Online Game Traffic Measurement & Analysis

2003. 1. 22

Yongho Seok (yhseok@mmlab.snu.ac.kr)

Seoul National University, Korea

Contents

- Motivation
- Approach of Traffic Measurement
- Game Traffic Analysis
- Conclusion

Motivation

- Network Games are Interesting for network engineers
  - High popularity
    - High End PCs, World Championships, ..
    - Large Share of total Internet Traffic : popular 6 games (3-4%)
  - High Requirements on Network
    - Highly Interactive => Real Time Critical
    - No guarantees in current Internet => Packet loss, delay and jitter

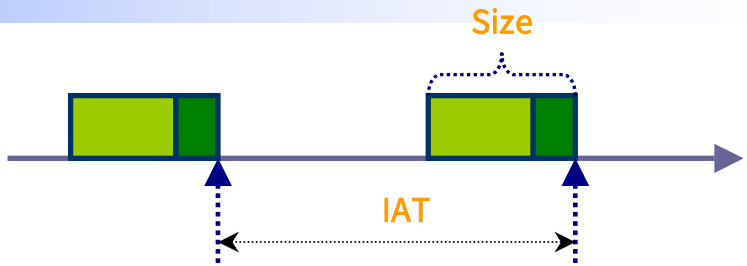
    $\Rightarrow$ Enhance Network to support Game Traffic

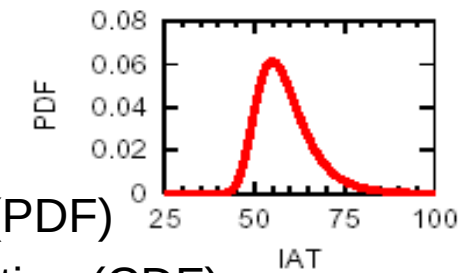
- Assessment of Enhancements by performance evaluation
  - Describe Enhancements in System Model
  - Test Performance of Model under Realistic Load

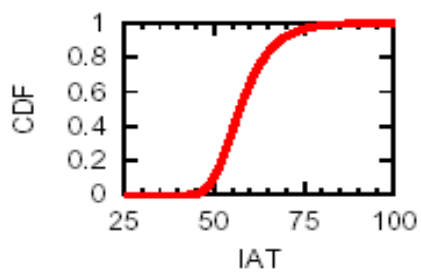
  => Traffic Model needed!

Traffic Modeling

- Traffic Characterization
  - Traffic Description
    - Packet Inter-arrival Time (IAT)
    - Packet Size
  - Statistical Description
    - Mean, variation
    - Probability density function (PDF)
    - Cumulative Distribution function (CDF)





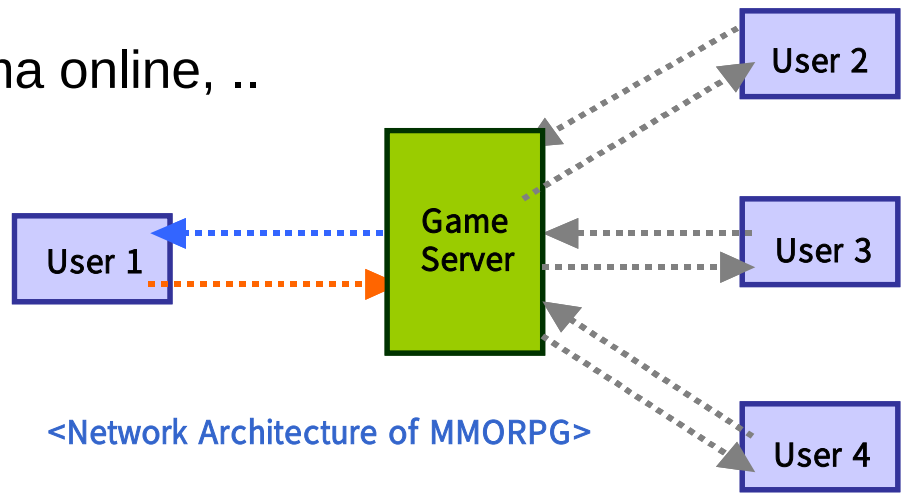


- Traffic Model for Performance Evaluation
  - Purpose : Generation of Suitable (Packet) Traffic

Traffic Modeling

- Scope of Network Game Traffic Model
  - general model for all network games?
  - Realistic : general model for every game genre (FPS, RTS, ..)
  - Here : Focus on MMORPG (Massively Multiplayer Online Role Playing Game)
    - Lineage, Ever Quest, Ultima online, ..
- Target : Lineage
  - NCSoft (Korea)
  - MMORPG
  - TCP/IP
  - Maximum User 4,000,000
  - Concurrent User > 300,000 (40 servers)

    => Traffic Model for Lineage



<Network Architecture of MMORPG>

Contents

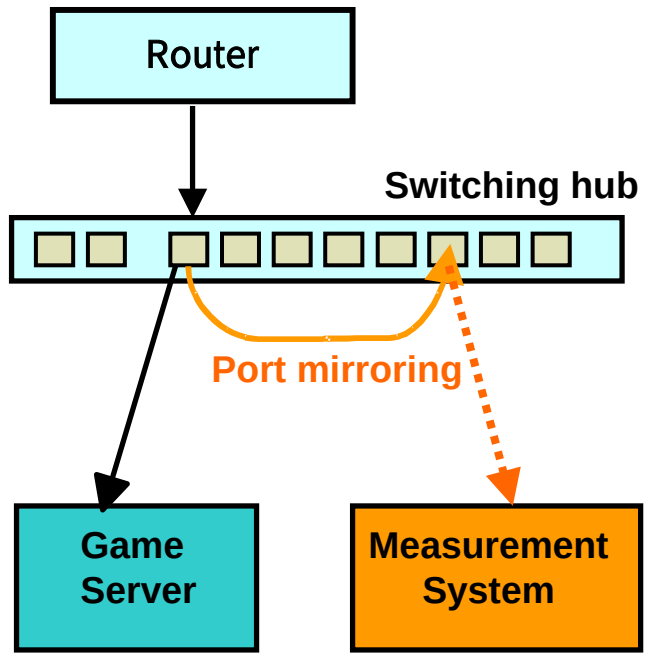
- Motivation
- Approach of Traffic Measurement
- Game Traffic Analysis
- Conclusion

Traffic Measurement Tool

- Active Measurement
  - Inject data probes into the network in a controlled fashion, and monitor performance characteristics (e.g., loss, delay, throughput,…)
  - Ping, traceroute, Surveyor,Netperf, Skitter
- Passive Measurement
  - Watch and monitor Packets
  - Capturing tools using tapping mechanism
  - MRTG, OC3MON, Netflow, NetraMet,...
  - Tcpdump : Our Choice!

Measurement System

- Measurement System
  - CPU : Intel P4-2.4 Northwood
  - Main Board : ASUS P4B533
  - Main Memory : 512MB DDR PC-2100
  - HDD : WD 100G 7200R X 9
  - LAN Interface : Gigabit Network card
- Measurement Approach
  - Port mirroring
  - TcpDump



Contents

- Motivation
- Approach of Traffic Measurement
- Game Traffic Analysis
- Conclusion

Analysis

- Packet Size
- Inter-arrival time
- Connection Time
- Per-minute Network Load of Server
- Relationship between User number & Packet number

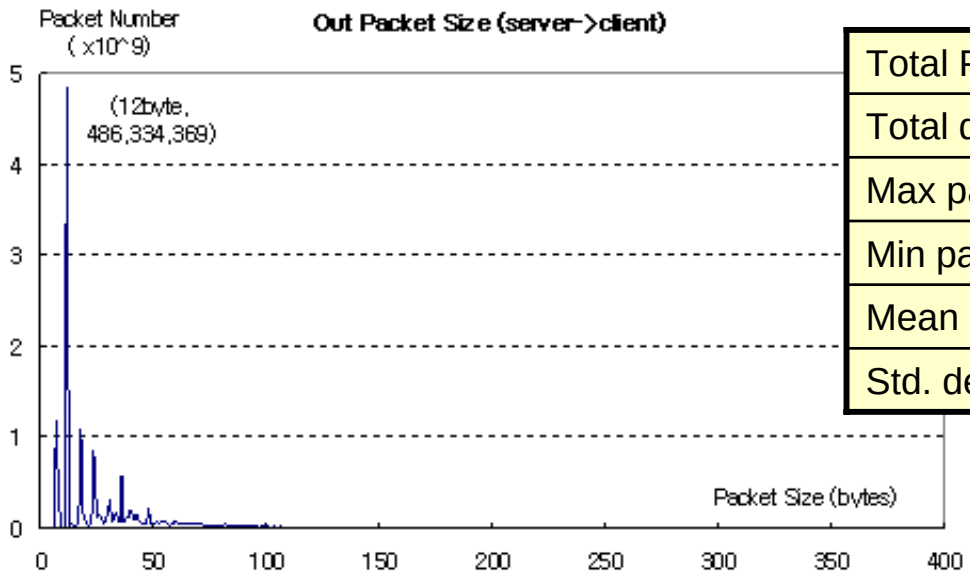
Trace Summary

- Duration : Aug 8 09:25:53 2002 ~ Aug 16 17:08:01 2002
- Total Time : 8 days, 7 hours, 42 minutes, 8 sec

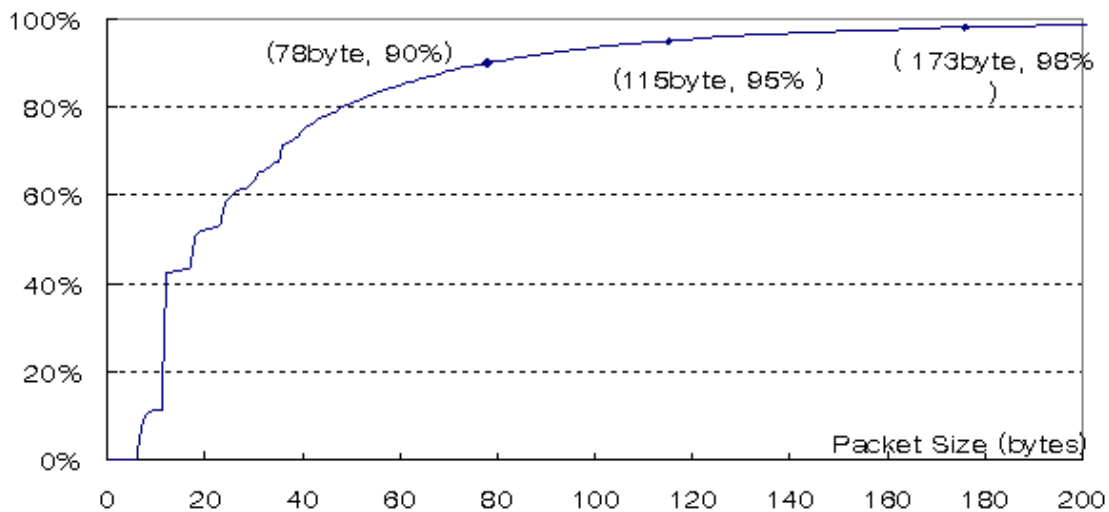
Established Connection (1sec ↑)	215,254 (161,648)
Mean Connection time	2980.846sec (49.68 min)
Total Packet Number (Data Packet)	3,500,532,933 (2,043,736,898)
Total In Packet (Data Packet)	1,860,209,597 (480,853,113)
Total Out Packet (Data packet)	1,640,323,336 (1,562,883,785)
Total Bytes (In/Out)	4,345 / 57,419 Mbytes
Mean Bandwidth (In/Out)	2.791 (1.166 / 1.625) Mbps
Mean Packet Number (In/Out)	4,869 (2,587 / 2,281) pps
Mean Data Packet Number (In/Out)	2,842 (668 / 2,173) pps

(* In : Client->Server / Out : Server->Client)

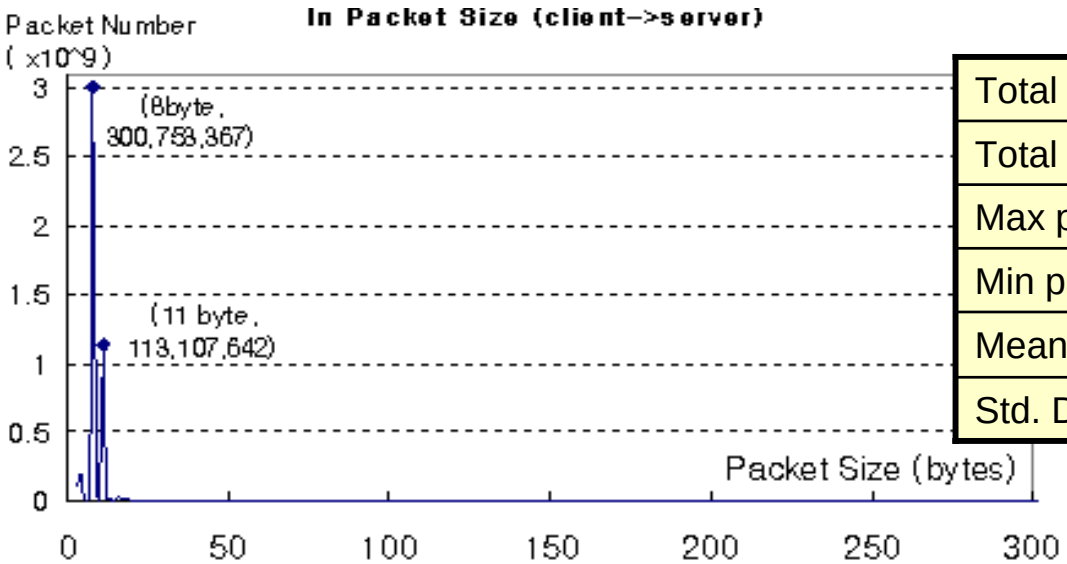
Out Packet Size (Server->Client)



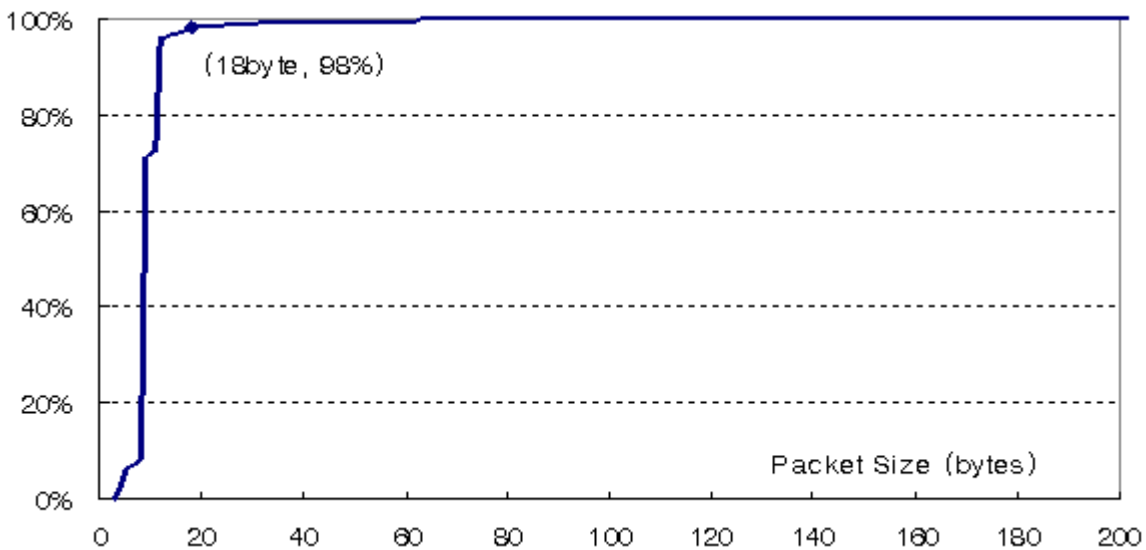
Total Packet Number	1,640,323,336
Total data packet number	1,562,883,785
Max packet size	1,460 bytes
Min packet size	0 bytes
Mean packet size	36.7390 bytes
Std. dev	58.6015



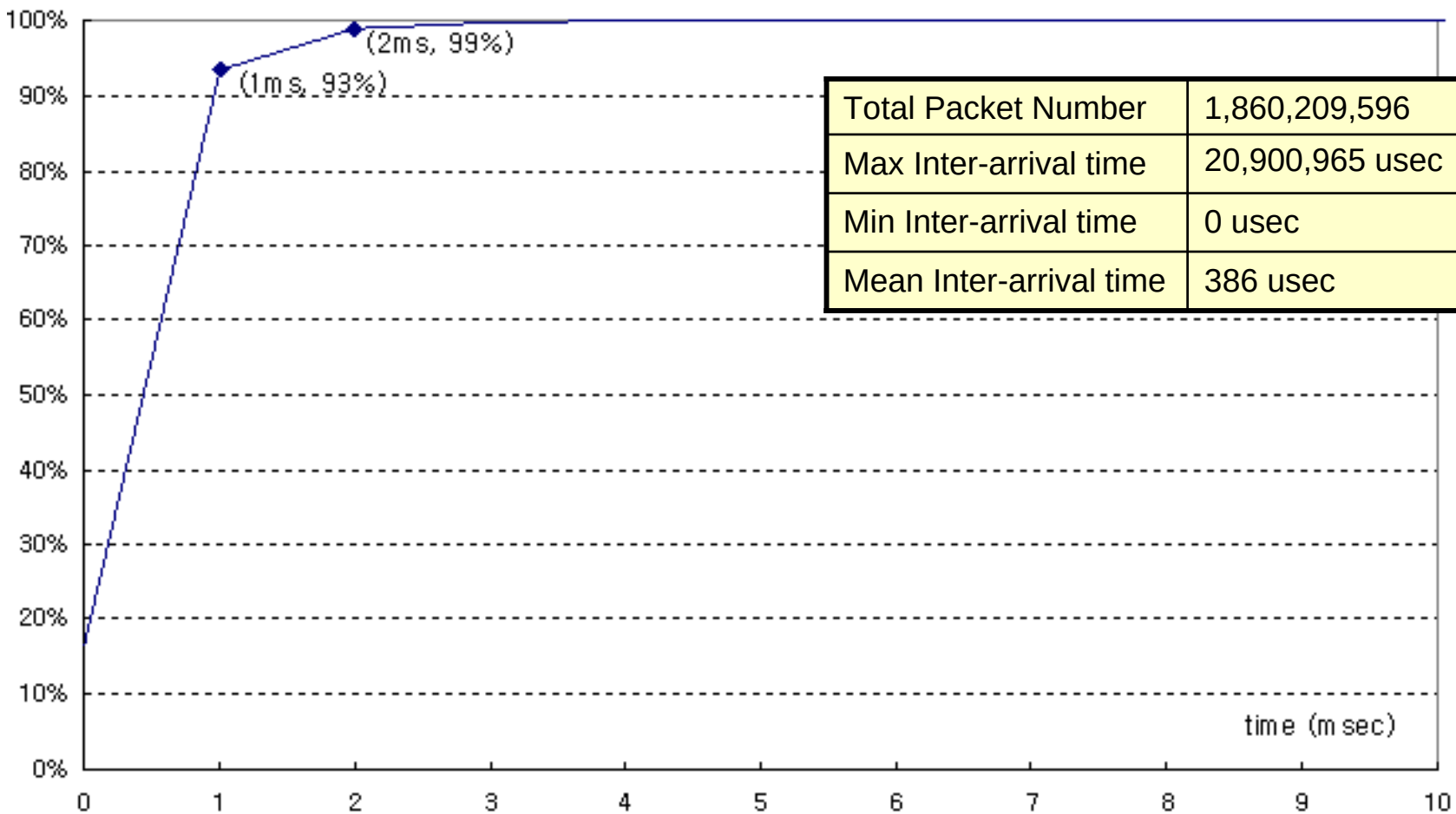
In Packet Size (Client->Server)



Total Packet Number	1,860,209,597
Total Data Packet number	480,853,113
Max packet size	1,460 bytes
Min packet size	0 bytes
Mean Packet Size	9.035 bytes
Std. Dev.	2.5169

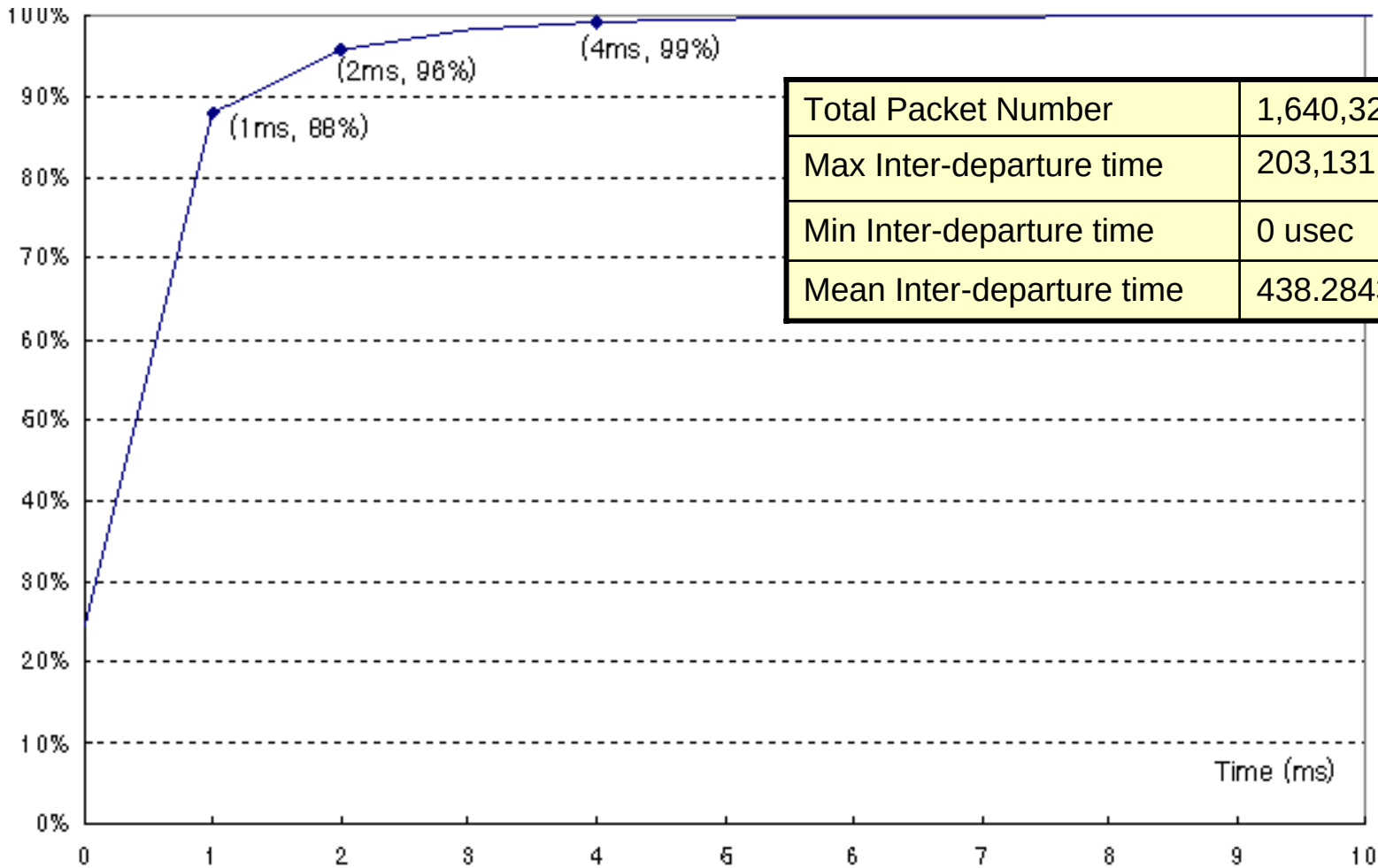


Inter-arrival time



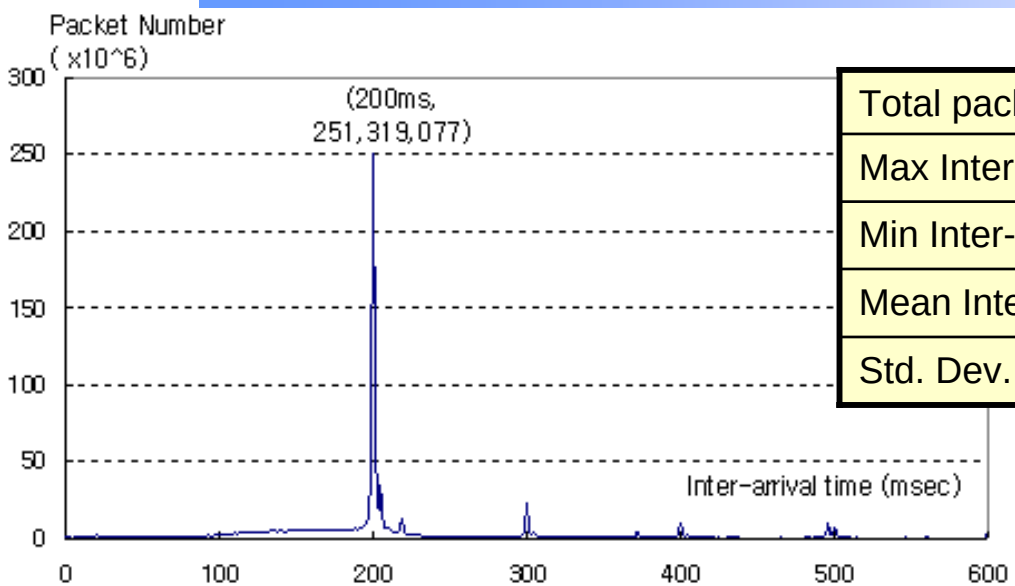
Total Packet Number	1,860,209,596
Max Inter-arrival time	20,900,965 usec
Min Inter-arrival time	0 usec
Mean Inter-arrival time	386 usec

Inter-departure time

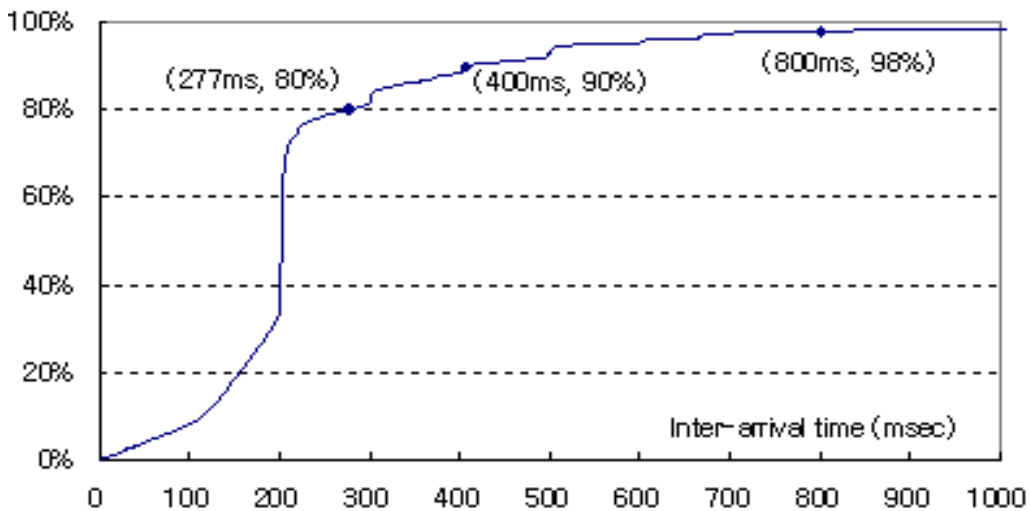


Total Packet Number	1,640,323,335
Max Inter-departure time	203,131,478 usec
Min Inter-departure time	0 usec
Mean Inter-departure time	438.2843 usec

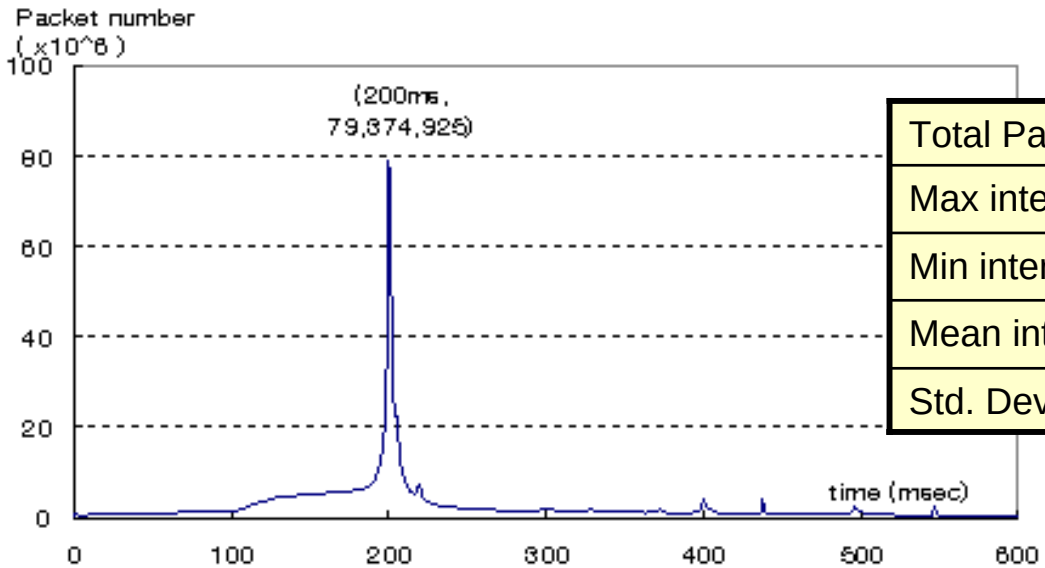
Inter-arrival time per Flow



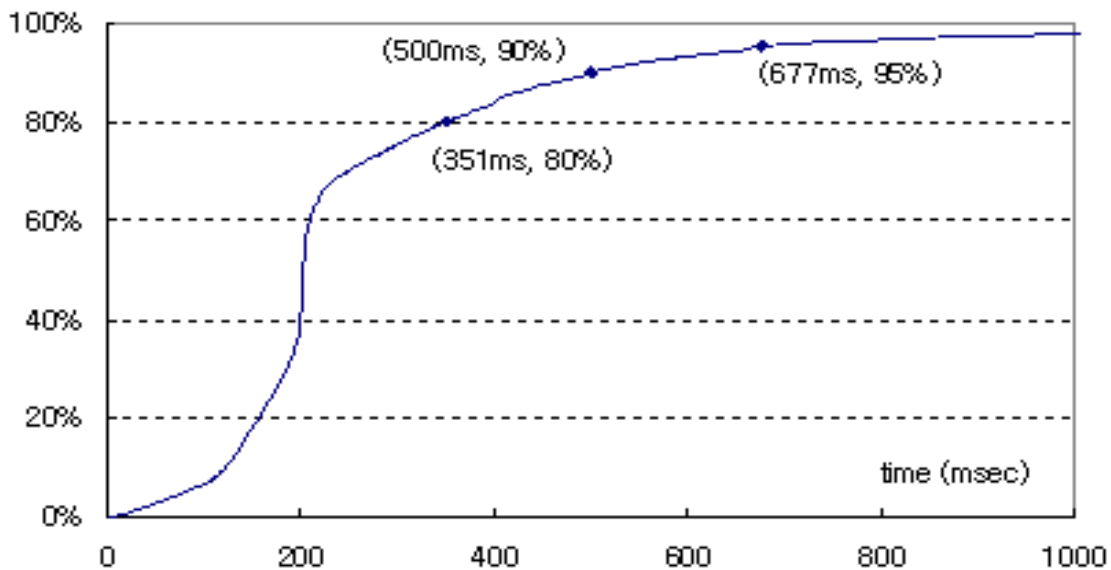
Total packet Number	1,843,416,501
Max Inter-arrival time	1,911,390 (msec)
Min Inter-arrival time	0 usec
Mean Inter-arrival time	263.5825 (msec)
Std. Dev.	52.9247



Inter-departure time per Flow

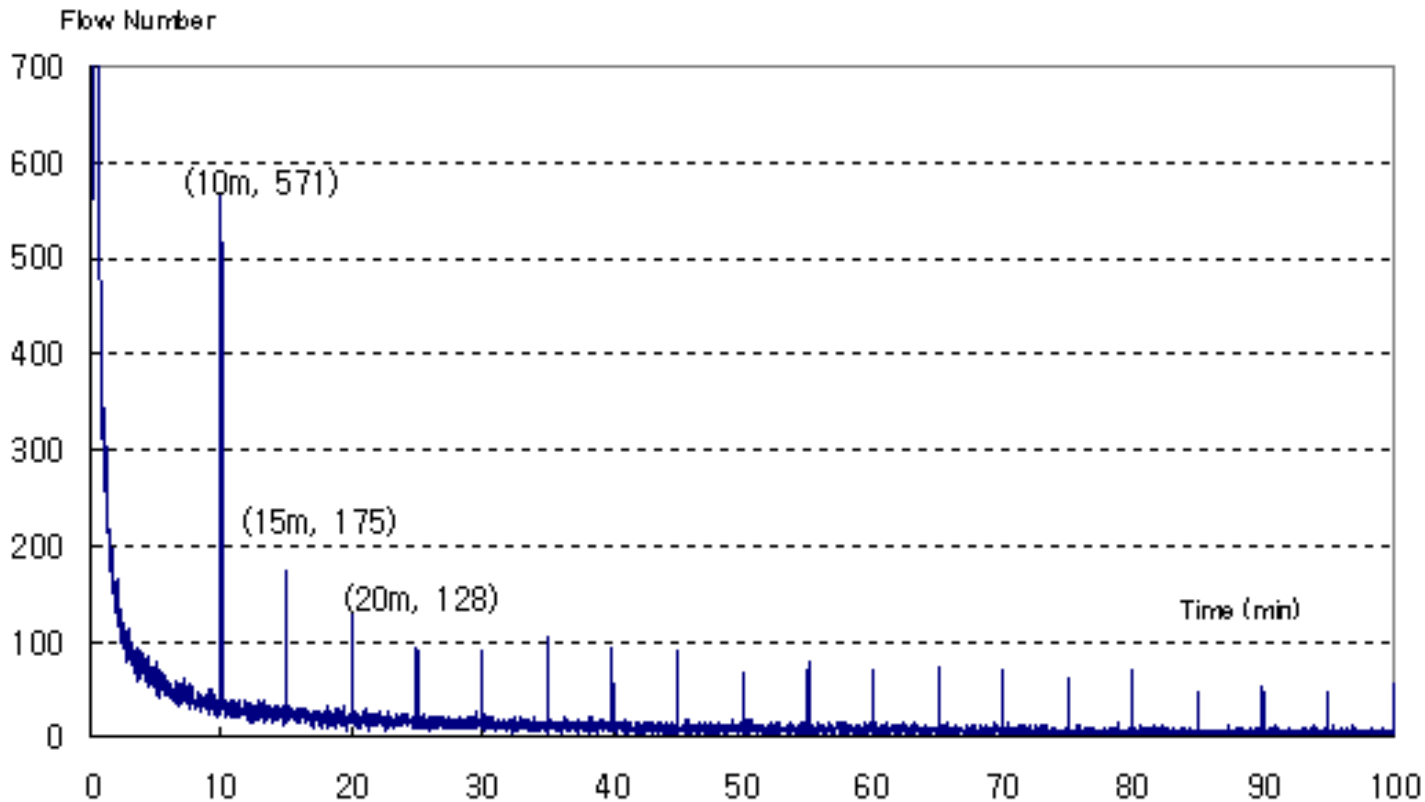


Total Packet number	1,624,911,989
Max inter-departure time	1,911,890 (msec)
Min inter-departure time	0 usec
Mean inter-departure time	298.3226 (msec)
Std. Dev.	68.6466

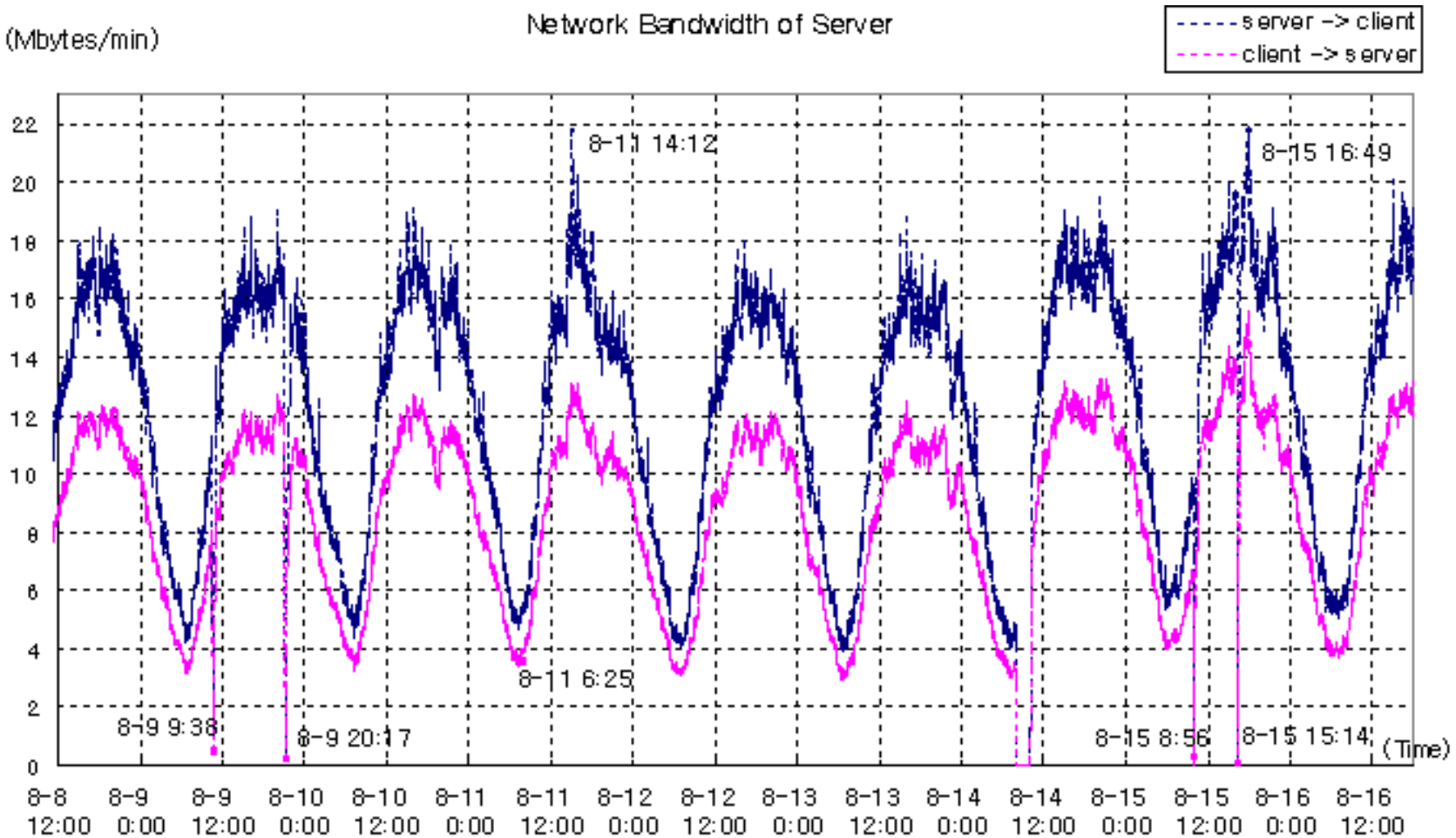


Connection Time Per Flow

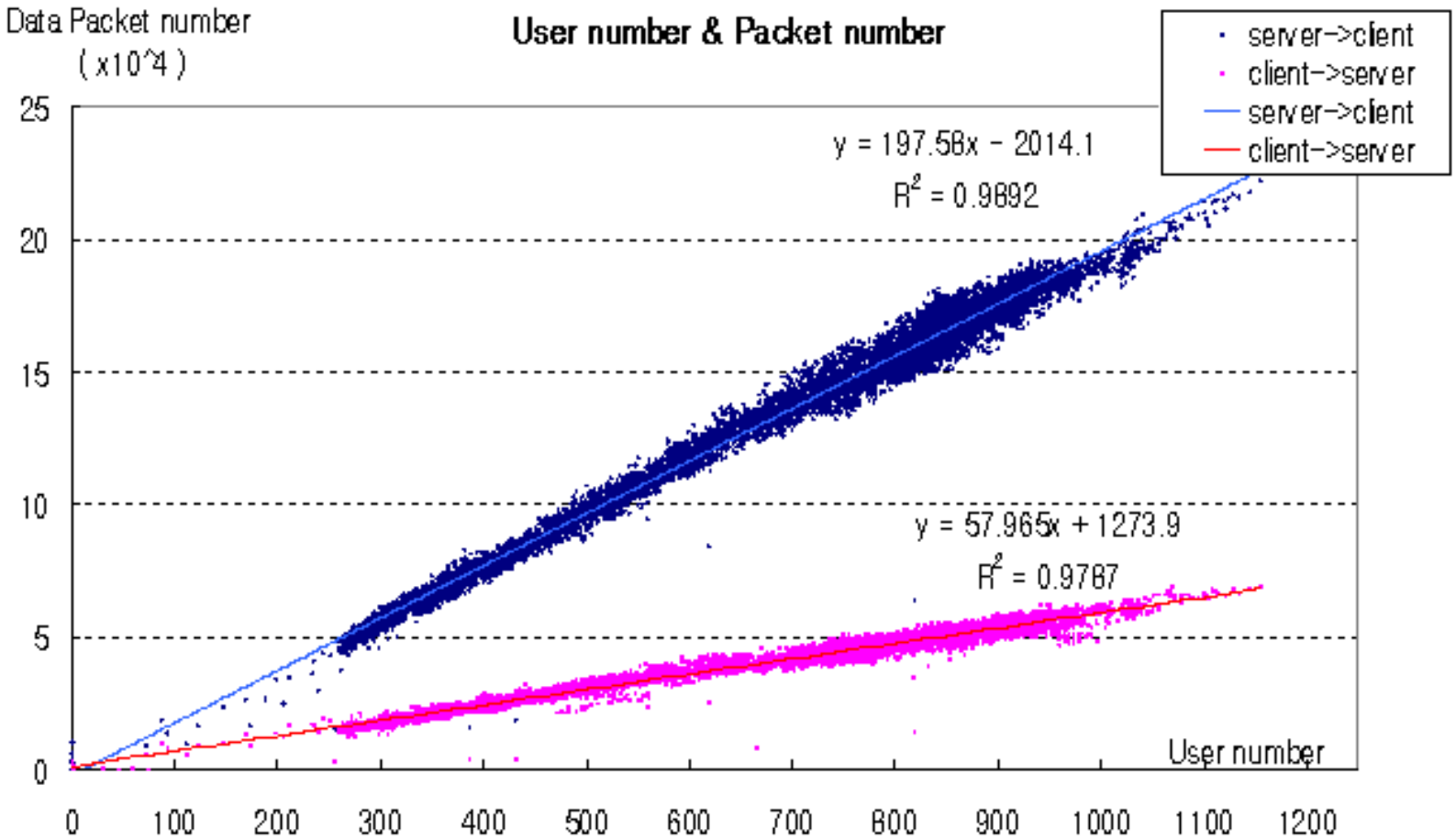
- Total Flow Number : 215,254 / 1sec ↓ : 53,606 / 1sec ↑ : 161,648
- Flow more than 1sec
  - Mean Connection Time : 2980.846 sec (49.68 min)



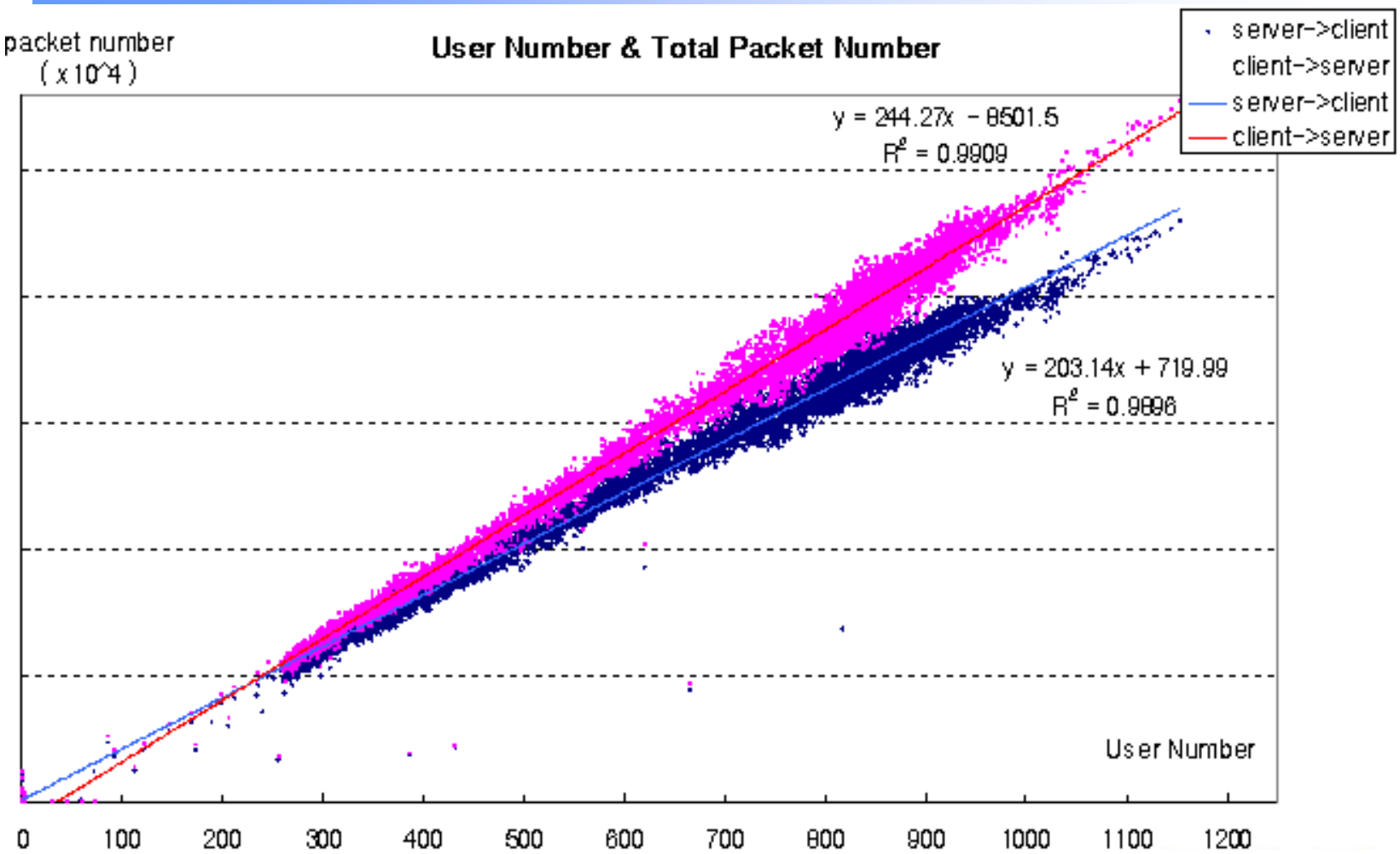
Per-minute Network Load of Server



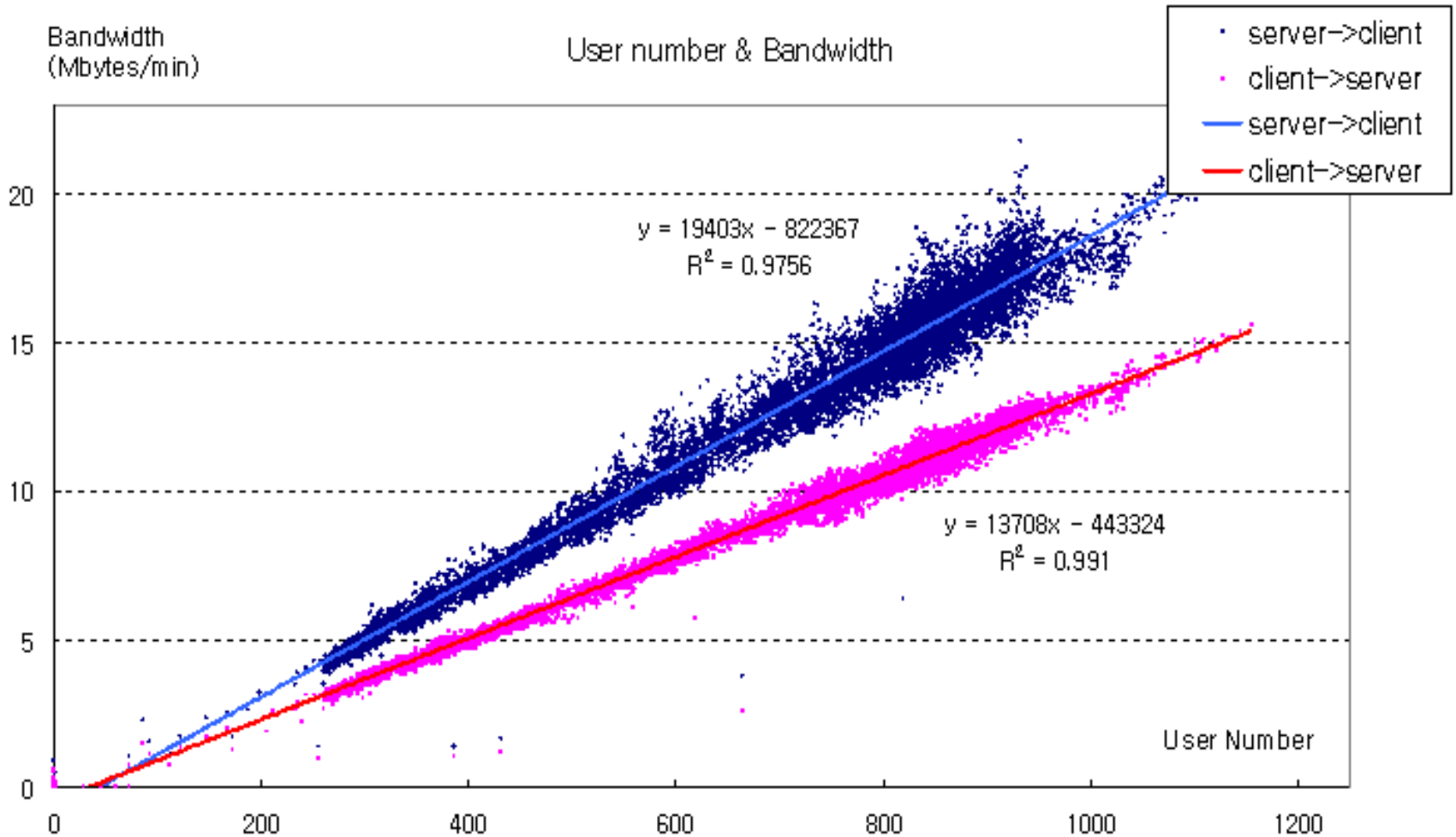
User Number & Packet Number



Packet Number Per User



Bandwidth Per User



Contents

- Motivation
- Approach of Traffic Measurement
- Game Traffic Analysis
- Conclusion

Conclusion

- Game Traffic Measurement & Analysis
  - MMORPG Traffic Model (Lineage)
    - Packet size, inter-arrival time, inter-departure time
    - Per-minute Network Load of Server
    - Relationship between user & packet number & bandwidth

    ⇒Large, periodic bursts of short packets
  - Future Game Traffic
    - No dramatic Changes in future Game Traffic expected
    - Additional Speech Traffic
- Future Works
  - Networking research into multiplayer games is still at an early stage
  - Need to investigate the QoS requirements for network games
  - Traffic Generator for research about Game Traffic