6G-Next Decade Wireless Technology

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Abstract— **In this work, we will discuss expectations pretraining to 6G technology along with existing technical challenges (majorly with mm waves small cells) and possible solutions for the next decade wireless technology. To this purpose, we will briefly review old technologies starting from 1G to 5G keeping the fact that 5G is yet to be commercialized.**

Keywords—6G, mm waves, small cells.

I. Introduction

Every new generation of wireless technology took approximate ten years to evolve before being commercialized across the globe moving from 1G to 5G. The technology evolved delivered faster speeds and more functionality through our smartphones; 1G brought us the very first cell phone, 2G allowed us to text for the first time, 3G brought us online (Mobile Internet), 4G delivered the speed that we enjoy today and 5G is yet to be commercialized possibly in 2020 although many trails and prototypes presented which promises a speed of 10 Gbps with low latency of 1 ms. Moving on, researchers already started working on 6G technology which promises even higher speed as the network traffic expected to grow at a massive scale for next two decades. Major players are focusing their efforts on the 140-gigahertz, 220-GHz, and 340-GHz frequencies-all significantly higher than the 3.4 to 3.8 GHz band being leveraged for 5G [1]. One of key feature of 5G/6G will be small cells which are portable miniature base stations that require minimal power to operate and can be placed every 250 meters or so throughout cities. To prevent signals from being dropped, telephone operators could install thousands of these stations in a city to form a dense network that acts like a relay team, receiving signals from other base stations and sending data to users at any location. Traditional cell networks have also come to rely on an increasing number of base stations because in order to achieve desired performance will require an even greater infrastructure. Therefore, we need high-capacity links between base stations to hold user traffic and need to move to higher-frequency spectrum mm waves of links up to 60 to 100 GHz.

II. Challenges

There are plenty of challenges need to be tackled if we are going to review next decade technology i.e. 5G beyond or 6G but here we will discuss few of them majorly related to mm Waves and small cells.

1) Delivering gigabits of capacity requires multiple gigahertz of spectrum via frequency reuse although 60 GHz has traditionally been avoided due to its high absorption of oxygen and water. Another major problem with the 60 GHz frequency is that it is weak when it comes to penetrating walls and structures, which is the main reason it’s not generally used. We are required to build a base station that can handle the frequency ranges expected to be part of future generations of wireless technologies. Also, estimating an optimum distance value between the base stations is vital in order to minimize the budget of miniature base stations and off course for its deployment.

2) Higher frequencies come with its own complexity because the components at the receiver end need to be packed more tightly which eventually introduce a risk of overheating. The packet loss will be massive which need to be addressed properly.

3) In [2], it is envisioned that a base station could emit up to a thousand beams simultaneously. “What you’re looking at is four surfaces, each capable of 250 simultaneous beams,”. Considering the fact that 5G technology speculates that each beam provides 10 gigabits per second then a single base station could transfer 10 terabits every second which introduces the issue of interferference.

4) Solving backhaul connectivity is critical before any 5G beyond/6G small cell deployments can scale up. There is no possibility to even consider adding wired backhaul drops to thousands of sites in an Urban environment which will be hectic and costly at the same time.

5) According to the DSL reports [3], 5G will be incredibly expensive for operators to deploy because tens of thousands of miniature base stations need to be deployed per country (in some cases may be in cities) but the industries is yet to disclose the best use case of 5G network because Internet of things (IoT), autonomous driving cars are actually relying more on computing power built into the device itself, rather than the network. Also, the question remains intact that how much consumers have to pay to enjoy 5G service. Keeping all these facts, one cannot even imagine the cost consumers have to pay for 6G.

III. POSSIBLE SOLUTIONS

Number of possible solutions has been proposed considering the challenges faced by 5G/6G technology and some of useful are discussed here.

1) Visual MIMO, an intriguing combination of machine-vision and multiple antennas. It uses cameras to spot obstacles that could obstruct line-of-sight transmission, essential for mmWave radio. The optimum path or reflections can be computed by spotting the obstructions such as birds, vehicles, rainfall etc. for cellular signals. It will be easy for a base station and harder on devices. In my opinion, not necessary we need device side visual capability, but I guess radio capability of the device and visual capability of base station should work too. So, if we can predict based on visual MIMO that bird is coming and may break the beam and perform some proactive decisions. Also, if base station predicts the position roughly, can use its visual part to complement.

2) Shaping the mm wave radio signals into a tight flashlight like beam in such a way that it can reach each individual device can be done by using the new antenna technology. This would help significantly in extending the range and penetration capability of mmWave radio signals.

3) Line of sight (LOS) at mm waves for backhauling model for a target density and consumer experience can be estimated using the LiDAR data.

4) Identifying the 5G service in geographical areas will be vital which can be done by RF assessment technology which uses machine learning techniques. This will save the cost associated with dispatching technicians all around and eventually customer satisfaction graph will grow. Detailed map data of an environment can be developed from multiple sources such as 360° street-level photography, overhead satellite maps and 3D building maps [4]. Together with Artificial Intelligence (AI) and detailed map can better simulate how mm waves radio signal will perform and react with environment.

5) By leveraging ML algorithms and techniques, miniature base stations (Fixed Wireless Access Points) can be empowered to predict what content consumers may request in near future which will minimize the latency and improves customer satisfaction. If local miniature base stations have the desired content, then we are done!! If not, then consumer will have to access the content from cloud server which might few seconds which won't work in the 5G/6G world [5]. Miniature servers (Small Cells) with enough storage and computing competences will be the best solution which will serve the user proactively.

6) Just as your personal computer or laptop can unexpectedly crash, so can base stations across the radio network in cellular communication. This can have a serious impact on service, especially within busy regions or busy times of the day. With the AI technology, one can analyze and learn from any network performance data to extract the sleeping cells details and trigger an automatic start.

IV. CONCLUSION

The creative solutions are time and cost effective in settling the inherent issues of mm Wave deployments. Also, they help streamline the deployment procedure for Network Service Providers, improve the financial quotient of deploying fixed wireless access broadband services and empower consumers or businesses with constrained or no service alternatives with the most recent ultra-broadband abilities.

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