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CONTEMPORARY INCLINATIONS IN FIBER OPTIC COMMUNICATIONS

K.V.S.S.S.S.Sairam, E. Nithya

Department of Electronics and Communications Engineering
Dhanalakshmi Srinivasan Engineering College, Tamil Nadu, India

Abstract–Fiber optic systems are essential telecommunication infrastructure for global broadband networks. Wide bandwidth sign transmission with low delay is a key requirement in present-day applications. Optical fibers provide huge and unsurpassed transmission bandwidth with negligible latency and are now the transmission medium of choice for lengthy distance and high data rate transmission in telecommunication networks. This paper gives an overview of fiber optic verbal exchange systems inclusive of their key applied sciences and additionally discusses their technological style closer to the next generation.

Index Terms - Bandwidth, Broadband, Fiber optics, Latency, Telecommunication.

I. INTRODUCTION

The fundamental driving force behind the extensive use of fiber optics conversation is the high and rapidly increasing client and industrial demand for extra telecommunication capability and net services, with fiber optic science succesful of providing the required records capability (larger than each wi-fi connections and copper cable). Advances in technology have enabled extra facts to be conveyed via a single optical fiber over lengthy distances. The transmission ability in optical verbal exchange networks is substantially elevated the usage of wavelength division multiplexing [1].

A perfect characteristic for future optical networks is the capacity to system statistics completely in the optical domain for the purpose of amplification, multiplexing, de-multiplexing, switching, filtering, and correlation considering the fact that optical sign processing is greater efficient than electrical signal processing. Several new training of optical verbal exchange networks are at present rising [2]. For example, Code Division Multiple Access networks the usage of optical signal processing methods have these days been introduced [3].

Despite the associated advantages of utilising optical fiber for communication (such as its high reliability over lengthy distances, low attenuation, low interference, excessive security, very high records capacity, longer lifespan and ease of maintenance), lookup is nevertheless ongoing to further improve on the present fiber optics verbal exchange system, and also to clear up some of the challenges facing it. Future optical conversation structures are predicted to be more sturdy than the present system. This paper is geared up as follows. Section II describes the simple ideas of fiber optics communication. Section III looks at the history and evolution of fiber optics conversation while section IV presents some expected future tendencies in fiber optics communication. In area V, we draw a conclusion for the paper.

II. BASIC PRINCIPLES OF FIBER OPTIC COMMUNICATION

Fiber optic conversation is a verbal exchange technology that uses light pulses to transfer data from one factor to every other through an optical fiber. The statistics transmitted is in actuality digital information generated by using smartphone systems, cable tv companies, and pc 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 greater than that of the outer medium (cladding) so that light pulses is guided alongside the axis of the fiber by whole inner reflection [4]. Fiber optic conversation systems consist of an optical transmitter to convert an electrical signal to an optical signal for transmission through the optical fiber, a cable containing a number of bundles of optical fibers, optical amplifiers to improve the strength of the optical signal, and an optical receiver to reconvert the obtained optical signal returned to the authentic transmitted electrical signal. Figure 1 gives a simplified description of a simple fiber optic conversation system.

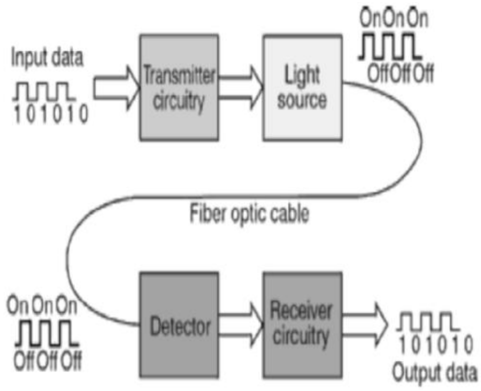

Fig.1. Basic fiber optic communication system [5]

Optical fibers fall into two predominant categories, namely: step index optical fiber, which includes single mode optical fiber and multimode optical fiber, and graded index optical fiber. Single mode step index optical fiber has a core diameter much less than 10 micrometers and only allows one mild path. Multimode step-index optical fiber has a core diameter greater than or equal to 50 micrometers and lets in countless light paths, this leads to modal dispersion. Graded index optical fibers have their core refractive index steadily reduce farther from the middle of the core; this extended refraction at the core middle slows the speed of some light rays, thereby permitting all the light rays to attain the receiver at nearly the identical time, thereby decreasing dispersion. Figure 2 gives a description of the a variety of optical fiber modes.

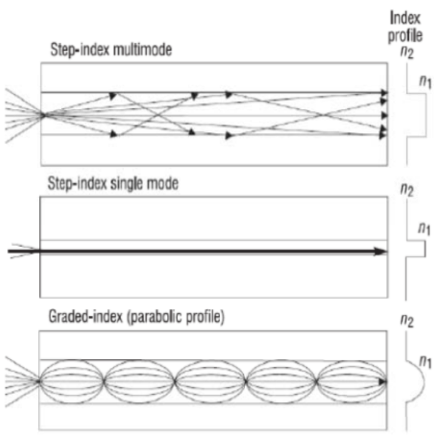

Fig.2. Optical Fiber Modes [6]

III. EVOLUTION OF FIBER OPTICS COMMUNICATION

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

In the early 1980s, the 2d generation of fiber optic communication was developed, it used InGaAsP semiconductor lasers and operated at a wavelength of 1.3 μm. By 1987, these fiber optic systems were working at bit quotes of up to 1.7 Gigabits/second on single-mode fiber with 50Km repeater spacing.

The 1/3 era of fiber optic communication running at a wavelength of 1.55 μm was once developed in 1990. These systems have been running 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 structures made use of optical amplifiers as a alternative for repeaters and utilized wavelength division multiplexing (WDM) to amplify data rates. By 1996, transmission of over 11,300Km at a records rate of 5Gigabits/second had been proven using submarine cables [7].

The fifth era fiber optic conversation systems use the Dense Wave Division Multiplexing (DWDM) to further increase statistics rates. Also, the notion of optical solutions, which are pulses that can hold their form by means of counteracting the bad consequences of dispersion, is additionally being explored. Figure 3 suggests the evolution of fiber optic communication.

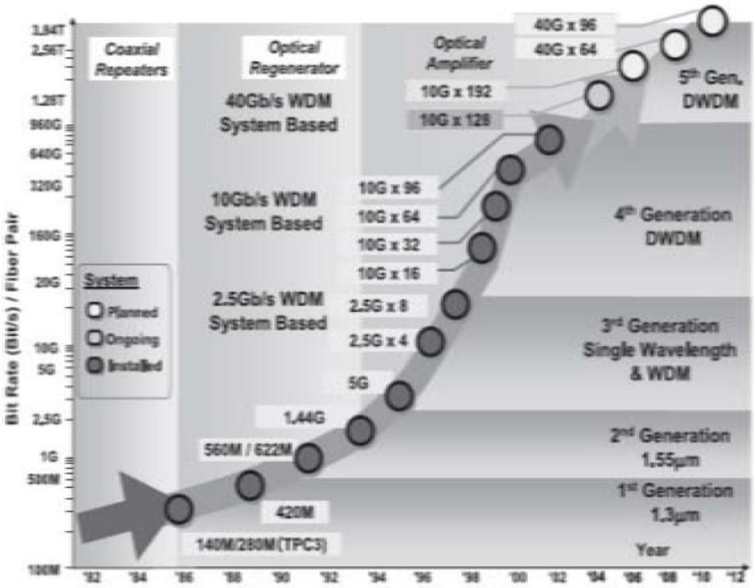

Fig.3. Generations of Fiber Optics Communication [8]

IV. FUTURE TRENDS IN FIBER OPTICS COMMUNICATION

Fiber optics verbal exchange is sincerely the future of information communication. The evolution of fiber optic communication has been pushed with the aid of development in science and multiplied demand for fiber optic communication. It is expected to proceed into the future, with the improvement of new and more advanced communication technology. Below are some of the anticipated future trends in fiber optic communication.

A. All Optical Communication Networks

An all fiber optic verbal exchange is expected which will be completely in the optical domain, giving upward jostle to an all optical verbal exchange network. In such networks, all indicators will be processed in the optical domain, except any shape of electrical manipulation. Presently, processing and switching of alerts take place in the electrical domain, optical indicators have to first be converted to electrical sign 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 lengthy distances to their destination. This optical to electrical conversion, and vice versa, effects in added latency on the network and for that reason is a predicament to accomplishing very high statistics rates.

Another benefit of all optical networks is that there will no longer be any need to replace the electronics when records fee increases, when you consider that all signal processing and routing takes place in the optical domain [9]. However, before this can emerge as a reality, difficulties in optical routing, and wavelength switching has to be solved. Research is presently ongoing to locate an tremendous answer to these difficulties.

B. Multi – Terabit Optical Networks

Dense Wave Division Multiplexing (DWDM) paves the way for multi-terabit transmission. The world-wide need for expanded bandwidth availability has led to the activity in developing multi-terabit optical networks. Presently, 4 terabit networks using 40Gb/s information charge mixed with one hundred DWDM channels exists. Researchers are searching at reaching even greater bandwidth with 100Gb/s. With the non-stop discount in the price of fiber optic components, the availability of much increased bandwidth in the future is possible.

C. Intelligent Optical Transmission Network

Presently, usual optical networks are not able to adapt to the speedy boom of on line information offerings due to the unpredictability of dynamic allocation of bandwidth, typical optical networks matter generally on guide configuration of network connectivity, which is time consuming, and unable to utterly adapt to the needs of the current network. Intelligent optical network is a future vogue in optical network improvement [2], and will have the following applications: site visitors engineering, dynamic resource route allocation, different control protocols for community 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 earlier than the shrewd optical community can be utilized to all tiers of the network, it will first be applied in long-haul networks, and gradually be applied to the community facet [10].

D. Ultra – Long Haul Optical Transmission

In the area of ultra-long haul optical transmission, the barriers imposed due to imperfections in the transmission medium are problem for research. Cancellation of dispersion impact has brought about researchers to study the potential benefits of soliton propagation. More appreciation of the interactions between the electromagnetic light wave and the transmission medium is integral to proceed towards an infrastructure with the most favorable conditions for a light pulse to propagate [11].

E. Improvements in Laser Technology

Another future vogue will be the extension of existing semiconductor lasers to a wider range of lasing wavelengths [12]. Shorter wavelength lasers with very high output powers are of hobby in some high density optical applications. Presently, laser sources which are spectrally shaped thru chirp managing to compensate for chromatic dispersion are available. Chirp managing potential that the laser is managed such that it undergoes a surprising exchange in its wavelength when firing a pulse, such that the chromatic dispersion skilled by way of the pulse is reduced. There is need to advance devices to be used to characterize such lasers. Also, single mode tunable lasers are of wonderful significance for future coherent optical systems. These tunable lasers lase in a single longitudinal mode that can be tuned to a range of exclusive frequencies.

F. Laser Neural Network Nodes

The laser neural network is an nice choice for the attention of optical network nodes. A devoted hardware configuration working in the optical domain and the use of ultra-fast photonic sections is expected to further enhance the capability and speed of telecommunication networks [12]. As optical networks grow to be extra complex in the future, the use of optical laser neural nodes can be an tremendous solution.

G. Polymer Optic Fibers Polymer optical fibers provide many advantages when in contrast to different facts conversation options such as copper cables, wi-fi conversation systems, and glass fiber. In contrast with glass optical fibers, polymer optical fibers provide an convenient and less expensive processing of optical signals, and are more bendy for plug interconnections [13]. The use of polymer optical fibers as the transmission media for aircrafts is presently under research through extraordinary Research and Development companies due to its benefits. The German Aerospace Center have concluded that "the use of Polymer Optical Fibers multimedia fibers seems to be feasible for future plane functions [14]. Also, in the future, polymer optical fibers will in all likelihood displace copper cables for the ultimate mile connection from the telecommunication company's remaining distribution container and the served stop consumer [15]. The future Gigabit Polymer Optical Fiber wellknown will be primarily based on Tomlinson-HarashimaPrecoding,Multilevel PAM Modulation, and Multilevel Coset Coding Modulation.

H. High – Altitude Platforms
Presently, optical inter-satellite links and orbit-to-ground links exist [16], the latter suffering from destructive weather prerequisites [17]. Current research explores optical verbal exchange to and from excessive altitude platforms. High altitude structures are airships located above the clouds at heights of 16 to 25Km, where the negative atmospheric have an impact on on a laser beam is much less extreme than without delay above the floor [18]. As shown in discern 4, optical links between excessive altitude platforms, satellites and ground stations are anticipated to serve as broadband back-haul communication channels, if a high-altitude platform features as a facts relay station.

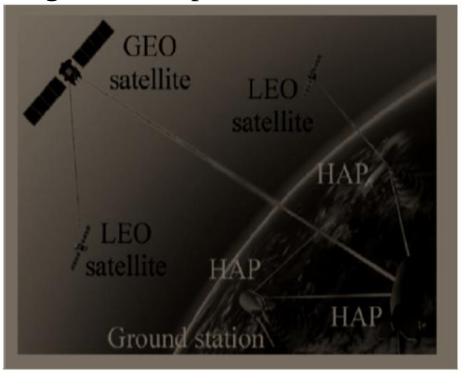

Fig.4. Laser Communication Scenarios from HAPs [4]

I. Improvements in Optical Transmitter/Receiver Technology
In fiber optics communication, it is essential to gain remarkable transmission even for optical signals with distorted waveform and low signal to noise ratio at some stage in transmission. Research is ongoing to improve optical transceivers adopting new and superior modulation technology, with remarkable chromatic dispersion and Optical Signal to Noise Ratio (OSNR) tolerance, which will be suitable for ultra-long haul verbal exchange systems. Also, higher error correction codes, which are extra efficient than the current BCH concatenated codes are predicted to be on hand in the nearest future.

J. Improvement in Optical Amplification Technology
Erbium Doped Fiber Amplifier (EDFA) is one of the quintessential technologies used in optical fiber conversation systems. In the future, better applied sciences to decorate EDFA performance will be developed. In order to expand the acquire bandwidth of EDFA, higher achieve equalization

technology for excessive accuracy optical amplification will be developed. Also, in order to achieve a greater output power, and a lower noise figure, high power pumping lasers that possess outstanding optical amplification traits with outputs of greater than +20dBm, and very low noise discern are estimated to exist in the nearest future. K. Advancement in Network Configuration of Optical Submarine Systems

In order to enhance the flexibility of network configuration in optical submarine verbal exchange systems, it is anticipated that the improvement of a science for configuring the mesh community will be a step in the proper direction. As shown in discern 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 indicators in the wavelength domain, it is viable to realize mesh network configuration that without delay inter-connects the stations. Research is ongoing, and in the future, such community configuration will be common.

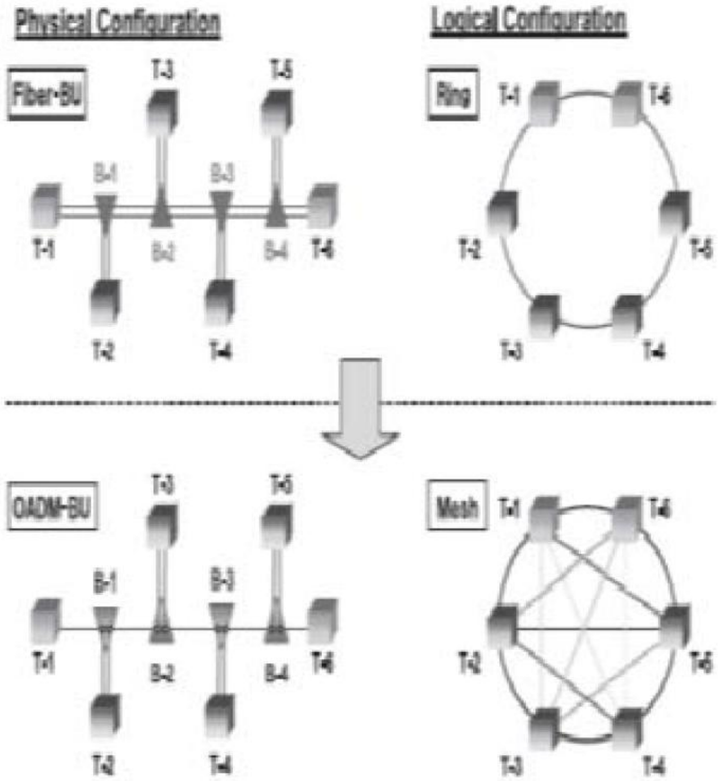

Fig.5. Optical Network Configurations [8]

L. Improvement in WDM Technology

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

M. Improvements in Glass Fiber Design and Component Miniaturization

Presently, a range of impurities are delivered or eliminated from the glass fiber to change its mild transmitting characteristics. The result is that the pace with which mild passes along a glass fiber can be controlled, therefore allowing for the manufacturing of personalized glass fibers to meet the particular visitors engineering requirement of a given route. This fashion is expected to continue in the future, in order to produce extra reliable and effective glass fibers. Also, the miniaturization of optical fiber communication aspects is some other trend that is most probable to proceed in the future. Switching strategies and extra smart network architectures that can automatically change dynamically in response to visitors patterns and at the identical time be value efficient. The trend is anticipated to continue in the future as breakthroughs already attained in the laboratory will be prolonged to practical deployment thereby leading to a new technology in fiber optics communications.

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