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(2/3)

科技部計畫編號：MOST 105-2221-E-008-029-MY3

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Content

The technology progress of mobile opportunistic networks (MONs) brings a variety of data services in emerging application fields. Data communications and networking in MONs are dynamic and highly affected due to intermittent connectivity, unstructured topology, and node mobility, etc. Traditional connection-oriented routing paradigms become infeasible in such environments. Our study aims for the design and development of novel data dissemination technologies to sustain the provision and performance of data dissemination in MONs.

In this project, our second-year research now obtains two efforts:(A) Data Forwarding with Finite Buffer Capacity in MONs, and (B) Routing with Temporal Periodicity for Message Delivery (TPMD) in MONs.

Part A

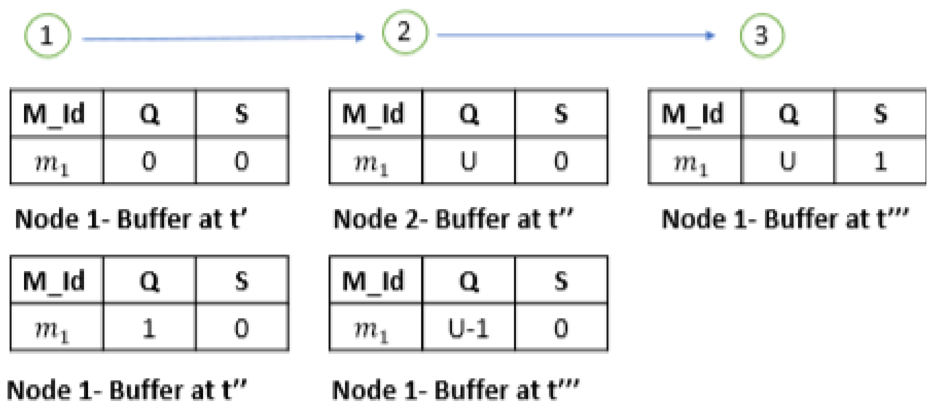
A1. Introduction

MONs usually adopt store-carry-forward strategy to replicate and carry messages in their buffer memory. To make sure that a message generated by source node, replicating messages are used as a promising approach in that at least one of message replicas will reach to the destination.

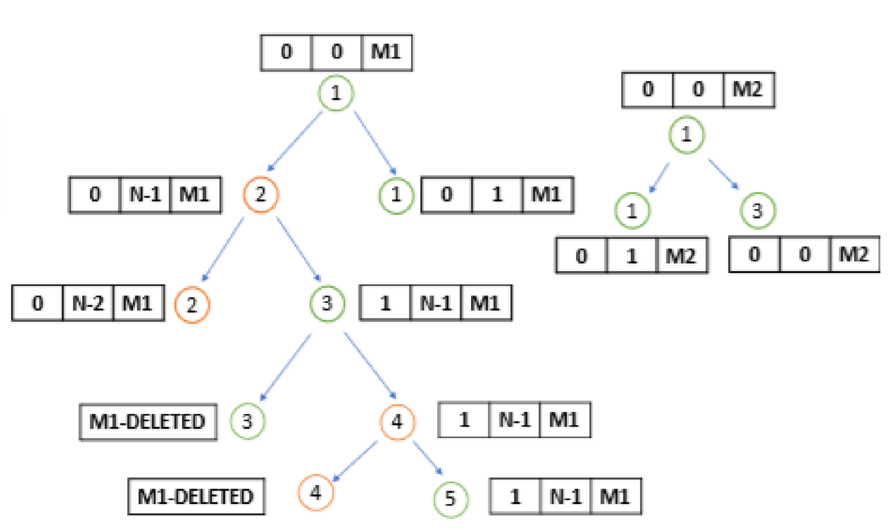
We design a new replication-based routing approach that considers replicating a message initially with a certain quota and use this approach to maintain higher delivery ratio with the minimum delay.

A2. Proposed Scheme

Let $node_1$ have a message m_1 to forward to $node_2$, and $node_2$ be a good forwarder node. Each node has a certain quota Q corresponding to how many times that a node can forward the same message. $node_1$ forwards the message $m1$ to $node_2$ that is a good forwarder. $node_2$will replicate this message further till its quota value becomes equal to one.

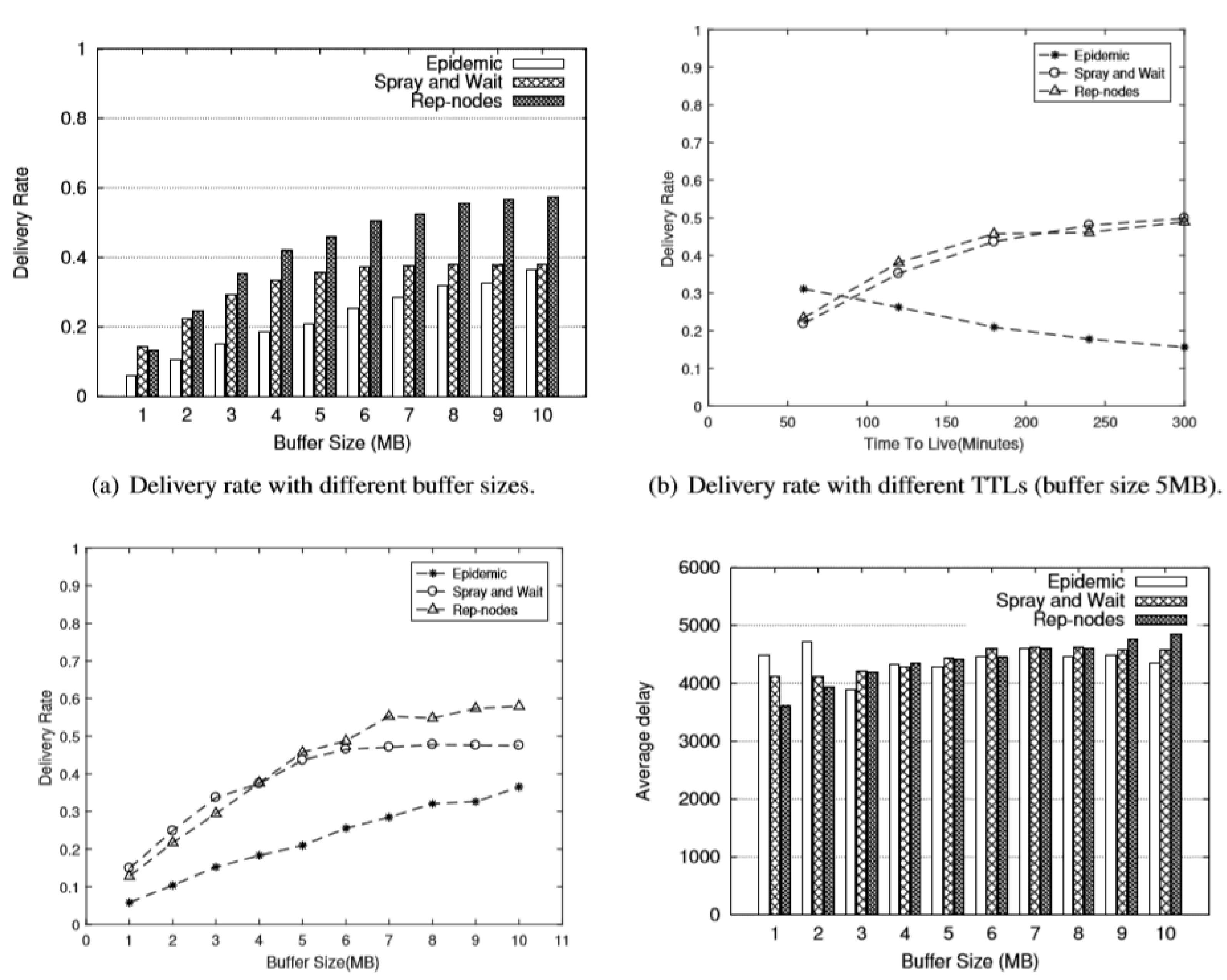


- Forwarding and updating values



- Replicating messages.

A3. Performance Results



(a) Delivery rate with different buffer sizes. (b) Delivery rate with different TTLs (buffer size 5MB). (c) Delivery rate with initial number of copies or quota value. (d) Delay with different buffer size (TTL 180 minutes).

Part B

B1. Introduction

A node in the network is periodic and predictable. However, the realistic behavior of node movement is not strictly periodic but with some time slackness. Hence, our study aims to quantify the periodicity and proposes a new routing scheme, named Temporal Periodicity for Message Delivery(TPMD). TPMD applies not only contact periodicity but also period similarity to develop a specific utility function. Performance results show that our approach can approximate to optimal delivery rate and overhead in MONs.

B2. Methodology

A series of contact instances between nodes nodes i and j from time 0 to t is denoted as $p_{i,j}(t)$. If nodes i and j contacts are periodic, we can predict the residual inter-contact time T_r. Assume that a specific contact period T consists of T_p time units.

With a period length in T_p units the similarity of the contact series between nodes i and j at n-th, denoted as $s_{i,j}(n)$ is derived from previous $u_{(n\to 2T_p \to n-1)}$ and $u_{(n\to 2T_p \to n-T_p-1)}$ units. We have

$$s_{i,j}(n) = 1 - \frac{1}{T_p}\sum_{i=0}^{T_p-1} \left|u_{(n-2T_p+i)} - u_{(n-T_p+i)}\right|$$

Then, we use (1) to calculate the exponential moving average $s^*_{i,j}$.

$$s^*_{i,j}(n) \leftarrow \gamma s_{i,j}(n) + (1-\gamma) s^*_{i,j}(n-1) \qquad (1)$$

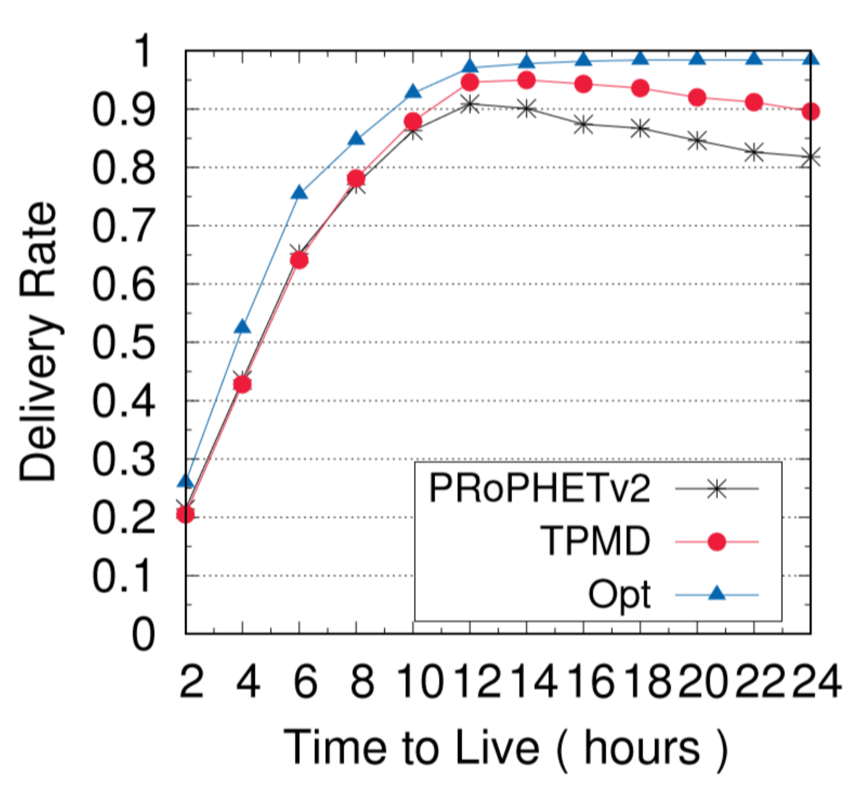
$$u_{i,j}(t) = s^*_{i,j}\left(\lfloor \frac{t}{T_u} \rfloor\right) \times (T_p - T_r) \qquad (2)$$

Hence, if node i contacts node j at time t and has a message destined to node d, node i will replicate the message to j if $u_{i,d}(t) < u_{j,d}(t)$.

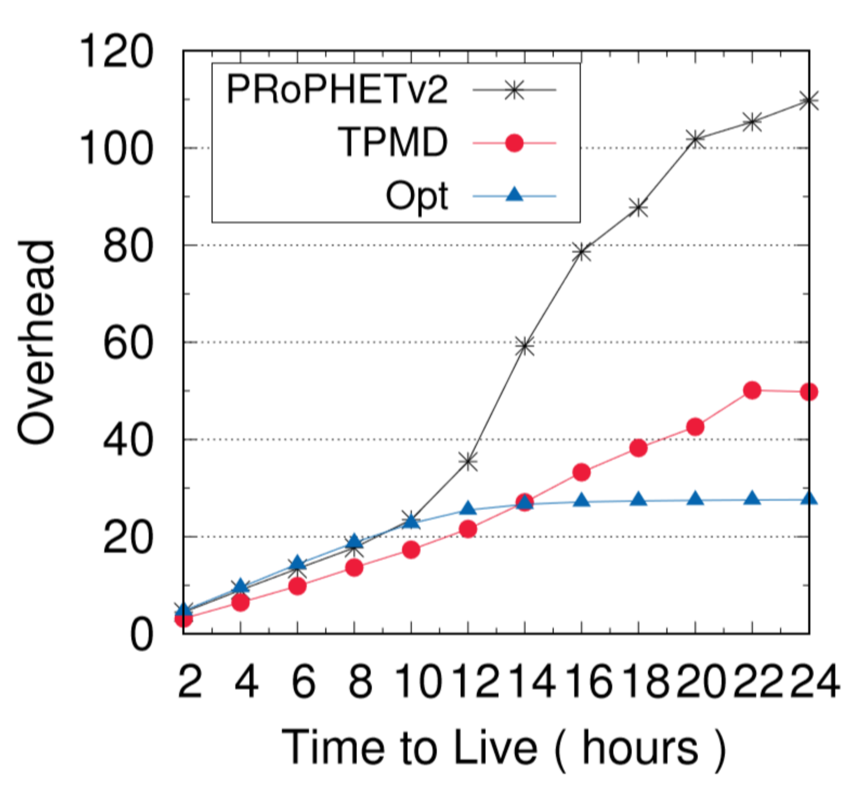
B3. Simulation Result

Parameter	TVCM	Parameter	TVCM
Number of nodes	50	Buffer size in a node	50 MB
Map size	1500×1500 m^2	Transmission speed	1 MB/s
Simulation time	10 days	Transmission range	100 m
Time to live (TTL) w.r.t. a message	2 - 24 hours	γ – factor in (7)	0.5
Message creation interval	300 seconds	T	86400 seconds
Message size	1 MB	T_u	1800 seconds

- Table: Simulation Parameters



- Delivery rate



- Overhead ratio

Summary

Part A has presented a data forwarding and scheduling scheme with finite buffer capacity for message delivery in MONs.

Part B has proposed a novel routing scheme, TPMD, which exploits the temporal periodicity of nodal contacts for determining the profitable relay node selection in MONs.

Both of them can improve delivery rate comparing with previous study in MONs.