A Traffic Characterization of Popular On-Line Games

Wu-chang Feng, Francis Chang, Wu-chi Feng, and Jonathan Walpole
Department of Computer Science, Portland State University

Presented by: Lara Deek

Previous results from year 2000

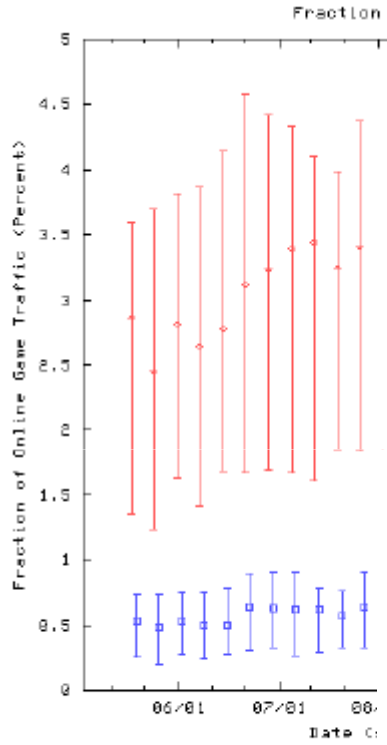


Figure 10: Fraction of online gar Traces are collected into weekly plotted.

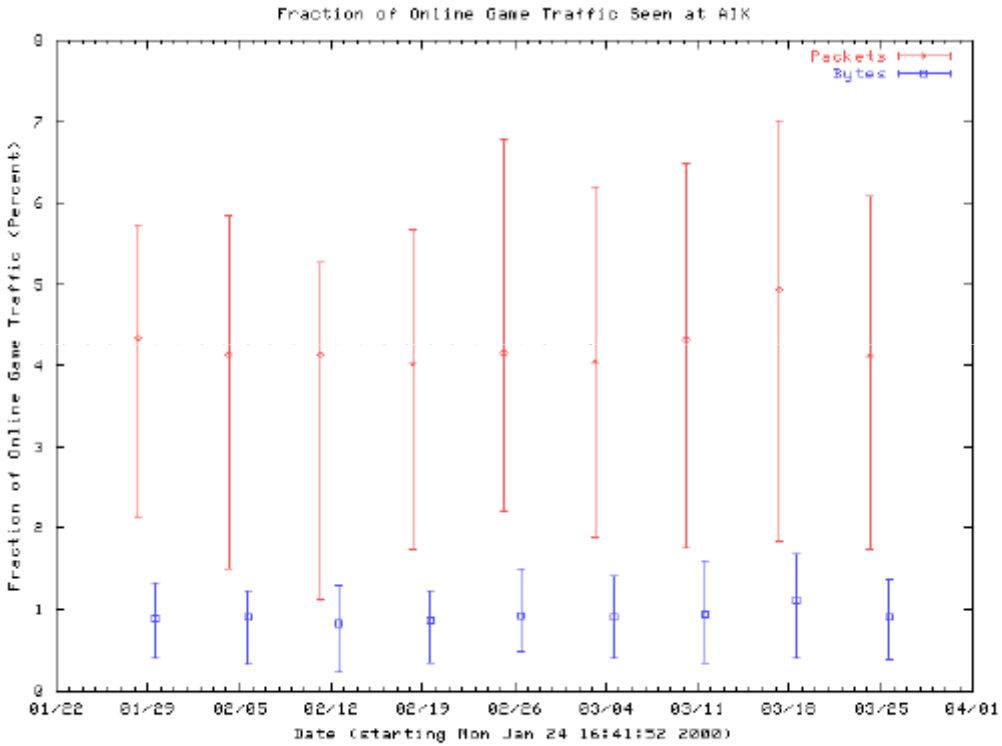


Figure 11: Fraction of online game traffic, including Half Life, Quake II, QuakeWorld, Quake 3: Arena, Starcraft, and Unreal. Traces are collected into weekly bins, and the median and first and third quartiles for each bin are plotted.

Fraction of traffic gen
over the first 8 month

Overall fraction of online game traffic seems to be on the rise.

S. McCreary and K. Claffy, "**Trends in wide area IP traffic patters: A view from ames Internet exchange**."

What online games do they look at?

- Counter Strike
- Day of Defeat
- Medal of Honor: Allied Assault
- Unreal Tournament 2003

Counter Strike

- Tactical first-person shooter video game
- Released 1999

- Traffic generated by game:
  - Real-time action
  - Coordinate information
  - Broadcast text-messaging
  - Broadcast voice communication

Trace summary of CS server

- Most popular on-line gaming community in Northwest: mshmro.com

- Start with a few important points summarized in tables:
- And now to understand the dynamics of the trace:

TABLE I

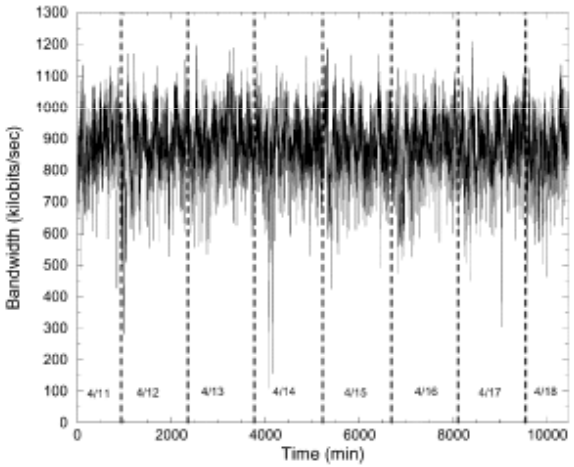
TRACE INFORMATION

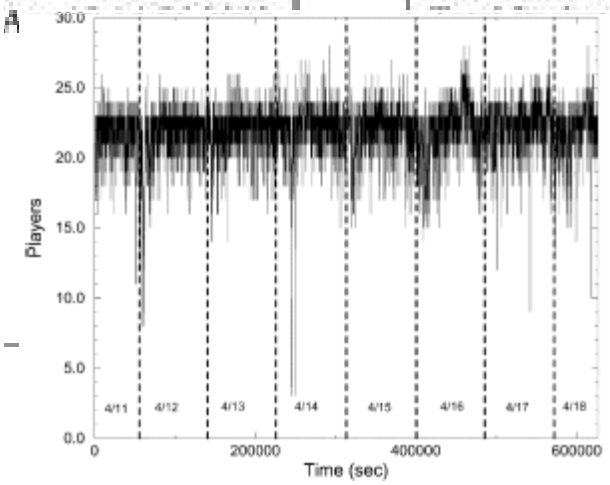
Apr 11 08:55 2002	

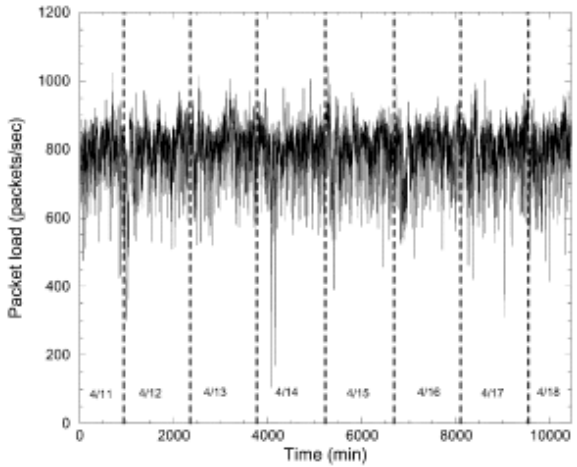
TABLE II

COUNTER-STRIKE TRACE NETWORK STATISTICS

Total Packets	500,000,000
s In	273,846,081
s Out	226,153,919
t Size	80.33 bytes







I – Traffic is periodic and predictable

- What does the server's network load look like?
  - Not stable across all time scales.
  - Shows periodic variation.

- To understand behavior at varying time scales:

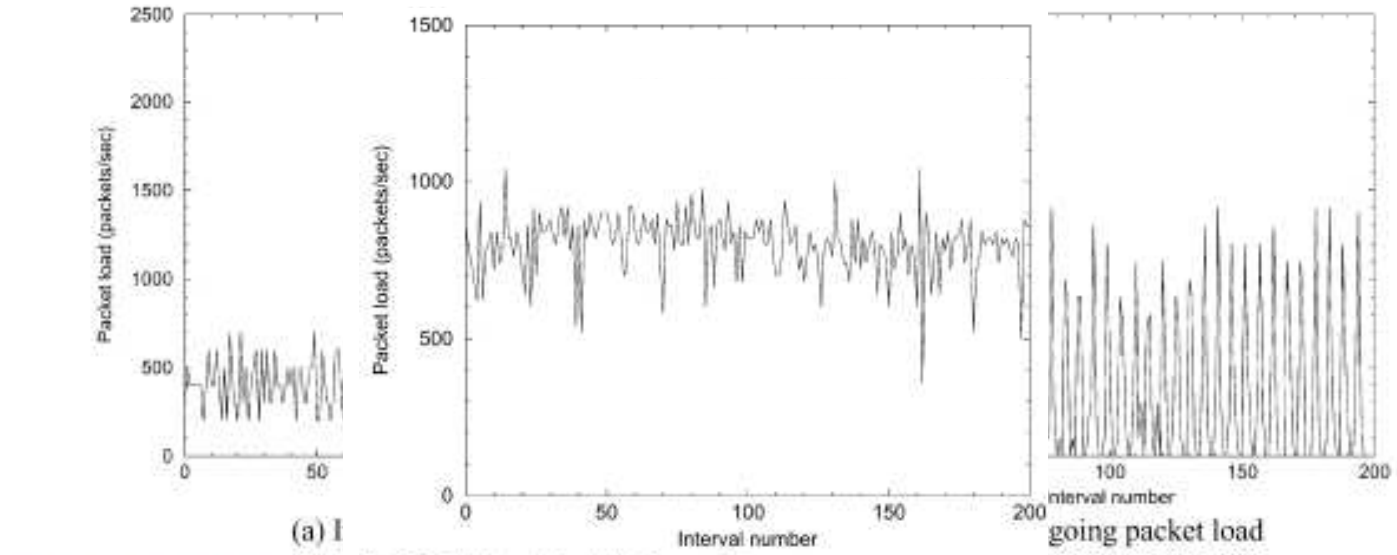
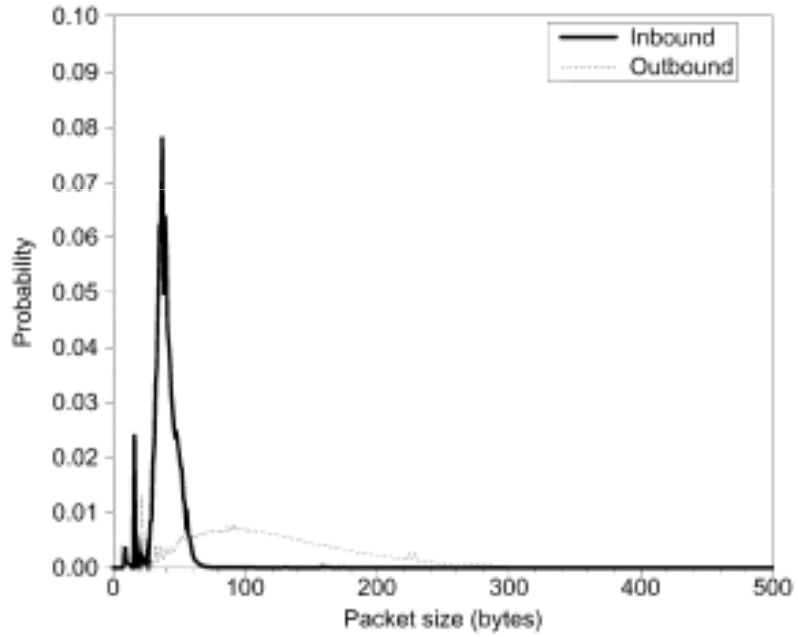


Fig. 6. Incoming and outgoing pac... Fig. 7. Total packet load plot for ... ms.

Bursty, highly periodic pattern

II – Traffic is characterized by tiny packets.

- Traffic:
  - Highly predictable and stable.
  - Large periodic bursts of small packets.



III – Traffic can characterize clients.

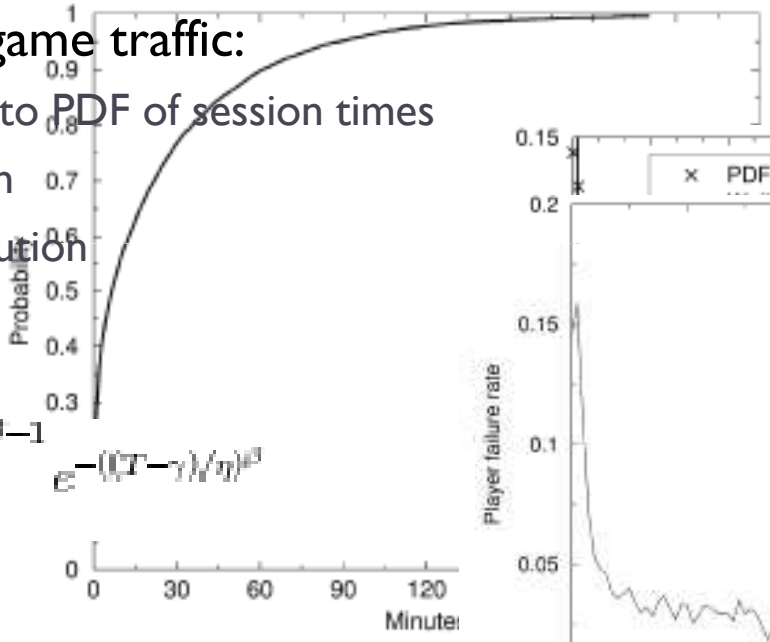
- Session-time distribution
- Geographic distribution

III.A – Session distribution

- What is the session time for players?
  - Source model for game traffic.

- Source model for game traffic:
  - Match distribution to PDF of session times
  - Weibull distribution
  - Exponential distribution

$$f(T) = \frac{\beta}{\eta}\left(\frac{T-\gamma}{\eta}\right)^{\beta-1} e^{-((T-\gamma)/\eta)^{\beta}}$$



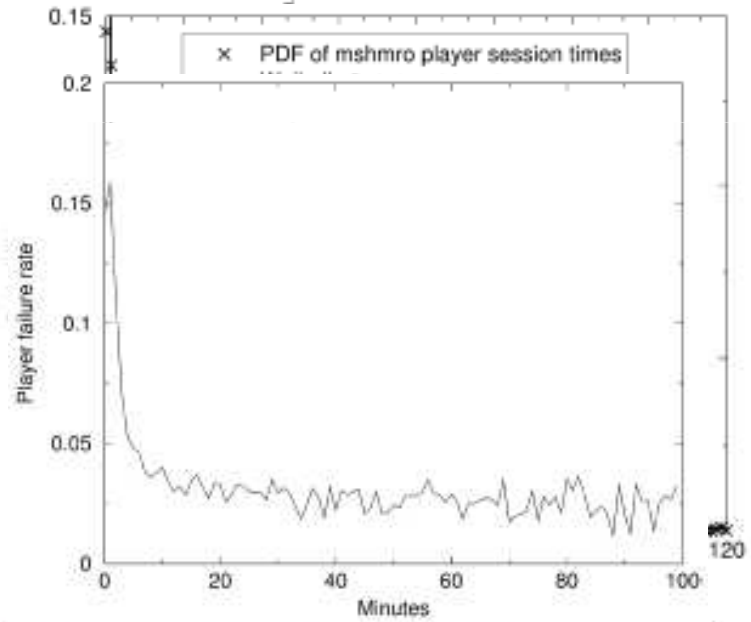
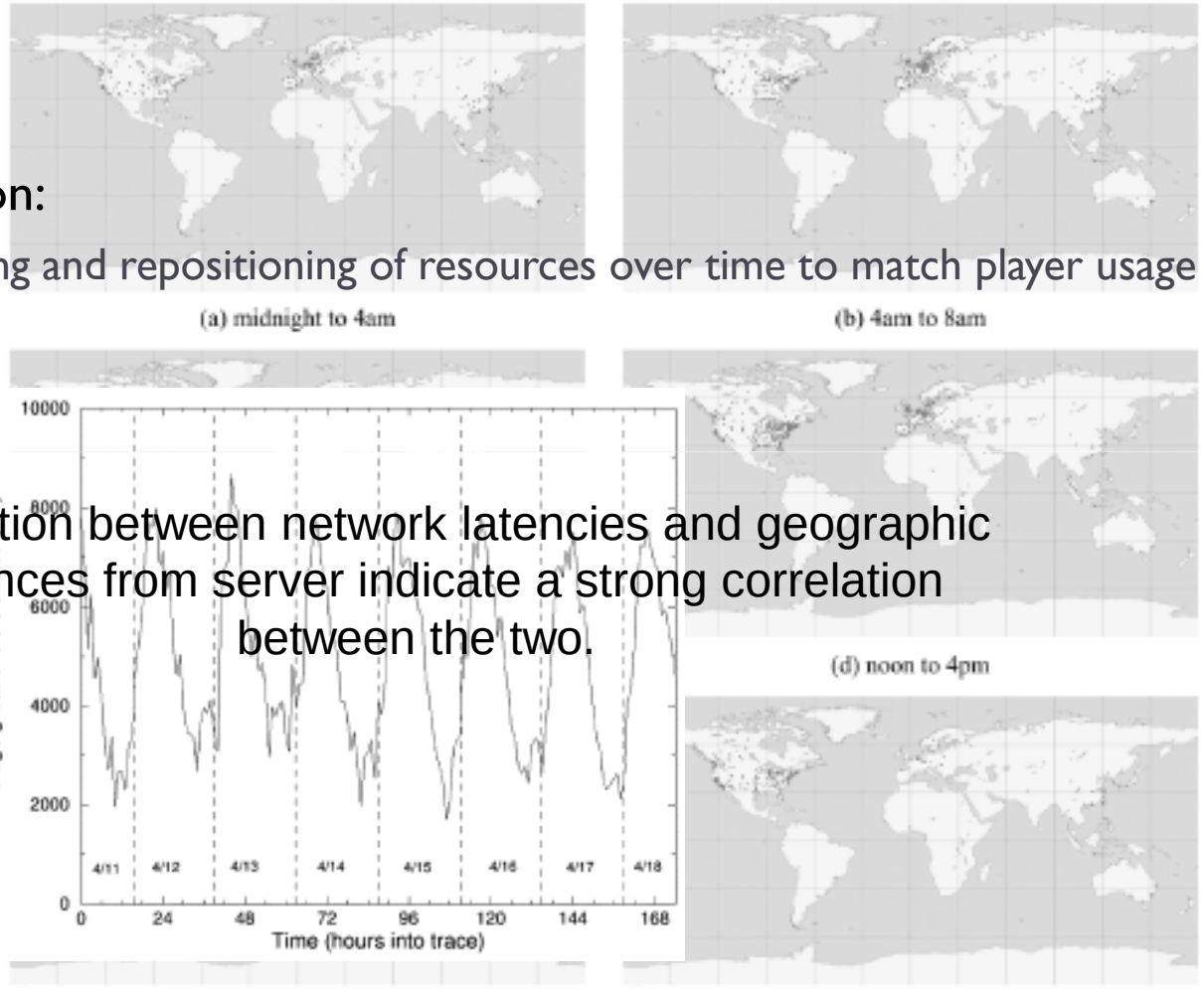


Fig. 14. Player failure rates for individual session times.

III.B – Geographic distribution (cont'd)

- Time of day?!

- Proposed solution:
  - Global positioning and repositioning of resources over time to match player usage patterns



Correlation between network latencies and geographic distances from server indicate a strong correlation between the two.

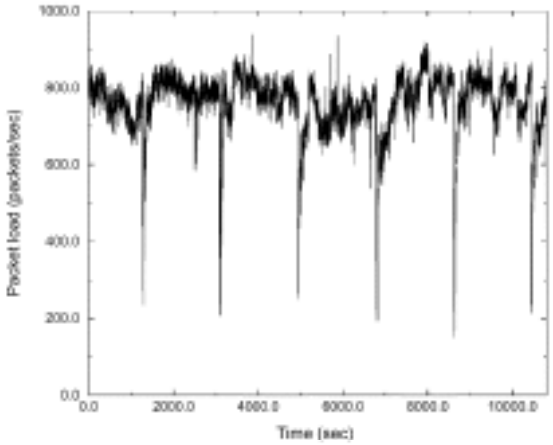
And finally… other FPS Games

- Trace summary:

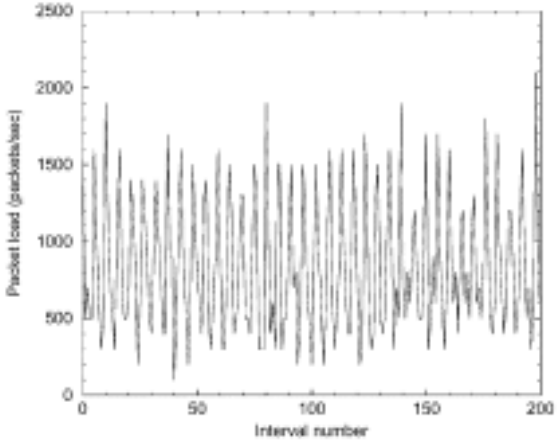
TABLE III
TRACE SUMMARIES FOR OTHER FPS GAMES

Day of Defeat	
Start Time	Sun Jul 28 23:00:00 2002
Stop Time	Mon Jul 29 02:00:00 2002
Packet rate (in/out)	421.85*pps*/341.92*pps*
Packet size (in/out)	41.73*bytes*/162.78*bytes*
Medal of Honor: Allied Assault	
Start Time	Thu Jul 25 01:00:00 2002
Stop Time	Thu Jul 25 04:00:00 2002
Packet rate (in/out)	379.67*pps*/294.10*pps*
Packet size (in/out)	50.10*bytes*/291.71*bytes*
Unreal Tournament 2003	
Start Time	Thu Oct 17 00:00:00 2002
Stop Time	Thu Oct 17 03:00:00 2002
Packet rate (in/out)	469.89*pps*/123.43*pps*
Packet size (in/out)	27.92*bytes*/117.74*bytes*

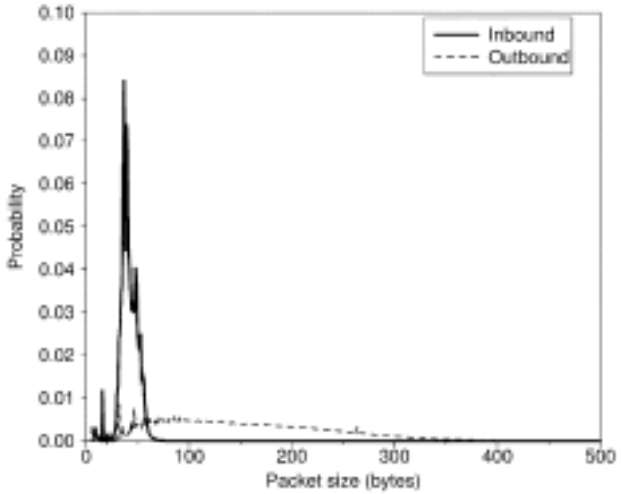
Other Games: Day of Defeat



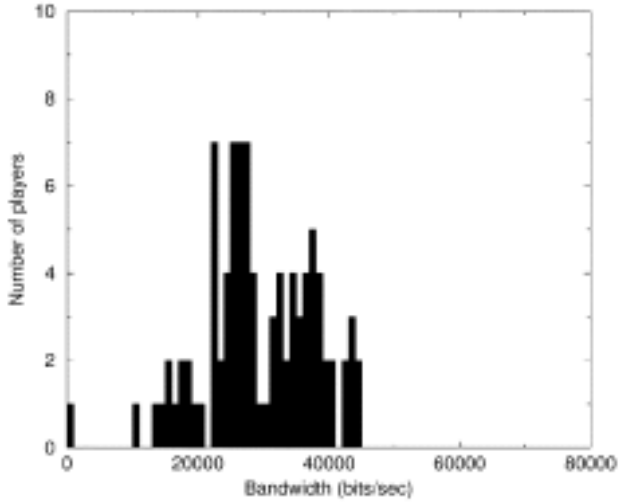
(a) Per-second packet load over trace



(b) Total packet load plot for $m = 10ms$

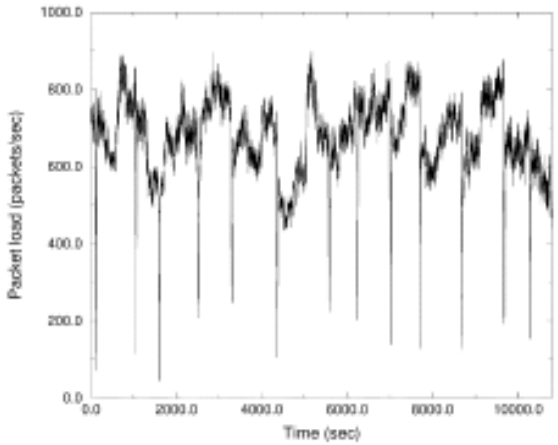


(c) Packet size PDF

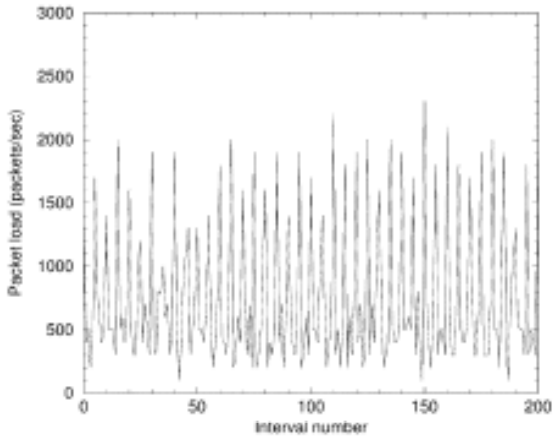


(d) Client bandwidth histogram

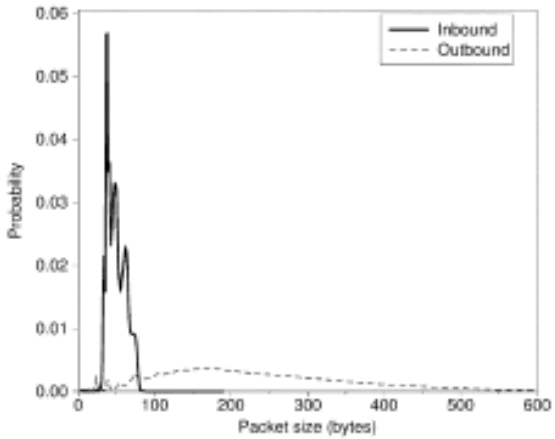
Other Games:
Medal of Honor: Allied Assault



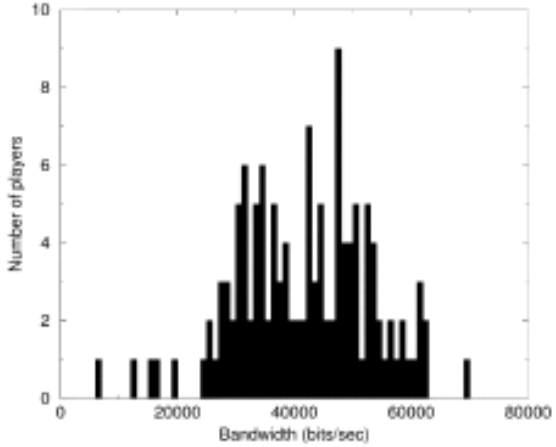
(a) Per-second packet load over trace



(b) Total packet load plot for $m = 10ms$

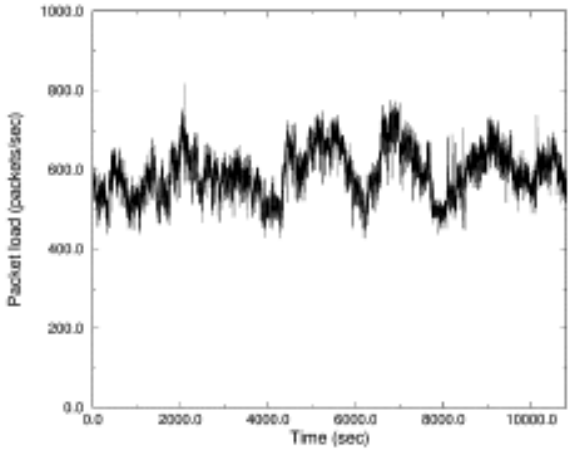


(c) Packet size PDF

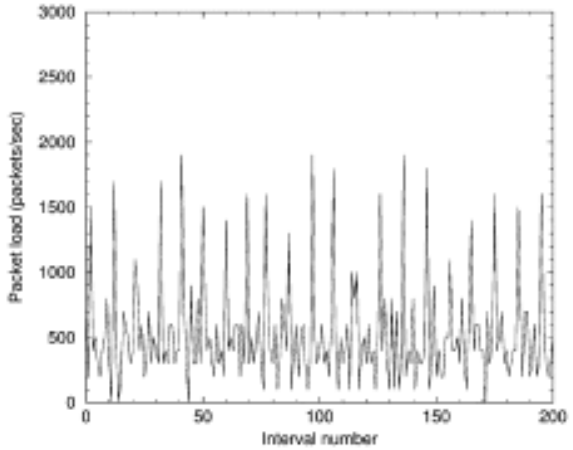


(d) Client bandwidth histogram

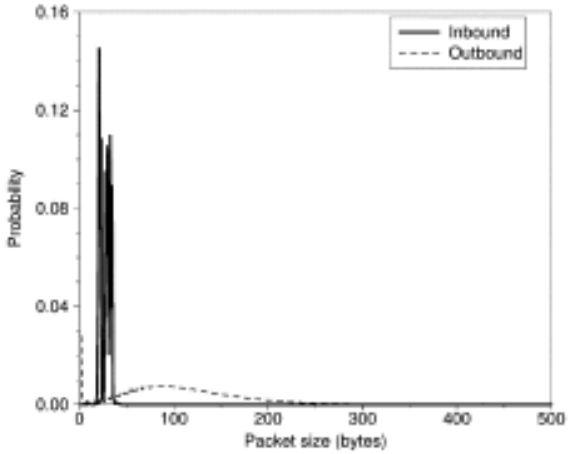
Other Games:
Unreal Tournament 2003



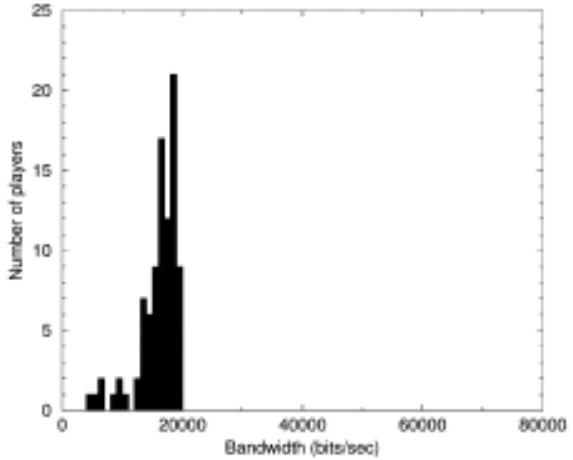
(a) Per-second packet load over trace



(b) Total packet load plot for $m = 10ms$



(c) Packet size PDF



(d) Client bandwidth histogram

Implications on routing infrastructure

- Traffic consists of large, periodic bursts of short packets.
- Network traffic designed for large packets, bulk transfers using TCP.

- Devices should:
  - Have sufficient forwarding capacity to handle small packet sizes
  - Employ ECN
  - Have small buffers
  - Emply active queue management

- The good news?
  - Traffic is predictable
  - Resource requirements are predictable
  - Modeling, simulation, and provisioning online gaming traffic a relatively simple task
  - Periodicity and predictability allow meaningful performance optimizations within network devices

Thank you for bearing with me!

Any questions?