# Chapter 9 SOM: Spiral-Fat-Tree-Based On-Demand Multicast Protocol in a Wireless Ad-Hoc Network

Prof. Yuh-Shyan Chen

Department of Computer Science and Information Engineering

National Taipei University

Page: 1/46

# **Best Paper Award in IEEE ICOIN-15**





## **Journal Publication**

Yuh-Shyan Chen, Tzung-Shi Chen, and Ching-Jang Huang, "SOM: Spiral-Fat-Tree-Based On-Demand Multicast Protocol in a Wireless Ad-Hoc Network," Computer Communications, Vol. 25, Issue 17, pp. 1684-1695, Nov. 2002.

Page: 3/46





# Outline

Page: 5/46

- I. Introduction
- II. Basic Idea
- **III.** Our Proposed Protocol
- **IV. Performance Evaluation**
- V. Conclusion



## I. Introduction

Propose a new multicast protocol in the Mobile Ad-hoc NETwork (MANET)

Page: 6/46

Develop a simulation platform to evaluate the performance of our protocol



## **Mobile Ad-Hoc Network**

#### Mobile Ad-hoc NETwork (MANET)

- Formed by wireless hosts which may be mobile
- Without (necessarily) using a pre-existing infrastructure
- Routes between nodes may potentially contain multiple hops

Page: 7/46

#### Design Difficulty:

- Node mobility
  - Topology is changeable



# **Existing Multicast Protocols**

### Tree-based multicast protocols

• There in only path from source to destination

### Mesh-based multicast protocols

 Source to destination has two or more paths

Page: 8/46





# **A Comparison Table**

	Protocol	Proactive/Reactive	Multi-Path	Location-Aware
Tree-based multicast protocol	CBT	Proactive	×	×
	AODV	Reactive	×	×
	DVMRP	Reactive	×	×
Mesh-based multicast protocol	CAMP	Proactive	✓	×
	FGMP	Reactive	✓	×
	ODMRP	Reactive	✓	✓
	Ours(SOM)	Reactive	<ul> <li>✓</li> </ul>	×

Page: 10/46



## **Tree-Based Approach**





## **Mesh-Based Approach**



Page: 12/46







# The robustness of multicasttree of existing reactive protocols is weak

 The motivation of this paper is to enhance the robustness of mutlicast-tree

Page: 14/46



## Contribution

### This paper presents a special multipath approach

 to enhance the <u>robustness</u> of multicast-tree

# Propose the Spiral-Fat-Tree-based scheme

 Advantage: reduce the probability of reconfiguration of multicast-tree

Page: 15/46



# II. Base idea

Page: 16/46

### The basic idea of Spiral-Fat-Tree-Based Scheme is

- Spiral-Path
- Spiral-Tree
- Spiral-Fat-Tree



# **Spiral-Path**

### A special robust-path (spiral-path) is adopted.

- This idea originated by our previous paper, which has been presented in *IEEE ICCCN 2000,* Las Vegas, U.S.A.
- Yuh-Shyan Chen and Kuan-Chang Lai, "MESH: Multi-Eye Spiral-Hopping Protocol in a Wireless Ad Hoc Networks, " *IEICE Transactions on Communications*, Vol.E84-B, No.8, pp. 2237-2248, Aug. 2001.

Page: 17/46

### Using the spiral-path to possibly construct a robust fat-tree structure





# Spiral-Path

















# **Branch-Node**





## Multiple-Path Searching Phase



## Merging Criterion Destination no des Destinationnodes. Destination nodes: Merging B Merging Merging B) Source node Source no de Source node ( a )(Ъ) (4)







#### Case 1: The failed node is not a merged node







## **IV. Performance Evaluation**

### Simulation environment

- Can choose 50, 75, 100 nodes in 500\*500 meters
- Transmitter range can be 50,100, 150 meters
- 1 source v.s. 4~12 destination nodes
- Speed 10~100 km/hr
- Five protocols are implemented and compared.
  - ► AODV, DVMPR, FGMP, ODMRP, and SOM.

Page: 35/46





# **Performance Metrics**

# RE (REachability)

 The number of all destination nodes receiving the data message divided by the total number of all destination hosts that are reachable, directly or indirectly, from the source host.

# **RB** (ReBroadcast)

 The number of REQUEST packets for all mobile hosts in MANET.

# AL (Average Latency)

 The interval from the time the multicast was initiated to the time the last host finishing its multicasting.

Page: 37/46





# Performance of REachability v.s. effect of Number of Mobile Hosts



Mob ility

<sup>(</sup>a)

# Performance of REachability vs. effect of Transmission Radius





# Performance of ReBroadcast vs. effect of Number of Mobile Hosts



## Performance of ReBroadcast vs. effect of Transmission Radius







# Performance of Average Latency vs. Effect of Mobility



# Performance of Average Latency vs. Effect of Number of Message Length



# Performance of Average Latency vs. Effect of Number of Destination Nodes



# Performance of Average Latency vs. Effect of Mobility with Number of Destination Nodes



## **V.** Conclusion

- This paper proposes a novel multicast routing (SOM) Protocol
  - Spiral-path-based scheme
- Our proposed protocol is truly efficient evaluated by our developed simulation platform

### Current Work

 Develop a QoS Routing Protocol using Spial-Path-Based Scheme

Page: 49/46

