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MOBILE APPLICATION SECURITY ANALYSIS MODEL BASED ON ARTIFICIAL INTELLIGENCE

Abstract. This article analyzes and studies holographic services, which established that the growth of traffic generated by holographic services will increase several times in the foreseeable future. The main features inherent in the holographic type of communication are identified. A study was conducted of innovative technologies for recording holographic copies, data compression methods to ensure holographic communication, and the transmission of holographic copies to the end user with high-quality reproduction. An analysis of the traffic of multimedia and holographic services, as well as Internet of Things services, was conducted, traffic models were developed, it was determined that the traffic of these services is a mixture of various distributions, and also that the traffic of holographic services has the property of self-similarity.

Keywords: holographic communication, traffic, Internet of Things, self-similarity, bandwidth.

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Introduction

Today, the transmission of holographic information to provide the effect of the presence of the interlocutor is of great interest to users and researchers around the world.

In practice, this is confirmed by the emergence of a huge number of diverse and different types of equipment that allows both to form a holographic flow and to reproduce it on the other side in real time [1]. Obviously, this type of communication places high demands on the network bandwidth, which for existing communication networks vary in the range from 10 Mbit/s to 4.2 Tbit/s [2].

Statement of the problem. Trends in the implementation of holographic services and holographic communication today already require a revision of the principles of planning, designing and building existing communication networks, as well as approaches to the implementation of sixth-generation 6G networks, which are based on the integration of various technologies and communication networks into a single network [3, 4].

A separate issue is the assessment of the quality of service and the quality of perception of holographic services by both objective and subjective assessment methods [5].

Analysis of recent research and publications. There are practically no criteria for assessing the quality of a holographic image, including scales and methods for subjective assessment of the quality of holographic services [6, 7].

Moreover, the properties of the holographic flow are poorly studied, and even less so its influence on communication networks and requirements for network parameters, which makes the tasks of studying traffic characteristics and assessing the quality of service of holographic services very relevant. [8]

Purpose of the article. The object of the article is the holographic type of communication, and the subject is the characteristics of traffic and quality of service of the holographic type of communication.

The purpose of the article is to study the models of traffic of the holographic type of communication in networks of the sixth and subsequent generations.

Presentation of the main material

The relevance of the article on the development of holographic technologies is due to the transition to a new stage of the implementation of modern innovative technologies, which involves the active use of holography in the future.

There is a general global trend in the work of specialists with three-dimensional images in various fields of human activity.

Holography, displaying an object in three dimensions, is one of the most promising areas of visualization of three-dimensional objects, which justifies the emergence of a certain scientific interest in this area of research.

Displaying real reality, the hologram exhibits a unique property: a holographic image reproduces an exact three-dimensional copy of the original object, unlike photography, which creates a flat image. A holographic image with a large number of angles that change with the movement of the observation point can be so realistic that it is often indistinguishable from a real object.

In the context of the introduction of modern technologies, the holographic method of recording information has received the opportunity to reveal its potential. The exponential increase in the number of scientific publications on the results of research into the theory of holography, its practical application indicates interest in the topic, its undoubted prospects and relevance.

Theoretical developments in the field of digital holography have made it possible to create devices with unique characteristics - a holographic TV, a digital holographic lensless microscope, holographic glasses, a holographic control system for unmanned aerial vehicles (drones). Holographic network applications are emerging, which is a direct development of the digital stage. Holographic assistants and holographic communication are becoming the most popular among the images of the future for young people.

One of the most promising areas is digital pictorial holography. The effect of presence in real time is achieved when computer programs synthesize color volumetric images of objects.

Considering the trajectory of the development of communication tools in accordance with the increase in the technological level of the communication system, it is possible to graphically represent from a landline telephone to a holographic type of communication through the stage of using mobile communication tools and sequentially through the stage of video conferencing.

Fig. 1 schematically shows the development of the communication system.

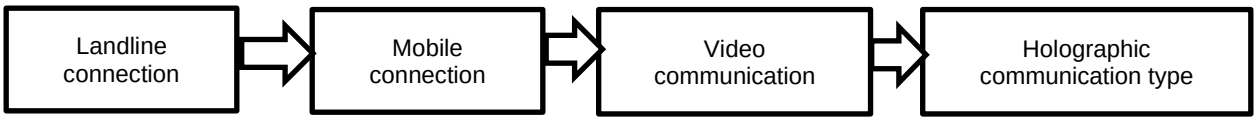

Fig. 1. The development of the communication system

The holographic method of recording information, which underlies holographic technologies and holographic communications, is just beginning to reveal its potential.

One of the most important scientific problems in the implementation of holographic communication is the problem of transmitting holographic copies to the end user with high quality reproduction.

The widespread implementation of holographic copies will depend on how communication networks can support high-quality interactive transmission of video holograms in real time.

Research of 3D video stream traffic servicing processes in various transmission environments. Transmission of various types of traffic is directly related to the study of the problem of the influence of the data transmission environment on the quality of service. Three types of data transmission environment can be distinguished, namely:

– electrical (copper) cables based on twisted pair wires;

– wi-fi;

– fiber optic.

Let's consider the objectively inherent features of the data transmission environment. Let's focus on the three most important of them:

- bandwidth (frequency range of signals) and signal attenuation. These characteristics are directly related to each other. Let's emphasize that with an increase in the signal frequency, its attenuation increases;

- noise immunity of the transmission environment;

- signal propagation speed.

Traffic, as a process of moving data through a network, can also, depending on the environment in which the transmission occurs, be wired and wireless.

Various technologies and protocols are used (IEEE 802.3 (Ethernet), TCP/IP). Wired networks provide high data transfer speeds (from 10 Mbit/s to 100 Gbit/s and higher) and a reliable connection.

Fiber optic cable, twisted pair (Cat5e, Cat6, Cat6a, etc.), and coaxial cable are used to transmit traffic.

Research of 3D video stream traffic transmission using wireless environment (Wi-Fi). The modern trend of expanding the scope of use (Wi-Fi) as a data transmission medium has necessitated the study of 3D video stream traffic and provision of innovative holographic communication services.

Indeed, mobility, ease of deployment, low installation cost, the ability to create public access points and connect Internet of Things (IoT) devices confirm the prospects for further development of this technology.

When studying the transmission of holographic copies in various environments, it is also necessary to study the transmission of holographic content using Wi-Fi.

For this stage of the study, a structural model of a full-scale experiment was developed.

The diagram of the laboratory stand is shown in Fig. 2.

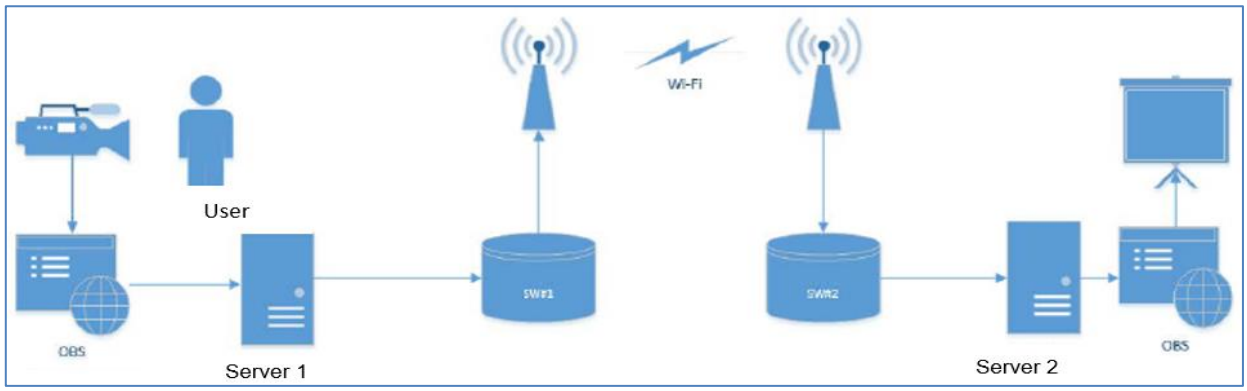

Fig. 2. Laboratory setup diagram

The necessary equipment for the laboratory stand was assembled on a modern technical base. The interaction between the switches was carried out via a wireless channel.

Below are graphic materials of traffic monitoring on the switches. The results of the 3D video stream transmission on the transmitting side are shown in Fig. 3. The packet transmission intensity during the observation

session is shown in Fig. 4. Thus, when using a wireless data transmission medium (Wi-Fi) between switches, the quality of holographic content reproduction may deteriorate.

Therefore, in order to implement this technology into mass use, it is necessary to solve the problem of increasing the network's resistance to peak loads and the influence of the external environment.

Transmission of 3D video stream traffic using Ethernet technology. To conduct the experiment, a full-scale model of the network was built, the structure of which is shown in Fig. 5.

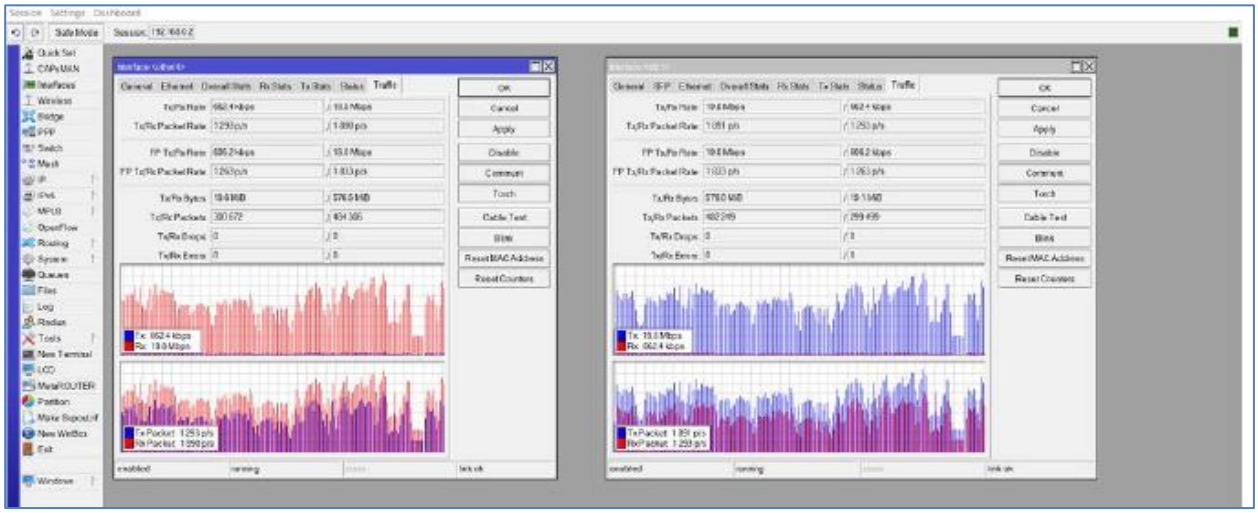

Fig. 3. Results of monitoring the transmission of 3D video stream on switches

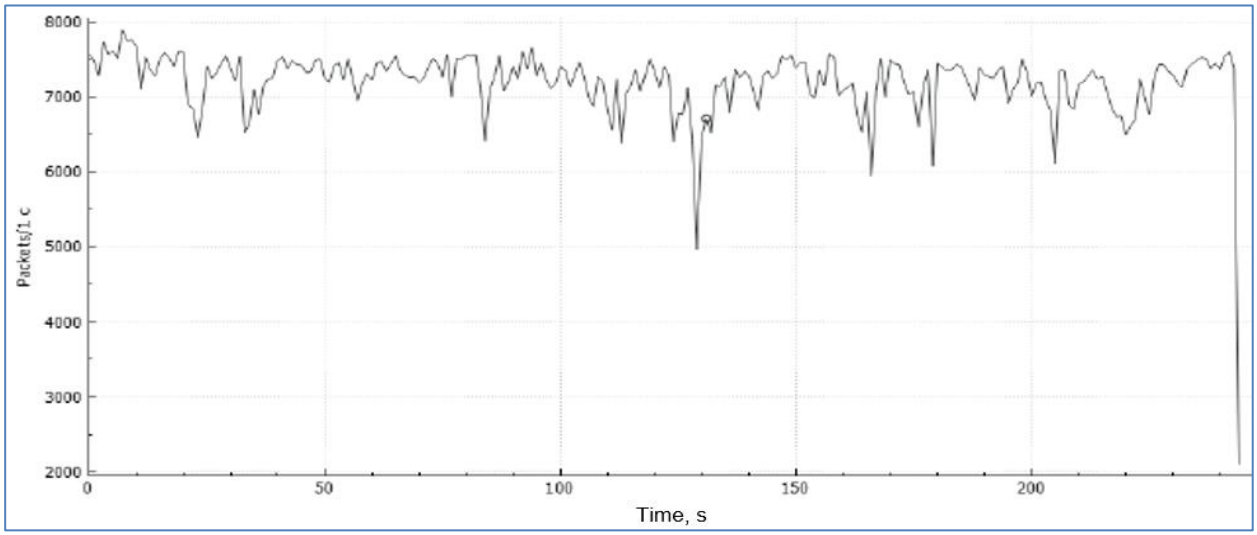

Fig. 4. Packet transmission intensity during the observation session

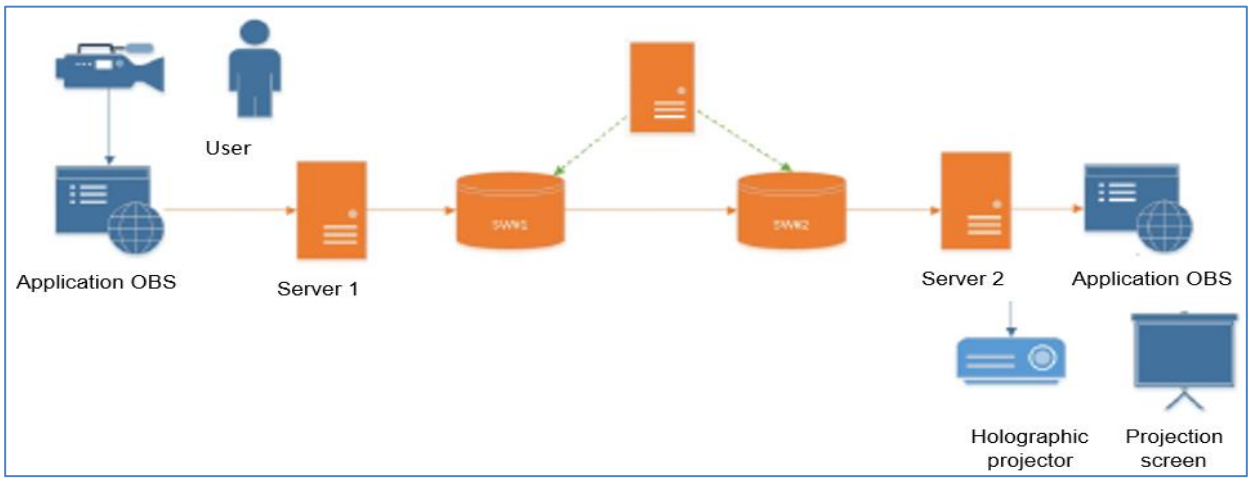

Fig. 5. Model network structure

It includes the following equipment: a Microsoft Kinect camera sensor, which allows recording a moving object in real time, two servers, two Mikrotik switches (SW#1, SW#2) and a holographic laser projector LG with 3D support for reproducing a three-dimensional image.

The data transmission medium between the switches is fiber optics, between the switch and the server - an SC-SC patch cord or a four-pair cat.5e 3.0m UTP patch cord, since twisted pair is used in access networks.

Video traffic was obtained using a Microsoft Kinect 3D camera (Full HD (1920×1080)).

The 3D video stream was generated using a special software tool – OBS Studio (Open Broadcaster Software). Wireshark was used to intercept and analyze network traffic. Web interfaces of switches were launched on the virtual server to monitor traffic. An SDN controller was implemented to virtualize the network management level.

Fig. 6 shows a graph demonstrating the dynamics of packet intensity changes during an observation session (350 s – total traffic recording time).

The traffic was obtained by recording human movements with a 3D camera and transmitting the resulting video image through the model network to a laser holographic projector for playback.

Fig. 7 shows a histogram illustrating the distribution of packet lengths.

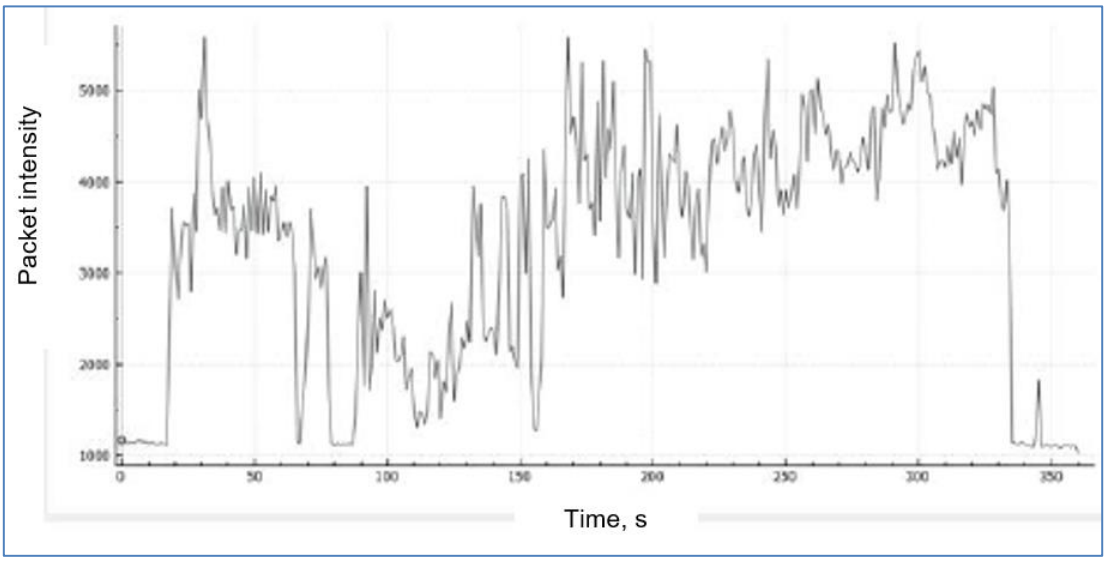

Fig. 6. Packet transmission intensity during the observation session

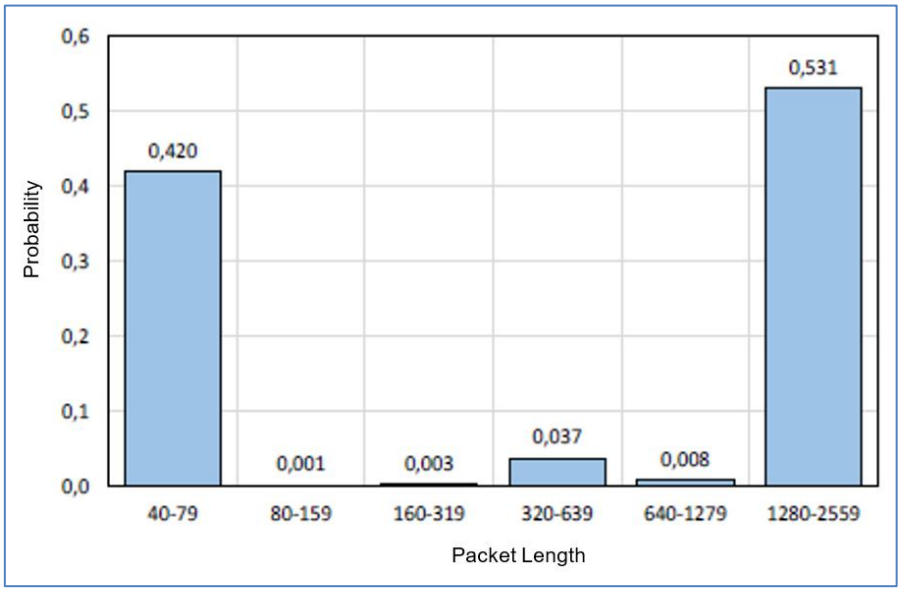

Fig. 7. Packet Length Distribution

The main parameters of the traffic under study are given in Table 1.

The histogram above shows that the largest share of packets (over 95%) are packets from 40 to 80 bytes in size and packets from 1280 to 2560 bytes in size. The average packet length and the standard deviation from it were 1226 bytes and 544 bytes, respectively. This result is important for describing the model of servicing a flow by a network as a mass service system in terms of choosing a model of packet transmission time.

Table 1 – **Numerical values of traffic parameters**

Parameter	Value
Packet intensity	3290,7 ± 113 Packet /s
Traffic intensity	32,3 ± 1,1 Mbit /s
Average packet size	1226 ± 1 byte
Total number of observed packets	1151745 number
Observation duration	350 s
Total traffic volume	**1412,04** Mbyte

Conclusions

The current trend of exponential increase in traffic volume and, accordingly, an increase in the network load, indicates a serious problem in the field of providing network resources.

The distribution of time intervals between packets has a multimodal distribution and can be described by a mixed distribution.

The obtained traffic characteristics allow us to judge it as a random process, as well as to obtain numerical estimates of its main parameters. The data set is sufficient for choosing models and calculating the main parameters of traffic servicing.

High bandwidth, low latency, connection reliability and standardization of communication networks are necessary conditions for the successful implementation of holographic communication.

The above results can be used to model the 3D video traffic service in a communication network. The results of the study of the distribution of intervals between packets and packet lengths make it possible to use approximate models from the theory of queuing to describe the time parameters of the functioning of the communication network.

Also, the result of the study was the developed analytical model of 3D video stream traffic, obtained on the basis of the data of a full-scale experiment and the results of statistical processing, which can be used in solving traffic research problems, as well as planning new networks and communication services taking into account the requirements for quality of service.

A promising direction of research may be a more comprehensive study of holographic traffic and problems of transmitting holographic copies.

The need to introduce new methods of visualizing objects based on holographic technologies creates a need to study the properties of a new type of traffic transmitting a 3D video stream in real time. The importance and relevance of the problem is emphasized by a significant number of studies devoted to the study of the characteristics of video traffic, multimedia traffic, 3D image traffic, and traffic modeling in the context of the development of communication networks.

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Трафік, що забезпечує голографічний тип комунікацій

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Анотація. У статті проведено аналіз та дослідження голографічних послуг, в ході якого встановлено, що зростання трафіку, що виробляється голографічними послугами, збільшиться в рази в найближчому майбутньому. Позначено основні особливості, властиві голографічному типу комунікації. Проведено дослідження інноваційних технологій запису голографічних копій, методів стиснення даних для забезпечення голографічного зв'язку, передачі голографічних копій кінцевому користувачеві з високою якістю відтворення. Проведено аналіз трафіку мультимедіа та голографічних послуг, а також послуг Інтернету речей, розроблено моделі трафіку, визначено що трафік даних послуг є сумішшю різних розподілів, а також, що трафік голографічних послуг має властивість самоподібності.

Ключові слова: голографічний зв’язок, трафік, Інтернет речей, самоподібність,, пропускна здатність.