IEEE Standard for a Precision Clock Synchronization Protocol for Networked Measurement and Control Systems

The protocol enhances support for synchronization to better than 1 nanosecond.

1. Overview

1.1 Scope

This standard defines a protocol enabling precise synchronization of clocks in measurement and control systems implemented with technologies such as network communication, local computing, and distributed objects. The protocol is applicable to systems communicating by local area networks supporting multicast messaging including, but not limited to, Ethernet. The protocol enables heterogeneous systems that include clocks of various inherent precision, resolution, and stability to synchronize to a grandmaster clock. The protocol supports system-wide synchronization accuracy in the sub-microsecond range with minimal network and local clock computing resources. The default behavior of the protocol allows simple systems to be installed and operated without requiring the administrative attention of users. The standard includes mappings to User Datagram Protocol (UDP)/Internet Protocol (IP), DeviceNet, and a layer-2 Ethernet implementation. It includes formal mechanisms for message extensions, higher sampling rates, correction for asymmetry, a clock type to reduce error accumulation in large topologies, and specifications on how to incorporate the resulting additional data into the synchronization protocol. The standard permits synchronization accuracies better than 1 ns. The protocol has features to address applications where redundancy and security are a requirement. The standard defines conformance and management capability. There is provision to support unicast as well as multicast messaging. The standard includes an annex on recommended practices. Annexes defining communication-medium-specific implementation details for additional network implementations are expected to be provided in future versions of this standard.