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Evaluation of Performance of different routing Algorithm using Noxim

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ABSTRACT
One of the primary methods for examining and testing novel ideas in the Network-on-Chip space is simulation. Noxim simulator enables the analysis of performance for both established wired NoC and new WiNoC architectures. User can modify the size of the network, size of the packet, routing algorithm, various strategy selection and packet injection rate. The simulator evaluates NoCs in terms of various parameters of Network throughput, delay etc. In particular, the user can obtain various assessment metrics such as overall number of received packets/flits, global average throughput, max/min global delay, consumption of total energy. and so on. In comparison to traditional mesh NoC, this paper examines how different routing methods and WiNoC sizes affect network traffic distributions. We analyze PIR, Network throughput parameters of 8*8 mesh networks for various routing algorithms and its impacts are investigated. Simulation of Mesh wireless NOC architecture is validated.
Keywords: Noxim, NOC, Network Throughput, Packet Injection Rate

1. Introduction

A core wireless network built on traditional NOC wire is used by a wireless NOC (Winoc). A set of tile nodes and a communications infrastructure are the two primary notions that are instantiated when designing a smart network architecture. Each tile node implements a specific computation or storage operation to carry out, and uses the communication infrastructure to exchange asynchronous data with other nodes [13]. The Noxim Runtime Engine (NRE), which is used to simulate the NOC instance, provides the System code needed to support the various NOC architectural parts and models. Numerous topologies, buffer and packet sizes, traffic distributions, routing algorithms, packet injection rates, etc. are supported by the NRE [2].
All parameters impacting the quantity and the kind of computation are associated with the workload class, which is provided as input to the NOC.

2. Methodology

Mesh topology is simple to build since all nodes are similarly spaced apart, as depicted, and because it makes addressing of the cores during routing very straightforward.
The routing algorithm is a key component in WiNoC design that helps to distinguish between the various architectures present in a literature, and is utilized in on-chip network communication.

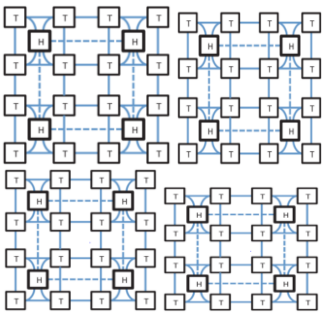

Fig 1: 8×8 WiNoC architecture in s 4x4 Radio hub

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In this, we have designed 8*8 Wireless Mesh topology for West first, North last Routing, XY and Odd Even Algorithms.

2.1 Routing Algorithms

(a) XY algorithm

One sort of distributed deterministic routing algorithm is the XY (Static XY OR XY) routing algorithm. The router (or IP) is identified by its coordinates to apply the traditional routing algorithm (x, y). The router address (Xdst,Ydst) of the packet (destination), that was recorded in the header flit, must be compared with the current router address (Xsource,Ysource), in accordance with the XY routing method.

(b) West first Algorithm

This algorithm forbids any 90-degree bends to the west; hence, a packet must begin its journey in the west. According to these criteria, the west-first routing method should be used: if necessary, route a packet first west, followed by an adaptive south, east, and north.

(c) Odd Even Algorithm

In an attempt to avoid deadlock, this routing technique based on the odd-even turn paradigm is used. Shortest path routing is done using the OE algorithm. A column is even in the odd-even turn model if its x-coordinate is even, and vice versa if its x-coordinate is odd. A two-dimensional mesh with dimensions X*Y, each node is recognized with its coordinates in the odd-even turn model (x,y). A column is considered to have existed in this paradigm even though its x dimension element is an even numerical column. A 90-degree turn is a turn. According to the direction that connected channels are traveling, there are eight different sorts of turns (row or column). Turns with the letters W, S, E, N denote West, South, East and North. are NW, NE, SW, SE, WS, WN and EN.

(d) North Last Algorithm

The North-Last method allows 90° turns and is only partially adaptable. In this algorithm, the packets are usually routed last in the North direction. The North-Last routing strategy enables six out of the eight possible turns, which is greater than the XY routing algorithm. This approach permits six turns instead of the eight that are accessible, which is greater than the XY routing algorithm. At any mesh network node, this method has two disallowed turns: North to West port and North to East port. The above four routing Algorithms are used in the estimation of the overall performance of various routing algorithmic efficiency using Noxim.

3. Results and Discussion

3.1 West First Algorithm

A. The impact of the WiNoC's network throughput for different packet injection rate

The network throughput comparison of various PIR is shown in Fig 3. As the PIR is increased, the network throughput also increases.

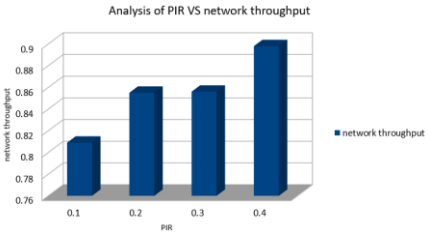

Fig 3: PIR VS Network throughput of West First Algorithm

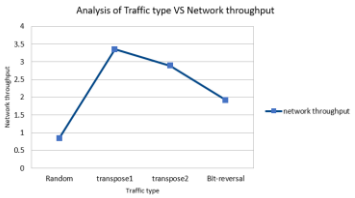

Fig 4: Traffic type VS Network throughput of West First Algorithm

B. The impact of the WiNoC's network throughput for different Traffic type

The network throughput comparison for various Traffic types is shown above in Fig 4, We can observe that Network throughput is very less for random traffic types and the highest throughput can be achieved by transpose1 type.

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C. Analysis of Packet Size vs Network Throughput

Several factors, including packet loss and network congestion, have an impact on the throughput of a network. The network throughput is observed for various packet sizes in Fig 5. It increases as packet size increases.

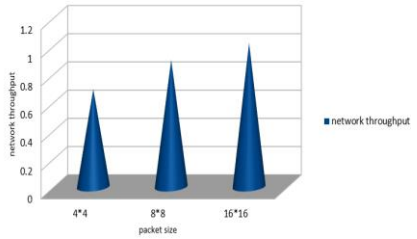

Fig 5: Packet size VS Network throughput of West First Algorithm

3.2 North Last Algorithm

A. The impact of the WiNoC's network throughput for different packet injection rate

The network throughput comparison of various PIR is shown below Fig 6. As the PIR is increased, the network throughput increases and then remains constant.

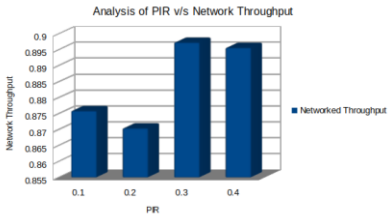

Fig 6: PIR VS Network throughput of North Last Algorithm

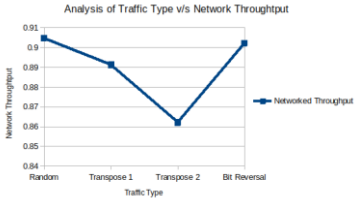

Fig 7: Traffic type VS Network throughput of North Last Algorithm

B. The impact of the WiNoC's network throughput for different Traffic type

The network throughput comparison of four for various Traffic types is shown above in Fig 7, We can observe that Network throughput is very less for Transpose 2 traffic type and the highest throughput can be achieved by Random type.

C. Analysis of Packet Size vs Network Throughput

The network throughput is observed for various packet sizes in Fig 8. It varies for different packet sizes.

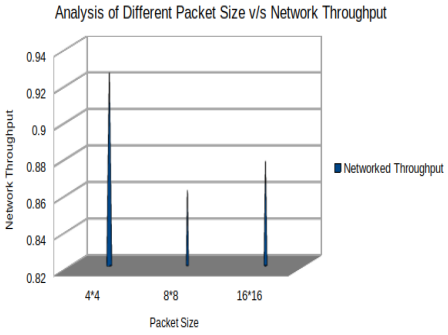

Fig 8: Packet size VS Network throughput North Last Algorithm

3.3 XY Algorithm

A. The impact of the WiNoC's network throughput for different packet injection rate

A node's rate of injecting packets into the network is commonly referred to as its packet injection rate (packet/cycle/IP). The network throughput comparison of various PIR is shown in Fig 9. As the PIR is increased, the network throughput increases.

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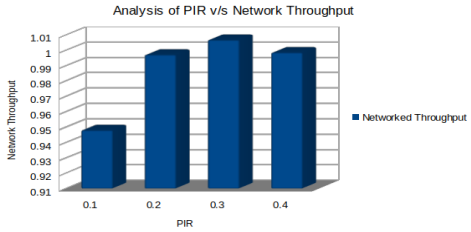

Fig 9: PIR VS Network throughput of XY Algorithm

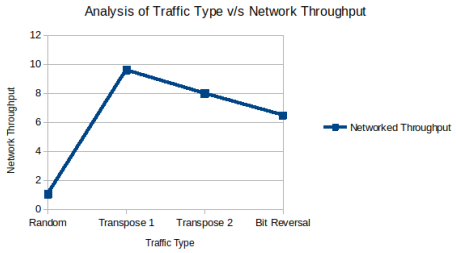

Fig 10: Traffic type VS Network throughput of XY Algorithm

B. The impact of the WiNoC's network throughput for different Traffic type

The network throughput comparison of the four for various Traffic types is shown in Fig 10, We can observe that Network throughput is very less for Random traffic type and the highest throughput can be achieved by Transpose 1 type.

C. Analysis of Packet Size vs Network Throughput

In this, we can observe the impact network throughput on various packet sizes in Fig 11. The network throughput is observed for various packet sizes. It increases as packet size increases.

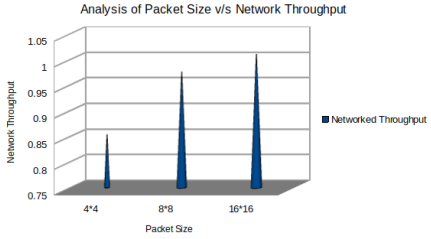

Fig 11: Packet size VS Network throughput of XY Algorithm

3.4 ODD EVEN Algorithm

A. The impact of the WiNoC's network throughput for different packet injection rate

On the other hand, congestion should be controlled through flow management and must not exceed a specific point. Beyond certain points, substantial congestion occurs with increasing pir. the network throughput comparison of various PIR is shown as below in Fig 12. As the PIR is increased, the network throughput increases.

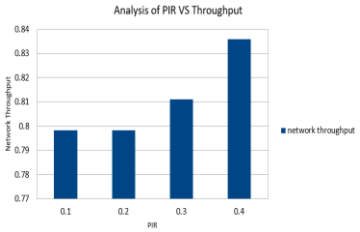

Fig 12: PIR VS Network throughput of Odd even Algorithm

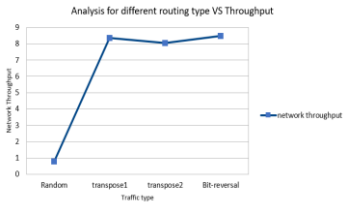

Fig 13: Traffic type VS Network throughput of Odd even Algorithm

B. The impact of the WiNoC's network throughput for different Traffic type

The network throughput comparison of the four for various Traffic types is shown in Fig 13, We can observe that Network throughput is very less for Random traffic type and the highest throughput can be achieved by Transpose 1 and Bit Reversal type.

C. Analysis of Packet Size vs Network Throughput

The network throughput is observed for various packet sizes in Fig 14. It increases as packet size increases.

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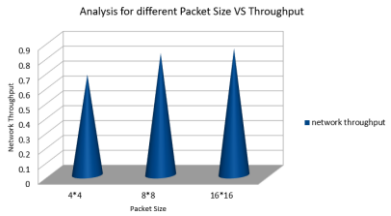

Fig 14: Packet size VS Network throughput of Odd even Algorithm

This study examines the effects of four different routing algorithms (Odd Even, West First, North Last and XY Algorithm) on an 8x8 WiNoC network with fixed subnets and changing PIR.
The various parameters like Network Throughput, PIR and Traffic type are used to examine the various routing algorithms performance.
Thus, it can be said that of the four employed routing methods,
(1)Network throughput is best for Transpose 1 traffic type in XY and West First Algorithm, and best for Random traffic type in North Last Algorithm. Bit reversal is the ideal traffic type for odd even algorithms.
(2)Network throughput is high for 16*16 packet size XY and west first algorithm, and odd even algorithm.
(3)Network throughput for the west first and odd even algorithms is strong at high PIR.

West First Algorithm

PIR	0.1	0.2	0.3	0.4
Network Throughput	0.81	0.85	0.85	0.89

XY Algorithm

PIR	0.1	0.2	0.3	0.4
Network Throughput	0.945	0.992	1	0.992

North Last Algorithm

PIR	0.1	0.2	0.3	0.4
Network Throughput	0.875	0.866	0.895	0.892

Odd Even Algorithm

PIR	0.1	0.2	0.3	0.4
Network Throughput	0.799	0.799	0.811	0.835

CONCLUSION

In this paper, we have investigated the impacts of various routing strategies and their effects for 8*8 mesh network size. By noticing the performance of the various routing algorithms with different routing parameters like Network throughput, Traffic type, PIR (Packet Injection Rate) and different packet size, it can be stated that this type of architecture gives the best performance among others. The performance of NoC and WiNoC architectures have been evaluated with different routing schemes, such as XY, north-last, west-first, and odd-even algorithms.

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