Time-Constraint Data Center Network Reliability Analysis

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***Abstract*- This paper analyses the time constraint reliability of two dimensional N×N torus and Benes networks with various sizes where N=8,16,32,64. In this study, reliability block diagram methods is used with a consideration of specific failure rate (λ 10^6) of the node to evaluate reliability. Matlab is used to validate the results and compare them to an existing Benes network. The analysis reveals that torus network has a higher network reliability compared to Benes network..**

Index Terms—Reliability block diagram, network reliability, Benes, torus, interconnection network

I. Introduction

The demand for data centers (DCs) is increasing with time as per the rise in internet traffic. Hence, highly reliable DCNs (data center networks) are required to provide communication within DCs. Optical DCNs are a complex connection of various nodes (such as routers) connected with optical fibers which establish the communication in between the remote DCs (inter-DCN) and the server racks within a DC (intra-DCN). The torus and Benes are suitable candidates for optical intra DCN with low latency and high throughput and scalability [1–3]. Time dependent network reliability is a major concern for the DCNs to support the increase in internet and cloud traffic, as it helps in predicting the performance of the network under faulty conditions accurately. Reliability block diagram (RBD) [4] determines reliability for torus and Benes network with various sizes. The remainder of the paper is laid out as follows: Section II explains the RBD method, Section III includes the evaluation of network reliability of Benes and torus networks and Section IV depicts the comparative analysis of BEnes and torus network and Section V concludes the work.

II. RBD Method

The reliability analysis of any interconnection network is performed using the RBD method [1]. RBD offers a graphical explanation the interconnection between network nodes reliability perspective [2]. The network is composed of links and nodes. These are interconnected in series, parallel, or a series-parallel combination. The nodes are assumed to be both faulty/non-faulty [3].

A. Series Reliability Block Diagram Method

The operating state of each node in a series reliability block diagram is interdependent. Hence, any single node failure is responsible for the complete network failure [3]. Therefore, a network in which nodes are interconnected in series has low reliability. The series reliability block diagram connecting a particular source to destination is shown in Fig. 1, where all the *n* intermediate nodes are connected to each other in series.

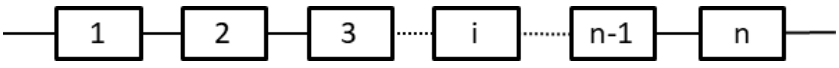

Fig. 1. A reliability block diagram depicting a series connection between a source and destination node pair.

$$P_S = \prod_{i=1}^{n} P_i \qquad (1)$$

Assuming P_i represents the reliability of i^{th} node, then series network reliability P_S is evaluated using equation (**??**).

B. Parallel Reliability Block Diagram Method

Reliability block diagram for a particular source-destination node pair connected in parallel is depicted in Fig. 2. In this figure, *n* nodes are arranged in parallel and in this type of connectivity it is possible to transmit the packet from source to