DNS: Root Name Servers

- contacted by local name server that can't resolve name
- root name server: provides pointers to authoritative servers at lower level of name hierarchy
- 13 "conventional" root name servers worldwide
- 20+ copies of "F-server" worldwide reached by specialized BGP routing
Generic TLD Servers Distribution -2006 (.org, .info, .mobi)

Summary of all TLD server locations
Performance of Object References

Cache Design Issues

- Size
  - influences "hit ratio" (though DNS caches are typically not size-limited)
  - \[ T_{\text{hit}} = \text{hit ratio} \times T_{\text{noop - weak}} + (1 - \text{hit ratio}) \times T_{\text{noop - strong}} \]

- Replacement
  - free space for new data when full
  - Usually not critical for DNS caches, since most are not size-limited

- (in)Validation
  - does the cache hold "current" information?

- Location
  - memory vs disk (speed vs size)
DNS Resolution with Cache

nslookup www.cs.cmu.edu

resolver

.edu NS A.ROOT-SERVERS.NET 198.41.0.1
cmu.edu NS LANACLOT.NET.CMU.EDU 123.2.232.1
co.cs.cmu.edu NS MANCC.ERG.CS.CMU.EDU 128.3.222.180
www.cs.cmu.edu A 128.3.220.70
Using Trace-driven Simulation to Study Effectiveness of Caching

- Goal: study effect of group size and TTls on cache hit rates
- Use traces to:
  - Derive databases of:
    - IP->name mapping
    - host->TTL values
  - Randomly divide TCP clients into groups of size <
- Simulate a shared DNS cache for each group
  - For each new TCP connection in the trace:
    - Use src IP addr to identify group
    - Use dest IP addr to identify domain name client would have looked up
    - Since not all DNS queries would appear in the trace
    - Record hits/misses based on group's simulated cache; update cache on miss
A-record Cache Sharing vs Hit Ratio

- Most benefits of sharing obtained with 10-20 clients per cache.
- With no sharing, avg hit rate is 60-70%.
- Zipf-like distribution of name popularity.

A-record TTL vs Hit Ratio

- Using small TTL is not likely to affect hit rates much.
- Same TTL simulated for all names.
Using Trace-driven Simulation to Study Effectiveness of Caching

- Per-client or per-application caching of A-records can almost entirely handle the job of reducing client-latency

- Not a good idea to reduce TTL values on NS-records (or for A-records for name servers)
  - Would increase the load on root and gTLD servers by a factor of 5!
  - Local proxy-based caching helps significantly reduce load on root servers

Mean DNS Time for 15,000 Names from 75 Different Internet Sites
Recent Optimizations

- ISP or large enterprise zone servers use zone-transfer protocol to copy root or TLD databases periodically (e.g., several times per day)
  - configure local zone servers to bypass root servers
- Co-location (hosting) of ISP or enterprise zone databases at TLD sites
  - leverage optimized hardware, software, facilities for running servers