科技部計畫名稱：行動機會網路下結合時空週期性之訊息傳輸技術(1/3)
科技部計畫編號：MOST 105-2221-E-008-029-MY3

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Content

Data dissemination in challenged environments or mobile opportunistic networks, such as space network, disaster communications, delay/disruptive-tolerant networks (DTN) and sparse MANET, often suffer from many problems such as unpredictable network topology, route looping and high message traffic overhead.

In this project, our first-year research exploits geographic information for message delivery in mobile opportunistic networks. We now obtain two efforts: (A) Using Two-Hop Neighborhood Information to Enhance Geographic Routing (Geo-Routing) in Sparse MANETs, and (B) Geo-Routing with Angle-Based Decision in Delay-Tolerant Networks.

Part A

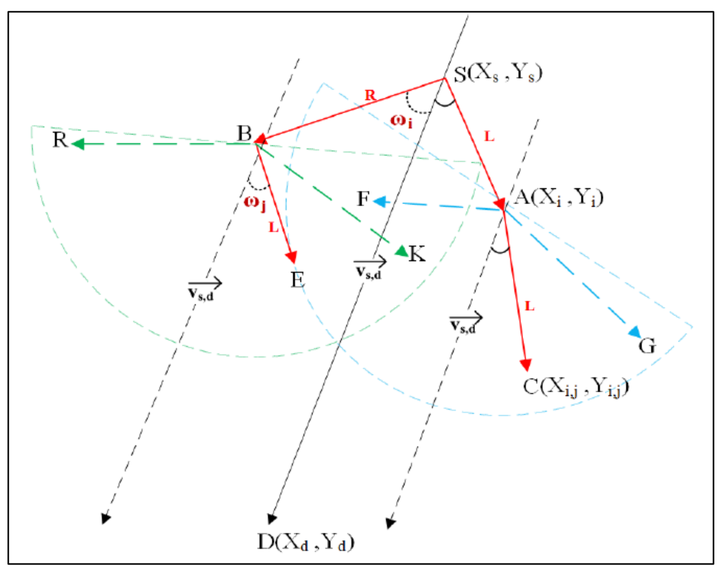
A1. Introduction

The geographic routing methodology does not require costly establishment and maintenance of complete routes from a source to a destination in a network. It is thus considered a pragmatic data delivery solution in highly dynamic network environments.

In this study, we propose a geographic rouging scheme which exploits the notions of two-hop information and forwarding area to support the data delivery in sparse MANETs. Our proposed scheme adopts two functions to remedy communication voids, as follows. Firstly, we define a new measure of the minimum summation angle. This measure can be referred to discern the "line quality" of a relay node. Secondly, we demarcate specific forwarding areas to avoid the loose selection of relay nodes in a vicinity.

A2. Scheme design

Nodes n_a and n_b are one-hop neighbor nodes, and nodes n_r, n_e, n_k, n_f, n_c, n_g are two-hop neighbor nodes. The calculation of w_i is given by $w_i = \arccos(\frac{\vec{v_i}\cdot\vec{v_{s,d}}}{\|\vec{v_i}\|\cdot\|\vec{v_{s,d}}\|})$. The geometric angle from ns to any $n_{i,j}$ in a two-hop transmission range can be determined by the result of summing up $\pm w_i$ and $\pm w_{i,j}$, as referring to summation angle in a polar system.

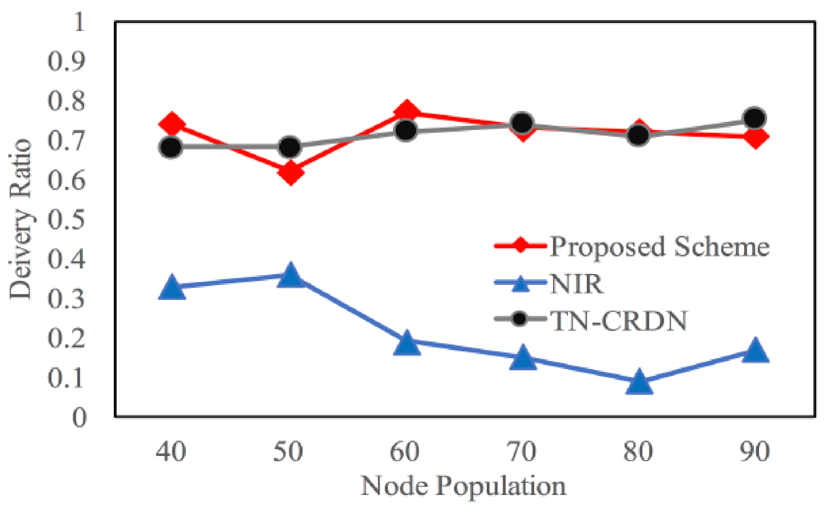


- Minimum summation angle

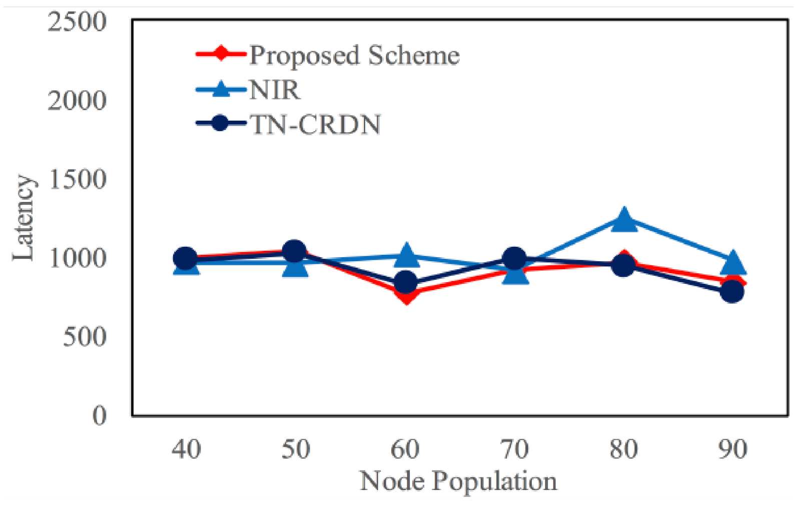
Parameter	Value
Map size	1000×1000 meter^2
Simulation time	86400 seconds
Number of nodes	40 ~ 90
Transmission radius	25 meters
Transmission data rate	3 Mbps
Message size	5 KB
Maximum buffer size	200 KB
Message time-to-live period (TTL)	40 ~ 90
Message generation period	60 ~ 60060 seconds
Message generation interval	60 seconds

- Simulation parameters

A3. Experiment result



- Delivery ratio w.r.t node population



- Latency w.r.t. node population

Part B

B1. Introduction

To enhance the performance of message delivery in DTNs, data replication is often used to increase the number of copies of an original message so as to increase the probability of a message received by its destination. A practical solution to any replication-based routing paradigms is to bound the message workload and communication cost in a network.

B2. Mechanism design

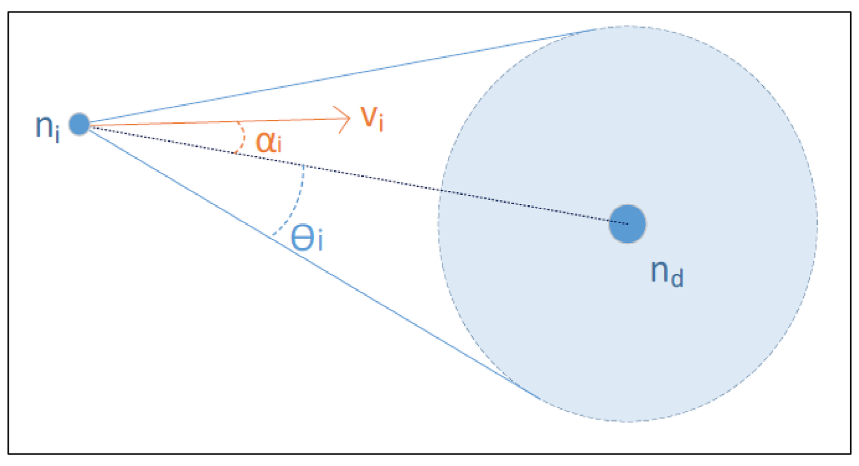
This study uses data replication and geographic information to design a Geographical Routing scheme with Angle-Based Decision (GRAD) for message delivery in a large-scaled DTN.

(1) GRAD combines the advantages of SnW with a binary spray-and-wait mode.

(2) GRAD takes account of moving direction, velocity and angle of each relay node related to a baseline between a data-carried node and a destination.

(3) GRAD can select an appropriate relay node and iteratively hand over message copies to relay nodes in a network.

(4) We compare GRAD with Flooding, Epidemic and SnW schemes under Random Waypoint RWP) and SLAW mobility models.

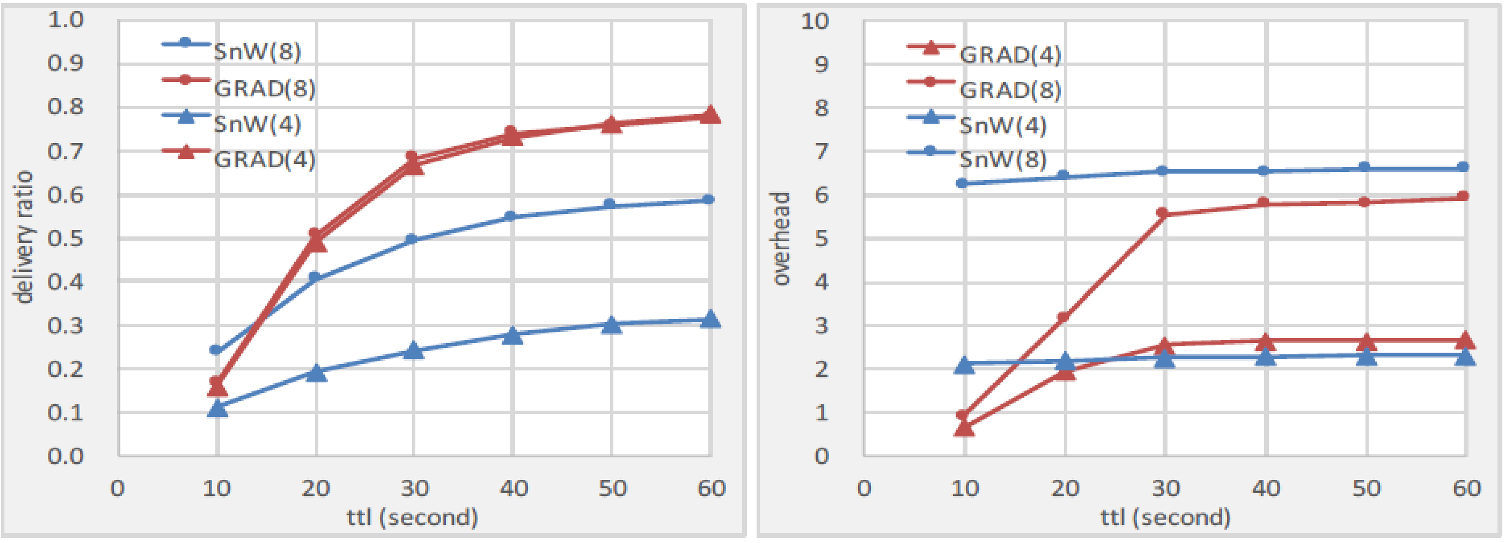


- Geographic angle-based computation

Parameter	Value
Map size	1000×1000 m^2
Number of nodes	22
Transmission radius	100 m
Node speed	2 m/s
Quota of a message	4 or 8
Message size	5 KB
Maximum buffer size	100 KB
Message generation interval	60 seconds

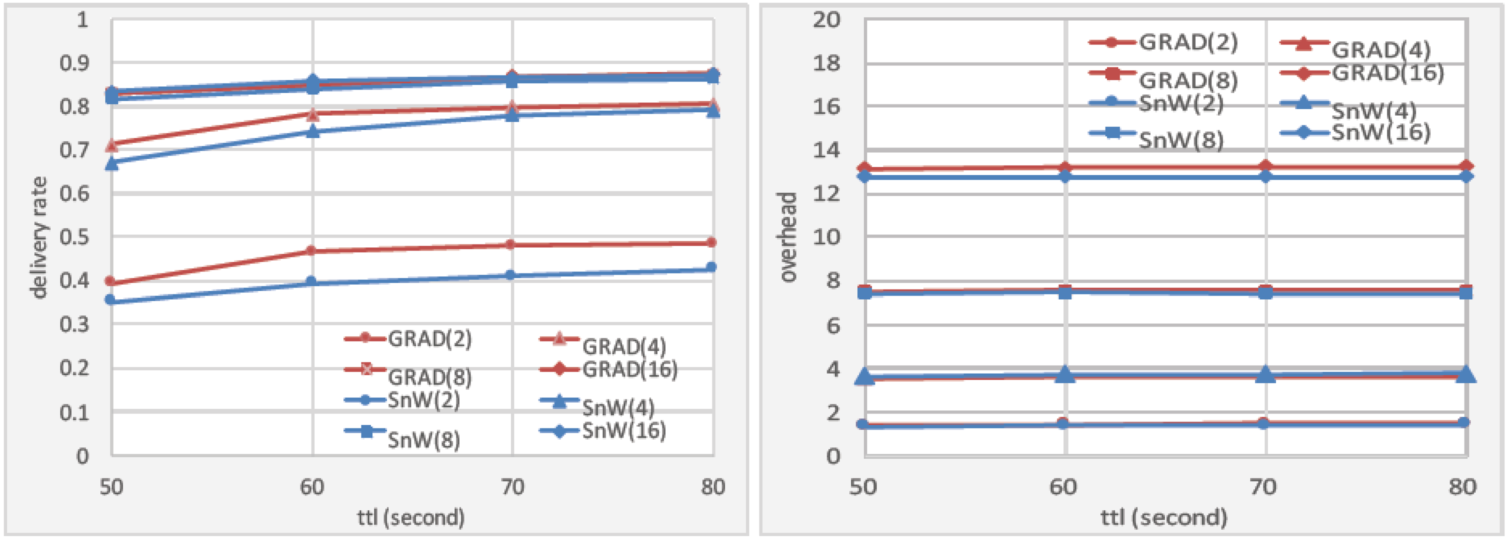
- Simulation parameters

B3. Simulation result



(a) Delivery ratio between GRAD and SnW (b) Overhead between GRAD and SnW

- Relative performance between GRAD and SnW under the RWP model



(a) Delivery ratio between GRAD and SnW (b) Overhead between GRAD and SnW

- Relative performance between GRAD and SnW under the SLAW model

Summary

In Part A, we propose a geographic routing scheme based on two-hop neighborhood information. This scheme exhibits the efficient performance with satisfactory delivery ratio and scalable latency. In Part B, we propose a geo-routing with angle-based decision (GRAD) scheme which uses the moving direction and the angle deviation between relay nodes and destinations in a network. Simulation results under both RWP and SLAW mobility models show that GRAD performs better than SnW.