Comparative Study of Prophet, MaxProp, Source Spray and Wait and Binary Spray and Wait Protocols in Delay Tolerant Networks

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Abstract— Delay-tolerant Networking (DTN) makes successful communication in sparse mobile ad-hoc networks and other challenged environments with verities of protocols. In this paper we have analyzed performance of various protocols that use replication and flooding mechanism to transfer message between nodes. Through the evolution of all routing protocol in with various numbers of nodes using simulation tool comparative study can be done. This paper focus on the performance of Prophet, MaxProp, Source Spray and Wait Routing Protocol and Binary Spray and Wait Routing protocol in random way point mobility model.

Keywords—Prophet, MaxProp, Binary Spray and Wait, Source Spray and Wait, Delay Tolerent Network; routing in DTN

Introduction

Today's communication over Internet is done by TCP/IP where end to end path has been established and then message is transferred from source to destination with high bandwidth and low delay. Also the message delivery probability is very higher with very low error rate. In Challenged Networks (such as Interplanetary Network, Military Battle Field, Sensor Network, Mobile Network) Communication where the destination is not always in direct touch with sender or far away from sender or having no Internet access TCP/IP scenario doesn't work [1]. In this case, Delay Tolerant Network concept will provide necessary facility for data transfer.

The main difference between Internet and DTN communication is absent of end to end communication path which leads disconnection, variable delay, and high error rate in communication. DTN uses store and forward concept to send message or packet from source to destination. DTN has various routing protocol based on knowledge or replication strategy for successful delivery of packet from sender to receiver. Protocols which works on knowledge of nodes or network (such as location based routing, Gradient Routing, Link Metrics) are decrease the delay but delivery probability is very low [2]. The new routing scheme, called Spray and Wait, in which works in two phases "Spray" phase number copies of message are generated and spread into network "Wait" phase will wait until the message meets to its destination node [3]. On other hand the routing using replication of message (such has in Direct Contact, Two way Hope, Tree Based routing, Epidemic Routing) delivery ration can be increased but resource consumption is high [3]. Binary Spray and Wait improves Spray and Wait with dividing initial number of copies [4].

Routings in DTN

The Spray and Wait protocol works in two different phases; "Spray" will spread number of copies and "Wait" will assure the copy meet to the destination [3][5].

Prophet (Probabilistic Routing Protocol using History of Encounters and Transitivity)

Prophet [10] is a DTN routing protocol aiming at using knowledge obtained from past encounters with other nodes to optimize the packet delivery. Each node keeps a vector of delivery predictability estimates, and uses it to decide whether an encountered node were carrier for a DTN packet. The predictability estimates are increased every time a node encounters another node, and they are decayed exponentially.

MaxProp Routing

The MaxProp protocol uses several mechanisms in concert to increase the delivery rate of delivered packets. MaxProp uses several mechanisms to define the order in which packets are transmitted and deleted. At the core of the MaxProp protocol is a ranked list of the peer's stored packets based on a cost assigned to each destination. The cost is an estimate of delivery likelihood. In addition, MaxProp uses acknowledgments sent to all peers to notify them of packet deliveries. MaxProp assigns a higher priority to new packets, and it also attempts to prevent reception of the same packet twice. The remainder of this section presents the details of destination cost estimation, our other mechanisms, and buffer management [11].

Source Spray and Wait

Spray and Wait [6] routing consists of the following two phases:

- spray phase: for every message originating at a source node, L message copies are initially spread – forwarded by the source and possibly other nodes receiving a copy – to L distinct "relays". (Details about different spraying methods will be given later.) [9]
- wait phase: if the destination is not found in the spraying phase, each of the L nodes carrying a message copy performs direct transmission (i.e. will forward the message only to its destination).

Binary Spray and Wait

Binary Spray and wait protocol will split number of copy in spray phase.

- spray phase: for every message originating at a source node, L/2 message copies are initially spread – forwarded by the source and possibly other nodes [7].
- Wait phase: In the Wait phase, we permit nodes to deliver the messages to the destinations using direct transmission only or drop the message when the TTL expires [8].

Simulation Environment

The ONE simulator is used for simulation. The simulation parameter setup is as per Table 1.

SIMULATION CONFIGURATION	
Simulation Time	2000s
Buffer Size	5 MB
Number of Nodes	10 ~ 50
Message Size	50k ~ 100k
Message Generation (Event Interval)	1 – 5
Message Lifetime	300s
Mobility Model	Random Way Point

Table 1: Simulation Configuration

Simulation Result

The simulation result has been analyzed and compared in four parameters Delivery Ratio, Overhead Ration, Message Drop and Average Latency with various numbers of nodes.

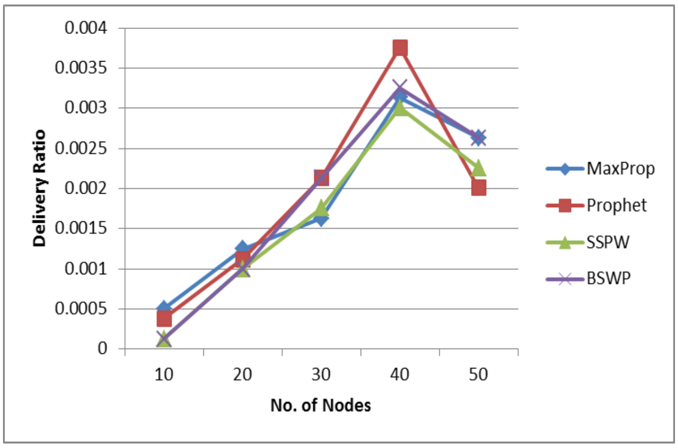

Fig. 1 Comparison of Delivery Ratio

Fig. 1 shows the result comparison of Delivery Ratio of Prophet, MaxProp, Source Spray and Wait and Binary Spray and Wait protocols. The result shows the delivery ratio of Prophet and Binary Spray and Wait is good compere to MaxProp and Source Spray and Wait protocols even numbers of nodes increased MaxProp provides better delivery ratio when numbers of nodes are small.

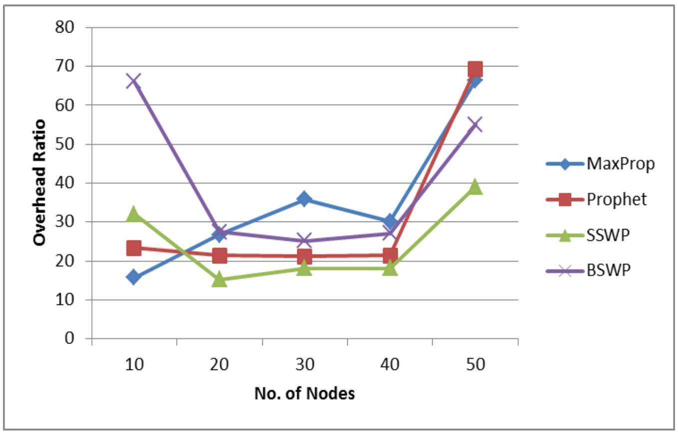

Fig. 2 Comparison of Overhead Ratio

Fig. 2 shows the result comparison of Overhead Ratio of Prophet, MaxProp, Source Spray and Wait and Binary Spray and Wait protocols. The results shows Source Spray and Wait give very low overhead ratio even numbers of nodes are more. Also we analyzed when numbers of nodes increased overhead ratio increased very much in Prophet and MaxProp protocols. Binary Spray and Wait has lower overhead ratio compare to Prophet and MaxProp but higher than Source Spray and Wait protocol.

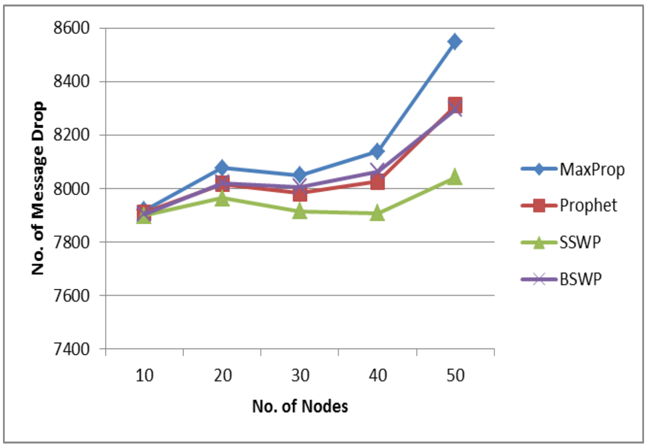

Fig. 3 Comparison of Numbers of Message Drop

Fig. 3 shows the result comparison of number of message drops during simulation of Prophet, MaxProp, Source Spray and Wait and Binary Spray and Wait protocols. Numbers of Message drop is very lower in Souce Spray and Wait compare to rest of all other protocols inspite of increasing number of nodes. Prophet and Binary Spray and Wait has almost same result in all scenario while maxProp has very higher number of messages dropped.

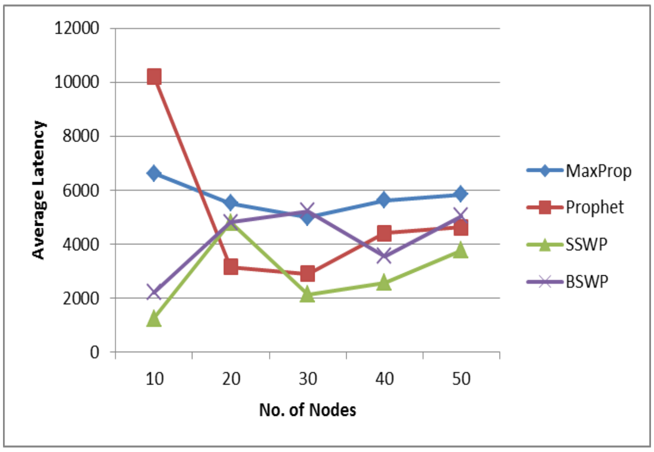

Fig. 4 Comparison of Average Latency

Fig. 4 shows the result comparison of number of message drops during simulation of Prophet, MaxProp, Source Spray and Wait and Binary Spray and Wait protocols. Average latency is also very lower in Source Spray and Wait protocol. Prophet and Binary Spray and Wait have almost lower latency than MaxProp protocol.

Conclusion

In this paper the result from simulation and comparison of various scenarios on Prophet, MaxProp, Source Spray and Wait and Binary Spray and Wait protocols, result shows that delivery ratio is very good in Prophet, MaxProp and Binary Spray and Wait compare to Source Spray and Wait protocol. But Source Spray and Wait provide has lower overhead ratio, number of message drop and average latency.

In order to improve delivery ratio Prophet, Maxprop and Binary Spray and Wait degrade the performance of overhead ratio, message drop and latency.

References

[1] Forest Warthman, "Delay Tolerant Networks (DTNs)" Warthman Association Version 1.1

[2] Kevin Fall, "A Delay-Tolerant Network Architecture for Challenged Internets" *SIGCOMM'03*, August 25-29, 2003, Karlsruhe, Germany.

[3] Thrasyvoulos Spyropoulos, Konstantinos Psounis, and Cauligi S. Raghavendra, "Spray and wait: an efficient routing scheme for intermittently connected mobile networks" ACM SIGCOMM workshop on Delay-tolerant networking 2005

[4] Anjula Mehto, Meenu Chawala, "Modified Different Neighbour History Spray and Wait using PROPHET in Delay Tolerent Network", International Journal of Computer Application, 2014

[5] Biren Patel, Dr. Vijay Chavada, Comparative Study of DTN Routing Protocols, International Journal of Advanced Research in Computer and Communication Engineering Vol. 4, Issue 5, May 2015

[6] Thrasyvoulos Spyropoulos, Konstantinos Psounis and Cauligi S. Raghavendra, “Spray and Wait: An Efficient Routing Scheme for Intermittently Connected Mobile Networks” SIGCOMM’05 Workshops, August 22–26, 2005, Philadelphia, PA, USA. Copyright 2005 ACM 1-59593-026-4/05/0008

[7] Mazlan Abbas, Nur Hasna Md Yusof, and Norsheila Faisal, “Perfomance Evalution of Binary Spray and Wait OppNet Protocolin Context of Emergency Scenario” Third International Workshop on Pervasive Networks for Emergency Management 2013, San Diego 978-1-6128-4937-9/13/$31.00 ©2013 IEEE

[8] Shahid Md. Asif Iqbal and Alok Kumar Chowdhury, “Adaption of Spray Phase to Improve the Binary Spray and Wait Routing in Delay Tolerent Network” 978-1-4673-4836-2/12/$31.00 ©2012 IEEE

[9] Jingfeng Xue, Xiumei Fan, Yuanda Cao, Ji Fang, Jiansheng Li, “Spray and Wait Routing Based on Average Delivery Probability in Delay Tolerant Network”, International Conference on Networks Security, Wireless Communications and Trusted Computing, 978-0-7695-3610-1/09 $25.00 © 2009 IEEE

[10] A. Lindgren, A. Doria, and O. Schelen, “Probabilistic routing in intermittently connected networks. SIGMOBILE Mob,” Comput. Commun. Rev. vol. 7, no. 3, 2003.

[11] John Burgess, Brian Gallagher, David Jensen and Brian Neil Levine, MaxProp: Routhing for Vehical-Based Distruption-Tolerent Networks” INFOCOM 2006