A SURVEY AND A COMPARATIVE STUDY OF MULTICAST ROUTING TECHNIQUES IN DISCONNECTED ADHOC NETWORKS

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ABSTRACT

Nowadays, wireless networks are used in several various extreme environments where they suffer from different kinds of link disruptions. Operation requirements of these networks are differently altered and their performance is negatively affected rendering them heterogeneous by nature. These networks are known as Intermittently Connected Networks (ICNs). The existing Internet protocols fail to work properly in the context of ICNs, thus leads to a variety of new challenging problems. Delay-/Disruption-Tolerant Networks are emerging solutions to networks where the network suffers from frequent network partitions and long end to end delay. Over time, unicast routing, one of the key components common to all DTNs, became an almost independent field of research in which maximum efforts continue to be invested. But in case of network architectural designs, scheduling and transferring issues dating from the early days of Inter-Planetary Networks (IPNs) have received relatively little attention and accumulate numerous challenges. This paper compares the application of various multicast routing techniques in DTN and highlight pending open issues in each of them.

Keywords: Inter planetary Networks, Multicast, ICN, DTN

I. INTRODUCTION

Delay tolerant networks (DTNs) are emerging solutions to networks where the network suffers from frequent network partitions and long end-to-end delay, many new network applications fall into this type, such as wildlife enquiry, military networks, and disaster recovery and emergency reaction systems. In DTNs an end-to-end path between the source and the destination may only exist for brief and unpredictable periods of time. DTNs are sometimes also called intermittently connected Mobile networks (ICMNS).

A large variety “challenged” networks come under this category ranging from outer-space networks, under-water networks, wireless sensor networks, vehicular networks, sparse mobile ad-hoc networks etc. Students roaming in a University buildings or vehicles moving about in a small metropolitan area, or a wireless sensor network with some mobile nodes acting as relay nodes to assist in the data-collection phase provide representative examples of DTNs.

Many networking applications like audio conferencing or video conferencing, video-on-demand services, electronic learning, electronic health, distributed interactive simulation, software enhancement, and distributed database replication need multicast communication, which is a fundamental type of group communications, over a large network. In multicast communication, messages from the senders are delivered to all the nodes of a multicast group. Like all distributed system, multicasting is desirable within DTNs for applications where close cooperation or collaboration between participating nodes is necessary. For example, sensors placed in a military field for intrusion detection way need to communicate with each other for complete information regarding an intruding object. In an emergency response scenario, rescue workers need to disseminate information regarding local conditions and hazard levels.

While such group communication needs and requirements can be fulfilled with various unicast operations, availability of path, power and storage restrictions and application-level delivery needs require the development of efficient group communication support in DTNs. DTN multicast operations among members that belong to the domains in same administrative region are called intra domain multicast while the effort of delivering multicast traffic among different domains will be referred to as the inter domain multicast. In this paper we compare and examine the problem of multicasting with various multicast routing algorithms in delay tolerant networks.
II. BACKGROUND
2.1 Geographical Routing with Location Services
This technique proposes a geographical routing algorithm called location aware routing for delay tolerant networks (LAROD), which is developed and enhanced with a location service, location dissemination service (LoDiS), which together are shown to suit an intermittently connected MANET (IC-MANET) [1]. Because location dissemination takes time in IC-MANETs, LAROD is created to route packets with only partial knowledge of geographic position. To achieve low overhead, LAROD uses a beaconless strategy which is combined with a position-based resolution of bids when forwarding packets. LoDiS is maintaining a local database of member locations, which is enhanced using broadcast gossip combined with routing overhearing.

2.2 Energy Efficient Optimal Opportunistic Forwarding
This model is using a continuous-time Markov framework for the message dissemination [2]. In this technique the optimization problem of opportunistic forwarding is taken, with the constraint of energy consumed by the message delivery for both two-hop and epidemic forwarding. Based on the results and solution of optimization problem different kinds of forwarding policies such as static and dynamic are developed. Among these policies, the threshold dynamic policy is best for both two-hop and epidemic forwarding and among the dynamic policies the negative power policy is providing relatively better performance.

2.3 VDTN Protocol for DTN
Disruptions, high dynamism and no end-to-end communication are some examples of the Vehicular Delay Tolerant Networks (VDTNs) main characteristics [4]. The VDTN protocol makes use of information and knowledge about previous encounters to estimate congestion and density and good in spreading the data bundles and limit the number of copies to reduce overhead. It is working better than Epidemic multicast and reveals better delivery ratio and delay with a large reduction of overhead.

2.4 Density Aware Routing
This technique introduces DA-SW (Density Aware Spray and Wait), a measurement based variant of the spray and wait algorithm that is created, in a dynamic fashion, the number of a message copies to be disseminated in the network [5]. The particularity of DA-SW is that it relies on a set of abaci that represents the three phases of the accordion phenomenon: aggregation, expansion, and stabilization.

2.5 Prediction based Routing
This technique introduces predict and relay (PER), an efficient routing algorithm for DTNs, where members determine the probability distribution of future contact times and choose a proper next hop in order to improve the end-to-end delivery probability [6]. The algorithm is based on two observations. One is that nodes usually moving around a set of well visited landmark points instead of moving randomly. The other is that node movement behavior is semi-deterministic and would be predicted once there is sufficient mobility history information. This approach employs a time homogeneous semi-Markov process model that describes node mobility as transitions between landmarks. This approach enhances the delivery ratio and also reduces the delivery latency compared to traditional DTN routing schemes.

2.6 Epidemic Based Controlled Flooding and Adaptive Multicast for Delay Tolerant Networks
DTN is a type of sparse Ad Hoc Networks in which no contemporaneous path exists between any two nodes most of the time [13]. ECAM (Epidemic based Controlled Flooding and Adaptive Multicast for Delay Tolerant Networks) reduces the time and range of message transmission, so that the large consumption of network resources caused by flooding can be saved. ECAM adopts the adaptive mechanism to work well under different network conditions with different node densities. It shows higher message delivery ratios and lower average message copies.

2.7 Multicast Routing in Deep Space Sensor Network
Deep Space Sensor Network has a specific conditions and technical advantages in deep space exploration due to its characteristics of lowest power, lowest cost, distribution and self organization [14]. Multicast routing protocol which is used in Deep Space Sensor Network (MPDSSN) is based on the architecture of Delay and Disruption Tolerant Networks has more superior performance in the average delay, power saving, survival time and packet loss ratio.

2.8 A non-replication multicasting scheme in delay tolerant networks
This technique is focused to provide a non-replication multicasting scheme in DTNs while keeping the number of transfer’s low [15]. The address of each destination is not replicated, but it is assigned to a particular member based on its location.
contact probability level and node active level. This scheme is based on a dynamic multicast tree where each head node corresponds to a destination. Each tree branch is created at a contact based on the compare and split rule. The compare part calculates when a new search branch is needed, and the split part calculates how the destination set should be partitioned.

2.9 Reliable Multicasting in Disruption Tolerant Networks
This is a scalable multicasting scheme that deterministically assures message delivery to all receivers which are presented in the group [16]. It makes limited use of non-multicast nodes to reduce latency of delivering the message. It has developed a new measure called termination delay, which is the delay incurred in guaranteeing that the receivers have obtained a copy of the message. It achieves much lowest latency and termination delay than other methods.

2.10 Efficient genetic algorithm for any cast routing in DTN
Any cast routing can be focused for many applications in DTNs, and is helpful when nodes wish to forward the messages to at least single and preferably only one, of the members in a receiver group [17]. The genetic algorithm (GA) is used to search the exact path combination to comply with the delivery needs of a group of any cast sessions simultaneously. The Genetic Algorithm solution is using the concept of subpopulation to generate the next generation population, a limited number of results to evaluated and yields minimum delay to produce a specified rate of delivery.

2.11 Node Selfishness on Multicasting in Delay Tolerant Networks
This technique needs nodes to send messages in a cooperative and selfish way [7]. Many of the nodes are showing the selfish behaviors, like individual and social selfishness. It has taken and considers two typical multicast forwarding schemes, namely two-hop relaying and epidemic relaying. It is using the Continuous time Markov chain model. It has shown that different selfish behaviors may have different impacts on different performance metrics. Selfish behaviors influence epidemic relaying more than two-hop relaying. It also reveals that the performance of multicast with selfish nodes depends on the multicast group size.

III. CONCLUSION AND FUTURE WORK
The usual assumptions that lead to the birth of the Internet are no longer valid when considering newly emerging issues of intermittently connected wireless networks. Such networks operate in extreme environments characterized by challenging conditions. Nevertheless, regardless of all those limitations, a wide variety of wireless network applications were expected to be supported. This is why researchers proposed a new network prototype referred to in the open literature as a Delay- or Disruption-Tolerant Network (DTN). There has been significant research advancement in DTNs. A large number of papers have been published. All of them aim at providing suitable solutions to different DTN problems in the context of some specific applications. We have observed a common performance evaluation practice in most of these works. The performance of a particular algorithm and technique that considers particular aspects under the context of a specific scenario is compared to those of other algorithms and techniques that consider totally different aspects and that were assigned for totally different scenarios.

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