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Going Digital

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Executive Summary

Digital has become a way of life with corporate India. Industrial leaders are digitising essential functions and processes of their companies to enhance revenue and get the best output. Besides, they are increasingly using digital to enhance their product portfolio. The greatest use of digital is witnessed around three major themes—customer, operational efficiency and new business models. For this, companies are investing in emerging technologies and devoting a high focus to the convergence of technology within and across industries. These applications are helping them to drive innovation and often significantly improve efficiency.

Concurrently, the government is also rushing to embrace the digital wave. Its e-governance initiatives expanded for wider sectoral applications, with an emphasis on citizen-centric services. Several states/UTs have also started various e-governance projects. The Rajasthan government, in particular, has taken several steps whereby e-governance is helping monitor and evaluate welfare schemes and building transparency in the government. In order to transform the entire ecosystem of public services through the use of information technology, the Government of India has launched the Digital India programme. The objective is to transform India into a digitally empowered society and knowledge economy.

There are two perspectives to view the paradigm shifts that are happening around the globe—a business perspective and a technology-led one. Across industry and the government, there are a few major technological themes which we expect to emerge as the world steps into the digital era. In this report, we introduce the new concepts, products and services on digital platforms and their applications.

Connectivity and broadband highways: The World Bank Development Report 2016[1] has stated that in low- and middle-income countries like India, the GDP increases by 1.38 percentage points for every 0.1 % increase in broadband penetration. Rural Internet connectivity can help initiate programmes such as e-governance, online education, online health, online banking and online retail (or e-tail). Further, making rural areas smart (as in smart cities) will involve bringing smart transportation, smart agriculture and electricity distribution management.

Blockchain: A relatively new concept, blockchain technology, could become significant in places where trading occurs, where trust is important and where people need protection from identity theft. It can be used in the public sector (managing public records and elections), healthcare (keeping records anonymous but easily available), retail (handling large-ticket purchases such as auto leasing and real estate) and financial services.

Internet of things (IoT): The world is moving towards interconnectedness of devices and humans. The facilitating technology behind it is called IoT—namely sensors and actuators that enable monitoring and automation. The biggest potential of IoT lies in the data that is collected and the way it is utilised. Analysing the data that is generated helps improve the way we lead our lives, better our experiences and improve the ease of living. IoT has vast applications in the industry, particularly in the manufacturing sector, healthcare industry, development of smart cities, etc.

Cloud computing: It is a term used for hosting services over the Internet so that the user can access his resources from any place whenever required. The computing resources can either be provided internally or by a third-person service provider having resources which might vary from data centres to applications, depending on the user requirements and demands. The resources, however, are used on a pay to use basis. There has been a significant proliferation in the number of medium, small and micro-scale enterprises (MSME) around the world, which entrepreneurs have used to build small-scale businesses. The primary enabler has been cloud computing because of the ubiquitous, multi-tenant and on-demand computing services it provides. The advantages of cloud

[1] Word Bank. (2016). World Development Report 2016: Digital dividends. Retrieved from http://www.worldbank.org/en/publication/wdr2016

computing are flexibility, security, capacity and the fact that it is open.

Artificial intelligence (AI): AI has become an important part of our life. A lot of companies have started research on AI and are spending huge funds on the same. AI improves the efficiency of decision-making because decisions are made based on data available, and this makes the process faster. AI finds applications in a wide range of fields, from aviation (flight simulators) to transportation (self-driving cars) and from banking (automated fraud detection) to music (melomics, which refers to the composition of music by computers).

Fintech: Financial technology—or fintech, as it is popularly called—refers to an emerging branch of technology that aims to reimagine the finance market in today's world. This covers a wide gamut of applications, including payments (e-money and digital wallets), insurance (connected insurance), financing (crowd-sourcing and peer-to-peer lending) and investment (algorithmic and social trading). In this knowledge paper, digital wallets have been chosen as special topic of focus, given the proliferation of mobile payment solutions in India. Digital wallets are electronic devices which allow the user to perform electronic transactions without using any physical money. In other words, it can also be termed as an electronic version of a physical wallet. They are accessed on smartphones and have begun to play a major role in terms of digital innovation. One of the major issues with digital wallets, which are largely used in e-commerce and bill payments of various services, is customers' data security.

Cybersecurity: Today's digital world is characterised by tonnes of data and vulnerabilities. In the wake of increased threats, corporations and government agencies are struggling to safeguard their data and networks. Cyber security has applicability across sectors and is particularly helpful for small and medium businesses. Special focus has been given to secure e-commerce transactions. E-commerce is slowly replacing physical stores across industries—from manufacturing to groceries and from electronics to fashion. E-commerce involves the sale of digital services, such as access to premium TV shows in India. The sector has grown by a CAGR of almost 35% from 3.8 billion USD in 2009 to a 12.6 billion USD in 2013 and is estimated to grow to USD 125 billion in 2020[2]. In order to maintain the security of e-commerce transactions, certain protocols have been developed to govern data exchanges for online transactions. These include the secure socket layer (SSL) and secure electronic transaction (SET).

[2] PwC. (2015). eCommerce in India: Accelerating growth. Retrieved from:http://www.pwc.in/publications/publications-2015/ecommerce-in-india-accelerating-growth.html

1. Connectivity and broadband highways

Information exchange has been the key to the social development of people. The Internet has been one of the biggest tools to fuel this process of information exchange. The total number of Internet users across the world is in the neighbourhood of 3 billion. But there are 4 billion people who are still not connected. While the penetration of mobile networks and broadband has been impressive, there is still a lot to be done in terms of ensuring Internet connectivity across the globe. According to a World Bank working paper, in low- and middle-income countries like India, the GDP increases by 1.38 percentage points for every 0.1 % increase in broadband penetration. E-retail, digital commerce and proximity marketing have been made possible by the Internet. As mobile networks and the broadband connect people to these services, they are referred to as digital highways.

India has a population of 1.25 billion, of which two-thirds live in rural areas. While the number of mobile Internet users is growing in these areas, broadband connectivity is still in a nascent stage. Broadband connectivity can enrich the lives of people in rural areas in many ways.

Rural Internet connectivity can help initiate programmes such as e-governance, online education, online health, online banking and online retail (or e-tail). Further, making rural areas smart (like smart cities) will involve bringing in smart transportation, smart agriculture and electricity distribution management. While a lot of initiatives, like the 'broadband highway' initiative (as part of the bigger Digital India push), are a right step in this direction, a lot of work needs to be done to ensure last-mile connectivity in such areas.

1.1 The present scenario

Existing broadband infrastructure includes close to 1,000,000[3] km of fibre optic cable. Indian cities generally have good Internet connectivity and are serviced by both public and private sectors. But, as we move from urban to semi-urban and then to rural areas, a sharp decline in the number of service providers is observed.

An interesting statistic to note is the increase in the number of broadband subscribers in India every month. According to a TRAI report,[4] the total number of broadband (wireless + wired) subscribers increased from 125 million in October 2015 to 131 million in November 2015 (5% increase) and from 136 million from the end of December 2015 to 140 million by the end of January 2016 (3% increase). Such numbers, coupled with India's huge young population, show that offering broadband connectivity as a service is a profitable avenue.

1.2 Governmental initiatives

Successive governments have recognised the importance of broadband connectivity in the development of the nation. Although many schemes have been proposed for the inclusion of the entire Indian population under broadband connectivity, all of them have fallen short in terms of last-mile connectivity. The Twelfth Five Year Plan (2012–17) made recommendations for the roll-out of rural broadband connectivity through strengthening augmentation, refarming of spectrum and harnessing of new technology. One of the biggest pushes for increasing broadband connectivity came through the Digital India programme. One of the pillars of this initiative is the ambitious 'Broadband Highways' project. It consists of three core components: 'Broadband for all – Rural', 'Broadband for all – Urban' and 'National Information Infrastructure'. The rural thrust of this programme involves connecting 2,50,000 gram panchayats under the National Optical Fibre Network (NOFN) by the end of December 2016. Through this effort, high-speed network connectivity will be provided to various government departments,

[3] Data collected by International Telecommunication Union (ITU), World Bank and United Nations Population Division

4 World Bank. (2015). Exploring the relationship between broadband and economic growth. Retrieved from: https://openknowledge.worldbank.org/handle/10986/23638

right to the bottom of the pyramid, that is, the gram panchayats. Its infrastructure components are expected to include the State Wide Area Network (SWAN)[5], National Knowledge Network (NKN), NOFN, Government User Network (GUN) and the MeghRaj Cloud Initiative.

[5] Press Information Bureau of India (Jan. 2015) : Digital India

2. Blockchain: Reimagining G2C and G2B transactions

2.1 Introduction

Everyone is talking about the blockchain. Some are saying that the blockchain has the potential to redefine transactions and bring about significant changes. One of the simplest explanations of the blockchain is that it is like a ledger (Excel spreadsheet) which accepts inputs from lots of different parties. This ledger or simple digital platform can be used for recording and verifying transactions, as long as they are in accordance with certain defined rules (called protocols in computing language). This ledger can be seen by all, even while the users remains anonymous within the system. The ledger can only be modified when there is a consensus amongst the parties (vis-à-vis the agreed majority threshold of that blockchain) and, thus, one cannot unilaterally erase any data. Hence, the ledger is secure and eliminates the need for any third party (i.e. a central authority who approves transactions). Instead, it is a self-governing group.

While the blockchain gained popularity because of bitcoin, newer applications are being imagined. What the blockchain offers is the ability to quickly create tamper-proof ledgers that bring in the ability to reduce the time for carrying out transactions and, hence, the cost per transaction. While monetary exchange is the only domain that has seen the proliferation of the blockchain, newer applications are being imagined. The blockchain will revolutionise the way these transactions are carried out—filing a police complaint, carrying out a transfer of securities, tendering for government contracts and voting, among others.

2.2 Features of a blockchain

The prevalent system of transactions involves two disparate parties: namely two enterprises—a business and its customer, or the government and its citizen. Transactions between them are typically characterised by a low speed and vulnerability to manipulation. This is further exacerbated as each entity involved in the transaction has an individual ledger (or record) of the transaction and it becomes difficult to validate transactions when this scenario is scaled up. Primarily, the main features of the blockchain that make it so attractive are its immutability and transparency.

The blockchain is similar to a ledger that a bank would maintain to record all transactions of their customers. However, in a bank, the ledger is controlled by the bank itself and only the bank can view the transactions. In a blockchain scenario, when a transaction occurs, both the buyer and seller broadcast the transaction and all the computers connected to the blockchain network (also called nodes) update their 'personal' register after checking if the transaction is broadcast according to the agreed protocols (consensus mechanism). Once a transaction is entered in the blockchain, it can never be erased or modified. In effect, a copy of the ledger file is shared globally across thousands of participants (nodes).

2.3 Blockchain applications: G2C and G2B

The blockchain technology could become significant in places where trading occurs, where trust is important and where people need protection from identity theft. It can be used in the public sector (managing public records and elections), healthcare (keeping records anonymous but easily available), retail (handling large-ticket purchases such as auto leasing and real estate) and financial services.

Land records are prone to forgery and tampering, leading to inconvenience to the common man. Legal cases involving the resolution of such disputes may take many years. Using the blockchain as the central repository of these records is a way of ensuring the authenticity and transparency of these documents.

Money laundering, black money and other issues stemming from financial irregularities have been in the news in recent times. Corporate governance (or rather the lack of it) in India is another topic that has been a part of popular discussion. Transparency and immutability in financial reporting are the only solution to these problems. Among other digital solutions that have been suggested, the blockchain presents an interesting possibility. Not only will the data be tamper-proof, but it will also be open to verification from the regulators in real time. Tendering for government work today happens in one of two ways: the physical route, where tenders are presented in sealed envelopes; and the digital route, where tenders are presented to a software controlled by the government. It has been suggested that the blockchain could be an alternative to traditional tendering processes. With the blockchain, the tenders can be made tamper-proof, while safeguards such as smart contracts can be incorporated so that tenders cannot be accessed until after the last date for submission.

3. IoT

3.1 Introduction: What is IoT?

Digital is now a priority for most companies across the world, as also in India. Corporate leaders, government (both at the centre and state level) as well as public sector undertakings in India are digitising essential functions within their internal vertical operations processes and are focused on driving both revenue growth and operational efficiencies by going digital. Needless to say, the Internet was one of the greatest inventions of the twentieth century. It helped connect millions of people from across globe and laid the foundation for innovation in the twenty-first century. The Internet has now transcended all boundaries and has made available a host of applications such as e-mail, netbanking, e-retail and several online open courses (MOOC)—applications that one would have never thought were possible.

In parallel, sensor technology has seen rapid advancements—starting from the rudimentary weights and scales, we have progressed to highly advanced digital sensors with incredibly high accuracy that are capable of directly supplying measurements to a computer system for further processing. Wireless and mobile networks are not new developments. But the problems of lack of bandwidth and connectivity and the presence of cyberthreats have arrested their growth. Advances in cybersecurity and the increasing use of high-frequency bandwidth frequencies have enabled the reliable transmission of information across large distances and in remote areas. The dawn of the new millennium witnessed the rapid growth in the volume of data arising from day-to-day operations. Of the data present in today's world, 90% is just about two years old. While managing the data posed a huge risk, businesses also saw this as an opportunity to reduce costs and drive up efficiencies through data analysis. This laid the foundation for a new branch of computer science, namely big Data. Today, data scientists pore over and make sense out of such data, enabling companies to make better decisions and enhance consumer experience.

A new field that encompasses all the above-mentioned technical advancements is IoT. Simply put, IoT is a network of objects that is able to collect and transmit data and communicate with each other. More precisely, IoT is a network of millions and millions of sensors (and actuators) that collect data from every activity that we perform. The biggest potential of IoT lies in the data that is collected and the way it is utilised. Analysing this data that we generate helps improve the way we lead our lives, better our experiences and improve the ease of living.

Over the past few years, some truly disruptive IoT applications have been pushed into the market, while others are in the pipeline. The main reasons for business and consumers adopting IoT has been its potential for reducing costs, driving up efficiencies, increasing transparency and improving the user experience.

3.2 Basic elements of an IoT system

An IoT system basically consists of a sensor, actuator, microprocessor, wireless network and an interface. The back end would consist of a hub (for data storage) and some algorithms for data analysis.

In today's markets, sensors are available to measure any (measurable) quantity under any possible condition and with the ability to give digital outputs. The most commonly measured quantities would be distance (proximity), light (camera), velocity, temperature, motion (gyroscopes), humidity and pressure. But combinations of these basic sensors today have led to the measurements of almost all thinkable parameters used for engineering and often businesses.

Microprocessors are analogous to the CPU of computers. They act as a hub for all operations of the various sensors and actuators. They provide a preliminary computing resource for conditioning of the sensor outputs and send those values to the central hub for analytics.

Wireless networking has grown by leaps and bounds over the past decade. While Wi-Fi has been the preferred mode of communication, mobile data usage has seen a tremendous boost with the introduction of 3G, 4G and proposed 5G, where higher frequency spectrums are being successively used for reliable data transfer over large distances at great speeds. Short-range communication has also seen the introduction of new low-power technologies such as Bluetooth LE (low energy) and NFC (the successor to radio frequency [RF] communication).

Cloud computing has replaced the huge server systems of the past. A cloud consists of a network of remote servers hosted on the Internet that stores, manages and processes data as opposed to the same being done on a local server or computer. This technology eliminates the need for huge (think big data) server rooms and is facilitated by the increase in network speeds.

Big data analysis is the need of the day. The huge volumes of data arising from IoT devices cannot be handled by traditional data processing algorithms in real time. Such data analysis requires a certain amount of pre-processing (removal of superfluous data-sets). It is followed by a weighing process to separate the relevant data from the less relevant data. A process of discretisation (a quantitative to qualitative transformation) of data follows. The final product is a prototype based on the feature selected. This is what is displayed to the user on the interface.

3.3 IoT: Market drivers

The rise of smartphones has been phenomenal. It is expected that the number of smartphone users across the world will cross 2 billion by the end of 2016. What makes a phone smart is the array of sensors it contains that sense the users' environment and drive the various functionalities of a smartphone. The gigantic rise in the number of smartphones has led to many new entrants in the sensor business and heavy research in the field of smartphone technology. This has led to the introduction of newer, more rugged and accurate sensors being available at a fraction of the costs of their predecessors. This is the first driver for the rise of IoT. The rise of the smartphone has been backed by the rise of mobile Internet. Though mobile data has generally been expensive in India, these trends are expected to change in the near future. The use of bands of higher frequencies and increasing bandwidth of network operators is dramatically increasing the reliability of connections and the speed of data transfer.

Another trend that is being observed in this regard is the rapid reduction in the cost of computing with increasing power. The increasing availability of cheap and powerful computing has paved the way for the introduction of new technologies such as cloud computing and big data. This is third and final market driver for the rising adoption of IoT. These drivers have made IoT-based services and products a profitable business proposition for the IT industry and an affordable solution for civic issues.

3.4 IoT applications

The applications of IoT are limitless. A few key applications that indicate the potential of IoT are listed below.

3.4.1 Smart city

A smart city, in layman terms, is one where interconnected technology is used to manage the city's assets. Rising problems of the lack of space, traffic congestion, absence of reliable electricity and water connections and waste management have paved the way for technological interventions to solve such civic issues. IoT plays a pivotal role in such technologically advanced cities.

IoT enables civic authorities to remotely review and control the city's resources and also generate meaningful insights from the data that is generated. Street lighting, for instance, could be controlled from distant control centres. Public transport systems and vehicular traffic can be analysed in real time to identify bottlenecks. Smart grids could be used to reduce the tremendous loads on the power-generating system during peak hours. Smart

equipment in the water systems of the city could be used to prevent leakages and wastage. Because IoT is transparent, all the above-mentioned data will be available at the fingertips of citizens by means of mobile applications.

3.4.2 IoT in healthcare

The current focus of the industry is on personalised healthcare. Applying IoT in personalized healthcare will result in an autonomous environment for an assistive healthcare data mining system linked to a supercomputer. Healthcare wearables are new devices worn on the body, such as a digital watch, knee brace, or healthcare patch. Such devices give healthcare professionals a real-time tracking of the patient's status variables, such as heart rate, blood sugar and body temperature. Similarly, there are activity trackers to measure physical activity, such as the steps taken in a day.

3.4.3 Industrial IoT (IIoT)

IIoT combines sensor data, machine-to-machine (M2M) communication, AI, machine learning and big data processing capabilities with the pre-existing automation systems, enabling companies to pinpoint inefficiencies and locate breakpoints. Advances in the fields of bigdata handling and advanced data analytics have opened up new avenues for investment in IIoT. These include predictive analytics—a technique of using previous data to predict failures in machine components well in advance, leading to scheduling of maintenance. It also helps in the prevention of catastrophic failures. IIoT also helps integrate manufacturing into the bigger supply chain, thus improving supply chain traceability.

4. Moving business to the cloud: The MSME advantage

Cloud computing is a generic term used for hosting web-based services so that the user can access his resources from any place whenever required. The computing resources can either be provided internally or by a third-party service provider having resources which might vary from data centres to applications depending on the users' requirements and demands. However, the resources are used on a pay to use basis. The properties of cloud services are:

- **Elasticity**: Cloud services can be scaled up or down according to the requirement.
- **Pay**: Payment is done for what computing resources are available and used at a granular level.
- **Self-service**: The computer resources are used by the users to meet almost any type of workload according to the demands. The cloud services can be categorised into private, public or hybrid.

Cloud services have been expanding over the years—both private as well as public clouds. A large number of SMEs have shown interest in cloud technologies around the world and acquired them in order to enjoy their benefits. The significant proliferation of cloud technology in the MSME segment is visible from the number of entrepreneurs who have used it to build small-scale businesses. The primary enabler has been the ubiquitous, multi-tenant and on-demand computing services cloud computing provides. As data exists on remote servers, it can be accessed as per user requirements. Hence, the need to develop or build on-site infrastructure for datastorage gets eliminated. Software, hardware, databases and data are delivered over the Internet with a minimum rental charge.

4.1 Types of cloud

Private: The deliverables are basically from the business data centres to the internal users. While preserving management, control and security, versatility and convenience are also offered by this model. Through IT chargeback, internal customers may or may not be billed for services.

Public: The cloud service provider who is involved in providing the service is the third party. The services are sold on demand. The payment is done for CPU cycles, bandwidth or storage by customers for the amount they consume.

Hybrid: The amalgamation of private and public cloud services is called hybrid cloud services. The public cloud is used for heavy workloads that must scale ondemand, whereas sensitive applications and mission-critical workloads are done on private cloud services used by the respective companies. The primary goal of the hybrid cloud is to create a unified, automated and scalable environment while maintaining control over mission-critical data takes advantage of the whole public cloud infrastructure.

4.2 Enabling business services

Businesses are increasingly employing the cloud for data storage and speedy transfer of information. This has created new avenues for businesses to deliver services to their clients:

Infrastructure as a service (IaaS): The workload is migrated by the users to a virtual machine (VM) by virtual server instance and storage, as well as the application program interfaces(APIs). Depending on their requirements, users have an allocated storage capacity and the ability to start and stop the VM as well as to configure the storage. Small, medium, large, extra-large, and memory- or computer-optimised instances are offered by the IaaS providers for various workload needs, in addition to customised instances.

Platform as a service (PaaS): In the PaaS model, development tools are hosted by the providers on their infrastructure. The user accesses various tools over the Internet using APIs, gateway software and web portals. PaaS is used for software development and is hosted later.

Software as a service (SaaS): SaaS is a distribution model where software applications are delivered over the Internet. These services are often called web services. Common SaaS offerings include productivity software and email services. Users can access SaaS applications and services user from any location using a mobile device or computer having Internet access.

4.3 Why are companies switching to the cloud?

Cloud computing is being developed since the last few years and will continue to expand for many more years to come.

- **Flexibility:** It can be scaled up and down according to the organisation's requirements. Flexibility is the main key in today's economy. IT expenditures can be adjusted to meet the organisation's immediate needs. No one needs to be constrained by decisions made or contracts signed in the past.
- **Security:** Data security is ensured in the cloud more than it is on an unsecured server room or under the desk.
- **Capacity:** Storage is always one of the main issues for businesses. Suppose one had to spend a lot of his IT budget in the past on human resources to manage software, then cloud is an appropriate solution as it provides sufficient storage and limits the additional cost.
- **Cost:** The maintenance fees are regulated and minimised by cloud technology, where additional servers and software aren't required. Software implementation, customisation, hardware, maintenance and training entail many hidden costs which are rolled into an apparently transparent subscription fee.
- **Openness:** By applying appropriate Internet standard and web services, services can be connected to each other, which implies that the information available can be accessed from anywhere in the world and, hence, it is centralised on any computer or mobile device at any time.

Customers are engaged via digital channels by small and medium businesses (SMBs) in India. It has become imperative for SMBs to not only raise business efficiencies and improve product quality but also to maintain a high level of customer service and constantly upgrade their technology. Indeed, SMBs in India are waking up to the potential of technology-driven transformation to enhance their current operations and keep up with the demands of global markets and supply chains. However, there remain significant barriers for companies looking to embrace the latest technologies. As a result, the rate of IT adoption among Indian SMBs is still relatively low.

4.4 SMBs and the cloud adoption challenge

The question now is, how prepared are SMBs to tap into these emerging opportunities and overcome the challenges that lie ahead of them? While investments are flooding India, the rules of the game are being redefined at a faster pace. Only those organisations who have learnt to dynamically adapt and respond to these changes might survive in the long run. Although the digital era could be turn out to be unfamiliar territory for the laggards or empower the technologically-savvy, till date, the deployment of new technologies by SMBs to avail of competitive business advantages has been quite slow. This could constrict their ability to thrive and grow in a digitised economy.

5. AI

AI is a branch of computer science which deals with the creation of intelligent machines who learn from their environments and then act and respond like humans. Some examples are talkback services on mobile phones, fraud detection and autonomous vehicles.

Funding and investment by companies has been increasing yearly in the technology used by companies to deploy machine learning algorithms. Simultaneously, the number of companies that are adopting machine learning is rising. It is mostly start-ups who have shown a keen interest in the latest developments in the field and have ventured into machine learning.

Some of the special properties of AI include:

- Speech recognition
- Learning
- Planning
- Problem solving
- Decision–making

Machine learning is a type of AI where the machine learns and implements what it learns without being explicitly programmed by a human. Here, computer algorithms are used to teach the machine to find patterns in existing data and use those patterns to react (or produce output) to new data.

Machine learning can be of two types:

Supervised learning: It is similar to a situation where a person studies for an exam from a textbook and all the questions in that exam are from that textbook only. Here, learning has been completed in the past and the application is utilised with new data. The computer is trained on a set of data and then used to predict the outcome based on a new set of data.

Predictive analysis: Today's social networks are slowly beginning to provide relevant content in their users' feeds. This phenomenon of relevant content works on the concept of supervised learning and predictive analysis, where based on past and repetitive experiences, actions and usage of text or objects, a text or object appears as a suggestion. This concept is currently being used in mobile devices, where text suggestions are offered from which the user can select the right option. Another very common examples are search engines that predict the user's search entry based on other popular searches from across the world.

Unsupervised learning: In unsupervised learning, the data is highly unstructured. Hence, categorising such data based on different labels is a very tedious process. Such data could be generated from disparate sources such user searches and text messages. In order to make sense of such data, clusters are created using specialised algorithms.

5.1 Innovations in the AI space

Chatbots are conversational agents or dialogue systems, and are one of the most trending topics in machine learning. They sense and process user inputs and then respond to the requests. Bot developers tend to build their bots for interaction, shopping, bookings or travel by using bot frameworks and software development kits (SDKs). Chatbots have begun to be widely used because they reduce the manpower required. When the user has a query, he sends a message to the bot and the bot processes the information based on its own background knowledge about the issue. Special keywords are programmed into the bot so that it can recognise the keywords and give

standard responses to complex queries by the user.

Another technology which is being worked on is autonomous vehicles. Such vehicles are based on AI and run without a driver. Map and sensor information is processed by the car to determine its location. The software also detects the presence of pedestrians and other vehicles in the surroundings. Accordingly, it chooses a safe speed and trajectory for the car.

5.2 Challenges faced by AI

AI as a field of technology is still at a nascent stage. While a huge number of applications have been envisaged, it is plagued by some very basic technical problems that are enumerated below:

- **Object definition:** Defining the objects is one of the issue. If we take the example of a pen, it is an object which is thin and has a writing tip. The precise shape can be defined but not the colour or the weight, yet when we see a chopstick or toothbrush, we recognise that it is not a pen but something else. However, when we see a marker, we distinguish it as a pen. It is this sense of understanding that humans have developed with the knowledge of their previous experiences.
- **Learning by imitation:** Humans find it easy to imitate the motion of animals or other humans instinctively. However, trying to convert the process of imitation into a sequence of steps is very difficult. The problem is compounded when these steps are to be implemented on actuators that are not our muscles.
- **Empathy and non-verbal language:** Tone is another issue for robots. A command can be given in various terms. For example, if someone says 'stop that' happily or angrily, the robot will not be able to sense the difference in tones because for it, only the command matters.
- **Ambiguity:** Human language is filled with ambiguities based on context. The meaning of a word depends on the context it is used in. While AI is able to detect the meaning of a word at face value, a lot of research is under way on quantifying the context.

While the above are representative of the technological issues faced by AI, they are accompanied by consumer-side issues as well. Any digital system is faced with cyber threats. Hence, a robust cyber security protocol is a must for AI to ensure protection of consumers and their data. It is true that the cost of computing power is drastically reducing. However, it is not reducing fast enough for the widespread adoption of AI-based products.

6. Digital wallets

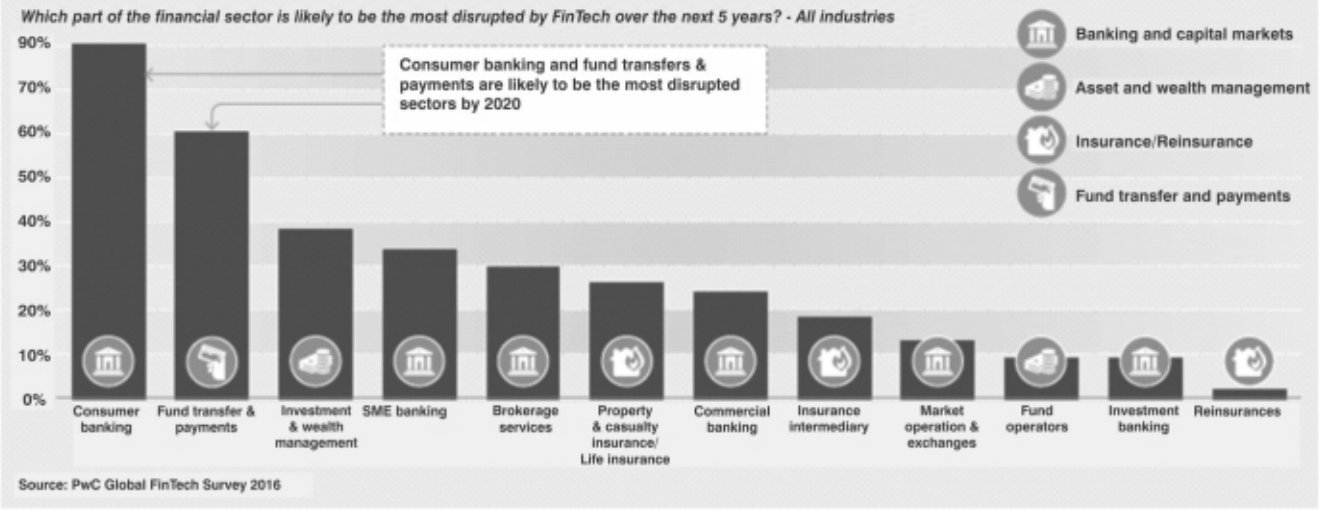
Digital wallets represent the technology-driven evolution of traditional physical wallets. They have four key functionalities: linking to physical accounts, holding value, funding commercial transactions and enabling access through various devices (computers, mobiles phones, tablets and so on). Digital wallets allow users to make payments in the online or virtual world. The e-wallet first appeared in the late 1990s and since then, adoption has grown exponentially, driven primarily by the rise in e-commerce. Early versions of digital wallets were limited to use on computers. But more recent versions have begun to incorporate newer technologies such as mobile applications, quick response (QR) codes and near-field communication (NFC) to explore new opportunities. The speed and sophistication of digital wallet development will be heavily dependent on geography. In developed markets, digital wallets will have to work with and enhance existing well-developed banking and payment arrangements to be successful. On the other hand, in emerging markets, digital wallets have the potential to become the first banking and non-cash payment arrangement for many people. This is primarily because in these markets, a low percentage of the population is 'banked' and often payments/banking infrastructure is poorly developed, although mobile penetration is relatively high.

6.1 Factors affecting adoption of digital wallets

Many factors are affecting the degree of adoption of digital wallets. Hence, the services of fintech providers will vary as per geography. In emerging markets, the proposition will focus on providing basic banking and payment services, normally using basic 'feature phones' and not smartphones. In contrast, in developed markets, the focus will be on providing an enhanced customer experience—for example, meeting the consumer desire for seamless integration and aggregation across their digital and payment activities. In emerging markets, the mobile network operators (MNOs) are better positioned due to the higher penetration of mobiles (versus banking) and the lack of traditional payment infrastructure. In the most developed markets, no winning competitive model or participant type has emerged, the exceptions being Japan and South Korea.

6.3 Fintech for the future

Figure 3: Areas of disruption



Identifying sectors for fintech interventions

Results of PwC's Global Fintech Survey 2016[6], indicates how the fintech industry is going to evolve in the next five years. One of the highlights of the study was the potential of digital wallets, as noted by some leading professionals of the industry. The survey suggests that by 2020, fund and payment transfer is going to be the most disruptive technology and, hence, we need some efficient methods to assist the same. For example, in commercial and consumer lending, the online platform allows lending and borrowing among consumers. Use of non-conventional data and powerful analytics to price risks, lower operating cost and customer-centric lending processes characterise such alternative credit models. Partnerships with fintech companies can be one of the major factors to increase the efficiency of incumbent businesses. Indeed, a majority of the respondents (73%) cited the rise of fintech as a major opportunity to reduce costs. Hence, core processes, services and products, and increased efficiencies in their operations could be realised by incumbents in the market.

Digital wallets and crypto currencies are a way of reimagining monetary transactions. The advantages of digital wallets are obvious. They offer a way to make transactions extremely fast and facilitate the transfer of exact amounts. They also eliminate the need for complex processes (such as those used in banks) and hence reduce the cost of transactions dramatically. The negatives of such a system, which are also obvious, primarily revolve around their susceptibility to cyber attacks. Other drawbacks include the absence of proper regulations for consumer protection. From a governmental perspective, digital wallets and currencies eliminate the occurrence of counterfeiting and enhanced compliance due to tracking of every transaction on the system. On the other hand, digital wallets increase the risk of unlawful activities like money laundering and drug trafficking. Hence, there are impediments in the path of large-scale adoption of digital wallets. From the industry perspective, the risk of cyberthreats needs to be minimized. The task for governments is also cut out: Internet penetration will have to be increased by expanding broadband connectivity and licensing higher-frequency bands to mobile operators. The online payment space will have to be regularised with watertight legislations to protect the rights of customers. The presence of a competent regulatory body will go a long way in alleviating the problems of consumers.

[6] PwC Global FinTech Report. (March 2016). Blurred lines: How FinTech is shaping financial services. Retrieved from: http://www.pwc.com/gx/en/industries/financial-services/fintech-survey/report.html

7. Cyber security

Cyber security is the body of technologies that analyses and protects networks, computers and data from unauthorised access. India is making considerable progress on its path to becoming a digital economy. However, an increasing use of technology is accompanied by greater more risks and threats. Data lies at the heart of technology, while networks are more vulnerable and interconnections can be exploited. In the wake of increased threats, corporations and government agencies are struggling to safeguard their data and networks. Risks to personally identifiable information (PII) and privacy of individuals have increased. Hence, security and privacy have gained even more importance in the current scenario.

7.1 Cybercrime trends

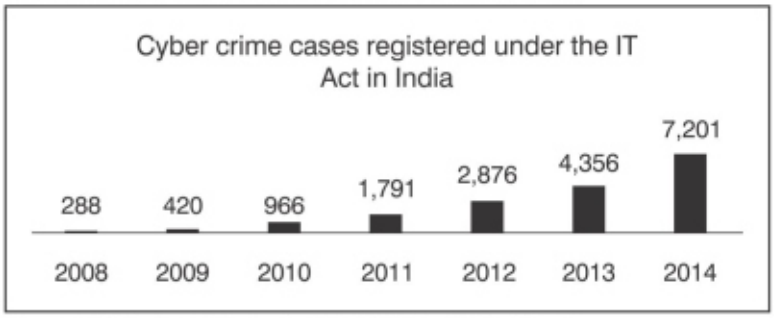
Digitisation has changed business models across the globe. The growth of digitisation has been closely followed by a rise in cyberthreats. Statistics indicate the seriousness of Internet crimes: simple phishing emails are generating around 1 billion USD for their perpetrators. Cybercrime is not new to India. Favourable demographics have led to the unplanned growth of mobile devices, and the large-scale proliferation of the Internet has led to an alarming spike in the rate of cybercrimes. The number of cybercrimes reported under the IT Act in 2014 was 7,201, up from 4,356 in 2013, a whopping increase of 65%.

7.2 Cybercrimes and businesses

PwC's Global State of Information Security Survey 2016[7] revealed that less than 36% of firms have a strategy in place for IoT. As more companies become connected, they will be prone to cyberattacks. A cyberattack can potentially cause irreparable damage to the company's reputation, which can turn away the customers, impact their share price and create loss of confidence among shareholders. Today, most small and medium businesses are leveraging technology for communications, marketing, selling, and product development, among other things. They remain attractive targets for cyberattacks because:

- Their security systems and policies are not as potent or mature as those in large enterprises.
- They lack awareness of the risk of cyberthreats and do not have in-house specialists to deal with cybercrime.
- They have not yet invested in security software and tools.

It is difficult for SMBs to invest in expensive security infrastructure or hire in-house cyber security experts. Nevertheless, it is important for them to have an internal business continuity plan and be prepared to deal with any incident with even minimal impact on the business.

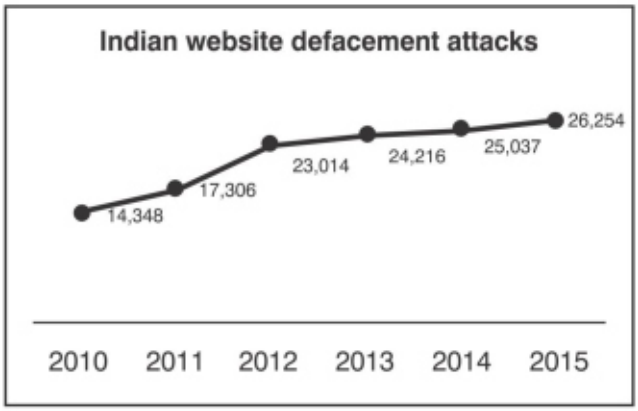


65%
increase in cases registered under the IT Act

Source:http://etaal.gov.in/etaal/CentralChart.aspx

Cybercrimes registered in India

[7] PwC. (2016). Global State of Information Security Survey 2016. Retrieved from:http://www.pwc.com/gx/en/issues/cyber-security/information-security-survey.html



Security incidents in 2015	
Phishing	534
Network scanning/probing	3673
Virus/malicious code	9830
Website defacement	26244
Website intrusion and malware propagation	961
Others	8213
Total	**49455**

Source: IC3 Annual Report on Internet Crime 2015

Summary of cyber security Incidents in 2015

The India Computer Emergency Response Team (CERT-In) has reported a surge in the number of incidents handled by it. In 2015, CERT-In handled close to 50,000 security incidents. The types of incidents handled were website intrusion andmalware propagation, malicious code, phishing, distributed denial of service attacks, website defacement and unauthorised scanning activities. In addition, around 61628 spam incidents were reported to CERT-In.

8. Security of e-commerce transactions

8.1 Introduction

E-commerce is slowly replacing physical stores across industries, from manufacturing to groceries and from electronics to fashion. Consumers use varied modes of payment across the country. These include cash on delivery (COD), digital wallets, netbanking, and credit and debit cards. While the benefits offered by the new model of business are huge, on the flip side, the open nature of the Internet has encouraged data breaches. At a basic level, user financial information such as credit card details may be stolen. While the benefits offered by the new model of business are huge, on the flip side, the open nature of the Internet has encouraged data breaches. At a basic level, user financial information such as credit card details may be stolen.

8.2 Existing e-commerce security systems

An e-commerce transaction is secure if the authenticity of the merchant and the customer can be verified, confidentiality and integrity of the data are maintained and the transaction cannot be repudiated.

Hence, certain protocols have been developed to secure e-commerce transactions and govern data exchanges.

8.3 SSL

The SSL protocol was first developed by Netscape in the 1990s. SSL 1.0 was followed by successive versions, until SSL 3.0 in 1996. The variants of SSL post the 3.0 version were renamed as TLS. In the simplest of terms, SSL creates a bidirectional tunnel (preventing external interaction) for communication between the client and server. Exchange of information in the SSL protocol happens in two steps. In the preliminary phase, SSL identifies the client and the server, negotiates the cryptographic attributes, and then generates and distributes the key for decryption. This is known as the handshake protocol. The second phase involves the actual sharing of data. It supports data confidentiality (encryption) and ensures that the client is connected to the relevant server (only and not a rogue one) through server authentication.

8.4 Secure electronic transaction (SET)

SET is a protocol developed for the purpose of securing financial transactions on the Internet. The basic premise for data exchange through this protocol is the use of dual signatures. SET involves the use of a digital wallet on the client's machine (smartphone or computer). The merchant has a similar software installed on their machine. When the customer installs the wallet, they receive a digital certificate which is a file and functions as a credit card for online transactions. It includes a public (decryption) key. The merchants also receive a certificate that contains the merchant's public key and the bank's public key. When the customer initiates a transaction, the browser contacts the merchant's machine and receives and confirms the merchant's certificate. The browser then sends the transaction information (such as the order that is placed) and the payment information. The order information is encrypted using the merchant's key, while the payment information is encrypted with the bank's key. Though both pieces of information are sent to the merchant, the merchant will not be able to access the payment information as they cannot read the bank's public key. This ensures correspondence between the transaction and payment details. After verifying the customer's digital signature, the order and payment information are sent to the bank. After verifying the merchant and customer's digital signatures, the bank authorises the payment. The main drawback of this system is the necessity of software installation by the customer.

8.5 Future threats

The cybersecurity industry has been characterised by breaches executed out by cybercriminals using innovative methods that are developed by them. Damage control then follows, along with the creation of protocols by cybersecurity professionals to prevent such attacks in the future. The cybersecurity industry and the industry in general are gradually beginning to wake up to these trends. This has forced firms in the e-commerce industry to employ rigorous testing programs on their frameworks and develop data security maintenance protocols for the same.

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