ITC 11, Minoru Akiyama (Editor)
Elsevier Science Publishers B. V. (North-Holland)

A METHOD FOR TRAFFICABILITY/RELIABILITY ANALYSIS : APPLICATION TO TROPICO-R SWITCHING SYSTEM

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ABSTRACT

A method is presented to evaluate the point-to-point loss probability is switching systems, considering the presence of failures.

INTRODUCTION

The design of a switching network must follow specified requirements imposed on point-to-point loss probability.
The point-to-point loss probability is evaluated considering that the network is fully operational. This analysis gives no insight in the way the network perfoms in presence of failures.
To consider the effects of failures (reliability analysis) we must consider the states where the network is still operational but failures increase the poin-to-point loss probability. For each state we can evaluate the corresponding point-to point loss probability (trafficability analysis) reflecting the new way the network perfoms.
To carry out the trafficability/reliability analysis we define the possible states of the network characterizing the different degradation states experimented after successive failures, establish the network's Markov reliability model by defining the transition rates between the defined states and evaluate, for each state, the corresponding point-to-point loss probability.

DESCRIPTION OF THE SWITCHING NETWORK

The TROPICO-R has a 3-stage switching network. The first and the last stages are time switches which multiplex 30 time-slots and in the central stage there are 3 non-blocking time-space switches wich multiplex 16 PCM links.
The connection graph representation of the switching network is given in the figure, where the stages are represented by nodes and the interconnecting channels by directed branches.

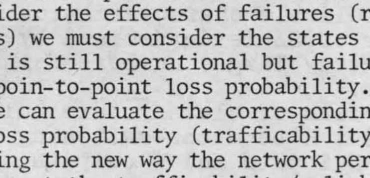

FIGURE 1 - CONNECTION GRAPH

TRAFFICABILITY/RELIABILITY/ANALYSIS

The blocking probability when the system is fully operational, under the hypothesis of homogeneous traffic distribution between the d central stages is :

$$B(d)=\sum_{i=0}^{m} P_A(i)\sum_{K=0}^{m} P_B(k)\left[b_A(i) + (1-b_A(i).b_B(k)\right]^d$$

where $b_A(i)$ is the the probability that i central stages are blocked at side A, and $P_A(i)$ is the probability that i links A are blocked. $P_B(i)$ and $b_B(i)$ have identical definitions corresponding to the B side.
The Markov reliability model is shown in figure-2. If a time (T) switch fails the system reaches an inoperable state (3,4,5). Occurring a failure in a time-space switch the system still functions but in degratation state (1,2/d=3). The failure rate of T and T̸ stages are λ_1 and λ_2 respectively. The repair rate is u when the system is in operation. We suppose that in an inoperable state all failures are repaired simultaneously.

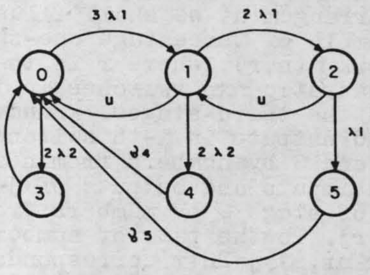

FIGURE 2 - TRANSITION DIAGRAM

To give quantitative results we use the mean blocking probability defined as : $\bar{B} = \sum_j P(j).\ \emptyset\ (j)$, where P(j) is the Markov model steady-state probability that the system is in state j and $\emptyset$ (j) is the network blocking probability given that it is in state j. Figure-3 shows the mean blocking probability as a function of λ_1/u, considering $\lambda_1 = \lambda_2$, $u = \vartheta_3 = \vartheta_4 = \vartheta_5$

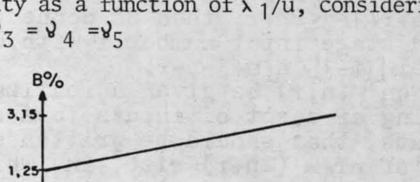

FIGURE 3 - BLOCKING PROBABILITY

The mean-loss probability increases as λ_1/u decreases. As a consequence the traffic capability of the switch must be reduced if the 1% loss probability is to be satisfied.