Optimized Replication Strategy for Intermittently Connected Mobile Networks

C. Poongodi, Kongu Engineering College, Perundurai, India
A. M. Natarajan, Bannari Amman Institute of Technology, India

ABSTRACT

Intermittently Connected Mobile Networks (ICMNs) are wireless networks where due to mobility of nodes and lack of connectivity, there may be disconnection among the nodes. Hence, the routing path from source to destination is not always available. In this case, Mobile Ad-hoc Network (MANET) protocols will not be utilized. In these networks, messages are to be flooded or multiple replications are needed to withstand the maximum delay and achieve the high delivery ratio. But multiple replication based protocols result in increased network overhead and high resource consumption because of uncontrolled replication. In this paper, the authors introduce a new simple scheme which applies knapsack policy based replication strategy in replicating the messages. The number of replication is reduced by appropriately selecting only limited messages based on the number of duplications of its own and its size. The messages are selected for forwarding to relay node based on the goodness of the relay node in contacting the destination and the buffer size of the relay node. Therefore, only limited messages will be replicated in the network and it will reduce the network overhead, resource consumption, delivery delay and increases the delivery ratio.

Keywords: Challenged Networks, Forward Transmission Count, Intermittently Connected Mobile Networks (ICMN), Knapsack, Mobile Networks

1. INTRODUCTION

A Mobile Ad-hoc Network (MANET) is an autonomous collection of mobile users where the network topology may change rapidly and unpredictably over time. Mobile ad-hoc networks may well complement infrastructure-based wireless networks and allow mobile users to obtain access to interact directly with one another even when they are outside the coverage area of cellular networks or wireless LAN. Similarly, MANETs may enable communication between vehicles, sensors, laptops and other mobile equipment without the need to deploy a fixed infrastructure network. Numerous dedicated routing protocols have been proposed to establish and maintain reachability between communicating nodes in such dynamic environments.

Challenged networks or Intermittently Connected Networks arise from MANETs primarily as a result of node mobility but may
also come into being as a result of disconnection due to power management or interference. As a result the network becomes partitioned. Unfortunately, with current ad hoc routing protocols, packets are not delivered if a network partition exists between the source and the destination when a message is originated. Certain applications, such as real-time, constant bit rate communication may require a connected path for meaningful communication. However, a number of other application classes benefit from the eventual and timely delivery of messages, especially in the case where frequent and numerous network partitions would prevent messages from ever being delivered end to end (Vahdat & Becker, 2000). Examples of such networks include terrestrial mobile networks, exotic media networks, military ad-hoc networks and sensor networks. These challenged networks are characterized by high latency, bandwidth limitations, high error probability, node longevity, or path stability that are substantially worse than is typical of today’s TCP/IP based networks. (Burleigh, Hooke, Torgerson, Fall, Cerf, Durst et al., 2003; Cerf, Burleigh, Hooke, Torgerson, Durst, Scott et al., 2007; Fall, 2003).

Existing TCP/IP based network protocols could not be utilized for these challenged networks since they operate on a principle of providing end-to-end inter-process communication through a concatenation of dissimilar link-layer technologies. A number of key assumptions are made regarding the overall performance of the underlying links in order to achieve smooth operation: an end-to-end path exists between a data source and its peer, the maximum round-trip time between any node pairs in the network is not excessive, and the end-to-end path loss probability is small. Unfortunately, challenged networks which may violate one or more of these assumptions, are becoming important and may not be well served by the current end-to-end TCP/IP model.

When a direct contact routing approach is applied to this type of network, the message delivery delay will be very high (Wang & Wu, 2006) and then they will get dropped by the network if delay increases further. Since many nodes are mobile nodes they will increase the delivery ratio in wireless environment (Grossglauser & Tse, 2002). Hence by using the mobility property of the nodes, there were numbers of routing protocols proposed for these partially connected networks and they are divided into replication based and knowledge based (Jain, Fall, & Patra, 2004). Replication based protocols create multiple copies of a message. A common technique used to maximize the probability of a message successfully transferred is to replicate many copies of the message in hopes that one will succeed in reaching its destination as said in Vahdat and Becker (2000). In this kind of flooding protocol, each node tries to forward every message to every one of its neighbors except the source node. This results in every message eventually being delivered to all reachable parts of the network.

The other kind of protocol is knowledge based (Lebrun, Chuah, Ghosal, & Zhang, 2005). Here, some knowledge is required about the network but they consume fewer resources compared to flooding strategies. In location based routing stated in Mauve, Widmer, and Hartenstein (2001), a node requires location co-ordinates of its own, destination co-ordinates and the co-ordinates of the potential next hops. With these, a node can easily compute the distance function and determine where the message should be sent.

In this paper, we focus on studying replication based routing in realistic network environments with limited bandwidth and limited node buffers. In such environments, if it uses the replication based protocol, when a transmission opportunity arrives, ideally, a node should transmit the packet when the transmission opportunity comes. Example for replication based protocol is Epidemic Routing (Vahdat & Becker, 2000), Spray and Wait, Spray and Focus (Spyropoulos, Psounis, & Raghavendra, 2005, 2007). Here, multiple copies are distributed for each message in order to increase the delivery ratio.
GNSS Data Processing and Analysis for Earthquake Disaster Prevention Monitoring
www.igi-global.com/article/gnss-data-processing-and-analysis-for-earthquake-disaster-prevention-monitoring/204483?camid=4v1a

Reliability Modeling of Embedded Nodes in Real Time Wireless Systems
www.igi-global.com/article/reliability-modeling-of-embedded-nodes-in-real-time-wireless-systems/96964?camid=4v1a