Online Interactive Game Traffic: A Survey & Performance Analysis on 802.11 Network – Demo Report by Susan Chiu

1. Description of the project

- Survey on online interactive game traffic characteristics and model
- Apply one type of game traffic model, specifically Counter Strike, to an 802.11 network and analyze the performance of the network

2. Implementation details

Counter Strike Traffic model proposed by Färber[1].

Table 1. Counter Strike Traffic Model[1]

	Server per client	Client
Interarrival time (ms)	Extreme (a=55, b=6)	Deterministic (40)
Packet size (byte)	Extreme (a=120, b=36)	Extreme (a=80, b=5.7)

Assumptions of the model:

(1) Client traffics are independent of each other

(2) Server per client traffic is independent of the number of clients

(3) Client traffic is independent of server traffic

Topology:

- A 500X500m campus map that contain wireless hosts. Hosts are 802.11 enabled and contains only up to the MAC layer because 802.11 is an MAC layer protocol, and the project is on evaluating 802.11 performances.
- A bridge acts as an access point (AP) is placed at the bottom-center of the map. Placing at the bottom is to have the maximum possible range of host locations to the AP in a small 500X500m map.
- The bridge is then connected to the game server via a 100Mbps Ethernet link.
- Each wireless host is loaded with Counter Strike client traffic destined to the game server.
- Assumption: every host's internet traffic contains only Counter Strike traffic

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

- Game server is loaded with Counter Strike server traffic sending to the clients.
- Simulation should run over one session of the game

Scenarios:

- verification scenario: 2 wireless hosts, traffic received should equal to traffic sent in both client and server direction
- 3 wireless hosts scenarios
- 5 wireless hosts scenarios
- 8 wireless hosts scenarios
- Statistics are collected to see the performance of every host in the same network
- Across scenarios some host remain at the same location to explore the effect of increasing number of hosts

Statistics collection:

- most importantly end-to-end delay
- packet received, throughput
- packet drop rate
- retransmission attempts, backoff slots
- some other minor ones

3. Design and code development

Host (client) modeling:

- Library Package: OPNET wireless LAN package
- Model: wlan_station_adv
  wlan_station_adv is used instead of wlan_wkstn_adv because wlan_wkstn_adv contains the TCP layer, which contains extra algorithm that this project does not wish to evaluate. wlan_station_adv has only up to the MAC layer
- Parameters setup:

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

Figure 1. Settings of the Hosts

- Traffic setup:

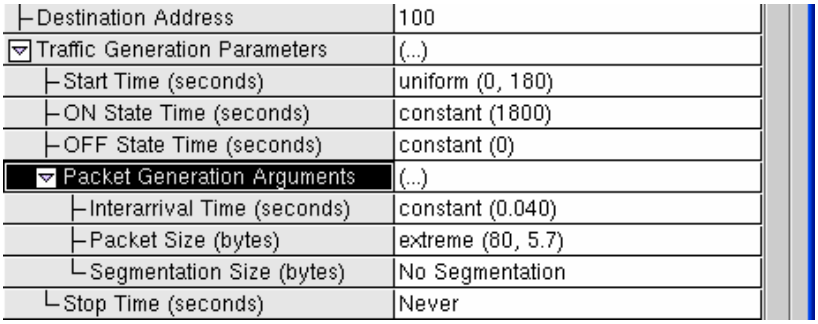

Figure 2. Traffic Settings of the Hosts

Server modeling:

- Library Package: OPNET Ethernet_advanced package
- Model: ethernet_station_adv
  ethernet_station_adv is used instead of ehernet_wkstn_adv, same reasoning as choosing host model. Only up to MAC layer wants to be evaluated.

- server traffic model manipulation

Figure 3-13 Extreme Value (Gumbel) PDF Definition

$$f(x) = (1/b)\exp[-(x-a)/b] \times \exp\{-\exp[-(x-a)/b]\} \qquad -\infty < x < \infty$$

Arg 1: location = a
Arg 2: scale = b > 0

mean: $E(x) = a - b\Gamma'(1)$

variance: $\sigma_x^2 = b^2\Pi^2/6$

$\Gamma'(1) = -0.57721$ $\Gamma(1)$ is the first derivative of the gamma function with respect to n at n = 1

Figure 3-14 Extreme Value (Gumbel) PDF Shape

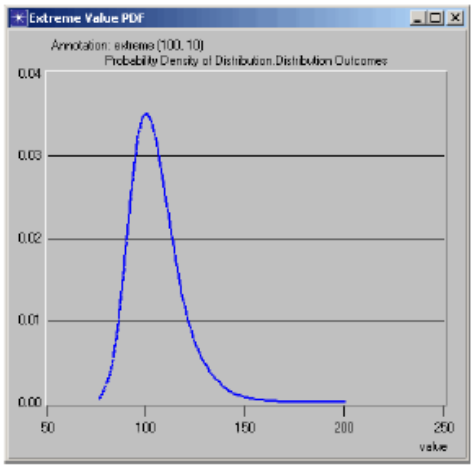

Figure 3. Extreme Value Distribution[2]

Shift the mean interarrival time of the server traffic when number of hosts increased.

Table 2. Server Traffic Manipulation

Number of Hosts	Interarrival time (ms)	Packet Size (byte)
1	Extreme (a=55, b=6)	Extreme (a=120, b=36)
3	Extreme (a=16.024, b=6)	Extreme (a=120, b=36)
5	Extreme (a=8.229, b=6)	Extreme (a=120, b=36)
8	Extreme (a=3.844, b=6)	Extreme (a=120, b=36)

[2] OPNET Technologies Inc., *Distribution Package*, OPNET Documentation 11.0

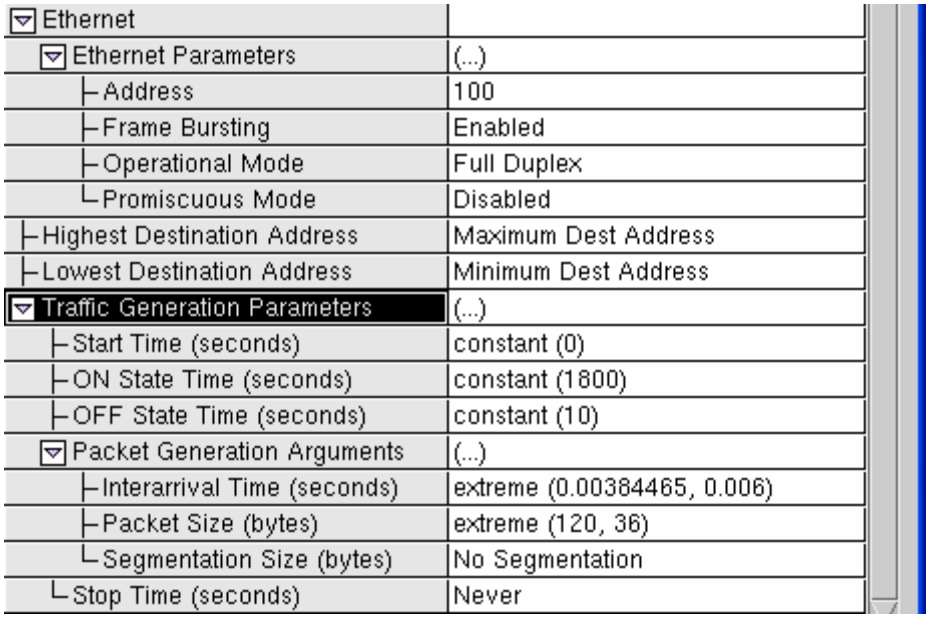

Figure 4. Settings and Traffic Settings of the Game Server

Bridge modeling:

- Library Package: OPNET wireless LAN package
- Model: wlan_eth_bridge_adv

Link modeling:

- Library Package: OPNET wireless LAN package
- Model: 100BaseT

4. Simulation results and analysis (20 points)

- End-to-end delay: **0.22ms** for 3-hosts simulation, **1.10ms** for 5-hosts simulation, **2.85ms** for 8-hosts simulation
- 12 times of increased in end-to-end delay while hosts only increased from 3 to 8.
- Contention increases as the number of hosts increased (ie. more collisions, more retransmission attempts)
- Distance from the host to the AP is the major factor of the factor of WLAN performance
- Hosts located beyond 400m have very poor performance, more than 10 packets drop per second, approximately 41% of packets not received
- AP workable range is 300m, maximum should be no greater than 330m