

Chapter 9

A Dynamic Reputation– Based Incentive Scheme to Encourage Selfish Nodes in Post–Disaster Situation Using Delay–Tolerant Network

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ABSTRACT

Modern communication infrastructures that usually keep people always on-line and inform “on-the-go” have repeatedly proved to be unreliable and unavailable during and after major disasters. In those situations the prime need is to quickly re-establish minimal communication infrastructures to start rescue operations. DTN is described by a special kind of mobile ad-hoc network where sparseness, large communication delay and lack of end to end path from source to destination exist. It is evident from this fact that data forwarding is dependent on the cooperation of multiple hops in “store-carry-forward” manner. However, nodes involved in communication may sometimes behave maliciously and may non-cooperate. So, the objective in this perspective is to develop a reliable data forwarding scheme by detecting malicious activities and encourage nodes to participate in Post Disaster Communication environment. Analysis of the proposed system, its protocols and performance studies are implemented and tested using Opportunistic Network Environment (ONE) simulator.

INTRODUCTION

Now-a-days Delay/Disruption Tolerant Network (DTN) is used in post-disaster situation to assist rescue operation. As it is a special type of wireless network with sporadic connectivity, lacks of infrastructure, very long delays due to network partitioning, are the universal aspects.

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In DTN, messages, also called bundles, are propagated using hop by hop fashion and buffered at the next hop until the next hop appears. This propagation process is named as store-carry-forward method where the users are opportunistic in nature. As in DTN end to end communication is no longer possible, data are forwarded in hop by hop approach via intermediate nodes (Chakrabarti, & Roy, 2015; Chakrabarti *et al.*, 2014). As a result, the architecture of DTN relies on the cooperation among nodes participating in data communication (Chakrabarti, Banerjee, & Chakrabarti, 2014). However, the intermediate nodes may sometimes become selfish (Chakrabarti, & Roy, 2015; Chakrabarti *et al.* 2014; Chakrabarti, Banerjee, Chakrabarti, Chakraborty, 2014a; Banerjee *et al.*, 2014; Chakrabarti, Banerjee, Chakrabarti, Chakraborty, 2014b; Banerjee, Chakrabarti, Chakraborty, Chakrabarti, 2014; Chakrabarti, 2014). Nodes may be selfish due to deficiency of its energy (battery power) or due to some malicious intention (Chakrabarti, Chakrabarti, Banejee, 2015). Therefore, how to efficiently and effectively resolve the selfishness problem has become the most challenging issue to achieve better packet delivery performance of DTNs. The most popular way is to detect and avoid those selfish nodes during data communication.

A node's selfishness may be typified as *non-cooperation* or dropping of messages (Chakrabarti *et al.*, 2014; Chakrabarti, Banerjee, Chakrabarti, Chakraborty, 2014a; Chakrabarti, Banerjee, Chakrabarti, Chakraborty, 2014b). Miao *et al.* (2012) classify selfish behavior into two categories: individual selfishness and social selfishness.

Individual selfishness is defined as the reluctance of a single node to relay others' messages, may be due to protect its limited resources or due to some malicious intention.

On the contrary, if a node belongs to a certain community, it is always willing to relay messages for the nodes within the same community/group but renounces to relay messages for the nodes outside its community/group (Wei *et al.*, 2011). This is termed as *social selfishness*.

In this paper, our objective is to assure reliable delivery of messages in DTN by avoiding the communication through selfish nodes as far as possible. We propose *a dynamic reputation based incentive scheme to detect selfish nodes and to encourage them* in a Post Disaster Communication environment. Here neighbor nodes will monitor a particular node's cooperation characteristics. Based on the cooperation characteristics of nodes in a network, Trusted Authority (TA) node publish *a universal node reputation matrix* from time to time which is consulted by each node to avoid selfish non-cooperative nodes during their data forwarding. Moreover, TA nodes will give incentives to the participated nodes, which will help them to take part in communication. We have simulated the scheme on ONE simulator and analyzed that the performance improves significantly with our proposed scheme. We also compared our performance with the "IRONMAN" scheme (Bigwood *et al.*, 2012) and with the "Pi" scheme (Lu *et al.*, 2010) using ONE simulator developed by netlab online and we got better result using our scheme with the perspective of data delivery and overhead.

The rest of the paper is organized as follows. Background describes the related research in this domain. Main focus of the chapter illustrates our reputation calculation and incentive assignment model. The simulation part depicts simulation parameters and performance of the proposed scheme. The Conclusion part concludes the paper. The last section discusses about the Future research directions.

BACKGROUND

In recent years DTN has got much attention from researchers and it has become very popular not only among the researchers but also among the common people (Chakrabarti, Chakrabarti, Chakrabarti,

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