

# Sensitivity Of Quake3 Players To Network Latency and ~~Jitter~~

An incomplete, experimental look at the impact of network conditions on a player's choice of server for multiplayer, networked games

(Oh, and something fun to do as well....)

Grenville Armitage  
gj\_armitage@yahoo.com  
Nov. 1st, 2001

# Introduction

- Qualitative assertion: Low latency and jitter are desirable for real-time, interactive games
- Quantitative assessments: Rare, yet useful to ISPs and game hosting companies
  - *What is the latency radius within which I'll find my primary population of players?*
- This project attempts to correlate observed player activity with network conditions
  - Specific context: *Quake III Arena*, a networked, multiplayer 'first person shooter' (FPS) game
- Hope others will embark on similar research
  - This project is self-funded, donated resources

# Test Environment

## Hypothesis:

- Players will prefer lower 'ping' times to servers
- Server usage patterns will reflect *topological locality* of players

## Methodology:

- Establish two QuakeIII servers that appear identical to client-side selection process
- Log players, their IP addresses, and in-game 'ping' samples over period of months
- Assess topological locality of players, and distribution of observed ping values.



## Reality:

- *Californian server*: 600MHz Celeron, 128MB, FreeBSD4.2, T1 link to PAIX (hosted in Palo Alto)
- *London server*: 900MHz Athlon, 128MB, Linux kernel 2.4.2, 10Mb link to UK net (hosted at University College London)
- Both servers advertised their location as "Palo Alto, California"

# Quick Stats....

## Duration of Trials:

- **Californian server:**

*May 17 to Aug 18, 2001  
5290 unique clients  
338 clients played  $\geq$  2hrs each  
164 'days' aggregate played time*

- **London server:**

*May 29 to Sep 12, 2001  
4232 unique clients  
131 clients played  $\geq$  2hrs each  
77 'days' aggregate played time*

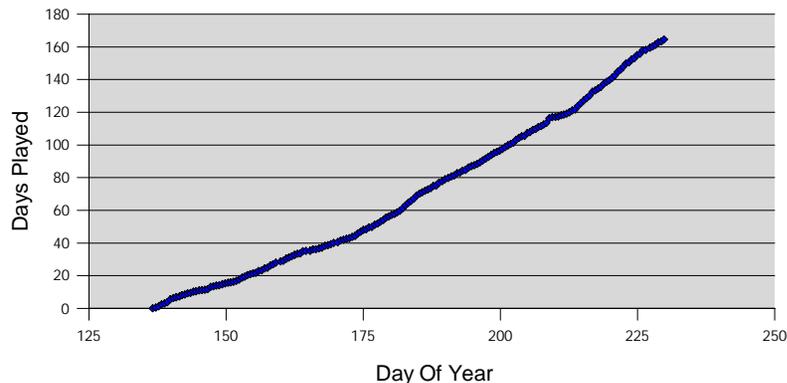
## Donated resources:

- Tristan Henderson supported server at UCL
- Brian Reid supported server in Palo Alto

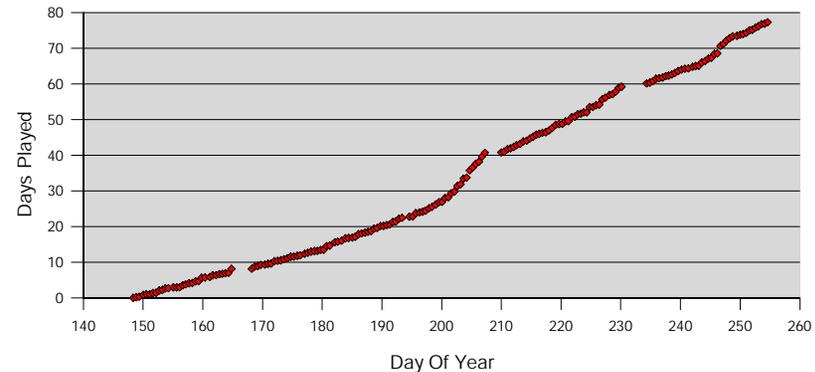
## Common server details:

- Quake III version 1.17 (linux binary)
- Same 6 maps, fixed cycle sequence
- 20 minutes per map
- Up to 6 remote players
- 2 permanent 'bots' to attract players
- Identical registration with master server (clients see latency as only difference)
- Server-side 'ping' sampled everytime player runs over an object, dies, or kills another player

Total Played Time on Californian Server



Total Played Time on London Server



# Popular Latencies

## Median 'ping' per game:

- Each player's 'ping' sampled > 10 times per game
- Median values per player per game
- Cumulative plot reflects most frequently appearing median ping values
- California and London curves similar

Players who picked up at least 1 item per minute (minimal activity)

**California 1: 80% < ~196ms**

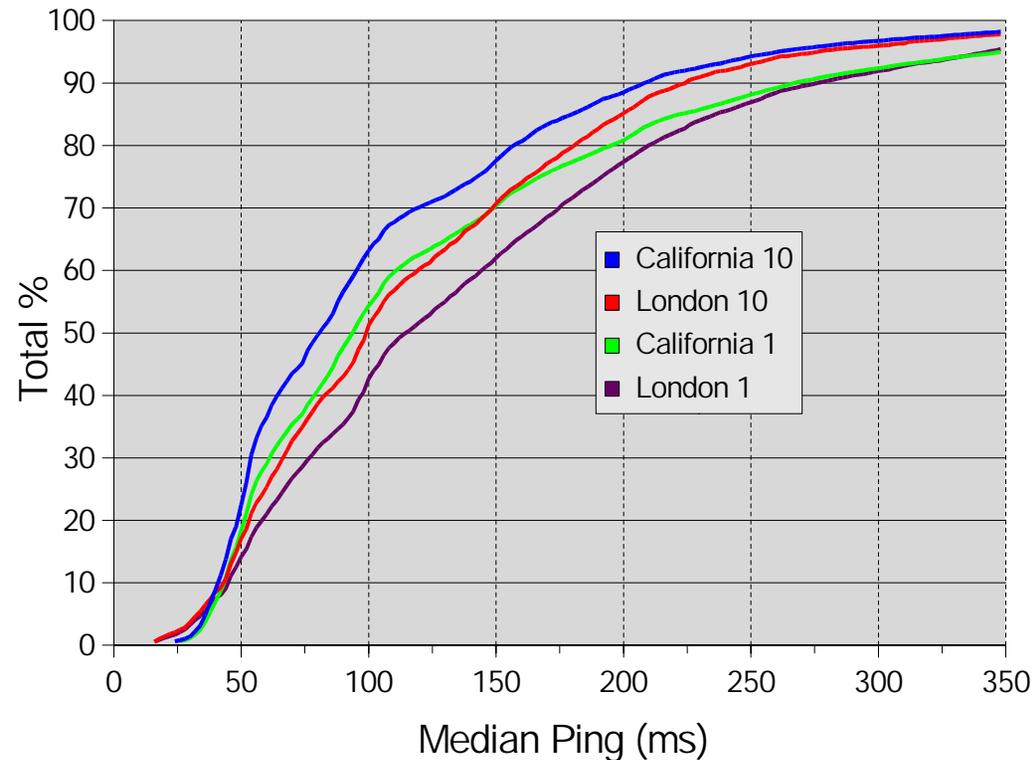
**London 1: 80% < ~210ms**

Players who picked up at least 10 items per minute (reasonably active)

**California 10: 80% < ~158ms**

**London 10: 80% < ~182ms**

Cumulative Median Ping



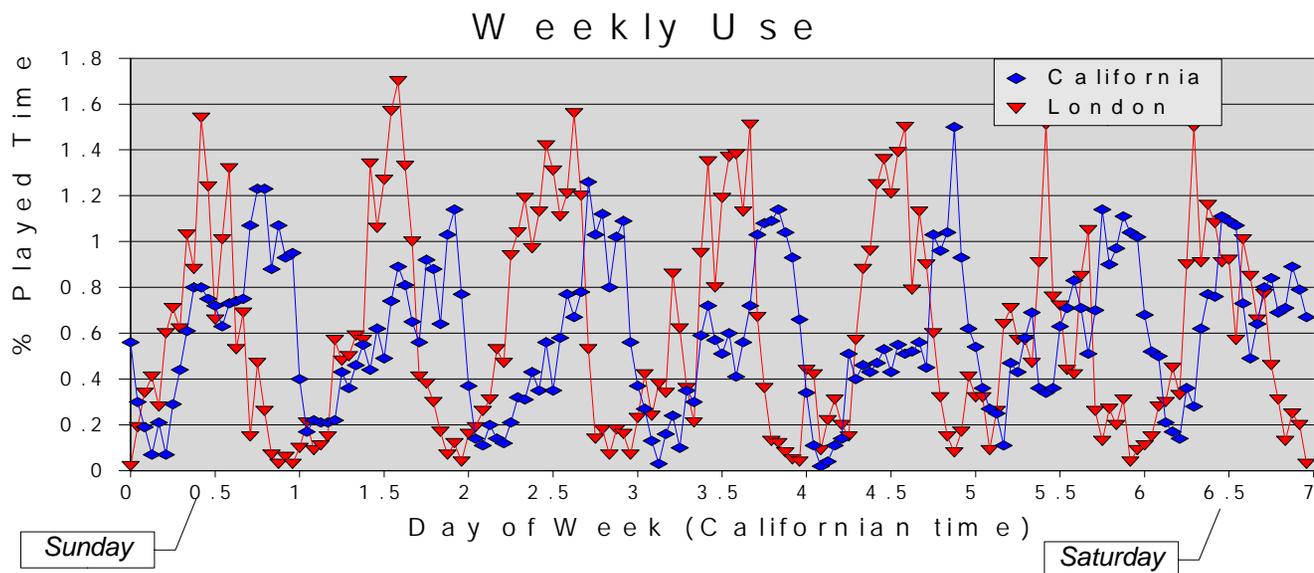
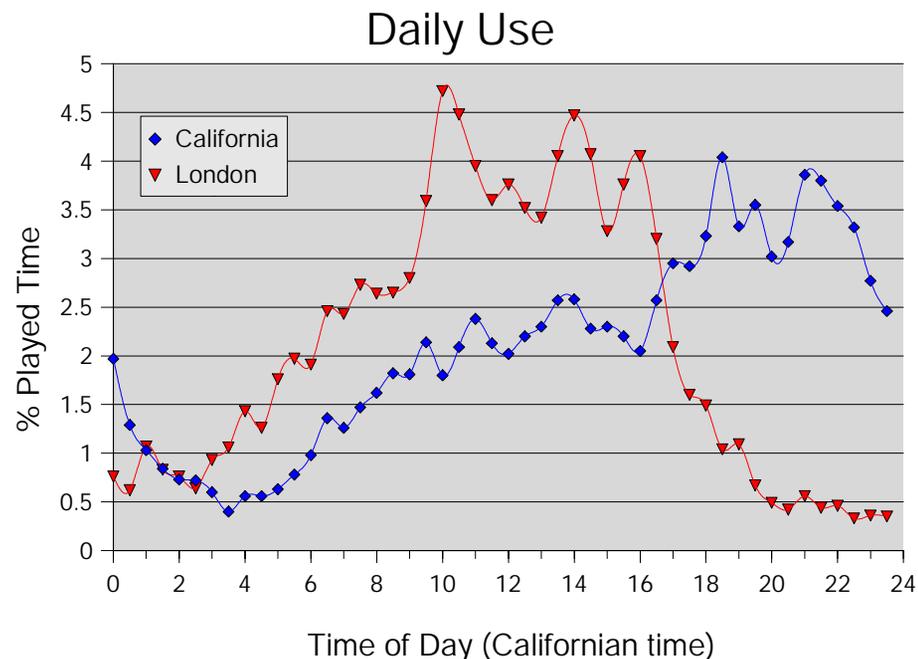
## But what does this prove?

- Perhaps nothing!  
.... if most of the Internet is less than 250ms from anywhere central
- Need evidence of regional locality...

# Evidence of Locality # 1

## Cyclical usage patterns:

- Usage patterns peak at different times, different demographics
- Peaks reflect afternoon and evening of their respective locations
  - London 8 hours ahead of Palo Alto
- Servers attract regional players
  - Supports hypothesis that clients prefer 'closer' server, other things being equal



# Evidence of Locality #2

## The Origin of Players:

- Based on reverse lookups on each player's IP address:

Californian server: mostly  
*North America*

London server: mostly  
*Europe and US East Coast*

- Since each server was otherwise identical, latency seems plausible as the client-observable metric on which a player chooses their server

Using active players who picked up at least 10 items per minute during each game:

Rank	Calforinia Games/Time(min)	Calforinia Origin	London Games/Time	London Origin
1	323 / 3005	.ed.shawcable.net	108 / 1027	.pit.adelphia.net
2	192 / 2072	.cruzio.com	73 / 690	.Uni-Mainz.DE
3	124 / 1383	(RogersEAST/@Home)	75 / 679	.upc-d.chello.nl
4	119 / 1246	.018.popsite.net	50 / 606	(telnordia.se)
5	118 / 1221	.tx.home.com	53 / 604	.dyn.optonline.net
6	150 / 1200	.mediaone.net	44 / 565	(Rogers EAST/@Home)
7	132 / 1178	.pit.adelphia.net	35 / 463	.dyn.optonline.net
8	115 / 1151	.socal.rr.com	53 / 448	.dialup.tiscalinet.it
9	87 / 980	.pa.home.com	34 / 430	.pa.home.com
10	93 / 938	.sfba.home.com	20 / 288	.tx.home.com
11	69 / 799	.hsia.telus.net	24 / 273	.btinternet.com

() bracketed origins involved looking up 'whois' database after .in-addr.arpa failed.

Table above shows origins of top 11 players on each server. Outside the top 11, the Californian server also saw dedicated players from ".jp" while the London server saw dedicated ".nl" and ".uk" players. There is also cross-over by players equidistant from either server.

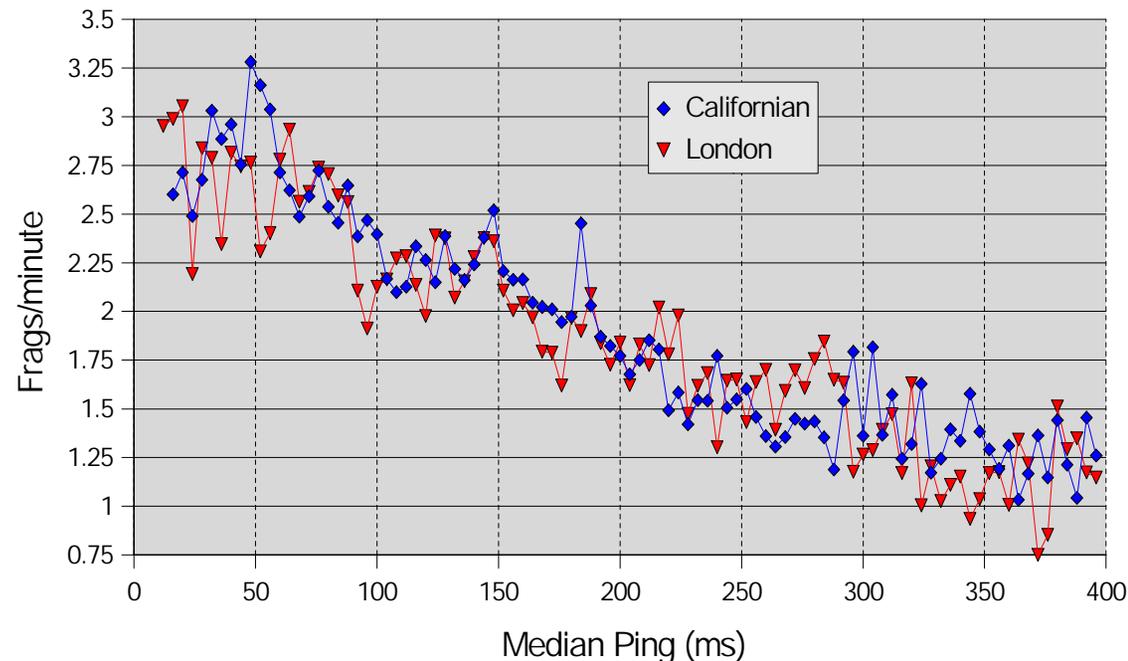
# Player effectiveness

## The aim is *fragging*

there is no other reason to play...

- Skill and response time influence a player's ability to frag (kill) others in the game
  - Response time has human and network components
- Average frag rate vs median ping hints at the negative impact of high latency
  - A player with 45ms ping could average 1 frag/min better than player with 200ms ping
  - "Well, *duh?*"

Frag(kill) Rate vs Median Ping



# Concluding thoughts....

## Learn anything useful?

- Players will tend to self-select servers within 200ms 'radius'
  - Two servers (separated by 147ms, distinct timezones and regional player populations) appear to validate this conclusion
  - Caveat: server ping estimates are only approximates
- Helps identify potential player population relative to server(s)

## Why is Jitter missing?

- Testbed's ping sampling too coarse (10+ samples/minute)
- Lacked resources to deploy revised sampling method (20+ samples/second)
- Jitter impact may be significant (hand-eye co-ordination adapts better to constant latency)

## Looking forward....

- Move to Half-Life or CounterStrike, dump QuakeIII
- Instrument servers to track packet loss and jitter
- No resources: I need multiple sites to host new servers with more accurate ping sampling