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Performance Improvement of Wireless LAN Over Wired Networking System

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Abstract - Present days various inventions take place in science and technology for the fulfillment of users demands. In today's world computer technology is on demand. In order to fulfill the demand of users 802.11wireless LAN standard developed by IEEE 802.11committee. Wireless networking is additional recent substitute to wired networking that relies on copper or fiber optic cabling. This paper will give the description about wireless LAN 802.11 standard. It will go in depth to what exactly wireless networking entails, how it works and advantages over wired network. With the help of this standard proper network is establish between different computers and transfer of information take place between devices at higher data rate without using wires within a local area. Users have the ability to transfer large files fastly, access the global network with high security, without having the need to attach network cables to ports that are connected to switches or hubs. Wireless network uses radio waves or microwaves for establish connection between different devices. This standard has recently become more and more popular due to its convenience and falling prices of hardware. This paper provide a detailed study of wireless LAN 802.11 standard, its different types and concerned issues.

Keywords - Wireless networking, standard, wires.

I. INTRODUCTION

IEEE committee developed 802.11 standard for wireless LAN network. Today we live in an age of wireless revolution where every effort is directed towards replacement of wires. Removing of wires not only makes things easy but also improves speed of operation. The wireless LAN network work in two modes:-

(i) Ad-Hoc (Peer to Peer configuration):- In Ad-Hoc mode computers can directly communicate with each other without using any access point. In this mode device is directly connected to each other by using radio waves. This mode is convenient for quickly setting up a wireless network.

(ii) Infrastructure mode:- In Infrastructure mode a number of computers are linked with access point in 802.11, access point act as a base station. Access point provide connection between wireless network and wired LAN network. This mode increases the range and help in connecting large number of devices.

There are lots of advantages of wireless LAN network over wired network. Some of them are as follows:-

i) Replacement of wires:- Here the medium of connectivity is air, radio waves travel in air provide connection between devices. Thus wires are not used for connection hence drilling of holes not required in buildings.

ii) Reduction of cost:- In wireless network installation is easy. Hence installation cost is reduces.

iii) Mobility and flexibility increases:- In is type of network devices have the freedom to move anywhere in a limited range.

iv) In this type of network data rate is high. Large files can be transmitted fastly.

v) It provide neat and clean pollution free communication.

(1.1) 802.11 Protocol stack:- In 802.11 protocol stack the lower layer is 'Physical layer', which comprises of different standards. In 1997,802.11 standard specifies three transmission techniques allowed in the physical layer. The infrared method uses the same technology as television remote controls do. The other two use short range radio using techniques called FHSS and DSSS.

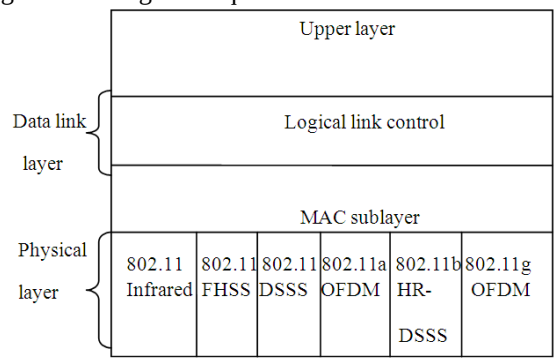

Fig. 1.1 802.11 protocol stack

Both spectrum does not require licensing (2.4GHz ISM band). In 1999, two new techniques were introduced to achieve higher bandwidth. These are OFDM (orthogonal frequency division multiplexing) and HR-DSSS (high data rate direct sequence spread spectrum). Other methods are Wi-Fi, HiperLAN/2, Bluetooth, Home RF. This physical layer is similar to the physical layer of OSI model.

Above it the other layer is data link layer, which split into two layers LLC (logical link control layer) and MAC layer (medium access control layer).

LLC layer is used to hide the differences between the different 802 variants and make them indistinguishable as far as the network layer is concerned. Logical link address, control information and data are handled by this layer.

(1.2) MAC sublayer protocol:- In 802.11 standard there are two types of functions are described for explaining medium access control process of 802.11. These two functions are:- DCF(distributed coordination function) and PCF(point coordination function).There are two important concern have to be considered before introducing wireless LAN to any organization are access control and privacy. Access control mechanism is managed by DCF and PCF.

i) Distributed coordination function:- Asynchronous transmission occur in this function and it is suitable for both ad-hoc and infrastructure configuration. This function

uses CSMA/CA(carrier sense multiple access with collision avoidance) method. In this method before transmitting frames each station sense the channel and avoid collision of data frames. In order to fulfill this phenomena two carrier sensing mechanism are uses one is Physical channel sensing and other is virtual channel sensing. In physical channel sensing first detect the presence of other station by analyzing all detected packets and channel activity by relative signal strength from other stations. Virtual channel sensing can be used by a station to inform all other stations in the same BSS (base service se) how long the channel will be reserved for its frame transmission.

In physical channel sensing a source station before starting its transmission sense the channel whether it is free or not. If the channel is free then station transmit the data frames otherwise wait for a particular time duration until channel is free. If collision occur due to transmission of frames by different station at the same starting time. Then colliding station wait a random amount of time after that it resend the frames.

In virtual channel sensing after sensing the status of channel the source station alert the other stations about its transmission. For this purpose sender can set a duration field in MAC header field of data frames or RTS or CTS frame. Then other stations can update their local timers of network allocation vector (NAV) to indicate this duration. Thus other stations stop their transmission during this time duration. This time duration is known as back off time duration. When back off time expire next station sent its frame, the next station access the medium. This back off time expire when previous station send all its data frame. A collision occur at the receiver side when data frames of different sender received. To avoid collision at receiver side sender sent short RTS (request to send) frame to the receiver. If receiver is ready to accept the data frames from sender then it sent CTS(clear to send) frame back to the sender. After receiving CTS frame sender sent its data frame. Finally if all data frames are received correctly by the receiver then it send positive acknowledgement frame to the sender.
Otherwise it resent the data frames.

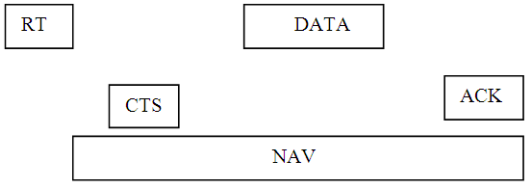

Fig.1.2 Distributed coordination function

ii)Point coordination function:- This function uses a centralized polling scheme. In this scheme each BSS contain one base station which polls the station of a BSS and asked them if they have any frame to send. Here base station decide which station transmit. Thus collision not occur because whole transmission is controlled by base station. Base station broadcast a beacon frame periodically. This beacon frame contain system parameter such as hopping sequence, clock synchronization etc. For saving power, the base station can direct a mobile station to go into sleep state until explicitly awakened by the base station or user. When first station send its frame then next station have to wait for certain amount of time to send its frame. This waiting time divided into several time intervals. There are four types of time intervals which decide when next station send its frame, they are as follows:-

i) SIFS (short interframe spacing):- In this time interval receiver sending CTS frame to respond RTS frame and after receiving data frame the receiver send acknowledgement frame. After that sender sent its remaining frame without sending RTS again.

ii) PIFS (PCF interframe spacing):- If station does not send all its frame in SIFS then base station send beacon frame. Thus base station allow its present station to complete its transmission in PIFS interval. After completion of transmission base station access the channel.

iii) DIFS (DCF interframe spacing):- In this time interval any station can send the new frame.

iv) EIFS (extended interframe spacing):-This is used by receiver when it receive a corrupted or unknown frame.

(2) Standards of 802.11:- There are different standards of 802.11 available. A number of standards developed for improving the performance of WLAN. Some of the important standards are as follows:-

(2.1) First standard 802.11:- This is the original specification of 802.11 standard and it was released in 1997 and clarified in1999.The data rate provided by this specification is 1 or 2Mbps and it is operated in 2.4GHz.It specify three physical layer technologies diffuse infrared, frequency hopped spread spectrum, direct sequence spread spectrum.

i) Diffuse infrared 802.11 standard:- In this standard infrared option uses diffused transmission at 0.85 or 0.95microns.The data rate provided by it is 1 or 2Mbps. At 1Mbps gray code encoding scheme is used in which 4 bits is encoded as a 16 bit codeword. In this coding method only single bit error occur. At 2Mbps the encoding takes 2 bits and produces a 4 bit codeword. Infrared signals cannot penetrate walls, so cells in different rooms are well isolated from each other.

ii) FHSS (Frequency hopped spread spectrum) 802.11 standard:- In this standard FHSS technique is used. The basic principle of FHSS is to change the carrier frequency of a narrow band transmission system so that transmission is done in one frequency band only for a short duration. There are two types of frequency hopping method one is slow and other fast. In fast frequency hopping the frequency of carrier signal vary several times during transmission of one symbol. Here one symbol transmit by using several frequencies during their transmission. In slow frequency hopped one or several symbols transmit at each frequency. In fast method more than one symbol are not transmitted at the same frequency. It properly allocate the spectrum and provide high security. This method is also insensitive to radio interference, which makes it popular for building to building links.

iii) Direct sequence spread spectrum 802.11 standard:- The basic principle of DSSS is to spreading the narrow

band input signal by multiplying it with a wideband signal. The bandwidth of this wideband signal is very large, this signal is used for spreading the transmit signal over large bandwidth. This is important in military applications, because unauthorized listeners cannot determine whether a signal is being transmitted. This method is also restricted to 1 or 2Mbps. It uses phase shift modulation and transmit 1 bit per baud when operating at 1Mbps and 2 bits per baud when operating at 2Mbps.

2.2) 802.11a OFDM (Orthogonal frequency division multiplexing):- This standard is based on OFDM principle. According to this principle a high data rate signal is converted into low data rate signal. These low data rate signals are transmitted over parallel narrowband channels that can be easily equalized. Thus OFDM breaks up fast serial information signals into several slower sub signals that are transferred at the same time via different frequencies providing more resistance to radio frequency interference.

Basically this standard operate at 5GHz with a maximum net data rate 54Mbps. However the disadvantage of this standard is that overall range is less because 802.11a signals are absorbed more readily by walls and other solid objects in their path due to their smaller wavelength. Interference is reduces by using this standard.

2.3) 802.11b HR-DSSS(high rate direct sequence spread spectrum) standard:- It is also known as Wi-Fi technology. This standard was developed in order to overcome the disadvantage of 802.11a. This standard is the direct extension of original 802.11 version. It uses the same modulation technique which is used by original 802.11 standard that is DSSS. It is operate at 2.4GHz band and minimum data rate is 11 Mbps .It is backward compatible with 802.11 standard. This standard under the marketing name of Wi-Fi has been implemented all over the world. This standard uses cck(Complementary code keying) modulation technique. 802.11b devices suffer interference from other products operating in the 2.4 GHz band. Devices operating in the 2.4GHz range include microwave ovens, Bluetooth devices, cordless telephones etc. The range of this standard is high in compare to 802.11 standard.

2.4) 802.11g standard:- This standard also based on the principle of OFDM. This is one of the best standard of 802.11 WLAN. This standard provide high data rate at low cost. It operate at 2.4GHz and data rate is 54Mbps.

3) FRAME FORMAT OF 802.11:- 802.11 standard define three types of frames:-

i) Data frame ii) control frame iii) Management frame

Data frame:- First field of data frame is frame control field. It has 11 sub fields. They are as follows:-

Version:- This indicate the version of IEEE 802.11 standard.

Type:- This specify the type of frame, whether it is data frame or control frame or management frame.

Subtype:- This specify whether it is RTS or CTS frame or beacon frame etc.

Frame control	Duration	Address 1	Address 2	Address 3	Sequence	Address 4	Data	Check sum

Fig.1.3 Data Frame structure of 802.11

Version	Type	Subtype	To D.S	From D.S.	M.F.	Retry	Power	More	W	O

Fig. 1.4 Subfield of frame control field

To D.S.(distribution system):- This indicate whether the frame is going to or coming from distribution system this field is set to 1 when frame is sent to distribution system.

From D.S.(distribution system):- This field is set to 1 when frame is received from the distribution system.

MF(more fragment):- This field is set to 1 when there are more fragments belonging to the same frame following the current frame.

Retry:- It indicate the retransmission of frame which sent earlier.

Power:- This field is used to indicate the power management mode. The power management bit is used by the base station to put the receiver into sleep state or take it out of sleep state.

More:- This field indicate that the sender has additional frames for the receiver.

W:- This field specifies that the frame body has been encrypted by using WEP(wired equivalent privacy) algorithm.

O (order):- This field indicate that the frame is being sent using the strictly ordered service class. The O bit tells the receiver that a sequence of frames with this bit on must be processed strictly in order.

Other fields of data frame are as follows:-

2) Duration field:- This field tells how long the frame and its acknowledgement will occupy the channel. The duration value is used for NAV calculation.

3) Address field:- There are four address. Two address represent source and destination station and other two address are used for intercell traffic.

4) Sequence field:- It represent fragment number and sequence number. It is used to represent the order of different fragments belonging to the same frame and to recognize packet duplication.

5) Data:- This field contain the information that is transmitted or received.

6) Checksum:- This field is used to detect error. It contain 32 bit.

Management frames have a format similar to that of data frames, except without one of the base station address because management frames are restricted to a single cell.

Control frames are shorter still, having only one or two address no data field and no sequence field.

CONCLUSION

The conclusion of this paper is that wireless LAN technology is very effective than wired technology. To fulfill different requirements of user different types of standards are available in wireless LAN 802.11. There is a wide scope in this technology. On the basis of above explanation we concluded that each standard has it's own advantage. Since 802.11a standard is faster than 802.11b, but the range of 802.11b is greater than 802.11a standard. Due to the lots of advantage of 802.11 standard it provided different types of services like association, dissociation, distribution integration etc.

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