Decentralized Message Routing in Mobile Networks

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Introduction

- Use of Wireless Technology is Increasing
- Could improve Message Routing of existing Centralized Networks
- New focus on more Efficient Decentralized Message Routing
Applications

- Personal communication
- Robots exploring a distant planet
- Computer Networks
- Wireless Networks
Simulation Environment

- StarLogo
  - Specializes in Simulation Decentralized Systems
  - Graphical Display
  - Easy to program
  - Good Functionality
  - Parallel Execution
Simulation Specifics I

- Environment
  - 50 x 50 grid with defined edges
  - Random initial distribution of Agents
  - Agents occupy 1 grid square
  - Agents move to a random neighboring empty grid square, if available
  - Variable Density of Agents
Simulation Specifics II

- Messages
  - Message known by 1 Agent to start
  - At each Time Step, Agents knowing the Message attempt to pass it to neighboring Agents
  - If an Agent has already received the Message, he refuses to receive it again
  - Agents “remember” the message for Specified number of Time Steps
Simulation Goals

- Maximize Message Saturation
  - Reliably relay Message to Agents
- Increase Efficiency
- Decrease Resources Used
A high Time Step or Density of Agents is required for near 100% Saturation

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Trends

- Threshold
  - Above threshold more than 80% Saturation is reached
  - Below threshold less than 20% of Agents receive the Message
  - Results in “S” Curve Graph, Figure 1
Figure 1

Varying Densities and Time Steps to Retain Message

Density:
0 0.2 0.4 0.6 0.8 1 1.2

Percent Reached:
0 5 10 15 20 25 30 35 40

Legend:
- 5 Steps
- 10 Steps
- 15 Steps
- 20 Steps
- 25 Steps
- 30 Steps

Graph showing the relationship between density and percent reached for varying time steps.
Summary

- Need a relatively high number of Time Steps to Retain Message or a relatively high density to reach near 100% Saturation
- Thresholds Exist among among Densities for each of the number of Time Steps to Retain Message
Conclusions

- Randomly Moving Agents with “Short-Term Memories” can Result in a Highly Saturated Mobile System
- As Density increases, the likelihood that sharing is possible Increases
- As the Time Steps to Retain Message increases, the likelihood that the agents will have a Message to share Increases