International Research Journal of Natural and Applied Sciences
Vol. 3, Issue 2, Feb 2016 IF- 2.818 ISSN: (2349-4077)
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Website: www.aarf.asia Email : editor@aarf.asia , editoraarf@gmail.com

EVALUATION OF AUXILIARY LINKS AND ROUTES IN IRREGULAR MODIFIED ALPHA NETWORK

Amardeep Gupta
Head Deptt of Computer Sc and IT
D A V College,Kt Sher Singh, Amritsar , Punjab, INDIA

ABSTRACT

New Multistage Interconnection network named as irregular Modified Alpha Network(Modified ALN), which is a modified form of Alpha network has been introduced and evaluated in this paper. The proposed network has increased values of performance parameters as compared to other existing MINs like Augmented Shuffle Exchange Alpha and Quad Tree MINs.

Key-Words:- Redundancy Graph, Auxiliary Links,Routing, Fault Tolerance,Experiment results, Conclusion.

1 Introduction

A new class of irregular Interconnection Network has been proposed and analyzed. The Interconnection Network connects Processors and /or Memory Modules. The new Network has lesser no of stages as compared to Alpha Network [3] maintaining the full access capability at the same time. Thus the Network has low latency[4], low cost and attains higher values of other important parameters.

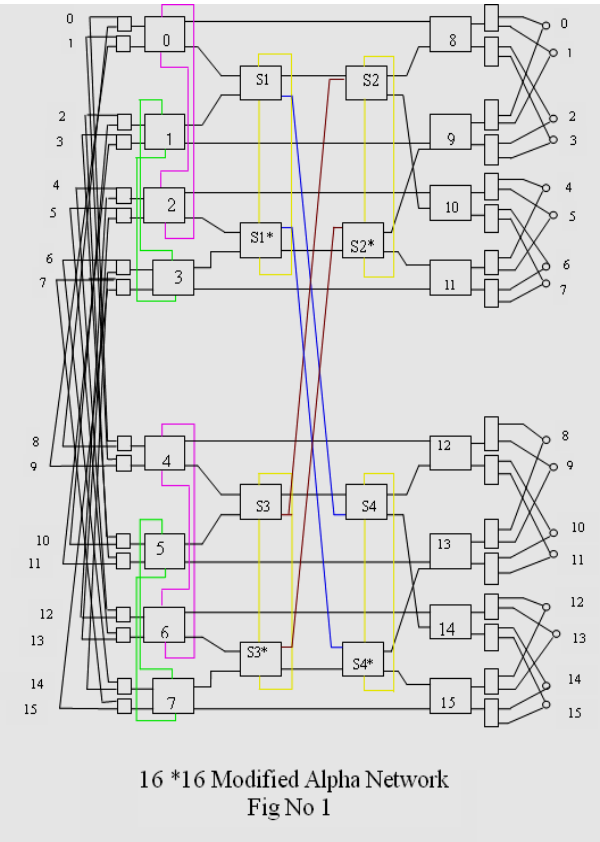
2 Design of Modified Alpha Network

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.

The modified Alpha network of size 2^n*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 switching element in each group with the help of multiplexers. The network of size 16*16 is depicted in fig no 1



16 *16 Modified Alpha Network
Fig No 1

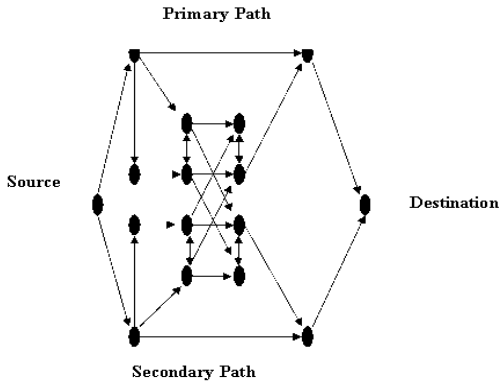


Fig No 2 Redundancy Graph

3 Routing Algorithm for Modified Alpha Network

Let the source and destination in binary [1] be represented as

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

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

Step1 : Start

Step2 : The MSB of the destination address is checked and on the basis of it ,one of the sub networks G0 or G1 is selected.

Step3 : Let us suppose the address of the following SE is known. If the destination address is the address of this SE ,then the shortest path is used and the further routing is not required as the data has reached the destination.

Step4 : If the SE is busy then route the data to auxiliary SE through auxiliary links. If this is also busy then drop the request. Otherwise go to step 5 .

Step5 : The secondary path is selected .Set MSB of the routing tag as 1.The bits of the destination will make the data to reach the

destination through intermediate stages. If the SE in any of the stages except the last one , is busy go to step 5

Step6 : Route the data [5] to auxiliary switch in the same stage (Route the data to auxiliary switch in the previous stage in case of faulty SE)

Step7 : Bit D_0 of the routing tag will guide the data through a particular demultiplexer and the destination will be reached.

Step8 : Stop

Sample : Routing example from source 0000 to all destinations for the Modified Alpha Network

Source	Destination	Path Lengths Available
	0000	2,4
	0001	2,4
	0010	2,4
	0011	2,4
	0100	4
	0101	4
	0110	4
	0111	4
0000		
	1000	2,4
	1001	2,4
	1010	2,4
	1011	2,4
	1100	4
	1101	4
	1110	4

Table no 1 All Path Lengths available

Network	Path Lengths
Alpha	$Log_2(N)$-2,$Log_2(N)$+1
Modified Alpha	$Log_2(N)$-2,$Log_2(N)$

Table no 2 Comparison of Path Lengths available

4 Fault Tolerance and Repair

If the network is able to work, of course with degraded efficiency, in the presence of faults in critical components [4][8] then the network is called as fault tolerant. A network is single fault tolerant if it can work with full access in the presence of fault in single SE. If the network is able to provide connections from all sources to all destinations in the presence of k faults in the network [2] , then this network is called as k fault tolerant network.

The proposed MIN satisfies the fault tolerant criteria [7] because it can work in the presence of certain faults. If there is fault in the primary path then secondary path will be chosen for routing the data.

Moreover the auxiliary links [2] in all the stages except the last one provides the alternate route of the data. The critical case is when the fault is present in the SE in same loop. In this case certain pair of

source and destination shall be disconnected.

Theorem 1 : Modified Alpha Network is single switch fault tolerant in all the stages

Proof: The auxiliary links are available in all the SE in all the stages except the last one. If fault in any of these SE happens then the data will be routed to the auxiliary SE in the same stage through auxiliary links.

Theorem 2 : Modified Alpha Network will be able to work in the presence of faults in the SEs in the loop in one Group at a time.

Proof : By guiding the data from the other Group (fault free) to the same stage ,where the fault was present in the faulty Group, we can pass the request to the desired destination.

Lemma 1 : If all the SEs in the loops in both the groups are faulty then Modified Alpha network fails.

Repair : To rectify, just replace the loop engaged in the faulty components with the new one.

7 Conclusion

The proposed Fault Tolerant Irregular Modified Alpha Network has more reliability as compared to Alpha, Quad tree and Augmented Shuffle exchange Networks.

The proposed network has lesser number of stages and hence has reduced the latency, hence the maximum path lengths have also been reduced. The cost of the proposed network is also less as compared to Alpha and Quad tree and the cost is same for Augmented Shuffle Exchange Network.

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