

Beyond-5G based Wireless Network Routing Architecture for Cooperative Communication

Nishant Tripathi¹

Assistant Professor, Department of Cyber Physical System, Faculty of Engineering and Technology,

JAIN (Deemed-To-be University), Bengaluru, Karnataka, India¹

phd.nishant17@gmail.com

Abstract: Cooperative communication in Beyond- 5G (B-5G) and Sixth-generation (6G) will be widely adopted in the near future with significantly additional services and applications than fifth generation. The fundamental concerns that is required to be have a proper solution with beyond 5G communication or 6G based services for wireless networks is having better throughput and capacity of the overall Wireless based networks. If the routing architecture, memory hierarchy and clustering technique of the network are arranged and structured properly then, most of the communication setup rallies faster and have longer life. Vast application areas of B-5G and 6G system with 4th industrial revolution in execution phase has a greater impact, and will launch the footprint for 5th industrial telecom revolution for 7G. Researcher and practicers of modern-day wireless industry needs incorporation of not only working to resolve clustering issues, but also the internal packet routing. So, we need a better OSI based communicating module for B5G and 6G based wireless networks. The present study will showcase the prototype of functional core of OSI networking architecture module for Beyond-5G based wireless network along with expanded areas of application markets existing in present or in upcoming time in future.

Keywords: Routing, Beyond 5G, Wireless Networks, 6G, Cooperative Communication

I. INTRODUCTION

6G system will be needed with new enticing characteristics to attain the new higher larger communication domain user objectives like round of clock connectivity, user security, maximum DR, one touch solution on single hand device and many more. 6G systems also needed to overcome the restrictions of 5G and beyond 5G for supporting new challenges. As a new improvement integration of services such as dynamic sensing intelligence with user to user or user to machine or vice versa interaction has also been a core area of 6G.

A pervasive AI with incorporation of THz communication, 3-dimensional networking system, intelligent reflecting surface (IRS) with proactive cache memory, the 6G communication will address all these add-ons and the shortcomings of the 5G system [10]. The confluence of all previous aspects, such as network compression, high output, more dependability, consumptions of lower energy, and huge connection, will be the major drivers of 6G. The 6G system would also convey on the previous generations propensities, which comprised futuristic cloud- AI-IOT based services.

Besides add-ons, an ultra- range communication and lower latency of around 1 millisecond is expected [14], [15]. An integration of Artificial Intelligence for independent self-driven systems is also an interesting feature of 6G. In 6G communications, data traffic in visual format is projected to provide better resolute and accurate outputs than other existing modules.

Communicating in Tera-Hertz band, services offered with Artificial Intelligence, support with 3D networking, applications associated with UAV, add-ons of IRS, along-side wireless power transfer are the most essential technologies that will drive 6G. This report attempted to present a comprehensive perspective of the future 6G communication infrastructure, taking into account current trends and research activities from around the world. Other articles dealt with related topics in a more separate manner.

In the current article firstly we will discuss the core network of B-5G for wireless networking, followed by certain tabular comparison of the applications of B-5G and 6G. The subsequent section will follow with B-5G based Wireless Network application supporting Cooperative Communication (CC), its need, application, advantages and future scope with conclusion.

II. HISTORY AND ONGOING TRENDS OF MOBILE SUBSCRIBER WITH VARIOUS GENERATIONS

B-5G and 6G will be boosted to prepare a better wireless network by using enormous data generated throughout the globe and its year wise distribution becomes the backbone of big-data analytics. The two charts below give a glimpse of the same.

Generation	1G	2G	2.5G	3G	4G	5G
Starting	1970	1980	1995	1999	2002	2010
Implemented	1983	1992	1995	2002	2010	2015
Standard	AMPS,TACS	AMPS,GSM,CDMA,PDC	GPRS,EDGE,IS-95	WCDMA,UW-C,CDMA2000	ADVANCED	ADVANCED
Applications	A/G Audio only	Digital voice	HPDA	Broadband	All multimedia	All Mutlimedia
MUX Basis	FDM Based	TDMA,CDMA	TDMA,CDMA	CDMA	OFDM	OFDM,MIMO
Data Rate	Above 9 kbps	above 14 kbps	abobe 380 kbps	Above 2Mbps	Above 200 Mbps	Above 1Gbps

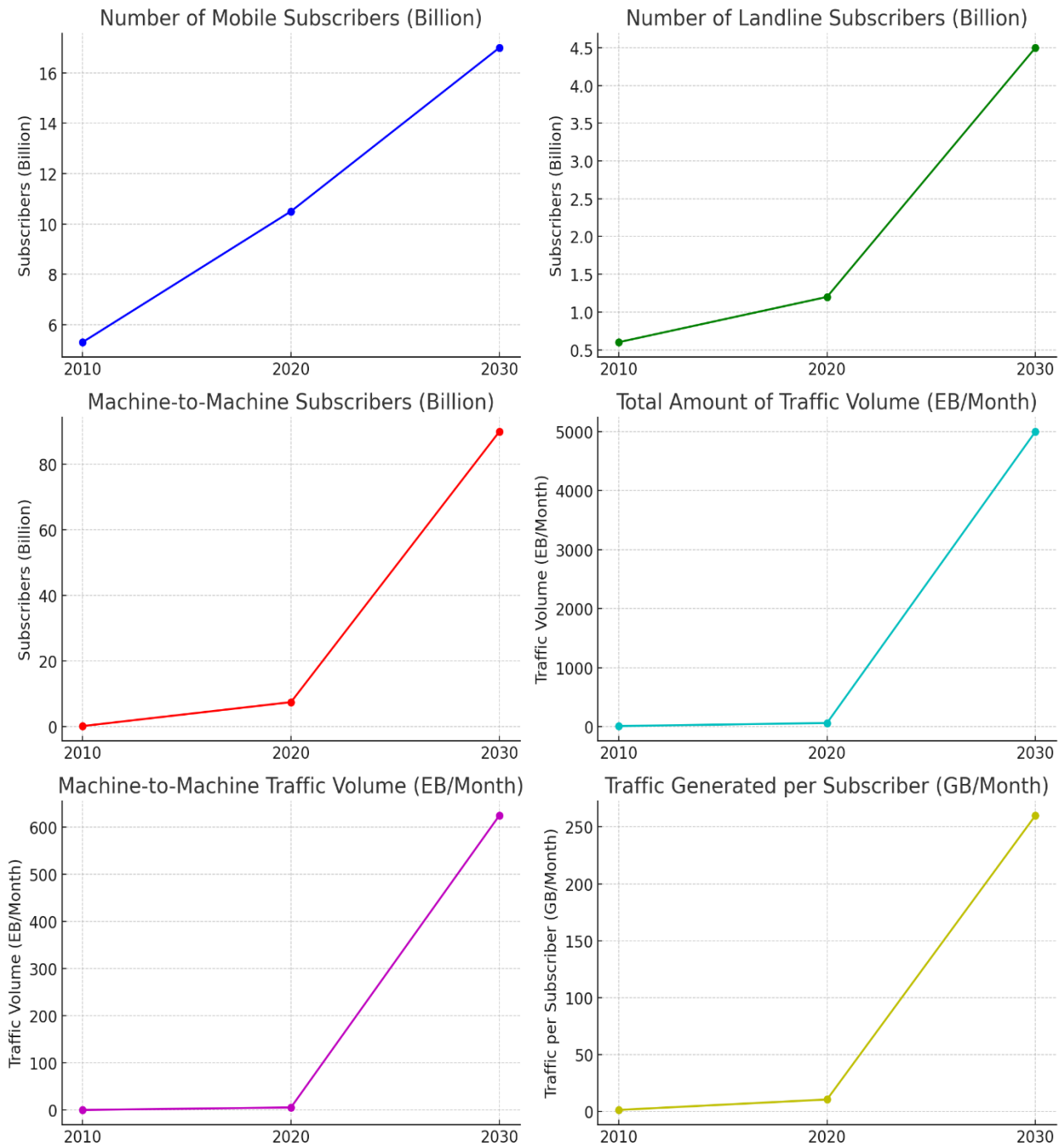
Table:1 Parameter comparison among various wireless communication generation

Furthermore, the utilisation of M-2-M connectivity will grow at an exponential rate. The volume of traffic for each mobile device will likewise increase.

In 2010, a mobile device's monthly traffic volume was more than 5 GB. However, by 2030, this volume will have increased by more than 50 times. In comparison to 2010, the number of M-2-M subscriptions will increase approximately by 33 times in 2020 and by 455 times in 2030.

Parameters	Year 2010	Year 2020 (Approximated value is equal to or more than)	Year 2030 (Prediction is equal to or more than the value)	Total units
Number of Subscriber(Mobile)	Beyond 5.3	10.5	17	Billion
Number of Subscriber (landline)	Beyond 0.6	1.2	4.5	Billion
Machine -2-Machine Subscriber	Beyond 0.2	7.5	90	Billion
Total Amount of traffic Volume	Beyond 7.5	60	5000	EB/Month
Machine -2-Machine Subscriber traffic volume approx.	Beyond 0.25	5.5	625	EB/Month
Traffic generated/subscriber	Beyond 1.3	10.5	260	GB/Month

Table 2: Parameter comparison from 2010 to 2030



III. ROUTING CORE MODULE FOR B-5G BASED NETWORK

Several challenges

- output
- overall delay
- Energy throughput profiling
- Rollout expenditure
- Dependability
- Difficulty of the machine-oriented system

are all linked with Beyond-5G technology. After 2030, B-5G is unlikely to be able to meet market expectations for wireless based networks for any kind of applications. Then, in instruction to tie between Beyond-5G and user-based market needs, 6G will be introduced.

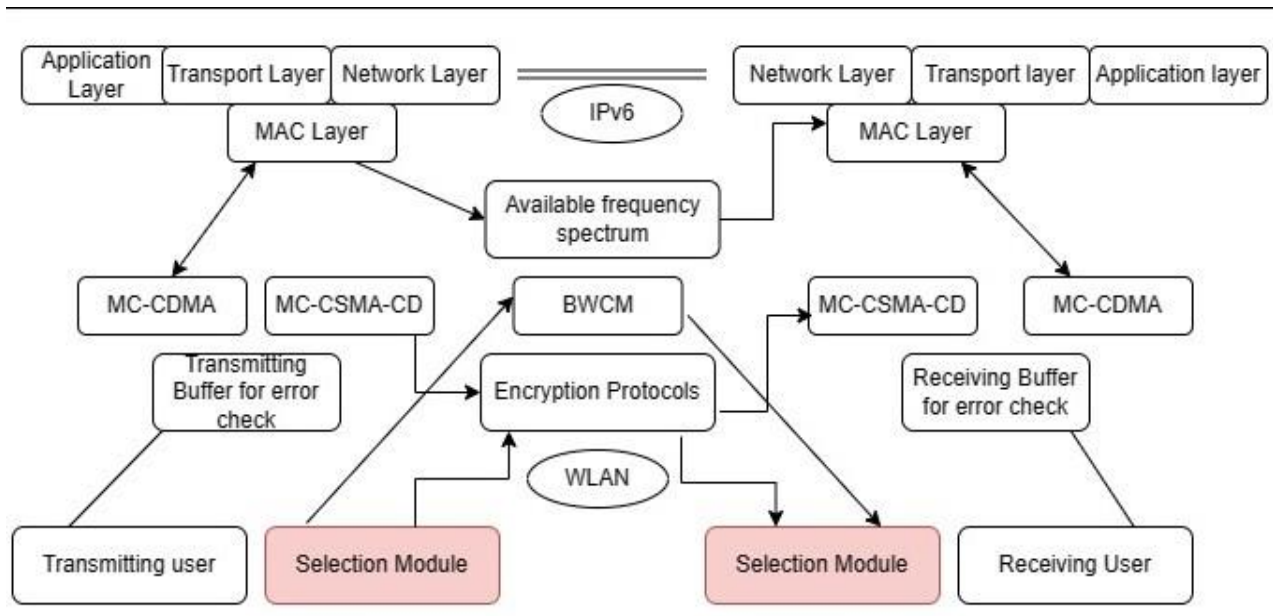


Fig.: 1

Mix-bandwidth Data Path routing overview model for 5G and beyond 5G based Wireless Networks (Camera based/non camera based)

- So, according to the future requirement and the number of subscriber support for B-5G based communication, we require a robust, more energy proficient and reliable model. In this model of routing transmitter and receiver can utilize the available spectrum on cooperative basis, making optimum use of available BW.
- This setup will surely help to reduce the increase BW requirement. Now, there should one control monitoring system which should be centralized for the whole network setup, when we have B-5G based communication setup in network.
- Multiple access should be multi-carrier, and data transmission efficiency should evaluated using Multi-carrier collision sense multiple access collision detection.
- There should be one encryption modelling in the selection module while selecting the appropriate frequency from the available spectrum during the transmission.
- The encryption level should be just above the MAC Layer of model, as fully virtualized system based on cloud services used in the network may also be secured during the transmission phase.
- Error detecting and correcting algorithm should also be added as an additional buffer in terms of space to support the overall transmission.

OSI Layers	Adaptability for working	Application Interface
Application Layer	Saas	Application based Services
Presentation Layer	Saas	Application based Services
Session Layer	Open Trasport Protocol	Infrastructure based Services
Transport Layer	Open Transport Protocol	Infrastructure based Services
Encryption at Network	Open Transport Protocol	Infrastructure based Services
Network Layer	Upper Network Layer	Infrastructure based Services
Network layer (2)	Lower Network Layer	Platform Based services
MAC	OWA	Platform Based services
Physical Layer	OWA	Platform Based services

Fig.:2 Protocol stack in B-5G and 6G

B-5G based OSI routing prototype will also behave for the 6G based communication module. However several more integrations will be available as a part of applications for the later. In this B-5G routing stack diagram for wireless based networks Figure No. 1, 2

Parameter of Comparison	4G/4G VOLTE	5G/5G+/Beyond 5G	6G
Maximum Data Rate/device	Around 1 GBPS	Around 10 GBPS	Can up to 1-5 Tbps
End to End (E-2-E) Latency	Around 80-100 ms	Around 5-10 ms	Expected to be around 1 ms
Spectral Efficiency	Ranging around 10-20 bp/Hz	Ranging around 30 bps/Hz	Expected to be around 100 bps/Hz
Mobility supporting rate	Close to 300-400 km/hr	Close to 500-600 km/hr	Expected to be around 1000 km/hr
Satellite system support and integration	Not available	Not available	Satellite integration support is possible
Artificial Intelligence support	Not available	Not available	AI based system design is available
Autonomous vehicle support system	Not available	Upgraded to provide partial support	Full support
XR support system	Not available	Upgraded to provide partial support	Upgraded to XR support fully

Table 3: Parameter comparison between multiple telecom technologies

IV. PRESENT APPLICATION AREAS WITH B-5G BASED WIRELESS NETWORK FOR COOPERATIVE COMMUNICATION

Present application area with 5G and beyond 5G:

- OFDM with 5G
- Ultra Wideband communication with 5G and Beyond 5G
- MC-CDMA
- Large Area Synchronized Code Division Multiple Access, is developed by Link Air Communication, a patented 5G wireless technology
- Local Multipoint distribution system, is the broadband wireless technology used to carry voice, data, Internet and video services in 25GHz and higher spectrum can be played as Micro Cell and Macro Cell in the 5G technology to be the main transmission protocol for the wireless devices.
- 5G will offer even more flat architecture by using advanced semi conductor technologies as 22mN CMOS. 5G will promote concept of Super Core, where all the network operators will be connected one single core and have one single infrastructure, regardless of their access technologies.

The Sixth Generation (6G)-with Satellite System: The 6th generation mobile communication networks can integrate satellite communication networks and 5G to make global coverage, which is shown in Figure. Satellite communications networks consist of navigation satellite networks, telecommunication satellite networks and Earth imaging satellites networks. The 6G will be fully AI-integrated. With ongoing 4th industrial revolution Below are a few of the most important 6G wireless communication possibilities and applications.

Super-Smart Society: Artificial Intelligence used and based on M-2-M communication with proper cluster energy harvesting, the improved structures of 6G expedited the development of smart societies, resulting in improved life QoS, better environmental monitoring, and automations [24], [25].

Extended Virtual Reality (EXVR) is inclusion of Augmented Reality (AR) which is an amazing modern-day tech which superimposes images onto a user's real view of the real nature and improve sound quality, physical touch quality in a sense and sometimes odour or smell quality, Mixed reality (MR) which is a combination real digital nature together as hybrid, and Virtual reality (VR) is a prolific and over the top digital world. All three of them together with three-Dimensional object-oriented approach and Artificial Intelligence as a key instrumental approach give an optimum throughput after their integration with 6G spectrum. 6G surely enables an over-the-top experience through collaborative design with 6G. In addition to that EXVR also give a perceptual cloud-based computing model, Neural network-based cognition and its system. EXVR make sure to provide optimum cloud storage for user-based traffic and its data.

Autonomous Systems and Linked Robotics: Several automotive technology researchers are currently studying autonomous and connected automobiles. Data-centric automation solutions are currently outperforming 5G in terms of performance. In some application domains, such as EXVR devices, communication rates over 10 Gbps are required. The deployment of connected robotics and autonomous systems will be aided by 6G technology. A system like this is the drone delivery UAV system. 6G encourages the widespread use of self-driving cars (autonomous cars or driverless cars).

6G integrated medical healthcare monitoring systems having recent trends in electronics and health Informatics have boosted the over all scenario of the health infrastructure. With the help of 6G remote surgery and enormous amount health care data can be processed very effectively and prominently. With the emergence of medical healthcare infrastructure with 6G remote based surgery is also possible. The 6G network will allow health care system to be a most dependable monitoring system. Extremely high rate of data transmission, very low latency with optimum reliability will make treatment and medical data care swiftly get communicated across several users.

Automation and Manufacturing: AI-based full automation will be provided by 6G. The control of processes, apparatus is referred to as "automation." The 6G revolution has given a new dimension to Industry 4.0 revolution, which is defined as cyber-physical system-based industrial procedures that use mechanization and data exchange. With its troublesome collection of technologies, 6G will fully characterise the automation system.

Internet of Everything (IoE): The Internet of Everything Thing (IoET) is the unified integration and autonomous management of a massive number of computational elements and sensing devices, items or equipment, people, procedures, and data aggregation using the Internet setup [30],[31]. By altering the standard mobile communication structure, 5G has revolutionary IoE goals.

5G, on the other hand, is seen as the start of IoE and handles a wide range of issues, from standard approach to commercial approach. The 6G system will support IoE in its entirety. It's essentially an IoT, an umbrella word that encompasses four elements in one frame: data, people, processes, and physical equipment [31],[32].

Artificial Intelligence: The construction of 4G network technologies did not include the application of artificial intelligence. Artificial Consciousness will be enabled to a limited or non-existent extent by the next-generation 6G modules and its networking protocols.

Although artificial intelligence will strongly support 6G in terms of great automation and cloud-based storage backup, this will not be the case in the near future. Radio transmissions will achieve greatness with AI-powered 6G, permitting for the move from a cognitive to an intellectual radio system [18], [19] that is based on digital technology.

It can be done by making sure to develop a system based on photonics CRS. AI integrated 6G will also provide low latency [22],[23] if the addition and combination of two future tech giants like ML and Big Data would provide optimum data route using analysis in a predictive manner to transmit user information.

Terahertz Communications: By expanding the bandwidth, spectral efficiency can be improved. Widening bandwidths and employing MIMO technology are two ways to do this. 6G uses mm-wave. The use of wave frequencies can increase data throughput while also opening up new options. 6G, on either hand, seeks to expand the boundaries of the frequency range all the way to THz in order to meet even greater demand. [38], [39], [40].

Optical Wireless Technology: OWC technologies are envisioned for 6G potential for equipment-to-access networks, which also access connectivity in network backend or frontend. Nevertheless, in order to satisfy the demands of 6G module broadly intending to be implemented. Some key points like

Light reliability

Visible Light Communication

FSO communication module in desired band of optical domain [42], [44], and [46].

Massive MIMO and Intelligent Reflecting Surfaces has a very wide concept and utility upon integrating with 6G. Based on the prerequisites of 6G based services in upcoming time for the users like the following, the integration will prove to be a boost for the telecom traffic and data traffic online with AI and IOT based services too.

Blockchain and its integration with 6G will manage large amounts of data in future 6G communication module [54–58]. Distributed ledger technology a sub-segment of blockchains, a database spreading athwart along numerous processors or sensing nodes.

3D Networking with 6G module is a support system for communications in the upright extension. This networking integration with the 6G module and system will combine ground and space or airborne subnets together for providing seamless services with minimum delay and obstructions.

3-Dimensional module networking with 6G will offer following key points;

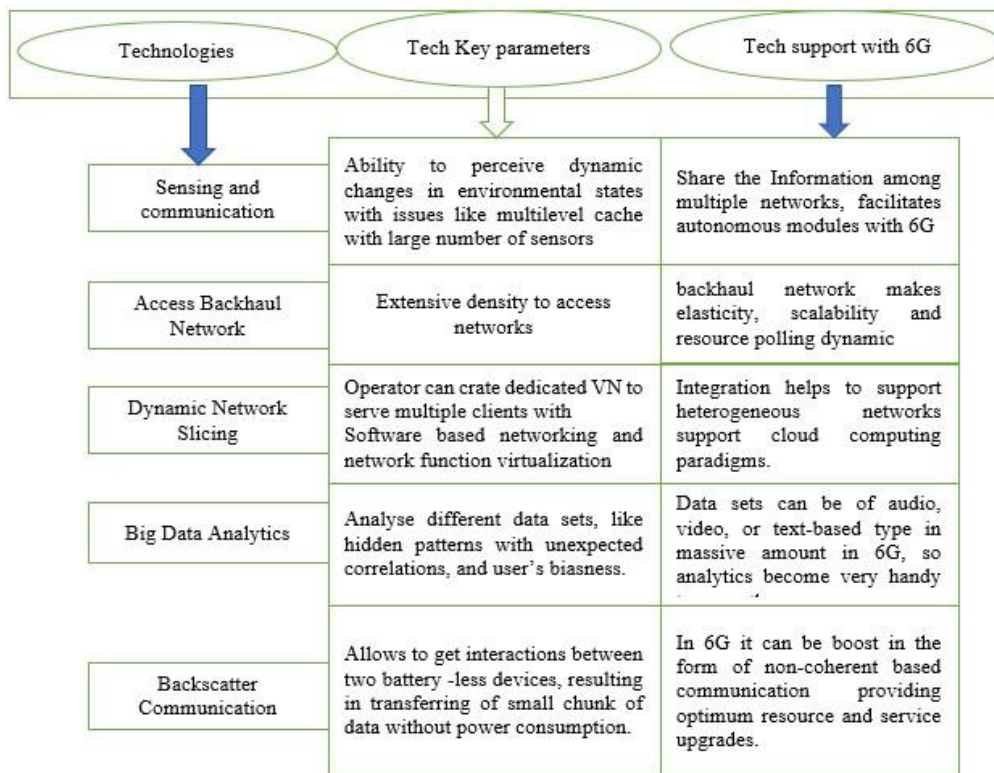


Fig :4 Integration technology names with parameters and support upon integrating with 6G for Wireless networks

V. CONCLUSION

The era of B-5G and 6G wireless communication system to support wireless networking is on the roll with such different types of features which a modern-day end user needs to have entirely different solutions under one umbrella. Having said that 5G and even beyond 5G with their amazing features and connectivity resolutions will still be incompetent and not capable to support the exponentially growing needs and requirements of modern-day end user. For wireless communicating network by the year 2030 approximately 20 billion user machine user-based data connectivity and their applications needed to be supported which is not feasible with existing generation. Wireless network needs frequency spectrum with cooperative basis. B-5G and upcoming 6G will provide extreme high data rate, with extremely minor latency rate. The routing of packet in wireless networks using B-5G will be providing better life time, as it reduces energy consumption of each device used in the sensor nodes. This can be justified by the fact and results that higher data rate with shared spectrum and low latency will make the transmission more feasible at each sensing point using B-5G in wireless networks. With B-5G as a communication media; Data gathering, data processing, information storing, while uploading everything on hybrid cloud of the network is faster, easier and secured for the network, user and access points. The new age add-on of technologies like AI based machine to machine communication, IOeT, can also be integrated with any kind of networks using B-5G while 6G will make even better use of extended virtual reality with satellite based communication being possible. Researcher will find much more to explore in 6G based networking while developing the theatrical, analytical description of its applications, topology, routing techniques, for more data security, energy efficiency, power optimization in near future.

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