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ASPECTS OF TRAFFIC GROWTH BASED ON IoT SERVICES

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ABSTRACT

Factors contributing to an increase in IoT traffic have been identified. The conditions necessary for the high-quality functioning of the IoT network infrastructure are determined. Some main trends in IoT have been identified, as well as the problems of IoT at this stage of its development have been noted and ways to overcome them have been proposed.

Keywords: network traffic, digital communications, Device-to-Device, infrastructure, Wireless Sensor Networks, IoT platform, machine learning, 5G, Industry 5.0.

INTRODUCTION

Data traffic is growing exponentially, a significant part of which is increasing due to the connection of various devices and sensors that will load the network both in the direction of

Machine-to-Machine (M2M) and People-to-Machine (P2M). Today there are a huge number of IoT (Internet of Things) devices located in different places and generating a stream of data at high speed. IoT allows to uniquely identify objects/things and their virtual representations in the Internet structure. Billions of devices will be deployed in the near future for new M2M applications and will require ubiquitous access and connectivity to the global network [1]. IoT plays an important role in the development of intelligent systems, especially in the industry. The IoT implementation can contain many electronic devices, mobile devices, industrial equipment, and also include a number of heterogeneous networks (WSN (Wireless Sensor Networks), wireless mesh networks, WLAN (Wireless Local Area Network), etc.) that help things in the IoT exchange information. IoT transforms an existing industry into an intelligent industry characterized by data-driven decision-making [2]. Various fragmentation of possible applications of IoT technologies depend on many parameters and requirements for design characteristics. For example, the IoT used in intelligent transport systems makes it possible to predict its future location and probable traffic.

Currently, the concept of IoT affects the development of communication networks, requires a revision of quantitative estimates of the customer base of communication networks. The implementation of the IoT concept is one of the defining requirements of the fifth–generation 5G communication networks standard. Minimizing devices, reducing battery consumption, the ability to connect millions of devices simultaneously and with minimal delay – all this is the focus of 5G technologies. A new type of D2D (Device-to-Device) interaction has appeared in 5G networks, which is inherently close to the interaction of sensor nodes. The features of D2D communication are low latency, low power consumption, traffic unloading, high spectral efficiency and a large cellular coverage area [3].

IoT connects physical devices and virtual objects using communication protocols (ZigBee, Z-Wave, NFC (Near Field Communications), BLE (Bluetooth Low Energy), Wi-Fi, 6LoWPAN (IPv6 over Low power Wireless Personal Area Networks), WirelessHART (Highway Addressable Remote Transmitter) and many others) [4], as well as LPWAN (Low Power Wide Area Networks) technologies, including Sigfox, LoRa, NB-IoT (Narrow Band IoT) and Industrial Ethernet [5].

In the coming years, the network infrastructure of enterprises will experience a leap in data production. If the performance monitoring platform cannot scale cost-effectively with such an increase in data volume, it will cause a number of serious problems. When choosing an effective system for managing and monitoring the performance of the Internet of Things, the following factors should be taken into account: vulnerabilities of IoT devices used; large amounts of data; new devices and protocols; pulsating traffic; more serious dependence on the cloud; increased need for IPv6 deployment [6]. All of the above suggests that this work, aimed at investigating aspects of traffic growth based on IoT services, is relevant.

MATERIALS AND METHODS

Complex processes for connecting various types of digital devices within the same technological infrastructure are formed in IoT platforms. The IoT engineering specification has a number of technical rules dictating positions on the communication of objects among

themselves. In general, the IoT infrastructure is completely independent, which allows it to be used in any machine-to-machine communication processes.

The values of the traffic flow parameters are used to obtain numerical estimates (mathematical calculation methods) of the required amount of equipment or bandwidth of the communication network and the quality of traffic service. To ensure ultra-large traffic and switching of a huge number of devices, it is impossible to do without introducing innovations, as well as optimizing current standards and technologies. To integrate digital processes, it is planned to use special communication protocols, which are very popular in the world of digital solutions. All of the above cannot exist without tools for working with big data and machine learning (ML). ML helps to analyze large heterogeneous data generated by IoT platforms. Artificial intelligence (AI) and ML serve as the dominant technologies in promising networks. Security is an important aspect of an IoT system, which requires an intelligent/secure protocol that allows IoT devices to periodically request software updates so that they protect against the latest threats.

RESULTS

In the process of digital management, traffic can be generated both from users who connect to the Internet to manage objects, and digital devices that independently perform the management process. IoT transforms traditional objects and devices into intelligent objects using Internet protocols and WSN technologies, which predominantly use interacting intelligent sensors for collaboration and monitoring. IoT provides connection of various devices (intelligent objects) equipped with various electronic or mechanical sensors, actuators and software systems that can perceive and collect information from the physical environment, and then perform actions in the physical environment [7]. IoT devices also have dynamic configuration and remotely accessible interfaces [8].

To manage IoT devices, outdated traditional approaches are gradually disappearing due to the development of new technologies and trends. To study network traffic in digitalization processes, algorithms are needed that determine the method of traffic generation. When choosing an effective IoT performance management and monitoring system, certain requirements should be taken into account [6], for example: the ability to cope with the rapid growth of traffic and data volumes; the ability to work simultaneously with IPv4 and IPv6 protocols; the ability to manage all new devices, regardless of the communication standard or performance metrics.

The 5G network, based on the technology of direct communication with the D2D terminal, is one of the most important functions that will contribute to the growth of IoT services/applications. Industry 4.0 has integrated IoT, big data, electric vehicles, 3D printing, cloud computing and AI, which allows systems to learn and adapt to changing conditions and make decisions [9]. The upcoming Industry 5.0 suggests that the full potential for progress lies in the cooperation of man and machine [10]. Industry 5.0 is a new standard that is already influencing the generational change in relation to the interaction and joint efforts of people and machines. Industry 5.0 is based on IoT technologies, AI, big data analytics, cloud computing [11]. As the 5.0 Industry generates more and more data, it becomes more and more

important to ensure their efficient storage, security [12]. Figure 1 shows the important categories within which the analytical framework of industry 5.0 is carried out.

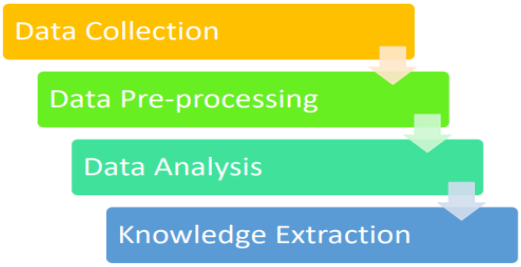

Fig. 1. Analytical base for abstractions industry 5.0 [13]

The new concept, called IoT Big Data, refers to the semantics and type of massive data generated by large-scale devices connected to the Internet of Things. Big Data analytics is a complex procedure for studying big data to identify hidden patterns, trends. With the growth of data volumes in Industry 5.0, rapidly increasing storage requirements are putting unbearable pressure on nodes and users, which makes it especially important to solve the scalability problem. Using lightweight nodes with a small amount of memory effectively reduces the network load of nodes, which can solve scalability problems and reduce the load on storage nodes.

DISCUSSIONS

Despite the large amount of research in the IoT field, there are still many unaccounted-for moments. IoT is a new strategic link on the way to the development of digitalization processes. Network traffic in digitalization processes is created using a different technological algorithm compared to standard telecommunication processes. This is due to the fact that up to a thousand devices can be used simultaneously within one digital infrastructure, which, depending on the design solution, will have to communicate with each other and transmit data at adjustable intervals. A distinctive feature of the IoT infrastructure is that it is constantly in development and in search of new algorithms for object communication. Thanks to huge advances in sensing technologies, the computing power of miniature devices and communication protocols, it is possible to deploy intelligent devices in various applications (industry, smart cities, etc.). Data in such applications is generated and consumed on a huge scale over time and transmitted over various device-to-device (D2D) communication protocols to satellite communication types.

Network performance monitoring by analyzing network traffic flows uses various platforms. Analyzing network traffic flows is considered a big challenge because data can be huge and complex in many IoT applications, such as augmented reality, car networks, interactive games and event monitoring. The need to analyze such data leads to the emergence of methods for monitoring and analyzing network traffic that can be used for various purposes, including detecting hidden patterns of traffic flows, making management decisions, as well as predicting possible events and problems.

The basis of many different IoT applications has become WSN, which is a distributed, self-organizing network of multiple sensors (sensor nodes with low energy consumption) and

actuators connected to each other via a radio channel [14]. IoT involves the interconnection of systems that can interact with each other using certain standard protocols in a cyberphysical manner [15]. Communication technologies of IoT applications are: WSN, providing communication between several nodes distributed in a given area; regular mobile networks; gateways for WSN access to the Internet [16]. Cellular mobile networks serve as a solution for servicing M2M traffic due to ubiquitous network connectivity, reliable communication and a high level of security, but the efficiency and scalability of the network can seriously suffer due to the large number of active users who can quickly overload the network.

IoT applications are mainly implemented using technologies such as cloud and fog computing, AI to help solve some of its key problems [17]. In particular, the communication problems of Tactile Internet, which involves human-machine interaction through tactile devices, are higher data transfer rates, ultra-low latency, high reliability and support for cloud/fog network overhead [18]. These requirements can practically be solved in a 5G environment. 5G gives IoT applications the opportunity to provide better services by collecting more data over a faster and safer channel. The era of 5G networks, the integration of AI and advanced computing enhanced (improved) IoT will significantly improve the quality of the user experience [19]. Low latency services require AI and computing power. The use of AI in 6G networks is also inevitable, since the vast and complex network topology cannot simply be controlled by humans [20].

CONCLUSIONS

The number of smart connected devices in one system and the amount of data generated by them is growing, which affects the bandwidth of telecommunications infrastructures that are responsible for the prompt execution of commands. IoT devices are characterized by a wide range of hardware and software, as well as insecure design, lack of updates and user engagement [21]. To connect a huge number of devices, modern hardware is not enough, so a transition to 5G technologies is required. For the effective operation of modern IoT systems, integration with third-party products that implement the appropriate functionality is vital. Advanced IoT platforms (for example, Google Cloud IoT and AWS IoT) allow you to integrate IoT devices with ML models and solve complex complicated tasks. In them, the growth of data quality increases the quality of decisions and notifications generated by the system.

Considering the complexity and diversity of data generated by heterogeneous devices and sensors, the issue of automation of their management and analysis is acute. It is important to properly distribute the work traffic generated in the structure of digital communication so that there are no difficulties in data transmission processes, as well as to comply with regulatory regulations on the communication integration of processes implemented at the level of physical equipment or at the level of the software environment.

There are various methods of traffic analysis (heuristic models, statistical methods, ML methods), which are mainly focused on extracting patterns and flow anomalies. Among them, ML methods usually promise better performance in terms of accuracy and speed, and also offer unique opportunities to solve problems related to prediction and adaptation to the environment.

Due to the avalanche increase in traffic (due to media data traffic, a wide variety of services/applications, the massive growth of device communications), it is necessary to develop new lossless data compression formats. In Industry 5.0, creative and intelligent intelligence collaborates with machines to increase customer satisfaction, which contributes to more productive employment [22]. The maximum potential of IoT can be used only by eliminating concerns about security and privacy, since especially systems based on the Internet of Things are more susceptible to cyber-attacks [23]. 5G technologies for IoT communications can provide features that can improve the overall quality of service and performance of IoT applications. New 5G and 6G network/computing paradigms motivate researchers to equip networks with methods of self-organizing networks and self-sustaining networks. The points noted in this paper will make it possible to regulate the general structure of the development of digital technologies, as well as to determine the total volume of generated traffic and processes for the correct management of data flows in IoT communications.

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