

Effects of real-time traffic prioritization in home based Broadband Internet connections

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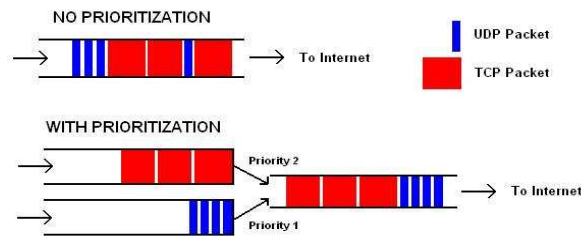


Outline

- Motivation
- Home broadband network test bed
- Software used / configurations
- Experiment procedure
- Results
- Further research ideas
- Summary
- Questions / Comments



Why prioritize traffic?

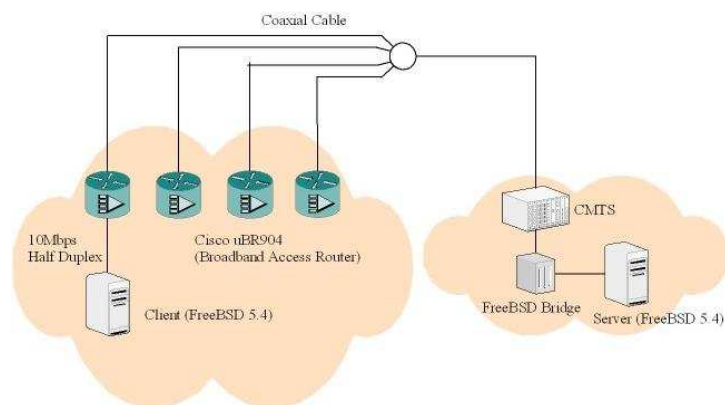


- Real time vs. Non real-time traffic.
- Real time includes game and VoIP traffic.
- Real time traffic is much less tolerant of loss and jitter.
- Prioritizing real-time traffic can increase performance of network gaming and the quality of a VoIP call.

BART Cable-modem test bed



BART Cable-modem testbed



Software used & Modifications



- **Software – iperf and tcpdump**
 - Create streams of UDP or TCP data with iperf.
 - UDP can have its bandwidth and packet size set
 - Tcpdump run on both client and bridge, and saved to file.

- **UDP data rates**
 - Client to server
 - 73* byte packet size, sent at 38ms* intervals
 - Server to client
 - 155* byte packet size, sent at 66ms* intervals

- **Other modifications**
 - Kernel
 - ALTQ (Alternate Queueing) enabled
 - PF
 - File pf.conf was edited with packet queueing, and packet filtering rules

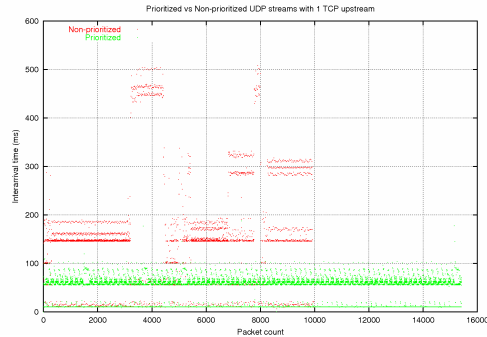
* Values obtained from technical report "Quake 3 Packet Inter-Arrival and Length Over the Internet" by Ana M. Pavlicic

Experiment procedure



1. Start tcpdump on bridge and client.
2. Start iperf streams on client and server.
3. Run for 10 minutes.
4. Each experiment repeated 5 times.

1 TCP upstream and 1 UDP upstream



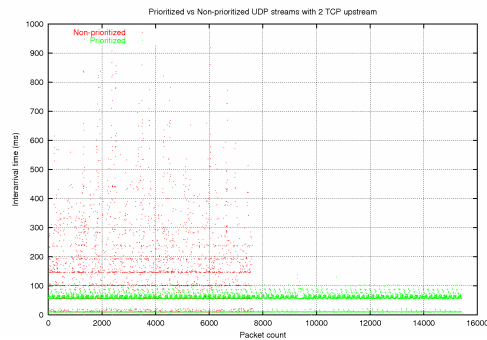
Results averaged over 5 trial runs	With no prioritization	With UDP prioritization
Average TCP upstream throughput	197Kbit/s	160.2Kbit/s
Average UDP loss rate	35%	0.027%
Average UDP jitter	83.908ms	26.967ms
Average UDP packets received	10013	15409
Average max. UDP interarrival time	512.818ms	337.417ms
Average UDP interarrival time	60.133ms	38.936ms



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2 TCP upstream and 1 UDP upstream



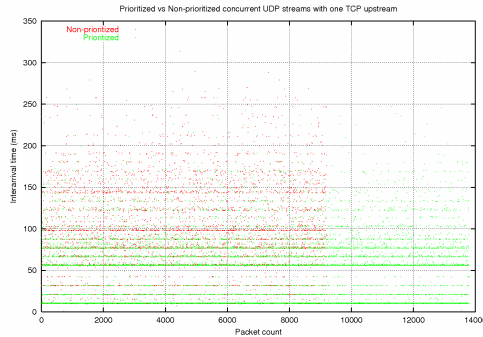
Results averaged over 5 trial runs	With no prioritization	With UDP prioritization
Average TCP upstream throughput	105.6Kbit/s (per stream)	75.1Kbit/s (per stream)
Average UDP loss rate	60%	0.18%
Average UDP jitter	142.406ms	25.860ms
Average UDP packets received	6174	15386
Average max. UDP interarrival time	946.905ms	200.343ms
Average UDP interarrival time	92.135ms	38.927ms



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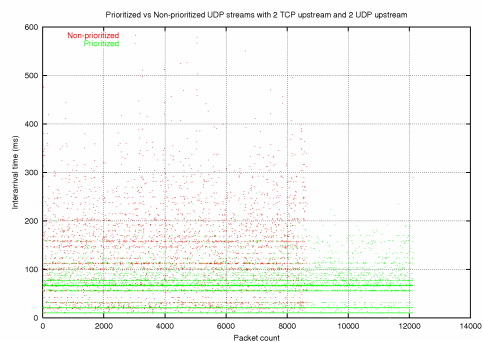
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1 TCP upstream and 2 concurrent UDP upstream



Results averaged over 5 trial runs	UDP stream with no prioritization	UDP stream with prioritization
Average UDP loss rate	40.2%	10%
Average UDP jitter	54.598ms	38.318ms
Average UDP packets received	9179	13868
Average max. UDP interarrival time	314.674ms	276.475ms
Average UDP interarrival time	65.601ms	43.391ms
Average TCP upstream throughput	No UDP PQ = 142.8Kbit/s, 1 UDP PQ = 137.6Kbit/s, 2 UDP PQ = 137.2Kbit/s	

2 TCP upstream 2 UDP upstream



Results averaged over 5 trial runs	With no prioritization	With UDP prioritization
Average TCP upstream throughput	83.17Kbit/s (per stream)	70Kbit/s (per stream)
Average UDP loss rate	49.4%	25.5%
Average UDP jitter	89.159ms	36.653ms
Average UDP packets received	7804	11481
Average max. UDP interarrival time	715.007ms	305.456ms
Average UDP interarrival time	78.283ms	52.668ms

What does this mean in the real world?



- These tests are rather synthetic
- Sent at constant bitrate, which is unlike real internet game traffic.
- VoIP calls are jitter tolerant, but cant cope with loss.
- Network games can cope with lost packets, but suffers when the jitter is high.

Further research ideas



- User experience
- Peer to peer connections
- Prioritization at both ends of the connection
- Alternate queueing strategies – Bandwidth based, class based.
- Queueing in the modem itself.

Conclusion



- What the experiments were trying to achieve?
- Results obtained
- Did we get the results we expected?
- Room for further research

Questions & Comments



- Any questions or comments?