ETH
Eidgenössische Technische Hochschule Zürich
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Distributed Computing

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Distributed Systems Part II

Exercise Sheet 11

Quiz

1 Clock Synchronization

a) Prove or disprove the following statement: If the average local skew is smaller than x, then so is the average global skew.

b) Prove or disprove the following statement: If the average global skew is smaller than x, then so is the average local skew.

Basic

2 Time Difference of Arrival

Assume you are located on a line $y = -x + 8km$ in the two dimensional plane. You also receive the GPS signals from two satellites A and B. Both signals were transmitted exactly at the same time t by both satellites. You receive the signal from satellite A $3.3\mu s$ before the signal of satellite B. You also know that satellite A is located at $p^A = (6km, 6km)$ and satellite B is located at $p^B = (2km, 1km)$, i.e. in the plane.

a) Formulate the least squares problem to find your location.

b) Are you more likely to be at position (2km,6km) or (4km,4km)?

c) What is the time when receiving the signal from satellite B?

3 Clock Synchronization: Spanning Tree

Common clock synchronization algorithms (e.g. TPSN, FTSP) rely on a spanning tree to perform clock synchronization. In the TPSN protocol sender-receiver synchronization is performed along the edges of the tree while FTSP is flooding synchronization messages along a tree rooted at the reference node. Finding a good spanning tree for clock synchronization is not trivial. Nodes which are neighbors in the network graph should also be close-by in the resulting tree. Show that in a grid of $n = m \times m$ nodes there exists at least a pair of nodes with a stretch of at least m. The stretch is defined as the hop distance in the tree divided by the distance in the grid.