
بسم الله الرحمن الرحيم

WIMAX

OBJECTIVES

- *Understand the basic of Wi-MAX standards*
- *Know the features, applications and advantages of Wi-MAX*

INTRODUCTION

WIMAX

- *the Worldwide Interoperability for Microwave Access, is a telecommunications technology aimed at providing wireless data over long distances*

- *Laying wires is especially difficult in hilly areas like Susquehanna.*

- *WiMax is a radio technology that promises to deliver two-way Internet access at speeds of up to 75 Mbps at long range.*

- *WiMax can transmit data up to 30 miles between broadcast towers and can cover areas more than a mile in radius with bandwidth that exceeds current DSL and cable broadband capabilities*

- *ISP see WiMax as a means of connecting rural or remote areas with broadband service, something that would be technically, physically or economically difficult to do by burying wire for DSL or cable connections.*
- *Laying wires is especially difficult in hilly areas like Susquehanna.*

MODULATION

- *Modulation is a way to modify our information so that it becomes suitable for transmission*
- *It is impossible for us to send information as it is due to medium problems*
- *We have Digital Modulation and Analog Modulation*

MODULATION

- *The radio technology is based on OFDM.*
- *802.16 standards incorporate use of adaptive antenna arrays, which can be used to create dynamic beams in desired directions.*
- *Standards offer option for a mesh mode network topology.*

CHOICE OF MODULATION SCHEME

- *We choose a modulation scheme by reviewing it's spectral efficiency and SNR performance*
- *Spectral Efficiency=Data Rate /bandwidth*
- *Power Efficiency=Bit Error rate/SNR*

MODULATION IN WIMAX

- *WiMAX uses OFDM technique which is resistive to co-channel interference.*
- *OFDM allows all channel to be allocated to a user thus providing high data rate.*
- *In WiMAX we use 64QAM,QPSK,BPSK modulation*

ADAPTIVE MODULATION IN WIMAX

- *An ideal modulation scheme is which gives high spectral efficiency (high data rate for a given bandwidth) and also has power efficiency i.e. it has low bit error rate for a low value of SNR.*
- *But practically the modulation schemes with high spectral efficiency have low power efficiency and vice versa, so we make a tradeoff between these two things.*

ADAPTIVE

- *As the word adaptive shows that adaptive modulation means changing of modulation schemes with our requirements or conditions.*
- *We monitor the condition of each channel and if channel shows low SNR then we use a low order modulation scheme and for good SNR conditions we use high order modulation scheme.*

COMPARISON

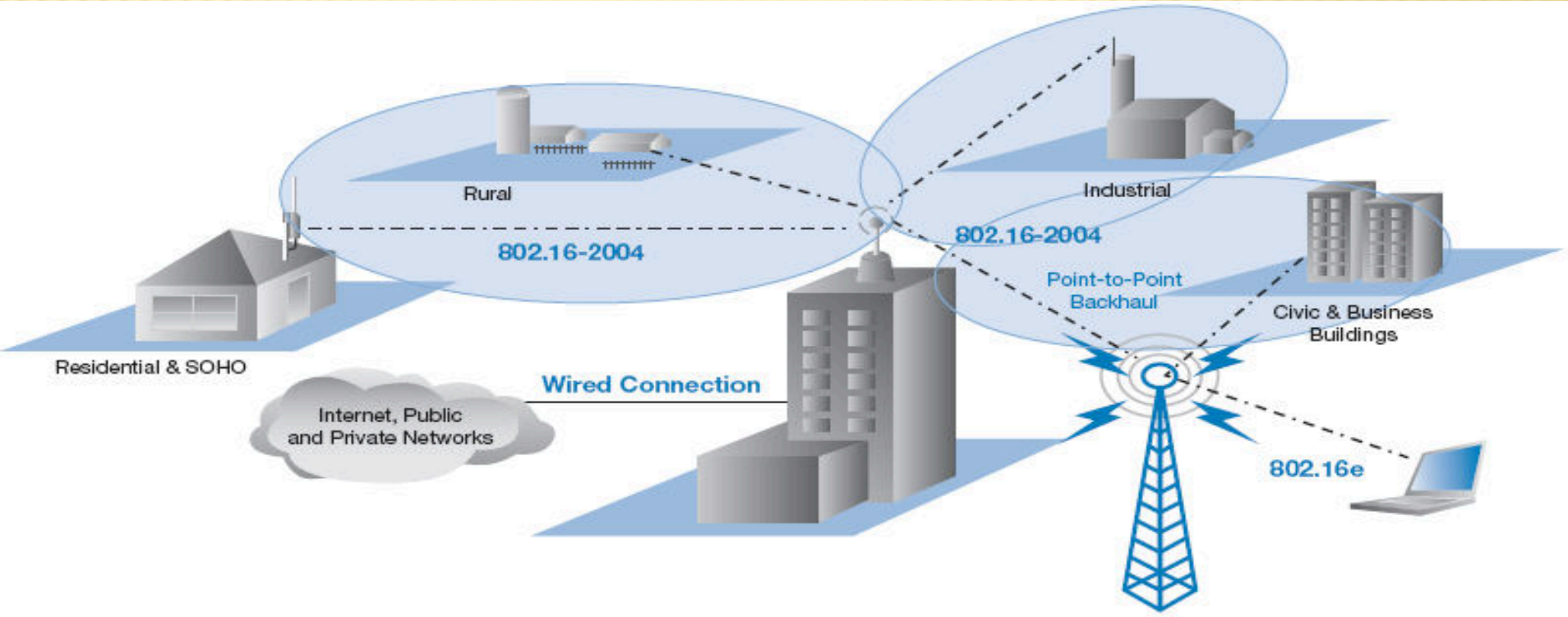
- 64QAM, 128 QAM
- *Good spectral efficiency*
- *Low power efficiency*
- *As distance increases bit error rate increases.*

- QPSK, BPSK
- *Low spectral efficiency*
- *Good power efficiency*
- *For larger distance the bit error rate decreases*

SCENARIO

- *A subscriber which is away from station and due to noise SNR value is low , now if we use high order modulation then the bit error rate will increase thus requiring large retransmissions so instead of it we use low order modulation scheme such as BPSK,QPSK these have low data rates but high spectral efficiency*

WIMAX SCENARIO



MESH NETWORKING IN WIMAX

- *When a subscriber unit is not in line of sight with the base station (does not have a good signal strength), then it may be able to make a peer-to-peer connection to a neighbor, i.e., hop to a neighbor's subscriber unit.*

- *The neighbor's unit may be in line of sight with the base station, in which case this neighbor would serve as a relay station (a repeater).*
- *If the neighbor's unit is not in line-of-sight then another hop can be made.*

IEEE 802.16-2004 STANDARD

- *Basically it is a Metropolitan Area Network (MAN) technology based on the IEEE 802.16 standards.*
- *Developed on the same concept as a WIFI, but WIFI is a LAN standard and Wimax is a MAN standard.*

	802.16	802.16a/Rev d	802.16e
Completed	December 2001	802.16a: Jan 2003 802.16Revd: June 2004	Est. Mid-2005
Spectrum	10 - 66 GHz	2 - 11 GHz	2 – 6 GHz
Application	Backhaul	Wireless DSL & Backhaul	Mobile Internet
Channel Conditions	Line of Sight Only	Non Line of Sight	Non Line of Sight
Bit Rate	32 – 134 Mbps at 28MHz channelization	Up to 75 Mbps at 20MHz channelization	Up to 15 Mbps at 5MHz channelization
Modulation	QPSK, 16QAM and 64QAM	OFDM 256 sub-carriers QPSK, 16QAM, 64QAM	Scalable OFDMA
Mobility	Fixed	Fixed	Pedestrian Mobility – Regional Roaming
Channel Bandwidths	20, 25 and 28 MHz	Selectable channel bandwidths between 1.5 and 20 MHz	Same as 802.16a with UL sub-channels to conserve power
Typical Cell Radius	1-3 miles	4 to 6 miles; Max range 30 miles based on tower height, antenna gain and power transmit	1-3 miles

- *Range 30 miles Radius from the Base Station for LOS*
- *Range 4 – 6 miles Radius from the Base Station for NLOS*
- *Maximum data speed supported is 70 Mbps*

- *Line of Sight is not needed between user and the base station unless very high data rates are required at the user premises.*
- *Licensed Frequency band: 2 – 11 GHz*
- *Unlicensed Frequency band: 10 to 66 GHz*

FEATURES

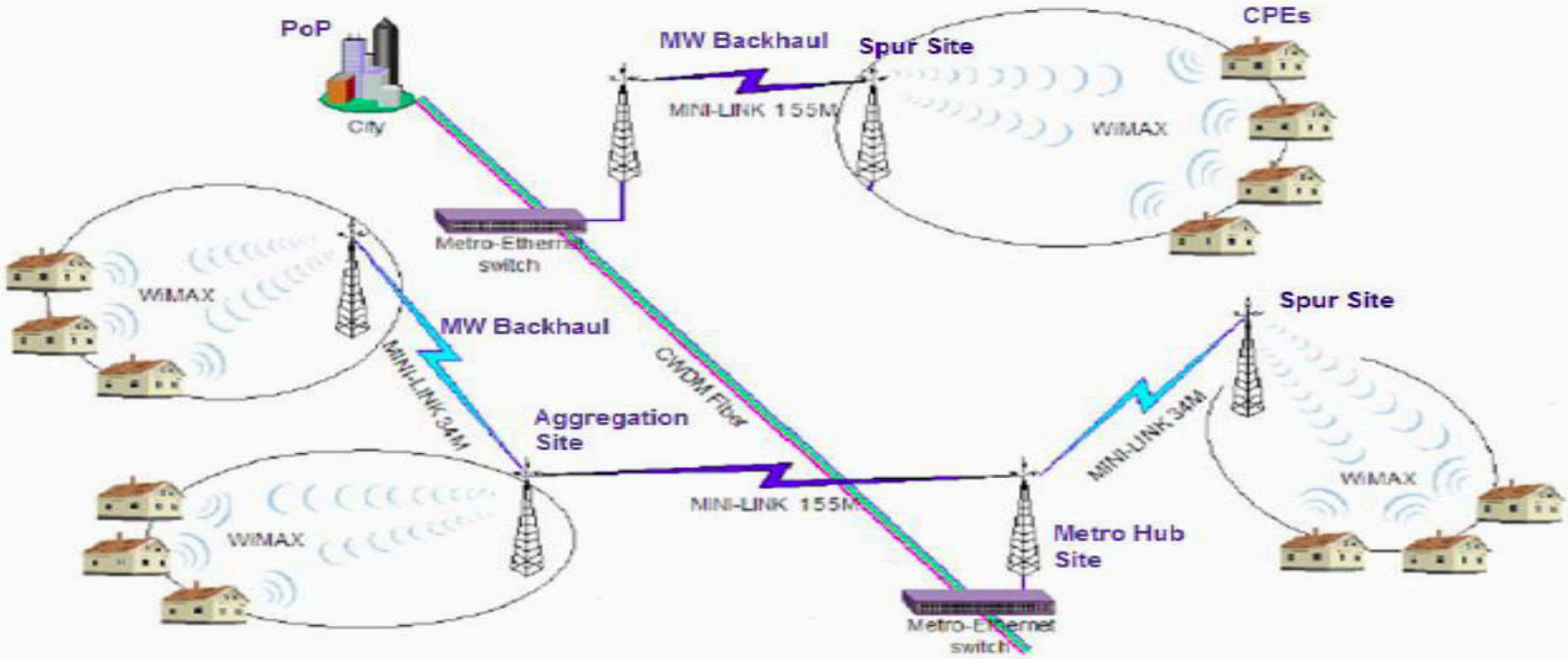
- *Wi MAX provides fixed , nomadic, portable and, soon, mobile wireless broadband connectivity without the need for direct line-of-sight with a base station. In a typical cell radius deployment of three to ten kilometers.*

APPLICATIONS

- *Wimax as a backhaul for telecom networks.*
- *Video streaming on the go, facilitating video conferencing.*
- *Wimax as a data service (Instead of GPRS,) and also facilitating internet calls in converged services of future.*

- *In rural areas, the real competition to WiMax would be satellite data services.*
- *The benefit that WiMax offers over satellite is that satellite offers limited uplink bandwidth (upload data rates are not as high as download data rates).*
- *Further, satellite suffers with high latency.*

WIMAX MICROWAVE BACKHAUL



NETWORK REFERENCE ARCHITECTURE

- *AAA: AAAServer, part of the CSN*
- *NAP: a Network Access Provider*
- *NSP: a Network Service Provider*
- *plus a number of interconnections (or reference points) between these, labeled R1 to R5 and R8.*
- *It's important to note that the functional architecture can be designed into various hardware configurations rather than fixed configurations. For example, the architecture is flexible enough to allow remote/mobile stations of varying scale and functionality and Base Stations of varying size*

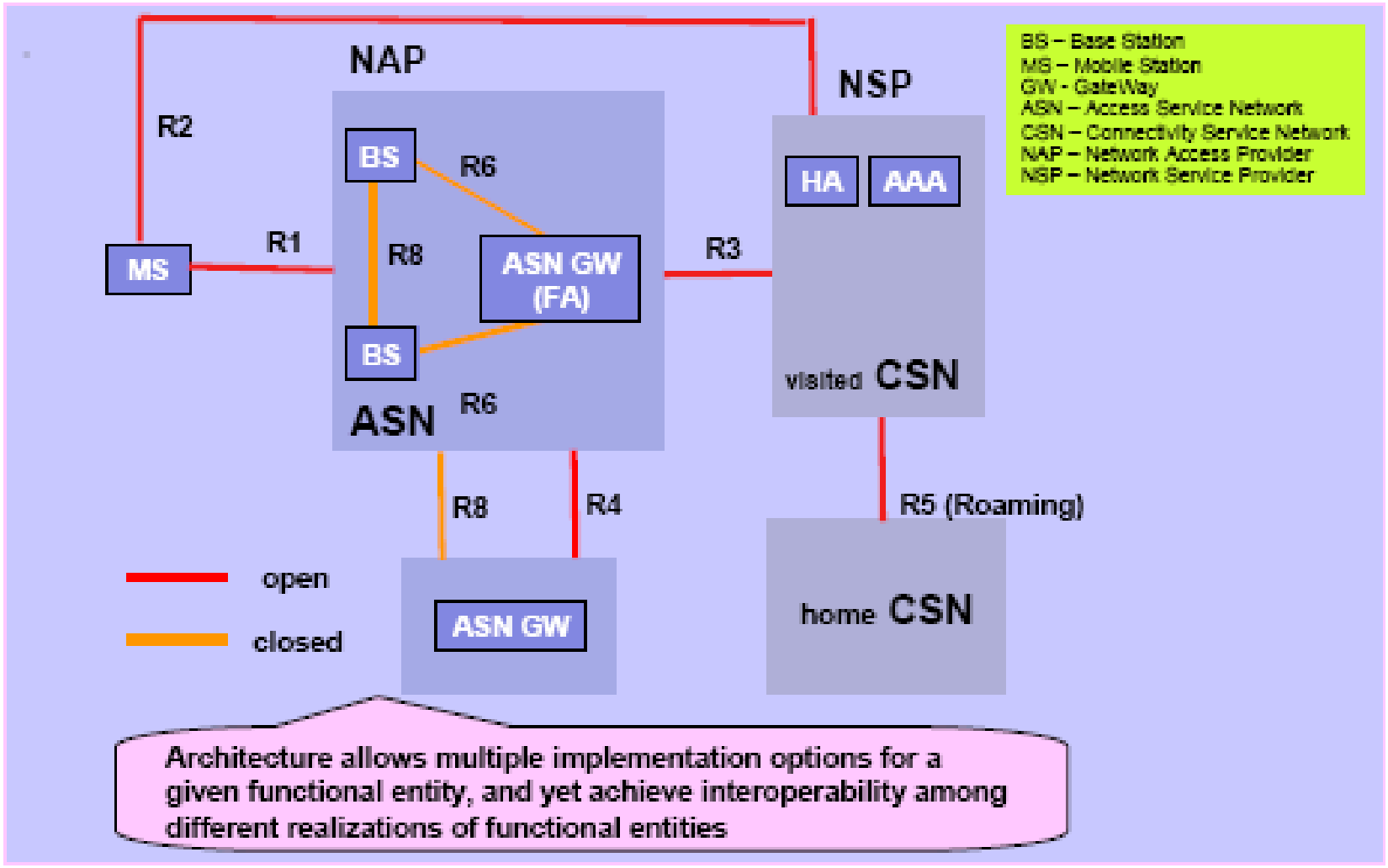
The WiMAX Forum has defined an architecture that defines how a WiMAX network connects with other networks, and a variety of other aspects of operating such a network, including address allocation, authentication, etc. An overview of the architecture is given in the illustration. This defines the following components:

- *SS/MS: the Subscriber Station/Mobile Station*
- *ASN: Access Service Network*

BS: Base station, part of the ASN

- *ASN-GW: the ASN Gateway, part of the ASN*
- *CSN: the Connectivity Service Network*
- *HA: Home Agent, part of the CSN*

Network Reference Architecture



SIMULATION OF WIMAX PLANNING TOOL

- *Rudimentary Work done till now, includes:-*

1).VS. net can be a proposed platform for simulation.

2). My research says, mapping and drawing can be done using Arc Engine.

3). Simple library for path loss calculations (Free Space, Hata) only formulas.

4). Simple library for coordination system calculations.

TOOLS REQUIREMENTS????

- Must have the ability to accept all types of data
  - terrain files
  - road files
  - land use files
  - census files

- *building files*
- *Google earth files*
- *satellite photography*
- *aerial photography*
- *RF propagation prediction*
- *Ray Tracing*

- *This tool must also be able to interpret all of the different modulation schemes in use today and be able to quickly add any new modulation schemes that come up in the future. The technologies to be served are:*
  - *802.11a,b,g,n.x*
  - *802.16-2004*
  - *802.16e*
  - *802.20*

- *Modulation techniques that will need to be accommodated are:*
  - *BPSK*
  - *QPSK*
  - *16 QAM*
  - *64 QAM*
  - *OFDM*
  - *OFDMA*

- *The tool should perform the following functions:*
  - *RF propagation prediction*
  - *Ray Tracing*
  - *Line of site analysis*
  - *Fresnel zone analysis*
  - *Interference analysis and identification*
  - *Throughput estimation (data feature) based on C/I. Eb/No and modulation technique*

- *Automatic Frequency planning.*
- *Automatic Cell planning.*
- *Traffic utilization prediction under various loads*
- *Call routing mapping and analysis (IP)*
- *Mesh Network routing simulation*
- *Network Statistics display*

IMPLEMENTATION OF WIMAX PHYSICAL LAYER.

- *The WiMAX physical layer is based on OFDM.*
- *OFDM is an elegant and efficient scheme for high data rate transmission in a non-line-of-sight or multipath radio environment.*
- *OFDM is based on the idea of dividing a given high-bit-rate data stream into several parallel lower bit-rate streams and modulating each stream on separate carriers—often called subcarriers, or tones.*

- *It can be shown that the OFDM signal is equivalent to the inverse discrete Fourier transform (IDFT) of the data sequence block taken L (Number of subcarriers) at a time. This makes it extremely easy to implement OFDM transmitters and receivers in discrete time using IFFT (inverse fast Fourier) and FFT respectively.*

IMPLEMENTATION CHALLENGES

Processing speed: Broadband wireless systems such as WiMAX have throughput and data rate requirements that are significantly higher than those in cellular systems such as WCDMA and cdma2000.

In order to be able to support such high data rates, the underlying hardware platform must have significant processing capabilities. In addition, several advanced signal processing techniques such as Turbo

coding/decoding, and front end functions such as FFT/IFFT, beamforming, MIMO, CFR and DPD are very computationally intensive and require several billion multiply and accumulate (MAC) operations per second.

Flexibility:

WiMAX is a relatively new market and is currently going through the initial development and deployment process. 802.16Rev d has just been standardized while the 802.16e mobile version is still in the works.

Under this current scenario,
having hardware flexibility/reprogrammability
in the end WiMAX
compliant product is very important.
This ensures that in-field
programmability is possible,
alleviating the risks posed by
constantly evolving standards.

Time to Market:

Because WiMAX is an emerging technology, time to market is a key differentiator for OEMs looking for early success in gaining market share. This has a direct effect on the development cycle and choice of hardware platform,

with designers requiring

easy-to-use development tools,

software, boards, and off-the-shelf

IP and reference designs in order to

accelerate the system design

Cost Reduction Path:

Another important requirement to keep in mind while choosing the hardware platform is the availability of a long term cost reduction path. The evolving WiMAX standard/market is expected to stabilize after the initial uncertainty surrounding it,

leading to a situation where cost of the final product becomes much more important than retaining flexibility. A hardware platform that has such a clear cost reduction path And enables a seamless flexibility, cost tradeoff is the need of the hour.

FPGA based WiMAX System Design

This section describes how each of the Implementation challenges associated with WiMAX system design,can be effectively addressed with FPGAs.

- Q??????????

- *ALLAH HAFIZ*
- *THANKS*