

# Fault Detection and DyAD Algorithm for NOC Architecture

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**ABSTRACT:** NOC is the ability to detect fault and failures in the architecture. It is scalable and flexible communication architecture. In this paper, we propose detection of data packet and routing algorithm errors. Both presented mechanism is used to determine permanent and transient errors and localize accurately the position of faulty blocks in the routers, to preserving throughput and data packet latency. The proposed method is based on new error detection mechanism suitable for dynamic NOCs, where the number and position of processor elements vary during runtime. This paper gives the traffic load variations on average latency and power for DYAD routing algorithm, this algorithm having both deterministic and adaptive routing algorithm. This algorithm is used to determine the path of a packet from source to the destination. The best performances of routing algorithm in the NOC architectures are minimum latency, minimum power and maximum throughput. The aim is to reduce the transmission delay and to ensure the priority to the shortest path routing of data. The simulation result explains the effectiveness of DYAD routing algorithm under different traffic patterns.

**KEYWORDS:** Network on chip, fault detection, Adaptive routing, Deterministic routing, Improved DYAD.

## I. INTRODUCTION

NOC architecture is based on packet switched network. The performance and the efficiency of the NOC heavily depends on communication infrastructure. On chip transistor density has increased the integration of dozens of intellectual property on a single die to form system on chip. The communication in these system, shared buses should be replaced by interconnection networks. It provides a ready architecture for scalable on-chip communication. The NOCs proposed a new paradigm for realizing complex SOCs. In on-chip communication the NOC scale have better performance and efficiently to detect fault tolerant characteristics. To determine the path of packet from source to destination by using routing algorithm. The routers in the network is classified into deterministic and adaptive. Deterministic routing is also called oblivious routing; the path is completely determined by the source and the destination. A routing technique is called as adaptive routing, [1] if the source and destination addresses are given the path taken by a particular packet and its depends on dynamic network conditions. In Dynamic Adaptive and Deterministic (DyAD) routing algorithm has both the characteristics of XY and OE routing model. The development of XY routing algorithm is simple but is not able to balance the load across the link in non-uniform condition. If the link or router failure means the OE routing algorithm [2] provide tolerance and to improve the network performance. The network traffic in the NOC is divided into two categories; Guaranteed Throughput (GT) and Best Effort (BT) traffics. GT acts like a circuit switched network and works with routing algorithm. In BE traffic there is no guarantees that BE packets will ever reach the receiver. The worst case packet can be lost in the BE traffics. In this paper, we present a routing scheme which combines the advantage of both deterministic and adaptive routing algorithm and is based on the current network congestion. This packet injection rate increases; deterministic routers suffer from throughput degradation, so they cannot respond to network congestion. In adaptive routers have some of the alternative paths, so they avoid network congestion and to get higher throughput. In DyAD routing, each router continuously monitors its local network load and make decision based on this information. If the DyAD routers

work in the deterministic mode means the network is not congested. In contrast, when the network is congested, the DyAD router back to the adaptive routing mode. To propose a valid approach and show how to avoid deadlock and livelock in the network[5]. In this paper we have to choose minimal odd-even routing as the adaptive routing for on chip routers. The minimal routing is used to reducing the energy consumption of communication, but also to keep the network free from livelock. Routing algorithm can be fault tolerant algorithm like backtracking. Most of the algorithm sends packets only in the direction. To overcome this problem by using DyAD routing algorithm.

## II. RELATED WORK

Interconnect scaling is one of the most crucial challenges in chip design. [4] NOC design methodology and 3D Integration are expected to overcome many of the challenges. The characterization of vertical interconnects for use in 3D NOCs with respect to physical implementation and Timing requirements. The routing technique involves two processes. The first involves the mechanisms that compute feasible path between originator-destination pairs. The feasible path is satisfies the correctness criteria and algorithm of the objective function. A correct path is free of any permanent loops; it represents a true simple path that packets can be forwarded unambiguously from originator to destination. The objective of this paper includes shortest path, minimum delay or maximum residual capacity. The shortest path routing algorithm attempt to minimize the delay to each OD pair and set the correct paths, minimum delay algorithm is used to balance traffic flows in order to achieve global minimum average delay. The second mechanism of routing involves the forwarding of packets along a feasible path. The shortest path routing provides only a single path. When forwarding packets, this process involves determining which interface to use. Here using two possible approaches. Source routing each packet includes a path specification which list subset of the nodes. In this technique each node can either directly extract the identity of which adjacent node to forward the packet. The second approach is hop by hop routing; this algorithm provides multiple routes in the routing table and to select the route additional information or policy to be required

## III. PROPOSED METHOD

In our fault model errors mainly due to fault concerning nodes of FIFO. These NI components are composed by memory cells and they are affected by both permanent and temporary faults. For implementing these basic components are based on the use of error correcting and detecting codes. Routing path errors registers of the LUT, reducing the probability of the wrong routing path register associated with an input destination address. The fig (1) shows the integration of the proposed FIFO architecture in an NOC implementing error detection and correcting in the links connecting NOC components.

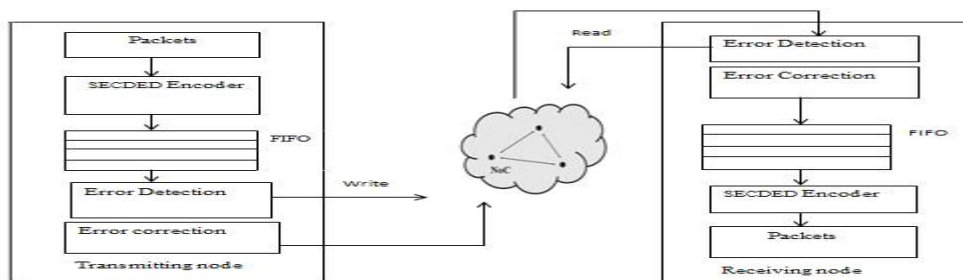


Fig. 1 Integration of the proposed FIFO architecture with NOC link implementing error correction and detection

### DyAD Routing

Dynamic Adaptive and Deterministic network on chip uses dynamically both deterministic and adaptive routing algorithms to route packets. Fig.2 shows the architecture of DyAD router. Here four types of different mode present in the DyAD router. Each input controller in fig has a separate FIFO is used to buffers the input packets before delivers to the destination.

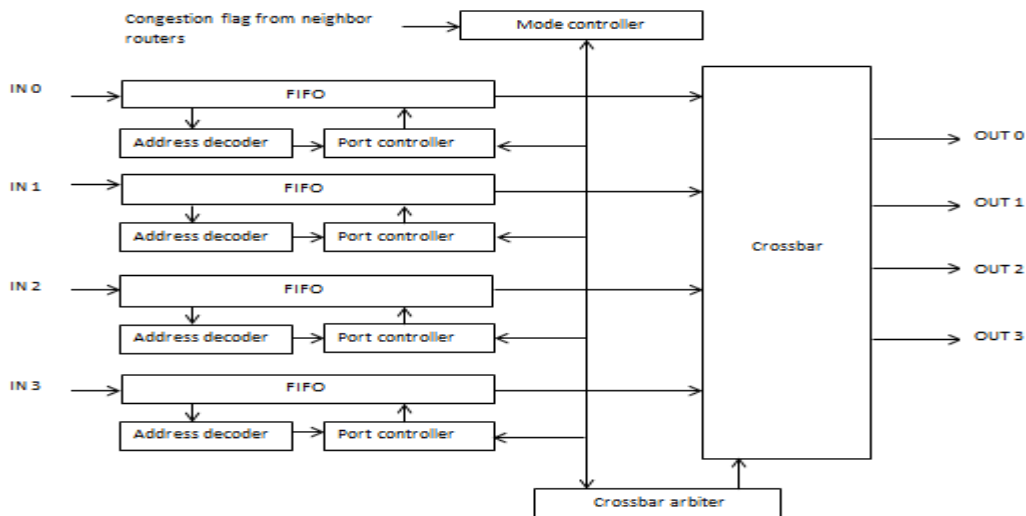


Fig 2. Router architecture

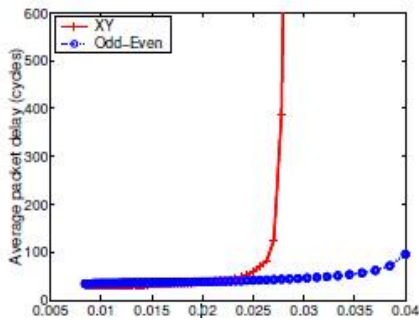
When a new header flit is received the address decoder processes that flit and then send to the port controller, this determines which one of the packet should be delivered to the destination and the port controller is used to select the direction in which the downstream router has more empty slots in FIFO. The input port controller also monitors the FIFO occupation ratio and the ratio reaches the congestion threshold level, it determines the value of 1 indicates the corresponding congestion flag wire and the value 0 indicates the upstream router. The advantage of DyAD routing algorithm is low latency in congestion free network but still good throughput in congestion network.

### DyAD –XY routing

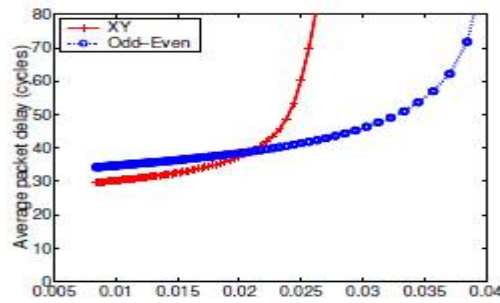
In this paper, the XY routing is used to representative deterministic routing scheme because its simplicity and popularity. XY routing is a minimal path routing algorithm and to avoid deadlock and livelock in the network. The deterministic routing, the source and destination address are given and the routing path is fixed once. But in the adaptive routing mode multiple routing path exist because adaptive routing offers packets more flexibility in choosing their routing paths. To solve the problem, this may be caused by packets waiting for each other in a cycle. In this routing the packets can be routed in both X and Y directions and this routing algorithm needs a mechanism to guarantee deadlock avoidance.

### DyAD-OE routing

In Odd-Even mode the packet can be routed to both output p1 and p2 and it always be routed to p1 in OE-fixed. In Fig (3) clearly shows the tradeoff between deterministic (XY) and adaptive(OE) routing. Compared to XY routing the OE routing to achieve much higher saturation throughput. If XY beats the OE routing then the network works in low packet latency. Dyad-OE is able to achieve a throughput of 0.027 packet/cycle. The same traffic pattern and injection rate, DyAD achieves shorter average packet latency.



Injection rate(Packets/cycles)



Injection rate (packets/cycles)

The result of this paper presents both minimum latency and to correcting the fault in the NOC design. The packets to be encrypted and then sent to FIFO. In FIFO some of errors to be occurred, to correcting the fault and the data sent to the destination. If the information are not affected means the destination receiving the data without fault occurrence. To implementing the DyAD algorithm and fault detection method in NOC design, we have to get minimum latency of 0.7382 and maximum throughput. The fig(4) shows the result of encrypted the input data by using SECDED encoding.

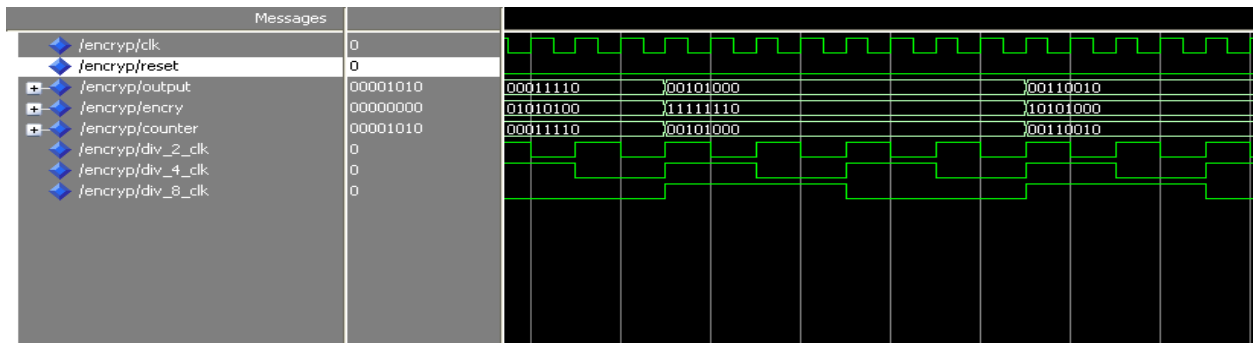


Fig. 4 Encryption of the Input data

#### IV. CONCLUSION

This paper gives the study on the implementation of fault tolerant network interfaces for NOCs. We showed that the occurrence of permanent and transient errors in the network could cause unwanted behavior of that create unrecoverable situations in the NOC, such that live lock and deadlock conditions. So we proposed new architectural solutions based on the use of error correcting and detecting codes and to create a shortest path routing for minimum latency by using DyAD routing algorithm.

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