Analysis the Effect of Transmission Cost on TTL and Number of Nodes in Social Aware Routing Protocols

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Abstract— The main challenge of Delay Tolerant Networks (DTN) is to select the best path for message delivery since in DTN has no guarantee to instant continuous connectivity between source to destination nodes. The ratio of message delivery depends on the mobility pattern of nodes. For improving the message delivery ratio between source to destination node, social-based routing protocol is an important topic in the research area. Social based routing protocol is a network which is depend on the social nature of human mobility to bring messages close to destination node. It is also considering the user behavior from their daily routine to deliver the message to destination node. There are several social based routing protocols such as Social-aware Content-based Opportunistic Routing Protocol (SCORP), Dlife, DlifeComm, Bubble Rap. In this paper, we measure the performance of SCORP, Dlife and DlifeComm routing protocol by using the simulations in Opportunistic Network Environment (ONE). We evaluated the performances in terms of Transmission Cost with necessary simulation settings by varying the Time-To-Live (TTL) and Number of nodes of each group. From the result, it is summarized that SCORP gives the best performance than Dlife, DlifeComm routing protocol.

Index Terms— Delay Tolerant networks (DTN), Social-aware Content-based Opportunistic Routing Protocol (SCORP), Dlife, DlifeComm, Bubble Rap and Opportunistic Network Environment (ONE).

1 INTRODUCTION

Most of the communication [1] of a network occur with each other by using TCP/IP based protocol and these protcols have end to end connection between source to destination node for maximize delivery ratio. This network is suitable where have an establish route between source to destination node for delivers the message. If the establish connection failure during the transmission of message, then the message can't reach at the destination node. Such kind of situation we can use Delay Tolerant Networks for continue the transmission [2, 3]. DTN are a class of traditional mobile ad-hoc networks that was proposed by the Internet Engineering Task Force (IETF) to handle the intermittently connected network. DTN is mainly developed for space-communication network [4]. The main difference between the ad-hoc network and the DTN is that the connection between source nodes to destination nodes has been established in order to hand over the message in ad-hoc networks, whereas no continuous connection is established to deliver the message in DTNs. DTNs use a mechanism to transfer the messages from the source node to the destination node, which is called "store-carry-and-forward". By using this mechanism, source nodes send the message to intermediate nodes that can store the message in the buffer, until finding the proper node to deliver the message to the destination node or intermediate node [5]. The challenging task of DTN is to design an efficient routing protocol. DTN must need an efficient routing protocol that have maximized deliver ratio, low average latency and transmission cost to deliver the message from source node to destination node. The delivery ratio will be high by replicating the message between different nodes so that at least one copy of message may reach at the destination node [6]. To improve the performance of a network the researchers start developing a concept of routing protocol that is able to absorb social interaction and also the interests of nodes in a network [7]. In this paper we look into performance of different social based routing such as SCORP, Dlife and DlifeComm in terms of Transmission Cost. The detail simulation setup and metrics is given in section 3.

The rest of this paper structured as follows: in section II, we discuss about Social Based routing protocol viz. SCORP, Dlife and DlifeComm. Section III recount the simulation environment. In section IV shows the simulation result. Session V concludes this paper.

2 SOCIAL BASED ROUTING PROTOCOLS

The node of a network has limited resources available for storing the message [11] and forwarding so routing is very important in a network. The maximize message delivery ratio also plays important role in routing. The design of routing protocol should as simple as possible, which will facilitate routing with least control messages [8].

2.1 Social-aware Content-based Opportunistic Routing Protocol (SCORP)

SCORP is a social-based routing protocol that considers the users' social interaction and their interests to improve the message delivery in dense scenarios. It utilizes social proximity and content knowledge to increase data delivery efficiency [8]. There are two reason to use social proximity with content knowledge:

- First, nodes with similar daily habits have higher probability of having similar (content) interest
- Second, Social Proximity metrics allow for faster data transmission by taking advantage of more frequent and long contacts between near nodes [9].

SCORP is only expected to create duplicates in nodes that are actually interested in content sent in the message, or have

a strong relation with nodes of that particular interest [10].

2.2 Dlife

Dlife is a social-aware routing protocol which considers the user's behavior based on their daily periods of time. It considers two complementary utility functions: Time-Evolving Contact Duration (TECD) and TECD Importance (TECDi). Using TECD function source node or intermediate node forward the message other node that have strong relationship with destination node than the current carrier node. With help of TECD each node calculates the average of their contact duration with other nodes. The TECD Importance (TECDi) function captures the evolution of the importance of the user based on its node degree and the social power of neighbors over time [9]. Finally, complete content and organizational editing before formatting. Please take note of the following items when proofreading spelling and grammar.

2.3 DlifeComm

DlifeComm is a community-based version of Dlife Routing protocol. It computed the social communities that are similar to BUBBLE Rap. It uses two utility function as like as Dlife routing protocol that is modification over time [12].

3 SIMULATION ENVIRONMENT

In this paper, we investigated the performance of SCORP, Dlife and DlifeComm social based routing protocols in Delay-Tolerant Networks. All these routing protocols are simulated using Opportunistic Network Environment (ONE) simulator of version 1.4.1. This section explains the ONE simulator, simulation environment setup.

3.1 The ONE simulator

For the purpose of simulation, we used Opportunistic Network Simulator (ONE) that running on Java platform. It is discreate agent-based event simulation engine that is created for DTN routing protocol evaluation. The main function

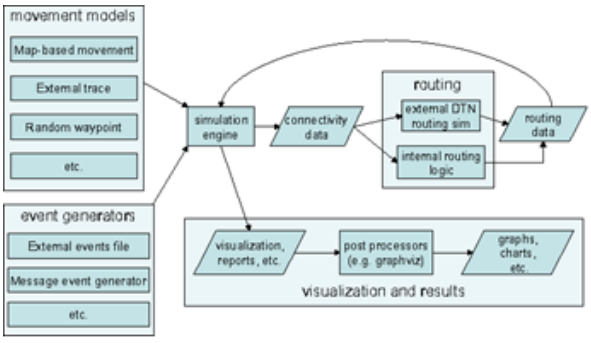

Figure-1: Overview of ONE Simulator

of one simulator is to inter-node connection respect to different interface, handling of message, movement model of node and interaction with application. Result analysis and collection are done by visualization, reports in a one package. The one simulator interaction and their element shown in fig-1. Which has four modules, namely, movement models, routing, event generator and visualization, and results. A full information of one simulator is available in [13] and the ONE simulator project page where the source code is also available [14].

3.2 Simulation Environment Setup

Parameter of simulation setup are summarized in table-1 that are used for current analysis

Table-1: Parameters for simulation set up

Parameters	Values
Simulator	Opportunistic Network Simulator (ONE)
Simulation time	43200 Sec (12 hour)
Update interval	0.1Sec
Interface	Bluetooth interface
Interface type	Simple Broadcast Interface
Transmit speed	220 Kb
Transmit range	10m
Familiar Threshold	700
Buffer size	10M
Message Size	200-600 KB
Total Message generation	250
Message TTL	120,240,360,480,600 (min)
Number of nodes each group	20,40,60,80,100
Routing protocol	SCORP, Dlife, DlifeComm
Movement model	Shortest path map-based movement
Simulation area size	8500 × 7500 m

4 SIMULATION RESULT AND ANALYSIS

In this section, we focused on the performance of social based routing protocol with regard to transmission cost varying the message Time to Live (TTL) and Number of Nodes of each Group. The results are presented here, obtained according to run the simulation as per as the parameter defined in Table 1.

Transmission cost can be defined as the number of relay operation over the number of total delivered message source node to destination node. It can be defined as

$$\text{Transmission cost} = (\beta-\alpha)/\alpha \quad (1)$$

Where β is the number of messages forwarded by relay nodes and α is number of messages delivered to the destination.

For varying the message TTL, we constraint the buffer size value to 10M, Message size to 200-600 kb, and number of nodes of each group to 40. From figures 2, it is evident that the transmission cost of Scrop routing protocol is low compared to that of Dlife and DlifeComm routing protocol. The transmission cost of these routing protocol is increased with increasing

the message TTL. But in Scrop routing protocol, the transmission cost is constant as the message TTL increase from 6 to 10 hours respectively. This occurs because, Scrop messages are routed based on interests, content types etc. So, fewer messaes are deployed for a successful message broadcast toward destination node and source node are forwarded the message that node has the same content interest of message carried by source or, that node has strong relationship to the source node. The transmission cost of Dlife and DlifeComm are increased with increasing the TTL because both routing protocol are copy of message toward encountered node since it has greater relation with destination node than current source node. Hence, Scrop exhibits highest and DlifeComm provides worst performances.

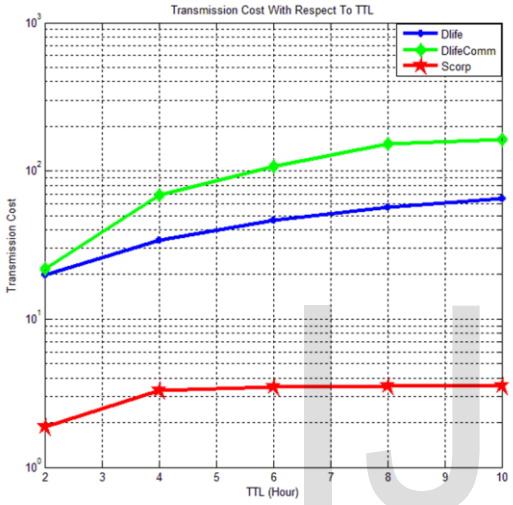

Figure-2: transmission cost with respect to varying message TTL

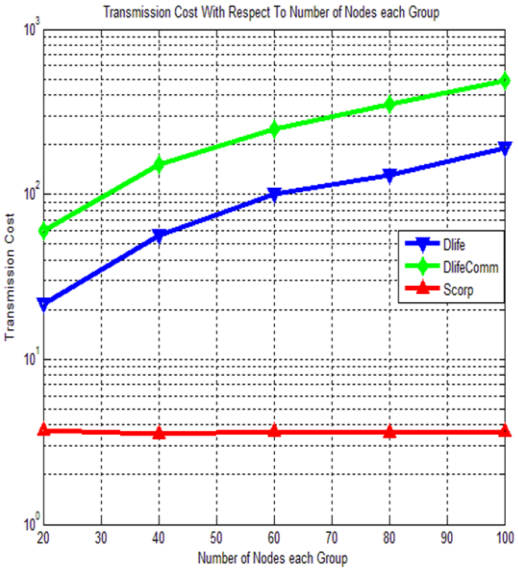

Figure-3: Transmission cost with respect to varying the number of nodes each group.

Varying number of nodes each group, we constraint the buffer size value to 10M, TTL value to 480 minutes and message size to 200-600kb. Figure-3 demonstrates the transmission cost with respect to varying the number of nodes each group for SCORP, Dlife and DlifeComm routing protocol. It is observed that the transmission cost of Dlife and DlifeComm routing protocol are increased with increasing the number of nodes each group. This is because as the number of nodes increase that means the density of nodes increase so the source node couldn't find proper node to forward the message towards to the destination node. In Scrop source node are forwarded the message that node has the same content interest of message carried by source. Therefore, we can say that SCORP has best transmission efficiency.

5 Conclusion

In this paper, we analyzed the performance of different social based routing based on Transmission Cost with the impact about number of nodes each group and message TTL. From the simulation result it is concluded that SCORP has low transmission cost where Dlife and DlifeComm has the highest transmission cost. In future, our aim is to evaluate the performance of these routing protocol with other performance metrics over the Bangladesh map which may help us to design a new practical social based routing protocol.

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