

Research Agenda for Vertical Handover between WiMAX and Wi-Fi Networks

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Abstract—

WiMAX and Wifi are the telecommunications technologies that offer transmission of wireless data via a number of transmission methods; such as portable or fully mobile internet access via point to multipoint links. The problem begin when a node moves from the cluster to outside the range of Cluster head. In such case the control of that node shifted to other Cluster Head. This process is called handoff mechanism. The proposed system is the scheme to elect the best cluster head for this node respective to the security and efficiency. The proposed work is the selection of cluster head or the base station in case of heterogeneous network. Here the heterogeneity is defined in terms of WiMAX and WiFi Networks. The process of handover between these networks is called vertical handover. The present work is about to optimize the vertical handover. In this work we have done the parametric changes while performing the selection of base station.

Keywords— WiMAX;WiFi;VHO ; IEEE 802.16e;IEEE 802.11.

I. INTRODUCTION

Wireless networks fetch essential changes to data networking and makes integrated networks an authenticity. Wireless networks is offering a network having no wires because by using wireless network you can connect your computer to a network using radio waves and can move your computer anywhere easily. Wireless network has made a network extremely portable because of digital modulation, adaptive modulation, and information compression.

A. Wireless Networks

Wireless means transmitting signals using radio waves as the medium instead of wires. Wireless technologies are used for tasks as simple as switching off the television or as complex as supplying the sales force with information from an automated enterprise application while in the field. Now cordless keyboards and mice, PDAs, pagers and digital and cellular phones have become part of our daily life. Some of the inherent characteristics of wireless communications systems which make it attractive for users are given below:

- (1) **Mobility:** A wireless communications system allows users to access information beyond their desk and conduct business from anywhere without having wire connectivity.
- (2) **Reachability:** Wireless communications systems enable people to be better connected and reachable without any limitation of any location.
- (3) **Simplicity:** Wireless communication system is easy and fast to deploy in comparison of cabled network. Initial setup cost could be a bit high but other advantages overcome that high cost.
- (4) **Maintainability:** Being a wireless system, you do not need to spend too much to maintain a wireless network setup.
- (5) **Roaming Services:** Using a wireless network system you can provide service anywhere any time including train, busses, aeroplanes etc.
- (6) **New Services:** Wireless communications systems provide new smart services like SMS and MMS.

B. WiMAX Technology

WiMAX stands for Worldwide Interoperability for Microwave Access. WiMAX technology is a telecommunications technology that offers transmission of wireless data via a number of transmission methods; such as portable or fully mobile internet access via point to multipoint links. The WiMAX technology offers around 72 Mega Bits per second without any need for the cable infrastructure. WiMAX technology is based on Standard that is IEEE 802.16, it usually also called as Broadband Wireless Access. WiMAX Forum created the name for WiMAX technology that was formed in Mid June 2001 to encourage compliance and interoperability of the WiMAX IEEE 802.16 standard. WiMAX technology is actually based on the standards that making the possibility to delivery last mile broadband access as a substitute to conventional cable and DSL lines.

Fig. 1 shows the architecture of mobile WiMAX network in terms of the network elements and their functions [2]. There are four main components in the architecture: MSS (Mobile Subscriber Station), BS (Base Station), ASN (Access Service Network) Gateway, and core network. The MSS communicates with the BS using IEEE 802.16e wireless access technology. The MSS also provides the functions of MAC processing, mobile IP, authentication, packet retransmission, and handover. The BS provides wireless interfaces for the MSS and takes care of wireless resource management, QoS

support, and handover control. The ASN Gateway plays a key-role in IP-based data services including IP packet routing, security, QoS and handover control. The ASN Gateway also interacts with the AAA (Authentication, Authorization, and Accounting) server for user authentication and billing. To provide mobility for the MSS, a ASN Gateway supports handover among the BSs while the mobile IP provides handover among ASN Gateways as shown in Fig. 1.

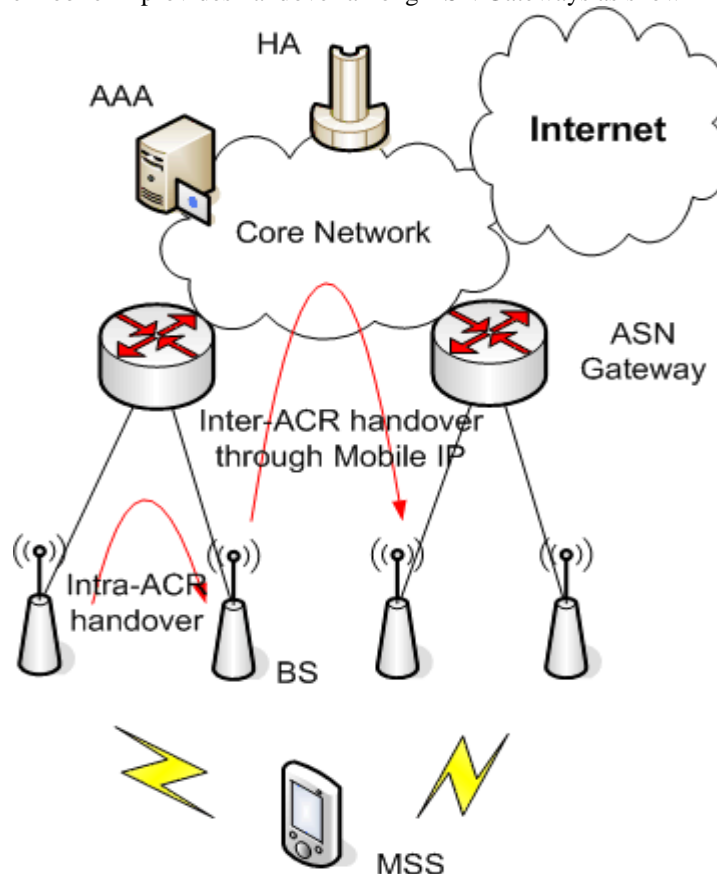


Figure 1. Network architecture of mobile WiMAX

1) Features of WiMAX

WiMAX is a revolutionary wireless technology that has a rich set of technological improvements compare to the other broadband access technology. The set of features of WiMAX are listed below:

- (1) **OFDM based physical layer:** WiMAX is based on orthogonal frequency division multiplexing that offers multipath resistance and allow NLOS communication.
- (2) **High data rate:** WiMAX can support very high peak data rate which is as high as 74 mbps.
- (3) **Quality of service:** WiMAX MAC layer is responsible for QoS. WiMAX MAC layer support real time, non real time and best effort data traffic and its high data rate, sub channelization, and flexible scheduling improve the QoS.
- (4) **Flexible architecture:** WiMAX architecture is very flexible. It can support point to point and point to multipoint connection according to its requirements. It also supports IP-based architecture that is easily converge with other networks and takes advantage of application development from the existing IP based application.
- (5) **TDD and FDD support:** WiMAX support both time division duplex and frequency division duplex which helps in spectrum management, transceiver design and low cost system development.
- (6) **Adaptive modulation and coding:** Adaptive modulation and coding scheme can connect more users. It is a technique to maximize throughput and able to setup connection in a low signal strength and noisy environment.
- (7) **Mobility support:** WiMAX offer optimized handover which support full mobility application such as voice over internet protocol (VOIP). It has also the power saving mechanism which increases the battery life of handheld devices.
- (8) **Strong Security:** WiMAX support extensible security feature for reliable data exchange. It use Advanced Encryption Standard (AES) encryption for secure transmission and for data integrity, it use data authentication mechanism.

C. Wi-Fi Technology

Wireless Fidelity (Wi-Fi) is a wireless technology which provides internet connectivity or connectivity among the users. In 1997 IEEE provide a set of specification and standards for Wi-Fi which is under the title 802.11 that explains the structure of the comparatively short range radio signal for Wi-Fi service. After that several specifications came and most commonly used specifications today are 802.11b, 802.11g and 802.11a. Out of these three, 802.11a can provide higher speeds within the various radio frequencies. IEEE is now working for a new standard 802.11n which is more reliable, secure and faster than the other standard.

Originally Wi-Fi was created for wireless extension for the wired LAN. That's why the distance between the Wi-Fi access point and user equipment is limited to around 100 feet indoor and up to 300 feet outdoors. So if a user moves its computer to a new location, he/she should find a new access point for continuing the communication.

Due to the cheap availability of the equipment and its maintenance and servicing cost, Wi-Fi is widely accepted throughout the world and it is widely used in a restaurants, hotels, airports and school campuses. It is also work well in the auditoriums, meeting rooms and small businesses. Internet service providers also use it for individual home connectivity and connectivity to the commercial complexes.

1) Wi-Fi Services

Wi-Fi standard 802.11b, 802.11g and 802.11n operate in a 2.4 GHz unlicensed frequency band. It's another standard 802.11 a uses 5.3 GHz band for transmitting the data. This signal strength can provide the service from 40-100 meter which can cover the entire house and reducing the data rate further increase the coverage area. Moreover installing additional access point (AP) and increasing the output power level greatly improved the coverage area.

D. Vertical Handover

Diverse processes are required in order to perform a Vertical Handover (VHO). Different authors divide the complete VHO process into three phases: i) Handover information gathering, ii) Handover decision, and iii) Handover execution. The information gathering phase is in charge of collecting relevant information from diverse context sources such as network capabilities, access points, user equipments, and user preferences. The most critical process in a VHO process is the decision phase since, depending on the network candidate chosen, the performance of the system could improve or decrease. Once the information is gathered it is processed by the VHDA. This algorithm is in charge of making a decision about When and Where to trigger the handover. This decision should consider several parameters in order to choose the best candidate network to hand over to. Concerning VHDA's, there are several proposals considering techniques such as fuzzy logic, pattern recognition and neural networks, among others. The execution phase is in charge of committing the VHO itself. In this process the UE leaves the current network and gets attached to a new network in a seamless manner, experiencing low latencies and minimal packet loss.

The IEEE has been making significant efforts in order to develop a protocol which may be able to homogenize VHO processes among heterogeneous networks. In that sense the IEEE 802.21 standard has been released.

II. OBJECTIVES

The presented work will cover the following research objectives

- (1) Study of Network Simulator.
- (2) Design and implementation of WiMAX and Wi-fi Clustered Network in Different Scenarios.
- (3) Study of Parameter that can affect Handover.
- (4) Implementation of Proposed Algorithm for efficient Hand Over between Clusters.
- (5) Analysis of result.

III. SIGNIFICANCE OF WORK

When we work with a large network with n number of clusters and the nodes over the network having the mobility in itself. A node move from one cluster area to other, In some case it is possible that more than one cluster head claim to control on that node. In such case which CH will be selected to take the control of communication for that network? The base station selection must be reliable and efficient. When we have a hybrid network the situation is more critical. The proposed approach is the work in the same direction such that a secure and efficient handover will be performed.

IV. PROPOSED WORK

The efficiency and reliability are the major requirement of any network. In case of high speed network like WiMax, or the Wi-Fi Networks, the network gives more data loss as some problem occur over the network. One of the major problems of such high speed network is handover. This problem becomes more critical when it is between two different networks. Such handover is called vertical Handover. In this work we are dealing with problem of data loss during the vertical handover between Wi-Fi and WiMAX network.

A. Hypothesis

The hypothesis is about the definition of proposed research questions respective to the research work. These research questions also correlate the research objectives around which the research will be performed. The research work covers the following research questions given as

- Is the work is effective respective to the network size and the base station ?
- What parameters will be taken while define the networks ?
- How the decision will be driven based on these parameters ?

B. Source of Data

To work with WiMAX network we need to define a hybrid network with n number of nodes and m number of clusters. Some cluster will represent the wimax network and some will represent the wi-fi network.. For this we need to collect the information about the network scenario. The scenario includes the information like

- No of Nodes
- Mobility
- Cluster Definition
- Channel Type
- Propagation
- Transmission Speed

To represent all these parameters we need to collect relevant scenarios. We can collect these scenarios either from some existing literature Surveys or by studying the network definition from the IEEE itself. We need to collect information about the parameters that can help to decide the cluster head selection such as distance, load etc. These parameters will be decided by study the existing literature.

V. RESEARCH DESIGN

Efficiency and the Integrity are always the major requirement for any network and when we talk about some wireless network the problem is more critical. We are proposing one of such a target cell selection scheme in case of handover in wimax network. The proposed handover scheme will evaluate the maximum effective capacity and the idle capacity of the base station for any point of time in the network. Then the triggering will be performed based on some decision factor. Base station having the more effective capacity will be elected for the next base station after handover. The proposed system will provide a reliable and energy efficient hand over. The steps involved in the algorithm are given here

- (1) Let the communication is being performed between 2 nodes present in coverage area of two different base stations or they can be in same base station called Node i and Node j.
- (2) During the data transmission Node i start moving to some indefinite direction.
- (3) As it moving there can be the requirement of Handover. Now the following steps are performed.

Find the capacity of each base station. For this we need to calculate the number of OFDM(Orthogonal Frequency Division Multiplexing) symbols and the overhead symbols in WiMAX and Wi-Fi Networks MAC frame. For this calculation the Time Division Duplexing is being used in this work. According to TDD every frame is further divided in two sub frames called DL.

A. Tool

- (1) MATLAB Editor is used for writing the code to implement our algorithm.
- (2) The result will be shown in the command window of MATLAB.

MATLAB is a high-level language and interactive environment that enables you to perform computationally intensive tasks faster than with traditional programming languages such as C, C++, and Fortran. [Matlab Toolbox]

- (1) Introduction and Key Features
- (2) Developing Algorithms and Applications
- (3) Analyzing and Accessing Data
- (4) Visualizing Data
- (5) Performing Numeric Computation
- (6) Publishing Results and Deploying Applications

MATLAB is a high-level technical computing language and interactive environment for algorithm development, data visualization, data analysis, and numeric computation. Using the MATLAB product, you can solve technical computing problems faster than with traditional programming languages, such as C, C++, and Fortran.

You can use MATLAB in a wide range of applications, including signal and image processing, communications, control design, test and measurement, financial modelling and analysis, and computational biology. Add-on toolboxes (collections of special-purpose MATLAB functions, available separately) extend the MATLAB environment to solve particular classes of problems in these application areas.

MATLAB provides a number of features for documenting and sharing your work. You can integrate your MATLAB code with other languages and applications, and distribute your MATLAB algorithms and applications.

1) *Key Features*

- (1) High-level language for technical computing.
- (2) Development environment for managing code, files, and data.
- (3) Interactive tools for iterative exploration, design, and problem solving.
- (4) Mathematical functions for linear algebra, statistics, Fourier analysis, filtering, optimization, and numerical integration.
- (5) 2-D and 3-D graphics functions for visualizing data.
- (6) Tools for building custom graphical user interfaces.
- (7) Functions for integrating MATLAB based algorithms with external applications and languages, such as C, C++, FORTRAN, Java, COM, and Microsoft Excel.

VI. CONCLUSION

A Hybrid network architecture supports all usage models (fixed, mobile & nomadic). It is also support high capacity real time and non real time voice, data and multimedia services. while maintaining the appropriate QoS. Moreover it supports idle mode operation and paging for the mobile station. Its network reference model support interoperability.

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