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METHOD OF CALCULATION OF THE SIGNALING TRAFFIC IN NETWORK COMMON CHANNEL SYSTEM SIGNALING AT LOWER LAYER

Bayram Ibrahimov[1], Shukur Mammadov[2]

[1]Azerbaijan Technical University, Baku, Azerbaijan, *i.bayram@mail.ru*
[2]Institute of Cybernetic of ANSA, Baku, Azerbaijan, *smamedov@afon.az*

Introduction. Effective functioning of modern digital telecommunication networks with common channel signaling considerably depend from delivery of signaling information in time and their reliable transmission at lower layer.

In systems of telecommunication among the using of the systems signaling in digital systems switching of the special place is occupied common channel signaling system (CCS No.7). System signalize CCS No.7 according to recommendations ITU-T Q.700 taking role as an universal common channel assignment and defining infrastructure of control for establishment of logical connection, data transfer and for releasing of logical signaling connection [1, p.3].

Researches of methods of improvement of quality of functioning of system for definition and an estimation of alarm loadings of networks of CCS No.7 have shown, that at rendering of multiservice services of users increase base and additional loadings of an alarm network (a direct communication, night service, etc.) at peak of traffics, that leads to increase of average time of an establishment of connection and separation, average time of a delay of transfer of the signaling traffic and even to refusals in networks of the user services [2, pp.119-122; 3, p.217].

In this connection in the given work questions of methods of calculation of signalling traffics of network of the common channel signaling system for definition of quantity of office channels and management of digital systems of switching at local level seven-layer model reference model of interaction of open systems interconnection (OSI), to first three bottom levels of model OSI - physical, channel and network are considered.

The given method of calculation of alarm loading of system is based on a principle of division of alarm loading of bottom subsystem CCS No7 at level of a link of the alarm system which allows to more precisely loading parameters of base and additional kinds of service in peak of traffic.

In [1, pp.18-19] defined that, in telecommunication system with CCS No.7 for realization basic and supplementary services used NSP (Network Service Part) subsystem. However, for provisioning network services CCS No.7 divided between subsystems MTP (Message Transfer Part) and SCCP (Signaling Connection Control Part), which is all together set up network service subsystem – NSP.

Subsystem MTP divided in to three layers (MTP - n, n=1, 2, 3) and each layer perform particular administrative function. All this come as a signaling section and creating signaling traffic load in the network which is defined with intensity of signaling unit and telecommunication services parameters.

The investigations and analysis show that [4, pp.17-18; 5] effective method of estimation signaling traffic in the signaling system network is the one of high priority trend on the development of telecommunication system.

Problem definition. For solution defined problem [1, pp.145-146; 2, pp.148-151] suggested estimation method of signaling traffic load in telecommunication networks with CCS No.7 on MTP and SCCP layers the estimation of signaling traffic consist of with two steps.

First step define the routing plan of signaling traffic Y_{ST}^{R} for all signaling sections but second step define signaling traffic of subsystems for each signaling interactions -Y_{SC}^{S}, MTP, SCCP, ISUP (Integrated Service User Part) and INAP (Intelligent Network Application Protocol) subsystems signaling traffic on signaling section.

The final value of signaling traffic according to suggested estimation method can be computed as follow:

$$У_{CCS} = У^{R}_{ST} + У^{S}_{SC} + \Delta У_{SS}\,, \tag{1}$$

here $\Delta У_{SS}$ is accordingly signaling traffic by serving supplementary services (SS) in peak of traffic on the signaling section layer.

Traced estimation method of signaling traffic in signaling section , beside above stated include signaling traffic of user subsystems and applications as well as following parameter of signaling system:

1. List of user subsystems of multiservice;
2. Signaling traffic parameters, like length of signaling unit, type of loss, sleeps on signaling section;
3. Functioning procedures and algorithms of common channel signaling system.

Mathematical formulation of the problem for suggested estimation method presented as following objective function:

$$У_{CCS} = E\,[\max_i\,(\,У_{i.MTP},\, \lambda_{i.SU},\, У_{i.SCCP}),\ \min_i\,(L_{i.SU}, T_{i.SU})],\ \ i = \overline{1,k}\,, \tag{2}$$

here $У_{i.MTP}$ – signaling traffic of i-message stream, $i = \overline{1,k}$ in MTP subsystem;

$\lambda_{i.SU}$ – buffering speed of i-message unit $i = \overline{1,k}$;

$У_{i.SCCP}$ – signaling traffic of SCCP subsystem by serving i-message stream $i = \overline{1,k}$;

$L_{i.SU}$ – length of i-message unit, $i = \overline{1,k}$;

$T_{i.SU}$ – average transmit time of i-message unit , $i = \overline{1,k}$.

The equation (2) show that traced estimation method of signaling traffic in common channel signaling system define their load characteristics and is the main problem of optimization of process of transmission signaling messages.

Beside that (2) define main point of this approach for evaluation of signaling traffic and it is a simple analytical function of effectiveness for evaluation throughput and value of signaling traffic in signaling section.

The analysis of parameters of the common channel systems signaling at the definition of size of alarm loadings. From effective functioning point of view common channel signaling networks it is necessary to develop effective structure of signaling section. For solution this problem suggested simple scheme of CCS No.7 system on lower layer which composed with following subsystems: MTP1, MTP2, MTP3, SCCP, subsystems to server ISDN (ISDN-Integrated Services Digital Network) networks with ISUP protocol and subsystems to server supplementary services intelligent networks (IN – Intelligent Network) with INAP protocol (figure1.)

Obviously from the figure, for execution of all lower layer functions in CCS No.7 model added subsystem to manage signaling connections, ISDN and IN subsystems which provide access to network and supplementary services.

According to working algorithm of CCS No7 system on lower layer found that, MTP subsystem transmit signaling unit with particular length to own subsystem - SCCP, ISUP and INAP [4, pp.26-28].

Lets assume, signaling section accept i-signaling unit with speed $\lambda_{i.SU}$, $i = \overline{1,k}$.

Then signaling traffic on signaling section MTP subsystem defined as follow:

$$У_{i.MTP} = \lambda_{i.SU} \cdot T_{i.SU}\,,\quad i = \overline{1,k}\quad (Erl.) \tag{3}$$

Equations (3) characterize value of signaling traffic on signaling section MTP subsystem on OSI layers.

As a result of above presented CCS No.7 structure MTP - it is a unit transport platform which is support user and application subsystems – SCCP, ISUP, INAP to provide appropriate basic and supplementary services.

In consideration of function structure of message transfer subsystem and working algorithm of suggested common channel signaling system scheme the value of signaling traffic in signaling section (SS) defined as follow:

$$У^{П}_{i.SS} = У_{i.MTP} + У_{i.SCCP} + У_{i.ISUP} + У_{i.INAP}, \; i = \overline{1,k} \qquad (4)$$

Here , $У_{i.SCCP}$, $У_{i.ISUP}$, $У_{i.INAP}$ – accordingly, value of signaling traffic created by i-message of stream entering to MTP, SCCP, ISUP and INAP subsystems in the signaling section.

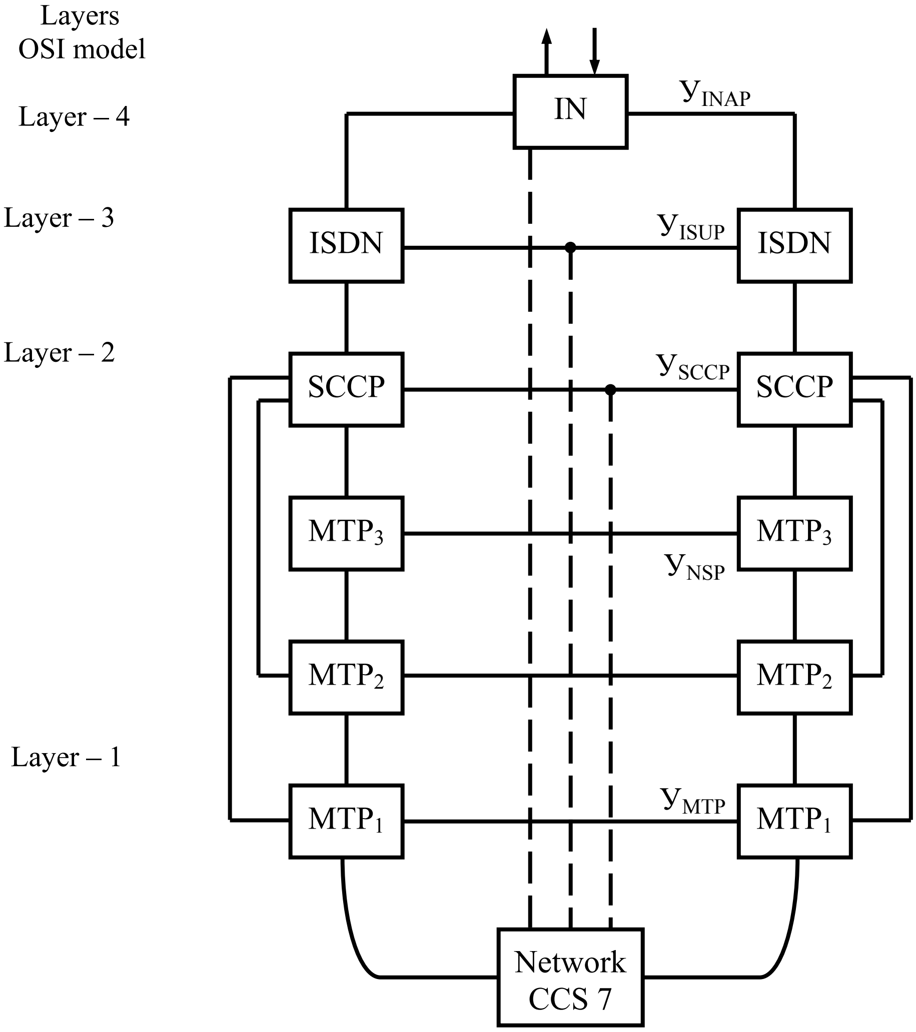

Figure1. Structural scheme of link network of the common channel signaling system at lower layer

Let us define signaling traffic of digital networks with integrated services on common channel signaling base which use ISUP protocol. For that, considered entering signaling stream speed to ISUP subsystem , average value of transmit L_d^{ISUP} and receive L_o^{ISUP} signaling traffic for all ISUP call type , as well as incoming and outgoing traffic load in telecommunication networks which can be defined as follow [2, p.150]:

$$y_i^L = \frac{N_i^{io}}{\ell_q \cdot Vs} \cdot T_{ia}^q, \quad i = \overline{1,k} \qquad \text{(Erl.)} \tag{5}$$

Here ℓ_q is quantity of binary code elements information messages in digital transmission system, (bit); $T_{i.a}^q$ is average seizure time of information channel for transmission i-traffic stream, (s); V_S is information communication channel work speed, (bit/s); N_t^{io} is total quantity of incoming and outgoing traffic per day (call/hour).

Subject to above stated and (5), value of signaling traffic of ISUP subsystem can be defined as below:

$$y_{i.ISUP} = [T_{ia}^q]^{-1} \cdot \frac{L_d^{ISUP} + L_o^{ISUP}}{y_{st}} \cdot y_i^L + \Delta y_{i.SS} \qquad \text{(Erl.)} \tag{6}$$

Here y_{st} is max switch load at peak of traffic (Erlang).

In terms of (5) and (6) similarly possible to specify signalling traffic $y_{i.SCCP}$ and $y_{i.INAP}$.

Conclusion. The offered method allows in more extensive spectrum to define signalling traffics of subsystem MTP, users SCCP, ISUP and appendices INAP of system common channel signalling at the lower layer, allowing estimating volumes of the signaling equipment of a link of the signaling in peak of traffic.

The carried out numerical calculations in peak of traffic have shown, that at $\square_{i.\,SU}$ $\square$ 0,18 (bit/s), $L_{SU}^{зн} = (80 \div 2232)$ bit, V_q=64 Kbit/s, ℓq = 8 bit, $T_{ia}^q \le (120 \div 190)$s, $y_{CCS} \le$ (0,176÷0,198)Erl ≤ $y_{CCS.supl.}$ = 0,20 Erl [6], and it is prove that obtained results correspond to recommendations ITU-T Q.761.

Literature

1. A.V. Roslyakov. Common Channel Signaling System №7. Eko-Trends, Moscow (2003), 176 p. (In Russian)
2. K.E. Samoylov. Calculation methods and analysis of CCS7 networks. Prod. RUDN, Moscow (2002), 292 p. (In Russian)
3. B.S. Goldshtain, I.M. Exriel, R.D. Rerle. Common Channel Signaling System No.7. SCCP Subsystem: Handbook. – BHV, St. Petersburg (2006) 320 p. (In Russian)
4. M.A. Shneps-Shneppe. Lecture for Next Generation Network NGN. Max Press. Moscow (2005) 232 p. (In Russian)
5. V.Q. Lazerev , E.I. Peyl . Intellectualization of telecommunication networks // Technology and facilities of communication. Moscow (1998) No.6, pp.28-33. (In Russian)
6. ITU-T Recommendation Q.761: Functional Description of the ISDN User Part of Signalling System No.7 // Geneva, Sept., (1997).