KPMG

INDIA MOBILE CONGRESS

5G driving the next growth wave for Digital India

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IMC Foreword

I would like to extend a warm welcome to you on the sixth edition of the India Mobile Congress which has established itself as a world class event aimed at bringing together players across the ICT sector to debate, discuss, and disseminate on the current trends and possibilities for the industry.

The theme for this year *'New Digital Universe'* reimagines the future of the nation as the frontier technologies like 5G, IoT, AI, AR, VR permeates our daily lives. It focusses on the evolution path of existing technology and what it holds for businesses and individuals for the future and the role of enabling governance and policy in this journey. A true digital enablement through policy intervention happens only when the industry and the government are in sync. Since the operating models are itself changing in a hyper-converged world with ever changing demands, there is a need to assimilate, assist and address technologies of tomorrow with India's needs in context. Cloud, AI, 5G, AR/VR, robotics, industry 4.0, blockchain, metaverse, and cyber-security are all congregating together to form a perfect path of tomorrow's connected and secured 'Atmanirbhar Bharat'.

Continuous innovation on the future networking technologies with right set of automation and optimization tools will ultimately enable frugal innovation and collaboration at scale for India. Unlocking innovation at grass-root levels through edtech, health-tech, Agri-tech, and fintech startups remains crucial in these changing times. A trillion-dollar digital economy led by a robust well connected digital national infrastructure thus needs to be supported by a skilled and a fungible workforce providing real world experiences via next-gen infrastructure, new age devices, and conversational AI-led services.

I would like to commend the teams at IMC and KPMG in India, for having put together a report that also attempts to declutter and demystify some of the top global 5G / industry 4.0 use cases which are pertinent for enterprises in India. I would like to acknowledge their efforts in the development of this insightful publication.

P Ramakrishna

CEO

India Mobile Congress

KPMG in India foreword

The pace of technological and digital change that we witness today is rebalancing, reshaping and re-imagining traditional ecosystems and business models. As countries, companies and consumers become digital-first, new combinations of talent and technology are delivering decisive advances in creating digital governance, digital business models and digital solutions. In this digital transformation journey, communication becomes a dominant pillar enabling some of the frontier technologies like AI, IoT, AR and VR to drive positive outcomes whether it's streamlining processes, harnessing data or shaping entirely new ways of doing business.

With a connected ecosystem of 1.16 billion telecom subscribers and digitally connected enterprises and government, today India boasts of unparalleled use of technology to drive a sustainable and inclusive growth. However, this is just the cusp of a digital revolution. With 5G on the anvil and a strong enabling regulatory environment, India has a potential to become digital superpower. 5G has a potential to commercialise emerging technologies and embed it in daily lives and create business value. From use of AR/ VR to create immersive experience for consumers to deploying Industry 4.0 solutions for corporate India and deployment of smart city solutions for smart governance, ICT companies have a great opportunity to serve the underserved.

The government's razor-sharp focus in creating a robust and enabling ICT ecosystem has helped the sector emerge from the woods. The impetus provided by the seminal reforms has enabled the sector to scale new heights resulting in a qualitative change in the lives of Indian consumers. The communication sector has not only supported the expansion of services in various sectors but also propelled the socio economic upliftment of the country. With the successful completion of 5G auctions, now the sector is ready to usher in a new chapter of growth unleashing new possibilities for consumers and enterprises.

Today's investments in 5G and tomorrow's ROI expectations signal a shift in the operating landscape of enterprises looking for value-driven partnerships. In association with IMC, KPMG in India is proud to present the report, '5G driving the next growth wave for Digital India', which provides a roadmap to organisations in ICT sector to re-purpose, re-engineer and re-position their offerings into an increasing complex and demanding enterprise world.

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Executive summary

Being the second largest mobile internet base, India has already cemented its place in the global telecom space. Now that the much awaited 5G spectrum auctions have been completed on the back of structural and policy changes, India is poised for a digital revolution. The next-gen digital services are expected to transform the way consumers connect, enterprises digitalise businesses, citizens consume government services, and the way Communications Service Providers (CSPs) bridge future communication needs with the current network transformation.

5G is set to become a connectivity fabric that connects people, devices, machines and ecosystems in a time of hyperconnectivity and quick technological advancements. With the low penetration of fixed broadband, 5G is set to deliver on the nation's dream to remove the digital divide and provide connectivity to citizens of Bharat. 5G trials have demonstrated the power of 5G FWA to bridge the digital divide by enabling access to high-speed broadband in rural areas. The recent trials also demonstrated the power of connected India, where there is a free flow of essential services like education, healthcare, e-governance through digital mediums. Use-cases from smart farming to remote healthcare to use of AR/VR for skilling could go a long way in digitally enabling the success of Bharat.

Similarly, low latency, improved bandwidth and large machine-type communications, which are typical characteristics of 5G, are expected to have a significant positive impact on businesses. As per KPMG's enterprise digital transformation survey, most businesses are already considering how 5G will benefit their process of digital transformation because of its service-based, cloud-native design and enhanced capabilities to support adoption of technologies like AI, IoT, robotics etc.

Some highlights from KPMG's enterprise digital transformation survey in 2022:

In the next 2-5 years, there is a visible increase in the quantum of budget allotted for ICT as well as 5G / industry 4.0 use cases globally – and for India ~50 per cent of enterprises surveyed point towards increased budgets, especially for non-time critical communications use cases. This indicates that most organisations that started their digital transformation initiatives are now ready to be nudged into a digital first state with 5G.

More than 85 per cent of enterprises across multiple sectors are expecting up to 20 per cent ROI on various 5G/ industry 4.0 use-cases ranging from non-time critical communication, connected goods, seamless ecosystem communication, remote operations and time critical communications. The expectation increases within the next two-to-five-year period and as 5G is substantiated with auxiliary technologies such as AI/ML, blockchain and AR/VR, the returns are expected to go higher.

As per survey findings, while enterprises have already embarked on big data and data led transformations, Industry 4.0 is the next big focus area. Only 15 per cent of global enterprises have industry 4.0 initiatives in a fully implemented state as compared to 34 per cent analytics fully implemented.

Growth, competition and the switch to 5G technology in existing 4G networks have greatly raised demand on CSPs to improve efficiency. From an operational and technological standpoint, the change to a more decomposed and open architecture for existing CSP environments is essential. To be ready for this opportunity, CSPs first will have to be agile in bringing this internal transformation up to speed and that will allow them to cater to newer revenue streams. As our survey indicated that as on date, CSPs are not the go-to vendor category for building enterprise capabilities in IoT, AR/VR, cloud or even AI/ML. To increase their pie of revenues, CSPs will have to look at creating capabilities beyond connectivity and create holistic solutions that deliver business value to enterprises. With 5G, CSPs will need to adapt to the new requirements which demand flexibility, openness, resiliency, reliability – all at a lesser cost and continual technology innovation.

Given the distinctiveness of India's telecom industry and infrastructure status, it is crucial that mobile broadband remains at the centre of the country's policy vision as India moves toward 5G and aims to fulfil its digital goals and ambitions. To genuinely make 5G an inclusive technology, emphasis should be put on how it affects the lives of rural and economically underserved communities. Eliminating the digital divide remains a crucial aspect for government which not only aims to reach the last mile but also enable empowerment of MSMEs and SMEs through digitalisation. For this to happen, skill enhancements for the sector coupled with sufficient R&D budget allocation remains crucial for holistic national growth. Furthermore, fiberisation of towers, virtualisation/softwarisation of telecom assets and capital outlay on small cells and street furniture is essential for realising 5G's true potential.

Also, operational efficiency remains at the heart of digital transformation for all surveyed enterprises. 50 per cent of enterprises track efficiency or productivity driven KPIs. Hence, in line with that, 52 per cent of the enterprises expect 5G to bring in efficiency in operations or supply chain.

For the digital transformation needs of the manufacturing sector, globally there is a USD43 billion plus total addressable market for top 10 industry 4.0 use cases where 5G plays a crucial role in boosting efficiency, automating processes, improving quality and tracking last mile operations via smart mobility. Given manufacturing vertical's heft in India's GDP, we have also looked at top 5G/industry 4.0 use cases and have given a road-map of possibilities for CSPs to build those capabilities.

When it comes to vendor selection for implementation of IoT use cases, CSPs might not be the preferred partners for enterprises. Enterprises currently lean more towards Original Equipment Manufacturers (OEMs), hyperscalers and System Integrators (SIs).

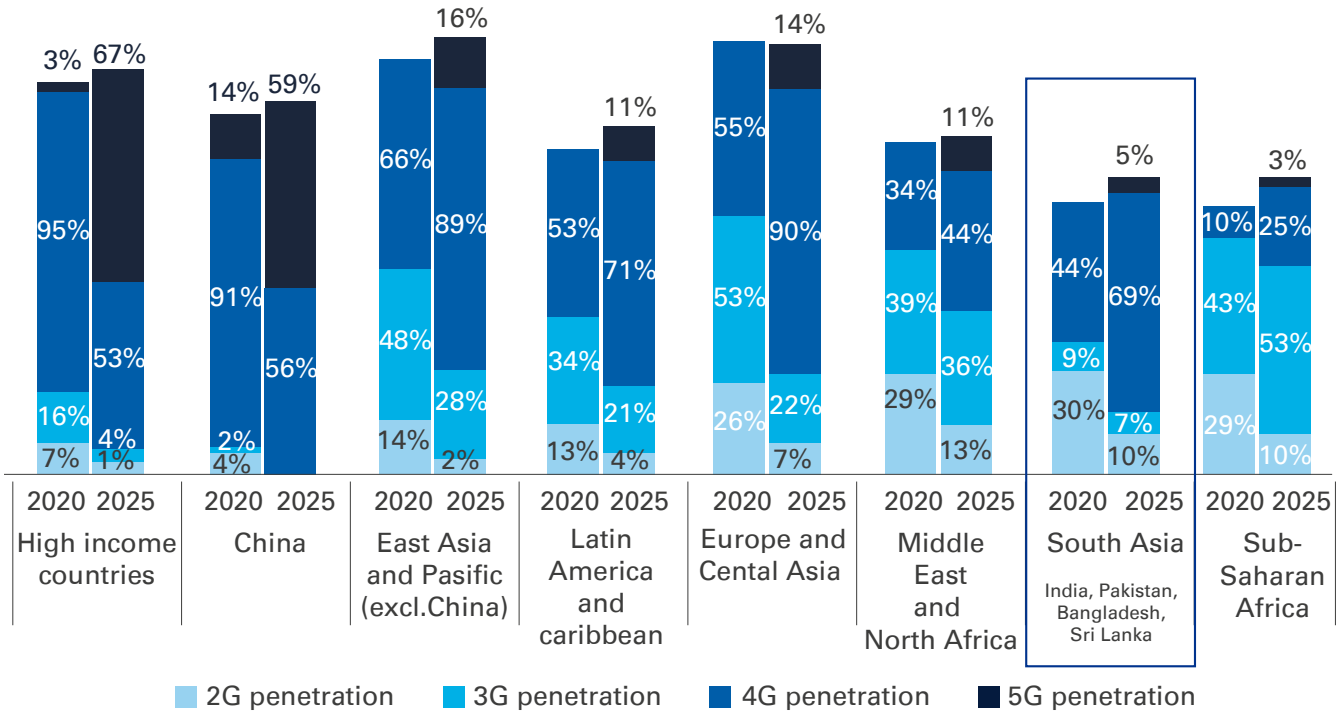
Contents

CHAPTER 01

Reforms in the Indian telecom sector make way for 5G growth

Overall, 5G subscriptions are forecasted to reach 4.4 billion in 2027 as per GSA. However, the world is not a homogenous place in terms of connectivity, coverage and capacity – especially Southeast Asia where 5G has been delayed as compared to other regions, and there is a vast chunk of rural coverage which still depends on 4G coverage.

Figure 1: *Market penetration by region, technology - 2020 and 2025 (%)*



Note: *Penetration is as per number of connections and not unique connections.*
Total is therefore not 100%.
The State of Mobile Internet Connectivity, GSMA, 2021

As is evident from the chart above, 5G adoption continues to grow rapidly in high income countries, whereas in South Asian countries 4G continues to dominate. However, the situation is likely to changes as some of the countries like India get ready to launch 5G services. Though late, these countries can expect an accelerated technology adoption rate, enabled by increased digital adoption, robust and growth centric policy and regulatory framework, maturity in 5G technology and ecosystem and rising 5G handset sales enabled by affordable pricing.

India has certainly come a long way from licence-raj era to adopting a 'customer first' approach in policy making; and moving away from an oligopolistic market to a more competitive ecosystem that focuses on using common infrastructure and allowing private enterprises to bid in the auctions. The last 18 to 24 months have been unprecedented in policy development and are helping India embark on a truly digital society of the future. Department of Telecommunications (DoT) and Telecom Regulatory Authority of India (TRAI) have been instrumental in understanding the needs of this digital society and laying a transparent yet balanced policy framework. We can divide India's telecom journey broadly into four phases:

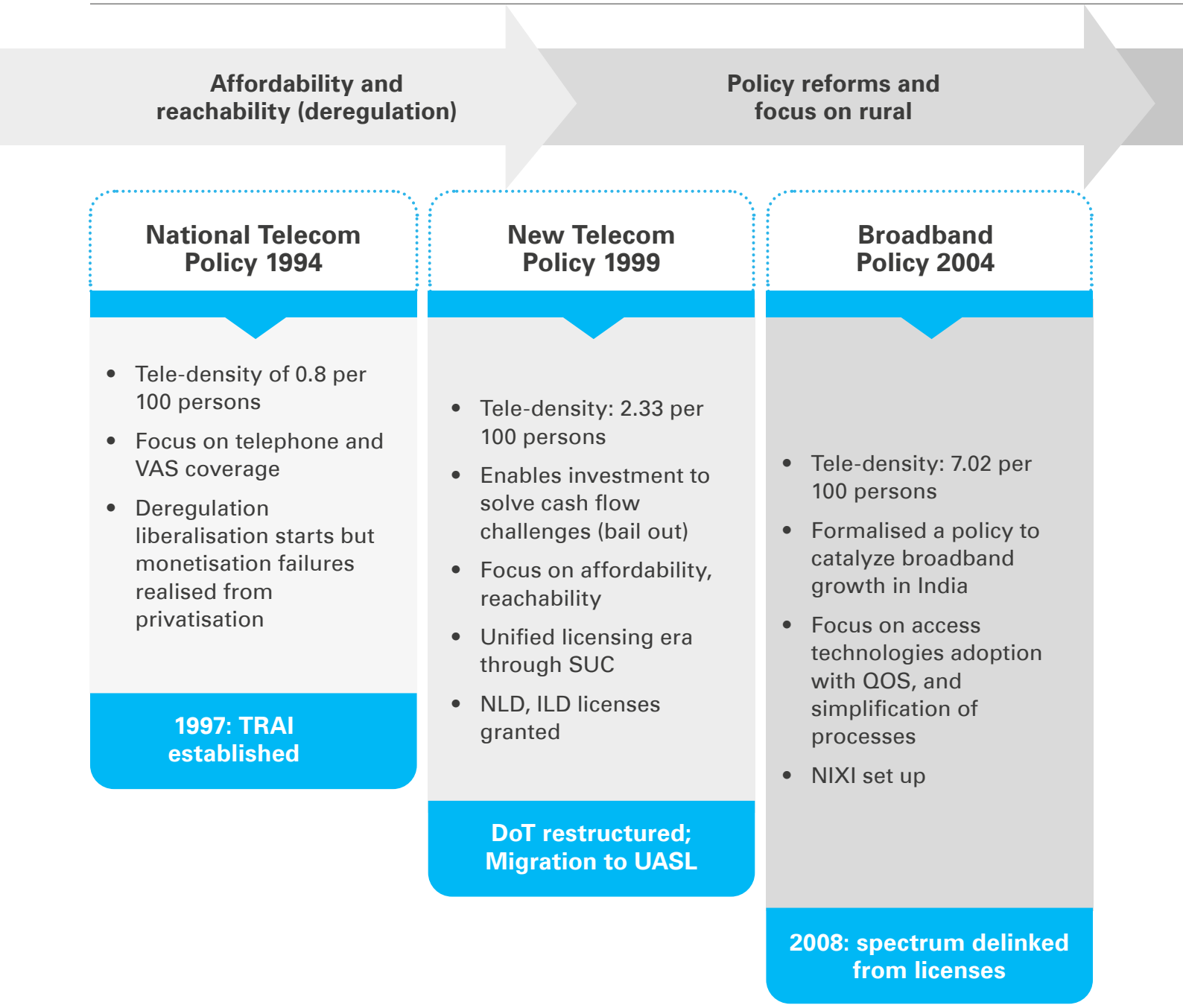
Deregulation phase of late 1990s

Rural focused phase of 2000s

Consolidation phase of 2010s

Holistic reforms-led phase 2020s

Figure 2: *Changing gears of Indian telecom regulations, policy shaping and reforms*



Source: *DoT, TRAI subscription data, KPMG, 2022;*
**Tele-density has reduced on account of various reasons including surrendering of multiple mobile connections over the pandemic*

Consolidation and convergence phase

Reforms 2.0 (holistic development, technology led light- touch, reformative and forward-looking regulatory focus)

National Telecom Policy 2012

- Tele-density: 78.66 per 100 persons
- Convergence in the theme and FTTH and optic fiber gains prominence
- Focus on reducing the digital divide begins; free roaming and MNP
- Introduction of virtual CSPs
- Telecom equipment manufacturing gets a boost; promotion of R&D

2013: Unified license repurposed

National Digital Communications Policy 2018

- Tele-density: 93.27 per 100 persons
- Broadband for all gathers momentum and focus on remote connectivity
  - BharatNet, GramNet, Jan Wi-Fi, and NagarNet to be funded by USOF
  - Public hotspots to reach 10 million by 2022
- Address bottlenecks in spectrum and satellite inefficiencies
- Focus on C-SAT
- Security, holistic growth, are priorities

2016: Reliance Jio is born

Bold Reforms, Change in Directions and 5G Launch (2021/22)

- Tele-density: 85.03 per 100 persons
- Definition of AGR revised; bank guarantees rationalised, spectrum holding tenure increased; no penalties on interest payment delays, de-stressing of capex burden (focus is on EODB, policy simplification)
- Focus is on greater PPP, inter-CSP co-operation with policy support
- Focus on 5G standardisation
- September 2021 bold reforms lay ground for 5G auctions and give a lifeline to Vi – to help India have 4-operator market for greater inclusion and diversity
- 5G trials start - supported by DoT
- **Draft Telecom Bill 2022 introduced**

2022: 5G spectrum auctions (new era begins for TRAI)

The year 2021 was a landmark year ushering in significant policy and structural reforms, which cemented the government's intention to create a thriving telecom sector. These reforms gave much-needed relief from a structural and procedural point of view and reduced financial and compliance burden on the service providers. Some of the key highlights of these reforms include:

1. Levy of spectrum usage charges (SUC) on the spectrum to be acquired in future auction has been removed
2. Spectrum acquisition period increased from 20 to 30 years
3. Requirement of submitting financial bank guarantee to securitise the annual spectrum instalments has been removed for future auctions
4. Rationalisation of interests on shortfall of payment of various levies and annual compounding of interest and penalties removed
5. AGR redefined to exclude non telecom revenue
6. Allowing up to 100 per cent FDI under the automatic route, which gave way for huge investments in the telecom sector – particularly in the private sector.
7. A four-year moratorium on the payment of Adjusted Gross Revenue (AGR) and other dues
8. ROW simplification: With the launch of GatiSakti Sanchar portal to process RoW applications and address issues related to swift resolution and roll-out of services, the government has also consolidated all state IT departments along with infrastructure central ministries such as Railways and Highways to prepare for 5G launch. Further, the administrative fees are also rationalised keeping the government out of the equation in many cases to quicken the rollout of fibre, poles and street furniture for 5G densification. As per MeitY, the average time for getting an approval has come down from 343 days to 16 days.
9. The semiconductor policy with an initial budget of INR76,000 crore worth of benefits which supports the design led PLI schemes for electronic devices manufacturing including the telecom equipment in the country. This is coupled with a PLI scheme on telecom and networking with an outlay of INR12,195 crore, IT hardware (INR7,325 crore) and on electronic systems including mobile phones (outlay of INR40,951 crore)[1].
10. A push to the development of an indigenous telecom stack with respect to infrastructure equipment, telecom transmission, radio systems and other supporting devices is now being carefully considered. India already is the second largest globally in manufacturing of mobile handsets. The manufacturing of enterprise grade equipment such as routers, servers, gateways, modules and peripheral equipment needed for 5G infrastructure will alter the dynamics of the industry.

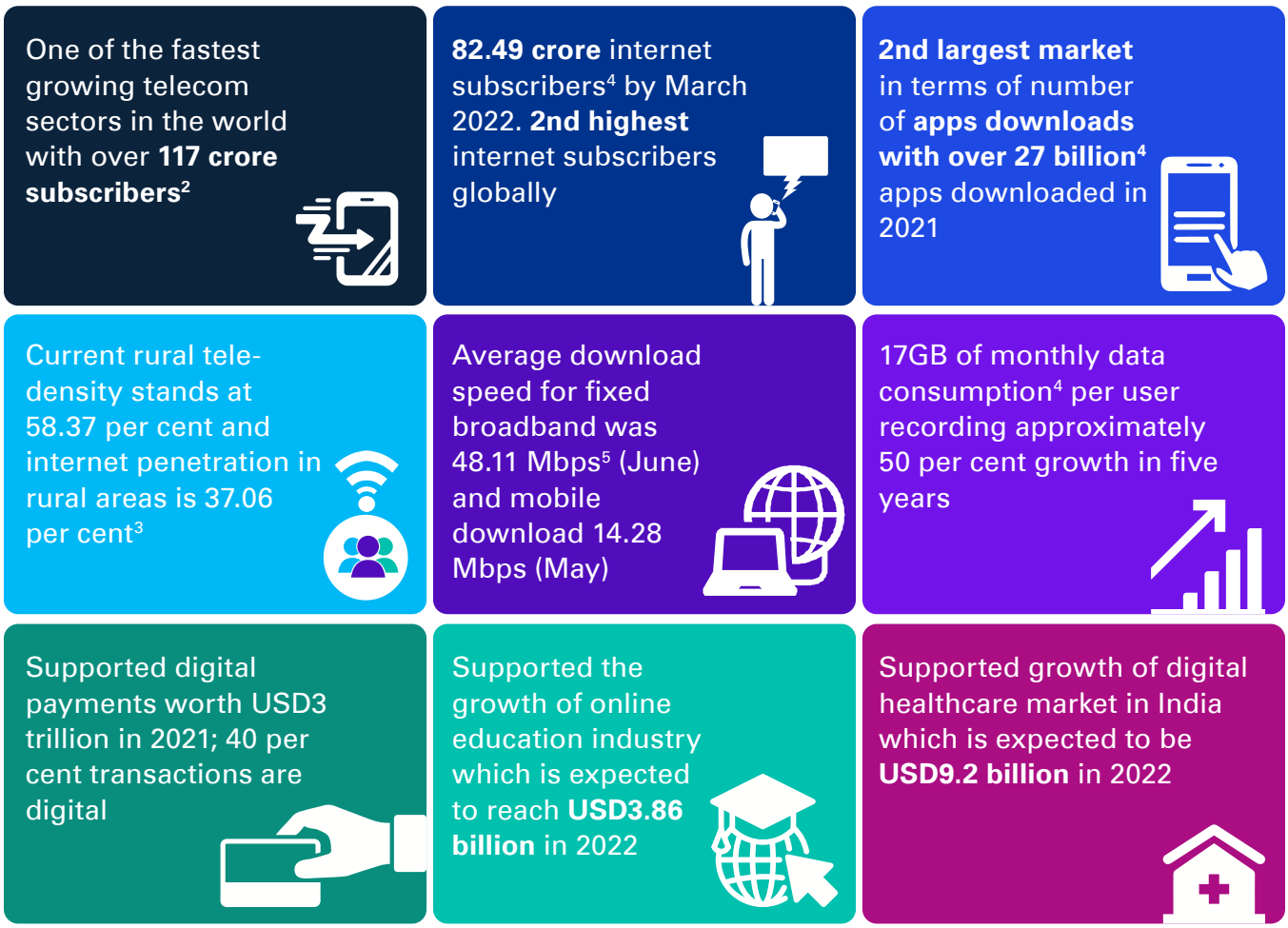
1. Invest India (Government of India)

These reforms laid the ground for 5G auctions and created an environment of certainty within the investor and CSP community. It has created a multiplier effect in the economy which has accelerated digital adoption in the country. Some of the visible changes brought in for both the consumers and the industry are summarised below:

Benefits for consumers:

The impetus provided by the reforms has enabled the sector to scale new heights resulting in a qualitative change in the lives of Indian consumers. The telecom sector has not only supported the expansion of services in various sectors but also propelled ed-tech, agri-tech, gaming, food-tech, health-tech, fintech thereby impacting the socio-economic upliftment of the country. A snapshot of the current landscape of the telecom industry is given below.

Figure 3: *Supporting digital economy's different pillars*

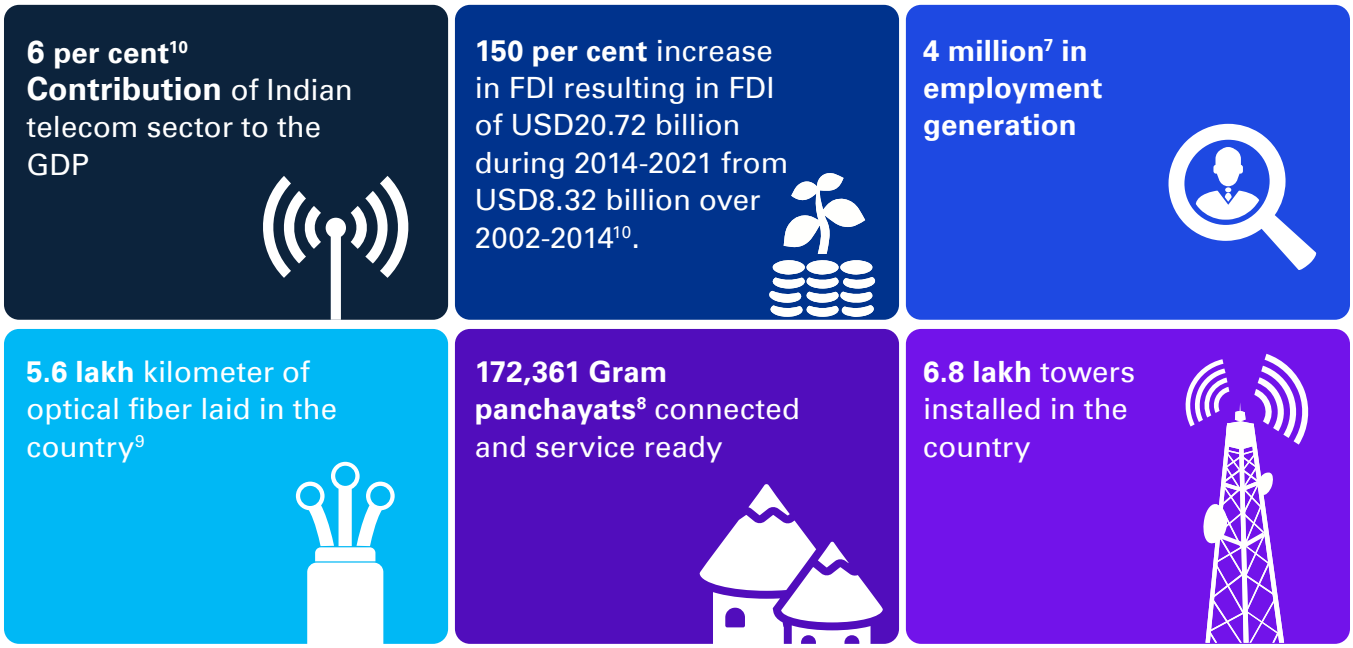


2. Explanatory note to the draft Indian Telecommunication Bill, 2022;
3. The Indian Telecom Services Performance Indicators, January – March 2022, TRAI;
4. TRAI;
5. Statista;
6. Ookla

Benefits for the industry:

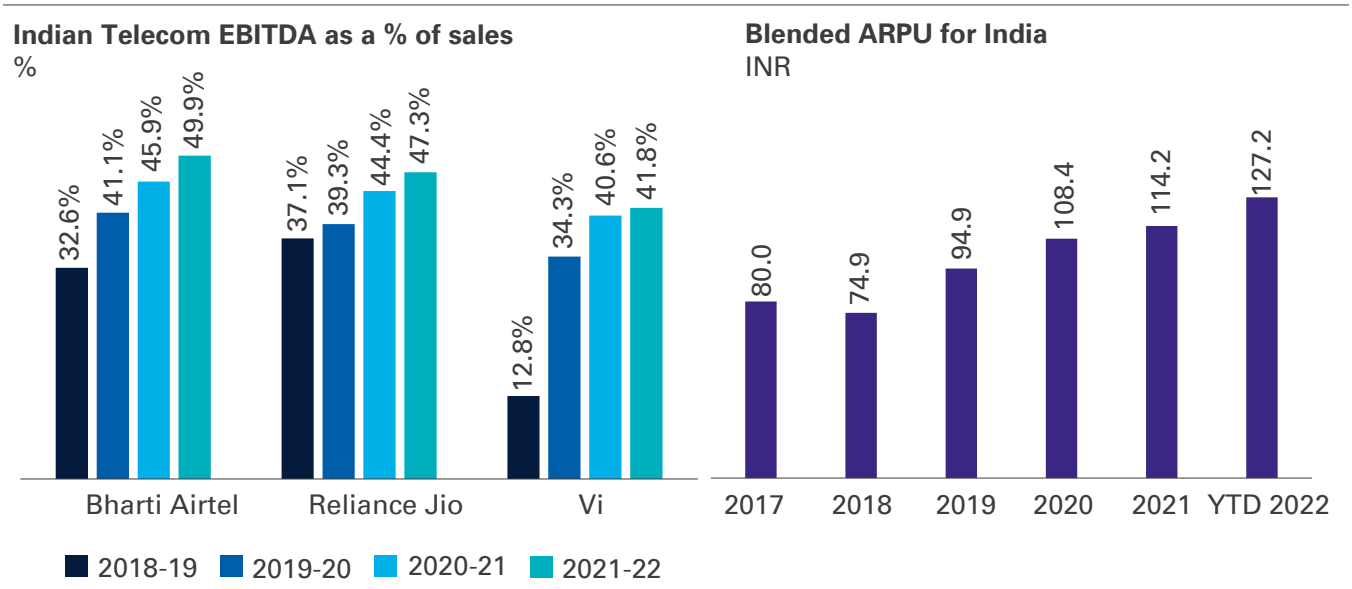
With sweeping financial, structural and process reforms in 2021, the sector, that was once ailed with litigations and financial distress, got a fresh lease of life. The reforms have not only revived the financial viability of the sector, but has also significantly increased investor confidence in the sector, which is demonstrated by the increased FDI. The reduced financial burden has allowed CSPs to increase their capital investment capacities for growth of network and telecom infrastructure. The below table summarises some of the achievements of the sector:

Figure 4: *Highlights of the telecom industry*



The overall growth in the sector has also been accompanied by improvement in the overall financial health of the industry. Although one of the lowest globally, blended ARPUs have risen 54 per cent from INR70.5 in 2018 to INR108.4 in 2021. Further, the ARPUs reached INR127 at the end of March 2022, portraying a healthy outlook of the sector.

Figure 5: *Improving financial conditions for the sector*



Source: *CSP annual reports, TRAI subscription data, KPMG, 2022*

7. Explanatory note to the draft Indian Telecommunication Bill, 2022;
8. The Indian Telecom Services Performance Indicators, January – March 2022, TRAI;
9. BharatNet, Government of India;
10. FDi, InvestIndia Website

5G relevance and roadmap for India: In the past two decades, India's technological landscape has undergone a dramatic transformation. Over the years, digital adoption has been widely accepted by consumers, businesses and governments. As more and more people in India adopt a lifestyle that is enabled by digital technology, the country's market has emerged as one of the largest and fastest growing in terms of population of digital consumers. As per the current trend, India is likely to become home to 900 million digital users by 2025[11]. Similarly on the business front, while the level of adoption may be different, the entire spectrum of the corporate entities from large conglomerates to SMEs earnestly participating in the digital revolution.

Communications industry being at the bedrock of this transformation, CSPs historically have played a significant role in unleashing the digital potential of the nation. Not only have they supported through robust networks but have also stepped up by providing solutions beyond connectivity and expanding their horizons in areas such as IoT, AI, blockchain, robotics, etc.

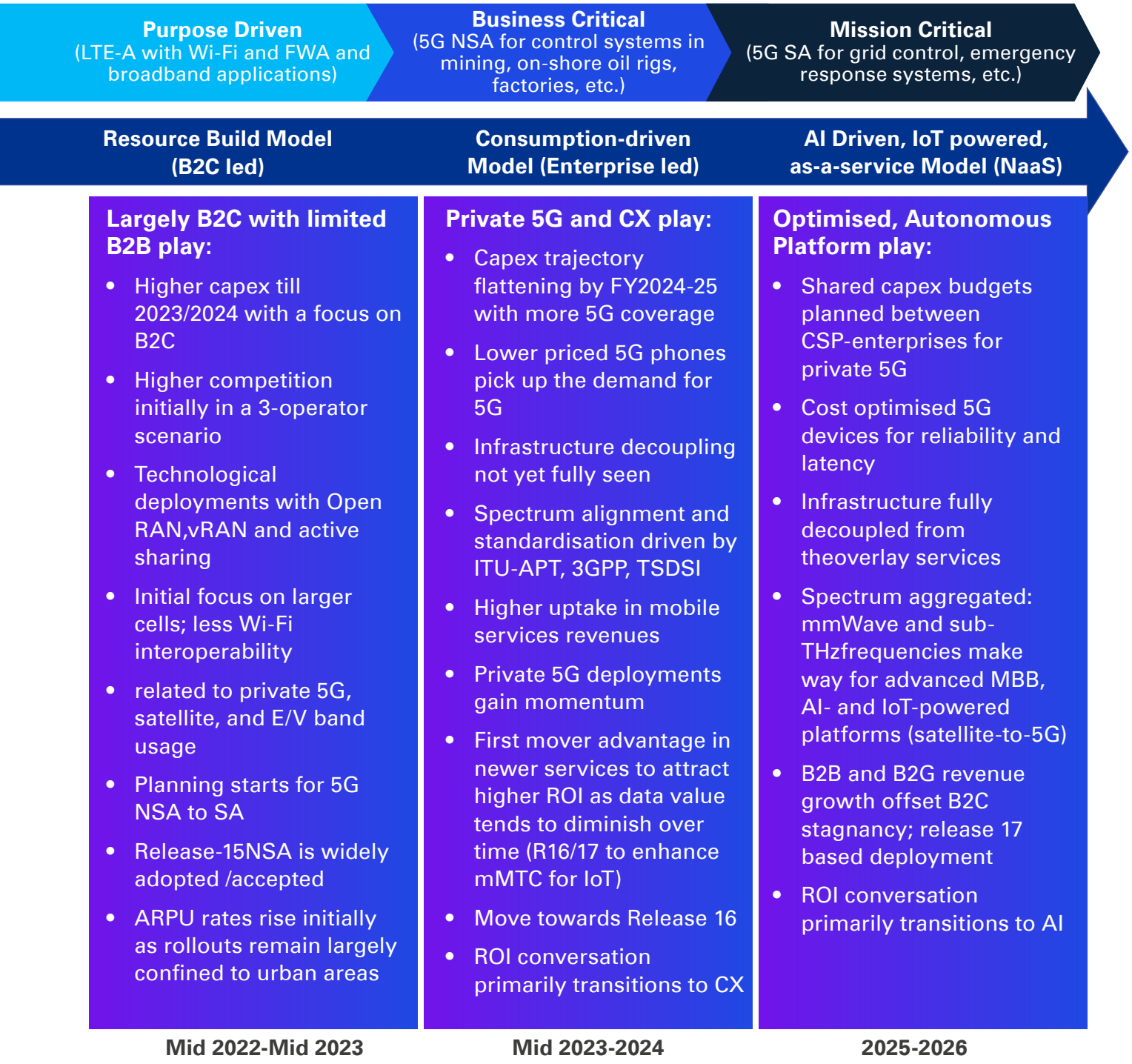
CSPs in the past have already invested in virtual networks and hybrid connectivity plays. They have also gradually transitioned into cloud-centric, automated and self-serve models which lend agility and flexibility. As they now move to balance their cost per byte, they look forward to monetising their investments with customer centric offerings. The 5G edge itself creates myriad of possibilities and opportunities across sectors. Further, while previous generations of technologies were connectivity and coverage centric, it is only with 5G that CSPs and technology companies (techcos) can come together to stitch a meaningful platform-centric digital transformation journey for consumers and enterprises. Use cases such as remote monitoring of oil and gas assets, smart grid, cloud gaming and content delivery networks, remote care delivery, smart traffic and lights, multi-access edge cloud (MEC) based customer experience demand network capabilities like slicing, low latency, extreme reliability, enhanced broadband combined with emerging technologies like massive IoT, AR/ VR, AI, robotics, etc. 5G in India will be the enabler for this digital transformation.

Despite being the bedrock of digital transformation, Indian CSPs have constantly struggled to monetising their investments. Indian CSPs have the lowest ARPU globally despite a reasonably high data consumption per SIM connection per month of around 15GB. Yet, this is just the beginning of the data explosion expected in the country, once 5G is rolled out and some of the emerging technologies like IoT, AI, AR/VR, etc. become mainstream. These technologies will require a significant amount of network transformation, which will allow it to carry enhanced workloads at a specified speed and latency and make it agile to allow newer services. It is broadly expected that by 2025, the data consumption per SIM connection per month will surpass 50GB. With such high expected data loads, Indian CSPs have pinned their hope on promise of 5G, which will allow them to bring in enhancement in capacities, efficiencies in their network, increase in ARPU and at the same time open new realms of revenue streams from the 5G play. The below table shows the expected roadmap, Indian 5G evolution is likely to undertake.

11. IBEF

> With our unique mix of exceptional technical talent, young entrepreneurial spirit, and growing high tech manufacturing industry, India is poised to take global leadership in the new digital economy. Jio's True Standalone 5G network, combined with digital platforms and innovative vertical solutions, is helping accelerate the Digital Bharat vision by empowering every individual and business across the country to realize the full potential of New India.
>
> ***Mathew Oommen, President Reliance Jio***

Figure 6: 5G monetisation considerations for India with timelines for broader deployment



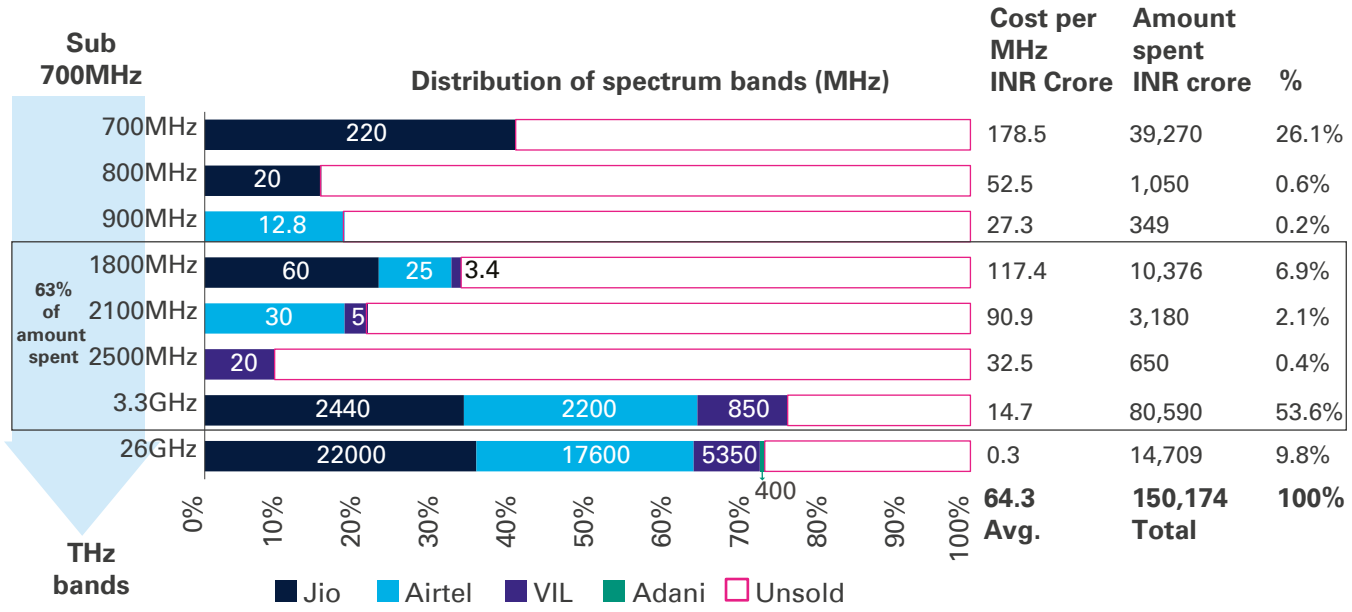
Source: *KPMG in India analysis, 2022*

Until mid-2023, Communications Service Providers (CSPs) are expected to carry aggressive 5G rollouts nationwide and although it will be the B2C segment that gets the ball rolling initially, CSPs would be keen on fine-tuning their operations with respect to radio signal coverage and virtualisation of some network functions for the enterprise space. From mid-2023, with a widespread awareness on benefits of private 5G, deployments will continue to pick up until 2025 as the ROI narrative now shifts to enterprise-led private 5G deployments. After 2025, as per KPMG in India, CSPs are expected to focus on higher automation, AI-driven, network as a service with the convergence of satellite and other unlicensed bands.

Spectrum and capex highlights:

The recent 5G auctions have opened a new chapter of connectivity for India. Recognising the need for affordable spectrum pricing, the auction witnessed a lower spectrum reserve price of 39 per cent. With 71 per cent of the total available spectrum auctioned, it helped the government garner INR1.5 lakh crore.

Figure 7: *The 5G auction relieves capacity crunch opening new opportunities*



Source: *DOT, Communications Today, KPMG in India, 2022*

The recent reforms which led to abolition of the SUC charges, resulted in approximately INR5,000 crore of savings for the telecom CSPs in the 5G auctions. The auction witnessed uptake of different bands by different CSPs depending on their nuanced 5G strategy (5G SA vs NSA). 11 per cent of spectrum bands sold were in the most coveted mid-band contributing to a 63 per cent of overall spend; and 88 per cent of the spectrum sold were in the mmWave bands.

The auction is expected to result in an 18 per cent YoY increase in spectrum-led capex in FY2022-23 (see figure below). This spend will have to be further augmented by capex to continually support the base stations and small cells deployment necessary for 5G implementation. The base stations are expected to have a linear increase to reach 2.9 million by March 2026 -and these will have to be supported by small cells.

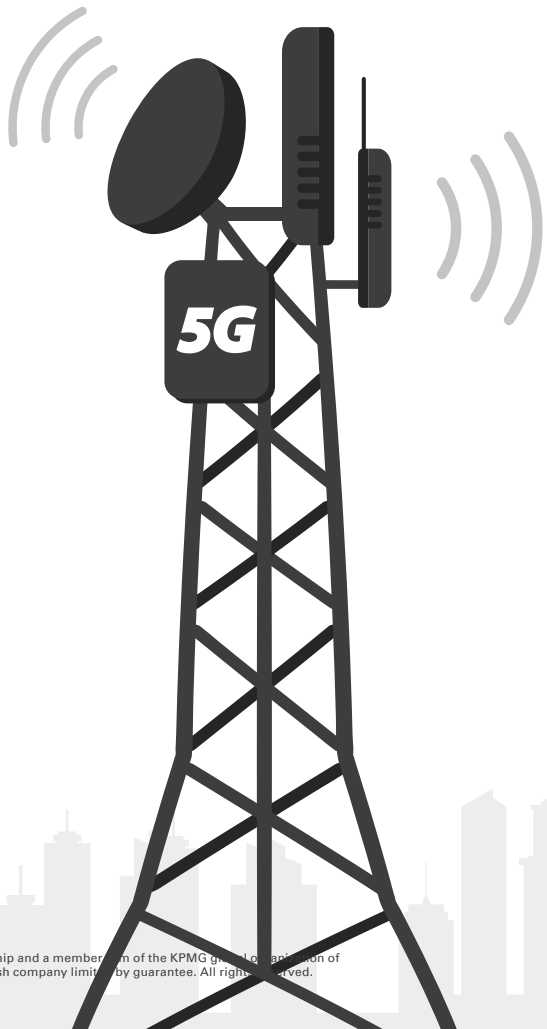
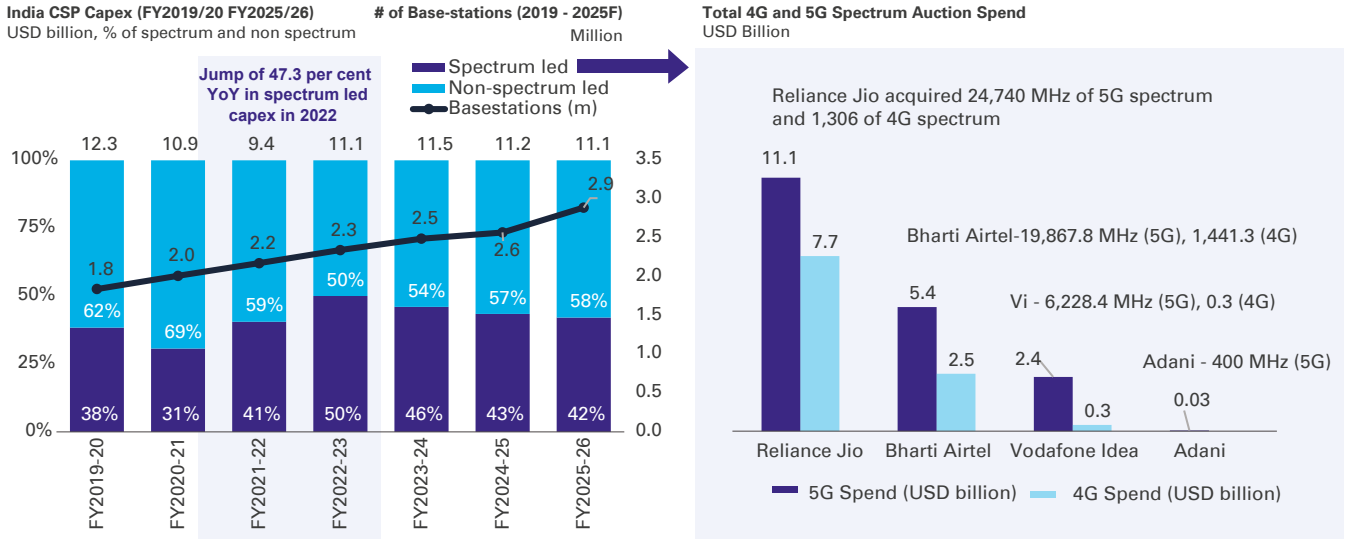


Figure 8: *CSP capex and total spend on spectrum/radio assets in 5G (July 2022) and 4G (September 2021)*



Note: *the 4G spectrum auction in September 2021 was geared towards buying harmonised bands in the contiguous spectrum to make the system more efficient*

For 4G auctions, USD rate of 1USD=74.16INR (average for September 2021) is used while for 5G, the rate used is 1USD=79.49INR (average for August 2022) for simplification of charts

Source: *DOT, CSP annual reports, KPMG in India analysis, Communications Today, Economic Times, 2022*

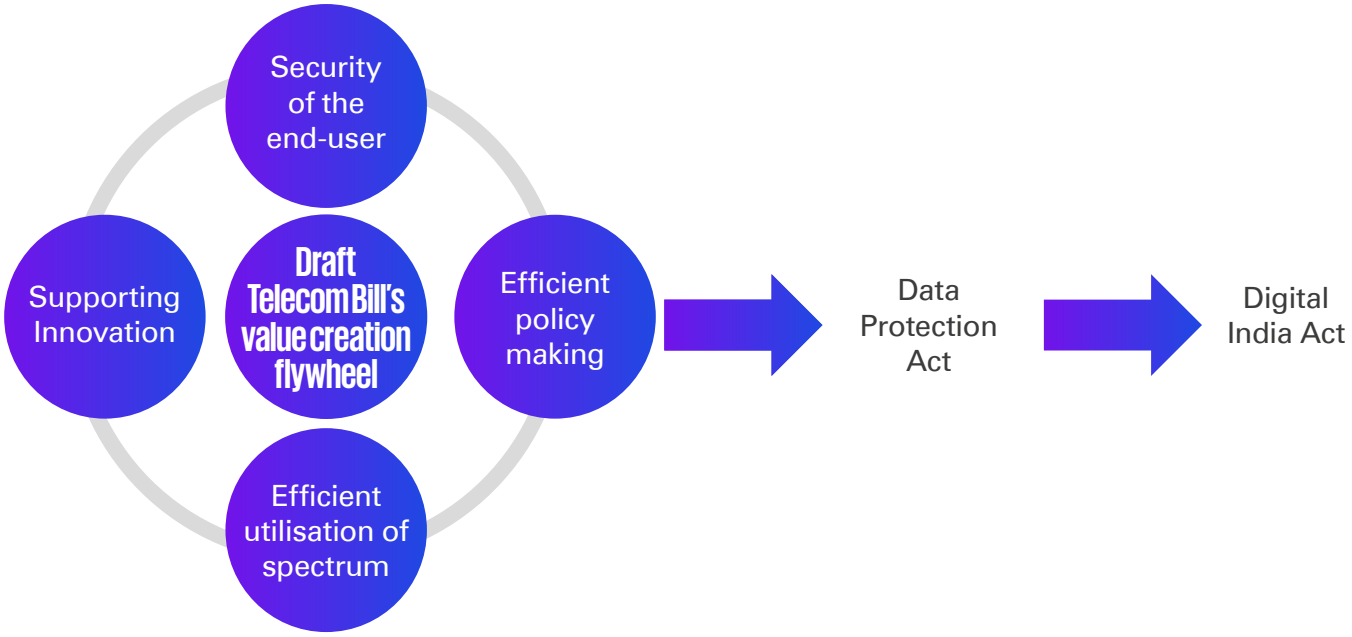
> 5G - with its low latency, high bandwidth and higher device density - will create new ways to solve some interesting challenges in the B2B space. We expect 5G penetration to lead the consumer penetration. 5G can help factories solve quality inspection, predictive maintenance, and remote maintenance using high quality videos. Hospitals can connect patients in ambulances to doctors real time. Small offices and retail points across the country can get high bandwidth internet access using 5G as last mile. Field work force can use the high bandwidth on their mobiles to do things which they currently can't do - e.g., high quality telecasting with just the mobile as a device.
>
> ***Ganesh Lakshminarayanan, CEO Enterprise Business, Airtel***

CHAPTER 02

Draft Telecommunications Bill 2022 setting the tone for growth and innovation

Continuing the momentum of reforms, the Government of India by releasing the Draft Telecommunications Bill 2022, has addressed the industry's need to consolidate and revamp the existing legal framework that governed the telecommunication sector. The proposed bill replaces Indian Telegraph Act, 1885, The Indian Wireless Telegraphy Act 1933 and The Telegraph Wires, (Unlawful Protection) Act 1950, which had become outdated and no longer relevant.

Figure 1: *Four pillars creating a value driven flywheel by the Draft Telecommunications Bill, 2022*



Source: *KPMG in India, 2022*

Efficient policy begets efficient operations: As mentioned earlier, the three outdated regulations, namely, The Indian Telegraph Act, 1885, Indian Wireless Telegraphy Act, 1933, and The Telegraph Wires (Unlawful Protection) Act, 1950 are being consolidated and modernised with the Draft Indian Telecommunication Bill, 2022. The government has focused on a non-discriminatory and a practical right of way policy by providing a legal backing to get swift clearances from state governments. Further, the decoupling of telecom infrastructure from its underlying premises has been a welcome move to avoid clashes in case of property purchases.

Further, the proposed legislation intends to smoothen the digital infrastructure creation process by replacing the licensing requirement with registration for infrastructure providers. Similarly, the telecom equipment can be plugged in with proper authorisation instead of waiting for licence approval process.

Optimum utilisation of spectrum: The bill views the spectrum allotment and auction in a new light to ensure that the natural resource is efficiently used. Auctions, assignments and administrative allotment are options for the government where primary and secondary assignees make way for optimal use of spectrum. Further, there is a focus on re-farming, leasing, or re-harmonising of spectrum for efficiency purposes. The other important aspect of the proposed bill is service continuity of operations – in the past, where CSPs suffered litigations and operational 'freeze' over their spectrum assets, service continuity suffered as they were unable to sell spectrum back to the government. The draft bill provides that a licensee undergoing insolvency proceedings can continue to operate provided it meets the prescribed conditions of the bill. Under special terms and subject to approvals, the government even has a provision of deferment or conversion to equity or write-off of debt or waivers. These clauses not only help the CSPs in their operational journey but also ensure continuity of services to citizens.

Innovation-led initiatives: Recognising the need for innovation in the sector, the telecommunications development fund, proposed under the draft bill, expands the ambit of erstwhile USOF to include providing services to under-served urban areas, skills enhancement, R&D and 6G technology and standards development. This will allow the nation to be at a level playing field in the existing technology development process and perhaps excel in some of the future next gen technologies such as 6G.

The bill also proposes a regulatory sandbox that promulgates innovation. The related provisions of the bill, allow companies, startups to use the sandbox to develop and test new technology and facilitate innovation under a suitably flexible framework. Such framework will provide special terms and conditions and exemptions from terms and conditions of any licence, assignment, registration or authorisation. Startups, SMEs and MSMEs along with CSPs and other stakeholders are provided a government backing to *'fail-fast, learn-faster'* under this sandbox. This not only empowers startups but also generates employment, reduces the time-to-market for new and complex technologies and helps secure funding for a long-term commitment.

While the draft bill demonstrates the intent of the government to enable the sector with light touch regulatory policy which prioritises security of an end user and gives a legal backing to every clause for betterment and upliftment of the masses through higher QoS levels, it would be critical for the government to demonstrate the continuity of this intent in the enabling rules and notifications too. It will be equally important for the government to maintain the light touch regulatory approach as it frames the operational mechanism of this framework to bolster investor confidence and not let regulation hinder growth and innovation.

> From an economic standpoint, by 2025, Cisco estimates that 5G will add USD1.3 trillion to the global economy and create 16 million jobs in its first ten years. However, to unleash this potential, the internet must be reinvented to become near-infallible, secure, predictive, and reliable. Similarly, security will be a prevalent domain, and network segmentation will be critical. Therefore, we must strengthen cybersecurity awareness amongst the citizens and develop robust cybersecurity policies. Most importantly, regulators, industry bodies, network CSPs, and service providers must come together to address the challenges facing widespread 5G adoption worldwide and maximise the opportunities it will bring across sectors, taking the country closer to its trillion-dollar vision.
>
> ***Anand Bhaskar, Managing Director, Service Provider Business, Cisco India and SAARC***

CHAPTER 03

Digital inclusion forms the basis of government's 5G mission

As is widely accepted and demonstrated by various studies, on an average, a 10 per cent increase in mobile adoption increases GDP by 1 per cent, and that rises to approximately 15 per cent when connections are upgraded from one mobile network technology to another. Overall, 5G is expected to generate USD960 billion in Global GDP by 2030.[1] In addition 5G is expected to generate significant socio-economic uplifters, which are likely to help countries remove the digital divide and enhance the quality of lives of its citizens through improved access to healthcare and education, enhanced public security and emergency response solutions and enhanced digital governance. Various countries such as South Korea, the US, the UK and other countries in Africa have specific rural/remote 5G strategies to support and connect the unconnected. The US leverages Connect America Fund to reach the unconnected using fibre and fixed wireless on the Citizens Broadband Radio Service (CBRS) while South Korean CSPs leverage shared infrastructure in rural communities. These strategies are top down so initially the focus is on carving out a holistic policy which then translates into business models and technological architectures from various entities including quasi-government players in the ecosystem.

India is focused on investing USD30 billion to improve last mile connectivity, but in addition to the reforms, the government has consistently worked on strengthening the digital infrastructure to enhance access to connectivity. The rural connectivity has got a renewed focus with the telecommunication development fund (erstwhile USOF) now being earmarked for connecting 7,287 villages. By end of 2022, India is expected to cover more than 93 per cent of villages and over 1,75,000-gram panchayats with broadband/ fibre connectivity. The PPP model for leveraging fibre network via the BharatNet programme has accelerated grassroot level connectivity. With over 0.5 million common service centres across urban and rural India, PM WANI and 5G are laying the base for common services, which also push for rural employment generation. SMEs and MSMEs, which contribute more than 40 per cent to India's GDP, are expected to get a boost via technological support in rural and semi-rural areas.

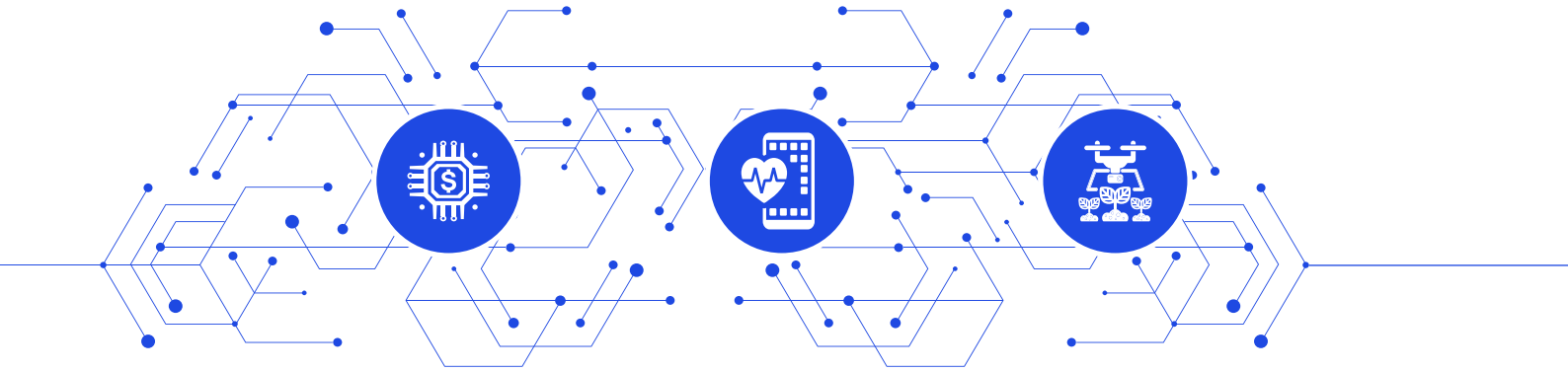
1. The Socio-Economic benefits of Mid band 5G Services, February 2022, GSMA

However, for India to achieve its digital ambitions, there must be concentrated efforts to accelerate technology adoption at grassroot level. 5G has the potential to commercialise emerging technologies and embed it in daily lives and create substantial business value. From the use of AR/VR to create immersive experience for consumers to deploying smart city solutions for smart governance, CSPs have a great opportunity to serve the underserved in rural/remote areas. India's ambitions for digital inclusion can be greatly helped by 5G, particularly in terms of the socio-economic multiplier effect that it can bring along through enhanced connectivity in rural and distant areas. Trials have demonstrated the potential of 5G to overcome the digital divide by providing fixed wireless access (FWA) users with access to high-speed broadband – often acting as wireless middle mile backhaul too. As such, smart village offices, small scale industries, agricultural entities, healthcare players, small transport companies, schools, banking institutions, and gram panchayats facilitating common services are all future 5G customers. Below is a quick look at the art of possible with 5G:

Fintech: 5G technology can lower operational costs in the future. Its high speeds and low latency can allow fast, visual authentication modes such as iris and fingerprint-based biometrics on inexpensive devices with low power requirements. Transaction failure rates can come down with 5G, increasing the level of consumer trust in digital payments. The PM Jan Dhan Yojana (PMJDY) coupled with UPI has already brought swathes of the unbanked population to the banking ecosystem. 5G can further enable virtual reality-based customer service, wealth management and financial counseling in rural areas, not only closing the loop of financial inclusion among the masses but also elevating the experience. 5G with blockchain can revolutionise microfinancing via off-grid digital identity verification in a secured environment. Technologies like conversational AI backed by multilingual capabilities will allow banks and financial institutions to take its services to the unbanked population, where digital low literacy/illiteracy has been a roadblock so far.

Health-tech: Real-time patient remote monitoring, fitness tracking and diagnostics through internet of medical devices, virtual home-care systems and complex clinical data analysis are some low-hanging 5G use cases on which multiple startups are already present. 5G can boost efficiency and effectiveness in real-time and relieve burdened city hospitals in the process. The Ayushman Bharat Pradhan Mantri Jan Arogya Yojana (AB PM-JAY) initiative gets a boost with efficient, accessible and affordable care with 5G.

Agri-tech: Quality grading of food, agri-products, warehouse management operations involving robotics, precision agriculture (analysing KPIs under the soil, on the soil and above the soil), drone-based fertiliser sprinkling across fields across villages and portraying farmers' output on live digital platforms (m-Kisan and others) are some 5G use cases where affordability and reach will be crucial in enhancing efficiency for 5.1 crore farmers. Underwater sensors to measure biofouling for fisheries, automated farm vehicles, IoT farm sensors, cattle cameras and AR/VR equipment to boost milk production are some more nuanced 5G use cases India could investigate.



Edu-tech: Pradhan Mantri Grameen Digital Saksharta Abhiyan (PMGDISHA) aims to digitally educate 6 crores[2] of households in rural areas. The PM ScHools for Rising India (PMSHRI) initiative aims to develop 14,500 schools with INR27,360 crore project cost over the next five years[3] focusing on the foundations of futuristic National Education Policy 2020. The creation of National Education Technology Forum provides a platform for infusing technologies such as AR/VR immersive learning applications, remote collaboration, virtual classes and other 5G specific use cases. Overall, 5G can act as a catalyst in India's skilling and learning objectives.

Table 1: *Some examples of global 5G use cases deployed in these areas (not exhaustive)*

Startup	Sector	CSP Partnership (if any)	Country	Why 5G	Benefits envisaged / current benefits	Auxiliary technology with 5G (if any)
Afluenta	Fintech	-	Argentina	Reach the remote locations thereby reducing cost; attract talent	Digital inclusion at the rural level	AR/VR
Visionable	Health-tech	UK, US, and Europe based CSPs	U.K.	Smart ambulance with video calls and data visualisations	Collaboration amongst doctors and paramedics, have a common platform; detects arrythmia	Analytics
Farm state of Goias	Agri-tech	Mexican CSP	Mexico	Need for fast broadband with real time cloud processing	Drones elevating efficiency and productivity and limiting the use of herbicides	Drones, cloud
Solinftech	Agri-tech	Brazilian CSP	Brazil	To connect farm machinery, deploy sensors for precision mapping	Boost farm yield; reduce fuel consumption	AI
Taranis	Agri-tech	-	Israel	Ultra-high resolution of images at speeds of 100mph	Drone recommends field level zoning to apply fertilizers at the best time	Drones, robots

Source: *Industry reporting, KPMG in India, 2022*

Apart from the startups, global telecom players are also invested in sandbox initiatives across med-tech, ed-tech, fintech, health-tech and agri-tech to deliver value.

2. PMGDISHA website
3. Government of India website

Connecting the unconnected via 5G FWA

When it comes to 5G for rural, India has made its mark by submitting a low mobility large cell (LMLC) 5Gi technology proposal in conjunction with TSDSI. This initiative finetunes the 'coverage ratios' for India specific use cases and poses an opportunity for system integrators, CSPs, vendors and other ecosystem players to foray into other emerging and underdeveloped countries with low cost 5G networks particularly geared for rural coverage.

As the uptake of fixed wireline connections and wi-fi hotspots has been slow in India, reliance on 5G enabled fixed wireless access (FWA) will have significant advantages such as faster time to market, lower cost, no vendor lock-ins, over the air upgrades, in alignment with global standards and easy provisioning with existing infrastructure. With FWA, CSPs have an extended range with the mmWave bands and the capability to connect the unconnected segments which do not have feasibility with fixed broadband connectivity. US and German CSPs are using FWA to varying degrees and reaping a multitude of benefits. With volume-based bulk offers for providing up to 50Mbps speeds, CSPs are augmenting rural reach supplementing government initiatives around reaching the rural or semi-rural areas. CSPs with some degree of mid-band spectrum and mmWave spectrum are planning to deploy FWA in urban and suburban areas in Europe and in the US, and could expect to see an improvement in cost savings when traffic demand is very high. Typical applications such as video streaming, gaming, music streaming, etc. are downlink-heavy, and are easily served by FWA technology. FWA holds a promise of not only connecting citizens and enablement of digital services to them but also of empowering small and medium scale enterprises in these areas. For SMEs, the number of connections, cloud-play, overall density of fibre, etc. are some characteristics with which upload-downlink requirements can be mapped with FWA.

As India is a distinct geography with unique characteristics - material used in building construction, heavily densified megacities as compared to other global megacities, and large rural areas with sparse population and different terrains from plains to plateaus to mountainous – 5G uptake depends on penetration characteristics of signals. As such, the fibre penetration needs to be supplemented with FWA type broadband services, which also double down as hetnets for offloading traffic from 5G wireless networks. Use of low band spectrum with wider channels can further improve signal propagation in rural settings.

For India, FWA seems to be a winner on all terms. The mid-band spectrum can help India solve its 'connectivity deficit' in the rural areas. With 5000 large enterprises, 1.4 small and medium businesses and 51 million registered MSMEs, India's demand for FWA is huge.

> Globally, education, healthcare and logistics are three key areas where 5G is expected to usher in a level of efficiency and accessibility. In addition to these areas, India will have its own 5G use cases - that solve India's challenges or capture opportunities that India offers. Similarly, fiberised towers and edge data centers are at the heart of 5G connectivity. Industry and government need to work together to enable a connected future where we can reach every village in India.
>
> ***Sudhir Pillai, Managing Director, Corning India***

CHAPTER 04

Role of CSPs within a new digital enterprise world

Within this gamut of things, the role of CSPs has elevated. All three private CSPs are expected to follow niche and specific strategies as 5G rollouts start. Fixed speed and bandwidth centric packages, variable or need based value-packages, experience centric AR/VR offers and other B2B2C offerings with third party players are some nuanced plays. If you only lower costs in networks and operations with a hybrid and multi-cloud strategy (as most Indian CSPs have done in the past to remain competitive), connectivity provisioning is seen as a profitable venture as you reduce the cost of per-bit data of transport. But it is an abyss hard to come out of. And, using just that strategy won't make a CSP a digital service provider. As digital service providers, CSPs must provide intelligent connections as well as services that benefit their clients. They must look outwards with the same momentum as they look inwards. And the journey to being a tech-co is a continual one – where partnerships will play a key role. Cloud hyperscalers, SIs, tech platform companies, independent software vendors, standards bodies, and even other utilities could be ideal partners in this journey as they too search for supporting value driven networks.

Enterprise digital evolution (B2B)

In the past decade, as we saw many online businesses burgeon, we also witnessed industries converging and blending with the use of platforms. We saw the third industrial revolution give way to the fourth industrial revolution with the industrial adoption of digital technologies including data analytics and artificial intelligence (AI), intelligent automation (IA), Internet-based services, including blockchain, the Internet of Things (IoT), cloud computing and others. Although the economic value created by the supply of these digital platforms and digital technology usage depends on the way it is calculated, few estimates point us to say that at least 20 per cent of the global GDP (or USD19 trillion) in 2021 was digital in nature[1]. And India aims to reach that 20 per cent by 2025 by having a trillion dollar digital economy of the total USD5 trillion economy.

In near term, platform usage, edge AI, AI based cloud services, cloud data ecosystems, Industry 4.0, open-source intelligence and telemetry systems are expected to be pervasive. Although technologies such as autonomic systems and sub-systems, AI generative code, digital twin of cities (encompassing humans, machines and all things connected in the middle), industry led cloud platforms, and decentralised identities with web3 architecture seem long term now, many companies have planted the seeds in these technologies to stay ahead of the race. There are city governments (Seoul in SK as an example) launching a metaverse pilot version of the city for visitors to explore virtual places such as City Hall and Seoul Plaza. South Korea intends to invest more than USD100 million over the next 3-4 years. Other cities such as Beverly Hills, Dubai, and Miami also have plans to promote tourism, art, education and commerce.

1. The Metaverse – How it will revolutionize Everything, Mathew Ball, 2022

Role of connectivity in a seamless connected enterprise

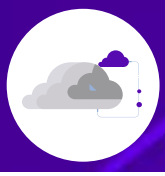
The future pushes for a seamless fabric supporting continuous interaction amongst all enterprises, things and places. This fabric between people, things, applications and processes is characterised by connectivity. To keep businesses and consumers connected, informed, safe, productive and entertained in this evolving era, intelligent connectivity has become table stakes, more crucial, more nuanced and more adaptive than ever before.

Organisations must handle connectivity disparities in various contexts and locations as workers and customers increasingly expect digital experiences backed by ubiquitous, dependable and robust connectivity. Additionally, businesses are transforming their operational procedures, promoting prompt decision-making, developing cutting-edge digital services, and providing their clients, partners, and workers seamless experiences.

Over the last couple of years, we have witnessed three things in the enterprise networking and communications:

Convergence of network and IT cores fueled by cloud-infrastructure

Migration of virtualised workloads to software-centric multi-cloud containerised workloads, which ease the management



Diversification of communication providers into cloud-enabled, lightweight and customised solutions.

> Going forward, many 5G innovations will happen at the edge of the network. These innovations will be powered by Linux containers, automation and Kubernetes to support all kinds of workloads from AI to IOT. Communications Service Providers (CSPs) are at the centre of this opportunity to drive innovation and capture new revenue streams. They would need to build hybrid and edge clouds that provide a high degree of security, flexibility, scalability, agility to support cloud- native and edge applications. They acknowledge that "Open Source" software is well suited for the task and is emerging as a preferred standard to build interoperable, flexible solutions for today and tomorrow. In fact, enterprise open-source solutions enable collaboration which will boost 5G adoption across industries like manufacturing, automotive, telemedicine, and transportation etc.
>
> ***Marshal Correia, Vice President and General Manager, India and South Asia, Red Hat***

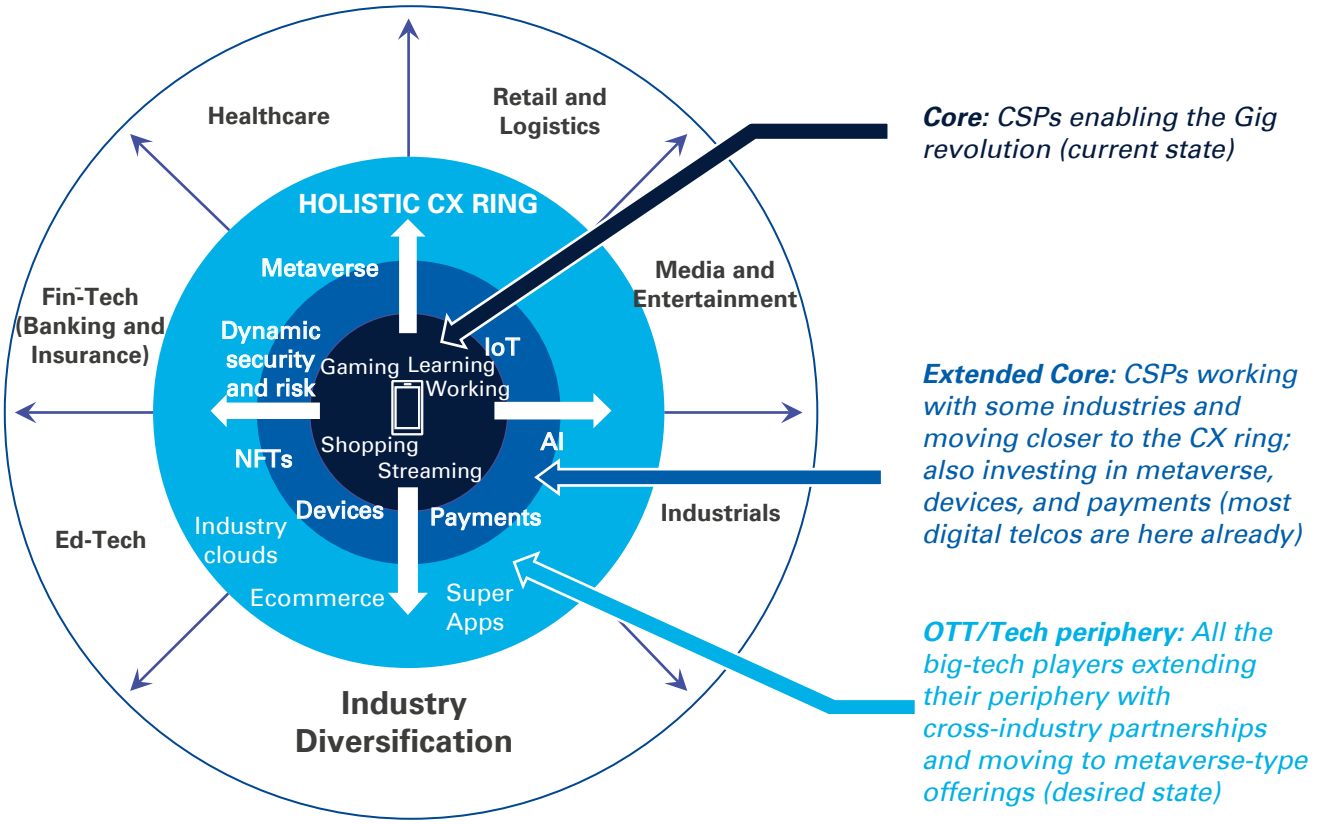
As such, a hybrid-cloud environment is now a de-facto infrastructure strategy adopted by enterprises. To capture the opportunities generated by this enterprise shift towards multi-cloud and multi-platform strategy, CSPs are shaping their seamless connected enterprise offerings addressing ever-increasing customer expectations, heightened partnership opportunities, quick expectations on monetisation from next gen connectivity and increased scrutiny of international and national regulation.

Future networks and the role of CSPs in the DX journey for connected enterprises

Amongst the many trends that the pandemic has unfolded, it has led companies to diversify - technologically, geographically as well as strategically - pushing them to purchase connectivity disparately or in bundles. Throughout the pandemic period, there has been a strong correlation between how Indian enterprises bought connectivity-led offerings and how they deployed ancillary technologies such as IoT, blockchain and AI on top of their connected investments.

And the stitch required at the backend between connectivity vendors/CSPs and ancillary tech vendors is still a work-in-progress in 2022. Once the integration process is set into motion, processes of rationalising the stack, addressing the silos, fine-tuning solutions and maintaining them through contract lifecycles make innovation a journey. As envisioned in the figure below, CSPs have a great opportunity to evolve from a CSP to a tech-co.

Figure 1: *CSPs have been placed at the heart of enterprise digital transformation*

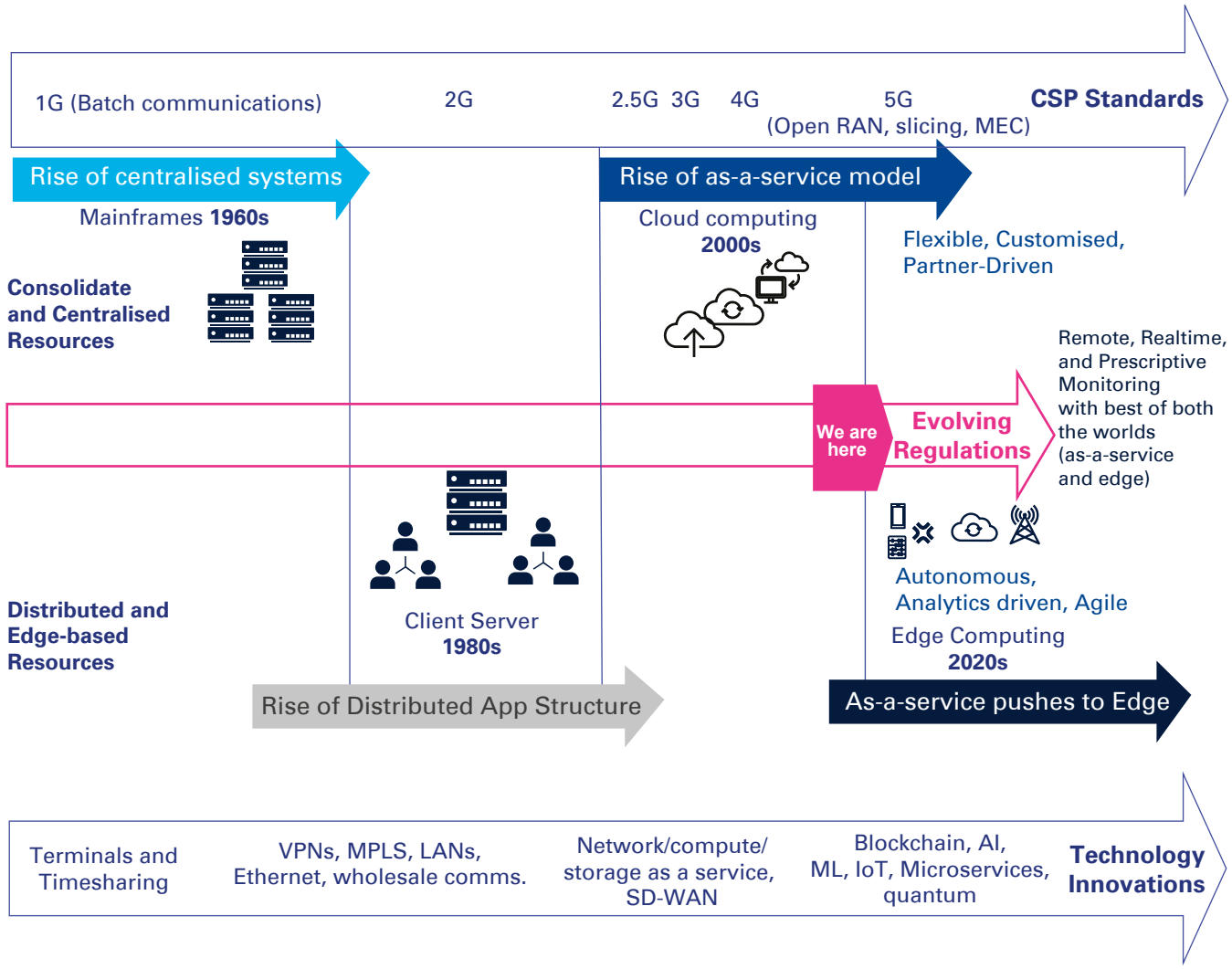


Source: *KPMG in India, 2022*

CSPs have already enabled and supported the gig-revolution in education, gaming and entertainment, working, and in other ways (the dark blue core). They have even ventured into payments, device leasing and tried metaverse type offerings (mostly global CSPs) along with their focus on digitalising their core, investing in cloud, data and security. But it is the holistic CX ring which contains web3 constructs, industry specific clouds, super apps driven by sophisticated AI driven networks and NFTs that is elevating the customer experience to a new level for enterprises. And it is only through 5G that CSPs will be able to morph into tech cos to own end-to-end view of the customer experience (see figure 1) to spearhead into multiple industries.

To understand how CSPs free themselves from the vicious cycle of continuous investments to cater to an ever-demanding consumer, it is important to see where current technology cycles are driving mobile networks (see below). In the past, the wireless telecom standards and network computing models have waxed and waned between centralised and decentralised resources as shown in the figure below. CSPs with their edge-centric capabilities are now focused on capturing customer value.

***Figure 2**: CSPs and networking standards have gyrated with the computing models in the past but 5G could change that*



***Source**: KPMG in India, 2022*

It is only now that the role of the edge is getting accentuated by distributed computing to have a superior customer experience (not necessarily only in B2C though). CSPs and networking have come a long way under the support of evolving computing models but with 5G and Wi-Fi 6/6E/7, the push towards the intelligent edge is reinforced by automated and agile applications which are increasingly blockchain-led, microservices-driven and often containerised. Today, CSPs not only talk about numerous KPIs on cloud visibility, cloud governance and automation, but also on agile centric business KPIs across customer experience, omnichannel, fraud, cyber-ops and others. We are witnessing their journey to a tech co in different forms.

To ultimately transform into tech-cos, CSPs need to selectively combine their IT and network teams, establish *'fail-fast, learn-faster'* approach for innovation, continue to virtualise and programme their networks, bring a consistent data fabric within and add vertical specific ecosystems with vendor agnostic engagements. This also means that internal transformation projects such as 5G launches, open ecosystems (RAN, WAN), cloud native deployments and automation need to be tightly coupled with external projects/outcomes such as bolstering of super apps/marketplaces, engagement with vertical specific software vendors, edge and analytics services, private 5G launches and differentiated network edge services.

Why enterprise focus for CSPs now:

Although 5G will allow CSPs to roll out new consumer services, including wireless home broadband (5G FWA), video, multiplayer mobile and cloud gaming, and AR/VR applications, customers expect service providers to offer price plans that include service bundling and data sharing – a move that doesn't justify the economics after spending close to USD19 billion in spectrum auctions. The price of 1GB of data continues to remain abysmal in contrast to other developing nations. The average price of 1GB barely touched USD0.7 in 2021 despite the growth in mobile service subscriptions and data consumption. As per Ericsson, mobile data traffic has increased from 0.8 EB per month in 2016 to 13EB per month in 2021. Juxtaposing this with the stiff competitive phase in 4G, CSPs are still expected to invest in terrestrial infrastructure. At best, as per industry consensus, the B2C use cases will fetch 15-20 per cent more on the current service plans – leading to an average blended ARPU below INR200 (approximately USD2.5). While the spectrum (radio-driven) capex alone is expected to jump almost 47 per cent YoY in 2022, the opportunity cost associated by not entering the enterprise market is huge.

The CSP enterprise market in India is almost 15-20 per cent of the overall market in revenue terms, and it has adjusted to the higher growth prospects across ethernet, E-LAN, E-Line, MPLS and ILL, given the remote working trends. As this continues, the next growth engine for CSPs is the wireless enterprise segment, which provides scalability, capacity and deeper context at the mobile edge. NB-IoT, LoRA, LTE-M, Zigbee, Sigfox are some technologies, which could work under the 5G umbrella to provide necessary boost to revenues as well as solve efficiency challenges.

The next section gives a glimpse of emerging digital needs of global enterprises, and we see where 5G fits.

> Adoption of Open RAN is critical from many aspects that include vendor diversity, security, innovation, cost savings and Make in India Initiatives. With Open RAN, radio systems use disaggregated stack that allows best of breed vendors to work together to achieve the best product possible... with strong focus on Math and Science, India has great talent that can bring in innovation in both hardware and software and have commercial success in open ecosystem.
>
> ***Pardeep Kohli, President and Chief Executive Officer, Mavenir***

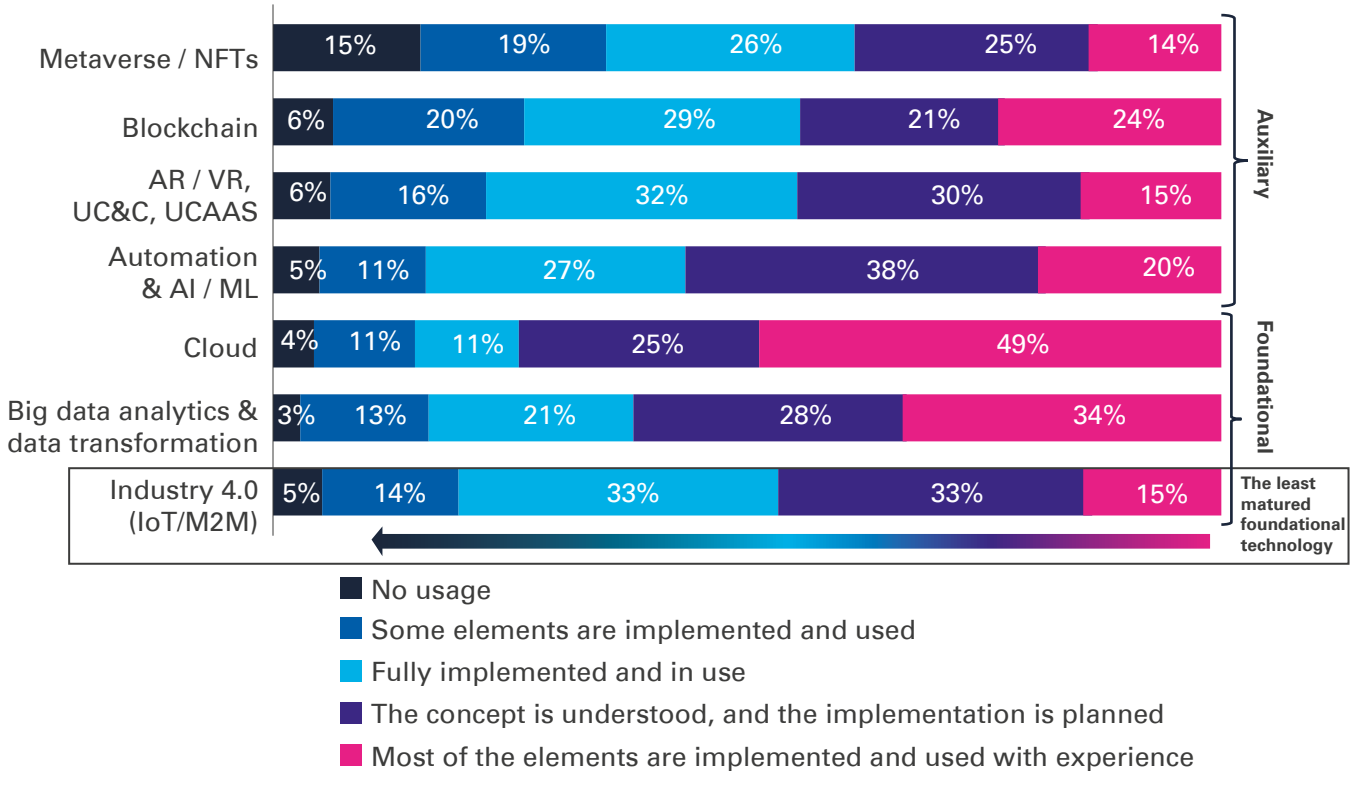
> The RoW process simplification with GATI Shakti Sanchar Portal coupled other initiatives reduce the approval times to a fifth and STL stands committed to these policies with the use of drones and other advanced technologies for surveying and faster fiberisation, however, India overall needs to move faster from its current speed of 17-20 million km per year to 60 million km per year within next 3-4 years to support more small cells. This needs to be supported by necessary skills and innovation across agriculture, logistics, manufacturing and allied sectors to nurture more scalable and AI quality driven use cases.
>
> ***Ankit Agarwal, Managing Director, Sterlite Technologies Ltd.***

CHAPTER 05

Digital transformation characteristics of enterprises and 5G relevance

While some of the technologies mature, some lag. If we compare the foundational stack (including cloud, big data, and industry 4.0 technologies) with the auxiliary stack (including AR/VR, blockchain, metaverse and automation), it is the former which has a lot of disparity and lag. The level of cloud adoption far exceeds the adoption of big data/analytics and industry 4.0. Further, industry 4.0 is the least mature of all the three technologies put together and the onus lies on not just the CSPs but also on the country-level CSP regulations.

Figure 1: *Maturity of some global digital transformation technologies*

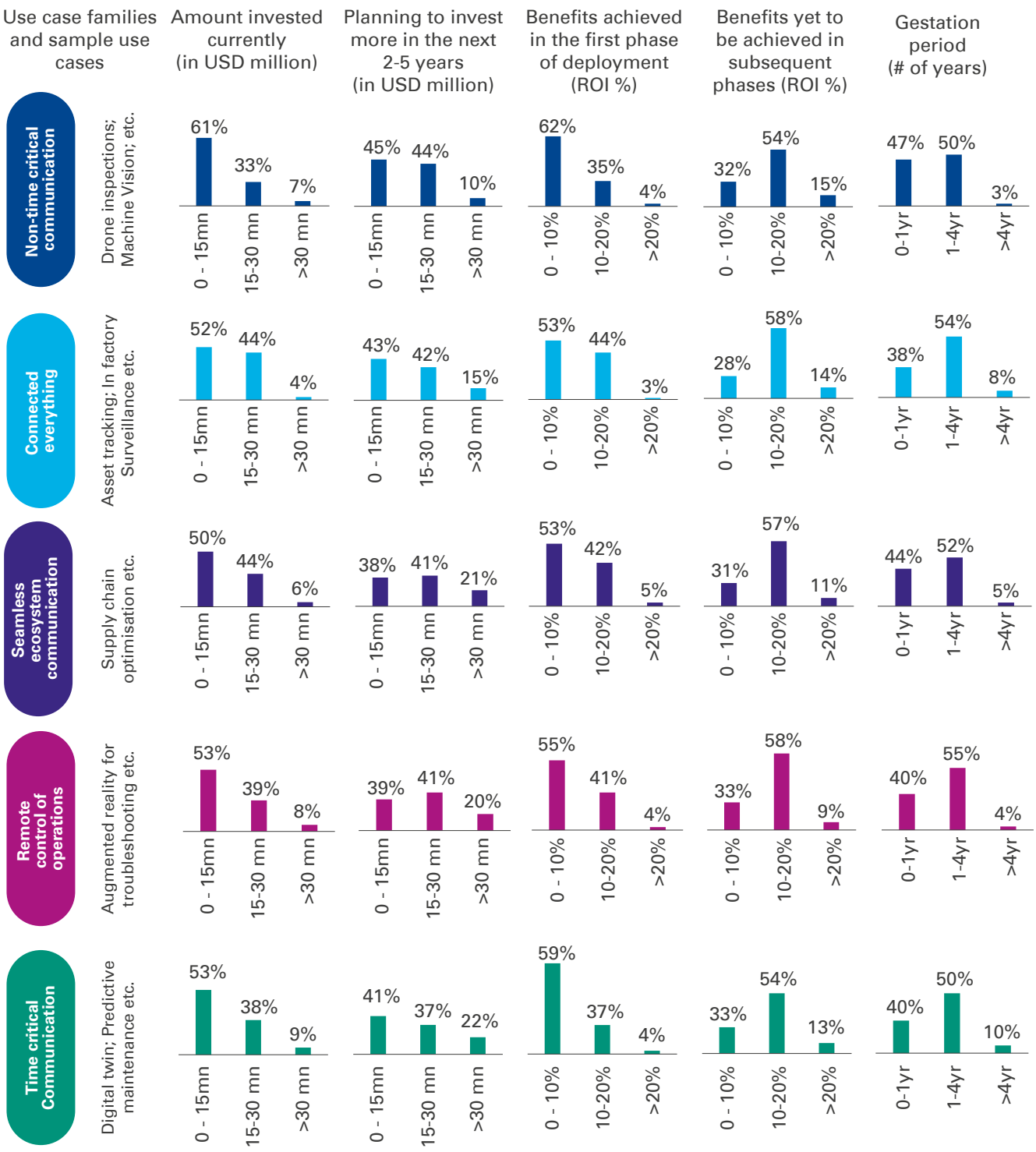


Source: *KPMG Enterprise Digital Transformation Survey, KPMG in India, 2022*

As enterprises look at deploying these technologies for business use cases, our survey indicated significant investments flowing into Industry 4.0 use cases which include the 5G element.

Figure 2: *Investments, ROI and gestation period for five industry 4.0/5G use case families:*

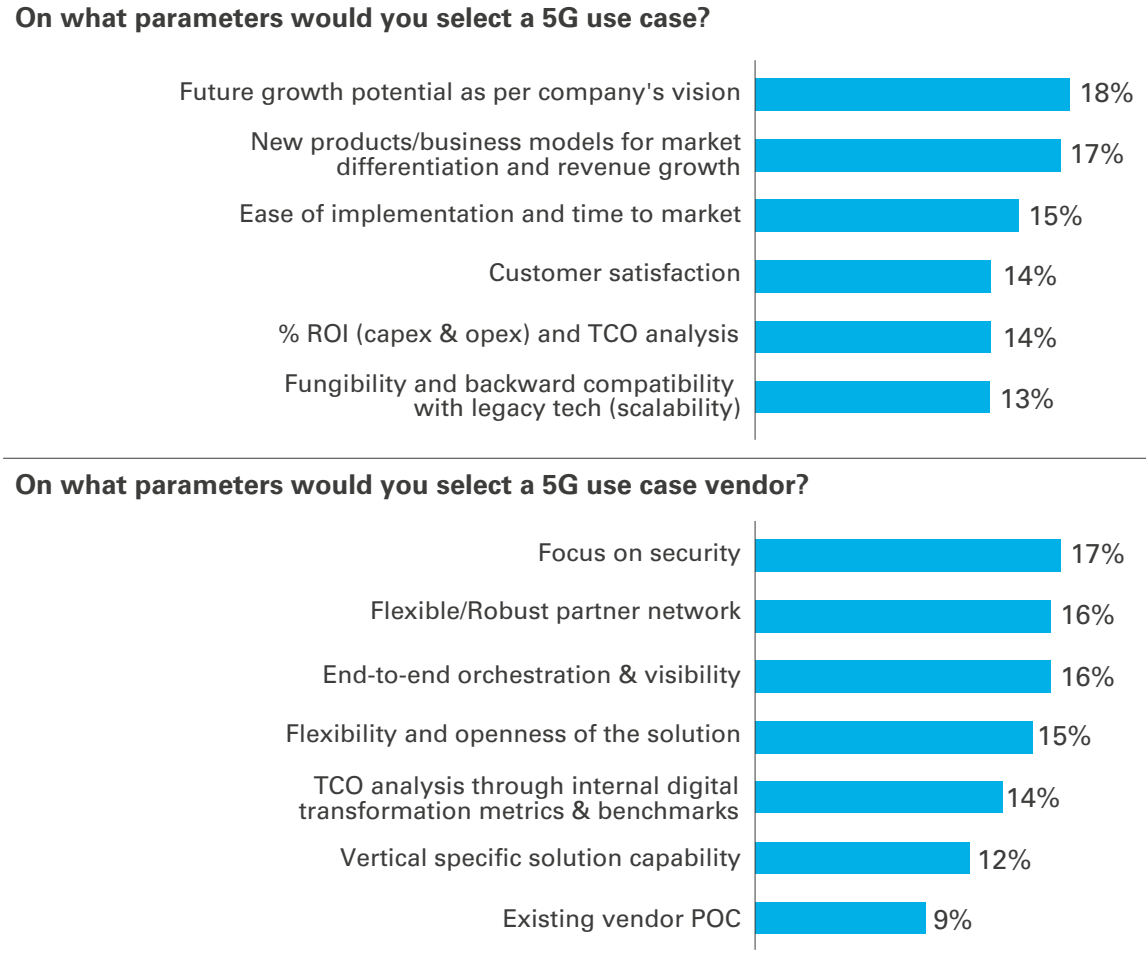
Across five use case families/themes, inputs around ROI, amount invested and gestation period for the use cases:



Source: *KPMG Enterprise Digital Transformation Survey, KPMG in India, 2022*
Note: *Gestation period is defined as the period taken from conceptualisation of a use case to when it starts being value accretive; ROI is the cashflow generated for a given total cost of ownership*

As per KPMG's survey, globally almost 51 per cent of the enterprises are looking to deploy 5G in conjunction with other wired and unlicensed wireless technologies. Larger companies tend to budget 10-15 per cent of their ICT spends on 5G and it usually grows over time. The reasons for deploying 5G, selecting use cases over 5G, and deploying it with select vendors is also pronounced in the figure 3 on the next page.

Figure 3: *Snapshot on 5G use cases and vendor selection criteria*



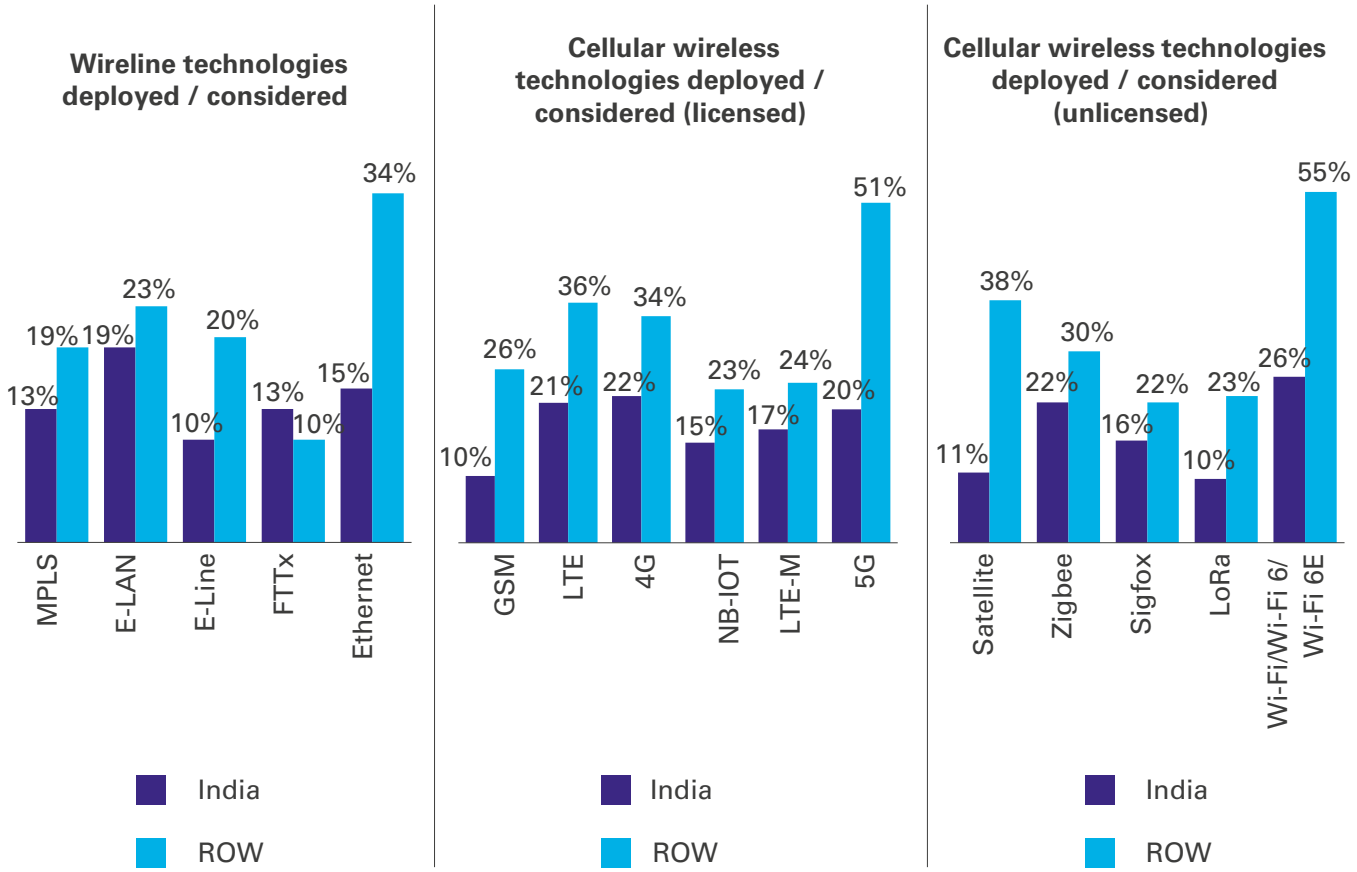
Source: *KPMG Enterprise Digital Transformation Survey, KPMG in India, 2022*

However, when it comes to vendor selection for implementation of these use cases, CSPs might not be the preferred partners for enterprises. Enterprises currently lean more towards hyperscalers, OEMs and SIs. To increase their pie of revenues, CSPs will have to look at creating capabilities beyond connectivity and build holistic solutions that deliver business value to enterprises. CSPs will need to adapt to the new requirements which demand flexibility, openness, resiliency reliability – all at a lesser cost and continual technology innovation. Partnerships and collaborations will also play a key role in this journey and only nimble footed organisations that shorten their time to market for these newer enterprise offerings will stand to gain from the market opportunity.

Digital transformation journey imperatives for Indian enterprises

On the network/IT side, Indian enterprises have relied on multiple wireless and wirelines technologies to boost enterprise connectivity. However, cellular and non-cellular dependency in India is skewed in favour of non-cellular wireless technologies as 5G auctions have just completed. Within the cellular space, Indian enterprises were already considering 5G even when they were using legacy and unlicensed technologies such as Wi-Fi 5/6. The figure 4 on the next page highlights the difference between adoption of two sets of wireless standards (licensed and unlicensed) in India versus rest of the world (ROW).

Figure 4: *Top protocols/standards used/considered across cellular and non-cellular technologies (for prominent use cases) in India and rest of the world*



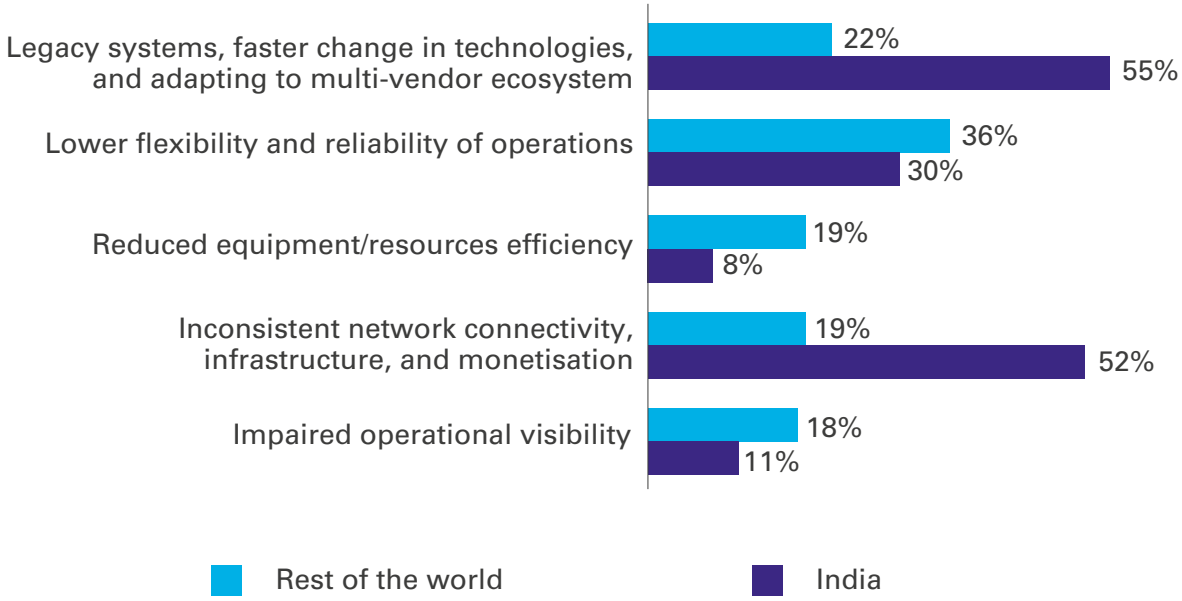
Source: *KPMG Enterprise Digital Transformation Survey (fielded May 2022 through June 2022)*

For most use cases, Ethernet, 5G, and Wi-Fi are the go-to technologies enterprises rely on CSPs for their connectivity requirements. Although most use cases can be implemented in other legacy technologies, the ROI and value benefit calculations are quite different. Couple of other observations from KPMG's enterprise digital transformation survey which are also opportunities for CSPs in India include:

- Indian enterprises are more prone to outsource their digital transformation efforts as compared to rest of the world enterprises
- Targeting efficiency, quality management and new revenue models are prime areas where KPIs are being tracked by Indian enterprises.

As per KPMG's survey, the top technical and operational business challenges envisaged for deploying 5G in India are network integration with legacy networks, faster technological changes (or low adaptability in a multi-vendor ecosystem), proving ROI and timelines and inconsistent network infrastructure.

Figure 5: *Snapshot of challenges in deploying 5G (India versus rest of the world, %)*



Source: *KPMG Enterprise Digital Transformation Survey, 2022*

CSP imperative: At the surface, CSPs certainly need to address backhauling and inconsistent network connectivity to provide the required visibility into operations for the enterprise. This needs to be supported by flexible solutions at the edge including mobility of nodes, API driven cross industry platforms, data compute and storage and power management. However, deficiency of usage of platforms to support new business models, network integration with legacy technologies, security and proving ROI with business context are some deeper level challenges CSPs need to address.

The next section focuses on deep diving into manufacturing industry vertical, highlighting their evolving digital needs and how 5G solutions can aid the growth of the sector.

CHAPTER 06

Roadmap to capture profitable growth in the manufacturing sector

Monetisable solutions/use cases within manufacturing sector that CSPs can target

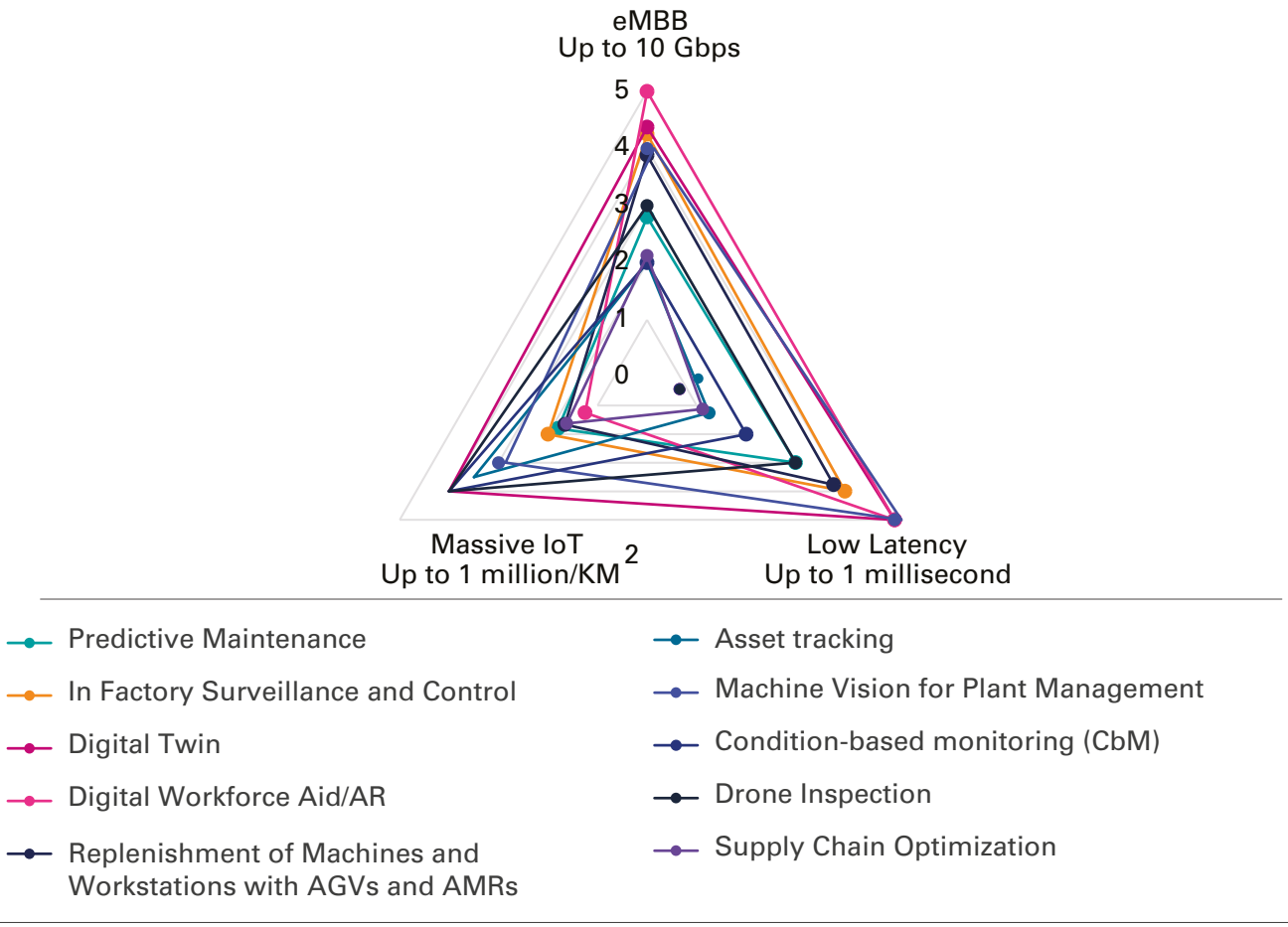
KPMG in India has looked at various use cases in the global manufacturing/industrials and mapped out broad requirements for the top 5G/industry 4.0 use cases as shown in the figure below.

Table 1: *Description, characteristics, and requirements* for prominent use cases in manufacturing/industrials across five use case families for 5G:*

Use case families	Non-time critical communication	Connected everything	Seamless ecosystem communication	Remote control operations	Time critical operations
Description and characteristics	Boosts operational efficiency while realising enhanced flexibility and environmental sustainability. Indoor coverage and high availability are essential needs because of the hostile and inhospitable settings Latency: NA Bandwidth: Low # of devices: Medium	Allows for the development of new value-added services and design optimisation driven by real-time data gathered over the course of a product's lifespan. Ultra-low-power (high autonomy), ultra-cheap communication platforms are required. Latency: <1s (NR-time) Bandwidth: Medium # of devices: High	Enables the efficient coordination of cross-value chain activities, monitoring of assets scattered across wider areas, and the improvement of logistical flows. Flexibility, reliability, interoperability and mobility assistance are required Latency: <30ms Bandwidth: Medium # of devices: High	Increases uptime while reducing operating costs. Integrates 3D virtual reality and calls for more processing power to enable video-supported remote maintenance from any location in the world. Latency: 10ms-50ms Bandwidth: High # of devices: Medium	Utilises sensing technologies, such as 3D scanning; wearables, and collaborative robots and machines to support closed-loop control systems, higher efficiency and safety. Communication latencies in this use case family may be as low as 1 ms. Latency: <10ms Bandwidth: High # of devices: High
Prominent use cases in Manufacturing	Drone inspections; Machine Vision; Power and Heat Management; field service, etc.	Asset tracking; In factory Surveillance and Quality Control; Sustainability and Governance, etc.	Supply chain optimisation; Factory floor communication; etc.	Augmented reality for troubleshooting; Autonomic operations support; etc.	Digital twin; Predictive maintenance; Replenishment of Machines with AGVs and AMRs

Source: *KPMG in India, 2022*

Figure 2: *Requirements for top use cases in Manufacturing/ Industrials*



Source: *KPMG in India, 2022*
*NA = not applicable; *Based on an internal benchmarking study for top 5G use cases in manufacturing.*

Basis KPMG's enterprise digital transformation survey, 2022, the above ten 5G/industry 4.0 use cases manufacturing sector presents a 5G opportunity of USD43.24 billion globally by 2025. With a gestation period ranging from 6 months to 4 years, these use cases generate a conservative ROI of 20.2 per cent on average.

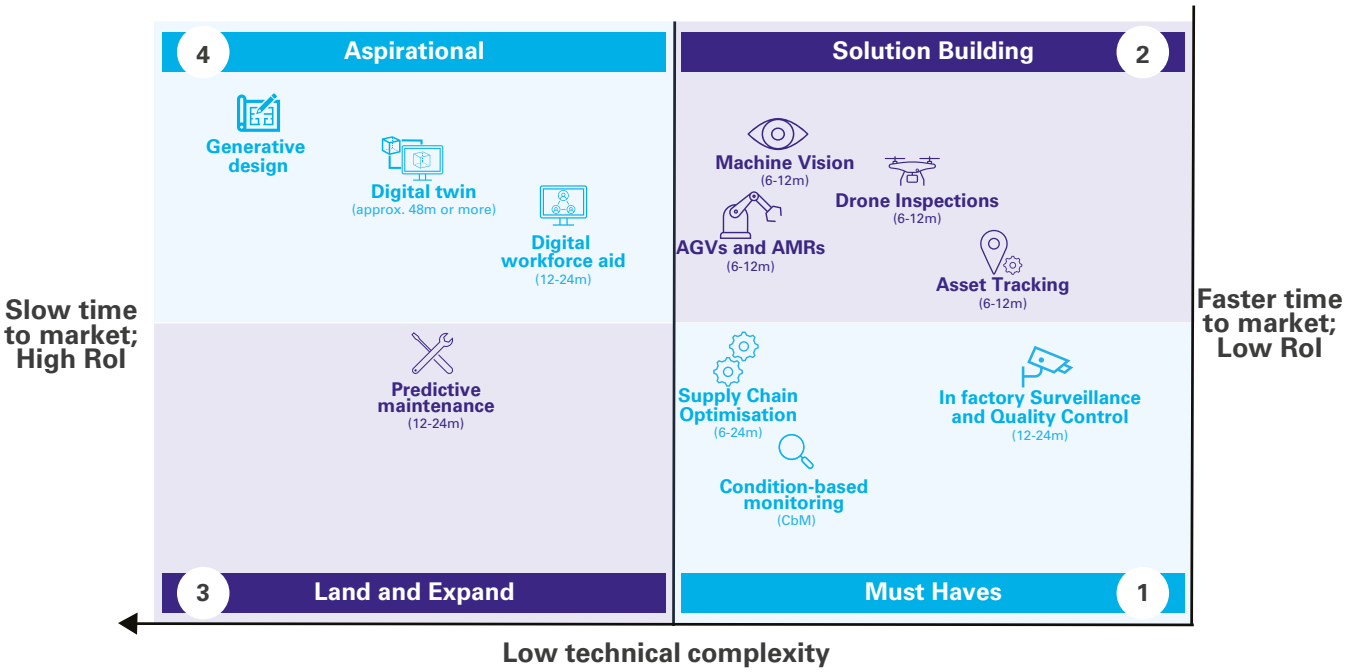
For CSPs to capture this market and deliver digital services, they need to advance the value chain with 5G and industry 4.0 offerings. The digital transformation and platformisation efforts that CSPs have taken help them launch new services with capacity, coverage and throughput in the 5G era. In addition to a new, more flexible approach to innovation, this move necessitates a fundamental change in the telecoms' business model and customer interaction strategy. CSPs with nimble core, operating in open ecosystems seem better able to handle this shift.

Based on the technical complexity of implementing these use cases and the time to market, we have bucketed these use cases into four categories:

- The must-have use cases are the low hanging fruits
- The solution building category needs more partnerships to address higher technical complexity
- The land and expand use cases are easy to deploy commercially
- The aspirational ones will take time to mature but CSPs must not linger in building POCs around them.

It is critical for CSPs to find a sweet spot for them amongst these four categories and consider building capabilities, either in-house or through partnerships.

Figure 3: *Shift left CSP 5G opportunity in the manufacturing vertical*



Source: *KPMG in India, 2022*
Note: *The text in (brackets) denote the gestation period for the use case; Gestation period is defined as the period taken from conceptualisation of a use case to when it starts being value accretive; ROI is the cashflow generated for a given total cost of ownership.*

> 5G will catalyse technology disruption creating immersive and incredible new opportunities. Not only will it usher in a new wave of opportunities for industries and businesses, but it will also unlock the next level of growth and development for the country. More than just seamless connectivity and fast speed, 5G technology will revolutionise businesses and industries, enhancing advancements and innovation and R&D while also improving customer experiences. Industry data states that India's digital economy has the potential to reach USD1 trillion by 2025 driven by the increased proliferation of smartphones, increased internet penetration, growth of mobile broadband, and growth of data and social media. 5G rollout will accelerate digitalisation across sectors creating newer opportunities and flagship solutions based on the diverse and dynamic customers' requirements.
>
> ***Anku Jain, Managing Director, MediaTek India***

CHAPTER 07

Recommendations

For a successful 5G roadmap and implementation, India needs a robust ecosystem of partners who are in sync with the government's Digital India mission. While the regulations gyrate on one side, strategies and initiatives in the ecosystem will define the speed and momentum of how soon India gets to a trillion-dollar digital economy. Today, communications services (and hence CSPs) are truly the face of digital change that gets showcased within an enterprise or for the consumer. But for CSPs to be at the heart of any digital transformation, they will need an internal cultural change coupled with adopting best practices from their partner ecosystem.

To prepare itself for the imminent 5G launch, CSPs have taken nuanced approaches to partnering as 5G needs an ecosystem view than siloed ways of working. Some of the key priorities that they need to focus on, in this journey include:

i. Get your network engine rolling:

Since the Draft Telecommunication Bill 2022 abstracts the words 'telecom' or 'video/text', it is imperative that the 'communications services' is an umbrella term governing all forms of communications including OTT (messaging or content), hence CSPs will need to be swift in upgrading their cores to support all forms of communications. Network upgrades need continual focus on building network slicing, edge-AI compute models, beamforming, dynamic spectrum sharing, access technology-agnostic user equipment functioning and network analytics. As CSPs forge partnerships with hyper-scalers and SIs to take their network to cloud, they should also borrow best practices to deliver value.

ii. Build and market new 5G revenue streams:

Leveraging the core and edge capabilities to create use cases that solve industry, societal and governance problem statements through partnerships across the ICT ecosystem including OEMs, technology providers, device manufacturers, etc. to speed up the time to innovate and go to market. Beyond building solutions, targeted marketing is essential too.

iii. Build a nimble organisation to support growth:

While robust networks and route to market are important in the 5G monetisation journey, it is equally important to protect margins by reducing total cost of ownership (TCO) by becoming a connected enterprise where front, back and mid office are connected through cloud native architecture where the traditional OSS, BSS are transformed and made nimbler. A quick way to achieve this is to re-balance the physical, virtual and cloud-native network functions into the CSP's core; then try to partner more in the ecosystem to innovate and bring relevant functions into the CSP domain. It is this continuous iteration which results in CSPs reaching an equilibrium, which is competent enough for the enterprise's digital journey. As the network functions mature, it is ripe to be infused into the enterprise's edge to bring in meaningful change via DevOps led change management.

Asks from the government:

i. 5G has provided India an opportunity to enhance the sector's contribution to the GVA of the country. However, the existing skills gap in the industry has a potential to de-rail the objective. As per a Telecom Sector Skill Council (TSSC) estimate[1], India requires 22 million people to be up-skilled/re-skilled by 2025. This uphill task can be undertaken only through collaborative efforts between government, industry and academia. A combination of both educational and vocational training would be required to bridge this skill gap. As such the new education policy needs to blend in this future requirement at the grassroots.

ii. The Draft Telecommunication Bill 2022 is a step change which builds on to the Insolvency and Bankruptcy Code of 2016 – but the bankruptcy provision needs to be linked to the technological roadmap for the concerned entity. As the spectrum is a scarce yet inexhaustible resource, continuity of operations needs to be linked to techno-commercial and legal roadmap together.

iii. Rollout of 5G now needs to be backed by speedier fibre deployment to improve the tower fiberisation from current levels. Small cells penetration will depend on the fibre outreach in the country. Speedier inclusion of new sources from bus depots to railway stations to street poles and street furniture, agile deployment and faster maintenance of such assets will be crucial.

1. TelekomTalk

iv. R&D funding levels from the government need to improve in conjunction with policies that lay down financial incentives for participating members such as system integrators, CSPs and other infrastructure vendors. A holistic model which links the USOF with different ministries and fast-tracks sandbox environments is required.

v. Clarity on spectrum allotment for private 5G networks by the spectrum managing agency is essential. This can even happen in parallel with spectrum sub-leasing department overseeing the spectrum allotment to the industry and ensuring affordability, reliability, flexibility and security in sub-leasing models. Also, pricing for low-band spectrum needs to be re-visited in line with international best practices to enhance rural coverage. Further, some part of spectrum in the sub 6GHz spectrum can also be reserved for select applications of national interest.

vi. The BharatNet and 'broadband for all' can also be supported by government-backed initiative on 'wireless broadband for all' via use of FWA. As such FWA rollouts need to be overseen and coupled with PM WANI scheme to obtain maximum coverage and benefits.

vii. The importance of personal data compliance has increased with 5G deployment. Managing client data across partner systems can quickly cause data security compliance issues, making it difficult to monitor compliance manually. A viable option to improve defence against cyberattacks is to combine private network infrastructure with a zero-trust security strategy with an automated threat management system. However, a comprehensive policy can set the tone and direction of private 5G deployment in the country.

Survey methodology

KPMG in India conducted Enterprise Digital Transformation Survey 2022 (fielded May 2022 through June 2022) by surveying 350+ global enterprises across manufacturing, healthcare, smart cities and utilities, telecom, media and technology verticals.

The survey focused on challenges, drivers, need identification, readiness assessment, 5G/industry 4.0 use case assessment and adoption propensity, go-to-market focus areas, monetisation methods and IT and business strategy for driving the use cases adoption.

The survey was conducted across India, Thailand, The Philippines, Malaysia, Singapore, Australia/New Zealand, The UAE, The Kingdom of Saudi Arabia, Qatar, Oman, U.S.A., The UK, France, Germany, Spain and Italy.

CXOs, directors, subject matter experts and senior managers and head of departments were also proportionately surveyed to have a balanced view across influencers, decision makers and procurement cohorts.

Discussion guides were prepared for one-on-one interviews with senior executives across from all the verticals mentioned above (from several geographies).

Glossary

3GPP	Third Generation Partnership Project
AGV	Automated Guided Vehicle
AMR	Automated Mobile Robot
AR/VR	Augmented Reality/Virtual Reality
CBRS	Citizens Broadband Radio Service
EB	Exabytes
E-LAN	Emulated Local Area Network
E-Line	Ethernet Line
eMBB	Enhanced Mobile Broadband
FWA	Fixed Wireless Access
IA	Intelligent Automation
ILL	Internet Leased Line
ITU-APT	International Telecommunications Union - Asia Pacific Telecommunity
MEC	Multi-Access Edge Computing
mMTC	Massive Machine Type Communications
MPLS	Multi-Protocol Label Switching
MVNO	Mobile Virtual Network Operator
NFTs	Non-Fungible Token
Open RAN	Decoupled and Disaggregated Radio Access Network
OTT	Over The Top
PM WANI	Prime Minister Wi-Fi Access Network Interface
PPP	Public Private Partnership
ROI	Return On Investment
SD-WAN	Software Defined Wide Area Network
TCO	Total Cost of Ownership
TSDSI	Telecommunications Standards Development Society, India
uRLLC	Ultra Low Latency Communications
USOF	Universal Service Obligation Fund
VPN	Virtual Private Network
Web3.0	Third Generation Of World Wide Web

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