6G Technology & Networks

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Abstract- *6G is the successor of the 5G network, it is the fastest cellular network of the today. 6G will support new upcoming technologies such as AI, Autonomous cars, etc. 6G will change communication and networking that we all know today. Although it is still being developed it has shown potential for very fast data speed, low latency along with its applications such as Autonomous vehicle and many more.*

Keywords- 6G, Networking, Cellular Network, ultra-fast data speed.

I. INTRODUCTION

6G is the successor of the 5G cellular network, it will faster than 5G and its latency will lower than 5G and its frequencies will be higher than 5G which will allow faster sampling rates. Researchers are working on making 6G faster by using new frequency bands like terahertz waves. 6G will be faster than current 5G by 100 times.

6G is expected to support the upcoming technologies such Artificial Intelligence, Internet of Things, Smart cities, etc. Many countries and companies are working on it but among them Japan stands out because its companies have developed top-level sub-Terahertz 6g device capable of 100 Gbps speed.

II. IMPACT OF 6G TECHNOLOGY: ADVANCING AI, VIRTUAL REALITY, AUTONOMOUS SYSTEMS, AND MORE

6G will bring together many types of technologies such as Artificial Intelligence, the Internet of Things, and virtual reality. In terms of AI, 6G will use in edge computing, making computing software and hardware closer to users for better analysis, decision-making and data processing. The AI will also be used for work like data offloading, resource allocation and content caching improving the experience of the user. And AI will also help with intelligent routing where routing algorithms are made to handle network traffic and meet the requirements of 6G uses.

When it comes to virtual reality the faster speed given by 6G will better the VR experience making it more interactive with good quality frame rate and resolution. This will benefit VR in gaming and entertainment but it will also be useful in medical and educational purposes. For example, VR will make remote surgery possible giving doctors the ability to treat patients when they are far away from the patient or hospital by the help of robotic surgical equipment. This can make local healthcare independent and unrestricted access to medical services.

In autonomous vehicle communications, 6G will give better real-time communication between autonomous vehicles and its infrastructure making navigation better and improving decision-making. AI will assist in routing decisions enhancing both navigation and passenger safety. In UAV (unmanned aerial vehicle) communication 6G will increase the reliability and connectivity of UAVs making them capable to operate over larger areas with low latency and high throughput which will give better security and efficiency in mission-critical tasks. The current Tesla car is an example of an AI that can auto pilot but it can become better with the help of 6G

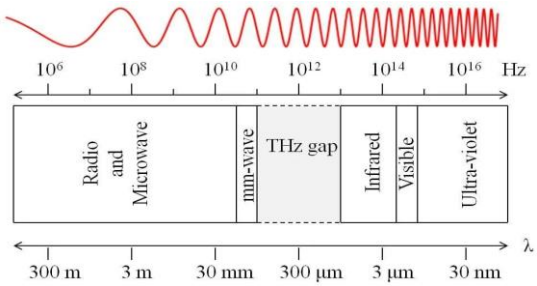
For smart robotics, 6G will speed up the development of connected robots and autonomous systems by improving their capability to interact with their environment. Robots will become able to function with different levels of autonomy complete tasks more properly, and respond to changes in real time. In the case of autonomous cars 6G will enable better processing of sensor data such as GPS, sonar, and radar which will make navigation better. In smart agriculture 6G will make farming more efficient with making data collection fast also real-time analysis, and automation. With speed that is 100 times faster than 5G farmers will be able to gather more data of their crops, like soil moisture and water usage leading to better decision-making and higher yields. This will help reduce costs and human errors in the process.

The Japan has developed the first 6G device although it was a prototype it achieved data speed up to 100Gbps which is faster than 5G speed by 100 times. Its range was 100 meter still it's a huge step towards development of the 6G. Currently researcher's predict that in 2030 we will have 6G it's a long time but there is a possibility that it will happen sooner than that.

III. WORKING, CHALLENGES AND BENEFITS OF 6G

A main goal of 6G is to reach higher data rates, potentially up to 1 terabit per second .To do this, 6G is expected to use frequency bands in the millimetres-wave (30 to 300 GHz) and terahertz (THz) ranges (300 GHz to 3 THz).

On the working 6G, 6G will use many things such as Terahertz band, sub-6 GHz frequency spectrum, The Upper Mid-Band, etc. one of them is Terahertz band whose wave length is 300µ. The terahertz waves is longer than infrared wavelength thus they have better penetration depth and less scattering in other word in crowded spaced buildings the 6G will run better. For better understanding of Terahertz wave look at the image below:



The sub-6 GHz frequency spectrum will be important in the creation and deployment of 6G technology. This range includes frequencies that are widely used in today's cellular networks.Currently higher frequency bands are getting more popularity for theircapabilities to offer very-fast data speed the sub-6 GHz spectrum willbe important for providing reliable coverage and supporting huge areasfor connectivity in 6G networks.

The Upper Mid-Band is also in working of 6g, The Upper Mid-Band ranging from 7 to 30 GHz, has lower propagation loss compared to sub-THz bands. It gives a middle ground between the high frequencies of mm Wave bands and the lower frequencies used in earlier wireless tech generations. This spectrum gives better coverage and capacity making it bestinsupporting high-bandwidth applications in urban and suburban areas without needing many small cells. On the other side the Millimetre-Wave Band (it covers 30-300 GHz frequencies providing multi-gigabit-per-second speeds with bigger bandwidths making it perfect for data-heavy applications like very high quality video streaming, virtual reality, augmented reality, and gaming.

6G is the future of cellular networks giving huge improvements in current technology. It will give faster speed and even better connections making it possible for industries like healthcare, smart cities and remote surgery to be developed. A huge part of 6G is the Artificial Intelligence to make networks better than the current networks. AI will help manage network traffic and fix problems automatically and make network work more efficiently. It will also help process data faster making work smoother.

One of the biggest goals in 6G is to give internet access to everyone also in the areas that currently have no coverage of cellular network. Right nowmanyof the areas still don't have access to internet because it's too expensive to make the infrastructure to have cellular network. 6G will change that by usage a both of satellites and ground stations to bring internet even to the remote places. Another new technology in 6G is Terahertz waves which will make the speed of the data much faster supporting things like very high quality video streaming and virtual reality. But these waves have challenges like low coverage and are expensive which will need to be solved out by industry and researchers.

6G will also use radio waves for more than just communication. It will become capable of sensing things like temperature moisture action which will help with things like tracking action in its vision and more accurate location services. This gives new opportunities for industries like healthcare and will help cities become better. The network will be flexible and will become capable different tasks as given. On top of that 6G will be designed to save energy which is important as the demand for faster networks and more data increases.

Security is important factor in 6G. Similarly like 5G making sure network is secure will be first priority but with 6G new technologies like quantum cryptography will be used to keep data safe. Now that Digital services becoming an even bigger part of our lives it is crucial that the network can protect users. Another feature will be self-repairing networks which means that if anything goes wrong the system will be able to fix itself without help. Finally, 6G will make better use of radio spectrum making sure bandwidth is used efficiently to meet growing demand.

IV. CONCLUSION

In conclusion of this research we have found the huge benefits of 6G not only the speed but there are many benefits that will increase the quality of life along with the coverage of 6G network will reach into areas where current cellular network does not reach. But there are many obstacles in the way of development and deployment of the 6G.The current predictions of its development and deployment if 2030.

REFERENCES

[1] https://www.linkedin.com/pulse/japan-announces-worlds-first-6g-device-kevin-huang-ofytc/
[2] https://www.techtarget.com/searchnetworking/definition/6G
[3] https://www.docomo.ne.jp/english/info/media_center/pr/2024/0411_00.html
[4] https://www.mdpi.com/2071-1050/16/15/6533
[5] https://currentaffairs.adda247.com/worlds-first-6g-device-launched-in-japan/
[6] https://www.mdpi.com/2673-4001/5/3/41
[7] https://www.everythingrf.com/community/6g-frequency-bands#:~:text=To%20achieve%20this%2C%206G%20is%20expected%20to%20utilize,going%20to%20depend%20solely%20on%20these%20high-frequency%20spectra.
[8] https://www.mdpi.com/2673-4001/5/3/41#B22-telecom-05-00041