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MION-A Deep Analysis of New Fault Tolerant MIN in Faulty and Non-Faulty Network Conditions for Medical Domain

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Abstract. Many stages of interconnected switching elements (SEs) forms a Multistage interconnection networks (MIN) which has high-speed, low cost and high reliability and used for parallel processing, broadband switching technology etc. Executing a task with good performance in faulty condition is very significant in a MIN. That's why fault tolerance in MINs is a very challenging issue in present research scenario. A new fault tolerant irregular MIN named as Modified Irregular Omega Networks (MION) is proposed in this research paper. The MION is a double switch fault tolerant MIN and it performs better fault tolerance than existing Irregular Advanced Omega Network (IAON) under non-faulty and faulty network environment.

Keywords: Multistage interconnection networks, Switching Elements, fault tolerance, non-faulty and faulty network.

1. Introduction

With emerge of parallel processing systems and broadband switching technology, the requirement of high-performance Multistage Interconnection Networks (MINs) is increased. MIN is form by processing elements at one end and memory elements or I/O devices at other end interlinked by switching elements [7]. MINs can be two types according to availability of paths: single path MINs and multi-path MINs. This multipath characteristic arises the importance of fault tolerance in MINs.

A number of regular and irregular networks have been proposed for increasing the ability of fault tolerance in MIN but there is very less research work have been done on the issue of double switch fault tolerant networks [5]. The MIN can be faulty if any switch failure or link failure occurs and it decreases the network performance [3][7]. This paper presents a new irregular MIN named as Modified Irregular Omega Network (MION) and its routing algorithm, which provides better fault tolerance capacity as compared to Irregular Advanced Omega Network (IOAN)[1] for faulty (single fault and double fault) and non-faulty situations. Here double switch fault tolerant MIN is a network which can tolerate faults when two switches are faulty in each stage [1].

2. Structure of Proposed Modified Irregular Omega Network (MION)

The Modified Irregular Omega Network (MION) is an N×N network which has N (or 2^n) source addresses and N (or 2^n) destination addresses with [($\log_2$N)-1] stages, where n=$\log_2$N. Each stage 0 and last stage have N/4 SEs and each intermediate stage have [(N/16) *3]. The SE has size 4×4 for each stage 0 & last stage. Each SE of each stage has size 4×4, when N=16. When N>16, each SE has size 4×3 for stage 1 and each SE has size 3×3 for each stage (2 to (n-3)). The MION consists of N Multiplexers (MUX) & N Demultiplexers (DEMUX) of size 4×1 & 1×4 respectively. The 16x16 network size MION is given below in Figure 1.

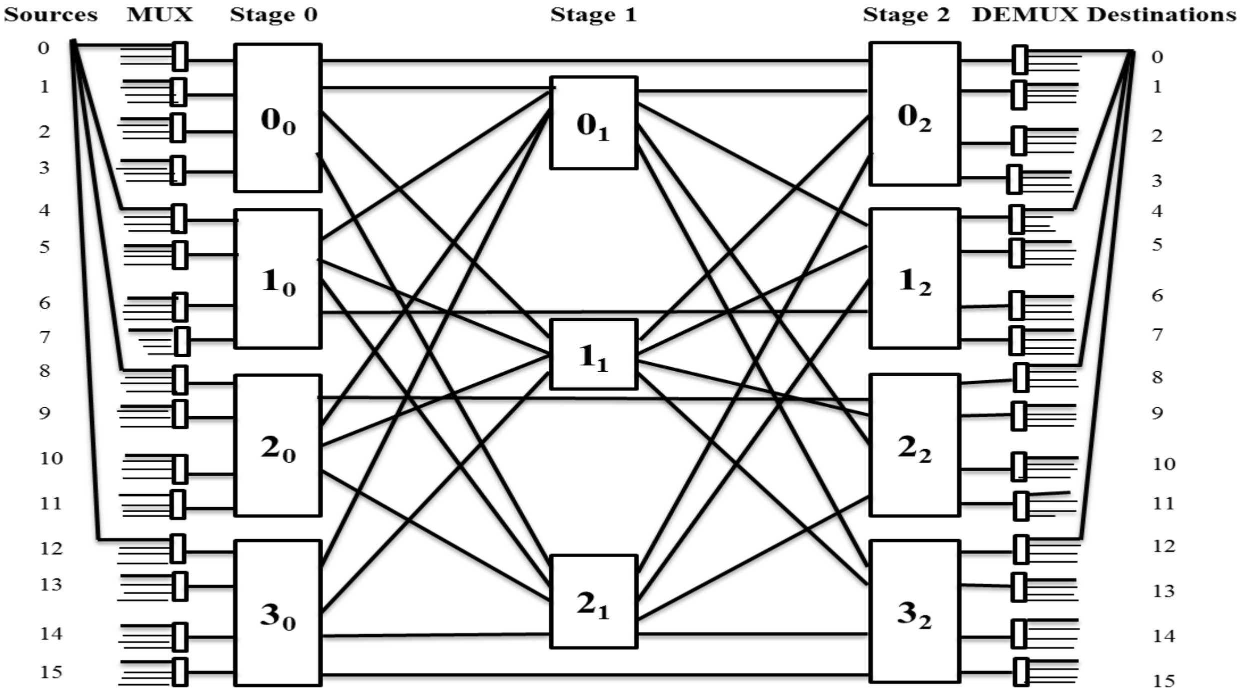

Fig. 1 Modified Irregular Omega Network (MION)

Each source is linked with 1 primary and 3 alternate/auxiliary links through MUX and each destination is connected with 1 primary and 3 alternate/ auxiliary links through DEMUX. In MION auxiliary/alternate) SE are three types: first alternate switching element (First_SE), second alternate switching element (Second_SE) and third alternate switching element (Third_SE).

2.1 Routing Algorithm of MION

The source address and its corresponding destination address or addresses (for broadcasting purpose) are mentioned in MION routing algorithm from user side. MION routing algorithm consists two sub-algorithms. In first algorithm, if last two binary bits of source and destination address are same then data packets can be directly send from given source to desired destination. Otherwise steps of second algorithm will be followed.

First_Algo	**Second_Algo**

{
BEGIN
If (S_i and D_i are same)
{
If (SE_0 and SE_L are not faulty)
Send request from SE_0 to SE_L;
Else
Second_Algo;
}
Else
{
Second_Algo;
}
	{
	Stage 0: If Primary_SE_0 == FB
	//FB→faulty or busy
	Then First_SE_0
	Else send data packet to Primary_SE_1
	If First_SE_0 == FB
	Then Second_SE_0
	Else send data packet to Primary_SE_1
	If Second_SE_0 == FB
	Then Third_SE_0
	Else send data packet to Primary_SE_1
	If Third_SE_0 == FB

End **}**	Network Fails **Else** send data packet to Primary_SE1 **For(stage i=1 to n-2)** **Stage i: If** Primary_SEi == FB Then First_SEi **Else** send data packet to Primary_SEi **If** First_SEi == FB Then Second_SEi **Else** send data packet to Primary_SEn-1 **If** Second_SEi ==FB Network Fails **Else** send data packet to Primary_SEn-1 **Last Stage**: **If** Primary_SEn-1 == FB Then First_SEn-1 **Else** send data packet to given destination **If** First_SEn-1 == FB Then Second_SEn-1 **Else** send data packet to given destination **If** Second_SEn-1 == FB Then Third_SEn-1 **Else** send data packet to given destination **If** Third_SEn-1 == FB Network Fails **Else** send data packet to given destination **}**

3. Performance Analysis and Parameters of MION

The performance of MION is evaluated and compared with the existing MIN in different parameters like bandwidth, probability of acceptance, processor utilization, throughput, processing power in faulty and non-faulty network environment.

Probability [2-4] that one output receiving the request from "i" inputs is:

$\rho_n = [1 - (1 - (\rho/o))^i]$

Probability equation for MION:

$\rho_0 = 1-(1- \rho/4)^4$

$\rho_1 = 1-(1- \rho_1/4)^4$

$\rho_2 = 1-[(1- \rho_2)*(1- \rho_1/4)]^4$

Where, ρ=Load factor or Request Generation Probability

3.1 Throughput (TP)

It is the average number of requests/packets delivered successfully from a source to the given destination in MIN per unit time [1][2][4].

$TP = BW/(d_n \times t)$

Where, t=data transmission time for no switch fault/ single switch fault/ double switch fault

3.2 Processor Utilization (PU)

PU is the percentage of time the processor is active doing computation without accessing the global memory [1][2][4][6].

PU= BW/(d_n×p×t)

4. Comparison and Analysis

In this work, we supposed that the routing time of data packets for the non-faulty network is 0.01 ms and for the single switch faulty network is 0.02 ms from the source node 0 to destination node 5. The request generation probability or offered load (p) is assumed here 0.1 to 1 with an interval of 0.1. Therefore, comparison between existing IAON and proposed MION is performed on different parameters such as bandwidth, probability of acceptance, throughput, processor utilization, and processing power in non-faulty and single switch fault case.

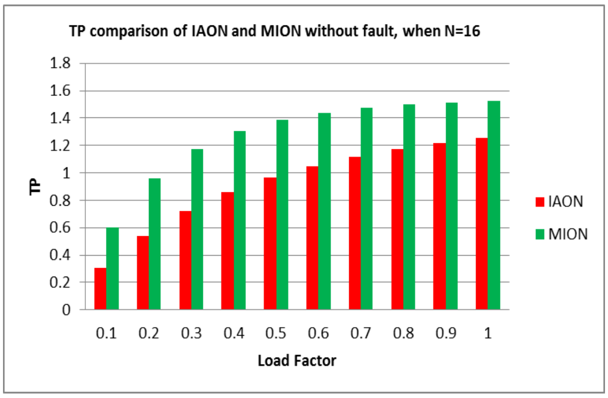

Fig 2. TP Comparison Non-Faulty condition

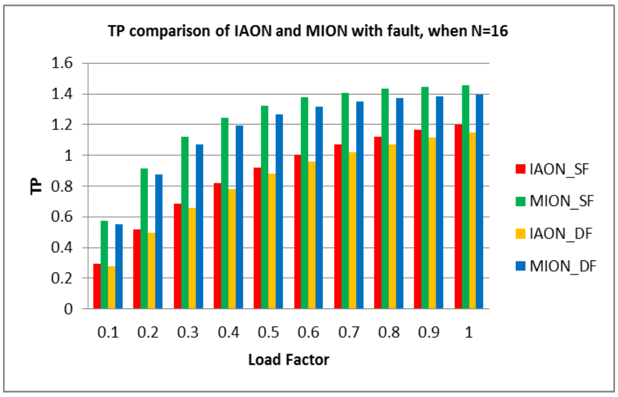

Fig 3. TP Comparison under Faulty condition

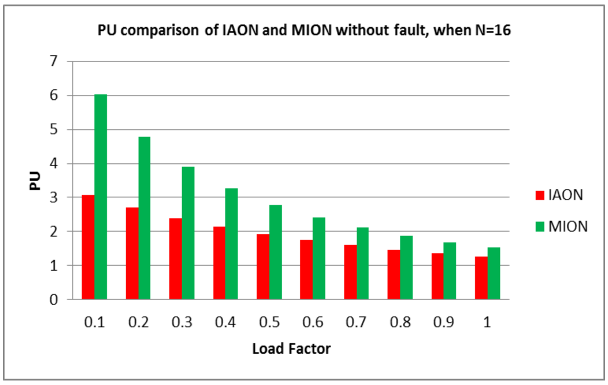

Fig 4. PU Comparison under Non-Faulty

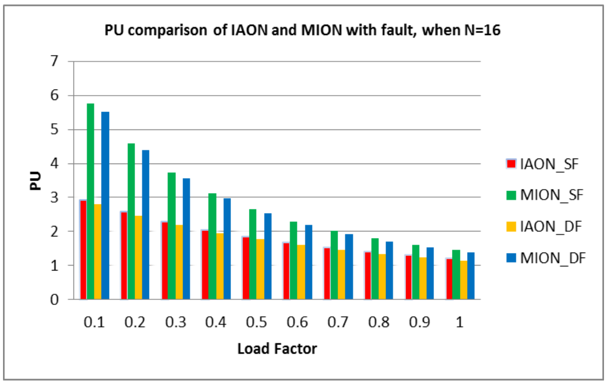

Fig 5. PU Comparison under Faulty conditions

5. Conclusion and Future Work

In this paper, the routing algorithm shows that the MION is double switch fault tolerant. According to the MION routing algorithm, the data transmission from the source to destination can only be possible if at least SEs in each stage is functioning otherwise data transmission will be stopped due to network failure. Hence, the proposed MION performs better than the IAON in faulty and non-faulty case. In future, the design pattern of MION can be changed to obtain more fault tolerant MIN at less cost.

6. References

[1] Ved Prakash Bhardwaj and Nitin, “Message Broadcasting via a New Fault Tolerant Irregular Advance Omega Network in Faulty and Nonfaulty Network Environments”, Journal of Electrical and Computer Engineering, 2013.

[2] Shobha Arya and Nipur Singh, “Performance Analysis of Fault Tolerant Advanced Irregular Shuffle Exchange Network (AISEN)”, Proceeding of ICTCS '16, March 04-05, 2016.
[3] Mamta Ghai, Vinay Chopra, and Karamjit Kaur Cheema, “Performance analysis of fault-tolerant irregular baseline multistage interconnection network”, International Journal on Computer Science and Engineering, vol. 2, no. 9, pp. 3079–3084, 2010.
[4] Shobha Arya and Nipur Singh, “Performance Analysis of FTISEN in Faulty and Non-Faulty Conditions”, JETIR, Volume 6, Issue 6, June 2019.
[5] Sony Bansal, Harsh Sadawarti, and Pawandeep Kaur, “A Fault-Tolerant Irregular Augmented Shuffle Exchange Network-4”, International Journal of Engineering Technology and Computer Research (IJETCR), Vol. 3, Issue 3, pp. 67–71, 2015.
[6] Shobha Arya and Nipur Singh, “Fault Tolerance Analysis of Modified Irregular Augmented
[7] Shuffle Exchange Network (MIASEN)”, International Journal of Engineering Research and Application, pp. 08–12, 2018.
[8] Menkae Jeng and Howard Jay Siegel ,“A fault tolerant Multistage Interconnection Network for multiprocessor systems using dynamic redundancy ”, IEEE, pp. 70-77, 1986.
[9] Abhishek Kumar, et al. "The state of the art of deep learning models in medical science and their challenges". Multimedia Systems. (2020).
[10] Abhishek Kumar, et al. "Efficient data transfer in edge envisioned environment using artificial intelligence-based edge node algorithm". Transactions on Emerging Telecommunications Technologies. (2020).
[11] Ambeth Kumar, V.D. et al. "Active volume control in smart phones based on user activity and ambient noise". Sensors (Switzerland) 20. 15(2020): 1-17.
[12] Vengatesan, K. et al. "Analysis of Mirai Botnet Malware Issues and Its Prediction Methods in Internet of Things". Lecture Notes on Data Engineering and Communications Technologies 31. (2020): 120-126.
[13] Vimal, V. et al. "Artificial intelligence-based novel scheme for location area planning in cellular networks". Computational Intelligence. (2020).
[14] Kumar, A. et al. "Comparative Analysis of Data Mining Techniques to Predict Heart Disease for Diabetic Patients". Communications in Computer and Information Science 1244 CCIS. (2020): 507-518.
[15] Sayyad, S. et al. "Digital Marketing Framework Strategies Through Big Data". Lecture Notes on Data Engineering and Communications Technologies 31. (2020): 1065-1073.
[16] Kumar, V.D.A. et al. "Exploration of an innovative geometric parameter based on performance enhancement for foot print recognition". Journal of Intelligent and Fuzzy Systems 38. 2(2020): 2181-2196.
[17] Vengatesan, K. et al. "Secure Data Transmission Through Steganography with Blowfish Algorithm". Lecture Notes on Data Engineering and Communications Technologies 35. (2020): 568-575.
[18] Lone, T.A. et al. "Securing communication by attribute-based authentication in HetNet used for medical applications". Eurasip Journal on Wireless Communications and Networking 2020. 1(2020).
[19] Vengatesan, K. et al. "Simple Task Implementation of Swarm Robotics in Underwater". Lecture Notes on Data Engineering and Communications Technologies 35. (2020): 1138-1145.
[20] Kesavan, S. et al. "An investigation on adaptive HTTP media streaming Quality-of-Experience (QoE) and agility using cloud media services". International Journal of Computers and Applications. (2019)
[21] Ankit Kumar, Vijayakumar Varadarajan, Abhishek Kumar, Pankaj Dadheech, Surendra Singh Choudhary, V.D. Ambeth Kumar, B.K. Panigrahi, Kalyana C. Veluvolu, Black Hole Attack Detection in Vehicular Ad-Hoc Network Using Secure AODV Routing Algorithm, Microprocessors and Microsystems, 2020, 103352, https://doi.org/10.1016/j.micpro.2020.103352