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INTERNET OF THINGS: AN OVERVIEW
OF KEY PROBLEMS AND CHALLENGES

Abstract. *The concept of the Internet of Things is complex and involves the integration of such areas as hardware, networks and software. As a result, a large number of problems and tasks arise, which are both technological and socio-legal. This article provides an overview of the some of them.*

Keywords: *Internet of Things, problems of IoT, security, standardization, energy efficiency, E-waste.*

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ИНТЕРНЕТ ВЕЩЕЙ: ОБЗОР ОСНОВНЫХ ПРОБЛЕМ И ЗАДАЧ

Аннотация. *Концепция Интернета Вещей является комплексной и подразумевает объединение таких областей как аппаратные средства, сети и программное обеспечение. В результате возникает большое число проблем и*

задач, которые являются как технологическими, так и социально-правовыми. В данной статье представлен обзор некоторых из них.

Ключевые слова: Интернет вещей, проблемы интернета вещей, безопасность, стандартизация, энергоэффективность, электронные отходы.

Introduction

The Internet of Things is a rapidly developing complex concept that includes research in computer science, networking, microelectronics and sensor technology. This paradigm is the main direction of the development of network technologies in the future and will allow to solve many routine tasks of mankind, from measuring environmental indicators to increasing production efficiency.

As with any new technology, the mass adoption of the Internet of Things is constrained by a number of challenges to be addressed. This article will present the main of these problems and challenges facing the implementation of this concept.

The main problems and challenges

1) Security

For a technology that collects a lot of personal and other data, the main concern is security and privacy. For IoT devices, security is primarily about code integrity, user and device authentication, ownership management, and the ability to repel virtual and physical attacks.

The Internet of Things bears little resemblance to traditional IT infrastructure, and this makes it difficult to protect IoT networks. Each time a physical device connects to the network, it becomes a security threat. IoT devices are supposed to automatically gain access to the network, and in the event of a breach, connecting a large number of malicious devices wirelessly would have dire consequences. Vulnerabilities in protection can cause physical harm to a person, for example, if access to explosive or flammable equipment is gained, or production downtime is caused, which will entail large financial losses.

Fig. 1 – IoT security

Another important security issue is that the intelligence of IoT devices exists in unique operating systems, which means there can be countless holes in control systems. The Internet of Things is needed to solve a different range of tasks, so their physical implementation and the logic of interaction in the network are very different for various types of devices.

In addition to the security aspects listed, other requirements will be important in the IoT. You will need to provide the device with selective access to a range of services, or prevent communication with other devices at certain time. Middleware must have built-in mechanisms for this task, along with user authentication and access control implementation.

Currently, there is a strong discrepancy between the price of IoT devices and their quality. On the one hand, the Internet of Things requires a high degree of security and data protection, and on the other hand, low cost of goods. But high safety requirements and low cost are incompatible things.

2) *Standards and Interoperability*

Standards are essential to create markets for new technologies. If devices from different manufacturers use different standards, interoperability will be more difficult,

requiring additional gateways to translate from one norm to another. In addition, a company that controls various parts of the market can overwhelm small players and entrepreneurs. Lack of uniform standards can also create problems for consumers, for example, if a device from one manufacturer is replaced by a similar device from another manufacturer, when it becomes impossible to transfer the accumulated information. Thus, users actually lose any benefit from the data that they have accumulated over time.

3) Energy efficiency

Another factor hindering the development of the Internet of Things is the problem of power supply of connected devices. Many of these devices are various wireless sensors. A huge amount of sensor data must be placed everywhere, including in hard-to-reach places, and the cost of replacing batteries in them can negate all the benefits of use.

Single devices, such as sensors, often run on internal batteries and therefore have a limited energy supply. In networks with large-scale deployments of sensor nodes or medical implants, these devices should work months or years.

This problem can be solved in different ways: autonomous power supply, chemical-technological engineering, the use of low energy technologies, such as Bluetooth LE, taking into account the requirements of low power consumption when building network architecture, special software, etc.

4) Increased e-waste

The concept of the Internet of Things assumes the addition of computing capabilities and radio transmitting modules to those devices that did not previously need it. This leads to an increase in non-recyclable electronic waste.

The reason for the rapid increase in waste is that IoT devices are relatively simple and cheap. Introduction of semiconductor cells and batteries to devices has limited their lifespan. If earlier some household appliances could work for ten years, now their lifetime has been reduced by 2-3 times. In addition, most modern electronic devices do not involve replacement, and in some cases, recharging of batteries. It is assumed that

after a battery failure, the device must be disposed of, and many companies shift this responsibility onto their users.

5) Storage and processing of large amounts of data in real time.

The information transmitted by one device is very little. One sensor always transmits only one value, for example temperature. But there are a lot of such elements, and there are many channels for collecting information. In an IoT system, there can be millions of constantly open connections that a server must handle. There are two problems: how to process this information quickly and save it just as quickly.

Processing and storing large amounts of data is a difficult task for large IoT projects. The classical approach assumes a database in which the information collection service enters all the information. The analytical subsystem makes selections from the database and generates reports for the users. But in the case of the IoT, this approach does not work: it is impossible to quickly add a huge amount of information into the database. Even if this issue is resolved, there will be a problem of efficient selection of data from a large array and building reports. Ideally, an IoT system should process incoming data in real time. But instant processing of big data is more a matter of the future, which is why this problem remains relevant.

6) Shortage of specialists

For projects in the field of the Internet of Things, appropriate specialists are needed. There are very few specialists on the market with «borderline» experience in engineering and software development. Even if such a professional is found, it is unlikely that he will be in demand in a new economic industry for him: completely various engineering experience is needed in construction, medicine and transport.

Conclusion

The Internet of Things is a complex field that requires the development of standards in different areas. Due to the complexity and structurality of the concept, many problems and tasks related to various areas arise on the way of its development. In this article, some of them have been identified.

Despite these development barriers, the future of the Internet of Things is great. Today, the efforts of many companies and organizations in the IT field are focused on finding solutions that minimize the problems that prevent the full implementation of IoT. Designing and deploying the Internet of Things can be challenging and require a lot of research effort to solve problems, but they can bring significant personal, professional and economic benefits in the near future.

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