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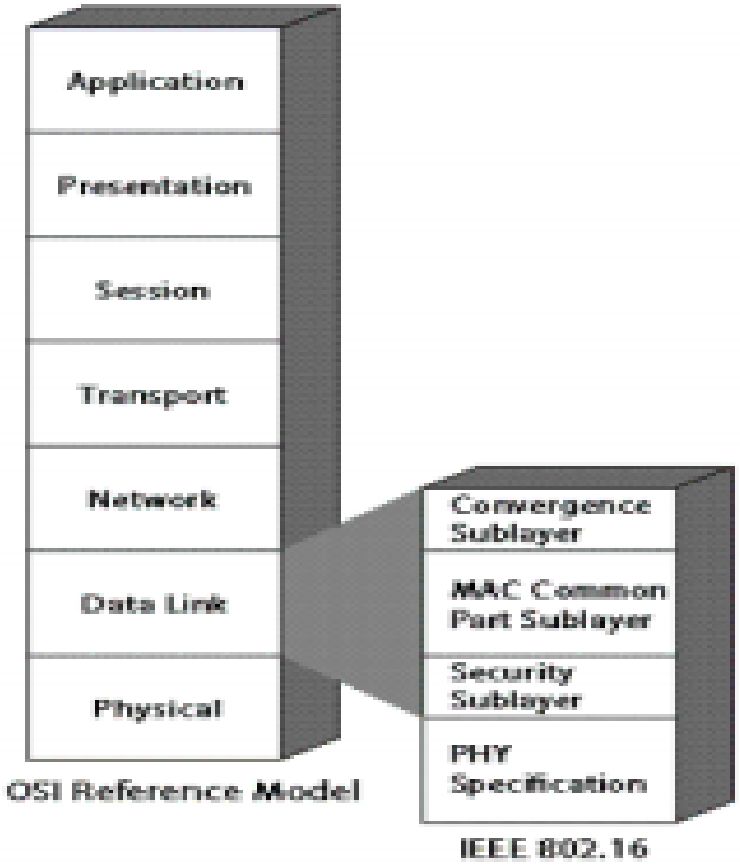
Topic:-

IEEE 802.16

Introduction to IEEE Standard 802.16

The IEEE Standard 802.16 is still very much a new standard when compared to existing standards such as the more mature IEEE Standard 802.11, the standard used for Wi-Fi networking commonly seen in home and business. However, while the 802.11 standard is primarily used for small local area networks, the 802.16 standard is designed to be used as a means of allowing wireless broadband access as an alternative to cable and DSL connections .

Figure 1: OSI Reference Model and IEEE 802.16.



The 802.16 standard is more commonly known referred to as WirelessMAN due to the fact that its goal is to implement a set of broadband wireless access standards for wireless metropolitan area networks. To this end, much of the work on the standard has been focused on the "last mile" that would allow fixed and mobile wireless substations to connect to the fixed wireless base stations, thus allowing the delivery of high-speed internet connections to customers [3].

The 802.16 standard corresponds to the physical and data link layers of the OSI reference model, as shown in figure one. The 802.16 standard follows other standards within the 802 family in that it defines multiple physical layer (PHY) specifications that can be used, but all of them are supported by the same medium access control (MAC) layer. This flexibility is important as it allows for a common MAC implementation to be used by manufacturers, providing support for each of the possible PHY specifications without having to redevelop the MAC.

Frequency Bands

The 802.16 standard defines a number of air interfaces that make use of a frequency band that can be divided into one of three categories: 10-66 GHz licensed bands, licensed bands below 11 GHz, and unlicensed bands below 11 GHz. Table 1 summarizes the air interface designations and their applicable category of frequency bands.

Table 1: Air Interface Designations and Frequency Bands

Designation	**Frequency Bands**
WirlessMAN-SC	10-66 GHz licensed bands
WirlessMAN-SCa	Below 11 GHz licensed bands
WirelessMAN-OFDM	Below 11 GHz licensed bands
WirelessMAN-OFDMA	Below 11 GHz licensed bands
WirelessHUMAN	Below 11 GHz license-exempt bands

The 10-66 GHz Licensed Bands

The first category of frequency bands is the 10-66 GHz licensed bands, these frequency bands have a short wavelength that requires line-of-sight (LOS); however, the multipath interference is negligible. The bands allow for data rates in excess of 120 Mb/s.

Below 11 GHz Licensed Bands

While still a part of the 10-66 GHz licensed bands category, the second category of licensed bands below 11 GHz requires special note due to the characteristics of the frequency bands. Due to the longer bandwidth of the frequency range, LOS is not necessary and the multipath interference may be significant.

Below 11 GHz License-exempt Bands

The final category of frequency bands are the license except frequencies below 11 GHz, typically using the 5-6 GHz bands. The operating environment of these bands is similar to those of the 11 GHz licensed bands; however, the license-exempt status of the bands introduces additional interference from the co existence of other devices within the range, as well as regulatory constraints that limit the radiated power. To overcome these problems mechanisms such as dynamic frequency selection is introduced to the PHY and MAC of the air interface.

Physical Layer Specifications

The 802.16 physical layer, or PHY, corresponds to layer one of the OSI model and provides downlink and uplink transmission capably. The standard defines five different PHY specifications that are designed to be used under different situations. The primary of these is the WirelessMAN-SC specification which is targeted for operation in the 10-66 GHz frequency band and is followed by the WirelessMAN-SCa, WirelessMAN-OFDM, and WirelessMAN-OFDMA specifications which are targeted for use in frequency bands below 11 GHz. Additionally, the Wireless HUMAN PHY defines specific components that are required for operation in non-licensed frequency bands.

Of the defined PHY specifications, Wireless MAN-SC is tailored to the delivery of service to static locations due to its LOS and fixed antenna requirements. This makes it attractive to businesses that are in need of a high-speed connection but do not have access to a conventional connection. In contrast, the Wireless MAN-SCa, Wireless MAN-OFDM, and Wireless MAN-OFDMA are tailored for delivery of service to homes and small businesses. This is possible due to the fact that the specifications are capable of NLOS transmission, larger coverage areas, and delivery of service to mobile substations. This increases the coverage area for service providers and lowers the cost for subscribers.

Security Sublayer

The standard builds on the PHY specification by implementing a security sublayer as part of the overall MAC functionally provided. This security sublayer is the lowest layer of the MAC and can provide strong encryption to outgoing data transmissions. This allows for communications security between the substation and base station, and additionally protects against theft of service by preventing unauthorized substations from connecting to the network.

The core architecture of the security sublayer is the use of two component protocols. These protocols include an encapsulation protocol that provides a means for encrypting data packets and a key management protocol that provides a means for the base station and substation to synchronize keys. Packets that are transmitted after being passed through the encapsulation protocol contain a generic unencrypted MAC header, with the internal data encrypted using the cipher text chaining mode of the US Data Encryption Standard (DES).

MAC Common Part Sublayer

Although the standard provides for more that one physical layer, only one common MAC layer is defined and it is compatible with all defined physical layers. The MAC is composed of the security sublayer that resides directly above the PHY layer, the common part sublayer that implements the majority of the MAC functionality, and the service-specific convergence sublayer that resides about the common part sublayer and provides an interface to higher level networks. Taken as a whole of the security sublayer, the common part sublayer, and the convergence sublayer the 802.16 MAC corresponds to layer two of the OSI networks model.

The MAC common part sublayer defines two different forms of network configurations in addition to defining how both of these network configurations access the network. The two network configurations that are defined are a point-to-multipoint (PMP) configuration and mesh topography. Each of these topographies in turn makes use of a common data/control plane that similar for both except in the area of addressing and connections which are configured specifically for the topography type.

Service-specific Convergence Sublayer

The service-specific convergence sublayer is the top layer of the MAC and provides an interface with higher level ATM and packet based protocols. The convergence sublayer is responsible for receiving a protocol data unit from a higher level protocol, performing classification and processing as necessary, and passing it down to the appropriate MAC service access point for delivery. Likewise, it accepts protocol data units from other peers on the 802.16 network to be passed up to the higher level protocol with applicable changes as necessary. Additionally, it is capable maintaining quality of service parameters from higher level protocols and adapting these as necessary as the data unit is passed along to the 802.16 network.

Conclusion

The development of the IEEE 802.16 Standard shows great promise for the increased delivery of high speed connections to areas that were previously unable to be connected or were connected at high costs. Additionally, the arrival of the standard means that service providers have an additional choice in the means of service delivery. This in turn means that customers will have additional choices in high-speed connections.