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## Quake 3 Packet Inter-Arrival and Length Over the Internet CAIA Technical Report 030919B

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September 19th, 2003

### Introduction

This investigation looks at [Quake 3](#) packet length and inter-arrival times generated to and from clients playing over the Internet. It extends work conducted by [Mark Pozzobon](#) into the characteristics and patterns seen in network gaming traffic. The results of this investigation may be slightly influenced by unwanted traffic arriving to the Quake 3 server from the Internet.

### Generating and Capturing Quake 3 Traffic

The game traffic used in this investigation was comprised of three games captured from three or four clients 9 to 16 hops away logging into the server running Quake 3 via the Internet. Each of the three data sets (games) analysed was captured on separate days over a one-month period with clients participating in a game for at least 10 minutes. The data in this report has been carefully selected so as to ensure the least amount of interference. All graphs generated and statistics calculated represent pure play time, where all three or four players were connected and no other players entered the game during this time. The end of each data set occurs just before one of the players exited the game. The first histogram of each graph is taken after the histogram where the transition before the game and after the game begins occurs. Likewise, the final histogram of each graph occurs before the histogram that would contain the data from the first player leaving the game or another player entering the game. The reason for this was to isolate the games and clearly identify the server changing maps, and the characteristics of these maps as well as investigating what results 'pure game time' produced.

The table below gives the statistics of each game analysed.

Game	Number of Clients	Start Time	End Time	Length of Game (mins)
1	3	02:02:24	04:45:00	162.600
2	3	02:54:10	03:14:15	20.083
3	4	10:06:41	10:33:39	26.967

The table below gives the client data and their actual connection time and duration. The length of the game, however, was determined by the period of time that all clients were clearly participating in the game.

Client	Game	Hops	Connection Time	Duration of Connection (mins)
A	1	13	00:56:39	176.657
B	1	16	01:49:41	173.117
C	1	11	01:57:12	160.617
D	2	12	02:27:50	79.500
E	2	13	02:28:12	79.700
F	2	10	02:53:35	20.433
G	3	13	21:27:43	81.900
H	3	9	21:33:05	55.033
I	3	9	21:56:49	33.333
J	3	14	22:04:53	43.117

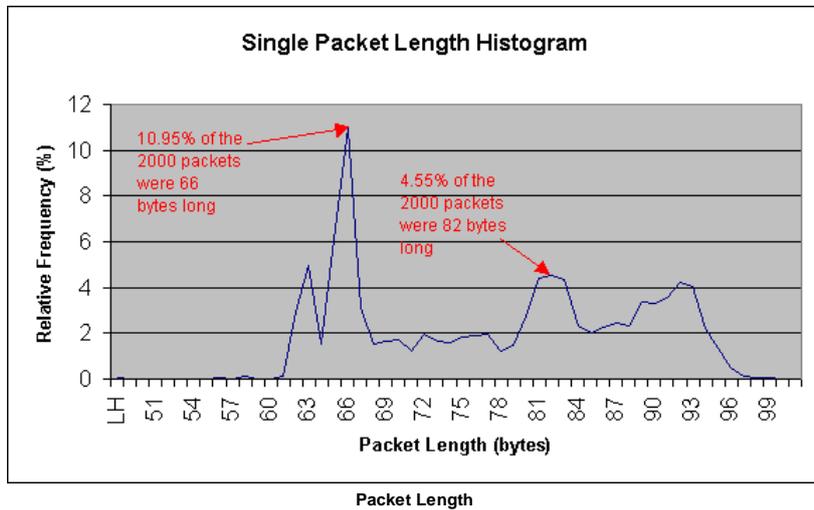
The following is a summary of the configuration/hardware employed by the game server (gs.caia.swin.edu.au) supporting Quake 3 [1]:

Brand: Compaq  
Model: EVO D500  
CPU: Pentium 4 1.6MHz  
RAM: 256Mb  
OS: FreeBSD 4.5  
Ethernet Port Details (fxp0)  
Brand: Intel  
Model: Pro/100 Ethernet  
Ethernet address: 00:08:02:3B:5B:71

### Results/Discussion

Each histogram in the results below is generated by the successful capture of 2000 packets with packet inter-arrival times of less than 800ms using [pkthisto](#) software. Only a flow of more than 200 packets is recorded to avoid interferences from the Internet such as GameSpy3D probing.

Each histogram in every graph shows the percentage of packets that arrived within a certain inter-arrival time (in milliseconds) or the percentage of packets that were a certain length (in bytes) as illustrated below.



The gs.caia.swin.edu.au server (port 27960) collected the data obtained for this investigation, cycling through 5 maps each running for a maximum of 15 minutes. The graphs generated by this data displayed common traits as described in the sections below:

- [Single Client Traffic Results](#)
- [Aggregate Flow Results](#)
- [Maps and Map Changes](#)

Controlled LAN conditions were conducted by Mark Pozzobon and those results can be seen [here](#).

### Summary and Further Analysis

The following tables show a summary of the results obtained during the investigation:

#### Packet Inter-Arrival Times:

Individual Client		Aggregate Flow	
Server to Client	Client to Server	Server to Client	Client to Server
<ul style="list-style-type: none"> <li>■ Mean: 66ms</li> <li>■ Peaks at 50ms intervals</li> <li>■ 90% of data from 40ms to 114ms</li> </ul>	<ul style="list-style-type: none"> <li>■ Mean: 38ms</li> <li>■ 90% of data from 27ms to 52ms</li> </ul>	<ul style="list-style-type: none"> <li>■ Mean: 19ms</li> <li>■ Peaks at &lt;3ms and 50ms</li> <li>■ 90% of data from 0ms to 58ms</li> </ul>	<ul style="list-style-type: none"> <li>■ Mean: 11ms</li> <li>■ 90% of data from 1ms to 22ms</li> </ul>

#### Packet Lengths:

Individual Client		Aggregate Flow	
Server to Client	Client to Server	Server to Client	Client to Server
<ul style="list-style-type: none"> <li>■ Mean: 155 bytes</li> <li>■ 90% of data from 56 bytes to 342 bytes</li> </ul>	<ul style="list-style-type: none"> <li>■ Mean: 73 bytes</li> <li>■ 90% of data from 60 bytes to 86 bytes</li> </ul>	<ul style="list-style-type: none"> <li>■ Mean: 158 bytes</li> <li>■ 90% of data from 58 bytes to 344 bytes</li> </ul>	<ul style="list-style-type: none"> <li>■ Mean: 73 bytes</li> <li>■ 90% of data from 63 bytes to 93 bytes</li> </ul>

As we can see these results differ from those obtained by Mark Pozzobon, most likely due to the unpredictable nature of Internet traffic beyond our control. Also, we could not compare the hardware and software specifications of the clients using the services of the game server to investigate how they may have an impact on these results.

Further analysis will include the Packets per second and Data rates arriving/departing to/from the server. It will then be followed by an analysis into the jitter, loss and latency experienced by the traffic across the Internet and Swinburne University backbone.

### References

- [1] Quake 3 Packet and Traffic Characteristics, Mark Pozzobon, CAIA Technical Report 021220A