

A Review of Handoff and Location Management Techniques in Ad-hoc Networks

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Abstract—With the invention of Web and wireless mobile communications and the increasing number of mobile subscribers, mobility management came to be as the most important and challenging problems for wireless mobile communication over the Web. Mobility management enables the existing networks to detect a mobile subscriber's point of attachment for sending the data to required terminal (i.e., location management), and maintain a mobile subscriber's connection as it continues to change its point of attachment (i.e. handoff management). The paper concentrates on the issues and functionalities of location management and handoff management in terms of mobile adhoc networks.

Keywords: *Mobility Management, Location Management, Multi-hop Nature, Handoff Management*

INTRODUCTION

With the growing era of mobiles in adhoc networks, mobility management is one of the important area need to be covered. A wireless ad-hoc network is a decentralized type of wireless network. The network is ad hoc because it does not depends on a pre existing network, for example routers in wired networks or access points in managed (infrastructure) wireless networks. Rather, each node participates in routing by passing data packets to another node, so as to judge the dynamic connectivity between the nodes in the network. [6] Mobility management is one of the major functions of a GSM or a UMTS network that allows mobile phones to work. The aim of mobility management is to track where the subscribers are, allowing calls, SMS and other mobile phone services to be delivered to them.

A Mobile Ad-hoc Wireless Network (MANET) is a self-configuring network of mobile nodes. Nodes serve as routers and may move arbitrarily. There is no static infrastructure and the communication network must be able to adapt to changes because of movement and other dynamics. Most of the MANET protocols do not assume that position data is available. However, if such position data is available then efficient location based communication protocols are applicable. The main problem in MANET is to find a multi-hop route between the source and the target of information. It is clear that if all the intermediate router nodes are moving that this type of network is very much affected by mobility. Especially if one takes into account that the transmitting range is rather restricted to a limited supply of energy. The main mobility problems for a MANET are routing a message, multicasting a message, and upholding the network routing tables for these issues. [1]

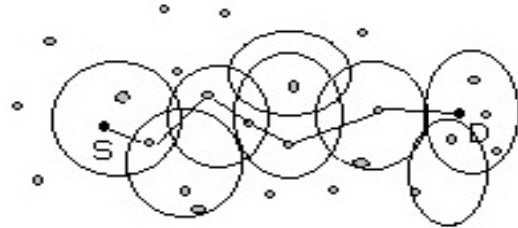


Fig. 1 Multi hop Packet Delivery of a MANET [6]

A. Mobility Management Techniques

Mobility management consists of handoff management and location management. In handoff management, the mobility is handled in such a way that during IP subnet handovers the current application connections remain intact, thus ongoing connections will be either preserved or restarted after a movement.

B. Location Management

Location management means the terminal also has to inform the current location (current IP on an interface) to its communication peers or some intermediate router in the network. This way all willing communication nodes can access a moving between subnets. Therefore, location management consists of two tasks:

1. Location Update – To track the location of mobile nodes, their location must be registered and this registration must be updated on every change.
2. Traffic delivery – Using the location information, traffic is delivered(routed) to the mobile node's current location.[2]

C. Handoff Management

With the moving nature of mobiles need to switch the base stations frequently to remain in the calling process and this process is known as handoff management. Thus, handoff management is the process through which a mobile node keeps itself in connection while it moves from one access point to another. Fig. 2 shows how a node can be disconnected if handoff is not implemented and thus calling process is crashed. To eliminate this problem handoff management is required. Handoff process consists of three stages. Firstly the initialization is being done either by mobile, dynamic network modifications or network agent. In second stage, new connection is being established by

searching for the resources for handoff management and required additional routing operations are being performed. Finally, taking care of Quality of Service (QoS) the data flow control maintains delivery of data from previous connection path to recent one.

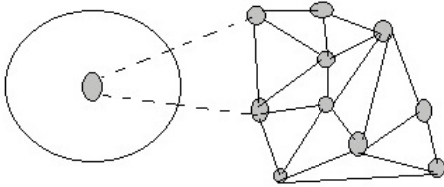


Fig. 2: Disconnection of Node Near the MANET Edge. The Node has Moved out of Range and Can no Longer Reach the Rest of the Network. [6]

Depending on the movement of the mobile device, handoff can be classified in various types. In a broad sense, handoffs may be of two types:

1. intra-system handoff (horizontal handoff).
2. inter-system handoff (vertical handoff). [3]

A homogenous network usually supports intra-system handoff. This type of handoff occurs when the signal strength of the serving Base Station goes below a certain threshold value.

Handoffs can also be classified into two type namely **hard handoff** and **soft handoff**.

A **hard handoff** can also be said as “break before make” connection. The BS handoffs the MS’s call to another call under the control of MSC and then drop the call. The link of previous BS is terminated before transferring the connection of mobile node to new BS; the MS is linked to no more than one BS at any given time and this type of handoff is called hard handoff. Hard handoff is supported mainly by TDMA (Time division multiple access) and FDMA (Frequency division multiple access), where adjacent channels uses different frequencies in order to reduce channel interference. So when the MS moves from previous BS to next BS, it becomes difficult for it to communicate with both BSs. [4]

A **soft handoff** can maintain multiple connections with neighboring cells. It is used where cells use same frequency and can be accessed by different code words such as CDMA (Code division multiple access). Each MS maintains an active set where BSs are added when the RSS exceeds a given threshold and removed when RSS drops below another threshold value for a given amount of time specified by a timer. When a presence or absence of a BS to the active set is encountered soft handoff occurs. [5]

II. RELATED WORK

As the paper specifies, there exists the various issues in mobility management of adhoc networks such as location management, handoff etc. Thus to eliminate

each issue it is required to know all the properties of the network specified. There are various location management strategies even such as Power-up and power-down location update, Time-based, Distance-based, Zone-based, Parameter-based, ordered update and implicit location update. Choosing the best combination of routing protocol and location update strategy will lead to a network with no disconnection of nodes. With this it must be checked that the network is FDMA, TDMA or CDMA as each access technique support different handoff management strategy, the first two works on Hard Handoff and former one is on Soft Handoff. Thus, to have a reliable network, it must be analyzed properly so as to know the best mobility management techniques.

Lidong Zhou, Zygmunt J. Haas (1999) [7] states that adhoc networks are not only used for military purposes but also for commercial use and thus security constraints are very important. The paper concentrates on various security issues and different solutions that can be applied such as cryptography schemes such as threshold cryptography.

Qing-An Zeng and Dharma P. Agrawal (2001) [4] says mobility is the most important feature of a wireless cellular communication system. To continue service of mobile stations handoff is very necessary otherwise it may lead to breakage of connection. The paper contains the different types of handoffs and how they affect handoff.

Brent Ishibashi, Raouf Boutaba (2004) [6] states that a highly dynamic topology is required in the mobile connection establishment and maintenance as links between nodes are created and broken, as the nodes are dynamic in the network. The network multihop nature not only affects the source or destination’s mobility but intermediate nodes also. Thus a topology is the extreme requirement so as to have an efficient adhoc network and thus the resulting routes can be extremely volatile. To have better understanding of adhoc networks number of factors are need to be studied such as link, routes and the environment, several parameters are required to be studied such as radio dimension range, number of nodes, network dimensions and mobility parameters are also examined so as to gain maximum speed and less wait time. Thus several properties require to be considered so as to establish a reliable adhoc network and a optimized MANET protocol.

Nasif Ekiz, Tara Salih, Sibel Küçüköner and Kemal Fidanboylu in 2005 [5] discussed that the quality of a cellular communication is measured by continuation of the call and this can be achieved by handoff process which enables a call to be transferred from one base station to another and thus maintains it and quality too. In this paper, an overview is represented regarding the issues in handoff intiation and maintenance and discussed about the different handoff techniques present.

Christian Schindelhauer (2007) [1] surveyed mobility patterns and mobility models for wireless networks. Mobility patterns are aerial, robot, dynamic medium and outer space motion. This paper presents the characteristics of each and shortly mentions the specific problems. It presents the specifics of cellular networks, mobile ad hoc networks, and sensor networks regarding mobility. It also discusses about the research regarding mobility in wireless networks and specifies mobility models from literature.

D. LI, J. WANG, L. ZHANG, H. LI and J. ZHOU (2009) [9] A MANET is a self configuring network so it is difficult to design a location management scheme that is both scalable and cost-efficient. A corporative location management scheme is introduced in this paper called CooLMS for MANETs. CooLMS combines the strength of grid based location management and pointer forwarding strategy to achieve high scalability and low signaling cost.

Jaydip Sen(2010) [3] states that as the demand of reliable network is increasing day by day so we need to an appropriate network supporting different types of traffic and obstacles coming in the network and the different Quality of Service. Different users require different types of services and there also exists different wireless technologies which satisfy these needs but as these wireless networks act as complementary to each other as some networks supports one application and some another and if they are integrated together they will result into a best network according to the user's requirements. To have the best network a proper handoff scheme is required. There also exist different handoff schemes in a heterogeneous networking environment which are also presented in the paper.

Umang, B.V.R. Reddy, M.N. Hoda (2011) [8] stated that as the nodes remain in moving state due to dynamic nature of adhoc network, they must be monitored on regular basis. The paper specifies the importance of management schemes in adhoc networks. Mobility and Traffic pattern of mobility models are generated by using AnSim Simulator and related with real life.

Anju Gill (2012) [10] provides an overview of routing protocol, traffic types, underlying issues and challenges related to security, mobility and resource limitation and also give possible solution for them.

Jani Puttonen (2013) [2] had discussed in dissertation about mobility management in IP based wireless environments. Mobility management can include both handovers within one technology and selection of access technology in a heterogeneous overlapping environment. Real time information about the link status and quality as well as user preferences is taken into account in the interface selection. The objective is to offer an Always Best Connected access to the user, and seamless handovers.

As per the previous research and discussion it has been concluded that there exists the various issues which are being studied in various papers and solution to them is being researched. Some common issues related to this paper are given in the below table:

Paper	Issue	Solution	Remarks
Lidong Zhou and Zygmunt Haas	Security Issues like poor physical protection	New cryptographic schemes, such as threshold cryptography can be applied.	Only cryptography cannot provide appropriate security required in the network.
Qing-An Zeng and Dharma P. Agrwal	Forced termination probability of ongoing calls	Traffic models and handoff schemes such as non priority and priority schemes	Termination problems can be solved by choosing accurate traffic model and handoff scheme
Christian Schindelhauer	Find a multi-hop route between the source and the target of information.	Choosing the best routing protocol and nodes positioning.	Sometimes the best protocol and nodes positioning also cannot work and network remains weak.
D.LI,J.WANG, L. ZHANG, H. LI, J. ZHOU	Location management scheme which is scalable and cost-efficient	CooLMS for MANETs is designed to achieve it.	Simulation results show CooLMS performs better than other schemes under certain circumstances.
Jaydip Sen	Delay in movement detection	Handoff for the forward and reverse direction	Handoff resolves this issue.
Umang, B.V. R. Reddy, M.N. Hoda	Nodes remain in dynamic state always	Regular monitoring through mobility management generated by An Sim Simulator	Simulator will help in detecting the position of the node and hence results in a reliable network.

III. OPEN ISSUES

Based on the literature survey done in previous sections, the important issues still need attention, said by research committee. To have efficient wireless networks with seamless services, all-IP framework and heterogeneous technologies will be used in future. But to have a reliable network given issues should be examined and needed to be resolved:

- Location and handoff management in wireless overlay networks*–Mobility management is the one of the important issue for future as the networks will be inherently hierarchal where different areas are need to be covered.
- Quality of Service Issue*–In future networks it is required to provide guaranteed QOS to mobile terminals. Various problems may occur while providing QOS such as inter-system handoff, location management etc.

- c. *Security Issues*-Security is the essential part especially where security sensitive applications exist. The various attributes required to be examined are integrity, authentication, availability, confidentiality and non-repudiation.
- d. *Limited radio range*-MANETS has limited radio range due to low transmission power.
- e. *Mobile node functioning as a router* – Each node has its own running protocol and thus it acts as a router and host too.

IV. FUTURE SCOPE AND CONCLUSION

About adhoc networks, it a network which does not rely on previous data and hardware such as routers and mobility management is the technique which allows mobile phones to work. It is one of the major issues of adhoc networks which can be further sub divided in Location Management and Handoff Management. Location Management is a method through which location of the mobility node is being detected and updated in the network. It includes location update strategies and traffic delivery constraints. Handoff Management refers to the technique which helps to switch the mobility nodes from one base station to another through two different methods namely hard handoff and soft handoff. Issues in location registration and handoff management have been identified and several existing mechanisms have been presented. Since global roaming will be an increasing trend in future, attention has been paid on mechanisms which are applicable in heterogeneous networks. Media Independent Handover Services of IEEE 802.21 standard as an enabler for handover has also been

presented. Mobility management is one of the major issues required to be work in future to have a reliable and secure network.

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