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Algorithm for Embedding Hybrid (Star-Bus) Topology onto Hex-Cell Topology

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Abstract: The present study was conducted to show an algorithm for embedding hybrid (star-bus) topology onto Hexcell interconnection network. Embedding capability of topological structures such as ring, bus, tree and mesh topologies can be done by Hexcell which is an interconnection network. We use two measurements to evaluate our proposed algorithms: congestion, expansion. Our evaluation results show that congestion is equal to 1 and the expansion equals to 1.

Key words: Embedding, Hexcell network, mapping, expansion, congestion, interconnection

INTRODUCTION

Routing algorithm acts an important role in communication system of network. Consequently, the data routing is most fundamental function in an inter connection network (Mohanty and Behera, 2017). Performance of the distributed computing system's is affected by the interconnection network topology. So, the choice of the interconnection network topology is considered a critical issue that must be taken into when designing distributed systems and developing. So, for this reason many interconnection network topologies have been proposed such as tree, mesh, hypercube, tree hypercubes, bus, ring and hexcell for this reason (Mohammad *et al*., 2015; Qatawneh *et al*., 2015, 2011; Mohammad and Khattab, 2015).

Several features affect the performance of distributed systems, since, each network topology has its exclusive features such as: node degree, network degree, diameter, bisection bandwidth, routing algorithm, partitioning, mapping (Qatawneh, 2016).

The capability of embedding topological structure is desirable features in network system (Qatawneh *et al*., 2011). Graph embedding is one of the critical issue in network evaluation and selection (Almobaideen *et al*., 2007; Ernastuti and Vajnovki, 2007).

Graph embedding (mapping) is a technique in inter connection networks that maps a guest graph into Hexcell network have scalability in a gradual fashion with minimal cost because of its recursive structure and another host graph (Qatawneh *et al*., 2011). There are more than criteria to assess embedding results have been mentioned in the literature (Lin *et al*., 2001; Qatawneh, 2011). Employs an efficient routing algorithm which requires less knowledge of the network interconnections and gathers less cost of communication (Sharieh *et al*., 2008).

In our reasearch, we propose an algorithm for embedding hybrid (star-bus) topology onto Hexcell network. We use two measurements to evaluate our proposed algorithms: congestion, expansion.

Definition of Hexcell network: An interconnection networks topologies called Hexcell which can be constructed by using units of hexagon cells. A Hexcell network has six nodes and d levels numbered from 1-d with depth d. Level 1 represents one hexagon-cell. Level 2 represents 6 hexagon-cells surrounding the hexagon-cell at level 1. Level 3 represents 12 hexagon-cells surrounding the 6 hexagon-cells at level 2 and so on. Each level i has Ni nodes, representing interconnection in a ring structure and processing elements (Qatawneh *et al*., 2011).

MATERIALS AND METHODS

Algorithm 1; Proposed embedding algorithm:

Step 1: Define the root of the star
star-root = (number of nodes(d-line)/2)+1, id = 1, adge = 0 nodes = 1
Step2: for each edge from the root
edge = edge+1
give id to the one edge nodes from the root
if the node has one edge to a non connected node then
start from up then opposite the clock wise)

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else
start from left then opposite the clock wise
end if
id = id+1
node = node+1
if edge<star-root then
nodes = 3*edge
else if edge = star-root -1 then
nodes = 3*edge-d
else if edge = star_root then
nodes = 3*d-1
else if edge = star_root+1 then
nodes = d
end if
if node = nodes then
Stop and send message to the lowest node id (signal to the lowest node id to be the one to start anew level (new edge) by doing step 2 again
Step 3: Delete all un used edge
Step 4: Each node with 3 edge become a root

RESULTS AND DISCUSSION

Figure 1-5 show the results of applying our algorithm for embedding hybrid (star-bus) topology onto hexcell topology. To evaluate our embedding algorithm we use two measurements: congestion and expansion. Congestion is the maximum number of edges mapped into any edge in the embedding and the expansion is the ratio of the number of nodes in the embedding algorithm to that in the original network (Mohammad and Khattab, 2015). Our algorithm shows that the (star-bus) topology can be embedded into Hexcell Network with congestion and expansion of 1 (Table 1).

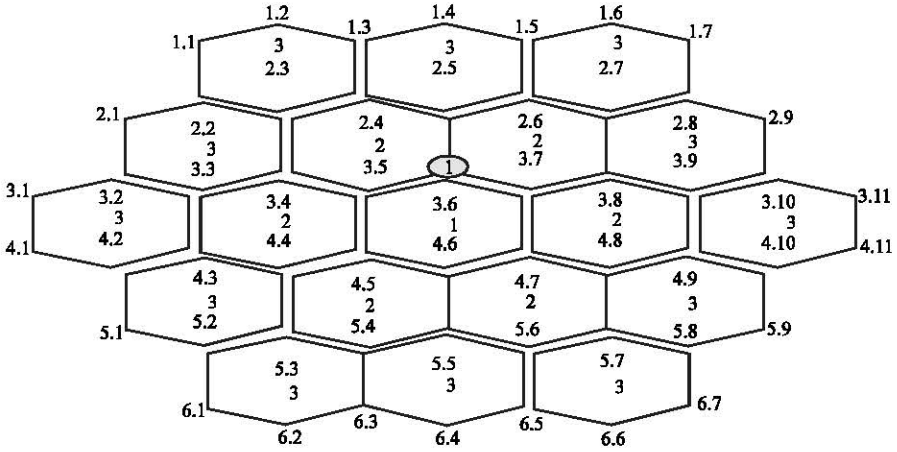

Fig. 1: Algorithm embedding (star-bus) onto Hexcell topology (step 1of the algorithm)

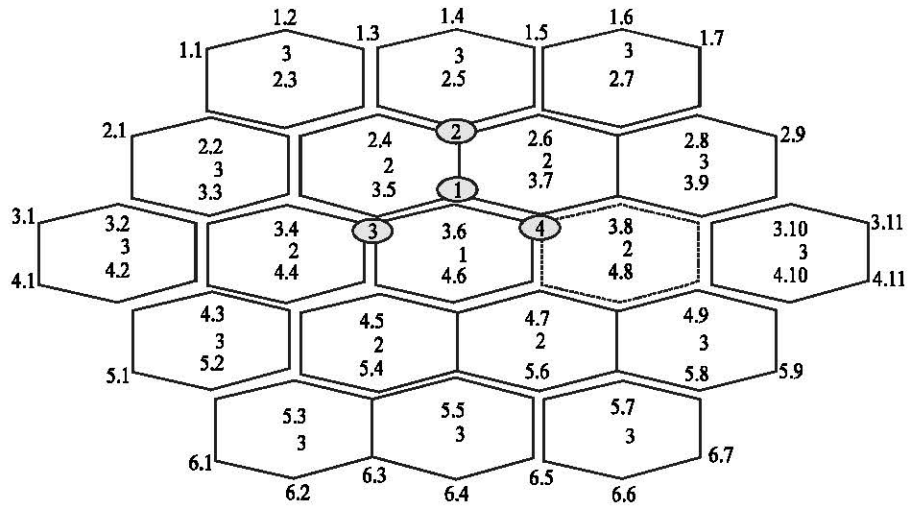

Fig. 2: Embedding (star-bus) onto Hexcell topology (step 2 of the algorithm)

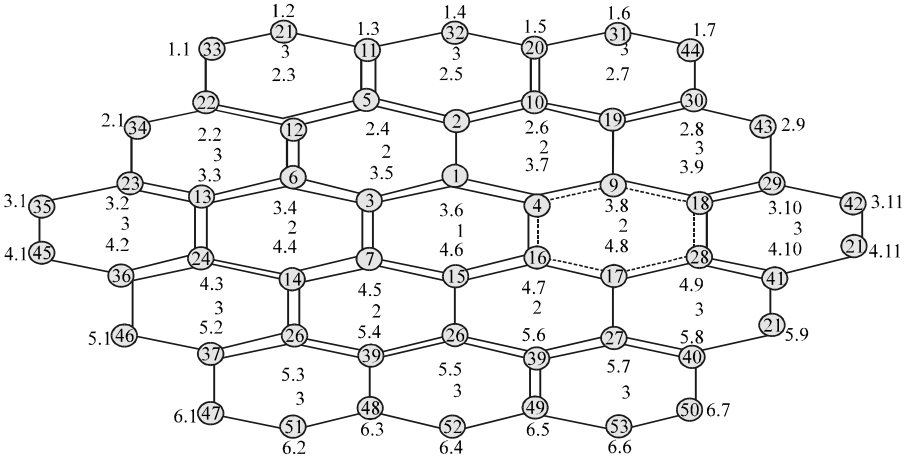

Fig. 3: The full addressing of (star-bus) onto Hexcell

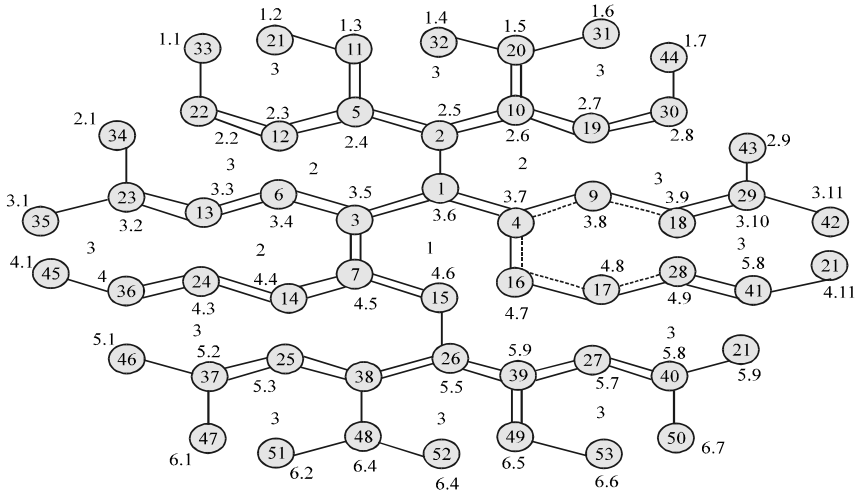

Fig. 4: Embedding (Star-bus) onto Hexcell topology (step 3 of the algorithim)

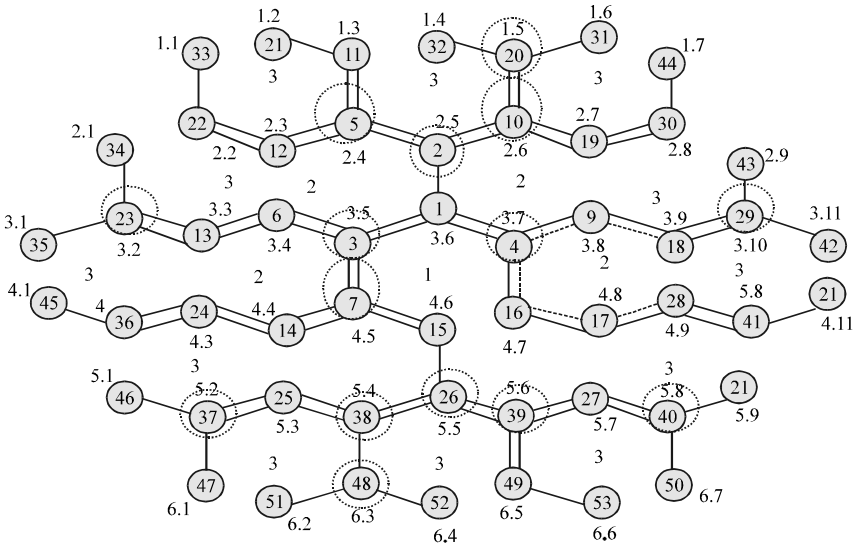

Fig. 5: Embedding (star-bus) onto Hexcell topology (step 4 of the algorithm) each node with 3 edge become a root (this step make it star-bus(tree))

Table 1: Algorithm performance evaluation

Performance	Algorithm
Congestion	1
Expansion	1

CONCLUSION

In this research, we proposed an algorithm for embedding hybrid star-bus topology onto Hexcell network. The measurements used to evaluate the proposed algorithms are congestion and expansion. Evaluation results show that the congestion and expansion is one for both.

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