Chapter 18

An Optimum Routing Technique for MANET over LTE Cellular Networks

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ABSTRACT

Mobile Ad Hoc Networks (MANET) is a peer-to-peer communication technique that can transmit voice or data from one mobile device to another without the support of fixed infrastructures. Multi-hop routing has improved in the last few decades and MANET is considered one of the latest trends in modern cellular communications. Studies have been carried out to find optimum routing techniques for MANET, but the majority of the works are within IEEE 802.11 environments. Long Term Evolution (LTE) series 8, which is an IP-based architecture, can offer the added benefit of co-operative communication and reduced transfer latency. Earlier research articulated a new MANET algorithm called IP Address Associated 4-N Intelligent Routing Algorithm (IPAA4NIR), which provided fast, reliable, and energy-efficient communications. This book chapter incorporates IPAA4NIR with co-operative communications to obtain an optimum routing technique for MANET using LTE cellular networks. The chapter also includes the statistical analysis of the proposed algorithm and simulations using OPNET modeller. A comparison with other prominent algorithm shows the proposed algorithm can use the added features of LTE and provides an optimum communication technique for MANET devices.

INTRODUCTION

Mobile Ad Hoc Network (MANET) is a communication technique which allows mobile devices to communicate with each other without every mobile within the network being connected to the fixed infrastructure. Whenever a call is established between two mobile devices in a conventional cellular network, traffic is sent from the initiator mobile device to the base station and then transmitted through the access and transmission medium to the destination mobile device. In a MANET environment, traffic is sent from source to destination using intermediate nodes as routers. MANET can
have at least one node connected with the fixed network which can allow other devices to communicate with the external world using the node as a gateway. A MANET node communicates directly with another node if both of them are within the transmission radius. Otherwise the sender finds intermediate nodes which can act as routers and transmit data to the destination node. In MANET every mobile device functions as a router and forwards the packet towards the destination node using a multi-hop technique.

Figure 1 represents a MANET model using LTE cellular network where all the mobile nodes can communicate with each other using intermediate nodes as routers. MANET also allows at least one nominated device to be connected to the IP backbone via eNodeB or Gateway so the other devices can communicate with external world using the nominated device as a router. Accordingly MANET is a self-configuring, autonomous and easily deployable network. It can be utilized to provide rapid communications at disaster affected areas, military operations, multi-hop large networks and at social or sporting events where the fixed infrastructure is unable to support traffic demands.

In spite of MANET concepts being introduced several decades ago, recent technology advances have provided the opportunity to enhance MANET through the introduction of mesh and advanced node-to-node relay capabilities. This technology not only eliminates the requirement for fixed infrastructures but provides convenience as well. Therefore customers are planning to embrace ad-hoc technology for convenience whereas service providers are planning to utilize the technology for minimizing infrastructure costs.

Current cellular networks that are a combination of circuit and packet switching cannot utilize the multi-hop characteristic of MANET efficiently. With the introduction of LTE (moving towards IMT-Advanced), MANET benefits from the use of IP and fast packet switching concepts. LTE supports a peak download limit of 300Mbps and upload limit of 75Mbps on a 20 MHz bandwidth which is considerably faster than its predecessor. LTE also uses the Evolved Packet Core (EPC) architecture and operates in a separate wireless spectrum from 2G and 3G. LTE has a packet switched radio interface to align with its all IP based network. Every LTE cell includes mobile nodes and an eNodeB which communicates with the outside network or IP backbone. Being an IP based architecture LTE provides the option of co-operative communication where an intermediate node will not only relay the packet but amplify as well. This is done by size matching of sent and received messages. Therefore LTE cellular networks are promising as an emerging technology for providing low cost but better quality voice services as well as ubiquitous and fast...