Mobile Ad-Hoc Networking

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Abstract
A mobile Ad Hoc network is collection of nodes that can physically move and that communicate using wireless technology. Each node can also act as a router and nodes cooperate to facilitate multy-hop connections. This is in contrast to the well-known single hop cellular network model that supports the needs of wireless communication by installing base stations as access points. In these cellular networks, communications between two mobile nodes completely rely on the wired backbone and the fixed base stations. In a MANET, no such infrastructure exists and the network topology may dynamically change in an unpredictable manner since nodes are free to move. A mobile Ad Hoc network sometimes called a mobile mesh network is a self- configuring network of mobile devices connected by wireless links. In this paper we discuss the overview of many applications scenarios today where mobile multy-hop mesh wireless communications technology, technical challenges network security quality of service represents.

Keywords
Ad-Hoc Network, 4G, Applications and Security Attacks

I. Introduction

Wireless networks have become increasingly popular in the past few decades, particularly within the 1990's when they are being adapted to enable mobility and wireless devices became popular. As the popularity of mobile devices (MDs) and wireless networks significantly increased over the past years, wireless ad hoc networks has now become one of the most lively and active fields of communication and networking research. As there are many attractive future applications of mobile ad hoc networks (MANETs), there are still some critical challenges and open problems to be solved.

A mobile Ad Hoc network (MANET) is generally defind as a network that has many free or autonomous nodes, after composed of mobile devices or other mobile pieces, that can arrange themselves in various ways and operate without strict top- down network administration. There are many different types of setup that could be called mobile Ad Hoc networks (MANETS) and the potential for this sort of network is still being studied.

1. Advantages of MANET

There are several advantages of using mobile ad hoc network:-

- Setting up a wireless system is easy and fast and it eliminates the need for pulling out the cables through walls and ceilings.
- Network can be extended to places, which cannot be wired.
- Multiple paths increase reliability.
- Wireless network offers more flexibility and adapt easily to changes in the configuration of the network.

2. Disadvantages of MANETS

Asymmetric links: Most of the wired networks rely on the symmetric links, which are always fixed. But this is not a case with ad-hoc networks as the nodes are mobile and constantly changing their position within network. For example consider a MANET (Mobile Ad-hoc Network) where node B sends a signal to node A but this does not tell anything about the quality of the connection in the reverse direction.

3. Characteristics of Mobile Ad-Hoc Networks:-

Does not rely on a fixed infrastructure for its operation autonomous transitory association of mobile nodes.

- It can be rapidly deployed with user intervention.
- Need not to operate in a standalone fashion but can be attached to the Internet or Cellular networks.
- Devices are free to join or leave the network and they may randomly, possibly
- Resulting in rapid and unpredictable changes.

The Bluetooth technology is a de-facto standard for low-cost, short-range radio links between mobile PCs, mobile phones, and other portable devices. A Bluetooth unit, integrated into a microchip, Enables wireless ad hoc communications, of voice and data between portable and/or fixed electronic Devices like computers, cellular phones, printers, and digital cameras. Due to its low-cost target, Bluetooth microchips may become embed-deed in virtually all consumer electronic devices in the future. As a low cost, low power solution and with industry-wide support, Bluetooth wireless tech-neology has already started to revolutionize the personal connectivity market by providing free-doom from wired connections—enabling portable links between mobile computers, mobile phones, Portable handheld devices, and connectivity to the of a scatter net, it does not provide the mechanisms To construct it. A scatter net can be dynamically constructed, in an ad hoc fashion, when some nodes belong (at the same time) to more than onepiconet, i.e., inter-pioneer units.

A. 4G Wireless Network Architecture

4G is all about an integrated global network based on an open-systems approach. Integrating different types of wireless networks with wire line backbone networks seamlessly and the convergence of voice, multimedia, and data traffic over a single IP-based core network will be the main focus of 4G. With the availability of ultrahigh bandwidth of up to 100Mbps, multimedia services can be supported efficiently. Ubiquitous computing is enabled with enhanced system mobility and portability support, and location-based services and support of ad hoc networking are expected. In Figure the networks and components within the 4G network architecture.

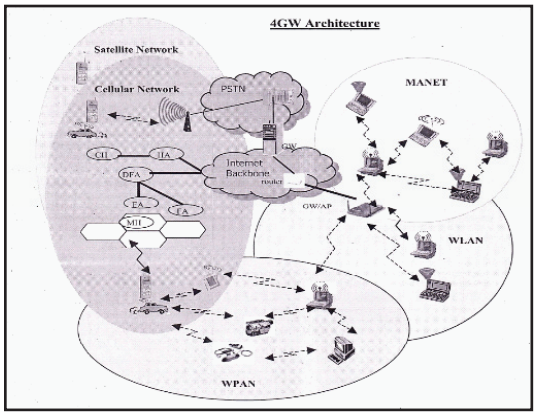

Fig. 1:

B. Mobile Ad-Hoc Networks

Mobile ad-hoc networks are formed dynamically by an au-tenuous system of mobile nodes that are connected via wireless links without using an existing network infrastructure orcentralizedadministration. The nodes are free to move randomly and organize themselves arbitrarily; thus, the network's wireless topology may change rapidly and unpredictably. Such a network may operate in a standalone fashion, or may be connected to the larger Internet. Mobile ad hoc networks are infrastructure-less networks since they do not require any fixed infrastructure such as a base station frothier operation. In general, routes between nodes in an ad hoc network may include multiple hops and, hence, it is appropriate to call such networks "multichip wireless ad hoc networks." Figure mobile ad hoc network and its communication topology

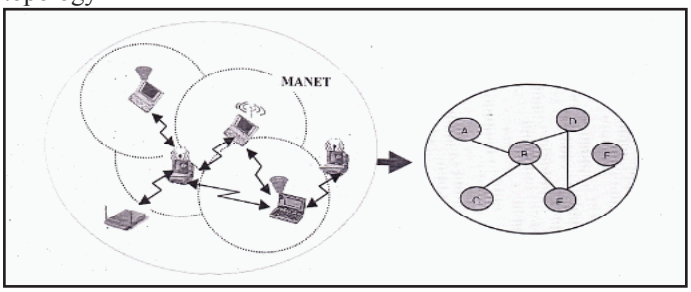

Fig. 2:

C. Applications of MANETs

Routing Overhead: In wireless ad hoc networks, nodes often change their location within network. So, some out-of-date routes are generated in the routing table, which leads to unnecessary routing overhead.

1. Interference

This is the major problem with mobile ad-hoc networks as links come and go depending on the transmission characteristics, one transmission might interfere with another one and node might overhear transmissions of other nodes and can corrupt the total transmission.

2. Dynamic Topology

This is also the major problem with ad-hoc routing since the topology is not constant.

The mobile node might move or medium characteristics might change. In ad-hoc networks routing tables must somehow reflect these changes in topology and routing algorithms have to be adapted. For example in a fixed network routing table updating takes place for every 30sec. This updating frequency might be very low for ad-hoc networks.

D. Applications of Ad-Hoc Networks

There are many applications to ad hoc networks. As a matter of fact, any day-to-day application such as electronic email and file transfer can be considered to be easily deployable within an ad hoc network environment. Web services are also possible in case any node in the network can serve as a gateway to the outside world. In this discussion, we need not emphasize the wide range of military applications possible with ad hoc networks. Not to mention, the technology was initially developed keeping in mind the military applications, such as battlefield in an unknown territory where an infrastructure network is almost impossible to have or maintain. In such situations, the ad hoc networks having self-organizing capability can be effectively used where other technologies either fail or cannot be deployed effectively. Advanced features of wireless mobile systems, including data rates compatible with multimedia applications, global roaming capability, and coordination with other network structures, are enabling new applications. Some well-known ad hoc network applications are:

1. Collaborative Work

For some business environments, the need for collaborative computing might be more important outside office environments than inside. After all, it is often the case where people do need to have outside meetings to cooperate and exchange information on a given project.

2. Crisis-management Applications

These arise, for example, as a result of natural disasters where the entire communications infrastructure is in disarray. Restoring communications quickly is essential. By using ad hoc networks, an infrastructure could be set up in hours instead of days/weeks required for wire-line communications.

3. Personal Area Networking and Bluetooth

A personal area network (PAN) is a short-Range, localized network where nodes are usually associated with a given person. These nodes could be attached to someone's pulse watch, belt, and so on. In these scenarios, mobility is only a major consideration when interaction among several PANs is necessary, illustrating the case where, for instance, people meet in real life. Bluetooth is a technology aimed at, among other things, supporting PANs by eliminating the need of wires between devices such as printers, PDAs, notebook computers, digital cameras, and so on.

Table 1 **Mobile ad hoc network applications**

Application	Possible scenarios
Tactical networks	• Military communication and operations • Automated battlefields
Emergency services	• Search and rescue operations • Disaster recovery • Replacement of fixed infrastructure in case of environmental disasters • Policing and fire fighting • Supporting doctors and nurses in hospitals
Commercial and civilian Environment	• E-commerce: electronic payments anytime and anywhere environments • Business: dynamic database access, mobile offices • Vehicular services: road or accident guidance, transmission of road and weather conditions, taxi cab network, inter-vehicle networks • Sports stadiums, trade fairs, shopping malls • Networks of visitors at airports
Home and enterprises Networking	• Home/office wireless networking • Conferences, meeting rooms • Personal area networks (PAN), Personal networks (PN) • Networks at construction sites
Educations	• Universities and campus settings • Virtual classrooms • Ad hoc communications during meetings or lectures
Entertainment	• Universities and campus settings • Virtual classrooms • Ad hoc communications during meetings or lectures
Sensor network	• Home applications: smart sensors and actuators embedded in consumer electronics • Body area networks (BAN) • Data tracking of environmental conditions, animal movements, chemical/biological detection
Context aware services	• Follow-on services: call-forwarding, mobile workspace • Information services: location specific services, time dependent services • Infotainment: touristic information

II. Technical Challenges

The specific MANET issues and constraints described in the previous section present a host of challenges in ad hoc network design. A significant body of research has been accumulated to address these specific issues and constraints. In this section, we describe some of the main research areas within the mobile ad hoc network domain. The MANET network layers and the corresponding research issues associated with each layer.

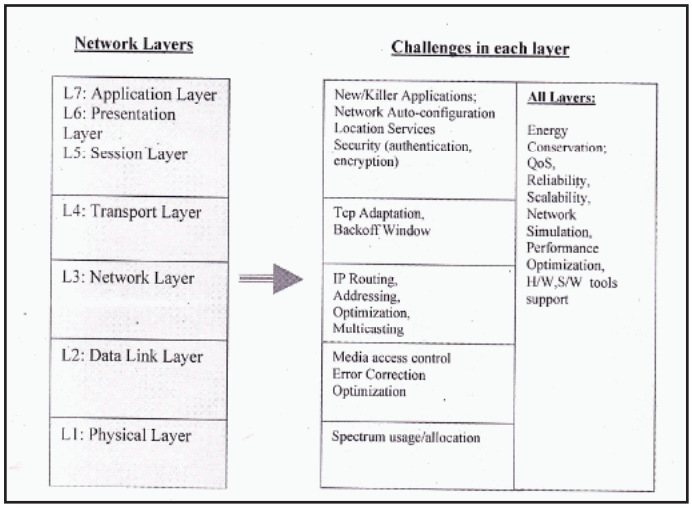

Fig. 3:

A. Network Security

The wireless and mobile ad hoc nature of MANET brings new security challenges to net-work design. Because nodes in mobile ad hoc network generally communicate with eachother via open and shared broadcast wireless channels, they are more vulnerable to security attacks. In addition, their distributed and infrastructure less nature means that central-ized security control is hard to implement and the network has to rely on individual security solutions from each mobile node. Furthermore, as ad hoc networks are often designed for specific environments and may have to operate with full availability even in adverseconditions,security solutions applied in more traditional networks may not be directly suitable Understanding the possible form of attacks is the first step toward developing good security solutions. In mobile ad hoc networks, the broadcasting wireless medium inherently signifies that an attack may come from any direction and from different layers (network or application transport such as TCP floods and SYN flooding). Possible attacks include:

Passive Eavesdropping

- Denial-of-service attacks
- Signaling attacks: Attackers may inject erroneous routing information to divert network traffic, or make routing inefficient
- Flow-disruption attacks: Intruders may delay/drop/corrupt all data passing through, but leave all routing traffic unmodified
- Resource depletion attacks: Intruders may send data with the objective of congesting a network or draining batteries
- Data integrity attacks, by accessing, modifying, or injecting traffic Stolen device attacks

B. Security Attacks

Mobile wireless networks are generally more vulnerable to information are physical security threats than fixed wire line networks. The use of open and shared broadcast wireless channels means nodes with inadequate physical protection are prone to security threats. In addition because a mobile adhoc network is a distributed infrastructure less network, it mainly relies on individual security solution from each mobile node, as centralized security control is hard to implement, some key security requirements in adhoc networking include:

- Confidentiality: preventing passive eaves dropping
- Access control: protecting access to wireless network infrastructure
- Data integrity: preventing tampering with traffic (i.e accessing, modifying or injecting traffic)
- Denial of service attacks by malicious nodes

Basic security attacks in Mobile Ad Hoc Wireless Net-works They are also classified into two types:

1. Active Attacks

Active attack is an attack when misbehaving node has to bear some energy costs in order to perform the threat. Nodes that perform active attacks with the aim of damaging other nodes by causing network outage are considered as malicious. Active attacks involve actions such as the replication, modifica-tion and deletion of exchanged data

2. Passive Attacks

Passive attacks are mainly due to lack of cooperation with the purpose of saving energy selfishly. Nodes that make passive attacks with the aim of saving battery life for their own communications are considered to be selfish

C. Media Access Control

In MANET, use of broadcasting and shared transmission media introduces a nonnegligi-ble probability of packet collisions and media contention. In addition, with half-duplex radio, collision detection is not possible, which severely reduces channel utilization as well

III. Conclusion

Mobile Ad Hoc Network is decentralized, self organized, any time any where network and provide cheap communication. Mobile ad hoc network applications from an historical perspective, and then focus on challenges in the MANET research activities. In this paper we focus on the MANET, the challenges in it and a wide area of its applications. We provide brief information about the history and evolution of MANET, next to it we discuss the major challenges in Mobile Ad Hoc Networks and towards the end we mentioned some of the application of MANET. in which mobile devices form a self-creating, self-organisingand self-administering wireless network, called a mobile ad hoc network. Its intrinsic flexibility, lack of infrastructure, ease of deployment, auto-configuration, low cost and potential applications makes it inessential part of future pervasive computing environments. As a consequence, the seamless integration of mobile ad hocnetworks with other wireless networks and fixed infrastructures will be an essential part of the evolution towards future fourth-generation communication networks. From technological point of view, the realization this vision still requires a large number of challenges to be solved related to devices, protocols, applications and services.

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