2010 Paper 5 Question 6

Concurrent and Distributed Systems

(*a*) When distributed systems are designed and engineered, certain fundamental characteristics have to be taken into account, including:

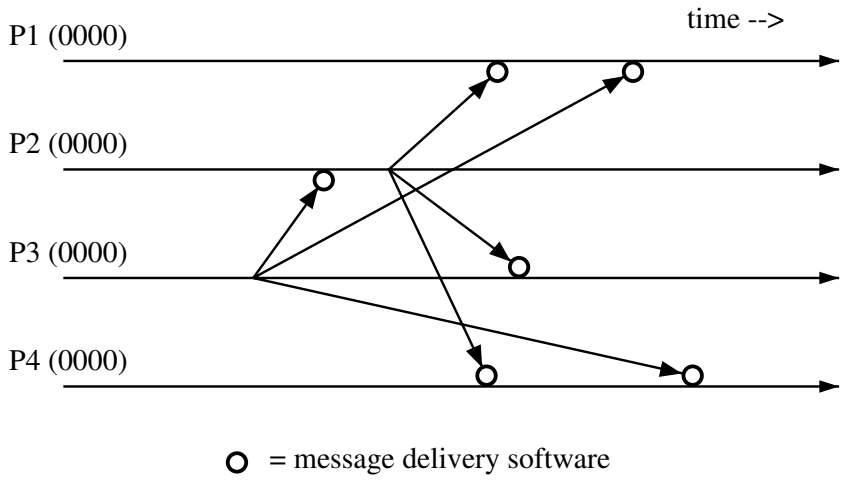
1. Concurrent execution of components.
2. Independent failure modes.
3. Communication delay.
4. No global time.

In the light of these characteristics, discuss the monitoring of a widely distributed industrial process with the following properties:

Distributed monitoring computers analyse regions of the process. Each region contains a number of sensors at identified locations and with the ability to generate timestamps. Some sensors monitor temperature, others monitor pressure.

If both temperature and pressure are found by a monitoring computer to be above their defined thresholds in a given locality within its region it sends an alarm signal to the process control centre, indicating the time and place of the occurrence. The control centre initiates action to bring the values under control. [10 marks]

(*b*) The diagram below represents a process group that communicates by means of multicast messages.



At each process-hosting node, message delivery software decides whether an incoming message should be delivered to the process or buffered for later delivery. This is achieved by the use of vector clocks.

With reference to the example shown in the diagram, describe the vector clock algorithm for delivery of messages in causal order. [10 marks]