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BISECTION WIDTH OF TORUS – BUTTERFY INTERCONNECTION NETWORK

Latifah
Dept. of Information System
STMIK JAKARTA STI&K, Lecturer of University of Gunadarma
Jakarta, Indonesia
latifah@staff.gunadarma.ac.id; latifah@jak-stik.ac.id

Abstract— The interconnection network Torus-Butterfly is a new Cartesian product network that has constant degree, low diameter, low network cost. Its also can be embedded in linear array with minimum dilation and expansion. That describes the good performance of this interconnection networks. Another metrics that also commonly used to describe the performance of interconnection networks is bisection width. This paper discuss about the bisection width of Torus - Butterfly interconnection network.

Key words— performance of interconnection networks, Cartesian Product Network, Bisection Width.

I. INTRODUCTION

Model (topology) of interconnection networks is an important part for parallel processing or distributed system [1]. Several metrics are coomonly used to describe the performance of interconnection networks are: Connectivity or degree, Diameter, Average Distance and Bisection Width [2]. A good model of the interconnection network must have the symmetry properties, measured (scalable), has a small diameter [3], and also has a constant and a limited degree [4, 5]. Torus – Butterfly has this good properties that is has constant degree and small diameter [6]. Bisection Width of interconnection networks has always been important in parallel computing, since it bounds the speed at which information can be moved from one side of a network to another [7].

There are research that measured the bisection width of interconnection network such as bisection width of Chained-Cubic Tree interconnection network [8], bisection width of Product Networks with application to Data Centers [7].

II. DEFINITION AND NOTATION

This part gives definition and notation use in this paper.

Definition 1: A graph G = (V, E) is called connected if for any two nodes of a graph G there is always the path that connects the second node [9].

Definition 2: The degree of a node $x \in V_G$, denoted by deg (x), is connected arc from x to nodes $y \in V_G$, $y \neq x$ [10].

Definition 3: The diameter of the connected graph G (V_G, E_G) is the maximum distance of all pairs of vertices [9].

Definition 4: Bisection Width of a network is the smallest number of wires you have to cut to disconnect the network into two equal halves [2].

Definition 5: If G = (V_1, E_1) is the Torus interconnection network model of size ml and H = (V_2, E_2) is the Enhanced Butterfly interconnection network model dimension n [11], then the Torus-Butterfly interconnection network model, denoted as TB (m, l, n), is the Cartesian product of Torus and Enhanced Butterfly, with m and l is the size of Torus interconnection network model and n is the dimension of the Enhanced Butterfly interconnection network model. This is true for $n \geq 3$, $m \geq 2$ and $l \geq 2$ [6].

Lemma 1: The degree of each node in the Torus -Butterfly interconnection network model is 9 [6].

Lemma 2: The diameter of the interconnection network Torus-Butterfly TB (m, l, n) is = max {⌊ m / 2 ⌋, ⌊ l / 2 ⌋} + n [6].

From the above degree and diameter of Torus-Butterfly interconnections network formula, the following network cost: of Torus-Butterfly interconnection network model is
9 (max {⌊ m / 2 ⌋, ⌊ l / 2 ⌋} + n) [6].

Furthermore bisection width (Bw) of a d- dimensional array is given by:

$$Bw(A^d) = \sum_{i=1 \text{ to } d} k_j, \qquad (1)$$ [12].

Linear array can be embedded into Torus – Butterfly interconnection network [13].

III. RESULTS AND DISCUSSION

From equation 1, the Bisection width of the Torus – Butterfly interconnection network is $ml + n2^n$ which m, l is the vertices of Torus and $n2^n$ is the vertices of Enhanced Butterfly

IV. CONCLUSION AND FUTURE WORK

The Torus – Butterfly interconnection network has enough large bisection width which is good for interconnection network performance. For future work it can be evaluated the average distance of Torus –Butterfly interconnection network.

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