SUGGESTED FUNCTIONAL SPECIFICATION for a GPS Synchronized Clock System using Network Time Protocol and Power over Ethernet

1.1 SCOPE

This document specifies a wired clock system that relies on the accuracy of the Global Positioning Satellite (GPS) system for synchronizing the time provided to clocks and network devices using the Network Time Protocol (NTP). Such a clock system relies on one or more NTP time servers with an integrated GPS receiver, to act as master clocks and virtually an unlimited number of network clock displays acting as client devices. In addition, other network client devices can benefit from the availability of the NTP timeservers. Data and low voltage DC power can be distributed over the same network cable using Power Over Ethernet technology, resulting in significant cost savings. The limitations are primarily network configuration and implementation based, as the system can be added to an existing network or configured as an independent network to simply provide a synchronized clock display system.

1.2 GENERAL

NTP (Network Time Protocol) servers allow clients to synchronize clocks, bells, computer clocks, other computer timing devices and other kinds of network equipment using a standard reference of time accepted worldwide, known as UTC (Universal Time Coordinated).

NTP servers with an integrated GPS receiver located on a LAN (Local Area Network) can provide the high accuracy of the GPS satellite system to provide the UTC reference time, eliminating the need to receive time from a NTP server located on the Internet. Placing one or more NTP on your local network behind your facilities firewall enhances reliability, redundancy, accuracy, and security.

Using NTP is clearly an advantage since it permits automatic synchronization of all the equipment hooked up to the network, thus reducing the need and associated cost for personnel to travel to remote clock locations to set the time manually.

In general, it has been observed that since the recent introduction of NTP as a standard for network synchronization, clock installations have become easier, better synchronized, more reliable, and provide a traceable source of time for critical network functions, resulting in lower overall cost.

NTP provides a simplified protocol called SNTP (Simplified Network Time Protocol), which clients can utilize to set the time to trusted NTP timeservers. SNTP V4 is a subset of the full NTP V3 version and is widely accepted for client devices.

POE (Power over Ethernet) is a recognized and a growing method of significantly reducing installation costs and providing low voltage DC power to network devices by distributing power over the unused pair of standard network cables. The modest incremental cost of purchasing POE equipment that is compliant to the IEEE 802.3af standard, dramatically offsets the installation costs and safety issues associated with utilizing and distributing AC power.

A GPS Synchronized clock system using NTP and POE offer significant installation and maintenance cost benefits over traditional clock systems.

2.0 REQUIREMENTS

2.1 GENERAL SYSTEM REQUIRMENTS

The synchronized clock system shall meet or exceed the requirements of this specification in all aspects.

2.2 OPERATIONAL REQUIREMENTS AND ENVIRONMENTAL SPECIFICATIONS

Operational Requirements

The clock system shall be located and operated in an indoor environment, within the parameters of a standard network configuration, and utilizing standard industry provided network equipment and distribution methods, including standardized POE distribution technology. The clock system shall operate autonomously and provide software configuration options for time zone offsets, automatic daylight saving time corrections without scheduled operator intervention or maintenance. The clock system shall be configured via software control and shall allow for remote monitoring and configuration changes while providing password protection.

Environmental specifications

The system shall operate under the following environmental conditions:

- Operating Range: 32° F to 122° F (0° C to 50° C)
- Storage Range: -40° F to 70° F (-40° C to 70° C)
- Relative Humidity: 0-90%, non-condensing

Compliance specifications

All equipment shall be tested, labeled and certified by a nationally recognized and approved testing laboratory to meet the following low voltage safety and electromagnetic compliance requirements of the United States and European Union.

- FCC, part 15, Class B limits for radiated and line conducted emissions
- Electromagnetic Compatibility 89/336/EEC ; 92/31/EC ; 93/68/EEC ; 2004/108/EC
- Low voltage directive 2006/95/EC

2.3 CLOCK ENGINEERING REQUIRMENTS AND PERFORMANCE

The network clocks shall meet the following engineering and performance requirements.

2.3.1 Network clock engineering general specification:

The network clocks shall be designed to provide years of reliable and maintenance free service and shall be constructed of all metal enclosures with high impact, UV stable lenses to ensure structural integrity and maximum durability. A wall mounting bracket, or other means, shall be provided for mounting to the surface of a wall.

The finish of the network clocks shall be of a high quality, durable, painted textured powder coat finish and available in a choice of colors.

The network clocks enclosure shall be available in optional unpainted stainless steel material and finish for special applications.

The network clocks shall be available in double faced or dual mount options for applications in hallways or corridors.

The network clocks shall be designed for easy, cost effective, and reliable installation and use standard RJ45, 10MB Ethernet style connectors.

Accuracy:

The networks clock displays shall be accurate to within 50 milliseconds of the UTC time reference provided by the NTP server(s), when synchronized.

Protocol:

The Ethernet wired clocks shall support the following protocols:

SNTP, Simple Network Time Protocol

The network clocks shall operate with an internal reference time that is set to UTC (Universal Coordinated Time) via a built-in the SNTP client, from up to two NTP timeservers. Selection of the primary and secondary servers shall be automatic, but configurable by either static IP address or DHCP provided IP address configuration methods.

The network clocks shall be configurable to operate as an SNTP client in the following operational modes: unicast (or query), broadcast, or multicast.

DHCP, Dynamic Host Configuration Protocol

The network clocks shall utilize DHCP (Dynamic Host Configuration Protocol), by default, as a means of automating the configuration of all required network settings utilizing the optional settings area of a DHCP server. All DHCP network and optional NTP settings shall allow for enabling or disabling at each clock, in order to use static IP address mode network and NTP settings.

Power:

The network clocks shall utilize a standardized Power over Ethernet (POE) technology to power the clock in compliance with the IEEE 802.3af Power over Ethernet specification.

The network clocks shall be considered to be and to operate as Powered Devices (PD); and shall utilize a 48V DC nominal voltage supplied over the spare Ethernet network cable pairs, and/or the shared data/pairs, from an IEEE 802.3af compliant Power Sourcing Equipment (PSE) device, with a 10/100 MB rating, for a distance of up to 100m (328 ft). Power consumption shall be less than 12.95 Watts maximum for all PD equipment. Each network clock PD shall have a typical power rating of less than 7.5 W.

The network clocks shall be made available with an optional AC power. The power input shall be made as a universal type with an input power range of 90-264 VAC, 47-63 Hz and utilizing a standard IEC power jack.

Connectors:

Type Connector

Ethernet 10/100 Base-T: RJ45

The network clock system shall utilize standard Cat 5 or Cat 6 cabling for the distribution of either data, or data and power using the same standard cable, and eliminating the need for an AC power source at the clock location.

Configuration settings:

The time displayed on the face of the network clocks may either be UTC time or local time and shall be configurable via software.

Clock displays shall offer flexibility to allow for any international time zone offset and automatic Daylight Saving Time (DST) adjustment and shall provide maintenance free reliable operation. Configuration changes shall be retained in non-volatile flash.

The network clocks shall utilize an internal maintenance free rechargeable battery backed real-time clock (RTC) to retain the internal time in the event of a power outage or for conditions when the NTP server(s) is not available. The network clocks shall not display the time during a power outage, but shall recover from such power outage as a system without intervention.

During such “free-wheeling” periods and while in operation, the network clocks shall provide a visual indication that the device is relying on the internal oscillator and is not currently synchronized to the network timeserver.

2.3.2 Analog clock engineering specification:

The shape of the analog clock shall be round 12” [30 cm] or 18” [46 cm]. The face of the clock shall be off-white, the time indication marks on face shall be black. The hour markings shall be in an Arabic numeral format and in an easily read font. Minute /second marking shall be provided. The analog clock shall have black hour and minute hands and a red second hand indicator.

The analog clock shall contain a stepper motor drive and state of the art microprocessor and electronics control to rapidly synchronize the hands on the face of the clock to an accurate NTP (Network Time Protocol) reference.

The stepper motor drive and gear system shall be of all metal construction for long maintenance free life and high product reliability. The gear and drive train system shall be smooth and quiet in operation to minimize motor noise.

An LED status indicator on the face of the clock shall illuminate when the clock is not synchronized.

The analog clock shall be available with the following options: LED illumination, double face ceiling or wall mount, stainless steel enclosure.

2.3.3 Digital clock engineering specification:

The displays shall utilize LED’s (Light Emitting Diodes) such that they are easy to read in various lighting conditions, allow for large viewing angles, maximum-viewing distances, long life expectance, and do not require back lighting. The LED’s shall be available in various colors including red, amber, green, and blue displays for various visibility requirements and in various sizes including 2.3” [5.8cm], 4” [10cm], and 7” [18cm] character heights. In addition, the brightness of the LED display shall be fully adjustable via software to allow for the display to be dimmed or brightened remotely, in order to accommodate various lighting conditions and requirements.

3.0 CONFIGURATION SOFTWARE

The network clock system shall be fully configurable and managed remotely through IP via software to simplify the costs associated with administration.

GUI Interface – Windows configuration

The network clock system shall include a GUI (Graphical User Interface) based network software application, operating under the Windows OS, for configuration and maintenance of [the network time server and] all network clocks.

The GUI application shall include password protection of the clock configuration, encrypted communication, and the ability to enable or disable options that might reduce security. A status display to remotely monitor the time displayed on the clock, the internal UTC time, synchronization status, and any error condition regarding the clocks network status shall be provided.

An optional advanced Windows based GUI configuration software package shall be available for separate purchase, for quickly configuring groups of clocks with the ability to save and load configurations.

Console interface – Unix/Linux, non-Windows platform configuration

A separate menu driven telnet console interface shall be provided for configuration, of the network time server and network clocks on a non-Windows OS such as UNIX, Linux.

4.0 REPAIR AND MAINTENANCE

Designed as solid-state devices, the clocks shall require no standard maintenance and shall have no user serviceable or replaceable parts inside in order to reduce the requirement for on-site maintenance and repair personnel.

Any necessary firmware updates shall be made available and able to be applied on location. Instructions and required update files shall be made available for download from the manufacturer's website.

A procedure for trouble-shooting typical installation, configuration, and operational issues shall be supplied as part of the documentation, as part of the user manual.

The manufacturer shall make warranty repair and service, as well as non-warranty repair service, available.