

Video Lecture 2: Game Traffic Analysis

7COM1030 – Multicast and Multimedia Networking

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Topics

- MMOG Structures
- MMOG Traffic Analysis

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MMOG

- The term **massively multiplayer online game (MMOG)** has become extremely popular in recent years. MMOGs extend the gaming experience from being confined to single or a few players to thousands of people who may participate and interact online simultaneously.

Counter Strike

World of Warcraft

Two key information:

- Massive players
- Online

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MMOG Genres

- MMOGs can be classified into a few different genres including:
 - First Person Shooter (FPS) games
 - Massively multiplayer online role-playing games (MMORPGs)
 - Real Time Strategy games (RTS)
 - Massively Multiplayer Online Racing (MMOR) games, a.k.a. Car Racing Simulations (CRS)
 - Sports games
 - Massively multiplayer online social games (MMOSG)
 - Fighting games
 - Puzzle games

Example titles:	
FPS	Counter Strike Quake Half Life Halo 2 Day of Defeat Medal of Honour Unreal Tournament 2003
MMOPRG	World of Warcraft Shenzhou Online Eve Online Star Wars Galaxies Guild Wars Lineage II The Legend of Mir Silkroad Online Anarchy Online
RTS	Warcraft III Age of Mythology Command and Conquer Age of Kings Starcraft
MMOR	Grand Prix 3 Test Drive Unlimited
Sports	Madden NFL Football Tony Hawk's Project 8
MMOSG	Second Life

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MMOG Network Architecture

- MMOG, sometime referred as “MMO games” nowadays, typically uses the three-tier network architecture. Current researchers are also investigating using the cloud architecture to support MMOGs.

Typical Network

Monitoring Perspective

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Three-Tier Server/Client Architecture

Terminal Server

Tier 1 (Presentation)
Clients

Tier 2 (Business Logic)
Application Servers

Tier 3 (Data/Resource)
Mainframe
Resource Manager
Resources (for example databases)

Tier 1: User interface
Tier 2: Logical process
Tier 3: Data storage

Application servers are used to service data requests between clients and database.

a.k.a.
Multi-tier Architecture

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MMOG Traffic Model

- ▶ MMOG traffic cannot be described using a generic statistic model, as each genre has its own characteristics.
- ▶ Game traffic models are affected by several parameters:
 - Traffic intensity is largely affected by a game's style or characteristics. Some games require real-time reactions (such as fast-paced shooting or action games), while others afford players more time to make decisions (such as role playing or strategy games).
 - The design of a game can also represent a critical factor in the game's overall performance over a network. An efficiently designed game is more likely to send less traffic across the network in order to avoid any potential bandwidth limitations.
 - Some researchers have argued that user experience also places a significant impact on traffic characteristics

	FPS	MMORPG	RTS	MMOR	Sports	MMOSG
Games studied	7	9	5	2	2	1
Packet interarrival time (ms)	Server: 10–200, client: 5–120	Server: 0–3179, client: 0–1264	0–300	0–298	0–308	Server: 0–680, client: 0–160
Packet size (bytes)	Server: 5–300, client: 15–110	Server: 4–636, client: 1–154	9–64	18–104	32–90	Server: 0–1400, client: 0–900
Transport protocol	UDP	TCP	TCP or UDP	UDP	UDP	TCP and UDP
Network architecture	Server/client	Server/client	Server/client	Server/client	Peer-to- Peer	Muti-server based
Upstream and Downstream	Asymmetric	Asymmetric	Symmetric	Symmetric	Symmetric	Asymmetric
Virtual environment	Repetitive	Persistent	Repetitive	Repetitive	Repetitive	Persistent

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TCP vs. UDP

	TCP	UDP
General Description	Full-featured protocol that allows applications to send data reliably without worrying about network layer issues	Simply high speed low functionality “wrapper” that interface applications to the network layer and does little else
Connection Setup	Connection-oriented; Must be established prior to transmission	Connectionless; Data is sent without setup
Reliability	Reliable delivery of data; acknowledged	Unreliable best-effort delivery without acknowledgements
Retransmission	Lost data are retransmitted automatically	Not performed. Application must detect data and retransmit if needed
Data Flow Management	Window-sized congestion control algorithms	None
Overhead	Low, but higher than UDP (20 bytes)	Very low (8 bytes)
Transmission Speed	Slower than UDP	Faster because there is no error-checking for packets
Data Quantity Suitability	Small to very large amount of data	Small to moderate amount of data

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Transport Protocols for MMOGs

- Online game applications tend to use UDP to transmit short and frequent data packets, and use TCP to transmit long and content-aware data packets.
- FPS, MMOR, and Sports games demand real-time, instant reactions, data delivery speed is a high priority for the network. Hence UDP is an ideal choice for the transport network.
- MMORPGs provide higher tolerances for network delays. TCP as a reliable transmission protocol is an ideal transport platform for MMORPGs as it can prevent error propagation during long play sessions.
- RTS is also delay-tolerant, which makes TCP suitable, although some games (e.g. Age of Kings) still use UDP to transmit game commands.
- Both TCP and UDP are typically used as the transport protocol in the network to support MMOSGs. UDP is used for the communication between game simulator servers and clients, while TCP is used for external audio streaming sources such as music downloading.

TCP	UDP	Either	Both
MMORPG	FPS, MMOR, Sports	RTS	MMOSG

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FPS vs. MMOR vs. Sports

- They can all be regarded as fast-paced games. They all send out short data packets across the network in a frequent pattern, and all require instant reactions from players. Hence, they all require UDP as the transport protocol.
- Both FPS and Sports games have the long tails in traffic stats distribution. Players are likely to be idle for short periods during the game session, e.g., a player hiding for an ambush attack in an FPS, Sports game players are also likely to have idle moments. On the other hand, MMOR games are in constant motion.
- Both MMOR and Sports games have a similar pattern for upload and download streams, whereas in FPS traffic, there is a severe contrast between the two streams.
- Both FPS and MMOR games employ server/client architecture, while Sports games mostly use peer-to-peer architecture.

CDF: Cumulative Distribution Function

Big contrast of traffic range in upstream/downstream for FPS

Game	Upstream Range (Bytes)	Downstream Range (Bytes)
Counter Strike	15 - 80	300
Quake	5 - 36	290
Half-Life	60 - 90	300

Packet Size (Bytes)

server client

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FPS vs. MMOR vs. Sports

Fast-paced;
Short packets;
UDP

Server/Client

Long Traffic Tail

Similar range between upstream and downstream

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FPS vs. MMORPG

- MMORPG and FPS represent the two largest categories of online games in terms of subscriptions. With the stimulation of the broadband Internet growth, the popularity of MMORPGs have largely exceeded FPS games in recent years.
 - One of the reasons for this is the novel and unique feature of MMORPGs which offers appealing and persistent virtual environment for players. This type of virtual world is typically hosted by a single game server and remains in constant operation, where thousands of players can join or exit the game at any time. Hence, a player who returns to the game after several days may find that the world has been subtly altered by other players. This sense of novelty and unpredictability means that MMORPGs can offer a unique sense of appeal to gamers.

	MMORPG	Other Genres
Game Session	One session for all players	Multiple sessions – one per player/group
Virtual Environment	The same gaming environment that is constantly updating	Can be different depending on the progress of each player/group

World of Warcraft

MMOSG is similar to MMORPG.

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FPS vs. MMORPG

- Packet inter-arrival time:** The one for MMORPGs are much longer than FPS games, indicating that MMORPGs are a relatively slower paced game type. Players in MMORPGs can make decisions in the order of seconds or even minutes, while FPS players often need to make instant, sub-second decisions.
- Packet size:** The server packet size is generally larger than the client packet size in an MMOG network, but this contrast in MMORPG traffic is considerably larger than that for FPS games. This implies that a MMORPG server may be dealing with much more players online simultaneously within one game, hence the server may have to send updates to thousands of players. On the other hand, the tasks of FPS game server are distributed to multiple game sessions where much fewer players are involved.

	FPS	MMORPG
Games studied	7	9
Packet interarrival time (ms)	Server: 10–200, client: 5–120	Server: 0–3179, client: 0–1264
Packet size (bytes)	Server: 5–300, client: 15–110	Server: 4–636, client: 1–154
Transport protocol	UDP	TCP
Network architecture	Server/client	Server/client
Upstream and Downstream	Asymmetric	Asymmetric
Virtual environment	Repetitive	Persistent

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MMORPG in Mobile Phones

- As amazing as MMORPG has been, it is rather challenging to implement it in mobile phone environment due to the limited hardware and software conditions in mobile phones.
- MMORPG either has to evolve to adapt, or fail.

Space Hunter's compact design means that smaller data packets are sent over the underlying networks, hence leading to shorter latency and swift network performance.

While being a successful title as MMORPG, Dragons Eight is not yielding satisfying performance in the mobile area.

	Space Hunter	Dragons Eight
Genre	Network, role playing, action	MMORPG
User review score	4.3 out of 5	3.8 out of 5
Total download	162 million	44 million
Graphics	2.5D	3D
Installation file	130 MB	248 MB
First mobile version	Nov 2012	Oct 2014
First PC version	Aug 2012	Jun 2006

2.5D animation is a 2D animation drawn into a 3-D space as it involves the motion of 2D-animated object in a 3-D space. It is a trick of visions.




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MMORPG vs. RTS

- There is often very little to distinguish between MMORPGs and RTS games. RTS games contain similar strategic and role-playing elements as found in MMORPGs.
 - In fact, the Warcraft franchise was initially designed as an RTS game, before its transition to an MMORPG in the form of World of Warcraft.
- However the traffic profiles for the two game genres are quite different. The major reason for this difference resides in the number of permissible online players. MMORPGs can generally employ a vast number of players at any given time, while the number of online players for an RTS is comparatively smaller.
- The diversity of the MMORPG traffic pattern is quite severe, while the traffic profiles for different RTS games are relatively consistent with each other.
 - As the number of players in MMORPGs are usually much larger than the one in RTS, a typical MMORPG server has to send out more update information than an RTS server, hence the range of packet size of an MMORPG server is much wider.

	MMORPG	RTS
Games studied	9	5
Packet interarrival time (ms)	Server: 0-3179, Client: 0-164	0-300
Packet size (bytes)	Server: 4-616; client: 1-154	9-64
Transport protocol	TCP	TCP or UDP
Network architecture	Server/client	Server/client
Upstream and downstream	Symmetric	Symmetric
Virtual environment	Persistent	Repetitive

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MMORPG vs. MMOSG

- ▶ Both MMOSG and MMORPG servers are always hosting one designated game environment where players may join and exit freely. The virtual world always remains persistent, and the number of online players can be in the order of thousands.
- ▶ With respect to game design, MMORPGs typically involve prescribed missions for game progression, while MMOSGs are centred on player socializing and player-defined objectives.
- ▶ Both games generate a diverse range of traffic patterns, and with occasional traffic burst
 - Burst examples: an initiation of a MMORPG mission, popular places in an MMOSG
- ▶ MMOSGs often involve video streaming and audio downloading, hence the packet size range of MMOSGs is larger than that for MMORPGs.

	MMORPG	MMOSG
Games studied	9	1
Packet interarrival time (ms)	Server: 0–3179, client: 0–1264	Server: 0–680, client: 0–160
Packet size (bytes)	Server: 4–636, client: 1–154	Server: 0–1400, client: 0–900
Transport protocol	TCP	TCP and UDP
Network architecture	Server/client	Multi-server based
Upstream and Downstream	Asymmetric	Asymmetric
Virtual environment	Persistent	Persistent

Questions?

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