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Future Tendency In Fiber Optics Communication

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Abstract- **Fiber optic communication is a communication technology that uses light pulses to transfer information from one point to another through an optical fiber.Thousands of these optical fibers are arranged in bundles in optical cables and are used to transmit light signals over long distance. They key requirement in today's world is wide bandwidth signal transmission with low delay. By the using optical fiber system we can provide huge and unsurpassed transmission bandwidth with negligible latency, and are now the transmission medium of choice for long distance and high data rate transmission in telecommunication networks.The new type of optical fiber as allowing 21 times more bandwidth than currently available in communication networks. This paper gives an overview of fiber optic communication system including their key technologies, and also discusses their technological trend towards the next generation.**

Key words – Bandwidth, Broadband, Fiber optics, Latency, Telecommuicaion

I.INTRODUCTION

Optical communication provides the high-capacity networking infrastructure that supports today's Internet. Consequently, it has enabled our global communication revolution, brought the world together at increasing speeds, and improved the quality of life for people everywhere.Modern optical networks feature transmission links that can reach high data-capacity on a single fiber by combining many wavelengths, operating at rates as high as 100 Gigabytes per second onto a single fiber.Optical communications historically has specialized in the transmission of large amounts of data over long distances. By the help of dispersion management we can improved the transmission capacity of the optical fiber.Optic fiber system largely replaced the radio transmission system. It is widely used for telephony, internet traffic, LANs , cable T.V etc. In optical Fiber a single silica fiber can carry hundreds of thousands of telephone channels, utilizing only a small part of the theoretical capacity.Day by day so many new technologies emerging such as CDMA , GSM, Wi-Max,etc. Within the last 30 years, the transmission capacity of optical fibers has been increased enormously. The rise in available transmission bandwidth per fiber is

even significantly faster than e.g. the increase in storage capacity of electronic memory chips, or in the increase in computation power of microprocessors. Researchers have developed a new fibre optic technology capable of transferring data at a rate of 255 terabits per second - more data than the total traffic flowing across the internet at peak time.According to a report from Intel in 2013, 10.6 terabytes of IP data is transferred across the globe every second - roughly one third of the 32 terabytes per second that the new experimental multi-core optical fibre is capable of.At such speeds, it is possible to transfer a 1GB movie in 0.03 milliseconds, or a one terabyte file – 1,000GB of data – in just 0.03 seconds.

II. BASIC PRINCIPLES OF FIBER OPTIC COMMUNICATION

The information transmitted is essentially digital information generated by telephone systems, cable television companies, and computer systems. An optical fiber is a dielectric cylindrical waveguide made from low-loss materials, usually silicon dioxide. The core of the waveguide has a refractive index a little higher than that of the outer medium (cladding), so that light pulses is guided along the axis of the fiber by total internal reflection.

The fiber optic communication system also is to transfer the signal containing information (voice,data,video) from the source to the destination. To convert the information into a form compatible with the communications medium. This is usually done by converting continuous analog signal such as voice and video (TV) signals into a series of digital pulses. An analog to digital converter is used for this purpose. This digital pulse are then used to flash a powerful light source off and on very rapidly. In a simple low cost system that transmits over short

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diode (LED). The light beam pulses are then fed into a fiber - optic cable where they are transmitted over long distances. At the receiving end, a light sensitive device known as a photocell or light detector is used to detect the light pulse. The photocell or photo detector converts the light pulses into an electrical signal. The electrical pulses are amplified and reshaped back into digital form. Both the light sources at the sending end and the light detectors on the receiving end must be capable of operating at the same data rate. The circuitry that drives the light source and the circuitry that amplifies and processes the detected light must both have suitable high – frequency response. The fiber itself must not distort the high-speed light pulses used in the data transmission. They are fed t a decoder , such as a Digital to Analog converter(D\A), where the original voice or video is recovered. In very long transmission system, repeater units must be used along the way. Since the light is greatly attenuated when it travels over long distance, at some point it may be too weak to be received reliably. To overcome this problem, special relay stations are used to pick up light beam, convert it back into electrical pulses that are amplified and then retransmit the pulses on another beam. The conventional problems of wire systems like those of ringing, cross talk, electromagnetic interference and induced errors, etc., optical fibers offers the following significant advantages for space

We can categorize the fiber optic communication in two categories:

1. Step Index

a. Single Mode
b. Multimode

2. Guided Index

Step Index:

These types of fibers have sharp boundaries between the core and cladding, with clearly defined indices of refraction. The entire core uses single index of refraction.

Single Mode Step Index:

Single mode fiber has a core diameter of 8 to 9 microns, which only allows one light path or mode.

Multimode Step-Index Fiber:

Multimode fiber has a core diameter of 50 or 62.5 microns (sometimes even larger). It allows several light paths or modes. This causes modal dispersion – some modes take longer to pass through the fiber than others

environment, namely high bandwidth, noise immunity, inherent radiation hardness, reduced weight, low bit error rate, size, weight and volume reduction. Figure 1 gives description of a basic fiber optic communication system

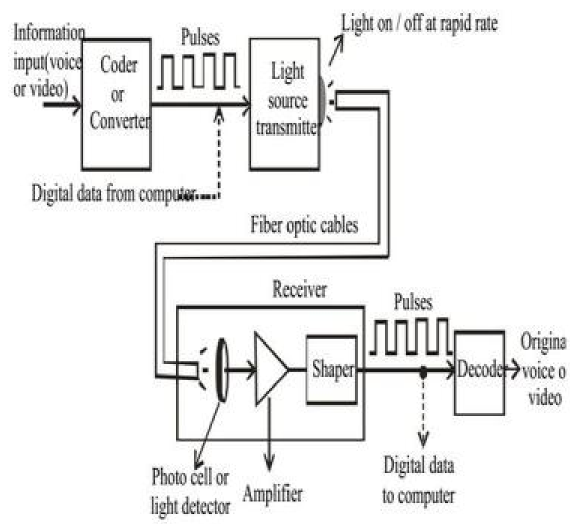

Fig.1. Fiber Optic Communication System

Multimode Graded-Index Fiber

Graded-index refers to the fact that the refractive index of the core gradually decreases farther from the centre of the core. The increased refraction in the centre of the core slows the speed of some light rays, allowing all the light rays to reach the receiving end at approximately the same time, reducing dispersion. Figure 2 Gives a Description of the Various Fiber Modes

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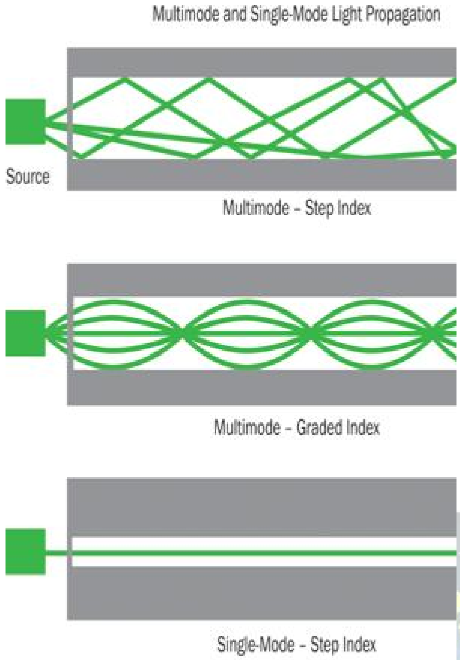

Fig.2.Optical Fiber Modes

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A research group at the Technical University of Denmark (DTU), which was the first to break the one-terabit barrier in 2009, has today managed to squeeze 43 terabits per second over a of around 5.4 terabytes per second.

Core: The inner light-carrying member

Cladding: The middle layer, which serves to confine the light to the core

Buffer: The outer layer which serves as a "shock absorber" to perfect the core and cladding from damage

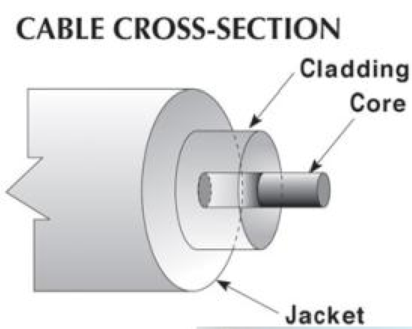

Fig.3.Optical Fiber Construction

III. EVOLUTION OF FIBER OPTICS COMMUNICATION

Optical fiber was first developed in 1970 by Corning Glass Works. At the same time, GaAs semiconductor lasers were also developed for transmitting light through the fiber optic cables. The first generation fiber optic system was developed in 1975, it used GaAs semiconductor lasers, operated at a wavelength of 0.8 μm, and bit rate of 45Megabits/second with 10Km repeater spacing.

In the early 1980's, the second generation of fiber optic communication was developed, it used InGaAsP semi conductor lasers and operated at a wavelength of 1.3 μm. By 1987, these fiber optic systems were operating at bit rates of up to 1.7 Gigabits/second on single mode fiber with 50Km repeater spacing.

The third generation of fiber optic communication operating at a wavelength of 1.55 μm was developed

single opticalfiber with just one laser transmitter. In a more user-friendly unit, 43Tbps is equivalent to a transfer rate.

in 1990. These systems were operating at a bit rate of up to 2.5 Gigabits/second on a single longitudinal mode fiber with 100Km repeater spacing.

The fourth generation of fiber optic systems made use of optical amplifiers as a replacement for repeaters, and utilized wavelength division multiplexing (WDM) to increase data rates. By 1996, transmission of over 11,300Km at a data rate of 5Gigabits/second had been demonstrated using submarine cables.

The fifth generation fiber optic communication systems use the Dense Wave Division Multiplexing (DWDM) to further increase data rates. Also, the concept of optical solitons, which are pulses that can preserve their shape by counteracting the negative effects of dispersion, is also being explored. Figure 3 shows the evolution of fiber optic communication.Figure4 shows the evolution of fiber optic communication

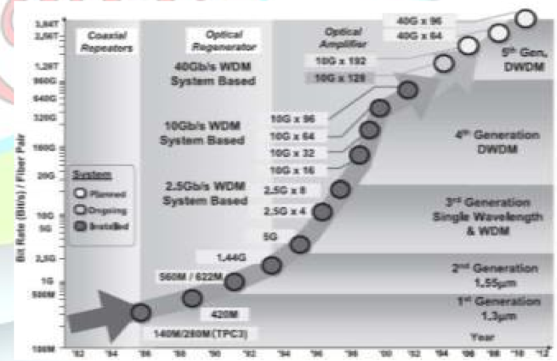

Fig.4. Generations of Fiber Optics Communication

IV. FUTURE TRENDS IN FIBER OPTICS

A.Communication

Fiber optics communication is definitely the future of data communication. The evolution of fiber optic communication has been driven by advancement in technology and increased demand for fiber optic communication. It is expected to continue into the future, with the development of new and more

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advanced communication technology. Below are some of the envisioned future trends in fiber optic communication.

B.All Optical Communication Networks

An all fiber optic communication is envisioned which will be completely in the optical domain, giving rise to an all optical communication network. In such networks, all signals will be processed in the optical domain, without any form of electrical manipulation. Presently, processing and switching of signals take place in the electrical domain, optical signals must first be converted to electrical signal before they can be processed, and routed to their destination. After the processing and routing, the signals are then re-converted to optical signals, which are transmitted over long distances to their destination. This optical to electrical conversion, and vice versa, results in added latency on the network and thus is a limitation to achieving very high data rates other benefit of all optical networks is that there will not be any need to replace the electronics when data rate increases, since all signal processing and routing occurs in the optical domain. However, before this can become a reality, difficulties in optical routing, and wavelength switching has to be solved. Research is currently ongoing to find an effective solution to these difficulties.

C. Multi – Terabit Optical Networks

Dense Wave Division Multiplexing (DWDM) paves the way for multi-terabit transmission. The world-wide need for increased bandwidth availability has led to the interest in developing multi-terabit optical networks. Presently, four terabit networks using 40Gb/s data rate combined with 100 DWDM channels exists. Researchers are looking at achieving even higher bandwidth with 100Gb/s. With the continuous reduction in the cost of fiber optic components, the availability of much greater bandwidth in the future is possible.

D. Intelligent Optical Transmission Network

Presently, traditional optical networks are not able to adapt to the rapid growth of online data services due to the unpredictability of dynamic allocation of bandwidth, traditional optical networks rely mainly on manual configuration of network connectivity, which is time consuming, and unable to fully adapt to the demands of the modern network. Intelligent optical network is a future trend in optical network development, and will have the following applications: traffic engineering, dynamic resource route allocation, special control protocols for network management, scalable signaling capabilities, bandwidth on demand, wavelength rental, wavelength wholesale, differentiated services for a variety of Quality of Service levels, and so on. It will take some time before the intelligent optical network can be applied to all levels of the network, it will first be applied in long-haul networks, and gradually be applied to the network edge.

E. Ultra – Long Haul Optical Transmission

In the area of ultra-long haul optical transmission, the limitations imposed due to imperfections in the transmission medium are subject for research. Cancellation of dispersion effect has prompted researchers to study the potential benefits of soliton propagation. More understanding of the interactions between the electromagnetic light wave and the transmission medium is necessary to proceed towards an infrastructure with the most favorable conditions for a light pulse to propagate.

F. Improvements in Laser Technology

Another future trend will be the extension of present semiconductor lasers to a wider variety of lasing wavelengths. Shorter wavelength lasers with very high output powers are of interest in some high density optical applications. Presently, laser sources which are spectrally shaped through chirp managing to compensate for chromatic dispersion are available. Chirp managing means that the laser is controlled such that it undergoes a sudden change in its wavelength when firing a pulse, such that the chromatic dispersion experienced by the pulse is reduced. There is need to develop instruments to be used to characterize such lasers. Also, single mode tunable lasers are of great

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importance for future coherent optical systems. These tunable lasers in a single longitudinal mode that can be tuned to a range of different frequencies.

G. Laser Neural Network Nodes

The laser neural network is an effective option for the realization of optical network nodes. A dedicated hardware configuration working in the optical domain and the use of ultra-fast photonic sections is expected to further improve the capacity and speed of telecommunication networks. As optical networks become more complex in the future, the use of optical laser neural nodes can be an effective solution.

H. Polymer Optic Fibers

Polymer optical fibers offer many benefits when compared to other data communication solutions such as copper cables, wireless communication systems, and glass fiber. In comparison with glass optical fibers, polymer optical fibers provide an easy and less expensive processing of optical signals, and are more flexible for plug interconnections. The use of polymer optical fibers as the transmission media for aircrafts is presently under research by different Research and Development groups due to its benefits. The German

Aerospace Center have concluded that "the use of Polymer Optical Fibers multimedia fibers appears to be possible for future aircraft applications. Also, in the future, polymer optical fibers will likely displace copper cables for the last mile connection from the telecommunication company's last distribution box and the served end consumer. The future Gigabit Polymer Optical Fiber standard will be based on Tomlinson-Harashima Precoding,Multilevel PAM Modulation, and Multilevel Coset Coding Modulation.

I. High – Altitude Platforms

Presently, optical inter satellite links and orbit-to-ground links exists, the latter suffering from unfavorable weather conditions. Current research explores optical communication to and from high altitude platforms. High altitude platforms are airships situated above the clouds at heights of 16 to 25Km, where the unfavorable atmospheric impact on a laser beam is less severe than directly above the ground. As shown in figure 4, optical links between high-altitude platforms, satellites and ground stations are expected to serve as broadband back-haul communication channels, if a high-altitude platform functions as a data relay station.

Fig.5. Laser Communication Scenarious from HAPs

J. Improvements in Optical Transmitter/ReceiverTechnology

In fiber optics communication, it is important to achieve high quality transmission even for optical signals with distorted waveform and low signal to noise ratio during transmission. Research is ongoing to develop optical transceivers adopting new and advanced modulation technology, with excellent chromatic dispersion and Optical Signal to Noise Ratio (OSNR) tolerance, which will be suitable for ultra-long haul communication systems. Also, better error correction codes, which are more efficient than the present BCH concatenated codes are envisioned to be available in the nearest future.

K. Improvement in Optical Amplification Technology

Erbium Doped Fiber Amplifier (EDFA) is one of the critical technologies used in optical fiber communication systems. In the future, better technologies to enhance EDFA performance will be developed. In order to increase the gain bandwidth of EDFA, better gain equalization technology for high accuracy optical amplification will be developed. Also, in order to achieve a higher output power, and a

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lower noise figure, high power pumping lasers that possess excellent optical amplification characteristics with outputs of more than +20dBm, and very low noise figure are envisioned to exist in the nearest future.

L. Advancement in Network Configuration of OpticalSubmarine Systems

In order to improve the flexibility of network configuration in optical submarine communication systems, it is expected that the development of a technology for configuring the mesh network will be a step in the right direction. As shown in figure 5, while a ring network joins stations along a single ring, a mesh network connects stations directly. Presently, most large scale optical submarine systems adopt the ring configuration. By adopting the optical add/drop multiplexing technology that branches signals in the wavelength domain, it is possible to realize mesh network configuration that directly inter-connects the stations. Research is ongoing, and in the future such network configuration will be common.

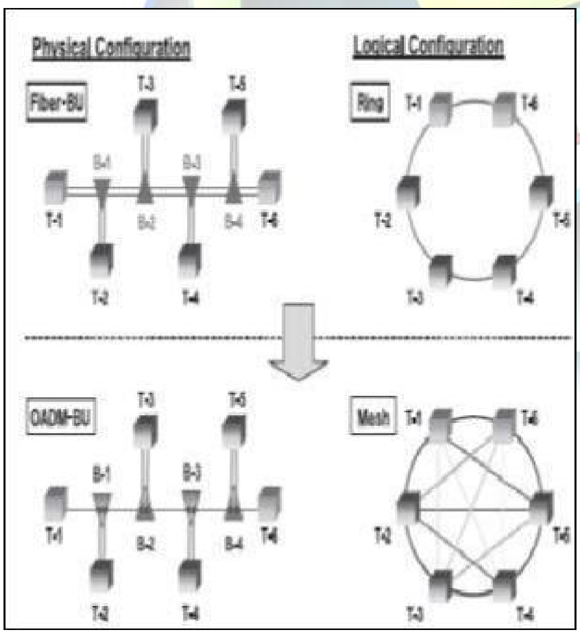

Fig.6. Optical Network Configurations

M. Improvement in WDM Technology

Research is ongoing on how to extend the wavelength range over which wave division multiplexing systems can operate. Presently, the wavelength window (C band) ranges from 1.53-1.57µm. Dry fiber which has a low loss window promises an extension of the range to 1.30 – 1.65 µm. Also, developments in optical filtering technology for wave division multiplexing are envisioned in the future.

N. Improvements in Glass Fiber Design and Component Miniaturization

Presently, various impurities are added or removed from the glass fiber to change its light transmitting characteristics. The result is that the speed with which light passes along a glass fiber can be controlled, thus allowing for the production of customized glass fibers to meet the specific traffic engineering requirement of a given route. This trend is anticipated to continue in the future, in order to produce more reliable and effective glass fibers. Also, the miniaturization of optical fiber communication components is another trend that is most likely to continue in the future.

V.CONCLUSIONS AND DISCUSSION

The main objective of this paper is to review of the latest research and development in the field of fiber optic communication. Fiber optics have a high bandwidth capabilities and low attenuation characteristics make it ideal for gigabit transmission and beyond.The growth of the fiber optics industry over the past five years has been explosive.

The techniques used by DTU to hit 43Tbps actually have a chance of making it into real-world networks in the next few years. You might soon be able to download a TV show or movie in quite literally the blink of an eye.Analysts expect that this industry will continue to grow at a tremendous rate well into the next decade and beyond.

REFERENCE

[1] Franz Fidler, Markus Knapek, Joachim Horwath, and Walter R.Leeb, "Optical Communications for High-Altitude Platforms", IEEE Journal of Selected Topics in Quantum Electronics, Vol. 16, no. 5, September/October 2010.

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[2] Prachi Sharma et al, "A Review of the Development in the Field of Fiber Optic Communication Systems", International Journal of Emerging Technology and Advanced Engineering, Vol. 3, no. 5, pp. 113-119, 2013

[3] T. Otani, K. Goto, H. Abe, M. Tanaka, H. Yamamoto, and H.Wakabayashi, Electron. Lett.31, 380, 1995.

[4] "Status of Optical Communication Technology and Future Trends", available at: www.qqread.net, 2013.

[5] U.H.P. Fischer, M.Haupt and M.Janoic, "Optical Transmission Systems Using Polymeric Fibers", In Tech, available from: http://www.intechopen.com/books, 2011.

[6] Colin Yao, "The Future of Fiber Optic Communication", available at: www.streetdirectory.com, 2013.

[7] DanKloe, Henrie Van Den Boom, "Trends in Electro-optical Communication Systems, Perspectives on Radio Astronomy: Technologies for Large Antenna Arrays, Proceedings of the Conference held at the ASTRON Institute in Dwingeloo on 12- 14 April 1999. Edited by A. B. Smolders and M. P. Haarlem. Published by ASTRON. ISBN: 90-805434-2-X, 354 pages, 2000., p.2851999.