

# The Pulse Protocol : Energy Efficient Infrastructure Access

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# Outline

- Introduction
- Related Work
- Pulse Protocol
- Pulse protocol in mobile ad hoc network
- Simulation
- Conclusion

# Introduction

- Tradition access point shortcoming

- Limited coverage range
- Single hop environment
- No Power Saving Strategy
- Routing mechanism

=> Pulse protocol is proposed to improve infrastructure network

# Introduction

- The goal of the pulse protocol is to provide multi-hop infrastructure access to mobile user
  - Routing
  - Synchronization
  - Energy efficiency
  - Increase coverage area

# Related Work

- The wireless interface is capable of being in four possible operational state

802.11B CARD POWER CONSUMPTION

Transmit	Receive	Idle	Sleep
1327.20 mW	966.96 mW	843.72 mW	66.36 mW

- Tradition routing protocol spend a great deal of time in IDLE state.

# Related Work

- Existing energy conservation strategy
  - Adjust transmission power
  - Connected Active Subset
  - Asynchronous Wake-Up
  - Synchronous Wake -Up

# Pulse Protocol

- Periodically updating each node
- A node needs to send and receive packet
  - Responds to the flood with reservation packet which contain address of the pulse source
  - All nodes on the reserve path between the sending node and pulse source
- Other nodes will place its radio in sleep mode

# Pulse Protocol

- A node attempting to initiate a connection must wait next pulse period

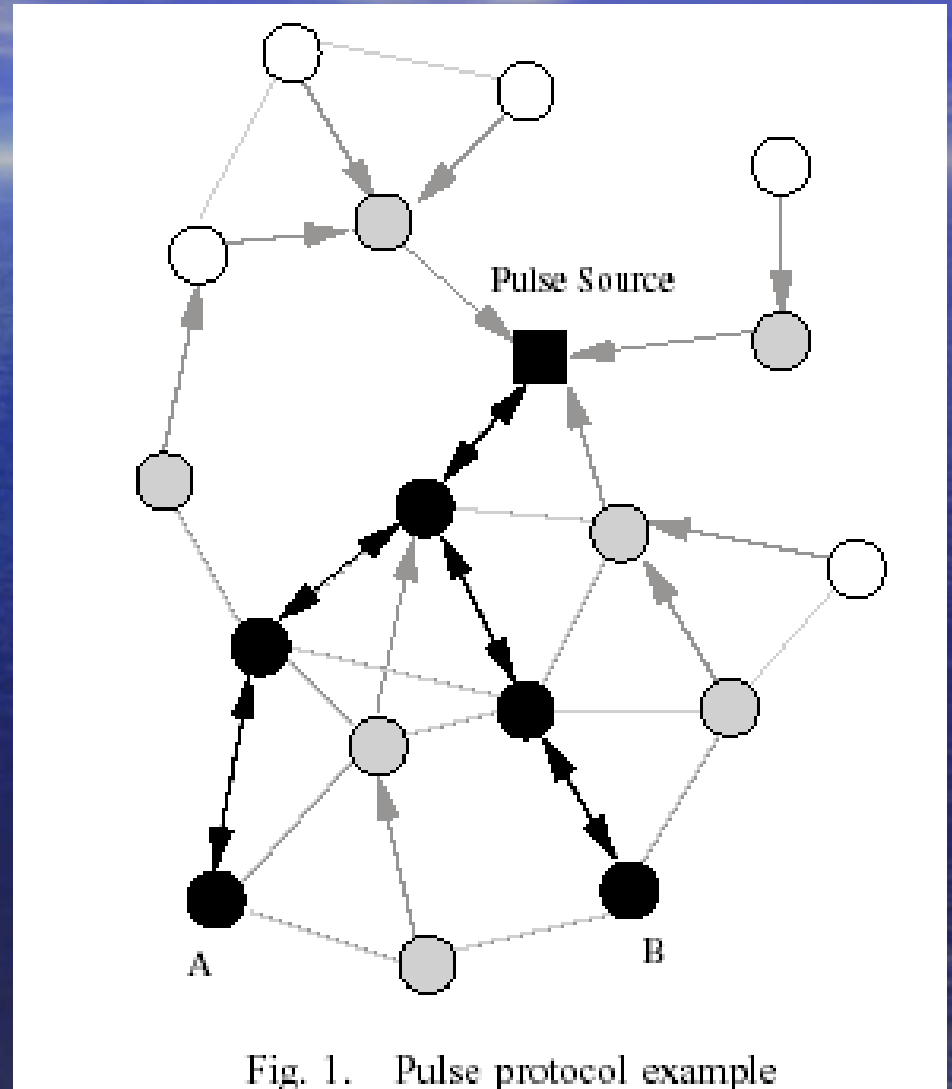
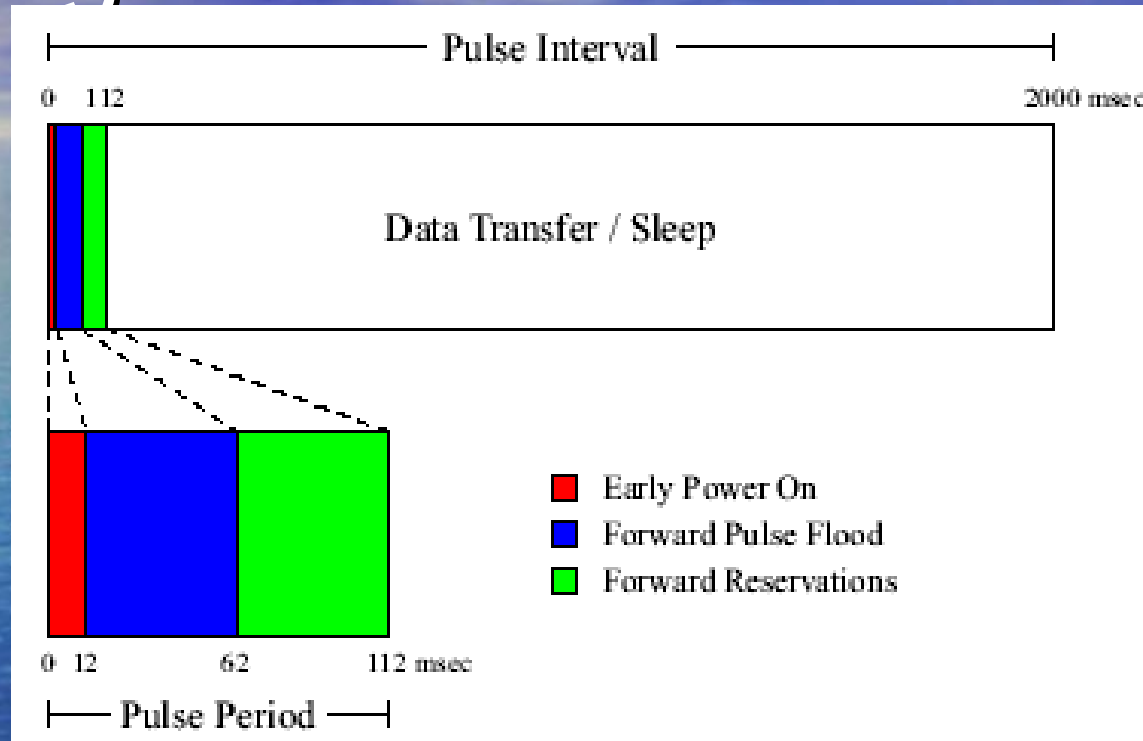


Fig. 1. Pulse protocol example



# Timing and Phase



- Power on before anticipated pulse arrival time
- Forward Pulse Flood : The pulse is flooded to all node
- Forward Reservations : allow reservation packets to be forwarded back to the pulse

# Flood Propagation

- The flood provides both routing and synchronization
- The pulse packet contains a few field :
  - Sequence number
  - Cost metric
  - Accumulated delay timer

# Time Synchronization

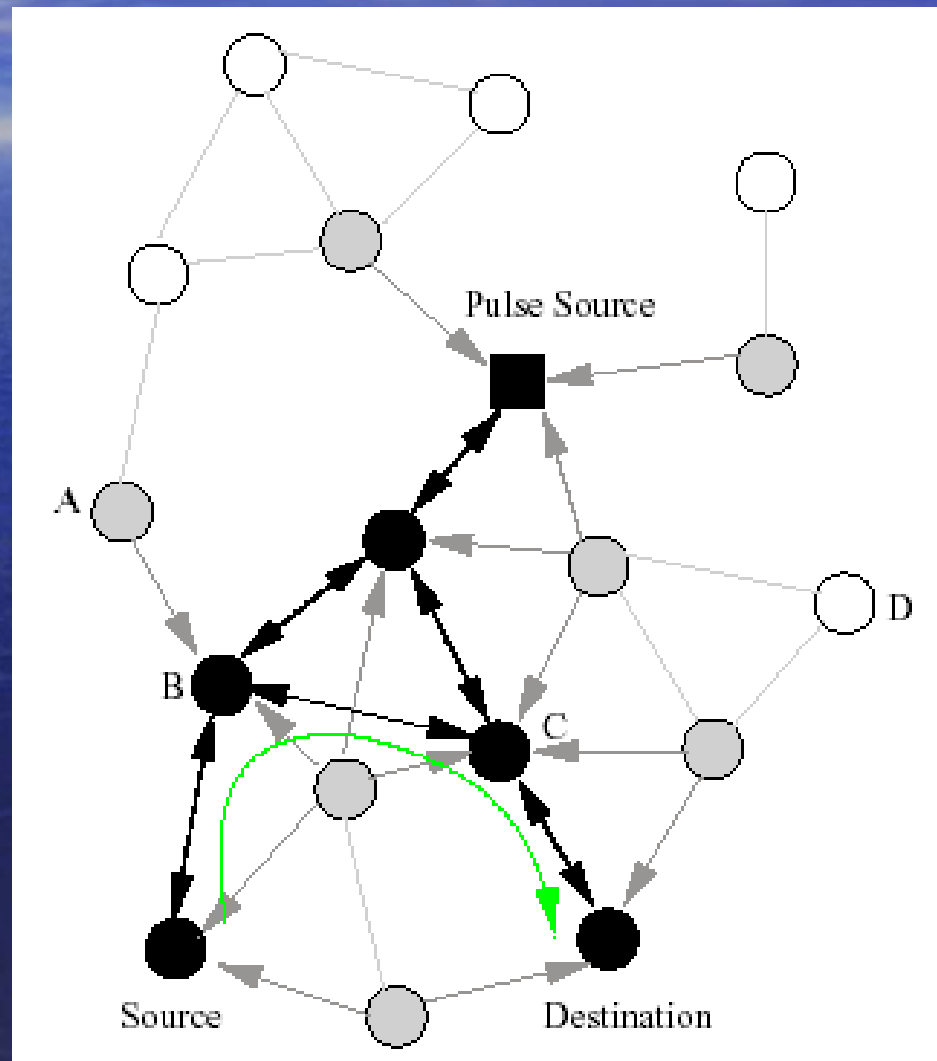
- Nodes must acquire and maintain accurate synchronization
  - Each flood packet contain a relative time offset (amount of time elapsed)
  - Using received time , its own local oscillator to predict the next flood will be sent by source

# Path Reservation

- Reservation packet has two purpose :
  - Activate intermediate node
  - Create reverse route
- The pulse protocol require a mechanism which allow it to overhear by neighboring node
  - Shortcut routes

# Path Reservation

- The bi-directional arrow between B and C
- B has a shortcut to destination , it sends the packet through C rather than up to root



# Paging

- In the event that packets arrive at the pulse source , but destination node have no active path
- The pulse source will page the node on the next pulse
- Paging involves placing the node's id in flood

# Multiple Pulse source Integration

- Pulse protocol can be operated using several infrastructure attached pulse source
- All the pulse source must use the some pulse interval
- Each node tracks the nearest pulse source

# Pulse protocol in Mobile ad hoc network

- Nodes should execute the leader election algorithm when pulse source is failuse
- Rotate the task of the pulse source among all the nodes in the network

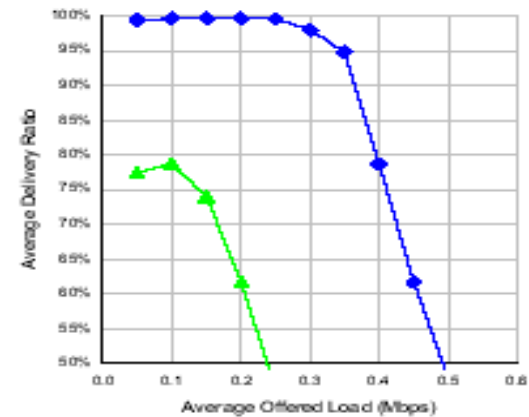
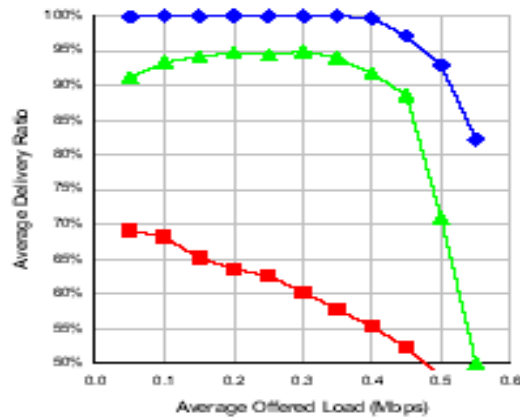
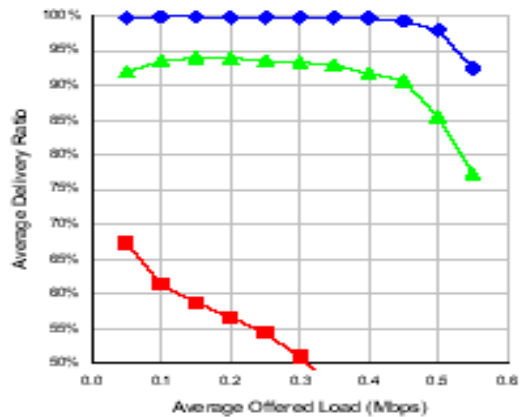


# Simulation

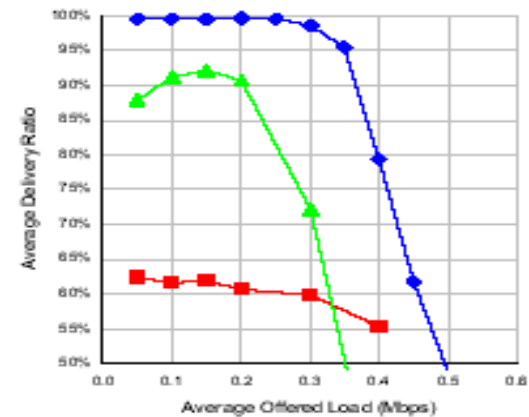
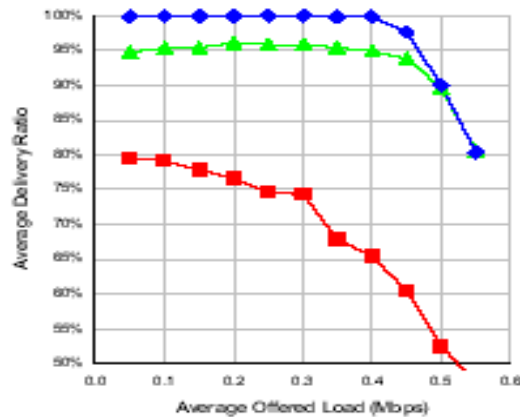
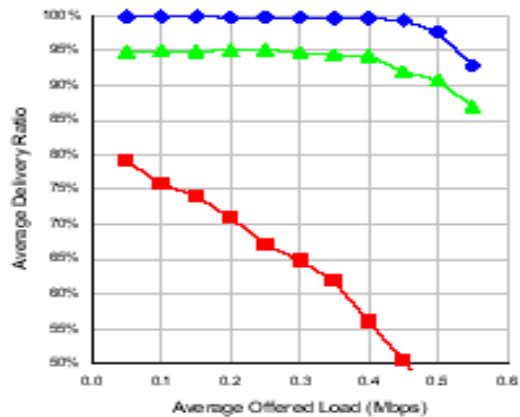
- Routing Evaluation
- Energy Conservation Evaluation
- Network Lifetime
  
- Compare AODV , DSR , Pulse protocol

# Simulation

medium - 10 m/s max



low - 5 m/s max



1km\*1km 50 nodes

1km\*1km 100 nodes

2km\*2km 200 nodes

# Simulation

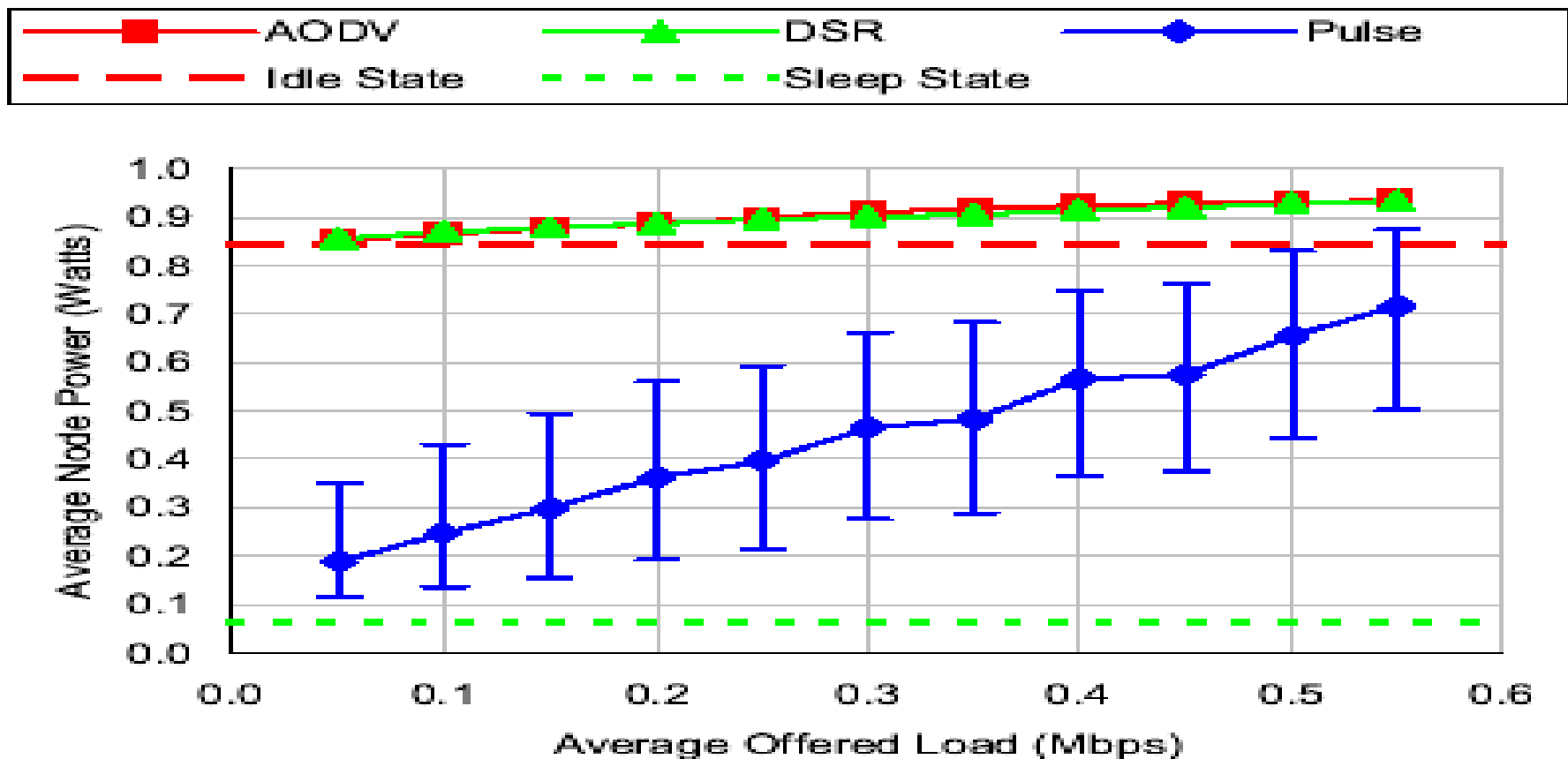
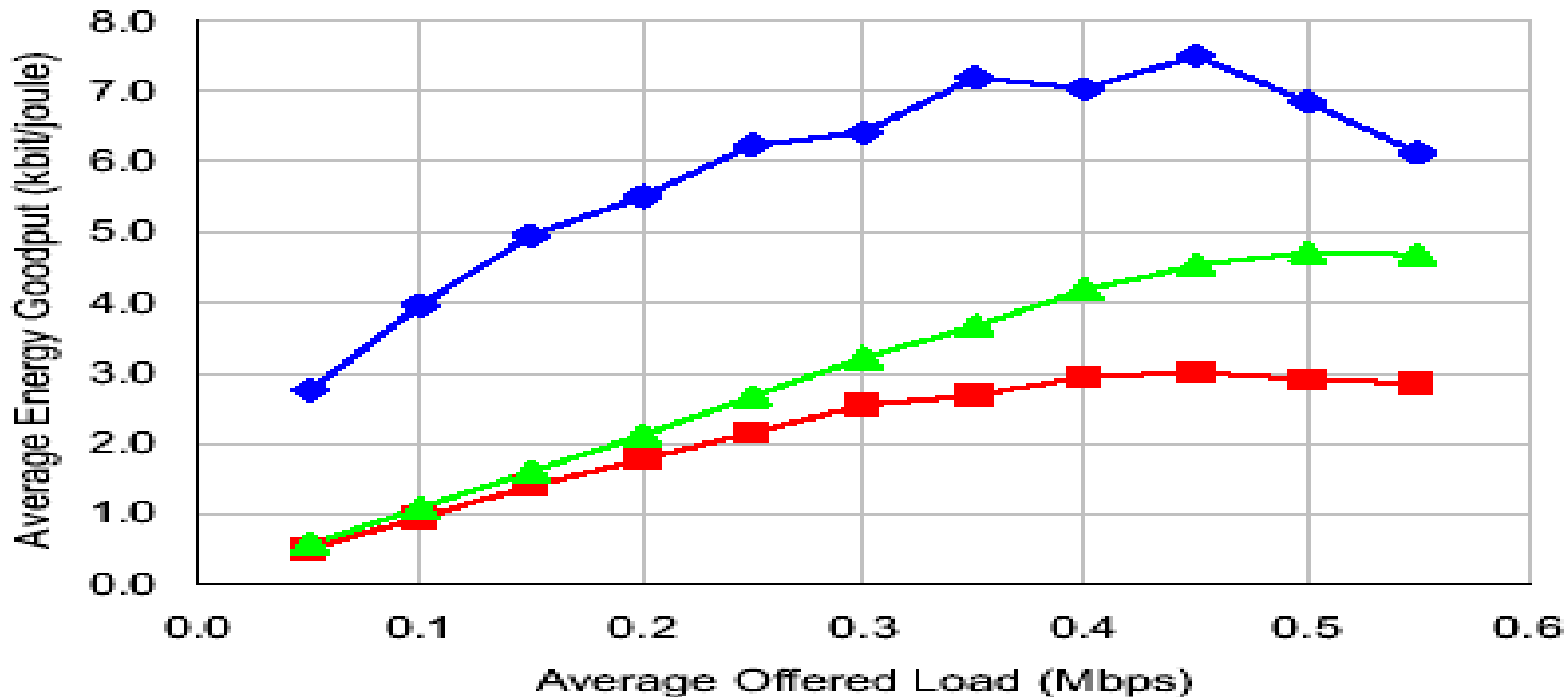


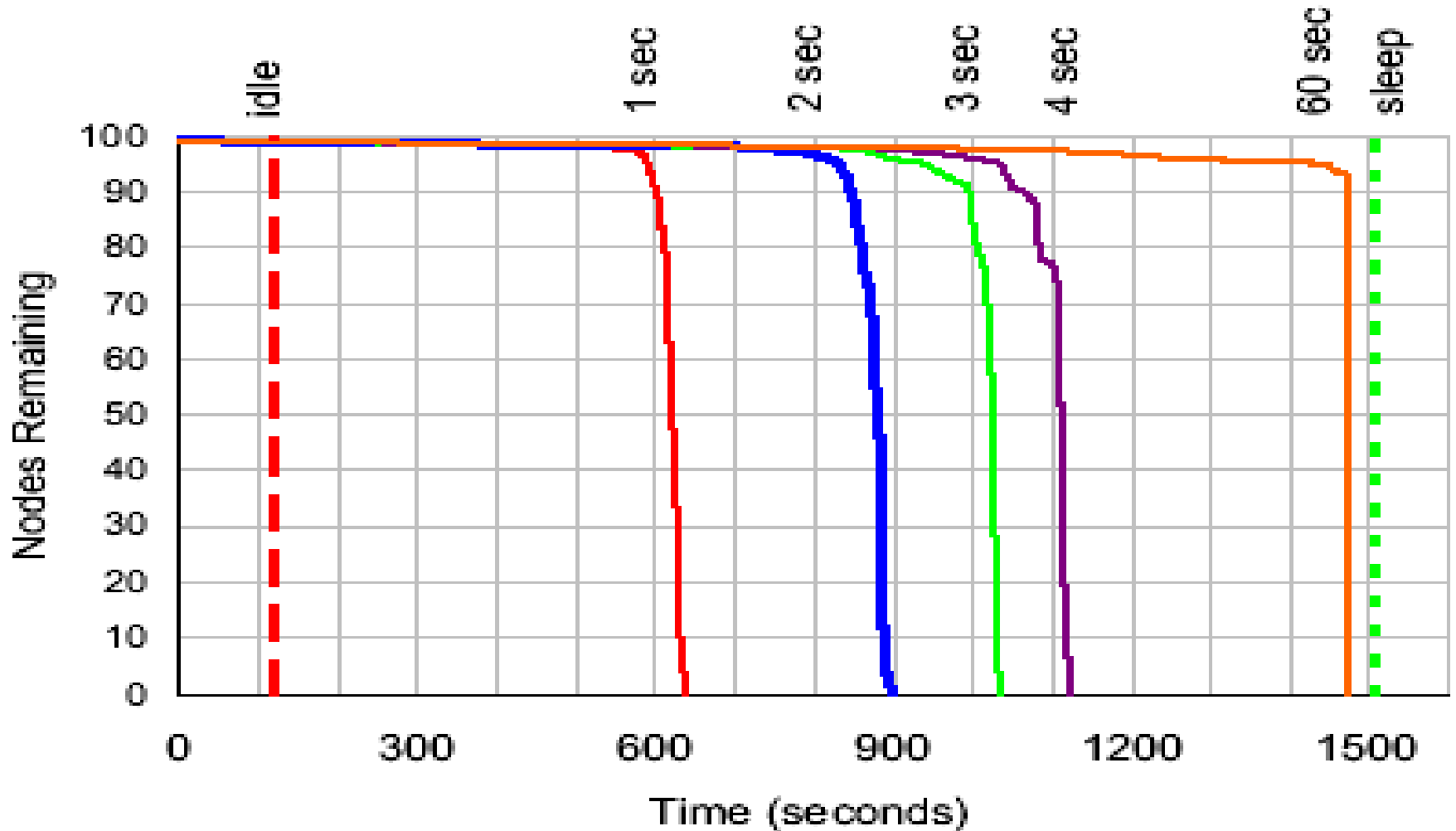
Fig. 5. Energy consumption in the 1km x 1km - 100 node - 5 m/s max scenario

# Simulation



- Good put : kilobyte delivered per joule

# Simulation



# Conclusion

- The pulse protocol is effective at both routing and conserving energy
- Improve infrastructure shortcoming
- Future work :
  - Leader election
  - Adaptive approach in multi-pulse source environment