ENSC 427: COMMUNICATION NETWORK
PROJECT PRESENTATION
Spring 2010
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Message Ferrying

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Roadmap

- Introduction
  - Background
  - Animated Example
  - Potential Uses
  - Project Overview
- Simulation
  - Network Architecture
  - Implementation
  - Simulation Results
- Conclusion and Discussion
- Future Work
- References

Introduction: Background

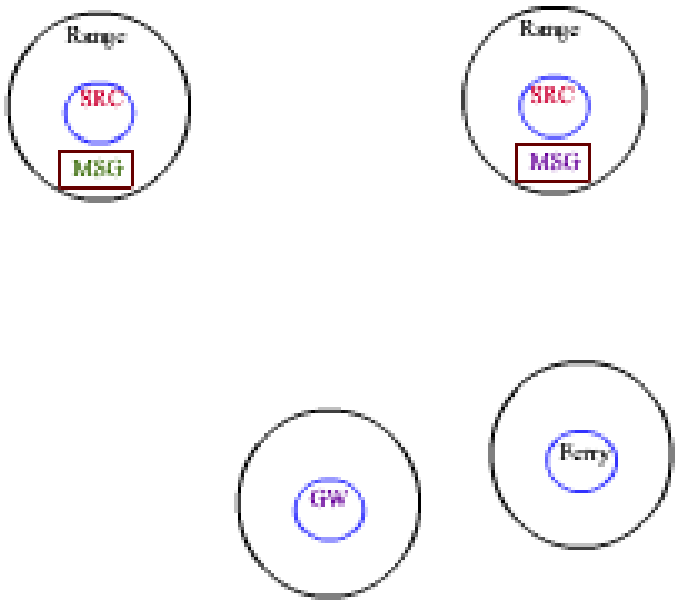
- **What is Message Ferrying?**
  - The process of physically carrying data between network nodes which cannot communicate directly
  - Also known as “store-carry-forward” routing
- **Past Research**
  - Existing research has focused on message ferrying in partitioned, wireless ad-hoc networks [1][2]
  - It has examined methods and algorithms to control ferry movement – *Message Oriented Ferries* [3]
    - Ex. Dedicated communication robots on a battlefield
  - Little research has been found which deals with random ferry mobility - *Task Oriented Ferries*. [3]
    - Ex. A ‘ferry enabled’ cell phone

Introduction: Background

- **Why Message Ferrying?**
  - We are transporting an increasingly large amount of technology all the time – try to utilize that fact
  - Requires virtually no physical infrastructure
  - For certain applications, existing networking options could be expensive or impractical
    - Wired (ex Ethernet)
    - Wireless (ex WiFi, WiMAX, cellular data modems)
  - Ad-hoc wireless networks perform poorly in sparse networks [3]

Introduction: Animated Example

- The ferry node is carrying messages between nodes which cannot communicate directly



Introduction: Potential Uses of Message Ferrying

- Message ferrying is suitable for applications that tolerate significant network **delay** and **loss**

Application	Suitable?
Remote sensor monitoring	Yes
E-mail	Potentially
Machine-machine communication	Yes
Disaster communications	Yes
Gaming	No
VoIP	No

Introduction: Project Overview

- Project Goals
  - Examine message ferrying with task oriented ferries
  - Design, implement, simulate, and evaluate a 3rd, 4th, and 5th layer (OSI) message ferrying network in OPNET
- Issues
  - OPNET has no support for message ferrying
  - All node and processes models were designed from scratch

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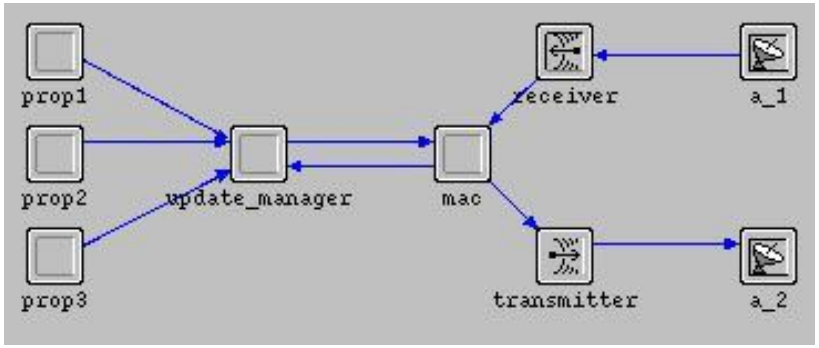
Simulation: Network Architecture

- Communication between arbitrary nodes is an extremely complex problem due to random ferry movement
- Instead, design a specialized ‘one way’ wireless network
- Three types of network nodes
  - **Source nodes**
  - **Ferry nodes**
  - **Gateway nodes**
- Data flow from source nodes to gateway nodes via ferry nodes

Simulation: Implementation

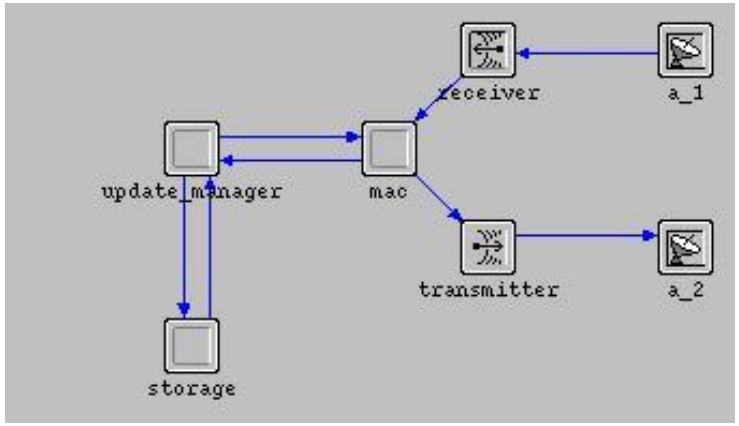
- Source nodes have properties (prop1, prop2, etc) which generate update messages that are carried to **any gateway node** by message ferries.

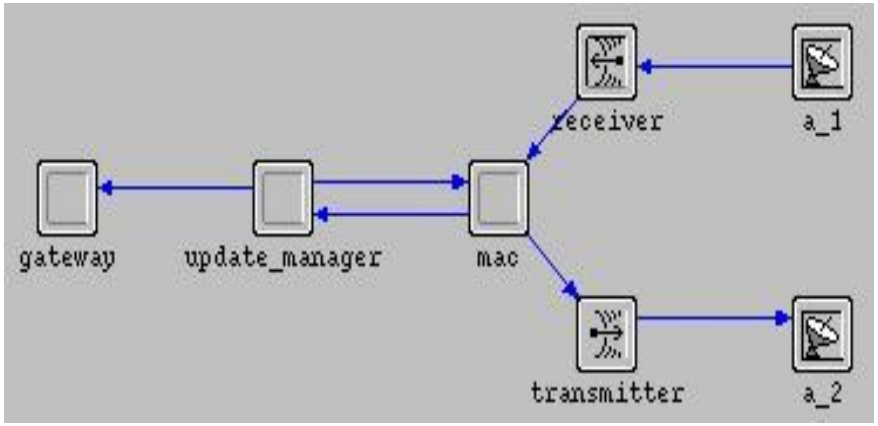


- 1. Source Node

  Static nodes which have a set of properties that generate update messages

Simulation: Implementation



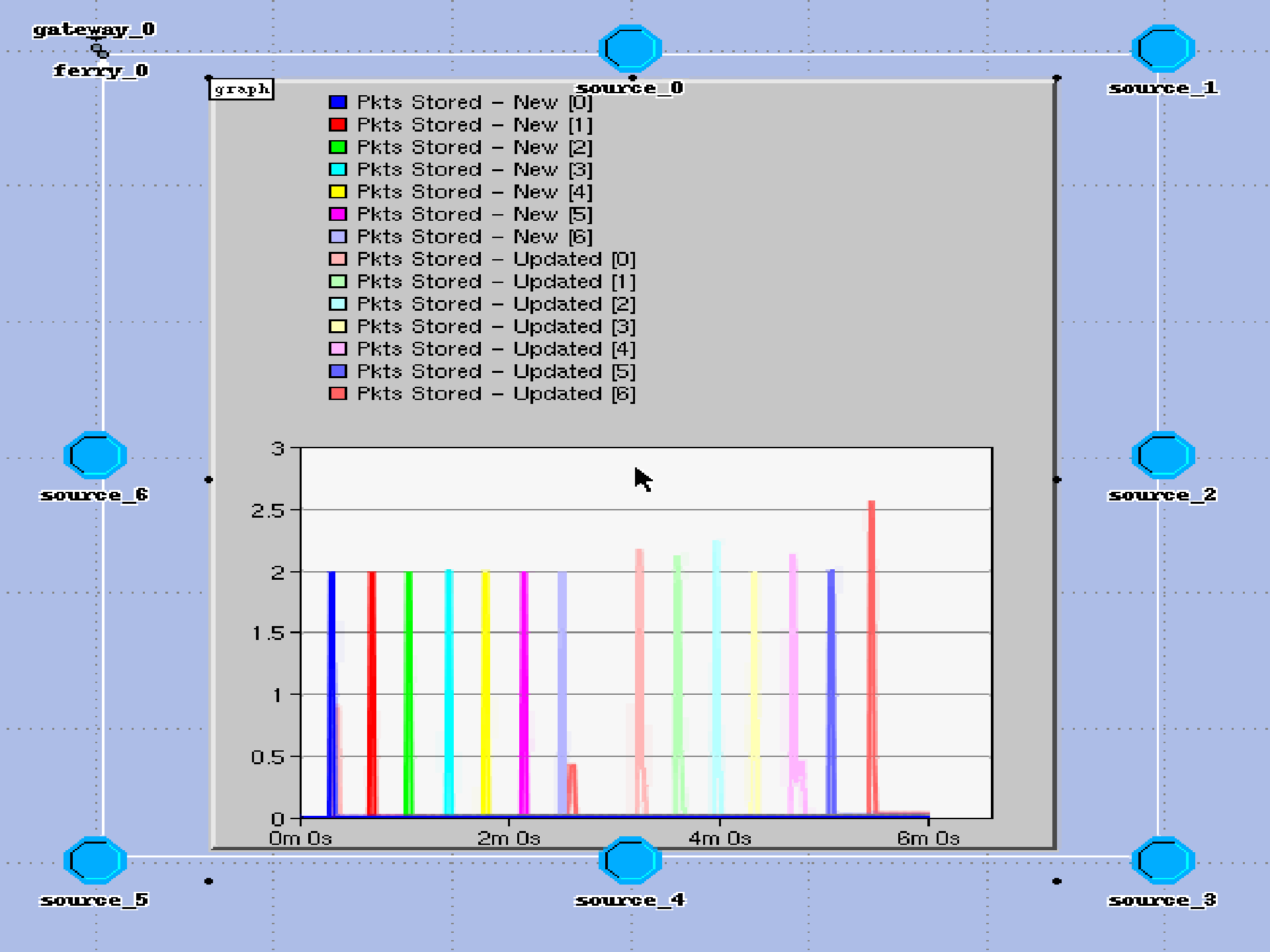


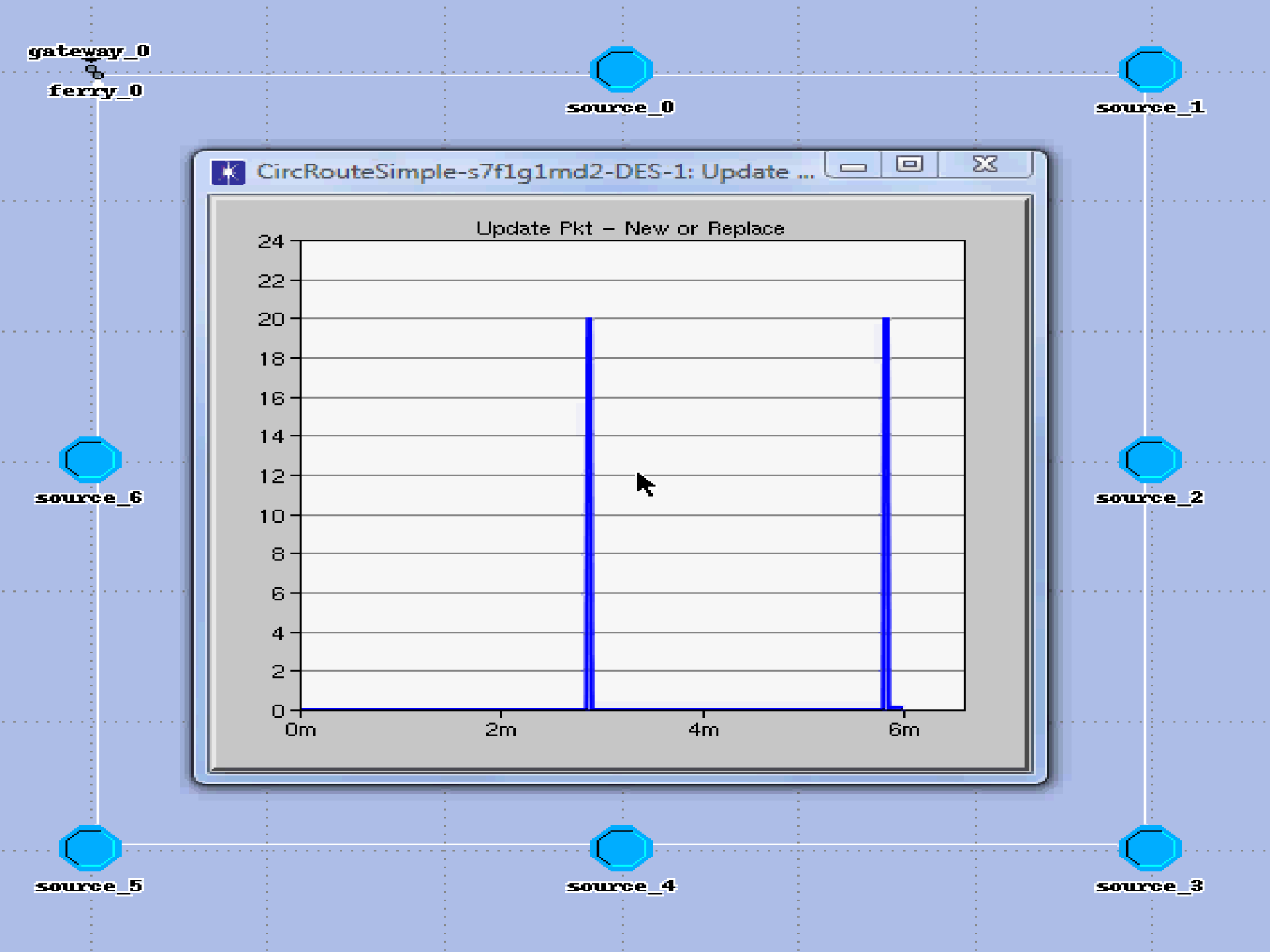
- 2. Ferry Node

  Mobile nodes which collects updates from source nodes when they are in range. Updates are stored in memory.

- 3. Gateway Node

  Gateways receive update messages from ferries and forward them to a final destination via the Internet.


gateway_0
ferry_0
source_0
source_1
source_2
source_3
source_4
source_5
source_6
graph
Pkts Stored – New [0]
Pkts Stored – New [1]
Pkts Stored – New [2]
Pkts Stored – New [3]
Pkts Stored – New [4]
Pkts Stored – New [5]
Pkts Stored – New [6]
Pkts Stored – Updated [0]
Pkts Stored – Updated [1]
Pkts Stored – Updated [2]
Pkts Stored – Updated [3]
Pkts Stored – Updated [4]
Pkts Stored – Updated [5]
Pkts Stored – Updated [6]
3
2.5
2
1.5
1
0.5
0
0m 0s
2m 0s
4m 0s
6m 0s


gateway_0
ferry_0
source_0
source_1
source_6
source_2
source_5
source_4
source_3
CircRouteSimple-s7f1g1md2-DES-1: Update ...
Update Pkt – New or Replace
24
22
20
18
16
14
12
10
8
6
4
2
0
0m
2m
4m
6m

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Conclusion and Discussion

- Successfully tested OPNET models and simulated a simple network
- Validated OPNET as a tool to analyze message ferrying
- General results
  - Minimum update delay is ferry travel time. Increasing the number of gateways reduces delay
  - Delivery success rate depends on the ferries memory capacity.

Future Work and Ideas

- Simulate realistic scenarios and use cases - source node placement, ferry movement and gateway locations
- Evaluate the performance of alternative heuristics used to discard packets when the ferries memory buffer is full
- Implement an acknowledgment mechanism to remove redundant update packets from the network
- Integrate with existing MANET routing protocols
- Reverse message transport, from gateway to source nodes – MUCH more complicated problem

References

- [1] R. Patra, K. Fall, and S. Jain, “Routing in a delay tolerant network,” in *Proceedings of the 2004 conference on Applications, technologies, architectures, and protocols for computer communications*, 2004.
- [2] W. Zhao, M. Ammar, and E. Zegura, “A message ferrying approach for data delivery in sparse mobile ad hoc networks,” in *Proceedings of the 5th ACM international symposium on Mobile ad hoc networking and computing*, College of Computing, Georgia Institute of Technology, Atlanta, Georgia 30332, 2004.
- [3] Y. Chen, W. Zhao, M. Ammar, and E. Zegura, “Hybrid routing in clustered DTNs with message ferrying,” in *Proceedings of the 1st international MobiSys workshop on Mobile opportunistic networking*, College of Computing, Georgia Institute of Technology, Atlanta, GA, 30332, 2007.

QUESTIONS?

THANK YOU FOR YOUR TIME