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ANALYSIS OF THE PROCEDURE LCAS IN TRANSPORT NETWORKS NGSDH

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The paper presents a procedure LCAS (Link Capacity Adjustment Scheme) - scheme of regulation of channel capacity, is built on virtual concatenation mechanism. LCAS protocol allows you to dynamically change the capacity of the channel without interference from staff. In particular, it is interesting to create a model protocol on one of the most common programming languages, since the simulation to evaluate the effectiveness of almost any technology to run it in operation.

Keywords: link capacity adjustment, simulation , virtual concatenation, dynamically change.

For the last 8-10 years the situation in the communication market has sharply changed. The global information society demands new technologies that are technologies of a packet transmission of the data, and to remain in the market, the operators maintaining networks with switching off ports should provide effective drive of the package traffic. Volumes of the package traffic have increased repeatedly. There is statistic data: access services to the information with use info communicational technologies (Internet) for 9 months 2010 have generated the traffic of 177 626 415 153 Mb that is 2,4 times more than a similar indicator in 2009.

Classical SDH (Synchronous Digital Hierarchy) it was developed for traffic transmission with constant bit speed and it is badly adapted for the package traffic drive. Nevertheless, high indicators of quality and possibility of self-restoration of a network are rather attractive to use SDH as transport for information networks. However at attempt directly to pack shots of a LCN into containers SDH engineers have faced certain difficulties, but the main thing, capacities of containers were filled inefficiently. Besides, the networks SDH are characterized by reservation, that is the big redundancy. Half of ports capacity is intended for reservation, thus, efficiency of transmission falls to several tens percent — some experts compare such operating ratio of throughput capacity with UAC of a steam locomotive [1].

Networks SDH are constructed and debugged, the big resources are enclosed into creation and operation, and to refuse further use, that means to pass to networks with switching off packages is impossible in many ways. Besides, the technology is worked out for many years, there are experts, and there is equipment. Introduction of new technologies can change this viewpoint. For example, Ethernet over SDH, EoSDH, can essentially expand a spectrum of services of communications service providers, as in many cases this is rather inexpensive enterprise (as SDH serves only as transport, modernization is necessary only on terminal points of a route).

For a solution of a problem of adaptation of the package traffic to ports with constant bit speed the modern report GFP already exists and it is supported by many manufacturers, allowing to smooth pulsations of the package traffic and economically using resource of virtual containers at the same time [2].

Typical speeds of networks of data transmission are poor coordinated with speeds SDH as capacities of virtual containers were developed for mostly ports of the vocal traffic transmission. This question is solved by procedure of virtual concatenation, allowing uniting capacities of several containers together for maintenance of the demanded pass-band.

Another problem issues that port loading can reach a maximum at certain hours and fall to a minimum during other time. It will be natural and expedient to change capacity of all port, adding or deleting the elements referring to the group of concatenated containers. In data transmission networks the traffic, instead of time usage of the allocated port is usually paid.

The decision of the given problem is procedure LCAS, that is the scheme of resetting of throughput capacity of the port, representing a superstructure over the gear virtual конкатенации. Report LCAS allows changing the capacity of the port dynamically without staff intervention.

Technology LCAS has appeared rather recently and isn't studied up to the end. In particular, creation of model of the report on one of widespread programming languages is a sphere of interest as it allows estimating efficiency of almost any technology before its start in operation.

Working out the model of report LCAS in language of high level and its analysis of functioning is the purpose of the given work.

For achieving the objective it is necessary to solve following problems:

1. To create the accurate description which considers difficult specificity of report LCAS.

2. On the basis of the information description to create virtual model of report LCAS

3. The results received at the analysis of virtual model of report LCAS should be as much as possible approached to the results received by means of practical modes at functioning of the report.

For creation of the description of report LCAS language SDL (recommendation ITU-T Z.100) which basis is made by the concept of interaction of final automatic machines was used. There are two versions of language SDL - graphic (SDL/GR) and SDL – program similar (SDL/PR). Each symbol SDL/GR corresponds to the concept and a designation in program similar version SDL. The description of telecommunication reports in language SDL in a graphic kind represents diagrams reflecting logic of the report, sequence of operations and changes of the object condition, presented in the form of blocks [3].

Each block in the SDL-system diagram can be divided further either into blocks or a set of processes. The process describes behavior in SDL and it is the most important object in language. The behavior of each process is defined by the expanded final automatic machines which perform operations and generates reactions (signals) in reply to external discrete influences (signals).

So, process in the SDL-specification has final number of states, in each of which it can accept a number of the admissible signals sent to these process (from other processes or from the timer). Process can be in one of the states or in transition between states. If during transition the signal intended for given process is received, it is put in turn to process arrives.

The operations performed during transition can include data transformation, as in signal transition to other processes etc. Signals can contain the information which is defined on the basis of the process data sending a signal in a parcel of signals, and it is used by process-addressee together with that information which this process has. Besides the processes contained in the considered system, signals can also go out of the system limits to environment, and arrive from environment as well. Environment is understood as everything which is out of SDL-system [4].

Sending and receiving signals, their transmission by means of the information from one process to another, processing and using this information also define the way of SDL-system functioning. It is supposed that after performance of the set of operations, the certain result in behavior of specified system, in particular, the signaling report should be achieved. As a rule, the expected result will mean that in reply to a number of the signals arriving from environment (for example, the terminal station complete set of a connecting line), the system should perform the certain operations terminating in message transfer into environment (in the same station complete set of a connecting line and/or in other program process managing the sending of tone signals, in process of information inquiry by AND, etc.) [5].

For the description of report LCAS in language SDL a modified version of the report is used, some elements aren't used, the values of the rest ones are resulted in Figure 1.

Graphic representation of sequence of states change and work mechanisms of the report gives more evident representation about its work and it is the analysis tool as well.

Report LCAS is described on diagrams SDL in detail to show the transition from one state into another. The functions performed by scheme LCAS, can be broken into following sections:

- A part of the report that is realized on the side of a source of group VCG;
- A part of the report that is realized on the side of the receiver of group VCG.

It is necessary to mean that the information stream from a source to the receiver is intended on each separate element of group VCG, i.e. SQ, CTRL, CRC and MFI. The stream of the information from the receiver to a source occurs by definition that is general for all elements of group VCG. Using these streams, it is possible to make the further division:

- A part performing functions on the source side, transferring the information of each separate element to the receiver side, i.e. SQ, CTRL, CRC, MFI. Information interchange SQ between group VCG elements is made. Information SQ is also transferred to a reception side to steer the distribution MST of a corresponding element;
- A part performing functions on the receiver side, both transferring the information of each separate element from the side of a source are directing SQ and the status of elements of the following part;
- A part which is performing functions on the receiver side, receiving the information, concerning all elements of group VCG, i.e. the status of elements of group VCG as a whole, and conferring the revealed change in numbering of sequence of group VCG;
- A part which is performing functions on the source side, receiving the information, concerning all elements of group VCG, i.e. VCG MST and RS-Ack, and distributing MST of each part of the element of group VCG.

In Figure 1 these parts are shown and the information stream between these parts is presented. Figure 2 shows events, signals that have been exchanged by separate parts of report LCAS.

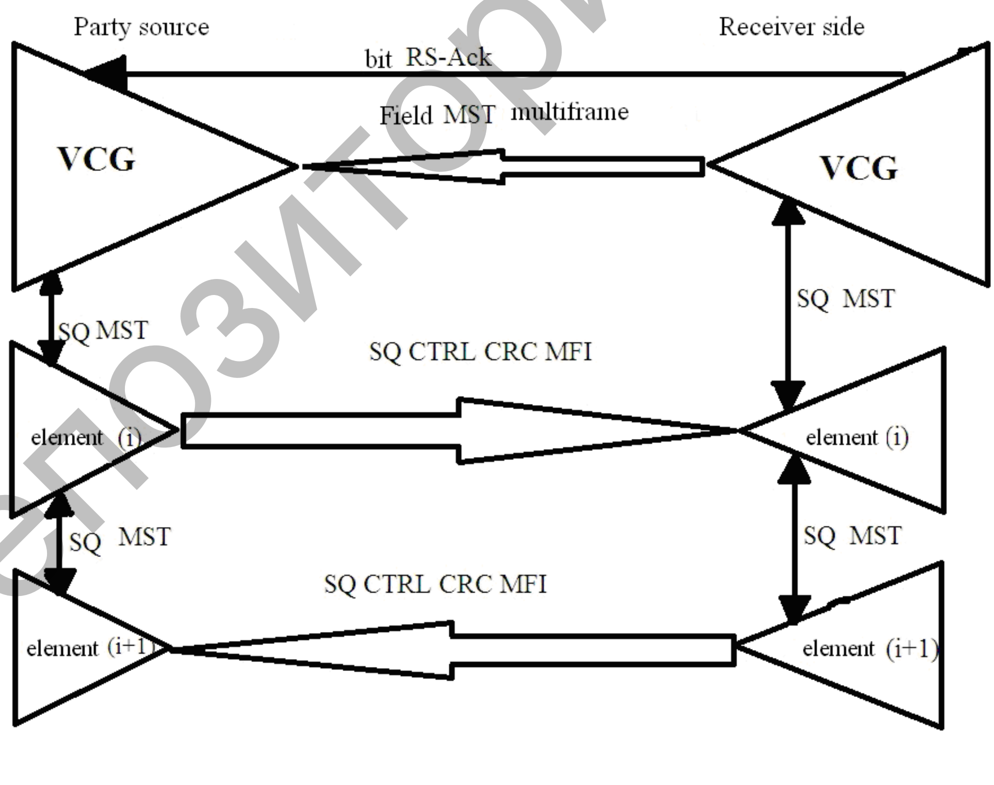

Fig. 1. Highlighting the sections of report LCAS

Figures 3 and 4 describe behavior of the source and the receiver accordingly, in language SDL of diagrams.

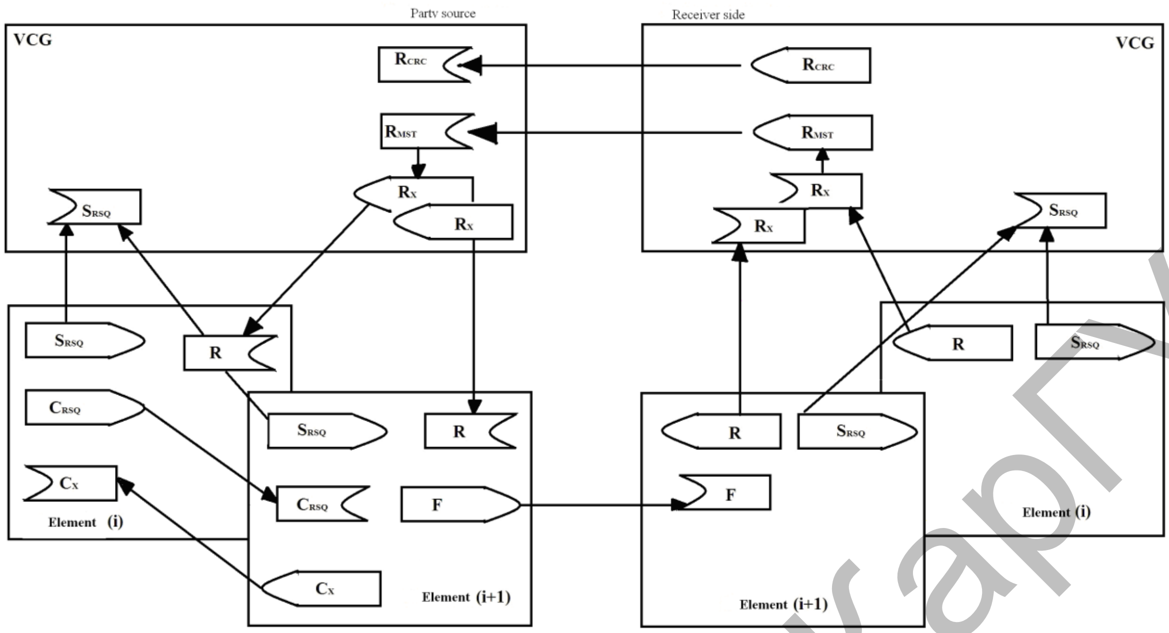

Fig. 2. the stream of events of report LCAS

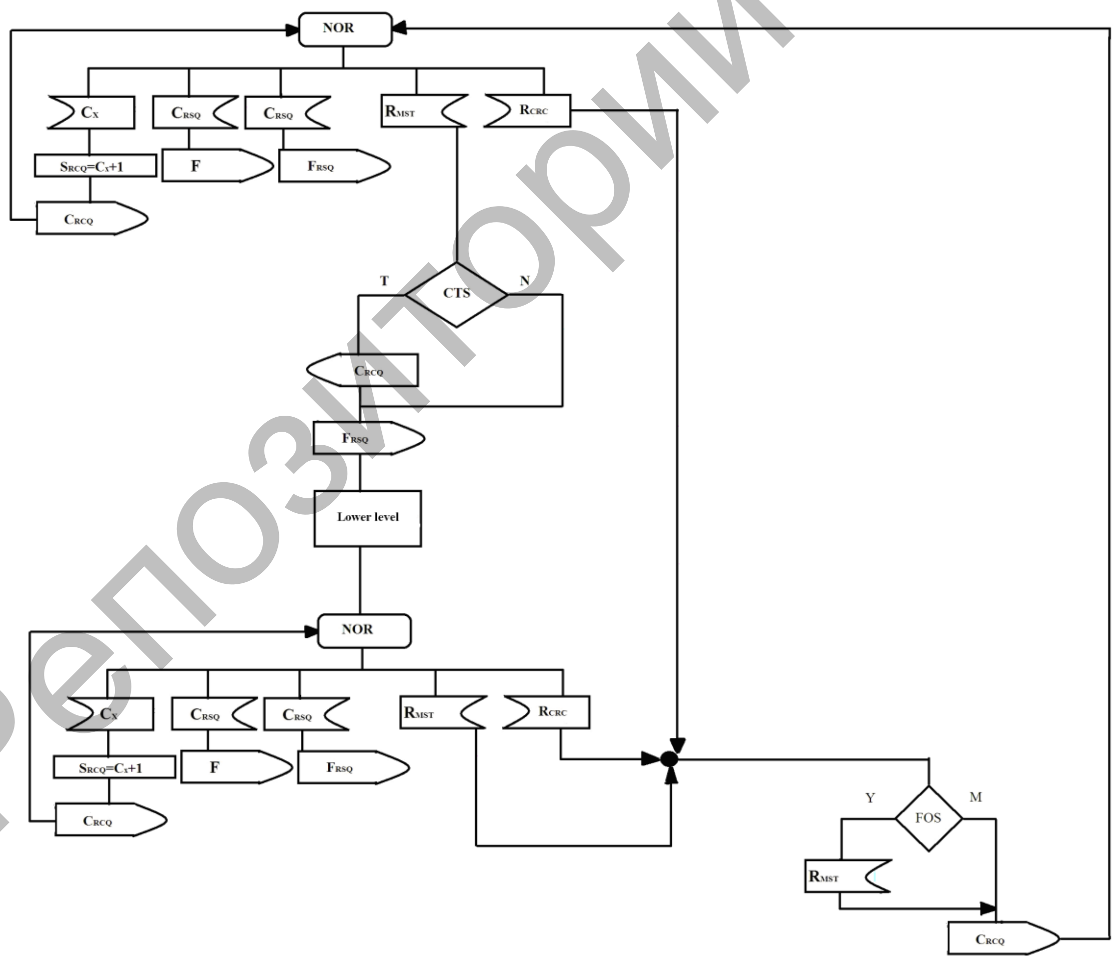

Fig. 3. Diagram of the source side states

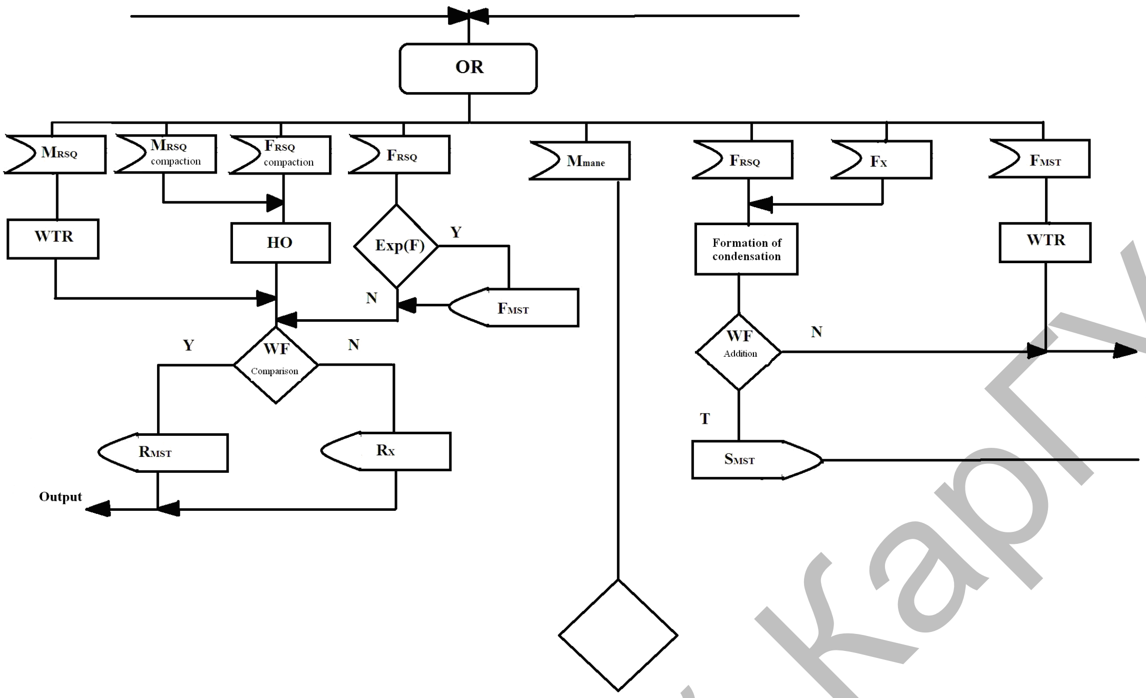

Fig. 4. Diagram of the source side states

Owing to the evident description of report LCAS in language SDL it is simple to make the information model of report LCAS which is based on the description of elements VCG of the source and the receiver in a programming language of high level as final automatic machines. The language C ++ was chosen as a language of high level, as the most suitable one in respect of simplicity of the class admission describing final automatic machines of the source and the receiver.

RESULTS OF MODELLING WORK OF REPORT LCAS

Let's consider some scenarios of work of report LCAS using of the received model. In each case the function contents ‘main’ will change. The target data are files of journals, it is possible to estimate correctness of work of the program referring to them.

1. Addition of two VC to VCG by turn and simultaneously

The key moment while addition the elements is the correct establishment (distribution) of indicators of sequence on the source side. We will check up the correctness of work of model when adding several containers simultaneously. In this case two containers, in the first example by turns, in the second one simultaneously are added. Initially all elements are in position IDLE, in group there are no active containers.

Results of work of the program are resulted in table 1.

The control system submits signals of addition to elements by turns, sequence indicators receive numbers 0 and 1 accordingly.

Let's consider further simultaneous addition, identifiers can not coincide with the previous case, but not with each other.

Simultaneous addition.

Table 1. Journal of the source and the receiver of the container №1

<table>
<tr><th>Источник (Source)</th><th>Приёмник (Sink)</th></tr>
<tr><td>(IDLE)</td><td>(IDLE)</td></tr>
<tr><td>>M ADD|</td><td>>M ADD|</td></tr>
<tr><td>|SQ=1|</td><td>(FAIL)</td></tr>
<tr><td>|F ADD></td><td>>F_ADD|</td></tr>
<tr><td>(ADD)</td><td>Connectivity check</td></tr>
<tr><td>>R OK|</td><td>|R OK></td></tr>
<tr><td>|SQ=1|</td><td>(OK)</td></tr>
<tr><td>|n=2|</td><td></td></tr>
<tr><td>|F EOS></td><td>>F_EOS|</td></tr>
<tr><td>|S RSQ></td><td>Reading payload</td></tr>
<tr><td>|C_NRM></td><td>(OK)</td></tr>
<tr><td>Start sending payload</td><td></td></tr>
<tr><td>(NORM/EOS)</td><td></td></tr>
</table>

Table 2. Journal of the source and the receiver of the container №2

<table>
<tr><th>Источник (Source)</th><th>Приёмник (Sink)</th></tr>
<tr><td>(IDLE)</td><td>(IDLE)</td></tr>
<tr><td>>M ADD|</td><td>>M ADD|</td></tr>
<tr><td>|SQ=0|</td><td>(FAIL)</td></tr>
<tr><td>|F ADD></td><td>>F_ADD|</td></tr>
<tr><td>(ADD)</td><td>Connectivity check</td></tr>
<tr><td>>R OK|</td><td>|R OK></td></tr>
<tr><td>|SQ=1|</td><td>(OK)</td></tr>
<tr><td>|n=2|</td><td></td></tr>
<tr><td>|F EOS></td><td>>F_EOS|</td></tr>
<tr><td>|S RSQ></td><td>Reading payload</td></tr>
<tr><td>|C_NRM></td><td>|S RSQ></td></tr>
<tr><td>Start sending payload</td><td>(OK)</td></tr>
<tr><td>(NORM/EOS)</td><td></td></tr>
</table>

Let's notice that log entries correspond to the report, and sequence indicators are established truly. In this case, as well as at addition of elements by turns, the model works truly.

2. Removal of an element

In case of element removal, as well as while addition, change of the indicator of number of sequence demands attention. When removing the last element of group, field CTRL of the penultimate element (having the highest number of sequence) changes. Numbering of the sequence and steering fields of other elements in group are not changed. If not last element is removed numbers of sequences, more than the removed one, should be counted.

Let's create the scenario in which three elements at first are added, then one of them we will remove. At first we will consider the removal of the second element, then removal of the last, the third one.

Removal of not last element of group

For creation of the specified scenario in the basic program the steering command about addition of three elements is given, and after processing of signals by function ‘main’, the second container receives a command for removal, and function ‘main’ is caused again. Journals of work for elements of the second and third containers are resulted as removal of the second container doesn't affect the work of the first one.

Having received a removal command, the source notifies about sequence change, it ceases to send loading and, having put SQ = 255, passes to a disabled state.

Table 3. Journal of the source and the receiver of the container №3

<table>
<tr><th>Источник (Source)</th><th>Приёмник (Sink)</th></tr>
<tr><td>(IDLE) >M_ADD|</td><td>(IDLE) >M_ADD|</td></tr>
<tr><td>|SQ=O|
|F ADD>
(ADD)
>R OK|
|SQ=2|
|n=3|
|F EOS>
|S RSQ>
|C_NRM>
Start sending payload
(NORM/EOS)
>C RSQ|
|SQ=1|
\C RSQ>
(NORM/EOS)</td><td>(FAIL)
>F_ADD|
Connectivity check
|R OK>
(OK)

>F_EOS|
Reading payload
|S RSQ>
(OK)</td></tr>
</table>

Apparently from table 3, the source of the second element informs the receiver about the change of number of sequence and changes it from SQ=2 to SQ=1, and also informs that now it is the last one in the sequence. The model works right.

In this case elements, having received a command of removal of the container, following report LCAS, put the container out of work, establishing SQ=255, pass in a disabled state.

In work the information model of report LCAS is developed. The created model adequately reflects principles of work of the report. While steering signals affect the system of elements the model processed them correctly, the elements were transferred into the necessary states and thus they sent signal messages to each other. The journals of work of elements received during modeling help to find out correctness of processing of messages of a model for debugging of a model or on the contrary they can help to find feeble sides in report LCAS.

As the report LCAS is for today young enough and it is not studied up to the end, the results received in given work, can be of interest both as a methodical material, and for use in research work.

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