The investigation of a system for assessing the quality of telecommunications services based on the SDN core.

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Content

Relevance

Today in Ukraine there are already more than 57 million subscribers of different mobile operators. The penetration level of mobile communication is about 130%. For 14 years, since 2003, the number of mobile subscribers has increased almost 9 times (6.5 million subscribers in 2003 and 57 million in the end of 2017). Just as the number of subscribers, the very concept of mobile phone and mobile communications is rapidly changing. We are no longer just enough phone calls or sms, the mobile phone has become the main means of communication, an integral part of our life.

Relevance

The complexity of building a quality management system is in the following main factors:

1. A lot of subscribers;
2. Many parameters that require quality control;
3. A large number of services for which you need to develop a management system;
4. Placement of equipment for the collection of information;
5. Plan for the collection of information;
6. Select the type of verification: solid or selective.

Thus, the creation of a quality management system is an urgent task facing telecom operators in the development of the network in the direction of the multiservice network.

The functioning of services quality control

Based on the general quality concept of ISO 8402, the main terms in the quality of service (QoS) were defined, and are given in Recommendation MCE-T E.800 for the first time. The Recommendation MCE-T E.800 provides the following definition of QoS: "aggregate service performance indicator that determines the degree of user satisfaction with the service".

Thus, QoS is not only defined or determined by indicators that can be expressed in technical indicators, but also determined by a subjective indicator that determines the expected and perceived quality for the user.

Analysis of the regulatory base, which addresses the issues of quality control of telecommunications services in mobile networks and access to the Internet

SOU 64.2 – 00017584 – 005:2009	Telecommunication networks of mobile (mobile) communication of general use. System of indicators of the quality of mobile services. General Provisions
SOU 64.2 – 00017584 – 006:2009	Telecommunication networks of mobile communication of general use. Telecommunication services. Quality indicators. Test methods
SOU 64.2 – 00017584 – 008:2010	Telecommunication networks of data transmission of general use. System of indicators of the quality of services for data transmission and Internet access. General Provisions
SOU 61–34620942–011:2012	Telecommunication networks of data transmission of general use. Telecommunication services. The main quality indicators. Test methods
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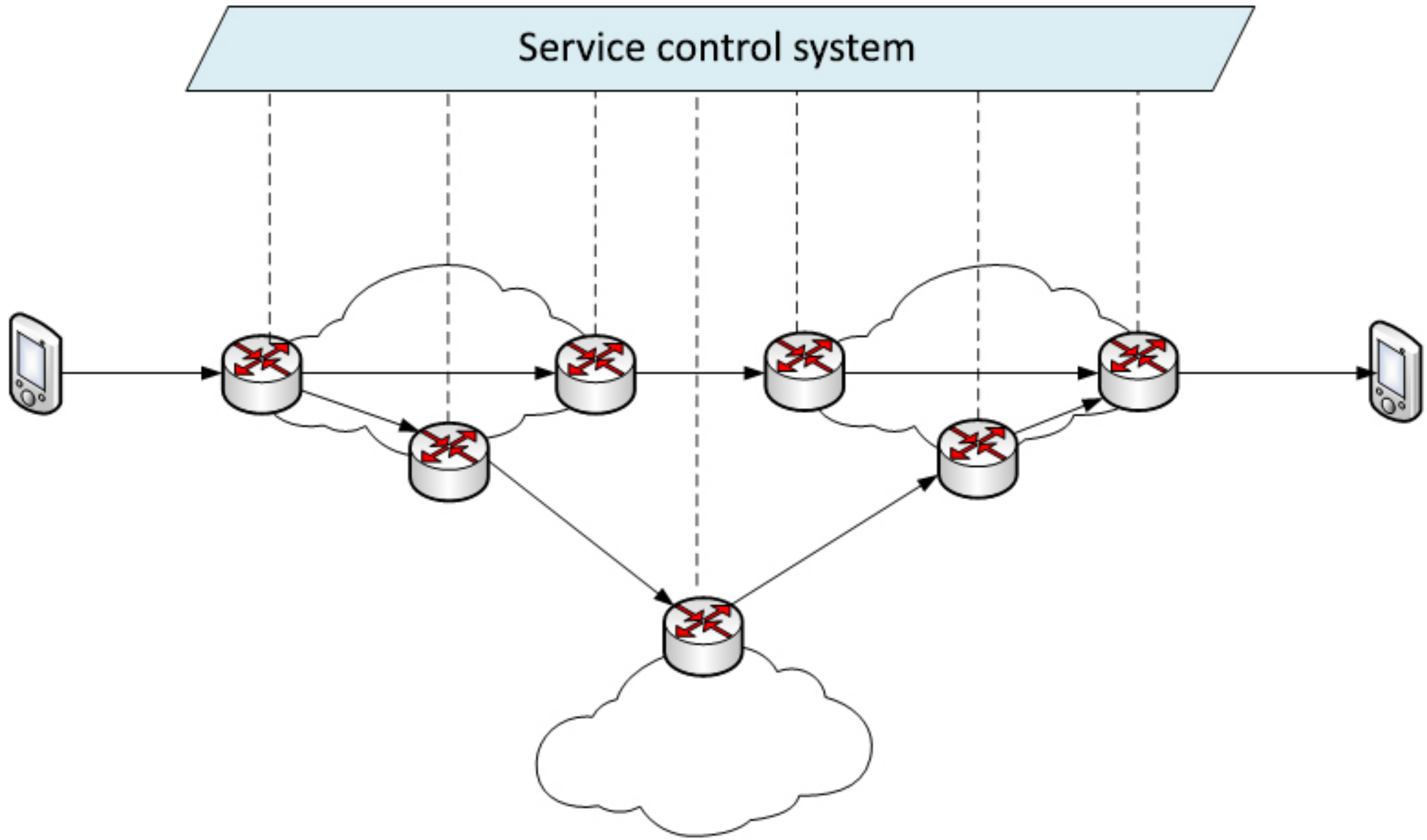
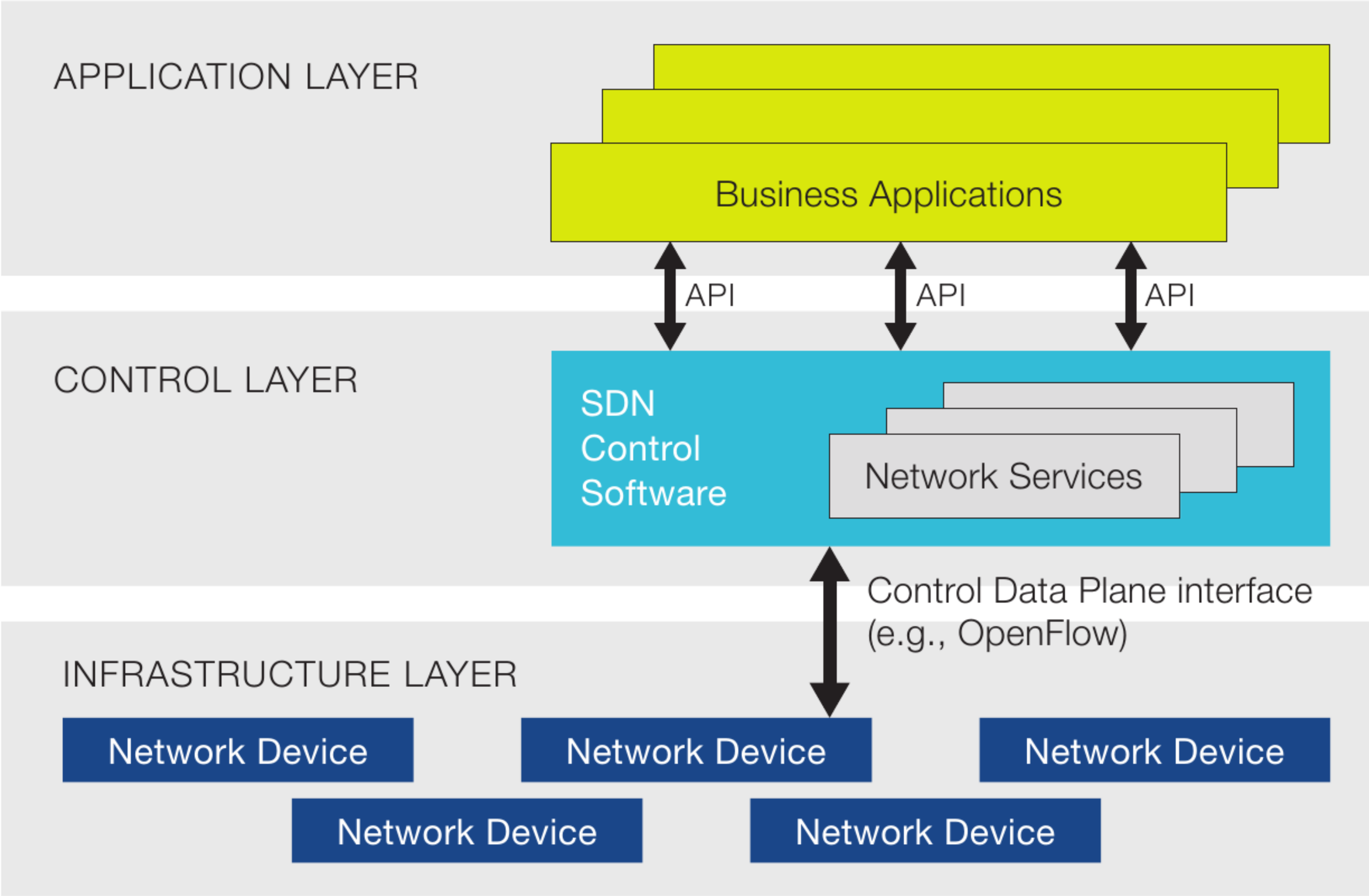
Analysis of the regulatory base, which addresses the issues of quality control of telecommunications services in mobile networks and access to the Internet

DSTU ETSI EG 202 057-1:2015	Aspects of processing, transmission of signals of speech information and ensuring their quality (STQ). Identify and measure customer-relevant QoS parameters
DSTU ETSI EG 202 057-2:2015	Aspects of processing, transmission of signals of speech information and ensuring their quality (STQ). Identify and measure customer-relevant QoS parameters. Part 2. Voice telephony, group 3 fax services and data and short messages (SMS) using a modem
DSTU ETSI EG 202 057-3:2015	Aspects of processing, transmission of signals of speech information and ensuring their quality (STQ). Identify and measure customer-relevant QoS parameters. Part 3. Special Service Quality Parameters for Mobile Public Land Mobile Networks (PLMN)
DSTU ETSI EG 202 057-4:2015	Aspects of processing, transmission of signals of speech information and ensuring their quality (STQ). Identify and measure customer-relevant QoS parameters
ITU-T Y.1545.1	Framework for monitoring the quality of service of IP network services
ITU-T P.1010	Fundamental voice transmission objectives for VoIP terminals and gateways
ITU-T P.1401	Methods, metrics and procedures for statistical evaluation, qualification and comparison of objective quality prediction models

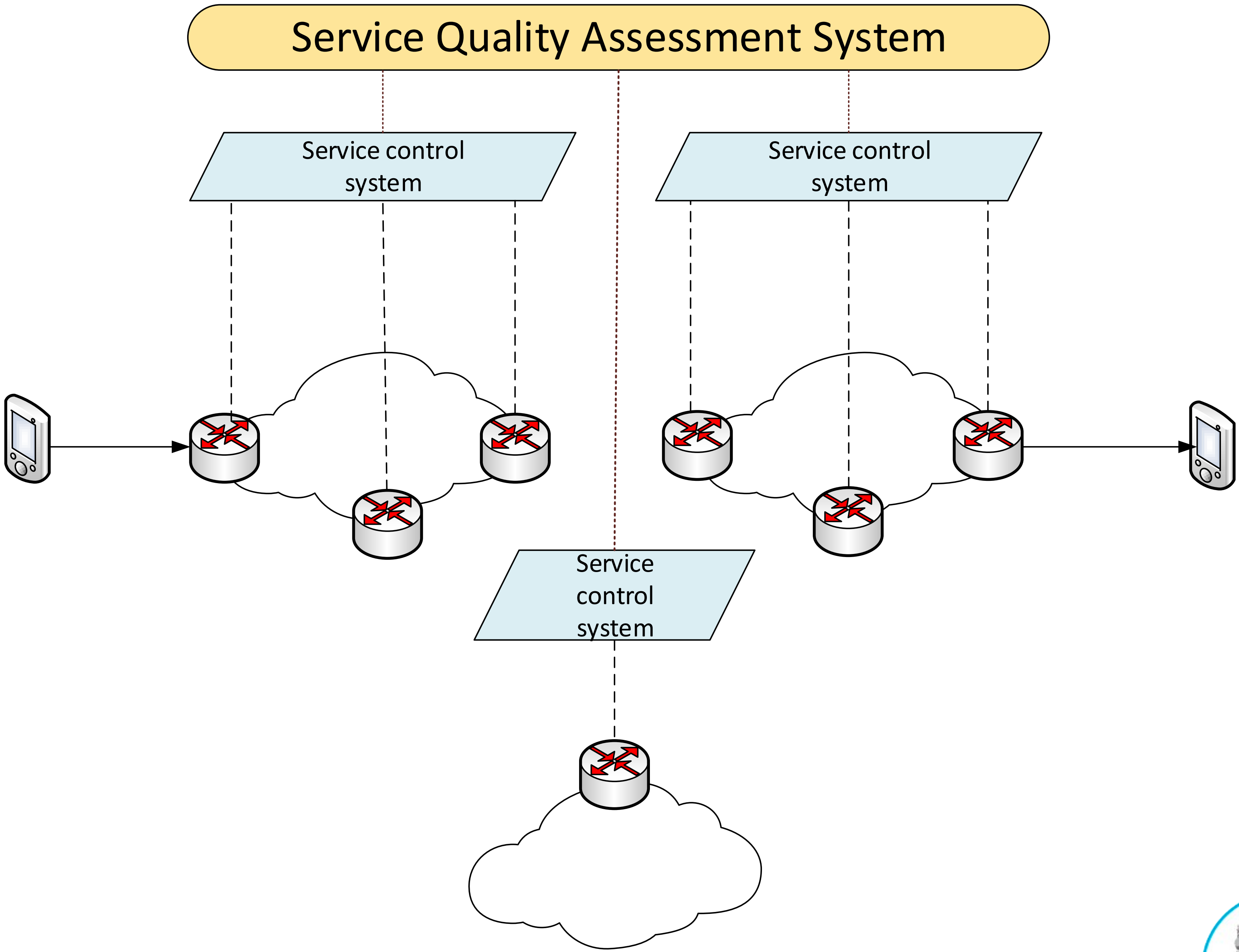
Service Quality Assessment System



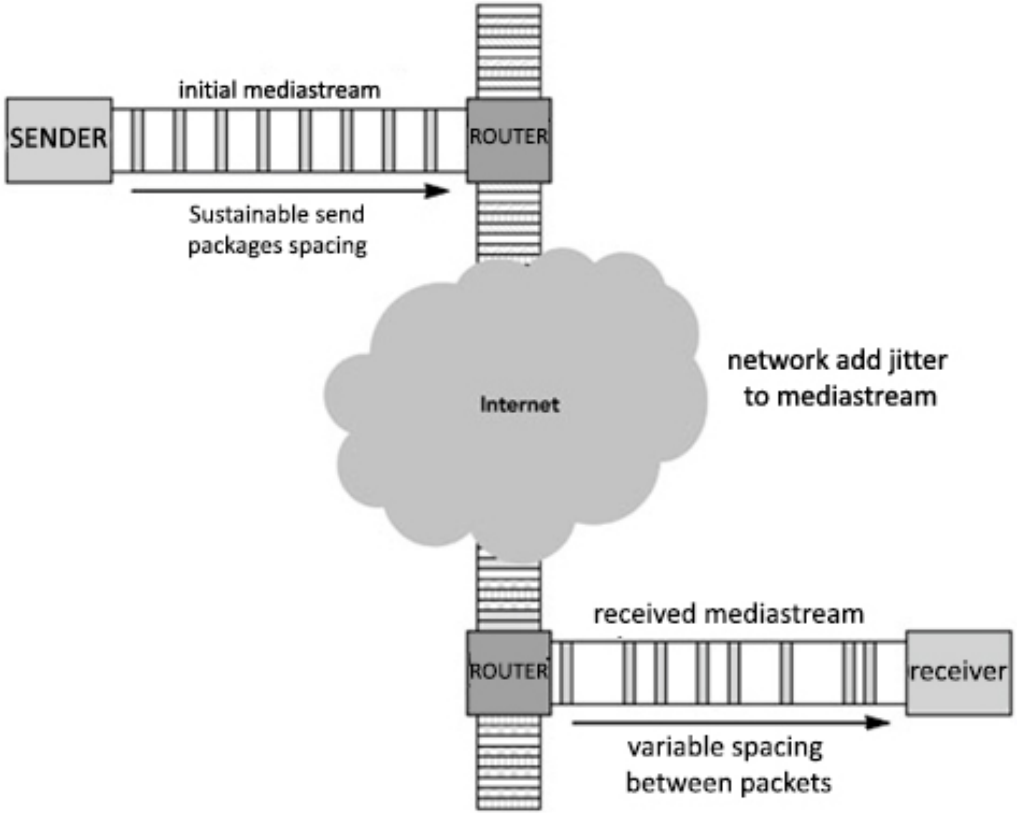
Simplified architecture SDN

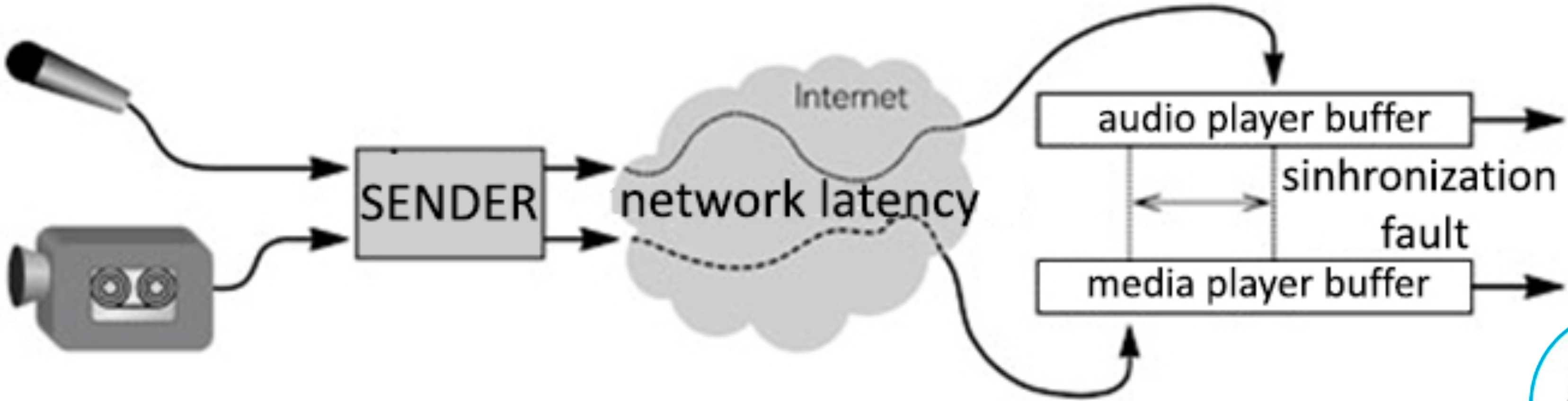


Система оценки качества сервисов

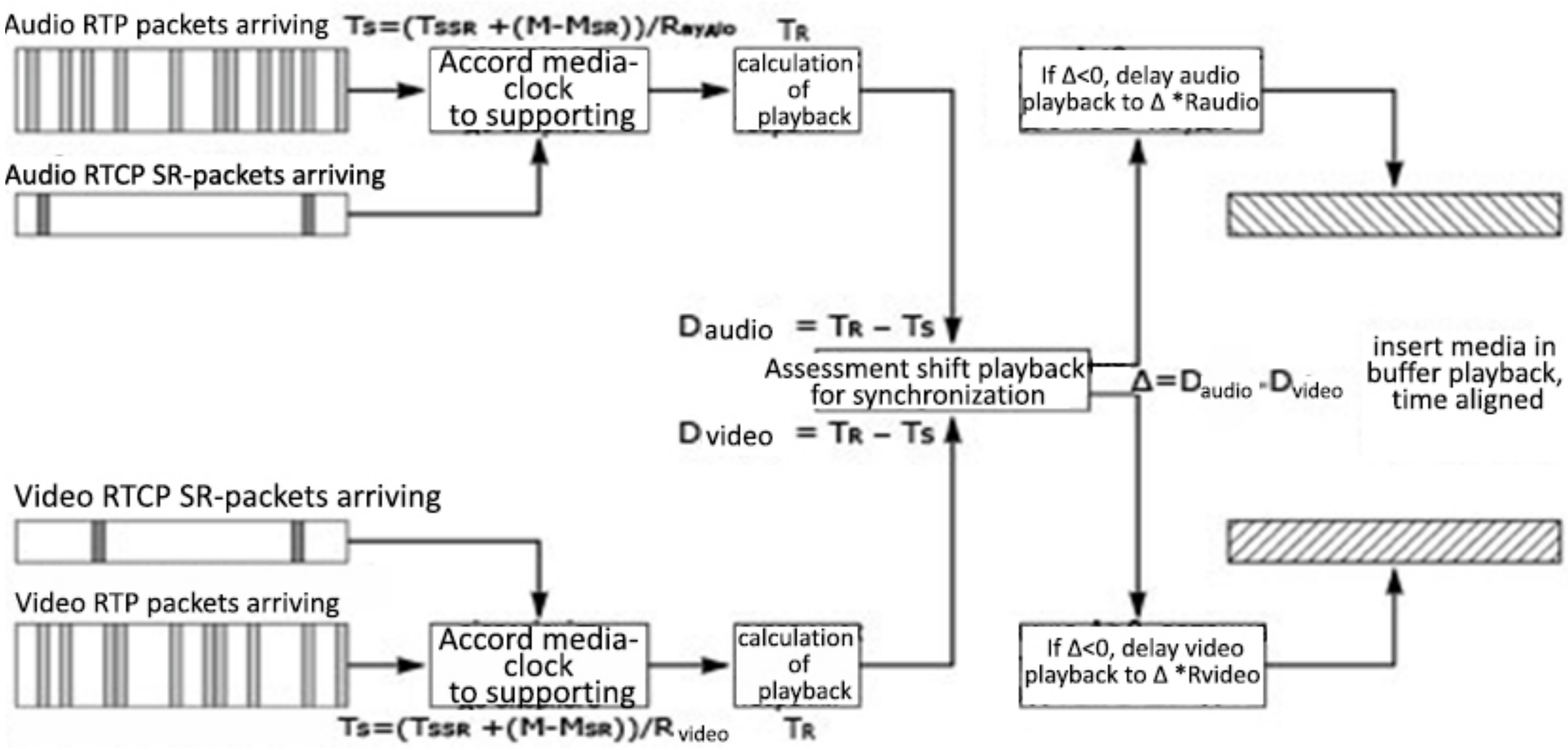


Implementation of the protocol RTP

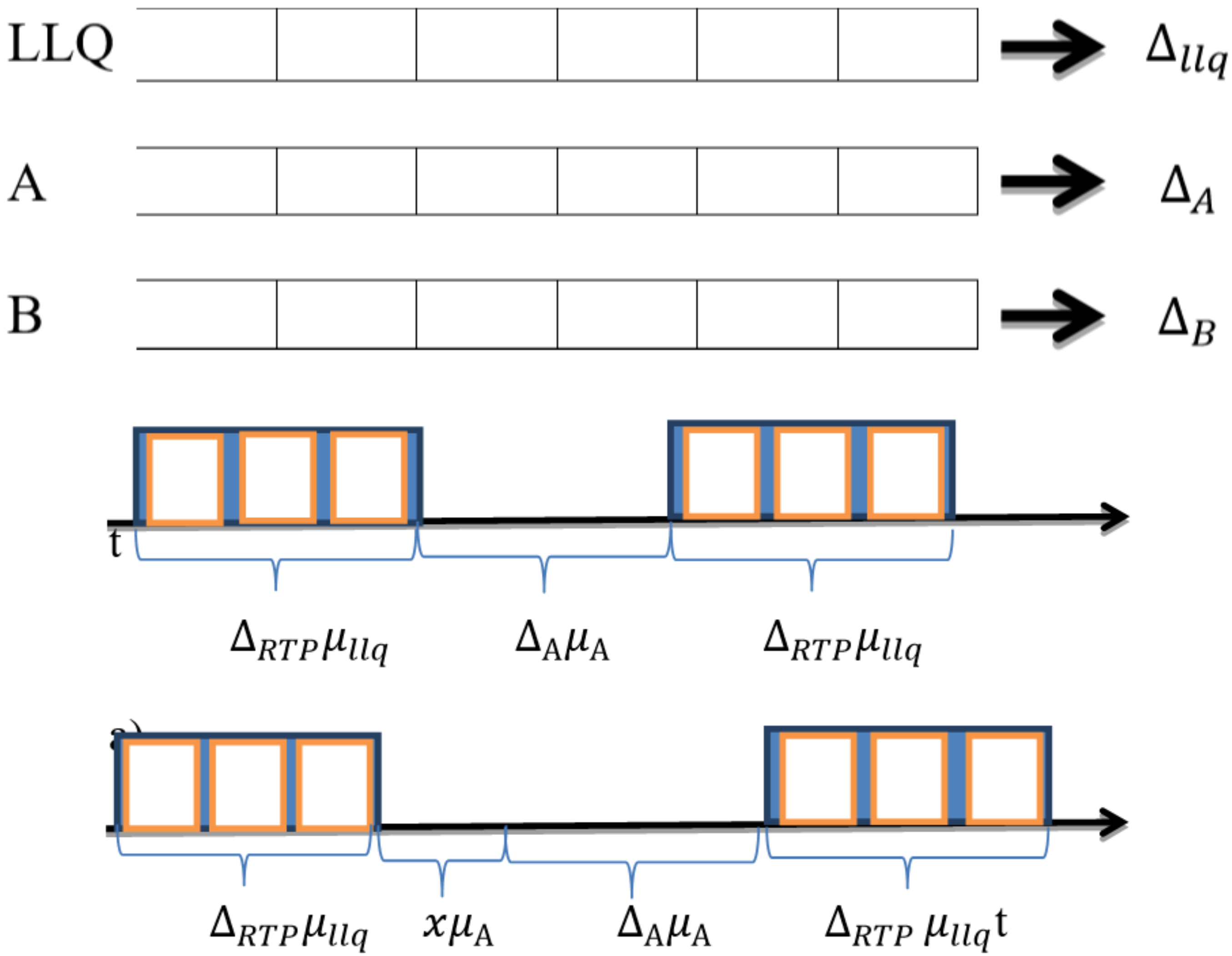




The mechanism for leveling the delay in RTP traffic



The mechanism of jitter formation



$t_3 = \Delta_A \cdot \mu_A + \Delta_{RTP} \cdot \mu_{llq} + x\mu_A$, when $\Delta_A = k \cdot R_A$,

The mechanism of jitter formation (continued)

Determination of the average delay value

$$t_{\text{cp}} = \sum_{i=R_{min}}^{R_{max}} t_{R_i} \cdot p(R_i)$$

Minimal delay will occur when $t_{3_{min}} = \Delta_{\text{A}}\mu_{\text{A}}$, and the maximum at $t_{3_{max}} = \Delta_{\text{A}}\mu_{\text{A}} + x\mu_{\text{A}}$. In this case, the probability of occurrence of a minimum delay will be provided that $x = 0$:

$$\text{p}(t_{3_{min}}) = \text{p}(x = 0),$$

The maximum delay, provided that $x = R_{max}$:

$$\text{p}(t_{3_{max}}) = \text{p}(x = R_{max}).$$

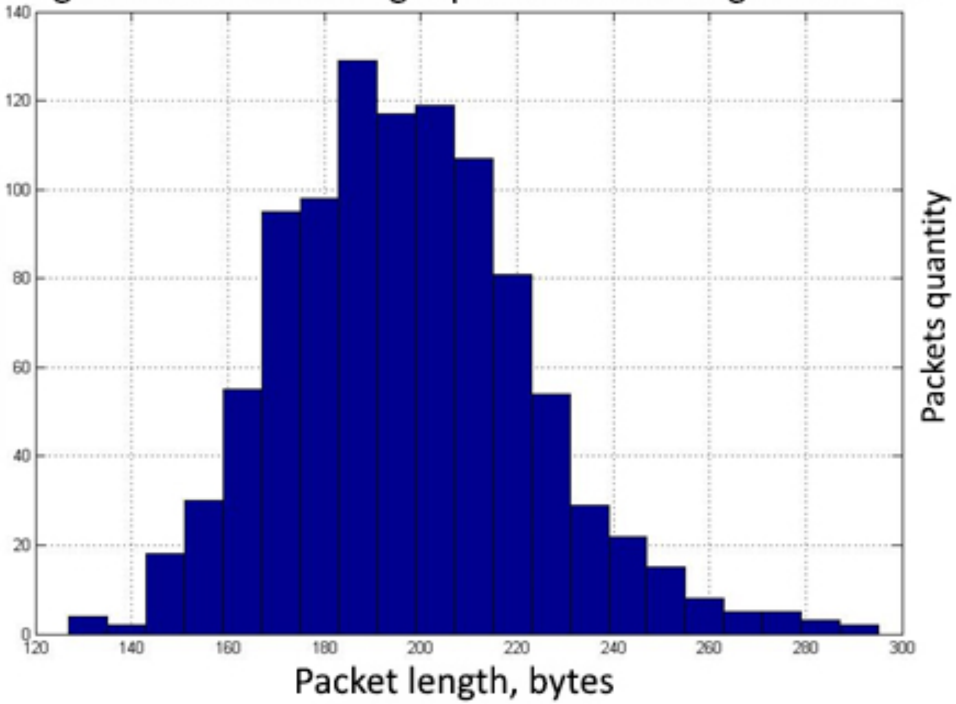
Thus, it is necessary to determine the probability that the sum of the packet length R_A will be greater than $k\Delta_{\text{A}}$, and also the probability of occurrence of each value of this difference.

Determination of the probabilistic characteristics of jitter

Determination of the average delay value

n	інтервал	P(n)	n	інтервал	P(n)
2	131-139	0,002	65	235-243	0,065
2	139-147	0,002	33	243-251	0,033
18	147-155	0,018	20	251-259	0,02
28	155-163	0,028	18	259-267	0,018
57	163-171	0,057	6	267-275	0,006
84	171-179	0,084	9	275-283	0,009
109	179-187	0,109	2	283-291	0,002
118	187-195	0,118	4	291-299	0,004
116	203-211	0,116	1	299-307	0,001
112	211-219	0,112	1	307-315	0,001
114	219-227	0,114	1	315-323	0,001
79	227-235	0,079	1	323-331	0,001

Histogram distribution length packets for the log-normal law



Determination of the probabilistic characteristics of jitter (continued)

Calculation of the characteristic function of a random variable

$$g(t) = \sum_{k=1}^{n} e^{itx_k} p_k,$$

where x_k – packet length, p_k – Probability of arrival of a package with length p_k.

Density of the allocation of the sum of the lengths of random packets

$$f_з(z) = \frac{1}{2\pi} \int_{-\infty}^{\infty} e^{-itz} g_z(t) dt.$$

In our case, we use the discrete Fourier transform, which has the form:

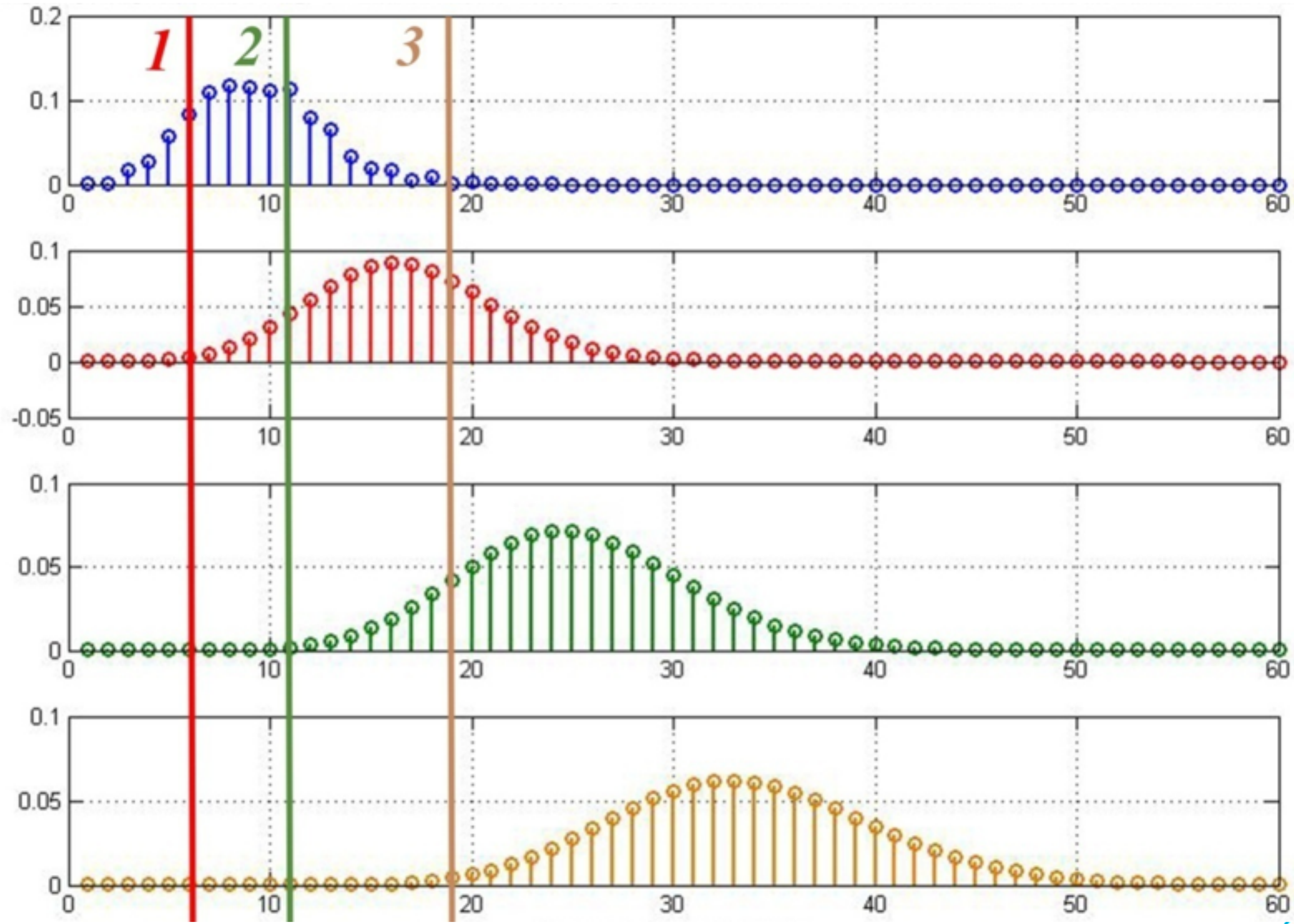
$$f_i = \sum_{k=0}^{n-1} \left(A_k \cos \frac{2\pi}{N} ki - B_k \sin \frac{2\pi}{N} ki \right), (i = 0,1,2 \ldots N-1),$$

where

$$A_k = \frac{1}{N} \sum_{i=0}^{N-1} f_i cos \frac{2\pi}{N} ki ;$$

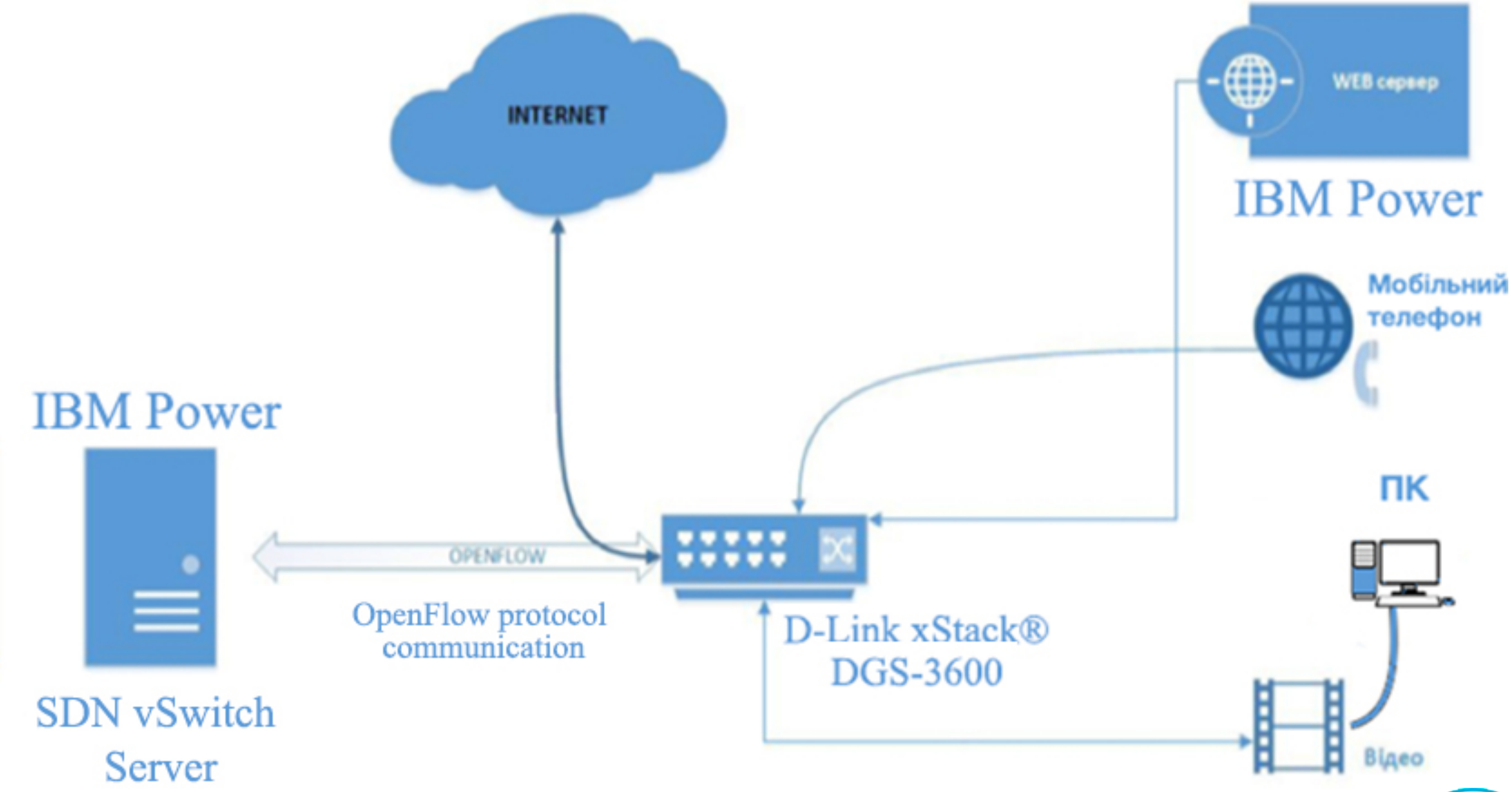
$$B_k = -\frac{1}{N} \sum_{i=0}^{N-1} f_i sin \frac{2\pi}{N} ki , (k = 0,1,2, \ldots , N-1).$$

Distributions of the probability density from the number of packets in the queue



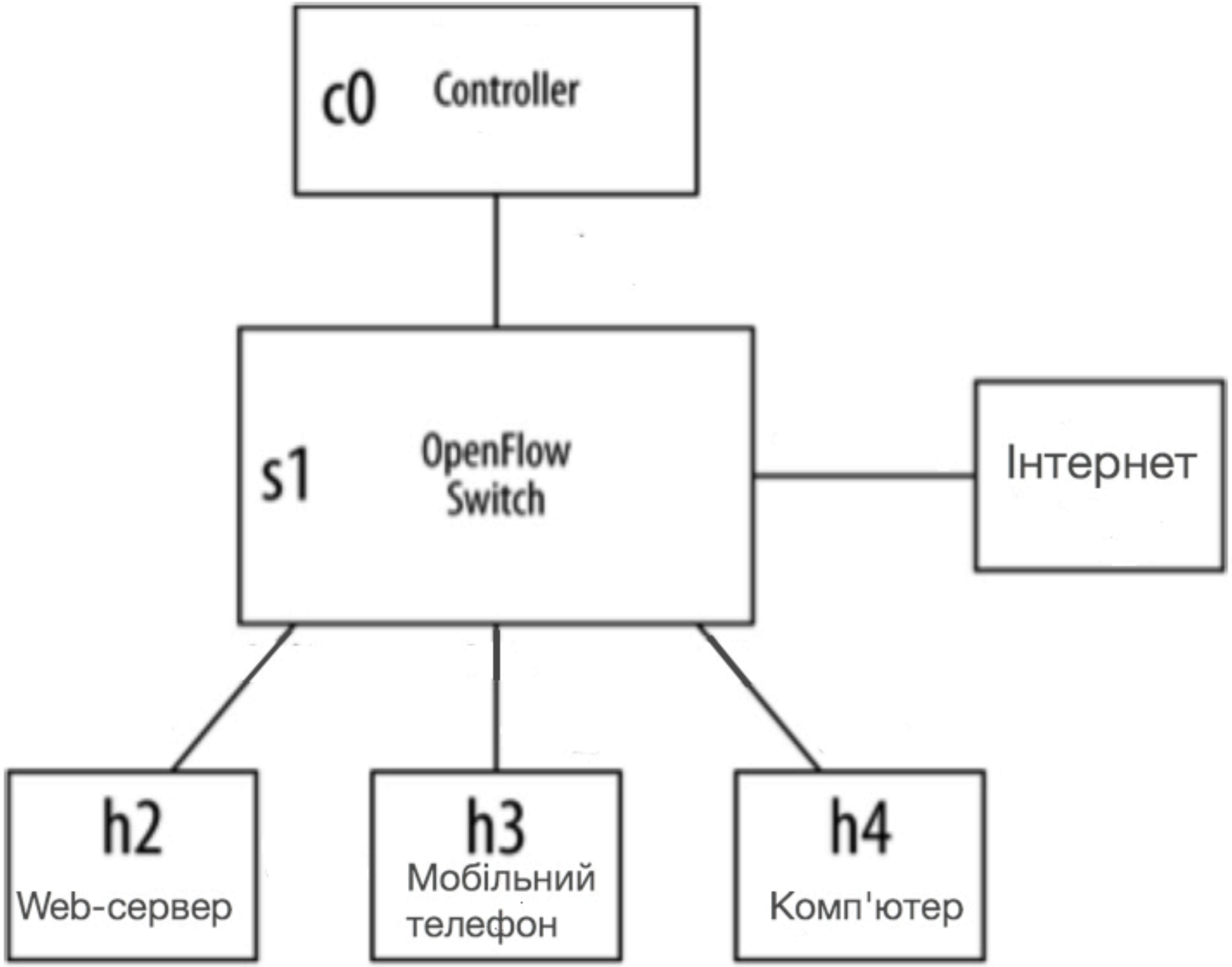
Experimental confirmation of the theoretical results

Physical Architecture

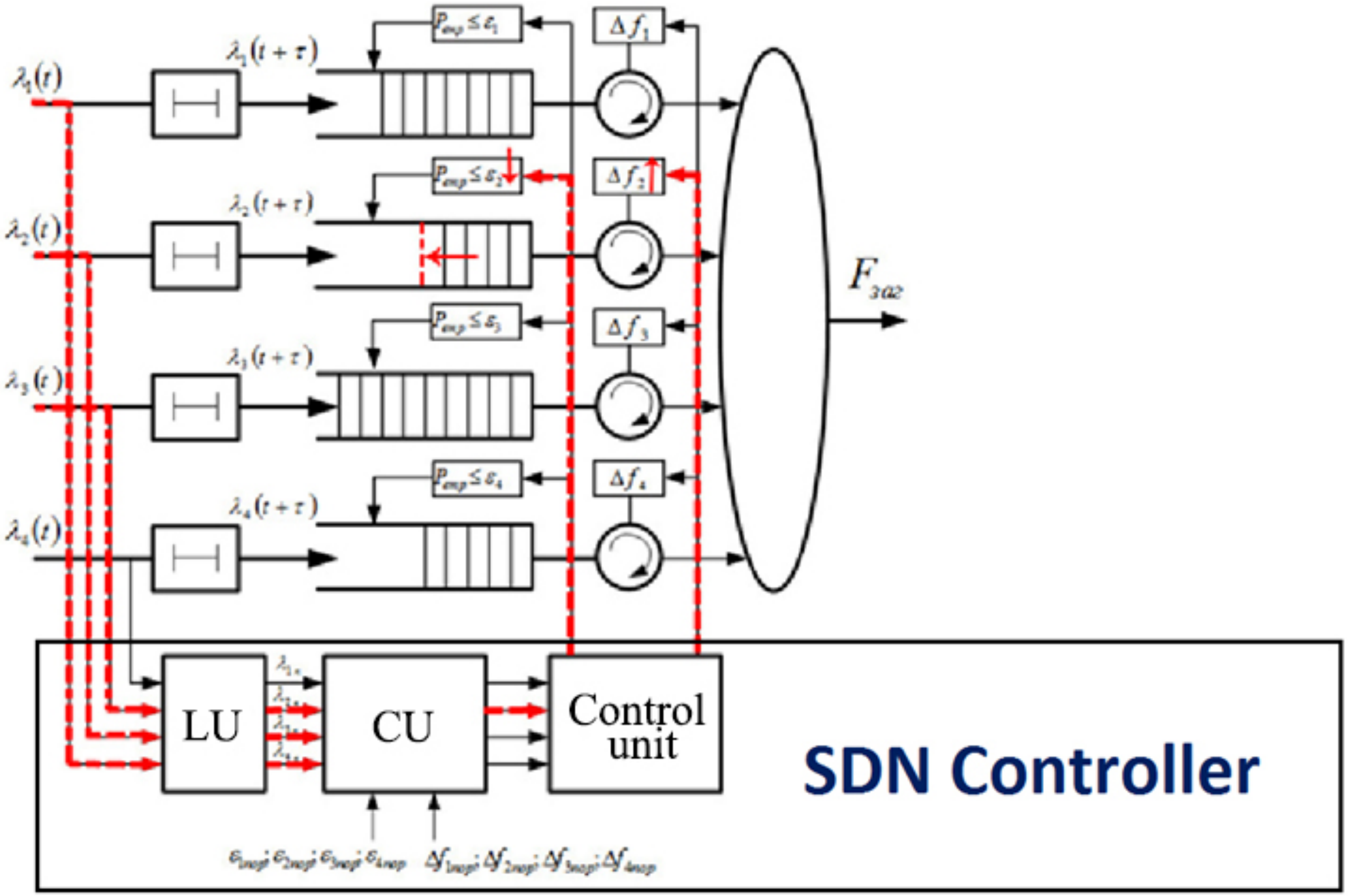


Experimental confirmation of the theoretical results

Logical architecture

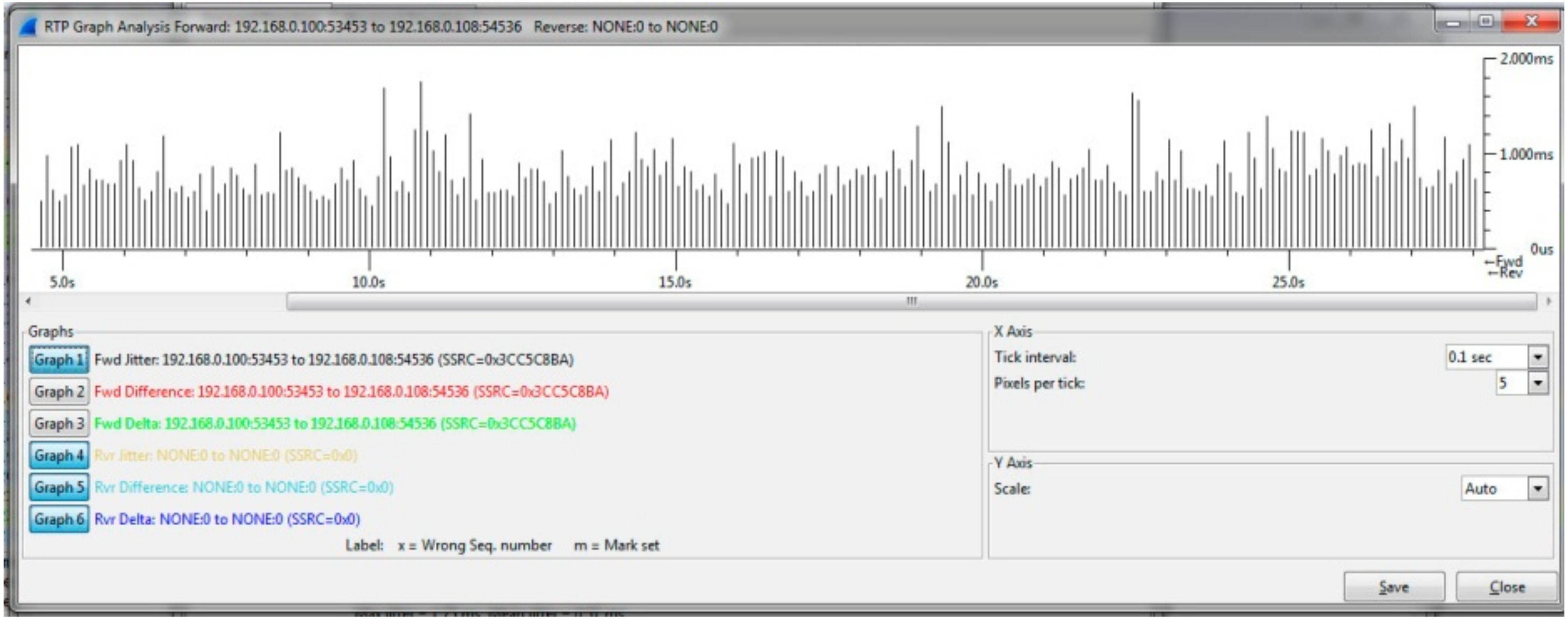


The scheme of the traffic quality management system via the RTP protocol



LU - Lateral unit
CU - Comparing unit

Experimental results of jitter values



Conclusion

The use of SDN technology in 4G / 5G networks will allow efficient and flexible implementation of algorithms for measuring and evaluating the quality parameters of transmitted services, which are used by national regulators to monitor the quality of services provided. And also allows to create a quality management system that is implemented within the operator / provider, which ensures a guaranteed quality of service provision.

THANK YOU FOR ATTENTION