

## Future Broadband Access Network Challenges

<sup>1</sup>Dr.K.Spurthi, Associate Professor , CSE(AIML), Kolluspoorthy03@gmail.com  
Swarna Bharathi institute of science and technology,

Khammam,

<sup>2</sup>B.Yugandhara Chary ,Assistant Professor, CSE(AIML), yugandhar.bandla@gmail.com  
Swarna Bharathi institute of science and technology,

Khammam

<sup>3</sup>B.Sowjanya, ,Assistant Professor, CSE(AIML), sowjib.194@gmail.com  
Swarna Bharathi institute of science and technology,

Khammam

### ABSTRACT

The convergence of optical and wireless communication systems will unlock the potential capacity of photonic technology to support the anticipated growth in interactive video, audio communication, and data traffic services, offering cost-effective and environmentally sustainable communication solutions. The growth of broadband internet over the past decade indicates that the number of active consumers will exceed 2 billion worldwide by the end of 2014. Enabling the unused capacity of photonic signal processing represents a promising solution for the seamless conveyance of future consumer traffic demands. This paper examines the projected development of internet traffic, the global wireless subscriber base, and end-user adoption over the past and upcoming decades. The limitations of conventional access networks and Radio over Fiber solutions are outlined.

### I.INTRODUCTION

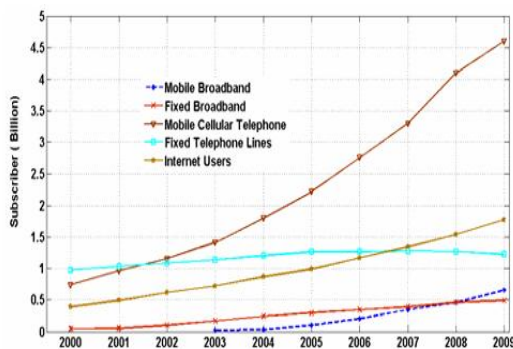
The evolving landscape of data communications and telecommunications has resulted in a sustained increase in the demand for transmitting vast quantities of information over considerable distances. The technologies that were widely utilized in the past, such as coaxial cable, satellite, and microwave radio for information transmission, were rapidly approaching their capacity limits. There was an increasing demand for a communication medium suitable for chaotic industrial environments where data transmission is required. This issue was resolved through the implementation of fiber optic communication systems. Fiber optic transmission has emerged as one of the most dynamic and swiftly evolving areas within telecommunication engineering. Fiber optic communication systems offer numerous advantages compared to traditional transmission systems. They are less susceptible to noise, entirely immune to electromagnetic interference (EMI) and radio

frequency interference (RFI), do not conduct electricity and thus offer electrical isolation, remain unaffected by lightning and high-voltage switching, and support exceptionally high data transmission rates over considerable distances, [1], [2]. The projected future network traffic, comprising approximately one hundred exabytes in video, data, mobile, and wireless communications, has already been demonstrated [3]. The transportation of the substantial traffic demand necessitates significantly greater network transmission bandwidth than the current infrastructure can support. By leveraging the extensive capacity of the optical communication network and system, along with ongoing technological advancements, this scheme is anticipated to become accessible in the near future. As a result, research activity in the field of optical networks and radio over fiber has experienced rapid and consistent growth over the past several years. This is due to the fact that optical communication is a promising solution to meet the continuously rising demand for bandwidth, leveraging the extensive capacity of fiber optics and its cost-effectiveness. In a different perspective, wireless communication is progressing into a new stage, with the emphasis transitioning from voice to multimedia services. Present-day consumers are no longer concerned with the underlying technology; their primary requirement is for dependable and cost-effective communication systems capable of supporting any media, at any time and from any location [1]. The structure of the paper is outlined as follows. In Section II, the growth in global internet and wireless network subscriptions over the past decade across various service domains—including wireless and fixed broadband, wireline, and mobile communication—is examined. In Section III, we have examined the solutions for transportation in the context of significant traffic demand, aligned with the anticipated growth in interactive video, voice communication, and data traffic to deliver

cost-effective communication services. In Section IV, the Radio over Fiber technique and system are presented as a comprehensive infrastructure and superstructure offering a promising solution for supporting super-broadband services for future end-users. It is characterized as a reliable, cost-effective, and environmentally friendly technology. Additionally, sample simulation results are provided. Finally, the concluding remarks are presented in Section V.

## II. Expansion of the Internet and Wireless Networks

Broadband wireless occupies a pivotal position at the intersection of two of the most significant growth narratives within the telecommunications industry in recent years.



**Figure 1. Global expansion of mobile telephony subscribers, internet consumers, and broadband access.**

Both wireless and broadband technologies have experienced their own swift and widespread diffusion in the mass market. Wireless mobile services have expanded from 11 million subscribers globally in 1990 to over 4.6 billion by the conclusion of 2009. In fact, the world's largest manufacturer of mobile phones has projected that by 2010, there will be over 3 billion mobile consumers worldwide. Furthermore, the number of active consumers accessing the internet through mobile broadband is projected to exceed 2 billion worldwide by the end of 2014. Furthermore, the fixed broadband subscribers, which numbered only 57,000 in 1998, increased to 487 million by the end of 2009. It is projected that this number will surpass 680 million within the next four years by 2013, notwithstanding the current economic conditions [2].

The increase in the number of telephone subscribers, broadband users, and Internet users over the past decade is illustrated in Fig. 1. The accessibility of a wireless broadband solution could potentially expedite this growth. There are significant concerns to address in order to justify this growth, including: (1) what are the applications that drive this expansion? Broadband users

worldwide are discovering that it significantly transforms the way we share information, conduct business, and pursue entertainment. (2) Will integrating the convenience of wireless technology with the robust performance of broadband represent the next frontier for industry growth? (3) Is such a combination technically feasible and commercially viable? , and \r\n(4) Can wireless technology provide broadband applications and services that are of interest to the end-user? Many industry analysts hold this view.

## III. FUTURE TRANSPORTATION SYSTEMS AND TRAFFIC

The widespread adoption of high-speed broadband and the continuous increase in internet traffic shifting from residential and business customers' homes have exerted significant demand on the underlying telecommunication infrastructure. There will be three phases of internet video development. The initial phase involves a growth in internet video consumption on personal computers. The subsequent phase will witness an increase in internet-delivered video content to television screens. The third phase will encompass a significant expansion in video communications. Each phase will affect a distinct aspect of the network. The initial two phases will predominantly affect the metro and access networks, whereas the third phase will influence the core network. In addition to internet video, there is significant growth in the IP transmission of cable and IPTV video-on-demand services, [2]. Only the virtually limitless bandwidth of a fiber-optic access network can deliver such capabilities for both wired and wireless connectivity. As illustrated in Fig. 2 (a) and (b), worldwide mobile data traffic is projected to double annually, reaching more than 2 exabytes per month by 2013. Furthermore, mobile data traffic is projected to increase from 1 petabyte per month to 1 exabyte per month in half the time required for fixed data traffic to achieve the same growth. Mobile voice service is now regarded as a fundamental requirement by many, and mobile data, video, and television are increasingly becoming integral components of end-users' daily activities. According to Fig. 1, the number of subscribers is increasing swiftly, and the demand for bandwidth due to data and video consumption is also rising. There is a requirement to augment backhaul capacity to support mobile broadband, data access, and video services in order to enhance end-user engagement and maintain cost efficiency.

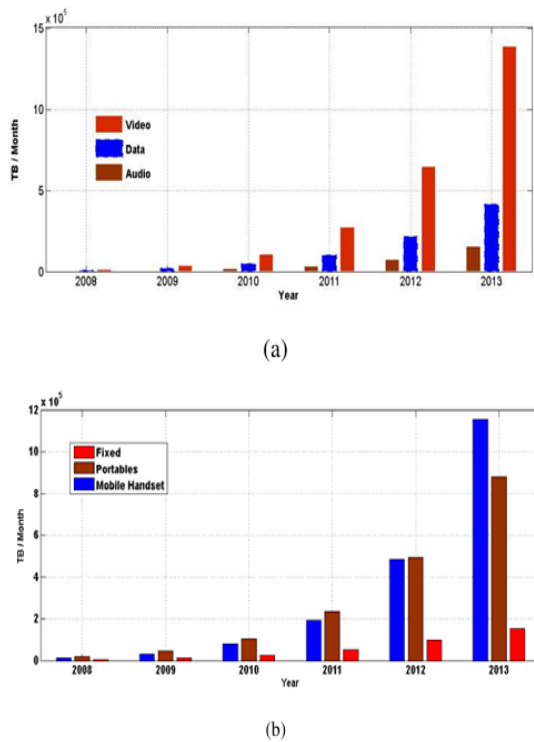


Fig. 2. The traffic growth of (a): the services type of traffic, (b): the wireless traffic

To deploy next-generation mobile networks, there is an increased demand for service portability and interoperability. With the proliferation of mobile and portable digital devices, there is an urgent need for networks to facilitate seamless connectivity for all these devices. The widespread expansion of wireless connectivity will lead to a significant increase in the number of consumers accessing and depending on mobile networks, thereby necessitating greater economies of scale and reduced per-bit costs. In response to this significant advancement, the metro and core networks of the telecommunication infrastructure have undergone substantial increases in bandwidth and capacity due to the extensive deployment of fiber optic technology over the past decade [4]. Data traffic velocities in metro and long-haul systems are progressing from 10 Gbps to 40 Gbps transmission, with 100 Gbps per wavelength channel systems emerging as the next advancement for core and metro networks [5]. Access bandwidth requirements for delivering multi-channel high-definition television (HDTV) signals and online gaming services are anticipated to increase to gigabits per second in the near future. However, the existing subscriber access networks have not been expanded proportionally. To prevent becoming the impediment in the final miles and meters, and to leverage the advantages of both wireline and wireless technologies, carriers and service providers are actively pursuing a convergent network architecture capable of delivering multiple services to accommodate both

fixed and mobile users. In this context, optical-wireless access technologies are regarded as the most promising solution for enhancing capacity, coverage, bandwidth, and mobility in environments such as conference centers, airports, hotels, retail complexes, and ultimately, residential and small office settings.

Therefore, the demand for utilization of the radio spectrum is extremely high, with terrestrial mobile phone and broadband internet systems representing only a subset of the numerous applications competing for adequate bandwidth. These applications necessitate systems capable of functioning reliably in non-line-of-sight conditions over propagation distances of 0.5 to 30 km, at velocities reaching 100 km/h or greater. This operating environment constrains the maximum RF frequency, since operating at very high frequencies near the millimeter-wave spectrum leads to significant channel path loss and increased Doppler spread at high velocities. This restricts the range available for mobile applications, thereby significantly increasing the value of the radio spectrum.

#### A. Optical Switching Framework

The primary challenges facing core and metro networks for future traffic conveyance are the current active electrical switching and routing systems, due to insertion delays in processing packets for switching within the electrical domain. Therefore, it requires time for the conversion of the signal between the optical and electrical domains, as well as for synchronization and data retiming processing. In particular, a significant portion of research in optical networks is focused on achieving transparency within optical networks to circumvent the Optical/Electrical/Optical (O/E/O) conversions at intermediate nodes in the network. Thus, several network protocols (such as MPLS, GMPLS, etc.) in conjunction with switching strategies (circuit, burst, or packet switching) are proposed to ensure data transparency within the network. Among the various switching strategies, burst switching is more compatible with existing optoelectronic technologies in terms of data transparency and switching speed. Packet switching is more efficient for data communication; however, due to the limited speed of electronic components (compared to the current optical bandwidth in fiber optics) and the incomplete development of all-optical signal processing alternatives, packet-based optical networks remain impractical for use in transparent optical networks, as illustrated in Fig. 3.

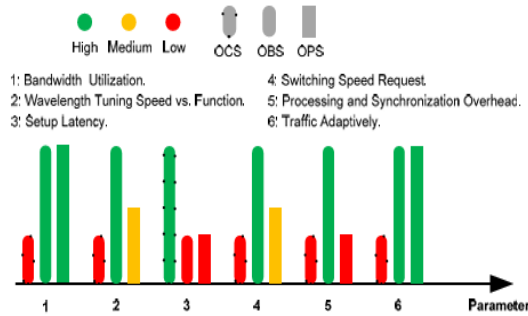


Fig. 3. The comparison between all-optical switching technologies.

Optical Packet Switching (OPS) has emerged as a viable candidate due to its nature as a purely connectionless networking solution that is fully compatible with IP-centric data traffic. It provides the highest network granularity, optimal bandwidth utilization, flexibility, high-speed performance, and the capability to utilize resources efficiently. An OPS denotes more stringent requirements than OBS due to real-time transmission processing. A more practical approach to the implementation of OPS involves the utilization of synchronously transmitted packets with fixed lengths. Nonetheless, in this instance, the hardware overhead pertains to the implementation of the packet synchronizer at the input. Despite their inherent feasibility limitations, OPS demonstrators contributed to the advancement of numerous ultra-fast switching and processing techniques, including wavelength conversion, header encoding and decoding, label swapping, rapid clock extraction, and regeneration. The primary challenges in OPS encompass the implementation of the optical header processing mechanism, the development of an intelligent switch controller, the achievement of ultra-fast switching at a nanosecond timescale, and the optimization of buffering mechanisms to mitigate packet blockage [6-9].

### B. Wireless and Wired Access Network

Currently, wireline and wireless services are delivered through two distinct physical networks. wireline networks utilizing Fiber to the Home (FTTH) access technologies offer substantial bandwidth to users but lack the flexibility required to support roaming connections. On the other hand, wireless networks provide mobility to users; however, they lack sufficient bandwidth to fully accommodate the high demand for multi-channel, high-definition video services. Therefore, the seamless integration of tethered and wireless services for future-proof access networks will facilitate the convergence of maximum high bandwidth capabilities for both fixed and mobile users within a unified, cost-effective transport platform. This can be achieved through the implementation of the advanced hybrid optical and

wireless networks, which are capable of transmitting wireless signals over fiber at the base station while concurrently delivering tethered services to end users. Broadband access not only facilitates speedier web browsing and more efficient file downloads, but also supports various multimedia applications, including real-time audio and video streaming, multimedia conferencing, and interactive gaming. Broadband connections are also utilized for voice telephony through Voice-over-Internet-Protocol (VoIP) technology. More sophisticated broadband access systems, such as FTTH and Very High Data Rate DSL (VDSL), facilitate applications including high-quality video entertainment, encompassing HDTV and Video on Demand (VoD). As the broadband market continues to expand, numerous new applications are expected to emerge, and it remains challenging to predict which will achieve success in the future. So, what is broadband wireless technology? Broadband wireless pertains to delivering the broadband experience within a wireless environment, providing users with distinct advantages and enhanced convenience. There are two essentially distinct categories of broadband wireless services. The initial efforts to deliver a range of services comparable to those of traditional fixed-line broadband, but utilizing wireless technology as the transmission medium. This variety, known as fixed wireless broadband, can be regarded as a competitive alternative to DSL or cable modem. The second category of broadband wireless technology, known as mobile broadband, provides the additional capabilities of portability, nomadicity, and mobility. Mobile broadband seeks to introduce broadband applications into novel user experience contexts and, as a result, can provide the end-user with a distinctly different value proposition.

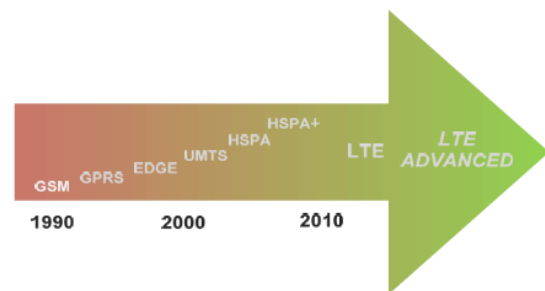


Fig. 4. Evolution of the GSM family toward Green Communication Technology.

For instance, WiMax (Worldwide Interoperability for Microwave Access) microwave access technology and Long Term Evolution .There is a novel radio platform technology in LTE that will Permit operators to attain even greater peak throughputs than High Speed Packet Access (HSPA+) in higher spectrum bandwidth. The



Optiwave-Optisystem and MATLAB environments, the attenuation and dispersion of the multimode fiber (MMF) are considered to be 2 dB/km and 100 ps/nm/km, respectively. A 10 mW laser source operating at 1550 nm is employed at the communication station as a continuous wave optical source. The system transmits a full-duplex 10 Gbit/s pseudo-random sequence that is orthogonally frequency division multiplexed (OFDM) and modulated with 4QAM (Quadrature Amplitude Modulation) over a 60 GHz RF carrier, which is itself modulated onto an optical carrier. The system performance is illustrated in Fig. 6 for full-duplex RoF signal transmission over a 1.5 km length of MMF, and the performance is heavily influenced by fiber attenuation and dispersion impairment.

## CONCLUSION

This paper presents the convergence of wireless and optical communication technologies for the deployment and provision of future ultra-broadband services. Fiber optic transmission has become one of the most exciting and rapidly dominant infrastructure mediums for the transportation of future large-scale fixed and mobile video content over the internet. This advancement is driven by the adoption of cost-effective and ultra-fast photonic switching, replacing active and passive electrical components and devices with their optical equivalents. Radio-over-Fiber as a solution has been addressing the distribution of broadband wireless signals in access networks, including the dynamic allocation of resources, with the deployment of basic and compact base stations under centralized operation being feasible. The demand for increased bandwidth allocation imposes a significant strain on the existing radio frequency (RF) spectrum and leads to spectral congestion at lower microwave frequencies.

## REFERENCE:

- 1.2R. Yuen, X. N. Fernando, and S. Krishnan, "Radio Over Multimode Fiber for Wireless Access," IEEE Canadian Conference on Electrical and Computer Engineering, Vol. 3, pp. 1715–1718, May 2004.
- 2.The World in 2009, ICT Facts and Figures, <http://www.itu.int>. Cisco Visual Networking Index: Global Mobile Data Traffic Forecast Update, January 2009.