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THE INTERNET OF THINGS (IOT) SYSTEMS CONTAINING NOMADIC UNITS ARCHITECTURE MODIFICATION AND THE MOST RATIONAL TECHNOLOGIES SELECTION

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Архитектура системы Internet of Things (IOT) содержащей мобильные (подвижные) узлы

В работе описана архитектура системы Internet of Things (IoT) содержащей мобильные (подвижные) узлы. Для систем такого типа предложен вариант использования существующей инфраструктуры сети сотовой связи, а именно использование технологии GPRS для передачи данных между мобильным узлом и облачным сервисом. В работе также осуществлен подбор рациональных протоколов для передачи данных от мобильного узла к облаку на прикладном уровне модели OSI.

Introduction. The IoT is expected to have great impact on several aspects of our everyday-life, enabling the development of a wide range of applications, including: sensor data aggregation, intelligent transportation schemes, business management, environmental monitoring, e-health and many others [1].

This paper is dedicated to analysis and comparison of protocols and technologies which are the most appropriate for devices interconnection. The entire system structure building is proposed.

There are a lot of solutions for IoT systems containing only static units. The structure of these systems is defined and is shown on the figure 1.

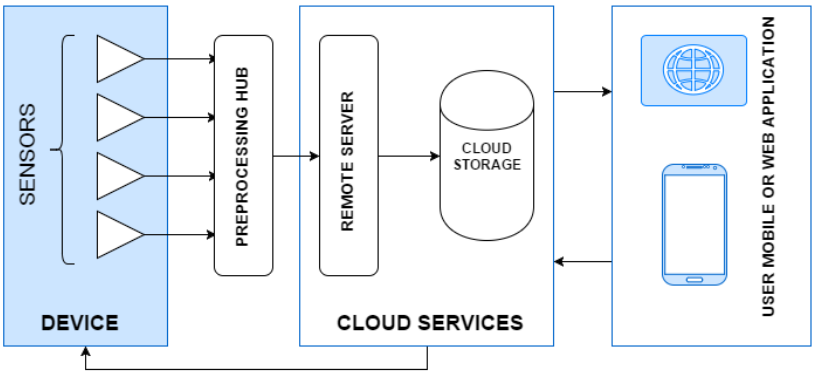

Fig. 1. "General structure of the typical IoT system".

For systems with nomadic units have been also proposed some decisions. One of them is new 3GPP Standard for IoT – a special technology to address the requirements of the IoT. The new technology will provide improved indoor coverage, support of a massive number of low-throughput devices, low delay sensitivity, ultralow device cost, low device power consumption, and optimized network architecture [2]. This technology has a great potential of development, but this paper

is aimed to find a solution based on usage of more common technologies for narrow range of systems. For such kind of system implementation there is no common developed infrastructure yet. To make a decision universal it is a need to use existing infrastructure.

Proposed architecture for systems with nomadic units. The mobility of these nomadic units can be considered in different areas of application. Talking about the Smart House conception, mobility is presented only within the home. It doesn't cause any essential problems because a majority of the modern houses are provided with some kind of network (usually it can be IEEE 802.11 (Wi-Fi) network or IEEE 802.15 (Bluetooth) network). But these technologies are not suitable for a number of IoT systems that require their units' interconnection at large distances.

According to this statement it is suggested to modify architecture to provide a connectivity of standalone nomadic unit using existing mobile networks. The structure of such system is shown on the figure 2.

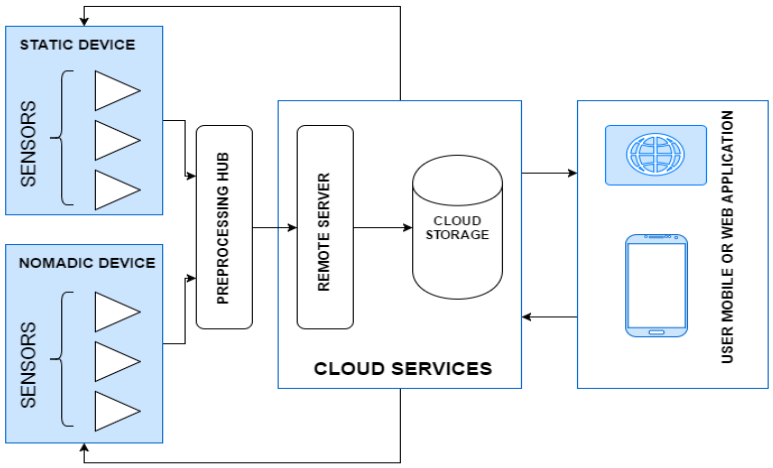

Fig. 2. "General structure of the IoT system including nomadic units".

The protocols of the network and transport layer of the OSI model for both variants of system configuration are quite definitely specified. Being an Internet using system, IoT uses TCP/IP stack of protocols on these layers. But there are some problems with an application and physical layers as the endpoints of the IoT system are smart devices.

1.1. Physical layer technologies.

It is necessary to provide a stable connection wherever the nomadic unit is. IEEE 802.11 Wi-Fi and IEEE 802.15 Bluetooth technologies are not suitable to use as their coverage area is extremely small. The best choice in today's situation is to use mobile GPRS, CDMA, HSPA (for 3G-networks), LTE or other like standards.

The data which is typically transferred is a couple of parameters definitions taken from the sensors. It means that the GPRS capabilities are completely enough for such systems. The infrastructure all over the world is quite developed to make a usage of this technology possible.

The advantages of the GPRS using in the IoT systems with the nomadic units:

1. Sufficient rates;

2. Developed infrastructure;
3. Density and common use;
4. Economic efficiency.

The disadvantages of the GPRS using in such systems:

1. Not enough capabilities in case of a big amount of data transferring;
2. Obsolescent technology in comparison with LTE and the others.

In the proposed solution GPRS technology was used that allows to use existing mobile telecommunication infrastructure.

1.2. Device-to-Cloud and Cloud-to-Device interaction ways.

The most widely used in the IoT systems protocols are AMQP (Advanced Message Queuing Protocol), MQTT (Message Queue Telemetry Transport) and HTTP or HTTPS (HyperText Transfer Protocol Secure).

Being the most universal, HTTP is widely used in the IoT systems, but it uses its potential rather in the device-to-cloud interaction than the nomadic-to-static units' connection. Its advantages are simplicity, universality and security (talking about the HTTPS). But it is not really adapted for the IoT systems.

In comparison to the HTTP/HTTPS, AMQP is used in the IoT systems rather due to its reliability and interoperability than the universality. The disadvantage of AMQP is that it is suitable mostly for the control plane or server-based analysis functions. It is good to be used between the device and cloud to provide efficient way of queues organizing and reliable messaging, as AMQP is aimed to avoid any losses of messages.

The most adapted to the IoT features is MQTT protocol. As its name states, its main purpose is telemetry, or remote monitoring.

In the proposed solution the MQTT protocol is used because being developed especially for IoT it matches all of the requirements to the IoT system units' proper interaction.

Conclusions

1. In this paper is suggested the approach to the IoT systems containing nomadic units design. This approach allows to use existing technologies efficiently;

2. The aspects of physical layer interaction (concerning mobile unit existing in a system) were researched. The way of interaction using existing mobile networks was proposed;

3. Device-to-Cloud and Cloud-to-Device communication ways are investigated and the most appropriate protocols were chosen.

References

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