



Selecting the Correct Timekeeping Solution for your Facility

A White Paper from American Time & Signal Co.

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Introduction: It can be a challenge trying to know which time measuring system is ideal for your facility. Your distinct application and budget are the determining factors from the many options to choose from. How do you know what's best for you? This white paper will help clarify what is available in the market and what is the best solution for your project. A little information and some common sense can help you to make the best decision.

To get started, some key factors come into play when trying to decide on a timekeeping solution:

Importance of time synchronization

Type of structure

Ease of installation and maintenance

Cost or budgetary considerations

All these things can impact your decision on what kind of clock solution to install. A basic understanding of time synchronization is the first step in selecting the best option for you.

Synchronized clocks-Often called system clocks, each clock is controlled by a master controller. All clocks are accurate within the second to each other. Daylight Saving Time changes are controlled by the master (or radio signal in the case of atomic clocks) so there's no yearly maintenance associated with DST. Synchronized clocks can be AC powered wired clocks, AC powered or battery operated wireless clocks, or atomic clocks.

Stand-alone clocks-Each clock operates independently in a non-synchronized fashion. The accuracy over a long period of time is good; however, the time on each clock can be set ahead or behind other clocks. Depending on the clock features, yearly maintenance may be required for Daylight Saving changes. In the case of battery operated clocks, yearly maintenance may also be required for battery changes.

At this point, it's important to determine your needs based on the type of structure. Some synchronized clocks require wiring; while battery operated clocks do not.

Application based on structure type:

Existing Structure addition, remodel or upgrade:

This can be the most difficult type of facility to outfit with clocks when AC clocks are required. Power access points are limited and extending an existing wired system into a new addition can be difficult.

This is a good application for battery operated clocks. If synchronized time is critical, a wireless system is also a good option.

New Construction:

Installing the wiring and conduit for a new clock system is a considerable expense, so choosing a wireless system in this situation saves time and money.

A wired clock system in new construction is a much easier install than in an existing structure.

Design Phase:

Whether you want the latest technology, a tried and true wired system, or a simple way to tell time, the initial design phase allows you to structure your clock system based on what's important to your facility.

Accuracy, ease of installation, cost, synchronization and maintenance is determined by the style of clock or clock system you choose.

Clock Style	Accuracy	Ease of Install	Cost Each	Synchronized to Master Clock or Other Clocks	Maintenance Changing Batteries	Twice Yearly DST Change
Battery Operated Quartz	Good	Easy	\$15-\$30	No	Yes	Yes
Battery Operated Auto DST	Good	Easy	\$25-\$35	No	Yes	No
Battery Operated Atomic (Radio Controlled)	Excellent-Synchronize daily Radio signal required	Easy	\$30-\$40	Yes	Yes	No
AC Powered Electric	Good	Moderate-AC power required	\$25-\$35	No	No	Yes
AC Powered Wired System	Excellent-Synchronize daily	Difficult-Requires master and conduit/wire in walls	\$100-\$170	Yes	No	No
Wireless System-Battery Operated	Excellent-Synchronize daily	Easy	\$100-\$170	Yes	Yes	No
Wireless System-AC Powered	Excellent-Synchronize daily	Moderate-AC power required	\$100-\$170	Yes	No	No

There are many timekeeping options available to meet your needs in today's market place. The following information addresses the different types of timekeeping solutions available with the pros and cons of each option.

Battery Operated Quartz Clocks

Explanation:

Clocks are stand-alone and need to be set manually to the correct time. Battery clocks are a low cost, easy installation solution. This is the most economical solution you will find when clock cost is the most important requirement. These clocks are battery powered and need to be set manually to the correct time at start-up and changed twice a year for daylight saving time. The price range for these analog clocks is \$15 - \$30 each.

Pros:

- Very portable and easy to mount in any location or move to a new location
- No AC power is required for this option
- Reasonably priced and readily available
- Very accurate over time (individually +/- 1 minute per year)
- Keep running during a power outage

Cons:

- Have to be reset manually twice a year for Daylight Saving Time
- Clocks are only as accurate with one another as you set them
- Styles and designs change frequently depending on where you purchase your clocks so it may be difficult to obtain a consistent look
- Battery replacement is required periodically (12 – 15 months use)

Battery Operated Quartz Clocks with Auto DST (Daylight Saving Time) Adjustment

Explanation:

These clocks are stand alone and need to be set manually to the correct time at start-up and will automatically adjust with daylight saving changes. This is an economical way to provide time within your facility. The price range for these analog clocks is \$25 - \$35 each.

Pros:

- Very portable and easy to mount in any location or move to a new location
- Easy manual reset
- No wiring or AC power is required
- Reasonably priced solution
- Accurate over time (individually +/- 1 minute per year)
- Clocks automatically change for Daylight Saving Time
- Will keep running during a power outage

Cons:

- Clocks are only as accurate to each other as you set them
- Battery replacement is required periodically (12 – 15 months use)

Defining NIST

There are some terms associated with various types of clocks that I want to clarify at this point. First, I want to explain the term “atomic” clock. The United States military uses a very precise time signal called “NIST” or the National Institute of Standards and Technology. NIST monitors and controls the National Atomic Clock.

The time signal from NIST is transmitted via a radio transmitting tower in Colorado out across the United States. This signal is received by atomic clocks just like a radio receives a signal from a broadcasting stations transmitting antenna. The NIST organization also sends the time signal to the GPS (Global Positioning Satellite) system that re-transmits it over all the earth through government satellites circling the globe. The NIST time can also be accessed via the internet. These precise time synchronization options are available to everyone in the United States.

Battery Operated Atomic Clocks / Radio Control

Explanation: Commonly referred to as atomic or radio-controlled clocks. An atomic clock uses the radio signal from NIST to synchronize its time. These clocks have time zone switches making them usable in all the time zones across the United States. The price range for these analog clocks is \$30 - \$40 each.

Pros:

- Very portable and easy to mount in any location or move to a new location
- Synchronized to NIST official time
- Reasonably priced synchronized clock to clock time solution
- Provides very accurate time (+/- 1 second per year)
- Keep running during a power outage
- Selectable time zone feature
- Most can run as a stand-alone clock where signal is not available via movement switch setting
- Automatic correction for Daylight Saving Time
- No FCC license required

Cons:

- Requires reception of the time signal from Colorado to operate properly
- May experience signal blockage based on geographic location or building construction materials
- Styles and designs change frequently depending on where you purchase your clocks so it may be difficult to obtain a consistent look
- Battery replacement is required periodically (12 – 15 months use)
- Cannot be manually reset

AC Powered Electric Clocks

Explanation:

Quartz clocks utilizing AC power are stand-alone and need to be set manually to the correct time at start-up. AC powered electric clocks are a low cost solution for timekeeping that eliminate the need for battery replacement. These clocks need to be plugged into a 120VAC outlet. The price range for AC analog clocks is \$25 - \$35 each.

Pros:

Easy to install or mount on the wall
Reasonably priced solution
Very accurate over time (individually +/- 1 minute per year)
120VAC operation eliminates the need to change batteries

Cons:

Have to be reset manually twice a year for Daylight Saving Time
Only as accurate with one another as you set them
Clocks require 120VAC
Will stop during power outages-manual time adjustment is needed when power returns

AC Powered Wired System and Clocks

Explanation: A wired clock system consists of a master time control unit and wires running to each clock. This creates a synchronized clock system. The master can be operated from its internal quartz timekeeper to an accuracy of +/- 1 minute per year.

Some masters are equipped to synchronize their time to NIST via GPS or Ethernet for very accurate time. This is a time tested and proven method of supplying synchronized time throughout a building and has been used since the early 1920's.

The system clocks typically require three wires for proper operation. One wire is the neutral, one wire is the power to run the clock and the third wire supplies the correction signal. The hourly and twelve hour correction keeps all the clocks synchronized to the master with an accuracy of +/- 1 second. These systems are available as 110 or 24 VAC.

Master clock prices range from \$500 – \$1,500. Analog system clocks synchronized with the master range from \$100 – \$170 each. Digital system clocks range from \$180 - \$500.

Pros (Masters):

Ability to very accurately synchronize time via GPS or Ethernet link to NIST (+/- 1 second)
Master time accuracy +/- 1 minute per year if not synchronized with GPS or Ethernet
Scheduling capability for class change notification (bells) is an option that can be built into the master
Remote program scheduling capabilities from your PC is an option on some wired masters
Internal battery keeps all the programmed data in memory during a power outage

Pros (Clocks):

Never require battery replacement
“Green” clock versions available that use very little power allow for reduced overall power consumption
Automatic time adjustment for Daylight Saving Time and power outages
1 hour and 12 hour correction signals provide very accurate time synchronization from master to clock to clock to clock (+/- 1 second)

Cons (Masters):

Difficult to link existing building to expansion projects to extend the wired system
Wired systems can only run a limited number of clocks without adding power boosters
Licensed electrician required for 110 VAC system installations
Conduit and wiring for the initial installation is expensive

Cons (Clocks):

Clocks stop during power outages and reset when power resumes (Note that some models are available with battery backup to keep them running during power outage)

Clock location is limited to AC power accessibility

Difficult to move or add new clock locations because AC power is required for each clock

Wireless System and Clocks

Explanation: The wireless clock system operates by receiving a time signal via one of multiple means of CDMA (cell phone time signal), Ethernet or GPS. It then re-transmits this signal throughout a facility to wireless clocks. The goal is to completely cover the entire facility or campus with a radio signal so regardless of where you place a clock; it receives a signal and synchronizes with the master.

The most common means of wireless master synchronization to NIST would be the GPS satellite system. The CDMA synchronization utilizes the cell phone tower time signal for perfectly synchronized time. The Ethernet synchronization provides time via SNTP (Simple Network Time Protocol) or Daytime Protocol. All of these sources of time synchronization link back to NIST.

Wireless systems can synchronize AC powered or battery operated clocks. One benefit of the wireless battery clock is the ability to locate it anywhere and move it easily to another location without running wires for power. The wireless system savings comes primarily from the elimination of running conduit and wire through a facility.

If a building is already wired for a system clock, using the power from the existing system is a great way to eliminate the need for battery usage. Wireless AC clocks draw very low power and use a capacitor for backup power to keep running during power outages. The time signal is received via the wireless radio signal and the clocks run off the line power already there.

Price ranges vary from \$1500 - \$10,000 for the head end master controller and is dependent on transmitter sizes needed to distribute wireless signal throughout single building or large, multi-building campus. Analog clocks range from \$100 - \$170 each while digital clocks range from \$290 - \$750.

Pros (Masters):

Receives the time synchronization information from a radio signal

Easy to program and install system. A big savings as there is no wiring or conduit installation required to operate clocks.

No purchased FCC license required for most installations

Can synchronize other equipment like intercom systems, PC or server to the wireless system

Synchronized to NIST official time

Pros (Clocks):

Clock to clock synchronization is very accurate (+/- 1 second)

Automatically corrects for Daylight Saving Time

Easy location of clocks-can be placed anywhere within the facility

Unlimited quantity of clocks can use the time synchronization signal

AC clocks can use existing wired power and wireless time signal and will never need battery replacement

Easy to move clock from location to location

Synchronizes digital or analog clocks

Cons (Clocks):

Battery operated clocks require battery replacement

Clocks require signal reception for synchronization-transmitter size is based on facility size

Summary: This paper considers the six most common known timekeeping solutions available to the industry. All of these are good and effective ways to maintain time tracking within your building or campus. The differences I've explained will help you make the best choice for your facility.

There is a wealth of information providing details on all of these types of systems and products on the internet. If you want to learn more about them, just search them out. Armed with correct information, you'll be able to consider and recommend the optimal timekeeping solution for your facility.

Good luck and good timekeeping.

For questions regarding timekeeping solutions, contact the clock experts toll-free at 1-800-328-8996 or visit www.atsclock.com online.