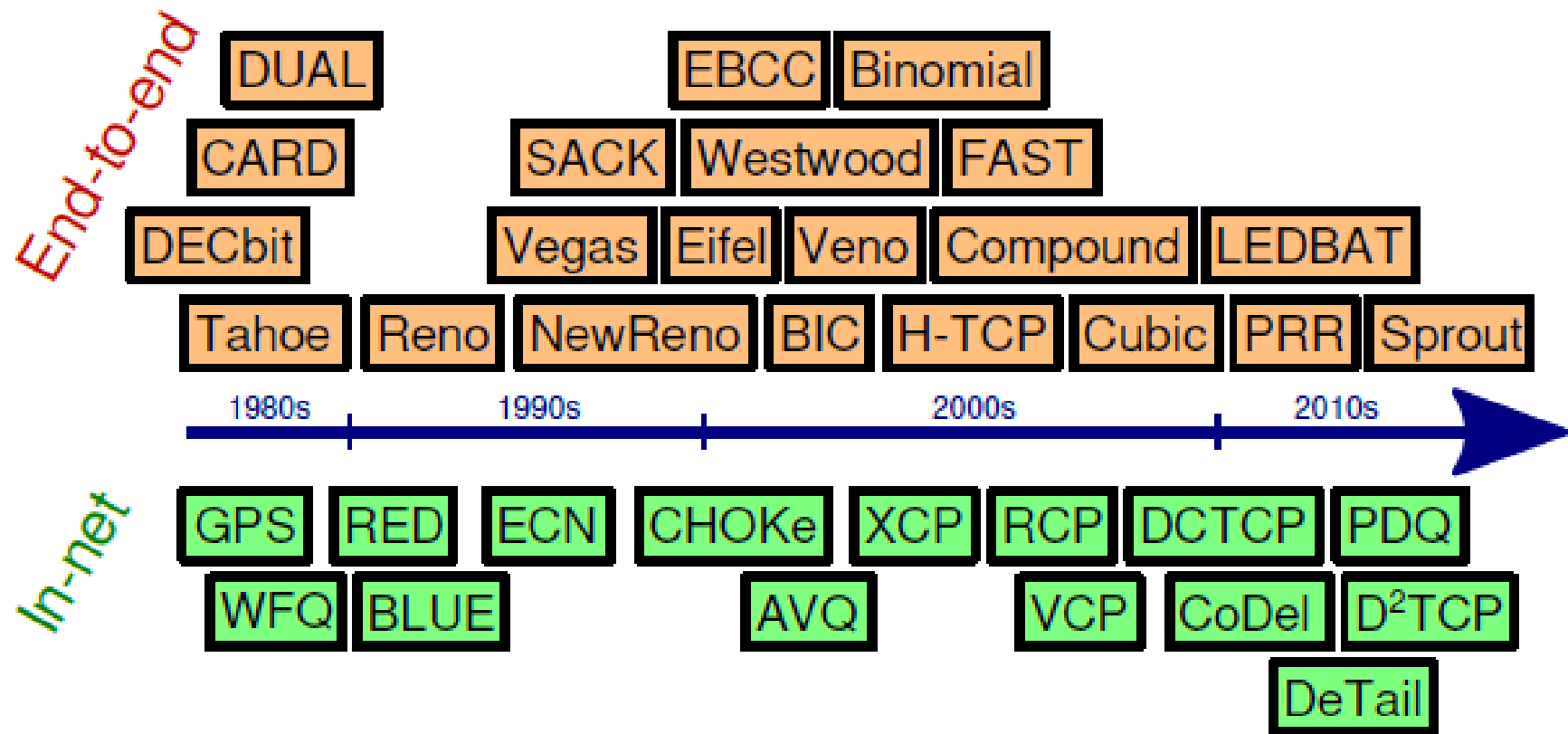


Performance of New Variants of TCP

Presenter - Bob Kinicki



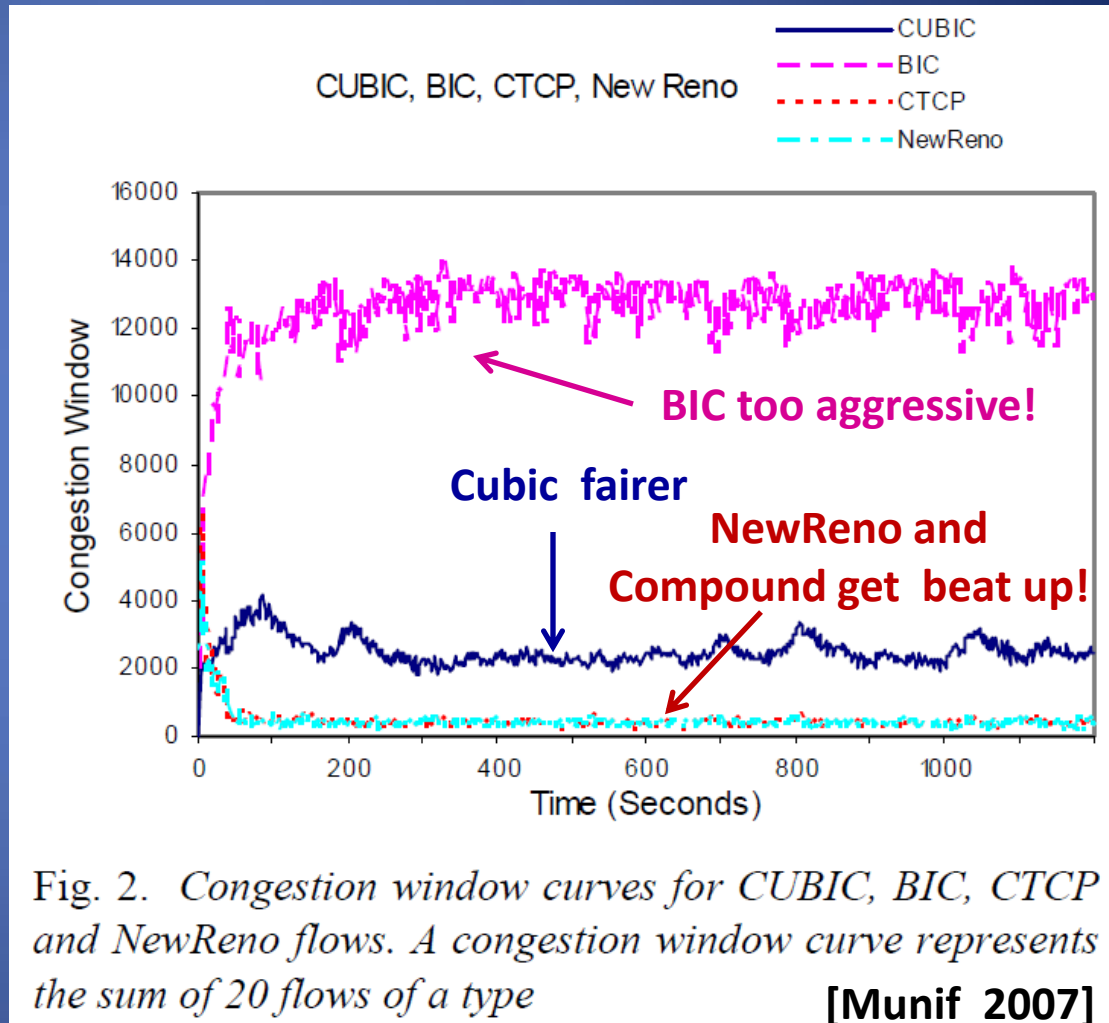
The march of congestion control mechanisms



Fairness in TCP Variants

ns-2 dumbbell simulations

- $C = 1$ Gbps
- Min RTT = 104 ms.
- Drop tail routers
- 1500 byte packets
- Buffer size = BDP
- 20 flows of each TCP variant
- 1200 sec. simulated



Fairness in TCP Variants

Table 1: Average transfer rates and average link utilization

Mechanism	Average Transfer Rate (Mbs)	Average Link Utilization (%)
CUBIC	151.11	15.11
BIC	764.42	76.42
CTCP	27.80	2.78
NewReno	26.59	2.66

Too Aggressive

[Munif 2007]

High Speed Simulations

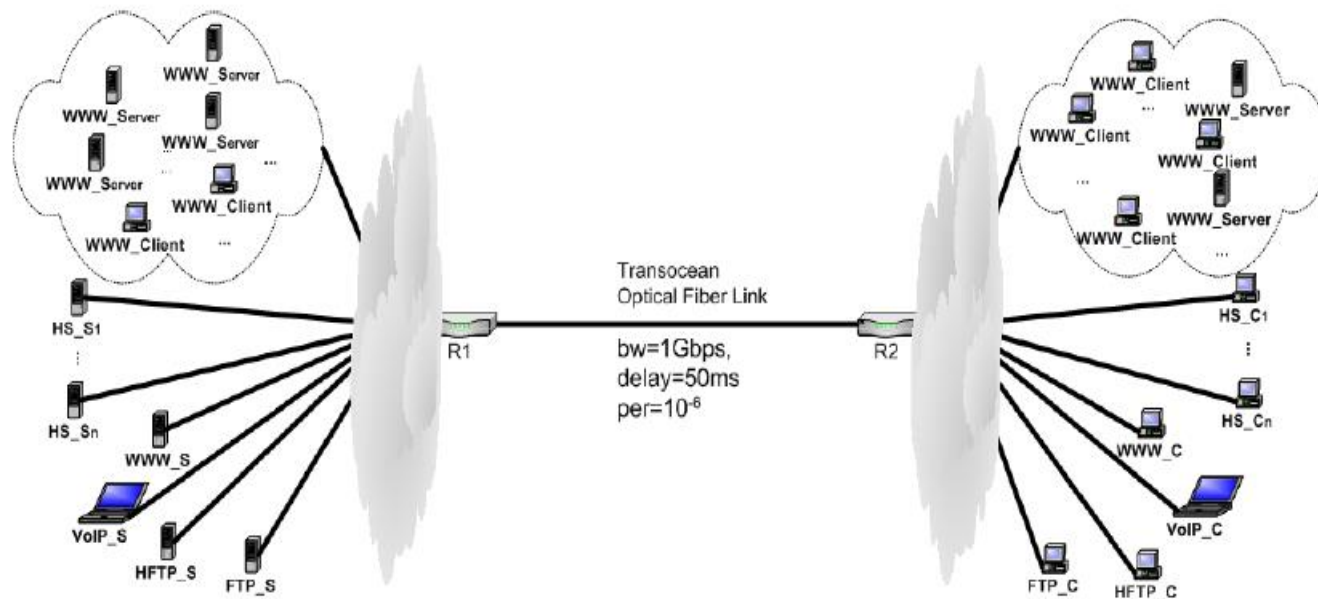
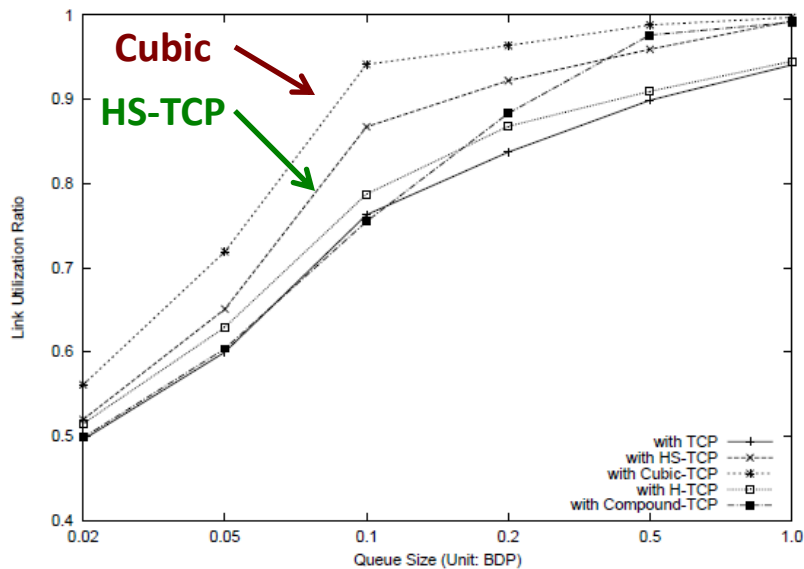


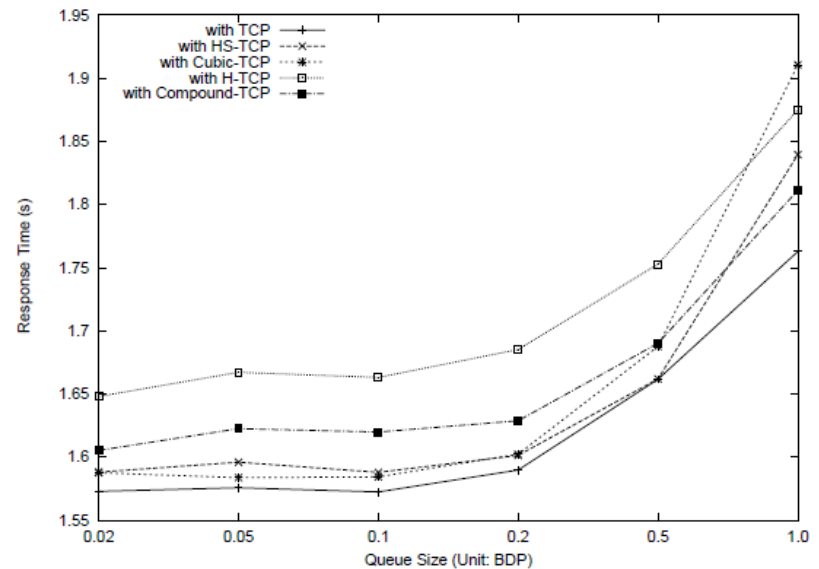
Figure 1: Wide Area Network Scenario: High Speed Congestion Control Algorithms on a Transocean Optical Fiber Link

[Wu 2008a]

Utilization and Response Time



(a) Link Utilization Ratio



(b) WWW (Response Data Size=64KB)

Figure 7: Twenty High Speed Flows on the Simulated Transocean Optical Fibre Link

[Wu 2008a]

Simulated Satellite Network

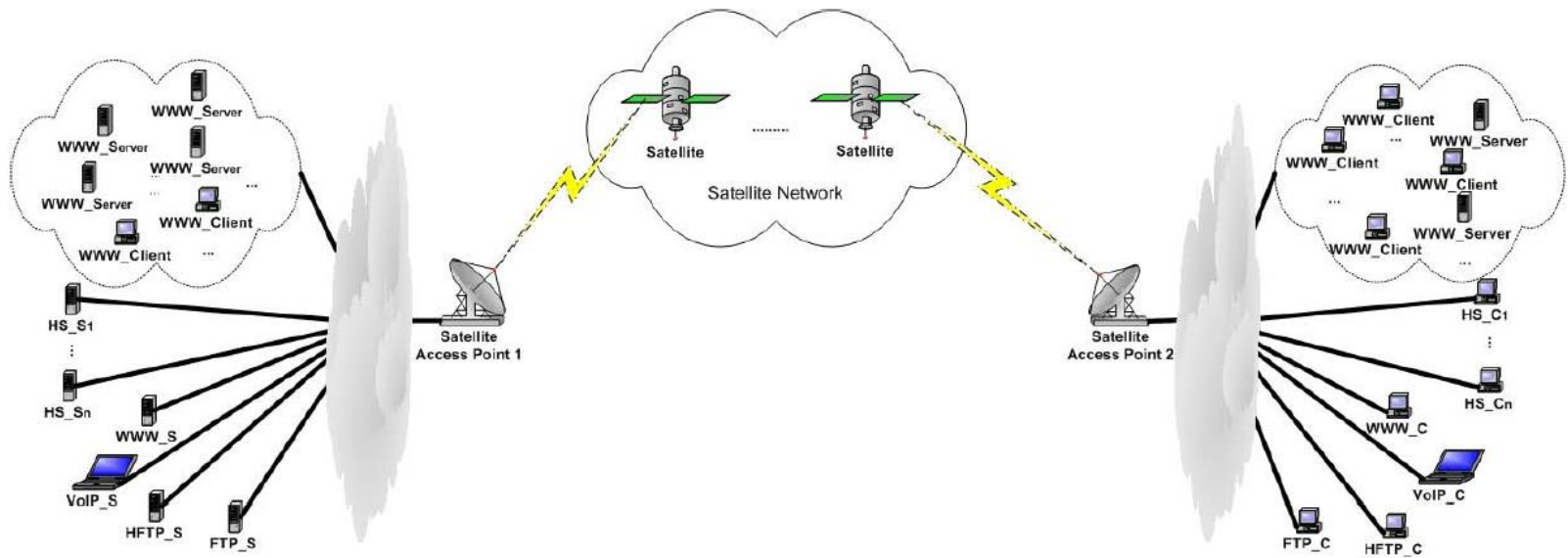


Fig. 1. Network Topology: Two High Speed Networks Connected Through Satellite Network

[Wu 2008b]

Satellite Simulations

Nodes	Delay of Side Link	Traffic Type	Traffic Load
WWW_Server and WWW_Client nodes	Random Number [5ms-15ms]	Background Web Traffic	800 Sessions / s (forward path) 200 Sessions / s (backward path)
HSCC_S _i HSCC_C _i	Random Number [5ms-15ms]	Long-Lived FTP Flows	4 Flows (forward path)
WWW_S WWW_C	10ms	HTTP Sessions	10 Sessions / s (forward path)
VoIP_S VoIP_C	10ms	ITU G.711 PCM Traffic	1 Connection (forward path)
HFTP_S HFTP_C	10ms	Long-Lived FTP Flow	1 Flow (forward path)
FTP_S FTP_C	10ms	FTP Flow (small buffer)	1 Flow (forward path)

TABLE I
PARAMETERS OF GENERATED TRAFFIC

HFTP flows: 100000 packet window
FTP flows: 64 packet window

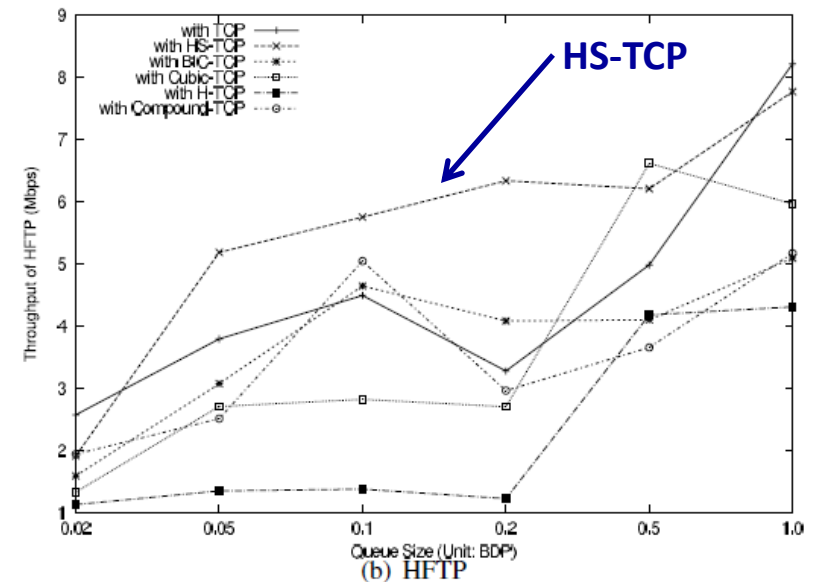
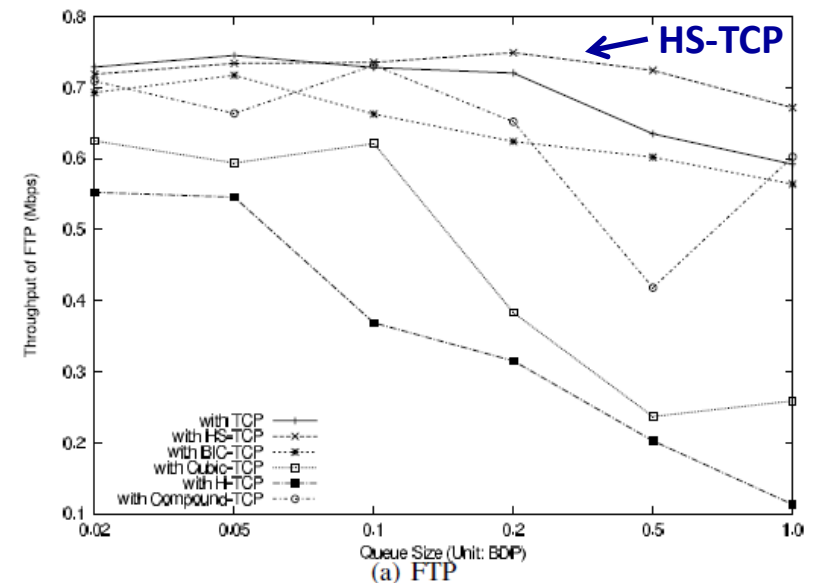


Fig. 5. FTP User Experience

[Wu 2008b]

TCP Variant Utilization

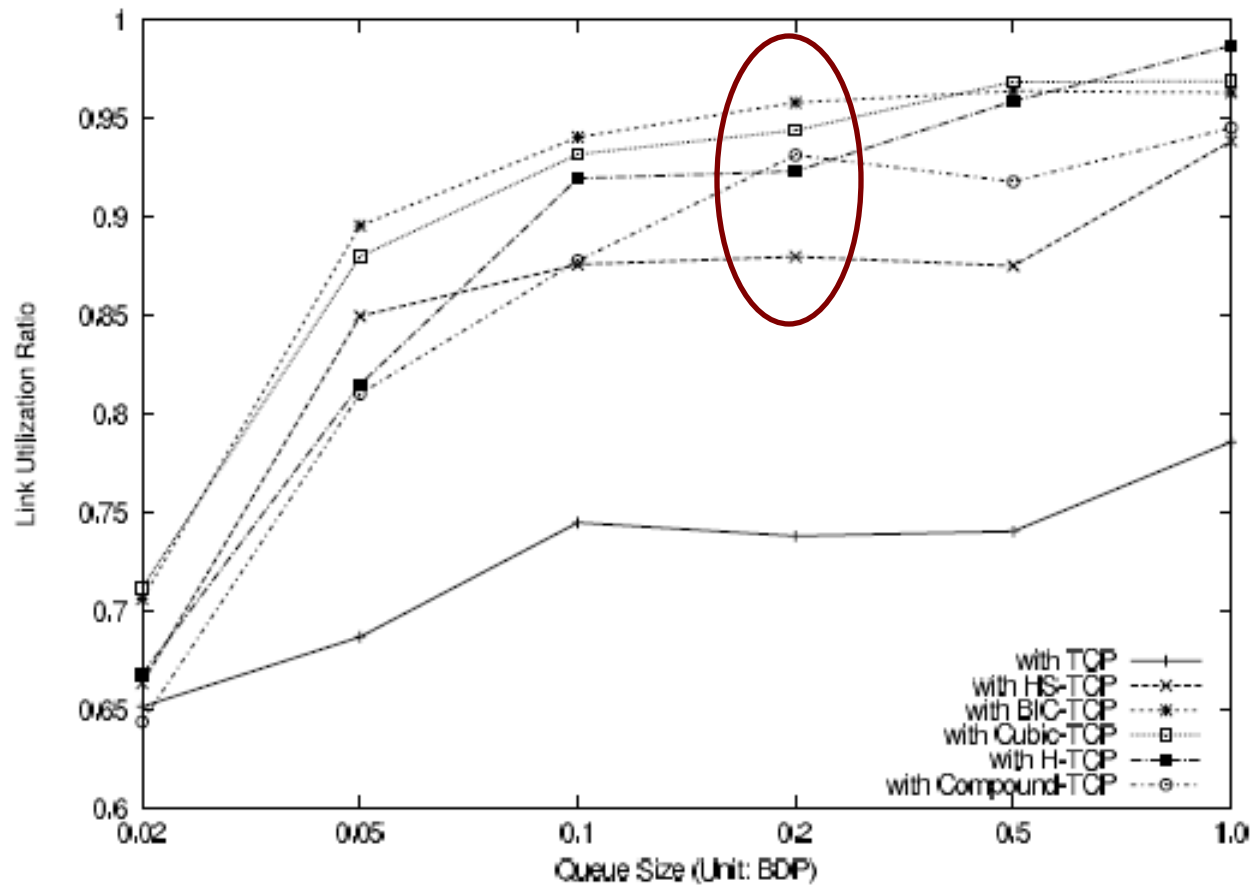
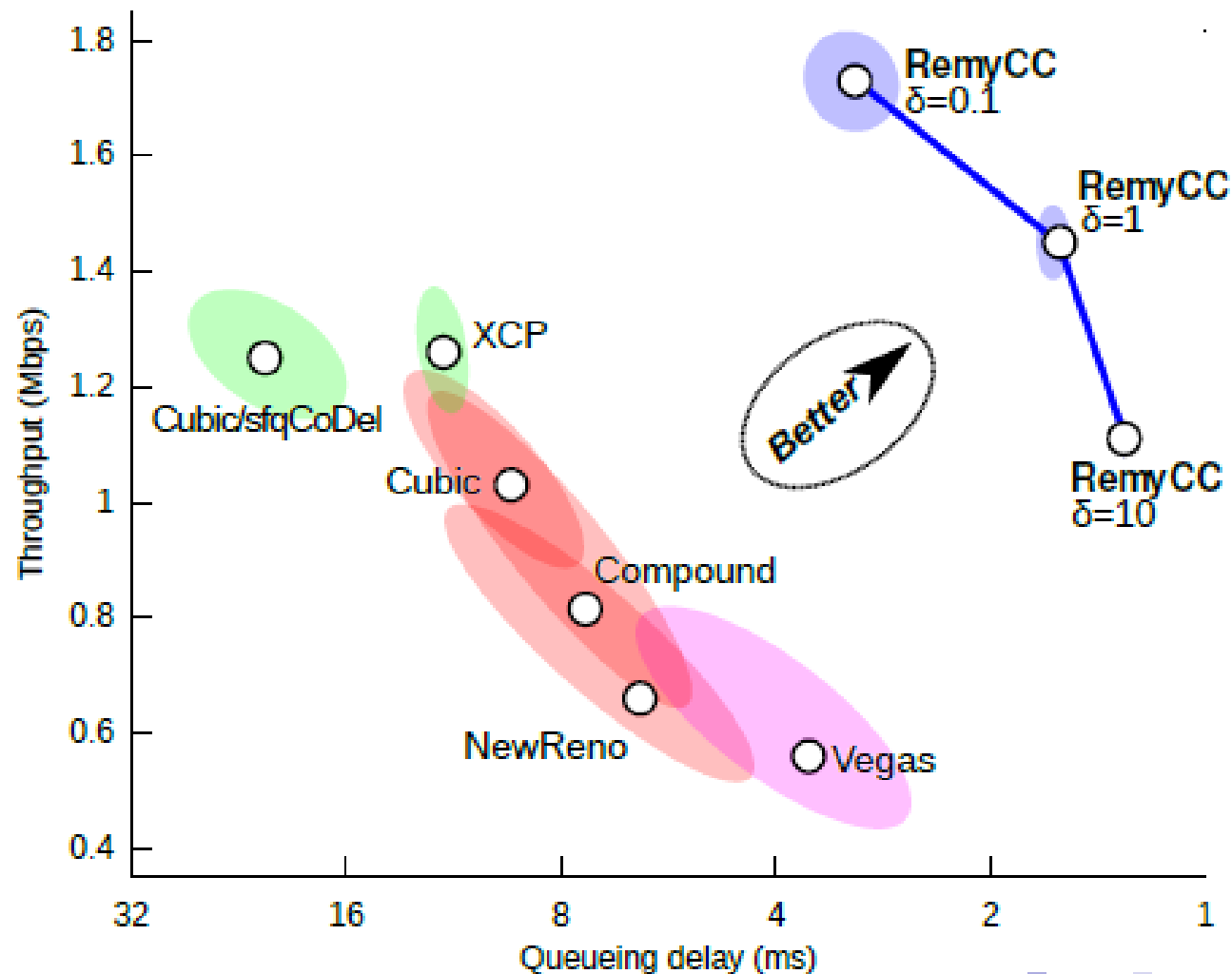


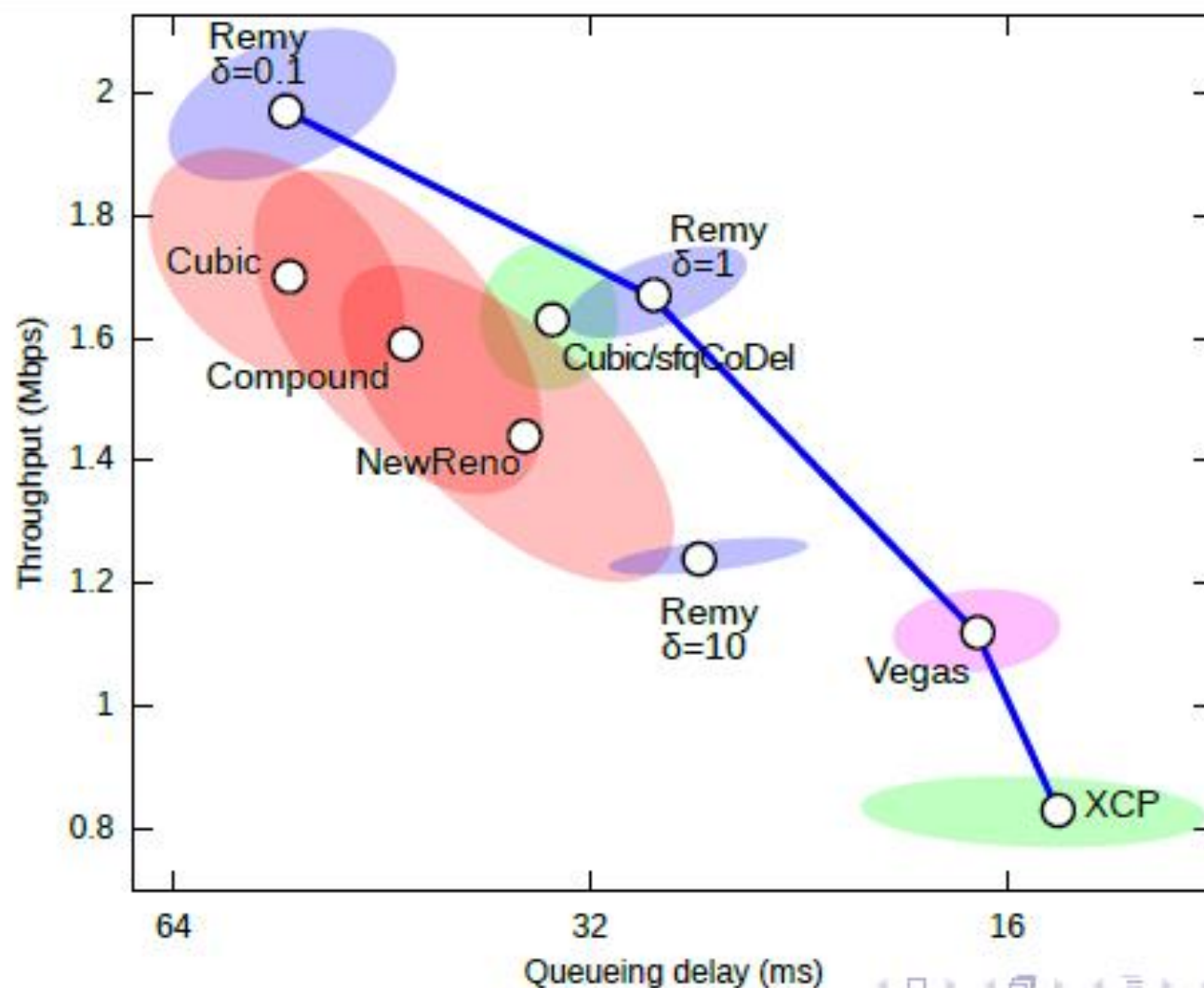
Fig. 6. Satellite Network Utilization Ratio

[Wu 2008b]

Scenario 1: throughput-delay plot



Scenario 2: Verizon LTE, $n = 8$



References

[Munif 2007] K. Munir, M. Welzl, D. Damianovic, “Linux beats Windows! – or the Worrying Evolution of TCP in Common Operating Systems” Fifth International Workshop on Protocols for FAST Long-Distance Networks (PFLDnet-07), February 2007, pp. 43-48.

[Winston 2013] K. Winston, H. Balakrishnan, “TCP ex Machina: Computer-Generated Congestion Control”, SIGCOMM’13, August 2013, Hong Kong.

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[Wu 2008a] X. Wu, “Effects of Applying High Speed Congestion Control Algorithms in the Internet”, National University of Singapore Tech Report 2008.

[Wu 2008b] Xiuchao Wu, M. C. Chan and A. L. Ananda, "Effects of Applying High-Speed Congestion Control Algorithms in Satellite Network", IEEE International Conference on Communications, Beijing, May 2008, pp. 1925-1929 .