International Journal of Science and Research (IJSR)
ISSN: 2319-7064
SJIF (2022): 7.942

Potential Applications of 5G FWA

Marisa Lemos

Technical Support Team, Sun Telecom, Shanghai-China, 201500
Email: *marisalemos[at]yahoo.com*

Abstract: ***5G fixed wireless access (FWA) is a cost-effective last-mile solution to provide ultra-high-speed broadband connectivity in urban, suburban, and rural areas. 5G FWA provides low-cost, low latency, low energy, fiber-like experience, high reliability, high security, and ease of installation and deployment. In addition, 5G FWA provides more innovative applications like 4K ultra HD streaming media, AR/VR, IoT/IoV, IP TV/ IP phone, CCTV, home, business, smart city, industry (healthcare, education, autonomous, energy, construction, government, military, supply chain, etc.). This paper discusses the network topology of 5G FWA, 5G FWA devices, and application scenarios.***

Keywords: 5G FWA, Network Topology, 5G FWA Devices, Application Scenarios

1. Introduction

The advent of 5G can help FWA to deliver ultra-high-speed broadband internet from homes, businesses, and other applications, where fiber, DSL (digital subscriber line), and cable are prohibitively expensive to lay and sustain.5G FWA is a cost-effective last-mile solution positioned somewhere between fiber and wireless. It is using electromagnetic waves instead of cables as the medium for signal transmission to avoid the issues of traditional broadband including trench digging and cabling [1]. 5G FWA provides three-dimensional coverage (as shown in figure 1), where users in the high-rise buildings covered by the site can relish ultra-high-speed broadband internet services. The key technologies used by 5G FWA are the new radio (NR) interface, massive multiple-input multiple-output (MIMO), network slicing, and quality of service (QoS) guarantee. 5G FWA provides users with a fiber-like experience. Furthermore, 5G FWA operates in millimeter waves (mmWaves) and sub-6GHz frequency [2]. 5G FWA offers the following advantages low cost, easy to install and deploy, high reliability, high data rates, low latency, low energy use, provider competition, and support enhanced mobile broadband (eMBB), ultra-reliable low-latency communication(URLLC), and massive machine-type communication (mMTC) services. Typical 5G FWA applications include broadband internet, video, Pay TV, virtual reality\ augmented reality (VR\AR), internet of things \ internet of vehicle (IoT/IoV), home, business, transportation, energy, etc. [3].

This paper is organized as follows. Section II presents the network topology of 5G FWA applications, section III discusses 5G FWA devices, section IV discusses 5G FWA application scenarios, and the conclusion of the paper is given in Section V.

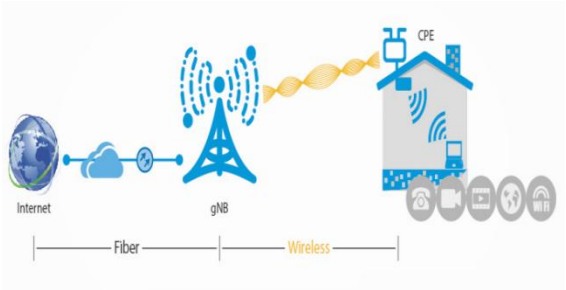

Figure 1: 5G FWA three-dimensional coverage [2].

2. Network Topology

5G FWA uses standardized 3GPP network topology and common mobile components to deliver ultra-high-speed broadband internet services to homes, businesses, public facilities, factories, electric vehicles, energy and utility, and many more applications [4].

Figure 2: 5G FWA application network topology example [4].

5G FWA DEVICES

5G FWA devices, known as 5G CPE (Customer Premise Equipment), are already commercially available on the market. 5G CPE is a 5G terminal device. It receives 5G signals from the 5G base station and converts them into a WiFi or wired signal, allowing more user devices (phone, PC, TV, iPad) to access the Internet, as shown in fig.3[5].

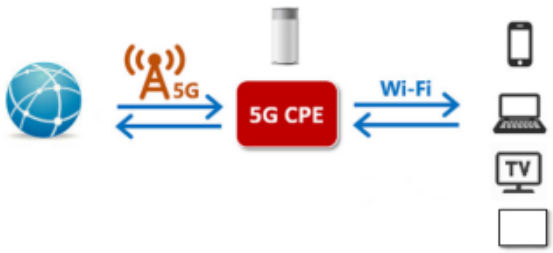

Figure 3: 5G CPE concept

5G CPE can be indoor and outdoor. Indoor 5G CPE consists of an indoor unit (IDU) that receives 5G signals and transmits data to terminals via Wi-Fi. Outdoor 5G CPE consists of an outdoor unit (ODU) that receives 5G signals and transmits data to the IDU via an Ethernet cable. Furthermore, outdoor 5G CPE supports wall-mounted and pole-mounted installation and power over ethernet (POE). It's also toughly built to withstand all weather conditions, rain or shine [6].

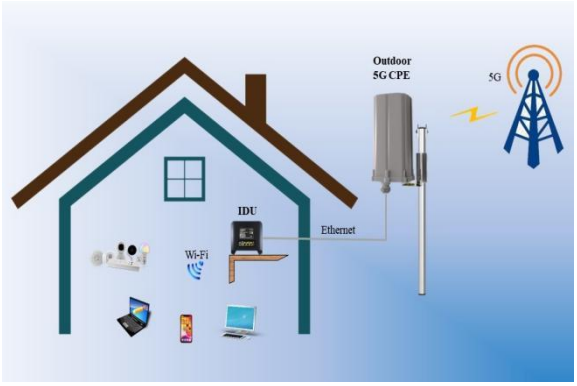

Figure 4: 5G CPE indoor and outdoor.

5G CPE provides high reliability, high data rates, high security, low latency, low energy, ultra-high-speed broadband, fiber-like experience, low cost, and ease of installation and deployment for end users. In addition, 5G CPE runs with a router or switch and supports a 5G/4G/3G network, compatible with standalone (SA), non-standalone (NSA) and LTE standards and built with Wi-Fi 6 technology [7, 8, 9, 10, 11, 12].

Figure 5: 5G CPE devices

3. Application Scenarios

5G FWA can support and promote some emerging application scenarios, mainly including VR\AR, IoT\IoV, high definition video streaming, gaming, smart home, smart city, smart sensor, military, government, industrial, supply chain, etc. Here are ten typical application scenarios: Home and business, smart city, healthcare, education, autonomous vehicles, energy and utility, mining, construction, smart agriculture, and smart factory.

a) Home and Business

5G FWA supports home entertainment (broadband internet, IP phone, IP TV, 4K ultra HD streaming media, Wi-Fi extender, IoT) and home security (home camera video surveillance CCTV) applications [13]. For example, 5G FWA allows users to set up a whole-home mesh network system that provides internet access to the home. As the user walks around the house, the connected device will automatically switch to the strongest signal in the system.

Figure 6: Whole-home coverage with wi-fi mesh network

In addition, 5G FWA powers security cameras on the network. This allows high-quality images and video to be captured remotely and transmitted in real-time[14].

Figure 7: Security camera application

High costs, logistical issues, and a high burst rate of real-time services are common challenges for operators when building and operating networks in urban or suburban areas, such as commercial business districts or malls. Thanks to 5G FWA, the business can benefit from high-speed network connections and low-cost installation [15, 16].

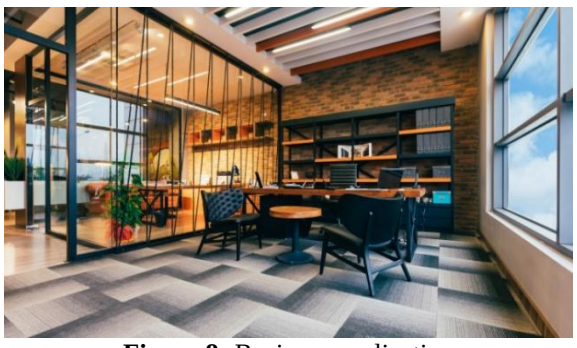

Figure 8: Business application

b) Smart City

As a widely distributed, integrated, and convenient urban infrastructure, a smart street lamp pole is the best carrier of a 5G. Using 5G FWA in the smart street lamp pole can reach wide signal coverage and vast amounts of data collection, which helps to build a smart city[17].

Figure 9: Smart city application

c) Healthcare

5G FWA is crucial in healthcare applications. The healthcare area needs to be full coverage with ultra-high-speed Internet connectivity. However, 5G FWA can help healthcare improve clinical efficiency and quality of patient care and reduce hospital costs. Remote diagnosis and remote treatment will undoubtedly become very convenient. Doctors can trace patients' physical condition according to the health data collected automatically and instantly, contributing to human welfare significantly [18].

Figure 10: Healthcare application

d) Education

In educational institutions, 5G FWA has the potential to introduce new devices and capabilities to enhance students' learning experiences. For example, students can participate in online learning and benefit from innovative educational content such as VR and AR [19]. Furthermore, IoT devices such as smart sensors, robots, and video cameras help students with physical needs by providing the ultra-high-speed broadband connectivity required for these devices to respond in real-time. To improve access to education in urban or rural areas, 5G FWA is used to live stream lessons (remote learning) in real-time with a 4K ultra HD resolution.

Figure 11: Education application

e) Autonomous Vehicles

The development of autonomous vehicles brings several social benefits for transportation, including the reduction of traffic congestion, which could be proactively reduced by smart city traffic management systems that are informed by machine-to-machine (M2M) communications with autonomous vehicles. In addition, autonomous vehicles are expected to improve road safety, as most car accidents are caused by human error. Autonomous vehicles can play an important role in both financial savings and human lifesaving. 5G FWA supports the automotive industry by providing safety systems and ensuring real-time vehicle-to-vehicle (V2V) communications [20].

Figure 12: Autonomous vehicles application

f) Energy and Utility

5G FWA enables ultra-high-speed connectivity, high reliability, and low latency for energy. From the perspective of power supply, 5G FWA help distributes energy faster, more secure, and more efficiently. Moreover, 5G FWA can help integrate clean energy sources like the wind into the grid, reduce waste and stabilize the renewable energy supply and reduce maintenance costs for energy and utility.

Figure 13: Energy and utility application

g) Mining

With 5G FWA, the environmental data of mines can be collected by various sensors in the devices and sent to the management center. Then workers can control all kinds of devices remotely. The massive data transmission and lower latency offered by 5G FWA are beneficial to human safety and efficiency.

Figure 14: Mining application

h) Construction

Construction industries need reliable, high-speed connectivity connections to accomplish tasks in a timely and efficient manner. Thank 5G FWA can offer high reliability and high-speed connectivity for the construction industry, where workers can easy to communicate between the field and offices. Also, 5G FWA improved safety and compliance on construction sites. For instance, 5G FWA eliminates the risk of service disruption from an accidental network cable cut at the construction site.

Figure 15: Construction application

i) Smart Agriculture

Using 5G FWA to extend the ultra-high-speed Internet, unmanned aerial vehicles can remotely spray pesticides, replacing traditional agricultural labor that could harm human health [21]. In addition, 5G FWA can help enhance farming management methods by allowing precision agriculture. This method aims to micro-optimize agricultural processes and practices via the massive collection, analysis, and utilization of data about soil, crops, labor, weather, pesticides, etc.

Figure 16: Smart agriculture application

j) Smart Factory

The smart factory is designed to enable fully automated production, where the factory can detect and solve problems by intelligently processing data from a network of Industrial Internet of Things (IIoT) sensors and robots. 5G FWA is used in the smart factory to provide wide signal coverage, low latency, and high reliability, thus the data of all machines is collected precisely in an instant. Furthermore, the remote control becomes convenient [22].

Figure 17: Smart factory application

4. Conclusion

In this paper, network topology, 5G CPE devices, and applications of 5G FWA are discussed.5G FWA can deliver ultra-high-speed internet access to homes and other applications with fiber-like speeds. 5G CPE can be easy to deploy and low cost compared to fixed-line DSL, copper, and fiber optic cable. In addition, 5G FWA provides more innovative services and applications. More importantly, connecting home, businesses, healthcare, education, etc with 5G FWA opens up several possible revenue streams beyond pure connectivity.

Acknowledgment

This work was supported by Sun Telecom.

References

[1] https://www.metaswitch.com/knowledge-center/reference/what-is-5g-fixed-wireless-access-fwa.
[2] https://www.zte.com.cn/global/about/magazine/zte-technologies/2019/1-en/Special-Topic/5.html.
[3] https://images.samsung.com/is/content/samsung/p5/global/business/networks/insights/white-paper/samsung-5g-fwa/white-paper_samsung-5g-fixed-wireless-access.pdf.

[4] https://www.industrial-innovation.com/5g-fwa-unlocking-limitless-innovation-and-potential-for-industrial-companies/.
[5] https://www.vsolcn.com/blogs-detail/what-is-5g-cpe#:~:text=5G%20CPE%20(Customer%20Premise%20Equipment,WiFi%20signals%20or%20wired%20signals.
[6] https://www.hocell.com/5G_CPE.
[7] https://www.oppo.com/en/accessories/5g-cpe-omni/.
[8] https://consumer.huawei.com/en/routers/5g-cpe-pro-2/.
[9] https://www.samsung.com/global/business/networks/solutions/fixed-wireless-access/.
[10] https://www.nokia.com/networks/fixed-networks/fwa-fastmile/?did=d000000005tx.
[11] https://ztedevices.com/en-gl/mc801a/.
[12] https://service-provider.zyxel.com/global/en/products/5g-nr4g-lte-cpe/5g-nr-cpe/idus/nr5103#resources_downloads.
[13] https://www.huawei.com/en/technology-insights/publications/winwin/37/new-trends-5g-fwa-homes-enterprises.
[14] https://en.suntelecom.cn/bullet-ip-camera.html.
[15] https://www-file.huawei.com/-/media/corporate/pdf/white%20paper/2019/huawei_wttx_4g_5g_fwa_broadband_industry_white_paper.pdf?la=en.
[16] https://www.huawei.com/us/technology-insights/publications/huawei-tech/202203/all-scenario-fwa-applications.
[17] https://www.milesight-iot.com/blog/milesight-5g-cpe/.
[18] https://futurehealthcaretoday.com/shifting-to-an-efficient-network-with-naas-part-3-of-the-connected-healthcare-journey/.
[19] https://www.sandvine.com/blog/five-opportunities-for-5g-fixed-wireless-access.
[20] https://www.5gamericas.org/wp-content/uploads/2021/11/5G-FWA-WP.pdf.
[21] https://www.maxis.com.my/content/dam/mxs/images/newsroom/2020/january/Maxis-5G-UseCases-Factsheet-ENG-200120.pdf.
[22] https://static.inseego.com/us/download/5g-fwa-white-paper.pdf.