Asian Journal of Computer and Information Systems (ISSN: 2321 – 5658)
Volume 03– Issue 03, August 2015

A Miniature Study on Mobile Ad-Hoc Networks

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ABSTRACT--- ***The wireless ad_hoc networks consist of a collection of wireless nodes, that communicate over a common wireless medium. The nodes communicate without an infrastructure. In the past few years, the industry have seen a rapid expansion in the field of mobile computing due to the proliferation of inexpensive, widely available wireless devices. However, current devices, applications and protocols are solely focused on cellular or wireless local area networks, not taking into account the great potential offered by mobile ad hoc networking. A mobile ad hoc network is an autonomous collection of mobile devices, 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 fixed infrastructure. This type of network, operating as a stand-alone network or with one or multiple points of attachment to cellular networks or the Internet, paves the way for numerous new and exciting applications. This paper provides insight into the potential applications of ad_hoc networks and discusses the technological challenges that protocol designers and network developers are faced with.***

Keywords---Manets**,** Protocol, Wireless, AdHoc Applications, Infrastructure

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1. INTRODUCTION

Mobile Ad Hoc Network (MANET) is a collection of two or more devices or nodes or terminals with wireless communications and networking capability that communicate with each other without the aid of any centralized administrator also the wireless nodes that can dynamically form a network to exchange information without using any existing fixed network infrastructure[1]. Network Components in a wireless network communicate with each other using wireless channels. The use of wireless networks has become more and more popular. Based on the type of network infrastructure used for communication. An ad hoc network is a collection of wireless mobile hosts forming a temporary network without the aid of any established infrastructure or centralized administration. In such an environment, it may be necessary for one mobile host to enlist the aid of other hosts in forwarding a packet to its destination, due to the limited range of each mobile host's wireless transmissions. Mobile ad hoc networks (MANET) comprised of small, mobile, wireless devices present a new and challenging area for the development and deployment of applications. As consumer devices equipped with Wi-Fi capabilities such as smart phones become more widespread, the possibility of impromptu networks also increases. Mobile applications are no longer limited to stand-alone or client-server programs, but can interact and form useful networks directly with each other. Such networks are ideal for situations in which there is no time to set up a fixed access point, or when there is no fixed infrastructure available. Many new applications, particularly in the consumer space are being applied to MANET, including collaborative software such as shared whiteboards, impromptu networks for communication and Entertainment, and peer-to-peer applications for sharing. While typical examples of MANETs include military units or disaster recovery scenarios, MANETs are also useful inside buildings where cellular reception might be unavailable, where censorship blocks free speech, or even for instant networked gaming between nearby friends. In mobile ad hoc networks (MANET), high nodal mobility causes frequent topology and route changes, making it difficult to maintain network connections between nodes. Many routes in the network span multiple wireless hops and may experience dramatic and unexpected punctuations in quality. The combination of mobility and wireless communication creates highly dynamic network topologies in which frequent, possibly permanent is connections are commonplace, rather than exceptional events. The dynamics of the network and the wireless channel requires changes to the networking stack and alternative solutions at the application level. While there has been a large amount of work focused on the network stack for MANETs, especially routing, the application layer is not insulated from the challenges faced at the networking layers. Mobile applications face several challenges when compared with programs intended for standard desktops: mobile devices are generally constrained in many ways: the screen size, processor power, memory, and battery power are often limited. Development platforms for mobile devices typically provide basic libraries for application support such as menus and access to data stored on the device. Networking, however, is generally limited to sockets, TCP/IP, and HTTP. In particular, applications are expected to either be standalone, like a calculator, or to only be using the network in a client-server manner, such as accessing websites or email servers. However, most laptop computers are already equipped with Wi-Fi which can operate in ad-hoc mode. Smart phones with Wi-Fi are becoming ubiquitous. In 2013, surveys showed 91% of adults in the United States had cell phones, and 56% of those are smart phone's Among teens, 78% had a cell phone, of which 37% are a smart phone Add Smartphone's to the proliferation of tablets and laptops and the ability for consumers to form mobile ad hoc networks (MANETs) is quickly becoming possible. However, applications designed for these networks remain in short supply. One way to encourage creation of MANET applications is to simplify communication between devices. Given the challenges of distributed communication in such volatile networks, MANET applications often implement an abstraction layer for network communication. The majority of these abstraction layers are based on traditional distributed computing paradigms which were not designed for unreliable, rapidly-changing wireless networks. The people behind this paper have examined these paradigms and the performance of their implementation for MANETs and found them to be unsuitable for general purpose communication needs of MANET Applications. Therefore, the people have designed a new communication paradigm specifically to meet the challenges of MANETs, rather than modify an existing paradigm which was not originally intended for the MANET environment.

2. HISTORICAL DEVELOPMENTS OF MANET

In early 1970s, the Mobile Ad hoc Network (MANET) was called packet radio network, which was sponsored by Defense Advanced Research Projects Agency (DARPA). They had a project named packet radio having several wireless terminals that could communication with each other on battlefields[2]. "It is interesting to note that these early packet radio systems predict the Internet and indeed were part of the motivation of the original Internet Protocol suite". The whole life cycle of Ad hoc networks could be categorized into the first, second, and the third generation Ad hoc networks systems. Present Ad hoc networks systems are considered the third generation.

The first generation goes back to 1972. At the time, they were called PRNET (Packet Radio Networks). In conjunction with ALOHA (Arial Locations of Hazardous Atmospheres) and CSMA (Carrier Sense Medium Access), approaches for medium access control and a kind of distance-vector routing PRNET were used on a trial basis to provide different networking capabilities in a combat environment.

The second generation of Ad hoc networks emerged in 1980s, when the Ad hoc network systems were further enhanced and implemented as a part of the SURAN (Survivable Adaptive Radio Networks) program. This provided a packet-switched network to the mobile battlefield in an environment without infrastructure. This program proved to be beneficial in improving the radios' performance by making them smaller, cheaper, and resilient to electronic attacks.
In the 1990s (**Third generation**), the concept of commercial Ad hoc networks arrived with notebook computers and other viable communication equipments. At the same time, the idea of a collection of mobile nodes was proposed at several researchers gatherings.

The next coming generations, the network is an autonomous transitory association of mobile nodes that communicate with each other over wireless links. Nodes that lie within each other's send range can communicate directly and are responsible for dynamically discovering each other[8]. In order to enable communication between nodes that are not directly within each other's send range, intermediate nodes act as routers that relay packets generated by other nodes to their destination. These nodes are often energy constrained—that is, battery-powered—devices with a great diversity in their capabilities. Furthermore, devices are free to join or leave the network and they may move randomly, possibly resulting in rapid and unpredictable topology changes. In this energy-constrained, dynamic, distributed multi-hop environment, nodes need to organize themselves dynamically in order to provide the necessary network functionality in the absence of fixed infrastructure or central administration.

Table-1 :Characteristics and complexities of mobile ad hoc networks
Autonomous and infrastructure less
Multi-hop routing
Dynamic network topology
Device heterogeneity
Energy constrained operation
Bandwidth constrained variable capacity links
Limited physical
Network scalability
Self-creation

The specific characteristics and complexities, which are summarized in Table 1, impose many design challenges to the network protocols. In addition, these networks are faced with the traditional problems inherent to wireless communications such as lower reliability than wired media, limited physical security, time varying channels, interference, etc. Despite the many design constraints, mobile ad hoc networks offer numerous advantages. First of all, this type of network is highly suited for use in situations where a fixed infrastructure is not available, not trusted, too expensive or unreliable. Because of their self-creating, self-organizing and self-administering capabilities, ad hoc networks can be rapidly deployed with minimum user intervention. There is no need for detailed planning of base station installation or wiring. Also, ad hoc networks do not need to operate in a stand-alone fashion, but can be attached to the Internet, thereby integrating many different devices and making their services available to other users. Furthermore, capacity, range and energy arguments promote their use in tandem with existing cellular infrastructures as they can extend coverage and interconnectivity. As a consequence, mobile ad hoc networks are expected to become an important part of the future 4G architecture, which aims to provide pervasive computer environments that support users in accomplishing their tasks, accessing information and communicating anytime, anywhere and from any device.

Table-2	**Mobile Ad hoc Networks Applications**
Applications	**Possible scenarios/services**
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 environments	• E-commerce: electronic payments anytime and anywhereEnvironments • 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 enterprise networking	Home/office wireless networking • Conferences, meeting rooms • Personal area networks (PAN), Personal networks (PN) • Networks at construction sites
Education	Universities and campus settings • Virtual classrooms • Ad hoc communications during meetings or lectures
Entertainment	Multi-user games • Wireless P2P networking • Outdoor Internet access • Robotic pets • Theme parks
Sensor networks	Home applications: smart sensors and actuators embedded in consumer electronics • Body area networks (BAN) • Data tracking of environmental conditions , animalmovements, chemical/biological detection
Context aware services	Follow-on services: call-forwarding, mobile workspace • Information services: location specific services, Time dependent services • Infotainment: touristic information

Coverage extension	Extending cellular network access • Linking up with the Internet, intranets, etc.

Table 2 provides an overview of present and future MANET applications[3]. The concept of mobile ad hoc networking is not a new one and its origins can be traced back to the DARPA Packet Radio Network project in 1973. The advantages such as flexibility, mobility, resilience and independence of fixed infrastructure, elicited immediate interest among military, police and rescue agencies in the use of such networks under disorganized or hostile environments. For a long time, ad hoc network research stayed in the realm of the military, and only in the middle of 1990, with the advent of commercial radio technologies, did the wireless research community become aware of the great potential and advantages of mobile ad hoc networks outside the military domain, witnessed by the creation of the Mobile Ad Hoc Networking working group within the IETF4. Currently, mobile ad hoc network research is a very vibrant and active field and the efforts of the research community, together with current and future MANET enabling radio technologies will certainly pave the way for commercially viable MANETs and their new and exciting applications, with some of these commercially oriented solutions already starting to [appear8].

3. ISSUES TO BE CONSIDERED WHEN DEPLOYING MANET

The following are some of the main routing issues to be considered when deploying MANETs

- Unpredictability of Environment
- Unreliability of Wireless Medium
- Resource-Constrained Nodes
- Dynamic Topology
- Transmission Errors
- Node Failures
  - Link Failures
  - Route Breakages
  - Congested Nodes or Links

Unpredictability of Environment: Ad hoc networks may be deployed in unknown terrains, hazardous conditions, and even hostile environments where tampering or the actual destruction of a node may be imminent. Depending on the environment, node failures may occur frequently[9].

Unreliability of Wireless Medium: Communication through the wireless medium is unreliable and subject to errors. Also, due to varying environmental conditions such as high levels of lectro-magnetic interference or inclement weather, the quality of the wireless link may be unpredictable.

Resource-Constrained Nodes: Nodes in a MANET are typically battery powered as well as limited in storage and processing capabilities[5]. Moreover, they may be situated in areas where it is not possible to re-charge and thus have limited lifetimes. Because of these limitations, they must have algorithms which are energy efficient as well as operating with limited processing and memory resources. The available bandwidth of the wireless medium may also be limited because nodes may not be able to sacrifice the energy consumed by operating at full link speed.
Dynamic Topology: The topology in an Ad hoc network may change constantly due to the mobility of nodes. As nodes move in and out of range of each other, some links break while new links between nodes are created. As a result of these issues, MANETs are prone to numerous types of faults including the following.

Transmission Errors: The unreliability of the wireless medium and the unpredictability of the environment may lead to transmitted packets being garbled and thus received packet errors.

Node Failures: Nodes may fail at any time due to different type of hazardous conditions in the environment. They may also drop out of the network either voluntarily or when their energy supply is depleted.

Link Failures: Node failures as well as changing environmental conditions (e.g., increased levels of EMI) may cause links between nodes to break. Link failures cause the source node to discover new routes through other links.

Route Breakages: When the network topology changes due to node/link failures and/or node/link additions to the network, routes become out-of-date and thus incorrect[6]. Depending upon the network transport protocol, packets forwarded through stale routes may either eventually be dropped or be delayed[10].

Congested Nodes or Links: Due to the topology of the network and the nature of the routing protocol, certain nodes or links may become over utilized, i.e., congested. This will lead to either larger delays or packet loss.

4. CONCLUSION

Ad-hoc networks are seen as a key in the evolution of wireless networks. Ad-hoc networks have several potentialities that are not available with traditional wireless networks and can be used in different environment. The research in mobile ad-hoc networking covers all the networking layers, ranging from the physical to the application layer, including social and economical aspects. In this paper it is illustrated a user/application approach to highlighting some application and social aspects of mobile ad-hoc networks. While there are several applications for mobile ad-hoc networks that will require being part of the Internet, mobile ad-hoc networks are also envisioned for different application models. For example, applications devoted to study and enhance the social interaction among people and facilitate their daily life; as well as applications based on models similar to the business model of citizen band, amateur radio, and talkie-walkie systems, where multi-hop wireless communications allow voice and data messaging among all users.

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