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A Path For Horizing Your Innovative Work

Challenges in Mobile Ad Hoc Networks (MANETS)

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Abstract: Next generation of mobile communication will include both popular infrastructure wireless networks and novel infrastructure less mobile ad-hoc networks (MANETS). A MANET is a collection of wireless nodes that can dynamically form a network to exchange information without using any pre-existing fixed network infrastructure. Wireless ad-hoc networks are more and more being used in the battlefield, emergency search, and rescue missions. The exceptional features of MANET bring great opportunities together with severe challenges. In this paper, we present the concept, features and fundamental problems of ad hoc networking.

Keywords: Mobile Ad Hoc Networks (MANET), Features, Challenges in MANET

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INTRODUCTION

A mobile ad hoc network is an autonomous collection of mobile devices (laptops, smart phones, sensors, etc.) that communicate with each other over wireless links and cooperate in a distributed manner in order to provide the necessary network functionality in the absence of a permanent infrastructure [1]. It is an autonomous system during which mobile hosts connected by wireless links are free to move at random. In MANET, nodes work both as host and routers.

2. HISTORY OF MANET

Fundamentally, MANET can be sorted into first, second and third generations [2, 3]. The first generation came up with “packet radio” networks (PRNET) [4], and was supported by Defence Advanced Research Project Agency (DARPA) in the mid 1970s. It has developed to be a vigorous, reliable, operational experimental network. The PRNET used a combination of Areal Location of Hazardous Atmospheres (ALOHA) and Carrier Sense Multiple Access (CSMA) for multiple access and distance vector routing [5]. The second generation evolved in early 1980’s when Survivable Adaptive Radio Networks (SURAN) considerably enhanced upon the radios (making them smaller, cheaper, and power-thrifty), scalability of algorithms, and resilience to electronic attacks. Significant developments during this period include GloMo (Global Mobile Information System) and NTDR (Near Term Digital Radio). GloMo used CSMA/CA and TDMA molds and provided self-organizing and self-healing network [3]. The NTDR used clustering and link-state routing, and self-organized into a two-tier ad hoc network. NTDR is the only “real” ad hoc network in use and it is used by US Army. The third generation evolved in 1990’s also termed as commercial network. Within the Internet Engineering Task Force (IETF), the Mobile Ad Hoc Networking (MANET) working group was born, and wanted to standardize routing protocols for ad hoc networks. The 802.1 1 subcommittee standardized a medium access
protocol derived from collision avoidance and tolerated hidden terminals for building mobile ad hoc network prototypes out of notebooks and 802.11 PCMCIA cards. HIPERLAN and Bluetooth were some auxiliary standards that addressed and benefited ad hoc networking.

3. FEATURES OF MANET

MANET has the following features[6,7]:

1. Autonomous terminal: In MANET, each mobile host is autonomous node, which might work as both a host and a router. The mobile nodes can also perform switching functions as a router and usually endpoints and switches are indistinguishable in MANET.

2. Distributed operation: There is no background network for the central control of the network operations, the control and supervision of the network is distributed among the terminals. The nodes involved in a MANET ought to collaborate amongst themselves and each node acts as a relay as required, to implement functions e.g. security and routing.

3. Multi-hop routing: Basic types of ad hoc routing algorithms can be single-hop and multi-hop. When delivering data packets from a source to its destination out of the direct wireless transmission range, the packets should be forwarded by the use of one or more intermediate nodes.

4. Dynamic network topology: Since the nodes are mobile, the network topology may change rapidly and randomly and the connectivity among the terminals may differ with time. The mobile nodes in the network dynamically establish routing among themselves as they move about, forming their own network on the fly. Additionally, a user in the MANET may work inside the ad hoc network, as well as may need access to a public fixed network.

5. Energy-constrained operation: Some or all of the nodes in a MANET may rely on batteries or other means for their energy. Such devices require optimized algorithms and mechanisms that implement the computing and communicating functions.

4. CHALLENGES OF MANET:

The features of MANET introduce a number of challenges that has to be studied carefully before a wide commercial deployment can be expected. These consist of [8, 9]:

1. Routing: Since the topology of the network is consistently varying, the problem of routing packets between any pair of nodes becomes a difficult task. Most protocols ought to be based on reactive routing rather than proactive. Multi cast routing is another challenge as a result of
the multicast tree is no longer static because of the random movement of nodes within the network. Routes connecting nodes might potentially contain multiple hops that are more complex than the single hop communication.

2. Security and Reliability: Additionally to the common vulnerabilities of wireless connection, an ad hoc network has its specific security issues because of e.g. nasty neighbor relaying packets. The feature of distributed operation needs totally different schemes of authentication and key management. Additional, wireless link characteristics bring in too reliability problems, owing to the restricted range of wireless transmission, the broadcast nature of the wireless medium (e.g. hidden terminal problem), the loss of mobility-induced packets, and data transmission errors.

3. Quality of Service (QoS): Providing totally different quality of service levels in a persistently changing environment will be a challenge. The intrinsic stochastic feature of communications quality in a MANET makes it tough to offer fixed guarantees on the services offered to a device. An adaptive QoS should be implemented over the traditional resource reservation to support the multimedia services.

4. Inter-networking: Additionally to the communication inside an ad hoc network, inter-networking among MANET and fixed networks (mainly IP based) is usually expected in several cases. The coexistence of routing protocols in such a mobile device could be a challenge for the harmonious mobility management.

5. Power Consumption: For the majority of the light-weight mobile terminals, the communication-related functions ought to be optimized for lean consumption of power. Conservation of power along with power-aware routing should be taken into consideration.

6. Multicast: Multicast is desirable to support multiparty wireless communications. As the multicast tree is not any longer static, the multicast routing protocol ought to be capable of dealing with mobility together with multicast membership dynamics (leave and join).

7. Location-aided Routing: Location-aided routing uses positioning information to describe associated regions so the routing is spatially oriented and restricted. This is often analogous to associatively-oriented and restricted broadcast in ABR.

5. APPLICATIONS OF MANET

With the rise of portable devices in addition to progress in wireless communication, ad-hoc networking is gaining significance with the increasing variety of widespread applications. Ad-hoc networking will be applied anyplace wherever there is very little or no communication
infrastructure or the existing infrastructure is costly or not convenient to use. Ad hoc networking permits the devices to take care of connections to the network additionally as simply adding and removing devices to and from the network. The set of applications for MANET is varied, starting from large-scale, mobile, extremely dynamic networks, to small, static networks which are controlled by power sources. In addition to the legacy applications that move from traditional infrastructure environment into the ad hoc context, an immense deal of new services will and can be generated for the innovative environment. Typical applications consist of [9, 10]:

1. Military Battlefield: Military equipment currently regularly contains some kind of computer equipment. Ad hoc networking would permit the military to acquire advantage of commonplace network technology to keep an information network between the vehicles, soldiers, and military information head office. The fundamental techniques of ad hoc network came from this field.

2. Commercial Sector: Ad hoc can be used in emergency/rescue operations for calamity relief efforts, e.g. in flood, fire, or earthquake. Emergency rescue operations should occur wherever non-existing or damaged communications infrastructure and quick deployment of a communication network is required. Information is relayed from one rescue team member to another over a small hand held. Other commercial scenarios embrace e.g. ship-to-ship ad hoc mobile communication, regulation enforcement, etc.

3. Local Level: Ad hoc networks will autonomously link a rapid and temporary multimedia network using notebook computers or palmtop computers to spread and share information among participants at e.g. conference or classroom. An additional suitable local level application can be in home networks wherever devices will communicate directly to exchange information. In the same way in additional civilian environments like sports arena, taxicab, ship and small aircraft, mobile ad hoc communications can contain numerous applications.

4. Personal Area Network (PAN): Short-range MANET will simplify the intercommunication among numerous mobile devices (such as a PDA, a cellular phone and a laptop). Tedious wired cables are replaced with wireless connections. Such an ad hoc network can also broaden the access to the Internet or other networks by mechanisms e.g. Wireless LAN (WLAN), GPRS, and UMTS. The PAN is probably a promising application field of MANET within the future pervasive computing context.

5. MANET-VoVoN: A MANET enabled version of JXTA peer-to-peer, modular, open platform is in use to support user location and audio streaming above the JXTA virtual overlay network. By
means of MANET-JXTA, a client might search asynchronously for a user and a call setup until a path is available to reach the user. The application uses a non-public signaling protocol based on the exchange of XML messages over MANET-JXTA communication channels [11].

6. CONCLUSION AND FUTURE SCOPE

The rapid evolution within the field of mobile computing is driving a new unusual approach for mobile communication, within which mobile devices form a self-creating, self-organizing, and self-administering wireless network, referred to as a mobile ad hoc network. In spite of the large efforts of the MANET research community a lot of challenging technical problems remains unreciprocated. The future of ad-hoc networks is in fact appealing, giving the vision of “anytime, anywhere” and low cost communications. From an economical point of view, mobile ad hoc networks open up new business opportunities for telecom operators and service providers. In the direction of an appropriate business scenarios, applications and economical models got to be known, in conjunction with technological advances, making a evolution of ad hoc networks to the commercial world viable.

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