



US Options
Complex Multicast TOP
Specification

Version 1.1.5

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1 Introduction

1.1 Overview

Note that this specification will be the standard Complex top of book specification to be used for the Cboe (“C1”) Options, C2 Options and EDGX Options exchanges.

Cboe customers may use the Complex Multicast TOP protocol to receive real-time top of book quotations from Cboe.

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
C1 Complex	WAN	Primary	CCD
C1 Complex	WAN	Primary	CDD
C1 Complex	WAN	Secondary	CED
C2 Complex	WAN	Primary	WCD
C2 Complex	WAN	Primary	WDD
C2 Complex	WAN	Secondary	WED
EDGX Complex	WAN	Primary	ECD
EDGX Complex	WAN	Primary	EDD
EDGX Complex	WAN	Secondary	EED

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.

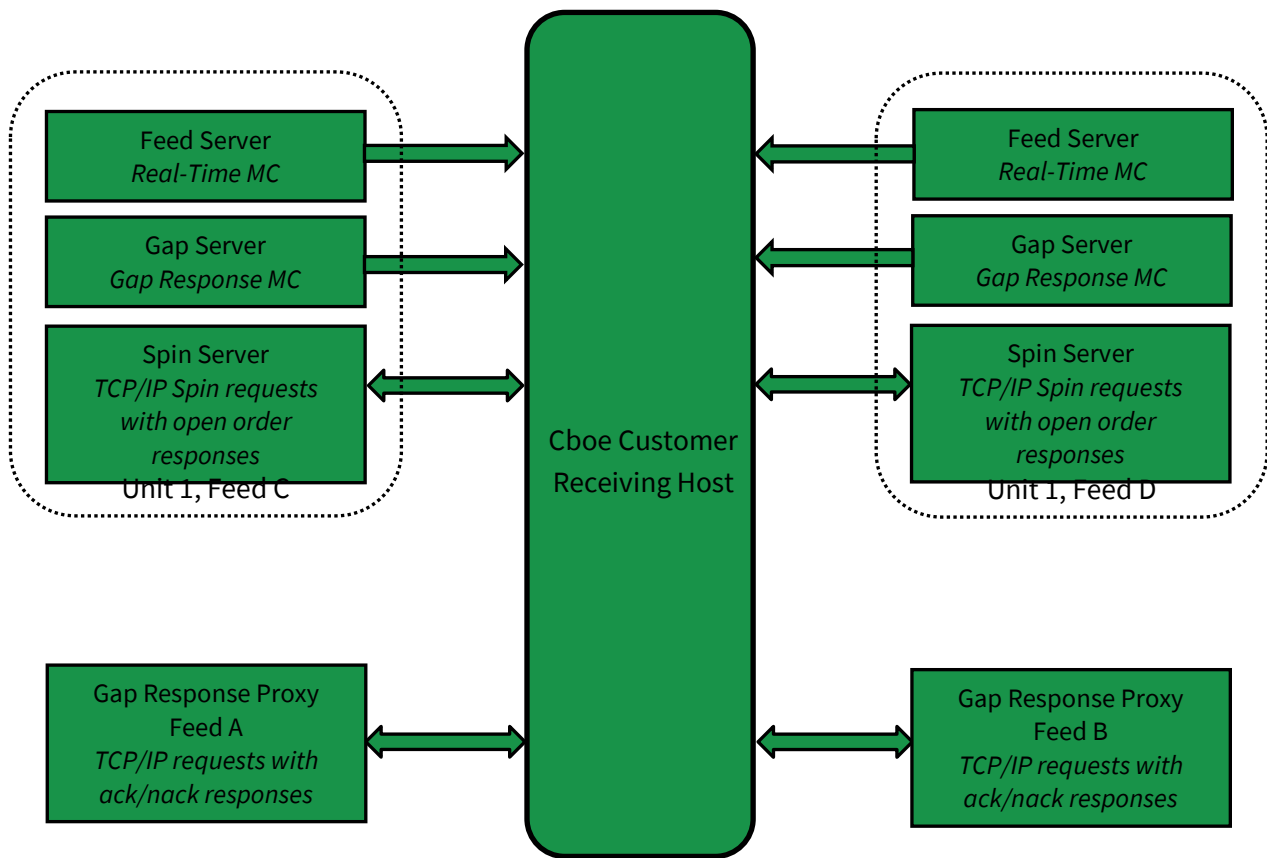
Customers with sufficient connectivity may choose to take more than one WAN-shaped feed from the Cboe’s primary datacenter and arbitrate the feeds to recover lost data. Alternatively, customers may choose to arbitrate feeds from both datacenters. It should be noted that feeds from the secondary

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datacenter will have additional latency for those connected with Cboe in the primary datacenter due to proximity.

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 Underlying 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 Expanded` 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 Expanded` 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 Complex 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 of `Two Side Update`, `Single Side Update`, `TOP Trade`, `Trading Status`, `Complex Instrument Definition Expanded` and `Time` messages. 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.

Customers can also use the Spin Server to request a spin of all `Symbol Mapping` and `Complex Instrument Definition Expanded` messages by sending an `Instrument Definition Request`. 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 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.

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 11Boolean 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.
- **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`.

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.

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<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 Eastern Time.
Total Length = 6 bytes				

3.2 Unit Clear

The `Unit Clear` message instructs feed recipients to clear all Cboe complex books 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 Expanded

A `Complex Instrument Definition Expanded` message represents a complex instrument that is available to place orders. It is sent as a sequenced message. `Complex Instrument Definition Expanded` messages will be sent in a continuous loop through the day at variable rates as bandwidth allows.

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

Complex Instrument Definition Expanded				
Field Name	Offset	Length	Type/(Value)	Description
<i>Length</i>	0	1	Binary	<i>Length</i> of this message including this field.

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<i>Message Type</i>	1	1	0x9A	Complex Instrument Definition Expanded 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>Complex Instrument Underlying</i>	12	8	Printable ASCII	Complex Instrument Underlying right padded with spaces.
<i>Complex Instrument Type</i>	20	4	Alphanumeric	character field; each field describes a characteristic. Character 1: Complex Option Type O = All legs are options E = One leg is an equity leg Characters 2-4: Reserved
<i>Leg Count</i>	24	1	Binary	The number of legs in the complex instrument. The maximum number of legs is currently 12 options legs and 1 (optional) equity leg.
The following fields repeat <i>Leg Count</i> times for multi-leg strategies. <i>Leg Index</i> is zero-based.				
<i>Leg Symbol</i>	25 + Leg Index * 13	8	Printable ASCII	Option or Equity Symbol of leg, right padded with spaces.
<i>Leg Ratio</i>	33 + Leg Index * 13	4	Signed Binary	Leg ratio (positive for buy-side, negative for sell-side). For options this is the number of contracts, for equities this is the number of shares.
<i>Leg Security Type</i>	37 + Leg Index * 13	1	Alphanumeric	O = Leg is an Option instrument E = Leg is an Equity instrument
Total Length = 25 + (Leg Count * 13) bytes				

3.4 Symbol Mapping

A *Symbol Mapping* message is used to map the 6 character simple instrument multicast feed symbol field to an OSI symbol and Underlying. These messages are not sequenced (sequence = 0) and are sent continuously through the day at variable rates as bandwidth allows.

Symbol Mapping				
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	0x2E	<i>Symbol Mapping</i> Message
<i>Feed Symbol</i>	2	6	Printable ASCII	<i>Symbol</i> right padded with spaces.
<i>OSI Symbol</i>	8	21	Printable ASCII	OSI Symbol
<i>Symbol Condition</i>	29	1	Alphanumeric	N = Normal C = Closing Only

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<i>Underlying</i>	30	8	Alphanumeric	Symbol of underlying equity right padded with spaces. All spaces if not available or not applicable.
Total Length = 38 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 Expanded (Short) and Single Side Update Expanded (Long). The Single Side Update Expanded (Short) message is used whenever possible, but the Single Side Update Expanded (Long) message is used when the *Price* cannot be represented by a Binary Short Price or the *Quantity* cannot be represented by an unsigned 16-bit integer.

3.5.1.1 Single Side Update Expanded (Short)

Single Side Update Expanded (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	0xD4	Single Side Update Expanded (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
<i>Bit Fields</i>	13	1	Bit Field	Bits 0-7 – Reserved There are no Bit Fields for Complex Multicast TOP.
<i>Price</i>	14	2	Binary Short Price	Price (may be a zero or negative price for some instruments).
<i>Quantity</i>	16	2	Binary	Total number of contracts on the inside book (customer and non-customer). A zero value denotes there is no <i>Bid/Ask</i> .
<i>Customer Quantity</i>	18	2	Binary	Number of customer contracts on the inside book. A zero value denotes that

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				there are no customer contracts at the inside price.
Total Length = 20 bytes				

3.5.1.2 Single Side Update Expanded (Long)

Single Side Update Expanded (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	0xD5	Single Side Update Expanded (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>Bit Fields</i>	13	1	Bit Field	Bits 0-7 – Reserved There are no Bit Fields for Complex Multicast TOP.
<i>Price</i>	14	8	Binary Long Price	Price (may be a zero or negative price for some instruments).
<i>Quantity</i>	22	4	Binary	Total number of contracts on the inside book (customer and non-customer). A zero value denotes there is no <i>Bid/Ask</i> .
<i>Customer Quantity</i>	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 *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 Expanded (Long) and Two Side Update Expanded (Short). The Two Side Update Expanded (Short) message is used whenever possible, but the Two Side Update Expanded (Long) message is used when the *Price* cannot be represented by a Binary Short Price or the *Quantity* cannot be represented by an unsigned 16-bit integer.

3.5.2.1 Two Side Update Expanded (Short)

Two Side Update Expanded (Short)

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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	0xD6	Two Side Update Expanded (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>Bit Fields</i>	12	1	Bit Field	Bits 0-7 – Reserved There are no Bit Fields for Complex Multicast TOP.
<i>Bid Price</i>	13	2	Binary Short Price	Bid Price (may be a zero or negative price for some instruments).
<i>Bid Quantity</i>	15	2	Binary	Total number of contracts on the inside bid (customer and non-customer). A zero value denotes there is no bid.
<i>Bid Customer Quantity</i>	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.
<i>Ask Price</i>	19	2	Binary Short Price	Ask Price (may be a zero or negative price for some instruments).
<i>Ask Quantity</i>	21	2	Binary	Total number of contracts on the inside ask (customer and non-customer). A zero value denotes there is no ask.
<i>Ask Customer Quantity</i>	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				

3.5.2.2 Two Side Update Expanded (Long)

Two Side Update Expanded (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	0xD7	Two Side Update Expanded (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>Bit Fields</i>	12	1	Bit Field	Bits 0-7 – Reserved There are no Bit Fields for Complex Multicast TOP.
<i>Bid Price</i>	13	8	Binary Long Price	Bid Price (may be a zero or negative price for some instruments).

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<i>Bid Quantity</i>	21	4	Binary	Total number of contracts on the inside bid (customer and non-customer). A zero value denotes there is no bid.
<i>Bid Customer Quantity</i>	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.
<i>Ask Price</i>	29	8	Binary Long Price	Ask Price (may be a zero or negative price for some instruments).
<i>Ask Quantity</i>	37	4	Binary	Total number of contracts on the inside ask (customer and non-customer). A zero value denotes there is no ask.
<i>Ask Customer Quantity</i>	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 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 Expanded or Two Side Update Expanded 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. A Top Trade message can also be sent when an auction executes against a non-displayed order, such as a contra response. 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.

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<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 O = Opening Trade A = SPIM Trade C = Combo Trade (C1 Only) X = Trade Break
Total Length = 37 bytes				

3.6 Options Auction Update

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

Options Auction Update				
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	0xD1	Options Auction Update Message
<i>Time offset</i>	2	4	Binary	Nanosecond offset from last unit timestamp.
<i>Complex Instrument ID</i>	6	8	Printable ASCII	<i>Complex Instrument</i> right padded with spaces.
<i>Auction Type</i>	14	1	Alphanumeric	G = GTH Opening O = RTH Opening H = Halt Re-Opening
<i>Reference Price</i>	15	8	Binary Signed Long Price	SNBBO Collared VMIM price computed on the queuing book only.
<i>Buy Contracts</i>	23	4	Binary	Cumulative Buy contracts at the <i>Reference Price</i> and above.
<i>Sell Contracts</i>	27	4	Binary	Cumulative Sell contracts at the <i>Reference Price</i> and below.
<i>Indicative Price</i>	31	8	Binary Signed Long Price	SNBBO Collared VMIM price computed on the combined queuing book and the continuous book. Equal to <i>Reference Price</i> for options that do not have a GTH trading session.

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<i>Auction Only Price</i>	39	8	Binary Signed Long Price	Volume Maximizing Price computed on the Auction-Only Book.
<i>Opening Condition</i>	47	1	Alphanumeric	0 = Would open
Total Length = 48 bytes				

3.7 Auction Summary

Auction Summary messages are used to disseminate the results of an auction of a complex instrument. An *Opening* or *Re-Opening* *Auction Summary* message for each complex instrument is sent at the conclusion of its *Opening* or *Re-Opening* auction and represents the Cboe opening price. Refer to the [Cboe Options Complex Book Process](#) specification for more information.

Auction Summary				
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	0x96	<i>Auction Summary</i> Message
<i>Time offset</i>	2	4	Binary	Nanosecond offset from last unit timestamp.
<i>Complex Instrument Id</i>	6	8	Printable ASCII	<i>Complex Instrument Id</i> right padded with spaces.
<i>Auction Type</i>	14	1	Alphanumeric	G = GTH Opening O = RTH Opening H = Halt Re-Opening
<i>Price</i>	15	8	Binary Long Price	Auction price
<i>Quantity</i>	23	4	Binary	Cumulative instrument quantity 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 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”oting 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.

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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.

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	Trading Status 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>Reserved</i>	12	2	Reserved	Reserved
<i>Trading Status</i>	14	1	Alpha	H = Halted Q = Quote-Only S = Exchange Specific Suspension T = Trading
<i>Reserved</i>	15	1	Reserved	Reserved
<i>GTH Trading Status</i>	16	1	Alpha	H = Halted Q = Quote-Only S = Exchange Specific Suspension T = Trading
<i>Reserved2</i>	17	1	Alpha	Reserved
Total Length = 18 bytes				

3.9 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	End of Session 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. Each of the following message types must be wrapped by an unsequenced unit header as described in Section 2.4. 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

Each of the following message types must be wrapped by an unsequenced unit header as described in Section 2.4.

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	<code>Spin Image Available</code> 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	<code>Spin Request</code> Message

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<i>Sequence</i>	2	4	Binary	Sequence number from a <i>Spin Image</i> Available 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	<i>Spin Response</i> Message
<i>Sequence</i>	2	4	Binary	Sequence number from a <i>Spin Image</i> Available message received by the customer.
<i>Order Count</i>	6	4	Binary	Always zero.
<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	<i>Spin Finished</i> Message
<i>Sequence</i>	2	4	Binary	Sequence number from the <i>Spin Request</i> message.
Total Length = 6 bytes				

5.7 Instrument Definition Request

The *Instrument Definition Request* message is used by a user's process to request transmission of this unit's Symbol Mappings and Complex Instrument Definitions. All Symbol Mapping Messages will be sent before Complex Instrument Definition Expanded messages. 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
<i>Length</i>	0	1	Binary	<i>Length</i> of this message including this field
<i>Message Type</i>	1	1	0x84	Instrument Definition Request Message
<i>Sequence</i>	2	4	Binary	Must be 0. Only the current Symbol Mappings and Complex Instrument Definitions are available.
Total Length = 6 bytes				

5.8 Instrument Definition Response

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
<i>Length</i>	0	1	Binary	<i>Length</i> of this message including this field
<i>Message Type</i>	1	1	0x85	Instrument Definition Response Message
<i>Sequence</i>	2	4	Binary	Will always be 0.
<i>Instrument Count</i>	6	4	Binary	Number of Symbol Mapping and Complex Instrument Definition (if applicable) messages which will be contained in this spin
<i>Status</i>	10	1	Alphanumeric	Accepted or reason for reject
Total Length = 11 bytes				
Instrument Definition Response – Status Codes				
'A'	Accepted			
'O'	Out of Range (<i>Sequence</i> 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

The Instrument Definition Finished message is sent to indicate that all Symbol Mapping and Complex Instrument Definition 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
<i>Length</i>	0	1	Binary	<i>Length</i> of this message including this field
<i>Message Type</i>	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 customer and Cboe's Multicast TOP feed and Spin Server.

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.

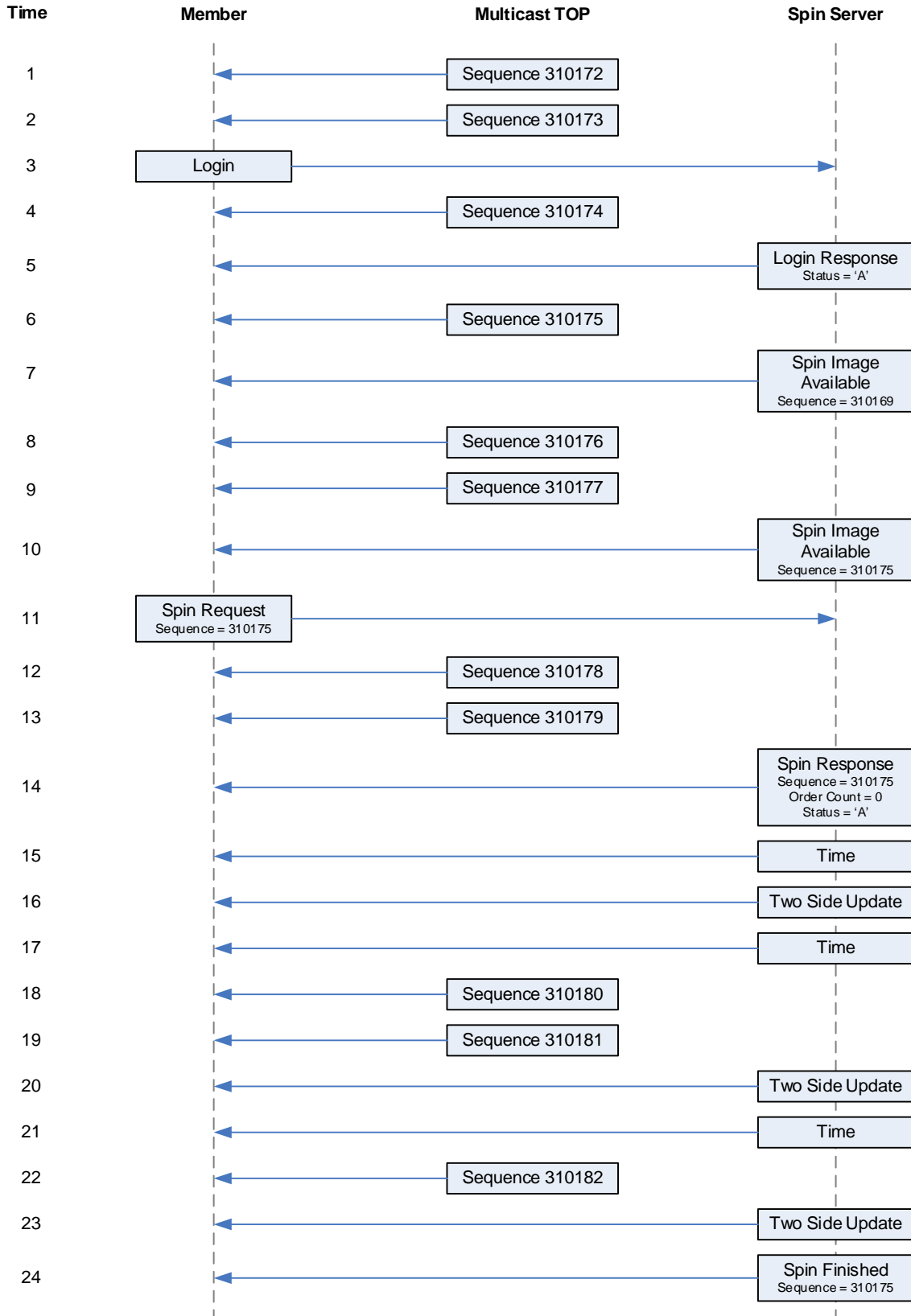
At time 14, the Spin Server acknowledges the `Spin Request` and indicates that three symbols will be sent.

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
0x84	Instrument Definition Request
0x85	Instrument Definition Response
0x86	Instrument Definition Finished

6.3 TOP Messages

0x20	Time
0x97	Unit Clear
0x9A	Complex Instrument Definition Expanded
0x2F	Symbol Mapping)
0xD4	Single Side Update Expanded (Short)
0xD5	Single Side Update Expanded (Long)
0xD6	Two Side Update Expanded (Short)
0xD7	Two Side Update Expanded (Long)
0xB8	TOP Trade
0xD1	Options Auction Update
0x96	Auction Summary
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

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	Always zero
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

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

7.10 Instrument Definition Response

Length	0B	11 bytes
Type	85	Instrument Definition Response
Sequence	00 00 00 00	Sequence: 0
Instrument Count	B8 0B 00 00	3000 Instruments
Status	41	Accepted

7.11 Instrument Definition Finished

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 Central

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

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7.14 Single Side Update Expanded (Short)

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
CID	30 31 32 33 34 35	012345
Side	42	B (Buy)
Bit Fields	00	Always Zero
Price	7B 00	\$1.23
Quantity	64 00	100 Contracts
Customer	64 00	100 Contracts
Quantity		

7.15 Single Side Update Expanded (Long)

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
CID	30 31 32 33 34 35	012345
Side	42	B (Buy)
Bit Fields	00	Always Zero
Price	E0 F4 8F 04 00 00 00 00	\$7654.3200
Quantity	64 00	100 Contracts
Customer	00 00	0 Customer Contracts
Quantity		

7.16 Two Side Update Expanded (Short)

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
CID	30 31 32 33 34 35	012345
Bit Fields	00	Always Zero
Bid Price	41 01	\$3.21
Bid Quantity	64 00	100
Bid Customer	32 00	50
Quantity		
Ask Price	43 01	\$3.23
Ask Quantity	C8 00	200
Ask Customer	64 00	100
Quantity		

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7.17 Two Side Update Expanded (Long)

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
CID	30 31 32 33 34 35	012345
Bit Fields	00	Always Zero
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

7.18 Options Auction Update

Length	30	48 bytes
Type	D1	Options Auction Update
Time offset	18 D2 06 00	447,000 ns since last Time Message
CID	43 30 30 30 31 32 20 20	C00012
Auction Type	4F	RTH Opening
Reference Price	00 00 00 00 00 00 00 00	\$0
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	00 00 00 00 00 00 00 00	\$0
Opening Condition	4F	O = Would Open

7.19 Auction Summary

Length	1B	27 bytes
Type	96	Auction Summary
Time offset	18 D2 06 00	447,000 ns since last Time Message
CID	43 30 30 30 31 32 20 20	C00012
Auction Type	4F	RTH Opening
Price	E8 A3 0F 00 00 00 00 00	\$102.50
Quantity	4B 00 00 00	75

7.20 TOP Trade

Length	25	37 bytes
Type	B8	TOP Trade

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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)

7.21 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

7.22 Complex Instrument Definition Message Expanded

Length	33	51 bytes
Type	9A	Complex Instrument Definition Expanded
Time offset	18 D2 06 00	447,000 ns since last Time Message
CID	43 30 30 30 31 32	C00012
Complex	5A 56 5A 5A 54 20 20 20	ZVZZT
Instrument		
Underlying		
Complex	4F 00 00 00	0 = All Legs are Options
Instrument		
Type		
Leg Count	02	2 Legs
Leg Symbol	30 30 30 30 30 31 20 20	000001
Leg Ratio	FF FF FF FF	-1 = Sell 1
Leg Security	4F	Option Leg
Type		
Leg Symbol	30 30 30 30 30 32 20 20	000002
Leg Ratio	01 00 00 00	1 = Buy 1
Leg Security	4F	Option Leg
Type		

7.23 Symbol Mapping Message

Length	26	38 bytes
Type	2E	Symbol Mapping

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Feed Symbol	30 30 6D 45 56 4F	Message
OSI Symbol	4D 53 46 54 20 20 31 30	00mEVO
	30 31 31 36 43 30 30 30	MSFT 100116C00047500
	34 37 35 30 30	
Symbol	43	'C' - Closing Only
Condition		
Underlying	4D 53 46 54 20 20 20 20	MSFT

7.24 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	998877
Reserved	20 20	Reserved
Trading Status	54	T = Trading
Reserved	20	Reserved
Global Trading	48	H = Halted
Hours Status		
Reserved	20	Reserved

7.25 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

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.

For additional information about physical connectivity, refer to the [US Equities/Options Connectivity Manual](#).

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8.1.2 Unit/Product Distribution

The following table describes an updated Cboe symbol distribution across units for C1, C2 and EDGX Options.

Unit	C2/EDGX Symbol Range	C2/EDGX Exceptions	C1 Symbol Range	C1 Exceptions
1	A – ADOZZ		A – ACNAZ	
2	ADP – ANETZ	Excludes AMZN	ACNB – AMGNZ	
3	ANEU – BAAAZ		AMGO – BAAZ	Excludes AMZN
4	BAAB – BKNFZ		BAB – BKNFZ	
5	BKNG – BZZZZ		BKNG – CASZZ	
6	C – CLGXZ		CAT – COOZZ	
7	CLGY – CSXAZ		COP – DEAAZ	
8	CSXB – DISAZ		DEAB – EEMAZ	Excludes DJX
9	DISB – ETFBZ		DJXA – FBAAZ	
10	ETFC – FIVDZ		FBAB – GOOFZ	
11	FIVE – GLDAZ		GOOG – GOOGZ	
12	GLDB – GOOGZ		GOOH – IFFAZ	
13	GOOH – HSXZZ		IFFB – IWLZZ	
14	HSY – IWLZZ		IWM – IWMAZ	
15	IWM – JNJAZ		IWMB – LOVZZ	
16	JNJB – LMTAZ		LOW – MPCAZ	
17	LMTB – MLNXZ		MPCB – NFLWZ	
18	MLNY – MUA AZ		NFLX – NUEAZ	
19	MUAB – NTESZ		NUEB – PEPAZ	Excludes OEX
20	NTET – OXYAZ		PEPB – QQPZZ	
21	OXYB – QGENZ		ROKV – SPZZZ	Excludes RUT, RUTW, SIXB, SIXC, SIXE, SIXI, SIXR, SIXRE, SIXT, SIXU, SIXV, SIXY, SPX, SPXW, SPY
22	QGEO – RHAAZ		SQ – TLRYZ	
23	RHAB – SMGZZ	Excludes RUT, RUTW	TLRZ – TSLAZ	
24	SMH – SYEZZ	Excludes SPY	TSLB – UVXXZ	
25	SYF – TSKZZ		UVXY – VZZZZ	Excludes VIX, VIXW
26	TSL – UALAZ		W – XLEAZ	Excludes XEO
27	UALB – VLOAZ		XLEB – ZZZZZ	Excludes XSP
28	VLOB – WDCAZ		QQQ	
29	WDCB – XLDZZ		AMZN	
30	XLE – ZZZZZ	Excludes XSP	SPY	
31	AMZN		DJX, OEX, RUT, RUTW, XEO, XSP, SIXB, SIXC, SIXE, SIXI, SIXR, SIXRE, SIXT, SIXU, SIXV, SIXY	
32	SPY		VIX, VIXW	
33	RUT (BZX only) RUT, RUTW (C2 only) XSP (EDGX only)		SPX	
34	N/A		SPXW	
35	N/A		SPX/SPXW Cross Product Spreads	

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 C1 Options Multicast Routing Parameters

Data Center	Rendezvous Point
Primary Data Center C feed	TBD
Primary Data Center D feed	TBD
Secondary Data Center E feed	TBD

8.1.4 C2 Options Multicast Routing Parameters

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

8.1.5 EDGX Options Multicast Routing Parameters

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

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8.1.6 C1 Options Address/Unit Distribution

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

Primary Datacenter		WAN-Shaped [CCD] TBD		WAN-Shaped [CDD] 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				
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				
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. 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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Secondary Datacenter		WAN-Shaped [CED] TBD	
Unit	IP Port	Real-time MC	Gap Response 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.

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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.

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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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.

8.1.8 EDGX Options Address/Unit Distribution

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

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				
33	30733				

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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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		
33	31533		

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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8.2 Certification Environment Configuration

8.2.1 Unit/Product Distribution

The following table describes the C1, C2 and EDGX Options symbol distribution across units.

Unit	C2/EDGX Symbol Range	C2/EDGX Exceptions	C1 Symbol Range	C1 Exceptions
1	A – ADOZZ		A – ACNAZ	
2	ADP – ANETZ	Excludes AMZN	ACNB – AMGNZ	
3	ANEU – BAAAZ		AMGO – BAAZ	Excludes AMZN
4	BAAB – BKNFZ		BAB – BKNFZ	
5	BKNG – BZZZZ		BKNG – CASZZ	
6	C – CLGXZ		CAT – COOZZ	
7	CLGY – CSXAZ		COP – DEAAZ	
8	CSXB – DISAZ		DEAB – EEMAZ	Excludes DJX
9	DISB – ETFBZ		DJXA – FBAAZ	
10	ETFC – FIVDZ		FBAB – GOOFZ	
11	FIVE – GLDAZ		GOOG – GOOGZ	
12	GLDB – GOOGZ		GOOH – IFFAZ	
13	GOOH – HSXZZ		IFFB – IWLZZ	
14	HSY – IWLZZ		IWM – IWMAZ	
15	IWM – JNJAZ		IWMB – LOVZZ	
16	JNJB – LMTAZ		LOW – MPCAZ	
17	LMTB – MLNXZ		MPCB – NFLWZ	
18	MLNY – MUA AZ		NFLX – NUEAZ	
19	MUAB – NTE SZ		NUEB – PEP AZ	Excludes OEX
20	NTET – OXY AZ		PEPB – QQPZZ	
21	OXYB – QGENZ		ROKV – SPZZZ	Excludes RUT, RUTW, SIXB, SIXC, SIXE, SIXI, SIXR, SIXRE, SIXT, SIXU, SIXV, SIXY, SPX, SPXW, SPY
22	QGEO – RHAAZ		SQ – TLR YZ	
23	RHAB – SMGZZ	Excludes RUT, RUTW	TLRZ – TSLAZ	
24	SMH – SYEZZ	Excludes SPY	TSLB – UVXXZ	
25	SYF – TSKZZ		UVXY – VZZZZ	Excludes VIX, VIXW
26	TSL – UALAZ		W – XLEAZ	Excludes XEO
27	UALB – VLOAZ		XLEB – ZZZZZ	Excludes XSP
28	VLOB – WDCAZ		QQQ	
29	WDCB – XLDZZ		AMZN	
30	XLE – ZZZZZ	Excludes XSP	SPY	
31	AMZN		DJX, OEX, RUT, RUTW, XEO, XSP, SIXB, SIXC, SIXE, SIXI, SIXR, SIXRE, SIXT, SIXU, SIXV, SIXY	
32	SPY		VIX, VIXW	
33	RUT (BZX only) RUT, RUTW (C2 only) XSP (EDGX only)		SPX	
34	N/A		SPXW	
35	N/A		SPX/SPXW Cross Product Spreads	

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8.2.2 Multicast Routing Parameters

Primary Certification Data Center	Rendezvous Point
C1	74.115.128.131
C2 and EDGX	74.115.128.129

8.2.3 C1 Options Address/Unit Distribution

The following table describes the unit distribution across certification C1 Options Complex Multicast TOP feeds out of the Primary datacenter.

Primary Datacenter		Certification 170.137.126.16/28	
Unit	IP Port	Real-time MC	Gap Resp. MC
1	32251	233.103.126.12	233.103.126.14
2	32252		
3	32253		
4	32254		
5	32255		
6	32256		
7	32257		
8	32258		
9	32259		
10	32260		
11	32261		
12	32262		
13	32263		
14	32264		
15	32265		
16	32266		
17	32267	233.103.126.13	233.103.126.15
18	32268		
19	32269		
20	32270		
21	32271		
22	32272		
23	32273		
24	32274		
25	32275		
26	32276		
27	32277		
28	32278		
29	32279		
30	32280		
31	32281		
32	32282		
33	32283		
34	32284		
35	32285		

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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8.2.4 C2 Options Address/Unit Distribution

The following table describes the unit distribution across certification C2 Complex Options Multicast TOP feeds out of the Primary 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.

8.2.5 EDGX Options Address/Unit Distribution

The following table describes the unit distribution across certification EDGX Options Complex Multicast TOP feeds out of the Primary 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		
33	32733		

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@cboe.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.
1.1.0	11/16/18	Added support for C1 Options.
1.1.1	12/06/18	Feature Pack 4 updates. Addition of new values O, A, C, F to <i>Trade Condition</i> field.
1.1.2	12/21/18	Removed Floor Trade value from Top Trade message, <i>Trade Condition</i> field, as this was added in error. Added note indicating a Top Trade message can also be sent when an auction executes against a non-displayed order, such as a contra response.
1.1.3	02/05/19	Removed references to cabinet size in messages, as C1 will not have an electronic book for Cabinet orders.
1.1.4	02/14/19	Added certification IP port and unit distribution information.

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1.1.5	03/05/19	Added matching engine unit 33 information in support of XSP trading on EDGX Options effective 04/08/19 . Added C1 primary data center rendezvous point IP address and C1 certification symbol ranges. <i>Order Count</i> in a spin is always zero for this feed.
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