Deploying DNSSEC

Using BIND 9.7

Internet Systems Consortium

NANOG 50

Deck Version 1.4

ISC

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About ISC

- Internet Systems Consortium, Inc.
  - Headquartered in Redwood City, CA
  - 501(c)(3) Nonprofit Corporation

- ISC is a public benefit corporation dedicated to supporting the infrastructure of the universal connected self-organizing Internet — and the autonomy of its participants — by developing and maintaining core production quality software, protocols, and operations.

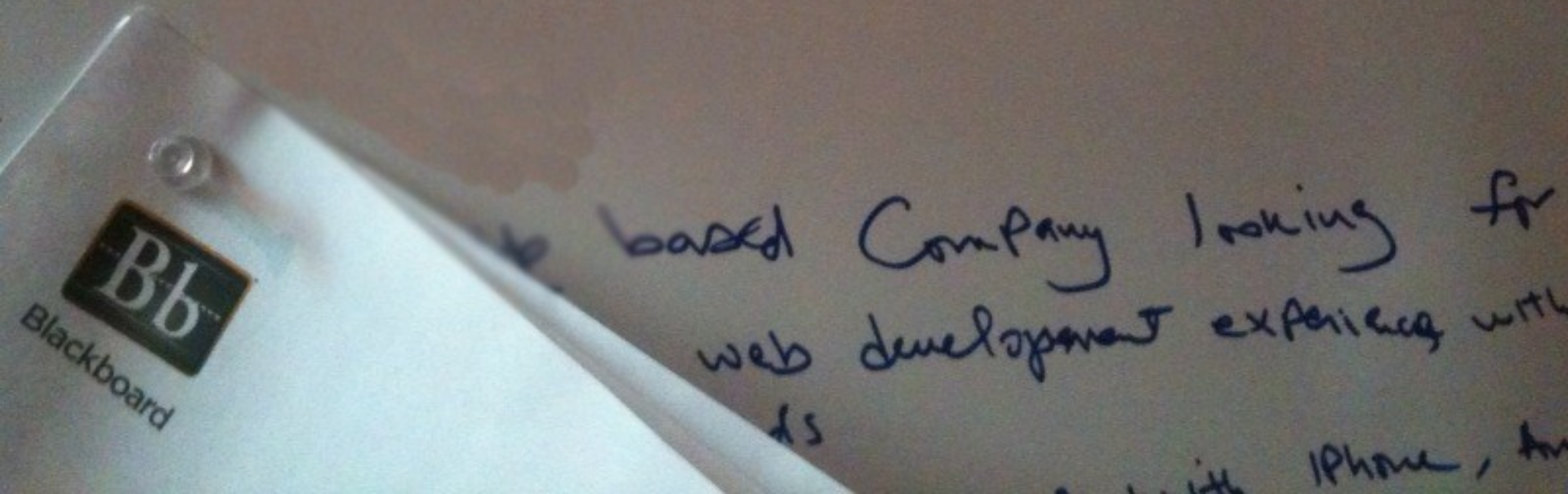
is the New "COBOL"

Deploy DNSSEC
NOW .... or something
bad might happen...

based Company looking for
web development experience with
ds
iPhone, and

is the New "COBOL"

Define a security standard for DNS that CAN be deployed, and operators will. ⟹ Deploy DNSSEC NOW .... or something bad might happen...



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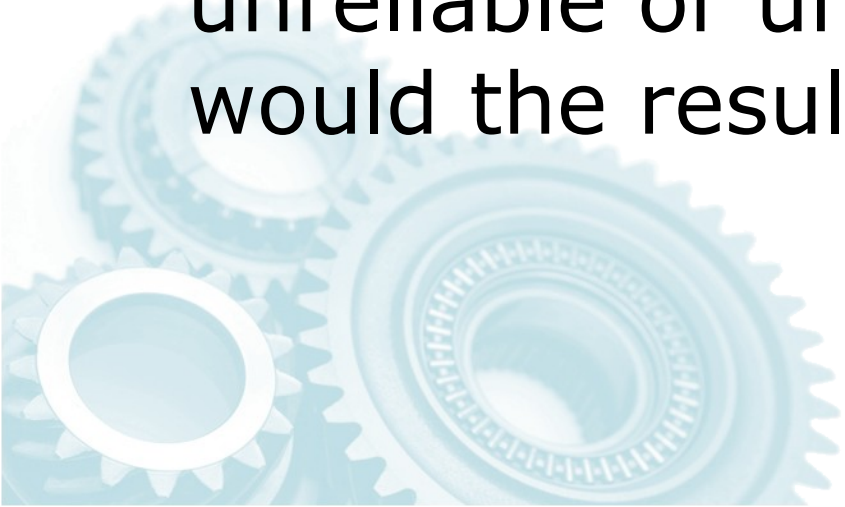
Understanding DNSSEC

Introduction

- Contemplate for a moment the amount of trust that we put into the DNS infrastructure

- If DNS were to suddenly become unreliable or untrustworthy, what would the result be?



Introduction

- With millions of recursive, caching servers on the Internet…
  - Each one needs to be able to be able to look up data from millions of zones
  - There is no way to distribute secret keys
    - Existing technology (TSIG) did not scale well

Introduction

- Central concept:

DNS data is augmented by a signature

- Validating resolvers can use the signature to verify that the data is authentic

Introduction

- DNSSEC is based on public key (asymmetrical) cryptography
  - Private key is used to sign DNS data
  - Public key is published via DNS so that validators can retrieve it
  - The public key is then used to validate the signatures, and there-by, the DNS data

Introduction

- DNSSEC provides cryptographic proof that the data received in response to a query is un-modified

- It does not deal with validating dynamic updates, nor with master to slave data transfers

Introduction

- DNSSEC enabled authoritative servers provide digital signatures across RRsets in addition to "standard" DNS responses

- DNSSEC validating resolvers provide authenticated responses with proven integrity

Introduction

- Clients using validating resolvers get "guaranteed good" results

- Data that does not validate provides a "**SERVFAIL**" response from the upstream resolver

Trust Validation

- With this knowledge, we are able to prove that data hasn't changed between the authoritative server and the validator, but how do we know we can trust it?

- Now that the root (".") is signed, that's easy, right?

Trust Validation

- DNSSEC is based on chains of trust
- At the top of chains are "trust-anchors"
  - One (signed) root, one trust-anchor
  - Until all TLDs are signed, it's not so easy
  - Trust anchors must be gathered and added to DNS configuration through leaps of faith

Trust Validation

- In BIND, trust anchors are added in "trusted-keys" statements

```
trusted-keys {
   . 257 3 8 "AwEAA[..]ihz0=";
};
```

- This creates an anchor based at the DNS root from which a chain is created

Chain of Trust

- Once a "trust anchor" is inserted, how does it actually create trust that leads down the DNS tree?

- Trust anchors consist of bits capable of validating the key used to sign the key that signs data in a given zone

Chain of Trust

- First, we must realize that there are TWO keys inserted into each zone
  - Zone Signing Key (ZSK)
    - Used to sign the resource records in the zone being secured
  - Key Signing Key (KSK)
    - Used to sign the Zone Signing Key

Chain of Trust

- Delegation of signed zones include a new Resource Record type
  - Delegation Signer – `DS`
  - Hash of the public portion of the child's Key Signing Key

Chain of Trust

- If the DS record in the parent is signed using the parent's zone signing key, we know that the DS record is valid.

- If the hash of the child's Key Signing Key record matches the DS record then we know that the Key Signing Key is valid.

Chain of Trust

- If the Key Signing Key is known to be valid, its signature of the Zone Signing Key proves that the Zone Signing Key is valid.

- If the Zone Signing Key is known to be valid, it can be used to validate other RRs in the zone.

Chain of Trust

- A living example:

`www.isc.org`

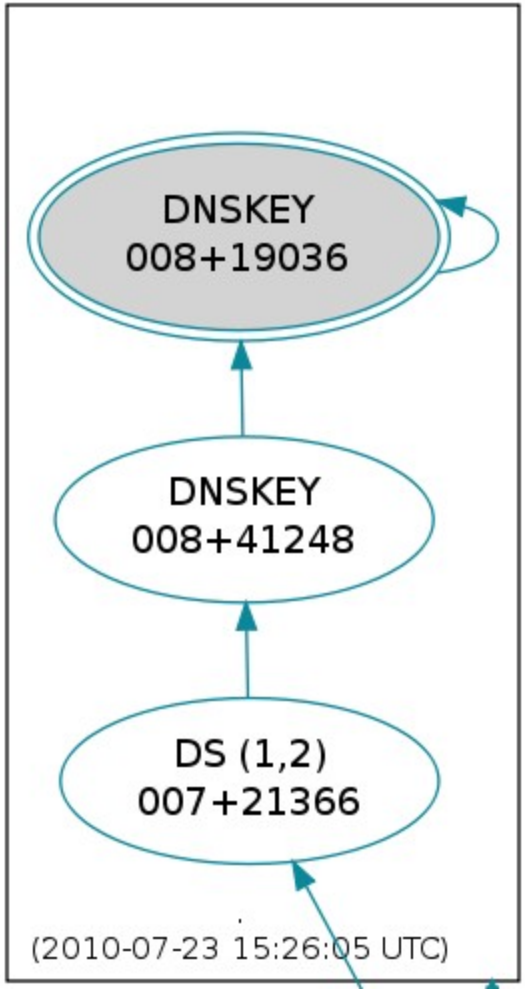
The following slides were created using Sandia National Laboratories "DNSViz"

http://dnsviz.net/

Trusting `isc.org`

. (root)

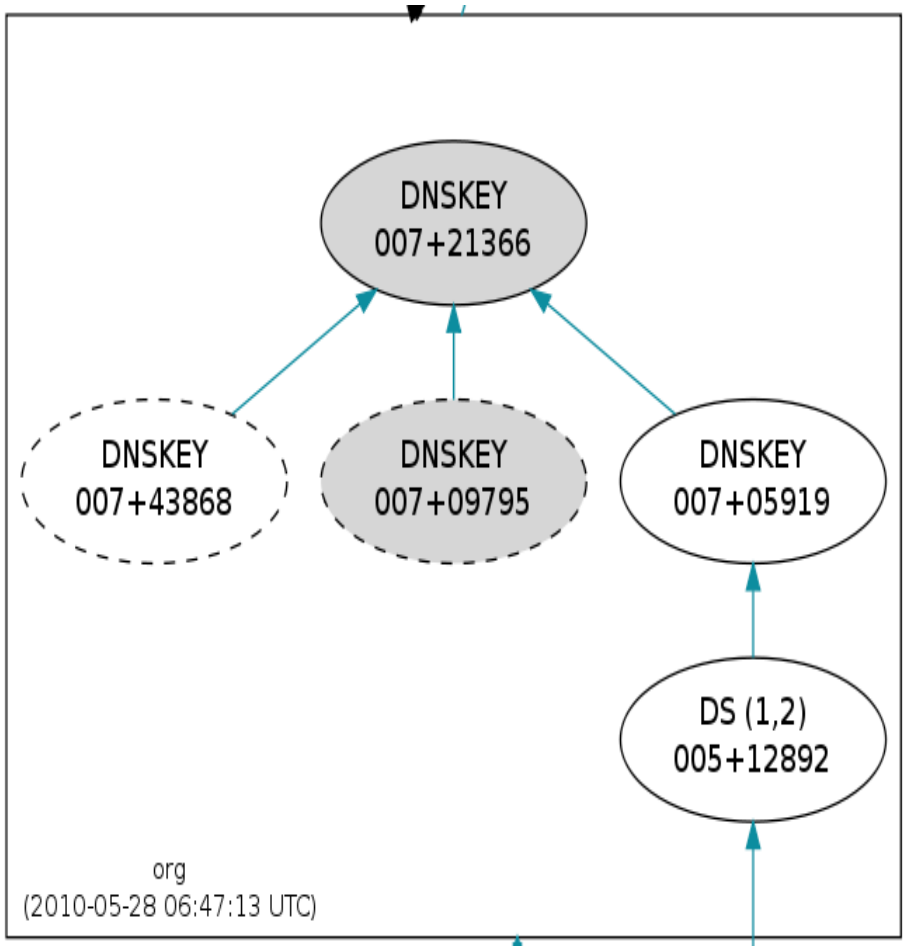
- KSK 19036
- ZSK 41248
  - Signed w/19036
- .org `DS` records
  - signed w/ 41248



Trusting `isc.org`

.org

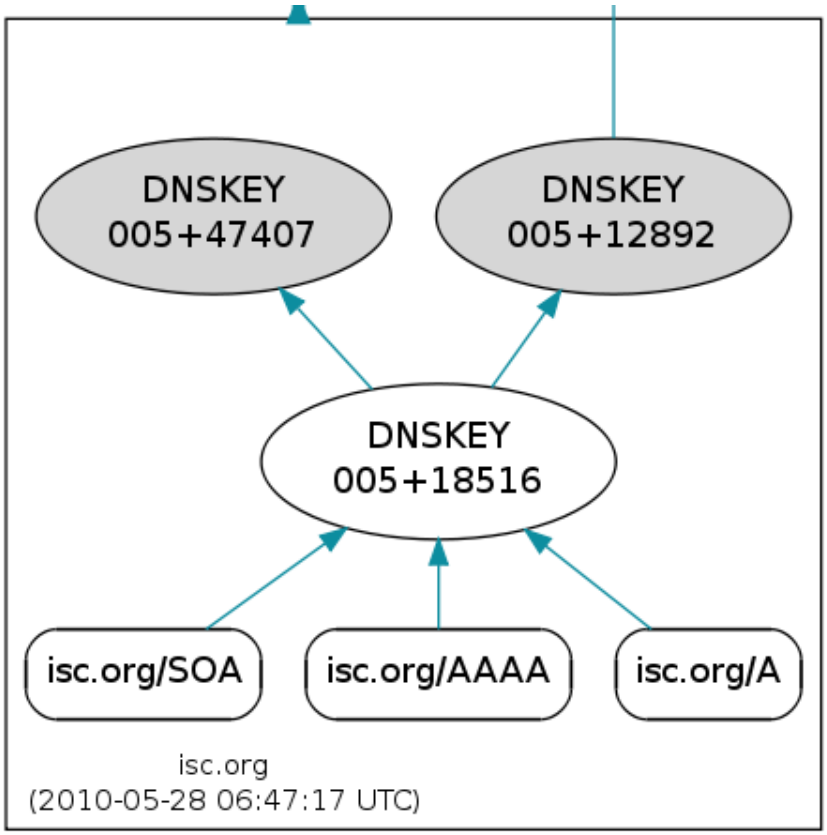
- KSK 21366
- ZSK 05919
  - Signed w/21366
- isc.org `DS` records
  - signed w/ 05919



Trusting isc.org

isc.org

- KSK 12892
  - Hashed into DS
- ZSK 18516
  - Signed w/ 12892
- SOA, AAAA, A
  - Signed w/ 18516



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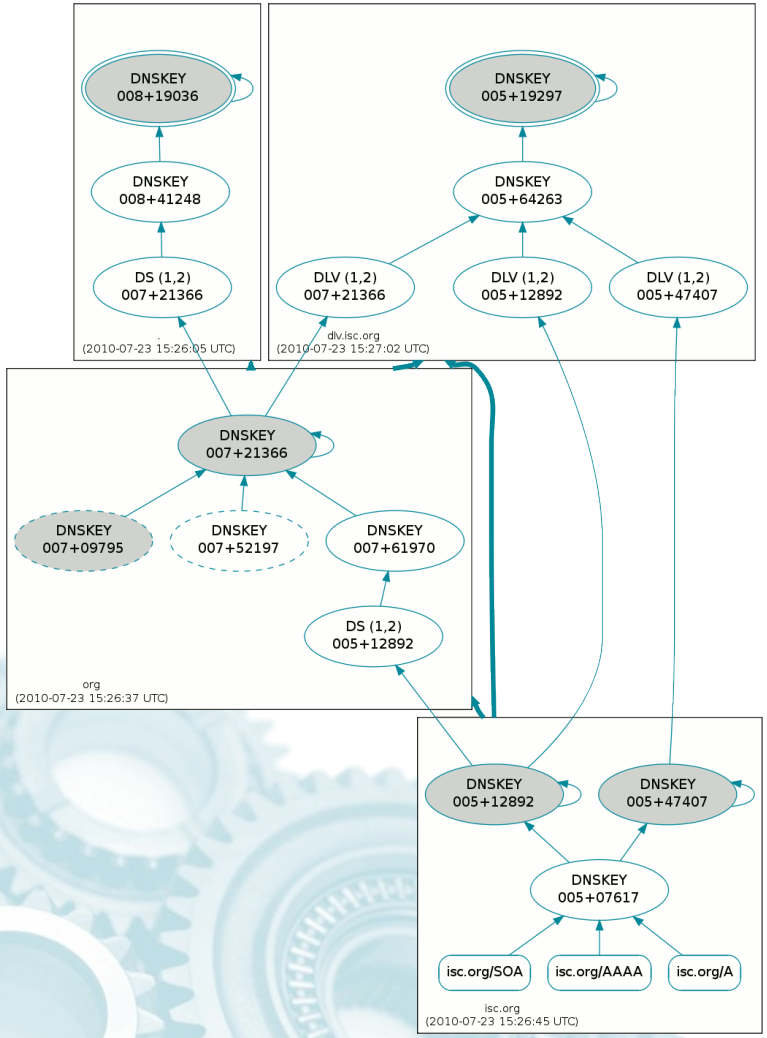

- With a trust anchor for root we can trust anything below it that is signed
  - And that has DS records in place

DNSSEC Deployment

BIND 9.7

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Recursive Server

Trust Validation

- In BIND, trust anchors are added in "trusted-keys" statements

```
trusted-keys {
   . 257 3 8 "AwEAA[..]ihz0=";
};
```

- But, what happens when a "hard-configured" key changes?

RFC-5011 ready anchors

- Be ready for KSK roll-over:

```
managed-keys {
      "." initial-key  257 3 8
       "AwEAA[..]k1ihz0=";
   };
```

- Defines the initial key used as KSK for the given zone

RFC-5011 ready anchors

- A file is created that tracks key changes

```
managed-keys.bind
managed-keys.bind.jnl
```

- This file will contain the currently active key, even if the configured key has rolled

RFC-5011 ready anchors

- Newly added "`rndc secroots`"
  - Creates a file "`named.secroots`" containing a list of the current managed keys that are in use:

```
10-Sep-2010 12:56:08.950

 Start view _default

./RSASHA256/19036 ; managed
dlv.isc.org/RSASHA1/19297 ; managed
```

RFC-5011 ready anchors

- One problem with `managed-keys`:
  - If a key has rolled without being noticed, validation will fail
  - This can happen if a validating server is off-line during a key roll-over, etc.

Authoritative Server

DNSSEC Deployment

- Generate required keys
  - `dnssec-keygen`
- Insert them into the zone
  - manual (or dynamic)
- Sign zone data
  - `dnssec-signzone` (or dynamic)
- Perform scheduled zone maintenance
  - manual (or dynamic)

DNSSEC Deployment

- `dnssec-keygen`
  - Used to create the required keys
    - Key Signing Key
    - Zone Signing Key

DNSSEC Deployment

- `dnssec-keygen`
  - Defaults algorithm to `RSASHA1`
  - Provides defaults for key size if default algorithm is used:
    - KSK – 2048 bits
    - ZSK – 1024 bits

DNSSEC Deployment

- `dnssec-keygen <zonename>`
- `dnssec-keygen -f KSK <zonename>`

- Produces 2 files per key

`K<zonename>+XXX+YYYY.key`

`K<zonename>+XXX+YYYY.private`

DNSSEC Deployment

- `dnssec-keygen`
  - Once keys are created, include their public portions (`.key`) into the zone file using standard procedures
  - Keep the `.private` portions secure

DNSSEC Deployment

- `dnssec-signzone`
  - Signs the zone data
    - Creates RRSIG resource records for each authoritative RRset in the zone
    - Transforms zone into "machine generated" file with a `.signed` extension

DNSSEC Deployment

- `dnssec-signzone`
  - BIND 9.7 introduced a new feature..
    - Smart Signing
      - Looks in key repository (directory) for keys
      - Keys are included in zone automatically
      - If key files contain timing meta-data, that timing data is used

DNSSEC Deployment

- `named`
  - New dynamic zone configuration
    - `update-policy local;`
      - Automatically creates "local-only" TSIG key
    - Allows BIND to update without complex configuration

DNSSEC Deployment

- `named`
  - New zone options for dynamic zones
    - `auto-dnssec off;`
      - Default
    - `auto-dnssec allow;`
      - Enables auto-inclusion of keys from repository
      - Enables "`rndc sign`"
    - `auto-dnssec maintain;`
      - Update DNSSEC based on key meta-data

DNSSEC Deployment

- `nsupdate`
  - New option `-l` (ell)
    - Use the named created "local key"
    - Set the `server` address to `localhost`

DNSSEC Deployment

- `rndc`
  - New option `sign`
    - Takes a dynamic zone, searches for keys in the key repository and signs the zone as needed.

Making it work...

```
zone test.com {
   type master;
   key-directory "keys";
   update-policy local;
   auto-dnssec maintain;
   file "dynamic/test.com.zone";
};
```

Making it work...

```
dnssec-keygen -K /etc/namedb/keys \
          test.com
dnssec-keygen -f KSK -K /etc/namedb/keys \
          test.com
rndc sign test.com
```

Zone is now signed and published

Zone will be automatically re-signed as needed

DNSSEC "just works"

- Adding or removing zone contents is now as simple as:

```
nsupdate -l
> update add <RRset>
> send
```

- `RRset` is added and signed data updated automatically

Timing Meta-Data

- `dnssec-keygen` creates meta-data in the key file:

`-P` –	Publication Date	(default: now)
`-A` –	Activation Date	(now)
`-R` –	Revocation Date	(none)
`-I` –	retIrement Date	(none)
`-D` –	Deletion Date	(none)

Timing Meta-Data

- These dates are used by `named` to maintain the zone signatures

- Date formats:

  `none` (literal)

  `YYYYMMDD`

  `YYYYMMDDHHMMSS`

  `now+<offset>`

  `y, mo, w, d, h, mi`

Timing Meta-Data

- To pre-publish a KSK without signing:

```
dnssec-keygen -K keydir \
  -f ksk -A none test.com
[...]Ktest.com.+005+11353

rndc sign test.com
```

Timing Meta-Data

- Once you are ready to sign the zone with the given key:

```
dnssec-settime -K keydir \
  -A now Ktest.com.+005+11353
rndc sign test.com
```

Timing Meta-Data

- To no-longer sign with the key, but leave it in the zone:

```
dnssec-settime -K keydir \
  -I now Ktest.com.+005+11353
rndc sign test.com
```

Timing Meta-Data

- And finally, remove the key from the zone:

```
dnssec-settime -K keydir \
  -D now Ktest.com.+005+11353
rndc sign test.com
```

Automation Warning!

Be aware that this automation does NOT deal with `DS` records in the parent or `DLV` records in a registry

DNSSEC Deployment

- BIND 9.7.2

  (currently [9/1/2010] release candidate)

`allow-new-zones` option

- boolean allowing creation of zones "on the fly"

`rndc addzone` / `rndc delzone`

- add and remove zones without manually editing `named.conf`

Create & Sign a zone

```
#!/bin/bash
cd /etc/namedb
cp template master/${1}

rndc addzone ${1} { type master\;\
                                file \"master/${1}\"\;\
                                update-policy local\; \
                                auto-dnssec maintain\; \
                                }\;

dnssec-keygen -f KSK -K /etc/namedb/keys $1
dnssec-dsfromkey -2 /etc/namedb/keys/K${1}.*.key > ds/${1}
dnssec-keygen -K /etc/namedb/keys $1
rndc sign ${1}
```

Create & Sign (NSEC3)

```
#!/bin/bash
SALT=`printf %04x%04x $RANDOM $RANDOM`
cd /etc/namedb
cp template master/${1}

rndc addzone ${1} { [..] };

nsupdate -l << //EOF
update add ${1} 30 IN NSEC3PARAM 1 0 10 $SALT

//EOF
dnssec-keygen -3 -f KSK -K /etc/namedb/keys $1
dnssec-dsfromkey -2 /etc/namedb/keys/K${1}.*.key > ds/${1}
dnssec-keygen -3 -K /etc/namedb/keys $1
rndc sign ${1}
```

Questions? Comments?

Ready to deploy?