

CS 640 Introduction to Computer Networks

Lecture 18

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Today's lecture

- Domain Name System
 - Overview
 - The hierarchy of domain names
 - DNS records
 - The resolution process

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Domain Name System Overview

- What are names used for in general?
 - identify objects
 - locate objects
 - define membership in a group
 - ...
- Basic Terminology
 - **Name space**
 - defines set of possible names
 - consists of a set of name to value *bindings*
 - **Resolution mechanism**
 - when invoked with a name returns corresponding value

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DNS Properties

- Size of Internet demands robust naming mechanism
 - Specified in RFC 1034, 1035 (Mockapetris '87)
 - Scalability through caching and hierarchy
 - Reliability through caching and redundancy
- Names versus addresses
 - Human readable versus router readable
 - Location transparent versus location-dependent
- Hierarchical
 - Names are divided into components
- Global versus local
 - What is the scope of naming?

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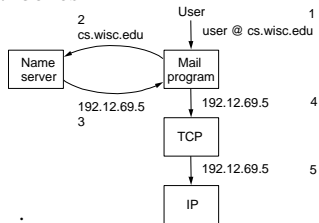
Examples of Mappings

- Hosts
`pluto.cs.wisc.edu` → `192.12.69.17`
`192.12.69.17` → `80:23:A8:33:5B:9F`
- Files
`/usr/llp/tmp/foo` → `(server, fileid)`
- Users
`Suman Banerjee` → `suman@cs.wisc.edu`

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Examples (cont)

- Mailboxes



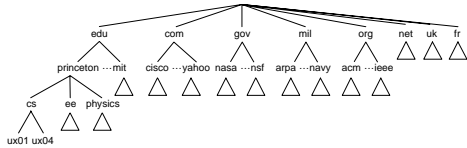
- Services

`nearby ps printer with short queue and 2MB`

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Domain Naming System

- Hierarchical name space for Internet objects

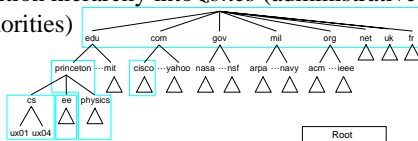


- Names are read from right to left separated by periods
 - Each suffix in a domain name is a domain
- `wail.cs.wisc.edu, cs.wisc.edu, wisc.edu, edu`

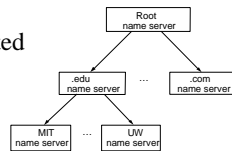
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Name Servers

- Partition hierarchy into *zones* (administrative authorities)



- Each zone implemented by two or more *name servers*



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Resource Records

- Each name server maintains a collection of *resource records* (**Name, Value, Type, Class, TTL**)
 - Each record is a translation based on type
 - Name/Value: not necessarily host names to IP addresses
- **Type** (some examples)
 - A: Name = full domain name, Value = IP address
 - NS: Value gives domain name for host running name server that knows how to resolve names within specified domain.
 - CNAME: Value gives canonical name for particle host; used to define aliases.
 - MX: Value gives domain name for host running mail server that accepts messages for specified domain.
- **Class**: allow other entities (other than NIC) to define types
 - IN is what is used by the Internet
- **TTL**: how long the resource record is valid

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gTLD Name Server

May contain the following resource records:

(wisc.edu, dns.wisc.edu, NS, IN)

(dns.wisc.edu, 128.105.12.11, A, IN)

(cisco.com, thumper.cisco.com, NS, IN)

(thumper.cisco.com, 128.96.32.20, A, IN)

...

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Wisconsin Server

May contain the following resource records:

(cs.wisc.edu, dns.cs.wisc.edu, NS, IN)

(dns.cs.wisc.edu, 128.105.2.10, A, IN)

(ece.wisc.edu, dns.ece.wisc.edu, NS, IN)

(dns.ece.wisc.edu, 128.105.40.12, A, IN)

(host1.cs.wisc.edu, 128.105.9.103, A, IN)

(host2.cs.wisc.edu, 128.105.9.13, A, IN)

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CS Server

CS server may contain following resource records:

(cs.wisc.edu, norm.cs.wisc.edu, MX, IN)

(norm.cs.wisc.edu, 128.105.8.45, A, IN)

(n.cs.wisc.edu, norm.cs.wisc.edu, CNAME, IN)

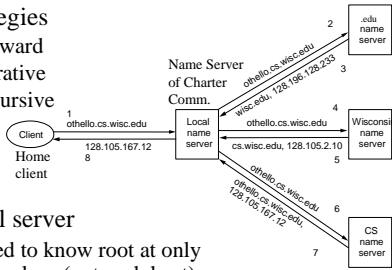
(othello.cs.wisc.edu, 128.105.167.12, A, IN)

(o.cs.wisc.edu, othello.cs.wisc.edu, CNAME, IN)

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Name Resolution

- Strategies
 - forward
 - iterative
 - recursive



- Local server
 - need to know root at only one place (not each host)
 - site-wide cache

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DNS Issues

- Top level domain names are tightly controlled
- Before an institution is granted authority for a second-level domain, it must agree to operate a DNS server that meets Internet standards.
 - Eg. all DNS info must be replicated on separate systems
- DNS is *very* important in the Internet
 - Security of this system is strict
- DNS lookups can affect performance
- In practice DNS more complicated than you might think

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PTR Record

- Used for IP to name resolution
- For IP address: a.b.c.d
 - PTR record stored at: d.c.b.a.in-addr.arpa.
- All PTR records are stored under in-addr.arpa. domain
- Consider the zone: 105.128.in-addr.arpa
 - This will typically be under control of CS dept of Wisconsin (since 128.105/16 belongs to the CS dept)
- PTR zone and the usual namespace zone may be inconsistent

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Resilience of DNS to attacks

- January 2001 flooding attack against Microsoft's name servers
 - Service went down because they were all on the same subnet
- October 2002 flooding attack on the 13 root name servers
 - 4 servers survived

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Other Naming Protocols

- X.500
 - Naming system designed to identify people
 - Each person is defined by attributes
 - Name
 - Title
 - ...
 - Too cumbersome
- Lightweight Directory Access Protocol (LDAP)
 - Evolved from X.500
 - System for learning about users

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