SWINBURNE UNIVERSITY OF TECHNOLOGY

A brief investigation into two common causes of TCP throughput degradation in a broadband access environment

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Brief summary

Investigated TCPs reactions to packet loss

Investigated TCPs interactions with competing streams

Caused intolerable amounts of packet loss on a DSL link

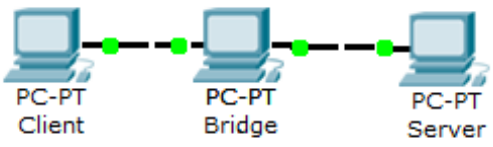
Packet loss

Why did we study this topic?

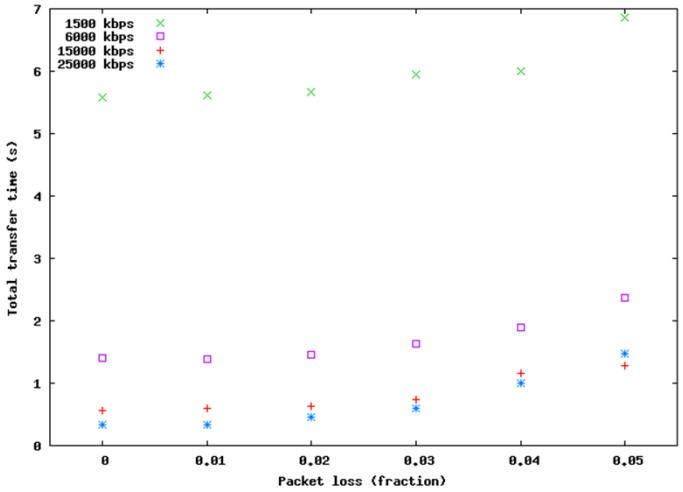
Can we predict the effects of the packet loss?

How severe is the impact to common home situations?

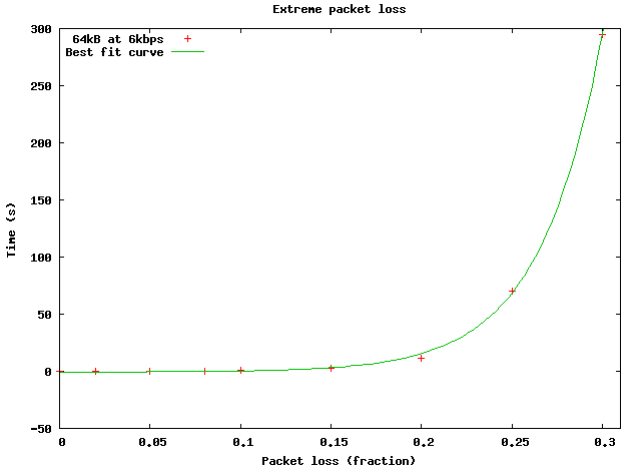
Experimental method



Measuring effects of packet loss

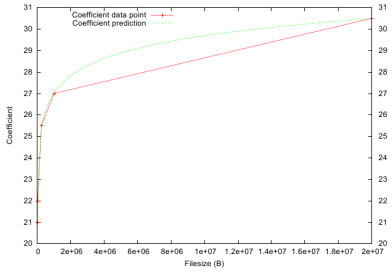


Sampling a wider range of data

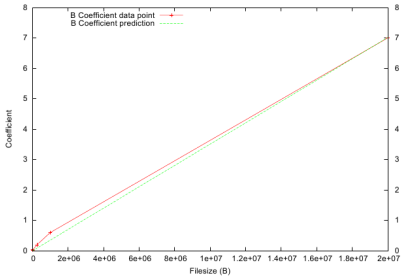


Working out an equation

C

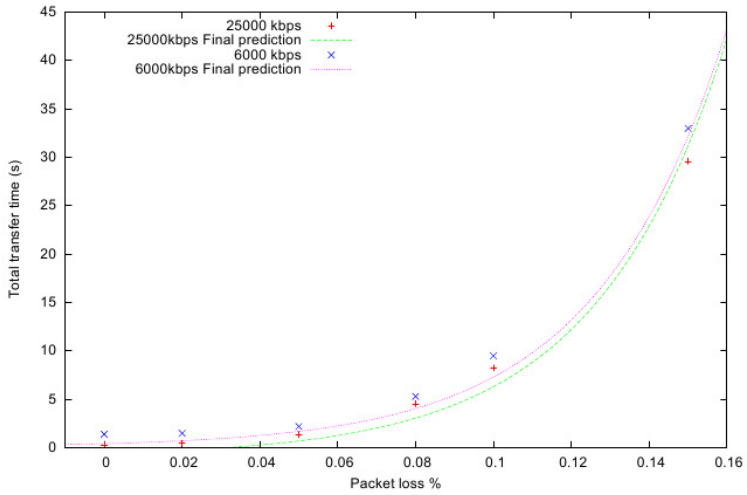


B

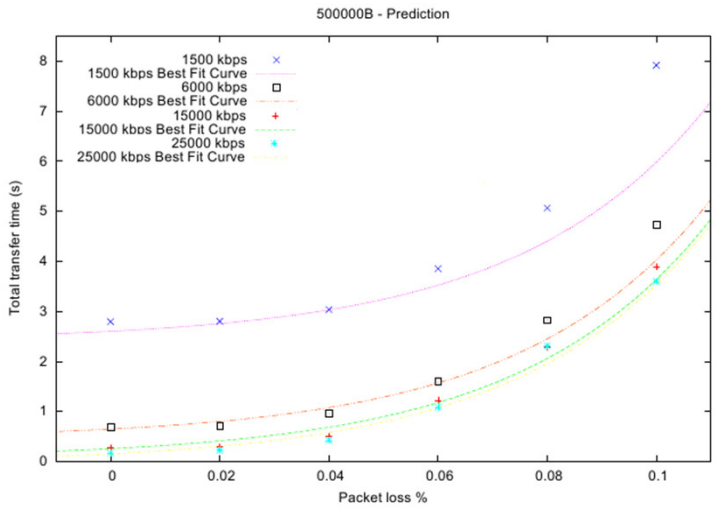


$y(x) = a + b * e^{c*x}$

Applying the prediction



Testing the model



Accuracy of data

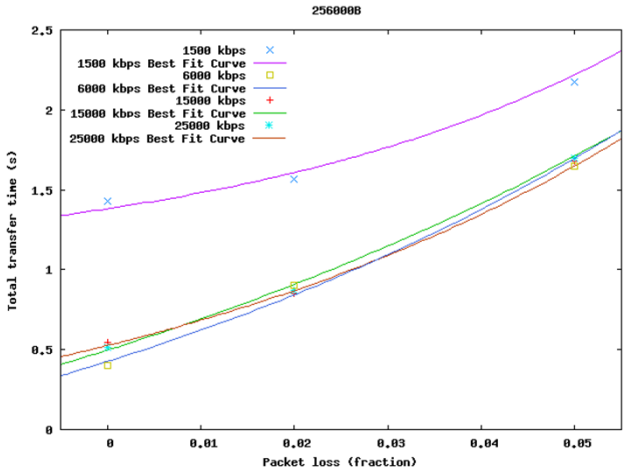
Figures for 500kB file, as depicted in previous slide.
Values are a percentage error

Filesize	Bandwidth	0%	2%	5%	8%	10%	15%
500000	1500	7.25	1.94	0.85	10.89	17.44	36.30
500000	6000	7.37	-9.08	-8.48	5.48	20.00	22.80
500000	15000	7.14	-26.91	-24.19	8.61	16.07	12.35
500000	25000	6.88	-24.68	-23.70	5.79	23.96	7.22

Standard deviation of experimental results, as a percentage of mean

Filesize	Bandwidth	0%	2%	5%	8%	10%	15%
500000	1500	0	1.69	9.26	24.28	21.77	38.39
500000	6000	0	9.32	25.58	39.68	41.86	37.73
500000	15000	0	21.07	47.71	56.05	41.71	30.41
500000	25000	0	40.79	52.03	48.08	52.16	44.68

Adding delays in



In the context of home

Packet loss hits HTTP browsing in multiple times

Interactive connections suffer even more

Streaming media could be subject to pauses while it buffers

Very noticeable in games

Alleviating packet loss

Identify and fix source of loss

Send less data (compression)

Use a different protocol

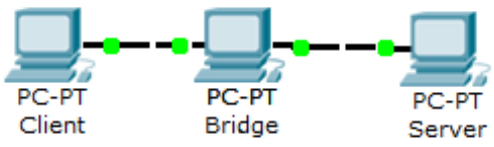
eg, SPDY

Send data multiple times, preempting that n% of the packets will get lost

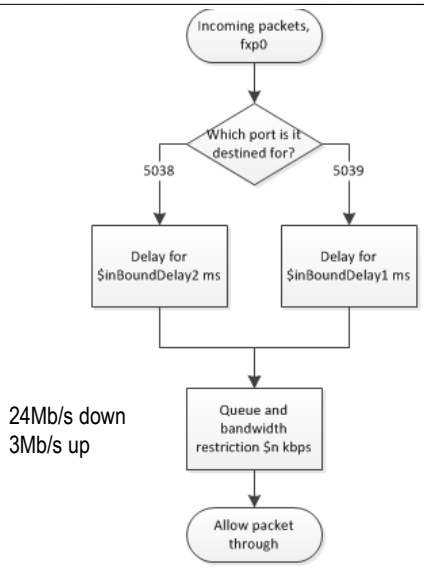
Diminishing returns

Competing TCP streams

Experimental setup



Dummynet configuration

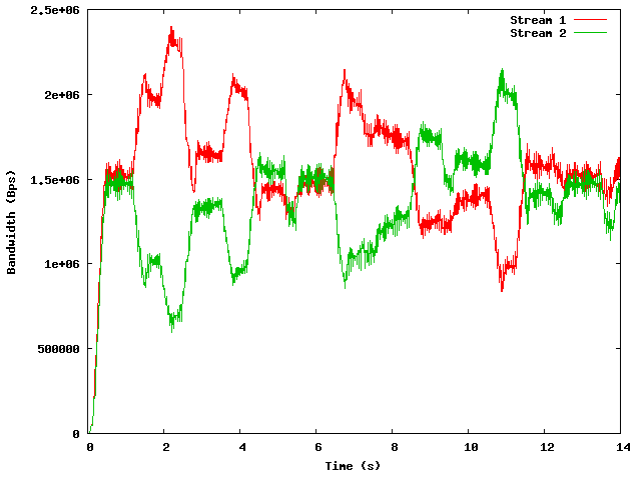


24Mb/s down
3Mb/s up

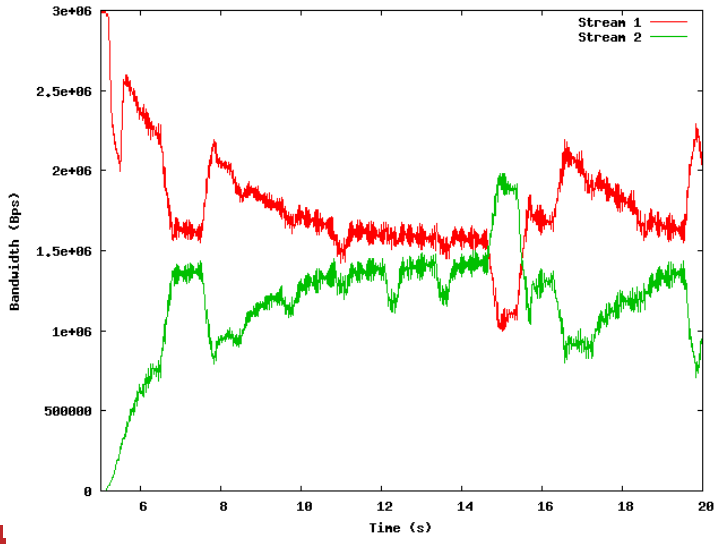
Experimental considerations

- Congestion control algorithm/OS specific nuances
- Plausible situations

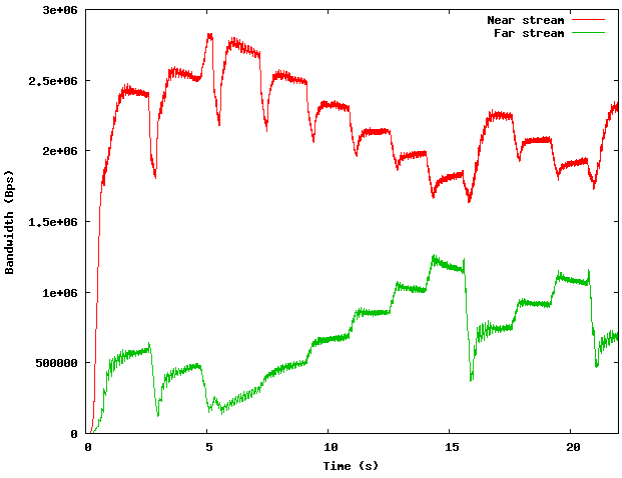
Control data



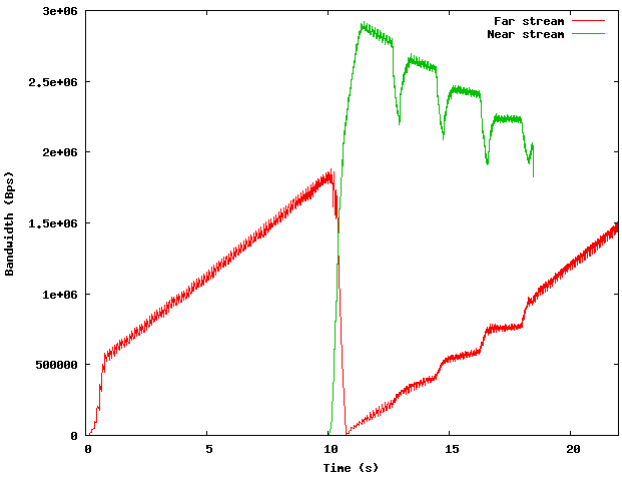
Control, staggered start



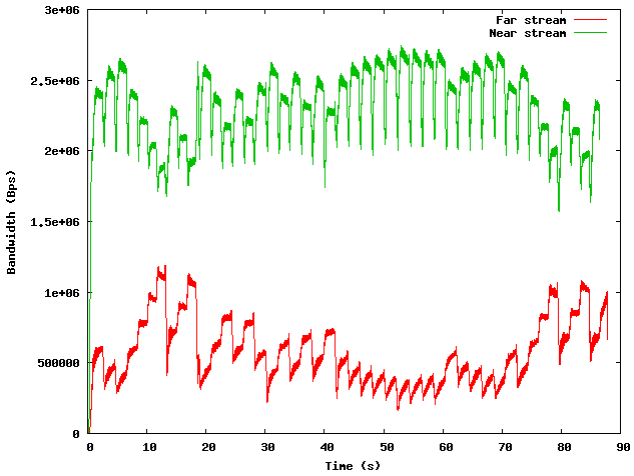
Disparate RTT values



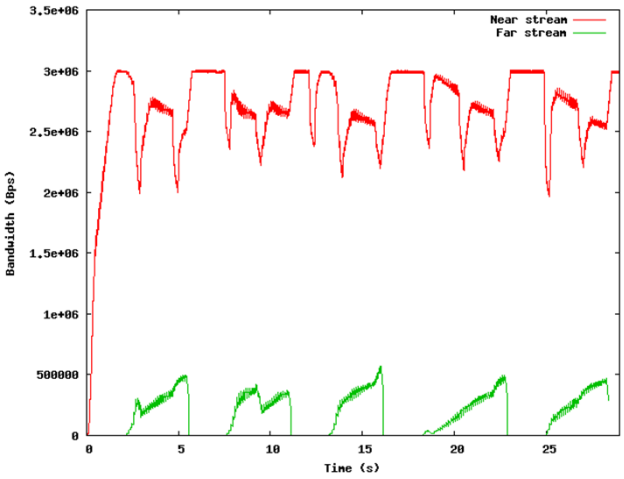
Disparate RTT values, staggered start



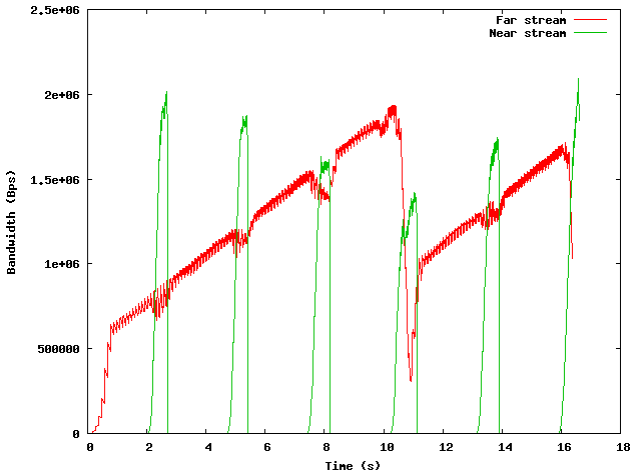
Long running with disparate RTTs



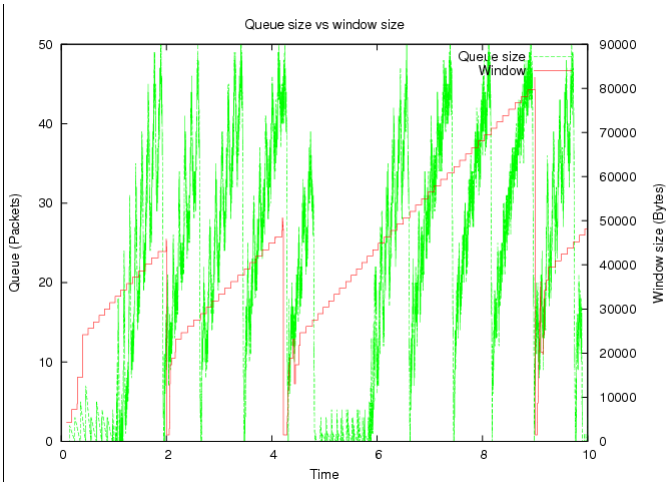
Short bursts of far traffic against near



Short bursts of near against far



Window size variation

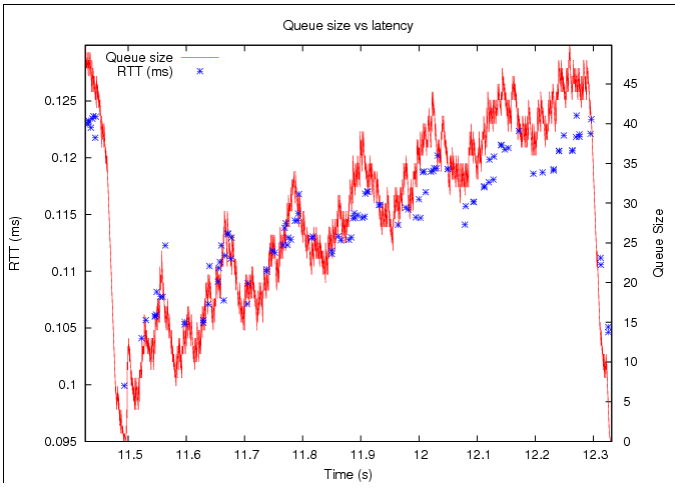


Alleviating these effects

Use a delay based congestion control

Some kind of QoS or put a cap on bandwidth available to individual streams

Other activities undertaken at CAIA



Real world packet loss

Used the BART equipment to test

Rather impractical to get packet loss to occur on ADSL

- Noise margin
- Tx/rx gain
- Modulation (g.lite – but it drops speed from 8Mb/s to 2Mb/s)
- 1.2km of cat5 in a box

ADSL line statistics

Noise Margin:	2.5 dB		7.0 dB	
Output Power:	17.0 dBm		12.0 dBm	
Attenuation:	12.5 dB		15.5 dB	
	Interleave	Fast	Interleave	Fast
Speed (kbps):	3968	0	608	0
Reed-Solomon EC:	26690	0	303	207
CRC Errors:	54799	0	561	318
Header Errors:	11645	0	576	324
Bit Errors:	0	0		
BER Valid sec:	0	0		
BER Invalid sec:	0	0		

ADSL testing conditions

(508 byte packet)

--- 10.2.0.55 ping statistics ---1000 packets transmitted, 760 packets received, 24.0% packet lossround-trip min/avg/max/stddev = 19.786/23.432/41.670/1.910 ms

(1008 byte packet)

--- 10.2.0.55 ping statistics ---5000 packets transmitted, 4894 packets received, 2.1% packet lossround-trip min/avg/max/stddev = 28.703/32.649/57.068/2.129 ms

Conclusion

Created a basic model for the impact of packet loss on file transfers

Found that in concurrent near and far TCP stream situations, the far stream always loses, sometimes badly.

Caused some significant packet loss on an ADSL line and ran some tests, but did not get to analyse in depth

Thank you!