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)

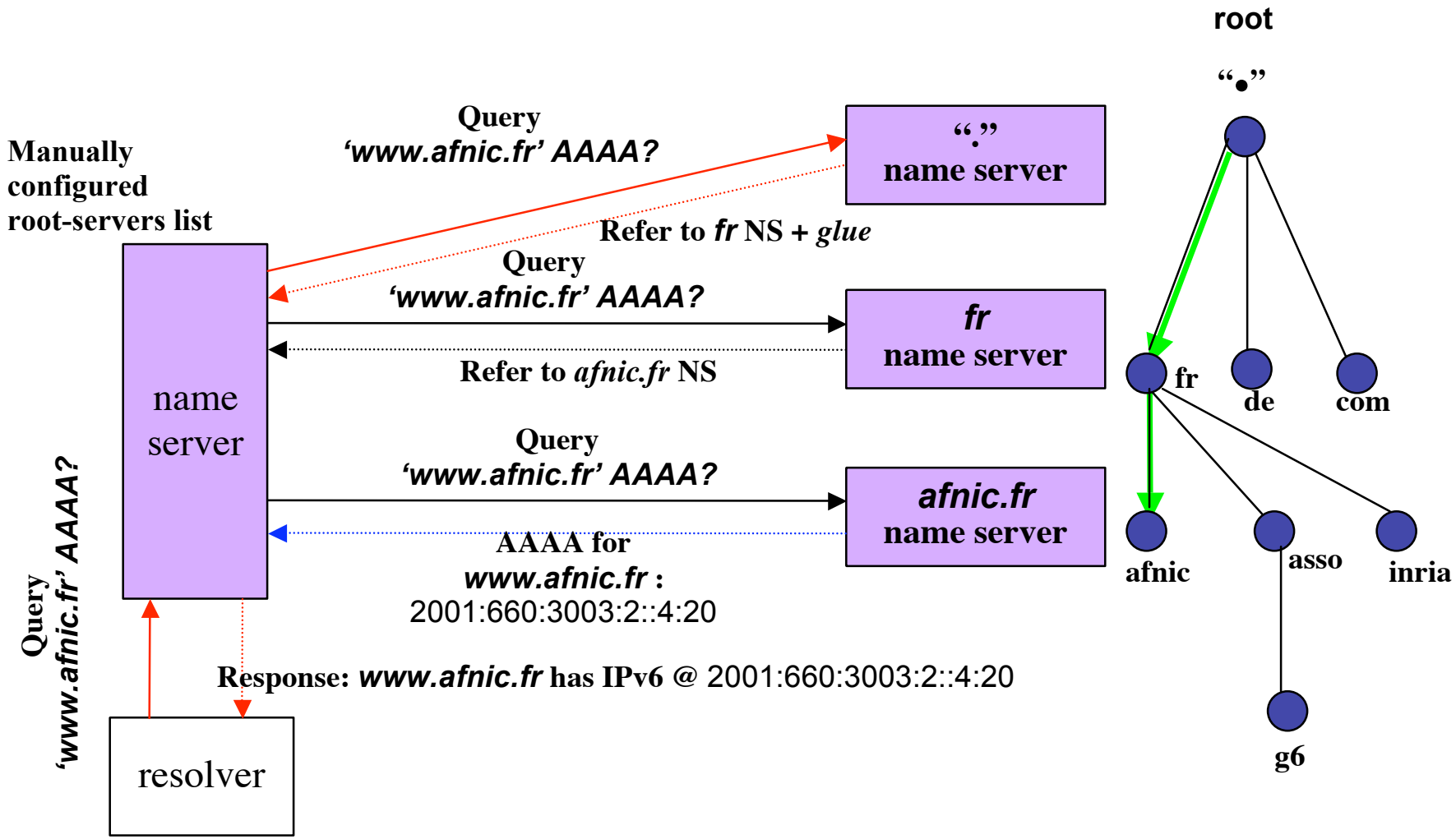
- ***Forward lookup*** ('Name → IPv6 Address'):
  - A **new** Resource Record (RR) : **'AAAA'**
    - The **'AAAA'** RR is for IPv6 what the **'A'** RR 'is for IPv4
    - Example:

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

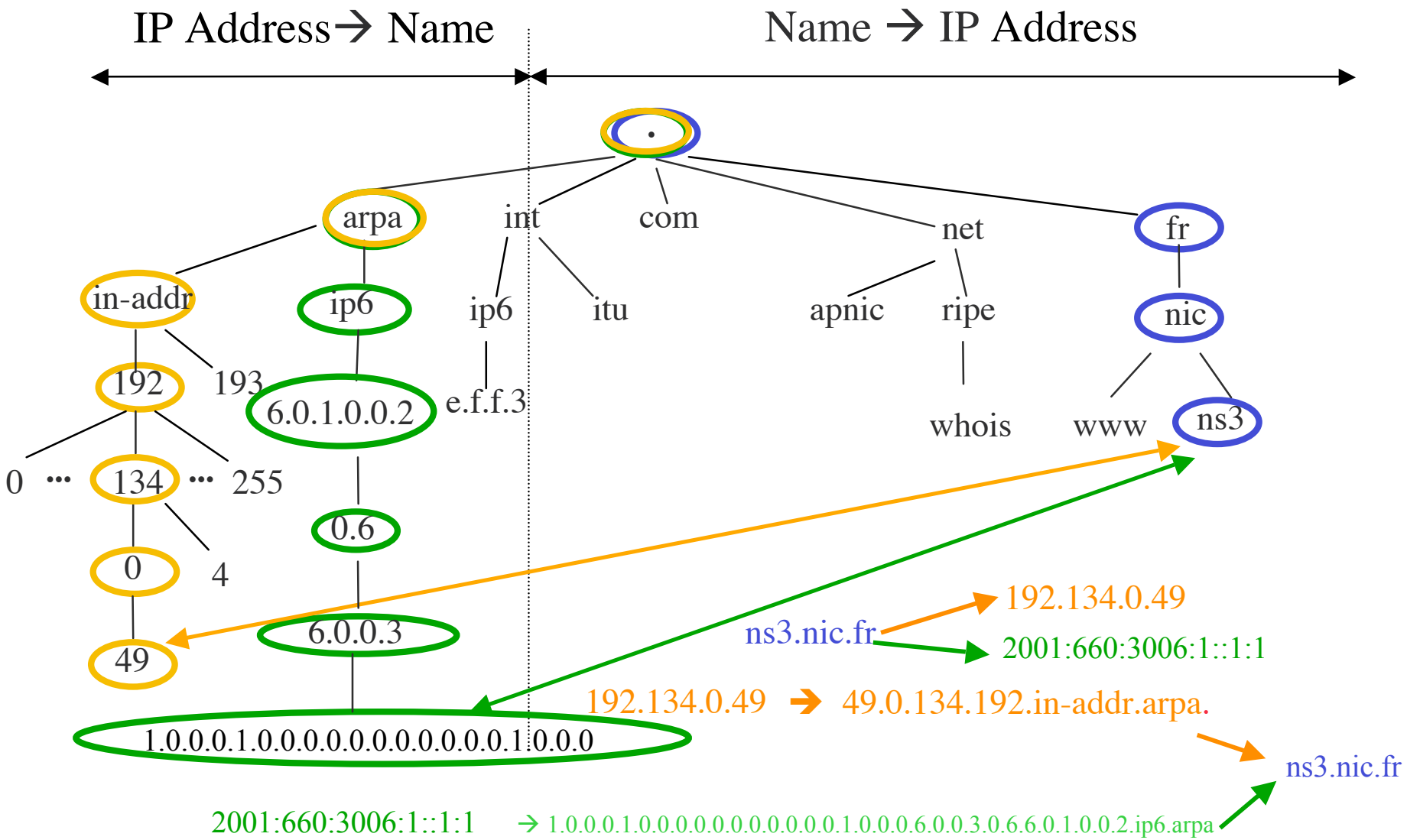
- ***Reverse lookup*** ('IPv6 Address → Name'):
  - **PTR** RR (pointer) applied to the **new** reverse tree: **ip6.arpa**
    - A dedicated tree with ***nibble*** (4 bits) ***boundaries***
    - ip6.arpa tree is for IPv6 what the in-addr.arpa tree is for IPv4
    - Example:

```
$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   PTR   ns3.nic.fr.
```

DNS AAAA Lookup



Lookups in an IPv6-aware DNS Tree



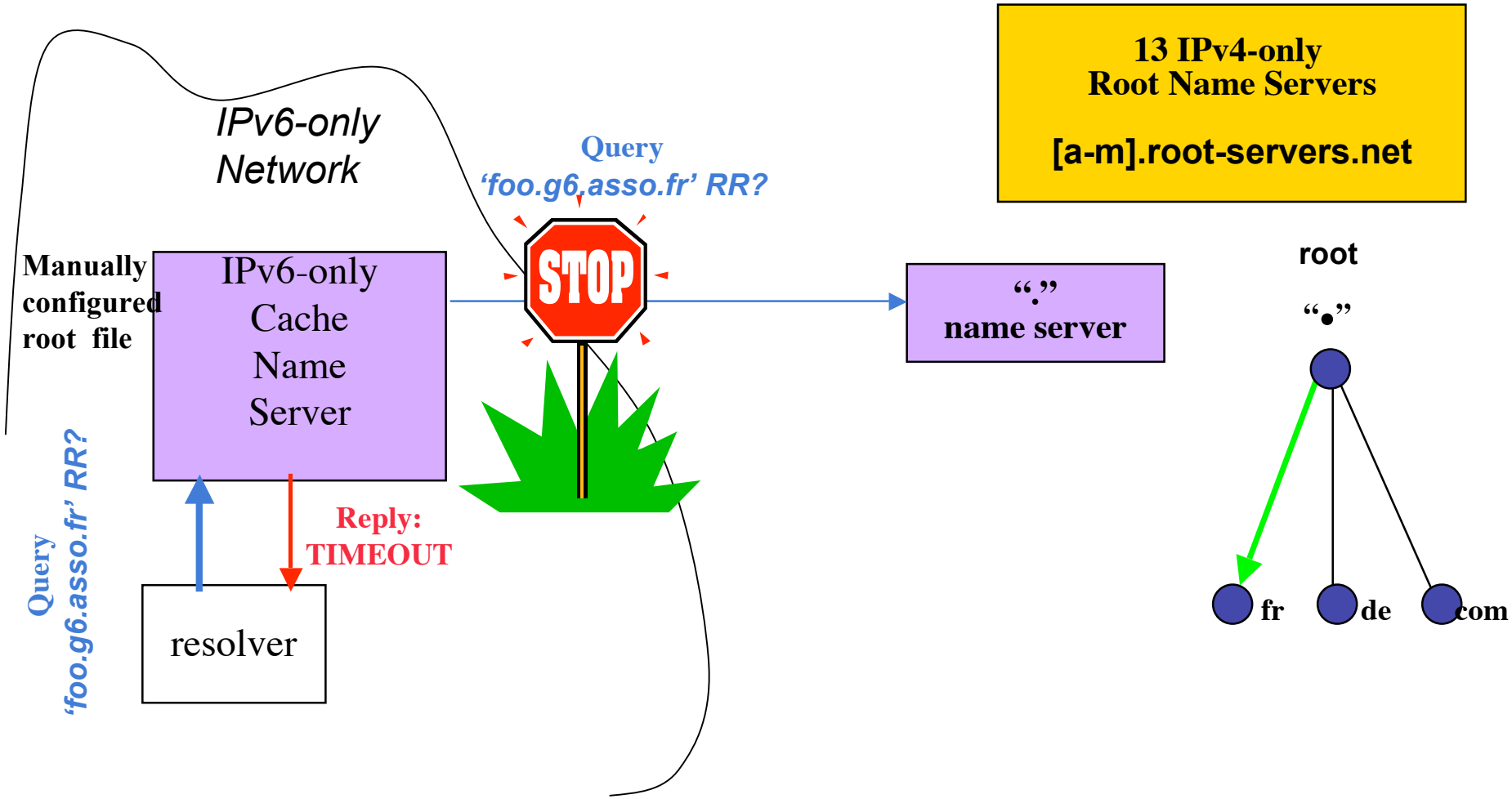
Recursive Name Servers Information Discovery

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

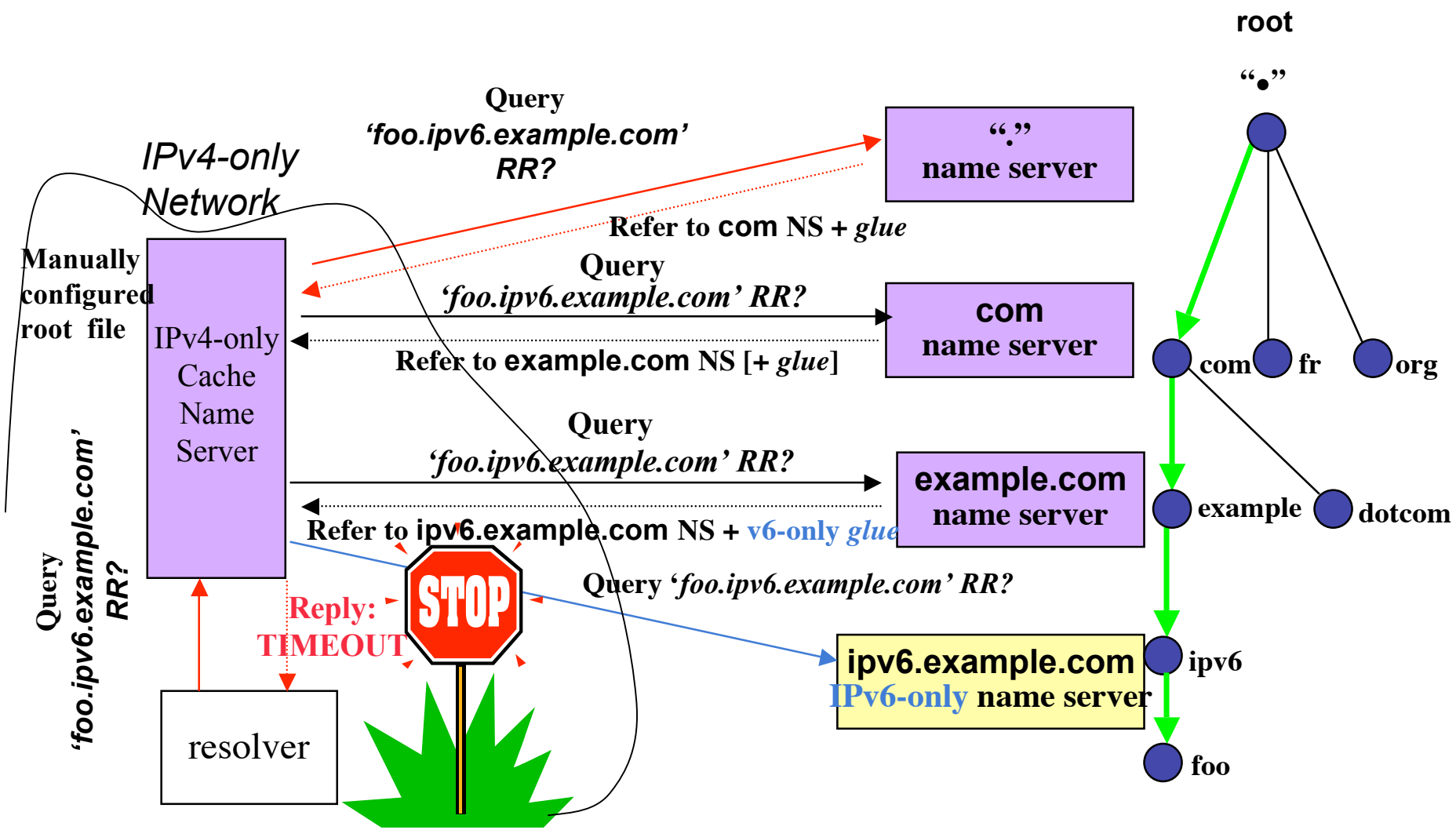
- In the IPv4 world, this DNS information is:
  - Either configured manually in the ***stub resolver*** (e.g. /etc/resolv.conf for Unix stations)
  - Or discovered via DHCPv4

- 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-respsize-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)