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A MILLIMETER WAVE OVER NEXT GENERATION PASSIVE OPTICAL NETWORK STAGE 2: AN IDEA FOR FUTURE GENERATION NETWORK

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ABSTRACT

The potential of millimeter wave to support next-generation passive optical network (NGPON2) technology is covered in this research. Millimeter wave offers optical access networks a number of benefits, including higher capacity, better spectrum usage, decreased latency, and improved security. The study goes on to look at the difficulties that need to be overcome in order to fully utilizemillimeter wave for NGPON2, such as the requirement for higher data rates, expanded transmission range, and enhanced antenna performance. The report concludes with a summary of the various millimeter wave enabled NGPON2 components and the ongoing research to improve their performance.

Keywords: 5G, Millimeter wave, Passive Optical Network, Next Generation Passive Optical Networks 2.

INTRODUCTION

Next Generation Passive Optical Networks (NGPON2) is a new generation of fiber-optic access networks that promises to provide unprecedented levels of bandwidth, speed and cost efficiency. It is expected to be the future of broadband access and will provide a platform for the delivery of advanced services such as voice, data, and video. NGPON2 is based on a point-to-multipoint network architecture, where a single Optical Network Terminal (ONT) is used to connect multiple subscribers to the network. This architecture simplifies the network architecture, reduces the cost of deployment, and increases the flexibility of service delivery.NGPON2 is based on the standardization of Passive Optical Networks (PON) technology. It is an extension of the current GPON (Gigabit PON) technology, which was the first PON standard implemented.

The demand for bandwidth and internet subscribers worldwide is one of the biggest problems of today. The Time and Wavelength Division Multiplexing-Passive Optical Network (TWDM-PON) has become a key driving technique under the standard ITU-T G.989 for the NGPON2 that takes this technology to the next level(Abdulnabi, Kadhim Saad, and Hamza 2020). It has emerged as a most prominent solution to accommodate the large number of rising mobile subscribers by providing

the large bandwidth. It is the descendent of two versions of PON known as Gigabit-PON (GPON) and 10G-PON, and it inherits all of their qualities. It has shown itself to be very capable of transmitting multiple wavelengths at a rate of 40 Gbps via single-mode fiber; in the future, 80 Gbps will be feasible. In addition to its high data transmission rate, NGPON2 also offers a number of other benefits. It provides the ability to support more advanced services such as multimedia, VoIP, and IPTV(Abdulnabi, Kadhim Saad, and Hamza 2020) (Lagkas et al.

2020). It also offers improved security, scalability, and reliability, making it ideal for mission-critical applications. Furthermore, it provides significant cost savings due to its lower deployment and maintenance costs. Despite its benefits, there are a number of challenges associated with NGPON2. For example, it requires the installation of new hardware and software, which can be costly and time-consuming. It also requires extensive training for service providers and technicians, and the complexity of the technology can lead to mistakes and delays in service. Additionally, it requires specialized equipment to be installed, which can further increase the cost of deployment. Despite these challenges, the potential benefits of NGPON2 are too great to ignore(Rajalakshmi and Shankar 2019). The technology has the potential to revolutionize broadband access, providing faster speeds, improved reliability, and lower costs. As such, NGPON2 is expected to be adopted by many service providers in the near future.

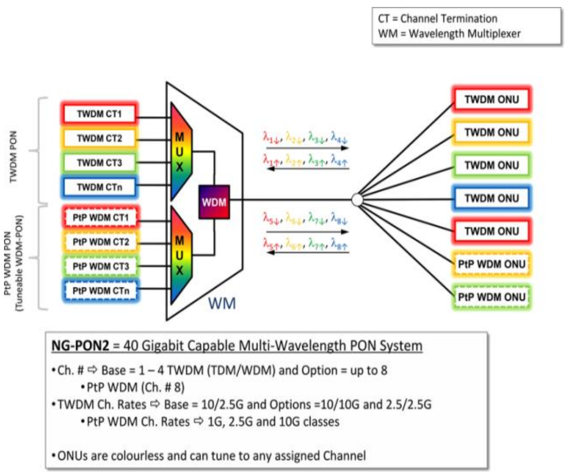

Figure 1: Architecture of NGPON2 with features(Nesset and Technologies 2016).

The architecture is shown in figure 1. The hybrid network's NGPON2 uses TWDM-PON, a technique covered by the ITU-T series-G.989 standard, to deliver the above mentioned features. By connecting optical line terminals (OLT) and optical network units (ONUs) via the same fiber, or optical distribution network, NGPON2 is more suitable for and promises to support the 5G fronthaul (FH) network (ODN). According to information obtained and discussed in the literature, NGPON2 FH provides a total bit rate of 40Gb/s that is evenly divided among 4 pairs of fibers with a 20km length, either upstream or downstream, to deal with the increase in mobile users and network traffic(Systems 2015). Despite the challenges associated with its deployment, the potential benefits are too great to ignore, and it is expected to be adopted by many service providers in the near future. Many methods, such as Ethernet-PON, Gigabit-PON, Orthogonal Frequency Division Multiplexing (OFDM), etc., had enabled long-distance transmission but at the expense of data rate (2.5-10Gb/s), split ratio (1:16-1:64), and multiplexing techniques like TDM, TDMA(Horvath et al. 2018). Nevertheless, NGPON2 has a higher split ratio, more wavelengths, and coverage of more than 100km, making it more able to employ transmission speeds of up to 40Gb/s or more. TWDM for FH has been used to study network capacity at the 20Gb/s transmission speed for both up and downlink across the 130km long fiber(Lagkas et al. 2020)(Anis, Qureshi, and Zafar 2017). Ultimately, research needs to be done in domain of millimeter wave over fiber. Therefore, the suggested research seeks to investigate millimeter wave over fiber for NGPON2 FH to make the best use of the limited resources to successfully meet the 5G needs under the bank. Here, the emphasis will also be on examining various long-reach designs with high bandwidth and data rates, allowing mobile customers to access the network whenever they want without worrying about congestion. In order to accommodate the numerous users, the limit is increased.

MILLIMETER WAVE OVER NGPON2

The 5G FH transmission utilizing the same fiber is compatible with millimeter-wave range between 30-300GHz to satisfy the appetite for bandwidth and efficient exploitation of high spectrum frequency band(Goel and Kaushik 2019). Figure 2 is shown that millimeter wave spectrum band.

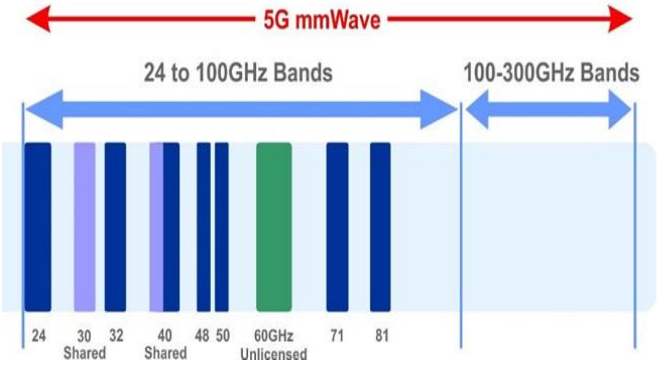

Figure 2: Millimeter wave spectrum band for 5G("5G MmWave_ NSA or SA_ - 5gmmwave," n.d.).

Millimeter wave over fiber millimeter wave over fiber is a technology that has been gaining more and more attention in recent years due to its potential to revolutionize the communication landscape. The potential of millimeter wave over fiber lies in its ability to transport millimeter wave signals over optical fibers(Goel and Kaushik 2019). Millimeter waves, which are higher frequency electromagnetic waves than the more traditional microwave radio waves, have many advantages over their lower-frequency counterparts, including increased bandwidth and the ability to penetrate objects with fewer attenuation losses. By transporting these higher frequency signals over optical fibers, the benefits of millimeter wave technology can be realized without the need for expensive and difficult-to-install microwave radio systems(Anand Prem P K and Arvind Chakrapani 2017)(Zhou et al. 2018). The core of a millimeter wave over fiber system consists of a specially designed laser source, an optical fiber, and a receiver. The laser source is used to generate a millimeter wave signal, which is then sent down the optical fiber(Zhou et al. 2018). At the other end of the fiber, the receiver is used to detect the signal and convert it into usable data. The core of the system is surrounded by a number of other components, such as a power source, amplifiers, filters, and other signal processing components, which are used to optimize the performance of the system.

In order to combine the NGPON2 and radio over fiber concepts for full-duplex to modulate millimeter wave at different speeds from 40-80Gb/s and coverage area from 20-40km, several modulation approaches, such as simple-phased, cross-phased, four-wave mixing, etc. have been investigated.

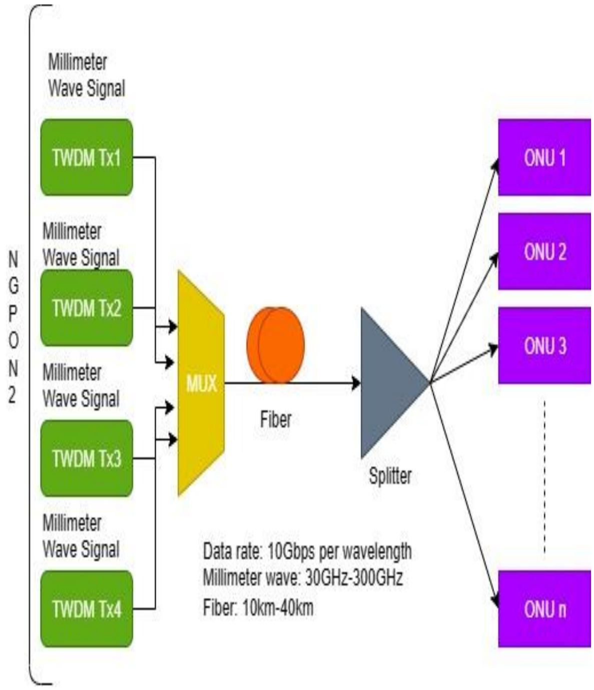

Figure 3: Structure of millimeter wave over NGPON2.

Millimeter wave over fiber has the advantage of preventing path loss during non-line of sight. Millimeter wave over NGPON2 is the latest technology in fiber optics that promises to revolutionize the way we communicate. This technology is being developed in order to provide extremely high-speed broadband access for both residential and commercial customers. The goal of this technology is to provide high-speed, low-latency broadband access over a single fiber optic cable. Millimeter wave over NGPON2 is a breakthrough technology because it uses millimeter-wavelength light to carry large amounts of data over a single fiber-optic cable. This technology is being developed to provide extremely high-speed broadband access for residential and commercial customers. It has the potential to provide speeds up to 10 gigabits per second (Gbps), which is faster than existing broadband technologies(Raddo et al. 2019).The technology works by using millimeter-wavelength light to send data over a single fiber optic cable. This wavelength is much smaller than that used by existing fiber optic networks, allowing for much higher data rates to be achieved. This technology is being developed to provide extremely high-speed broadband access for residential and commercial customers. The technology is also being developed to work over existing fiber-optic cables, which means that it can be implemented without the need for additional infrastructure.

CHALLENGES

Millimeter wave is a new technology for 5G networks that is expected to enable a variety of services and applications including ultra-low latency and high capacity. However, it also presents a number of challenges. The millimeter wave frequency range of 24 to 86GHz is much higher than the range used for previous generations of mobile networks, which means that the signals will be more susceptible to interference, attenuation, and other physical obstacles. One of the major challenges of millimeter wave is the fact that its signals have a much shorter range than those of lower frequency signals. This means that the coverage area of a single base station must be much larger in order to reach the same number of user. This requires a larger number of base stations, which increases the complexity and cost of deployment. Another challenge is the fact that millimeter wave signals are easily blocked by physical obstacle such as walls, trees, and other obstructions. This makes it difficult to provide reliable coverage in areas with high levels of physical obstructions, such as urban environments.

The deployment of millimeter wave technology on existing networks such as NG-PON2 will also present a challenge. NG-PON2 is designed to support a range of different types of traffic, and the addition of millimeter wave signals may require changes to the existing infrastructure. This could be costly and time-consuming, making it difficult to quickly deploy millimeter wave technology on existing networks. In summary, the deployment of millimeter wave technology on NG-PON2 networks presents a number of challenges. These include the need for larger coverage areas, the susceptibility of the signals to interference and obstruction, the need for more advanced antennas and receivers, and the potential for costly and time-consuming changes to existing infrastructure. Despite these challenges, millimeter wave technology is expected to play an important role in the future of 5G networks. As the technology matures, these challenges can be overcome and the benefits of millimeter wave can be realized.

FUTURE SCOPE

Millimeter wave technology is a key component of the next generation of 5G networks, and NGPON2 is one of the most promising technologies to enable these networks. Millimeter wave technology has been used in wireless communications systems since the 1980s, but it has been limited to short-range applications due to the high propagation losses associated with the frequencies. In recent years, there has been increased interest in the use of millimeter wave technology for longer-range applications, such as 5G cellular networks. This is due to the fact that millimeter wave frequencies are less congested and have the potential for wide bandwidths. NGPON2 is a technology that is being developed to enable the deployment of millimeter wave networks over long distances. It is based on the same principles as passive optical networks, but it uses a different modulation technique to provide higher data rates and longer-range coverage.

The main advantage of NGPON2 for millimeter wave networks is that it provides a cost-effective way to deploy millimeter wave networks over long distances. Unlike traditional networks, NGPON2 does not require expensive base stations or expensive backhaul links. Instead, the network can be deployed using a single fiber connection between two points, allowing for a cost-effective deployment of the network. Additionally, NGPON2 can provide much higher data rates than traditional networks, allowing for the deployment of high-speed data services over long distances. One of the main challenges with NGPON2 is that the technology is still in its early stages of development, and there are many technical issues that need to be addressed before it can be implemented in real-world networks.

Additionally, there is currently no standard for NGPON2, and different vendors have developed their own proprietary implementations. This can lead to interoperability issues between different vendors. Despite the challenges, there is a lot of potential for NGPON2 to enable the deployment of millimeter wave networks for 5G. The technology can provide cost-effective and high-performance networks over long distances, and it has the potential to revolutionize the way 5G networks are deployed. As the technology matures, it is likely that NGPON2 will become a key component of 5G networks, enabling the deployment of high-speed data services over long distances. There is also the potential for NGPON2 to be used for other applications, such as enabling the deployment of wireless networks in rural areas or in remote locations.

CONCLUSION

Overall, millimeter wave over fiber systems offer many advantages over traditional radio systems, making them an attractive option for many applications. They are much cheaper and easier to install, more reliable, and more secure than traditional radio systems, making them a perfect choice for many applications. As the technology continues to improve and become more widely available, more and more people are beginning to realize the potential of millimeter wave over fiber systems, and the communication landscape is sure to be revolutionized as a result. Millimeter wave over NGPON2 is an exciting technology that could revolutionize the way we communicate. It has the potential to provide extremely high-speed broadband access for residential and commercial customers, and to reduce the cost of broadband access for consumers. It is also being developed to work over existing fiber-optic cables, which means that it can be implemented without the need for additional infrastructure. This makes this technology extremely beneficial for users, as it can reduce the cost of broadband access and make it more affordable. This technology is sure to have a huge impact on the future of broadband access and communications.

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