IOSR Journal of Electronics and Communication Engineering (IOSR-JECE)
e-ISSN: 2278-2834,p- ISSN: 2278-8735.Volume 13, Issue 6, Ver. I (Nov.-Dec. 2018), PP 59-62
www.iosrjournals.org

A Study on the Significance of Optical Fibers with a Reference of 5g Technology

S.K. Satnoor
Associate professor Department of Electronics B.V.Bhoomaraddi College Bidar :- 585403 Karnataka

Abstract *5G supports IoT and Big Data, which rely heavily on real-time data collection and transfer. Because decisions are being made instantaneously (and automatically, in many cases) based on this data, lower latency and higher bandwidth levels are needed to ensure that the data gets to where it needs to go quickly. Because of its unlimited bandwidth potential, fiber is the cable of choice to support these bandwidth levels.*

To handle larger amounts of data, 5G uses much higher radio frequencies than existing mobile networks. These higher frequencies, however, have very short ranges. For 5G to work as expected and provide multi-gigabit service to users and devices, many additional "cells" covering small areas must be installed throughout a venue (spaced as close together as 200 feet apart, according to some experts).The current paper highlights the significance of optical fibers in the form of 5G technology.

Keywords: *Optical, Fibers, 5G Technology*

I. Introduction

Fiber is the preferred option for 5G because of its scalability, security and ability to handle the vast amount of backhaul traffic being generated.

In addition to being the No. 1 option for network backhauls, fiber is also preferred for the fronthaul portion of the network as well (the portion that connects the small cells).

It can handle 5G's increased speeds with lower attenuation, is immune to electromagnetic interference and offers practically unlimited bandwidth potential.

To improve the coverage, capacity, and overall Quality of Experience (QoE) of mobile users, Mobile Network Operators (MNOs) are adopting small cells, which strategically place radios closer to users. Small cells can be backhauled over copper (xDSL, HFC-based cable modems…), air (microwave, millimeterwave…), or fiber (Ethernet, PON…). All three media options are being used today, to varying degrees, with the technology choice based on economic, environmental, regulatory, and time-to-market criteria, which are often specific to the target geographic location and application. Fiber-based small cell MBH is always the preferred option, whenever and wherever possible, because the technology is scalable, secure, understood, and in many cases, the most cost-effective. However, there are indeed cases where deploying fiber simply isn't a viable option.

The maximum theoretical download speed for LTE-Advanced (Release 8) is 300Mbps, although typical real-world download speeds are far lower at about 40Mbps, if you're fortunate enough to even have this type of service coverage in your neck of the woods. As an increasing number of mobile users access more video-centric content for longer periods of time using increasing powerful smartphones, Radio Access Network (RAN) bandwidth demands will continue to grow, unabated.

Today, a typical modern macrocell is served by a 1GbE packet-based optical MBH network link, although the typical traffic over this 1GbE physical connection is about 200Mbps to 300Mbps, leaving some room for growth, for 4G networks. Thus, the total aggregate bandwidth consumed by all of the concurrent mobile users to a typical macrocell is roughly equivalent to the maximum theoretical download speed of a single LTE-Advanced (Release 8) user connection. Granted, this is a rough estimate but you see where I'm going. Although current MBH networks may suffice for 4G today, the promised access speeds of 5G is likely going to overload existing MBH networks quite quickly.

MNOs connecting 3G and 4G cells, small and macro, via fiber are also laying the foundation for 5G, which has maximum theoretical download speeds from 1Gbps for high mobility users (ex. bullet train commuters) to 10Gbps for low mobility users (ex. stationary, walking). Even if the maximum theoretical download speed of 10Gbps were scaled down by 90% to 1Gbps, the entire 1GbE MBH connection to a typical macrocell today, intended to serve all concurrent 4G users, would be consumed by one bandwidth-hungry 5G user.

It's important to lay fiber now to small and macro cells, wherever and whenever possible, if these cell sites are to be upgraded to 5G in the coming years, as copper and air-based MBH options simply cannot scale to the immense amount of backhaul traffic that'll be generated by a 5G RAN. Fortunately, 5G is intended as an overlay to existing 3G/4G mobile networks, meaning that for existing cells that need not be upgraded to 5G in the future, using air and copper-based backhaul options are viable options for today, and tomorrow.

Most bandwidth consumed over mobile network airwaves is related to video-centric content flowing from a distant data center located across a city, a country, or even an ocean. Our growing affinity, dependence, and downright addiction to our mobile devices has led them to being the often preferred access vehicle to online content relegating cable and xDSL modems to a more secondary role. If 5G is to be aggressively rolled out in the coming years delivering real-world access speeds significantly faster to what's available on today's 3G/4G networks, whatever the 5G speed will ultimately be, all parts of the wired network connected to the RAN will be affected by the deluge of content flowing to and from data centers. The only transport media capable of scaling to these demands is fiber meaning it'll have to be available everywhere, particularly in the RAN to the hundreds of thousands of small and macro cells deployed worldwide.

SIGNIFICANCE OF OPTICAL FIBERS WITH A REFERENCE OF 5G TECHNOLOGY

Essentially all metro, regional, long haul, and submarine networks today are fiber-based, meaning they can already scale to voracious DCI growth by leveraging the very latest in optical transmission technologies. The access network, which includes the RAN, is the one part of the global network infrastructure that still has a significant amount of copper and wireless (microwave/millimeterwave) technology deployed, which will be a problem for 5G deployments, due to the promised speeds of this new technology.

Areas targeted for 5G coverage require lots of fiber to be successful, and not just for capacity reasons, but also to meet the other rather formidable 5G performance goals related to network diversity, availability, and coverage, since all three of these goals are achieved through a greater number of interconnected paths, of fiber. It's rather ironic that the projected performance goals of 5G *wireless* will depend on the availability of *wireline* fiber.

To provide multi-gigabit service to the users and applications that want access to 5G networks, the cells redistribute signals from cellular carriers through the air or via direct line, bringing them inside and/or dispersing them across a vast area. Without them, carriers struggle to get their signals indoors. Based on application size, they may take the form of femto cells, small cells, enterprise radio access networks (RAN), distributed antenna systems (DAS) or Cloud RAN (CRAN).

5G is the fifth generation of wireless networking. And while 5G doesn't exist yet — and won't be available for widespread use until the 2020s — the performance goals it promises are unprecedented for wireless networks.

As a result, the projected performance of 5G has opened up a debate about whether fiber optic or 5G wireless networks will be better. But this debate is predicated on a false assumption: That, as 5G technology rolls out in coming years, it will replace fiber.

Rather, 5G wireless networks and fiber optic networks complement each other, together offering a more cohesive internet experience across fixed and mobile applications than either could alone. Without 5G, fiber would lack mobility.

Fiber optic networks are a type of high-speed wireline network offering improved speed, security and bandwidth over legacy copper systems. Fiber optic technology has long been used in long-haul networks due to its high performance over long distances — fiber can travel as far as 40 miles without losing signal strength.

Now fiber is increasingly being used in metro and access networks instead of copper. And because copper can only carry a gigabit signal about 300 feet, many businesses choose to continue the fiber connection all the way to their premises — called a fiber to the premises (FTTP) configuration — to avoid losing signal strength. In essence, fiber optic networks are limited only by the technology used to transmit and receive signals.

In an ideal world, every phone, smart sensor and mobile device could be directly connected to the fiber backbone — but that would limit the mobility of the devices. That's where 5G wireless network technology comes in. 5G networks will essentially be designed to bridge the short distance between a mobile device (as in 5G mobile services) or business (as in 5G fixed broadband) and the fiber backbone.

Recently, we've been reaching the limits of current wireless network technology. Average mobile data usage has inched up steadily every month since 2014, mobile traffic is set to quadruple before 2021, and a user's bandwidth is expected to grow nearly 50% every year according to Nielsen's Law of Internet Bandwidth. A new solution is needed to keep up with these bandwidth and speed needs, and 5G may be the answer.

The first generation (1G) coincided with the introduction of cell phone technology, 2G introduced text messages and 3G allowed for cellular internet browsing. 4G was introduced in 2008, offering a marked improvement on network reliability and speeds as high as 100 megabytes-per-second (Mbps) — allowing for on-the-go video conferencing and gaming.

The predicted performance goals of 5G wireless networks blow previous wireless network generations out of the water. 5G wireless networks will provide nearly 100% network availability, less than 1 millisecond latency, 1,000 times the bandwidth and 10 gigabit-per-second (Gbps) speeds. 5G could potentially allow you to download a two-hour movie in 3.6 seconds. The same task takes about six minutes on 4G. But the key benefits span far beyond speed — 5G allows for a massive increase in connected devices at lower latency.

Time will tell if these lofty goals are met, as 5G standards are still being developed and 5G technology has yet to be deployed. 5G is expected to begin to roll out in 2019 and become widely available in the 2020s, first as a fixed wireless broadband solution and then as a mobile service akin to the 4G cellular technology we see today.

II. Discussion

4G macro cell towers relied on radio frequency spectrums, which were able to travel great distances — reducing the number of towers needed to serve an area — but were unable to achieve the growing speed, latency and bandwidth businesses will require in coming years. And adding more towers would be an expensive fix.

5G wireless networks will use higher frequency millimeter waves. The millimeter wave spectrum provides exponentially higher bandwidth with virtually no latency.

Unfortunately, millimeter waves can only travel about 250 feet. Because of this, 5G will force telecom companies to switch from the large cell towers to low cost, low power small cell sites — basically radios that will transmit and receive signals from devices within their small coverage area. Small cells are much cheaper than macro cell towers and require less power, allowing for a denser scattering of cells on streetlamps and buildings.

This 5G small cell model will bring the fiber backbone closer to the end user, allowing for use of higher frequency waves and vastly improving the quality of experience when using wireless devices. Indeed, the future success of 5G hinges on the availability of a deep fiber backhaul.

5G wireless small cells and their fiber wireline networks will never be mutually exclusive. To understand the relationship between wireless and wireline networks, it's helpful to think of a city's network in physiological terms: 5G will function splendidly as the capillaries (mobile fronthaul) of a city's networking system — but internet traffic will travel nearly its entire journey in the veins or arteries (fiber backhaul).

In fact, much like the human bloodstream, only about 11% of traffic is carried by wireless networks, according to a study by Deloitte. The other 90% of internet traffic is supported and carried by the wireline network.

So in a 5G world, the customer experience will be improved by better small cell wireless access points. But ultimately, the quality and reliability of the *wireless* network will depend on the *wirelin*e (fiber) network carrying traffic to and from the 5G small cells.

But it's up to policymakers and business owners to take advantage of this asset. They'll have to work in tandem to ensure investment in fiber deployment continues to be a priority as we lay the groundwork for 5G wireless networks.

The ubiquitous 4G cellular technology is poised to be replaced by 5G. However, the lofty goals for the level of connectivity required in 5G networks has been subject to much criticism. However, these requirements were generated in order to support the nearly exponential increase in connected devices in the coming decades. The current prediction, according to Statista, is 75.4 billion connected devices by 2025. This number includes both Internet of Things (IoT) devices and mobile phones where short-range IoT devices are expected to surpass the number of mobile phones by 2025. In the IoT space, the myriad system requirements have led to a proliferation of standards committees and hardware designs backed by a variety of protocols. So it follows that there are often somewhat disjointed technologies with compatibility issues in the IoT realm. Systems such as Zigbee, Z-wave, and Bluetooth are really meant for short- to medium-range static applications with nominal throughputs (< 1 Mbit/sec).

III. Conclusion

Cellular technologies, however, are a different beast altogether. Not only must a handheld device stay connected while mobile, but in order to be considered 5G-compatible, it also must be able to stream what is essentially 4K video seamlessly regardless of the traffic density hitting the base station. Furthermore, 5G technologies, from the chipsets to the user equipment (UE) to the cell towers must be compatible across all the radio access networks (RAN) that 5G will have to use. This led to a few major global organizations dedicated to the standardization of 5G, that often have a history of releasing previous generations of wireless standards (i.e. 3GPP, GSMA, ITU).

Several hardware methodologies have been developed to help achieve 5G. One is massive MIMO—massive multiple-input/multiple-output—or outfitting a base station with hundreds of antennas to reach 5G-rate spectra efficiencies and data rates in sub-6-GHz mobile applications. To date, there are a handful of successful massive MIMO trials with spectral efficiencies on the order of 140 bits/sec/Hz. This technology, however, is not yetcommercialized.

References

[1]. A To Z Of Nanotechnolgy, http://www.azonano.com
[2]. A. A. Baladin, "Nanoscale thermal management," IEEE Potentials, pp.II-15.
[3]. Brown J. and A. Pohm"l-Mb Memory Chip Using Giant Magneto' resistive Memory Cells", IEEE Trans on Camp, Pack and Manu fact Techno.
[4]. Centre for Ultra structure Research and Ludwig Boltzmann Institute for Molecule Nanotechnology http://www.boku.ac.atlzu£.
[5]. Collins, P.G., A. Zettl, H. Bando, A. Thess, and R.E. Smalley. Nanotube nanodevice. Science 278: 100
[6]. D. B. Rutledge, M. S. Muha, IEEE Transaction on Antennas and Propagation.
[7]. Institute of Nanotechnology provides substantial list of nano sites http.z/www.nano.org. uk!
[8]. In Proc. MEMS98, IEEE 11th Annual International Workshop on MEMS.
[9]. F. J. Gonzalez, B.Ilic, J. AIda, G. Boreman, IEEE Journal of Selected Topics in Quantum Electronics

S.K. Satnoor. " A Study on the Significance of Optical Fibers with a Reference of 5g Technology." IOSR Journal of Electronics and Communication Engineering (IOSR-JECE) 13.6 (2018): 59-62.