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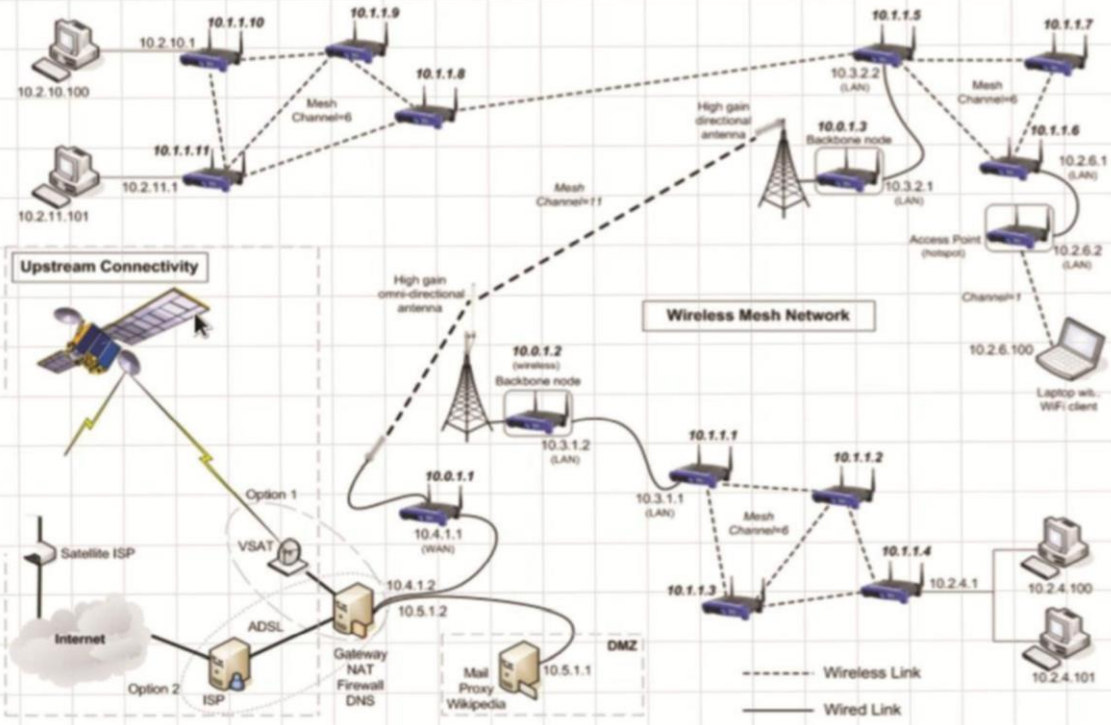
ROUTING ISSUES IN MANETs



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About The Book

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Dedication And Thanks

First and foremost, I would like to thank my Mother Balusupati Umasavithri I dedicate this book to her. And my Father B.K. Sydulu for their support and then I would like to thank my wife Sujatha for standing beside me throughout my career and writing this book. She has been my inspiration and motivation for continuing to improve my knowledge and move my career forward. And I also thank my wonderful children: Akshaya, Abhiram for always making me smile and for understanding on those weekend mornings when I was writing this book instead of playing games with them. I hope that one day they can read this book and understand why I spent so much time in front of my computer. I'd like to thank Dr. J. Apparao Garu always supported me throughout my career and authoring this book and I really appreciate it. And I would like to thank Dr. K. Haribabu Garu Our Director for his support. I look forward to discussing this book with my family at future gatherings as I'm sure they will all read it soon. My Dear Friends T.V.N. Prapulla Chandu, Ch. Ranjith Kumar, Prof. K. Venkateswara Rao garu, D. Nagaraju, A. Rakesh Babu, Rambabu,…. who showed me the ropes in IT. Without that knowledge I wouldn't have ventured into learning about MANETS, which ultimately led to this! I'd like to especially thank Dr. G. Manoj Someswar for trusting me to guide and develop the applications for our department, and for allowing me the freedom to manage my projects and provide the necessary time and resource toward our applications and databases. Thanks to each and every one in Educreation Team for giving me such support to publish this book.

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Preface

This book gives a comprehensive overview of the challenges and possible solutions in Mobile Adhoc Networks with particular reference to Routing and other network topologies in order to improve the efficiency. When a routing protocol for MANET Networks (mobile and ad hoc networks) does a route discovery, it does not discover the shortest route but the route through which the route request flood traveled faster. In addition, since nodes are moving, a route that was the shortest one at discovery time might stop being so in quite a short period of time. This causes, not only a much bigger end-to-end delay, but also more collisions and faster power consumption. In order to avoid all the performance loss due to these problems, this paper develops a technique to periodically discover shortcuts to the active routes that can be used with any destination vector routing protocol. It also shows how the same mechanism can be used as a bidirectional route recovery mechanism. We consider the problem of incorporating security mechanisms into routing protocols for ad hoc networks. Canned security solutions like IPSec are not applicable. We look at AODV in detail and develop a security mechanism to protect its routing information. We also briefly discuss whether our techniques would also be applicable to other similar routing protocols and about how a key management scheme could be used in conjunction with the solution that we provide.

So many researches were concentrated on MANET routing issues but very less scholars were discussed about the multicasting in MANET. Dynamic node movements are problematic to manage the connectivity and routing. There are some problems of the existed mobile computing applications are MANET Region Establishment, membership management, data transmission failures, delivery acknowledgement etc.

Previous researches designed some ad hoc network routing protocols LAM, MZRP and ODMRP are to enable the membership management and transport of data packets from one point to

another. But all of these protocols can have their own inherent limitations due the nodes dynamism, increasing group members and maintaining the complex group structure. Another main challenge in MANET is designing the robust security solutions that can protect MANET from various routing attacks.

In order to address the issues in multicasting over MANETs, this thesis proposed an Upgraded Scalable Virtual structures based Geographic Multicasting (USVGM) Protocol, which can extent to a large group size and large network size and this protocol will provide efficient multicast packet transmissions in a dynamic mobile ad hoc network environment. USVGM protocol is implemented with the two layer architecture to avoid the membership management problem.

In recent years mobile ad hoc networks (MANETs) have received tremendous attention because of their self-configuration and self-maintenance capabilities. While early research effort assumed a friendly and cooperative environment and focused on problems such as wireless channel access and multihop routing, security has become a primary concern in order to provide protected communication between nodes in a potentially hostile environment. Although security has long been an active research topic in wireline networks, the unique characteristics of MANETs present a new set of nontrivial challenges to security design. These challenges include open network architecture, shared wireless medium, stringent resource constraints, and highly dynamic network topology. Consequently, the existing security solutions for wired networks do not directly apply to the MANET domain. One fundamental vulnerability of MANETs comes from their open peer-to-peer architecture. Unlike wired networks that have dedicated routers, each mobile node in an ad hoc network may function as a router and forward packets for other nodes.

The wireless channel is accessible to both legitimate network users and malicious attackers. As a result, there is no clear line of defense in MANETs from the security design perspective. The boundary that separates the inside network from the outside world becomes blurred. There is no well defined place/infrastructure where we may deploy a single security solution. Moreover, portable devices, as well as the system security

information they store, are vulnerable to compromises or physical capture, especially low-end devices with weak protection. Attackers may sneak into the network through these subverted nodes, which pose the weakest link and incur a domino effect of security breaches in the system. The stringent resource constraints in MANETs constitute another nontrivial challenge to security design. The wireless channel is bandwidth-constrained and shared among multiple networking entities. The computation capability of a mobile node is also constrained. For example, some low-end devices, such as PDAs, can hardly perform computation-intensive tasks like asymmetric cryptographic computation. Because mobile devices are typically powered by batteries, they may have very limited energy resources. The wireless medium and node mobility poses far more dynamics in MANETs compared to the wireline networks. The network topology is highly dynamic as nodes frequently join or leave the network, and roam in the network on their own will. The wireless channel is also subject to interferences and errors, exhibiting volatile characteristics in terms of bandwidth and delay. Despite such dynamics, mobile users may request for anytime, anywhere security services as they move from one place to another. The above characteristics of MANETs clearly make a case for building multi fence security solutions that achieve both broad protection and desirable network performance. . The design of the multicast scheme in MANET is more complex because of the dynamic change in the network topology and the limited bandwidth availability constraints.

We feel it a great privilege to present this book in in a simple and crisp manner so that it is not only useful to those who are learning the subject but also for the general readers who would like to broaden their knowledge in the area of MANETs.

B.V.V.S. Prasad

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Abstract

Mobile Ad hoc Network (MANET) become a prominent solution for emergency applications, Military services and many other location based on-demand services. Increasing wireless mobile devices utilization needs the dynamic collaboration of nodes for communication and information exchange without having the base stations. Due to the importance of MANETs recent researches were concentrated on expanding the horizons of it by introducing some new aspects like multicasting, virtual network zones creation, multi hop management and geographic routing etc. Efficient routing protocol is the backbone of MANET to achieve the scalability, reliability and security.

Since last decade, many routing protocols and network topologies were introduced in MANETs to improve the efficiency. There are still some more challenges need to solved in the area of MANETs routing, communication, data transfer and multicasting etc. This main aim of this research is to identify the possible solutions for challenges in Mobile Ad hoc Networks with an Emphasis on Routing.

A Mobile Ad hoc Network is shortly called as MANET is an unstructured collection of wireless nodes. MANET supports the on demand private network establishment among wireless communicable mobile devices to exchange the information. These networks can created automatically without expecting any base station or guided network to maintain the communication. Due to its wireless node mobility support and quick network establishment features many areas like military services, pervasive applications, emergency applications, dedicated group communications and so on are adopted MANETs for infrastructure less low cost network creation.

There were many challenges existed in the area of MANET environment to do research and innovation. Some of the main areas are routing, data transfer, data acknowledgement, protocol implementation, multi casting, delay management and security etc. Efficient routing protocol is the backbone of MANET to achieve

the scalability, reliability and security. Since last decade, many routing protocols and network topologies were introduced in MANETs to improve the efficiency. Earlier researches were concentrated on designing new protocols or updating the existing protocols to made MANET routing more efficient.

This thesis mainly concentrated on the challenges of MANET routing protocols and provides the possible solutions to them by introducing the USVGM and EMR protocols. These two protocols will concentrates on two different ways of MANET routing are single path routing and multi path routing.

This thesis addresses the above routing and data transfer problems of MANET by introducing the Efficient Multipath Routing (EMR) and its features in a streamlined manner. EMR creates multiple shortest paths in between source and destination to overcome the data transmission problems. In order to support the node mobility while data transmission EMR implements the Dynamic Source Routing (DSR) with the help of decentralized management.

Each mobile node of EMR can behave as a simple network node to network group manager depends on the circumstances. All nodes are having the GPS reorganization system, neighbor node detection mechanism, Location dependent services and updates etc. EMR nodes are also flexible enough to support the Dynamic Source Routing (DSR) to track the node movements perfectly.

In EMR, all the nodes will send the signals to enquire the neighbor's in their transmission range and send the test packets to ensure the connectivity. If any node is belongs to the same category and looking for similar activity to perform then it would be considered as a neighbor node. This process will continue with all the nodes to find the neighbor's as well as to form the dynamic network zone. This dynamic network zone size and area is subjective to the dynamic mobile nodes moving, joining and leaving. EMR approach uses the GPS location information with every node to update the node location information. Instead of maintain one node as a server node to place the member nodes information; EMR keeps the neighbor's data with all network nodes.

Generally the transmission errors are common in MANETs due to the node mobility and region changes. Transmission path information should be update periodically to the source nodes to follow up the node movements effectively. EMR is implementing the sub regions based multipath routing in MANETs to avoid the transmission errors and to find the malicious nodes.

Load balancing and link failures are two important factors to consider while transmitting the data from sender to receiver through intermediate nodes. Due the limited resource configurations of MANET nodes they cannot handle the high density circumstances and expects the balancing of load.EMR is avoiding this problem also by using the multipath implementation. If any link failed in case of while transferring the data our approach immediately use another path which is already established as a part of multipath routing. This process save the time delay of alternate route finding of single path routing and also balances the load of traffic through multiple paths to improve the data transfer rate.

The next part of our research will concentrates on multicasting, which is a powerful scenario in MANET's environment. The design of the multicast scheme in MANET is more complex because of the dynamic change in the network topology and the limited bandwidth availability constraints. So many researches were concentrated on MANET routing issues but very less scholars were discussed about the multicasting in MANET. Dynamic node movements are problematic to manage the connectivity and routing. There are some problems of the existed mobile computing applications are MANET Region Establishment, membership management, data transmission failures, delivery acknowledgement etc.

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ABOUT THE AUTHOR:

B. V. V. S. Prasad (Ph.D) is a Research Scholar under the Guidance of Dr. G. Manoj Someswar, and completed M.Tech in Computer Science & Engineering. He is presently working as an Associate Professor in Chebrolu Engineering College, Chebrolu, Guntur, India. He is having 8 years of teaching experience in different Engineering Colleges and an associate member of CSI and life member of ISTE, Member in IEEE. Undergone CIT program conducted by IIIT Hyderabad and published more than 5 international journals in the area of Data Mining and Image Processing, Published 2 international journals in the field of Mobile Ad-hoc Networks and Present one international conference on Fuzzy logic in IRNET. Recently attended a National Seminar conducted by GITAM University Vizag, on Cloud Computing.

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