

*Comparison of TFRC and TCP(1,1/2)
congestion control algorithms*

ENSC835 and CMPT885 project demo

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Roadmap

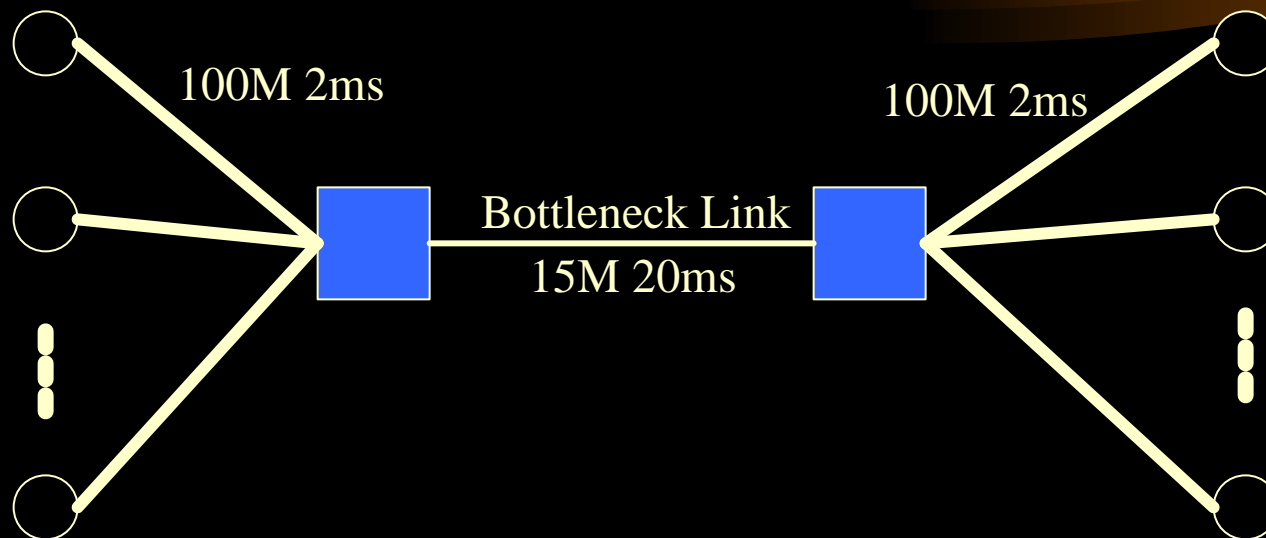


- Introduction
- Simulation Senario
- Simulation & Comparison
 - Window size effect
 - Throughput & lossrate comparison
 - Trunklink capacity effect
 - Queuing effects
 - Transmission delay effects

Simulation Scenario(1)

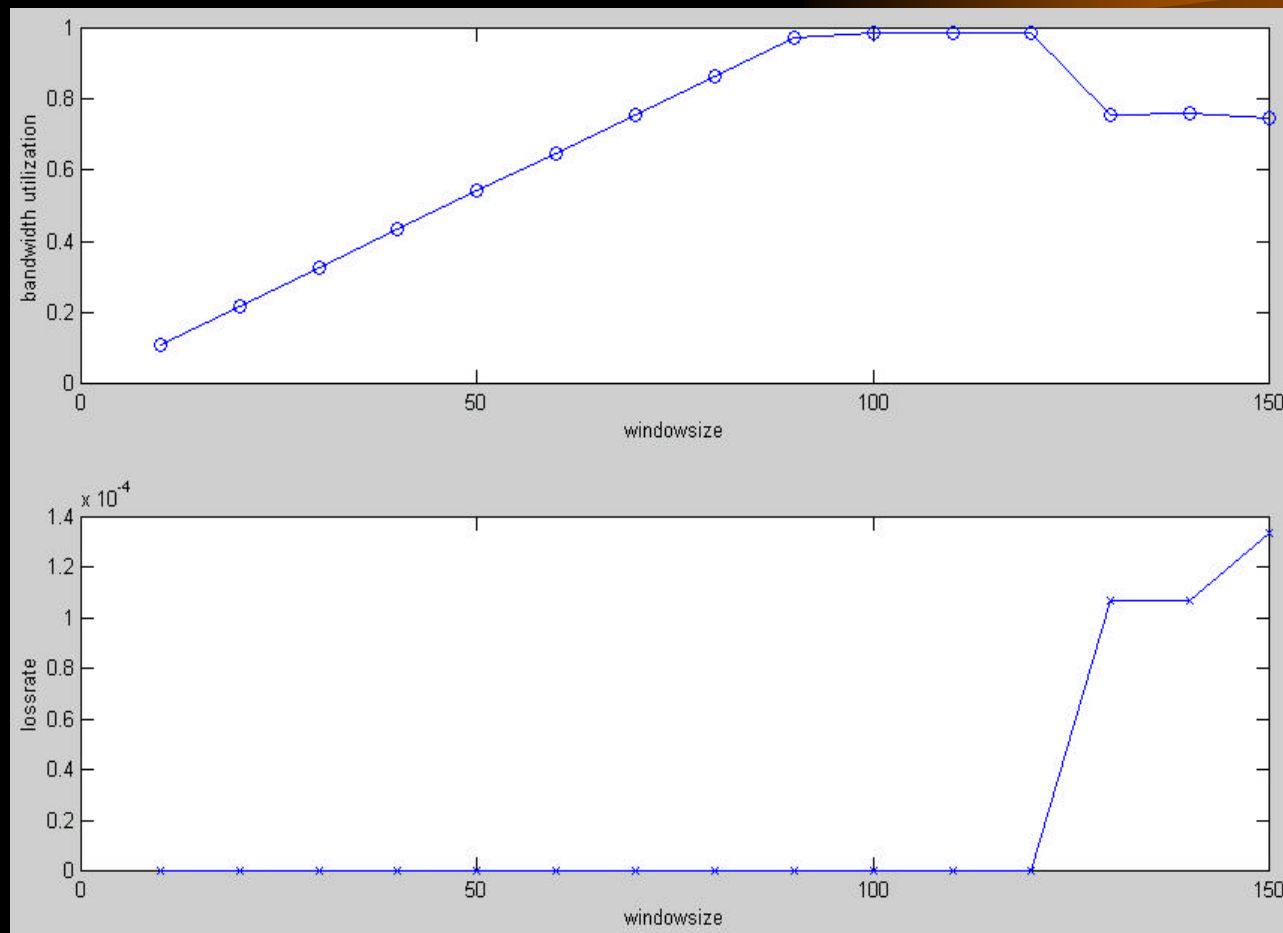
Senders

Receivers

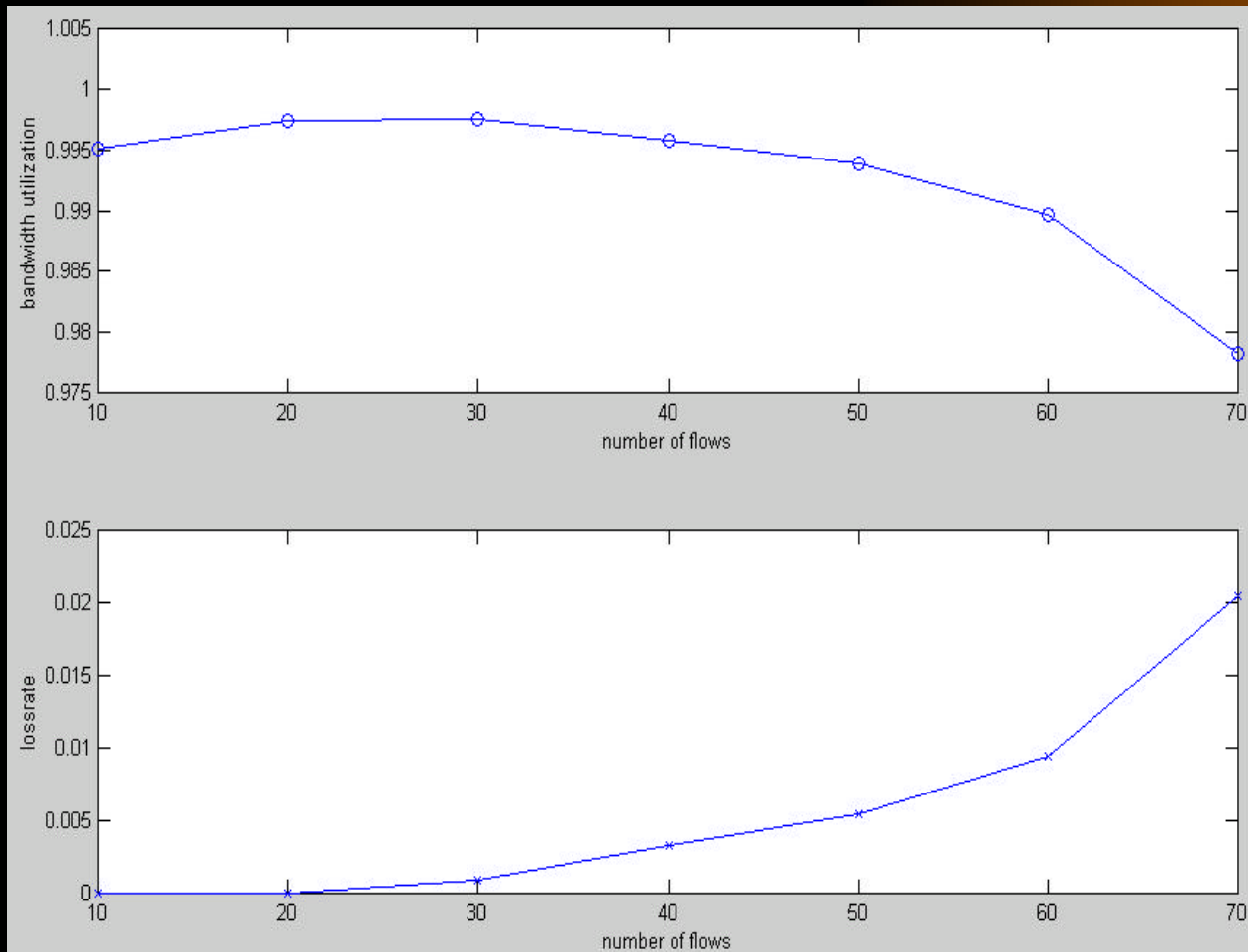


- Topology: Dumb-bell
- Metrics: *throughput, loss rate*

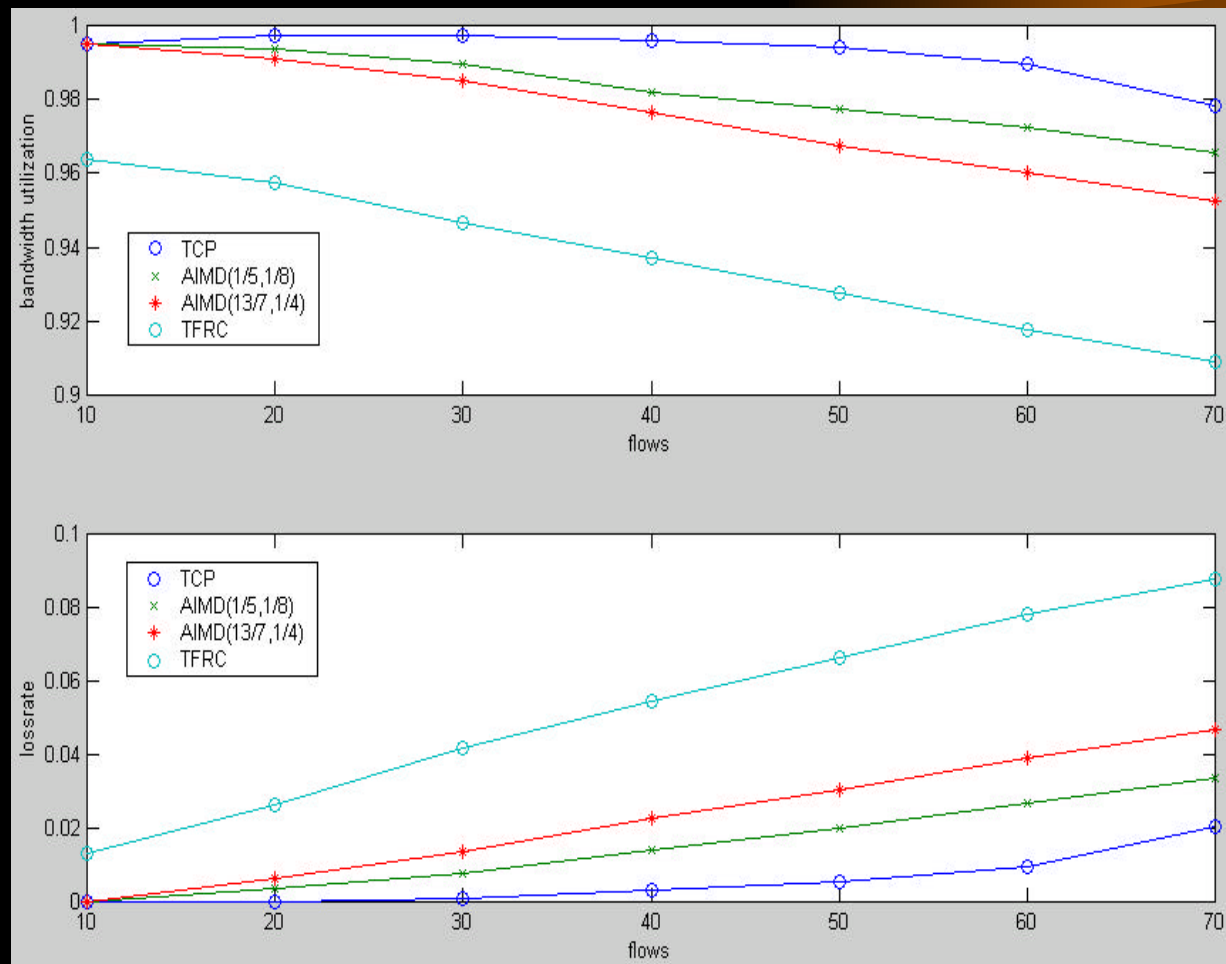
window size effect on Bandwidth utilization of TCP(1,1/2)



Bandwidth utilization of TCP(1,1/2)



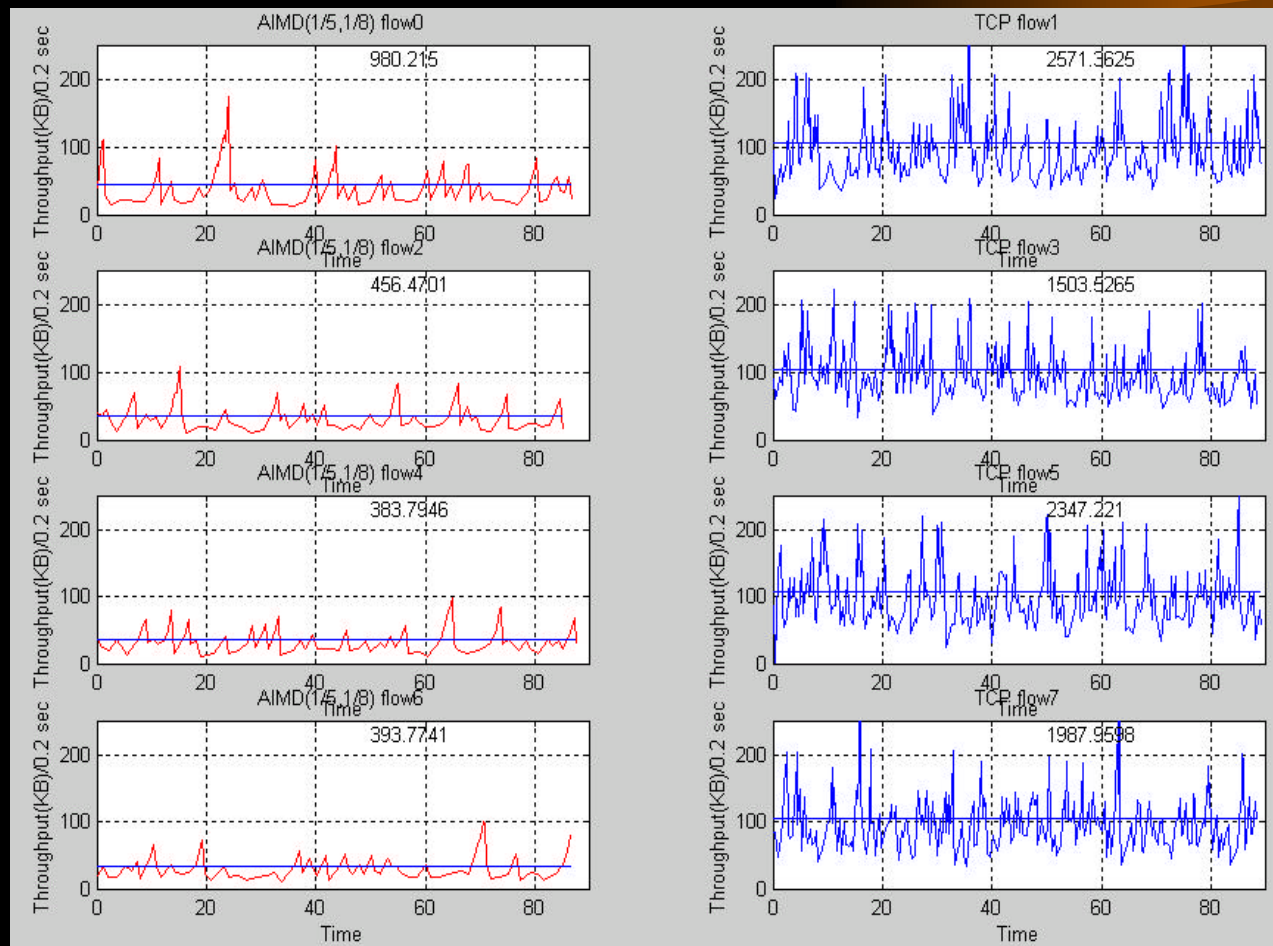
Bandwidth utilization & lossrate comparison



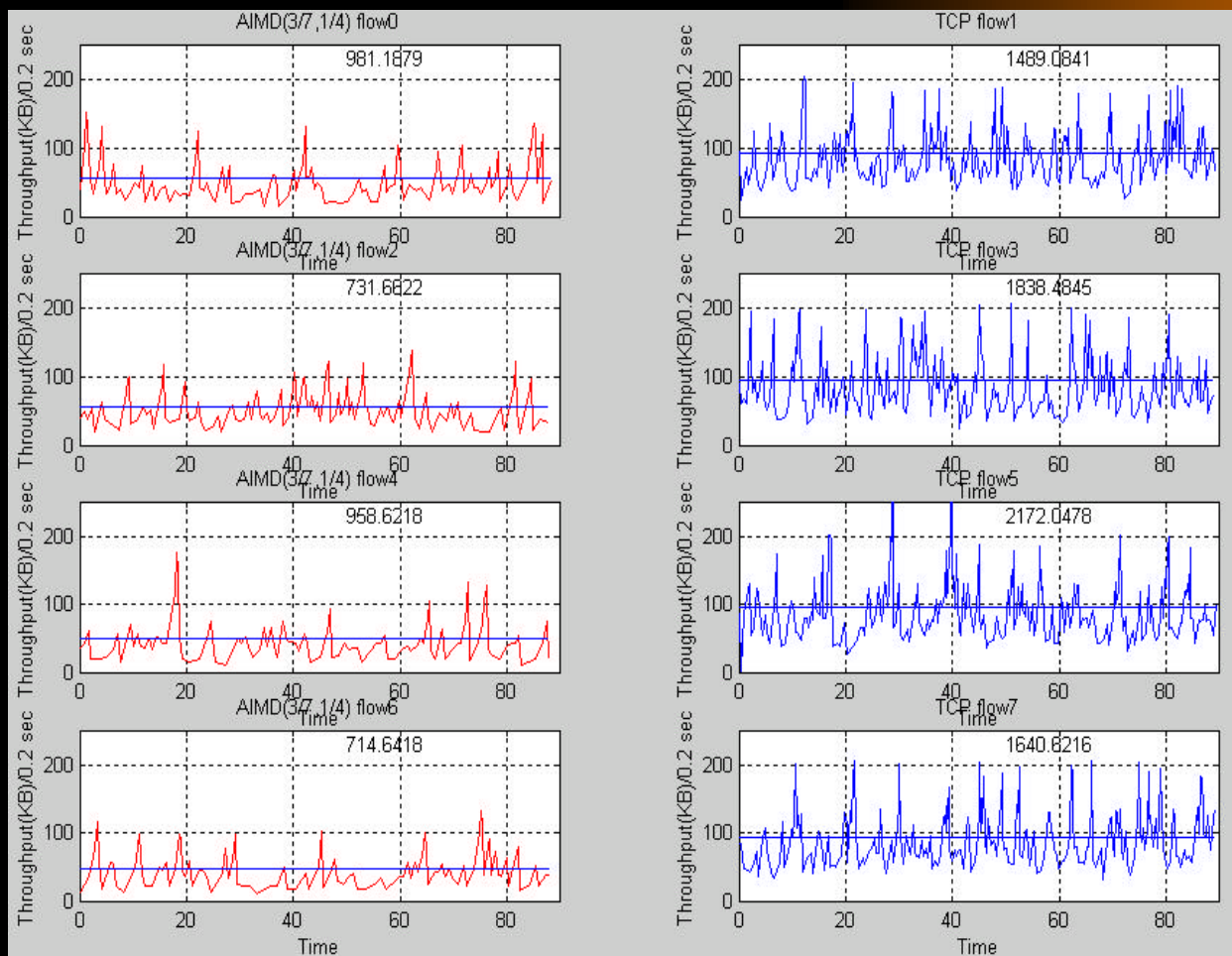
Comparison of Throughput and Smoothness

- TCP(1/5,1/8) Vs TCP(1,1/2)
- TCP(3/7,1/4) Vs TCP(1,1/2)
- TCP(1/5,1/8) Vs TFRC
- TCP(1,1/2) Vs TFRC
- TCP(3/7,1/4) Vs TFRC
- TCP(3/7,1/4) Vs TFRC

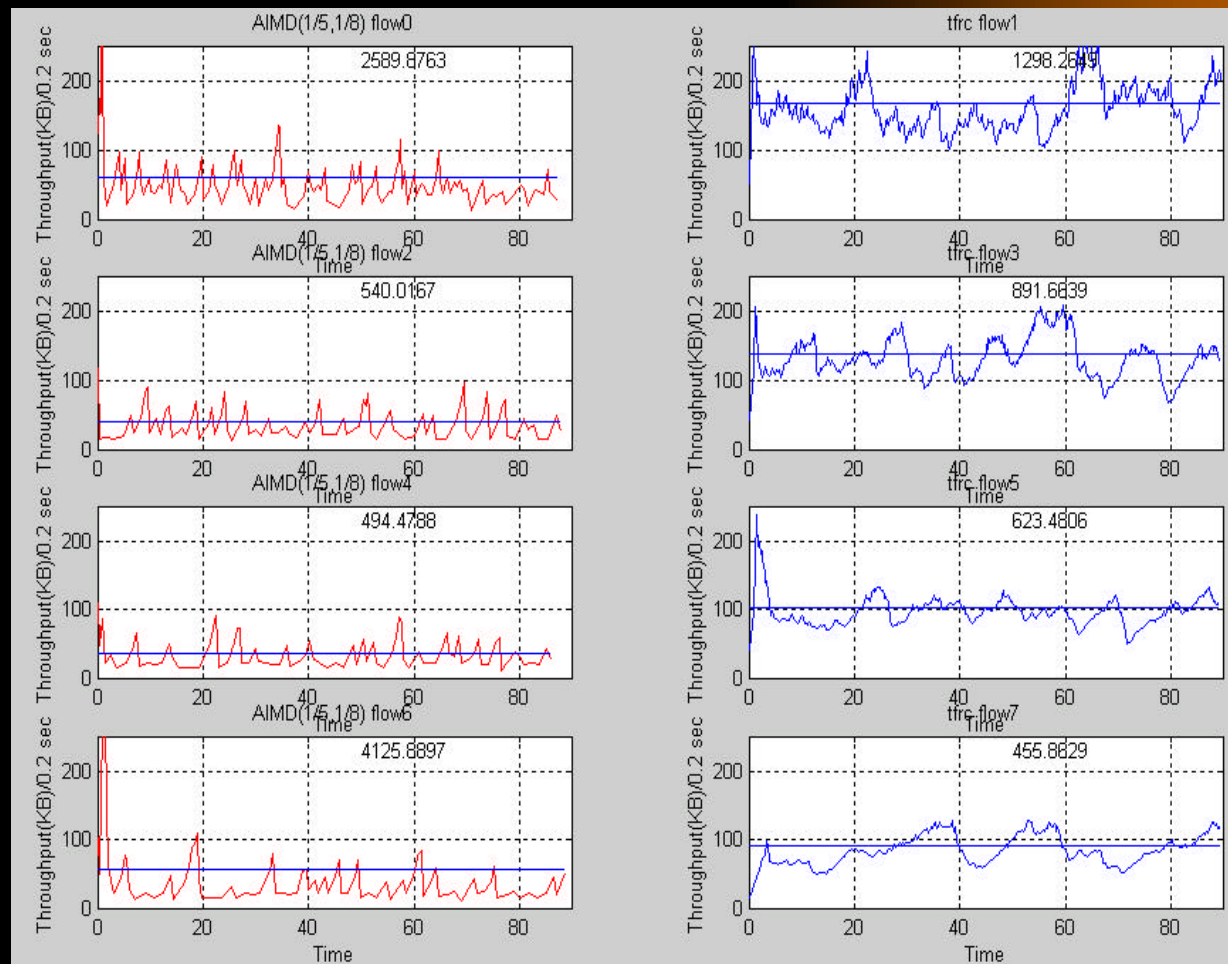
TCP(1,1/2)(1/5,1/8) Vs TCP(1,1/2)(1,1/2)



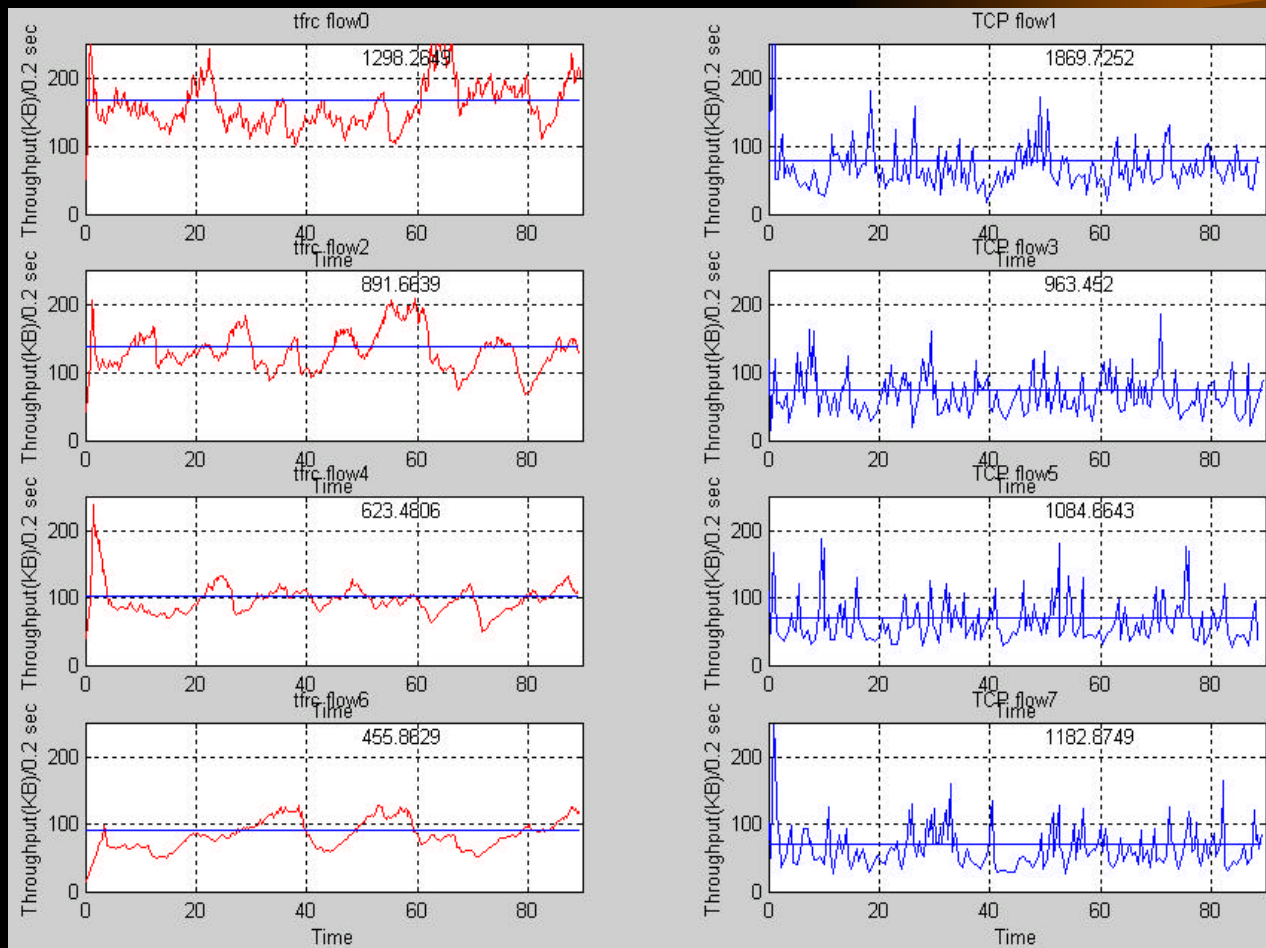
TCP(1,1/2)(3/7,1/4) Vs TCP(1,1/2)(1,1/2)



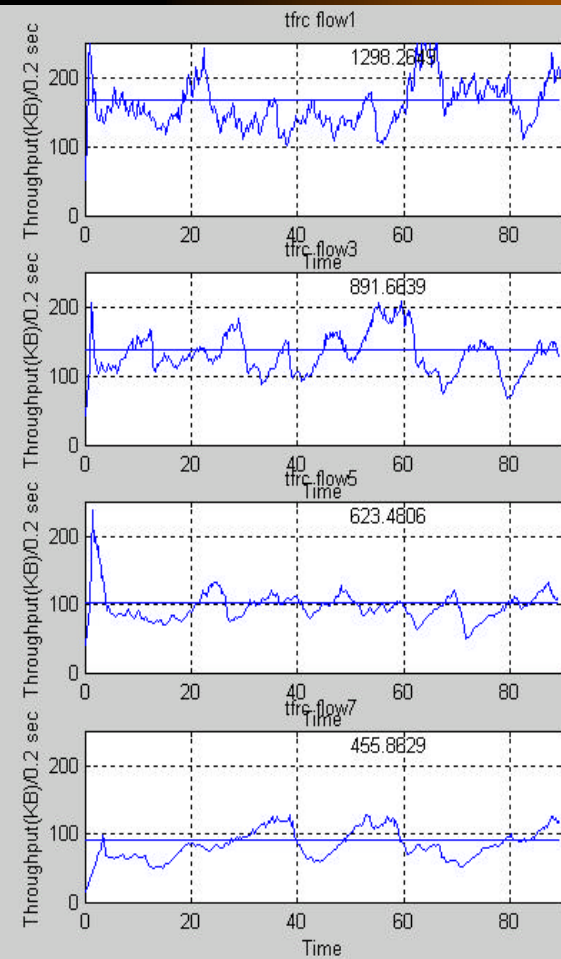
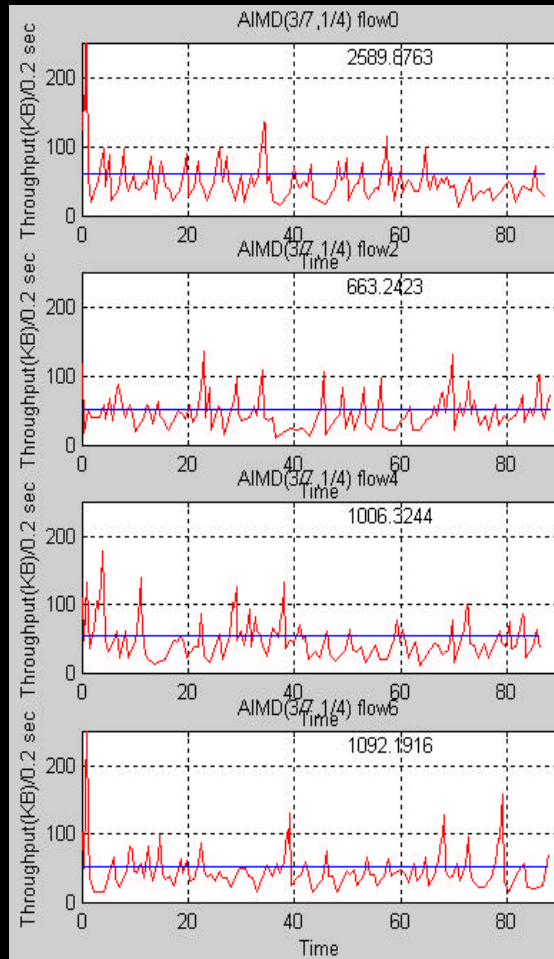
TCP(1,1/2)(1/5,1/8) Vs TFRC



TCP(1,1/2) Vs TFRC



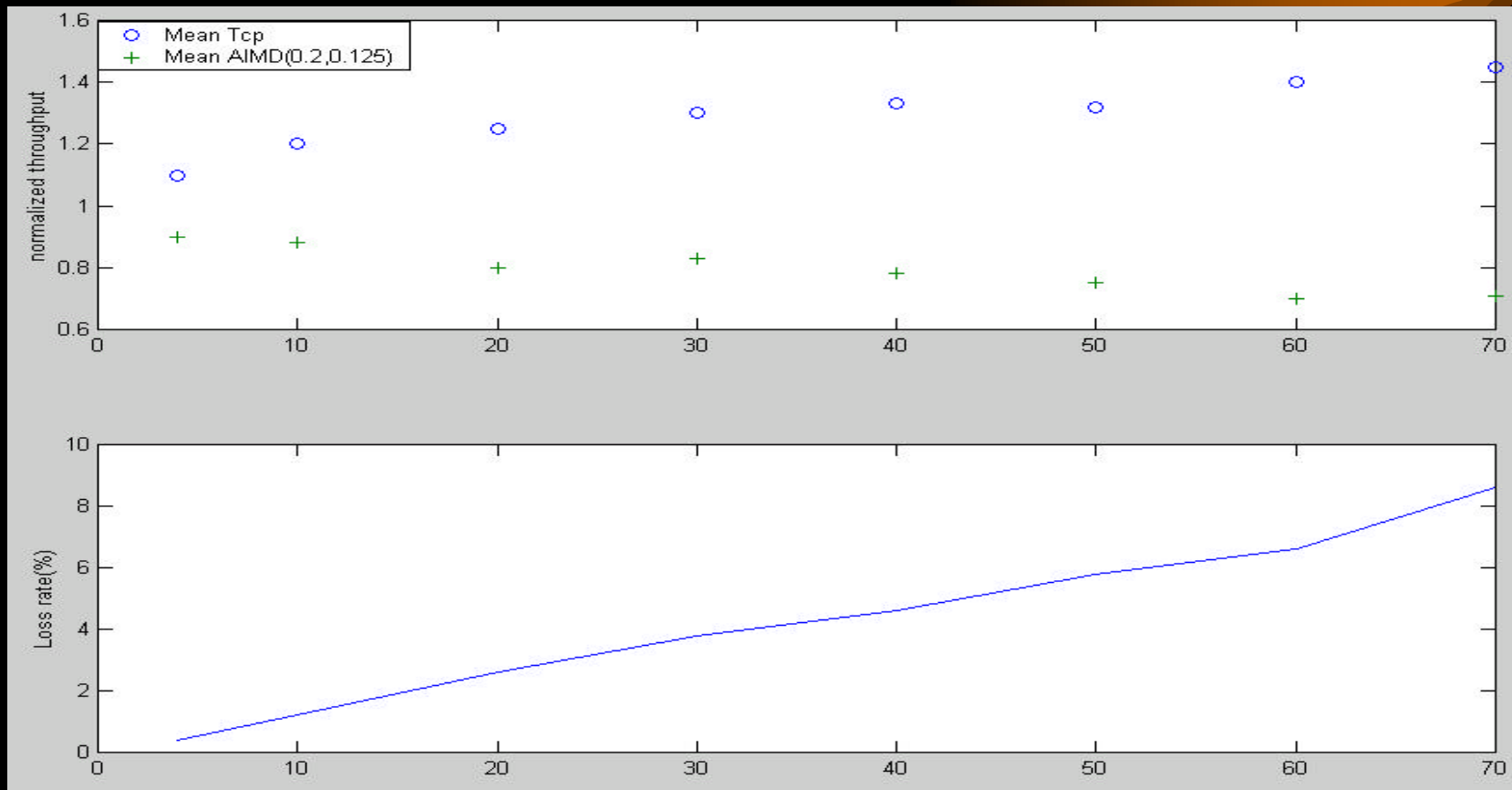
TCP(3/7,1/4) Vs TFRC



Comparison of different bottleneck bandwidth effects

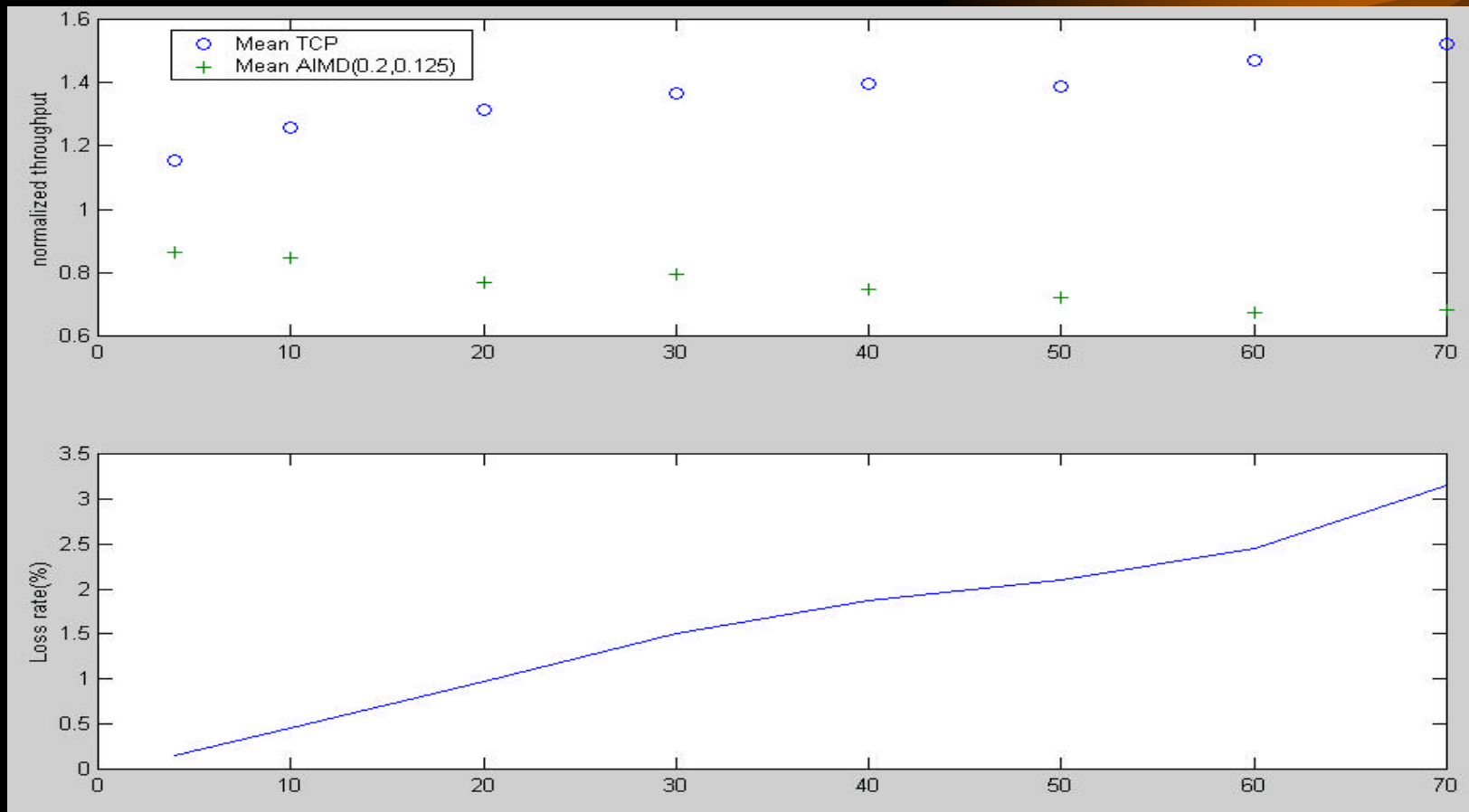
- **Bottleneck bandwidth: 15Mbps**
- **Bottleneck bandwidth: 60Mbps**

TCP(1,1/2) Vs TCP(1/5, 1/8)



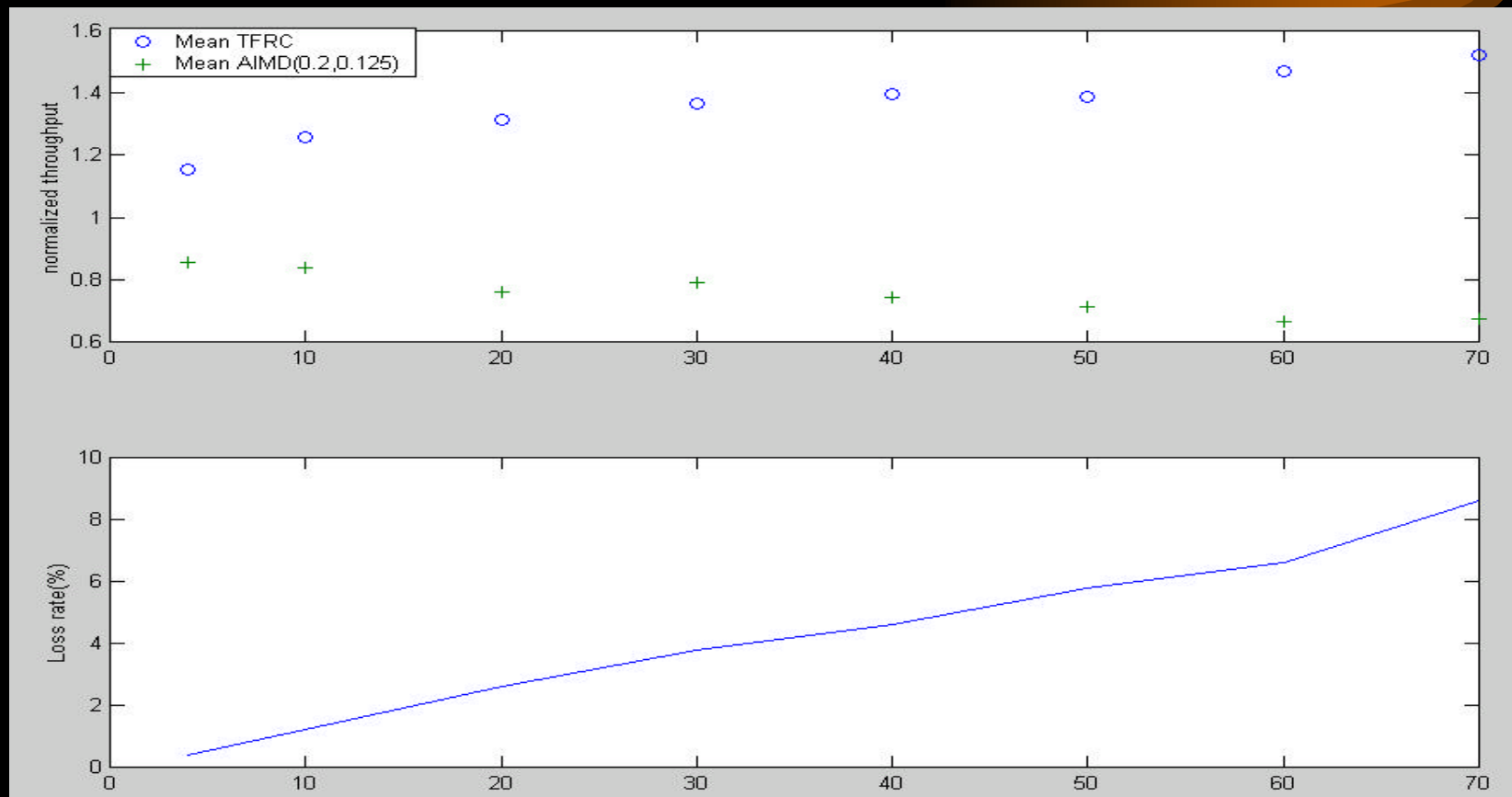
Trunk link capacity:15Mbps

TCP(1,1/2) Vs TCP(1/5, 1/8)



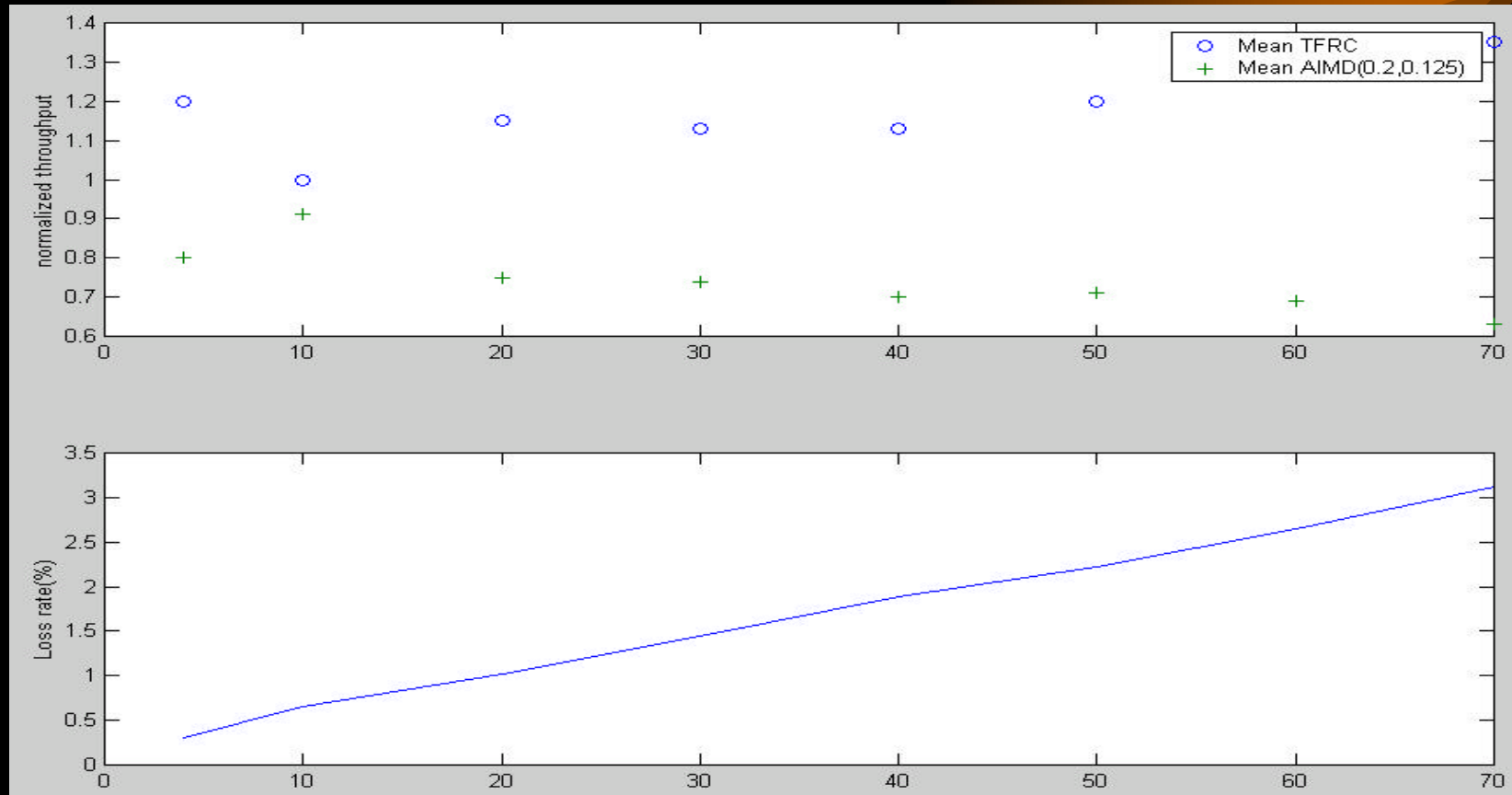
Trunk link capacity:60Mbps

TFRC Vs TCP(1/5, 1/8)



Trunk link capacity:15Mbps

TFRC Vs TCP(1/5,1/8)



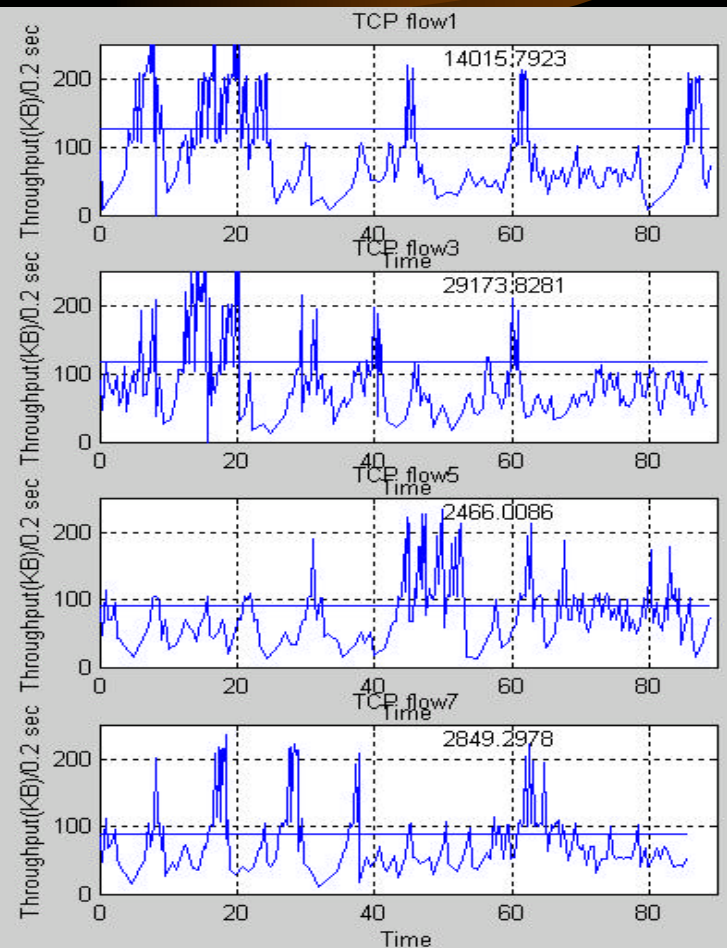
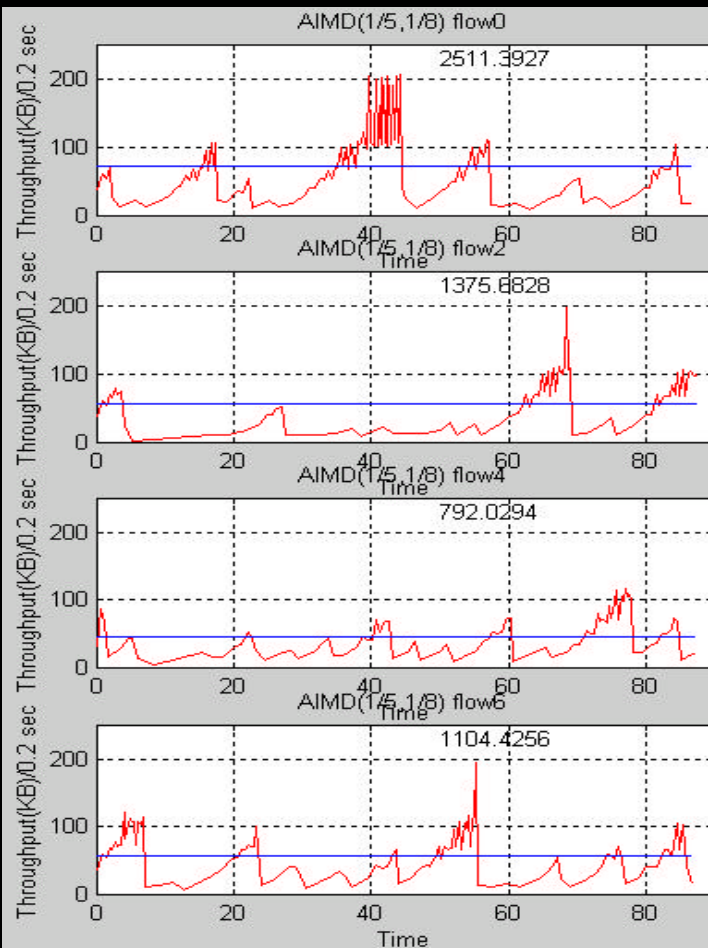
Trunk link capacity:60Mbps

Comparison of different queuing effects

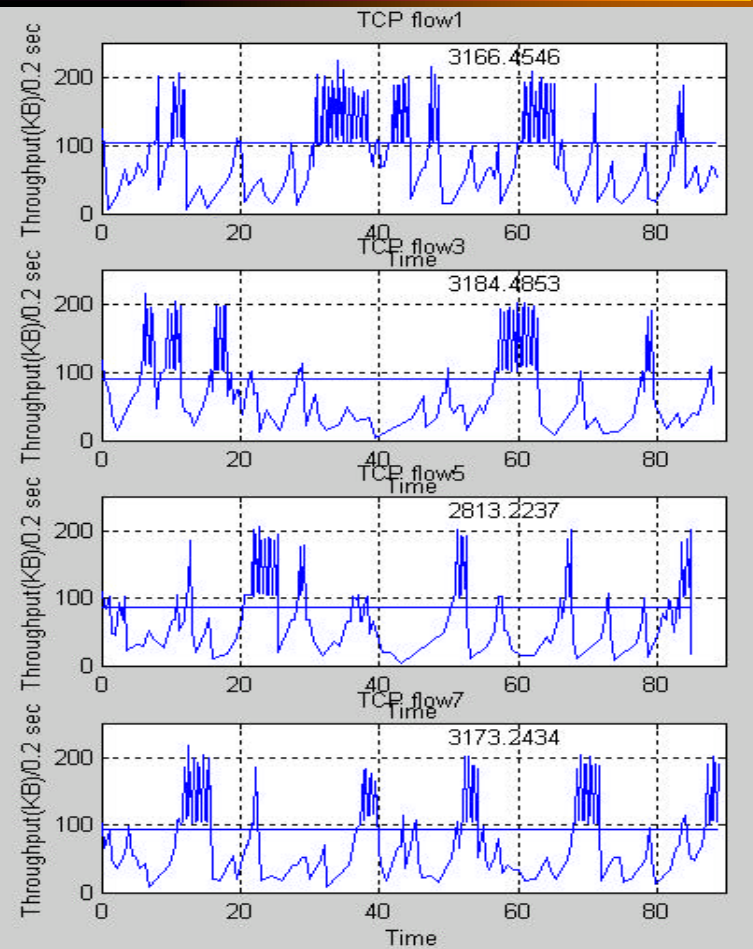
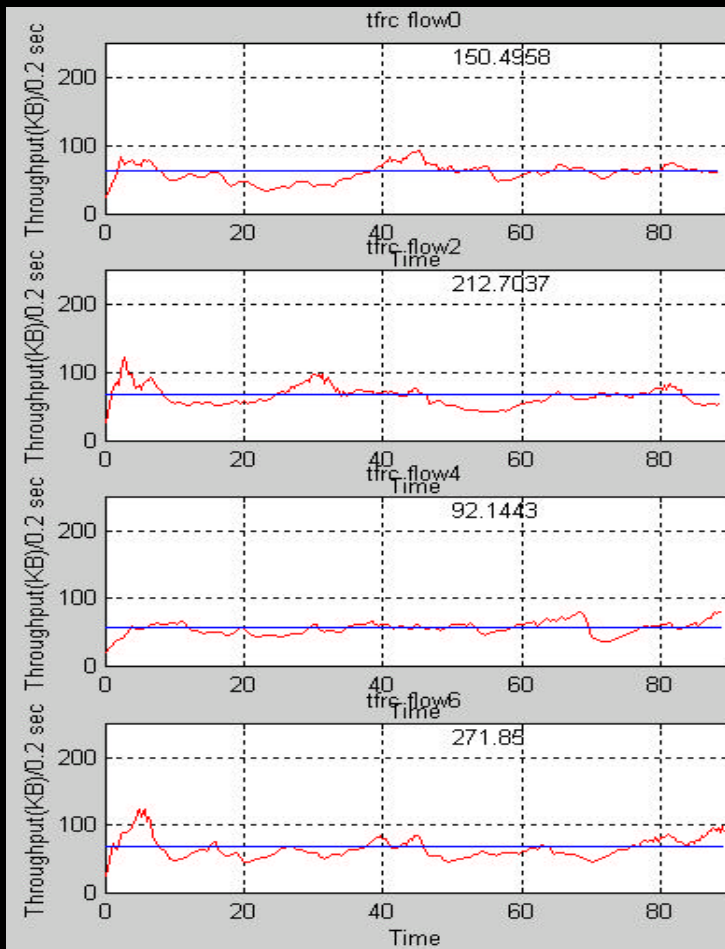


- **Drop-tail**
- **RED (Random Early Drop)**

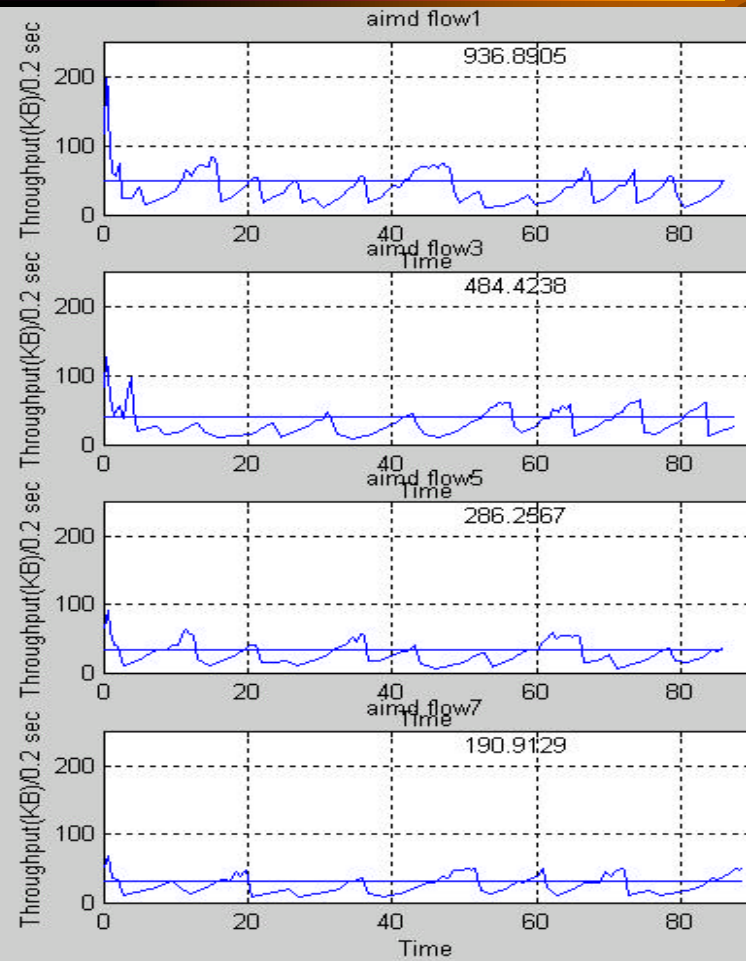
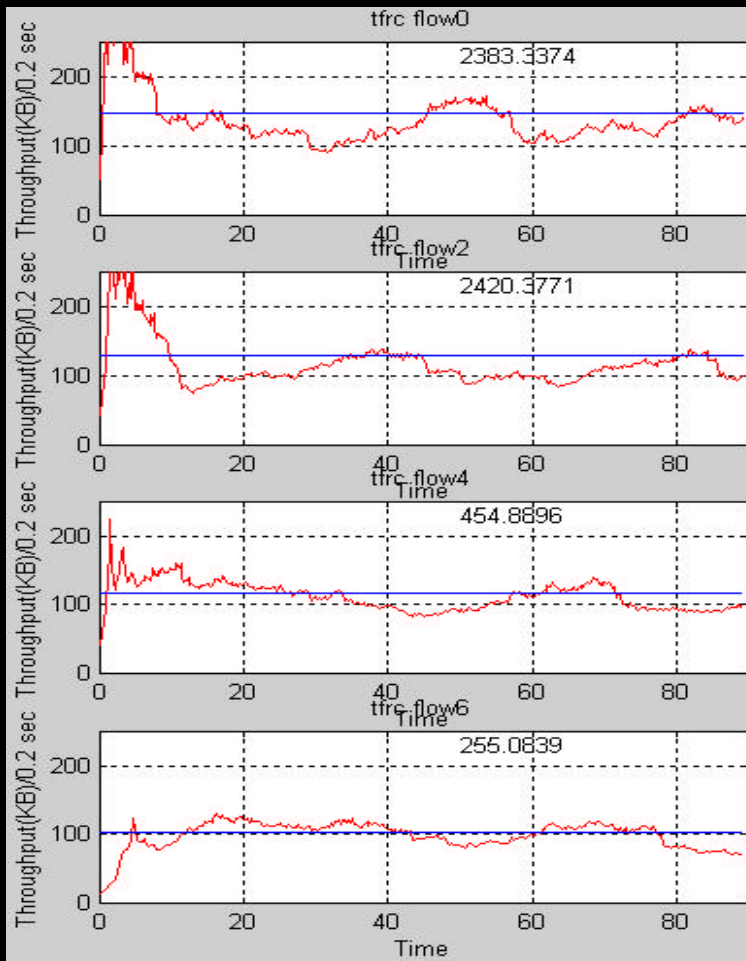
Drop-tail(TCP compares with TCP(1,1/2))



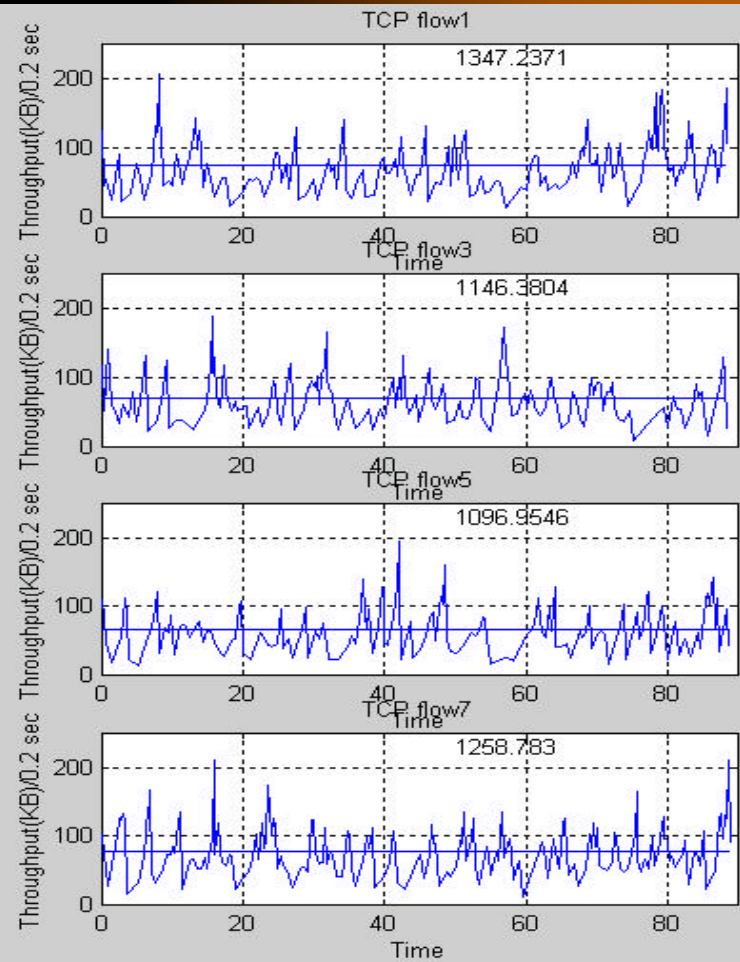
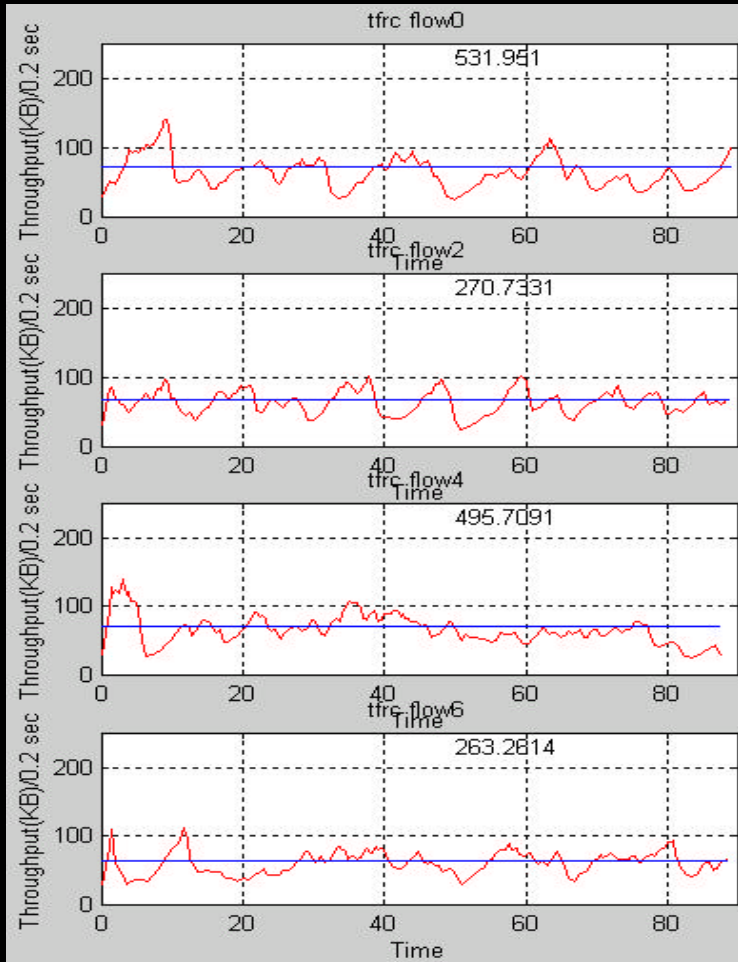
Drop-tail(TFRC compares with TCP(1,1/2))



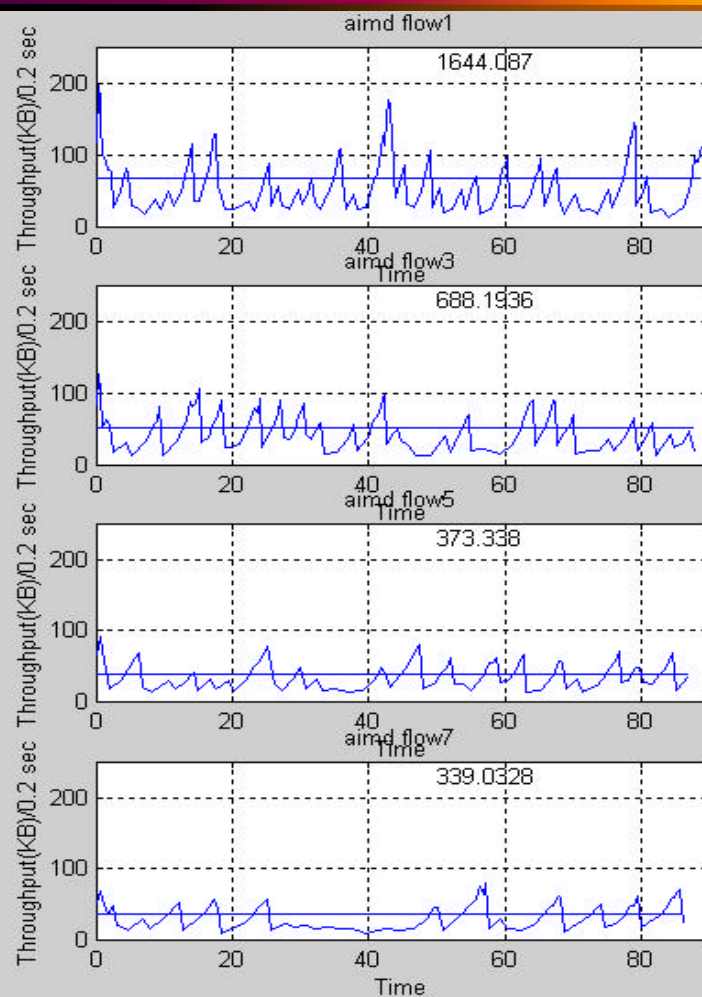
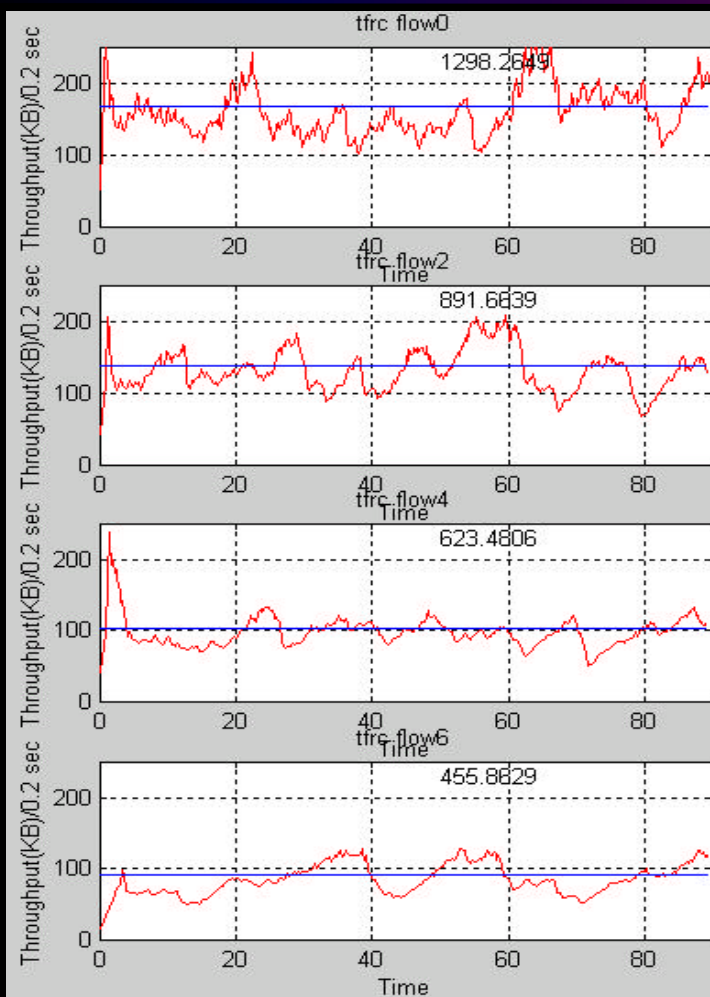
Drop-tail(TFRC Vs TCP)



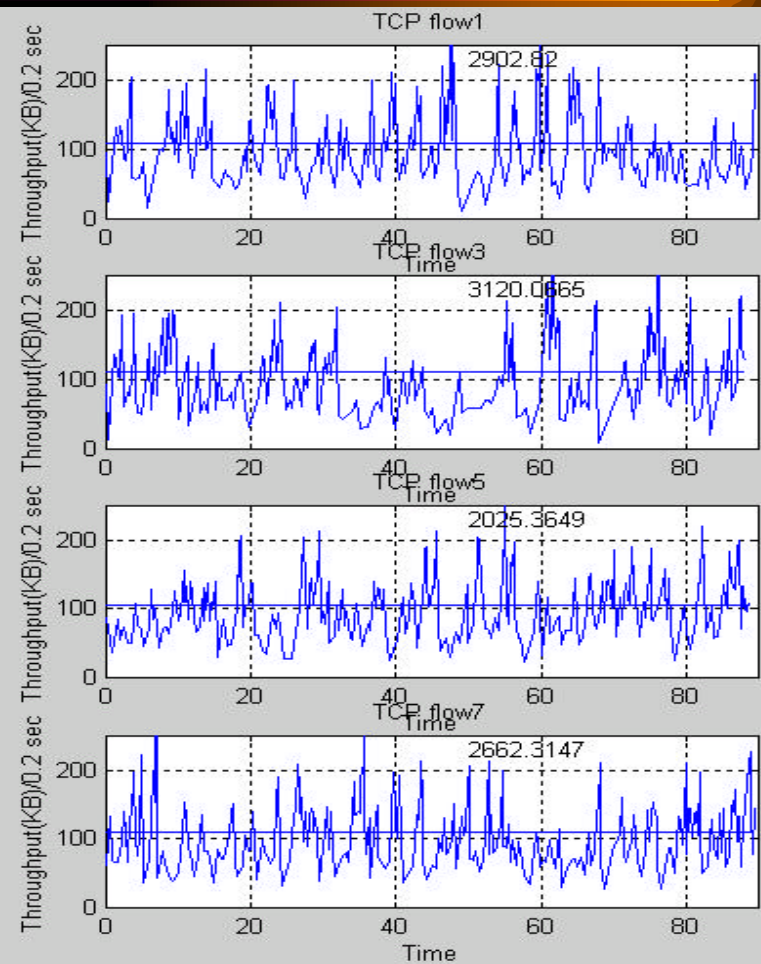
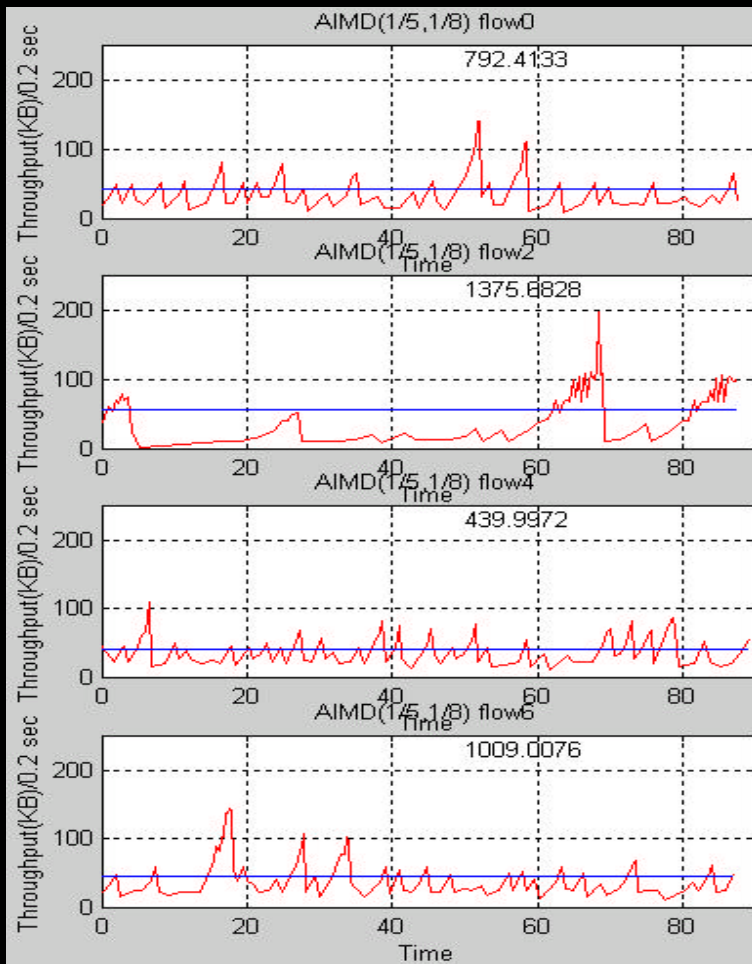
RED(TFRC Vs TCP(1,1/2))



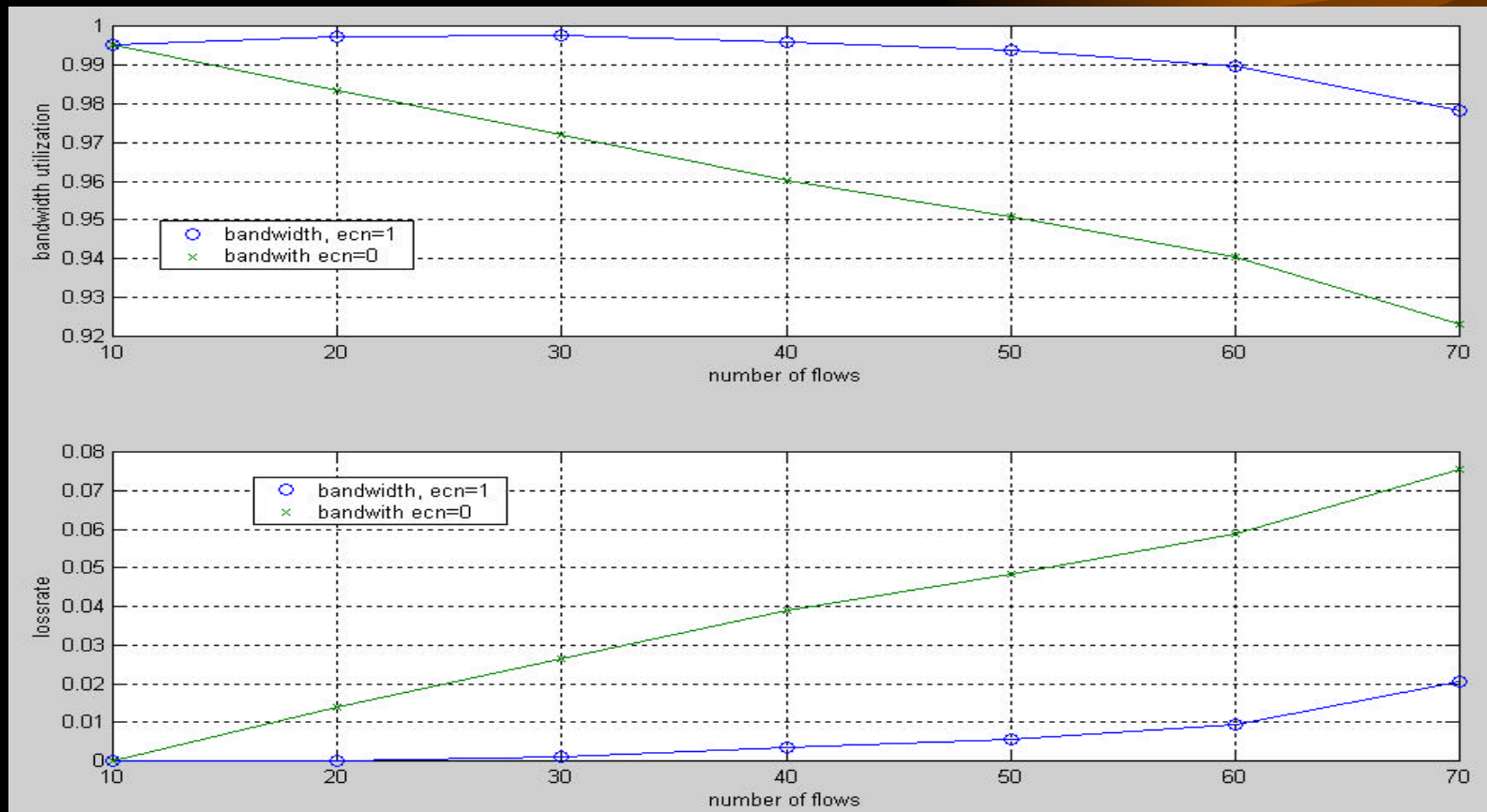
RED (TFRC Vs TCP)



RED(TCP Vs TCP(1,1/2))



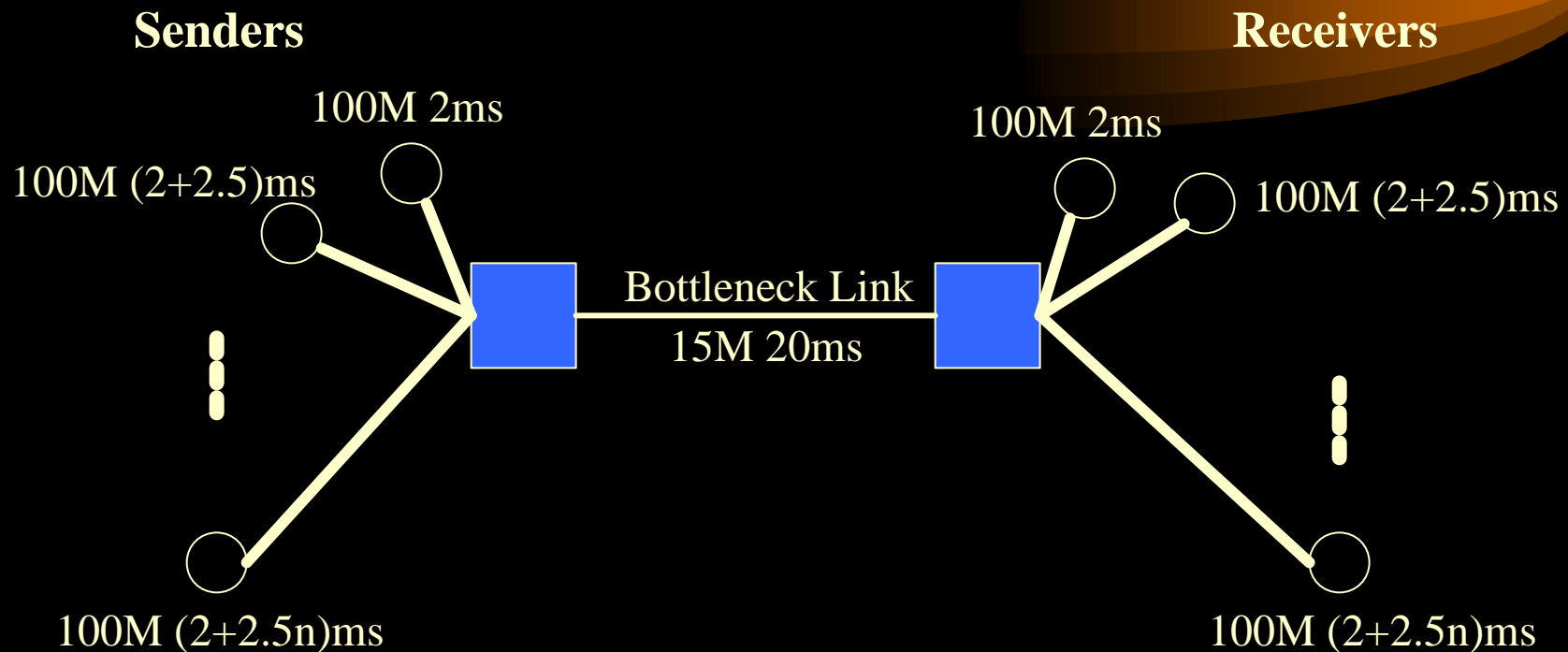
Effects of ECN in RED queuing



Comparison of transmission delay effect

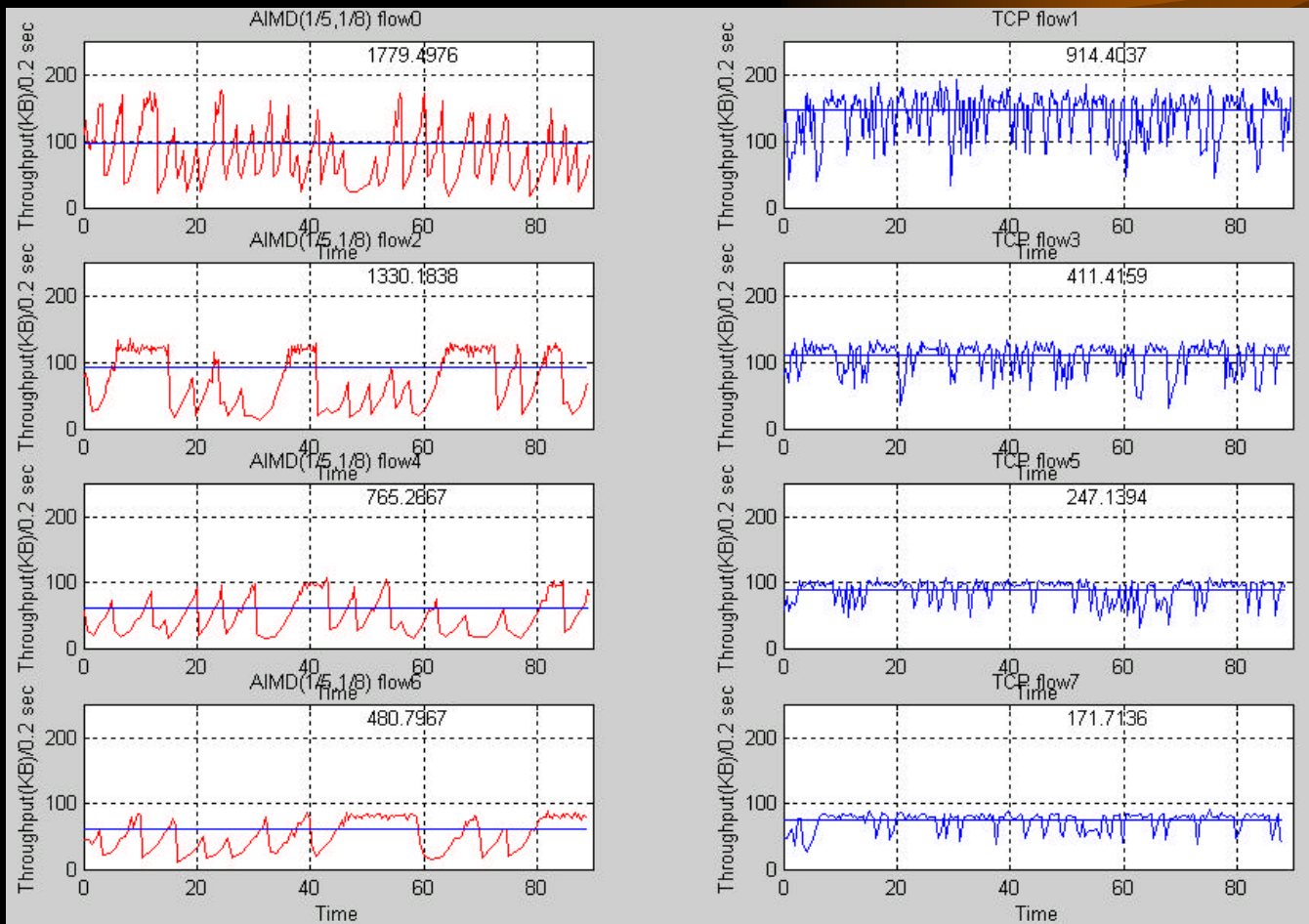
- TCP(1/5,1/8) Vs TCP(1,1/2)
- TCP(3/7,1/4) Vs TCP(1,1/2)
- TCP(1/5,1/8) Vs TFRC
- TCP(1,1/2) Vs TFRC

Simulation Scenario(2)

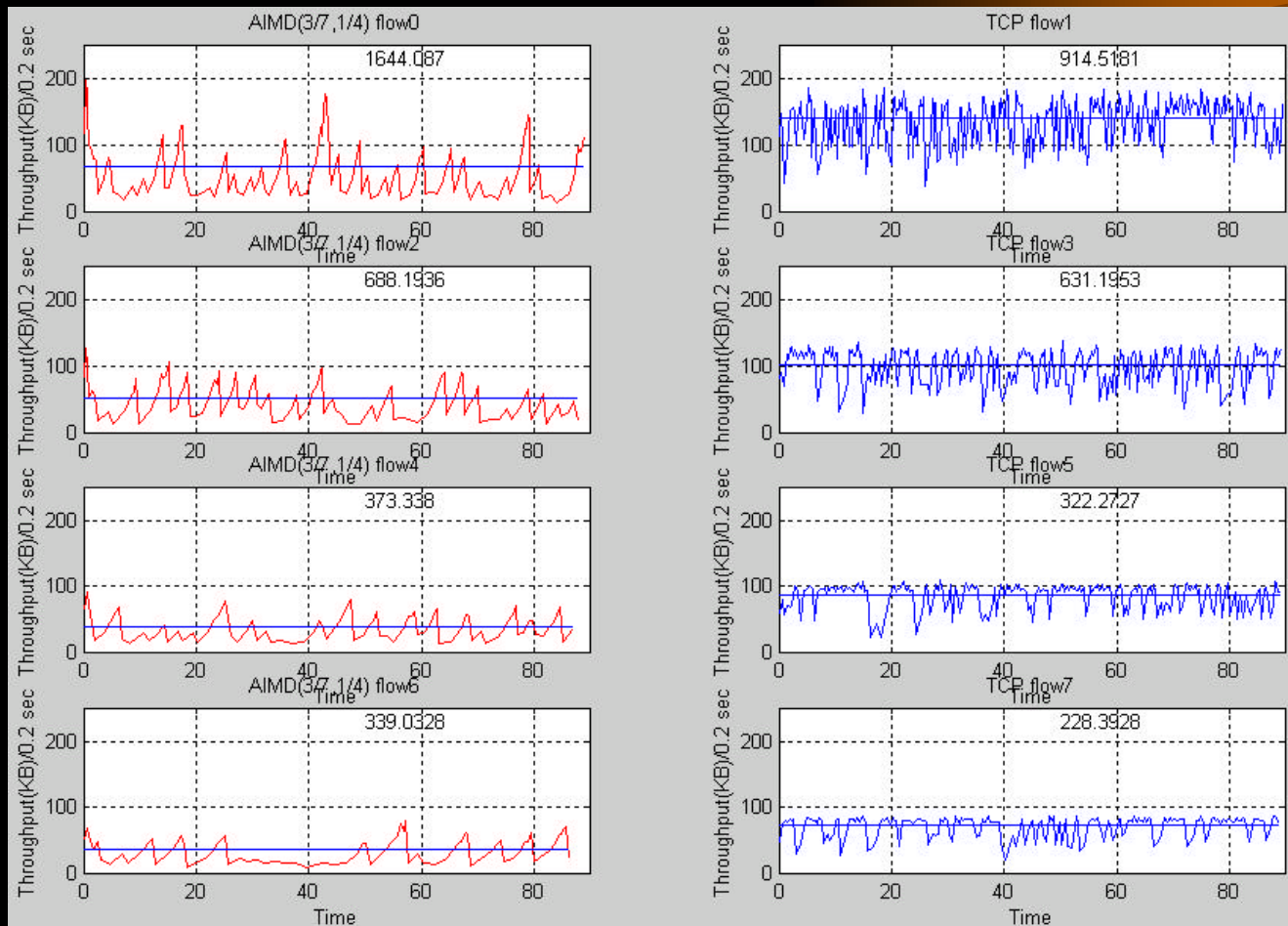


- Topology: Dumb-bell
- Metrics: *throughput, loss rate*
- n : number of flows

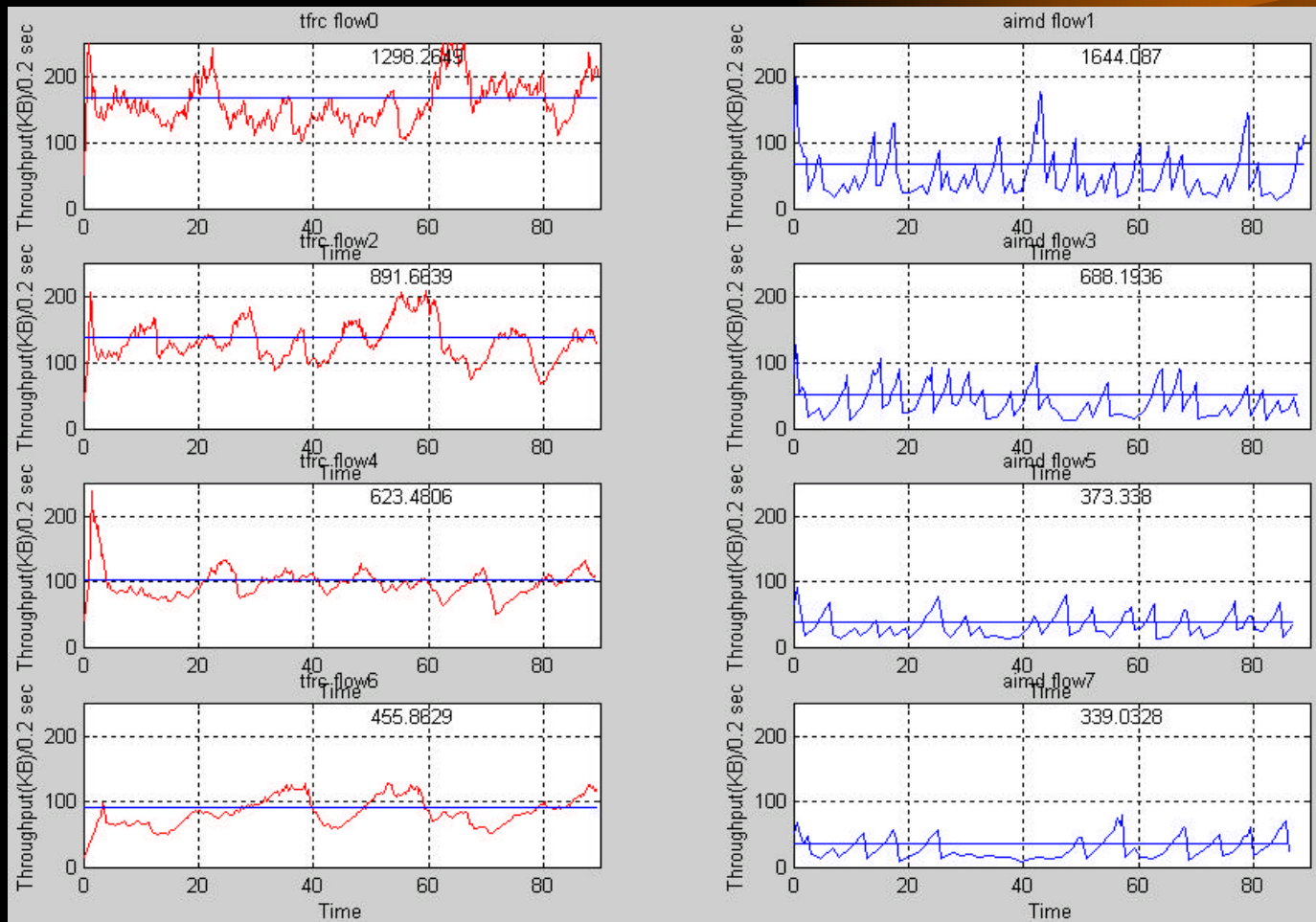
TCP(1/5,1/8) Vs TCP(1,1/2)



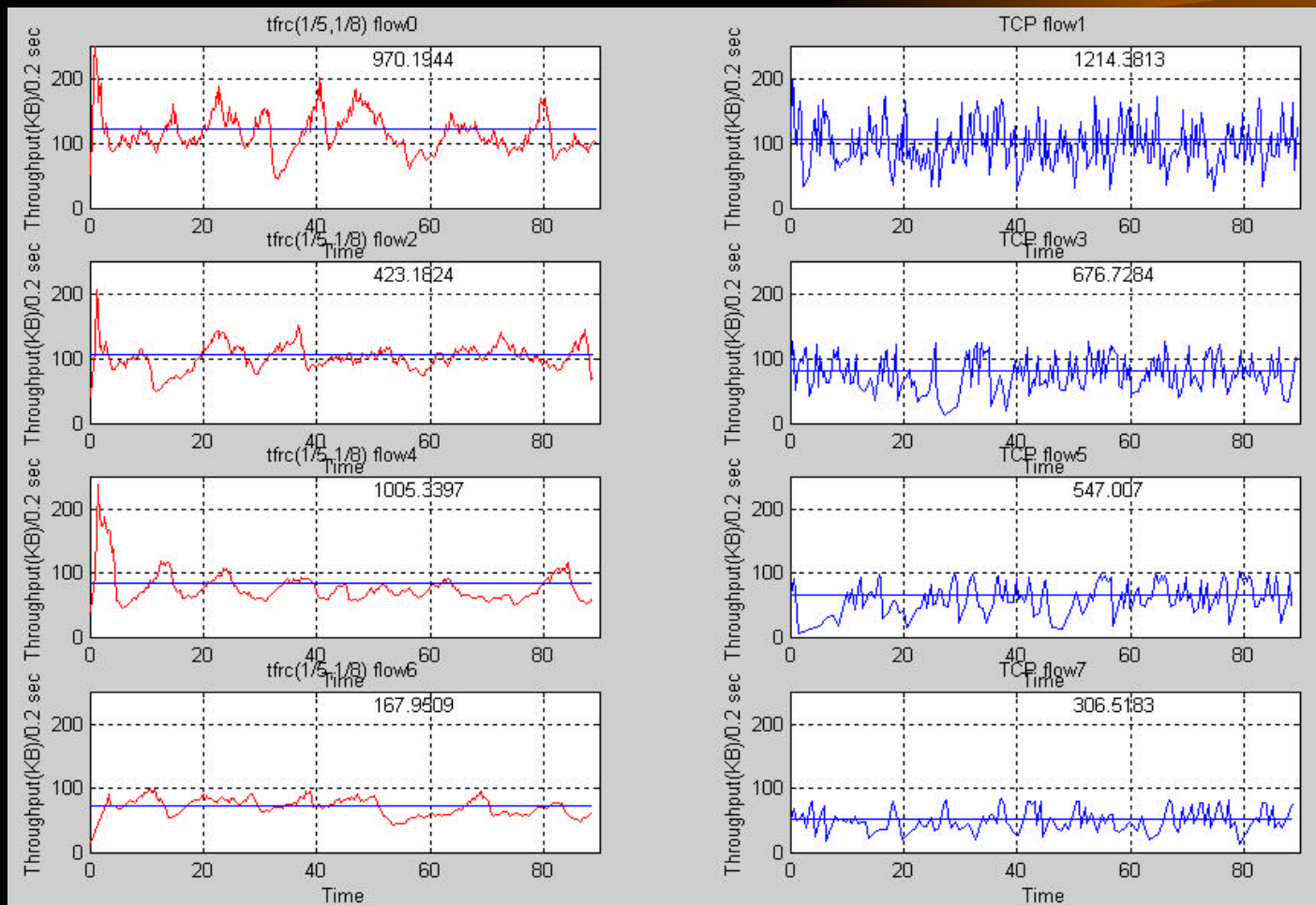
TCP(3/7,1/4) Vs TCP(1,1/2)



TCP(1/5,1/8) Vs TFRC



TCP(1,1/2) Vs TFRC



Conclusions

- **Window size affects the throughput and loss rate of flows**
- **TCP(3/7, 1/4) and TCP(1,1/2)(1/5, 1/8) flows are smoother than the TCP(1,1/2) flows, but less smooth than the TFRC flows**
- **Throughput of TCP(1,1/2)(1/5, 1/8) is smaller than TCP(1,1/2)(3/7, 1/4) but smoother than the latter**
- **Comparing TCP(1,1/2)(3/7, 1/4) and TCP(1,1/2)(1/5, 1/8) with TCP(1,1/2), throughput of TCP(1,1/2) is higher**
- **TCP(1/5, 1/8) and TCP(3/7, 1/4) compete fairly with TCP(1,1/2) and with TFRC, while avoiding TCP(1,1/2)'s reduction of the sending rate in half in response to a single packet drop**
- **Different Queuing algorithms have different effects on throughput, RED better than Droptail.**
- **Transmission Delay affects the bandwidth utilization of flows**

Main References

- **Jamal Golestani, A Class of End-to-End Congestion Control Algorithms for the Internet , Proceedings of ICNP, 1998.**
- **S. Kunniyur and R. Srikant, "End-To-End Congestion Control: Utility Functions, Random Losses and ECN Marks", Longer version of the paper that appeared in Proceedings, INFOCOM 2000, Tel-Aviv, Israel, March 2000. Also submitted to IEEE Transactions on Networking**
- **S. Kunniyur and R. Srikant, "Fairness of Congestion Avoidance Schemes in Heterogeneous Networks", Proceedings, International Teletraffic Congress-16, Edinburgh, Scotland, 1999**
- **Yair Bartal, J. Byers and D. Raz, Global Optimization using Local Information with Applications to Flow Control, STOC, October 1997.**
- **TCP(1,1/2) Friendly Rate Control (TFRC): Protocol Specification, Handley, M., Padhye, J., Floyd, S., and Widmer, J. Internet draft draft-ietf-tsvwg-tfrc-02.txt, work in progress, May 2001.**
- **R. Rejaie, M. Handley, and D. Estrin. "An End-to-end Rate-based Congestion Control Mechanism for Real-time Streams in the Internet". In *Proceedings of INFOCOMM 99*, 1999.**