Bound Analysis of Proposed MALN with Alpha Network

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***Abstract*— The network is assumed to be faulty if any source destination pair cannot be connected because of the presence of faulty components in the network. In this paper reliability of the proposed Multistage Interconnection Network MALN (Modified Alpha Network) has been evaluated and compared with existing Alpha Network.**

***Index Terms*— Irregular Fault Tolerant MIN, MTTF (Upper Bound),MTTF(Lower Bound),Reliability.**

I. INTRODUCTION

The reliability can be measured in terms of MTTF i.e. Mean Time To Failure Balaguruswami E (1989). It is defined as expected time elapsed before some source is disconnected from some destination. This paper analyses and compares Upper Bound and Lower Bound reliability of a new class of Irregular Fault Tolerant MIN named as MALN MIN. On the basis of Reliability, the Proposed MIN has been compared with popular MIN) Alpha Network.

II. DESIGN OF MALN MIN

The Network is an Irregular Multistage Interconnection Network, of size N*N. It has N sources and N destinations. The network Comprises of two identical groups of SEs, named as G^0 and G^1.Each group incorporates N/2 sources and N/2 destinations. Both the groups are connected to the N inputs through N multiplexers, and to the N outputs through N no. of demultiplexers. The modified Alpha network of size 2^n*2^n [$n=\log_2 (N)$], consists of (2m-2) stages
where $m=\log_2 (N/2)$.This network has 2^n no. of switches of size 3*3 and 2^{n-1} no. of switches of size 2*2. Each source is connected to one SE in each group with the help of multiplexers. The switches in all the stages are of size 3*3 except the last one. The switches in the m-2 and m+1 stages have been named as 0,1,2,3----i, i=N-1. The switches in the stage m-1 have been named as S1, S1*,S3 and S3*. The names of the switches used in m stage are S2,S2*,S4 and S4*. The switches in the stages m-2,m-1 and m have been connected to each other through links called as auxiliary links and are called as complimentary switches. These links are used when the SE in the next stage is busy or faulty. This makes the network more Fault-Tolerant and reliable.
The network of size 16*16 is depicted in Fig 1

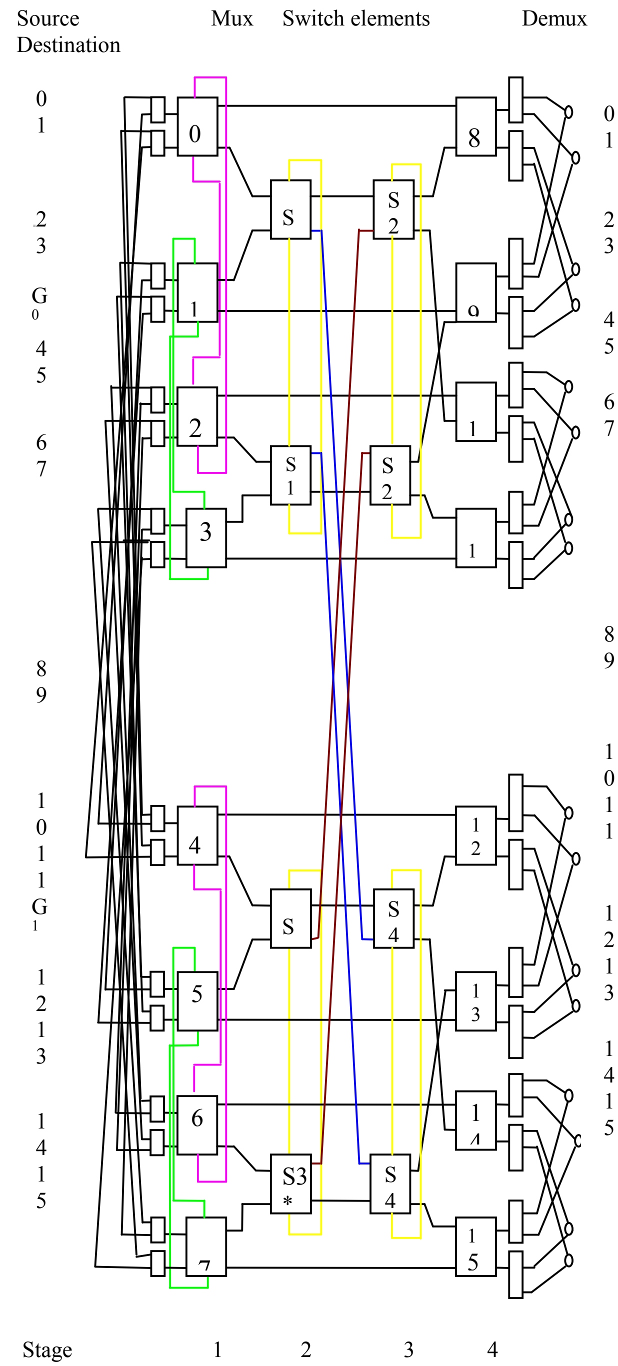

Fig 1 Design of MALN MIN

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III. MTTF

Reliability R(t) is the probability that the network does not fail in the interval (0,t).The network is assumed to be faulty if any source destination pair cannot be connected because of the presence of faulty components in the network.

The reliability can be measured in terms of MTTF i.e. Mean Time To Failure Balaguruswami E (1989). It is defined as expected time elapsed before some source is disconnected from some destination.

1. Some of the assumptions used to calculate the reliability are as under
2. Switches are statistically identical and are either fully operational or failed.
3. The Switch failure occur with a failure rate of $\lambda = 10^{-6}$ per hour.
4. Failure rate of 2 * 2 Switching Element is considered as $\lambda_2 = \lambda$
5. Failure rate of 3 * 3 Switching Element is taken as $\lambda_3 = 2.5\ \lambda$
6. For a m:1 multiplexer, the failure rate is considered as $\lambda_m = m\lambda/4$.
7. For 1: m demultiplexer, the failure rate is considered as $\lambda_d = \lambda_m$.
8. Switching Elements in the last stage and corresponding demultiplexers are taken together as a series system having failure rate of $\lambda_{2d} = 2\ \lambda$.

a) Upper Bound analysis

The network is operational if the critical set of switches is operational. The critical set is the set of k SEs, each from different module such that a failure occurs if all k SEs are faulty simultaneously Blake J.T et al.(1989). The expression for Upper Bound Reliability is

$$MTTF = \int_0^\infty R_{UB}\ (t)\ dt$$

b) Lower Bound analysis

In the Lower Bound Analysis, the input side SEs and their corresponding multiplexers are considered as a series system and failure of any component leads to the failure of all three. The expression for Lower Bound Reliability is MTTF =

$$\int_0^\infty R_{LB}\ (t)\ dt$$

The probability, Rcs(t) of a critical set not being faulty is $R_{cs}(t) = [\ 1\text{-}[1\text{-}e^{\ \lambda t}]^m]$

A good IN should have good performance i.e. high values of Bandwidth, Probability of Acceptance, Processor Utilization, Processor Power and Throughput. It should have lower values of path length and should be cost effective. In this type of network the Permutations passable

should not get effected under faulty cases other than critical faults. The network should be reliable.

Table1 shows the MTTF Upper Bound comparison of MALN and ALN

Table1: MTTF Upper Bound (UB) comparison of MALN and ALN

MTTF(UB) → SIZE ↓	MALN	ALN
16*16	142036	136078
32*32	90791	86187
64*64	59916	56566
128*128	40323	37909
256*256	28904	25753
512*512	25168	17658
1024*1024	18051	12187

Table2 shows the MTTF Lower Bound comparison of MALN and ALN

Table 2: MTTF Lower Bound comparison of MALN and ALN

MTTF(LB) → SIZE ↓	MALN	ALN
16*16	138408	117616
32*32	80113	74392
64*64	50160	48691
128*128	36295	32540
256*256	25557	22049
512*512	18006	15083
1024*1024	13998	10390

CONCLUSION

It has also been observed that proposed MIN has better MTTF Upper as well as Lower Bounds and other performance parameters as compared to similar class of existing MIN ALN. The proposed MIN is reliable for all sizes as compared to ALN

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