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NEW TRUNK RESERVATION SCHEME

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Abstract The new trunk reservation scheme in the network with alternative routing is proposed. This scheme is based on the limiting of the difference between overflowed calls and background calls. It is shown, using the simulation, that this scheme is always more efficient than the common scheme based on limiting of number of overflowed calls. Efficiency increase is proportional to degree of reservation

Key words: Telecommunication networks, teletraffic theory, alternative routing.

1. Introduction

Trunk reservation scheme (*TRS*), [1], is the method which is used in alternative routing to ensure the balance of two components of traffic: background (arrived or external) traffic and overflowed traffic. Using of this method has two consequences. Balance of traffic, i.e. balance of grade of service (*GOS*) is reached, but some calls are lost due to reservation. It is clear that the goal of *TRS* design is to maximize the protection of the balance, and to minimize the losses due to reservation. A new model of dynamic reservation that minimizes losses due to reservation is proposed in this letter.

2. TRS model

TRS model, (ref. [1], subsection 5.3.3.), is composed of high usage group of M trunks (or channels), and an alternative, or overflow group of N trunks. Offered calls to the high usage group make the traffic A_2 and background calls offered to overflow group make the traffic A_1. New call offered to the high usage group occupies one out of M trunks, if any idle. Otherwise, this call is offered to the overflow group. This, overflowed, call is realized in

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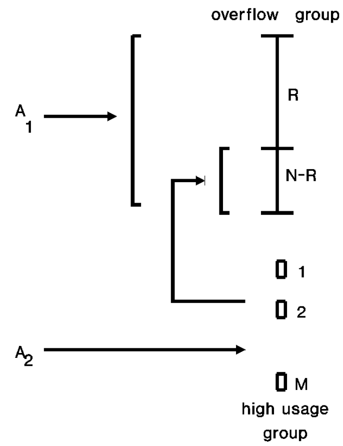


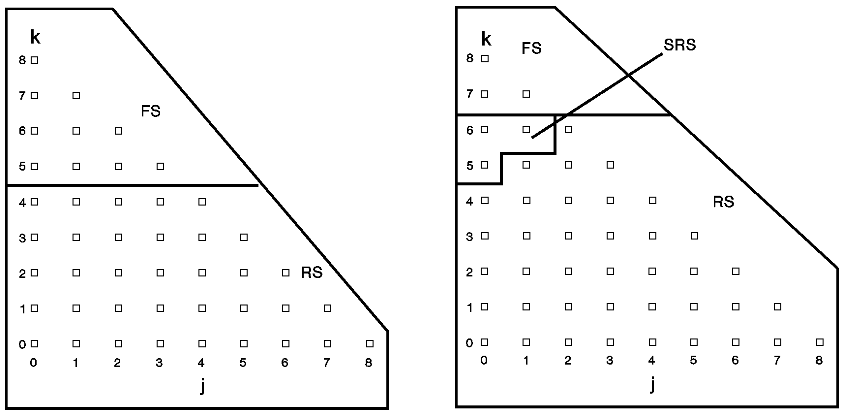
Fig. 1. $TRS(N, R, M, A_1, A_2)$ model.

overflow group, only if number of idle trunks is greater than R. Background call is realized in alternative group only if there is, at least, one idle trunk. This model will be designated with the label $TRS(N, R, M, A_1, A_2)$. Model is shown in Fig. 1 in which the number of trunk in alternative group should be understood as the number of idle trunks.

Alternative group can be described by the states $\{j, k\}$ where j is the number of trunks occupied by background calls ($j = 0, 1, 2, ...N$) and k is the number of trunks occupied by overflowed calls, ($k = 0, 1, 2, ...N - R$). These states can be designated as regular states RS, Fig. 2a. It is clear that model can not be in any of the states $\{j, k\}$ where $k > N - R$ holds, and these states are called forbidden states, FS, Fig. 2a. States $\{j, k\}$ where $j + k = N$ holds, are called *loss states due to lack of idle trunks.* States $\{j, k\}$ where $j + k < N$ and $k = N - R$ holds, are called *loss states due to the reservation.* The model $TRS(8, 4, M, A_1, A_2)$ is shown in Fig. 2a. This reservation can be called *fixed*, and is described by the rule:

the number of overflowed calls in the alternative group can not be larger than the designated (prescribed) number of calls, regardless of the number of the background calls i. e. the condition for the completion of the new overflowed call is $k < N - R$.

For example, in the model $TRS(6, 4, M, A_1, A_2)$ transition from the state $\{3, 2\}$ to the state $\{3, 3\}$ is impossible, regardless of the fact that the state $\{3, 3\}$ does not disturb the balance of background and overflowed traffic.



a) b)

Fig. 2. *a)* $TRS(8, 4, M, A_1, A_2)$
b) $NTRS(8, 4, M, A_1, A_2)$

Hence, the possibility of dynamic or adaptive reservation that will protect the balance of traffic components when the possibility exist that the balance would be disturbed should be explored. That means that the new model of trunk reservation, $NTRS$, with as few as possible forbidden states, should be designed.

Adaptive, or dynamic, reservation is well known method, used for protection of outgoing or incoming traffic in both-way telephone trunk groups, [2], [3]. "Reservation domain method" described in ref. [2] uses two reservation parameters and is similar to the reservation method with one parameter described in [3]. Unfortunately, the method described in [2] is always exposed to the random incoming and outgoing traffic and can not be directly applied to the observed model of overflowed traffic.

3. NTRS model

To protect the balance of both traffic components and GOS, and to eliminate the loss due to reservation in the states of small unbalance of traffic components, a model with reservation in the group of alternative trunks is suggested, where following rule applies:

new overflowed call in alternative group can be realized if the difference of number of existing overflowed and background calls is smaller than the prescribed number that can be named the threshold of reservation, i. e. if $k - j < N - R$.

An example of this model designated with the label $NTRS(8, 4, M, A_1, A_2)$ is shown in Fig. 2b. It can be seen that the number of regular states is larger than in the model with fixed reservation. This intuitively leads us to the conclusion that losses in this model are smaller. It can be seen, also, that besides regular and forbidden states, a group of *semi-regular* states, SRS, exists. In this example, semi-regular states are $\{0, 5\}$, $\{0, 6\}$ and $\{1, 6\}$. Semi-regular state $\{j, k\}$ is the state that can be entered only by interruption of call i. e. from the states $\{j + 1, k\}$ or $\{j, k + 1\}$ but not from the states $\{j - 1, k\}$ or $\{j, k - 1\}$. Semi-regular states diminish the number of forbidden states, but don't influence on decrease of losses, because they are in the reservation region.

4. Results

The calculation of the models with reservation is quite complicated. To determine the advantage of $NTRS(N, R, M, A_1, A_2)$ over $TRS(N, R, M, A_1, A_2)$ programs for simulation of traffic processes in these models are constructed. Simulation program for model $TRS(N, R, M, A_1, A_2)$ is verified

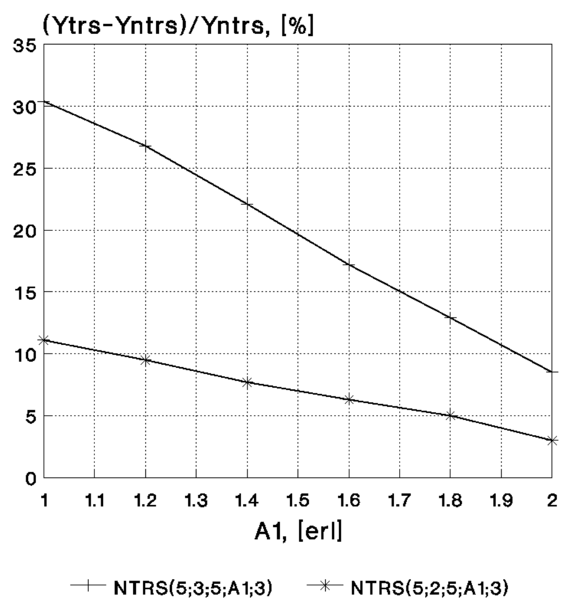


Fig. 3. Relative decease of lost traffic in $NTS(5; 3; 5; A_1; 3)$ and $NTRS(5; 2; 5; A_1; 3)$ against A_1.

on the numerical results given in ref. [1], pages 122-124. Both models have the same parameters in simulated processes. The total lost traffics, $Yntrs$ and $Ytrs$ are used as the parameters for comparison of models. The total lost traffic is calculated as $Y = B_1A_1 + B_2A_2$ where B_1 is the loss of background calls due to lack of idle trunks and B_2 is the loss of overflowed calls due to lack of idle trunks and reservation.

The results of simulation show that the model $NTRS(N, R, M, A_1, A_2)$ always has smaller lost traffic than the model $TRS(N, R, M, A_1, A_2)$. The dependence of decrease of lost traffic of the model $NTRS(5, R, 5, A_1, 3)$ compared to model $TRS(5, R, 5, A_1, 3)$ against A_1 for $R = 2$ and $R = 3$ is shown in Fig. 3. The dependence of decrease of lost traffic of the model $NTRS(5, R, 5, 1, A_2)$ compared to model $TRS(5, R, 5, 1, A_2)$ against A_2 for $R = 2$ and $R = 3$ is shown in Fig. 4. Simulated models are loaded by offered traffics that cause the component losses cca $0.01 - 0.05$.

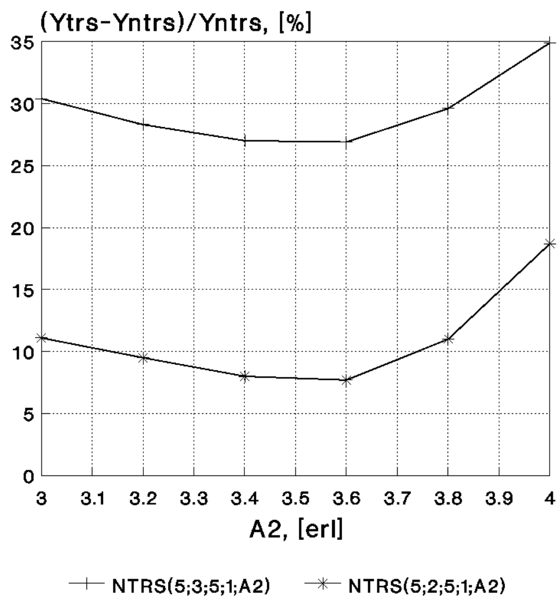


Fig. 3. Relative decease of lost traffic in $NTS(5; 3; 5; 1; A_2)$ and $NTRS(5; 2; 5; 1; A_2)$ against A_2.

5. Conclusion

The suggested new trunk reservation scheme in the alternative group protects the background calls from increased overflowed calls. From the numerical examples we see that new adaptive trunk reservation scheme has the greater throughput than the usual (fixed) trunk reservation scheme. Advantage of new reservation scheme over the fixed reservation scheme is proportional to the number of reserved trunks R.

REFERENCES

1. Akimaru, H. and Kawashima, K.: *Teletraffic, Theory and Applications.* Springer Verlag, 1993, pp 105-124.
2. Toda, A: *Traffic design of telecommunication network with both-way circuits operation.* ITC-12, Torino, 1988, pp 35-41.
3. Kljajić, D.: *Dynamic reservation of telephone channels in both-way operation.* M. Sc. Thesis, University of Belgrade, 1996, (in Serbian)