DNS Session 3: Configuration of Authoritative Nameservice

Recap

DNS is a distributed database

Resolver asks Cache for information

Cache traverses the DNS delegation tree to find Authoritative nameserver which has the information requested

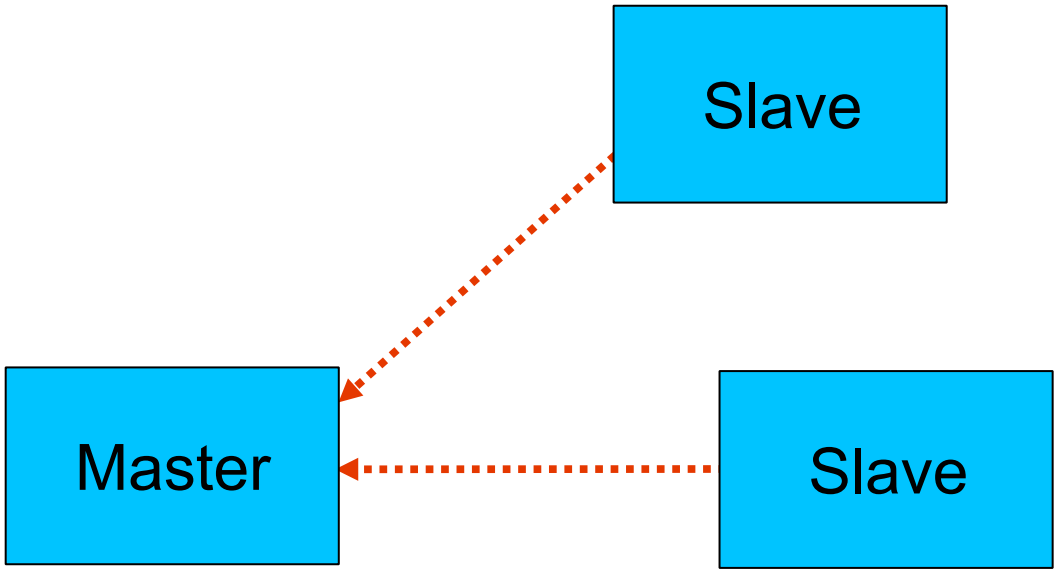
Bad configuration of authoritative servers can result in broken domains

DNS Replication

- For every domain, we need more than one authoritative nameserver with the same information (RFC 2182)
- Data is entered in one server (Master) and replicated to the others (Slave(s))
- Outside world cannot tell the difference between master and slave
  - NS records are returned in random order for equal load sharing
- Used to be called "primary" and "secondary"

Slaves connect to Master to retrieve copy of zone data

The master does not "push" data to the slaves



When does replication take place?

- Slaves poll the master periodically - called the "Refresh Interval" - to check for new data
  - Originally this was the only mechanism
- With new software, master can also notify the slaves when the data changes
  - Results in quicker updates
- The notification is unreliable (e.g. network might lose a packet) so we still need checks at the Refresh Interval

Serial Numbers

- Every zone file has a Serial Number
- Slave will only copy data when this number *INCREASES*
  - Periodic UDP query to check Serial Number
  - If increased, TCP transfer of zone data
- It is your responsibility to increase the serial number after every change, otherwise slaves and master will be inconsistent

Recommended serial number format: YYYYMMDDNN

YYYY = year

MM = month (01-12)

DD = day (01-31)

NN = number of changes today (00-99)

e.g. if you change the file on 18th April 2012, the serial number will be 2012041800. If you change it again on the same day, it will be 2012041801.

Serial Numbers: Danger 1

If you ever decrease the serial number, the slaves will never update again until the serial number goes above its previous value

RFC1912 section 3.1 explains a method to fix this problem

At worst, you can contact all your slaves and get them to delete their copy of the zone data

Serial Numbers: Danger 2

Serial no. is a 32-bit unsigned number

Range: 0 to 4,294,967,295

Any value larger than this is silently truncated

e.g. 20080527000 (note extra digit)

= 4ACE48698 (hex)

= ACE48698 (32 bits)

= 2900657816

If you make this mistake, then later correct it, the serial number will have decreased

Configuration of Master

/etc/bind/named.conf points to zone file (manually created) containing your RRs

Choose a logical place to keep them

/var/cache/bind/zones/master/com.example.db*

*Reverse lexical order to improve sorting

```
zone "example.com" {
        type master;
        file "/var/cache/bind/zones/master/com.example.db";
        allow-transfer { 10.10.0.254;
                         10.10.0.31; };
};
```

Configuration of Slave

named.conf points to IP address of master and location where zone file should be created

Zone files are transferred automatically

Don't touch them!

```
zone "example.com" {
        type slave;
        masters { 192.188.58.126; };
        file ”/var/cache/bind/zones/slave/example.com";
        allow-transfer { none; };
};
```

Master and Slave

It's perfectly OK for one server to be Master for some zones and Slave for others

That's why we recommend keeping the files in different directories

/etc/bind/zones/master/

/etc/bind/zones/slave/

(also, the slave directory can have appropriate permissions so that the daemon can create files)

allow-transfer { ... }

Remote machines can request a transfer of the entire zone contents

By default, this is permitted to anyone

Better to restrict this

You can set a global default, and override this for each zone if required

```
options {
    allow-transfer { 127.0.0.1; };
};
```

Structure of a zone file

- Global options
  - $TTL 1d
  - Sets the default TTL for all other records
- SOA RR
  - "Start Of Authority"
  - Housekeeping information for the zone
- NS RRs
  - List all the nameservers for the zone, master and slaves
- Other RRs
  - The actual data you wish to publish

Format of a Resource Record

www	3600	IN	A	212.74.112.80
Domain	*TTL*	*Class*	*Type*	*Data*

One per line (except SOA can extend over several lines)

If you omit the Domain Name, it is the same as the previous line

TTL shortcuts: e.g. 60s, 30m, 4h, 1w2d

If you omit the TTL, uses the $TTL default value

If you omit the Class, it defaults to IN

Type and Data cannot be omitted

Comments start with SEMICOLON (;)

Shortcuts

If the Domain Name does not end in a dot, the zone's own domain ("origin") is appended

A Domain Name of "@" means the origin itself

e.g. in zone file for example.com:

`@` *means* `example.com.`

`www` *means* `www.example.com.`

If you write this...

```
$TTL 1d
@                               SOA  ( ... )
                                NS   ns0
                                NS   ns0.as9105.net.
; Main webserver
www                             A    212.74.112.80
                                MX   10 mail
```

... it becomes this

```
example.com.          86400   IN   SOA  ( ... )
example.com.          86400   IN   NS   ns0.example.com.
example.com.          86400   IN   NS   ns0.as9105.net.
www.example.com.      86400   IN   A    212.74.112.80
www.example.com.      86400   IN   MX   10 mail.example.com.
```

Format of the SOA record

```
$TTL 1d

@   1h   IN   SOA   ns1.example.net. joe.pooh.org. (
                    2004030300      ; Serial
                    8h              ; Refresh
                    1h              ; Retry
                    4w              ; Expire
                    1h )            ; Negative

          IN   NS   ns1.example.net.
          IN   NS   ns2.example.net.
          IN   NS   ns1.othernetwork.com.
```

Format of the SOA record

`ns1.example.net.`

hostname of master nameserver

`joe.pooh.org.`

E-mail address of responsible person, with "@" changed to dot, and trailing dot

Serial number

Refresh interval

How often Slave checks serial number on Master

Retry interval

How often Slave checks serial number if the

Format of the SOA record (cont)

- Expiry time
  - If the slave is unable to contact the master for this period of time, it will delete its copy of the zone data
- Negative / Minimum
  - Old software used this as a minimum value of the TTL
  - Now it is used for negative caching: indicates how long a cache may store the non-existence of a RR
- RIPE-203 has recommended values
  - http://www.ripe.net/ripe/docs/dns-soa.html

Format of NS records

List all authoritative nameservers for the zone - master and slave(s)

Must point to HOSTNAME not IP address

```
$TTL 1d

@   1h   IN   SOA   ns1.example.net. joe.pooh.org. (
                    2004030300      ; Serial
                    8h              ; Refresh
                    1h              ; Retry
                    4w              ; Expire
                    1h )            ; Negative

          IN   NS   ns1.example.net.
          IN   NS   ns2.example.net.
          IN   NS   ns1.othernetwork.com.
```

Format of other RRs

```
IN   A     1.2.3.4
IN   MX    10 mailhost.example.com.
```

The number is a "preference value". Mail is delivered to the lowest-number MX first

Must point to HOSTNAME not IP address

```
IN   CNAME   host.example.com.
IN   PTR     host.example.com.
IN   TXT     "any text you like"
```

When you have added or changed a zone file:

Remember to increase the serial number!

```
named-checkzone example.com \
     /etc/bind/zones/master/com.example.db
```

bind 9 feature

reports zone file syntax errors; correct them!

```
named-checkconf
```

reports errors in named.conf

```
rndc reload
```

or: `rndc reload example.com`

```
tail /var/log/syslog
```

These checks are ESSENTIAL

If you have an error in named.conf or a zone file, named may continue to run but will not be authoritative for the bad zone(s)

You will be lame for the zone without realising it

Slaves will not be able to contact the master

Eventually (e.g. 4 weeks later) the slaves will expire the zone

Your domain will stop working

Other checks you can do

`dig +norec @x.x.x.x example.com. soa`

- Check the AA flag
- Repeat for the master and all the slaves
- Check the serial numbers match

`dig @x.x.x.x example.com. axfr`

- "Authority Transfer"
- Requests a full copy of the zone contents over TCP, as slaves do to master
- This will only work from IP addresses listed in the allow-transfer {...} section

So now you have working authoritative nameservers!

But none of this will work until you have delegation from the domain above

That is, they put in NS records for your domain, pointing at your nameservers

You have also put NS records within the zone file

The two sets should match

Any questions?

TOP TEN ERRORS in authoritative nameservers

- All operators of auth nameservers should read RFC 1912
  - Common DNS Operational and Configuration Errors
- And also RFC 2182
  - Selection and Operation of Secondary DNS servers

1. Serial number errors

- Forgot to increment serial number
- Incremented serial number, then decremented it
- Used serial number greater than 2^{32}
- Impact:
  - Slaves do not update
  - Master and slaves have inconsistent data
  - Caches will sometimes get the new data and sometimes old - intermittent problem

2. Comments in zone files starting '#' instead of ';'

Syntax error in zone file

Master is no longer authoritative for the zone

Slaves cannot check SOA

Slaves eventually expire the zone, and your domain stops working entirely

Use "named-checkzone"

Use "tail /var/log/syslog"

3. Other syntax errors in zone files

e.g. omitting the preference value from MX records

Same impact

4. Missing the trailing dot

```
; zone example.com.
@   IN   MX 10   mailhost.example.com
```

becomes

```
@   IN   MX 10   mailhost.example.com.example.com.
```

```
; zone 2.0.192.in-addr.arpa.
1   IN   PTR     host.example.com
```

becomes

```
1   IN   PTR     host.example.com.2.0.192.in-addr.arpa.
```

5. NS or MX records pointing to IP addresses

They must point to hostnames, not IP addresses

Unfortunately, a few mail servers do accept IP addresses in MX records, so you may not see a problem with all remote sites

6. Slave cannot transfer zone from master

Access restricted by allow-transfer {...} and slave not listed

Or IP filters not configured correctly

Slave will be lame (non-authoritative)

7. Lame delegation

You cannot just list any nameserver in NS records for your domain

You must get agreement from the nameserver operator, and they must configure it as a slave for your zone

At best: slower DNS resolution and lack of resilience

At worst: intermittent failures to resolve your domain

8. No delegation at all

You can configure "example.com" on your nameservers but the outside world will not send requests to them until you have delegation

The problem is hidden if your nameserver is acting both as your cache and as authoritative nameserver

Your own clients can resolve www.example.com, but the rest of the world cannot

9. Out-of-date glue records

Exercise left for the reader

10. Not managing TTL correctly during changes

e.g. if you have a 24 hour TTL, and you swing www.example.com to point to a new server, then there will be an extended period when some users hit one machine and some hit the other

Follow the procedure:

- Reduce TTL to 10 minutes
- Wait at least 24 hours
- Make the change
- Put the TTL back to 24 hours

Practical

Create a new domain

Set up master and slave nameservice

Obtain delegation from the domain above

Test it