



US Options
Complex Multicast TOP
Specification

Version 1.0.12

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1 Introduction

1.1 Overview

Note that this specification will be the standard top of book specification to be used for the US Options Exchange platform.

Cboe customers may use the Complex Multicast TOP protocol to receive real-time top of book quotations from Cboe. **Currently, feeds for the complex order book only are provided.**

The quotations received via Complex Multicast TOP provide an aggregated size and do not indicate the size or number of individual orders at the best bid or ask. The Complex 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 Cboe FIX or BOE Specification.

All current versions of the US Options Complex Multicast TOP feed are WAN-shaped (maximum 100 Mb/s) and available from both of Cboe's datacenters. Customers may choose to take one or more of the following Multicast TOP feeds depending on their location and connectivity to Cboe.

Complex Multicast TOP Feed Descriptions:

Exchange	Shaping	Served From Data Center (Primary/Secondary)	Multicast Feed ID
EDGX Complex	WAN	Primary	ECD
EDGX Complex	WAN	Primary	EDD
EDGX Complex	WAN	Secondary	EED
C2 Complex	WAN	Primary	WCD
C2 Complex	WAN	Primary	WDD
C2 Complex	WAN	Secondary	WED

1.2 Feed Connectivity Requirements

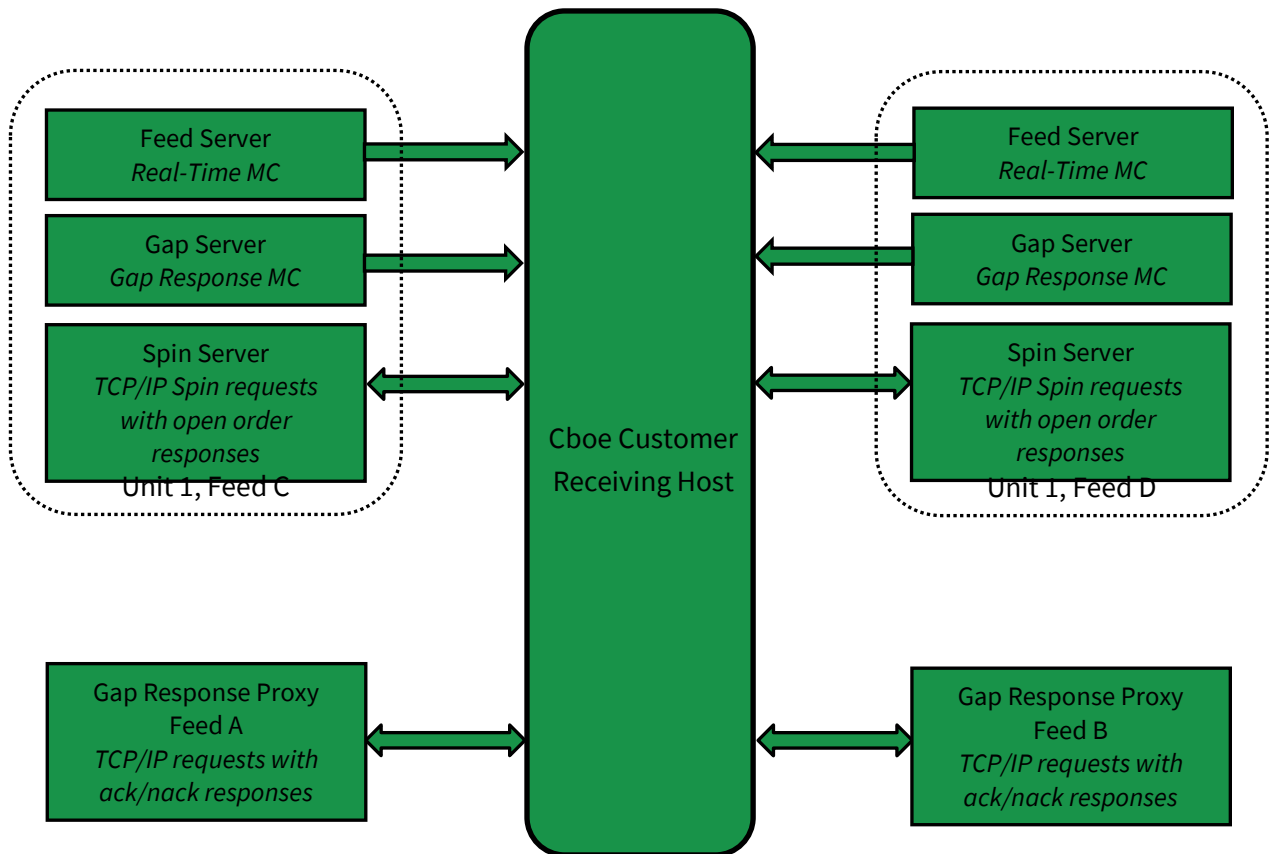
WAN-Shaped feeds are available to customers who meet the minimum bandwidth requirements to Cboe via cross-connect, dedicated circuit, or a supported carrier.

Customers with sufficient connectivity may choose to take more than one WAN-shaped feed from the Cboe's primary datacenter and arbitrate the feeds to recover lost data. Alternatively, customers 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.

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Cboe Complex 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 all open orders may be requested from a Spin Server. This allows a client to become current without requesting a gap for all messages up to that point in the day.

The following diagram is a logical representation Complex Multicast TOP feed message flow between Cboe and a customer feed handler that is listening to the “C” and “D” instances of two units:



1.3 Symbol Ranges, Units, and Sequence Numbers

Products will be separated by OSI Root into units and [product distribution](#) will not change intra-day. Cboe does, however, **reserve the right to add multicast addresses or change the product distribution with 48 hours prior notice to customers.** Care should be taken to ensure that address changes, address additions, and product 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 Complex Options Specific Symbol Processing

Cboe has implemented a Complex Instrument Creation (“CIC”) process which enables the dynamic creation of new complex instruments. As a result, new symbol IDs associated with dynamically created instruments may appear on the feed intraday.

Real-time CIC messages are available on each unit’s multicast feed. `Complex Instrument Definition` messages are used to map the 6 character feed Complex Instrument ID (“CID”) to the complex instrument definition. A complex instrument definition consists of two or more option legs. **The complex instrument is valid only for the current trading date on which it was created.** `Complex Instrument Definition` messages are sequenced messages and can be sent from pre-market through the end of trading. Once a complex instrument is created, it cannot be deleted or modified for the remainder of the trading day.

1.5 Gap Request Proxy and Message Retransmission

Requesting delivery of missed sequenced data is achieved by establishing a TCP connection to a Cboe Gap Request Proxy (“GRP”) port. This GRP port is specific to Multicast TOP and is NOT shared with the Multicast PITCH GRP or Complex Multicast PITCH GRP ports. Customers 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. Customers 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

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requested unit. Customers will receive a total daily allowance of gap requested messages. In addition, each customer 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. Customers 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 customers 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 customer can get the current book for multicast TOP 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 customer 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 customer 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`, `Complex Instrument Definition` and `Time` messages for symbols that have had orders that day or had a limited trading state. While receiving the spin, the customer must buffer multicast messages received. If the `Spin Image Available` message sequence number is the customer's reference point, multicast messages with larger sequence numbers should be buffered. If a non-`Spin Image Available` sequence number is the customer's

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reference point from 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.

[Section 5.7](#) shows an example flow of messages between a customer 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.

TOP cannot be used to enter orders. For order entry, refer to the Cboe FIX or BOE Specification.

All complex orders and executions are reflected via the TOP feed. All complex orders and executions are anonymous, and do not contain any customer identity.

2.1 Message Format

The messages that make up the TOP protocol are delivered using the Cboe `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. Customers 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 Long Price** fields are signed Little Endian encoded 8 byte binary fields with 4 implied decimal places (denominator = 10,000).

- **Binary Short Price** fields are signed Little Endian encoded 2 byte binary fields with 2 implied decimal places (denominator = 100).
- **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).
- **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.
- **Binary Date** fields are 4 byte unsigned Little Endian values where the base-10 representation is the YYYYMMDD representation of that date. For example, October 30, 2023 would be represented as 20,231,030 (20231030).
- **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 `Cboe 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 Cboe Sequenced Unit Header

The `Cboe Sequenced Unit Header` is used for all Cboe Complex 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`.

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Sequenced Unit Header				
Field	Offset	Length	Value/Type	Description
<i>Hdr Length</i>	0	2	Binary	Length of entire block of messages. Includes this header and <i>Hdr Count</i> messages to follow.
<i>Hdr Count</i>	2	1	Binary	Number of messages to follow this header.
<i>Hdr Unit</i>	3	1	Binary	Unit that applies to messages included in this header.
<i>Hdr Sequence</i>	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 a *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.

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

3.2 Unit Clear

The `Unit Clear` message instructs feed recipients to clear all market snapshots for the Cboe complex 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
<i>Length</i>	0	1	Binary	<i>Length</i> of this message including this field.
<i>Message Type</i>	1	1	0x97	Unit Clear Message
<i>Time Offset</i>	2	4	Binary	Nanosecond offset from last unit timestamp.
Total Length = 6 bytes				

3.3 Complex Instrument Definition

A `Complex Instrument Definition` message represents a complex instrument that is available to place orders. It is sent as a sequenced message.

The `Complex Instrument Definition` message will contain two or more repeating groups of leg definitions. There is a limit of 12 leg definitions.

The `Leg Offset` field is provided to support adding additional fields to this message between the offset field and the Leg definitions. A `Leg Offset` of 1 means the leg definitions begin immediately following the `Leg Offset` field.

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Complex Instrument Definition				
Field Name	Offset	Length	Type/(Value)	Description
<i>Length</i>	0	1	Binary	<i>Length</i> of this message including this field
<i>Message Type</i>	1	1	0x99	Complex Instrument Definition Message
<i>Time offset</i>	2	4	Binary	Nanosecond offset from last unit timestamp
<i>Complex Instrument Id</i>	6	6	Printable ASCII	Complex Instrument Id right padded with spaces
<i>Leg Count</i>	12	1	Binary	The number of legs in this complex instrument
<i>Leg Offset</i>	13	1	Binary	Leg definitions begin this many bytes past this field
The following fields repeat <i>Leg Count</i> times (maximum of 12) for multi-leg strategies.				
<i>Leg Ratio</i>	13 + Leg Offset + (10 * Leg Index)	4	Signed Binary	Leg ratio (positive for buy-side, negative for sell-side)
<i>Leg Symbol</i>	13 + Leg Offset + (10 * Leg Index)	6	Printable ASCII	Option Symbol of leg right padded with spaces
Total Length = 13 + Leg Offset + (Leg Count * 10) bytes				

3.4 Refresh and Spin Messages

3.4.1 Market Snapshot

A *Market Snapshot* message provides a snapshot of the price and size for the bid and ask, last trade price, instrument size traded, and the current trading status of a single complex instrument. The *Market Snapshot* message will be included during a Spin for all instruments traded so far this trade date.

The *Unit Timestamp* field is provided instead of referencing the previous *Time* message. Since some Cboe markets can cross midnight, the Epoch (midnight, January 1, 1970 UTC) is used as a reference point.

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 (-327.68 to +327.67) 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
<i>Length</i>	0	1	Binary	<i>Length</i> of this message including this field.
<i>Message Type</i>	1	1	0xB2	<i>Market Snapshot (Short)</i> Message
<i>Time Offset</i>	2	4	Binary	Nanosecond offset from <i>Unit Timestamp</i> in this message.

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<i>Complex Instrument ID</i>	6	6	Printable ASCII	Complex Instrument Id right padded with spaces.
<i>Unit Timestamp</i>	12	4	Binary	Last unit timestamp expressed as number of whole seconds since the Epoch (Midnight, January 1, 1970 UTC).
<i>Bid Price</i>	16	2	Binary Short Price	Bid price (may be a zero or negative price for some instruments).
<i>Bid Quantity</i>	18	2	Binary	Quantity available at the inside (a zero value denotes the <i>Bid Price</i> is invalid).
<i>Ask Price</i>	20	2	Binary Short Price	Ask price (may be a zero or negative price for some instruments).
<i>Ask Quantity</i>	22	2	Binary	Quantity available at the inside (a zero value denotes the <i>Ask Price</i> is invalid).
<i>Last Trade Price</i>	24	2	Binary Short Price	Price of last execution (this can be zero or negative for some instruments).
<i>Last Trade Size</i>	26	2	Binary	Quantity of the last trade (if this value is 0 the <i>Last Trade Price</i> is invalid).
<i>Last Trade Condition</i>	28	1	Alphanumeric	(space) : Normal Trade X : Trade Break
<i>Total Volume</i>	29	4	Binary	Total quantity traded on the current business day.
<i>Trading Status</i>	33	1	Alphanumeric	See <i>Trading Status</i> field of Trading Status message.
<i>Reserved</i>	34	3	Alphanumeric	Reserved for use in other markets.
<i>Bit Fields</i>	37	1	Bit Field	Bit 0: Reserved Bit 1: If set, bid has customer orders Bit 2: If set, ask has customer orders
Total Length = 38 bytes				

Market Snapshot (Long)				
Field Name	Offset	Length	Type/(Value)	Description
<i>Length</i>	0	1	Binary	<i>Length</i> of this message including this field.
<i>Message Type</i>	1	1	0xB3	Market Snapshot (Long) Message
<i>Time Offset</i>	2	4	Binary	Nanosecond offset from <i>Unit Timestamp</i> in this message.
<i>Complex Instrument ID</i>	6	6	Printable ASCII	Complex Instrument Id right padded with spaces.
<i>Unit Timestamp</i>	12	4	Binary	Last unit timestamp expressed as number of whole seconds since the Epoch (Midnight, January 1, 1970 UTC).
<i>Bid Price</i>	16	8	Binary Long Price	Bid price (may be a zero or negative price for some instruments).
<i>Bid Quantity</i>	24	4	Binary	Quantity at the inside bid (a zero value denotes the <i>Bid Price</i> is invalid).
<i>Ask Price</i>	28	8	Binary Long Price	Ask price (may be a zero or negative price for some instruments).

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<i>Ask Quantity</i>	36	4	Binary	Quantity at the inside offer (a zero value denotes the <i>Ask Price</i> is invalid).
<i>Last Trade Price</i>	40	8	Binary Long Price	Price of last execution (this can be zero or negative for some instruments).
<i>Last Trade Size</i>	48	4	Binary	Quantity last traded (if this value is 0 the <i>Last Trade Price</i> is invalid).
<i>Last Trade Condition</i>	52	1	Alphanumeric	(space): Normal Trade X : Trade Break
<i>Total Volume</i>	53	4	Binary	Quantity traded on the current business day.
<i>Trading Status</i>	57	1	Alphanumeric	See <i>Trading Status</i> field of <i>Trading Status</i> message.
<i>Reserved</i>	58	3	Alphanumeric	Reserved for use in other markets.
<i>Bit Fields</i>	61	1	Bit Field	Bit 0: Reserved Bit 1: If set, bid has customer orders Bit 2: If set, ask has customer orders
Total Length = 62 bytes				

3.5 Market Update Messages

Market Update messages reflect real-time events that update 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 *Complex Instrument ID*. 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 two variants: Single Side Update (Long) and Single Side Update (Short). 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.

Single Side Update (Short)				
Field Name	Offset	Length	Type/(Value)	Description
<i>Length</i>	0	1	Binary	<i>Length</i> of this message including this field.
<i>Message Type</i>	1	1	0xB4	Single Side Update (Short) Message
<i>Time Offset</i>	2	4	Binary	Nanosecond offset from last unit timestamp.
<i>Complex Instrument ID</i>	6	6	Printable ASCII	Complex Instrument Id right padded with spaces.
<i>Side</i>	12	1	Alphanumeric	B = Bid Side S = Ask Side

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<i>Price</i>	13	2	Binary Short Price	Price (may be a zero or negative price for some instruments).
<i>Quantity</i>	15	2	Binary	Quantity at the inside (a zero value denotes the <i>Price</i> is invalid).
<i>Bit Fields</i>	17	1	Bit Field	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)
Total Length = 18 bytes				

Single Side Update (Long)				
Field Name	Offset	Length	Type/(Value)	Description
<i>Length</i>	0	1	Binary	<i>Length</i> of this message including this field.
<i>Message Type</i>	1	1	0xB5	Single Side Update (Long) Message
<i>Time Offset</i>	2	4	Binary	Nanosecond offset from last unit timestamp.
<i>Complex Instrument ID</i>	6	6	Printable ASCII	Complex Instrument Id right padded with spaces.
<i>Side</i>	12	1	Alphanumeric	B = Bid Side S = Ask Side
<i>Price</i>	13	8	Binary Long Price	Price (may be a zero or negative price for some instruments).
<i>Quantity</i>	21	4	Binary	Quantity at the inside (a zero value denotes the <i>Price</i> is invalid).
<i>Bit Fields</i>	25	1	Bit Field	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)
Total Length = 26 bytes				

3.5.2 Two Side Update Message (C2 Only)

Two Side Update messages provide an updated price and size for both sides of a *Complex Instrument ID*. 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 two variants: Two Side Update (Long) and Two Side Update (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.

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Two Side Update (Short)				
Field Name	Offset	Length	Type/(Value)	Description
<i>Length</i>	0	1	Binary	<i>Length</i> of this message including this field.
<i>Message Type</i>	1	1	0xB6	Two Side Update (Short) Message
<i>Time Offset</i>	2	4	Binary	Nanosecond offset from <i>Unit Timestamp</i> in this message.
<i>Complex Instrument ID</i>	6	6	Printable ASCII	Complex Instrument Id right padded with spaces.
<i>Bid Price</i>	12	2	Binary Short Price	Bid price (may be a zero or negative price for some instruments).
<i>Bid Quantity</i>	14	2	Binary	Quantity at the inside bid (a zero value denotes the <i>Bid Price</i> is invalid).
<i>Ask Price</i>	16	2	Binary Short Price	Ask price (may be a zero or negative price for some instruments).
<i>Ask Quantity</i>	18	2	Binary	Quantity at the inside offer (a zero value denotes the <i>Ask Price</i> is invalid).
<i>Bit Fields</i>	20	1	Bit Field	Bit 0: Reserved Bit 1: If set, bid has customer orders Bit 2: If set, ask has customer orders
Total Length = 21 bytes				

Two Side Update (Long)				
Field Name	Offset	Length	Type/(Value)	Description
<i>Length</i>	0	1	Binary	<i>Length</i> of this message including this field.
<i>Message Type</i>	1	1	0xB7	Two Side Update (Long) Message
<i>Time Offset</i>	2	4	Binary	Nanosecond offset from <i>Unit Timestamp</i> in this message.
<i>Complex Instrument ID</i>	6	6	Printable ASCII	Complex Instrument Id right padded with spaces.
<i>Bid Price</i>	12	8	Binary Long Price	Bid price (may be a zero or negative price for some instruments).
<i>Bid Quantity</i>	20	4	Binary	Quantity at the inside bid (a zero value denotes the <i>Bid Price</i> is invalid).
<i>Ask Price</i>	24	8	Binary Long Price	Ask price (may be a zero or negative price for some instruments).
<i>Ask Quantity</i>	32	4	Binary	Quantity at the inside offer (a zero value denotes the <i>Ask Price</i> is invalid).
<i>Bit Fields</i>	36	1	Bit Field	Bit 0: Reserved Bit 1: If set, bid has customer orders Bit 2: If set, ask has customer orders
Total Length = 37 bytes				

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3.5.3 TOP Trade Message

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

Any complex 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, and trade condition of a trade as well as the cumulative volume for the business day. A TOP Trade message will be sent after every execution, but not every TOP Trade message indicates a trade. The *Trade Condition* value of 'X' (Trade Break) is sent whenever an execution on a complex instrument is broken. Trade breaks are rare and only affect applications that rely upon Cboe execution-based data. 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
<i>Length</i>	0	1	Binary	<i>Length</i> of this message including this field.
<i>Message Type</i>	1	1	0xB8	TOP Trade Message
<i>Time Offset</i>	2	4	Binary	Nanosecond offset from last unit timestamp.
<i>Complex Instrument ID</i>	6	6	Printable ASCII	Complex Instrument Id right padded with spaces.
<i>Quantity</i>	12	4	Binary	Incremental quantity executed or cancelled (see <i>Trade Condition</i>).
<i>Price</i>	16	8	Binary Long Price	The execution price of the order.
<i>Execution Id</i>	24	8	Binary	Cboe generated day-unique execution identifier of this trade. <i>Execution Id</i> is also referenced in the Trade Break message.
<i>Total Volume</i>	32	4	Binary	Total quantity traded on the current business day (may decrease if the <i>Trade Condition</i> field indicates a cancelled trade).
<i>Trade Condition</i>	36	1	Alphanumeric	(space): Normal Trade X : Trade Break
Total Length = 37 bytes				

3.6 Trading Status

The `Trading Status` message is used to indicate the current trading status of a complex instrument. A `Trading Status` message will be sent whenever a complex instrument trading status changes.

A `Trading Status` message will be sent for all complex instruments where the underlying security is Halted, Trading or Quoting.

`Trading Status` of “S” is to be implied at system startup for all series. Starting at 7:30AM ET, Cboe will send a `Trading Status` of “Q” once complex orders can be accepted for queuing in preparation for the market open. Sometime after 9:30AM ET, Cboe will send a `Trading Status` of “T” as complex instruments are open for trading on the Cboe platform. Note `Trading Status` of “Q” can also be explicitly disseminated during a Regulatory Halt Quoting Period.

A `Trading Status` message will also be sent:

- for a Regulatory Halt “Q”uoting Period in any complex instrument 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				
Field Name	Offset	Length	Type/(Value)	Description
<i>Length</i>	0	1	Binary	Length of this message including this field
<i>Message Type</i>	1	1	0x31	<code>Trading Status</code> message
<i>Time offset</i>	2	4	Binary	Nanosecond offset from last unit timestamp
<i>Complex Instrument ID</i>	6	8	Printable ASCII	Complex Instrument Id right padded with spaces.
<i>Trading Status</i>	14	1	Alpha	H = Halted Q = Quote-Only S = Exchange Specific Suspension T = Trading
<i>Reserved</i>	15	3	Alpha	Reserved
Total Length = 18 bytes				

3.7 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
<i>Length</i>	0	1	Binary	<i>Length</i> of this message including this field.
<i>Message Type</i>	1	1	0x2D	<code>End of Session</code> Message
<i>Timestamp</i>	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. Customers 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
<i>Length</i>	0	1	Binary	<i>Length</i> of this message including this field.
<i>Message Type</i>	1	1	0x01	Login Message
<i>SessionSubId</i>	2	4	Alphanumeric	<i>SessionSubId</i> supplied by Cboe.
<i>Username</i>	6	4	Alphanumeric	<i>Username</i> supplied by Cboe.
<i>Filler</i>	10	2	Alphanumeric	(space filled)
<i>Password</i>	12	10	Alphanumeric	<i>Password</i> 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
<i>Length</i>	0	1	Binary	<i>Length</i> of this message including this field.
<i>Message Type</i>	1	1	0x02	Login Response Message
<i>Status</i>	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
<i>Length</i>	0	1	Binary	<i>Length</i> of this message including this field.
<i>Message Type</i>	1	1	0x03	Gap Request Message
<i>Unit</i>	2	1	Binary	<i>Unit</i> that the gap is requested for.
<i>Sequence</i>	3	4	Binary	<i>Sequence</i> of first message (lowest sequence in range).
<i>Count</i>	7	2	Binary	<i>Count</i> 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
<i>Length</i>	0	1	Binary	<i>Length</i> of this message including this field.
<i>Message Type</i>	1	1	0x04	Gap Response Message
<i>Unit</i>	2	1	Binary	<i>Unit</i> the gap was requested for.
<i>Sequence</i>	3	4	Binary	<i>Sequence</i> of first message in request.
<i>Count</i>	7	2	Binary	<i>Count</i> of messages requested.
<i>Status</i>	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
<i>Length</i>	0	1	Binary	<i>Length</i> of this message including this field.
<i>Message Type</i>	1	1	0x80	Spin Image Available Message
<i>Sequence</i>	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
<i>Length</i>	0	1	Binary	<i>Length</i> of this message including this field.
<i>Message Type</i>	1	1	0x81	Spin Request Message
<i>Sequence</i>	2	4	Binary	Sequence number from a <code>Spin Image Available</code> message received by the customer.
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
<i>Length</i>	0	1	Binary	<i>Length</i> of this message including this field.
<i>Message Type</i>	1	1	0x82	<code>Spin Response</code> Message
<i>Sequence</i>	2	4	Binary	Sequence number from a <code>Spin Image</code> Available message received by the customer.
<i>Order Count</i>	6	4	Binary	Number of <code>Add Order</code> messages which will be contained in this spin.
<i>Status</i>	10	1	Alphanumeric	Accepted or reason for reject*.
Total Length = 11 bytes				
Spin Response - Status Codes				
'A'	Accepted			
'O'	Out of Range (<i>Sequence</i> requested is greater than <i>Sequence</i> 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 customer's copy of the book to make it current.

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

5.7 Spin Server Usage Example

The following diagram (see next page) shows the exchange of messages over time between a customer and Cboe' Multicast TOP feed and Spin Server. Note that while the example may seem to imply `Market Snapshot` messages only would be sent on a Spin, this is not the case. `Trading Status` message may be sent at the beginning of the spin session and `Time` messages may be found mixed between `Market Snapshot` messages according to their timestamps.

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

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

At time 7, the customer 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 customer does not have all messages cached after 310169 (they are missing 310170 and 310171), so this spin is not useful to the customer.

At time 10, the customer 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 customer has all messages after 310175 cached.

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

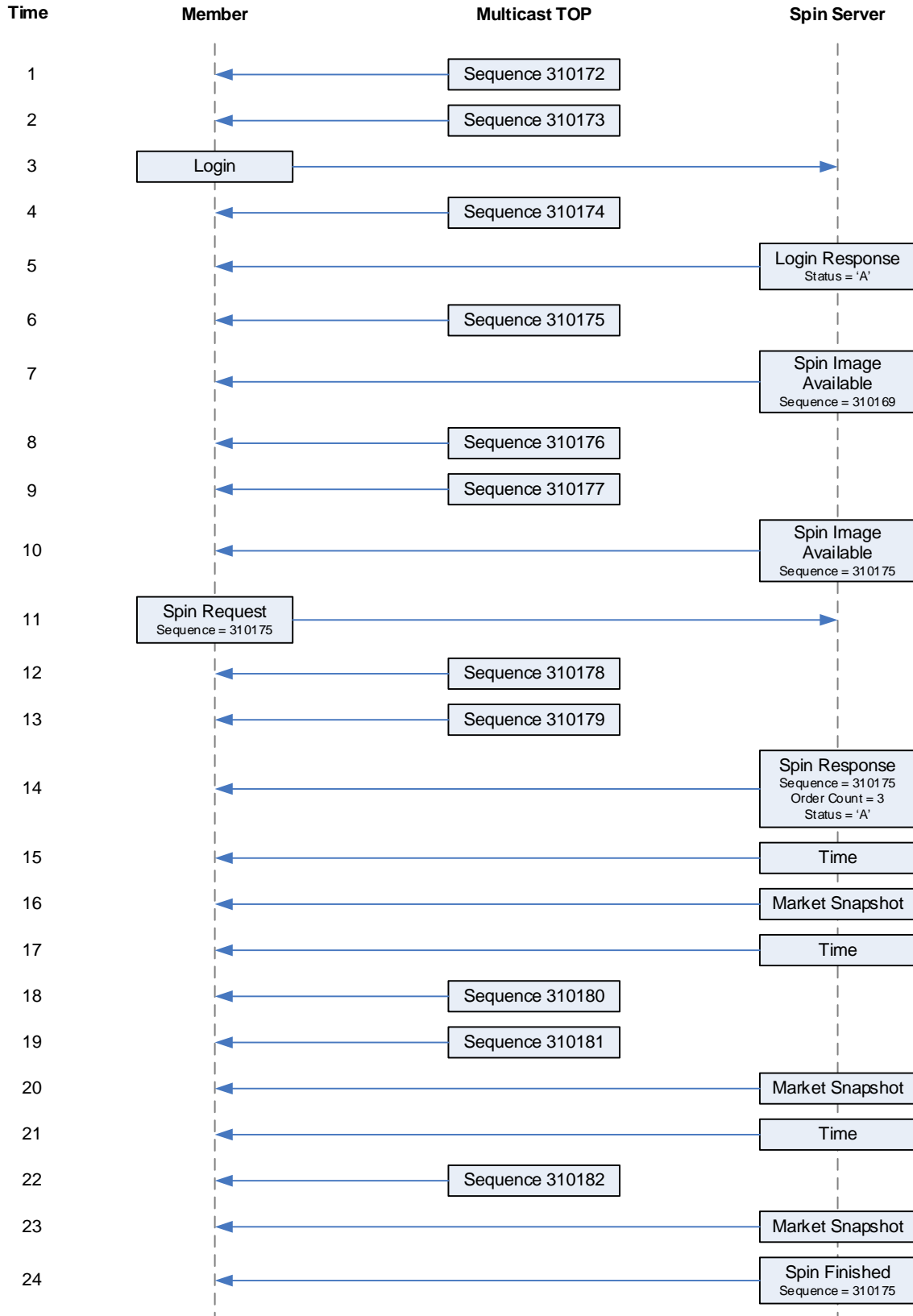
At time 14, the Spin Server acknowledges the `Spin Request` and indicates that three symbols will be sent.

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

Notes:

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

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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

6.3 TOP Messages

0x20	Time
0x97	Unit Clear
0x99	Complex Instrument Definition
0xB2	Market Snapshot (Short)
0xB3	Market Snapshot (Long)
0xB4	Single Side Update (Short)
0xB5	Single Side Update (Long)
0xB6	Two Side Update (Short)
0xB7	Two Side Update (Long)
0xB8	TOP Trade
0x31	Trading Status
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

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7.7 Spin Response Message

Length	0B	11 bytes
Type	82	Spin Request
Sequence	3B 10 00 00	Sequence: 4155
Order Count	42 00 00 00	66 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 Time Message

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

7.10 Unit Clear

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

7.11 Market Snapshot (Short)

Length	26	38 bytes
Type	B2	Market Snapshot (Short)
Time Offset	08 5C 44 25	625,237,000 ns
CID	30 31 32 33 34 35	012345
Unit Timestamp	96 A5 99 5A	2018-03-02 13:27:18 Eastern (1520018838 seconds since the Epoch)
Bid Price	41 01	\$3.21
Bid Size	BC 02	700
Ask Price	B0 01	\$4.32
Ask Size	84 03	900
Last Trade Price	8F 01	\$3.99
Last Trade Size	FE FF	65,534
Last Trade Condition	20	Normal Trade (space)
Total Volume	32 54 76 98	2,557,891,634
Trading Status	54	T - Trading
Reserved	30 20 20	Reserved

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Bit Fields	00	Neither bid nor ask have customer orders
------------	----	--

7.12 Market Snapshot (Long)

Length	3E	62 bytes
Type	B3	Market Snapshot (Long)
Time Offset	08 5C 44 25	625,237,000 ns
CID	30 31 32 33 34 35	012345
Unit Timestamp	96 A5 99 5A	2018-03-02 13:27:18 Central (1520018838 seconds since the Epoch)
Bid Price	9C 82 FF FF FF FF FF FF	\$-3.21
Bid Size	BC 02 00 00	700
Ask Price	E0 F4 8F 04 00 00 00 00	\$7,654.32
Ask Size	84 03 00 00	900
Last Trade Price	DC 9B 00 00 00 00 00 00	\$3.99
Last Trade Size	64 00 00 00	100
Last Trade Condition	20	(space) Normal Trade
Total Volume	78 56 34 12	305,419,896
Trading Status	54	T - Trading
Reserved	30 20 20	Reserved
Bit Fields	06	Bid and ask have customer orders

7.13 Single Side Update (Short)

Length	12	18 bytes
Type	B4	Single Side Update (Short)
Time Offset	30 FA D3 29	701,758,000 ns since last Time Message
CID	30 31 32 33 34 35	012345
Side	42	B (Buy)
Price	0C 30	\$1.23
Quantity	64 00	100
Bit Fields	02	Bid has customer orders

7.14 Single Side Update (Short, Negative Price)

Length	12	18 bytes
Type	B4	Single Side Update (Short)
Time Offset	30 FA D3 29	701,758,000 ns since last Time Message
CID	30 31 32 33 34 35	012345
Side	42	B (Buy)

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Price	85 FF	\$-1.23
Quantity	C8 00	200
Bit Fields	02	Bid has customer orders

7.15 Single Side Update (Long)

Length	1A	26 bytes
Type	B5	Single Side Update (Long)
Time Offset	30 FA D3 29	701,758,000 ns since last Time Message
CID	30 31 32 33 34 35	012345
Side	42	B (Buy)
Price	0C 30 00 00 00 00 00 00	\$1.23
Quantity	64 00 00 00	100
Bit Fields	04	Ask has customer orders

7.16 Two Side Update (Short)

Length	15	21 bytes
Type	B6	Two Side Update (Short)
Time Offset	30 FA D3 29	701,758,000 ns since last Time Message
CID	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

7.17 Two Side Update (Long)

Length	25	37 bytes
Type	B7	Two Side Update (Long)
Time Offset	30 FA D3 29	701,758,000 ns since last Time Message
CID	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

7.18 TOP Trade

Length	25	37 bytes
Type	B8	TOP Trade
Time Offset	10 84 D4 23	601,130,000 ns since

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										last Time Message
CID	36	35	34	33	32	31				654321
Quantity	BC	02	00	00						700
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						1,000,000
Trade Condition	20									Normal Trade (space)

7.19 TOP Trade (Condition = Trade Break)

Length	25									37 bytes
Type	B8									TOP Trade
Time Offset	10	84	D4	23						601,130,000 ns since last Time Message
CID	36	35	34	33	32	31				654321
Quantity	BC	02	00	00						700
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						999,300
Trade Condition	58									X = Trade Break

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7.20 Complex Instrument Definition Message

Length	22	34 bytes
Type	99	Complex Instrument Definition
Time offset	18 D2 06 00	447,000 ns since last Time Message
CID	43 30 30 30 31 32	C00012
Leg Count	02	2 legs
Leg Offset	01	One byte
Leg Ratio	01 00 00 00	1 = Buy 1
Leg Symbol	30 30 30 30 30 31	000001
Leg Ratio	FF FF FF FF	-1 = Sell 1
Leg Symbol	30 30 30 30 30 32	000002

7.21 Trading Status Message

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

7.22 End of Session Message

Length	06	6 bytes
Type	2D	End of Session
Time Offset	18 D2 06 00	447,000 ns since last Time Message

7.23 Sequenced Unit Header with 2 Messages

Sequenced Unit Header:

Hdr Length	3E 00	62 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

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Message 1: TOP Trade

Length	25	37 bytes
Type	B8	TOP Trade
Time Offset	10 84 D4 23	601,130,000 ns since last Time Message
CID	36 35 34 33 32 31	654321
Quantity	BC 02 00 00	700
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	1,000,000
Trade Condition	20	Normal Trade (space)

Message 2: Single Side Update

Length	11	17 bytes
Type	B4	Single Side Update (Short)
Time Offset	30 FA D3 29	701,758,000 ns since last Time Message
CID	36 35 34 33 32 31	654321
Side	42	B (Buy)
Price	0C 30	\$1.23
Quantity	64 00	100
Bit Fields	02	Bid has customer order

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. Customers should ensure that their infrastructure is configured accordingly.
WAN-Shaped Throttle	100 Mb/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.

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8.1.2 Unit/Product Distribution (Effective through 4/13/18)

The following table describes an updated Cboe symbol distribution across units for EDGX and C2 Options.

Unit	Symbol Range	C2 Symbol Range
1	A - ADRZZ	A - ADRZZ
2	ADS - AMZMZ	ADS - AMZMZ
3	AMZN - AOZZZ	AMZN - AOZZZ
4	AP - BACAZ	AP - BACAZ
5	BACB - CASZZ	BACB - CASZZ
6	CAT - CMGAZ	CAT - CMGAZ
7	CMGB - CYGZZ	CMGB - CYGZZ
8	CYH - DOWAZ	CYH - DOWAZ
9	DOWB - FASTZ	DOWB - FASTZ
10	FASU - FOWZZ	FASU - FOWZZ
11	FOX - GOLFZ	FOX - GOLFZ
12	GOLG - GPBZZ	GOLG - GPBZZ
13	GPC - HULZZ	GPC - HULZZ
14	HUM - IPAAZ	HUM - IPAAZ
15	IPAB - IWLZZ IWMA - LDLAZ	IPAB - IWLZZ IWMA - LDLAZ
16	LDLB - MCDAZ	LDLB - MCDAZ
17	MCDB - MTVZZ	MCDB - MTVZZ
18	MTW - NKEAZ	MTW - NKEAZ
19	NKEB - PCLMZ	NKEB - PCLMZ
20	PCLN - PCLNZ	PCLN - PCLNZ
21	PCLO - QQPZZ QQQA - REGNZ	PCLO - QQPZZ QQQA - REGNZ
22	REGO - SNEAZ	REGO - RUSZZ RUTA - RUTVZZ RUTWA - SNEAZ
23	SNEB - SPXZZ SPYA - TLLPZ	SNEB - SPXZZ SPYA - TLLPZ
24	TLLQ - TTMAZ	TLLQ - TTMAZ
25	TTMB - USFZZ	TTMB - USFZZ
26	USG - VRWZZ	USG - VRWZZ
27	VRX - WFLZZ	VRX - WFLZZ
28	WFM - XLP AZ	WFM - XLP AZ
29	XLPB - ZZZZZ	XLPB - ZZZZZ
30	IWM	IWM
31	QQQ	QQQ
32	SPY	SPY
33	N/A	RUT, RUTW

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8.1.3 Unit/Product Distribution (Effective 4/14/18)

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

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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.

8.1.4 EDGX Options Multicast Routing Parameters

Data Center	Rendezvous Point
NY5 Primary Data Center C feed	74.115.128.162
NY5 Primary Data Center D feed	74.115.128.163
CH4 Secondary Data Center E feed	174.136.181.240

8.1.5 C2 Options Multicast Routing Parameters

Data Center	Rendezvous Point
NY5 Primary Data Center C feed	74.115.128.176
NY5 Primary Data Center D feed	74.115.128.177
400SL Secondary Data Center E feed	170.137.16.134

8.1.6 EDGX Options Address/Unit Distribution

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

NY5 Primary Datacenter		WAN-Shaped [ECD] 174.136.164.32/28		WAN-Shaped [EDD] 174.136.164.48/28	
Unit	IP Port	Real-time MC	Gap Resp. MC	Real-time MC	Gap Resp. MC
1	30701	224.0.131.156	224.0.131.158	233.130.124.156	233.130.124.158
2	30702				
3	30703				
4	30704				
5	30705				
6	30706				
7	30707				
8	30708				
9	30709				
10	30710				
11	30711				
12	30712				
13	30713				
14	30714				
15	30715				
16	30716				
17	30717	224.0.131.157	224.0.131.159	233.130.124.157	233.130.124.159
18	30718				
19	30719				
20	30720				
21	30721				
22	30722				
23	30723				
24	30724				
25	30725				
26	30726				
27	30727				
28	30728				
29	30729				
30	30730				
31	30731				
32	30732				

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. Addresses in the gray area are pre-assigned but not available. Customers should not configure their networks or systems for these addresses.

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CH4 Secondary Datacenter		WAN-Shaped [EED] 174.136.176.144/28	
Unit	IP Port	Real-time MC	Gap Response MC
1	31501	233.19.3.140	233.19.3.142
2	31502		
3	31503		
4	31504		
5	31505		
6	31506		
7	31507		
8	31508		
9	31509		
10	31510		
11	31511		
12	31512		
13	31513		
14	31514		
15	31515		
16	31516		
17	31517	233.19.3.141	233.19.3.143
18	31518		
19	31519		
20	31520		
21	31521		
22	31522		
23	31523		
24	31524		
25	31525		
26	31526		
27	31527		
28	31528		
29	31529		
30	31530		
31	31531		
32	31532		

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.

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8.1.7 C2 Options Address/Unit Distribution

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

NY5 Primary Datacenter		WAN-Shaped [WCD] 174.136.164.64/28		WAN-Shaped [WDD] 174.136.164.80/28	
Unit	IP Port	Real-time MC	Gap Resp. MC	Real-time MC	Gap Resp. MC
1	30351	224.0.131.252	224.0.131.254	233.130.124.252	233.130.124.254
2	30352				
3	30353				
4	30354				
5	30355				
6	30356				
7	30357				
8	30358				
9	30359				
10	30360				
11	30361				
12	30362				
13	30363				
14	30364				
15	30365				
16	30366				
17	30367	224.0.131.253	224.0.131.255	233.130.124.253	233.130.124.255
18	30368				
19	30369				
20	30370				
21	30371				
22	30372				
23	30373				
24	30374				
25	30375				
26	30376				
27	30377				
28	30378				
29	30379				
30	30380				
31	30381				
32	30382				
33	30383				

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. Addresses in the gray area are pre-assigned but not available. Customers should not configure their networks or systems for these addresses.

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400SL Secondary Datacenter		WAN-Shaped [WED] 170.137.17.96/29	
Unit	IP Port	Real-time MC	Gap Response MC
1	31351	233.182.199.108	233.182.199.110
2	31352		
3	31353		
4	31354		
5	31355		
6	31356		
7	31357		
8	31358		
9	31359		
10	31360		
11	31361		
12	31362		
13	31363		
14	31364		
15	31365		
16	31366		
17	31367	233.182.199.109	233.182.199.111
18	31368		
19	31369		
20	31370		
21	31371		
22	31372		
23	31373		
24	31374		
25	31375		
26	31376		
27	31377		
28	31378		
29	31379		
30	31380		
31	31381		
32	31382		
33	31383		

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/Product Distribution (Effective through 4/13/18)

The following table describes the EDGX and C2 Options symbol distribution across units.

Unit	EDGX Symbol Range	C2 Symbol Range
1	A - ADRZZ	A - ADRZZ
2	ADS - AMZMZ	ADS - AMZMZ
3	AMZN - AOZZZ	AMZN - AOZZZ
4	AP - BACAZ	AP - BACAZ
5	BACB - CASZZ	BACB - CASZZ
6	CAT - CMGAZ	CAT - CMGAZ
7	CMGB - CYGZZ	CMGB - CYGZZ
8	CYH - DOWAZ	CYH - DOWAZ
9	DOWB - FASTZ	DOWB - FASTZ
10	FASU - FOWZZ	FASU - FOWZZ
11	FOX - GOLFZ	FOX - GOLFZ
12	GOLG - GPBZZ	GOLG - GPBZZ
13	GPC - HULZZ	GPC - HULZZ
14	HUM - IPAAZ	HUM - IPAAZ
15	IPAB - IWLZZ IWMA - LDLAZ	IPAB - IWLZZ IWMA - LDLAZ
16	LDLB - MCDAZ	LDLB - MCDAZ
17	MCDB - MTVZZ	MCDB - MTVZZ
18	MTW - NKEAZ	MTW - NKEAZ
19	NKEB - PCLMZ	NKEB - PCLMZ
20	PCLN - PCLNZ	PCLN - PCLNZ
21	PCLO - QQPZZ QQQA - REGNZ	PCLO - QQPZZ QQQA - REGNZ
22	REGO - SNEAZ	REGO - RUSZZ RUTA - RUTVZZ RUTWA - SNEAZ
23	SNEB - SPXZZ SPYA - TLLPZ	SNEB - SPXZZ SPYA - TLLPZ
24	TLLQ - TTMAZ	TLLQ - TTMAZ
25	TTMB - USFZZ	TTMB - USFZZ
26	USG - VRWZZ	USG - VRWZZ
27	VRX - WFLZZ	VRX - WFLZZ
28	WFM - XLPZ	WFM - XLPZ
29	XLPB - ZZZZZ	XLPB - ZZZZZ
30	IWM	IWM
31	QQQ	QQQ
32	SPY	SPY
33	N/A	RUT, RUTW

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8.2.2 Unit/Product Distribution (Effective 4/14/18)

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

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.

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8.2.3 Multicast Routing Parameters

Data Center	Rendezvous Point
NY5 Primary Data Center A feed	74.115.128.129

8.2.4 EDGX Options Address/Unit Distribution

The following table describes the unit distribution across certification EDGX Options Complex Multicast TOP feeds out of the NY5 datacenter.

Primary Datacenter		Certification 174.136.174.176/28	
Unit	IP Port	Real-time MC	Gap Resp. MC
1	32701	224.0.74.192	224.0.74.194
2	32702		
3	32703		
4	32704		
5	32705		
6	32706		
7	32707		
8	32708		
9	32709		
10	32710		
11	32711		
12	32712		
13	32713		
14	32714		
15	32715		
16	32716		
17	32717	224.0.74.193	224.0.74.195
18	32718		
19	32719		
20	32720		
21	32721		
22	32722		
23	32723		
24	32724		
25	32725		
26	32726		
27	32727		
28	32728		
29	32729		
30	32730		
31	32731		
32	32732		

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 table describes the unit distribution across certification C2 Complex Options Multicast TOP feeds out of the NY5 datacenter.

Primary Datacenter		Certification 174.136.160.80/28	
Unit	IP Port	Real-time MC	Gap Resp. MC
1	32351	224.0.74.168	224.0.74.170
2	32352		
3	32353		
4	32354		
5	32355		
6	32356		
7	32357		
8	32358		
9	32359		
10	32360		
11	32361		
12	32362		
13	32363		
14	32364		
15	32365		
16	32366		
17	32367	224.0.74.169	224.0.74.171
18	32368		
19	32369		
20	32370		
21	32371		
22	32372		
23	32373		
24	32374		
25	32375		
26	32376		
27	32377		
28	32378		
29	32379		
30	32380		
31	32381		
32	32382		
33	32383		

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 Cboe Multicast data feeds. For more information on receiving Options Complex 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 WAN-shaped feeds require 100Mbps of bandwidth. Cboe will use 90% of these respective bandwidths for Multicast TOP to allow customers 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@bats.com.

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Revision History

Document Version	Date	Description
1.0.0	05/11/17	Initial version.
1.0.1	05/18/17	Various minor updates and clarification added.
1.0.2	07/28/17	Added Multicast IPs/Ports for Certification environment. Added <i>Execution Id</i> field to TOP Trade message.
1.0.3	08/08/17	Added Multicast IPs/Ports for Production environment.
1.0.4	09/01/17	Added C2 Options references. Updated description of TOP Trade message to describe behavior of <i>Trade Condition</i> field = 'X' (Trade Break).
1.0.5	10/02/17	Removed Trade Status code "A".
1.0.6	10/17/17	Cboe branding/logo changes. Fixed incorrect Multicast IP for units 17-32 of EDD feed.
1.0.7	11/24/17	Added C2 Options Certification IP and Port information. Added RUT, RUTW options (C2 Options Only) to distinct unit (unit 33).
1.0.8	12/11/17	Added Two Side Update Message for C2 Options only. Corrected message type in Top Trade example. Added <i>Bit Fields</i> to all Market Update messages and Market Snapshot messages. Effective 1/22/2018.
1.0.9	02/05/18	Updated C2 Options IP and Port information.
1.0.10	03/08/18	Updated Unit Distribution ranges
1.0.11	03/22/18	Corrected GR MC Addresses for C2 C feed.
1.0.12	03/23/18	Unit Distribution ranges Effective Date updated to 4/14/18.