

MINISTRY SCIENCES AND HIGHER EDUCATION RUSSIAN FEDERATION FEDERAL
STATE AUTONOMOUS EDUCATIONAL
INSTITUTION HIGHER EDUCATION
"NORTH CAUCASIAN FEDERAL UNIVERSITY"

METHODOLOGICAL INSTRUCTIONS

By execution laboratory work

By discipline "Signal and System" for students in
the training program

11.03.02 Infocommunication technologies And systems connections

Direction (profile)

"Intellectual processing data V infocommunication systems and
networks"

Content

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PRACTICAL WORK # 1

TOPIC "PROCESSES INSTITUTIONS VARIOUS TYPES CONNECTIONS WHEN USING THE 2VSK (R1.5) ALARM SYSTEM"

1 Target classes

Study of the processes of exchanging linear signals and routing signals when establishing successful and unsuccessful connections using 2BCK (R1.5) signaling.

2 Literature

1. Goldstein B.S. Switching systems / Textbook. – St. Petersburg: BHV-St. Petersburg, 2004. – P. 190-199.
2. Roslyakov A.V. Abstract lectures By educational discipline "Signaling V digital communication networks". – Samara, PGUTI, IUNL, 2013. – P. 10-40.

3 Questions For self-tests

1. Please explain the essence decadal method transmissions signals routing.
2. How are transmitted numbers numbers on the opposite side at in a decadal manner?
3. Which linear signals are used at establishment local connections? Explain their purpose.
4. What general And how differ signals "Pause" And "Inter-serial interval"?
5. Which linear signals are used at destruction connections? Please explain their purpose.
6. Please explain way transmissions signals routing "impulse shuttle".
7. How are the numbers of a number transmitted to the opposite side using the "pulse shuttle" method?

4 Preparation To occupation

Study indicated literature.

5 Individual tasks

Draw an arrow diagram of the exchange of signal messages (linear signals and routing signals) when using the 2BCK (R1.5) signaling system in the process of establishing a connection between stations A and B in accordance with the individual tasks given in Table 1. Specify the stable states call and the main information content of the transmitted signals.

Table 1. Individual tasks (number options corresponds last one digital grade book numbers)

No. options	1	2	3	4	5	6	7	8	9	0
Way transmissions signals routing (D - decadal, Ch - pulsed shuttle)	D	Ch	D	D	Ch	Ch	D	Ch	Ch	D
Quantity numbers V room subscriber B	4	6	3	4	7	5	4	7	6	3
Exodus call (U - successful, N - unsuccessful)	U	U	N	N	U	U	N	N	U	U
Cause unsuccessful call (Z - employment subscriber B, N - subscriber B unavailable)	-	-	Z	N	-	-	Z	N	-	-
First beats off subscriber at (successful call)	A	B	-	-	B	A	-	-	A	B

Note: Specific numbers numbers subscriber B are being asked arbitrarily.

6 Content report

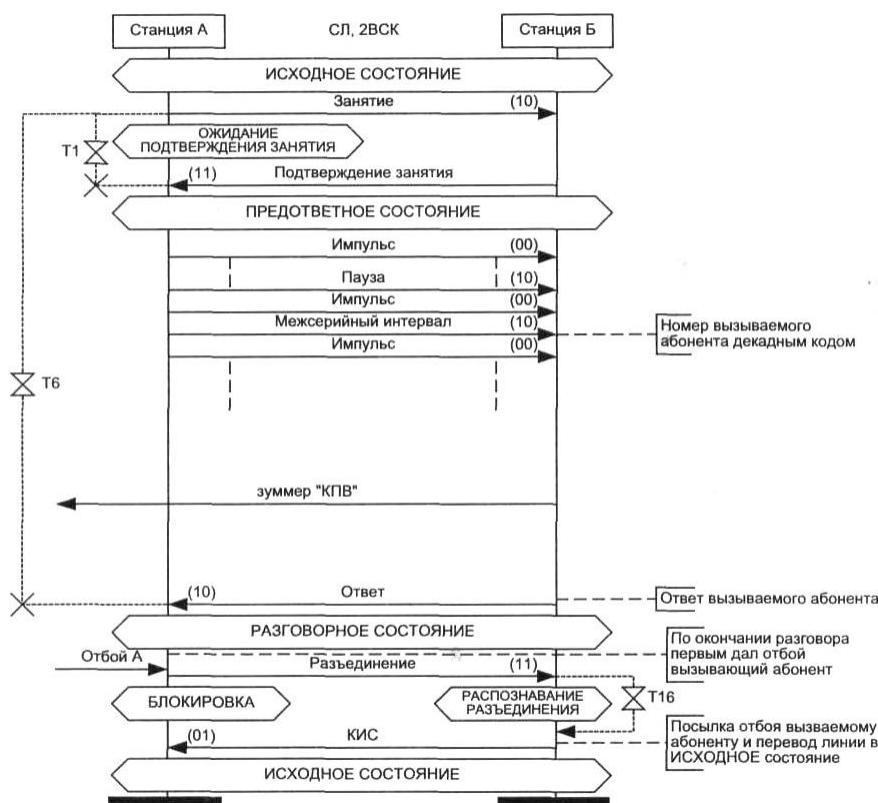
An arrow diagram of the exchange of signaling messages during the connection establishment process, indicating the stable call states and the main information content of the transmitted signals.

7 Methodological instructions

7.1 Decadal way transmissions signals routing

Successful compound, lights out subscriber A

In the INITIAL state, the line signal "Disconnection" (11) is transmitted from the outgoing PBX to the connecting line, and the line signal "Initial State Control - ISC" (01) is transmitted from the incoming PBX (note: the numbers indicated in brackets next to the name of the line signals indicate the value of the first two bits transmitted in the 1st or 2nd dedicated signal channel (DSC) of the 16th channel interval of the primary digital stream PCM-30/32) (Fig. 1).



Rice. 1. Successful compound, lights out subscriber A

At attempt install compound outgoing PBX transmits V line signal "Seizure" (10) and waits for 1 s for the "Seize Confirmation" (11) signal, after which the connection goes into the PRE-RESPONSE state. When transmitting the called subscriber's number in a ten-day manner, the "Seizure" (10) signal is replaced by the alternately transmitted routing signals "Pulse" (00) and "Pause" (10) or "Inter-serial interval" (10). The difference between the "Pause" and "Inter-serial interval" signals for transmission which serves one And that same bit combination (10), consists of only V

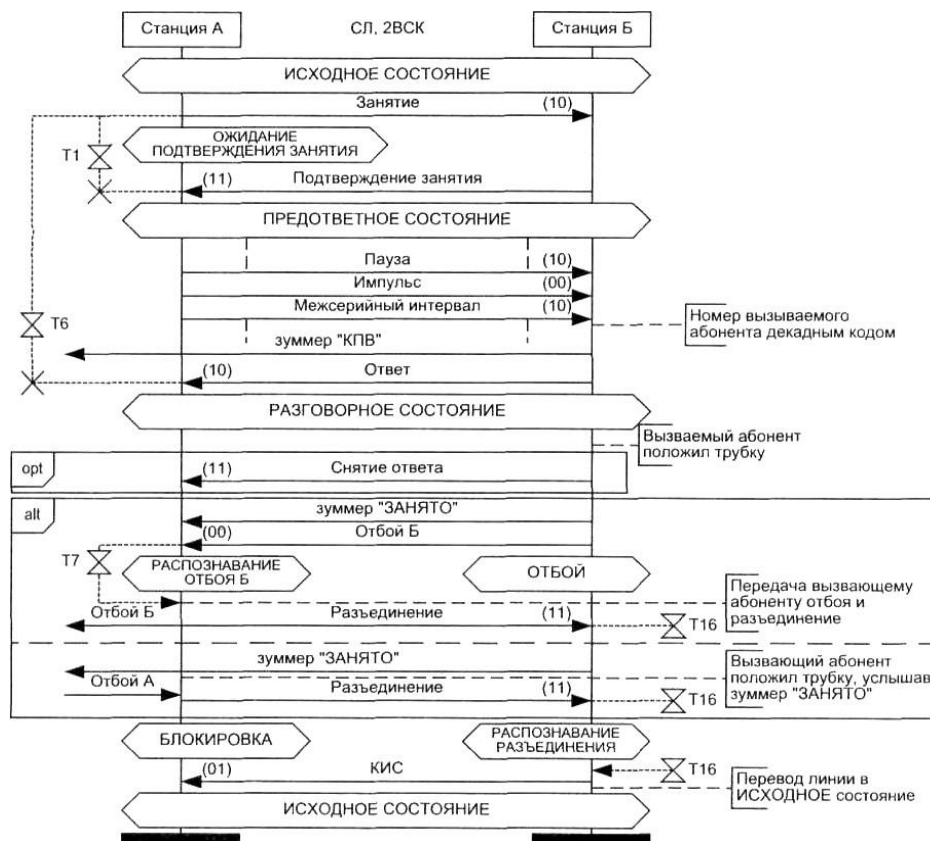
transmission duration. If the pause duration exceeds 150 ms, this signal is recognized as an "Inter-serial gap."

When the called subscriber answers, the "Answer" signal (10) is transmitted to the line, after which the line enters the conversation state. With a one-way hang-up system, if subscriber A hangs up first (the time the hook is pressed is at least 200 ms), outgoing side transmits signal "Disconnection" (11). After recognition signal "Disconnection" and if ready to process the next call, the incoming party transmits the "Initial State Control" signal (01), after which the line goes into the INITIAL state.

Successful compound, lights out subscriber B

The first stages of establishing a connection are similar to those of subscriber A hanging up. If subscriber B hangs up first after a conversation, the incoming party transmits the signal "Hang up B" to the connecting line. (00), accompanied by the transmission of a tone signal "BUSY" on the voice line. After receiving the "Hang-up B" signal, the outgoing party transmits the "Disconnect" (11) line signal to the incoming PBX, and the "BUSY" buzzer to subscriber A. After transmitting the "Initial State Control" (01) signal, the line returns to the INITIAL state.

Some types of existing electromechanical exchanges precede the transmission of the line signal "Clear B" by briefly disabling the "Answer" signal. If the incoming party does not transmit the line signal "Clear B," then the hang-up of subscriber B will be indicated by the acoustic signal "BUSY." If, after subscriber B hangs up, the incoming station does not receive the line signal "Hang up B" (the line signal "Answer" will be disconnected and the acoustic signal "BUSY" will be transmitted), the connection on the outgoing side should not be broken, and the connecting line should not be released until subscriber A hangs up (Fig. 2).

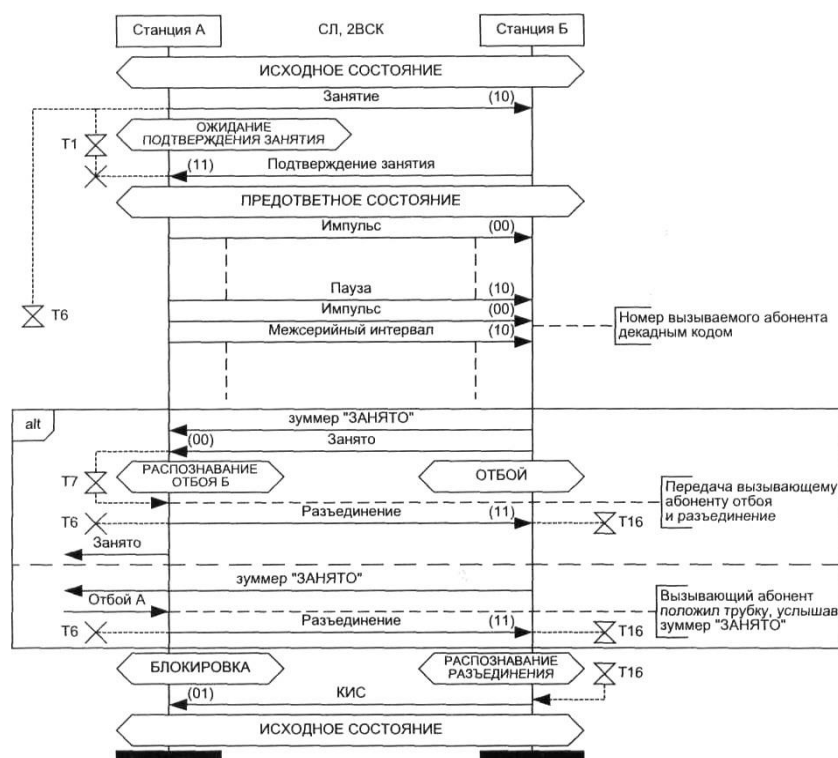


Rice. 2. Successful compound, lights out subscriber B

Unsuccessful compound (subscriber busy or unavailable)

After receiving the called subscriber's number, if it is busy, the incoming party transmits linear signal Busy (00), accompanied buzzer "BUSY" as reactions on which outgoing PBX transmits V side incoming PBX signal

"Disconnection" (11), A to the subscriber A - buzzer *BUSY* (rice. 3).



Rice. 3. Unsuccessful compound (subscriber B busy or unavailable)

7.2 Way transmissions signals routing "impulse shuttle"

Summoned subscriber free

Figure 4 shows a scenario for establishing a local connection to a free subscriber. Not previously how through 150 ms after reception signal "Class" And transmissions signal "Confirmation of occupation"—the incoming PBX requests the required number digit using a frequency-based method. This request is then transmitted using A1 (digit 1) signals. ÷ A10 (number 0) (table. 2). IN dependencies from schemes constructions networks And from At the connection stage, the incoming party requests the first digit of the number (signal B1), the next digit of the number (signal B2), or the last transmitted digit, that is, the digit already used in the connection process (signal B3) (Table 2).

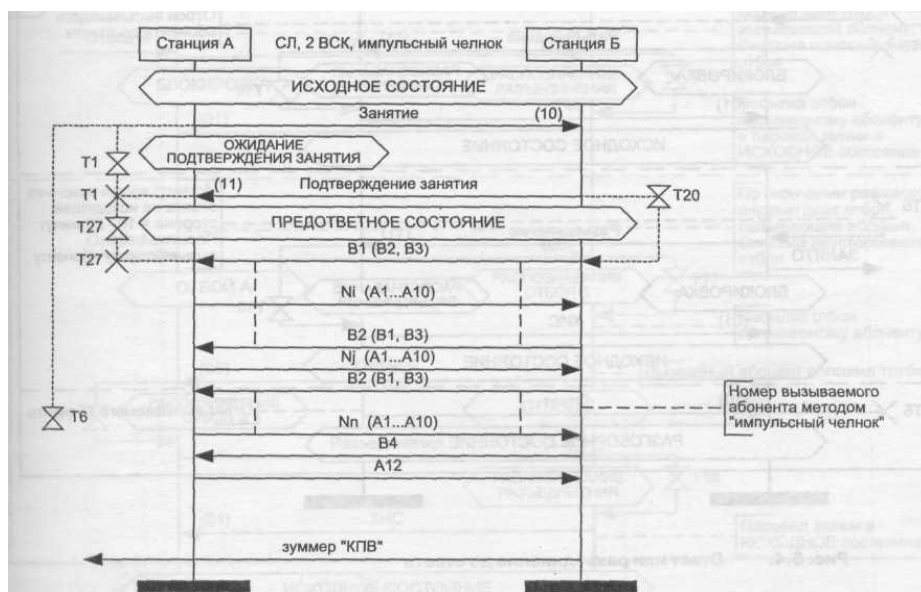
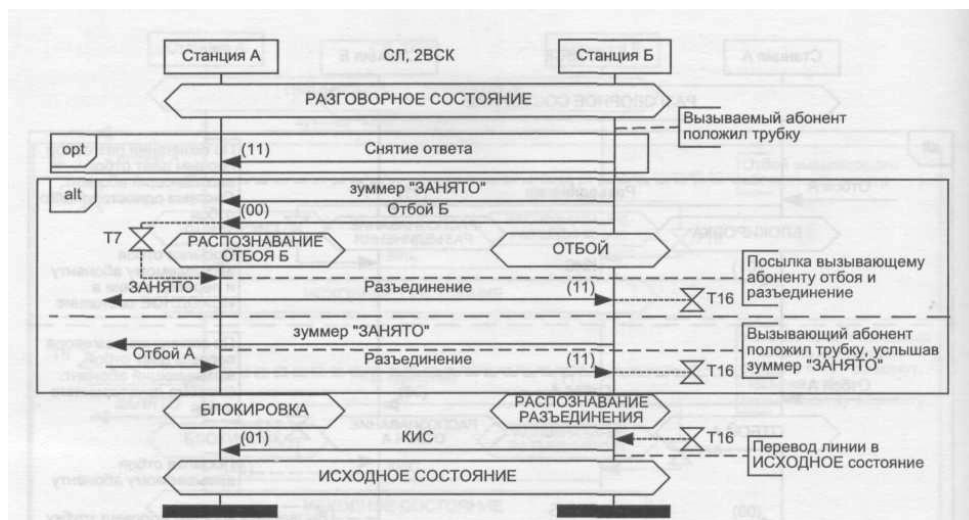


Рис. 4. Summoned subscriber free

Table 2 Frequency signals direct And reverse directions alarms 2VSK+MChK

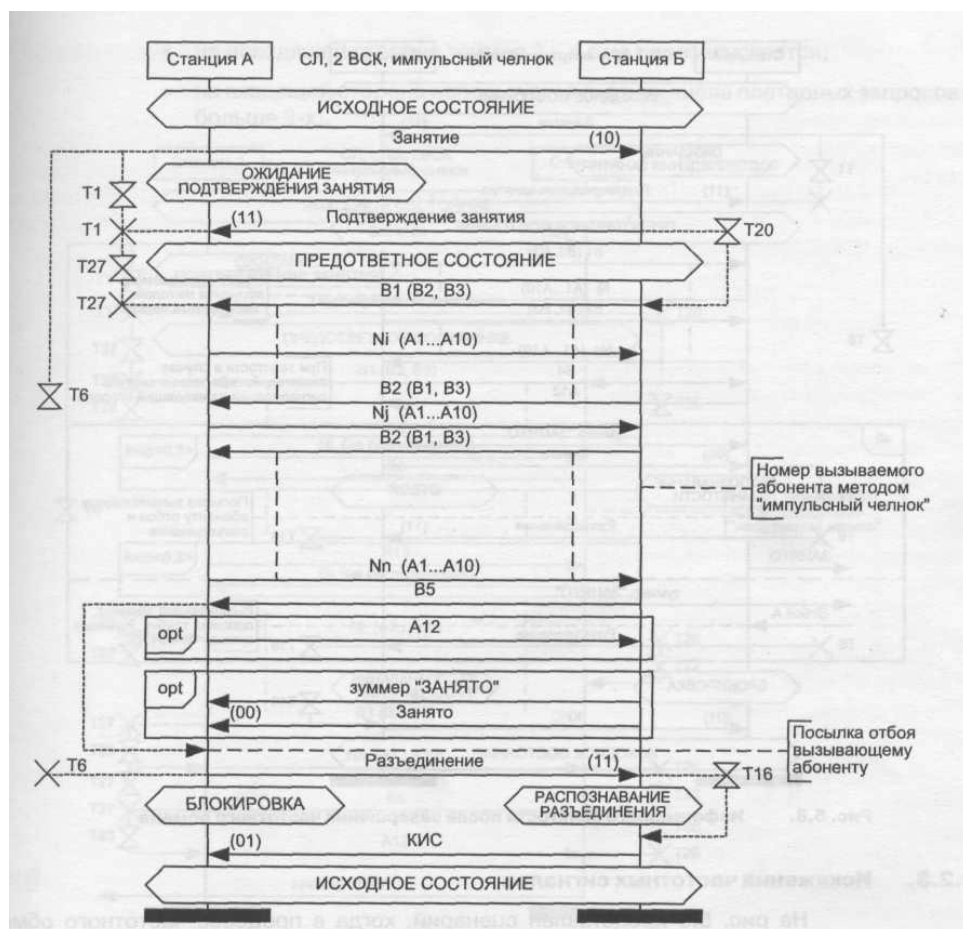
Frequency composition	Transmitted information (combination)	
	direct direction A	the opposite direction IN
f_0, f_1	Number 1 (A1)	Request first numbers numbers V multi-frequency code (B1)
f_0, f_2	Number 2 (A2)	Request next numbers V multi-frequency code (B2)
f_1, f_2	Number 3 (A3)	Request previous numbers V multi-frequency code (B3)
f_0, f_4	Number 4 (A4)	Summoned subscriber free (B4)
f_1, f_4	Number 5 (A5)	Summoned subscriber busy (B5)
f_2, f_4	Number 6 (A6)	Request previous numbers accepted With mistake (request about repetition) (B6)
f_0, f_7	Number 7 (A7)	Subscriber unavailable (employment connecting paths) (B7)
f_1, f_7	Number 8 (A8)	Request on transmission total numbers battery method (B8)
f_2, f_7	Number 9 (A9)	Request on transmission remaining numbers numbers battery method (B9)
f_4, f_7	Number 0 (A10)	Request on transmission numbers numbers, starting With previous, battery method (B10)
f_0, f_{11}	Reserve	Request for long-distance call category (semi-automatic) or automation) from AMTS (B11)
f_1, f_{11}	Confirmation reception feedback signals directions 4, 5, 8, 9, 10 (A12)	Reserve
f_2, f_{11}	Request for transfer of previously transferred signal, accepted with an error (A13)	Reserve
f_4, f_{11}	Automatic long-distance connection (A14)	Reserve
f_7, f_{11}	Semi-automatic long-distance compound (A15)	Absence information (B15)



Rice. 7. Lights out subscriber B

Summoned the subscriber is busy

On rice. 8 reviewed option establishments local connections To to a busy subscriber. After definitions states called subscriber (busy) V The B5 frequency signal is transmitted to the outgoing station, after which the frequency exchange is completed. The A12 frequency signal is not required in this case. It is possible the line signal "Busy" and the buzzer "BUSY", but their transmission must not begin until the frequency exchange with the code "2 of 6" is completed.



Rice. 8. Employment subscriber B

In the event that the incoming side does not provide the ability to quickly determine the status of the called subscriber and transmit the frequency signal B5, or does not have information about the status of the called subscriber (for example, in the case of interaction of different signaling systems on the incoming side), instead of the B5 signal, the B4 signal is transmitted, and to transmit information about the busy status of the called subscriber, the line signal “Busy” is used, accompanied by the “*BUSY*” *buzzer*.

PRACTICAL WORK # 2

TOPIC "FORMAT SIGNAL UNITS OKS No. 7"

6 Target classes

Study of the format and purpose of information fields of significant signal units (MSU) and acquisition of practical skills in decoding signal messages of the SS7.

7 Literature

1. Roslyakov A.V. System common channel alarms OKS No. 7 / Educational allowance. - Samara, PGUTI, 2008. – P. 28-38.
2. Roslyakov A.V. Abstract lectures By educational discipline "Signaling V digital communication networks". – Samara, PGUTI, IUNL, 2013. – P. 49-56.

8 Questions For self-tests

1. Which there are signal units And V how their difference?
2. Please specify difference formats different types signal units.
3. What such flag And For what He is it needed?
4. For what needed indicator bits ?
5. How are signal units transmitted in different directions along a cable system link numbered? Which signal units are assigned serial numbers and why?
6. What is it? Maybe be length signal unit?
7. Which field defines subsystem user?
8. How is being carried out addressing transmissions signal units?
9. Please specify appointment fields labels ISUP routing .
10. How connected signal information link OKS No. 7 With conversational channel?

9 Preparation To occupation

Study indicated literature.

10 Individual tasks

1. To depict format significant signal units OKS No. 7 With filling common fields and routing labels in binary and hexadecimal codes in accordance with the specified option (Table 1).
2. Specify appointment fields of significance signal units.
3. Define general length significant signal units.

Table 1. Individual tasks (number options corresponds last one digital grade book numbers)

No. options	0	1	2	3	4	5	6	7	8	9
Ordinal number last one transferred to the CE	34	22	1	11	86	104	0	28	17	127
The serial number of the last Right accepted CE	0	127	64	1	35	106	59	78	99	83
Previous direct bit value indicator	0	1	0	1	0	1	0	1	0	1
No. options	0	1	2	3	4	5	6	7	8	9

Previous the value of the inverse bit-indicator	1	0	0	1	1	0	0	1	1	0
Broadcast CE V direct direction	first	repeat	repeat	first	first	repeat	repeat	first	first	repeat
Confirmation CE in reverse direction	floor	floor	neg	neg	floor	neg	neg	floor	neg	floor
Length CE	37	60	21	44	48	17	32	29	16	24
Service networks	TUP	ISUP	SCCP	TUP	ISUP	SCCP	TUP	SCCP	ISUP	SCCP
Type networks	MN	MG	local	MN	MG	local	MN	MG	local	MN
Code point departures	1834	2538	3894	24	136	201	17	24	11	47
Code point appointments	125	934	17	180	304	408	135	209	303	15
No. tract ICM	21	17	2	31	126	93	87	180	73	64
No. canal	2	10	30	18	24	13	1	16	19	8
Length fields signaling information, byte	28	14	19	21	33	17	26	15	30	12

Conditional designations:

perv. – CE is transmitted for the first time; rep. – CE is transmitted again; pol. – positive confirmation of CE in the opposite direction; neg. – negative confirmation of CE in the opposite direction; NN – international network, MG – long-distance network, local – local network

11 Content report

1. Table With original data.
2. A table with the filling of the fields of the significant signal unit in binary and hexadecimal codes with the necessary comments on the contents of each field.
3. Results calculation general lengths significant signal units.

12 Methodological instructions

7.1 Functions And codes fields signal units

Any information is transmitted through the SS7 signaling link using data packets called *signal units (SUs)*. A signal unit consists of a variable-length signaling information field, which transmits information generated by the user subsystem, and several fixed-length fields, which transmit information used to control message transmission.

They differ three type signal units:

- 1) *Message Signal Unit (MSU)* which is used to transmit signaling information generated by user subsystems or SCCP;
- 2) *Link Status Signal Unit (LSSU)*, which is used For control states link alarms and is being formed on 3 level MTR;
- 3) *filling signal unit (Fill In Signal Unit - FISU)*, which is used to ensure link phasing in the absence of signaling traffic.

Direct formation signal units is being carried out on 2nd at the level of the MTR message transmission subsystem.

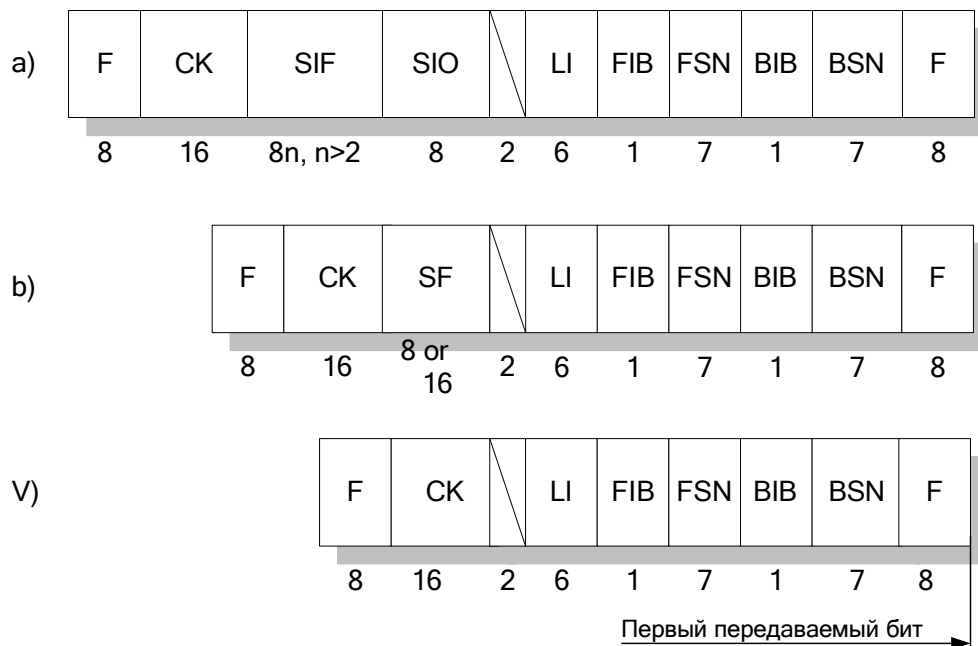
Significant signal units are repeated in case of an error, link state signal units and filling signal units are not repeated.

Format signal units defined V Recommendations ITU-T Q.703. Basic format signal units shown on rice. 1. Most complex By structure is

significant signal unit (MSU) . The MSU consists of a series of fields that contain a fixed or variable number of bits.

The flag (Flag - F) marks the beginning of a signal unit. The opening flag of a given signal unit is usually the closing flag of the preceding signal unit. The closing flag marks the end of the signal unit. The bit sequence in the flag is as follows: 01111110.

To prevent the imitation of a flag by information contained in another part of the signaling unit, the transmitting part of the signaling link terminal device (Level 2 functions) inserts a "0" after each sequence of five "1"s before attaching the flag and transmitting the signal unit. At the receiving end of the signaling link, after the flag is detected and separated, each zero following five "1"s is removed. This operation is called *bit stuffing* .



Rice. 1. Formats signal units:

A) significant signal unit MSU;
b) signal unit states link LSSU; c) filling signal unit FISU

Ordinal numbering signal units includes *direct ordinal number* (Forward Sequence Number - FSN) And *back ordinal number* (Backward Sequence Number - BSN). FSN is the serial number of the signaling unit in which it is transmitted to the opposite signaling point. BSN is the serial number of the confirmed signaling unit, which is received from the opposite signaling point. FSN fields and BSN occupy 7 bits each and represent binary numbers in a cyclically repeating sequence from 0 to 127.

Indicator bits include the Forward *Indicator Bit* (FIB) And *back indicator bit* (Backward Indicator Bit - BIB). FIB And BIB together With FSN And BSNs are used in the basic error protection method to ensure the correct sequence of signal units and to perform acknowledgement functions.

When a significant signal unit is correctly received for a positive acknowledgement, the value of the reverse sequence number (BSN) is formed in accordance with the FSN of the signal unit for which the acknowledgement is issued, i.e., $BSN = FSN$. The BBI value is assumed to be equal to the FBI of the received MSU.

If the initial signal unit is incorrectly received, a retransmission request is issued to the transmitting side for negative acknowledgement. The retransmission request is generated such that BSN = FSN of the last correctly received signal unit, and the BBI value is inverted relative to the last FBI value of this signal unit.

The Length Indicator (LI) is used to indicate the number of bytes following the length indicator byte, and preceding the check bits, and is one of the binary numbers in the range from 0 to 63 (since it occupies 6 bits). The length indicator identifies three types of signal units as follows:

LI = 0, If This filling signal unit FISU;

LI = 1 or 2, If This signal unit states link LSSU; LI >2 if it is a significant signal unit MSU.

In national signalling networks, when the signalling information field occupies 62 bytes or more (in some cases it can be up to 272 bytes), the length indicator takes a value of up to 63.

It should be noted that the LI indicator is not used to determine the length of the signal unit (flags are used for this purpose), but rather determines the type of signal units.

The Signaling Information Octet (SIO) is divided into a *Service Indicator* (SI) and a *Subservice Field* (SSF). The Service Indicator serves to establish the correspondence of signal information to a specific user subsystem and is contained only in significant signal units. The service indicator SI (4 most significant bits of SIO) is encoded as follows:

0000 - control network alarms; 0001 - alarm

link test;

0011 - SCCP - subsystem management through signal channel; 0100 - TUP - telephony user subsystem;

0101 - ISUP - subsystem user ISDN; The remaining code

combinations are reserve.

The SSF service subtype field (4 least significant bits of SIO) contains network indicator (bits C and D) and two reserve bat (bits A and B). The network indicator distinguishes international messages from domestic ones. The SSF field is encoded as follows:

bits D From V A

SSF = 0 0 X X - international network;

0 1 X X - reserve (only For international applications);

1 0 X X - national net (V Russia - intercity net);

1 1 X X - reserve For national applications (V Russia - local net).

The Signaling Information Field (SIF) consists of an integer number of bytes greater than or equal to 2 and less than or equal to 62. In national signaling networks, it may include up to 272 bytes (256 bytes for the message and 16 bytes for the label). This field is intended to transmit useful information over the signaling link. It should be noted that MTP does not recognize the contents of the SIF, except for the routing label, which is used to route messages within the signaling network. Not counting this information about route, MTR Just transmits the information contained in the SIF from layer 4 of one signaling point to layer 4 of another signaling point. The general structure of signaling information for ISDN user subsystems (ISUP subsystem) is shown in Fig. 2.

Информационные элементы сообщения ISUP	Тип сообщения	Этикетка С
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Rice. 2. Structure signal messages subsystems ISUP

The signaling information contains information about the actual user (one or more signals for servicing a telephone call or data transmission, information (management and maintenance, etc.) and information defining the message type and format. The signaling information also includes a label containing information that allows the message to be routed to its destination by layer 3 functions through the signaling network (this part of the label is called *the routing label*).

According to the code allocation plan established for addressing, the routing label assigns a unique 14-bit code to each point in the signaling network. Messages addressed based on international or national code allocation plans are differentiated using the service subtype field (SSF).

Label routing ISUP contains 4 byte And includes next fields

(Fig. 3):

- code point appointments (Destination Point Code - DPC) - 14 bit;
- code outgoing point (Origination Point Code - OPC) - 14 bit ;
- field selection link alarms SLS - 4 bits.

Additionally V messages subsystems ISUP, oriented on compound, V label routing is added code identification channel CIC length 12 bit.

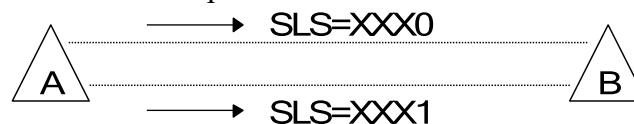
Messages ISUP: label type C

Signal information	CIC	SLS	Departure point code ORS	Destination code DPC
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Rice. 3 Label routing V messages subsystems ISUP

The Signaling Link Selection Field (SLS) is a code used to divide the entire signaling load between different links within a single signaling link group or between different routes within a single signaling route group. For signaling units belonging to TUP and ISUP user subsystems, the SLS field is the four least significant bits of the call channel identification field. To implement the load sharing process at each signaling point, a special directive can be used to specify the bit numbers of the SLS field, based on which the load is divided (Figure 4).

Rice. 4 Example divisions loads V beam links



The Channel Identification Code (CIC) serves as a label for connection-oriented signaling messages in the ISUP subsystem. The five least significant bits denote the conversation channel (channel slot) number in the PCM-30/32 (E1) path, and the seven most significant bits denote the PCM path number.

Check Bits (CK) are 16 bits of information for error detection, obtained by linear operations on the previous bits of the signal unit (not filled in the practical lesson).

PRACTICAL WORK # 3

TOPIC "FORMAT SIGNAL MESSAGES SUBSYSTEMS ISUP»

1 Target classes

Study of the format and purpose of information fields of signaling messages of the ISUP subsystem and acquisition of practical skills in their coding.

2 Literature

1. Roslyakov A.V. System common channel alarms OKS No. 7 / Educational allowance. - Samara, PGUTI, 2008. – P. 83-130.
2. Roslyakov A.V. Abstract lectures By educational discipline "Signaling V digital communication networks". – Samara, PGUTI, IUNL, 2013. – P. 69-77.

3 Control questions

1. Please specify fields signal messages ISUP. How They are they different?
2. What such parameter messages And which fields He Maybe have?
3. Which format have parameters, finding V different parts messages?
4. WITH what it begins mandatory variable Part messages ISUP?
5. Please explain appointment main parameters messages IAM.
6. Please explain methodology filling fields messages IAM.
7. How define By signal message IAM, What:
 - call must be served How international;
 - V conversational tract is used satellite channel;
 - terminal equipment Not ISDN;
 - there is interaction OKS No. 7 With another system alarms.

4 Preparation To occupation

Study indicated literature.

5 Exercise

Display the format of the ISUP message "IAM Start Address" indicating the values of the message parameters in accordance with the specified initial data (see Table 1) in binary and hexadecimal codes.

Table 1. Individual assignments (the option number corresponds to the last digit of the grade book number)

No. options	0	1	2	3	4	5	6	7	8	9
Number of satellite channels in connection	0	1	2	0	1	2	0	1	2	0
Train examination	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes
Incoming semi-set echo suppressor	on	off	on	off	on	off	on	off	on	off
Type call	nat	m/n	nat	m/n	nat	m/n	nat	m/n	nat	m/n
"Method from end to the end"	No	MTR	SCCP	No	MTR	SCCP	No	MTR	SCCP	No
Availability	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No

No. options	0	1	2	3	4	5	6	7	8	9
interactions of systems alarms										
Information «from end in thread»	available	shortage	available	shortage	available	shortage	available	shortage	available	shortage
Use ISUP everywhere paths	net	yes	net	yes	net	yes	net	Yes	No	Yes
Preferably use ISUP	prep.	req.	n/req.	prep.	req.	n/req.	prep.	req.	n/req.	prep.
Access ISDN	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No
Method SCCP	without mouth	With mouth	any	without mouth	With mouth	any	without mouth	With mouth	any	without mouth
Category of the caller subscriber	usual	tester	taxi	prior.	p/day	author And k	p/a And k	author II k	p/a. II k	tester
Wednesday transmissions	speech	audio	64 kbps	384 kbps	64 kbps	920 kbps	speech	audio	64 kbps	384 kbps
Type numbers called subscriber	subscriber	nat	m/n	subscriber	nat	m/n	subscriber	nat	m/n	subscriber
Routing by internal number	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No
Called number subscriber	135489	2514	54866	501248	32109	40900	721904	9640	64801	391057
Type numbers calling subscriber	nat	m/n	subscriber	nat	m/n	nat	m/n	subscriber	nat	m/n
Providing the calling number subscriber	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes
Control numbers calling subscriber	users	net	users	net	users	net	users	net	users	net
Caller ID subscriber	32019	210364	5430	97802	356420	706952	59087	36059	530971	65908

Designations: dost. – available, nedost. – unavailable, nat. – national, m/n – international, auth. – auto, prep.- preferably, p/a - semi-automatic, subscriber - subscriber, user – user.

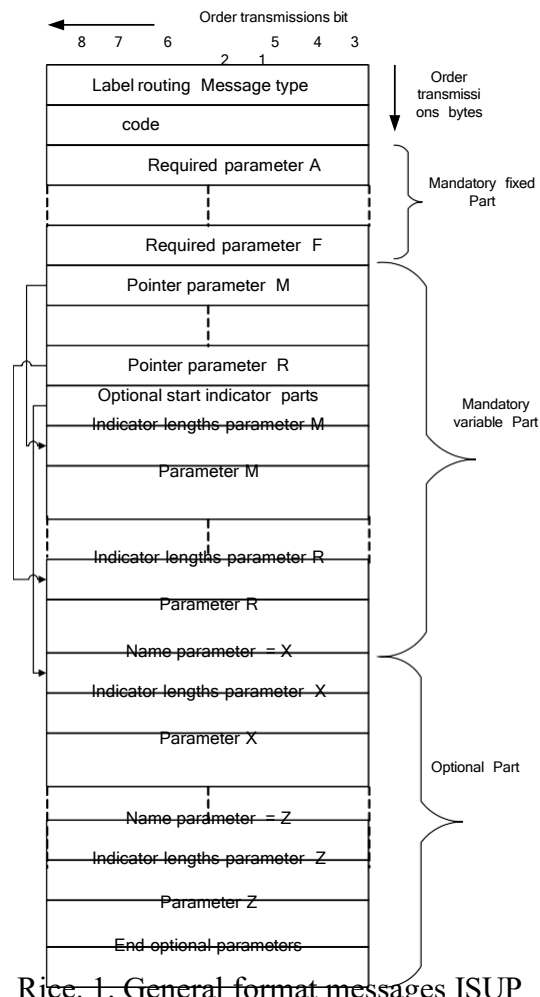
6 Content report

1. Table With original data.
2. Table With filling fields messages ISUP "Elementary address IAM» V binary and hexadecimal codes with the necessary comments on the contents of each field.

7 Methodological instructions

ISUP messages begin with a one-byte message type code field, which is mandatory for all messages. The message type code uniquely identifies function And format each ISUP messages. Assignment codes type The message is shown in Table 5.1 of the textbook.

Each ISUP message consists of a number of parameters (Figure 1). Each parameter has a "name" encoded as a single byte. The parameter length can be fixed or variable; a single-byte "length indicator" can be included for each parameter. Each message type has a uniquely defined format.



Rice. 1. General format messages ISUP

Mandatory fixed-length parameters for a specific message type must be contained in the "fixed mandatory part." The position, length, and order of the parameters are uniquely determined by the message type. Therefore, the parameter names and length indicator are not included in the message.

Mandatory parameters of variable length must be included in the variable mandatory part. The name of each parameter and the order of passing pointers are implicitly determined by the message type. Therefore, Parameter names are not included in the message. A pointer is used to mark the start of each parameter, so parameters may be transmitted out of order of the pointers. Each pointer is encoded as a single byte. The number of parameters, and therefore pointers, is uniquely determined by the message type. All pointers are sent sequentially at the beginning of the mandatory variable part. Each parameter contains a parameter length indicator followed by the parameter content.

The optional part consists of parameters that may or may not be included in a particular message type. Parameters may be fixed-length or variable-length. Optional parameters may be transmitted in any order. Each optional parameter may include a parameter name (one byte) and a length indicator (one byte), followed by the parameter content.

After everyone optional parameters transmitted consisting from some zeros byte "end optional parameters." This byte turns on V message only at the presence of optional parameters in the message.

The length indicator field is a binary code indicating the number of bytes in the parameter content field. The length indicator does not include the parameter name byte or the byte indicator lengths. The pointer value (binary) indicates quantity bytes between the pointer (inclusive) and the first byte (not including) of the parameter associated with that pointer. A pointer value of all zeros is used to indicate that, in the case of optional parameters, there are no such parameters.

The composition of the parameters of various ISUP messages is provided in Appendix 3 of the tutorial. As an example, we will describe the format of the **Initial Address Message (IAM)** . This message is the first one to be transmitted when establishing a connection. It contains address digits (e.g., the digits dialed by the subscriber for call routing). Its transmission results in the station seizing the channel. The IAM message format includes five mandatory fixed-length parameters, one mandatory variable-length parameter, and a number of optional parameters (see Appendix 3 of the tutorial).

The first mandatory fixed-length parameter (1 byte = 00000001) specifies the message type (IAM).

The second mandatory fixed-length parameter (1 byte) defines the nature of the established connection. This parameter characterizes the status of the connection being established, such as the presence or absence of an echo suppressor, whether a satellite channel is included in the connection, etc.

The third fixed mandatory parameter of 2 bytes in length characterizes the forward direction of the call and defines the connection capabilities, for example, connection from the end to the end or ISUP availability throughout the connection.

Another fixed mandatory single-byte parameter defines the category of the calling party, i.e. whether the calling party is a subscriber or an operator, including an indication of the language group, etc.

The last fixed one-byte mandatory parameter describes the requirements for the transmission medium, for example, a 64 Kbps channel is requested.

The IAM address message has one mandatory variable parameter 4-11 bytes long, defining the calling party's number (e.g., the dialed digits), and optional parameters: calling number subscriber length 4-

12 bytes, direct user-to-user information of 3-131 bytes in length, allowing subscribers to exchange data during the connection establishment procedure, etc.

PRACTICAL WORK # 4

TOPIC "PROCESSES INSTITUTIONS CONNECTIONS WITH USING THE ISUP-R SUBSYSTEM»

1 Target classes

Study of the processes of establishing and disconnecting various types of telephone connections using the ISUP-R subsystem and acquisition of practical skills in drawing up signal diagrams of the SS7.

2 Literature

1. Roslyakov A.V. System common channel alarms OKS No. 7 / Educational allowance. - Samara, PGUTI, 2008. – P. 130-133.
2. Roslyakov A.V. Abstract lectures By educational discipline "Signaling V digital communication networks". – Samara, PGUTI, IUNL, 2013. – P. 78-85.

3 Control questions

1. Please explain, How is being implemented signal net at use related alarm mode .
2. In what difference organizations networks alarms at quasi-related mode?
3. How are related conversational paths And paths transmissions signal information under different alarm modes?
4. What is the difference between block mode and overlap mode when transmitting number digits?
5. What ISUP subsystem signaling messages are transmitted when a telephone connection is successfully established?
6. Which signal messages subsystems ISUP are transmitted at unsuccessful call?
7. Please explain, How V OKS No. 7 transmitted signal information from end V end.
8. Which values accept fields OPC, DPC, CIC V messages ISUP when using different alarm modes?
9. IN how the essence one-sided lights out And How He is being implemented V subsystem ISUP?
10. How transmitted on opposite paragraph alarms cause disconnection?

4 Preparation To occupation

1. Study indicated literature.

5 Exercise

IN in accordance With individual task (cm. table 1):

1. To depict schemes conversational And signal connections For given options.
2. To depict diagram exchange signal messages ISUP between signaling points in the OKS No. 7 network.
3. Specify informational content fields OPC, DPC, CIC, CV transmitted signaling messages.

6 Content report

1. Schemes conversational And signal connections For given options (table. 1).

2. ISUP signaling message exchange diagram between signaling points in the OKS№7 network with indication of the fields of signaling units OPC, DPC, CIC, CV.

Table 1 Individual tasks (number options corresponds last one digital grade book numbers)

No. options	0	1	2	3	4	5	6	7	8	9
Type connections	Success noe	Failure eshnoe	Success noe	Failure eshnoe	Success noe	Failure eshnoe	Success noe	Failure eshnoe	Success noe	Failure eshnoe
Reason for unsuccessful connection	-	Abone nt busy	-	Abone nt not answer et	-	Incomplet e number	-	Numbe r change d	-	Refusal of a call
First the subscribe r hangs up	A	-	IN	-	A	-	IN	-	A	—
Connection type	Local	Local	Between the cities oh	Inside the isons oh	Internatio nal oh	Local	Inside the isons oh	Local	Between the cities oh	Between the cities oh
Number of intermediate stations V conversational connection	1	0	2	2	3	0	1	0	2	2
Number of intermediate signaling points in the signal connection	1	1	2	2	3	1	2	2	3	2

7 Methodological instructions

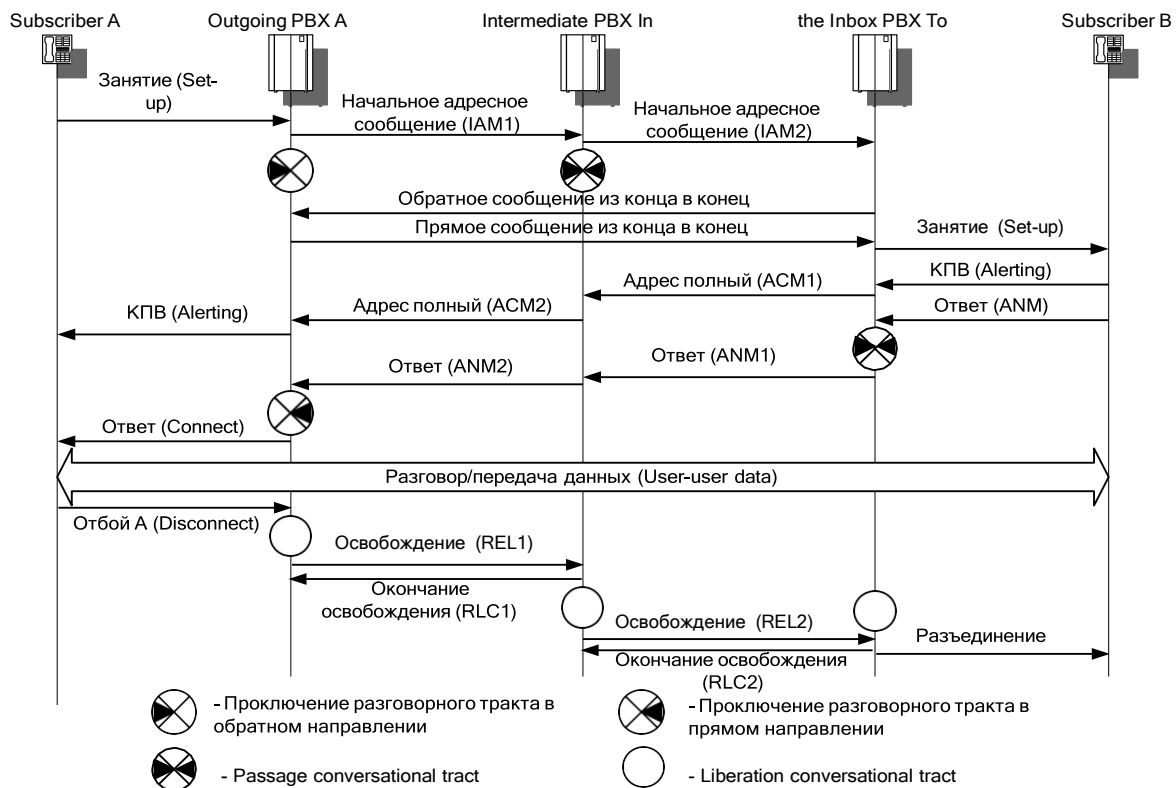
The ISUP subsystem, using MTP and SCCP services, provides a logical connection between two ISDN end stations. Establishing and maintaining a call in an ISDN network requires the transmission of various service information between the end stations. Thus, the telephone number indicated by the ISDN terminal is used by MTP and/or SCCP for routing during connection establishment; the channel identification code (CIC) is used by the ISUP subsystem for the connection in the SS7 network, and the call information determines the type of connection between the ISDN end station and the ISDN terminal. The procedure for establishing and disconnecting a basic connection is shown in the form of an arrow diagram in Figure 1. This diagram also demonstrates the relationship between ISDN subscriber signaling (EDSS1) and ISUP messages.

When a user initiates an ISDN call (e.g. by picking up the telephone handset), the originating terminal device of subscriber A sends a "Connect" message over the D-channel to end station A.

Upon receiving a connection request from a calling subscriber, originating PBX A analyzes the routing information and generates an initial address message (IAM). The IAM message conveys address information, as well as information related to establishing a connection (for example, whether the echo cancellation device subset is enabled on the outgoing side, the type of outgoing access: analog or ISDN, whether there is a satellite channel in the connection, and other information).

By analyzing the called subscriber's number, originating PBX A determines the call routing direction. In the example shown in Figure 1, the call is routed to transit PBX B, which also functions as the signaling endpoint SP. The information in the fixed mandatory IAM parameter indicates the type of call requested by the caller. subscriber connections, For example, compound 64 Kbps. This information

is sent To transit PBX IN, V result what corresponding colloquial the path is connected in the opposite direction to the calling subscriber.



Rice. 1. Establishment And disconnection basic connections V ISUP

Connecting the talk path only in the reverse direction at this stage allows the calling party to hear the tones sent by the network, but prevents the transmission of information from the calling party to the talk path.

If block mode is used, all address digits necessary for routing the call to the calling subscriber are included in the IAM1 message. If overlap mode is used, the IAM1 is sent when only the digits necessary for routing to the transit PBX B have been received, and the remaining address digits are transmitted through the network in subsequent SAM address messages.

Transit PBX B receives IAM1 and analyzes the information it contains. Analysis of the called subscriber's number digits at transit PBX B determines the subsequent route to incoming PBX B. Analysis of the remaining information contained in IAM1 determines the selection of the appropriate call path, for example, a 64 kbps channel. Exchange B generates IAM2 and transmits it to PBX B, which also connects the call path.

When an IAM2 message arrives at incoming PBX B, the called subscriber's number is analyzed and additional information from outgoing PBX A is determined before connecting to the called subscriber. If additional information is required, an end-to-end message is sent to outgoing PBX A stating this request. Note that transit PBX B does not need to analyze this end-to-end message, since transparent transmission takes place for this message. The outgoing PBX provides the appropriate information by sending a response. message from the end to the end.

After receiving the necessary information from incoming PBX B, the called subscriber is informed of the incoming call, and from incoming PBX B to transit PBX B, an ACM1 message is sent about the acceptance of the full address. An ACM2 message about the acceptance of the full address is then sent transmitted To outgoing PBX A. Reception messages O acceptance complete addresses on

any station involved in establishing the connection indicates successful routing of the call to subscriber B and allows the information to be deleted from memory, connection related.

When called subscriber answers on call, incoming PBX B switches on the conversation path and transmits the message "Answer" ANM1 about the answer to the transit ATC

B, which, V my queue, transmits message answer ANM2 on outgoing PBX A. Upon admission messages answer outgoing PBX switches on colloquial tract V direct direction.

Like this in this way, is being installed compound defiant And called subscribers, it begins tariffing call And is being carried out talk or broadcast data.

The ISUP subsystem uses a one-way release method, i.e., the call path between subscribers is disconnected upon receiving a release from one side. In Fig. 1, calling subscriber A first sends a disconnect signal to outgoing exchange A. Outgoing exchange initiates disconnection and transmits a release message REL1 (with reason code CV=16 – "normal release") to transit exchange B. Once the call path is released and ready to service a new call, transit exchange B sends a release completion message RLC1 to outgoing exchange A. Exchange B also transmits a release message REL2 to incoming exchange B. Upon receipt of the release message REL2, the call path is disconnected at incoming exchange B and a release completion message RLC2 is transmitted to exchange B.

PRACTICAL WORK # 5

TOPIC "CONJUGATION SYSTEMS ALARMS 2VSK AND OKS No. 7"

1 Target classes

Study of the processes of establishing and disconnecting various types of telephone connections during the interaction of 2VSK and OKS№7 signaling systems and acquisition of practical skills in drawing up signal diagrams.

2 Literature

1. Roslyakov A.V. Abstract lectures By educational discipline "Signaling V digital communication networks". – Samara, PGUTI, IUNL, 2013. – P. 86-90.

3 Control questions

1. When on transit node switching it begins process establishments connections to the incoming station during interaction of the 2VSK-OKS№7 signaling systems?
2. How answer subscriber is broadcast V networks alarms at interaction alarm systems 2VSK-OKS№7?
3. How lights out subscriber is broadcast V networks alarms at interaction alarm systems 2VSK-OKS№7?
4. How are transmitted numbers numbers called subscriber at interaction alarm systems (2VSK+dekadik)-OKS№7?
5. How are transmitted numbers numbers called subscriber at interaction alarm systems (2VSK+MChK package) - OKS№7?
6. How are transmitted numbers numbers called subscriber at interaction alarm systems (2VSK+MChK shuttle) - OKS№7?
7. How signal employment called subscriber is broadcast V networks alarms when interacting with the 2VSK-OKS№7 alarm systems?

4 Preparation To occupation

Study indicated literature.

5 Exercise

1. Draw an arrow diagram of the exchange of signaling messages when interfacing the 2VSK and OKS No. 7 (ISUP-R) signaling systems in the process of establishing a connection between stations A and B, passing through transit switching node B in accordance with the individual tasks given in Table 1.
2. Specify the main information content of the transmitted interaction signals and management of 2VSK and OKS No. 7 (ISUP-R).

Table 1 Individual tasks (number options corresponds last one digital grade book numbers)

No. options	1	2	3	4	5	6	7	8	9	0
Alarm on section between the outgoing station A and a transit hub switching B	2VSK	OKS No. 7 (ISUP - R)	2VSK	OKS No. 7 (ISUP - R)	2VSK	OKS No. 7 (ISUP - R)	2VSK	OKS No. 7 (ISUP - R)	2VSK	OKS No. 7 (ISUP - R)
No. options	1	2	3	4	5	6	7	8	9	0

Signaling on the section between transit switching node B and incoming station B	OKS No. 7 (ISUP - R)	2VSK	OKS No. 7 (ISUP - R)	2VSK	OKS No. 7 (ISUP - R)	2VSK	OKS No. 7 (ISUP - R)	2VSK	OKS No. 7 (ISUP - R)	2VSK
Way signal transmission routing in signaling 2VSK	Decades - naya	MChK Imp. shuttle to	MChK Imp. package	Decades - naya	MChK Imp. shuttle to	MChK Imp. package	Decades - naya	MChK Shuttle to	MChK Imp. package	Decade
Exodus call	Successful	Successful	Unsuccessful	Unsuccessful	Successful	Successful	Unsuccessful	Unsuccessful	Successful	Successful
First the subscriber hangs up	A	B	-	-	B	A	-	-	A	B
Cause unsuccessful call	-	-	Busy Ab-ta B	No answer ab-ta B	-	-	Busy Ab-ta B	No answer ab-ta B	-	-

6 Content report

Diagram of the exchange of signaling messages 2BCK and OKC№7 (ISUP) between network stations indicating the types and information content of linear signals, signals routing and signaling units of OKS№7.

7 Methodological instructions

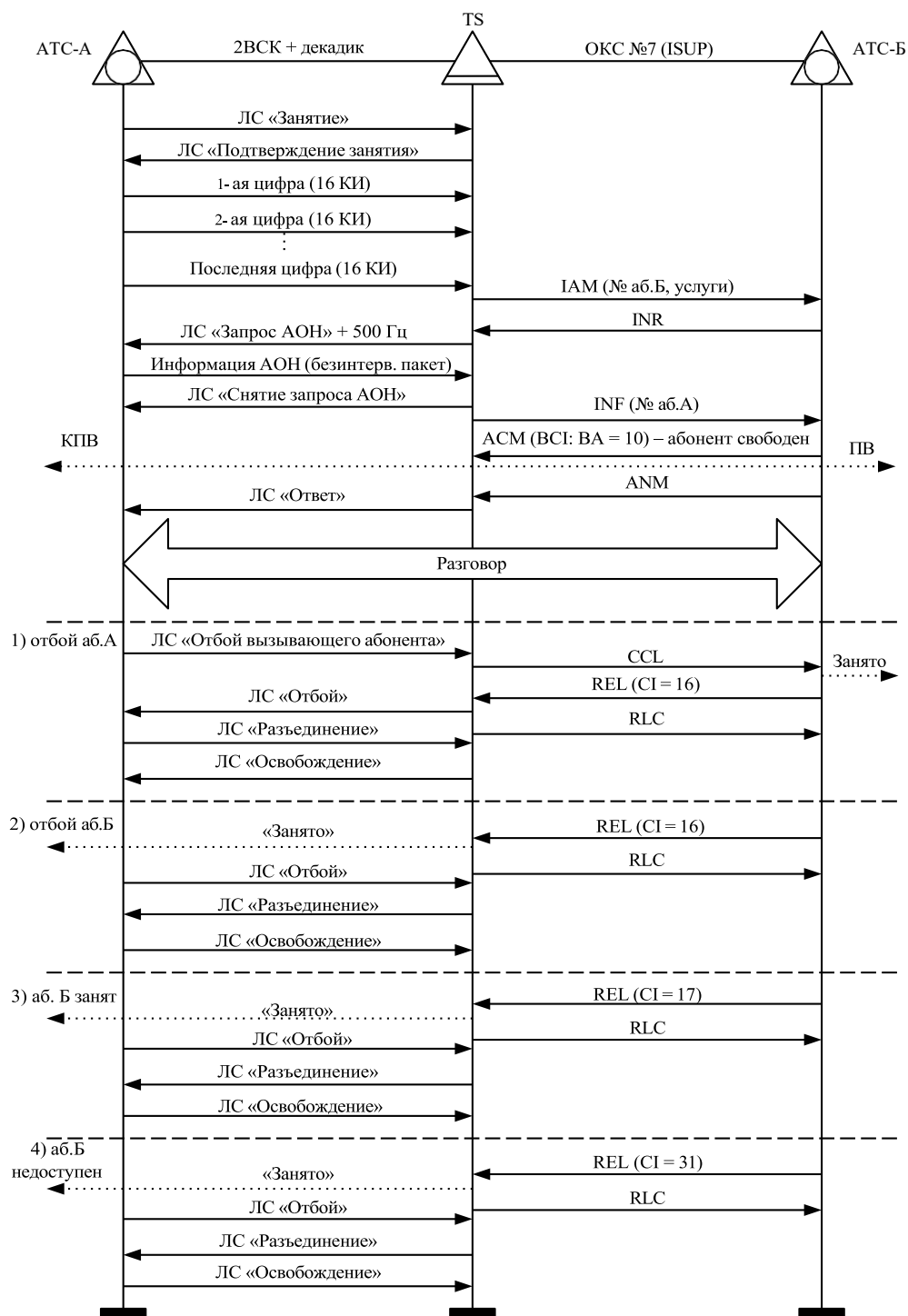
Let's consider a local connection where the outgoing PBX operates with the transit node using 2VSK signaling with a decadal method of transmitting number digits (decadal), and the incoming PBX operates using OKS No. 7 signaling of *the ISUP-R-2000 subsystem* (Fig. 1). The figure at the bottom shows possible alternative call outcomes – subscriber A's hang-up, B's hang-up, B's busy status, etc. (separated from each other in the figure by dotted lines).

Establishing a connection begins with the transmission of the line signal "Seizure" in 16 CI of the outgoing SL of the PBX A in one of the two VSK in a certain cycle of the PCM flow superframe Depending on the occupied channel slot (CSS). The oncoming transit station (TS) confirms this by transmitting a "Confirmation of Occupancy" message in the same CSS and in a similar cycle of the PCM stream superframe.

Station A issues the first digit of the number according to 16 KI in the same VSK and in a similar The same superframe cycle as the "Occupation" LS, is carried out by transmitting combinations of "1" and "0" in successive superframes, where the number of "1"s is equal to the digit being transmitted, and the number of "0"s is one less. Next, the inter-serial interval code combination is transmitted (a combination of "0"s, running for a certain number of superframes). The second and all subsequent digits of the B number are transmitted in a similar manner.

After receiving the last digit of subscriber B's number, the transit exchange determines the direction of the connection, selects the outgoing RCT, connects it with the incoming RCT from station A, and transmits an initial address message (*IAM*) to the signaling link of SS7. In an outgoing electromechanical exchange, subscriber A's number is unknown at the transit exchange and is therefore not included in *the IAM*.

Station B, having received *an IAM without subscriber A's number*, transmits an *INR* message (information request) to the TC via link 7 of the CC. The TC, having received *the INR*, transmits a combined "Caller ID Request" signal to Station A, consisting of the "Caller ID Request" signal and a 500 Hz tone transmitted via the RC.



Rice. 1 Interaction OKS No. 7 With alarm 2VSK+decadik V process establishing a local telephone connection

Station A, having received signal "Request AON», transmits By RKI way "interval-free packet" with dual-frequency code combinations "2 of 6" a nine-digit codegram, including the category and number of subscriber A. Having received information about the number of subscriber A, the vehicle transmits this number to station B in the *INF* message - information.

If subscriber B is free, the incoming station turns on the "PV" signal for him, and "KPV" in RKI for subscriber A through the connected connection in the TS.

On the OKS link #7, station B transmits the *ACM* message with the indication *BA = 10* (subscriber is free). When subscriber B answers, station B turns off the "PV", "KPV" signals, and

switches on

the conversation path to subscriber B and transmits the message *ANM* – response to the CC #7. In the telephone system, upon receiving the message, *the ANM* is transmitted to the Station A LS "Answer". The call enters the conversation state between the subscribers.

CCL message is sent to the telephone system towards station B – calling subscriber hangs up. Station B gives out to the subscriber B "Busy" buzzer. Subscriber B puts tube, station B transmits a *REL message to the TC (Occupied Control System #7)* – release with reason indicator *CI* = 16. This *REL* message is acknowledged by the transit station towards station B with an *RLC message* – release completed. In the TC and station B, the RCIs are released.

The vehicle is moving to the side Station A issues the "Release" signal, which is confirmed by Station A's "Disconnection" signal, in response to which the TS issues the "Release" signal. The RCI between the TS and Station A is released.

Note: V case transmissions numbers numbers from outgoing stations A on TS frequency method using the "shuttle" method a request for the required digits of the vehicle's number is made and these digits are issued by station A using the two-frequency code "2 of 6" according to the RKI.

PRACTICAL WORK # 6 And No. 7
TOPIC "DECIPHERING SIGNAL MESSAGES ISUP-R- 2000»

1 Target classes

Studying formats messages OKS No. 7 And receiving practical skills By decoding the hexadecimal code of ISUP-R-2000 subsystem messages.

2 Literature

1. Roslyakov A.V. System common channel alarms OKS No. 7 / Educational allowance. - Samara, PGUTI, 2008. – P. 90-130.

3 Control questions

1. Which fields messages OKS No. 7 are used subsystem MTR?
2. How are used pointers V messages ISUP?
3. How define, Where it begins mandatory variable And optional parts in ISUP messages?
4. How are described parameters messages ISUP, used V mandatory fixed, mandatory variable and optional parts??
5. What way are transmitted numbers numbers subscribers A And B V messages ISUP?

4 Preparation To occupation

Study indicated literature.

5. Exercise

Decipher the OKS№7 signal messages presented in hexadecimal code in accordance with the individual assignment specified in Table 1 (the option number corresponds to the student's number in the group list)

Table 1 Individual tasks (number options corresponds student number V group list)

Variant 1	Variant 2
TLink1B 00:00.828 000: D1E52D85 416000F8 4F000100 48000A03 010: 020A0883 90832139 26600F0A 07031324 020: 31258035 00 TLink1A 00:01.146 000: E5D30D85 01601008 8E000C02 00028A90 TLink1B 00:01.157 000: D3E60985 416000E8 8E001000 TLink1B 00:01.369 000: D3E70D85 416000D8 6D010C02 00028A90 TLink1A 00:01.388 000: E7D40985 016010D8 6D011000 TLink1B 00:02.167 000: D6EC1885 41600038 B3000100 4800F603 010: 020008831083216536330F TLink1A 00:02.212 000: ECD70B85 01601038 B3000301 0000 TLink1B 00:02.224 000: D7ED0B85 41600038 B3000401 0000 TLink1A 12:19.375 000: DAEE0A85 01601008 37000D01 00 TLink1A 12:24.426	TLink1A 00:02.725 000: F4DE2285 01801008 50010100 48000A03 010: 020A0883 90183252 85510F0A 07031383 020: 21464822 00 TLink1B 00:04.930 000: E2F60D85 41600098 09010C02 00028A90 TLink1A 00:04.952 000: F6E30985 01601098 09011000 TLink1B 00:05.073 000: E3F70D85 41600008 50010C02 00028A91 TLink1A 00:05.091 000: F7E40985 01601008 50011000 TLink1A 00:05.401 000: F7E52285 01601008 9A000100 48000A03 010: 020A0883 90187225 56980F0A 07031383 020: 21467744 00 TLink1A 00:06.231 000: F7E80985 01601008 6B000900 TLink1B 00:07.349 000: EBFB2985 416000F8 0F000100 6000F603 010: 020A0883 90832104 23060F0A 07031380 020: 25273885 00

000: F6870B85 01601018 51010616 0100	TLink1B 12:19,373 000: EDDB0D85 416000F8 BF000C02 00028A90
Option 3 TLink1B 00:07.742 000: EBFD2585 416000B8 CB000108 4800F403 010: 020A0883 90832129 29720F0A 07031348 020: 28027757 08010000 TLink1B 00:07.986 000: ECFE0985 416000B9 CB000501 TLink1A 00:07.887 000: FDED0F85 01601098 E9000616 34012901 010: 0000 TLink1B 00:08.678 000: EE800B85 41600058 35000100 4800F603 010: 02000883 10832191 76970F TLink1A 00:10.192 000: 87F30B85 01601008 35000616 0100 TLink1A 00:10.203 000: 87F50D85 01601008 0F000C02 00028A91 TLink1B 00:06.533 000: E8F80B85 41600088 68000616 0100 TLink1A 12:19.395 000: DBEF0985 016010F8 BF001000 TLink1A 12:24.675 000: F6880E85 01601008 1B000901 21020008 010: 00	Option 4 TLink1B 00:10,781 000: F78B1C85 416000D8 9D010108 4800F603 010: 020A0883 10832142 31040F08 010000 TLink1A 00:10.817 000: 8BF80B85 016010D8 9D010301 0000 TLink1A 00:10.822 000: 8BF90D85 01601008 69000C02 00028AE6 TLink1A 00:10.842 000: 8CFA0985 01601008 69001000 TLink1B 00:10.886 000: FA8E0B85 416000D8 9D010401 0000 TLink1A 00:11.090 000: 90FC0D85 01601068 66010C02 00028A90 TLink1B 00:11.220 000: FC922585 41600038 43000108 60000A03 010: 020A0883 90832144 68 240F0A 07031338 020: 26360911 08010000 TLink1B 12:19.540 000: F1DD0985 41600078 87011000 TLink1B 12:19.817 000: DEF30D85 01601008 37000C02 00028AE6
Variant 5 TLink1B 00:11.744 000: FC951885 41600078 37000100 4800F603 010: 02000883 10832193 13060F TLink1A 00:11.773 000: 95FD0B85 01601008 37000301 0000 TLink1B 00:11.787 000: FD960B85 41600078 37000401 0000 TLink1B 00:12.274 000: FD970985 41600088 68000900 TLink1A 00:12.383 000: 97FE0D85 01601008 37000C02 0002839F TLink1A 00:13.073 000: 9B811385 0160100805000601 04012901 010: 01120283 8100 TLink1A 00:13.175 000: 9B820B85 016010D8 9D010616 0100 TLink1B 00:13.743 000: 829C2585 416000D8 8D000108 60000A03 010: 020A0883 90836126 82240F0A 07031338 020: 24022141 08010000 TLink1B 12:19.830 000: F3DF0985 41600078 37001000	Variant 6 TLink1B 00:13.904 000: 829E1C85 41600038 F3000100 4800F603 010: 020A0883 10832112 51720F08 010000 TLink1A 00:13.928 000: 9E830B85 01601038 F3000301 0000 TLink1B 00:14.000 000: 839F0B85 41600038 F3000401 0000 TLink1A 00:14.224 000: 9F842285 01601048 84010100 48000A03 010: 020A0883 90183292 94010F0A 07031383 020: 21128228 00 TLink1B 00:14.401 000: 84A11885 41600098 89010100 4800F703 010: 02000883 10832113 44520E TLink1A 00:14.458 000: A1870D85 016010A8 FA000C02 00028A90 TLink1B 00:14.472 000: 87A30985 416000A9 FA001000 TLink1B 00:14.877 000: 88A51385 41600048 84010601 04011202 010: 849F2901 0100 TLink1A 00:15.103 000: F6890D85 01601008 9B000C02 00028A90
Variant 7 TLink1B 00:16.624 000: 8CA91885 41600058 25010100 4800F603 010: 02000883 10832142 90960F TLink1A 00:16.648 000: A98D0B85 01601058 25010301 0000 TLink1B 00:16.661 000: 8DAA0B85 41600058 25010401 0000 TLink1A 00:17.361 000: AC8F0B85 01601008 43000616 0100	Variant 8 TLink1B 00:19.302 000: 9BB92585 41600038 13010100 48000A03 010: 020A0883 90832124 71940F0A 07031793 020: 25350690 08010000 TLink1A 00:19.666 000: B99D0D85 01601058 25010C02 00028A91 TLink1B 00:19.681 000: 9DBA0985 41600058 25011000 TLink1A 00:19.844
TLink1B 00:17.433 000: 8FAD0985 416000A8 9A000900	000: BA9E0D85 01601008 47000C02 00028A90 TLink1B 00:19.918

TLink1B 00:17.633 000: 90AE1C85 41600058 05010100 4800F600 010: 020A0883 10832132 60880F08 010000 TLink1B 00:18.107 000: 94B30A85 416000A8 1A000D01 00 TLink1B 00:18.142 000: 95B40985 416000A8 1A001000 TLink1B 00:18.518 000: 95B51885 41600098 79010100 4800F603 010: 02000883 10832175 97300F TLink1B 12:24.735 000: 89F70985 416000B8 9B001000	000: 9EBC0D85 41600048 44000C02 00028491 TLink1A 00:20.119 000: BCA10B85 01601058 05010616 0100 TLink1B 00:20.666 000: A1BD2F85 41600058 15010100 20010A03 010: 020A0883 90832112 45910F0A 06831329 020: 9994091D 039090A3 03041E02 85830801 030: 0000 TLink1A 00:20.971 000: BEA20B85 01601008 1D000301 0000 TLink1A 00:21.044 000: A2BF0B85 416000D8 1D000401 0000 TLink1A 21:55.398 000: E4810985 41600058 95011000
Variant 9 TLink1B 00:21.986 000: A3C02485 41600018 91000100 48000A03 010: 020A0883 90832153 37670F TLink1A 00:22.012 000: C0A40B85 01601008 91000301 0000 TLink1B 00:22.146 000: A5C10B85 41600018 91000401 0000 TLink1B 00:22.151 000: A5C20D85 41600058 15010C02 00028090 TLink1A 00:22.170 000: C2A60985 01601058 15011000 TLink1A 00:22.344 000: C2A70B85 01601038 13010616 0100 TLink1A 00:22.765 000: C4AA0D85 01601008 39000C02 00028A90 TLink1A 00:23.650 000: C6AE2285 01601008 B0010100 4800E303 010: 020A0883 90243147 44960F0A 07031383 020: 51259154 00	Option 10 TLink1B 00:24.061 000: AFC81C85 416000B8 BB010100 4800F603 010: 020A0883 10832165 78880F08 010000 TLink1A 00:24.088 000: C8B10B85 016010B8 BB010301 0000 TLink1B 00:24.182 000: B1C90B85 416000B8 BB010401 0000 TLink1A 00:24.480 000: CAB30D85 01601008 68000C02 00028A90 TLink1B 00:24.492 000: B3CB0985 41600088 68001000 TLink1B 00:24.786 000: B3CC2585 41600038 53010100 4800F603 010: 020A0883 90832156 51330F0A 07031370 020: 22433166 08010000 TLink1B 00:24.907 000: B3CD1885 41600018 81010100 4800F603 010: 02000883 10832129 13590F TLink1A 00:25.084 000: D1B80985 01601058 05010900 TLink1A 00:28.553 000: E0C50F85 01601008 91000C02 00028491
Variant 11 TLink1B 11:59.860 000: 94822585 41600038 93010108 60000A03 010: 020A0883 90835120 11730F0A 07031338 020: 24022141 08010000 TLink1B 12:00.003 000: 94840985 41600038 93010501 TLink1A 12:00.214 000: 84950B85 01601038 63010616 0100 TLink1A 12:00.239 000: 84960985 01601058 A5000900 TLink1B 12:00.852 000: 96851885 41600078 77000100 4800F603 010: 02000883 10837125 18970F TLink1A 12:00.893 000: 85970B85 01601008 77000301 0000 TLink1B 12:00.904 000: 97860B85 41600078 77000401 0000 TLink1B 12:00.909 000: 97870D85 41600078 27000C02 00028A90 TLink1B 12:00.927 000: 87980985 01601008 27001000	Variant 12 TLink1B 12:01.318 000: 98881285 416000E8 9E010C02 04028A91 TLink1A 12:01.338 000: 88990985 016010E8 9E011000 TLink1B 12:02.149 000: 99893385 41600058 A5010100 20010A00 010: 020A0883 90832165 31700F0A 06831329 020: 9994091D 038090A3 03087D02 91811E02 030: 85830801 0000 TLink1B 12:02.267 000: 998A0F85 416000E8 3E010612 34012901 010: 0100 TLink1B 12:02.272 000: 998B0F85 416000E8 3E012C01 01110216 010: 1400 TLink1B 12:02.786 000: 9A8D2485 416000B8 BB000100 00000A00 010: 020A0883 10836198 15590F TLink1A 12:02.814 000: 8D9B0B85 016010B8 BB000301 0000 TLink1B 12:02.827 000: 9B8E0B85 416000B8 BB000403 0000
Variant 13 TLink1B 12:02.906	Variant 14 TLink1B 12:04.826

000: 9B902F85 41600078 97000100 20010A00 010: 020A0883 90832192 87600F0A 06831329 020: 9994091D 038090A3 03041E02 80830801 030: 0000 TLink1B 12:02.913 000: 9B911885 41600098 89000100 4800F603 010: 02000883 10832132 84000F TLink1A 12:02.973 000: 919C0B85 01601008 89000301 0000 TLink1A 12:02.989 000: 9C920B85 41600098 89000401 0000 TLink1A 12:03.171 000: 929D0B85 01601078 67010616 0100 TLink1A 12:03.378 000: 9D930D85 41600098 89000C02 00028A90 TLink1A 12:03.399 000: 939E0985 01601008 89001000 TLink1A 12:04.182 000: 939F0B85 01601018 A1000616 0100 TLink1A 12:04.550 000: 9F941885 416000F8 DF000100 4800F603 010: 02000883 10832135 62480F	000: A1971C85 41600078 D7000100 4800F603 010: 020A0883 90832135 48320F08 010000 TLink1A 12:04.857 000: 97A30B85 016010F8 DF000616 0400 TLink1A 12:04.891 000: 97A40B85 01601078 D7000301 0000 TLink1B 12:05.045 000: A4980B85 41600078 D7000401 0000 TLink1B 12:05.129 000: 98A50B85 01601078 D7000301 0000 TLink1B 12:05.286 000: A5990B85 41600078 D7000401 0000 TLink1B 12:05.337 000: 99A60D85 01601078 D7000C02 00028491 TLink1B 12:05.349 000: A69A0985 41600078 D7001000 TLink1B 12:05.622 000: A69B1885 41600058 75010100 4800F603 010: 02000883 10832131 85030F TLink1B 12:05.819 000: A89E1C85 416000F8 7F000108 4800F603 010: 020A0883 10832135 00280F08 010000
Variant 15 TLink1B 12:06.543 000: AEA41C85 416000D8 9D000108 48000A03 010: 020A0883 10832133 94220F08 010000 TLink1A 12:06.570 000: A4AF0B85 01601008 9D000301 0000 TLink1B 12:06.727 000: AFA50B85 416000D8 9D000401 0000 TLink1A 12:06.728 000: A4B00985 01601078 67010900 TLink1B 12:07.098 000: A6B12285 01601068 36010100 60000A03 010: 020A0883 10182584 20280F0A 07031383 020: 21359630 00 TLink1B 12:07.184 000: B1A80985 41600088 68010900 TLink1B 12:07.333 000: A9B40B85 01601058 D5000616 0100 TLink1B 12:07.829 000: A9B50D85 01601088 59010C02 00028A90	Variant 16 TLink1B 12:16.147 000: E2D33085 416000B8 1B000100 20010A03 010: 020A0883 90832192 30090F0A 07031390 020: 75729927 1D039090 A303041E 02818108 030: 018000 TLink1A 12:16.431 000: D3E32285 01601028 62010100 48000A03 010: 020A0883 90184224 78550F0A 07031383 020: 21328125 00 TLink1B 12:18.684 000: E7D60985 416000B8 5B011000 TLink1A 12:18.785 000: D6E90A85 01601008 5F000D01 00 TLink1B 12:18.811 000: D6EA0D85 01601008 5F000C02 00028AE6 TLink1B 12:18.822 000: EAD70985 416000F8 5F001000 TLink1B 12:05.659 000: A79C0B85 41600058 75010401 0000
Variant 17 TLink1A 12:19.924 000: DFF42285 01601008 2A000100 60000A03 010: 020A0883 10182797 97750F0A 07031383 020: 21558197 00 TLink1A 12:21.169 000: DFF60985 01601008 9B000900 TLink1A 12:21.852 000: E4FB0985 01601018 A1000900 TLink1B 12:22.120 000: FBE51885 41600018 51010100 4800F603 010: 02000883 10832113 57710F TLink1B 12:22.622 000: FEE81885 41600078 87000100 4800F603 010: 02000883 10832142 90960F TLink1B 12:22.827 000: FFEA0B85 416000A8 2A000612 0100 TLink1B 12:22.897 000: FFEB1885 416000D8 4D010100 4800F603 010: 02000883 10832165 25820F TLink1B 12:23.184	Variant 18 TLink1B 21:15.907 000: E7F13085 416000F8 EF000100 20010A03 010: 020A0883 90837125 28080F0A 07031390 020: 75729927 1D039090 A303041E 02818108 030: 018000 TLink1B 21:16.238 000: E9F31885 416000B8 5B000100 4800F603 010: 02000883 10832136 11660F TLink1B 21:16.301 000: EAF40B85 416000B8 5B000401 0000 TLink1B 21:16.901 000: EAF50B85 41600088 08010602 0100 TLink1A 21:17.042 000: F5EB0985 016010B8 CB000900 TLink1A 21:17.276 000: F5EC0D85 01601058 E5000C02 00028A91 TLink1B 21:17.289 000: ECF60985 41600058E5001000 TLink1B 21:17.781 000: ECF80B85 416000C8 1C000602 0100

000: 83F12485 41600098 C9000100 4800F603 010: 020A0883 10832132 75360F0A 06831311 020: 11110108 010000	TLink1B 21:17.808 000: ECF91885 416000F8 FF000100 4800F603 010: 02000883 10832179 06990F
Variant 19 TLink1B 21:32.833 000: A6A92F85 41600098 F9000100 20010A00 010: 020A0883 90832139 66580F0A 06831329 020: 9994091D 038390A3 03041E02 80830801 030: 0000 TLink1A 21:33.128 000: AAAA0D85 01601038 63010C02 0002839F TLink1B 21:33.138 000: AAAB0985 41600038 63011000 TLink1B 21:34.212 000: ACAE1885 416000F8 8F000100 4800F603 010: 02000883 10832133 51850F TLink1A 21:34.252 000: AEAD0B85 01601008 8F000301 0000 TLink1B 21:34.264 000: ADAF0B85 416000F8 8F000401 0000 TLink1B 21:35.063 000: ADB01C85 41600098 C9000108 48000A03 010: 020A0883 10832152 75740F08 010000 TLink1A 21:35.089 000: B0AE0B85 01601098 C9000301 0000 TLink1B 21:35.239 000: AEB20B85 41600098 C9000401 0000 TLink1B 21:35.253 000: AEB30985 41600098 C9000501 TLink1A 21:35.288 000: B3AF0D85 016010F8 0F010C02 00028491 TLink1B 21:35.302 000: AFB40985 416000F8 0F011000	Variant 20 TLink1B 21:54.071 000: DDF82A85 416000D8 ED000100 2000F600 010: 020A0883 10832165 30230F0A 07031368 020: 53125070 1D038090 A3080100 00 TLink1A 21:54.211 000: F8E00D85 016010B8 AB010C02 00028A90 TLink1B 21:54.223 000: E0FA0885 416000B8 AB011000 TLink1B 21:54.228 000: E0FB2585 416000D8 5D010100 4800F603 010: 020A0883 90832152 70760F0A 07031380 020: 76376109 08010000 TLink1A 21:54.612 000: FBE20985 016010F8 9F010900 TLink1B 21:54.619 000: E2FC1C85 41600058 95000108 48000A03 010: 020A0883 10837133 34780F08 010000 TLink1A 21:54.652 000: FCE30B85 01601008 95000301 0000 TLink1B 21:54.813 000: E3FE0985 41600058 95000501 TLink1B 21:55.181 000: E3FF2585 41600058 95010108 60000A03 010: 020A0883 90832155 17620F0A 07031338 020: 26463025 08010000 TLink1B 21:55.330 000: E3800985 41600058 95010501 TLink1A 21:55.386 000: 80E40D85 01601058 95010C02 00028491
Variant 21 TLink1B 22:00.892 000: D1E52D85 416000F8 4F000100 48000A03 010: 020A0883 90832139 26600F0A 07031324 020: 31258035 00 TLink1A 16:19.158 000: F7E40985 01601008 50011000 TLink1B 10:08.798 000: EE800B85 41600058 35000100 4800F603 010: 02000883 10832191 76970F TLink1A 06:16.670 000: 90FC0D85 01601068 66010C02 00028A90 TLink1B 07:33.769 000: 829C2585 416000D8 8D000108 60000A03 010: 020A0883 90836126 82240F0A 07031338 020: 24022141 08010000 TLink1A 10:19.136 000: F6890D85 01601008 9B000C02 00028A90 TLink1B 19:17.382 000: 90AE1C85 41600058 05010100 4800F600 010: 020A0883 10832132 60880F08 010000 TLink1A 50:19.962 000: B99D0D85 01601058 25010C02 00028A91 TLink1A 00:22.765 000: C4AA0D85 01601008 39000C02 00028A90 TLink1B 00:24.907 000: B3CD1885 41600018 81010100 4800F603 010: 02000883 10832129 13590F	Option 22 TLink1B 00:24.061 000: AFC81C85 416000B8 BB010100 4800F603 010: 020A0883 10832165 78880F08 010000 TLink1B 12:00.003 000: 94840985 41600038 93010501 TLink1A 12:02.814 000: 8D9B0B85 016010B8 BB000301 0000 TLink1A 12:04.550 000: 9F941885 416000F8 DF000100 4800F603 010: 02000883 10832135 62480F TLink1B 12:05.819 000: A89E1C85 416000F8 7F000108 4800F603 010: 020A0883 10832135 00280F08 010000 TLink1B 12:06.543 000: AEA41C85 416000D8 9D000108 48000A03 010: 020A0883 10832133 94220F08 010000 TLink1B 12:16.147 000: E2D33085 416000B8 1B000100 20010A03 010: 020A0883 90832192 30090F0A 07031390 020: 75729927 1D039090 A303041E 02818108 030: 018000 TLink1A 12:22.425 000: E7FE0B85 01601008 18000616 0100 TLink1B 21:17.808 000: ECF91885 416000F8 FF000100 4800F603 010: 02000883 10832179 06990F TLink1B 21:34.264 000: ADAF0B85 416000F8 8F000401 0000
Variant 23	Variant 24

TLink1B 00:00.828 000: D1E52D85 416000F8 4F000100 48000A03 010: 020A0883 90832139 26600F0A 07031324 020: 31258035 00 TLink1A 00:07.887 000: FDED0F85 01601098 E9000616 34012901 010: 0000 TLink1B 00:13.743 000: 829C2585 416000D8 8D000108 60000A03 010: 020A0883 90836126 82240F0A 07031338 020: 24022141 08010000 TLink1B 00:17.433 000: 8FAD0985 416000A8 9A000900 TLink1A 00:22.765 000: C4AA0D85 01601008 39000C02 00028A90 TLink1B 12:00.003 000: 94840985 41600038 93010501 TLink1A 12:04.550 000: 9F941885 416000F8 DF000100 4800F603 010: 02000883 10832135 62480F TLink1B 12:06.736 000: B0A60985 416000D8 9D000501	TLink1A 00:02.725 000: F4DE2285 01801008 50010100 48000A03 010: 020A0883 90183252 85510F0A 07031383 020: 21464822 00 TLink1B 00:10.781 000: F78B1C85 416000D8 9D010108 4800F603 010: 020A0883 10832142 31040F08 010000 TLink1A 00:14.224 000: 9F842285 01601048 84010100 48000A03 010: 020A0883 90183292 94010F0A 07031383 020: 21128228 00 TLink1A 00:20.119 000: BCA10B85 01601058 05010616 0100 TLink1B 00:24.786 000: B3CC2585 41600038 53010100 4800F603 010: 020A0883 90832156 51330F0A 07031370 020: 22433166 08010000 TLink1A 12:02.814 000: 8D9B0B85 016010B8 BB000301 0000 TLink1B 12:05.819 000: A89E1C85 416000F8 7F000108 4800F603 010: 020A0883 10832135 00280F08 010000
Variant 25 TLink1B 00:00.828 000: D1E52D85 416000F8 4F000100 48000A03 010: 020A0883 90832139 26600F0A 07031324 020: 31258035 00 TLink1A 12:00.239 000: 84960985 01601058 A5000900 TLink1A 00:05.401 000: F7E52285 01601008 9A000100 48000A03 010: 020A0883 90187225 56980F0A 07031383 020: 21467744 00 TLink1B 12:02.786 000: 9A8D2485 416000B8 BB000100 00000A00 010: 020A0883 10836198 15590F TLink1B 00:08.678 000: EE800B85 41600058 35000100 4800F603 010: 02000883 10832191 76970F TLink1A 12:04.550 000: 9F941885 416000F8 DF000100 4800F603 010: 02000883 10832135 62480F TLink1B 00:11.220 000: FC922585 41600038 43000108 60000A03 010: 020A0883 90832144 68 240F0A 07031338 020: 26360911 08010000	Option 26 TLink1B 11:59.860 000: 94822585 41600038 93010108 60000A03 010: 020A0883 90835120 11730F0A 07031338 TLink1A 12:00.214 000: 84950B85 01601038 63010616 0100 TLink1B 12:00.852 000: 96851885 41600078 77000100 4800F603 010: 02000883 10837125 18970F 020: 24022141 08010000 TLink1B 12:00.003 000: 94840985 41600038 93010501 TLink1A 12:00.239 000: 84960985 01601058 A5000900 TLink1A 12:00.893 000: 85970B85 01601008 77000301 0000 TLink1B 12:00.904 000: 97860B85 41600078 77000401 0000 TLink1B 12:00.909 000: 97870D85 41600078 27000C02 00028A90 TLink1B 12:00.927 000: 87980985 01601008 27001000
Variant 27 TLink1B 00:10.935 000: FB900985 416000D8 9D010501 TLink1A 00:11.090 000: 90FC0D85 01601068 66010C02 00028A90 TLink1B 00:10.781 000: F78B1C85 416000D8 9D010108 4800F603 010: 020A0883 10832142 31040F08 010000 TLink1A 00:10.817 000: 8BF80B85 016010D8 9D010301 0000 TLink1A 12:04.550 000: 9F941885 416000F8 DF000100 4800F603 010: 02000883 10832135 62480F TLink1A 00:10.842 000: 8CFA0985 01601008 69001000 TLink1B 00:10.886	Variant 28 TLink1B 00:14.877 000: 88A51385 41600048 84010601 04011202 010: 849F2901 0100 TLink1A 00:14.224 000: 9F842285 01601048 84010100 48000A03 010: 020A0883 90183292 94010F0A 07031383 TLink1B 00:13.904 000: 829E1C85 41600038 F3000100 4800F603 010: 020A0883 10832112 51720F08 010000 TLink1A 00:13.928 000: 9E830B85 01601038 F3000301 0000 TLink1B 00:14.000 000: 839F0B85 41600038 F3000401 0000 020: 21128228 00 TLink1B 00:14.472

000: FA8E0B85 416000D8 9D010401 0000 TLink1B 00:11.220 000: FC922585 41600038 43000108 60000A03 010: 020A0883 90832144 68 240F0A 07031338 020: 26360911 08010000 TLink1B 12:19.540 000: F1DD0985 41600078 87011000	000: 87A30985 416000A9 FA001000 TLink1B 00:14.401 000: 84A11885 41600098 89010100 4800F703 010: 02000883 10832113 44520E TLink1A 00:14.458 000: A1870D85 016010A8 FA000C02 00028A90
Option 29 TLink1A 12:16.431 000: D3E32285 01601028 62010100 48000A03 010: 020A0883 90184224 78550F0A 07031383 020: 21328125 00 TLink1B 12:18.271 000: E3D40D85 41600028 62010C02 000283 9F TLink1B 12:16.147 000: E2D33085 416000B8 1B000100 20010A03 010: 020A0883 90832192 30090F0A 07031390 020: 75729927 1D039090 A303041E 02818108 030: 018000 TLink1A 12:18.289 000: D4E40985 01601028 62011000 TLink1B 12:18.684 000: E7D60985 416000B8 5B011000 TLink1A 12:18.785 000: D6E90A85 01601008 5F000D01 00 TLink1B 12:18.811 000: D6EA0D85 01601008 5F000C02 00028AE6 TLink1B 12:18.822 000: EAD70985 416000F8 5F001000	Option 30 TLink1B 00:01.157 000: D3E60985 416000E8 8E001000TLink1B 00:00.828 000: D1E52D85 416000F8 4F000100 48000A03 010: 020A0883 90832139 26600F0A 07031324 020: 31258035 00 TLink1A 00:01.388 000: E7D40985 016010D8 6D011000 TLink1A 00:01.146 000: E5D30D85 01601008 8E000C02 00028A90 TLink1B 00:01.369 000: D3E70D85 416000D8 6D010C02 00028A90 TLink1B 00:02.167 000: D6EC1885 41600038 B3000100 4800F603 010: 020008831083216536330F TLink1B 00:02.224 000: D7ED0B85 41600038 B3000401 0000 TLink1A 00:02.212 000: ECD70B85 01601038 B3000301 0000 TLink1A 12:19.375 000: DAEE0A85 01601008 37000D01 00

6. Contents report

Table With transcripts signal messages With indication binary field values and their semantic meaning.

7. Methodological instructions

Example execution control tasks

A signal trace is specified in hexadecimal code (HEX) (the first line indicates the identifier of the OKSN₇ link and the time the trace was taken; at the beginning of each subsequent line, a hexadecimal number with a colon indicates the number of the first byte of the line):

```
TLink1B 00:07.742
000: EBFD2585 416000B8 CB000108 4800F403
010: 020A0883 90832129 29720F0A 07031348
020: 28027757 08010000
```

Each hexadecimal number is converted to a 4-bit binary code, and then, using the known format of the SS7 signal unit, all signal message fields are decoded byte-by-byte at the MTP and ISUP levels. Each functional field of the signal unit must be written in a separate table row. An example of the decoding format for the above signal trace is provided. in the following table:

Subsystem transmissions messages – Message Transfer Part (MTP)

HEX - code	Comment to decryption	Deciphered meaning (V corresponding codes)
EB 1110 1011	Back ordinal number (BSN -OPN)	•1101011 – 107'DEC
	Back bit indicator (BIB- OBI)	1 ••• ••••
FD 11111101	Direct ordinal number (FSN- PPN)	•1111101 – 125'DEC
	Direct bit indicator (FIB- PBI)	1 ••• ••••
25 0010 0101	Indicator lengths (LI- ID)	•• 10 0101 – 37'DEC (ZNSE with fields SIO/SIF length 37 byte)
	Reserve	00 •• ••••
85 1000 0101	Byte official information (SIO- BSI)	85'hex = nISUP
	Indicator user (SI- IP)	•••• 0101 – ISUP subsystem user CIS
	Field subtype of service	10 •• - national intercity net. •• 00 - Reserve

Subsystem user networks With integration services - (ISUP)

41 0100 0001 60 0110 0000	Code point appointments (DPC - KPN)	41-0100 0001 60- •• 10 0000 10 0000 0100 0001 = 8257'DEC
00 0000 0000 B8 1011 1000	Code outgoing point (OPC -KIP)	60 - 01 •• •••• 00 – 0000 0000 B8 - •••• 1000 1000 0000 0000 01 = 8193'DEC
	Field selection link alarms (SLS -SEZ)	B8 - 1011 •••• - 11 (Code signaling link selection (SLS))
CB 1100 1011 00 0000 0000	Code identification conversational channel (CIC-KIK)	0000 1100 1011 0000110 - No. tract = 6'DEC 01011 - Channel No. = 11'DEC
	Reserve	0000 ••••
01	Type messages	01h – IAM - elementary address

Mandatory parameters fixed long.

08	Indicators type connections NCI	0 0 0 0 1 0 0 0 HGFE DCBA
	Indicator satellite channel	BA = •••• •• 00 - the satellite channel is not used in the connection
	Indicator train checks	DC = •••• 10 •• loop test completed on previous section
	Indicator management echo cancellation device	E = ••• 0 •••• - incoming semi-set echo suppressor Not included
	Reserve	HGF = 000 • ••••

48 00	Indicators call direct directions - FCI	1 0 0 1 0 0 0 0 HGFE DCBA 0 0 0 0 0 0 0 0 PONM L KJ I
	National/International Indicator call	A = ●●●● ●● 0 - call should be processed as national
	Indicator method from end V end	SV = ●●●● ● 00 ● - method from end to end not accessible
	Interaction indicator	D = ●●●● 0 ●● - interaction is not used
	Indicator information from end completely	E = ●●● 1 ●●●● – not is used
	Indicator subsystems user of the CIS	F = ●● 0 ● - ISUP Not used throughout the entire route
	Indicator preferences ISDN user subsystems	HG = 10 ●● ●●●● - required usage ISUP on all the way
	Indicator access CIS	I = ●●●● ●● 0 – outgoing access Not is access ISDN
	Indicator method SCCP	KJ = ●●●● ● 00 ● – no indication
	Reserve	PONML = 0000 0 ●●●
F4	Category defiant subscriber	11110100 - auto call categories III
03	Requirements To means transmissions	0000 0011 – 3.1 kHz, audio

Mandatory parameters variable length

02	M1 - Pointer parameter V1	2 - variables mandatory parameters are beginning from the second byte
0A	PO - Pointer beginning options (optional part)	0000 1010 = 10'DEC - optional parameters start from the 10th byte
08	L1 - length first mandatory variable parameter	8 – byte
V1 - First required variable parameter - Number called subscriber		
83 1000 0011	Even/odd indicator	1 ●●● ●●●● - odd – odd col- in address signals
	Indicator address type	●000 0011 – national (meaningful) number
90 1001 0000	Indicator intranet numbers (INN)	1 ●●● ●●●● - routing by internal number not allowed
	Indicator numbering plan	●001 ●●●● □ numbering plan ISDN (telephony)
	Reserve	●●●● 0000
83 21 29 29 72 0F	Address signals	381-2-92-92-27 - number called subscriber F = 1111 – ending set numbers (ST signal For (AMTS) 0 = 0000 - aggregate

Optional parameters

0A	Number called subscriber	
07	Length first optional parameter	0000 0111 – 7 - byte
Meaning first optional parameter - Number called subscriber		
03 0000 0011	Indicator even/odd quantity digits in the address ab.A	0 ●●● ●●●● - even number of addressable signals
	Indicator address type	●000 0011 - national (significant) number (i.e. intercity number)
13 0001 0011	NI - indicator completeness providing the calling party's number	0 ●●● ●●●● = number subscriber And it is presented in full
	Indicator plan numbering	●001 0011 = ISDN (Telephony) numbering plan
	Indicator restrictions providing the calling party's number	●●●● 00 ●● = Provision of number ab.A is permitted
	Screening - Indicator, pointing - who provided the calling party's number	●●●● ●● 11 = number provided by the network (those. aba. myself Not dials his number)
48 28 02 77 57	Address signals	848-2-02-77-57 - number defiant subscriber
08	Optional indicators call V direct direction - name of the second optional parameter	
01	Length second optional parameter	0000 0001 – 1 byte
00	Meaning second optional	0 0 0 0 0 0 0 0 HGFE DCBA
	Bits BA - Indicator closed groups users (CUG)	00 - challenge Not from CUG
	Bit WITH - Indicator simple segmentation	0 - additional information be transmitted Not will
	Bits DG free bits, Bye Not are used And are not processed	
	Bit H - Indicator request identification connected lines	0 - No request identification connected lines
00	00 - end optional (optional) parts	

MINISTRY SCIENCES AND HIGHER EDUCATION RUSSIAN FEDERATION FEDERAL
STATE AUTONOMOUS EDUCATIONAL
INSTITUTION HIGHER EDUCATION
"NORTH CAUCASIAN FEDERAL UNIVERSITY"

METHODOLOGICAL INSTRUCTIONS

By organizations And conducting independent work on the
subject "Signal and System"

For students directions preparation

11.03.02 Infocommunication technologies And systems
connections Direction (profile)

"Intellectual processing data V infocommunication systems and networks"

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INTRODUCTION

The primary goal of higher education is to develop creative individuals capable of self-development, self-education, and innovation. This goal can hardly be achieved solely through the transfer of ready-made knowledge from teacher to student. To address this, independent work, which constitutes a significant portion of students' study time, is included in the curricula of all specializations.

In this regard, students must transform from passive consumers of knowledge into active creators, able to formulate a problem, analyze solutions, find the optimal result, and prove its validity. The ongoing reform of higher education is essentially associated with a paradigm shift. The paradigm shift in learning is crucial. In this regard, it should be recognized that independent student work is not simply an important part of the educational process but should become its foundation. This requires a focus on active learning methods, the development of students' creative abilities, and a shift from streamlined to individualized learning, taking into account the needs and capabilities of the individual.

In a broad sense, independent work should be understood as the totality of all independent activities of students both in the classroom and outside it, in contact with the teacher and in his absence.

Independent Job *With contact With teacher* is being implemented:

- directly during the classroom sessions – during lectures, practical and seminar classes, and during laboratory work;
- outside the schedule - during consultations on academic issues, during creative contacts, when paying off debts, when the student is completing academic and creative tasks.

Species tasks For *extracurricular* independent work can be:

1. For mastery knowledge:

- reading the text (textbook, primary source, additional literature);
- compilation plan text;
- graphic image structures text;
- note-taking text;
- Job with dictionaries And reference books;
- Job With normative documents;
- educational and research Job;
- use of audio and video recordings, computer equipment, the Internet, etc.

2. For fastening And systematization knowledge:

- Job With notes lectures (processing text);
- re-work on educational material (textbook, primary source, additional literature, audio and video recordings);
- compilation plan And theses answer;
- compilation tables For systematization educational material;
- studying regulatory materials;
- answers on control questions;
- analytical processing text (annotation, reviewing, abstracting, synopsis, analysis, etc.);
- Preparation messages To performance on seminar, conferences;
- Preparation abstracts, reports;
- compilation bibliographies;
- testing And etc.

3. For formations skills:

- solution tasks And exercises By sample;

- solution variant tasks And exercises;
- solution of situational production (professional) problems

tasks;

- Preparation To business games;
- design And modeling different species And components

professional activities;

- Preparation coursework And diploma works (projects);
- experimental Job;
- reflexive analysis professional skills, With using audio and video

equipment, etc.

The boundaries between these types of work are quite blurred, and the types of independent work themselves overlap.

1 GENERAL CHARACTERISTICS OF STUDENT INDEPENDENT WORK IN STUDYING THE DISCIPLINE " SIGNALING PROTOCOLS"

The goal independent work student at studying disciplines "Signaling Protocols" is designed to develop students' personal qualities, as well as a set of professional competencies for future bachelor's degrees in accordance with the requirements of the Federal State Educational Standard of Higher Education in the field of study 11.03.02 - Infocommunication Technologies and Communication Systems.

Tasks independent works:

- study of the basic methods of construction and principles of operation of signaling systems in modern information and communication networks;
- development of students' knowledge, skills and abilities, allowing one to independently conduct a theoretical analysis of processes in modern signaling systems of communication networks.

The following types of independent work are defined in the work program for the discipline "Signaling Protocols":

- Preparation To laboratory work;
- independent studying literature.

The purpose of the independent work “ *Preparation for laboratory work* ” on the subject “Signaling protocols” is to consolidate the students’ theoretical material in the specialty and develop skills for independent professional and scientific research activities in the field of information and communication systems and networks.

The objectives of the independent work type “ *Preparation for laboratory work* ” on the discipline “Signaling protocols” are determined by the need for the student to obtain knowledge, skills, and abilities in accordance with the requirements Federal State Educational Standard IN By direction preparation 11.03.02 -

Infocommunication technologies and communication systems, on the basis of which the corresponding planned learning outcomes for the discipline are formed (module), correlated With planned results mastering the educational program of competence.

Code, formulation of competence	Code, indicator formulation	Planned learning outcomes for the discipline (module), characterizing the stages of formation of competencies, indicators
OPK-1. Capable of using the principles, laws, and methods of natural science and mathematics to solve engineering problems.	ID-1 OPK-1 understands the fundamental laws of nature and the basic physical mathematical laws and methods of accumulation, transmission and processing of information.	Understands the fundamental laws of nature, physical phenomena, and processes that occur in telecommunications systems; the basic physical methods and mathematical techniques used in telecommunications for storing, transmitting, and processing information.
	ID-2 OPK-1 applies physical laws and mathematical methods to solve theoretical and applied problems.	Applies physical laws and methods to formalize the representation of physical phenomena and processes occurring in telecommunications.
	ID-3 OPK-1 uses knowledge of physics and mathematics when solving practical problems.	Uses knowledge of physics to solve practical engineering problems in the field of telecommunications.
OPK-2. Capable of independently conducting experimental research and using basic techniques for processing and presenting the obtained data.	ID-3 OPK-2 understands the basic methods and means of conducting experimental research, standardization and certification systems.	Understands the basic methods and means of conducting experimental research using computer technology.
	ID-4 OPK-2 selects measurement methods and tools and conducts experimental research.	Selects the necessary methods and means of measurement, conducts experimental research.
	ID-5 OPK-2 has methods for processing and presenting the obtained data and assessing the error of the measurement results.	Proficient in methods of processing and presenting obtained laboratory data and assessing the error of measurement results.
OPK-3. Capable of applying methods for searching, storing, processing, analyzing, and presenting information from various sources and databases in the required format, while adhering to basic information security requirements.	ID-1 OPK-3 understands the basic principles of information transmission in information and communication systems, the main types of signals used in telecommunication systems, and the specifics of transmitting various signals through channels and paths of telecommunication systems.	understands the basic principles of information transmission in information and communication systems, the main types of signals used in telecommunication systems, and the specifics of transmitting various signals through channels and paths of telecommunication systems.
	ID-2 OPK-3 understands the principles, basic algorithms, and devices of digital signal processing; the principles of constructing various types of telecommunication systems and methods of distributing information in communication networks.	understands the principles, basic algorithms and devices of digital signal processing; the principles of constructing telecommunication systems of various types and methods of distributing information in communication networks.

Code, formulation of competence	Code, indicator formulation	Planned learning outcomes for the discipline (module), characterizing the stages of formation of competencies, indicators
	ID-3 _{ОПК-3} solves data processing problems using computer technology.	solves data processing problems using computer technology.
	ID-4 _{ОПК-3} builds probabilistic models for specific processes and carries out the necessary calculations within the framework of the constructed model.	builds probabilistic models for specific processes and carries out the necessary calculations within the framework of the constructed model.
	ID-5 _{ОПК-3} has the methods and skills to ensure information security.	possesses methods and skills to ensure information security.

The purpose of the independent work type “ *Independent study of literature* ” on the subject “Signaling protocols” is to expand and consolidate the knowledge acquired by the student in traditional forms of classes and to develop independent work skills working with literature and sources.

The objectives of the independent work type " *Independent study of literature* " on the subject "Signaling protocols" are determined by the need for the student to obtain knowledge, skills, and abilities in accordance with the requirements of the Federal State Educational Standard of Higher Education in the field of training 11.03.02 - Infocommunication technologies and communication systems, on the basis of which the corresponding planned learning outcomes for the discipline are formed (module), correlated With planned results mastering the educational program

Code, formulation of competence	Code, indicator formulation	Planned learning outcomes for the discipline (module), characterizing the stages of formation of competencies, indicators
OPK-1. Capable of using the principles, laws, and methods of natural science and mathematics to solve engineering problems.	ID-1 _{OPK-1} understands the fundamental laws of nature and the basic physical mathematical laws and methods of accumulation, transmission and processing of information.	Understands the fundamental laws of nature, physical phenomena, and processes that occur in telecommunications systems; the basic physical methods and mathematical techniques used in telecommunications for storing, transmitting, and processing information.
	ID-2 _{OPK-1} applies physical laws and mathematical methods to solve theoretical and applied problems.	Applies physical laws and methods to formalize the representation of physical phenomena and processes occurring in telecommunications.
	ID-3 _{OPK-1} uses knowledge of physics and mathematics when solving practical problems.	Uses knowledge of physics to solve practical engineering problems in the field of telecommunications.
OPK-2. Capable of independently conducting experimental research and using basic techniques for processing and presenting the obtained data.	ID-3 _{OPK-2} understands the basic methods and means of conducting experimental research, standardization and certification systems.	Understands the basic methods and means of conducting experimental research using computer technology.
	ID-4 _{OPK-2} selects measurement methods and tools and conducts experimental research.	Selects the necessary methods and means of measurement, conducts experimental research.
	ID-5 _{OPK-2} has methods for processing and presenting the obtained data and assessing the error of the measurement results.	Proficient in methods of processing and presenting obtained laboratory data and assessing the error of measurement results.
OPK-3. Capable of applying methods for	ID-1 _{OPK-3} understands the basic principles of information transmission in	understands the basic principles of information transmission in information and

Code, formulation of competence	Code, indicator formulation	Planned learning outcomes for the discipline (module), characterizing the stages of formation of competencies, indicators
searching, storing, processing, analyzing, and presenting information from various sources and databases in the required format, while adhering to basic information security requirements.	information and communication systems, the main types of signals used in telecommunication systems, and the specifics of transmitting various signals through channels and paths of telecommunication systems.	communication systems, the main types of signals used in telecommunication systems, and the specifics of transmitting various signals through channels and paths of telecommunication systems.
	ID-2 ОПК-3 understands the principles, basic algorithms, and devices of digital signal processing; the principles of constructing various types of telecommunication systems and methods of distributing information in communication networks.	understands the principles, basic algorithms and devices of digital signal processing; the principles of constructing telecommunication systems of various types and methods of distributing information in communication networks.
	ID-3 ОПК-3 solves data processing problems using computer technology.	solves data processing problems using computer technology.
	ID-4 ОПК-3 builds probabilistic models for specific processes and carries out the necessary calculations within the framework of the constructed model.	builds probabilistic models for specific processes and carries out the necessary calculations within the framework of the constructed model.
	ID-5 ОПК-3 has the methods and skills to ensure information security.	possesses methods and skills to ensure information security.

2 SCHEDULE FOR INDEPENDENT WORK

The first step is to familiarize yourself with the course syllabus, which covers the content of the lecture course topics, the relationship between lecture topics and laboratory classes, and the topics and types of independent work. Specific reporting forms are provided for each type of independent work.

Technological map independent work student

Codes implemented competencies, indicator(s)	View student activities	Tools and technologies assessments	Volume hours, V volume number		
			SRS	Contact work with teacher	Total
8th semester					
OPK-1 ID-1 OPK-1 ID-2 OPK-1 ID-3 OPK-1 OPK-2 ID-3 OPK-2 ID-4 OPK-2 ID-5 OPK-2 OPK-3 ID-1 OPK-3 ID-2 OPK-3 ID-3 OPK-3 ID-4 OPK-3 ID-5 OPK-3	Independent studying literature	Passable exercise upon completion individual (group) tasks	20.52	1.08	21.60
OPK-1 ID-1 OPK-1 ID-2 OPK-1 ID-3 OPK-1 OPK-2 ID-3 OPK-2 ID-4 OPK-2 ID-5 OPK-2 OPK-3 ID-1 OPK-3 ID-2 OPK-3 ID-3 OPK-3 ID-4 OPK-3 ID-5 OPK-3	Preparation To laboratory work	Interview By questions For interviews	6.84	0.36	7.20
Total for semester			38.48	2.03	40.50
TOTAL			38.48	2.03	40.50

Name laboratory works

No. Subjects of the discipline	Name those laboratory works	Volume of hours	From them practical training, hours
8th semester			
2	General principles alarms R1.5.	3.00	3.00
2	Processes establishments connections when using R1.5 alarm.	3.00	3.00
2	Formation MSC scenario local call using the "Inductive Code" protocol.	3.00	3.00
2	Formation MSC scenario local call using the linear data exchange protocol signals By 2VSK.	1.50	1.50
2	Formation MSC scenario call from AMTS via SLM using the 2VSK linear signal exchange protocol.	1.50	1.50
2	Formation SDL diagrams process processing alarms By 1VSK (inductive code) for incoming local call.	1.50	1.50
2	Formation SDL diagrams process processing alarms By 1VSK (inductive code) for incoming long-distance call.	1.50	1.50
4	Subsystem MTR stack signaling protocols of OKS No. 7.	3.00	3.00
5	Subsystem SCCP stack signaling protocols of OKS No. 7.	3.00	3.00
5	Subsystem ISUP stack signaling protocols of OKS No. 7.	3.00	3.00
Total per semester		24.00	24.00
TOTAL		24.00	24.00

3 CONTROL POINTS AND TYPES REPORTING BY HIM

Within the framework of the rating system, students' academic performance is assessed during ongoing monitoring and midterm assessment.

Current control

Rating grade knowledge student

Item No.	View activities students	Completion deadlines	Number of points
8th semester			
1	Passable class By lab. works No. 1–5. Interview By results independent studies literature.	8	25
2	Passable class By lab. works No. 7–10. Interview By results independent studies literature.	17	30
	Total for 8th semester:		55

The maximum possible score for the entire ongoing assessment is set at 55. A current assessment is considered passed if the student receives at least 60% of the maximum score established for that assessment. The rating score assigned to a student for a current assessment completed within the deadlines set in the assessment schedule is determined as follows:

<i>Level execution control task</i>	<i>Rating score (V % from maximum score for the test task)</i>
<i>Great</i>	<i>100</i>
<i>Good</i>	<i>80</i>
<i>Satisfactory</i>	<i>60</i>
<i>Unsatisfactory</i>	<i>0</i>

Current assessment of students is carried out by teachers conducting laboratory classes in the discipline, in the following forms: interview.

to participate in laboratory work if they have printed options report.
Protection report passes V form

a student's report on the completed work and answers to the teacher's questions.

A student receives the maximum number of points if the report formatting meets established requirements and the report fully explains the essence of the work. Reasons for lowering the grade include:

- the presence of errors in the report that do not distort the essence of the issue under consideration;
- answers on questions teacher Not are exhaustive;
- writing report completed V careless form.

Report Maybe be sent on revision V following cases:

- V presented in writing report given incorrect calculations;
- in the submitted written report unsubstantiated conclusions are presented;
- exercise completed Not fully.

Intermediate certification

Midterm assessment in the form of **an exam** involves a mandatory examination procedure and is worth 40 points out of 100. If a student's rating score for a subject at the end of the semester is 60, the program automatically adds 32 bonus points and assigns a grade of "excellent." A student's positive response to the exam is assessed with rating points ranging from 20 to 40 (20 δ Sex δ 40); a score of less than 20 is considered unsatisfactory.

Scale conformity rating points exam 5-point system

Rating score By discipline	Grade By 5-point system
35 – 40	Great
28 – 34	Fine
20 – 27	Satisfactorily

The final grade for a course studied in one semester is determined by the sum of the points earned for work during the semester and the points received upon passing the exam:

Scale recount rating points By discipline V assessment By 5-point system

<i>Rating score By discipline</i>	<i>Grade By 5-point system</i>
<i>88- 100</i>	<i>Great</i>
<i>72- 87</i>	<i>Fine</i>
<i>53- 71</i>	<i>Satisfactorily</i>
<i><53</i>	<i>Unsatisfactory</i>

4 METHODOLOGICAL RECOMMENDATIONS FOR THE STUDY OF THEORETICAL MATERIAL

When working with recommended literature and sources, the student must first pay attention to the following points:

1. Carefully study the materials characterizing the course and the topics of independent study, as set out in the educational and methodological complex for the discipline. This will allow clearly imagine as a circle, the topics studied, as well as the depth of their comprehension.

2. Compile a selection of literature sufficient for studying the proposed topics. The curriculum or methodological guidelines must include primary and secondary reading lists available to students. These are advisory in nature, meaning there are always references that may not be included in the list but are essential for mastering the topic. It's important to keep in mind that different types of literature are needed:

- textbooks, educational And educational and methodological benefits;
- monographs, collections scientific articles, publications V magazines;
- reference literature – encyclopedias, dictionaries, thematic and terminological reference books;

3. The learner must make his own intellectual efforts, and not just mechanically memorize concepts and provisions.

Interview questions on the topic of independent study

Basic level

Topic 1. Introduction to signaling systems . Principles of linear signaling

1. What enters V concept "system alarms" V communication networks ?

2. What types of alarm systems are there? Why aren't there standard in-station alarm systems?
3. What is a "signaling link" and what types of signals are transmitted over it?
4. Explain the classification features of telephone alarm systems in the Unified State Register of the Russian Federation.
5. Explain which forward line signals are transmitted and when when establishing a local telephone connection.
6. What line signals are transmitted in the opposite direction and what subscriber information signals do they initiate when establishing a local telephone connection?
7. Draw diagrams of the exchange of line signals when establishing a local telephone connection for the following cases:
 8. called subscriber B busy;
 9. called subscriber B Not answers, lights out subscriber A;
 10. on stations B are absent free connecting paths.
11. Draw a diagram of the exchange of linear signals over a call-connection line (CCL) with a zone transit node (ZTN) during an outgoing long-distance telephone connection.
12. Explain the principle, advantages and disadvantages of the method of transmitting linear signals with direct current.
13. What methods of transmitting linear signals are possible using analog transmission systems? How do they differ?
14. What are the requirements for selecting the signal frequency value for out-of-band and in-band methods of transmitting linear signals?
15. What methods are used in a line signal receiver to protect against signal frequency spoofing by talk currents during in-band signaling?
16. How is protection against distortion of signaling information bits ensured during 2BCK signaling?

Topic 2. Principles of constructing routing signaling .

Subscription signaling

1. Which signals are included V compound alarms routing?
2. Why alarm routing often they call register?
3. Compare different methods of encoding routing signals in terms of ease of implementation and information transfer rate.
4. Specify the parts of telephone networks that use the corresponding methods of transmitting multi - frequency signals.
5. Why it is forbidden use intervalless plastic bag on long intercity and international channels?
6. Why is one method of transmitting multi-frequency routing signals called a "shuttle"?
7. Depict temporary diagram changes permanent current V subscriber line when transmitting the number 0 using a loopback method.
8. From what kind considerations selected values frequencies V code DTMF?
9. By what criteria can all international standard signaling systems be divided into groups?
10. Why was the continuous numbering order of international standard signalling systems disrupted?
11. Which system alarms is basic on international channels? What makes it special?

Topic 3. General principles constructions systems alarms OKS No. 7

1. Explain how line signals and routing signals are transmitted in decentralized signaling systems.
2. Specify the advantages and disadvantages of decentralized alarm systems.
3. When did it become possible to implement a centralized alarm system?
4. Compare the advantages and disadvantages of decentralized and centralized alarm systems.

5. Please explain main peculiarities general signaling channel .
6. What information can be transmitted over a common signaling channel?
7. Which levels models VOS And Why implemented V models OKS No. 7?
8. Please explain appointment main subsystems users OKS No. 7, used V present time on networks connections.

Topic 4. Message transmission subsystem of the signaling system OKS No. 7

1. How many types signal units is used V OKS No. 7? How are they different and when are they used?
2. What is it like? appointment flag? What such bitstuffing?
3. How will it be? transferred V link OKS No. 7 codes combinations 01111111 and 11111000?
4. What is the difference between the use of the length indicator in international and national networks of OKS No. 7?
5. Specify the contents of the SIO service indicator when transmitting ISUP subsystem signaling information in the international SS7 network.
6. IN what kind cases are transmitted signal units states LSSU link? What signaling link states can they indicate?
7. It is transmitted whether something By serviceable link alarms, when the station does not service any calls?

Topic 5. User and application subsystems of the signaling system OKS No. 7

1. Why Now Not are used subsystems users TUP and DUP?
2. For what was required development national specifications ISUP?
3. Specify the features of the Russian national specifications ISUP-R and ISUP-R-2000.
4. Which parts contain messages ISUP? IN how their difference?

5. What such parameter messages ISUP? How He characterized by?
6. What such indicator And Which lengths He Maybe be?
7. What is the difference between passing a parameter in the mandatory fixed, mandatory variable, and optional parts of an ISUP message?
8. What such pointer And what He Maybe be equal?
9. In the ISUP message, byte number 27 transmits a pointer whose value is
9. At what byte does the parameter pointed to by this pointer begin?
10. Please specify main groups messages ISUP- R.
11. What such signal compound"? When it is it used?
12. What general And how differ subsystems MTR and SCCP?
13. What is the purpose SCCP subsystems? On what model level VOS does it work and why?
14. What is an "extended address" and what is its purpose in SCCP subsystem?
15. Please explain compound architecture subsystems SCCP.
16. On which classes are divided services SCCP And V how their difference?
17. Specify the features of using SCCP services on the OKS№7 network in Russia.

Topic 6. Principles constructions networks OKS No. 7

1. Specify the main principles of implementing the OKS No. 7 network on the international fragment of the Unified State Network of the Russian Federation.
2. What user subsystems and in what specifications are implemented in the signaling points of the international network of the SS7 on the Unified State Network of the Russian Federation?
3. Please explain diagram organizations intercity networks OKS No. 7 on Unified State Educational Institution
4. How is being organized net OKS No. 7 on networks mobile connections Unified State Educational Institution Russian Federation?
5. Where And which points alarms are being organized on networks mobile connections?

Rus
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erat
ion.

6. IN how peculiarity implementation zonal networks OKS No. 7?

Topic 7. Testing networks OKS No. 7

1. What levels of operational tasks can be identified when considering the SS7 network?
2. List operational tasks second level V networks OKS

No. 7.

3. Please comment compound schemes test configurations For level 2 MTP.
4. Please comment on the composition of the test configuration diagram for MTP Layer 3.
5. IN what kind cases necessary test protocol OKS No. 7 on full compliance with technical requirements?
6. Which categories tests are being carried out V OKS No. 7?
7. Please comment peculiarities conducting tests conformity in OKS No. 7.
8. Please comment on the specifics of conducting joint functioning tests in OKS No. 7.
9. Please comment peculiarities conducting tests interactions in OKS No. 7.
10. Please comment on the specifics of conducting functionality tests in OKS No. 7.

Topic 8. Measurements V networks OKS No. 7

1. What kind properties are characterized by conducted V networks OKS No. 7 measurements according to ITU-T Recommendation Q.752?
2. Name it measurable parameters at assessment functioning of the signaling link in the message transmission subsystem.
3. List the parameters measured when assessing the performance of a signaling link bundle in a message transmission subsystem.
4. Name it measurable parameters at assessment functioning of the signaling point SP in the message transmission subsystem.

5. List the parameters measured when evaluating the performance of a destination in a message transfer subsystem.
6. Name the parameters measured when assessing the functioning of the signaling route in the message transmission subsystem.
7. Name it measurable parameter at assessment distribution received signaling traffic in the message transmission subsystem.
8. Name the measured parameter when assessing the distribution of transmitted signaling traffic in the message transmission subsystem.
9. Name the measured parameter when assessing the distribution of the TP signaling message in the message transmission subsystem.
10. Name the measured parameter when assessing the distribution of received TP signaling messages in the message transmission subsystem.
11. Name the measured parameter when assessing the distribution of transmitted MTP signaling messages in the message transmission subsystem.
12. Name the measured parameter when evaluating the distribution of a detailed MTP signaling message in the message transmission subsystem.
13. List the parameters measured when assessing the performance of the SCCP.
14. Name it measurable parameters at assessment availability SCCP.
15. List the parameters measured when evaluating the use of SCCP.
16. Name it measurable parameters at assessment availability ISUP.
17. List the parameters measured when evaluating the use of ISUP messages.
18. Name it measurable parameters at assessment functioning ISUP node .

Topic 9. Monitoring networks OKS No. 7

1. What is main sign overloads OKS No. 7?

2. List the approaches to signaling control on connecting lines using OKS No. 7.
3. What are the performance requirements for the hardware and software monitoring system for the SS No. 7 network?
4. List the general functional requirements for a set of hardware and software tools for monitoring the SS7 network.
5. Name the functions implemented by the hardware and software complex for monitoring the OKS No. 7 network.
6. What information does the hardware and software monitoring system for the SS7 network handle when performing the configuration description function?
7. What does the SS7 network performance monitoring function include?
8. What does the network fault monitoring feature include? OKS No. 7?
9. In accordance with what information does the hardware and software monitoring system for the SS7 network operate when monitoring a “suspicious” signal load?
10. Please comment on the composition of the typical structure of the hardware and software monitoring system for the SS No. 7 network.
11. List the software requirements for the hardware and software monitoring system for the SS7 network in terms of security.
12. What are the software requirements for the hardware and software monitoring system for the SS7 network in terms of scalability?
13. List the hardware requirements for the hardware and software monitoring system for the SS7 network.

Topic 10. Broadcast messages OKS No. 7 through IP networks

1. What are the main functional elements that make up the NGN network structure? List the functions they perform.
2. Name the protocols that are used to transmit SS7 signal units over IP networks.
3. List the components of the SIGTRAN architecture for transmitting SS7 signaling messages over IP networks.
4. What requirements are set out in ITU-T documents for the processes of transporting MTP messages over time-division multiplexing networks, as well as over IP networks?
5. Name the features that provide reliable transmission of signaling messages over IP networks when using the SCTP flow control transmission protocol.
6. List the key features of the SCTP flow control transmission protocol.
7. Determine place protocol SCTP V stack protocols TCP/IP.
8. Describe the format of the SCTP flow control transmission protocol packet.
9. Describe the format of the SCTP flow control transmission protocol packet header.
10. Describe format teams protocol packet transmissions With SCTP flow control.
11. List the general capabilities of the user adaptation levels (UA) of the MTR OKS No. 7 subsystem.
12. Please comment terms, which connected With levels user adaptation (UA) of the MTR OKS No. 7 subsystem.
13. Conduct comparison protocols second level M2UA And M2RA.

Increased level

Topic 1. Introduction to signaling systems. Principles of linear signaling

1. Specify the superframe number, the VSC number and its binary content when transmitting a line signal with binary code 10 associated with the conversational channel of the 23 PCM cycle.
2. How many cycles And supercycles ICM-30/32 occupies broadcast one linear signal with 2BCK signaling, provided that the signal is transmitted for 40 ms?
3. How much time will it take to transmit the number 0 using the decadal method when using 2VSK signaling?

Topic 2. Principles constructions alarms routing. Subscription signaling

1. What signaling systems are used on the international channels of the Unified State Telecommunications System of the Russian Federation, and what are the specifics of their application?
2. What signaling systems are used in urban telephone networks when connecting decade-step, coordinate and digital stations and nodes with each other?
3. What's the difference between one-way and two-way occupancy lines?
What signaling systems can be used?

Topic 3. General principles constructions systems alarms OKS No. 7

1. Please specify main functions subsystems transmissions messages MTR.
2. How Can implement link data alarms?
3. Which main functions performs link alarms OKS No. 7?

Topic 4. Subsystem transmissions messages systems alarms OKS No.

7

1. Which one? function perform filling signal units
FISU?

2. Which signal units have own ordinal numbers?

Topic 5. User and application subsystems of the signaling system OKS No. 7

1. Provide specific examples of the use of the SCCP subsystem in the implementation of services in intelligent networks and GSM cellular networks .
2. What address categories are used in the SCCP subsystem for routing signaling messages and how do they differ?

3. Specify all possible combinations of called user addresses in the SCCP subsystem.
4. Please explain differences processes provision subsystem SCCP connection-oriented and connectionless services.
5. What is a transaction? At what level models VOS are transactions being executed ?
6. What are the benefits of introducing the TSAR transaction capabilities subsystem into the SS7 architecture ?
7. How many classes transactions supports subsystem TSAR And V What is the difference between them?

Topic 6. Principles constructions networks OKS No. 7

1. Specify the main principles of implementation of urban networks of OKS No. 7 on the Unified State Network of the Russian Federation.
2. How organized net OKS No. 7 on rural telephone networks?

Topic 7. Testing networks OKS No. 7

1. Please comment peculiarities testing networks OKS No. 7 when turning on the analyzer instead of SP.
2. Please comment peculiarities testing networks OKS No. 7 when simulating STP.
3. Which actions includes V myself stressful testing networks OKS No. 7.
4. Please comment peculiarities testing networks OKS No. 7 when simulating SCP.
5. How are OKS # 7 analyzers classified according to the scale of the tasks they solve?

Topic 8. Measurements V networks OKS No. 7

1. List the parameters measured when assessing the performance of an ISUP network.
2. Name it measurable parameters at assessment availability TCAP.
3. List the parameters measured when evaluating the use of TCAP components.
4. Name the parameters measured when evaluating the use of TCAP messages.
5. List the parameters measured when assessing the performance of TCAP.
6. What categories of data need to be provided to the network operations center or operations support system?
7. Name it categories classifications measurements V networks alarms.

Topic 9. Monitoring networks OKS No. 7

1. Name it algorithmically simple tasks solvable hardware of the network monitoring complex of the SS No. 7.
2. Name the algorithmically complex tasks (implemented programmatically) performed by the network monitoring complex of SS No. 7.
3. List elements structural schemes systems monitoring OKS No. 7 networks.
4. Name it elements structural schemes software provision of the server for the network monitoring system of the SS No. 7.

Topic 10. Broadcast messages OKS No. 7 through IP networks

1. Which actions are being carried out at support protocol third M3UA level?
2. Conduct comparison protocols M3UA And SUA.
3. On which devices is the IUA subscriber signaling user adaptation layer protocol implemented ?
4. On execution what kind tasks aimed protocol level adaptations user of IUA subscriber signaling?
5. What functions does the IUA subscriber signaling user adaptation layer protocol perform?

1. Criteria assessments competencies

an " **excellent** " grade if: they have solid and well-reasoned knowledge; they possess the skills necessary to confidently solve professional problems; and they possess comprehensive skills for solving professional problems.

A " **good** " grade is awarded to a student if: the student possesses the knowledge necessary to solve standard professional problems; possesses the skills necessary to solve professional problems; and possesses the necessary techniques and skills to solve professional problems.

A " **satisfactory** " grade is given to a student if: in individual sections of the course the student demonstrates a level of knowledge that is insufficient to solve standard problems of professional activity; are present mediocre skills, necessary For

solving problems of professional activity; has weak skills necessary for solving problems of professional activity.

The grade " **unsatisfactory** " is given to a student if: there is a lack of knowledge; there are no skills necessary for solving problems of professional activity; there are no skills necessary for solving problems of professional activity.

2. Description scales assessments

The maximum possible score for the entire ongoing assessment is set at **55**. A current assessment is considered passed if the student receives at least 60% of the maximum score established for that assessment. The rating score assigned to a student for a current assessment completed within the deadlines set in the assessment schedule is determined as follows:

Level execution control task	Rating score (V % from maximum points for the test task)
Great	100
Good	80
Satisfactory	60
Unsatisfactory	0

3. Methodological materials defining the procedures for assessing knowledge, skills, abilities and (or) work experience, characterizing the stages of competence development

The procedure for conducting this assessment includes an interview on the questions specified in the sections. The number of tasks specified in the Assessment Fund Passport (summary table) should be used as a guide.

The tasks offered to the student allow them to check the development of the competencies PC-1, PC-3, PC-4.

To prepare for this assessment, students must study the recommended readings listed in the course's Syllabus. Upon receiving the assignment, students must answer the interview questions immediately, without preparation.

When preparing for an answer, the student is given the right to use technical means for completing calculation and graphic tasks, maps, reference books, tables and other reference literature. only with the appropriate permission from the department.

When checking the level of mastery of topics assigned for independent study, the following are assessed:

- completeness knowledge;
- systematicity And generality knowledge;
- depth knowledge;
- efficiency knowledge.

Evaluative sheet

Item No.	Full name student	Points (0 – 0.5 – 1)				
		Given answers to everything basic level questions	Understanding the essence the material presented	The speech is literate and clear, accurate	Analyzing the essence of the issue, giving your own examples	Answers to advanced questions were provided
1.						
2.						

5 GUIDELINES FOR PREPARATION FOR LABORATORY WORK

When conducting laboratory work on the discipline "Signaling Protocols", the student must know and possess the skills, the content of which is presented in the program for the discipline.

5.1. Methodological instructions at preparation To laboratory work

It is recommended to prepare for laboratory work in the following sequence:

- to understand topic And target, upcoming classes;
- study the theoretical material in accordance with the topic of the lesson (it is recommended to use the recommended literature, notes lectures, tutorial (workshop)).

5.2. Guidelines for completing laboratory work assignments

At execution tasks laboratory work students should strictly observe established labor safety rules.

At execution tasks students recommended:

- to understand target, performed tasks And methods their solutions;
- tasks, fulfill V that one sequences, V which They indicated in the practical guide;
- at execution tasks And studying theoretical use the teacher's help to obtain the material;
- design report By laboratory work;
- answer on control questions.

5.3. Guidelines for preparing for the defense of laboratory work

When preparing to defend a laboratory work, students are advised to:

- prepare report By laboratory work;
- be able to justify, made conclusions;
- to consolidate knowledge of theoretical material on the topic of the lesson (it is recommended to use test questions);
- know order conducting calculations (conducted research).

The lab work defense is conducted through an interview between the student and the instructor. During the interview, the student submits a lab report for review.

The interview with a student applying for an “excellent” grade is conducted on issues of advanced level of education.

An interview with a student who is not aiming for an "excellent" grade is conducted using basic-level questions, which are listed in the assessment toolbox for the discipline.

Questions (tasks) For checks level training

Basic level

Practical work 1. General principles alarms R1.5.

1. Give it to me definition alarms V networks connections.
2. What types of signaling exist in different parts of the communication network?
3. What methods exist for transmitting inter-station signaling information?
4. What categories of signals are transmitted during inter-station signaling?
5. List main linear signals.

6. Name its peculiarities transmissions linear signals And pulses of decade dialing in the digital transmission system PCM-30.

7. Comment on the methods of transmitting control signals in the 2-of-6 multifrequency code.

8. Which frequencies are used at formation multi-frequency signals using the pulse shuttle protocol?

9. What are the features of organizing the process of exchanging multi-frequency signals using the "pulse shuttle" protocol?

10. Describe the pulse packet formats for different call types.

11. Name the features of organizing the process of exchanging multi-frequency signals using the "pulse packet" protocol.

Practical work 2. Processes establishments connections when using R1.5 alarm.

1. From what kind main elements consists of MSC- scenario?

2. Explain the essence of the decadal method of transmitting routing signals.

3. How are transmitted numbers numbers on opposite side with the decade method?

4. What line signals are used to establish a local connection? Explain their purpose.

5. What general And how differ signals "Pause" And "Inter-serial interval"?

6. What line signals are used when a connection is broken ? Explain their purpose.

Laboratory work 3. Subsystem MTR of the signaling protocol stack of OKS No. 7.

1. Which there are signal units And V how what is the difference between them ?

2. Please specify difference formats different types signal units.

3. What such flag And For what He is it needed?

4. For what needed indicator bits ?
5. How are signal units transmitted in different directions along a cable system link numbered? Which signal units are assigned serial numbers and why?
6. What is it? Maybe be length signal units?
7. Which field defines subsystem user?
8. How is being carried out addressing transmissions signal units?

Practical work 4. SCCP subsystem of the signaling protocol stack of the SS7.

1. Common Channel Signaling Systems No. 7 and their purpose subsystems of MTP, SCCP and ISUP from the standpoint of the ISO open systems interaction model.
2. Types and purpose of signaling units in interstation interaction of signaling points.
3. Types and purpose of the main signaling messages when servicing a basic ISDN call.
4. Types and purpose of information parameters of the main signaling messages when servicing a basic ISDN call.
5. Features of the organization of inter-station signaling “from link to link” (link-to-link) and “from end to end” (end-to-end).
6. Explain the methods for implementing end-to-end inter-office signaling: the cut-through method and the SCCP method.
7. Explain the signaling point code numbers in structural, decimal and hexadecimal format.
8. On example routes signal messages explain structure Significant signal unit format fields. Specify the principle of dividing signal units into filler, link state, and significant.
9. Determine the constant length of signal units of the MTP message transmission subsystems and the ISDN user subsystem.

10. Using the example of signal message routes, explain the implementation of the main method of protection against errors of signal units of the OKS No. 7 system.

11. Explain the principle of signal load separation and the purpose of the SLC signaling link selection field information element.

12. Using the example of signaling message routes, explain the features of interaction between signaling points when providing additional services and the structure of the information parameters that support them.

13. Explain the structure and purpose of the information parameters of the ISDN user subsystem messages for managing the configuration of the information network.

14. Format And appointment code identifier channel CIC.

Increased level

Practical work 1. General principles alarms R1.5.

1. Describe structure signal "Request "AON".
2. Describe structure codograms Caller ID.
3. Name the features of the organization of the process of exchanging multi-frequency signals using the “gapless packet” protocol.

Practical work 2. Processes establishments connections when using R1.5 alarm.

1. Please explain way transmissions signals routing "pulse shuttle".
2. How are transmitted numbers numbers on opposite side with the "pulse shuttle" method?

Laboratory work 3. Subsystem MTR of the signaling protocol stack of OKS No. 7.

1. Please specify appointment fields labels routing ISUP.
2. How is the signaling information of the SS7 link related to the voice channel? Define signaling in communication networks.

Practical work 4. SCCP subsystem of the signaling protocol stack of the SS7.

1. Using the example of signaling message routes, explain the features of servicing calls to subscribers of ISDN and non-ISDN networks.
2. Addressing signaling messages in a single-level and two-level signaling network and the purpose of the SIO service information byte.
3. Explain the structure of the ISDN number and the routing information for signalling messages at terminal, transit and gateway signalling points.
4. Using the signaling message routes for a fragment of a two-level common-channel signaling network, construct a block diagram of the algorithm for the procedure for interaction between end and transit stations when servicing a basic ISDN call.

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When preparing for an answer, the student is given the right to use technical means for completing calculation and graphic tasks, maps, reference books, tables and other reference literature. only with the appropriate permission from the department.

At verification tasks, are evaluated:

- sequence of completing the task presented in the laboratory work;
- rationality of completing the task presented in the laboratory work;
- accuracy calculations at execution tasks, presented in laboratory work.

Evaluative sheet

Item No.	Full name student	Points (0 – 0.5 – 1)				
		Given answers to everything basic level questions	Understanding the essence the material presented	The speech is literate and clear, accurate	Analyzing the essence of the issue, giving your own examples	Answers to advanced questions were provided
1.						
2.						

LIST RECOMMENDED LITERATURE

Main literature:

1. Berlin, A.N. Telecommunication networks and devices. Electronic resource: textbook / A.N. Berlin. - Telecommunication networks and devices, 2019-12-01. - Moscow: Internet University Information Technologies (INTUIT), 2016. - 395 c. - The book is in the basic version of the IPRbooks electronic library system. ISBN 978-5-94774-896-3

2. Roslyakov, A.V. Signaling in digital networks Electronic resource: textbook / A.V. Roslyakov. - Samara: Volga Region State university telecommunications And computer science, 2013. - 129 c. - Book located V basic versions EBS IPRbooks.

3. Sorokin, A. S. Fundamentals of the Theory of Building Telecommunication Networks and Systems Electronic resource: Textbook / A. S. Sorokin. - Fundamentals of the Theory of Building Telecommunication Networks and Systems, 2022-04-

04. - Moscow: Moscow Technical University of Communications and Informatics, 2012. - 50 p. - The book is in the premium version of the IPR BOOKS electronic library system. - ISBN 2227-8397

Additional literature:

1. Pyatibratov, A.P. Computers, Networks, and Telecommunication Systems. Educational and Methodological Complex / A.P. Pyatibratov; Gudyno, L. P.; Kirichenko, A. A. - Moscow: Eurasian Open Institute, 2009. - 292 p. - ISBN 978-5-374-00108-2

2. Yakovlev, S. V. (SevKavGTU). Intelligent networks / S. V. Yakovlev ; North-Cav. state. techn. un-t. - Stavropol : SevKavGTU, 2011. - 189 s. : ill. - Bibliogr.: s. 187–188

3. Yakovlev, S. V. (SevKavGTU). Fundamentals of building telecom system and networks : educational manual / S. V. Yakovlev ;

North Caucasus state tech. un- t. - Stavropol: SevKavSTU, 2010. - 350 p. - Bibliography: p. 349

4. Yakovlev, S. V. (SKFU). Intelligent networks: a tutorial (laboratory practical training) / S. V. Yakovlev; FGAOU North-Caucasian Federal University. - Stavropol: SKFU Publishing House, 2012. - 152 p.: ill. - Bibliography: p. 149