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AUTOMATION TOOLS FOR THE DEVELOPMENT OF INTERNET OF THING NETWORKS

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Abstract. The analysis of the state and development of platforms for creating IoT networks is presented. The structure and purpose of the IoT platform components are considered. Features of the IoT platform with big data are given. Characteristics of the most common global platforms for building IoT networks and the features of the EAEU platform market are discussed. An algorithm for network modeling based on the AWS IoT platform is presented.

Keywords: Internet of things, IoT networks, IoT platform components, big data, IoT network modeling.

Introduction

With the continued development of large and small networks in Infocommunication (WAN, LAN) intended for the Internet of People (IoP), a variety of Internet of Things (IoT) networks are becoming more widespread [1]. IoT is a set of embedded systems, networks of wireless sensors, control systems and automation tools for processing information received from sensors. IoT networks allow a user to implement automation of production processes, management of transport, energy, agriculture, medicine, and create smart stores, smart homes, districts, and cities at a new level.

IoT is a concept of the network infrastructure development (physical basis) online, in which «smart» things without human intervention are able [2]:

− to connect to the network for remote interaction with other devices (Thing-Thing);

− to interact or interaction with autonomous or cloud data processing centers (Thing-Web Objects) for data transmission, storage, processing, analysis and management decisions aimed at changing the environment;

− to interact with user terminals (Thing-User) for the control and management of these devices.

This requires not only the development of scientific research and industrial development, but also the improvement of personnel training in this area [3].

IoT development automation

To automate the creation of IoT systems, leading global companies have developed design tools in the form of IoT platforms [4]. IoT platforms are becoming the central backbone of IoT deployments. The IoT platform market will reach $ 22,3 billion by 2023 year [5]. Due to the large volume of information received from IoT sensors, such platforms provide analytical tools for processing Big Data. Let's look at these questions in more detail.

In may 2020, the analytical company Counterpoint Research named the leading platforms for creating IoT networks and applications in terms of versatility (to meet the needs of users) and other parameters. The first position was taken by the Microsoft Azure platform, the second position − by Amazon Web Services (AWS), the third place − by Huawei OceanConnect, the fourth − by PTC ThingWorx, and the fifth place-by IBM Watson [4, 5]. This study took into account eight components: distribution, growth rate, integration and scaling capabilities, application support, cloud components, peripheral interaction, device data processing, and peripheral components [5].

An IoT platform is a hardware and software system for connecting end devices (sensors, sensors, etc.) to a cloud environment. The purpose of the IoT platform is to provide wireless communication of peripherals (sensors, devices), through additional interfaces (gateways) and communication protocols, as well as storage, processing and data mining [4]. The network structure using the platform includes end devices (sensors), a cloud platform, and applications for monitoring sensor information. The typical structure of the IoT platform includes the following components [6, 7]:

1. Communication: combines special protocols and data structures into a single software interface that provides accurate streaming of information and interaction with peripheral devices.

2. Device management: supports the work of connected sensors, the correction and updates for the software running on devices or boundary gateways.

3. Database: stores data in special formats transmitted from devices; supports requirements for hybrid cloud databases for a number of parameters (volume, speed, verification).

4. Event management: analyzes data using rule-based knowledge of events-actions that allow you to make decisions based on specific information received from sensors.

5. Analytics: performs complex analyses from basic data clustering and deep machine learning to predictive Analytics, extracting maximum value from the IoT data stream.

6. Visualization: allows users to identify patterns and observe trends using visualization dashboards, where data is depicted using linear or pie charts, 2D or 3D models.

7. Tools: allow IoT developers to prototype, test, and promote IoT network options, creating platform ecosystem applications for visualizing, managing, and controlling connected devices.

8. External interfaces: enable integration with other systems and part of the broader it ecosystem through embedded application programming interfaces (APIs), software development kits (SDKs), and gateways.

IoT platform analysis

Let's look at the most well-known platforms from the world's leading IT-companies [8, 9]. The Microsoft Azure IoT Platform supports testing a user-developed network variant by modeling, as well as the ability to design new network solutions that meet the specifics of an original project. This platform has information security tools, the ability to expand and integrate with existing or planned systems. The platform allows a user to connect multiple devices from different manufacturers, to process data received from sensors, connect analytics tools and generate appropriate reports. So, it uses the information obtained from sensors for subsequent machine learning process. Let's consider the main features of other popular IoT platforms [9].

AWS IoT Core (Amazon) is a platform on which a user can create local networks or IoT applications. It supports special communication protocols, including custom ones, which allows a user to communicate between devices from different manufacturers. The AWS IoT Device Management platform component supports adding and managing external devices, monitoring and configuring them, and updating their operation. The WS IoT Analytics platform component implements automatic processing and analytical calculations of large amounts of data from various IoT devices and sensors. The AWS IoT Device Defender platform component supports configuring information security tools for IoT networks (authentication, encryption). It allows a user to create and adjust security policies, manage device authentication and authorization, provide a private transmission channel (encryption).

The Google Cloud IoT platform includes a number of components that a designer can use to create new IoT networks. This platform includes: Cloud IoT Core service for securely connecting, managing and retrieving data from peripherals; Cloud Pub/Sub service for processing event data and implementing analytical flow processing; Cloud Machine Learning Engine service for creating a machine learning model using data received from IoT sensors.

The Cisco IoT platform services additionally support voice and data transmission, enable the development of various IoT applications and perform many others functions to generate revenue from the project. By choosing the Cisco platform to host an IoT application, the user gets a set of convenient sensor management and monitoring functions, as well as advanced security measures, including identification of devices with the platform, use closed transmission channels, etc. All these tools are with the operation of mobile applications and remote interaction with the consumer. A number of additional services allow a user to implement other functions. For example, a user can take IoT services for engineering networks development, when project systems intended for use by utilities to monitor and control the relevant sensors. The IoT Advisory service provides access to expert advice on the main business tasks in the field of the Internet of things.

The cloud platform of the German company SAP has all the necessary components for creating and managing IoT network applications. Remote devices can be connected either directly or via a cloud service. Advanced Analytics tools enable a client to receive, process, analyze, and explore Big Data received from sensors, meters, and other devices in IoT networks. Following the latest technological trends, the SAP IoT platform provides the ability to use IoT data to create custom applications with elements of artificial intelligence and machine learning.

More than half of all market projects in Belarus and Russia are developed by domestic companies from the EAEU countries − Belarus, Russia and Kazakhstan (51 %). The second supplier of IoT platforms to the EAEU market is the United States (23 %). The analysis of IoT platforms by industry reflects the overall market dynamics. Most competitive segments on this market are transport and logistics (42 %) and Smart city (32 %) projects [10].

Modeling an IoT network based on the Amazon platform

The typical network on base of IoT platforms includes:

– sensors, devices sending control information;
– IoT network gateway for converting the format of transmitted information;
– authentication and sensor management tools;
– cloud service components (infrastructure, platform blocks, etc.);
– user interfaces;
– user additional applications.

Let's consider an algorithm for modeling the Internet of things network using the IoT platform. Amazon IoT platform create services that meet multiple user requirements, and as a result, you can build a network quickly. This cloud platform has a significant advantage – the ability to independently model the network in a short time, without involving the corporate it service and additional information security tools. The generalized algorithm for creating a network on the AWS platform looks like this:

1. Sensors measure the parameters of processes (devices) that interact with the IoT platform using development tools (SDKs).

2. Devices send messages that are verified by the platform's authentication and authorization service. If the verification is not successful, the device IDs must be corrected.

3. Information from devices is sent to the gateway (Device Gateway), and various network protocols can be used. When information is converted in the gateway, it is sent to the rules processing unit (communication with Analytics) and in parallel to the Device storage unit (Device Shadows).

4. Device Shadows stores the current state of network peripherals for continuous access by software applications. If there is no connection to an individual device in the network, the Device Shadow block executes commands from applications, and when the connection is restored, it synchronizes the current state with the device.

5. Depending on the nature of the received data, the rule handler performs (programmed) actions: saves data in the database, sends SMS or e-mail information to the network Manager about their receipt, calls the HTTP API, sends data to the Analytics system, and so on.

6. Applications use this data to control devices by using the AWS API (application programming interface).

7. Information about all devices is stored on the AWS IoT platform.

Conclusion

The article considers the relevance of the development of Internet of things networks for many sectors of the economy, as evidenced by the analysis of the world, Russian and EAEU markets. IoT platforms are used to automate development. An analysis of their development is given, and the structure of such IoT platforms is discussed. The features of working with big data as part of IoT platforms due to the huge amount of information coming from sensors and devices are discussed. The features of the most popular IoT platforms in the world are considered. An algorithm for network modeling based on the AWS IoT platform is presented.

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