KPMG

INDIA MOBILE CONGRESS

# Imagine a new connected world

**Intelligent. Immersive. Inventive.**

October 2019

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5G contribution to annual GDP has the potential to be in the range of

**0.35-0.5 per cent**

**Source:** KPMG in India's survey 'Industry's Technology Readiness Index'

**31 per cent**

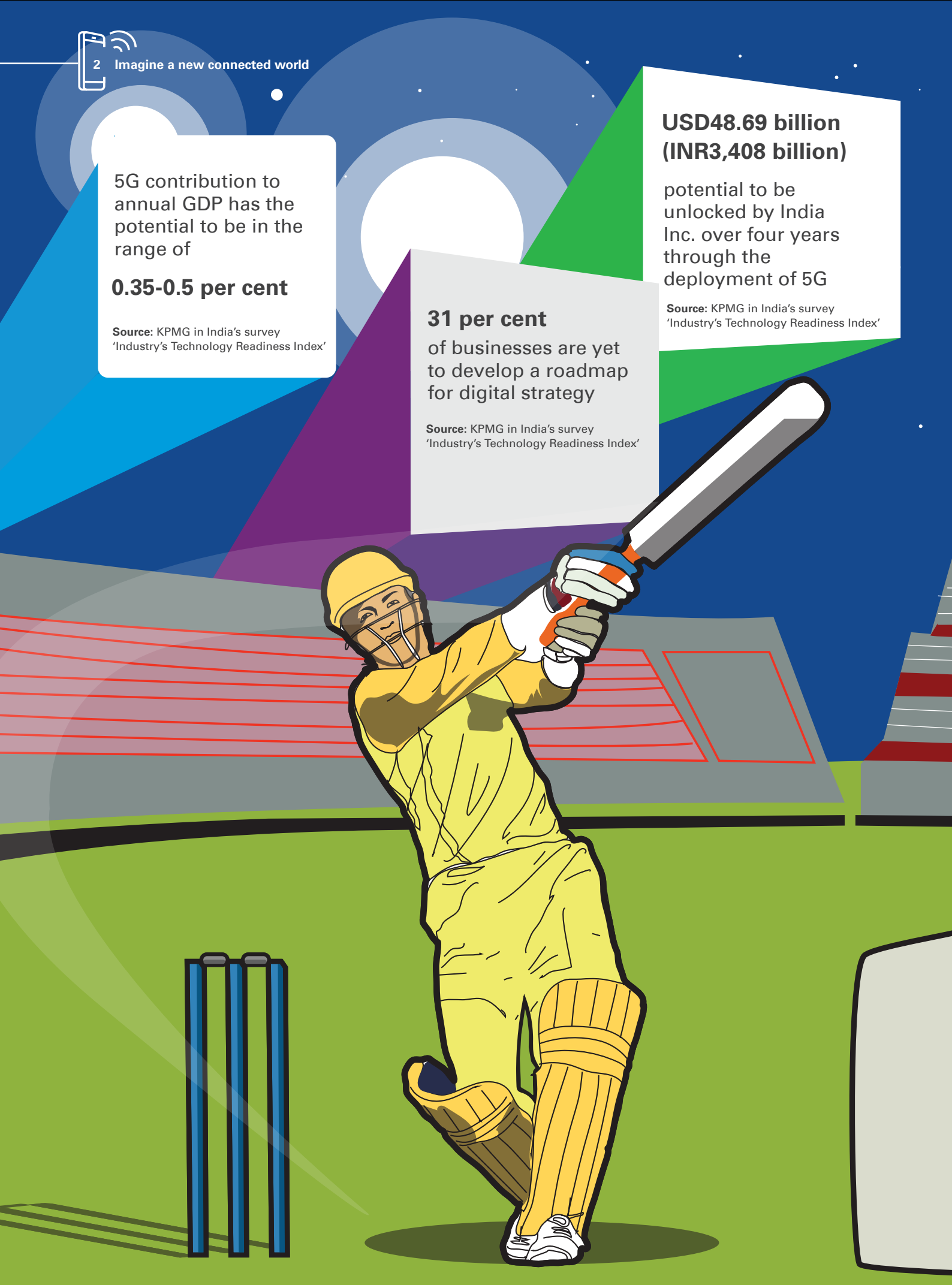
of businesses are yet to develop a roadmap for digital strategy

**Source:** KPMG in India's survey 'Industry's Technology Readiness Index'

**USD48.69 billion (INR3,408 billion)**

potential to be unlocked by India Inc. over four years through the deployment of 5G

**Source:** KPMG in India's survey 'Industry's Technology Readiness Index'



## Data privacy should be a top priority

~60 per cent of companies have a privacy initiative in their goals

## From connectivity to content

Telcos to pivot from being mere 'pipe providers' to offering a credible platform within a broader content ecosystem

Absolute value unlocked through 5G deployment, will be highest in

- Retail
- Financial Services
- Technology

# Foreword

IMC in its third year continues to provide a common platform for a vast range of dignitaries and speakers to come together and present their views as well as discuss the way forward for the telecom industry. IMC has established itself as a formidable platform to bring different stakeholders together to not only showcase innovations but also share contributions made towards building the digital economy of India.

The theme for this year's event has been very aptly chosen as 'Imagine a new connected world: Intelligent. Immersive. Inventive'. While we are well on our way to achieving a national teledensity of 100 per cent, things are also looking promising on the broadband front with more players offering high speed broadband at affordable rates to consumers. Further, even though India started the IoT journey a little later than the rest of the world, the installed base of devices is expected to grow at a much faster rate. The IoT market for example is expected to be USD9 billion by 2020 with an installed device base of close to two billion, as per NASSCOM. Also, India is perhaps the only country in the world which has adopted blockchain in telecom with its deployment by the Indian telecom regulator for unsolicited commercial communication.

The concept of 'Intelligent Connectivity and Immersive World' will reap societal benefits by revolutionising the way core services are delivered to our consumers. High-speed wireless connectivity with AR/VR applications, autonomous vehicles, personalisation based on consumers' preferences, access to continuous health monitoring through IoT devices and smart cities and buildings are a few such exciting and innovative services that will pave the way for the fourth Industrial Revolution. The intelligent connected network will leverage and blend the data collected through IoT with deep learning algorithms to drive productivity, enhance decision making and enable automation across sectors.

It has been estimated by a high-powered committee on 5G in India, that the cumulative impact of 5G in India can reach USD1 trillion by 2035. To create a collaborative ecosystem and enable customer adoption for emerging technologies, the key players and various stakeholders should come forward and address the challenges like lack of infrastructure, consumer constraints, state of telecom industry like concerns over investment climate, lack of relevant skill sets, spectrum pricing and a forward-looking regulatory framework to facilitate ease of business and competitive market structure in deployment of an intelligent and immersive network.

I am delighted that IMC, COAI along with KPMG in India, have put together a comprehensive report that focuses on how futuristic technologies can be harnessed for the Indian consumer. I would like to acknowledge their efforts in the development of this timely and insightful publication.

**Rajan S Mathews**

Director General
COAI

# Foreword

I would like to extend a warm welcome to you to the third iteration of the India Mobile Congress which has established itself as a world class event in the field of telecommunications and technology, aimed at bringing together players across the telecommunications sector to debate, deliberate and discuss on the happenings of the industry.

The success of the previous iterations of the event has emboldened us to make the event bigger and better this year with a focus on technologies and ideas that promise to revolutionise the sector along with delivering value to the end consumer. The theme for this year is aimed at discussing the plethora of opportunities that new technologies like 5G, IoT, AR/VR, etc. bring. It will provide a platform for industry players to showcase the best of their offerings to current and potential consumers and engage with them towards their refinement and roll-out.

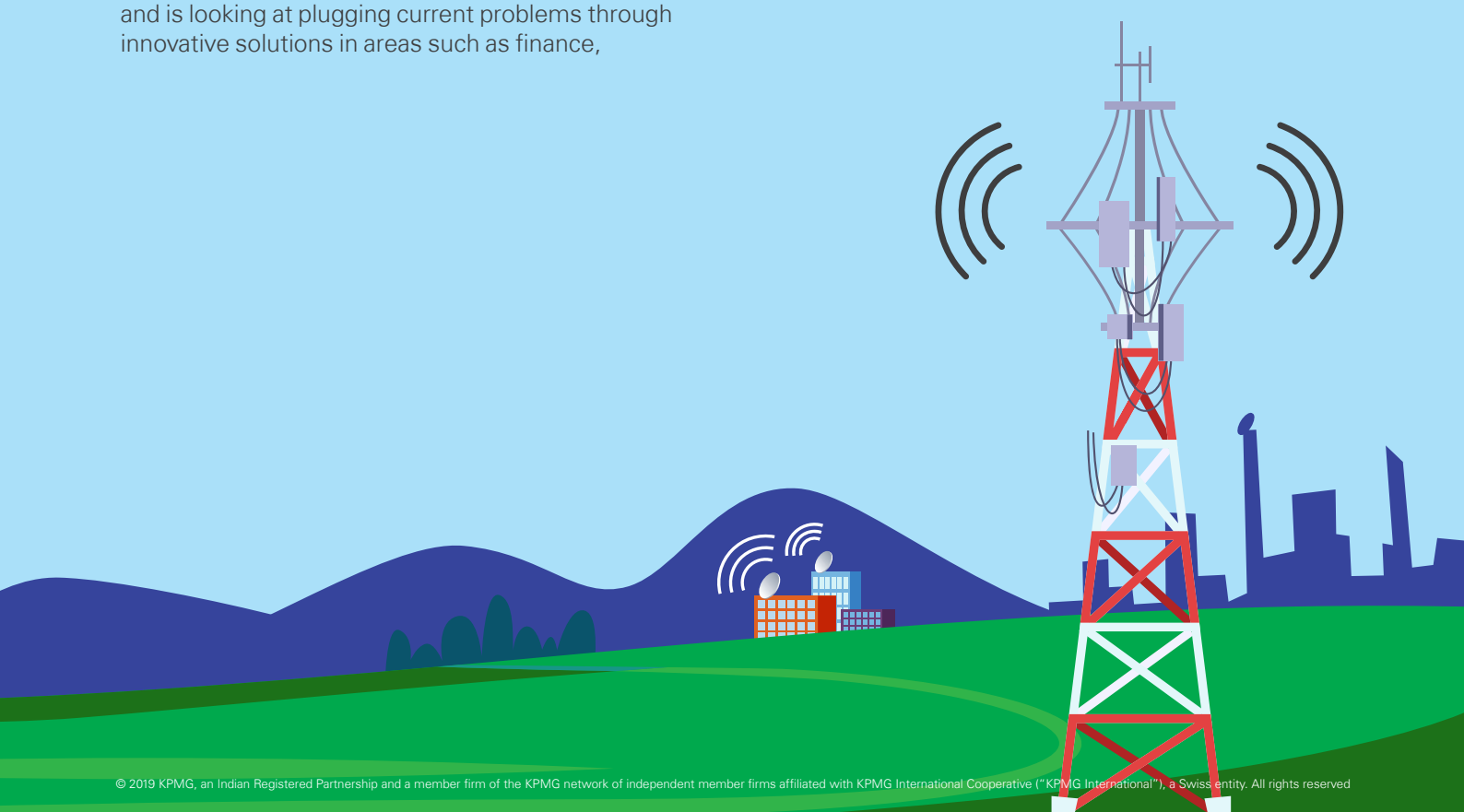
India with its growing digital economy and pro-digitalisation approach is poised to take advantage of this opportunity given the diverse and large scale of implementation. India will be a lucrative market for new innovations across the world alongside China and the U.S.A.. With digitalisation, the market data for various sets of customers has become more accessible, hence helping businesses to leverage the implementation.

The growing start-up ecosystem in India is farsighted and is looking at plugging current problems through innovative solutions in areas such as finance, agriculture, retail, technology, etc. The government is supporting the ecosystem with digital enablement programmes such as Digital Initiative, National Digital Communications Policy, Make in India, BharatNet, etc. However, there is still scope of improvement for industry players as well as the government to contribute towards achieving the trillion-dollar digital economy.

Our research paper put together by our knowledge partners, KPMG in India, has evaluated multiple use cases amongst the new emerging technologies as well as has evaluated the readiness for adoption in the form of a survey conducted amongst industry leaders to gauge preparedness for adoption. I would like to thank the teams across IMC, COAI and KPMG in India in working together to deliver this programme to you.

**P Ramakrishna**

CEO
India Mobile Congress



# Foreword

Emerging technologies such as 5G, IoT, Augmented Reality, Virtual Reality, Robotics, etc. have changed the way businesses operate and customers' experience. We stand on the cusp of another major technological revolution – which some are calling the fourth Industrial Revolution – moving from mobile computing towards intelligent and immersive computing. The advancements and innovations made are already shaping our lives in this modern era. Machines are outperforming humans in various areas with high-level precision.

In association with IMC and COAI, KPMG in India is pleased to present the report, 'Imagine a new connected world: Intelligent, Immersive, Inventive'. The report traces the next wave of growth in the telecommunications and technology sector in India fuelled by the push from the government in digital technologies, and helps in understanding the various opportunities as well as use cases associated with these technologies and how they will impact the overall Digital India ecosystem. With 5G implementation becoming imminent, it is imperative for us to understand the state of readiness of technology adoption in the businesses and where do business leaders see the biggest potential and challenges. We have conducted a survey across more than 150 companies to arrive at our findings and inferences.

The incentivisation of the start-up sector in India has been a great step by the government, and this has encouraged entrepreneurs to invest in building innovative solutions in areas such as health, finance, agriculture, retail and of course, technology. While, the Government of India is supporting the telecom and technology ecosystem with digital enablement programmes such as Digital India, National Digital Communications Policy, Make in India, Bharat Net, etc. a lot more could still done by the industry as well as government to make India a technology super power.

To monetise and maximise the benefit of these technologies, mobile connectivity will play a critical role in enabling machine to machine (M2M) connectivity. The ubiquity of connectivity enabled by wireless networks will improve collaboration, partnership and interoperability between players across sectors and will be of critical importance in accelerating the digital transformation. Connecting devices in a seamless, automated environment will open the gates to multiple data points, and utilising that with the right vision and content will extend the reach of services in a myriad of ways.

The Indian government through its various mission programmers like Digital India, Smart Cities and forward-looking policy environment like National Digital Communications Policy 2018 (NDCP) has started laying down structural guidelines to fulfil the dream of USD1 trillion digital economy. IoT deployments in line with technologies like AI, ML and AR will help in addressing the challenges in sectors like healthcare, transportation, agriculture, education in a much broader scope and most importantly, within the true context or realm of digitisation.

However, apart from alliances between industries, we also need to focus on maintaining the market equilibrium in a competitive environment. The government should deal with looming concerns like financial health of the telecom sector, spectrum policy, infrastructure, skill development, data privacy, etc. to promote ease of doing business and fast-track the implementation of the framework for the new technologies. Steps need to be taken to safeguard private and sensitive data of end-consumers and show zero tolerance towards data leakage and disrespecting customers' consent and preferences.

The future looks bright for the sector as we look at embracing newer technologies that promise to help achieve the goal of greater socio-economic development. A digital economy cannot just provide cutting-edge technology but also ultimately impacts how people live their daily lives.

**Arun M Kumar**
Chairman and CEO
KPMG in India

**Satya Easwaran**
Partner
Telecom, Media and Technology Sector Leader
KPMG in India

**Purushothaman K G**
Partner
Telecom Sector Leader
KPMG in India

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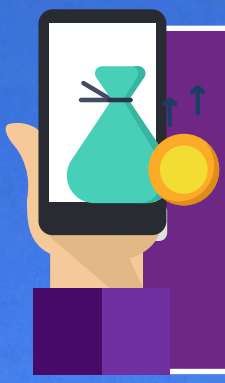
# Industry statistics

| | |
|---|---|
| Number of mobile subscribers | 1.17 billion |
| Number of internet subscribers | 665.31 million |
| Teledensity | Overall: 90.23 per cent, Urban: 161 per cent, Rural: 57 per cent |
| Contribution to GDP | 6.5 per cent in 2017 to reach 8.2 per cent in 2020 |
| Average Revenue Per User (ARPU) | USD1.00 |

**Source:** TRAI performance indicators report, April-June 2019, InvestIndia, KPMG in India analysis 2019



| | |
|---|---|
| Average mobile data cost/GB | USD0.26/GB is lowest in the world |
| Average mobile data usage (GB) per user per month | 9.77 GB |
| OTT consumers | 580 million OTT consumers by FY24 |
| Number of UPI payment transcations | 5.35 billion (FY19) |

**Source:** TRAI performance indicators report, April-June 2019, KPMG in India Media and Entertainment report 2019, RBI Annual Report 2019

| | |
|---|---|
| Number of smart cities | 100 smart cities are being developed at an investment of USD292.88 billion |
| Number of start-ups | 7,200 in 2018 |

**Source:** Smart Cities Mission, NASSCOM, KPMG in India analysis 2019

## Internet subscribers per 100 population

### Internet subscribers per 100 population

**Urban**
2017: **77** | 2018: **94**

**Rural**
2017: **15** | 2018: **24**

**Source:** TRAI performance indicators report, April-June 2019

### Internet subscribers per 100 population

**Female**
2017: **39** | 2018: **42**

**Male**
2017: **61** | 2018: **58**

**Source:** KANTAR IMRB - 21st edition ICUBE™ 2019

# Executive summary

We live in an exciting time – where technology is fundamentally disrupting business models, social structures and consumer behaviour at an unprecedented speed. There are four key themes namely 5G, IoT, AI and AR/VR that are driving the change around building a connected India. These are unlocking values in the ecosystems by creating better, more secure and personalised experiences for everyone. The telecom industry is at the forefront of this digital revolution by providing services beyond the traditional building blocks of access, interconnectivity and applications. The ever-increasing competitiveness of the telecom industry has made the internet more equitable in India. Having the world's cheapest mobile data at USD0.26 per GB[1] has resulted in greater affordability and therefore higher usage. However, affordability is only one aspect of greater internet inclusion. India is also performing better on regional and gender parity parameters, with improvements in both rural penetration and number of female users. By 2030, a billion Indians are expected to be connected to the internet[2].

The future value that will be delivered through telecom operators is not by being the provider of 'connectivity' but as being a trusted partner and platform provider offering value and services and experiences to customers.

Therefore, this year's India Mobile Congress (IMC) is focusing on 'Imagine a new connected world' which is on the back of an 'Intelligent India' that is connected and enabled through technology and a range of 'immersive experiences'. They converge to create an 'inventive ecosystem' that enables it to co-exist, converge and contribute.

### Key technology trends

The trends that KPMG in India sees emerging in 2019-2020 are an amalgam of intelligent, immersive and inventive technologies. The perfect harmony of telecom, media and technology will create a world where businesses are all about improved, enhanced and enriched customer experiences.

### 5G has the potential to add between 0.35 per cent to 0.5 per cent to the GDP of India

The 5th generation of mobile technology or 5G is a trend that has emerged unequivocally. It is going to give us super-fast download and upload speeds as well as more stable connections. While 5G mobile data networks became available for the first time globally in 2019, they were mostly still expensive and limited to functioning in confined areas or major cities. In India, 5G is most likely to see widespread adoption by 2025. With potential from existing technologies (2G, 4G) not fully exploited, India is expected to see a gradual migration to 5G by 2022. Until then 2G, 4G and 5G will co-exist. It is projected that the number of 5G connections in India is expected to reach 88 million by 2025, which will constitute seven per cent of total mobile connections[3].

Super-fast data networks will not only give us the ability to stream video and music at much higher quality, the enhanced throughput may also mean that mobile networks will eventually become even more usable than the wired networks running into our homes and businesses. Enterprises will have to consider the business implications of having super-fast and stable internet access anytime, anywhere.

The increased bandwidth will enable machines, robots and autonomous vehicles to collect and transfer more data than ever before, leading to advances in multiple technologies like IoT, AI, AR/VR, etc.

Our thought leadership report has focused on exploring the potential of 5G in promulgating business propositions like machine enhanced decision-making, agile automation, intelligent efficiency, trusted connections. It has also tried to assess the technology readiness of India Inc. through an extensive survey rolled out to more than 5,000 participants and 150 enterprises (hereafter referred to as 'the survey').

As per our analysis, India Inc. has the potential to unlock USD48.69 billion (INR3,408 billion) through the deployment of 5G over four years. Timelines for deployment – and therefore value generation – will however have to be considered, because it is still a few years away. We estimate that the 5G contribution to annual GDP will likely be in the range of 0.35-0.5 per cent by 2025[4]. The absolute value unlocked is expected to be highest in the retail sector, followed by finance and then the technology sector respectively.

1. TRAI performance indicators report, April-June 2019
2. KPMG in India Media and Entertainment Report 2019
3. India: Becoming 5G ready, GSMA, 2019
4. KPMG in India analysis 2019

### Disruptive technologies: table stakes or future stars

Our survey also tried to understand which technologies are generating most impact and which technologies are seeing maximum investment focus. The survey revealed that while India Inc.'s current table stakes are on data analytics and cloud, IoT, blockchain and AI are projected to be strategic investments and robotics and AR/VR are the future stars.

The most immersive, intelligent and inventive of all technologies, IoT will soon be ubiquitous, incorporated into how we live, work and play. From smart homes and spaces, to autonomous vehicles, to predictive and personalised medicine, IoT is going to take over the technology world, empowered and enabled by the underlying telecom infrastructure.

Blockchain is a technology trend that has seen wide implementation during 2019 and its applications will continue to expand going forward. Blockchain is continuing to receive investments by industry leaders in technology, retail, logistics and financial services. Business leaders in India are seeing use cases of Blockchain beyond cryptocurrency/digital currency.

Our survey ranks AI, AR/VR, cognitive computing and machine learning as the top technologies that have the highest potential to generate immersive experiences but are nascent in terms of their evolution and adoption. AR/VR and AI will all come together to form 'Extended Reality' (XR). Although these technologies have been around for a few years, they have been largely confined to the world of entertainment. Going forward, as businesses delve into the world of possibilities offered by all the immersive technologies, and how well customers respond to them, XR tools will become increasingly popular for training, interacting with customers and simulations of various types, including digital twining.

### Intelligent digital ecosystem is for real but the pace of adoption is slow

Transformational changes in the telecom sector, technological advancements, positive policy intervention and increasing connectivity penetration have been key enablers of India's digital dream. While the government is taking constructive steps, the onus is also on the private players to step up their efforts and play their role in the evolving digital ecosystem. Our survey indicates that 43 per cent of companies have begun work on emerging technologies but almost 31 per cent are yet to develop a roadmap for digital strategy. The importance of digital transformation has been recognised but the journey in transformation is still evolving.

### Need for use cases that are affordable, agile, scalable and customer relevant

Digital technologies already pervade key sectors of the Indian economy. As per our survey, sectors that are likely to be the most disrupted by emerging technologies are retail, financial services and TMT.

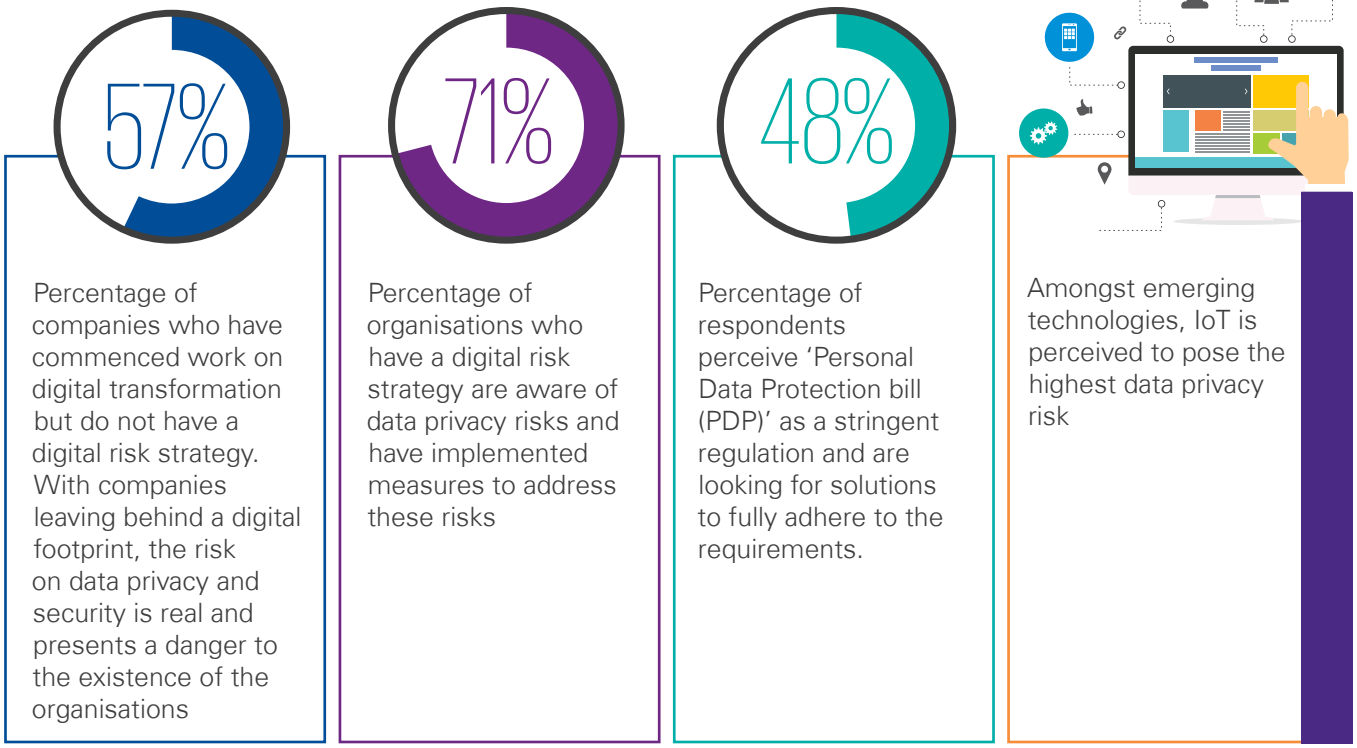
As sectoral innovation like connected cars, digital logistics and mHealth are shaping the contours of each sector, businesses will have to find new ways to engage with customers. Our survey on how the industry perceives technology impacting customer experience revealed the following:

90 per cent of the respondents feel the need for product innovation with newer technologies is needed to enhance customer experience.

While the current investment and focus is on creating an enriched omni-channel experience for customers imbibing AI and ML, survey respondents reckon face-to-face video communication, use of bots and blockchain that are going to be a game changer in enhancing customer experience over the next five years.

## Digital risk and data privacy will need management screen time

With the near ubiquitous nature of digital technologies, digital risk acquires strategic importance. Adoption of multiple digital technologies by the enterprises exposes them to a myriad of vulnerabilities impacting consumers' privacy. USD1.57 million (INR110 million) was the average total cost of data breaches in India in 2017[5]. Further, a data breach could ruin the reputation of an organisation, thereby severely affecting their business. Our survey further emphasised the need and urgency to mitigate these security concerns:




**Source:** KPMG in India analysis 2019

In this regard, the organisations believe 'selling data to third parties' as the top reason for data pilferage. Hence, organisations are very guarded with their customer data, and it is imperative to develop a robust privacy framework encompassing all stakeholders like vendors, employees and customers to prevent any data breach.

As data is turning out to be both an asset and a liability, organisations and regulators have to balance the need to use data for incremental growth, with the concerns of data leakage. The entire ecosystem has to build holistic controls that ensure privacy but at the same time not hamper the flow of data to generate insights for businesses.

5. Frequent data breaches are bleeding Indian companies, Quartz India, July 12, 2018.

### Challenges in the implementation of the digital vision

Despite the Government of India being strongly committed to building a connected and digital India, the following are some of the challenges in implementation:

- Adoption of the National Digital Communications Policy 2018 (NDCP) needs to be done in a more efficient and productive manner
- Financial stress in the telecom industry coupled with the high price of spectrum provides limited room for the industry to deploy and scale digital infrastructure
- Inadequacy of a fibre network and the lack of device interoperability standards are impacting the quality of technology implementation and limiting innovation in the sector
- Enactment of the Personal Data Protection (PDP) bill is a step in the right direction as far as data privacy is concerned but effective implementation and customer education is necessary to improve customer confidence in adoption of digital technologies

### What is the need of the hour?

The key would be the effective mitigation of these challenges, which would require a concerted and collaborative effort from all the relevant stakeholders.

#### Policy

The pace of technology proliferation in the country is directly linked to policy reforms made by the government. Policy interventions relating to 'ease of doing business', RoW clearance, Public-Private Partnership (PPP) models for infrastructure development, creation of a national portal to monitor and track the development and adoption of emerging technologies, expediting the roll-out of smart cities, finalising the Personal Data Protection (PDP) bill, drafting an IoT policy and implementation of a national programme on AI will accelerate the adoption of digital technologies in the country.

Additionally, in the long term, the domestic manufacturing for telecom equipment and fibre can be given a boost through direct tax incentives for reducing manufacturing cost, formation of special economic zones, and increasing export incentives. In the short term, till the local capability scales up, the government could consider providing custom duty exemptions on telecom equipment to ensure timely roll out of networks.

#### Investments

To promote investments in the sector, the government could create Special Purpose Vehicles (SPVs) to support international lending organisations and provide substantial investments into digital infra projects at cheaper interest rates. Additionally, funding can also be provided from tax-free bonds, infrastructure debt bonds, central road funds, monetising government-owned road assets and budgetary allocation. It is recommended that an optical fibre market development fund be set up that can support the service providers, incentivise product and market development expenses with low cost loans.

## Spectrum

As the country is gearing up for 5G, it is critical that the additional spectrum should comprise a mixture of coverage (i.e. lower frequency) and capacity (i.e. higher frequency) bands to ensure that networks can provide high speed, cost effective services in rural and urban areas alike. It is equally important that the additional spectrum identified is globally and regionally harmonised, to enable low cost consumer devices through economies of scale while also enabling roaming and minimising cross-border interference. Some of the other policy interventions towards transparent spectrum allocation, optimal pricing of spectrum, allocation of spectrum for microwave access and backbone, allocation of E&V bands and spectrum sharing and leasing regimes to optimise utilisation would be critical.

## Easing the financial burden of the sector

With the total levy of between 29 and 32 per cent in the form of GST[6], licence fee (LF) and spectrum usage charge (SUC) on the telecom sector, there is a clear need for levy rationalisation. The Universal Service Obligation Fund (USOF) contribution and SUC could be reduced to three per cent and one per cent respectively, to make the sector competitive. Further, declaration of a three-year moratorium on spectrum payments to the government with abeyance on interest charges, refund of accumulated unutilised input tax of USD4.24 billion are some of the other demands of the debt-laden sector[6]. The government could also consider doing away the levy of GST on government payments such as LF and SUC.

## Ecosystem

- Incubation hubs and accelerators along the lines of the Atal Incubation Centres (AICs) can be established, specifically for emerging technology start-ups
- Establishment of a funding mechanism like the VC funding scheme and Startup India, to provide grant funding to emerging tech start-ups to facilitate their operations and business
- Players across the digital value chain will need to adopt a sustainable and transparent pricing model
- A collaborative effort is needed from the government, industry and academia to re-skill and up-skill the existing talent in the country
- Given the significant changes envisaged in the future networks, we recommend an extremely light touch Regulatory approach so that these technological initiatives and innovations are not hampered by the Net Neutrality regulations. A more nuanced approach to traffic management will also be required to ensure that the industry reaps the benefits of 5G

With the growing number of data users, evolving consumer expectations and focus on digitalisation, industry stakeholders will need to re-evaluate their existing strategies and operating models, and reinvent themselves to leverage emerging technologies to tackle challenges. With these things in place, we are on the cusp of becoming the largest digital economy in the world.


6. Cellular Operators Association of India (COAI)

# Intelligent

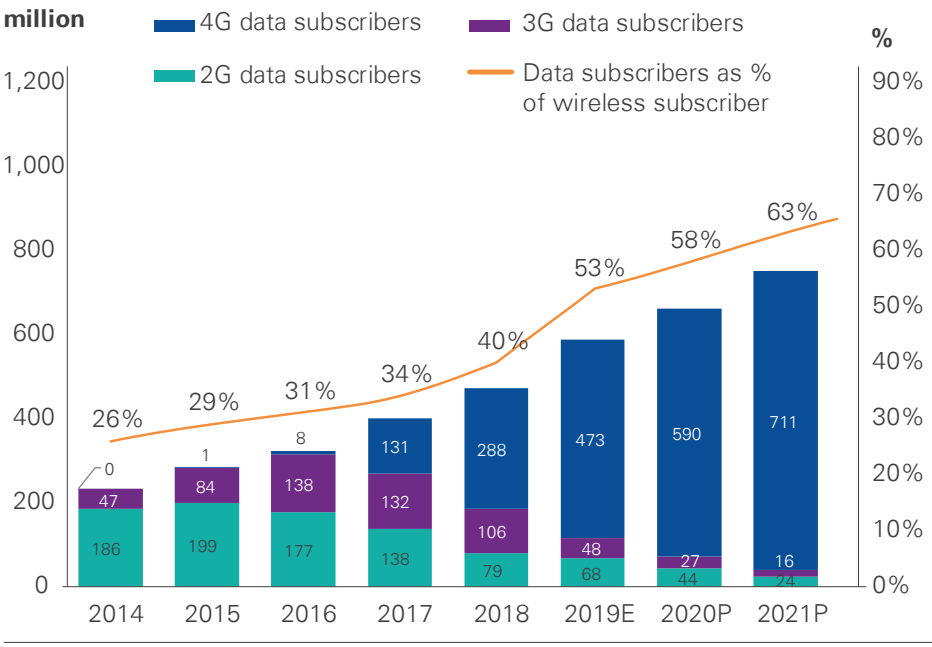
## Paving the way for a connected, digital, 'Intelligent' India

With a total telecom subscriber base of 1.17 billion and over 600 million broadband subscribers[1], connectivity and online presence in India have registered phenomenal growth in the past decade. Teledensity has also skyrocketed from 18.2 per cent in 2007 to 90.23 per cent in 2019[1] and India has emerged as the second-largest telecommunications and the fastest growing smartphone market in the world. Driven by affordable data and devices, the number of smartphone users is expected to rise from 400 million in 2017 to 829 million in 2022[2].

The pace of adoption of newer generations of technologies has been accelerating as consumers realise the potential benefits of the transition. In the quarter ending March 2019, 4G contributed to 91.2 per cent of the total volume of wireless data usage while 3G and 2G accounted for a mere 8.2 per cent and 0.6 per cent[3].

As shown in the graph below wireless data subscribers will continue to transition to 4G over the next few years and post 2021, predominantly 4G technology will exist. 5G is expected to account for seven per cent of total mobile connections in India by 2025.

### Transition of 2G/3G data subscribers to 4G




**Source:** Telecom Data Services, CRISIL Research, March 2019

1. TRAI performance indicators report, April-June 2019
2. India's digital future – Mass of Niches, KPMG in India's Media and Entertainment report 2019
3. TRAI performance indicators report, January-March 2019

With voice services becoming almost obsolete, voice over LTE (VoLTE) technology and its widespread adoption could be an important catalyst for a digitally empowered and connected India. India is expected to have 780 million VoLTE subscribers, while total smartphone subscriptions in the country will grow 2.5 times to cross 975 million by 2023[4]. This growth has been well supplemented by the availability of VoLTE enabled smartphones from major brands across various price points starting from as low as USD42.77 (INR3,000)[5].

Transformational changes in the telecom sector, technological advancements, positive policy intervention and increasing connectivity penetration have been key enablers of India's digital dream. India's technology and telecom industry is at the forefront of the digital revolution the country is bracing itself for. It will take the combined will of all stakeholders – public and private – to build a conducive ecosystem to enable a swifter proliferation of digitisation of the country. While the government is taking constructive steps (also enumerated in the table below), the onus is also on the private players to step up their effort and play their role in the evolving digital ecosystem.

**Key government initiatives:**

| Digital infrastructure | Digital empowerment of citizens | Digital policies and framework | Innovation and centre of excellence |
|---|---|---|---|
| 5x growth in broadband access | 1.2 billion Indians have a digital identity through Aadhaar cards | National Digital Communications Policy 2018 (NDCP) roll out | 5G test bed and ecosystem development in collaboration with IITs |
| Over 300,000 kms. of optical fibre cable layout through BharatNet | USD85.56 billion disbursed through Aadhaar based DBT to beneficiaries | 268 unique mobile and mobile component manufacturing units have been set up providing direct and indirect employment opportunities to 670,000 citizens | National Program on Artificial Intelligence |
| 121,000 gram panchayats connected | Delivery of e-services through GI Cloud | The National Policy on Software Products 2019 | Strong and robust network established under National Knowledge Network aiming to connect 1,500 educational and research institutions |
| | Over 3 million CSCs across the country | Reformed guidelines for transfer/ merger of telecom licences | |
| | | Proposed regulatory framework for OTT communication services | |

**Source:** KPMG in India analysis 2019

## Moving on to the next phase of growth

Continued internet penetration along with the transition of telecommunication providers to high-speed 4G LTE and later to 5G wireless technologies will drive the next phase of growth. This growth will be complemented by adoption of digital technologies.

This wave of upgrade of the digital infrastructure is a setting, which will help the digital economy in India to reach USD1 trillion by 2025[6] and Indian citizens stand to gain great social and economic benefits.

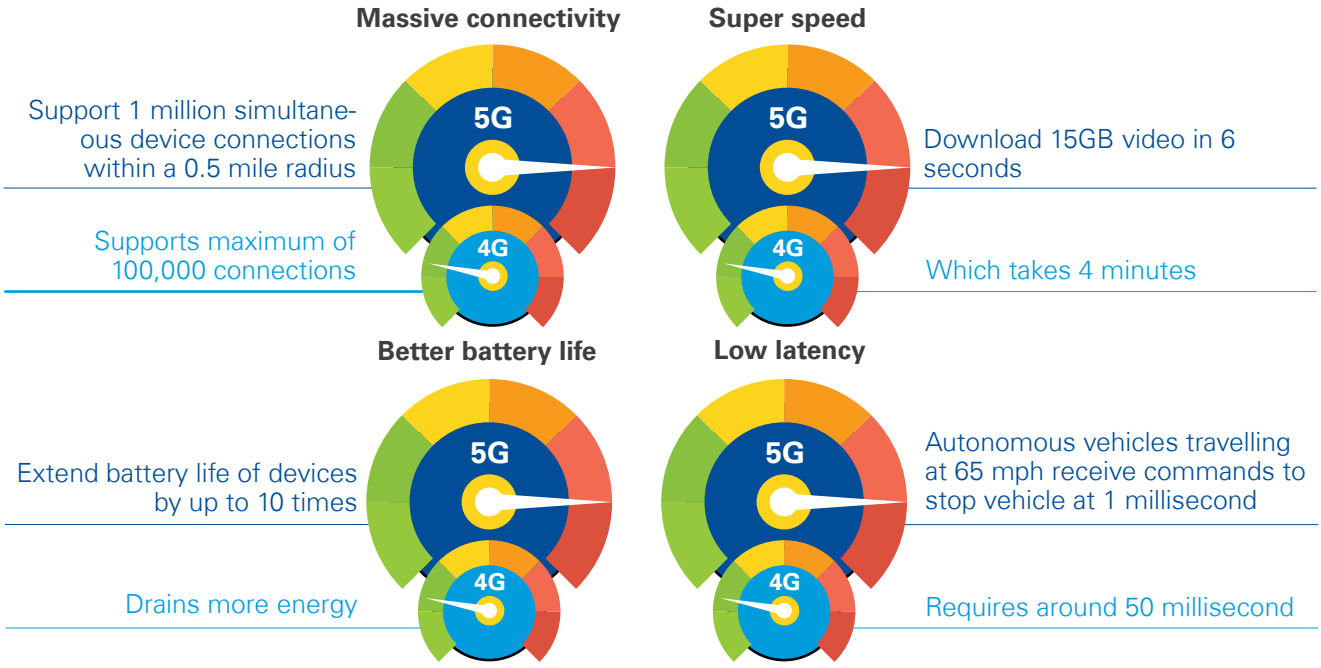
> Data is the primary driver of growth in the industry today and the demand for it is all set to go up. With 5G on the horizon, the high capacity, throughput, and availability offered by optical networks can help meet these demands. 5G will bring the speed, which will lead to more devices being connected while virtualisation will help manage all of this without incurring high costs. The service providers need to keep up with market demands while bringing consumers into the fold to form a symbiotic ecosystem.
>
> 
>
> **Dr Anand Agarwal**
> Group CEO, Sterlite Technologies

4. Mobility Report, Ericsson, June 2018
5. 5 Cheap And Best 4G VOLTE Mobiles India (2019), Candytech, 03 January 2019
6. KPMG in India analysis 2019

## India gearing up for the 5G revolution

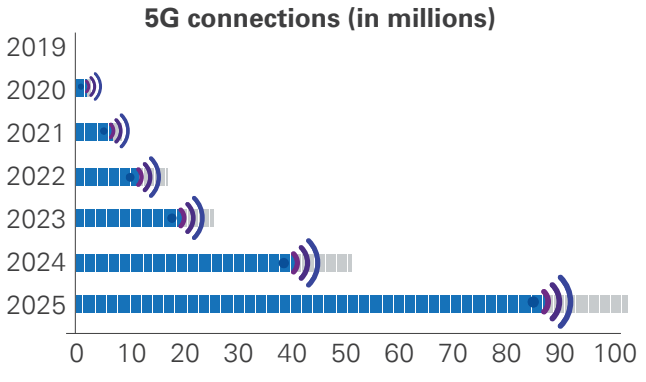
Since more than one-third of the connection base in India is still operating over 2G networks, it is anticipated that India will witness a gradual migration to 5G by 2025. The number of 5G connections in India is projected to reach 88 million by 2025, corresponding to approximately seven per cent of the total connection base in the country[7].

### 5G vs. 4G




**Source:** Enabling the Enterprise through 5G, Samsung and KPMG, 03 June 2019

### Adoption of 5G in India




**Source:** India: Becoming 5G ready, GSMA, 2019

### Unlocking value through 5G

#### Becoming 5G-ready: Estimating the value potential

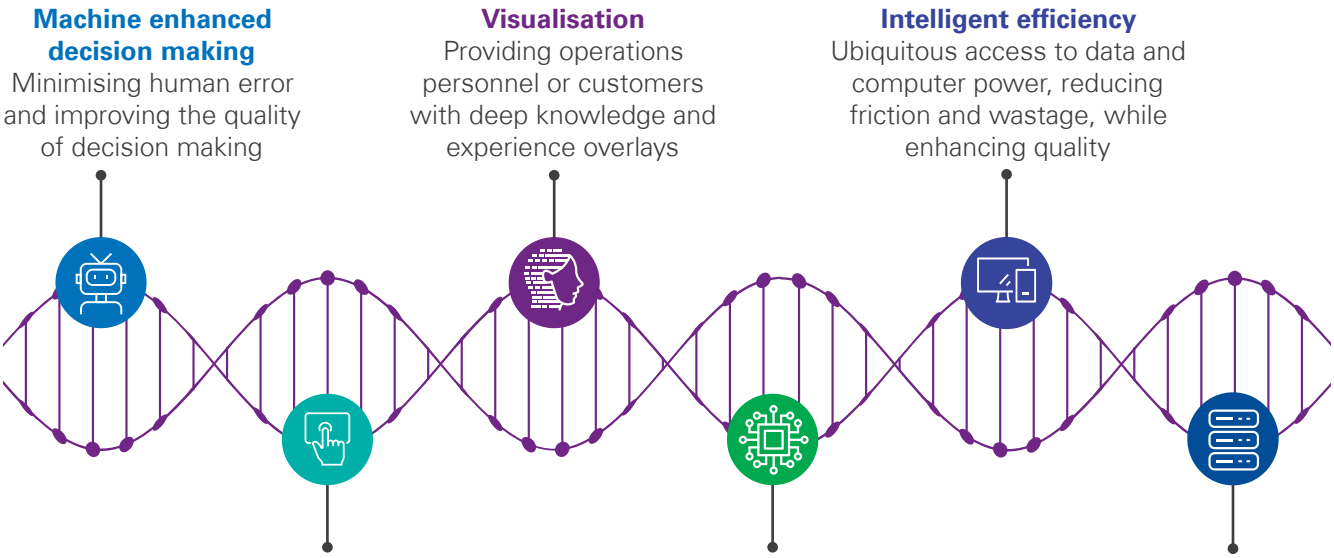
Unlike previous generations of mobile networks, 5G technology is expected to fundamentally transform the role that connectivity would play in the society. 5G will act as a catalyst in the way people and machines communicate with each other and amongst themselves.

5G will not only enrich customer experience on personal mobile devices, but also provide a framework for implementation of IoT and Machine to Machine (M2M) communications. As the harbinger of exponential changes, 5G promises to be a fundamental enabler of the digital economy, including IoT, AI, analytics, AR/VR, robotics and autonomous vehicles (AVs). Given the Indian government's plan of rolling out 5G services by 2020[8], the change is nearly upon us.

7. India: Becoming 5G ready, GSMA, 2019
8. 5G spectrum auction by year-end or early 2020: Ravi Shankar Prasad, The Economic Times, 13 September 2019

KPMG has developed a framework to assess the business benefits from 5G across the following levers of value:

**The DNA of 5G value for an enterprise**




**Source:** Enabling the Enterprise through 5G, Samsung and KPMG, 03 June 2019

As per KPMG in India analysis, India Inc. has the potential to unlock USD48.69 billion (INR3,408 billion) through the deployment of 5G over four years. Timelines for deployment - and therefore value generation – will however have to be considered, which we estimate is still a few years away. 5G is potentially expected to unlock between 0.35 per cent to 0.5 per cent of the GDP[9].

**Industries likely to create maximum value through 5G**

| Industry | Value unlocked (in USD billion) |
|---|---|
| Retail | 26.02 |
| Finance | 10.35 |
| Technology | 5.5 |

**Source:** KPMG in India analysis 2019

**Industries likely to get maximum impacted as a per cent of revenues**

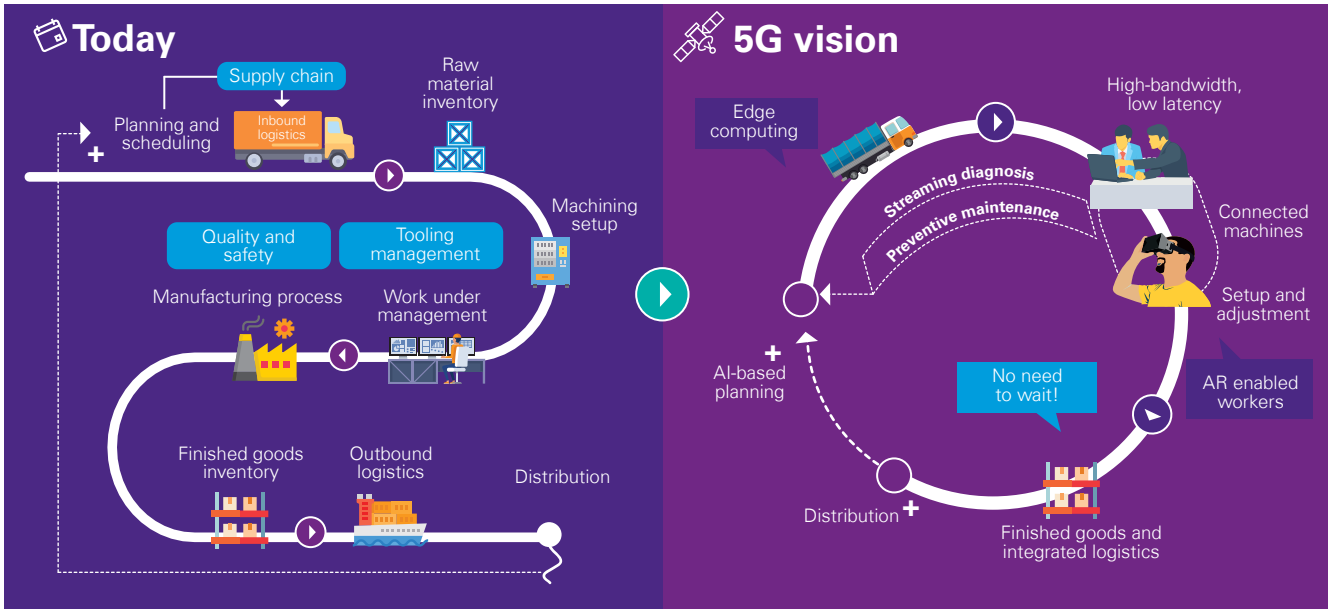
| Industry | Value unlocked as a per cent of revenues (2019) |
|---|---|
| Technology | 4.1 per cent |
| Manufacturing | 3.4 per cent |
| Transport | 3.0 per cent |

**Source:** KPMG in India analysis 2019

9. KPMG in India analysis 2019

5G has the ability to support a number of technologies, platforms and processes. In the case of manufacturing, for example, most facilities are set up in a linear fashion where machines, people and systems operate independently and in isolation.

It is a mostly linear, inflexible process. The deployment of 5G with its high bandwidth and low latency features, organisations can leverage AI-based planning, connected machines and edge computing for higher agility, speed and productivity.




However, while there are compelling business rationales for 5G deployment, stakeholders might need to consider the commercial viability of their respective use cases as well as their readiness to implement them.

To assess the state of readiness of the technology adoption in the country and to bring an outside-in perspective to our research, KPMG in India ran a survey titled 'Industry's Technology Readiness Index' to gauge the preparedness amongst Indian technology players to adopt new technologies such as 5G, IoT, AR/VR among others (Please refer to *page 75* for detailed survey methodology). The survey indicated:

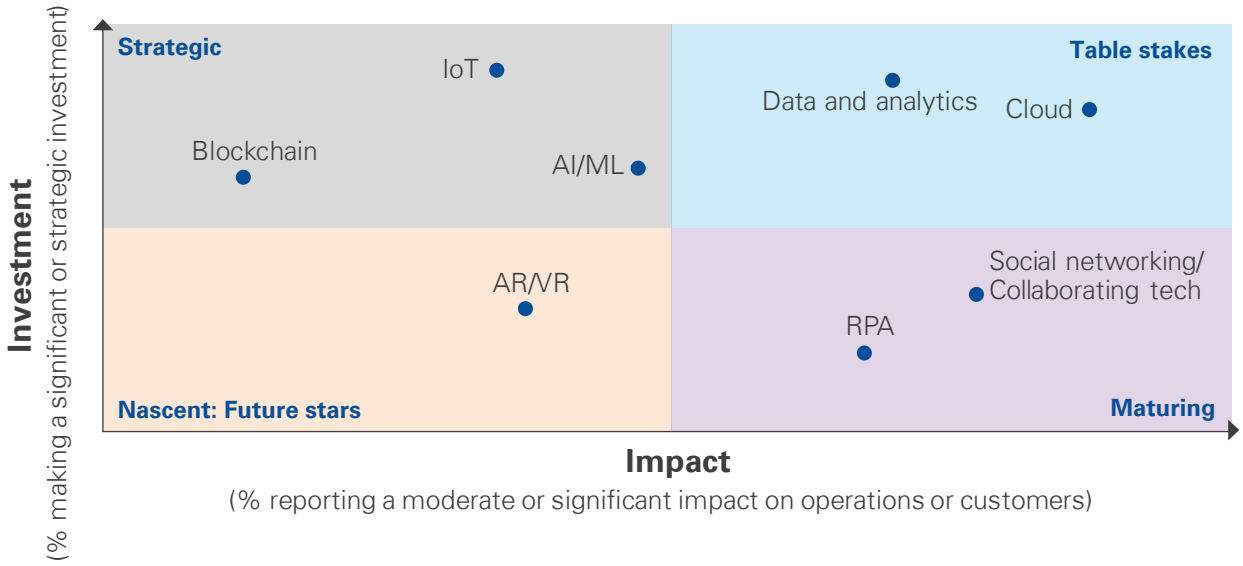
**Digital Maturity Index**

**Findings:** 43 per cent of companies have begun work on emerging technologies but almost 31 per cent are yet to develop a roadmap for digital strategy

**Insight:** The journey to digital services has slowly begun but a considerable number of companies need assistance in developing a digital roadmap

## Disruptive technologies: table stakes or future stars?

Building on data and insights from the survey, we evaluated eight major disruptive technologies using the following metrics: impact on operations, impact on business models and level of investment. Combining these three metrics, we have created the disruptive technology value map to help leaders guide investment decisions on disruptive technologies. The focus of investment needs to be determined by the business goals of the company as well as the stage of development of each technology. It can also help companies benchmark themselves against their peers to prioritise different disruptive technologies.




**Source:** KPMG in India analysis 2019

**Table stakes**
Receives high investment and generates strong impact today. They have reached an initial phase of business maturity but remain vigorously innovative and challenging to master

**Strategic**
Receives significant investment today in search of strong impact tomorrow. They are high on investment and medium-to-low on current impact

**Maturing**
Generates strong impact, but no longer requires high investment. They now receive medium-to-low investment, as system hum along at producing value

**Nascent: Future stars**
Receives lesser levels of targeted investment and have yet to generate serious impact, but are seen as potential future stars

The survey indicated that India Inc.'s current table stakes are technologies like data and analytics and cloud. Businesses failing to embrace these technologies risk falling behind in terms of efficiency, productivity and customer experience.

The respondents have classified IoT and AI/ML and blockchain as strategic technologies that are starting to deliver and carry exceptional future promise.

The survey respondents indicated that while Robotic Process Automation (RPA) and social networking are two technologies which companies have already implemented and reaped its benefits; AR/VR are the potential future stars.

Our survey also ranked certain industries as follows:

**Sectors which have the maximum potential to be disrupted by the emerging technologies**

| | 1 | 2 | 3 |
|---|---|---|---|
| IoT | Retail | TMT | Automobiles |
| RPA | Financial Services | TMT | Retail |
| AI | Healthcare | TMT | Financial Services |
| Blockchain | Financial Services | TMT | Healthcare |
| AR/VR | TMT | Retail | Automobiles |
| Social Networking/ Collaborating technologies | Retail | Financial Services | TMT |
| Data and analytics | Retail | Financial Services | Agriculture |
| Cloud | TMT | Healthcare | Retail |

**Source:** KPMG in India analysis 2019

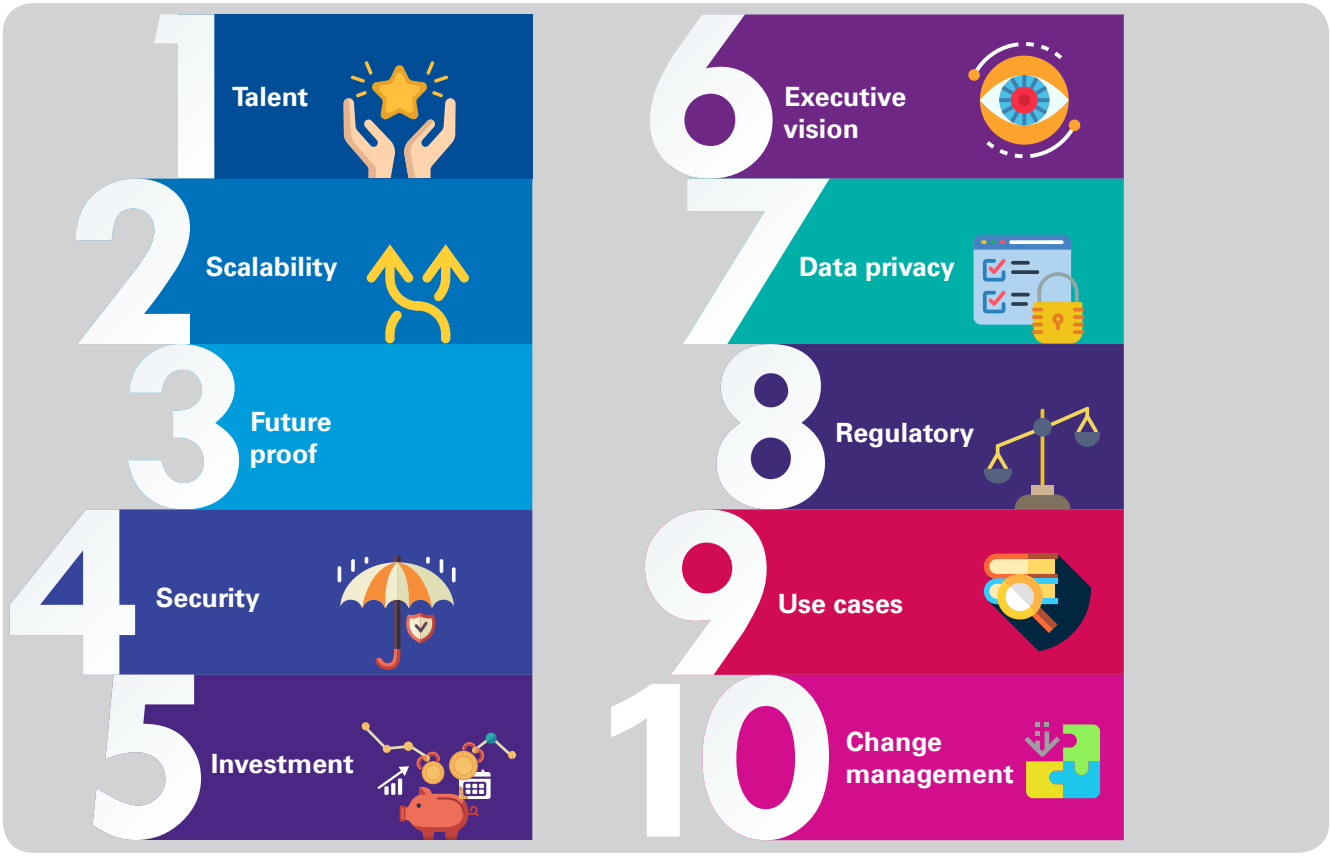
While there is broad consensus on the immense benefits of these emerging technologies across sectors, the risk associated with the implementation needs to be given consideration.

**Digital Risk Index**

**Findings:** 57 per cent of the companies who have started work on digital do not have a wholistic digital risk strategy

**Insight:** Digital risk is a less understood topic and needs to be detailed with the organisations that have embarked on the digital journey

**The following are some challenges identified by our participants for adoption of emerging technologies:**




**Source:** KPMG in India analysis 2019

## Revolutionising the way people live, work and play

Information today, has reached levels where it is both exciting and overwhelming. The reliance on apps for providing information is increasing by the day. Three concerns spanning the digital space are -


66 Per cent

Nearly two thirds of potential consumers drop out of the purchase journey of telco products and services due to friction

**Source:** KPMG Facebook report 2018 on eliminating friction in smartphone path to purchase

Reducing friction is pivotal to enhancing customer experience. Digital interventions are key to assisting the customer journey and wowing the customer. For instance, about seven in ten smartphone purchases in 2022 are likely to be through a mobile device.

**54** Per cent

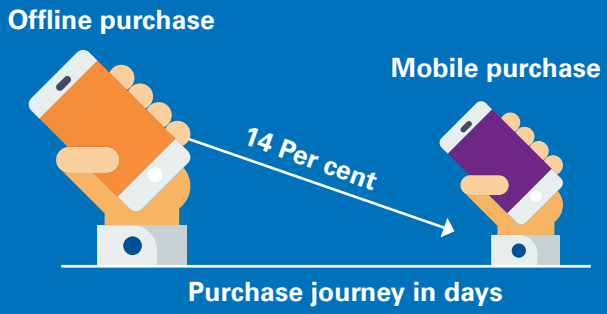
of users in India have felt overwhelmed while using applications and have disconnected services on applications indicating the need to simplify and improve user interface.

**Source:** KPMG Facebook report 2018 on eliminating friction in smartphone path to purchase

Life with a smart phone is now the new normal. Connectivity is essential and critical. Operating models of businesses are being designed keeping in mind how content and commerce will be done today and in the future. India has changed and its value experiences are becoming truly omni-channel. The challenge is that a 'copy-paste' of any other example from outside India may not always be successful here, because of the unique circumstances that constitute the market in India, such as existance of primarily 2G market, the socio-economic diversity, and the non uniformity of network layout through out the country.

Indian customer experience initiatives focus on personalisation of services to customers. Technologies like AI/ML are very deeply integrated into some of the apps. These technologies are aiming to create a more closely connected society, both in terms of interpersonal interactions and to build a connected ecosystem. However, it is imperative to remember that only data that is collected can be analysed and then used to proactively and intuitively pre-empt the needs of every individual. Fuelling these technological advances is the generation of consumers – especially the millennial and Gen Z who use apps extensively to manage the information overload. With this technological ecosystem in place, 5G will only make the access, much faster and much more pervasive.

Drawing on lower latency and higher data throughput, 5G can offer a host of new services by vastly improving consumer experience. For example, AR/VR apps for immersive TV and gaming experience, 4K ultra HD video streaming, and other content for connected devices and smart homes.




Similar services currently available have lower quality output and a broken customer experience due to the limited storage and computation capability of the average devices. From technology perspective, lower latency and higher throughput enable more time critical decisions to be pushed to cloud where additional resources are available to take automated, accurate and intelligent decisions. This enables edge devices to focus on rendering the perfect end-customer experience personalised to current context, while the 'heavy lifting' is done on the cloud. This would inter alia imply transformed gaming experiences, better virtual working, collaboration and telepresence, real time adaptive education, convergence of digital and physical retail, logistics, security and healthcare.

As sectoral innovations are shaping the contours of each sector, businesses will have to find new ways to engage with customers. Our survey on how the industry perceives technology impacting customer experience revealed the following:

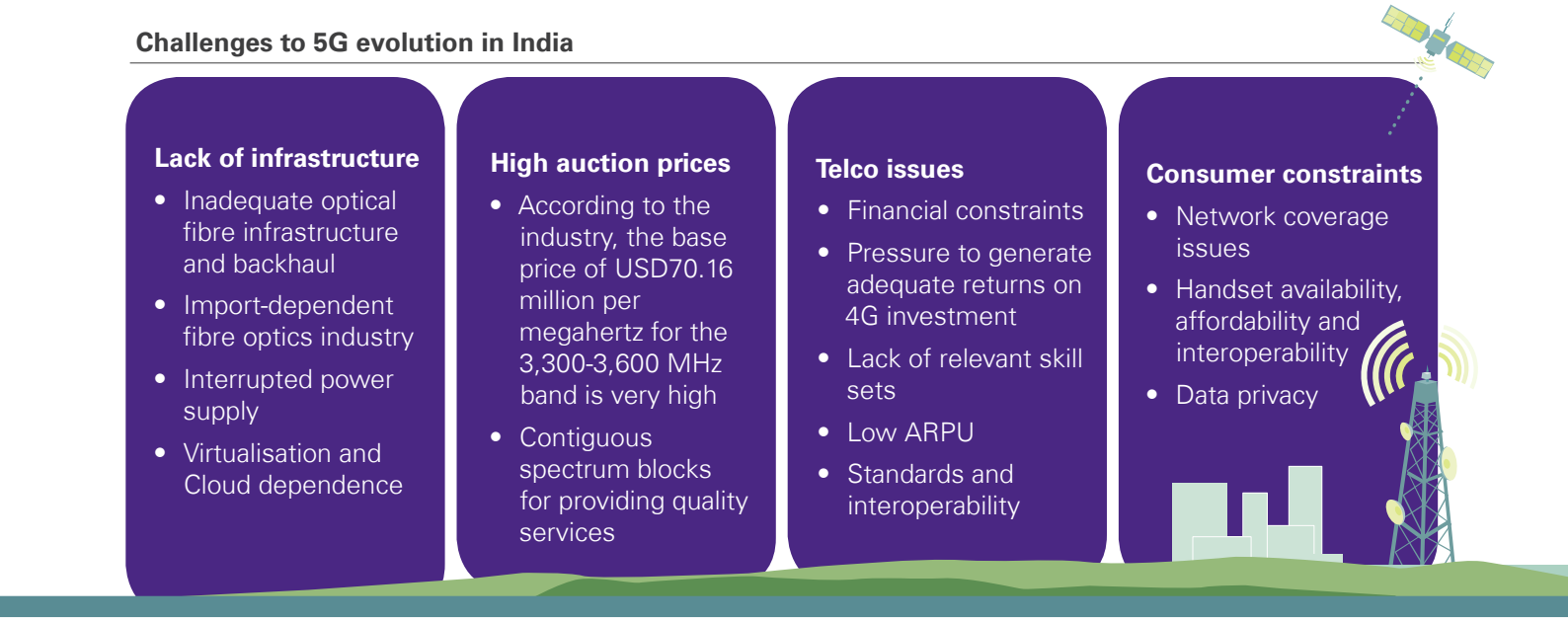
- 90 per cent of the respondents felt the need for product innovation with newer technologies to enhance customer experience
- While the current investment and focus is on creating an enriched omni-channel experience for customers imbibing AI and ML, survey respondents reckon face-to-face video communication, use of bots and blockchain that are going to be a game changer in enhancing customer service experience over the next five years.

## Infrastructure, state of telecom industry and skill gaps are the key challenges

Although 5G in India is expected to account for seven per cent of total connections by 2025, India would still lag its closest neighbour China as Chinese 5G connections are estimated to account for nearly 30 per cent of total connections by 2025[10].

A number of factors may inhibit rapid adoption of 5G in India.

### Challenges to 5G evolution in India




1. **Source:** India: Becoming 5G ready, GSMA, 2019
2. **Source:** Price stalemate expected to prolong India's wait for 5G, Livemint, 09 Jul 2019
3. **Source:** Current telecom infrastructure growth rate may play spoilsport to India's 5G party, Economic Times, 04 June 2019

The survey respondents have categorised these three areas as the primary areas of concern.

High spectrum charges prevent MNOs from investing in network as 5G requires more densification. This is on top of the high debt already accumulated by the telcos in India. Also, Indian telcos have a unique network strategy of running multiple generations from 2G till 5G


The technology standardisation in terms of 5G as well as IP address allocation of IoT/M2M applications are still being delibrated and there is no clarity on the means to implement a standardised solution

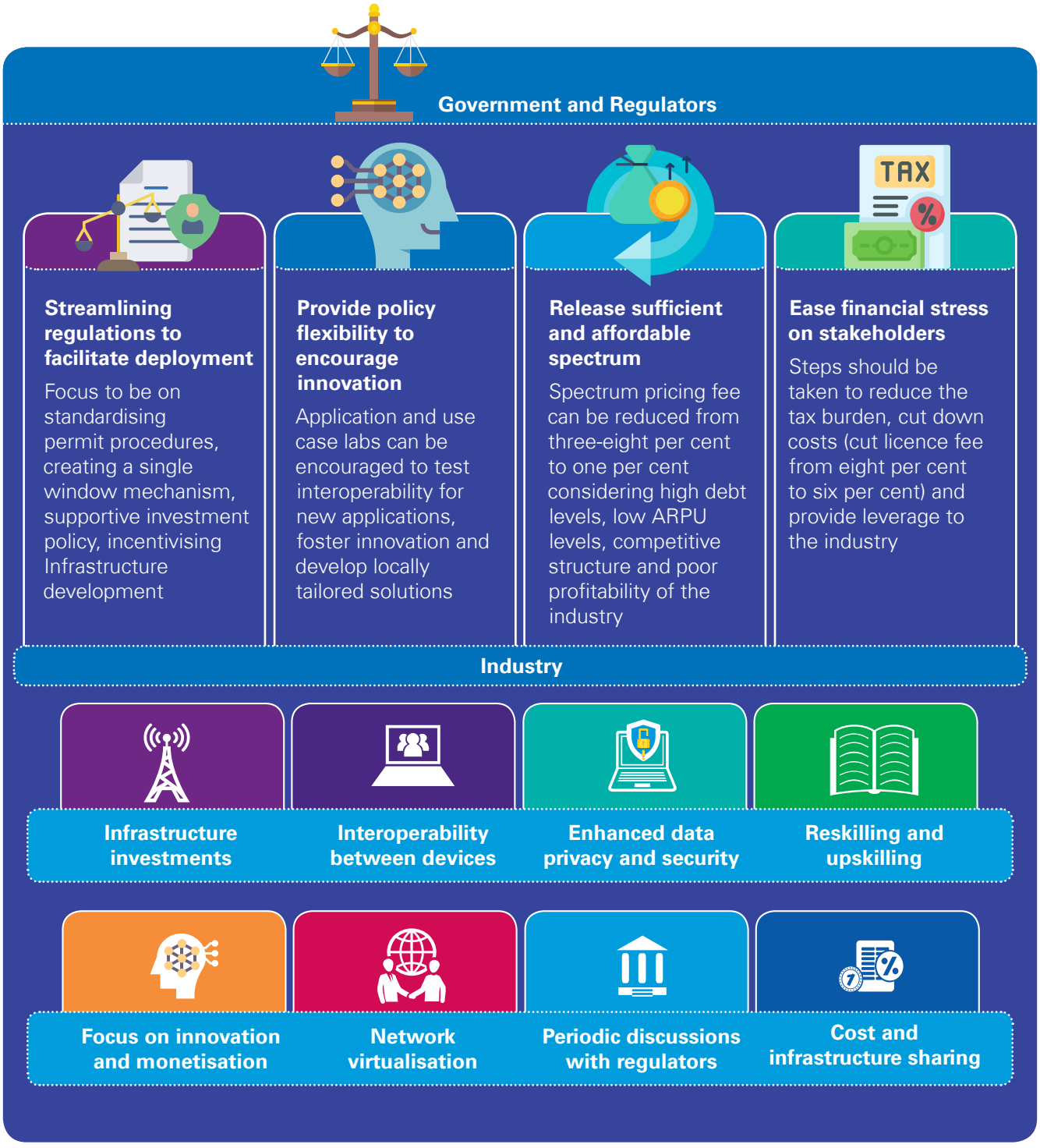

The fiberisation of sites in India is in the range of 20-30 per cent and 5G requires extensive fiberisation of sites to provide industry grade QoS. Fiber rollout requires massive CAPEX and complicated Right of Way (RoW) clearance


10. India: Becoming 5G ready, GSMA, 2019

## Building a collaborative framework between regulators and industry would be key to overcome these challenges

To accelerate commercial and industrial adoption of 5G, the government, along with industry stakeholders, needs to create a framework that will foster a pro-investment and pro-innovation environment. The government can introduce certain interventions to tackle the headwinds from the existing policy and regulatory environment, in terms of infrastructure deployment, network management flexibility, spectrum access and investment.

### Key interventions required




**Source:** India: Becoming 5G ready, GSMA, 2019

## Role of government and regulators – clarity in policy framework and regulations

The government has taken a step in the right direction by publishing the NDCP 2018. It laid ground rules and the principle framework that will enable creation of a vibrant competitive telecom market. The key themes that the policy aims to look at include the regulatory and licensing framework impacting the sector, connectivity for everyone, ease of doing business and adoption of new technologies including 5G.

Additionally, a 5G High Level Forum has been established to ensure an active role in development of 5G and its involvement in delivering government initiatives such as the Smart Cities Mission and Digital India.

## Enabling ecosystem

Stakeholders need to develop supporting infrastructure to create the ecosystem for 5G. This includes a robast, scalable and agile architecture and infrastructure.

As a step in this direction, the government approved a financial grant for indigenous 5G test beds project across IITs and Indian Institute of Science (IISc) in March 2018. The collaborating institutes include IITs in Mumbai, Chennai, Hyderabad, Delhi, Kanpur; IISc Bangalore; Society for Applied Microwave Electronics Engineering and Research (SAMEER) and Centre of Excellence in Wireless Technology (CEWiT). With a duration of three years and a budget of USD31.94 million[11], the project has the ability to enhance the country's telecom technology and manufacturing competency and develop intellectual property.

Additionally, network virtualisation would help to optimise capital and operating expenditure efficiencies, manage spectrum and bandwidth, and enhance the experience for each subscriber. Network slicing and cell virtualisation can be used to achieve network virtualisation.

## Enhanced data privacy and security

An optimum interplay of a robust data protection policy framework and protocols for endpoint security is the prime necessity to tackle the challenges of data privacy and security. These need to be supported adequately by a secure infrastructure platform with end to end encryption for identity and user protection.

## Interoperability between devices and networks

Going forward, 2G and 4G will continue to co-exist with 5G in India. However, due to the lack of 5G devices and networks, interoperability seems to rest in the hands of telcos.

## Skilling up for the 5G revolution

The new generation of networking and digital technologies demands a huge transformation, and Indian stakeholders need to acquire suitable capabilities in the form of skills, competence and operating models. The need of the hour is to match the pace of innovation in the telecom industry with the skills required, which can only be achieved through reskilling.

5G connectivity is anticipated to create three million additional jobs globally[12], and substantially increase the skill demand across four key areas:

### Skills in demand

**Cloud-based and security skills**
Skills related to software and endpoint security and privacy will be critical in the 5G era along with knowledge of cloud-based technologies and virtualisation are needed to cope with the increased volume of data and devices

**Machine learning algorithms and big data**
With more data being collated from connected devices and sensors, employees would need expertise to extract big data and create algorithms to provide insights and analytics to optimise business processes

**GPS and IoT-focused design**
A new set of mechanical engineering skills will help design the new 5G-enabled smart devices. These are usually location aware and would need GPS integration to manoeuvre them

**Electrical engineering**
Electrical engineering skills would help develop embedded devices for mobile apps and smart devices, design systems with future-proof circuits for low-power consumption and program microcontrollers

1. **Source:** India: Becoming 5G ready, GSMA, 2019
2. **Source:** Price stalemate expected to prolong India's wait for 5G, Livemint, 09 Jul 2019

11. Current telecom infrastructure growth rate may play spoilsport to India's 5G party, Economic Times, 04 June 2019
12. India: Becoming 5G ready, GSMA, 2019

India has more than 600,000 digitally skilled talent[13]. However, this is not enough. India will have to reskill nearly 40 per cent of its total workforce over the next five years[14] to cope with emerging trends such as 5G, IoT, networking, AI, machine learning and blockchain.

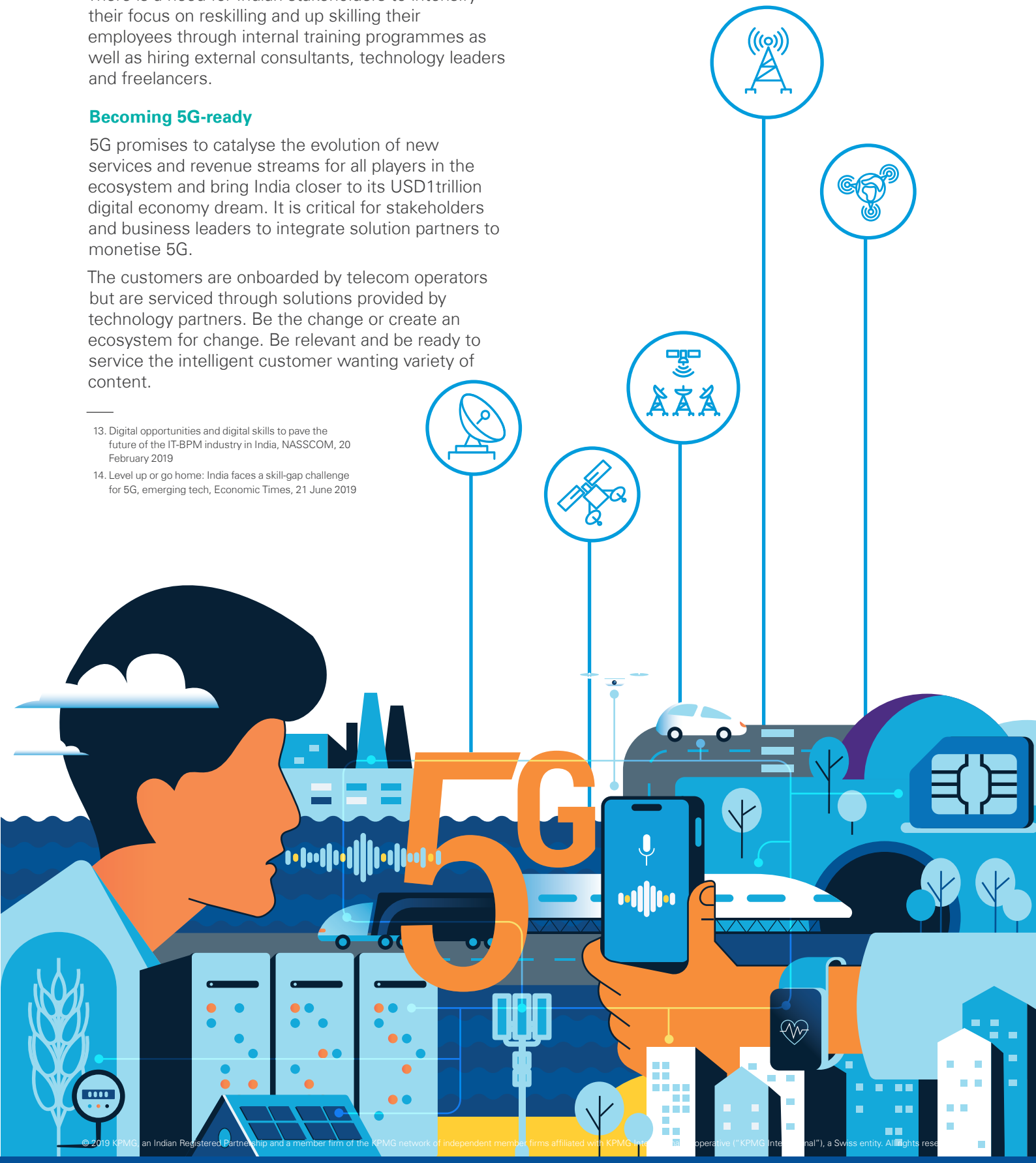
There is a need for Indian stakeholders to intensify their focus on reskilling and up skilling their employees through internal training programmes as well as hiring external consultants, technology leaders and freelancers.

## Becoming 5G-ready

5G promises to catalyse the evolution of new services and revenue streams for all players in the ecosystem and bring India closer to its USD1trillion digital economy dream. It is critical for stakeholders and business leaders to integrate solution partners to monetise 5G.

The customers are onboarded by telecom operators but are serviced through solutions provided by technology partners. Be the change or create an ecosystem for change. Be relevant and be ready to service the intelligent customer wanting variety of content.

13. Digital opportunities and digital skills to pave the future of the IT-BPM industry in India, NASSCOM, 20 February 2019
14. Level up or go home: India faces a skill-gap challenge for 5G, emerging tech, Economic Times, 21 June 2019



# Immersive

## Immersive

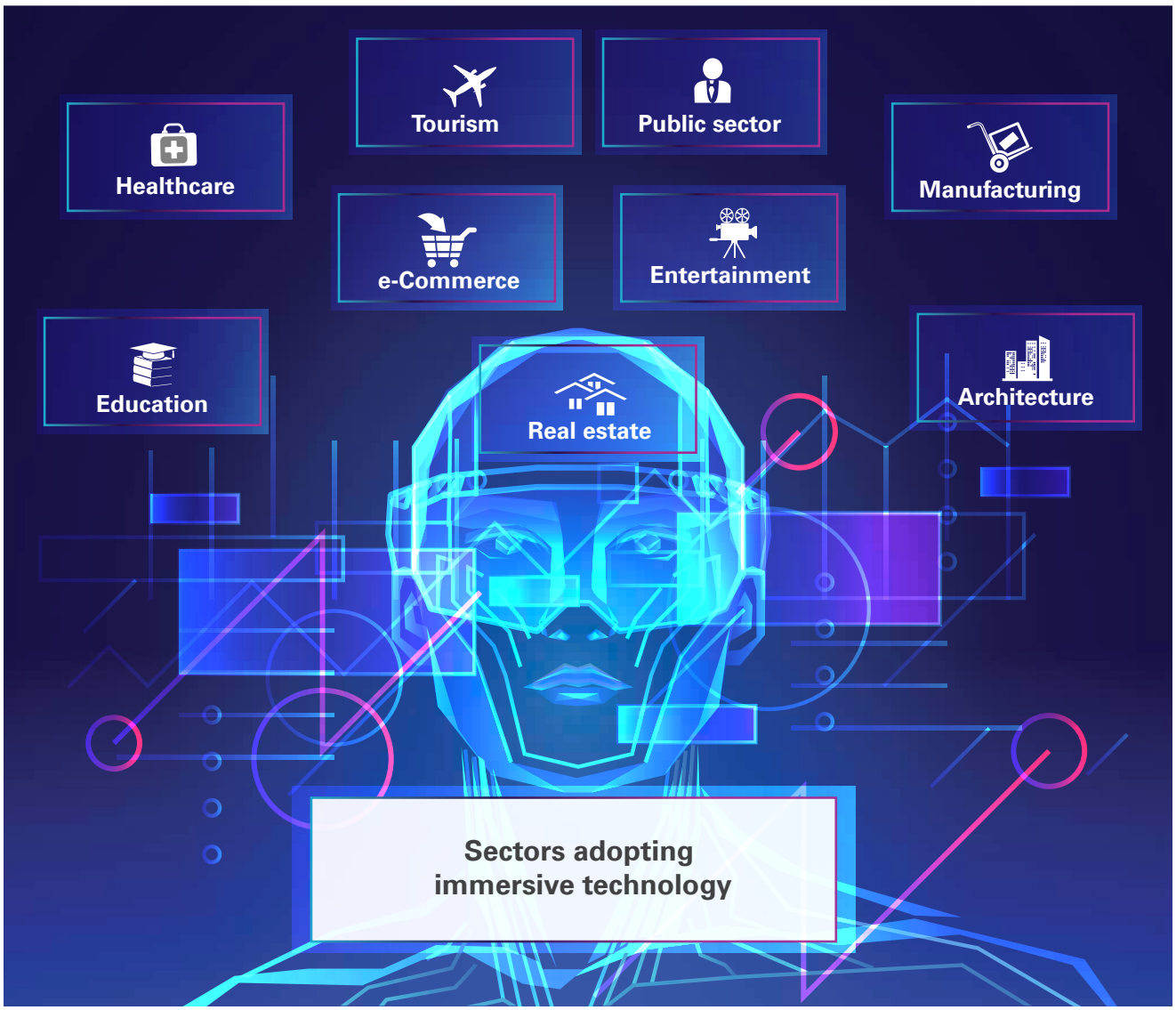
This is a decade of evolving digital technology, and immersive technology is one of the most interesting among them. Immersion into virtual reality is a perception of being physically present in a non-physical world. The perception is created based on the strength of advanced connectivity to manage data with low latency, by surrounding the user with images, sound or other stimuli that provide a personalised experience. These are interactive virtual reality platforms that offer unique collaborative ways to conduct business. Some of the different technologies used for immersive experiences are brain-computer interface, gesture recognition, omni-directional treadmill and speed recognition. In addition, AR/VR, AI and IoT are also some of the revolutionary forces changing the way we interact with each other and our surroundings by building a new immersive world. AI is capable of replicating the human learning and problem-solving abilities, which when coupled with AR/VR and IoT, can allow businesses a glimpse into what the audience wants in future.

These technologies have a significant effect in a broad range of sectors, and are likely to alter the way companies connect with consumers, do business, boost productivity and reduce overall costs.

### Applications of immersive technologies are multifold

Although the popularity of immersive technologies began with entertainment and gaming products, there are now multiple application areas. These technologies will have a significant effect in a broad range of sectors and are likely to alter the way companies do business, boost productivity and reduce overall costs.

**Popular application areas of immersive technologies**



### How will immersive technology influence the business world?

Although the application of these emerging technologies across sectors is still evolving, it is certainly changing the way businesses interact with customers. For instance, it has proved extremely useful to use VR in imparting trainings. An average business approximately spends USD1,208 per employee on training related to the development of new skills, but up to two-thirds of this expense is linked with travel[1]. In this scenario, virtual training sessions based on VR are gaining popularity among employees across countries and have proven to be more engaging than phone or video conference calls.

The essence of using AR/VR or even Mixed Reality (MR) is to provide the users with near real-life experiences that helps them visualise the new world in three dimensions and intuitively interact with it. AR/VR technology has emerged as the next big thing after PC, web, and mobile.[2]. This has resulted in hardware sales as key requirement and content subscription and advertising as emerging business models. Consumers today are demanding a seamless 'phygital' (physical + digital) experience and AR/VR solutions are key for an organisation to meet that requirement.

### Case study: Enabling visualisation in the e-Commerce and retail sector

A study shows that about 77 per cent[3] of online shoppers leaves sites without making a purchase, indicating a gap between what online retailers offer and what customers are looking for. The use of VR products is likely to close this gap by ensuring better customer experience and engagement.

Using an immersive technology to take advantage of a mobile phone's sensory inputs (like its gyroscope, magnetometer, and accelerometer) allows the immersive ad to respond to device motion, which makes it very effective for mobile advertising. This makes the ad very interactive in nature and gives greater potential for conversions to revenue.

Major companies are integrating AR-enabled shopping experience and using AR catalogue apps to allow users to virtually visualise how the products will fit and look in their homes. Some companies are also planning to launch a VR-enabled department stores and collaborate with virtual artists.

More stores are using AR apps to allow users to test out their products beforehand. Even with VR, brands like those within the automobile industry are using virtual showrooms where consumers can look at cars, take virtual test drives and even 'sit inside' them. The experience is made even more immersive by letting users sit in actual car seats to make them feel like they are actually inside a car.

### Immersive technology solutions are also finding their way across various niche areas

The scope of applications continues to grow as governments work closely with private players, research bodies, think tanks and organisations to deploy immersive technology solutions that address distinctive problems and ultimately generate greater comfort for citizens, increase safety, efficiency and response management.

### Emerging niche applications


1. How Reality Technology is Used in Business, Reality technologies, accessed on 30 August 2019
2. A new reality awaits: are AR and VR the next big platforms?, The Delta Perspective, January 2018
3. 3 Ways Virtual Reality Will Transform eCommerce, Toptal, Accessed on 30 August 2019

## Indian AR/VR market poised for a rapid growth

Globally, the AR/VR market is expected to reach USD170 billion by 2022[4]. The AR/VR sector in India is also expected to grow rapidly, led by increasing adoption in gaming, media and other sectors.

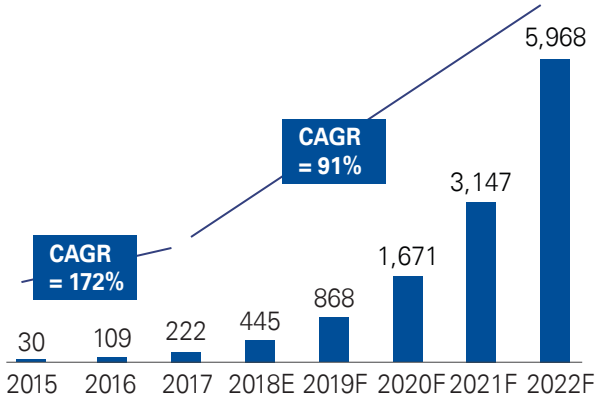
Innovation and disruption in India's start-up ecosystem may well see a major shift as companies focusing on technology-driven consumer models attract substantial investments. As of January 2018, 170 AR/VR start-ups had emerged in the country, 60 per cent of which established themselves in the period 2016-2018[5]. By 2022, Indian immersive media is expected to reach the size of USD6.5 billion[6].

> Till a few years back, most content was hosted centrally in hyperscale data centers. However, with emerging use cases there is a need to move content toward the edge and create a distributed cloud architecture. I predict that edge compute is a domain where service providers and enterprises such as internet content providers in India will experience 'coopetition'. Over time, they will find the right models to work together and create a win-win scenario for monetising the connect of the network edge in India

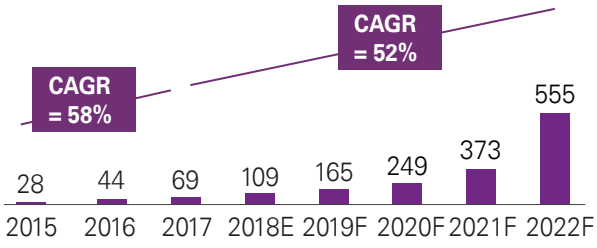
**Ryan Perera**
Country Manager, Ciena

### AR/VR market in India projected to grow

**AR market growth in India (USD million)**




**VR market growth in India (USD million)**




**Source:** Growth of Immersive Media - A Reality Check, NASSCOM, 2019

4. Virtual and Augmented Reality market to boom to $170 billion by 2022, Consultancy UK, 12 July 2018
5. It's real: AR/VR market to grow 76per cent over 5 years, The Hindu Business Line, 03 January 2018
6. Growth of Immersive Media - A Reality Check, NASSCOM, 2019

### 5G is crucial to the future

As the popularity of AR/VR and AI in India increases, its use across platforms throughout mobile devices, PCs and connected devices via Wi-Fi will rise rapidly. It is estimated that 5G will result in a 10x overall improvement, 10x latency decrease, 100x traffic capacity improvement and 100x network efficiency improvement over 4G[7]. The adoption of 5G will therefore be critical for the development and success of the immersive ecosystem in India.

### The question of user privacy remains

> 5G is not just radio, it is end-to-end. It's about transport, virtualisation and edge computing etc. So, while preparing for transition to 5G, operators need to consider end-to-end network planning including backhaul, fronthaul, core virtualisation etc., to provide the real 5G user experience. This has to be planned much before the 5G Radio network which depends upon spectrum. For India 5G trial, we would recommend that 5G technology trials should be decoupled from 5G use-case trials. The launch of 5G should be looked in a holistic way that continues to innovate these in our labs, incubation centers, and supported by cross ministerial govt initiatives.

**Mr. Sanjay Malik**
Senior VP and Head of India Market, Nokia

Like other technologies driving the new digital revolution, AR/VR deliver value by collecting and interpreting data. Immersive technology captures facial expressions, speech information, retina patterns and everything a user sees and hears.

With everything being connected with each other and the internet, the data collected can be vulnerable to a new set of challenges related to data security, privacy and cyber-attacks. Users create and share data on their behaviour and movement in virtual environments that could one day be used to mimic or steal their virtual identities or real-world assets.

Having a robust cybersecurity framework in place, investing in data protection solutions, explicit communication of the data collection and protection policy to consumers, limiting the collection of data, not limiting access to an experience based on who opt in to data collection and setting up review boards could be some potential solutions to safeguarding user privacy[8].

Organisations must adapt their strategies to factor in the risk arising from the commercial use of these immersive technologies.

### Challenges require an integrated approach

Mass proliferation of immersive technologies would require enhanced connectivity, where technologies would require enhanced connectivity, where technologies like 5G play a differentiating role. Some of the other enabling factors include building data ecosystems, focussed AI research, expanding AI expertise, clear privacy, security and ethical regulations and an enforceable Intellectual Property (IP) regime.

These enablers, through collaborative efforts by industry stakeholders, with government playing a leading role, could be the building blocks in India's march towards leadership in immersive technologies.

### Government taking steps to boost innovation

Providing customers with an immersive and innovative experience ensures the customer's engagement level, resulting in higher customer retention. However, due to the complexity and high cost associated with investments in immersive technologies, the entire immersive ecosystem still needs to be fully developed and innovation would be absolutely critical for the technologies to become mainstream[9].

The Government of India has realised the importance of technology and is playing a crucial role in boosting technological growth in India through a number of schemes. Schemes such as Atal Incubation Centres (AIC), Scheme for Scale-up Support to Establishing Incubation Centres, High Risk-High Reward Research and Technology Development Programme (TDP)[10] have been introduced to enable innovative technology start-ups, including those focused on AR/VR, AI and IoT to become scalable and sustainable businesses.

An IoT policy framework is also under progress. With this framework, the government plans to develop a connected and smart IoT-based system for the country's economy, society, environment and global needs[11].

Given these government schemes, India is poised to see a significant rise in the adoption as well as number of emerging tech start-up ventures. In the days to come, immersive technologies will become increasingly market-oriented and accessible as technology continues to evolve and appears to be getting faster and more cost-effective.

7. How will 5G boost VR and AR?, 5G UK, November 2018
8. Industry review boards are needed to protect VR user privacy, World Economic Forum, 29 August 2019
9. Augmented and Virtual Reality: Are Companies Prepared? Jabil, Accessed on 25 August 2019
10. The 49 Start-up Schemes By Indian Government, Inc42, 2018
11. Internet of Things in Smart cities, KPMG, May 2019

# Inventive

## Inventive

We are no more restricting our lives to a single dimension of consumption. Indian Premier League (IPL) viewership on OTT platform has been a resounding success. The rise of digital payments platform to complete the last mile transaction is now an established way of doing business. Digital point of sales has spread to towns and districts. Healthcare, insurance, assisted commerce have started using mobility as the new normal to create products and services.

Hence, customer centricity as we know it has changed dramatically purely owing to the preference of a consumer to do things quickly, easily and accurately. That said, the traditional system of try and buy has not changed; however, the modus and modes of the 'try' part have changed significantly. Organisations are experimenting with immersing the customer with the kind of experience that the product was meant to offer, in order to closely connect the product and the buyer.

In this context, based on a study conducted by KPMG in India, Facebook and Nielsen, it is imperative that organisations create a path of least resistance to avoid friction. Any unnecessary additional effort, incremental step or inconvenience which leads consumers to abandon their purchase journey is defined as 'friction'. Friction may occur offline or online, subjecting consumers to unnecessary waiting, queuing, clicking, typing and form filling. On their journey, they may also have to load an application, buffer a page, switch channels/windows or hold for service. This can adversely impact consumer experience, which, in turn, could affect the consumer purchase journey.

Engaging the new Indian is a sector-agnostic concept and the smart consumer of today relates to his/her experience with one sector against an unrelated one. For instance, a large e-commerce platform can deliver goods at the consumer's doorstep within a day's time while a global courier brand, given the constraints that it works with, can take a couple of days to deliver a parcel. The consumer, however, is unfazed by the constraints that the courier company works with and looks for other avenues to complete the task.

Organisations across sectors are constantly innovating to create new products and services to address various use cases and enhance quality of life, keeping the customer at the centre. We take a look at some of the sectors in the subsequent sections.

### Autonomous vehicles (AVs) - the future of mobility

Autonomous Vehichles (AVs) or driverless automobiles that can manoeuvre themselves without any human action are paving the way for a zero-incident future. This involves integration of Global Positioning System (GPS) sensing knowledge, multiple sensors and AR technologies. Such driver-less vehicles will alter the dynamics of car ownership, parking facilities, garages and workshops, rental agencies, insurance and sales process.

Globally, auto Original Equipment Manufacturers (OEMs), tech giants and start-ups are all competing to be the first to introduce AVs to the world by investing their efforts, intelligence and investments to solve the problem of urban mobility. Driven by these efforts, the global market for AVs is expected to accelerate by CAGR of about 40 per cent between 2019 and 2026 reaching over USD550 billion by 2026[1].

### Transcending towards autonomous cars

Indian stakeholders have also been exploring the concept by investing in research, carrying out tests and undertaking pilot projects on driverless cars. This trend is being supported by the new Indian traffic rules that have made it mandatory for all new cars and heavy vehicles sold in India to be equipped with Advanced Driver Assistance Systems (ADAS) by 2022. This would also include automatic braking, collision avoidance and lane departure warning. The new rules are likely to bode well for the roll-out of AVs in the future.

**Path towards autonomy**

#### Phase 1

The 'Assist Phase' of autonomy is already underway. New vehicles that are being produced today safeguard the driver with a security net – cameras, sensors and alerts – to avoid accidents and injuries. Equipped with ADAS, these vehicles can keep a safe distance from other vehicles by covering the 'blind spots' and alerting the driver to imminent risks.

While these technological characteristics help make driving safer, a rider at the wheel still needs to act on the system's advice.

#### Phase 2

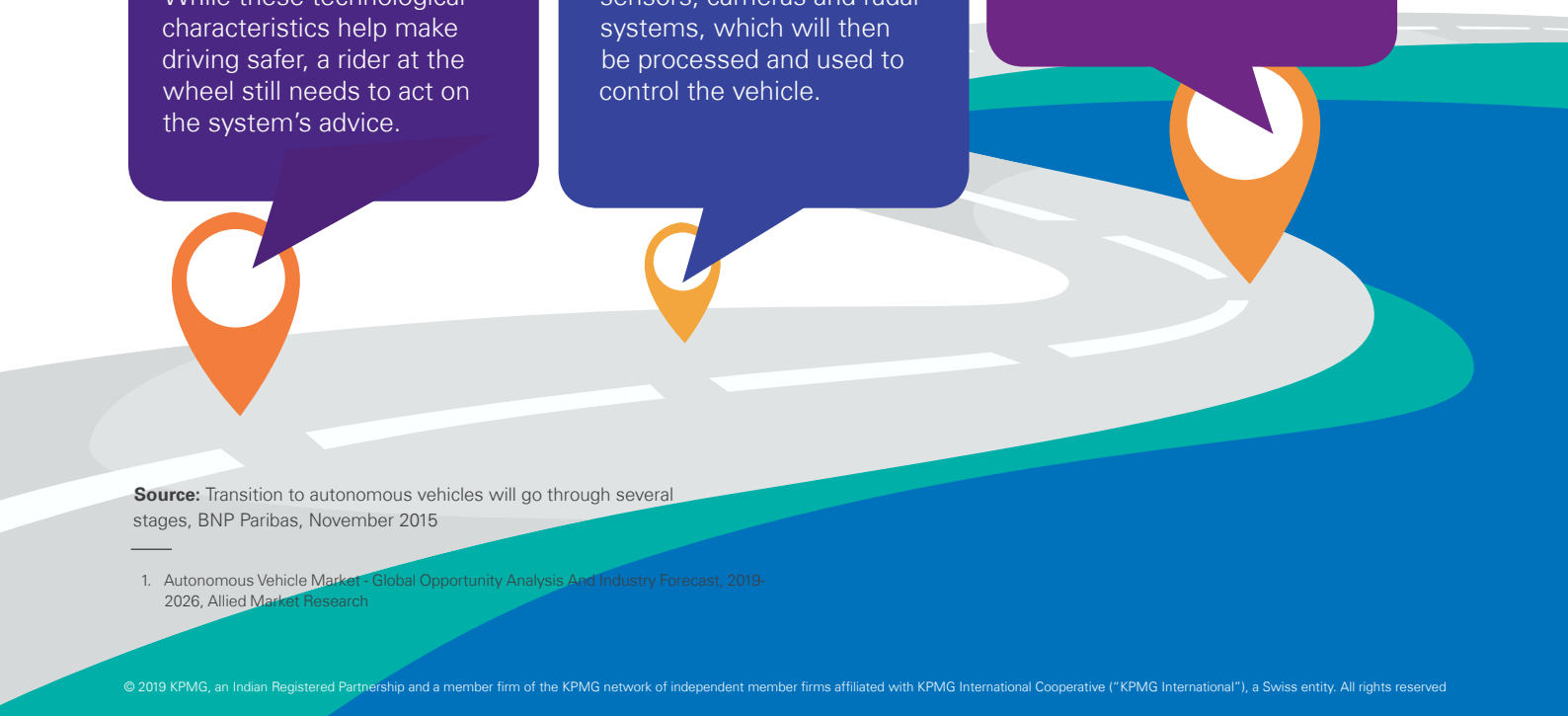
The second phase 'Automate' may commence post 2022. This time period will witness the growth of vehicles capable of carrying out all the tasks associated with driving. The driver will only play the role of a co-pilot, alert enough to intervene if required.

These vehicles will collect a large quantity of data on the surroundings with the assistance of sensors, cameras and radar systems, which will then be processed and used to control the vehicle.

#### Phase 3

The final 'Autonomous Phase', would not kick start until beyond 2030.

Vehicles will achieve total independence from human interference in this phase. They would be able to detect and handle obstacles and avoid them even before they could be realised by a human brain.



**Source:** Transition to autonomous vehicles will go through several stages, BNP Paribas, November 2015

1. Autonomous Vehicle Market - Global Opportunity Analysis And Industry Forecast, 2019-2026, Allied Market Research

In India, autonomous tractors, mining equipment and specialised non-road vehicles are likely to hit the roads far sooner than self-driving cars. Some of the new tractor models have the ability to auto-steer and use geo-fencing through the GPS. Companies have also showcased a semi-autonomous tractor in 2018 and plan to introduce a quasi-driverless and fully-driverless model in the near future[2].

However, at the start, AVs are likely to be introduced in closely controlled environments with fixed routes, such as college campuses, factories, hospitals and mining. Once these technologies develop and mature, a gradual shift is likely to more Advanced Driver Assistance Systems (such as automatic brakes and assisted parking) to eventually fully autonomous cars from driver-dependent vehicles.

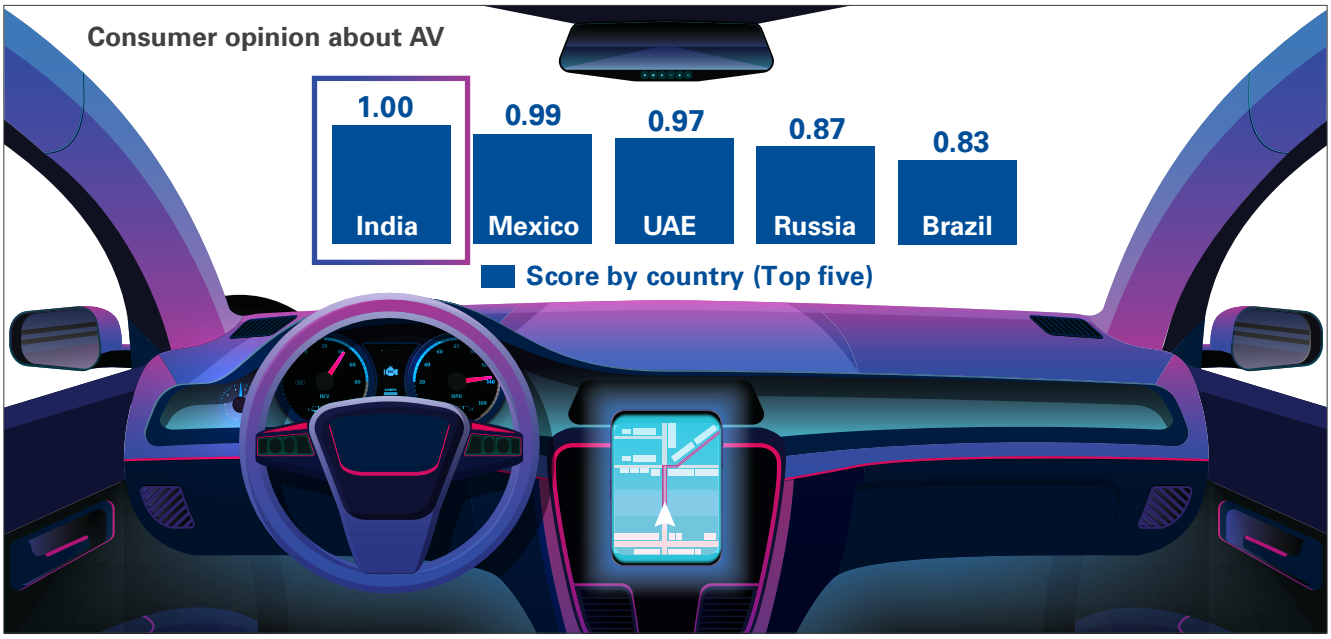
## State of India's readiness for AVs

As per Autonomous Vehichles Readiness Index (AVRI) 2019 by KPMG, India ranked 24th out of 25 countries measured for the level of preparedness for AVs indicating a long journey to cover in terms of policy and regulation, technology and innovation, infrastructure development.

## Indian consumer has a high enthusiasm for AVs

As per a survey rolled out by KPMG, India is leading the customer opinion metric of the Autonomous Vehicles Readiness Index (AVRI), with the most favourable responses to the probability of using an AV and readiness to purchase or lease one[3].
In a similar study, close to 50 per cent of Indians surveyed said they wanted driverless cars.

**Consumers are keen on having AVs in the country**

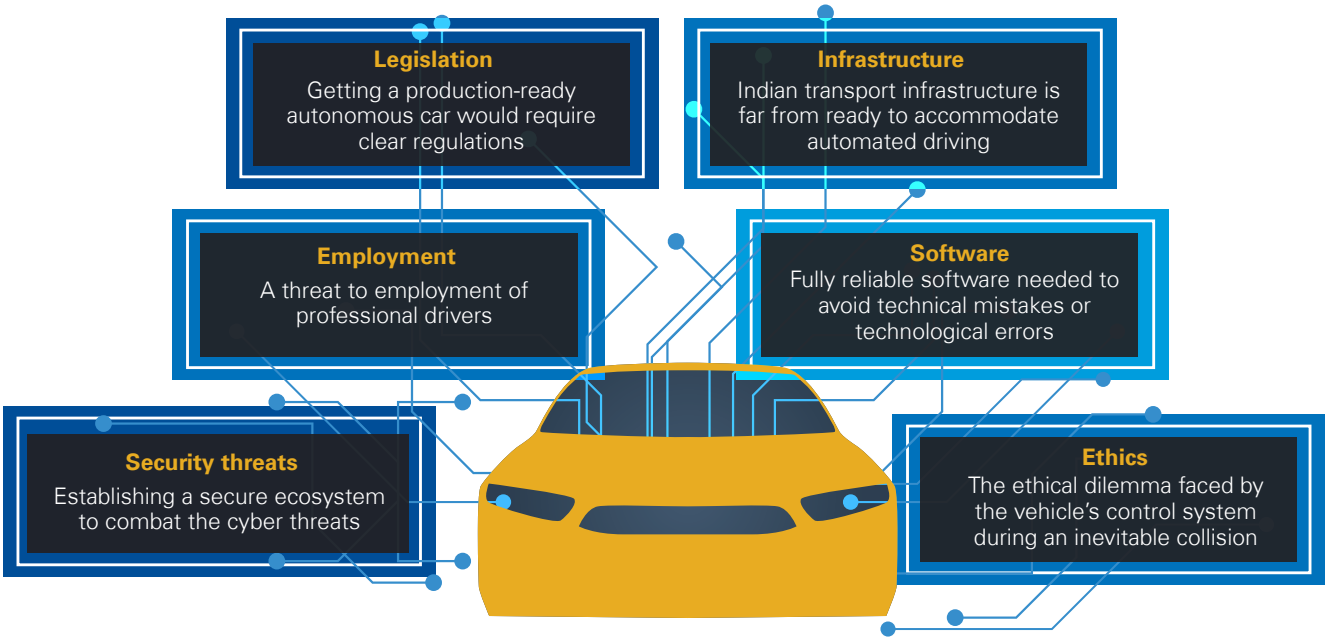



1. **Source:** Autonomous Vehicles Readiness Index 2019, KPMG
2. **Source:** Stuck in traffic, Indians are desperate for self-driving cars, Quartz India, 18 July 2018

While implementing driverless technology in India is far more complicated since predicting traffic patterns is not as simple as it is in developed countries, India should capitalise on its innovation and technology strength. Several Indian startups are working on developing AV products for truck, mini buses and cars, in some cases with a focus on exporting to other countries.

2. Autonomous drive: Going beyond cars, The Economic Times, 17 May 2019
3. Autonomous Vehicles Readiness Index 2019, KPMG

### Hurdles for AVs/self-driving cars




1. **Source:** Autonomous drive: Going beyond cars, The Economic Times, 17 May 2019
2. **Source:** Preparing for a driverless future, Nishith Desai Associates, May 2019

## Leveraging AVs to create a positive impact

The transition towards progressive autonomy will radically transform the manufacturing process, user behaviour and business models for the automotive sector. There would also be reduction in the number of car accidents occurring due to human error, thus creating a safer environment. However, it would be key to evolve a legal framework and update the Motor Vehicle Act 1988 to resolve some of the conundrums that are likely to emerge in India.

## Smart spaces

### Redefining interactions with spaces

As technology becomes an integral part of our daily lives – with cities and homes becoming smarter, workplaces getting digitalised, and increased connectivity within factories – the penetration of smart spaces around the globe is accelerating.

More than 80 per cent of new construction is now incorporating at least one aspect of IoT and/or related smart technology solutions. Driven by such factors, the global market for smart spaces is estimated to reach USD19.9 billion by 2024 from USD8.5 billion in 2019[4].

4. Making spaces smart, Cognizant, June 2019

Smart technologies and solutions are creating smart spaces where humans and technology-enabled systems interact in an intelligent, open, connected and coordinated manner. Various elements within a smart space synchronise and harmonise with each other to create a more interactive, immersive and automated experience for users. They also help optimise efficiency, improve productivity, simplify complex processes and enable more meaningful interactions between people and their environment.

## Smart spaces are of many types

**Homes**
IoT connectivity and mobile apps for monitoring and controlling WiFi, HVAC, appliances, and sensors

**Offices**
Smart meeting rooms, charging and space management solutions and personalised lighting, and ambience control

**Airports**
Facial recognition for faster security and check-ins, AI for traffic management, self-service kiosks and integrated messaging service

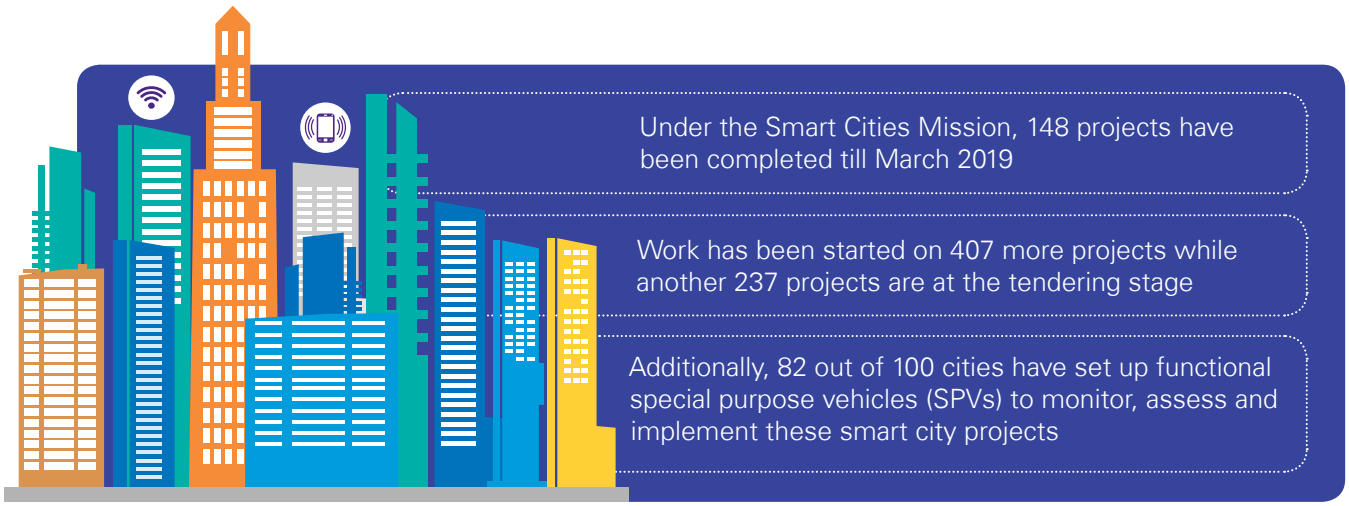
**Retail stores**
Interactive shelf labels, mobile apps for scanning with digital coupons, nutrition information, AR/VR

**Hospitals**
Trackers, connectivity and interactive surfaces to place prescription orders, transfer medical records and remote patient assessment

As these built environments begin to further connect with each other, the ecosystem would create healthier, cleaner and sustainable smart cities. Adoption of smart solutions in India is being driven by the Smart Cities Mission and Digital India initiatives undertaken by the Government of India.

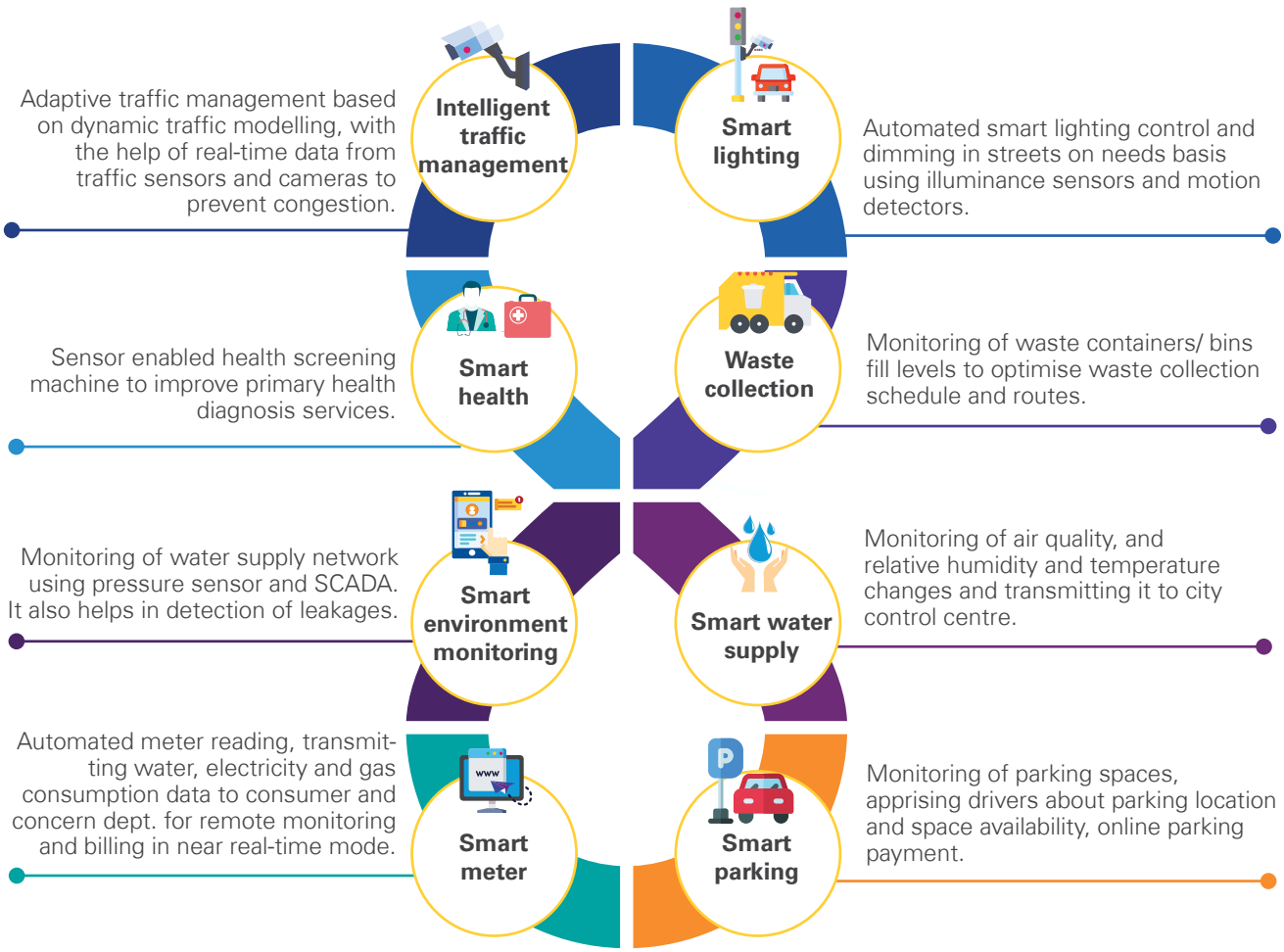
Adoption of smart solutions has gained a large traction in the smart city initiative across India. With a large volume of sensor based infrastructure, citizen centric solutions, big data analytics solutions being taken up in smart cities, the IoT platform provides the right platform to manage and monitor modern urban landscapes.

## Initiatives propelling the adoption of smart spaces in India




**Source:** Demystifying the current state of India's ambitious smart city mission, Digit, 25 March 2019

## Internet of Things (IoT) in smart cities




**Source:** Internet of Things in Smart Cities, KPMG, May 2019

## Future feasibility

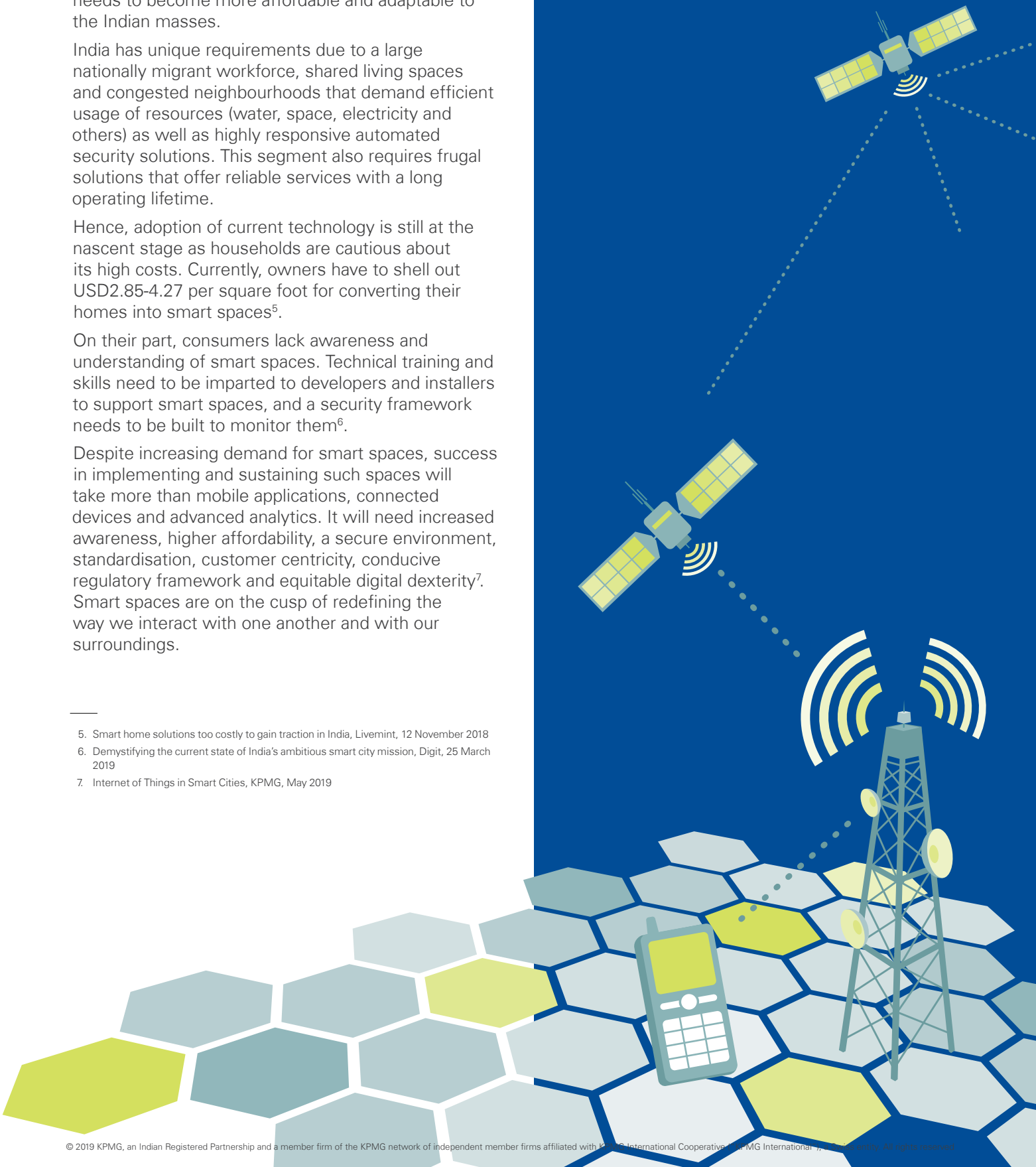
With the onset of 5G and affordable broadband connections, the average Indian household will have a higher degree of connectivity by 2025. However, for increased penetration of smart spaces and its acceptance across a large consumer base, technology needs to become more affordable and adaptable to the Indian masses.

India has unique requirements due to a large nationally migrant workforce, shared living spaces and congested neighbourhoods that demand efficient usage of resources (water, space, electricity and others) as well as highly responsive automated security solutions. This segment also requires frugal solutions that offer reliable services with a long operating lifetime.

Hence, adoption of current technology is still at the nascent stage as households are cautious about its high costs. Currently, owners have to shell out USD2.85-4.27 per square foot for converting their homes into smart spaces[5].

On their part, consumers lack awareness and understanding of smart spaces. Technical training and skills need to be imparted to developers and installers to support smart spaces, and a security framework needs to be built to monitor them[6].

Despite increasing demand for smart spaces, success in implementing and sustaining such spaces will take more than mobile applications, connected devices and advanced analytics. It will need increased awareness, higher affordability, a secure environment, standardisation, customer centricity, conducive regulatory framework and equitable digital dexterity[7]. Smart spaces are on the cusp of redefining the way we interact with one another and with our surroundings.



5. Smart home solutions too costly to gain traction in India, Livemint, 12 November 2018
6. Demystifying the current state of India's ambitious smart city mission, Digit, 25 March 2019
7. Internet of Things in Smart Cities, KPMG, May 2019

## mHealth

### Promoting inclusive and affordable healthcare

Globally, healthcare has come a long way. Rapid strides have been made to overcome some of the most acute public health challenges and improve levels of health in general. While many challenges have been addressed, few still remain (e.g. improving access to quality healthcare services) and newer challenges are now emerging, which include rising cost of healthcare, ageing population and shift in disease profile from communicable to non-communicable diseases. Consequently, newer innovative approaches are emerging to address these issues.

Technology is having a big impact on the way healthcare is getting delivered today. It is enabling healthcare services in so many different innovative ways which were thought of nearly impossible not so long ago. Within a wider domain of eHealth, mHealth (or mobile health), which entails using mobile devices and core mobile technologies, is emerging a game changer in the healthcare domain. Use of information and communication technologies has been recognised as an important resource in achievement of many of the Sustainable Development Goals by 2030. As per WHO Global Observatory for survey of eHealth in 2015, there has been a surge in adoption of eHealth in member countries, with 121 countries having national eHealth strategies.

Mobile health (mHealth) is emerging as one of the key technologies with the potential of offering high-quality and cost-effective information through mobile applications. mHealth has the ability to make healthcare delivery faster and more efficient, expand access to remote areas, offer quality and affordable service and empower patients. It also allows customising healthcare delivery through preventive and participatory care and streamlined communication between patients and medical practitioners.

Recognised as one of the fastest-growing sectors in the world, the Indian healthcare sector has traditionally been slow in embracing technology-driven initiatives. Even though the government has encouraged the use of technology to improve healthcare delivery and outcomes, its adoption remains at the nascent stage.

mHealth has the potential to play a major role in accelerating progress towards universal health cover. Some of the key impact areas include:

- Increasing access to quality health services: There is a significant disparity in the quality and access to healthcare services across geographies and income groups as many regions still have limited or no access to healthcare resources that can cater to their healthcare-related needs. While there are many last mile access challenges, many use cases have emerged where the solution includes attaching specialized devices and sensors and leveraging the inherent capability of mobile technologies to increase the reach of expertise in disease diagnosis, monitoring and management. There are solutions which target areas such as eye ailments, skin ailments, remote radiology and pathology, cancer detection, tele-consultations, among others.
- Reducing premature mortality from NCDs (non-communicable diseases) and associated comorbidities: Under the Ayushmaan Bharat scheme, the government is in the process of setting up 150,000 health and wellness centres. The use of mHealth technologies to improve disease diagnosis and tracking, nudging patients to adopt fitness and healthy lifestyles, and combining mobile technologies with self and home care technologies can be the key for the success of the health and wellness centres. Not only can these help overcome the challenges of shortage of quality health workers, but also enable delivery of standardised health care services.
- Increased access to maternal and child health services, thereby reducing maternal, infant and neonatal mortality: The goal of such mHealth solutions is to provide an integrated solution across the reproductive, maternal, new born and child health.
- Increased access to mental health services: In India, one in seven people face mental health issues. While the treatment gap is ~80-85 per cent, with a significant contributing factor being fear, availability of skilled resources is also extremely low (0.07 psychiatrists per 100,000 population (U.S.A. has ~ 1.1 per 100,000 population). Given these challenges, there are initiatives to develop mobile technology enabled interventions to address treatment gaps.

## Current status of mHealth in India

mHealth can be used across the healthcare value chain for research, clinical trials, patient monitoring, and administrative purposes at local sites and beyond. Thus far, the scale of adoption of mHealth India has been limited to health awareness through portals, medical transcription, mobile access to medical records, telemedicine, and hospital management system and online customer service using the internet.

Cost reduction and accessibility would be the key criteria to drive the adoption of mHealth in India as 70-80 per cent of health care expenses are borne by patients themselves[8]. mHealth is expected to be further stimulated by the government's Digital India initiative. Moreover, growing investments and interest from private players are laying the foundation of mHealth in India. Driven by such factors, India's mHealth market is projected to reach USD945 million by 2020 from USD435 million in 2018[9].

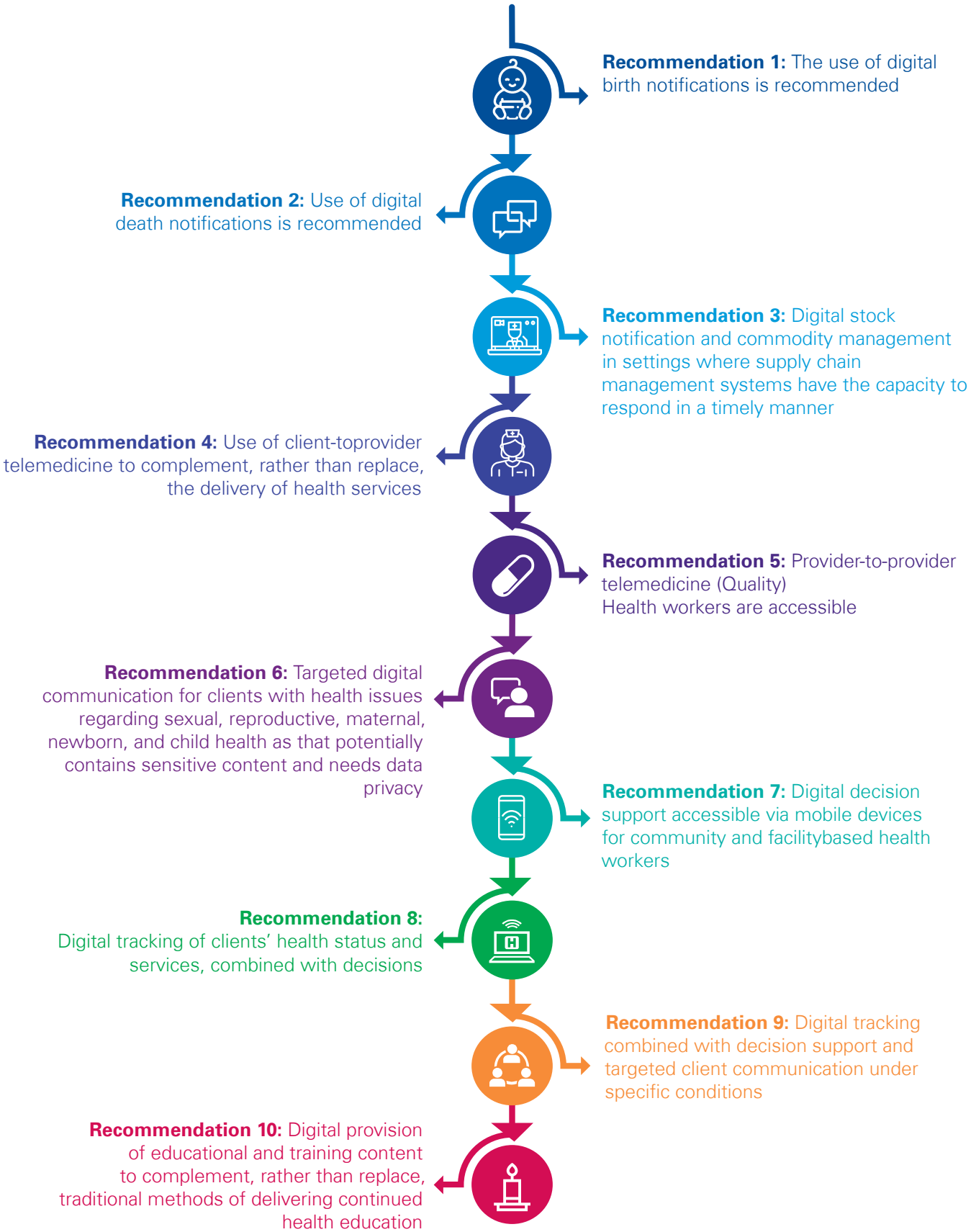
Currently, state governments and NGOs are managing around 73 active mHealth projects[10] under an mGovernance initiative such as Kilkari, Mobile Academy, M-Cessation, and TB Missed Call Initiative.

The recent systematic review on the mHealth interventions from a health systems point of view noted that despite a large number of mHealth initiatives in India, a comprehensive approach towards health systems strengthening is missing. A noteworthy finding was the concentration of mHealth solutions in a few states, with almost absolute exclusion of the others, including some of the most underserved areas such as the north-eastern states and Jammu and Kashmir, where mHealth could bring high effectiveness[11].

The WHO Guideline recommendations on digital health interventions cover a broad range of mHealth approaches. The links between the different recommendations and the interconnection of digital measures can address health system needs, in a cohesive manner.

8. Why India needs to adopt mHealth to enhance traditional models, Healthcare Global, 22 May 2015
9. Projected size of India's mHealth devices and services market from 2014 to 2020 (in million U.S. dollars), Statista, Accessed 10 September 2019
10. National Health Portal, Ministry of Health and Family Welfare (MoHFW), Accessed on 10 September 2019
11. Current Status and Future Directions of mHealth Interventions for Health System Strengthening in India: Systematic Review, JMIR publications, 26 October 2018

## Synopsis of the recommendations




**Source:** WHO Guideline – Recommendations on digital interventions for health system strengthening, 2019

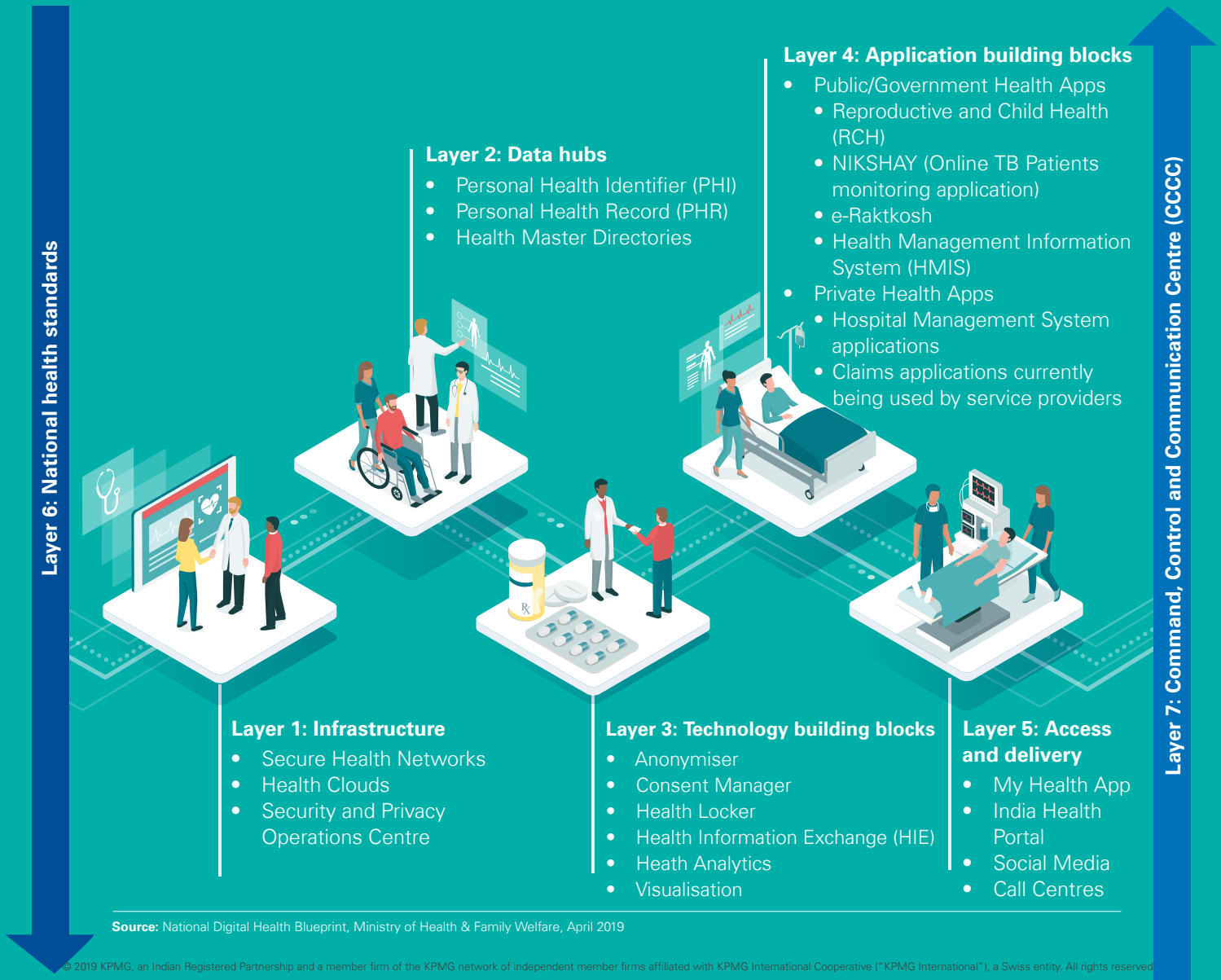
### Need for an ecosystem approach

In July 2019, the Union Minister of Health and Family Welfare released the National Digital Health Blueprint (NDHB), bringing in the National Digital Health Eco-system (NDHE) that can ensure the availability of healthcare services on a wider scale. The vision is to create an ecosystem that supports Universal Health Coverage in an efficient, accessible, inclusive, affordable, timely and safe manner, through provision of a wide range of data, information and infrastructure services. It will leverage open, interoperable, standards-based digital systems, and aims to ensure the security, confidentiality and privacy of health-related personal information.

NDHB has the following eight key objectives:

1. Establishing and managing the core digital health data and the infrastructure required for its seamless exchange
2. Promoting the adoption of open standards by all the actors in the NDHE for developing several digital health systems that span across the sector from wellness to disease management
3. Creating a system of personal health records, based on international standards, and easily accessible to the citizens and to the service providers, based on citizen consent
4. Following the best principles of cooperative federalism while working with the states and union territories for the realisation of the vision
5. Promoting health data analytics and medical research
6. Enhancing the efficiency and effectiveness of governance at all levels
7. Ensuring quality of healthcare
8. Leveraging the information systems already existing in the health sector.

### National Digital Health Blueprint (NDHB)




**Source:** National Digital Health Blueprint, Ministry of Health & Family Welfare, April 2019

## Technologies which enable mHealth

mHealth benefits from the modern connected environment. Sensors and monitoring tools incorporated into wearables, IoT and mobile devices collect and leverage information that can either be transferred to an AI-based platform via APIs for further processing or deliver immediate results via in-app analytical algorithms. AI and machine learning are not the only technologies that provide innovation components for mHealth solutions. Future applications are 3D printing for smart med-tech and additive manufacturing.

## Applications and use-cases

The ImTeCHO mobile-based application of government of Gujarat has been instrumental in improving the healthcare system in the state. The Department of Health of the government of Gujarat and the National Health Mission provided all Auxiliary Nurse Midwives (ANMs) with 11,000 smartphones and data plans in 2018. Until February 2019, 58 million individuals, 0.51 million pregnant women and 0.68 million infants under the age of one year have been enrolled in the TeCHO Plus app in Gujarat by ANMs. Accredited Social Health Activist (ASHA) recorded 75 per cent of due services in ImTeCHO app. There was 91 per cent rise in antenatal care, 62 per cent increase in exclusive breast feeding, 55 per cent increase in home-based neonatal care, 59 per cent increase in care seeking for high risk conditions in new-born babies and a 16 per cent lower infant mortality rate in ImTeCHO project areas compared to control area[12].

Another use case is the Seamless User-centred Proactive Provision of Risk-stratified Treatment in Peritoneal Dialysis (SUPPORT-PD) study being conducted at Postgraduate Institute of Medical Education and Research, Chandigarh and Sanjay Gandhi Post Graduate Institute of Medical Sciences, Lucknow. This is an observational cohort study aimed at developing a user-friendly and functional IT-based education and tracking system for patients undergoing peritoneal dialysis at home[13].

## mHealth adoption faces challenges

Security and privacy of healthcare information could be identified as a key barrier to mHealth adoption. Data security is a precondition for any movement of information. While data protection and patient privacy have been discussed in several forums, data privacy in health is currently a grey area. Ultimately, a thoughtful policy to facilitate patient mobility and data exchange is needed to foster mHealth growth in the country.

Several applications enable users to anonymously post data, and not all the data is credible or factually accurate. There is a danger that users will diagnose themselves, self-medicate, overlook symptoms or panic at minor symptoms, all of which can be harmful.

Another concern in India is that mHealth applications are too complex and with a country with literacy issues and numerous spoken languages, this can be a legitimate concern.

## Policy focus on digital health could help mHealth adoption

The NDHB sets out the 'building blocks' for the implementation of National Health Stack (NHS) aimed at deploying AI to leverage health records. The blueprint recommends linking various databases to generate larger, granular data that both the government and private sectors can leverage

In 2018, The Ministry of Health and Family Welfare released a draft Digital Information Security in Healthcare Act (DISHA) requesting remarks on data privacy and data security from the general public and concerned stakeholders. The draft was India's first legislative effort to introduce data safety policies specifically in the healthcare industry and to ensure that those seeking medical help have the right to privacy

As part of the process, it was also suggested that a nodal body, the 'National Digital Health Authority' be established through a Parliamentary act that will not only secure electronic health information, but also regulate the storage and exchange of electronic health records. The act aims to regulate the generation, collection, storage, transmission, access and use of all electronic health data, including information such as a patient's age, contact details, vital signs, laboratory records, medical history including immunisations, allergies, current and past medications.

12. Government of Gujarat's ImTeCHO mobile-based application instrumental in improving Gujarat's health care system reveals study, Government of Gujarat, Accessed 27 September 2019

13. Seamless User-centred Proactive Provision Of Risk-stratified Treatment in Peritoneal Dialysis (SUPPORT-PD), The George Institute, Accessed 27 September 2019

## Preparing for the future

The widespread utilisation of mHealth requires access to technology, healthcare provider acceptance, and extensive network coverage. There is also a need to generate awareness among consumers that are resistant to change and educate them on the benefits of mHealth.

This should be complemented by a concrete healthcare data governance framework that will address data integrity, accuracy and security concerns among industry participants. In addition, market players will also need to strictly adhere to regulatory requirements of maintaining security and privacy of the collated patient information data.

To get beneficial results, there is a need to focus on creating the right 'fit' between mHealth and healthcare needs to create customised solutions.

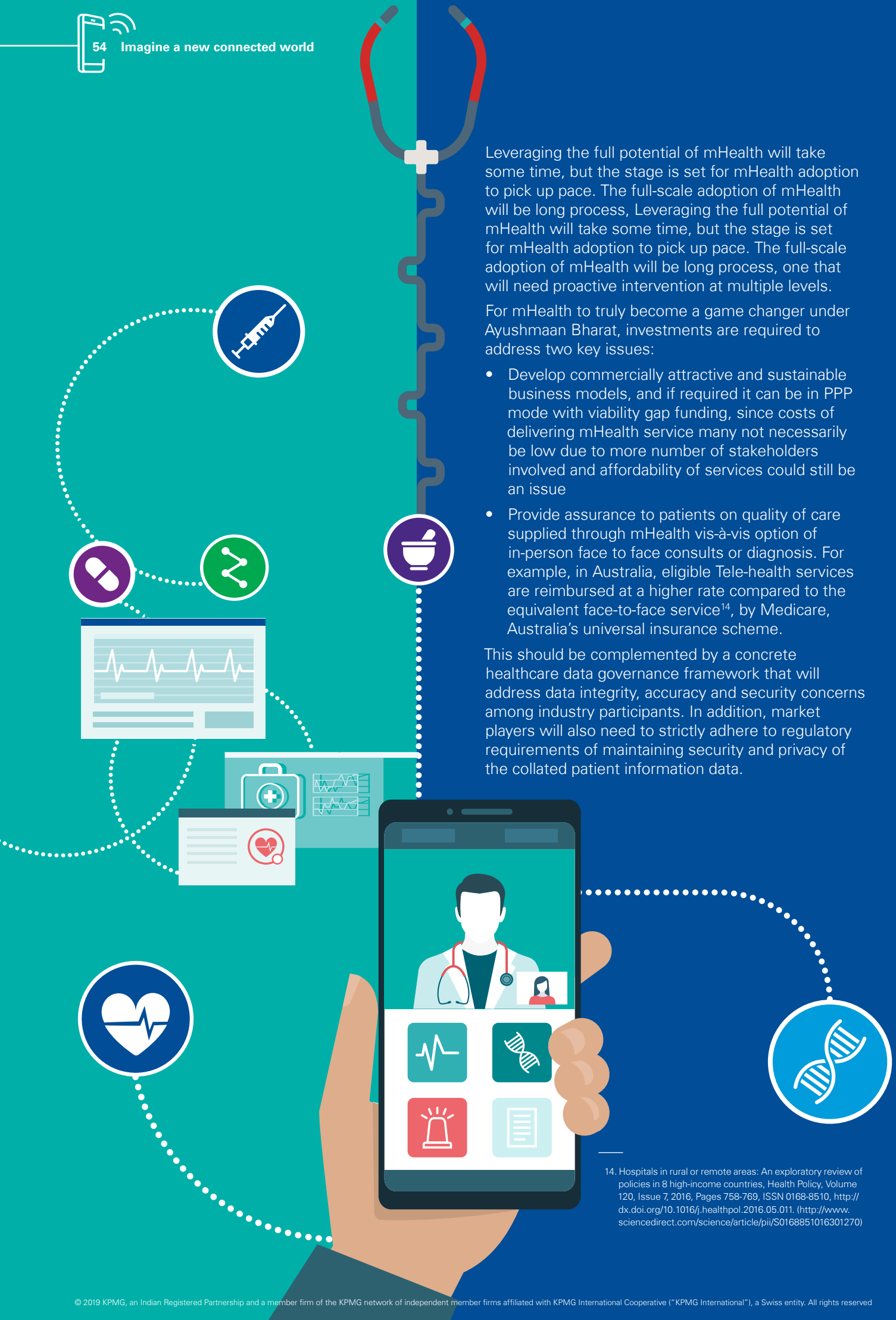
Moreover, stakeholders can develop two distinct mHealth strategies to promote its use. First, stakeholders can increase mHealth's reach to rural communities and provide services where there is limited capacity. Second, urban areas will get access to monitoring services that stand to improve their health.

The government can also incentivise healthcare providers to increase IT investments, and encourage health-tech start-ups to drive further innovation. On the other hand, telcos will have to step up and provide uninterrupted network access and end-to-end service deliveries.

In India, the adoption of mHealth can enable a transition towards a precision and outcome-based model coupled with patient-centric personalised service to provide inclusive and affordable healthcare.

Companies can focus on providing a one stop shop platform that offers services such as doctor consultation, fitness, beauty care, heath check-up, pharmacies and insurance in one place.


**Source:** WHO Guideline – Recommendations on digital interventions for health system strengthening, 2019



Leveraging the full potential of mHealth will take some time, but the stage is set for mHealth adoption to pick up pace. The full-scale adoption of mHealth will be long process, Leveraging the full potential of mHealth will take some time, but the stage is set for mHealth adoption to pick up pace. The full-scale adoption of mHealth will be long process, one that will need proactive intervention at multiple levels.

For mHealth to truly become a game changer under Ayushmaan Bharat, investments are required to address two key issues:

- Develop commercially attractive and sustainable business models, and if required it can be in PPP mode with viability gap funding, since costs of delivering mHealth service many not necessarily be low due to more number of stakeholders involved and affordability of services could still be an issue
- Provide assurance to patients on quality of care supplied through mHealth vis-à-vis option of in-person face to face consults or diagnosis. For example, in Australia, eligible Tele-health services are reimbursed at a higher rate compared to the equivalent face-to-face service[14], by Medicare, Australia's universal insurance scheme.

This should be complemented by a concrete healthcare data governance framework that will address data integrity, accuracy and security concerns among industry participants. In addition, market players will also need to strictly adhere to regulatory requirements of maintaining security and privacy of the collated patient information data.

14. Hospitals in rural or remote areas: An exploratory review of policies in 8 high-income countries, Health Policy, Volume 120, Issue 7, 2016, Pages 758-769, ISSN 0168-8510, http://dx.doi.org/10.1016/j.healthpol.2016.05.011. (http://www.sciencedirect.com/science/article/pii/S0168851016301270)

## Logistics of the future

### Consumer-centric approach

With digital innovation, an increasingly service-oriented economy and continued globalisation altering consumer expectations, stakeholders are witnessing an increased consumer demand for personalised, faster and flexible deliveries at minimum costs. Moreover, supply chain operators are also facing more pressure than ever to up the ante and cater to the rapidly changing consumer demand.

The future lies in ensuring economic sustainability while maintaining consumer focus. To achieve this, a new approach is required that focuses on stakeholder relationships, circular supply chains and redefined performance parameters. Businesses have realised the importance of moving away from inward-focused, reactive and forecast-dependent supply-chains, and are becoming more consumer-centric.

### Technological transformation

Technology, data and connectivity are key enablers in unlocking and analysing huge amounts of data, enabling

- Enhanced visibility and real-time asset tracking,
- Negligible latency and time delay in communication
- Stakeholder cooperation and collaboration across supply chains

Technology is facilitating digitisation and disruption, with information and insights emerging as the gears of next-gen supply chains. Moreover, businesses are riding the global wave of digitisation — sensors, machine learning, predictive analytics, automation and IoT — to reduce costs and increase efficiency across supply chains.

### Functional changes

In the current scenario, it is not possible to change supply chain dynamics by just relying on technology alone. In addition, companies will have to implement functional changes to procurement, transportation and warehousing practices.

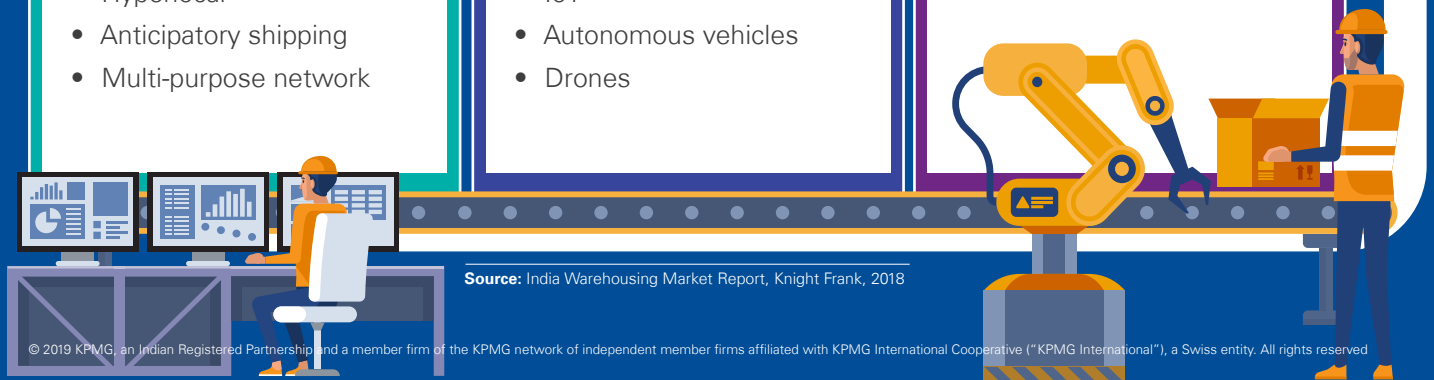
For instance, procurement teams have the option of utilising supplier data in the decision-making process for evaluating suppliers and recommending business partners. Teams can also analyse data related to industrial and political trends to mitigate supply chain risks and address inventory shortages. Moreover, collaboration among supply chain players can streamline internal processes and reduce an over-utilisation of resources.

Smart warehouses or intelligent warehouses have gained the ability to coordinate and perform multiple functions simultaneously with the help of technology, ensuring seamless operations. IoT, big data analytics, cloud computing, robotics and automation boost the concept of a smart warehouse. In addition, new modes of transportation such as temperature-controlled trucks, autonomous vehicles and relay trucking are becoming increasingly popular. Considering its cost effectiveness and easy adaptability, these technology innovations are likely to gain traction in the coming years.

### Trends in the logistics sector

**What they bring to the table…**

| Functional | Technological | Warehousing |
|---|---|---|
| • Supergrid<br>• Shared economy<br>• Omni-channel<br>• Temperature controlled<br>• Relay trucking<br>• Hyperlocal<br>• Anticipatory shipping<br>• Multi-purpose network | • 3D printing<br>• Augumented Reality<br>• Big data<br>• Robotics<br>• Digital supply chain<br>• IoT<br>• Autonomous vehicles<br>• Drones | • Smart warehousing<br>• Temperature controlled<br>• Multi-storey<br>• Robotic Process Automation (RPA) |



**Source:** India Warehousing Market Report, Knight Frank, 2018

## India – changing horizons

The Indian logistics and warehousing sector is also ramping up to cater to future demands.

Currently, costs related to logistics in India account for 12-13 per cent of GDP. This is almost 2x the ratio in developed countries such as the U.S.A., Hong Kong and France. Higher costs are being attributed to the fragmented structure of the warehousing sector (poor road connection and limited use of alternate modes of transportation like inland waterways and railways) and slow implementation of global trends[15].

To encourage the transformational efforts, the Government of India published a Draft National Logistics Policy 2018, which aims to reduce the ratio of logistics cost to GDP to 10 per cent by optimising the current modal mix; improving first mile and last mile connectivity; increasing digitisation and technology adoption; and ensuring standardisation in logistics.

Many state governments have also incentivised technology adoption within the logistics and warehousing sector[15].

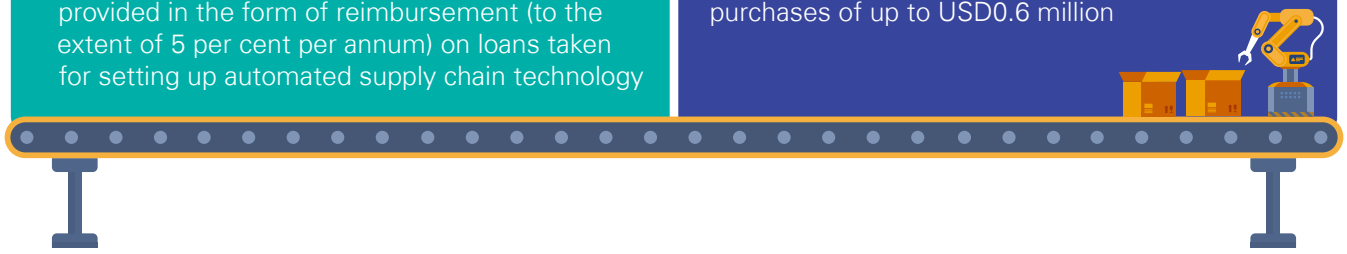
Also with warehousing being included under the infrastructure umbrella as well as the focus on improvement of transport infrastructure, the Indian logistics sector is likely see an investment worth USD10 billion by 2022.

A major chunk of this investment would go into integration of global practices into the supply chain operations, particularly automation, design, robotics, modern technology, inventory management tools and light manufacturing. There has been an increase in adoption of Warehouse Management System (WMS) and other IT-driven solutions[16]. The aim is to optimise resource utilisation, seamless distribution, and improve efficiency and competitiveness in the industry. Considering the cost-effectiveness and easy adaptability, there is further scope of penetration of these technology innovations in the future.

Amid such dynamic technological and functional changes, the future will witness a self-orchestrated supply chain. With such trends on the horizon, the supply chain of the future will be leaner, faster, and collaborative.

The Uttar Pradesh Warehousing and Logistics Policy 2018 states that interest subsidy is provided in the form of reimbursement (to the extent of 5 per cent per annum) on loans taken for setting up automated supply chain technology

The Chhattisgarh Logistics Park Policy 2018-23 states that a subsidy is provided on technology purchases of up to USD0.6 million

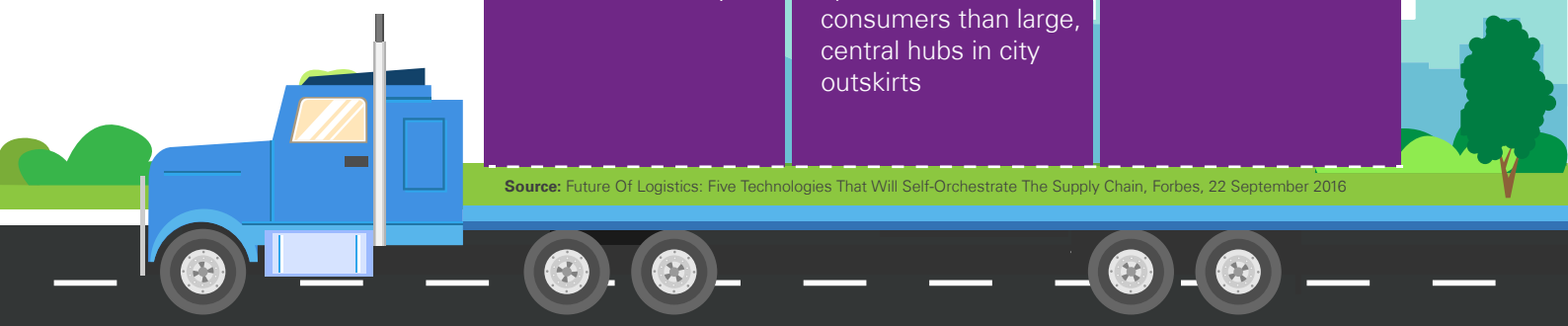


### Technology impact on the logistics sector

Possible to reduce the gestation gap between ordering and processing of products to mere seconds; from same-day delivery to same-hour delivery

A 50 per cent reduction in transport volumes in warehouses and a 30 per cent decrease in warehouses sizes, with more smaller spokes closer to consumers than large, central hubs in city outskirts

Increased level of automation, with 50 per cent fleet having some level of autonomy



**Source:** Future Of Logistics: Five Technologies That Will Self-Orchestrate The Supply Chain, Forbes, 22 September 2016

15. India Warehousing Market Report, Knight Frank, 2019
16. The rise of Smart Warehousing in India, The New Indian Express, 06 May 2019

In an increasingly competitive environment, with stagnating business growth and declining profit margins, logistics stakeholders would need to fortify operational, financial and digital fitness to stay relevant and meet consumer expectations.

As the demand for warehousing space skyrockets and stakeholders take active measure to transform the supply chain, the Indian logistics industry is anticipated to double its value from USD180 billion in 2018 to USD356 billion in 2025.

With the future of logistics hinging on innovation and technology, the first-mover advantage is up for the taking.

### Emerging technologies in media and entertainment (M&E)

Media and entertainment in India has been fundamentally transformed by the digital revolution. Even a few years ago, the value chain in the sector was mostly linear with content creators and consumers having little say in the face of large companies that controlled ownership and distribution. In the last few years however, greater affordability of devices and access to the internet has led to a manifold increase in the number of connected users in the country. Consumption has expectedly gone up and consumers have staked their rightful place at the centre of this ecosystem.

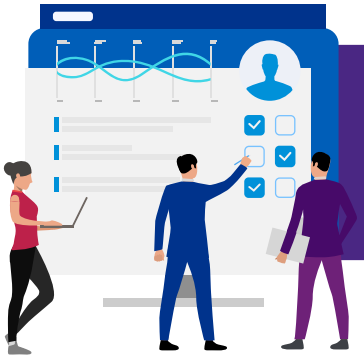
The continuous evolution of business models in the M&E industry has been driven by the imperative to own the user experience and alongside, the consumer relationship. Erstwhile business to business to consumer models (B2B2C) like film studios and TV broadcasters have had to pivot to direct to consumer (D2C) ones. This D2C relationship can only be sustained when there is a deep understanding of consumer profiles and behaviours coupled with usage patterns and preferences.

To cater to evolving consumer demands, M&E companies are tweaking their business models to deliver personalised content of choice, convenience and value. Given the exponential increase in the content being produced, M&E companies are finding it difficult to organise and monetise content effectively. Many are adopting emerging technologies and smart automation tools to tackle this challenge.

### AI, machine learning and personalisation

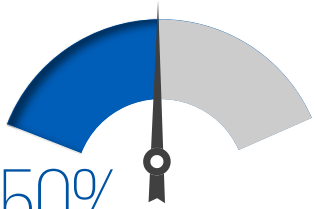
M&E companies have had to contend with an addressable 'segment of one' where each consumer is looking for personalised and relevant content. The ability to capture, process and effectively leverage data on consumer behaviour is predicated on emerging technologies such as AI and machine learning that power the recommendation engines on OTT platforms. India has over 35+ OTT players – navigation, ease of discovery and the ability to predict preferences are critical competitive differentiators.

### The impact of personalisation in M&E



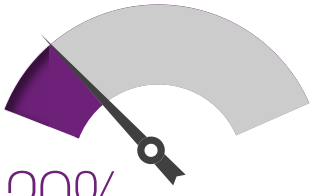
**76%** Of consumers would be more likely do business with M&E websites/apps if they offer personalised experiences

### What will move the needle?



**50%**
Keeps track of your viewing history for your reference and to make it easier to view new content

**36%**
Recommendations of other shows you might like based on viewing habits



**29%**
Reminders of when to watch specific events / shows based on viewing habits

**Source:** The power of me: The impact of personalization on marketing performance, Epsilon Marketing, 04 January 2018

AI and machine learning are also being used by content creators and financiers to green light projects based on data on what has worked with the target audiences earlier. While this is expected to help make more informed decision, it is meant to supplement rather than replace what is essentially a creative process.

### Value added by automation

Businesses are now able to organise and tag metadata to categorise and handle media clips and episodes faster by using ML, RPA and AI. In addition, companies are increasingly using data as a powerful tool for content marketing. In M&E, digital labour (RPA, enhanced process automation and cognitive automation) has found use cases in content generation, discovery and regulation, and support function automation.

## Potential technology application in M&E

### Insight generation

With the help of AI, content producers can get deeper insights from sports footage and use that for better story telling. Player actions, scores, etc. are measured and analysed by AI in real time. In 2011, IBM partnered with Wimbledon to introduce an AI-powered scoreboard that identifies the play pattern of a player to predict the winning chances of a player.

### Content localisation

The ever improving support to regional languages and advanced language processing capabilities makes translating and make the subtitling process more effective. Skilled workers can now just review the outputs from automation engines rather than manually performing the content localisation processes, and thus reduce the quantum of manual labour.

### Content generation

Auto generation of highlights/key events of a sports programme or gener-ating a movie trailer video out of actual lengthy video files are all examples of similar work. Computer vision, using neural networks, has been exten-sively used in 2018 FIFA World Cup Football to generate automated video highlights. American newspaper print and online media company, Tribune Publishing, uses artificial intelligence to monitor trending news and use that information to automatically generate multimedia digital content without any human intervention.

### Content discovery

Traditional media companies used to rely on basic metadata like title, cast, synopsis, genre or other keywords to search and find content. With the help of natural language processing, image processing and machine learning algorithms, bots can be tasked with generating detailed insights like specific actors, theme/emotion of the scene, props used in a scene. Using this advanced metadata, enhanced search can be done on content libraries uncovering new links between files.

### Content regulation

To manually regulate the content being posted in social media is an impossible task. So, social media platforms are now leveraging their expertise in cognitive automation to tackle this situation. Facebook uses advanced machine learning and predictive algorithm tools to detect sensitive content, identify hate speech, fake news and take action.

### Support function automation

Just like any other industry, RPA is being used by M&E companies as well to automate processes across enterprise business functions like finance & accounting, human resources, sales & marketing, customer support, supply chain etc.

**Source:** India's digital future – Mass of Niches, KPMG in India's Media and Entertainment report 2019

Increasingly, media channels are preferring to provide immersive experiences as a means to deliver engaging and personalised content. VR is a prominent use case for immersive consumption of film and TV. Immersive tech is also used for advertising in print, out-of-home and social media to drive customer engagement. Furthermore, firms producing films, television and other audio-visual content are likely to tap this trend by creating immersive consumer experiences, allowing consumers to spend more time on these devices, thus boosting their advertising and subscription revenue[17].

17. Growth of Immersive Media - A Global Check, NASSCOM, 2019

# Privacy and ethics

## Privacy and ethics in the era of technology

### Technological disruption enabling a digital, data-driven economy

The increasing focus on digitalisation has led to organisations adopting digital technologies to enhance business functions and offer personalised and immersive services. In today's marketplace, customised environment and recommendations are becoming the norm and providing organisations an edge over their competition.

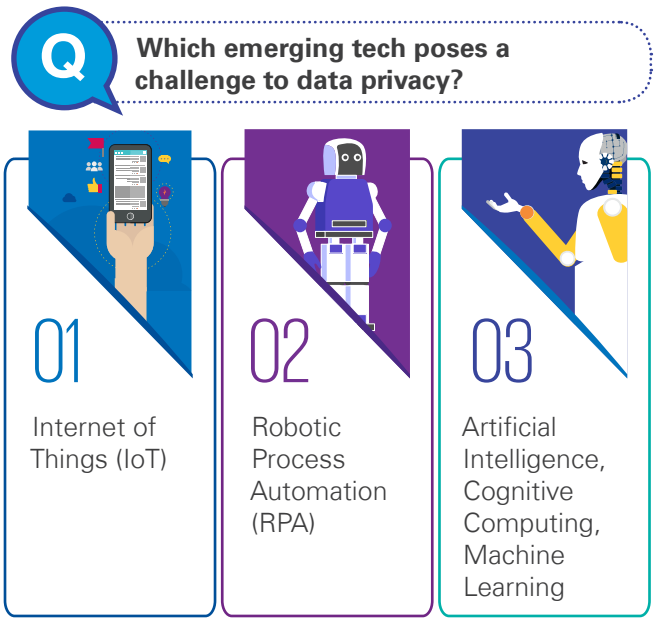
Organisations are now monetising by collecting huge amounts of data to create customer profiles in a new and unique way. Such user profiles not only identify the person for whom the content is targeted but also provide insights into their preferences, beliefs and routines. Data is termed to be the new oil for organisations.

### Growing instances of data breaches and privacy risks

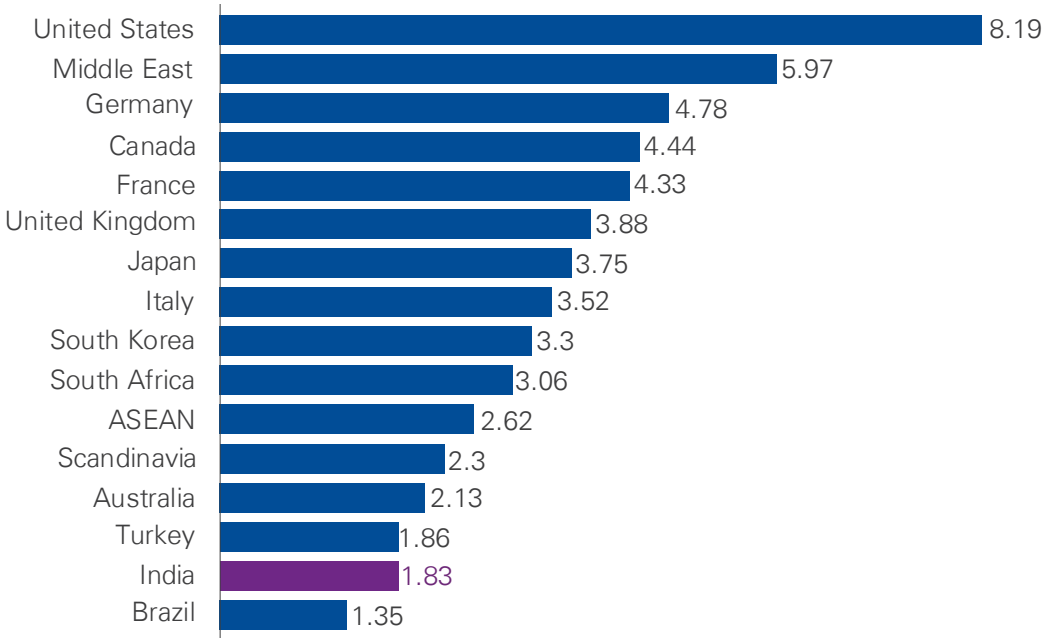
The number of data breaches encountered by organisations has expanded steadily since 2008. There were 685 instances of data breaches impacting more than 10 million customers in 2018. According to a survey by Thales, 52 per cent respondents in India reported a breach as opposed to 36 per cent globally[1].

The impact of a data breach to an organisation averaged USD3.9 million globally; it was around USD1.83 million[2] in India in2018.

However, adopting digital technologies opens up the surface of vulnerabilities for organisations, thus, considerably impacting consumers' privacy and raising concerns. Our survey indicated IoT, RPA and AI, cognitive computing and machine learning as the highest ranked technologies posing a threat to data privacy:




### High cost of data breach (USD million)




**Source:** Biggest data breaches in history, Comparitech, 30 July 2019

1. 93 per cent Indian companies plan to increase IT security spending: Survey, Business Today, 27 July 2018
2. Cost of a data breach report, IBM security, 2019

There have been instances of more serious 'mega breaches' that have impacted millions of consumers with huge financial losses.

### Significant data breaches in recent times

## Global

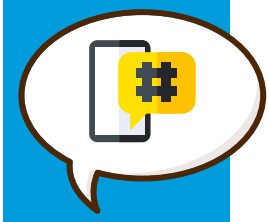
**Facebook**

In 2018, Cambridge Analytica harvested the personal data of Facebook users without their prior consent and used it for political promotion. Facebook estimated that 87 million user profiles were compromised.

**Yahoo**

In 2013–14, Yahoo suffered the biggest data breach in history, impacting 3 billion user accounts. Real names, birth dates, email addresses and contact numbers of users were breached during sale negotiations with Verizon.

**Instagram**



A total of 49 million records of Instagram influencers' details were left exposed without passwords. This database was hosted on Amazon Web Services.

**British Airways**

Hackers stole personal data of almost half a billion of British Airways passengers from its website and mobile app. The airline may be fined GBP183 million for the breach.

**Marriott**


Marriott may face a USD124 million fine for failing to protect customer data. The data breach began in 2014 and exposed 339 million guest records globally, but was only discovered in November 2018.

**A small school in Sweden**

A Swedish school was penalised USD20,559 in August 2019 for using facial recognition for attendance tracking when simpler and effective alternatives are available.

## India

**UIDAI (Aadhaar)**

The early January data breach on Aadhaar risked the data of 1.1 billion Indian citizens. Anonymous sellers on WhatsApp were offering access to Aadhaar information.

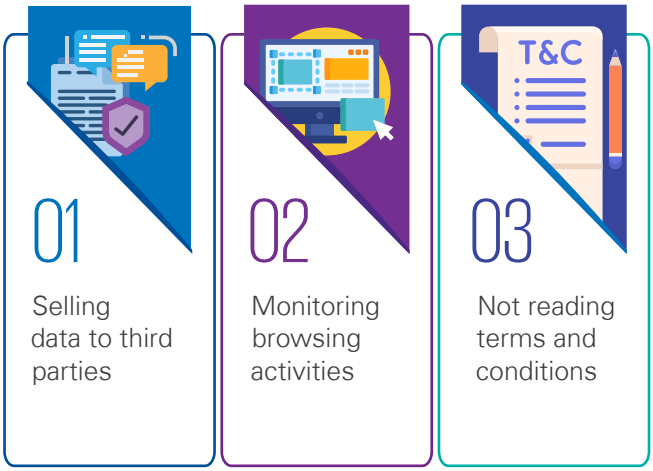
**Zomato**

In 2017, names, email addresses and passwords of 17 million users were stolen by an ethical hacker; the motive was to make the company acknowledge its data security vulnerability.

1. **Source:** Biggest data breaches in history, Comparitech, 30 July 2019
2. **Source:** The 18 biggest data breaches of the 21st century, CSO, 20 December 2018
3. **Source:** Facebook might not sell user data, but internal documents suggest it was certainly considered, The Verge, 29 November 2018

**Our survey indicated the following as the key practices that impact data pilferage:**

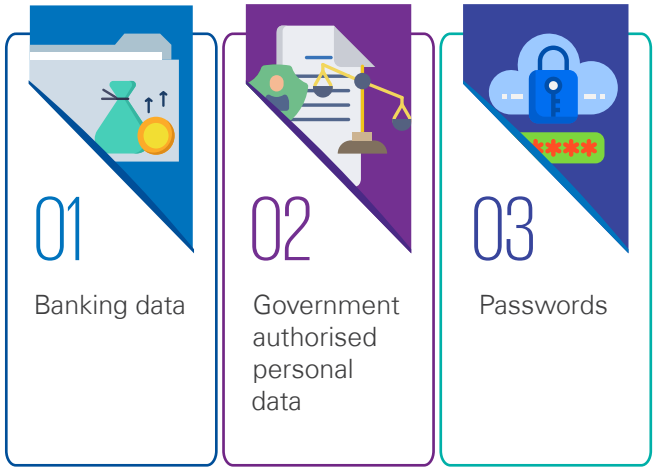
**Practices that can impact data pilferage**




## Data is turning out to be both an asset and a liability

When data is used inappropriately or in a non-compliant way, the consumer trust is broken, resulting in reputational damage and financial loss for the organisation. Respondants to our survey indicated:

**Most sensitive data**



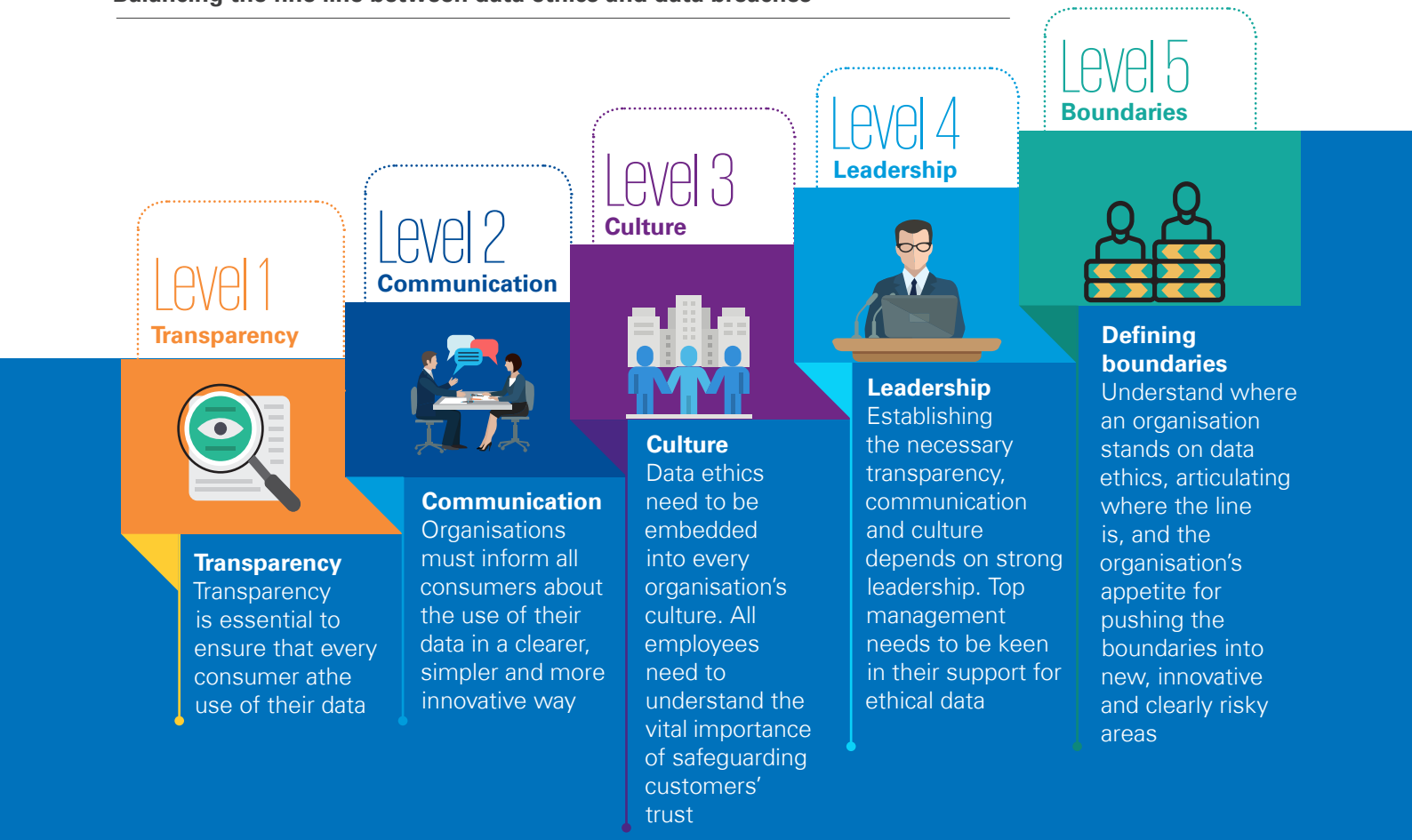

Organisations need to abide by regulatory requirements and gain the trust of consumers as loyalty and brand reputation are key in the digital ecosystem.

### Data ethics will play an increasingly important role

Organisations need to be open with consumers about their data being collected and understand from their consumers think about it. Organisations need to elucidate the purpose for which it is being used, with whom they will share it if at all, and reassure the consumers that they can protect it.

How individuals react to their data being used may vary vastly depending on data use and the individual's age, nationality and personal views. This makes the task of identifying a single agreed upon view of how data, particularly personal data, should be used from an ethical stance more challenging from an organisational standpoint. How does one maintain trust and still innovate?

### Balancing the fine line between data ethics and data breaches




**Source:** The future of data ethics and regulation, KPMG, 06 December 2018

## Laying down the regulatory groundwork

Even with the ethical boundaries defined, data is still exposed to cybersecurity threats and data breaches[3].

It has become vital to lay down regulations and policies to securely handle data. Regulators and industry bodies around the world have already begun the process of developing frameworks to protect data and implementing it.

One such regulation is the General Data Protection Regulation (GDPR) outlined by the European Union (EU). The GDPR created a shift in the way privacy laws are perceived across the globe. The regulation created a massive ripple in data protection governance as it is mandatory to implement GDPR as there are repercussions, both financially and others. The wave was not only limited to the EU, but also the rest of the world. GDPR made organisations across the globe take pragmatic steps to implement controls and understand and mitigate any privacy risk exposure.

In 2018, India took a step towards becoming a truly digital economy by releasing its first draft of the Personal Data Protection bill (PDP). Most rules outlined are similar to the ones drafted under the GDPR such as the legal grounds of processing personal data, data protection obligations, data subject rights and measures such as privacy by design.

This bill mandates that a copy of personal data as well as certain categories of data notified by the central government/Data Protection Authority of India termed as critical personal data shall only be processed and stored on servers/data centres in India. This mandate has created apprehension with the multinationals on two fronts: they will now need to establish a dedicated data storage ecosystem in India; and they may also lose out on the value derived through data analytics in a consolidated manner, including the data pertaining to India.

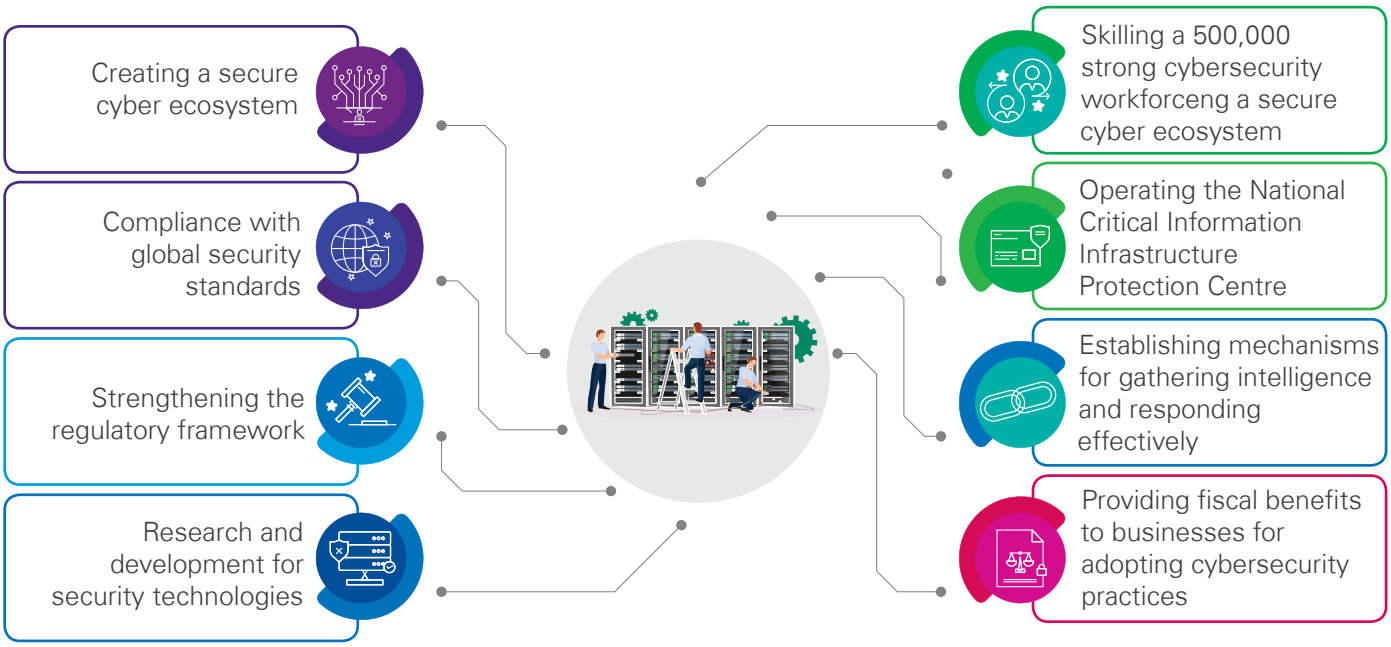
In addition to administrative fines, PDP bill also considers non-compliance to be a criminal offence. Organisations are granted a transition period of 12 months after the enactment of PDP bill to become compliant. This bill with minor changes is expected to be passed in the Indian Parliament and is set to become a law, but enforcement and adherence to it once it becomes a law will evolve with time.

India also established rules favouring Net Neutrality in 2018, ensuring that the internet remained free and fair[4]. Under these rules, Internet Service Providers (ISPs) must treat all communication over the internet equally without discrimination or extra charges based on the type of content, platform, user, equipment and more. In September 2019, the Kerala High Court ruled access to internet as a fundamental right which cannot be taken away arbitrarily[5].

The government also adopted a formal National Cybersecurity Policy 2013. The policy aims to build a secure and resilient cyberspace for citizens and organisations.

3. India's digital future – Mass of Niches, KPMG in India's Media and Entertainment report 2019
4. Internet to remain free and fair in India: Govt. approves net neutrality, Times of India, 12 July 2018
5. Access to internet fundamental right: Kerala High Court, The Economic Times, 19 September 2019

### Objectives of the National Cybersecurity Policy 2013



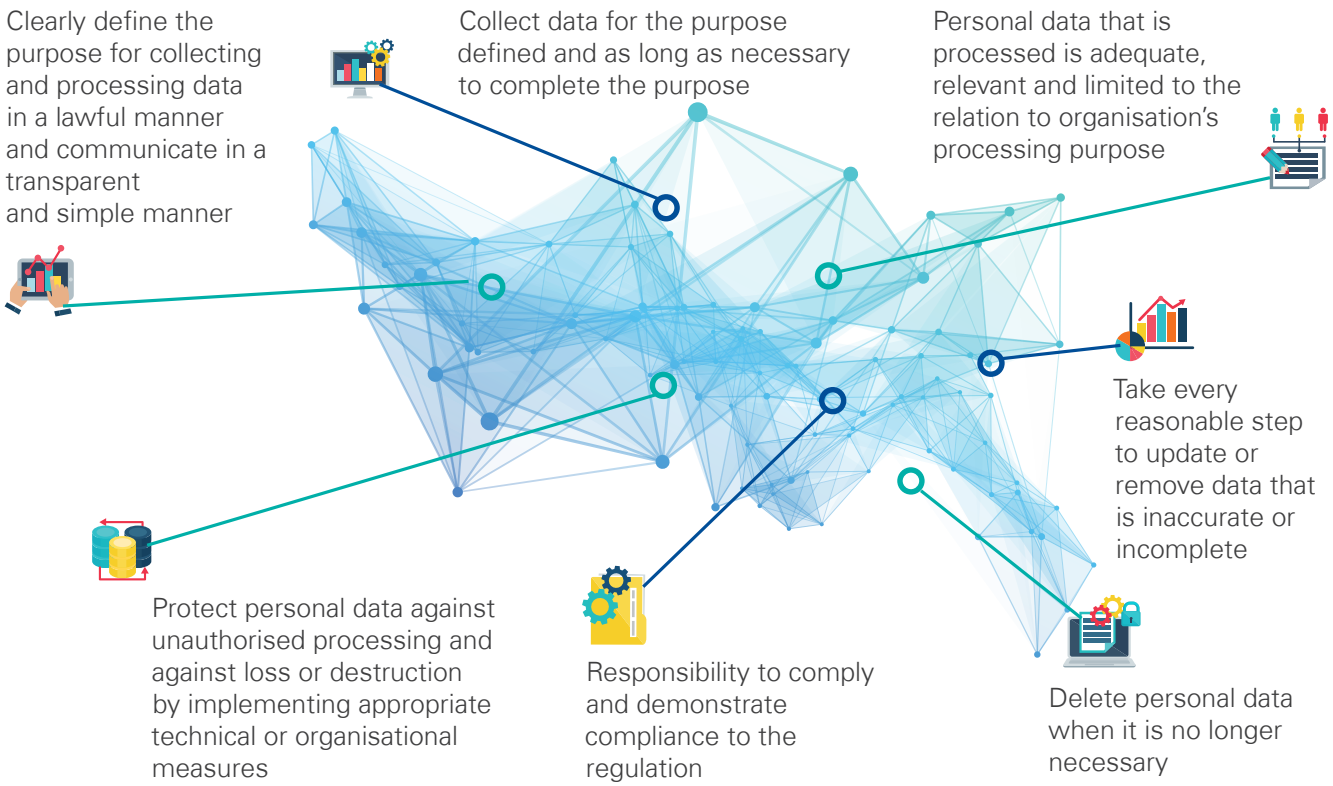

**Source:** National Cyber Security Policy, 2013, Department of Electronics and Information Technology

Although the government has taken initiatives towards creating a secure data environment, it is essential for organisations to undertake expansive and aggressive measures to support the government's efforts.

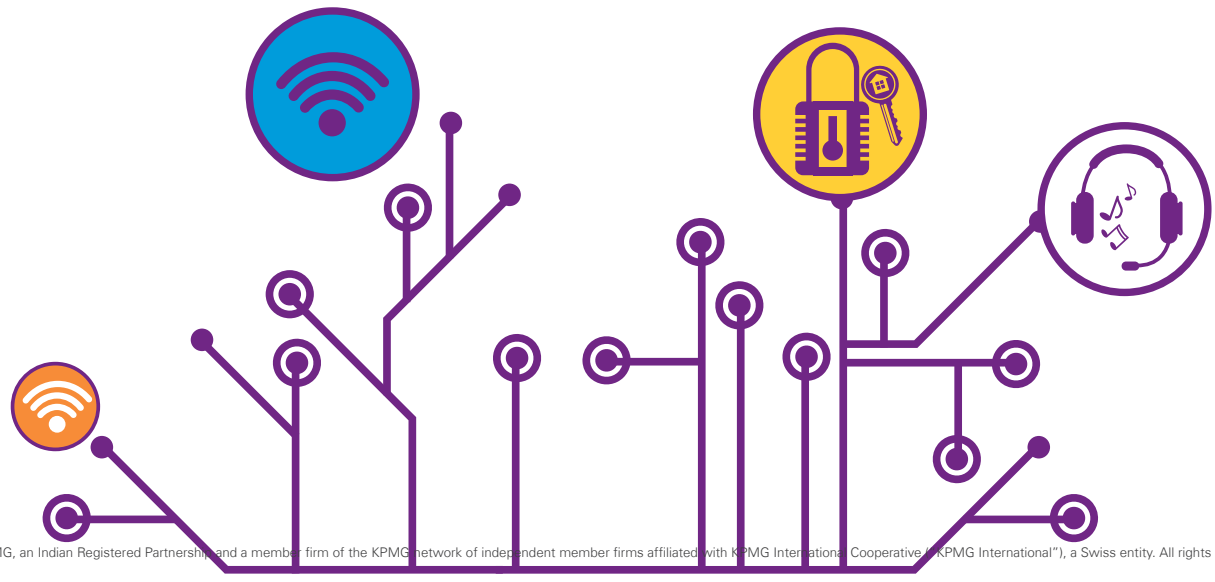
### Handling data with care, privacy and security

Traditionally, companies in India have been reluctant to allocate budget to cybersecurity unless there is a law or a standard to be met and there has been a data breach. With a strong regulatory framework on the horizon, Indian organisations would have to take a step back and incorporate the key privacy principles in their daily operations.

### Key principles to address privacy risks

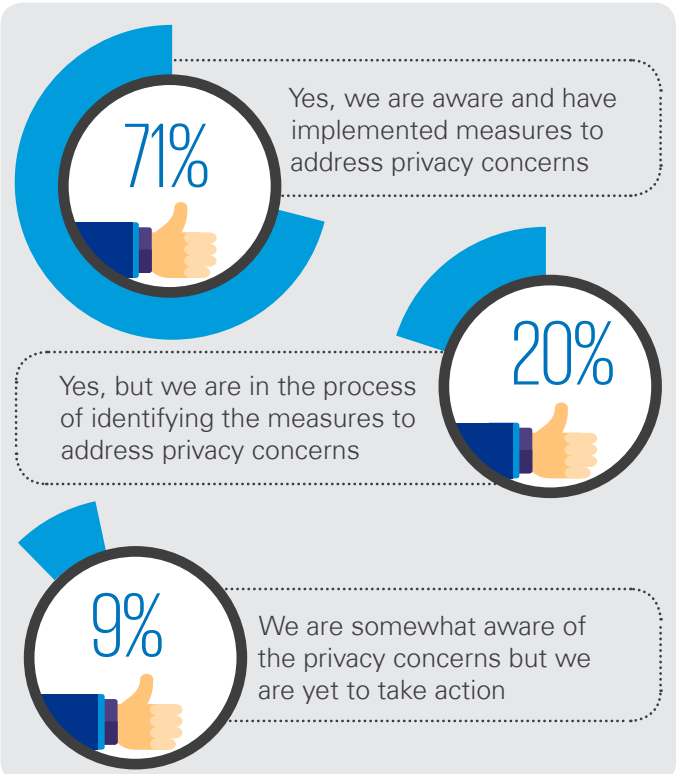



**Source:** KPMG in India analysis 2019



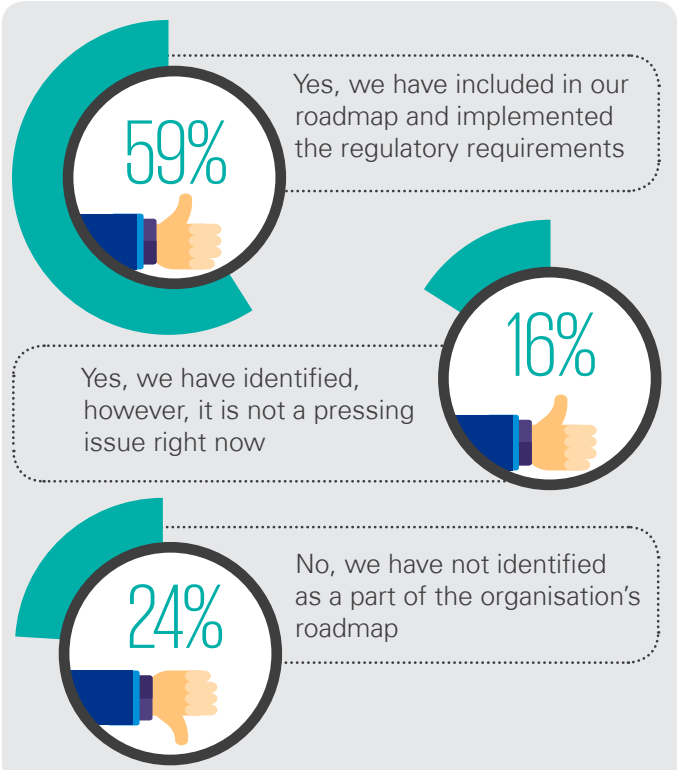
Our survey indicated that while 71 per cent of the companies are aware of the data privacy risks but only 20 per cent are in the process of identifying the measures to address privacy concerns.

**Is the organisation aware of data privacy risks?**




The survey also indicated that, approximately half of the respondents have already set up a stringent privacy framework to address the regulatory requirements.

**Are privacy initiatives part of your organisational roadmap?**




Despite the significant investment to upgrade cybersecurity, India has faced one of the highest rates of cybersecurity threats in the Asia Pacific region, receiving over 500,000 security alerts daily. This is nearly three times the global average[6].

Nearly 39 per cent of these alerts remain unattended owing to the lack of relevant skill sets[6]. Though there are aproximately 600,000 digitally skilled employees in India, only 10-12 per cent have cybersecurity skills, while even fewer have data protection and privacy skills[7]. These include privacy and security risk assessment, risk mitigation, privacy certifications/seals and information security standards certifications[8].

The skill gap may increase further with rapid digitalisation and is being cited as one of the main reasons for not adopting advanced security practices and technology. Hence, it has become essential for organisations to offer relevant training to up-skill and reskill employees.

To add to their burden, more than half the security alerts investigated by organisations turned out to be false. This exerts additional pressure on cybersecurity personnel, who need to identify and tackle genuine threats from a huge number of daily alerts.

Also, globally, data privacy is viewed as a legal subject. With citizens given a legal right to privacy, organisations are compelled to act in a way to preserve that right. Whereas in India, privacy is perceived as a techno-legal subject with more emphasis being placed on the technological aspect rather than the legal.

Furthermore, the use of multiple cybersecurity vendors and products makes the issue even more complex. In India, more than half the organisations deal with more than 10 security vendors, while eight per cent had more than 50 security vendors[9]. This increases both complexity and vulnerability, as having so many security products can prolong the time to detect and manage a breach.

Security and privacy would continue to be a key concern with an increase in connectivity across people, machines, equipments and products. Going forward, organisations should consider taking measures that are compliant with regulatory requirements.

6. India faces one of the highest cyber security threats in APAC: Study, CIO, 19 September 2018
7. Decoding Digital, NASSCOM, 2019
8. What skills should your DPO absolutely have?, IAPP, 24 January 2017
9. Privacy By Design: What Needs to be Done, How to do It, and How to Sell It to your Boss, Medium, 30 October 2018

## Recommendations for data privacy governance

01 Understand the data that is being handled

02 Identify individuals across organisations responsible for driving the privacy initiative and also define roles and responsibilities for privacy governance

03 Establish a privacy management framework keeping in mind the applicable regulatory requirements and industry best practices

04 Frame policies and procedures, which would act as guidelines for operationalising privacy practices in the organisation

05 Conduct training and awareness sessions across different levels in the organisation

06 Identify processes and applications dealing with personal data in the organisation

07 Provide a privacy notice to consumers to highlight the reason for collecting the personal data and processing that would be performed on the data provided

08 Identify and inventorise the personal data attributes

09 Create data flow maps to establish data lineage

10 Perform Privacy Impact Assessments (PIA) for high risk processing activities to identify and mitigate privacy risks

11 Identify and review the supporting applications involved in processing personal data for compliance to privacy requirements

12 Incorporate the principles of privacy by design for all new processes and applications

13 Implement appropriate technical and organisational controls to protect the personal data that is collected, processed and retained

**Source:** KPMG in India analysis 2019

**Addressing the data privacy and security challenge is the key to building a robust digital ecosystem**

As India speeds up its mission to transform into a truly digital economy, cybersecurity threats and privacy concerns could impede its success. All stakeholders involved (government, industry, consumers and regulators) should consider implementation of advanced cybersecurity technologies. They should also look at bridging the skill gap of cybersecurity professionals through relevant training and support.

Since the definition of personal data is becoming broad, it is a positive sign that India is considering data governance around non-personal information as well.

Considering the rising threats of the digital age, organisations need to have a comprehensive security architecture in place, one which ensures the protection of critical data across varied networks and environments, and technologies that dynamically respond to threats as they emerge.

In addition to that, the organisations must balance the personalisation requirements of customer experience with data privacy compliance. While requirements of personalised experience and data privacy may appear counter to each other, they can be both managed by giving control to the end user and following a need-based data governance model.

**What good experience looks like for your customers and implications on privacy**

| KPMG Connected Enterprise Capabilities | What good experience looks like for customers? | Implications on security and privacy |
|---|---|---|
| Product, Pricing and Customer Strategy | Connection to brand, relevance of product and experience | Aggregate level insights/analytics with appropriate use of Personally Identifiable Information (PII) |
| Experience Centricity | Experience brand promise at all touch points | Federated data security |
| Responsive Supply Chain | Receive products or services when, where and how its convenient | Additional security and privacy controls implemented at edge |
| Partnerships, alliances and vendor management | Reap benefits of partnerships without compromising perception | Governance framework and audit for data shared with third parties |
| Advanced data and analytics | Personalised experience with brand leveraging customer data | Consent and preference management |
| Technology architecture and enablement | Frictionless use of technology across journey and experience | Pervasive security solutions, Secure Development Lifecycle |
| Seamless commerce | Seamless and secure payments across channels | Compliance to secure payment data handling standards |
| Organisation alignment and people capability | Seamless and consistent experience across all brand interactions | Building a security culture within the organisation |

**Source:** KPMG in India analysis 2019

Globally, regulators are becoming more active regarding data protection and questioning the consent management practices implemented by organisations. There is a growing awareness among the consumers even though most of the regulations do not mandate for explicit consent. As more and more countries create an environment conducive for data privacy, the awareness across the value chain including dealers and telcos is increasing. Telcos are viewing privacy as a key stepping stone in their digital journey, and are looking for trust mark or seal or certification for their privacy compliance.

It is becoming clear that data ethics, privacy and security need to form an integral part of every organisation's risk appetite and Board agendas to monitor progress. This will require collaboration between entities that extract the data, and those responsible for ensuring that the data is used effectively and ethically. The key would be to ensure a consistent, organisation-wide approach to data and balance it with satisfying customer experience requirements.

# Need of the hour

## Need of the hour

India, one of the fastest digitising countries in the world, is gearing up to leverage the trend of smart, technologically advanced and digitally enabled economies. On its part, the Government of India has set out strong on riding this wave and building a connected and digital India.

These are exciting times, with plenty of headroom for companies to roll out internet connections, given that only 48 per cent of the Indian population has access to internet services at present[1]. India plans to set out on the path to become intelligent, immersive and inventive which would necessitate the emerging technologies to be simple, user-friendly and accessible. In addition to this, India will have to focus on improving consumer readiness and building supporting infrastructure.

Transitioning towards digital maturity and new technologies is inevitable and is likely to transform businesses and ultimately the economy.

### Challenges remain/way forward

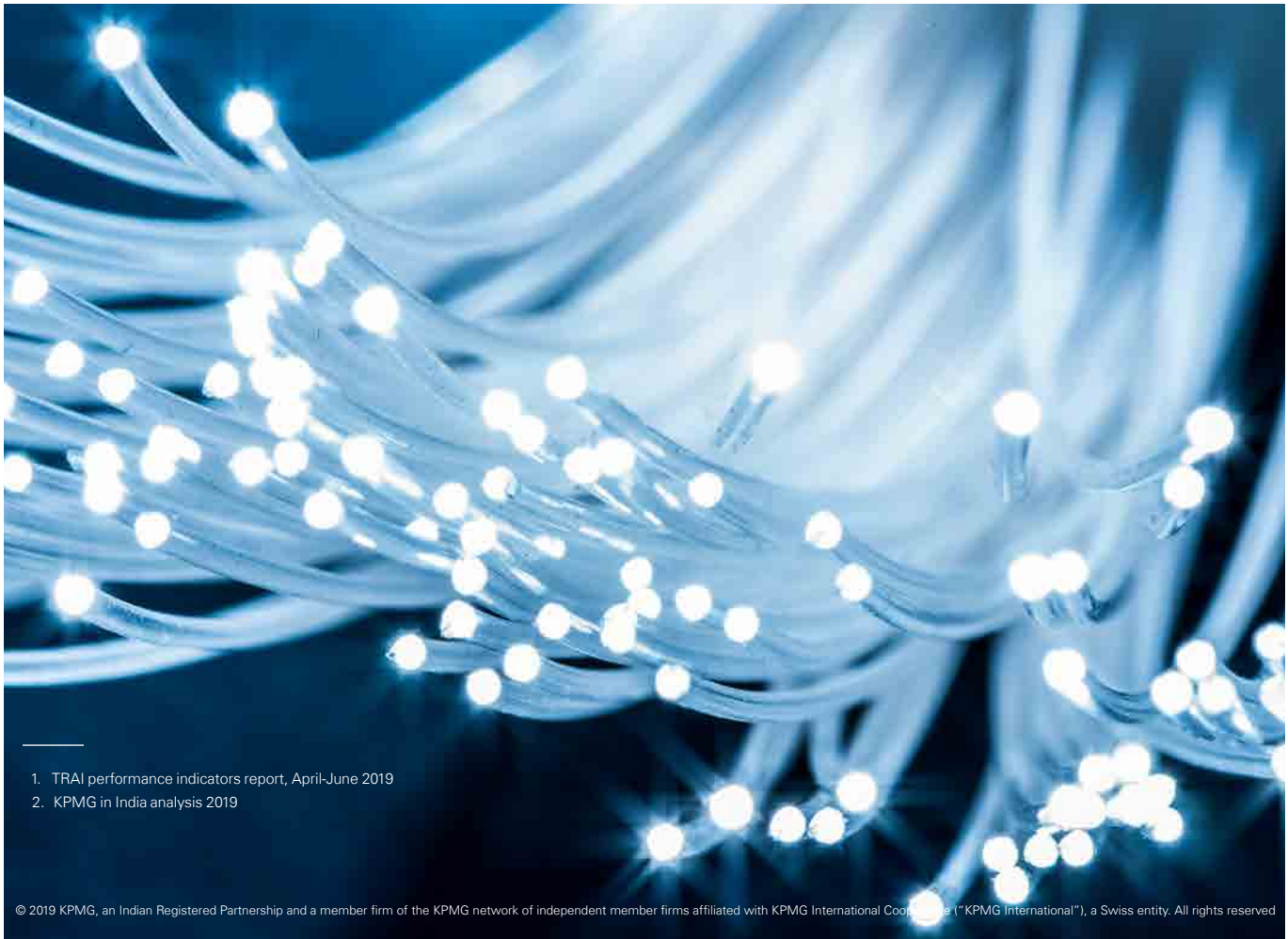
Though India has made significant progress so far, we continue to face digitisation and connectivity challenges that need to be addressed to achieve the goal of becoming the fastest digitised country.

Adoption of the National Digital Communications Policy 2018 (NDCP) needs to be done in a more efficient and productive manner

Financial stress in the telecom industry coupled with the high price of spectrum provides limited room for the industry to deploy and scale digital infrastructure

Inadequacy of a fibre network and the lack of device interoperability standards are impacting the quality of technology implementation and limiting innovation in the sector

Enactment of the Personal Data Protection (PDP) bill is a step in the right direction as far as data privacy is concerned but effective implementation and customer education is necessary to improve customer confidence in adoption of digital technologies



1. TRAI performance indicators report, April-June 2019
2. KPMG in India analysis 2019

### Fibre roll-out standards and device interoperability

The dearth of fibre and device interoperability standards is impacting quality of technology implementation. According to the DoT, less than a quarter of the towers are fibre-connected as Indian operators typically rely on microwave for backhaul. As recognised in the NDCP, it is critical to focus on fibre deployment and Right of Way (RoW) clearances, for both over ground and underground infrastructure, which are prerequisites for 5G network deployments.

Additionally, a streamlined transition from 2G, 3G and 4G to 5G may prove to be difficult as there is no interoperability currently between devices and networks.

The country would also need to move away from Internet Protocol version 4 (IPv4) towards IPv6 addresses as the current technology has limited number of addresses and shorter battery life for the successful deployment of IoT networks.

> There is a growing need to address India's ongoing network expansion and densification efforts as it prepares for 5G. An all-outdoor, disaggregated wireless hauling approach that follows open networks initiatives, is key to simplifying and speeding up India's evolution to 5G
>
> 
>
> **Ira Palti**
> President and CEO, Ceragon

### Affordable handsets and devices

Although 5G services are expected to launch in India in 2020, expensive devices are likely to constrain their adoption.

Due to their enhanced features such as 4K and 8K displays and additional cameras and sensors to support AR/VR applications, 5G handsets will probably cost more than the most advanced 4G devices currently available. They will also need to support multiple spectrum bands.

While prices for first-generation VR headsets have dropped, they are still not easily accessible to drive popularity. Initial headset models of top technology companies were launched for about USD400 in 2016, but with technological advancement their costs are falling, with newly launched variants of the same companies now available at around USD100 per headset[3]. These devices, however, require a high-end laptop or desktop, increasing the overall cost of ownership.

The cost of devices is a critical factor in a price-sensitive market like India, but prices may fall as the technology scales and matures.

### Data privacy and security

With more telecom providers pursuing growth strategies based on data-fuelled services and entertainment, the volume and types of personal data that consumers are trusting providers to maintain are increasing exponentially.

As the world become more sensitive towards the privacy of individuals, the enactment of PDP bill is expected to strengthen India's stature as a 'safe country' to handle and process personal data.

However, the regulatory bodies, law enforcement and judiciary still have to be equipped, trained and made ready for capacity building to regulate and enforce the provisions of the PDP bill to ensure that the rights are protected.

Private sector organisations also need to make sure they adhere to data protection laws while handling personal data. Data protection is essential to drive organisation-wide adherence so that companies do not become liable for compliance breaches and heavy criminal and financial implications.

### Use cases/business models – monetisable and relevant ones

As digital infrastructure and technologies are still in the nascent stages of adoption, the industry has not yet fully explored the possible use cases that are relevant in the Indian context and can be monetised successfully.

It is imperative for the industry to develop clearly articulated business cases and business models that can be financially and commercially viable.

The key would be the effective mitigation of these challenges, which would require a concerted and collaborative effort from relevant stakeholders.

3. Immersive Reality – How to make VR affordable for the masses, 360degrees, September 2018, Oculus Rift Price Officially Cut Again, Now USD349, UploadVR, January 2019

## Role of the government

**To ease the telecom sector's financial distress, and encourage digital adoption in India, the government needs to take actions across policies, investments and spectrum allocation:**

### Policies

- Need for a strong 'ease of doing business' policy with transparent tendering processes, reduction in human touch points and single window approval mechanism to guarantee better accountability and reduce technology implementation delays
- A common RoW permission mechanism needs to be set up for all utilities, such as water, electricity, gas pipes and optical fibre which could ensure a synchronised approach towards efficient and cost-effective infrastructure development[9]. The government can add incorporating fibre, along with other public utilities into the national building codes to ensure a fast roll-out of broadband access
- Encourage infrastructure sharing and the public-private partnership (PPP) model for infrastructure development
- Additionally, the government can boost domestic manufacturing for telecom equipment and fibre by announcing for reducing manufacturing cost, forming of special economic zones and electronic clusters, increasing export incentives and ensuring more capacity and scale to capture global demand
- Additional budget allocation and tax incentives for research and development activities in emerging technologies and interoperability
- A national portal or platform would help monitor and track the development and adoption of emerging technologies across the country
- Constructive, prompt steps towards building smart cities, finalising the Personal Data Protection Bill, drafting an IoT policy, national programme on AI to accelerate the adoption of digital technologies.
- Promote domestic manufacturing for telecom equipment and fibre through direct tax incentives for reducing manufacturing cost, formation of special economic zones, increasing export incentives. In the short term, till the local capability scales up, the government should provide custom duty exemptions on telecom equipment to ensure timely roll out of network.

### Investments

- Create a Special Purpose Vehicle (SPV) to support international lending organisations and provide substantial investment into digital infra projects at cheaper interest rates. International investment can bring the cost of capital from 15 per cent down to ~one per cent[4]. Several private players can also pool resources into these SPVs to avail the funding and share knowledge on international best practices
- It is recommended that an optical fibre market development fund be set up that can support the service providers, incentivise product and market development expenses with low cost loans.
- Funding can also be provided from tax-free bonds, infrastructure debt bonds, central road funds, monetising government-owned road assets, and budgetary allocation

4. KPMG in India analysis 2019

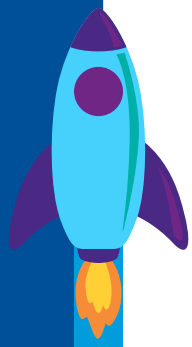
## Spectrum

- Develop policies towards transparent spectrum allocation, optimal pricing of spectrum and spectrum sharing and leasing regimes to optimise utilisation
- Consider a review of the licence fee and spectrum charges and reduction in other levies and charges such as USOF.
- Consider a three-year moratorium on spectrum payments to the government with abeyance on interest charge, refund of accumulated unutilised input tax of USD4.24 billion[5]
- Consider doing away with the levy of GST on government payments such as LF & SUC
- Some of the other policy interventions towards transparent spectrum allocation, optimal pricing of spectrum, allocation of spectrum for microwave access and backbone, allocation of E&V bands and spectrum sharing and leasing regimes to optimise utilisation would be critical.

### Role of start-up/ecosystem

**Stakeholders need to create a supporting and fulfilling ecosystem for the adoption of emerging technologies.**

- Incubation hubs and accelerators can be established, specifically for emerging technology start-ups
- Establishment of fund to provide grant funding to emerging technology start-ups to facilitate their operation and business
- Players across the digital value chain will need to adopt a sustainable and transparent pricing model
- A collaborative effort is needed from the government, industry and academia to re-skill and up-skill the existing talent in the country
- Telcos may have to step in and adopt best practices from developed countries to ensure interoperability between devices and networks
- Additionally, telcos would have to invest in blended communications on the mobile device such as phone, gaming device and personal TV. Technology creators and start-ups would play a key role in enabling the technological integration
- The time has come for telcos to look beyond the traditional business models and build capabilities in emerging technologies and advanced digital applications, including automation, AI, AR/VR, IoT, cloud, cybersecurity and big data analytics
- In an increasingly competitive environment, telcos would need to focus on enterprise (B2B2X) models
- Given the significant changes envisaged in the future networks, we recommend an extremely light touch Regulatory approach so that these technological initiatives and innovations are not hampered by the Net Neutrality Regulations. A more nuanced approach to Traffic Management will be required so as to ensure that the industry reaps the benefits of 5G.



Given the growing number of internet users, evolving consumer expectations and focus on digitalisation, industry stakeholders will need to re-evaluate their existing strategies and operating models, and reinvent themselves to leverage emerging opportunities and tackle challenges. With these interventions in place, India will be in a sweet spot to make significant in-roads towards becoming intelligent, immersive and inventive sooner rather than later.

5. Cellular Operators Association of India (COAI)

## KPMG in India Survey 2019 - Industry's Technology Readiness Index

### Background and significance

Much has been said about emerging technologies and their ability to transform business landscapes and individual lifestyles in the digital age. Connectivity and information sharing can lead to the emergence of efficient collaborations – among devices, machines and people – and create a network effect of higher productivity. But what is the current pulse of India Inc. with respect to these disruptive technologies? KPMG in India sought out to outline the major emerging technologies likely to generate this impact and take stock of the state of preparedness with respect to adoption of these solutions.

### Research questions

Our survey centred around the business implications of emerging technologies such as IoT, robotic process automation, blockchain, AI, cognitive computing and machine learning, AR/VR, social networking/ collaborating technologies, data and analytics and cloud. The survey was broadly categorised into three sections (1) Technology adoption (2) Customer experience (3) Security and data privacy.

1Q

**Technology adoption**

The digital maturity of an organisation was tested along a scale with 'Exploratory' (early stages of digital evolution) at one end and 'Advanced' (digital maturity is scalable and advanced) at the other. The same scale was also applied to assess digital risk preparedness of the company. Further, respondents were asked about planned investments and perception of impact – immediate and long term – of these emerging technologies. Industry-specific questions in terms of technology likely to create maximum impact, and challenges in adoption were also featured.

2Q

**Customer experience**

Under this section, respondents were requested to list the primary objectives of their customer-centric strategy as well as its key enablers and obstacles. The role of digital technologies – app availability, web presence, AI, AR/VR experience, etc. – in enhancing customer experience was also incorporated.

3Q

**Security and data privacy**

This section began with specific questions on the awareness of data privacy risks impacting the organisation and the presence of a roadmap to address these concerns.

Respondents were also asked to list the strategies that enabled the adoption of stronger data privacy measures, while identifying measures that heightened the risk of data pilferage.

### Sample size

The survey was sent to 5,000 participants in over 150 companies.

### Selection criteria

Companies were selected from a range of sectors including telecommunications, technology, financial services, consumer markets, healthcare, transport, industrial manufacturing, building and construction, energy and natural resources among others. Respondents were primarily from CXO level teams in India (68 per cent) and overseas (32 per cent) including the U.S.A., South Africa, Bangladesh and Australia. Sample designations of the respondents are given below:

- Director
- Manager
- Vice President
- Chief Financial Officer
- Chief Risk Officer
- Senior Manager
- Chief Technical Officer
- Chief Executive Officer
- Chief Human Resource Officer
- Chief Commercial Officer

## Estimation model for unlocking value of 5G

### Background and significance

5G provides an exciting opportunity for Mobile Network Operators (MNOs) to create profitable new revenue streams from their enterprise customers. Enterprises are unlikely to pay more for higher speeds but would be inclined to invest to realise the significant value 5G creates by solving existing challenges and enabling new business models. So, it is important to understand the value 5G unlocks for different industries to develop various business models that generate meaningful returns to all stakeholders in the value chain.

### Methodology:

The following sectors were considered for the model as they contribute a major percentage of GDP of India:

- Aerospace and defence
- Entertainment and media
- Finance and insurance
- Healthcare
- Insurance
- Logistics
- Manufacturing
- Mining
- Professional services
- Retail
- Technology
- Transport and mobility
- Utilities
- The model estimated the growth rates in different industries through expert interviews, secondary research and global trends
- It assessed the impact of the entire spectrum of new-age digital solutions that are expected to be promulgated through 5G.
- The solutions and sector impact were amalgamated to arrive at the value unlocked by 5G.

# Glossary

| | |
|---|---|
| **2G** | Second Generation |
| **3D** | Three Dimensional |
| **3G** | Third Generation |
| **4G** | Fourth Generation |
| **4K** | 4000 pixels |
| **5G** | Fifth Generation |
| **8K** | 8000 pixels |
| **ADAS** | Advanced Driver Assistance Systems |
| **AI** | Artificial Intelligence |
| **AIC** | Atal Incubation Centre |
| **ANM** | Auxiliary Nurse Midwife |
| **API** | Application Programming Interface |
| **AR** | Augmented Reality |
| **ARPU** | Average Revenue per User |
| **ASHA** | Accredited Social Health Activist |
| **AV** | Autonomous Vehicle |
| **AVRI** | Autonomous Vehicles Readiness Index |
| **B2B2C** | Business to Consumer Model |
| **BTS** | Base Transreceiver System |
| **CAGR** | Compound Annual Growth Rate |
| **CAPEX** | Capital Expenditure |
| **CEWiT** | Centre of Excellence in Wireless Technology |
| **COAI** | Cellular Operators Association of India |
| **CSC** | Common Service Center |
| **D2C** | Direct to Consumer |

| | |
|---|---|
| **DBT** | Direct Benefits Transfer |
| **DISHA** | Digital Information Security in Healthcare Act |
| **DNLP** | Draft National Logistics Policy |
| **DoT** | Department of Telecommunications |
| **DPAI** | Data Protection Authority of India |
| **EU** | European Union |
| **FY** | Financial Year |
| **GB** | Gigabyte |
| **GDP** | Gross Domestic Product |
| **GDPR** | General Data Protection Regulation |
| **GI cloud** | Government of India cloud |
| **GP** | Gram Panchayat |
| **GPS** | Global Positioning System |
| **GST** | Goods and Services Tax |
| **HD** | High Definition |
| **HIE** | Health Information Exchange |
| **HMIS** | Health Management Information System |
| **IISc** | Indian Institute of Science |
| **IIT** | Indian Institute of Technology |
| **IMC** | India Mobile Congress |
| **ImTECHO** | Innovative Mobile-phone Technology for Community Health Operations |
| **INR** | Indian Rupee |
| **IoT** | Internet of Things |
| **IP** | Intellectual Property |
| **IPL** | Indian Premier League |

| | |
|---|---|
| **IPv4** | Internet Protocol version 4 |
| **IPv6** | Internet Protocol version 6 |
| **ISP** | Internet Service Provider |
| **LF** | Licence Fee |
| **LTE** | Long Term Evolution |
| **M&E** | Media and Entertainment |
| **M2M** | Machine to Machine |
| **mHealth** | Mobile Health |
| **ML** | Machine Learning |
| **MNO** | Mobile Network Operator |
| **MR** | Mixed Reality |
| **NASSCOM** | National Association of Software and Services Companies |
| **NCD** | Non-Communicable Disease |
| **NDCP** | National Digital Communication Policy |
| **NDHA** | National Digital Health Authority |
| **NDHB** | National Digital Health Blueprint |
| **NDHE** | National Digital Health Eco-system |
| **NGO** | Non Government Organisation |
| **NHS** | National Health Stack |
| **OEM** | Original Equipment Manufacturers |
| **OTT** | Over the Top |
| **PC** | Personal Computer |
| **PDP** | Personal Data Protection bill |

| | |
|---|---|
| **PHI** | Personal Health Identifier |
| **PHR** | Personal Health Record |
| **PPP** | Public Private Partnership |
| **QoS** | Quality of Service |
| **RCH** | Reproductive and Child Health |
| **RoW** | Right of Way |
| **RPA** | Robotic Process Automation |
| **SAMEER** | Society for Applied Microwave Electronics Engineering and Research |
| **SCADA** | Supervisory Control And Data Acquisition |
| **SPV** | Special Purpose Vehicle |
| **SUC** | Spectrum Usage Charge |
| **SUPPORT-PD** | Seamless User-centred Proactive Provision of Risk-stratified Treatment in Peritoneal Dialysis |
| **TB** | Tuberculosis |
| **TDP** | Technology Development Programme |
| **TMT** | Technology, Media and Telecommunications |
| **TV** | Television |
| **UPI** | Unified Payment Interface |
| **USD** | United States Dollar |
| **USOF** | Universal Service Obligation Funds |
| **VC** | Venture Capitalist |
| **VoLTE** | Voice over Long Term Evolution |
| **VR** | Virtual Reality |
| **WHO** | World Health Organization |
| **Wi-Fi** | Wireless Fidelity |
| **WMS** | Warehouse Management System |
| **XR** | Extended Reality |

# About IMC

India India Mobile Congress (IMC) is the largest digital technology platform in South Asia. Since the resounding success of its inaugural chapter in 2017, IMC has become a key platform to showcase India's digital journey towards becoming an empowered global digital USD 1trillion economy. Organised jointly by the Department of Telecom (DoT) and COAI, the mega-event will allow the world to see India as a leader in the telecommunications and technology space. IMC 2019 is supported by several Government of India bodies, such as the Ministry of Electronics & Information Technology (MeitY), Ministry of Skill Development & Entrepreneurship (MSDE), Ministry of Road Transport & Highways (MORTH) and the Ministry of Housing and Urban Affairs (MHU), in addition to various other technical and regulatory outfits.

With this year's theme 'Imagine: a new CONNECTED world. Intelligent. Immersive. Inventive.' IMC 2019 is anticipated to be bigger, better and even more vibrant than its previous two iterations. Participation from 40 Countries, 300+ Global Speakers, 300+ Exhibitors, 5,000+ CXOs, 1,000+ International Media and 100,000+ visitors is expected. The international conference will encourage discussions and dialogue that impact policy and standards, which in turn should help in propelling India's digital journey, enable financial investments and create and facilitate an ecosystem for the development of intelligent, immersive and inventive technologies. The aim is to create an ecosystem for ICT players and all relevant stakeholders to take part in the realisation of the Digital India program. With more than 36 sessions and 300 plus speakers, IMC conference sessions will address industry defining topics revolving around 5G, Intelligent Edge, Immersive World, Privacy & Ethics, Autonomous Things, Smart Spaces, Augmented Analytics, Inventive Unicorns, Health and Future Logistics. This year, the event will particularly encourage the country's robust startup ecosystem and budding entrepreneurs, through various targeted engagement and networking programmes.

# About KPMG in India

KPMG in India, a professional services firm, is the Indian member firm affiliated with KPMG International and was established in September 1993. Our professionals leverage the global network of firms, providing detailed knowledge of local laws, regulations, markets and competition. KPMG has offices across India in Ahmedabad, Bengaluru, Chandigarh, Chennai, Gurugram, Hyderabad, Jaipur, Kochi, Kolkata, Mumbai, Noida, Pune and Vadodara. KPMG in India offers services to national and international clients in India across sectors. We strive to provide rapid, performance-based, industry focused and technology-enabled services, which reflect a shared knowledge of global and local industries and our experience of the Indian business environment.

**KPMG International**

KPMG is a global network of professional services firms providing Audit, Tax and Advisory services. We operate in 152 countries and have 189,000 people working in member firms around the world. The independent member firms of the KPMG network are affiliated with KPMG International Cooperative("KPMG International"), a Swiss entity. Each KPMG firm is a legally distinct and separate entity and describes itself as such.

The KPMG Audit practice endeavours to provide robust and risk-based audit services that address member firms' clients' strategic priorities and business processes. KPMG's Tax services are designed to reflect the unique needs and objectives of each client, whether firms are dealing with the tax aspects of a crossborder acquisition or developing and helping to implement a global transfer pricing strategy. In practical terms that means, KPMG firms work with their clients to assist them in achieving effective tax compliance and managing tax risks, while helping to control costs.

KPMG Advisory professionals provide advice and assistance to help enable companies, intermediaries and public sector bodies to mitigate risk, improve performance, and create value. KPMG firms provide a wide range of Risk Consulting, Management Consulting and Deal Advisory services that can help their clients respond to immediate needs as well as put in place the strategies for the longer term.

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# KPMG in Brazil contacts


**Luis Motta**
**Sócio-líder de Tecnologia, Mídia e Telecomunicações**
KPMG na América do Sul
LLuz@kpmg.com.br
(11) 3940-8314

**Dustin Pozzetti**
**Sócio-líder de Tecnologia, Mídia e Telecomunicações**
KPMG no Brasil
dustinpozzetti@kpmg.com.br
(11) 3940-1958

**Francisco Clemente**
**Sócio-diretor de Tecnologia, Mídia e Telecomunicações**
KPMG no Brasil
fclemente@kpmg.com.br
(11) 3940-8381

**Marcelo Ribeiro**
**Sócio-diretor de Tecnologia, Mídia e Telecomunicações**
KPMG no Brasil
marceloribeiro@kpmg.com.br
(11) 3940-1960

**Jorge Wada**
**Sócio-diretor de Tecnologia, Mídia e Telecomunicações**
KPMG no Brasil
jorgewada@kpmg.com.br
(11) 3940-5882

**Henrique Pinheiro**
**Gerente de Tecnologia, Mídia e Telecomunicações**
KPMG no Brasil
henriquepinheiro@kpmg.com.br
(21) 2207-9446

**Ersin Sungur**
**Gerente Sênior de Tecnologia, Mídia e Telecomunicações**
KPMG no Brasil
esungur@kpmg.com.br
(11) 3940-4153


**home.kpmg/br**

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