



cutting through complexity



Confederation of Indian Industry

# Digital infrastructure: enabling the world of tomorrow

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# Foreword

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As the next industrial revolution sweeps the world, and the Internet of Things rides the wave, the reality here and now is that organizations of the future are destined to be digital by default. We need to prepare for this transformation in our country, attempting to ensure that a strong foundation, infrastructure and enablers are in place to survive and be successful in the new generation technology. This means, three constituents of the Digital world, the enterprise, the consumer and the government accept and work with game-changing shifts in the way work is accomplished, the way people communicate, and the way capabilities are built. The key would be to envision a network-centric society and create enablers for these shifts through investments and capabilities in technology. As the citizen adopts a digital lifestyle, the industry and the government need to respond positively, to operate in the connected world of tomorrow.

In the dynamic world we live in, the smart device often seems all pervasive. Yet the accelerating pace of technological change can make us feel smart devices are just not smart enough. We are therefore exploring a smart ecosystem of devices that carries a huge bundle of intelligence, and which can actually be foolproof. These devices would be capable of communicating with each other, exchanging and analysing critical data and providing humans with actionable insights that an independent device would be incapable of doing. This ecosystem is termed as 'Digital Infrastructure' and it can be imperative that we make full use of it to leapfrog into the Digital future.

This distinct concept of Digital Infrastructure with its connected smart devices can revolutionise the way we view things. From simple applications like a wearable tech product connected to the internet that constantly monitors our health, to a completely out-of-the-world experience provided by a smart city, digital infrastructure could play a critical role in several walks of life. Human ingenuity would lie in understanding how this immense technological advancement can be leveraged, and in applying it for the benefit of all the stakeholders.

The digital services will likely completely change the way we experience products around us. We, as consumers would no longer need to wait to receive information on our products at home or at the workplace. They would constantly be communicating with us transmitting information instantaneously. The impact of this on efficiency and productivity can well be imagined. The extension of this concept to government services implies increased transparency, quicker turnaround time and higher service levels, with the access to real-time data. We, as citizens, can expect a better quality of living that is powered by knowledge and is barrier-free. For enterprises, large and small, digital infrastructure can be a powerful enabler for new and innovative ways of doing business that comes with enormous cost savings. And more importantly, it provides a differentiator which is – the much sought after competitive edge. The business landscape can monetize this opportunity to create new set of offerings, and convert significant revenue into recurring revenue with real-time tracking of the data.

What could this mean for technology vendors? Communication being the spine of digital infrastructure, it can ill-afford any weak link. Inter-device communication becomes vital, and a main challenge for vendors lie in making their devices interoperable with those of their competitors. This means that the communication protocols used by all these devices should be common and latest at the same time. These technology providers would now have to look at investing their time, effort and resources into emerging technologies, to be able to provide their customers and cost efficient solutions while maintaining high standards. Certain sectors like hardware, software, telecom, semiconductor manufacturers may be propelled forward as these are some of the building blocks of digital infrastructure. The technology providers would be left with no option but to change their approach, strategy and tactics to stay in the race. Adapting to this advancement would be key to success.

As industry converge towards a digital era, there is expected to be a lot of investment around various applications of digital infrastructure like smart cities, smart healthcare, smart retail and intelligent transportation; where government may play a significant role in developing and regulating guidelines for the sectors. If this growing hunger for technology is to be supported, there must be strong regulatory and policy frameworks in place, and the government must be supportive. Equally important is the investment in capability creation, building the technology education and research infrastructure, providing incentives to skill building and the creation and adoption of innovative solutions. Towards all this, the government should embrace this new technology and work with organizations to boost its acceptance and deployment across the country.

A barrier to wide acceptance could be the perceived threat of security breaches. As data transfer between devices is at the core of digital infrastructure, it is important to address this risk. Corporations and governments must invest in high-end security measures to mitigate these risks and initiate campaigns to help ensure user confidence.

The Indian government is currently developing roadmaps for digitally uplifting the city and society to make technological advancements. The Indian government drafting a policy around digital infrastructure envisioning more than USD50 billion market in India by 2020, with the smart city initiative only contributing USD35 billion. ICT players can join hands with the government to reach the ultimate goal and peg this billion dollar opportunity. Like everything else, the growth of digital infrastructure has its own challenges. There will likely be a distinct set of challenges for businesses and consumers. India, as a growing nation, would be looking to invest continuously in newer technologies and capabilities, while also driving their mass deployment, overcoming the challenges that manifest as hard and soft issues.

This paper explores the immense opportunities digital infrastructure provides and suggests ways in which these opportunities can effectively be tapped by both IT service providers and the user community at large. We hope you find this interesting and useful. We welcome your comments and feedback.



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# Preface

Computing power, data storage and communication network speed are the parameters which have been growing at a rapid pace consistently. This digital avalanche has given rise to faster and smarter computers. On the other hand, relatively slower but consistent advances in robotics technology are making machines do the tasks which require precision at high speeds. Convergence of these two technological developments has fueled the growth of a truly digital infrastructure, enabling Internet of Things (IoT).

IoT is a significant phenomenon and a new paradigm in which the existing technologies can work in harmony to make things happen, which otherwise would be impossible. Information technology transformed the way information is created, stored, transmitted and used; similarly, a fully functional digital infrastructure can transform the way we live and work.

As it is true for anything so powerful, the IoT has the potential to be misused and can create dangerous outcomes, if not controlled appropriately. Security and privacy continue to remain major issues and need to be dealt with holistically. While computing, storage and communication technologies have seen multi-fold improvement in performance, eco system and infrastructure remains a big challenge. CONNECT 2014 expects to multiple dimensions of this transformation, the opportunities and challenges this brings to the stakeholders, and the possible options to move ahead in this exciting journey.



**Akhilesh Tuteja**  
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## Way Forward

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'Names of brands/companies used as examples in this report are without any prejudice to any specific brand/company.'



## Understanding the Role of Digital Infrastructure

### 1.1 Digital Infrastructure - The Imperative

Digital infrastructure is one of the key enabling technologies for an interconnected and instrumented world which enables what we call 'Internet of Things' (IoT). The Internet of Things is the term used to describe a phenomenon where physical objects such as devices are both smart and connected, with the ability to collect and share data, which can create new interactions that will help unleash a new era of technology. It is a pervasive phenomenon which can dynamically change the life of billions of people using trillions of devices. As electronic devices like mobile phones, tablets, sensors and embedded chips become mainstream, they enable access to unprecedented amount of data and meaningful use by applying real time analytics and providing insights for effective action. As this concept of digital connectivity spreads across the world, the array of smart devices used by common people could enhance their quality of lives in probably unfathomable ways.

Many visionaries are betting on streamlining and automating processes and tasks with a universe of connected devices. As mentioned in the book 'The New Digital Age' people would be able to integrate clothing machines which will keep an inventory of clean clothes and algorithmically suggest outfits based on a user's daily schedule. Haircuts would be automated and precise<sup>1</sup>. With the digital infrastructure enabling varied functional improvements in devices and services, it can result in meaningful improvements in the quality of life: things that make you safer, healthier, and more engaged.

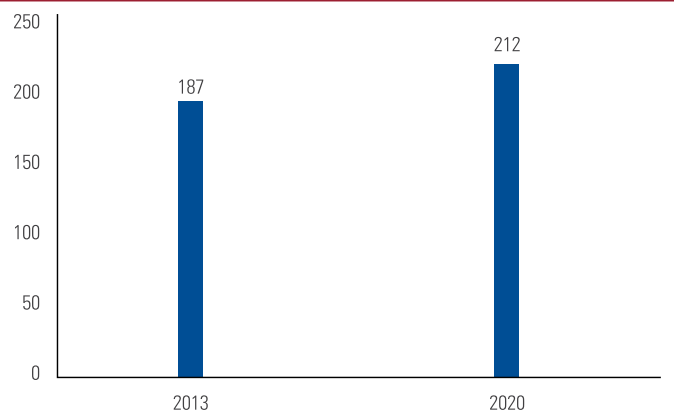
### 1.2 Digital Infrastructure – The current scenario

Digital infrastructure typically consists of an ecosystem of connected devices exchanging information with each other. One of the first examples of digital infrastructure emerged as Massachusetts Institute of Technology (MIT) developed networked radio frequency identification (RFID) and other sensing technologies in 1999.

With the advent of the Personal Computer (PC), the number of active Internet connections swelled into the millions.

Then came the second wave as smartphones and tablets were introduced and quickly adopted, and all of a sudden a single person could have multiple devices connected to each other<sup>2</sup>. We are now at the beginning of the third wave as wearable devices (fitness bands, watches, and eyeglasses), automobiles, appliances, and sensors connect to the Internet, bringing the number of connected devices into tens of billions<sup>2</sup>. This rapid growth is being driven by a steep decline in prices of components such as the, including Radio Frequency Identification (RFID) chips, and the increasing ubiquity of broadband access.

#### Total number of connectable things (in billion)



Source: EMC Digital Universe with Research & Analysis by IDC, <http://www.emc.com/leadership/digital-universe/2014iview/internet-of-things.htm>, accessed 18 November 2014

### 1.3 Key emerging applications of digital infrastructure

Digital Infrastructure is expected to have a transformative impact on almost all industries and provide opportunities to both new and existing players to gain recognition by innovations and providing phenomenal growth. Out of the potential digital infrastructure application areas, smart cities, smart car, mobility, smart home and assisted living, smart industries, smart energy and grids, and smart healthcare have acquired high attention.

1. New Digital Age: Reshaping the Future of People, Nations and Business by Eric Schmidt and Jared Cohen  
\*EMC digital universe with research and analysis by IDC, <http://www.emc.com/leadership/digital-universe/2014iview/internet-of-things.htm>

2. KPMG report on The Internet of Everything is Now, <https://www.kpmg-institutes.com/content/dam/kpmg/advisory-institute/pdf/2014/internet-of-everything.pdf>, accessed 6 November 2014



### 1.3.1 Smart cities

According to World Health Organisation, the global urban population is expected to grow approximately 1.84 per cent per year between 2015 and 2020, 1.63 per cent per year between 2020 and 2025, and 1.44 per cent per year between 2025 and 2030<sup>3</sup>. Currently cities face a variety of challenges including employment generation, economic growth, environmental hazards and enormous population. Given the challenging environment, smart cities become critically important in addressing these concerns.

Digital infrastructure can enable the administration to not only overcome these challenges, but also to transform the way citizens experience things around them will need to share, harness, and analyse data, and provide real time solutions. For instance, sensors can monitor the availability of parking spaces, vehicular traffic flow and suggest an appropriate route for travelling. Another example can be, a central operation center in a city transforming different elements, for example acting as a thermostat to ensure no energy is wasted, in addition to monitoring and optimising utility services. The central operations center can also monitor the city to reduce crime rate by setting up surveillance cameras, spotting anomalies and taking quick action.

#### Indian scenario<sup>4,5,6,7</sup>

Ever since the government announced the plan to build 100 smart cities, there has been a lot of buzz around the same in India as well as in other countries. With rapid urbanisation and growing population, India needs smart cities in the coming years. Cities should be selected on the basis of their population, tourist or religious significance; the government has allocated INR 1000 crore for each city<sup>4</sup>. The initiative has not only attracted ICT players across the world, but government organisations from Singapore, U.K., have offered to work with the Indian government in developing the smart cities<sup>5</sup>. Several initiatives have already been taken for the smarter management of Indian cities. The Government's National e-governance Plan is aiding urban governance. The Ministry of Power has allocated 14 Smart grid pilot projects that is expected to be implemented by state-owned distribution utilities in India<sup>6</sup>. Seven more pilot projects are also being planned and would be initiated shortly<sup>5</sup>. Advanced communications systems using next-generation technologies and optic fibre networks are being deployed to enable an uninterrupted communication channel. A few cities are also exploring intelligent transportation systems to manage traffic congestion and integrated fare collection systems. There is an increasing focus on smart buildings to ensure energy efficiency, safety and security.

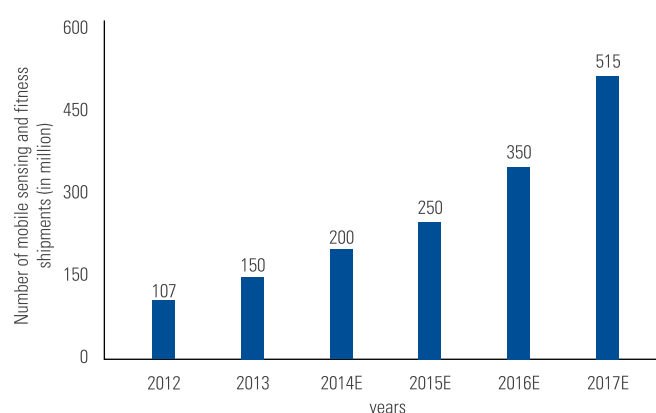
3. WHO website, [http://www.who.int/gho/urban\\_health/situation\\_trends/urban\\_population\\_growth\\_text/en/](http://www.who.int/gho/urban_health/situation_trends/urban_population_growth_text/en/)  
 4. -11 5 key elements of PM Narendra Modi's 100 smart cities, <http://www.indiantollways.com/2014/09/11/5-key-elements-of-pm-narendra-modis-100-smart-cities/>, September 11, 2014  
 5. Taken from <http://www.indiainfrastructure.com/confpdf/brochure-smart-cities-in-india-oct2014.pdf>  
 6. [www.indiasmartgrid.com](http://www.indiasmartgrid.com)  
 7. <http://www.prweb.com/releases/2013/5/prweb10778118.htm>

### 1.3.2 Smart health

With rising population, we face a lot of challenges such as, life style related health issues, chronic diseases and growing costs. The digital infrastructure, facilitating billions of connected devices including sensors, mobiles, actuators, etc. is making holistic tracking, remote house calls, data driven treatments and cloud powered medical records more accessible and feasible.

According to a survey, by 2017 there will be 1.4 billion mobile sensing health and fitness app downloads worldwide and health apps will increase the fastest over the next five years (mobile sensing solutions include wearable and implantable sensors as well as carry-able devices that can be used while the user is mobile<sup>7</sup>).

#### Global mobile sensing health and fitness sensor shipments



Source: ON World: 515 Million Mobile Sensing Health & Fitness Sensor Shipments in 2017, PR Wen news releases, 30 May 2013

#### Connected e-cigarettes

Smokio, the world's first connected e-cigarette was launched in February 2014 and the trend has attracted attention from players. These cigarettes are able to connect to the Internet and mobile app and share interesting data on usage, and should be able to even "automatically pre-order additional smoking articles" based on usage patterns. This data can be quite valuable for clinical trials. Smoking patterns and other data can be synced with health record and other apps that can help in reducing smoking intake.



Source: <http://www.smokio.com/>

Large ICT players have been working on futuristic concepts which are likely to significantly change the way the healthcare sector works. These tech players have been investing in devices which focus on healthier living with exclusive features to track heart rate, steps, calories burn and sleep quality. One of the biggest internet giants has been working on innovative concepts like smart contact lens (with the potential to monitor the wearer's blood sugar levels) and cancer detecting pills.

Connected devices in the future could remind users to go for a walk if they feel it has a prescribed benefit. If medications should be taken at prescribed intervals, users might be alerted at optimal durations.

IoT in healthcare is expected to play a major role in lowering the overall patient discharge cost. With the advent of sensors and DIY diagnosis, patients should be able to diagnose the problem at the right time with timely treatment from doctors and hospitals. Wearable devices can save billions of dollars by reducing the number of hospitals visits, diagnosis, reports and scans by capturing data and instantly updating doctors about the appropriate problem and recommendations through cloud-based records. With the advent of cognitive technologies by one of the technology giants, even identification of for best prescription for cancer patients is possible now. With the advancement of such technologies, even recommendations for potential treatments can be automated in the future.

**“Devices and Body Sensors can will enable real-time data for personalised prescription”**

### Smart Toilets

Researches are working on making our toilets smarter with built-in sensors that are able to read a person's genetic code for health markers. Such toilets can provide vital information usually provided by a health checkup on a daily basis. These smart commodes can also save this data on the cloud and sync it with the person's personal health record system which can be shared with their personal doctors. This can help in the detection of diseases and even measurement of the likelihood of certain diseases.



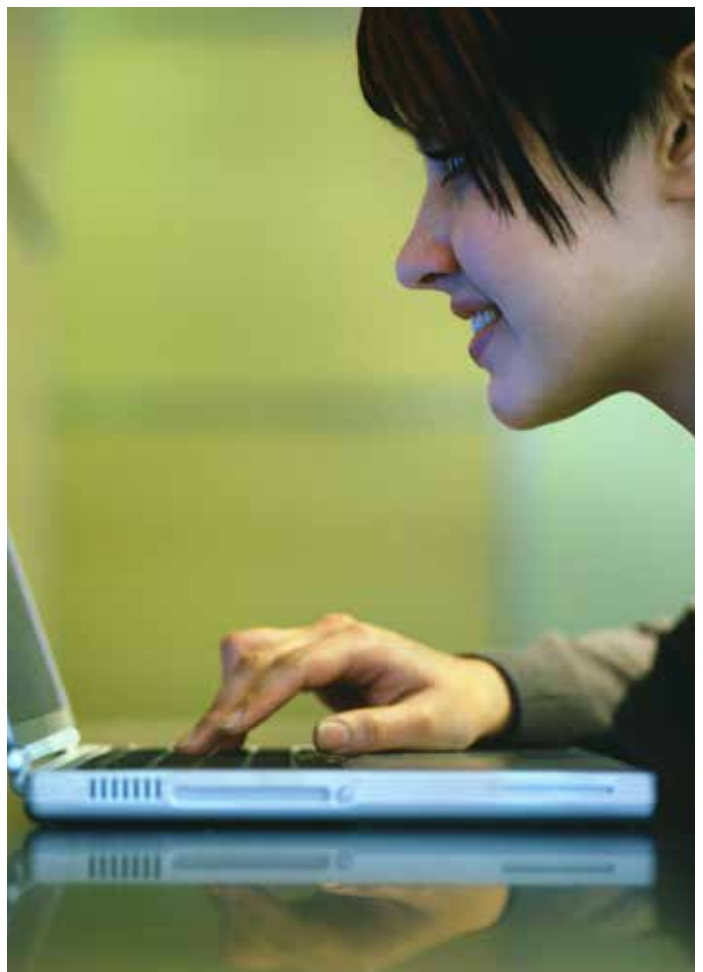
Source: [http://www.wfs.org/Forecasts\\_From\\_The\\_Futurist\\_Magazine](http://www.wfs.org/Forecasts_From_The_Futurist_Magazine)

### Indian scenario

Digital infrastructure and wearable devices in the healthcare market in India is still at a nascent stage and very few healthcare providers are using these advancements. Given India's huge population, low income level and lack of basic healthcare facilities in many rural areas, managing healthcare in India is often a challenge. However, there is hope that once digital infrastructure technologies around healthcare are mature, they can provide a lot of opportunities to bring low cost and effective technology to rural areas and enhance the quality of existing healthcare services.

Reliance Hospital intends to use Google Glass to pull patient's medical history using 'We Care', an app developed by SAP, thus allowing the treatment to begin within a few minutes. This app is connected to the hospital information system and can also pull additional data such as X-rays, blood works and radiology reports amongst others. In addition to this, doctors can also leverage Google Glass to create new records by just talking to the glass instead of scribbling notes on a piece of paper.

Source: <http://www.reliance-tracker.in/reliance/doctors-at-sir-h-n-reliance-hospital-will-use-google-glass-to-improve-healthcare-service-delivery/>

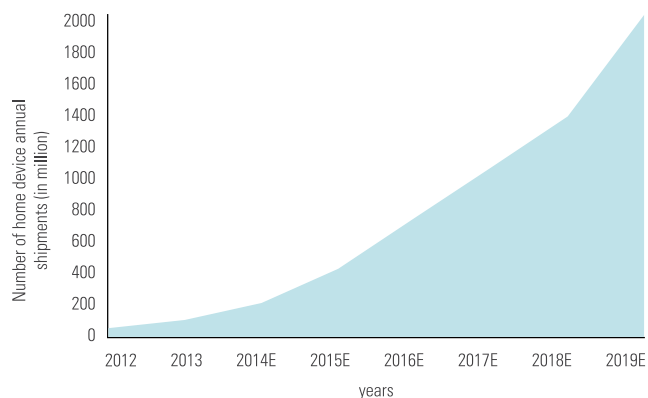


### 1.3.3 Smart homes

A Smart home would be a house with smart, connected devices which can be remotely controlled and can be connected to the internet. This enables devices to be controlled by a mobile, or be linked together electronically. A Smart Home foresees and responds accordingly to the needs of the residents; working towards enhancing their comfort, convenience, security, and entertainment by using the Internet as the backbone for communications with and among the various devices<sup>9</sup>. With the advent of sensors in home appliances, increasing network bandwidth and improved connectivity, smart homes are on the verge of becoming mainstream. The concept of “Smart Homes” is increasingly becoming the focus of a lot of research and development leading to disruptive applications like IFTTT (If This, Then That) which are improving technology adoption by making it easier to apply conditions on devices; for example, you can set rules to open the garage door when you arrive at home using a Garageio channel recipe in IFTTT<sup>10</sup>. According to some of the leading electronics manufacturing companies, – devices would be able to figure out when you wake up and start the coffee; prompt you to take your medicines on time; turn out the lights when you doze off; suggest recipes that use up ingredients before they go bad.

The major drivers for the smart homes market include enhanced security, comfort, functionality, reduced energy consumption and regulatory initiatives by governments amongst others<sup>11</sup>. Smart homes are expected to be driven by the increased adoption of smart washing machine, smart refrigerators, smart air-conditioner, smart vacuum cleaner, smart TV, etc.

#### Global connected - home device annual shipments



Source: Business Insider, THE CONNECTED-HOME: Forecasts and Growth Trends for the Leading 'Internet Of Things' Market, Sep 30, 2014

8. <http://www.marketsandmarkets.com/Market-Reports/smart-homes-and-assisted-living-advanced-technologie-and-global-market-121.html>, October 2013
9. Garageio blog, by Dave Reif, October 23, 2013 <https://garageio.com/blog/>
10. Smart Homes Market - by Products, and Geography - Analysis & Global Forecast (2013 - 2020), <http://www.marketsandmarkets.com/Market-Reports/smart-homes-and-assisted-living-advanced-technologie-and-global-market-121.html>, October 2013
11. IDC press release, <http://www.idc.com/getdoc.jsp?containerId=pr1N24908614>, 4 June, 2014
12. CISCO newsroom, [http://newsroom.cisco.com/release/766978/Mantri-Developers-Appoints-Cisco-as-its-Strategic-ICT-Pa\\_2](http://newsroom.cisco.com/release/766978/Mantri-Developers-Appoints-Cisco-as-its-Strategic-ICT-Pa_2), March 27, 2012
13. <http://www.airforce-technology.com/features/featurege-smartsignal-helping-military-maintenance-fix-before-failure-4316508/>

**Siri for your smart home:** Apple has announced HomeKit, a framework in iOS 8 to communicate with and control connected devices. Home automation apps would be able to integrate with Siri enabling users to give voice commands to manage smart devices. United Computer Intelligence Corporation has also recently launched Ubi, a device that allows people to talk to their homes. This plug-in device connects to the home WiFi and currently integrates with SmartThings and WeMo devices.

Source: Apple insider, <http://appleinsider.com/articles/14/06/20/first-look-siri-gains-smart-home-controls-with-homekit-in-ios-8>, June 20, 2014

#### Indian scenario

“Smart homes” is still an emerging concept in India; with the government announcing the budget for 100 smart cities, the future outlook for adoption of smart homes seems bright. According to the International Data Corporation, India is currently among the fastest growing smart phone markets in Asia Pacific and has seen a 31 per cent sales growth in the first quarter of 2014, which is higher than China<sup>12</sup>. So there can be a positive adoption of smart homes especially with India’s growing middle and affluent class and rise in disposable incomes. As smart homes can provide enhanced safety, security, functionality, comfort and style, it is only a matter of time before home automation systems become mainstream. Many builders are also tying up with technology companies to provide smart homes. Many leading builders and real estate developers are collaborating with ICT players to develop new Information and Communication Technologies (ICT)-enabled real estate models to create smart urban homes where not just the apartment, but the entire project could be connected through a wireless network making it a smart living environment<sup>12</sup>.

“ Having built an ERP-class application to be completely web-enabled and accessible on Mobile and tablets, ‘digital’ is a way of life at Ramco. The growing availability of bandwidth and digital infrastructure is helping us innovate and build solutions that are able to touch the lives of the end-user in a positive way. We proudly say, the aircraft that safely flies you to a destination to the distributor chain that connects the farmer till the point of sale is networked and connected on an application built by Ramco. This has been possible with the advent of technological innovation and growth in digital infrastructure. ”

#### Harsh Vardhan

Executive Vice President (Marketing and Partnerships)  
Ramco Systems

### 1.3.4 Smart e-commerce

There has been a phenomenal growth and technological advancement in the space of e-commerce, where social, mobile and analytics technologies have made consumers empowered and at the same time predictable with respect to their buying behavior. Smart e-commerce has the potential to generate dynamic value for both the buyer and seller. For example, super markets would be able to predict the exact date when a consumer would return and the amount he/she would spend. Consumers would be able to analyse their purchase history with smart vending machines using images to buy the appropriate amount of items.

#### Same day delivery by drones



An individual likes a pair of shoes of an actress in a sitcom on television



Using gestures, she points to the pair of shoes. The TV connects to the internet and provides her more details



The TV connects to the retail system of a nearby retailer as it already knows the size and shipping details of the customer



A drone delivers the package containing the shoes in 30 minutes charged automatically to her card

Use case scenario	Potential
Predictive maintenance <sup>14</sup>	General Electric's Smart Signal monitors the pieces that make up an equipment and predicts any failure in advance using algorithmic functions. In the use case scenario, it can save billions of dollars in aircrafts and vehicles in military to identify potential break downs, and also precious human life. The company has successfully used the same technology in various sectors like gas, energy, civil aviation and mining industries.
Smart Vending machine <sup>15</sup>	SAP is working on a Smart Vending based on the SAP HANA data platform featuring near field communication (NFC). The intelligent machine is expected to allow customers to purchase items and connect them with social media platforms. It also gives customers various offers according to the purchase history, making the purchase easier for them. From a business perspective, NFC enabled vending machines will help retailers to understand customers preferences and manager their offerings more efficiently.

Indian startups making advancement in the arena:

Use case scenario	Potential
Entrib ShopWorx <sup>16</sup>	Entrib by ShopWorx helps to digitise the floor with sensors, real time data communication with remote systems and intelligent software applications. These devices are being deployed at the manufacturing plants which acts as virtual assistants. This structure enables machines to notify downtimes for instant action and measures resulting into higher quality of production.
SenseGiz <sup>17</sup>	FIND by SenseGiz is a track & find Bluetooth tag which helps to prevent losing or misplacing objects like keys, bags, pets, laptops, phones or any other useful object. It raises an instant alarm if the tagged object is left behind. And, if the distance between the phone and FIND goes beyond the range, it alerts with an alarm.

### Indian scenario

According to Forrester, Indian online retail spending will reach \$16 billion by 2018, where online retail in India grew by 67per cent in 2013<sup>18</sup>. The number of Indian online buyers is expected to grow to 128 million by 2018. Currently, India has very strong base of e-commerce companies where few of them are currently dominating the market; recently one of the leading online shopping websites in India sold products in a very small duration generating millions of dollars of revenue in a day. With such a fast growing e commerce scenario in India, adoption of digital infrastructure seems very much possible, where concepts like drones are not distant dreams.-

// The infusion of new technologies like sensors, devices, efficient networks and advanced analytics is increasingly enabling the convergence of back-end Information Technology (IT) systems to the front-end Operations Technology (OT) devices and platforms that are predominantly proprietary systems.

We believe that there is tremendous potential in the coming years for new devices, applications and platforms at the intersection of IT and OT. We are also studying the trend of smart wearable devices influencing the emergence of new enterprise level applications and use cases. Our focus is across segments of:

1. Wearable device-based computing and intelligence
2. Smart Handhelds and Appliances
3. Industrial Machines.

The connected devices and IOT adoption is happening across the industry segments and we at Wipro are working closely with our clients in helping them leverage value from the connected ecosystem. //

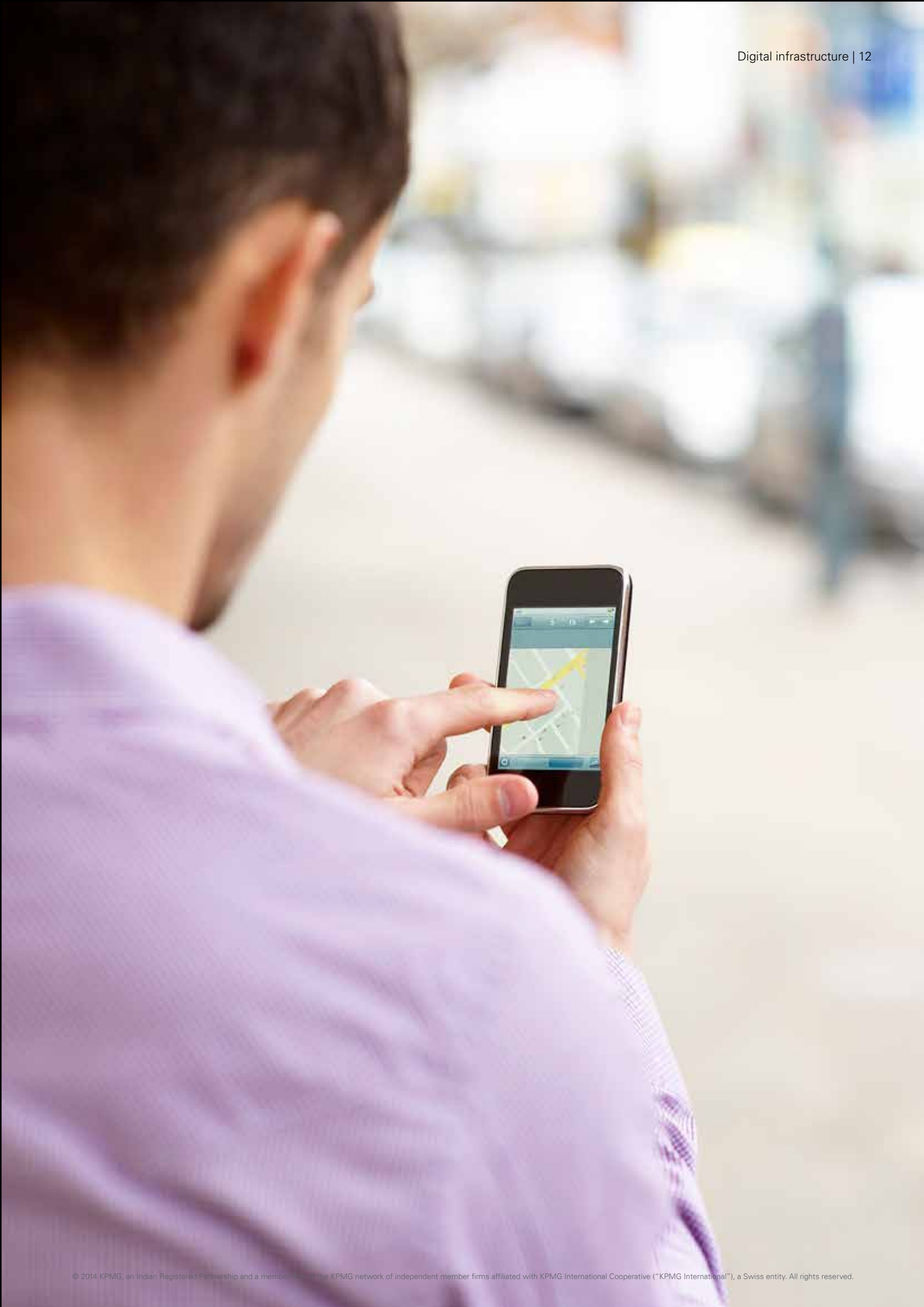
**Satishchandra Doreswamy**  
Chief Business Operations Officer, Wipro limited

14. SAP blog by Julian Hooks, June 23, 2014, <http://blogs.sap.com/innovation/innovation/smart-vending-machine-the-future-of-technology-01253903>

15. <http://www.entrib.com/about-us/>

16. <http://sensegiz.com/find/>

17. Forrester blog, [http://blogs.forrester.com/jitender\\_miglani/14-03-04-indias-online-retail-spending-will-reach-16-billion-by-2018](http://blogs.forrester.com/jitender_miglani/14-03-04-indias-online-retail-spending-will-reach-16-billion-by-2018), accessed on November 13,2014



# Business of Things

## 2.1 Business of things

Machine to machine communication along with IoT forms the foundation for digital infrastructure, which means that devices are able to exchange information and respond to other devices. Considering the amount of value derived from digital infrastructure, many companies are already investing in it to reap early benefits. Technology visionaries and several startups are already flooding the market with smart devices and are intent on taking it to the next level where these devices, would be collectively intelligent. There are certain elements that act as building blocks for a any digital infrastructure set-up and they include:

1. Hardware components such as sensors, cameras, and microphones to extract and collect data by detecting movement, capturing images, etc.
2. Semiconductors to analyse and process the information

3. Telecom networks and information-exchange to connect one device with another, and further bind them to a cloud-based network
4. Software applications and platforms to integrate data and create user interface, analytics, automation technology, etc.

Digital infrastructure can also provide enhanced transformation opportunities to businesses which, by utilising these new capabilities, can provide value-added services to their customers. On a practical note, RFIDs, sensors, wearable tech products, connected devices, chips, etc are creating real-time data for businesses, which are being analysed for generating better insights.

### Total number of connectable things (in billion)



Source: EMC Digital Universe with Research & Analysis by IDC, <http://www.emc.com/leadership/digital-universe/2014/view/internet-of-things.htm>, accessed 18 November, 2014

The information generated by connected devices in a digital infrastructure can benefit enterprises in the following ways:

**Real time insights:** For any business, real time customer insight generation can bring a wave of new business opportunities. Digital infrastructure can provide the ability to collect real time data, analyse it and eventually capture the consumer mindset and successfully predict purchase patterns. Customer life cycle remains crucial to a business and real time insights can work wonders to retain these customers. Companies can install and connect sensors to increase utilisation of a facility and through more effective monitoring of conditions, extend its useful life, and this certainly can matter a lot in facility-intensive businesses like manufacturing and retail.

**Personalisation:** Real time insights generation can help businesses delight their customers across the customer life cycle. With increasing availability of customer attributes and interactions, it will likely be easier for businesses to customise offerings to suit the individual.

**Responsiveness:** Real time data can be put to use by agile businesses to respond to customer needs in a more responsive manner. An automobile service provider can use timely notifications regarding the wear and tear of a vehicle and respond with a targeted service delivery. Also, as we saw in the e-cigarette example earlier, a connected e-cigarette can automatically order additional articles related to smoking as and when to provide a hassle-free experience for customers

**Revenue generation:** Digital infrastructure can allow businesses to use data and connections to open up new revenue streams and increase customer life time value. By personalising business offerings to suit individuals, the propensity to convert a prospect to a customer could increase manifold. In addition to this, multiple value-added services enabled by digital infrastructure can also add to the revenue stream of the business.

### Value Generation for Business



Source: HBR Article by Gordon Hui, 29 July 2014, <https://hbr.org/2014/07/how-the-internet-of-things-changes-business-models>, KPMG in India analysis



// Digital Infrastructure as a concept is presenting numerous growth opportunities for organisations playing in the ICT space. Client organisations are increasingly looking to not only reduce cost but also gain competitive advantage leveraging Digital technologies in their own industries. Everyone is fast realising that it is imperative to view technology as game changers rather than things that are required to support business operations. This view will gain further impetus as IOT/ digital infrastructure promises much more than what we have experienced till now. We are transitioning from smart devices to smart ecosystem of devices and this is going to provide bigger market opportunities for organisations looking to succeed in this space. //

**Chandra Sekaran,**  
Executive Vice Chairman  
Cognizant  
India

## 2.2 Ecosystem for Digital Infrastructure

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The Ecosystem of things constitute enabling technology behind digital infrastructure for example, hardware such as sensors & actuators and software such IoT platform, APIs, middleware etc. working as a middle layer of digital infrastructure for the companies. The opportunities presented by digital infrastructure are driving investment from several traditional and non-traditional ICT vendors who are looking to take advantage of the growth opportunities available to them.

**Devices:** Hardware players need to evolve their devices to exploit digital infrastructure to their advantage. They need to add sensors, chips and ability to connect to network amongst other modifications. Devices need to be manufactured as per the standards to make them compatible example. If a hardware manufacturer wants to connect to iOS, they need to manufacture the devices using Apple's MFi guidelines and incorporate technical specifications specified by Apple.

**Gateways:** Connectivity is a key enabling technology for digital infrastructure and many players have introduced gateways to connect legacy and new devices to local compute platforms. Gateways can collect sensor data, then act as a filter to analyse the data for sharing it onto the cloud. To enable uninterrupted and secure data flow between connected devices, one of the world's largest chip manufacturers and one of the leading security providers have joined hands to offer integrated gateway solutions.

**Network:** Network providers have an increasingly important role to play as connected devices connect to cloud to transmit data and get instructions. Network providers need to expand their network capabilities and make their networks compatible with connected devices. This would also open new avenues for growth and revenue generation for network providers.

**Cloud:** The Cloud will likely come to the forefront as a key technology to bring the benefits of digital infrastructure to life. Data collected by smart devices would be sent to cloud, analysed over cloud, possible actions and instructions sent to the device back from cloud. The Cloud would also serve as a key connector between different devices, platforms and services. Several technology majors are developing applications and platforms around internet of things; a leading technology provider has already built a platform that helps in quick development and deployment of cloud-based applications for various vertical industries.

**Platform:** Platform is a key enabler for running and developing new applications and services in a digital infrastructure. Applications developed by a third party organisation would require different platforms and environments to run smoothly, so their integration and compatibility is important. Organisations need to focus on

developing applications that can efficiently and smoothly run on different platforms.

### Applications and Solutions:

Many Application providers are developing applications to bring in new features and services from digital infrastructure and connected devices to life. In digital infrastructure, applications hold the command for the efficient functioning of connected devices; whether it is real-time data exchange or generating insights, they possess key ingredients for running functions smartly.

**Services:** Many service providers are moving to expand IT services and offer IoT related services. From consulting and proposing solutions leveraging digital infrastructure to deploying & implementing these solutions, many service providers are emerging as key players that integrate and help deliver IoT services. Companies like IBM and HP are using their Systems-Integration capabilities and Professional Services relationships with IT organisations to develop new offerings for clients<sup>20</sup>.

## 2.3 Challenges

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**Data security:** When everything from devices, homes, cities, clothes, shoes and many more things are connected to the internet, it could get difficult to manage security due to vast connections and exchange of information. As a lot of data would be exchanged over the platform, attacks from unauthorised sources would be a key concern.

As these connections will likely also use personal information from consumers, there would be vulnerability in the form of hackers stealing information to access important information. For example, a smart home would carry every bit of personal information and daily schedule of those who live there, a sensor could become dysfunctional and expose data openly through wireless networks. Many organisations are seriously working on these issues for safe exchange of data information between things in the digital universe.

**Lack of standards:** Standardisation of devices, connectivity and government bodies can be major challenge for a quick adoption of digital infrastructure. Manufacturers need to be persuaded to build standard communication platforms and create data in a way that sharing is easy. Companies and governments need to work together to tackle the issue of standardisation.

**Interoperability:** Going by the definition of digital infrastructure where almost every device can exchange information, however devices maybe unable to integrate as they are made different manufacturers and use different platforms. Digital infrastructure requires open and smooth exchange of information, which maybe unlikely to happen if there is no protocol followed by the vendors that allows their brand of devices to connect and exchange data.



**Privacy:** In this new hyper connected world, where IT giants are investing billions of dollars for securing personal information and building a secure platform for information exchange, we are still seeing some ambiguity in the ecosystem. Billions of devices can create excessive data which might add more complexity, resulting in lesser control

and security. Data privacy in digital infrastructure holds a high value as it is directly related to personalisation and real time insight generation.



// Digital transformation is the most exciting technology revolution in the current era. It is amongst the top 3 priorities for clients across industries and has the ability to create momentous impact to the enterprises. Digital Infrastructure allows enterprises to redefine consumer experiences and reach, simplify business operations and processes and leverage new business models and product possibilities. The world of connected devices and IOT offers new possibilities of engagement and revenue to enterprises.

The benefits of Digital transformation is leveraged at its best when there is convergence of great consumer experiences, made feature rich through enterprise features and software apps often on the cloud.

Market opportunities are abundant in the above mentioned areas for technology, computing, and consulting companies. It is imperative to strive for innovation to find suitable industry solutions, which is fit-for-purpose & use and provides transformational benefits. //

**Thothathri V**

Vice President  
Life Sciences & DC Head - Chennai  
Infosys Limited



// The benefits of digital transformation can be compounded with technology innovation and enablement in the digital infrastructure areas of telecom infrastructure, standards, communication technologies – wireless low energy communication, embedded computing systems.

Let us take the Retail industry as an example for illustration of adoptions of digital transformation. We are already witnessing how Omni-channel commerce is driving fundamental shift in India in terms of market reach, buying pattern, and re-shaping the consumer behavior. Omni-channel commerce supported by Social Media Insights, in-store computing devices, digital coupons and wallets will enhance the adoption and further enrich the consumer experience. //

**Sriram Ramanujam**

Practice Manager  
Retail, CPG & Logistics  
Infosys Limited

## Value generation in India

### 3.1 Value generation in India

Digital infrastructure has the potential to transform industries and segments by forming a nexus between various independent technologies and taking them to the next level of advancement. This nexus of things provides enormous data which can be analysed to improve the performance and efficiency of systems in different sectors catering to their current issues. It can create new opportunities and revenue streams benefiting almost all sectors in the industry.

As predicted by Gartner, the total economic value add for the IoT will be \$1.9 trillion dollars by 2020. Manufacturing, healthcare, insurance, banking and retail sectors have the maximum potential and lead the overall opportunity<sup>18</sup>.

“IoT industry in India is expected to be a USD15 billion market by 2020, it has been assumed that India would have a share of 5 to 6 per cent of the global IoT industry<sup>19</sup>”

– Department of Electronics and Information Technology (DeitY)

### 3.2 Opportunities for ICT players in India

#### 1. Hardware providers

Indian companies have a huge opportunity to build devices that can connect and exchange information. As China is the global hub for mobile manufacturing, similarly India can lead in manufacturing sensors and embedded technology used for smart cities, smart transport, smart infrastructure and so forth. India has the human capital and resources to build devices for building digital infrastructure.

- The Indian government has launched the ‘Make in India’ campaign and several companies are in the process of establishing new manufacturing facilities in India, which are expected to drive the demand for electronic components and semiconductor designs in the future.
- India is expected to be the second largest market for mobile devices as they gain traction in IT, industrial electronics and consumer markets. Indian players are expected to see significant growth, and huge opportunity is expected for players proficient and skilled in the manufacturing of such devices and their components.

- As Indian government executes its plan to build 100 smart cities in India, a \$140B opportunity over next 20 years, hardware and ICT players can expect good growth from partnering with Indian government in developing roadmaps for the investments.

#### 2. Applications & Platforms

Like in hardware, a significant opportunity also exists for companies in building applications and platforms for digital infrastructure. Interoperability is one of the biggest challenges that hinders devices to connect and exchange information with each other; application and platform providers have an opportunity here to come up with solutions which enables connectivity between different devices and platforms. IBM, Oracle, TCS and many other companies have developed or are developing applications and platforms to cater to the needs of connected devices.

#### 3. Service providers

Different companies cater to different dimensions of the digital infrastructure ecosystem. Indian companies with their traditional strength in IT services and consulting are positioned well to provide wide-ranging solutions integrating software and other elements from different players. A huge demand is expected: from consulting different verticals on effectively using digital infrastructure and internet of things, to implementing these solutions and eventually providing data analytics services to further refine customer experience for their clients. We have seen multiple efforts by different companies for example, Wipro and Tele2 recently announced a partnership around M2M/IoT solutions. Wipro, TCS, Cognizant and other service providers have also identified IoT as a key growth area<sup>23</sup>.

#### 4. Network providers

As connectivity forms the backbone for billions of connected devices, Indian network providers can leverage the opportunity by investing in the digital infrastructure blueprint created by the Indian government which is focussed on three areas: digital infrastructure as a utility to every citizen, governance & services on demand and digital empowerment of citizens.

18. Gartner press release, <http://www.gartner.com/newsroom/id/2621015>, November 11, 2013

19. <http://deity.gov.in/content/internet-things>.

- Also, the Indian government has launched several initiatives to bridge the 'digital divide' between urban and rural areas and harness the digital revolution to increase the spread of education. Programmes like the 'National Knowledge Network' and 'National Optical Fiber Network' are expected to require investments in telecom equipment worth billions.

### 3.3 Companies investing in IoT through partnerships, training employees and funding startups in India:

Company	Initiative
Wipro <sup>24</sup>	Setting up an internal facility to train employees on emerging technologies. The <b>training will focus on areas such as Internet of Things (IoT)</b> , social, mobile, analytics, cloud (SMAC) and open source technology.
Infosys <sup>25</sup>	Partnered with Philippines-based wireless provider <b>SMART Enterprise</b> to develop new industry solutions in the areas of <b>machine to machine (M2M) communication and Internet of Everything</b>
Cisco <sup>26</sup>	Cisco will invest <b>USD 40 million</b> over the next 12 to 18 months to <b>fund early-stage firms in India</b> working on big data & analytics, <b>Internet of Things (IoT)</b> , <b>connected mobility</b> , storage, silicon, content technology ecosystem among others.
TCS <sup>27</sup>	TCS is looking at digital as key growth driver and its current CEO believes that it can be a multi-billion dollar business for the company. Digital business for TCS will include big data analytics, Internet of Things etc. TCS has seen significant success esp. in smarter utilities business and has also launched TCS Connected Universe Platform (TCUP) which makes it easy to develop, deploy and administer IoT and Machine-to-Machine (M2M) software applications.

### 3.4 Value generation possibilities for various sectors:

Segment	Challenges	Solution	Value generation
Healthcare	<ul style="list-style-type: none"> <li>- India spends just 2.5 per cent of its GDP on health care, high out-of-pocket expenditure, has only 6.49 doctors per 10,000 people<sup>28</sup></li> <li>- Basic health concerns in rural areas</li> </ul>	<ul style="list-style-type: none"> <li>- Remote monitoring in rural areas</li> <li>- Sensors detecting early signs of health problems</li> <li>- Cloud-based historical records for easier diagnosis</li> </ul>	<ul style="list-style-type: none"> <li>- Reduced healthcare costs</li> <li>- More patients can be served by the doctors</li> <li>- Understanding health issues from the root cause</li> </ul>
Manufacturing	<ul style="list-style-type: none"> <li>- Infrastructure bottlenecks, frequent power outages, transportation causing long delays<sup>29</sup></li> <li>- Inefficient supply chain operations</li> </ul>	<ul style="list-style-type: none"> <li>- Instrumented and connected machines in plants to reduce time to market, improved quality and efficient resource utilisation</li> <li>- Using sensors and embedded technology to enhance transportation system by real time tracking and monitoring, e.g. notifying drivers to take the shortest distance</li> </ul>	<ul style="list-style-type: none"> <li>- Reduction in overall supply chain operations</li> <li>- Digital empowered manufacturing</li> <li>- Fast delivery of goods</li> </ul>
Power	<ul style="list-style-type: none"> <li>- Power sector debt reached US\$77 billion in 2011, power theft, inefficiency in distribution<sup>30</sup></li> <li>- High power consumption by industries and consumers</li> </ul>	<ul style="list-style-type: none"> <li>- Smart Grids for analysing fluctuations in demand</li> <li>- Fault detection through sensors</li> <li>- Smart meters can help consumers to keep a tap on their usage and manage their consumption accordingly</li> <li>- Smart grids and meters can help in load balancing</li> </ul>	<ul style="list-style-type: none"> <li>- Increased efficiency for power distribution</li> <li>- Automation for managing load capacity in grids</li> </ul>
Road Transportation	<ul style="list-style-type: none"> <li>- Roads are generally in poor condition, urban traffic is clogged, Highest rate of road deaths ~140,000 in 2012<sup>31</sup></li> <li>- Less parking space</li> <li>- Technology has not been widely utilised</li> </ul>	<ul style="list-style-type: none"> <li>- Real time traffic monitoring</li> <li>- Sensor-based parking</li> <li>- Notifying road crews for maintenance during harsh weather</li> </ul>	<ul style="list-style-type: none"> <li>- Lowering road death rate in India with road maintenance and efficient traffic monitoring systems</li> </ul>
Railways	<ul style="list-style-type: none"> <li>- Improper signaling &amp; track changing</li> <li>- Delays due to extreme weather conditions</li> <li>- Lack of new and efficient technology</li> <li>- Rail fractures ~6247 in 2012<sup>32</sup></li> </ul>	<ul style="list-style-type: none"> <li>- Smart track signaling mechanisms</li> <li>- Monitor wheel temperature</li> <li>- Data generation from railway tracks</li> </ul>	<ul style="list-style-type: none"> <li>- Efficient operations during extreme weather conditions</li> <li>- Less occurrences of derailling</li> <li>- Reduced manual effort</li> </ul>
Retail <sup>33</sup>	<ul style="list-style-type: none"> <li>- Heterogeneous market,</li> <li>- Poor supply chain infrastructure</li> <li>- Retail shrinkage due to frauds</li> <li>- Possibilities of incorrect deliveries - Higher instances of return to COD (cash on delivery)</li> </ul>	<ul style="list-style-type: none"> <li>- Predictive analytics</li> <li>- Digital commerce solutions</li> <li>- Supply chain management</li> <li>- Personalised solutions</li> </ul>	<ul style="list-style-type: none"> <li>- Better understanding of the buyer</li> <li>- Cost efficient order processing</li> <li>- Targeted marketing with higher potential to convert</li> </ul>

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21. <http://www.cxotoday.com/story/infosys-partners-with-smart-to-offer-m2m-innovation/>, 04 July 2014

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27. World Bank article, <http://www.worldbank.org/en/country/india/brief/india-safe-clean-affordable-smart-transport>, 13 August 2014

28. Rail Business, Volume 5, Issue 24 May 2014

29. Indian retail, The next growth story, KPMG Whitepaper, 2014, [www.kpmg.com/IN/en/issuesAndInsights/.../Documents/BBG-Retail.pdf](http://www.kpmg.com/IN/en/issuesAndInsights/.../Documents/BBG-Retail.pdf), accessed on November 17, 2014

## Way Forward

Digital infrastructure can power the next mega trend as connected devices can converge bringing more efficiency and possibilities in the future. Industry players and society as a whole is expected to leverage digital infrastructure to create economic value. India, with an enhanced focus on 'digital infrastructure' under the new government, can look forward to address the current social economic challenges faced by the people leveraging the power of digital infrastructure. In addition, digital infrastructure can also be expected to play a big role in the success of the 'Make in India' programme

### Government

The Indian government has announced significant plans to build 'digital infrastructure' as part of 'Digital India' initiative weaving together a large number of ideas and thoughts into a single, vision. Given the transformative nature and benefits, the Indian government has announced investments of over INR113,000 crore to build digital infrastructure. The Indian government needs to ensure various sub-programs are working in synergistic and coherent manner to deliver a truly transformative digital infrastructure which can propel India to the lead the internet of things revolution. The Government also needs to play a major role in creating rules & regulations, especially around data security to help ensure the protection of users. In addition,

the government also needs to ensure a consistent regulatory framework across industries especially where we see an overlap, for example any regulation in the energy sector which overlaps with the IT industry can cause issues while providing smart energy over smart grids.

### Industry Associations

Associations and industrial policy makers need to take a lead in proposing standards and identifying opportunities for various players to work in a synergistic manner on a compatible platform. Industry players can benefit only if they form a consensus on issues like interoperability and work on the guidelines of mutual trust. Associations need to take a lead here and help establish the framework and ensure its implementation.

### Firms

Digital infrastructure is expected to create tremendous economic value, both in creation of infrastructure and in key applications like smart cities, smart utilities, smart healthcare, smart transportation and more. Internet of things can unleash a new era in technology and it can be imperative for industry players to fully harness the power of digital infrastructure to introduce new products and services with enhanced functionality. Almost all industry verticals will likely be touched by digital infrastructure and a tremendous opportunity exists for early adopters to establish themselves as leading players on a global scale.

// Traditionally, Intel India R&D has been focussed on developing software and hardware graphics, and the central processing units for servers. Now, we are also looking at developing solutions in the IoT space, to be developed into a product for the India market. This step comes in the wake of the Indian IT market showing signs of maturity, backed by government initiatives such as Digital India.

Computing in the digital world can transform businesses and enrich lives of people, which has become more immersive, perceptive and social to enhance user experience and productivity. Our local and frugal innovations can help in building enabling technologies for the government's Digital India plans spanning infrastructure, e-governance, utilities, literacy and empowerment of citizens. Technology usage in India is catching up and entering new areas, marked by acceleration in IP (intellectual property) creation and digital literacy to serve local needs, mobile penetration and social entrepreneurship. //



### Srinivas Tadigadapa

Director  
Enterprise Solutions Sales,  
Intel South Asia



// The Internet of things is a powerful composite force that combines the power of digital forces to help companies and governments re-imagine themselves. The impact of it is going to be bigger than that of the Internet by a factor. Data from objects stationary and mobile, anywhere, all the time coupled with the tremendous explosion in computing capability will drive analytics and prediction to the next level. Modern big data systems on the cloud are already enabling some of this. Commerce will propel to the next orbit with the advent of these technologies. It therefore poses a tremendous challenge and hence a huge opportunity to Industry and commerce. The infrastructure creation, harnessing and leveraging the same will bring tremendous opportunities across the spectrum transforming our lives. Be it education, health and most other essential services, a new paradigm will evolve. //

**Ravi P Viswanathan**

President  
Growth Markets  
TATA Consultancy Services



// As the physical and digital worlds continue to converge, information and communication technologies (ICTs) have become very important and is top priority in the minds of the industry leaders, given that it has a huge impact on our daily lives. Expectations will only rise, and industries are pushed to look at such challenges today, as part of their key strategies and planning, as we prepare for the future.

Changes in the way people communicate in the twenty-first century has become a huge challenge for telecom operators and it is become a highly competitive world. The creation, maintenance and upgradation of infrastructure are all very capital-intensive, with shorter equipment lifecycles, which is today one of the biggest challenge that an operator faces. Further complicating things, the revenues/profits keep shrinking as a result of such changes or expectations.

To balance the needs of the future with the pressures of today, three things will need to happen:

- Establish the right regulatory and industry policies to encourage infrastructure investment
- Reduce the cost of network infrastructure
- Enhance collaboration both within ICT and across industries. //

**Chandramouli**

Vice President & Centre Head  
Mindtree Limited

\*The views and opinions expressed herein are those of the interviewees and do not necessarily represent the views and opinions of KPMG in India.\*

# About KPMG in India

## **KPMG in India**

KPMG in India, a professional services firm, is the Indian member firm of 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 in India provide services to over 4,500 international and national clients, in India. KPMG has offices across India in Delhi, Chandigarh, Ahmedabad, Mumbai, Pune, Chennai, Bengaluru, Kochi, Hyderabad and Kolkata. The Indian firm has access to more than 8,000 Indian and expatriate professionals, many of whom are internationally trained. We strive to provide rapid, performance-based, industry-focussed 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 International is a global network of professional firms providing Audit, Tax and Advisory services. KPMG member firms operate in 155 countries and have 155,000 people working in member firms around the world.

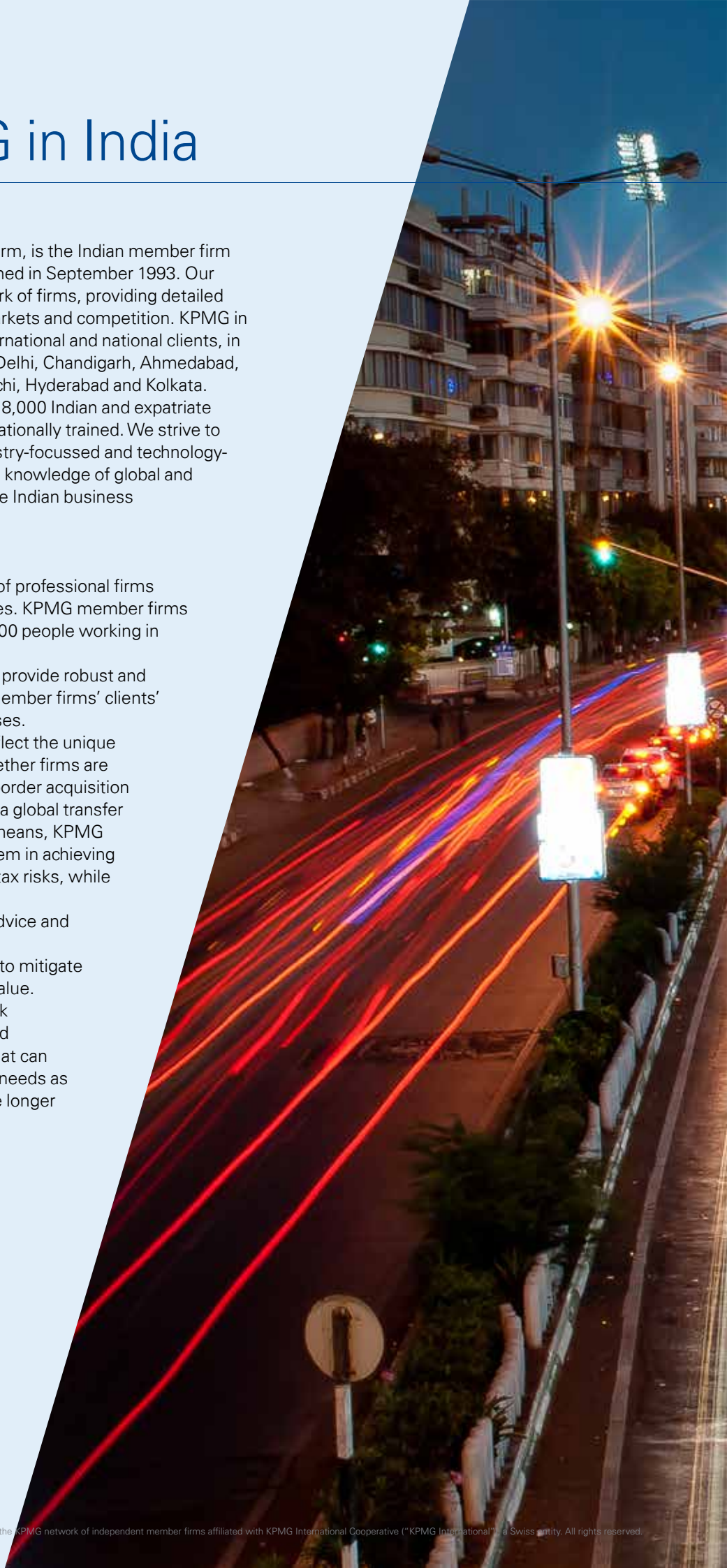
The KPMG Audit practice endeavours to provide robust and risk based audit services that address member firms' clients' strategic priorities and business processes.

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# About CII

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The Confederation of Indian Industry (CII) works to create and sustain an environment conducive to the development of India, partnering industry, Government, and civil society, through advisory and consultative processes.

CII is a non-government, not-for-profit, industry-led and industry-managed organization, playing a proactive role in India's development process. Founded in 1895, India's premier business association has over 7200 members, from the private as well as public sectors, including SMEs and MNCs, and an indirect membership of over 100,000 enterprises from around 242 national and regional sectoral industry bodies.

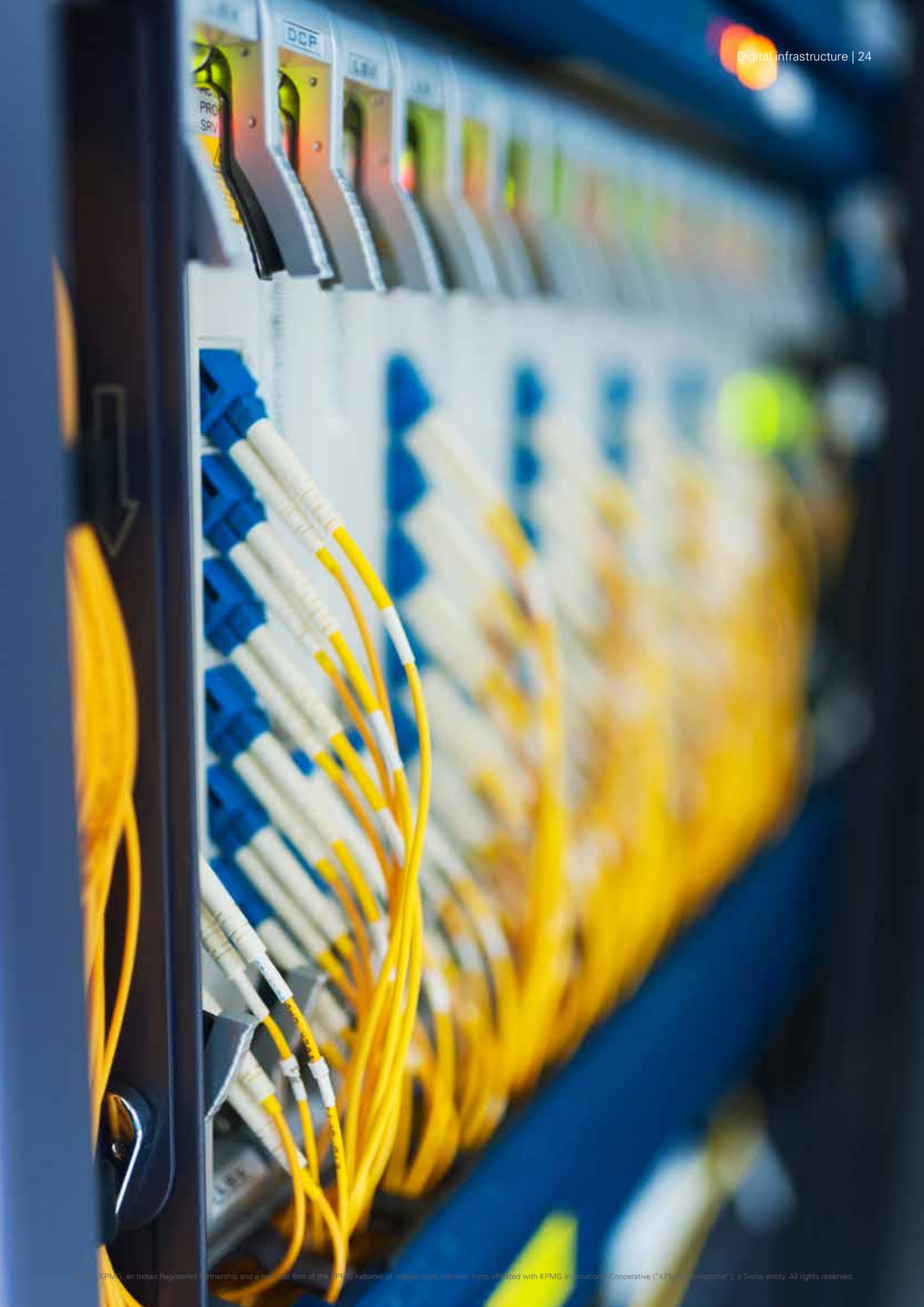
CII charts change by working closely with Government on policy issues, interfacing with thought leaders, and enhancing efficiency, competitiveness and business opportunities for industry through a range of specialized services and strategic global linkages. It also provides a platform for consensus-building and networking on key issues.

Extending its agenda beyond business, CII assists industry to identify and execute corporate citizenship programmes. Partnerships with civil society organizations carry forward corporate initiatives for integrated and inclusive development across diverse domains including affirmative action, healthcare, education, livelihood, diversity management, skill development, empowerment of women, and water, to name a few.

The CII theme of 'Accelerating Growth, Creating Employment' for 2014-15 aims to strengthen a growth process that meets the aspirations of today's India. During the year, CII will specially focus on economic growth, education, skill development, manufacturing, investments, ease of doing business, export competitiveness, legal and regulatory architecture, labour law reforms and entrepreneurship as growth enablers.

With 64 offices, including 9 Centres of Excellence, in India, and 7 overseas offices in Australia, China, Egypt, France, Singapore, UK, and USA, as well as institutional partnerships with 312 counterpart organizations in 106 countries, CII serves as a reference point for Indian industry and the international business community.









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