DNSSEC Exposed
Deploying DNSSEC in Real Life

Internet Systems Consortium
About the Presenter

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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...

Web based Company looking for
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iPhone, An...
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...
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 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 thereby, 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/
Tusting 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

(2010-05-28 06:47:13 UTC)
Tustering isc.org

- isc.org
  - KSK 12892
    - Hashed into DS
  - ZSK 18516
    - Signed w/ 12892
  - SOA, AAAA, A
    - Signed w/ 18516
• With a trust anchor for root we can trust anything below it that is signed

– And that has DS records in place
DNSSEC Deployment
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
  
  $K<\text{zonename}>+XXX+YYYY.key$
  
  $K<\text{zonename}>+XXX+YYYY.private$
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

- New dynamic zone configuration

- `update-policy local;`
  - Automatically creates "local-only" TSIG key

- Allows BIND to update without complex configuration
DNSSEC Deployment

- 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...

```plaintext
zone secure.udp53.org {
  type master;
  key-directory "keys";
  update-policy local;
  auto-dnssec maintain;
  file "dynamic/secure.zone";
};
```
Making it work...

dnssec-keygen -K /etc/namedb/keys \\
  secure.udp53.org

dnssec-keygen -f KSK -K /etc/namedb/keys \\
  secure.udp53.org

rndc sign secure.udp53.org

Zone is now signed and published

Zone will be automatically re-signed as needed
Making it work...

- 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 beta-2)

new-zone-file option
• specifies the name of a file to which 'dynamically created' zones are added

rndc addzone / rndc delzone
• add and remove zones without manually editing named.conf
Questions?
Comments?
Ready to deploy?