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masibus

GPS TIME SYNCHRONIZATION












What is GPS ?

GPS stands for Global Positioning System, is a technology developed by the US Department of Defense for positioning and timing information and is used as an inexpensive, readily availble utility for high precision positioning, navigation & time synchronization.

Currently there are 30+ satellites orbiting earth which provides accurate time & positioning information.

- 24 hours/day, 7 days/week
- Under any weather conditions
- Anywhere in the world

GPS Signal Provides longitude, latitude and altitude of coordinates in the space. It also provides information regarding the critical fourth dimension - time. Each GPS satellite contains multiple atomic clocks that contribute very precise time data to the GPS signals.

The positioning information is used for navigation purpose & timing information is used for time synchronization.

Type of Navigation system other than GPS

(GNSS = Global navigation satellite system)

1. **IRNSS** is an autonomous system designed to cover the Indian region and 1500 km around the Indian mainland. This GNSS is owned and operated by the Government of India.
2. **GLONASS:** (Globalnaya Navigazionnaya Sputnikovaya Sistema, or Global Navigation Satellite System) is a global GNSS owned and operated by the Russian Federation.
3. **Galelio:** Galileo is a global GNSS owned and operated by the European Union.
4. **QZSS:** QZSS is a regional GNSS owned by the Government of Japan and operated by QZS System Service Inc. (QSS). QZSS complements GPS to improve coverage in East Asia & Oceania.
5. **BeiDou Navigation Satellite System (BDS):** BeiDou, or BDS, is a global GNSS owned and operated by the People's Republic of China.

Our time synchronization product can capture time signal from GPS / GLONASS / NAVIC Satellites. Precise time is crucial to a variety of economic activities around the world. Communication systems, electrical power grids, and financial networks all rely on precision timing for synchronization and operational efficiency. Here we have mentioned why time syhchronication is necessary

Why Time Synchronization is Required

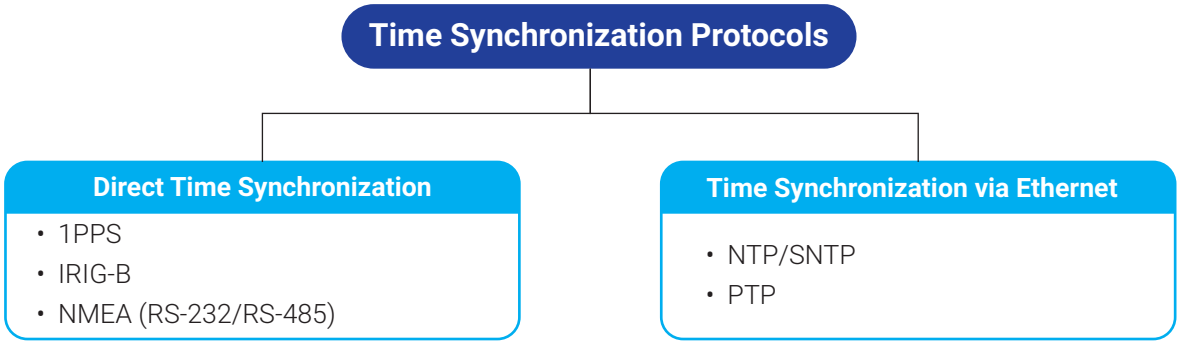
- Time synchronisation required in most of the industry with time stamping of events with an accuracy of **1 millisecond (1 ms) to 1 microsecond (1 µs)** and this can not be provided via Global NTP Server. So to provide **higher accuracy Local time server** is required.

- To have common reference time throughout the organization. (e.g. Manufacturing Units, Airports, Railways, Share Market, Bank, etc).

- To correlate historical data points for post-event fault analysis to enabling real-time visibility for higher efficiency management of load and generation fluctuations, problem analysis and isolation, and reducing the impact of wide area outages.

- To Comply with Government Guideline (ex. Audit Trails in Pharma)

For time synchronization, the GNSS signal is received, processed by a local master clock / time server or primary reference, and passed on to downstream devices, systems or networks so that their local clocks are also synchronized to UTC. Typical accuracies range from better than 1 microsecond to a few milliseconds depending on the synchronization protocol.



Direct Time Syncronization

1PPS

- 1PPS stands for one pulse per second. It is a high-precision time pulse from precision clocks like a GPS receiver that very precisely indicates the start of a second. Accuracy of time synchronization of 1 PPS can be in the Nanosecond range.

- The 1-PPS specification most commonly used for synchronising signals in substations comes from IEC 60044-8 and is referred to by the IEC 61850-9-2 process bus implementation.

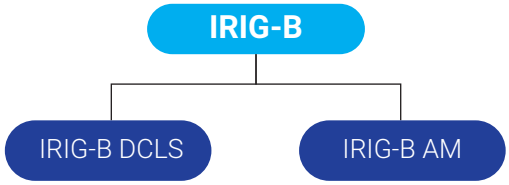
- 1-PPS requires a dedicated distribution network, which can use coaxial or twisted pair or fibre-optic (multi-mode or single-mode) cables.

- The rise and fall time (tf) between the 10% and 90% levels must be less than 200 ns, and the high time (th) must be between 10 µs and 500 ms (measured at the 50% level).

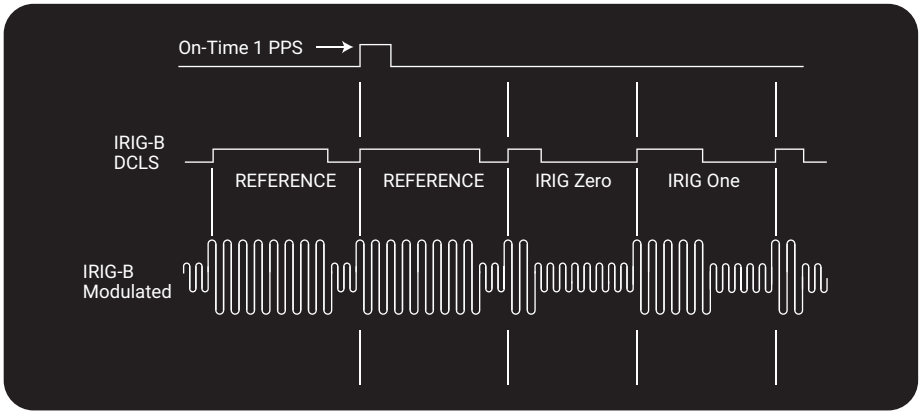
IRIG-B

- IRIG-B stands for Inter-range instrumentation group time codes B. IRIG-B can be applied in a substation for power quality and system stability monitoring, event recording and accurate time stamping for revenue billing (1 uS).

- This time code can be transmitted as raw pulses over copper cables (coaxial or twisted pair) and fibre-optic cables, or as an amplitude modulated (AM) 1 kHz carrier over coaxial cable.



- Below is the figure for IRIG – B AM and IRIG-B DCLS signal. IRIG-B AM is distinctive because of the 1 KHz sine wave carrier. It is similar to IRIG-B DCLS, since Pick-Pick values of the carrier signal follow the same form as IRIG-B DCLS, which contains the information



Supported IRIG-B Protocol in Masibus GPS Master Clock

IRIG-B Protocol	Data
IRIG-B007	100 PPS, DCLS Signal, No carrier Frequency BCDTOY, BCDYR, SBS (Time of Day)
IRIG-B0127	100 PPS, DCLS Signal, 1KHz carrier Frequency BCDTOY, BCDYR, SBS (Time of Day)
IEEE 1344 (C37. 118-2005)	100 PPS, AM Signal, 1KHz carrier Frequency BCDTOY, BCDYR, SBS IEEE1344 assignment of CF bits
	100 PPS, DCLS Signal, No carrier Frequency BCDTOY, BCDYR, SBS IEEE1344 assignment of CF bits

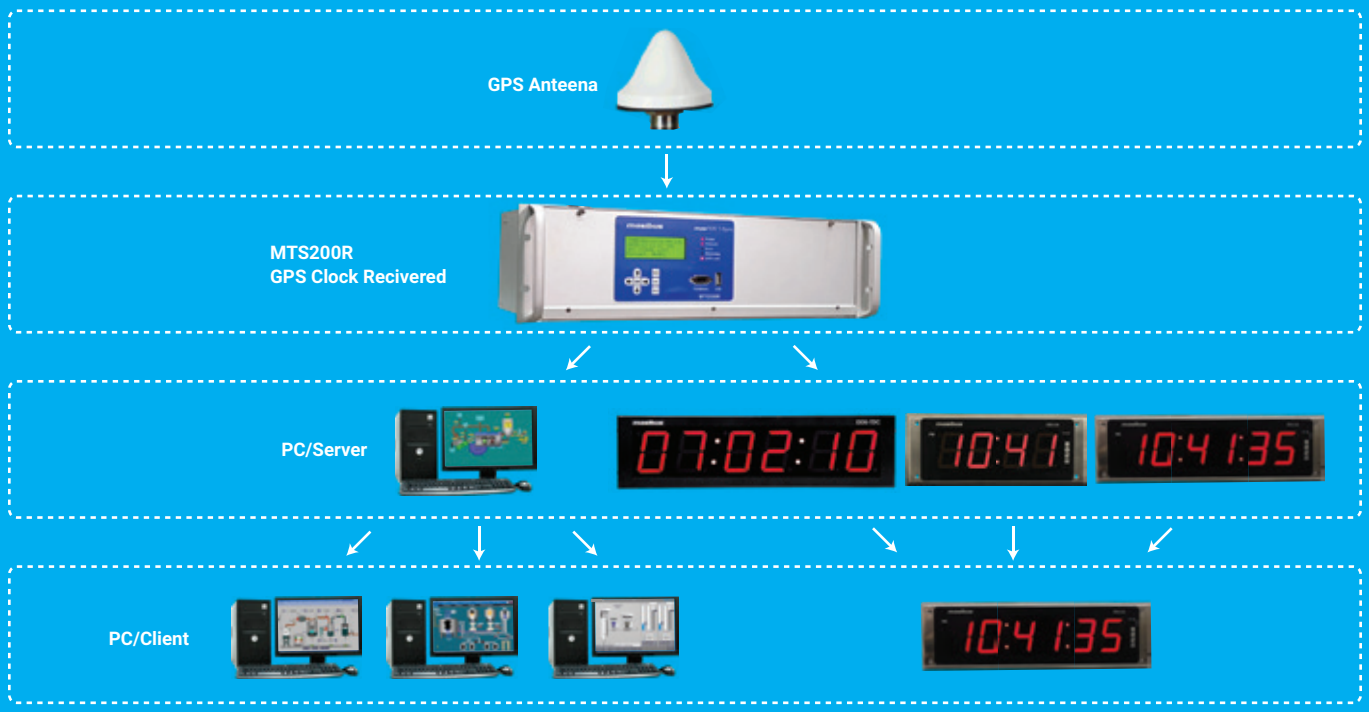
Time Synchornization Via LAN/ Ethenert

NTP/SNTP

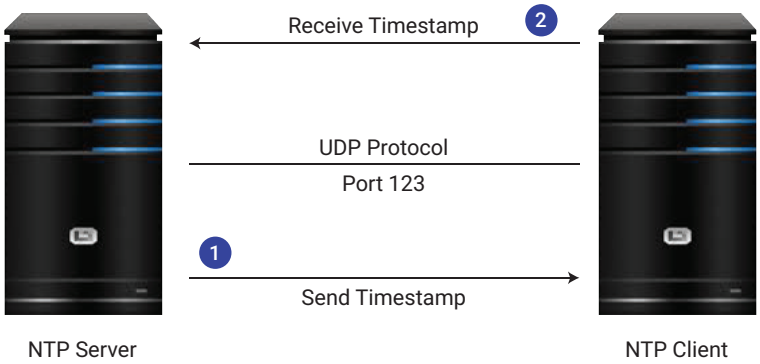
The NTP standard employs servers that supply clients, such as the computers in your network, with current Coordinated Universal Time, or UTC, information in response to individual requests. Although your hardware can ask for the present time from many different servers in the network, some devices provide more accurate data than others due to factors like system lag and latency.

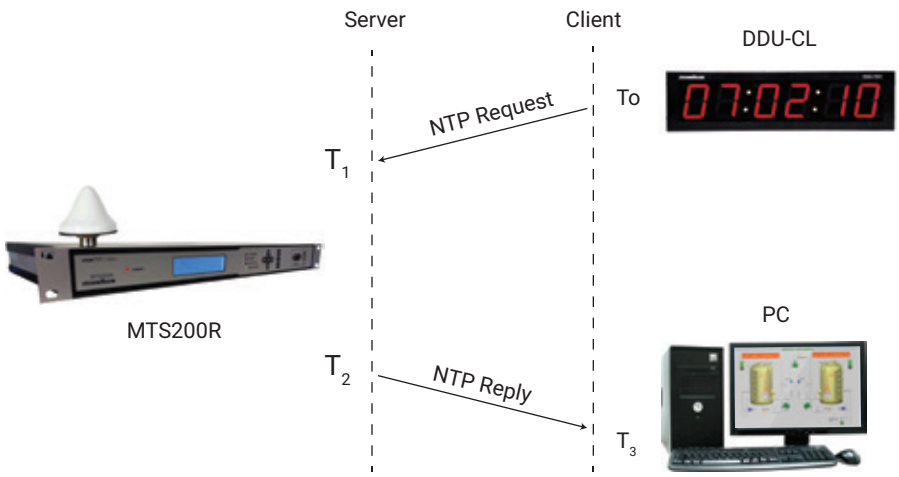
The timekeeping servers in these networks are arranged in distinct strata, also known as layers. The most accurate devices exist in Stratum 0, and they include atomic, radio and other high-precision clocks, such as those found in NIST laboratories and GPS satellites. Stratum 1 servers, also known as primary time servers, are connected directly to Stratum 0 devices as well as their same-level peers.

Another variant of this protocol, known as SNTP or Simple Network Time Protocol, employs the same packet and message format. The major difference is that SNTP is significantly less accurate. Since clients cannot obtain timing data from multiple sources or use MD5 checksums, they're vulnerable to general network inaccuracies and malicious agents that intentionally provide incorrect time stamps.



Time Synchronization with NTP Protocol





The Precision Time Protocol (PTP) is a protocol used to synchronize clocks throughout a computer network. On a local area network, it achieves clock accuracy in the sub-microsecond range, making it suitable for measurement and control systems.

Features of PTP

- It has an alternate time-scale functionality.
- It uses a Grand Master clock to synchronize the communication.
- It works on master-slave architecture.
- It makes the path of communication traceable.

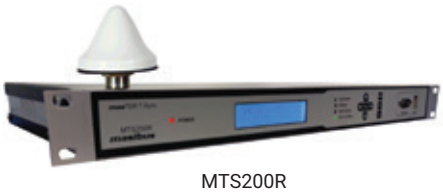
Working of PTP

PTP is a protocol that works for seamless communication between different devices. It uses a master-slave system of time resources and provides synchronization. This system consists of one or more communication devices and a single network connection provided by a grandmaster device. This grandmaster is responsible for the root timing reference. The grandmaster transmits synchronized information to the devices residing in the communication medium.

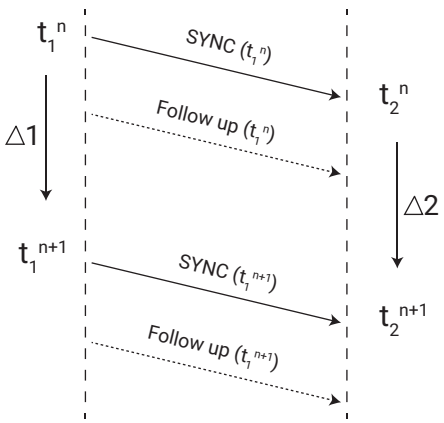
This Protocol also

- Lets clients connect to multiple NTP servers for data backups, heightened accuracy and testing purposes
- Corrects for communication latency and individual clock drift
- Uses a standardized, 64-bit UDP packet that can theoretically achieve picosecond (trillionth of a second) timing and determine dates within a 136-year range
- Permits peer-to-peer communication, broadcasting, multicasting, calibration and secure MD5 hash algorithms

Time Synchronization with PTP Protocol



MTS200R



Send interval Master $\triangle_1 = t_1^{n+1} - t_1^n$

Receive interval Slave $\triangle_2 = t_2^{n+1} - t_2^n$

Drift of the slave $= \frac{\triangle_2 - \triangle_1}{\triangle_2}$

Margin Unit

Time Synchronization Master Clocks

MTS300R

High Performance, Accurate, Modular

- 19" 3U Rack mount modular architecture
- Maximum 36 number of timing output can be provided

MTS200R

High Performance, Accurate, Modular, Compact

- 19" 1U Rack mount modular architecture
- Maximum 12 number of timing output can be provided based on the configuration selected

- Remote alarm notification using SNMP v1, v2, v3 and syslog, remote configuration using SSH, web, SNMP, telnet.
- Supporting timing protocols are IEEE 1588 PTP (Power and power utility profile), NTP/SNTP, IRIG-B AM and IRIG-B TTL, FDM, 2.048 MHz. frequency O/P, fiber optic O/P, NMEA, proprietary serial O/P, NTP v2/v3/v4 with MD5 authentication with symmetric and auto key management.
- Supporting networking protocols: IPv4, IPv6, UDV, TCP, SNMP, SSH, SCP, HTTP, HTTPS, SYSLOG, telnet.
- Redundant and non- redundant GPS master time synchronization unit with internal comparator and switching module for redundancy.
- Provides secured access for configuration and management through SSH, SCP, HTTPS. Full featured SNMP protocol with encryption DES/AES and authentication SHA/MD5 mechanisms.
- User accesses for console and web program are encrypted password supported.
- MTS300R and MTS200R are complying cybersecurity Guidlines.

MTS200L

Accurate, Reliable, Modular, Compact

- 19" 1U Rack mount modular architecture
- Maximum 16 number of timing output can be provided
- Power supply redundancy can be provided
- Supporting timing protocols are IEEE 1588 PTP (Power and power utility profile), SNTP/ NTP, IRIG-B AM and IRIG-B TTL, FDM, 2.048 MHz.
- frequency O/P, fiber optic O/P, NMEA, proprietary serial O/P
- Supporting networking protocols: IPv4, UDP, SNMP, telnet Remote alarm notification using SNMP, remote configuration using SNMP v1, v2, telnet

MC-1-U

Accurate, Reliable, Compact

- 19" 1U Rack mount architecture
- Maximum 10 number of timing output can be provided

MC-1-DE/DH

Accurate, Reliable, Compact

- Din-Rail mount/ rack mount /wall mount architecture
- Maximum 07 number of timing output can be provided

- Supporting timing protocols are SNTP/NTP, IRIG-B AM and IRIG-B TTL, NMEA, proprietary serial O/P
- Supporting networking protocols: IPv4, UDP, SNMP, telnet
- Remote alarm notification using SNMP, remote configuration using SNMP v1, v2, telnet

Time Display Units / Slave Clocks

DDU-HZ

DDU-TDC

DDU-DT

DDU-46

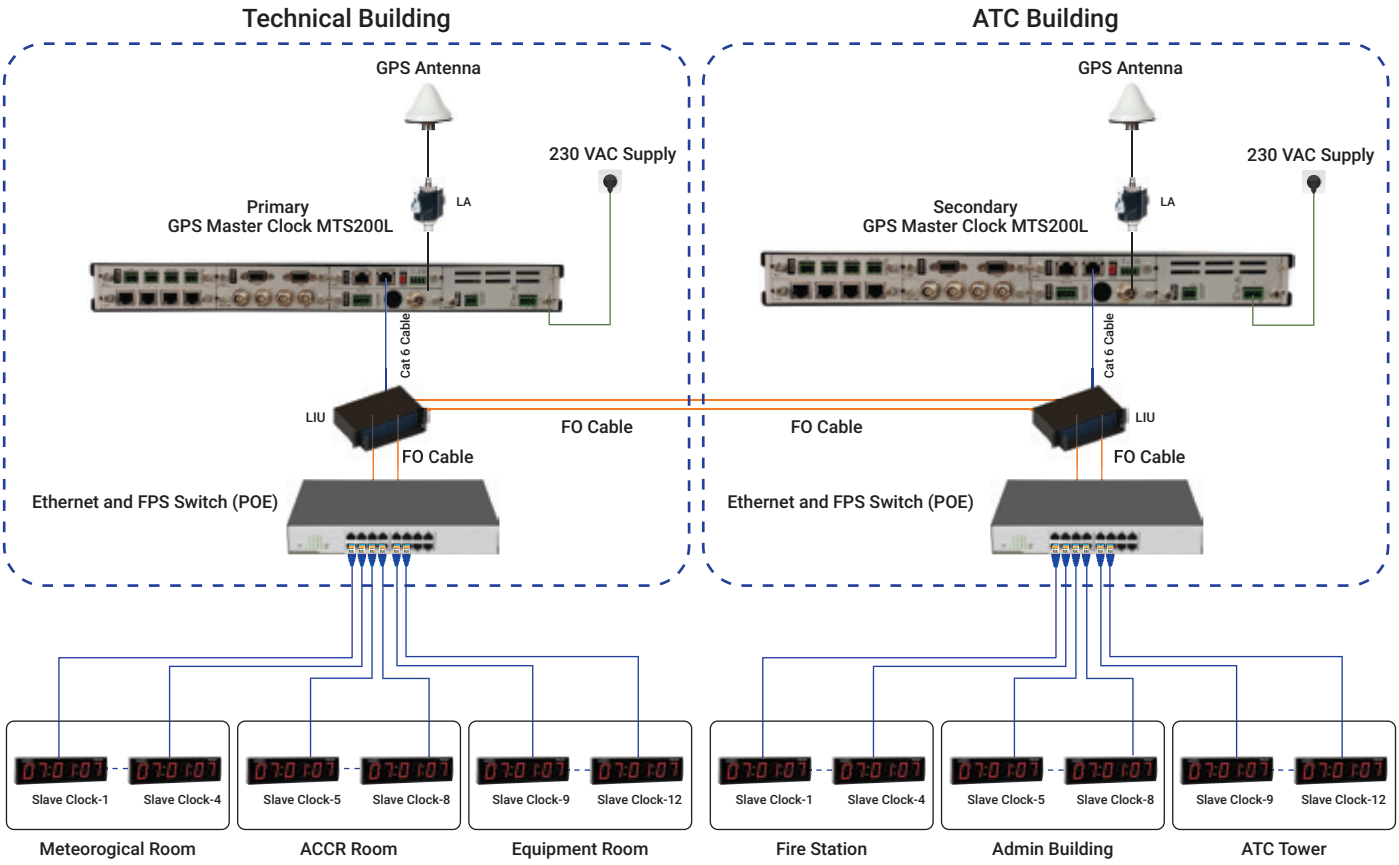
DDU-DY

DDU-44

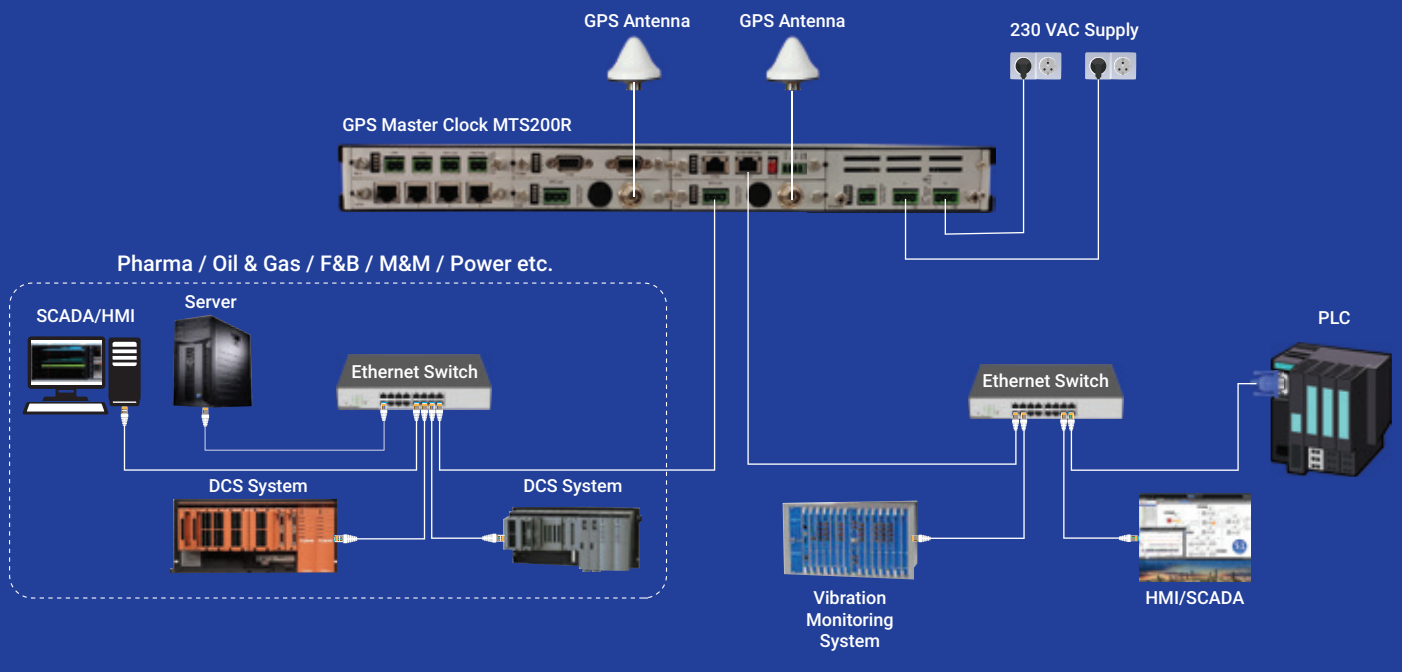
DDU-CL

DDU-TM

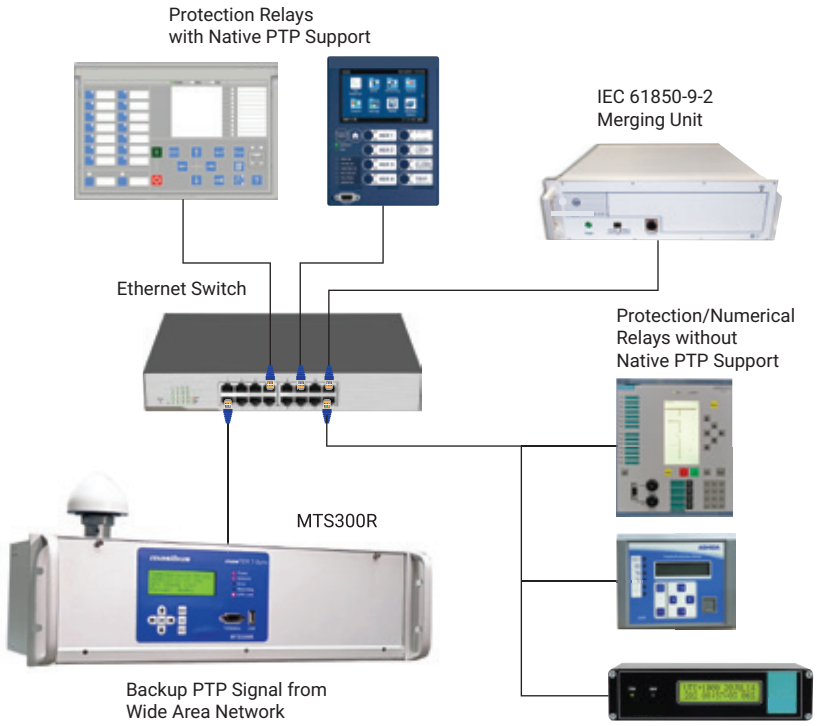
Time Synchronization in Airports



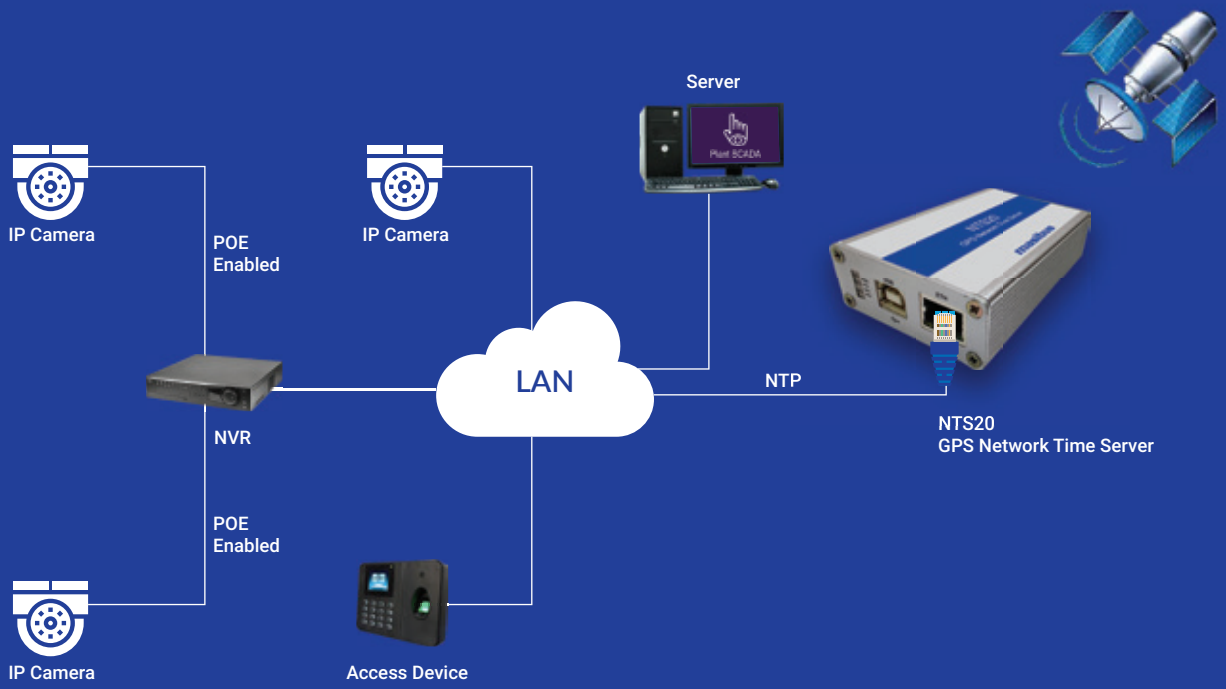
Configuration Example in Process Industries



Time Synchronization in Substation Automation



Time Synchronization in Security & Surveillance Application



Video surveillance is an essential part of today's security system. Without accurate time stamps, surveillance video cannot be reliably used for event checking or other legal purposes. Therefore, it is necessary to use a system that provides accurate and reliable time stamping for legally traceable time.
Many systems rely on their internal clocks that have the tendency to drift—to gradually fall away from the actual current time. Such systems provide a false sense of security in that their time stamps can not be considered as valid proof.

NTP or Network time protocol is a time synchronization protocol is standard protocol is currently available in most of the IP cameras, Access control systems and computers. NTS20 will work as NTP server and all other devices like IP cameras, Access Control system will work as a NTP Client.

Master Clock with Wireless Connectivity

MC-2

GPS Wireless Master Clock - MC-2

- Receives automatic time from network of GPS satellites
- Transmits the time to clock through RF or serial
- Synchronization of server time system through RS-232/RS-485

DDU-24

DDU-26

Wireless Slave Clock - DDU-24/26

- Each clock can act as repeater to extent network range
- Works in stand-alone mode if network fails
- DDU-24 / DDU-26 is also available in Ex-proof enclosure for gas group IIA and IIB (IP65)

DDU-44

DDU-46

Wireless Slave Clock - DDU-44/46

- Use of unlimited slave clocks with in transmitter's range
- Optional NTP (LAN Interface) with IEEE 802.3af compliant PoE
- Retains time during loss of power/time code

DDU-24-XP

DDU-26-XP

Frequency Hopping

- Frequency-hopping is a method of transmitting radio signals by rapidly changing the carrier frequency among many frequencies occupying a large spectral band.

- The Frequency changes are controlled by a code known to both transmitter and receiver DDU Clocks

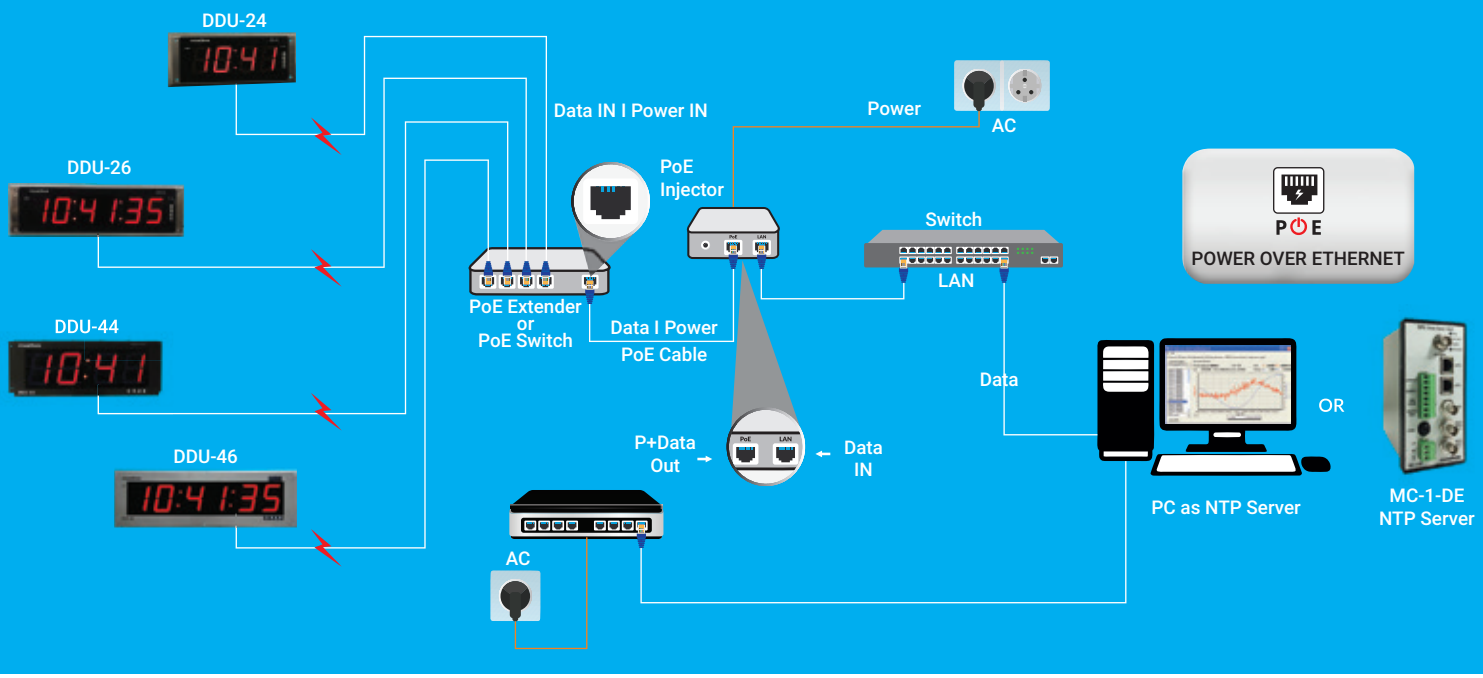
- It is inevitable that the wireless module will encounter frequency interference during communication. At this time, the wireless module will continuously switch frequencies of 868MHz band until the module avoids the interfered frequency and resumes communication at both the ends of the transceiver, which further extends the RF range and enhances the error free performance between the wireless clocks within the network

- RSSI (Received Signal Strength Indicator) function is inbuilt inside our clock model MC-2 & DDU

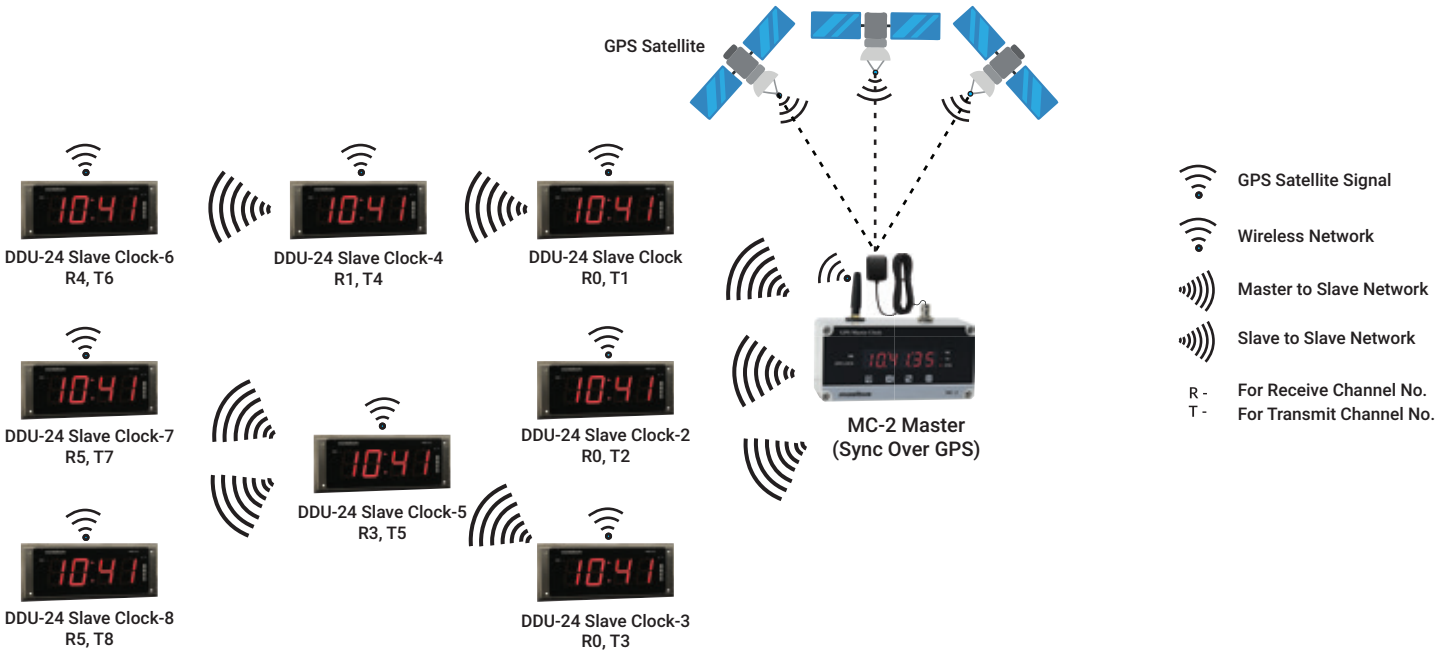
- Frequency hopping technique needs constantly switch the frequency, but it does not know whether the Particular RF channel can be used or not. So the RSSI can help the frequency hopping function to quickly find the available channels for communication

- Our Transceivers MC-2 / DDU Clocks determines the available channels and assign it to each clock for further internal RF continuous communication in the same network

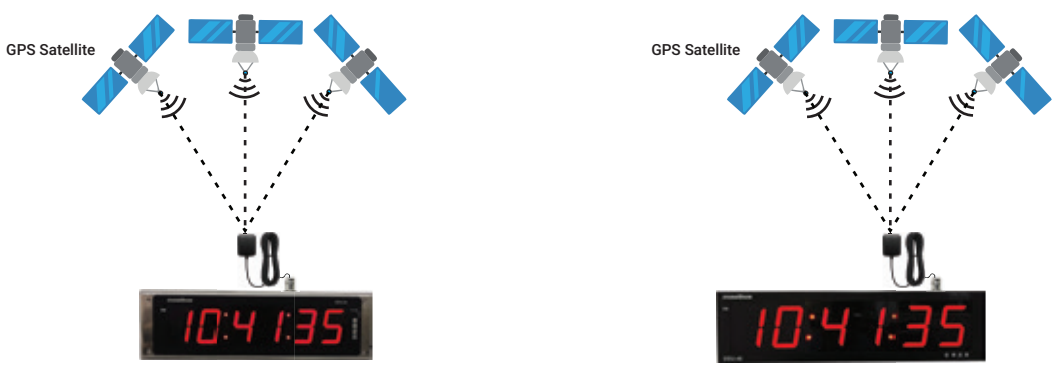
Local Clock Display in any Process Industries



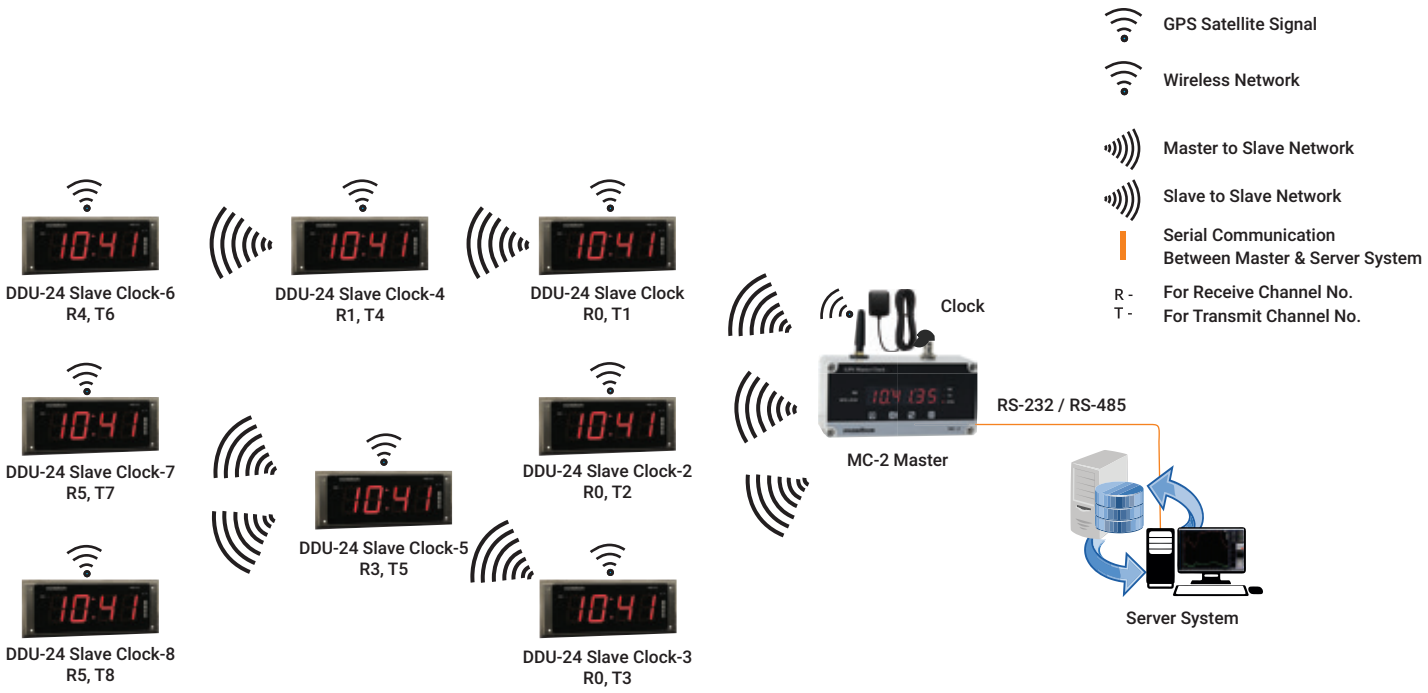
Wireless Master Sync Over GPS Application Diagram



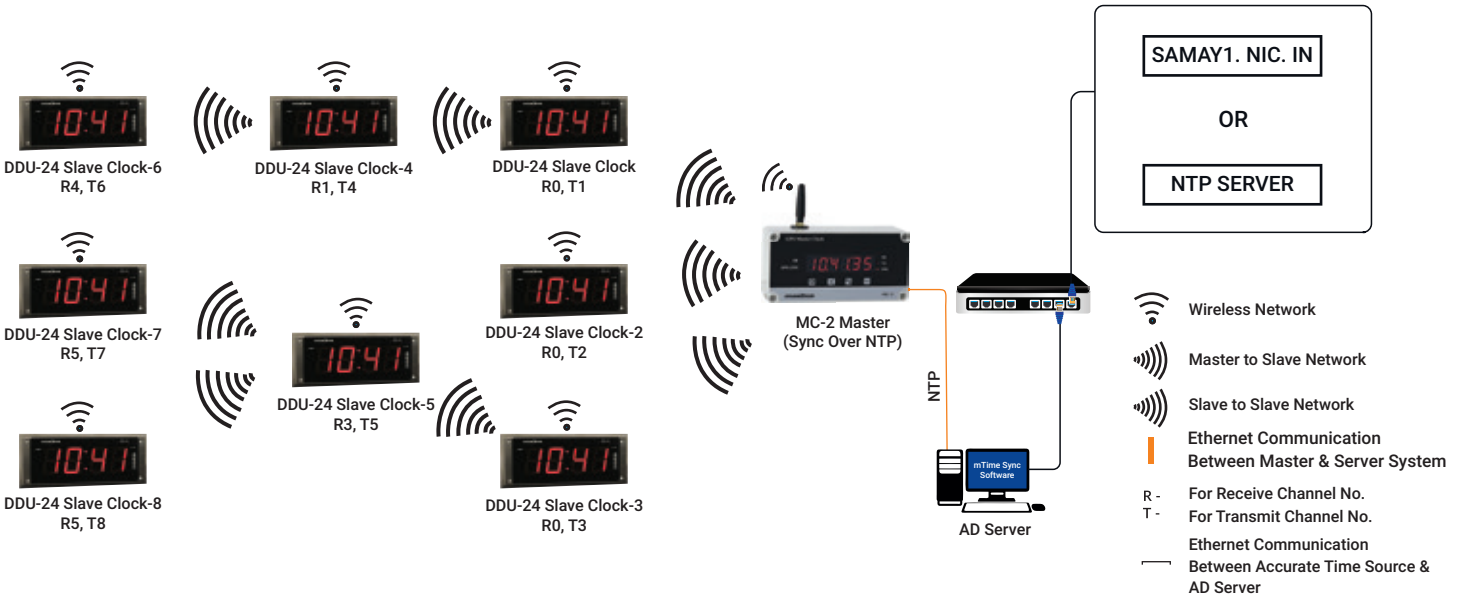
Standalone Clock Sync Over GPS Application Diagram



Wireless Master Sync Over Serial Application Diagram

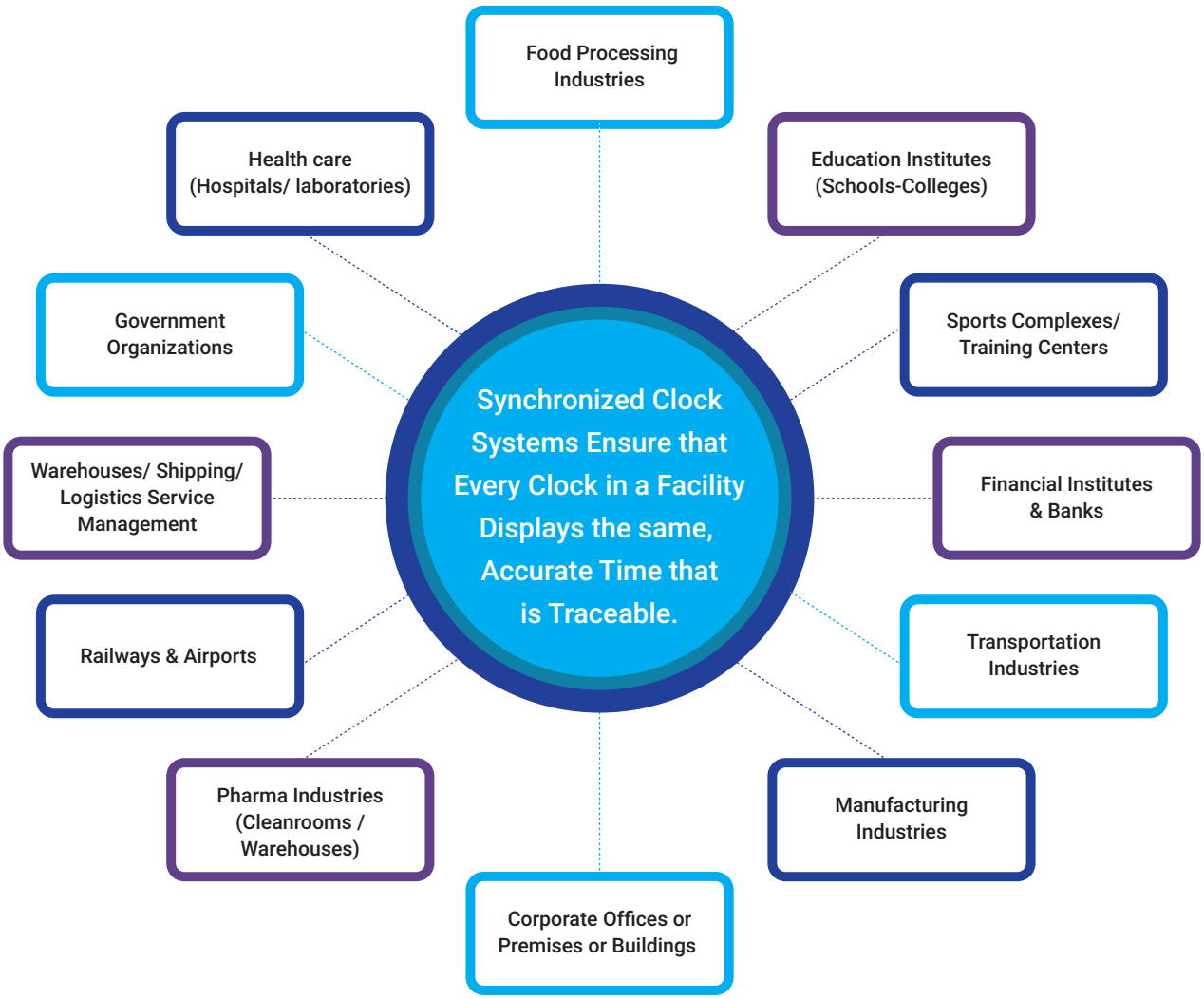


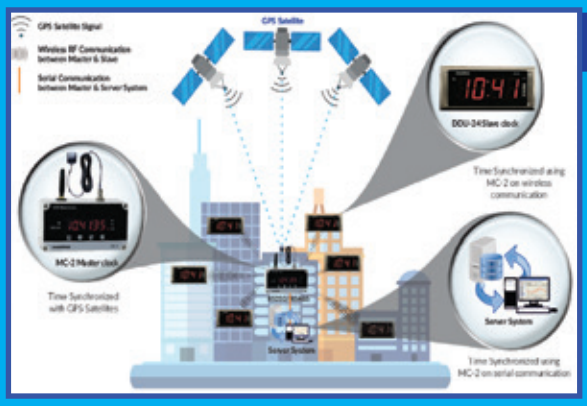
Wireless Master Sync Over NTP Application Diagram



Masibus Wireless Master / Slave Clocks for Accurate Time Synchronization

Model	MC-2	DDU-24	DDU-44
Unit	Master Clock	Slave Clock	Slave Clock
Display Size	6 digit, 0.56"(14mm)	4 digit, 2.3" (57mm)	4 digit, 4" (100 mm)
Display Type	LED	LED	LED
Mounting	Table-top/ Wall	Wall/ Panel/ Flush	Wall/ Panel/ Flush
Repeater	✗	✓	✓
Communication	RF or Serial or both	RF or Serial or both	RF or Serial or both
Time frame Inputs	NMEA-0183[RMC]/ NGTS/ T-Format	NMEA-0183[RMC]/ NGTS/ T-Format	NMEA-0183[RMC]/ NGTS/ T-Format
Timing Accuracy	< 15 ns with GPS Locked	< 15 ns with GPS Locked	< 15 ns with GPS Locked
Flameproof	Available	Available	Available





Government Departments/Corporate Buildings-Offices

To maintain workflow, IT server rooms, interdepartmental activities, meetings, deadlines, employee schedules to optimize and increase productivity and efficiency. Same accurate time across workstations, offices, departments, meeting rooms, activity areas in the entire facility

Manufacturing Industries

- Local time display of Manufacturing processes
- Shift changes
- Packaging & shipping schedules
- Maintain accurate timing
- Better processes management for entire premises or plant

Pharmaceutical Industries

- Local time display at various section
- All pharmaceutical company (Manufacturing / warehouses / cleanrooms)
- Time punctuality in clinical research, Operation/ production/ reports
- USFDA compliance (21 CFR) - legally traceable timestamps, audit trails, file logs & process reports etc.

Public Transports - Railways & Airports

Provide accurate time information to waiting rooms / IT networks / maintenance areas / terminals / station-displays/ service area / canteens and workforce management in different areas at railways and airports

Where all GPS Clock is Used

Airport

Surveillance / Traffic Signal

Banking Sector

Power Generation
(Fossil, Renewable, Hydraulic, Nuclear etc.)

Metro Railways

Process Industries for time stamp & SOE

Power Distribution

Hospital

Educational Institute

Shopping Mall

Sonepar India Pvt. Ltd.

Gandhinagar
Address: B-30, G.I.D.C. Electronic Estate, Sector - 25, Gandhinagar - 382 016, Gujarat, India
E-mail: sales.masibus@soneparindia.com
Ph. No.: +91 9662042824

Goa
Address: C-6, Phase 1-A, Verna Industrial Estate, Verna, Salcette - 403722, Goa, India
E-mail: sales.masibus@soneparindia.com
Ph. No.: +91 9822135796

Pune
E-mail: sales.masibus@soneparindia.com
Ph. No.: +91 9689937234

Bengaluru
E-mail: sales.masibus@soneparindia.com
Ph. No.: +91 8732971943

Chennai
E-mail: sales.masibus@soneparindia.com
Ph. No.: +91 9725154195

Delhi
E-mail: sales.masibus@soneparindia.com
Ph. No.: +91 9909949742

Hyderabad
E-mail: sales.masibus@soneparindia.com
Ph. No.: +91 9909949062

Kolkata
E-mail: sales.masibus@soneparindia.com
Ph. No.: +91 9512003359

Mumbai
E-mail: sales.masibus@soneparindia.com
Ph. No.: +91 9689937234

Gurgaon
Address: Plot No. 229/239, Village - Kherki Daula, Sector 76, Gurugram, Haryana, 122004, India

Kolkata
Address: 503, Block 4B, Ecospace Business Park, Newtown, Rajarhat, Kolkata, West Bengal, 700160, India

Chennai
Address: Plot No. 1, Gokul Garden, Melnallathur, Thiruvallur, Chennai, Tamil Nadu, 602002, India

Aurangabad
Address: FP-42, Five Star Industrial Area, Shendra MIDC, Aurangabad, Maharashtra, 431201, India

Panchkula
Address: Plot No. 263, Industrial Area, Phase-II, Panchkula, Haryana, 134113, India

Bhubaneshwar
Address: Plot No. 443, 1st Floor, Saheed Nagar, Bhubaneshwar, Odisha, 751007, India

Website: www.soneparindia.com
Website: www.masibus.com
E-mail: sales.masibus@soneparindia.com

Masibus Automation & Instrumentation FZC

Sharjah
Address: A2-102, SAIF Zone, PO Box 120145 Sharjah, UAE

E-mail: sharjahall@masibus.com
Ph. No.: +971 65574650