Top of Market Feed

ToM Interface Specification

Revision Date: 03/16/2018

Version: 2.2

Table of Contents

1 Overview

MIAX Top of Market (**ToM**) is a data feed that allows subscribers to receive real-time updates of the following information from the MIAX Options Market

- MIAX Best Bid or Offer (MBBO): Best Bid or Offer price with aggregate orders and quote size of contracts that can be displayed. For purposes of this document, MBBOs are subject to quote mitigation processing (details of Quote mitigation on MIAX website).
- Display of Public Customer interest at MBBO.
- Display of Priority Customer interest at the MBBO.
- MIAX Last Sale (trades)

ToM Features:

ToM messaging and the system architecture are designed for low latency and high throughput messaging. Some of the key features of the interface are:

- ToM uses binary numeric fields, fixed length ASCII fields and single sided top of market messages in order to utilize bandwidth efficiently and assist in achieving **low latency**.
- Message formats are designed to use **less bandwidth**. Some examples: ToM disseminates top of MIAX Bid separate from top of MIAX Offer. ToM also uses a compact version of the Top of Market message for most quotes with small prices/sizes and uses the larger message only when necessary. ToM disseminates a separate Seconds message instead of sending this with every message. ToM messages use Product IDs in each message in place of a full canonical symbol.
- ToM uses binary message formats and bundles multiple application messages into a single packet in order to facilitate **high throughput**.
- ToM is offered with redundant multicast feeds (A Feed & B Feed) to provide single point of failure hardware and network fault tolerance and to provide an opportunity for recipients to arbitrate the two feeds to auto-fill gaps.
- ToM real-time messages are disseminated over multicast to achieve a fair delivery mechanism.
- ToM requires the use of MIAX proprietary SesM over TCP/IP protocol for retransmission lines in order to provide a **guaranteed delivery** mechanism for gap fills.
- The ToM retransmission service also provides a Last Value Refresh Service to facilitate fast intra-day recovery without a full day gap fill.
- ToM notifications provide current **electronic system status** allowing the subscribers to take necessary actions immediately.

This specification is intended to be used by MIAX ToM subscribers only.

1.1 Exchange related information

1.1.1 Hours of operation for MIAX Options Exchange

Please refer to MIAX website at http://www.MIAXOptions.com for details about times for each of these events.

Note: Times specified below are in United States Eastern Time zone.

Start of Session: Start of dissemination of messages. After 5:00 a.m.
Trading Session for Equity Options: 9:30 a.m. to 4:00 p.m. (ends at 1:00 p.m. on early closing days). MIAX may send trade related data following the end of trading session due to the issuance of manual trades, trade cancels, trade corrections or for various operational reasons as needed.

Trading Session for ETF and Index Options: 9:30 a.m. to 4:15 p.m. (ends at 1:15 p.m. on early closing days). MIAX may send trade related data following the end of trading session due to the issuance of manual trades, trade cancels, trade corrections or for various operational reasons as needed.

1.1.2 Obtaining more information

Information such as (but not limited to) membership, rules, data feeds, fees and support can be obtained by sending an email to Trading Operations or by referring to MIAX website at http://www.MIAXOptions.com.

1.2 Testing of ToM Subscription

MIAX can provide testing assistance on MIAX testing area for the retransmission interface.

Please contact MIAX Trading Operations to obtain more information about the aforementioned.

1.3 Answers to FAQs

Subscription: Please contact Trading Operations for details about subscribing to ToM.

Symbol management: Subscribers to the data feed will get a list of all option symbols that will be traded and sourced on that feed at the start of every session. If firms cannot start listening to the feed in time for the normal symbol broadcast, they can connect to the ToM Retransmission service and request for all messages published and then subsequently process only the symbol messages to build their symbol list. The MIAX assigned Product ID of each option in this symbol list will be sent in every message so that firms can tie each message to an option symbol.

Quote Mitigation: MIAX Best Bid or Offer disseminated on this feed is subject to quote mitigation processing at MIAX. Please refer to MIAX website in order to understand the quote mitigation processing.

Retransmission: Gap-fill packets generated as a response to retransmission requests are only disseminated on the retransmission TCP channels and not on the real-time multicast feeds.

Redundant Feeds: In order to achieve higher availability, MIAX offers the real-time ToM feed in two separate redundant and identical feeds named “A Feed” and “B Feed”. Firms are advised to arbitrate

between the two feeds in order to mitigate gaps and achieve higher availability. “A Feed” is the primary feed from the primary data center and “B Feed” is the secondary feed from the secondary data center.

Trading Status: The first “regular” trade or “regular (automatic execution eligible)” MBBO quote of the day or “regular” MBBO after a halt indicates that the given product (option symbol) is open for trading at MIAX. Halts are communicated as top of market messages with a condition of ‘T’.

Refresh Service: Refresh service is provided only on the retransmission TCP channels and does not affect the real-time ToM feed.

1.4 Data Types

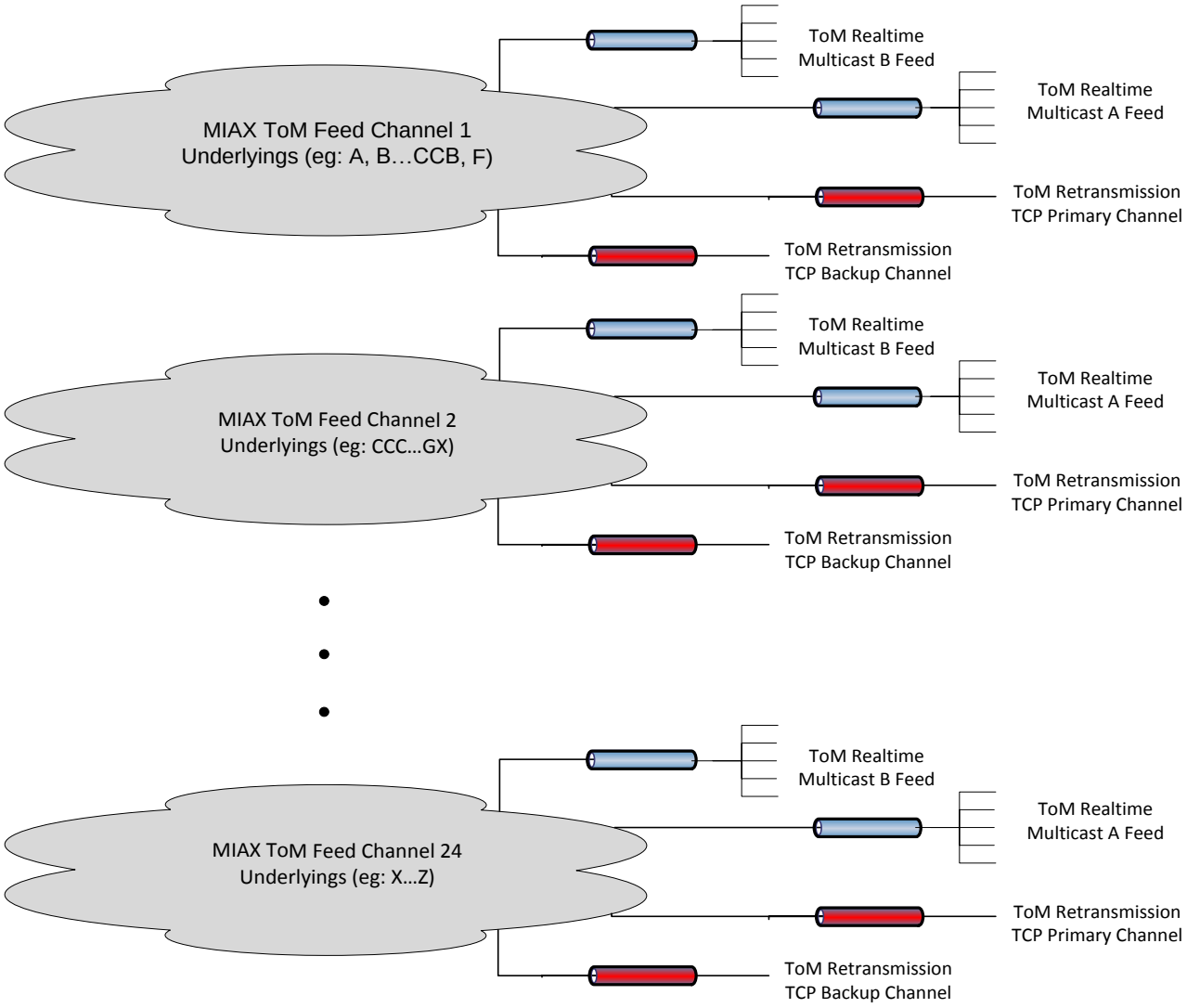
The following table describes the data types used in ToM messaging:

Note: Time fields in all messages are as per timings of United States Eastern Time zone unless specified otherwise.

Data Type	Description
BinaryU	Unsigned, Intel x86 byte-ordered (**little-endian**), binary encoded numbers
BinaryPrc4U	BinaryU Field with the last 4 (right most) digit places being decimal places
BinaryPrc2U	BinaryU Field with the last 2 (right most) digit places being decimal places
SecTime	BinaryU field that contain transaction time in seconds since Epoch (January 1, 1970, 00:00:00 **UTC**)
NanoTime	BinaryU field that contain transaction time in nanoseconds since past second
Alphanumeric	Each place can contain characters or numbers. Left justified and space-padded on the right

2 ToM Architecture

MIAX Top of Market (ToM) Architecture



Highlights:

- Real-time dissemination is separated out on to 24 separate Feed channels.
- A Feed channel will contain sourced data for all options for a single underlying.
- Any options for any given underlying will only be sourced by a single feed channel on any given day.
- Each Feed channel sources independently from the other groups and hence has independent sequence numbers.
- All the messages on each feed channel will be published in FIFO sequence.
- MBBO data is disseminated on same multicast group as Trades in each of these Feeds.

- High availability is achieved by disseminating identical data on an "A Feed" and "B Feed" for each Feed channel
- Underlyings may not be contiguously distributed according to symbol ranges in each Feed channel.
- Two separate TCP based retransmission channels for each Feed channel supply ToM retransmission via the ToM Retransmission Interface.

3 Session Level Protocol

3.1 Real-time ToM Feed

ToM real-time feed uses MIAX's proprietary **MACH protocol**. Each ToM Packet may have multiple application messages and each application message is encapsulated in a MACH protocol packet. Hence a single ToM packet may contain 1 or more sequenced MACH protocol packets.

Please refer to MACH document (available at the MIAX website) for details about MACH protocol. This protocol layer offers low latency application messaging over multicast, sequencing of messages and heartbeats.

3.2 ToM Retransmission Interface

ToM Retransmission Interface uses MIAX's proprietary **SesM – TCP Session Management Protocol**. Please refer to the latest SesM TCP Session Management document (available at the MIAX website) for details about SesM session management protocol. This protocol layer offers session management capabilities such as authentication, application messaging over TCP/IP, sequencing of messages, heartbeats and gap fills.

Firms must first use the `Login Request` with a requested sequence number of **zero** to login to the Interface. After receiving a successful `Login Response`, the firm can choose either the SesM Gap Fill Service or Last Value Refresh Service.

3.2.1 SesM Gap Fill Service

Firms can use the **Retransmission Request** session management message, available in the SesM protocol, to request retransmission of a specific range of packets, identified by sequence numbers.

3.2.2 Last Value Refresh Service

3.2.2.1 Request Message to MIAX

Firms can use the **Unsequenced Data Packet,** available in the SesM protocol, to request a last value refresh of various MBBO market data and status information. The Refresh Request has the following format:

Field Name	Length	Data Type	Notes
SesM Packet Length	2	Binary	

Field Name	Length	Data Type	Notes
SesM Packet Type	1	Alphanumeric	*'U' – SesM Unsequenced Packet*
Request Type	1	Alphanumeric	"R" – Refresh
Refresh Message Type	1	Alphanumeric	"P" - Simple Series Update Refresh "Q" – Simple Top of Market Refresh "U" – Underlying Trading Status Refresh "S" – System State Refresh

3.2.2.2 Response Message from MIAX

The Retransmission feed will respond to the Refresh request with a series of SesM-TCP "unsequenced packets" based on the `Refresh Message Type`. Each response message will have the *following format:*

Field Name	Length	Data Type	Notes
SesM Packet Length	2	Binary	
SesM Packet Type	1	Alphanumeric	*'U' – SesM Unsequenced Packet*
Response Type	1	Alphanumeric	"R" – TOM Refresh
Sequence Number	8	BinaryU	Original sequence number from live feed.
Application Message	varies	See section 4	Based on the message type requested.

The first SesM-TCP packet to be received by the firms will be the MIAX System Time Message (See section 4.1). The timestamp (combined with the nanosecond part in the subsequent messages) represents the most recent Matching Engine transaction time . It is ***not*** the original timestamp from the MACH sequenced messages in the live feed. *The sequence number in the refresh messages may be used to arbitrate with the sequenced packets from live feed (eg: data with higher sequence number from either the refresh or the live feed represents latest information).*

3.2.2.3 End of Refresh Notification from MIAX

When the refresh is complete MIAX will send the following message.

Field Name	Length	Data Type	Notes
SesM Packet Length	2	Binary	
SesM Packet Type	1	Alphanumeric	*'U' – SesM Unsequenced Packet*
Response Type	1	Alphanumeric	"E" – End of Request.
Refresh Message Type	1	Alphanumeric	from Refresh Request

3.2.3 Session Termination

After satisfying the retransmission request, ToM Retransmission Interface will send a `Goodbye Packet` and disconnect the TCP connection.

Note: Upon receipt of an unknown, malformed or illegal session message, MIAX will send a SesM "Goodbye Packet" with a human readable reason text string and MIAX will disconnect the line.

4 Application Message Formats

This section consists of format of messages sent over the ToM feed.

The time specified in the *Timestamp* field in all the messages below is the time at which the Matching Engine associated with that underlying group published the message. This is the same timestamp that will get included in the messages transmitted on the retransmission interface.

4.1 MIAX System Time Message

This is the message format that will be used to disseminate the "seconds" part of the timestamp that is applicable to all messages that are sent in the current second.

Field Name	Length	Data Type	Notes
MACH Protocol Data			*Refer to MACH Protocol Specification*
Message Type	1	Alphanumeric	"1"
Time Stamp	4	SecTime	Seconds part of the time that applies to all messages that gets disseminated until this message gets sent again.

Points to note:

- Note that this message is only sent when there are any application messages that are going to be sent during any second. Firms are advised to not assume that there will be a message for every second of the day.

4.2 Simple Series Update

This is the message format that will be used to disseminate all Option series traded on MIAX for the current session. The product ID sent in this message is what will be disseminated in Top of Market BBO and Last Sale messages.

Field Name	Length	Data Type	Notes
MACH Protocol Data			*Refer to MACH Protocol Specification*
Message Type	1	Alphanumeric	"P"
Product Add/Update Time	4	NanoTime	Time at which this product is added/updated on MIAX system today.
Product ID	4	BinaryU	MIAX Product ID mapped to a given option. It is assigned per trading session and is valid for that session.
Underlying Symbol	11	Alphanumeric	Stock Symbol for the option.
Security Symbol	6	Alphanumeric	Option Security Symbol
Expiration Date	8	Alphanumeric	Expiration date of the option in YYYYMMDD format
Strike Price	4	BinaryPrc4U	Explicit strike price of the option. Refer to data types for field processing notes
Call or Put	1	Alphanumeric	Option Type "C" = Call

<table>
<tr><th>Field Name</th><th>Length</th><th>Data Type</th><th>Notes</th></tr>
<tr><td></td><td></td><td></td><td>“P” = Put</td></tr>
<tr><td>Opening Time</td><td>8</td><td>Alphanumeric</td><td>Expressed in HH:MM:SS format. Eg: 09:30:00</td></tr>
<tr><td>Closing Time</td><td>8</td><td>Alphanumeric</td><td>Expressed in HH:MM:SS format. Eg: 16:15:00</td></tr>
<tr><td>Restricted Option</td><td>1</td><td>Alphanumeric</td><td>“Y” = MIAX will accept position closing orders only
“N” = MIAX will accept open and close positions</td></tr>
<tr><td>Long Term Option</td><td>1</td><td>Alphanumeric</td><td>“Y” = Far month expiration (as defined by MIAX rules)
“N” = Near month expiration (as defined by MIAX rules)</td></tr>
<tr><td>Active on MIAX</td><td>1</td><td>Alphanumeric</td><td>Indicates if this symbol is tradable on MIAX in the current session:
“A” = Active (tradable) on MIAX
“I” = Inactive (not tradable) on MIAX</td></tr>
<tr><td>MIAX BBO Posting Increment Indicator</td><td>1</td><td>Alphanumeric</td><td>This is the Minimum Price Variation as agreed to by the Options industry (penny pilot program) and as published by MIAX
<table>
<tr><th rowspan="2">Indicator</th><th colspan="2">BBO Increments</th></tr>
<tr><th>Price <= $3</th><th>Price > $3</th></tr>
<tr><td>“P”</td><td>Penny (0.01)</td><td>Penny (0.01)</td></tr>
<tr><td>“N”</td><td>Penny (0.01)</td><td>Nickel (0.05)</td></tr>
<tr><td>“D”</td><td>Nickel (0.05)</td><td>Dime (0.10)</td></tr>
</table></td></tr>
<tr><td>Liquidity Acceptance Increment Indicator</td><td>1</td><td>Alphanumeric</td><td>This is the Minimum Price Variation for Quote/Order acceptance as per MIAX rules
<table>
<tr><th rowspan="2">Indicator</th><th colspan="2">Quoting Increments</th></tr>
<tr><th>Price <= $3</th><th>Price > $3</th></tr>
<tr><td>“P”</td><td>Penny (0.01)</td><td>Penny (0.01)</td></tr>
<tr><td>“N”</td><td>Penny (0.01)</td><td>Nickel (0.05)</td></tr>
<tr><td>“D”</td><td>Nickel (0.05)</td><td>Dime (0.10)</td></tr>
</table></td></tr>
</table>

<table>
<tr><th>Field Name</th><th>Length</th><th>Data Type</th><th>Notes</th></tr>
<tr><td>Opening Underlying Market Code</td><td>1</td><td>Alphanumeric</td><td>Options opening will be triggered on receipt of Opening quote/trade from this Underlying market:
<table>
<tr><th>Market Code</th><th>Description</th></tr>
<tr><td>A</td><td>NYSE Amex</td></tr>
<tr><td>B</td><td>NASDAQ OMX BX</td></tr>
<tr><td>C</td><td>National Stock Exchange</td></tr>
<tr><td>D</td><td>FINRA ADF</td></tr>
<tr><td>E</td><td>Market Independent (Any market that opens first)</td></tr>
<tr><td>I</td><td>International Securities Exchange</td></tr>
<tr><td>J</td><td>EDGA Exchange, Inc</td></tr>
<tr><td>K</td><td>EDGX Exchange, Inc</td></tr>
<tr><td>M</td><td>Chicago Stock Exchange</td></tr>
<tr><td>N</td><td>NYSE Euronext</td></tr>
<tr><td>P</td><td>NYSE Arca Exchange</td></tr>
<tr><td>Q</td><td>NASDAQ OMX (via UTP Feed)</td></tr>
<tr><td>T</td><td>NASDAQ OMX (via CTA Feed)</td></tr>
<tr><td>V</td><td>IEX</td></tr>
<tr><td>X</td><td>NASDAQ OMX PHLX</td></tr>
<tr><td>Y</td><td>BATS Y-Exchange, Inc</td></tr>
<tr><td>Z</td><td>BATS Exchange Inc</td></tr>
</table></td></tr>
<tr><td>Priority Quote Width</td><td>4</td><td>BinaryPrc4U</td><td>Maximum allowable width for a quote for this Option during regular trading in order to be considered as Priority Quote.
0 when Priority Quote Width is not applicable.</td></tr>
<tr><td>Reserved</td><td>8</td><td>BinaryU</td><td>** Reserved for future use **</td></tr>
</table>

Points to note:

- Entire Options list will be disseminated at the start of day.
- In each channel, firms will only receive the series associated with the Engine that is servicing that channel.
- Intra-day updates will also be published as they occur.
- In case of an intra-day reconnection, users can request all Options series data from the ToM retransmission line.
- The Priority quote width specified in this message is not applicable to Opening. Please refer MIAX rules and circulars for details about priority quote width applicable during Opening.

4.3 System State

This message format is used to notify the firms of the state changes of the system. This is a notification that applies to each Underlying group. Firms can use notifications as triggers in their system to ensure electronic synchronization of systems.

Field Name	Length	Data Type	Notes
MACH Protocol Data			*Refer to MACH Protocol Specification*
Message Type	1	Alphanumeric	"S"

Field Name	Length	Data Type	Notes
Notification Time	4	NanoTime	Time at which this was generated by MIAX system.
ToM Version	8	Alphanumeric	Eg: TOM2.1
Session ID	4	BinaryU	MIAX assigned ID for the current trading session
System Status	1	Alphanumeric	Current system status: "S" = Start of System hours "C" = End of System hours "1" = Start of Test Session (sent before tests). "2" = End of Test Session.

Points to note:

- Firms must ensure that messages sent on the ToM Feed from the beginning of "start of test session" to the end of "end of test session" will not affect their production session while allowing the firms to still be involved in production tests and dry runs.
- A change in Session ID will mean that restarting at MACH sequence number 1 for that Underlying group. Refer to MACH protocol specification for details about this. Firms must be able to handle more than one trading session in a single trading day.

4.4 Simple Top of Market (Best Bid or Offer) Message – Compact Format

This is the message format that will be used to disseminate each side of the MIAX Simple Top of Market for options with low premiums and small aggregate MIAX Best Bid or Offer (MBBO) size.

Field Name	Length	Data Type	Notes
MACH Protocol Data			*Refer to MACH Protocol Specification*
Message Type	1	Alphanumeric	"B" = MIAX Simple Top of Market on Bid side "O" = MIAX Simple Top of Market on Offer side
Timestamp	4	NanoTime	Nanoseconds part of the timestamp
Product ID	4	BinaryU	MIAX Product ID mapped to a given option. It is assigned per trading session and is valid for that session.
MBBO Price	2	BinaryPrc2U	MIAX Best price at the time stated in Timestamp and side specified in Message Type
MBBO Size	2	BinaryU	Aggregate size at MIAX Best Price at the time stated in Timestamp and side specified in Message Type
MBBO Priority Customer Size	2	BinaryU	Aggregate size of Priority Customer contracts at the MIAX Best Price

<table>
<tr><th>Field Name</th><th>Length</th><th>Data Type</th><th>Notes</th></tr>
<tr><td>MBBO Condition</td><td>1</td><td>Alphanumeric</td><td>Valid Values:
<table>
<tr><th>Condition Code</th><th>Description</th></tr>
<tr><td>A</td><td>Regular (Eligible for Automatic Execution)</td></tr>
<tr><td>B</td><td>Quote contains Public Customer interest (Priority & Non-Priority Customer Interest)</td></tr>
<tr><td>C</td><td>Quote is not firm on this side</td></tr>
<tr><td>R</td><td>** Reserved for future use **</td></tr>
<tr><td>T</td><td>Trading Halt</td></tr>
</table></td></tr>
</table>

Points to note:

- MIAX will only disseminate the side on which the MBBO changed. Firms must preserve the MBBO for the other side until an update is sent for that side.
- MBBO Condition B is sent when there is any Public Customer Interest at the MBBO price.

4.5 Simple Top of Market (Best Bid or Offer) Message – Wide Format

This is the message format that will be used to disseminate MIAX Simple Top of Market for options with high premiums or large aggregate MIAX Best Bid or Offer (MBBO) size.

<table>
<tr><th>Field Name</th><th>Length</th><th>Data Type</th><th>Notes</th></tr>
<tr><td>MACH Protocol Data</td><td></td><td></td><td>Refer to MACH Protocol Specification</td></tr>
<tr><td>Message Type</td><td>1</td><td>Alphanumeric</td><td>“W” = MIAX Simple Top of Market on Bid side
“A” = MIAX Simple Top of Market on Offer side</td></tr>
<tr><td>Timestamp</td><td>4</td><td>NanoTime</td><td>Nanoseconds part of the timestamp</td></tr>
<tr><td>Product ID</td><td>4</td><td>BinaryU</td><td>MIAX Product ID mapped to a given option. It is assigned per trading session and is valid for that session.</td></tr>
<tr><td>MBBO Price</td><td>4</td><td>BinaryPrc4U</td><td>MIAX Best price at the time stated in Timestamp and side specified in Message Type</td></tr>
<tr><td>MBBO Size</td><td>4</td><td>BinaryU</td><td>Aggregate size at MIAX Best Price at the time stated in Timestamp and side specified in Message Type</td></tr>
<tr><td>MBBO Priority Customer Size</td><td>4</td><td>BinaryU</td><td>Aggregate size of Priority Customer contracts at the MIAX Best Price</td></tr>
<tr><td>MBBO Condition</td><td>1</td><td>Alphanumeric</td><td>Valid Values:
<table>
<tr><th>Condition Code</th><th>Description</th></tr>
<tr><td>A</td><td>Regular (Eligible for Automatic Execution)</td></tr>
<tr><td>B</td><td>Quote contains Public Customer interest (Priority & Non-Priority Customer Interest)</td></tr>
<tr><td>C</td><td>Quote is not firm on this side</td></tr>
<tr><td>R</td><td>** Reserved for future use **</td></tr>
<tr><td>T</td><td>Trading Halt</td></tr>
</table></td></tr>
</table>

Points to note:

- MIAX will only disseminate the side on which the MBBO changed. Firms must preserve the MBBO for the other side until an update is sent for that side.
- MBBO Condition B is sent when there is any Public Customer Interest at the MBBO price.

4.6 Simple Double-Sided Top of Market (Best Bid or Offer) Message – Compact Format

This is the message format that will be used in the real-time feed and refresh service to disseminate both sides of the MIAX Simple Top of Market for options with low premiums and small aggregate MIAX Best Bid or Offer (MBBO) size.

Field Name	Length	Data Type	Notes
MACH Protocol Data			*Refer to MACH Protocol Specification*
Message Type	1	Alphanumeric	"d" (lower case 'D')
Timestamp	4	NanoTime	Nanoseconds part of the timestamp
Product ID	4	BinaryU	MIAX Product ID mapped to a given option. It is assigned per trading session and is valid for that session.
Bid Price	2	BinaryPrc2U	MIAX best bid price at the time stated in Timestamp and side specified in Message Type
Bid Size	2	BinaryU	Aggregate size at MIAX best bid Price at the time stated in Timestamp and side specified in Message Type
Bid Priority Customer Size	2	BinaryU	Aggregate size of Priority Customer contracts at the MIAX Best Bid Price
Bid Condition	1	Alphanumeric	Valid Values: Condition Code: A — Description: Regular (Eligible for Automatic Execution) Condition Code: B — Description: Quote contains Public Customer interest (Priority & Non-Priority Customer Interest) Condition Code: C — Description: Quote is not firm on this side Condition Code: R — Description: ** Reserved for future use ** Condition Code: T — Description: Trading Halt
Offer Price	2	BinaryPrc2U	MIAX best offer price at the time stated in Timestamp and side specified in Message Type
Offer Size	2	BinaryU	Aggregate size at MIAX best offer Price at the time stated in Timestamp and side specified in Message Type
Offer Priority Customer Size	2	BinaryU	Aggregate size of Priority Customer contracts at the MIAX Best Offer Price

<table>
<tr><th>Field Name</th><th>Length</th><th>Data Type</th><th>Notes</th></tr>
<tr><td>Offer Condition</td><td>1</td><td>Alphanumeric</td><td>Valid Values:
<table>
<tr><th>Condition Code</th><th>Description</th></tr>
<tr><td>A</td><td>Regular (Eligible for Automatic Execution)</td></tr>
<tr><td>B</td><td>Quote contains Public Customer interest (Priority & Non-Priority Customer Interest)</td></tr>
<tr><td>C</td><td>Quote is not firm on this side</td></tr>
<tr><td>R</td><td>** Reserved for future use **</td></tr>
<tr><td>T</td><td>Trading Halt</td></tr>
</table></td></tr>
</table>

Points to note:

- MBBO Condition B is sent when there is any Public Customer Interest at the MBBO price.
- *The sequence number in the refresh messages may be used to arbitrate with the sequenced packets from live feed (eg: data with higher sequence number from either the refresh or the live feed represents latest information).*

4.7 Simple Double-Sided Top of Market (Best Bid or Offer) Message – Wide Format

This is the message format that will be used in the real-time feed and refresh service to disseminate both sides of the MIAX Simple Top of Market for options with high premiums or large aggregate MIAX Best Bid or Offer (MBBO) sizes.

Field Name	Length	Data Type	Notes
MACH Protocol Data			*Refer to MACH Protocol Specification*
Message Type	1	Alphanumeric	"D"
Timestamp	4	NanoTime	Nanoseconds part of the timestamp
Product ID	4	BinaryU	MIAX Product ID mapped to a given option. It is assigned per trading session and is valid for that session.
Bid Price	4	BinaryPrc4U	MIAX best bid price at the time stated in Timestamp and side specified in Message Type
Bid Size	4	BinaryU	Aggregate size at MIAX best bid Price at the time stated in Timestamp and side specified in Message Type
Bid Priority Customer Size	4	BinaryU	Aggregate size of Priority Customer contracts at the MIAX Best Bid Price

<table>
<tr><th>Field Name</th><th>Length</th><th>Data Type</th><th>Notes</th></tr>
<tr><td>Bid Condition</td><td>1</td><td>Alphanumeric</td><td>Valid Values:
<table>
<tr><th>Condition Code</th><th>Description</th></tr>
<tr><td>A</td><td>Regular (Eligible for Automatic Execution)</td></tr>
<tr><td>B</td><td>Quote contains Public Customer interest (Priority & Non-Priority Customer Interest)</td></tr>
<tr><td>C</td><td>Quote is not firm on this side</td></tr>
<tr><td>R</td><td>** Reserved for future use **</td></tr>
<tr><td>T</td><td>Trading Halt</td></tr>
</table></td></tr>
<tr><td>Offer Price</td><td>4</td><td>BinaryPrc4U</td><td>MIAX best offer price at the time stated in Timestamp and side specified in Message Type</td></tr>
<tr><td>Offer Size</td><td>4</td><td>BinaryU</td><td>Aggregate size at MIAX best offer Price at the time stated in Timestamp and side specified in Message Type</td></tr>
<tr><td>Offer Priority Customer Size</td><td>4</td><td>BinaryU</td><td>Aggregate size of Priority Customer contracts at the MIAX Best Offer Price</td></tr>
<tr><td>Offer Condition</td><td>1</td><td>Alphanumeric</td><td>Valid Values:
<table>
<tr><th>Condition Code</th><th>Description</th></tr>
<tr><td>A</td><td>Regular (Eligible for Automatic Execution)</td></tr>
<tr><td>B</td><td>Quote contains Public Customer interest (Priority & Non-Priority Customer Interest)</td></tr>
<tr><td>C</td><td>Quote is not firm on this side</td></tr>
<tr><td>R</td><td>** Reserved for future use **</td></tr>
<tr><td>T</td><td>Trading Halt</td></tr>
</table></td></tr>
</table>

Points to note:

- MBBO Condition B is sent when there is any Public Customer Interest at the MBBO price.
- *The sequence number in the refresh messages may be used to arbitrate with the sequenced packets from live feed (eg: data with higher sequence number from either the refresh or the live feed represents latest information).*

4.8 Last Sale (Trade) Message

This is the message format that will be used to disseminate Trades that are resulting from executions on MIAX during the current trading session.

Field Name	Length	Data Type	Notes
MACH Protocol Data			*Refer to MACH Protocol Specification*
Message Type	1	Alphanumeric	"T"
Timestamp	4	NanoTime	Nanoseconds part of the timestamp
Product ID	4	BinaryU	MIAX Product ID mapped to a given option. It is assigned per trading session and is valid for that

Field Name	Length	Data Type	Notes
			session.
Trade ID	4	BinaryU	Unique Trade ID assigned to every Trade.
Correction Number	1	BinaryU	Trade correction number. 0 for New trades. Greater than or equal to 0 for trades resulting from corrections/adjustments.
Reference Trade ID	4	BinaryU	0 (zero) if new trade. Trade ID of the original trade if this trade originated as a correction of the original trade.
Reference Correction Number	1	BinaryU	Correction Number of the trade that was just corrected/adjusted. 0 for new trades.
Trade Price	4	BinaryPrc4U	Price at which this product traded
Trade Size	4	BinaryU	Number of contracts executed in this trade
Trade Condition	1	Alphanumeric	Valid Values: Please refer to Appendix A

Points to note:

- Most trades generated from Trade corrections will have the same Trade ID and Reference Trade ID. But the correction number of the newer trade is 1 more than that of the reference trade. Some new trades generated from certain types of trade corrections can have a Trade ID different than the original trade and hence they will have correction number of 0.

4.9 Trade Cancel Message

This is the message format that will be used to disseminate canceled Trades that are resulting from Trade cancellations or corrections on MIAX during the current trading session.

Field Name	Length	Data Type	Notes
MACH Protocol Data			*Refer to MACH Protocol Specification*
Message Type	1	Alphanumeric	"X"
Timestamp	4	NanoTime	Nanoseconds part of the timestamp
Product ID	4	BinaryU	MIAX Product ID mapped to a given option. It is assigned per trading session and is valid for that session.
Trade ID	4	BinaryU	Trade ID of the Canceled Trade
Correction Number	1	BinaryU	Trade correction number of the trade being canceled. 0 for New trades being canceled. >=0 if this is cancel of a trade that resulted from corrections/adjustments.
Trade Price	4	BinaryPrc4U	Trade price of the Canceled Trade
Trade Size	4	BinaryU	Trade volume of the Canceled Trade
Trade Condition	1	Alphanumeric	Trade condition of the Canceled Trade Valid Values: Please refer to Appendix A

4.10 Underlying Trading Status Notification

This message format will be used to notify firms of changes to the trading status of all the options of an underlying.

Message Direction: MIAX to Firm

Field Name	Length	Data Type	Notes
MACH Protocol Data			*Refer to MACH Protocol Specification*
Message Type	1	Alphanumeric	"H"
Timestamp	4	NanoTime	Time at which this was generated by MIAX system.
Underlying Symbol	11	Alphanumeric	Underlying Symbol
Trading Status	1	Alphanumeric	"H" = MIAX has halted trading for this Underlying Symbol "R" = MIAX will resume trading (reopen) for this Underlying Symbol "O" = MIAX will open trading for this Underlying Symbol
Event Reason	1	Alphanumeric	"A" = This event resulted from automatic/market driven event "M" = MIAX manually initiated this event
Expected Event Time: Seconds Part	4	SecTime	Seconds portion of the expected time of the event. Always use in conjunction with the Nano-seconds part field.
Expected Event Time: Nano-Seconds Part	4	BinaryU	Nano-seconds portion of the expected time of the event. Specifies number of nano-seconds since the seconds specified in "Expected Event Time Seconds" field.

Points to note:

- When underlying trading status ="H", Expected Event Time Seconds/Nano-Seconds will be set to 0 (zero).
- When underlying trading status = "R" or "O", Expected Event Time (Seconds/Nano-Seconds Parts) will be set to the time at which the opening/reopening process will start for this Underlying Symbol.

Appendix A: Trade Conditions

Trade conditions sent as in the Last Sale and Trade cancel message:

Condition Code	Description
Space	Regular
A	Cancel of Trade previously reported other than as the last or opening for the particular Option
B	Trade that is Late and is out of sequence
C	Cancel of the last reported Trade for the particular Option
D	Trade that is Late and is in correct sequence
E	Cancel of the first (opening) reported Trade for the particular Option
F	Trade that is late report of the opening trade and is out of sequence
G	Cancel of the only reported Trade for the particular Option
H	Trade that is late report of the opening trade and is in correct sequence
I	* Reserved for future use *
J	Trade due to reopening of an Option in which trading has been previously halted; process as a regular transaction.
K	* Reserved for future use *
L	Transaction represents a trade in two options in the same class (a buy and a sell in the same class). Prefix appears solely for information; process as a regular transaction.
M	Transaction represents a trade in two options in the same class (a buy and a sell in a put and a call). Prefix appears solely for information; process as a regular transaction.
N	* Reserved for future use *
O	* Reserved for future use *
P	Transaction represents the option portion of an order involving a single option leg (buy or sell of a call or put) and stock. Prefix appears solely for information: process as a regular transaction
Q	Transaction represents the buying of a call and the selling of a put for the same underlying stock or index. Prefix appears solely for information; process as a regular transaction
R	Trade was the execution of an order which was "stopped" at a price that did not constitute a Trade-Through on another market at the time of the stop. Process like a normal transaction except don't update "last".
S	Trade was the execution of an order identified as an Intermarket Sweep Order (ISO).
T	* Reserved for future use *
X	Trade that is Trade Through Exempt. The trade should be treated like a regular sale.

Appendix B: MIAX ToM Subscription/Connectivity Information

Please visit MIAX website at http://www.MIAXOptions.com to obtain the most up-to-date information about the following:

- Real-time Feed multicast groups, ports for A feed and B Feed
- Retransmission IP addresses and ports for primary and backup channels.

Appendix C: Contact List

Please visit MIAX website at http://www.MIAXOptions.com to obtain the most up-to-date contact list and other such information.

Appendix D: Revision History

Revision Date	Version	Author	Description
Sep 29 2011	1.0	Vinay S. Rao	First release.
Apr 18 2012	1.1	Vinay S. Rao	Fix message type, Changes to messages and verbiage due to requirements changes.
Sep 10 2012	1.2	Vinay S. Rao	1) Moved Appendix D to E and introduced new Appendix D 2) Data Types: SecTime definition changed to Epoch 3) Addition of a new code for Nasdaq OMX Equity market in Series Update message. 4) Notes clarifications in Bulk Quote Message, eQuote Message, eQuote Response, Liquidity Seeking Event Notification 5) Addition of Trade-Through-Exempt trade condition in Appendix A.
Nov 7 2012	1.3	Kevin Mueller	Msg Type Top Of Market Compact and Wide format, added new MBBO Condition 'B' and added reserved field. MsgType SeriesUpdate, added priority quote width and reserved field Appendix D: Price not published for Route message
Feb 08 2013	1.3a	Kevin Mueller	Updated legal statement in footer
Mar 28 2013	1.4	Vinay S. Rao	Added Attributable ID to Liquidity Seeking Event Notification in the reserved bytes making this message backward compatible with v1.3a.
June 10 2013	1.5	Kevin Mueller	Added Priority Customer size to Top of Market compact and wide message.
Sep 3, 2013	1.6	Anatoly Khusid	1) Added Underlying Trading Status Notification messages. 2) Updated Appendix D (Liq Seeking Event Notif Details) to reflect Multiple-MPV trading.
March 20, 2014	1.7	David Blackman & Vinay S. Rao	1) Update to Liquidity Seeking Event Notification for MIAX PRIME. 2) Update Appendix D to reflect MIAX PRIME auction 3) Appendix D – Free Trading Route Event – Price changed back to zero.
May 14 2015	1.7a	Vinay S. Rao	Deprecated Liquidity Seeking Event Notification and corresponding Appendix. That notification is only published in AIS feed now.
June 29 2015	1.8	David Lehmann	Added description of ToM Last Value Refresh feature
Jan 15 2016	1.9	Siddharth Sahoo	Underlying Market Code: Added 'V' for IEX in Series Update message

Feb 1st 2016	2.0	Kevin Mueller	Update Appendix A Trade Conditions to support Complex Orders. Added values L, M, and Q.
April 12 2016	2.0a	Kevin Mueller	Updated field Tom Version in the System State message
Feb 27th 2017	2.0b	Vinay S. Rao	System startup time moved up.
Mar 13th 2017	2.0c	Vinay S. Rao	Wrong packet length notes removed from Last value Refresh Service request.
July 12th 2017	2.1	Siddharth Sahoo	Simple Double-Sided Top of Market messages will be disseminated real-time in TOM feed. Description of "Simple Double-Sided Top of Market (Best Bid or Offer) Message – Compact Format" and "Simple Double-Sided Top of Market (Best Bid or Offer) Message – Wide Format" updated to indicate that these will be disseminated over the real-time feed, in addition to the refresh service. Simple Double-Sided Top of Market Message – Wide Format: Fixed a typo in the Data Type for Bid Price and Offer Price. These should be BinaryPrc4U as updated.
Mar 16th 2018	2.2	Siddharth Sahoo	Defined Trade Condition "P" for a transaction that represents the option portion of an order with a single option leg (buy or sell of a call or put) and stock leg