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FUNCTIONALIZED NETWORK CORE ARCHITECTURE FOR BEYOND-5G BASED WCS NETWORK USED IN COOPERATIVE COMMUNICATION

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Abstract – The present study will showcase the prototype of functional network core architecture for Beyond-5G based setup and OSI modelling overview which will support wireless network along with its expanded areas of application markets existing in present or in upcoming time in future. The study will provide an overview for 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 proposed Beyond-5G routing architecture, with OSI networking module for the WCS (Wireless Camera Sensor) network will make 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 practiceners 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 B-5G and 6G based wireless networks.

Keywords – Beyond 5G, Wireless Networks, 6th Generation, Cooperative Communication, Network Architecture

1. INTRODUCTION

6G systems 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 addons and the shortcomings of the 5G system [1-2].

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 futuristics cloud- AI-IOT based services. Besides add ons, an ultra- range communication and lower latency of around 1 millisecond is expected [4], [5]. An integration of Artificial Integration for independent self-driven systems is the 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, addons of IRS, along-side wireless power transfer

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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. [7], [8]

2. HISTORY AND ON-GOING TRENDS OF MOBILE SUBSCRIBER WITH VARIOUS GENERATIONS

Knowing the difference between 1G, 2G, 3G, 4G, and 5G networks makes it easy to evaluate a cell phone's underlying technology. The generations of wireless cellular technology are denoted by prefixes: 1G for the first generation, 2G for the second, and so on. It's only natural that newer models would be more efficient and have better features. When you're in a place where only 3G speeds are available, you can still use your phone with a carrier that supports both 4G and 3G. Since 1G debuted in the 1980s, a new wireless mobile telecommunications technology has been introduced roughly every decade. Each of these terms is a reference to the underlying mobile network and device technology. The newer models are faster and have more advanced features than their predecessors. 5G, the next generation, debuted in 2020. Faster data-transmission speeds were made possible by the advent of 3G networks in 1998, allowing for more data-intensive cell phone uses like video calling and mobile internet access. The third generation of mobile networks (3G) is where the term "mobile broadband" was first used. Similarly to how 2G morphed into 3G, 3G accelerated to 3.5G and 3.75G as more features were introduced in preparation for 4G. For stationary devices, the top 3G speed was around 2 Mbps, while the top speed for mobile devices was around 384 Kbps.

Table 1 Parameter comparison from 2010 to 2030

Parameters	Year 2010	Year 2020	Year 2030	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

*Year 2020-Approximated value is equal to or more than

*Year 2030-Prediction is equal to or more than the value)

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In 2008, the fourth generation of wireless networking, known as 4G, became available. In addition to mobile web access, it also supports other high-bandwidth services such as gaming, HD mobile TV, video conferencing, and 3D television. Moving at full speed, a 4G connection can reach up to 100 Mbps. For calls where the caller has low mobility, such as when they are standing still or strolling, the speed is 1 Gbps. Most new smartphones today can connect to both 4G and 3G networks. The Next Generation of Wireless Technology is 5G and 6G which is a new wireless standard that will eventually replace 4G. The next generation of wireless networking, 5G, will bring numerous benefits, including increased data transfer speeds, increased connection densities, decreased latency, and reduced power consumption. Theoretical estimates put 5G connection speeds at 20 Gbps.[10],[11]

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. Furthermore, the utilization 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.

There are some of very important research gaps and ideas which makes B-5G and 6G a huge potential in upcoming time for wireless networks to promote CC. Observing Point of view of B-5G/6G to felicitate Wireless Networks

2.11 Higher data rate of the user traffic

2.12 Proper secured network for providing better reliability

2.13 Low latency rate/ user for entire network

2.14 Optimum load balancing with better energy efficiency

3. ROUTING CORE MODULE FOR BEYOND-5G BASED WCS NETWORK

Several challenges are available in building a sophisticated module of routing and communication for any wireless network. With B-5G as a media of communication routing in networks has become a lot easier. For wireless based networks there are still few key areas of concerns which need addressability even with B-5G and probably with upcoming 6G module too:

1. Output
2. Overall delay
3. Energy throughput profiling
4. Rollout expenditure
5. Dependability
6. Difficulty of the machine-oriented system

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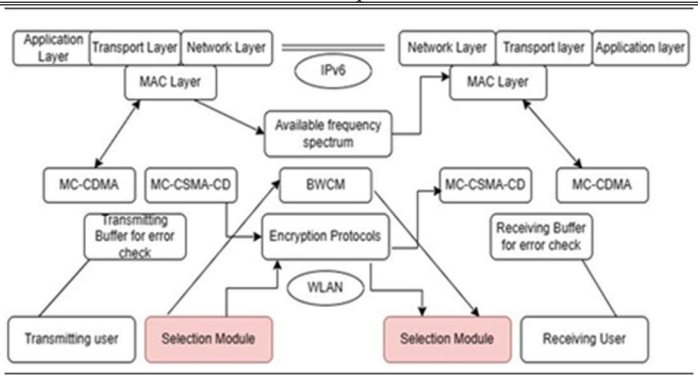

Fig. 1. Mix-bandwidth Data Path routing overview model for 5G and beyond 5G based Wireless Networks
(Camera based/non camera based)

The prototype module of the Routing Core Module for Beyond-5G based WCS (Wireless Communication System) network is a critical component that governs the efficient flow of data packets within the network. It leverages various advanced technologies and incorporates key features:

3.1 TCP/IP layer of protocol: The module interfaces with the TCP/IP layer of the communication protocol. It manages the transmission and reception of data packets, ensuring reliable and ordered delivery across the network. By interacting with this layer, the module facilitates seamless communication between different devices.

3.2. MC-CDMA (Multi-Carrier Code Division Multiple Access): This technology is utilized for multiple access schemes, allowing multiple users to share the same frequency band. The module employs MC-CDMA to efficiently allocate resources and manage simultaneous transmissions, enhancing overall spectral efficiency.

3.3 MC-CSMA-CD (Multi-Carrier Carrier Sense Multiple Access with Collision Detection): This mechanism is employed for channel access in a multi-carrier system. It helps prevent collisions by sensing the channel before transmitting data. The module incorporates MC-CSMA-CD to effectively manage access to the shared communication channel.

3.4 Buffer: The module integrates a buffer to temporarily store data packets. This buffer helps manage the flow of data between different parts of the network, allowing for smoother and more controlled data transmission.

3.5 Error control: The module implements error control mechanisms to detect and correct data transmission errors. It uses techniques like forward error correction and retransmission protocols to ensure the reliability of data delivery.

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3.6 Users: The module is designed to handle multiple users simultaneously. It allocates resources efficiently, ensuring fair and optimal distribution of bandwidth and capacity among different users within the network.

3.7 Overall delay: The module aims to minimize the overall delay in data transmission. Through advanced routing algorithms and the utilization of Beyond-5G technologies, it significantly reduces the time taken for data to traverse the network. This ensures prompt and responsive communication.

3.8 Energy throughput profiling: The module analyses and profiles the energy consumption associated with different routes and transmission strategies. It selects paths that minimize energy expenditure, contributing to the overall energy efficiency and sustainability of the network.

3.9 Rollout expenditure: The deployment of the Routing Core Module considers the associated rollout expenditure. This includes costs related to module implementation, integration with existing network infrastructure, and compatibility with other components. Cost-effectiveness is a key consideration in the module's development.

3.10 Dependability: The module places a strong emphasis on dependability. It is engineered to operate reliably under various network conditions and loads. Redundancy mechanisms and fault-tolerant algorithms are integrated to ensure uninterrupted communication even in the face of failures or adverse circumstances.

3.11 Difficulty of the machine-oriented system: The module is designed to minimize the complexity and difficulty associated with machine-oriented systems. User-friendly interfaces and intuitive configuration options are implemented to facilitate easy deployment and management. This ensures that network administrators can effectively utilize the module without encountering unnecessary technical complexities. The proposed prototype module of the Routing Core Module for Beyond-5G based WCS network is a sophisticated component that optimizes data routing and transmission. It integrates various advanced technologies and features to ensure reliable, efficient, and sustainable communication within the network.

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

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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 model for 5G and beyond 5G based Wireless Networks (Camera based/non camera based)

4. Present application areas with B-5G based WCS Network for Cooperative Communication

1. OFDM using B-5G for camera-based sensor networks
2. Ultra-Wideband communication with B-5G
3. MC-CDMA link establishment.
4. Concept of virtual reality using AI integration.
5. Large Area Synchronized Code Division Multiple Access is developed by Link Air Communication, a patented B-5G wireless technology

As we move from 4th Generation wireless communication setup to 5th Generation and eventually to 6th Generation, there is a substantial increase in data rates for the bidirectional transmission through all the digital devices, a significant reduction in latency as per the need of the hours in modern day trends, and a substantial improvement in spectral efficiency. Additionally, mobility support rates also increase across these generations. Moreover, the higher generations, especially 6G, exhibit capabilities such as satellite integration, AI support, and robust support for autonomous vehicles and extended reality (XR) systems. This signifies a significant advancement in telecommunications technology, enabling a wide range of applications and services that were not feasible in earlier generations.

Next-generation telecom technologies, ranging from 4G to 6G, exhibit remarkable advancements. 6G, the most forward-looking, demonstrates exceptional capabilities with a potential maximum data rate/device of 1-5 Tbps, ultra-low latency at approximately 1 ms, and an impressive spectral efficiency of about 100 bps/Hz. It also supports high mobility rates of up to 1000 km/hr and integrates with satellite systems. Notably, 6G pioneers in artificial intelligence support for system

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design and offers full-scale backing for autonomous vehicle and extended reality applications. In contrast, 4G lags significantly in all these aspects, underscoring the transformative potential of subsequent generations in revolutionizing communication networks.

Table 2 Next-Generation Network Capabilities Comparison between multiple Telecom Technologies

Parameters	4G/4G VOLTE	5G/5G+/Beyond 5G	6G
Maximum Data Rate/device	Around 1 GBPS	Around	Can up to
		10 GBPS	1-5 Tbps
End to End (E-2-E) Latency	Around 80-100 ms	Around	Expected to be around
		5-10 ms	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	Not available	Not available	Satellite integration support
and integration			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

5. WCS Network based on B-5G Prerequisite

5.1 WCS Network based prerequisites for next generation: - The Wireless Communication System (WCS) Network, integral to the framework of B-5G (Beyond 5G) Prerequisites, embodies a cutting-edge wireless communication infrastructure poised to drive the evolution of next-generation communication technologies. It encompasses a suite of advanced functionalities and capabilities engineered to elevate the standards of wireless connectivity.

Ultra-High Frequencies: The WCS operates within frequency spectrums of extraordinary magnitude, thereby enabling accelerated data transmission rates and heightened network capacity.

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This, in turn, facilitates the expeditious conveyance of voluminous data payloads with minimal latency.

Massive MIMO (Multiple Input, Multiple Output): The network leverages Massive MIMO technology, an approach that integrates a multitude of antennas at both base stations and user terminals. This confers a substantial augmentation in spectral efficiency and facilitates concurrent communication with a multitude of devices.

Ultra-Reliable Low Latency Communication (URLLC): The WCS Network, as part of B-5G imperatives, prioritizes ultra-reliable, low-latency communication protocols. This holds critical import for applications such as autonomous vehicular systems, mission-critical industrial processes, and indispensable infrastructure.

Network Slicing: This feature enables the WCS Network to be partitioned into distinct virtual networks, each adeptly tailored to specific use cases or industries. This affords bespoke connectivity solutions attuned to the diverse exigencies of varying applications.

Dynamic Spectrum Access: The WCS Network is meticulously designed to intelligently harness available frequency bands, adeptly adapting to shifting network dynamics and traffic demands. This ensures the judicious employment of spectrum assets, thus optimizing network efficacy.

High Density Deployment: In order to meet the demands of densely populated urban landscapes and high-traffic environments, the WCS Network accommodates the deployment of a profusion of small cells and base stations. This enables the seamless provision of connectivity in densely populated locales.

Security and Privacy Augmentation: The network integrates sophisticated security protocols and encryption methodologies to safeguard data integrity and ensure user privacy. This assumes paramount importance in an era marked by escalating cyber threats and heightened privacy concerns.

Energy Efficiency: The WCS Network underscores energy-conservation technologies and protocols, thereby curtailing the environmental footprint of communication infrastructure, while upholding the imperative of sustainable operational practices.

5.1.1 Ultra-broadband mobile service for Everyone (MUB-U): MUB-U aims to provide high-speed mobile internet access to a wide demographic, ensuring fast and reliable connectivity for all users. This initiative focuses on expanding the coverage and capacity of mobile networks to offer seamless browsing, streaming, and communication experiences, irrespective of location or device.

5.1.2 Communications at ultra-high speeds and with low

delay (HSLLC-U): HSLLC-U focuses on enabling lightning-fast data transmission and minimal latency in communication networks. This technology strives to facilitate real-time interactions, critical for applications like virtual reality, autonomous vehicles, and telemedicine. It aims to revolutionize how we connect and communicate, opening up new possibilities for various industries.

5.1.3 Machine communication on a large scale (MMC): MMC pertains to the efficient and widespread exchange of data between machines. This technology enables seamless communication between IoT devices, autonomous systems, and industrial equipment. It plays a

crucial role in the development of smart cities, automated factories, and interconnected systems, enhancing productivity and efficiency across various sectors.

5.1.4 Data density is really high (HDD-U): HDD-U emphasizes the ability to store and process large volumes of data in compact spaces. This technology addresses the growing demand for high-capacity storage solutions, critical in fields like cloud computing, big data analytics, and AI. It seeks to maximize data storage efficiency, allowing for the management of vast amounts of information.

5.2 Functionalized add-ons applications with B-5G WCS Network module support

5.2.2 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.

5.2.3 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).

5.2.4 6G integrated medical healthcare monitoring systems having recent trends in electronics and health Informatics have boosted the overall 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 surgeries 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.

5.2.5 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 characterize the automation system.

5.2.6 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

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sensing devices, items or equipment, people, procedures, and data aggregation using the Internet setup [20], [21]. 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 [21], [22].

5.2.7 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.

6 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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