Title:
Clocks' synchronization in large-scale systems

Presenter:
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Abstract:
During the last decade, clocks' synchronization in networked systems has received a large interest in the control community, mainly due to its relevance in many domains, e.g., robotic, sensor networks, power networks, just to mention a few. In the first part of the talk, after proposing a suitable clock model, we review some of the state of the art synchronization protocols. In particular, we concentrate on flooding-based methods, where, typically, one node is selected as reference for all the other nodes, and, periodically, disseminates its stable information through the network via flooding, which is a common method to achieve network-wide time synchronization in WSNs thanks to its being a basic and simple communication primitive. Each receiver node calculates its offset and frequency difference with respect to the received time information, and synchronizes its clock by employing least-squares regression. Despite being simple and robust, these methods have considerable overhead in terms of computation and memory allocation and lead to exponentially increasing synchronization error with the network diameter, i.e. poor performance scalability. In the second part of the talk, we illustrate a different approach based on control theory, where synchronization is achieved by using linear feedback on the measured local synchronization error. The major advantage of this approach is that the error sources appear as additive noise so that the global time synchronization error approximately grows as the square root of the network diameter. In particular, we review, recently proposed algorithms, which compensate the clock offsets and the differences in clock speeds based on a Proportional-Integral (PI) controller. These algorithms are linear, simple and easy to implement, which make them suitable for both flooding-based and fully-distributed architectures, i.e., where there is no any special node which acts as a time reference for the other nodes and all sensor nodes interact only with their direct neighbours in a peer-to-peer fashion. We conclude the talk by presenting some experimental comparisons between the protocols previously illustrated.