Comparison of the routes availability in class of Irregular MINs with unequal number of stages

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Abstract-Multistage Interconnection Networks (MINs) are important networks used to interconnect various processors and memory modules. Need of the era is to to improve the performance of these MINs.In this paper the permutations passable of a new class of Irregular Fault Tolerant MIN named as Triangle MIN has been analysed and compared with same class of existing MIN named as Quad Tree(QT).

Keywords Irregular Fault Tolerant MIN, Design of MIN, Performance Parameters, Permutation passable.

I. INTRODUCTION

The MINs use more than one stage of small interconnection networks like Switching Elements (SEs)[1].Broadly there are two types of MIN namely static regular and irregular. If the MIN has same no of SEs in all the stages then it is called as regular MIN, otherwise it is called as irregular MIN. This paper analyses and compares permutation passable of a new class of Irregular Fault Tolerant MIN named as Triangle MIN. On the basis of Permutation Passable , the Proposed MIN has been compared with popular MIN Quad Tree(QT).

II. DESIGN OF TRIANGLE MIN

The Network is an Irregular Multistage Interconnection Network, of size N*N. It has N sources and N destinations. The MIN consists of n stages ($n=\log_2 N$).

The network Comprises of two identical groups of switching elements (SEs), named as G0 and G1.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 switches in all the stages are of size 3*3 except the last one. The switches in the stages n-3,n-2 and n-1 have been connected to each other through links called as auxiliary links. These links are used when the SE in the next stage is busy or faulty. This makes the network more fault tolerant and reliable[4].

The Triangle network of size 2^n*2^n consists of (2m-2) stages where $m=\log_2(N/2)$.This network has $(2^n -2)$ no. of switches of size 3*3 and 2^{n-1} no. of switches of size 2*2.Each source is connected to one switching element in each group with the help of multiplexers. The network of size 16*16 is shown in

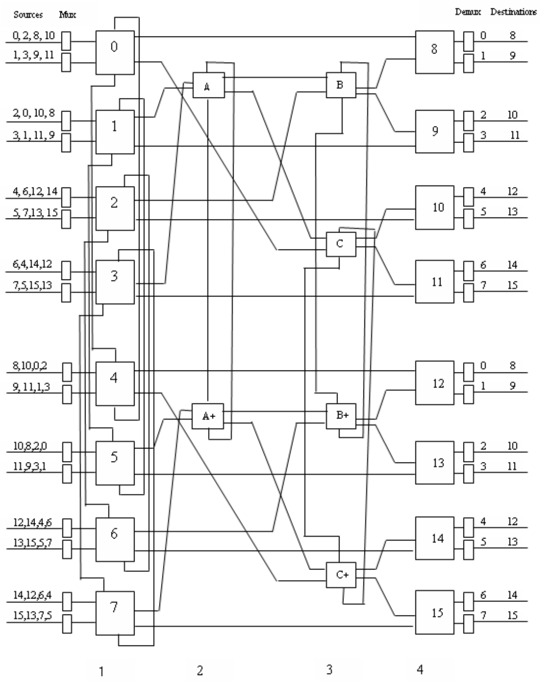

Fig I Design of Triangle MIN

III. REDUNDANCY GRAPH

The Redundancy Graph is a pictorial representation of the architecture of a MIN. It shows all the possible paths from every source to every destination. [5][6]

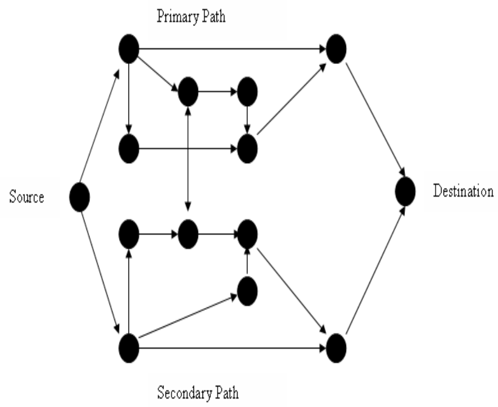

Fig II Redundancy Graph of Triangle MIN

IV. PERMUTATION PASSABLE

It is a set of N data transfers, all of which are performed simultaneously in the network. The $\log_2 N$ stages network allows only some subset of N! passable permutations.

Let the source and destination in binary [2][3][7] be represented as

$S=S_{n-1}\ldots\ldots\ldots\ldots S_1S_0$

$D=D_{n-1}\ldots\ldots\ldots D_1D_0$

There are two ways to evaluate the Permutation Passability of the MINs.

Identical Permutation

It is one to one communication between same source and same destination.

$S_{n-1} \rightarrow D_{n-1}$, --------- , $S_o \rightarrow D_o$

Incremental Permutation

Here each source is connected to destination in a circular chain[3]

Example $S_0 \rightarrow D_4$, ……… , $S_{n-1} \rightarrow D_3$

Two cases have been considered

I Non Critical (N-cr) It is a case when fault is present in a single switch.

II Critical (Cr) It is a case when fault is present in a loop

In the tables and figures discussed below n-cr stands for Non Critical case and cr stands for Critical case in the respective MINs. The incremental permutation of Omega Network has not been discussed because Omega Network is a regular network. It has static routing and has equal path lengths because of same no of switches in all the stages.

The table I shows the actual no of requests getting matured and their average path lengths for Triangle MIN.The values have been depicted in Fig III.

Table I Routes available in Triangle MIN

Fault	Total. Path Length	Total No. of requests matured	Average Path Length	% of requests Matured
No Fault	24	8	3	50
Mux	24	8	3	50
S1 n-cr S1 cr	32 16	8 4	4 4	50 25
S2 n-cr S2 cr	28 20	7 5	4 4	43 31
S3 n-cr S3 cr	28 24	7 6	4 4	43 37
S4	24	8	3	50
DEMUX	24	8	3	50

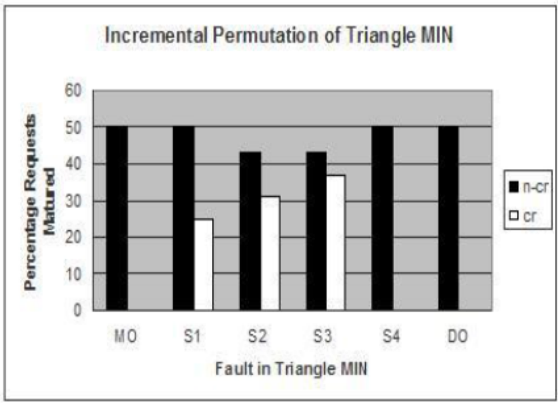

Fig III

The table II shows the actual no of requests getting matured and their average path lengths for Quad Tree (QT) MIN.The values have been depicted in Fig IV.

Table II Routes available in QT

Fault	Total Path Length	Total No. of requests matured	Average Path Length	% of requests Matured
No Fault	20	4	5	25
Mux	20	4	5	25
S1 n-cr S1 cr	20 20	4 4	5 5	25 25
S2 n-cr S2 cr	15 10	3 2	5 5	18 12
S3 n-cr S3 cr	10 0	2 0	5 0	12 0
S4 n-cr S4 cr	15 10	3 2	5 5	18 12
S5	20	4	5	25
DEMUX	20	4	5	25

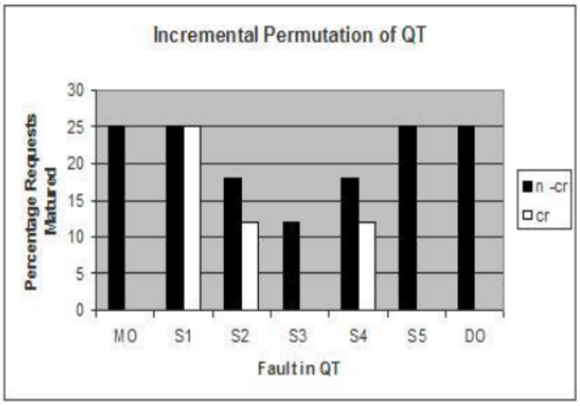

Fig IV

Method A simulator in c# in .Net platform has been designed. All the performance parameters discussed have been analyzed on this simulator.

V. CONCLUSION

The proposed Fault Tolerant Irregular Triangle MIN is better as compared to QT Network. The proposed network has reduced latency as compared to 5 stages

Quad Tree Network .The Triangle MIN has more no of requests getting matured in fault free as well as non critical and critical faulty components.

At the same time the proposed network has variable shorter path lengths from source to destination as compared to discussed network.

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