COMP 790-088
Networked and Distributed Systems

**Naming**

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**Types of Identifiers**

- **Names**
  - for human consumption
  - location independent

- **Addresses**
  - used internally in system
  - encoding side in locating entity
Saltzer’s (1977) Naming Objectives

- Share objects by references to names
- Multiple, independent name creators
- Sharing (and naming) independent of location
- Objects can move without changing names or embedded references to names
- Object references can proceed even if some systems are down or isolated

Lampson’s (1986) Name Resolution Service adds:

- Universal (all distributed objects)
- Arbitrary number of names and administrative organizations
- Long duration with many changes in the name space and its configuration
- Mistrust among users
Internet Names and Addresses

- Internet Names
  - Human consumable, location independent, identifiers for hosts, service aliases, etc.
  - examples:
    - swift
    - cap@four.cs.unc.edu
    - www.amazon.com

- Internet Addresses
  - 32-bit integer (IPv4) or 128 bits (IPv6)
  - Identifies connection to Internet
    - synonyms with network interfaces
  - examples:
    - 153.2.136.10
    - 152.2.1.28.25
    - 208.33.218.15
Domain Name System

- Primary functions:
  - map domain names for machines to Internet addresses
  - maps name to list of addresses (0, 1, N)
  - e.g.:
    - carebear.cs.unc.edu 152.2.128.19
    - smith 152.2.128.25
    - www.libera.com [65.127.140.23, 65.126.254.23]
  - map domain names for services/unix (e.g. mail) to Internet addresses
    - mail.cs.unc.edu www.cs.unc.edu 152.2.128.80

Name Hierarchy in DNS

name = "dot" separated concatenation of domain names along path toward the root
  e.g. unc.edu
  cs.unc.edu
  cs.dept.unc.edu
Top Level Domains

Generic Domains
- Current
  - .com, .org, .net, .edu, .gov, .mil, .int, .biz, .info, .name, .pro, .mobi
- Special Sponsored names
  - .aco, .coop, .museum, .jobs, .travel

Country Code Domains
- .uk, .de, .jp, .us, .cn, .in, etc.

Growth of DNS Registrations

Source: Internet Software Consortium (http://www.isc.org)
Names Became Valuable!


Net Address Sold at Auction for $823,456

LOS ANGELES, Aug. 8 (AP) —
A domain name that the Internet ad
vertising company DoubleClick had
filed to trademark went up in auc-
tion today for $823,456, a record
for an Internet domain.

The business that controls the
name DoubleClick.com, a joint ven-
ture of DoubleClick and the search
engine Google Inc., has agreed to
sell the name to a rival company in
a move that could set a new stan-
dard for trading Internet names.

Several Internet companies and
venture capitalists have expressed
an interest, according to
people involved in the deal.

But the sale of the name will
also be watched closely by
companies that make their liv-
lings from the DoubleClick do-
namers.

"It will be a sign of things to
come," said Michael Zorin,
founder of the Internet na-
me registrar Dotcom Registry.

"This could be a new standard
for trading Internet names."

The sale, which is expected
to close within the next few
weeks, is expected to set a
price point that others will
cite when they sell their own
Internet addresses.

"This is a great day for the
Internet," Mr. Zorin said.

"It's going to be a great day for
anyone who wants to make a
profit on the Internet."

GIVE TO THE FRESH AIR FUND

Names Became More Valuable!

Some Recent Prices (BuyDomains.com, GreatDomains.com), 8/20/07

<table>
<thead>
<tr>
<th>Domain</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>SoulStream.com</td>
<td>$4,350,000</td>
</tr>
<tr>
<td>healthsource.com</td>
<td>$3,999,000</td>
</tr>
<tr>
<td>shrimp.com</td>
<td>$2,600,000</td>
</tr>
<tr>
<td>message.com</td>
<td>$750,000</td>
</tr>
<tr>
<td>BearStreams.com</td>
<td>$380,000</td>
</tr>
<tr>
<td>streetsmaps.com</td>
<td>$350,000</td>
</tr>
<tr>
<td>LiveHomes.com</td>
<td>$339,000</td>
</tr>
<tr>
<td>oem7.com</td>
<td>$320,000</td>
</tr>
<tr>
<td>lovelifec.com</td>
<td>$350,000</td>
</tr>
<tr>
<td>PopcornMachine.com</td>
<td>$375,000</td>
</tr>
<tr>
<td>Muertos.com</td>
<td>$215,000</td>
</tr>
</tbody>
</table>

The story of .tv domain

Since 1999, .tv has been able to make over several million dollars a year marketing it's Internet domain name through the American Company TV Corporation. .tv's unique suffix, .tv, attracts interest from many individuals, utilities and television companies around the world, and some have been willing to pay large sums for internet addresses such as www.chanell.tv or www.body.hamburger.tv. The scheme got off to a rough start, but has now proven to be the largest source of income for the nation. http://www.tv.atlantic.net/around.html

<table>
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</tr>
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<tbody>
<tr>
<td>videos.tv</td>
<td>$250,000</td>
</tr>
<tr>
<td>lunchtv.tv</td>
<td>$250,000</td>
</tr>
<tr>
<td>movietv.tv</td>
<td>$750,000</td>
</tr>
<tr>
<td>ziptv.tv</td>
<td>$250,000</td>
</tr>
<tr>
<td>food.tv</td>
<td>$125,000</td>
</tr>
<tr>
<td>hotel.tv</td>
<td>$100,000</td>
</tr>
<tr>
<td>channel.tv</td>
<td>$85,000</td>
</tr>
<tr>
<td>hamburger.tv</td>
<td>$80,000</td>
</tr>
</tbody>
</table>
Characteristics of Domain Names

- Large database (proportional to number of users)
- Queries are much more frequent than updates
- Query rate is very high (millions/second?)
- Most data changes slowly (local exceptions)
- Access is more important than timeliness
- Strong shift in names that are queried most?
  - "nearby" to "remote"
DNS Name Servers

- **Authoritative Name Server:**
  - designated repository for a host's IP address and name
  - performs name/address translation for that host name
- **Local Authoritative Name Servers:**
  - each ISP, university, company, etc., has a local (default) name server authoritative for its own hosts, routers, etc.
  - always query a local name server to resolve any host name

DNS: Using Hierarchy for Resolving

- To resolve non-local name:
  - local name server queries .com server: "What server is authority for www.cnn.com?"
  - .com server returns name and IP address of server if known or closest match to query
  - local server sends same query to twdns-01.ns.aol.com
  - process can be iterated until the local authoritative name server is found and responds

Diagram:
- .com name server
- local name server
- authoritative name server
- requesting host
- local host
DNS Resolution - Iterated Query

DNS Records

DNS: distributed database storing Resource Records (RR)

RR format: <name, value, type, time_to_live>

- **Type=A**
  - name is hostname
  - value is IP address

- **Type=CNAME**
  - name is an alias name for some “canonical” (the real) name
  - value is canonical name

- **Type=NS**
  - name is domain (e.g. fox.com)
  - value is name of authoritative name server for this domain

- **Type=MX**
  - value is name of mail server host associated with name
DNS Protocol and Messages

DNS protocol: query and reply messages, both with same message format

- **Header:**
  - **Identification:** 16-bit # for query, reply to query user same # for matching
  - **Flags:**
    - *query or reply*
    - *reply is authoritative*
    - *etc.*

- **Name, Type fields:**
  - RRs that answer (resolve) the name, may not be present
  - RRs for authoritative servers
  - Additional information (usually the IP address of authoritative servers)
Example Reply from .edu Zone Server

```bash
> host -t ns chsu.edu
Try:ing null domain
rcode = 0 (Success), wann = 2
For authoritative answers, see:
  chsu.edu 73748 IN NS steels.chsu.edu
  chsu.edu 73748 IN NS freeman.chsu.edu
  chsu.edu 73748 IN NS medgen.chsu.edu
  chsu.edu 73748 IN NS cse.ug.i.edu
Additional information:
  steels.chsu.edu 73748 IN A 137 53 1.40
  freeman.chsu.edu 73748 IN A 137 53 1.30
  medgen.chsu.edu 81292 IN A 139 52 203 8
  cse.ug.i.edu 122220 IN A 129 55 20.2
```

DNS Database Maintenance

- **Zone Server**: Containers in records:
  - refresh interval (e.g., 3 hours)
  - retry frequency (e.g., 10 minutes)
  - expiration (e.g., 24 hours)

- **Zone Data Refresh**

- **Zone Server (col.*)**
Cache Design Issues

- **Size**
  - Major influence on "hit ratio"
  - $T_{Total} = hit\_ratio \times T_{Cache} + (1 - hit\_ratio) \times T_{Network}$

- **Location**
  - Memory vs disk (speed vs size)

- **Replacement**
  - Free space for new data when full

- **(m)Validation**
  - Does the cache hold "current" information?