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INTERNET OF THINGS CONCEPT

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Annotation

For any organization, first of all, during a crisis, it is important to rethink the changes taking place around it, assess the factors affecting it, find its strengths and come up with new breakthrough solutions that will help reduce costs, increase profits and attract new customers. The purpose of this study is to reveal the essence of the concept of the "Internet of Things", the prerequisites for its appearance, its significance for society and business at the moment and in the future. And also analyzed the main platforms of the Internet of Things, the standards being created and the prospects for the development of this direction.

Introduction

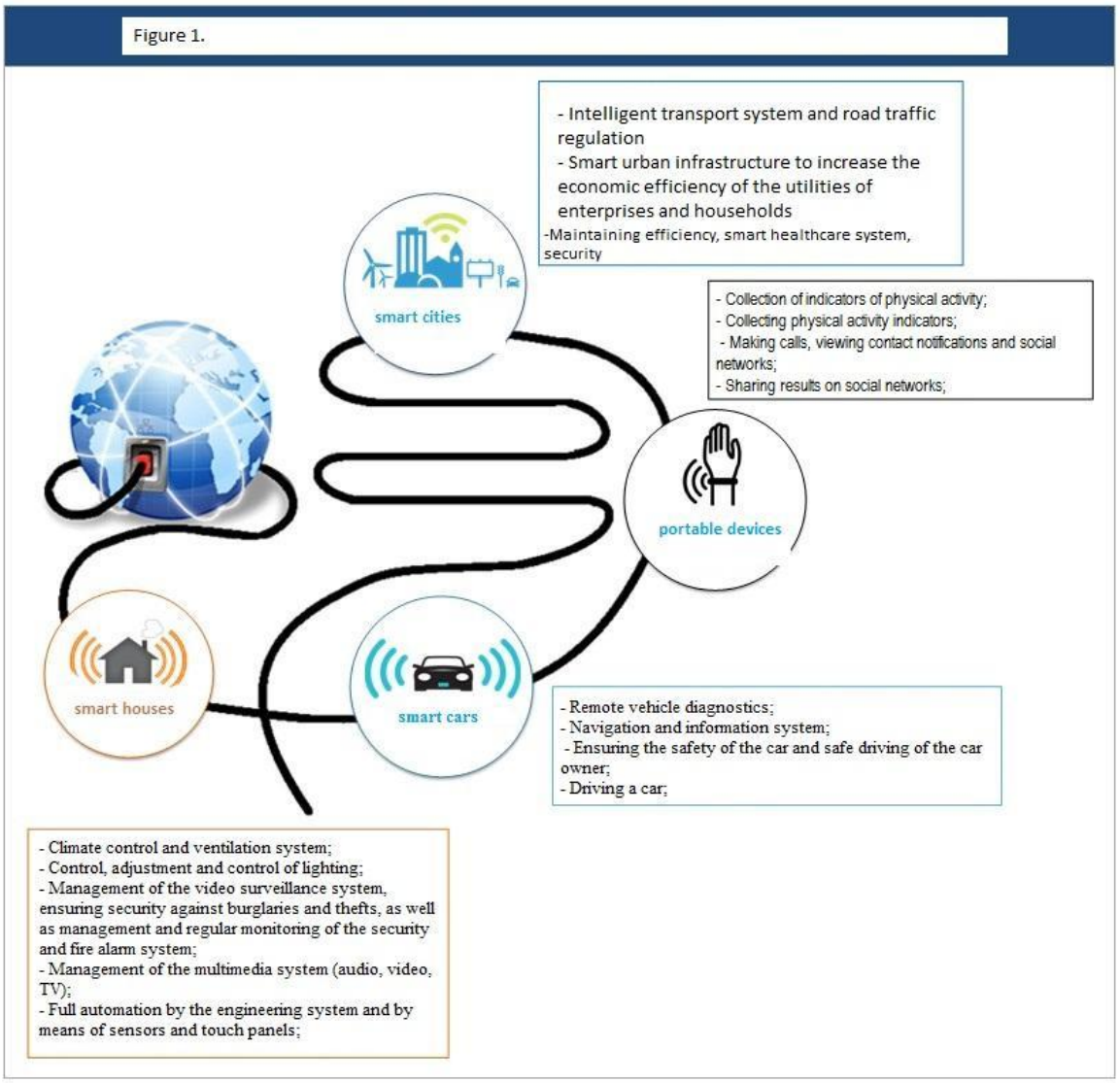
Currently, we can observe the penetration of digital technologies into both business and everyday life. This trend opens up new opportunities for individual companies and entire industries. The integration of enterprises and digital platforms, the physical and virtual world, as well as businesses of the most different industries: mobile operators and banks, telecommunications and insurance companies. This process is associated with the need to process large amounts of data, expand data transmission channels, effectively interconnect machines with each other, which creates a synergy between the classical and digital economies.

This digital transformation allows companies to more accurately predict changes in the market and make decisions based on the collected, processed and analyzed information about various components of business. One of the incarnations of digital transformation is the concept of "Internet of things".

The term "Internet of things" (IoT) was coined in 1999 by Kevin Ashton, who suggested that it is possible to link several physical objects ("things") in production to exchange information and interact with each other and with the outside surroundings. In 2010, as a result of the rapid spread of smartphones and tablet computers, the concept of the Internet of Things began to mean not just the automation of processes in local production, but also a more global concept, when not only a computer or smartphone, but also other devices, starting with a coffee machine in the office and ending with a refrigerator at home, connected to the internet.

For ordinary consumers of such technologies, life becomes more comfortable. In the national economy, this is a way to save resources and optimize production [1]. The Internet of Things allows you to create dynamic networks consisting of billions of elements interacting with each other (Fig. 1). Thus, a connection is provided between the accumulated amount of data and real objects for which applications, services, devices themselves are data sources.

Figure 1. IoT consumer device ecosystem Source: J'son & Partners Conculting



Источник: J'son & Partners Consulting

At the moment, the structure of the Internet of Things consists of loosely connected disparate networks, each of which has been deployed to solve its specific tasks. But as the Internet evolves, these and many other networks will connect to each other and use ever-increasing security, analytics, and governance tools (Figure 2).

As a result, the Internet of Things will make it possible to acquire even more opportunities for opening up new, vast prospects for humanity, as well as provide an opportunity to increase production potential and reduce costs. An analysis of the last few years has shown that innovative developments in the IT field have a beneficial effect on the life of society as a whole [3].

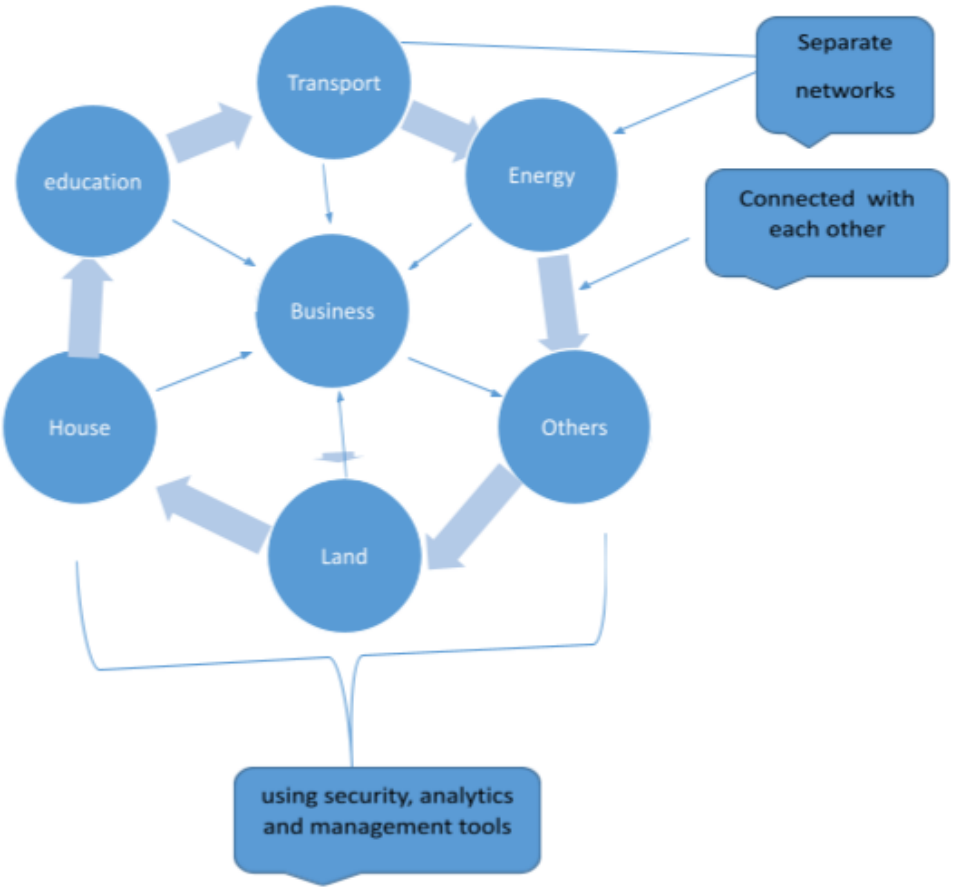


Figure 2. The Internet of Things as a "Network of Networks"

The main factors that contributed to the emergence of the concept of the Internet of Things and its development in theoretical and practical terms [4]:

- increasing the bandwidth of the Internet (allows exchange an unlimited amount of required data in different formats);
- Internet accessibility through differentiated communication channels and in various modes (provides users and devices with access to the network from many places with a given quality of service);
- an increase in the number of devices with Internet access (forms an actively interacting environment of users and devices and contributes to the emergence of corresponding needs);
- a variety of devices with access to the Internet (serves the development of technologies and communication protocols for users and devices, as well as the implementation of a wide range of tasks using the network);
- the formation of needs related to the interaction of devices within the global information network (promotes interest in the problems of intensive communication between users and devices on the Internet of many commercial and public structures);
- expansion of business projects and relationships within the Internet (forms the infrastructure, economic and financial models that support the development of the network);

- a variety of innovative ideas, projects and businesses in within the framework of network communication of users and devices (actively develops in theory and practice the forms and formats of network communications);
- understanding the obvious benefits of networking (attracts resources, information, entrepreneurs and investments);
- development of the infrastructure of the Internet of Things, including: network storage of data, certificates of identification and security, secure data chains, standards and regulations of interaction (makes the development of the network stable and irreversible).

Methods and Results

One of the first incarnations of the Internet of Things can be considered machine-to-Machine (M2M) communication. M2M is the general name for technologies that enable machines to communicate with each other. For example, ATMs or payment terminals have the ability to automatically transfer information via GSM networks that they have run out of cash or, conversely, that there is too much cash and the arrival of collectors is necessary.

Today M2M solutions are used in logistics, consumer electronics, security, medicine, industry, trade, energy, housing and communal services and many other industries. One of the subclasses of M2M is machine-to-machine communication using mobile solutions; the abbreviation M2M (Mobile-to-Mobile) can also be used for it. At the moment, Mobile-to-Mobile makes up a significant part of the field of machine-to-machine communication. The global leaders in M2M are American (AT&T, Verizone, Sprint and others) and European (Telenor Connexion, Telstra, Vodafone and others) operators. In the Russian M2M market, the key players are cellular operators and the banking sector.

Mobile operators offer their solutions: MTS, Megafon, Beeline, Tele2 and some others. There are still few solutions unrelated to Mobile-to-Mobile in Russia. These include M2M-Telematics and GO +, a resident of the Skolkovo Foundation.

Analysts have estimated the Russian M2M market at $ 3 billion at the end of 2013. Experts estimate the volume of the world market at $ 250 billion, and by 2022 they forecast up to $ 1.2 trillion [5]. M2M technology has also been developed in the direction of remote monitoring and control of processes using various sensors, sensors and tags. The most famous example of tags is Radio frequency identification (RFID). Such radio frequency tags and sensors provide the ability to track in detail the production process of products, as well as the storage of finished goods in a warehouse. Moreover, they allow you to optimize logistics and production chains, minimize the cost of transport, storage and reduce the importance of the human factor at all stages of production and sale of goods [6]. Smart products with tags or sensors with their own unique identifier can be tracked at any time, know their history, current status and can report operational problems in time.

The M2M segment is in many ways the basis of the concept of the Internet of Things, which at its initial stage of development was actually synonymous with M2M. With the development of Internet technologies, the concept of the Internet of Things began to imply a broader concept than M2M technologies: at the moment, machine-to-machine communication implies interaction between machines, which are used mainly in manufacturing, while the Internet of things primarily implies interaction between a machine and a person.

An integral part of the Internet of Things is informationration technologies. Sensors, processors and software are included in every product across all industries and are complemented by analytical tools. This combination allows you to highlight unique information, for example, about the hidden needs of customers and, accordingly, change the way you interact with them. All kinds of innovations arising from the Internet of Things can manifest themselves at all stages of the business process. Depending on the stage or process in which they are planned to be introduced, different effects are possible: in some

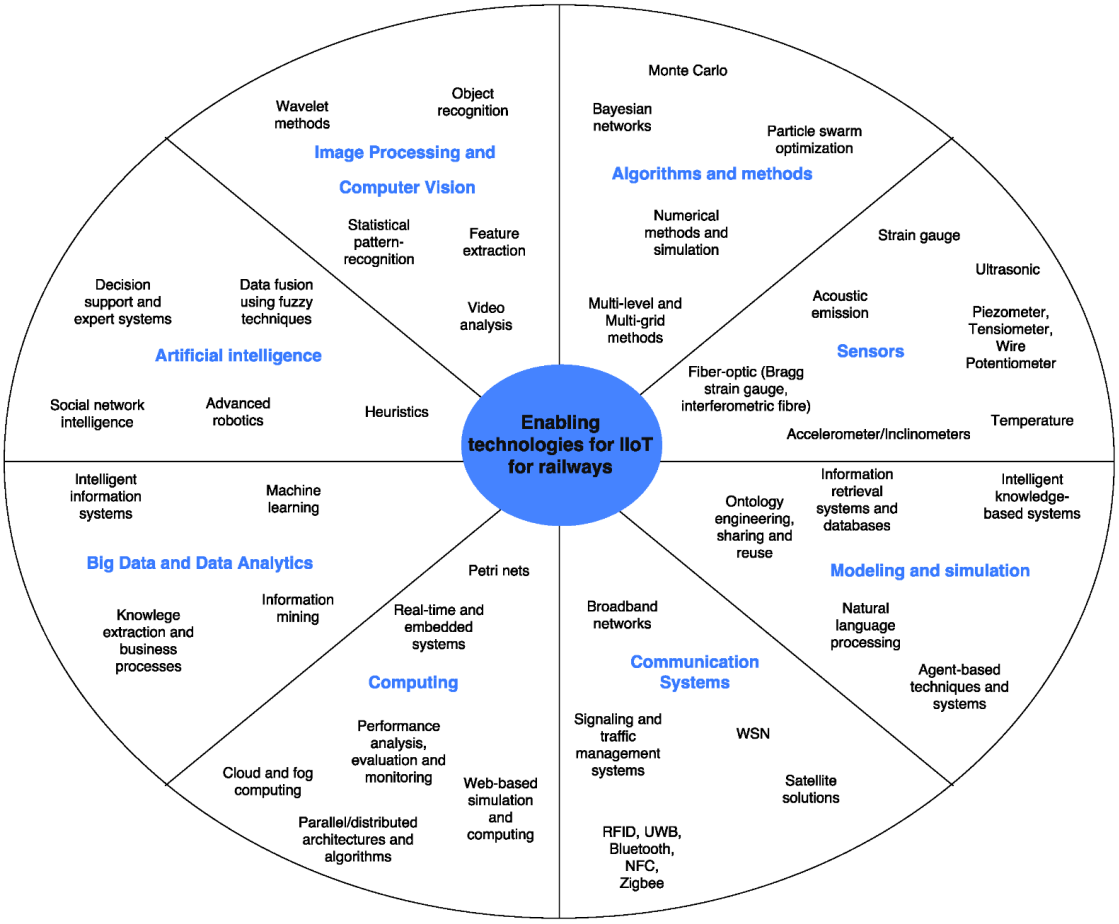
cases, costs will decrease and warehouse storage will be optimized, stocks, and in others it will be possible to attract additional buyers or increase the average check [7].

For successful implementation of Internet-based solutions a technical platform is required on which to build various solutions to rationally and efficiently achieve commercial benefits. To create various levels of complexity of the architecture of projects, both free access platforms and commercial platforms are provided. An experienced user, if desired, can build suitable solutions himself or contact specialists in this field. Several large corporations are working in this direction (their number is increasing every year) for the production of electronic devices, software, information systems, and so on. For example, Intel Corporation, which developed the Intel® IoT Platform, a platform for the Internet of Things in the automotive, energy, healthcare, industrial systems, retail, smart buildings and houses, SAP SE, which developed the SAP HANA Cloud Platform for the Internet of Things for the transport industry, energy, construction, medical systems, retail, telecommunications, oilfield services, metallurgy, fleet management, asset management. Since 2015, Google Inc, Samsung Group, Microsoft and some others have taken this issue seriously. IoT data solutions from companies provide everything you need to collect data-driven information, received from people, devices and other objects connected to the network. This makes it possible to integrate all information about the client company into the cloud using new generation Internet devices and transform business processes at a new level, developing the capabilities of the company itself and its customers. In-memory computing enables customers to rapidly design, implement, and manage IoT and machine-to-machine (IoT) applications.

Figure 3 shows the IoT-relevant services that are now available for use in real business. In this case, the direction can be both from left to right (messages are transmitted, eventually arriving at some output tool), and from right to left (when the user, using a button on the website, initiates the execution of a command on the end device - for example, a sensor or a sprinkler). Since there is no one “recipe” for an IoT project, the architecture of each project is considered separately - you can use several services or just one, for example, to store messages. Let's consider some of the services shown in the figure in more detail [8]:

- Event Hub - collection of large amounts of data from various sensors.
- Stream Analytics (streaming analytics), which allows you to define requests on "live" streams of data coming from Event Hubs, due to which you can quickly implement their preprocessing and organize reactions to events.

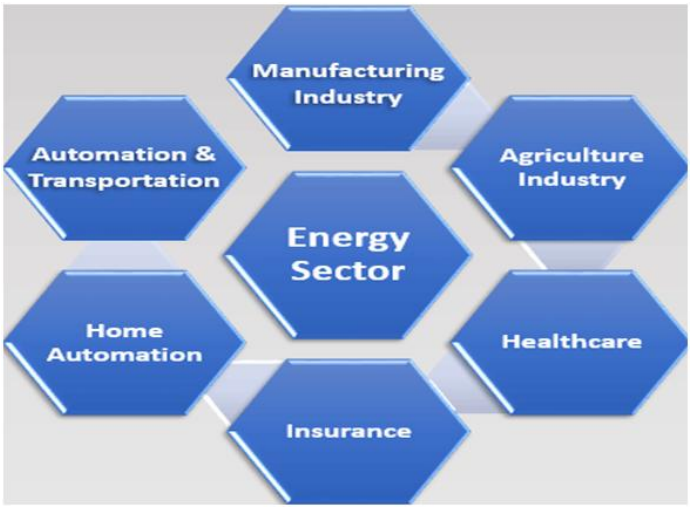
Figure 3. IoT-relevant services



Discussions and results

Most IoT technologies are surviving and growing today. At the same time, according to most experts, the Internet of Things market has great potential. Its prospective development should include the following directions, shown in Figure 4.

Fig 4. The main directions of the development of the Internet of Things market



The milestones of the Internet of Things can be captured using the so-called Hype Cycle (Gartner Curve), a branded graphical tool developed and used by IT research and consulting firm Gartner to represent the maturity, adoption and social application of high technology. Figure 5. shows the state of the Internet of Things on this Gartner curve.

There are 5 main phases in this cycle:

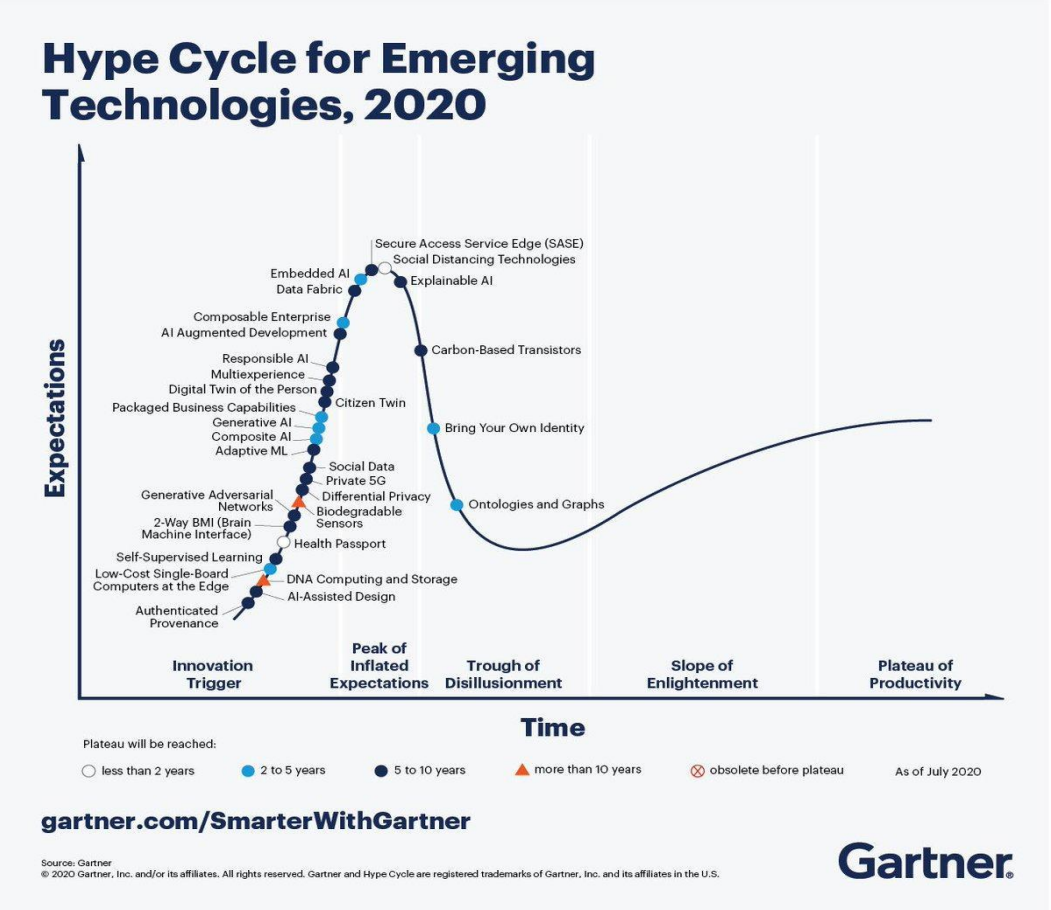
- Innovation trigger - the beginning of innovation. A new technology is being discovered / initiated. Stories appear to support this concept and generate widespread public interest.
- Oftentimes, useless products emerge at this stage that have not been proven commercially viable.
- Peak of Inflated Expectations - the peak of inflated expectations.
- Numerous success stories appear in the media, often accompanied by stories of failures. Some companies are taking some steps to implement these technologies, many are not.
- Trough of Disillusionment - recession, disappointment. Interest is dwindling due to the complexities and failures of technology adoption and unsuccessful experiments. Innovation makers make changes to technology or leave. Investment only continues if

surviving manufacturers modify their product to suit early adopters.

- ✓ Slope of Enlightenment - slope / angle of enlightenment.

More examples are emerging of how this technology can be benefited. Businesses have a better and deeper understanding of this technology. Manufacturers release second and third generation products. Many businesses are launching pilot projects, but conservative companies remain wary.

Figure 5. Position of the Internet of Things on the Gartner curve



✓ Plateau of Productivity - productivity stability.

Begins to be used by the majority, i.e. innovation is becoming mainstream. The criteria for assessing the viability of the producer are becoming clearer.

The Internet of Things has recently passed its inception stage and is now at the peak of “inflated” expectations [10]. For the stability of the productivity of this technology, it will take about 10 years.

An important role in its development will play the creation of standards that are needed to govern the four main aspects of the Internet of Things: communication, interaction, privacy and security. These security standards and technologies are currently under development. Several groups of companies are involved in the development of these standards, such as:

- The All Seen Alliance is the first IoT standards development group. It was founded by the Linux Foundation, a non-profit organization. At the moment, it includes more than 50 organizations, including Microsoft, Qualcomm, LG, Sharp and Panasonic. All Seen is looking for a way to create universal application frameworks. Technologies such as Wi Fi, Ethernet, Powerline, Bluetooth, 6LoWPAN, ZigBee and Z-Wave are used for data transmission. Particular emphasis is placed on the compatibility of devices from different manufacturers; the popular operating systems Android, iOS, Linux, Open WRT, Windows and OS X will be used as a platform. To ensure the proper level of protection and confidentiality, AllJoyn encrypts data transmitted between devices;
- The Open Interconnect Consortium (OIC) - Supported by Intel, Atmel, Broadcom, Dell. The main task is to develop general requirements for the compatibility of smart devices. Based on these requirements, an open source framework has already been created, called IoTivity. The goal of the OIC is not to propose another version of the standards, but to make its implementation a reference;
- The Thread Group - Formed by Google's Nest Labs. Includes more than eighty members: Samsung, ARM Holdings, Silicon Labs and others. The goal of this group is to encourage manufacturers of smart home devices in every possible way to use their communication standards over the network. Unlike other alliances, Thread has relied on the low-power radio protocol 6LoWPAN;
- HomeKit - Supported by Apple and enables to device manufacturers to label "Compatible with iPhone". HomeKit provides a set of tools for developers to build smart home apps. HomeKit devices transmit data encrypted;

Industrial Internet Consortium - founded by Intel, Cisco, AT&T, GE and IBM. Includes more than 150 participants who are engaged in the joint development of communication standards between devices. ICC has entered into a strategic agreement with OIC to widely disseminate information regarding device compatibility standards.

The definition of security and privacy standards IIC entrusted to CyberX and software giant SAP.

IoT is fundamentally shaped by the leaders of the IT market and largely depend on their technical and technological innovations.

Conclusion

Today, the Internet of Things is approaching a stage where heterogeneous networks and multiple sensors will have to come together to interact under the control of common standards. This goal requires businesses, government agencies, standard-setting bodies and educational institutions to work together towards a common goal. For the Internet of Things to become popular with ordinary users, operators and other market participants must develop applications that significantly improve the quality of life for people.

In the long term, not only houses, but also cities and even (some) states will become “smart”. But at this stage in the development of technology and society, the Internet of Things is being actively

implemented not on a global scale, but within companies engaged in the production of goods, energy, transport, etc. - where new technologies are expected to increase productivity and competitiveness. The difficulty of scaling this experience is due to the fact that it is necessary to integrate many systems from different suppliers into a single whole, and to establish their coordinated work is a more difficult task than to achieve the harmonious sound of the Bolshoi Symphony Orchestra.

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