Rolling the Root Zone DNSSEC Key Signing Key

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Motivation for this talk

- ICANN is about to change an important configuration parameter in DNSSEC
- For a network operator, this may create a need for action
- This discussion is meant to inform: Why this is happening, what is happening, and when
    - Highlighting: the availability of project plan documents

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Trust Anchors & Root KSK

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Root Zone DNSSEC

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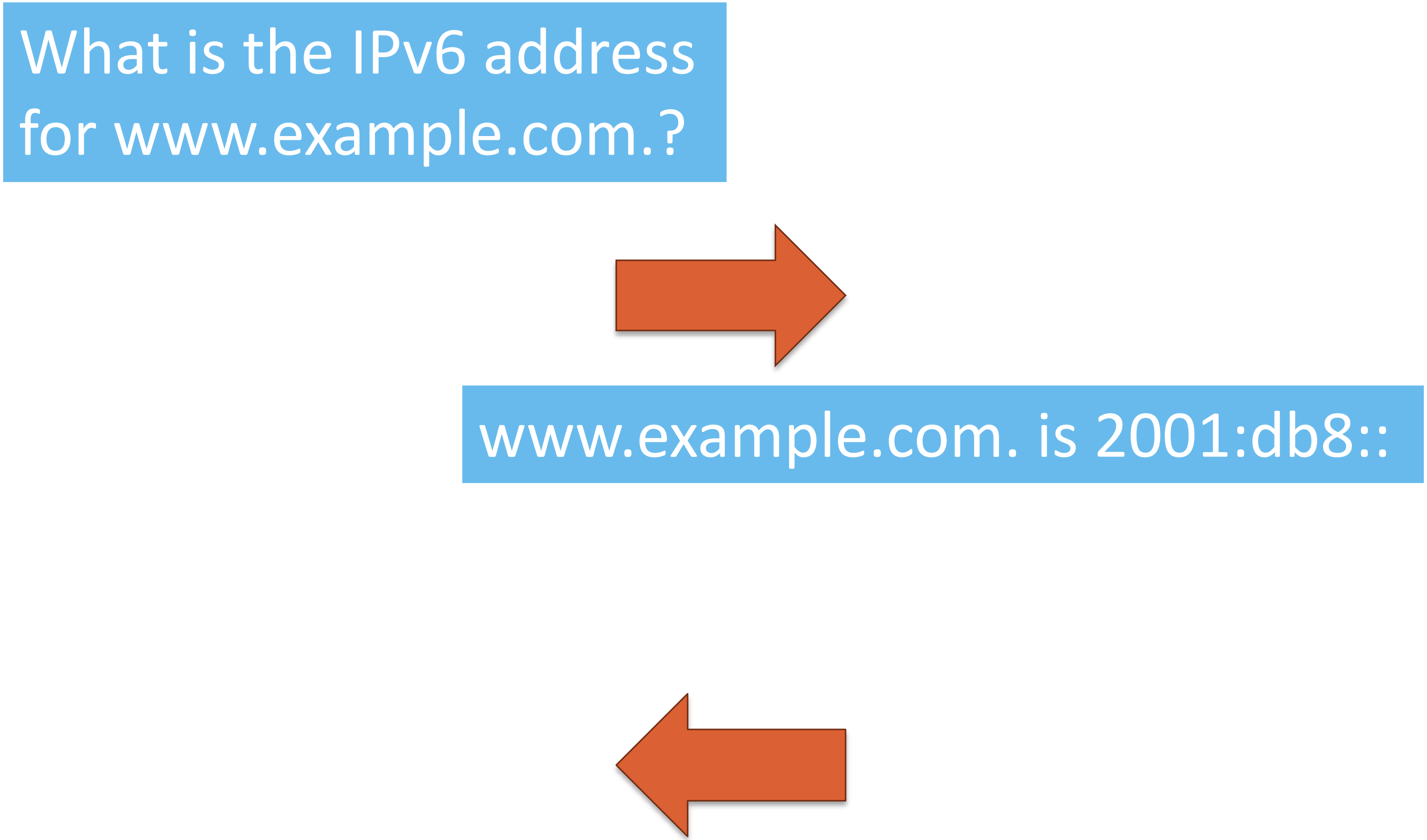
KSK Roll Project

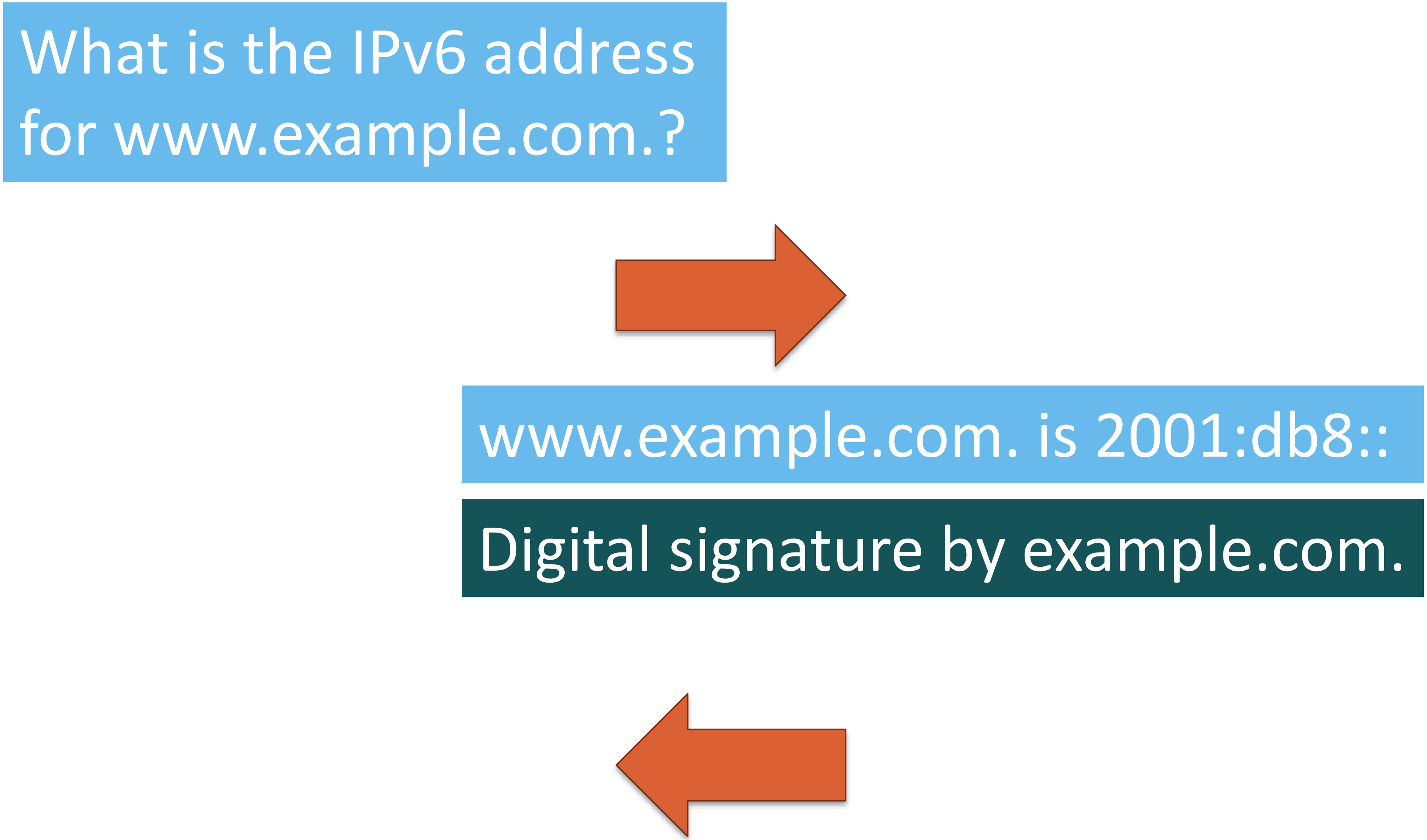
DNS for Those Who Don't Like Protocols



What is the IPv6 address for www.example.com.?

www.example.com. is 2001:db8::

DNSSEC for Those Who Don't Like Protocols



What is the IPv6 address for www.example.com.?

www.example.com. is 2001:db8::

Digital signature by example.com.

What is DNSSEC Validation?

- Validation includes the process of inspecting the digital signature and the data to verify the answer is the appropriate one
  - The signature and data need a public key, a chain of keys, and a trust anchor
  - Software tools today can do this when configured
- Validation is more than a cryptographic check
  - Is the answer related to the question?
  - Is the answer "fresh", replayed, and so on?

Why Bother?

- Why bother?
  - The DNS protocol is gullible, easily fooled
  - Forged answers in DNS can result in misdirected traffic
  - Protect your DNS service, protect customers

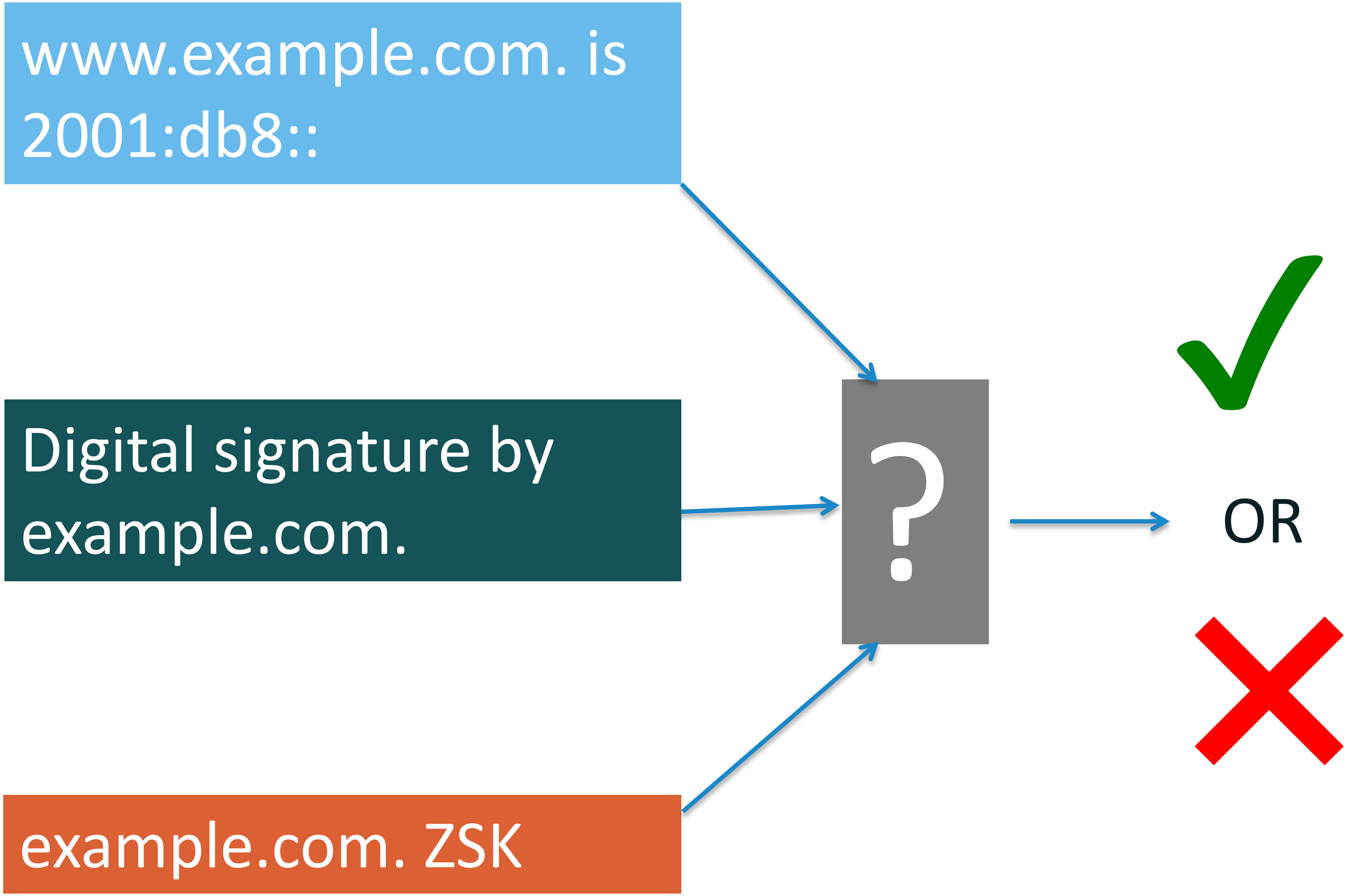
- Validation is "self-protection"

- With DNSSEC as a base
  - Extensions to secure email transfer (stop spam)
  - Supplement to X.509 Certificate operations

Roles of Keys in DNSSEC

- DNSSEC has three kinds of records that, in some loose definition, hold cryptographic key data. The records exist because of the use of the data or "role"/"job"
  - KSK – Key Signing Key, produce signatures of keys
  - ZSK – Zone Signing Key, produces all other signatures
  - DS – Delegation Signer, a "pointer" to a key
- *This was supposed to simplify DNS operations!*

Crypto-checking a Signature

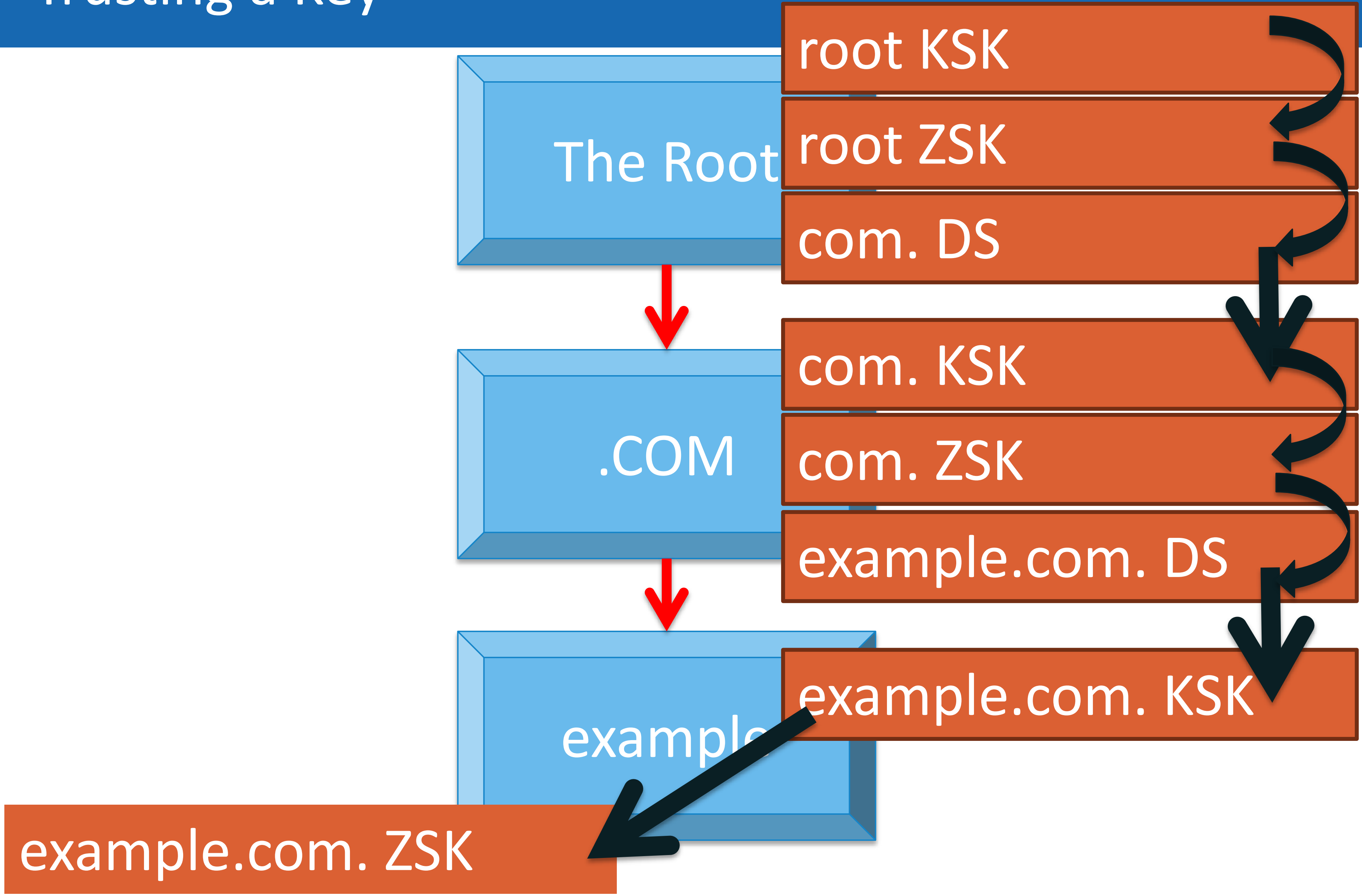


www.example.com. is 2001:db8::

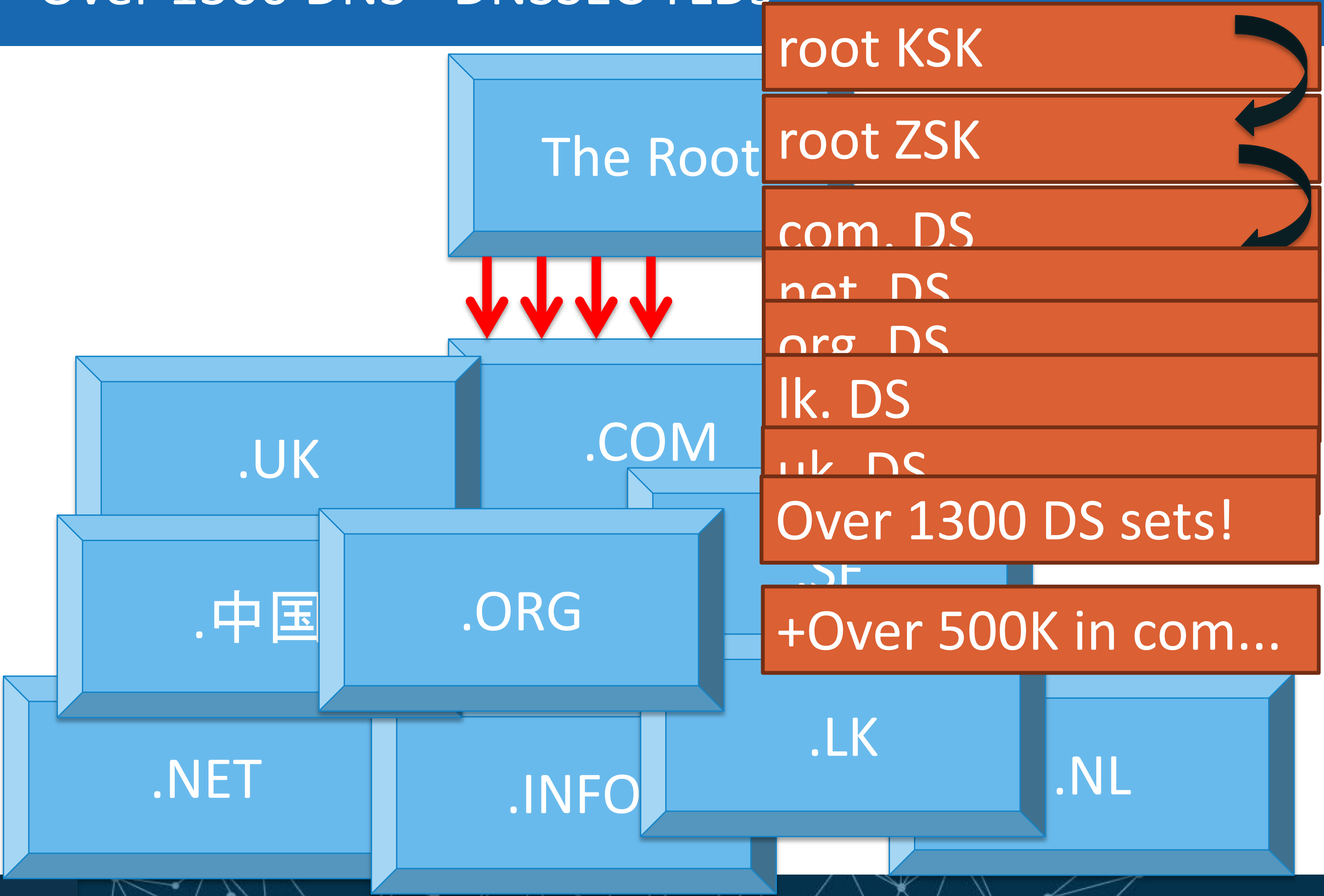
Digital signature by example.com.

example.com. ZSK

Trusting a Key



Over 1300 DNS - DNSSEC TLDs



root KSK

root ZSK

com. DS

net. DS

org. DS

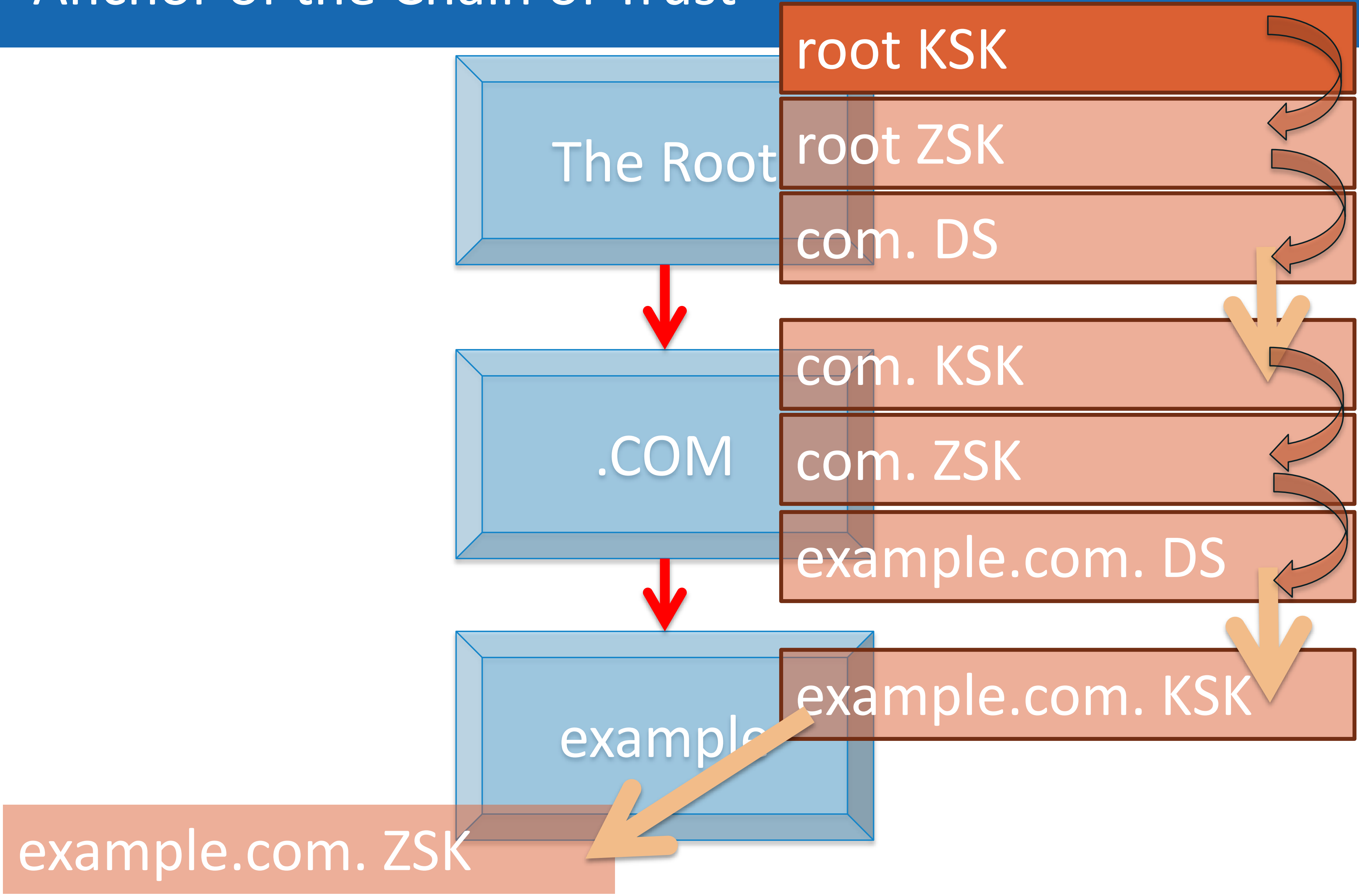
lk. DS

uk. DS

Over 1300 DS sets!

+Over 500K in com...

Anchor of the Chain of Trust



What is a Trust Anchor?

- Besides being the "top" of any DNSSEC validation process?

- A trust anchor is a key that an operator places full faith and trust into for the purposes of verifying responses
  - It could be implicitly trusted because it came with the software
  - It could be explicitly trusted via due diligence examination

Is the Root Zone KSK *the* Trust Anchor?

- Maybe
- It's really up to you

- By convention, there's a unique root zone, it has a KSK, for the global public Internet operated by ICANN
- By default, DNSSEC validation tools come configured with that KSK as ***the*** trust anchor

- But a user of the tools can add other trust anchors

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DNSSEC in the Root Zone

- DNSSEC in the Root Zone is managed by:
  - ICANN, responsible for operating the root KSK
  - Verisign, responsible for operating the root ZSK
- Operating the KSK
  - KSK lifecycle management, "sign the ZSK"
- Operating the ZSK
  - ZSK lifecycle management, "sign the root zone"

- Activities are coordinated but operated separately

Current Root KSK

- The current root KSK was created in 2010
  - Stored in Hardware Security Modules in two Key Management Facilities
  - The operations surrounding the key is an entirely different talk

Getting the Root KSK (Public portion only!)

- Via the DNS
  - As reliable as the data in unprotected DNS
  - (Works if you not subject to an "attack")
- Via the Web
  - *https://data.iana.org/root-anchors/root-anchors.xml*
  - Secured by an X.509 certificate and signature
- Via other means
  - Code
  - Presentations, t-shirts, friends
  - Always remember to check the legitimacy!

Changing the Root KSK

- There is a plan in place to change the root KSK
  - For the first time

- This plan is precedent setting
  - Because it involves an uncountable roster of participants and impacted parties
  - When ICANN changes the KSK on our end -
  - Anyone who (anonymously) relies on it has to change a configuration on their end
  - No one can list all those involved – unless something goes wrong

Why (rock the boat)?

- Good cryptographic hygiene
  - Secrets don't remain secret forever

- Good operational hygiene
  - Have a plan, complete enough to execute
  - Exercise the plan under normal circumstances

- Why not a private test?
  - The change of the KSK involves everyone doing DNSSEC validation on the Internet, service operators, software producers

Bottom Line

- Changing the root KSK will impact just about all DNSSEC validations
  - If the trust anchor is "misconfigured" (i.e., the wrong key) DNSSEC will reject legitimate responses
  - To anyone or any process relying on DNS, it will appear that the desired data is unavailable, website is unreachable, "the Internet is down"

- There's a broader topic of trust anchor maintenance, but that is for another time

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KSK Roll Project

The KSK Rollover Project and Network

- The project is meaningful to you if you are performing DNSSEC validation
  - Geoff Huston stats: steady 15% world wide
  - DNSSEC signing is not affected
- If you are validating it's time to revisit configurations and processes
  - A root KSK roll hasn't happened before, it's new to all of us

The KSK Rollover Plan Documents

- Available at: *https://www.icann.org/kskroll*

  2017 KSK Rollover Operational Implementation Plan

  2017 KSK Rollover Systems Test Plan

  2017 KSK Rollover Monitoring Plan

  2017 KSK Rollover External Test Plan

  2017 KSK Rollover Back Out Plan

- We encourage interested folks to given them a read

Overview of Project Plans

- Plans say - On **October 11, 2017** a new KSK will go into use and the current KSK retired
  - On this day, if preparations haven't been made, trouble will ensue

- Plans include
  - Retaining the current cryptography settings
    - No change in key size, cryptographic algorithm, etc.
  - Following *Automated Updates of DNSSEC Trust Anchors*
    - Defined in RFC5011
  - Fitting the roll into normal maintenance events
    - Regular quarterly key ceremonies
  - Testing and monitoring

The Project's DNS Response Size Concerns

- Significant DNS responses will grow to 1425 bytes during the project
  - The root “key set”: all the DNSKEY records at the root
- Experimentation, especially in IPv6, suggests this might be a concern despite empirical evidence to the contrary
- How to avoid potential problems
  - Where UDP is allowed to port 53, also allow TCP
  - Refrain from filtering DNS messages based on size

IPv6 fragmentation and DNS

- IPv6 fragmentation is done by the sender with intermediate nodes using ICMP to indicate a fragment as being "too big"
  - By the time the DNS sender gets the ICMP, DNS has forgotten what it had sent

- From Geoff Huston experiments and analysis
  - *http://www.potaroo.net/ispcol/2016-05/v6frags.html*
  - TCP over IPv6 use an MTU of 1,280 bytes
  - UDP has marginal advantages with using larger MTU

Dates to Watch

- September 19, 2017
  - The root zone DNSKEY set will increase to 1414 bytes for 20 days, prior to that date 1139 bytes has been the high water mark

- **October 11, 2017**
  - On this date the root zone DNSKEY set will be signed only by the new KSK

- January 11, 2018
  - The root zone DNSKEY set will increase to 1425 bytes for 20 days

Trust Anchor Management

- How do you trust and configure?
  - Are trust anchors subject to configuration control?
  - Rely on embedded data in software?
  - Are DNSSEC validation failures monitored?
- Automated Updates of DNSSEC Trust Anchors
  - Most direct, reliable means for getting the key
- Negative Trust Anchor management – RFC 7646
  - Protects against errors made by others

Tools & Testbeds

- We are working with DNS software and tool developers and distributors
  - Management/troubleshooting aids
  - Updates of bundled keys

- Testbeds for Code Developers
  - Automated updates: *http://keyroll.systems/*
  - Root zone model: *https://www.toot-servers.net/*

- Testbeds for Service Operators
  - I.e., using "off-the-shelf" parameters
  - Planned for end-of-2016

For More Information

- Join the ksk-rollover@icann.org mailing list:
  - https://mm.icann.org/listinfo/ksk-rollover
- Follow on Twitter
  - @ICANN
  - Hashtag: #KeyRoll
- Visit the web page:
  - https://www.icann.org/kskroll

Engage with ICANN

Thank You and Questions

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