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CENTRE FOR ADVANCED INTERNET ARCHITECTURES

Evaluation of FAST TCP in Low-Speed DOCSIS-based Access Networks

by

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Presentation Outline

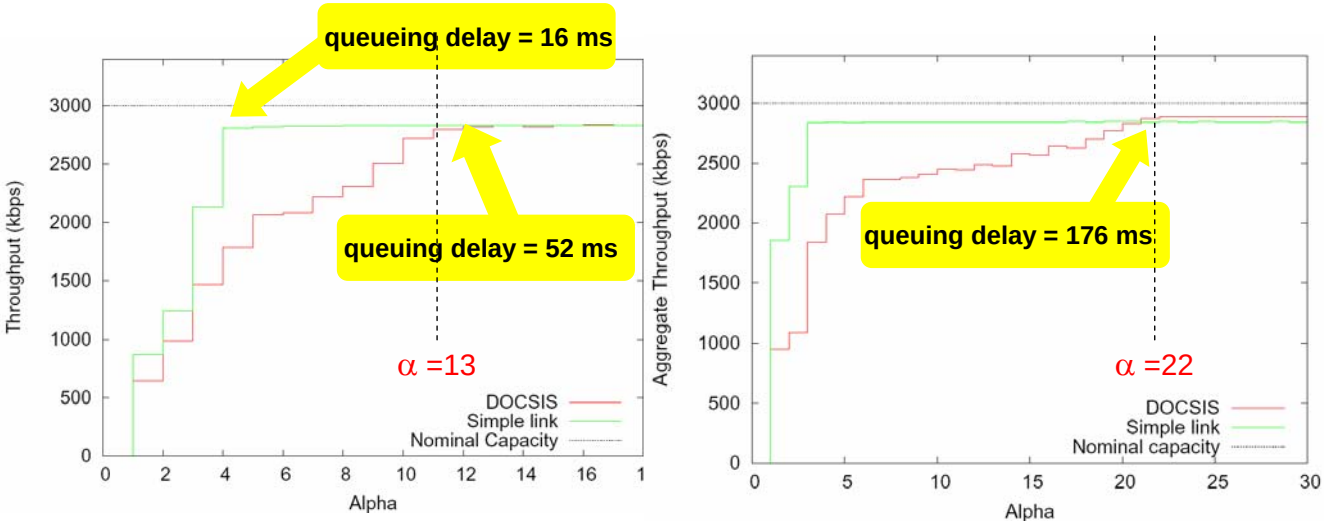
- Motivation
- Background on some previous results
- Experimental setup
- Results and analysis
- Conclusions

Motivation

- Tencon'05 paper - evaluated the performance of FAST in two low speed environments (0.5 – 3 Mbps): *DOCSIS cable modem system* and *simple low rate links*
  - One of the main findings – DOCSIS introduces "phantom" queuing delay on an underutilized link which results in the need for W >> B-D product & increased target queue size parameter α
  - The study only considered static scenarios involving 1 or 2 flows in a single CM system
- This project extends the analysis of the Tencon paper to:
  - Multiple flows of FAST interacting over a single bottleneck link in a single, as well as multiple CM system
  - Multiple protocols (i.e., standard Reno & FAST)

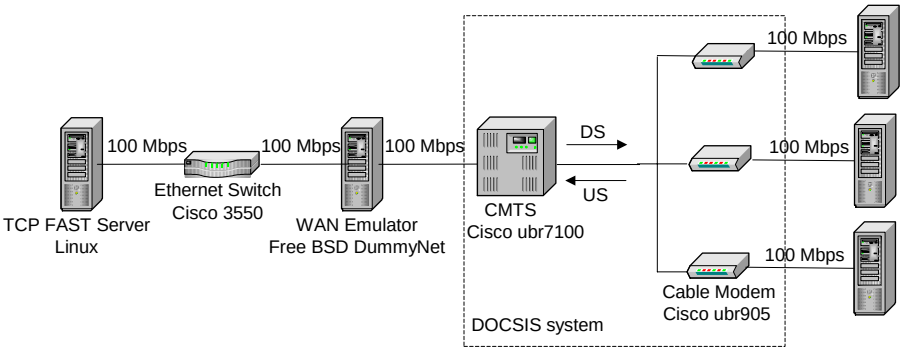
Tencon'05 result – the trend of increasing α

Throughput vs. α parameter for DS = 3 Mbps and US = 512 Kbps



1. The rule for setting α, applied in high speed regime, does not work for low-speed especially in DOCSIS system
- The required α value *does not scale inversely with n* where n is the number of flows on the bottleneck link

Experimental Setup

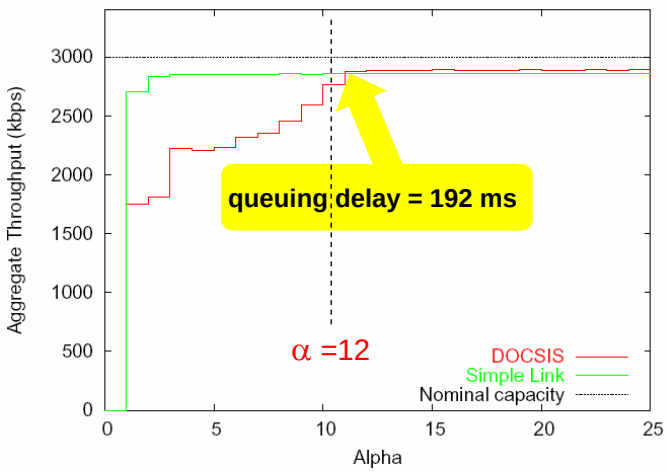


DS	US
3 Mbps	512 Kbps

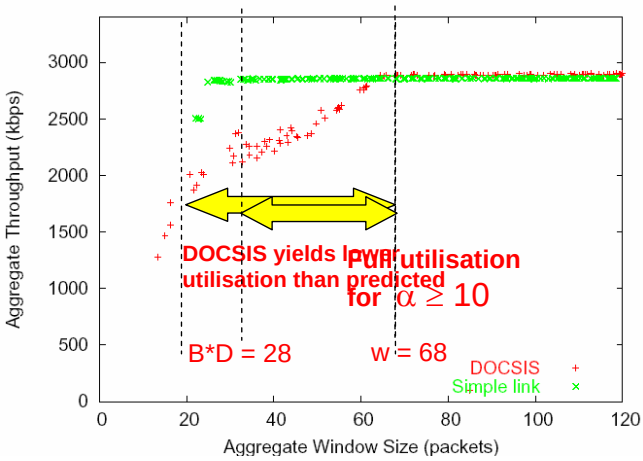
- DOCSIS link:
  - Dummynet: RTT=100ms, no bandwidth limitations, buffer size of 2048 Kbytes
  - Maximum buffer size at CMTS set to the max Cisco value of 1024ms
- Simple rate-limited link:
  - DOCSIS system was bypassed. Dummynet emulated system with equivalent US and DS capacities and buffering. Also, RTT=100ms.
- Extended testbed- involved inclusion of multiple cable modems i.e., 2 CM system and 3 CM system

One CM Results – 4 Flows

Aggregate throughput vs. individual α parameter for 4 flows and one cable modem (DS=3Mbps, US=512Kbps)

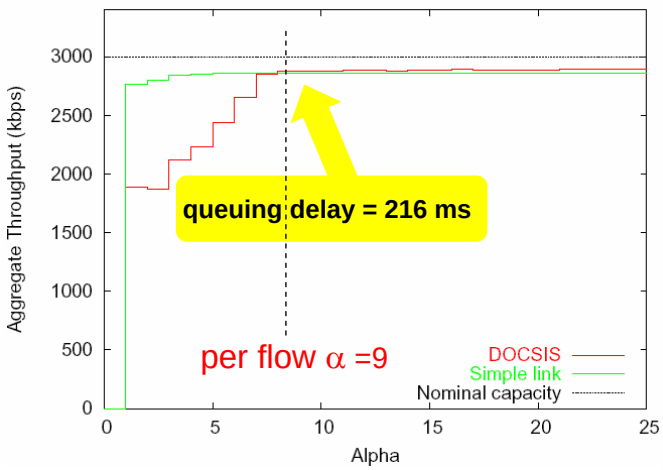


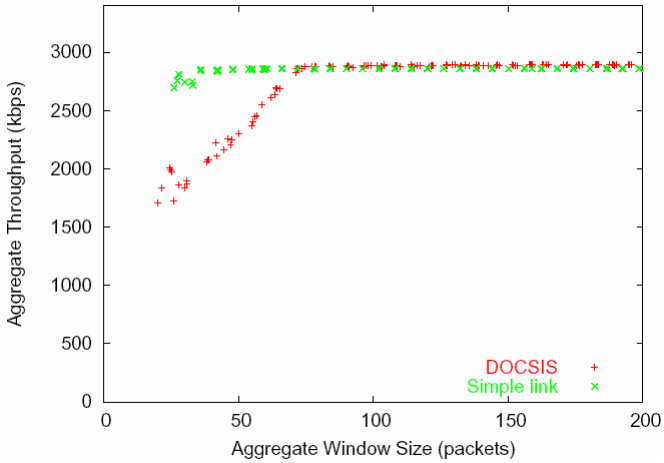
FAST ability to accurately set its window size is unaffected by the latency fluctuations introduced by DOCSIS



One CM Results – 6 Flows

Aggregate throughput vs. individual α parameter for 6 flows and one cable modem (DS=3Mbps, US=512Kbps)





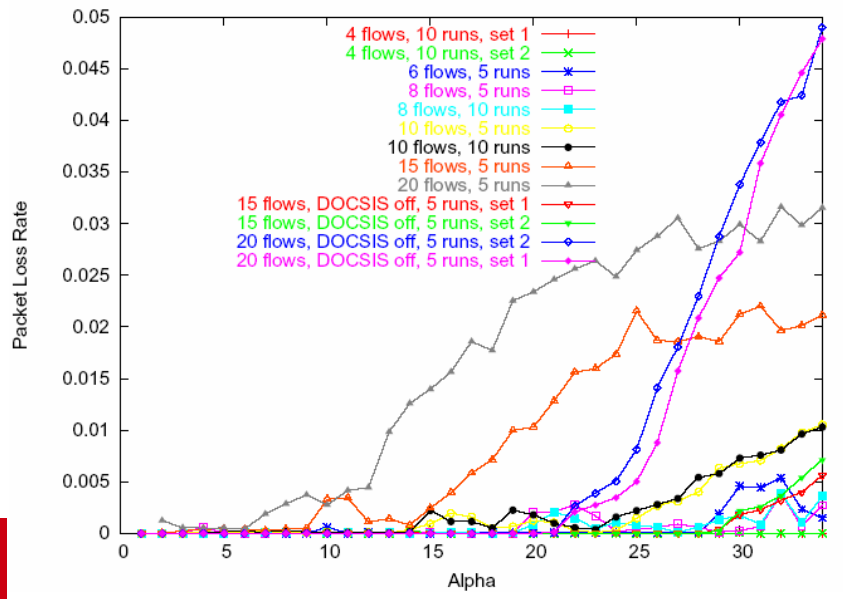
Summary of One CM

# of Flows	Total alpha required	Target Queuing Delay (ms)
1	13	52
2	44	176
4	48	192
6	54	216
8	72	288
10	80	320

Total target queuing delay increases as the number of flows increases.

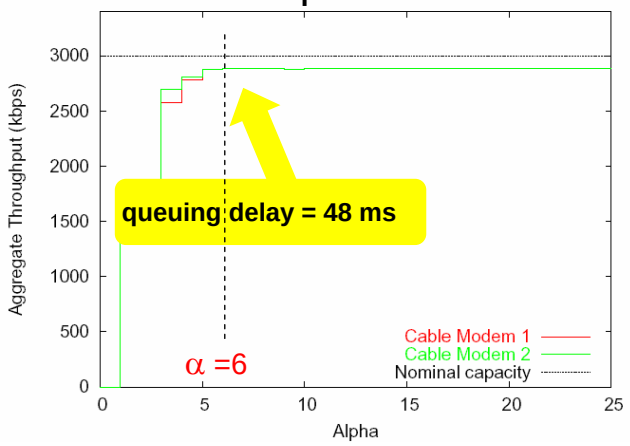
Packet Loss

Packet loss occurs if the alpha parameter is set too high. This graph shows loss occurring at different alpha values for each different number of flows.

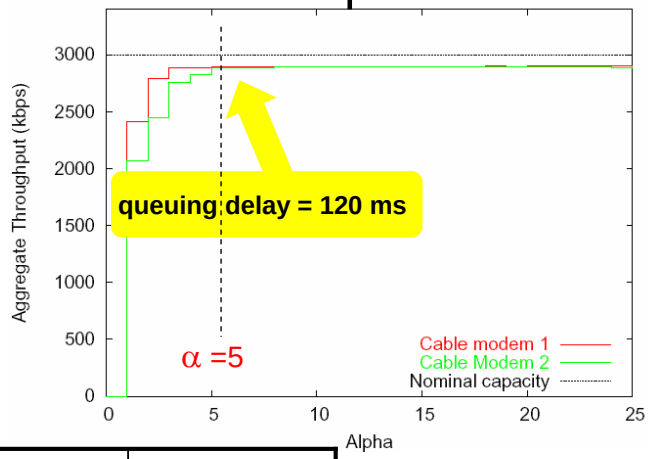


Two CMs Results

1 Flow per CM



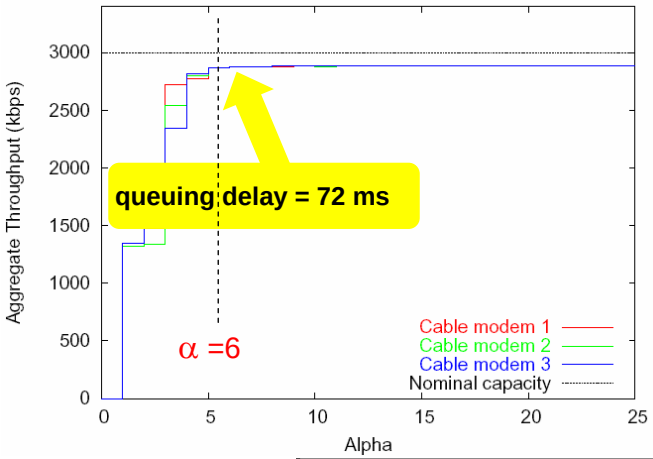
3 Flows per CM



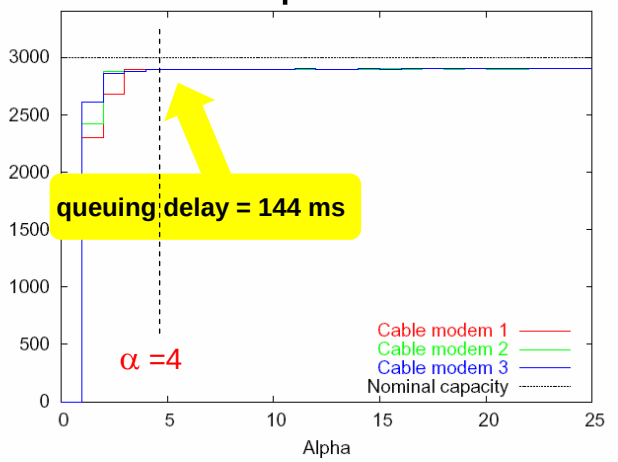
# of Flows per CM	Alpha required	Target Queuing Delay (ms)
1	12	48
2	16	64
3	30	120
4	32	128
5	30	120
10	60	360

Three CMs Results

1 Flow per CM



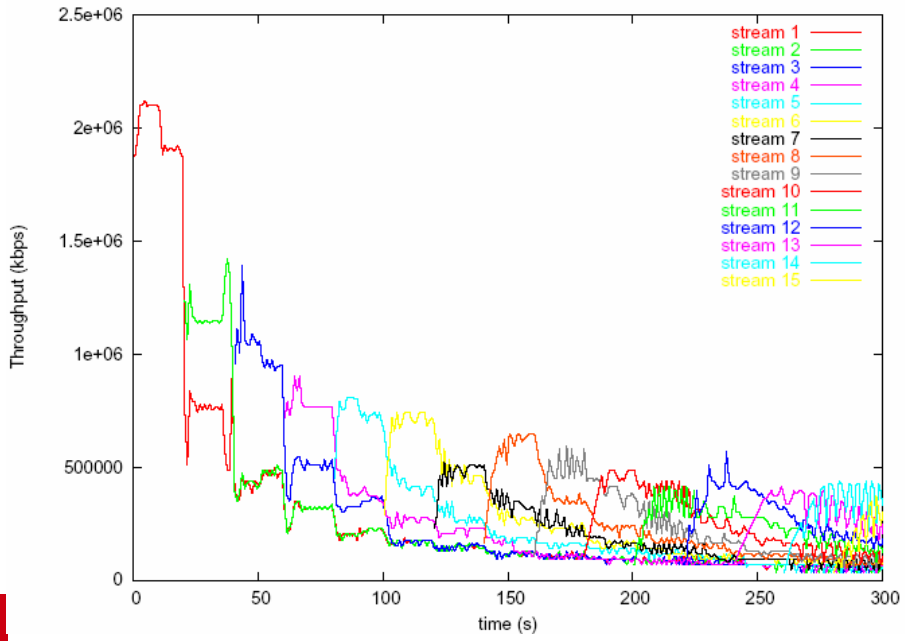
3 Flows per CM



# of Flows per CM	Alpha required	Target Queuing Delay (ms)
1	18	72
2	32	128
3	36	144
4	48	192
5	45	180

Fairness Analysis

Throughput vs. time for each flow, where new flows are introduced every 20 seconds



Conclusion

- Performance of FAST over DOCSIS and simple low-rate link investigated with multiple flows and multiple cable modems
- Some insights were gained for setting the required alpha parameter to achieve full utilization
- It was observed that the total target queuing increases with the increase of the number of flows
- Some fairness issues observed as well
- Further investigation is required to better understand the system behaviour

Thank You

…any questions?