PROVIDERS OF IOT SOLUTIONS IN THE SLOVAK REPUBLIC

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ABSTRACT

The Internet of Things is currently a popular topic, with great potential for use in a wide range of areas. The connection of the physical world with the virtual one brings new, extensive possibilities. IoT systems can make decisions and implement activities autonomously based on the acquired knowledge. The article is focused on defining the concept of the Internet of Things, the elements that make it up, networks for the Internet of Things and analysis of providers of IoT solutions and coverage of networks for the Internet of Things within the Slovak Republic. The Internet of Things will be as much a matter of course in companies as corporate websites, so companies should start addressing the issue as soon as possible, otherwise they may not be sufficiently competitive in the market in the future.

Kľúčové slová: Internet of things, Big data, Cloud computing, Sensors, Sigfox, LoRa, NB-IoT

INTRODUCTION

The term Internet of Things is currently a widely used term in the field of information and communication technologies. The issue of the Internet of Things is quite extensive, as it concerns almost all fields of human activity. Within the Internet of Things, physical and virtual objects exchange data over the Internet. The connection of the physical world with the virtual one brings new, extensive possibilities. The goal of the Internet of Things is to connect systems, services and devices in order to obtain a huge amount of data that can be transformed into information and subsequently into knowledge that can be applied. IoT (Internet of Things) systems can thus make decisions and implement activities autonomously on the basis of acquired knowledge.

This article focuses on the Internet of Things. It includes a theoretical definition of basic concepts related to the Internet of Things and analysis of networks for the Internet of Things in the Slovak Republic, their operators and providers of IoT solutions.

CHARAKTERISTICS OF IOT

The Internet of Things is a network of interconnected and uniquely addressable objects that contain built-in technologies for exchanging and sharing data and information. The Internet of Things consists of two main areas, the industrial Internet of Things, which is used in industries for example to use resources more efficiently, reduce operating costs or to interconnect technological units, and the Consumer Internet of Things, which focuses on consumers' daily lives, for example through automation. households or via wearable electronics to achieve a higher user experience. [1]

The Internet of Things uses a wide range of technologies to run. It is a very wide spectrum, which includes not only the identification of objects but also their autonomous operation or communication between individual objects.

Communication technologies

It is important for the future of the Internet of Things that the directions of its development are very diverse. This is a large area that cannot be covered by just one technology. Among the most used communication technologies in the Internet of Things, these are mainly wireless technologies, whose advantages are efficiency, mobility and high adaptability to the environment:

- Wi-Fi
- Bluetooth
- Zigbee
- LoRa
- Sigfox
- NB-IoT
- RFID [2]

Identification technology

A necessary condition is that each device within the Internet of Things contains a unique identifier that allows communication with the device. Originally, the identification process was to be performed using an RFID code. However, over time, this idea has evolved into objects with their own IP addresses. [3]

Sensors

Sensors are types of so-called transducers that convert physical ambient sensations such as temperature, light, or sound into electrical signals. They act practically as inputs to certain systems of behavior of which they are a part. Sensors can be passive or active. A passive sensor, such as a thermometer, collects data that occurs naturally in its vicinity and does not need its own energy source. [4]

Cloud computing

Cloud computing is a method of providing information technology services, where resources are obtained from the Internet through web tools and applications, as opposed to a direct connection to a server.

Cloud computing is therefore a technology that allows access to applications and data via the Internet

instead of access through your own hard drive, anytime, anywhere. The largest providers of cloud computing solutions include companies such as Microsoft, IBM, Amazon, Google, SAP, Dropbox, Oracle or Adobe. [5] [6]

Big data

Big data can be defined as structured or unstructured data in large volumes, usually five bytes in size (1015 bytes) and larger, which are enormously diverse and exceed the capabilities of current database technologies. Special procedures and software tools are used for their processing. The analysis of these data provides the basis for better and faster process optimization. Processing and analyzing big data is an essential part of the Internet of Things. [7] [8]

All IoT devices must be clearly identifiable in order to communicate with each other through communication technologies such as Wi-Fi, Bluetooth, Zigbee, Sigfox, LoRa, NB-IoT or RFID. Every device of the Internet of Things includes sensors that are used to obtain Big Data, which is then stored in the cloud.

METHODOLOGY

The aim of the article is to analyze the offered solutions of individual providers within the field of IoT and their communication infrastructure for the Internet of Things. The analysis was carried out on the basis of the processing of secondary sources, which were focused on the three most widespread networks for the Internet of Things and their operators within the addressed country. The results describe the coverage of individual networks in the Slovak Republic, which is also graphically represented by created maps. The analysis consists in defining specific IoT solutions and at the same time presents the possibilities of their use in various areas, but also in everyday life.

RESULTS

IoT solutions are currently being developed by a number of companies that enable the use of the IoT in a variety of areas. In addition to providing IoT solutions, some companies are building and operating their own communications infrastructure for the Internet of Things. The most widespread networks include Sigfox, LoRa and NB-IoT, which are based on the technologies of the same name. Multinational companies that provide IoT solutions almost on the global market are IBM, Google, Microsoft, Cisco, Oracle, Bosch, etc., which, however, usually do not have their own networks for the Internet of Things in individual countries, but use other companies' networks to implement IoT solutions.

There are several providers of IoT solutions operating in the Slovak Republic, but the number of companies that provide IoT solutions and at the same time implement them through their own communication infrastructure is considerably limited for the given country. SimpleCell Networks Slovakia, a.s., Slovanet, a.s. were selected to approximate the activities and offers of providers. and Slovak Telekom, a.s., which are among the first operators of individual networks for the Internet of Things and among the largest providers of IoT solutions in the Slovak Republic.

The first company to launch the Internet of Things in the Slovak Republic is Slovanet, a.s. The basis of the company's network and solutions is LoRa technology, but in terms of coverage, the technology is so far only in sixteen Slovak cities. The company provides solutions for companies focused on, for example, process automation, monitoring of vehicles, goods and inventory, automatic measurement of energy consumption and microclimate management in the company. Process automation solutions enable companies to make better use of the potential of production machines, employees and materials. For store-based companies, it provides a revolutionary use of Big Data to analyze and track customer purchasing behavior, employee behavior, product deployment, interior and personnel to achieve greater operational efficiency and customer satisfaction. Also popular are solutions for microclimate management in buildings, which allow, for example, control and management of temperature and humidity in warehouses, production halls and shops. Solutions in the field of microclimate are followed by solutions for intelligent energy monitoring, which enable monitoring of energy consumption between individual operations, workplaces or specific devices for more accurate evaluation and management of production process costs. [9]

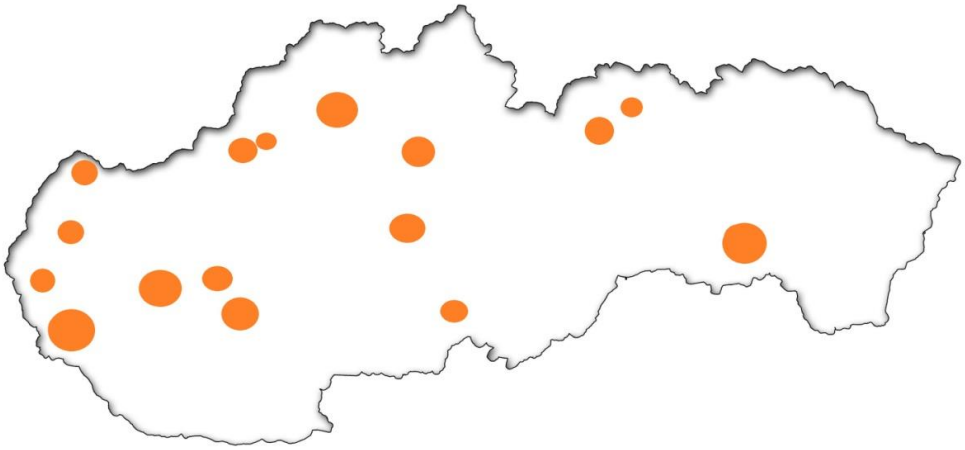

Figure 1. Map of LoRa network coverage within the Slovak Republic (Source: [9])

SimpleCell Networks Slovakia, a.s. is the first provider of the Internet of Things through Sigfox technology in the Slovak Republic. In a short time, the company managed to achieve coverage of almost the entire territory of the Slovak Republic, 87% of the territory and 92% of the population, which it supports by so-called base stations, which increase the quality of coverage in hard-to-reach places. The company provides several options for implementing the Internet of Things in industrial enterprises. In the field of optimization of production processes, the company focuses on the implementation and interconnection of sensors, which can be used to monitor, for example, vibration, temperature, pressure, wear and failure of equipment and easily perform predictive maintenance using sensor data. The company also provides a simple solution for monitoring the state of stocks, where, based on the data, the systems report insufficient stock capacity or provide assumptions and options for replenishing stocks. Sensors and devices provide real-time data, greatly streamlining the data collection process, so managers can check real-time employee attendance, for example. Securing the company's premises through Sigfox technology has several advantages over conventional alarm and security devices, such as long battery life, which can work continuously for more than ten years or high resistance to signal jammers. [10] [11]

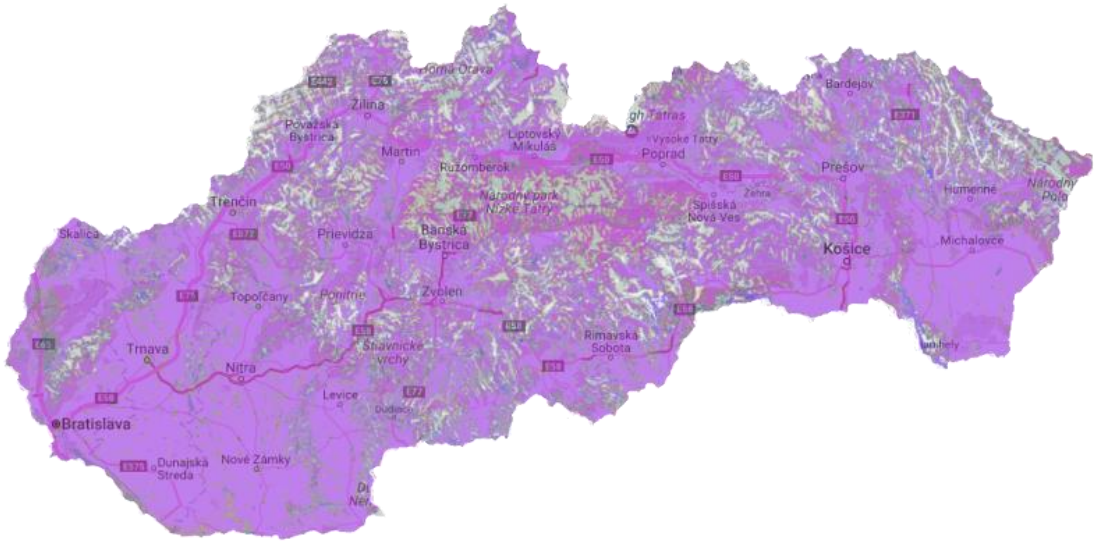

Figure 2. Sigfox network coverage map within the Slovak Republic (Source: [12])

Slovak Telekom, a.s., has launched the first network for the Internet of Things based on NB-IoT technology and it is the first network for the Internet of Things in the licensed band in the Slovak Republic. The network covers approximately 75% of the territory and 88.5% of the population of the Slovak Republic. Although the company initially started to provide only solutions aimed at creating smart homes, it is currently implementing pilot projects and starting to provide services for businesses. The company uses the acquired experience in the field of smart home also for the protection of business buildings and the transformation of offices into smart spaces with modern technologies. Of course, there are solutions in the field of energy, which enable monitoring of energy consumption and its regulation at a distance. The company also provides solutions focused on automation of production processes, data analysis and monitoring of the current state of equipment. For companies, it offers the possibility of implementation in the field of logistics, such as monitoring of goods and vehicles. It can also be used in industrial companies by some of the solutions that the company offers for cities, such as security cameras, intelligent lighting or waste management. The parent company Deutsche Telekom AG provides the same services in the Czech Republic and the United Kingdom. [13] [14]

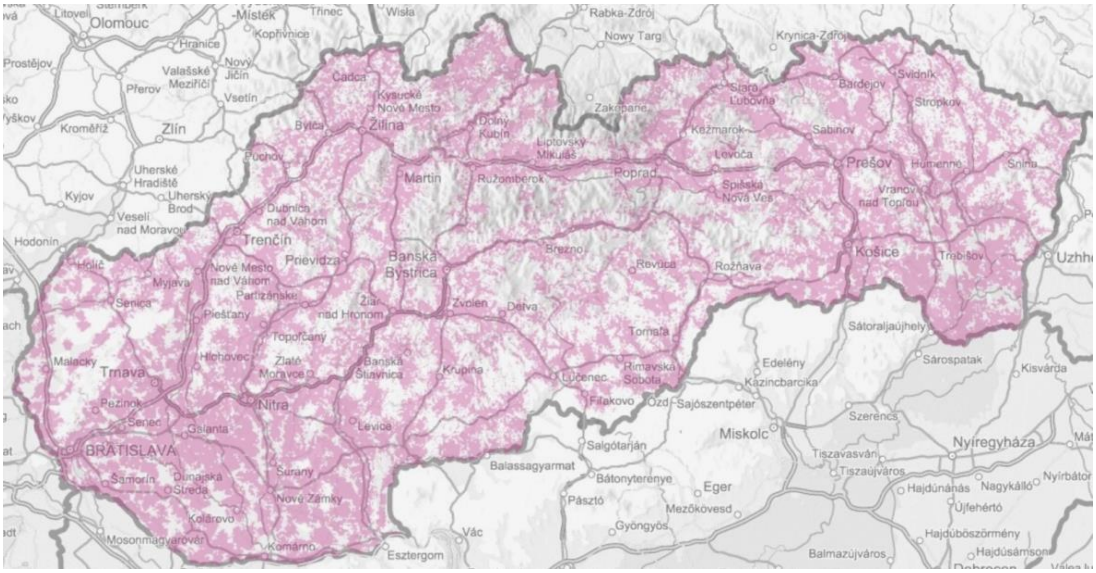

Figure 3. Map of NB-IoT network coverage within the Slovak Republic (Source: [15])

There are not many operators of Sigfox, LoRaWAN and NB-IoT networks and technologies in the Slovak Republic, but the coverage they have created is sufficient to satisfy the needs of Slovak business entities. The largest coverage of the network for the Internet of Things was built by SimpleCell Networks Slovakia, a.s. while the network covers 92% of the population and 87% of the territory of the Slovak Republic. Although individual network operators use different technology, they provide comprehensive solutions for a wide range of IoT implementation options.

CONCLUSIONS

The Internet of Things is a technological phenomenon today and represents independently functioning interconnections of various devices, devices, chips, sensors and systems in order to obtain and share information and data and their subsequent analysis to achieve added value. The Internet of Things can be divided into two main directions, the industrial Internet of Things and the consumer Internet of Things. The Internet of Things uses a diverse range of technologies. Communication technologies include Wi-Fi, Bluetooth, BLE, Lora, Sigfox or NB-IoT. Operators of networks for the Internet of Things within the Slovak Republic include companies such as SimpleCell Networks Slovakia, a.s., Slovanet, a.s. and Slovak Telekom, a.s., which are among the first operators of individual networks for the Internet of Things and among the largest providers of IoT solutions in the Slovak Republic. In addition to operating networks, the above companies also focus on providing IoT solutions that can be used in various fields.

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ANALYSIS OF THE USE OF THE TRIPLE BOTTOM LINE CONCEPT IN THE BUSINESS ENVIRONMENT

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ABSTRACT

Over the last few years, businesses have begun to move towards sustainability. Sustainability is nowadays considered a primary part of companies striving to have a better approach to nature and to use resources more efficiently. Businesses see sustainability as a way to be more competitive in the market in which they operate, to make their awareness visible and to gain new customers. Today, companies strive to protect the environment in which they operate through sustainability, and at the same time their activities try to eliminate the negative impacts on nature. The aim of the article is to analyze the application of the concept of Triple Bottom Line in the business environment. Secondary research deals with the analysis of the use of the Triple Bottom Line concept in the environment of selected companies.

Keywords: sustainability, Triple Bottom Line concept, economic measures, environmental measures, social measures

INTRODUCTION

At present, sustainability is understood as an exceptional factor that contributes to the creation of business success in terms of the company's business strategy, which is based on a long-term perspective. [1] Over the last 20 years, sustainability has begun to evolve from a level of macroeconomics whose ideology is to keep the company productive over time and maintain its potential in terms of long-term profitability. Sustainability aims to stabilize or increase the comfort of the population during the set time. [2] Measuring sustainability from a business perspective is a challenging process. For companies to be able to express their degree of sustainability, they implement the Triple Bottom Line concept in their business. [3]

The Triple Bottom Line concept originated in the second half of the 1990s. Its author is John Elkington, whose aim was to measure sustainability through a new framework that focuses on expressing performance in a selected American company. Elkington's Triple Bottom Line framework replaced the original framework, which focused on measuring the company's profits, return on investment and quantifying the value, which was important information for shareholders and investors. [4, 5]

The Triple Bottom Line (TBL) concept is based on triple corporate responsibility. The triple responsibility of companies is represented by the economic, social and environmental areas. The essence of the concept lies in the creation of mutual connections between the mentioned spheres and in achieving an optimal and balanced relationship between them, thus ensuring sustainable growth of the company. The importance and significance of risks and obstacles to our shared sustainability in the growing opportunities will affect the transparency of economic, social and environmental impacts as a key component in effective stakeholder decision-making, investment decisions and other market relationships. [6] Triple Bottom Line and its core value of sustainability have become compelling in the business world due to the accumulation of anecdotal evidence of greater long-term profitability. For example, reducing packaging waste can have the effect of reducing business costs. There are companies in the world that operate based on the philosophy of the Triple Bottom Line concept (General Electric, Unilever, Proctor and Gamble, Cascade Engineering, etc.) [4]