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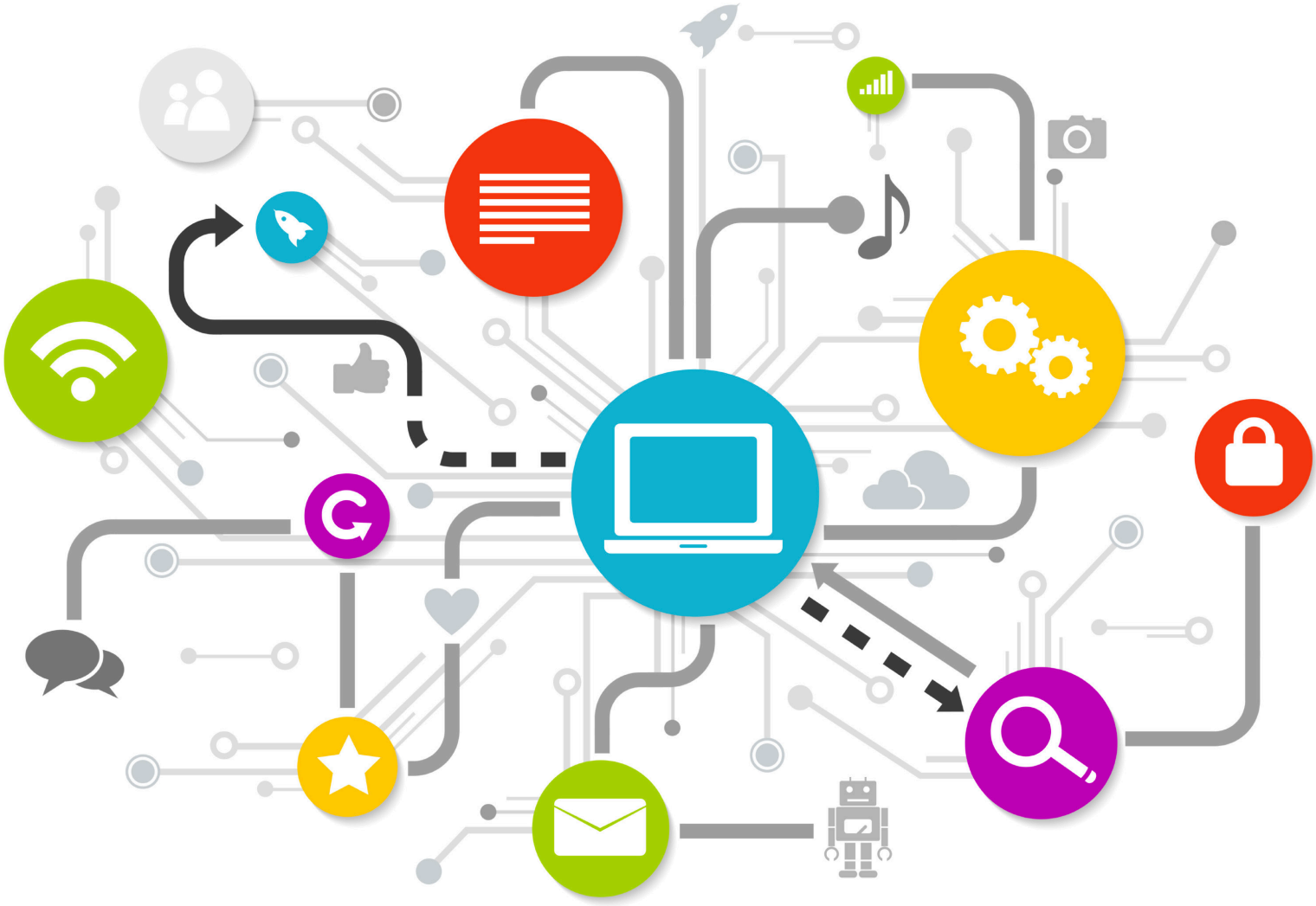

# Internet of Things: Entering the Realm of Science Fiction

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# Table of Contents

# Abstract

Recent advances in networking and communication technologies have led to the emergence of the Internet of Things – a deeply interconnected web of machines. A wide range of consumer devices are now equipped with sophisticated sensors to track user behavior and preferences. Car makers, healthcare firms, utilities companies are all rising to the challenge and making their products more "sentient." The information they gather and analyze is being used to make everyday lives better for people across the globe.


## What is driving the Internet of Things?

Internet of Things (IoT) refers to connectivity – through wired or wireless networks – between physical objects embedded with sensors and actuators[1]. Machines first started facilitating human-to-human communication with the invention of printing press, telegraphy and telephony. When more intelligent devices (i.e., computers) came along, we saw the first human-machine interactions. IoT represents the third phase in this series, machine-to-machine communication that often goes on without human intervention.

Machines are becoming increasingly personalized and integrated into our daily lives. They come equipped with sophisticated sensors and data analytics capabilities that can understand our behavior, communicate with other relevant devices, and respond in real time. For instance, a "smart refrigerator" can monitor its contents and give dietary recommendations based on the users' lifestyle. It can even be programmed to place grocery orders online as and when required!

There are three main forces that have driven the rapid adoption of IoT technologies across various industries:

1. Sensing and computational capabilities

   Sensing , computing and data analytics have advanced to a stage where they can benefit individual consumers and not just enterprises. The smart refrigerator may have been too frivolous and expensive a decade ago, but may well become a necessity 10 years hence.

2. Consumer awareness

   Consumers have become more technology savvy and their expectations are growing. They are more accepting of radical new devices and are more open to sharing personal data than they were at the turn of the century. A device manufacturer no longer needs to worry whether its new wearable gadget will be accepted in the market or not. Rather, a bigger worry for it would be rapid obsolescence of new devices and cut-throat competition. Such is the appetite of today's consumers.

3. End to End Automation and Efficiency

   IoT typically helps reduce operating costs while ensuring continuous availability of the concerned devices. Greater connectivity and automation means that the machines can be monitored better and human error reduced. When one part of a process gets automated and brings some benefits wrt efficiency – it shifts the bottlenecks to some other part of the process, and puts pressure on that part to get automated which in turn drives IOTization of that part as well driving end to end efficiency.

[1] *http://www.mckinsey.com/insights/high_tech_telecoms_internet/the_internet_of_things*

# How are industries adopting IoT?

The internet of things is gaining traction across a range of industries. Let's look at a few examples:

1. Automotive Industry

   Cutting edge telematics can help make our roads safer and enable easier vehicle maintenance. Cars equipped with intelligent devices can have service schedules based on actual wear-and-tear rather than on mileage or time-since-last-service. The ultimate achievement for IoT devices in this space will be the driverless car. Google has already clocked several hours of highway testing, while Tesla Motors is targeting to roll out a 90% autonomous car by 2016[2].

2. Healthcare

   Preventive care has been transformed thanks to wearable devices that monitor health factors (like heart rate and blood pressure). Hospitals are now able to discharge patients earlier since they can be monitored at homes through IoT-enabled devices. As algorithms become increasingly advanced, devices will be able to do basic health check-ups at the backend while doctors can get involved as and when required.

   Curative care is also getting a boost through IoT. Microbots and nanobots can help address specific problems even in the more inaccessible parts of the body. For instance, researchers have already developed the MagnetoSperm[3], a tiny robot that can help in targeted drug delivery, cell sorting, and cleaning of clogged arteries.

3. Energy and Utilities

   Some countries have rolled out smart metering that can track and predict consumption patterns. Since electricity is something that cannot be stored, this can help reduce overproduction without risking power shortages. In the same vein, smart grids can be used to perform predictive analytics for both production and consumption. For instance, favorable wind conditions in one part of the country can allow a coal-fired power plant to be shut down for some time. Such measures can go a long way in reducing carbon footprints.

4. Consumer Electronics

   The consumer electronics industry is at the forefront of technological changes that we have talked about so far. NFC (near field communication) enabled smartphones have already hit the market. Earphones that can track heart rates are another example of futuristic IoT devices. Indeed, we are soon going to see Loaded Consumer Electronics devices power-packed with features related to entertainment, gaming, safety, etc.

For automotive and consumer electronics, IoT is the next obvious step in advancement. Telematics sensors can be installed for a minor cost relative to the cost of a car. Almost all vehicles and gadgets are natural candidates for conversion to IoT. For healthcare and utilities, IoT adds significant consumer value to the existing offerings.

# Risks and Rewards – Finding a balanced approach to IoT

A 2013 EIU study estimates that three-quarters of companies worldwide are either exploring the use of IoT or already using it[4]. The Underground, London's metro system, has already put IoT to use for tracking equipment malfunction, controlling CCTV and PA systems etc. It expects to improve customer service levels by 30%, besides saving 30% on support costs[5].

However, there is still a lot of uncertainty about this complex futuristic technology as organizations find it difficult to understand how a connected toaster or washing machine could help their business.

It is quite understandable to be wary of potential risks associated with a new technology. Organizations must manage risks and control costs by making gradual changes without disrupting existing workflows. Data security can be another concern with an increased flow of device information. At the same time, an organization must not lag behind in adopting this potential game-changer, lest it loses its competitive edge.

[2] *http://www.dailymail.co.uk/sciencetech/article-2424312/Teslas-Elon-Musk-says-self-driving-cars-produced-2016.html*

[3] *http://www.thewire.com/technology/2014/06/tiny-sperm-like-robots-want-to-deliver-you-medicine/372076/*

[4] *http://www.economistinsights.com/analysis/internet-things-business-index*

[5] *http://www.smh.com.au/it-pro/business-it/london-underground-on-track-to-join-the-internet-of-things-20140417-zqvmr.html*

The IoT-CUVE (Customer Value Enhancement) Methodology makes an ecosystem-oriented cost-benefit analysis of converting a device to IoT. The ecosystem consists of three stakeholders – (1) device manufacturers; (2) service providers; and (3) consumers. The approach covers an exhaustive list of factors critical to the decision-making process:

1. **Capital expenditure** required for procuring the device in question.

2. **Service value** realized by service provider once the device is IoT enabled. For example, this would include monthly subscription fees for a "diet planner" service bundled with a refrigerator in IoT form.

3. **Customer value** realized by those who avail of this service. Continuing with the example of the smart refrigerator, this would include the value accruing to users because of a well-managed diet plan as well as the convenience of having grocery orders placed automatically.

4. **Cost of conversion** to IoT. This accounts for the incremental capex for converting the existing device. For a refrigerator this could be anywhere between 5% and 20% of the base price, and could have significant implications when it comes to user acceptance.

5. **Potential customer base** for the IoT device.

Let us take the example of water heaters in the context of home use and industrial use. An IoT-enabled heater would monitor the efficiency and alert the service provider if it falls below a certain threshold. Table 1 gives estimates of the five CUVE factors for both cases.

| CUVE Factor | Household water heater | Industrial boiler |
|---|---|---|
| Capex | $100 | $10,000 |
| Service value (monthly) | $10 | $100 |
| Customer value (monthly) | $5 (efficiency) | $200 (efficiency and safety) |
| Cost of conversion | 5% of capex | 5% of capex |
| Potential customer base | All households | All firms using boilers |

*Table 1. CUVE Factors for home and industrial use water heaters*

For the domestic appliance, conversion to IoT adds a small amount of customer value due to improved efficiency. However, for the industrial boiler, IoT addresses concerns around both safety and efficiency. Hence, the latter is a natural candidate for conversion to IoT because it would be beneficial to all stakeholders.

# The Next Steps

IoT-enabled devices are likely to transform the lives of consumers and enterprises alike in the coming years. The full potential of the synergies between connected devices is yet to be discovered. However, there is also a significant level of uncertainty surrounding the adoption and penetration of these machines. In such a scenario, it can be beneficial for manufacturers to partner with an experienced service provider to offset some of the risks associated with converting everyday devices to IoT.

We also predict that the IoT will not only bring the process efficiency to enterprises and comfort to human life, but it will also fuel the growth of advanced robotics and Knowledge Work Automation.

# About the Author

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For last 2 decades, Mandar has been in various leadership roles in IT Consulting industry in the U.S., the Middle East, APAC, ANZ and India. He is the Author of ASSIMPLER Framework for EA and IT Strategy. He has led many cross-cultural teams onshore and offshore. His experience spans across Energy and Utilities, Telecom, BFSI, Pharma, Infrastructure and Government. Mandar has also led Practices, ODCs and start-up organizations in the capacity of Head, CTO and CEO, to successful profit centers. He is a strategy Coach and Mentor to many Country-wide & Organization wide transformational initiatives. The countrywide EA framework project which he directed has also received UN award.

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