A SURVEY ON PREDICTION BASED ROUTING PROTOCOLS IN DELAY TOLERANT NETWORK

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Abstract — Delay Tolerant Networking is a kind of technology which provides reliable communication between devices in such a network where there might not be continuous connectivity among nodes. The source to destination connectivity is not guaranteed in DTN. The store and forward capability of DTN helps to increase message delivery possibility irrespective of time taken to deliver message over normal MANET. Every Node in Network may exchange messages when they come across in transmission range of one another. The issue of Routing is very significant due to limited resources for message storage capability and forwarding mechanism. Hence the issue routing among nodes is measured by many researchers which leads to various routing protocols on the basis of Flooding and Forwarding mechanism. Hence, this paper tries to analyze various probabilistic routing protocols. The analysis presented in this paper can provide useful guidance on the design and choice of appropriate routing protocols for DTN based applications.

IndexTerms — Delay Tolerant Networks, DTN Routing.

I. INTRODUCTION

Delay Tolerant Network (DTN) or Disruption Tolerant Network is a next version of Mobile Ad hoc Network. The increasing popularity of ubiquitous computing and communication has prompted to a requirement of data tradeoff between wireless mobile devices, e.g. mobiles, laptops, tablets, and other portable devices, regardless of any guaranteed end-to-end connectivity. Delay tolerant networking (DTN) addresses the technical challenges on communication among such devices where lose of continuous connectivity because of mobility. At Present, DTNs have been applied to a vast of areas, including vehicular networks [1], wildlife tracking [2], and social network analysis [3], etc. However, there are certain limitations exist in DTN. For example, because of asynchronous end-to-end connection characteristic, mobile devices have to carry the messages and forward them opportunistically upon encountering the destinations, or forward messages to other relays to help the delivery which might lead to long message transmission delay and low message delivery ratio. Along with that the limitations on wireless devices, such as storage capacity, battery power and communication bandwidth can significantly impact the successful message delivery rate. Hence, the design of routing protocols for DTNs should be able to adapt to the network variation and be efficient to utilize the hardware resources [1].

Recent analysis on all major routing protocols designed for DTNs explores high similarity in concepts, but they are significantly disparate in terms of performances. Epidemic routing Protocol blindly floods messages to all devices in the network which leads to better message delivery ratio irrespective of network overhead. Spray and Wait routing protocol is a two-phase protocol which is a flooding-controlled version of Epidemic, as it halves message copies which can be flooded to the network. ProPHET and MaxProp are prediction-based routing protocols, in which the decision of forwarding messages are made based on a quality metric called encounter predictability which is calculated from past encounters. However, Important Factors like contact time and contact durations are ignored. The Enhancement of performance of routing schemes could be done significantly by the exploitation and utilization of frequent patterns of routing.

It is tough to develop a completely good routing protocol that suits to all or any DTN applications. The performance of a routing protocol is largely dependent by many factors, such as the no. of active nodes and popularity of nodes, different values of parameters for mobile nodes, etc. The goal of all these is to explore some important guidance on predication-based routing protocol design and selection for DTN [1].

II. ROUTING STRATEGIES IN DTN

In routing methodologies, directing in DTN is classified in to significant classifications like Flooding, Forwarding and Probabilistic based routing. Flooding system depends on the key of repeating messages to enough nodes with the goal that destination node must get it. Forwarding scheme utilizes best of existing network knowledge in order to choose best route to the destination node. However, there are a few techniques that are categorized in to probability-based routing [2].

1. Flooding Strategy

In this scheme, the different copies of same message will be made and these copies will be conveyed to the arrangement of nodes called relay nodes. Relay nodes stores the messages until the point that they interact with destination node. When the contact is made during "contact" phase, the messages are delivered by the relay nodes. Along with Flooding many other strategies studied to have better routing scheme for DTN. Message replication is then used to build the possibility that the message is effectively delivered to the destination node. This protocol doesn't need any previous global or local knowledge about network [2].

2. Forwarding Strategy

Forwarding Method makes utilization of the network topology and local or global information to discover best way towards the destination node. This best route is utilized to deliver the messages. This technique does not recreate the message. Rather, A solitary way is utilized which is assessed by assessing a portion of the network parameters [2].

3. Probabilistic Strategy

It is a prediction-based plan. It executes a quality metric which figures the predictability to quantify the capability of the encountering nodes regardless of whether it can transmit the message to the destination. A copy of a message is propagated to the encountering node in the event that it has a higher predictability than its holder. This ensures each time a message can simply be spread to a superior relay [15].

III. PROBABILITY-BASED ROUTING PROTOCOLS

Xu wang et al. [3]. In previous works prophet protocol worked for only a single hop, but in this paper prophet protocol works for "two-hops" using the delivery probability of one hop neighbor to make a decision for message forwarding. In this paper for better performance instead of PROPHET the authors used Improve PROPHET; for two hop nodes, which can be frequently connected with each other for forwarding information. They are improving the average overhead, average delay, total energy computation. ONE simulator is used for simulation and Random way point mobility model is also used. But for the best performance they took unlimited buffer size and bandwidth, but in reality, buffer size and bandwidth are scarce resources. Movement of the node is in a predication manner to occupy the best result. They proposed this protocol for:

i) Reducing the amount of delivery message to destination
ii) Reducing the amount of aborted transmission and lowering the buffer time.

Phearin Sok et al. [4] proposed a distance-based prophet protocol used for encountering same information. In the prophet protocol if two of the nodes encounter each other and their delivery probability is same, then no path will be found. To solve this problem distance-based prophet can be used. They are using distance-based prophet cross layer implementation for distance value retrieval. It improves of delivery ratio and delay ratio. The Basic mechanism used here is the bundle protocol (hop by hop for the distance count). DiProphet counts the distance between two node sand it is the modified version of the PROPHET protocol. They used NS2 simulation and random waypoint mobility model. DiProphet reduces the delay in routing and produces less overhead compared to the traditional prophet.

Jingfeng Xue et al. [5] used the advance prophet protocol rather Hana traditional prophet, which solves the jitter problem in routing. The Average delivery predictabilities mechanism is used to avoid the jitter problem. Advance prophet protocol gives better performance in large buffer size.

Ying Vang et al. [6] proposed a ferry node design for deleting the replica of the message. In prophet protocol each node encounters and sends the duplication of the message for all the messages stored in buffer space. The main mechanism to develop this protocol is that, it deletes the unused duplicated messages by introducing ferry nodes. It increases the delivery ratio and the probability of message delivery.

Ting-Kai Huang et al. [7] proposed protocol, prophet+, designed for maximizing data delivery rate and minimizing delay in transmission. Delivery probability can be counted based on weighted function. prophet+ gives better performance if the best weighted function is chosen. As observed by the prophet+. First in first out (FIFO) based routing is used for the packet transmission, bandwidth parameter, popularity parameter and power parameter. This protocol improves the delivery ratio and delay between two nodes can be decreased easily.

Phearin Sok and Keecheon Kim etal. [8] proposed a distance-based prophet protocol, which can solve the problem; where the two of the nodes carry the same distance value of the node. Then the node transmitting the data first takes the neighbor node distance first, then transmits each of the data to the network where random way point model and community models are used. Simulation can be done in NS2 by this protocol and it gives a better average ratio, delivery ratio and buffer size can be less.

Jae-Choong Nam et al. [9] proposed enhance prophetv2. It is used when two of the nodes encounter each other frequently during shorter time. The delivery probability is higher to send the node in the network for inter-meeting between the two node sand can be less effective. So for this purpose the enhance prophetv2 uses the contact duration between two nodes. ONE simulator and working day movement model are used. Rather than using prophetv2, enhance prophetv2 gives low overhead ratio and high delivery ratio.

Ho-Jong Lee etal. [10] proposed enhance prophet, which uses the message delivery predictability. History of an encounter and transitivity is used to deliver maximum messages to the destination while sending multiple copies of the single message overhead ratio. And for the increase in delivery ratio, message delivery predictability can be used; that controls spreading of the messages. Time to Live (TTL) plays the main role to control the message overhead ratio. ONE simulation and Helsinki downtown city model are used. Overhead, delivery ratio and the number of the drop messages can be less.

Nidhi Rajpoot al. [11] proposed a protocol to work in underwater communication which can be considered as the terrestrial environment for the improve prophet protocol. During communication with wireless network, the probability of message delivery is improved in the underwater communication. They used the traditional prophet protocol to sense message delivered in a different way. Whereas improve prophet, calculates all the information before the transmission by improving the transitivity. If the last encounter node is near to equal to the old node, then it takes the value of the old node. It provides better message delivery and less overhead ratio.

Suman Bhatta charjee et al. [12] proposed protocol to solve the disaster communication of Nepal earthquake where the propriety enhances prophet used with NLP to communicate with the different areas. Important messages can be dropped while there is more buffer space for each of the messages to be properly transmitted to the end with enhance prophet protocol. One simulator can be used to reach the disaster area. To deliver information regarding help; sentimental Messages can be used. Delivery of the successful messages can be received by the rescue team. It gives better effort message delivery and high delivery ratio.

El matapha sammou[13] proposed a protocol where spreading of the messages is divided into zones, where nodes can frequently encounter each other. Their approach is based on the frequent meeting of the node and visiting the routes in each of the zones that calculates the two metrics. It improves delivery probability and delivery ratio.

Neha Agrawal et al. [14] proposed prophet protocol for detecting crime in rural areas. They have used prophet and prophetv2 [17]. Kiosk is created which helps to share the crime information. It was implemented in the high frequency traffic areas. If high frequency of car or any vehicle is detected, then the sensor automatically senses the network and comes into the range of transmission information from rural areas to urban areas by the enhance prophet delivery probability which is used as the high frequency of the sensor. It improves the buffer size and delay ratio is less than other routing protocols.

Shuang Xia et al. [15] proposed spray and wait protocol, which works in two phases. The spray and wait protocol, include prophet methodology and introduces the new routing algorithm Delivery probability routing (DPR)works same as the prophet but there is a twist in spray and wait routing. It updates delivery vector for each node. Forwarding strategy is based on both the phases of the algorithm. Delivery ratio is high and delay is less.

-PROPHET gives the best result.

Aysha Al-Hinai et al. [16] proposed a protocol about message forwarding based on contact patterns between two nodes in the network. Each of the node uses sliding window mechanism to maintain historical contact information in the network. By this new contact information network can easily incorporate and un-used history information is deleted easily. Information about collecting history of contact is adjusted by the size of the sliding window. For message forwarding to the node, greedy approaches used. If frequent disconnection takes place, FG.

Table 1. Performance comparison Probability Based Routing Protocol

Protocols	Mechanism	compare with	simulator/model	Advantages	Disadvantages
improve prophet[3]	for selecting best forward weighted function added.	traditional prophet and prophetv2	one random waypoint mobility	better the average delivery rate and average delay ratio.	it gives better performance for the ideal resource (i.e. unlimited bandwidth and energy) utilization only.
di-prophet[4]	distance based delivery probability hop by hop	traditional prophet and distance prophet	ns2 random waypoint movement model	using delivery probability vector metric, the delivery ration increased.	if the dilemmas of messages more while in transmission, than delivery ratio will be reduced.
advance prophet[5]	to solve the jitter problem used the advance delivery probability	traditional prophet and advance prophet	one helsinki city	avoids jitter problem.	results are better when higher average delivery rates and shorter average delay in the network.
prophet[6]	ferry node which used prophet for deleting replica of messages.	prophet and improve prophet	one four quarter area	it gives better performance in message delivery.	if duplication of message more in the network then, more delay occurs.
prophet+[7]	to maximize data delivery rate delivery probability used weighted function	traditional prophet with prophet+	one imote trace human mobility model	by shifting weighted function it provide better performance in other environment.	it only gives better performance if logical choices for weights are used.
di-prophet[8]	at the same time delivery probability cross layer implementation used.	improve prophet with distance based prophet	ns2 random waypoint and community model	if two or more nodes carry equal delivery predictability then, it gives better results for forwarding information.	it's only suitable when distance metric can be added.
prophet[9]	message delivery predictable can be used for the better delivery ratio	prophet with message delivery predictable (mdp)	one helsinki city	it controls the spreading of messages.	it doesn't suitable for those messages which are may use in future.
prophetv2[10]	contact duration time between intermediate node	traditional prophet with prophet version 2	one working day movement model	it provides a bette rdelivery ratio and less overhead ratio.	this can be more useful only when contact duration time considers in the network.
prophet[11]	opportunistic network with the message delivery probability	prophet and enhance prophet	one caribbean sea	itprovides a better message delivery probability and less overhead ratio	it doesn't suitable in high communication environment
prophet[12]	priority enhance prophet and nlp for better message delivery ratio	prophet and efficient prophet	one map of nepal disaster	its gives best effort delivery.	process become complex if more message in buffer space.
prophet[13]	history encounter and transitivity used their own approach for delivery probability	prophet	own simulator java based random waypoint and restricted random waypoint	it reduces the delay and minimize the resource computation.	it can be more suitable when networks are divided in zone wise.
enhance prophet[14]	enhance prophet for high frequency ratio	prophetand prophetv2 ,enhance prophet	one helsinki road map	it provides trump efficiency and additional the buffer size.	detection of crime in rural area becomes complex.
improve spray and wait[15] and prophet	delivery probability routing	epidemic and traditional spray and wait and prophet	one disasters scenario	it provides a high message delivery ratio and low average latency.	it's suitable for the vehicle network scenario in the disaster.

fg-prophet[16]	fine grained contact and sliding window	prophet and prophet v2 ,fg-prophet	one helsinki city map	it provides better message delivery rate with low communication overhead.	to adjust the sliding window size may difficult if there are more messages.

IV. CONCLUSION

The Paper represents the brief summary of Probability based routing protocols available in the literature. Each protocol in DTN has its own pros and cons. The DTN based applications mostly agonized from low resources as well as bandwidth. Routing Protocols of Delay Tolerant Network provides different Performances under different circumstances. Many of the routing protocols provide better results as per the requirement, but Prediction based routing protocol gives a better delivery ratio, message probability ratio, less overhead ratio. We have summarized performance of the various Prediction based Protocols along with their Features.

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