DNS is a simple game?

Musing about a protocol

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In the beginning

- HOSTS.TXT (RFC 952)
- Maintained by SRI (Stanford)
  - Later by ISI
- A look up table
- Didn’t scale well

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EXAMPLE OF HOST TABLE FORMAT

   NET : 10.0.0.0 : ARPANET :
   NET : 128.10.0.0 : PURDUE-CS-NET :
   GATEWAY : 10.0.0.77, 18.10.0.4 : MIT-GW.ARPA,MIT-GATEWAY : PDP-11 :
             MOS : IP/GW,EGP :
   HOST : 26.0.0.73, 10.0.0.51 : SRI-NIC.ARPA,SRI-NIC,NIC : DEC-2060 :
          TOPS20 :TCP/TELNET,TCP/SMTP,TCP/TIME,TCP/FTP,TCP/ECHO,ICMP :
   HOST : 10.2.0.11 : SU-TAC.ARPA,SU-TAC : C/30 : TAC : TCP :
```

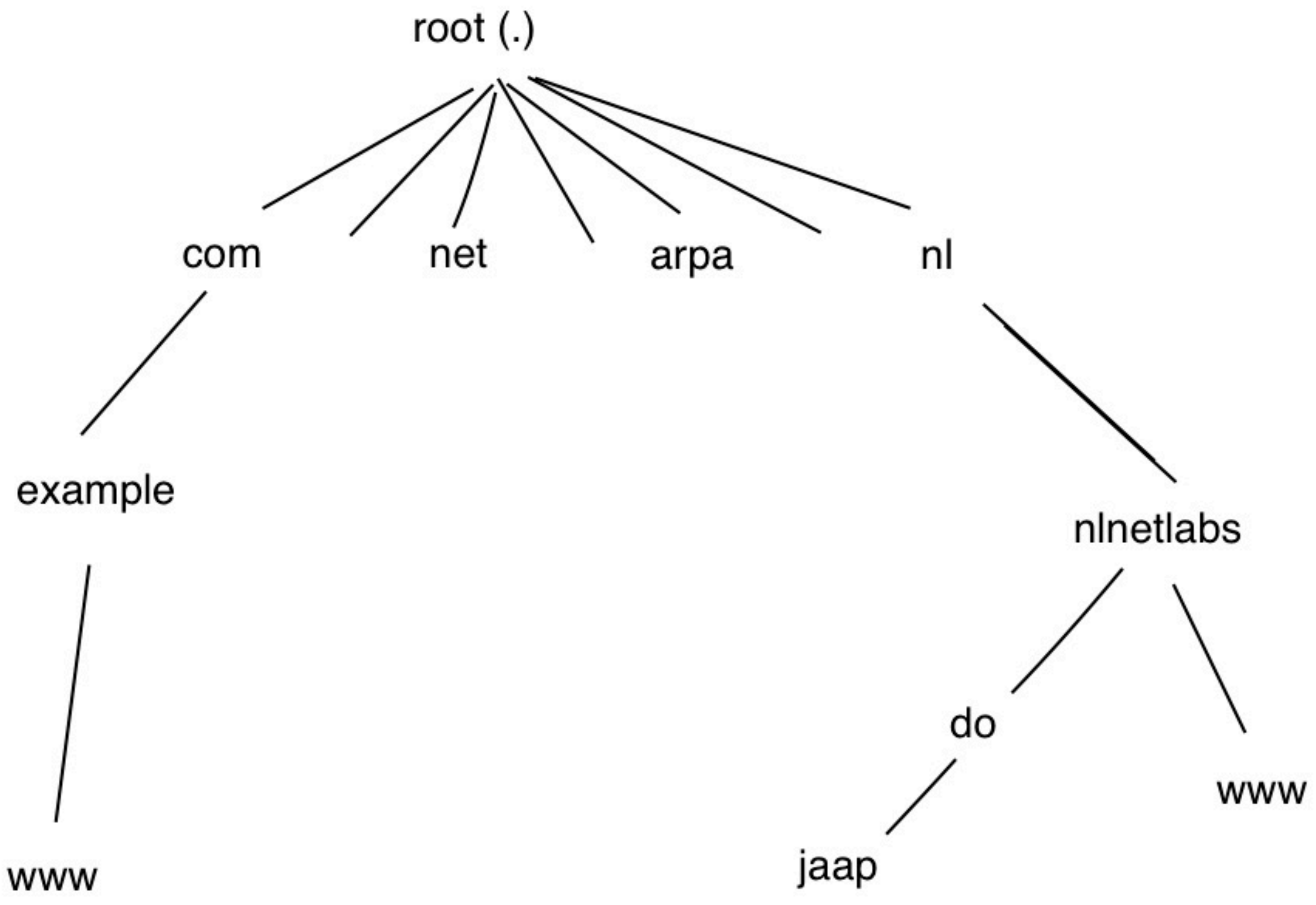
Three Pillars make the Internet

- Naming — how we call things
  - Domain names
- Numbers — how address things uniquely
  - IP Number assignment (IANA, RIR's)
- Routing — how to get to the address
  - Autonomous systems and BGP

Domain Name Service

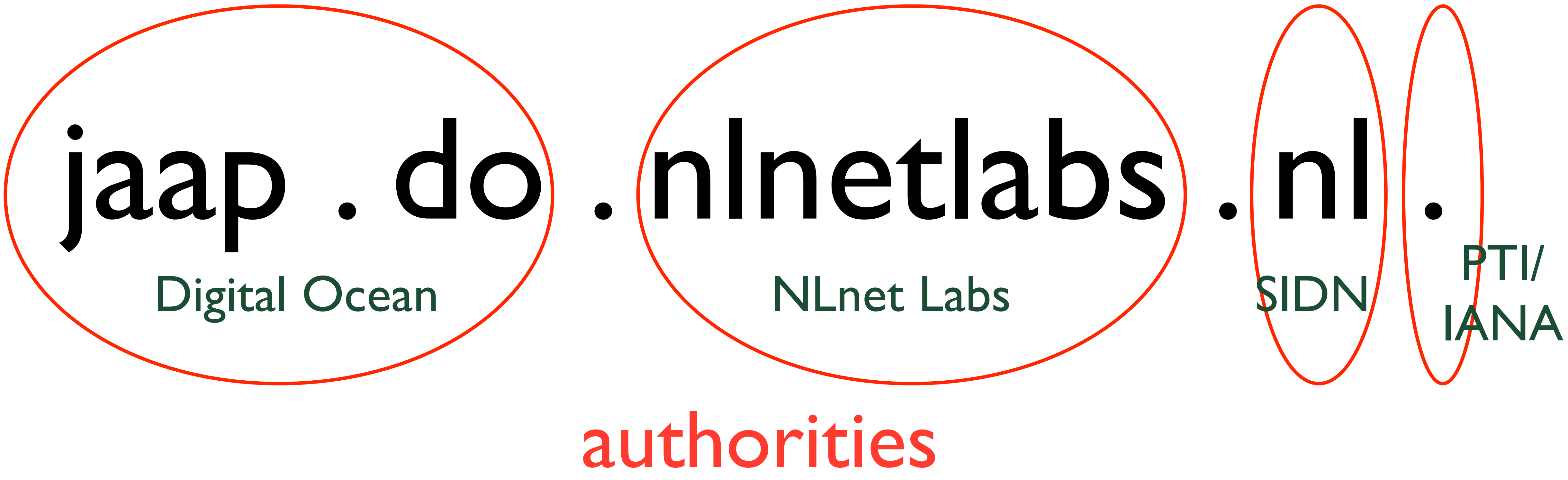
- Hierarchical name space
- Notion of delegation
- Best effort
  - a-synchronic updates
  - a loosely coherent database
- Still: lookup of information
  - not a search engine!
- RFC 103[345]

DNS name space



Delegated Authority

- Fully Qualified Domain Name



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Digital Ocean

NLnet Labs

SIDN

PTI/
IANA

authorities

jaap.do.nlnetlabs.nl. ???

- Ask the root-servers, refer to
- nl. name servers, refer to
- nlnetlab.nl. name servers, refer to
- digital.ocean.com. servers answers

with IP-address (A record) 167.172.34.102

Name Server Types

- Stub resolver, talks to
- Recursive resolver
  - can caching answers
  - can talks to other resolvers
    - actually iterative
  - can follow referrals
- Authoritative server
  - gives the final answer

Not just IP addresses

- MX: mail address
- CNAME: alias to other name
- SOA: Start of authority
- AAAA: IPv6 addres
- NS: name servers

- location, mothers name etc….

Scales well

- Started with thousands of names
- Now billions of names
- Thanks to lots of caching
- Loosely coherent system

What goes wrong?

- Sloppy implementations
- Desire to always try to give an answer
- Sloppy configuration
  - 90% of name servers are wrong, DNS works by accident
- Easy for monkey in the middle attacks (MITM)
  - data is public
- It is a cost center

Implementation

- Install and forget
- Often done on the cheap
  - old hardware
  - junior sysadmin is made responsible

- Importance often overlooked

Naming Complications

- Private name spaces
  - Company Intranet
  - NAT boxes
  - “split horizons”
  - leaking information
- Name collisions
  - fritz, corp, home,
  - corp.com
  - Certificates for non-FQDN’s

Security extensions

- Authenticates the answer
  - Note, the authority might still be lying
  - Allow for auditing
  - Substrate for other security methods
    - DANE etc.
- Changes paradigm
  - needs maintenance
  - make the systems brittle
    - punishes badly configured DNS servers
- Data is still public

Games with DNS

- Make answer dependent on question
  - CDN can route to topological closest data
    - best effort
  - Defer some kinds of DOS attacks
- Rewrite (negative) answers to insert adds etc.
  - DNSSEC can prevent that
- Forwarding
  - Central caching, avoiding ISP etc.

Privacy extensions

- Data is public
  - easy to listen to
  - post Snowdon people started to worry about “Meta Data”
- Hop by hop
  - DNS cookies
- End to end
  - VPN style

DOT: DNS over TLS

- TLS protection
- Per system same namespace
- Known port, easy to block

DOH: DNS Over HTTPS

- Bypasses the local stub resolver
  - application picks the resolver
  - trust that that resolver doesn't lie
  - impossible to scan
    - malware?
  - possible to control the name space for that application
  - difficult for "parent controls"
    - my net, my rules
  - "Balkanisation" of the net for different apps
    - IETF Working Group: ADD

Who controls the root?

- ICANN: International Corporations for Assignment of Names and Numbers
  - Protocol parameters, mostly via IETF
    - Internet Engineering Task Force
  - IP numbers, policies by ASO, but really NRO
    - Address Support Organization
    - Number Resource Organisations (RIRs)
  - Names via SO's (GNSO, CNSO) and AC's
    - Generic Name SO, Country Name SO
    - Government Advisory Committee

IANA — PTI

- Registry for Protocol Parameters
- Registry for IP numbers
- Root Registry allocates TLDs
  - legacy (com, org, net, edu …)
  - country codes (nl, us, ss …)
  - sponsored (aero, jobs, gov …
  - generic (club, xyz, politie, study …)
    - brand domains (sony, canon …)

Root Zone Maintenance

- IANA/PTI decides (confirmed by ICANN)
- Verisign for technical checks and database operator
- 12 Root Zone operators, see root-servers.org
  - 9 root zone operators in Amsterdam
  - Zone current refreshed twice daily
  - More then 1000 instances
    - by means of anycasting

Wat can you do?

- Fix your DNS, add DNSSEC
  - Check with internet.nl for advice
- Help with open standards
  - ietf.org
- Become a politician
  - ICANN
  - IGF