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HoptroffTime™ synchronized atomic timestamping

Delivering accurate time to the application

With industry-leading accuracy of up to tens of nanoseconds, HoptroffTime™ distributes synchronised time that enables end-to-end timestamping of trade flows. The solution combines hyper-accurate atomic 'grandmaster clocks' with patent-pending software that automatically corrects for latency right through to application level.

The solution has built-in redundancy features, is co-locatable with minimal power and space requirements, and does not normally require upgrades to existing infrastructure and networks.

A HoptroffTime™ installation comfortably exceeds MiFID II RTS-25 reporting and forensics requirements. It is a powerful tool for defining, comparing and masking your latency profile; identifying when others seek to exploit that profile; and generating data insights that support marketing to clients, regulatory compliance, and robust defence against disputes.

The solution is the result of intensive research, testing and benchmarking by Hoptroff London – founded by physicist Richard Hoptroff, and developer of the world's most accurate atomic timepieces for consumer markets.

Hoptroff London's financial sector products and services are licensed exclusively through emagine.

emagine's HoptroffTime™ is an elegant, unique self-contained solution for financial institutions that need to demonstrate high levels of consistency, traceability and granularity against Coordinated Universal Time (UTC).

Benefits at a glance

HoptroffTime™ is the only solution that delivers traceable UTC right down to the application level, exceeding MiFID II compliant levels by orders of magnitude. Designed for the finance industry, its business advantages include:

- ↗ Irrefutable accuracy for better defence against disputes with other parties.
- ↗ Prevent other parties from exploiting synchronisation delays with trading venues, by reliably defining latency profile of own organisation compared with others.
- ↗ Drive up customer/market reputation by transparently demonstrating competitive efficiency.
- ↗ Ensure uninterrupted trading if UTC feeds fail. HoptroffTlime™ is highly resilient and able to maintain holdover accuracy for up to three weeks.

HoptroffTime™ uses rack-mounted non-invasive technology that works as a grandmaster timing source for your entire data centre infrastructure. Where space is at a premium, credit card-sized grandmasters can be fitted into existing servers.

- ↗ Reuse existing network infrastructure – normally no need to upgrade.
- ↗ No need to re-code applications.
- ↗ Save on expensive additional co-located power and space.

What does HoptroffTime™ comprise?

HoptroffTime™ uses proprietary Hoptroff London GMC™ atomic clocks installed in the data centre, ResilientPTP™ technology to distribute UTC, and PacketPrecision™ software to measure and adjust for latency within the server.

The grandmaster acquires UTC using GPS, GLONAST, NPL or NIST via satellite or fibre optic distribution, and the system's own software automatically corrects for latency, steering accurate time all the way down to server and application level.

In this way, timestamps are accurately synchronised between every application, on every server, at every location.

HoptroffTime™ constantly monitors application timestamping latency and logs packet-by-packet timing for reporting and later analysis.

The system can provide nanosecond granularity, with variance of up to 1 second every 10,000 years, exceeding MiFID II's specification by orders of magnitude.

Hoptroff London GMC™ atomic clocks

The grandmaster clock at the heart of the system uses chip scale atomic clock (CSAC) technology – developed by the US Army – which connects to the network card. The clock forms part of a standard HoptroffTime™ appliance, which occupies a 1U rack space. Each grandmaster's software manages time distribution and monitoring functions.

For co-located sites and where space is at a premium, Hoptroff London GMC™ grandmaster atomic clocks are available as credit card-sized inserts that can fit inside existing servers. This unique feature not only helps keep down the cost of rack space but – by making the grandmaster actually part of the server – removes another latency obstacle. Should a grandmaster cease operating the system will failover to the best alternative. Should all time sources and/or switches cease it will 'holdover' without reference to an exterior time source to an accuracy of 100 microseconds for up to three weeks.

Rack mount Hoptroff London GMC™ atomic clock.

ResilientPTP™ time distribution

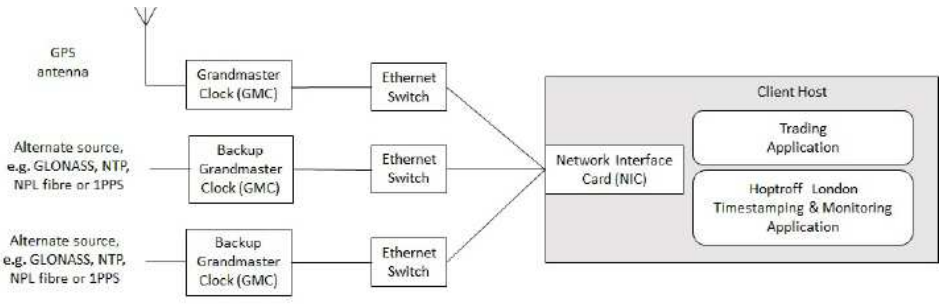
ResilientPTP™ technology is used to distribute UTC robustly throughout the data centre over the existing network infrastructure. This avoids the need for costly upgrades as long as you already have confidence in the resilience of the network.

All software associated with HoptroffTime™ has been designed to have negligible network impact so as to not interfere with the existing data flow, and allowing maximum time interval error (MTIE) to be minimised and accurately recorded.

PacketPrecision™ nanosecond application timestamping

Latencies already measured due to cabling, server technology and other factors, are augmented by PacketPrecision™, which adds accurate microsecond clock latency compensation within the application layer.

PacketPrecision™ is a patent-pending solution that measures clock-to-application latency as it happens, in real time. The software collates second-by-second latency statistics that measure clock-to-application latency to establish if it is significant relative to other latencies. PacketPrecision™ timestamping can also create individual hardware timestamp records for each packet with nanosecond precision as it enters or departs the gateway. This supplementary individual packet recording allows finer granularity analysis where needed, for strategic business improvement or post-event audit.



Centralised management and monitoring of all elements.

How does HoptroffTime™ compare with other approaches?

There are a number of time-keeping solutions available that can meet or exceed MiFID II's divergence requirement of 100 microseconds but, compared with HoptroffTime™, no other addresses the specific timestamping needs of the finance industry, avoiding major technology upgrades and application recoding, and including built-in redundancy/holdover safeguards.

There are broadly three approaches to ensuring UTC consistency and accuracy of trade records. The 'DIY' solution is to use IEEE 1588 Precision Time Protocol (PTPv2) and/or Network Time Protocol (NTP) and to your modify systems, networks and applications as necessary. An off-the-shelf approach is to collect timestamp data using a purpose-built analytics appliance that corrects for any variances. Both these methods generally require installation of a separate authoritative 'grandmaster clock' UTC source. The third option is to use a dedicated grandmaster clock-based system.

Bespoke PTP/NTP implementation

Some organisations are attempting to address their needs by adapting existing technologies like Precision Time Protocol (PTP) and Network Time Protocol (NTP), but these have their own difficulties achieving reliability and consistency with legacy network topographies. PTP depends on rigorous local clock disciplining at implementation, while NTP can be a highly technical solution that requires extensive customisation and engineering support.

To meet MiFID standards without specialist additional equipment many organisations would have to make a substantial investment in upgrading their trading venue networks and making coding changes for all applications and databases. Redundancy would still be likely to be an issue, and there would also be a question over what you should use as your 'grandmaster' UTC authority.

HoptroffTime™ is non-invasive and generally requires no modification to trading venue architecture, networks, systems or applications. It implements PTP or NTP time distribution (whichever is optimal). The solution creates a measurable, but ultimately negligible, network load, owing to its synchronisation protocols, and needs no separate grandmaster clock. Failover and holder features protect against component redundancy. HoptroffTime™ accuracy is likely to be much higher and more consistent than a bespoke solution.

Analytics appliances

Another approach is to overlay a timestamp analytics engine that tracks reportable events against a verified time source and attempts to resolve any ambiguities between application timestamps (the time at which the trading application made the decision), host timestamps (the time a specific message was sent or received), and wire timestamps (when a gateway sent or received an order).

A typical installation would involve rack mounting an appliance running dedicated analytics software. This approach can be useful; it crunches the numbers effectively post-event and can avoid the need for infrastructure upgrades, but the user still needs to factor in the cost of purchasing and integrating a reliable, separate UTC grandmaster.

Analytics appliances can help meet basic MiFID requirements, but overall accuracy of a HoptroffTime™ solution can be much higher and provides other competitive advantages.

HoptroffTime™ not only provides detailed analytics that can accurately report on key events with exceptional granularity, but is able to maintain fully-auditable 'real time' microsecond synchronisation of application timestamps and nanosecond granularity recording of individual hardware timestamps for each packet as it enters or departs the gateway. It, of course, requires no separate grandmaster clock.

Timestamping synchronisation systems (TSS)

Highly-accurate grandmaster satellite clock TSS can take up valuable real estate in the data centre. The most robust installations use multiple independent rack-mounted grandmasters, each connected fed by a different UTC reference. With co-located rack rental typically costing hundreds of thousands of pounds a year, space alone can represent a massive cost even before the technology is included.

Although positioned as plug-and-play solutions, installation of many grandmaster systems is also complex, with multiple patch and antenna cables being required. Grandmaster appliances are typically capable of correcting for legacy network latency issues, but do not manage anything at the application layer.

HoptroffTime™ is easy to install, with minimal patching. Grandmasters occupy only 1U rack space, and modular, card-sized modules can instead be installed within existing servers.

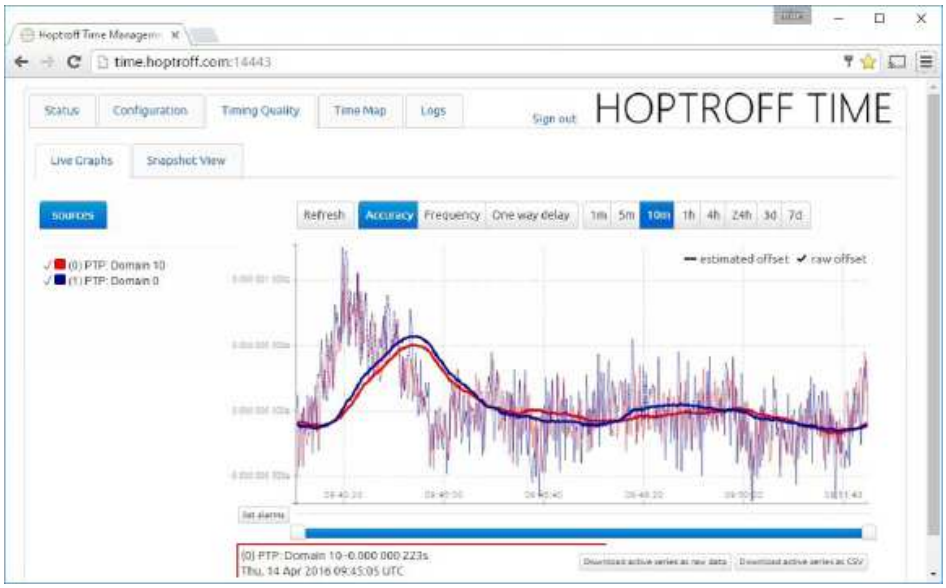
Unlike other TSS solutions, HoptroffTime™ collects performance statistics directly at the application level; it accurately measures clock to application latency and adjusts for this to provide microsecond clock UTC traceability.

Alternative credit card-sized unit for internal server installation.

Installation and support

emagine's HoptroffTime™ installations have minimal cabling requirements. Implementation is non-invasive, using techniques developed in house that allow us to measure and calibrate out the variances between true gateway time and the timestamp created by the trading application. To this end, for example, we open-sourced our algorithms for FIX message nanosecond timestamp granularity.

The software layer provides the first layer of service support, as it reports any drift in timing accuracy or server synchronisation outside set parameters. If a fault cannot be corrected at the data centre, it will be escalated to the service support desk which will provide any necessary software fixes or replacement components to restore the coherence of the timing network without any interruption in service.



Raw v offset time measurement.

About emagine

emagine is an independent financial technology consultancy with 30 years' specialist banking experience.

Formerly the internal technologists for one of the world's leading merchant banks, our heritage continues to give us a clear understanding of our clients' business objectives.

We operate in 24 countries and have revenues of €93m (2015).

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