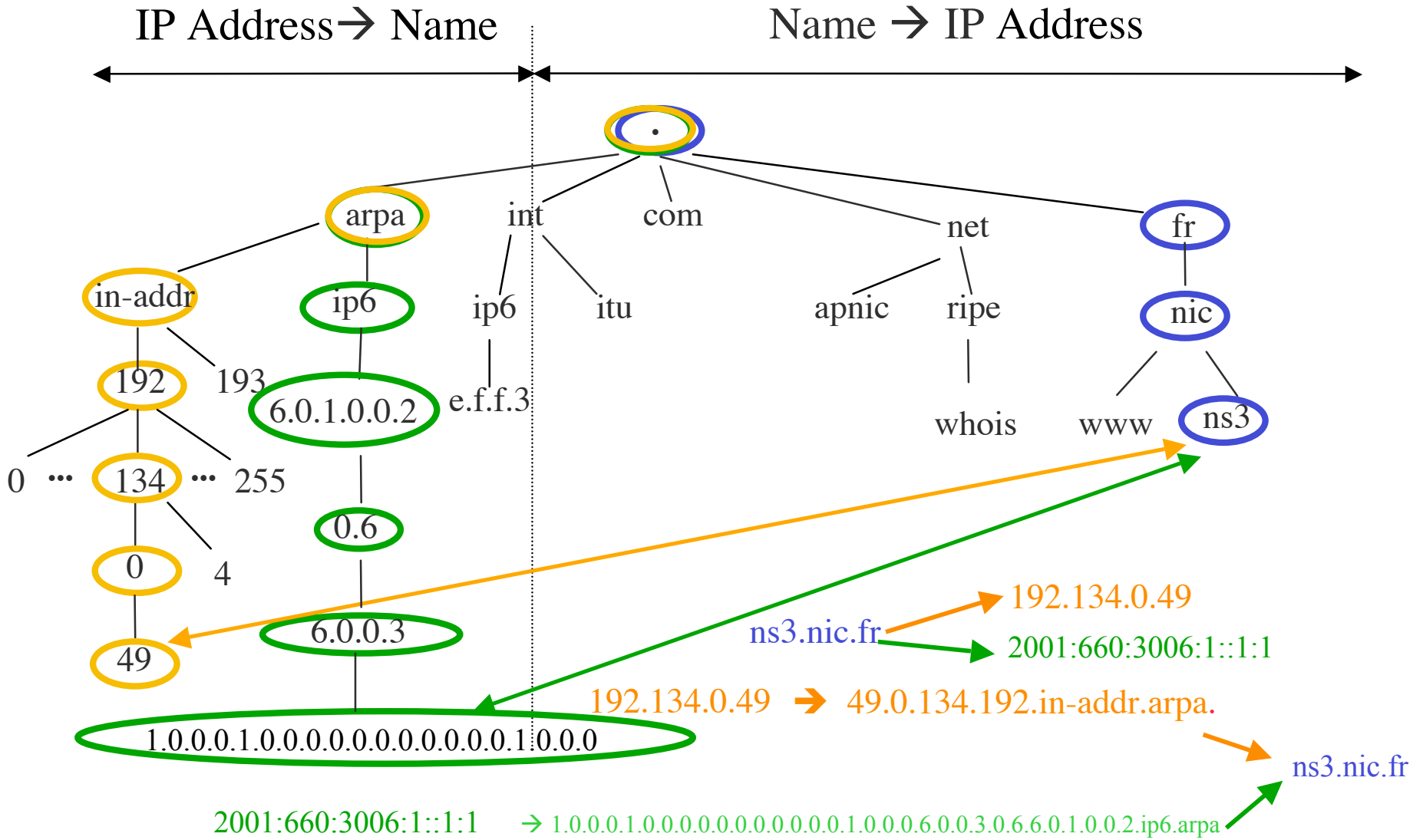


DNS AAAA Lookup





Lookups in an IPv6-aware DNS Tree





Recursive Name Servers Information Discovery

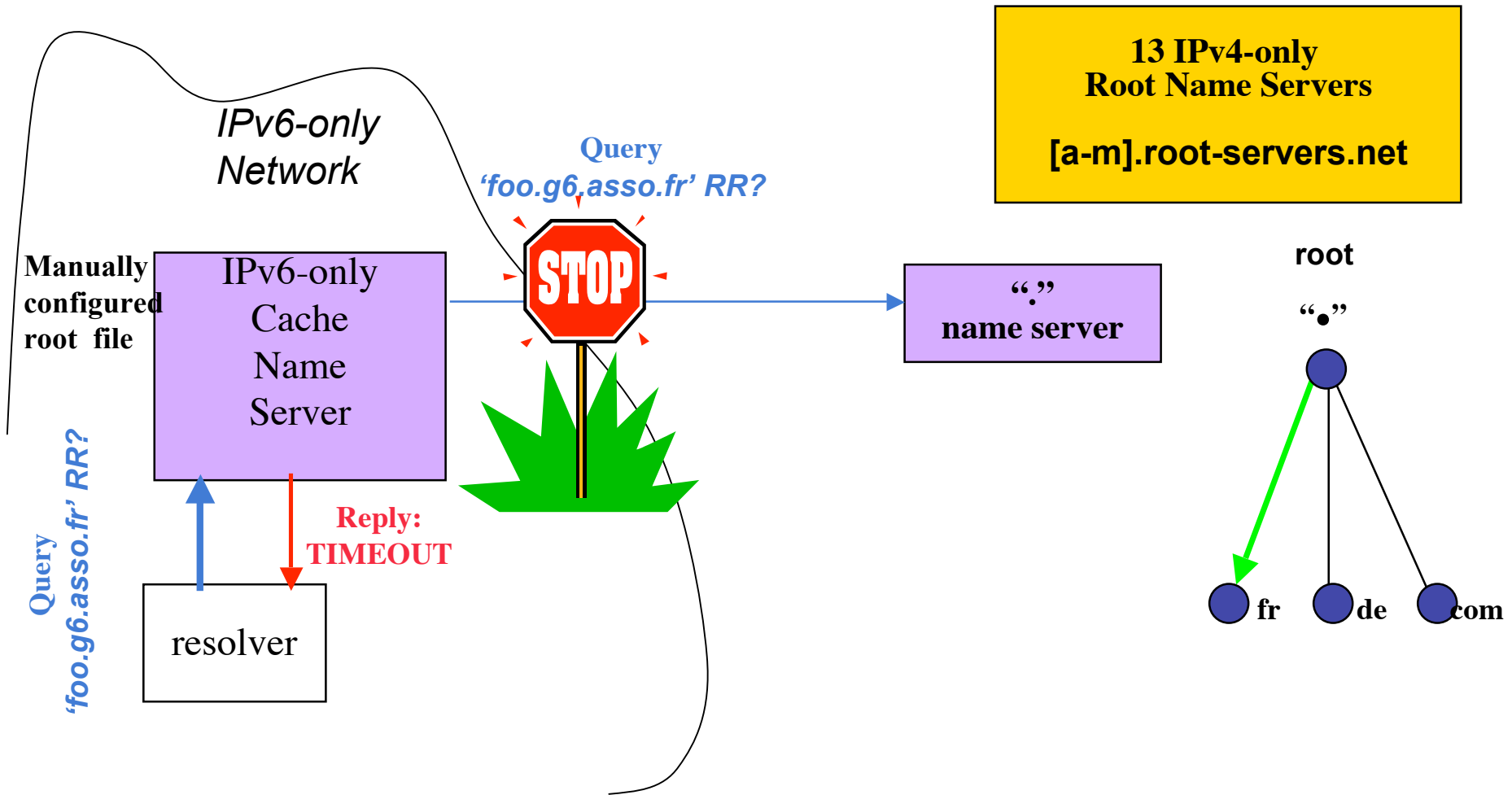
- A **Stub Resolver** needs a **Recursive Name Server address** to which it sends **name resolution** queries

- In the IPv4 world, this DNS information is:
 - Either configured manually in the **stub resolver** (e.g. /etc/resolv.conf for Unix stations)
 - Or discovered via DHCPv4

- In the IPv6 world: [RFC4339](#) (IPv6 Host Configuration of DNS Server Information Approaches)
 - Via stateful DHCPv6 ([RFC 3315](#))
 - Via stateless DHCPv6 ([RFC 3736](#), “DHCPv6-light”) → best preferred
 - RA-based: <http://www.ietf.org/internet-drafts/draft-jeong-dnsop-ipv6-dns-discovery-08.txt> (not so popular → towards an experimental RFC)
 - Well-known address (anycast or unicast)
 - Manual configuration as for IPv4
 - If IPv4 is supported, than run a DHCPv4 client

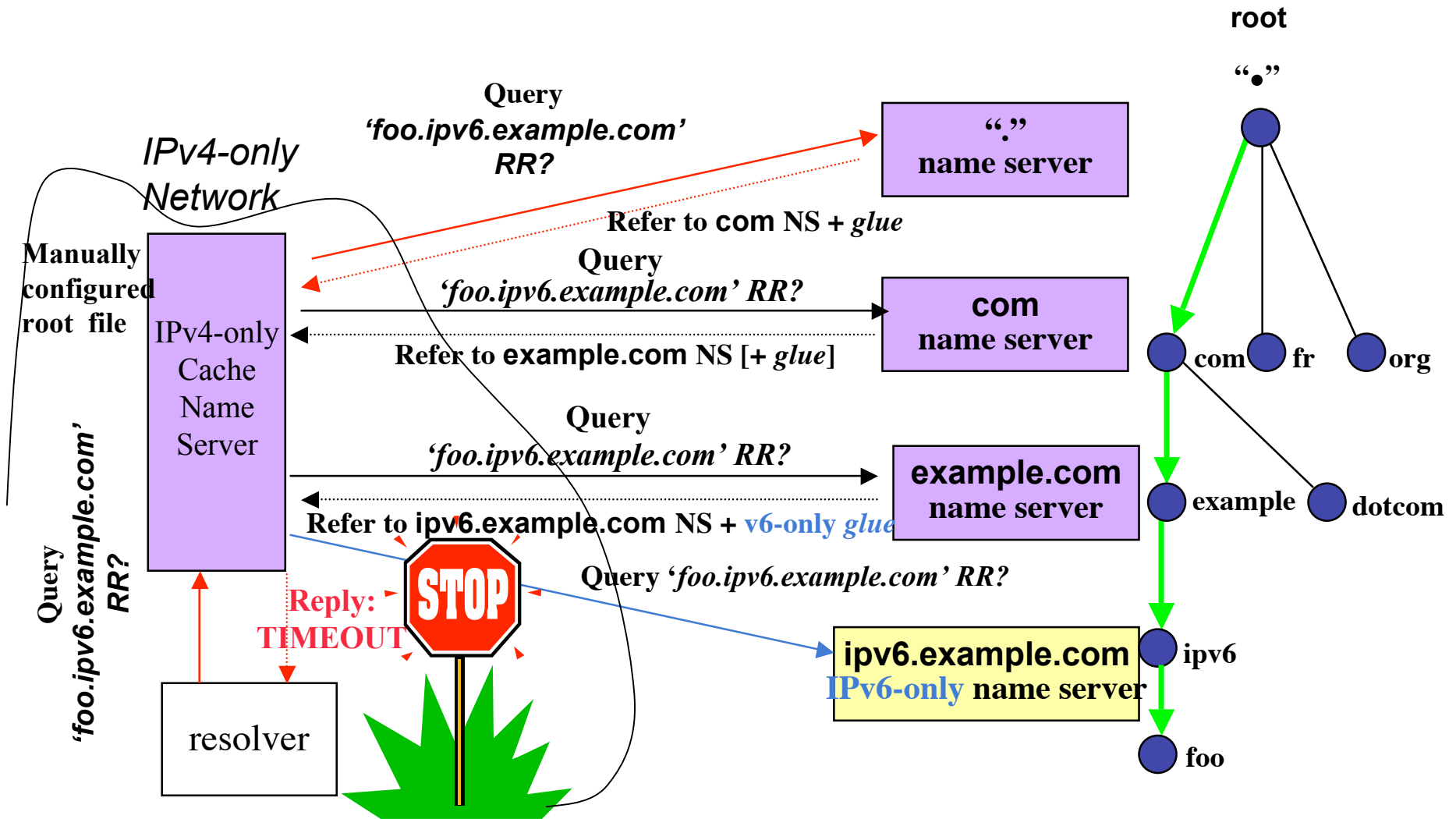


DNS Service Continuity through IP Networks





DNS Service Continuity through IP Networks (2)





DNSv6 Operational Requirements, Recommendations & Issues

- [RFC 3901](#): “DNS IPv6 Transport Operational Guidelines ”
 - To guarantee DNS service continuity across a mixture of IPv4/v6 networks:
 - Every Recursive Name Server SHOULD be either IPv4-only or dual stack:
 - Use dual-stack forwarders (DNS ALG) if necessary
 - Every DNS zone SHOULD be served by at least one IPv4-reachable Authoritative Name Server → Avoid IPv6-only servers
- **Bear in mind**
 - During the long IPv4-IPv6 transition period: some systems will stay IPv4-only, others will be/become dual-stack & others will be IPv6-only
- [RFC4472](#) “Operational Considerations and Issues with IPv6”, among others:
 - Misbehavior of some DNS servers and Load-balancers
 - Handling special (e.g. limited-scope) IPv6-addresses (published vs reachable)
 - Service name vs Node name
 - IPv6 and Dynamic DNS Update (RFC 2136)



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 **fr**

```
@ IN SOA oldnsmaster.nic.fr. hostmaster.nic.fr.
(
    2005020800 ;serial
    3600 ;refresh
    1800 ;retry
    3600000 ;expire
    5400 ;negative ttl
    IN NS a.nic.fr.
    IN NS b.nic.fr.
[...]
```

```
renata.fr. IN NS paris.amen.fr.
           IN NS ns2.amen.fr.
renater IN NS ns1.renater.fr.
           IN NS calypso.urec.cnrs.fr.
ns1.renater.fr. IN A 193.49.159.2
                IN AAAA 2001:660:3001:4002::2
[...]
```

- IPv4 glue (A 193.49.159.2) is required to reach ns1 over IPv4 transport
- IPv6 glue (AAAA 2001:660:3001:4002::2) is required to reach ns1 over IPv6 transport



IPv6 support by Root and TLD Servers

- 13 root servers « around » the world (10 in the US):
 - [A-M].root-servers.net
 - In fact, more than 13: due to **anycast** deployment
- Some root-servers are reachable on IPv6 transport
 - But their IPv6 address is NOT published in the root zone
 - E.g.: B, F, H, K, M, ... Cf. <http://www.root-servers.org/>
- Why IPv6 transport is not yet officially supported by the root servers?
 - Technical reasons: UDP response size limit (512 bytes)
 - Other reasons? ...
- AAAA Glue records already present in the root zone for TLD delegation
 - Who puts them?
 - ICANN/IANA
 - When started?
 - 21 July 2004 with: FR, JP & KR
 - Today: more than 30 TLDs
 - How to proceed for a TLD?
 - <http://www.iana.org/procedures/delegation-data.html>



DNS IPv6-capable software

- BIND (Resolver & Server)
 - <http://www.isc.org/products/BIND/>
 - BIND 8.2.4 (or later)
 - BIND 9
- On Unix distributions
 - Resolver Library (+ (adapted) BIND)
- NSD (authoritative server only)
 - <http://www.nlnetlabs.nl/nsd/>
- Microsoft Windows (Resolver & Server)
- ...



APIs

- **getaddrinfo()** for *forward* lookup
 - *hostname* → *addresses*
 - Replacement for **gethostbyname()**
 - With AF_UNSPEC, applications become protocol-independent

- **getnameinfo()** for *reverse* lookup
 - *address* → *hostname*
 - Replacement for **gethostbyaddr()**



References

- DNSv6-related RFCs & Internet-Drafts
 - [RFC 3596](#) : “DNS Extensions to Support IP Version 6”
 - [RFC 3901](#): “DNS IPv6 Transport Operational Guidelines”
 - [RFC 4472](#): “Operational Considerations and Issues with IPv6”

 - “DNS Response size issues” (A. Kato & P. Vixie, work in progress)
[draft-ietf-dnsop-resize-03.txt](#)

- Other technical documents
 - Adding IPv6 Glue To The Rootzone (R. van der Pol & D. Karrenberg)
<http://www.nlnetlabs.nl/ipv6/publications/v6rootglue.pdf>
 - “DNS Response Size and Name Compression” (M. Souissi, AFNIC)
<http://w6.nic.fr/dnsv6/resp-size.html>

- Books
 - DNS and BIND, 5th edition (Paul Albitz & Cricket Liu)