Top of Market Feed

ToM Interface Specification

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1 Overview

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

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

MIAX Emerald is referred to as Emerald in the rest of the document.

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 Emerald Bid separate from top of Emerald 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 Emerald ToM subscribers only.

1.1   Exchange related information

1.1.1   Hours of operation for Emerald 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). Emerald 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). Emerald 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 Emerald testing area for the data feed and 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 Emerald 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: Emerald Best Bid or Offer disseminated on this feed is subject to quote mitigation processing at Emerald. 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, Emerald 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)" EBBO quote of the day or "regular" EBBO after a halt indicates that the given product (option symbol) is open for trading at Emerald . 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

Emerald Top of Market (ToM) Architecture
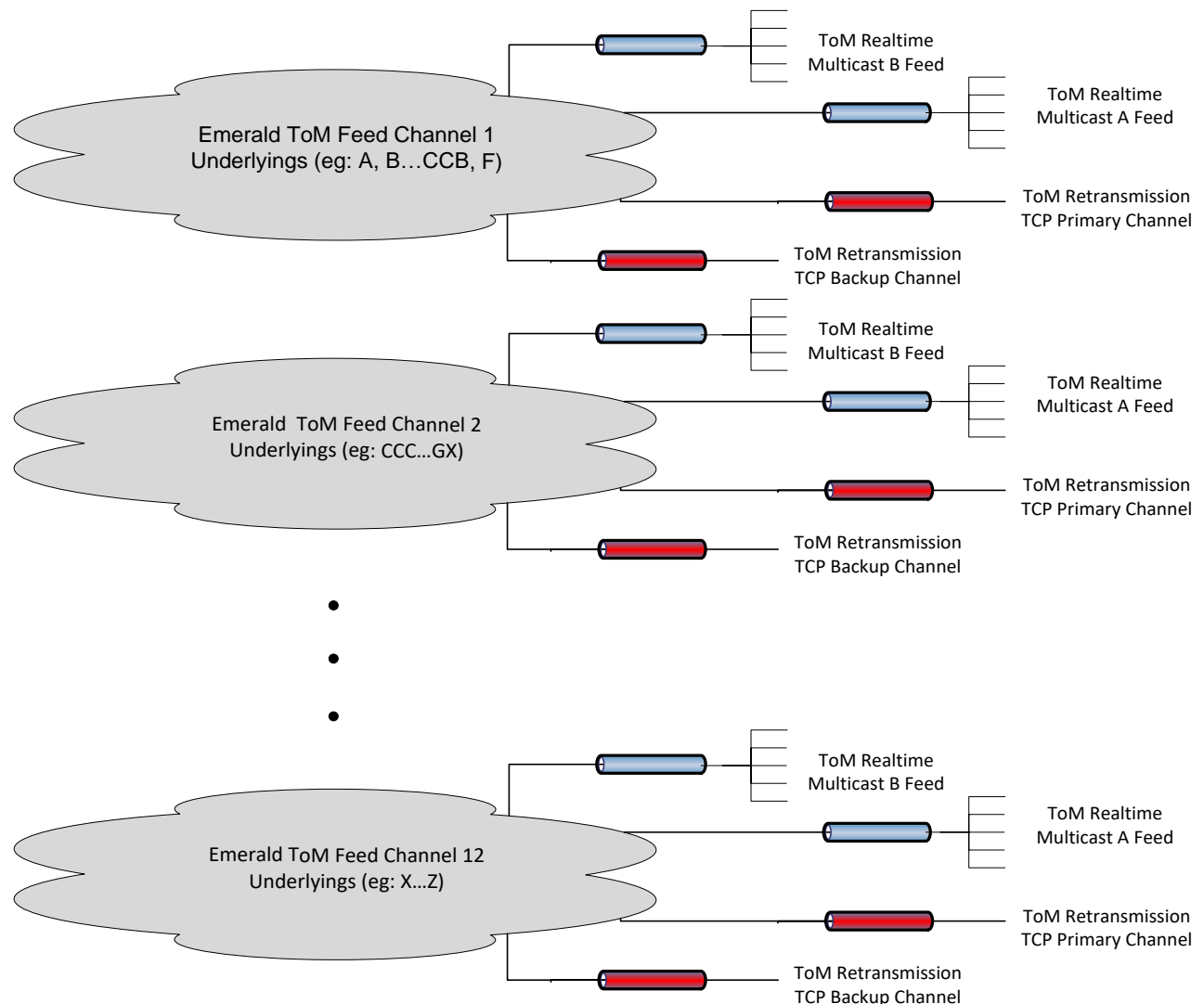
Highlights:

- Real-time dissemination is separated out on to 12 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.
- EBBO 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 Emerald
Firms can use the **Unsequenced Data Packet,** available in the SesM protocol, to request a last value refresh of various EBBO 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 Emerald*

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 Emerald 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 Emerald*

When the refresh is complete Emerald 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, Emerald will send a SesM "Goodbye Packet" with a human readable reason text string and Emerald 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 Emerald 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 Emerald 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 Emerald system today.
Product ID	4	BinaryU	Emerald 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

Field Name	Length	Data Type	Notes
			"C" = Call "P" = Put
Opening Time	8	Alphanumeric	Expressed in HH:MM:SS format. Eg: 09:30:00
Closing Time	8	Alphanumeric	Expressed in HH:MM:SS format. Eg: 16:15:00
Restricted Option	1	Alphanumeric	"Y" = Emerald will accept position closing orders only "N" = Emerald will accept open and close positions
Long Term Option	1	Alphanumeric	"Y" = Far month expiration (as defined by Emerald rules) "N" = Near month expiration (as defined by Emerald rules)
Active on MIAX	1	Alphanumeric	Indicates if this symbol is tradable on Emerald in the current session: "A" = Active (tradable) on Emerald "I" = Inactive (not tradable) on Emerald
Emerald BBO Posting Increment Indicator	1	Alphanumeric	This is the Minimum Price Variation as agreed to by the Options industry (penny pilot program) and as published by Emerald *see BBO Increments table below*
Liquidity Acceptance Increment Indicator	1	Alphanumeric	This is the Minimum Price Variation for Quote/Order acceptance as per Emerald rules *see Quoting Increments table below*

BBO Posting Increment Indicator table:

Indicator	BBO Increments	
	Price <= $3	Price > $3
"P"	Penny (0.01)	Penny (0.01)
"N"	Penny (0.01)	Nickel (0.05)
"D"	Nickel (0.05)	Dime (0.10)

Liquidity Acceptance Increment Indicator table:

Indicator	Quoting Increments	
	Price <= $3	Price > $3
"P"	Penny (0.01)	Penny (0.01)
"N"	Penny (0.01)	Nickel (0.05)
"D"	Nickel (0.05)	Dime (0.10)

Field Name	Length	Data Type	Notes
Opening Underlying Market Code	1	Alphanumeric	Options opening will be triggered on receipt of Opening quote/trade from this Underlying market:

Market Code	Description
A	NYSE Amex
B	NASDAQ OMX BX
C	National Stock Exchange
D	FINRA ADF
E	Market Independent (Any market that opens first)
I	International Securities Exchange
J	EDGA Exchange, Inc
K	EDGX Exchange, Inc
M	Chicago Stock Exchange
N	NYSE Euronext
P	NYSE Arca Exchange
Q	NASDAQ OMX (via UTP Feed)
T	NASDAQ OMX (via CTA Feed)
V	IEX
X	NASDAQ OMX PHLX
Y	BATS Y-Exchange, Inc
Z	BATS Exchange Inc

Field Name	Length	Data Type	Notes
Priority Quote Width	4	BinaryPrc4U	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.
Reserved	8	BinaryU	** Reserved for future use **

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 Emerald system.
ToM Version	8	Alphanumeric	Eg: TOM1.0
Session ID	4	BinaryU	Emerald 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 Emerald Simple Top of Market for options with low premiums and small aggregate Emerald Best Bid or Offer (EBBO) size.

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

Field Name	Length	Data Type	Notes
EBBO Condition	1	Alphanumeric	Valid Values:

Condition Code	Description
A	Regular (Eligible for Automatic Execution)
B	Quote contains Public Customer interest (Priority & Non-Priority Customer Interest)
C	Quote is not firm on this side
R	** Reserved for future use **
T	Trading Halt

Points to note:

- Emerald will only disseminate the side on which the EBBO changed. Firms must preserve the EBBO for the other side until an update is sent for that side.
- EBBO Condition B is sent when there is any Public Customer Interest at the EBBO 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 Emerald Simple Top of Market for options with high premiums or large aggregate Emerald Best Bid or Offer (EBBO) size.

Field Name	Length	Data Type	Notes
MACH Protocol Data			*Refer to MACH Protocol Specification*
Message Type	1	Alphanumeric	"W" = Emerald Simple Top of Market on Bid side "A" = Emerald Simple Top of Market on Offer side
Timestamp	4	NanoTime	Nanoseconds part of the timestamp
Product ID	4	BinaryU	Emerald Product ID mapped to a given option. It is assigned per trading session and is valid for that session.
EBBO Price	4	BinaryPrc4U	Emerald Best price at the time stated in Timestamp and side specified in Message Type
EBBO Size	4	BinaryU	Aggregate size at Emerald Best Price at the time stated in Timestamp and side specified in Message Type
EBBO Priority Customer Size	4	BinaryU	Aggregate size of Priority Customer contracts at the Emerald Best Price
EBBO Condition	1	Alphanumeric	Valid Values:

Condition Code	Description
A	Regular (Eligible for Automatic Execution)
B	Quote contains Public Customer interest (Priority & Non-Priority Customer Interest)
C	Quote is not firm on this side
R	** Reserved for future use **

Field Name	Length	Data Type	Notes
			T Trading Halt

Points to note:

- Emerald will only disseminate the side on which the EBBO changed. Firms must preserve the EBBO for the other side until an update is sent for that side.
- EBBO Condition B is sent when there is any Public Customer Interest at the EBBO 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 Emerald Simple Top of Market for options with low premiums and small aggregate Emerald Best Bid or Offer (EBBO) 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	Emerald Product ID mapped to a given option. It is assigned per trading session and is valid for that session.
Bid Price	2	BinaryPrc2U	Emerald best bid price at the time stated in Timestamp and side specified in Message Type
Bid Size	2	BinaryU	Aggregate size at Emerald 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 Emerald Best Bid Price

Field Name	Length	Data Type	Notes
Bid Condition	1	Alphanumeric	Valid Values:

Condition Code	Description
A	Regular (Eligible for Automatic Execution)
B	Quote contains Public Customer interest (Priority & Non-Priority Customer Interest)
C	Quote is not firm on this side
R	** Reserved for future use **
T	Trading Halt

Field Name	Length	Data Type	Notes
Offer Price	2	BinaryPrc2U	Emerald best offer price at the time stated in Timestamp and side specified in Message Type
Offer Size	2	BinaryU	Aggregate size at Emerald 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 Emerald Best Offer Price
Offer Condition	1	Alphanumeric	Valid Values:

Condition Code	Description
A	Regular (Eligible for Automatic Execution)
B	Quote contains Public Customer interest (Priority & Non-Priority Customer Interest)
C	Quote is not firm on this side
R	** Reserved for future use **
T	Trading Halt

Points to note:

- EBBO Condition B is sent when there is any Public Customer Interest at the EBBO 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 Emerald Simple Top of Market for options with high premiums or large aggregate Emerald Best Bid or Offer (EBBO) 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

Field Name	Length	Data Type	Notes
Product ID	4	BinaryU	Emerald Product ID mapped to a given option. It is assigned per trading session and is valid for that session.
Bid Price	4	BinaryPrc4U	Emerald best bid price at the time stated in Timestamp and side specified in Message Type
Bid Size	4	BinaryU	Aggregate size at Emerald 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 Emerald Best Bid Price
Bid Condition	1	Alphanumeric	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>
Offer Price	4	BinaryPrc4U	Emerald best offer price at the time stated in Timestamp and side specified in Message Type
Offer Size	4	BinaryU	Aggregate size at Emerald best offer Price at the time stated in Timestamp and side specified in Message Type
Offer Priority Customer Size	4	BinaryU	Aggregate size of Priority Customer contracts at the Emerald Best Offer Price
Offer Condition	1	Alphanumeric	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>

Points to note:

- EBBO Condition B is sent when there is any Public Customer Interest at the EBBO 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 Emerald 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	Emerald Product ID mapped to a given option. It is assigned per trading session and is valid for that 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 Emerald 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	Emerald 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

Field Name	Length	Data Type	Notes
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: Emerald 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 Emerald system.
Underlying Symbol	11	Alphanumeric	Underlying Symbol
Trading Status	1	Alphanumeric	"H" = Emerald has halted trading for this Underlying Symbol "R" = Emerald will resume trading (reopen) for this Underlying Symbol "O" = Emerald will open trading for this Underlying Symbol
Event Reason	1	Alphanumeric	"A" = This event resulted from automatic/market driven event "M" = Emerald 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

Note that the trade conditions below are intended to be aligned with the OPRA trade conditions as a convenience. However, this is not a fixed requirement and, as such, they may digress at times.

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

Condition Code	Description
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	Auto
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.
a	Trade from a Paired PRIME transaction
b	* Reserved for future use *
c	Trade from PRIME Customer to Customer Cross or PRIME QCC transaction
d	* Reserved for future use *
e	* Reserved for future use *
f	Trade from a Complex transaction that is not Complex stock-tied and does not involve legging

g	Trade from a Complex PRIME transaction that is not Complex stock-tied and does not involve legging
h	Trade from a Complex PRIME Customer to Customer Cross or Complex PRIME QCC transaction that is not Complex stock-tied
i	* Reserved for future use *
j	Trade from a Complex legging transaction that is not Complex stock-tied
k	Trade from a Complex PRIME stock-tied transaction that does not involve legging
l	Trade from a Complex PRIME legging transaction that is not Complex stock-tied
m	* Reserved for future use *
n	Trade from a Complex stock-tied transaction that does not involve legging
o	Trade from Complex Customer to Customer Cross stock-tied or Complex QCC stock-tied transaction
p	* Reserved for future use *
q	* Reserved for future use *
r	* Reserved for future use *
s	* Reserved for future use *
t	* Reserved for future use *

NOTE: The list of trade conditions above is a superset of those supported by the MIAX Exchange Group for Options. Individual exchanges may or may not emit certain trade conditions depending on the related supported functionality.

Appendix B: Emerald 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 07 2018	1.0	Vinay S. Rao	First release.
Jun 10 2019	1.1	Vinay S. Rao	Added new trade conditions to Appendix A.
July 25, 2019	1.1a		Added comment to Appendix A