

# Internet of Things: making sense of the next Mega-Trend

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**Abstract:** The Internet of Things, or IoT, is emerging as the next technology mega-trend, with repercussions across the business spectrum. Internet of Things (IoT), which will create a huge network of billions or trillions of “Things” communicating with one another, are facing many technical and application challenges. IoT is triggering a careful thinking on the role and modes of providing care to people in order to ensure a decent quality of life, without imposing traumatic changes of habits and domestic environment. RF identification (RFID) technology is now mature to provide part of the IoT physical layer for the personal healthcare in smart environments through low-cost, energy-autonomous, and disposable sensors. Wireless Sensor Network (WSN) and smart mobile technologies are also leading this evolutionary trend. In the wake of this tendency, this paper proposes a novel, IoT aware, smart architecture for automatic monitoring and tracking of patients, personnel, and biomedical devices within hospitals and nursing institutes.

**Keywords:** Internet of Things (IoT), Social Internet of Things (SIoT), social networks (SNs), RF identification (RFID) technology, Wireless Sensor Network (WSN).

## 1. Introduction

The Internet of Things (IoT) is a recent communication paradigm that envisions a near future, in which the objects of everyday life will be equipped with microcontrollers, transceivers for digital communication, and suitable protocol stacks that will make them able to communicate with one another and with the users, becoming an integral part of the Internet [1]. It is an extension and expansion of Internet-based network, which expands the communication from human and human to human and things or things and things. In the IoT paradigm, many objects surrounding us will be connected into networks in one form or another. RF identification (RFID), sensor technology, and other smart technologies will be embedded into a variety of applications [2].

Improving the efficiency of healthcare infrastructures and biomedical systems is one of the most challenging goals of modern-day society. In fact, the need of delivering quality care to patients while reducing the healthcare costs and, at the same time, tackling the nursing staff shortage problem is a primary issue. As highlighted in [3], in fact, current procedures for patient monitoring, care, management, and supervision are often manually executed by nursing staff. This represents, de facto, an efficiency bottleneck which could be cause of even tragic errors in practices. Recent advances in the design of Internet of Things (IoT) technologies are spurring the development of smart systems to support and improve healthcare and biomedical-related processes [4]. Automatic identification and tracking of people and biomedical devices in hospitals, correct drug-patient associations, real-time monitoring of patients' physiological parameters for early detection of clinical deterioration are only a few of the possible examples [5].

In this complex scenario, the application of the IoT paradigm to an urban context is of particular interest, as it responds to the strong push of many national governments to adopt ICT solutions in the management of public affairs, thus realizing the so-called Smart City concept [6]. Although there is not yet a formal and widely accepted definition of “Smart City,” the final aim is to make a better use of the public resources,

increasing the quality of the services offered to the citizens, while reducing the operational costs of the public administrations. This objective can be pursued by the deployment of an urban IoT, i.e., a communication infrastructure that provides unified, simple, and economical access to a plethora of public services, thus unleashing potential synergies and increasing transparency to the citizens [1].

## 1. Current Trends in IoT

The Internet of Things, or IoT, is emerging as the next technology mega-trend, with repercussions across the business spectrum. By connecting to the Internet billions of everyday devices—ranging from fitness bracelets to industrial equipment—the IoT merges the physical and online worlds, opening up a host of new opportunities and challenges for companies, governments, and consumers.

### a. The IoT as the Third Wave of the Internet

Gadget trends come and go, with only a few starting real tech revolutions. Thus, it is natural to be skeptical about the latest gadgets trend: the Internet of Things (IoT) as shown in Fig.1.

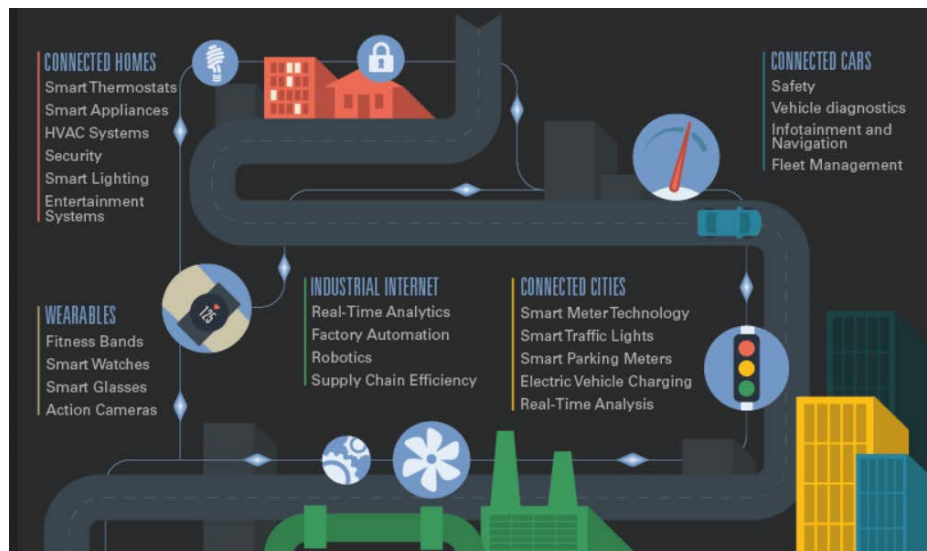


Fig.1. Representation of IoT with devices.

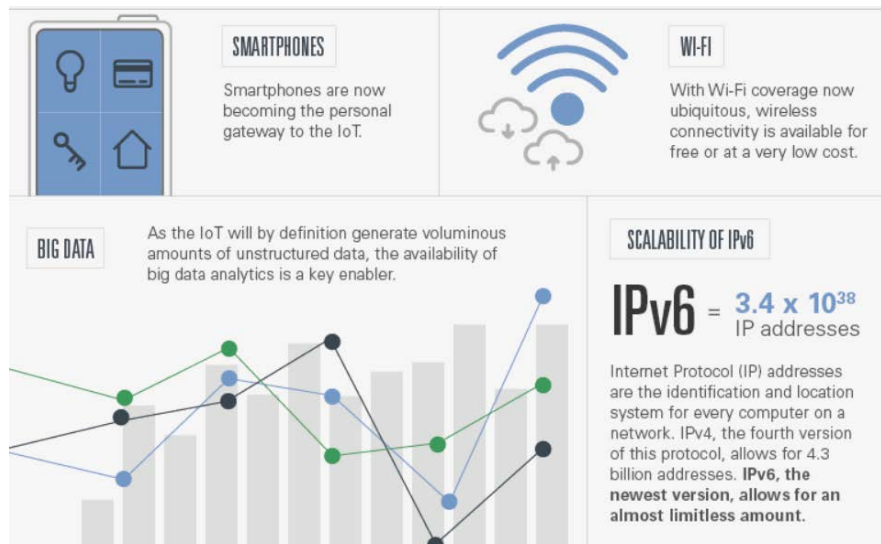


Fig.2. Growth of IoT

**b. Driving Growth**

The IoT value proposition a driver of new product cycles and another leg of cost efficiencies.

**c. Revenue Generation**

Companies are focused on the IoT as a driver of incremental revenue streams based on new products and services.

**d. Productivity and Cost Savings**

Businesses are also embracing the IoT to improve productivity and save costs. Consumer demand is also driving IoT adoption as they embrace new technology to improve health, energy savings and safety as shown in Fig.2.

**2. IoT Paradigm**

The IoT paradigm represents an ecosystem that allows people and smart devices to interact within a social framework. On top of this framework, applications and services can be offered relying on Web technologies. To realize this framework, some major building blocks should be provided. In this section, the key aspects that constitute the basis of SIoT: the social role, intelligence, socialized devices, and everything as a service.

**A. Social Role**

In [7]–[9], the social role initiates from users’ SN, where the argument to bring it into IoT world is to guarantee the network navigability, and an efficient service discovery. Similarly in [10], the social role is promoted by the use of popular online SNs and their APIs to maintain a social structure and relationships with smart objects. Also, this suggested social structure allows to share smart objects relying on the trust provided by the community. In [11], users’ SN accounts can help in service operation for SIoT, for instance, to utilize geo-location data or publish devices’ status and updates. The social role appears in [12] in terms of utilizing SNs as an interface to control smart objects.

**B. Intelligence**

In [8], the concept of intelligence is mentioned as an essential component of the SIoT paradigm which is responsible for starting, updating, and terminating the objects' relationships in SIoT. This is not only the scope of intelligence, in [10], the notion of intelligence is to allow dynamic thing-to-thing service discovery where smart objects can understand each others' services in an automated way. The work presented in [13] envisions that intelligence is implemented as a middleware combining many technologies such as ontologies, techniques for processing user generated content, and recommendation techniques. In short, intelligence in literature appears to be a sort of decision maker to drive the use of services.

### C. Socialized Devices

The concept of socialized devices as brought in by very early contributions in SIoT such as [7]–[9] may be the most essential architectural component because it implies the mechanism which various smart objects and embedded devices will use to communicate with people through the Internet. Reference [14] introduced the idea of collaboration between SNs and smart objects, an analysis of the features of social devices is also presented in this paper, focusing on the vision of enabling smart devices to “talk” with other objects, to share experience about certain situations and to seek help. In [10], social devices rely on Web protocols to communicate with users through an SN environment.

### D. Everything as a Service

The notion of turning objects and SNs functionalities into services and enable them to be easily discovered and integrated with various other services has been presented in the literature to utilize the convergence between the social and devices roles as promoted by SIoT. Thus, people can share the services offered by smart objects with friends or objects [15]. This kind of sharing implies the use of the social role to discover and promote services. However, the concept of turning “everything” to a service is presented in [8] as a wider vision, by associating smart objects with the services they deliver. The discovery of new services to be utilized or mashed-up with other services can take place endorsed by the social role, where a user can discover trustworthy services within her/his social community [16].

## 3. Future of IoT

The internet of things (IoT) is emerging as a third wave in the development of the internet. Personal lives, workplace productivity and consumption will all change. There will be a string of new businesses from those that will expand the internet pipes, to those that will analyze the reams of data, to those that will make new things. In the near future the Internet and wireless technologies will connect different sources of information such as sensors, mobile phones and cars in an ever tighter manner. The number of devices which connect to the Internet is – seemingly exponentially – increasing. These billions of components produce consume and process information in different environments such as logistic applications, factories and airports as well as in the work and everyday lives of people. The society need new, scalable, and compatible and secure solutions for both the management of the broader, complexly-networked Internet of Things, and also for the support of various business models.

## 4. Conclusion

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The IoT's paradigm aims at connecting anything, to be accessed at anytime from anywhere. It is based on making available a set of services coming from the interoperation of billions of devices, with the ultimate objective of improving user's everyday lives. In this paper, the solutions currently available for the implementation of urban IoTs were analyzed. The discussed technologies are close to being standardized, and industry players are already active in the production of devices that take advantage of these technologies to enable the applications of interest. A much focused effort is, therefore, needed to manage the conversion from experiments to the real use and mass production within a so potentially fast growing market. The overcoming of the slowing factors demands a coordinated activity of the IoT community to stimulate interest in potential final users and, in parallel, to boost the evolution of readers, software, and devices toward a more interconnected perspective. The future of IoT will be expected to be unified, seamless, and pervasive. Large-scale service deployment needs to be framed within a set of standards. Thus, the developments of IoT as an intelligent system can be proceeding with interoperability, energy sustainability, privacy, and security. IoT have become an inevitable trend of development of information industry, which bound to bring new changes to our lives.

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