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30 YEARS SINCE 1994

India pivots from edge to hyperscale data centres, driven by a surge in AI demands and government initiatives



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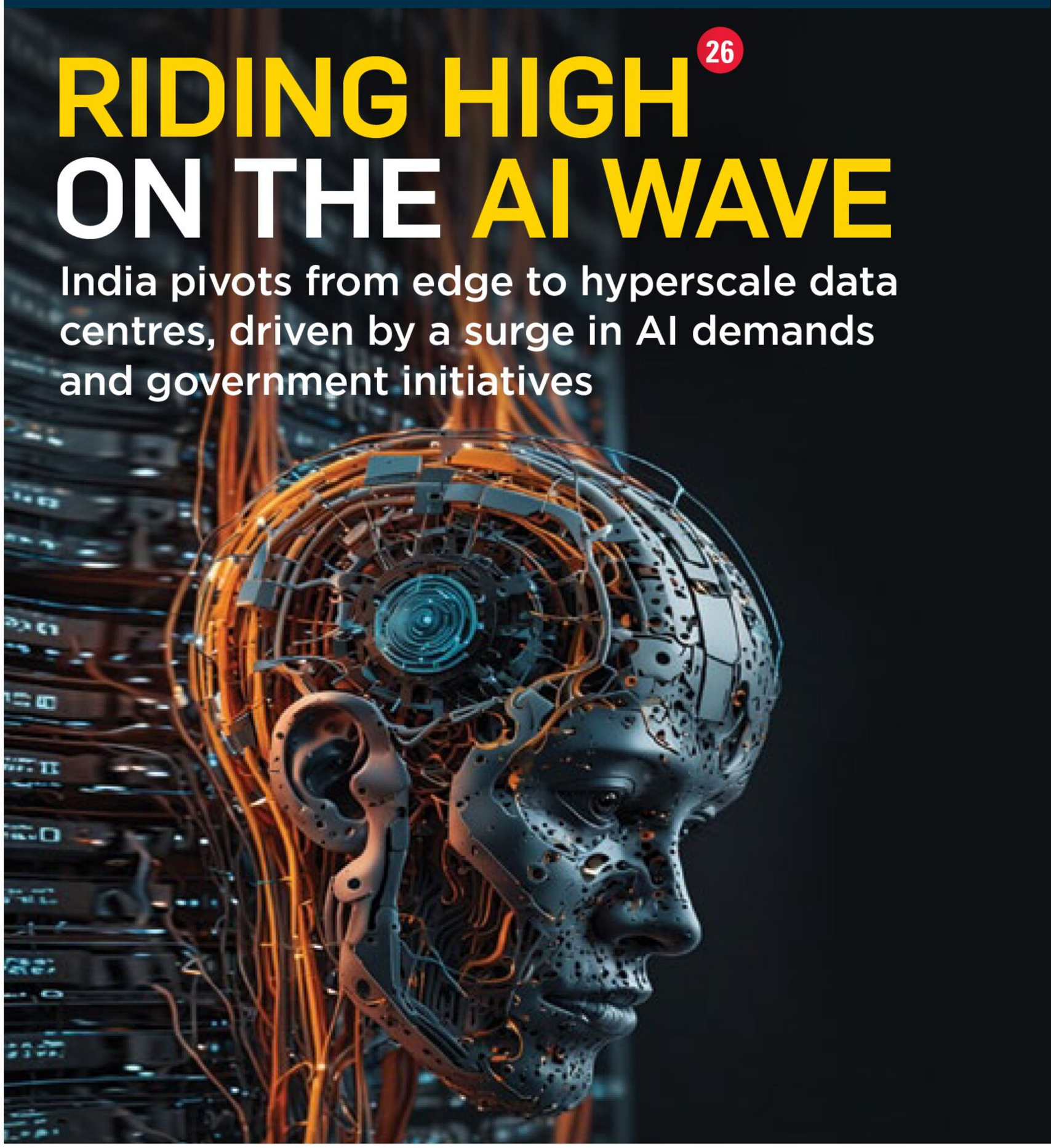
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June 2024

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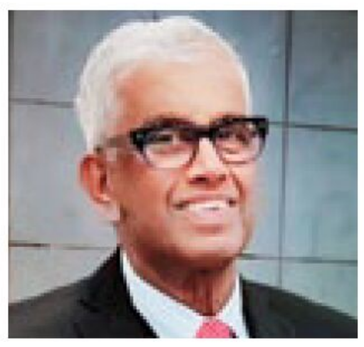
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NEXT ISSUE

TECHNOLOGIES THAT CHANGED COMMUNICATION IN INDIA



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SHUBHENDU
PARTH

[OPENING NOTE]

Telecom triumph: 30 Years of connecting India

Three decades ago, India's telecom landscape resembled a quaint, antediluvian gramophone record – a single, limited melody accessible only to a privileged few. Conversations were measured in precious minutes, and teledensity was a mere murmur at 0.2%. The 1994 National Telecom Policy proved transformative, ushering in an era of vibrant competition and private participation. The year also marked the launch of Voice&Data.

Subsequent telecom policies, the opening up of India's economy, and the vision of 'telecommunication for all' acted as a powerful crescendo, driving private players into joining the orchestra and transforming the sluggish system into a dynamic network, carrying a symphony of voices. Today, India boasts the world's second-largest telecom market, with an overall teledensity of 85.64% and an urban teledensity of 134.13% as of February 2024. Mobile phones have become ubiquitous, connecting families, businesses, and communities nationwide.

The initial years of the telecom revolution (cellular phone) were characterised by fierce competition, drastically reducing call rates. Prepaid recharge plans democratised mobile services, bridging the digital divide and empowering even the remotest villages. This democratisation of access played a crucial role in India's digital transformation, strengthening it further during the pandemic-driven lockdown.

Innovation has been at the heart of this evolution. The introduction of 3G services revolutionised mobile Internet access, followed by the transformative impact of 4G. Today, India boasts the world's fastest 5G rollout, with nearly 180 million subscribers, achieved in just over 18 months. This rapid advancement promises faster speeds and a multitude of new applications, fuelling the growth of e-commerce, mobile banking, and a vibrant startup ecosystem.

The telecom sector has become a vital pillar of India's economic growth, contributing significantly to the GDP and creating millions of jobs, particularly in the service sector. It has empowered small and medium businesses to reach wider markets and compete globally, ensuring every enterprise has a voice.

The story of India's telecom sector is one of remarkable progress, driven by policy reforms, private sector dynamism, and a national spirit to connect and grow. As we enter the fourth decade, the melody of progress continues, with the nascent 6G initiative promising even more groundbreaking advancements. The *Atmanirbhar Bharat* initiative fosters self-reliance in telecom equipment manufacturing, exemplified by the successful deployment of a Made in India 4G stack and handset manufacturing at a scale.

However, challenges remain. Bridging the rural-urban connectivity gap and ensuring equitable access to the digital revolution's benefits are critical. Additionally, data privacy and security concerns must be proactively addressed to maintain a secure and efficient network. Last but not least, the ARPU needs to go up for service providers to remain viable.

For the past 30 years, this magazine has been a steadfast companion of the incredible telecom journey. It has documented the evolution of technologies, told stories of triumphs and tribulations, and provided valuable insights into shaping the sector's future. As India strives to become a digitally empowered nation, the publication's role in fostering informed discussions and propelling innovation remains ever more crucial.

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[INDUSTRY SPEAK]

CLOUD SECURITY

Fortifying India's data castle in the cloud realm

Prioritising proactive security, compliance, and ethics is pivotal for harnessing the cloud's potential while ensuring data integrity and privacy



BY RUCHIN KUMAR

Cloud computing has heralded a new digital transformation era, reshaping the operational landscape across industries worldwide. Amidst its rapid technological evolution spurred by Digital India and Aadhaar initiatives, India finds itself at the forefront of this paradigm shift. However, as Indian organisations increasingly embrace cloud-based infrastructures, the imperative to safeguard data protection and privacy has never been more critical. This comprehensive exploration delves into the multifaceted challenges and intricacies of securing sensitive information in India's burgeoning cloud era.

INDIA'S DIGITAL SURGE

India's digitalisation journey has been nothing short of a revolution, driven by a staggering increase in mobile subscriptions and Internet usage. With a population exceeding a billion, the sheer volume of data generated and stored online is mind-boggling. While the cloud offers unmatched scalability and accessibility, it poses significant data security and privacy risks. This is a critical concern for entities entrusting their valuable data to cloud services, including personal information, financial records, or proprietary business data.

Despite robust security measures implemented by cloud service providers, the threat of unauthorised access and data breaches looms large in the cloud environment. Cyber threats, from sophisticated phishing attacks to insidious ransomware campaigns, present significant challenges. The shared responsibility model, a fundamental aspect of cloud service provision, highlights the need for joint efforts between providers and customers to strengthen security comprehensively. While providers offer robust security infrastructures, customers must enhance these with strict access controls, encryption protocols, and vigilant monitoring to effectively mitigate risks.

India's regulatory framework has evolved significantly since the introduction of landmark legislation such as the Personal Data Protection Bill and the GDPR-inspired Data Protection Framework. These regulations aim to fortify data protection norms, empowering individuals with greater control over their data and imposing stringent penalties for non-compliance. However, the effective implementation of these regulations still needs to be improved, marred by compliance hurdles and calls for heightened regulatory oversight. The intricacies of data sovereignty, cross-border data transfers, and regulatory ambiguity add complexity for organisations navigating the cloud landscape.

BEST PRACTICES IN DATA GOVERNANCE

Adhering to best practices is paramount for organisations traversing the cloud. Rigorous risk assessments serve as the cornerstone for proactively identifying vulnerabilities and threats. Implementing robust encryption protocols at rest and in transit fortifies data security against potential breaches. Moreover, compliance with data residency requirements, particularly in regulated sectors like healthcare and finance, is indispensable to mitigate legal risks. Comprehensive employee training and awareness programmes are essential to mitigate human error and insider threats, ensuring personnel are well-equipped to safeguard sensitive data effectively.



IN BRIEF

- India's cloud adoption demands rigorous data protection and privacy measures to handle the massive data generated.
- Despite robust security measures, cloud environments face significant cyber threats, requiring joint efforts for enhanced protection.
- India's evolving regulatory framework strengthens data protection, yet challenges in compliance and oversight persist.
- Best practices in data governance, such as encryption and employee training, are crucial for mitigating risks in cloud infrastructures.
- The shift to remote work underscores the need for zero-trust security models to protect sensitive data from various access points.

Technological advancements, such as Artificial Intelligence (AI) and Machine Learning, hold immense promise in augmenting traditional security measures within the cloud. AI-powered security solutions offer enhanced threat detection capabilities, analysing vast real-time data troves to proactively identify anomalies and potential security incidents. However, deploying these technologies raises ethical concerns surrounding data privacy and algorithmic bias. Striking a delicate balance between innovation, ethics, and regulatory compliance is imperative to harness the full potential of emerging technologies while safeguarding data privacy and integrity.

The COVID-19 pandemic has catalysed a seismic shift towards remote work and digital collaboration, underscoring the critical importance of robust cloud security measures. With employees accessing sensitive data from disparate locations and devices, organisations must adopt a zero-trust security model. This paradigm verifies every user and device accessing the network, regardless of their location, mitigating the risk of insider threats and unauthorised access.

The advent of the cloud era heralds unprecedented opportunities for innovation and growth, yet it brings formidable data protection and privacy challenges. Collaborative efforts across stakeholders, encompassing government agencies, regulatory bodies, cloud service providers, and businesses, are imperative as India charts its digital trajectory.

Prioritising proactive security measures, regulatory compliance, and ethical considerations is pivotal to unleashing the cloud's transformative potential while safeguarding data integrity and privacy. Upholding the highest data protection and privacy standards is paramount for fostering trust and confidence in India's burgeoning digital economy.



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[NEWS ANALYSIS]
BROADCOM–VMWARE

Brewing a new cloud frontier

Broadcom's acquisition of VMware marks a crucial moment in the tech industry, setting the stage to reshape the cloud-computing landscape



BY THOMAS GEORGE

In the last few weeks, the enterprise landscape has been abuzz with announcements from Broadcom's corner room. The pot of enterprise Cloud and virtualisation market is being stirred up with many bold and unexpected moves.

Broadcom's acquisition of VMware has marked a pivotal moment in the tech industry, setting the stage to reshape the cloud computing landscape. In the post-acquisition period, the organisation made substantial progress towards cementing Broadcom's position as a leading global infrastructure technology company, a journey detailed in Hock Tan's blog, VMware by Broadcom: the first 100 days. Voice&Data analysis delves into Broadcom's comprehensive strategic overhaul and its implications across the market.

> CEO Hock Tan noted that Broadcom's commitment to invest USD 1 billion in innovation bolsters the VMware Cloud Foundation's growth trajectory.

> By streamlining operations and adopting a subscription model, Broadcom aims to enhance the accessibility and adaptability of its offerings.

STRATEGIC OVERHAUL, MODEL-FLIP, MARKET ADAPTATION

Broadcom's strategic integration of VMware has been extensive, encompassing sweeping changes to software portfolios, go-to-market strategies, and organisational structures. The shift from perpetual to subscription licensing reflects a broader industry trend, aligning with modern business models that accentuate flexibility and scalability. By streamlining operations and adopting a subscription model, Broadcom aims to enhance the accessibility and adaptability of its offerings, thus augmenting value for its customers.

INNOVATION AND CUSTOMER-CENTRIC REFORMS

CEO Hock Tan noted that Broadcom's commitment to invest USD 1 billion in innovation bolsters the VMware Cloud Foundation's (VCF) growth trajectory. VCF aptly demonstrates Broadcom's strategy to simplify IT infrastructure, enabling rapid business acceleration in a competitive environment. This platform integrates software-defined computing, networking, storage, and management into a unified service that significantly reduces complexity and boosts operational efficiency.

Key themes from discussions with CIOs and industry leaders—speed, simplicity, and security—lie at the heart of Broadcom's revamped strategy. VCF addresses these needs and fortifies the resilience and security vital in today's digital ecosystem. The platform's comprehensive integration empowers businesses to fully leverage their technology investments, offering a hybrid model that melds public cloud agility with private cloud security.

PRICING STRATEGY AND CLOUD COMPETITION

In a strategic move to broaden VCF's accessibility, Broadcom has slashed the subscription list price by half – a stark challenge to the rising costs of public clouds. This pricing strategy aims to improve enterprises' total cost of ownership, positioning the innovative platform as an appealing alternative to existing public cloud solutions.

BATTLING RESISTANCE, STRENGTHENING PARTNERS

Adjustments to Broadcom's partnership program, prompted by the acquisition, have stirred the ecosystem, initially leading to some resistance from partners who need clarification about the new directions. However, proactive engagement and transparent communication have been crucial in re-establishing trust and alignment with long-tail service providers and significant partners.

The competitive landscape has seen heightened aggressiveness from various companies, challenging Broadcom to maintain its market lead through sustained innovation and customer engagement. Broadcom's strategy seems to focus not solely on technological excellence but also on nurturing a robust, knowledgeable partner network capable of effectively driving the new integrated solutions to the market.

FUTURE DIRECTIONS AND ROADMAP

Broadcom's future in cloud infrastructure is closely tied to the continued development and enhancement of VCF. It introduces new capabilities, such as Tanzu for container management and integrated networking and security solutions, which could position VCF as a formidable competitor to traditional public cloud services. Extending cloud capabilities to the edge with software-defined Edge will hopefully underscore Broadcom's commitment to innovation and its strategic vision for a comprehensive, scalable cloud environment.

EASIER SAID THAN DONE

While the strategy of simplification appears promising, implementing it poses significant challenges. Customers require definitive assurances about their future within Broadcom's ecosystem, emphasising the need for clear and robust solution roadmaps and dependable support systems. The transitions must be

[NEWS ANALYSIS]

BROADCOM–VMWARE

Broadcom's future in cloud infrastructure is closely tied to the continued development and enhancement of VMware Cloud Foundation.



IN BRIEF

- **Strategic integration:** VMware's acquisition will bring sweeping changes to software portfolios, go-to-market strategies, and subscription licensing.
- **Innovation investment:** Broadcom committed USD 1 billion to VMware Cloud Foundation, which integrates computing, networking, and storage to simplify IT infrastructure.
- **Customer-centric focus:** Broadcom's strategy is guided by key themes of speed, simplicity, and security, enhancing IT investments and offering a hybrid cloud model.
- **Competitive pricing:** Broadcom halved VCF subscription prices, positioning it as a cost-effective alternative to expensive public cloud solutions.
- **Partner engagement:** Despite initial resistance, the company aims to strengthen and align its partner network with the new strategic direction.
- **Future vision:** With new capabilities and a focus on edge computing, Broadcom aims to lead in cloud infrastructure innovation and secure its competitive edge.

seamless, emphasising enhancing customer service and meticulously managing customer relationships. This would require a lot of work in many areas, mainly related to the conversion and renewal of long-term contracts.

Furthermore, effectively integrating and empowering the partner ecosystem is crucial. Partners must be successfully incorporated into the Broadcom Advantage program, essential for driving the business forward under the new subscription model. This program must align with Broadcom's strategic goals and resonate with partners' business models and market goals.

Broadcom's acquisition of VMware represents more than just a consolidation of technological assets; it is a strategic realignment that looks like it is being aimed at crafting a more agile, secure, and cost-effective cloud infrastructure landscape. As elucidated by Hock Tan, the journey beyond the first 100 days is poised to revolutionise how enterprises leverage cloud technology, with VMware Cloud Foundation leading this transformative endeavour.

With significant investments in innovation and a focused effort on simplifying technological complexities, Broadcom is set to spearhead a new era in infrastructure technology, delivering substantial benefits to customers and partners alike. The unfolding of this strategy for VMware Cloud Foundation promises to establish it as the premier platform for deploying a comprehensive, flexible, and integrated private cloud infrastructure across various endpoints.

We are here to watch and analyse this pot, smelling the new future as it unfolds.

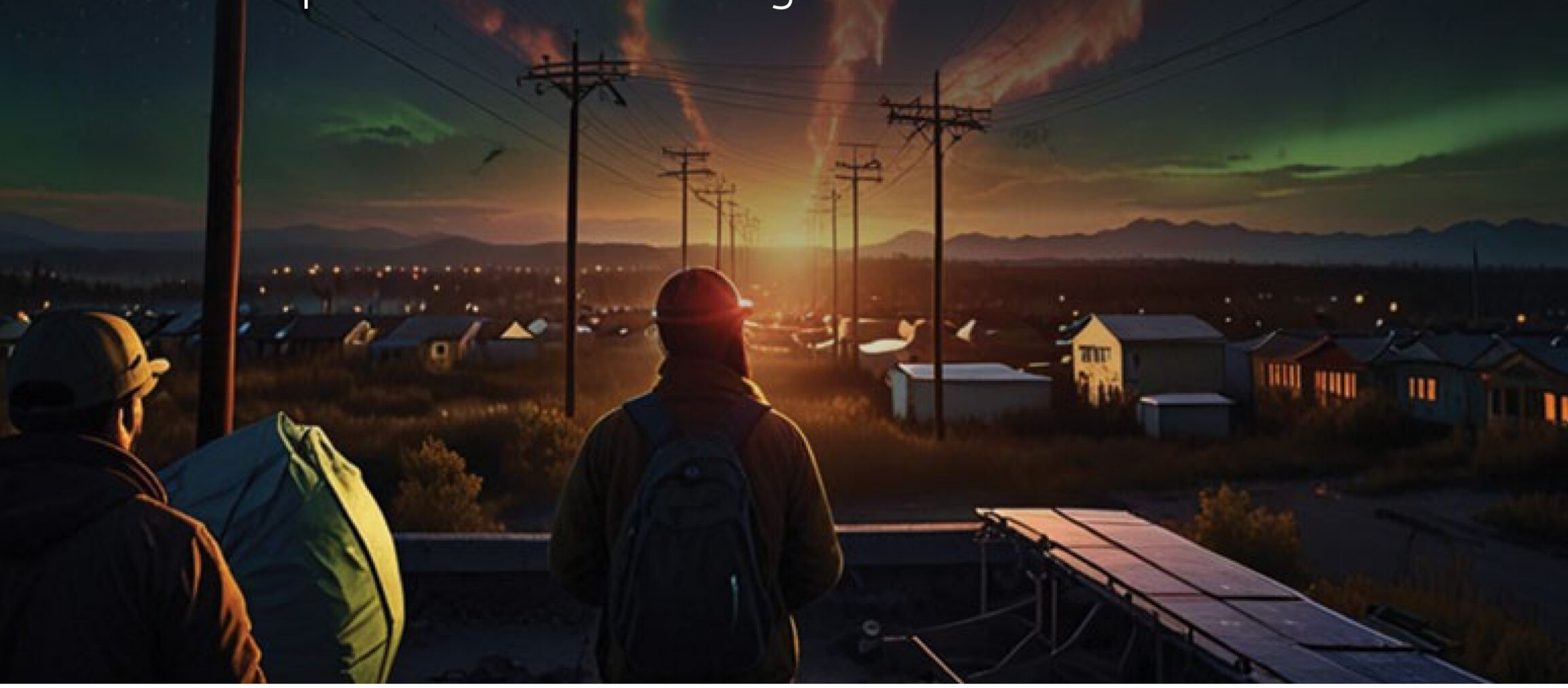
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Sun's wrath threatens communication on Earth

May's intense solar flares highlight the vulnerability of global communication and power infrastructure to blackout risks from unpredictable solar changes



BY VERNIKA AWAL

During the month of May, Earth was struck by the most severe solar storm it has encountered in the past two decades. This event sparked concerns about the potential for multiple blackouts, including those of satellites in orbit, ground stations, power grids, and global communications and networking infrastructure. The incident underscored a long-standing worry that has plagued humanity for years—what might occur when the most devastating solar storm inevitably strikes Earth?

While the worst circumstances were avoided this time, the issues are not out of the line. Solar storms, which occur due to solar flares that come in periodic intervals, can be devastating. At their potential worst, solar storms can destroy satellites in orbit. This can damage most

> The 1859 Carrington Event knocked out global telegraph infrastructure, while the 2003 Halloween Storm impacted power grids in South Africa and Sweden.

> With AI, algorithms can help predict and project the intensity of a bad solar storm's impact and help protect satellites against irreversible damage.

of the global positioning systems and communication frequencies. On the ground, this can cause satellite stations to stop working as radio frequencies and laser-based data transfers are interrupted. In their worst cases, solar storms that eventually hit the lowest rungs of the atmosphere can potentially damage power grids and transformers, too—all of which can come together to bring the global juggernaut of telecommunications, positioning and networking infrastructure to a grinding halt.

Even as the gorgeous aurora borealis, or the northern lights, continue to entice tourists and make them travel far and wide in search of magical experiences, these solar storms can be catastrophic for communications and technologies that make the world function.

WHAT ARE SOLAR STORMS?

The Sun, the central star of the solar system, has been studied extensively since the mid-1700s, providing nearly three centuries of data and observations regarding its behaviour. As a result, one key observation made is its periodic cycles—solar activity follows an 11-year pattern. In this cycle, material activity on the Sun's surface and magnetic activity in its atmosphere increases to reach a crescendo in the middle of the cycle before gradually slowing down. Eventually, it follows an ebb-and-flow pattern.

When the activity peaks, plasma material on the Sun's surface reacts violently due to gaseous reactions and 'storms' on the solar mass. This leads to an incident that space observation bodies have termed 'coronal mass ejection' or CME—an activity that causes the storm to spew out plasma material from its surface. This, in turn, causes the magnetic field around the solar atmosphere to eventually snap due to the sheer force, ejecting a spew of charged particles with their magnetic field across the solar system. While this happens across all directions of space, what concerns scientists are only the storms that face Earth's way.

When the storm nears Earth, its magnetic field—the outermost layer of the atmosphere—helps protect against most of it. However, in the most powerful solar storms, the charged particles ejected by the Sun overwhelm the Earth's magnetic field, and the ions from the Sun enter the lower levels of the atmosphere. While this is what causes the Northern Lights, it also affects most of the global infrastructure. This is commonly referred to as a solar storm.

HOW DOES IT IMPACT?

When a solar storm occurs, satellites placed in orbit get affected since the atmosphere around the Earth gets heated up. This, in turn, changes the density of the atmosphere, which impacts how objects in the Earth's atmosphere travel. For satellites, changes in trajectories could be planned. However, what cannot be planned are changes to the trajectories of space debris—which in turn leaves satellites at potential collision risk.

These satellites can also end up defunct or dysfunctional if the storm is exceptionally high and makes a direct hit on the satellites before they can react. In such cases, the electrical circuits in a satellite are overwhelmed and risk being entirely damaged. Charged solar particles also interfere with radio frequency transmissions and laser communications systems between satellites in orbit or satellites to ground stations—thereby leading to faulty wireless data transmission or, worst case, no transmissions at all.

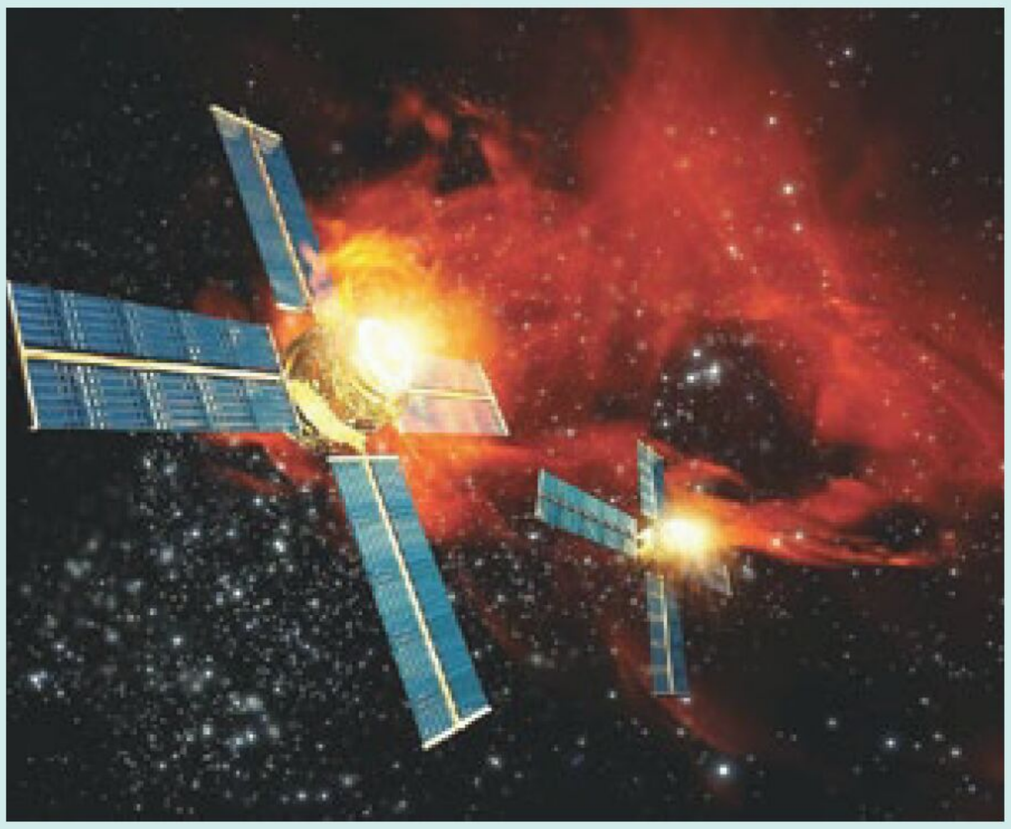
At the lowest levels of the atmosphere, charged particles can also overpower on-ground power grids. This can lead to irreversible damage to power infrastructure, which then needs to be replaced.

As a result of all this, what can potentially go wrong is global communications infrastructure. With India opening up space-based satellite communications as a field, Satcom-powered Internet services can potentially face complete blackouts. Satellite operators may also lose satellites—like Elon Musk's Starlink in 2022. Such incidents have already happened before—in the infamous 'Carrington Event' of 1859, the global telegraph infrastructure was knocked out. More recently, in 2003's 'Halloween Storm', power grids in South Africa and Sweden were knocked offline by vicious solar storms.

WHAT CAN BE DONE?

Solar storms are nothing unusual, to be sure, and vary in magnitude. The most benign are solar storms rated as 'C', which are low intensity. The 'M' rated storms are also essentially harmless, and with prior knowledge, any damage can be avoided.

Solar storms can cause satellite stations to stop working, interrupting radio frequencies and laser-based data transfers and halting communication.



IN BRIEF

- May saw Earth hit by its worst solar storm in two decades, raising concerns about potential blackouts in satellites, ground stations, power grids, and global communications infrastructure.
- Solar storms result from periodic solar flares, with the potential to disrupt satellites, communication frequencies, and ground infrastructure.
- Solar storms can lead to trajectory changes for satellites, collisions with space debris, and electrical circuit damage due to charged particles.
- The impact of solar storms can extend to defunct satellites, faulty wireless data transmission, and damage to power grids.
- Solar observatories like NOAA and ESA monitor solar behaviour, but AI and data analytics are crucial for predicting and mitigating the impact of severe solar storms.
- Despite efforts, the unpredictability of solar storms poses ongoing challenges for protecting global infrastructure.

The concerning ones are rated 'G' and 'X'—leaving the world's satellite, networking and power operators with work. However, experts have conducted regular research to understand the related incidents thoroughly. For instance, the United States National Oceanic and Atmospheric Administration (NOAA) under the National Aeronautics and Space Administration, as well as the European Space Agency, continuously study solar behaviour through satellites and spacecraft placed at strategic 'Lagrange' points between the Earth and the Sun. The Indian Space Research Organisation has also joined this party, with its maiden Aditya-L1 solar observatory sitting at Lagrange Point-1, or L1, to observe changes and errant behaviour from the Sun.

For the most part, solar observatories do a reasonable job of warning systems back on Earth about potentially devastating solar storms. However, the Sun's behaviour can also be erratic, which means that simply following a set pattern may not help in protecting the global infrastructure.

This is where Artificial Intelligence (AI) and data analytics come into play. With AI, algorithms can help predict and project the intensity of a bad solar storm's impact. If used correctly, solar storms can be expected and protected against—which may help protect satellites against irreversible damage. In the long run, this is key.

SO, ARE WE SAFE?

Unfortunately, as with all things space, one can never say never. As the solar surface continues to age, solar storms could become increasingly unpredictable. As they worsen, ruling out the possibility of being completely protected against a solar storm surpassing all others may prove challenging.

However, until then, global coordination across space agencies, on-ground studies and dedicated bodies studying space weather remain vigilant to ensure that satellites are shielded and diverted when such storms hit. For instance, even during May's X-rated storm, no significant impact was reported worldwide.

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[USE CASE]

INTERNET OF THINGS

The rise of new IoT-enabled business models

Backed by government initiatives and tech advancements, IoT-enabled business models are driving innovation and reshaping India's business landscape



BY AMIT SATPATHY

The Internet of Things (IoT) has emerged as a transformative force, reshaping industries and unlocking unprecedented business opportunities worldwide. The Indian IoT market is poised for exponential growth, fuelled by favourable government initiatives, technological advancements, and increasing digitalisation across industries.

According to a report by Nasscom, the IoT market in India is expected to reach USD 15 billion by 2025, with significant contributions from sectors such as manufacturing, healthcare, agriculture, and smart cities. The proliferation of IoT devices and the exponential growth of data these industries generate have paved the way for innovative business models centred around IoT data monetisation.

> Companies are now sharing vehicles, optimising their usage and maximising ROI through IoT-enabled tracking and monitoring systems.

Using IoT data, Altizon Systems and Flutura Decision Sciences have developed AI-driven platforms to optimise processes and improve decision-making.

From Platform as a Service (PaaS) to decentralised IoT networks, businesses are exploring diverse avenues to capitalise on this data-driven revolution.

The Centre of Excellence for IoT in Bangalore is critical for the Digital India initiative, aiming to unite startups, enterprises, and the government to tackle real-world challenges using IoT and frontier technologies like AI, big data, and AR/VR. Supported by a co-working space and an innovation lab with advanced facilities, the initiative also benefits from government schemes like the Production Linked Incentive Scheme, now extended to smart meters. Additionally, the government has allocated Rs 1 lakh crore (USD 12 billion) to the Smart Cities Mission to further IoT deployments.

Robust mobile Internet penetration (48%) encourages India's IoT ecosystem, driven by expanding 4G networks and affordable services. Mobile operators have invested in NB-IoT networks, with 95% population coverage, fostering IoT growth. The country hosts a thriving community of device manufacturers, integrators, and startups, with IoT solutions emerging across utilities.

PAAS: EMPOWERING BUSINESSES

Platform-as-a-service (PaaS) has become a cornerstone for IoT-enabled businesses in India. These platforms offer a comprehensive suite of tools and services for developing, deploying, and managing IoT applications. Companies like Bosch IoT Suite, Tata Communications' IoT Marketplace, and Wipro Holmes IoT Platform have gained traction in the Indian market, providing scalable solutions for IoT data management and analytics.

The PaaS model enables businesses to streamline operations, enhance efficiency, and drive innovation by harnessing the power of IoT data. A fully integrated, self-care platform for IoT asset management further strengthens the data-driven revolution. It enhances business efficiency by remotely connecting, controlling, and managing customers' IoT assets through a single dashboard. It future-proofs IoT deployments by offering fully integrated IoT connectivity and device management on a single platform and flexible and easy-to-integrate APIs with third-party applications. This helps seamlessly manage IoT assets and in-life operations.

SAAS: LEVERAGING IOT INSIGHTS

Software-as-a-service (SaaS) has revolutionised how businesses leverage IoT insights to deliver customers predictive maintenance solutions, remote monitoring services, and asset performance management tools.

Businesses can create new revenue streams by offering value-added services based on IoT insights. These could include premium analytics dashboards, consulting services based on data insights, or subscription packages with IoT monitoring and support. For instance, startups like Altizon Systems and Flutura Decision Sciences have developed AI-driven SaaS platforms that empower manufacturing, healthcare, and agriculture industries to optimise processes and improve decision-making based on real-time IoT data.

Freight Tiger, a leading logistic solution provider, offers an IoT-enabled freight management platform that leverages freight data to provide insights and help optimise operations and distribution. This intelligent platform combines location intelligence, visibility fulfilment, freight management, and payment transaction details in one place. It helps provide actionable recommendations based on the data to improve logistic efficiency and streamlined operations.

ASSET SHARING AND PAY-PER-USE MODELS

Asset sharing and pay-per-use models are disrupting traditional business paradigms across various sectors in India. Companies are now sharing vehicles, optimising usage, and maximising ROI through IoT-enabled tracking and monitoring systems. In the logistics, transportation, supply chain, and agriculture industries, companies are sharing their resources like vehicles, warehouses, and collaborative robots by leveraging IoT solutions.

This helps monitor vehicle fleets, track inventory, reduce costs, and optimise resource allocation. Pay-per-use models, facilitated by IoT sensors and smart meters, are gaining momentum in utilities. In these models, consumers pay based on actual consumption, promoting sustainability and cost-effectiveness.

Government bodies like the Ministry of Housing and Urban Affairs are also repowering smart transport

[USE CASE]

INTERNET OF THINGS

Freight Tiger offers an IoT-enabled freight management platform that leverages freight data to provide insights and help optimise operations and distribution.



IN BRIEF

- India's IoT market is rapidly growing, driven by government support, technological advancements, and increasing digitalisation across industries.
- The Centre of Excellence for IoT in Bangalore plays a crucial role in fostering collaboration among startups, enterprises, and the government.
- IoT-facilitated asset sharing and pay-per-use models optimise resource allocation and promote cost-effectiveness across various sectors.
- PaaS empowers businesses with scalable IoT solutions, enhancing efficiency and innovation through IoT data management.
- SaaS leverages IoT insights to offer predictive maintenance, remote monitoring, and asset performance management.
- Decentralised IoT networks enhance security and scalability, with blockchain technology ensuring secure data exchange and integrity.

initiatives, employing IoT for traffic management, vehicle detection, and electronic fare systems in cities like Navi Mumbai, Pimpri-Pune, and Raipur.

Drone applications are also gaining traction, supported by national drone regulations and aspirations to establish India as a global hub by 2030. Primarily used for healthcare, food, and last-mile services, drone deployments are currently in the trial and proof-of-concept phase, reflecting the rapid growth of the drone startup landscape.

DRIVING INNOVATION AND SECURITY WITH DECENTRALISED IOT

Decentralised IoT networks are emerging as game-changers in the Indian landscape, offering enhanced security, scalability, and interoperability. Blockchain technology and IoT devices enable secure data exchange and transactional integrity, eliminating single points of failure and reducing the risk of cyber threats. Globally, startups like IoTeX and IOTA and Indian startups like Transo, O'right, and Datoms are pioneering decentralised IoT solutions, empowering businesses to build transparent ecosystems for data monetisation while ensuring data privacy and sovereignty.

New IoT-enabled business models are reshaping the Indian business landscape, unlocking unprecedented opportunities for innovation, efficiency, and growth. From PaaS and SaaS solutions to asset sharing, pay-per-use models, and decentralised IoT networks, businesses harness IoT data's power to drive value creation and competitive advantage. As the IoT ecosystem continues to evolve, businesses that embrace data-driven strategies and leverage IoT technologies will emerge as leaders in the digital economy, shaping the future of industries across India and beyond.



The author is EVP and Head of IoT Business at Vodafone Idea.

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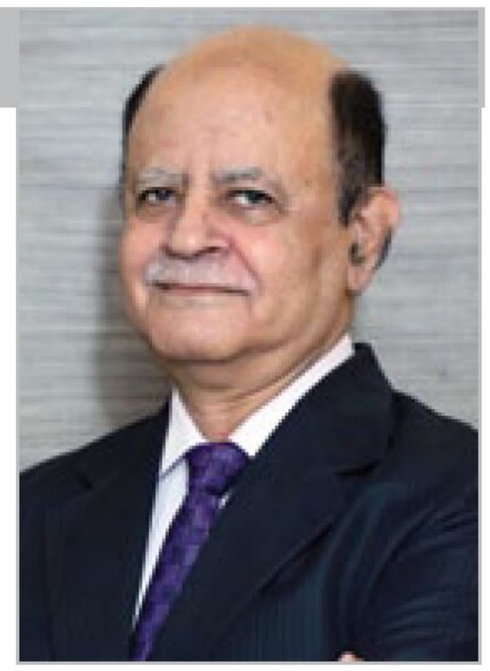
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LT GEN DR S P KOCHHAR

SPECTRUM SYMPHONY: ORCHESTRATING THE MELODY OF FINITE RESOURCES



Efficient spectrum management is essential for India's digital growth and security amidst rising wireless demand and technological advances

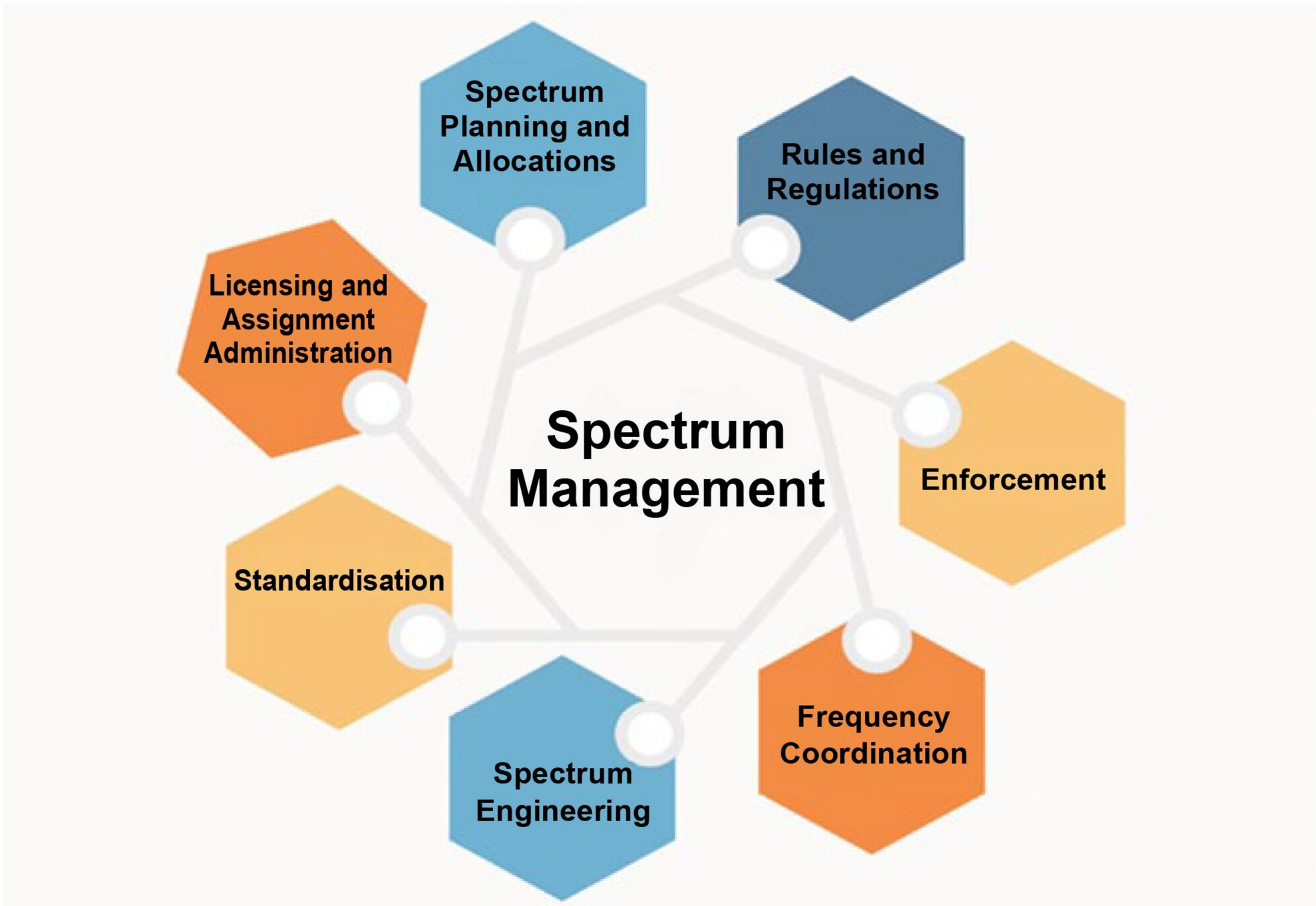
The electromagnetic spectrum serves as the lifeblood of modern communications infrastructure. The spectrum underpins virtually every aspect of modern life, from enabling ubiquitous mobile connectivity to powering innovative Internet of Things (IoT) applications. However, as the digital landscape evolves rapidly, managing finite-spectrum resources becomes increasingly complex.

In a country where millions rely on wireless technologies for essential services, education, commerce, and communications, efficient spectrum management emerges as a paramount concern for sustaining its digital momentum and propelling socioeconomic development. Currently, India stands at a pivotal juncture where strategic actions in spectrum management are imperative to drive the country's digital ambitions to the next level and foster sustainable development across various sectors.



> The intricate balance between meeting current technological needs and planning for future advancements is at the heart of effective spectrum management.

In India, RF spectrum management and regulation are crucial due to the country's vast and diverse needs for wireless communication.



IMPORTANCE OF SPECTRUM MANAGEMENT

Spectrum management and regulation are essential for organising and coordinating the use of the radio frequency (RF) spectrum to prevent interference between different users. The radio spectrum is a finite resource that supports various services, including telecommunications, broadcasting, navigation, and national defence. Without effective management and regulation, the increasing demand for wireless technologies could lead to spectrum congestion, where too many signals interfere with each other, degrading service quality or making specific applications unusable.

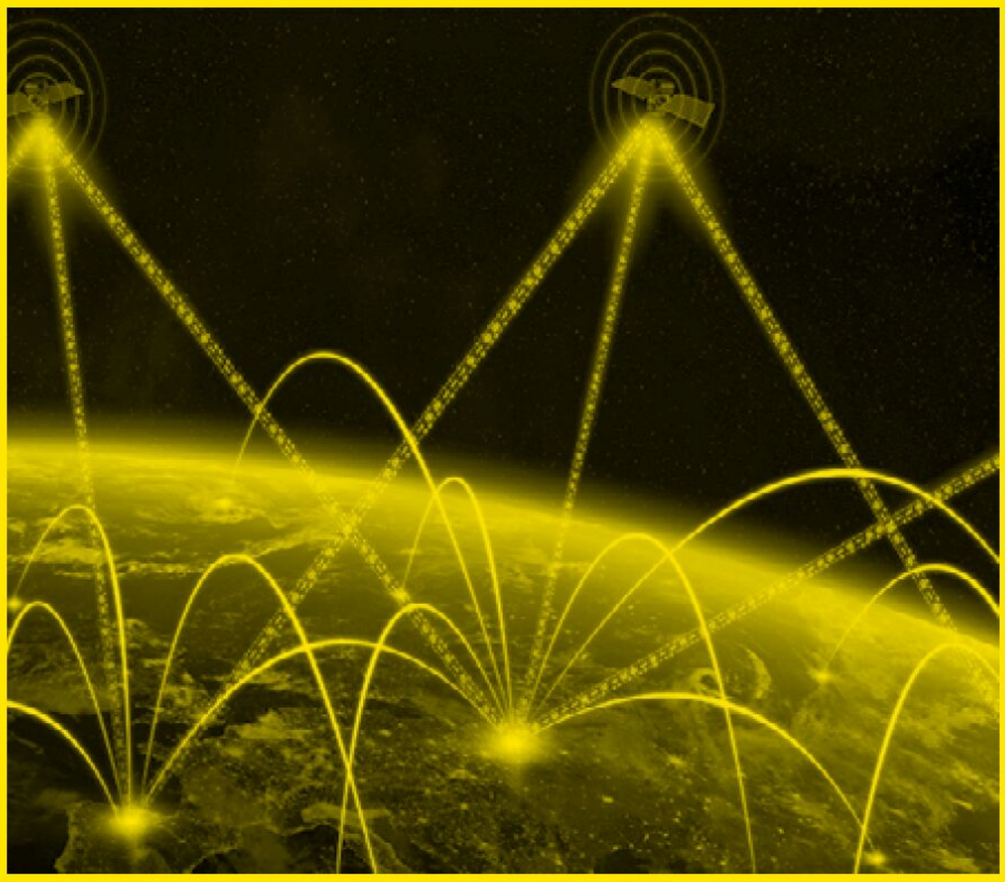
Regulation ensures that the spectrum is used efficiently and fairly, allocating specific bands for particular uses and implementing technical standards to maximise compatibility and minimise interference. This promotes innovation and investment in new technologies and safeguards critical communications, especially in emergencies and public safety operations.

THE INDIA CONTEXT

In India, RF spectrum management and regulation are crucial due to the country's vast and diverse needs for wireless communication, spanning urban to remote rural areas. The Department of Telecommunications, under the Ministry of Communications, oversees spectrum management and regulation, ensuring that the radio frequency spectrum is used efficiently to meet the growing demands for digital communications.

With India's rapid technological growth and the digital revolution, efficient spectrum management supports a wide range of services, including cellular telephony, broadband wireless access, and direct-to-home broadcasting.

Border regions face the challenges of overlapping spectrums that can cause interference, security breaches, and disruptions in communications.



IN BRIEF

- Poor spectrum management can lead to interference, disrupting critical communications and posing security risks.
- India's diverse needs demand robust regulation and coordination to ensure smooth wireless communication.
- Strategic actions in spectrum management are crucial to drive India's digital ambitions and foster sustainable development.
- International collaboration and harmonisation are vital to optimise spectrum use and promote global connectivity.
- Collaborative efforts and bilateral agreements are essential to manage spectrum use effectively, especially in border regions prone to interference and security risks.

The regulatory framework in India also focuses on auctioning spectrum bands to telecom operators, a method that efficiently allocates spectrum and generates significant revenue for the government. This process, along with setting technical and operational standards, ensures that interference is minimised and spectrum is used to promote competition, innovation, and access to digital services for all Indians.

REGULATORY FRAMEWORKS AND NATIONAL STRATEGIES

A robust regulatory framework is the cornerstone of effective spectrum management. Continuous monitoring and enforcement are essential to maintaining order and integrity when using the spectrum. Monitoring involves tracking frequency usage across the spectrum to detect unauthorised or inefficient use.

Regulatory agencies employ advanced monitoring equipment and software to monitor spectrum activities. When irregularities are detected, enforcement actions are taken, which may involve fines, license revocations, or other corrective measures. This vigilance is crucial for preventing interference and maximising the utility of the spectrum.

In addition to allocation and monitoring, countries develop National Frequency Allocation Plans (NFAPs). These strategic plans outline how frequency bands are allocated domestically, taking into account national security, public safety and economic interests. The NFAP is a dynamic document that evolves to accommodate technological advancements and changing societal needs. It serves as a blueprint for managing the spectrum within a country's borders and ensures its use aligns with national priorities.

Moreover, technical standards play a pivotal role in spectrum management. These standards define the rules and protocols governing how different wireless devices and services communicate. They enable interoperability, allowing devices from various manufacturers and services to work together seamlessly. In a world where an array of wireless technologies coexist, standards are the pivots that facilitate harmonious interaction. They

> When spectrum allocations are aligned globally, manufacturers can produce standardised devices at a lower cost, benefiting consumers worldwide.

are crucial in integrating emerging technologies like 5G and the Internet of Things, where diverse devices must communicate seamlessly to deliver their full potential.

SPECTRUM MANAGEMENT FOR DEFENCE

Effective spectrum management at national borders and for defence purposes is a critical aspect that cannot be overstated. Border regions often face unique challenges due to the overlap of different countries' spectrum allocations. Without meticulous management, this overlap can lead to interference, disrupt critical communication channels, and potentially lead to security breaches.

The spectrum is an invaluable asset for national defence. Military operations rely heavily on secure and reliable communication channels, which can be compromised by interference from civilian networks, especially in border areas. Ensuring a clear and interference-free spectrum for defence purposes is a matter of operational efficiency and national security.

To mitigate these risks, countries often enter bilateral or multilateral agreements, especially with neighbouring nations, to coordinate spectrum use along their borders. These agreements are crucial for establishing protocols and guidelines for managing the spectrum in ways that respect each country's needs and minimise interference.

Additionally, defence departments work closely with national spectrum regulatory bodies to carve out dedicated frequency bands for military use. These bands are often shielded from civilian use, ensuring that defence communications remain precise and secure. This separation is vital in times of crisis or military exercises, where the demand for reliable communications is at its peak.

SPECTRUM HARMONISATION AND COLLABORATION

The radio spectrum knows no borders, making international coordination and harmonisation imperative. Without global cooperation, radio frequency interference would be rampant, disrupting wireless communication across national boundaries. Organisations like the International Telecommunication Union (ITU) are the top brass for these efforts, pivotal in setting global standards and managing international spectrum allocation.

Global conferences and agreements, such as the World Radiocommunication Conference, are platforms where countries negotiate and agree upon allocating frequency bands for different services worldwide. These conferences are a testament to the importance of international collaboration, as they ensure efficient global communication and facilitate economies of scale in equipment production. When spectrum allocations are aligned globally, manufacturers can produce standardised devices at a lower cost, benefiting consumers worldwide through reduced prices and enhanced interoperability.

The intricate balance between meeting current technological needs and planning for future advancements is at the heart of effective spectrum management, an essential endeavour for the seamless functioning of modern wireless communication technologies. From establishing national regulatory frameworks to international coordination through organisations like the ITU, spectrum management ensures the optimal use of the spectrum, paving the way for technological innovations and enhanced global connectivity, benefiting societies, economies and individuals alike.

As wireless technologies evolve rapidly, spectrum management will remain a dynamic field, requiring ongoing adaptation and collaboration to meet the ever-growing demands for wireless connectivity. In this digital era, the responsible and efficient management of airwaves is more critical than ever, serving as the foundation upon which our interconnected world is built.

The author is a decorated military veteran who retired as Signal Officer-in-Chief, the head of the Indian Army's ICT. He was also the first CEO of the Telecom Sector Skill Council (TSSC) and is the Director General of the Cellular Operators Association of India (COAI).

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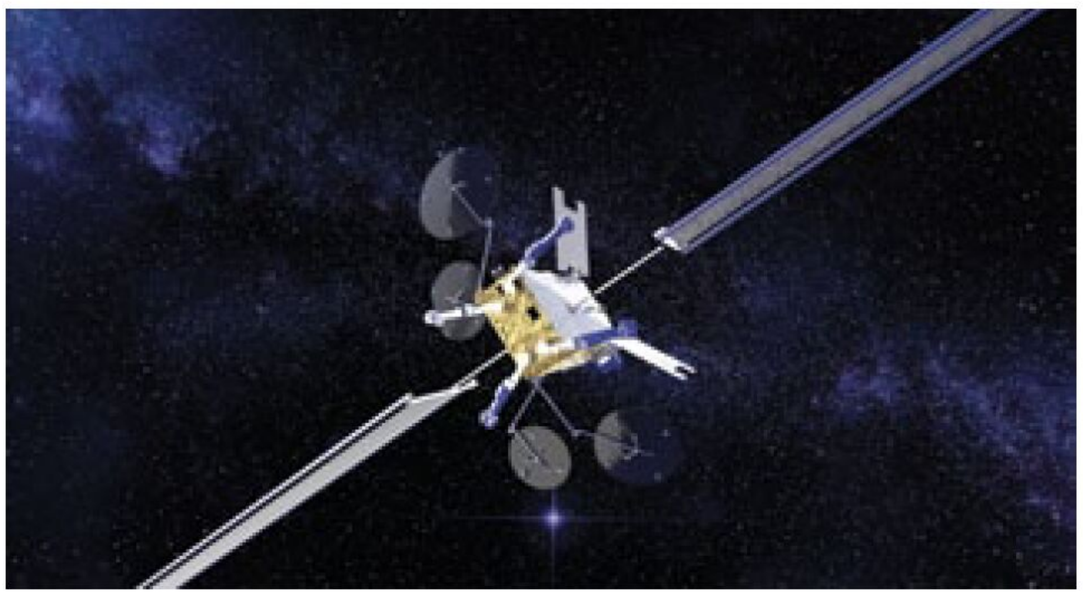
SKY Perfect JSAT, Thales Alenia Space to build software-defined satellite

Satellite operator SKY Perfect JSAT and Thales Alenia Space, the joint venture between Thales (67%) and Leonardo (33%), have signed a contract to build JSAT-31, a new generation of software-defined satellite based on the Space INSPIRE platform by Thales Alenia Space.

Operating in both Ka and Ku frequency bands, JSAT-31 will offer high-speed broadband services over Japan, Southeast Asia, Australia, New Zealand, and the Pacific islands. With a 50Gbps-class capacity, it will have the largest capacity in SKY Perfect JSAT's history and is expected to launch in 2027. It is the 31st satellite procured by SKY Perfect JSAT and the first ordered from Thales Alenia Space.

As the prime contractor, Thales Alenia Space is responsible for the design, manufacturing, testing, and delivery of the satellite, as well as the ground segment and associated services. CNES supports the development of the Space INSPIRE product line.

"JSAT-31 will enhance our offering by providing high-speed, high-capacity, high-reliability, user-friendly, and competitively priced satellite communications services,"



said Eiichi Yonekura, President and CEO of SKY Perfect JSAT. "JSAT-31 will play a key role in our infrastructure, allowing us to meet advanced customer needs and cater to growing markets, especially in the global and mobile sectors."

SKY Perfect JSAT's newest satellite will rely on Space INSPIRE, a software-defined solution offering instant in-orbit adjustment to broadband connectivity demand, maximising the effective use of satellite resources. SKY Perfect JSAT will leverage this flexibility to provide enhanced communications services throughout JSAT-31's lifespan in orbit.

Mavenir, Qualcomm, EchoStar demonstrate 5G RedCap on Open vRAN

Mavenir, Qualcomm, and EchoStar have successfully demonstrated the Reduced Capability (RedCap) 5G capabilities of Mavenir's Open virtualised Radio Access Network (Open vRAN) on the Boost Mobile Network in the US. This milestone, achieved using Qualcomm's Snapdragon X35 5G Modem-RF System, marks the first validation of 3GPP RedCap 5G on an Open RAN network, showing promise for current and future 5G IoT and connected device applications.

RedCap solutions provide enhanced coverage through low power, reducing commercial connectivity costs for applications that do not need full broadband capabilities. EchoStar's integration of RedCap into its Open RAN network expands its market reach, unlocking new revenue streams and opportunities by serving simpler and lower-power 5G devices and applications. This capability allows EchoStar to tailor services to meet the diverse needs of important customer segments.

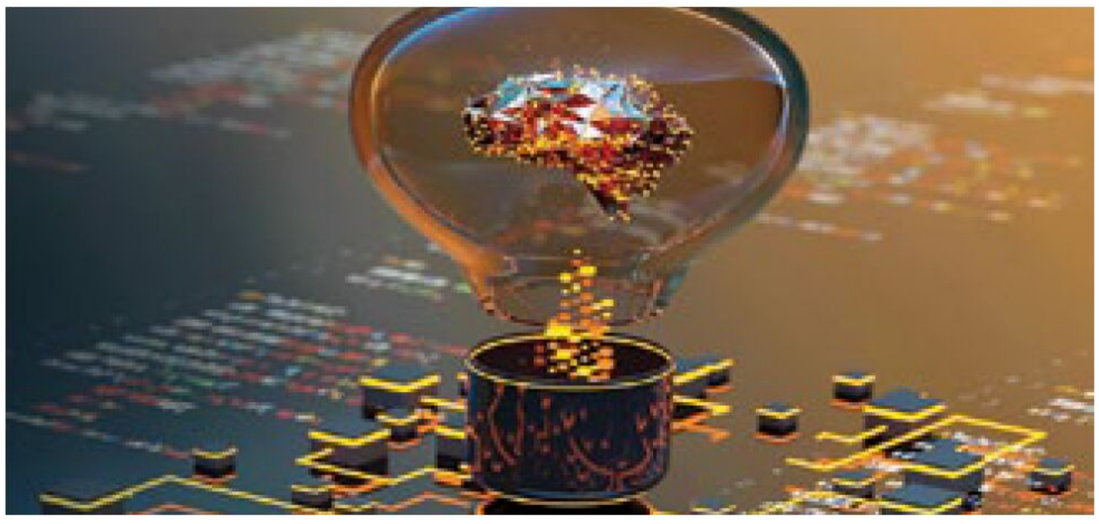
BG Kumar, President, Access Networks, Platforms, and MDE at Mavenir, commented: "The work with RedCap on



the Boost Mobile Network exemplifies our commitment to driving innovation and advancing Open RAN networks. It is a significant step forward for operators seeking to maximise 5G revenue through extensive device connectivity, paving the way for flexible, scalable, and energy-efficient mobile networks."

Gautam Sheoran, VP and General Manager – Wireless and Broadband Communications at Qualcomm Technologies, added: "5G RedCap will be crucial in maximising the efficient use of next-gen networks. We applaud Mavenir and EchoStar for demonstrating these capabilities and marking a true industry milestone."

MediaTek, NVIDIA integrate AI for enhanced IoT solutions



MediaTek has announced the integration of NVIDIA TAO with its NeuroPilot SDK, advancing the edge inference silicon roadmap. This integration aims to streamline the development of edge AI, including generative AI, for a wide array of IoT applications powered by MediaTek's silicon. This initiative supports IoT verticals such as smart retail, manufacturing, healthcare, transportation, and smart cities.

MediaTek powers over two billion connected devices annually. Its edge silicon portfolio is optimised for the performance and efficiency of edge AI applications, incorporating MediaTek's multimedia and connectivity technologies. The portfolio includes chipsets across premium, mid-range, and entry levels, enabling AI experiences on devices at different price points.

Integrating MediaTek's NeuroPilot SDK with NVIDIA TAO will enable developers to advance Vision AI on all MediaTek devices with an easy-to-use interface and performance optimisation features. NVIDIA TAO provides over 100 pre-trained models, facilitating customised vision AI for various solutions and use cases. It automates AI model tuning, reducing development time and complexity, thus accelerating time-to-market for products, even for developers without deep AI expertise.

"Integrating NVIDIA TAO with MediaTek NeuroPilot will expand our vision of democratising access to AI, helping drive a new wave of AI-powered devices and experiences," said CK Wang, General Manager – IoT Business Unit at MediaTek. "With these expanded resources and MediaTek's Genio product line, it is easier for developers to design innovative Edge AI products," he said.

"Generative AI is enhancing computer vision for AIoT and edge applications," said Deepu Talla, Vice President – Robotics and Edge Computing at NVIDIA. "Combining NVIDIA TAO and MediaTek NeuroPilot SDK brings advanced vision AI models to billions of IoT devices," he stated.

Qlik unveils AI-driven enterprise data solutions



Data integration, analytics, and Artificial Intelligence (AI) solution provider Qlik unveiled two new solutions, Qlik Talend Cloud and Qlik Answers, at its annual event, Qlik Connect. These innovations aim to accelerate enterprise AI adoption, reinforcing Qlik's commitment to delivering comprehensive AI solutions for competitive advantage.

Qlik Talend Cloud offers no-code to pro-code, AI-augmented data integration capabilities, ensuring data integrity with extensive quality and governance features. Built on the cloud infrastructure, it facilitates integration for Qlik Analytics users. The platform evolves from Qlik's 2023 acquisition of Talend, introducing data products for faster, quality-assured data curation and a dynamic data marketplace.

It includes data engineering tools and the Qlik Talend Trust Score for AI, assessing data health to set new standards in AI readiness. The solution also incorporates Stitch's SaaS data connectivity, enhancing its ability to handle diverse data sources efficiently.

Qlik Answers, a generative AI-powered knowledge assistant, changes how businesses use unstructured data. It delivers personalised answers from private, curated sources such as knowledge libraries and document repositories, ensuring instant, relevant insights. This plug-and-play, self-service solution integrates into existing systems, enabling real-time decision-making with full explainability of answers.

"With full explainability, users know the origin of answers, maintaining trust and transparency. Qlik Answers offers best-in-class security and governance, making it a complete, easy-to-deploy solution for leveraging unstructured data to drive improved business performance," the company stated in a press release.

[COVER STORY]
DATA CENTRE

RIDING HIGH ON THE AI WAVE

India pivots from edge to hyperscale data centres, driven by a surge in AI demands and government initiatives, heralding a new data era

BY VERNIKA AWAL

For the longest time, the expansion plan for data centres in India was charted quite simply. Most industry experts pegged 'edge' data centres as the way that the industry would grow. Large players in the market would set up large-scale, heavy-investment hyperscale facilities that would work as the main hubs in which India's data centres would concentrate most of their capacities.

In data centre vocabulary, 'edge' facilities make for data centre infrastructure that is small and regional. Inherently, data centres are large facilities that host thousands of racks and consume power in megawatts of server load. Edge data centres, on this note, are much smaller—hosting fewer racks and cabinets and consuming power in kilowatts. As a result, they came to be known as 'hubs'. In turn, the established model for the data centre industry became a hub and spoke model.

Significantly, the expansion of India's data centre industry is no longer reliant on edge facilities. Instead, it's pivoting towards scaling up hyperscale units or integrating managed cloud platforms and services within existing data centre operations. This strategic shift, driven by industry dynamics, is set to redefine the trajectory of India's data centre market.

WHY THE PARADIGM SHIFT?

In a groundbreaking move in November 2022, US-based artificial intelligence (AI) research firm OpenAI, with Elon



"AI could push companies globally to spend over USD 200 billion in hyperscale data centres within two years, and the same is evident in India too."

JATINDER SINGH PABLA

Chief Sales & Marketing Officer – India, ST Telemedia Global Data Centres



"A surge in data consumption, propelled by the proliferation of IoT devices and online content streaming, is driving the expansion of data centre capacities."

SRIDHAR PINNAPUREDDY
Founder & CEO, CtrlS and Cloud4C



IN BRIEF

- From edge to hyperscale: India's data centre growth is moving from small, regional edge facilities to larger hyperscale units that integrate cloud services.
- AI's impact: The AI boom, highlighted by services like ChatGPT, is driving massive data requirements, influencing data centre expansion and operations.
- Government initiatives: India is heavily investing in AI, with initiatives like the IndiaAI Mission and global partnerships bolstering the data centre market.
- Rising power demand: AI-driven data centres are expected to significantly increase global electricity demand, with a projected 160% rise by 2030.
- Market response: Major industry players are scaling operations, leveraging AI to meet growing demands, with a focus on hyperscale facilities.

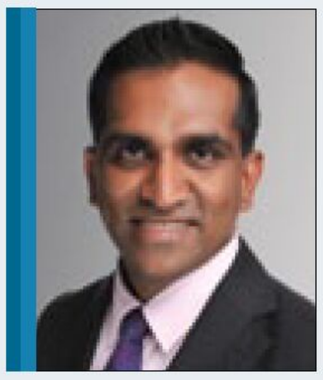
Musk as one of its initial founders and investors, unveiled ChatGPT. This revolutionary service quickly amassed 100 million users within less than 60 days since its public launch, sparking a global race to develop increasingly intelligent AI applications and creating an entire industry of generative AI.

AI, thus, came to the fore in every industry—it became commonplace in automating customer relationship management (CRM) services in enterprises, defined cyber security research operations, overlooked smart factories and global manufacturing, offered insights on weather and worldwide oil pipelines, and more.

As this global AI race picked up pace, the world realized one thing—this entire generation now needed more data than ever before. Today, every single task uses AI, a small subset of which is accounted for by generative AI.

And, wherever there's AI, there's data. The world's servers were suddenly needed to host and crunch massive amounts of data at all times. India was no different—the erstwhile Centre issued multiple statements on prioritising AI, framed an IndiaAI Mission with an investment outlay of $1.24 billion, and hosted the Global Partnership on AI (GPAI) Summit in New Delhi to show that as one of the world's biggest economies and an emerging market, India was ready for AI.

This, in turn, has enthused data centre operators in India and globally. More and more ventures are now entering the AI domain with cloud services and increased capacities to capture a rising share of a growing pie of data centre demand. Case in point: homegrown Hiranandani Group-backed data centre firm Yotta Infrastructure, in December last year, signed a partnership deal with global chip behemoth Nvidia for access to its in-demand H100 chips. On top of this, it also became the first domestic venture to get access to Nvidia's 'Blackwell' GPUs—unveiled in March this year for AI compute purposes.



"AI adoption is driving demand for data centres by increasing the need for storage, computational power, and real-time processing capabilities."

CB VELAYUTHAN
CEO, Digital Connexion

The writing was thus on the wall—AI, it seems, will transform the future of data centres too, after all.

WHERE DOES THE MARKET STAND TODAY?

On 30 April, financial services firm Goldman Sachs published a global electricity equity research mote, underlining that AI is pushing data centres to become a key contributor to rising electricity demand worldwide. While noting that AI could lead to a rise in sustainability factors too, Brian Singer, global head of investment research at Goldman Sachs, said, "The combination of AI, ex-AI increases in data demand, and a material slowdown in power efficiency gains is making data centres a critical driver of accelerating global electricity demand growth. We assume data centre power demand, excluding cryptocurrency, will grow by 160% in 2030 versus 2023—representing an increase of about 650TWh by 2030."

Goldman Sachs's prediction until 2030 suggests a compounded annual growth rate of 0.3% to increases in global power demand from data centres driven by AI. Because of this, data centres' power draw could rise from 1-2% of global power consumption to 3-4%—a very significant hike. Singer added that AI will represent 19% of all data centre power demand by 2028.

In India, market stakeholders agree. "AI, the next big growth driver and enabler globally, holds enormous potential in India," said Jatinder Singh Pabla, Chief Sales and Marketing Officer – India, ST Telemedia Global Data Centres (GDC).

"63% of Indian firms are slated to initiate investment in AI and machine learning in 2024, while 66% of all Indian CEOs see generative AI as a top investment area. India has the second-highest AI talent base in the world. With key existing and upcoming government acceleration efforts, India has an opportunity to leapfrog into global AI leadership. Globally, the resurgence in hyperscale spending in cloud and data centres is evident," Pabla said.

He added that AI could push companies to spend over USD 200 billion in hyperscale data centres in the next two years and the same is evident in India too.

Sridhar Pinnapureddy, Founder and CEO, CtrlS Data Centres, agrees that AI will "significantly impact the way data centres are designed and built." He further explained: "The increasing adoption of cloud computing services by enterprises is a major catalyst, as data centres provide the critical infrastructure backbone for cloud service providers. Another driving force is the exponential surge in data consumption, propelled by the proliferation of smartphones, IoT devices, and online content streaming, necessitating the expansion of data centre capacities."

CB Velayuthan, CEO of Reliance Jio and Brookfield-backed data centre firm Digital Connexion, further added, "As enterprises and consumers accelerate AI adoption, the latter is driving demand for data centres by increasing the need for storage, computational power, and real-time processing capabilities."

The impact of AI's rise is further reflected in the way new capacity is coming up among India's biggest data centre operators. For instance, Equinix, which operates two active and two planned data centres in Mumbai, is expanding the latter based on demand for hyperscale facilities in India's most populous data centre market. Multi-industry conglomerate Adani Enterprises' data centre joint venture, AdaniConneX, and Digital Connexion, have been formed in the past two years to cash in on this demand, too.

While the market is evolving with the entry of every new player and changing technology dynamics, specific demand for edge facilities has remained slim so far. Edge facilities have yet to draw the attention that was projected, leaving AI to become the primary contributor to India's data centre growth trajectory.

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INDIA'S DATA BOOM: HOMEGROWN PLAYERS JOIN GLOBAL GIANTS

From importing capacity to fostering homegrown operators, India's data centre industry is booming. Meet the key players driving the country's digital transformation



BY VERNIKA AWAL

Every year, India's data centre industry goes from strength to strength. The most apparent reasons are easy to see—data consumption among consumers and enterprises is increasing rapidly, driving the demand for data centres in the country. However, of late, the influx of artificial intelligence (AI) to every industry imaginable has kicked off rapid growth in India's data centre industry. Projections hold steadfast in this regard—last month, individual reports by industry and real estate trackers JLL India and CBRE estimated separately that the data centre market in India, which currently has a net capacity of around 850MW across key operators and facilities, might nearly double to around 1.7GW by the end of 2026.

While these estimates are tall, it is understandable why they hold ground. Nascent Indian startups are eyeing the generative AI bandwagon to create and introduce large language models (LLMs) proficient in Indian languages and contexts. However, developing LLMs requires vast data combined with robust cloud services that are available ubiquitously across the industry. This, in turn, creates a roadmap for multiple established and small players to enter the industry and contribute to building India as a major data centre hub for Asia and the rest of the world.

With dedicated data privacy regulations, policies like the India AI Mission, and more, the country now has a favourable regulatory framework for global data centre operators to cater to the market. On this note, here is a look at some of India's prominent data centre companies, what each offers today, and their plans for the near future.

Note: *The following list does not make a qualitative judgement on any data centre service provider in India. All firms are arranged in sequence by their year of establishment in India, derived from their year of registration with the Registrar of Companies, Ministry of Corporate Affairs.*

TATA COMMUNICATIONS

Year of commencement/registration: 1986
(as VSNL)
Total capacity: 300MW (including planned)

India's oldest data centre operator is also one of the country's most well-equipped in terms of its overall

India's data centre market is set to double its net capacity from 850MW across key operators and facilities to around 1.7GW by the end of 2026.

services. Tata Communications began its journey as a public-sector, government-owned facility, Videsh Sanchar Nigam Limited (VSNL). The company claims it is one of the country's broadest data centre service providers, having over 44 data centres worldwide. The company's facilities also provide rack space to third parties, thereby being one of the few colocation data centres in the country.

Tata Communications has also been growing at a steady pace. As of FY24, the company grew at 17.5% annually to hit a revenue milestone of USD 2.51 billion. It also owns, operates, and maintains what it claims is the world's largest subsea cable network, giving it an advantageous position in the industry regarding latency and service uptime.

NTT GDC INDIA

Year of commencement/registration: 1994
Total capacity: 265MW (including planned)

One of the country's most significant data centre operators, NTT Global Data Centres (GDC) India, has 18 facilities in Mumbai, Chennai, Bengaluru, and the National Capital Region (NCR). The data centre operator's lineage goes back to Japan-based Fortune 500 company Nippon Telegraph and Telephone (NTT) Corporation, which part-owns its fellow Japan-headquartered firm, NTT Data.

Earlier this week, media reports claimed that Abhijit Dubey, of Indian origin, is set to become the first-ever non-Japanese chief executive of NTT Data. The company's India revenue is expected to be close to USD 1 billion, while its global revenue is around USD 30 billion. It also provides managed IT services, cloud platforms, systems integration, application development, and more.

SIFY TECHNOLOGIES

Year of commencement/registration: 1995
Total capacity: 398MW (including planned)

The third-oldest data centre service provider is among the most well-recognised names in the enterprise tech domain for its rich diversity and range of services. For instance, Sify's Rabale campus specifications can be considered an ideal example—showcasing 10 buildings of eight floors each in which data centre capacities are spread across. With its sheer size, Sify's data centre is estimated to be one of the biggest in the nation.

Today, even though its data centre operations serve a global market with a specific focus on the US, one of the biggest reasons why Sify Technologies is remembered in the consumer domain is its running of a successful 'Sify iWay' cyber cafe chain with more than 1,000 outlets across the country. The latter is often credited with improving last-mile internet connectivity in various regions across India and introducing video conferencing into the mainstream internet users' fold.

WEB WERKS

Year of commencement/registration: 1996
Total capacity: 40MW (200MW planned)

Web Werks has been one of the foremost data centre operators in India. Still, despite being registered in India for a long time, it has not seen its operations scale up massively. Now, with the advent of data usage, regulations and involvement in almost every business aspect, Web Werks is scaling up its operations in the country. A crucial part of this scaling up was announced last year when the company and US-based IT firm Iron Mountain unveiled a new USD 170 million green-field data centre in Mumbai.

This, though, is not all—earlier this year, the state government of Karnataka announced that the Web Werks-Iron Mountain joint venture would cumulatively invest a whopping USD 2.4 billion to build a full-scale data centre park in Bengaluru, Karnataka. A memorandum of understanding for the facility was signed between the Karnataka state government and Web Werks at last year's World Economic Forum in Davos, Switzerland.

STT GDC

Year of commencement/registration: 2005
Total capacity: 318MW

ST Telemedia Global Data Centres (GDC) is no longer a bit-part player and seeks to cash in on the AI and data

boom by expanding in tandem with demand. Over the past year, media reports have cited Chief Executive Officer Sumit Mukhija, who stated that the company is looking to invest USD 1 billion in expanding its data centre capacity. Specifically, the company wants to double its existing data centre capacity every four years. This would leave the company with nearly 600MW of data centre capacity by 2027, making it one of the country's biggest service providers.

STT is a portfolio company of global investor Temasek Holdings, thus giving it potentially deep coffers to invest in its overall infrastructure. The company offers outsourced IT services to its clients, including managed cloud platforms.

CtrlS

Year of commencement/registration: 2007
Total capacity: 275MW
(planned up to 600MW)

This pure-play Indian data centre operator is betting on the country and plans to more than double its data centre capacity in India in the coming years. CtrlS clearly focuses on expanding its presence in India while considering sustainable operations as a key offering to rival others in this sector. One of the key features that it provides is support for private cloud adoption among enterprises— a growing facet of tech spending across various industries today.

Going forward, CtrlS is poised to be one of India's biggest data centre operators alongside fellow global rivals with a strong presence in India. Alongside data and AI, CtrlS' expansion plans are also driven by a strategy to expand to 'edge' markets—where it already has two facilities in Lucknow and Patna. With such facilities at hand, CtrlS is likely to add more small facilities in niche markets—a strategy that was long labelled as the primary expansion strategy for all data centre firms.

ESDS SOFTWARE SOLUTIONS

Year of commencement/registration: 2008
Total capacity: 5MW

Initially, a smaller data centre operator than many of its rivals, ESDS today has five facilities that offer niche facilities, including cloud platforms for migration, private cloud services, bundled cyber security and more to its enterprise clients. Today, the company has five facilities across Nashik, Bengaluru, Mohali and Mumbai. One of the essential things that ESDS promises is multiple high-bandwidth links between the data centre itself and the host clients, along with 100Gbps backbone links that serve as the primary network links for the company's data centre. ESDS is a steady, reliable service provider with a growing presence across India.

NXTGEN DATACENTER AND CLOUD TECHNOLOGIES

Year of commencement/registration: 2012
Total capacity: 4,200 racks
(including planned, NA in MW)

Spread across four independent data centres and ready to welcome the fifth, NxtGen Datacenter is a high-density data centre in the country. The company claims to provide dedicated rack data hosting for enterprises, which essentially lets enterprises segregate their data from each other. This could be beneficial since downtime in one server rack would not immediately lead to downtime in multiple services—but just one. NxtGen also claims to provide higher data density, which lets the operator stack up higher data capacity within their facility and improve energy efficiency.

NXTRA

Year of commencement/registration: 2013
Total capacity: 200MW (including planned)

Backed by Bharti Airtel, Nxtra is one of India's most expansive data centre operators by the sheer number of geographies they are present. A 21MW hyperscale data centre is already functional in Pune, while six more are being built across Mumbai, Kolkata, Hyderabad, Noida and Bengaluru. It does not just operate hyperscale facilities, though—Nxtra also has 11 core data centres spread across Chennai, Mumbai, Pune, Bengaluru, Noida, Manesar and Bhubaneswar. Core data centres are central to a region, more powerful and significant than edge data centres, and form central units that serve an entire circle of multiple states—instead of any singular state or district.

Nxtra, however, does that, too; its official website lists over 120 edge data centres spread across 65 cities, making it a key country-wide offering under its umbrella.

YOTTA

Year of commencement/registration: 2019
Total capacity: 250MW (including planned)

The Hiranandani Group has emerged as one of the most prominent companies in the data centre domain. Yotta Data Services struck popularity because of its USD 1 billion deal with chipmaker Nvidia. In partnership with Yotta, the latter is supplying GPUs to create the first official Nvidia Network Cloud Partner in India. The entire cloud platform is set to source up to 4,000 GPUs from Nvidia's H100 range of chips by the end of this year, followed by a total of nearly 16,000 GPUs by next year.

This, in turn, is expected to help build one of the largest cloud platforms in India in terms of AI compute power. Instead of focusing on overall server hosting and generic cloud platforms, Yotta is squarely targeting the generative AI wave to rope in client contracts.

EQUINIX

Year of commencement/registration: 2021
Total capacity: 6,760 cabinets (NA in MW)

Equinix is one of the newest entrants in India's data centre markets, which it did by acquiring two data centres in the country's Mumbai Metropolitan Region. While its collaborative capacity is at mass, Equinix's focus is as an interconnect specialist and colocation facility. The mass-scale data centre is pitching itself as a large-scale data hub for streaming services, gaming, and other consumer-end applications. It presently requires increasing low-latency connection points to process data. Within just over three years, Equinix has extended its facilities to four, including active and planned data centre facilities in the country.

ADANICONNEX

Year of commencement/registration: 2022
Total capacity: 33MW (planned up to 1GW by 2030)

Such is the scale of the AdaniConneX data centre joint venture that two months ago, Adani Enterprises raised a net debt of USD 1.44 billion to build a series of data centres. The joint venture between the latter and data centre firm EdgeConneX aims to invest at least USD 875 million in the next three years, with further expansion planned. Eventually, the JV aims to establish its own data centre capacity of 1GW by 2030—a substantial target within the next six years.

> Indian startups are leveraging Gen AI to create LLMs proficient in local languages and contexts, fuelling the growth of the data centre industry.

The move, however, will be critical for Adani Enterprises, a multi-business conglomerate, in terms of maintaining its cost and data sanctity across its various businesses. This would work similarly to how Nxtra works for the telecom operator Bharti Airtel, becoming a service provider to the conglomerate's companies. The company has one operational data centre in Chennai and is setting up two more in Noida and Hyderabad. It plans to build nine more by 2030.

DIGITAL CONNEXION

Year of commencement/registration: 2024
Total capacity: 20MW (160MW planned)

With two facilities in Chennai and Mumbai, Digital Connexion offers enterprises custom data centres and cloud deployment solutions as its key offerings. The data centre platform counts Brookfield Infrastructure and Jio Platforms as its joint investors, making it another strategically crucial platform akin to Adani's AdaniConneX and Airtel's Nxtra.

Overall, Digital Connexion has a sizeable expansion plan, which could largely be accounted for by Reliance Jio's tech subsidiary's expansion plans. The firm also has an open partner programme that lets enterprises apply to become its business partners, offering key technology and sales exchange initiatives to grow its ambit. However, its net capacity is not yet among India's most significant data centres.

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TV RAMACHANDRAN



INDIA'S INNOVATION CATALYST: REGULATORY SANDBOXES

Regulatory sandboxes foster innovation by letting startups test new tech in controlled settings, boosting R&D, fintech, and telecom advancements

India is fully leveraging regulatory sandboxes in critical sectors in its fast-paced journey to digital leadership. Many might wonder, what are these special devices called regulatory sandboxes? A regulatory sandbox is a framework that allows startups and other innovators to conduct live experiments in a controlled environment under a regulator's supervision. It aims to provide a safe space where businesses can test innovative products, services, business models, and delivery mechanisms while temporarily suspending regulatory barriers associated with commercial operations.

The concept has gained traction globally as a method of fostering innovation by using new technologies to make services affordable and easy to deliver to consumers while maintaining the stability of the financial system.

MAKING SENSE FOR R&D

R&D and experimentation form the bedrock of a country's positioning on a global technology map, enabling it to grow as a knowledge society. By creating an environment where regulations are temporarily relaxed, companies can experiment with new technologies and business



> A telecom regulatory sandbox has immense potential. It would offer the industry a controlled environment to test new technologies and business models.

models that would otherwise be difficult or impossible to test due to stringent regulatory requirements. This facilitates a faster innovation cycle, allowing companies to iterate quickly, identify potential issues, and refine their products before full-scale deployment.

For instance, the sandbox approach helps gather empirical data on the impacts of new technologies and business practices. Regulators, in turn, can use this data to make informed decisions about whether and how to modify existing regulations or create new ones. This collaborative approach not only accelerates the pace of innovation but also ensures that it happens in a way that is safe and beneficial for consumers.

IMPACT OF FINTECH REGULATORY SANDBOX

India's fintech sector has seen remarkable growth, driven in part by implementing a regulatory sandbox by the Reserve Bank of India (RBI). Launched in 2019, the RBI's sandbox provides a platform for fintech startups to test their innovations under a less burdensome regulatory framework. This initiative has been instrumental in promoting innovation, enhancing competition, and ensuring consumer protection in the financial services industry.

Several fintech startups, including Nucleus Software, ToneTag, Cashfree, and Open, have benefited from the RBI's regulatory sandbox. However, one of the most significant outcomes has been the success of the Unified Payments Interface (UPI). The regulatory sandbox facilitated the development and widespread adoption of UPI, which has transformed digital payments in India, making them more accessible, secure, and efficient. UPI's success has boosted domestic digital payments and set a benchmark for similar innovations globally.

THE TELECOM SECTOR REGULATORY SANDBOX

Building on the success of the fintech sandbox, India is now exploring the implementation of regulatory sandboxes in the telecom sector. The telecom industry, like finance, is heavily regulated, and stringent regulatory requirements can stifle innovation.

A telecom regulatory sandbox would provide a similar controlled environment for testing new technologies and business models. The National Digital Communications Policy (NDCP) identified the following goals: providing broadband for all, enhancing India's contribution to the global supply chain, and ensuring digital sovereignty.

Domestic competencies and locally relevant, cost-effective technologies are key to achieving the goals outlined in the NDCP. Innovations and development must be encouraged through experimentation in digital communications and their applications. This can lead to the generation and protection of Indian Intellectual Property Rights (IPR) and expertise in the domain. This will encourage R&D in industry, academia, and startups to try innovation in India.

FACILITATING FRAMEWORKS FOR TELECOM INNOVATIONS

This requires immediately developing facilitating frameworks and making necessary resources available for experimentation and trials, including spectrum. To encourage the development of indigenous products and promote Aatmanirbharta (self-reliance), the concept of the government facilitating the establishment of large anechoic chambers to test products in radiated environments without causing interference with other equipment was mooted.

Wireless product development involves rigorous testing of product functions under real radiating conditions, the performance of radiating resources, and mitigation of potential interference issues. This requires outdoor testing as part of the maturity cycle in real-field conditions. According to a report shared by the Press Information Bureau, the MSME sector's contribution to India's GDP has been around 30% in recent years. Local startups and MSMEs, which form the bedrock of Aatmanirbhar and indigenous product development, need handholding and support to enhance the ease of doing business and reduce transaction costs in obtaining such outdoor testing permissions.

Facilitating such outdoor product testing in spectrum regulatory sandboxes is strongly needed to position India as an R&D and Manufacturing hub and actively facilitate and encourage trials and innovations per the national

India's fintech sector has seen remarkable growth, driven in part by the implementation of a regulatory sandbox by the Reserve Bank of India.



IN BRIEF

- **Fintech success:** RBI's fintech sandbox has propelled startups like UPI, enhancing digital payments, competition, and consumer protection in India.
- **Telecom advancements:** A telecom sandbox aims to foster innovation in the heavily regulated telecom sector, supporting NDCP goals and digital sovereignty.
- **Support for startups:** Simplifying outdoor testing rules and providing resources like spectrum can help startups and MSMEs innovate and become globally competitive.
- **Global examples:** Regulatory sandboxes in the UK, South Korea, and Australia have accelerated telecom advancements, showcasing the potential impact in India.
- **Economic impact:** Regulatory sandboxes could add 0.5% to India's GDP over five years by fostering tech innovation, enhancing R&D, and creating new IPRs.

missions of Aatmanirbhar Bharat (self-reliant India) and Make in India.

Simplifying the rules for outdoor testing for radiating products will help new locally developed products be tested and matured to become globally competitive. India improved its ranking in the Global Innovation Index 2023, from 46th in 2022 to 40th. This improvement is partially attributed to increased governmental support for R&D and innovation through initiatives like the regulatory sandbox.

GLOBAL TELECOM REGULATORY SANDBOXES

To understand the potential impact of a telecom regulatory sandbox in India, looking at successful examples from other countries is useful.

#1

United Kingdom: Ofcom, the UK's communications regulator, launched a regulatory sandbox to enable companies to trial new wireless communication technologies, including 5G, in a real-world environment. This initiative has helped accelerate the deployment of advanced telecom technologies and fostered innovation in the sector.

#2

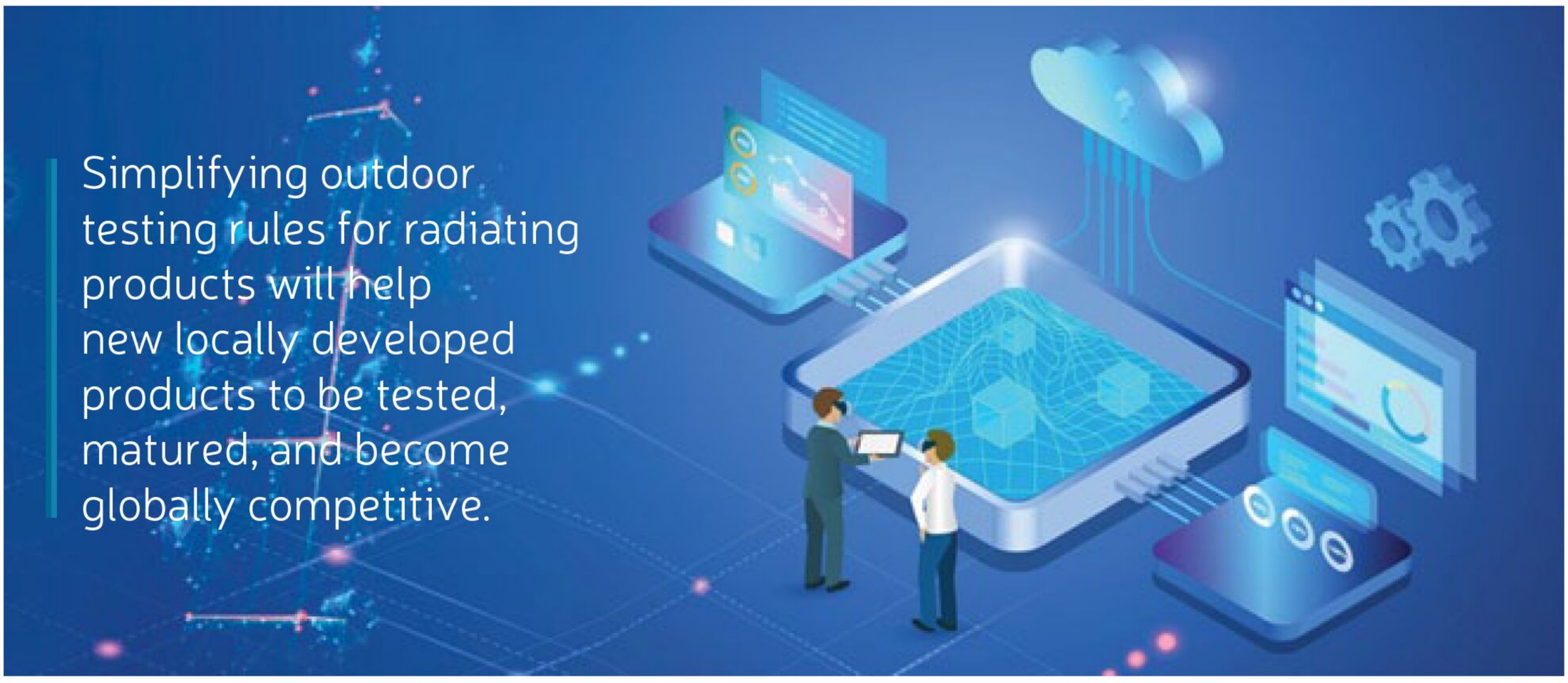
South Korea: The Korea Communications Commission established a regulatory sandbox to support developing and testing new telecom technologies, including IoT and smart city applications. This sandbox has been instrumental in positioning South Korea as a leader in advanced telecom solutions and services.

#3

Australia: The Australian Communications and Media Authority implemented a regulatory sandbox for telecom innovations. This initiative has supported the development of new wireless technologies and helped ensure Australia's telecom infrastructure remains cutting-edge and competitive globally.

TRAI'S PROGRESSIVE RECOMMENDATIONS

The recent Telecom Regulatory Authority of India



(TRAI) recommendations encouraging innovative services, technologies, use cases, and business models using regulatory sandbox in the digital communications sector are focused on providing enabling platforms for talented startups and developers to test their innovative products and solutions in live networks.

This move will significantly augment the startup and MSME ecosystem through the entry of credible new local players, thereby enhancing both competition and technological innovation while also attracting investments in the long run.

The Department of Telecommunications (DoT) has the Digital Communication Innovation Square initiative under the Champion Services Sector Scheme. Over 200 beneficiaries have been reported in the last three years, showcasing the growing interest and active participation.

Permission via the Regulatory Sandbox initiative to carry out outdoor testing of wireless products in live networks will allow the startup ecosystem to test their reliability and suitably tweak them to make them more mature and ready for adoption by operators in commercial networks. The recent guidelines for Spectrum Regulatory Sandbox or Wireless Test Zones aim to foster innovation, enhance the ease of doing business, and promote the country's self-reliance in developing indigenous telecom products and solutions.

The Ministry of Electronics and Information Technology estimates that the regulatory sandbox initiatives could potentially add 0.5% to India's GDP over the next five years by fostering innovation and improving the technological capabilities of Indian startups. These initiatives would also act as a catalyst for bringing new technologies into the industry, promoting innovation, and creating IPRs.

The forward-looking recommendations recently announced by TRAI provide startups and MSMEs with an option to directly apply to the DoT when they cannot agree with reasonable terms with the local operators for live testing. TRAI has empowered the DoT to help startups in such situations after conducting due diligence to ensure that the innovations may have a widespread impact on society, the economy, and technology.

By recommending that DoT shall have the right to mandate Regulatory Sandbox testing on an operator's network, including fixing the terms and conditions of such testing, TRAI has provided an excellent opportunity for Indian startups and MSMEs, technology developers, and innovators to develop and mature their products and solutions in live testing environments within India itself.

As India becomes increasingly an R&D-driven innovative nation, with the government enabling the active involvement of academia and research institutions through suitable initiatives and schemes, the country is poised to become a global innovation hub for all new technology-driven products and solutions in the decades ahead.

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[INTERVIEW]

HINDUSTAN ZINC LIMITED

C CHANDRU
CEO – Smelters, Hindustan Zinc Limited

[INTERVIEW]

HINDUSTAN ZINC LIMITED

"IoT is helping us monitor and reduce mining emission levels"

With a wealth of experience and expertise, ***C Chandru,*** *CEO – Smelters, Hindustan Zinc Limited (HZL), has been instrumental in steering the company towards technological advancements and operational excellence. In an exclusive interview with* ***Aanchal Ghatak,*** *he discusses the innovative approaches adopted by HZL, exploring its evolution from traditional smelting methods to the integration of cutting-edge technologies such as the Internet of Things (IoT), drones, and Artificial Intelligence (AI). Excerpts:*

Please share an overview of HZL's smelting facilities, including their locations and distinctive features.

Hindustan Zinc operates smelting facilities across Rajasthan, with smelters in Chanderiya, Dariba, and Debari, alongside zinc-lead-silver metal refineries in Pantnagar, Uttarakhand. Since its disinvestment in 2002, the company has witnessed a five-fold increase in its zinc, lead, and silver metal production capacities, with the current capacity exceeding 1.1 million tonnes per annum compared to 204,000 tonnes per annum in 2002.

The Chanderiya Smelting Complex in Chittorgarh district is the world's second-largest single-location integrated zinc smelting complex, boasting a production capacity of 558,000 tonnes and a lead production capacity of 85,000 tonnes per annum. It is complemented by captive power plants generating 234 MW and additional green power through waste heat recovery boilers.

The Dariba Smelting Complex in Rajsamand district has a capacity of 250,000 tonnes of zinc and 125,000 tonnes of lead per annum. Notably, it is self-sufficient with zinc and lead smelters and captive power plants of 170 MW strategically positioned near the Sindesar Khurd mine and Rajpura Dariba mine. Debari, in Udaipur district, houses India's oldest zinc smelter with a production capacity of 88,000 tonnes of zinc metal per annum. Additionally, Pantnagar's zinc, lead, and silver metal refinery can produce 800 metric tonnes of silver annually. These facilities collectively underscore HZL's prominent position in the metal production industry.

The company has evolved from using traditional smelting methods to incorporating IoT, drones, and AI. Please help us understand these initiatives.

Hindustan Zinc has undergone a transformative journey in its smelting processes, transitioning from traditional pyrometallurgy methods to more efficient hydrometallurgical processes, such as electrolytic zinc smelting. These advancements have significantly improved energy efficiency, recovery rates, and environmental sustainability. However, the innovations did not stop there. We have incorporated advanced technologies across operations at HZL, enhancing efficiency and safety.

In recent years, the company has embraced advanced automation, IoT, drones, and AI to enable precise process control, real-time data collection from remote locations, and efficient monitoring and inspection of facilities. These technologies also help conduct sophisticated analyses for process optimisation and safety enhancement. The integration of these technologies has helped HZL increase efficiency, improve safety standards, reduce environmental impacts, and enhance profitability in zinc smelting operations, positioning the company as a leader

> HZL has embraced IoT, drones, and AI to enable precise process control, real-time data collection, and efficient facility monitoring and inspection.

> Drones enable improved data collection through high-resolution imagery and sensor data, facilitating detailed analysis and maintenance planning.

in embracing Industry 4.0 principles for a sustainable and smart future.

Does this include using AI to optimise furnace operations and enhance precision within the smelting processes?

We have employed AI in the smelting operations to optimise furnace performance and improve precision. AI and Machine Learning (ML) algorithms help create recommendation models for setting blast furnace process variables. These models analyse historical and real-time data to determine the optimal settings, resulting in more efficient utilisation of coke and other raw materials. This optimisation leads to a reduction in consumption norms by 5–10%. Additionally, we use AI to develop soft sensors for critical quality parameters of roasters. These sensors enable the operations team to make real-time decisions, aiming for a 3–5% improvement in throughput.

What about the drones? How is the company using them?

At HZL, we have integrated drone-based inspections into the smelting operations, facilitating various crucial tasks such as replacing aviation lights, physical inspections of critical structures like tanks, chimneys, and furnaces, verification of raw material stockpiles, and periodic aerial surveys to ensure facility compliance.

Drone-based inspections have yielded significant safety and efficiency benefits for our zinc smelting operations. They have drastically reduced worker exposure to hazards by eliminating the need for personnel to enter risky environments, substantially decreasing the likelihood of accidents. Moreover, drones have led to faster inspections, saving us over 95% of the time compared to traditional methods.

Drones also offer a cost-effective solution, cutting expenses by 30-40% as they eliminate the requirement for costly scaffolding, specialised equipment, or additional workforce. Lastly, drones enable improved data collection through high-resolution imagery and sensor data, facilitating detailed analysis and enhancing future maintenance planning.

And the IoT? Where is the company deploying the sensors, and how is it helping HZL?

IoT sensors provide real-time data and improve decision-making within Hindustan Zinc's smelting facilities. They offer real-time data for better decision-making and contribute to environmental sustainability by monitoring emission levels. This helps us take proactive measures to control the environmental impacts.

IoT sensors also enable predictive maintenance by collecting equipment data, predicting potential failures, and allowing for proactive maintenance. This reduces downtime by 10-15% and enhances operational efficiency and cost savings.

Technology has several dimensions, and so does mining. Has HZL undertaken other tech initiatives to streamline its smelting processes and operations?

At Hindustan Zinc, we actively explore various technological initiatives to enhance the smelting processes and overall operational efficiency. For instance, we use AI—and ML-powered image recognition to inspect finished products, ensuring consistency in quality and monitoring safety hazards to prevent accidents.

We are leveraging Digital Twins, virtual representations of physical assets and processes, for virtual simulation, predictive maintenance, and process optimisation. This enables risk-free testing of new parameters and configurations, real-time identification of equipment failures, and optimisation of process parameters for enhanced efficiency and quality control.

Additionally, we have employed Augmented Reality and Virtual Reality for training, remote monitoring, troubleshooting, and design planning. These technologies provide immersive experiences for safe training, remote troubleshooting, and efficient equipment or layout planning within the smelter. These initiatives underscore the company's commitment to leveraging advanced technologies to optimise operations and drive efficiency gains across processes.

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[INTERVIEW]

AMAZON WEB SERVICES

“We are committed to making GenAI accessible to SMBs in India”



PRAVEEN SRIDHAR

Head, Partner Business, Amazon Web Services (AWS) India and South Asia

Over the past year, Generative AI (GenAI) has not just piqued the interest of businesses, it has also sparked a revolution, transitioning from pilot experimentation to a realm of large-scale impact. The growth in enterprise GenAI adoption, experimentation, and large-scale pilots has been phenomenal. This surge has instilled a growing belief that GenAI has the potential not just to augment but even replace human efforts in complex and unstructured areas of value creation. On the sidelines of the recent AWS Summit 2024 in Bengaluru, ***Praveen Sridhar,*** *the head of Partner Business, Amazon Web Services (AWS) India and South Asia, shared his insights with* ***Prabhu Ram,*** *the head of the Industry Intelligence Group at CyberMedia Research. Excerpts from their intriguing conversation:*

> AWS Marketplace allows Independent Software Vendors in India to list their GenAI solutions, allowing them to reach a global audience.

Paving the Way for the Adoption of GenAI

With its expertise in cloud computing, AWS is not just a facilitator but a true enabler, empowering businesses of all sizes to harness GenAI's full potential. The company recognises the importance of a comprehensive stack, offering a complete set of tools to facilitate success.

Infrastructure: Efficiently running GenAI models requires significant computing power. AWS's custom-designed chips, Trainium and Inferentia, further optimise performance for GenAI workloads. Additionally, tools like SageMaker provide a comprehensive platform for training, building, and deploying GenAI models.

Model marketplace: AWS offers pre-trained large language models or LLMs through Bedrock. AWS announced the general availability of Amazon Bedrock in the Asia-Pacific region (specifically Mumbai). Launched in 2023, Bedrock offers diverse foundation models from leading companies like Anthropic, Meta, Cohere, as well as AWS. This empowers customers to build secure applications leveraging these models, ultimately enhancing user experiences, boosting productivity, and streamlining operations. Bedrock also provides customisation features like Guardrails and Knowledge Bases, enabling users to tailor the models for specific applications.

Applications: At the top layer, AWS goes beyond just the infrastructure and tools. They integrate GenAI capabilities into various AWS services, making it easier for users to leverage this technology. For instance, Amazon QuickSight provides user-friendly interfaces powered by GenAI for data visualisation tasks. Additionally, AWS is exploring consumer products like Rufus that could utilise GenAI functionalities.

Partner Ecosystem: The Force Multiplier

Partners play a critical role in accelerating GenAI adoption. AWS fosters a comprehensive partner ecosystem with different competency levels, including a specific GenAI competency. This ensures partners have the expertise to build and deliver effective GenAI solutions. Additionally, AWS supports partners through training programmes and marketplaces. These programmes equip partners with the necessary skills, while the marketplaces allow them to showcase their GenAI solutions and reach a wider audience.

GenAI in Action: Real-World Examples

The impact of GenAI is already being felt across India. Companies of all sizes are leveraging AWS to create innovative solutions. Shellcode, for example, uses GenAI to automate tasks and streamline invoice processing. HCL Technologies employs it to enhance developer productivity.

Even the sports industry is getting a makeover with Tech Mahindra's use of GenAI to create immersive fan experiences. Similarly, Mindtickle, a data dumping platform, empowers sales organisations with GenAI tools, while Freshworks, an Indian software company, utilises GenAI to improve customer journeys.

Empowering Small and Medium Businesses

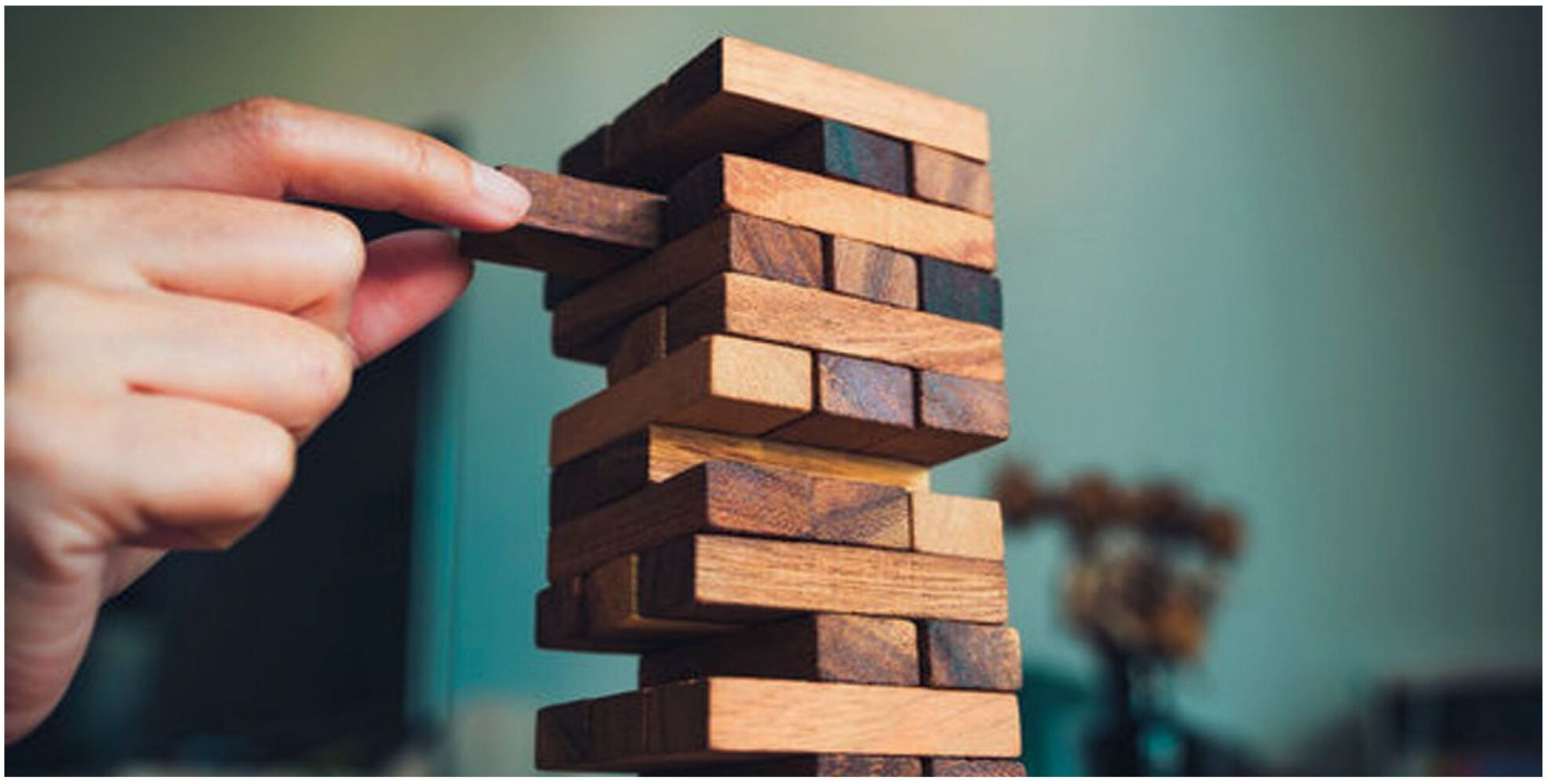
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A high-stakes Jenga game

Open RAN's progress reflects a delicate balance between promises and practical hurdles, including slow adoption and single-vendor imperialism



BY PRATIMA HARIGUNANI

In an ideal world, it should have been like a fun and stimulating game of Lego blocks. But, as the practical world would dictate, it turned into that delicate and tenuous game of Jenga, where removing one important block would bring down the whole structure—collapsing—like a house of cards.

No wonder the buzz at the last Mobile World Congress was more about a one-vendor deal than any jaw-dropping innovation. The USD 14 billion contract between AT&T and Ericsson, reportedly the largest in the Swedish company's history, was the talk of the town. Bruno Zerbib, Chief Technology Officer, Orange even dared to ask in an interview: "If there is a democracy with only one candidate, is it really a democracy?"

A BLACK AND WHITE RUBIK'S CUBE

When Open Radio Access Network (RAN) was launched, it was based on the idea that combining components from various small suppliers could provide an alternative to large suppliers like Huawei, Ericsson, Nokia, and ZTE. However, as John Strand, CEO of Strand Consult, explains, the reality has turned out to be quite different.

"Open RAN was marketed with the promise that network components could be pieced together from different manufacturers to provide alternatives to end-to-end solutions from larger vendors. Numerous Open RAN 'trials' were announced by operators worldwide. However, 294 mobile operators in 109 countries and territories have launched 3GPP-compatible 5G services, either mobile or fixed wireless access. Overall, Open RAN equipment accounts for only about 1–2% of the total 5G equipment installed and used by customers today," he points out.

Regarding the operators that have fully committed to Open RAN, such as Rakuten in Japan, 1&1 in Germany, and Dish in the US, they have struggled to attract and retain



"Two major deals—Ericsson for AT&T and Ericsson with Samsung for Verizon—show that the industry is yet to embrace a truly multi-vendor Open RAN ecosystem."

SYLWIA KECHICHE

Senior Director – Industry Analysis, Opensignal

customers. Strand explains that vendors like Parallel Wireless and, more recently, Airspan have faced financial challenges, illustrating the reality of Open RAN.

"The concept of Open RAN was introduced to create a more open and competitive environment within the telecommunications industry," echoes Manish Mangal, Chief Technology Officer, Telecom and Global Business Head, Network Services, Tech Mahindra.

Mangal affirms the dominance of one or two vendors: "Open RAN design aims to shift away from traditional RAN systems that are often constrained by single-vendor dependencies. Nevertheless, the transition to a genuinely open RAN is fraught with challenges. While Open RAN promotes using different vendors to stimulate technological advancement and cost efficiency, the reality is somewhat different due to the persistence of 'single-vendor imperialism.' This phenomenon is exemplified by various deals where operators opt for single-vendor solutions to mitigate integration complexities and ensure reliable performance."

Ask Sylwia Kechiche, Senior Director – Industry Analysis, Opensignal, about this, and she predicts that a truly multi-vendor Open RAN ecosystem is still some way off. "The concept of Open RAN is based on the desire to reduce vendor lock-in and create competition for smaller players by separating hardware and software components."

She cites data to illustrate this further: "According to Heavy Reading's 2023 Open RAN Operator Survey, 31% of respondents plan to use a new single vendor that is Open RAN compliant, closer to the existing RAN operating model. For instance, in the US, two major Open RAN deals involved a single vendor (Ericsson for AT&T) or two vendors (Ericsson and Samsung for Verizon), indicating that the industry has yet to fully embrace the concept of a truly multi-vendor Open RAN ecosystem."

Ashwinder Sethi, Partner, Analysys Mason, avers, "Both in India and global markets, Open RAN is a nascent area due to concerns from multiple operators, despite broad statements and commitments in the US and Europe. There are medium-term and long-term ambitions. We only see a nascent ecosystem, except for Rakuten, which has worked substantially in Open RAN. It is hard to make definitive statements until someone deploys it properly and maintains it for two to three years."

"Just look at India, which has talked much about Open RAN. The classic suppliers, Ericsson and Nokia, have secured the big contracts," Strand argues. "The AT&T–Ericsson deal is another great example."

"In India, Airtel, Jio, and Vi have conducted some pilots, but they are small-scale deployments," Sethi concurs. "Also, the cost of ownership is not very different from a conventional OEM."

While operators such as Jio and Airtel have taken steps toward adopting Open RAN, progress has been slow, mainly due to the perception that it is still maturing, explains Priyanka Kulkarni, Manager – Telecom, Media, and Technology Sector, Aranca. "To push adoption, the Indian government has recently developed the US-India Open RAN Acceleration Roadmap, aimed at facilitating interoperability and widespread deployment of Open RAN products. This roadmap is also seen as an effort to encourage Indian telcos to adopt and deploy the technology."

Sethi adds that it is interesting how Nokia and Ericsson have entered this space. "They have realised they might face a much smaller market if they do not participate and support wide-scale adoption. There are also OEMs in this ecosystem—such as Mavenir—and traditional ones like Nokia and Ericsson, which are entering this space now."

As Kulkarni assesses, the current Open RAN landscape is witnessing a rise in vendor acceptance beyond the



"The problem with Open RAN is not the state of the standard but the operationalisation of the available Open RAN solutions."

MANISH GANGEY

Executive President – Product Line Management, HFCL

traditional giants. "Companies like Mavenir, NEC, Parallel Wireless, Fujitsu, Altiostar, and Airspan are increasingly gaining traction globally." While this could signal a change in the previously traditional vendor-dominated market, single-vendor solutions are still expected to drive the lion's share of Open RAN revenues, as many operators still depend on traditional vendor solutions.

"Single-vendor Open RAN solutions are likely to account for 15–20% of overall RAN revenues in 2028, whereas multi-vendor solutions are forecast to represent just 5–10% of the total market," she points out.

CHIPS AND BLOCKS

What prevents RAN from being Open? There are numerous factors to consider.

Let us delve into the internals first. Silicon's significance has become pivotal as telecom infrastructure moves towards openness and disaggregation. Much relies on how easily hardware and software can be segregated and combined in new (non-proprietary) permutations and combinations. This is where the debate between general-purpose accelerators and inline accelerators gains momentum.

A lot hinges on how open, flexible, and programmable processors are. This makes the choice between custom-made chips and general-purpose silicon crucial and consequential for openness. Should one opt for custom-built silicon for Layer 1 and let the rest of the RAN work on general-purpose silicon? However, Layer 1 is the real spine, and if that gets hard-coded, how open is 'open'?

Locking in silicon while opening up other RAN areas is a futile endeavour. However, reshuffling things in areas like Layer 1 and base-station silicon is no easy decision, given the availability and openness of processors. With Ericsson's venture into purpose-built silicon and alliances between Nokia and Marvell or Vodafone and Intel, the dynamics of silicon for the Telco industry have witnessed many twists and turns.

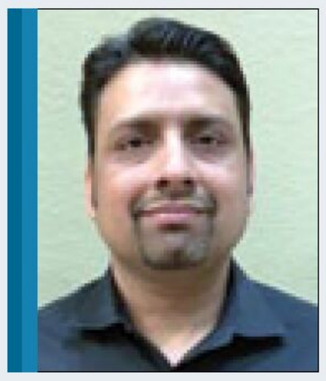
Then, there is another factor: software. One cannot overlook the unique and entangled relationship between hardware and software, which can perpetuate the continuity of single-vendor RAN setups.

Kulkarni agrees. "The relationship between hardware and software in RAN does play a role in the dominance of single vendors. Traditional RAN deployments often result in operators being locked into using hardware and software from a single vendor, making it challenging to switch vendors or alter the network."

"This vendor lock-in is a form of dominion that the close coupling of hardware and software can perpetuate. However, the shift towards Open RAN fosters a more open and collaborative environment. It allows product designers to select the hardware and software solutions that work best for them, leading to improved product performance, innovation, and cost-effectiveness," she explains.

"Different processor architectures used by various vendors can lead to compatibility issues and hinder seamless integration of hardware responsible for base-band data processing and performance," Kulkarni adds. "Front-haul specifications are another critical aspect of the Open RAN architecture, wherein the new front-haul protocol optimised for mMIMO allows for better performance but continues to be dominated by traditional vendors. Standardisation of front-haul interfaces while ensuring bandwidth requirements between DU and RU is crucial for interoperability and multi-vendor participation in Open RAN."

Manish Gangey, Executive President – Product Line Management, HFCL offers a specific perspective here. "Traditional architectures always had the advantage of tweaking the functionality to suit their system design guidelines. When some of these nuances in design have to be communicated to a third party, it becomes complicated. Over time, these nuances in design



"The path to a fully open network is complex, exemplified by deals where operators choose single vendors to avoid integration issues and ensure reliability."

MANISH MANGAL

CTO – Telecom & Global Business Head, Network Services, Tech Mahindra

requirements would become better known for the individual system components to be more independent. But if this argument was used against opening up the interfaces (in an open-source model), it was only to gain time against what is inevitable."

SQUARES AGAINST CIRCLES

Let us now shift our focus to other components. The lack of a fluid interface between the base-band and radio sides means RAN merely pays lip service to the word "open".

Apart from intent and imperialism, the on-ground integration and interoperability problems also throw a wrench into the Open RAN idea. This is particularly challenging due to the need for appropriate APIs, software, and algorithms that can power the 'openness' of RAN – facilitating the connection of different pieces of software and hardware across many network layers.

Mangal explains that one-two vendor decisions are often influenced by the current limitations in the availability of fully interoperable and mature technologies within the Open RAN ecosystem. "The Brownfield operators, for instance, might begin their Open RAN journey with a single vendor due to existing legacy systems but aim to transition to a multivendor setup in the future."

It is crucial to fix interoperability for Open RAN, especially at the Distributed Unit (DU)–Central Unit (CU) level and between DU and Radio Unit (RU). Is that happening? Will it happen?

Kechiche agrees that the interoperability challenges between different hardware and software stacks slow its implementation and lead operators to choose a single supplier.

The problem with Open RAN is not the state of the standard but the operationalisation of an Open RAN solution points out Gangey. "The goal of Open RAN is to have open, interoperable standard interfaces beyond what 3GPP prescribes. Some interfaces are more developed than others; for example, open front-haul is more evolved than an E1 or E2 interface."

As he further explains, operators are accustomed to single-point troubleshooting scenarios when they encounter issues in the network. Now, they have to determine which part of the solution is causing the problem in the network. This requires both skills and knowledge of the internal workings of the solution as a whole. "Therefore, you see a deal like AT&T–Ericsson where they feel they get the best of both worlds."

Here, Strand sheds light on how operators purchasing Open RAN equipment primarily buy from Ericsson, Nokia, and Samsung, not from the smaller players claiming Open RAN would radically change the market. "Operators prefer one-stop solutions, not multi-vendor solutions."

Mangal delves deeper. "Interoperability in Open RAN, particularly at the DU-CU level and between DU and RU, presents notable challenges, primarily due to the nascent stage of this technology. Achieving true interoperability involves adhering to specifications and ensuring that different hardware and software components work seamlessly in diverse service provider environments." Additionally, new specifications such as Split 7.2x Cat-B ULPI for Massive MIMO front-haul and the abstraction layer for processors reflect ongoing efforts to resolve compatibility challenges.

Kulkarni breaks this into three key components of gNodeB: the central unit (CU), distributed unit (DU), and radio unit (RU). "Integrating and managing the intricate technicalities of the key components to ensure seamless communication across these interfaces in a multi-vendor ecosystem while simultaneously adapting to changes for a tailored network configuration increases the complexity of the system."



"Single-vendor solutions are expected to drive the lion's share of Open RAN revenues, as many operators still depend on traditional vendor solutions."

PRIYANKA KULKARNI
Manager – Telecom, Media, & Technology Sector, Aranca



THE 'OPEN' CHALLENGE

- **Integration complexities:** Open RAN requires significant effort to integrate different hardware and software components, causing operators to favour single vendors.
- **Interoperability issues:** Ensuring seamless interaction between various Open RAN components is challenging, often leading to compatibility problems.
- **Vendor lock-in:** Traditional RAN systems' close coupling of hardware and software perpetuates vendor lock-in, hindering true multi-vendor ecosystems.
- **Slow adoption:** Despite industry interest, Open RAN deployments remain limited to trials and small-scale projects, with full-scale adoption progressing slowly.
- **Cost and performance:** Open RAN has yet to deliver on promises of cost savings and improved performance, deterring widespread implementation by operators.

Gangey contends, rightly so, that interoperability works well when both sides are transparent. "The DU-CU splits are not as challenging as DU-RU splits because, in the former case, both components typically come from the same vendor, whereas in the latter case, they can come from two vendors. The front-haul specs have evolved and are much better today compared to when they started, but it is more about how you can make two functions talk to each other without extensive and expensive code reworking."

Standardised open interfaces are key to building high-performing networks by enabling different vendors and components to work together efficiently. However, gaining consensus on the best ways to achieve it has proven difficult at times, Kechiche points out the thorn in the pillow.

"Among these interfaces, front-haul is one of the most critical in Open RAN as it connects the radio units to the network, making it central to the performance of the air interface and the overall RAN efficiency. Open RAN-dependent systems and components that can be procured from various vendors require a considerable amount of system integration expertise to ensure successful deployment," she says.

According to her, the level of difficulty associated with integration varies depending on the size and internal structure of the operators and whether there is a need to integrate with existing systems. "Typically, larger operators with in-house engineering resources tend to fare better than smaller ones that may not have access to local system integration skills."

Mangal suggests that when assessing the openness of RAN, it is crucial to consider several additional factors beyond the basic framework of Open RAN. "Firstly, the integration of RAN Intelligent Controllers, xApps, and rApps enhances the network's intelligence and functionality. Additionally, the ability of Open



"Open RAN brings competitive pricing for equipment, but from what we see now, it will take five to six years for the ecosystem to evolve."

ASHWINDER SETHI
Partner, Analysys Mason

RAN to handle and analyse the increased volume of data must be scrutinised, especially in terms of data management and privacy concerns," he says, reminding how security and interoperability are crucial emphasis areas too.

OTHER PIECES OF THE PUZZLE

There is also a flurry of new technologies, like virtualisation, Cloud RAN, and Massive MIMO—but are they helping or hampering the cause of openness in RAN?

"These technologies enhance openness by enabling flexibility and resource sharing but also pose challenges related to interoperability, integration, and vendor dependencies," remarks Kechiche. "For example, Massive MIMO requires close coordination between RU and DU and involves stringent performance requirements."

Kulkarni, too, points out that while these technologies enable the disaggregation and innovation within Open RAN, they also introduce complexity and pose interoperability challenges that need to be carefully managed.

Gangey zooms in on the 'why' of Open RAN, which is attempting two major changes to the Radio Network: openness through open interfaces and disaggregation of hardware from software.

"This creates a complexity that people outside of operators usually underestimate. In the technology world, new concepts bring complexity to deployment and operations before they get to simplification. Here, the virtualisation and cloud concepts are alien to the network world, especially radio access networks; therefore, it would take time for these to be understood, mastered, and then deployed at scale. So, in some sense, the introduction of too many changes together has hampered adoption," he points out.

SO? WHAT TOPPLES NEXT?

Open RAN fosters more competition in the market, and increased competition is good for operators and customers, Sethi paints the big picture. "It also brings competitive pricing for equipment. But from what we see now, it will take five to six years for the ecosystem to develop towards Open RAN."

The Open RAN segment requires effective multipronged collaboration among various vendors, notes Nityesh Bhatt, Professor – Information Management Area, Institute of Management, Nirma University. "Openness is a continuum that takes time to mature and can never be perfect. Interoperability, as seen in many sectors including SIM cards and IoT, is a result of numerous initiatives from the industry (R&D, resources, intent), government (policies), regulators, research organisations, and think tanks across the globe."

As Sethi predicts: "In the next two to three years, we are not going to see massive adoption of Open RAN, except only limited deployments here and there."

Ask Strand, and he reiterates the long-held argument with a close focus on costs. "It is certain that Open RAN has not delivered what it promised when it comes to cost savings, more competition, and low prices. It will remain a commercial disaster as we had predicted several years ago."

In the view of Kechiche, Open RAN represents an important new methodology for MNOs, promising lower capex and cost efficiency. However, reliability and security are two aspects that cannot be overlooked.

"The GSMA Intelligence Network Transformation Survey 2023 points to solution reliability, integration with existing operations, and systems integration as the top three deployment concerns for operators, all of which cannot be ignored. Replacing manual processes with zero-touch operations is one of the key advantages of Open RAN," she reiterates



"It is certain that Open RAN has not delivered on promises of cost savings, more competition, and low prices, and it will continue to be a commercial disaster."

JOHN STRAND
CEO, Strand Consult

Open RAN initiatives are gaining global momentum, with trials and deployments occurring across various continents, including Asian countries like Japan, India, and Thailand, and others in Africa, Europe, and the USA; Kulkarni maintains an optimistic stance. "Japan is one of the leading markets where operators have partnered with multiple vendors for Open RAN deployments. For example, Rakuten Mobile has partnered with over 20 vendors like Altiostar, Cisco, Nokia, Intel, Mavenir, Quanta Cloud Technology, Sercomm, Tech Mahindra, Allot, and Innoeye, while NTT has joined hands with more than four vendors," she stresses.

Similarly, KDDI has partnered with two vendors and is exploring more options. In the US, Dish Network has partnered with over 12 vendors and Inland Cellular with over four vendors. There are also examples from European and African markets where operators are using multiple vendors for the deployment of O-RAN networks.

Adopting Open RAN requires a mindset shift and is more suitable for new operators starting from scratch, Kechiche dissects. "Rakuten Mobile is currently the only commercially available nationwide network deployed using Open RAN technology, making it the poster child for this new paradigm. However, beyond Rakuten, Open RAN deployments have been slow so far, mostly limited to proof-of-concept and trials, very much following the natural rhythm of technology upgrades."

Some governments, such as the UK, are strong proponents of Open RAN, and so are several European operator groups, such as Deutsche Telekom, Orange, Telecom Italia, Telefonica, and Vodafone. For example, Vodafone plans to use Open RAN across 30% of its European footprint by 2030, including Open Front-haul as a new addition to its requirements on the single RAN part. "We should see more Open RAN networks towards the second half of the decade, with Open RAN fully baked into 6G standards," Kechiche adds.

As Mangal illustrates, Europe, Japan, and the USA have been pioneers in adopting this technology, driven by regulatory support and industry initiatives that promote a diversified vendor ecosystem. "These regions exemplify how Open RAN can successfully address the traditional constraints of mobile network expansion. These include high costs and vendor lock-in, which can be achieved by leveraging cloudification and advanced intelligence within the RAN. The momentum for Open RAN is now spreading to other regions, including the Middle East, indicating broader acceptance and implementation across various markets."

Kulkarni observes that despite advancements in the 5G market (considerations of 6G) and the current state of deployment, achieving an Open RAN state is still a long way off.

In a February 2023 paper on this subject, Vodafone and DOCOMO acknowledged that the operators are responsible for improving the journey. The two companies recommended appropriate paths for vendors to take depending on which part of the Open RAN jigsaw they are developing. It was also underscored here that automation alone is not enough. It is vital that all parties make an effort to collaborate and leave behind any protectionism, the companies had emphasised.

To add to that, experts have also pointed out how the layered nature of most networks in this industry could lead to vendors being boxed in as per those layers—like management, CUs, DUs, and RUs. So, some layers could be more ready for multiple vendors, and some not. And some vendors may be more ready for turning 'open', and some not.

Interesting! Could Open RAN turn into a game of Woodoku next? In an ideal world, again.

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MANISH GANGEY
Executive President–Product Line Management, HFCL

"Operators are used to single-neck-to-choke scenarios"

With extensive experience in Telecom, Networking, and Semiconductors, he has steered Airtel's ORAN strategy, Jio's disaggregated product development, and more. ***Manish Gangey,*** *Executive President–Product Line Management at HFCL, has led multi-functional teams in product line management, R&D, engineering, supply chain, and business development during his 30 years of career. In this interview with* ***Pratima Harigunani,*** *he explains why the operationalisation of an Open RAN solution, too many changes too soon, inadequate transparency across components, and how overall problem-resolution complexity are real impediments to Open RAN's acceleration. Excerpts:*

What is your reckoning of Open RAN's progress? Would you call the current state of Open RAN open?

Open RAN aims to have open, inter-operable standard interfaces beyond what 3GPP prescribes. Some

Open RAN is attempting two major changes to the radio network: openness through open interfaces and disaggregation of hardware from software.

interfaces are more developed than others; for example, open fronthaul is more evolved than an E1 or E2 interface. The problem with open RAN is not the state of the standard but the operationalisation of an open RAN solution. Operators are used to single-neck-to-choke scenarios when they need to make a single call in case of issues in the network; now, they have to determine which part of the solution is creating the issue in the network. This requires both skills and knowledge of the internal workings of the solution as a whole. Therefore, you see a deal like AT&T-Ericsson where they feel they get the best of both worlds.

So, is it a problem of complexity? How do technologies like virtualisation, Cloud RAN and Massive MIMO play out in this context?

Open RAN is attempting two major changes to the radio network: openness through open interfaces and disaggregation of hardware from software. This creates a complexity that people outside of operators usually underestimate. In the technology world, new concepts bring complexity to deployment and operations before they get to simplification. The virtualisation and cloud concepts are alien to the network world, especially radio access networks.

It would take time for these to be understood, mastered, and then deployed at scale. So, in some sense, the introduction of too many changes has hampered adoption.

What about interoperability at the level of the Distributed Unit (DU) and Centralised Unit (CU) or between DU and the Remote Unit (RU), and the area of fronthaul?

Interoperability works well when both sides are looking to be transparent. The DU-CU splits are not as challenging as DU-RU splits because, in the former case, both components typically come from the same vendor, whereas in the latter case, they can come from two vendors. The fronthaul specs have been evolving and are much better today than when they started, but it is more about how to make two functions talk to each other without going through an extensive and expensive code reworking.

What about the equation between hardware and software in RAN?

Disaggregation of hardware and software comes with its own set of challenges. Traditional architectures always had the advantage of tweaking the functionality to suit their system design guidelines. When some of these nuances in design have to be communicated to a third party, it becomes complicated. Over time, these nuances in design requirements would become better known for the individual system components to be more independent. But, if this is against opening up the interfaces in an open-source model, it was only to gain time against what is inevitable.

Who will take the lead, or rather who should?

In our view, the open RAN renders itself very well to private 5G network deployments. In the telecom operator market, Open RAN deployments will have to be led by Tier-1 operators because of their ability and resources to handle the complex integrations and leverage to influence incumbents to open up the interfaces. This will allow small and innovative companies to build solutions from which the industry can benefit.

We have a success story in the making at a few places like Dish in the US and another smaller operator in Germany. We should not evaluate the impact of open RAN through these; instead, we should evaluate it from the perspective of what type of innovations this brings to the industry.

Are there any other important factors to consider when evaluating the openness of RAN?

The semiconductor ecosystem for RAN systems must become wider for the industry to flourish. At the moment, very few players are operating in the market, and hence, support is required for start-ups to contribute to this space.

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[TECHNOLOGY]
NETWORKING

Powering up smarter, intelligent telecom networks

AI-driven network optimisation ensures seamless connectivity and reliability amid rising mobile data demands, boosting customer satisfaction and efficiency



BY DHIRENDRA PRATAP SINGH

The growing dependence on mobile data creates significant pressure on telecom networks. Imagine the disappointment of millions of users facing unexpected internet disruptions during crucial business video calls or while watching their favourite shows. Such downtime can significantly decrease customer satisfaction and loyalty, potentially prompting them to explore other service providers. This highlights the critical importance of network optimisation in guaranteeing seamless data transmission and catering to users' increasing needs.

Mobile data consumption is rapidly increasing. For example, the Nokia India report says that the average Indian consumed 24.1 GB of mobile data per month in 2023, a 24% increase from 2022. GSMA predicts that mobile data traffic in Europe will almost triple between 2023 and 2028. The industry rolled out 5G to address the increasing data demands and to support new use cases. This new standard brought about additional frequency bands, various radio types, increased base stations, and a broader range of connected devices, leading to more network complexity. Additionally, as the network becomes more open, vendor complexity is increasing.

NETWORK OPTIMISATION AND PREDICTIVE MAINTENANCE

AI-driven network optimisation is vital for improved connectivity and network performance. Telecom firms use machine learning to analyse real-time data, identify

> Using AI for predictive maintenance allows telecom operators to identify and avoid network failures, reducing downtime and improving user satisfaction.

congestion spots, and optimise systems efficiently. Unplanned network outages resulting from equipment malfunctions disrupt services, inconvenience customers, and result in significant revenue losses.

AI algorithms can predict potential network problems by analysing historical network data patterns and user behaviour. This leads to consistent network performance, minimal downtime, and the capability to address issues proactively through preventive maintenance. Using AI for predictive maintenance will allow telecom operators to predict and avoid network failures, reducing downtime and improving user satisfaction.

For example, AI can analyse traffic fluctuation patterns, signal strength variations, and equipment performance metrics. This enables the early detection of possible bottlenecks and equipment malfunctions before they develop into significant outages. Moreover, AI can enhance resource allocation by modifying network configurations according to real-time data. This ensures optimal bandwidth usage and effectively reduces congestion.

A global study of telecom and IT engineers about AI and the network by Ciena says that India boasts the highest proportion of respondents of any region that are very confident in CSPs' ability to monetise AI traffic over networks, with 68%. In comparison, 69% of survey respondents believe AI will create more job roles within CSP businesses.

According to a report from Valuates, global AI in the telecommunications market is projected to reach a remarkable USD 19.17 billion by 2029. This exponential growth is fuelled by the increasing adoption of AI across various applications within the telecommunications landscape and the proliferation of AI-powered smartphones.

GENERATIVE AI IN TELECOM

In the face of high competition and cost-cutting in the telecommunications industry, initial signs indicate that generative AI might be the key to sparking growth following a decade of stagnation.

Generative AI enables telecommunication companies to handle large volumes of data, recognise patterns, and create innovative solutions. This technology has the potential to revolutionise traditional approaches and drive industry-wide advancements. Embracing generative AI allows telecom firms to address obstacles, discover new revenue sources, enhance operational effectiveness, and provide outstanding customer service. One McKinsey study found that software developers can complete coding tasks up to twice as fast with gen AI.

DELIVERING INTELLIGENT CUSTOMER SERVICE

Sustaining dependable and top-notch service within intricate networks involving various technologies poses a significant operational challenge, demanding ongoing monitoring and issue resolution. Conversely, poor service quality reduces customer satisfaction, attrition, and revenue decline. A report by Emplifi found that 63% of consumers would leave a brand because of poor customer experience.

AI-driven chatbots and virtual assistants are set to transform customer service within the mobile telecom sector. These AI agents will manage a broader range of customer inquiries, offering instant support around the clock. Generative AI can play a more prominent role in advancing bot-type automation. Through natural language processing algorithms, chatbots will enhance their ability to comprehend and address queries more precisely, simulating human-like interactions and enhancing the overall user experience.

ENABLING FRAUD DETECTION

A Communications Fraud Control Association report says that telecommunications fraud surged 12% in 2023 despite preventive measures, resulting in a substantial USD 38.95 billion loss, equivalent to 2.5% of total sector revenues. Fraudulent activities such as subscription fraud, SIM box fraud, and international revenue share fraud pose a multi-billion-dollar challenge for the telecommunications industry.

AI-powered solutions analyse vast datasets, including call detail records, subscriber data, and network traffic patterns.

> With its ability to optimise energy consumption, AI can play a crucial role in creating a more sustainable future for the telecommunications sector.



IN BRIEF

- AI-driven network optimisation is crucial for reliable connectivity, reducing downtime, and enhancing customer satisfaction.
- Mobile data consumption is surging, with a 24% increase in India in 2023 and predictions of tripling in Europe by 2028, necessitating more complex network management.
- AI algorithms predict and prevent network failures by analysing historical data and user behaviour, ensuring proactive maintenance.
- AI can detect traffic fluctuations and equipment issues early, optimise real-time resource allocation, and reduce network congestion for improved efficiency.
- Gen AI helps telecom companies process large data volumes, identify patterns, and innovate, potentially sparking industry growth.
- AI-driven solutions in telecom can significantly reduce fraud, boost network security, and protect privacy by analysing patterns and behaviours in real time.

Unusual behaviours, such as abnormal call lengths, a large number of international calls, or peculiar call ending patterns, are promptly identified and flagged in real time. AI-driven systems can analyse user behaviour patterns to develop individualised behavioural profiles for each user. This aids in identifying account takeovers or instances of identity theft.

AI is set to have a vital impact on boosting network security and protecting privacy within the mobile telecom ecosystem. Machine learning algorithms can constantly monitor network traffic patterns to identify and address security risks in real time. AI-driven behavioural analytics detect unusual user actions and possible security breaches, improving fraud detection and prevention abilities.

DRIVING ENERGY CONSERVATION

The growing need for data results in a larger energy footprint for telecom networks, which leads to increased operational expenses and environmental challenges. A GSMA report highlighted that the telecom sector contributes to approximately 3% of global electricity consumption, highlighting the need for sustainable solutions.

AI-Powered Solution constantly examines network traffic patterns and user actions in real time, enabling them to adapt network configurations and enhance the efficiency of network equipment power consumption. Using a data-driven strategy greatly reduces energy usage while maintaining service quality. With its ability to optimise energy consumption, AI can play a crucial role in creating a more sustainable future for the telecommunications sector.

The potential for AI in the telecommunications industry is vast. Companies amid a digital transformation are achieving success by leveraging AI early on and developing suitable software. With AI's ability to process massive amounts of data and human expertise, the possibilities are endless.

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A multimodal odyssey beyond words

From OpenAI's GPT-4 to Google's Gemini Pro, AI is fast becoming multimodal, integrating voice, text, image, and video for more human-like interactions



BY VERNIKA AWAL

On May 14, Google unveiled its latest suite of AI tools, services, and models—including its new large language model, Gemini 1.5 Pro. This announcement came just a day after OpenAI's latest release in the Generative AI (Gen AI) battlefield, emphasising one essential factor: multimodality. This marks a significant milestone in the evolution of Gen AI this year, where AI tools are now being designed with multimodality from the ground up.

But why is this important? For starters, multimodality refers to the ability of an AI algorithm to understand multiple 'modes' of input. Traditionally, AI models were designed to process text queries and generate text responses. Over time, these models advanced to understand and create images based on text or image queries.

The latest advancements include generating videos from a few words of text, cloning, and generating audio snippets from just a few seconds of sample audio.

> To truly emulate human interaction, algorithms must understand multiple languages and interpret images, spoken words, voice snippets, and videos.

> Accessing data to train AI is becoming increasingly complex as regulators worldwide address concerns that companies are scraping copyrighted material.

With these capabilities, AI can now comprehend and generate inputs across all formats within a human-computer interface (HCI). This progress brings AI closer to seamlessly integrating texts, images, audio, voice, and data, enhancing overall user experience and interaction.

FIRST, WHY MULTIMODAL AI?

To understand the rise of multimodal AI, it is important to understand why such a factor is important. In 2017, eight Google-backed researchers published the paper 'Attention is all you need', detailing their work on the transformer AI model. This technology offered a somewhat simple logic: Can AI contextually understand queries, process the information like humans do when asked a question, and respond in a humane way?

This task is more challenging than it appears. Algorithms are designed to execute commands and tasks, regardless of their complexity. However, human commands are often imperfectly structured. As a result, in most human-machine interactions, such as with chatbots, queries not phrased as expected by the algorithm often lead to unsatisfactory responses.

The transformer model, now commonly known as generative AI, set out to address this issue. To truly emulate human interaction, algorithms must handle more than just English text queries. Companies require algorithms that understand multiple languages and interpret queries through various modes of communication—images, spoken words, voice snippets, and even videos.

This necessity gave rise to multimodal generative AI. While the importance of this approach was widely recognised, the real challenge lay in the enormous volume of data required to train such models.

THE HUNT FOR THE WORLD'S DATA

In OpenAI's presentation of its latest large language model (LLM), GPT-4, the company described it as a "flagship model that can reason across audio, vision, and text in real time." A slightly more detailed description of the need for the model states that it is "a step towards much more natural human-computer interaction—it accepts as input any combination of text, audio, image, and video and generates any combination of text, audio, and image outputs."

Amplifying this further, on 14 May, Google and Alphabet CEO Sundar Pichai said that its latest model, Gemini Pro, is "designed to be multimodal from the ground up." To add further to this versatility, mentioned that Google is doubling the model's 'token window'—essentially, the amount of text, or the length of an audio or video clip, that the latest Gemini model can process from its query.

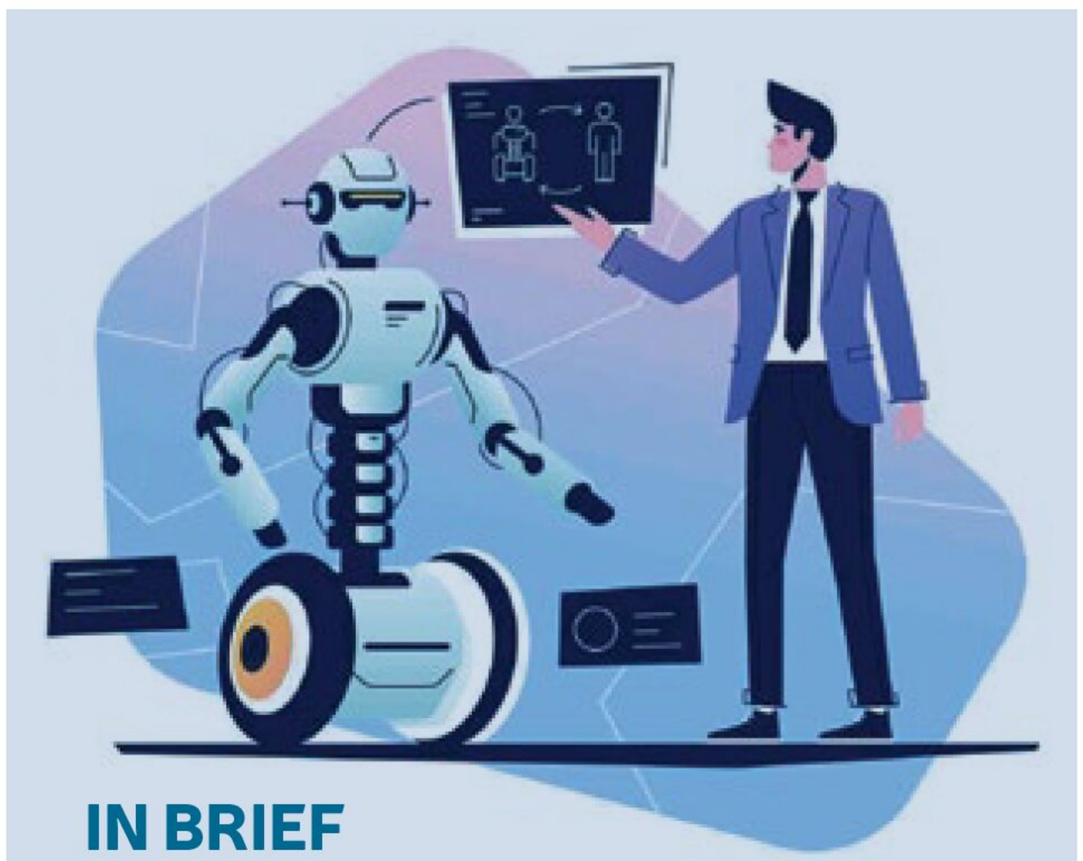
While these advancements demonstrate significant progress toward making machines more human-like and cognizant, substantial challenges remain—those related to data, copyrights, cost, and computing power.

Training an AI algorithm to understand such extensive context requires tech companies to use enormous amounts of data. The more data an AI model is trained on, the better its chances of providing contextually accurate responses. This need is amplified by multimodality; for reference, just for text and image inputs, OpenAI's GPT-4 AI model needs an estimated 1.75 trillion data parameters.

The required data should theoretically increase exponentially when images, videos, and audio are incorporated into an AI tool. While this still holds true, most of the popular LLMs have received substantial training from public usage during the past two years. However, even with this, billions of data points are necessary to train AI models to interpret inputs such as images with scribbled handwriting, low-quality video snippets, or garbled voice clips with background noise accurately.

This vast data requirement is crucial for making AI truly usable, for instance, in aiding vocally impaired individuals in accessing websites and conducting transactions. Although current AI models are bringing us closer to this reality, the challenges of data acquisition and processing costs remain significant obstacles.

Gemini 1.5 Pro marks a milestone in the evolution of Gen AI, where AI tools are being designed with multimodality from the ground up.



IN BRIEF

- Google introduces Gemini 1.5 Pro, a multimodal AI model that enhances AI's ability to process diverse inputs like text, images, audio, and video.
- Pioneered by transformer models, multimodal AI addresses the need for AI to interpret human-like queries across multiple formats.
- Training these advanced AI models requires massive data and computational resources, raising concerns about data acquisition, cost, and copyright issues.
- The ethical and regulatory landscape surrounding data usage for AI training is evolving, with increasing scrutiny on how copyrighted materials are used.
- Companies must balance the potential of multimodal AI with the challenges of securing vast data and managing the costs and ethical implications.

WHY THE CHALLENGE?

Sourcing the vast amounts of visual and auditory data required for multimodal AI is a significant challenge. It demands substantial financial resources. OpenAI CEO Sam Altman has admitted to spending billions of dollars to develop their GPT models to match their current state. Moreover, access to this data is becoming increasingly complex as regulators worldwide address artists' concerns that tech companies are scraping copyrighted material from the open Internet to train their AI models without compensating the original audio, image, or video content creators.

These practices have raised ethical questions about tech companies' actions, highlighting a murky area in technology. The question has been about who truly owns the content on social media platforms. Is it the user who created it or the platform that distributes it, or is any content published on social media fair game for reuse unless explicitly stated otherwise?

While regulations have largely left these areas ambiguous, more nations are seeking answers to address these concerns. Can AI withstand the wave of copyright conflicts coming its way? Privacy and copyright advocates argue that tech companies should not evade responsibility by citing commercial interests and withholding details about their data sources.

The long answer may be even more complicated. Add the cost factor to this argument, and the matter becomes exponentially more complex since only a handful of companies can afford the capital required to train such AI models.

Is multimodality worth these costs and compromises?

It may be too soon to tell, but in the long run, the answer will largely depend on how commercially successful and socially impactful these AI models become.

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[TECHNOLOGY]
EDGE COMPUTING

Telecommunications' swift-winged messenger

Edge computing marks a transformative phase in telecommunications, driving the industry towards efficiency, reliability, and innovation



BY AANCHAL GHATAK

Edge computing involves processing data closer to its origin, at the network's edge, rather than relying on centralised cloud systems. This strategic shift significantly reduces data travel distances, slashing latency and bolstering application responsiveness.

Implementing edge computing in telecom networks offers many advantages over traditional centralised architectures.

Piyush Somani, Founder, CMD and CEO of ESDS Software Solution, emphasises the transformative potential of edge computing: "Edge computing reduces data travel distances and substantially mitigates latency by relocating data processing closer to the source. This addresses the latency challenges Internet of Things (IoT) devices encounter in telecommunications networks."

Somani underscores the explosive growth of the global edge computing market, which is projected to

> Edge computing's scalability and flexibility enable telecom operators to roll out new services and swiftly handle fluctuating loads.



"Edge computing reduces data travel distances, substantially addressing the latency challenges the IoT devices encounter in telecommunications networks."

PIYUSH SOMANI
Founder, CMD & CEO, ESDS Software Solution

reach USD 274 billion by 2025. This meteoric rise mirrors the escalating utilisation of edge computing for network optimisation, particularly in latency reduction efforts. Telecommunication giants stand poised to deliver unparalleled low-latency experiences by leveraging local data processing at the edge.

Notably, applications like online gaming, real-time video analysis, and autonomous vehicles stand to benefit immensely. The resultant swift response time elevates user satisfaction and unlocks novel use cases once deemed impractical.

KEY BENEFITS FOR TELECOM NETWORKS

Implementing edge computing in telecom networks offers many advantages over traditional centralised architectures. Somani emphasises several significant benefits: "Edge computing substantially reduces latency. Critical applications can respond immediately when real-time processing takes place locally," he points out, adding that processing data locally increases bandwidth efficiency and frees up core network resources for other uses.

He further stresses the importance of reliability, noting that "edge architectures are more reliable since edge devices can continue to operate independently during network disruptions, ensuring uninterrupted service."

When discussing the scalability of edge computing, Somani explains that the processing capacity can be quickly adjusted at various points in the network to suit particular requirements. The scalability and flexibility that edge computing offers enable telecom operators to roll out new services and swiftly handle fluctuating loads. Besides, processing sensitive data locally according to data regulations improves privacy and security.

However, all of these involve a substantial initial setup cost.

Nevertheless, Somani points out the long-term savings in central processing and data transfer. "This makes edge computing cost-effective. It also facilitates the development of novel, latency-sensitive services that improve user engagement and innovation," he explains.

REAL-TIME DATA PROCESSING FOR IOT APPLICATIONS

Edge computing is particularly beneficial for IoT applications that demand real-time data processing, specifically for smart city initiatives and the healthcare and industrial automation sectors.

Smart Cities: Traffic management systems and public safety applications rely on real-time data to function effectively.

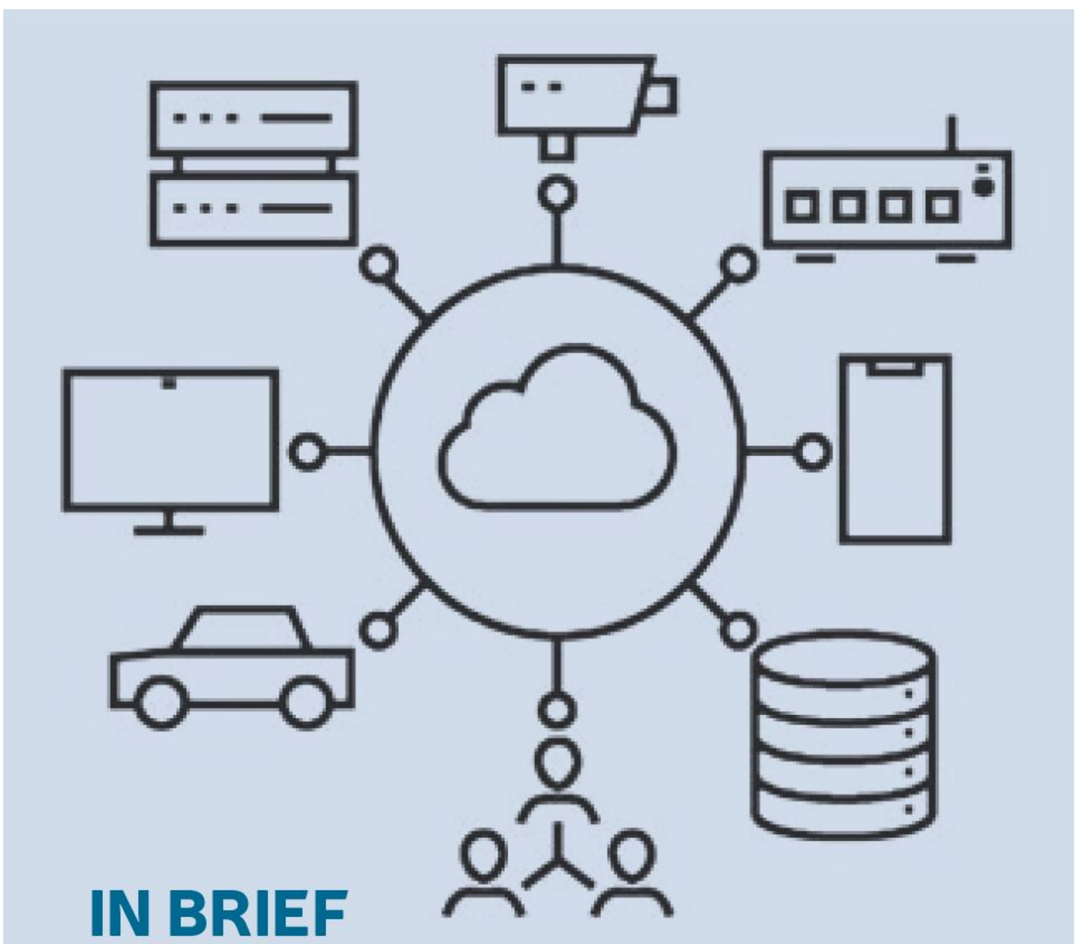
Healthcare: Remote monitoring and telemedicine services require immediate data analysis to provide timely medical interventions.

Industrial Automation: Manufacturing processes and supply chain management benefit from instantaneous data processing for efficient operation.

"The full potential of IoT data in telecom can be tapped through real-time processing," says Somani, noting that the global deployment of 15 billion edge devices underscores the demand for effective data processing solutions, such as edge computing. "For example, network equipment sensor data can be used to anticipate and prevent failures before they occur or dynamically modify network resources in response to actual traffic patterns, maximising efficiency," he says.

Experts point out that edge computing opens up new possibilities for user experiences, such as latency-sensitive services like connected automobile applications or augmented reality. It provides a local source for data processing and storage requirements

By minimising the need to send data over the network, edge data processing improves privacy and lowers vulnerability to potential cyber risks.



IN BRIEF

- Edge computing drives telecom innovation, optimising resources for swift service delivery and enhanced user experiences.
- Real-time processing enhances IoT applications, improving efficiency in smart cities, healthcare, and industrial automation.
- Beyond IoT, edge computing benefits telecommunications with low-latency solutions for CDN, AR/VR, and 5G networks.
- Enhanced network efficiency and reliability result from local data processing, reducing congestion and increasing resilience.
- Edge computing ensures data privacy and compliance, offering security benefits and adherence to data sovereignty laws.

for IoT. Machine learning and analytics algorithms facilitate timely decision-making, local data processing, and aggregation.

Overall, the edge computing industry is projected to expand at a compound annual growth rate of 34.1%, from USD 3.6 billion in 2020 to USD 15.7 billion by 2025. The demand for real-time data processing in various IoT applications fuels this increase.

BEYOND IOT: BROADER APPLICATIONS IN TELECOM

Edge computing extends its benefits beyond IoT applications, offering valuable solutions for various use cases in the telecommunications sector, including Content Delivery Networks (CDNs), Augmented and Virtual Reality (AR/VR), and 5G networks.

CDN: Edge computing reduces latency and enhances the user experience by caching content closer to users.

AR/VR: Low-latency processing is essential for delivering seamless, immersive experiences.

5G: Edge computing meets the low-latency requirements of 5G applications, significantly enhancing the capabilities of next-generation mobile networks.

ENHANCING NETWORK EFFICIENCY AND RELIABILITY

Edge computing significantly enhances the efficiency and reliability of telecom networks. By processing data locally, it conserves bandwidth and reduces operational costs. It also decreases the pressure on core networks, resulting in numerous advantages. This increases network efficiency and reduces traffic congestion, enabling faster data flow and reaction times. Moreover, the distributed nature of edge computing makes networks more resilient, ensuring high performance even in the event of individual node failures.

DATA PRIVACY AND COMPLIANCE

Deploying edge computing in telecom networks also offers substantial security benefits. Processing data at the edge

The edge computing industry is projected to expand at a CAGR of 34.1%, from USD 3.6 billion in 2020 to USD 15.7 billion by 2025.



ADDRESSING LATENCY CHALLENGES

- Latency, the delay before data transfer begins following an instruction for its transfer, is a critical factor in the performance of the Internet of Things (IoT) applications. Traditional cloud computing models, which process data on centralised servers often far from the data source, can introduce significant delays. Edge computing addresses these challenges by enabling:
- Proximity to data sources: By processing data near the IoT devices that generate it, edge computing reduces the distance data must travel, reducing transmission delays.
- Reduced network congestion: Offloading data processing to the edge reduces the burden on the central network, decreasing traffic and improving overall network performance.
- Faster data processing: Localised data processing allows immediate analysis and response, crucial for real-time decision-making applications.

reduces the need for extensive data transmission, minimising the risk of exposure to cyber threats. "By minimising the need to send sensitive data over the network, edge data processing improves data privacy and lowers vulnerability to potential cyber risks," Somani notes.

Processing data locally also helps telecom operators adhere to data sovereignty laws and regulations, ensuring that sensitive information is managed according to local standards. "Telecom providers must ensure edge deployments comply with applicable data privacy laws. Strong data encryption is advised for every device in the network, from the edge to the core," adds Somani.

EDGE COMPUTING FOR NEW SERVICES

Telecom operators can increasingly leverage edge computing to optimise network resources and deliver innovative services. By deploying edge nodes, operators can offer local content caching. This helps enhance user experience by reducing access times for frequently requested content. It also helps improve threat detection and response times, enhancing overall network security. "Since edge computing allows real-time threat detection and mitigation at the network edge, it guarantees the reinforcement of security postures," explains Somani.

Similarly, real-time analytics provides valuable insights for better decision-making and operational efficiency. "Edge processing facilitates fast data analysis that provides insightful information for network optimisation and service enhancement," he says, adding that the telecom operators are poised to innovate their services with edge computing.

"Operators who use this technology can set the standard for new developments in real-time data processing, network efficiency, and focused customer innovation," Somani concludes.

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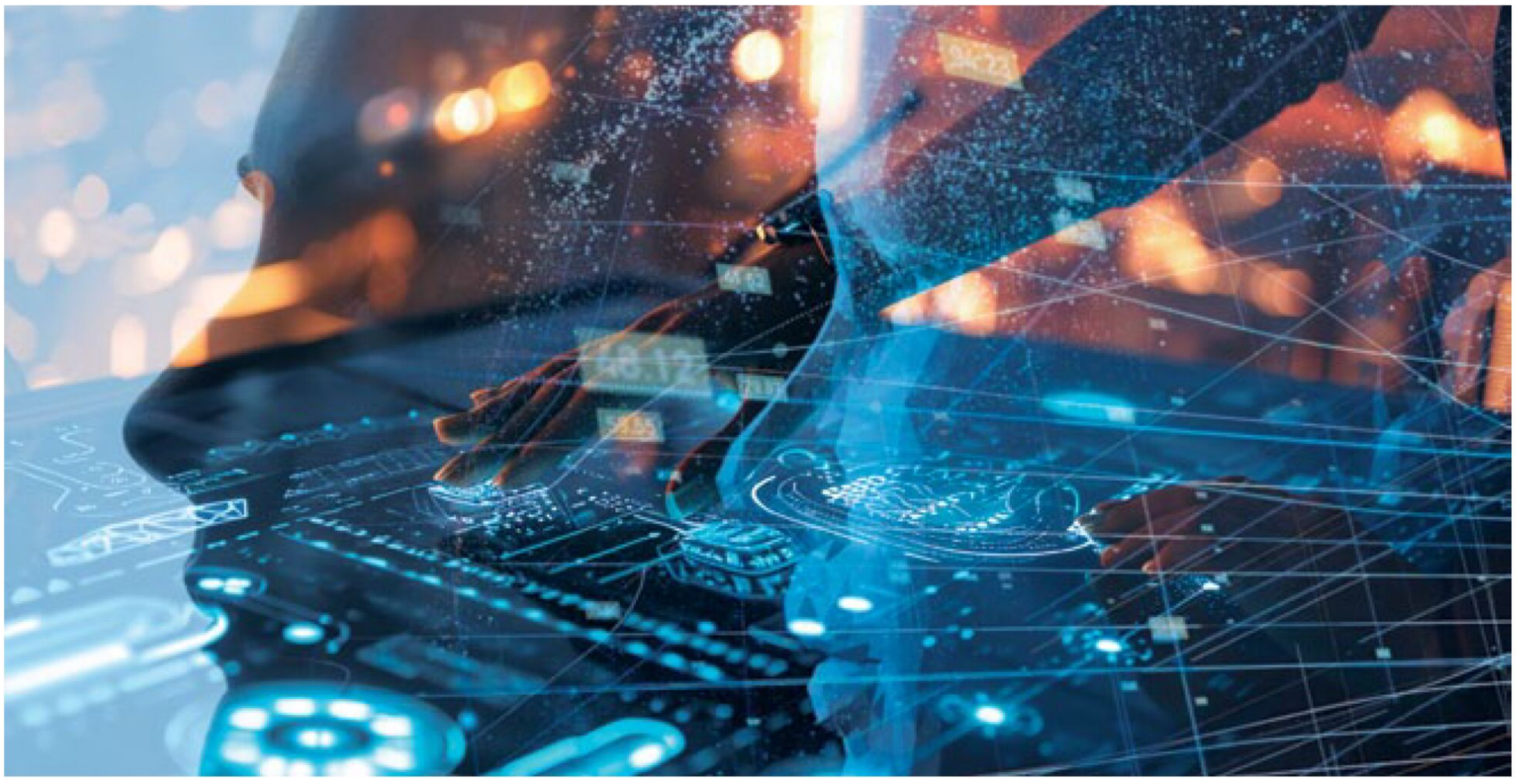
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[TECHNOLOGY]

DIGITAL TWIN

The digital-era Alchemy

By creating precise digital counterparts, virtual replicas are bringing a new era of efficiency and innovation, transforming industries in unprecedented ways



BY PRATIMA HARIGUNANI

It is a world where people do not think it stupid to mummify kings, where a child bawls with pain when someone kicks his pup, and where most people run first to save a seemingly silly object like a Teddy, a favourite book, a picture frame, or a pair of sneakers before picking up their wallet or property papers when a fire alarm goes off. It is also a world where the essence of machines and processes can be replicated in Digital Twins.

Not strictly for the same reason, but by the same logic, one's life is hinged closely to the other.

Enter the world of digital clones.

NOT WITCHCRAFT BUT WIZARDRY

In an era where creating products or controlling processes is often laden with costs, complexity, and chaos, it is a much-needed marvel to have a virtual counterpart handy—one that works well. With this digital replica, a company can design, monitor, repair, correct, and improve the product or process without tweaking anything physically. That saves money and also spares everyone the irreversibility of mistakes.

What a doozy! Digital Twins provide that extraordinary comfort. They can simulate many characteristics of their physical counterparts. Since these models process and react to various stimuli (per the data representing the external environment), making any change is safe and timely. With the approximation of a real object that they bring in, they go way beyond erstwhile simulation techniques and whiteboards. Companies have a chance to improve productivity and time-to-market window, as well as the powerful button to augment operational processes and avoid losses.

Not surprisingly, product development is one big area for using Digital Twin. As McKinsey estimates, over the next five years, about USD 30 trillion in corporate revenues may depend upon products that have not yet



"Almost every manufacturing customer in the enterprise space is interested in adopting digital manufacturing, Industrial IoT, and digital twin use cases."

P K GUPTA

Global CTO & APJ Presales Lead – Global Alliances Presales, Dell Technologies

reached the market. How do you make these products compelling? By staggering performance improvements and features that will make jaws drop and also make people very happy.

But all that would require the integration of complex and novel technologies. Also, the growing spotlight on personalisation and sustainability completely changes how companies look at material and component selection, repairability, and end-of-life considerations. So, keeping R&D costs low while innovating with mind-blowing products would be a tough juggling act without the help of Digital Twin.

Digital Twins would help nail this tough balancing dance, accelerate design and engineering cycles, and give more-than-ever design choices and more prototypes. This gets even more helpful when a company is creating products that are manufactured in small volumes, as big-ticket items, or as exclusive ones.

In fact, 75% of product development executives reported further digitisation as a key priority for them, according to a Research and Markets Forecast for 2027. This is especially true in advanced industries, where almost 75% of companies have already adopted Digital Twin technologies that have achieved at least medium levels of complexity. The use of Digital Twins is more advanced in verticals like automotive, aerospace, defence, logistics, infrastructure, and energy—for understandable reasons.

That explains the growth lined up ahead for this technology wonder.

NOT SO TINY AN USHABTI

According to Global Market Insights, the Digital Twin market was at USD 9.9 billion in 2023 and can rise to about USD 125 billion by 2032. The Grand View Research pegs the global Digital Twin market size at USD 16 billion in 2023, with a growth projection of a compound annual growth rate (CAGR) of 35.7% from 2024 to 2030. According to Fortune Business Insights, this space was roughly USD 17 billion in 2024 and can surge to USD 259 billion by 2032.

PK Gupta, Global CTO and APJ Presales Lead – Global Alliances Presales, Dell Technologies, explains that Digital Twins are transforming industries by creating virtual replicas for optimisation. These digital shadows drive innovation and efficiency from factories to hospitals and cities. Almost every enterprise manufacturing customer is interested in adopting digital manufacturing, Industrial IoT (IIoT), and Digital Twin use cases.

Ashwin Kumar, Partner – Growth and Solutioning, TheMathCompany, opines that the potential for Digital Twins in India is vast, driven by complex supply chains and deep technology entrenchment across the country.

And what kind of enterprises are tapping these twins?

"Applications for Digital Twins span industries, but supply chain, last-mile delivery, manufacturing, and product design have significant opportunities for adoption. Industries like manufacturing, where precision and efficiency are paramount, embrace Digital Twins to optimise production processes and enhance product quality," explains Kumar.

In healthcare, for instance, Digital Twins facilitate personalised treatment plans and predictive modelling for improved patient outcomes. Likewise, in retail and FMCG, it can help optimise inventory management, streamline logistics, and enhance customer experiences. "The versatility of Digital Twins ensures their relevance and applicability across India's economic landscape," adds Kumar.

Gupta also points out the areas heavily leaning towards adopting it: "The healthcare industry has shown significant interest in utilising Digital Twins for medical research purposes, particularly in areas like COVID-19 and cancer studies. Digital Twins are gaining traction in urban planning within digital cities, where they are applied for managing construction sites, optimising smart buildings,



"Digital Twin require in-depth process understanding and system design to translate real-world parameters into simulations."

ASHWIN KUMAR
Partner – Growth & Solutioning, TheMathCompany



IN BRIEF

- Digital Twin allow virtual replication of machines and processes, enabling safe and efficient design, monitoring, and improvement.
- It helps reduce costs, speed up product development, and improve operational efficiency in various industries.
- The Digital Twin market is expected to grow significantly, with projections reaching up to USD 259 billion by 2032.
- Adoption is especially high in sectors like automotive, aerospace, healthcare, and urban planning, where precision and efficiency are crucial.
- Digital Twins face challenges such as integrating with legacy systems, ensuring data compatibility, and maintaining cybersecurity.
- India's ecosystem, including startups and government initiatives, is driving the adoption and innovation of Digital Twin technologies.

monitoring traffic, mitigating noise pollution, and simulating flood scenarios."

ABRACADABRA AT WORK

Let us enter the premises of a giant energy company in the USA. When serving more than five million customers or over 10 million people across the state, operating 11 fossil fuel power generation plants, there is a need to take care of critical assets like gas and steam turbines and generators. Before adopting Digital Twins, each plant's operations and maintenance process was being carried out locally. Then, it decided that there could be a strong way to increase power reliability and reduce operational costs by centralisation.

The idea was to redefine fleet monitoring and centralisation of operations and maintenance activities. As shared by Happiest Minds, the company made a shift to a better and more digital way of doing business with the P&ID Digital Twin. The initiative also entailed providing deep-dive details on the Fossil Centre of Work Excellence (FCWE) Daily and Outage processes. It also began using Artificial Intelligence and Machine Learning models to optimise work orders and improve data quality for validation, prioritisation, and scheduling FCWE Daily and outage work.

Gupta also gives a peek into some work happening in this space. "We have successfully deployed several projects in the automotive and healthcare sectors. These projects aim to optimise production processes and solve factory issues virtually by offering extensive 3D simulations for design and process improvement."

He shared an example from the automotive sector, where a significant reduction in car production time from 48 months to 12 months was recorded, along with a 50% reduction in costs. Besides, it significantly decreased the safety certification timelines.

Then there is the case of a retailer that adopted a digital process twin to tackle critical challenges after establishing a new e-commerce fulfilment wing at their



"Digital Twin has emerged as a lever enabling a real-time view of the supply chain and the business, empowering teams to make informed decisions."

MANOJ KARANTH
Vice President & Global Head – Technology and Delivery, Connected Universe, LTIMindtree



THE TWINS

The Good Spell

- Save costs in design and repair, which usually take a lot of resources with actual product or prototype
- Reduce the risks of accidents or damage by trying everything on simulation first
- Give real-time data and visibility, driving efficiencies
- Improve time to market cycles and cut down on wastage as well
- Easy for collaboration, high-stake innovation and new ideas

The Tricky Part

- Legacy issues
- Inability to simulate details
- Compatibility issues
- Data hurdles
- Security exposure
- Easy attack surfaces

primary US-based centre. The new facility provided additional capacity, but the increased volume exposed inefficiencies in the sequence of the products picked and grouped into respective orders. This led to decreased fulfilment SLAs in terms of orders serviced.

TheMathCompany built and implemented a Digital Twin to replicate the picking and grouping process, offering three distinct features: real-time scheduling, simulations, and optimisations. The process simulation allowed analysis of the critical SKUs and their demand, sizes, frequency, etc., to iterate over multiple sequences. Process changes in sequences were simulated to analyse the potential impact and reconcile it with historical performances, explains Kumar.

"With optimisation of the layer based on the constraints, SLAs were performed to recommend the best-fit sequence to maximise the number of orders fulfilled. The recommendations were tracked in real-time in terms of throughput, accuracy, and efficiency of pickings."

As he shares further, the initial pilot phase was rolled out in four months, followed by a period of testing and fine-tuning over three months. Post enhancements, the system was completely rolled out in three months. This initiative enabled the centre to increase the number of orders fulfilled by 20% over the next six months, leading to increased customer satisfaction and brand value enhancement. The solution was modularised to scale it across multiple facilities, achieving 50% efficiencies in time and investment.

As further illustrated by Manoj Karanth, Vice President and Global Head – Technology and Delivery, Connected Universe, LTIMindtree, Industrial Digital Transformation has been a key theme across the industry. At the same time, there has been a lot of uncertainty across supply chains and variation in demand, to name a few. Getting a real-time view of the business and empowering teams to make decisions has emerged as a real need. Digital Twin has emerged as a lever to enable this visibility.

> Homegrown Independent Software Vendors and innovative startups in India are fuelling advancements, driving the adoption of Digital Twin.

LTI Mindtree cites the example of a Mid-Stream Oil Major in the US. They have 6,000 miles of pipelines with 40-50 processing plants and are one of the largest producers of natural gas liquids. They source the gas from the producers, treat and clean it, and make it available to actual consumers. They needed a view of the business in real time so that people could make informed decisions to improve productivity and realise commercial value.

This required a complete process, Digital Twin, which gathered data in real time from multiple sources, including IIoT sensors, commercial contracts, market prices and KPIs, to comprise a single source of truth. Real-time value chain optimisation uses live process simulations to maximise productivity. The single Digital Twin hub allows operators, engineers and business analysts to coordinate decisions, operate plants remotely and receive performance alerts.

In its first year, this initiative realised USD 50M in net income and USD 13M margin improvement, with a 4% increase in commitment accuracy. It matched production to demand in real time, thus bolstering supply chain resiliency.

WHEN THE POPPET POPS

Digital Twins are not without their share of painful needles, though.

A lot of challenges exist before their true magic can be tapped. Especially if a company already has a monkey sitting on its shoulder in the form of heavy legacy systems.

Kumar outlines that the successful implementation of Digital Twins faces challenges in terms of Technology and Process Design. “Digital Twin require in-depth process understanding and system design to translate real-world parameters into simulations. They also necessitate a sophisticated IT infrastructure facilitating seamless connectivity and communication. Legacy systems, prevalent in many organisations, pose a hurdle to data collection and integration with modern Digital Twin technologies. Ensuring compatibility between existing infrastructure and Digital Twin solutions becomes imperative to unlock their full potential.”

Kumar also points out the torn parts of security here. “Additional cybersecurity oversight would be required to protect sensitive business process parameters and design. Overcoming these challenges requires concerted efforts and strategic investments in upgrading IT infrastructure and implementing robust cybersecurity protocols to enable the widespread adoption of Digital Twins in India.”

GET YOUR BONSAI

The future of Digital Twins is excellent, with more and more industries and governments adopting it by bringing Physical and Digital (Phygital) worlds together. “A thriving ecosystem of homegrown Indian Independent Software Vendors (ISVs) and innovative startups are fuelling advancements in this domain. The adoption of IIoT and Digital Twins in India is experiencing significant momentum,” Gupta reckons.

“This momentum is further supported by the recent establishment of an India branch by the ‘Digital Twin Consortium’, a global organisation promoting industry standards and education. The ‘Sangam initiative’ by the Department of Telecommunications (DoT) fosters collaboration between public entities, infrastructure planners, tech giants, startups, and academia. This collaborative approach positions India as a major player in developing and deploying next-generation IIoT and Digital Twin solutions.”

Digital Twins are full of many good omens. However, they should be deployed and used with comprehension, clarity, caution, and care. Now is an excellent time to consider their advantages and pragmatic hurdles in the context of Indian conditions, limitations, and possibilities, as well as the vertical or industry in which one operates.

As John Naka advises: “The object is not to make the tree look like a Bonsai but to make the Bonsai look like a tree.”

Next time there is a fire alarm, you may want to save your Bonsai/Digital Twin and that machine in the glass house later. And not only because you can actually run with it.

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HCLTech to acquires HPE's Communications Technology Group



HCLTech has announced that it will acquire the Communications Technology Group (CTG) from Hewlett Packard Enterprise (HPE). This acquisition includes intellectual property, engineering and R&D talent, and client relationships with top global Communication Service Providers (CSPs).

The acquisition will enable HCLTech to enhance its service offerings with new capabilities in Business Support Systems, network applications, service cloudification, and data intelligence. These additions will complement its existing services in AI, IoT, and data-driven models, improving efficiency and integration.

HPE will retain its Operations Support Systems (OSS) business, focusing on OSS, orchestration, assurance, public 5G SDM, and private 5G networking through its Telco Solutions group within HPE Aruba Networking.

"With this transaction and our planned strategic partnership with HPE, we are strengthening our telecom practice to address the expanding global telecom market," said C Vijayakumar, CEO and Managing Director of HCLTech. "With the incoming engineering talent and industry-leading IP from CTG, we are enhancing our capabilities and relationships with global CSPs, accelerating our growth in the telecom industry."

Antonio Neri, President and CEO of HPE, added, "HPE is pleased to have identified HCLTech as the right partner to support the ongoing transformation of global telecom, media, and tech companies. The Communications Technology Group will become part of a strong partner that understands its heritage, strategy, and potential."

As part of this agreement, approximately 1,500 CTG employees will transfer to HCLTech in Spain, Italy, India, Japan, and China to service clients globally.

Constl deploys Ciena's optical tech for high-speed network



Ciena has announced that Constl, a subsidiary of Space World Group, is deploying its optical technology to offer high-speed Metro Area Network and National Long Distance connectivity services across India. Central to this network is Ciena's 6500 Packet-Optical Platform, powered by WaveLogic 5 Extreme. It supports up to 800G services and can scale up to 1.6T with WaveLogic 6 shortly. The reconfigurable line system can handle unpredictable traffic and adapt its network to customers' needs.

"We aim to capitalise on technology innovations and provide our customers with an alternative digital infrastructure. Ciena will be crucial to our growth by bringing resilient connectivity and scalable networks. We are building a digital platform to deliver a top-tier customer experience over a robust fibre infrastructure with self-service capabilities," said Sunil Kumar, CEO of Constl.

He further stated that Constl is rolling out new fibre infrastructure in and between major metro cities, connecting data centres, cable landing stations, telco POPs, and other major service provider POPs to enhance India's digital connectivity landscape. The company also plans to use Ciena's Navigator Network Control Suite for a centralised view of its multi-layer network, enhancing planning, provisioning, and assurance workflows.

"Aided by the need for data centre interconnectivity and the growth of 5G and AI, Constl is advancing with a unique vision. Ciena's optical technologies will provide the company with capacity and network programmability to meet the changing demands of this hyper-connected world," said Amit Malik, Vice President of Ciena India.

Digital Connexion, DE-CIX to provide interconnection services

Digital Connexion and DE-CIX India have announced a strategic partnership to provide Internet peering and interconnection services to Indian enterprises. This collaboration includes establishing a new point-of-presence (PoP) at Digital Connexion's MAA10 data centre in Chennai.

The partnership aims to benefit enterprises, cloud and content providers, and Internet service providers (ISPs) in southern India. Companies hosted at MAA10 will gain expanded high-speed interconnection capabilities, improved network performance, cloud connectivity, and Internet peering services. DE-CIX's presence at MAA10 will also address low-latency edge requirements and ensure seamless content delivery through a robust network footprint, helping enterprises accelerate digital transformation and enhance customer experience.

With DE-CIX's multi-service interconnection platforms, customers can access various services, including connectivity to hundreds of local carriers, ISPs, and content and application providers, without needing separate direct connections with each network. DE-CIX DirectCLOUD allows Digital Connexion customers to reach global cloud providers such as Microsoft Azure, AWS, and Google Cloud through a single point, eliminating direct connection costs.

CB Velayuthan, CEO of Digital Connexion, highlighted the importance of next-generation infrastructure for



India's digitising economy. He stated that the partnership with DE-CIX enables efficient digital transformation and provides various interconnection services, fostering a connected ecosystem.

Sudhir Kunder, Chief Business Officer of DE-CIX India, expressed excitement about the partnership, emphasising the diverse solutions and efficient interconnection options it offers enterprises and ISPs. This collaboration marks the fourth PoP for DE-CIX in Chennai, bringing the total number of PoPs across India to 20.

Zeronsec partners with Web Werks to boost data centre security

Zeronsec, a cybersecurity solutions provider, has announced a strategic partnership with Web Werks Data Centers. This collaboration aims to enhance the security infrastructure and operational efficiency for businesses using Web Werks' data centres.

Zeronsec will deliver the Security Operations Center (SOC) as a Service to Web Werks' clients. This service includes real-time threat monitoring, rapid incident response, and advanced threat intelligence to ensure the security of critical data and applications. Key benefits of the partnership include improved security monitoring and response through Zeronsec's 24/7 SOC services, which utilise AI and machine learning for threat detection and response.

"Clients will benefit from Zeronsec's expertise in cybersecurity, gaining access to the latest threat detection methodologies and advanced threat intelligence. The SOC services are scalable and flexible, allowing businesses to tailor their security solutions to meet specific needs and regulatory requirements," the company stated in a press release.

Dipak Vagadiya, Founder and CEO of Zeronsec, noted that it combines the company's cybersecurity expertise with Web Werks' infrastructure to offer robust security solutions. Amit Agrawal, Chief Business Officer of Web Werks – Iron Mountain Data Centers, emphasised the importance of security for their customers and the value of Zeronsec's SOC services in protecting data and applications.

Integrating Zeronsec's SOC as a service into Web Werks' data centres is designed to be seamless, ensuring minimal disruption and enhanced security. This partnership highlights both companies' commitment to providing top-tier security solutions and supporting the digital transformation of businesses across various sectors.

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