US Options
Multicast Top Specification

Version 1.2.1

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Contents

1 Introduction

1.1 Overview

Note that this specification will be the standard Multicast Top specification to be used for the BZX Options, Cboe Options ("C1"), C2 Options and EDGX Options Exchange platforms. This specification is for the Simple book only, refer to the US Options Complex Multicast Top Specification for Complex book information.

Options participants may use the Multicast Top protocol to receive real-time top of book quotations direct from each exchange. Market data received through Multicast Top is less timely than receiving the same data from the Multicast PITCH Depth of Book feed. The Top protocol offers a significant reduction in the number of events and number of bytes of application data sent, compared to the US Options Multicast PITCH protocol.

The quotations received via Multicast Top provide an aggregated size and do not indicate the size or number of individual orders at the best bid or ask. The Multicast Top protocol also provides last trade price and size and cumulative volume data.

Complete depth of book market data can be received via the US Options Multicast PITCH protocol.

Top cannot be used to enter orders. For order entry, refer to the appropriate US Options FIX or BOE Specification.

All versions of the Multicast Top feed will be Gig-shaped (maximum 1 Gb/s) and will be available from one or both of Cboe's datacenters. Participants may choose to take one or more of the following Multicast Top feeds depending on their location and connectivity to Cboe.

Multicast Top Feed Descriptions:

Exchange	Shaping	Served From Data Center (Primary/Secondary)	Multicast Feed ID
BZX Options	Gig	Primary	OAT
BZX Options	Gig	Primary	OBT
BZX Options	Gig	Secondary	OET
C1 Options	Gig	Primary	CAT
C1 Options	Gig	Primary	CBT
C1 Options	Gig	Secondary	CET
C2 Options	Gig	Primary	WAT
C2 Options	Gig	Primary	WBT
C2 Options	Gig	Secondary	WET
EDGX Options	Gig	Primary	EAT
EDGX Options	Gig	Primary	EBT
EDGX Options	Gig	Secondary	EET

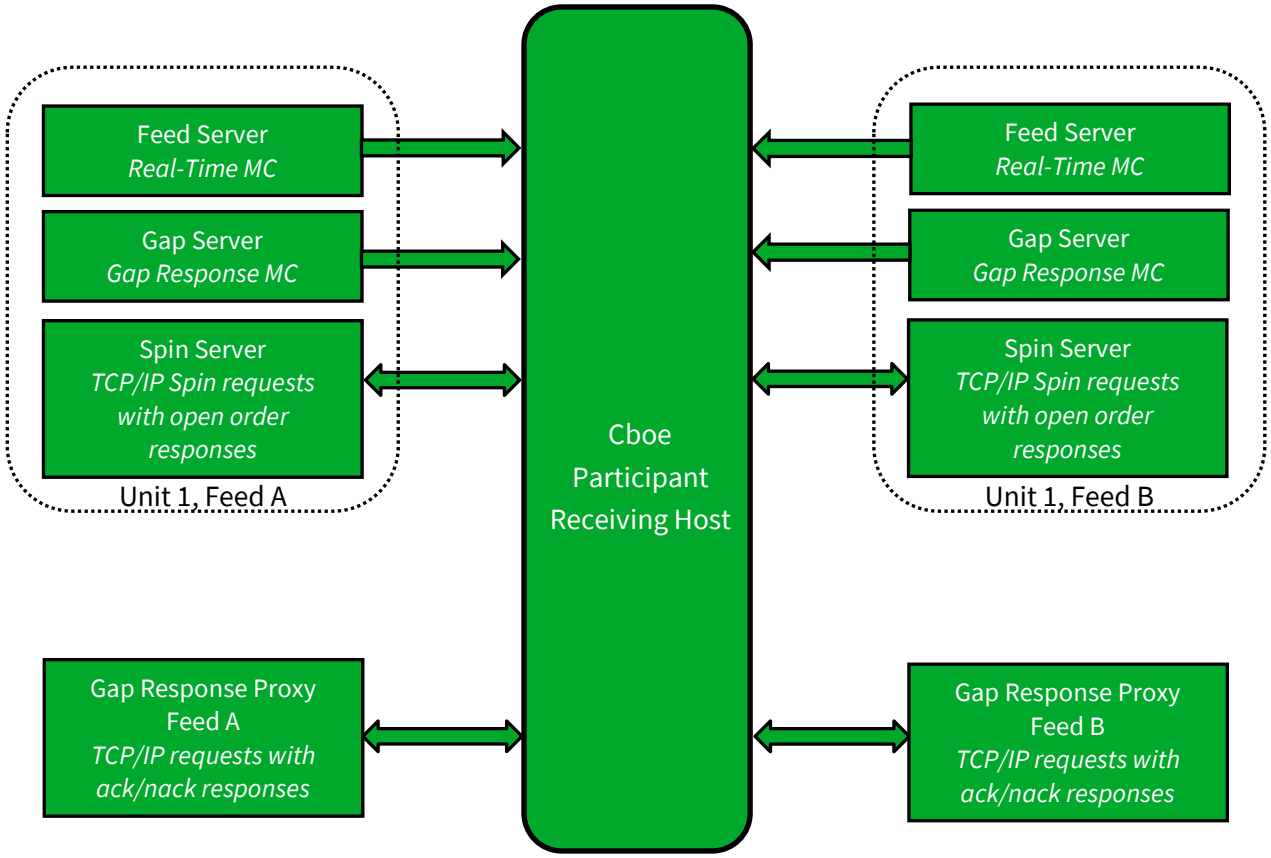
1.2 Feed Connectivity Requirements

Gig-Shaped feeds are available to participants who meet the minimum bandwidth requirements to Cboe via cross-connect, dedicated circuit, or a supported carrier.

Participants with sufficient connectivity may choose to take both the A and B feeds from Cboe's primary datacenter and arbitrate the feeds to recover lost data. Alternatively, participants may choose to arbitrate feeds from both datacenters. It should be noted that feeds from the secondary datacenter will have additional latency for those connected with Cboe in the primary datacenter due to proximity and business continuity processing.

Multicast Top real-time events are delivered using a published range of multicast addresses divided by symbol range units. Dropped messages can be requested using a TCP/IP connection to one of Cboe's Multicast Top Gap Request Proxy ("GRP") servers with replayed messages being delivered on a separate set of multicast ranges reserved for packet retransmission. Intraday, a spin of current top of book may be requested from a Spin Server.

The following diagram is a logical representation Multicast Top feed message flow between Cboe and a participant feed handler that is listening to the "A" and "B" instances of two units:



1.3 Symbol Ranges, Units, and Sequence Numbers

Symbols will be separated into units and symbol distribution will not change intra-day. Cboe does, however, reserve the right to add multicast addresses or change the symbol distribution with 48 hours prior notice to participants. Care should be taken to ensure that address changes, address additions, and symbol distribution changes can be supported easily.

Message sequence numbers are incremented by one for every sequenced message within a particular symbol unit. It is important to understand that one *or more* units will be delivered on a single multicast address. As with symbol ranges, unit distribution across multicast addresses will not change intra-day, but may change after notice has been given.

Symbol distribution across units as well as unit distribution across multicast addresses are identical for real-time and gap response multicast addresses.

1.4 Options Specific Symbol Processing

Cboe has implemented a symbol mapping mechanism (`Symbol Mapping` message) for the Multicast Top feeds, which maps each specific simple options contract to a six character, ASCII *Symbol*. This symbol mapping significantly reduces the size of the Multicast Top feed and allows participants to use the same symbol handling mechanisms for the Cboe operated equity, options, and futures exchanges. This symbol mapping is the same as the US Options Multicast PITCH feed.

Mapping occurs on a continuous basis on each unit's multicast feed. `Symbol Mapping` messages will be un-sequenced and are sent from pre-market through the end of trading. The rate is variable and will be adjusted as bandwidth allows. Once the same contract has been seen twice, the user can be certain the full loop has been observed.

In addition to the symbol mapping events available on the Multicast Top feed, a downloadable file with current mappings is available via the Cboe website.

1.5 Gap Request Proxy and Message Retransmission

Requesting delivery of missed sequenced data is achieved by establishing a TCP connection to a Gap Request Proxy ("GRP") port. This GRP port is specific to Multicast Top and is NOT shared with the Multicast PITCH GRP port. Participants who do not wish to request missed messages do not need to connect to a GRP port for any reason or listen to the multicast addresses reserved for message retransmission. Participants choosing to request missed data will need to connect to their assigned GRP port, log in, and request gap ranges as necessary. All gap requests will be responded to with a `Gap Response` message. A `Gap Response` *Status* code of 'A'ccepted signals that the replayed messages will be delivered via the appropriate gap response multicast address. Any other `Gap Response` *Status* code will indicate the reason that the request cannot be serviced.

Gap requests are limited in message count, frequency, and age by the GRP. Gap requests will only be serviced if they are within a defined sequence range of the current multicast sequence number for the requested unit. Participants will receive a total daily allowance of gap requested messages. In addition, each participant is given renewable one second and one minute gap request limits.

If more than one gap request is received for a particular unit/sequence/count combination within a short timeframe, all requests will receive a successful `Gap Response` message from the GRP, but only a single replayed message will be sent on the gap response multicast address.

If overlapping gap requests are received within a short period of time, the gap server will only send the union of the sequence ranges across grouped gap requests. Participants will receive gap responses for their requested unit/sequence/count, but receivers should be prepared for the gap responses to be delivered via multicast in non-contiguous blocks.

Gap acknowledgements or rejects will be delivered to users for every gap request received by the GRP. Users should be prepared to see replayed multicast data before or after the receipt of the gap response acknowledgement from the GRP.

1.6 Spin Servers

A Spin Server is available for each unit. The server allows participants to connect via TCP and receive a spin of the inside book and symbols with limited trading conditions on that unit. By using the spin, a participant can get the current book quickly in the middle of the trading session without worry of gap request limits. The Spin Server for each unit is assigned its own address and/or TCP port.

Upon successful login and periodically thereafter, a `Spin Image Available` message is sent which contains a sequence number indicating the most recent message applied to the book. Using a `Spin Request` message, a participant may request a spin for the orders up to a sequence number noted within one of the *last ten* `Spin Image Available` messages distributed. If the `Spin Request` submitted does not present a sequence number that matches one of the last ten `Spin Image Available` messages distributed, the spin will return orders up to the next closest sequence number reported through a `Spin Image Available` message that is greater than the sequence number requested.

In the case a participant sends a sequence number in a `Spin Request` that is higher than the sequence number reported by the most recent `Spin Image Available` message, the next spin image to be generated will be returned when it is available. If the requested sequence number is still higher at that time, an "O" (Out of Range) error will be generated.

A spin consists only of `Market Snapshot` and `Time` messages for symbols that have had orders that day or had a limited trading state (BZX, EDGX and C2 Only) **Deprecated with Feature Pack 4**. A spin for C1 Only **(Effective in BZX, C2, and EDGX with Feature Pack 4)** will consist of `Two Side Update`, `One Side Update`, `TOP Trade`, `Trading Status` and `Time` messages. While receiving the spin,

the participant must buffer multicast messages received. If the `Spin Image Available` message sequence number is the participant's reference point, multicast messages with larger sequence numbers should be buffered. If a non-`Spin Image Available` sequence number is the participant's reference point which they send in their `Spin Request`, they should buffer from that point on, but note that within the spin they may receive sequence numbers beyond that point which they may disregard. When a `Spin Finished` message is received, the buffered messages must be applied to spun copy of the book to bring it current.

Customers can also use the Spin Server to request a spin of all `Symbol Mapping` messages by sending an `Instrument Definition Request` (C1 Only) **Effective in BZX, C2, and EDGX with Feature Pack 4**. The Spin Server can only process one spin at a time. Customers will need to wait for a `Spin Finished` or `Instrument Definition Finished` message before submitting another request.

Section 5 shows an example flow of messages between a participant and Cboe's Multicast Top feed and Spin Server.

2 Protocol

Cboe users may use the Top protocol over multicast to receive real-time top of book quotations and execution information direct from Cboe.

2.1 Message Format

The messages that make up the Top protocol are delivered using `Sequenced Unit Header` which handles sequencing and delivery integrity. All messages delivered via multicast as well as to/from the Gap Request Proxy ("GRP") or Spin Server will use the `Sequenced Unit Header` for handling message integrity.

All UDP delivered events will be self-contained. Developers can assume that UDP delivered data will not cross frame boundaries and a single Ethernet frame will contain only one Sequenced Unit Header with associated data.

TCP/IP delivered events from the GRP may cross frames as the data will be delivered as a stream of data with the TCP/IP stack controlling Ethernet framing.

The Top data feed is comprised of a series of dynamic length sequenced messages. Each message begins with *Length* and *Message Type* fields. Cboe reserves the right to add message types and grow the length of any message without notice. Participants should develop their decoders to deal with unknown message types and messages that grow beyond the expected length. Messages will only be grown to add additional data to the end of a message.

2.2 Data Types

The following field types are used within the `Sequenced Unit Header`, GRP messages, and Top.

- **Alphanumeric** fields are left justified ASCII fields and space padded on the right.
- **Binary** fields are unsigned and sized to "Length" bytes and ordered using Little Endian convention (least significant byte first).
- **Signed Binary** fields are signed and sized to "Length" bytes and ordered using Little Endian convention (least significant byte first).
- **Binary Price** fields are unsigned Little Endian encoded 8 byte binary fields with 4 implied decimal places (denominator = 10,000).
- **Binary Short Price** fields are unsigned Little Endian encoded 2 byte binary fields with 2 implied decimal places (denominator = 100).
- **Binary Long Price** fields are unsigned Little Endian encoded 8 byte binary fields with 4 implied decimal places (denominator = 10,000).

- **Bit Field** fields are fixed width fields with each bit representing a Boolean flag (the 0 bit is the lowest significant bit; the 7 bit is the highest significant bit).
- **Multiplier** fields are unsigned Little Endian encoded 4 byte binary fields with 1 implied decimal place (denominator = 10).
- **Printable ASCII** fields are left justified ASCII fields that are space padded on the right that may include ASCII values in the range of 0x20 – 0x7e.
- **Time Offset** are 4 byte unsigned Little Endian values that represent the number of nanoseconds since the last `Time` message.

2.3 Message Framing

Top of book update messages will be combined into single UDP frame where possible to decrease message overhead and total bandwidth. The count of messages in a UDP frame will be communicated using the `Sequenced Unit Header`. Framing will be determined by the server for each unit and site. The content of the multicast across feeds (e.g. A/B) will be identical, but framing will not be consistent across feeds. Receiving processes that receive and arbitrate multiple feeds cannot use frame level arbitration to fill gaps.

2.4 Sequenced Unit Header

The `Sequenced Unit Header` is used for all Multicast Top messages as well as messages to and from the Gap Request Proxy ("GRP") and Spin Servers.

Sequenced and un-sequenced data may be delivered using the `Sequenced Unit Header`. Un-sequenced headers will have a 0 value for the *Hdr Sequence* field and potentially for the *Hdr Unit* field. All messages sent to and from the GRP and Spin Server are un-sequenced while multicast may contain both sequenced and un-sequenced messages.

Sequenced messages have implied sequences with the first message having the sequence number contained in the header. Each subsequent message will have an implied sequence one greater than the previous message up to a maximum of count messages. Multiple messages can follow a `Sequenced Unit Header`, but a combination of sequenced and un-sequenced messages cannot be sent within one header.

The sequence number for the first message in the next frame can be calculated by adding the *Hdr Count* field to the *Hdr Sequence*. This technique will work for sequenced messages and `Heartbeats`.

Sequenced Unit Header				
Field	**Offset**	**Length**	**Value/Type**	**Description**
Hdr Length	0	2	Binary	Length of entire block of messages. Includes this header and *Hdr Count* messages to follow.

Hdr Count	2	1	Binary	Number of messages to follow this header.
Hdr Unit	3	1	Binary	Unit that applies to messages included in this header.
Hdr Sequence	4	4	Binary	Sequence of first message to follow this header.
Total Length = 8 bytes				

2.5 Heartbeat Messages

The `Sequenced Unit Header` with a count field set to "0" will be used for `Heartbeat` messages. During trading hours `Heartbeat` messages will be sent from the GRP, Spin Server, and all multicast addresses if no data has been delivered within one second. `Heartbeat` messages never increment the sequence number for a unit, but can be used to detect gaps on the real-time multicast channels during low update rate periods.

`Heartbeats` on the real-time multicast addresses during trading hours will have an *Hdr Sequence* value equal to the sequence of the next sequenced message to be sent for the unit. `Heartbeats` on gap multicast addresses will always have the *Hdr Sequence* field set to 0. All `Heartbeat` messages sent to and from the GRP and Spin Server are considered un-sequenced and should have sequence and unit fields set to 0.

Outside of trading hours Cboe sends `Heartbeat` messages on all real-time and gap channels with a sequence of "0" to help users validate multicast connectivity. `Heartbeat` messages might not be sent outside of normal trading hours.

Cboe expects `Heartbeat` messages to be sent to the GRP on live connections no less than every 5 seconds. Failure to receive two consecutive `Heartbeat` messages will result in the GRP or Spin Server terminating the client connection.

3 Top Messages

With the exception of `Time` messages, each Top message reflects the update of the top of book or execution of an order in the system.

3.1 Time

A `Time` message is sent whenever the source time for a unit passes over a second boundary. All subsequent time offset fields for the same unit will use the new `Time` value as the base until another `Time` message is received for the same unit. The *Time* field is the number of seconds relative to midnight Eastern Time, which is provided in the `Time Reference` message.

Time				
Field Name	**Offset**	**Length**	**Type/(Value)**	**Description**
Length	0	1	Binary	*Length* of this message including this field.
Message Type	1	1	0x20	`Time` Message
Time	2	4	Binary	Number of whole seconds from midnight Eastern Time.
Total Length = 6 bytes				

3.2 Unit Clear

The `Unit Clear` message instructs feed recipients to clear all market snapshots for the book in the unit specified in the `Sequenced Unit Header`. This message will be sent at startup each day. It would also be distributed in certain recovery events such as a data center fail-over.

Unit Clear				
Field Name	**Offset**	**Length**	**Type/(Value)**	**Description**
Length	0	1	Binary	*Length* of this message including this field.
Message Type	1	1	0x97	`Unit Clear` Message
Time Offset	2	4	Binary	Nanosecond offset from last unit timestamp.
Total Length = 6 bytes				

3.3 Symbol Mapping

The `Symbol Mapping` message are sent as an unsequenced message. One unsequenced `Symbol Mapping` message for each *Symbol* are sent in a continuous loop as bandwidth allows.

Members who consume the 5G-Shaped Multicast PITCH feeds will be able to receive the full list of symbols in approximately 5 minutes, and will allow for optimal distribution in situations where market data is susceptible to throttling as a result of high message burst rates. All 1 Gigabit-Shaped ("1G-Shaped") feeds will continue to complete the full loop of *Symbol Mapping* messages in approximately 30 minutes.

Symbol Mapping				
Field Name	**Offset**	**Length**	**Type/(Value)**	**Description**
Length	0	1	Binary	*Length* of this message including this field.
Message Type	1	1	0x2E	`Symbol Mapping` Message
Feed Symbol	2	6	Printable ASCII	*Symbol* right padded with spaces.
OSI Symbol	8	21	Printable ASCII	OSI Symbol
Symbol Condition	29	1	Alphanumeric	N = Normal C = Closing Only
Underlying C1 Only **Effective in BZX, C2, and EDGX with Feature Pack 4**	30	8	Alphanumeric	Symbol of underlying equity right padded with spaces.
Total Length = 30 bytes or 38 bytes for C1				

3.4 Refresh and Spin Messages

3.4.1 Market Snapshot (BZX, C2 and EDGX Only) Deprecated with Feature Pack 4

A `Market Snapshot` message provides a snapshot of the price and size for the bid and ask, last trade price, total number of contracts traded, and the current trading status of a single symbol. The `Market Snapshot` message will be included during a Spin for all symbols traded so far this trading session.

The *Unit Timestamp* field is provided because the timestamp for a `Market Snapshot` is the last time an event occurred on that *Symbol*.

The `Market Snapshot` message comes in two variants: `Market Snapshot (Long)` and `Market Snapshot (Short)`. The `Market Snapshot (Short)` is used whenever possible, but the `Market Snapshot (Long)` version is used if any of the *Price* fields cannot be represented by a Binary Short Price ($0.00 to $655.36) or any of the *Quantity* fields cannot be represented by an unsigned 16-bit value (65536).

Market Snapshot (Short)				
Field Name	**Offset**	**Length**	**Type/(Value)**	**Description**
Length	0	1	Binary	*Length* of this message including this field.
Message Type	1	1	0xB2	`Market Snapshot (Short)` Message
Time Offset	2	4	Binary	Nanosecond offset from *Unit Timestamp* in this message.
Symbol	6	6	Printable ASCII	*Symbol* right padded with spaces.
Unit Timestamp	12	4	Binary	Last unit timestamp expressed as number of whole seconds since the Epoch (Midnight, January 1, 1970 UTC).

Bid Price	16	2	Binary Short Price	Bid price
Bid Quantity	18	2	Binary	Number of contracts on the bid side of the inside book (a zero value denotes there is no *Bid*).
Ask Price	20	2	Binary Short Price	Ask price
Ask Quantity	22	2	Binary	Number of contracts on the ask side of the inside book (a zero value denotes there is no *Ask*).
Last Trade Price	24	2	Binary Short Price	Price of last execution
Last Trade Size	26	2	Binary	Number of contracts traded on the last trade (if this value is 0 the *Last Trade Price* is invalid).
Last Trade Condition	28	1	Alphanumeric	Trade Condition for Last Trade `(Space):` Normal Trade `S:` Spread Trade `X:` Trade Break
Total Volume	29	4	Binary	Total number of contracts traded on the current trading session.
Trading Status	33	1	Alphanumeric	See *Trading Status* field of `Trading Status` message.
Reserved	34	3	Alphanumeric	Reserved for use in other markets.
Bit Fields	37	1	Bit Field	Customer bits set on BZX and EDGX only. Will always be zero for C2. **Bit 0: Reserved** **Bit 1:** If set, bid has customer orders **Bit 2:** If set, ask has customer orders **Bits 3-7 - Reserved**
Total Length = 38 bytes				

Market Snapshot (Long)				
Field Name	**Offset**	**Length**	**Type/(Value)**	**Description**
Length	0	1	Binary	*Length* of this message including this field.
Message Type	1	1	0xB3	`Market Snapshot (Long)` Message
Time Offset	2	4	Binary	Nanosecond offset from *Unit Timestamp* in this message.
Symbol	6	6	Printable ASCII	*Symbol* right padded with spaces.
Unit Timestamp	12	4	Binary	Last unit timestamp expressed as number of whole seconds since the Epoch (Midnight, January 1, 1970 UTC).
Bid Price	16	8	Binary Price	Bid price

Bid Quantity	24	4	Binary	Number of contracts on the bid side of the inside book (a zero value denotes there is no *Bid*).
Ask Price	28	8	Binary Price	Ask price
Ask Quantity	36	4	Binary	Number of contracts on the ask side of the inside book (a zero value denotes there is no *Ask*).
Last Trade Price	40	8	Binary Price	Price of last execution
Last Trade Size	48	4	Binary	Number of contracts traded on the last trade (if this value is 0 the *Last Trade Price* is invalid).
Last Trade Condition	52	1	Alphanumeric	Trade Condition for Last Trade `(Space):` Normal Trade `S:` Spread Trade `X:` Trade Break
Total Volume	53	4	Binary	Total number of contracts traded on the current trading session.
Trading Status	57	1	Alphanumeric	See *Trading Status* field of `Trading Status` message.
Reserved	58	3	Alphanumeric	Reserved for use in other markets.
Bit Fields	61	1	Bit Field	Customer bits set on BZX and EDGX only. Will always be zero for C2. **Bit 0: Reserved** **Bit 1:** If set, bid has customer orders **Bit 2:** If set, ask has customer orders **Bits 3-7 - Reserved**
Total Length = 62 bytes				

3.5 Market Update Messages

Market Update messages reflect real-time events to the current state of the market. These messages are always sequenced and may be recovered via the Gap Request Proxy ("GRP").

3.5.1 Single Side Update

`Single Side Update` messages provide an updated price and size for a single side of a *Symbol*. The side is denoted by the *Side* field. One `Single Side Update` message may reflect one or more updates to the inside book that were processed at the same time, but will only be done so in a way that can be arbitrated between A/B feeds.

`Single Side Update` messages come in four variants: `Single Side Update (Short)`, `Single Side Update Expanded (Short)`, `Single Side Update (Long)` and `Single Side Update Expanded (Long)`. The `Single Side Update (Short)` message is used whenever possible, but the `Single Side Update (Long)` message is used whenever the *Price* cannot be represented by a Binary Short Price or the *Quantity* cannot be represented by an unsigned

16-bit integer. For C1, only the Expanded versions of the `Single Side Update` message will be used.

Only the Customer bit in *Bit Fields* matching the *Side* field is valid. For example, if *Side* is B (bid), then only Bit 1 is valid. The value of Bit 2 may not be used (regardless of value). (BZX, C2, and EDGX Only)

If any All or None size exists on both sides at a price level at or better than the firm quote, it will be represented by a separate message. If any Cabinet size exists, it will be represented in a separate message.

3.5.1.1 Single Side Update (Short) (BZX, C2 and EDGX Only) Deprecated with Feature Pack 4

Single Side Update (Short)				
Field Name	**Offset**	**Length**	**Type/(Value)**	**Description**
Length	0	1	Binary	*Length* of this message including this field.
Message Type	1	1	0xB4	`Single Side Update (Short)` Message
Time Offset	2	4	Binary	Nanosecond offset from last unit timestamp.
Symbol	6	6	Printable ASCII	*Symbol* right padded with spaces.
Side	12	1	Alphanumeric	B = Bid Side S = Ask Side
Price	13	2	Binary Short Price	Price
Quantity	15	2	Binary	Number of contracts on the inside book (a zero value denotes there is no *Bid/Ask*).
Bit Fields	17	1	Bit Field	Customer bits set on BZX and EDGX only. Will always be zero for C2. **Bit 0: Reserved** **Bit 1:** If set, bid has customer orders (if *Side* = B) **Bit 2:** If set, ask has customer orders (if Side = S) **Bits 3-7 - Reserved**
Total Length = 18 bytes				

3.5.1.2 Single Side Update Expanded (Short) (C1 Only) Effective in BZX, C2, and EDGX with Feature Pack 4

Single Side Update Expanded (Short)				
Field Name	**Offset**	**Length**	**Type/(Value)**	**Description**
Length	0	1	Binary	*Length* of this message including this field.
Message Type	1	1	0xD4	`Single Side Update Expanded (Short)` Message
Time Offset	2	4	Binary	Nanosecond offset from last unit timestamp.
Symbol	6	6	Printable ASCII	*Symbol* right padded with spaces.
Side	12	1	Alphanumeric	B = Bid Side S = Ask Side

Bit Fields	13	1	Bit Field	**Bits 0-2 - Reserved** **Bit 3 - AON** `0` = Price level is a firm quote `1` = Price Level is AON (All or None) **Bit 4 - Cabinet Order** `0` = Price level is a standard order `1` = Price Level is a Cabinet Order **Bits 5-7 - Reserved**
Price	14	2	Binary Short Price	Price
Quantity	16	2	Binary	Total number of contracts on the inside book (customer and non-customer).
Customer Quantity	18	2	Binary	Number of customer contracts on the inside book. A zero value denotes that there are no customer contracts at the inside price.
Total Length = 20 bytes				

3.5.1.3 Single Side Update (Long) (BZX, C2 and EDGX Only) Deprecated with Feature Pack 4

Single Side Update (Long)				
Field Name	**Offset**	**Length**	**Type/(Value)**	**Description**
Length	0	1	Binary	*Length* of this message including this field.
Message Type	1	1	0xB5	`Single Side Update (Long)` Message
Time Offset	2	4	Binary	Nanosecond offset from last unit timestamp.
Symbol	6	6	Printable ASCII	*Symbol* right padded with spaces.
Side	12	1	Alphanumeric	B = Bid Side S = Ask Side
Price	13	8	Binary Long Price	Price
Quantity	21	4	Binary	Number of contracts on the inside book (a zero value denotes there is no *Bid/Ask*).
Bit Fields	25	1	Bit Field	Customer bits set on BZX and EDGX only. Will always be zero for C2. **Bit 0: Reserved** **Bit 1:** If set, bid has customer orders (if *Side* = B) **Bit 2:** If set, ask has customer orders (if Side = S) **Bits 3-7 - Reserved**
Total Length = 26 bytes				

3.5.1.4 Single Side Update Expanded (Long) (C1 Only) Effective in BZX, C2, and EDGX with Feature Pack 4

Single Side Update Expanded (Long)				
Field Name	**Offset**	**Length**	**Type/(Value)**	**Description**
Length	0	1	Binary	*Length* of this message including this field.
Message Type	1	1	0xD5	`Single Side Update Expanded(Long)` Message
Time Offset	2	4	Binary	Nanosecond offset from last unit timestamp.
Symbol	6	6	Printable ASCII	*Symbol* right padded with spaces.
Side	12	1	Alphanumeric	`B` = Bid Side `S` = Ask Side
Bit Fields	13	1	Bit Field	**Bits 0-2 - Reserved** **Bit 3 - AON** `0` = Price level is a firm quote `1` = Price Level is AON (All or None) **Bit 4 - Cabinet Order** `0` = Price level is a standard order `1` = Price Level is a Cabinet Order **Bits 5-7 - Reserved**
Price	14	8	Binary Long Price	Price
Quantity	22	4	Binary	Total number of contracts on the inside book (customer and non-customer).
Customer Quantity	26	4	Binary	Number of customer contracts on the inside book. A zero value denotes that there are no customer contracts at the inside price.
Total Length = 30 bytes				

3.5.2 Two Side Update Message

`Two Side Update` messages provide an updated price and size for both sides of a *Symbol*. One `Two Side Update` message may reflect one or more updates to the inside book that were processed at the same time, but will only be done so in a way that can be arbitrated between A/B feeds.

`Two Side Update` messages come in four variants: `Two Side Update (Long)`, `Two Side Update Expanded (Long)`, `Two Side Update (Short)` and `Two Side Update Expanded (Short)`. The `Two Side Update (Short)` message is used whenever possible, but the `Two Side Update (Long)` message is used whenever the *Price* cannot be represented by a Binary Short Price or the *Quantity* cannot be represented by an unsigned 16-bit integer. For C1, only the Expanded versions of the `Two Side Update` message will be used.

If any All or None size exists on both sides at a price level at or better than the firm quote, it will be represented by a separate message. If any Cabinet size exists, it will be represented in a separate message.

3.5.2.1 Two Side Update (Short) (BZX, C2 and EDGX Only) Deprecated with Feature Pack 4

Two Side Update (Short)				
Field Name	**Offset**	**Length**	**Type/(Value)**	**Description**
Length	0	1	Binary	*Length* of this message including this field.
Message Type	1	1	0xB6	`Two Side Update (Short)` Message
Time Offset	2	4	Binary	Nanosecond offset from *Unit Timestamp* in this message.
Symbol	6	6	Printable ASCII	*Symbol* right padded with spaces.
Bid Price	12	2	Binary Short Price	Bid price
Bid Quantity	14	2	Binary	Number of contracts on the bid side of the inside book (a zero value denotes there is no *Bid*).
Ask Price	16	2	Binary Short Price	Ask price
Ask Quantity	18	2	Binary	Number of contracts on the ask side of the inside book (a zero value denotes there is no *Ask*).
Bit Fields	20	1	Bit Field	Customer bits set on BZX and EDGX only. Will always be zero for C2. **Bit 0: Reserved** **Bit 1:** If set, bid has customer orders (if *Side* = B) **Bit 2:** If set, ask has customer orders (if Side = S) **Bits 3-7 - Reserved**
Total Length = 21 bytes				

3.5.2.2 Two Side Update Expanded (Short) (C1 Only) Effective in BZX, C2, and EDGX with Feature Pack 4

Two Side Update Expanded (Short)				
Field Name	**Offset**	**Length**	**Type/(Value)**	**Description**
Length	0	1	Binary	*Length* of this message including this field.
Message Type	1	1	0xD6	`Two Side Update Expanded (Short)` Message
Time Offset	2	4	Binary	Nanosecond offset from last unit timestamp.
Symbol	6	6	Printable ASCII	*Symbol* right padded with spaces.
Bit Fields	12	1	Bit Field	**Bits 0-2 - Reserved** **Bit 3 - AON** `0` = Price level is a firm quote `1` = Price Level is AON (All or None) **Bit 4 - Cabinet Order** `0` = Price level is a standard order `1` = Price Level is a Cabinet Order **Bits 5-7 - Reserved**
Bid Price	13	2	Binary Short Price	Bid Price

Bid Quantity	15	2	Binary	Total number of contracts on the inside bid (customer and non-customer). A zero value indicates there is no bid.
Bid Customer Quantity	17	2	Binary	Number of customer contracts on the inside bid. A zero value denotes that there are no customer contracts at the inside price.
Ask Price	19	2	Binary Short Price	Ask Price
Ask Quantity	21	2	Binary	Total number of contracts on the inside ask (customer and non-customer). A zero value indicates there is no ask.
Ask Customer Quantity	23	2	Binary	Number of customer contracts on the inside ask. A zero value denotes that there are no customer contracts at the inside price.
Total Length = 25 bytes				

3.5.2.3 Two Side Update (Long) (BZX, C2 and EDGX Only) Deprecated with Feature Pack 4

Two Side Update (Long)				
Field Name	**Offset**	**Length**	**Type/(Value)**	**Description**
Length	0	1	Binary	*Length* of this message including this field.
Message Type	1	1	0xB7	`Two Side Update (Long)` Message
Time Offset	2	4	Binary	Nanosecond offset from *Unit Timestamp* in this message.
Symbol	6	6	Printable ASCII	*Symbol* right padded with spaces.
Bid Price	12	8	Binary Long Price	Bid price
Bid Quantity	20	4	Binary	Number of contracts on the bid side of the inside book (a zero value denotes there is no *Bid*).
Ask Price	24	8	Binary Long Price	Ask price
Ask Quantity	32	4	Binary	Number of contracts on the ask side of the inside book (a zero value denotes there is no *Ask*).
Bit Fields	36	1	Bit Field	Customer bits set on BZX and EDGX only. Will always be zero for C2. **Bit 0: Reserved** **Bit 1:** If set, bid has customer orders (if *Side* = B) **Bit 2:** If set, ask has customer orders (if Side = S) **Bits 3-7 - Reserved**
Total Length = 37 bytes				

3.5.2.4 Two Side Update Expanded (Long) (C1 Only) Effective in BZX, C2, and EDGX with Feature Pack 4

Two Side Update Expanded (Long)				
Field Name	**Offset**	**Length**	**Type/(Value)**	**Description**
Length	0	1	Binary	*Length* of this message including this field.
Message Type	1	1	0xD7	`Two Side Update Expanded (Long)` Message
Time Offset	2	4	Binary	Nanosecond offset from last unit timestamp.
Symbol	6	6	Printable ASCII	*Symbol* right padded with spaces.
Bit Fields	12	1	Bit Field	**Bits 0-2 - Reserved** **Bit 3 - AON** `0` = Price level is a firm quote `1` = Price Level is AON (All or None) **Bit 4 - Cabinet Order** `0` = Price level is a standard order `1` = Price Level is a Cabinet Order **Bits 5-7 - Reserved**
Bid Price	13	8	Binary Long Price	Bid Price
Bid Quantity	21	4	Binary	Total number of contracts on the inside bid (customer and non-customer). A zero value indicates there is no bid.
Bid Customer Quantity	25	4	Binary	Number of customer contracts on the inside bid. A zero value denotes that there are no customer contracts at the inside price.
Ask Price	29	8	Binary Long Price	Ask Price
Ask Quantity	37	4	Binary	Total number of contracts on the inside ask (customer and non-customer). A zero value indicates there is no ask.
Ask Customer Quantity	41	4	Binary	Number of customer contracts on the inside ask. A zero value denotes that there are no customer contracts at the inside price.
Total Length = 45 bytes				

3.5.3 Top Trade Message

The `Top Trade` message provides information about executions of orders on the book. `Top Trade` messages are necessary to calculate execution-based data. `Top Trade` messages do not alter the book. One or more `Single Side Update` or `Two Side Update` messages will follow a `Top Trade` message to reflect the updated book (for example, an aggressive order may take out one or more price levels and establish a new level on the opposite side).

Any order may be executed in parts. A complete view of all executions can be built from all `Top Trade` messages.

The `Top Trade` message sends the trade price, trade quantity, execution id, and trade condition of a trade as well as the cumulative volume for the trading session. A `Top Trade` message will be sent for each execution, but not every `Top Trade` message indicates a trade. The *Trade Condition* value of 'X' (Trade Break) is sent whenever an execution is broken. Trade breaks will contain the *Symbol*, *Quantity*, *Price,* and *Execution Id* of the original trade. The *Total Volume* field will be reduced by the number of shares reported in the *Quantity* field.

Top Trade				
Field Name	**Offset**	**Length**	**Type/(Value)**	**Description**
Length	0	1	Binary	*Length* of this message including this field.
Message Type	1	1	0xB8	`Top Trade` Message
Time Offset	2	4	Binary	Nanosecond offset from last unit timestamp.
Symbol	6	6	Printable ASCII	*Symbol* right padded with spaces.
Quantity	12	4	Binary	Incremental number of contracts executed or corrected (see *Trade Condition*).
Price	16	8	Binary Long Price	The execution price of the order.
Execution Id	24	8	Binary	Cboe generated day-unique execution identifier of this trade. *Execution Id* is also referenced in the `Trade Break` message.
Total Volume	32	4	Binary	Total number of contracts traded on the current trading session (may decrease if the *Trade Condition* field indicates a canceled trade).
Trade Condition	36	1	Alphanumeric	**All values will be available on BZX, C2, and EDGX with the implementation of Feature Pack 4.** `(Space):` Normal Trade `O:` Opening Trade (C1 Only) `S:` Spread Trade `A:` SPIM Trade (C1 Only) `I:` ISO Trade (C1 Only) `L:` Late Trade (C1 Only) `C:` Combo Trade (C1 Only) `K:` Cabinet Trade (C1 Only) `F:` Floor Trade (C1 Only) `X:` Trade Break
Total Length = 37 bytes				

3.6 Options Auction Update (C1 Only)

`Options Auction Update` messages are used to disseminate price and size information during Opening and Re-Opening (halt) auctions. The `Auction Update` messages are sent every five seconds during an opening period. Refer to the Cboe Opening Process specification for more information.

The `Options Auction Update` message has the following format:

Options Auction Update				
Field Name	**Offset**	**Length**	**Type/(Value)**	**Description**
Length	0	1	Binary	*Length* of this message including this field.
Message Type	1	1	0xD1	`Options Auction Update` Message
Time offset	2	4	Binary	Nanosecond offset from last unit timestamp.
Symbol	6	8	Printable ASCII	*Symbol* right padded with spaces.
Auction Type	14	1	Alphanumeric	G = GTH Opening O = RTH Opening H = Halt Re-Opening V = Volatility Opening
Reference Price	15	8	Binary Long Price	Collared Auction-Only Price
Buy Contracts	23	4	Binary	Cumulative Buy interest at the Reference Price.
Sell Contracts	27	4	Binary	Cumulative Sell interest at the Reference Price.
Indicative Price	31	8	Binary Long Price	Collared Volume Maximizing Imbalance Minimizing Price computed on combined Auction-Only and Continuous Book.
Auction Only Price	39	8	Binary Long Price	Volume Maximizing Price computed on the Auction-Only Book.
Opening Condition	47	1	Alphanumeric	O = Would open Q = Need quote to open B = Need more buyers S = Need more sellers
Total Length = 48 bytes				

3.7 Auction Summary (C1 Only)

`Auction Summary` messages are used to disseminate the results of an auction. An Opening or Re-Opening `Auction Summary` message for each symbol is sent at the conclusion of its Opening or Re-Opening auction and represents Cboe opening price.

The `Auction Summary` message has the following format:

Auction Summary				
Field Name	**Offset**	**Length**	**Type/(Value)**	**Description**
Length	0	1	Binary	Length of this message including this field.

Message Type	1	1	0x96	`Auction Summary` Message
Time offset	2	4	Binary	Nanosecond offset from last unit timestamp.
Symbol ID	6	8	Printable ASCII	*Symbol* right padded with spaces.
Auction Type	14	1	Alphanumeric	G = GTH Opening O = RTH Opening H = Halt Re-Opening V = Volatility Opening
Price	15	8	Binary Long Price	Auction price.
Quantity	23	4	Binary	Cumulative number of contracts executed during the auction.
Total Length = 27 bytes				

3.8 Trading Status

The `Trading Status` message is used to indicate the current trading status of an options contract. A `Trading Status` message will be sent whenever a security's trading status changes. The following summarizes the Trading Status values in the Cboe system:

- H = Halt state.
- Q = Queuing. Sent starting at 7:30AM ET once orders can be accepted for queuing in preparation for the market open.
- S = Suspended. Implied at system startup for all series.
- T = Trading. Sent when symbol is open for trading, sometime after 9:30AM ET.

A `Trading Status` message will also be sent:

- For a Regulatory Halt "Q"ueuing Period in any symbol where the underlying has experienced a Regulatory Halt as well as the "T"rading resumption for the same instrument.
- In the event of an Exchange specific "S"uspension.

Trading Status (BZX, C2 and EDGX) Deprecated with Feature Pack 4				
Field Name	**Offset**	**Length**	**Type/(Value)**	**Description**
Length	0	1	Binary	Length of this message including this field.
Message Type	1	1	0x31	`Trading Status` message
Time Offset	2	4	Binary	Nanosecond offset from last unit timestamp.
Symbol	6	6	Printable ASCII	*Symbol* right padded with spaces.
Reserved	12	2	Alpha	Reserved
Trading Status	14	1	Alpha	H = Halted Q = Queuing S = Exchange Specific Suspension T = Trading
Reserved	15	3	Alphanumeric	Reserved
Total Length = 18 bytes				

For C1 Options **(Effective in BZX, C2, and EDGX with Feature Pack 4)** the *Trading Status* field will be used to represent the status of the RTH Session (9:30am ET – 4:15pm ET) and the *GTH Trading Status* field will be used to represent the status of the GTH Session (2am ET – 9:30am ET).

Trading Status (C1 Only)				
Field Name	**Offset**	**Length**	**Type/(Value)**	**Description**
Length	0	1	Binary	Length of this message including this field
Message Type	1	1	0x31	`Trading Status` message
Time offset	2	4	Binary	Nanosecond offset from last unit timestamp
Symbol	6	6	Printable ASCII	*Symbol* right padded with spaces.
Reserved	12	2	Reserved	Reserved
Trading Status	14	1	Alpha	H = Halted Q = Quote-Only R = Opening Rotation S = Exchange Specific Suspension T = Trading
Reserved	15	1	Reserved	Reserved
GTH Trading Status	16	1	Alpha	H = Halted Q = Quote-Only S = Exchange Specific Suspension T = Trading
Reserved2	17	1	Alpha	Reserved
Total Length = 18 bytes				

3.9 Width Update (C1 Only)

The `Width Update` message is used to communicate opening quote width multiplier. This message will be sent at the beginning of the day for all underlyings and in the event that the exchange decides to change the quote width multiplier on a per underlying basis. For complete details on the opening collars see the Cboe Opening Process Specification.

Width Update				
Field Name	**Offset**	**Length**	**Type/(Value)**	**Description**
Length	0	1	Binary	*Length* of this message including this field.
Message Type	1	1	0xD2	`Width Update` Message
Time Offset	2	4	Binary	Nanosecond offset from last unit timestamp.
Underlying	6	8	Printable ASCII	Underlying right padded with spaces.
Width Type	14	1	Alphanumeric	R = Regular V = Volatility
Multiplier	15	4	Multiplier	Width multiplier
Total Length = 19 bytes				

3.10 End of Session

The `End of Session` message is sent for each unit when the unit shuts down. No more sequenced messages will be delivered for this unit, but heartbeats from the unit may be received.

End of Session				
Field Name	**Offset**	**Length**	**Type/(Value)**	**Description**
Length	0	1	Binary	*Length* of this message including this field.
Message Type	1	1	0x2D	`End of Session` Message
Timestamp	2	4	Binary	Nanosecond offset from last unit timestamp.
Total Length = 6 bytes				

4 Gap Request Proxy Messages

The following messages are used for initializing a TCP/IP connection to the Gap Request Proxy ("GRP") and to request message retransmissions. Participants only need to implement the following messages if gap requests will be made. The following messages will not be delivered using multicast.

4.1 Login

The `Login` message is the first message sent to the GRP by a user's process after the connection to the GRP is established. Failure to login before sending any other message type will result in the connection being dropped by the GRP.

Login				
Field	**Offset**	**Length**	**Value/Type**	**Description**
Length	0	1	Binary	*Length* of this message including this field.
Message Type	1	1	0x01	`Login` Message
SessionSubId	2	4	Alphanumeric	*SessionSubId* supplied by Cboe.
Username	6	4	Alphanumeric	*Username* supplied by Cboe.
Filler	10	2	Alphanumeric	(space filled)
Password	12	10	Alphanumeric	*Password* supplied by Cboe.
Total Length = 22 bytes				

4.2 Login Response

The `Login Response` message is sent by the GRP to a user's process in response to a `Login` message. The status field is used to reflect an accepted login or the reason the session was not accepted. If login fails, the connection will be dropped after the `Login Response` message is sent.

Login Response				
Field	**Offset**	**Length**	**Value/Type**	**Description**
Length	0	1	Binary	*Length* of this message including this field.
Message Type	1	1	0x02	`Login Response` Message
Status	2	1	Alphanumeric	Accepted or reason for reject.
Total Length = 3 bytes				

Login Response - Status Codes	
'A'	Login Accepted
'N'	Not authorized (Invalid Username/Password)
'B'	Session in use
'S'	Invalid Session

4.3 Gap Request

The `Gap Request` message is used by a user's process to request retransmission of a sequenced message (or messages) by one of Cboe's gap servers.

Gap Request				
Field	**Offset**	**Length**	**Value/Type**	**Description**
Length	0	1	Binary	*Length* of this message including this field.
Message Type	1	1	0x03	`Gap Request` Message
Unit	2	1	Binary	*Unit* that the gap is requested for.
Sequence	3	4	Binary	*Sequence* of first message (lowest sequence in range).
Count	7	2	Binary	*Count* of messages requested.
Total Length = 9 bytes				

4.4 Gap Response

The `Gap Response` message is sent by the GRP in response to a `Gap Request` message. The *Unit* and *Sequence* fields will match the values supplied in the `Gap Request` message. A `Gap Response` message, with a Status of Accepted or reason for failure, will be sent for each `Gap Request` message received by the GRP.

Gap Response				
Field	**Offset**	**Length**	**Value/Type**	**Description**
Length	0	1	Binary	*Length* of this message including this field.
Message Type	1	1	0x04	`Gap Response` Message
Unit	2	1	Binary	*Unit* the gap was requested for.
Sequence	3	4	Binary	*Sequence* of first message in request.
Count	7	2	Binary	*Count* of messages requested.
Status	9	1	Alphanumeric	Accepted or reason for reject*.
Total Length = 10 bytes				

Gap Response - Status Codes	
'A'	Accepted
'O'	Out of range (ahead of sequence or too far behind)
'D'	Daily gap request allocation exhausted
'M'	Minute gap request allocation exhausted
'S'	Second gap request allocation exhausted
'C'	Count request limit for one gap request exceeded
'I'	Invalid Unit specified in request
'U'	Unit is currently unavailable

* - All non-'A' status codes should be interpreted as a reject.

5 Spin Messages

5.1 Login

The `Login` message is the first message sent to the Spin Server by a user's process after the connection to the Spin Server is established. Failure to login before sending any other message type will result in the connection being dropped by the Spin Server.

The format of the `Login` message for the Spin Server is identical to that of the GRP described previously in Section 4.1.

5.2 Login Response

The `Login Response` message is sent by the Spin Server to a user's process in response to a `Login` message. The status field is used to reflect an accepted login or the reason the session was not accepted. If login fails, the connection will be dropped after the `Login Response` message is sent.

The format of the `Login Response` message for the Spin Server is identical to that of the GRP described previously in Section 4.2.

5.3 Spin Image Available

The `Spin Image Available` message is sent once per second and indicates through what sequence number a spin is available.

Spin Image Available				
Field Name	**Offset**	**Length**	**Type/(Value)**	**Description**
Length	0	1	Binary	*Length* of this message including this field.
Message Type	1	1	0x80	`Spin Image Available` Message
Sequence	2	4	Binary	Spin is available which is current through this sequence number.
Total Length = 6 bytes				

5.4 Spin Request

The `Spin Request` message is used by a user's process to request transmission of a spin of the unit's order book. Refer to Section 1.6 for more complete details regarding *Sequence* specification as well as buffering requirements.

Spin Request				
Field Name	**Offset**	**Length**	**Type/(Value)**	**Description**
Length	0	1	Binary	*Length* of this message including this field.
Message Type	1	1	0x81	`Spin Request` Message
Sequence	2	4	Binary	Sequence number from a `Spin Image Available` message received by the participant.
Total Length = 6 bytes				

5.5 Spin Response

The `Spin Response` message is sent in response to a user's `Spin Request` message indicating whether a spin will be sent.

Spin Response				
Field Name	**Offset**	**Length**	**Type/(Value)**	**Description**
Length	0	1	Binary	*Length* of this message including this field.
Message Type	1	1	0x82	`Spin Response` Message
Sequence	2	4	Binary	Sequence number from a `Spin Image Available` message received by the participant.
Order Count	6	4	Binary	Always zero.
Status	10	1	Alphanumeric	Accepted or reason for reject*.
Total Length = 11 bytes				
Spin Response - Status Codes				
'A'	Accepted			
'O'	Out of Range (*Sequence* requested is greater than *Sequence* available by the next spin)			
'S'	Spin already in progress (only one spin can be running at a time).			

* - All non-'A' status codes should be interpreted as a reject.

5.6 Spin Finished

The `Spin Finished` message is sent to indicate that all messages for the spin requested have been sent. A `Spin Finished` message is only sent if a `Spin Request` was not rejected. Upon receipt of a `Spin Finished` message, any buffered multicast messages should be applied to the participant's copy of the book to make it current.

Spin Finished				
Field Name	**Offset**	**Length**	**Type/(Value)**	**Description**
Length	0	1	Binary	*Length* of this message including this field.
Message Type	1	1	0x83	`Spin Finished` Message
Sequence	2	4	Binary	Sequence number from the `Spin Request` message.
Total Length = 6 bytes				

5.7 Instrument Definition Request (C1 Only) Effective in BZX, C2, and EDGX with Feature Pack 4

The `Instrument Definition Request` message is used by a user's process to request transmission of this unit's Symbol Mappings. Refer to Section 1.6 for more complete details regarding *Sequence* specification as well as buffering requirements.

Instrument Definition Request				
Field Name	**Offset**	**Length**	**Type/(Value)**	**Description**
Length	0	1	Binary	*Length* of this message including this field

Message Type	1	1	0x84	`Instrument Definition Request` Message
Sequence	2	4	Binary	Must be 0. Only the current Symbol Mappings are available.
Total Length = 6 bytes				

5.8 Instrument Definition Response (C1 Only) Effective in BZX, C2, and EDGX with Feature Pack 4

The `Instrument Definition Response` message is sent in response to a user's `Instrument Definition Request` message indicating whether a spin will be sent.

Instrument Definition Response				
Field Name	**Offset**	**Length**	**Type/(Value)**	**Description**
Length	0	1	Binary	*Length* of this message including this field
Message Type	1	1	0x85	`Instrument Definition Response` Message
Sequence	2	4	Binary	Will always be 0.
Instrument Count	6	4	Binary	Number of `Symbol Mapping` messages which will be contained in this spin.
Status	10	1	Alphanumeric	Accepted or reason for reject
Total Length = 11 bytes				

Instrument Definition Response - Status Codes	
'A'	Accepted
'O'	Out of Range (*Sequence* must be 0)
'S'	Spin already in progress (only one spin can be running at a time)

* - All non-'A' status codes should be interpreted as a reject.

5.9 Instrument Definition Finished (C1 Only) Effective in BZX, C2, and EDGX with Feature Pack 4

The `Instrument Definition Finished` message is sent to indicate that all `Symbol Mapping` messages for this unit have been sent. An `Instrument Definition Finished` message is only sent if an `Instrument Definition Request` was not rejected.

Instrument Definition Finished				
Field Name	**Offset**	**Length**	**Type/(Value)**	**Description**
Length	0	1	Binary	*Length* of this message including this field
Message Type	1	1	0x86	`Instrument Definition Finished` Message
Total Length = 2 bytes				

5.10 Spin Server Usage Example

The following diagram (see next page) shows the exchange of messages over time between a participant and Cboe's Multicast Top feed and Spin Server. `Time` messages may be found mixed between `Market Snapshot` messages according to their timestamps.

At time 1, the participant has no state of the book and desires to become current. The participant caches the received Multicast Top messages (sequences 310172 and 310173) for later use. Since the participant has no book, they cannot yet be applied.

At time 5, the participant has successfully logged into the Spin Server and has cached another message, sequence 310174.

At time 7, the participant receives a `Spin Image Available` message which indicates that the spin server is capable of giving them a spin of all symbols as of sequence 310169. The participant does not have all messages cached after 310169 (they are missing 310170 and 310171), so this spin is not useful to the participant.

At time 10, the participant receives a `Spin Image Available` message which is useful since it would be a spin of all orders up to and including sequence 310175 and the participant has all messages after 310175 cached.

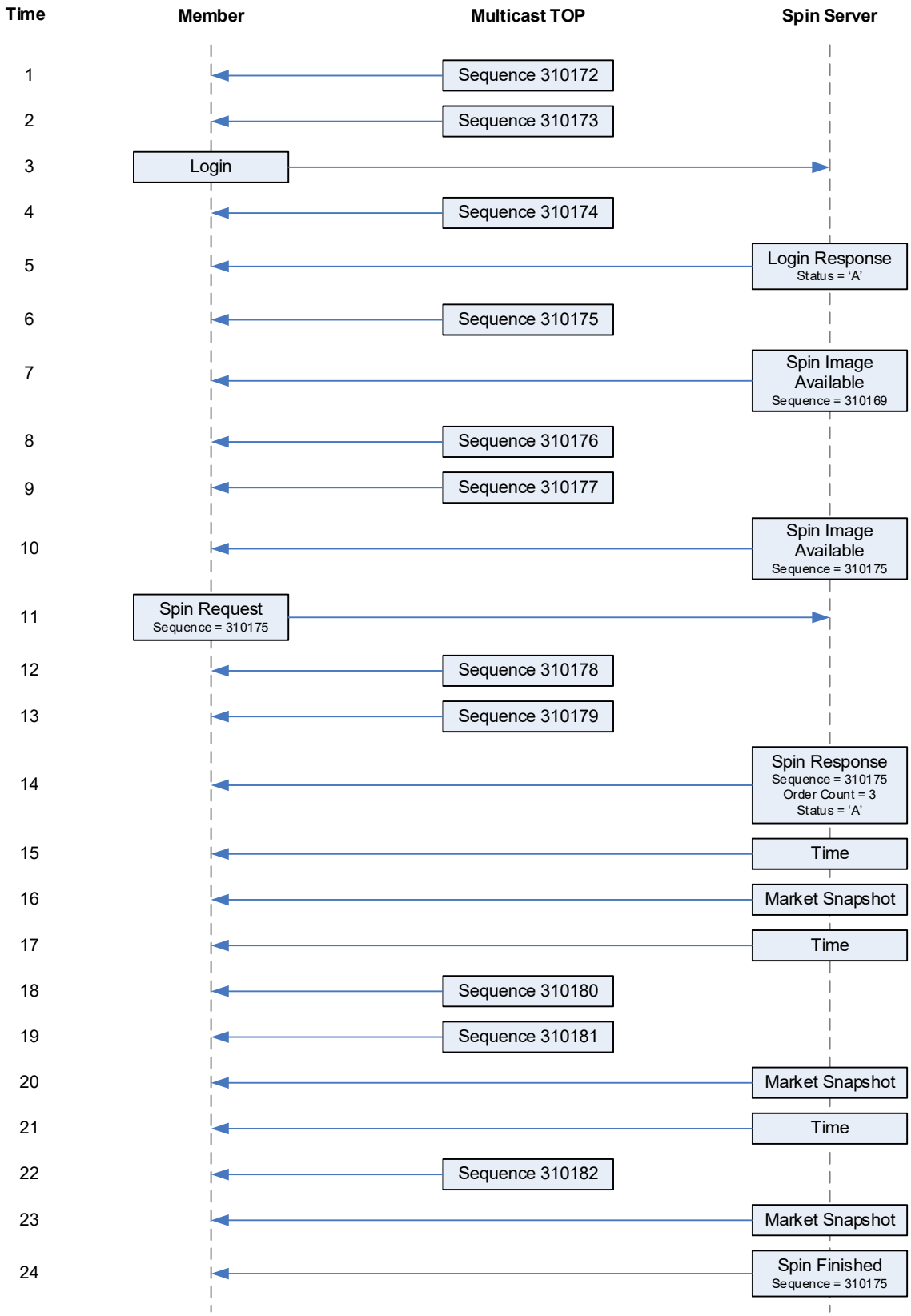
At time 11, the participant sends a `Spin Request` for all messages up to and including 310175 and continues to cache Multicast Top messages received.

At time 14, the Spin Server acknowledges the `Spin Request` and indicates that three symbols will be sent.

At time 24, the spin server indicates that it has finished sending all open orders. The participant must then apply the cached messages from sequence number 310176 through current.

Notes:

- Spin Servers are available for each unit. Participants may need to employ multiple Spin Servers depending upon their architecture.



6 Message Types

6.1 Gap Request Proxy Messages

0x01	Login
0x02	Login Response
0x03	Gap Request
0x04	Gap Response

6.2 Spin Server Messages

0x01	Login
0x02	Login Response
0x80	Spin Image Available
0x81	Spin Request
0x82	Spin Response
0x83	Spin Finished
0x84	Instrument Definition Request
0x85	Instrument Definition Response
0x86	Instrument Definition Finished

6.3 Top Messages

0x20	Time
0x97	Unit Clear
0x2E	Symbol Mapping
0xB2	Market Snapshot (Short)
0xB3	Market Snapshot (Long)
0xB4	Single Side Update (Short)
0xD4	Single Side Update Expanded (Short)
0xB5	Single Side Update (Long)
0xD5	Single Side Update Expanded (Long)
0xB6	Two Side Update (Short)
0xD6	Two Side Update Expanded (Short)
0xB7	Two Side Update (Long)
0xD7	Two Side Update Expanded (Long)
0xB8	Top Trade
0xD1	Options Auction Update
0x96	Auction Summary
0x31	Trading Status
0xD2	Width Update
0x2D	End of Session

7 Example Messages

Each of the following message types must be wrapped by a sequenced or un-sequenced unit header as described in Section 2.4. Note that in the following examples, each byte is represented by two hexadecimal digits.

7.1 Login Message

Length	16	22 bytes
Type	01	Login
SessionSubId	30 30 30 31	"0001"
Username	46 49 52 4D	"FIRM"
Filler	20 20	" "
Password	41 42 43 44 30 30 20 20 20 20	"ABCD00"

7.2 Login Response Message

Length	03	3 bytes
Type	02	Login Response
Status	41	Login accepted

7.3 Gap Request Message

Length	09	9 bytes
Type	03	Gap Request
Unit	01	Unit 1
Sequence	3B 10 00 00	First message: 4155
Count	32 00	50 messages

7.4 Gap Response Message

Length	08	8 bytes
Type	04	Gap Response
Unit	01	Unit 1
Sequence	3B 10 00 00	First message: 4155
Status	41	Accepted

7.5 Spin Image Available Message

Length	06	6 bytes
Type	80	Spin Image Available
Sequence	3B 10 00 00	Sequence: 4155

7.6 Spin Request Message

Length	06	6 bytes
Type	81	Spin Request
Sequence	3B 10 00 00	Sequence: 4155

7.7 Spin Response Message

Length	0B	11 bytes
Type	82	Spin Request
Sequence	3B 10 00 00	Sequence: 4155
Order Count	00 00 00 00	0 orders
Status	41	Accepted

7.8 Spin Finished Message

Length	06	6 bytes
Type	83	Spin Finished
Sequence	3B 10 00 00	Sequence: 4155

7.9 Instrument Definition Request (C1 Only) Effective in BZX, C2, and EDGX with Feature Pack 4

Length	06	6 bytes
Type	84	Instrument Definition Request
Sequence	00 00 00 00	Sequence: 0

7.10 Instrument Definition Response (C1 Only) Effective in BZX, C2, and EDGX with Feature Pack 4

Length	0B	11 bytes
Type	85	Instrument Definition Response
Sequence	00 00 00 00	Sequence: 0
Instrument Count	B8 0B 00 00	3,000 Instruments
Status	41	Accepted

7.11 Instrument Definition Finished (C1 Only) Effective in BZX, C2, and EDGX with Feature Pack 4

Length	02	2 bytes
Type	86	Instrument Definition Finished

7.12 Time Message

Length	06	6 bytes
Type	20	Time
Time	98 85 00 00	34,200 seconds = 09:30 AM Eastern

7.13 Unit Clear

Length	06	6 bytes
Type	97	Unit Clear
Time Offset	18 D2 06 00	447,000 ns since last Time Message

7.14 Market Snapshot (Short) Deprecated with Feature Pack 4

Length	26	38 bytes
Type	B2	Market Snapshot (Short)
Time Offset	08 5C 44 25	625,237,000 ns
Symbol	30 31 32 33 34 35	012345
Unit Timestamp	E6 EB 99 5A	2018-03-02 12:27:18 Eastern
Bid Price	41 01	$3.21
Bid Size	BC 02	700 contracts
Ask Price	B0 01	$4.32
Ask Size	84 03	900 contracts
Last Trade Price	8F 01	$3.99
Last Trade Size	FE FF	65,534 contracts
Last Trade Condition	20	(space) Normal Trade
Total Volume	32 54 76 98	2,557,891,634 contracts
Trading Status	54	T - Trading
Reserved	31 20 20	Reserved
Bit Fields	00	Neither bid nor ask have customer orders

7.15 Market Snapshot (Long) Deprecated with Feature Pack 4

Length	3E	62 bytes
Type	B3	Market Snapshot (Long)
Time Offset	08 5C 44 25	625,237,000 ns
Symbol	30 31 32 33 34 35	012345
Unit Timestamp	E6 EB 99 5A	2018-03-02 12:27:18 Eastern
Bid Price	64 7D 00 00 00 00 00 00	$3.21
Bid Size	BC 02 00 00	700 contracts
Ask Price	E0 F4 8F 04 00 00 00 00	$7,654.32
Ask Size	84 03 00 00	900 contracts
Last Trade Price	DC 9B 00 00 00 00 00 00	$3.99
Last Trade Size	64 00 00 00	100 contracts
Last Trade Condition	20	(space) Normal Trade
Total Volume	78 56 34 12	305,419,896 contracts
Trading Status	54	T - Trading
Reserved	31 20 20	Reserved
Bit Fields	06	Bid and ask have customer orders

7.16 Single Side Update (Short) Deprecated with Feature Pack 4

Length	12	18 bytes
Type	B4	Single Side Update (Short)
Time Offset	30 FA D3 29	701,758,000 ns since last Time Message
Symbol	30 31 32 33 34 35	012345
Side	42	B (Buy)
Price	7B 00	$1.23
Quantity	64 00	100 contracts
Bit Fields	02	Bid has customer orders

7.17 Single Side Update Expanded (Short) (C1 Only) Effective in BZX, C2, and EDGX with Feature Pack 4

Length	14	20 bytes
Type	D4	Single Side Update Expanded (Short)
Time Offset	30 FA D3 29	701,758,000 ns since last Time Message
Symbol	30 31 32 33 34 35	012345
Side	42	B (Buy)
Bitfields	00	Firm Quote
Price	7B 00	$1.23
Quantity	64 00	100 Contracts
Customer Quantity	64 00	100 Contracts

7.18 Single Side Update (Long) Deprecated with Feature Pack 4

Length	1A	26 bytes
Type	B5	Single Side Update (Long)
Time Offset	30 FA D3 29	701,758,000 ns since last Time Message
Symbol	30 31 32 33 34 35	012345
Side	53	S (Sell)
Price	E0 F4 8F 04 00 00 00 00	$7654.3200
Quantity	64 00 00 00	100 contracts
Bit Fields	04	Ask has customer orders

7.19 Single Side Update Expanded (Long) (C1 Only) Effective in BZX, C2, and EDGX with Feature Pack 4

Length	1E	30 bytes
Type	D5	Single Side Update Expanded (Long)
Time Offset	30 FA D3 29	701,758,000 ns since

		last Time Message
Symbol	30 31 32 33 34 35	012345
Side	42	B (Buy)
Bitfields	00	Firm Quote
Price	E0 F4 8F 04 00 00 00 00	$7654.3200
Quantity	64 00	100 Contracts
Customer Quantity	64 00	100 Contracts

7.20 Two Side Update (Short) Deprecated with Feature Pack 4

Length	15	21 bytes
Type	B6	Two Side Update (Short)
Time Offset	30 FA D3 29	701,758,000 ns since last Time Message
Symbol	30 31 32 33 34 35	012345
Bid Price	41 01	$3.21
Bid Quantity	64 00	100
Ask Price	43 01	$3.23
Ask Quantity	C8 00	200
Bit Fields	02	Bid has customer orders

7.21 Two Side Update Expanded (Short) (C1 Only) Effective in BZX, C2, and EDGX with Feature Pack 4

Length	19	25 bytes
Type	D6	Two Side Update Expanded (Short)
Time Offset	30 FA D3 29	701,758,000 ns since last Time Message
Symbol	30 31 32 33 34 35	012345
Bitfields	08	AON (All or None)
Bid Price	41 01	$3.21
Bid Quantity	64 00	100
Bid Customer Quantity	32 00	50
Ask Price	43 01	$3.23
Ask Quantity	C8 00	200
Ask Customer Quantity	64 00	100

7.22 Two Side Update (Long) Deprecated with Feature Pack 4

Length	25	37 bytes
Type	B7	Two Side Update (Long)
Time Offset	30 FA D3 29	701,758,000 ns since last Time Message
Symbol	30 31 32 33 34 35	012345
Bid Price	64 7D 00 00 00 00 00 00	$3.2100
Bid Quantity	00 00 01 00	65536

Ask Price	2C 7E 00 00 00 00 00 00	$3.2300
Ask Quantity	C8 00 00 00	200
Bit Fields	04	Ask has customer orders

7.23 Two Side Update Expanded (Long) (C1 Only) Effective in BZX, C2, and EDGX with Feature Pack 4

Length	2D	45 bytes
Type	D7	Two Side Update Expanded (Long)
Time Offset	30 FA D3 29	701,758,000 ns since last Time Message
Symbol	30 31 32 33 34 35	012345
Bitfields	00	Firm Quote
Bid Price	64 7D 00 00 00 00 00 00	$3.2100
Bid Quantity	00 00 01 00	65536
Bid Customer Quantity	64 00	100
Ask Price	2C 7E 00 00 00 00 00 00	$3.2300
Ask Quantity	C8 00 00 00	200
Ask Customer Quantity	64 00	100

7.24 Top Trade

Length	25	37 bytes
Type	B8	Trade
Time Offset	10 84 D4 23	601,130,000 ns since last Time Message
Symbol	36 35 34 33 32 31	654321
Quantity	BC 02 00 00	700 contracts
Price	08 E2 01 00 00 00 00 00	$12.34
Execution Id	34 2B 46 E0 BB 00 00 00	0AAP09VEC
Total Volume	40 42 0F 00 00 00 00 00	1,000,000 contracts
Trade Condition	20	Normal Trade (space)

7.25 Top Trade (Condition = Trade Break)

Length	25	37 bytes
Type	B8	Trade
Time Offset	10 84 D4 23	601,130,000 ns since last Time Message
Symbol	36 35 34 33 32 31	654321
Quantity	BC 02 00 00	700 contracts
Price	08 E2 01 00 00 00 00 00	$12.34
Execution Id	34 2B 46 E0 BB 00 00 00	0AAP09VEC
Total Volume	84 3F 0F 00 00 00 00 00	999,300 contracts
Trade Condition	58	X - Trade Break

7.26 Options Auction Update Message (C1 Only)

Length	30	48 bytes
Type	D1	Options Auction Update
Time offset	18 D2 06 00	447,000 ns since last Time Message
Symbol	30 30 6D 45 56 4F	00mEVO
Auction Type	56	Volatilty Auction
Reference Price	E8 A3 0F 00 00 00 00 00	$102.50
Buy Contracts	64 00 00 00	100 Contracts
Sell Contracts	C8 00 00 00	200 Contracts
Indicative Price	E8 A3 0F 00 00 00 00 00	$102.50
Auction Only Price	E8 A3 0F 00 00 00 00 00	$102.50
Opening Condition	4F	O = Would Open

7.27 Auction Summary Message (C1 Only)

Length	1B	27 bytes
Type	96	Auction Summary
Time offset	18 D2 06 00	447,000 ns since last Time Message
Symbol	30 30 6D 45 56 5F 20 20	00mEVO
Auction Type	4F	O = Opening
Price	E8 A3 0F 00 00 00 00 00	$102.50
Quantity	4B 00 00 00	75

7.28 Symbol Mapping Message Deprecated with Feature Pack 4

Length	1E	30 bytes
Type	2E	Symbol Mapping Message
Feed Symbol	31 20 20 20 20 20	
OSI Symbol	4D 53 46 54 20 20 31 30 30 31 31 36 43 30 30 30 34 37 35 30 30	MSFT 100116C00047500
Symbol Condition	43	'C' - Closing Only

7.29 Symbol Mapping Message (C1 Only) Effective in BZX, C2, and EDGX with Feature Pack 4

Length	26	38 bytes
Type	2E	Symbol Mapping Message
Feed Symbol	30 30 6D 45 56 4F	00mEVO
OSI Symbol	4D 53 46 54 20 20 31 30 30 31 31 36 43 30 30 30 34 37 35 30 30	MSFT 100116C00047500
Symbol Condition	4E	'N' - Closing Only
Underlying	4D 53 46 54 20 20 20 20	MSFT

7.30 Trading Status Message Deprecated with Feature Pack 4

Length	12	18 bytes
Type	31	Trading Status
Time Offset	18 D2 06 00	447,000 ns since last Time Message
Symbol	39 39 38 38 37 37	998877
Reserved	20 20	Reserved
Trading Status	54	T = Trading
Reserved	30 20 20	Reserved

7.31 Trading Status Message (C1 Only) Effective in BZX, C2, and EDGX with Feature Pack 4

Length	12	18 bytes
Type	31	Trading Status
Time Offset	18 D2 06 00	447,000 ns since last Time Message
Symbol	39 39 38 38 37 37	998877
Reserved	20 20	Reserved
Trading Status	54	T = Trading
Reserved	20	Reserved
Global Trading Hours Status	48	H = Halted
Reserved	20	Reserved

7.32 Width Update Message (C1 Only)

Length	13	19 bytes
Type	D2	Width Update
Time Offset	18 D2 06 00	447,000 ns since last Time Message
Underlying	5A 56 5A 5A 54 20 20 20	ZVZZT
Width Type	52	R = Regular
Multiplier	0F 00 00 00	Multiplier of 1.5

7.33 Sequenced Unit Header with 2 Messages

Sequenced Unit Header

Hdr Length	3F 00	63 bytes, including header
Hdr Count	02	2 messages to follow
Hdr Unit	01	Unit 1
Hdr Sequence	01 00 00 00	First message has sequence number 1

Message 1: Trade

Length	25	37 bytes
Type	B4	Trade
Time Offset	10 84 D4 23	601,130,000 ns since last Time Message
Symbol	36 35 34 33 32 31	654321
Reserved	20 20	

Quantity	BC 02 00 00	700 contracts
Price	08 E2 01 00 00 00 00 00	$12.34
Execution Id	34 2B 46 E0 BB 00 00 00	0AAP09VEC
Total Volume	40 42 0F 00 00 00 00 00	1,000,000 contracts
Trade Condition	20	Normal Trade (space)

Message 2: Single Side Update

Length	12	18 bytes
Type	B8	Single Side Update (Short)
Time Offset	30 FA D3 29	701,758,000 ns since last Time Message
Symbol	36 35 34 33 32 31	654321
Side	42	B (Buy)
Price	0C 30	$1.23
Quantity	64 00	100 contracts
Bit Fields	02	Bid has customer orders

8 Multicast Configuration

8.1 Production Environment Configuration

8.1.1 Limitations/Configurations

The following table defines the configuration for network and gap request limitations. These limitations are session based. Cboe reserves the right to adjust the gap request limitations to improve the effectiveness of the gap request infrastructure.

Period/Type	Limit/Setting	Notes
MTU	1500	Cboe will send UDP messages up to 1500 bytes. Participants should ensure that their infrastructure is configured accordingly.
Gig-Shaped Throttle	1 Gb/s	The real-time and gap multicast head ends are configured to shape their output to this level to minimize packet loss.
Gap Response Delay	2 ms	The Gap Server will delay resending sequenced messages via multicast for the specified limit in order to satisfy multiple GRP gap requests with one multicast response.
Count	100	Any single gap request may not be for more than this number of dropped messages.
1 Second	320 Requests	This is the maximum number of retransmission requests allowed per second for each session. This is renewed every clock second.
1 Minute	1,500 Requests	This is the maximum number of retransmission requests allowed per minute for each session. This is renewed every clock minute.
Day	100,000 Requests	This is the maximum number of retransmission requests allowed per day for each session.
Within Range	1,000,000 Messages	Users' retransmission requests must be within this many messages of the most recent sequence sent by the real-time feed per session.

8.1.2 Unit/Product Distribution

Unit	BZX Symbol Range	C1 Symbol Range	C2 Symbol Range	EDGX Symbol Range
1	A – ADOZZ	TBD	A – ADOZZ	A – ADOZZ
2	ADP – ANETZ* *except AMZN	TBD	ADP – ANETZ* *except AMZN	ADP – ANETZ* *except AMZN
3	ANEU – BAAAZ	TBD	ANEU – BAAAZ	ANEU – BAAAZ
4	BAAB – BKNFZ	TBD	BAAB – BKNFZ	BAAB – BKNFZ
5	BKNG – BZZZZ	TBD	BKNG – BZZZZ	BKNG – BZZZZ
6	C – CLGXZ	TBD	C – CLGXZ	C – CLGXZ
7	CLGY – CSXAZ	TBD	CLGY – CSXAZ	CLGY – CSXAZ
8	CSXB – DISAZ	TBD	CSXB – DISAZ	CSXB – DISAZ
9	DISB – ETFBZ	TBD	DISB – ETFBZ	DISB – ETFBZ
10	ETFC – FIVDZ	TBD	ETFC – FIVDZ	ETFC – FIVDZ
11	FIVE – GLDAZ	TBD	FIVE – GLDAZ	FIVE – GLDAZ
12	GLDB – GOOGZ	TBD	GLDB – GOOGZ	GLDB – GOOGZ
13	GOOH – HSXZZ	TBD	GOOH – HSXZZ	GOOH – HSXZZ
14	HSY – IWLZZ	TBD	HSY – IWLZZ	HSY – IWLZZ
15	IWM – JNJAZ	TBD	IWM – JNJAZ	IWM – JNJAZ
16	JNJB – LMTAZ	TBD	JNJB – LMTAZ	JNJB – LMTAZ
17	LMTB – MLNXZ	TBD	LMTB – MLNXZ	LMTB – MLNXZ
18	MLNY – MUAAZ	TBD	MLNY – MUAAZ	MLNY – MUAAZ
19	MUAB – NTESZ	TBD	MUAB – NTESZ	MUAB – NTESZ
20	NTET – OXYAZ	TBD	NTET – OXYAZ	NTET – OXYAZ
21	OXYB – QGENZ	TBD	OXYB – QGENZ	OXYB – QGENZ
22	QGEO – RHAAZ	TBD	QGEO – RHAAZ	QGEO – RHAAZ
23	RHAB – SMGZZ* *except RUT	TBD	RHAB – SMGZZ* *except RUT, RUTW	RHAB – SMGZZ
24	SMH – SYEZZ* *except SPY	TBD	SMH – SYEZZ* *except SPY	SMH – SYEZZ* *except SPY
25	SYF – TSKZZ	TBD	SYF – TSKZZ	SYF – TSKZZ
26	TSL – UALAZ	TBD	TSL – UALAZ	TSL – UALAZ
27	UALB – VLOAZ	TBD	UALB – VLOAZ	UALB – VLOAZ
28	VLOB – WDCAZ	TBD	VLOB – WDCAZ	VLOB – WDCAZ
29	WDCB – XLDZZ	TBD	WDCB – XLDZZ	WDCB – XLDZZ
30	XLE – ZZZZZ	TBD	XLE – ZZZZZ	XLE – ZZZZZ
31	AMZN	TBD	AMZN	AMZN
32	SPY	TBD	SPY	SPY
33	RUT	TBD	RUT, RUTW	N/A
34	N/A	TBD	N/A	N/A
35	N/A	TBD	N/A	N/A

Note - Cboe reserves the right to add units and/or change symbol distribution with 48 hours of notice and no migration period. Notice will be given that the distribution will change on a certain date. Care should be taken to support mappings in these tables via software configuration.

8.1.3 BZX Options Multicast Routing Parameters

Data Center	Rendezvous Point
NY5 Primary Data Center A feed	74.115.128.178
NY5 Primary Data Center B feed	74.115.128.179
CH4 Secondary Data Center E feed	174.136.181.223

8.1.4 C1 Options Multicast Routing Parameters

Data Center	Rendezvous Point
NY5 Primary Data Center A feed	TBD
NY5 Primary Data Center B feed	TBD
CH4 Secondary Data Center E feed	TBD

8.1.5 C2 Options Multicast Routing Parameters

Data Center	Rendezvous Point
NY5 Primary Data Center A feed	74.115.128.174
NY5 Primary Data Center B feed	74.115.128.175
400 S. LaSalle Secondary Data Center E feed	170.137.16.133

8.1.6 EDGX Options Multicast Routing Parameters

Data Center	Rendezvous Point
NY5 Primary Data Center A feed	74.115.128.180
NY5 Primary Data Center B feed	74.115.128.181
CH4 Secondary Data Center E feed	174.136.181.251

8.1.7 BZX Options Address/Unit Distribution

The following tables describe the unit distribution across the BZX Options Multicast Top feeds.

NY5 Primary Datacenter		Gig-Shaped [OAT] 174.136.164.128/28		Gig-Shaped [OBT] 174.136.164.144/28	
Unit	**IP Port**	**Real-time MC**	**Gap Resp. MC**	**Real-time MC**	**Gap Resp. MC**
1	30151	224.0.62.0	224.0.62.4	224.0.73.0	224.0.73.4
2	30152				
3	30153				
4	30154				
5	30155				
6	30156				
7	30157				
8	30158				
9	30159	224.0.62.1	224.0.62.5	224.0.73.1	224.0.73.5
10	30160				
11	30161				
12	30162				
13	30163				
14	30164				
15	30165				
16	30166				
17	30167	224.0.62.2	224.0.62.6	224.0.73.2	224.0.73.6
18	30168				
19	30169				
20	30170				
21	30171				
22	30172				
23	30173				
24	30174				
25	30175	224.0.62.3	224.0.62.7	224.0.73.3	224.0.73.7
26	30176				
27	30177				
28	30178				
29	30179				
30	30180				
31	30181				
32	30182				
33	30183				

Note - Cboe reserves the right to add multicast addresses with prior notice, but no migration period. Notice will be given that the distribution will change on a certain date. Care should be taken to support mappings in these tables via software configuration.

CH4 Secondary Datacenter		Gig-Shaped [OET] 174.136.181.192/28	
Unit	**IP Port**	**Real-time MC**	**Gap Resp. MC**
1	31851	233.19.3.160	233.19.3.164
2	31852		
3	31853		
4	31854		
5	31855		
6	31856		
7	31857		
8	31858		
9	31859	233.19.3.161	233.19.3.165
10	31860		
11	31861		
12	31862		
13	31863		
14	31864		
15	31865		
16	31866		
17	31867	233.19.3.162	233.19.3.166
18	31868		
19	31869		
20	31870		
21	31871		
22	31872		
23	31873		
24	31874		
25	31875	233.19.3.163	233.19.3.167
26	31876		
27	31877		
28	31878		
29	31879		
30	31880		
31	31881		
32	31882		
33	31883		

Note - Cboe reserves the right to add multicast addresses with prior notice, but no migration period. Notice will be given that the distribution will change on a certain date. Care should be taken to support mappings in these tables via software configuration.

8.1.8 C1 Options Address/Unit Distribution

The following tables describe the unit distribution across the C1 Options Multicast Top feeds.

NY5 Primary Datacenter		Gig-Shaped [CAT] TBD		Gig-Shaped [CBT] TBD	
Unit	**IP Port**	**Real-time MC**	**Gap Resp. MC**	**Real-time MC**	**Gap Resp. MC**
1	TBD	TBD	TBD	TBD	TBD
2	TBD				
3	TBD				
4	TBD				
5	TBD				
6	TBD				
7	TBD				
8	TBD				
9	TBD	TBD	TBD	TBD	TBD
10	TBD				
11	TBD				
12	TBD				
13	TBD				
14	TBD				
15	TBD				
16	TBD				
17	TBD	TBD	TBD	TBD	TBD
18	TBD				
19	TBD				
20	TBD				
21	TBD				
22	TBD				
23	TBD				
24	TBD				
25	TBD	TBD	TBD	TBD	TBD
26	TBD				
27	TBD				
28	TBD				
29	TBD				
30	TBD				
31	TBD				
32	TBD				
33	TBD	TBD	TBD	TBD	TBD
34	TBD				
35	TBD				

Note - Cboe reserves the right to add multicast addresses with prior notice, but no migration period. Notice will be given that the distribution will change on a certain date. Care should be taken to support mappings in these tables via software configuration.

CH4 Secondary Datacenter		Gig-Shaped [CET] TBD	
Unit	**IP Port**	**Real-time MC**	**Gap Resp. MC**
1	TBD	TBD	TBD
2	TBD		
3	TBD		
4	TBD		
5	TBD		
6	TBD		
7	TBD		
8	TBD		
9	TBD	TBD	TBD
10	TBD		
11	TBD		
12	TBD		
13	TBD		
14	TBD		
15	TBD		
16	TBD		
17	TBD	TBD	TBD
18	TBD		
19	TBD		
20	TBD		
21	TBD		
22	TBD		
23	TBD		
24	TBD		
25	TBD	TBD	TBD
26	TBD		
27	TBD		
28	TBD		
29	TBD		
30	TBD		
31	TBD		
32	TBD		
33	TBD	TBD	TBD
34	TBD		
35	TBD		

Note - Cboe reserves the right to add multicast addresses with prior notice, but no migration period. Notice will be given that the distribution will change on a certain date. Care should be taken to support mappings in these tables via software configuration.

8.1.9 C2 Options Address/Unit Distribution

The following tables describe the unit distribution across the C2 Options Multicast Top feeds.

NY5 Primary Datacenter		Gig-Shaped [WAT] 174.136.168.224/28		Gig-Shaped [WBT] 174.136.168.240/28	
Unit	**IP Port**	**Real-time MC**	**Gap Resp. MC**	**Real-time MC**	**Gap Resp. MC**
1	30251	224.0.131.240	224.0.131.244	233.130.124.240	233.130.124.244
2	30252				
3	30253				
4	30254				
5	30255				
6	30256				
7	30257				
8	30258				
9	30259	224.0.131.241	224.0.131.245	233.130.124.241	233.130.124.245
10	30260				
11	30261				
12	30262				
13	30263				
14	30264				
15	30265				
16	30266				
17	30267	224.0.131.242	224.0.131.246	233.130.124.242	233.130.124.246
18	30268				
19	30269				
20	30270				
21	30271				
22	30272				
23	30273				
24	30274				
25	30275	224.0.131.243	224.0.131.247	233.130.124.243	233.130.124.247
26	30276				
27	30277				
28	30278				
29	30279				
30	30280				
31	30281				
32	30282				
33	30283				

Note - Cboe reserves the right to add multicast addresses with prior notice, but no migration period. Notice will be given that the distribution will change on a certain date. Care should be taken to support mappings in these tables via software configuration.

400 S. LaSalle Secondary Datacenter		Gig-Shaped [WET] 170.137.17.88/29	
Unit	**IP Port**	**Real-time MC**	**Gap Resp. MC**
1	31251	233.182.199.96	233.182.199.100
2	31252		
3	31253		
4	31254		
5	31255		
6	31256		
7	31257		
8	31258		
9	31259	233.182.199.97	233.182.199.101
10	31260		
11	31261		
12	31262		
13	31263		
14	31264		
15	31265		
16	31266		
17	31267	233.182.199.98	233.182.199.102
18	31268		
19	31269		
20	31270		
21	31271		
22	31272		
23	31273		
24	31274		
25	31275	233.182.199.99	233.182.199.103
26	31276		
27	31277		
28	31278		
29	31279		
30	31280		
31	31281		
32	31282		
33	31283		

Note - Cboe reserves the right to add multicast addresses with prior notice, but no migration period. Notice will be given that the distribution will change on a certain date. Care should be taken to support mappings in these tables via software configuration.

8.1.10 EDGX Options Address/Unit Distribution

The following tables describe the unit distribution across the EDGX Options Multicast Top feeds.

NY5 Primary Datacenter		Gig-Shaped [EAT] 174.136.164.160/28		Gig-Shaped [EBT] 174.136.164.176/28	
Unit	**IP Port**	**Real-time MC**	**Gap Resp. MC**	**Real-time MC**	**Gap Resp. MC**
1	30751	224.0.62.8	224.0.62.12	224.0.73.8	224.0.73.12
2	30752				
3	30753				
4	30754				
5	30755				
6	30756				
7	30757				
8	30758				
9	30759	224.0.62.9	224.0.62.13	224.0.73.9	224.0.73.13
10	30760				
11	30761				
12	30762				
13	30763				
14	30764				
15	30765				
16	30766				
17	30767	224.0.62.10	224.0.62.14	224.0.73.10	224.0.73.14
18	30768				
19	30769				
20	30770				
21	30771				
22	30772				
23	30773				
24	30774				
25	30775	224.0.62.11	224.0.62.15	224.0.73.11	224.0.73.15
26	30776				
27	30777				
28	30778				
29	30779				
30	30780				
31	30781				
32	30782				

Note - Cboe reserves the right to add multicast addresses with prior notice, but no migration period. Notice will be given that the distribution will change on a certain date. Care should be taken to support mappings in these tables via software configuration.

CH4 Secondary Datacenter		Gig-Shaped [EET] 174.136.176.112/28	
Unit	**IP Port**	**Real-time MC**	**Gap Resp. MC**
1	31701	233.19.3.168	233.19.3.172
2	31702		
3	31703		
4	31704		
5	31705		
6	31706		
7	31707		
8	31708		
9	31709	233.19.3.169	233.19.3.173
10	31710		
11	31711		
12	31712		
13	31713		
14	31714		
15	31715		
16	31716		
17	31717	233.19.3.170	233.19.3.174
18	31718		
19	31719		
20	31720		
21	31721		
22	31722		
23	31723		
24	31724		
25	31725	233.19.3.171	233.19.3.175
26	31726		
27	31727		
28	31728		
29	31729		
30	31730		
31	31731		
32	31732		

Note - Cboe reserves the right to add multicast addresses with prior notice, but no migration period. Notice will be given that the distribution will change on a certain date. Care should be taken to support mappings in these tables via software configuration.

8.2 Certification Environment Configuration

8.2.1 Unit/Symbol Distribution

Unit	BZX Symbol Range	C1 Symbol Range	C2 Symbol Range	EDGX Symbol Range
1	A – ADOZZ	TBD	A – ADOZZ	A – ADOZZ
2	ADP – ANETZ* *except AMZN	TBD	ADP – ANETZ* *except AMZN	ADP – ANETZ* *except AMZN
3	ANEU – BAAAZ	TBD	ANEU – BAAAZ	ANEU – BAAAZ
4	BAAB – BKNFZ	TBD	BAAB – BKNFZ	BAAB – BKNFZ
5	BKNG – BZZZZ	TBD	BKNG – BZZZZ	BKNG – BZZZZ
6	C – CLGXZ	TBD	C – CLGXZ	C – CLGXZ
7	CLGY – CSXAZ	TBD	CLGY – CSXAZ	CLGY – CSXAZ
8	CSXB – DISAZ	TBD	CSXB – DISAZ	CSXB – DISAZ
9	DISB – ETFBZ	TBD	DISB – ETFBZ	DISB – ETFBZ
10	ETFC – FIVDZ	TBD	ETFC – FIVDZ	ETFC – FIVDZ
11	FIVE – GLDAZ	TBD	FIVE – GLDAZ	FIVE – GLDAZ
12	GLDB – GOOGZ	TBD	GLDB – GOOGZ	GLDB – GOOGZ
13	GOOH – HSXZZ	TBD	GOOH – HSXZZ	GOOH – HSXZZ
14	HSY – IWLZZ	TBD	HSY – IWLZZ	HSY – IWLZZ
15	IWM – JNJAZ	TBD	IWM – JNJAZ	IWM – JNJAZ
16	JNJB – LMTAZ	TBD	JNJB – LMTAZ	JNJB – LMTAZ
17	LMTB – MLNXZ	TBD	LMTB – MLNXZ	LMTB – MLNXZ
18	MLNY – MUAAZ	TBD	MLNY – MUAAZ	MLNY – MUAAZ
19	MUAB – NTESZ	TBD	MUAB – NTESZ	MUAB – NTESZ
20	NTET – OXYAZ	TBD	NTET – OXYAZ	NTET – OXYAZ
21	OXYB – QGENZ	TBD	OXYB – QGENZ	OXYB – QGENZ
22	QGEO – RHAAZ	TBD	QGEO – RHAAZ	QGEO – RHAAZ
23	RHAB – SMGZZ* *except RUT	TBD	RHAB – SMGZZ* *except RUT, RUTW	RHAB – SMGZZ
24	SMH – SYEZZ* *except SPY	TBD	SMH – SYEZZ* *except SPY	SMH – SYEZZ* *except SPY
25	SYF – TSKZZ	TBD	SYF – TSKZZ	SYF – TSKZZ
26	TSL – UALAZ	TBD	TSL – UALAZ	TSL – UALAZ
27	UALB – VLOAZ	TBD	UALB – VLOAZ	UALB – VLOAZ
28	VLOB – WDCAZ	TBD	VLOB – WDCAZ	VLOB – WDCAZ
29	WDCB – XLDZZ	TBD	WDCB – XLDZZ	WDCB – XLDZZ
30	XLE – ZZZZZ	TBD	XLE – ZZZZZ	XLE – ZZZZZ
31	AMZN	TBD	AMZN	AMZN
32	SPY	TBD	SPY	SPY
33	RUT	TBD	RUT, RUTW	N/A
34	N/A	TBD	N/A	N/A
35	N/A	TBD	N/A	N/A

Note - Cboe reserves the right to add units and/or change symbol distribution with 48 hours of notice and no migration period. Notice will be given that the distribution will change on a certain date. Care should be taken to support mappings in these tables via software configuration.

8.2.2 Certification Multicast Routing Parameters

Data Center	Rendezvous Point
NY5 Certification Data Center	74.115.128.129

8.2.3 BZX Options Address/Unit Distribution

The following tables describe the unit distribution across the certification BZX Options Multicast Top feeds.

Primary Datacenter		Gig-Shaped [Cert] 174.136.174.112/28	
Unit	**IP Port**	**Real-time MC**	**Gap Resp. MC**
1	32151	224.0.74.148	224.0.74.150
2	32152		
3	32153		
4	32154		
5	32155		
6	32156		
7	32157		
8	32158		
9	32159		
10	32160		
11	32161		
12	32162		
13	32163		
14	32164		
15	32165		
16	32166		
17	32167	224.0.74.149	224.0.74.151
18	32168		
19	32169		
20	32170		
21	32171		
22	32172		
23	32173		
24	32174		
25	32175		
26	32176		
27	32177		
28	32178		
29	32179		
30	32180		
31	32181		
32	32182		
33	32183		

Note - Cboe reserves the right to add multicast addresses with prior notice, but no migration period. Notice will be given that the distribution will change on a certain date. Care should be taken to support mappings in these tables via software configuration.

8.2.4 C1 Options Address/Unit Distribution

The following tables describe the unit distribution across the certification C1 Options Multicast Top feeds.

Primary Datacenter		Gig-Shaped [Cert] TBD	
Unit	**IP Port**	**Real-time MC**	**Gap Resp. MC**
1	TBD	TBD	TBD
2	TBD		
3	TBD		
4	TBD		
5	TBD		
6	TBD		
7	TBD		
8	TBD		
9	TBD		
10	TBD		
11	TBD		
12	TBD		
13	TBD		
14	TBD		
15	TBD		
16	TBD		
17	TBD	TBD	TBD
18	TBD		
19	TBD		
20	TBD		
21	TBD		
22	TBD		
23	TBD		
24	TBD		
25	TBD		
26	TBD		
27	TBD		
28	TBD		
29	TBD		
30	TBD		
31	TBD		
32	TBD		
33	TBD		
34	TBD		
35	TBD		

Note - Cboe reserves the right to add multicast addresses with prior notice, but no migration period. Notice will be given that the distribution will change on a certain date. Care should be taken to support mappings in these tables via software configuration.

8.2.5 C2 Options Address/Unit Distribution

The following tables describe the unit distribution across the certification C2 Options Multicast Top feeds.

Primary Datacenter		Gig-Shaped [Cert] 174.136.160.80/28	
Unit	**IP Port**	**Real-time MC**	**Gap Resp. MC**
1	32301	224.0.74.172	224.0.74.174
2	32302		
3	32303		
4	32304		
5	32305		
6	32306		
7	32307		
8	32308		
9	32309		
10	32310		
11	32311		
12	32312		
13	32313		
14	32314		
15	32315		
16	32316		
17	32317	224.0.74.173	224.0.74.175
18	32318		
19	32319		
20	32320		
21	32321		
22	32322		
23	32323		
24	32324		
25	32325		
26	32326		
27	32327		
28	32328		
29	32329		
30	32330		
31	32331		
32	32332		
33	32333		

Note - Cboe reserves the right to add multicast addresses with prior notice, but no migration period. Notice will be given that the distribution will change on a certain date. Care should be taken to support mappings in these tables via software configuration.

8.2.6 EDGX Options Address/Unit Distribution

The following tables describe the unit distribution across the certification EDGX Options Multicast Top feeds.

Primary Datacenter		Gig-Shaped [Cert] 174.136.174.176/28	
Unit	**IP Port**	**Real-time MC**	**Gap Resp. MC**
1	32451	224.0.74.152	224.0.74.154
2	32452		
3	32453		
4	32454		
5	32455		
6	32456		
7	32457		
8	32458		
9	32459		
10	32460		
11	32461		
12	32462		
13	32463		
14	32464		
15	32465		
16	32466		
17	32467	224.0.74.153	224.0.74.155
18	32468		
19	32469		
20	32470		
21	32471		
22	32472		
23	32473		
24	32474		
25	32475		
26	32476		
27	32477		
28	32478		
29	32479		
30	32480		
31	32481		
32	32482		

Note - Cboe reserves the right to add multicast addresses with prior notice, but no migration period. Notice will be given that the distribution will change on a certain date. Care should be taken to support mappings in these tables via software configuration.

9 Connectivity

9.1 Supported Extranet Carriers

Cboe has certified a number of carriers defined in the Cboe US Equity/Options Connectivity Manual with respect to redistribution of Multicast data feeds. For more information on receiving Options Multicast Top through any of these providers, reach out to the vendor contact noted in the Extranet Providers section of the Connectivity Manual.

9.2 Bandwidth Recommendation

The Gig-shaped feeds require 1 Gb/s of bandwidth. Cboe will use 90% of these respective bandwidths for Multicast Top to allow participants to use the same physical connection for order entry if desired.

10 References

For more information on Cboe Symbology, please refer to the Cboe Symbology Reference document.

11 Support

Please e-mail questions or comments regarding this specification to tradedesk@cboe.com.

Revision History

Document Version	Date	Description
1.0.0	11/29/2017	Initial version.
1.0.1	12/11/2017	Corrections to Two Side Update (Long) example message. Corrected message type for `Top Trade` example message.
1.1.0	01/29/2018	Added BZX and EDGX Options Top feeds. Effective in certification on 02/02/18 and production 03/09/18.
1.1.1	02/05/2018	Added C2 Options Production IP and Port information. Improved distribution of Symbol Mapping Messages Effective 3/2/2018.
1.1.2	02/27/2018	Added IP Addresses for the BZX and EDGX Options exchanges for NY5 and CH4.
1.1.3	02/28/2018	Corrected BZX Options IPs and Ports.
1.1.4	03/08/2018	Updated Unit Distribution ranges.
1.1.5	03/14/2018	Corrected the name of the EDGX Options Feed to EAT, EBT and EET.
1.1.6	03/23/2018	Unit Distribution ranges Effective Date updated to 4/14/18.
1.1.7	06/21/2018	Corrected `Trading Status` example message. *Order Count* on `Spin Response` is always zero.
1.1.8	08/15/18	Updated BZX Options Unit Distribution ranges to support RUT on new unit 33.
1.1.9	08/21/18	Removal of Customer Indicator for C2 Options effective 08/31/18.
1.2.0	11/16/18	Added support for C1 Options.
1.2.1	12/06/18	Added notes identifying Feature Pack 4 updates.