

6G and Beyond

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Abstract

The commercialization of 5G has gone underway and globally the world is preparing to embrace it. With 5G now out and at the consumers fingertips the thought of the next wireless network is now in the brains of all different countries and companies. With an expected deployment of 2030 there is a long way to go for when the next big network hits everyone in the face with its phenomenal speed and much more. With data rates that blow out 5G by whopping amounts. The 6G network will be exploring the current issues of its predecessor and capitalize on all that will make it that much better. Thus, this paper will explain paths that are being taken to look into what 6G will eventually possibly become.

1. Introduction

There has been a ginormous amount of effort put into the concept of wireless networks. Not only just man power but millions of dollars put towards the development of faster and larger data flowing wireless networks. This first kicked off with 4G, when people were requiring a faster network other than 3G.

Now an even faster network is out there in 5G, but will this be enough to sustain what people and devices require out of the data flow and its speeds. Devices like cars, ones that can drive themselves or better known as autonomous driving; need a network that surpasses 5G and all of its capabilities in every way. These frequencies that the 5G network is sending and receiving at needs to be more than what they are today in order for the world to function without latency; which creates a plethora of issues. The 5G network data rates are currently around 100 Gbps which without a doubt is a groundbreaking outcome, but that will just not be the end goal. [1] The world needs a higher frequency at which we operate, so the next step into wireless networks is diving into the realm of 6G. In 6G the data rates will reach new heights that will propel the future tremendously. Though this will take beyond the amount of time that we would prefer for it to take. The estimated arrival time of 6G is about a decade from now. 2030 is when we should be expecting the new and improved wireless network of 6G to be implemented. [1] The main concern is the way that we get there, 6G needs to be up to standards and can not be lacking in any fields. Especially when it comes to frequency, we are expecting around 100 GHz to 1 THz

frequency bands from 6G. [1] Though the reason for concern is if this can really be reached at all, the amount of challenges that are ahead may be too much for 6G to appear in just 10 years.

2. Background

There are currently a few parts of 6G development that have already started. One main part is the equipment that will be used for 6G. Suppliers have hopped on board with the 6G idea and have begun development for the future product. The other is many universities are starting to scratch the surface of research into the new wireless network. [4] The current place where we can see just the beginning of 6G is in 5G itself. Although it is not up to par with what 6G will need to be and there are lots of technological advancements that are to be made on it, it is a start in the end. [4]

The new millimeter waves that are being introduced are called terahertz waves. This is the central reason and promise behind 6G. They are to deliver data rates that are up to one terabit per second along with a low latency that will improve everything drastically. The speed at which data can travel is going to be extremely essential to the speed at which the future will move. [4]

3. Results

Though there are no current results for 6G as development of it is still in the early stages there are many things that we look forward to seeing in 6G.

The creation of 6G is going to begin off of the current best wireless network in 5G. 5G will be the seed to what 6G will become, those who started with developing 5G started off of 4G itself, so the same thing will occur here.[3] There are plenty of features that are going to be new in 6G but most of the time they will end up being branches off of things that are currently in the 5G network. There are a bunch of applications that we expect to see in the future on the 6G network.

3.1 eMBB-Plus

The 5G network has its own eMBB but it's expected to be placed with a plus version in the 6G network. The hope is for it to be able to provide high-quality experience with data utilization along with other components. For example providing an accurate indoor positioning system and a global system that is connected throughout all mobile networks that will be available at an affordable price. The thought is for this to be completed without the concern of security and privacy of the customer. [2]

3.2 BigCom

BigCom is the idea of being able to provide a wide range of coverage for everyone. Not just in cities but also rural and remote areas while maintaining that high speed data rate. The large bandwidth adopted by 6G will help benefit those in areas that don't currently have the best connection to a wireless network. [2]

3.3 SURLLC

SURLLC in 6G is an upgrade from URLLC and mMTC in 5G. 6G will have a more secure network that is also more reliable. The latency is thought to be less than 0.1 ms. This is a huge jump from the latency that 5G provides. [2]

After all the 6G network is expected to blow 5G out of the park with all of the upgrades that will be coming to it. We will expect to see the same reliability that we see with wired connections in 6G. The improvements stated above will be the reasons that 6G will be the next big thing, though the wait for it is going to have to be at least a decade from now.

4. Research

Many different countries have started to take their shot at 6G and beyond networks. To start off with in 2018 the first country to start off the 6G research was Finland. The University of Oulu launched a 6G initiative. Following them was the United States who created a new category of licenses between 95 GHz and 3 THz. Along with creating a group that will focus on the requirements needed for 6G in the year 2030. After the U.S. the E.U. , South Korea and China all started conducting research on the idea of 6G with help from the initiative set by the University of Oulu. Japan followed up by readying \$2 Billion dollars to support the research of 6G. Companies like Samsung, LG, Nokia and Ericsson all are a part of this initial stage of research into 6G. [2]

5. Conclusion

After the Results of 5G being commercialized the next step was not to sit by and wait until a newer network would be necessary; but to immediately start brainstorming, researching and testing the possibilities of an even better network in 6G and beyond. With 6G looking to increase bit rates immensely and reducing latency like crazy, plus a bunch of other features including security and privacy and much more; 6G is soon to be the next big thing when it comes to fruition. Along with the launch of research by multiple countries and companies the idea of 6G is one that should come to reality.

References

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Appendix

Abbreviations-

3G:	Third Generation
4G:	Fourth Generation
5G:	Fifth Generation
6G:	Sixth Generation
MHz:	Megahertz
THz:	Terahertz
eMBB:	enhanced Mobile BroadBand
BigCom:	Big communications
SURLLC:	Secure ultra-reliable low-latency communications
URLLC:	ultra-reliable low-latency communications
mMTC:	massive Machine Type Communication
U.S.:	United States
E.U.:	European Union
LG:	Lucky GoldStar™