

CS 525M – Mobile and Ubiquitous Computing Seminar

802.11 MAC Protocol in Multihop Wireless Ad Hoc Network

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Introduction

- IEEE 802.11 MAC protocol is the standard for wireless LANs
 - Can support some ad hoc network architecture but not intended to support ad hoc networks

Outline

- Introduction
- Overview of 802.11
- Simulation Environment
- TCP Instability and Analysis
- Summary and Related Work
- Conclusion

802.11

- 802.11 covers the MAC and physical layers
 - Distributed Coordination Function (DCF) and Point CF (PCF) available
 - DCF is basically CSMA/CA mechanism
 - If medium is free, transmit. If not, defer transmission.
 - Effective when the medium is not heavily loaded

802.11

- Sender: sense the medium
 - If free for Distributed Interframe Space (DIFS), transmit
 - If not, defer transmission
- Receiver: check the cyclic redundancy check (CRC) and send acknowledgement (ACK)
- Sender: wait for ACK
 - If no ACK, retransmit the frame

Well Known Problems

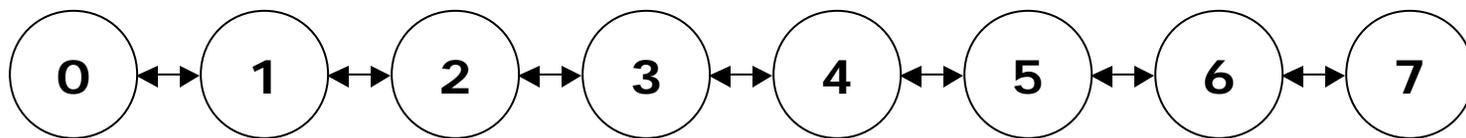
- Hidden Node Problem
 - Due to nodes within the interference range of the destination
 - Request-To-Send (RTS) and Clear-To-Send (CTS) to mitigate
- Exposed Terminal Problem
 - Due to nodes within the sensing range of the source but outside the interference range of the destination

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Simulation Environment

- NS-2 with extensions from the MONARCH project at CMU
 - Bandwidth: 2 Mbps
 - Transmission Radius: 250 m
 - Queue: IFQ (50 packets)
 - Routing Protocol: DSR
 - String (Chain) topology
 - TCP for transport protocol (Reno)

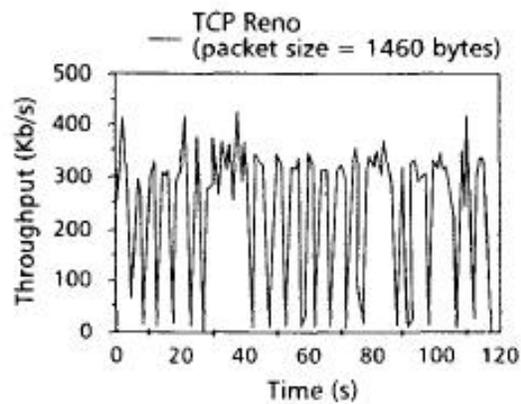


Outline

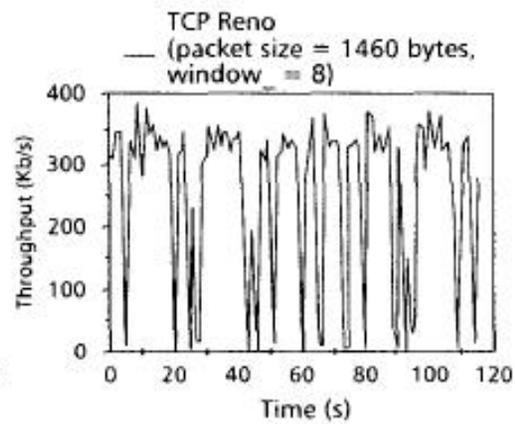
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TCP Instability

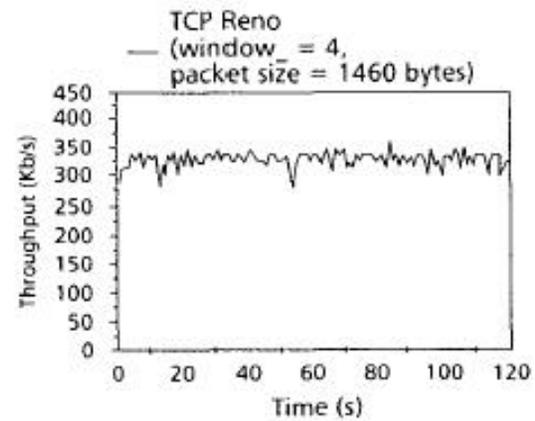
- Single 4-hop TCP connection
 - Node 1 to Node 5
 - 120 seconds



(a) Reno, window_ = 32



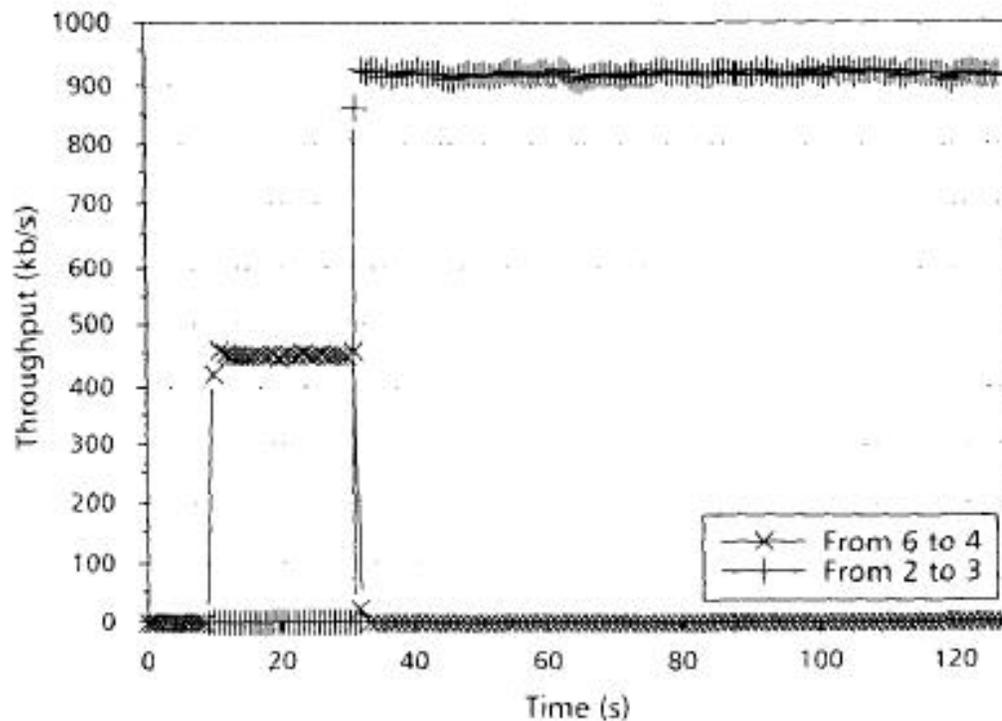
(b) Reno, window_ = 8



(c) Reno, window_ = 4

TCP Unfairness

- Two TCP Connections
 - 1-hop connection from Node 2 to Node 3
 - 2-hop connection from Node 6 to Node 4



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Summary

- Hidden node problem still exists even with much attention.
- There is no mechanism to mitigate the exposed terminal problem.
- The sensing and interfering ranges are larger than the communicating range.
- The exponential backoff favors the latest successful node.

Related Work

- Gerla et al. investigated the impact of MAC protocol on TCP performance in wireless ad hoc network.
 - Unfairness and capture problem
 - Yield time proposed
- Fairer backoff schemes proposed
- Adjusting the sensing and interfering ranges

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Conclusion

- 802.11 is the standard for wireless LANs.
 - Supports some ad hoc architecture
- Due to the problems presented, 802.11 MAC protocol does not work well for wireless ad hoc networks.
 - Hidden node problem
 - Exposed terminal problem
 - Exponential backoff scheme