ATCP : TCP for Mobile Ad Hoc Networks

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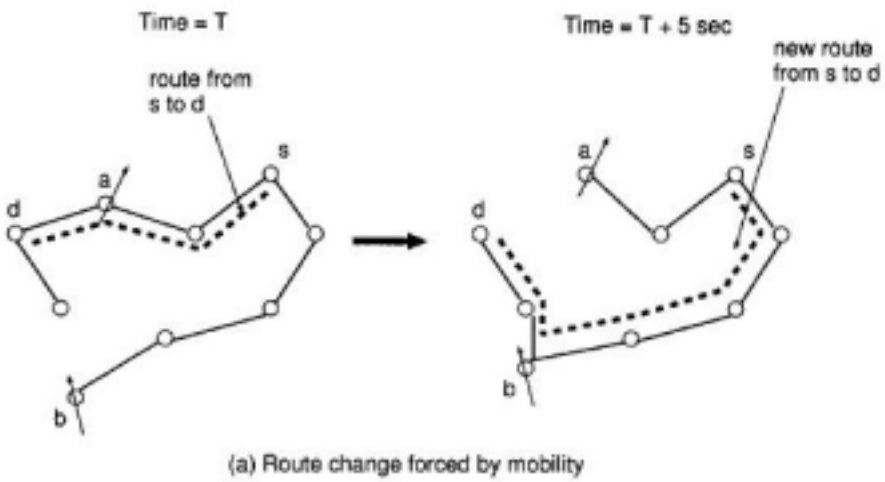
Outline

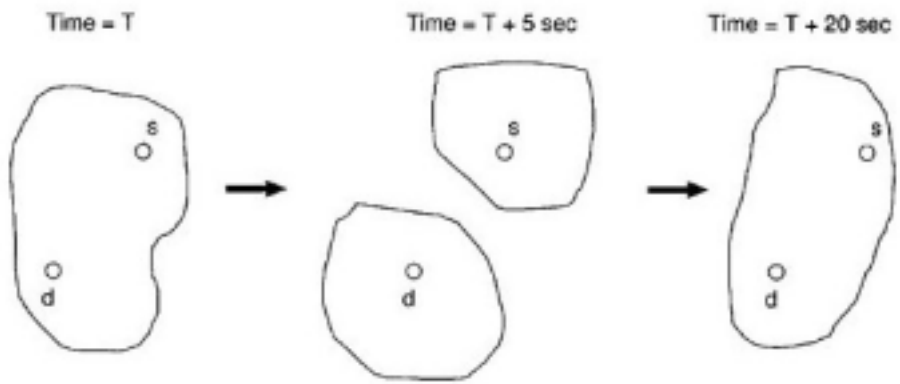
- Introduction
- Design of ATCP
- Implementation of ATCP
- Simulation results and analyses
- Conclusion

Introduction

- TCP over Ad Hoc Networks
  - High bit error rate
  - Frequent route change
  - partition



(a) Route change forced by mobility



(b) Partitions are formed and recombined by mobility

Introduction (cont.)

- Implementing a thin layer between IP and TCP.
  - ATCP (Ad hoc TCP)
  - Standard TCP/IP is unmodified
  - ATCP is invisible to TCP

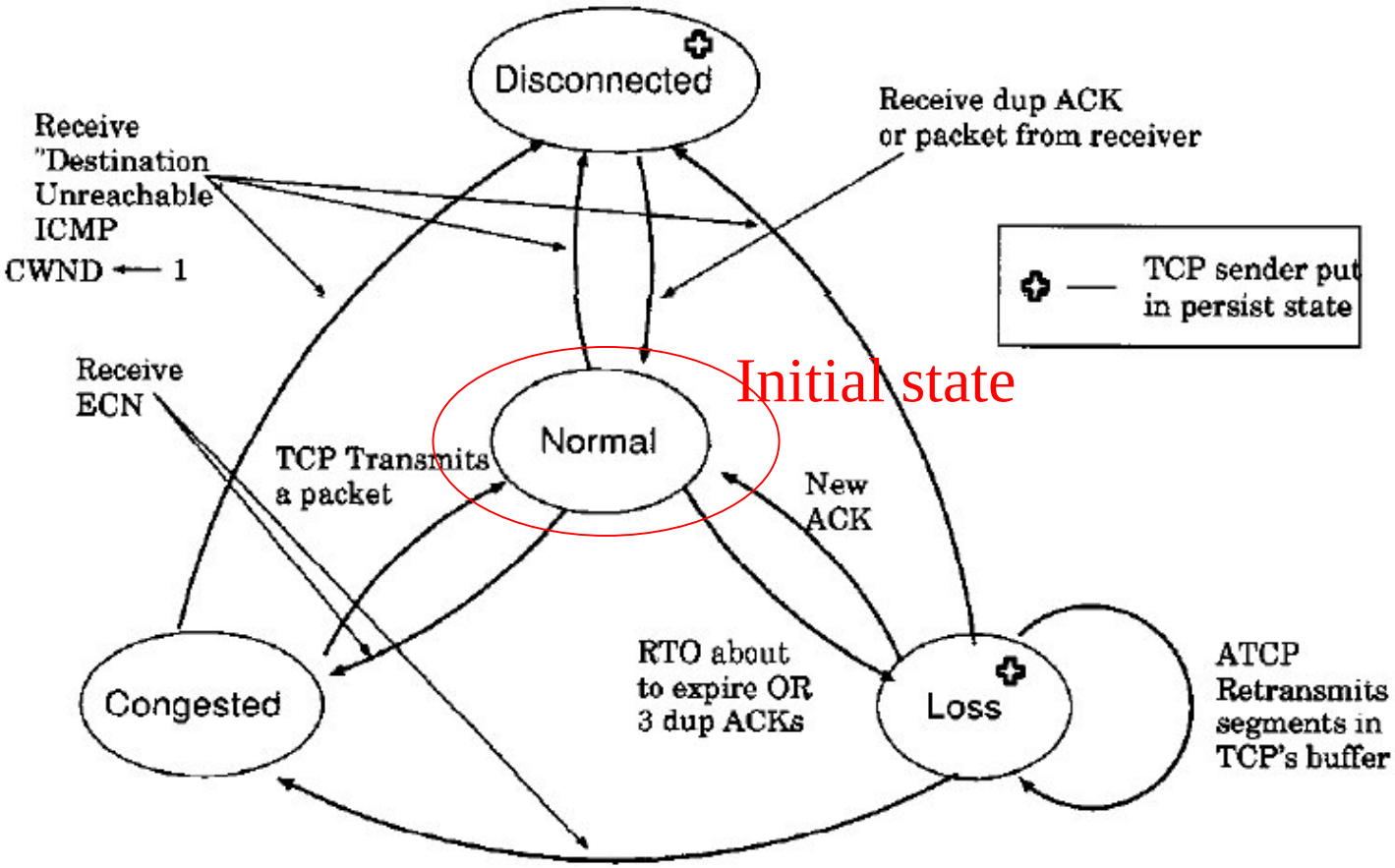
Design goals

- Improve TCP performance for connections setup in ad hoc networks.
- Maintain TCP's congestion control behavior.
- Appropriate congestion window behavior.
- Maintain end-to-end TCP semantics.
- Be compatible with standard TCP.

Design of ATCP

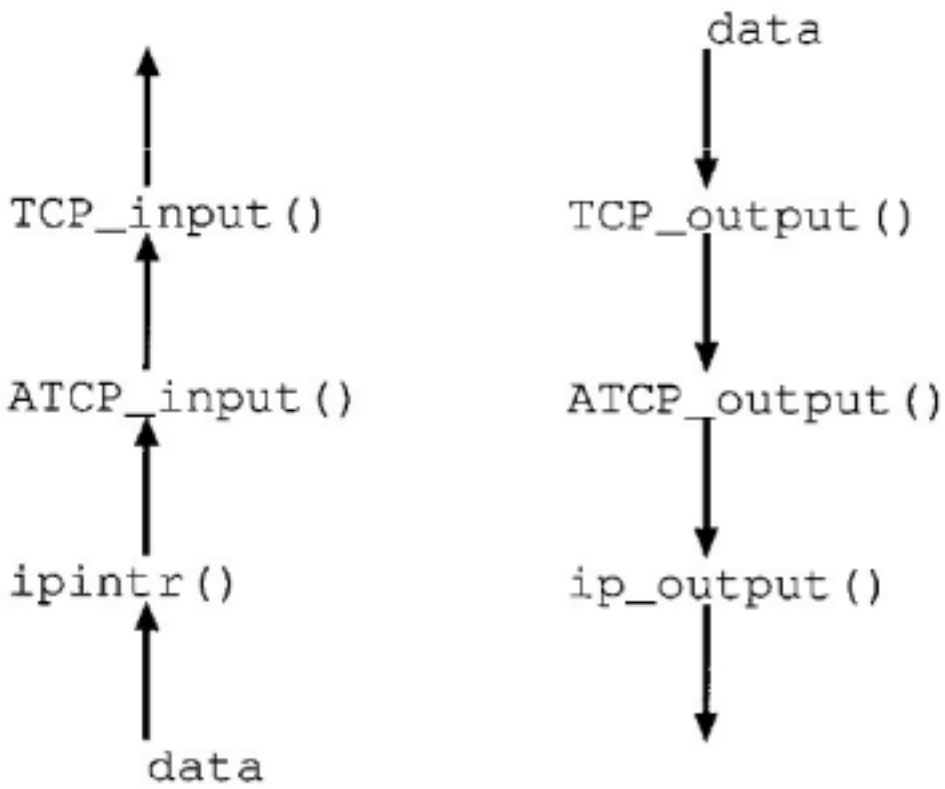
- This paper utilizes network layer feedback to put the TCP sender into either a persist state, congestion control state, or retransmit state.

State transition diagram for ATCP at the sender

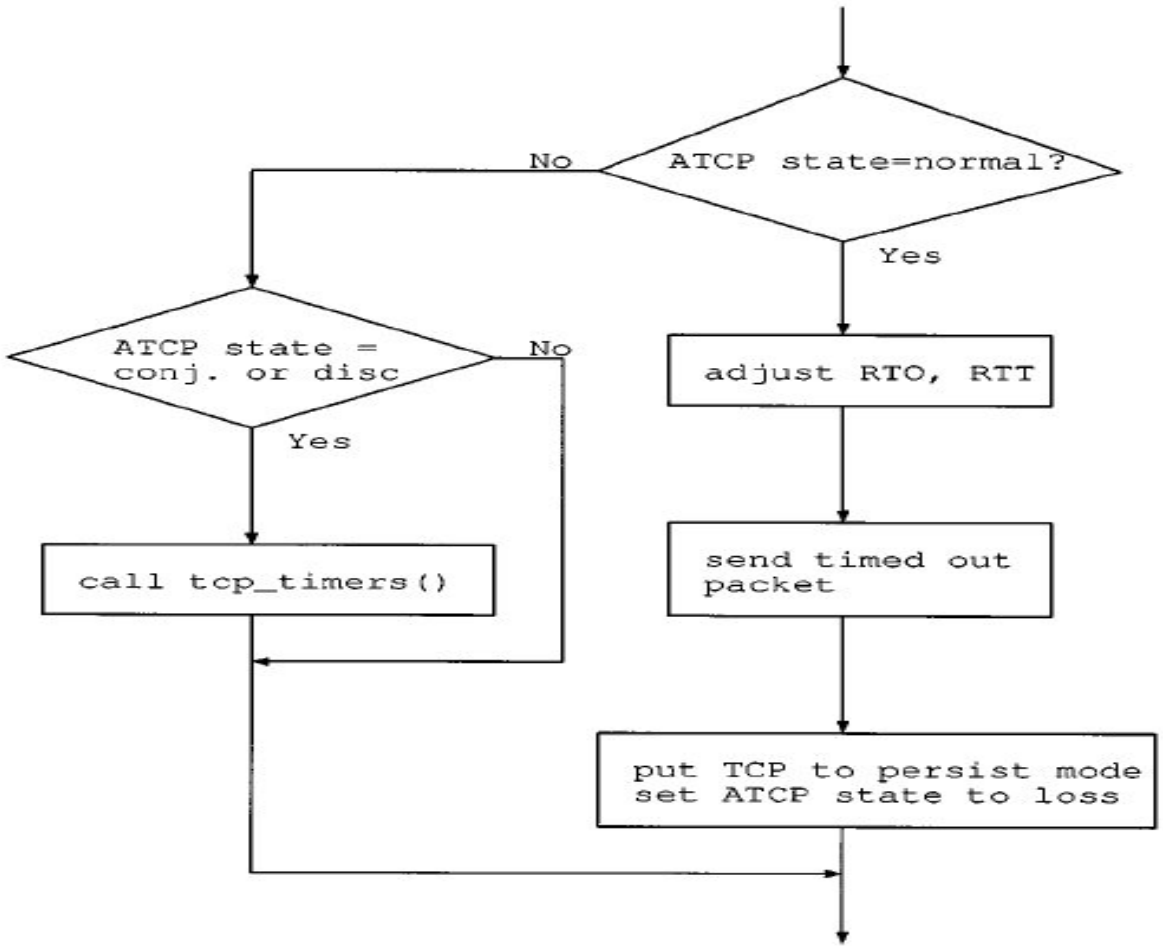


Implementation of ATCP

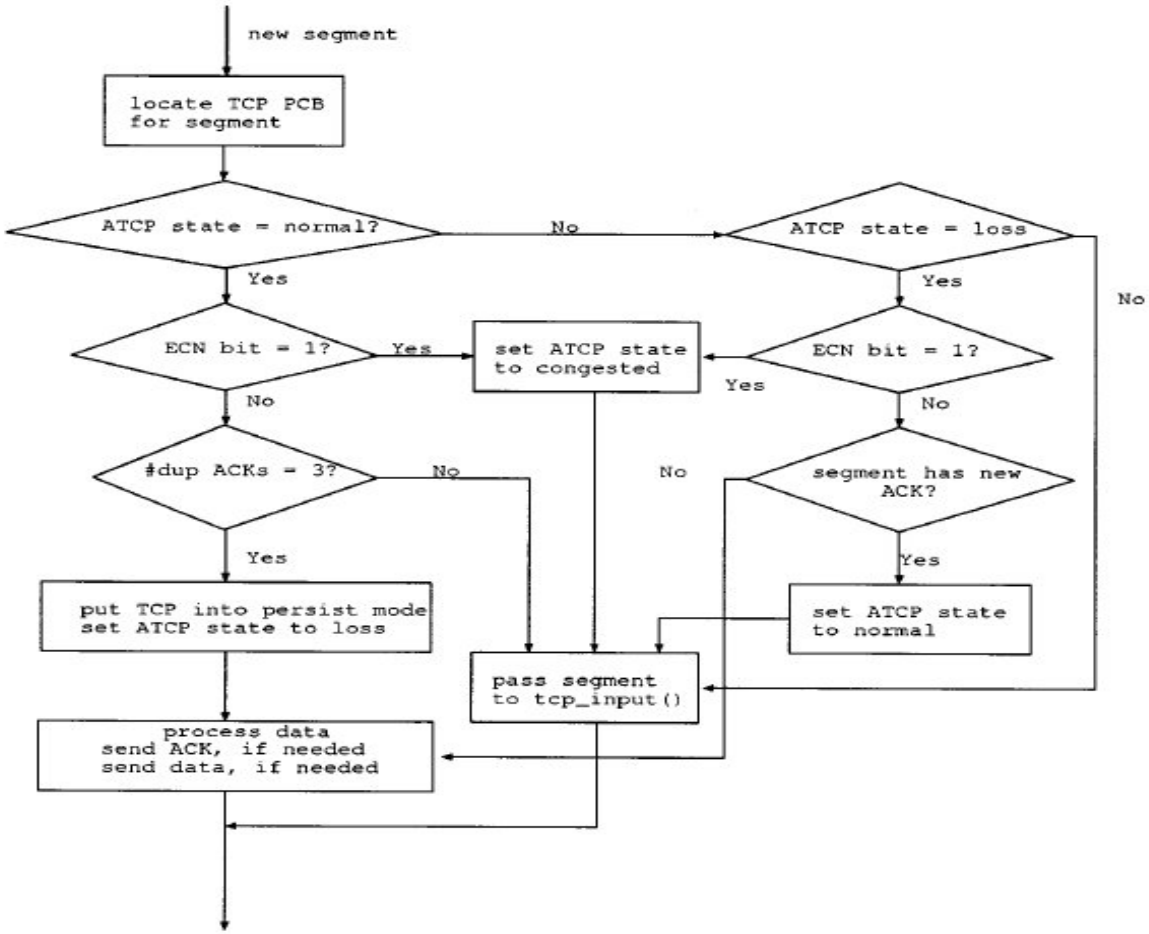
Data flow through the TCP/ATCP/IP stack



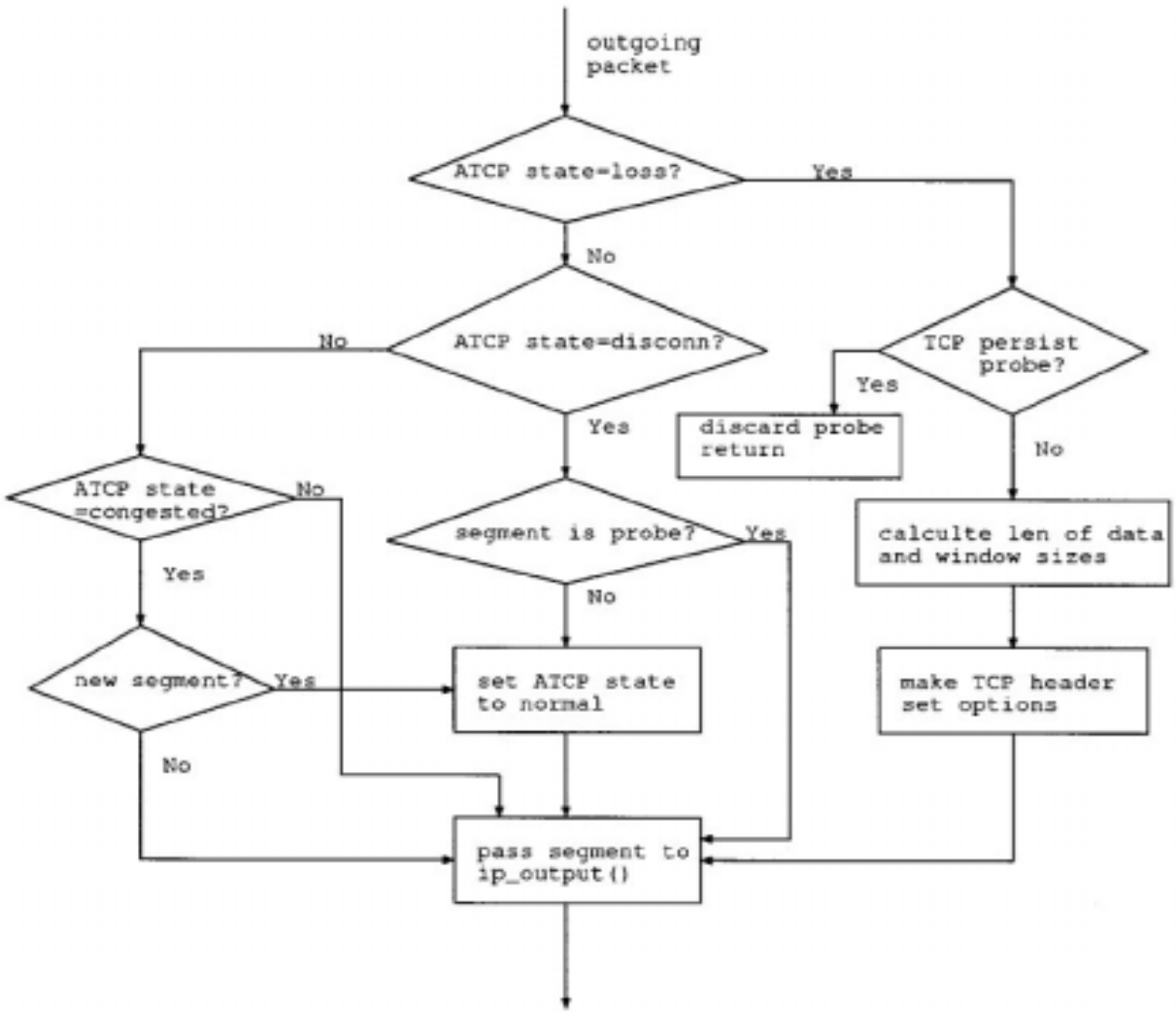
Flowchart for function atcp_timer()



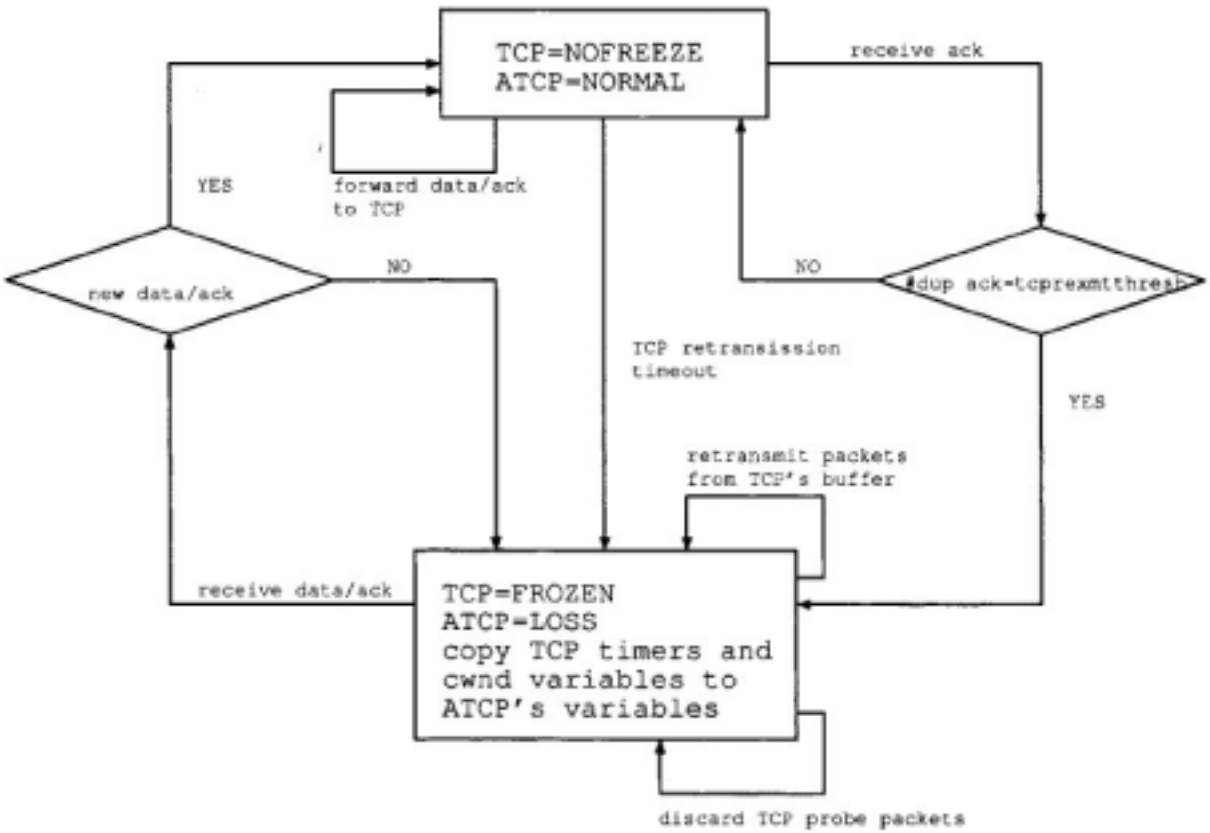
Flowchart for function atcp_input()



Flowchart for function atcp_output()

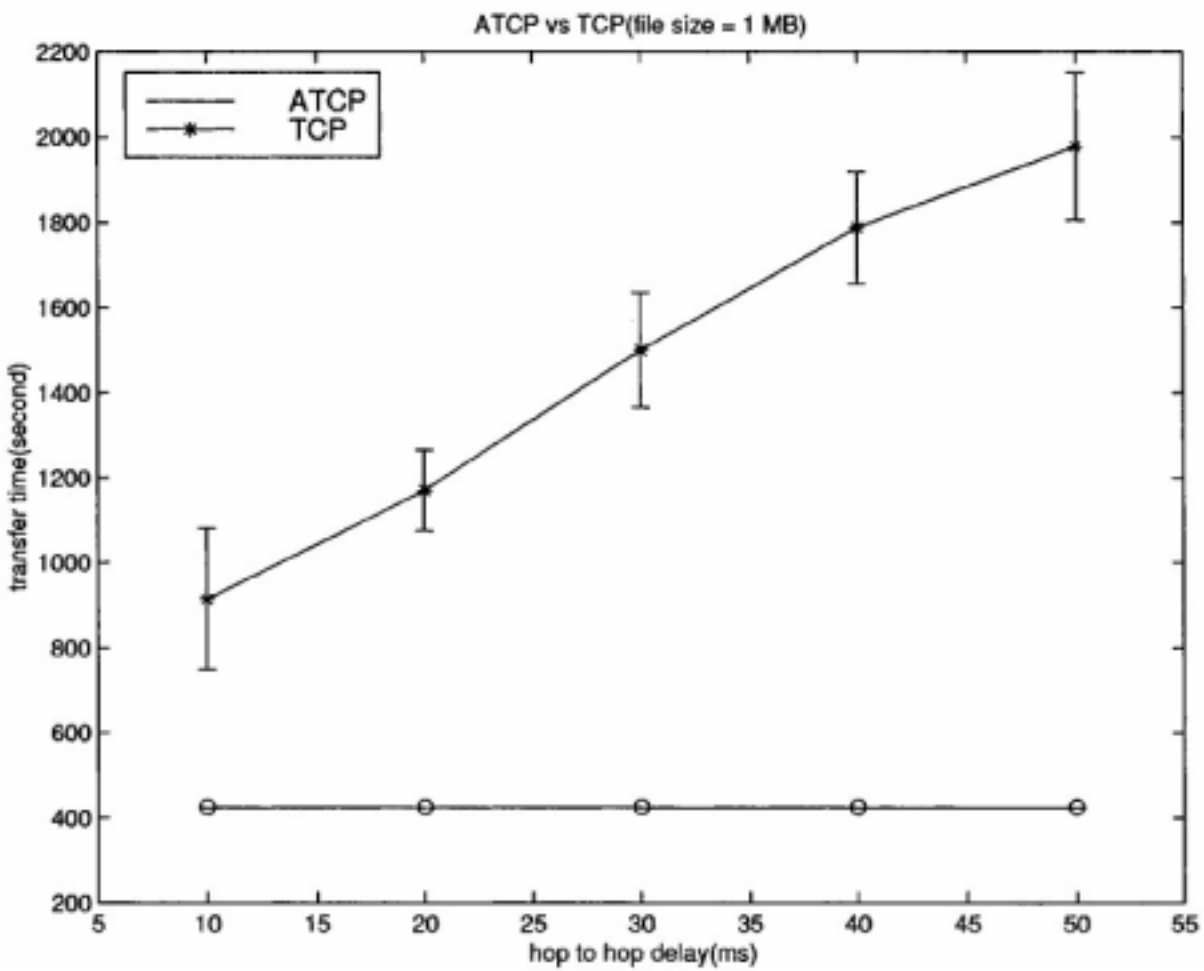


Flowchart for ATCP transition between normal and loss states

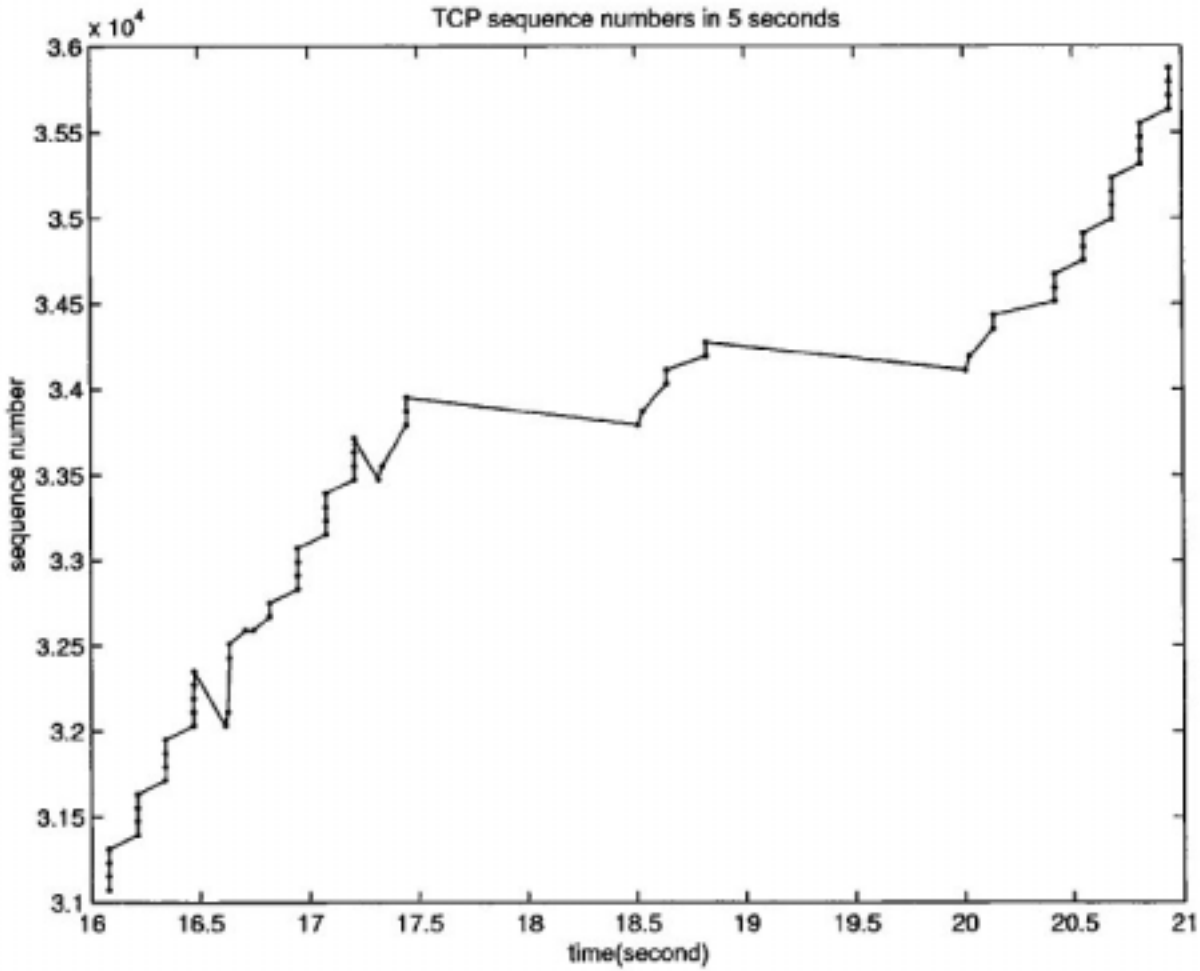


Simulation results and analyses

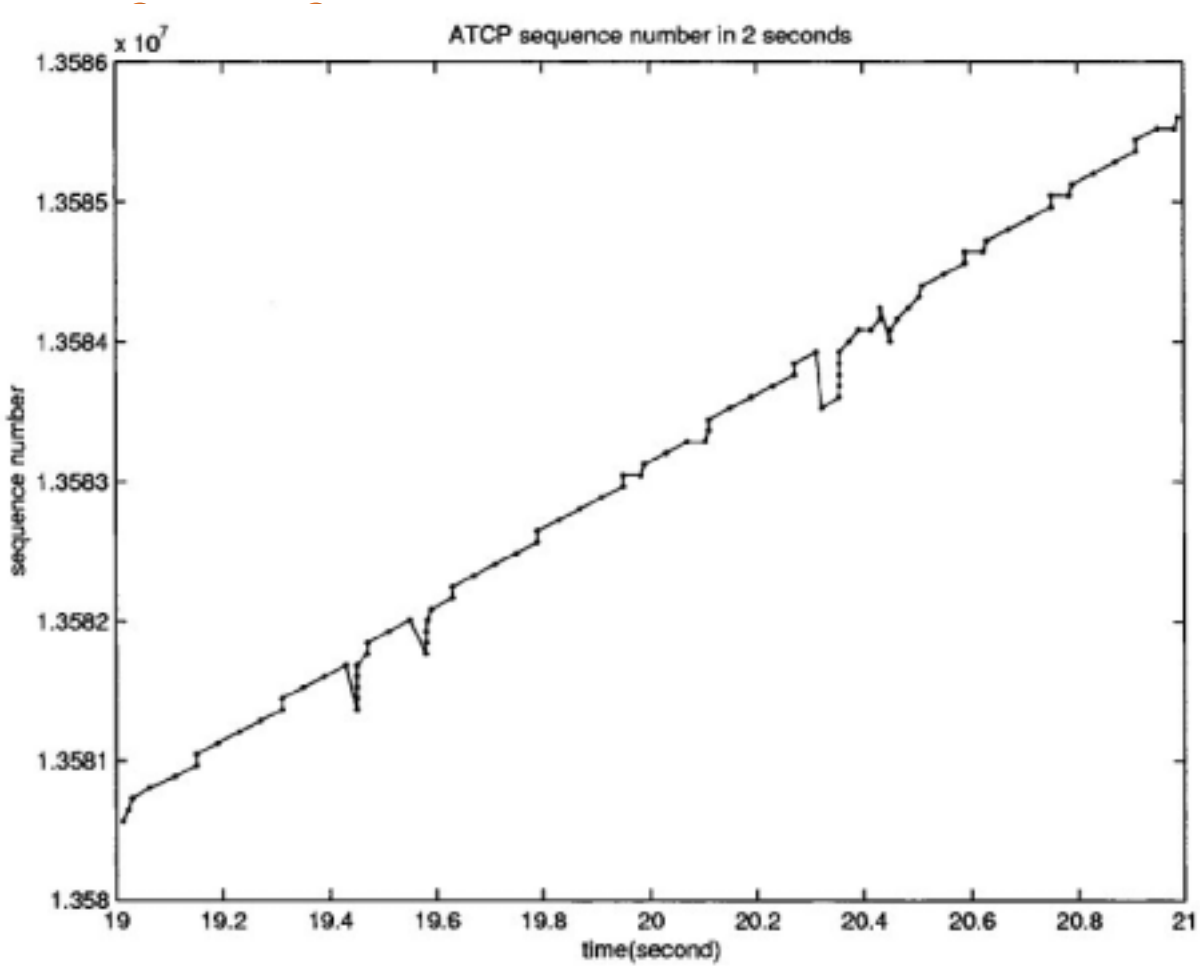
ATCP and TCP performance in the presence of bit error only



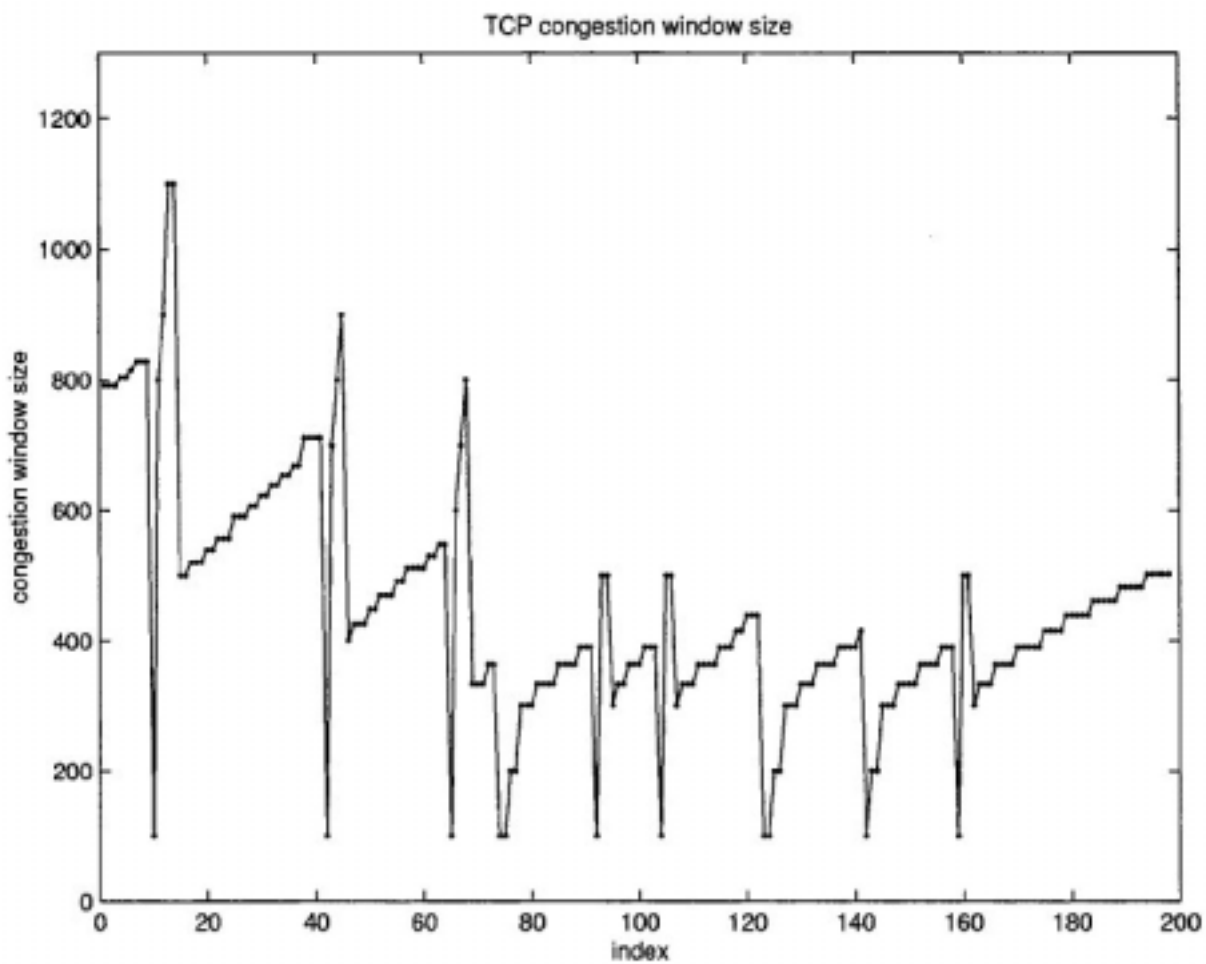
TCP trace in the presence of bit error only



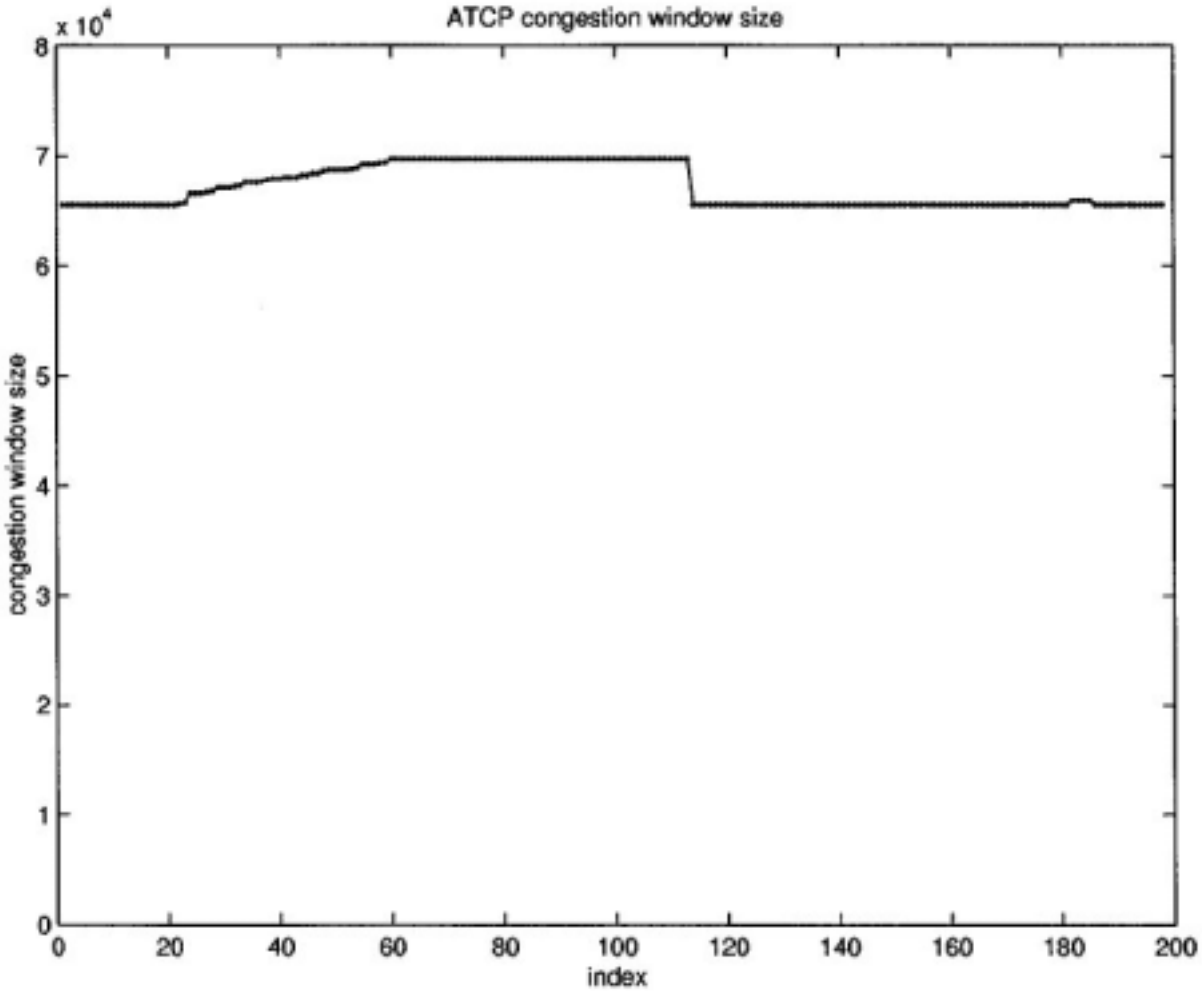
ATCP trace in the presence of bit error only



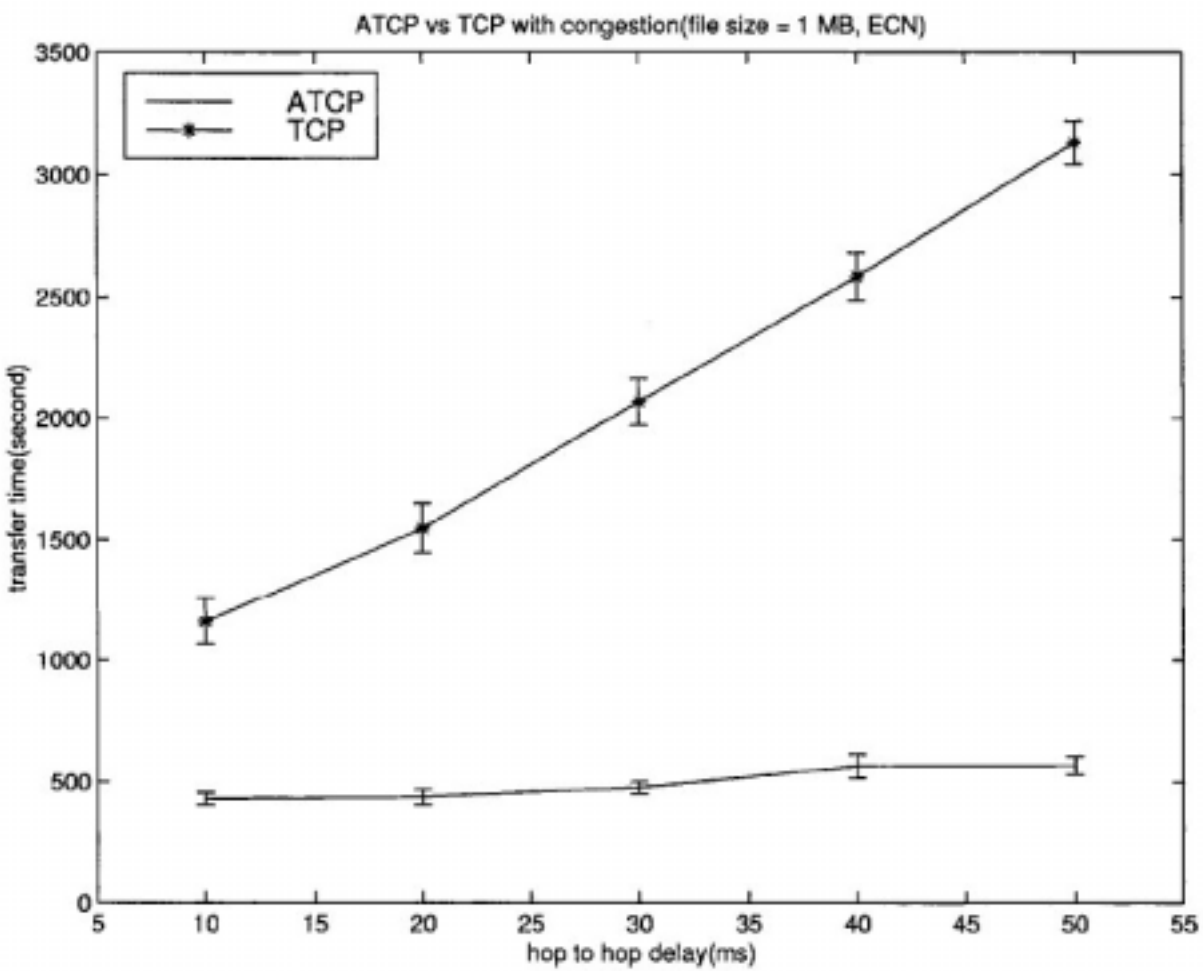
TCP congestion windows in the presence of bit error only



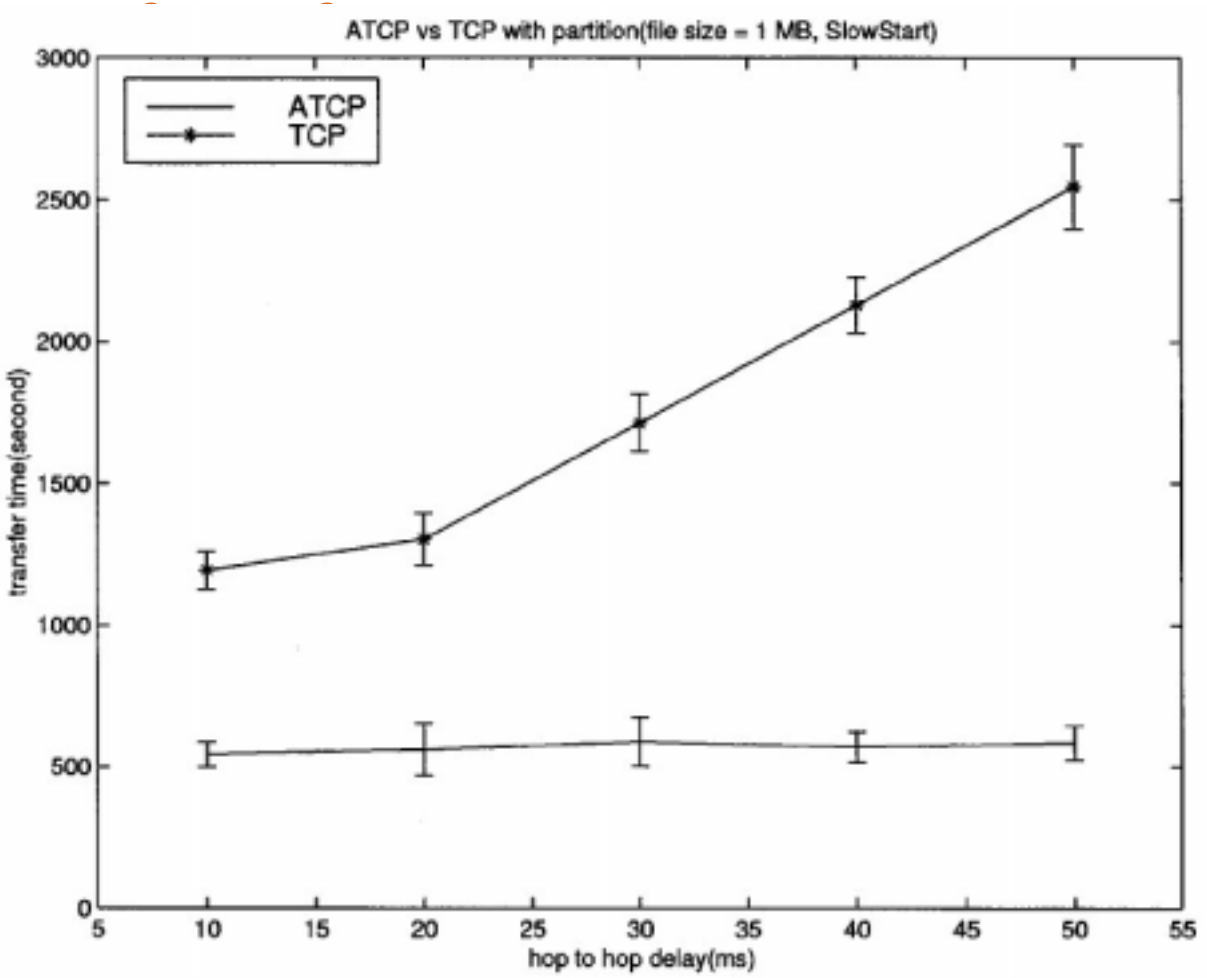
ATCP congestion windows in the presence of bit error only



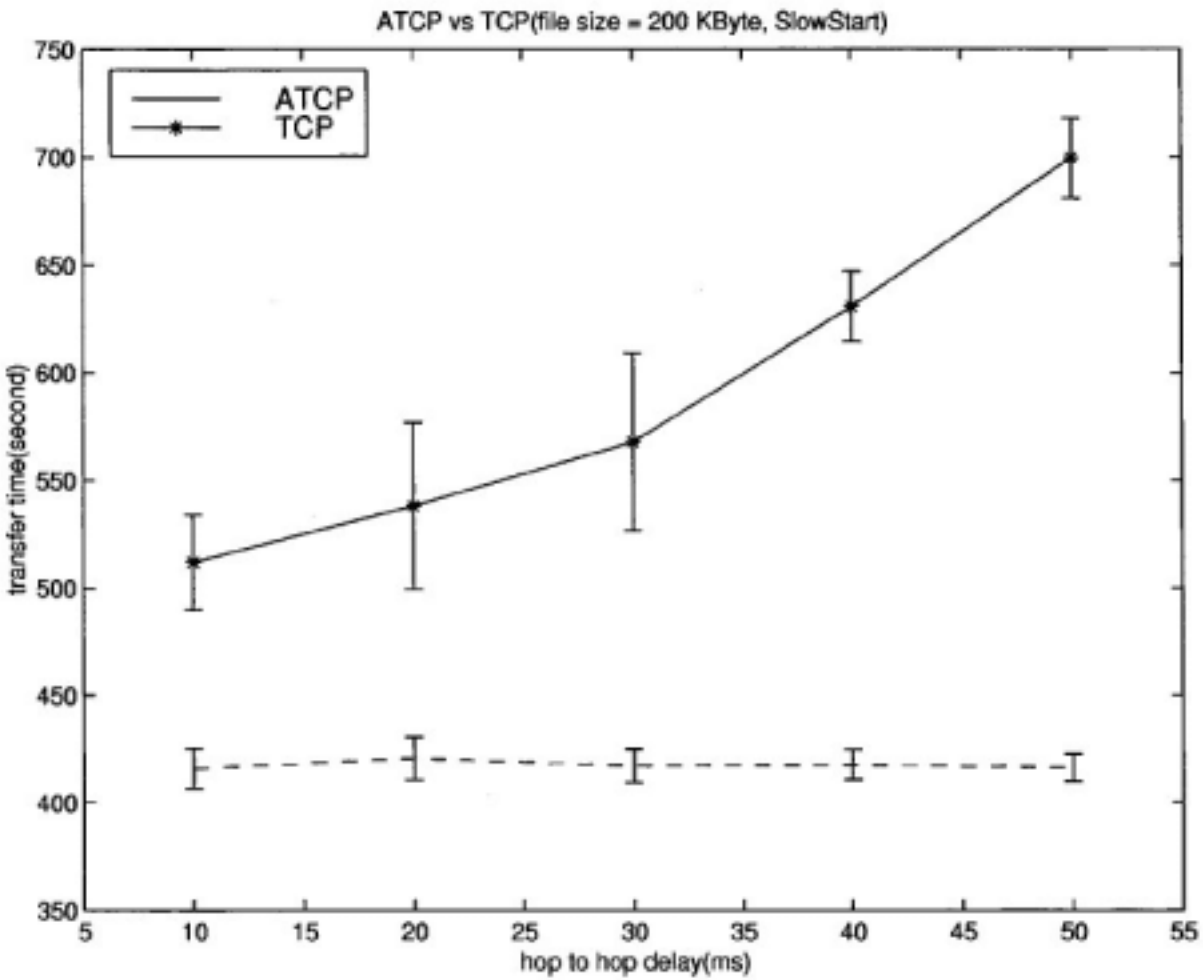
ATCP and TCP performance in the presence of bit error and congestion



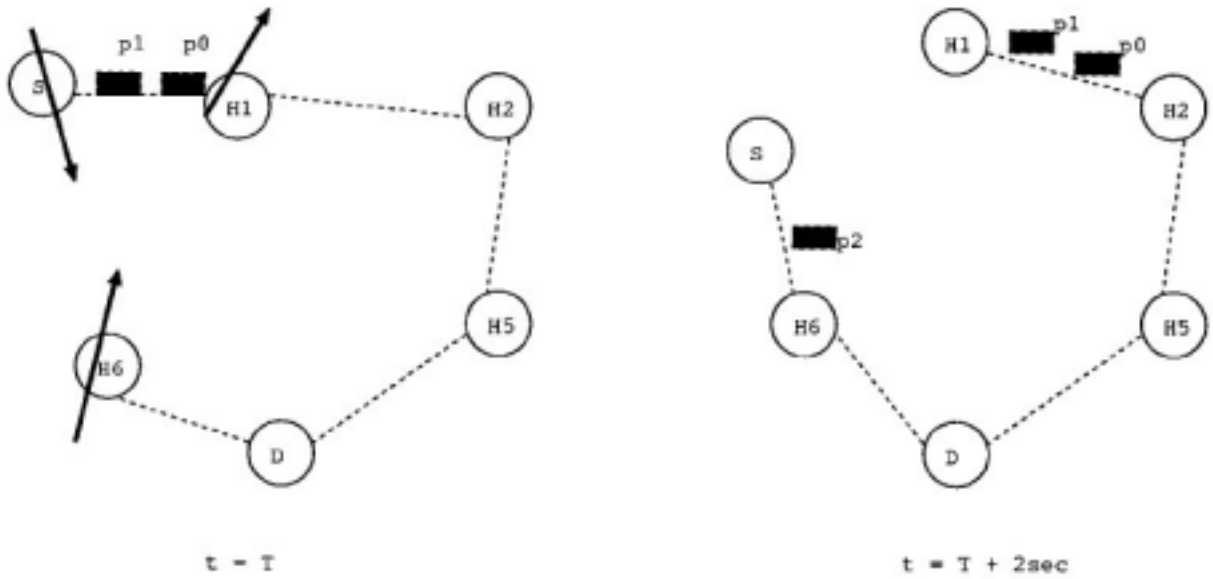
ATCP and TCP performance in the presence of bit error and partition



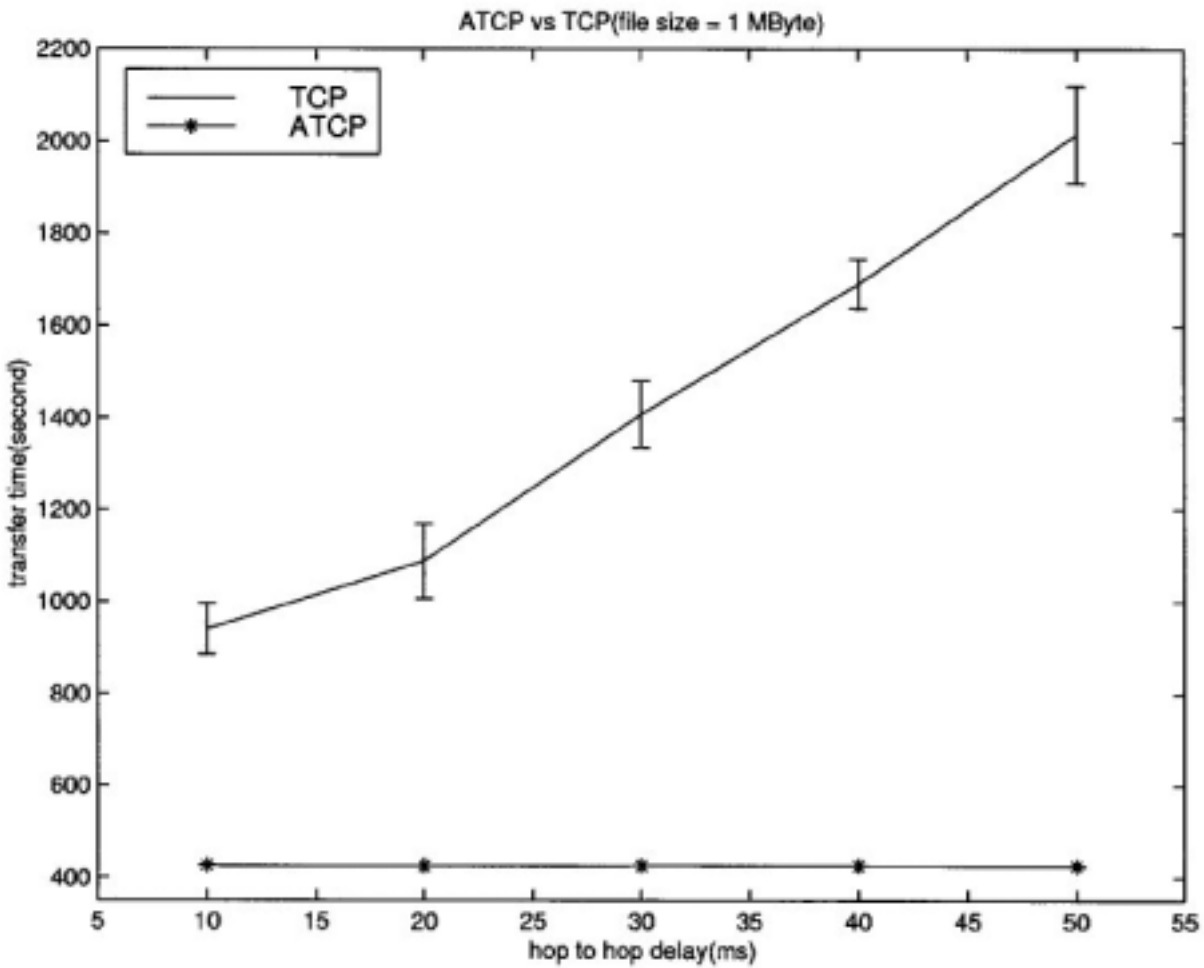
ATCP and TCP performance in the presence of bit error and larger partition



Route re-computation causes packet reordering



ATCP and TCP performance in the presence of bit error and packet reordering



TCP and ATCP transfer time for 1MB data in the general case

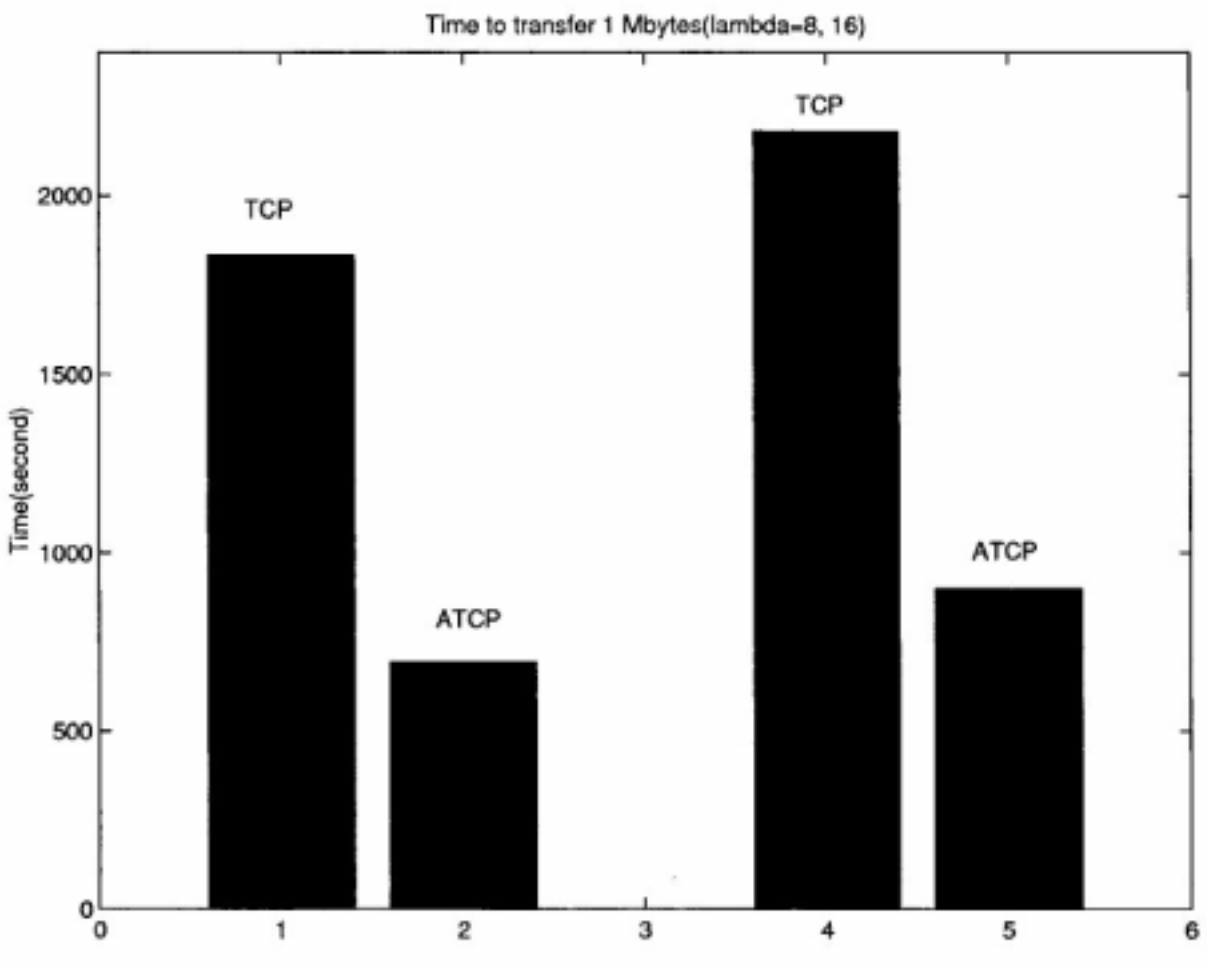


TABLE I
SUMMARY OF DIFFERENCES

Circumstance	*ATCP*	*[7]*	*[4]*
Packet Loss due to high BER	ATCP Retransmits, TCP does not invoke congestion control (CC)	Not Handled	Not Handled
Route Changes	ICMP "Destination Unreachable" puts sender in *persist* until new route found	ELFN freezes sender state	RRN freezes sender state
Network Partition	As above	As above	As above
Packet Reordering	ATCP reorders packets so TCP does not generate duplicates	Not handled	Not handled
Congestion	ECN used to quickly notify sender of congestion. Sender invokes CC.	Not Handled	Not Handled
CWND	Reset for each new route	Old CWND used	Old CWND used

- [4] K. Chandran, S. Raghunathan, S. Venkatesan,and R. Prakash,"A feedback-based scheme for improving TCP performance in ad hoc wireless networks," ICDCS, May 26-29, 1998, pp.474-479.
- [7]G. Holland and N. Vaidya,"Analysis of TCP performance over mobile ad hoc networks," in Proc. ACM Mobile Communications Conf., Seattle, WA, August 15-20, 1999, pp.219-230.

Conclusion

- The highlights of ATCP are the following
  - End-to-end TCP semantics are maintained.
  - ATCP is transparent
  - ATCP does not interfere with TCP's congestion control behavior when there is network congestion.