Evaluating the Impact of DNS and HTTP Session Characteristics on Consumer ISP Web Traffic

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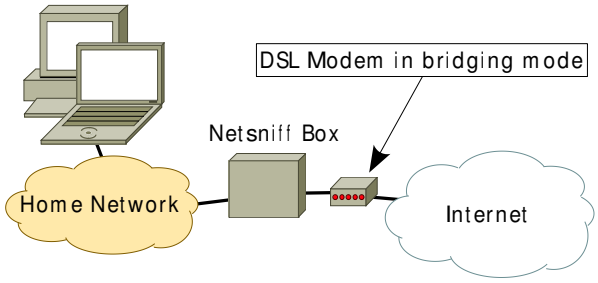
Outline

- Motivation
- Experimental Environment
- What makes up a HTTP Session
- Results
  - Gathered DNS Lookup Statistics
  - Gathered HTTP Transaction Statistics
- Caching Content
  - Cacheability of Content
  - Potential to Improve the Online User Experience

Motivation

- Web caches considered good
- Evaluate their effectiveness in the consumer ISP context
- Aim to meaure the entire user web experience
  - Correlate HTTP transactions with corresponding DNS queries
  - Measure the impact of client-server RTT with respect to HTTP transaction time
  - Estimate potential improvements to user web access times using different caching models

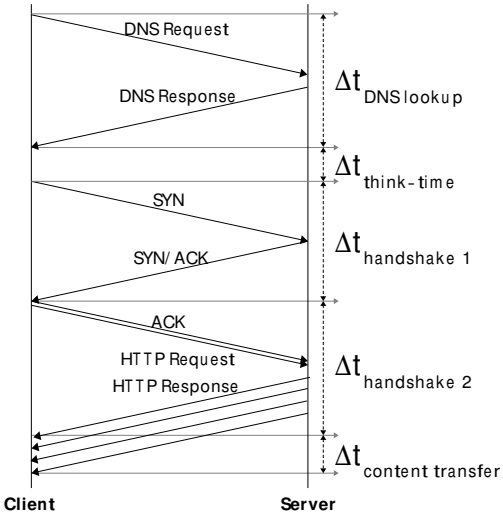
Experimental Environment



- NetSniff[1] Box running FreeBSD 5.3
  - Manages ISP Connection
  - Provides DHCP and DNS forwarding services within the home LAN
  - Provides a NAT service to any computer on the home LAN
  - Restarts data gathering upon failure
  - Logs rolled over daily and transfered to CAIA at 3AM

[1] Multi protocol layer network traffic analysis tool developed at CAIA - http://caia.swin.edu.au/ice/tools/netsniff

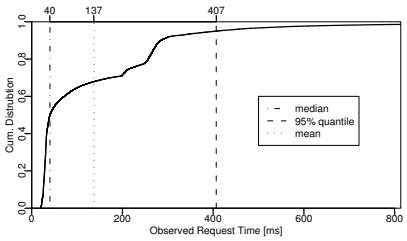
What Contributes to a HTTP Session



- DNS Query
  - If result is not locally cached
- HTTP Transaction
  - TCP Handshake
  - Content Transfer Time

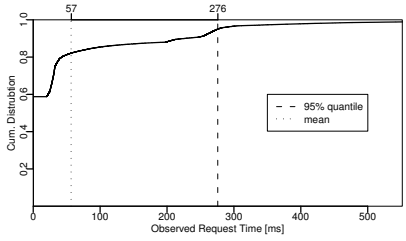
DNS Lookup Statistics

DNS Lookup Times for HTTP Transactions having a lookup



- About 73,500 DNS Requests
- Requests within 40ms handled by ISP DNS Server
- Responses > 250ms reflect access to an overseas DNS

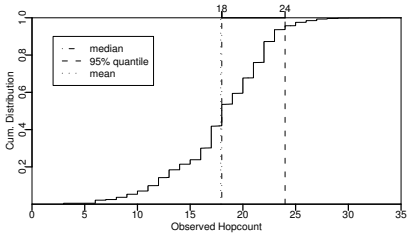
DNS Lookup Times for HTTP Transactions including browser cached entries



- Total 179,000 HTTP Transactions
- Other transactions incur no DNS lookups
  - DNS resolution cached at client
  - Equivalent to a DNS resolution of 0ms

Hop Counts to HTTP Servers

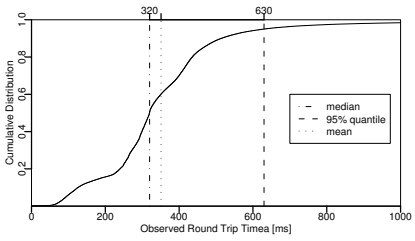
Path Hop Count Distribution for HTTP Transactions



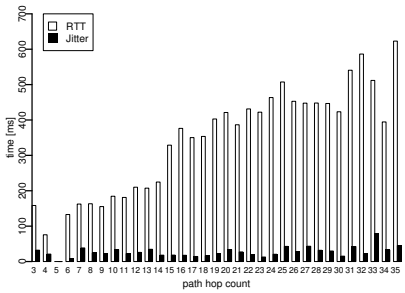
- Results indicate the absence of a Web Cache at the ISP
- Mean/median hop count to a web server is 18

RTT Distributions

RTT Distribution for HTTP Transactions



Mean RTT and Jitter vs. Path Hop Count for HTTP Transactions

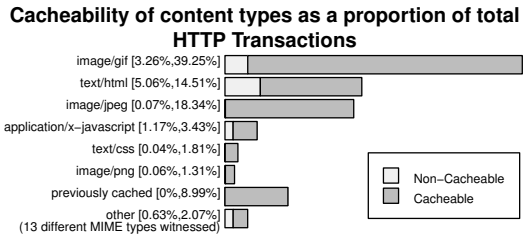


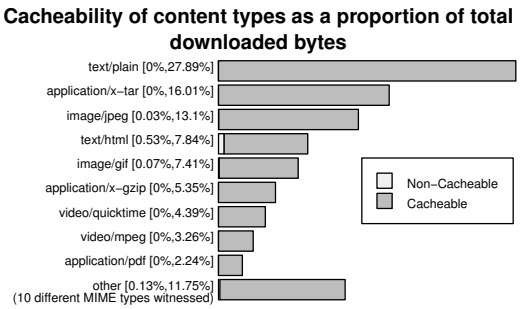
- Resonably linear spread of HTTP RTT distributions
  - Interrupted at 200ms (overseas servers)
- RTT and Jitter both related to number of hops in path

Would a Web Cache Help

- Decrease the Hop Count to the server
- Decrease the $2\ x\ RTT$ factor that makes up the overall content download time
  - Which will remain constant even as Internet access rates increase
- Minimise DNS query time
- Is enough content cacheable to justify?
- How much of an impact would it have?

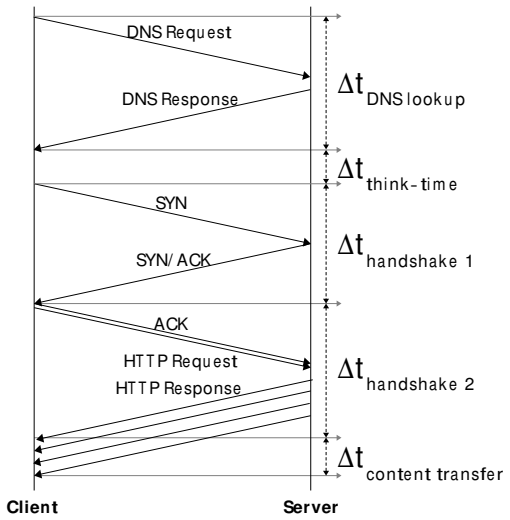
Cacheability of Content

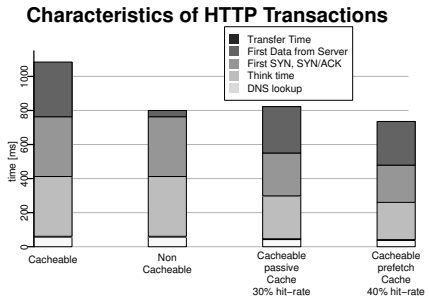




- Majority of downloaded content is cacheable
  - ~ 90% of individual HTTP transactions
  - > 99% of downloaded bytes
- Whether content is cached depends on the hit-rate of the cache
- Potential for large savings in access times

Potential Benefits





- Transfer time calculated as download at 512kbps
- For a cache hit
  - DNS lookup will be 0ms
  - HTTP RTT is equal to 20ms
- More potential for savings:
  - Up to 88% of content is cacheable

Conclusions

- ISP's we used did not cache web content locally
- RTT to the web server forms a significant proportion of the HTTP Transaction time
- Web Caches would reduce this RTT
  - Potential for 24-32% savings in average HTTP transaction time
- Reduce core traffic for other Internet applications
- Potential to become more important as access speeds increase
  - Data transfer time drops
  - RTT to server becomes a greater part of the HTTP transaction time