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A Brief Review on Wireless Networks

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Abstract - *Wireless networks have important roles in telecommunication especially in a long distance, therefore, the study of different wireless networks are more highlighted. In this paper, wireless networks such as WLAN, WiMAX and satellites are considered. Also, in recent years, the integration of these networks which are applied in different fields of telecommunication are increasing. These applications are used for different purposes, including architecture, QoS, coverage and hardware. Therefore, in this study, a brief review is done on recent works on these networks as well as their integration.*

Key Words: **Wireless network, WLAN, WiMAX, Ad Hoc, Integration**

1. INTRODUCTION

Wireless networks are based on radio communication to connect end users to each other. These kinds of network include cell phones, satellites, wireless sensors and microwaves. Wireless networks have different types [1] [2] [3] such as personal area networks (PAN) which covers a small area like ZigBee, local area networks (LAN) which covers more distances like WiFi and Ad hoc or mesh network which allows to nodes to directly communicate with each other without using access point, metropolitan area networks (MAN) which connects several wireless LAN`s like WiMAX, wide area networks (WAN) which has larger coverage areas, cellular network which is based on cells and end users and they can communicate with each other within the cells, global area network which supports mobiles by using LAN`s and satellites.

There are some reviews on wireless networks and their combination, one of them is how to merge wireless and wireline intelligent network [4] in which it creates wireline services such as call waiting/forwarding and voice mail, also, some mobility such as prepaid services and personal toll-free number. It [4] uses the operators such as Verizon, SBC, BellSouth, BT, and KT and standards such as 3GPP, ETSI TISPAN, and ATIS of using IMS (IP multimedia subsystem). In [5 and [6], security and security protection of wireless networks are discussed. The study in [5] mentioned that the wireless networks are open in a free-space environment, therefore, they are vulnerable to attacks and active jamming. First, it [5] reviews the wireless networks with more focused on some parameters such as authenticity, confidentiality, integrity, availability and then, attacks are studied and the security are measured for each layers. Security protocols such as Bluetooth, Wi-Fi, WiMAX, and LTE are reviewed in [5]. Then, some security measurements for physical layer such as information-theoretic, artificial-noise-aided, security-oriented beamforming, diversity-assisted and physical-layer key generation approaches are reviewed. Also, various jammer attacks as well as combination of physical layer with authentication and cryptography are reviewed. A comparison on different security protocols such as WEP, WPA, WPA2 is done in [6]. It mentioned that WPA2 is better among them. Also, the paper suggests some improvements on wireless network security.

Wireless sensor networks in smart grids is discussed in [7]. It mentioned that cost, scalability, expense of building and lack of monitoring systems are regular problems in the smart grids. These problems exist in the traditional power system. By developing the technology and enter the wireless sensor networks to power industry, traditional power systems change to smart grids. This evolution can solve the aforesaid problems by using real-time information from wireless sensor networks. The paper [7] more focused on applications, design challenges and protocols of wireless sensor networks based on smart grids.

A survey on intrusion detection is done in [8]. It classifies the intrusion detection system (IDS) techniques and then the advantage and disadvantage of them are discussed. This classification is based on target wireless network, detection technique, collection process, trust model and analysis technique. The target networks in [8] are including wireless local area networks, wireless personal area networks, wireless sensor networks, Ad hoc networks, mobile telephony, wireless mesh networks and cyber physical systems.

A survey on Ad Hoc networks is provided in [9]. It more focused on performance improvement of the medium access control (MAC), routing, and transport layers of the network and the network`s problems are discussed in the paper.

QoS of the heterogeneous wireless networks are discussed in [10]. These networks can make the connectivity ubiquitous and can solve the capacity, spectrum efficiency, coverage and reliability problems. First, it studies the heterogeneous wireless networks and categorizes them, then, after a comparison, advantages and disadvantages of them are discussed.

Broad band optimal and wireless networks are discussed in [11]. It reviews and compare the hybrid networks which are a combination of optical access networks and wireless networks. As the paper mentioned, this combination is powerful to a good scalability, cost effective, a flexible communication system and bandwidth demand.

The paper [12] is reviewed the techniques which are applied to high efficiency wireless local area networks including physical layer techniques, medium access control layer strategies, spatial frequency reusing and power saving algorithms. As the paper [12] mentioned, improve the efficiency of WiFi standard and wireless local area networks are important with consideration of increasing the end users day by day. They are defined by future usages, performance, traffic and channel models.

2. WIRELESS NETWORKS

2.1 WLAN

The importance of the channel in WLAN is discussed in [13]. It introduced a new structure between user and access point. As the traditional IEEE 802.11 WLAN`s have problem with MAC layer multi-rate, the study in [14] introduces an appropriate algorithm which is based on EMAC agreement and also, it uses basic rate for MAC header and a confirmation frame in order to carry the channel information. Therefore, it can reduce the overhead as well as it is flexible to channel changes. Another improvement on MAC layer and transport layer is made in the [15]. It is based on a new MAC protocol with carrier sense multiple access/collision avoidance (CSMA/CA). It uses connection-oriented MAC protocol with fast collision resolution (FCR) algorithm and consequently improve the performance which are high throughput and low latency. The FCR has a smaller initial contention window, larger maximum contention window, larger contention window in collision, differing states, smaller back-off timer in case of a fixed number of consecutive idle slots and maximum packet transmission in order to improve the user serving. Therefore, FCR algorithm has better efficiency than the IEEE 802.11 MAC. A study on QoS of IEEE 802.11e WLAN`s is done in [16]. It is more focused on MAC and then, an evaluation is done on enhanced distributed coordination function (EDCF) and hybrid coordination function (HCF).

An improvement on ODMRP multicast Ad hoc protocol is done in [17]. It can increase the data delivery ratio. Another study on Ad hoc network [18] more focused on supporting variable geocaching application in which the data packets are delivered to the nodes in the specified geocaching region. Also, the mobility pattern based geocaching is used in order to solve service disruption due to the data non-optimization which exists in the path. The solution for ad hoc cloud computing is discussed in [19] and also, problems and their solutions are reviewed. Control of the performance of mobile Ad hoc network with an appropriate node is difficult, therefore, diffusion-type flow control (DFC) is proposed [20] and it is applied to TCP in Manet. It can monitor the wireless traffic. The security threats in Ad hoc networks such as AODV and DSR are discussed in [21]. Then, a solution is proposed in which no pre-required network infrastructure is needed. The protocol that is used in [21] is a strong and certified protocol which its name is *ARAN.*

2.2 WiMAX

Worldwide Interoperability for Microwave Access (WiMAX) / IEEE 802.16 has high data rate which is based on orthogonal frequency division multiplexing (OFDM). The frequency that is used is between 2 to 11 GHz. The loss path which is important in the WiMAX network as well as models including free space path loss model (FSPL), Hata-Okumura extended (ECC-33), cost 231 Walfish-Ikegami and Stanford university interim is discussed in [22]. It uses 3.5GHz spectrum range based on the condition in Bulgaria. It mentioned that FSPL has the lowest path loss and ECC-33 model is useful for urban area. The study in [23] is discussed about new different businesses in industry which is brought by WiMAX technology. These are included applications in mobile and wireless systems.

A fractional-N structure PLL-based frequency synthesizer which is based on 0.13umCMOS technology is designed for WiMAX in [24]. Also, a gain-linearizer block for VCO is used in order to improve the linearity and phase noise. It mentioned that the phase margin is more than 50° and the phase noise is lower than -120 dBc/Hz with 1MHz with 3µsec setting time. A type-I loop N-fractional PLL is used for WiMAX in [25] and [26] in order to avoid linearization techniques in which the operating point in phase detector is closed to zero phase error. Also, it the design in [25] can be applied with PFD, loop filter and DAC in order to reduce the DeltaSigma error such as quantization as well as nonlinearities. The quantization noise reduced more than 20dB with a 1MHz loop bandwidth [27]. The power supply with 1.8 v and 26mA are set for synthesizer and also, PMOS topology is used for VCO. A synthesizer based on 0.18m CMOS technology with 1.8 v and 26mA introduced in [26]. Also, another fractional-N synthesizer with CP (Charge Pump) PLL for mobile WiMAX is designed in [28]. The CP PLL has switched loop bandwidth and the reference frequency is 32 MHz.

2.3 Satellite

The study in [29] is discussed about the satellite technology in personal communication. Also, current challenges are discussed in the future of personal satellite communication. A comprehensive study on new technologies and applications of satellite and space communication is done in [30]. The parameters such as multi

carrier systems, modulation, QoS, error, synchronization and security are the issues which are discussed in the paper. A network of portable terminals intended for personal satellite communications (PoST) system is implemented in [31]. Also, in order to support FCC regulations, efficient utilization and code division multiple access (CDMA) and a direct sequence spread spectrum waveform are used.

Disaster management is one of the most challenging issues in wireless communication. It includes earth quack, flood, thunderstorms as well as air crashes and accidents. In [32], ka-band aeronautical satellite communications are discussed in which the system has 3 subsystem including a Ka-band aeronautical satellite communication (KASC), a position-estimation and data-processing (PEDP) and an information-distributing internet application. Also, a research on remote sensing satellite and how do they use in disaster management is done in [33]. A combination of GPS and GSM is used in the study in [34] in order to implement an Emergency Aid System (EAS) and tracking the vehicle in which a SMS is sent to the nearest service aid station via second generation technology in order to help people in accidents and breakdown. An effective and economic use of satellite to track the vehicle by using low cost L1 C/A GPS is done in [35]. It is based on GPS signals which are received by GPS signals from civil activities. In a study in [36], use of triple DME is proposed instead of GPS in which longitude and latitude on the user`s receiver is measured by triple DME.

3. WIRELESS NETWORKS

3.1 WiMAX and WLAN integration

In [37] after review and comparison of IEEE 802.16/WiMAX and IEEE 802.11/WLAN networks, an integration of them is discussed in order to serve telemedicine services. It is more focused on QoS, radio resource management, scheduling, admission control, handover and mobility management. An integration of IEEE 802.16/802.11 with the approach of bandwidth management and admission control is done [38] in order to preserve the QoS. The bandwidth allocation for base stations and access points in this hierarchical model is based on bargaining game. Also, corresponding service utilization is used for admission control design and traffic is estimated by admission control game. Another IEEE 802.16 and IEEE 802.11 integration is proposed in [39] and it can support QoS and how the applications specify their QoS. Different parameters of different flows are identified and checks the application whether or not receive QoS. In order to support QoS of VOIP traffic, an integration of IEEE 802.16 /WiMAX and WiFi is proposed in [40]. In this integration more focused on cost analysis and resource management during the handover.

In [41], an integration of IEEE 802.16 and Ad hoc networks is proposed and also, admission control and hand off are considered in this scenario. WiMAX is useful to cover larger areas and Ad hoc is useful for smaller areas and this combination can keep the received signal power above the satisfactory threshold as well as the delay. The delay in IEEE 802.16/WiMAX and IEEE 802.11 networks especially in IEEE 802.16 is a major problem. It can be reduced by decrease the number of users but, study in [42] suggested a rerouting on CBR traffic over UDP connections in access points (IEEE 802.11) based on scheduling. Vertical (MAV) handover algorithm is proposed in [43] between two WiMAX and WLAN networks. It is designed to avoid unnecessary handover between two networks by adjust the dwell time and predict the residual time. Also, vertical and horizontal handoff in integration of WLAN and Mobile WiMAX is discussed in [44]. It causes a complete handoff by adding a waiting time to the station before maximize the delivered traffic (bits) during the dwelling time. Another integration of IEEE 802.11/ MESH WLAN and IEEE 802.16/WiMAX is done in [45] over telemedicine. It more focused on vertical handoff and admission control for fixed and mobile users in order to preserve the connection in which a fast and error-free hand off is applied during the connection.

3.2 WiMAX and WLAN with satellite integration

The emergency communication for disaster area by a combination of GASM/ WiFi and satellite is proposed in [46]. The GSM serves as backhaul and connects to the core and also, internet connectivity such as web browsing and email is provided by WiFi.

Mobile Ad hoc networks (MANETs) are flexible and can cover the areas without infrastructure and also, satellite networks can cover large areas without infrastructure by one gateway in each footprint [47]. They can be complementary for each other, for example, in the areas that there is no line of sight for satellites, MANETs can cover that area. Therefore, an interface between these two networks are designed [47] in order to integrate them.

An integration of WiMAX network and satellite based on the channel reservation is proposed [48] in order to support QoS. It mentioned that the network has good performance in the presence of lower users in base stations. The proposed hybrid network which is integration of IEEE 802.16/ WiMAX and satellite can solve the problem of line of sight which exists for satellite communication [49]. Also, the header compression (Hybrid-ROHC or in short H-ROHC) in which the resource over the network are saved with a premium bandwidth is proposed in [49].

3. CONCLUSIONS

As mentioned in this study, a brief review on wireless networks and their combination is done. This study covered

the different dimension of the wireless networks. These networks are WLAN, WiMAX and Satellite. As discussed before, integration of them can improve some necessary blocks in the network as well as fulfill some weaknesses in the network. As an example, one of the weaknesses is the coverage problem which can be solved by these kinds of integration.

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