科技部計畫名稱：耐延遲網路下路由與資料管理技術(1/2)

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Content

Delay-tolerant networks(DTNs) emphasize the aspects of environmental affects in reality, high node mobility and uncertainty of node presence in large-scale geographic scope, as compared with traditional mobile ad hoc networks that are mainly applied to network services in managed network domains. In response to critical circumstances above, a promising solution is essential for the design and development of delay-tolerant data dissemination technologies, thereby being a vital research dimension.

We study the mobility features of human and design a routing algorithm based on skewed movement patterns. We now obtain two efforts: (A) Analyzing human mobility in delay-tolerant networks with NCU scenarios, and (B) Messages forwarding with ferries in DTNs

Part A

A1. Introduction

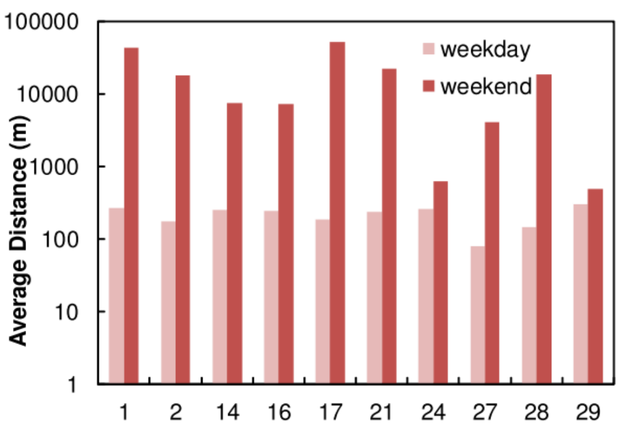
In DTNs, unscheduled contacts among devices carried by individuals are important for messages transferring. We make a real world experiment which includes mobile users who study in National Central University. From analysis, we discover several mobility features of human including periodical contacts of participants, relationships between contacts, social human features and contact duration etc. Researchers could design message routing algorithms with these results in order to enhance data delivering performance.

A2. Experiment Setup

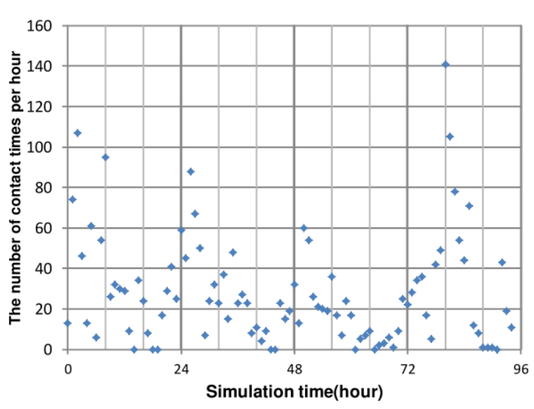
Thirty participants are asked to install an application, called MyTracks developed by Google on Android phones. This software is able to save locations of mobile nodes with GPS signals. The experiment started on Monday, December 15th 2014, 12:00 (UTC+8) and stopped on Tuesday, December 30th 2014, 12:00 (UTC+8).

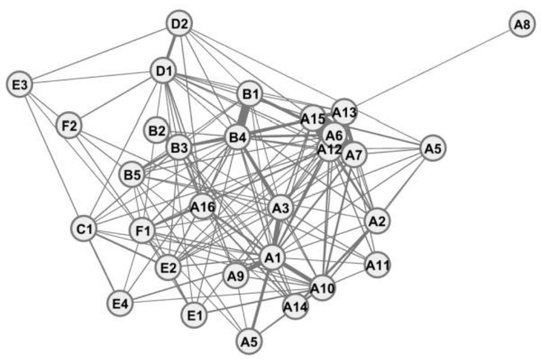
A3. Experiment result

- Average distribution of certain nodes



- The number of contact times per hour





duration(s)	amount	ratio	times	amount	ratio
0 100	1771	65.64%	1	62	17.08%
100 200	237	8.78%	2	49	13.50%
200 300	114	4.23%	3	39	10.74%
300 400	63	2.34%	4	37	10.19%
400 500	33	1.22%	5	41	11.29%
500 600	17	0.63%	6	25	6.89%
600 700	24	0.89%	7	23	6.34%
700 800	25	0.93%	8	16	4.41%
800 900	7	0.26%	9	14	3.86%
900 1000	33	1.22%	10	9	2.48%
>1000	374	13.86%	>10	48	13.22%
all	2698	100.00%	all	363	100.00%

- Contact duration and times in pair of nodes
- Gephi: a network of contact times and social features

We discover several human mobility patterns from above experiments. Thus, researchers couldn't ignore these mobility features as considering design of routing algorithms.

Part B

B1. Introduction

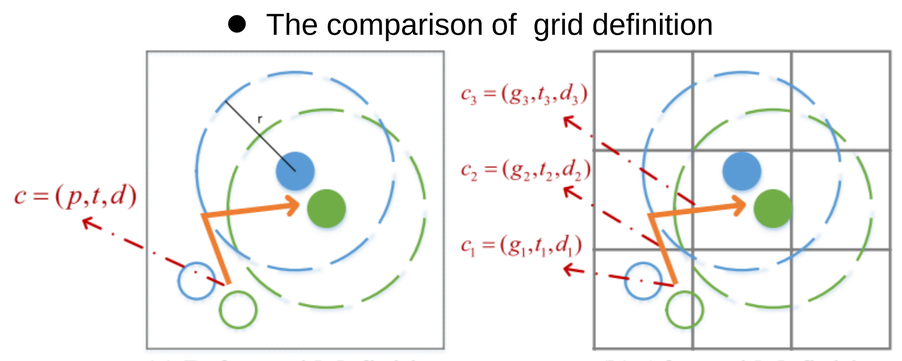
Network performance in DTNs is obviously affected by nodes mobility and broken network topology. To mitigate these problems, this paper considers the use of message ferries to provide controllable movement and boost non-randomized contact opportunity. This paper designs a geographic ferry movement scheme that allows ferries to determine hotspots by contact history and to determine their routes dynamically. The proposed scheme (GFM) has three contributions:

1) GFM provides a novel scheme to determine hotspot areas.
2) GFM leverages the solutions in Travelling Salesman Problem to design ferry movement.
3) The effect of ferries enhances the delivery ratio and the latency significantly, but somehow causes larger transmission overhead.

B2. Mechanism design

We assume that both nodes and ferries are equipped with GPS. Nodes use GPS to generate contact records whenever they contact with each other:

- The comparison of grid definition

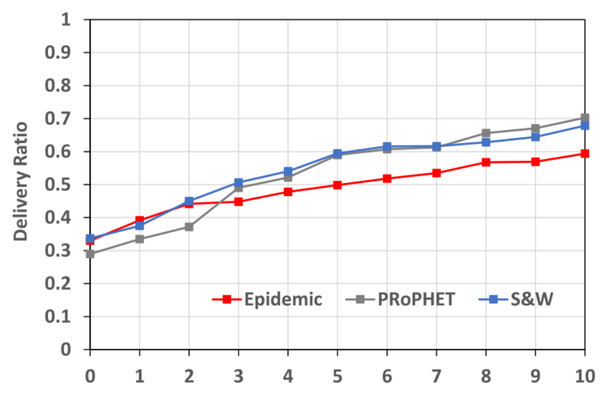


(a) Before grid definition (b) After grid definition

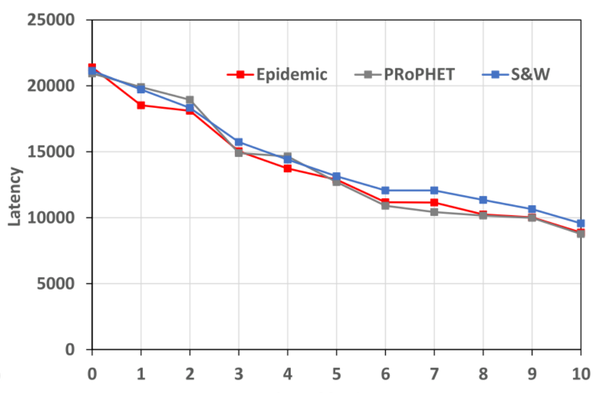
We use the Pareto principle to design the hotspot definition. If α percent contact durations belong to 100 − α percent grids, the ferry assign these grids as hotspots. After ferries determinate where hotspots are, they use the **Travelling Salesman problem** to schedule a tour of hotspots. We use the branch-and-bound (BB) algorithm and the nearest neighbor (NN) algorithm to solve TSP.

B3. Simulation result

- Delivery Ratio in NCU Trace



- The latency in NCU Trace



We evaluate our scheme with three different routing algorithms: Epidemic, PRoPHET and Spray&Wait. Our proposed scheme is able to increase delivery ratio and decrease latency in all routing schemes.

Summary

Therefore, the first-year research achieves two contributions capable of performance improvement for message delivering in DTNs. Our research actions are going to develop a message buffer scheme for not only unicasting but multicasting in a network. Finally, we will analyze the influence of stationary nodes in a network and develop a placement method to potentially enhance performance and reliability.