Abstract

Opportunistic Mobile Networks (OMNs) are a variant of Delay/Disruption Tolerant Networks (DTNs), which, unlike traditional networks, suffer from the lack of end-to-end connectivity among nodes due to frequent network partitioning. Messages in OMNs are "opportunistically" routed to their destinations using the store-carry-and-forward transfer mechanism. Mobility among users creates new opportunities to connect and communicate with one another using wireless devices. In OMNs, a source node can directly deliver a message if it comes in contact with the corresponding destination node; otherwise, it forwards the message to the other nodes in contact with the hope that the message would eventually reach the destination. So, the intermediate nodes play the crucial role of cooperation by storing, carrying, and forwarding the messages of other nodes. Multiple routing protocols were proposed in the literature based on the assumption that nodes are fully cooperative. However, this may not be always true since the nodes independently decide whether or not to accept messages of the other nodes (i.e., the nodes are rational). According to the traditional approaches, cooperation can be enforced by incentive- or reputation-based mechanisms. However, such mechanisms require the presence of a server and/or tamper-proof hardware for monitoring the actions taken by each node.

Motivated by these problems, in this thesis, we identify different aspects based on which nodes in OMNs could cooperate. First, we propose a Distributed Information-baSed Cooperation UShering Scheme (DISCUSS) to promote cooperation amongst nodes, where the nodes dynamically adapt their message forwarding strategies. Second, we design a Distributed Strategy Identification Scheme (DISIDE) using which a node identifies other nodes' strategies locally. In this scheme, a node learns from its own observations while receiving or forwarding messages to other nodes. Additionally, it learns from other nodes by exchanging information. Based on these observations, each node identifies the other nodes' strategies in a distributed manner. Third, we study the problem of cooperation among the groups of nodes based on the strategies – cooperate, exploit, and isolate – and determine the relationship among them. We investigate the impact of such behaviors on the performance of message delivery using Evolutionary Game Theory (EGT), specifically the Rock-Scissors-Paper (RSP) game. Based on this, we propose a cooperative communication scheme among the nodes in an OMN in the presence of

non-cooperative nodes using coalitional game approach. Since all aspects of cooperation strongly depend upon an efficient underlying routing protocol, we finally propose the Contact-Based Routing algorithm to minimize the average message buffer time of a node while maintaining a targeted message delivery ratio compared to the existing state-of-the-art routing protocols. Results of experiments performed using real-world traces as well as synthetic mobility models show that the performance of the OMNs in terms of message delivery ratio increases when the nodes cooperate with each other in message forwarding.

Keywords: Opportunistic Mobile Networks, Cooperation, Rock-Scissors-Paper game, Strategy identification, Routing, Performance analysis, Coalition Formation.