Mobile Ad-Hoc Networks Its Advantages and Challenges

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Abstract: **Mobile Ad-hoc networks have been widely researched for many years. Mobile Ad-hoc Networks are a collection of two or more devices equipped with wireless communications and networking capability. Wireless Ad-hoc Networks do not have gateway, every node can act as the gateway. Mobile Ad-hoc Networks (MANET) are a fundamentally flawed architecture. As argument, we try to clarify the definition, architecture and the characters of MANET, as well as the main challenges of constructing the MANET. Although many works have been done to solve the problem, we will show in this paper its advantages and limitations which made the Mobile Ad-hoc Networks a flawed architecture. After giving many evidences and analysis, we could see that the key technologies of Wireless Ad-hoc Networks were not implemented as well as we expect. That is to say, many problems are inherently unsolvable. Thus, we could explain why we take the position that Mobile Ad-hoc Networks are flawed architecture.**

Keywords: **MANET, Infrastructured, Infrastructure less networks, Pros of Ad-hoc, Cons of Ad-hoc**

1. INTRODUCTION

The people's future living environments are emerging based upon information resource provided by the connections of various communication networks for users. New small devices like Personal Digital Assistants (PDAs), mobile phones , handhelds, and wearable computers enhance information processing and accessing capabilities with mobility. Moreover, traditional home appliances, e.g. digital cameras, cooking ovens, washing machines, refrigerators, vacuum cleaners, and thermostats, with computing and communicating powers attached, extend the field to a fully pervasive computing environment. With this in view, modern technologies should be formed within the new paradigm of pervasive computing, including new architectures, standards, devices, services, tools, and protocols. Wireless ad hoc networks are collections of wireless nodes , that communicate directly over a common wireless channel. The nodes are equipped with wireless transceiver. They don't need any additional infrastructure, such as base station or wired access point, etc. Therefore, each node doesn't only plays the role of an end system, but also acts as a router, that sends packets to desired nodes. Mobile networking is one of the most important technologies supporting pervasive computing. During the last decade, advances in both hardware and software techniques have resulted in mobile hosts and wireless networking common and miscellaneous. Generally there are two distinct approaches for enabling wireless mobile units to communicate with each other:

A. Infrastructured:

Wireless mobile networks have traditionally been based on the cellular concept and relied on good infrastructure support, in which mobile devices communicate with access points like base stations connected to the fixed network infrastructure. Typical examples of this kind of wireless networks are GSM, UMTS, WLL, WLAN, etc.

B. Infrastructureless:

As to infrastructureless approach, the mobile wireless network is commonly known as a mobile ad hoc network (MANET) .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. This is a very important part of communication technology

that supports truly pervasive computing, because in many contexts information exchange between mobile units cannot rely on any fixed network infrastructure, but on rapid configuration of a wireless connections on-the-fly. Wireless ad hoc networks themselves are an independent, wide area of research and applications, instead of being only just a complement of the cellular system.

Fig.1 shows the examples of both infrastructured and infrastructureless ad hoc wireless networks.
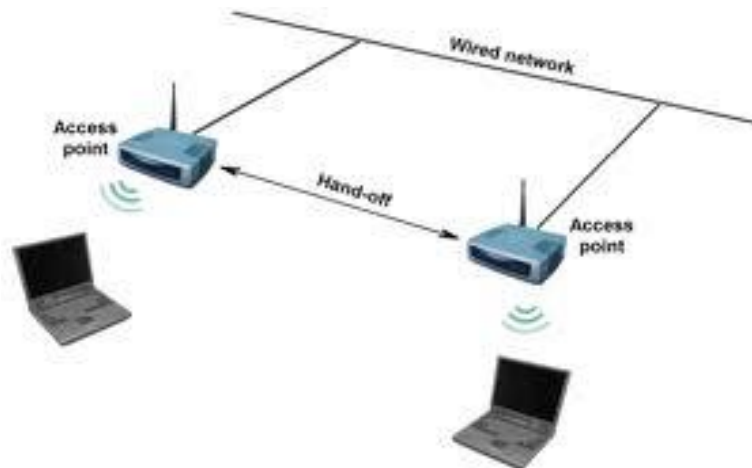

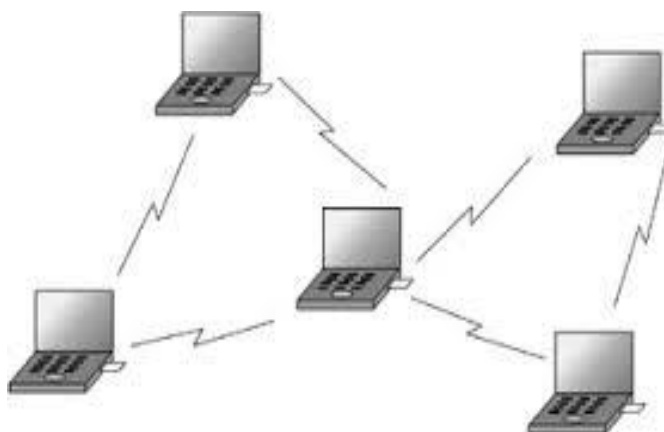**Fig.1 Infrastructure ad hoc wireless networks**

Fig.2 Infrastructureless ad hoc wireless networks

2. MANET CONCEPT

A mobile ad hoc network is a collection of wireless nodes that can dynamically be set up anywhere and anytime without using any pre-existing network infrastructure. It is an autonomous system in which mobile hosts connected by wireless links are free to move randomly and often act as routers at the same time. The traffic types in ad hoc networks are quite different from those in an infrastructured wireless network, including:

A. Peer-to-Peer:

Communication between two nodes which are within one hop. Network traffic (Bps) is usually consistent.

B. Remote-to-Remote:

Communication between two nodes beyond a single hop but which maintain a stable route between them. This may be the result of several nodes staying within communication range of each other in a single area or possibly moving as a group. The traffic is similar to standard network traffic.

C. Dynamic Traffic:

This occurs when nodes are dynamic and moving around. Routes must be reconstructed. This results in a poor connectivity and network activity in short bursts.

3.   MANET APPLICATIONS

With the increase of portable devices as well as progress in wireless communication, ad hoc networking is gaining importance with the increasing number of widespread applications. Ad hoc networking can be applied anywhere where there is little or no communication infrastructure or the existing infrastructure is expensive or inconvenient to use. Ad-hoc networking allows the devices to maintain connections to the network as well as easily adding and removing devices to and from the network. The set of applications for MANETs is diverse, ranging from large-scale, mobile ,highly dynamic networks, to small, static networks that are constrained by power sources. Typical applications include:

A. Military battlefield:

Military equipment now routinely contains some sort of computer equipment. Ad-hoc networking would allow the military to take advantage of commonplace network technology to maintain an information

network between the soldiers, vehicles, and military information head quarters. The basic techniques of ad hoc network came from this field.

B. Commercial sector:

Ad hoc can be used in emergency/rescue operations for disaster relief efforts, e.g. in fire ,flood, or earthquake. Emergency rescue operations must take place where non-existing or damaged communications infrastructure and rapid deployment of a communication network is needed. Information is relayed from one rescue team member to another over a small handheld. Other commercial scenarios include e.g. ship-to-ship ad hoc mobile communication , law enforcement, etc.

C. Local level:

 Ad hoc networks can autonomously link an instant and temporary multimedia network using notebook computers or palmtop computers to spread and share information among participants at a e.g. conference or classroom .Another appropriate local level application might be in home networks where devices can communicate directly to exchange information. Similarly in other civilian environments like taxicab, sports stadium, boat and small aircraft ,mobile ad hoc communications will have many applications.

D. Personal Area Network (PAN):

Short-range MANET can simplify the intercommunication between various mobile devices (such as a PDA, a laptop, and a cellular phone). Tedious wired cables are replaced with wireless connections .Such an ad hoc network can also extend the access to the Internet or other networks by mechanisms e.g. Wireless LAN(WLAN), GPRS, and UMTS. The PAN is potentially a promising application field of MANET in the future pervasive computing context.

4.   PROS OF AD HOC NETWORKS

There are many reasons better to use ad hoc than infrastructure. The biggest ad hoc's strength is its independency from any infrastructure. Therefore, it is possible to establish an ad hoc network in any difficult situations. The following are the advantages of ad hoc networks.

A. No infrastructure and lower cost:

There are situations, with which a user of a communication system cannot rely on an infrastructure. Using a service from a infrastructure can be expensive for specific applications. In an area with very low density, like desert, mountain, or isolated area it is not impossible to establish an Infrastructure. But if we compare how often the people there are using service of infrastructure and how many data per day transmitted with cost of installation, maintenance, and repair, it is maybe too expensive. Almost the same problem with military network. It is obviously very useless to build an infrastructure in a battlefield. Aside from cost of installation, the enemy can destroy the infrastructure in short time. An independent from infrastructure network is needed for both cases.

B. Mobility (MANET only):

In the next generation of wireless communication systems, there will be a need for the rapid deployment of independent mobile users. The most popular examples include military networks, emergency / rescue operations, disaster effort. In these scenarios we can't rely on centralized connectivity. MANETs support nodes' mobility. We can still communicate with our mobile devices as long as the destination is reachable.

C. Decentralized and robust:

Another advantage of ad hoc networks is that they are inherently very robust. Imagine that for some reason one of the base stations is not working. In this case, all users of that base station will lose connectivity to other networks. In the ad hoc networks you can avoid such problem. If one node leaves the network or is not working, you can still have connectivity to other nodes and maybe you can use these nodes to multi-hop your message to the destination nodes, as long as there is at least one way to desired node.

D. Easy to build and spontaneous infrastructure:

Malfunction of a network infrastructure is sometimes not avoidable. It is obviously difficult to repair or replace the malfunction infrastructure in short time, while the network's existence must be maintained all-time. Establishing an ad hoc is a good deal in such situation. The network participants can act as ad hoc nodes and hop the messages.

5. CONS OF AD HOC NETWORKS

The wireless communication is very famous nowadays; using wireless can make rooms look better, because fewer cables are used. The weakness of wireless link impact ad hoc. Lower data rate, security, and medium access control are common problems in the wireless communications. Ad-hoc's strengths cause also some problems. The following are the disadvantages of ad hoc networks.

A. Higher error rate:

Unlike wired transmission, the wireless transmission may deal with problem the characteristic of the electronic wave. In a free room without obstacle the electronic wave propagate linear independently from its frequency. There is seldom such a situation. The obstacle causes shadowing, reflection, scattering, fading, refraction, diffraction of the wave. These propagation may lead to transmitted packets being garbled and thus received in error.

B. Lower data rate:

One of biggest Problem of ad hoc networks is reduced data rates. The characteristic of wave, which is used for wireless communication, prevents wireless communication to transmit data better than wired communication. A higher frequency can transmit more data, but then it is more vulnerable to interference and performs well in short range.

C. Dynamic topology and scalability:

Because ad hoc networks do not allow the same kinds of aggregation techniques that are available to standard Internet routing protocols, they are vulnerable to scalability problem

D. Routing:

Since the topology of the network is constantly changing, the issue of routing packets between any pair of nodes becomes a challenging task. Multicast routing is another challenge because the multicast tree is no longer static due to the random movement of nodes within the network. Routes between nodes may potentially contain multiple hops, which is more complex than the single hop communication.

E. Security and Reliability:

In addition to the common vulnerabilities of wireless connection, an ad hoc network has its particular security problems due to e.g. nasty neighbour relaying packets. The feature of distributed operation requires different schemes of authentication and key management. Further, wireless link characteristics introduce also reliability problems, because of the limited wireless transmission range, the broadcast nature of the wireless medium(e.g. hidden terminal problem), mobility-induced packet losses, and data transmission errors.

F. Quality of Service (QoS):

Providing different quality of service levels in a constantly changing environment will be a challenge. The inherent stochastic feature of communications quality in a MANET makes it difficult to offer fixed guarantees on the services offered to a device

G. Internetworking:

In addition to the communication within an ad hoc network, internetworking between MANET and fixed networks (mainly IP based) is often expected in many cases. The coexistence of routing protocols in such a mobile device is a challenge for the harmonious mobility management.

H. Power Consumption:

For most of the light-weight mobile terminals, the communication-related functions should be optimised for lean power consumption. Conservation of power and power-aware routing must be taken into consideration.

I. Client-server model shift and service location:

In the Internet, a network client is typically configured to use a server as its partner for network transactions. These servers can be found automatically or by static configuration.

In ad hoc networks, however, the network structure cannot be defined by collecting IP-addresses into subnets.

There may not be servers, but the demand for basic services still exists. Address allocation, name resolution, authentication and the service location itself are just examples of the very basic services which are needed but their location in the network is unknown and possibly even changing over time.

J. Interoperation with the Internet:

It seems very likely that one of the most common applications of ad hoc networks require a connection to the Internet.

By ad hoc network technology the coverage of wireless LAN systems can be expanded and complemented. However, the issue of defining the interface between the two very different networks is not straightforward.

6. CONCLUSION AND FUTURE WORK

The paper explains MANET concept and wireless network can be deployed in either infrastructure mode or an ad-hoc basis. Applications for MANETs have been discussed besides the legacy applications that move from traditional infrastructured environment into the ad hoc context, a great deal of new services can and will be generated for the new environment. The other main impetus to ad hoc networks comes from the rapidly improving communications technologies. Wireless communication devices are getting smaller, cheaper, more sophisticated, and hence more ubiquitous .Exploitation of these technologies for better ad hoc networking gives rise to new problems that point to new research. For instance, the use of smart antennas in ad hoc networking requires new medium access and neighbor discovery protocols.The ability to dynamically alter spread spectrum codes, modulation schemes, and waveforms require corresponding innovations at the higher layers. Hop-by-Hop TCP can minimize packet delivery time end-to-end packet delivery time while maintaining reasonable bandwidth utilization, minimizing the number of retransmissions , minimizing the occurrence of network congestion. Power based connectivity definition is a new concept in wireless ad-hoc networks. It attempts to improve the end to-end network throughput and the average power consumption. This is due to the fact that as the power gets higher, and the connectivity range increases, each node would reach almost all other nodes in a single hop. However, since higher powers cause a higher interference level, more collisions occur, and hence there will be more transmission attempts. By reducing the transmission power levels at each node such that the node can directly connect. Although there are some differences between the traditional wired network and the mobile ad hoc network, intrusion detection technique, which is developed first in the wired network and has become a very important security solution for the wired network, has also gained some attentions from the researchers when they explore the security solution for the mobile ad hoc network. An adaptive QoS must be implemented over the traditional resource reservation to support the multimedia services In ad hoc some recent proposals have considered integrating route discovery and service location tasks by allowing only particular kind of services to react to the broadcast requests. This approach, however, can be seen to have the deficiencies like inserting application service discovery into a network layer protocol violates the modular protocol design, the client may not be able to specify the required service in a way that the request can be carried on the network layer, authorization can be difficult at the network layer. Other possibilities are, e.g., using well-known multicast addresses for very basic features, such as DNS. Also protocols for service location have been proposed. Some recent works on this field. An intellectual challenge related to the service availability problems is the design of distributed network functions .It could be investigated whether and which services or their locations could be shared or circulated among nodes. If a node in ad hoc network has an Internet connection ,it could offer Internet connectivity to the other nodes. The node could defined itself as a default router and the whole ad hoc network could be considered to be "single-hop" from the Internet perspective although the connections are physically over several hop links.

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