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SPECTRUM

Spectrum

Publication	ET TELECOM
Headline	6GHz Spectrum Band key to fast 5G roll outs in India

Imagine an India with world-class healthcare infrastructure, experiential education, smart-agriculture, non-existent digital divide between the rural and the urban, individuals and organization's in every corner of the nation with access to real-time data backed by Artificial Intelligence, Machine Learning, Big Data and the list goes on.

As we envision India marching towards a truly digital nation and breaking all shackles of being technologically tied in any sense, let us explore the possibilities in this regard.

Undoubtedly, India has come a long way in its evolution of technology and digitalisation. Cloud-based data systems continue to make Digital India a reality. Subsequently, with the roll-out of 5G network services, the country has a plethora of unseen opportunities to explore in every sector. In fact, the telecom industry has a major role to play in enabling each sector to tap the great potential of automation and Industry 4.0 for the Indian industrial landscape via 5G.

5G is not just another 'G', it's indeed a class apart. And thus, for India to unlock all the unprecedented capabilities of 5G, the crucial ingredient of spectrum needs to be fortified. The need for mid-band spectrum, which provides a balance of wide coverage and capacity, is critical for the rapid and cost-efficient deployments of 5G mobile networks and to meet the exponentially increasing data demands of the citizens at affordable terms.

With only 300 MHz in 3300-3600 MHz planned for 5G in India, the shortfall to achieve at least 2 GHz of mid-band spectrum for 5G operations, as recommended by GSMA, is indeed a grave concern. The 6 GHz band provides the most optimal solution to this, as this unused band has the requisite traits as well as adequate availability to meet the requirement to a great extent. As it has been established by now, the spectrum is qualified to bring ground-breaking upgrades to the mobile broadband ecosystem. Faster data speed, wider network capacity, efficiency through low latency and higher reliability, are sure-shot maneuvers with the 6 GHz band!

Some would contend that India should follow global examples for the 6 GHz band, whereby some countries have partially/fully delicensed it, rather than identifying the full 1200 MHz of the band for IMT. But what is not being thought through is that India's demographics as well as needs are quite distinct from such countries, like USA or Brazil for example. We have a much higher population density compared to any of these nations, while at the same time, we are the highest consumer of mobile data globally. Obviously, our spectrum needs would be much higher to cater to this continuously rising usage demand and higher capacities required over each mobile tower.

The current population density of India in 2023 is 464 persons per square kilometer, compared to USA having a population density of 36 persons per square kilometer and Brazil having 25 persons per square kilometer. This unique demographic trait necessitates that spectrum loading in India happens to the tune of ~96%, compared to 40-50% in USA or Brazil. So, the average population served by each antenna in India is roughly 8 times that of these countries, putting a requirement of almost 4-5 MHz of spectrum per person in India. Well, drawing parallels with these nations definitely doesn't seem rational or prudent in that case.

If India were to allocate the 6 GHz spectrum band for commercial use, it could help accelerate the country's 5G rollout by enabling mobile network operators to deploy faster and more efficient networks. Some of the potential benefits of allocating the spectrum for commercial use would include:

- Increased Network Capacity: The 6 GHz spectrum band provides a large amount of available spectrum, which can be used to increase the capacity of mobile networks. This would enable operators to provide more bandwidth to their customers, supporting the growing demand for data services in India.
- Faster Data Speeds: The 6 GHz band offers high-speed data rates, which can enable faster download and upload speeds for consumers. This would help support applications such as video streaming, online gaming, and other data-intensive services.
- ·Improved Network Performance: The 6 GHz band offers low latency, which is critical for supporting emerging applications such as virtual and augmented reality, autonomous vehicles, and industrial IoT. This would enable operators to provide their customers with a reliable and responsive network.
- ·Better Spectrum Efficiency: The 6 GHz band is a contiguous block of spectrum, which can enable better spectrum efficiency for mobile network operators. This would allow them to provide more services to customers while reducing their operating costs.

In addition, the 6 GHz spectrum band can help address the growing demand for wireless connectivity in India, as the country has one of the world's largest mobile markets with more than 1.2 billion wireless subscribers. With the increased capacity and efficiency provided by the band, operators could better serve this large and growing market and support the development of new and innovative wireless services.

On the other hand, a shortage of 6 GHz band spectrum would compel TSPs to densify networks to meet IMT-2020 performance requirement for 5G, leading to 60% higher annual costs, as well as reduced speeds, affordability and therefore, uptake of 5G services.

Allocating the 6 GHz spectrum band for commercial use would provide a significant boost to mobile broadband, which caters to over 95% of the user base in India. It could prove to be an important step towards building a world-class 5G network and supporting the country's digital transformation efforts.

With hopes that the decision goes in favour of building an India that can compete with the growing speed of the world, the greatness of everything set to be unlocked is enormous… Greatness that will make India capable of leading. Especially, with the undaunted aid by network operators holding the prime responsibility to enable each industry in tapping the services of 5G technology to its fullest potential.
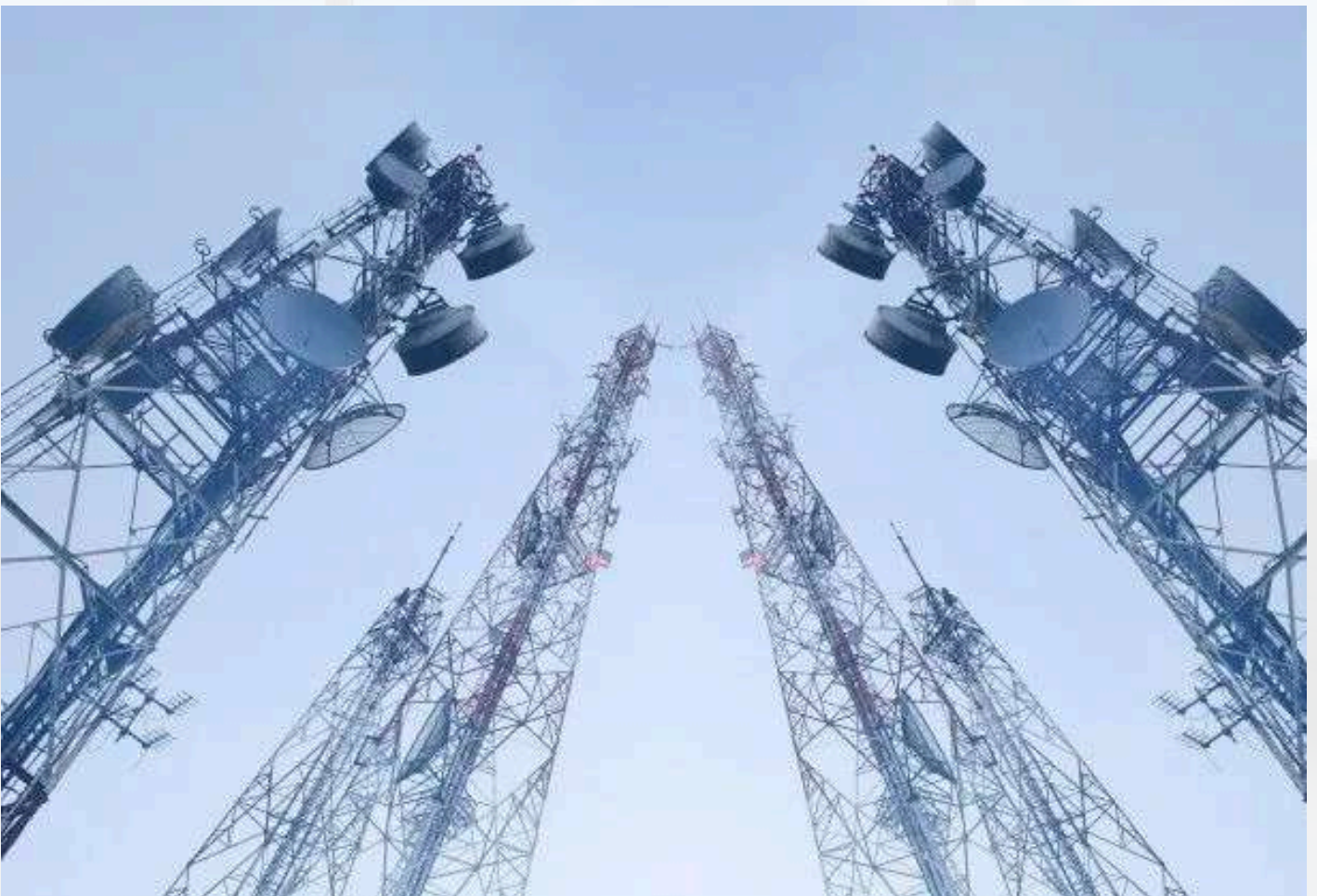
Importance of Spectrum and its efficient Management in Telecom

In telecommunications, the term "spectrum" refers to a range of radio waves used for communication purposes – comprising of radio and microwave frequencies. Radio frequencies are used for a wide variety of applications, including FM and AM radio broadcasts, television broadcasts, satellite communications, Wi-Fi, Bluetooth, and cellular data transmission. The specific frequencies in use and the technology used to convert those waves into communication mediums (like voice, SMS, webpages, or videos) differentiate these services.

Understanding Frequency and Its Importance
Frequency, the number of repetitions of the waves per second, is a key characteristic of spectrum. High-frequency waves repeat more times per second compared to low-frequency waves, meaning they require more energy to travel the same distance. However, they can pack more information in the same amount of time. The frequency also influences the wave's energy level, capacity to carry more information, ability to travel long distances and to penetrate obstacles. Lower-frequency waves are thus used for applications like AM radio, where the signal needs to travel long distances and penetrate buildings.

Spectrum Allocation and Regulation: Ensuring Order in the Airwaves
The radio spectrum, being critical for various applications, needs careful regulation to prevent interference between services. In India, the 2.4 GHz and 5 GHz bands are unlicensed for use in technologies like Wi-Fi and Bluetooth, while the commonly used bands for cellular communication are 800 MHz, 900 MHz,1800 MHz, 2100 MHz, 2300 MHz and 3300 MHz. The government plays a crucial role in managing the spectrum, dividing it into bands and assigning these bands to different services. This process is guided by international agreements and standards to ensure worldwide harmonisation in communication services.

Telecom Circles and Spectrum Licensing: Managing Spectrum on a National Scale
In India, spectrum management at the national level is done by dividing the country into 22 telecom circles. Telecom companies bid for a spectrum license in these circles to offer uninterrupted access across India. This system allows for more granular control over spectrum allocation and ensures nationwide access to telecommunications services.

The Evolution of Cellular Technology: From 2G to 4G and Beyond
Over the past few decades, we have seen a rapid evolution in cellular technology, from the 1G analog systems of the 1980s to the 5G digital systems of today. Each new generation has brought significant improvements in speed, capacity and functionality.

These generations are not just defined by their improved capabilities, though. They also correspond to use of different frequency bands. For example, in India, 2G services were launched over 900 MHz and later 1800 MHz, which is also being used for 4G. 3G services ran on both 900 MHz and 2100 MHz. LTE, a standard for 4G, initially required a higher frequency for the greater data speeds it offered, but technology advancements made it possible to use 1800 MHz instead.

The Shift to 5G: A New Generation of Connectivity

5G, the latest iteration of cellular technology, is designed to increase the speed, aggregation capacity and responsiveness of wireless networks significantly. It's not just about faster, better mobile internet for smartphones but also providing vast connectivity for everything from cars to smart home devices. How is 5G Different from 4G? 5G is not just an incremental improvement over 4G — it is the next major evolution of mobile communication technology with performance upgrades of several orders of magnitude over today's networks. Key differences between 5G and 4G:
- Speed: 5G enhances download speeds by 10-20 times, enabling faster streaming and downloads.
- Latency: 5G drastically cuts latency to about 1 ms, supporting real-time response applications.
- Capacity: With 5G, network capacity is greatly expanded, accommodating numerous devices without compromising performance.
- Frequency Bands: Unlike 4G, 5G uses a broader frequency spectrum, ensuring faster data speeds and more capacity but with a shorter range.
- Applications: With its advanced features, 5G supports new possibilities such as smart cities, advanced IoT, holographic communication, and more reliable remote operations.

Does the Frequency Matter? The Trade-Offs of Different Frequency Bands

Lower frequencies can cover large distances and penetrate obstacles well, making them ideal for providing wide area coverage. Higher frequencies, on the other hand, can carry more data, making them suitable for providing high-capacity service in densely populated areas.

In the transition from 4G to 5G, which requires a combination of wide coverage and high capacity, the mid-band spectrum plays a vital role. Frequencies such as 1800 MHz, 2100 MHz and the newly released 2300 MHz and 2500 MHz bands are crucial in striking this balance. Another such band of particular interest is the 6 GHz band - due to the large amount of contiguous spectrum for high-capacity connections, and the fact that it is currently underutilized.

Spectrum determines 5G coverage and speed
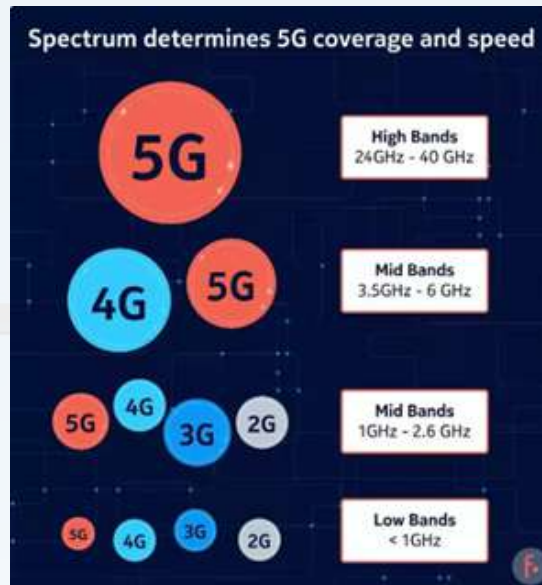
Spectrum Auctions: Allocating Spectrum in a Fair and Transparent Manner

In India, the practice of auctioning for spectrum allocation began with the first auction for the 900 MHz band in 1994, marking the beginning of a transparent and competitive process in the telecom sector. The spectrum auction process is fundamental to providing fair and transparent allocation of limited telecom resources. The administrative allocation method adopted in between, resulted in irregularities and much lower realised value, leading to significant financial losses. The Supreme Court thereafter mandated auctioning of spectrum to maintain and enhance transparency and competitiveness in the process.

The latest 5G spectrum auction of 2022 demonstrated the effectiveness of this transparent process, as it became the most successful spectrum auction in India till date, bringing in an unprecedented INR 1.5 lakh crore of revenues. The auction process, therefore, is crucial in ensuring fairness and optimizing resource utilization.

Conclusion:

The future of telecommunications is deeply tied to the effective management and allocation of spectrum. As technologies evolve and the demand for data grows, the importance of spectrum will only increase. It's an area that needs continuous innovation, regulation and investment to keep up with the growing demand for wireless services.

Understanding the Importance of Bandwidth in Spectrum

Bandwidth, in spectrum, refers to a range of frequencies used to convey the signals which transmit the data over the radio frequency. Understanding bandwidth is vital, as it significantly influences the capacity, reach and latency of a communication system. For a nation like India, with its large and dynamic market, it becomes increasingly crucial to comprehend the intricacies of bandwidth allocation, both for licensed International Mobile Telecommunications (IMT) and unlicensed use. This understanding gains even more importance in the context of the impending 5G technologies, which hold the promise of revolutionary changes in the wireless communications landscape. Understanding Bandwidth and Its Impact on Capacity, Reach and Latency.

- **Capacity:** The capacity of a network, which signifies the volume of data that can be transmitted over a network in a given time, is directly proportional to the bandwidth. Simply put, a higher bandwidth implies that a larger amount of data can be transmitted concurrently, thus increasing the network's capacity. This concept has its roots in Shannon's theorem, which states that the maximum possible data rate of a channel (under noiseless conditions) equals the bandwidth of the channel times the binary logarithm of the number of distinct signal levels.

- **Reach**: Contrary to capacity, the reach or coverage of a signal is inversely related to the bandwidth. High frequency bands, which provide greater bandwidth, usually have a shorter range and lack the ability to penetrate obstacles effectively. This limitation can compromise the coverage area. On the other hand, lower frequency bands, despite having less bandwidth, can transmit signals over larger distances and can better penetrate physical obstructions like buildings, thereby providing improved coverage.

- **Latency**: Latency, which is the time delay experienced before a data transfer begins after an instruction for its transfer has been issued, is also impacted by bandwidth. Higher bandwidths enable faster data transmission, which in turn lowers latency. However, it's worth noting that other factors such as signal propagation time, processing delay and network congestion also play a role in determining latency.

Factors Determining Bandwidth: Several factors can influence the bandwidth in a wireless communication system:

- **Frequency Range**: The bandwidth is directly tied to the frequency range used for communication. A larger frequency range naturally provides a larger bandwidth.

- **Signal-to-Noise Ratio (SNR):** The presence of noise can hinder the signal and limit the effective bandwidth. Higher SNR results in better-quality signal and more effective utilization of the available bandwidth.

- ·**Transmission Medium:** The physical attributes and quality of the medium used for transmission also play a role in determining the bandwidth. For instance, fiber-optic cables are capable of providing higher bandwidths compared to coaxial cables or twisted pair cables.

- ·**Channel Coding and Modulation Scheme:** Different coding and modulation schemes have varying efficiencies in utilizing the available bandwidth, which impacts the rate of data transmission.

Bandwidth Allocation for Licensed IMT Use in India

The Department of Telecommunications (DoT) in India, through the Wireless Planning & Coordination (WPC) Wing, is responsible for allocating bandwidth for various licensed uses. The WPC has designated specific frequency bands for IMT, which include technologies like 2G, 3G, 4G, 5G and the upcoming 6G. The selection of these bands is influenced by factors like international harmonization, the likelihood of interference issues and the existing spectrum's availability.

Bandwidth Allocation for Unlicensed Use in India

Unlicensed bands are those sections of the spectrum where a user is not required to acquire a license to operate wireless equipment. These bands, such as the 2.4 GHz and 5.8 GHz bands, are typically employed for technologies like Wi-Fi, Bluetooth and other similar short-range wireless communication devices.

Understanding the 6 GHz Band

The 6 GHz band is a portion of the radio frequency spectrum that ranges from 5.925 GHz to 7.125 GHz. This range is divided into two sections: the lower half (5.925 GHz to 6.425 GHz), referred to as UNII-5, and the upper half (6.425 GHz to 7.125 GHz), referred to as UNII-6, UNII-7 and UNII-8. This band has attracted considerable attention due to its potential for high-speed, low-latency wireless connections.

Relevance of the 6 GHz Band for 5G in India

The advent of 5G brings along a dire need for additional spectrum. This new generation of wireless communication technologies aims to deliver unprecedented data speeds, incredibly low latency and highly reliable connections, which can only be achieved with a larger spectrum and consequently, a higher bandwidth.

The potential utilization of the 6 GHz band in 5G could be transformative for a country like India, which has diverse connectivity requirements. Ensuring efficient use of this band could lead to substantial improvements in both urban and rural connectivity, thus helping bridge the digital divide. However, careful planning is necessary to avoid interference with existing services and to ensure efficient utilization of this band.

In summary, a thorough understanding of spectrum and bandwidth is crucial to make informed decisions related to wireless communications. The rapid advancement of technologies like 5G and the potential utilization of the 6 GHz band can drastically alter the landscape of network performance and connectivity in India, rapidly growing to be the leading digital market in the world. Striking a balance that ensures coexistence without significant interference between licensed and unlicensed users of the spectrum; and more importantly, understanding the unique and specific requirements of the nation and addressing it, are the critical focus areas lying ahead.
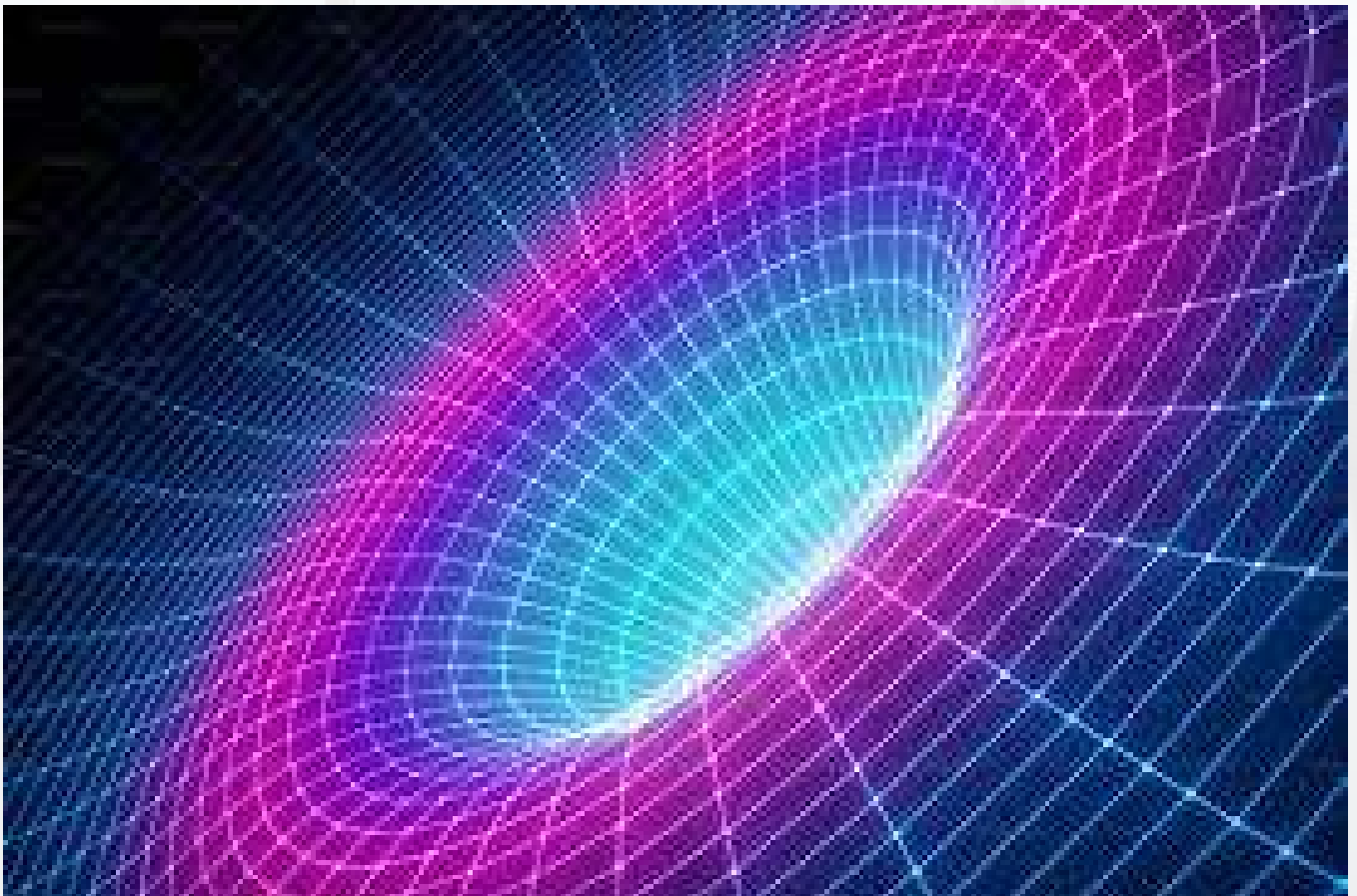
Understanding the Spectrum: Radio Frequency, Optical Fiber & Modulation Techniques

In today's digital era, understanding electromagnetic spectrum and how it facilitates communication is increasingly significant. This article attempts to provide an understanding of the electromagnetic spectrum with a focus on radio frequency (RF), optical fibers, various modulation techniques, propagation characteristics and multiplexing techniques, to help understand the important facets of spectrum.
Radio Frequency and Optical Fiber.

Radio frequency (RF) refers to the part of the electromagnetic spectrum where electromagnetic waves can be generated by alternating current fed to an antenna. It spans from around 3 kHz to 300 GHz. RF has become the foundation of modern wireless communication, powering devices like smartphones, Wi-Fi routers and satellite televisions.

RF communication primarily works by creating electromagnetic waves at a source and broadcasting them into the environment. These waves are then captured by a receiver and translated into usable information. However, this method's effectiveness is directly tied to the characteristics of the RF signals, such as frequency, power and modulation technique, which impact range, data speed and reliability.

Illustration of Radio Frequency Transmission

On the other hand, optical fibers use light, lying at an even higher frequency range in the electromagnetic spectrum (roughly between 430 THz - 790 THz), to carry information. An optical fiber is a flexible, transparent fiber made by drawing glass or plastic to a diameter slightly thicker than that of a human hair. It functions as a waveguide, or "light pipe," to transmit light between the two ends of the fiber.

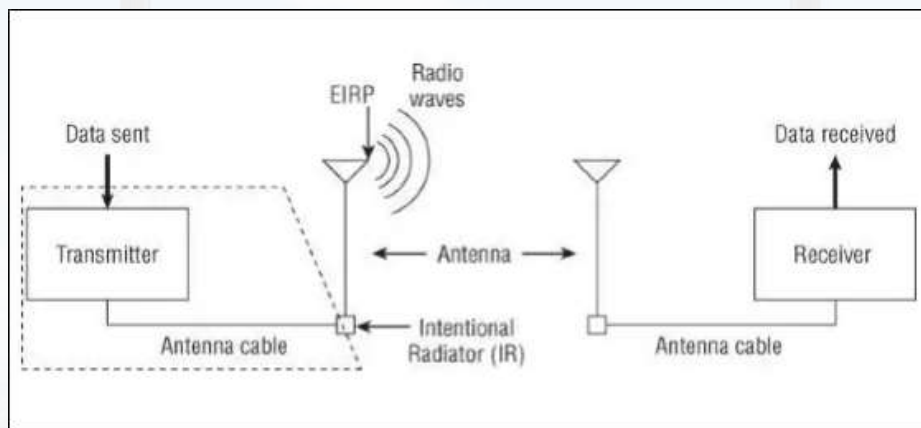The essential components of OF system are transmitter (producing the light signal), optical fiber (transmission medium), and optical receiver (which receives and decodes the signal). Optical fibers have an edge over traditional metal wires as they can carry much more information and are less susceptible to interference and signal degradation.

Modulation (AM, FM, Pulse Modulation)

Modulation refers to the process of varying one or more properties of a periodic waveform, known as the carrier signal, with a modulating signal that typically contains information to be transmitted. It is vital for successful transmission and reception of data.
Amplitude Modulation (AM) and Frequency Modulation (FM) are two fundamental modulation techniques. In AM, the strength (amplitude) of the carrier wave is varied in proportion to the waveform of the source signal. AM is used in short-wave broadcasts and AM radio. However, it is more susceptible to noise and interference.

FM though, varies the frequency of the carrier wave for signal transmission, based on the instantaneous amplitude of the modulating signal. FM is used in audio signal broadcasting like FM radio, and offers better sound quality due to its higher immunity to noise and interference. Pulse Modulation (PM) is another essential category of modulation techniques, where the pulses or pulse positions are varied according to the modulating signal. Some commonly used types of pulse modulation are Pulse Amplitude Modulation (PAM), Pulse Width Modulation (PWM), Pulse Position Modulation (PPM) and Pulse Code Modulation (PCM). These are widely used in digital communication systems, including optical fiber communications.

Propagation Characteristics

Propagation characteristics explain how electromagnetic waves travel when they are transmitted. These characteristics can significantly influence the effectiveness and quality of a communication system.

For radio waves, propagation occurs in several ways: ground waves, sky waves and line-of-sight. Ground wave propagation follows the Earth's curvature, making it suitable for AM radio, whereas sky wave propagation bounces off the ionosphere, enabling long-distance communications.

However, most RF communications use line-of-sight propagation, which means the waves travel directly from the source to the receiver. Optical fiber, on the other hand, employs a propagation principle called total internal reflection. Here, the light signal is repeatedly reflected within the fiber core, enabling it to travel great distances with minimal loss.

Factors like attenuation (signal loss), dispersion (spreading of signal), interference and environmental factors like humidity, temperature and physical obstacles significantly impact the propagation of both RF and optical signals.

Multiplexing Techniques

Multiplexing, another cornerstone of telecommunications, allows for the simultaneous transmission of multiple signals over a single data link. By doing so, multiplexing optimizes the usage of bandwidth and maximizes the data transmission rate, leading to enhanced efficiency and economy.

Following is a table describing the different types of multiplexing techniques and their common use in the real world.

Multiplexing Technique	Description	Usage
Frequency Division Multiplexing (FDM)	Divides the total bandwidth into several non-overlapping frequency sub-bands, each carrying a separate signal.	Radio and TV broadcasting
Time Division Multiplexing (TDM)	Different signals are transmitted in different time slots. Each signal uses the entire bandwidth during its slot.	T1 lines, E1 lines
Code Division Multiplexing (CDM)	Also known as CDMA in communication systems, each signal is assigned a unique code.	3G cellular networks
	All signals are transmitted at the same time over the same frequency.	
Orthogonal Frequency Division Multiplexing (OFDM)	Divides the available bandwidth into many narrow, closely spaced, orthogonal sub-carriers. Each sub-carrier carries a portion of the data.	Digital television, Wi-Fi, 4G/5G cellular networks
Wavelength Division Multiplexing (WDM)	Sends different signals over the same fiber at different wavelengths (colors) of light.	Fiber-optic communication systems
Space Division Multiplexing (SDM)	Multiple signals are transmitted simultaneously in the same frequency band but via different spatial paths.	Multiple Input Multiple Output (MIMO) systems in 4G/5G cellular networks

Conclusion:

Spectrum functions as an invisible orchestrator behind the stage of modern telecommunication systems. It enables us to navigate the vast realm of information that connects us, from the audible chatter of radio frequencies to the silent whispers of light in optical fibers. The modulation techniques are like cryptographers, encoding and decoding information onto these carriers, each carrying a unique signature. Signal propagation reminds us that the communication journey is often influenced by a mixture of factors, from signal strength to environmental nuances. As we continue to stretch the boundaries of communication and connectivity, a profound understanding of these elements is not just an academic endeavor, but a blueprint for future telecommunications landscapes.

| **The Importance of Spectrum as a National Asset** |

The electromagnetic spectrum is a critical resource that underpins modern telecommunications and various forms of wireless technology. As such, it is increasingly being recognized as a valuable national asset. The efficient management and utilization of the spectrum can have significant implications for a nation's economic growth, social development and overall technological advancement.

Understanding Spectrum as a National Asset

Understanding the spectrum as a national asset involves recognizing its critical role in modern communications and technology. It is the invisible infrastructure that enables wireless connectivity, supporting a wide range of services and applications that are integral to modern economies and societies. Enabling mobile broadband that supports internet access, spectrum is a key enabler of information exchange and connectivity.

The spectrum's value to a nation lies not only in its pervasive use in technology but also in its potential for economic growth, social development and overall technological advancement. As a national asset, spectrum is a strategic resource that, when managed effectively, can drive innovation, support public services and contribute to a nation's economic and social prosperity.

Economic Relevance of Spectrum

The economic relevance of the spectrum is multifaceted. Firstly, the spectrum is a source of revenue for governments through spectrum auctions, where rights to use, certain frequencies are sold to telecommunications companies. These auctions can generate significant revenue. For instance, the Indian government's auction of spectrum in 2022, fetched over INR 1.5 lakh crores.

Secondly, spectrum supports a wide range of industries and services that contribute to economic growth. The mobile communications industry, for instance, relies heavily on access to the spectrum and contributes significantly to GDP. Moreover, the spectrum enables the delivery of digital services that drive economic productivity and innovation, from cloud computing to the Internet of Things (IoT).

Socio-Economic Impact of Spectrum
The socio-economic impact of spectrum is profound and far-reaching. By enabling wireless connectivity, the spectrum supports a multitude of services and applications that have significant social implications.

- **Enhancing Communication and Connectivity**
- At the most basic level, spectrum facilitates communication and connectivity. It enables the operation of mobile networks, radio and television broadcasting, and satellite communications, among other services. This connectivity is crucial in today's digital age, where information exchange is vital for both personal and professional activities. It allows individuals to stay connected with family and friends, access news and entertainment, and participate in the digital economy.

- Driving Social Development
Beyond facilitating communication, spectrum also plays a pivotal role in driving social development. It supports the delivery of digital services that can transform various sectors of society.

In education, for instance, spectrum enables the delivery of digital learning resources and remote teaching, thereby expanding access to education and improving its quality. This is particularly relevant in a country like India, where the digital divide can limit access to quality education in remote and underprivileged areas.

In healthcare, spectrum supports telemedicine services, allowing healthcare providers to reach patients in remote areas. It also enables remote patient monitoring and the use of mobile health apps, which can improve healthcare outcomes and efficiency.

In agriculture, the use of spectrum-enabled technologies can help increase productivity and sustainability. For instance, farmers can use mobile apps to access real-time information on weather, crop prices and best farming practices.

- Supporting Financial Inclusion
Spectrum also plays a crucial role in supporting financial inclusion. It enables the operation of mobile banking and digital payment services, which can provide access to financial services for the unbanked and underbanked populations. This can help reduce poverty and drive economic growth.

- Facilitating Social Inclusion
Finally, spectrum can facilitate social inclusion. By enabling access to digital services, it can help bridge the digital divide and ensure that all sections of society can participate in the digital economy. This is particularly important in a diverse and populous country like India, where ensuring social inclusion is a key policy priority.

Prudent Utilization of Spectrum for National Benefit

Given the spectrum's economic and socio-economic importance, its prudent utilization is critical. Efficient spectrum management involves ensuring that this finite resource is used optimally, minimizing interference between different uses and maximizing the benefits derived from its use.

This requires a balanced approach that considers the needs of different users and applications, from commercial telecommunications services to public safety communications and scientific research. It also involves planning for future needs, given the growing demand for spectrum with the advent of new technologies like 5G and the IoT.

Government policies and regulations play a crucial role in spectrum management. This includes the allocation and assignment of spectrum, the setting of technical standards to prevent harmful interference, and the enforcement of rules and regulations. Through prudent spectrum management, governments can ensure that this valuable resource is used in a way that maximizes the benefit for the nation and its citizens.

The Future of Spectrum Management

Looking ahead, the importance of the spectrum as a national asset is only set to increase. Emerging technologies like 5G, the IoT, and autonomous vehicles will drive demand for spectrum, while advances in spectrum management techniques, such as dynamic spectrum access, offer opportunities for more efficient use of this resource.

However, these developments also pose challenges. Balancing the competing demands of different users and applications will become increasingly complex, while the need to prevent harmful interference will become even more critical. Moreover, the global nature of many wireless services and technologies means that international coordination and cooperation in spectrum management will be essential.

Conclusion

The spectrum is a critical national asset that underpins modern telecommunications and wireless technology. Its economic relevance and socio-economic impact are significant, and its prudent utilization can bring substantial benefits for a nation and its citizens. As we move into an increasingly digital future, the importance of spectrum as a national asset will only grow, making its effective management a key priority for nations worldwide.

ET TELECOM
Exploring the Historical, Current & Future Implications of Spectrum

The electromagnetic spectrum, the invisible yet omnipresent backbone of our digital world, is a complex and multifaceted entity. Its management and utilization have far-reaching implications for a multitude of industries and services. This article explores the intricacies of spectrum data, in terms of its historical evolution, the economic aspects of spectrum pricing, the technical factors that dictate its quantity requirements and the potential future trends in spectrum use and allocation.

Spectrum's Historical Evolution

The history of electromagnetic spectrum is a fascinating journey that mirrors the evolution of wireless communications. The concept of electromagnetic spectrum was first introduced by James Clerk Maxwell in the 19th century. However, it was Guglielmo Marconi's invention of radio at the turn of the 20th century, that marked the beginning of the practical use of the spectrum.

In the early days, spectrum was primarily used for radio and television broadcasting. These were the first widespread applications of spectrum, enabling mass communication and shaping the cultural and social landscape of the time. However, the advent of new technologies expanded the use of spectrum to include mobile communications, satellite navigation and other wireless services. This evolution necessitated changes in spectrum management, with governments worldwide implementing policies and regulations to manage this valuable resource effectively.

Current Spectrum Landscape: Low Band, Mid Band and High Band

Today, the spectrum is divided into different bands based on frequency: low band (below 1 GHz), mid band (1 GHz to 6 GHz) and high band (above 6 GHz). Each band has its characteristics and uses, shaped by the evolution of wireless technologies and the growing demand for wireless services.

The low band spectrum, often referred to as "coverage spectrum," is ideal for providing wide area coverage due to its excellent propagation characteristics. It is commonly used for 2G, 3G and 4G services. The mid band spectrum, or "capacity spectrum," offers a balance between coverage and capacity. It is increasingly being used for 4G and 5G services, providing faster data speeds and supporting a greater number of users. The high band spectrum, also known as "millimeter wave," offers very high data capacity but has limited coverage. It is being used for 5G services, enabling ultra-high-speed data transmission.

Spectrum Pricing

Spectrum pricing is a complex issue influenced by several factors which are crucial to understand for both policy makers and industry players, as it impacts the allocation and utilization of this valuable resource.

- Scarcity and Demand: Spectrum is a finite resource with a growing demand, leading to increased prices. As more services and applications become reliant on the spectrum, competition for this resource intensifies, driving up its cost.
- Cost of Deployment and Maintenance: Building and maintaining wireless networks involves significant expenses, including the cost of spectrum licenses, network equipment and installation. These costs, along with the ongoing expenses of network maintenance and regulatory compliance, contribute to the overall price of the spectrum.
- Auctions and Market Forces: While auctions are designed to allocate the spectrum to those who value it the most and can make the most efficient use of it, they can also lead to high prices, particularly in markets with strong competition. The auction process itself can also influence prices. For instance, the format of the auction, the reserve price, the rules regarding bidding and the terms of the license can all impact the final price.
- Economic Value: The price of the spectrum also reflects its economic value. The spectrum enables a myriad of services and applications that contribute to economic growth and societal development.

Quantity of Spectrum Required

The quantity of spectrum required depends on several factors, including the type of service being provided, the technology being used, and the number of users. For mobile communications, more spectrum is needed to support higher data speeds and more users. The shift towards 5G, which supports higher data speeds and more connected devices, is driving demand for more spectrum.

Other factors that dictate the quantity of spectrum required include the geographical area to be covered and the desired quality of service. For instance, providing coverage in rural areas may require more spectrum due to the larger geographical area, while providing the same in urban areas with high user density may also require more spectrum.

Future Trends in Spectrum Usage and Allocation

It is evident that emerging technologies like IoT, autonomous vehicles, telemedicine, and AI will lead to an increased demand. This need is particularly apparent due to their requirements for high-capacity, low-latency spectrum. As we are in the roll-out phase of 5G and envisioning future wireless generations like 6G, there's a clear need for more spectrum, especially in the high and mid-band ranges.

To accommodate these needs, innovative spectrum management approaches are essential, pushing the potential for more efficient use and possibly even the reallocation of existing resources. We also anticipate a growing prevalence of Shared Spectrum models and Dynamic Spectrum Access (DSA) techniques. These allow multiple users to share the same frequency band, maximizing the use of this vital resource.

Simultaneously, the importance of reliable, high-speed communication for public safety leads us to predict an increased spectrum allocation for emergency services. Lastly, the role of Artificial Intelligence (AI) in spectrum management cannot be overstated, as it allows real-time monitoring and dynamic allocation based on immediate needs, greatly enhancing spectrum utilization efficiency.

Conclusion

Spectrum's history, utilization, pricing and the factors that dictate its quantity requirements are all interconnected, reflecting the complex interplay of technological, economic, and social factors. The future of spectrum use and allocation will also be heavily influenced by technological advancements, increased demand and the implementation of innovative management strategies that prioritize efficiency and flexibility. As we move into an increasingly digital future, the importance of the spectrum will only grow, making its effective management a key priority for nations worldwide. Understanding the intricacies of spectrum data is crucial for this endeavor, as it provides the foundation for informed decision-making and effective spectrum management.

Bridging the Spectrum Gap: The Crucial Role of Mid-Bands in 5G & Beyond

The advent of 5G technology has ushered in a new era of connectivity, promising high bandwidth, low latency and substantial aggregation capabilities. The choice of spectrum plays a pivotal role in realizing these promises, with mid-band frequencies emerging as a critical component to strike the right balance between coverage and capacity. This article delves into the significance of mid-bands, particularly the C-Band, in meeting the demands of discerning users worldwide.

However, as we examine the global landscape of 5G deployment, it becomes evident that securing optimal mid-band spectrum poses challenges, with certain regions, including India, facing a significant shortfall. In light of these challenges, this article explores potential solutions, emphasizing the role of the 6 GHz band, and advocates for a collaborative effort to ensure the availability of the right spectrum to meet the evolving requirements of 5G and pave the way for the future introduction of 6G technology.

The essence of 5G lies in its promise of delivering high bandwidth, low latency, and robust aggregation capabilities, achieved through advanced modulation techniques and antenna diversity. Therefore, 5G is actually a technology which is agnostic of the spectrum that it uses – which will be determined by the user requirements or application.

However, today's discerning users seek a harmonious blend of expansive coverage and high bandwidth. It is a well-known fact regarding the electromagnetic spectrum that the higher the frequency, the higher is the capacity but the coverage becomes lower.

While the 26 GHz band meets the demand for high bandwidth, it falls short on coverage. Conversely, lower bands in the MHz range provide extensive coverage but with limited capacity. Moreover, the higher the frequency, the higher is the attenuation of the waves through objects like dust particles, gases, rain, humidity, clouds, vegetation, etc.

It is thus evident that in the current context, we require mid-bands that provide adequate coverage, enhanced bandwidth, and minimal attenuation. The C band especially, not only meets all requirements but is easily encapsulated in handsets/devices. Therefore, all the development and rollout work the world over is generally concentrated on mid-bands. This assumption has worked well for the 5G technology deployment across the world in the last three years. Meanwhile, research and development efforts continue for high-frequency bands tailored to specific use cases.

These frequency spots in lower, middle, and upper bands can be strategically deployed based on local requirements and aggregated into a comprehensive 5G cloud. This is currently being done through carrier aggregation technology wherein the benefits of coverage of the lower band and the capacity of the higher band are used to provide good QoS to the users. This approach caters to diverse use cases, ensuring the benefits of both coverage and capacity.

Mid-band has been examined for various aspects that impact the minimum requirements to be met by operators to service their consumers in different geographies. Analysis reveals that ideally, 3-4 operators require 2 GHz of mid-band spectrum to offer optimal 5G services. Deviating below this threshold would lead to sub-optimal performance while surpassing it could result in wastefulness.

However, the global rollout of 5G faces challenges, with each country having unique occupancy on mid-band frequencies. While some countries can make the entire 2 GHz available in the C band by reallocating usage, others, like India, grapple with limitations, and are able to secure only 800 MHz out of the required 2 GHz in the mid-band because of the inability to vacate critical and strategic use cases from the C band. This leaves a substantial deficit of 1200 MHz in the mid-band, for the requisite, adequate and optimal 5G services to be provided to our users, as envisaged in literature and as expected by the Government.

To make up for this deficiency, we need to go to the nearest frequency ranges which could close the gap. A simple scan shows that the 6 GHz band has 1200 MHz of spectrum available, which should be earmarked for mobile services – both for 5G technology and early stages of 6G – in case India has to be reckoned as a country with good quality f 5G services and similar prowess further in the introduction of 6G. These are the realities that exist today.

As regards providing ubiquitous 5G both outside and inside buildings (obstacles), innovative concepts such as Outdoor Unit – Indoor Unit (ODU-IDU) and In-Building Solutions (IBS) with Femto and Pico cells, etc. have already started being rolled out to provide an equal grade of services both indoors and outdoors. These can easily integrate most applications and devices which were hitherto dependent on technologies like Wi-Fi and Bluetooth. However, by no means does it imply the end of life of these technologies – they will also continue to exist.

In light of the expanding user base, it also becomes cost-effective and strategically important for the Government, Original Equipment Manufacturers (OEMs), and R&D units to focus on creating a conducive and interoperable ecosystem of devices, primarily centred around TSPs' networks.

It is, therefore, imperative for all stakeholders to prioritize national interests and ensure that the right kind of wherewithal – like mid-band spectrum – is made available to meet the evolving demands of 5G and lay the foundation for the anticipated transition to 6G.

Use of Spectrum in Different Technologies & Verticals

The electromagnetic spectrum represents a diverse and invaluable resource used across a multitude of technologies and verticals. The range of frequencies that constitute the spectrum serves as the underlying medium for various communication, navigation, entertainment and strategic applications. This article delves into the use of the spectrum across different technologies and sectors, with specific emphasis on use cases and examples from the Indian context.

Defense

The Defense sector relies heavily on spectrum for secure and robust communications, surveillance, radar systems and navigation. It is critical for both strategic planning and real-time tactical operations. Use Cases in India include –

- Radar Systems: India's defense forces employ radar systems such as the Indian Doppler Radar (INDRA), which uses specific frequencies within the spectrum for detecting aircraft, ships and weather phenomena. These radar systems are vital for air defense, maritime security and weather forecasting.

- Secure Communications: The defense sector requires encrypted and secure channels for communications. The Indian Navy, for instance, uses Rukmini (GSAT-7), a dedicated military communication satellite that operates in UHF, S, C, and Ku bands. This ensures confidential communications between naval units and headquarters, enhancing operational efficiency.

- Electronic Warfare: Spectrum manipulation and control are vital for electronic warfare. India's DRDO has developed systems like Samyukta Electronic Warfare System that are capable of intercepting, jamming and deceiving various signals across the spectrum. These systems give India a strategic edge in electronic countermeasures during conflicts.

Challenges

Spectrum allocation and management within the defense sector must ensure that no interference or security breaches occur, maintaining integrity and confidentiality. Continuous research and development is required to stay ahead in electronic warfare capabilities.

Wi-Fi

Wi-Fi technology enables wireless connectivity for devices using the 2.4 GHz and 5 GHz bands within the spectrum. It has revolutionized internet access and communication. In India, Wi-Fi use cases are –

- Public Wi-Fi: India's government has initiated projects to provide public Wi-Fi services in urban and rural areas, using designated bands within the spectrum. This effort aims to bridge the digital divide, bringing internet access to remote regions and fostering digital inclusion.
- Smart Cities: Wi-Fi plays a crucial role in India's smart city initiatives, offering connectivity for IoT devices, traffic management, and public services. Smart city projects in India leverage Wi-Fi to create efficient urban environments and improve the quality of life for residents.

Challenges

Spectrum congestion and interference, particularly in densely populated areas, are major challenges. Regulatory compliance and efficient spectrum management are vital to ensure that Wi-Fi networks provide reliable and high-speed connectivity to users across the country.

Satellites

Satellites employ various portions of the spectrum, such as C, Ku, Ka and X bands, to provide communication, weather forecasting, remote sensing and navigation services. Some use cases in India are :

- Communication: India's GSAT satellites offer communication services, including broadband and telemedicine, across the country using different bands within the spectrum. These satellites play a crucial role in connecting remote and underserved areas.

- Navigation: The Indian Regional Navigation Satellite System (IRNSS), also known as NavIC, provides accurate positioning information over India using S and L bands. NavIC enhances navigation accuracy for both civilian and military applications, including disaster management and precision agriculture.

- ·Remote Sensing: India's remote sensing satellites like Cartosat, employ specific frequencies for agricultural monitoring, urban planning and disaster management. These satellites aid in resource management, disaster preparedness and environmental monitoring.

Challenges

Spectrum coordination, regulatory compliance and avoiding interference with other satellite or terrestrial services are significant challenges. India must continue to invest in satellite technology to maintain its presence in space-based services.

Broadcasting

Broadcasting utilizes various bands within the spectrum for transmitting television, radio and digital media content. In India, this is used for –

- Television Broadcasting: India's vast television network operates in VHF and UHF bands, reaching millions of households. Television broadcasting is a primary source of entertainment and information dissemination in the country, playing a crucial role in cultural and social development.
- FM Radio: FM radio in India uses the VHF band, providing diverse content across cities and towns. It offers a wide range of music, news and entertainment options to listeners, fostering regional diversity.
- Digital Broadcasting: The migration to digital broadcasting, such as DVB-T2 in India, allows better quality and more efficient use of the spectrum. Digital broadcasting enhances the viewer experience and opens up opportunities for interactive and multimedia content delivery.

Challenges

Ensuring quality, managing interference and adapting to new digital standards are ongoing challenges in the broadcasting sector.

RF Mesh

RF (Radio Frequency) Mesh networks use radio frequency bands to create flexible and self-healing wireless networks. In India, these are widely used in industrial applications like:

- Smart Grids: RF Mesh is implemented in India's smart grid projects to enable real-time communication and control over the electricity distribution network. This technology improves energy efficiency, reduces power outages and supports the integration of renewable energy sources.
- Industrial Automation: Various industries in India utilize RF Mesh networks for automation and control, enhancing efficiency and responsiveness. This includes manufacturing, logistics and agriculture, where RF Mesh facilitates real-time monitoring and optimization.

Challenges

Interference management, scalability and ensuring robust communication in harsh environments are key challenges in implementing RF Mesh networks. India must invest in research and development to overcome these challenges and fully realize the potential of RF Mesh technology.

Conclusion

The electromagnetic spectrum stands as a critical asset across various technologies and verticals, driving innovation, efficiency and connectivity. The Indian scenario, with its unique challenges and opportunities, reflects a microcosm of the global landscape. From defense to Wi-Fi, satellite, broadcasting and RF Mesh, the spectrum's utilization represents a complex and dynamic interplay of technology, regulation and strategic imperatives. Continued research, robust governance and mindful exploitation of this invaluable resource will shape the future of communications, security and development, not only in India but across the globe. As technology evolves, so too will the importance of electromagnetic spectrum in shaping the world we live in.

BEYOND 5G: DEVELOPMENT & SKILLING

Beyond 5G: Development & skilling

A Progressive Year: 5G Services & Government Reforms Revitalize the Indian Telecom Industry

forum   23RD ANNIVERSARY

A Progressive Year

5G services and government reforms revitalise the Indian telecom industry

Lt Gen. Dr S.P. Kochhar, Director General, COAI

With over 1.17 billion subscribers, the Indian telecom industry ranks second internationally and is the world's largest data consumer. The expectations from the sector have grown as a result of the daily introduction of new technologies. The trend of data dependence has become more pronounced now with the much-anticipated launch of 5G services. The sector has been collaborating closely with the government and other stakeholders to keep up with these technical improvements. During the past year, there have been several encouraging developments.

The Indian Telegraph Right of Way (Amendment) Rules, 2022, and the Wireless Licensing Reforms of 2022 have made infrastructure deployment across the nation simpler and quicker. We warmly applaud the reduction of the processing charge and the accelerated SACFA certificate approval procedure. The Right of Way (RoW) Amendment Rules address problems brought on by a dearth of street furniture for deployment and limitations on placing towers or small cells adjacent to hospitals, airports, schools and other facilities. Another major plus of the rules is the newly decreased rates for the installation of tiny cells on poles and aerial optical fibre cable (OFC).

Business is made easier because of the government's focus on digitising processes on a number of fronts. For instance, the introduction of the 5G RoW application form by the Gati Shakti Sanchar portal created an institutional framework for collaboration between all parties, including the central and state/union territory governments, to make it easier to submit RoW applications and obtain permissions for the installation of digital infrastructure, which includes mobile towers and OFC. In order to speed up the deployment of equipment across the nation, self-declaration clearance has replaced the previous scrutiny-based clearance process and shifted the import licence application process online. The process of getting the Department of Telecommunications' technical approval for telecom towers has been streamlined in a similar way. The digitisation of records and the automatic renewal of licences have significantly decreased the

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time required to provide services. Through the Saral Sanchar portal, the entire licensing procedure has been made online, reducing the processing time to just two months on average.

In order to replace the outdated directives, futuristic and forward-looking policy and regulatory procedures must be developed in today's era of digital convergence. The draft Indian Telecommunication Bill, 2022 is a suitable step in this direction because it aims to modernise and combine the existing laws governing the allocation of spectrum as well as the provision, development, extension, and operation of telecommunication services, networks and infrastructure. The law will be more effective thanks to the bill's requirements for effective spectrum usage, a licence framework, dispute resolution, and graded penalties. The draft bill also places focus on reforms relating to the use of spectrum, such as refarming, harmonisation, sharing, trading, leasing, technology-agnostic use, giving back unneeded spectrum to the government and surrender of spectrum.

With crucial clauses on know your customer (KYC), protection against unsolicited messages, duty of the user to provide correct KYC, etc., the draft bill places a high focus on the "protection of users". This will aid in preventing problems with user security, fraud, and unwanted telemarketing calls and messages.

It is most fairly and practicably proposed that over-the-top (OTT) communication platforms, which provide telecom services like voice/video calls and messaging to the same clients directly, be included in the Telecom Act. OTT communication service providers are not subject to any kind of regulation, which significantly undermines the market's fairness. Moreover, being outside the licensing regime, OTT communication providers do not have any obligation towards security requirements, which poses a great risk to national security. Given the alarmingly high cases of frauds and scams on OTT platforms, focusing on safeguarding the security and privacy of users has become all the more important, in view of consumer interest and well-being. OTT communication services must be incorporated into the draft tele-

com bill framework to bring in accountability, security, fair competition and a level playing field in the sector.

These forward-thinking actions taken by the sector are essential to revive the country's digital economy. The telcos are investing heavily in 5G networks while focusing on rural markets to offer these services all across the country.

Going forward, the adoption of 5G technology would spark a tremendous societal shift in India and enhance value creation. While a few industries like healthcare and education are anticipated to lead in 5G use, its adoption will also have a significant positive impact on other sectors like automotive, retail and logistics. Since public 5G will initially be applicable and used in a small number of consumer segments such as high-tech gaming, augmented reality (AR)/virtual reality (VR) apps, etc., enterprise business will be the main force behind its adoption and usage. Further, the enhanced network connectivity of 5G will lead to an increase in the use of remote-controlled devices in various industries, thereby improving safety in potentially dangerous areas. Massive factory automation would increase output, effectiveness, and control. The development of intelligent gadgets and network edges made possible by 5G will spur worldwide innovation.

The growth of 5G has also sparked an urgent need for a variety of qualified workers to meet the deployment and applica-

tion needs of the technology. It is predicted to create a sizeable amount of direct and indirect job possibilities, opening the doors for individuals and companies with the capacity to fundamentally alter India's economic landscape. India is anticipated to require 22 million skilled workers with 5G-related skills by the year 2025. It would be essential to have experts in fields like secure network architecture design, artificial intelligence and machine learning, big data analytics, programming, cloud computing, internet of things, DevOps, automation and orchestration, open source software, and electrical engineering fundamentals in order to compete internationally.

The rapid advancement in technology is also leading to increased demand for skilled cybersecurity professionals to safeguard the networks and applications of the future, especially with the growing threat of cybercrimes and frauds. Cybersecurity and resilience would be a crucial area for skill development in the coming year.

In 2023, we anticipate a growth in the implementation of 5G enterprise use cases. The areas of emphasis business-to-business use cases will include fixed wireless, healthcare industry, sensor-based systems, network edge, remote devices and AR, connected cars, etc. Some of the use cases, including holographic communications, immersive VR advertising, VR classroom, safety at construction sites (metro rail), smart agriculture, connected ambulances, and smart industrial manufacturing/factories, have already been demonstrated by telcos and original equipment manufacturers at the recent India Mobile Congress 2022. We anticipate that telecom service providers will begin implementing the majority of these use cases in 2023. Additionally, we expect to see an increase in tech-telco agreements for the construction of private 5G networks. 5G services are expected to play a significant role in India achieving its economic goal of becoming a $5 trillion economy by 2024-25.

As an industry, we look forward to providing our support and efforts towards minimising the digital divide and helping India become a $1 trillion digital economy by 2025, as we march towards achieving the nation's "Digital India" vision. ▲

[TELECOM TALK]
SKILL DEVELOPMENT

LT GEN DR S P KOCHHAR

5G ERA WILL PLACE SKILLING ON THE FAST LANE

The next-generation telecom network will drive growth across sectors, creating new opportunities and better job options in India

ndia successfully launched 5G in the country last year, becoming one of the 95 nations to achieve this feat. With ultra-low latency and high data speed, 5G is on its way to becoming an extremely reliable communication system, connecting every corner of rural and urban India and seamlessly transferring real-time information.

The launch of 5G has also amplified the demand for a wide array of skilled manpower to meet the nation's deployment needs. Estimates by staffing firms indicate that 5G services in India will likely create a demand for up to 45,000 jobs by the end of this financial year. The mere anticipation of the 5G rollout has already resulted in 80,000 5G-related hirings in the calendar year 2022.

As per TSSC, India may require an estimated 22 million skilled workers possessing 5G-related competencies by 2025. It is also likely to generate direct and indirect job opportunities significantly, thereby opening new avenues for people and businesses with the potential to change

> " Unlike the pre-covid era, 5G will ensure greater access and a superior experience in the corporate world.

> There will be a 20% rise in the hiring of networking engineers, AI/ML experts, UX designers, cybersecurity specialists, data scientists, and data analysts.

the economic landscape of India. The hike in demand for 5G-related skills is not just limited to the telecom sector.

Various applications of 5G will also necessitate skill development and specialisation across diverse functional areas, including resources for sectors like education, healthcare, agriculture, manufacturing, energy and utilities, retail, financial services, logistics and transportation, mining, automobile, media and entertainment, etc. In effect, 5G is expected to trigger societal transformation in India by strengthening the use of ICT across sectors and thereby propelling Industry 4.0 and value creation to the next level. As a result, India will witness a thrust in the economy, access to the international markets, and most importantly, new tech-focused job opportunities.

NEW JOBS, NEWER OPPORTUNITIES

Hiring for job roles like networking engineers, Artificial Intelligence and Machine Learning (AI/ML) experts, UX designers, cyber security specialists, cloud computing experts, and data science and data analytics experts are expected to see a 20% rise quarter-on-quarter, as per experts. Sensor-based crop monitoring, remote equipment control, energy management, surveillance and smart transportation are some other applications that might prove to be a game-changer with increased coverage and technology in India.

Major demand for these experts will come from Industry 4.0 and smart city use cases for the Internet of Things (IoT), Augmented Reality, Virtual Reality (AR/VR), and AI that will be enabled by 5G. Currently, around 44% of 5G applications worldwide are found in the above segments. These 5G-induced job opportunities are likely to sustain over the next few quarters, with companies focusing on skilling and upgrading their workforce.

From the perspective of enhancing digital prowess, skills in areas such as secure network architecture design, AI/ML, Big Data analytics, programming, cloud computing, IoT, DevOps, automation and orchestration, open-source software, and electrical engineering fundamentals would be crucial to achieving a globally competitive position for India. A key resource requirement to emerge in 5G is also that of data science professionals.

Besides the technical aspects of network planning, deployments and operations, a radical increase in the use of coders, data analytics, data management, etc. will be needed for the next generation of networks. This will become vital as the AI and software would need real-time, rapid interpretation and use of data to translate into meaningful applications and interventions in the operational sphere. This will also open up the gates for a new breed of skilled professionals for assuming important roles and responsibilities at different levels, generating both employment opportunities as well as skill development initiatives.

[TELECOM TALK]
SKILL DEVELOPMENT

> The Department of Telecommunications will train over one lakh youth in 5G and allied technologies over the next three years with the support of industry bodies.

The rapid advancement in technology is also leading to an increase in demand for efficient and qualified Cybersecurity professionals, to safeguard the networks and applications of the future. Rising methods and incidences of cybercrimes and frauds make it imperative to build robust, scalable and continuously upgrading defence systems and mechanisms to curb this global menace. Cybersecurity and resilience would be crucial areas for skill development as well as rising employment opportunities in the coming year, not just for telecom, but the entire digital ecosystem in the country.

FACILITATING MULTI-SECTOR GROWTH

The Department of Telecommunications exhorted the telecom industry to make all-out efforts to enhance and deepen the skilling initiatives that will meet the evolving needs of the sector. The government recently announced setting up a task force to develop highly skilled workers and designers in the telecom sector. A skilled workforce and their empowerment in the sector will surely serve as an effective and efficient facilitator for all other segments, given the use cases of 5G across industries. With the advent of new technology, skilled workers will be capable of accomplishing complex tasks and facilitating the longevity of the systems.

Unlike the pre-covid era, 5G will ensure greater access and a superior experience in the corporate world; be it entry-level candidates looking to equip themselves with technical skills or experienced ones aiming to upskill or reskill to remain relevant, there is a widespread reliance on digital learning. Smarter training rooms and classrooms at professional training institutions will enjoy increased bandwidth, reduced latency, and more robust support for the security framework. Using digital training and skill assessment, platforms will be able to deliver a highly immersive, convenient, and memorable experience for corporate trainees.

Since last year (2022), employee training evolved to a greater extent as the workplace has become digitally complex. With 5G, companies will have significant leverage as the technology will help build possible remote workplaces. Similarly, it can improve employees' training experiences and allow them to learn new skill sets. The industry also needs to develop a pool of skilled labourers to accommodate 5G.

One of the best ways to do this is through internal education programmes. With optimum technical and managerial training, companies can update their employees to understand the new technology and give them the essential skills required to install it on a large-scale while being sensitive to the needs of each carrier.

The Union Budget 2023 also introduced some provisions which are expected to indirectly have a positive impact on the telecom sector. The budget emphasised on innovation, job creation and skilling, with a continued push towards Digital India. The announcement on setting up of three centres of excellence for AI and 100 labs in engineering colleges for the development of 5G applications will help in fueling the proliferation of the technology and its ecosystem in the country while augmenting the need and nurturing of skilled resources with expertise in these advanced technologies.

As has been evident in recent years, the telecom industry, which is the lifeline of the country, does not sit passively in the back seat of reforms but is rather progressing with zeal and intent, especially on the front of new technologies. The government has been highly progressive in its approach towards enabling the creation of a robust digital infrastructure and manufacturing ecosystem in the country, to expedite deployments and roll-out of pan-India services by the next year. Furthermore, the DoT will train over one lakh youth in 5G and allied technologies over the next three years with the support of industry bodies. With such initiatives, the industry will positively see India emerge as a digitally leading and economically inclusive nation shortly. ❦

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THINK CT TANK

A Think Tank team of selected stalwarts, business thinkers and successful leaders in their respective fields pen their thoughts exclusively for us, making gripping narratives.

Powering telecom for Digital India!

It is safe to say that even before the global pandemic hit us, telecom-powered digital connectivity services had been established as an essential service, a true leveler and the most potent tool for digital inclusion and empowerment across the world. The pandemic put to rest any doubts or debates in this regard.

In today's modern world, digital services, riding on robust digital infrastructure, are the key enablers and critical determinants of a state and nation's growth and wellbeing. Availability of digital services is vital for the economic and social development of all Indians, and is the only way to remove the digital divide between the haves and the have-nots.

Whether it be healthcare, education, defense, agriculture, transport, e-commerce, law enforcement, or governance, the telecom sector is one that is relied on by so many, and in so many ways. Mobile connectivity and broadband, AI technology, use of IoT and sensors, 5G networks, etc., are transforming the society into one that is constantly connected, aiding key societal functions, such as data processing, customer service, entertainment purposes, and even national security.

The telecom sector, in turn, relies heavily on uninterruptible power supply to ensure it can provide communication continuity, minimize downtime, and provide customers with satisfactory service. In fact, the energy sector also relies on telecom – to help manage and maintain their network of generators and grid distribution, and ensure grid resiliency during adverse situations. With such a crucial role to play in our day-to-day lives, the importance of electricity for the telecom sector cannot be overemphasized.

Unfortunately, unreliable electrical grid supply is one of the biggest challenges faced by the rapidly growing telecom tower industry in India. On an average, two-thirds of rural and two-fifths of urban areas face power outages at least once a day (IRES 2020). Telecom tower operators have to rely on diesel generators, batteries, and a variety of power-management equipment to address the demand–supply gap. The energy costs alone account for about 25–30 percent of the total network operating costs, affecting the profitability of the operators.

While the Government of India had provided infrastructure status to telecom industry way back in March 2012, no noticeable benefits have been extended to the sector even after a decade, especially in the matter of electricity provisioning. Despite the established importance of telecom in all aspects today, most states in India do not extend these much-needed benefits to the sector.

On the contrary, most of the states are levying commercial/non-industrial tariff on telecom – one of the highest brackets of tariff rate, resulting in undue financial burden on this sector, which works round the clock, and thereby hampering growth of this critical infrastructure. Given that telecom tariffs in India are amongst the lowest in the world, high electricity tariffs are one of the biggest challenges faced by the rapidly growing telecom tower industry in India. It is estimated that almost 30 percent of the tower's OpEx accounted for is related to electricity tariffs, which is a significant amount.

In most states, the difference between an industrial electricity tariff category and a commercial electricity tariff is significant, leading to avoidable burden to overall telecom sector. For the continued growth and advancement of the sector to meet the needs of our fast-progressing *Digital India*, it is imperative that industrial tariff rates be applied to the telecom sector across all the states. It may be worth learning from China on this facet, which has provisioned that the energy utilized by 5G base stations, constructed by telecom operators and China Tower, will qualify for power–cost reduction incentives. Moreover, the electricity consumption of 5G base stations in China will be subsidized for three consecutive years.

Since setting up of network facilities in rural and semi-urban areas requires huge capital expenditure, high operational costs like commercial electricity tariff further adds to the burden. As a consequence, the telecom industry is hindered from expanding its footprint in the rural areas at a pace which is desirable. Hence, benefits of various government schemes are not reaching out to the rural populace, who are supposed to get the benefits as the schemes were designed for their betterment and overall digital inclusion.

In order to improve the lives of millions of such people, it is important and imperative to encourage the telecom sector to deploy networks in such areas through suitable incentivization, such as on power tariffs. In fact, the Telecom Regulatory Authority of India (TRAI), in its report titled, "Recommendations on Use of Street Furniture for Small Cell and Aerial Fiber Deployment" dated 29.11.2022, also recommended that it is justified that telecom sites be provided electricity connection at industrial/utility tariffs. Further, as part of the additional recommendations of the working group to the Forum of Indian Regulators (FOIR) on "Cross Sector Collaborative Regulation Between Telecom Regulators and Electricity Regulators," it has been stated that "Telecom sites should be provided electricity connection under utility/industrial tariff. SERCs may be requested to incorporate the same in their tariff orders."

Moreover, with the launch of 5G, we are at the cusp of embracing the next stage of digital revolution. Early deployment of 5G will lead to multiple new sources of revenue generation for the nation, state governments, local bodies, startups, existing businesses, and most importantly, benefits for the citizens. For this massive deployment of small cells (5G), there will be need for high number of electricity connections across the states.

While the 5G-new-radio standard is more energy efficient per GB than 4G, the proposed 5G use cases and new spectrum bands will require many more mobile sites. Further, as the technology advances and more services are provided at the edge, the need for storage and computation facilities like data centers will also rise.

One may ask in this regard, what about the use of green energy for powering the telecom towers?
The Ministry of Power has allowed *green open access* to consumers and the consumption requirement limit of open access transaction has been reduced from 1 MW to 100 kW for green energy, which is a welcome step. However, the telecom towers, which are the backbone of the network, have a power energy load requirement ~10 kW each and are being considered as individual units, instead of being treated as per the combined use of the sector. Hence, the reduction in consumption requirement for availing green open access is not helping the telecom industry, where the total number of telecom towers are almost 7.5 lakh and projected to grow at a very fast pace. For active participation of the telecom industry in the green energy initiative, electricity consumption at each telecom site must be allowed to be aggregated and offset with green power (solar, wind, hydro, etc.) generated at distant locations. This would make it more cost-effective for the telcos, while may also help in meeting India's carbon emission targets.

Besides the critical aspects of affordability and availability of power, there are other important areas of concern for the industry on the power front that can be addressed to facilitate the telecom sector toward faster and efficient rollout of networks, such as new connections need to be provided in a predictable time bound manner. Also, being an essential service, exemption from scheduled power load-shedding is necessary for the telecom sector and must be provisioned.

Also, while there has been a significant increase in the installation of smart/pre-payment meters, their presence is negligible even in urban areas. The Electricity (Rights of Consumers) Rules 2020, clearly state that – *"No connection shall be given without a meter and such meter shall be the smart pre-payment meter or pre-payment meter."* Since telecom network is present at the site, functioning of a smart meter is crucial and timely replacement of faulty meters, with smart/prepaid meters is vitally needed.

If the state governments provide such incentives to the telecom industry as mentioned above, the telecom infrastructure will be appropriately powered to meet the connectivity needs of our vast nation. Electricity accounts for ~25–30 percent of OpEx of a tower site, and with the densification and use of small cells in 5G, consumption is only expected to rise northwards. Positive provisions by the state governments in facilitating this essential sector will help minimize the dependence on battery banks and DG sets, and reasonable cost of grid-supplied power will help support the sector's financial viability. The consumer will also be able to enjoy high-speed 5G networks with minimum impact on prices. This, in turn, would also catalyze the deeper penetration of telecom connectivity and help bridge the digital divide. Lower costs of power will not only provide much needed relief to the telecom sector but also ensure better reach of new-age technologies, such as AI, ML, AR, VR, and robotics powered by 5G to the far-flung corners of the country.

This article is authored by Lt. Gen. Dr. S.P. Kochhar, Director General, COAI. Views expressed are personal.

CT- THINK TANK MAGAZINE

Leverage Technology for Skilling on New and Future Digital Technology

A Think Tank team of selected stalwarts, business thinkers and successful leaders in their respective fields pen their thoughts exclusively for us, making gripping narratives.
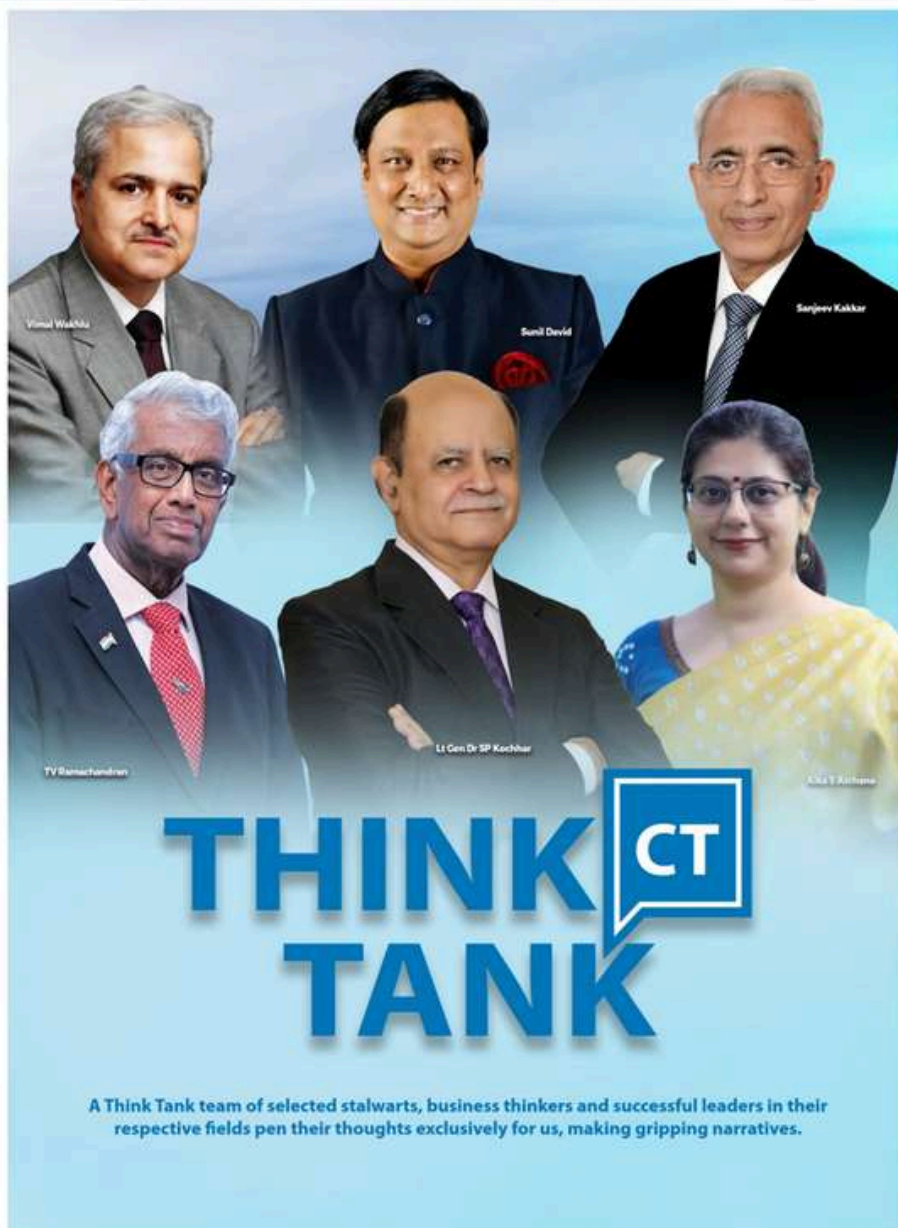
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CT THINK TANK

Leverage technology for skilling on new and future digital technologies

In the rapidly evolving digital landscape, where technology is constantly advancing, the need to upskill and adapt to new digital technologies has become paramount. The Fourth Industrial Revolution has ushered in a wave of transformative technologies, such as artificial intelligence (IA), blockchain, and the Internet of Things (IoT), creating both challenges and opportunities. To remain competitive and thrive in this digital era, it is crucial to leverage technology as a powerful tool for upskilling, enabling individuals to acquire the necessary knowledge and skills to navigate the ever-changing digital landscape.

According to a report by the Telecom Sector Skills Council (TSSC), India requires a minimum of 22 million skilled professionals by 2025, in order to fully harness the advantages of 5G technology. However, the report highlights a significant demand-supply gap of 28 percent. The telecom council plans to train 1 lakh people in the next three years and open 10 new Centers of Excellence across the country. But the greater question lies in how effective the skilling and training programs are, and if the output from these would suffice the rapidly evolving requirements and expectations at the operational levels of the companies who are hiring.

The skilling ecosystem faces some major challenges at the grassroots level. The availability of both skilled and unskilled manpower is a key requirement in this ecosystem. While skilled manpower typically emerges from the urban areas, Tier-II/III cities, towns and rural areas provide the bulk of the unskilled resources. Training for these unskilled resources encompasses addressing a host of challenges.

Most of these candidates lack appropriate infrastructure for training and skilling, and a majority have to travel to different cities/towns to get the basic training. This geographical disconnect poses a grave hurdle at the beginning of the process itself. Moreover, lack of training modules and content in regional/vernacular dialect, even for teacher–student interactions, presents a severe handicap to comprehensive

and meaningful learning for the resources. It is also not feasible to provide physical training infrastructure/institutes in every location since the student distribution is pretty widespread.

The trainees from the non-urban locales are also not too aware or updated on the opportunities present in the industries, and the avenues to understand where and what skills need to be pursued for a successful career.

Presently, the connect between the industry and these trainees is not adequate, which leads to an overwhelming gap between the industry's skillset requirements, and the training being imparted to the students. The industry faces difficulties in allotting time and resources for the mapping and sourcing of skilled manpower, which leads to lack of clarity on how the on-ground needs of the industry can be met. The training institutes and trainers are, therefore, bereft of industry knowledge and clear-cut terms of requirements, which would greatly benefit the students. The quality control in terms of courses and content also cannot be monitored/evaluated fruitfully without the industry's active involvement. There is a serious dearth of learning and development (L&D) divisions in the industry for this purpose.

A collaborative approach with equitable involvement and contributions from both the industry and the academia is of critical importance for proper and productive training and skilling of resources. Measures like cross-movement between the academia and industry and joint labs for facilitating up-to-date operational-level training can help develop resources as per the actual evolving needs of the industry.

These students are not very well versed with IT and technology on a day-to-day basis either, which becomes a disadvantage in their adaptability to technical training. Most of the training centers lack modern facilities, and need to upgrade significantly. This is a fundamental requirement as the use of modern technology tools can very well address these preva-

lent problems mentioned above. Here is how we can better our learning and development programs so that the gap is lessened and the youth are able to get hired into their right domain of interest:

- The challenge of adequate training infrastructure and capacities can be overcome efficiently today, especially with the advent of 5G technology. Virtual classrooms and training facilities could meet this requirement with minimal physical infrastructure spends. Virtual use of resources through technology can deliver the best available content and teachers, both global and domestic, to the students in the neediest places. This would bring uniformity in the training imparted, thus minimizing the difference in quality of training and content for the trainees, irrespective of their locations.
- A learning management system (LMS) may be used that would facilitate access to educational content through various technologies, such as the web, smartphones, tablets, DTH (direct-to-home) with toll-free voice channel, social media, CBTs (computer-based training), and traditional textbooks. 5G will further offer real-time remote teaching or even high-quality simulations through the use of AR/VR and AI technologies. The creators of the LMS should possess the requisite expertise in application development and utilization.
- A hub-and-spoke model can ensure equitable access to high-quality content and teachers for all students, fostering a comprehensive and productive learning environment. In this system, a highly qualified teacher, based in an urban area, can teach through an LMS from a studio, supported by a local teacher in rural areas, facilitating self-learning. The master instructor, preferably from the industry, can teach in Hindi, English, or other languages for global experts, while the local facilitator translates into the regional dialect, eliminating the need for content translation into multiple dialects. Advancements in natural language processing, like the government's *Bhashini* initiative, coupled with AI utilization, are expected to enhance this aspect further. This approach offers growth opportunities for local teachers, bridges the gap between students and the industry, and aligns with Digital India and Make AI in India objectives.
- Upon the completion of the course, students will have to undergo online assessments based on outcomes and heuristics. Technology specialists are needed to create assessment platforms meeting quality assurance standards. An ecosystem of assessors, supported by local facilitators, will conduct assessments online. The models for internet-connected and non-internet-connected locations can use web or Android-based tablets. Furthermore, on obtaining a skill or academic certification, trainees will have the option to enter either the job stream or the entrepreneur stream.

On the technology part, 5G will facilitate high bandwidth, faster speeds, 100 times more capacity for aggregation of consumers, without any degradation in quality and access to last-mile teaching facilities with increasing network proliferation. It will provide access to unlimited digital highways without congestion, with the capacity to connect all entities and facilities to a central location for uniform training. Edge computing, enabled by 5G, could facilitate a hierarchy-based computing network, which would benefit the local students – the local edge could cater to the needs of the specific area/district, while connecting to the entire world. High-data applications can be utilized via overlay on 5G apps for the convenience and benefit of the trainees as well as teachers. 5G can also enable customized learning, based on deep analytics and student assessment, to cater to the specific needs of different segments of students. Moreover, the industry will get the benefit of choosing from a country-wide pool of uniformly trained resources to mold and absorb in their operations, as per their requirements.

The industry is encountering significant challenges in finding the ideal candidates who possess the necessary knowledge, skillsets and mindset for the desired job profiles. Additionally, the intense competition within the industry makes it challenging to attract and retain top talent. The evolving work environment and adopting hybrid ecosystems present further hurdles when relying on traditional methods.

Embracing technology-driven approaches in the hiring process and providing potential employees with opportunities to grow alongside the industry are effective strategies to overcome these challenges. Leveraging technology for upskilling empowers individuals to stay ahead of the curve, adapt to changing digital landscapes, and unlock new career opportunities. Moreover, it enables organizations to build a future-ready workforce that can drive innovation and competitiveness in the digital era. With cohesive efforts, we can build a future that is driven by knowledge, innovation, and the limitless potential of technology.

This article is authored by Lt. Gen. Dr. SP Kochhar, Director General, Cellular Operators Association of India (COAI). Views expressed are personal.

5G in India offers a variety of opportunities for businesses and consumers, leading to increased demand for skilled labour to meet operational requirements, *writes Dr. S P KOCHHAR*

India has joined the elite group of nations that have successfully launched 5G networks, marking a significant technological milestone. With this accomplishment, India joins 94 other countries in harnessing the power of fifth-generation wireless technology, ushering in a new era of connectivity and innovation for the country. The Prime Minister's announcement of 5G in India at the India Mobile Congress 2022 has created a plethora of opportunities in a variety of sectors, promising faster speeds, lower latency, and unprecedented connectivity for businesses and consumers alike. This has also increased the demand for a diverse range of skilled labour to meet the nation's deployment and operational requirements.

The global 5G services market is expected to be worth USD 249.2 billion in 2026, with a CAGR of 29.4%, while the global 5G infrastructure market is expected to be worth USD 47.7 billion in 2026, with a CAGR of 67.1%. According to TSSC, India will require an estimated 22 million skilled workers with 5G-related competencies by 2025 to meet these rising industry demands. According to staffing firm estimates, 5G services in India are expected to generate demand for up to 45,000 jobs by the end of this fiscal year. The mere anticipation of the 5G rollout has already resulted in 80,000 5G-related hires in 2022 alone.

5G is expected to significantly increase both direct and indirect job opportunities, allowing people and businesses to enter markets that have the potential to completely transform India's economic landscape. The increase in demand for 5G-related profiles is not limited to the telecom industry; other industries such as automobile, healthcare, education, e-governance, manufacturing, and retail are also supporting it. 5G is expected to spark societal transformation in India by increasing the use of ICT across sectors, propelling Industry 4.0 and value creation to new heights. As a result, India's economy will benefit from a boost, increased access to international markets, and, most importantly, new tech-related job opportunities. Hiring for job roles such as networking engineers, machine learning and artificial intelligence experts, user experience designers, cyber security specialists, cloud computing experts, and data science and data analytics experts is expected to increase by 20% quarter on quarter.

To improve India's digital prowess, skills in areas such as secure network architecture design, AI and ML, big data analytics, programming, cloud computing, IoT,
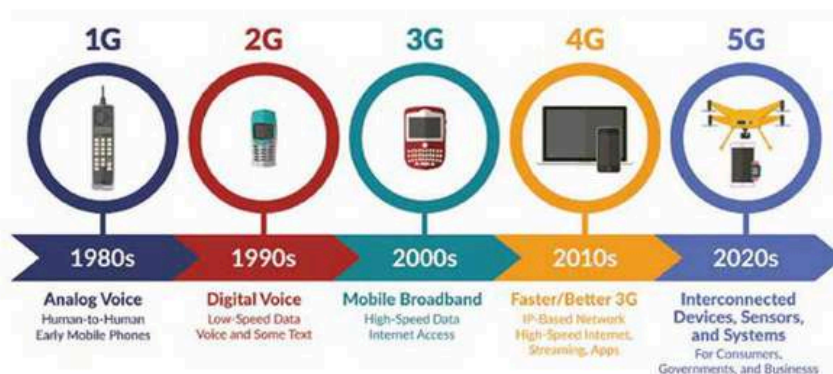
TELE-TALK

1G	2G	3G	4G	5G
1980s	1990s	2000s	2010s	2020s
Analog Voice Human-to-Human Early Mobile Phones	**Digital Voice** Low-Speed Data Voice and Some Text	**Mobile Broadband** High-Speed Data Internet Access	**Faster/Better 3G** IP-Based Network High-Speed Internet, Streaming, Apps	**Interconnected Devices, Sensors, and Systems** For Consumers, Governments, and Business

DevOps, automation and orchestration, open-source software, and electrical engineering fundamentals would be critical. Demand for specialised or skilled roles in pure network as well as application areas such as data sciences, network engineering, edge computing, software integration, AI/AR/VR, information security, and forensics is expected to increase. Precision engineering, assembly lines, design engineering for chipsets, FABs, SoCs, packaging, scrapping, and other sectors will also expand. Increased 5G adoption would also increase the demand for individuals with multi-trade skills who can adapt and work in a variety of settings.

Besides the technical aspects of network planning, deployment, and operations, the next generation of networks will require a significant increase in the use of coders, data analytics, data management, and so on, because AI and software will require real-time or rapid interpretation and use of data to translate into meaningful applications or interventions in the operational sphere. This will also allow a new generation of skilled professionals to assume important roles and responsibilities at various levels, resulting in both job opportunities and skill development initiatives.

The Department of Telecommunications urged the telecom industry to make all-out efforts to improve and deepen skilling initiatives that will meet the sector's evolving needs. The government recently announced the formation of a task force to develop highly skilled telecom workers and designers. Given the use cases of 5G across industries, a skilled workforce and their empowerment in the sector will undoubtedly serve as an effective and efficient facilitator for all other segments. With the advent of new technology, skilled workers will be capable of completing complex tasks and enhancing system longevity.

The Union Budget 2023-24 included provisions that are expected to have an indirect positive impact on the telecom sector. With a continued push towards a digital India, the budget emphasised innovation, job creation, and skilling. The announcement of three artificial intelligence (AI) centres of excellence and 100 labs in engineering colleges for the development of 5G applications will help fuel the proliferation of 5G and its ecosystem in the country while augmenting the need for and nurturing skilled resources with expertise in these advanced technologies.

As has been demonstrated in recent years, the telecom industry, which is the country's lifeline, does not sit passively in the back seat of reforms, but rather advances with zeal and intent, particularly on the front of new technologies. The government has been extremely forward thinking in its approach to enabling the creation of a strong digital infrastructure and manufacturing ecosystem in the country in order to accelerate deployments and the rollout of pan-India services by the end of the year. Furthermore, with the support of industry bodies, the DoT will train over 1 lakh youth in 5G and related technologies over the next three years. The road ahead appears promising, and in order for 5G to succeed in India, we must embrace innovative technologies with open arms in order to make the future brighter and more equitable for all.

(The Writer Lt. Gen. Dr. S.P. Kochhar is Director General, COAI)

ET TELECOM
India's Telecom Industry Stands on Cusp of Transformative Change in 2024

For the telecom industry in India, the year 2023 brought in innovation and resilience, thanks to the concerted efforts and ground-breaking advancements witnessed across infrastructure, technology and regulatory domains. As of August 2023, the sector boasts a staggering 1.148 billion wireless subscribers, marking a 1.9% surge from the previous year. Fuelling this growth is the expansive reach of 4G and 5G networks, propelling data usage to an average of 17.4 GB per month per subscriber. This surge catapults India's share of global mobile data traffic from 3% to an impressive 20%, with 70 million new smartphone subscriptions signaling an imminent digital revolution.

Despite these milestones, the sector grapples with a set of challenges that demand strategic solutions for continued success.

Fair Share Contribution from LTGs

Telecom service providers (TSPs) in India have been steadfastly advocating for a fair share contribution from the large traffic generators (LTGs) who generate disproportionately high traffic on the networks, highlighting the need for a more equitable distribution of costs amidst the rising CAPEX and OPEX that the industry is grappling with. While TSPs diligently invest in network infrastructure and technology upgrades, these LTGs reap substantial profits without bearing a fair share of the associated costs. This disparity places an undue burden on TSPs, impacting their financial sustainability and hindering their ability to invest in future upgrades. The call for a more equitable contribution from LTGs arises not as an impediment to innovation but as a necessary measure to ensure the continued growth and viability of the essential telecom sector.

Allocation of 6 GHz Spectrum Band for 5G/IMT Services

The 6 GHz spectrum band emerges as a valuable asset for enhancing mobile networks' quality and coverage. Allotting this spectrum to 5G communications becomes crucial to meet the escalating demand for data services. With the potential to revolutionize wide-area applications, including telemedicine and smart cities, 5G takes center stage as a catalyst for transformative change and needs to be supported aptly with requisite spectrum.

Need for Industrial/Utility Electricity Tariff Rates for Telecom Infrastructure

The high cost of commercial electricity tariffs emerges as a challenge in meeting the escalating power demand of the sector, esp. telecom towers. Telcos face hurdles in expanding networks and delivering quality services due to exorbitant electricity charges. A shift to industrial tariffs or renewable energy subsidies is imperative to spur investment, improve network quality and become more cost-efficient.

Supply-Demand Gap in Telecom Workforce

As telecom converges with the technology sector, the requirement for a skilled workforce capable of addressing the latest demands in the industry becomes paramount. As per the latest report from TSSC, a staggering 2.41 million demand-supply gap looms the sector, projected to increase by 3.8 times by 2030. Bridging this gap necessitates strategic reskilling and hiring, focusing on talent in Tier-II & III cities and universities.

Increase in Unsolicited Commercial Communication (Spam Calls/Messages)

The rise in unsolicited communications such as spam calls and messages, has necessitated tightened regulations and trials - to create a more secure and user-friendly telecom environment. The Indian TSPs are working closely with the Regulator and the Government in the efforts to curb this menace.

Amid the challenges, the sector witnessed commendable progress in 2023:

Leadership in 6G: India is positioning itself as a global leader in 6G technology, with Prime Minister Narendra Modi unveiling the "Bharat 6G Vision" this year. Industry players like Nokia and Ericsson are also establishing 6G labs in India, setting the stage for ground-breaking research and development.

Green Energy Open Access: The Ministry of Power's gazette notification allows telecom operators to harness renewable energy under the open access route, fostering the use of green energy in the sector.

Clarity on EMF Audit Fees: The Department of Telecommunications resolved a longstanding issue by clarifying the applicable fees for EMF audit tests.

New Progressive RoW Rules: The Ministry of Defence introduced a progressive Right of Way (RoW) rules, facilitating the expansion of telecom infrastructure in Defence land and estates.

Extension of MTCTE Phases 3 and 4: The Telecommunication Engineering Centre has extended the implementation timelines for Mandatory Testing and Certification of Telecommunication Equipment (MTCTE), addressing industry challenges.

Recommendations on Submarine Cable Landing: TRAI recommended the use of Indian-owned vessels for submarine cable maintenance, reducing reliance on foreign providers.

Indian Telegraph RoW (Amendment) Rules, 2023: Amendments allow licensees to set up temporary telegraph infrastructure, facilitating rapid repairs and network connectivity.

Improving Infrastructure in North-East: TRAI recommendations for enhancing telecom infrastructure in North-eastern India represent a positive stride, with potential to significantly boost the region's socio-economic and digital advancement through improved telecom and broadband services.

India Emerges as Global 5G Leader: In a remarkable feat, India attained the status of having the world's second-largest 5G network within just 10 months, as well as the fastest in 5G rollout globally, establishing over 3.97 lakh 5G BTS sites across more than 717 districts nationwide. Expectations from 2024

As 2023 draws to a close, the telecom sector stands on the cusp of transformative change. TRAI recommendations are awaited on various critical issues, including regulatory mechanisms for OTT services and selective banning of OTT services, assignment of spectrum for space-based communication, rating framework for digital connectivity, assignment of spectrum in E&V bands, and spectrum for microwave access and backbone, etc. are anticipated to be decisive for the telecom sector, shaping its future progress and industry dynamics.

The appointment of a new TRAI Chairman is keenly awaited while the industry also anticipates the second round of 5G spectrum auctions. The enactment of the new Telecom Bill will be vital in determining the industry's growth trajectory in the coming year, esp. on critical issues like fair-share from LTGs and clarity on 5G use cases for enterprises . The sector's resilience and commitment to innovation would pave the way for continued growth and advancement, propelling India towards a brighter digital future.

[TELECOM TALK]
DIGITAL INDIA

LT GEN DR S P KOCHHAR

THE TRIPLE 'A' STRATEGY FOR SUCCESS

Affordability, accessibility and technological advancements are the critical aspects that India needs to take care of in its digital mission journey

In the rapidly evolving global digital arena, India emerges as a front-runner. This transformative journey, catalysed by the ambitious Digital India initiative, revolutionises the nation into a digitally empowered society and knowledge economy. The telecom industry, at the heart of this transformation, transcends its role as an economic entity to become a catalyst for societal and technological change. The COVID-19 pandemic demonstrated the indispensable role of telecom in lives today, from education, healthcare, and social communications, to governance, or anything else. It reinforced the sector's status as a lifeline, connecting and empowering societies during times of crisis.

The digital consumer landscape in India is witnessing a democratisation of access, with an increasing digital appetite not just in urban areas but in rural regions as well. This broad-based engagement is bridging the urban-rural digital divide and expanding the market for digital services. With one of the world's largest mobile subscriber bases and a burgeoning internet user community, India's telecom sector is ripe for the adoption of next-generation technologies like 5G, which promises not just enhanced connectivity but a potential revolution in various sectors. However, there are challenges to be met, like infrastructure development, regulatory hurdles, and ensuring accessibility and affordability.

As India stands at this digital juncture, the telecom sector is not just reflecting the nation's aspirations but also shaping the potential for an inclusive digital future. This article aims to explore the interplay of affordability, accessibility and technological advancements in shaping India's telecom narrative and its impact on the country's digital destiny.

INDIA'S TELECOM SECTOR STATUS

With over 1.17 billion subscribers and the number of internet users surpassing 881.26 million, India's telecom industry is a cornerstone of the nation's socio-economic progress, propelled by the government's progressive push for digital initiatives, aiming to provide digital infrastructure as a utility to every citizen.

India's vast and varied geography, with its mix of urban, semi-urban and rural areas, poses unique challenges and opportunities for telecom expansion. While urban areas boast high telecom density and advanced services, basic connectivity is still being developed in some rural regions. Economically, India presents a contrast between a burgeoning middle class with an increasing digital appetite and significant sections still facing economic constraints impacting digital access.

AFFORDABILITY, ACCESSIBILITY, ADVANCEMENTS

In its report on the connected world, McKinsey categorised countries into four groups based on their rate of progress in the connectivity continuum. These groups are named 'Pioneers', 'Leaders', 'Followers' and 'Trailing Markets'. However, McKinsey assigned China and India to

> " The government must explore options to make 5G infrastructure development more cost-effective, easing the financial burden on telecom operators.

> In a price-sensitive market like India, where the majority of the population has limited spending capacity, making 5G services and devices affordable is crucial.

IN BRIEF

- India's telecom sector has emerged as a transformative force, connecting societies and catalysing technological change amid global competition.

- Affordability, cost-effective infrastructure, and financial inclusion are vital to propel digital inclusion and effective network development.

- Embracing 5G advancements, including spectrum technologies and IoT integration, is crucial for India's global competitiveness.

- Indigenous research, investment in education, and a robust application ecosystem is imperative for sustained leadership.

- Addressing affordability and accessibility ensures widespread benefits, fostering social inclusion and positioning India as a global tech hub.

- Collaboration between the government, industry, and stakeholders is essential to ensure equitable access to digital transformation.

distinct archetypes, acknowledging their unique status. Specifically, McKinsey described India as 'digitising faster than any trailing market'.

The nation's connectivity providers are contending with price wars, and McKinsey suggests that either price increases or government intervention may be necessary to encourage further network development. Given these unique challenges, India's approach to enhancing digital infrastructure must differ from other countries. A focused and tailored strategy is essential for a more effective digital rollout in India. Each component of this triad — affordability, accessibility, and advancement — has its own aspects, and we must look at them more holistically.

OVERCOMING AFFORDABILITY BARRIERS

Affordability is a pivotal aspect of 5G adoption in India. Consumer pricing plays a crucial role, particularly in a price-sensitive market where the majority has limited spending capacity. Ensuring the affordability of 5G services and devices becomes imperative for widespread adoption.

Cost-effective infrastructure development is another consideration. The Indian government might explore measures to make 5G infrastructure development more economical. This approach would alleviate the financial burden on telecom operators, potentially leading to lower service costs for consumers.

Additionally, fostering financial inclusion is essential. This involves creating financial products and services tailored for low-income groups, enabling them to afford digital services and devices. This strategy contributes to broader digital inclusion, aligning with India's vision for widespread technological accessibility.

FORMULATING ACCESSIBILITY STRATEGIES

Bridging the urban-rural digital gap is a pressing need, making the deployment of 5G in rural areas dependent on innovative infrastructure solutions and government support. Ensuring digital equity requires a focus on digital inclusion for all society segments, particularly marginalised communities.

To enhance the appeal and utility of digital services in rural and semi-urban areas, the development of localised

> Efficient and strategic use of spectrum, like the allocation of the potent 6 GHz band for 5G services is important to ensure optimal use of this limited resource.

content and services in regional languages is crucial. Strengthening Public-Private Partnerships (PPPs) is vital for the development of telecom infrastructure in hard-to-reach areas and there is a need to leverage the strengths of both sectors to achieve greater reach and impact.

ADVANCING TECHNOLOGICAL FRONTIERS

To stay globally competitive, India must embrace the latest 5G advancements. This includes adopting new spectrum technologies, Edge computing and IoT integration. There is also the need to support engineering technologies by recognising that 5G's role in driving AI, AR/VR, and smart cities is crucial for India's digital evolution.

Further, encouraging indigenous 5G research and development is vital to reduce reliance on foreign technology and tailor solutions to local needs, while investing in education and training programmes is essential to cultivate a skilled workforce capable of supporting these advanced telecom technologies.

An important initial lesson from 5G implementation is the significance of developing applications tailored to market requirements alongside standards and network technologies. As India looks toward a leadership role in 6G, the young and creative workforce must ideate and develop applications which help propel the uptake and use of these technologies efficiently and optimally. There is also a need for the government to foster a robust ecosystem for application development, much like the recently committed 100 5G labs announced for the development of use cases.

IMPACTING INDIA'S DIGITAL MISSION

Affordable and accessible 5G technology can revolutionise various sectors, including healthcare, education, agriculture and manufacturing, aligning with the goals of Digital India and Industry 4.0. Widespread 5G adoption can significantly contribute to India's economic growth, creating new job opportunities and fostering innovation across industries.

By addressing affordability and accessibility, India can ensure that the benefits of digital transformation are equitably distributed, contributing to social inclusion and national development. Besides, advancements in 5G technology can stimulate an ecosystem of innovation,

attracting global investments and positioning India as a hub for technological innovation.

CHALLENGES AND FUTURE OUTLOOK

While the potential impact is immense, India grapples with multifaceted challenges in its digital transformation journey, encompassing infrastructure limitations, regulatory complexities, and the imperative of ensuring technology's inclusive reach. Addressing these challenges necessitates a concerted effort from the government, industry, and various stakeholders.

Infrastructure scaling: The primary challenge revolves around scaling infrastructure, particularly in rural and remote areas, to facilitate the robust support needed for high-speed internet and the extensive reach of 5G networks.

Regulatory framework: Streamlining the regulatory framework becomes imperative for expeditious technology deployment. This includes supporting the swift implementation of new technologies, ensuring data privacy and security, and effective enforcement of progressive government measures such as right-of-way rules.

Spectrum allocation: The judicious and strategic allocation of spectrum, especially the potent 6 GHz band for 5G services, is crucial. This aims to optimise the use of this limited resource, striking a balance that meets the diverse needs of various stakeholders in the technological landscape.

India's telecommunications sector plays a crucial role in realising the nation's digital ambitions. Balancing the three aspects of affordability, accessibility and technological advancements, will not only drive the sector's growth but also significantly contribute to India's socio-economic development, ensuring that the benefits of digital transformation are accessible to all segments of the population. Collaborative efforts from the government, private sector and civil society are essential to overcome the challenges and harness the full potential of digital technologies for national progress and prosperity. ✋

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UNION BUDGET 2023

UNION BUDGET 2023

Publication	ET TELECOM
Headline	Budget 2023: Reformative Tax Regime Quintessential for Driving Telecom

Telecom is one of the highly regulated industries in the nation, with onerous tax and regulatory burdens on telecom service providers. Considering the financial health of the industry and the huge investments underway to fulfil our goal of a digitally connected India in line with the National Broadband Mission, it is vital for the TSPs that enabling provisions are made in the Union Budget to ease the burden and help the sector progress at pace with global developments. COAI has made a detailed representation to the Finance Ministry in this regard, some of the key submissions of which are highlighted in this article.

In terms of regulatory levies, we have requested that the USO contribution of 5% of AGR may be suspended till the existing USO corpus (with an unused surplus of INR 64774 crore as of 31.10.2022) is exhausted, and License Fee may be brought down from 3% to 1% to cover only administrative costs. Further, it would be beneficial if the definition of Gross Revenue (GR) makes it abundantly clear that the revenue from activities believed to be incidental to telecom activity are not part of GR.
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Since lapse of business losses post 8 years would affect the already distressed sector - as the income during the recovery phase would be subject to tax outflows and other committed pay-outs related to AGR, spectrum, etc., a special regime has been requested to be introduced for TSPs under Section 72 of the Income Tax Act, 1961, wherein business losses can be carried forward and set-off till 16 assessment years instead of the existing 8 years.

To help facilitate an environment supporting the Digital India initiative, the threshold of keeping 75% book value of fixed assets has been urged to be brought down to 50%, and held for a maximum period of 2-3 years instead of the existing requirement of 5 years.

We have requested that suitable directions are provided by CBDT so that Interconnect Usage Charge (IUC) payments to Foreign Telecom Operators for TDS under section 195 of the Act are not withheld, and it is clarified that provision of domestic law cannot be read into or overridden by the provisions of the tax treaties between two countries, unless the treaty is amended by both the countries. For TDS under section 194H of the Act, it would be helpful if it is clarified that trade margins earned by telecom distributors do not fall under the ambit of TDS provision. Considering the low margins earned by the distributors, a lower withholding tax rate of 1% instead of the current 5% has been requested to be prescribed.

Higher Basic Customs Duty (BCD) of 20% levied on most telecom equipment is disrupting the cost effectiveness of telcos, as around 85% of the equipment is imported under Chapter Head 8517, since the required manufacturing facility has not yet been set up in India. Hence, we have submitted that levy of BCD charges on importing essential equipment be exempted, which would help in expanding pan-India telecom deployment and smooth roll-out of 5G.

Presently, interpretational issues in Customs lead to the sector suffering higher rate of duty @ 20% (in place of the applicable 0-10%). Therefore, we have requested that the various terminologies used in tariff/exemption notifications for import of different equipment be clearly defined, to help prevent disputes and litigation. Similarly, clarification for activities relating to cable repair/installation operations carried out in Exclusive Economic Zone (EEZ) and Amnesty for erstwhile Central Taxes (Excise and Service Tax) would be helpful for the sector.

The industry has proposed that a centralized registration under GST for industries having spread in all 36 States/UTs, or alternatively, a centralized jurisdiction to govern the day-to-day affairs of the taxpayers, be formed. Centralized Assessment, Audit Procedure for large taxpayer units with turnover of over INR 500 crore and presence in over 12 States/UTs may also be facilitated, as it would limit this facility to less than 1% of all Corporates and ensure EoDB with no corresponding loss of revenue to the Government.

Clarification has been requested to safeguard that ITC on network equipment installed on towers is not denied. It is also submitted that an appropriately worded law is provided to avoid the ambiguity on availability of ITC on telecom towers, which is resulting in blockage of working capital.

Given the dismal financial state of the sector, it has been suggested that a special benefit be provided to telecom operators by way of exemption of GST on regulatory payments of LF, SUC and spectrum assigned under auction - at least until the sector recovers financially. This would provide substantial relief and help in the revival of the industry. Alternatively, payment of Reverse Charge Mechanism (RCM) on Government Services from Input Tax Credit (ITC) balance may be permitted.

The accumulation of ITC (over INR 32,000 crore) has been requested to be refunded as it is posing a huge financial burden on the telcos. Alternatively, this amount could be allowed to be adjusted against statutory dues payable or to be used as collateral against loans. The industry hopes that these are considered by the GST Council.

2023 marks a significant year for investments in the telecom industry, especially owing to the roll-out of 5G. The Union Budget will play a quintessential role in defining the growth and cost-effectiveness of the sector in 2023-2024. The Government is cognizant of the industry's areas of concern, and we are hopeful that they will be considered on merit. We share the administration's vision of 'Digital India' and look forward to supporting the progressive objective of reducing the digital divide through seamless connectivity across the nation.

FIRST POST
Union Budget 2023-2024: Why Nirmala Sitharaman's Proposal will be Vital for Revival and Progress of Telecom Sector

Telecom has today clearly emerged and is widely acknowledged as one of the essential services, just like electricity and water supply. With every new generation of technology coming in, the investments and costs of the sector keep increasing, as is the case presently with 5G being deployed across India.

As the Union Budget for FY 2023-24 approaches, the industry is hopeful that some of the heavy tax and regulatory burdens on the operators are considered and addressed by the government so that the financial viability and sustainability of this crucial sector are safeguarded.

With our aspirations to be a digitally powered knowledge economy as well as a global manufacturing, R&D, and supply chain hub, the sector looks forward to some supportive provisions in this year's Budget, which would help continue our progressive streak, while establishing global competence at the same time.

Telecom sector wishlist:

Special I-T regime for operators

The industry has made some suggestions to the Finance Ministry in this regard, to aid in the revival and advancement of Indian Telecom. We have requested that a special regime be introduced for the operators under Section 72 of the Income Tax Act, 1961, whereby the business losses can be carried forward and set off until 16 assessment years instead of the 8 years presently. Otherwise, a lapse of business losses post-8 years would affect the already troubled sector since the income during the recovery phase would be subject to tax outflows and other committed payouts associated with AGR, spectrum, etc.

The threshold of the book value of fixed assets has also been recommended to be reduced to 50 percent from the current 75 per cent, to be held for a maximum period of 2-3 years instead of 5 years currently.

Clarify tariffs, exemption technologies

To bring in more transparency, we have requested various terminologies in Customs to be clarified for tariff/exemption notifications for the import of telecom equipment since owing to interpretational issues currently, a much higher 20 per cent rate of duty is being charged in place of the applicable 0-10 percent rate. The sector would also benefit from clarification on activities relating to cable repair/installation operations carried out in Exclusive Economic Zone and Amnesty for erstwhile Central Taxes (Excise and Service Tax). We are also hopeful that Gross Revenue (GR) would be defined in such a way that makes it clear that the revenue from activities incidental to telecom activity are not part of it.

Bring down license fee to 1%

In order to ease the financial burden on the telcos and aid in the revival of the sector, we have requested that the License Fee be brought down from 3 per cent to 1 per cent to cover only administrative costs, and the USO contribution of 5 per cent of AGR be deferred till the existing amount is exhausted. It has also been proposed that telcos be granted GST exemption on various regulatory payments like License Fees, SUC, and spectrum awarded through auction, at least till there is some financial stability in the sector. Alternatively, it has been requested to permit payment of Reverse Charge Mechanism (RCM) on Government Services from Input Tax Credit (ITC) balance.

As regards ITC, we have requested a refund of the Rs 32000+ crore accumulated, which is adding to the industry's financial woes. Alternatively, this sum could be permitted to be adjusted against the statutory obligations due or used as collateral for loans. Clarification has also been sought to ensure that ITC on network equipment fitted on towers is not refused. An aptly drafted law is requested to avoid confusion over the availability of ITC on telecom towers, which is preventing the flow of working capital.

Waive BCD levy for import of equipment

Another request made is for Basic Customs Duty (BCD) levy to be waived for the import of necessary equipment, to support the pan-India expansion of telecom networks and 5G deployment. This is because almost 85 per cent of the equipment is currently imported (under Chapter Head 8517) due to the unavailability of the manufacturing facility in India and 20 per cent BCD is applied on the same, impacting the viability of the telcos.

A centralized registration under GST for industries having spread in all 36 States/UTs or a centralized jurisdiction to govern the day-to-day affairs of the taxpayers has been requested to be formed. It has also been proposed that Centralized Assessment and Audit Procedures be facilitated for large taxpayer units with turnover of over Rs 500 crore and presence in over 12 States/UTs. It would limit this facility to less than 1 per cent of all corporates while enhancing EoDB with no corresponding loss of revenue to the Government.

A request has been made for suitable directions to be provided by CBDT to prevent withholding of Interconnect Usage Charge (IUC) payments to Foreign Telecom Operators for TDS under section 195 of the Act and to clarify that provision of domestic law cannot be read into or overridden by the provisions of the tax treaties between two countries unless it is amended by both countries. For TDS under section 194H of the Act, it has been entreated to clarify that trade margins earned by telecom distributors do not fall under the ambit of TDS provision and considering their small margins, a lower withholding tax rate of 1 per cent be prescribed instead of the current 5 per cent.

While the government has rewarded the telecom sector with a variety of reforms last year, financial relief and clarity under various segments as mentioned above would be welcome. The rollout of 5G networks in India is being noticed globally and is a proud milestone for every citizen. The support, which we are hopeful of being granted by the Government, will surely help the sector to act as a major enabler for realizing the collective vision of making India a $1 trillion digital economy by 2025.

SAFETY & SECURITY

SAFETY & SECURITY

Publication	VOICE&DATA
Headline	Time to Get Rid of Saboteurs

[TELECOM TALK]
INFRASTRUCTURE

LT GEN DR S P KOCHHAR

TIME TO GET RID OF THE SIGNAL SABOTEURS

The rise of illegal mobile signal boosters poses a major challenge for India's telecom industry, causing network issues like call drops and slow data speeds

The mushrooming of illegal mobile signal boosters or repeaters, especially in urban locations, has emerged as a significant challenge for India's telecom industry. These devices, designed to amplify and distribute mobile tower signals in areas with poor connectivity, are commonly installed in buildings. While this issue is not talked about much in everyday discussions, the fact is – the widespread use of these unauthorised boosters is a leading cause of network issues such as call drops and slow data speeds, particularly in densely populated areas.

These devices are classified as "Wireless Telegraphy Apparatus" and "Wireless Transmitter" under the Indian Wireless Telegraph Act, 1933. The possession and sale of such equipment, without acquiring the necessary permissions under the Act and Rules framed therein, constitutes a breach of the Act's provisions and is a punishable offence. Despite this, these boosters are readily available in electronics markets and are installed by unauthorised entities in homes, offices, hostels, guest houses, etc.

> " The illegal use of boosters and repeaters interferes with mobile networks and diminishes the experience for all users in the periphery

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MAGZTER

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> Illegal mobile signal boosters adversely affect the connectivity uplink path and amplify received noise at the site, leading to a decline in network experience.

While telecom service providers (TSPs) typically install repeaters or small cells after meticulous inspections in response to specific requests or identified needs, they ensure that such installations do not disrupt network coverage for individuals outside the distribution area. However, the unchecked illegal use of repeaters interferes with mobile networks, diminishing the experience for all users in the periphery.

These boosters adversely affect the connectivity uplink path and amplify received noise at the site, leading to a decline in network experience, Key Performance Indicators such as accessibility, retention, and user throughputs. Further, these devices usually support all spectrum bands and operate continuously, thus interfering with the service provider's cell sites. The increased interference in the uplink also causes mobile handsets to transmit at a higher power to maintain connectivity with the site, leading to increased battery consumption and a degraded network experience.

Such illegal signal repeaters have been discovered in substantial numbers in various Indian cities, including major metros like Delhi, Mumbai, Kolkata, and Bengaluru. In Delhi NCR alone, over 30% of cell sites (approx. 8,000 cells) have high interference from illegal repeaters across all bands and technologies, with 9 locations having the highest concentration of illegal repeaters. In some areas like Laxmi Nagar, PG Hostels even advertise "Network Boosters" as a facility for tenants. Back in February, in Nagpur, the Wireless Monitoring Organisation (WMO) of the Department of Telecom (DoT) and city police conducted raids in localities like Itwari, Mominpura, and Gandhi Bagh, whereby seven boosters, 30 antenna panels and several meters of cable were seized.

Locating and shutting down illegal repeaters is a laborious task and the telecom industry requested DoT to take appropriate measures in this regard. In a welcome development a few months back, DoT issued guidelines on how to deal with matters unauthorised boosters and repeaters which are causing harmful interference to telecom services. As per the guidelines, the WMO will be inspecting sites upon receiving complaints of interference and can take penal action against those who do not remove or surrender such illegal equipment on being notified by the government. This is a positive step by the government, as the issue is so severe that it impedes the licensed operators' ability to provide uninterrupted telecom services and launch new services.

THE IMPACT ON TELCOS

Already burdened with debts, the telecom industry is facing massive losses due to this problem, as it is losing thousands of crores of investment, necessitating immediate intervention from the relevant authorities. The industry demands that those selling, installing and housing these illegal repeaters be held accountable. The Indian Wireless Telegraph Act, 1933, clearly prohibits the possession of wireless telegraphy apparatus without a license, and violation of this law can result in serious penalties. To effectively deter the use of such illegal devices, we believe that their use must be treated as a punishable offence with adequate jail terms, a fine, or both.

The other equally grave issue is that these devices are readily available in the grey market and on e-commerce platforms. The DoT and TSPs have written numerous detailed letters to the e-commerce websites and platforms selling such illegal equipment, informing them that possession and sale of such equipment, without obtaining requisite permissions constitutes a violation of the provisions of the Telegraph Act. Though some of the e-commerce companies have ceased such activities, others still continue to sell them.

While it has been conveyed to the e-commerce companies that no person or dealer, shall sell or hire a wireless set or equipment to any person unless such person or dealer holds a valid Dealer Possession License (DPL), the online companies contend that their role is of an intermediary only and they do not need a DPL. But DoT has further clarified that e-commerce portals are operating as an "online marketplace" and hence, are covered under the purview of the Information Technology

INFRASTRUCTURE

> Illegal signal repeaters have been discovered in substantial numbers in various Indian cities including major metros like Delhi, Mumbai, Kolkata, and Bengaluru.

THE BOOSTER PROBLEM

- Illegal mobile signal boosters in India pose a significant challenge to the telecom industry, causing network issues and hindering connectivity.

- The use of unauthorised repeaters disrupts mobile networks, leading to call drops, slow data speeds, and degraded network experience.

- The possession and sale of illegal boosters violate the Indian Wireless Telegraph Act, 1933, and punishable actions can be taken against offenders.

- Telecom service providers face substantial losses due to the proliferation of illegal boosters, necessitating immediate intervention from authorities.

- Similar problems exist globally, and countries like Australia, South Africa, the USA and UK have implemented strict regulations and penalties against illegal booster usage.

Act 2000 as intermediaries. Hence, the IT Act and Information Technology (Intermediaries guidelines) Rules, 2011 apply to them, whereby it is the responsibility of these intermediaries to follow certain due diligence guidelines, including the signing of a "User Agreement" for access or usage of the intermediary's computer resource by any person, which includes the need for compliance of any law by the sellers and the purchasers.

Furthermore, in case a wireless apparatus or transceiver is required to be imported from abroad, the importing entity needs to obtain an import license, as required under relevant Customs rules. So, the arguments of e-commerce companies to justify the possession, sale and use of such illegal devices by unauthorised entities do not hold ground.

One also does not realise that these devices are not even an effective solution to enhance network coverage in an area since most manufacturers of illegal boosters often utilise inexpensive and recycled components that have short lifespans. These devices typically exhibit poor performance, generate excessive noise, and users are constantly exposed to the possibility of legal consequences. The lack of provisions for refunds, warranties, and customer service means that users have no recourse if any issue were to arise. Given the highly unregulated nature of the market, malfunctions are also frequent, posing a potential risk to the individuals in close vicinity of such devices.

A GLOBAL MENACE

The concerns about the widespread use of illegal mobile signal boosters or repeaters are not limited to India. Globally too, this has been a menace in several countries that are grappling with similar challenges. In the USA, the Federal

> The public needs to be aware that these boosters are not only illegal but also harmful to the network infrastructure.

Communications Commission (FCC) has implemented strict regulations against the use of unauthorised signal boosters, and violators can face substantial fines. In 2013, the FCC further adopted new rules that require all consumer signal boosters to be registered with a wireless provider before use.

In the United Kingdom, Ofcom has made it clear that the use of these devices can lead to interference with emergency services and other radio users. They have also implemented strict penalties for those found to be using or selling these devices, including fines and potential imprisonment. In Australia, the Australian Communications and Media Authority has taken a multi-faceted approach to address the issue. They have launched public awareness campaigns about the risks associated with using illegal boosters. At the same time, they also conduct raids to confiscate these devices and have implemented strict penalties for those found to be using or selling them.

In South Africa, the Independent Communications Authority of South Africa has warned that the use of such devices can lead to interference with other users' signals and can degrade the quality of service for all users and also implemented strict penalties for those found to be using or selling these devices.

DEALING WITH THE PROBLEM

To mitigate these issues, the sale of illegal repeaters should be banned with immediate effect, and the Telecom Enforcement Resource and Monitoring and WMO should be empowered to take strict legal action against the offenders. Regular inspections need to be conducted to ensure that only authorised boosters are installed in areas where there is a need for signal amplification. There is also a need for time-bound resolution of identified network interference cases to ensure the flawless delivery of telecom services to customers.

While it is important for the authorities to act against the use of illegal boosters, it is also important for the public to be aware of the fact that these boosters are not only illegal, but also harmful to the network infrastructure, and can lead to poor quality of service for all customers. Besides, they also have the potential to disrupt emergency communication services, such as police and ambulance communication channels, which could lead to serious consequences.

The users also have a responsibility to be aware of the risks associated with illegal boosters and to refrain from using them. The industry will continue to work closely with the relevant government authorities to raise awareness about the negative impacts of using such devices and to enforce the Indian Wireless Telegraph Act, 1933. Only by working together can we ensure a safe and reliable telecommunication infrastructure for all. 🌸

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Can Technology Help in Disasters, Emergencies & Rescue Operation

Natural calamities, disasters and accidents are some of the greatest challenges we confront. Recent events like the devastating railway accident and cyclone Biparjoy are examples where we have had to contend with emergencies. What can possibly be done to minimise damage and losses to lives and property? But with the rapid advancement of technology, there could be enhancement of both prevention, mitigation and damage control methods for crises; 5G technology, the latest generation of mobile networks, is emerging as an instrumental tool for rapid response and efficient coordination in such situations.

Whether it is the fury of nature like an earthquake, flood, or a tragedy like an accident, timely intervention can significantly mitigate the impacts. Here, the role of 5G becomes crucial, as it promises near-instantaneous communication and data sharing, crucial for successful disaster response efforts.

Traditional disaster response relies heavily on human input and coordination, which often results in delayed response times. With 5G technology, loT (Internet of Things) devices can collect and relay real-time data about such incidents Instantly. For example, in railway accidents, timely availability and fast relay of data like the number of trains Involved, the severity of the crash and the number of passengers, can help expedite the deployment of emergency services, possibly saving more lives.

In disaster management, coordination between different response units is of utmost importance, and here too, technology is making a difference. In traditional disaster response models, the chain of information often becomes a bottleneck. However, 5G's capacity for Massive Machine Type Communication (mMTC) allows for seamless integration of thousands of devices and systems, ensuring that every response unit, whether on ground or in a control room, receives real-time updates. The key now lies in making this technology accessible and integrated into our disaster response systems.

An example in the case of Cyclone Ana, which hit the Australian coast earlier this year, displays the role of technology in monitoring and effectively using early warning systems. Meteorologists were able to collect detailed data about the cyclone faster than ever, which improved the accuracy of their predictions. This helped evacuate people in the cyclone's path in advance, reducing potential casualties. Additionally, 5G-enabled drones were deployed for immediate damage assessment post-cyclone, facilitating faster recovery and relief operations.

Current networks are often unable to handle the surge in communication demands during disasters.

High-speed and high-capacity networks are incredibly useful in search and rescue operations. Quick and accurate location identification can be critical in situations where people are stranded or trapped due to a natural disaster or accident. In such instances, drones equipped with thermal imaging and connected via 5G can swiftly survey large areas, transmitting real-time images and data back to the rescue teams, expediting the tracking of location of survivors.

5G would also play a pivotal role in the recovery phase following a disaster. Its capabilities aid in damage assessment, resource allocation and rehabilitation efforts, allowing a more streamlined and efficient recovery process. Post Cyclone Ana, 5G-enabled drones and lot devices were utilised for a quick assessment of the damage. pinpointing the most affected areas. This real-time data collection and analysis facilitated efficient allocation of resources, thus speeding up the recovery process.

Moreover, the advent of 5G is opening doors to the utilization of Virtual Reality (VR) and Augmented Reality (AR) in disaster management. By leveraging 5G's high- speed and low-latency network, remote experts can provide real-time guidance to on-ground teams. This technological assistance can prove critical in emergency medical situations, and even in pre-disaster training simulations, equipping rescue teams to respond more effectively to real disaster situations.

According to a 2023 study by the World Economic Forum, leveraging 5G in disaster management could reduce the response time by up to 30%, potentially saving millions of lives annually. The same study suggested that with widespread 5G adoption, economic losses due to natural disasters could decrease by 20%.

Despite the immense possibilities that 5G technology brings to disaster management, challenges such as infrastructure investment, security concerns and mass-scale technological adoption remain. However, considering the potential benefits, the effort to overcome these hurdles is imperative. As the world continues to grapple with natural and man-made disasters, the integration of technology into disaster management strategies could be the key to reducing their devastating impacts.

LT GEN DR S P KOCHHAR

GET READY FOR
MORE CYBERATTACKS

Convergence can amplify the attack surface through a troika of increased digital access, rapid digitisation, and amalgamation of technologies

As we navigate the labyrinth of the digital age, we encounter a phenomenon where once distinct and disparate technologies are progressively knitting themselves together into a cohesive whole. This phenomenon, known as technology convergence, is an amalgamation of technologies, systems, and services, gradually adapting and merging to perform harmonising functions. With an estimated 759 million internet users as of May 2023 and a rapidly expanding digital ecosystem, India is experiencing technology convergence across a variety of sectors such as finance, healthcare, communications, and entertainment. While this process brings significant opportunities, it also poses unique challenges to India's security and privacy landscape, due to the blurring boundaries of technologies and their emerging security implications.

> Threat landscape in India is evolving with the advent of interconnected devices, systems, and networks, leading to an increasing risk of single points of failure.

CYBER SECURITY
CYBER ATTACK
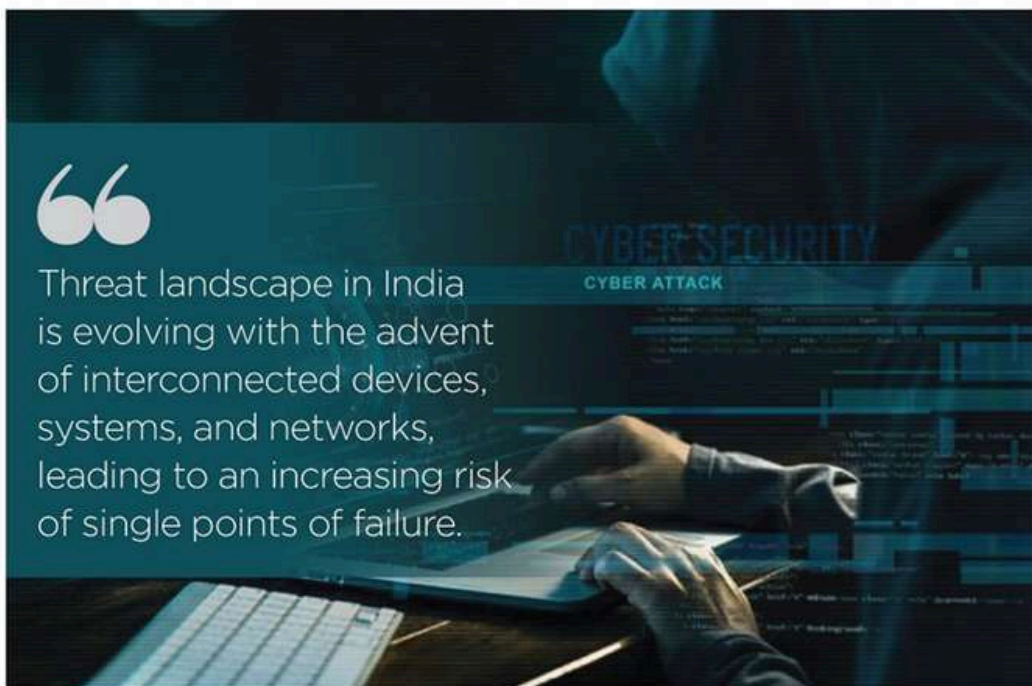
> The increase in connected devices implies a proportional increase in the attack surface, requiring 5G networks to have robust security protocols in place.

EXPANDED ATTACK SURFACE

Technology convergence in the Indian landscape has drastically amplified the attack surface through a combination of increased digital access, rapid digitisation of services, and the amalgamation of technologies, such as the Internet of Things (IoT), Artificial Intelligence (AI), Machine Learning (ML), 5G networks, and Cloud Computing.

With its burgeoning digital population and widespread adoption of IoT devices, India is a prime example of how this expansion can occur. According to Statista, an estimated two billion IoT devices existed in India as of 2021, and this number is set to exponentially rise to a staggering 25 billion by 2030. These IoT devices range from personal gadgets like smartphones and wearable tech to home automation systems and healthcare devices. However, many of these devices lack adequate security measures, thereby posing a significant security risk. For instance, the absence of robust authentication methods, outdated software, and the use of default credentials can make these devices easy targets for cybercriminals, providing them a foothold in larger networks.

Parallelly, as AI and ML technologies increasingly become integral to businesses in India, new attack vectors emerge. Adversarial attacks, a specific type of attack on ML models, can manipulate these models in subtle ways that cause them to malfunction or produce incorrect results. Given the growing reliance on these models for crucial decision-making processes, such attacks could have wide-ranging implications.

The rise of 5G networks, touted to revolutionise India's digital landscape, brings its own set of security issues. With a much larger bandwidth and lower latency, 5G is expected to connect to countless more devices and enable new applications and services. However, the increase in connected devices also implies a proportional increase in the attack surface, requiring 5G networks to have robust security protocols in place to mitigate potential threats. The introduction of network slicing, a key feature of 5G,

can further complicate security management as each slice can potentially be a new point of attack for malicious entities.

The role of Cloud Computing in expanding the attack surface cannot be understated. The market for cloud services in India is projected to reach USD13 billion by 2026. While cloud services offer significant benefits in terms of scalability, efficiency, and cost reduction, they also extend the organisation's network boundaries beyond their direct control, introducing a shared security model. This model suggests that both the provider and consumer of the cloud service are responsible for security. However, if either party does not fulfil its security obligations, it can result in vulnerabilities. Furthermore, multi-tenancy in cloud services can also lead to data leakage if proper data isolation measures are not implemented.

COMPLEX THREAT LANDSCAPE

The convergence of technology in India has not only expanded the attack surface but also led to a considerable increase in the complexity of the threat landscape. This landscape is evolving with the advent of interconnected devices, systems, and networks, leading to an increasing risk of single points of failure and cascading effects.

Firstly, the sheer number of interconnected and interoperable devices that technology convergence brings forth has significantly amplified the potential for large-scale, coordinated attacks. This issue is particularly notable with IoT devices, where a security breach in a single device can compromise the entire network. An example of this was seen in the Mirai botnet attack in 2016, where numerous IoT devices were compromised and used to launch a distributed denial of service attack. With the IoT market in India expected to grow to USD27.31 billion by 2023 as per Statista, the potential for such attacks is a substantial concern.

Advanced Persistent Threats (APTs) in India have also evolved in step with the changing technological landscape. APTs are targeted, stealthy threats designed

> Network slicing, a key feature of 5G, can complicate security management as each slice can potentially be a new point of attack for malicious entities.

Cyberattacks & Security Breaches on Critical Infrastructure in India

Aug 2022
248 successful data breaches were reported by Indian banks between June 2018 and March 2022

June 2022
Goa's flood monitoring system was attacked with a ransomware

Oct 2020
A 10 hour blackout in Mumbai, Thane because of a malware attack

May 2022
Ransomware attacks on SpiceJet halts flights for 4 hours

Feb 2021
Air India's data servers were targetted by cyberattack affecting more than 4.5 million customers

April 2022
A ransomware attack on Oil India Limited which knocks off company's IT Systems

Banking • Disaster Management • Aviation • Oil/Energy • Aviation • Power

CRITICAL INFRASTRUCTURE SECTORS

Source: Compiled from different media reports.

to maintain a long-term presence in the target's systems, siphoning off data or causing damage without detection. These threats have begun to exploit the interconnected nature of converged technologies, making detection and mitigation even more challenging. For instance, the 'Side Copy' APT targeted the Indian government and military personnel in 2021, demonstrating the increasing sophistication of such attacks.

The advent of AI and ML in the cyber threat landscape has given rise to intelligent malware and ransomware. Such malware uses advanced techniques to evade detection, adapt to the environment, and target specific system vulnerabilities. This development has been increasingly troublesome for Indian businesses, which were among the top targets of ransomware attacks in 2020. The increasing use of AI and ML in

Cloud services offer significant benefits in terms of scalability, but multi-tenancy in cloud services can lead to data leakage if data isolation measures are not in place.

cyber threats poses a daunting challenge, as they can outpace traditional security defences and require new mitigation strategies.

Adding to the complexity is the increasing prevalence of cyber-physical attacks, which target the intersection of digital and physical infrastructure, such as power grids or transport systems. For example, the 2020 cyber-attack on Mumbai's power grid displayed how vulnerable such systems could be. With more physical systems becoming networked and automated, the potential for such attacks is expected to continue to rise.

GOVERNANCE, RISK, AND COMPLIANCE

Technology convergence has intensified the issues related to governance, risk, and compliance in India. The Ministry of Electronics and Information Technology (MeitY) has recognised these challenges and has taken several significant steps. While the Indian government has initiated regulation with the Personal Data Protection Bill (PDPB) and the National Cyber Security Strategy, MeitY also understands that these legal frameworks, currently under development, may not fully cover the fast-paced evolution of technology.

Emerging technologies such as blockchain and quantum computing, which India, through initiatives under MeitY, is actively exploring, bring added layers of complexity. Data protection, privacy, and cyber-physical security are pivotal areas. To tackle these, MeitY has initiated dynamic and adaptive risk management approaches, such as the establishment of the Indian Computer Emergency Response Team (CERT-In) and the Cyber Swachhta Kendra.

Furthermore, the Information Security Education and Awareness (ISEA) project has been instrumental in raising cybersecurity awareness. These proactive steps have become even more crucial considering the country's push for its Digital India and Make in India objectives.

To summarise, technology convergence presents a unique set of opportunities and challenges for India. While it offers the potential for innovation, productivity, and economic growth, it also introduces new security implications. It is critical that as technology continues to evolve and converge, so must the strategies for securing it. By understanding and addressing these emerging security implications, India can ensure a safe, secure, and prosperous digital future in the era of technology convergence. ✦

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NEXT GEN TECHNOLOGIES
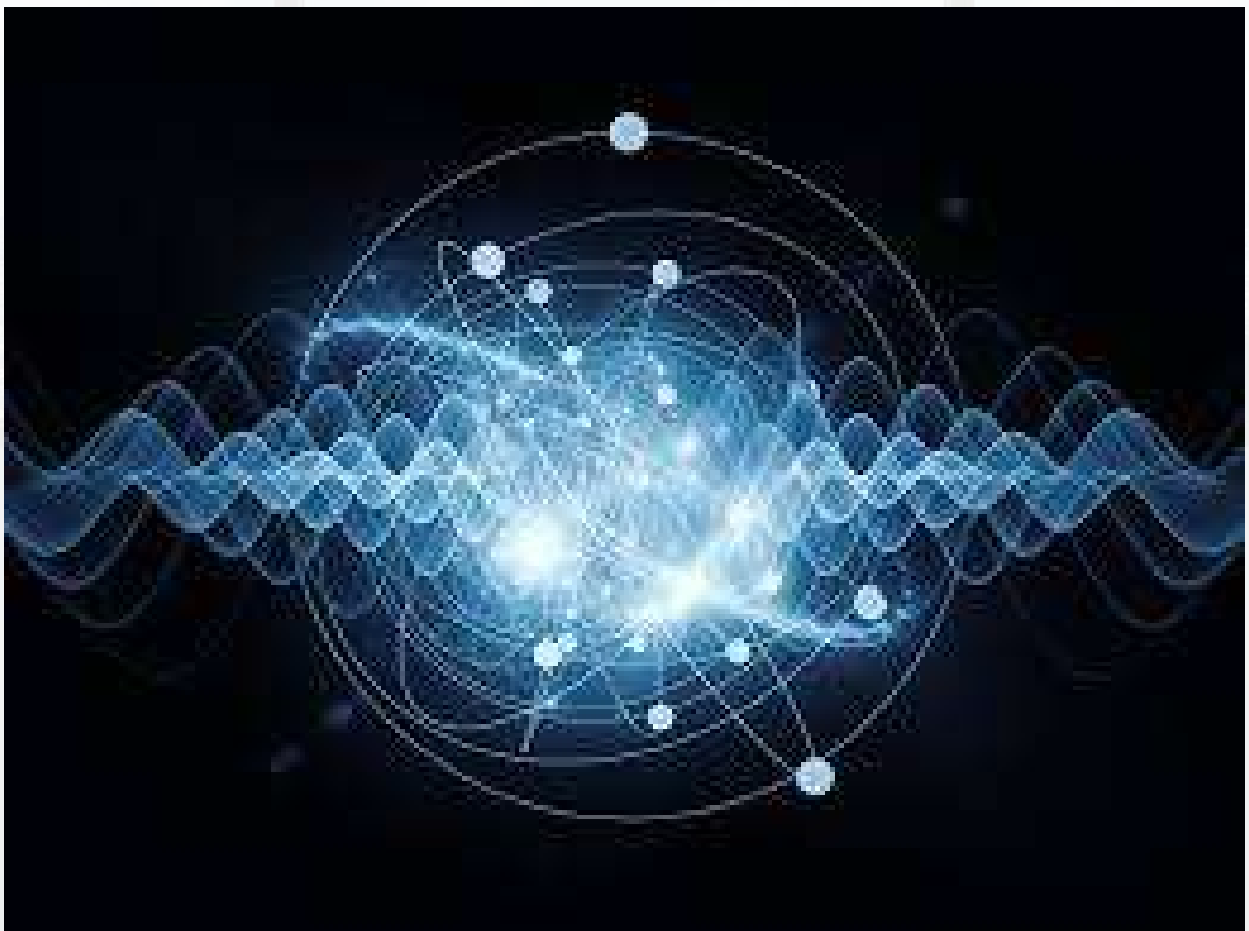
NEXT GEN TECHNOLOGIES

Publication	EXPRESS COMPUTER
Headline	Quantum Technologies in the Telecommunication Industry

Quantum technologies represent a paradigm shift in the world of computing and telecommunications. It is not simply an incremental upgrade over classical computing, but rather a new approach that promises to provide unprecedented levels of speed, security, and efficiency.

Quantum communications can be used to transmit data securely and efficiently. Unlike classical communication, where information is transmitted in bits, quantum communication can transmit information in quantum bits, or qubits, which can be both 0 and 1 simultaneously. This property allows for much more efficient data transfer as well as the ability to perform calculations exponentially faster than classical technologies, allowing quantum computers to perform many calculations simultaneously, drastically reducing the time required to perform complex calculations.

Additionally, quantum communication is inherently secure, as any attempt to eavesdrop on the communication will disturb the quantum state, alerting the sender and receiver to the intrusion. This makes quantum communication ideal for transmitting sensitive information, such as financial transactions and government communications.

Quantum technologies have the potential to revolutionize 5G networks by enhancing security, increasing network capacity, and reducing latency. Some of the applications of quantum technologies in 5G include quantum key distribution, quantum cryptography, and quantum sensing.

Quantum key distribution (QKD) is a technique that uses quantum mechanics to distribute encryption keys securely. QKD is a promising technology for 5G networks as it can provide unbreakable encryption, which is essential for securing critical communications. By using QKD, 5G networks can prevent eavesdropping and data tampering, which are major concerns in modern communication systems.

Quantum cryptography is another technology that can be used in 5G networks. It uses the principles of quantum mechanics to create unbreakable encryption codes. Quantum cryptography can ensure the integrity and confidentiality of data transmitted over 5G networks. Quantum sensing is a technology that uses quantum mechanics to detect and measure physical parameters with high precision. Quantum sensors can be used in 5G networks to monitor the environment, detect anomalies, and optimize network performance.

Blockchain technology can also be used simultaneously with quantum technologies in 5G networks. Blockchain is a distributed ledger technology that can provide secure and transparent transactions. By using blockchain, 5G networks can ensure the authenticity of data, prevent data tampering, and enable decentralized trust. Blockchain can also enable secure peer-to-peer transactions, which can be useful for micropayments and other use cases in 5G networks.

There are several examples of the use of quantum technologies in 5G networks, although commercial deployment of these technologies is still in the early stages. Here are some examples:

1. In 2020, China Mobile partnered with QuantumCTek to deploy a 5G network that uses quantum cryptography to provide secure communication between two government agencies in Shanghai. The network uses QKD technology to encrypt data transmitted between the agencies, ensuring the security of the communication.

2. In 2021, SK Telecom, a South Korean telecommunications company, partnered with ID Quantique to deploy a 5G network that uses quantum cryptography to secure critical communication between its headquarters and data center. The network uses QKD technology to provide unbreakable encryption for data transmission.

As for factual figures, it is worth noting that quantum technologies are still in the early stages of commercial deployment in 5G networks, and it is difficult to provide exact numbers. However, it is estimated that the global market for quantum cryptography could reach $2.2 billion by 2026, driven by the growing demand for secure communication in 5G networks and other industries. Additionally, according to a report by ResearchAndMarkets, the market for quantum sensors is expected to grow from $278 million in 2020 to $1.1 billion by 2025, driven by the increasing adoption of quantum technologies in various applications, including 5G networks.

India has also been actively exploring the use of quantum technologies in various industries, including telecommunications. The Indian government announced the establishment of the Quantum Communication Application and Technology (Q-CAT) lab in Delhi, which is a joint initiative of the Department of Telecommunications (DoT) and the Indian Institute of Technology (IIT) Delhi. The lab is expected to develop indigenous technologies for secure communication, including QKD for 5G networks. The Indian Institute of Science Education and Research, Pune (IISER) also established a Technology Innovation Hub (TIH) on Quantum Technology with support from the Department of Science and Technology (DST), which will work towards development of novel computing and quantum materials, sensors, quantum communication devices and systems along with quantum computers.

Recently, the Union Cabinet of the Indian Government approved the National Quantum Mission (NQM), which aims to accelerate research and development in quantum technologies and establish India as a leader in this field, and involves a cost of INR 6,003.65 crore from 2023-24 to 2030-31. With this, India becomes the sixth country in the world to have a dedicated quantum mission.

The import of these initiatives is significant as they reflect India's recognition of the importance of quantum technologies in various industries, including telecommunications. The establishment of the Q-CAT lab and the NQM are expected to accelerate the development and adoption of quantum technologies in India, which could have implications for the global quantum technology landscape. Furthermore, the indigenous development of quantum technologies in India could lead to the creation of new jobs and the growth of the domestic technology industry. It is an exciting time to be at the forefront of this quantum revolution, where the possibilities for discovery and advancement are endless.
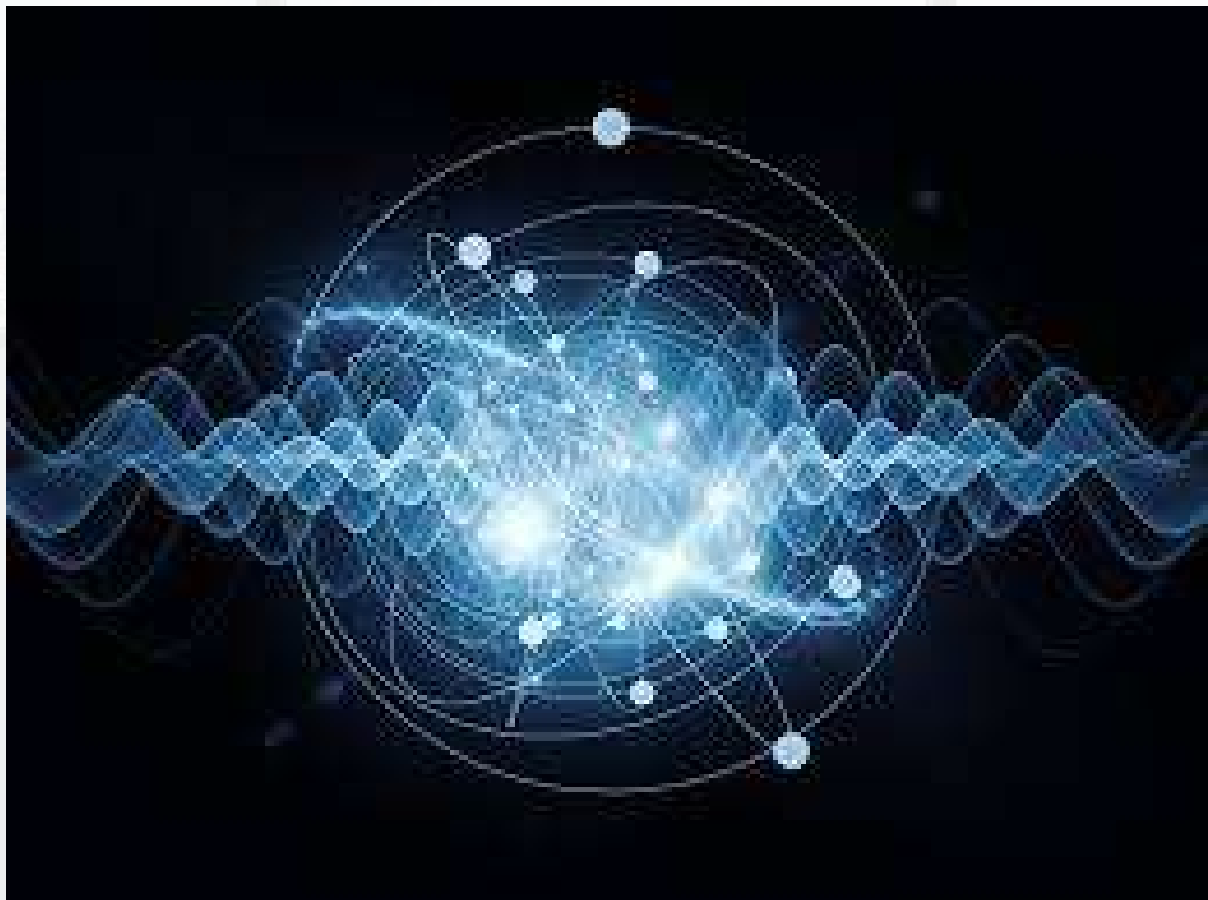
LT GEN DR S P KOCHHAR

TRANSFORMING THE TELECOM NETWORK

Automated networks can revolutionise telecom by creating a responsive, efficient, and resilient environment, enabling innovation in services and applications

The convergence of automation and telecommunication networks marks a revolutionary phase in the history of networking technology. Automated networks, characterised by their ability to self-manage, adapt and optimise, are becoming the foundation for a new era of intelligent and dynamic communications systems. Leveraging cutting-edge technologies like Artificial Intelligence (AI), Machine Learning (ML) and Software-Defined Networking (SDN), automated networks present an opportunity to redefine the way network resources are managed and optimised.

Let us explore the various aspects of automated networks, from their underlying architecture and key components to applications, challenges and the future landscape.

> "While the path to full automation may present challenges, the rewards include a more interconnected, intelligent, and prosperous future."
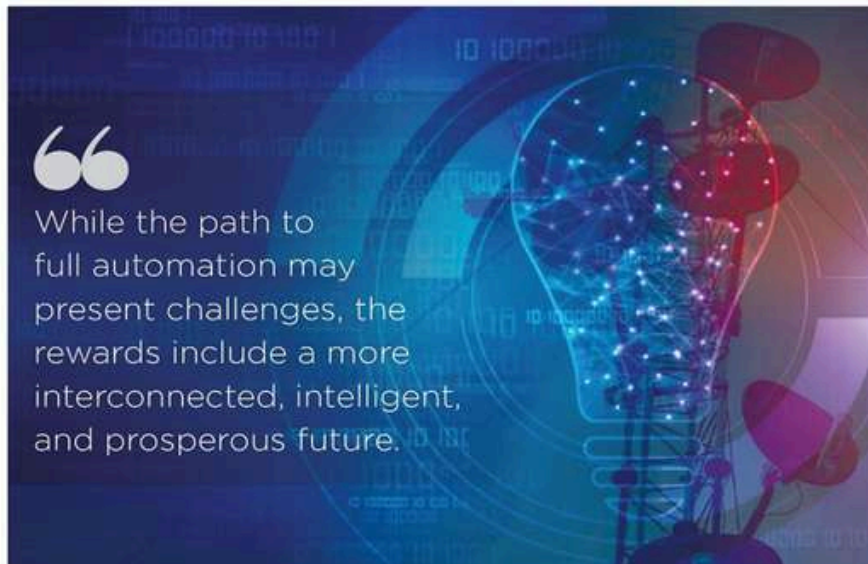
> Achieving seamless collaboration among equipment from various vendors within an automated ecosystem is a challenge that needs to be addressed.

Automated networks encompass a range of technologies and methodologies aimed at creating a self-reliant network environment. By implementing automation across different layers of the network, these systems can adapt to changing conditions, forecast potential challenges and respond proactively without human intervention.

KEY COMPONENTS OF AUTOMATED NETWORKS

Software-defined networking (SDN): SDN is a transformative technology that separates the control and data planes in networking devices. By centralising control, administrators can manage the entire network from a unified interface, drastically simplifying configuration and optimisation processes. This separation also paves the way for a more dynamic network, where resources can be allocated or reconfigured in real time based on demand.

Network function virtualisation (NFV): NFV extends the virtualisation concepts familiar from the server world into networking. By decoupling network functions from specific hardware, NFV allows for greater flexibility and scalability in deploying services. It also facilitates the rapid provisioning of network services, reducing costs and enhancing agility.

ML and AI: Machine learning algorithms and AI play a crucial role in automated networks by providing the intelligence needed for predictive analysis and decision-making. Through continuous monitoring and learning, these technologies can detect patterns, predict potential issues and even take pre-emptive actions to mitigate problems, leading to a more robust and adaptive network.

Architecture and design: Automated networks follow a three-tier architecture, including the infrastructure, control, and application layers.

The infrastructure layer consists of the physical and virtual resources, such as switches, routers and servers, which form the backbone of the network. This layer serves as the foundation for network services, and its virtualisation enables more efficient utilisation of resources.

Similarly, the control layer is home to the SDN controller, which orchestrates the network's overall behaviour. By centralising control, it allows for real-time monitoring and management of network resources. This layer serves as the "brains" of the network, translating high-level policies into low-level configurations and adjustments.

The third, application layer hosts various business and consumer applications that interact with the network. These can range from cloud computing platforms to IoT devices to 5G services. By interfacing directly with the control layer, these applications can make dynamic requests for network resources, ensuring optimal performance and user experience.

APPLICATIONS AND USE CASES

In today's rapidly evolving technological landscape, automated networks have become a cornerstone of various industries, revolutionising processes and enhancing efficiency across the board. From telecommunications to Industry 4.0, these automated networks are unlocking new possibilities and driving innovation. Let's delve into some key applications and use cases.

Telecommunications: In the realm of telecommunications, automated networks are ushering in a new era of efficiency, performance, and customer satisfaction. For example, automation plays an important role in 5G networks by enabling intelligent routing, load balancing, and resource allocation. This ensures that network resources are utilised optimally, adapting to varying user demands without compromising service quality.

The Internet of Things (IoT) has unleashed a multitude of interconnected devices, each requiring seamless communication. Automated networks step in to manage this complexity gracefully. They provide intelligent routing and resource allocation, facilitating smooth interactions among diverse devices and systems within the IoT ecosystem.

Industry 4.0: Automated networks are at the heart of Industry 4.0, the fourth industrial revolution, where they bring significant enhancements to various industrial

[TELECOM TALK]
INFRASTRUCTURE

NUTS & BOLTS
KEY COMPONENTS

- Software-defined Networking centralises control, simplifying network management.
- Network Function Virtualisation enables flexibility and rapid service deployment.
- Machine Learning and AI enhance predictive analysis and decision-making.
- Architecture and design follow a three-tier structure, enhancing resource utilisation.

APPLICATIONS AND USE CASES

- **Telecommunications:** Automation improves 5G networks and IoT integration.
- **Industry 4.0:** Automation in manufacturing and smart grids enhances efficiency.

CHALLENGES AND LIMITATIONS

- **Security concerns:** Robust protocols are essential to mitigate vulnerabilities.
- **Interoperability:** Standardisation and testing are crucial for equipment collaboration.
- **Complexity of implementation:** Transitioning requires planning, skilled personnel, and investment.

processes. In the manufacturing sector, for example, automation takes centre stage by enabling real-time data analysis, predictive maintenance, and quality control. Manufacturers can swiftly respond to changes in demand, equipment status, or market conditions, leading to more agile and efficient operations.

Automated networks also play a vital role in energy distribution through smart grids. By providing real-time monitoring and control, they allow for more efficient distribution, fault detection, and energy management, ultimately reducing costs and environmental impact.

CHALLENGES AND LIMITATIONS

While automated networks hold immense promise, they are not without their share of challenges and limitations that must be addressed for their effective implementation. With increased complexity and intelligence, automated networks become susceptible to security vulnerabilities. To mitigate risks, robust security protocols and measures must be in place to safeguard against unauthorised access and potential breaches.

Achieving seamless collaboration among equipment from various vendors within an automated ecosystem is another significant challenge that needs to be addressed. Standardisation and rigorous testing are imperative to ensure that different components can work together cohesively, promoting interoperability.

And then there are the issues driven by the complexities of the implementation. Transitioning from traditional networks to automated ones involves a substantial level of complexity, time, and investment. Comprehensive planning, a skilled workforce, and strategic technology investments are essential to successfully navigate this transition. Careful consideration of the implementation process is crucial to minimise disruptions and maximise the benefits of automation.

Here are some examples of real-world applications of automated networks and how they have benefitted organisations.

#1
SCHNEIDER ELECTRIC AND CAPGEMINI COLLABORATION ON 5G INDUSTRIAL AUTOMATION

Schneider Electric and Capgemini, with support from Qualcomm, have joined forces to accelerate 5G industrial automation. Their collaboration aims to enhance efficiency and connectivity in industrial settings.

By providing real-time monitoring and control, automated networks allow for more efficient distribution, fault detection, and energy management.

Key features of this collaboration include leveraging 5G technology for faster and more reliable communication between machines and systems, seamless integration of IoT devices for real-time monitoring and control of industrial processes, and the creation of smart factories capable of adapting to changes in demand, equipment status, or market conditions.

The impact: This partnership represents a significant step toward Industry 4.0, where automation, connectivity, and intelligence converge in manufacturing processes. It promises more agile and efficient operations, resulting in cost reductions and enhanced productivity.

#2

ORANGE PIKEO'S CLOSED-LOOP NETWORK OPERATIONS AUTOMATION

Orange Pikeo, demonstrated by HPE and Orange Innovation at the Mobile World Congress 2023 in Barcelona, showcases the automation of 5G operations through a closed-loop process.

Key features include the integration of assurance and orchestration to automate 5G operations, ensuring optimal performance and reliability, real-time monitoring and control of network resources for quick adjustments and adaptations, and the use of AI and ML to detect patterns, predict potential issues, and take preemptive actions to mitigate problems.

The impact: Orange Pikeo represents a significant advancement in network automation, providing a responsive and resilient environment for 5G operations. It opens up exciting possibilities for new services and applications across sectors, from healthcare to transportation to entertainment. Implementing closed-loop automation will be crucial for the success of 5G networks in meeting the demands of a constantly evolving technological landscape.

THE FUTURE PROSPECTS

Automated networks have the potential to transform the telecommunications landscape. By providing a more responsive, efficient, and resilient environment, they offer opportunities for innovative services and applications, across various sectors, from healthcare to transportation and entertainment.

They represent a major evolution in telecommunications, combining virtualisation, artificial intelligence, and advanced networking principles. The benefits in terms of operational efficiency, adaptability, and the creation of new services are substantial. To remain competitive and innovative in our ever-changing technological world, telecom operators and related industries must embrace automated networks. While the path to full automation may present challenges, the rewards include a more interconnected, intelligent, and prosperous future. ♣

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Quantum Computing and the Future of Encryption

Quantum computers and classical computers are fundamentally different

Introduction: Decoding Quantum Mechanics

The curious world of quantum mechanics plays host to quantum computers. Unlike traditional computers, quantum computers operate with qubits, the quantum version of classical bits. In a fascinating twist of quantum physics, qubits can be both a 0 and a 1 simultaneously due to a quantum property known as superposition. Furthermore, qubits can become entangled, a state where the information of one qubit is inextricably linked to another, no matter the distance between them. Apart from the number of qubits, quantum computers' efficiency is influenced by a range of factors including qubit quality (measured by coherence time), error rates, connectivity (how qubits can interact with each other) and control precision. These nuances mean that quantum computing is as much an engineering challenge as a scientific one.

Quantum Computers vs. Classical Computers: More than Just a Numbers Game

Quantum computers and classical computers are fundamentally different. They are not competitors, but rather complementary tools optimized for different types of problems. Classical computers excel at tasks like running operating systems, managing databases and performing complex arithmetic operations, whereas quantum computers could be capable of transforming fields that involve combinatorial optimization, quantum system simulations and prime factorization of large numbers used in cryptography.

Central to these differences are the algorithms employed by each system. Take Shor's algorithm, for example. This quantum algorithm enables quantum computers to factorize large numbers exponentially faster than classical computers can, posing a potential risk to RSA encryption, the backbone of today's internet security. However, it's crucial to understand that not all computational tasks will enjoy this quantum speedup—many will see only modest improvement, while some tasks might not benefit at all from quantum processing.

Modern Encryption Schemes: The Security Backbone of the Digital World

The secure communication that underpins today's internet infrastructure relies on several encryption schemes. RSA (Rivest-Shamir-Adleman) and ECC (Elliptic Curve Cryptography) are vital for public-key cryptography, while AES (Advanced Encryption Standard) is a common choice for symmetric-key encryption. These cryptographic systems protect a vast range of digital interactions — from your personal emails and credit card transactions to the blockchain networks that enable cryptocurrencies like Bitcoin.

Quantum Threat to Encryption: A Future Concern?
The potential for quantum computers to efficiently solve the hard mathematical problems that underpin RSA and ECC encryption makes these systems vulnerable. In theory, Shor's algorithm could break RSA-256 bit encryption with about 4098 logical qubits and ECC-256 with around 2330 logical qubits. However, these numbers don't account for the error correction overhead, which could multiply the required number of qubits by several orders of magnitude.

AES encryption, meanwhile, faces less risk. Grover's algorithm—a quantum algorithm — could be used to halve the key length. This would make AES-256 effectively equivalent to AES-128 in a quantum era. But even this scaled-down threat would require an impractical number of about 6.7 million physical qubits, once we consider error correction needs.

Breaking 256-bit Elliptic Curve Encryption with a Quantum Computer
Bitcoin uses the Elliptic Curve Digital Signature Algorithm (ECDSA), which relies on the hardness of the Elliptic Curve Discrete Log Problem (ECDLP), and a modified version of Shor's algorithm can provide an exponential speedup using a quantum computer for solving this problem. The encryption of keys in the Bitcoin network is only vulnerable for a short window of time, around 10 min to an hour, depending on the fee paid.

The number of physical qubits required to break the 256-bit elliptic curve encryption of keys in the Bitcoin network within the small available time frame in which it would pose a threat to do so. It would require 317 million physical qubits to break the encryption within one hour using the surface code, a code cycle time of 1 µ_s, a reaction time of 10 µ_s, and a physical gate error of $(10)^{-3}$. To instead break the encryption within one day, it would require at least 13 million physical qubits.

The Future of Encryption: Navigating a Quantum World
Despite the theoretical threats, the actual breaking of modern 256-bit encryption by quantum computers remains a distant prospect. As of 2023, the most advanced quantum computers have a few hundred physical qubits, and logical qubits are still in the experimental stage. We are likely several decades away from having the required number of high-quality, error-corrected qubits to break modern encryption.
However, the clock is ticking. The field of post-quantum cryptography is already developing new cryptographic systems believed to be secure against quantum attacks. Transitioning to these systems will present its own challenges, but it's a necessary move to ensure data security in a future quantum world.

Understanding Governance in Web 3.0

The digital landscape has undergone a profound metamorphosis over the last few decades. From the static, one-way communication of Web 1.0 to the interactive, socially driven Web 2.0, we now find ourselves on the precipice of Web 3.0 - a decentralized web that is fundamentally reshaping how we interact, transact and govern digital spaces. This article focuses on the intricate world of Web 3.0 governance, delving into its evolution, principles, challenges and the future it promises.

Evolution of Web Governance

Web 1.0 (Static Web):

The inception of the World Wide Web brought us Web 1.0, characterized by static web pages and a rudimentary form of governance. In this early stage, websites were mostly informational, and governance primarily revolved around content management and hosting. Centralized entities maintained control over the content, often resulting in limited user interaction.

Web 2.0 (Social Web):

As technology evolved, so did the web. Web 2.0 ushered in the era of social media, user-generated content, and centralized governance. Companies like Facebook and Twitter became dominant forces, shaping user experiences and content moderation. This centralization gave rise to concerns about data privacy and content censorship.

Web 3.0 (Decentralized Web):

Web 3.0 represents a paradigm shift towards decentralization. It leverages blockchain technology to create trustless (in blockchain terms, trustless refers to a mechanism wherein the network participants can reach a consensus without relying on a 3rd party), peer-to-peer networks, enabling users to interact and transact without intermediaries. Governance in Web 3.0 is a stark departure from the centralized models of Web 2.0, fostering community-driven decision-making and autonomy.

Basics of Web 3.0 Governance

With Web 3.0 governance, we refer to the intricate process of formulating and enforcing decisions within a decentralized ecosystem. It encompasses the creation and execution of rules, protocols, and smart contracts that govern these networks. Unlike the centralized models where a single entity calls the shots, Web 3.0 governance is often carried out collectively by network participants, each with a stake in the platform's success.

Governance tokens, such as those found in decentralized autonomous organizations (DAOs), represent voting power and provide a mechanism for stakeholders to participate in decision-making.

I**mportance of Governance in Web3:**

Governance is paramount in decentralized systems, as it ensures fairness, security, and the evolution of the network. Without effective governance, decentralized platforms risk becoming chaotic or susceptible to manipulation.

Mechanisms:

Web 3.0 employs various governance mechanisms, including on-chain voting, off-chain voting, liquid democracy, and more. These mechanisms enable stakeholders to participate in decision-making, depending on the specific needs of the network.

Key Principles of Web 3.0 Governance

Transparency: Transparency is a foundational principle of Web 3.0 governance. All decisions and actions should be open and accessible to all participants, promoting trust and accountability within the community.

Inclusivity: Inclusive governance ensures that every stakeholder has a voice, regardless of their stake or contribution. It prevents the concentration of power and fosters a diverse range of perspectives.

Decentralization: Decentralization minimizes single points of control or failure. Instead of relying on a central authority, power is distributed among participants, reducing the risk of censorship or manipulation.

Immutability: Blockchain technology plays a crucial role in Web 3.0 governance by ensuring that decisions, once made, are irreversible. This immutability safeguards the integrity of the system and the trust of its users.

Challenges in Web 3.0 Governance

Coordination: Managing large, diverse groups of stakeholders is a challenge. Effective coordination mechanisms must be developed to prevent gridlock and ensure decisions can be made efficiently.

Voter Apathy: Low participation rates in governance decisions can hinder progress. Web 3.0 communities must actively engage users and incentivize their involvement to combat voter apathy.

Scalability: As decentralized networks grow; governance mechanisms must scale to accommodate the increased number of participants and decisions. Scalability solutions are essential to maintain network efficiency.

Security: Decentralized networks are vulnerable to attacks and malicious actors. Robust security measures, including threat modeling and audits, are crucial to protect the integrity of the ecosystem.

Case Studies

Ethereum's Transition to Ethereum 2.0:
Ethereum, one of the pioneering blockchain platforms, is undergoing a significant upgrade known as Ethereum 2.0. This upgrade addresses scalability issues and introduces a new consensus mechanism. It also reflects the dynamic nature of Web 3.0 governance, showcasing how decentralized networks adapt and evolve over time.

Ethereum's transition illustrates the challenges and innovations associated with Web 3.0 governance, as stakeholders collaborate to shape the platform's future.

Decentralized Autonomous Organizations (DAOs):
DAOs represent a cutting-edge form of Web 3.0 governance. They are autonomous entities governed by code and the votes of token holders. DAOs exemplify decentralized decision-making, where token holders collectively make choices, fund projects, and shape the future of platforms. DAOs like The DAO and MakerDAO have provided valuable lessons and insights into the potential and challenges of decentralized governance.

Future of Web 3.0 Governance
The future of Web 3.0 governance holds exciting possibilities. Predictions include more streamlined and efficient decentralized decision-making processes, improved user engagement, and the emergence of innovative governance models.

Emerging Trends:
Emerging trends in Web 3.0 governance point towards a dynamic and evolving landscape. Concepts such as liquid democracy, where users can delegate their votes to trusted entities, demonstrate the adaptability of governance mechanisms.

The proliferation of DAOs and decentralized governance experiments in various industries, from art to gaming, underscores the continued growth and diversification of Web 3.0 governance.

Role of AI and Machine Learning:
AI and machine learning are poised to play a significant role in decentralized governance. They can assist in decision-making processes, analyze data, and enhance the efficiency of governance systems.

Conclusion:

As a final thought, Web 3.0 governance is a transformative force in the digital world. It marks a departure from the centralized models of the past and embraces transparency, inclusivity, decentralization, and immutability as its guiding principles. As we navigate the challenges and opportunities of Web 3.0 governance, active participation and continuous learning are essential to ensure the success of this evolving landscape. The future of the internet is being reshaped, and its governance is in our hands.

Empowering Financial Inclusion with Web 3.0

Web 3.0 and blockchain technology promise to disrupt the financial landscape significantly, particularly concerning financial inclusion. This could be truly relevant for India, with its vast population, significant rural presence, and unique set of challenges, wherein these technologies can play a defining role.

Challenges in Traditional Banking Services

Traditional banking services, due to their centralized structure, often present significant barriers to low-income individuals and small enterprises. Accessibility is hampered by factors such as geographical isolation, high banking fees, and minimum balance requirements, which make these services untenable for low-income groups.

Moreover, conventional banking systems necessitate the presence of physical infrastructures like ATMs and branches. However, in remote and underdeveloped areas, such infrastructure is often deficient or entirely absent. This spatial disparity restricts financial access to a significant population segment.

Blockchain: A Paradigm Shift for India's Financial Sector

Blockchain technology, underpinning the principles of Web 3.0, stands in stark contrast to the traditional banking system. India's National Strategy on Blockchain, released by the Ministry of Electronics and Information Technology (MeitY), acknowledges blockchain as a strategic disruptor for India's financial sector.

Decentralization and Smart Contracts

Unlike centralized financial systems, blockchain operates on a distributed network of computers, or nodes. Each node possesses a full copy of the transactional ledger, negating the need for intermediaries like banks. Transactions are peer-to-peer, driven by algorithms and consensus protocols like Proof-of-Work (PoW) or Proof-of-Stake (PoS). Banks like ICICI and Yes Bank have already experimented with blockchain-based domestic and international remittances.

Smart contracts, code-based contracts residing on the blockchain, facilitate automated transactions based on pre-set rules. These contracts are triggered when specific conditions are met, executing the terms without manual intervention. This automation reduces the costs associated with traditional contract execution and enhances transaction speed.

Immutable Records and Distributed Ledger Technology

In blockchain, transaction records are immutable, meaning once information is validated and stored in a block, it cannot be altered. This immutability protects against fraudulent activities, ensuring the integrity of transactions.

Distributed Ledger Technology (DLT), a key blockchain component, maintains and updates transaction records across all nodes in the network. DLT's synchronization mechanism ensures every transaction's universal validity and transparency, bolstering the security and resilience of the network. This feature has attracted the attention of various Indian governmental bodies. For instance, the Telangana government has partnered with Tech Mahindra to secure property registration data using blockchain.

Transparency and Speed of Transactions

Blockchain is renowned for its unprecedented level of transparency. Every validated transaction becomes public information, visible to all participants in the network, thereby fostering an environment of trust and accountability. Ripple's partnerships with Indian Banks such as Axis and Yes Bank for cross-border remittances exemplify this potential.

Moreover, blockchain's peer-to-peer nature removes intermediaries, significantly enhancing transaction speed and reducing the costs associated with conventional banking systems.

Web 3.0, DeFi, and Digital Wallets

Web 3.0 leverages blockchain's foundational principles, ushering in a new financial era characterized by Decentralized Finance (DeFi) platforms and digital wallets.

DeFi platforms are blockchain-based applications that emulate traditional financial services, like lending, borrowing and trading, in a decentralized environment. They operate through smart contracts, eliminating the need for intermediaries. DeFi applications have the potential to revolutionize the financial landscape in India by providing inclusive, secure and accessible financial services, especially in areas like:

1. Peer-to-Peer Lending: Enabling individuals to lend and borrow funds directly without intermediaries. DeFi lending platforms can provide an alternative source of financing where access to credit can be a challenge. It allows lenders to earn interest on their funds and borrowers to access loans with transparent terms, lower fees, and faster processes.
2. Remittances: India is one of the largest recipients of remittances globally, with a large diaspora population living abroad. DeFi applications can facilitate cross-border transactions and remittances, reducing costs and improving efficiency compared to traditional remittance services. By leveraging blockchain and cryptocurrencies, DeFi platforms can enable faster, cheaper, and more secure remittances, benefiting both senders and recipients.
3. Decentralized Insurance: DeFi can disrupt the traditional insurance industry by offering decentralized insurance protocols. These protocols allow users to pool funds and collectively insure against risks, eliminating the need for traditional insurance intermediaries. In India, where insurance penetration is relatively low, DeFi-based insurance solutions can provide affordable and accessible coverage for individuals and businesses.
4. Microfinance and Savings: DeFi platforms can facilitate microfinance services, allowing individuals with limited financial resources to access small loans and savings opportunities. This can empower underserved populations in India, particularly those in rural areas or without access to traditional banking services, to build financial stability and engage in economic activities.

Digital wallets, in synergy with DeFi, can store, send and receive digital assets like cryptocurrencies. These wallets enable financial transactions without requiring traditional bank accounts, thereby providing a viable solution to the unbanked and underbanked.

Leveraging Web 3.0 for Financial Inclusion

Web 3.0, leveraging blockchain and DeFi, stands poised to address financial inclusion's key challenges, in the following ways:

1. Decentralization and Peer-to-Peer Transactions: Web 3.0's decentralized nature democratizes financial access, as transactions occur directly between peers, without requiring an intermediary. This decentralization extends financial services to individuals and businesses traditionally excluded from conventional banking systems. Peer-to-peer lending platforms like RupeeCircle and IndiaMoneyMart are examples of how decentralization can provide financial services to individuals and small businesses traditionally excluded from conventional banking systems.
2. User Sovereignty and Security: Web 3.0 enhances user sovereignty, allowing individuals control over their financial data. Blockchain's security features, like cryptographic algorithms and consensus protocols further safeguard transactions against fraud and unauthorized access.
3. Smart Contracts and Programmable Money: Smart contracts automate various financial processes, making services like lending, borrowing and insurance more efficient and affordable. Programmable money, like cryptocurrencies, offer novel business and financial models, fostering innovation and inclusion.

Projects like Compound and MakerDAO exemplify the potential of these technologies. They provide lending and borrowing services through smart contracts, enabling users to collateralize their digital assets and earn interest or borrow against them. Such platforms offer accessible financial services to unbanked individuals or small businesses, often excluded from traditional lending mechanisms.

Initiatives by the Indian Government

The Indian government has shown an interest in harnessing the potential of blockchain technology in various financial use-cases.

1. National Blockchain Strategy: MeitY unveiled a draft National Strategy on Blockchain in 2020. This strategic framework aims to identify the potential applications of blockchain in financial sectors and other public and private industries.

2. IndiaChain: NITI Aayog, the policy think tank of the Indian government, is reportedly working on a project called "IndiaChain", which aims to bring transparency and traceability into the Indian financial system by fully harnessing the power of blockchain technology.

3. State Government Initiatives: Several Indian states, including Telangana, Kerala and Maharashtra, are exploring the use of blockchain in various sectors, including financial services. For instance, the government of Maharashtra announced plans to implement blockchain technology in supply chains, agricultural marketing, vehicle registration and document management system.

4. RBI Regulatory Sandbox: The Reserve Bank of India (RBI) has included blockchain technology in its regulatory sandbox for financial technology firms. This move allows the testing of blockchain-based financial products in a controlled environment, facilitating innovation and development in the sector.

5. Blockchain for Land Registry: The government of Andhra Pradesh, in collaboration with Swedish start-up ChromaWay, is testing the use of blockchain technology for land registration and property transaction processes, a move that could have significant financial implications.

Augmenting Supply Chain Management with Web 3.0
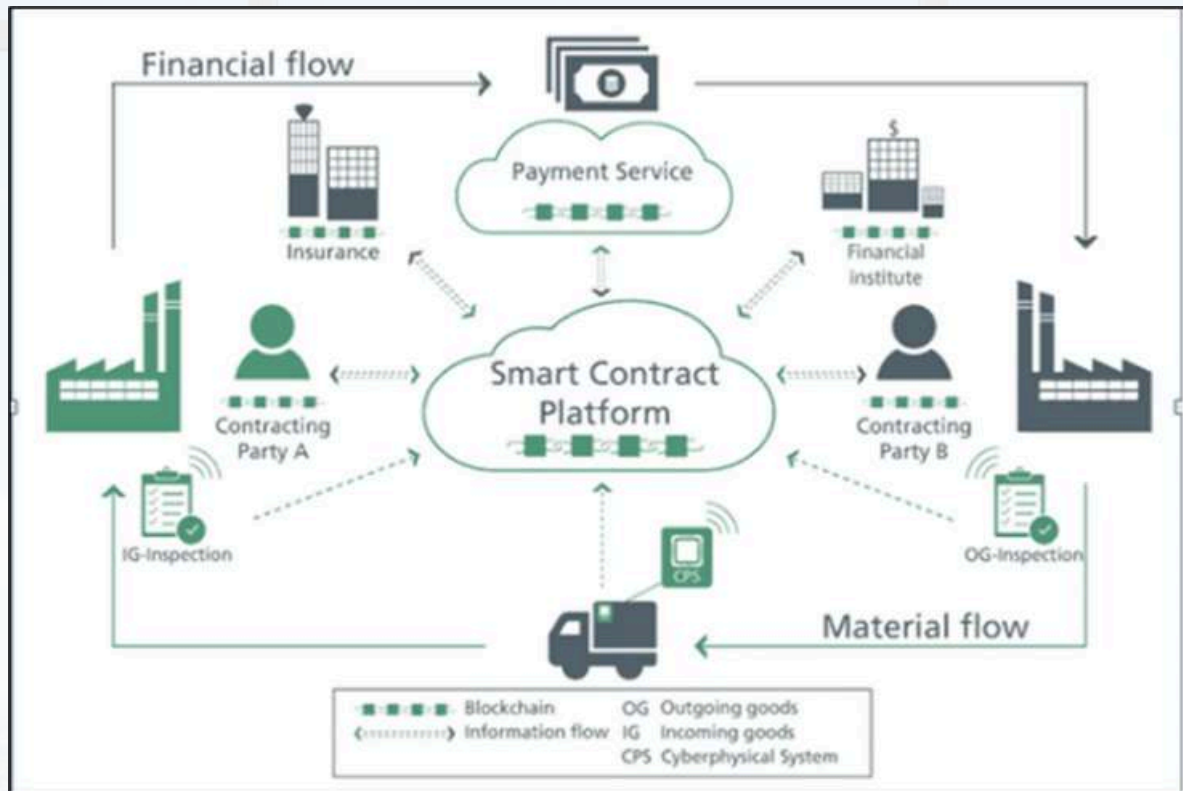
In today's complex global business landscape, Supply chain management stands at the nexus of various stakeholders that play a role in the production, storage and distribution of goods. It encompasses every detail, from raw materials sourcing, to product delivery, to the end-user. Supply chain management has emerged as a mission-critical aspect of operations across industries. However, the traditional supply chain models face a slew of formidable challenges, prompting a need for innovative solutions. This is where Web 3.0 and smart contracts emerge as potent solutions poised to fundamentally transform supply chain management.

Challenges of Supply Chain Management

Supply Chain Management (SCM) encompasses the planning, control and optimization of the flow of goods, services, information and finances from the point of origin to the point of consumption. Despite its fundamental importance, several challenges have persistently plagued SCM:

- Lack of Transparency: Supply chains are often complex webs involving multiple entities, making it difficult to trace the journey of products and understand the provenance of components.
- Trust Issues: Building trust among supply chain partners, especially when they are geographically dispersed and have varying interests, has traditionally been challenging.
- Security Concerns: The interconnected nature of modern supply chains exposes them to cybersecurity threats and data breaches.
- Inefficiencies: Manual processes, physical documentation and reliance on intermediaries can introduce inefficiencies, delays and increased operational costs.

Evolution from Web 2.0 to Web 3.0

To grasp the transformative power of Web 3.0 and smart contracts in reshaping supply chains, it's essential to trace the internet's evolutionary path. Web 2.0, referred to as the 'social web', ushered in an era of user-generated content, social networking and collaboration. This evolution amplified user interaction and data sharing across the internet, yet it left core supply chain challenges unaddressed. Enter Web 3.0 or the 'semantic web'. This next evolutionary phase emphasizes decentralization, data interoperability and the fluid integration of diverse online services. Such a profound change in the internet's foundational principles is crucial in redefining supply chain dynamics.

Smart Contracts

Smart contracts are self-executing contracts with the terms and conditions of the agreement directly embedded in code. These contracts are enabled by blockchain technology, which ensures the integrity, security and immutability of transactions. Smart contracts have the potential to automate and streamline supply chain processes in a trustless (meaning a mechanism wherein the network participants can reach a consensus without relying on a 3rd party) manner.

Web 3.0 and Its Implications for Supply Chain

Web 3.0's transformative power for supply chains lies in its core components and features:

- Decentralization: Web 3.0 moves away from centralized systems, reducing dependence on single points of control or failure. This fosters resilience and autonomy in supply chains, while enhancing agility and responsiveness
- Peer-to-Peer Networks: Supply chain stakeholders can directly interact in peer-to-peer networks, eliminating intermediaries and expediting processes.
- Semantic Web: The semantic web incorporates technologies that enable computers to understand the meaning and context of data. This facilitates better data utilization and context-aware decision-making.
- Interoperability: Web 3.0 allows data from diverse sources to seamlessly interoperate, enabling a holistic view of the supply chain.
- Enhanced Security: The utilization of blockchain technology ensures data security through cryptographic validation and consensus mechanisms, making supply chains more resilient to cyberattacks.

Transparency, Real-Time Tracking and Enhanced Security

Leveraging the decentralized nature of Web 3.0 integrated with blockchain, supply chains benefit in multiple ways. Transactions, goods movement and data exchanges are recorded transparently, bolstering trust among partners. Real-time tracking offers continuous visibility into product location and status. Additionally, the cryptographic features of blockchain fortify data and transaction security, mitigating fraud and unauthorized access risks.

Powering Trust: Smart Contracts

Smart contracts, built on the secure and immutable blockchain technology, are self-executing agreements governed by code. They are built on the trustless architecture and offer security in various supply chain management aspects. These contracts automate payments based on predefined criteria and self-executing code, minimizing delays and disputes. They enable trustless agreements, eliminating the need for a central authority. By offering a transparent transaction record in the form of distributed ledgers, they simplify dispute resolution and reduce fraud risks in supply chain processes.

Real-World Examples showcasing Integration Benefits

Leading companies are already leveraging smart contracts and Web 3.0 principles to enhance their supply chains. For instance:

Walmart employs blockchain for food traceability, enabling rapid identification of the source of contamination concerns.

Maersk, a global shipping conglomerate, collaborates with IBM to enhance the transparency and efficiency of global trade using blockchain. platform, known as TradeLens, digitizes the supply chain process, reducing paperwork and delays.

Challenges, Solutions, and the Road Ahead

The promise of Web 3.0 and smart contracts in supply chain management is immense, but there are hurdles to address. Blockchain networks need to scale effectively, balancing transaction volume with speed and security. Achieving the necessary throughput for supply chain efficiency remains a technical obstacle. Legal clarity and enforceability demand evolving legal and regulatory frameworks for smart contracts. Moreover, broad adoption entails technological integration, education, change management and setting industry standards.

Future Innovations and Trends

As technology continues to evolve, the following trends are expected in supply chain management with the integration of Wb 3.0:
- Greater Automation: Automation will become more pervasive, reducing the need for human intervention in routine supply chain processes.
- IoT Integration: IoT will play a pivotal role in collecting real-time data from supply chain nodes, providing insights for optimization.
- AI and Machine Learning: These technologies will further enhance predictive analytics, demand forecasting and decision-making in supply chain management.

Conclusion

The integration of Web 3.0 and smart contracts has the potential to revolutionize supply chain management, addressing long-standing challenges and unlocking new levels of efficiency, security and transparency. As we navigate the road ahead, businesses must embrace these technologies to stay at the forefront of supply chain innovation.

Charting the Path from "Make in India" with Industry 4.0

India's progressive strides towards Industry 4.0 have been catalyzed by the introduction of 5G services. The high-speed, low-latency connectivity offered by 5G underpins the integration of advanced technologies such as lot and Al into manufacturing processes. By fostering the establishment of smart factories that are efficient, predictive and interconnected, 5G stands as a cornerstone of the digital industrial revolution in India. The advanced features of 5G, such as network slicing, massive machine-type communications (mMTC) allowing connections up to 1 million devices per square kilometer, enhanced authentication, edge computing and massive bandwidth, offer unprecedented flexibility for Industry 4.0.

MeitY's Digital Blueprint: Architecting a Tech-Forward Nation

The Ministry of Electronics and Information Technology (MeitY) has been at the forefront of India's journey towards Industry 4.0. The recent initiatives by Meity encapsulate the vision of a Digital India, aiming to ensure that every Indian reaps the benefits of the digital age:

- **Strengthening the Digital Foundations:** Meity actively supports the essential components of the digital era: hardware and software. By promoting the expansion of knowledge-driven enterprises, the ministry seeks to amplify IT exports and boost India's international tech competitiveness.
- **Promoting Local Production through PLI:** Realizing the significance of in-house electronics production, Meity introduced the Production Linked Incentive (PLI) Scheme. Specifically designed for expansive electronics manufacturing, it provides incentives ranging from 4%-6% on additional sales of products made in India. This would support qualifying companies for 5 years following the base year, cultivating an encouraging environment for electronics production nationally.
- **Paving the Way for Robotics and Automation:** Looking ahead, Meity has outlined a detailed National Strategy on Robotics. This plan emphasizes the crucial role of robotics automation in key areas, such as manufacturing, agriculture, healthcare and national defense. Moreover, it promotes creative financial channels for robotics startups, ensuring they are equipped to introduce their innovations to the market and strengthen the overarching infrastructure.
- **Advocating for Cloud Adoption**: Strategically, under the MeghRaj initiative, Meity has endorsed a 'Cloud First' stance. This requires all government sectors to assess and, when viable, migrate to cloud solutions. To aid this transition, Meity has presented thorough guidelines to facilitate the cloud services incorporation across diverse departments.
- **Launching the Smart Manufacturing Competency Centre (SMCC)**: In a joint effort with the Centre of Excellence IoT & AL, the Government of Gujarat and NASSCOM, Meity established the SMCC in Ahmedabad, designed as a focal point for startups and tech vendors to showcase their groundbreaking solutions to industry leaders. It presents a concrete preview of the digital tools that can revolutionize efficiency, safety and productivity in manufacturing facilities.

Balancing Tech Advancements with Customer-Centricity

Today's networks have undergone a paradigm shift from the earlier 4G systems. While technological advancements drive them, it's imperative to recognize that in the current digital age, the customer reigns supreme. Every innovation, every upgrade should be envisioned keeping the end-user in mind.

However, this emphasis on customer-centricity doesn't overshadow the intrinsic business model of TSPs, which remains predominantly network-focused. While the Indian telecom industry remains committed to help realise the progressive objective of a digitally inclusive India, as envisioned by Meity, it would necessitate developing telecom networks of requisite quality and reach to achieve optimum results from the 5G technology, to ensure that customer benefits are maximized without compromising the holistic vision of a Digital India. Therefore, it becomes imperative to find ways to help raise the capex required by the TSPs to meet the current and upcoming digital demands.

Technical and Commercial Backbone for a Digital India

Realizing this ambitious vision necessitates a two-fold support system technical and commercial. Technical Support: Beyond research and development, there's an imminent need to erect robust networks, which implies not just enhancing existing networks, but also provisioning for additional efficient spectrum to accommodate the rising needs. Prioritizing the 6 GHz band for IMT services could be a monumental step towards optimizing the delivery of 5G, 5G Advanced and the future 6G services.

Commercial Support: In addition to the concerns of the TSPs over the high taxes and levies imposed on the sector which need to be reduced, there's another broader perspective to consider from a long-term view. The services which are delivered over the networks whose quality can be either accentuated or hampered by the network quality, brings the role of Large Traffic Generators (LTGs) into the spotlight. These LTGs, which rely heavily on telecom networks for their operations, are required to partner in rolling out the networks.

The economic terrain for TSPs is becoming increasingly challenging. On one hand, their capital expenditures are skyrocketing, while on the other hand, they grapple with diminishing returns on these massive investments. Some Indian TSPs are yet to achieve a break-even point, wherein their investments are matched by profits. For a few, this financial gap continues to widen. Thus, there is a dire need for adding these supportive pillars of the Indian Telecom Industry.

From Make-in-India to Made-in-India

The Government's thrust on 'Make-in-India', and the eventual objective to evolve to 'Made- in-India', is evident with a slew of initiatives introduced to encourage and facilitate the development of a robust, world-class and self-sufficient, Atmanirbhar manufacturing and supply chain ecosystem in the country, gradually positioning India as a global leader and export hub as well. This commendable aspiration necessitates fostering an ecosystem where Indian companies both big and small, receive adequate support to be able to fulfill their potential and emerge as successful, profitable ventures which contribute to the economy and nation-building.

Indian telcos have led India's digital revolution by facilitating equitable and inclusive socio- economic development by enabling ubiquitous and affordable connectivity across the nation. Their efforts need to be complemented via responsible fair-share contributions from such services which exploit the Indian telecom networks to benefit/profit immensely such as the large OTT Service providers, majorly owned by global technology giants. A fair and equitable contribution from these large foreign entities will also relieve the pressure on consumer prices for communication services. Needless to say, Indian Startups and MSMEs are not intended to make such contributions, so as to help foster innovation and entrepreneurship, as envisioned by our Hon'ble Prime Minister. In fact, a fair-share contribution from LTGs would ensure that smaller players enjoy the advantages of improved network quality.

The Promise of the Future: 6G and Beyond

Despite the myriad challenges, there's a silver lining. As the global tech community ardently hunts for the next big "killer app", there's hope that the genesis of the 6G killer app might find its roots under the efforts of Meity, in addition to the commendable strides being made in R&D, standards development, among others.

It is anticipated that the eventual breakthrough for a killer app would most possibly happen in the application layer (i.e., OTT platforms or deep tech) and will primarily benefit these riders of the network. We will, of course, explore how the TSPs could find a way to benefit from the cutting-edge use cases of 6G apps.

Furthermore, with the escalating demands and potential data-heavy applications expected to emerge in 6G, it's imperative to recognize the future needs and the existing necessities for a sturdy and capable infrastructure to be put in place. A supportive ecosystem with responsible contributions from all stakeholders is essential to meet these demands and lay the foundation for the next generation of connectivity.
As a final observation, with the unwavering commitment of stakeholders, the promise of a connected, efficient Digital India is not just a distant dream but a tangible reality in the making. As these digital narratives unfold, they will weave the tapestry of a modern India, resilient and resplendent in its digital avatar, turning aspirations of a technologically empowered society into a living reality.

TELECOM DRIVE
Empowering Indian Telcos in the Age of Industry 4.0

India stands on the brink of another digital revolution, powered by Industry 4.0, which, at its core, revolutionizes manufacturing, creating intelligent factories where cyber-physical systems co-exist, monitoring physical processes, making decentralized decisions and communicating in real time. These smart factories, equipped with sensors, can accurately predict downtimes, monitor production and significantly reduce wastage, thereby enhancing overall product quality. Telecom service providers (TSPs) are at the forefront of this revolution by providing connectivity and facilitating the integration of such advanced technologies.

5G, the backbone of Industry 4.0

The high-speed, low-latency connectivity offered by 5G forms the lifeline of real-time data processing and communication between devices. Advanced features of 5G, like network slicing, enhanced authentication, edge computing and massive bandwidth, offer unprecedented flexibility for Industry 4.0.

These capabilities, along with future developments like time-sensitive networking, enable seamless transition from wired to wireless networks, enhancing the potential of Industry 4.0 technologies, says GSMA. By deploying and managing 5G networks, telcos enable businesses to adopt Industry 4.0 technologies seamlessly, ensuring a rapid and efficient digital transformation.

IoT as a catalyst

In the intricate web of Industry 4.0, Internet of Things (IoT) emerges as a pivotal force enabling seamless communication among interconnected devices, enabling them to collect and exchange data seamlessly, fostering intelligent decision-making. Acting as facilitators, telcos provide essential IoT connectivity and services, so that businesses can harness valuable insights, optimizing their operations and enhancing productivity. Industry 4.0 opens the path for telcos to create innovative offerings, such as IoT-enabled smart city solutions, aligning their services with the demands of the digital age.

AI's role in transforming modern industries

Artificial Intelligence (AI) stands at the forefront of Industry 4.0, optimizing efficiency and productivity across sectors. AI impacts various aspects of industries such as production planning, predictive maintenance, machinery inspection, logistics, inventory management and process control.

AI-driven machine vision is transforming industries. Smart cameras powered by AI enable rapid and accurate analysis, replacing labour-intensive tasks. In process industries, AI-based leak detection swiftly identifies hazardous chemical or gas leaks, ensuring prompt and precise responses. Telcos play an active role in this transformation, not only by integrating AI into industrial networks, but also offering AI-powered customer analytics and data-driven network insights.

Transforming insights into actions

Telcos can utilize big data analytics to extract invaluable insights derived from customer behaviors and network performance patterns, to enhance decision-making processes. From improving network performance to developing customer-centric products and services, big data analytics is key to staying ahead in the digital race.

Network virtualization and cybersecurity

The evolution of Industry 4.0 demands agile, scalable and automated network operations. Telecom companies can achieve this through network virtualization and Software-Defined Networking (SDN). By decoupling control from hardware and centralizing management, networks become more adaptive, efficiently handling varying demands and ensuring a seamless user experience. Additionally, robust cybersecurity measures are paramount in this digital age. Investments in threat intelligence, network security and data protection safeguard telecom networks, services and customer data from potential cyber threats, ensuring uninterrupted services and safeguarding customer trust.

Turning challenges into opportunities: real-world examples

Globally, telcos are strategically harnessing Industry 4.0 technologies to revolutionize their services. Few examples:

- Verizon in the U.S. and Telstra, Australia, utilize AI to optimize its network performance. Through machine learning algorithms, network congestion is predicted and prevented, ensuring enhanced reliability and performance for its customers.
- Vodafone's TOBi and AT&T Intelligent Virtual Agent (IVA) are AI-driven chatbots, which handle customer service efficiently, addressing customer queries 24×7, reducing wait time and eliminating the need for in-person resources.
- Vodafone, in collaboration with cities worldwide, is developing IoT-enabled smart city solutions, ranging from traffic management to environmental monitoring, which exemplify the real-world applications of IoT, revolutionizing urban living experiences.
- Deutsche Telekom harnesses big data analytics to enhance network performance and develop innovative products and services, while China Mobile utilizes the same to provide insights to retail chains.
- AT&T and China Mobile have set good examples, offering IoT solutions for agriculture, enabling farmers to monitor crops and livestock, and control irrigation systems remotely.

MeitY's Multifaceted Initiatives for Industry 4.0 in India

MeitY has introduced a slew of initiatives to ensure the nation's robust participation in Industry 4.0 and sculpting a vibrant Industry 4.0 ecosystem in India

- Fostering the Hardware and Software Ecosystem: MeitY has been proactive in nurturing the twin pillars of the digital age – hardware and software. By championing the growth of knowledge-based enterprises, the ministry aims to bolster IT exports, thereby enhancing India's global competitiveness in the tech arena.
- Laying the Groundwork for Robotics and Automation: With an eye on the future, MeitY has proposed a comprehensive National Strategy on Robotics, underscoring the importance of robotics automation across pivotal sectors including manufacturing, agriculture, healthcare and national security. It also advocates innovative funding avenues for robotics startups, ensuring they have the resources to bring their innovations to the market and contribute to the overarching infrastructure.
- Embracing Cloud Computing: Under the MeghRaj initiative, MeitY has championed the 'Cloud First' approach, mandating all governmental departments to evaluate and, if feasible, transition to cloud services. To ensure a seamless shift, MeitY has rolled out comprehensive guidelines, streamlining the adoption of cloud services across various departments.
- Inaugurating Smart Manufacturing Competency Centre (SMCC): In collaboration with the Centre of Excellence – IoT & AI, Government of Gujarat and NASSCOM, MeitY has set up the SMCC in Ahmedabad. This center is envisioned as a nexus where startups and tech solution providers can demonstrate their innovations to industry stalwarts. By doing so, it offers a tangible glimpse into the transformative digital solutions that can redefine productivity, efficiency and safety standards within manufacturing units.

By laying down the infrastructure, championing R&D, ensuring localized supply chain and fostering robotics innovation, MeitY aims to ensure that India is not just a participant, but a leader in the global Industry 4.0 narrative.

The road ahead: transforming India's digital landscape

As Industry 4.0 sweeps across the globe, with indications of Industry 4.0 market growing from $130.90 billion in 2022 to $377.30 billion by 2029, Indian telecom companies stand poised to capitalize on the opportunities presented in various ways, thereby monetizing their own services and expertise. Telecom companies can use Industry 4.0 technologies to improve their operational efficiency by automating tasks, streamlining processes and optimizing resource utilization.

The ultra-fast, low-latency connections can spur the adoption of applications like augmented reality (AR) and virtual reality (VR), offering seamless experiences, from immersive gaming to virtual business meetings, and enhance user satisfaction and engagement. With IoT, telcos are positioned to diversify revenue streams by offering services, from asset tracking in logistics to energy management in commercial buildings. Industry 4.0 also allows telcos to personalize services based on user behaviour and preferences.

In essence, Industry 4.0 presents Indian telcos with an unprecedented opportunity to innovate, diversify and enhance their services. By aligning with global examples and leveraging cutting-edge technologies, they can not only meet the demands of the digital age but also lead India into a future marked by connectivity, efficiency, and unparalleled customer experiences. The chances for growth are vast, making it imperative for Indian telcos to seize this moment and transform India's digital landscape.

VOICE&DATA
Harnessing Blockchain for Identity Management in the Web 3.0 Era

Introduction

The advent of Web 3.0, characterized by an intelligent and interconnected internet, has highlighted the need for robust identity management in digital ecosystems. Unlike its predecessor, Web 2.0, which focused on information sharing and collaboration, Web 3.0 offers a more personalized and context-aware user experience with the aid of artificial intelligence and machine learning. Blockchain technology, as part of the distributed infrastructure of Web 3.0, has the potential to revolutionize identity management due to its decentralization, security and immutability.

Blockchain and Web 3.0: A New Infrastructure

In the Web 3.0 era, blockchain serves as an underlying infrastructure for decentralized, secure, and transparent online interactions. This is a significant departure from the centralized server-based approach of Web 2.0. With blockchain's distributed ledger and peer-to-peer network, data control and ownership can be decentralized, mitigating the risks associated with central points of failure and centralized control.

Further, Web 3.0 leverages DAOs, essentially smart contracts-enabled, blockchain-based organizations, for more autonomous and democratic decision-making. DAOs, by their very nature, reduce the need for intermediaries and offer more direct, transparent, and efficient interactions, contributing to the formation of a trustless and secure internet environment.

Advantages of Web 3.0

Web 3.0 offers several advantages over Web 2.0. The integration of AI and machine learning enables semantic comprehension and interconnectivity, resulting in a more intuitive and user-centric internet experience. Furthermore, Web 3.0's decentralized nature addresses data privacy and control concerns by allowing users to maintain control over their personal information, enhancing data security and privacy. This inclusive approach extends digital services to marginalized or remote populations previously excluded due to centralized access barriers.

Identity Management: Current Challenges and the Blockchain Solution

Identity management essentially involves the identification, authentication and authorization of individuals across diverse systems. Current centralized identity management systems suffer from vulnerabilities, privacy violations and limited global reach. Blockchain technology offers an innovative solution by promoting decentralization, ensuring security and immutability, and fostering trust and transparency. Through blockchain, individuals can maintain control over their digital identities, ensuring privacy and reducing the risk of identity theft and fraud. The cryptographic mechanisms employed by blockchain ensure secure identities, while its transparency and collective verification instils trust.

Embracing Blockchain for Identity Management in Web 3.0

Blockchain plays a crucial role in identity management within the Web 3.0 framework, enabling the concept of self-sovereign identity (SSI). Decentralized identifiers (DIDs) powered by blockchain allow individuals to create and manage their unique identifiers, linked to cryptographic keys controlled by the owner. Verifiable Credentials (VCs) further enhance privacy and give users greater control over their personal data.

The Finnish example:

In a unique collaboration, the Finnish Immigration Service and blockchain company MONI have provided blockchain-powered digital identities to asylum seekers. These identities are unique cryptographic identifiers, stored in a secure, decentralized manner, thanks to blockchain. In addition to providing a tamper-proof digital identity, the system offers prepaid Mastercards linked to the identity, allowing individuals to receive payments, make purchases and even build a financial history. This system offers financial inclusion to often marginalized groups who lack access to traditional banking services.

Smart Contracts, Decentralized Identity and Blockchain Interoperability

Blockchain identity management also benefits from smart contracts - programmable contracts that automatically execute when specific conditions are met. In identity management, smart contracts can automate the verification process, reducing human error and enhancing the system's efficiency.

Decentralized Identity (DID) removes power from centralized authorities and places it back in the hands of individuals. In a DID model, individuals manage their identifiers, improving privacy and granting control over the sharing of identity information.

Furthermore, blockchain's interoperability and standardization facilitate universal identity solutions that work across different domains. Organizations like the Decentralized Identity Foundation (DIF) and the World Wide Web Consortium (W3C) are working towards developing open standards for decentralized identity systems. The goal is to create a universally acceptable framework that allows for secure and seamless digital interactions across different services and platforms.

How India can benefit from Blockchain based Identity Management

Blockchain-based identity management can bring significant benefits and address various challenges in India across multiple sectors, such as:

1. Secure Digital Identities for Citizens: Blockchain can provide a secure and tamper-proof digital identity system for Indian citizens. Each citizen's identity information can be stored on the blockchain, encrypted and accessible only by the individual. This system can streamline access to government services, reduce identity theft and enable secure digital interactions.
2. Decentralized Voting Systems: Blockchain-based voting systems can enhance the transparency and integrity of elections in India. By recording votes on a distributed ledger, blockchain can prevent tampering and provide an immutable record of each vote. This can increase trust in the electoral process and improve voter participation, as citizens can verify their votes while maintaining anonymity.
3. KYC (Know Your Customer) Verification: Blockchain-based KYC verification can simplify and secure the customer onboarding process for financial institutions and other service providers. Instead of duplicating KYC processes for each institution, individuals can have their identity information verified and stored on the blockchain. Service providers can then request access to the verified KYC data, reducing redundant paperwork and enhancing efficiency while ensuring data privacy.
4. Land Registry and Property Ownership: Blockchain can streamline land registry processes, reducing fraud and disputes related to property ownership in India. By recording land ownership transactions on the blockchain, a transparent and auditable history of property transfers can be established. This can enhance trust in land records, simplify property transactions, and reduce legal disputes.
5. Supply Chain and Product Authentication: Blockchain can be utilized to ensure the authenticity and traceability of products in the supply chain. By recording information about each stage of the supply chain on the blockchain, consumers can verify the origin, quality, and authenticity of products. This can help combat counterfeiting, ensure fair trade and enhance consumer trust in the Indian market.
6. Healthcare Records and Interoperability: Blockchain-based solutions can enable secure and interoperable healthcare records in India. Medical data can be stored on the blockchain, ensuring privacy and allowing individuals to have control over their health information. Interoperability between healthcare providers can be facilitated, enabling seamless sharing of patient data while maintaining data integrity and privacy.
7. Intellectual Property Rights: Blockchain can provide a transparent and tamper-proof system for registering and protecting intellectual property rights. Artists, inventors and creators can record their work on the blockchain, establishing proof of ownership and timestamped evidence. This can help safeguard intellectual property and simplify the process of copyright registration and licensing.

Conclusion

As we traverse deeper into the Web 3.0 era, the demand for secure, decentralized and efficient identity management systems becomes increasingly apparent. Blockchain technology, with its unique advantages, is already making significant strides globally. By leveraging the decentralized, secure and transparent nature of blockchain, India can address various challenges and create more efficient, trustworthy, and inclusive systems across multiple sectors, including vital ones like governance, finance and healthcare. The trans-formative power of blockchain in identity management can pave the way for a digital future where data is secure, identities are protected, and trust is paramount.

Navigating Telecom Manufacturing Landscape in India: Turning Challenges into Opportunities

The telecom sector in India, the second largest in the world, is undergoing a remarkable transformation. As of July 2023, the country registered a subscriber base of 1.17 Bn, with a staggering 881.26 Mn internet subscribers, as per DoT.

On the flip side, a significant challenge casts a shadow over the industry: 90% of India's telecom equipment demand is met through imports. In this context, the emergence of indigenous telecom startups becomes pivotal to address this dependency, while also fostering innovation and economic growth.

Hardware Startup Challenges In India

There is a striking disparity between software and hardware startups in India. A whopping 95% of tech startups in India are software-related and less than 5% specialise in deeptech.

Hardware startups face multifaceted challenges, creating significant hurdles for their growth:

Extended Gestation Period And Funding Scarcity

Hardware startups, by nature, demand extensive research and development, leading to prolonged gestation periods. This protracted timeline poses financial challenges for both founders and investors, necessitating sustained funding over several years. As a result, they struggle to secure investments. Venture capitalists often prefer quicker returns, making it challenging for hardware ventures to fetch consistent financial backing.

Talent Acquisition And Skill Gap

Acquiring skilled talent is an enduring challenge. The limited pool of research talent is predominantly absorbed by multinational companies, leaving startups struggling to find resources with the necessary expertise for deep tech innovation.

Higher salary packages offered by big companies makes it even harder for start-ups to fulfil their requirement for skilled employees.

High Testing Costs And Infrastructure Limitations

The testing process for telecom hardware start-ups comes with significant expenses, and there is a scarcity of testing infrastructure as well. As a result, startups face substantial financial challenges when trying to test and certify their products. Limited access to proper testing facilities further complicates the situation, hindering their progress and the growth of the industry.

Limited Domestic Supply Chains

The absence of a robust domestic supply chain hampers the hardware start-up ecosystem. Most component types, even those assembled in India, are sourced from international markets, highlighting a crucial supply chain gap that impedes the growth of indigenous hardware production.

Despite these challenges, the tide is turning for Indian telecom startups. The advent of 5G presents novel opportunities, inspiring them to explore areas like open RAN, Smart City solutions, AI and Edge technologies.

Major players in the telecom sector are actively engaging with startups, fostering collaborations and partnerships. This newfound synergy, coupled with government initiatives, is paving the way for a thriving telecom start-up ecosystem.

Government Initiatives: Nurturing Innovation

The Indian government has embarked on initiatives to bolster the telecom startup ecosystem. Recognising the dearth of testing infrastructure, the Department of Telecommunications (DoT) has opened government-owned labs for start-ups to conduct tests.

Further, the government has offered free access to 5G test beds for government-owned startups, aiming to boost innovation and experimentation. To back the startups with financial support, DoT approved a grant of INR 50 Cr to 43 startups and MSMEs for indigenous 5G equipment development through the Digital Communication Innovation Square initiative.

These add to the Startup India initiative launched in 2016, which aims to fortify the ecosystem for startups and innovation in India, contributing to substantial economic growth and employment opportunities.

Since its inception, 92,683 entities have been recognised as startups by the Department for Promotion of Industry and Internal Trade (DPIIT) as of February 28, 2023, facilitating tax exemptions and easier funding accessibility.

The initiative connects Indian startups to global ecosystems, provides government funding through a Fund of Funds with a corpus of INR 10,000 crore and offers mentorship along with incubation support.

The recently released draft National Deep Tech Start-up Policy (NDTSP) serves as a comprehensive roadmap to overcome the challenges faced by deep tech start-ups in India.

The policy aims to nurture the research, development and innovation ecosystem by increasing gross expenditure on R&D, amending research assessment practices and creating partnerships for technology commercialisation.

Additionally, the policy emphasises strengthening India's Intellectual Property Rights (IPR) regime by establishing a Single Window Platform for Unified IP Framework and enhancing global IP conventions. Targeted long-term funding is facilitated through thematically-focused Fund of Funds (FoF) and Technology Impact Bonds.

To address infrastructure challenges, the policy proposes infrastructure and resource sharing, promoting the use of existing infrastructure and establishing standardized field test sites.

By developing favourable regulations, standards and certifications through multi-stakeholder consultations and regulatory sandboxes, the industry can acquire the required momentum. Capacity building initiatives include skill enhancement grants, specialized courses, mentorship programs and international collaborations.

The policy also promotes procurement and adoption of deep tech products through quality-focused procurement, collaborative research models and subcontracting by large firms.

It enhances policy and program inter linkage by creating an Inter-Ministerial Deep Tech Committee, integrating deep tech startups into international trade agreements, and addressing import dependencies and supply chain vulnerabilities.

Additionally, the policy proposes funding mechanisms embracing the "failing by design" principle and a central core mission office to simplify procedures and enable IP protection.

Lessons From Global Markets

Around the world, major economies are strategically harnessing the potential of deep tech innovations and science-based startups to enhance their socio-economic competitiveness.

Initiatives like UK Catapult, Belgium's WSL, Germany's EXIST Program and Canada's Innovation Superclusters Initiative emphasise collaboration, sector-specific focus, comprehensive support, funding access, internationalisation support and entrepreneurship education. India aims to cultivate a thriving deeptech ecosystem inspired by these examples.

Future Outlook

Looking ahead, the trajectory of India's telecom industry appears promising. Projections by Deloitte India and CII suggest that by the end of 2023, the Indian telecom sector will reach USD 12.5 billion.

Technological advancements, coupled with the 5G rollout, industry collaborations and government support, are set to propel the telecom startup ecosystem further, ushering in an era of innovation and self-sufficiency in India's telecom equipment production.

Readying for 6G- India's Vision for Digital Leadership

As the dawn of 6G technology approaches, the global telecommunications landscape stands on the brink of a major evolutionary leap. Under the steadfast vision of our Hon'ble Prime Minister Shri Narendra Modi, India has sounded the clarion call to take lead in 6G, which has reverberated globally. Our nation stands at the cusp of a transformative era, building upon the solid foundations laid in the 5G landscape. The inception of 6G is not just a technical upgrade; it is a transformative shift that could redefine the digital experience, enabling real-time connectivity across the most remote corners of India and fostering economic growth through innovation.

Understanding 6G

Sixth-Generation (6G) wireless technology represents the next frontier in mobile telecommunications, following on the heels of the 5G networks currently being deployed. While 5G focuses on enhanced mobile broadband, ultra-reliable low-latency communications and massive machine-type communications, 6G aims to revolutionize the interaction between humans and the digital world, further blurring the lines between physical and virtual realities.

6G is anticipated to support terabit-per-second (Tbps) data rates, near-zero latency, and. unparalleled reliability. It will also introduce new dimensions in communication, including high-fidelity mobile holography, multi-sensory data transmission, and precision sensing. These attributes will open the door for transformative applications in telemedicine, smart cities, autonomous systems, and advanced manufacturing, enabling seamless human- machine interfaces and fostering applications that are still in the realm of science fiction.

Global 6G landscape

As 6G begins to take shape, countries around the globe are investing in research and development to stake their claim in the future of telecommunications. The United States, China, the European Union, and South Korea are among the frontrunners, launching initiatives to explore the potential of 6G and its enabling technologies. Japan has also joined this race, with NTT announcing their plan to invest in the 6G space.

Standardization bodies, including the International Telecommunication Union (ITU) and the 3rd Generation Partnership Project (3GPP), have begun to consider the frameworks that will underpin 6G. The collaborative efforts are focusing on defining the frequencies, technologies, and architectures that will form the backbone of 6G networks.

Technical innovation behind 6G

The technical innovations underpinning 6G are expected to be a convergence of advancements from various domains. The core innovations span from sub-terahertz (THz) radio frequencies, which promise to offer vast bandwidth and high data rates, to advanced photonics for ultra-fast data transmission. Moreover, 6G is likely to leverage novel networking paradigms, such as network slicing and edge computing to a greater extent, providing customized virtual networks and reducing latency by bringing computation closer to end users. Artificial intelligence (AI) will play a pivotal role in managing the complexity of 6G networks, enabling predictive maintenance, energy efficiency, and intelligent resource allocation. Quantum communications and computing are also on the horizon as potential game-changers for secure communications and complex problem- solving.

Economic potential of 6G in India

The economic impact of 6G in India could be profound, opening up new avenues for growth, innovation, and social progress. India's burgeoning digital economy, with its vast base of mobile users, presents an ideal landscape for 6G deployment. By leveraging 6G technology, India could see significant improvements in industrial productivity, healthcare outcomes, and education delivery, along with creating a fertile ground for start-ups and new ventures in the tech space.

The introduction of 6G in India is expected to fuel job creation, both directly in the telecom and technology sectors, and indirectly by enabling new business models and services. It could significantly enhance the Digital India initiative, providing high-speed connectivity to the most remote areas and thus, democratizing access to information and opportunities.

Standardization and regulations

At this juncture, understanding two pivotal pillars of 6G becomes imperative standardization and policy regulations. These building blocks are not just technical aspects but the cornerstones that will define the global landscape of 6G connectivity, ensuring seamless integration, innovation, and widespread accessibility.

As technology progresses, policies and regulations must evolve in tandem. India's policies, meticulously established for 5G, are now positioned to seamlessly extend to the 6G landscape. This shift represents a departure from the Make in India approach to a more expansive Made in India strategy. Supported by robust financial backing and a focused effort in policy formulation, India is steadily transitioning to becoming a global exporter of advanced telecom technologies. While the transformation may seem gradual, India is steadfast in its journey toward embracing 6G with open arms, reinforcing its commitment to global standards.

Industry support and collaboration

India's 6G journey is gaining substantial backing from industry stakeholders. Nokia, for example, has established a ground-breaking 6G lab in Bengaluru to focus on foundational technologies, such as network-as-a-sensor. Serving as a collaborative platform, the lab fosters innovation and tests new solutions that bridge the gap between the digital and physical worlds. This collaborative effort among the government, academia, and industry players showcases India's vibrant and dynamic tech landscape.

In another instance, Ericsson is focusing on India 6G program, leveraging its seasoned research leaders and experts in radio, networks, Al, and cloud technologies across R&D centers in Chennai, Bengaluru, and Gurgaon. Collaborating with global counterparts in Sweden and the US, Ericsson's India research team focuses on creating a cyber-physical continuum, ensuring the delivery of critical services, immersive communications, and omnipresent IoT experiences while upholding data integrity.

India's unique position

India's distinct position in the 6G landscape lies in its ability to address specific challenges and opportunities, unique to the nation. The integration of Al in 6G networks, with emphasis on automation and intelligent transformation, highlights the paramount importance of cybersecurity. Stringent security measures are being integrated into 6G infrastructure, ensuring data privacy and bolstering overall cybersecurity, thus fostering a secure digital environment. Moreover, India's focus on the evolution of openness and customization in 6G is crucial. Collaborative efforts within the telecom industry are aimed at effectively addressing these challenges, exploring emerging applications, achieving universal network coverage and developing a flexible, redundant, and self-healing network. These initiatives form the core of India's holistic strategy.

Lessons from 5G and role of the youth

The rollout of 5G in India, while setting world records for its speed, has also brought to light the critical need for applications that can fully utilize the network's capabilities. The experience has underscored the importance of developing a robust ecosystem of applications and services that can drive the use and, consequently, the revenues necessary sustain the network. As we transition to 6G, the focus on nurturing indigenous to applications and services that cater to the unique needs of the Indian market becomes paramount. In this context, the role of India's youth is crucial. For India to become a leader in 6G, our youngsters must step forward to create innovative applications tailored to this new technology. This aligns with the Prime Minister's ambition for India to not only expand its 5G network, but to also take the lead in 6G technology development.

A vision for the future

India envisions a future, where 6G networks seamlessly connect humans and machines, blurring the boundaries between the physical and digital realms to create immersive experiences. The India 6G era, envisioned in collaboration with the government, academia, and the industry ecosystem, marks a significant milestone in India's technological journey. With a legacy of being a global 5G leader, India, alongside its industry partners, is well- positioned to pioneer the 6G revolution, ushering in a new era of innovation and connectivity.

As India prepares to host the prestigious World Telecommunication Standardisation Assembly (WTSA) in 2024, the nation stands as a beacon of technological prowess, ready to shape the future of global telecommunications. With a forward-thinking approach, collaborative spirit and a robust foundation in 5G technologies, India's journey into the 6G era promises a quantum leap, propelling the nation into the forefront of the global technological evolution.

[TELECOM TALK]
NETWORKS

LT GEN DR S P KOCHHAR

NAAS: THE FUTURE OF NETWORKS

This cloud-based networking paradigm is here to stay and transform modern IT, enhancing flexibility, security, and efficiency for businesses globally

Network as a Service (NaaS) is a cloud-based service model that enables users to easily operate the network and achieve the outcomes they expect from it without owning, building or maintaining their infrastructure. NaaS represents a paradigm shift in networking, providing organisations with a powerful tool to address challenges such as recurring capital costs, staffing and skills shortages, and the increased complexity associated with securing remote access for employees and managing multi-cloud environments.

It brings software-defined networking (SDN), programmable networking, and API-based operation to WAN services, transport, hybrid cloud, multi-cloud, Private Network Interconnect and Internet exchange points. NaaS is capable of replacing several legacy network configurations such as multi-protocol label switching or MPLS and virtual private networks or VPNs, as well as on-premises networking hardware like firewall hardware and load balancers.

NaaS providers enable their customers to set up their networks without hardware, instead, using software delivered over the Internet. NaaS services can range from managed software-defined WAN and network access including wireless to security, unified communications services and more.

> NaaS has the potential to drive innovation and efficiency in the telecom industry and beyond, making it a technology to watch closely in the coming years.

> By offering a flexible, scalable and efficient networking solution, NaaS is poised to become a cornerstone in the modern IT landscape.

WHY DO WE NEED NAAS?

To appreciate NaaS fully, it's essential to trace the evolution of networking. Traditional networks relied heavily on physical components like fibre optics, copper cables, routers and switches. However, the advent of SDN introduced a transformative approach, enabling the management of network traffic through software and orchestrating the interactions between network components. This, coupled with the emergence of Network Function Virtualisation (NFV), which allowed network functions to be executed through software rather than dedicated hardware, laid the foundation for NaaS. The synergy between SDN and NFV ushered in an era where service providers could offer NaaS, heralding a new era of networking possibilities.

NaaS offers a multitude of benefits to businesses. One of its key advantages lies in IT simplicity and automation. By continuously integrating new features and capabilities, NaaS keeps businesses updated with the latest technological advancements. Additionally, it ensures enhanced security by integrating network and security solutions, creating a robust defence against cyber threats with advanced firewall capabilities.

Moreover, NaaS provides valuable visibility and insights through proactive network monitoring, powered by AI technologies. This allows businesses to gain crucial insights into network performance and user behaviour. The service also guarantees an improved application experience through AI-driven network optimisation,

Network-as-a-Service - Digital, Global and Invisible
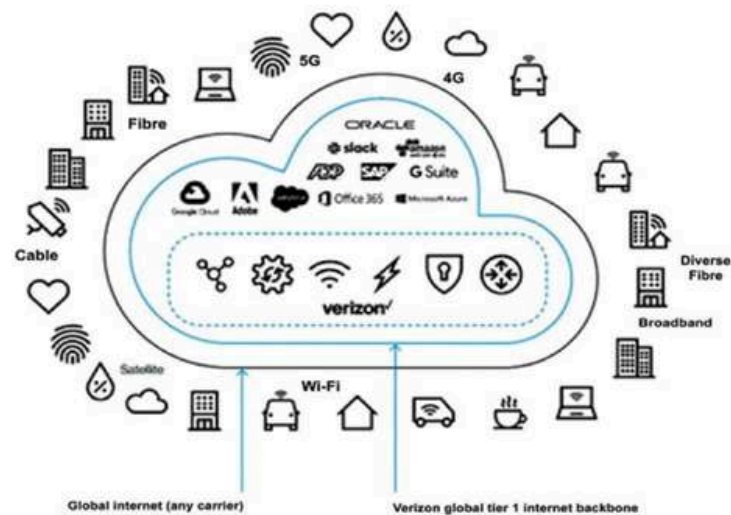
Source: Network-as-a-Service explained. Verizon; 2021.

> A reliance on specific features from a single NaaS provider can result in vendor lock-in, inhibiting the flexibility to switch to alternative providers.

ensuring seamless user interactions with critical applications.

Flexibility is another major perk of NaaS. It offers the agility required to promptly adapt to changing business requirements, enabling businesses to stay responsive in dynamic market environments. Scalability is simplified with NaaS, allowing for the effortless expansion of network infrastructure without the need to acquire new hardware. This streamlined scalability process makes expanding operations smooth and efficient.

Furthermore, NaaS's cloud-based nature ensures accessibility from any location worldwide. This means businesses can access their network services from anywhere, providing a level of convenience and connectivity crucial in today's global business landscape.

CORRELATION OF NAAS AND 5G

The intricate correlation between 5G and NaaS represents a transformative shift in the telecommunications sector. At the heart of this synergy lies the ability of NaaS to amplify the inherent capabilities of 5G through dynamic network configurations, enabled by SDN. This agility ensures rapid service deployment and optimal resource allocation in real time.

Furthermore, by harnessing Network Functions Virtualisation, NaaS eliminates the dependency on dedicated hardware, making 5G deployments more cost-efficient. The convergence of NaaS and 5G also shines in the realm of edge computing, where NaaS provisions resources closer to end-users, enhancing the performance of latency-sensitive 5G applications.

This collaboration extends to 5G network slicing, with NaaS dynamically managing slices to cater to diverse service requirements, from

WHY NAAS?

- **IT simplicity and automation:** By integrating new features and capabilities, NaaS ensures that businesses stay at the forefront of technological advancements.

- **Enhanced security:** The integration of network and security solutions creates a fortified defence against cyber threats, bolstered by advanced firewall capabilities.

- **Visibility and insights:** Proactive network monitoring, augmented by AI-powered technologies, provides insights into network performance and user behaviour.

- **Improved experience:** AI-driven network optimisation guarantees a seamless user experience for critical applications.

- **Flexibility:** NaaS offers the agility needed to promptly adapt to changing business requirements.

- **Scalability:** The ability to expand network infrastructure effortlessly, without the burden of acquiring new hardware, makes scaling operations a breeze.

- **Anywhere access:** The cloud-based nature of NaaS ensures accessibility from any corner of the globe.

NaaS can amplify the inherent capabilities of 5G through dynamic network configurations, enabled by SDN.

IoT to high-definition streaming. Security, a paramount concern in 5G, is bolstered by NaaS's integrated security features, ensuring robust data protection and resilience against threats. Additionally, in Multi-access Edge Computing or MEC environments within 5G, NaaS's ability to manage computational resources further optimises latency and localised data processing.

Additionally, NaaS is instrumental in realising the "network as a sensor" concept. By virtualising sensing capabilities, NaaS transforms networks into adaptive sensors, enabling real-time data collection and the 6G vision of creating authentic digital twin representations of the physical world with multi-layered maps of our environment. In short, NaaS acts as a bridge, seamlessly connecting the present capabilities of 5G with the future potential of 6G.

THE FUTURE PROPOSITIONS

The future of NaaS appears exceedingly promising. A report by Forrester reveals that nearly two-thirds of IT leaders are actively transitioning to NaaS and other "as-a-service" models. Much akin to the meteoric rise of SaaS, NaaS is poised to revolutionise networking functions in the decade ahead, ushering in an era of heightened connectivity and efficiency.

Challenges in NaaS implementation: While NaaS offers a plethora of benefits, it is not without its challenges. Compatibility issues may arise when attempting to integrate legacy systems with NaaS infrastructures. On-premise data centres may not seamlessly mesh with cloud-based NaaS models, leading to potential operational hiccups. Furthermore, a

reliance on specific features from a single NaaS provider can result in vendor lock-in, inhibiting the flexibility to switch to alternative providers.

NaaS vs. other service models: It's crucial to distinguish NaaS from other service models like Infrastructure as a Service (IaaS) and Platform as a Service (PaaS). Unlike IaaS, which provides infrastructure resources, or PaaS which offers software platforms, NaaS's primary focus is on delivering networking services. It does not encompass the provision of business software or data storage, thus carving its unique niche within the realm of cloud services.

Relation with SASE: Secure Access Service Edge (SASE) aligns seamlessly with NaaS infrastructures. SASE focuses on securing individual applications, making it an ideal complement to NaaS. NaaS providers can secure specific applications without compromising performance, thereby ensuring a seamless and secure networking experience.

NaaS stands as a transformative force reshaping how businesses approach networking. By offering a flexible, scalable and efficient networking solution, NaaS is poised to become a cornerstone in the modern IT landscape. Its potential to drive innovation and efficiency in the telecom industry and beyond is undeniable, making it a technology to watch closely in the coming years. With NaaS, the future of networking is brighter and more adaptable than ever before. 🔻

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SUSTAINABLE TELECOM NETWORKS

SUSTAINABLE TELECOM NETWORKS

Publication	THE FINANCIAL EXPRESS
Headline	Green Telecom Networks: Exploring Sustainability through Non-Conventional Power Sources

In our increasingly interconnected world, the telecommunications industry serves as the backbone of global connectivity. However, as the specter of climate change looms large, there is an urgent need to pivot towards more sustainable and eco-friendly practices. Enter green telecom networks, a transformative concept that places energy efficiency, carbon emissions reduction and long-term sustainability at the forefront of its operations. Here's a peek into the pivotal role that green technologies like fuel cells and hydrogen cells play within the framework of green telecom networks, and their significance in steering the industry towards a more environmentally responsible future.

Need for Green Telecom

Telecom operators currently account for a notable 1.6% of global CO_2 emissions within the Information and Communication Technology (ICT) sector. With the imminent proliferation of the present 5G and future 6G technologies and their diverse applications, this figure is poised to surge, making it imperative for the industry to undertake a sustainable transformation. As per a report by the Japan Science and Technology Agency, the world IP traffic is estimated to reach 30 times more than the present in 2030 and 4,000 times in 2050. Assuming that related technologies remain similar, the electric power consumption for the same is estimated to reach 42PWh annually in 2030, and 5000PWh in 2050, much greater than the current world electricity consumption of about 24PWh. So, cost-effective throughput is as important a reason for transitioning to green technologies, as is mitigating climate change and reducing carbon footprints.

Technology advancements

Some advancements in Green Telecom are already showing the way for more efficient energy usage. For example, the evolution of Energy-Efficient Equipment like routers, switches and base stations now facilitate advanced power management systems and energy-efficient components, yielding substantial energy savings for operators. Intelligent network technologies also reduce the amount of equipment needed by optimizing the utilization of the equipment, thus reducing capex. Furthermore, intelligent base station designs can dynamically adjust power consumption, enhancing efficiency during off-peak hours.

Integration of renewable energy is invariably the right path forward. We can see that solar panels, wind turbines and innovative energy kites are reshaping the energy landscape across the world. Solar panels harness sunlight in sun-drenched regions, while wind turbines generate clean electricity in areas with consistent wind patterns. Energy kites, on the other hand, utilize high-altitude winds for reliable energy generation with minimal environmental impact. Through subtle design innovations and integration, these could contribute significantly to the energy needs of the telecom sector.

When it comes to digital infrastructure, submerged data centers represent a groundbreaking approach to cooling and power consumption. Placed underwater, these centers utilize natural water cooling to maintain ideal server temperatures. Additionally, liquid and free cooling techniques promise to further boost energy efficiency in telecom operations.

Network Optimization via advanced algorithms, dynamic spectrum access and IoT-enabled optimizations can streamline network operations for energy efficiency. Intelligently routing data and optimizing resources help conserve power, while IoT sensors optimize cooling and fuel monitoring, making networks more efficient while also helping reduce opex.

Key energy-demand and cost-reduction opportunities include waste management protocols and material recycling, essential facets of telecom sustainability. Many RAN suppliers are also investing in green technologies for the upcoming 6G era, such as zero-energy devices and reconfiguring intelligent surfaces.

Rise of Fuel Cells

In the quest for uninterrupted network connectivity, the telecom industry is undergoing a significant shift. Conventional backup power sources, such as diesel generators, are being eclipsed by the adoption of fuel cells. These innovative energy systems offer reliability and eco-friendliness, positioning them as ideal solutions for standalone operations. Their continuous operation, minimal emissions, longevity and reduced maintenance needs make them a compelling choice.

Hydrogen fuel cells are one of the best sustainable fuel cell options, using hydrogen to produce only water as a byproduct, ensuring zero emissions. Their benefits for Base Transceiver Stations (BTS) include high energy density, eco-friendliness, scalability and flexible storage. The automobile sector is increasingly exploring these cells for commercial vehicles. India's Hydrogen Fuel Cell Vehicle Market is projected to grow from USD 900.24 Mn in 2023 to USD 1737.9 Mn by 2028, with a CAGR of 14.06%.

[TELECOM TALK]
SUSTAINABILITY

LT GEN DR S P KOCHHAR

GREEN TELECOM: KEY TO A SUSTAINABLE DIGITAL FUTURE

An array of options is available to the sector to meet its energy demand in an eco-friendly way. An industry veteran compares them and points to the future

The telecommunications industry has become an indispensable part of our lives, connecting billions of people around the world. But as in every other sector, the growing environmental concerns necessitate the adoption of more sustainable and eco-friendly practices. The emergence of green telecom networks, which prioritise energy efficiency, reduced carbon emissions and overall long-term sustainability, would play a decisive role in this endeavour for the future of the sector.

THE NEED FOR GREEN TELECOM

It is vital to understand the pressing need for green telecom networks. Within the ICT sector, telcos are responsible for 1.6% of total global CO_2 emissions, which contribute to climate change. As the demand for telecom services is expected to grow exponentially with the upcoming 5G and 6G technologies and their use cases, this figure is expected to rise further. This makes it imperative to transition towards more sustainable and eco-friendly operations.

Advancements in telecom technologies have led to practices which optimise power consumption and lead to more efficient use. Some of these are:

ENERGY-EFFICIENT EQUIPMENT

Modern routers, switches and low-energy base stations have transformed the telecom industry through significant advancements in energy efficiency. These devices now incorporate advanced power management systems and energy-efficient components. Cutting-edge semiconductors and processors are designed to consume less power while maintaining high performance. This not only reduces energy consumption but also leads to substantial cost savings for telecom operators. Moreover, new base station designs with intelligent systems can dynamically adjust power consumption based on network traffic patterns, further enhancing energy efficiency during off-peak hours.

INITIATIVES AND STRATEGIES

Advanced algorithms play a pivotal role in optimising network operations for energy efficiency. By intelligently routing data to minimise transmission distances, these algorithms reduce energy consumption. For instance, data can be routed through paths with lower energy requirements, thereby conserving power.

Dynamic spectrum access allows networks to adapt and allocate frequencies as needed, reducing the energy expended on idle or underutilised spectrum. Further, IoT-enabled optimisations like the utilisation of sensors to optimise cooling, smart metering and fuel monitoring can help in making the network more efficient.

> " Embracing sustainable energy solutions is not only an opportunity to reduce operational costs but also a vital contribution to global sustainability goals.

> Advancements in telecom technologies have led to practices which optimise power consumption and lead to more efficient use.

Submerged datacentres: Submerged datacentres offer an innovative approach to cooling and power consumption. These datacentres are placed underwater, leveraging the natural cooling properties of water to maintain optimal temperatures for the servers. Liquid and Free Cooling are other promising cooling techniques to enhance energy efficiency to reduce the energy footprint for telecom network operations.

Waste management protocols: This involves responsible disposal and recycling of electronic waste arising from outdated equipment. Sustainable e-waste management not only curbs environmental impact but also ensures adherence to regulatory mandates. In tandem, material recycling represents another crucial facet of telecom sustainability.

Renewable energy integration: The integration of solar panels into telecom infrastructure has become a game-changer. Photovoltaic cells capture sunlight and convert it directly into electricity. This renewable energy source is particularly effective in regions with abundant sunshine. Telecom operators are increasingly adopting solar panels to reduce their reliance on conventional power sources. For locations with consistent wind patterns, wind turbines can be utilised to generate clean electricity. This approach is better suited for remote areas with limited access to the grid.

An emerging and innovative approach to renewable energy integration in green telecom networks is the use of energy kites. Energy kites, also known as airborne wind energy systems, are a groundbreaking technology that harnesses wind energy at higher altitudes using tethered kites. The key advantages of this technology include the utilisation of stronger and more consistent winds for reliable energy generation, higher portability, lower installation and maintenance costs, 24/7 operation and a minimal physical footprint.

POTENTIAL OF FUEL CELLS IN TELECOM OPERATIONS

In the ever-evolving world of telecommunications, ensuring uninterrupted network connectivity is paramount. However, the challenge of power cuts and inconsistent power supplies adds significant operational

costs to the equation. Currently, diesel generators serve as the go-to backup power source to maintain continuous operation in the case of electricity disruptions. But as we confront the environmental impact of diesel generators and the growing demand for sustainable solutions, the telecom industry is shifting its focus towards the adoption of fuel cells. These innovative energy systems offer a reliable and eco-friendly alternative, making them ideal for standalone operations and supplementing the quest for uninterrupted connectivity.

Fuel cells: Fuel cells are electrochemical devices that efficiently convert chemical energy from fuel and oxygen into electricity. Unlike batteries, fuel cells require a continuous source of fuel and oxygen to operate, but produce minimal emissions in the process. Some examples of fuel cells are Proton Exchange Membranes (PEMFC), Solid Oxide Fuel Cells (SOFC) and Direct Methanol Fuel Cells (DMFC).

Fuel cells are renowned for their longevity. They have a significantly longer operational life compared to traditional batteries, reducing the frequency of replacements and associated waste. Another compelling advantage of fuel cells is their eco-friendliness and high reliability. These devices produce minimal emissions, significantly reducing the carbon footprint of telecom operations.

In the context of backup power sources for telecom networks, fuel cells outperform traditional batteries and diesel generators. They continuously generate electricity as long as fuel is supplied, making them ideal for networks with varying power needs. Additionally, they have longer life spans, reducing the need for frequent replacements and waste. Compared to diesel generators, fuel cells are quieter and require less maintenance.

HYDROGEN CELLS FOR BTS: A DEEP DIVE

Hydrogen fuel cells use hydrogen as a fuel source and oxygen, usually sourced from the air, as an oxidant. The only byproduct of this electrochemical reaction is water, ensuring zero emissions and making it an exceptionally clean and environment-friendly energy source.

Government initiatives: The Indian government has been taking significant steps towards promoting green

An emerging and innovative approach to renewable energy integration in green telecom networks is the use of energy kites (aka airborne wind energy systems).
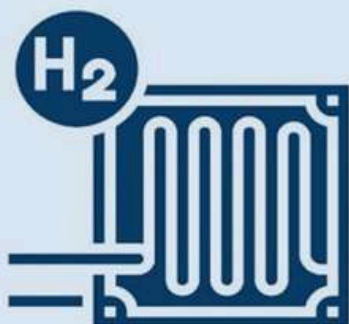
WHY HYDROGEN CELLS FOR BTS?

- **High energy density:** Hydrogen boasts an impressive energy-to-weight ratio, making it highly efficient for powering Base Transceiver Stations (BTS). These stations require a reliable and consistent source of energy, and hydrogen cells offer an energy-dense solution that aligns perfectly with their needs.

- **Clean energy:** As water is the only byproduct of the hydrogen-oxygen reaction, hydrogen cells are an ideal choice for reducing the carbon footprint of BTS.

- **Scalability:** Highly scalable, hydrogen fuel cells can be easily adjusted to match the energy requirements of BTS, providing flexibility in network infrastructure planning and deployment.

- **Storage:** Hydrogen can be stored in various forms, depending on the specific requirements of BTS operations. It can be stored as a compressed gas, a liquid, or even in chemical compounds. This versatility ensures that hydrogen can be tailored to suit the needs of different telecom installations.

technology initiatives and has set ambitious targets to achieve net-zero emissions by 2070. India has already implemented several policy measures to accelerate the shift to cleaner and more efficient technologies, such as subsidies for electric vehicles and the removal of subsidies for petrol and diesel.

The government has approved the National Green Hydrogen Mission, which aims to make India a leading producer and supplier of green hydrogen in the world. The mission has an initial outlay of Rs. 19,744 crore and aims to achieve a green hydrogen production capacity of at least 5 million metric tonnes per annum with an associated renewable energy capacity addition of about 125 GW in the country.

It has also introduced the Green Credits Programme to incentivise voluntary environmental actions undertaken by individuals, private sectors, small-scale industries, cooperatives, forestry enterprises and farmer-produce organisations for their environmental actions. Significant steps have been taken to promote green technology initiatives, and these initiatives could help India emerge as a key base for hydrogen electrolyser production with 8GW capacity by 2025.

ROLE OF PUBLIC-PRIVATE PARTNERSHIPS

Driving the shift to green telecom solutions necessitates a synergistic approach, and collaborations between governments and private telecom operators have proven instrumental in this regard. Governments can play a pivotal role by providing fiscal incentives and tax breaks, which considerably reduce the financial burden on private entities keen on transitioning to green solutions. Moreover, pooling resources from both public and private sectors can expedite joint research and development initiatives, thereby fast-tracking technological advancements. Beyond the technical and financial facets, these collaborations hold the potential to spearhead public awareness campaigns, educating the masses on the environmental implications of telecom operations and elucidating the imperative transition towards greener solutions.
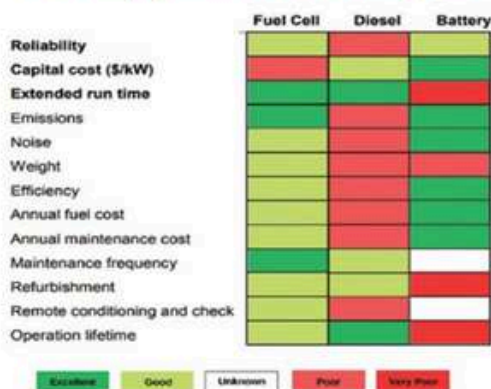
Simplified mechanics of a hydrogen fuel cell
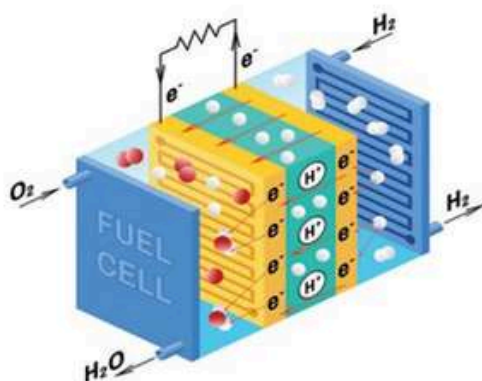
Source: Mechanics of a hydrogen fuel cell made simple. Andretti Group; 2021. https://andretti1.com/mechanics-hydrogen-fuel-cell.

Qualitative comparison of backup power technologies

	Fuel Cell	Diesel	Battery
Reliability			
Capital cost ($/kW)			
Extended run time			
Emissions			
Noise			
Weight			
Efficiency			
Annual fuel cost			
Annual maintenance cost			
Maintenance frequency			
Refurbishment			
Remote conditioning and check			
Operation lifetime			

Legend: Excellent · Good · Unknown · Poor · Very Poor

Source: Hydrogen fuel cell performance as telecommunications backup power in the United States. National Renewable Energy Laboratory; 2015. https://www.energy.gov/eere/fuelcells/articles/hydrogen-fuel-cell-performance-telecommunications-backup-power-united.

GREEN TELECOM ROADBLOCKS

The transition towards green telecom solutions, while essential, comes with its set of challenges that the industry grapples with. High upfront investment is often necessary, especially when considering the shift to promising technologies such as hydrogen fuel cells. Many operators find this initial capital requirement daunting.

Furthermore, there's the intricate task of retrofitting and altering existing network infrastructures to accommodate these new energy sources, presenting both logistical and financial hurdles. Even as hydrogen emerges as a beacon of hope for green energy, consistent availability, especially of green hydrogen, remains a concern, underscoring supply chain issues. Additionally, on the path to full adoption, the industry still has technical speed bumps that need addressing, underscoring the need for ongoing innovation and problem-solving.

On-ground support is also required for the implementation of progressive policy measures like the Green Energy Open Access enabled by the Ministry of Power, which the states and discoms need to adopt swiftly to help enhance green energy use in telecom.

THE ROAD AHEAD

The integration of fuel cells, especially hydrogen cells, into telecom operations is not merely a passing trend but a necessity. As the telecommunications industry continues to expand to meet the growing demand for connectivity, so does its energy consumption. Embracing sustainable energy solutions is not only an opportunity to reduce operational costs but also a vital contribution to global sustainability goals.

Green telecom networks represent a promising future for both the telecom industry and the planet. By embracing these innovative technologies and practices, telecom operators can lead the way in creating a greener, more sustainable world. It's a journey that aligns with global and national sustainability objectives and promises to make telecom an even more responsible and environment-friendly industry. 🍀

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FAIR SHARE CONTRIBUTIONS FROM LTGs

FAIR SHARE CONTRIBUTIONS FROM LTGs

Publication	ET TELECOM
Headline	Fair Share: Aligning with the Digital India Mission

The Digital India mission, a flagship initiative of the Indian government, aims to foster a digitally inclusive society, ensuring that the benefits of the digital revolution reach every nook and corner of the country. However, as we embark on this ambitious journey, a pertinent issue looms large: the equitable distribution of network usage costs between Telecom Service Providers (TSPs) and Over-The-Top (OTT) platforms. This question, while technical in its essence, strikes at the very heart of our collective digital dream, urging us to redefine value, responsibility and fairness in this brave new world.

The Digital Surge and Data Transmission

The digital age has ushered in a new era of content consumption. OTT platforms, from streaming giants to social media behemoths, have become integral to our daily lives. This digital proliferation has led to a massive surge in data transmission, with millions streaming, downloading and sharing content simultaneously. While this aligns with the Digital India mission's objectives, it also poses significant challenges for TSPs, who are grappling with the escalating capital expenditure (capex) required to support this data deluge.

The Unsung Heroes: TSPs at the Forefront

The narrative of India's digital transformation often celebrates the rise of OTT platforms, e-commerce giants and tech startups. While their contributions are undeniable, the foundational role of Telecom Service Providers (TSPs) tends to be overshadowed. Yet, without their relentless efforts, the digital dreams of millions would remain just that – dreams.

TSPs have been the backbone of India's digital revolution. They have tirelessly worked to provide ubiquitous connectivity, even in the remotest parts of the country, ensuring that the benefits of digitalization are universally accessible. Their commitment is evident in their massive investments in spectrum acquisitions (INR 1.5 lakh crore in the last auction itself), network deployments and the introduction of cutting-edge technologies like 5G. They've poured billions into acquiring spectrum rights, often at premium prices. Beyond these headline numbers, there's a continuous investment in upgrading and maintaining networks, ensuring that they can handle the ever-increasing data demands of a burgeoning digital population.

Yet, as they bear the brunt of the increasing data demand, there's a growing clarion call for a more equitable compensation model.
Rethinking Compensation: The B2B Model

The current digital ecosystem is a complex web of interactions between Telecom Service Providers (TSPs), OTT platforms, advertisers and consumers. Each entity plays a distinct role, and each derives value in its own way. However, as the lines between content providers and content deliverers blur, there's a growing realization that the traditional models of compensation might no longer be tenable.

TSPs' approach is clear and consumer-centric: seek compensation through Business-to-Business (B2B) means without burdening the end consumer with additional costs. In the current digital ecosystem though, while TSPs charge only the consumers for network access, OTT platforms enjoy a dual revenue advantage, charging both advertisers and consumers. This the disparity between the investments made by TSPs and the benefits reaped by OTT platforms is becoming increasingly evident in the rapidly evolving digital landscape.

Balancing the Scales

To bridge this gap and ensure a more equitable distribution of network usage costs, a fair-share charging methodology emerges as a promising solution. And it is a prevailing concept practiced in other sectors, though absent and opposed in telecom somehow.

If we look at sectors like Broadcasting or Railways/Roadways, users of the networks/roads pay a charge for using the infrastructure to carry out their business activities. In broadcasting, the Content Provider pays a port charge to the Network Provider for using their networks to reach their consumers. In fact, the charges are higher for HD/Premium channels which require more bandwidth, in comparison to SD or FTA channels, for appropriate compensation. Similarly, passenger/carriage vehicles like buses/trucks, pay a toll tax for using the highways/expressways which allow greater loads and require more maintenance, while a municipal tax is paid for State Highways or Village Roads which can accommodate less loads. A similar model is imperative for telecom in India!

Under this proposed model, OTT platforms would be charged based on their traffic generation. This approach recognizes the vast differences in data usage patterns among OTT platforms. For instance, a streaming service like Netflix would naturally consume more bandwidth compared to a text-based messaging app.

By focusing on Large Traffic Generators (LTGs) — the major players in the OTT space — this model ensures that those platforms which place a higher demand on the network infrastructure contribute more significantly to its upkeep and expansion. Such a system not only promotes fairness, but also encourages OTT platforms to optimize their data usage, leading to a more efficient and sustainable digital ecosystem.

Protecting the Underdogs: Small OTTs and Startups

While the focus is on ensuring that digital giants contribute their fair share, it's equally crucial to protect the interests of smaller OTTs and startups. These emerging platforms, although smaller in scale, play a pivotal role in fostering innovation and diversity in the digital content space. Hence, a nuanced strategy that differentiates between LTGs and protects the rise of innovation and entrepreneurship through smaller players is necessary.

Debunking Popular Misconceptions

There are arguments from certain quarters that LTGs also invest substantially in creating infrastructure like undersea cables, CDNs, etc. Fact is, OTTs make these investments in their own products and services, which do not replace or complement the investments on national core, aggregation and access networks made by the TSPs. Neither do the investments made by OTTs compensate for the recurring costs of TSP networks. These facilities are not shared with the TSPs or used by others for catering to public service requirements. At most, the infrastructure developed by OTTs can be compared to private lawns, serving their own requirements only, while TSP Networks are comparable to Public Parks as they serve all customers.

Further, some misconceptions emerge that a fair-share charge would go against the Net Neutrality principle. Through proper study of the concept, one would realise that Net Neutrality concerns unbiased treatment of content, and is completely unrelated to the proposed fair-share charge to be paid by OTTs to TSPs. Let me emphasize here that TSPs are bound and committed to follow the Net Neutrality principle as per their licensing conditions, irrespective of any other development in the ecosystem.

The Global Perspective

It's worth noting that this debate isn't unique to India. Globally, countries are grappling with similar challenges. For instance, in South Korea, the tussle between SK Telecom and Netflix over network usage fees has set a precedent. The European Union is also mulling over a policy framework to ensure that big tech companies contribute to telecom capex budgets.

Towards a Collaborative Future

The Digital India mission envisions a future where digital services are accessible, affordable and inclusive. Realizing this vision requires a collaborative approach, where all stakeholders - including TSPs and OTT platforms/any other mega data generator, contribute and work together towards a prosperous digital future. As we stand at this digital crossroad, it's time to foster a dialogue, address the challenges and collaboratively pave the way for a harmonious and sustainable digital ecosystem for the good of the common man.

OUTLOOK initiative

Understanding Fair Share: Why contribution from OTTs is critical?

By Lt. Gen. Dr. S.P. Kochhar, Director General, COAI

The Indian telecom sector's proposal for a fair-share contribution from Over-the-Top (OTT) services to support network expenses and expansion has ignited a heated debate. While differing views have emerged, here's an attempt to clearly articulate the concept of fair-share and its rationale, while debunking some popular misconceptions.

Let's draw an analogy between constructing a building and creating & operating telecom networks. The cost of land for a building is akin to the entry and license fees paid by telecom companies. Constructing the building is similar to building a network and acquiring spectrum. Building operation costs include electricity, water, maintenance and sanitation, while in telecom, it encompasses running a network in all its aspects, including technology refresh/upgrades.

In both cases, the recovery of the investments/costs is achieved through rent for a building and revenue from services for telecom networks. If an occupant of a building (or a user of a network) sits/rides on top for free, e.g., OTT, and doesn't contribute to land/building/network costs by refusing to pay rent or for maintenance or upgrades while benefiting directly from the property/network, the building or network becomes a non-profitable enterprise for the owner, even though profits accrue to the 'free' occupant who cannot conduct his/her business without the building/network.

The fallacious argument that revenue is accrued when OTTs drive subscribers to the telecom networks is ill founded. A fact is that the bandwidth-heavy services offered by OTTs lead to increased network traffic, necessitating further upgrades and capacity enhancement. Similarly, the business activities of unauthorised building occupants lead to ongoing strengthening and expansion costs, alongside rising operational expenses. In India, with its low tariff rates and Average Revenue Per User (ARPU), the added traffic from OTTs does not offset the substantial investments made by TSPs.

It is often argued that TSPs could always hike their tariffs to make up for the required revenues. But that is not the intent of this sector, which is committed to facilitating the national goal of 'Digital India' and fulfilling the 'Right to Internet' for all Indian citizens. Therefore, the focus of the TSPs would be on applications and services. While the significant 5G investments by TSPs are being taken for granted, the nation aims for leadership in advanced technologies like 6G, which will demand more bandwidth, increasing network pressures and investment needs. For TSPs to invest further, they need fair returns. The Indian telecom sector, which positioned the nation on the global digital map, has provided affordable digital connectivity across the country and introduced advanced technologies like 5G.

It's imperative that responsible contributions are needed from all stakeholders in the digital ecosystem to ensure the continued progress of our digital ambitions. We hope for a greater sense of holistic development and benefits for all to take centre stage in this matter, looking forward to similar initiatives in the Indian market.

OTTs Must Pay Up Cash-Strapped Indian Telcos. Don't worry, it won't violate Net Neutrality

The Indian telecommunications industry faces a sad predicament today. Icons of India's digital revolution and the nation's ascension as a digital economy, telecom service providers will continue to bear the massive burden of driving the highly ambitious digital agenda alone. Providing ubiquitous, affordable, and expansive digital connectivity services across the diverse and difficult topography of the country isn't enough anymore. But would it be possible to do more at the cost of losing business viability or even by risking sustenance?

We are in an era of convergence when new and sophisticated technologies are emerging every day and existing ones are evolving at a rapid pace. It is no surprise, then, that these technological advancements are being leveraged to the maximum by new applications and services like OTTs, which create and then cater to a demand for the same.

The incredible digital proliferation, once again thanks to the telcos, has led to a massive surge in data transmission, with millions streaming, downloading, and sharing content simultaneously. While this aligns well with the Digital India mission's objectives, it also poses significant challenges for TSPs, which are struggling with the escalating capital expenditure (capex) required to support this data deluge and ensuring both capacity and quality for the consumers at the same time.

While the mammoth investments by TSPs in acquiring spectrum to ensure bandwidth grab headlines every now and then, the 'unsung' investments in network deployments, upgrades, operations, and maintenance go unnoticed. Pan-India telecom networks, created through decades of efforts and continued colossal investments, seem to be taken for granted and expected to serve as free rides for the OTTs and similar services.

Not giving back to India

Digital India envisions a digitally inclusive society, ensuring that the benefits of the revolution reach every nook and corner of the country. Given this ambitious objective and keeping in mind the price-sensitive nature of the Indian market, it is neither feasible nor preferable that consumer prices be hiked to ensure sustenance and business viability as often suggested by some. It is only prudent that telcos will look at more practical avenues to gather support for the immense financial obligations to deliver the nation's digital goals. The focus, invariably and inevitably, would be on networks, applications, and innovative services that include OTTs.

The OTTs, especially the large traffic generators (LTGs) that generate the majority of the internet traffic, are happy to earn from both consumers and advertisers, racking up exponential revenues by exploiting telecom networks. But when it comes to giving back to the networks, they are indifferent, or rather hostile. It is ironic that these entities, majorly owned by global tech giants whose individual revenues probably far surpass the collective ones of all Indian TSPs together, are strongly opposed to contributing to the network building, maintenance, and upgradation costs of the telcos. Moreover, they deliver leviathan revenues to their home countries — and little to no contributions to the Indian government as they do not pay any license fee or regulatory costs/expenses, which are borne by TSPs
.
The concept and practice of payment to infrastructure providers is not a unique one. If we look at sectors like broadcasting, railways, or roadways, users of the infrastructure pay to the providers. This could be in the way of some charges levied by broadcasters or in the form of toll/municipal taxes or freight carriage charges in railways. So what prevents OTTs from paying a similar fair-share charge to cash-strapped telcos?

Contrary to some misguided opinions being floated in various forums, a fair-share contribution from OTTs will not violate net neutrality. Indian telcos are bound by their licence conditions to ensure net neutrality and will continue to do so, fair-share or not.

Expect more financial burden ahead

As we stare into a future of more advancements in technology and further convergence of digital and communication platforms, especially with the introduction of 5G, 5G+ and our aspirations for the future 6G, it's realistic to expect the emergence of more bandwidth-heavy applications and services. This means both capex and investments to deliver them would also soar—and become impossible for the telcos to bear alone.

If we are to truly realise the Digital India vision, collaborative efforts and responsible contributions need to be made by all the stakeholders involved. Only this can ensure sustainability and advancement of the continued incredible journey of India's technological growth and prowess.

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OTHERS

ET TELECOM

World Telecom day

In the kaleidoscopic world of technology, we find ourselves in an era where connectivity weaves an intricate fabric in our lives. Smartphones, tablets and a wealth of information have transcended mundane necessity to become essential ingredients for our existence. We now reside in a domain labelled "Connected Living".

As we traverse this futuristic landscape, our homes will become digital strongholds that can be remotely controlled to modulate temperature and prevent water leaks while we are away. Contrary to conventional wisdom, big data and artificial intelligence (AI) are revolutionising how we combat fatal diseases. We are on the verge of a technological revolution, but not all of us are fortunate enough to enjoy its benefits. The least developed countries (LDCs) are at the bottom of the scale in terms of technological advancement and its effective implementation. For these nations, a satisfying, fruitful, secure, affordable and enriching online experience remains elusive due to economic, political and social obstacles.

In contrast to the global average of 66%, only 36% of the LDC population will use the internet in 2022, according to data from the International Telecommunication Union. Surprisingly, 17% of the population lacked access to fixed or mobile broadband networks, while the remaining 47% encountered barriers such as affordability.

This year's World Telecommunication and Information Society Day (WTISD) theme is "Empowering the least developed countries through information and communication technologies" to ensure that they can harness the power of emerging technologies like AI and Internet of Things (IoT), and achieve sustainable development goals for all. This initiative seeks to increase awareness of the transformative potential of the Internet and other ICTs in closing the digital divide.

By connecting the unconnected, ICTs are capable of opening doors to vast realms of knowledge, fostering innovation and creating opportunities for individuals and communities alike. In the face of an increasingly interconnected world, bridging the digital divide has become imperative to achieving a more equitable and inclusive society, where everyone, regardless of their location or socioeconomic background, can harness the benefits of digital technologies.

One such example of the transformative potential of ICTs is the rise of telemedicine and remote learning in underserved communities. By overcoming geographic barriers, these technologies are breaking down the walls of traditional healthcare and education systems, enabling remote communities to access high-quality medical care and learning resources that were once out of reach.

Moreover, the proliferation of mobile devices and their increasing affordability are catalysing a wave of innovation in emerging markets, empowering individuals with tools to become digital entrepreneurs, creating local solutions to local problems, and driving social change. Digital development is the key to prosperity for the world's least developed nations.

It is crucial to ensure extensive data connectivity in the most remote regions of the world and to leave no stone untouched in the pursuit of growth and empowerment. The introduction of 5G technology will be a game-changer, propelling LDCs towards poverty eradication, sustainable development and global competitiveness.

With the arrival of 5G, high-performance mobile services are reaching remarkable levels worldwide. In India, the introduction of 5G will enable numerous advantages, including much faster internet speeds, enhanced connectivity and superior user experiences. As a driver of economic development and innovation, 5G is poised to establish India as a global leader in the telecommunications industry.

Nestled amidst the verdant tapestry of the Indian countryside lies a hidden powerhouse, fuelling the engine of the nation's economic expansion – rural India. With its abundant resources and boundless spirit, the potential of our rural economy will be fuelled by a combination of both tradition and innovation. Digital literacy programs sow the seeds of knowledge, empowering villagers to access global markets, opening vistas of opportunities and fostering a generation of homegrown entrepreneurs.

Due to 5G, rural India, a pillar of the nation's economic expansion, will experience unprecedented development acceleration. This would revolutionise agriculture by streamlining operations and bridging the urban-rural divide. However, the transformation will be incremental, reliant on the development of infrastructure and government support through favourable policies and regulations.

India stands on the cusp of a digital revolution, with the rapid deployment of 5G technology paving the way for the nation to achieve its ambitious goal of a $1 trillion digital economy by 2025.

The widespread adoption of 5G is set to unleash a wave of unprecedented speed and connectivity, propelling India into a future of unparalleled innovation and growth. This technological leap will not only enhance existing industries, but also catalyse the emergence of new ones, ultimately driving the country towards a prosperous and digitally empowered society, bringing closer to attaining the Digital India vision. The future is upon us and is carving its route through the technological universe.

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INSIGHT

Women in tech – Bridging the gender gap towards excellence

Lt. Gen. Dr. S.P. Kochhar | Director General | COAI

Sheryl Sandberg, the former COO of Meta Platforms, once remarked, "The word 'female', when inserted in front of something, always comes with a note of surprise. Female COO, female pilot, female surgeon – as if the gender implies surprise. One day there will not be female leaders. There will just be leaders." This statement underscores the prevailing surprise associated with women in leadership roles, especially in the tech industry.

Globally, women remain under-represented in decision-making positions. Yet, their participation is not merely a matter of rights; it is pivotal for sustainable development. Engaging both genders in decision-making fosters creativity, innovation, and broadens the talent pool. Research indicates that diverse workplaces outperform their homogeneous counterparts, emphasizing the importance of gender diversity for innovation and global competitiveness.

Recent years have witnessed a commendable increase in the representation of women in tech. For instance, 34 percent of IT professionals in India are women, predominantly under the age of 30. Furthermore, India is nearing a balanced gender ratio among STEM graduates. Such strides are encouraging, but there is still a long road ahead.

Studies by the Boston Consulting Group reveal that women-led businesses yield higher returns on investment, compared to those led by men. When startups helmed by women secure funding, they tend to employ 2.5 times more women than men. These businesses often prioritize social contributions and foster positive employee relationships.

The e-commerce sector has emerged as a potent platform for women entrepreneurs. Notable names include Harini Sivakumar (Founder & CEO, Earth Rhythm), Naomi Leon (Founder & Director, Rapid Delivery), and Michelle Lau (Founder & CEO, ClightShip). Platforms like Etsy have further empowered women, with 83 percent of its sellers identifying as female,

contrasting sharply with the global average where women constitute about 35 percent of business owners.

Moreover, women are making significant inroads as content creators and social media marketers. They are redefining influencer marketing, collaborating with brands, and carving out unique identities for themselves.

Women played a pivotal role in the ambitious Chandrayaan-3 mission with over 100 women scientists and engineers reported to have been involved in the mission, lending their knowledge and commitment to different elements of the undertaking. Women have actively shaped the trajectory of the mission, working as scientists, engineers, project managers, and administrators. They have made significant contributions in a variety of important fields, including mission planning, spacecraft design, navigation, and data analysis.

The inclusion of women in key roles not only showcases the progressive approach of the Indian Space Research Organization (ISRO), but also highlights the importance of diversity in scientific endeavors. The Chandrayaan-3 mission not only aims to explore the lunar surface further, but also symbolizes the breaking of gender barriers in the field of space exploration, encouraging more women to pursue careers in science and technology.

However, challenges persist. Women in tech often grapple with:

- Gender bias and stereotypes. Many women feel compelled to outperform due to prevailing biases. Tech firms can counteract this by promoting awareness and training staff to recognize biases and employing gender-neutral language.

- Lack of female mentors. The absence of female role models can be discouraging. Encouraging mentorship by senior female executives can bridge this gap.

- Networking constraints. Networking is crucial for career growth. Events and conferences can actively promote female participation to foster connections.

- Work-life balance. Women often juggle work and family responsibilities. Tech companies can alleviate this by offering flexible work arrangements.

By adopting these strategies, the tech industry can pave a smoother path for women, enabling them to contribute their expertise on a global platform.

The Indian government, recognizing the importance of women in tech, emphasizes women-led development. Prime Minister Narendra Modi envisions creating 20 million lakhpati didis across villages, and lauds the Tech Equity Platform for promoting digital and financial literacy among women. Under India's G20 Presidency, a dedicated G20 Empower Working Group on Corporate Women Empowerment is in the works to focus on accelerating advancement of women in the private sector to drive global economic growth and transformative progress for the world economy. The success of flagship programs like Chandrayaan, Gaganyaan, and the Mars Mission is also attributed to the talent and dedication of women scientists.

We can, at this juncture, be confident that the momentum is building towards a gender-equal tech environment. The goal is clear – to foster an unbiased ecosystem where women occupy primary positions, serving as role models and leaders for future generations. ∎

> WOMEN WILL SOON OCCUPY PRIMARY POSITIONS SERVING AS LEADERS FOR FUTURE GENERATIONS.

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