Development of an Algorithm for Increasing the Capacity of Mobile Telecommunication Networks.

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ABSTRACT

The article discusses the importance, features and options for increasing the throughput of mobile telecommunications networks, the development of the telecommunications sector, the article writes about increasing the throughput on the transit networks of mobile operators (TS) in its functions is similar to long-distance and international fixed networks. And it describes the signaling system of SS No. 7, about its capabilities related to the management of conversational and signaling traffic in changing conditions on the transit network, as well as to increase the efficiency of using network resources.

Keywords: capacity, telecommunications network, algorithm, cellular network, development, mobile operators.

Telecommunication network - a set of communication lines (channels) of switching stations, terminal devices, on the territory, providing transmission and receipt of messages Network throughput - this is the maximum allowed traffic processing rate, which is determined by the network standards. It shows what is the maximum amount that can be transferred per unit of time (most often it is one second).
Algorithm - A system of sequential operations (in accordance with certain rules) for solving some kind of problem. tasks.

Introduction

Any company doing business in the field of telecommunications is faced with the task of minimizing the cost of building and developing a network while maintaining acceptable quality indicators. Cellular communication companies are no exception. At present, the Republic is experiencing a rapid development of the telecommunications sector, and especially mobile communications, with the GSM standard being most widely used. More and more services are in demand by an ordinary cellular subscriber: various services based on GPRS / EDGE technology (soon using newer UMTS technology), SMS and MMS messaging, and these additional services allow, according to various estimates, to increase this important the economic indicator of the operator's activity as ARPU (average income per subscriber) by 1520% [2]. Naturally, the development of new technologies requires the development of equipment on which these technologies will be implemented. This is quite a difficult task, and different hardware companies solve it in their own way, but satisfying the requirements of standards (ETSI, ITU, etc.). However, a number of methods used in the implementation of a particular node are common.

Main Part

As an example, we can cite methods for linearizing power amplifiers [3,4-9,10], the use

of which becomes relevant in cellular networks during the transition to EDGE and third-generation networks, where signals are used not with a constant (as in GSM), but with a variable envelope [1].

Taking into account the above factors, analysis, evaluation of the effectiveness and impact on quality indicators of the main options that allow increasing the network capacity, as well as finding the parameters of a mathematical model for predicting congestion and redistributing voice and packet traffic in relation to GSM networks are relevant tasks.

One of the most important tasks is to develop an algorithm for increasing the throughput of mobile telecommunications networks.

To achieve this goal, it is necessary to solve the following tasks:

- based on the analysis of the possibilities of assessing the mobility of subscribers in networks, determine the parameters of the mathematical model for predicting congestion on the radio interface of the base station subsystem;

- develop practical recommendations on the use of existing options to increase network capacity;

- on the basis of statistical processing of the available experimental data obtained from various network elements, develop an algorithm for calculating the allowable values of the logical parameters of base stations when setting up the "direct reassignment" procedure;

- on the basis of experimental data, develop and justify an algorithm for redistributing resources on the radio interface between packet and voice traffic in order to maximize the effective use of the available network capacity.

When developing an algorithm for calculating the allowable values of the logical parameters of base stations, when setting up the “direct reassignment” procedure and determining the model parameters by congestion prediction, methods of queuing theory and teletraffic theory, probability theory and statistical radio engineering can be used.

It is required to determine: parameters that allow assessing the mobility of subscribers, taking into account the peculiarities of determining the location of subscribers in networks.

Determine a mathematical model for predicting congestion in networks, and its parameters are determined taking into account the found mobility parameters.

To develop an algorithm for setting up the "direct reassignment" procedure, which allows reducing congestion at the radio interface of the base station subsystem while maintaining a low percentage of connection drops.

- application of the direct reassignment procedure allows to increase the network capacity by up to 25%;

- setting up a dual-band network allows you to increase the efficiency of using the cell resource by up to 5%;

- the use of pseudo-random frequency tuning makes it possible to improve the CunSR values by 15%, and the TAsFRradio value - almost twice.

• The parameters of the mathematical model for predicting the growth of congestion based on mobility parameters calculated in GSM networks show that at intensity = 10 ab/s, the required analysis interval is 100-250 s, which is approximately 34 times less than the time of occurrence of really noticeable congestion from -for any situations such as "traffic jams", accidents, etc. This allows you to use the resulting model in equipment for the dynamic redistribution of network resources.

The resulting analytical formula shows that with the Signallevmin = -95 dBm, in order to keep the values of unsuccessful connections no higher than 2%, the logical parameters responsible for the operation of the “direct reassignment” procedure should be configured in such a way that the proportion of signals with a level below the boundary level does not exceeded 15%.

The found settings for the algorithm for redistributing resources on the radio interface between voice and packet traffic make it possible to keep the Rotk gprs value at a level of 1-2 %, with minimal impact on Rotk:

Qty TKHSharmetr HIGHTRAFFIC MAXPDCH

1 TRX 83% 5
2TRX 92% 12
3TRX 90% 19
4TRX 93% 26
5TRX 94% 34
6TRX 95% 41 and

- for sectors with one and two transceivers, regardless of the presence of the Half Rate mode, the values of MAXPDCH and HIGHTRAFFIC:

MAXPDCH = Number of TS - 1, where TS are available time slots not occupied by overhead channels.

MAXPDCHHIGHTRAFFIC = 100*(MAHRBSN)/(Number of TS);

- for sectors with three or more transceivers, regardless of the Half Rate mode:

MAX PDCH = Number of TS- 2,

HIGHTRAFFIC = 100 *(MAHRBSN)/(Number of TS).

One of the objects of mobile telecommunications communication is the transit network of mobile operators (TS) in its functions is similar to long-distance and international fixed networks. It consists of transit switching centers of cellular mobile communications (TCC CMS), local switching centers of cellular mobile communications (LCC CMS) and international switching centers (ICC) interconnected by digital communication channels. Its feature is a much larger (compared to fixed communication networks) volume of processed signal load, since in addition to signaling information about establishing a connection, information about the location of mobile subscribers, their registration in a particular network, additional services available to these subscribers. As a result, the signaling network can be subject to significant congestion, which leads to increased connection setup time and failures.

At present, the transit network of mobile operators uses a fixed call routing scheme and a procedure

sequential pre-booking of voice channels for the time of establishing a connection and the waiting time for a subscriber's response, which leads to inefficient use of its resources.

With a sharp increase in the load on communication networks, the required quality of service for calls on them can be ensured by using effective methods to increase the throughput of these networks.

The alarm system OKS No. 7 is a powerful tool for managing an information network. Using its capabilities allows solving problems related to the management of conversational and signaling traffic in changing conditions on the transit network, as well as increasing the efficiency of using network resources. In this regard, the task of developing a new method for increasing the throughput of the transit network of mobile operators is relevant.

As a result of research on the transit network of operators mobile communication load parameters in the conditions of its large growth the following results are obtained:the average duration of calls in various directions of the transit network of mobile operators during busy hours (HHH) is 47 seconds. Approximately 12%> of conversations are less than 10 seconds long;

Between 2003 and 2006, the transit network of mobile operators in the CNN experienced an increase in the average connection setup time. So, in 2003 it was 4.2 seconds; in 2004 - 4.4 seconds; in 2005 - 4.7 seconds; in 2006 - 5.1 seconds. This is due to congestion on the transit network of mobile operators due to a sharp increase in the number of mobile subscribers. The results obtained were taken into account in the study of the efficiency of using the resources of the considered transit communication network.

Analysis of the causes of failures in establishing connections on various directions of the transit network of mobile operators in the CNN allowed determine the average range of occupations, which with a confidence probability 0.95 was: for calls that ended in an answer (Poo=0.73±0.03); For calls that ended in no answer (Pno=0.11±0.02); for calls ended in failure to establish connections (Pc=0.16±0.02). Received the results were used in the development of a mathematical model for servicing calls on the transit network of mobile operators.

.The notion of guaranteed channel resource threshold of spoken channels on the first choice path for implementation of

connection establishment guarantees has been introduced. A procedure has been developed for determining its value in relation to the total number of voice channels on the first choice path, upon reaching which, in order to exclude failures, connections are established along other paths. An algorithm for establishing connections has been developed that takes into account the threshold of a guaranteed channel resource.

.A mathematical model of call handling on the transit network of mobile operators has been developed, based on the refusal to pre-book conversational channels on the first choice path for the time of establishing a connection and the waiting time for a response from the called subscriber. The mathematical model takes into account the main specifics of the transit network of mobile operators - sequential control of the establishment of connections; high connectivity; an increase in the load concentration factor in the CHIN with an increase in the distance between the switching centers; hierarchical building structure.

Subject to semi measured characteristics of the average spectrum of occupations for various directions of communication, principles of construction and routing calls on the transit network of mobile operators developed algorithm for calculating the probability of call losses and a procedure is proposed determining the number of spoken channels needed for effective use of transit network resources. Recommendations have been developed for maintaining normal quality indicators.

Conclusion

The developed method makes it possible to increase capacity of the transit network of mobile operators by 9-14%, and can also be effectively used on other communication networks,having a structure similar to the transit communication network. This method takes into account the specifics of the transit network of mobile operators -hierarchical construction structure, sequential control establishing compounds, increasing the concentration factor loads in LHV with increasing distance between switching centers,high connectivity.

The developed algorithm for determining the probability of call losses makes it possible to carry out calculations for each route of establishing connections, taking into account all possible paths, as well as to evaluate the efficiency of using channel resources of a communication network and the quality of service for calls on it. When using a PC with an Intel Pentium 4 processor with a clock frequency of 2.4 GHz, it takes 6 minutes to calculate the probability of loss of calls on the considered fragment of the transit network of mobile operators, with the maximum number of available voice channels and the intensity of incoming calls.

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