DNSSEC made easy

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The theory

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The need for DNSSEC

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DNS has weak inbuilt security

- ID field, 16 bit integer, returned in reply.
  - Some implementation use 14 bits
  - Multiple queries allow “birthday attack”
  - 16,384 packets is not a lot
- UDP generally preferred over TCP
  - No source address validation
  - Authoritative server addresses well known
- Spoofing data is hard to detect
  - Not much monitoring of DNS server caches
  - Increasingly targetted

A solution

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DNSSEC adds security to DNS

- Authoritative server replies now signed.
  - Queries not signed - one way security.
- Keys published in zones like other data.
  - New DNS RR types for keys, signatures (and others) specific to DNSSEC.
- All sorts of usual stuff
  - Expiry dates for keys and signatures
  - Key rollover mechanisms
  - Support for different algorithms

Signatures

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New DNS resource record RRSIG

- Sent automatically to DNSSEC aware resolvers
  - Flagged by setting D0 bit in query
- One per RRSET
  - RRSET has same owner, class and type
- Not used for NS records (more on that later)

```
$ORIGIN internet.co.uk.

@               SOA     …
                RRSIG   SOA     …

www             A       …
                A       …
                RRSIG   A       …
```

Keys

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New DNS resource record DNSKEY

- Two types of keys (convention not protocol):
  - Zone Signing Keys (ZSKs) - used to sign zone data
    - short, fast signature verification, short lifetime
  - Key Signing Keys (KSKs) - used to sign KSKs
    - long, long signature verification, long lifetime

```
$ORIGIN internet.co.uk.

@       DNSKEY 256 3 5 ( AQOeiiR0GOMYkDshWoSKz9Xzfw
                         Jr1AYtsmx3TGkJaNXVbfi/2pHm822aJ5iI9BM
                         zNXxeYCmZDRD99WYwYqUSdjMmmAphXdv
                         xegXd/M5+X7OrzKBaMbCVdFLUUh6DhweJBj
                         EVv5f2wwjM9XzcnOf+EPbtG9DMBmADjFDc2
                         w/rljwvFw== ) ;  key id = 60485
```

Delegations

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Trust passes from parent and child zones

- Reminder on delegation data
  - Child is authoritative not parent
  - If NS records disagree then child wins
  - Parent data is just a hint
- DNSSEC handles delegations to fit these principles
  - NS records are not signed
  - New DNS resource record - DS (Delegation Signer)
    - Hash of child DNSKEY record data
    - Signed itself by an RRSIG
- Passes right way up to the root zone
  - Root zone keys must be implicitly trusted.

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The chain of trust

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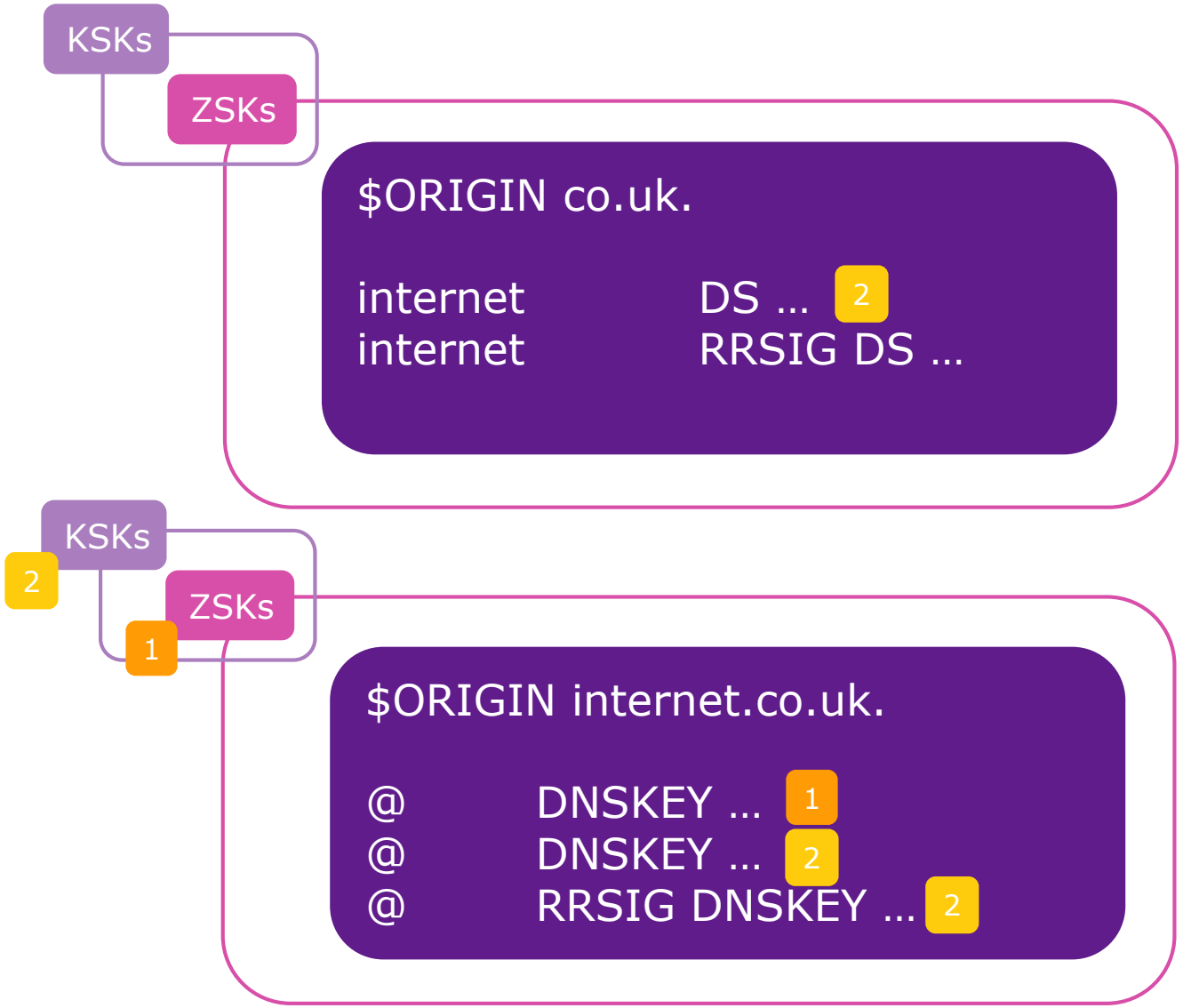

Provable non-existence

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Two new DNS resource records - NSEC and NSEC3

- Define a span - two adjacent existing names
  - Zone file contains aaa and ccc, client asks for bbb
  - Server responds with NSEC for aaa to ccc
  - Proves that bbb does not exist

```
$ORIGIN internet.co.uk.

aaa     A       …
        RRSIG   A …
        NSEC    ccc …
        RRSIG   NSEC …

ccc     A       …
```

Recent RFCs

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Tackle implementation issues

- Zone file walking
  - Using NSECs can walk a zone file
  - If privacy is not an issue then bandwidth is !
- NSEC3 used instead of NSEC where needed
  - Spans of hashed names
- Huge increase in zone file size
  - Immediate 10x size increase
- Opt-out allows choice of signed delegations
  - No child key no security on delegation
  - Allows organic zone file growth
- Not quite finished - Automated root zone key rollover

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The practice

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Using secured incoming DNS data

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Putting into practice simpler than understanding theory

- Caveat - Not all of this is possible yet
- Securing caching resolvers
  - Find and install root zone keys (if only!)
  - Turn on DNSSEC
  - Done !!
- Securing applications at the OS level
  - Turn on DNSSEC in resolver library
    - Backwards compatibility - Use DNSSEC if present, otherwise work as before. (Now)
    - Strict DNSSEC - Only use DNSSEC, unsigned records discarded. (5 years?)

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Securing outgoing DNS data

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This requires planning

- Generate keys
  - Choices on key sizes - KSKs, ZSKs, size etc
  - Choices on securing keys - HSMs, silo keys etc
- Sign the zones
  - Choices on mechanism - crypto accelerators
  - Choices on signature lifetimes - resigning timetable
  - Choices on delegations - sign all or opt-out
- Resource planning
  - 10x zone file increase
  - Higher bandwidth
  - More TCP to nameserver
- Send keys to registry

Best practice tips

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We are writing documents on this !

- Signing schedules
  - Ensure always a current signature
  - Match zone generation/reload schedule
  - Implement continuous signing if zones not reloaded
- Ensure always active keys
  - Key rollover strategy
  - Schedule transmission of keys to registry
- If you delegate zones as well
  - Mechanism for receiving keys
  - Manage growth of zones

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The politics

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Current DNSSEC deployment

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Some early adopters

- Isolated trust anchors
  - Individual registries have signed their zones
    - .se, .pr, RIPE
  - Sysadmins must manually find and install keys
  - No automated key rollover - manual process
- Does not scale
  - Whole point of DNS is a single root !
- Others insistent they will not sign yet
  - .uk, .de - zone walking solution
  - .com - opt-out

Signing the root

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Two different camps on signing the root

- Camp one - the 'hidden agenda' brigade
  - US DoC will have too much control
  - Signatures have a special meaning
  - Needs a new body to manage root signing
- Camp two - the 'just get on with it' brigade
  - US DoC already has control - changes nothing
  - Signatures are just error checking
  - IANA and RZM (Verisign) already control this
- Where is this going?
  - Root politics already difficult
  - IANA now ready to do this (taking over RZM function?)
  - US DoC NTIA consulting on way forward

Summary

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Remember

- DNSSEC is coming
  - Internet must be secured in layers - DNS layer is critical
- Protocol is a lot to learn but straightforward
- Implementation has two parts
  - Securing incoming DNS data - simple
  - Securing outgoing DNS data - requires planning
- And by the time you are ready
  - They might have signed the root !

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The end

Questions?

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