

## THE INTERNET OF THINGS (IOT) AND ITS APPLICATIONS IN MODERN INFORMATION SOCIETY: SMART HOME AND SMART CITY SYSTEMS

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**Abstract:** *The Internet of Things (IoT) represents a revolutionary technological paradigm that enables interconnected devices to collect, process, and exchange data with minimal human intervention. This paper explores the evolution of IoT, its historical milestones, and its practical applications in modern society. The study highlights the role of IoT in industrial, commercial, and domestic environments, including smart homes, smart cities, and urban infrastructure. Key factors driving IoT adoption, such as convenience, safety, and efficiency, are analyzed, alongside challenges related to data security, privacy, and technical compatibility. The article demonstrates how IoT technologies are transforming socio-economic structures, enhancing productivity, and reshaping daily life.*

**Keywords:** *Internet of Things (IoT), Smart Homes, Smart Cities, Connected Devices, Data Analytics, Industrial IoT, Information Society, Home Automation, IoT Security*

The Internet of Things (IoT) is a complex of technologies that enables data exchange between interconnected mechanical and digital devices, objects, sensors, and other systems connected through the Internet or local networks. IoT systems are capable of collecting, processing, and analyzing information automatically, without human intervention, thereby becoming an integral part of modern digital infrastructure. Today, the Internet of Things holds not only technical but also significant social and economic importance. IoT technologies are penetrating almost every aspect of our daily lives — from consumer goods and transportation vehicles to industrial automation, energy systems, healthcare, agriculture, and urban infrastructure. These technologies allow real-time data analysis, improving production efficiency, facilitating human labor, and ensuring more rational use of resources. In recent years, the development rate of IoT technologies has accelerated dramatically. According to research, by 2025, more than 100 billion devices worldwide will be connected to IoT systems, and their impact on the global economy is expected to reach up to 11 trillion USD. This clearly demonstrates the transformative potential of IoT as a driving force of global economic evolution.

However, IoT-related technologies also bring a number of challenges. Above all, issues such as data security, privacy protection, and resistance to cyber threats remain highly relevant. As the number of IoT devices increases, so does their vulnerability to

attacks. Therefore, improving technical standards, implementing reliable encryption mechanisms, and strengthening legal and regulatory frameworks are essential.

In addition, the stable functioning of IoT infrastructure requires sustainable energy sources, high-speed broadband networks, and highly integrated software solutions. Political, economic, and social support for these processes is of crucial importance to fully harness the potential of IoT technologies [1].

The term “Internet of Things” (IoT) was coined in 1999 by Kevin Ashton, one of the three founders of the Auto-ID Center at the Massachusetts Institute of Technology (MIT). The term has multiple definitions, none of which are entirely precise. In this article, we adopt the definition recommended by Gartner, which integrates the concept of Enterprise Resource Planning (ERP):

“The Internet of Things is a network of physical objects equipped with internal technologies that allow them to interact with the external environment, transmit information about their state, and receive data from external sources”.

An integral part of the Internet of Things is its industrial application, known as the Industrial Internet of Things (IIoT). At the same time, a newer term, the Internet of Everything (IoE), has emerged, which is expected to gradually replace the traditional IoT terminology in the near future. The IoE concept expands upon IoT by connecting not only objects but also people, data, and processes through networks.

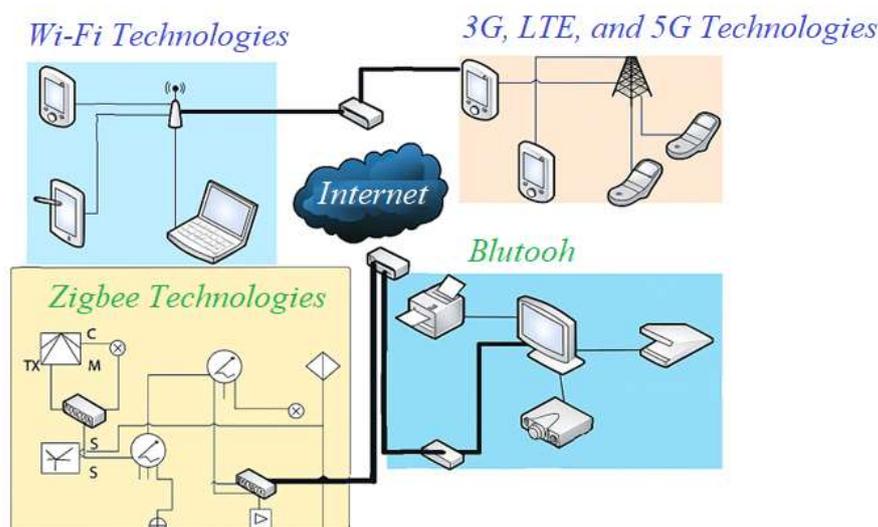


Fig.1. Structure of an IoT Network

From a technical perspective, the Internet of Things (IoT) is a term that unites a set of technologies designed to acquire data from the external environment and process it with minimal human intervention. In this context, direct use of the Internet is not necessarily the primary factor. Broadly speaking, the term “Internet” in the IoT concept refers not only to the Internet itself but also to other means of transmitting accumulated information about the surrounding world [2].

The IoT concept can be implemented using a variety of technological tools, including electronic monitoring systems. Currently, there are numerous technical developments aimed at expanding the scope and capabilities of IoT technologies.

Objects associated with the Internet of Things are generally referred to as “Connected Things.” However, in practice, it is logical to further differentiate between “Connected Devices” and “Connected Things.” A connected device refers to a node within an IoT network that can independently perceive the surrounding reality and transmit data. On the other hand, connected things are objects with a unique identification feature in the information space but do not have the ability to acquire data from the external environment.

When discussing both groups simultaneously, the term “connected object” may be used as a general category.

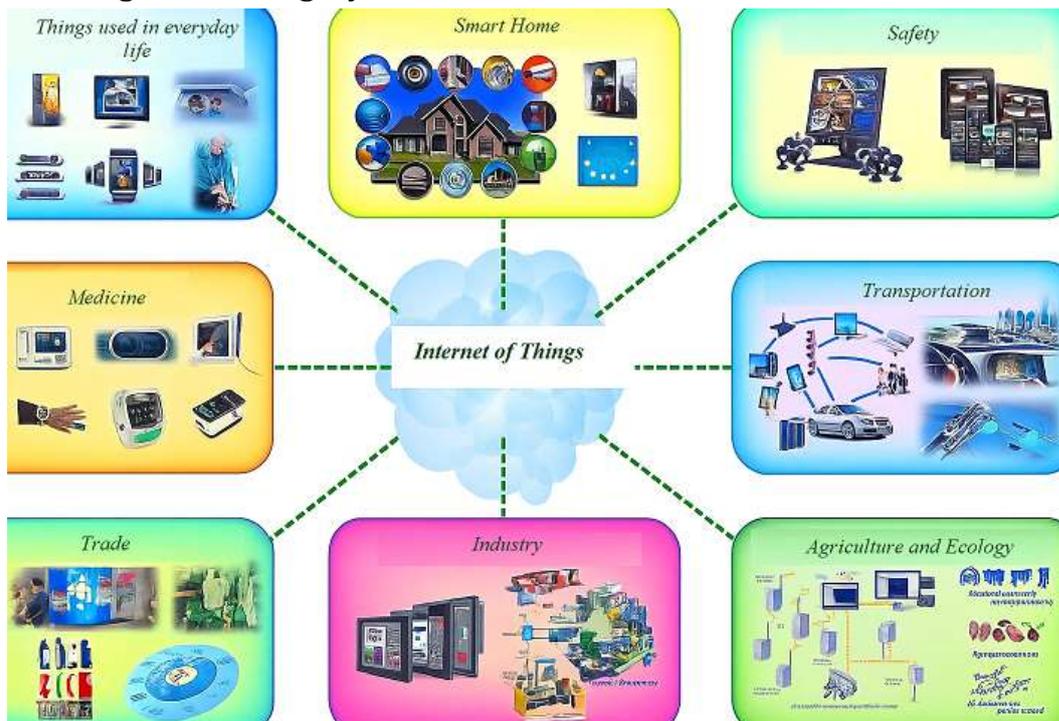


Fig.2. Application Areas of IoT Technologies

To date, the vast accumulation of information and the emergence of advanced information and communication technologies (ICTs) have fundamentally transformed the socio-economic structure of modern society. While the mid-20th century was characterized by a clearly defined industrial society, scholars now describe the current stage as a transition to a post-industrial or information society. This transformation reflects a major shift in labor resources, with increasing emphasis on service provision and information management rather than traditional industrial production [3].

**Service Sector:** This sector represents the segment of the economy encompassing all types of commercial and non-commercial services, delivered by enterprises, organizations, and individuals. It covers a wide range of activities, including financial services, information management, housing and utilities, household services, rentals, travel and tourism, legal and regulatory services, hospitality and security, translation services, trade, and transportation.

**Labor Force Composition:** In economically developed countries, the service sector accounts for more than 60% of the total workforce, reflecting its dominant role in modern economic activity. This redistribution of labor illustrates the decreasing

relative importance of manufacturing and industrial production and the rising significance of knowledge-based and service-oriented activities.

Implications for IoT: The evolution toward an information society has created fertile ground for the adoption of IoT technologies. By integrating sensors, devices, and communication networks, IoT can enhance service efficiency, optimize resource allocation, and support real-time decision-making across diverse sectors, ranging from finance and transportation to healthcare and urban infrastructure. The transformation of labor and economic structures makes IoT not just a technological advancement, but a crucial component of the socio-economic evolution of modern society [4].

The development of human society has always relied on material tools, energy, and other resources, including information. At present, the volume of information flows is experiencing an unprecedented growth, affecting nearly every sphere of human activity. The most significant increases in information volume are observed in industrial, trade, financial-banking, and educational sectors.

The growing prevalence of the Internet is closely associated with the ability to conduct almost all business processes electronically using this technology. These processes include purchasing and selling goods and services, making financial investments, acquiring information, and concluding contracts. Today, the development of the Internet is deeply intertwined with the growth of electronic commerce (e-commerce).

Historically, the expansion of information and communication has undergone several key milestones:

1. The Invention of Writing – marking the beginning of recorded information and knowledge preservation.
2. The Invention of Printing – enabling the mass dissemination of knowledge through books.
3. The Information Revolution – The Internet – facilitating instantaneous global access to vast amounts of information and transforming social, economic, and industrial practices.

Nowadays, communication via the Internet, video calls, and even conducting business transactions have become routine for everyone. Even governments perform certain functions through the Internet. However, the potential of the global network is not limited to human activities alone. Various household appliances, considered as human inventions, are now also connected to and using the Internet. This development led to the introduction of the term “Internet of Things” (IoT) in the field of information technology. The first household appliance to communicate via the Internet was a toaster. This technology was practically tested by Jon Romkey, a graduate of the Massachusetts Institute of Technology (MIT). In 1990, he connected the toaster to a network via the TCP/IP protocol, allowing it to be operated remotely.

In 1999, MIT established the Auto-ID Center, focusing on radio-frequency identification and new sensor technologies. According to the Internet Business

Solutions Group (IBSG), one of its divisions, “there will come a time when the number of Internet-connected objects exceeds the number of humans.” In 2003, with a global population of 6.3 billion, the number of Internet-connected objects was about 500 million, which corresponded to only 0.08 devices per person [5].

In 2004, the scientific journal *Scientific American* published an article about the Internet of Things. The article described household products (e.g., clocks, air conditioners), home systems (e.g., security, plant irrigation, lighting), and sensors (e.g., temperature, illumination) that were interconnected through networks and capable of fully automated control.

By 2010, the number of Internet-controllable objects had actually surpassed the global human population. While the world population was 6.8 billion, IoT devices reached 12.5 billion, which equated to 1.84 devices per person.

According to the prominent theorist Rob van Kranenburg, the Internet of Things consists of four generations, with the following stages:

Stage 1: Identification connection of each object.

Stage 2: Systems that meet individual human needs, e.g., “Smart Homes.”

Stage 3: Urbanized life and city management, e.g., “Smart Cities.”

Humanity’s control of objects via the Internet across multiple networks — even between separate megacities — can be attributed to two primary factors. The first and most immediate is convenience. Imagine preparing breakfast without leaving your bed: by connecting kitchen appliances to the Internet, each device can be controlled remotely via a smartphone, tablet, or voice assistant. This includes ovens, coffee machines, refrigerators, and even automated breakfast makers. Such integration allows users to set schedules, monitor device status, and adjust operations in real time, significantly reducing daily effort and improving efficiency.

The second factor is safety and security. After leaving the house, people often wonder: “Did I unplug the iron?”, “Did I turn off the gas and water?”, or “Did I lock the door?” IoT-enabled home systems allow for real-time monitoring and automatic responses, which mitigate these concerns. For example:

- Appliance Control: Irons, stoves, or heaters can be programmed to turn off automatically after a preset period of inactivity.

- Water and Gas Monitoring: Sensors detect leaks or running taps, automatically shutting off supply and notifying homeowners via mobile alerts.

- Home Security: Windows can close automatically when leaving the house, while intrusion detection cameras capture images or video, send alerts to homeowners, and activate alarm systems. Advanced configurations can even notify local authorities immediately in case of attempted break-ins.

Beyond personal convenience, IoT integration enhances energy efficiency. Smart thermostats, lighting systems, and HVAC (heating, ventilation, and air conditioning) devices adjust automatically based on occupancy, time of day, or environmental conditions, reducing unnecessary energy consumption.

Moreover, IoT allows for data-driven decision making. By analyzing patterns from connected devices, homeowners can identify habits, optimize appliance usage, and anticipate maintenance needs. For instance, predictive maintenance sensors can alert users before a device fails, preventing accidents and saving costs [6].

In urban contexts, this concept scales to smart homes and smart cities, where networks of connected devices coordinate to optimize traffic flow, energy distribution, public safety, and emergency response. The same principles that improve individual homes are applied at a city level, demonstrating IoT's broad potential to enhance quality of life, safety, and sustainability.

In conclusion, the combination of convenience, security, energy efficiency, and predictive intelligence makes IoT not just a technological innovation, but a transformative element in modern daily life, reshaping how humans interact with their environment.

Conclusion: In conclusion, the Internet of Things has significant potential to enhance efficiency, improve safety, and transform everyday human activities across multiple sectors. Its applications extend from household appliances to industrial systems and urban infrastructure, demonstrating far-reaching socio-economic impact. At the same time, challenges such as security, personal data protection, and technical interoperability remain critical areas requiring ongoing development. The continued evolution of IoT promises not only technological advancement but also the optimization of human life, resource management, and societal operations.

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