

# Gemini Communication Ltd.

*Innovation & Leadership*

**RF APPLICATIONS**

Ref. 1020008100

# RF Technology APPLICATIONS



# RF Applications



In Telecommunications

- Microwave Links
- Satellite Communications
- Cellular Mobile Communications – GSM and CDMA
- Fixed Wireless Telephony – WiLL
- Wireless WAN – WiMAX
- Wireless LAN – WiFi
- Wireless PAN – Bluetooth



# IEEE 802

- A family of IEEE standards about LAN and MAN
- Restricted to networks carrying variable size packets
- The protocols specified here map to the lower two layers (Data Link and Physical) of OSI layers
- Splits the Data Link Layer into two sub-layers
  - Logical Link Control (LLC)
  - Media Access Control (MAC)



# Drive for MMDS

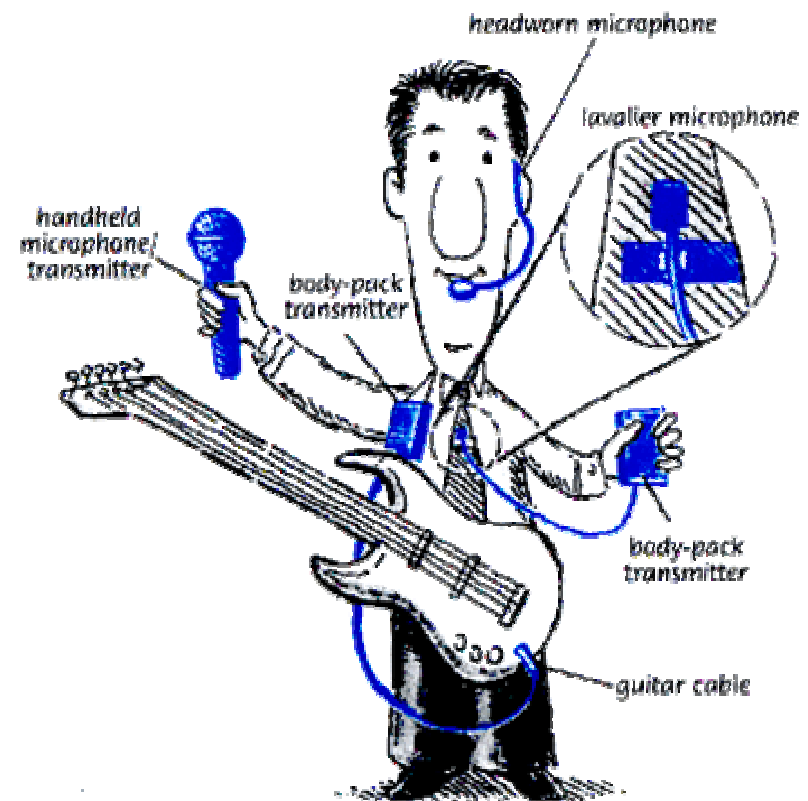
- The last mile is a very critical part of any telecom service provisioning
- There are two ways the last mile can be implemented
  - Traditional Wireline access through Fiber or Copper
  - Wireless Access through Radio Frequency
- IP services can be delivered on RF last mile in the vicinity of 20-25 km from the IP node
- Uses licensed and protected frequency band
- Most of the ISP's using for 3.3 – 3.4 GHz and 5.4 – 5.7 GHz frequency bands
- These two bands were not used for any MMDS activities in past



# RF vs. Wireline

## Advantages of RF over Wireline

- RF is preferable where wire-line connectivity is not feasible because of local constraints like geography
- Ease and speed of deployment
- Fast realization of revenue



# RF vs. Wireline

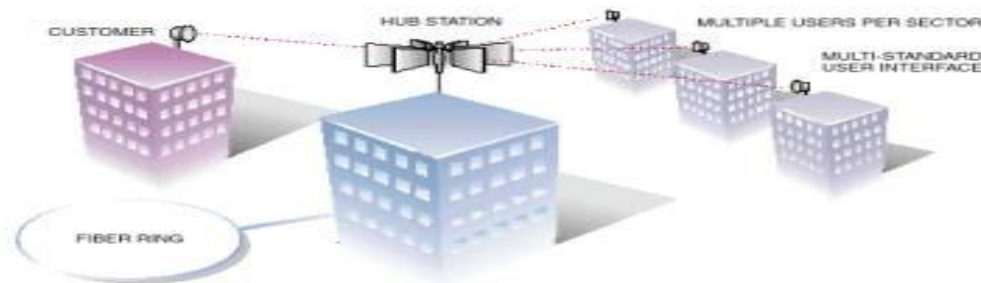
## Disadvantages of RF over Wireline

- Spectrum availability and other regulatory constraints
- Operating cost very high because of higher annual spectrum fee
- Line of sight clearance is must in most of the cases
- Availability is relatively poor because of various external environmental factors



# Local Multipoint Distribution System (LMDS)

- LMDS employs transmitters in 4-5 km radius cells to cover their serving area
- They gather video, telephony, and data signals for distribution
- They broadcast the signal to subscribers
- Subscribers need small antennas to pick up the signal
- A set top box is required to convert video signals suitable for TV
- The subscriber antenna must be within line of sight of the transmitting antenna
- LMDS can be used to provide high-speed data links to businesses including E1 and E3



# LMDS

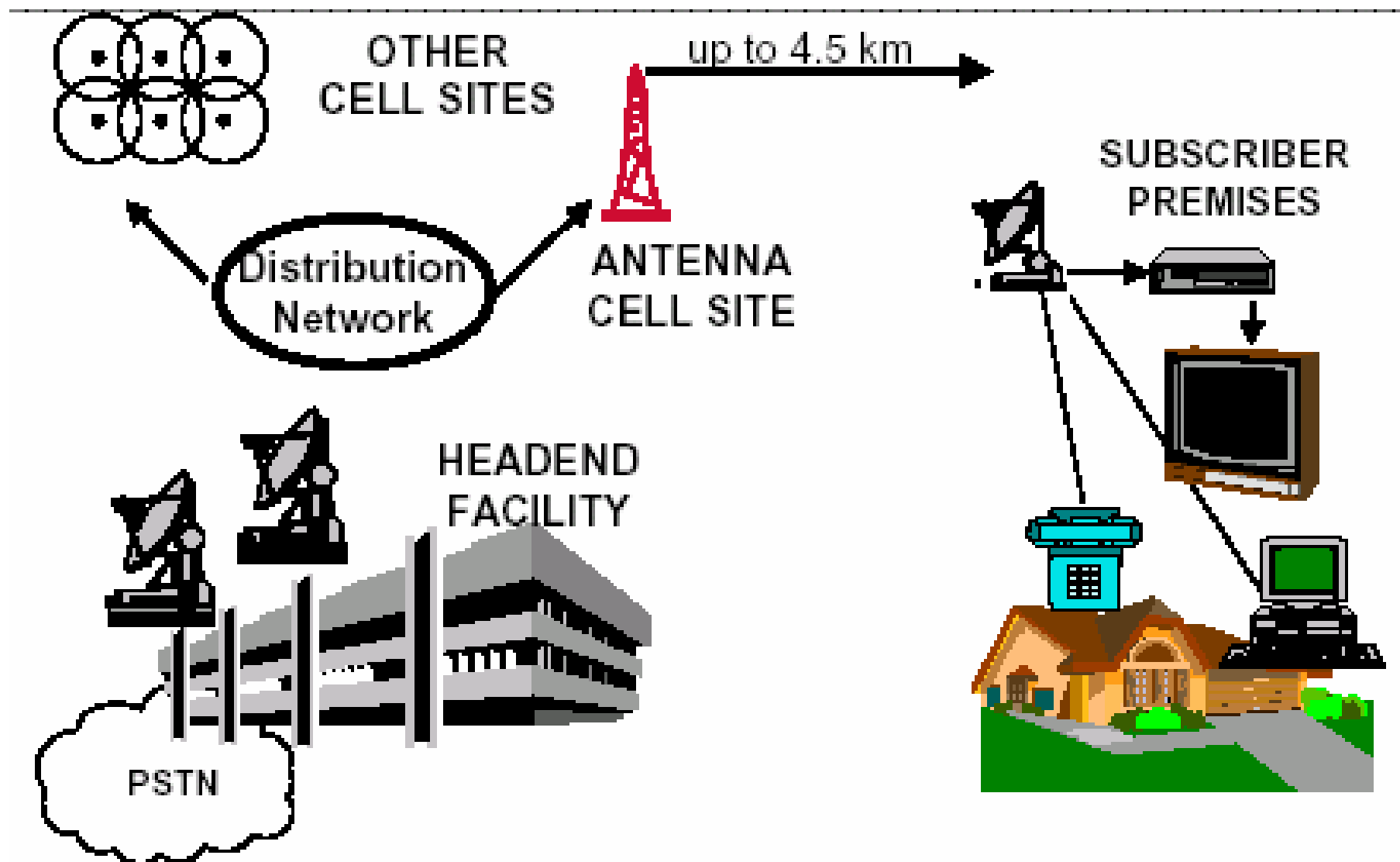


Figure 1. Local Multipoint Distribution Service (LMDS) system

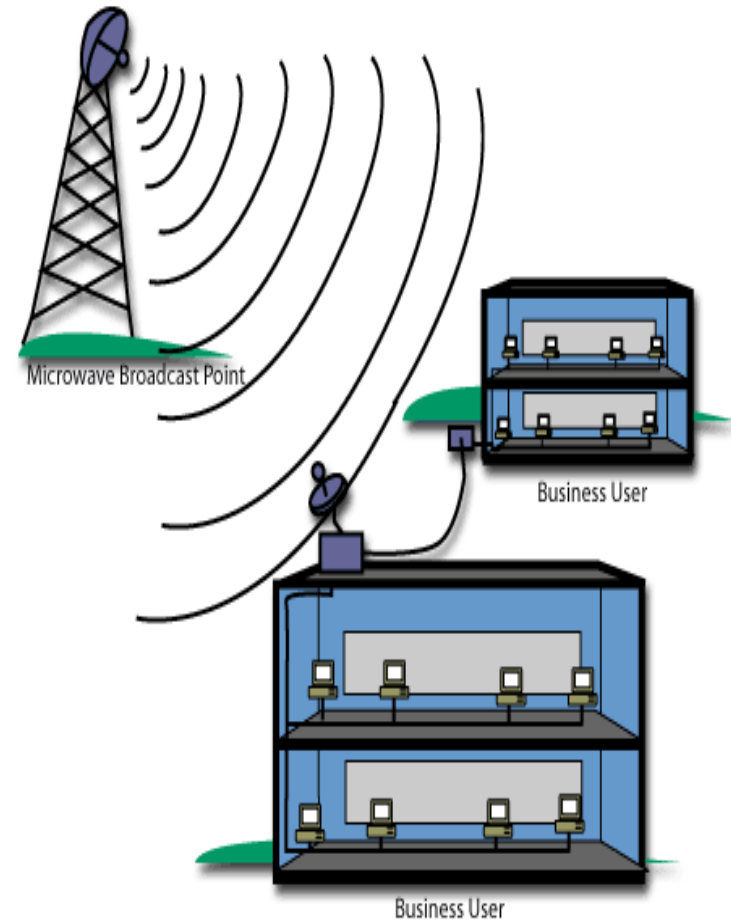
# LMDS

## LMDS Advantages

- Ease and speed of deployment
- Fast realization of revenue
- Easy network management
- Large bandwidth
- Small cell size

## LMDS Disadvantages

- Requires Line of Sight
- Affected by rain, foliage and reflections
- Many cell sites are required
- Multiple cell sites cause interference
- Security concerns



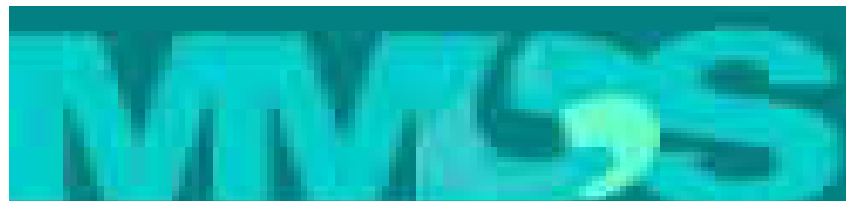
# Multi-channel Multipoint Distribution Service (MMDS)

- Covers an approximate 25 km radius with a single antenna
- One hub can cover the majority of a city
- Does not require line of sight
- Relatively low initial deployment costs
- Relatively less affected by weather and foliage



## MMDS Disadvantages

- Limited two way capabilities (upstream bandwidth is limited)
- Shadowing and interference prevents coverage
- Normal radio security concerns



# MMDS

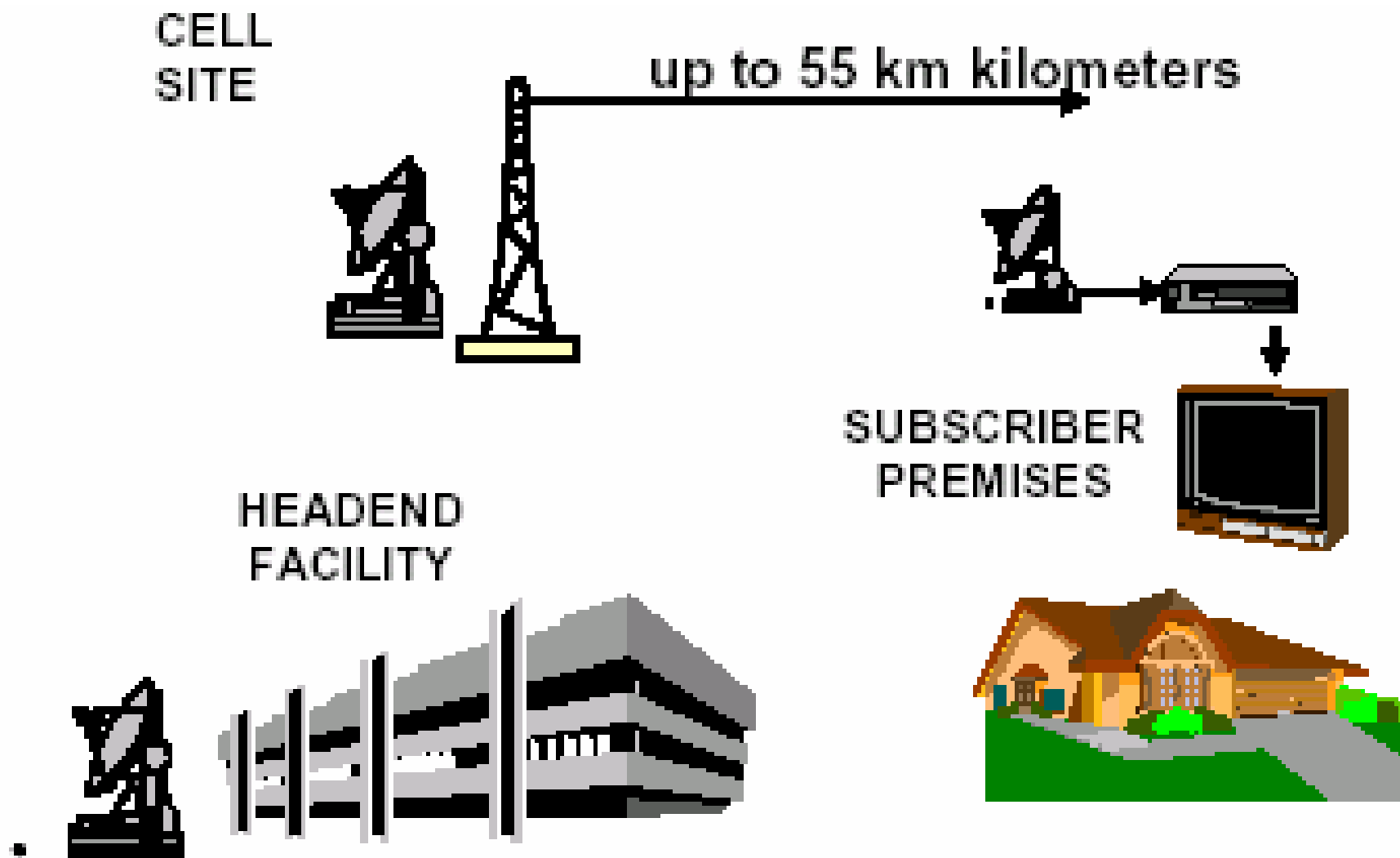


Figure 2. MMDS Architecture

# MMDS vs. LMDS

L  
M  
D  
S

Supports larger coverage area hence few cell sites required to cover a city

Also works in Near Line of Sight (NLoS) conditions

Supports relatively lower bandwidths but does not get affected by the rain or foliage conditions

Multi-channel Multipoint Distribution Service

Local Multipoint Distribution Service

Operates in smaller radius and hence more number of cell sites required for a city coverage

Requires Line of Sight conditions to serve

Supports high bandwidths but gets affected by rain, foliage and reflections

M  
M  
D  
S

# Frequency of Operation

Frequency based last mile is operating in a frequency that is

Exclusive to 25 Km range from Base Station)

Licensed and Protected frequency band

Non Interference prone

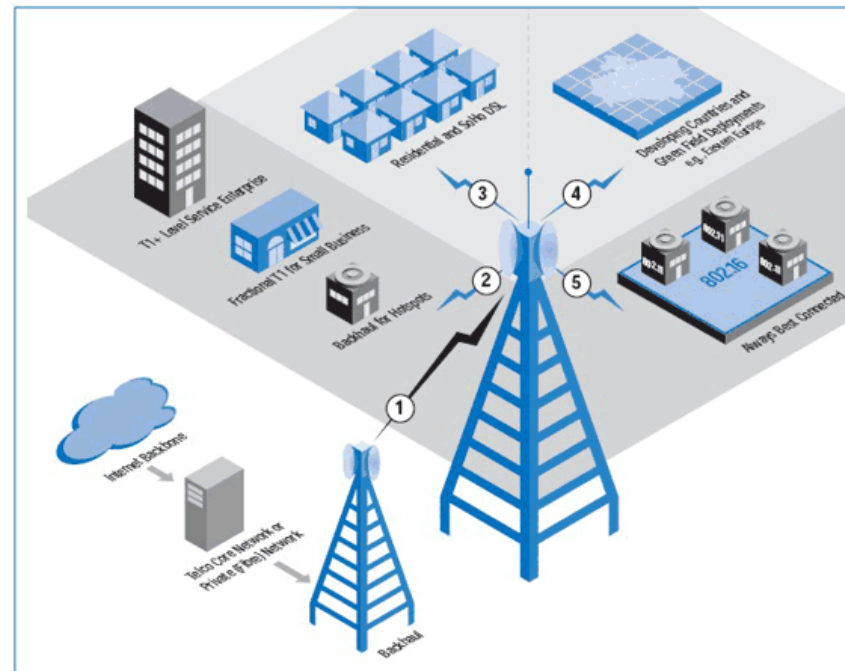
Same frequency of operation across all the operating cities

It is in non congested 3.3 – 3.4 GHz band



# WiMAX

- **Worldwide Interoperability for Microwave Access**
- A certification for products that pass conformity and interoperability tests for the IEEE 802.16 standards
- **IEEE 802.16** is working group number 16 of IEEE 802
- Specializing in point to multipoint broadband wireless access



# WiMAX Specifications

- Because IEEE 802.16 networks use the same LLC layer as other LANs and WANs, it can be both bridged and routed to them
- IEEE 802.16 defines a MAC layer that supports multiple physical layer specifications
- The 802.16 MAC is a scheduling MAC where the station only has to compete once in the beginning
- After that it is allocated a time slot by the base station
- The time slot can enlarge and constrict, but it remains assigned to the station
- The scheduling algorithm allows the base station to control QoS



WiMax

# WiMAX Specifications

- In full mesh networking capability, WiMAX nodes simultaneously operate in station and base station modes
- IEEE 802.16 specifies WiMAX in the 10 to 66 GHz range
- 802.16 a added support for the 2 to 11 GHz range
- The WiMAX specifications have increased bandwidth and stronger encryption
- NLoS connectivity between network endpoints in also planned
- WiMAX makes clever use of multi-path signals



# WiMAX Standards

- The current standard is **IEEE Std 802.16-2004**
- IEEE Std 802.16-2004 addresses only fixed systems
- An amendment 802.16 e will add mobility components
- IEEE 802.16-2005, the WiMAX mobility standard, is an improvement on the modulation schemes
- It allows NLoS applications primarily by enhancing the OFDMA
- Scalable OFDMA in 802.16-2005 will make 802.16-2004 which uses OFDM-256 obsolete



# WiMAX Standards

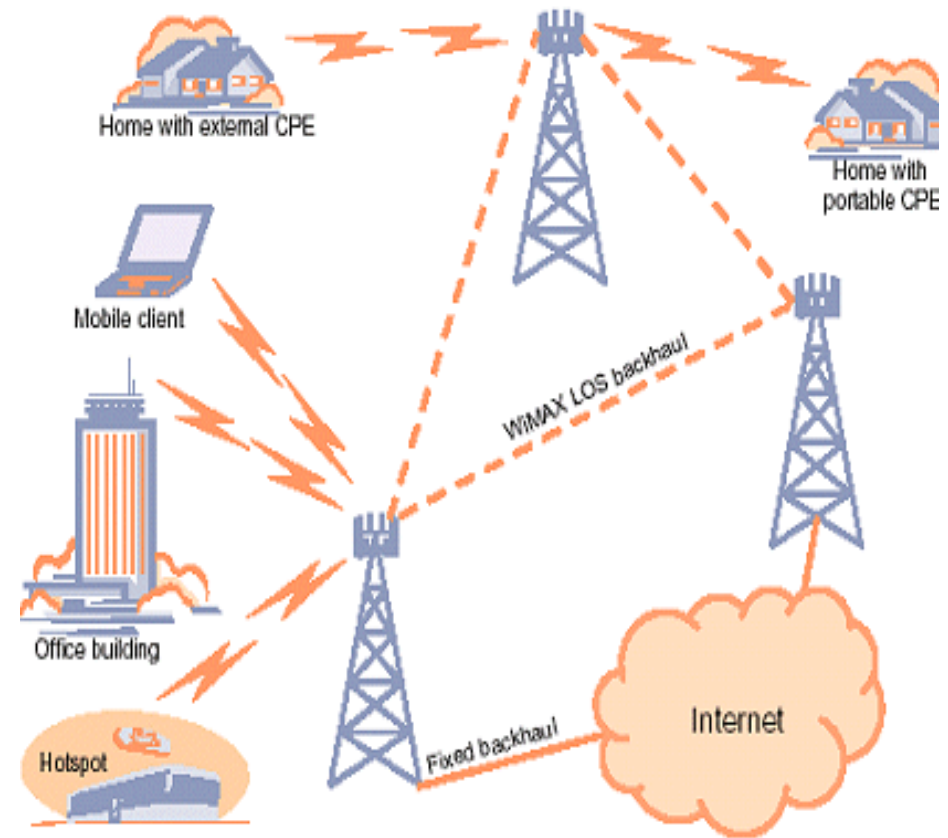
SOFDMA will improve OFDM-256 for NLoS applications by

- Improving NLoS coverage by utilizing advanced antenna diversity schemes, and hybrid Automatic Retransmission Request (hARQ)
- Increasing system gain by use of denser sub-channelization, thereby improving indoor penetration
- Introducing high performance coding techniques such as Turbo Coding and Low Density Parity Check, enhancing security and NLoS performance
- Introducing downlink sub-channelization, allowing trade of coverage for capacity or vice versa
- Improving coverage by introducing Adaptive Antenna Systems (AAS) and Multiple Input Multiple Output (MIMO) technology
- Eliminating channel bandwidth dependencies on sub-carrier spacing, allowing for equal performance under any RF channel spacing
- Enhanced Fast Fourier Transform (FFT) algorithm can tolerate larger delay spreads, increasing resistance to multi-path interference



# Uses for WiMAX

- WiMAX is a wireless MAN technology
- Can connect IEEE 802.11 (WiFi) hotspots with each other and to other parts of the network
- Provides a wireless alternative to cable and DSL for last mile broadband access
- IEEE 802.16 provides up to 50 km of linear service area range
- Allows connectivity between users without a direct line of sight
- The technology claims to provide shared data rates up to 70 Mbps



# Uses for WiMAX

- WiMAX will allow inter-penetration for broadband service provision of VoIP, video, and Internet access, simultaneously.
- Many companies are testing the potential of WiMAX for last mile connectivity
- There is potential for interoperability of WiMAX with legacy cellular networks
- Some cellular companies are evaluating WiMAX as a means of increasing bandwidth for a variety of data-intensive applications
- Another application under consideration is gaming
- Sony and Microsoft are closely considering the addition of WiMAX as a feature in their next generation game console
- This will allow gamers to create ad hoc networks with other players



# Similar Technologies

- UMTS (Universal Mobile Telecommunications System) is a direct competitor to WiMAX
- The HSDPA (High Speed Downlink Packet Access) technology enables downlink up to 8-10 Mbps
- WiMAX's equivalent in Europe is HIPERMAN (High Performance Radio Metropolitan Area Network)
- WiMAX Forum is working on methods to make 802.16 and HIPERMAN interoperate
- Korea's telecoms industry has developed its own standard, WiBro (Wireless Broadband)
- Intel and LG Electronics have agreed on interoperability between WiBro and WiMAX



# WiMAX Vendors



***Thank You***  
**Contact : [info@gcl.in](mailto:info@gcl.in)**