Game Environments Internet Utilisation Study
http://caia.swin.edu.au/genius/
Mark Pozzobon
GENIUS

• Game Environments Internet Utilisation Study
  • So what are we trying to do?
    • Play Games?
    • Analyse Networking Gaming Traffic
    • More importantly understand characteristics of this traffic
  • Why?
    • PC Gaming/Video console market is lucrative
    • New opportunities for ISPs to offer services targeted at online game players

• Aims
  • To characterize the 'offered load' introduced by popular online, interactive, real-time games.
  • To gain an understanding of how games interact with networks.
GENIUS – Focus Areas/Games Studied

• Focus Areas
  • Short timescale game traffic characteristics
  • Long timescale aggregate usage patterns
  • Game player sensitivity to network characteristics

• Games Studied:
  • Xbox – Halo
  • Quake 3 Arena
  • Half Life – Counter Strike (Soon)
GENIUS – Xbox (Halo) Traffic

- Preliminary investigation of Xbox in-game network traffic
GENIUS – Xbox (Halo) Traffic

• Equipment used
  • 2 Xbox consoles & 2 copies of Halo
  • 4 Xbox controllers
  • 2 Televisions
  • 1 10Mbit/sec Hub
  • Packet Sniffing Computer running FreeBSD
    • Running Tcpendump and Pkthisto (With some modifications)
GENIUS – Calibrate Equipment

• Why?
  • Ensure some level of accuracy in timestamping

• Equipment
  • Netcom System Smartbits 2000 Multiport Port/Stream/Layer Performance Analysis System
  • Tcpdump
    • Timestamp/capture packets
    • Analyse captured traffic.
GENIUS – Calibrate Equipment

- Results
  - Most lab computer configurations seemed to perform to an adequate level
  - Greater variation of interpacket arrivals was present with slower CPU-based machines
  - Variation in timestamping between Operating Systems
  - NOTE: Ensure that all configuration changes are noted and tested prior to use for data acquisition
GENIUS – Calibrate Equipment

- Results (cont’d)
  - Noticed some peculiar behaviour upon adding a 2\textsuperscript{nd} network card to Intel CA810e

![Graph showing inter-packet arrival times with bursts of fixed-spacing Ethernet frames of 125\textmu s seconds for Intel CA810e running FreeBSD 4.6 (tcpdump)]
GENIUS – Xbox (Halo) Traffic

- What did we see?
  - 2 Player Game
GENIUS – Xbox (Halo) Traffic

• What did we see?
  • Similar results for 3 & 4 player games
  • Packet per second rates (Overall)
    • Server to Client: 25 packets per second
    • Client to Server: 30 packets per second
GENIUS – Xbox (Halo) Traffic

• What did we see?
  • Data Rates (Overall)
## GENIUS – Xbox (Halo) Traffic

### Xbox Traffic Summary

<table>
<thead>
<tr>
<th></th>
<th>Server to Client</th>
<th>Client to Server</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Inter-packet Arrival Times</strong></td>
<td>On average 40ms</td>
<td>On average 40ms</td>
</tr>
<tr>
<td><strong>Packet Lengths</strong></td>
<td>Typically 160, 192 or 216 bytes depending on number of players</td>
<td>Typically 72, 112 or 136 bytes depending on number of players</td>
</tr>
<tr>
<td><strong>Packets per second</strong></td>
<td>25 packets per second</td>
<td>30 packets per second</td>
</tr>
<tr>
<td><strong>Data Rate</strong></td>
<td>32+ kbit/sec, depending on number of players</td>
<td>25+ kbit/sec, depending on number of players</td>
</tr>
</tbody>
</table>
GENIUS – Xbox (Halo) Traffic

• Where to next?
  • Analysing the effects of jitter, packet loss and link latency on game play
  • Routing System Link traffic over public Internet paths
  • Explore traffic patterns by adding a third Xbox
GENIUS – Quake 3

- Preliminary investigation of Quake in-game network traffic
GENIUS – Quake 3 Traffic

- Traffic captured in LAN environment
- Typically 2 - 5 players 1 hop from the server (~2ms).
- Game Server/Packet Sniffing Computer (gs.caia.swin.edu.au)
  - Compaq EVO
  - Quake 3 (v1.31)
  - Pkthisto 0.1.2
GENIUS – Quake 3 Traffic

- Controlled (Single Client) test sequence performed
- Illustrates in-game (active & idle) and inter-game traffic patterns

Quake 3 Interarrival Histogram for Single Client (Client to Server)

Changing of maps

Idle Client
GENIUS – Xbox (Halo) Traffic

• Quake 3 Aggregate Traffic (at Server)
  • Important to observe because it affects:
    • Network components near server
    • Affects network performance and Internet

• Traffic Results/Summary

<table>
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<th>Inter-packet Arrival Times</th>
<th>Server to Client</th>
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<tbody>
<tr>
<td></td>
<td>Many back-to-back packets (&lt; 100usec) and 50msec</td>
<td>100usec – tens of milliseconds</td>
</tr>
<tr>
<td></td>
<td>Depending upon number of players</td>
<td>Upper limit dependent on the number of players</td>
</tr>
</tbody>
</table>

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<tr>
<th>Packet Lengths</th>
<th>Server to Client</th>
<th>Client to Server</th>
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<tbody>
<tr>
<td>mean of 100 bytes</td>
<td>mean of 60 bytes</td>
<td></td>
</tr>
</tbody>
</table>
GENIUS – Quake 3 Traffic

• Where to next?
  • Look at player sensitivity to jitter, latency and packet loss
  • Develop some type of model(s) for traffic seen
    • Useful for identifying & monitoring game traffic on a network
    • Ability to deliver the correct Quality of Service
GENIUS – Next?

- Further development of Pkthisto
- Simulating packet latency & loss (Dummynet)
- Half Life – Counter Strike Game Server
- Xbox game play over the Internet
GENIUS – Special Thanks

- weasel
- Saucy/Walla Walla
- Frenchy/Unnamed Player
- Stumpy/Inspector Gadget
- StRikeR