



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

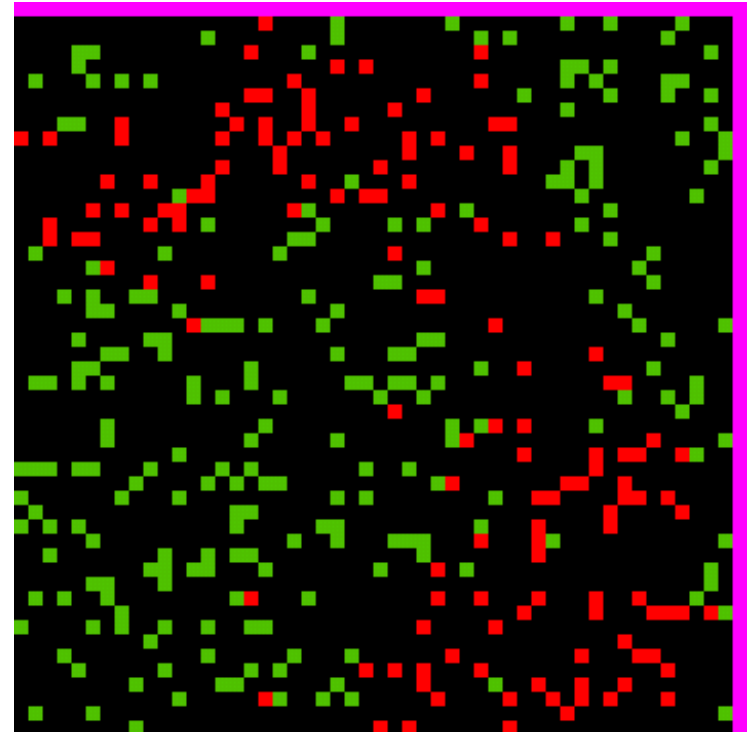
- Personal communication
- Robots exploring a distant planet
- Computer Networks
- Wireless Networks



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



Data

- A high Time Step or Density of Agents is required for near 100% Saturation

Table 1
Time Steps Message Retained

	5	10	15	20	25	30	
Density	3	---	0.015	0.047	0.052	0.076	0.159
5	0.015	0.051	0.095	0.197	0.186	0.397	
8	---	---	---	0.577	0.86	0.9	
10	0.035	0.239	0.601	0.932	0.981	0.993	
13	---	---	---	0.988	0.995	0.998	
15	0.077	0.815	0.97	0.994	0.999	1	
18	---	---	0.994	---	---	---	
20	0.406	0.98	0.996	0.999	1	0.999	
25	0.887	0.998	0.999	0.999	1	1	
30	0.977	0.999	0.999	1	1	1	
35	0.993	---	---	---	---	---	

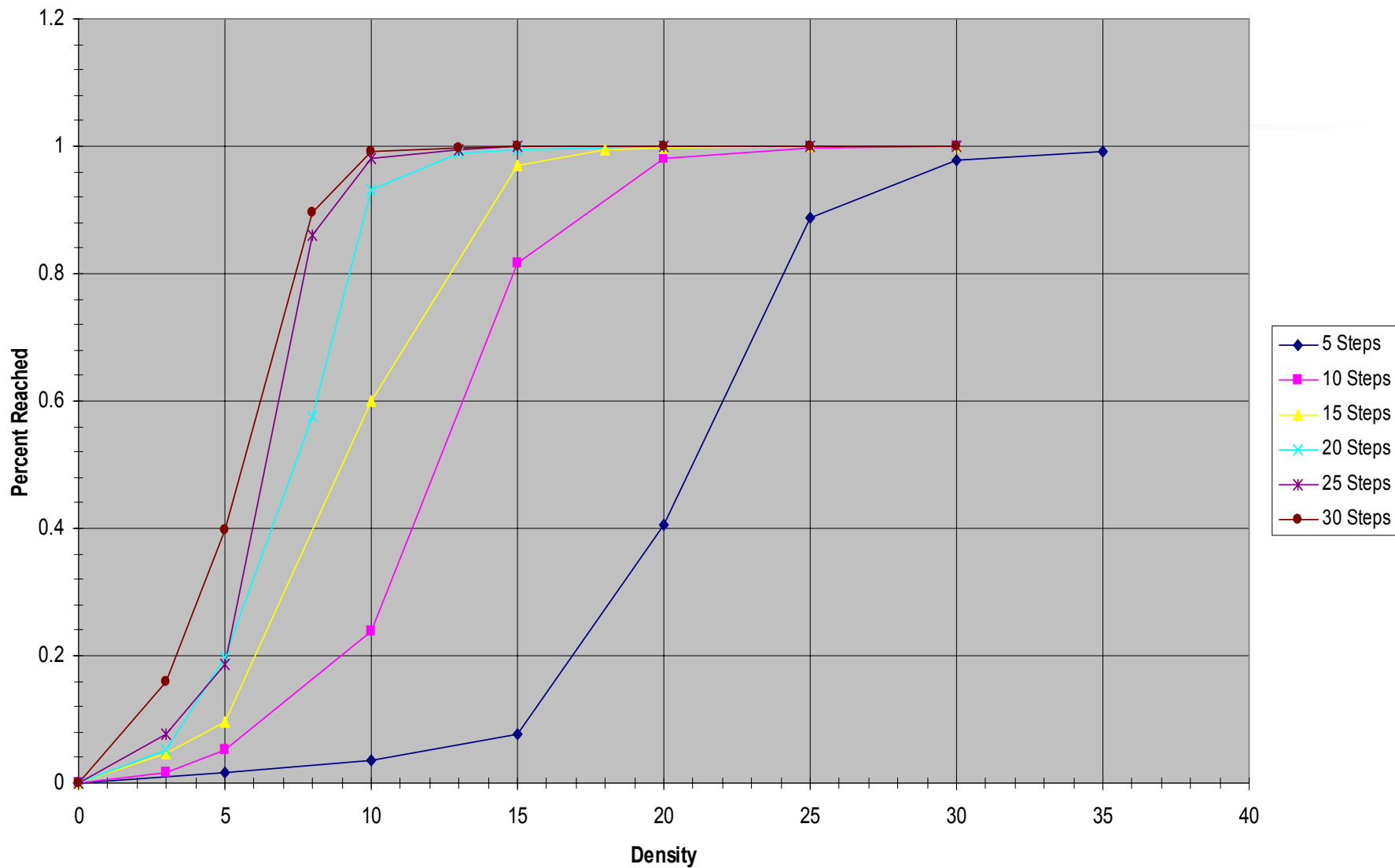


Trends

- 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





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