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 Lookup

1. Resolver queries name server with 'foo.g6.asso.fr' RR?
2. Name server refers to fr NS + glue
3. Resolver queries fr name server with 'foo.g6.asso.fr' RR?
4. Fr name server refers to asso.fr NS [+ glue]
5. Resolver queries asso.fr name server with 'foo.g6.asso.fr' RR?
6. Asso.fr name server refers to g6.asso.fr NS [+ glue]
7. Resolver queries g6.asso.fr name server with 'foo.g6.asso.fr' RR?
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 1.0.0.6.0.0.3.0.6.6.0.1.0.0.2.ip6.arpa.
1.0.0.0.1.0.0.0.0.0.0.0.0.0.0.0.0.PTR ns3.nic.fr.
```
Lookups in an IPv6-aware DNS Tree

IP Address → Name

<table>
<thead>
<tr>
<th>Name</th>
<th>IP Address</th>
</tr>
</thead>
<tbody>
<tr>
<td>arpa</td>
<td>6.0.1.0.0.2</td>
</tr>
<tr>
<td>int</td>
<td>e.f.f.3</td>
</tr>
<tr>
<td>com</td>
<td></td>
</tr>
<tr>
<td>net</td>
<td></td>
</tr>
<tr>
<td>fr</td>
<td></td>
</tr>
<tr>
<td>nic</td>
<td></td>
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<td>itu</td>
<td></td>
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<tr>
<td>apnic</td>
<td></td>
</tr>
<tr>
<td>ripe</td>
<td></td>
</tr>
</tbody>
</table>

Name → IP Address

<table>
<thead>
<tr>
<th>IP Address</th>
<th>Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>192.134.0.49</td>
<td>ns3.nic.fr</td>
</tr>
<tr>
<td>192.134.0.49</td>
<td>49.0.134.192.in-addr.arpa</td>
</tr>
</tbody>
</table>

Guatemala – Jan-Feb 2007
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

```plaintext
@     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)…
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)
  - 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?
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