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A Study on Guided and Unguided Transmission Medias and a Proposed Idea to Extend the Limit of Gi-Fi

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ABSTRACT
Networking in computers enables sharing of information by interconnecting the computing devices. The sharing of information is possible through transmission media. The transmission media is classified as wired or wireless. Wired media have limitation in geography. But wireless is not bounded by geography. In the wireless world the first wireless technology was infrared and it was a very slow technology. So, inventions were continued to find a better wireless technology, finally we got Bluetooth, Wi-Fi ,WI-MAX and Gi-Fi. In this paper we discussed about different Wired and Wireless Technologies and given a proposed idea to extend the limit of Gi-Fi beyond 10 meters.
Keywords: Bluetooth, CMOS, GiFi, Repeater, WiFi, WiMax.

I. INTRODUCTION

Nowadays, due to existence of distributed systems, thanks to the power of internet, be it government or private sectors they share information throughout the organization in a more efficient and productive manner. This can be possible only by networking the computers. To make the Network there are two options one is wired network and the second is Wireless network. Our focus is to improve GiFi, which is a wireless network. The wireless network uses radio frequencies, microwave to connect computer. Wireless networks have given the flexibility to be mobile and this improves availability. This paper focuses on different hardware requirements, the range and benefits of wired and wireless networks. Finally a method is proposed to improve the transmission limit of GiFi.

This paper is logically split into 6 sections. Section 1 is about introduction. Section 2 discusses about guided or wired communications. Section 3 gives an introduction about unguided or wireless communications, Section 4 elaborates about GiFi, Section 5 proposes the new model of GiFi with repeater booster like devices and section 6 is conclusion.

II. GUIDED OR WIRED COMMUNICATIONS

To connect the computing devices different types of cables are used. They are:

2.1 Coaxial Cable

Figure 1: Coaxial cable

In early days of networks, network people used coaxial cable (as shown in figure 1) to connect computers together. Coaxial cable was one of the common cable used for LAN. The other name for coaxial cable is *ThinNet*. Coaxial cable are of two types:

- baseband
- broadband

Coaxial cable is terminated with British Naval Connectors (BNC). Terminators used with BNC/thin coaxial cabling must be 50-ohm terminators. Table 1 furnishes the facts about coaxial cable.

Table 1: coaxial cable facts

Cable type	Coaxial
Maximum Bandwidth	10 megabits per second
Transmission distance	Long distance – 185 meters maximum
Usage	Cable TV networks

2.2 Twisted-Pair Cable

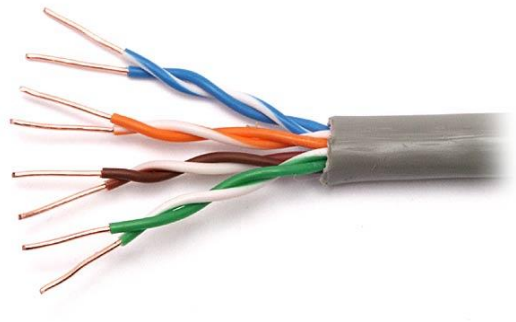

Figure 2: Twisted pair cable

Twisted-pair cable (as shown in the figure 2) is separated categorized into five types as specified by the TIA/EIA 568-A standard.

Table 2: categories of twisted pair cable & applications

Sno	Category	Appication
1	Category-1	Telephone Systems
2	Category-2	Token Ring Networks
3	Category-3	Ethernet Networks
4	Category-4	Ethernet Networks
5	Category-5	Lan

In a unshielded twisted-pair (UTP) cable there are 1to 4 pairs (2 to 8 wires). Each pair is twisted around each other at a different rate. Each pair has a color-coded, confining to the standards. The UTP cable is inside a protective plastic insulation sheath. In Category 5 UTP, there are 4 pairs of wires, one wire of solid color and one of white with the same color stripe in each pair:

- 1 orange pair
- 1 brown pair
- 1 blue pair
- 1 green pair

The TIA/EIA 568 [7] standard has two wiring sequences, T568A and T568B. The sequence of the wires decides how the wires are terminated on the RJ-45 connector. Either sequence may be used to set up a network. On a network the same sequence is used throughout the network. The signal quality depends upon correctness in pairing of wires. Table 3 describes about the facts of twisted pair cable.

Table 3: Twisted pair cable facts

Cable type	UTP Cable: Category 5
Maximum Bandwidth	100 megabits per second
Transmission distance	Maximum distance is 100 meters.
Usage	LAN

2.3 Fiber-Optic Cable

Fiber optic cable (as shown in figure 3) uses light pulses to transmit information across a network and hence it is very fast in nature. The cable may be used over many miles because there is no electrical EMI and the bandwidth is very high. Extra care is taken to install a fiber optic cable and it used for the backbone of a network. To locate a flaw in the fiber optic cable high end tools are needed.

The core of the cable consists of glass or plastic, and it is safeguarded by a layer of gel or light reflecting plastic. A plastic insulation sheath then surrounds the entire cable. Fiber Optic transmission speed is of 10 Gigabits per second.

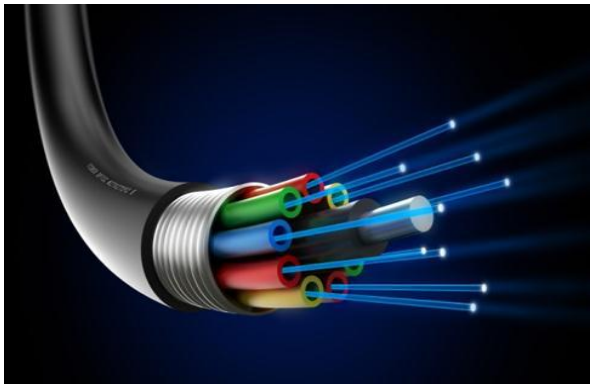

Figure 3: Fiber-Optic cable

Table 3: Fiber-Optic cable facts

Cable type	Fiber Optic Cable
Maximum Bandwidth	10 Gigabits per second.
Transmission distance	Many miles
Usage	Any long distance network cabling

2.4 Repeaters

Repeaters are one of the networking devices. It is used to enhance a cabling system to extend beyond its maximum allowed length. It does this by amplifying the network voltages to travel further. It is more like amplifiers and are very inexpensive. The only constraint in repeaters is that it can only be used to regenerate signals between similar network segments.

For example (refer figure 4), we can extend an Ethernet 10Base2 network to 400 meters with a repeater. But we can't connect an Ethernet and Token Ring network together with one.

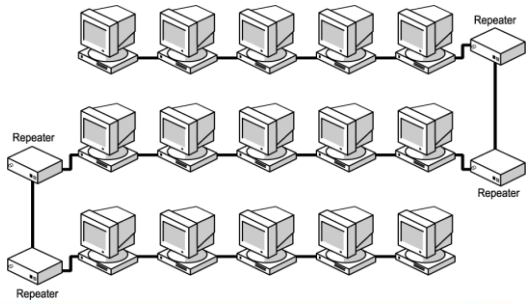

Figure 4: Expanding the network using repeaters

III. UNGUIDED OR WIRELESS COMMUNICATIONS - INTRODUCTION

Computer networks have undergone a huge evolution as shown in figure 5. For many years cables ruled the world of computer networks. Then came optical fiber and it played a upper hand because of its higher bit rates and faster transmission. It had its own challenges in its installation and it caused a great difficulty thus we led to wireless access [1]. First came Bluetooth. It has been used as wireless access which can cover a very short distance of 9-10 meter. Next Wi-Fi, having coverage area of 91meters, has brought a revolutionary solution to the short comings that appeared in the previous technology. Those days the development of technology in Wireless networks was not fortifiable [1]. But as days went by due to advancement in technology, WiFi became part and parcel of life.

The following are the different types of wireless technologies:

1. Bluetooth
2. Wi-Fi
3. WiMax
4. Gi-Fi

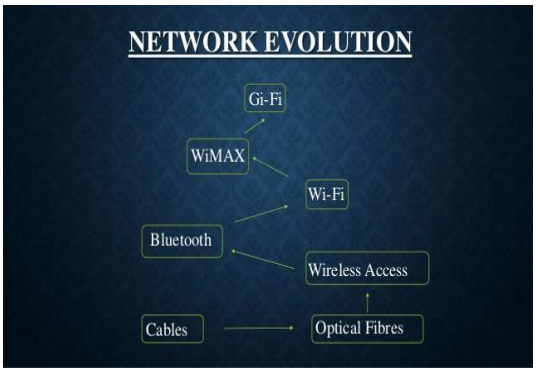

Figure 5: Network evolution

3.1 Bluetooth

Figure 6: Bluetooth

Bluetooth (as shown in figure 6) [2] is one of the first wireless technology. It connects devices to transmit data over short distances. The standard it follows is IEEE802.15 standard. Two types of network are used:

- ***Piconet***
  - A piconet is formed by a primary and one or more secondary stations. All the secondary stations synchronizes with their clocks. The number of stations in Piconet is minimum one primary and maximum seven secondary stations.

- ***Scatternet.***
  - To create Scatternet we can combine Piconet, and secondary in one piconet can be the primary in another piconet.

- ***Applications***
  - communication of wireless mouse or keyboard with computer
  - home security devices to connect different sensors with main security controller
  - Synchronization of computers at a conference etc.

3.2 Wi-Fi

Wi-Fi technology (as shown in figure 7) on a network must confine to IEEE 802.11

standards. With Wi-Fi local area networks (LANs) can function without cables to connect client devices. The cost of establishment is reduced considerably.

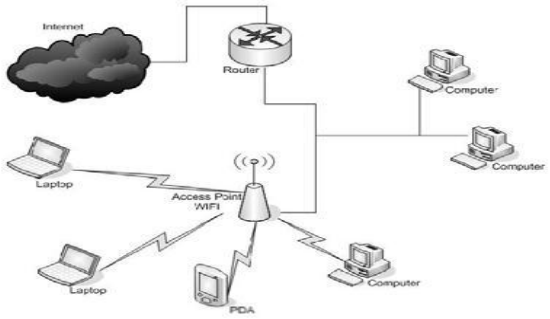

Figure 7: WiFi network

It can be used is places where cables cannot be run, in outdoor areas and historical buildings where we cannot tamper the history, by hosting wireless LANs. Nowadays all the laptops and most of the desktops having wireless connectivity . Thanks to the advancement and the competition in hardware, for bringing the price of chipsets for Wi-Fi. Hence, WiFi has been made available for public access at ease.

3.3 WIMAX

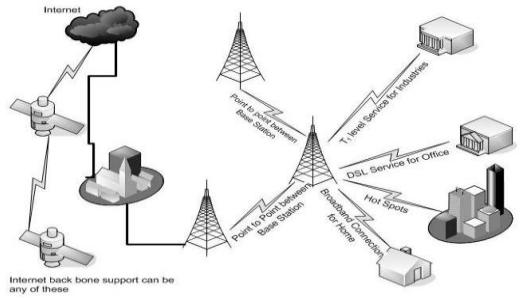

Figure 8: WIMAX network

WiMAX [3] [4] is the enhanced version of Wi-Fi technology. The expansion of WiMax is, Worldwide Interoperability for Microwave Access (WiMAX). It abides by IEEE802.16 standard. The features are as follows:

- High speed wide area broadband wireless access.
- Long range connectivity
- High security
- Low power utilization and excellent quality of service (QOS) – to save battery power.
- It has maximum coverage area with 50kms.
- Flexible.

WiMAX -three techniques for radio link:

1. SC-A
2. OFDM
3. OFDM-A.

Applications

- Portable broadband connectivity
- Enterprise data service.
- Maintain dedicated links
- VOIP services at a reliable and high quality speed.

IV. GI-FI

With internet spectrum swelling up to 5G and so on, the requirement to transfer data with huge size at the faster rate becomes a challenge. The solution came up, with a new technology namely Gi-Fi. Gi-Fi provides fast information rate in Gbps, less power consumption and low cost for short range communication.

Gi-Fi or gigabit wireless is the world's first transceiver integrated on a single chip (as shown in figure 9) that operates at 60GHz on the CMOS .process. It will allow wireless transfer of audio and video data at up to 5 gigabits per second. It is almost ten times the current maximum wireless transfer rate, at one-tenth the cost. The Melbourne University based laboratories of NICTA (National ICT Australia Limited) [8], Australia's Information and Communications Technology Research Centre of Excellence have chosen to develop this technology in the 57-64GHz unlicensed frequency band as the millimeter-wave range of the spectrum makes possible high component on-chip integration as well as allowing for the integration of very small high gain arrays. The available 7GHz of spectrum results in very high data rates, up to 5 gigabits per second to users within an indoor environment within a range of 10 meters. It fulfills the standards of IEEE 802.15.3C.

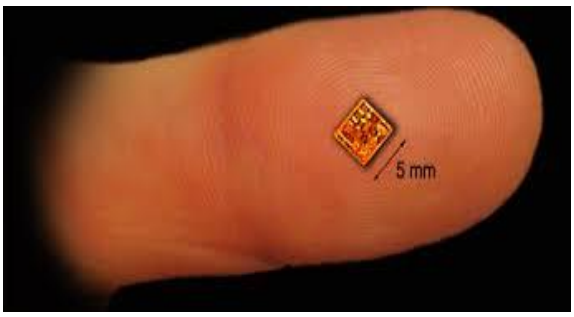

Figure 9: Gi-Fi Chip

4.1 Architecture of Gi-Fi

The main component of a GI-FI system is the subscriber station and it is available to several access points. It satisfies the standard of IEEE 802.15.3C Wireless PAN [9].The wireless pan is computer network used for communication among computer devices (including telephones and personal digital assistants) close to one person.

An 802.15.3c based system uses a small antenna at the subscriber station. The antenna is mounted on the roof of the client.

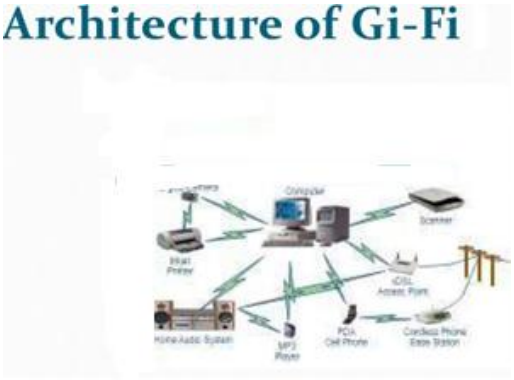

Figure 10: Architecture of Gi-Fi

4.2 Fundamental Technologies in 802.15.3c

This millimeter-Wave WPAN will operate in the new and clear band including 57-64 GHz unlicensed band defined by FCC 47 CFR 15.255[10]. The millimeter-wave WPAN will allow high coexistence (close physical spacing) with all other microwave systems in the 802.15 family of WPANs. The quality of service (interference) is maintained by transmitting multiple signals simultaneously across the wireless transmission paths.It uses ultra wide band which consists of:

1) High bit rate
2) High security
3) Faster data transmission

Two Technologies that help realize GWLAN are:

1. **M**ultiple **I**nput **M**ultiple **O**utput (MIMO)
2. **S**ystem-**O**n-a-**P**ackage(SOP)

Multiple Input Multiple Output (MIMO)

MIMO wireless is an economical technology that offers flexibility in making 1Gbps wireless links a possible one. MIMO wireless allows speeds in Gbps on NLOS wireless networks. The performance improvements are due to

- Array gain
- Diversity gain
- Spatial Multiplexing Gain
- Reduction in Interference.

System-On-A-Package (SOP)

SOP is a better option in the solution for next-generation wireless networks. Recent development of materials and processes in packaging area allows bringing the concept of SOP into the RF world to meet the strict needs in wireless communication area. SOP goes ahead one step beyond Multi Chip Module (MCM) by enhancing overall performances and adding more functionality into it.

4.3 Applications Of Gi-Fi

1. Household appliances
2. Office appliances
3. Video information transfer
4. Inter-vehicle communication system

4.4 Advantages And Disadvantages Of Gi-Fi

4.4.1 Advantages Of Gi-Fi Technology

1. High Speed of Data Transfer
2. Low Power Consumption
3. High Security [5,6]
4. Cost Effective
5. Portability
6. High Mobility

4.4.2 Disadvantage of Gi-Fi

The main disadvantage of Gi-Fi Technology is the Distance Limitation [up to 10 meters].

V. PROPOSED METHOD

Even though **t**he Gi-Fi Technology offers faster information rate in Gbps, less power consumption and low cost for short range transmissions as compare to current technologies , we are unable to use this technology beyond 10 meters . Our proposed idea is by using some devices like Repeaters / Signal Boosters we can extend the Gi-Fi network beyond 10 meters and communicate with other Gi-Fi networks.

Figure 11: proposed Gi-Fi network with repeaters

VI. CONCLUSION

In this paper, we have discussed about the pros and cons of guided and unguided transmission mediums in computer networks, their evolution, a brief about Gi-Fi, identified the advantages & disadvantages of Gi-Fi and proposed a model to improve the transmission distance of Gi-Fi.

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