Раздел 2. «Информационно-коммуникационные технологии»

G.A. Krivoruchka [1], Zh.I. Titova, S.V. Kan[1]

[1]Karaganda Industrial University, Temirtau, Kazakhstan

Universal Internet of Things Protocol «Matter»

This article discusses the new standard for smart home automation "Matter". To date, there are many standards for connecting smart home devices to each other. The main problem in this diversity is the compatibility of all these standards with each other. Because of this, it turns out that when buying devices that support one standard, it becomes irrational to buy devices with a different protocol, which causes inconvenience to consumers. But in December 2019, companies such as Google, Amazon, Apple, Comcast and the Connectivity Standards Alliance (formerly ZigBee Alliance) announced the creation of a project group to develop a single, open, Royalty-free standard for smart home automation «Matter» (formerly CHIP).

Keywords: ZigBee, Thread Technology, CHIP, Matter, smart home, Internet of Things.

Consider the main existing standards for the Internet of Things.
ZigBee Technology[1].
ZigBee is an open wireless communication standard for data acquisition and management systems.ZigBee technology allows you to create self-organizing and self-repairing wireless networks with automatic message relay, with support for battery and mobile nodes.

The ZigBee standard provides frequency channels in the 868 MHz, 915 MHz and 2.4 GHz bands. The highest data transfer rates and the highest noise immunity are achieved in the 2.4 GHz band. Therefore, most chip manufacturers produce transceivers specifically for this range, which provides 16 frequency channels in 5 MHz increments. The data transfer rate along with the service information on the air is 250 kbit/s. At the same time , the average throughput of a node for useful data , depending on the network load and the number of retransmissions , may lie in the range of 5 ... 40 kbit/s. The distances between network nodes are tens of meters when working indoors and hundreds of meters in open space. Due to retransmissions, the network coverage area can be significantly increased.

The ZigBee network is based on a mesh topology. In such a network, each device can communicate with any other device either directly or through intermediate network nodes. Cellular topology offers alternative options for choosing a route between nodes. Messages flow from node to node until they reach the final recipient. Various ways of passing messages are possible, which increases the availability of the network in the event of a failure of one or another link.

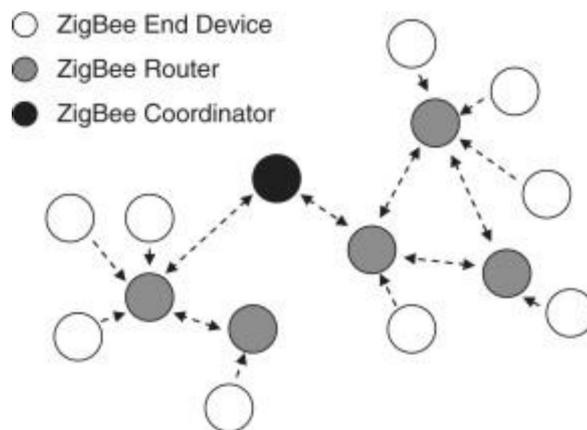**Раздел 2. «Информационно-коммуникационные технологии»**

Figure 1 – Mesh topology of the ZigBee standard network

There are three types of nodes in the ZigBee network: coordinator, router and devices.

The ZigBee specification regulates the protocol stack of network nodes, in which the protocols of the upper layers use the services provided by the protocols of the lower layers.

The IEEE 802.15 standard is used as the two lower layers (physical and MAC environment access layer).4. The MAC layer in the ZigBee network implements the CSMA/CA mechanism (listening to the carrier and eliminating collisions), the NWK network layer is responsible for message routing, and the APS application support layer provides an interface with the application layer.

The ZDO (ZigBee® Device Object) sector, which connects the top three levels, is responsible for determining the role of the device in the network (whether it will be a coordinator or an end device), initializing and responding to connection and discovery requests, and establishing a reliable and secure connection between network devices. The SSP (Security Service Provider) sector performs operations related to security at the network level and at the application support level.

One of the main ideas behind the development of the ZigBee standard was to enable devices from different manufacturers to work together in one wireless network. It is obvious that ZigBee devices require a standard communication language to ensure compatibility at the application level. To implement this task, the ZigBee Cluster Library ZCL (ZigBee Cluster Library) was developed.

A cluster is similar to a class in object-oriented programming and is a collection of:
  – descriptions of a standard ZigBee device (lighting device, dimmer, switch, meter)
  – descriptions of standard attributes for this device (on/off, brightness, meter readings)
  – descriptions of standard commands for this device (set brightness level, read readings, turn on/off)

Disadvantages of ZigBee technology:

Loyal certification. Due to loyal certification, many standards may not be met. This leads to 2 drawbacks.

There is no guarantee of compatibility. Due to non-compliance with all standards in ZigBee technology, devices from different manufacturers may not be compatible

Thread Technology

Thread is a network technology for building wireless mesh networks with IP technology support. This technology allows you to combine devices into a single infrastructure that has access to a local/global network. Through a LAN or Internet network, a user can manage individual nodes, groups, or an entire network.

Thread technology combines the advantages of networks that support the IP protocol (such as Wi-Fi) with the ability to freely access the Internet or IP networks, and networks with mesh topology support with the ability to self-repair and relay messages, as well as support for "sleeping" nodes that must operate from a low-capacity power source.

The Internet Protocol (IP) is the main communication protocol of the Internet. It provides the main mechanism for transmitting datagram messages over IP networks, as well as routing capabilities, which makes inter-network interaction possible.

Раздел 2. «Информационно-коммуникационные технологии»

Network technologies that do not support the Internet Protocol (IP), in order to work in IP networks, must convert messages on a special gateway in order to be able to interact with external devices in an IP network. This process involves repacking data from a format accepted on a particular network into an IP datagram message. This entails the need to decrypt the transmitted message on the gateway and then encrypt it into an IP datagram message.

Figure 2 – Packet routing to an IP network in the absence of IP protocol support (ZigBee, Bluetooth LE, ANT/ANT+)

On the other hand, network technologies such as Thread and Wi-Fi, which have built-in support for the IP protocol, can transmit data without additional overhead.
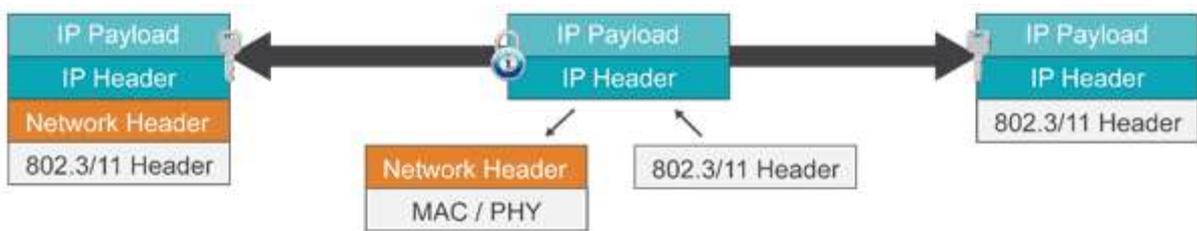

Figure 3 – Packet routing to an IP network with support for the IP protocol (Thread, Wi-Fi)

OSI model of Thread technology[3]

Thread uses a physical interaction layer (PHY) and an Environment Access Control Layer (MAC) conforming to the IEEE 802.15.4-2006 standard, which allows devices to operate in the 2.4GHz frequency range. The bandwidth of the communication channel is 250 kbit/s.
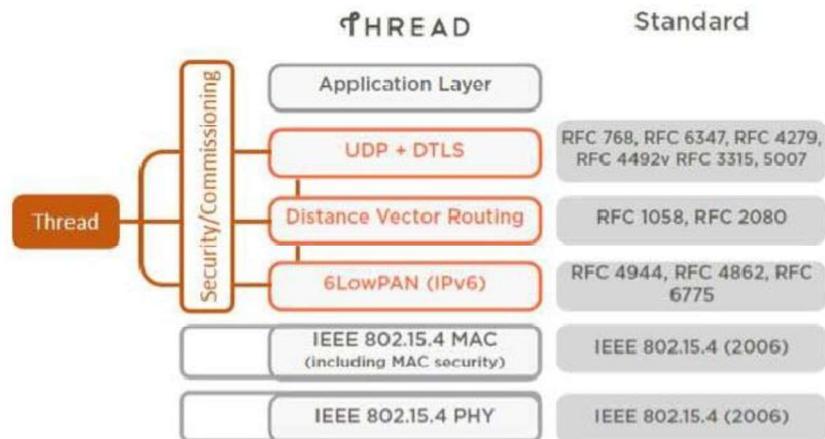

Figure 4 – OSI model of Thread technology

Thread and 6LoWPAN

The acronym 6LoWPAN stands for IPv6 over Low Power Wireless Personal Area Networks. It was specially designed to transmit IPv6-datagram messages over an 802.15.4 connection in conditions of limited device resources, which are a low-consumption controller + RF transceiver.

There are only two types of devices used in the Thread network:

− Router (Router Eligible)
− End Node (End Device)

Disadvantages of Thread:

Incomplete standard. Thread describes only the physical and network layer of the OSI model. Due to the lack of a description of the application layer, there is no language of communication between devices

Matter Technology[4].

Matter (formerly Project Connected Home over IP or Project CHIP) is a single open source standard that makes it easy to configure and synchronize IoT devices from different manufacturers.

The essence of the Matter project is to create an ever-expanding modular system that is simple for developers and, at the same time, compatible with most manufacturers' devices. Matter is based on the IP protocol and aims to combine IoT devices, mobile applications and cloud services into a single network that allows both protecting the final product from intruders and certifying it. At the moment, Matter greatly simplifies the interaction of IoT devices with voice assistants (Alexa, Siri and Google Assistant).

The Matter protocol already supports data exchange over Wi-Fi, Bluetooth Low Energy and Thread − an open protocol of a local wireless network with a mesh topology, created specifically for communication of IoT devices.
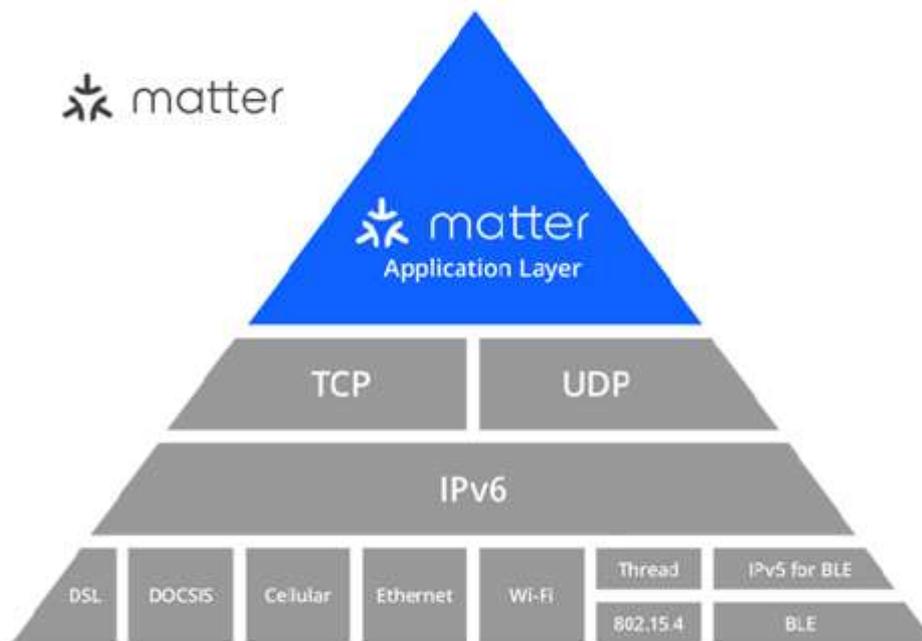

Figure 5 − OSI model of Matter technology

BLE technology in the Matter standard will be used by devices that act as organizers of a wireless network. Devices using wireless technologies without IP addressing, such as ZigBee, must connect to the Matter network through gateways.

Раздел 2. «Информационно-коммуникационные технологии»

Figure 6 – Demonstration of the work of Matter in two networks

References

1 ETSI. – Zigbee 3.0 and Dotdot Connecting the IoT. – 2017. – https://docbox.etsi.org/Workshop/2017/201710_IoTWEEK/WORKSHOP/S04_CONNECTING_IoT/SCHNEIDER_DESBENOIT_VULCANO.pdf
2 Silicon Labs. – Dotdot Unifies IoT Device Networks. – 2020. – https://www.silabs.com/documents/public/presentations/ew-2018-dotdot-unifies-iot-device-networks.pdf
3 CSA. – ZigBee Cluster Library Specification – 2016. – https://www.silabs.com/documents/public/presentations/ew-2018-dotdot-unifies-iot-device-networks.pdf
4 Devopedia. – Dotdot – 2022. – https://devopedia.org/dotdot

Г.А. Криворучка, Ж.И. Титова, С.В. Кан

Универсальный протокол Интернета вещей «Matter»

В этой статье рассматривается новый стандарт автоматизации умного дома "Matter". На сегодняшний день существует множество стандартов подключения устройств "умного дома" друг к другу. Главной проблемой в этом разнообразии является совместимость всех этих стандартов друг с другом. Из-за этого получается, что при покупке устройств, поддерживающих один стандарт, становится нерациональным покупать устройства с другим протоколом, что доставляет неудобства потребителям. Но в декабре 2019 года такие компании, как Google, Amazon, Apple, Comcast и Альянс стандартов подключения (ранее ZigBee Alliance), объявили о создании проектной группы для разработки единого, открытого, безвозмездного стандарта автоматизации умного дома «Matter» (ранее CHIP).

Ключевые слова: ZigBee, Thread Technology, CHIP, Matter, умный дом, Интернет вещей.

Г.А. Криворучка, Ж.И. Титова, С.В. Кан

«Matter» интернет заттарының әмбебап хаттамасы

Бұл мақалада «Matter» ақылды үйді автоматтандырудың жаңа стандарты қарастырылады. Бүгінгі таңда "ақылды үй" құрылғыларын бір-біріне қосудың көптеген стандарттары бар. Бұл әртүріліктің басты мәселесі-барлық осы стандарттардың бір-бірімен үйлесімділігі. Осыған байланысты, бір стандартты қолдайтын құрылғыларды сатып алғанда,

тұтынушыларға қолайсыздық тудыратын басқа протоколы бар құрылғыларды сатып алу қисынсыз болады. Бірақ 2019 жылдың желтоқсанында Google, Amazon, Apple, Comcast және қосылу стандарттары Альянсы (бұрынғы ZigBee Alliance) сияқты компаниялар "Matter" (бұрынғы CHIP) Ақылды үйді автоматтандырудың бірыңғай, ашық, өтеусіз стандартын әзірлеу үшін жобалық топ құрғанын жариялады.

Кілт сөздер: ZigBee, Thread Technology, CHIP, Matter, ақылды үй, Заттар интернеті.