Requirements and Methods for Distributing Accurate and Traceable Time Information

Judah Levine
NIST, Time and Frequency Division
Boulder, Colorado, 80305, http://tf.nist.gov

Extended Abstract

I will describe the financial and industrial requirements for highly accurate time information that is traceable to Coordinated Universal Time (UTC) as defined by international standards and as realized by National Metrology Institutes and timing laboratories. The accuracy that is required varies from one application to another, but accuracies of microseconds are often needed, and nanosecond-level accuracies are likely to be required in the foreseeable future.

There are two aspects of traceability. Technical traceability requires an unbroken chain of calibrated measurements between the end-user application and the time scale provided by a National Metrology Institute or recognized timing laboratory. Legal traceability adds requirements for documentation, which might be required to prove traceability in a judicial proceeding. Legal traceability includes methods for handing and certifying documents that may exist only in digital format.

I will focus on the requirements of the power industry's "smart grid" and the forensic and auditing requirements of the high-frequency trading of stocks and similar commodities. Satisfying these requirements becomes challenging when the need for extreme reliability and the limitations of many of the common distribution channels are considered.

Methods based on signals from global navigation satellites (such as GPS) are commonly used to support these requirements, but these solutions have vulnerabilities and limitations that are of increasing concern. Signals from these satellites can be subject to intentional or inadvertent jamming, in which the true signal is blocked by a much stronger noise source, and also to spoofing, in which the receiver is fooled into accepting a rogue signal as genuine. Even in the best of circumstances, it can be difficult to establish traceability in real time, since the relationship between the transmitted time and UTC is a prediction and not a measurement. In addition, many receivers and end-user applications have not been calibrated, so that the delays through these links in the measurement chain are not known.

I will discuss network-based methods that can satisfy the current and future requirements of commercial and industrial applications and which are not limited by the vulnerabilities of distribution methods that are based on signals from navigation satellites.