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A Survey on IEEE 802.11 Wireless LAN Technologies

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ABSTRACT: The wireless field has grown tremendously the last three decades finding its use in educational institutes, offices, etc. Wireless Local Area Network WLAN is one of the most widely used technologies. Wireless LAN or Wireless Local Area Network refers to the local area network which does not need any wires to communicate with different devices; instead it uses Radio waves and IEEE 802.11 for communication. Wireless LAN comprises of a Base stations which are the basic devices with computing capabilities and Access Point (AP) which is nothing but a wireless LAN transceiver which serves as the focal point of a standalone network or acts as the linking or connection point between a wired and wireless network. It has simplified the networking domain by enabling multiple computing devices to simultaneously communicate without incurring additional cost of wires. It offers a great deal of promise by providing features like cost effectiveness, flexibility, scalability, etc. Through this paper we try to capture the factors which influenced the growth of this technology, the components and the architecture of this network.

KEYWORDS: WLAN; Access Point (AP); Base Station (BS); OSI;

INTRODUCTION

Computer technology has grown tremendously in the field of communication [1] in the past decade. One of the most important factors is Internet. A transition is seen from wired wireless network. A steady increase in the demand for the wireless LAN can be attributed to a simplified approach of letting multiple users can simultaneously share resources without bearing additional wiring. It employs orthogonal frequency-division multiplexing (OFDM) radio or spread spectrum technology, and connects to the wider internet by making use of access points [2]. The users have the flexibility to move in and around the local coverage area and continue being connected to the network.

It offers features like high flexibility and network installation is very easy in comparison to the wired infrastructure [3]. It offers the same features like the wired LAN which includes high capacity, full connectivity among the stations attached and broadcasting capability.

The most common standard used in the modern WLAN is IEEE 802.11

The table below gives the evolution of the IEEE protocols in terms of transfer Rate and range of the network.



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IEEE Protocol Family

Protocol	Date of Release	Frequency	Rate	Rate (Maximum)	Range
Legacy	1997	2.4 GHz	1 Mbps	2 Mbps	-
802.11a	1999	5 GHz	25 Mbps	54 Mbps	~30 m
802.11b	1999	2.4 GHz	6.5 Mbps	11 Mbps	~30 m
802.11g	2003	2.4 GHz	25 Mbps	54 Mbps	~30 m
802.11n	2008	2.4-5 GHz	200 Mbps	540 Mbps	~50 m

LITERATURE SURVEY

The Author in [1] talks about the wireless LAN technologies and the issues concerned with it. The paper gives a brief description of the wireless LAN network and even talks about the history of WLAN. It discusses the various threats faced by the wireless technologies and gives suggestions for the same.

The Author in [2] discusses the Architecture of Wireless local area networks. The 2 different modes of operations in the WLAN which are ad hoc and infrastructure mode are discussed in detail in this paper. The author describes how the wireless networks over a period of time are replacing the wired networks.

The Authors in [3], [4], and [8] are one of the first books to look at Wireless Networks and Mobile Computing from a computer scientist's perspective. It gives a practical approach to cover key topics like cellular networks, queuing, routing, channel assignment, power optimization, and much more

The Author in [5] discusses in detail about the available Wireless local area networks. It talks about the various advantages offered by the network. The paper even discusses the security threats faced by the networks and discusses a couple of proposed solutions to counter the security threats

BRIEF HISTORY OF WLAN

IEEE 802.11 wireless LAN working group was created in the year 1987 [4] in order to standardize the spread spectrum in WLAN. It is used primarily inside a building as it utilizes low power level and is generally does not require license for the spectrum use. In the past few years WLAN has gained a lot of importance.

WLAN did not find success in early 1990's [5]. The products in those days were very slow, the hardware was very expensive, equipment was too bulky and power hungry. The first significant opportunity for WLAN emerged in late 1990's in the form of broadband internet connection for PC's within the home between various networked devices. By the end of 1990's the early development including proprietary protocols and industry-specific solutions was replaced by different versions of IEEE 802.11.

There are two main standards available for WLAN

- 1) IEEE 802.11
- 2) HIPER LAN



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IEEE 802.11 is a mature standard from an industrial standpoint. IEEE 802.11 access points and cards are produced by various manufactures [6].It operates on 2.4 GHz Ism band and it provides wireless connectivity for mobile station and portable station within a local area.

HIPERLAN (High Performance Radio Local Area Network) is a family of standards developed and provided by European Telecommunication standard institute (ETSI).This technology is appropriate for interconnecting portable devices to each other and also broadband core network like ATM.IP and UMTS. But to the best of our knowledge this technology is still at prototype level.

COMPONENTS OF WLAN

IEEE 802.11 is composed of 4 major components

Base stations or stations: Stations are devices with computing capabilities equipped with wireless network interfaces. The network is built and designed to transfer data between stations. They are generally battery operated laptops or handheld devices, though there is no need for a station to be a portable device. These stations are controlled by access points.

Access points: The most important contribution of an Access point is bridging, i.e. the frame which is used for communication in a wireless network needs to be converted to another type for it to be delivered to the rest of the world. It allows wireless devices to get connected to a wired network

Wireless medium: A wireless medium is used to move the frames from one station to another. The architecture allows a number of physical layers to be developed in order to support 802.11.Initially 1 Infrared physical and 2 Radio frequency (RF) physical layers were standardized but RF proved to be more popular.

Distributed system: An Access points forming a large coverage area need to communicate with one another to track the movements of the mobile stations. A logical component of the 802.11 the distributed system is used to forward these frames to their destination. It is often called the backbone network .It is implemented as a combinations of a distributed system medium and bridging engine. Most of the commercially successful products use Ethernet as their backbone network technology.

WLAN ARCHITECTURE

IEEE 802.11 allows the network to be configured in 2 ways [3]

1. Infrastructure mode
2. Adhoc mode

In Infrastructure mode a central a central Access point is needed which acts as the coordinator to connect wireless station with the distributed stations. In adhoc mode no central coordinator is present the all the stations are distributed across the network

Infrastructure Mode:The access method used in Infrastructure mode is Distributed Coordination Function (DCF) and Point Coordination Function (PCF), while Distributed Coordination Function (DCF) is the access mode used in Adhoc Mode.

Distributed Coordination Function: It uses Carrier sensing CSMA/CA protocol[7] (Carrier Sense Multiple Access with Collision Avoidance).The medium is sensed for a period greater than Distributed InterFrame Space and if it is found to be idle the station is allowed to transmit a packet in the alternate case the station computes a back off time which is randomly generated called the back off time which is in the range of 0 and Contention Window(CW).This back off timer gets



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decremented periodically ,upon reaching the value of 0 the station is allowed to access the Network again. If acknowledgement is not received the station assumes a collision has taken place and re-schedules a transmission by re-entering the back off process.

Point Coordination Function: It employs the Time Division Multiplexing (TDM) technique. The point coordinator functions as a master while the stations as slaves. The transmission time is divided into poll slots for the stations in a network. The stations can transmit data only after receiving a polling frame from the point coordinator. The point coordinator decides which station must be polled for data transmission. There is no delay caused due to collision as the PCF even provides bounded delay keeping intolerant applications like video, audio, etc in mind.

This method is employed only for the infrastructure configuration .The access point can be optionally configured in this mode .Even after enabling this mode it's up to the stations to decide whether to employ polling or not.

IEEE PROTOCOL ARCHITECTURE

The architecture was developed by IEEE 802 committee has been adopted by all organizations which work with LAN standard specification. This is popularly known as IEEE reference model.

The lowest layer corresponds to the physical layer of the OSI model.

The functions included are:

- Encoding and decoding a signal
- Generation and removal of preamble for synchronisation
- Transmission and reception of bits

The functions related to providing the service to the LAN users are present above the Physical layers. It includes

- The data needs to be assembled into frames adding address and error detection fields on transmission
- The frame needs to be disassembled and address recognition and error detection needs to be performed on reception
- Monitor access to the LAN transmission medium
- Create an interface with the higher layers in order to perform error and flow control

These functions are mainly associated with OSI layer 2. These functions are grouped into logical link control(LLC) and Medium access control(MAC). The first three functions are associated with MAC layer while the later ones are associated with LLC. There are 2 separate layers for the following reasons

- The traditional data link layer does not provide access to shared access medium.
- For one LLC multiple MAC optional may be present

The data at the higher level is pushed down to the lower layer i.e. the LLC which adds the control information creating a *LLC protocol data unit (PDU)*. This is used in the operation of the LLC protocol, The entire protocol data unit is then passed down to the MAC layer which adds its own control information at the beginning and ending of the packet, resulting in a MAC frame. This control information is useful to the MAC Protocol for its operations.

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RESULTS

The study involves studying the IEEE 802.11 Architecture at various levels. In Fig.1 the various components which are involved in the WLAN are displayed. 802.11 is comprised of 4 major components 1) Base Station 2) The Wireless Medium 3) Access Point and 4) Distributed system. Interworking of these components is the basic requirement of a Wireless Network.

IEEE 802.11 allows the network to be configured in 2 ways 1) Infrastructure mode and 2) Adhoc mode which is shown in Fig.2 and Fig.3 The access method used in Infrastructure mode is Distributed Coordination Function (DCF) and point Coordination Function (PCF), while Distributed Coordination Function (DCF) is the access mode used in Adhoc Mode; this is configured on top of the physical layer which is shown in Fig.4. In Fig.5 a comparison is made between the 7 layers of OSI and IEEE protocol layers, The figure depicts the scope of the IEEE protocol standards. The Fig.6 shows how data is pushed down to the lower layers and how each layer adds its header and control information

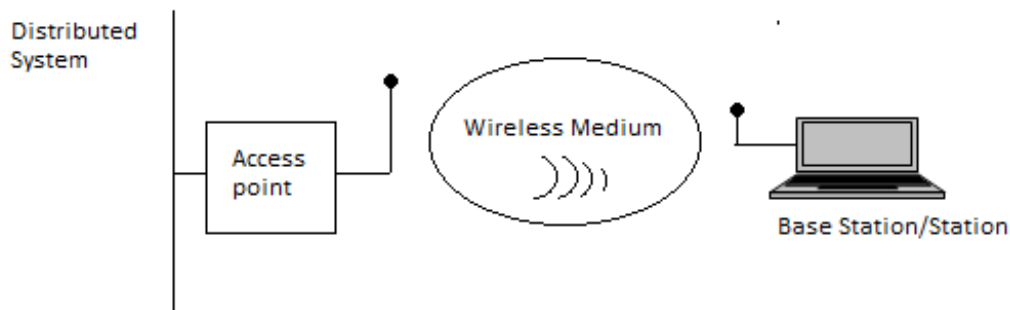


Fig.1. IEEE 802.11 WLAN Components

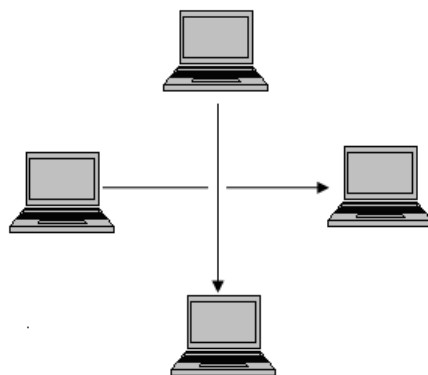


Fig.2. Adhoc Mode

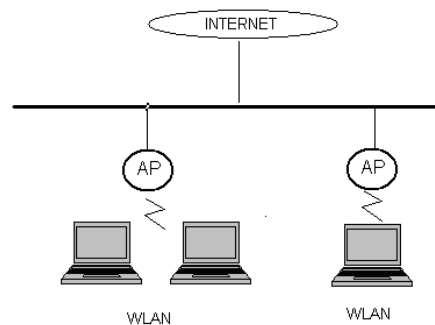


Fig.3. Infrastructure Mode

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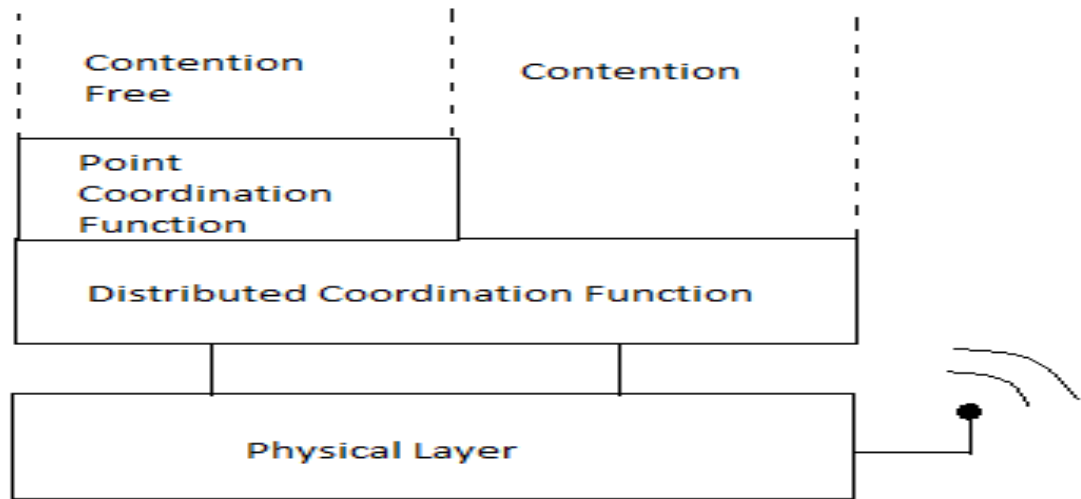


Fig.4. IEEE 802.11 Architecture

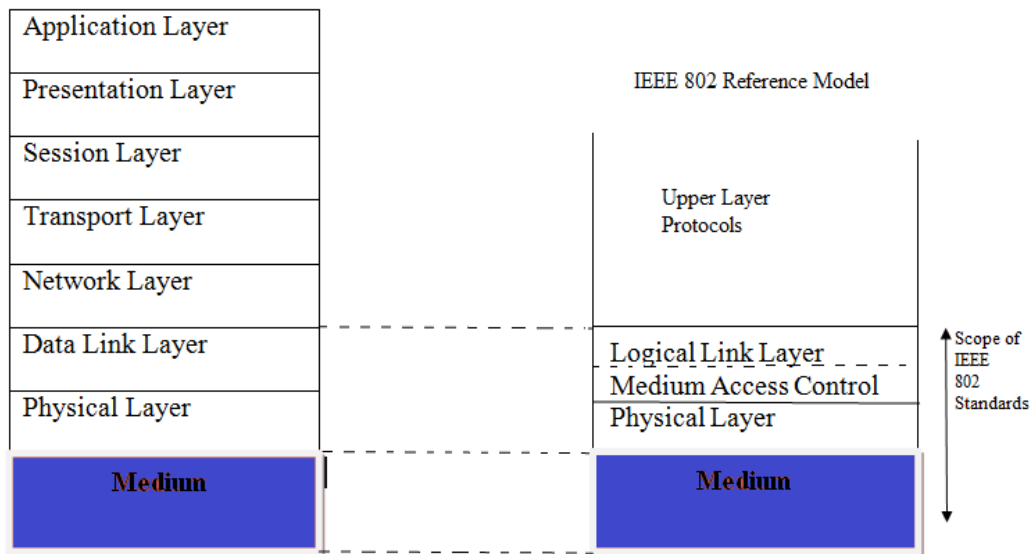


Fig.5. A Comparison between OSI Layers and IEEE Protocol Layers

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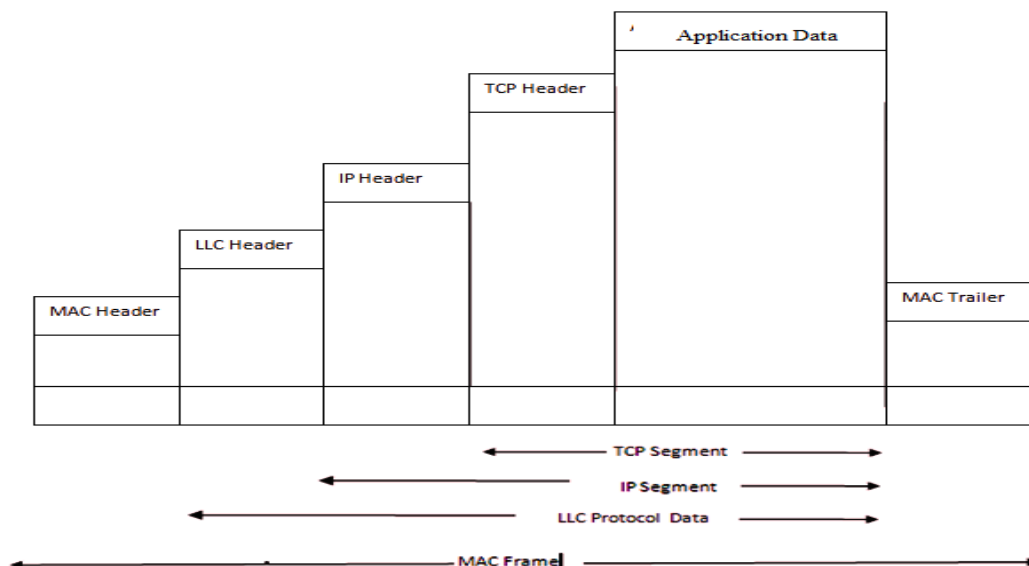


Fig.6. IEEE 802.11 Protocols in context

CONCLUSION

In this paper we review of IEEE 802.11 architecture and show how it is slowly replacing the wired network technology. The wireless field has grown tremendously the last three decades finding its use in educational institutes, offices, etc. Wireless Local Area Network WLAN is one of the most widely used technologies. Wireless Network is one of the most widely used technologies .It offers a great deal of promise by providing features like scalability ,cost effectiveness, flexibility, etc. It has grown tremendously in the last decade and shows a great deal of promise

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