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The Leap of Technology: Japan Tests 6G Network

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The evolution of the internet has brought fundamental changes to the everyday operations of human life. It has been a generation-defining technology, and its advancement continues to take people by surprise. In its nascent stage, it was the narrowband internet in the 1960s in the form of ARPANET.[1] Over time, the world was introduced to 'Broadband' technologies like Digital Subscriber Line (DSL) and cable modems, which started the journey of 'speed of the internet.[2] Ever since 'speed' became a defining feature of the internet, states took it upon themselves to excel in this race. Japan is the latest nation to take a leap forward by testing for a 6G network. This 'Generational' change is rooted in a history of its own, starting with the 1G networks.

Evolution of the Internet

1G was launched by Nippon Telegraph and Telephone in 1979 for the citizens of Japan. It was later introduced in the US. The first commercial cell phone, made by Motorola, only came around in 1983. It was called the Dyna TAC. It had its limitations, as the quality of sound was extremely low and there was constant crackling in the background.[3] The speed was incredibly low and it has tremendous scope for improvement. It was only with the coming of 2G that these loopholes started to get filled.

The second generation, also known as the 2G network, laid the foundation for digital communication technology in the early 1990s, marking a shift from the analogue to the digital realm. It gave the world Global System for Mobile Communication (GSM), which facilitated voice calls and basic internet services like messaging. The limited digital communication that was offered paved the way for further advances in technology and birthed mobile broadband.[4]

Mobile broadband, deemed as the third generation or 3G mobile technology, emerged in the early 2000s. The data services of 3G were significantly different from its predecessor 2G, offering higher data transfer rates, better speed, and multimedia services like video calls. This progress was further complemented by the Universal Mobile Telecommunications System (UMTS) and Code Division Multiple Access 2000 (CDMA2000). UMTS used Wideband Code Division Multiple Access (W-CDMA) as its interface technology, which allowed for the more efficient use of spectrum. It was designed to support multimedia services, including video streaming, video conferencing and high-speed internet. The most significant advantage that it offered was global roaming capability, which allowed users to access UMTS services across the regions and in different countries, provided UMTS networks are deployed there.[5]

CDMA 2000 was developed by 3rd Generation Partnership Project 2 (3GPP2) and was a successor to 2G CDMA. It used a CDMA-based air interface, enabling numerous users to share the same frequency channel, made possible by giving unique codes to all users.[6] They played a crucial role in transitioning from 3G to 4G LTE networks.

Fourth Generation (4G): The Dawn of High-Speed Mobile Broadband

Up until now, the speed of the internet was rather upsetting. However, with the advent of 4G in the late 2000s, the data transfer speed and network capacity amplified manifolds. This generation was supported by technologies like Long Term Evolution (LTE) and Worldwide Interoperability for Microwave Access (WiMAX). LTE offers low latency, which in turn supports the smooth functioning of real-time applications like online gaming and video conferencing. Moreover, it can operate on a wide range of frequency bands, including both 2G and 3G. This feature allows for more effective spectrum utilisation and makes deployment easier. It is an all-IP Network, which means that both the data services and voice services are carried over an IP-based network, thus simplifying the network infrastructure and allowing for the integration of several services.[7] In addition, it uses Multiple Input Multiple Output (MIMO) technology, that uses multiple antennas at both receiver and transmitter end to improve network capacity.[8]

WiMAX technology was primarily designed to provide internet access across long distances. It was proposed as an alternative to traditional wired broadband like cable internet.[9] Its most significant advantage was the long-range capability along with operationality in various frequency bands.

Fast forward to the present times, the evolution has touched the Fifth Generation, i.e., the 5G mark. It has been deemed as the catalyst for a more connected world. The 5G technology has carved a space of its own, and rightly so, provided the endless merits it beholds.[10] 5G has enabled several transformative applications with its unprecedented speed, ultra-low latency, device connectivity and data rates. It has the potential to revolutionise various sectors, from autonomous vehicles and smart cities to remote surgery and industrial automation.

Japan's Tech Leap

The wonders of 5G were just unfolding when Japan made history by testing the world's first sixth-generation device. This prototype has been designed by four Japanese telecommunication companies, namely, NEC, NTT, DOCOMO and Fujitsu.[11] They have been researching and working

on the development of sub-terahertz devices since 2021. Its speed goes up to 100Gbps, which is 20 times faster than 5G. This ultra-high speed is its biggest advantage as it provides data transfer at the speed of light, which enables users to effectively use real-time applications from augmented reality and high-quality video streaming to virtual reality. This also motivates companies to research more along these lines and advance these real-time applications.

Furthermore, 6G offers an exceptionally low rate of latency, which would be beneficial for real-time contact and support ventures like driverless cars, industrial control, and automated surgeries. In addition, 6G technology can operate an extensive number of networked devices. The wonders that this technology has will unfold in due course of time. However, at present, it has its share of difficulties. The current infrastructure is not adequate to accommodate 6G advances, and it would have to be revamped to implement the same. More capital and resources are needed to build new power stations and towers. Moreover, spectrum allocation and user security are also points of concern. As more devices become linked to the internet and its range expands, there is a concern that it would infringe on the privacy of individuals, thereby making data security and user privacy a factor to consider.

Japan's sudden announcement has rekindled the race for technology, and countries like China, the US and South Korea are also forging ahead with their 6G initiatives. India has also brought to light its goal for 6G last year with 'Bharat 6G Vision'.[12] This vision document marks key research areas and pathways that the world is following along with highlighting the possibilities for India.

India's Vision for 6G Technology

India is also aware of the fact that technology alone is not sufficient, it must be introduced in an ecosystem that is compatible. There needs to be committed research on the device ecosystem and equipment. However, the government alone cannot shoulder this R&D burden. Therefore, it has taken steps to ensure that Original Equipment Manufacturers (OEMs) are also involved. For instance, Ericsson and Nokia are establishing 6G labs in India to foster development and research. The 6G Vision document is also considerate of suitable applications that can be made available commercially. It further aims to leverage new-age technologies like Artificial Intelligence and Machine Learning, integrating them while also addressing socio-economic disparities.

To conclude, Japan has earned the first-mover advantage with its unprecedented technological leap. However, it has yet to conform to global standards and develop the technology

further. Its successful testing is a small step in a long journey of technological advancement. It would take time to come to terms with this major advancement at a time when the nations have still not fully explored and exploited the potential of 5G. Therefore, Japan is currently at the tip of the iceberg, with vast opportunities for exploration and innovation lying beneath the surface.

NOTES:

[1] Mary Bellis, "ARPAnet: The World First Internet," ThoughtCO, September 24, 2018, https://www.thoughtco.com/arpanet-the-worlds-first-internet-4072558. Accessed on May 13, 2024.

[2] Luke Pensworth, "What is DSL Internet? How Does DSL work and How Fast is it Really?" DailyWireless, March 7, 2020, https://dailywireless.org/internet/dsl-internet-work/. Accessed on May 13, 2024.

[3] Adam Fendelman, **"**1G, 2G, 3G, 4G, & 5G Explained", Lifewire, September 3, 2021, https://www.lifewire.com/1g-vs-2g-vs-2-5g-vs-3g-vs-4g-578681. Accessed on May 13, 2024.

[4] "Difference between 2G and 3G Cellular Network", Geeks for Geeks, July 7, 2022, https://www.lifewire.com/1g-vs-2g-vs-2-5g-vs-3g-vs-4g-578681. Accessed on May 13, 2024.

[5] Kelsie Anderson, "What is UMTS, and why is it still important?" Telnyx, December 11, 2023, https://telnyx.com/resources/what-is-umts. Accessed on May 13, 2024.

[6] Solomon Ndungu, "CDMA (Code-Division Multiple Access)", TechTarget, March 2021, https://www.techtarget.com/searchnetworking/definition/CDMA-Code-Division-Multiple-Access. Accessed on May 13, 2024.

[7] Alejandra Jasso**,** What's the Difference between 4G, LTE and 5G Cell Networks?, WilsonAmplifiers, February 12, 2024. https://www.wilsonamplifiers.com/blog/the-difference-between-4g-lte-and-5g/. Accessed on May 13, 2024.

[8] "What is MIMO Technology?" everythingRF, April 4, 2019, https://www.everythingrf.com/community/what-is-mimo-technology. Accessed on May 13, 2024.

[9] "What is WiMAX", Broadband Search, https://www.broadbandsearch.net/definitions/wimax. Accessed on May 13, 2024.

[10] "Everything you need to know about 5G", Qualcomm, https://www.qualcomm.com/5g/what-is-5g. Accessed on May 13, 2024.

[11] Rajesh**, "**Japans unveils world's first 6G device; it's 20x faster than 5G", *GIZMOCHINA*, May 5, 2024, https://www.gizmochina.com/2024/05/05/japans-unveils-worlds-first-6g-device-its-20x-faster-than-5g/. Accessed on May 13, 2024.

[12] Aditi Singh, 'Bharat 6G Vision: India's Push for the Next Generation of Telcom Technology', *Invest India*, April 11, 2023, https://www.gizmochina.com/2024/05/05/japans-unveils-worlds-first-6g-device-its-20x-faster-than-5g/. Accessed on May 13, 2024.