Advances and Applications in Mathematical Sciences
Volume 18, Issue 9, July 2019, Pages 835-842

A TECHNICAL INSIGHT OF MANET

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Abstract

Mobile Adhoc NETwork (MANET) is a current and a hot topic in the Internet world. Because the Internet usage has increased and moved from the wired communication to wireless communication. In a MANET, the architecture and routing process follow arbitrary manner. MANET has unique characteristics based on its usage in several application areas such as military, commercial sectors, disaster areas, etc. This paper deals detailed concepts of MANET applications, architecture in OSI layers and various routing protocols.

1. Introduction

Mobile Adhoc networks (MANET) are established with wireless mobile nodes communicating freely and dynamically, self-organizing arbitrary, temporary without a centralized control or established infrastructure or centralized structure [1]. All the mobile nodes act as end systems or routers for forwarding the data packets within MANET. Researches in MANET have been carrying for the past 20 years and today various networking programs are to be processed such as the Tactical Internet (TI), Near-Term Digital Radio (NTDR), Defense Advanced Research Projects Agency (DARPA), Global Mobile (GloMo), Small Unit Operations (SUO) Programs, Army Research

2010 Mathematics Subject Classification: Primary 05A15; Secondary 11B68, 34A05.
Keywords: MANET technology, Routing Protocols, Architecture, Security Issues.
Received December 26, 2018; Accepted January 25, 2019

Laboratory's Advanced Telecommunications and Information Distribution Federated Laboratory Program (ATIRP). In a MANET, all mobile nodes should possess and execute the communication activities such as discovering the topology and delivering messages by themselves. Routing functionalities are incorporated into mobile nodes over wireless links with the effects such as noise, fading, and interference. To conciliate the topology changes, various routing algorithms have been proposed and the protocols should satisfy the characteristics of density, size and the mobility of the nodes. In cellular communication, it is an observed fact that the overall size of data transmission around the world has consumed about 2.5 Exabyte per month in the year 2014 and it is estimated that 25 Exabyte per month will be in the year 2019, in developing countries like Latin America, China, and the Middle East [2]. This paper presents the evolution of MANET in section II. Section III, deals the OSI architecture of MANET and its characteristics. The important application areas are focused in section IV. The three major categories of routing protocols are summarized with merits and demerits in section V. Section VI concludes with our further research.

2. Evolution

Several projects related to communication between wireless terminals on battlefield fields are still in research. It is to be noted that these early packet radio systems predict the Internet and indeed a part of the motivation of the original Internet Protocol suite. The radio packets of generations are categorized according to the level and environment usages. The MANET life cycle is categorized by first, second and third generations. The current generation is to be called third generation MANET. The first generation of MANET is introduced in 1972 and named as Packet Radio Networks (PRNET). In conjunction with Arial Locations of Hazardous Atmospheres (ALOHA) and Carrier Sense Medium Access (CSMA), approaches have been used on a trial basis to provide different networking capabilities in a combat environment. The second generation of MANET is introduced in 1980s; implemented as Survivable Adaptive Radio Networks (SURAN) and provides packet switched network to the mobile battlefield in an environment without infrastructure. The third generation of MANET started in 1990s. The concept of adhoc networks has been initially worked with notebook computers. IEEE

802.11 has adopted the term "AdHoc Network" and deploying it in different areas of applications. Initially, two kinds of mobile wireless networks as infrastructure networks with wired gateways as Wireless Local Area Networks (WLANs) and infrastructless mobile network which is termed as MANET are proposed [3].

3. Protocol Layers and Characteristics

The MANET architecture follows the structure of OSI/TCP/IP layers. The application layer is responsible for providing location based services. The presentation layer provides the services for the data representation. In the transport layer, reliable delivery by the use of acknowledgments and retransmission are to be ensured. In a MANET, the acknowledgement of mobile nodes will cause packets to be delivered out of order and significant delay due to its structure less architecture and wireless channel. Retransmissions are very expensive due to its power requirements [10]. Many routing algorithms and techniques have been initiated to find a path between the source and destination nodes [4]. The data link layer consists of the Logical Link Control (LLC) and the Medium Access Control (MAC) sub layers. The MAC sub layer is responsible for channel access, and the LLC is responsible for link maintenance, framing data unit, synchronization, error detection, and possible recovery and flow control. There is an interest in the power design of MAC layer protocols for MANET. IEEE 802.11 has a built in power saving feature that allows nodes to available status during the connection period and to go to sleep mode if it is either not receiving or transmitting [16]. The physical layer specifies the operating frequency range, the operating temperature range, modulation scheme, channelization scheme, channel switch time, timing, synchronization, symbol coding, interference from other systems, carrier-sensing and transmit/receive operations of symbols, and power requirements for operations. MANET nodes are equipped with wireless transmitters and receivers using antennas and may transmit signals as omnidirectional, highly directional or the combination of both. MANET has several characteristics such as, (i) Dynamic Network Topology- all mobile nodes are free to move arbitrarily and may change its topology randomly and rapidly at an unpredictable time either bidirectional or unidirectional links, (ii) Bandwidth-constrained- variable

capacity link-In MANET, the wireless links have significantly lower capacity than their hardwired links and (iii) Limited physical Security- mobile nodes are usually compact, soft and handheld in nature.

4. Applications

MANET allows the mobile nodes to maintain the connections between the network as well as adding and removing devices to and from the network dynamics. The main and important application of ad-hoc network is military kind, pervasive computing, VANET, and educational area. Other applications are mainly used in rescue such as police and firefighters, search and rescue missions, possible commercial purposes could be for taxi communication, on boats, aircraft, monitor remote or inhospitable physical environments and sports stadiums [5]. The set of applications for MANET is diverse, ranging from large-scale, mobile, highly dynamic networks, to small, static networks that are constrained by power.

5. Routing Protocols

The communication models such as Wireless Local Area Network (WLAN) and Global System for Mobile communications (GSM) where takes place the communication via some centralized access points. In a MANET, mobile nodes exchange packets within the Internet by global IP address and find the available Internet gateways to communicate with each other [6, 7 and 8]. The routing protocols play an important role to route the information frequently in Adhoc Network.

5.1. Proactive (Table-driven or non-position-based) Routing Protocols:

Each mobile node maintains a routing table where data packets are broadcasted periodically within the network. When a source node wants to transmit the data from source to destination, it searches the routing table to find a destination node which is matched. The various routing protocols of proactive are tabulated in table, Table 1.

Table 1. Proactive Routing Protocols.

S.No	Routing Protocol	Function	Merits	Demerits
1.	Destination Sequenced Distance Vector (DSDV)	Maintain table for identifying the next hop to reach all destinations.	Less delay and Less modification	Less battery power, less bandwidth and not suitable for dynamic or large scale networks.
2.	Wireless Routing Protocol (WRP)	Maintain table for more accurate information.	Faster convergence and fewer table updates.	Larger memory, greater processing, high mobility.
3.	Cluster Switch Gateway Routing (CGSR)	Destination cluster head for every node and the list of next-hop nodes for reaching the destination cluster.	Better bandwidth utilization, easy to implement the priority scheduling scheme.	Increase in path length, Instability, Frequent changes in the cluster-head.
4.	Source Tree Adaptive Routing Protocol (STAR)	Routers in STAR communicate with its neighbors, their source routing trees either incrementally or in atomic updates.	Low mobility patterns, Eliminates frequency of updates in that case, support Quality of Service.	Not suited for high mobility patterns, or fast moving nodes, no scalability.

The proactive routing protocol supports the features of maintaining up to date route information, quick establishment of routes and small delay with lack in slow reaction on restructuring and failures, waste of bandwidth, Redundant route entries for the specific destination in the routing tables and the tables occupies extra memory space and resource networks.

5.2. Reactive Routing Protocols

This kind of routing uses the flooding technique for discovering the routes. This routing protocol searches the route in on demand manner and sets the link to send and accept a packet from source node to the destination node. In reactive, the routes are discovered only when the source needs to transmit the data, so that the control packet overhead will be reduced. The main advantage of this type of routing protocols is to save precious bandwidth of Adhoc network. The routing protocols proposed under this category are

tabulated in table, Table 2.

Table 2. Reactive Routing Protocols.

S.No	Routing Protocols	Function	Merits	Demerits
1.	Dynamic Source Routing Protocol (DSR)	Source routes by accumulating the address of each device between the source and destination during route discovery.	Eliminates flood, suitable for static and low mobility environments, No need to update routing tables,	Route maintenance mechanism does not locally repair a broken link and small time delay at the begin of a new connection.
2.	Ad-Hoc on-demand Distance-Vector Routing Protocol (AODV)	Broadcast messages sent throughout the network and reduce the routing overhead.	Minimizes the number of broadcasts, reliable for the wireless mesh networks, loop free and the connection setup delay are less.	Do not utilize any congestion control, inconsistent route and Heavy control overhead.
3.	Temporally-Ordered Routing Algorithm (TORA)	Suppress the routing path	Better delivery ratio in less sources, Increase overhead in the network	Poor performance.
4.	Location-Aided Routing Protocol (LAR)	Based on GPS, the mobile hosts identify the physical locations for routing.	Reduce, control overhead and increase utilization, bandwidth	Depend on GPS

The reactive routing protocol supports the features of reduction in routing overhead, saving of resources, loop free in routing and lack in the features of latency time, flooding can lead to network clogging, control traffic and overhead cost.

5.3. Hybrid Routing Protocol

Hybrid routing protocol combines the features of reactive and proactive protocols. These protocols have the advantages of both proactive and reactive routing protocols to balance the delay and control overhead. This hybrid Routing protocol is advantages that the routing is proactive for short distances and reactive for long distances. The protocol under this category are tabulated in table, Table 3.

Table 3. Hybrid Routing Protocols.

S.No	Routing Protocols	Function	Merits	Demerits
1.	Zone Routing Protocol (ZRP)	Divides the network to local "neighborhoods" called as zones.	Reduces the control traffic, reduce waste of bandwidth	The large overlapping of routing zones
2.	Core Extraction Distributed Ad Hoc Routing (CEDAR)	A core node on every three hops and picks up a node within a distance not greater than one hop from it.	Utilization of core nodes reduces the traffic overhead and efficiently with the help of core nodes.	Control overhead.
3.	Zone Based Hierarchical Link State Routing Protocol (ZHLS)	The network is divided into non-overlapping zones.	Information is distributed to all nodes, Reduces the traffic and avoids single point of failure.	Additional traffic produced
4.	Distributed Dynamic Routing Algorithm Protocol (DDR)	Periodic messages are constructed trees and messages are exchanged among neighbouring nodes.	Reduce routs complexity and improve delay performance, Does not require physical location information.	Bottleneck occur

The hybrid routing protocol supports the features of scalability, limited search cost, up to date route information and lack in support of overlapping in routes, longer delay if route not found immediately, core node movement which affects the routing performance.

6. Conclusion

MANET is a self-configuring, infrastructure less network of mobile devices which are connected wirelessly. Each device in a MANET is free to move independently in any direction, and will therefore change its links to other devices frequently. MANET offers many characteristics and applications. Routing protocols are used to provide efficient energy aware and secure routing schemes to MANET. The three types of routing protocols, the generation and evolution of MANET are highlighted in this paper. Also the implemented areas in which MANET can be implemented are presented.

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