INVESTIGATION OF METHODS OF CALCULATION SIGNALING LOAD CREATED BY SERVICES OF MULTISERVICE TELECOMMUNICATION NETWORKS

Bayram Ibrahimov[1], Shukur Mammadov[2]

[1]Azerbaijan Technical University, Baku, Azerbaijan
[2]Cybernetics Institute of ANAS, Baku, Azerbaijan
[1]*i.bayram@mail.ru*, [2]*smamedov@azerfon.az*

Abstract. In this paper analyzed questions of influence the basic and supplementary services on multiservice telecommunication networks to loading characteristic of common channel signaling system. The common channel signaling networks - which formed by the hardware and software modules- was investigated and on this basis offered model of calculation of load characteristics of common channel signaling systems. The analytical formulas were proposed which allow to estimate loading characteristics of common channel signaling system while handling basic and supplementary multiservice.

1. Introduction. One of the basic characteristics - defined in researches of creation of common channel signaling (CCS) networks, is load characteristic of the mixed traffic – such as payload and administrative traffics created by users of multiservice networks of telecommunication.

Functioning quality of multiservice networks of telecommunication essentially depends on time delivery and reliability of transfer of administrative traffic via multifunctional signal terminals for operative management and control of telecommunication processes- transmission, processing and reception of administrative traffic while establishment of connections between users of multiservice communication networks [1, pp.250-253].

For solution of such problems big attention is given to creation of effective networks of CCS for management of transfer of the non-uniform traffic, that gets greater importance in management communication systems. The CCS is the digital channel between two signaling terminal devices for an exchange of administrative messages. The multiservice network – is a communication network which is constructed according to the concept of a communication network NGN (NGN - Next Generation Network) and providing of a unlimited set of basic and supplementary services. It is obvious that supplementary and intellectual services increase loadings of CCS. Therefore the analysis and estimation of traffic load of CCS networks while performing supplementary services (telemetrically services, mobile communication, intellectual networks, etc.) delivered to users of multiservice network is extremely important.

The analysis of CCS networks and methods of calculation traffic load of administrative messages are widely discussed in [2, pp.140-142; 3, pp.56-57; 4, pp.27-30]. These purpose is analyze methods of CCS networks and estimation of administrative traffic load in telephone systems of communication.

In connection with the above-stated, given article is devoted to questions of research of CCS networks and estimation of administrative traffic loading generated by calls of multiservice networks of telecommunication.

2. General statement of problem. Multiservice network of telecommunication served by CCS, consists of from some switching centers connected between each other, having multilevel structure of distribution functions and form functional blocks. Multiservice networks of telecommunication are meant as digital networks of integrated services ISDN, intellectual networks (IN), mobile and mobile telecommunication networks of the general using. Among multiservice networks of telecommunication, recently have received wide development of intellectual communication networks [4, pp.176-177].

The investigated system and its subsystems working in the mixed mode (connected, kvaziconnected and untied), demand creation of architectural distributed intellectual network, a functioning on low and high level of OSI - Open System Interconnection -in BH of traffics (IPTT, Busy Hour - BH).

In multiservice networks of telecommunication following additional services, such as «Freephone» (FPN), "Televoting" (TVO), «Mass Calling» (MAC), «Universal Access Number» (UAN) and etc. [4, pp.151-154] widely are used. These services are examples of services of an intellectual communication network. For their realization the so-called intellectual platform representing hardware-software adjustment above a base network is used and all the basic units of this platform are connected by means of CCS network [5, pp.39-40]. On fig.1 shown the structural - functional scheme of the network equipment of an intellectual platform in CCS networks with subsystem INAP where the following is accepted to be represented: STOI - Signaling Terminals with an Open Interfaces; AITE - Automatic International Telephone Exchange; SSC - Service Switching Point; SCP - Service Control Point.

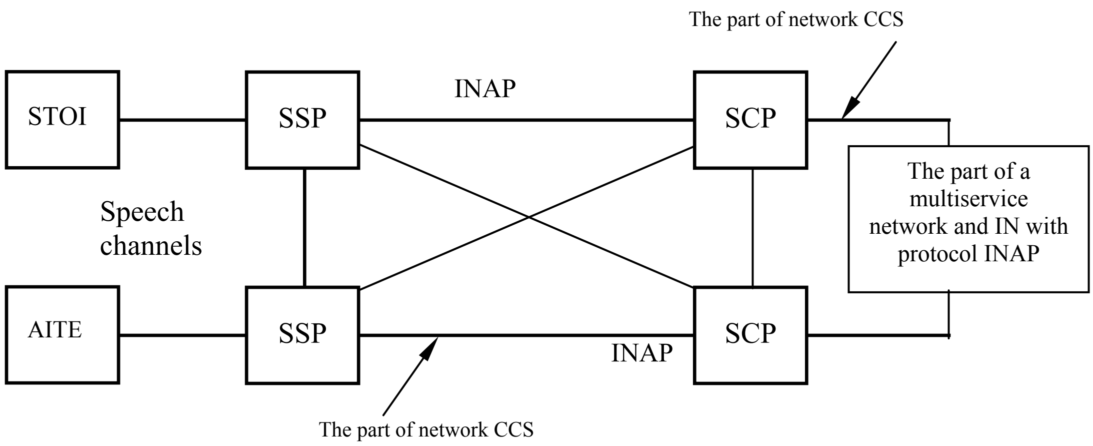

Fig.1. The structural - functional scheme of the network of an intellectual platform in CCS network with subsystem INAP

From the scheme it is obvious that for performance of supplementary services in system CCS the subsystem of an intellectual network according to protocol INAP (Intelligent Network Application Protocol), providing the reference of a subsystem of message transfer to network and supplementary service is added.

Let's assume that in intellectual communication networks the calls received from AITE through STP (Signaling Transfer Point) to Service Switching Point SSP, further for handling transmitted to Service Control Part SCP. Here the functions of SSP realized on transit switches and the unit of SCP is realized by dedicated hardware-software platform. In connection with stated above follows that the problem consists on calculation of signaling traffic load on bunches of a part of the signaling system between the units SSP and SCP while handling supplementary services.

3. Creation the model for calculation of administration traffic load created by a call of supplementary services. The analysis [3, pp.149-150] has shown that administrative traffic load should be calculated for all administrative interrelations of network CCS. For its solution it is necessary to estimate sizes of administrative traffic load Y_{INAP} by granting various services of intellectual communication networks with subsystems INAP. Using base models of the administrative traffic subsystems CCS offered in [3, pp.56-59], we shall define the administrative traffic loading created by calls of services IN on BH of traffics from station in a direction from unit SSP to unit SCP in forward and backward directions. It can be expressed as follows:

- In a forward direction, SSP $\rightarrow$ SCP

$$У_m^1 = \frac{\lambda_m}{V_k \cdot T_c} \cdot L_m^1, \text{ m} = \overline{1, M} \qquad (1)$$

- In the opposite direction, SCP→ SSP

$$У_m^2 = \frac{\lambda_m}{V_k \cdot T_c} \cdot L_m^2, \text{ m} = \overline{1, M}, \qquad (2)$$

where λ_m is speed of receipt of calls on BH of traffics from station; T_c is quantity of seconds in an hour; V_k is speed of transfer of the administrative traffic in intellectual communication networks; L_m^1 is average volume of the administrative information sent from unit SSP to unit SCP by granting of service m, m $=\overline{1, M}$; L_m^2 is average volume of the administrative information sent from unit SCP to unit SSP by granting of service m, m $=\overline{1, M}$.

Let's assume that if in calls on BH of traffics of any additional service create administrative loading $У_{INAP}$ not in BH of traffics signal loading make size $k \cdot У_{INAP}$, where k $\in [0,1]$. Then at each hour of h-day administrative loadings of service between units SSP and SCP in forward $У_m^1$(h) and in the backward $У_m^2$(h) directions are determined as follows [5, pp.41-42]:

$$У_m^1\text{(h)} = У_m^1 \cdot \text{km (h)}, \quad \text{h} = \overline{0, 23}, \quad \text{m} = \overline{1, M} \qquad (3)$$

$$У_m^2\text{(h)} = У_m^2 \cdot \text{km (h)}, \quad \text{h} = \overline{0, 23}, \quad \text{m} = \overline{1, M} \qquad (4)$$

Where, k_m(h) is the correcting factor of the account of loading not in for both services also is expressed as

$$k_m(h) = \begin{cases} 1, & if \quad h + \Delta z \in B_m \\ k, & if \quad h + \Delta z \notin B_m \end{cases}, \text{ h} = \overline{0, 23}, \text{ m} = \overline{1, M}, \qquad (5)$$

where Δz is a difference in time zones, concerning time zone Baku (Ankara, London, Moscow, etc.), for unit of a network of telecommunication; B_m - set IPTT for m-th additional service and $B_m \subset \{0, \ldots, 23\}$.

From received (3) and (4) the total loading created by all services from station follows, that, at each an hour of h-day in forward $У^1$(h) and in the backward $У^2$(h) directions is defined by following expressions [5, pp.45-47]:

$$У^1\text{(h)} = \sum_{m=1}^{M} У_m^1(h), \text{ m} = \overline{1, M} \qquad (6)$$

$$У^2\text{(h)} = \sum_{m=1}^{M} У_m^2(h), \text{ m} = \overline{1, M} \qquad (7)$$

Thus, on base of research CCS networks in intellectual communication networks the model of the administrative traffic load calculation method is given, where created by calls of intellectual communication networks.

It is necessary to note that at a following stage for an estimation of size of administrative loading by means of an offered method it is necessary to define size of administrative loading for each pair units SSP and SCP an intellectual communication network. The received values in the further can be used for calculation of quantity of equipments of the signal system of subsystem INAP in the node where connecting units SSP and SCP:

For calculation of capacity of nodes of a part of the signal system between units SSP and SCP, the administrative loading necessary for the handling created in BH of traffic by calls of all services, in view of a difference in time zones it is necessary to define values of administrative loading of subsystem INAP in forward $У_{INAP}^1$ and in the backward $У_{INAP}^2$ directions.

From the received formulas (1) - (7) follows that required sizes can be calculated on following expressions:

$$У_{INAP}^{1} = \max_{h} У^{1}(h), \text{ h} = \overline{0,23} \tag{8}$$

$$У_{INAP}^{2} = \max_{h} У^{2}(h) \text{ h} = \overline{0,23} \tag{9}$$

Having values of administrative loadings it is possible to calculate capacity of nodes between units SSP and SCP an intellectual communication network. For this purpose for each unit SSP it is enough to define value of integer size N_{INAP} which is defined by the formula:

$$N_{INAP} = \left[\frac{\max(У_{INAP}^{1}, У_{INAP}^{2})}{У_{доп.INAP}} \right] \tag{10}$$

Performed numerical calculations based on proposed method calculation of value of administrative loading on the CCS networks and following results were received: M=2, L_m^1 = 363 bayt, B_1={15,16,17,18}, λ_m= (6,…,8)·10^3 pak/s, L_m^2 = 738 bayt, B_2={18,19,20,21}, h = 18 hour, T_c =3600s, k = 0,45, m=1,2; V_{SSP} = 64 Кbit/s, (SSP→SCP), $У_m^1$ = 0,1008 Erl and (SCP→SSP), $У_m^2$ = 0,2050 Erl. As in dismissed the approach it is made for fixed time of day h=18 hours, under the formula (8) and (9) $У_{INAP}^1$ = 0,0824 Erl $\leq У_{adm.INAP}$, $У_{INAP}^2$ =0,1875 Erl $\leq У_{adm.\,INAP}$ = 0,20 Erl [5, p.54-55, 6].

Then the number of subsystem INAP on the level of node the signal system between units SSP and SCP, necessary for service of administrative loading at 18 o'clock for each administrative relation is defined as follows:

$$N_{INAP} = [\max(0{,}0824; 0{,}1875)]/(0{,}20) = [0{,}938] = 1$$

Numerical analyses have shown, that the received results correspond to recommendations ITU-T Q.706 and Q.766 [6].

4. Conclusion. As a result of investigation intellectual communication networks with protocol INAP the analytical formulas are defined which allow calculate capacity of resources between units SSP and SCP, where necessary for handling administrative traffic created on BH by all services.

References

1. A.V. Roslyakov. CCS No 7: architecture, protocols, application. (In Russian), Eko-Trends, Moscow (2008) 320 p.
2. B.J. Lihttsinder, M.A. Kuzyakin, A.V. Roslyakov, S.M. Fomitchyov. Intellectual of communi -cation networks. (In Russian), Еко-Trendz, Moscow (2000) 258 p.
3. B.G. Ibrahimov, Sh.M. Mammadov. Method of calculation of the signaling traffic in network common channel system signaling at lower layer // The Second International Conference «Problems of Cybernetics and Informatics», (in Baku), Vol. 1 (2008) pp. 56 – 59.
4. K.E. Samoylov. Calculation methods and analysis of CCS 7 networks. (In Russian). RUDN, Moscow (2002) 292 p.
5. A.I. Letnikov, A.P. Pshenichnikov, Y.V. Gaydamaka, A.V. Chukarin. The signal system in networks with switching channels and packages. (In Russian), MTUSI, Moscow, (2008) 195 p.
6. ITU-T Recommendation Q.761: Functional Description of the ISDN User Part of Signalling System No.7 // Geneva, Sept. (1997).