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GIFI New Era of Wireless Technology

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Abstract: GI-FI will helps to push wireless communications to faster drive. For many years cables ruled the world. Optical fibers played a dominant role for its higher bit rates and faster transmission. But the installation of cables caused a greater difficulty and thus led to wireless access. The foremost of this is Bluetooth which can cover 9-10mts. Wi-Fi followed it having coverage area of 91mts. No doubt, introduction of Wi-Fi wireless networks has proved a revolutionary solution to "last mile" problem. However, the standard's original limitations for data exchange rate and range, number of channels, high cost of the infrastructure have not yet made it possible for Wi-Fi to become a total threat to cellular networks on the one hand, and hard-wire networks, on the other. But the man's continuous quest for even better technology despite the substantial advantages of present technologies led to the introduction of new, more up-to-date standards for data exchange rate i.e., GI-FI. GI-FI or Gigabit Wireless is the world's first transceiver integrated on a single chip that operates at 60GHz on the CMOS process. It will allow wireless transfer of audio and video data up to 5gigabits per second, ten times the current maximum wireless transfer rate, at one-tenth of the cost, usually within a range of 10 meters. It utilizes a 5mm square chip and a 1mm wide antenna burning less than 2watts of power to transmit data wirelessly over short distances, much like Bluetooth. The development will enable the truly wireless office and home of the future. As the integrated transceiver is extremely small, it can be embedded into devices. The breakthrough will mean the networking of office and home equipment without wires will finally become a reality. In this we present a low cost, low power and high broadband chip, which will be vital in enabling the digital economy of the future.

Keywords: Wi -Max, Optical fibers, Gigabit Wireless, high broadband chip.

I. INTRODUCTION

Wi-Fi (IEEE-802.11b) and WI-MAX (IEEE-802.16e) have captured our attention, as there are no recent developments in the above technologies which cannot transfer data and video information at a faster rate and led to the introduction of GI-FI technology. It offers some advantages over Wi-Fi, a similar wireless technology, that offers faster information rate in Gbps less power consumption and low cost for short range transmissions.

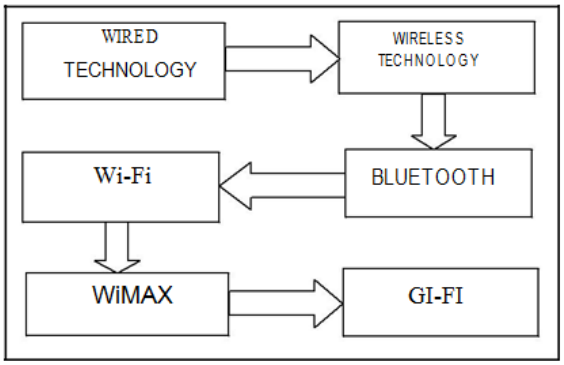
GI-FI or Gigabit Wireless is the world's first transceiver integrated on a single chip in which a small antenna used and both transmitter-receiver are integrated on a single chip which is fabricated using the complementary metal oxide semiconductor (CMOS) process. Because of GI-FI transfer of large videos, files can be done within seconds. Researchers of Melbourne University has come up with a wireless technology which promises high speed short range data transfers with a speed of up to 5Gbps within a radius of 10 meters. The new wireless technology is named as GI-FI and operates on the 60GHz frequency band, which is currently mostly unused. The GI-FI Chip developed by the Australian researcher's measures 5mm square and is manufactured using existing complementary metal-oxide-semiconductor (CMOS) technology, the same system that is currently used to print silicon chips.

The best part about this new technology is its cost effectiveness and power consumption, it consumes only 2watts of power for its operation with antenna (1mm) included and the development of GI-FI chip costs approximately $10(Rs 380) to manufacture.

In theory this technology would transfers GB's of your favorite high definition movies in seconds. So GI-FI can be considered as a challenger to Bluetooth rather than Wi-Fi and could find applications ranging from new mobile phones to consumer electronics

II. NETWORK EVOLUTION

Communication technology can be divided into two types.1) wired technology and 2) wireless technology. The evolution of wireless technology will leads to the GI-FI technology. The following diagram will gives the network evolution.



A. WI-MAX

Worldwide Interoperability for Microwave Access (WiMAX) is the common name associated to the IEEE 802.16a/REVd/e standards. These standards are issued by the IEEE802.16 subgroup that originally covered the Wireless Local Loop (WLL) technologies with radio

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spectrum from 10 to 66 GHz. Recently, these specifications were extended below 10GHz. Harmonize standards and certify interoperability between equipment from different vendors. Standardized Interoperable solutions will result in mass volume and bring down costs, promote and establish a brand for the technology. Wi-Fi style access will be limited to a 4-to-6 mile radius (perhaps 25 square miles or65 square km of coverage, which is similar in range to a cell-phone zone). Through the stronger line-of-sight antennas, the WiMAX transmitting station would send data to WiMAX-enabled computers or routers set up within the transmitter's 30-mile radius (3,600 square miles or 9,300 square km of coverage). This is what allows WiMAX to achieve its maximum range.

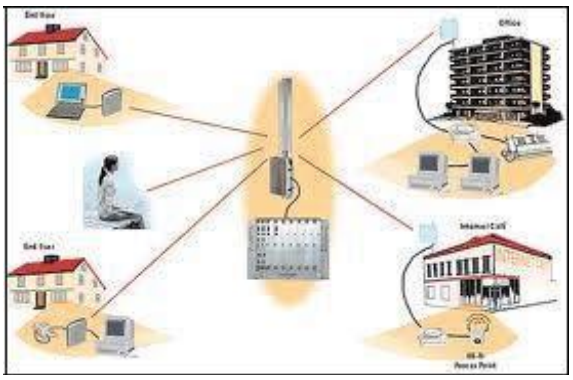


Fig. 3: WiMax Services

B. GI-FI

GI-FI or gigabit wireless is the world's first transceiver integrated on a single chip that operates at 60GHz on the cmos process. It will allow wireless transfer of audio and video data at up to 5gigabits per second, ten times the current maximum wireless transfer rate, at one- tenth the cost. NICTA researchers 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, usually within a range of 10 meters .It satisfies the standards of IEEE 802.15.3C .

A new silicon chip developed in Melbourne is predicted to revolutionize the way household gadgets like televisions, phones and DVD players talk to each other. The tiny five- millimeter-a-side chip can transmit data through a wireless connection at a breakthrough five gigabits per second over distances of up to 10 meters.

An entire high-definition movie could be transmitted to a mobile phone in a few seconds, and the phone could then upload the movie to a home computer or screen at the same speed. This means his team is ahead and stood in front of the competition in terms of price and power demand. His chip uses only a tiny one-millimeter-wide antenna and less than two watts of power, and would cost less than $10 to manufacture.

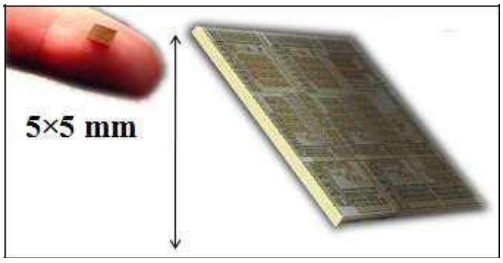


Fig. 4: Chip of GI-FI

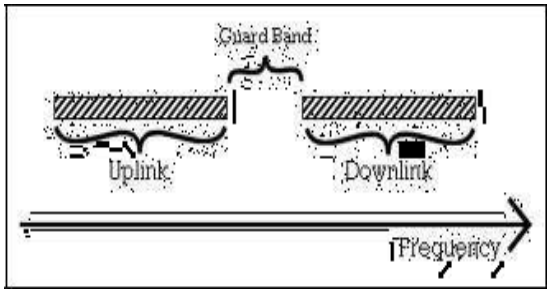
III. WORKING PRINCIPLE USED IN GI-FI

In this we will use time division duplex for both transmission and receiving. Here data files are up converted from IF range to RF60Ghz range by using 2 mixers and we will feed this to a power amplifier, which feeds millimeter wave antenna.

The incoming RF signal is first down converted to an IF signal cantered at 5 GHz and then to normal data ranges. Here we will use heterodyne construction for this process to avoid leakages due to direct conversion and due to availability of 7 GHz spectrum the total data will be will be transferred within seconds.

A. Time -Division Duplex

Time-Division Duplex (TDD) is the application of time-division multiplexing to separate outward and return signals. It emulates full duplex communication over a half duplex communication link. As uplink traffic increases, more channel capacity can dynamically be allocated to that, and as it shrinks it can be taken away.



Time division duplex (TDD) refers to duplex communication links where uplink is separated from downlink by the allocation of different time slots in the same frequency band. It is a transmission scheme that allows asymmetric flow for uplink and downlink data transmission. Users are allocated time slots for uplink and downlink transmission. This method is highly advantageous in case there is an asymmetry of uplink and downlink data rates. TDD divides a data stream into frames and assigns different time slots to forward and reverse transmissions, thereby allowing both types of transmissions to share the same transmission medium.

1. Techologies Used

This mmWave WPAN will operate in the new and clear band including 57-64 GHz unlicensed band defined by FCC 47 CFR 15.255. 2 types.

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(i). Multiple Input Multiple Outputs
MIMO wireless is an emerging cost effective technology that offers substantial leverages in making 1Gbps wireless links a reality. We can in principle, meet the 1Gbps data rate requirement if the product of bandwidth (measured in Hz) and spectral efficiency (measured in bps/Hz) equals 10^9. MIMO wireless constitutes a technological breakthrough that will allow Gbps speeds in NLOS wireless networks. The performance improvements resulting from the use of MIMO systems are due to
1. Array gain
2. Diversity gain
3. Spatial Multiplexing Gain
4. Interference Reduction

2. System-On-A-Package
SOP approach for the next-generation wireless solution is a more feasible option than SOC. Recent development of materials and processes in packaging area makes it possible to bring the concept of SOP into the RF world to meet the stringent needs in wireless communication area.

Wireless devices implementing complex functionality require a large amount of circuitry and consequently, require a large conventional package or MCM real estate. SOP goes one step beyond Multi Chip Module (MCM) by enhancing overall performances and adding more functionality

3. OPERATION AT 60 GHZ
Here we will use millimeter wave antenna which will operate at 60 GHz frequency which is unlined band Because of this band we are achieving high data rates energy propagation in the 60 GHz band has unique characteristics that make possible many other benefits such as excellent immunity to co-channel interference, high security, and frequency re-use.

Point-to-point wireless systems operating at 60 GHz have been used for many years for satellite-to-satellite communications. This is because of high oxygen absorption at 60 GHz (10-15 dB/Km). As shown in the figure 5.1.1 the absorption attenuates 60 GHz signals over distance, so that signals cannot travel far beyond their intended recipient. For this reason, 60GHz is an excellent choice for covert communication.

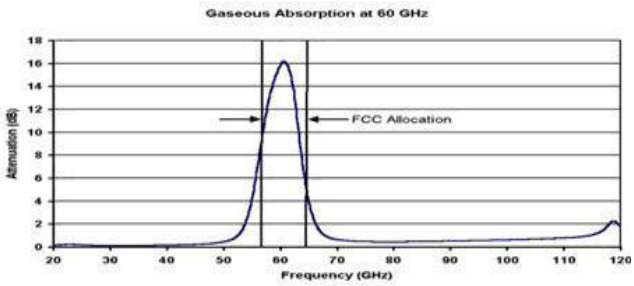

Fig 5. Oxygen Attenuation vs. Frequency

(i). Ultra Wide Band Frequency Usage
A technology with high bit rate, high security and faster data transmission. It is a zero carrier technique with low coverage area. So we have low power consumption.

These features are Ultra-Wideband is a technology for transmitting information spread over a large bandwidth (>500 MHz) that should, be able to share spectrum with other users. Regulatory settings of FCC are enabling both high data rate personal-area network (PAN) wireless connectivity and longer-range, low data rate applications as well as radar and imaging systems.

(ii). Features
- High level of frequency re-use enabled – communication needs of multiple customers within a small geographic region can be satisfied
- It is also highly portable-we can construct where ever we want.
- It deploys line of sight operation having only shorter coverage area, it has more flexible architecture.
- Multi-gigabit wireless technology that removes the need for cables between consumer electronic devices.
- More than 100 times faster than current short-range wireless technologies.
- Allows wireless streaming of uncompressed high-definition content.
- Operates over a range of 10 meters without interference.
- Entire transmission system can be built on a cost effective single silicon chip

IV. COMPARISON OF GI-FI AND EXISTING TECHNOLOGIES

Characteristics	Bluetooth	Wi-Fi	Gi-Fi
Specification Authority	Bluetooth SIG	IEEE, WECA	NICTA
Development Start date	1998	1990	2004
Primary Devices	Mobile phones, PDAs, Consumer, Electronics Office Industrial, automation Devices	Notebook Computers, Desktop Computers, Servers	Mobile phones, Home Devices, PDAs, Consumer, Electronics, Office, Industrial, automation Devices
Power Consumption	5 mw	10 mw	<2 mw
Data Transfer Rate	800 Kbps	11 Mbps	5 Mbps
Range	10 Meters	100 Meters	10 Meters
Frequency	2.4 GHz	2.4 GHz	57-64 GHz

A.Advantages of Gi-Fi

1. Removing Cables
For many years cables ruled the world. Optical fibers played a dominant role for its higher bit rates and faster transmission. But the installation of cables caused a greater difficulty and thus led to wireless access. The foremost of this is Bluetooth which can cover 9-10mts. Wi-Fi followed it having coverage area of 91mts. The standard's original limitations for data exchange rate and range and high cost of the infrastructures have not yet made it possible for Wi-Fi to become a good replace for the cables. Gi-Fi technology Removes need for cables to connect consumer electronics devices and all the devices in the range of 10 meters can be connected in order to transmit the data wirelessly.

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2. Low Cost Chip

Gi-Fi's chip uses only a tiny one-millimeter-wide antenna and less than 2mili watts of power. Low-cost chip allows technology to be readily incorporated into multiple devices. The chip in Gi- fi would likely cost about $10 or less to build. This and a small design would allow cell phones and other small devices to add the technology without significantly drive up the price, according to the company. GI-FI is based on an open, international standard. Mass adoption of the standard, and the use of low-cost, mass-produced chipsets, will drive costs down dramatically, which is very less in compare to present technologies.

3. Security

Among the factors that have held back enterprise uptake of wireless LANs outside green field sites have been security fears and lack of performance compared to wire line Ethernet. About 70 per cent of firms have deployed their WLAN in a secure firewall zone but are still using the old WEP protocol, which does not protect the application layer effectively, so better encryption is urgently needed. Secure encryption technology in GI-FI ensures privacy and security of content.

4. Simplicity

One of the problems with wire connections and cables is complexity for connecting, but in the Gigabit wireless technology simplicity is one of the features. Simple connection improves the consumer experience. The new gigabit wireless system provides Multi-gigabit wireless technology that removes the need for cables between consumer electronic devices and is More than 100 times faster than current short-range wireless technologies such as Bluetooth and Wi-Fi. This technology with high level of frequency re-use can satisfy the communication needs of multiple customers within a small geographic region. This GI-FI technology allows wireless streaming of uncompressed high-definition content and operates over a range of 10 meters without interference. It is highly portable and can be constructed in everywhere. Entire transmission system can be built on a cost effective single silicon chip that operates in the unlicensed, 57-64 GHz spectrum band. GI-FI technology also enables the future of information management is easy to deployment with the small form factor. GI-FI chip has flexible architecture.

B. APPLICATIONS OF GI-FI

1. GI-FI Access Devices

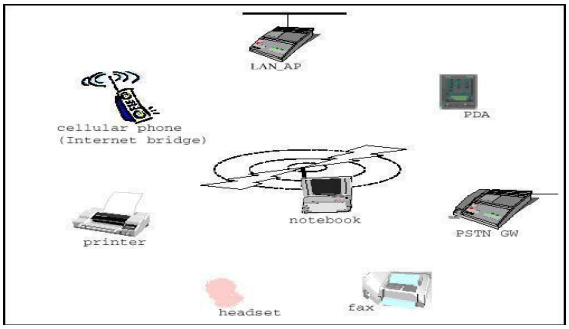

Fig . GI-FI access devices

Some of the GI-FI access devices are shown in fig. These access devices include termination units, internal radio modules, network interface cards, printers, PC's, and all household electronic appliances.

2. Broadcasting Video Signal Transmission System in Sports Stadium

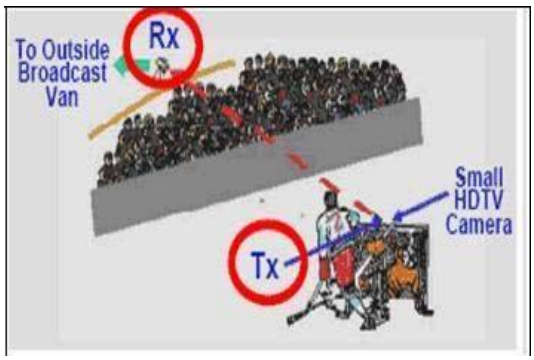

Fig. 6. Sports Stadium

Easy and immediate construction of temporal broadband network such as in sports stadium for the advertisement of information distribution can be possible as shown in fig. 6.

3. Office Appliance

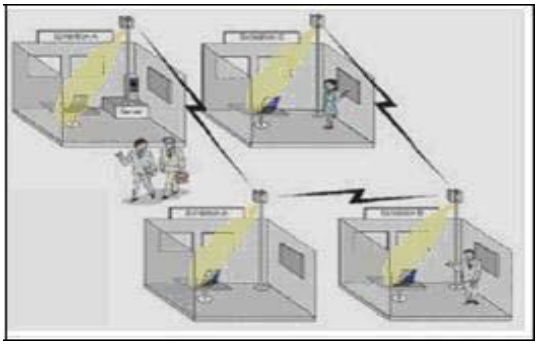

Fig 7. In office

As GI-FI data transfer rate is very high we can transfer data at very high speed in offices as shown in fig. 7 which made work very easy and it also provides high quality of information from the internet.

4. Video Information Transfer

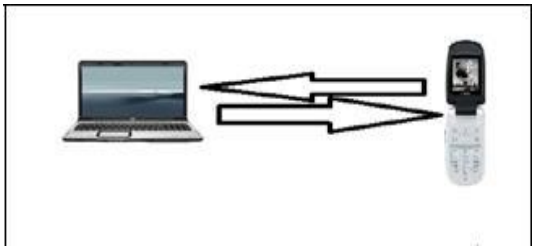

Fig 8.video transformation

By using present technologies video swapping takes hours of time where as with this technology as shown in fig 8 we can transfer data at a speed of giga bits/sec same as that for the transfer of information from a PC to a mobile and vice-versa.

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5. Inter Vehicle Communication System

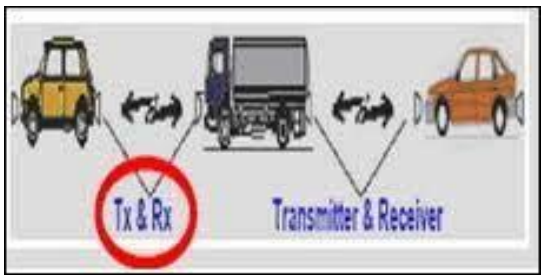
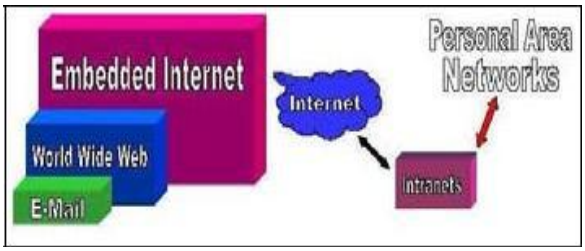


Fig 9. Inter vehicle communication system

The data exchange between vehicles is made possible by ad-hoc networks. These short- distance connections are spontaneously created between the vehicles as the need arises and can organize themselves without the help of any external infrastructure.

6. Media Access Control (MAC) and Imaging and Others



V. FUTURE SCOPE

A completely integrated single chip transceiver has been fabricated, tested and demonstrated in GI-FI chip and a transceiver with integrated phased array antenna on 65nm CMOS technology has been sent for fabrication. GI-FI technology demonstrates the world's first fully integrated transceiver on CMOS technology operating at 60 GHz and provides new technique for integrating antennas on CMOS. The GI-FI team is looking for partners interested in commercializing its 60GHz chips and with growing consumer adoption of High-Definition (HD) television, low cost chip and other interesting features of this new technology it can be predicted that the anticipated worldwide market for this technology is vast. Within next few years, we expect GI-FI to be the dominant technology for wireless networking. By providing low-cost, high broadband access, with very high speed large files swapped within seconds it could develop wireless home and office of future.

As the integrated transceiver is extremely small, it can be embedded into devices. The breakthrough will mean the networking of office and home equipment without wires will finally become a reality. The GI-FI integrated transceiver chip may be launched by the starting of next year by NICTA. Due to the less cost of chip so many companies are coming forward to launch the chip. The potential of microwave

Companies like Intel, LG, Panasonic, Samsung, Sony & Toshiba to form wireless HD. Specifically wireless HD has a stated goal of enabling wireless connectivity for streaming high definition content between source devices and high definition devices.

VI. CONCLUSION

In this paper GI-FI technology is defined that will allow wireless transfer of audio and video data up to 5 gigabits per second, ten times the current maximum wireless transfer rate, at one-tenth of the cost, usually within a range of 10 meters that operates at 60GHz on the CMOS process. This technology removes cables that for many years curled the world and provides high speed data transfer rate. The comparison that is performed between GI-FI and existing wireless technologies in this paper shows that these features along with some other benefits such as Low-cost chip, No Frequency Interference, Low Power Consumption and High Security that are explained in detail in this paper, makes it suitable to replace the existing wireless technologies for data transmission between devices that are placed in the short distances from each other. GI-FI technology has much number of applications and can be used in many places and devices such as smart phones, wireless pan networks, media access control and mm-Wave video-signals transmission systems. This chip could also replace HDMI cables and develop wireless home and office of future. Finally some of the future works related to GI-FI has given and it is conspicuous that more research should be done in the field of this new wireless technology and its applications.

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