6G WIRELESS COMMUNICATION VISION AND POTENTIAL TECHNIQUES

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Abstract: The demand for wireless connectivity has grown exponentially over the last few decades. Withthe fast development of smart terminals and emerging new applications (e.g., real-time and interactive services), wireless data traffic has drastically increased, and current cellular networks (even the forthcoming 5G) cannot completely match the quickly rising technical requirements. To meet the coming challenges, the sixth generation (6G) mobile network is expected to cast the high technical standard of new spectrum and energy-efficient transmission techniques. In this Project, we sketch the potential requirements and present an overview of the latest research on the promising techniques evolving to 6G, which have recently attracted considerable attention. Moreover, we outline a number of key technical challenges as well as the potential solutions associated with 6G, including physical-layer transmission techniques, network designs, security approaches, and testbed developments.

Keywords: Massive MIMO, 5G, signal detection, bit error rate, computational complexity.

I.INTRODUCTION

With the maturity and forthcoming commercialization of the fifth generation (5G), the expectation and development of 6G mobile network have attracted a great deal of attention. In the past two years, some countries have released relevant research plans concerning the development of 6G. For example, in September 2017, the European Union launched a three-year research project on the basic 6G technologies. The main task is to study the next generation forward error correction coding, advanced channel coding, and channel modulation technologies for wireless terabit networks.At the end of 2017, China began to study the 6G mobile communication system to meet the inconstant and rich demands of the Internet of Things (IoT) in the future, such as medical imaging, augmented reality, and sensing (www.china.org.cn). In April 2018, the Academy of Finland announced an eight-year research program, "6Genesis," to conceptualize 6G through a joint effort of the University of Oulu and Nokia. More recently, the U.K. government has invested in some potential techniques (e.g., €15 million in quantum technology studies) for 6G and beyond some universities in the United States have lunched research on terahertz-based 6G wireless networks, and South Korea Telecom (SKT) has started 6G research based on the cellfree and non-terrestrial network techniques. In [1], based on the regularity of market entry of past commercial wireless communication systems and the expectation for 6G, the authors forecasted that 6G will start its commercialization in 10 years.

II. LITERATURE SURVEY:

Estimated that the international standardization bodies will sort out the standards for year 2035. While the rollout of 5G is still underway, the researchers across the tentative timeline for the implementation of 5G, B5G, and 6G standards by2020 (IMT2020 Standard) in 2015 for the 5G network standards. At the same time, standardization of 6G (ITU-R IMT-2030) by the end of the year 2030, whereas 3GPP workgroup for exploring the system technologies for B5G/6G systems in July communication technologies . The vision of 5G technologies is extended for the 6G networks by speculating the visionary technologies for next-generation wireless systems in [5]. Different networking scenarios are presented in [15]. The authors in [12] and [13] give a predictive technical framework for industries in future generations of communication systems mainly focusing on the specifications of future generations of the communication system. Cell-less architecture, decentralized networking, and resource allocation, and three- dimensional radio connectivity including the vertical direction are expected in next- generation communication systems. The evolution of wireless systems from 1G to 6G is outlined in [14]. The authors in [15] presented the role of intelligent surfaces in the architecture of 6G networks. The authors in [16,17] presents the expected technologies, possible applications of 6G. The articles present the system-level perspective of the 6G scenario with use cases, vision, and technologies.

III EXISTINGSYSTEM

The existing systems are 1G, 2G, 3G, 4G, 5G. The 1G network was all about voice. 2G network was all about voice and texting. 3G network was all about voice, texting, data. 4G network was everything in 3G but faster version and the 5G is even faster, has better battery life and very low latency than 4G.

IV. PROPOSED SYSTEM

In general, the 6G mobile network is expected to provide ultrafast speed, greater capacity, and ultra-low latency for supporting the possibility of new applications, such as fine medicine, intelligence disaster prediction, and surreal virtual reality (VR). Based on the former evolution rule of mobile networks, early 6G networks will be mainly based on the existing 5G architecture, inheriting the benefits achieved in 5G (e.g., the increased authorized frequency bands and the optimized de-centralized network architecture) and prodigiously changing the way we work and play. Around 2030, our society will likely become data-driven, enabled by nearly instantaneous, unlimited wireless connectivity [1]. As a result, 6G is expected to advance the wireless technologies we are familiar with today and achieve considerably enhanced system performance. As a vision for the future, in terms of speed, 6G will probably utilize higher frequency spectrum than previous generations in order to improve the data rate expected to be 100 to 1000 times faster than that of 5G [2]. To be specific, 6G networks will allow hundred gigabits per second to terabit-per-second links by 6 making use of multi-band high-spread spectrum; for example, the combination use of 1–3 GHz band, millimeter-wave (mmWave) band (30–300 GHz), and terahertz band (0.06–10 THz) [3]. On the other hand, in terms of capacity, compared to 5G, 6G will be able to flexibly and efficiently connect upper trillion-level objects rather than the current billion-level mobile devices. As a result, the 6G network becomes extremely dense, and its capacity may be 10 to 1000 times higher than that of 5G systems and networks. Furthermore, in terms of latency, from 2G to 5G, the evolution of mobile communication networks is centered on service people, and hence latency depends on human reaction times, such as the auditory reaction time (~100 ms), the visual reaction time (~10 ms), and the perceptual response time (~1ms). For the application of tactile Internet, 5G technology will allow for a latency time of 1 ms; however, this is too long for Industrial IoT and some other latency-sensitive applications. For example, a minimal latency time is essential for decreasing collision rates and improving the safety in autonomous vehicles. For this purpose, 6G aims for an undectable or even nonexistent latency, since it can enhance the application of autonomous vehicles, augmented reality, and medical imaging. Indeed, with the emergence of more new unmanned and autonomous applications, the latency time no longer solely depends on human reaction times. While the preliminary sketch of 6Gis being drawn up, efforts on configuring the potential techniques to match the aforementioned appealing vision remain in a nascent stage. It is worth noting that in [1], the authors first provided a general survey of different wireless generations and then highlighted an initial sketch of 6G based on the requirements of future users. Compared to [1], this article summarizes the potential requirements and the latest research on promising techniques toward the evolution to 6G. Another important purpose of this article is to provide the scientific community with an overview of the most challenging aspects in the focused context of 6G mobile networks and to give helpful suggestions for overcoming these challenges. Laptops, mobile data traffic has observed an exponential growth during the past few years, and this growth is expected in next few years as well. With the increase in the number of mobile users, not only the mobile traffic has increased but every user wants higher data rate with more accuracy and reliability. This considerable amount of mobile data traffic is challenging to manage with current technologies.

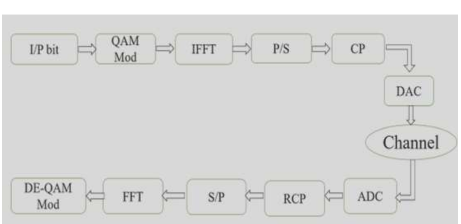


Figure1: Block Diagram of proposed system

NETWORK DIMENSIONS AND POTENTIALTECHNIQUES :

Network intelligence will be an essential component of 6G networks and the networkwill take actions dynamically according to the environmental conditions. The idea ofclouds, fog, and edge computing is applied for fast access to services. The features ofself-optimization,self-organization,self-reconfigurationwillbeachievedthroughsoftwarization, virtualization, and slicing. The detailed discussion on each networkdimensionis given as follows**.** Thousands of sensors are installed in the industries and hundreds of the sensors areinstalled in homes. It is very difficult to connect all these sensors with wires [67], and,allthesedevicescanproducealargeamountof data.Also,thesedevicesaresmartandintelligent,capableofmakingsmartdecisionsandlessprocessingpower.Therefore, we need to offload the data from cloud to edge and device end. To reducethe processing delay, we need to shift the process near to end devices in terms ofcloud/fog. We need to place the workload closer to the edge for a better quality ofservice**.**

PotentialFeatures:

In order to provide satisfying services for Industry 4.0, personalized health services,virtual presence, and other challenging anticipated applications in the future, 6Gneeds to further enhance its scalability, flexibility, and efficiency by embracing noveltechniques. Like the emergence of many new technologies when the wireless worldmoves toward 5G, the new requirements of 6G will influence the main technologytrends in its evolution process. The success of 6G will have to leverage breakthroughsin thenovel technologicalconcepts.A wide range of recent research findings related to 6G design, including multi-bandultrafast-speedtransmissiontechniques,super-flexibleintegratednetworkdesigns,multi-mode multi-domain joint transmission, as well as machine learning and big-dataassistedintelligent approaches.

Multi-BandUltrafast-SpeedTransmission:

For our bandwidth-hungry society, 2G, 3G, and 4G have used frequencies that reachapproximately up to 6 GHz, while 5G systems exploit the range of less than 6 GHz asefficiently as possible by combining 24–100 GHz. Recently, developers are realizingthatthecurrentfrequencybandsmay notbeenoughtoservethegrowingdemands;for example, an uncompressed ultra high-definition video may reach 24 Gb/s, andsome 3D videos may reach to 100 Gb/s [3]. Asa result, in 6G, we will jump above100 GHz, and the new radio will consider not only the traditional sub-5 GHz band butalsovalidatelittle-exploredfrequencysourcessuchasmmWave andterahertzbandsto overcome the spectrum scarcity and provide wide bandwidth from hundreds ofmegahertz to several gigahertz and even to terahertz. In recent years, a flurry ofresearchactivitieshavebeenreportedconcerningtheuseofmultiplehigh-frequency bandsforultrafast-speedtransmissions,whicharerecommended aspromisingsolutions for 6G. Specifically, a consortium of DARPA, IBM, andIntel has focusedonresearchintousing140GHz,220GHz,and340GHzfrequencies.Inearly2014,Akyildiz etal.providedan in-depthviewofterahertz band in the range of 0.1–10 THz for supporting terabit-per-second high-speed communications [4].Teams atNew York University are already working on terahertz research and quantum devices,with the goal that transmit rates in 6G are expected to be 1000 times faster than thosein 5G. Furthermore, we can also combine the fiber optictechnologywiththewireless-typetransmissionsforfurtherimprovement.Thecoexistence of multiple high-frequency bands and the dynamic utilization of differentfrequencies can be realized by advanced software defined radio (SDR) and softwaredefined networking (SDN) techniques. Moreover, the emerging block chain techniquemay be an appealing solution to facilitate dynamic spectrum sharing in the future(https://venturebeat.com/). With these aforementioned novel techniques, it is expectedthat 6G networks will be easier to upgrade based on the existing 4G and future 5Gequipment.

SuperFlexibleIntegratedNetwork:

6G systems will also need to serve a wide range of applications in diverse scenarios,whichhavebeendefinedin5G.Moreover,withtheriseofsmarthomes,buildings,cities,andsociety,6Gwillmeettheincreaseddemandsforhuman-to-machineandmachine-to-machinecommunications,especiallywiththe developmentofroboticandautonomous drone systems. Moreover,withtheriseofsmarthomes,buildings,cities,andsociety,6Gwillmeettheincreaseddemandsforhuman-to-machineandmachine-to-machinecommunications,especiallywiththe developmentofroboticandautonomous drone systems. By jointly exploitingtheadvantagesofsatellitesystems, airsegmentnetworks,andgroundsegmentsystems,thismultidimensionalnetworkwillbringlotsofbenefitsforfuture6Gwireless communications. In particular, as shown in [6], with the increasing numberand types of aerial vehicles, such as balloon, airship, and unmanned aerial vehicle(UAV), the flyingbasestation(FBS) assisteddynamic networkscanbe builttoimprove the conv

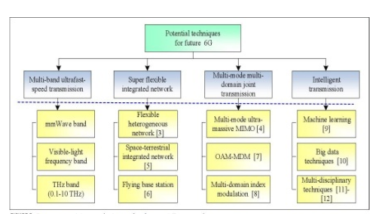
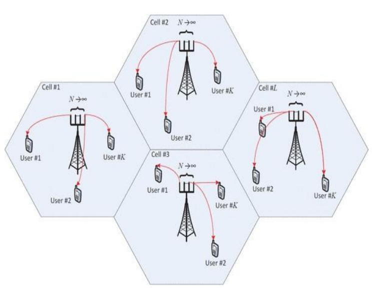


Fig2 : Potentialtechniquesof6G.

Multi-ModeMulti-DomainJointTransmission:

Oneofthemostchallengingtasksin6Gi stoconceivesuitablephysical-layertransmission techniques to support the newly used spectral bands and enable newapplications, including ultrahigh-speed indoor wireless services. For example, whenTHz band frequencies are utilized, how to deal with the high spreading loss andmolecular absorption isa vital issue. For this research objective, manyuniversitiesand research centers have begun to study the next generation forward error correctioncoding, advanced channel coding, and channel modulation technologies for multi-bandultrafast-speedwirelesscommunications[1,4].In[4],adistance-adaptivephysical layer design was proposed for mmWave and THz band communications,where each GHz (even THz) ultra-wide band was divided into narrower but stillbroadbandsub-windowsfor allowingparallel



multiplewidebandtransmissions.

Fig3: MassiveMIMO.

In each band, to add efficiency, novel multiple antenna techniques can be adapted,such as the PM-MI - MO technique. Specifically, as shown in [4], a novel class ofPM-MIMO,namelyUM-MIMO,isapromisingsolutionforincreasingthecommunicationdistanceandimprovingtheattainablecapacityoftheTHz-bandnetworks.

Moreover, for further enhancing the PM-MIMO design, the multi-modemultiple antenna techniques, such as beam forming (BF) and spatial multiplexing(SMX), can be dynamically combined and adapted. BF can effectively decrease theeffects of high attenuation at mmWave and THz bands, while SMX is able to increasethe capacity per user. The above benefits of BF and SMX can be simultaneouslyobtainedbyadoptingtheircombinationintheseparallelbroadbands.Furthermoreto spacediversity techniques, such as some classic space-time block codes (STBCs), can alsobe integrated. Besides the multi-mode techniques, multi-do-main joint transmissiontechniquesarealsopromisingforfuture6Gtransmission.Forexample,orbitalangular momentum-based mode-division multiplexing (OAM-MDM) is an emerginglow-complexity but high-spectral-efficiency physical layer solution for short-distanceline-of-sight wireless communications, which is capable of employing all availableDoFs toconvey the information overwirelesslinks, including phase,polarizationstate, and other spatial DoFs [7]. In contrast, for innovatively exploiting the DoFs ofmultiple antennas (space-domain) and multiple carriers (frequency domain), in [8] amulti-do - main index modulation (MD-IM) technique was proposed, which relies onthe generalized on/ off keying principle applied to any of the available signal resourcedomains to modulate the information bits on to the indices of the transmit resources,including the indices of subcarriers, transmit/receive antennas, code types, dispersionmatrices, signal powers, precoding matrices, and so on. In general, OAM-MDM andMDIM create completely new dimensions for data transmission. The main benefit ofOAM-MDM and MD-IM techniques is that they can be flexibly configured to satisfydifferentperformancerequirementsfor supportinga wide varietyofapplications,which is in accord with the basic requirement of 6G network design. As a furtheradvance,theabove-mentionedmulti-modeandmulti-domaintechniquescanberoundlyand penetrativelycombined formoreefficient and

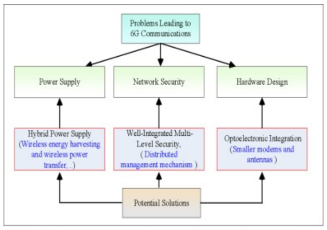


FIGURE 3. Some potential problems for 6G development and their promising solutions.

flexibledesigns.

.Fig4:Potentialproblemsfor6Gdevelopment

MachineLearningandBigDataAssistedIntelligentTransmission:

Another trend predicted for 6G is intelligent networks and technologies to enable afully immersive experience for users. For this research objective, 6G needs to beinnovated by using and combining technologies from other fields. In recent years,breakthroughs have been made in the fields of artificial intelligence and machinelearning technologies, such as deep learning neural network (DNN) algorithms [9]. Inmachine learning, the optimal solution (e.g., the optimal transmit mode) is capable ofbeingobtainedbyclassificationorneuralnetworklearninginsteadoftediouscalculation, where the classifiers and DNNs can be trained by offline datasets. Thesemachine-learning-based methods are the best candidates to improve the design andoptimization of the wireless digital communication systems in real time. Specifically, the key issues behindsynchronization, channel estimation, equalization, MIMO signal detection, iterativedecoding, and multi-user detection in wireless communication systems are similar tothetheoreticalbasisofmachinelearning.As a result, besides the machine learning techniques, someemerging big data techniques can be employed for further improving the 6G networkdesign.Specifically,machinelearningwasconsidered asakeyapproaching [1]forrealizing 6Gfromauserperspective.In[9]theauthorssummarizedthemachinelearningtechniquesformassiveMIMOoptimization,heterogeneousnetworkdesign,anddevice-to-devicecommunications.In [10], a novel mobile network architecture enabling big data analytics was proposedfor facilitating physical layer optimizations. It is worth noting in [9–11] that machinelearning and big data techniques will not only deliver compelling system performancebut also profoundly change the design and configuration of the future 6G networks (e.g., the physical-layer processing and MAC protocol). Furthermore, machine learningandbig dataanalytics arenot independent andunrelated infuture6G networkdesign. Asnoted in[11],byjointlyutilizingthese techniques,the mobile networkswillbecome more promising in terms of self-adaptive, self-aware, and predictive ability.Indeed, intelligent 6G network design requires knowledge and methods from multi-disciplinary aspects. To be specific, methods in optimization theory, data mining,computer science, and even life science will be involved. Recently, based on thedevelopmentof brain-machine interface techniques,mind-controlledmachinesaregradually being realized [12], which have led some scientists to speculate that mind-to-mindcommunicationsmaybepossiblein6Gandbeyond(https://www.iflscience.com/).Moreover, a6Gnetworkmayalsoincludeothercommunication types, such as molecular communications [13] for future micro-ornanoscalemedicalapplications.Intheselong-term,forward-looking,andservice-orientedvisions,thebiologyandchemistryfieldsareinvolvedinfuturecommunicationtheory.

V RESULTS AND DISCUSSIONS

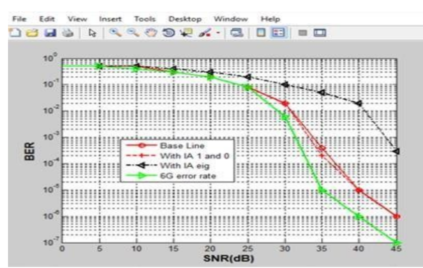


Fig5 : Output 1using32:32 SNRalgorithm.

Here in our project we obtained our output comparing the latency rate andBER(BitError

Rate)of 6G networkand othernetworks.Output 1 result shows the comparision of 6G and 5G networks BER using32:32 algorithm. In the above graph the green line indicates the 6G network and redline indicates the 5G network. The X-axis shows the SNR(Signal to Noise ratio)and Y- axis shows the BER. On comparing the 6G and 5G networks the greenline i.e., 6G networks is showing the low BER around 10^-7 which is lowcomparedtothe 5G network. Low BERindicatesthe reduceof SNRand thedatatransmitted with low latency to thereceiver.

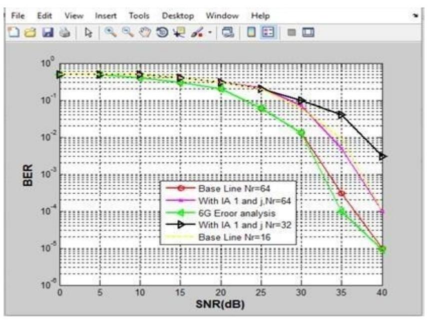


Fig5.1: Output2 using64:64SNRalgorithm.

In this project, we put our proposal into the Vienna Matlab platform and receive thesimulation results. Here, we assume that D2D communication reuses the downlinkresource for transmission. Otherwise, the collision probability reduces as m increases.Therefore, we need to choose a suitable m that considers both the collision probabilityand the access probability. At this point, we assume that the arrival of the D2DUE'saccess request follows the Poisson process. This result will satisfy the need of apractical system performance. Through numerical simulation on the Vienna Matlabplatform, we can obtain the average access delay under the premise of a differingnumberof preambles.

VI. CONCLUSION

We have presented a vision for 6G mobile net - works, which can cater to the growing demands of IoE. We commence with a sketch of 6G from the viewpoint of time, frequency, and space resource utilization. Then we review some promising recent approaches that could move this vision closer to reality. Finally, we focus our attention on some challenges in 6G communication systems, which will hopefully serve as guidelines for their future development. We note that the major features of 6G networks are their flexibility and versatility, and the design of 6G networks is a truly multidisciplinary field of science. We expect that the new research on 6G will also impact the areas of medical imaging, semiconductors, spectroscopy, chemistry, and even biotechnology.

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