DNSSEC: A Vision

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Outline

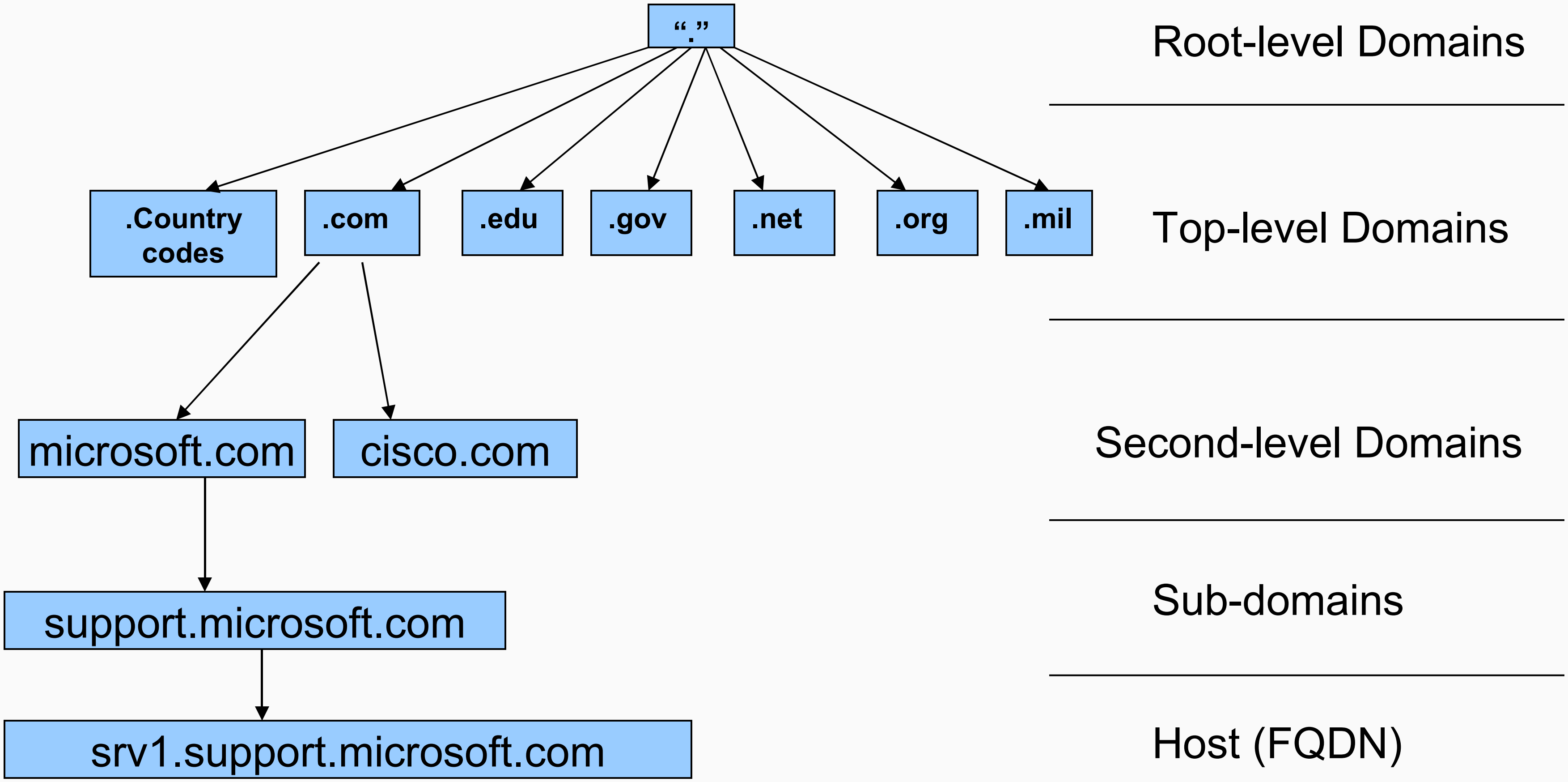
- DNS Today
- DNS Attacks
- DNSSEC: An Approach
- Countering DNS Attacks
- Conclusion

DNS Today

- DNS is a distributed dynamic database application with a hierarchical structure and offering a dependable service
- Originally DNS design was focused on data availability and did not include it's security
- DNS major components:
  - The Database
    - Domain name space (DNS Tree)
    - Resource Records
  - The Server
    - Name Server
  - The Client
    - Resolvers

DNS Namespace

DNS uses a hierarchical namespace to locate computers



“.”

Root-level Domains

.Country codes

.com

.edu

.gov

.net

.org

.mil

Top-level Domains

microsoft.com

cisco.com

Second-level Domains

support.microsoft.com

Sub-domains

srv1.support.microsoft.com

Host (FQDN)

DNS Attacks

- June 1997, Eugene Kashpureff (Alternic founder) redirected the internic.net domain to alternic.net by caching bogus information on the Internic name server
- In early February 2006, name servers hosting Top Level Domain zones were the repeated recipients of extraordinary heavy traffic loads
- On 6 February 2007, starting at 12:00 pm UTC, for approximately two-and-a-half hours, the system that underpins the Internet came under attack. Three-and-a-half hours after the attack stopped, a second attack, this time lasting five hours, began

DNS Hacking Objectives

- Attacking DNS server data
- Attacking the DNS server

DNS Today: Potential Problems

- Original DNS design focused on data availability and did not include security

- DNS design included no authentication

- The DNS protocol does not allow you to check the validity of DNS data

- DNS data can be spoofed and corrupted between master server and resolver or forwarder

Securing DNS

- Built security into DNS systems

- TSIG Transactions
  - Enhancements to secure Server-Server transactions

- DNS Security Extensions (DNSSEC)
  - Enhancements to secure Server-Client transactions

DNSSEC: An Approach

- DNSSEC (short for Domain Name System Security Extensions) adds security to the Domain Name System's query / response
- Protects against unauthorised DNS data corruption and DNS spoofing
- It provides:
  - origin authentication of DNS data
  - data integrity but not confidentiality
  - authenticated denial of existence
- It is designed to be interoperable with non-security aware implementations

DNSSEC: Characteristics

- Changes to DNS Protocol
  - DNSSEC adds four new Resource Records (RR)
    - KEYRR(DNSKEY): Key Resource Record specifies:
      - the type of key (zone, host, user)
      - the protocol (DNSSEC, IPSEC, TLS, etc.)
      - the algorithm (RSA/MD5, DSA, etc.)
    - SIGRR : Signature resource record specifies:
      - the RR type covered (SOA, A, NS, MX, etc.)
      - the algorithm (RSA/MD5, DSA, etc.)
      - the inception & expiration times
      - the signer key footprint
    - DS: Delegation Signer
      - a pointer to the next key in the chain of trust

DNSSEC: Characteristics

- NXTRR(NSEC): Next Secure
  - the next name in the zone
  - all the RR types covered by the current name

- The private key is kept off-line and is used to sign the RR sets of the zone file

- The public key is published in the KEY RR

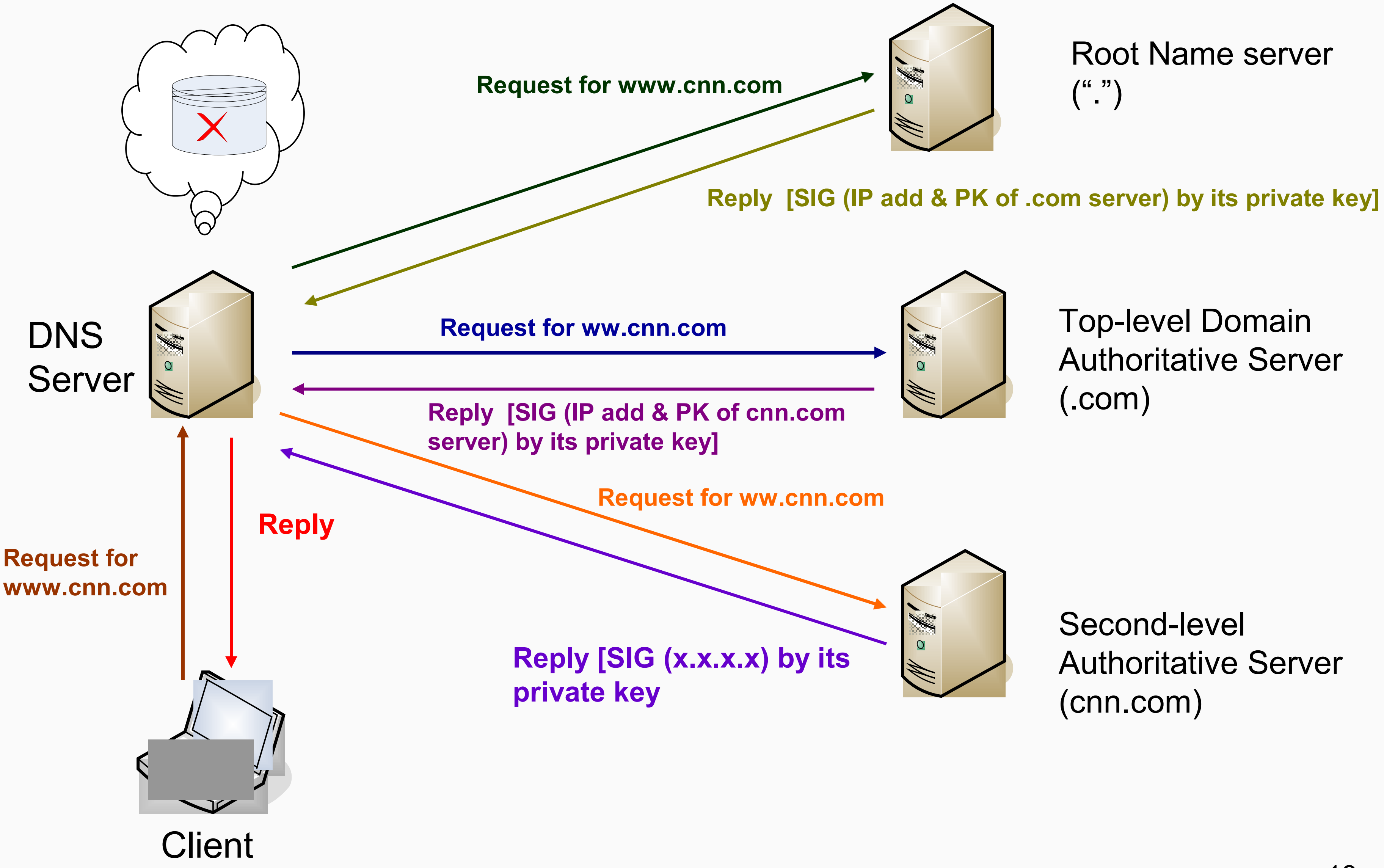
- The public key of a zone is signed by the parent zone private key

- The parent zone signature on the zone’s public key is added to the zone file

What DNSSEC does NOT do

- Does NOT provide confidentiality of DNS responses
- Does NOT protect against DDOS attacks
- Does NOT protect against IP Spoofing
- Is NOT about privacy
- Is NOT a PKI

DNSSEC Query

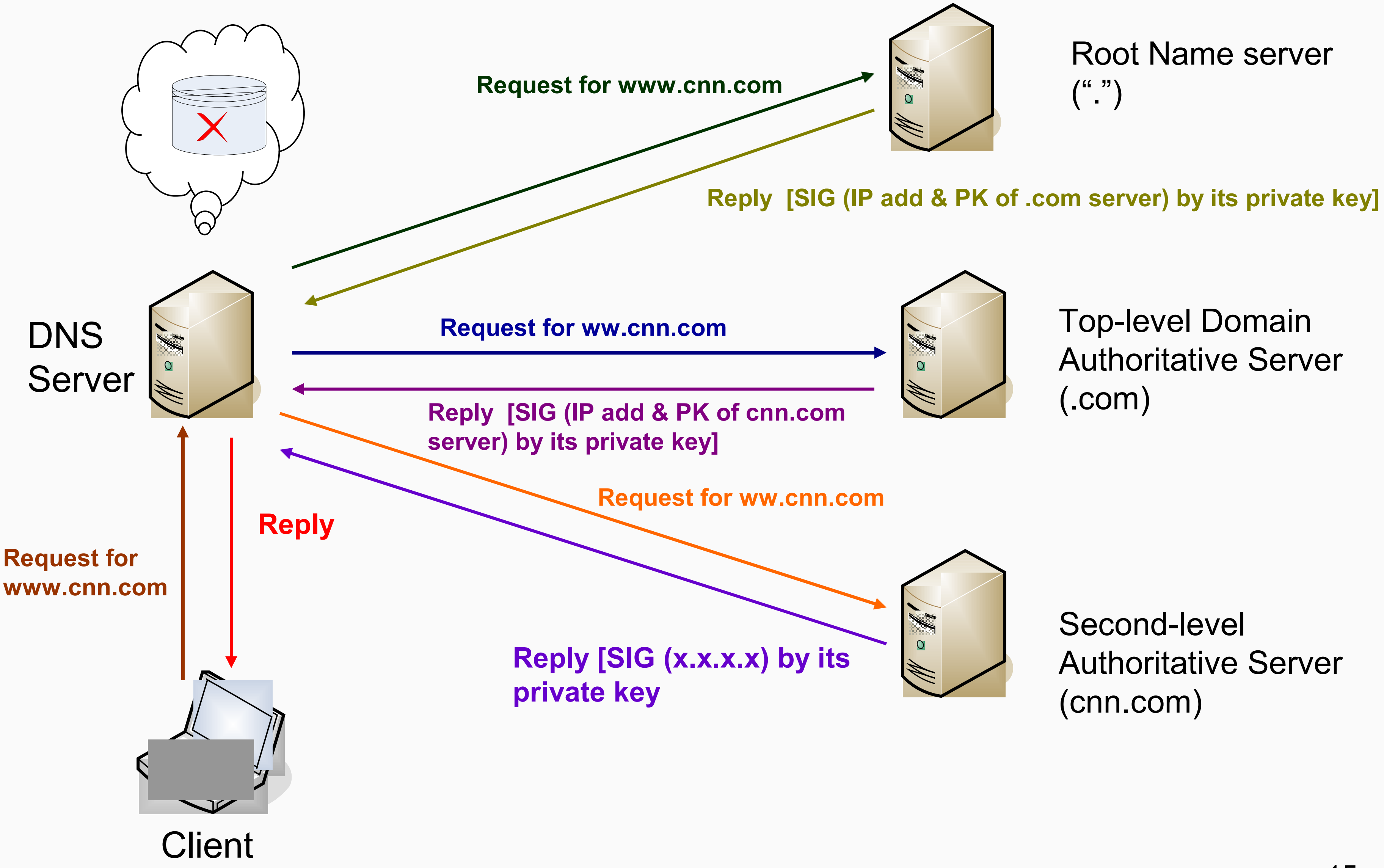


DNSSEC – Response Validation

- Validation of a DNS response:
  - Did the matching private key sign the RRSIG RR?
  - Does the hash match the RR data?
  - Does the public key validate?
    - Does the parent have a DS RR?
    - Has the Parent signed the matching RRSIG RR?
    - Does the parent's key validate?
    - Loop until you get to a recognised "trust anchor"

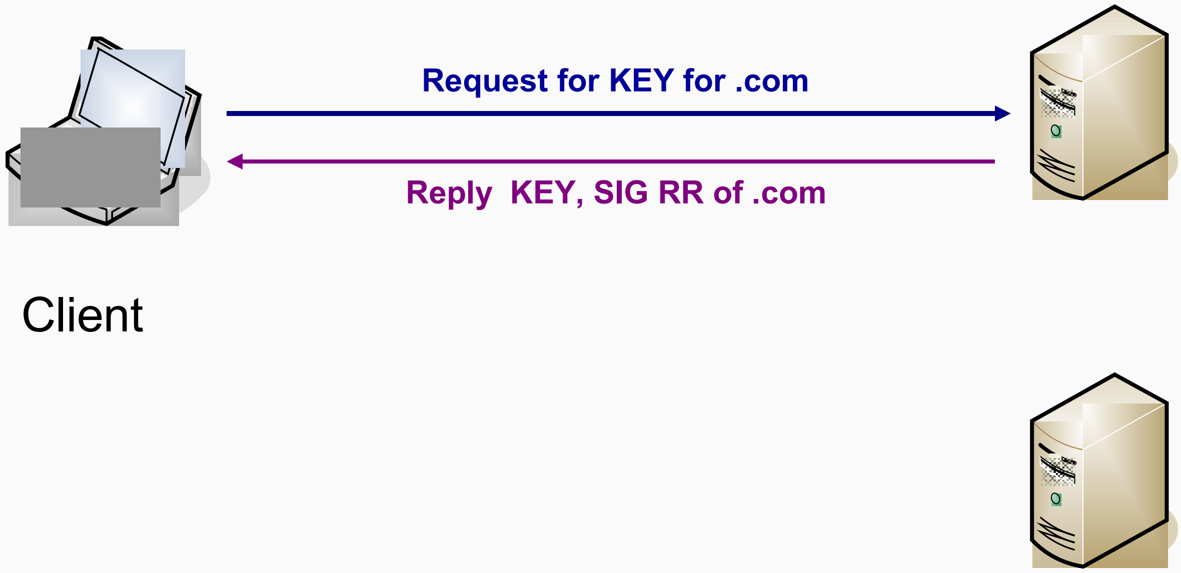
This interlocking of parent signing over child is a critical aspect of the robustness of DNSSEC. It's also DNSSEC's major weakness in today's partial DNSSEC deployment world

DNSSEC: Chain of Trust



Request for www.cnn.com
Root Name server
(".")
Reply [SIG (IP add & PK of .com server) by its private key]
DNS Server
Request for ww.cnn.com
Top-level Domain Authoritative Server (.com)
Reply [SIG (IP add & PK of cnn.com server) by its private key]
Request for ww.cnn.com
Reply
Request for www.cnn.com
Second-level Authoritative Server (cnn.com)
Reply [SIG (x.x.x.x) by its private key
Client

DNSSEC: Chain of Trust



Request for KEY for .com

Reply KEY, SIG RR of .com

Client

Top-level Domain
Authoritative Server
(.com)

Second-level
Authoritative Server
(cnn.com)

DNS Defenses

Protocol Based Exploits	Defense
DNS reconnaissance	Split-level DNS topologies Network and Name Server monitoring, intrusion detection **DNSSEC** digital signatures to secure DNS data Server-side access controls Configuration audit and verification tools
Protocol-based denial-of-service	Split-level DNS topologies DNS redundancy Stateful firewalling Server-side access controls Network and Name Server monitoring, intrusion detection Patches and service packs
Dynamic DNS (DDNS) hacking	Split-level DNS topologies Network and Name Server monitoring, intrusion detection Server-side access controls for DDNS **DNSSEC**: authentication of DDNS requests Configuration audit and verification tools Patches and service packs

DNS Defenses

Application Based Exploit	Defense
Buffer overflow attacks	System and service hardening Network and Name Server monitoring, intrusion detection Stateful firewalling Split-level DNS topologies DNS redundancy Patches and service packs Third-party application-layer security tools

DNS Defenses

Trust Based Exploits	Defense
DNS registration hacking	Imposition of registration controls
DNS spoofing	Split-level DNS topologies Stateful firewalling Server-side access controls Network and Name Server monitoring, intrusion detection **DNSSEC** digital signatures to secure DNS data Patches and service packs Upgrade to latest version(s) of Name Server software (protections against DNS ID hacking)
Cache poisoning	Split-level DNS topologies Stateful firewalling Server-side access controls Network and Name Server monitoring, intrusion detection **DNSSEC** digital signatures to secure DNS data Patches and service packs
DNS hijacking	Split-level DNS topologies Stateful firewalling Server-side access controls Network and Name Server monitoring, intrusion detection **DNSSEC** digital signatures to secure DNS data Patches and service packs

DNSSEC: Deployments

- DNSSEC test deployment at IANA
  - This data, including the signed zones, are purely for test purposes and are not to be used in any production capacity
- DNSSEC testbed in
  - Sweden (.se)
  - Russia (.ru)
  - United Kingdom (.uk)
  - Mexico (.mx)
  - Puerto Rico (.pr)
  - Netherlands (.nl)
  - Bulgaria (.bg)
  - Brasil (.br)
  - Malaysia (.my)
- VeriSign

Why DNSSEC is important?

Is this ROI or Return on Risk ?

- Total dependence on DNS for the functioning of Internet
- Low security awareness
- Rise in threats

How costly is the exploitation that occurs if we don’t have this protection?

Refrences

- http://www.dnssec.net
- http://www.dnssec-deployment.org
- http://www.ripe.net
- http://www.icann.org
- RFCs: 4033, 4034, 4035 and 3833

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