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 usingnetwork simulations

Real-Life Game Traces

- Users' action trace of Angel's Love

User ID	Actions (M: Move, A: Attack, T: Talk)
10159	MMMMMMMMMMMMMAMMAMMMMMMAMMMMMMMMMM
12454	MMAAMAMMMMMAAMAMAMAMAMAMAMAMAMAMAMA
16728	MMMMMMMMMMMMMMMMMMMMMMMAMMTTTTTTTTTTT

Transport Strategies

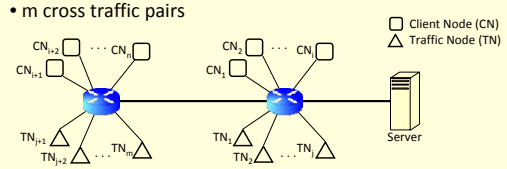
Message Type	In-Order Delivery	Reliability
Move		
Attack		√
Talk	√	√

- 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



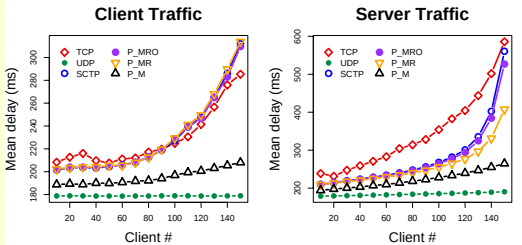
- Bandwidth & propagation delay

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

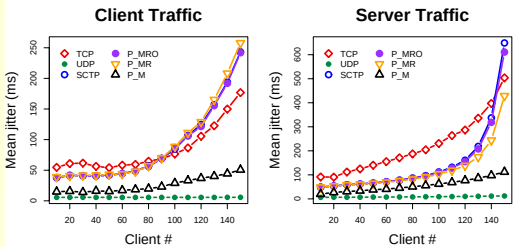
- 11 pairs cross traffic with 500 Kbps sending rate

Performance Evaluation

- Average end-to-end transmission latencies

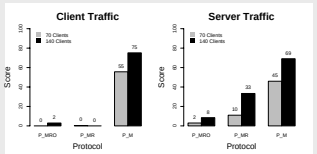


- Average end-to-end delay jitters (standard deviation of delays)

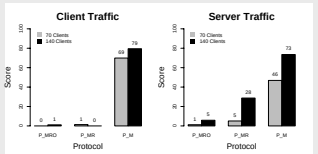


Summary

Improvement of Delay



Improvement of Delay Jitter



	Client to Server		Server to Client	
Protocol	Delay	Jitter	Delay	Jitter
TCP	NA	NA	NA	NA
SCTP	≈	≈	★	★
DCCP (TCP-like)	★★★★	★★★★	★★★	★★★
DCCP (TFRC)	☆	☆	☆	☆
UDP	★★★★	★★★★	★★★★	★★★★
P_{MRO}	≈	≈	★	★
P_{MR}	≈	≈	★★	★★
P_M	★★★	★★★	★★★	★★

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

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