

Student's name:

Class:

**Class Exercises**  
**Module: Distributed Systems**  
**Chapter 6: Synchronization (1/2)**

Question 1: Give two examples to demonstrate the importance and the need of synchronization mechanism between processes in distributed systems.

Question 2: Compare Network Time Protocol and Berkeley algorithm.

Question 3: What is the typical characteristic of synchronization algorithm for wireless networks?

Question 4: What is the difference between physical synchronization and logical synchronization?

Question 5: What are the update steps of counters to implement Lamport's logical clock?

Question 6: An algorithm for the physical clock synchronization is described as follows:

The system has one time server  $S$  that is assumed to have the exact time value. A thor process has to synchronize with  $S$ . The synchronization has three following steps:

- Process  $P$  sends the request message to  $S$ .
- After receiving the request message from  $P$ , server  $S$  will reply with its current physical time value:  $T_Q$
- $P$  receives the reply message and adjusts its time value based on the formula:  $T_P = T_Q + \frac{RTT}{2}$

Where  $RTT$  (Round-trip time) is the total time it takes for a the request message from  $P$  to  $S$  and for the reply message back again to  $P$ .

- a) The value of  $T_P$  calculated by the above formula is absolutely accurate? Explain it.
- b) Let  $\delta$  be the deviation of time value. So, we have the formula to calculate the  $T_p$  is:

$$T_P = \left( T_Q + \frac{RTT}{2} \right) \pm \delta$$

Let  $min$  the minimum time value it takes to transmit a message one-way.  
 How to determine the value  $\delta$  in using only 2 variables  $RTT$  and  $min$ ?

Question 7: In using the Vector Clock concept for enforcing causal communication, answer the following questions:

- a) List two conditions the receiving process use to check whether the message satisfies causality.
- b) See an example of 3 processes as shown below. We assume that the vector clock values at the beginning are (0;0;0). What are the vector clock values for 4 points  $X_1$ ,  $X_2$ ,  $X_3$ , and  $X_4$ ?

- c) Which message will be kept at the middleware level because it does not satisfy the two conditions in question *a*?

