IFERP connecting engineers... developing research

ISSN (Online) 2394-2320

International Journal of Engineering Research in Computer Science and Engineering (IJERCSE)
Vol 5, Issue 1, January 2018

GHFP: Geocasting with HTOF using Flooding and PRoPHET Algorithm

[1] Medha Sharma, [2] Shivika Arora, [3] Tanvi Bansal, [4] Preeti Nagrath
[1-4] Department of Computer Science & Engineering, Bharati Vidyapeeth's College Of Engineering, New Delhi, India

Abstract: - **Delay Tolerant Networks (DTNs) make effective communication possible in challenging environments wherein the connectivity is intermitted or no end to end path has been established. They follow Store-Carry-Forward mechanism in which the information is sent to an intermediate station, where it is kept for a certain duration and is later sent to either another intermediate station or a final station. Geocasting involves sending the message to a specific quest, followed by dissemination of the message within the cast. In this treatise, we propose Geocasting with HTOF using Flooding and PRoPHET Algorithm (GHFP), an optimized geographic routing algorithm. We also delve into single copy routing schemes that use only, one copy per message, thereby significantly reducing the resource requirements. Highest TTL Out First (HTOF) buffer management policy is used to enhance the network performance. Under the GHFP algorithm, the devices do not exchange any location-related information, and hence there's no risk of any intrusion into the user's privacy. DTN offers services in communication challenged areas which render GHFP algorithm advantageous for message transmission in diverse fields like war and disaster prone regions, areas where government censorship imposes restrictions on the content that can be transmitted and also in advertising in expanses having a high user density. The resulting analysis indicates that the GHFP algorithm is efficient in terms of latency and network overhead.**

Keywords: - **Buffer Scheduling, Delay Tolerant Networks, Geocasting, Highest TTL Out First, ONE Simulator, PRoPHET.**

I. INTRODUCTION

The 21st century can be termed as the 'Era of Micronization'. The late 20th century acted as the harbinger of this phenomenon, which ushered in a wave of change. Computers, which were once large enough to occupy an entire room, could now easily fit into an average sized handbag. Driven by the immense reduction in size, several kinds of research aimed at harnessing the benefits of the mobility of the devices were envisaged. Consequently, MANET (Mobile Ad-Hoc Network) and VANET (Vehicular Ad-Hoc Network) became the key areas of research [1]. Around the same time, NASA (National Aeronautics and Space Administration) began exploring the domain of IPN (Interplanetary Internet). Kevin Fall, in 2002, endeavored to apply some of the concepts of the IPN architecture in terrestrial networks. This led to the birth of Delay Tolerant Networking [2]. What sets it apart from the rest of the networks is the fact that it contravenes some surmises that are prevalent with regards to the TCP/IP Internet. Such networks are characterised by intermittent connectivity and dynamic topology, due to which no fixed end-to-end paths exist, unlike the traditional net-works. It is in situations like these that popular ad-hoc networking protocols like AODV (Ad-Hoc On Demand Distance Vector) Routing Protocol [3] and the DSR (Dynamic Source Routing) Protocol [4] fail to offer any satisfactory solution. The aforementioned protocols fail in such scenarios because they first discover a route and it is after the route establishment that actual transfer of data takes place. But this methodology cannot be applied in the context of DTN since the network topology keeps on changing at every instant. Thus, the establishment of any route prior to data transmission is futile here. To conquer this quandary, DTN employs a "Store and Forward" [5] [6] strategy wherein the data to be transmitted is stored in each node. This data is forwarded from one node to another. The transmission is carried out in such a manner that sooner or later, the message reaches the destined node. Protocols like PRoPHET [7], Epidemic [6], Spray-and-Wait [8], Direct Delivery [9] etc. have been commonly employed for routing of messages in DTNs. Also referred to as geocasting, geographical routing refers to the process of trans-mitting the message to a particular location (known as a cast), as opposed to the general process of routing wherein the message is sent to a particular node. This form of routing could be of tremendous use in the current scenario, given the fact that mobile devices heavily rely on the Global Positioning System (GPS) to deliver location based services to users. Determining which nodes reside within the cast isn't as straightforward as it seems which makes the implementation of geocasting in delay tolerant networks a herculean task.
The aim of the disquisition is to propound an optimized geographic routing algorithm. This has been used in conjunction with buffer scheduling technique to ensure that

ISSN (Online) 2394-2320

International Journal of Engineering Research in Computer Science and Engineering (IJERCSE)

Vol 5, Issue 1, January 2018

the buffer, which is a precious commodity in the realm of networking, is efficiently utilized. The rest of the paper is organized as follows. Section 2 highlights the related works in this domain. This is followed by section 3 which illustrates the GHFP algorithm. The simulation scenarios are presented in section 4. Next in series is section 5 which mentions the results. Section 6 mentions the application areas and the conclusions. The references have been specified thereafter.

II. RELATED WORK

Mobile devices such as laptops, smart phones, tablets, smart watches etc. have be-come ubiquitous in the recent years. These devices render on the move connectivity, enabling communication anytime, anywhere. Fuelled by these advancements, Delay Tolerant Networks has emerged as one of the prime research areas. They refer to a subset of networks wherein end to end connectivity between two communicating nodes isn't guaranteed. This implies that a well-defined path between the source and the destination may not exist at all times since the network topology is ever changing. These networks are gaining massive popularity since they offer several advantages over the existing infrastructures like elevating network capacity, aiding in the transmission of fugacious content, operating amidst intermit-tent connections etc. Due to these attributes, they find application in various do-mains. Some of them are being enumerated here: inter-planetary satellite communication, military networks, wireless sensor networks, sparse mobile ad-hoc net-works, providing connectivity to rural networks etc. Not much research has been carried out in performing geocasting within delay tolerant networks. Few of such studies have been summarized in the subsequent paragraphs.

The paper by Aydin Rajaei et al. Presented Geocasting Spray And Flood (GSAF) routing protocol. This simple yet efficient and flexible technique could be employed for geocasting messages in delay-tolerant networks. The researchers highlighted significant challenges in geocasting, in the context of opportunistic networks, and described how GSAF deals with those challenges along with over-coming limitations of existing approaches. GSAF delivers messages to their destination casts in two phases. During the first one, a message is replicated to the devices encountered en route, in a controlled way (using a ticketing mechanism). When the message reaches its destination cast, GSAF's second phase is enabled and the message is carefully flooded within the limits of the cast. Casts need not be pre-defined and users are free to define their own casts even on a per-message basis. Casts are polygons in a two-dimensional space, allowing for flexible and efficient information dissemination. The performance of GSAF was extensively evaluated using performance parameters like user density, buffer capacity and message lifetime [10].

The work by Christian Maihofer presents a survey of geocast routing protocols. He analyzed that the protocols mainly differ in whether they are based on flooding, directed flooding, or on routing without flooding, and whether they are suitable for ad-hoc networks or infrastructure-based networks. The analyzed protocols like LBM, GeoGRID, and Flooding etc. differ in their message and memory complexity, robustness, and in their ability to deliver geocast packets in partially partitioned networks. Simulation results indicate that there are significant differences in a protocol's ability to successfully deliver the geocasts to their intended destination regions and in the network load induced [11].

Laura Galluccio et al. discussed some design guidelines for geocasting protocols in ad hoc and sensor networks. Their analysis focused on adding some mechanisms which help to either improve reliability or decrease energy consumption in forwarding data packets to geocast groups. The performance results indicate that sufficient reduction in the energy consumption can be obtained along with a decrease in the number of copies travelling in the network. Diminution in the packet loss can be obtained by conveniently setting the required number of ACKs and the number of thresholds, to enlarge or restrict the forwarding zone [12].

III. PROPOSED WORK

The suggested work aims to ameliorate the geographical routing algorithm in Delay Tolerant Networks (DTNs). The model can be fragmented into two parts for a better comprehension of the algorithm. The former part deals with the optimization of message delivery till the cast boundary and the latter part comprises of disseminating the message to all the nodes within the cast at that instant of time. Firstly, Probabilistic Routing Protocol using History of Encounters and Transitivity (PRoPHET) has been used due to its prediction based behavior. It takes into account 'history of encounters' for computing delivery predictability parameter. This parameter is calculated for all the neighboring nodes and the paths having low delivery predictability are pruned as it implies a lesser probability of future contacts between them. This gives PRoPHET an upper hand in collation to other routing protocols. The latter part of the pro-pounded algorithm involves disseminating the message at the cast boundary to all the devices within the cast. To achieve the desired delivery rate, self-regulating flooding has been employed. The message is forwarded to every path in the network be-fore it reaches the destined node. The simplicity and flexibility of this algorithm comes with a potential of packet duplication. This requires buffer management technique to mitigate the flooding drawback by efficiently managing buffer. Also known as dropping control, buffer management performs packet discard judgment that is

ISSN (Online) 2394-2320

International Journal of Engineering Research in Computer Science and Engineering (IJERCSE)
Vol 5, Issue 1, January 2018

necessary either at the inception of congestion or upon the arrival of a new packet. Buffer scheduling policies also are necessary due to the limited network bandwidth and communication time constraints of devices. Highest TTL Out First (HTOF) buffer scheduling technique was applied since it transcends other scheduling techniques in this scenario. HTOF utilizes the TTL (Time to Live) field, which is also known as hop limit or counter. It prevents an undeliverable packet from circulating in the networks. Its value is set by the sender and is decreased by one on every hop. When the TTL field reaches zero, the packet is discarded.

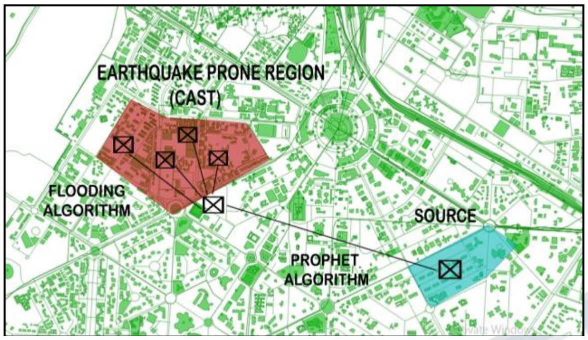

Fig. 1. Diagrammatic representation of the GHFP algorithm

ONE (Opportunistic Network Environment) Simulator has been used to perform the simulation of the geocasting routing algorithm. The ONE provides an environment that can be used to simulate the network scenarios. Tasks ranging from creating node movements using many available movement models, routing messages using many routing protocols, visualizing the scenarios in real time and generating reports can be accomplished very easily by using it. The supremacy of the propounded algorithm has been established by drawing a parallel with traditional spray and wait routing algorithm. This has been elaborated in the results section.

IV. SIMULATION SCENARIOS

The GHFP algorithm is applicable for pre-defined casts i.e. casts could be identified in advance, according to its application such as disaster prone areas, advertising in some specific geographical locations etc. We have simulated the GHFP algorithm for a variety of cast sizes i.e. 400 X 400m, 800 X 800m, 1600 X 1600m, along with two buffer sizes viz. 5M and 10M.

Table 1. Simulation Parameters

Parameter	Value
Simulation Time	100000 seconds
Wireless Interface	Bluetooth
Number of Host Groups	6
Message TTL	300 minutes
Number of Nodes	21
Buffer Size	5 M, 10 M
Transmission Speed	250 Kbps
Cast Size	400 X 400 m, 800 X 800 m, 1600 X 1600 m
Routing Protocol	GHFP Protocol

V. RESULTS AND ANALYSIS

In this section, we evaluate the results of the GHFP algorithm by gauging its performance in comparison to that of the spray and wait algorithm. Many parameters were taken into account to evaluate the efficiency of the algorithms in different scenarios. The following graphs indicate the comparison between the GHFP algorithm and the spray and wait algorithm, taking average latency as the parameter for comparison. The variation in average latency with respect to cast size was also captured in the graph. The results show that the GHFP algorithm works better than the spray and wait algorithm.

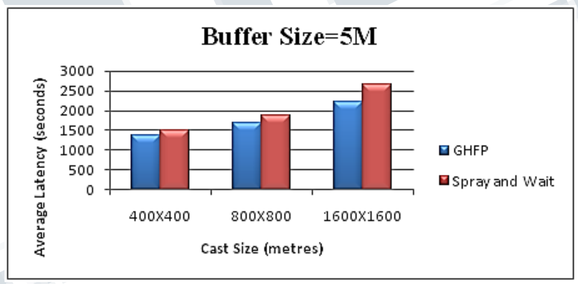

Fig. 2. Graph depicting the variation in average latency as a function of cast size when buffer size is 5M

Fig. 2 shows the variations in average latency for GHFP algorithm and spray and wait algorithm, for 3 different cast sizes, when the buffer size is taken as 5M. The results indicate that the GHFP algorithm gives 11.95% decrease in average latency when compared to the spray and wait algorithm.

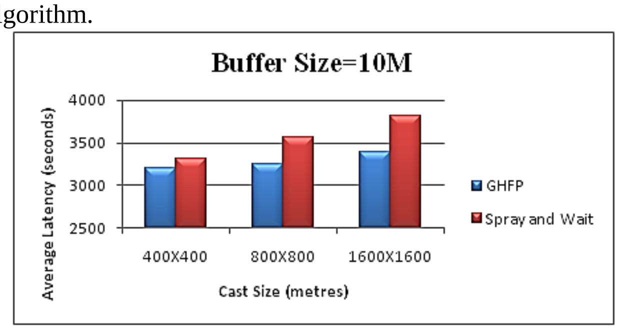

Fig. 3. Graph depicting the variation in average latency as a function of cast size, when buffer size is 10M

Fig. 3 shows the variations in average latency for GHFP algorithm and spray and wait algorithm, for 3 different cast sizes, when the buffer size is taken as 10M. It gives 7.84% decrease in average latency in comparison to the other algorithm.

VI. APPLICATION AREAS AND CONCLUSION

The GHFP algorithm could find application in several scenarios such as sending notifications or providing medical assistance to areas that have been affected by some natural disaster, epidemics or wars; aiding in military setup in areas where the priority and security of messages, as well as the geography of the destination, are of prime importance; delivering some important message to regions where physical access is not easily possible etc. Apart from these, it could also be used for advertising in some specific locations where the user density is quite high (say during a concert or movie screening), or in areas where censorship by the government imposes stringent restrictions on the kind of content the users can access. Extensive study in the field of DTN routing protocols manifested that the PRoPHET algorithm is best suited for conveying the message to the cast boundary since it takes into account the history of encounters and transitivity. Some form of scheduling is necessary due to the limited network bandwidth and communication time constraints of devices. Highest TTL Out First (HTOF) buffer scheduling technique was used since it offers better performance as compared to other scheduling techniques. In geocasting, the goal is to successfully deliver a message to all users (or to as many as possible) inside a specific geographical area, within a specified time interval; i.e. it is not only necessary for a message to reach the cast boundary, but it must also be efficiently disseminated within the cast. Thus, flooding technique optimizes this task by increasing the delivery probability of messages within the cast. The analysis also indicates good results in terms of average latency. When the buffer sizes are 5M and 10M, the GHFP algorithm gives a considerable decrease in average latency when compared to other algorithm.

REFERENCES

1. “Mobile Ad-Hoc and DTN Networks at IPCAS Lab” online available: http://www.ece.gatech.edu/research/labs/WCCL/DTN2.html, last accessed 2017/04/23

2. K. Fall, 2003, August. A delay-tolerant network architecture for challenged internets. In Proceedings of the 2003 conference on Applications, technologies, architectures, and protocols for computer communications (pp. 27-34). ACM.

3. C. Perkins, E. Belding-Royer and S. Das, 2003. Ad hoc on-demand distance vector (AODV) routing (No. RFC 3561).Author, F.: Article title. Journal 2(5), 99–110 (2016).

4. D.B. Johnson and D.A. Maltz, 1996. Dynamic source routing in ad hoc wireless networks. Mobile computing, pp.153-181.

5. J. Burgess, B. Gallagher, D. Jensen and B.N. Levine, 2006, April. MaxProp: Routing for Vehicle-Based Disruption-Tolerant Networks. In Infocom.

6. A. Vahdat and D. Becker,, 2000. Epidemic routing for partially connected ad hoc networks.

7. A. Lindgren, A. Doria and O. Schelén, 2003. Probabilistic routing in intermittently connected networks. ACM SIGMOBILE mobile computing and communications review, 7(3), pp.19-20.

8. T. Spyropoulos, K. Psounis and C.S. Raghavendra, 2008. Efficient routing in intermittently connected mobile networks: The multiple-copy case. IEEE/ACM Transactions on Networking (ToN), 16(1), pp.77-90.Author, F., Author, S.: Title of a proceedings paper. In: Editor, F., Editor, S. (eds.) CONFERENCE 2016, LNCS, vol. 9999, pp. 1–13. Springer, Heidelberg (2016).

9. T. Spyropoulos, K. Psounis and C. S. Raghavendra , 2004, October. Single-copy routing in intermittently connected mobile networks. In Sensor and Ad Hoc Communications and Networks, 2004. IEEE SECON 2004. 2004 First Annual IEEE Communications Society Conference on (pp. 235-244). IEEE.

10. A. Rajaei, D. Chalmers, I. Wakeman and G. Parisis, 2016, June. GSAF: Efficient and flexible geocasting for opportunistic networks. In World of Wireless, Mobile and Multimedia Networks (WoWMoM), 2016 IEEE 17th International Symposium on A (pp. 1-9). IEEE.

11. C. Maihofer, 2004. A survey of geocast routing protocols. IEEE Communications Surveys & Tutorials, 6(2).

12. M. Castro, L. Galluccio, A. Kassler and C. Rametta, 2011. Opportunistic P2P communications in delay-tolerant rural scenarios. EURASIP Journal on Wireless Communications and Networking, 2011(1), p.892038.