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:

```
IN A 192.134.0.49
IN AAAA 2001:660:3006:1::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 1.0.0.0.0.3.0.6.6.0.1.0.0.2.ip6.arpa.
1.0.0.0 1 0.0.0.0.0.0.0.0.0.0.0.0.0.0 PTR ns3.nic.fr
```

DITCHE, Port Elizabeth, Sep. 2005
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, ...
  - 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!

Lookups in an IPv6-aware DNS Tree
DNS Service Continuity through IP Networks

IPv6-only Network
Manually configured root file
Query 'foo.ipv6.example.com' RR?
Reply: TIMEOUT
resolver

IPv6-only Cache Name Server

13 IPv4-only Root Name Servers
[a-m].root-servers.net

name server

DNS Service Continuity through IP Networks (2)

IPv4-only Network
Manually configured root file
Query 'foo.ipv6.example.com' RR?
Reply: TIMEOUT
resolver

IPv4-only Cache Name Server

13 IPv4-only Root Name Servers
[a-m].root-servers.net

name server

IPv6-only Network

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
900000 ;refresh
3600 ;retry
3600000 ;expire}
IN NS rsm
IN NS univers.enst-bretagne.fr.
...
ipv6 IN NS rhadamanthe.ipv6
IN NS ns3.nic.fr.
...
lnunivers.enst-bretagne.fr.
```
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 EDNSO 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, ...

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)!

• 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)
  - 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)
  ...