IJARCCE

ISSN (Online) 2278-1021
ISSN (Print) 2319-5940

International Journal of Advanced Research in Computer and Communication Engineering

Vol. 8, Issue 12, December 2019

Study the Impact of Latency on Delay-Tolerant Networks (DTN) Based on Social Based Routing Protocols

Sujan Chandra Roy[1], Md. Firoz Ahmed[2], Farhana Enam[3]

Department of ICE, University of Rajshahi, Rajshahi, Bangladesh[1,2,3]

Abstract: The classical wireless networks based on TCP/IP protocols will provide better performance to the users when end to end connection is available. However, if the path is not available, then the TCP concept is not applicable. In such a case, Delay Tolerant Networks were applicable. DTN networks are also infrastructure-less wireless networks like Ad-hoc and Mobile Ad-hoc Networks (MANET), where the deployment is not depended on fixed infrastructure such as base station, router for successful data transmission. Messages are delivered from a source node to a destination node via a store-carry and forward based mechanism. In this article, we investigate the performance of two DTNs routing protocols such as Epidemic as well as Binary Spray and Wait (BSNW) together with two social-based routing protocols such as SCORP and dLife conducting Opportunistic Network Environment (ONE) simulator based on average latency by varying node density of every group and buffer size. Simulation result mention that, Binary Spray and Wait routing protocol performs excellent among the considered routing protocols as well as the simulation scenarios.

Keywords: Delay-Tolerant Networks (DTN), Binary Spray and Wait (BSNW), Social-aware Content-Based Opportunistic Routing Protocol (SCORP), dLife, Ad-hoc and Mobile Ad-hoc Networks (MANET) Opportunistic Network Environment (ONE)

I. INTRODUCTION

The main principle of any communication system [1-4] is to transfer data source to destination without facing any problem. Delay Tolerant Networks (DTNs) are a new enlargement in the network research field. DTNs are one kind of Ad-hoc wireless network that possesses communication where the connection matters like a rare connection, interrupted connection, high latency, Long delays, high error rates, asymmetry rates. Such kind of network the source to destination path does not seem obtainable all time. So, the message delivery end to end path occurs only by using multiple hops [5-6]. However, DTN use tore-carry and forward (SCF) based mechanism for successfully delivery message from source to destination node. By using the SCF mechanism in DTN, a source node sends the message to the nearest node that can deliver the message to the target node, and this node keeps the message in the buffer and carries until to get the destination node or an intermediate node. Forward the message when getting the desired node. These messages are forwarded to other nodes based on predefined criteria. Finally, the messages are delivered to a destination node via multiple hops [7-9]. Figure 1 shows a basic example of DTN. Here, the source node wishes to send a message to the destination but cannot because no direct connection with the destination node for forwarding message or is too expensive to use (e.g., GSM). So, the source node first forwards the message to the nearest neighbour node or relay node within range. This node stores the message in the buffer and forwards the message next intermediate node, and finally, the message reaches the destination node by using multiple hops. DTNs can be employed in interplanetary networks.

In an opportunistic network, the routing must be capable of serving with irregular contacts, device constraints with storage, highly mobile nodes, intermittent connectivity, and no existence path between source to destination. As the end to end, the path does not exist, so routing is one of the main issues for message transmission. The main concern of routing protocol is the high delivery ratio, low latency, low hop count, and low energy-consuming. Achieving those goals, the researchers begin to develop an idea of routing protocol that enables social interaction and also interests the content that nodes want [10].

In this paper, we look into the impact of node density of each group and buffer size, taking into general DTN routings such as Epidemic as well as Binary Spray and Wait (BSNW), including social-based routing protocol; SCORP and dLife. The residual of this paper is organized as follows: Section II, Investigated DTN, and Social- based routing protocol are illustrating. Section III explain the simulation Settings. Later, section IV explains the simulation results. Finally, Session V concludes this paper.

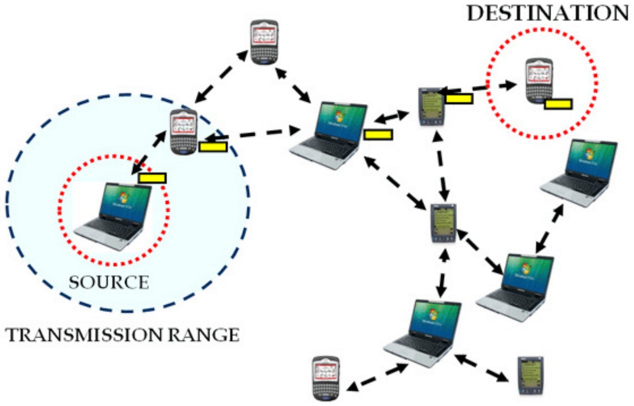

Fig. 1: Message delivery system in DTN

II. DIFFERENT ROUTING PROTOCOLS

A brief description of viewed customary DTN and Social based DTN routing protocols: Epidemic, Binary Spray and Wait (BSNW), Scorp and dLife are discussed in this section.

A. EPIDEMIC

The Epidemic is the first routing protocol in DTN that proposed by Vahdat and Becker et al. (2000). This protocol has zero knowledge about other nodes in a network. This protocol mainly forwards the message to the next node by replicating the message copy. In this protocol, the source node forwards the message to all the encountered nodes without maintaining rules so that at least one copy of the message can reach the destination node. As the Epidemic does not maintain any rules for forwarding message so this protocol takes more message copy and more many hope to message handover to the destination node [11].

B. BINARY SPRAY AND WAIT (BSNW)

To resolve the replication problem of Epidemic routing, the authors [12] proposed the Spray and Wait for the routing protocol. The main dissimilation between Epidemic and Spray and Wait (SnW) routing protocol is that SnW generates a few numbers of message copies than Epidemic.

SnW protocol follows two phases one is the spray phase, and another one is the waiting phase for forwarding message copy to the destination node. In the first phase, the message owner node forwards only a limited number of message copy to the neigh boring nodes in this network. In the second phase, that nodes got message copy from the source node are waiting for direct delivery to the destination node.

To raise the acquisition of spray and wait protocol Spyropoulos et al. (2005) bring forward the Binary Spray and Wait (BSNW) routing protocol. In BSNW, the source node procreates a few numbers of message copy and then forward only half number message copy from generating a message to the encountered nodes in the network. This process is continued until one message copy is reached to the next intermediate node. At a time, another half copy message that holds by the source node is waiting direct transmission trusting on the savor of spray routing used [12].

C. SOCIAL-AWARE CONTENT-BASED OPPORTUNISTIC ROUTING PROTOCOL (SCORP)

SCORP is a social proximity-based routing protocol. It looks at the user's social interaction and their interests to enhance message delivery in urban and dense scenarios. It uses social proximity and content knowledge to enhance the efficiency of data delivery. There are mainly two reasons to use social proximity:

- At first, that nodes have alike daily habits have a higher probability of having a similar (content) interest
- Second, Social Proximity metrics allows faster data transmission by taking the convenience of more frequent and prolonged contacts between neighbour nodes.

SCORP is merely expected to generate duplicates in nodes that are initially interested in content sent in the message or have a strong relation with nodes of that particular interest [13].

D. DLIFE

dLife is a social-based opportunistic routing protocol that takes into the dynamism of users' social behavior in daily periods. dLife mainly uses two complementary utility functions: time-evolving Contact Duration (TECD) and TECD Importance (TECDi) for forwarding the message source to destination. With the help of TECD, each node chooses the next node that has a strong relationship or intensity than the current node to deliver the message to the destination node or relay node. By using TECD, each node computes the average of their contact duration with other nodes. The TECD Importance (TECDi) function, where the neighboring nodes get the message from the source node if the nodes have greater importance than the current carrier node to deliver the message copy to the destination node [14].

III. SIMULATION SETUP

In this paper, we used Opportunistic Network Simulator (ONE) that running on Java platform for simulation. It is discrete agent-based event simulation engine that is created for DTN routing protocol evaluation [15]. A brief description of ONE simulator is available in [16] and the ONE simulator project page where the source code is also available [17]. Obligate parameters for simulation as well as the routing strategies are outlined in table I and II respectively.

Table I: Parameters for Simulation Set Up

Parameters	**Values**
Simulator	Opportunistic Network Simulator (ONE)
Simulation time	28800 Sec (8 hour)
Update interval	0.2 Sec
Interface	Bluetooth interface
Interface type	Simple Broadcast Interface
Transmit speed	270 Kb
Transmit range	10m
Buffer size (MB)	4,8,12,16,20
Message Size	700 KB
Total Message generation	3
Message TTL	240 min (4 hour)
Number of nodes each group	30,50,70,90,110
Routing protocol	Epidemic, B-SNW,SCORP, dLife
Movement model	Shortest path map-based movement
Simulation area size	9500x9000 m

IV. SIMULATION RESULT

In this section, we focus on the performance of traditional DTN and social-based routing protocol based on average Latency by varying node density in each group and buffer size of each group. The simulation results are outlined here are acquired according to the parameter defined in Table I and II.

Table-II: Parameters for Routing Protocols

Routing Algorithm	**Parameters**	**Value**
Epidemic	N/A	N/A
Binary Spray and Wait	No. of Copies (L)	8
Scorp	Group Router	Decision Engine Router
dLife	Group Router	Decision Engine Router
	Decision Engine Router Familiar Threshold	700

AVERAGE LATENCY FOR VARYING NODE DENCITY

Average Latency can be defined as the average time that is needed for successfully message transmission from the message source node to the destination node. For varying the node density, we constraint the buffer size value to 8M, Message size to 700 KB, and takes a total of 8 groups of nodes.

Figure 2 shows how the average latency value is changed by varying the node density of each group. From the graph, it is evident that the average latency value of BSNW is lower than other routing protocols that means the BSNW routing protocol required less time to deliver the message to the destination node from the message owner node. BSNW routing generates only a few numbers of messages copy from the source node, and from there, only half of the messages are forward to the next node, and half message copy is waiting for direct transmission.

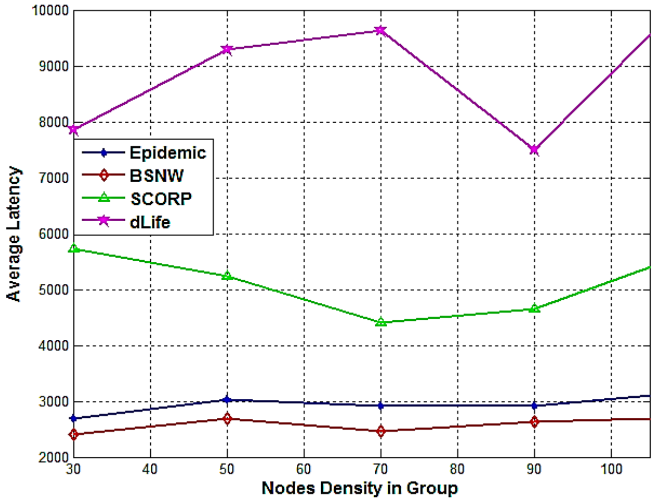

Fig. 2: Average Latency for varying Node density in each group.

In the dLife routing protocol, messages are forwarded to the next relay node that has strong social links or highly essential nodes in the current daily sample with the destination node. If not find a robust social link and a more significant importance node, then nodes store the message itself. Thus, messages are needed more time to deliver the message to the destination node. It is clear from the plot that Binary Spray and Wait protocol perform better, and dLife protocol performs worst one among these routing protocols for our considered simulation settings.

A. AVERAGE LATENCY FOR VARYING BUFFER SIZE

For varying buffer size, we constraint node density value per group 50, Message size to 700 KB. Fig. 3 illustrates the average Latency for varying buffer size for Epidemic, Binary Spray and Wait, SCORP, and dLife routing protocol. If a message can reach the destination to source node spending less time, then this routing protocol is better. We can see from the graph that the value of average latency dLife protocol is fixed by increasing the value of buffer size. As dLife forward the message considering high social links and higher importance of message copy than the current carrier node. In SCORP, the average Latency does not affect when changing the value of buffer size. An Epidemic, the average latency value is increased by increasing the value of buffer size because this protocol forwards the message to all the possible encountered nodes in a network. Thus, the network is congested when using Epidemic protocol, and the same message has all of the nodes, and hence message takes more time to reach the destination node. In BSNW, the average latency value first increased, but after some time, the value is fixed even we increased the value of buffer size. Hence, from this graph, conclude that Binary Spray and Wait is the best, and dLife is the worst one among these protocols.

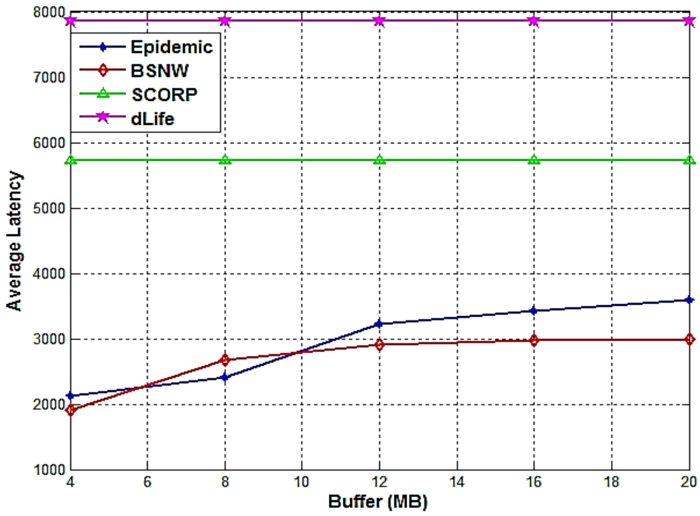

Fig. e: Average Latency for varying Buffer size in each group.

 DOI 10.17148/IJARCCE.2019.81211

V. CONCLUSION

The intention of Delay Tolerant Networks is to data delivery within a short time where has no continues connection between source to a destination node. So the routing is the primary concern for date delivery in DTN. In this paper, we evaluate the performance of Epidemic, B-SNW, Scorp, dLife for changing the value of node density and buffer size in every group by using ONE simulator. From the simulation results, it is concluded that the BSNW performs excellent, and dLife performs worst. In this work, we illustrate the performance considering only one performance metric. In the future, we analyzed the performance of these routing protocols in terms of energy consumption by changing the map of the Helsinki city map.

REFERENCES

[1]. Nuzhat Tasneem Aown, Md. Ashraful Islam, Md. Mizanur Rahman and A.Z.M. Touhidul Islam "Effect of AWGN & Fading (Rayleigh & Rician) channels on BER performance of a WiMAX communication System", International Journal of Computer Science and Information Security, IJCSIS, Vol. 10, No. 8, August 2012, USA.

[2]. Md. Ashraful Islam, Md. Mahbubur Rahman, Farhana Enam and Halida Homyara, "Analysis the Effect of Spectral Efficiency on Digitally Modulated OFDM Communication System over Realistic Channel Condition", International Journal of Scientific & Engineering Research, Volume 7, Issue 1, Page 1019-1024, January-2016, France.

[3]. Md. Polas Tai, Md. Ashraful Islam, Farhana Enam and Md. Arifur Rahman, "Secure Color Image Transmission Over WIMAX Communication System", Journal of Multidisciplinary Engineering Science and Technology (JMEST), Vol. 3 Issue 6, June – 2016, page 5040-5047, Berlin, Germany.

[4]. Md. Abdul Halim, Md. Ashraful Islam, Tonima Islam, Halida Homyara and Mustari Zaman "Performance Analysis of Cyclic Redundancy Check(CRC) encoded Fixed WiMAX Wireless Communication System under Implementation of M-ary Quadrature Amplitude Modulation(QAM) Technique", International Journal of Engineering Research and Applications, IJERA, Vol. 2, No. 5, pp. 1056-1062, September-October 2012.

[5]. P. M. Mendes and W. Moreira, "Survey on Opportunistic Routing for Delay/Disruption Tolerant Networks," February, 2010.

[6]. E. Spaho, K. Bylykbashi, L. Barolli, V. Kolici and A. Lala "Evaluation of Different DTN Routing Protocols in an Opportunistic Network Considering Many-to-One Communication Scenario", 19th International Conference on Network-Based Information Systems (NBiS), September 2016.

[7]. K. Fall, "A delay-tolerant network architecture for challenged internets," in Proc. of ACM SIGCOMM, Karlsruhe, Germany, August 2003, pp. 27–34

[8]. M. Boudguig and A. Abdali "New DTN Routing Algorithm" IJCSI International Journal of Computer Science Issues, Vol. 10, Issue 2, No 3, March 2013.

[9]. S.Burleigh, A.Hooke, L. Torgerson et al., "Delay-tolerant networking: An approach to interplanetary internet", IEEE Communications Magazine, vol. 41, no. 6, pp. 128–136, July, 2003.

[10]. I G. Agus S. Negara, L. V. Yovita and T. A. Wibowo, "Performance Analysis of Social-aware Content-based Opportunistic Routing Protocol on MANET Based on DTN", International Conference on Control, Electronics, Renewable Energy and Communications (ICCEREC), September, 2016.

[11]. A. Vahdat and D. Becker, "Epidemic routing for partially connected ad hoc networks," Department of Computer Science, Duke University, Tech. Rep. CS–2000–06, Apr. 2000.

[12]. T. Spyropoulos, K. Psounis and C. S. Raghavendra, "Spray and wait: an efficient routing scheme for intermittently connected mobile networks," in Proc. of ACM WDTN, Philadelphia, PA, USA, Aug. 2005, pp. 252– 259.

[13]. W. Moreira, P. Mendes, and S. Sargento, "Social-aware opportunistic routing protocol-based om user's interactions and interests," in Proc. Of ADHOCNETS, Barcelona, Spain, Oct. 2013.

[14]. W. Moreira, P. Mendes and S. Sargento "Opportunistic Routing Based on Daily Routines" IEEE International Symposium on a World of Wireless, Mobile and Multimedia Networks (WoWMoM), 25-28 June 2012.

[15]. S. C. Roy, Md. M. Ali and Md. A. Islam, "Analysis the Effect of Transmission Cost on TTL and Number of Nodes in Social Aware Routing Protocols", International Journal of Scientific & Engineering Research Volume 10, Issue 9, September-2019.

[16]. A. Keränen, J. Ott, and T. Kärkkäinen, "The ONE simulator for DTN protocol evaluation," in Proc. of the 2nd International Conference on Simulation Tools and Techniques, Rome, Italy, Mar. 2009.

[17]. Project page of the ONE simulator, [Online], https://www.netlab.tkk.fi/tutkimus/dtn/theone. [Accessed: December 2018].