Online Interactive Game Traffic: A Survey & Performance Analysis on 802.11 Network

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Roadmap

- Introduction
- Interactive Game Traffic Models
- Simulation Setup
- Simulation Results
- Conclusion & Future Improvements

Introduction

- Motivations
  - 3~4% of Internet traffic are game traffic[1]
  - Few attentions paid to game traffic QoS
  - Especially interesting to see performance over WLAN
- Scope
  - Studies on 3 types of game traffic characteristics
  - Simulation
    - only on one type of the traffic

[1] S. McCreary and K. Claffy, "Trends in Wide Area IP Traffic Patterns: A View from Ames Internet Exchange", 13th ITC Specialist Seminar on Measurement and Modeling of IP Traffic, Sept 2000, pp. 1-11.

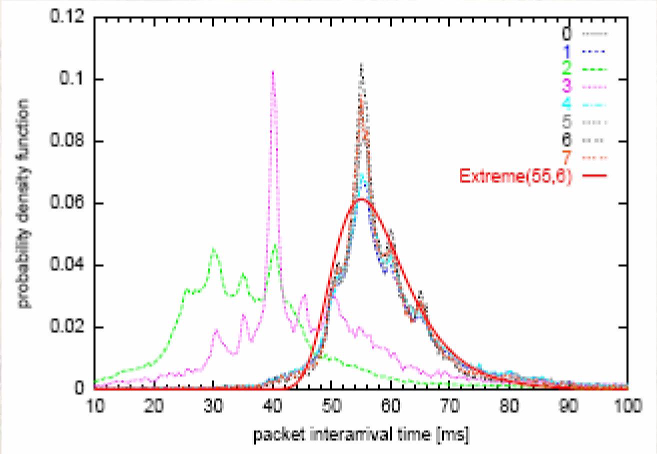
First Person Shooting

- Description
  - Participants equipped with guns and play back-to-back rounds of shooting
  - Goal: Defeat other players and/or teams
  - Example: Counter Strike
  - Architecture: Client-server application
- Traffic Characteristics
  - Bursty server traffic to update status of all clients (ie. periodic burst of small UDP packets)
  - Clients synchronize server game state with their local state (almost constant packet interarrival time)
  - Model Proposed by Färber[2]

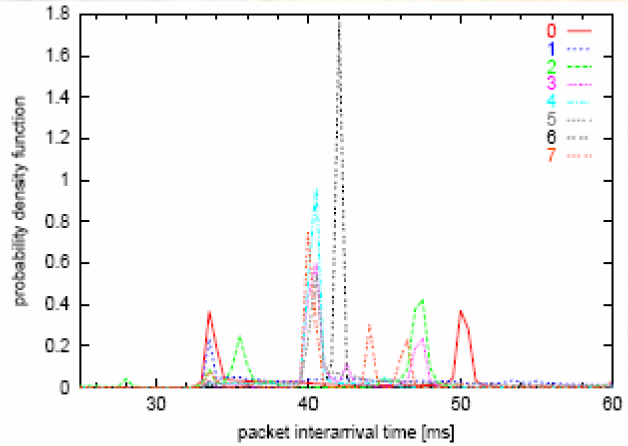
[2] J. Färber, "Network Game Traffic Modelling", *Proceedings of the 1st Workshop on Network and System Support for Games*, ACM Press, 2002, pp. 53-57

Counter Strike: Traffic Model

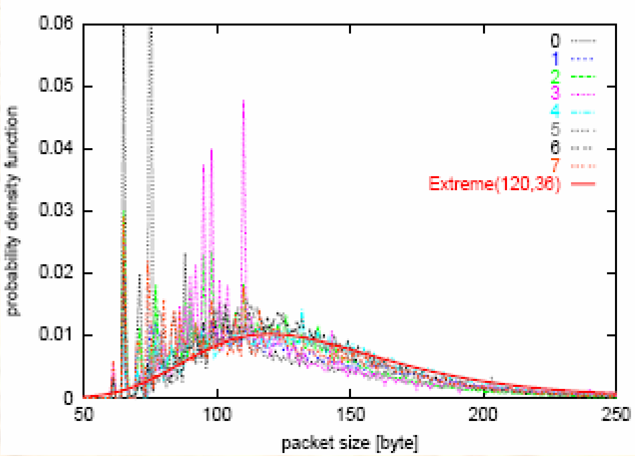
- Model proposed by Färber:



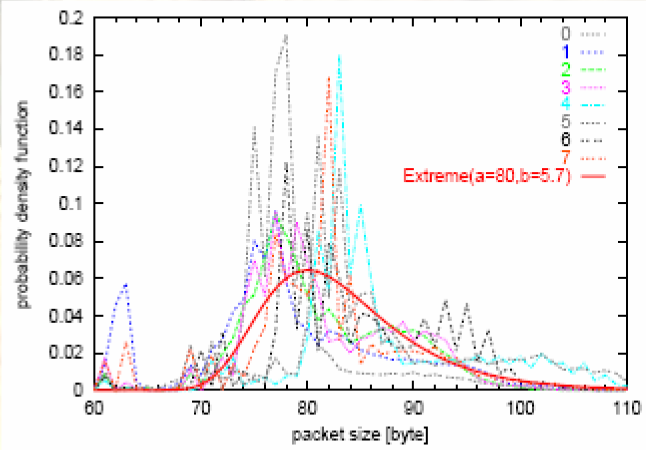
Server per client packet interarrival time ~ Extreme(55,6) ms



Client packet interarrival time ~ Deterministic(40) ms



Server packet size ~ Extreme(120,36) bytes



Client packet size ~ Extreme(80,5.7) bytes

Real-time Strategy

- Description
  - Players build troops and attack other troops
  - Goal: Defeat the opponent allies
  - Example: Starcraft
  - Architecture: Synchronous Peer-to-Peer
- Traffic Characteristic
  - TCP packets setup the connection among participants for the session
  - UDP packets exchange between peers to update each other's status

Starcraft: Traffic Summary

[3]

IAT (sec) Interarrival Time	Exponential (μ=0.043633)
IDT (sec) Inter-departure Time	Deterministic (0), for p = 66.2% Uniform (a=0.05, b=0.17), for p = 27.8% Deterministic (0.21), for p = 6%
PSI (byte) Packet size – input	Deterministic (16), for p = 3.2% Deterministic (17), for p = 10.8% Deterministic (23), for p = 72.4% Deterministic (27), for p = 6.2% Deterministic (33), for p = 7.4%
PSO (byte) Packet size – output	Deterministic (16), for p = 6.2% Deterministic (17), for p = 10.9% Deterministic (23), for p = 74.2% Deterministic (27), for p = 8.7%

[3] A. Dainotti, A. Pescapé, and G. Ventre, "A packet-level Traffic Model of Starcraft", *2nd International Workshop on Hot Topics in Peer-to-Peer Systems*, July 2005, pp. 33-42.

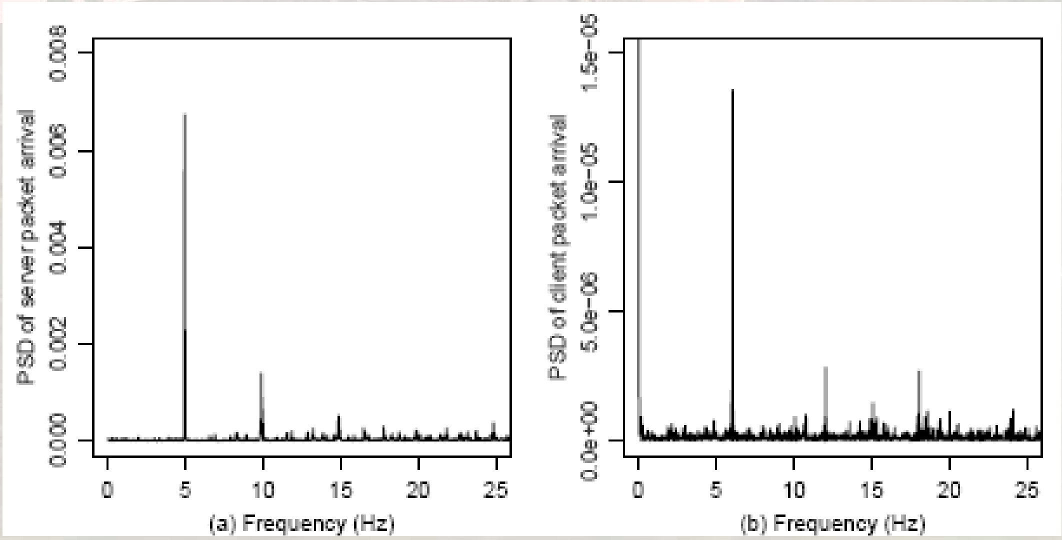
Massive Multiplayer Online Role Playing Game (MMROPG)

- Description
  - Thousands of participants create roles to join one huge game map, and defeat AI monsters
  - Goal: In general, advance to higher level
  - Example: ShenZhou Online
  - Architecture: Client-server(cluster)
- Traffic Characteristics[4]
  - TCP traffic in most of Asian MMROPG
  - 98% of client payload are ≤ 31 bytes
  - Headers takes up 73% of the transmission, and TCP acknowledgement take up 30%

[4] G. Huang, M. Ye, L. Cheng, "Modeling System Performance in MMORPG", *Globecom Workshop on Global Telecommunications Conference*, Nov-Dec 2004, pp. 512-518

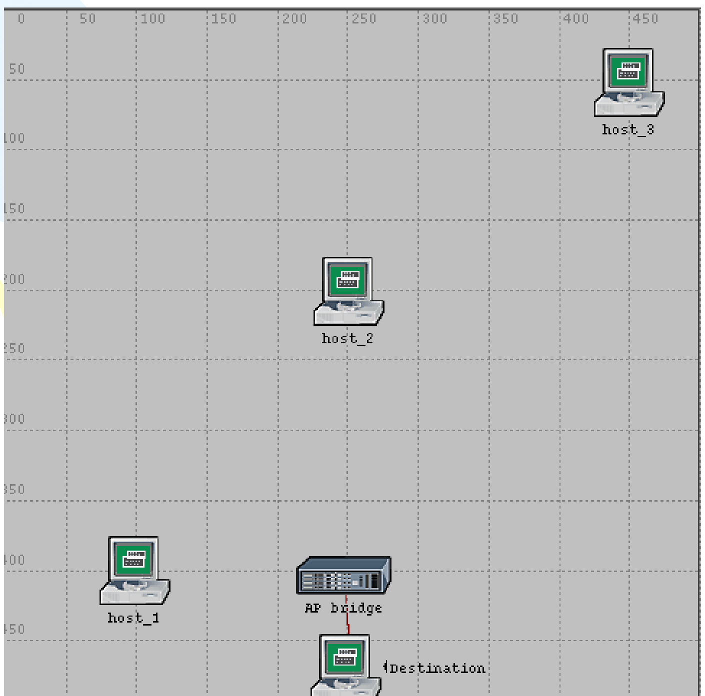
Massive Multiplayer Online Role Playing Game (MMROPG)

- Traffic Characteristics (ShenZhou Online) cont'd[4]
  - Both client/server traffics are highly periodic
    - Server refresh nearby object within certain metrics in multiples of 5Hz
    - Client sends action command with multiples of 6Hz according to skill type or level



Simulation Topology & Parameter Setup

- Traffic model chosen: Counter Strike
- 3 Scenarios – 3, 5 & 8 playing hosts



Network Topology

Destination Address	100
Wireless LAN MAC Address	1
Wireless LAN Parameters	(...)
BSS Identifier	0
Access Point Functionality	Disabled
Physical Characteristics	Extended Rate PHY (802.11g)
Data Rate (bps)	54 Mbps
PCF Parameters	Disabled
Roaming Capability	Disabled

Key Parameter Settings

Simulation Results: 3 hosts

Statistics	Host 1 150m left	Host 2 200m above	Host 3 403m top-right
End-to-end Delay (ms)	0.22	0.22	3.40
Traffic Received (pkt/s)	17.1	17.0	7.1
Throughput (kbps)	19.1	19.0	7.3
Packet Drop (pkt/s)	0	0	10.3
Retransmission Attempt (pkt)	0.168	0.168	2957

Simulation Results: 3-Hosts Discussion

- Ete-delay is ~0.2ms at Host 1 and 2
- Host 3
  - Ete-delay increases 17 times
  - traffic received degrades ~60%
  - Packet drop observed
  - Retransmission attempts are significantly higher
- Conclusion
  - The network is able to handle the traffic, but the distance from a host to the AP is the major factor.

Simulation Results: 5 hosts

Statistics	Host 1 150m	Host 2 200m	Host 3 224m	Host 4 291m	Host 5 425m
End-to-end Delay (ms)	1.09	1.11	1.10	1.12	4.96
Traffic Received (pkt/s)	16.7	16.6	16.6	16.6	0.767
Throughput (kbps)	18.7	18.7	18.6	18.6	0.719
Packet Drop (pkt/s)	0	0	0	0	21.3
Retransmission Attempt (pkt)	0.192	0.194	0.194	6.14	4455

Simulation Results: 5-Hosts Discussion

- Ete-delay is more than 1ms for Host 1~4
- Host 4
  - Observable retransmission attempts
- Host 5
  - ~4.5 times of increase in ete-delay
  - ~95% of degrade in traffic reception
  - Much higher packet drop and retransmission
- Conclusion
  - Distance to the AP is still the major factor of performance
  - Increase in load is observed from network performance (increase in ete-delay)

Simulation Results: 3,5 and 8 hosts

	150m	200m	291m	304m	403m	425m
End-to-end Delay (ms)	0.22	0.22			3.40	
	1.09	1.11	1.12			4.96
	2.59	2.62	2.62	2.66	6.04	6.44
Traffic Received (pkt/s)	17.1	17.0			7.1	
	16.7	16.6	16.6			0.767
	13.9	13.7	13.7	13.7	5.81	0.658
Throughput (kbps)	19.1	19.0			7.3	
	18.7	18.7	18.6			0.719
	15.5	15.4	15.5	15.4	5.99	0.607
Packet Drop (pkt/s)	0	0			10.3	
	0	0	0			21.3
	0	0	0	0	10.3	21.3
Retransmission Attempt (pkt)	0.168	0.168			2957	
	0.192	0.194	6.14			4455
	0.374	1.36	7.07	20.9	2980	4455

Simulation Results: 3,5 and 8-Hosts Discussion

- 8-Hosts Scenario:
  - 8-hosts scenario exhibits general behaviours, distance to AP still a major factor
  - Hosts within 300m range to the AP still has an acceptable ete-delay but performance degrades as the host is further
  - Hosts beyond 400m almost don’t get through the network at all
- Across Scenarios:
  - Ete-delay increased almost 13 times from 3 to 8-hosts simulation
  - Increased in retransmissions infers more collisions as number of hosts increased

Conclusion

- The performance of WLAN is mostly affected by the distance to the AP.
- The network performance definitely degrade as the number of active hosts increased.
- Inferring from ete-delay, 802.11g is capable of handling Counter Strike traffic.
- OPNET simulates a very stable wireless transmission medium within the working range (ie. 300m)
- Wireless is much less stable in real life due to interference and obstacle diffraction

Conclusion (cont'd)

- Delay in this project encapsulates only up to MAC layer. More delays are expected at application layer.
- Future Improvements
  - Evaluation up to transport or application layer
  - Packet error generator to simulate the unstable wireless medium
  - More sophisticated traffic model or trace-driven simulation

Reference

[1] S. McCreary, and K. Claffy, "Trends in wide area IP traffic patterns: a view from Ames Internet Exchange," *Proceedings of 13th ITC Specialist Seminar on Measurement and Modeling of IP Traffic,* Sept. 2000, pp. 1-11.

[2] J. Färber, "Network game traffic modelling," *Proceedings of the 1st Workshop on Network and System Support for Games*, ACM Press, 2002, pp. 53-57.

[3] W. C. Feng, F. Chang, W. C. Feng, and J. Walpole, "A traffic characterization of popular on-line games," *IEEE/ACM Transactions on Networking*, Vol. 13, No. 3, pp. 488-500, June 2005.

[4] A. Dainotti, A. Pescapé, and G. Ventre, "A packet-level traffic model of Starcraft," *Proceedings of the 2nd International Workshop on Hot Topics in Peer-to-Peer Systems*, July 2005, pp. 33-42.

[5] G. Huang, M. Ye, L. Cheng, "Modeling system performance in MMORPG," *Globecom Workshops on Global Telecommunications Conference*, Nov-Dec 2004, pp. 512-518.

[6] K. T. Chen, P. Huang, C. Y. Huang, C. L. Lei, "Game traffic analysis: an MMORPG perspective,“ *Proceedings of the International Workshop on Network and Operating Systems Support for Digital Audio and Video*, 2005, pp. 19-24.

[7] OPNET Technologies, Inc., *Wireless LAN Model User Guide*, OPNET Documentation 11.0.

[8] OPNET Technologies, Inc., *Discrete Event Simulation API Reference Manual: Distribution Package*, OPNET Documentation 11.0.