DNS – Domain Name System

Seminar in distributed Computing 2007/08

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Overview

- Naming and Binding of Network Destinations
  - Terminology
  - Examples
  - Interpretation
- Development of the Domain Name System
  - Design
  - Surprises
  - Successes / Shortcomings
  - Conclusions
- Link between papers
- Things change 1988 <-> 2007
Naming and Binding

- Confusion about terminology
- Analogy to operating systems
What are we looking at…

- **4 Objects:**
  - Services
  - Nodes
  - Attachment Point
  - Routes

- **3 Bindings:**
  - Service to node
  - Node to attachment point
  - Attachment point to route
Terminology

- Name
- Address
- Route

Via della Pace 11 (Piazza Navona)
Types of Network Destinations

- Service and users
  - Time of day, Notebook
- Nodes
  - PC on which a service runs, forwarding node
- Network attachment points
  - Ports of a network
- Paths
  - Run between network attachment points
Name != Name

- Print name
- Machine Name
  - often called address
- Name – broad sense

“A-real-good-name”

“01010010”
Binding among network destinations

- Service and Node
- Node and network attachment point
- Attachment points and paths

Preserve identity
Concrete Examples

my-service.ch ➔ 128.12.4.6 ➔ 08:00:00:3a:12:80

file ➔ storage region ➔ physical location

- Bind network attachment point to path?
Send data packet to Service

- Find node
- Find net. att. Point
- Find path
- Service name resolution
- Node name resolution
- Route service
Example: ARPANET NCP protocol

Confusion:
- Different Name
Authors Interpretation of terminology

- **Name** – human readable character string
- **Address:**
  - Service  Node  Network attachment point
- **Route** ↔ **Path**
Development of the DNS

The following slides summarize the paper 'Development of the Domain Name System, Mockapetris, Dunlap, SIGCOMM 1988'

- Today – largest name service in operation
- History with hosts.txt
DNS Design assumptions

- Same information as hosts.txt
- Distribution
- No size limits
- Interoperate in many environments
- Performance
“Leanness Criterion”

Lean service

- More implementation effort and early availability

general distributed database

- More applications
- Greater functionality
- Operate in more environments

The following was omitted:
- Dynamic updates with atomicity
- Backup considerations
Quick “Refresher”

- Student within ETH
- Local name server: dns.ethz.ch
- Root name server
- Authoritative name server: dns.delivery.it
- Pizza delivery: pizza.delivery.it
Design points

- Architecture
  - Name servers
  - Resolvers

- Hierarchical name space

- Database distribution
  - Zones
  - Caching

Resource Record

<table>
<thead>
<tr>
<th>Name (Variable length)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type (16 bits)</td>
</tr>
<tr>
<td>Class (16 bits)</td>
</tr>
<tr>
<td>TTL (32 bits)</td>
</tr>
<tr>
<td>Data_length (16 bits)</td>
</tr>
<tr>
<td>Data (Variable length)</td>
</tr>
</tbody>
</table>

(Source: wikipedia.org)
Surprises for developers

- Semantics well-understood?
  - Example: multiple addr. for single host
- Performance of underlying network
  - Response time 30-60 sec (worst case)
- Negative caching
Successes

- Datagram access
  - ✅ 512 byte restriction, better performance than TCP
  - ✗ Develop/Refine retransmission strategies
- Additional section processing
- Caching
Shortcomings

- Type and class growth
- Easy upgrading of applications
  - Transient failure of a distributed naming system
- Distribution of control vs. distribution of expertise
Conclusions

- What the “dns-team” learned:
  - Caching and also negative caching
  - Difficulty of removing fkt. vs. adding new fkt.
  - Implementers don’t like optimizing …
Link between the two papers

- DNS provides binding between Service and Node
- Remove DNS ??
  - Address the host directly with IP
  - “google” for it
- Problems:
  - Moving service to another node
Figures ...

Paper (1988): 20,000 hosts

Internet Domain Survey Host Count

Source: Internet Systems Consortium (www.isc.org)
1988 <-> 2007: things change...

- **DDoS attack (distributed denial of service)**
  - October 2002 – 9 of 13 root servers down
  - February 2007 – 2 root servers down

- **Phishing attacks:**
  - DNS-spoofing
  - Cache poisoning

- **Networks change:**
  - Mobility (WLAN, GSM, ad-hoc, P2P, …)
DNS Extensions to support IPv6

- New resource record type (AAAA)
- New domain to support lookups based on addr.
  - 4321:0:....:89ab -> b.a.9.8 ... 0.1.2.3.4.IP6.INT
- Additional section processing redefined for processing both IPv4 and IPv6
The papers...

- On The Naming and Binding of Network Destinations.
  Jerome H. Saltzer, in Pier Ravasio et al.
- Development of the domain name system.
  Mockapetris, P. and Dunlap, K. J.
Additional papers …

- RFC 1886, S.Thomson and C.Huitema
- GSEC Paper Practical Assignment Version 1.4b, David Hinshelwood – DNS,DNSSEC and the Future
Burning Questions at this moment?
Discussion inputs …

- Bindings (more/less – examples?)
- What about an open name space? (whatever.I.want)
- Future: DNSSec (secure DNS)
- Alternative root servers
- Politics:
  - VeriSign … “SiteFinder”
  - ICANN … “influenced by …” (.xxx discussion)
Thanks for your attention....