Application layer

Goals:

- Conceptual aspects of network application protocols
  - Client server paradigm
  - Service models
- Learn about protocols by examining popular application-level protocols
  - HTTP
  - DNS

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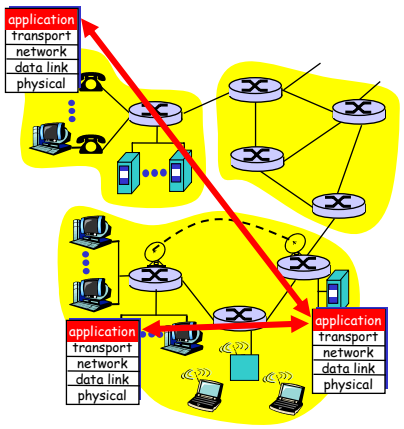
Application-layer protocols

Application-layer protocols
- One "piece" of an app
- Define messages exchanged by apps and actions taken



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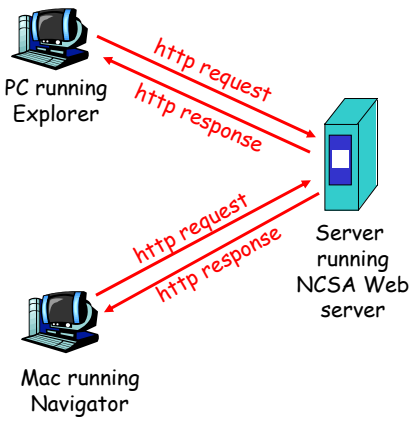
WWW: the HTTP protocol

HTTP: hypertext transfer protocol

- WWW's application layer protocol
- Client/server model
  - *Client:* browser that requests, receives, "displays" WWW objects
  - *Server:* WWW server sends objects in response to requests
- HTTP/1.0: RFC 1945
- HTTP/1.1: RFC 2616



The HTTP protocol: More

HTTP: TCP transport service:

- Client initiates TCP connection (creates socket) to server, port 80
- Server accepts TCP connection from client
- http messages (application-layer protocol messages) exchanged between browser (http client) and WWW server (http server)
- TCP connection closed

HTTP is "stateless"

- Server maintains no information about past client requests

aside

Protocols that maintain "state" are complex!

- Past history (state) must be maintained
- If server/client crashes, their views of "state" may be inconsistent, must be reconciled

DNS: Domain Name System

People: many identifiers:
- SSN, name, Passport #

Internet hosts, routers:
- IP address (32 bit) – used for addressing datagrams
- "name", e.g., gaia.cs.umass.edu – used by humans

Q: Map between IP addresses and name?

- Secure Domain Name System (DNS) Dynamic Update: RFC 3007

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DNS: Domain Name System

Domain Name System:
- *Distributed database:* implemented in hierarchy of many *name servers*
- *Application-layer protocol:* host, routers, name servers communicate to *resolve* names (address/name translation)
  - Core Internet function implemented as application-layer protocol
  - Complexity at network's "edge"

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DNS name servers

No server has all name-to-IP address mappings

Local name servers:

- Each ISP, company has *local (default) name server*
- Host DNS query first goes to local name server

Authoritative name server:

- For a host: stores that host's IP address, name
- Can perform name/address translation for that host's name

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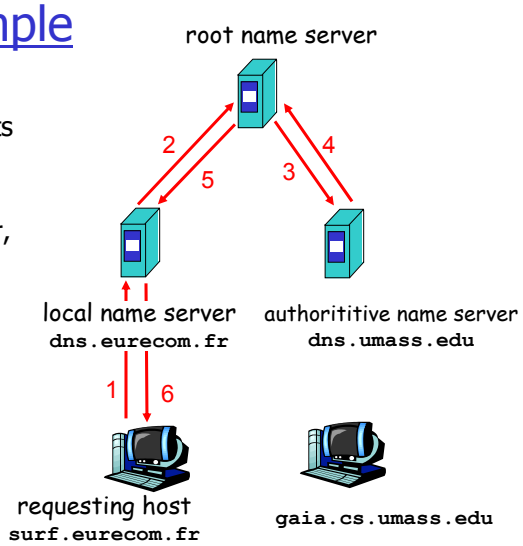
Simple DNS example

Host **`surf.eurecom.fr`** wants IP address of **`gaia.cs.umass.edu`**

1. Contacts its local DNS server, **`dns.eurecom.fr`**
2. **`dns.eurecom.fr`** contacts root name server, if necessary
3. Root name server contacts authoritative name server, **`dns.umass.edu`**, if necessary



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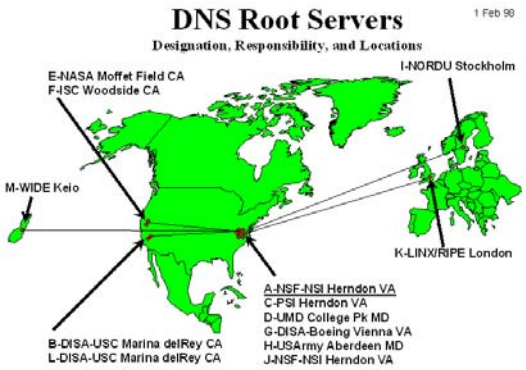
DNS: Root name servers

- Contacted by local name server that can not resolve name
- Root name server:
  - Contacts authoritative name server if name mapping not known
  - Gets mapping
  - Returns mapping to local name server
- ~ dozen root name servers worldwide



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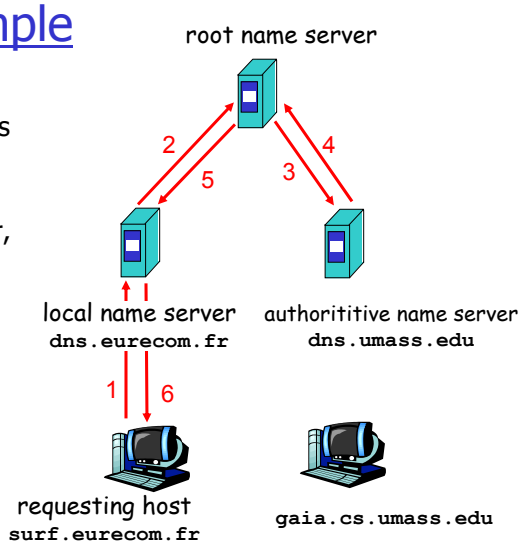
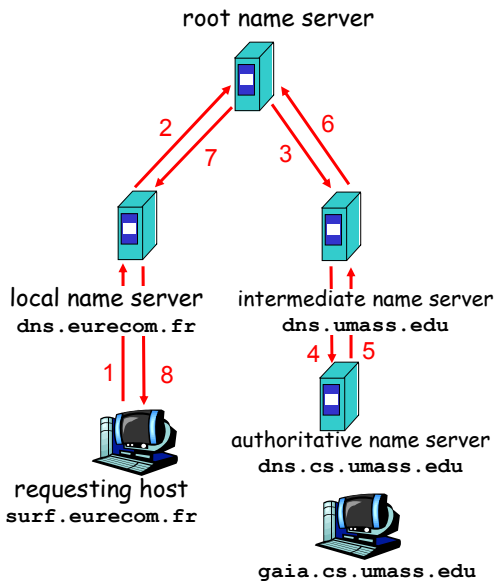


DNS example

Root name server:

- May not know authoritative name server
- May know *intermediate name server:* who to contact to find authoritative name server



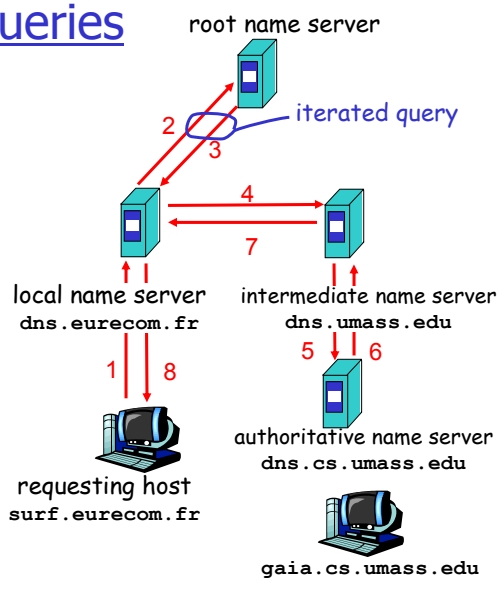
DNS: Iterative queries

Recursive query:

- Puts burden of name resolution on contacted name server
- Heavy load?

Iterated query:

- Contacted server replies with name of server to contact
- "I don't know this name, but ask this server"



DNS: Caching and updating records

- Once (any) name server learns mapping, it *caches* mapping
  - Cache entries timeout (disappear) after some time
- Update/notify mechanisms under design by IETF
  - RFC 3007 (Feb. 2004)
  - http://www.ietf.org/html.charters/dnsind-charter.html

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