

# Quantifying the Effect of Content-based Transport Strategies for Online Role Playing Games

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## Motivation

Protocol	MMORPGs
TCP	World of Warcraft, Lineage I/II, Guild Wars, Ragnarok Online, Anarchy Online, Angel's Love
UDP	EverQuest, City of Heroes, Star Wars Galaxies, Ultima Online, Final Fantasy XI
TCP/UDP	Dark Age of Camelot

There is no consensus on protocols for MMORPGs

- MMORPGs requirements
  - Low transmission latency
  - No unexpected "lags"

## Objective

- Quantify the effect of content-based transport strategies
- Evaluate existing transport protocols
  - TCP, UDP, DCCP, SCTP
- Propose and evaluate three content-based transport strategies using network simulations

## Real-Life Game Traces

Users' action trace of Angel's Love



User ID	Actions (M: Move, A: Attack, T: Talk)
10159	MMMMMMMMMMMMMAMMMMMMMMMMMMMMMMMMMMM
12454	MMAAMMMMMMAAMAMAMAMAMAMAMAMAMAMAMA
16728	MMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMTTTTTTTTTTTT

## Transport Strategies

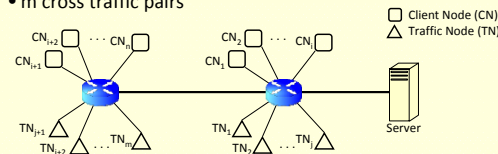
Message Type	In-Order Delivery	Reliability
Move		
Attack		✓
Talk	✓	✓

- Multi-streaming
  - Put different message types into separate streams
  - e.g., move message, attack message, talk message
- Optional ordering
  - Certain message types do not require in-order transport
  - e.g., move message, attack message
- Optional reliability
  - Certain message types do not require reliability
  - e.g., move message

Strategy	Multi-Streaming	Optional Ordering	Optional Reliability
MRO	✓		
MR	✓	✓	
M	✓	✓	✓

## Simulation Setup

- Trace-driven network simulation using ns-2 simulator
- Fishbone topology
  - 1 game server
  - 2 network routers
  - n game clients
  - m cross traffic pairs



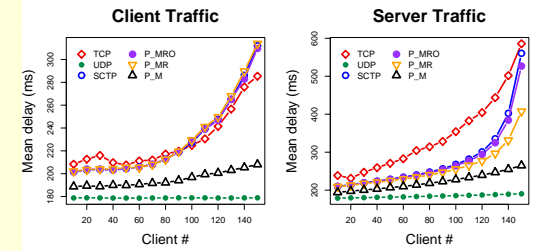
Bandwidth & propagation delay

Link	Bandwidth	Propagation Delay
Server <-> Router	600 Kbps	70 ms
Router <-> Router	600 Kbps	70 ms
Router <-> Client	64 ~ 128 Kbps	70 ms
Router <-> Traffic Node	64 ~ 128 Kbps	70 ms

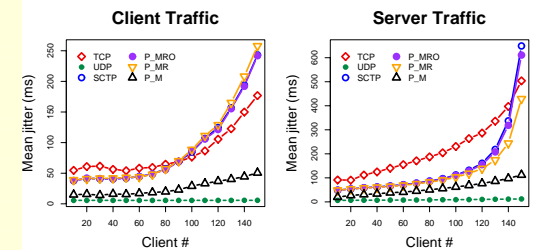
11 pairs cross traffic with 500 Kbps sending rate

## Performance Evaluation

Average end-to-end transmission latencies

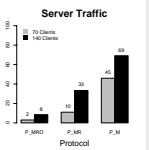
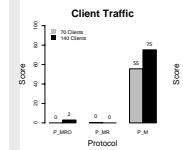


Average end-to-end delay jitters (standard deviation of delays)

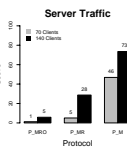
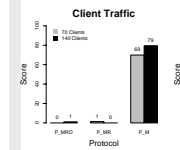


## Summary

Improvement of Delay



Improvement of Delay Jitter



Protocol	Client to Server		Server to Client	
	Delay	Jitter	Delay	Jitter
TCP	NA	NA	NA	NA
SCTP	~	~	★	★
DCCP (TCP-like)	★★★★	★★★★	★★★	★★★★
DCCP (TFRC)	☆☆	☆	☆☆	☆☆
UDP	★★★★	★★★★	★★★★	★★★★
P <sub>MRO</sub>	~	~	★	★
P <sub>MR</sub>	~	~	★★	★★
P <sub>M</sub>	★★★	★★★	★★★	★★★

Description: NA denotes incomparable, ~ denotes similar, ☆ denotes worse, ★ denotes better, ★★ denotes much better, ★★★ denotes good, ★★★★ denotes very good, and ★★★★★ denotes excellent.

