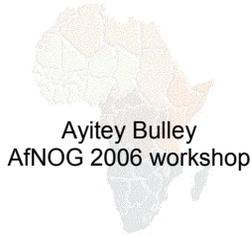


## DNS Session 3: Configuration of Authoritative Nameservice



## Recap

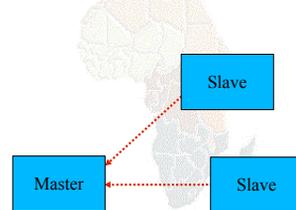
- DNS is a distributed database
- Resolver asks Cache for information
- Cache traverses the DNS delegation tree to find Authoritative nameserver which has the information requested
- Bad configuration of authoritative servers can result in broken domains

## 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 8th May 2006, the serial number will be 2006050800. If you change it again on the same day, it will be 2006050801.

## 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. 20060508000 (note extra digit)
  - = 4AA7EC968 (hex)
  - = AA7EC968 (32 bits)
  - = 2860435816
- If you make this mistake, then later correct it, the serial number will have decreased

## Configuration of Master

- /etc/namedb/named.conf points to zone file (manually created) containing your RRs
- Choose a logical place to keep them
  - e.g. /etc/namedb/master/tiscali.co.uk
  - or /etc/namedb/master/uk.co.tiscali

```
zone "example.com" {
    type master;
    file "master/example.com";
    allow-transfer { 192.188.58.126;
                    192.188.58.2; };
};
```

## 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 "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/namedb/master/
  - /etc/namedb/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

Domain	TTL	Class	Type	Data
www	3600	IN	A	212.74.112.80

- 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 Master did not respond

## 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.othenetwork.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/namedb/master/example.com
  - 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/messages

## 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/messages"

### 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)



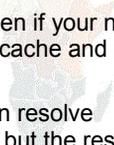
### 7. Lame delegation

- 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

- See later



## 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

