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Analysis of 6G Wireless Communication Technology, Network Architecture & Applications

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Abstract: ***Fifth Generation (5G) wireless communication technology already been officially announced by china, and it may be deployed world-wide by the end of the 2020, But still there are some issues, which need to be addressed by 5G technology are very low latency, higher data rate, and improved quality of service (QoS). This paper presents the concept of sixth generation (6G) wireless communication network, its architecture, applications in emerging technologies and comparison with previous generations of wireless technologies.***

Keywords: Sixth Generation, 6G, Wireless Communication, 5G, Communications.

I. INTRODUCTION

Fifth generation wireless technology may be deployed world-wide by the end of 2020, China has officially announced its launch, and telecom companies are supposed to start their trail launchings, mobile industry & electronic chipsets are also coming in to the market by the end of 2020, This is too early to talk about 6G But still there are lot of issues that are need to be addressed by 5G technology, that's why researchers are already started planning and solutions that are need to be addressed in 6G technology, it is very common to start research on any technology before a decade to its launching or end user deployment, 6G may not come as quick as previous technologies but 6G launching is expected in the period of 2027 to 2030, eventually it replaces the functioning of 5G, NTTDoCoMo has published a white paper of 6G & it also showed how mobile communication technology has evolved previously. 6G will be similar to 5G but even higher data rates, even more low latencies and makes instant device to device connectivity possible, every improvement that 5G bringing will be even better and enhanced versions will be there in 6G.

The 1G systems evolved with Time Division Multiple Access or Frequency Division Multiple Access schemes, The 2G systems used Code Division multiple Access (Known as CDMA), The 3G systems used Wideband Code division multiple access scheme (WCDMA), 4G has developed using two ways one uses WiMax & OFDM in both modes (Up-link & Down-link) other one uses LTE with OFDM only in Downlink mode And 5G could use Sprase Code Multiple Access or Non Orthogonal Multiple Access or Any of the Orthogonal Frequency Division Multiple Access types like C-OFDM, Wide-Band OFDM, MIMO-OFDM, V-OFDM, Flash OFDM techniques.

5G is designed to allow virtual networking configurations to align network costs, which allows network operators to grab IoT market as well. 5G for consumers means not only just a faster internet, but also an internet connectivity in many more devices. 5G enables the true IoT echo system, the automated car and the advanced IoT based home are the best suitable two examples of the up-coming 5G revolution.

Expected characteristics after deploying 5G

1) Higher data traffic
2) Increased number of Internet based devices
3) Higher dependency on cloud
4) Low End-End / Device-Device / Machine-Machine latency

China Unicom has set up 5G in a few locations in 2019. 460 million 5G connections are expected by GMSA in China by 2025[3], India targeting to deploy 5G in the year end of 2020.

As the advancements in Internet of Things (IoT), Machine learning, Artificial intelligence moving towards fully automated and remote control systems expects ultra-low latencies and extreme high data rates, very high speed in connectivity between device to device or machine to machine for controllability, Data centres need to handle heavy loads, 6G is expected to support speed of a TBPS (Tera byte per second), high level of system capacity and extreme low latency comparing with 5G and 6G will be deployed by fully integrating with AI, XR, Haptic Communication and Automation with processing delays in terms of ns, The advantage of 6G over 4G and 5G are given by the following table.

TABLE I
Advantages of 6G over 4G and 5G

Parameters	4G	5G	6G
Latencies	100ms	10ms to 1ms	<1ms
Peak data rate per device	1Gbps	10Gbps	400Gbps to 1Tbps
AI Integration	No	Partial	Full
Satellite Integration	No	No	Full
Autonomous Vehicle	No	Partial	Full
Mobility	Up to 100km/h	Up to 500km/h	Up to 1000km/h
Frequency	2 to 8Ghz	3 to 300Ghz	Up to 1000Ghz
Technology Development	Fully IP based network	Multi RAT Connectivity / Millimetre wave transmission	Spectrum unification, Artificial Intelligence in network organization

This paper is classified into four sections, Section-I gives the Introduction, Section-II briefs Service requirements & Architecture and its applications, Section-III describes the Comparison of 6G with previous generations and Section-IV concludes the paper.

II. SERVICE REQUIREMENTS AND ARCHITECTURE OF 6G

The sixth generation system will come up with the full integration of AI Systems, it increases the performance and maximizes QoS several trade-offs will be addressed with some extended features.

A. Service Requirement of 6G

1) Ultra-low latency communications
2) Enhanced mobile broad-band Systems
3) Holographic communication
4) High Speed machine-machine communication
5) AI integrated communication & Automated network organization using AI & ML
6) Deep sensing: Tactile Internet
7) High throughput & High network capacity
8) Very high controllability of devices over the internet
9) High energy efficiency
10) Instant device-device communication
11) Ubiquitous connection: Air, Space, Ground, See every where
12) Low backhaul and access network congestion
13) Ultra-fast EDGE
14) Enhanced data security

The Japan based NTTDoCoMo in their white paper they explained these six technology benchmarks for 6G to achieve shown in below Fig. 1.

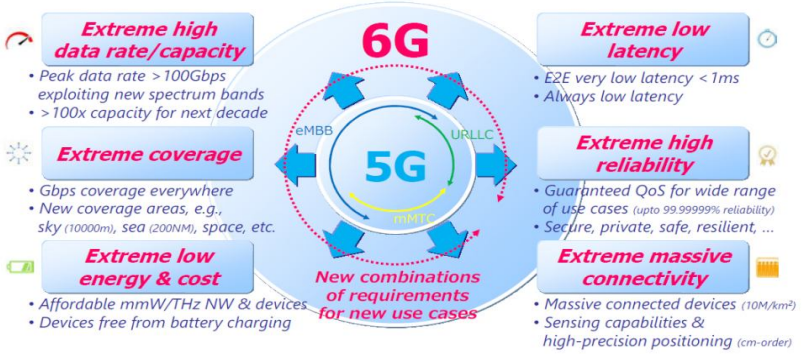

Fig.1 Requirements of 6G wireless communication technology (Source: NTTDoCoMo)

B. Predicted Architecture 6G

The predicted architecture of 6G is shown in Fig. 1.

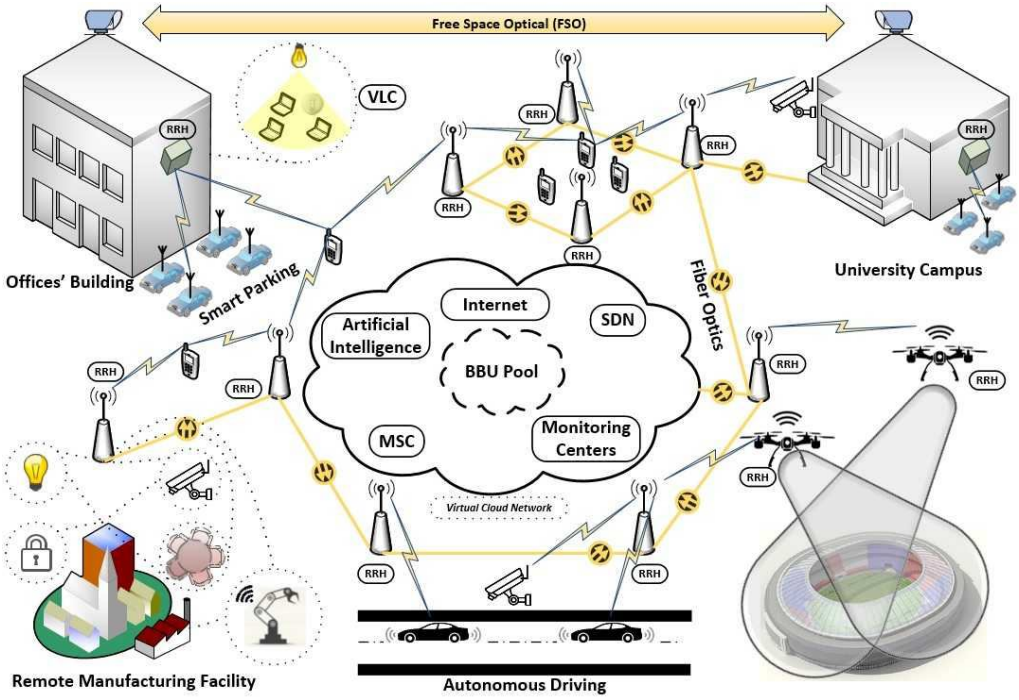

Fig. 1 Predicted heterogeneous architecture by 6G

In the sixth generation wireless systems the THz band is the major challenging issue, as the atmospheric absorption and propagation loss are very high this is the biggest challenge need to be addressed and power efficiency should be taken care as the billions of devices will be connected to 6G, it also requires adaptive multiple access protocols.

The three dimensional facets of 6G wireless communication technology consists of control, network, infrastructure views, these three views explained in below Fig.3

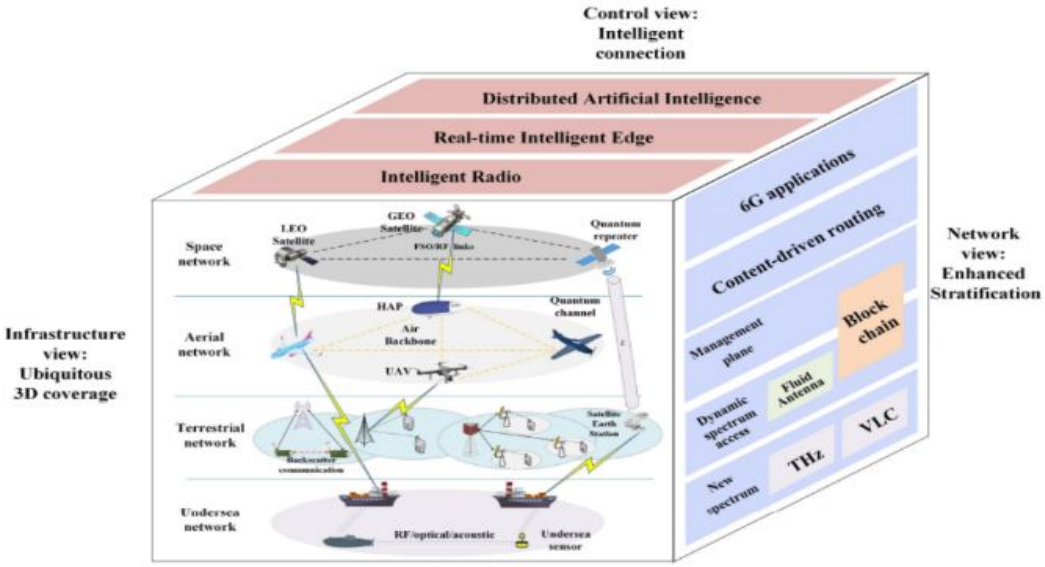

Fig. 3 Three dimensional view of 6G [5]

The infrastructure view shown in Fig.3 & Architecture in Fig.2 are predicted to be heterogeneous connection of various networks that are integrated to 6G. In Sixth generation control will be autonomous based on Artificial intelligence, Machine learning, deep learning.

C. Applications of 6G with examples

1) Mobile broadband reliable low latency communication : XR/AR/VR, data streaming, Autonomous vehicle systems & drones,
2) Ultra-High reliability and low latency communication (URLLC): Multi-sensory systems, tracking and control, IoT, Autonomous robots.
3) AI Equipped Ultra-fast EDGE mobile computing & Wireless AI Based Networking
4) Intelligent Deep Learning based Spectrum management, Mobility and handoff management.
5) Intelligent Sensor, Control & Application layers
6) Tele Medicine
7) Space and Defence technology will take tremendous change in 6G
8) Autonomous robotics
9) Efficient energy management, wireless charging could be possible
10) Integrated heterogeneous high frequency bands

III. COMPARATIVE ANALYSIS OF 6G WITH PREVIOUS TECHNOLOGIES

Comparison of 1G, 2G, 3G, 4G, 5G and 6G is explained in the following table

TABLE III
Comparison of various generations

Parameter	Generations						
	1G	2G	2.5G	3G	4G	5G	6G
Deployed time	1970 to 1980	1980 to 1990	1990 to 2004	2004 to 2010	2010 to till	Soon in 2020	Expected to be in between2027 to 2030
Technology	Analog	Digital	CDMA	WCDMA And Broad band	LTE & wiMax unified IP & VOIP, Broad band	4G+ WWWW	Integration of various heterogenious networks
Core network	PSTN	PSTN	PSTN	Packet N/w	Internet	Internet	Internet
Data Bandwidth	2Kbps	64Kbps	~144Kbps	2Mbps	200mbps to 1Gbps	>1Gbps	~1Tbps
Switching	Circuit	Circuit	Circuit	Packet	All packet	All packet	?

IV. CONCLUSION

In this paper we have presented the evolution of 5G, issues needs to be addressed in 5G wireless communication, and how 6G will solve the issues. We have also presented the services requirements of 6G, architecture and three dimensional facets of 6G, listed brief applications and tabulated the comparison of 6G with previous generations. As a continuation for this paper we will further continue research and future scope will be on survey of various multiple access schemes, analysis of techniques which are suitable for 6G and MATLAB based design and simulations for 6G.

REFERENCES

[1] Mostafa Zaman Chowdhury, Md. Shahjalal, Shakil Ahmed, Yeong Min Jang, “6G Wireless Communication Systems: Applications, Requirements, Technologies, Challenges, and Research Directions ”,2019.
[2] https://www.gemalto.com/mobile/inspired/5G
[3] Yang, Helin & Alphones, Arokiaswami & Xiong, Zehui & Niyato, Dusit & Zhao, Jun & Wu, Kaishun. “Artificial Intelligence-Enabled Intelligent 6G Networks” 2019.
[4] “White paper 5G evolution and 6G”, NTT Docomo Inc, January 2020.
[5] Katrodiya, Renil “A Survey on 6th generatio” 2019.