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## Internet of Things:
### Consumerisation of Technology

*Technology democratization has weaved an ecosystem powered by intelligent systems, connectivity services, analytics, and technology infrastructure to deliver services. With internet as the backbone of disruptive technology referred as "Internet of Things", is expected to propel consumer and business demands for adoption of innovative solutions in most industry verticals. It is essential for service providers and buyers to understand the ramification of this disruptive technology. To leverage this technology to devise innovative solutions for industry, streamline business processes and drive profitability, Internet of Things is likely to make this new technology revolution a key enabler.*

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In this 25th anniversary year of the Internet, the World Wide Web connects more than two out of five individuals globally. Tim Berners-Lee's idea to make the internet a universal medium of connectivity allowing people to share anything on the web has snowballed into a concept of connected everything. The early concept of interconnected computing first came into limelight in the year 1980 when programmers at the Carnegie Melon University connected a Coke machine to the internet. This allowed them to evaluate the possibility of cold drink's availability, when they made a trip to the machine. Two decades later, in 1999, Kevin Ashton, co-founder and executive director of the Auto-ID Center, while making a presentation to Proctor & Gamble on the possibility of connecting company's RFID technology to the internet, named this phenomenon as "Internet of Things (IoT)."

The evolution of internet to interconnect the physical world is revolutionizing the way we explore, observe, understand, and interact with our surroundings, on a daily basis. With the expected growth in the number of connected devices from 9 billion in 2012 to more than 50 billion in 2020, IoT presents an unprecedented business opportunity for global economic value of $1.9 trillion, according to Gartner. The penetration of connected device will increase from 0.6 percent in 2012 to 2.7 percent by 2020.
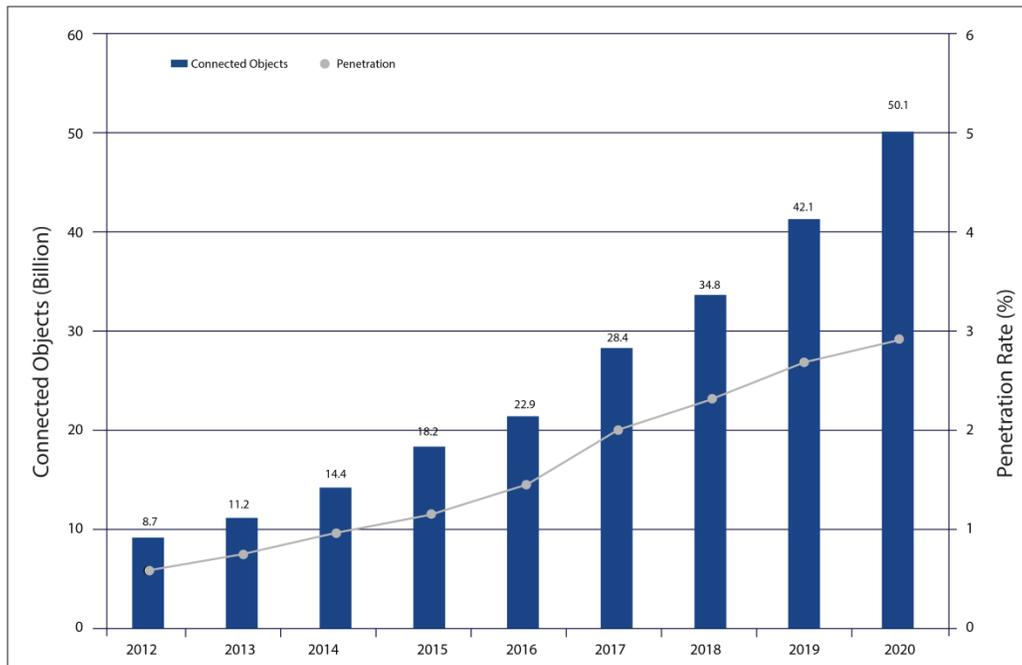


Figure1: Connected Devices (2012-2050)
Source: Cisco 2013

## Rise of the Connected Physical Objects

The evolution of the internet into a network of connected devices that not only sense data from the ecosystem and communicate with physical objects but also standardize information dissemination, analytics and new age application, have revolutionized the manner in which business paradigms of the 21st century enterprises need to evolve. Open wireless Technology such as Bluetooth, RFID (Radio Frequency Identification), embedded sensors and actuator nodes are catalyzing the phenomenon of IoT.

In this new era of IoT, physical objects are classified depending on technological prowess they demonstrate to disseminate data. The classification of connected devices depends on the benefits they offer:

**Data Collection & Transmission Devices-** Embedded sensors form the core of devices, which collect data and enable its transmission. Gadgets like wearable gears are enabled to collect data around and about human activities and events.

**Action Triggering Devices -** These devices are oriented to be triggered under a set of commands. Devices that allow turning on & off light bulbs, depending on the period of the day, through triggers fall in this category.

**Information Capture and Processing Devices** - IoT devices capture information and process them over a network to assist us with an insightful analysis.

**Devices that aid Communication -** These devices help to forward data within the same network and often act as messengers between two points.

From manufacturing plants to energy grids, healthcare to transportation, and agriculture automation to security & surveillance, Internet of Things has woven a thread across industry verticals which is supported by embedded sensors and connected networks. With physical objects going digital, these intelligent systems have made computing, ubiquitous. Today, large volumes of data are being continually generated by devices and are analyzed in real time for actionable outcomes. With the widespread adoption of wearable gadgets utilizing sensors, human intervention to collect and conduct data analysis has become minimal. Notable examples are NikeFuel Band and Fitbit, which collects data on workouts and transmit it to a server so that the user accesses it to analyze their fitness performance across multiple devices.

## The Market Opportunity

According to Cisco, only 0.6 % of the physical objects globally are communicating among themselves, at present. This leaves us with a whopping opportunity to connect many of the remaining devices. The potential of IoT to snowball into a revolution is immense. Advancements in mobility technology and the concept of Bring Your Own Device (BYOD) have triggered the growth of a number of interconnected devices to an estimated 11 billion, at present. Over the next ten years, IoT will present a business opportunity of $14.4 trillion across the industries globally. Of which more than $9.5 trillion is expected from industry specific uses, such as smart grid, smart buildings and connected commercial vehicles, etc. The remaining $4.9 trillion will be for telecommuting and virtual workspaces, etc.

**Revenue Opportunity offered by Internet of Things (2023)**
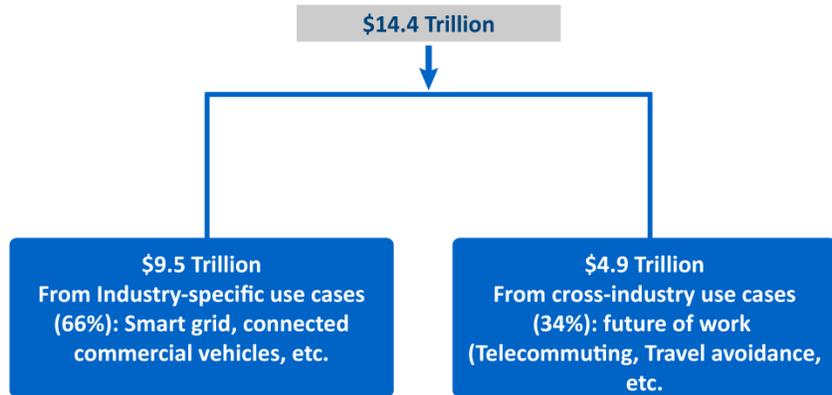


Figure2: Value of IoT Stake in the Economy
Source: Cisco IBSG, 2013

Global organizations have recognized the opportunity and are implementing the strategy and evolving innovative business paradigms to leverage IoT solutions. This has led to a greater utilization of networks, nodes, tags and sensors. Forrester consulting survey on IoT solutions places Bar codes, real time location tracking, and Wi-Fi connectivity among the most important technologies attributing to the success of IoT solutions. Phenomenal growth in the number of mobile phones globally has placed mobile computing at the center of IoT revolution across the enterprises.

In addition to, machine-to-machine (M2M) connectivity, IoT allows interaction between humans and their environment. Over the next three to five years, Internet of Things will be one of the fastest growing technology segments for the Information Technology (IT) Industry with a significant investment from firms in most industry verticals.

Technologies Enabling Internet of Things in an Enterprise Setup
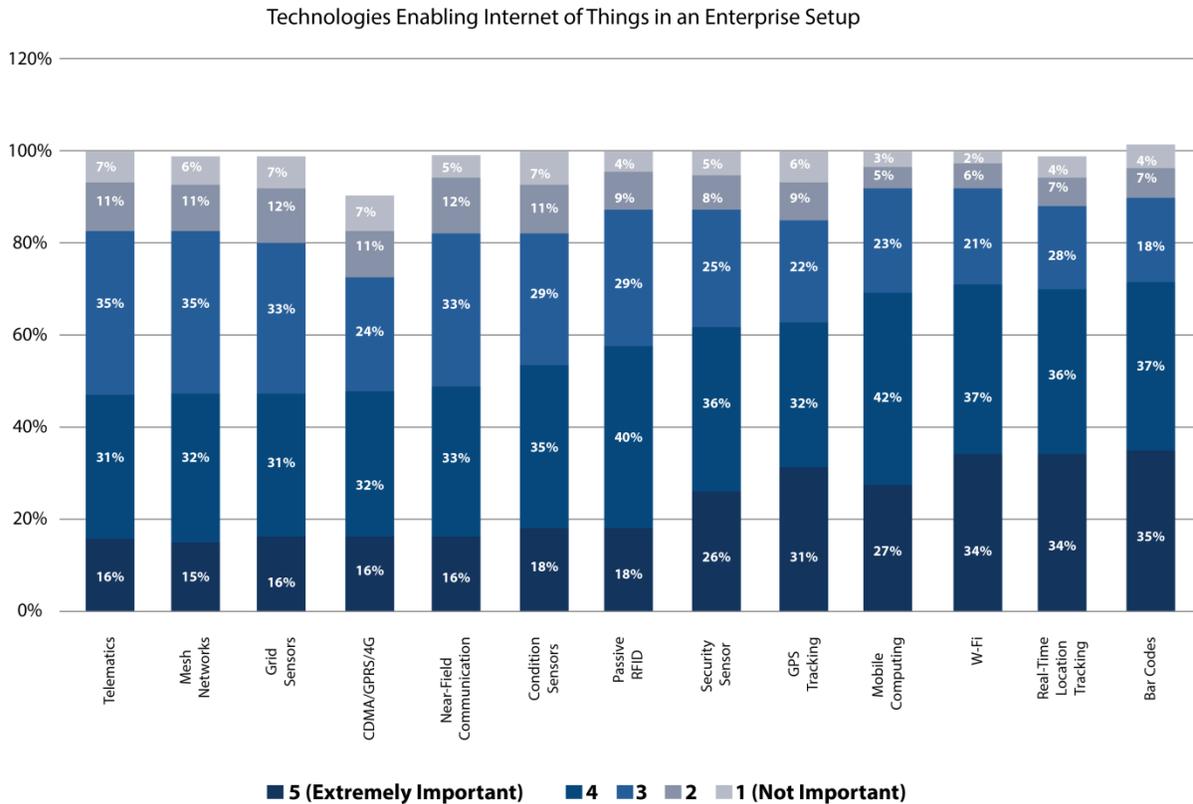


Figure 3: Technologies that enable Internet of Things solutions survey
Source: Forrester Consulting/Zebra Technologies 2012, adapted by Business Insider

## Smart Technologies for the Industry

Communication of data forms the basis of Internet of Things. The process by which data are disseminated to servers and analyzed to obtain an insightful report have enhanced our affinity towards connected devices. In our ecosystem, IoT solutions have influenced every industry and created an economic opportunity by propagating new business paradigms, which were non-existent earlier. Although initial trials on IoT began with the industrial internet (connecting industrial equipment over the internet), today it brings many more personal devices used in our daily life under its fold.

The Automotive and the Consumer electronics industry are witnessing rapid adoption of Internet of Things. Customer service enhancements, optimizing cost of production, improving production line, maximizing distribution and monitoring & controlling asset are drivers for rapid adoption of IoT by these industries. Internet of Things is directly impacting healthcare technologies, including clinical care, disease management, and remote monitoring. In Agriculture and Mining, IoT solutions are helping increase productivity through initiatives like precision farming and improving safety standards for mining professionals. The technology revolution has considerably brought down connectivity cost. This has spurred the opportunity to connect any device, or an application over the internet. Cloud based services have further accelerated the growth of Internet of Things, where data are analyzed in the cloud and

reported on mobile devices. With Internet of Things playing a greater role in securing smart homes, safety of residents is ensured by deploying perimeter access-control technology. M2M communication, powered by mobility solutions, has lowered the maintenance cost of industrial machines and provided a health check on the operational processes.

## Behold the Future

As the 21$^{st}$ century unfolds, we are witnessing a significant technological innovation. An increase in the number of connected objects has accelerated the rate of data generation. The rise of cloud computing has increased the portability and accessibility of data. M2M communications have made industries smarter and allowed them to capture any flaw in the production process with ease. With greater technology penetration, governments and enterprises need to adapt existing strategies to further application of IoT solutions across industry verticals. Although IoT is expected to automate real time business processes, on the flip side, it will raise data security concerns in the near future.

Connected objects (sensors, networks, and actuators) manufacturers and suppliers will see a tremendous rise in business opportunity due to an increase in the demand for smart technology solutions across industries. Data visualization in the cloud will support real time analytics over the next few years.  Both public and private sectors will consume data to customize offerings which will ease the lives of end users. The need for change in government policies to support the growth of technology will push governments to reorganize their citizen centric services. One of the major fallback of IoT is the threat to data security witnesses with an increase in the volume of data generated at an accelerated pace by connected devices. As there is an increase in the number of data hacking incidents and its misuse, corporate strategies and government policies will need to address this menace with stricter reg- ulation and greater control. As enterprises continually adopts Internet of Things solutions, it will present a tremendous opportunity to expand their customer base leading to a  greater control over market share and gaining competitive advantage thereby increasing their profitability. This technological revolution, Internet of Things, is already here and enterprises need to seize the opportunity now.

**Authors**

**Dr. Pradeep K. Mukherji is President APAC & Africa and Partner with Avasant. For more insights on Avasant digital services email him at** pk.mukherji@avasant.com

**Alok Ranjan is a Marketing Specialist with Avasant.  For more insights email him at** alok.ranjan@avasant.com

**Business & IT Transformation**

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**Sourcing Advisory**

1960 E. Grand Avenue. | Suite 1050 | Los Angeles | California 90245 | USA

Tel:    310-643-3030

Fax:    310-643-3033

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