Courtesy Piggybacking: Supporting Differentiated Services in Multihop Mobile Ad Hoc Networks

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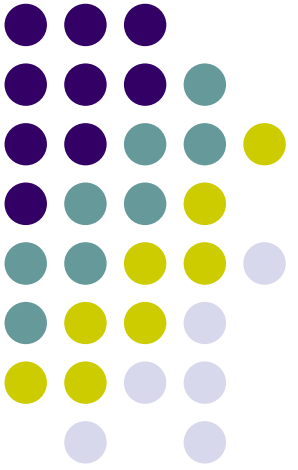


Outline

- Introduction
- The Courtesy Piggybacking Scheme
- Performance evaluation
- Discussions
- Conclusions

Introduction

- The salient characteristics in multihop mobile ad hoc networks
  - time-varying and error prone wireless link ,
  - dynamic and limited bandwidth,
  - time-varying traffic pattern and user location,
  - energy constraints.

- Try to support heterogeneous traffic with the following goals:
  - Providing high wireless channel utilization,
  - Long-term fairness,
  - Bandwidth guarantee, and
  - Delay bounds for flows with error-free links or links with sporadic errors

Introduction

- Cross-layer design
  - attempts to make use of the inter-layer coupling to develop more efficient schemes to handle heterogeneous traffic over wireless link
- Cross-layer design issues :
  - Scheduling
  - Adaptivity
  - Diversity

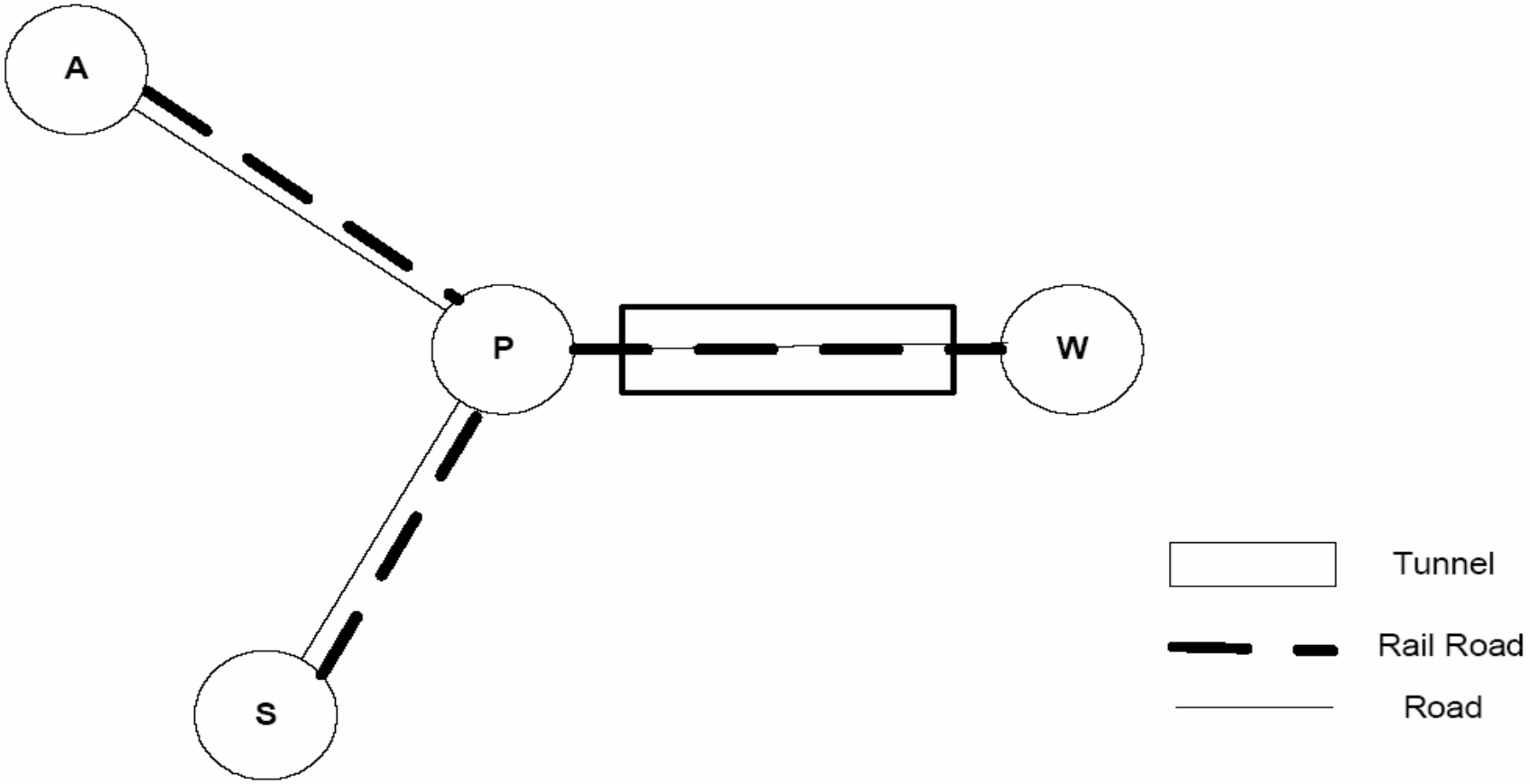
Introduction

- What do we need to address in order to efficiently handle heterogeneous traffic over wireless links?
  - (1)to handle the reliable mobile communications in MANETs.
  - (2) to provide QoS provisioning for heterogeneous traffic with different quality of service (QoS) requirements in terms of BER, throughput, and delay.
    - Priority schemes or service differentiation
    - Reservation-based MAC or contention-based MAC

Introduction

- Main targets of Courtesy Piggybacking mechanism
  - Conflict between throughput and fairness
  - Starvation problem
  - Implementation simplicity

The Courtesy Piggybacking Scheme



The Courtesy Piggybacking Scheme

- **Adaptive transmission techniques**
  - exploit the channel dynamics to provide more bandwidth.
  - adjust the parameters such as modulation level and symbol rate to maintain an acceptable BER without wasting much bandwidth.
- **Rate-adaptive schemes**
  - improve the system throughput in WLANs.
- **Adaptive fragmentation schemes**(for 802.11) :
  - designed with the rate adaptation to enhance the system throughput
    - The greater the received SNR is , the greater the fragment threshold (FT) will be.

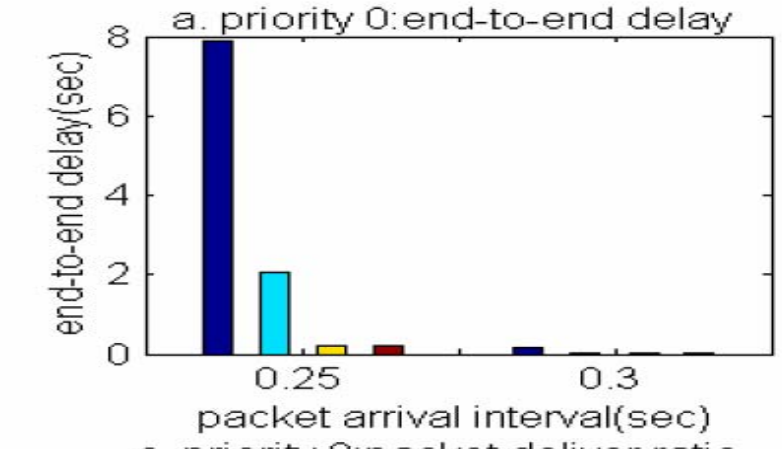
The Courtesy Piggybacking Scheme

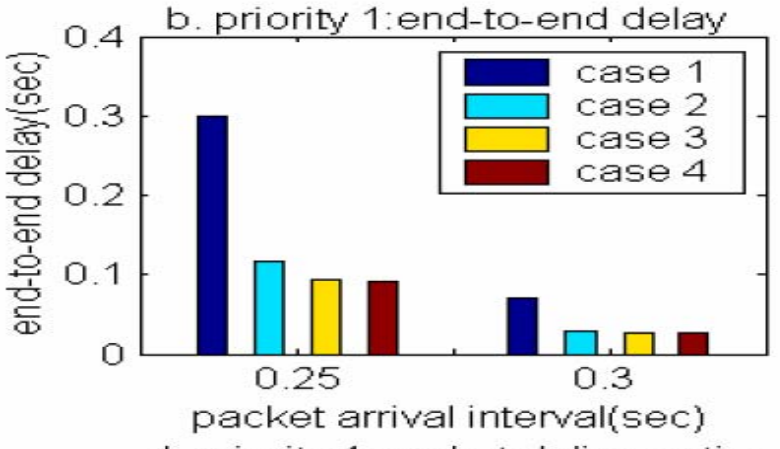
- Where does the free space come from ?
- How MANY- WHO problem
  - How many: channel dependent
  - Who: To design piggybacking rules that guide the MAC layer to assemble enough and proper bit form the queue

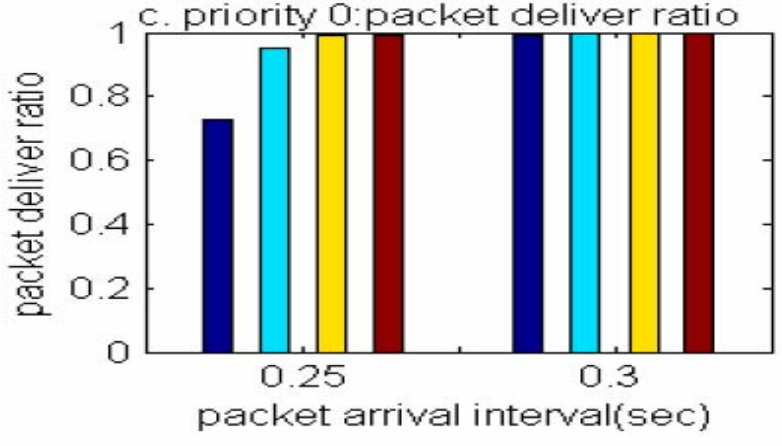
Performance evaluation

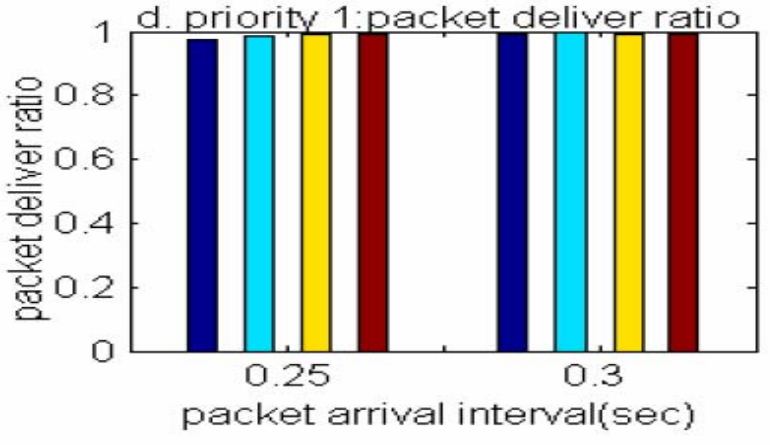
- Rules:
  - Rule1: the priority 0 service is piggybacked by priority 1 service only when no more priority 1 services left in the queue
  - Rule2: the priority 0 service is piggybacked no matter how many priority 1 services left in the queue
- Cases:
  - Case 1: the networks unaware of channel states;
  - Case 2: the networks aware of channel states with dynamic transmission rate;
  - Case 3: the networks employing the Courtesy Piggybacking with rule 1;
  - Case 4: the networks employing the Courtesy Piggybacking with rule 2.

Performance evaluation

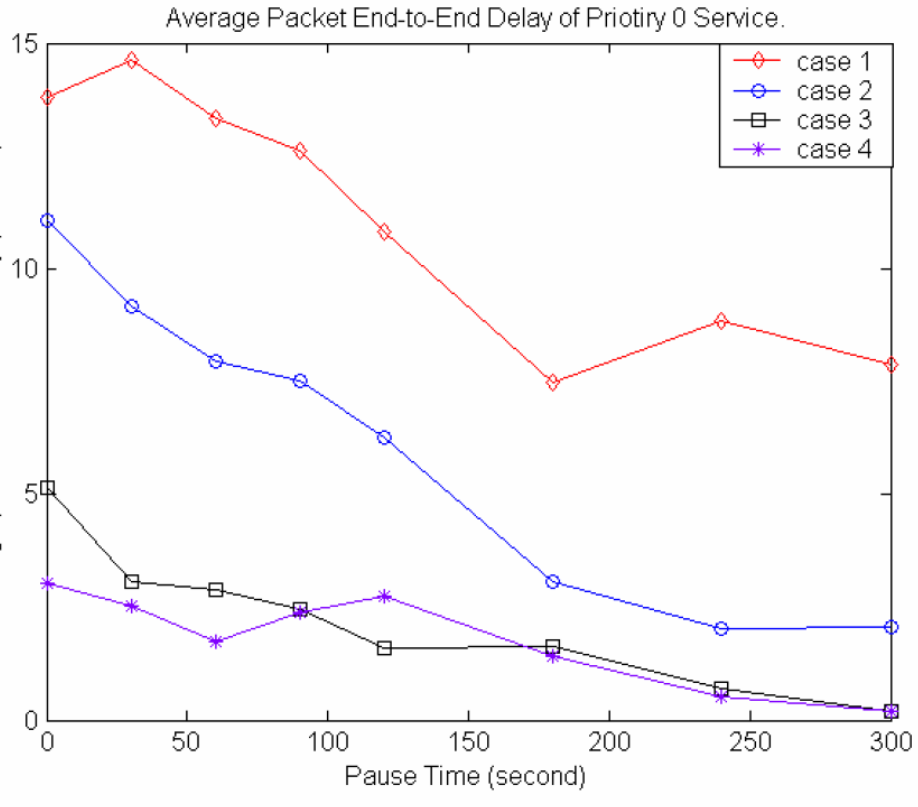








Performance evaluation



igure 10.a. Average end-to-end delay of priority 0 service

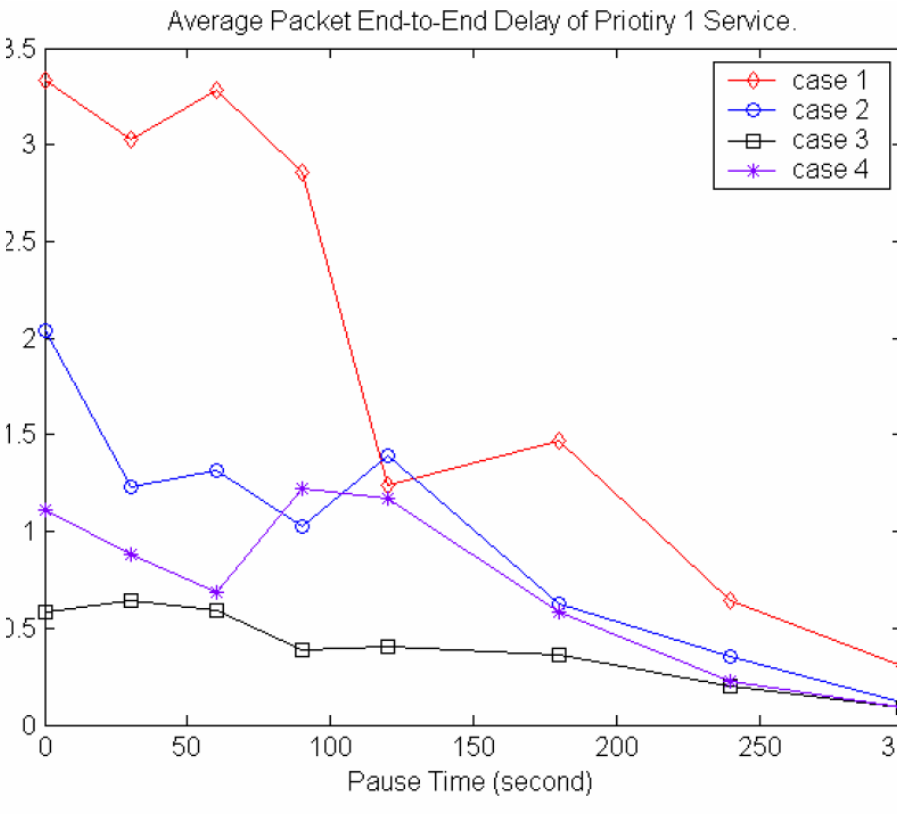


Figure 10.b Average end-to-end delay of priority 1 service

Performance evaluation

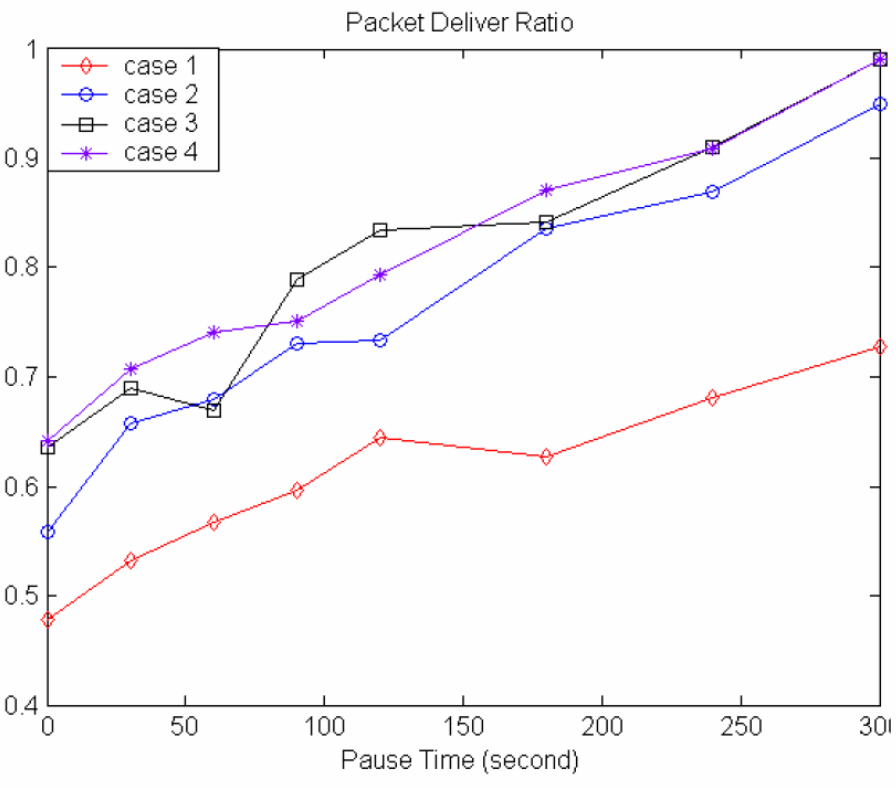


Figure 10.c. Packet delivery ratio of Priority 0 service

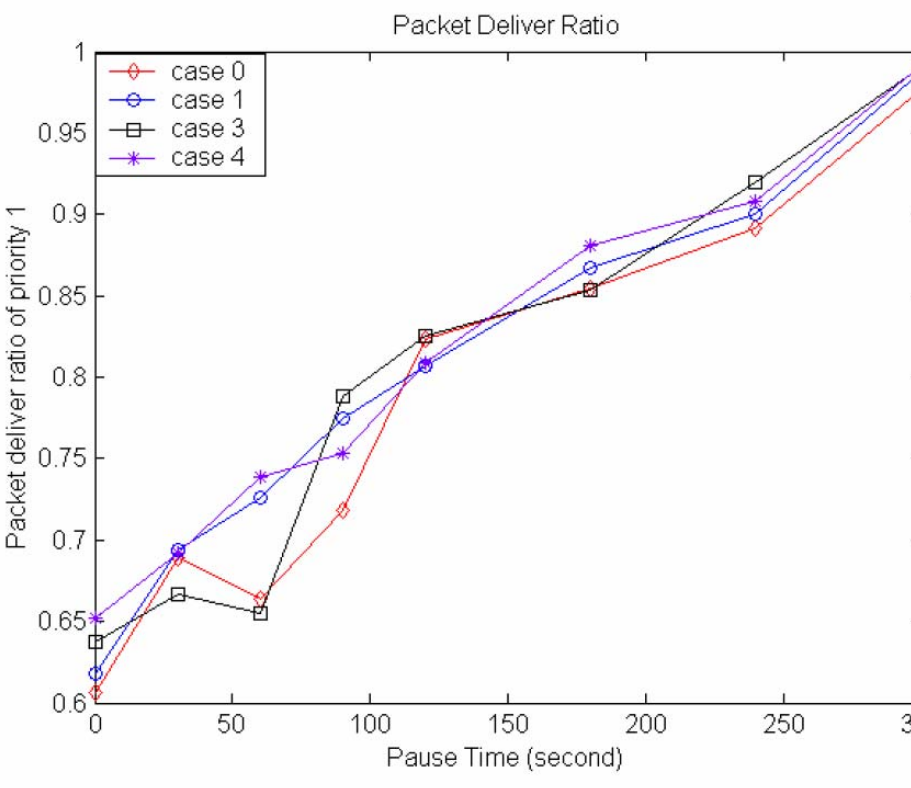


Figure 10.d. Packet delivery ratio of Priority 1 service

Discussions

- We have to examine the destination of the bits in a single piggybacked transmission
- One node's courtesy piggybacking of low priority services may help its neighbors' transmissions of high priority traffic, because less low priority traffic will reduce the contention for the high priority traffic.
- one packet arrives at one node later may leave the node earlier than some earlier arrival packets even though they have the same priority.
- The piggybacking rule is important
- Should the b-MSDUs be fragmented?
- Exclude the scheduling mechanisms

Conclusions

- we propose a novel scheme, called *Courtesy Piggybacking*, to alleviate the conflict between throughput and fairness for different prioritized traffic in a differentiated service system in mobile ad hoc networks.
- It can improve the end-to end delay and packet delivery ratio significantly.
- It easy to implement and can be implemented in a distributed fashion.