

Citrius - Multicast Server protocol

version: 2.4.a

revision date: February 20th, 2025

| Changes with revision 2.4.a | | |
|-----------------------------|-----------------|--|
| date | breaking change | change |
| 1.23.23 | | explicitly designated message type 0 as undefined/reserved |
| 1.23.23 | | added hyperlinks for message types |
| 1.29.23 | YES | changed sequence numbers to be 64 bit |
| 1.29.23 | YES | updated sequence number increments to use number of message in packet rather than monotonically (as was done with prior revisions). |
| 2.01.23 | YES | added enumerations for sale conditions: <ul style="list-style-type: none">• extended hours indicator• settlement type indicator• sro trade indicator• trade through exemption indicator |
| 2.01.23 | YES | updated the trade message to use the four sale condition enumerations: extended hours indicator, settlement type indicator, sro trade indicator and trade through exemption indicator rather than the previous sale condition indicator[4] |
| 2.06.23 | YES | deprecated bid and ask messages |
| 2.13.23 | YES | deprecated “total volume” field in trade message |
| 2.16.23 | YES | added mpid field to top of book message as well as nbbo appendage |
| 2.24.23 | NO | added additional values to quote condition enumerator |
| 3.16.23 | NO | added “market independent SIP” to participant id enumeration |
| 3.17.23 | NO | corrected label of participant id bzx (was incorrectly spelled byz) |
| 3.28.23 | YES | added quote condition indicator to top of book appendage |
| 3.29.23 | NO | deprecated participant enum ids nasdaq_ise and nasdaq_phlx |
| 4.11.23 | NO | corrected overall top of book message size (incorrect size of appendage) |
| 8.7.23 | YES | Add message size field to citrius message header |
| 8.7.23 | YES | Add Citrius receive timestamp to following messages: top of book, order add, order cancel, order delete, order replace, trade, trade cancel, order executed, imbalance, trading status, short sale restriction status, price band, start of day summary, end of day summary |
| 8.11.23 | NO | corrected binary example of option description message |
| 8.16.23 | NO | added citrius message type #255 as reserved |
| 8.23.23 | YES | Added ‘unsequenced’ to retransmit_indicator enum. Renamed enum to transmission_status_indicator, and reclassified heart_beat messages to ‘unsequenced’ indicating that this message types DOES NOT increment the multicast sequence number. |
| 8.23.23 | YES | Added exchange feed id and ‘reserved’ field to option_description message |
| 8.23.23 | YES | Added exchange feed id to symbol_description. removed 4 bytes from ‘reserved’ field |
| 8.23.23 | YES | removed ip address field from sequence_gap message and replaced and added market feed id field |

| | | |
|----------|-----|--|
| 9.24.23 | YES | updated/fixed enumeration table for cross_indicator |
| 11.07.23 | YES | <ul style="list-style-type: none"> • added trading session indicator • added trading_session message • added trading session indicator field to order_add message |
| 11.14.23 | NO | <ul style="list-style-type: none"> • added volume_update_indicator • added volume update indicator to trade message using first of four reserved bytes |
| 11.22.23 | NO | <ul style="list-style-type: none"> • added participant id miax saphire |
| 2.5.24 | YES | updated market feed id (multicast_id) from 32 bits to 64 bits affected messages: <ul style="list-style-type: none"> • option description • symbol description • sequence gap |
| 2.8.24 | YES | Updated option_description to use plain text OSI name rather than itemize each field of the OSI |
| 2.13.24 | YES | reduced size of option description and symbol description by four bytes by removing them from the reserved field. marked multicast id field in sequence gap as reserved (made obsolete) |
| 3.11.24 | YES | expanded sequence gap message by 4 bytes to accommodate 8 byte multicast id |
| 5.6.24 | YES | Added book clear message |
| 7.15.24 | NO | Added two values to trade through exemption indicator: not_applicable and exempt_611 |
| 7.15.24 | NO | Added “regular sale” to sro trade indicator |
| 9.23.24 | NO | Fixed documentation error on field offset in block header |
| 2.20.25 | NO | Added order modify message |

multicast structure:

- sequence number
- multicast source identifier

data types:

- integers
- enumerations
- timestamps
- prices
- book identifier

multicast message structure:

- block header
- message header
- message type

messages:

- Quote Messages
 - ask
 - bid
 - top of book
 - order add
 - order cancel
 - order delete
 - order replace
 - order modify
- Trade messages
 - trade
 - trade cancel
 - order executed
- Status messages
 - imbalance
 - trading status
 - short sale restriction status
 - price band
 - trading session
- Administrative Messages
 - heart beat
 - start multicast
 - end multicast
 - option description
 - symbol description
 - start of day summary
 - end of day summary
 - sequence gap
 - book clear
- Enumerations:
 - tick size
 - buy sell indicator
 - cross indicator
 - trading status indicator
 - gap origin indicator
 - short sale restriction indicator
 - price status indicator
 - participant id
 - settlement type indicator
 - trade through exemption indicator
 - limit up/limit down indicator
 - extended hours indicator
 - sro trade indicator
 - NBBO status indicator
 - transmission status indicator
 - trade high/low/last/open indicator
 - quote condition indicator
 - trading session indicator
 - volume update indicator

The Citrius Multicast Protocol is a managed market data feed produced by the Lime FinTech Citrius v2.0 market data solution.

The Citrius 2.0 protocol is multicast UDP based. Messages within the protocol inform the consumers of that multicast about the availability of books (osi for options, symbols for equities, etc) as well as events which update the state of those books (top of book, trade, cancel trade, trading status, etc).

Endian: All integer values are represented in big endian format.

Sequence Numbers:

Each multicast datagram will contain exactly one block of multicast messages and is uniquely identified by a sequence number. This sequence number will increase by the number of messages contained within each multicast datagram. Gaps in the multicast feed are therefore detected via missing sequence numbers.

When a multicast stream's block sequence number reaches the maximum 64 bit unsigned integer value of 18446744073709551615 it will wrap to the next expected sequence number which will be 0.

Multicast Source Identifiers:

Each block header contains a source identifier field which will remain constant for all blocks which originate from the same instance of the same Citrius multicast server. The source identifier is the number of milliseconds since midnight at which time the particular instance of the Citrius multicast server was created. Therefore, failover/restarts of Citrius multicast servers can be detected by a change in the source identifier field. The sequence number which appears with each unique source identifier will be reset to start at 1. In the event that a multicast stream momentarily contains datagrams with varying source identifier values only those with the larger of the two source identifiers should be considered valid as this field represents the time when the originating instance of a Citrius multicast server was started and, therefore, datagrams with lower source identifier field should be regarded as 'stale' and as having originated from an instance which has been superseded by a more recent instance.

Data Types:

Integer types are unsigned unless otherwise specified. The size of integer fields is as follows:

| Name: | Size: | Range: |
|------------|---------|-----------------------------------|
| integer_8 | 8 bits | [0 -> 255] |
| integer_16 | 16 bits | [0 -> 65,535] |
| integer_32 | 32 bits | [0 -> 4,294,967,295] |
| integer_64 | 64 bits | [0 -> 18,446,744,073,709,551,615] |

Enumerated values are unsigned integer fields. The size of enumerated fields is as follows:

| Name: | Size: | Range: |
|---------|---------|---------------|
| enum_8 | 8 bits | [0 -> 255] |
| enum_16 | 16 bits | [0 -> 65,535] |

Timestamps:

Timestamps are 8 bytes in size (integer_64) and represent the nanosecond since epoch.

Prices:

Price fields are 4 bytes (integer_32) or 8 bytes (integer_64) in size and are followed by a one byte field indicating the number of decimal places in the primary Integer price field.

| Name: | Size: | Range: |
|----------|------------|-----------------------------------|
| price_32 | integer_32 | [0 -> 4,294,967,295] |
| price_64 | integer_64 | [0 -> 18,446,744,073,709,551,615] |

| | |
|--|--|
| example of price_32 structure: struct price_32 { integer_32 mantissa_ integer_8 exponent_ }; | example of price_64 structure: struct price_64 { integer_64 mantissa_ integer_8 exponent_ }; |
|--|--|

Book Identifiers:

Each unique symbol or OSI is referenced by a unique 64 bit (integer_64) symbol mapping. See the CitrusBookServer document for details about acquiring symbol mapping values.

Multicast Message Block and Message Structure:

All Citrius multicast messages appear in blocks of one or more messages per datagram and are preceded by a single block header structure.

| block header | | |
|----------------------|--|--------|
| Field type | Field Description | Offset |
| integer_8 | Citrius multicast version. v2.4.a = 4 | 0 |
| integer_16 | block size in bytes including block header | 1 |
| source identifier | identifies the specific Citrius multicast producer | 3 |
| sequence number | sequence number of first message in current packet | 7 |
| integer_8 | total messages in the block | 15 |
| timestamp | Citrius multicast server timestamp (Citrius tx time) | 16 |
| integer_16 | packet checksum excluding this checksum field | 24 |
| transmission_status | transmission status | 26 |
| integer_8 | reserved | 27 |
| Total Size: 28 Bytes | | |

Each Citrius multicast message block will contain one or more Citrius multicast messages. Each Citrius message begins with the standard message header structure:

| message header | | |
|--------------------|---|--------|
| Field type | Field Description | Offset |
| message type | indicates the type of message which follows | 0 |
| integer_16 | message size | 1 |
| Total Size: 3 Byte | | |

Each unique Citrius multicast message is specified by the message header's message_type field which is an enumeration as follows:

| Message Type | Value | Feed Type |
|--------------------------------|-------|--|
| <i>[undefined/reserved]</i> | 0 | <i>none</i> |
| <i>reserved</i> | 255 | <i>none</i> |
| Quote Messages | | |
| bid | 1 | <i>[deprecated]</i> |
| ask | 2 | <i>[deprecated]</i> |
| top of book | 28 | BBO, Consolidated BBO, Consolidated NBBO |
| order add | 22 | Depth of Book |
| order cancel | 23 | Depth of Book |
| order replace | 24 | Depth of Book |
| order delete | 25 | Depth of Book |
| Trade Messages | | |
| trade | 13 | BBO, Consolidated BBO, Consolidated NBBO |
| order executed | 26 | Depth of Book |
| trade cancel | 14 | Depth of Book |
| Status Messages | | |
| imbalance | 21 | any |
| trading status | 30 | any |
| short sale restriction status | 31 | any |
| price band | 29 | any |
| trading session | 33 | any |
| Administrative Messages | | |
| option description | 3 | options feeds |
| symbol description | 27 | equities feeds |
| start multicast | 5 | any |
| end multicast | 6 | any |
| heart beat | 7 | any |
| sequence gap | 36 | any |
| start of day summary | 99 | any |
| end of day summary | 100 | any |
| book clear | 37 | any |
| Total Size: 1 Byte | | |

Quote messages:

| ask <i>[deprecated]</i> | | |
|--------------------------------|-------------------------------------|--------|
| Field type | Field Description | Offset |
| message header | message type = 2, message size = 29 | 0 |
| book id | symbol mapping | 3 |
| participant id | | 11 |
| integer_32 | quantity | 12 |
| price_32 | price mantissa | 16 |
| integer_8 | price exponent | 20 |
| timestamp | exchange timestamp | 21 |
| Total Size: 29 Bytes | | |

Ask messages represent a new offer price for the book associated with the message's book id field.

| bid <i>[deprecated]</i> | | |
|--------------------------------|-------------------------------------|--------|
| Field type | Field Description | Offset |
| message header | message type = 1, message size = 26 | 0 |
| book id | symbol mapping | 3 |
| participant id | participant id | 11 |
| integer_32 | quantity | 12 |
| price_32 | price mantissa | 16 |
| integer_8 | price exponent | 20 |
| timestamp | exchange timestamp | 21 |
| Total Size: 26 Bytes | | |

Bid messages represent a new bid price for the book associated with the message's book id field.

| top of book | | |
|---|--|--------|
| Field type | Field Description | Offset |
| message header | message type = 28, message size = 65+ | 0 |
| book id | symbol mapping | 3 |
| NBBO status indicator | nbbo status | 11 |
| participant id | bid participant | 12 |
| char[4] | bid mpid (<i>relevant for some participant ids, otherwise empty</i>) | 13 |
| integer_32 | bid quantity | 17 |
| price_32 | bid price mantissa | 21 |
| integer_8 | bid price exponent | 25 |
| participant id | ask participant | 26 |
| char[4] | ask mpid (<i>relevant for some participant ids, otherwise empty</i>) | 27 |
| integer_32 | ask quantity | 31 |
| price_32 | ask price mantissa | 35 |
| integer_8 | ask price exponent | 39 |
| timestamp | exchange tx timestamp | 40 |
| timestamp | citrius rx timestamp | 48 |
| integer_64 | exchange order id | 56 |
| quote condition indicator | quote condition | 64 |
| top of book appendage | [optional NBBO appendages] | 65+ |
| Total Size: 65 Bytes + (15 Bytes per appendage) | | |

| top of book appendage | | |
|---------------------------|--|--------|
| Field type | Field Description | Offset |
| participant id | participant id | 57/72 |
| char[4] | mpid (<i>relevant for some participant ids, otherwise empty</i>) | 58/73 |
| integer_32 | quantity | 62/77 |
| price_32 | NBBO price mantissa | 66/81 |
| integer_8 | NBBO price exponent | 70/85 |
| quote condition indicator | quote condition | 71/86 |
| Total Size: 15 Bytes | | |

| order add | | |
|--------------------|--------------------------------------|--------|
| Field type | Field Description | Offset |
| message header | message type = 22, message size = 50 | 0 |
| book id | symbol mapping | 3 |
| integer_64 | Exchange order reference number | 11 |
| buy sell indicator | side | 19 |
| integer_32 | shares | 20 |
| price_32 | price mantissa | 24 |
| integer_8 | price exponent | 28 |
| char[4] | mpid | 29 |

| | | |
|---------------------------|-----------------------|----|
| timestamp | exchange tx timestamp | 33 |
| timestamp | citrius rx timestamp | 41 |
| trading session indicator | trading session | 49 |
| Total Size: 50 Bytes | | |

| order cancel | | |
|----------------------|--------------------------------------|--------|
| Field type | Field Description | Offset |
| message header | message type = 23, message size = 39 | 0 |
| book id | symbol mapping | 3 |
| integer_64 | exchange order reference number | 11 |
| integer_32 | shares | 19 |
| timestamp | exchange tx timestamp | 23 |
| timestamp | citrius rx timestamp | 31 |
| Total Size: 39 Bytes | | |

| order delete | | |
|----------------------|--------------------------------------|--------|
| Field type | Field Description | Offset |
| message header | message type = 24, message size = 35 | 0 |
| book id | symbol mapping | 3 |
| integer_64 | exchange order reference number | 11 |
| timestamp | exchange tx timestamp | 19 |
| timestamp | citrius rx timestamp | 27 |
| Total Size: 35 Bytes | | |

| order replace | | |
|----------------------|--------------------------------------|--------|
| Field type | Field Description | Offset |
| message header | message type = 26, message size = 52 | 0 |
| book id | symbol mapping | 3 |
| integer_64 | original order reference number | 11 |
| integer_64 | new order reference number | 19 |
| integer_32 | quantity | 27 |
| price_32 | price mantissa | 31 |
| integer_8 | price exponent | 35 |
| timestamp | exchange tx timestamp | 36 |
| timestamp | citrius rx timestamp | 44 |
| Total Size: 52 Bytes | | |

| order modify | | |
|----------------|--------------------------------------|--------|
| Field type | Field Description | Offset |
| message header | message type = 38, message size = 52 | 0 |
| book id | symbol mapping | 3 |
| integer_64 | original order reference number | 11 |

| | | |
|----------------------|-----------------------|----|
| integer_32 | quantity | 19 |
| price_32 | price mantissa | 23 |
| integer_8 | price exponent | 27 |
| timestamp | exchange tx timestamp | 28 |
| timestamp | citrius rx timestamp | 36 |
| integer_64 | [reserved] | 44 |
| Total Size: 52 Bytes | | |

Trade messages:

| trade | | |
|------------------------------------|--------------------------------------|--------|
| Field type | Field Description | Offset |
| message header | message type = 13, message size = 55 | 0 |
| book id | symbol mapping | 3 |
| participant id | volume | 11 |
| integer_32 | shares | 12 |
| price_32 | price mantissa | 16 |
| integer_8 | price exponent | 20 |
| timestamp | exchange tx timestamp | 21 |
| timestamp | citrius rx timestamp | 29 |
| integer_64 | exchange trade id | 37 |
| settlement type indicator | settlement type | 45 |
| trade through exemption indicator | trade through exemption | 46 |
| extended hours indicator | extended hours | 47 |
| sro trade indicator | sro trade detail | 48 |
| integer_8 | trade specific properties | 49 |
| volume update indicator | volume update flags | 50 |
| char[3] | reserved | 51 |
| trade high/low/last/open indicator | high/low/open/last flags | 54 |
| Total size: 55 Bytes | | |

Trade messages represent a new trade for the book associated with the message's book id field.

The trade specific properties field has a variable meaning depending upon the origin of the original exchange trade message:

- If the original information for the trade originated with OPRA then this field maps to the OPRA message type field. Consult the current *"Options Price Reporting Authority (OPRA) – Binary Data Recipient Interface Specification"* documentation for *"Equity and Index Last Sale (message category 'a')"* for more information.

If the original information for the trade originated with TotalViewItch then this field is ignored if the original message is of type (Trade Non-Cross). This field carries the 'cross type' value if the original message is of type (Cross Trade).

| trade cancel | | |
|----------------------|--------------------------------------|--------|
| Field type | Field Description | Offset |
| message header | message type = 14, message size = 49 | 0 |
| book id | symbol mapping | 3 |
| participant id | | 11 |
| integer_32 | volume | 12 |
| timestamp | exchange tx timestamp | 16 |
| timestamp | citrius rx timestamp | 24 |
| integer_64 | exchange trade id | 32 |
| char[4] | reserved | 40 |
| integer_8 | trade specific properties | 44 |
| char[4] | reserved | 45 |
| Total Size: 49 Bytes | | |

Trade cancel messages represent a new cancel trade for the book associated with the message's book id field.

The trade specific properties field has a variable meaning depending upon the origin of the original exchange trade message:

- If the original information for the trade originated with OPRA then this field maps to the OPRA message type field. Consult the current *"Options Price Reporting Authority (OPRA) – Binary Data Recipient Interface Specification"* documentation for *"Equity and Index Last Sale (message category 'a')"* for more information.
-

| order executed | | |
|----------------------|--------------------------------------|--------|
| Field type | Field Description | Offset |
| message header | message type = 25, message size = 52 | 0 |
| book id | symbol mapping | 3 |
| integer_64 | exchange order reference number | 11 |
| integer_64 | exchange trade id | 19 |
| integer_32 | shares | 27 |
| price_32 | price mantissa | 31 |
| integer_8 | price exponent | 35 |
| timestamp | exchange tx timestamp | 36 |
| timestamp | citrius rx timestamp | 44 |
| Total Size: 52 Bytes | | |

Status Messages:

| imbalance | | |
|----------------------|--------------------------------------|--------|
| Field type | Field Description | Offset |
| message header | message type = 21, message size = 53 | 0 |
| book id | symbol mapping | 3 |
| participant id | | 11 |
| buy sell indicator | side | 12 |
| cross indicator | type | 13 |
| price_32 | reference price mantissa | 14 |
| integer_8 | reference price exponent | 18 |
| integer_32 | paired shares | 19 |
| timestamp | exchange tx timestamp | 23 |
| timestamp | citrius rx timestamp | 31 |
| integer_32 | imbalance shares | 39 |
| price_32 | near price mantissa | 43 |
| integer_8 | near price exponent | 47 |
| price_32 | far price mantissa | 48 |
| integer_8 | far price exponent | 52 |
| Total Size: 53 Bytes | | |

| trading status | | |
|--------------------------|--------------------------------------|--------|
| Field type | Field Description | Offset |
| message header | message type = 30, message size = 29 | 0 |
| book id | symbol mapping | 3 |
| participant id | | 11 |
| trading status indicator | trading status | 12 |
| timestamp | exchange tx timestamp | 13 |
| timestamp | citrius rx timestamp | 21 |
| Total size: 29 Bytes | | |

| short sale restriction status | | |
|----------------------------------|--------------------------------------|--------|
| Field type | Field Description | Offset |
| message header | message type = 31, message size = 29 | 0 |
| book id | symbol mapping | 3 |
| participant id | | 11 |
| short sale restriction indicator | status | 12 |
| timestamp | exchange tx timestamp | 13 |
| timestamp | citrius rx timestamp | 21 |
| Total size: 29 Bytes | | |

| price band | | |
|----------------|--------------------------------------|--------|
| Field type | Field Description | Offset |
| message header | message type = 29, message size = 39 | 0 |
| book id | symbol mapping | 3 |

| | | |
|-------------------------------|-----------------------|----|
| participant id | | 11 |
| limit up limit down indicator | status | 12 |
| price_32 | upper price mantissa | 13 |
| integer_8 | upper price exponent | 17 |
| price_32 | lower price mantissa | 18 |
| integer_8 | lower price exponent | 22 |
| timestamp | exchange tx timestamp | 23 |
| timestamp | citrius rx timestamp | 31 |
| Total Size: 39 Bytes | | |

| trading session | | |
|---------------------------|--------------------------------------|--------|
| Field type | Field Description | Offset |
| message header | message type = 33, message size = 28 | 0 |
| book id | symbol mapping | 3 |
| trading session indicator | current trading session | 11 |
| timestamp | exchange tx timestamp | 12 |
| timestamp | citrius rx timestamp | 20 |
| Total size: 28 Bytes | | |

Administrative:

| heart beat | | |
|--------------------|------------------------------------|--------|
| Field type | Field Description | Offset |
| message header | message type = 7, message size = 3 | 0 |
| Total Size: 3 Byte | | |

Heart beat messages are sent every 10 seconds if the multicast feed is idle for 10 seconds or more. heart beat messages are also emitted prior to the start multicast message until at least 8192 heart beat messages are emitted and for a minimum of 1 millisecond. Heart beat messages do not cause an increment in the multicast sequence number and always appear as the only message in the packet. The packet shall be treated as “unsequenced”. See `transmission_status_indicator`.

| start multicast | | |
|------------------------|------------------------------------|--------|
| Field type | Field Description | Offset |
| message header | message type = 5, message size = 3 | 0 |
| Total Size: 3 Byte | | |

Each instance of a Citrius Multicast Server, at start up, will produce exactly one start multicast multicast message prior to any other multicast messages with the exception of an arbitrary number of heart beat messages. The start multicast message should be used to determine the starting sequence number for valid messages for the specified source identifier.

Note: Each start multicast message for any given multicast feed should be treated as an indicator that the source identifier has changed which implies that the producer of the multicast has changed. This is expected behavior at start of day as well as in the event of a server restart.

| end multicast | | |
|----------------------|------------------------------------|--------|
| Field type | Field Description | Offset |
| message header | message type = 6, message size = 3 | 0 |
| Total Size: 3 Byte | | |

The end multicast message shall appear once as the final valid message produced by a Citrius Multicast Server which has gracefully terminated. It has no other significance.

| option description | | |
|----------------------|--------------------------------------|--------|
| Field type | Field Description | Offset |
| message header | message type = 3, message size = 57 | 0 |
| char[32] | symbol name | 3 |
| book id | symbol mapping | 35 |
| integer_32 | open interest | 43 |
| tick size | tick size (not yet implemented) | 47 |
| integer_64 | unique id of exchange multicast feed | 48 |
| char | reserved | 56 |
| Total size: 61 Bytes | | |

The option description message appears prior to the first of any messages which reference the given option. The message contains the fields necessary to construct the OSI symbol for the specific option as well as the unique 64 bit book id that shall be used by all subsequent messages in order to reference the specific option.*

** tick size is not currently implemented*

| symbol description | | |
|----------------------|--------------------------------------|--------|
| Field type | Field Description | Offset |
| message header | message type = 27, message size = 62 | 0 |
| char[32] | symbol name | 3 |
| book id | symbol mapping | 35 |
| integer_64 | unique id for exchange feed | 43 |
| char[11] | reserved | 51 |
| Total size: 62 Bytes | | |

The symbol description message appears prior to the first of any messages which reference the given symbol. The message contains the fields necessary to map the symbol to the unique 64 bit book id that shall be used by all subsequent messages in order to reference the specific symbol.

| start of day summary | | |
|----------------------|--------------------------------------|--------|
| Field type | Field Description | Offset |
| message header | message type = 99, message size = 57 | 0 |
| book id | symbol mapping | 3 |
| participant id | | 11 |
| price_32 | previous close price mantissa | 12 |
| integer_8 | previous close price exponent | 16 |
| timestamp | previous close date | 17 |
| timestamp | exchange tx timestamp | 25 |
| timestamp | citrius rx timestamp | 33 |
| char[16] | reserved | 41 |
| Total size: 57 Bytes | | |

The start of day summary message shall be broadcast for each symbol or OSI which will appear on the specific multicast.

| end of day summary | | |
|----------------------|---------------------------------------|--------|
| Field type | Field Description | Offset |
| message header | message type = 100, message size = 67 | 0 |
| book id | symbol mapping | 13 |
| participant id | | 11 |
| price_32 | low price mantissa | 12 |
| integer_8 | low price exponent | 16 |
| price_32 | high price mantissa | 17 |
| integer_8 | high price exponent | 21 |
| price_32 | last trade price mantissa | 22 |
| integer_8 | last trade price exponent | 26 |
| integer_64 | total volume | 27 |
| timestamp | exchange tx timestamp | 35 |
| timestamp | citrius rx timestamp | 43 |
| char[16] | reserved | 51 |
| Total size: 67 Bytes | | |

The end of day summary message shall be broadcast for each symbol or OSI which appeared on the specific multicast feed on that given day.

| sequence gap | | |
|----------------------|--------------------------------------|--------|
| Field type | Field Description | Offset |
| message header | message type = 36, message size = 28 | 0 |
| sequence number | first sequence number in gap | 3 |
| integer_64 | number of messages in gap | 11 |
| gap origin indicator | origin of gap (exchange, citrius) | 19 |
| integer_64 | multicast id | 20 |
| Total Size: 28 Bytes | | |

Sequence gap messages are used to convey data loss on a particular multicast feed. The gap origin indicator can be used to determine where the loss appeared.

| book clear | | |
|----------------|--------------------------------------|----------------------|
| Field type | Field Description | Offset |
| message header | message type = 37, message size = 27 | 0 |
| book id | symbol mapping | 3 |
| timestamp | exchange tx timestamp | 11 |
| timestamp | citrius rx timestamp | 19 |
| | | Total Size: 27 Bytes |

book clear message indicates that the book should be invalidated.

Enumerations:

Various messages contain fields which reference enumerations. These enumerations are as follows:

| tick size | enum_8 |
|---------------------------|--------|
| <i>undefined</i> | 0 |
| penny always | 1 |
| penny until 3 then nickel | 2 |
| nickel until 3 then dime | 3 |
| milray until 1 then penny | 4 |
| Total Size: 1 Byte | |

| buy sell indicator | enum_8 |
|--------------------|--------|
| <i>undefined</i> | 0 |
| unknown | 1 |
| buy | 2 |
| sell | 3 |
| both | 4 |
| none | 5 |
| Total Size: 1 Byte | |

| cross indicator | enum_8 |
|--------------------|--------|
| <i>undefined</i> | 0 |
| unknown | 1 |
| open | 2 |
| market | 3 |
| halt | 4 |
| close | 5 |
| none | 6 |
| extended close | 7 |
| Total Size: 1 Byte | |

| trading status indicator | enum_8 |
|--------------------------------|--------|
| <i>undefined</i> | 0 |
| trading halted | 1 |
| trading paused | 2 |
| trading | 3 |
| quotes only | 4 |
| unknown | 5 |
| revoked | 6 |
| deleted | 7 |
| security status not applicable | 8 |
| opening delay | 9 |
| no open no resume | 10 |
| price indication | 11 |
| trading range indication | 12 |
| market imbalance buy | 13 |
| market imbalance sell | 14 |
| market on close imbalance buy | 15 |
| market on close imbalance sell | 16 |
| reserved | 17 |
| no market imbalance | 18 |
| no market on close imbalance | 19 |
| Total Size: 1 Byte | |

| gap origin indicator | enum_8 |
|--|--------|
| Description | Value |
| <i>undefined</i> | 0 |
| gap appeared between exchange and Citrius multicast server | 1 |
| gap appeared between Citrius multicast server and Citrius proxy (or client) | 2 |
| gap appeared between Citrius proxy and client application (client too slow) | 3 |
| Total Size: 1 Byte | |

| short sale restriction indicator | enum_8 |
|--------------------------------------|--------|
| Description | Value |
| <i>undefined</i> | 0 |
| short sale restriction activated | 1 |
| short sale restriction in effect | 2 |
| short sale restriction continued | 3 |
| short sale restriction not in effect | 4 |
| short sale restriction deactivated | 5 |
| unknown | 6 |
| Total Size: 1 Byte | |

| price status indicator | enum_8 |
|------------------------|--------|
| Description | Value |
| <i>undefined</i> | 0 |
| high | 1 |
| low | 2 |
| last | 4 |
| open | 8 |
| close | 16 |
| canceled | 32 |
| corrected | 64 |
| none | 128 |
| Total Size: 1 Byte | |

| participant id | enum_8 |
|---|--------|
| Description | Value |
| <i>undefined</i> | 0 |
| unknown | 1 |
| nyse american | 2 |
| nyse national | 3 |
| nyse chicago | 4 |
| nyse | 5 |
| nyse arca | 6 |
| nasdaq gemx | 7 |
| <i>reserved/deprecated</i> | 8 |
| nasdaq mrx | 9 |
| nasdaq omx psx | 10 |
| nasdaq omx bx | 11 |
| nasdaq | 12 |
| nasdaq options market | 13 |
| nasdaq bx options | 14 |
| <i>reserved/deprecated</i> | 15 |
| finra alternative display facility | 16 |
| international securities exchange | 17 |
| long term stock exchange | 18 |
| members exchange | 19 |
| investors exchange | 20 |
| boston options exchange | 21 |
| miami international securities exchange | 22 |
| miax pearl | 23 |
| miax emerald | 24 |
| otc | 25 |
| cboe | 26 |
| cboe edga | 27 |
| cboe edgx | 28 |
| cboe byx | 29 |
| cboe bzx | 30 |
| cboe options exchange | 31 |
| cboe edgx options | 32 |
| cboe c2 options exchange | 33 |
| cboe bzx options exchange | 34 |
| consolidated quotation system | 35 |
| options price reporting authority | 36 |
| market independent SIP | 37 |
| miax sapphire | 38 |
| Total Size: 1 Byte | |

| settlement type indicator | enum_8 |
|---------------------------|--------|
| Description | Value |
| <i>undefined</i> | 0 |
| regular | 1 |
| cash | 2 |
| next day | 3 |
| seller | 4 |
| yellow flag | 5 |
| Total Size: 1 Byte | |

| trade through exemption indicator | enum_8 |
|-----------------------------------|--------|
| Description | Value |
| <i>undefined</i> | 0 |
| no reason | 1 |
| inter market sweep | 2 |
| market center open | 3 |
| derivatively priced | 4 |
| reopening | 5 |
| market center close | 6 |
| qualified contingent | 7 |
| reserved | 8 |
| corrected consolidated close | 9 |
| exempt rule 611 | 10 |
| not applicable | 11 |
| Total Size: 1 Byte | |

| limit up limit down indicator | enum_8 |
|-------------------------------|--------|
| Description | Value |
| <i>undefined</i> | 0 |
| unknown | 1 |
| price band | 2 |
| republished price band | 3 |
| not applicable | 4 |
| Total Size: 1 Byte | |

| extended hours indicator | enum_8 |
|---|--------|
| Description | Value |
| <i>undefined</i> | 0 |
| not extended hours | 1 |
| form t | 2 |
| sold last | 3 |
| sold out of sequence | 4 |
| extended trading hours sold out of sequence | 5 |
| Total Size: 1 Byte | |

| option type | char |
|--------------------|-------|
| Description | Value |
| <i>undefined</i> | 0 |
| put | P |
| call | C |
| Total Size: 1 Byte | |

| sro trade indicator | enum_8 |
|-----------------------|--------|
| Description | Value |
| <i>undefined</i> | 0 |
| no sro required | 1 |
| average price | 2 |
| automatic execution | 3 |
| price variation | 4 |
| odd lot | 5 |
| rule 127 | 6 |
| rule 155 | 7 |
| market center close | 8 |
| prior reference price | 9 |
| market center open | 10 |
| contingent | 11 |
| cross trade | 12 |
| stopped stock | 13 |
| acquisition | 14 |
| bunched | 15 |
| distribution | 16 |
| placeholder | 17 |
| bunched sold trade | 18 |
| split trade | 19 |
| Regular sale | 20 |
| Total Size: 1 Byte | |

| NBBO status indicator | enum_8 |
|------------------------|----------|
| Description | Bit flag |
| <i>undefined</i> | 0 |
| no nbbo bid | 0x01 |
| no change to nbbo bid | 0x02 |
| is nbbo bid | 0x04 |
| has nbbo bid appendage | 0x08 |
| no nbbo ask | 0x10 |
| no change to nbbo ask | 0x20 |
| is nbbo ask | 0x40 |
| has nbbo ask appendage | 0x80 |
| Total Size: 1 Byte | |

NBBO status indicator is used to indicate if top of book messages contain NBBO bid and/or ask information and if such information is defined in top of book appendages which immediately follow top of book messages. If the NBBO status indicator is 0x08 or 0x80 then there will be exactly one such appendage message. If the NBBO status indicator is 0x88 then there will be exactly two such appendages with the bid appendage preceding the offer appendage.

| transmission_status_indicator | enum_8 |
|-------------------------------|--------|
| Description | Value |
| original transmission | 0 |
| retransmission | 1 |
| unsequenced transmission | 2 |
| Total Size: 1 Byte | |

transmission_status_indicator is used to indicate how a packet is to be treated.

original transmission indicates the packet contains original multicast information and should affect the multicast's sequence number.

retransmission indicates that the packet is a copy of an original and therefore does not affect the original multicast's sequence number.

unsequenced transmissions are packets which contain messages which do not affect the multicast's sequence number. These message types DO NOT increment the multicast sequence number and are conveyed in a packet which contains ONLY that message.

| trade high/low/last/open indicator | enum_8 |
|------------------------------------|---|
| Description | Bits ('-' is used to indicate bits not related to value) |
| participant none | 0x-0 |
| participant high | 0x-2 |
| participant low | 0x-1 |
| participant last | 0x-8 |
| participant high/last | 0x-a |
| participant low/last | 0x-9 |
| participant open | 0x-4 |
| participant open/high | 0x-6 |
| participant open/low | 0x-5 |
| participant open/high/low/last | 0x-f |
| participant open/last | 0x-c |
| participant open/high/low | 0x-7 |
| participant open/high/last | 0x-e |
| participant open/low/last | 0x-d |
| participant high/low | 0x-3 |
| participant high/low/last | 0x-b |
| consolidated none | 0x0- |
| consolidated high | 0x2- |
| consolidated low | 0x1- |
| consolidated last | 0x8- |
| consolidated high/last | 0xa- |
| consolidated low/last | 0x9- |
| consolidated high/low/last | 0xb- |
| consolidated high/low | 0x3- |
| Total Size: 1 Byte | |

Trade high/low/last/open indicator is used to indicate if trade messages are the high, low, last and/or open price for the day. The lower four bits are used to represent this status with the following flags:

| Description | Bit flag |
|-------------|----------|
| none | 0x00 |
| low | 0x01 |
| high | 0x02 |
| open | 0x04 |
| last | 0x08 |

If the feed in question is a consolidated feed then the upper four bits contain the same flags but represent the state for the consolidated feed.

| quote condition indicator | enum_8 |
|--|--------|
| Description | Value |
| <i>undefined</i> | 0x00 |
| not applicable | 0x01 |
| news dissemination | 0x02 |
| trading range indication | 0x03 |
| order imbalance | 0x04 |
| luld trading pause | 0x05 |
| new pending | 0x06 |
| resume | 0x07 |
| equipment changeover | 0x08 |
| sub penny trading | 0x09 |
| no open no resume | 0x0A |
| luld price band | 0x0B |
| mwcb 1 breach | 0x8C |
| mwcb 2 breach | 0x8D |
| mwcb 3 breach | 0x8E |
| republished luld price band | 0x0F |
| slow offer | 0x90 |
| slow bid | 0x91 |
| closing | 0x12 |
| slow offer lrp or gap | 0x93 |
| slow bid lrp or gap | 0x94 |
| slow bid and offer | 0x95 |
| closed market maker | 0x16 |
| non firm | 0x17 |
| opening quote | 0x98 |
| regular | 0x99 |
| slow bid and offer lrp or gap | 0x1A |
| slow bid and offer list | 0x9B |
| on demand intra day auction | 0x1C |
| manual ask automated bid | 0x9D |
| manual bid automated ask | 0x9E |
| fast trading | 0x1F |
| manual bid and ask | 0xA0 |
| open quote automated | 0xA1 |
| regular two sided open quote automated | 0xA2 |
| manual bid and ask non firm | 0x23 |
| order influx | 0x24 |
| automated bid no offer or automated offer no bid | 0xA5 |
| additional information requested | 0x26 |
| regulatory concern | 0x27 |

| | |
|---|------|
| merge effective | 0x28 |
| etf component prices not available | 0x29 |
| corporate action | 0x2A |
| new security offering | 0x2B |
| interday indicative value not available | 0x2C |
| Total Size: 1 Byte | |

Quote condition indicator uses the most significant bit (0x80) to indicate an NBBO qualified quote.

| trading session indicator | enum_8 |
|---------------------------|--------|
| Description | Value |
| <i>undefined</i> | 0x00 |
| morning | 0x01 |
| normal | 0x02 |
| morning and normal | 0x03 |
| late | 0x04 |
| normal and late | 0x06 |
| morning, normal and late | 0x07 |
| Total Size: 1 Byte | |

| volume update indicator | enum_8 |
|-------------------------|--------|
| Description | Value |
| <i>undefined</i> | 0x00 |
| volume update | 0x01 |
| no volume update | 0x02 |
| unknown | 0x03 |
| Total Size: 1 Byte | |

The volume update indicator determines if a trade's shares should or should not be used to update the total volume of the book associated with that sale.