

DNS: Internet Domain Name System

foo.cs.bu.edu → 128.50.1.3
hostname name resolution IP address

1) how names are structured?
 2) how to maintain mapping info & access it efficiently?

Names *flat, globally unique (managed by ICANN)*
structured (ease of mgmt)

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DNS: Internet Domain Name System

- a *distributed database* used by TCP/IP applications to map from hostnames to IP addresses
- name servers*
 - user-level library routine *gethostbyname()* contacts local name server via port 53
 - name server returns IP address of requested hostname

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Why geeks say Ted Cruz is wrong about ICANN

Sen. Ted Cruz is pushing hard for Congress to prevent Obama from relinquishing US authority over the Internet body, citing concerns that it will give China and Russia greater flexibility to censor free speech.

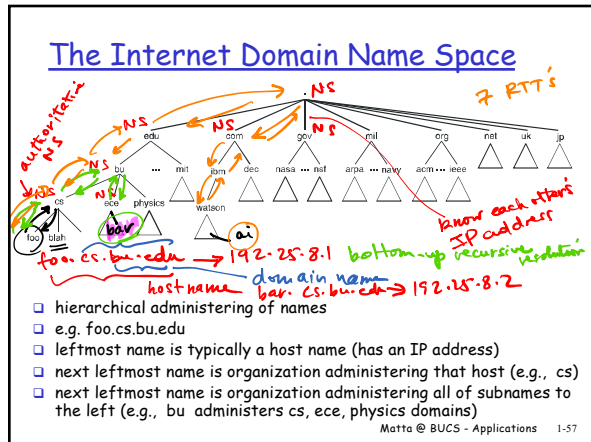
By Laurent Belsie, Staff writer | SEPTEMBER 24, 2016

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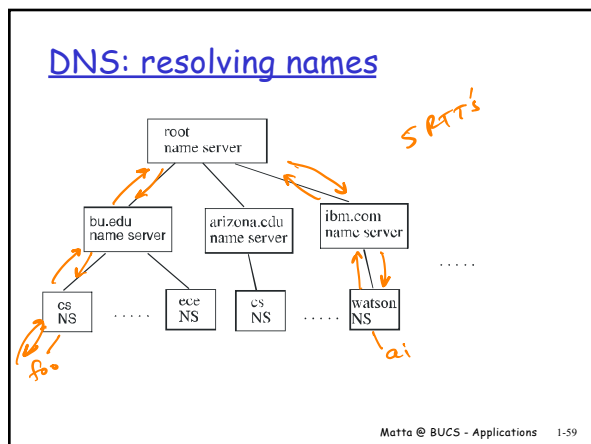
The Internet Domain Name Space (cont'd)

- rightmost (highest) domain is organization, structure, country

domain	usage	example
com	business	watson.ibm.com
edu	educational	cs.bu.edu
gov	US non-military gov't	nasa.gov
mil	US military	arpa.mil
org	non-profit organization	acm.org
jp	Japan	osaka-u.ac.jp

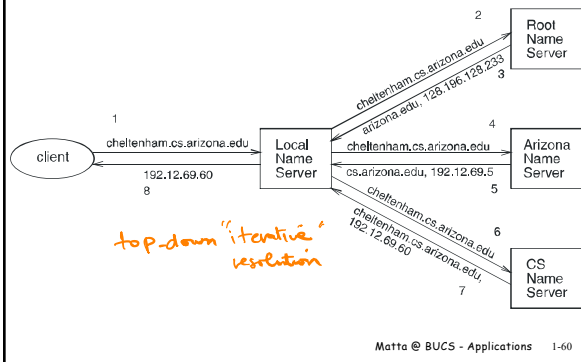
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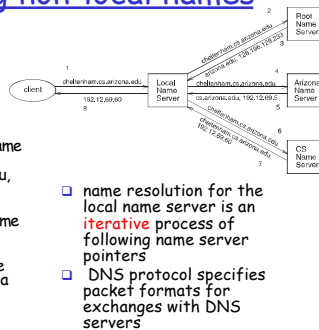
DNS: resolving non-local names



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DNS: resolving non-local names

- no single name server has complete information
- if local name server can't resolve address, contacts root name server:
 - currently, **13 root name servers** world-wide
 - each has addresses of name servers for all level-two name servers (e.g., bu.edu, ibm.com)
 - contacted root server returns IP address of name server which should be contacted next
 - contacted level-two name server may itself return a pointer to another name server



- name resolution for the local name server is an **iterative** process of following name server pointers
- DNS protocol specifies packet formats for exchanges with DNS servers

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DNS Caching

- Once (any) name server learns mapping, it **caches** mapping
 - cache entries timeout (disappear) after some time
 - marked as "non-authoritative" mapping with address of authoritative server

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DNS Records

DNS: distributed db storing resource records (RR)

RR format: (name, value, type, ttl)

- Type=A
 - name is hostname
 - value is IP address
- Type=NS
 - name is domain (e.g. foo.com)
 - value is name of authoritative server for this domain
- Type=CNAME
 - name is alias name for some "canonical" (the real) name
www.ibm.com is really servereast.backup2.ibm.com
 - Or ibm.com is really www.ibm.com
 - value is canonical name
- Type=MX
 - value is name of mail server associated with name

(cs.bu.edu, dns.cs.bu.edu, NS, -)
(cs.bu.edu, mail.cs.bu.edu, MX, -)

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Root NS

(startup.com, dns.startup.com, NS, -)
(dns.startup.com, 128.15.12.46, A, -)

Authoritative NS (dns.startup.com)

(foo.startup.com, 128.15.12.30, A, -)
(www.startup.com, 128.15.12.35, A, -)
(startup.com, mail.startup.com, MX, -)
(mail.startup.com, 128.15.12.26, A, -)
(startup.com, www.startup.com, CNAME, -)

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Inserting records into DNS

- Example: just created startup "Network Utopia"
- Register name networkutopia.com at a **registrar** (e.g., Network Solutions, delegated by ICANN)
 - Need to provide registrar with names and IP addresses of your authoritative name server (primary and secondary)
 - Registrar inserts two RRs into the com top-level server:

(networkutopia.com, dns1.networkutopia.com, NS)
(dns1.networkutopia.com, 212.212.212.1, A)
- Put in authoritative server Type A record for www.networkutopia.com and Type MX record for networkutopia.com

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DNS protocol, messages

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

msg header

- **identification:** 16 bit #
for query, reply to query
uses same #
- **flags:**
 - query or reply
 - recursion desired
 - recursion available
 - reply is authoritative

identification	flags	12 bytes
number of questions	number of answer RRs	
number of authority RRs	number of additional RRs	
questions (variable number of questions)		
answers (variable number of resource records)		
authority (variable number of resource records)		
additional information (variable number of resource records)		

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DNS protocol, messages

(*cs.bu.edu, MX*)
Name, type fields
for a query

(*cs.bu.edu, mail.cs.bu.edu, MX*)
RRs in response
to query

records of
authoritative servers
(records of type "NS")

additional "helpful"
info that may be used
(e.g., IP address of mail server)
(*mail.cs.bu.edu, 128.15.1.5, A, -*)

identification	flags	12 bytes
number of questions	number of answer RRs	
number of authority RRs	number of additional RRs	
questions (variable number of questions)		
answers (variable number of resource records)		
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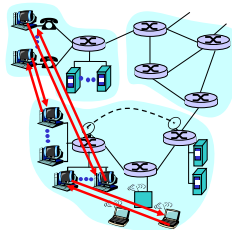
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Beyond client-server: P2P architecture

- no always-on server
- arbitrary end systems
directly communicate
- peers are intermittently
connected and change IP
addresses
- examples: BitTorrent (Vuze
client), Skype

All peers are servers = highly
scalable!

But difficult to manage

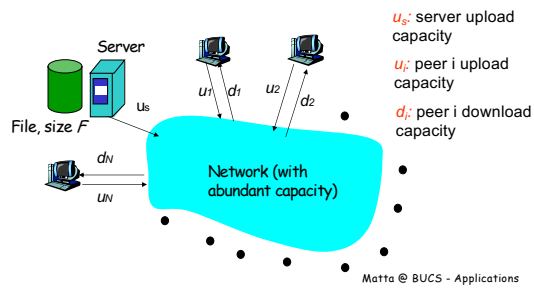


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File Distribution: Server-Client vs P2P

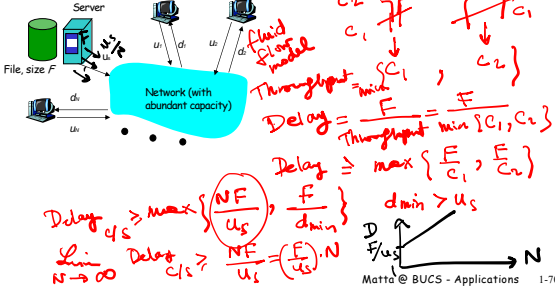
Question: How much time to distribute file from one server to N peers?



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File Distribution: Server-Client vs P2P

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