耐延遲網路下結合社會網絡之資料傳播技術

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Content

This project considers the delay- or disruption-tolerant networking (DTN) technologies that are characterized by high node mobility, uncertainty of node existence, and intermittent connectivity. Data dissemination in DTNs resorts to new routing paradigms instead of traditional end-to-end routing paradigms in mobile ad hoc networks (MANET).

The first-year research studies new message routing mechanisms in DTNs. Our efforts have: (A) a density-aware routing scheme for the efficient delay tolerant message delivery, and (B) message multicasting with erasure coding-based routing in DTNs.

Part A

A1. Introduction

This study designs a density-aware routing scheme (DARS) by which mobile nodes can sense node density in their vicinities and then decide how to exchange messages with any encountered nodes during movements. This scheme is simple and of less complexity, achieving comparable effects in terms of message delivery ratio and communication costs in DTNs.

A2. Density-Aware Routing Scheme

DARS includes following four phases：

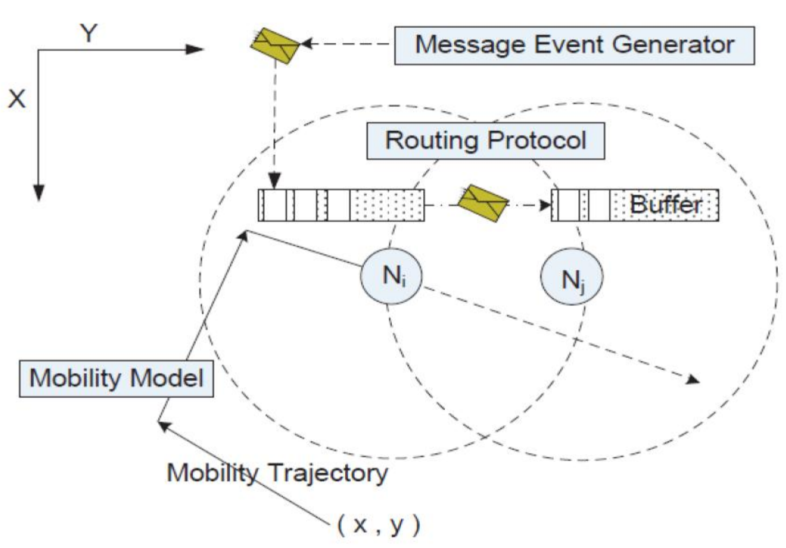
(1) Inter-meeting time normalization

$$\bar{I}_i^{\alpha} = I_i^1 + I_i^2 + \cdots + I_i^{\alpha} = (\sum_{k=1}^{\alpha} I_i^k)/\alpha$$

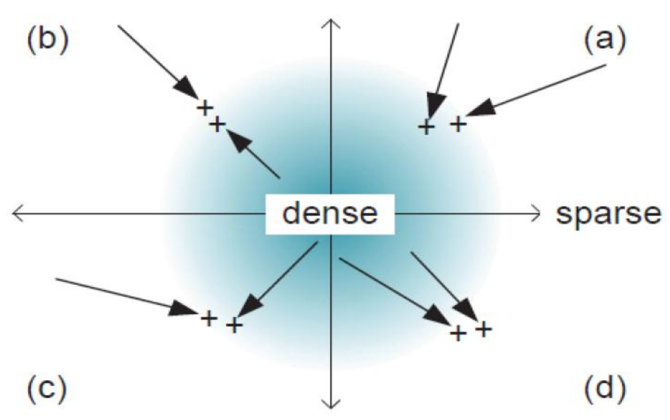
(2) Density estimation

(3) Boundary detection

(4) Forwarding strategy



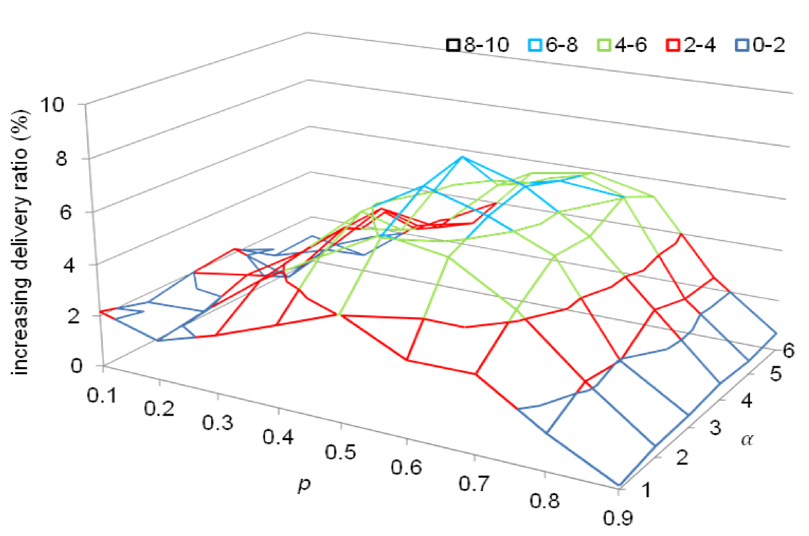
(a) A DTN environment



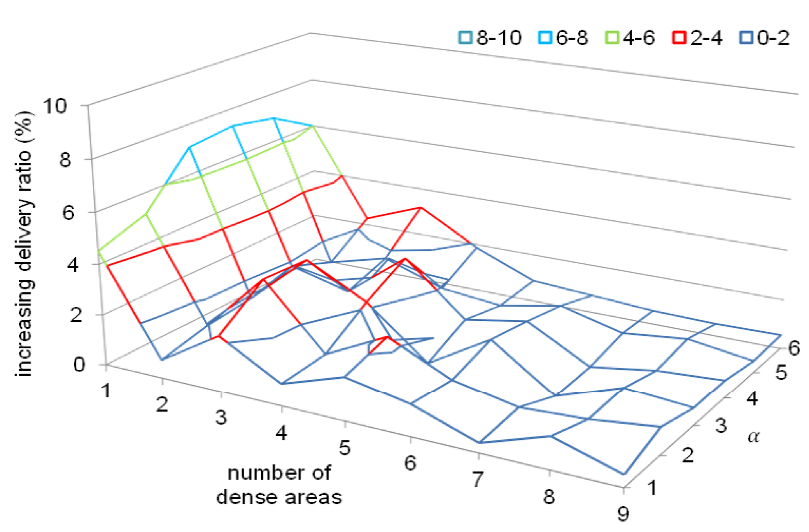
(b) Two nodes encounter in the boundary

Density-aware routing in DTNs

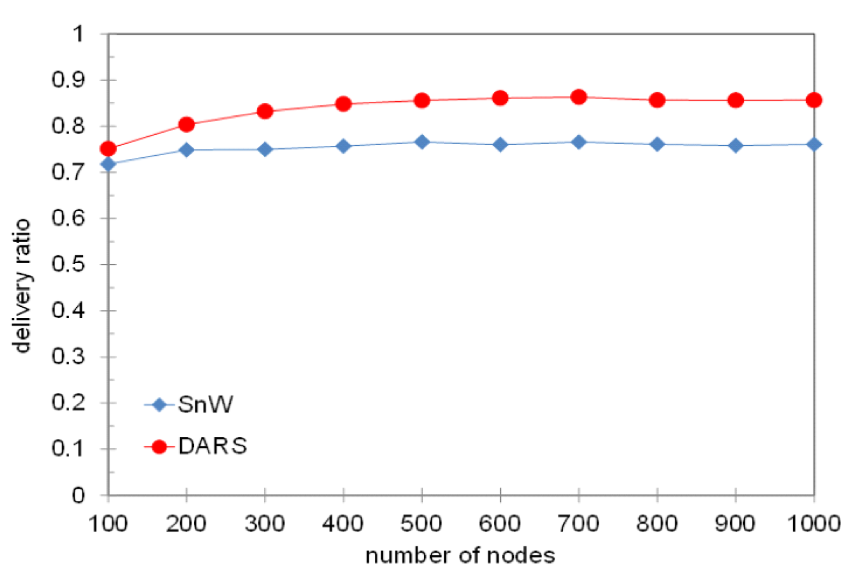
A3. Performance result



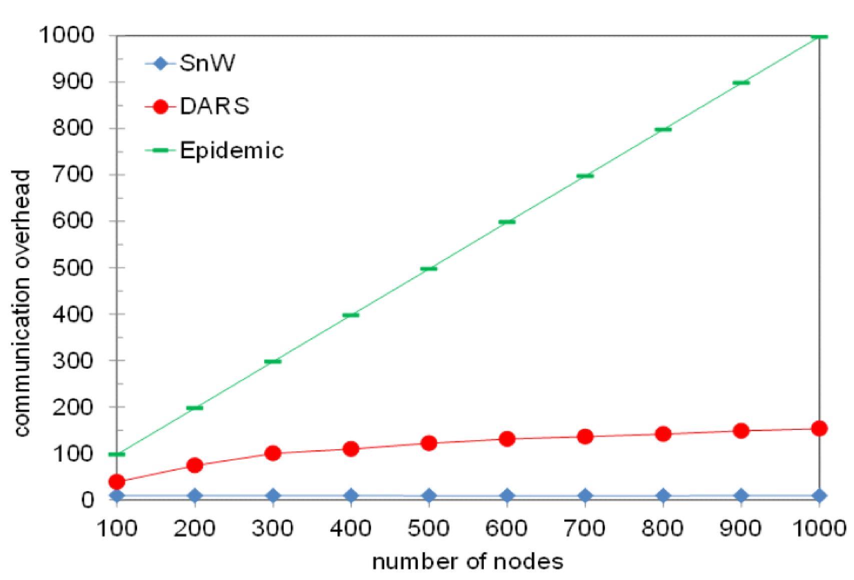
(a) Delivery ratio under a dense area



(b) Delivery ratio under multiple dense areas



(c) Delivery ratio by node population



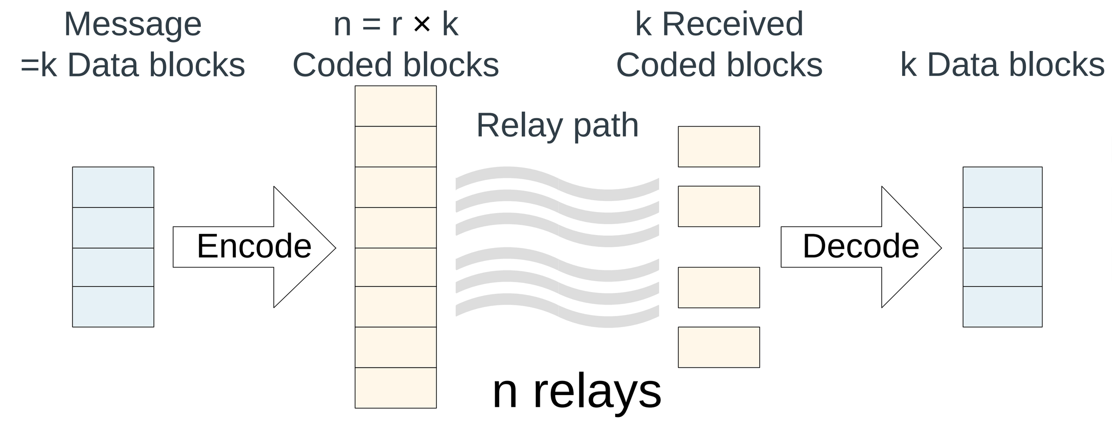
(d) Communication cost by node population

Part B

B1. Introduction

This study quantifies the cost measurement of erasure coding-based routing for both message unicasting and multicasting in DTNs. Upon delivery ratio and delay time, performance examination obtains many new observations, properties and insights into the virtue of the erasure coding based routing paradigm, providing significant information for developing erasure coding-based routing schemes in support of multicasting in DTNs.

B2. A Basic of Erasure Coding

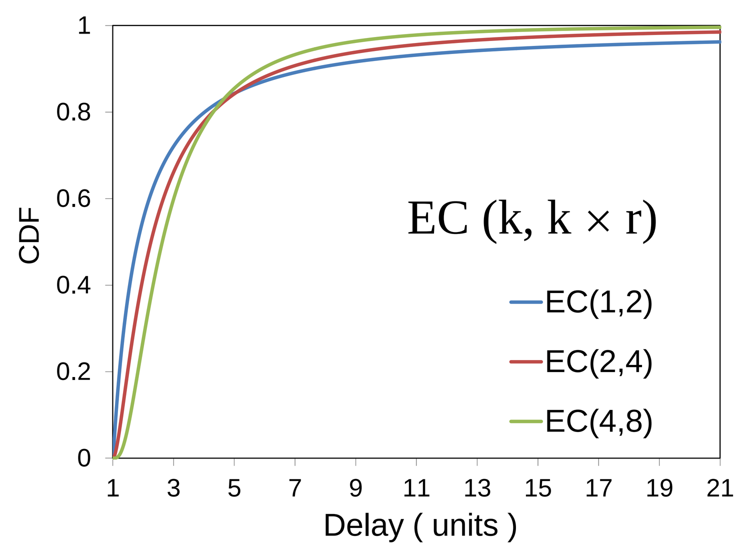


r:replication factor
k:number of divided blocks .

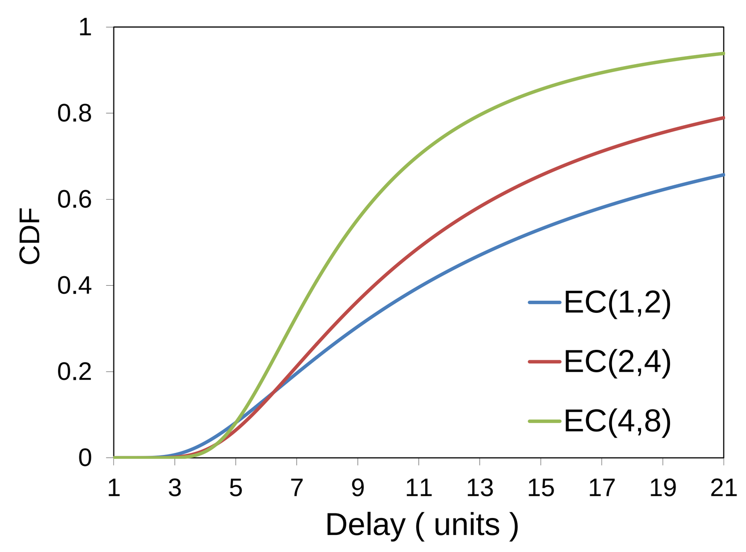
B3. Delay Distribution Analysis for Message Multicasting

Considering a basic EC approach with a replication factor *r* and a split degree *k*. (n=k×r).Applying the order statistics, the delivery delay by EC is Y_k^n . Considering there are N destination nodes, the delay for multicasting is the delay of the N-th destination node . Applying the *order statistics* to obtain the delay distribution of multicasting with N destination nodes

$$Z_N(w) = f(w)\frac{N!}{(N-1)!(N-N)!}F(w)^{N-1}(1-F(w))^{N-N}$$
$$= f(w) * N * F(w)^{N-1}$$



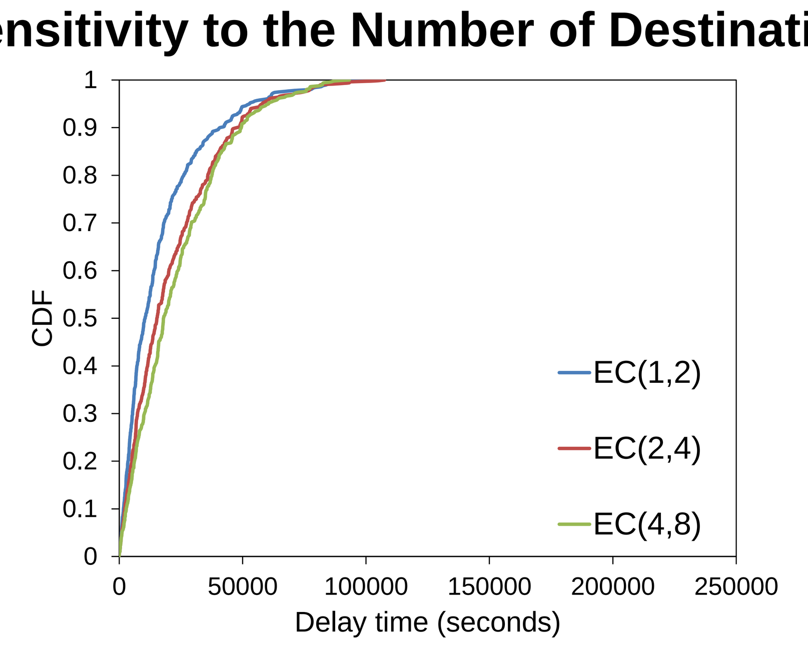
(a)1 destination



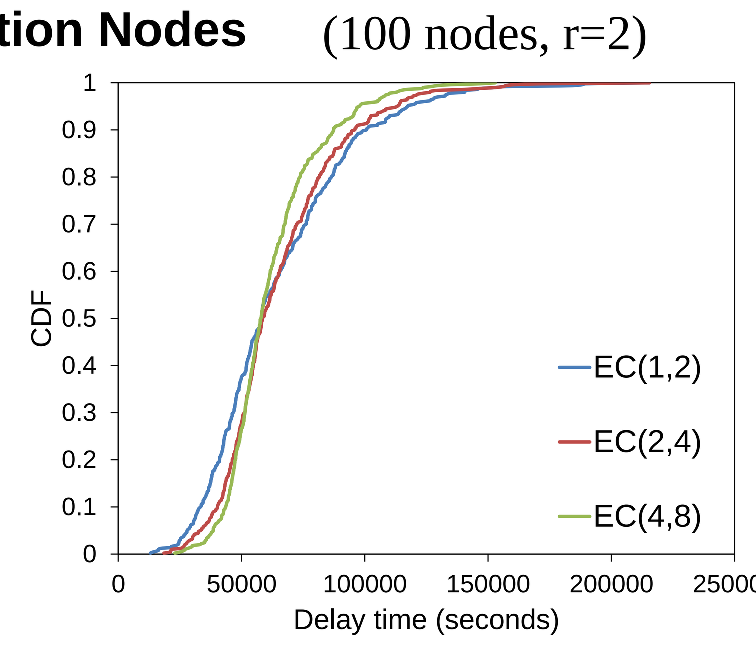
(b)16 destinations

B4. Simulation result

Sensitivity to the Number of Destination Nodes (100 nodes, r=2)



(a)1 destination



(b)16 destinations

Summary

Therefore, the first-year research result achieves two novel delay-tolerant routing mechanisms for data dissemination in dynamic network environments. Their effects are manifested under both analytical and performance investigations. Our research actions are to conduct the study of performance optimization upon the specific routing functionality in accordance with various features of social relationship among nodes, as well as different mobility patterns in delay-tolerant network environments.