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CONTENTS

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HYPOTHESES

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WI-FI DEPLOYMENTS IN CONJUNCTION WITH WI-MAX FOR NEXT GENERATION HETEROGENEOUS NETWORK

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ABSTRACT

In the past few years the Wireless Local Area Network (WLAN) has been the most popular choice of communication amongst users. WLAN, which is based on the IEEE 802.11 standard, also known as Wireless Fidelity (WiFi), offers mobility and flexibility with a relatively low cost to users. In addition, wireless technology is providing easier internet access to areas that are too difficult and expensive to reach with traditional wired infrastructure. IEEE 802.16, also known as Worldwide Interoperability for Microwave Access (WiMAX), is another standard with similar general principles as WiFi with the main advantages being it covers a larger area and has a higher data rate. Although WiMAX greatly outperforms WiFi, user devices such as desktops, laptops and cell phones need to have WiMAX capability to be able to connect to WiMAX sources. Currently, not many user devices have WiMAX capability, the majority has WiFi capability. The best way to enjoy the advantage of the WiMAX system is to combine the WiMAX and WiFi systems together. This paper shows the logical model for usage of both together. Here, the scenario turns out to be the viable model for using WiMAX in a Wi-Fi world. Consider the usual configuration of a Wi-Fi access point: it provides service to Wi-Fi clients, and connects to the Internet by a wired Ethernet connection. The alternative, whether in a corporate or metropolitan network, would be to use a mesh Wi-Fi connection. This can be useful but requires access to different locations to complete the mesh and connect at a wired Internet hub. If a cellular data or WiMAX connection is available, it is possible to use this for the backhaul connection. As broadband mobile data rates increase and coverage expands, it becomes viable to incorporate a cellular NIC card into a Wi-Fi access point and build a highly-mobile Internet service. Just power-up the access point and it provides Wi-Fi coverage for local clients while connecting to the outside world or similar connection. This paper shows the advantages of using both wimax/wifi together by combining the usage of both. It explores the complementary nature of wifi/wimax as well as illustrates how users can leverage these technologies to use wireless broadband internet connectivity and compelling new services at affordable prices and in more locations.

KEYWORDS
Ad-hoc Network, DSL, NIC, Wireless Network, WLAN.

INTRODUCTION

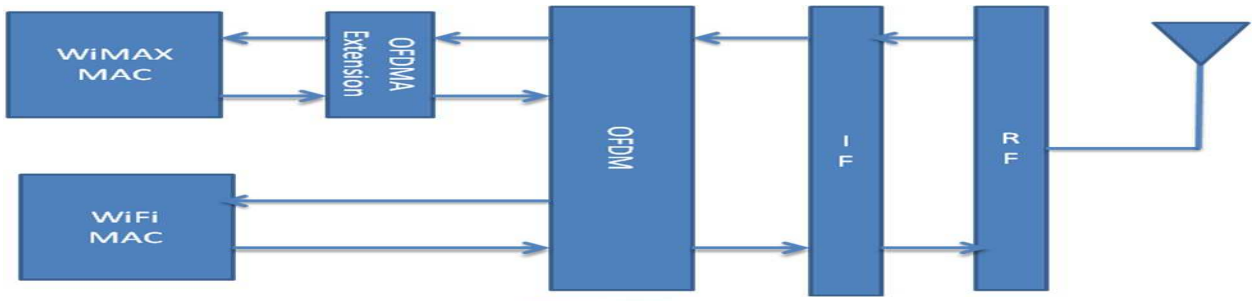
Many people in the world today have the need for unlimited access to the Internet. Unlimited Internet access is actually no issue. All you really need to do is subscribe to a good broadband or cable connection and you are good to do. This is only applicable when talking about 24/7 Internet access. Network integration for Next generation wireless networks, where the diverse of the technologies available and optimized for different usages models. WiMAX and WiFi are the most promising techniques for future wireless networks; internetworking between these technologies is inevitable for better usability of the network infrastructure and support for seamlessly mobility and roaming. The unique similarities between WiFi and WiMAX networks that make the proposed synergy promising and meaningful that both technologies are fully packet switching uses IP based network approaches provide compelling benefits to service providers to collaborate between these technologies. By Digital Subscriber Line (DSL) and other fixed broadband connections within wireless hotspots, WiFi has dramatically increased productivity and Convenience. WiFi delivers high speed WLAN connectivity to millions of offices, homes and public locations. The integration of WiFi into notebooks or other devices has accelerated the adoption of WiFi to the point where its nearly a default feature in these devices. On other hand WiMAX takes wireless internet access to the next level and overtime could achieve similar rates to devices as WiFi. WiMAX can deliver internet access miles from the nearest WiFi hotspot and cover large area called WLAN, be they metropolitan with multi megabit per second mobile broadband internet access. This standards and IP based network approach provides compelling benefits to service providers to collaborate between these technologies.

- ✓ Wireless broadband services which enable for attaining rapid user adoption.
- ✓ Any WiMAX or WiFi devices are able to connect to any WiMAX or WiFi network that supports the same network settings.
- ✓ It provides certification profiles, facilitating volume production & global economies of scale.
- ✓ All IP based networks infrastructure, enabling cost effective deployments for operators and open internet services for users.[1]

LAYER INTEGRATION

There are many similarities between WiFi and WiMAX at PHY and MAC Layers. At the MAC Layer the media independent handover protocol developed which enables the handover of IP sessions from one layer to access technology to another to achieve the mobility of end use devices. At PHY layer OFDM transmission concepts and mobile WiMAX is using OFDMA techniques. The convergence at physical layer will reduce the base station cost significantly where the base station can use the same IF, RF and antenna parts for both technologies. The integration at PHY level needs a change on the silicon chip which increases the complexity of baseband chip. This can be realized by implementing software defined radio technique to switch between the two techniques at baseband and RF levels where components that have typically been implemented in hardware instead of implemented using software on the base station baseband.

FIGURE 1: INTEGRATION OF WIMAX AND WIFI PHY LAYER AT BASEBAND LEVEL



INTEROPERABILITY OPPORTUNITIES & CHALLENGES

The WiFi and WiMAX have fundamental differences in their MAC layer. WiMAX is a frame based centrally coordinated MAC protocol. WiFi allows distributed control and a contention free centrally controlled access to the channel. Both have a similar OFDM based transmission scheme and channelization which facilitates their internetworking.

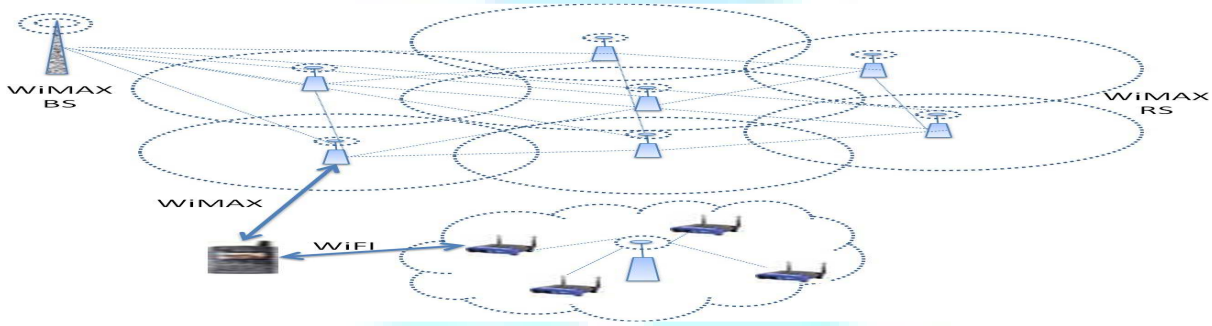
The integration of both implies internetworking between similar and different types of devices in a common protocol. The network is coordinated by central coordinator which combines WiMAX BS with the point coordination function of WiFi. This integration is capable of operating in the both mode. It's also known as Base station Hybrid Coordinator where internetworking is based on an integration of WiFi transmission sequences into the MAC frame structure of WiMAX. The common framework was introduced that allows the operation of WiFi and WiMAX with optimal bandwidth sharing. Game theory and genetic algorithm have been used to analyze and obtain the optimal pricing for bandwidth sharing between a WiMAX BS and WiFi APs.

The integration and convergence can be done in OSI model. The easiest way is to go for upper layer where all the implementation will be based on software. [3]

INTEGRATED SERVICES

WiFi specifying standards for WiFi WLAN and WiMAX specify the standard for WiMAX MMR networks. The next generation network architecture consists of optical networks, WiMAX relay networks and WiFi mesh networks as per shown in figure.

FIGURE 2: WIFI – WIMAX NETWORK



The wavelength division multiplexing optical ring forms the core of MAN. WiMAX BS and RS form WiMAX MMR network that passes traffics to core network. WiFi mesh network provides direct high data rate connection to end user. Different transmission points serves as bridge between networks for traffic distribution. The WDM ring have optical switch node which are portal nodes in WiMAX MMR networks and responsible for traffic transformation. Same as WiMAX BS and RS serve as portal node in WiFi mesh networks.

This integration enabling the sharing of silicon blocks at the baseband level to reduce die size and cost. It shares the antennas so saves component cost and device real estate. It provides common platform level approach for interfacing the operating system's power management utilities optimizes power consumption and maximizes battery life. At the user interface level, a common connection manager coordinates and displays available WiMAX and WiFi networks, and compatibility-tested software drivers work harmoniously together. It provides common user experience for access network and also optimizes the traffic.

WIFI – WIMAX INTEGRATED SYSTEM

The main aim of this integration is to defining an efficient user-driven mechanism which does not require any change on network and protocol architecture that can be easily applied in current integrated WiFi/WiMAX systems. The WiMAX addresses Non-Line-Of-Sight operations and it has about 400 meters of radius when used at 3.5 GHz with a maximum 20Mbps data rate when using a 7MHz bandwidth. Whereas WiFi, well developed and commercialized at this day, operates in the 2.4GHz unlicensed band and offers coverage of about 70-80 meters with a maximum data rate of 54Mbps.

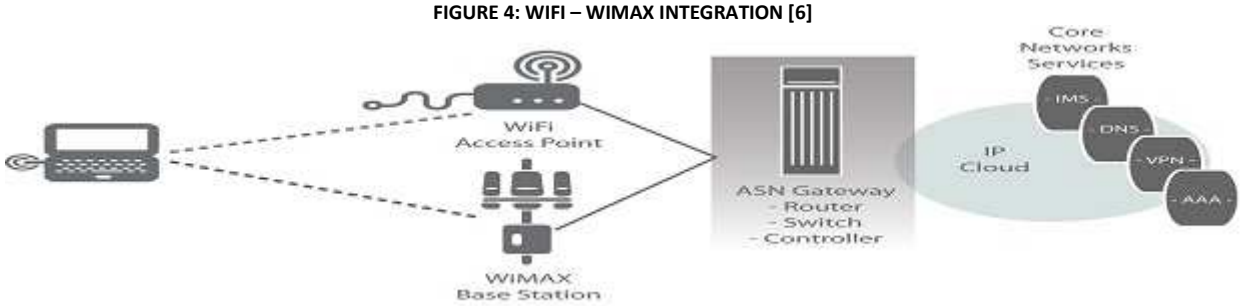
FIGURE 3: WI-FI -WIMAX COMPARISON

Technology	Wi-Fi 802.11 n	WiMAX
Application	Wireless LAN,Internet	Metro Area Broadband Internet Connectivity
Frequency Range	2.4 GHz	2.11 GHz
Typical Range	100m	50 km.
Data Rate	108-600 mbps	75 mbps
Modulation	DSSS	QAM
Network	IP & P2P	IP
IT Network Connectivity	Yes	Yes
Network Topology	Infrastructure(Ad-hoc also)	Infrastructure
Access Protocol	CSMA/CA	Request/Gant
Key Attribute	Wider Bandwith Flexibility	Throughput,Coverage

The WiFi and WiMAX networks are deployed considering their complementarities in terms of data rate performance and coverage: we assume that the WiMAX network guarantees users mobility in a large area and is accessible everywhere, while the WiFi APs are selectively deployed in locations with a concentration of mobile users and heavy network traffic (Hot Spot). User equipment that embeds two MAC interfaces with different IP addresses assigned respectively by the AP

and the WiMAX Base Station (BS). These two MAC interfaces work independently and periodically monitor several metrics as link quality, channel occupancy, error rate. This information is then forwarded to a "mobility management" process implemented at the top of the MAC layer: this entity controls continuously the behavior of each stack and triggers when required. Link quality parameters are reported by the MAC layer to the mobility management process for analyzing connection performance. The measurement of these parameters is required to satisfy the properties continuously monitoring the access network condition, currently unused interface traffic, no need for special AP and BS cooperation and use measured parameters indicators in terms of performance.

FIGURE 4: WIFI – WIMAX INTEGRATION [6]



The integration of WiFi & WiMAX requires two key elements as per figure 4, Multi-mode subscriber devices that can communicate on both WiMAX and WiFi networks and ability to provide service across WiMAX and WiFi networks when users move between them. This is generally implemented through a controlling Access Service Network Gateway (ASN GW) and common Authentication, Authorization, and Accounting (AAA) service functionality located in the service provider network. [6]

In WiFi and WiMAX the method of estimating bandwidth occupation is not same since they rely on different medium access mechanisms. WiFi Uses CSMA/CD for continuously listen the channel before competing for the access. The MAC process records the channel busy time, then periodically calculates the channel occupancy percentage. Whereas WiMAX uses access to the channel is synchronized and network resource usage is controlled by the BS. [5]

CONCLUSION

WiMAX will be useful for providing intermediate-distance backhaul for Wi-Fi access points, sometimes a preferable arrangement to Wi-Fi mesh technology. The inter-working capabilities between WiMAX and WiFi enable service providers to deliver consistent, transparent, and user-friendly broadband services to their subscribers. WiMAX extends the benefits of WiFi networks to deliver the next-generation mobile Internet. Integrating of WiMAX and WiFi provides affordable broadband connectivity that brings new deployment models for service providers, as well as new usage models for subscribers. The ability to be connected to the Internet and to have access to real-time information in more places is of high value to Business professionals and consumers. It provides portable services.

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With sincere regards

Thanking you profoundly

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