Benha University
Faculty of Engineering (at Shoubra)
Electrical Engineering Department
M.Sc. (Computer Systems Engineering**)**

Midterm Exam
Subject: Distributed and Parallel Systems - CES 601
Date: Sat 01/04/2017
Duration: 1 hour

Attempt the following questions.

№ of Questions: 4 in 1 page(s)
Total Points: 20 (10 **Marks**)

Question 1:   (**05** pts)

Consider the following code fragment:

```
for (i = 0; i < 1000; i++)
    column_sum[i] = 0.0;
        for (j = 0; j < 1000; j++)
            column_sum[i] += b[j][i];
```

   a) Identify the problem that causes poor memory system performance.   (**02** pts)
   b) Make any reasonable assumption and restructure the code fragment to eliminate the problem.   (**03** pts)

Question 2:   (**05** pts)

Formulate message passing costs in parallel computers in the following routing techniques:
   a) Store-and-Forward Routing   (**01** pt)
   b) Packet Routing   (**02** pts)
   c) Cut-Through Routing   (**02** pts)

Question 3:   (**05** pts)

   a) Consider a complete binary tree of 2^d - 1 nodes in which each node is a processing node. What is the minimum-dilation mapping of such a tree onto a d-dimensional hypercube?   (**03** pts)
   b) Derive the diameter, number of links, and bisection width of a k-ary d-cube with p nodes. Define l_{av} to be the average distance between any two nodes in the network. Derive l_{av} for a k-ary d-cube.   (**02** pts)

Question 4:   (**05** pts)

A $\sqrt{P} \times \sqrt{P}$ reconfigurable mesh consists of a $\sqrt{P} \times \sqrt{P}$ array of processing nodes connected to a grid-shaped reconfigurable broadcast bus. A 4 x 4 reconfigurable mesh is shown. Each node has locally-controllable bus switches. The internal connections among the four ports, north (N), east (E), west (W), and south (S), of a node can be configured during the execution of an algorithm. Note that there are 15 connection patterns. For example, {SW, EN} represents the configuration in which port S is connected to port W and port N is connected to port E. Each bit of the bus carries one of 1-signal or 0-signal at any time. The switches allow the broadcast bus to be divided into subbuses, providing smaller reconfigurable meshes. For a given set of switch settings, a subbus is a maximally-connected subset of the nodes. Other than the buses and the switches, the reconfigurable mesh is similar to the standard two-dimensional mesh. Assume that only one node is allowed to broadcast on a subbus shared by multiple nodes at any time.
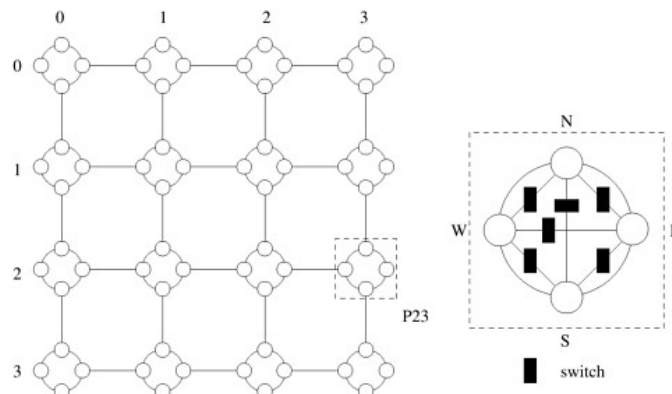
Determine **a)** the bisection width, **b)** the diameter, and **c)** the number of switching nodes and **d)** communication links for a reconfigurable mesh of $\sqrt{P} \times \sqrt{P}$ processing nodes. What are **e)** the advantages and disadvantages of a reconfigurable mesh as compared to a wraparound mesh?

Good Luck
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