FIFO MFIX Trade, Timestamps, PTP
Frequently Asked Questions

1. FIFO MFIX Trade – general info

1.1. What is FIFO MFIX Trade?

FIFO MFIX Trade is designed as the fastest transactional interface for MOEX Securities and FX markets. The FIFO principle of First In First Out message delivery from the FIFO Gateway towards the Trade Engine with a probability of over 99.5% is ensured by new hardware, significantly modified FIFO Gateway core architecture, a dedicated network and the operational principles of REBUS (ex-ASTS) trading and clearing engines.

1.2. Why is FIFO MFIX Trade available on the Securities and FX markets only? Are there any plans to implement the similar service for Derivatives market?

Currently there are no plans for implementing similar service for the Derivatives market Spectra platform. Nevertheless, the Moscow Exchange is conducting research the on potential implementation of FIFO principles for the Derivatives market.

1.3. What are the key benefits of FIFO MFIX Trade?

- the fastest order entry interface for MOEX Securities and FX markets;
- reduced and more predictable Latency compared to MFIX Transactional: FIFO MFIX trade one way latency is ≈ 50-100 microsecond less;
- increased system predictability to ensure technological Fair Play;
- 99,5 % First in – First out probability in message delivery from FIFO Gateway toward Trade Engine;
- new dedicated network infrastructure exclusively servicing transactional traffic to eliminate additional latencies caused by market data and auxiliary services traffic.

1.4. Who can benefit from this service? Will I get any benefit if I'm not the fastest on the market?

FIFO MFIX Trade is primarily designed for HFT and Low-latency trading strategies, where reaction times to a market events are measured in microseconds or less. The service significantly increases the transparency and predictability of the trading infrastructure by reducing Latency and Jitter. According to clients` feedback the implementation of FIFO principles significantly improves the predictability of algorithms' trading results for all types of trading strategies.

1.5. Which markets and trading modes (boards) are supported?

FIFO MFIX Trade is a trading interface for MOEX Securities (Equity & Bond) and FX markets platforms.
The service is principally designed for normal trading (CLOB) boards:

CETS on FX market, and TQBR, FQBR on Securities market.
Also supported:
- SDBP («speedbump») on FX market (see Question 1.9 for more details)
- all CLOB boards on Securities market similarly to MFIX Transactional: T0, T+, REPO, REPO with GCP.

1.6. May FIX TradeCapture and DropCopy services be used in a combination with FIFO MFIX Trade?

Yes, TradeCapture and DropCopy services may be used with FIFO MFIX Trade according to user permissions in the Trading system.
- TradeCapture contains trades made with FIFO MFIX Trade;
- DropCopy contains execution reports for FIFO MFIX Trade orders and trades made with FIFO MFIX Trade.

1.7. Are SMA and pre-trade checks available? Do they slow down my trading algorithms?

SMA-IDs directly connect to the MOEX Trading system and are available as long as the corresponding MASTER ID is online.

SMA pre-trade checks do not slow down trading as they are performed on the Trade Engine after the message receives its timestamp; therefore the message position in the matching queue is not affected.

1.8. How many sessions do I need for optimal performance? How do I know that I am using an insufficient number of sessions?

Moscow Exchange does not regulate the number of sessions (User IDs) to be used with FIFO MFIX Trade and the optimal number depends on a specific trading strategy.

However please note that within one session FIFO gateway cannot deliver the next message to the Trade Engine until it receives a reply to the previous message.
This behavior is due to the following:

- FIFO MFIX Trade uses MTE_EXECTRANS function of libmtesrl.so library (ASTS Bridge - Native API) to deliver transactions to the Trade Engine. The function returns result to client only after receiving an answer from Trade Engine. *For a given FIX session, it is impossible to send to Trade Engine next transaction until this function return.*

- *FIX/FIFO FIX gateway* can receive incoming messages asynchronously, with very short intervals, but it *cannot deliver to Trade Engine next message until it receives a reply from Trade Engine for the previous one*.

- *FIFO principle works fine for messages that can be sent to the Trade Engine without waiting for a reply to the previous message on this session*.
If such waiting state occurs, then the transaction is moved out of the FIFO

queue and inserted after receiving a reply to the previous transaction.

For these reasons it is strongly recommended to send transactions to a FIX gateway only after you receive a reply to the previous message on the same FIX session. Reception of a reply guarantees that a session is ready to deliver the next message to the Trade Engine with no queuing inside the FIX gateway.

Insufficient number of sessions is indicated by a violation of the FIFO principle in message delivery to Trade Engine due to waiting for a reply from the Trade Engine to the previous transaction.

This information is transmitted in:

- Execution Report (35=8) (New, Cancelled, CancelReplace),
- Order Cancel Reject (35=9),
- Order Mass Cancel Report (35=r).

in the optional `FIFOViolationReason (Tag = 5800, Type: int)` field

- 5800=0 has a meaning that message was processed out of FIFO queue for other reason;
- 5800=1 has a meaning that incoming message was delayed due to waiting for Trading System reply to the previous message of this FIX session;
- Absence of tag 5800 indicates that incoming message was processed in FIFO queue.

If you need to deliver N messages to Trade Engine as soon as possible, then the right way is to send them over N FIX sessions.

1.9. May FIFO MFIX trade be used for trading in the SDBP (speedbump) mode on the FX market? Are there any specific recommendations for such use?

FIFO MFIX Trade supports trading in SDBP on the FX market, but please note the following:

- While trading in SDBP board of FX market, *the issue of waiting for a reply to previous transactions (see Question 1.8)* becomes more serious. If you have sent an order, then this FIX session cannot deliver new transactions for an interval of random delay in a range of 10 to 30 milliseconds. You cannot cancel orders over this FIX session until you receive a reply for your order.

`FIFOViolationReason` (Tag = 5800, Type: int), 5800=1 indicates that FIFO principle in delivering message to the Trade engine was violated due to waiting to Trading System reply to the previous message.
(see Question 1.8).

It is recommended that you use at least 2 FIX sessions each with the ability to cancel orders in the SDBP board. This guarantees minimal delivery time of Order Cancel Request from your software to Trade Engine. Order cancel reply may be delayed due to processing queue at Trade Engine side, however, a place of your Cancel Request in that queue is at least 9 milliseconds ahead of the nearest aggressive order.

If you need to deliver N messages to Trade Engine as soon as possible, then the right way is to send them over N FIX sessions.

1.10. May an order sent via standard MFIX Transactional reach the Trade Engine earlier than one sent via FIFO MFIX Trade?

In a straight comparison of transaction delivery speed on one single transaction: FIFO MFIX Trade is guaranteed to be faster.

When comparing on multiple transactions submitted by multiple clients:
~10 first transactions on Trade engine will be from FIFO MFIX Trade;
further transactions will be mixed in approximately equal amounts.

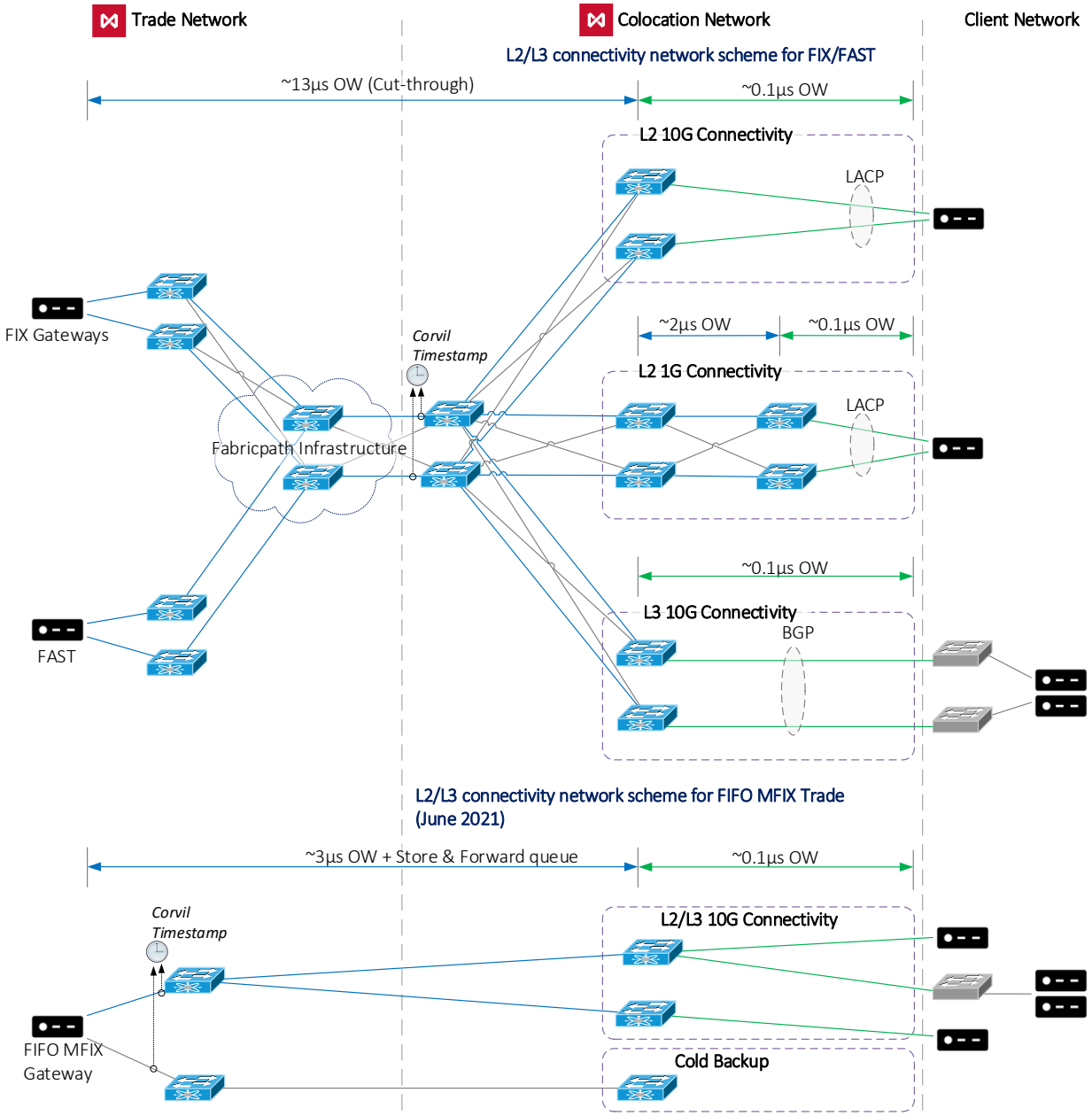
Absolute advantage of FIFO MFIX Trade in transactions delivery speed cannot be guaranteed now. In rare high load situations order sent via MFIX Transactional may reach Trade Engine earlier than one sent via FIFO MFIX Trade.

In SDBP («speedbump») trading mode on the FX market, transactions mixture and random delay always occur due to structure of this trading board.
For more details on using FIFO MFIX Trade in SDBP see Question 1.9.

2. FIFO MFIX Trade – service architecture

2.1. What is the service network architecture? How is it different from the standard MFIX Transactional?

The following scheme shows network architecture of standard MFIX Transactional, FAST and FIFO MFIX Trade services:



FIFO MFIX Trade network infrastructure was upgraded on 26 June 2021. The main change is replacing single client-facing switch with a pair of identical switches with improved technical characteristics.

2.2. Which networking equipment is used?

FIFO MFIX Trade network segment uses industry-standard equipment supplied by a well-known manufacturer.

FIFO Gateway servers are equipped with SolarFlare interfaces.

2.3. Store-and-Forward or Cut-Through?.

Client facing network switch operates in Store-and-Forward mode.

2.4. Why is FIFO MFIX Trade is available in MOEX Co-location only?

FIFO MFIX Trade is primarily designed for HFT and Low-latency trading strategies, whose reaction time to a market events is measured by fractions of a microsecond. Such times may only be achieved using 10G links in MOEX Co-location.

2.5. Why has the service a dedicated network link?

FIFO MFIX Trade uses the dedicated network segment isolated from the main segment. This solution is designed to reduce Latency and make it more predictable by eliminating interference with market data and auxiliary services traffic.

2.6. How the FIFO principle is ensured?

FIFO operation is ensured by the following:
- there is only one network path between client equipment and FIFO Gateway;
- each Trade Engine is served by only one FIFO gateway (standard MFIX Transactional is served by 3 FIX Gateway instances for each Trade Engine);
- FIFO MFIX gateway delivers messages to the Trade Engine in strict ascending order of hardware timestamps assigned at FIFO Gateway entry.

2.7. I know that different ports on a network equipment may have different latencies, is that correct? What is the Exchange's position on this?

Yes, Latency values are slightly different on different ports of each industry standard network device. Moscow Exchange aims to provide clients with maximum technological Fair Play that may be reached on the current infrastructure. MOEX Co-location is based on pre-terminated network, clients` equipment is connected using cables of equal length (with standard suppliers` dimensional tolerance), ports on network equipment are allocated randomly.

MOEX plans to minimize this latency difference and is conducting internal research and is in close contact with manufacturers and studying relevant industry best practices. We expect that a planned upgrade of the network infrastructure will minimize this difference, but not completely eliminate it, as currently there are no commercially available devices with completely equal latency on different ports.

2.8. Are there any limitations on excessive load?

FIFO Gateway does not send duplicated Order Cancel or Replace messages to Trade Engine. This mechanism is implemented to reduce excessive load on Trade Engine.
Regular network monitoring is carried out to identify excessive non-trading load on the service.

2.9. Which backup method is provided?

Currently only cold backup is provided and there are no plans to implement hot backup now. In case of FIFO MFIX Trade unavailability, it is recommended to switch to standard MFIX Transactional to continue trading.

2.10. May FIFO MFIX Trade User IDs connect to the standard MFIX Transactional and how?

Yes, FIFO MFIX Trade User IDs may connect to standard FIX servers of Securities and FX markets in case the following conditions are met:
- connectivity to the main MOEX network segment exists. Connection from the FIFO MFIX Trade network segment to standard MFIX Transactional cannot be established;
- corresponding IP-addresses are allowed for a particular User ID;
- User ID is not connected to FIFO MFIX Trade.

Each user ID may simultaneously be connected to only one of two services – FIFO MFIX Trade or MFIX Transactional.

2.11. May I restore the missed trades when switching from FIFO MFIX Trade to MFIX Transactional?

FIFO MFIX Trade and MFIX Transactional do not provide such an ability, as well as trades cannot be restored when client switches from one standard FIX gateway to another.

Using MFIX DropCopy is recommended for this task as it contains all trades and orders. For example one of the FIFO MFIX Trade User IDs may connect to DropCopy in case of FIFO gateway unavailability.

2.12. Is there any difference in FIFO MFIX Trade and MFIX Transactional interfaces?

FIFO MFIX Trade and MFIX Transactional client interfaces are both based on FIX 4.4. and are very similar.

There only difference at the moment is the following:

FIFO MFIX Trade delivers optional field FIFOViolationReason (Tag = 5800, Type: int) in the Execution Report (35=8) (New, Cancelled, CancelReplace), Order Cancel Reject (35=9) and Order Mass Cancel Report (35=r) to indicate that incoming message was processed out of FIFO queue and delayed:
- 5800=0 has a meaning that message was processed out of FIFO queue for other reason;
- 5800=1 has a meaning that incoming message was delayed due to waiting for Trading System reply to the previous message of this FIX session;
- Absence of tag 5800 indicates that incoming message was processed in FIFO queue.

For more information on transaction processing out of FIFO queue see Question 1.8.

3. TIMESTAMPS Analytics product

3.1. What is TIMESTAMPS Analytics product? What is it designed for?

The product is designed to provide HFT and latency sensitive traders with data on order routes and timestamps measured at different points of the Exchange infrastructure:
- at Exchange`s switch in Co-location;
- at Trade Engine.

The product shows how much your reaction to certain market events was faster or slower than your competitors`.

3.2. What data does the product contains?

Product contains standard market data (all orders log and trades log), and exclusive additional data on FIFO MFIX Trade and MFIX Transactional orders sent from Co-location:
- timestamp at Exchange`s switch in Co-location;
- IP-address of Gateway which processed the order;

TIME	TICKER	ACTIOIN	ORDERNO	VOLUME	DIR	PRICE	TRADENO	DSTIP	COLOTIME
100000023008	USD000UTSTOM	1	20075519160	200000	S	69.5625			
100000023704	USD000000TOD	1	20075519161	50000	S	69.545		91.203.252.29	100000023518.251
100000024338	USD000UTSTOM	1	20075519162	200000	S	69.5725			

standard market data *Timestamps*

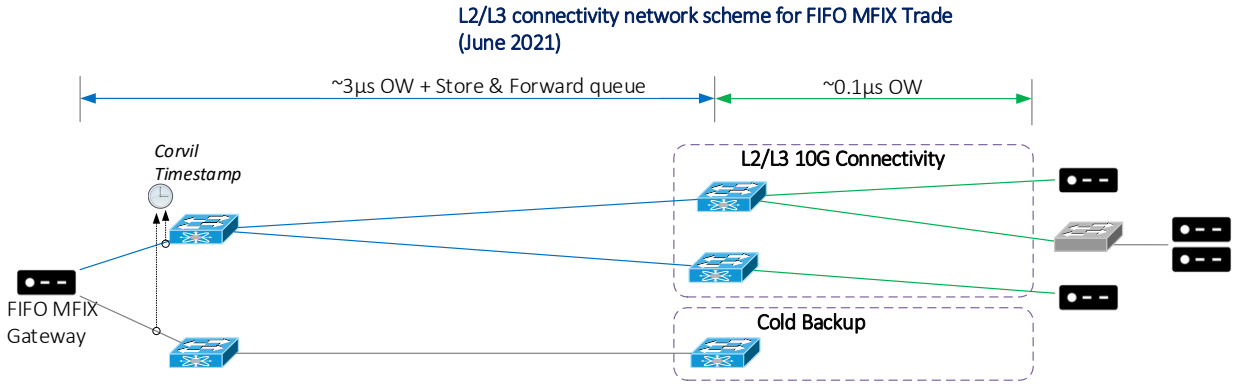
The product also contains data on orders rejected by Trading System. Such orders may result an additional load on exchange infrastructure on activity spikes, therefore, the disclosure of such orders may provide client with additional useful information on market behavior.

The product is anonymous and identical for all customers. Available for the FX and Securities markets.

3.3. How can this product be useful in combination with the FIFO MFIX Trade?

The product contains data on orders sent via FIFO MFIX Trade. The Timestamp is taken in the following point (marked with red arrow):

Client



TimeStamps may be useful for post analysis of market situations and events, and fine tuning of trading algorithms considering timestamps assigned at Exchange`s network switch in Co-location and Trade Engine.

3.4. What is COLOTIME and DSTIP? Where timestamps are taken?

- COLOTIME is a timestamp assigned at network switch in MOX Co-location (see scheme above)
- DSTIP is an IP-address of Gateway which processed the order.

These fields contain the data for orders sent from Co-location using FIX and FIFO FIX services only. Client

3.5. In what cases are the COLOTIME and DSTIP fields are empty?

COLOTIME (timestamp at Exchange`s network switch in Co-location) and DSTIP (IP address of the Gateway) are empty:
- for trades (ACTION = 2);
- for orders that were not sent from Co-location.

3.6. How are clocks in different schemes synchronized?

MOEX systems are synchronized via PTP in both data centers. Exchange infrastructure receives precision time by GPS signals processed by separate Grandmaster clocks, each with its' own GPS-antenna.

These times are also transmitted to clients via separate network circuits using separate PTP domains as an additional service in MOEX Co-location (see Section 4).

For each scheme timestamps are taken from both switches (marked with red on scheme in Question 3.4 above). Clocks of both switches are synchronized with maximum PTP precision for these devices.

Timestamps of two packets that were sent actually at the same time through different connection schemes may differ due to different channel loads and devices configuration on the path between client and timestamp registration point.

3.7. How accurate is COLOTIME?

COLOTIME is measured in nanoseconds.

Clocks of Exchange`s switches (marked with red on scheme in Question 3.4. above) are synchronized with one PTP domain with maximum precision available for the particular device. But the direct comparison of COLOTIME for these two connection schemes is not correct due to different network architecture and device settings. Within each scheme in 1 microsecond range timestamps accuracy is about several nanoseconds.

3.8. Why do some orders take abnormal long time to be delivered to Trade Engine (milliseconds)?

This may be due to Gateway cannot deliver next transaction to Trade Engine until gets reply from Trade Engine to the previous transaction within one session.
See Question 1.8.

Additional delay of 10-30 milliseconds is applied when trading in SDBP ("speedbump") mode on the FX market. For more information see Question 1.9.

3.9. How and when is the product distributed?

The product is distributed on a daily basis at 10:00 A.M. MSK with the data for the previous trading day. Distribution via ftp. Data format is csv.

3.10. How can I get sample data?

Sample data is available at https://fs.moex.com/f/0/ts_sample.7z

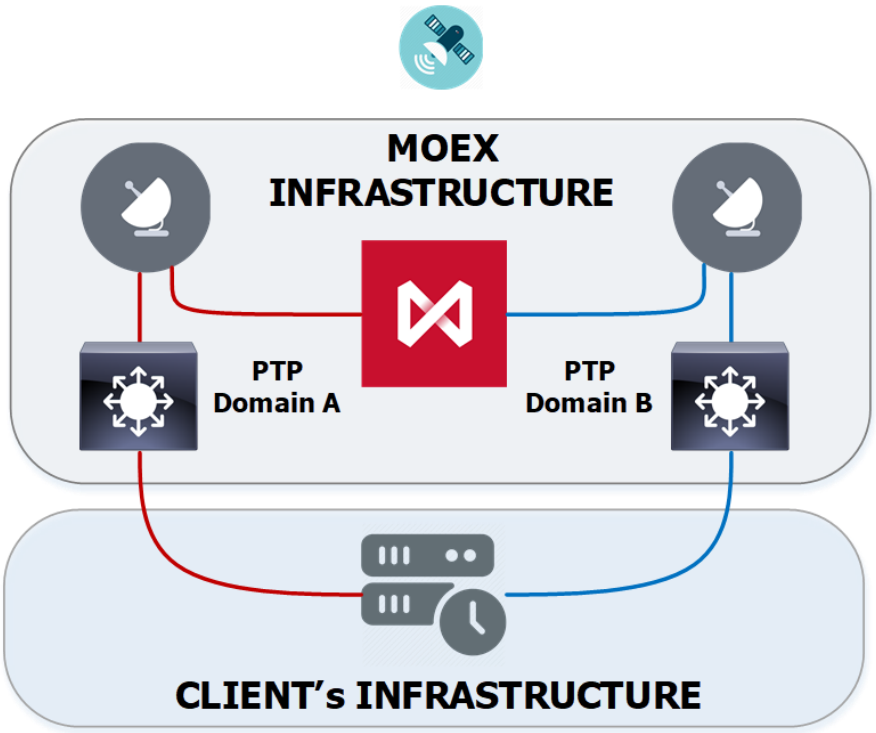
4. Time synchronization over PTP in MOEX Co-location

4.1. What is the MOEX PTP service? What are the typical use cases?

Time synchronization with MOEX Trading Systems Grandmaster clocks over Precision Time Protocol (PTP).

MOEX infrastructure receives precision time by GPS signals processed by separate Grandmaster clocks, each with its' own GPS-antenna.

This signal is used for MOEX trading systems time synchronization and also transmitted to Co-location clients who ordered the service via separate network circuits using separate PTP domains.



Use cases:
- Precise analysis of trading situations using timestamps on the client side and timestamps assigned by trading systems.
- The service allows to reduce the difference between the client's and trading system's clocks to a several microseconds.
- MIFID II compliance.
- Grandmaster clocks as a service.

Service parameters:
- Regular Synchronization preciseness - less than 1µs: 100 times better than MIFID II requirements.
- Nanosecond timestamping.
- Redundant connection with fault tolerance via two separate PTP domains (signals from separate GPS antennas).
- Available exclusively in MOEX Co-location (DC Dataspace1).

4.2. Is PTP used in MOEX infrastructure?

MOEX systems are synchronized via PTP since late 2017. Time synchronization system is deployed in both data centers and ensures precise synchronization of infrastructure components to each other and to UTC time. This scheme shown excellent result on 2019 public stress testing: precision checks for clocks on the network devices have shown that the time deviation has been no more than 500 nanoseconds. No failures of synchronization on the network devices or servers have been noted.

4.3. How can I benefit from using PTP with FIFO MFIX Trade?

The services provide the client with the ability to improve the accuracy of trading situations analysis by using timestamps on the client's side in a combination with timestamps received from the trading system.

4.4. What is the advantage of using PTP and TimeStamps together?

Using PTP and TimeStamps provides client with the following information which may be used for trading algorithms tuning:

- data about the time when the order was sent;
- time when order passed Exchange`s switch in MOEX co-location;
- time when order was delivered to the Trade Engine;
- what place the order took in the trade engine queue.
- an assumption can be made on how long it took to deliver the order to the Gateway.

4.5. What is the advantage of MOEX PTP over other precision time sources?

Synchronization with MOEX PTP-Grandmaster is more valuable than other sources for trading on MOEX markets as client receives times which MOEX Trading Systems use in their operation.

The use of other sources reduces the accuracy of times of order passage through the MOEX infrastructure.

4.6. How is the PTP service redundancy ensured?

Redundancy is ensured by transmitting data in two PTP domains each with its` own GPS-antennas. This signal is transmitted via separate network circuits.