# IPv6 DNS

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# Outline

1. **IPv6 Address Records**
2. Operational Issues with Forward Lookups
3. Reverse IPv6 DNS

# AAAA

- Historical
- Provides full 128 bits of address information in one record

```
example.domain 3600 IN AAAA 4321:0:1:2:3:4:567:89ab
```

# A6

- New Style
- Define variable number of bits of address information
- Chain to other A6 records to provide the rest of the address, if they supply less than 128 bits.

# A6 Chain Example

```
$ORIGIN x.example.
host        IN A6 64 ::1234:5678:9abc:def0 subnet-1.ip6
subnet-1    IN A6 48 0:0:0:1:: ip6
ip6         IN A6 48 0::0 subscriber-x.ip6.a.net.
ip6         IN A6 48 0::0 subscriber-x.ip6.b.net.

subscriber-x.ip6.a.net. IN A6 0 1111:2222:3333::
subscriber-x.ip6.b.net. IN A6 0 9999:8888:7777::
```

# A6 Lookup Overview

host.x.example. IN A6 64 ::1234:5678:9abc:def0 subnet-1.ip6.x.example.

subnet-1.ip6.x.example. IN A6 0:0:0:1:: ip6.x.example.

=>

host.x.example. IN A6 48 ::1:1234:5678:9abc:def0 ip6.x.example.

ip6.x.example. IN A6 48 0::0 subscriber-x.ip6.a.net.

ip6.x.example. IN A6 48 0::0 subscriber-x.ip6.b.net.

=>

host.x.example. IN A6 48 ::1:1234:5678:9abc:def0 subscriber-x.ip6.a.net.

host.x.example. IN A6 48 ::1:1234:5678:9abc:def0 subscriber-x.ip6.b.net.

# A6 Lookup Overview (continued)

subscriber-x.ip6.a.net. IN A6 0 1111:2222:3333::

subscriber-x.ip6.b.net. IN A6 0 9999:8888:7777::

=>

host.x.example. IN A6 0 1111:2222:3333:1:1234:5678:9abc:def0

host.x.example. IN A6 0 9999:8888:7777:1:1234:5678:9abc:def0

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# Resolvers

- Only make AAAA queries currently
- More complexity following A6 chains
  - Bind 9 provides a way to synthesize AAAA records from A6 chains

  OR

  - new resolver stub/resolver daemon protocol for communication between resolver stub and a daemon on the local machine that can follow A6

    chains.
- Speak IPv6, put an IPv6 address record in nameserver line in resolv.conf

# Lwres

- New protocol for secure communication between stub and resolving daemon
- No authentication currently, so should run on the local host
- Caches, and can optionally load zones in the same way as nameservers
- Can run as part of the nameserver process
- Will allow central configuration of searchlists for all clients using lwres server. Useful when authentication is added.

# Nameservers

- More work done by resolving nameservers
  - Potentially many more queries following an A6 chain than looking up an A record
  - Slower
- Limit A6 chain depth
  - Two-record A6 chain suggested. Local 80 bits, and network 48 bits
- Include 128 bit A6 record as glue, for nameservers (where required)

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3. **Reverse IPv6 DNS**

# Nibble Format

- Much the same as IPv4 DNS, but using nibbles (in hex) rather than bytes (in decimal)
- Matched AAAA records
- RFC defined the ip6.int domain to contain the nibble-format records
- Not flexible enough to work with A6, because of bit-level delegation.

```
0.f.e.d.c.b.a.9.8.7.6.5.4.3.2.1.1.0.0.0.3.3.3
  .3.2.2.2.2.1.1.1.1.ip6.int.
```

# Bitstring labels

- Introduced to allow bit-level delegation of zones
- Considerably more complex
- Somewhat counterintuitive
- Obsoletes nibble-format reverse records
- RFC defined the ip6.arpa to contain the bitstring-format records
- In the transition period, new implementations first attempt to look up bitstrings in ip6.arpa, then try looking up nibbles in ip6.int
- Where not broken on a nibble boundary, labels are right-padded with zeroes
- Label order of the broken up address is reversed in the same way as IPv4 reverse addresses

# Bitstring Example

**\[x123456789abcdef0/64].\[x0001/16].\[x888911119998/45].\[x0/3].ip6.arpa**

**\[x11112222333300011234567 89abcdef0/128].ip6.arpa**

- **These are the same number, the top example is broken at bits 3, 48, and 64; the bottom example is not broken up.**

# DNAME

- Used to provide an alternate name to an entire tree, similar to the use of CNAME to provide an alternate name for a given node
- Is used in place of zone cuts and NS records
- Potentially quite useful in other cases, also
- Can maintain forward and reverse DNS in the same zone now.

# DNAME Example

$ORIGIN ip6.backbone.net.

\[x0/3].ip6.arpa. IN DNAME ip6.backbone.net.

$ORIGIN ip6.backbone.net.

\[x888911119998/45].ip6.arpa IN DNAME ip6.x.example.

$ORIGIN ip6.x.example.

\[x0001/16].ip6.x.example. IN DNAME subnet-1.ip6.x.example.

\[x123456789abcdef0].subnet-1.ip6.x.example. IN PTR
host.x.example.

# Bitstring Label Example

```
1111 2222 3333 0001 1234 5678 9abc def0

   1    1    1    1    2    2    2    2    3    3    3    3    0    0    0    1
0001 0001 0001 0001 0010 0010 0010 0010 0011 0011 0011 0011 0000 0000 0000 0001
   1    2    3    4    5    6    7    8    9    a    b    c    d    e    f    0
0001 0010 0011 0100 0101 0110 0111 1000 1001 1010 1011 1100 1101 1110 1111 0000

000/0/
    0
\[x0/3]

1 0001 0001 0001 0010 0010 0010 0010 0011 0011 0011 0011/000/
    8    8    8    9    1    1    1    1    9    9    9   8
\[x888911119998/45]
```

# Bitstring Label Example
## continued

```
0000 0000 0000 0001
   0    0    0    1
\[x0001/16]

0001 0010 0011 0100 0101 0110 0111 1000 1001 1010 1011 1100 1101 1110 1111 0000
   1    2    3    4    5    6    7    8    9    a    b    c    d    e    f    0
\[x123456789abcdef0/64]

\[x123456789abcdef0/64].\[x0001/16].\[x888911119998/45].\[x0/3].ip6.arpa
```

# IPv6 Reverse Operational Issues

- DNAMEs cause a restart of the lookup
- They should be kept as short as practical
- Less control over this than A6 chains

# IPv6 zone example

```
nominum.com     IN SOA ns1 postmaster (
  2001010100 3600 600 86400 600)
                IN NS ns1.nominum.com.
ip6prefix       IN A6 0 3ffe:1234:5678::
ns1             IN A6 48 ::1:a:b:c:d ip6prefix
www6            IN A6 48 ::1:b:c:d:e ip6prefix
ftp6            IN A6 48 ::1:c:d:e:f ip6prefix

east            IN NS ns1.east.nominum.com.
ns1.east        IN A6 0 3ffe:1234:5678:2:1:2:3:4
```

# IPv6 zone example (cont'd)

```
\[x0001000a000b000c000d/80].ip6 IN PTR ns1
\[x0001000b000c000d000e/80].ip6 IN PTR www6
\[x0001000c000d000e000f/80].ip6 IN PTR ftp6
\[x0002/16].ip6 IN DNAME ip6.east
```