

IN2011 Computer Networks : Application Layer 2

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Last Week On IN2011...

- HyperText + Internet + Multi-media → WWW
- Three key ideas : URL, HTML, HTTP
- The “killer app” for the Internet
- Originally page-orientated, JavaScript et al. add dynamic behaviour but . . .
- Originally stateless, cookies add state but . . .

TCP/IP Reference Model

Application

Transport

Network

Link

Physical

TCP/IP Reference Model

Application

Transport

Network

Link

Physical

TCP/IP Reference Model

Application

DNS

Transport

Network

Link

Physical

The Problem

IP address' are not human orientated.
Want human readable names.

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Want human readable names.

(assigning, distributing, updating, ownership ...)

Elizabeth “Jake” Feinler



For most of the 1970s and 1980s – ask her.

HOSTS.TXT

```
;GIDNEY::<PAETZOLD.ARPANET>HOSTS.TXT.5, 27-Mar-85 13:11:54, Edit by PAETZOLD
;GIDNEY::<PAETZOLD.ARPANET>HOSTS.TXT.4, 25-Mar-85 13:56:55, Edit by PAETZOLD
;local stuff

; DoD Internet Host Table
;   22-Mar-85
;   Version number 436
;
; Changes, corrections, comments or questions to (HOSTMASTER@SRI-NIC)
;
; The format of this file is documented in RFC 810, "DoD Internet
; Host Table Specification", which is available online at SRI-NIC
; as the file
;           [SRI-NIC]<RFC>RFC810.TXT
; It may be retrieved via FTP using username ANONYMOUS with
; any password.
;
; NOTE CAREFULLY: RFC 810 has been slightly revised since the original
; version was written. In particular, the version printed in the
; "Internet Protocol Transition Workbook" does not document the
; added "machine type" field (between the host-name and system-name
; fields).
;
; The format for entries is:
```

HOSTS.TXT

```
HOST : 32.2.0.42 : UCL-TAC,LONDON-TAC : H-316 : TAC : TCP :
HOST : 36.44.0.1 : SU-SAFE,SAFE : VAX-11/750 : UNIX : UDP,TCP/TELNET,TCP/FTP,TCP/SMTP
HOST : 36.47.0.1 : SU-ARDVAX,ARDVAX : VAX-11/750 : UNIX : UDP,TCP/TELNET,TCP/FTP,TCP/SMTP
HOST : 36.2.0.5 : SU-HELENS,HELENS : VAX-11/780 : UNIX : UDP,TCP/TELNET,TCP/FTP,TCP/SMTP
HOST : 36.10.0.5 : SU-STAR,STAR : VAX-11/780 : VMS : TCP/TELNET,TCP/FTP,TCP/SMTP,TCP/SMTP
HOST : 36.10.0.6 : SU-CORONA,CORONA : VAX-11/750 : VMS : TCP/TELNET,TCP/FTP,TCP/SMTP,TCP/SMTP
HOST : 36.8.0.8, 36.36.0.101 : SU-PESCADERO,PESCADERO : VAX-11/750 : UNIX : TCP/TELNET,TCP/FTP,TCP/SMTP
HOST : 36.9.0.8 : SU-WHITEHEAD, WHITEHEAD : VAX-11/750 : VMS : TCP/TELNET,TCP/FTP,TCP/SMTP
HOST : 36.9.0.9 : SU-RUSSELL,RUSSELL : VAX-11/750 : UNIX : UDP,TCP/TELNET,TCP/FTP,TCP/SMTP
HOST : 36.47.0.9 : SU-HPP-3600-1,HPP-3600-1 : SYMBOLICS-3600 : LISP : UDP/TIME
HOST : 36.47.0.10 : SU-HPP-3600-2,HPP-3600-2 : SYMBOLICS-3600 : LISP : UDP/TIME
HOST : 36.8.0.11, 36.36.0.102 : SU-GREGORIO,GREGORIO : VAX-11/750 : UNIX : TCP/TELNET,TCP/FTP,TCP/SMTP
HOST : 36.9.0.11 : SU-LINDY,LINDY : VAX-11/780 : UNIX : TCP/TELNET,TCP/FTP,TCP/SMTP,TCP/SMTP
HOST : 36.47.0.11 : SU-HPP-3670-3,HPP-3670-3 : SYMBOLICS-3670 : LISP : UDP/TIME
HOST : 36.9.0.12 : SU-FORSYTHE,FORSYTHE : IBM-3081 : MVS : TCP/SMTP :
HOST : 36.47.0.12 : SU-HPP-3670-4,HPP-3670-4 : SYMBOLICS-3670 : LISP : UDP/TIME
HOST : 36.10.0.14 : SU-MOJAVE,MOJAVE : VAX-11/780 : UNIX : UDP,TCP/TELNET,TCP/FTP,TCP/SMTP
HOST : 36.22.0.20 : SU-AMADEUS,AMADEUS : VAX-11/780 : UNIX : UDP,TCP/TELNET,TCP/FTP,TCP/SMTP
HOST : 36.18.0.93 : SU-CSLI,CSLI,SU-TURING : DEC-2060 : TOPS20 : TCP/TELNET,TCP/FTP,TCP/SMTP
HOST : 36.40.0.99 : SU-SONOMA,SONOMA : VAX-11/780 : UNIX : UDP,TCP/TELNET,TCP/FTP,TCP/SMTP
HOST : 36.40.0.192, 36.10.0.1 : SU-SHASTA,SHASTA : VAX-11/750 : UNIX : UDP,TCP/TELNET,TCP/FTP,TCP/SMTP
HOST : 36.45.0.193 : SU-AIMVAX,AIMVAX,SU-DIABLO,DIABLO,SU-HNV : VAX-11/780 : UNIX : UDP,TCP/TELNET,TCP/FTP,TCP/SMTP
HOST : 36.40.0.200 : SU-DIT,DIT,SU-DSN,DSN : VAX-11/780 : UNIX : TCP/TELNET,TCP/FTP,TCP/SMTP
HOST : 36.40.0.201 : SU-ISL,ISL : VAX-11/780 : UNIX : TCP/TELNET,TCP/FTP,TCP/SMTP,TCP/SMTP
```

Design Goals 83-85

- Distributed (technical and organisational)
- Highly Robust
- Highly Scalable

Domain Name System

A Map

Name * Type * Class → Data

Names

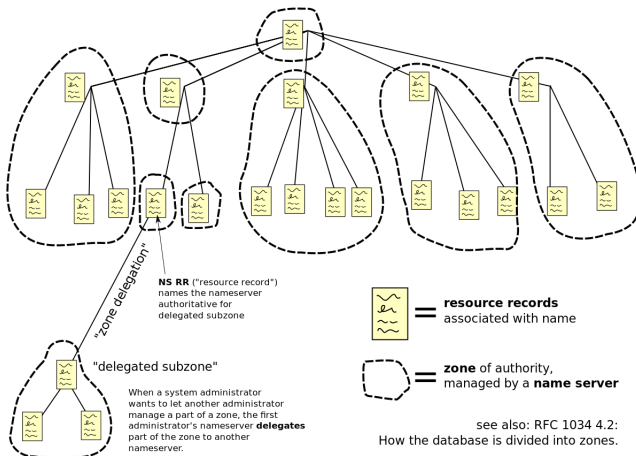
- A tree
- One or more labels separated by dots
- A restricted subset of ASCII
- Read right to left : `www.staff.city.ac.uk.`

Types of Record

Type	Meaning	Value
SOA	Start of authority	Parameters for this zone
A	IPv4 address of a host	32-Bit integer
AAAA	IPv6 address of a host	128-Bit integer
MX	Mail exchange	Priority, domain willing to accept email
NS	Name server	Name of a server for this domain
CNAME	Canonical name	Domain name
PTR	Pointer	Alias for an IP address
SPF	Sender policy framework	Text encoding of mail sending policy
SRV	Service	Host that provides it
TXT	Text	Descriptive ASCII text

Zones

Domain Name Space



Accessing DNS

- Client / server
- Server types : primary, secondary, caching, etc.
- Recursive resolution vs. iterative resolution
- TTL vital for scaling

dig

Let's use dig

- Recursive resolution
- Iterative resolution
- Different record types
- “Reverse” DNS

So What Happens...

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IT WORKS!

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But...

- “Cyber squatting”
- Typos
- Homographs & phishing
- Wildcards
- Monitoring & censorship
- Internationalisation
- “Same origin” policy
- Load balancing

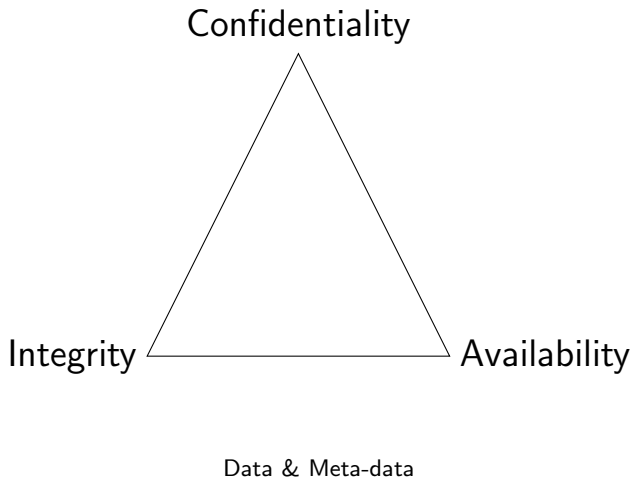
So What Happens...

IT WORKS!

But...

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- Typos
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Delegation of authority vs. delegation of responsibility



Integrity : DNSSEC

- (Offline) digital signature of records
- Use DNS to distribute public keys
- Hierarchy of DNS → Hierarchy of trust
- Simple but ...

Confidentiality : DNS-over-TLS (DoT) / DNS-over-HTTP (DoH)

- Re-use existing crypto
- Protect client \leftrightarrow recursive server confidentiality
- Simple but ...

DNS Overview

- Scale : PAN, LAN, MAN, WAN
- Mobile / Dynamic vs. Static
- Centralised vs. Federated
- Open
- Packet vs. Stream
- Broadcast vs. Unicast vs. Multi-cast
- Synchronous vs. Asynchronous
- Reliable vs. Unreliable

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DNS vs. CRN

Both distributed hash tables
so why are they different?

	DNS	CRN
Control	Heirarchical	Decentralised
Access	Mostly read	Read / write
Change rate	Low	Fast
Responsibility	Heirarchical	"Local"

Conclusion

- Domain Name System – Key Infrastructure
- Distributed database at vast scale
- Intersection of technology and power

Reading “Computer Networks”, Tanenbaum, Feamster &
Wetherall, 6th
Section 7.1

Practical DNS exercises and coursework help

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Thank you for your time and attention.

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