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A Gateway To Wimax Profiling Services In Libya

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Abstract:- Several empirical studies on Internet traffic have been made recently for various communications networks proving that the actual Internet traffic is self-similar or long-range dependent. WiMAX is a technology that provides delivery of wireless broadband services for both fixed and mobile users which became prominent in 2006 through the deployment of the 2.3GHz version of WiMAX services. The expected demand for WiMAX services will increase due to the existence of the current traffic profile for the network and as a result help service providers effectively plan in providing high quality of service (QoS) to its potential end users. There is necessity for a traffic profiling study by Libyan Telecommunication Network in order to prepare comprehensive traffic patterns based on real traffic captured from the existing network. This study is to prove that implementing WiMAX services as an alternative to currently available internet services will enable internet users to increase in the country, especially in remote locations or locations where people don't have internet access. This paper works out the necessities that are expected to undergo in achieving WiMAX profiling services in Libya.

Keywords:-WiMAX; Libyan Telecommunication; Information and Communication Technology; Network Management System; Quality of Service.

I. INTRODUCTION

Information and communication technology (ICT)has been found to be a key player in making IT and IT-enabled services of many countries tradable, causing a faster average annual growth in their economy [1]. Many of the developing and developed countries such India, Ireland, Hungary, the Russian Federation, Switzerland, Poland, Denmark, China, Singapore, Finland, Sweden and Spain achieved an annual growth of 15% or more from the exportation of IT and IT-enabled services as of the year 2006 which added to their economic growth [2] as shown in Figure 1.

Fig. 1: Country IT-Enabled Services Export in 2006

According to telecom data published on 5th of August 2010, it was reported that Asia-Pacific region has overtaken North America as the home to the largest number 4G broadband wireless subscribers. In addition, TeleGeography's 4G Research Service figured that there were around 1.7 million pre-WiMAX and WiMAX customers in Asia at the end of March 2010 compared to 1.4 million in the US and Canada. Also it was stated that the total number of 4G subscribers are more than 5.7 million of the world population. Based on the above statistics, Asia-Pacific region presently has covered 29% of the overall market, up from 22% a year earlier and just 6% at the end of 2006 [3]. Figure 2, shows the data chart.

Fig. 2: WiMAX Subscribers by Regions, (2008 – 2010)

Wireless broadband (or wireless broadband access) is a technology that uses point-to-point (sometimes point-to-multipoint) microwaves in frequencies that range from2.5 to 43 GHz to transmit signals between hub sites and end-users, or receivers. This is sometimes regarded as suitable for both access and backbone infrastructure [4]. Examples of prominent wireless broadband technology are wireless fidelity (WiFi) and worldwide interoperability for microwave access (WiMAX). WiMAX is a promising technology for broadband wireless access in the near future. The excessive demand for providing mobile (remote) users with broadband wireless access has attracted tremendous investment from the telecommunications industry in the development of WiMAX networks. Voice over IP (VoIP) over WiMAX will be one of the killer applications for rapid deployment of WiMAX networks due to the increase in the portion of voice traffic in the WiMAX networks. Hence, VoIP, as the current technology for making voice calls through packet switch networks, will be a key application in WiMAX networks [5].

Libyan telecommunication services has been a prominent service provider in Libya since 2004 and has built a network of wireless connections to support mobile phone services in various regions of Libya, improving its functions to provide Internet services, MMS, and voice mail to schools and business organizations. The company provides access to each registered household in Libya and currently has established more than 15 service centers in several districts scattered across the country. It has receivedover6.2 million subscribers during the past 5years of operation through WiMAX services [6].

Libyan telecommunication subscribers have been experiencing some unified challenges in the usage of their WiMAX services which come in forms of low speeds, and degradation of service quality. The advocates of WiMAX technology have been seen to be working tirelessly on the improvement of the low speed, and service delay of their technology [7]. Much is needed to be done to boost the overall efficiency of user services provided by Libyan telecommunications in Libya. It is critical that solutions to low speed and quality of service are provided by the company to cope with providing user satisfaction. This could be used for evaluating the company, since WiMAX is always encountering constant limitations of wireless bandwidth.

The expected demand for WiMAX services will increase dramatically due to the existence of current traffic profile for the network, and thus help the operator to effectively plan in providing high quality of service (QoS). There is necessity for a traffic profiling study of Libyan telecommunication network in order to prepare comprehensive traffic patterns based on real traffic captured from the network. Various parameters such as temperature, humidity, speed, and geographical positions must be studied in the profiling processes. Hence, a network planner tool, or set of tools, should be designed based on the captured profile to forecast the future traffic scenario, so that the service provider can be one step ahead and maintain a constant flow of quality service and user satisfaction in the future. This paper comes out with a route to follow designed for achieving successful WiMAX profiling for Libyan Telecommunication Company in Libya.

II. WIMAX TECHNOLOGY

WiMAX is short for Worldwide Interoperability for Microwave Access. It was developed by the IEEE and promoted by WiMAX Forum which was established in June 2001 to promote conformance and interoperability of the IEEE 802.16 standard (Wireless Metropolitan Area Networks, Wireless MAN).WiMAX is a new solution or a new technology which was built to focus on solving the problems of point-to-multipoint broadband outdoor wireless networks. It has a large amount of applications that include last mile connectivity for businesses and homes and backhaul for wireless hot spots as well.

Nithyanandan and Parthiban (2012), proposed WiMAX-WLAN-LTE interworking system to extend the services capabilities of WiMAX network to WLAN and LTE environment using signal strength based handoff initiation as mobility. In gateway relocation mechanism the gateways of the serving base station (LTE eNodeB) and target base station (here WLAN AP) are connected through Multi Protocol Label Switching tunnel. Their applied four different types of interworking architectures between WLAN, LTE and WiMAX networks: (tightly coupled integration, loosely coupled integration, tight coupling with neighbor reservation and with gateway relocation). It was found that tight coupling with neighbor reservation and with gateway relocation provides better handover performance. By simulating the network, interworking architecture with gateway relocation creates a secondary path prior to handover resulting in less handover delay [8]. Kaveh Shafiee, et al., (2011), considered a vehicular heterogeneous network comprised of WLAN and cellular systems. They applied vehicle handoff (VHO) to obtain cost and time effectiveness of communication system in the case of lower speeds, whereas it would be better to avoid VHO and stay in the cellular network at higher speeds. They further demonstrated the possibility of combining vehicle-to-vehicle (V2V) communication technique with WLAN, cellular and ad hoc networking as another means of saving cost and time in terms of transmission process [9]. Enrique Stevens-Navarro et al., (2009), investigated on the Virtual Partitioning with preemption technique to be used for admission control in cellular/802.16e interworking. They used admission control algorithms for connection requests that consider the class of service and the type of user. Furthermore, horizontal and vertical handoffs were looked into and suitable preemption rules were defined for the RT and NRT connections. They

also worked out method of cost reduction by dealing with the problem of blocking/dropping of joint connection and packet-level QoS optimization approach [10].

WiMAX Evolution was a book forwarded by Siavash M. Alamouti and edited by Marcos D. Katz Frank H.P. Fitzek, Tsutomu Ishikawa (2009), the book explicitly reviewed various kinds of traffics on communication networks and proved that the actual Internet traffic is self-similar or long-range dependent [11], [12]. WiMAX is generally believed as a technology that provides delivery of wireless broadband services for both fixed and mobile users which became prominent in 2006 through the deployment of 2.3GHz version of WiMAX services called WiBRO by Korea Telecom in order to provide high performance for data and video. [13] A recent statistics report was submitted stating that WiMAX market projects over 133 million subscribers globally by the end of the year 2012.

Traffic forecasting has always been a challenging issue for many researchers while traffic prediction plays a fundamental role in characterizing a network's performance and it is of significant interest in many network applications (admission control, network management). Recently, many approaches involving time series models have been used for traffic forecasting, such as pure statistical or based on neural networks [14]. In addition, WiMAX is a standard-based wireless technology that provides high throughput broadband connections over long distances. WiMAX can be used for a number of applications which include last mile broadband connections, hotspots and high-speed connectivity for business and customer services. It also provides wireless metropolitan area network (MAN) connectivity at speeds up to 70 Mbps, and the WiMAX base station covers a radius of 5 to 10 km. An overview of WiMAX is shown in table 1 below.

Table 1: WiMAX Overview

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WiMAX technology is considered to be highly reliable, competing with third generation (3G) cellular networks. This means that WiMAX can covers geographical areas that other network providers cannot [15]. Mobile WiMAX supports best in class security features by adopting the best technologies and support, for mutual device/user authentication, flexible key management protocol, strong traffic encryption, control and management plane message protection and security protocol optimizations for fast handovers in order to ease the use internet access [16].

The imperativeness and wonders of WiMAX communication system to the present generation of global telecommunication has made other telecommunication networks such as broadband Internet access, Bluetooth, cellular phones and other internet communication gadgets, to be of less attraction to the masses. This is because WiMAX has more features and ability to provide better internet access than WiFi and WLAN [17]. Its accessibility is ubiquitous like that of global systems for mobile communication (GSM).

This directly gives an idea of why WiMAX is increasing in demand by internet users. A user that has access to a WiMAX network can simply use it just as they would use a WiFi access point. The only difference is that when using WiFi, they would have to be near a hot spot, when using WiMAX; however, they don't have to worry about being near a WiMAX hotspot. Think of it as a form of WiFi, but there is only one hotspot, and it is located everywhere as shown in Figure 3.

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Fig. 3: WiMAX Architecture

(http://web.mst.edu/~mobildat/wimax/introduction.htm)

A WiMAX network can be configured as a future versatile wireless network to support multiclass traffic for various applications and solutions. The QoS characteristics involved in every connection should be a reference for the performance of resource allocation involved in serving the connections. The effectiveness of a WiMAX network should be viewed from packet and connection overhead point of views. The analysis of the configured service flow parameters and the sub-frame resource allocation methods that endorse the creation of a novel round robin based scheduler called New MDRR has always been a common practice in the analysis of WiMAX.

While WiMAX does not have that much of popularity of Wi-Fi (IEEE 802.11), the technology is gaining significant attraction from the largest companies and corporations around the world. Supporters of WiMAX standard have great expectations for its future. Intel, for example, said that IEEE 802.16 is, "as important as the Internet itself" -- a technology that will enable up to 5 billion people to be connected over time.

III. RELATED WORK

A performance Analysis of an Integrated Wireless Network Using WiMAX as Backhaul Support for WiFi Traffic was addressed by [18] leading to an analytical model that aids the usage of WiMAX as backhaul support for WiFi traffic and evaluates the system's overall performance. One unique feature is that the WiFi traffic completely reflects the realistic user behavior. Various traffic arrival rates and performance metrics were derived and analyzed. A Preliminary Analysis that aims to realize a long-range dependence analysis for WiMAX traffic was exhibited and estimating Hurst parameter using the R/S method [14]. Researchers proved that LRD depends on the duration of the time series. Researchers further submitted that there are other improvement strategies to be considered in WiMAX network which could be imagined after the LRD analysis of the uplink traffic.

[19] Technical and market studies have been performed on WiMAX and depicts that WiMAX development and deployment have been affected by the current crisis. This happens at commence of expansion of the deployment of WiMAX services in the world. The influence for WiMAX is more serious than the 3G competitors due to its immaturity in the market and WiMAX is expected to continue growing at an alarming rate after it has proven successful in dealing with the crisis. However, this paper looked into traffic profiling of WiMAX services for determining the level of diffusion of WiMAX services in Libya. This could be implemented in state mail survey aiming at constructing a profile of educational internet access and investigate consumer preferences attributes in the institutions of higher learning.

IV. WIMAX NETWORK DEPLOYMENT AND MANAGEMENT

The network deployment scheme of fixed WiMAX (IEEE Std. 802.16d-2004) in Figure 4 shows the interconnections between each entity of network with Network Management System (NMS). This kind of structure is a common possible approach of a fixed WiMAX deployment scenario. NMS is installed in a separated machine outside the WiMAX network to accomplish network monitoring and traffic recording. Once all connections are ready, network management can be carried out [20].

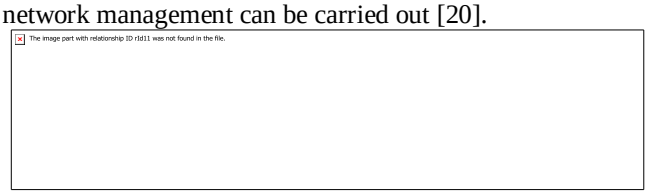

Fig. 4: WiMAX Network Deployment Scheme (Source: Dedi et al., 2009)

Network management needs registration of entity's objects to the NMS before monitoring. An object has attributes to be defined and shall be matched with its definition in Management Information Base (MIB). The MIB may come in the form of a standardized MIB, private MIB, or user-defined MIB.

V. WIMAX TRAFFIC MONITORING TECHNIQUE

Generated traffic flow is the integration of the whole network system which establishes a connection that includes the traffic source (depending on the QoS classifiers), the protocol being used, and the connectivity medium. For the traffic to be generated, the notebook clients should establish connections to specific application servers outside the WiMAX network. The amount of inbound and outbound traffic which flows through client-AP-SS-BS-outside server (Uplink or UL) and vice versa (Downlink or DL) will be captured periodically by the NMS. This WiMAX system is a bundled version of Tsunami Proximal Wireless [21] which includes 1 BS and 2 SSs only.

Whenever the WiMAX system fails to implement WiMAX interface object IDs, there will be approximate traffic patterns which measure the inbound and outbound traffic flowing on their Ethernet interface with extracted MIB objects. DL packets are the inbound traffic flowing to BS Ethernet that is expected to deliver to both SS1 and SS2, while UL packets flow on the opposite direction from DL. They come from SS1 and SS2 Ethernet inbound traffics and flow to BS. There are two kinds of traffic load in terms of network utilization. Moreover, high load is a condition where there are attempts to fully utilize the available bandwidth or keep the channel busy in order to establish a connection successfully. Light load is a normal number of connections where there are up to 50-60% spare network percentage links available. There is a need to set up several parameters to distinguish the traffic characteristics of each quality of science (QoS) service flow. By having all the parameters in place, there could be immediate monitoring of each service that is classified as

heavy or light load traffic. Traffic flows only in one active QoS service class at one time while the traffic behavior is analyzed by using variance plot and RlS plot. The regression technique is expected to be used in order to estimate Hurst parameters.

For successful deployment and management of a common WiMAX system, it is vital that the system is initially designed in synchronization with the base station and base station engineers to accurately monitor, control, maintain frequency use, interference, and system functionality.

VI. WIMAX TRAFFIC ANALYSIS

A normal communication coordinates utilization of both UL and DL, while NMS will record the inbound and outbound packets for each device. However, whenever there is huge amount of data in the analysis, there is a need to choose an evaluated stream that represents the WiMAX network. If UL could not provide a significant amount of data, DL analysis is preferred to be chosen. The recorded traffic from SS1 should be used as an assessment stream and the SNMP sampling interval, which is the time interval, of SNMP PDU would be sent to the responsible agents in order to get the updated value of packets. Figure 5 summarizes the traffic analysis protocol.

Fig. 5: WiMAX Traffic Analysis

VII. CONCLUSION

The excessive demand for providing mobile users with broadband wireless access has attracted tremendous investment from the telecommunications industry in the development of WiMAX networks. Voice over IP (VoIP) over WiMAX will be one of the popular applications, and one of the reasons for rapid deployment of WiMAX networks due to the increase in the portion of voice traffic in the WiMAX networks. The Libyan Telecommunication Company provides access to each household in Libya and currently has established well over 15 service centers in different districts within the country. It has provided services to more than 6.2 million subscribers during its five years of operation through WiMAX services. Many of the users or subscribers have called for investigations on the current status of the services they are receiving from the company. This accordingly created a need for a gateway to successful WiMAX profiling services by the Libyan Telecommunication Company, which has been technically explained in this paper; such as WiMAX network deployment and management, WiMAX monitoring technique and traffic analysis. Submissions have also been made that should a WiMAX system fail to implement WiMAX interface object IDs, an approximate traffic pattern which measures the inbound and outbound traffic flowing on their Ethernet interface with extracted MIB objects will be alternatively used. DL packets are the inbound traffic flowing to BS Ethernet that is expected to deliver to both SS1 and SS2, while UL packets flow on the opposite direction from DL, technically speaking. In summary, the increasing demand for WiMAX systems and functionality in Libya has created a link or gateway that ensures successful WiMAX profiling services by the Libyan Telecommunications Company. This will ensure that the company will maintain and control, and cope with WiMAX system functionality provided to its current subscribers and the increasing demand for future subscribers to the service as well. Therefore, traffic profiling of WiMAX services is an important issue that will help in determining the level of diffusion of its WiMAX services in Libya. This will be done by employing a state mail survey and aims to construct a profile of educational internet access and investigate consumer preferences attributes in various institutions of higher learning.

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