



Cboe Futures Exchange Multicast TOP Specification

Version 1.1.9

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1 Introduction

1.1 Overview

Note that this specification is the standard Multicast TOP specification for the Cboe Futures Exchange (“CFE”) platform.

CFE participants may use the CFE Multicast TOP protocol to receive real-time top of book quotations direct from CFE. Market data received through Multicast TOP is less timely than receiving the same data from the CFE Multicast PITCH Depth of Book feed. The TOP protocol offers approximately 66% reduction in the number of events and 66% reduction in the number of bytes of application data sent, compared to the CFE Multicast PITCH protocol.

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

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

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

All versions of the Multicast TOP feed are WAN-shaped (maximum 100 Mb/s) and are available from one or both of CFE’s datacenters. Participants may choose to take one or more of the following Multicast TOP feeds depending on their location and connectivity to CFE.

Multicast TOP Feed Descriptions:

Exchange	Shaping	Served From Data Center (Primary/Secondary)	Multicast Feed ID
CFE	WAN	Primary	FCT
CFE	WAN	Primary	FDT
CFE	WAN	Secondary	FET

1.2 Feed Hours and System Restart

The TOP feed will startup on Sunday at approximately 10:00 a.m. CT and shutdown on Friday at approximately 4:05 p.m. CT. A daily restart occurs between 4:05 and 4:45 p.m. CT each day at which time sequences will be reset. The daily restart is typically observed between 4:05 and 4:10 p.m. CT, but could occur later if needed for operational reasons. Feed startup and shutdown times may be adjusted without notice.

Under normal operations, it is expected that the order books will be cleared (including GTC and GTD orders), prior to the daily restart and reset of sequences. Persisted GTC and GTD orders will be added back onto the order books immediately after restart.

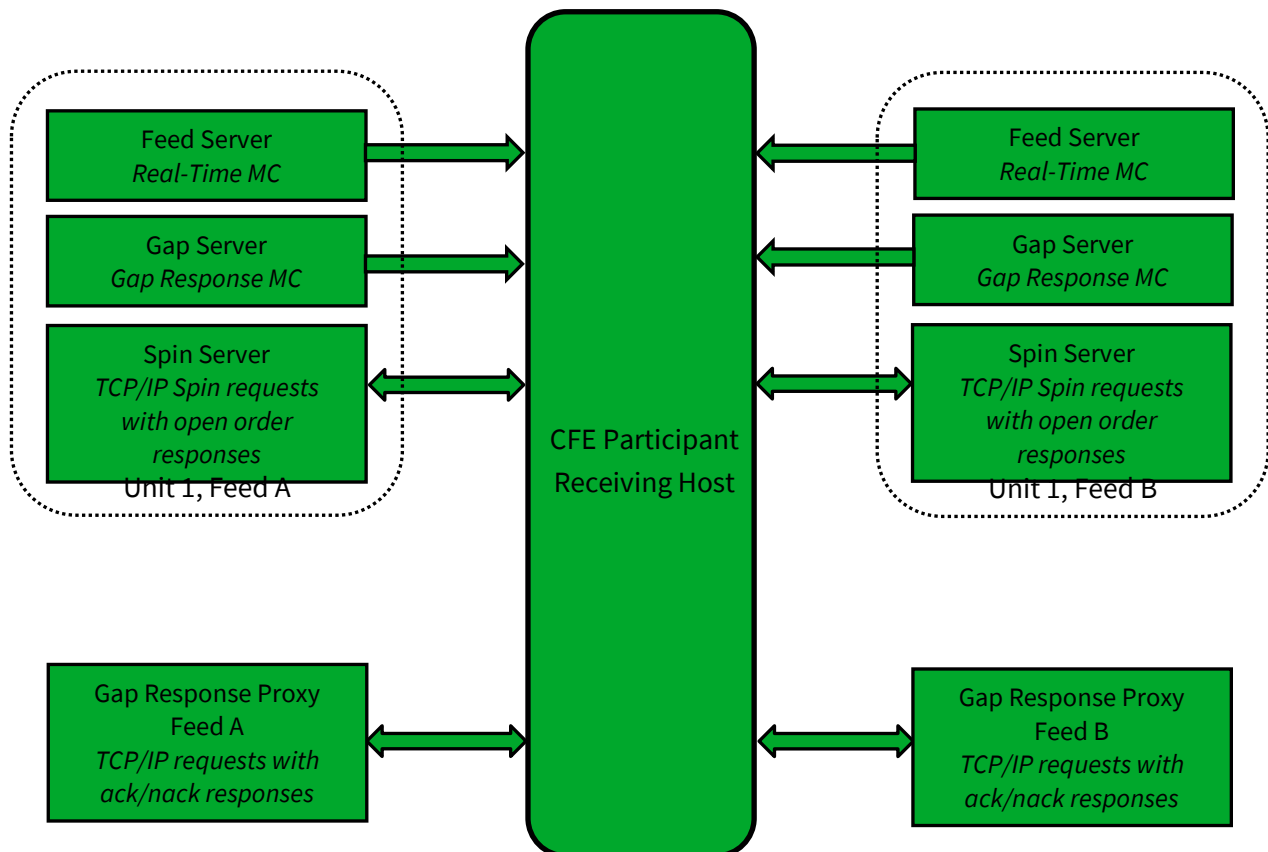
1.3 Feed Connectivity Requirements

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

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

CFE 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 CFE'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. Alternatively, the Periodic Refresh mechanism may be used by latency insensitive participants to recover missed messages or gaps. 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 Multicast TOP feed message flow between CFE and a participant feed handler that is listening to the "A" and "B" instances of two units:



1.4 Symbol Ranges, Units, and Sequence Numbers

Products will be separated into units and [product distribution](#) will not change intra-day. CFE does, however, **reserve the right to add multicast addresses or change the product distribution with 48 hours prior notice to participants**. 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.

1.5 Futures Specific Symbol Processing

CFE has implemented a symbol mapping mechanism (`Futures Instrument Definition` message) for the Multicast TOP feeds, which maps each specific simple futures contract or spread instrument to a six character, ASCII *Symbol*. For example, the weekly VX11 contract expiring March 14, 2017 might be represented by the *Symbol* '0abC12'. This symbol mapping significantly reduces the size of the Multicast TOP feed for futures and allows participants to use the same symbol handling mechanisms for the Cboe operated equity, options, and futures exchanges. This symbol mapping is the same as the Multicast PITCH feed.

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

Spread instruments may be occasionally created intra-day. In these cases, the `Futures Instrument Definition` message will be sent as a sequenced message on the real-time feed and from the Spin Server before any other messages that reference an instrument created intra-day are sent.

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

Production symbol files:

- ❖ [Simple](#)
- ❖ [Spread](#)

Certification symbol files:

- ❖ [Simple](#)
- ❖ [Spread](#)

1.6 Periodic Refresh

The CFE Multicast TOP feed will periodically broadcast un-sequenced Futures Instrument Definition, Price Limits, and Market Snapshot messages that participants can use to recover from gaps or that may be used by late joiners to obtain a current state of the top of book for each *Symbol*. Un-sequenced messages are sent in a continuous loop. The Price Limits, and Market Snapshot messages complete their loop approximately once every three seconds. The Futures Instrument Definition message completes its loop once a minute.

Participants that are not latency sensitive can use the Periodic Refresh mechanism as a substitute for the sequenced, real-time TOP messages. These participants would process only the un-sequenced Futures Instrument Definition, Price Limits, and Market Snapshot messages to get a periodic view of the top of book quote and volume for each *Symbol*.

1.7 Gap Request Proxy and Message Retransmission

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

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

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

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

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

1.8 Spin Servers

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

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

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

A spin consists only of `Market Snapshot`, `Futures Instrument Definition`, `Settlement`, `Price Limits`, `Time Reference` and `Time` messages for symbols that have had orders that day or had a limited trading state. While receiving the spin, the participant must buffer multicast messages received. If the `Spin Image Available` message sequence number is the participant’s reference point, multicast messages with larger sequence numbers should be buffered. If a non-`Spin Image Available` sequence number is the participant’s reference point which they send in their `Spin Request`, they should buffer from that point on, but note that within the spin they may receive sequence numbers beyond that point which they may disregard. When a `Spin Finished` message is received, the buffered messages must be applied to spin copy of the book to bring it current.

[Section 5.7](#) shows an example flow of messages between a participant and CFE’s Multicast TOP feed and Spin Server.

2 Protocol

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

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

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

2.1 Message Format

The messages that make up the TOP protocol are delivered using the CFE `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. **CFE reserves the right to add message types and grow the length** of any message without notice. Participants should develop their decoders to deal with unknown message types and messages that grow beyond the expected length. Messages will only be grown to add additional data to the end of a message.

2.2 Data Types

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

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

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- **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.

2.2.1 Trade Date

Throughout this document, the term “Trade Date” is synonymous with the term “Business Date”. The term Trade Date is used within this document to match identically named fields in the CFE FIX and BOE specs.

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 CFE `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 CFE Sequenced Unit Header

The CFE `Sequenced Unit Header` is used for all CFE 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`

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`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
<code>Hdr Length</code>	0	2	Binary	Length of entire block of messages. Includes this header and <code>Hdr Count</code> messages to follow.
<code>Hdr Count</code>	2	1	Binary	Number of messages to follow this header.
<code>Hdr Unit</code>	3	1	Binary	Unit that applies to messages included in this header.
<code>Hdr Sequence</code>	4	4	Binary	Sequence of first message to follow this header.
Total Length = 8 bytes				

2.5 Heartbeat Messages

The CFE `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 CFE 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.

CFE 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.

2.6 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.

2.7 Time

A `Time` message is immediately generated and sent when there is a TOP event for a given clock second. If there is no new sequenced TOP event for a given clock second, then no `Time` message is sent for that second. All subsequent time offset fields for the same unit will use the new `Time` value as the base until another `Time` message is received for the same unit. The `Time` field is the number of seconds relative to midnight Central Time, which is provided in the `Time Reference` message. The `Time` message also includes the `Epoch Time` field, which is the current time represented as the number of whole seconds since the Epoch (Midnight January 1, 1970).

Time				
Field Name	Offset	Length	Type/(Value)	Description
<code>Length</code>	0	1	Binary	<code>Length</code> of this message including this field.
<code>Message Type</code>	1	1	0x20	Time Message
<code>Time</code>	2	4	Binary	Number of whole seconds from midnight Central Time.
<code>Epoch Time</code>	6	4	Binary	Number of whole seconds since the Epoch (Midnight January 1, 1970 UTC).
Total Length = 10 bytes				

2.8 Unit Clear

The `Unit Clear` message instructs feed recipients to clear all market snapshots for the CFE book in the unit specified in the `Sequenced Unit Header`. It would be distributed in rare recovery events such as a data center fail-over. It may also be sent on system startup (after daily restart) when there are no persisted GTCs or GTDs.

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

2.9 Time Reference

The `Time Reference` message is used to provide a midnight reference point for recipients of the feed. It is sent whenever the system starts up and when the system crosses a midnight boundary. All

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subsequent `Time` messages for the same unit will use the last `Midnight Reference` until another `Time Reference` message is received for that unit. The `Time Reference` message includes the `Trade Date`, so most other sequenced messages will not include that information.

`Time Reference` messages will be included in a spin response.

Time Reference				
Field Name	Offset	Length	Type/(Value)	Description
<code>Length</code>	0	1	Binary	<code>Length</code> of this message including this field.
<code>Message Type</code>	1	1	0xB1	<code>Time Reference</code> Message
<code>Midnight Reference</code>	2	4	Binary	Midnight Central Time reference time for subsequent <code>Time</code> messages, expressed as number of whole seconds since the Epoch (Midnight January 1, 1970 UTC).
<code>Time</code>	6	4	Binary	Number of whole seconds from midnight Central Time.
<code>Time Offset</code>	10	4	Binary	Nanosecond offset from last unit timestamp.
<code>Trade Date</code>	14	4	Binary Date	Current Trade Date
Total Length = 18 bytes				

2.10 Futures Instrument Definition

The `Futures Instrument Definition` message can be sent as a sequenced message or an un-sequenced message. It is sent as a sequenced message when the system starts up at the beginning of a trading session or an the instrument is created or modified during a trading day. A new sequenced message may be sent for a `Symbol` that does not visibly change any attribute. One un-sequenced `Futures Instrument Definition` message for each `Symbol` is also sent in a continuous loop, which completes approximately once every minute as part of the Periodic Refresh mechanism.

If the instrument is a spread (`Leg Count` > 0) then the message contains one or more repeating groups of leg definitions beginning at the field indicated by `Leg Offset`. There is a limit of 4 leg definitions.

If the instrument is a variance future (`Variance` bit in `Futures Flags` = 1) then the message contains a block of Variance Future parameters beginning at the offset indicated by `Variance Offset`. A `Futures Instrument Definition` may have a Variance Futures block or Leg definitions, but not both. If the values for the Variance Future block are not available at the beginning of the trading day, "0" will be sent for those values until they are available. At that point, a sequenced `Futures Instrument Definition` message will be sent with the updated values.

The `Leg Offset` and `Variance Offset` fields are provided to support adding additional fields to this message between the offset fields and the Variance Future block and Leg definitions.

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The *Report Symbol* field will contain either the weekly (e.g. VX01) or the monthly (e.g. VX) symbol for any simple futures contract. The *Report Symbol* will always contain the standard futures root symbol (e.g. VX) for all spread instruments.

Futures Instrument Definition messages are included in a spin response. Simple leg Futures Instrument Definition messages will be disseminated before complex leg Futures Instrument Definition messages sent in a spin response.

Futures 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	0xBB	Futures Instrument Definition Message
<i>Time Offset</i>	2	4	Binary	Nanosecond offset from last unit timestamp or <i>Unit Timestamp</i> in this message if it is non-zero.
<i>Symbol</i>	6	6	Printable ASCII	Six character, base 62 symbol.
<i>Unit Timestamp</i>	12	4	Binary	Unit timestamp expressed as number of whole seconds since the Epoch (Midnight, January 1, 1970 UTC).
<i>Report Symbol</i>	16	6	Alphanumeric	Symbol for product or underlying security.
<i>Futures Flags</i>	22	1	Bit Field	Bit 0 – Variance (1: Variance Future, 0: Standard Future)
<i>Expiration Date</i>	23	4	Binary Date	Expiration Date of Instrument.
<i>Contract Size</i>	27	2	Binary	Contract size of Instrument.
<i>Listing State</i>	29	1	Alphanumeric	A = Active I = Inactive T = Test
<i>Price Increment</i>	30	8	Binary Price	Minimum Price Increment.
<i>Leg Count</i>	38	1	Binary	Values greater than 0 indicate this is a spread instrument.
<i>Leg Offset</i>	39	1	Binary	Leg definitions, if any, begin at this offset from the beginning of the message. Possible values are 0 (no legs present) or 45 (spread instrument). Cboe reserves the right to change these values without prior notice.

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<i>Variance Block Offset</i>	40	1	Binary	Variance Future parameter block begins at this offset from the beginning of the message. Possible values are 0 (no Variance Block) or 45 (Variance Block present). Cboe reserves the right to change these values without prior notice.
<i>Contract Date</i>	41	4	Binary Date	Populated for single leg instruments only. Zero-filled for spread instruments. The date that should be used in describing the future's third party symbol and the measurement period of the contract. Set to same value as <i>Expiration Date</i> for futures that have a <i>Contract Date</i> that does not differ from expire date.
The following fields are only present if <i>Variance</i> bit in <i>Futures Flags</i> = 1.				
<i>Realized Variance</i>	45	8	Signed Binary	Realized Variance to date (signed 64-bit decimal with 8 implied decimal places)
<i>Num Expected Prices</i>	53	2	Binary	Number of expected S&P500 prices to be used for calculating returns during the life of the contract
<i>Num Elapsed Returns</i>	55	2	Binary	Number of returns elapsed as of the beginning of the trading day
<i>Previous Settlement</i>	57	8	Binary Price	Previous day Settlement Value
<i>Discount Factor</i>	65	8	Signed Binary	Discount Factor (signed 64-bit decimal with 16 implied decimal places)
<i>Initial Strike</i>	73	8	Binary Price	Initial strike

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<i>Previous ARMVM</i>	81	8	Signed Binary	ARMVM that was used to adjust the previous day settlement price (signed 64-bit decimal value with 6 implied decimal places)
<i>Fed Funds Rate</i>	89	8	Signed Binary	Fed Funds rate of prior day (signed 64-bit number with 6 implied decimal places)
The following fields repeat <i>Leg Count</i> times (maximum of 4) for spread instruments.				
<i>Leg Ratio</i>	<i>Leg Offset + (10 * Leg Index)</i>	4	Signed Binary	Leg ratio (positive for bid-side, negative for ask-side).
<i>Leg Symbol</i>	<i>Leg Offset + 4 + (10 * Leg Index)</i>	6	Alphanumeric	Symbol of leg.
Variable Total Length = 45 (+ 52 if Variance Future) + (Leg Count * 10) bytes				

2.11 Price Limits

The *Price Limits* message can be sent as a sequenced or un-sequenced message. As a sequenced message, it is sent out at the start of the session for products that are subject to price limits per the contract specifications. The *Price Limits* message does not signal whether price limits are in effect for that symbol; it simply provides those values for when they are in effect. If multiple *Price Limits* messages are received for the same *Symbol*, the most recent values will override the previous values.

As an un-sequenced message, it is sent out with a *Market Snapshot* message as part of the Periodic Refresh mechanism.

Price Limits messages are included in a spin response.

Price Limits				
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	0xBE	<i>Price Limits</i> Message
<i>Time Offset</i>	2	4	Binary	Nanosecond offset from last unit timestamp.
<i>Symbol</i>	6	6	Printable ASCII	Six character, base 62 symbol.
<i>Upper Price Limit</i>	12	8	Binary Price	Upper price limit
<i>Lower Price Limit</i>	20	8	Binary Price	Lower price limit
Total Length = 28 bytes				

2.12 Refresh and Spin Messages

2.12.1 Market Snapshot

A `Market Snapshot` message provides a snapshot of the price and size for the bid and ask, last trade price, total number of contracts traded, and the current trading status of a single symbol. The `Market Snapshot` message will be included during a Spin for all products traded so far this Trade Date. Finally, `Market Snapshot` messages will also be sent in a continuous loop as part of the Periodic Refresh mechanism.

The `Unit Timestamp` field is provided because the timestamp for a `Market Snapshot` is the last time an event occurred on that `Symbol`. Since the Futures market can cross midnight Central Time, 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	Market Snapshot (Short) Message
<i>Time Offset</i>	2	4	Binary	Nanosecond offset from <i>Unit Timestamp</i> in this message.
<i>Symbol</i>	6	6	Printable ASCII	Six character, base 62 symbol.
<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	Number of contracts on the bid side of the inside book (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).

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<i>Ask Quantity</i>	22	2	Binary	Number of contracts on the ask side of the inside book (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	Number of contracts traded on the last trade (if this value is 0 the <i>Last Trade Price</i> is invalid).
<i>Last Trade Condition</i>	28	1	Alphanumeric	Trade Condition for Last Trade (Space) = Normal trade O = Opening trade S = Spread trade B = Block trade E = ECRP trade X = Trade break
<i>Total Volume</i>	29	4	Binary	Total number of contracts traded on the current business day.
<i>Trading Status</i>	33	1	Alphanumeric	See <i>Trading Status</i> field of <i>Trading Status</i> message.
<i>Reserved</i>	34	3	Alphanumeric	Reserved for use in other markets.
Total Length = 37 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>Symbol</i>	6	6	Printable ASCII	Six character, base 62 symbol.
<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 Price	Bid price (may be a zero or negative price for some instruments).
<i>Bid Quantity</i>	24	4	Binary	Number of contracts on the bid side of the inside book (a zero value denotes the <i>Bid Price</i> is invalid).

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<i>Ask Price</i>	28	8	Binary Price	Ask price (may be a zero or negative price for some instruments).
<i>Ask Quantity</i>	36	4	Binary	Number of contracts on the ask side of the inside book (a zero value denotes the <i>Ask Price</i> is invalid).
<i>Last Trade Price</i>	40	8	Binary Price	Price of last execution (this can be zero or negative for some instruments).
<i>Last Trade Size</i>	48	4	Binary	Number of contracts traded on the last trade (if this value is 0 the <i>Last Trade Price</i> is invalid).
<i>Last Trade Condition</i>	52	1	Alphanumeric	Trade Condition for Last Trade (Space) = Normal trade O = Opening trade S = Spread trade B = Block trade E = ECRP trade X = Trade break
<i>Total Volume</i>	53	4	Binary	Total number of contracts 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.
Total Length = 61 bytes				

2.13 Market Update Messages

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

2.13.1 Single Side Update

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

Single Side Update messages come in 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.

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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>Symbol</i>	6	6	Printable ASCII	Six character, base 62 symbol.
<i>Side</i>	12	1	Alphanumeric	B = Bid side S = Ask side
<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	Number of contracts on the inside book (a zero value denotes the <i>Price</i> is invalid).
Total Length = 17 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>Symbol</i>	6	6	Printable ASCII	Six character, base 62 symbol.
<i>Side</i>	12	1	Alphanumeric	B = Bid side S = Ask side
<i>Price</i>	13	8	Binary Price	Price (may be a zero or negative price for some instruments).
<i>Quantity</i>	21	4	Binary	Number of contracts on the inside book (a zero value denotes the <i>Price</i> is invalid).
Total Length = 25 bytes				

2.13.2 Two Side Update Message

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

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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.

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>Symbol</i>	6	6	Printable ASCII	Six character, base 62 symbol.
<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	Number of contracts on the bid side of the inside book (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	Number of contracts on the ask side of the inside book (a zero value denotes the <i>Ask Price</i> is invalid).
Total Length = 20 bytes				

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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>Symbol</i>	6	6	Printable ASCII	Six character, base 62 symbol.
<i>Bid Price</i>	12	8	Binary Price	Bid price (may be a zero or negative price for some instruments).
<i>Bid Quantity</i>	20	4	Binary	Number of contracts on the bid side of the inside book (a zero value denotes the <i>Bid Price</i> is invalid).
<i>Ask Price</i>	24	8	Binary Price	Ask price (may be a zero or negative price for some instruments).
<i>Ask Quantity</i>	32	4	Binary	Number of contracts on the ask side of the inside book (a zero value denotes the <i>Ask Price</i> is invalid).
Total Length = 36 bytes				

2.13.3 TOP Trade Message

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

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

The TOP Trade message sends the trade price, trade quantity, execution id, and trade condition of a trade as well as the cumulative volume for the business day. A TOP Trade message will be sent for each execution, but not every TOP Trade message indicates a trade. The *Trade Condition* value of 'X' (Trade Break) is sent whenever an execution on CFE is broken. Trade breaks are rare and only affect applications that rely upon CFE 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.

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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>Symbol</i>	6	6	Printable ASCII	Six character, base 62 symbol.
<i>Quantity</i>	12	4	Binary	Incremental number of contracts executed or corrected (see <i>Trade Condition</i>).
<i>Price</i>	16	8	Binary Price	The execution price of the order.
<i>Execution Id</i>	24	8	Binary	CFE generated day-unique execution identifier of this trade. <i>Execution Id</i> is also referenced in the <i>Trade Break</i> message.
<i>Total Volume</i>	32	4	Binary	Total number of contracts traded on the current business day (may decrease if the <i>Trade Condition</i> field indicates a canceled trade).
<i>Trade Condition</i>	36	1	Alphanumeric	(Space) = Normal trade O = Opening trade ¹ S = Spread trade ¹ B = Block trade E = ECRP trade ¹ Sent for simple (non-spread) symbols only.
Total Length = 37 bytes				

2.14 End of Day Messages

Several different message types are sent after the close to signify the end of a Trading Day.

2.14.1 Settlement

Settlement messages are sent once per day per instrument after settlement prices have been calculated for all applicable instruments on a given business date. If there is an error in the settlement it may be re-issued (see the *Issue* field).

Settlement messages will be included in a spin response.

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Settlement				
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	0xB9	Settlement Message
<i>Time Offset</i>	2	4	Binary	Nanosecond offset from last unit timestamp.
<i>Symbol</i>	6	6	Printable ASCII	Six character, base 62 symbol.
<i>Trade Date</i>	12	4	Binary Date	Trade Date for the settlement.
<i>Settlement Price</i>	16	8	Binary Price	Settlement Price
<i>Issue</i>	24	1	Alphanumeric	S = Initial Settlement R = Re-issued Settlement
Total Length = 25 bytes				

2.14.2 End of Day Summary

The *End of Day Summary* is sent out right after trading ends for a symbol. No more Market Update messages will follow an *End of Day Summary* for a particular symbol. A value of zero in the *Total Volume* field means that no volume traded on that symbol for the day. The *Total Volume* field reflects all contracts traded during the day. Block and ECRP trades are included in the *Total Volume* field, but they are also reported separately to provide more detail.

The *Summary Flags* field provides additional information on how to interpret the *High Price* and *Low Price* fields, especially in instruments that had no volume for the day and/or where 0 is a valid price (e.g. Trade At Settlement products). There are flags that indicate whether or not the *High Price* and *Low Price* fields are valid. If they are not valid, then there was no High (and/or Low) Price for the day. There are also flags that indicate whether the *High Price* was set by the highest bid and the *Low Price* was set by the lowest offer rather than a trade.

All *End of Day Summary* message values will span the full trading day, including all extended hours trading and all trading segments.

End of Day Summary				
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	0xBA	<i>End of Day Summary</i> Message
<i>Time Offset</i>	2	4	Binary	Nanosecond offset from last unit timestamp.
<i>Symbol</i>	6	6	Printable ASCII	Six character, base 62 symbol.
<i>Trade Date</i>	12	4	Binary Date	Trade Date for the message.
<i>Open Interest</i>	16	4	Binary	Prior Trade Date Open Interest for this symbol.

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<i>High Price</i>	20	8	Binary Price	The higher of highest bid price and highest trade price for the day. Block and ECRP trades (<i>Trade Condition = B or E</i>) do not update <i>High Price</i> .
<i>Low Price</i>	28	8	Binary Price	The lower of lowest offer price and lowest trade price for the day. Block and ECRP trades (<i>Trade Condition = B or E</i>) do not update <i>Low Price</i> .
<i>Open Price</i>	36	8	Binary Price	The first trade on the day (in any session) will set the <i>Open Price</i> for the day (valid only if <i>Total Volume > 0</i>). Block and ECRP trades (<i>Trade Condition = B or E</i>) do not update <i>Open Price</i> .
<i>Close Price</i>	44	8	Binary Price	The last trade on the day (in any session) will set the <i>Close Price</i> for the day (valid only if <i>Total Volume > 0</i>). Block and ECRP trades (<i>Trade Condition = B or E</i>) do not update <i>Close Price</i> .
<i>Total Volume</i>	52	4	Binary	Total number of contracts traded for the day, including Block and ECRP trades.
<i>Block Volume</i>	56	4	Binary	Total number of block contracts traded for the day.
<i>ECRP Volume</i>	60	4	Binary	Total number of contracts traded for the day.
<i>Summary Flags</i>	64	1	Bit Field	<p>Bit 0 = <i>High Price</i> Valid – Set if <i>High Price</i> is a valid value.</p> <p>Bit 1 = <i>High Price</i> is bid– Set if <i>High Price</i> was set by the highest bid (rather than a trade).</p> <p>Bit 2 = <i>Low Price</i> Valid – Set if <i>Low Price</i> is a valid value.</p> <p>Bit 3 = <i>Low Price</i> is offer – Set if <i>Low Price</i> was set by the lowest offer (rather than a trade).</p> <p>Bit 4 = Open/Close Valid – Set if both. <i>Open Price</i> and <i>Close Price</i> fields contain valid values</p> <p>Bit 5-7 = Reserved</p>
Total Length = 65 bytes				

2.15 Trading Status

The `Trading Status` message is used to indicate the current trading status of a Futures contract. A `Trading Status` message will be sent whenever a security’s trading status changes. If a `Trading Status` has not been received for a symbol, then the *Trading Status* for the symbol should be assumed to be “S = Suspended”. The following summarizes the `Trading Status` values in the CFE system:

- S = Suspended. A contract is in a suspended state when the associated product is closed and not accepting orders.
- Q = Accepting orders for queuing. Queuing state is used during the Pre-Open for all products and 3:15-3:30 pause in VX. It is also used for spread instruments that may not be tradeable due to Threshold Width.
- T = Trading. Used for both Extended and Regular Hours trading.
- H = Halt state. This state is used for Supervisory Halts initiated by the Trade Desk. Orders are not being accepted in this state.

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>Symbol</i>	6	6	Printable ASCII	Six character, base 62 symbol.
<i>Reserved1</i>	12	2	Alpha	Reserved
<i>Trading Status</i>	14	1	Alpha	S = Suspended Q = Queuing T = Trading H = Halted
<i>Reserved2</i>	15	3	Alphanumeric	Reserved
Total Length = 18 bytes				

2.16 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				

3 Gap Request Proxy Messages

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

3.1 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 CFE.
<i>Username</i>	6	4	Alphanumeric	<i>Username</i> supplied by CFE.
<i>Filler</i>	10	2	Alphanumeric	(space filled)
<i>Password</i>	12	10	Alphanumeric	<i>Password</i> supplied by CFE.
Total Length = 22 bytes				

3.2 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			

3.3 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 CFE'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				

3.4 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.

4 Spin Messages

4.1 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](#).

4.2 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](#).

4.3 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				

4.4 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 1.7](#) 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
<i>Sequence</i>	2	4	Binary	Sequence number from a <code>Spin Image Available</code> message received by the participant.
Total Length = 6 bytes				

4.5 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	Spin Response Message
<i>Sequence</i>	2	4	Binary	Sequence number from a Spin Image Available message received by the participant.
<i>Order Count</i>	6	4	Binary	Number of Add Order 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.

4.6 Spin Finished

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

Spin Finished				
Field Name	Offset	Length	Type/(Value)	Description
<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				

4.7 Spin Server Usage Example

The following diagram (see next page) shows the exchange of messages over time between a participant and CFE's 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 participant has no state of the book and desires to become current. The participant caches the received Multicast TOP messages (sequences 310172 and 310173) for later use. Since the participant has no book, they cannot yet be applied.

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

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

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

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

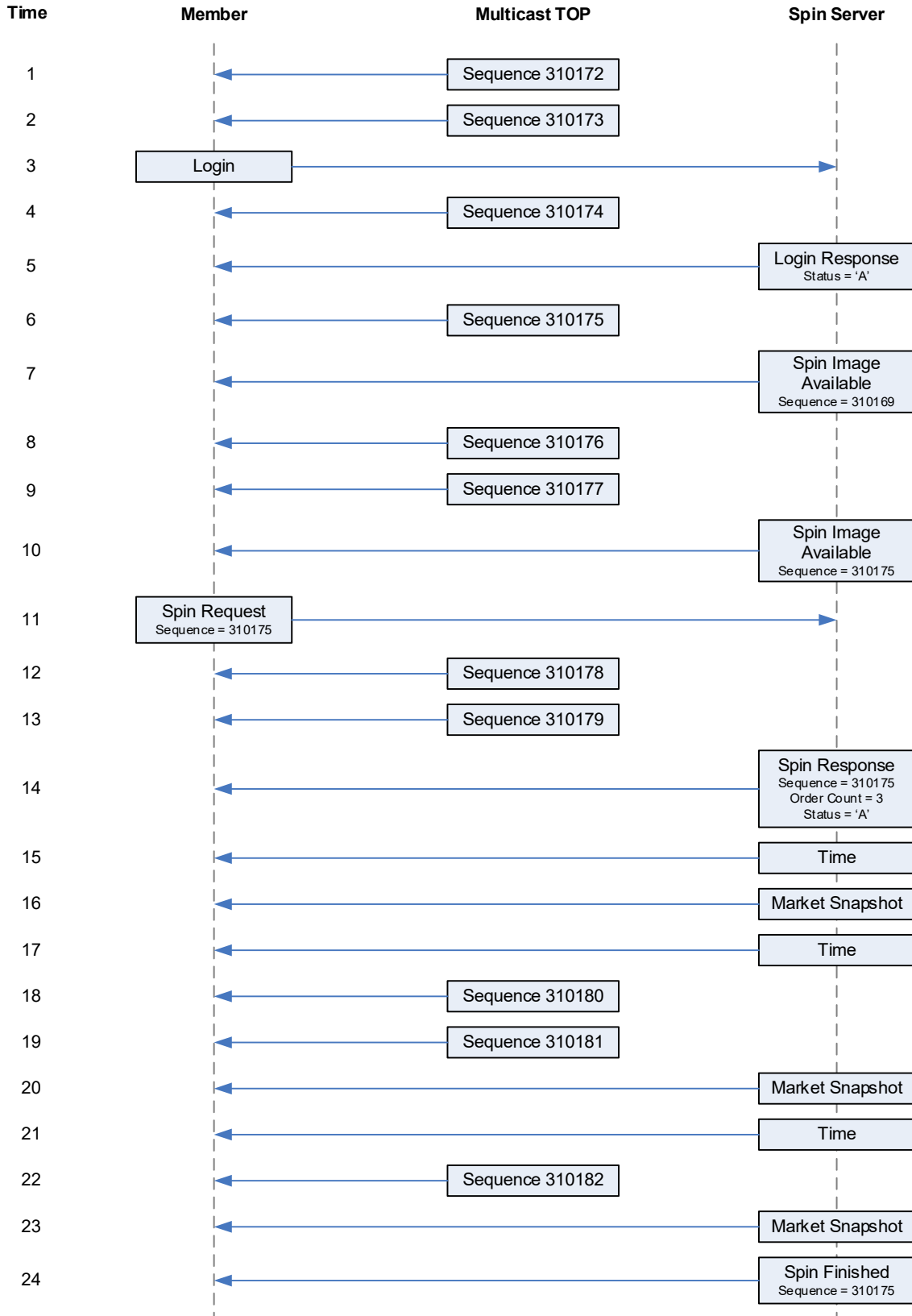
At time 14, the Spin Server acknowledges the `Spin Request` and indicates that three symbols will be sent.

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

Notes:

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

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5 Message Types

5.1 Gap Request Proxy Messages

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

5.2 Spin Server Messages

0x01	Login
0x02	Login Response
0x80	Spin Image Available
0x81	Spin Request
0x82	Spin Response
0x83	Spin Finished

5.3 TOP Messages

0x20	Time
0x2D	End of Session
0x31	Trading Status
0xB1	Time Reference
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
0xB9	Settlement
0xBA	End of Day Summary
0xBB	Futures Instrument Definition
0xBE	Price Limits

6 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.

6.1 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 "

6.2 Login Response Message

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

6.3 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

6.4 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

6.5 Spin Image Available Message

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

6.6 Spin Request Message

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

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6.7 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

6.8 Spin Finished Message

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

6.9 Time Message

Length	0A	10 bytes
Type	20	Time
Time	98 85 00 00	34,200 seconds = 09:30 AM Central
Epoch Time	F8 27 94 5A	1519659000 = February 26, 2018 9:30:00 AM Central

6.10 Unit Clear

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

6.11 Time Reference

Length	12	18 bytes
Type	B1	Time Reference
Midnight Reference	E0 50 92 5A	2018-02-25 00:00:00 Central (1519538400 seconds since the Epoch)
Time	00 E1 00 00	16:00:00
Time Offset	00 00 00 00	Exactly 16:00:00
Trade Date	02 ED 33 01	20180226 February 26, 2018

6.12 Market Snapshot (Short)

Length	25	37 bytes
Type	B2	Market Snapshot (Short)

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Time Offset	08 5C 44 25	625,237,000 ns
Symbol	30 31 32 33 34 35	012345
Unit Timestamp	E6 EB 99 5A	2018-03-02 12:27:18 Central (1520036838 seconds since the Epoch)
Bid Price	41 01	\$3.21
Bid Size	BC 02	700 contracts
Ask Price	B0 01	\$4.32
Ask Size	84 03	900 contracts
Last Trade Price	8F 01	\$3.99
Last Trade Size	FE FF	65,534 contracts
Last Trade Condition	20	(space) Normal Trade
Total Volume	32 54 76 98	2,557,891,634 contracts
Trading Status	54	T - Trading
Reserved	31 20 20	Reserved

6.13 Market Snapshot (Long)

Length	2D	61 bytes
Type	B3	Market Snapshot (Long)
Time Offset	08 5C 44 25	625,237,000 ns
Symbol	30 31 32 33 34 35	012345
Unit Timestamp	E6 EB 99 5A	2018-03-02 12:27:18 Central (1520036838 seconds since the Epoch)
Bid Price	9C 82 FF FF FF FF FF FF	\$-3.21
Bid Size	BC 02 00 00	700 contracts
Ask Price	E0 F4 8F 04 00 00 00 00	\$7,654.32
Ask Size	84 03 00 00	900 contracts
Last Trade Price	DC 9B 00 00 00 00 00 00	\$3.99
Last Trade Size	64 00 00 00	100 contracts
Last Trade Condition	20	(space) Normal Trade
Total Volume	78 56 34 12	305,419,896 contracts
Trading Status	54	T - Trading
Reserved	31 20 20	Reserved

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6.14 Single Side Update (Short)

Length	11	17 bytes
Type	B4	Single Side Update (Short)
Time Offset	30 FA D3 29	701,758,000 ns since last Time Message
Symbol	30 31 32 33 34 35	012345
Side	42	B (Buy)
Price	0C 30	\$1.23
Quantity	64 00	100 contracts

6.15 Single Side Update (Short, Negative Price)

Length	11	17 bytes
Type	B4	Single Side Update (Short)
Time Offset	30 FA D3 29	701,758,000 ns since last Time Message
Symbol	30 31 32 33 34 35	012345
Side	42	B (Buy)
Price	85 FF	-\$1.23
Quantity	C8 00	200 contracts

6.16 Single Side Update (Long)

Length	1B	27 bytes
Type	B5	Single Side Update (Long)
Time Offset	30 FA D3 29	701,758,000 ns since last Time Message
Symbol	30 31 32 33 34 35	012345
Side	42	B (Buy)
Price	0C 30 00 00 00 00 00 00	\$1.23
Quantity	64 00 00 00	100 contracts

6.17 TOP Trade

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

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Trade Condition 20 Normal Trade (space)

6.18 TOP Trade (Condition = Trade Break)

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

6.19 Settlement

Length	19	25 bytes
Type	B9	Settlement
Time Offset	60 84 8E 00	9,340,000 ns since last Time Message
Symbol	36 35 34 33 32 31	654321
Reserved	20 20	
Trade Date	03 ED 33 01	20180227 February 27, 2018
Settlement Price	4C F8 06 00 00 00 00 00	\$45.67
Issue	53	S - Initial Settlement

6.20 End of Day Summary

Length	41	65 bytes
Type	BA	End of Day Summary
Time Offset	18 D2 06 00	447,000 ns since last Time Message
Symbol	39 38 37 36 35 34	987654
Open Interest	B1 68 DE 3A	987,654,321 contracts
High Price	DC FB 09 00 00 00 00 00	\$65.43
Low Price	08 E2 01 00 00 00 00 00	\$12.34
Open Price	E0 49 08 00 00 00 00 00	\$54.32
Close Price	F8 A9 08 00 00 00 00 00	\$56.78
Total Volume	15 CD 5B 07 00 00 00 00	123,456,789 contracts
Block Volume	88 13 00 00	5,000 Block contracts
ECRP Volume	E8 03 00 00	1,000 ECRP contracts
Summary Flags	15	High Price Valid 0x01 Low Price Valid 0x04

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Has Open/Close 0x10

6.21 Futures Instrument Definition (Contract Date Different from Expiration Date)

Length	2D	45 bytes
Type	BB	Futures Instrument Definition Message
Time Offset	E8 61 BF 23	599,745,000 ns since Last Time Message
Symbol	30 30 30 33 6C 4E	00031N
Unit Timestamp	75 2D 40 5E	2020-02-09 10:04:05 Central Time (1581264245 seconds since Epoch)
Report Symbol	41 4D 42 33 20 20	AMB3
Futures Flags	00	0
Expiration Date	D4 3D 34 01	20200916 - September 16, 2020
Contract Size	19 00	25
Listing State	41	A - Active
Price Increment	C4 09 00 00 00 00 00 00	\$0.25
Leg Count	00	0 legs
Leg Offset	00	0 - No Legs
Variance Block	00	0 - No Variance Block
Contract Date	A9 3C 34 01	20200617 - June 17, 2020

6.22 Futures Instrument Definition (Contract Date Same as Expiration Date)

Length	2D	45 bytes
Type	BB	Futures Instrument Definition Message
Time Offset	80 A3 14 27	655,664,000 ns since Last Time Message
Symbol	30 30 30 33 69 34	0003i4
Unit Timestamp	75 2D 40 5E	2020-02-09 10:04:05 Central Time (1581264245 seconds since Epoch)
Report Symbol	56 58 20 20 20 20	VX
Futures Flags	00	0
Expiration Date	A9 3C 34 01	20200617 - June 17, 2020
Contract Size	E8 03	1000
Listing State	41	A - Active
Price Increment	F4 01 00 00 00 00 00 00	\$0.05

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Leg Count	00	0 legs
Leg Offset	00	0 - No Legs
Variance Block	00	0 - No Variance Block
Contract Date	A9 3C 34 01	20200617 - June 17, 2020

6.23 Futures Instrument Definition w/ 2 Legs(Contract Date Populated with Zero value)

Length	41	65 bytes
Type	BB	Futures Instrument Definition Message
Time Offset	E8 61 BF 23	599,745,000 ns since Last Time Message
Symbol	30 30 30 33 6C 52	00031R
Unit Timestamp	75 2D 40 5E	2020-02-09 10:04:05 Central Time (1581264245 seconds since Epoch)
Report Symbol	41 4D 42 33 20 20	AMB3
Futures Flags	00	0
Expiration Date	A9 3C 34 01	20200617 - Wednesday, June 17, 2020
Contract Size	19 00	25
Listing State	41	A - Active
Price Increment	C4 09 00 00 00 00 00 00	\$0.25
Leg Count	02	2 legs
Leg Offset	2D	Legs begin at byte 45
Variance Block	00	0 - No Variance Block Offset
Contract Date	00 00 00 00	0
Leg #1 Ratio	FF FF FF FF	-1 (1 Sell)
Leg #1 Symbol	30 30 30 33 67 75	0003gu
Leg #2 Ratio	01 00 00 00	1 (1 Buy)
Leg #2 Symbol	30 30 30 33 6C 4E	00031N

6.24 Trading Status Message

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

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6.25 Price Limits

Length	1C	28 bytes
Type	BE	Price Limits
Time Offset	18 D2 06 00	447,000 ns since last Time Message
Symbol	31 32 33 34 35 20	12345
Upper Price Limit	08 E2 01 00 00 00 00 00	\$12.34
Lower Price Limit	8C 81 01 00 00 00 00 00	\$9.87

6.26 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

Message 1: Trade

Length	25	37 bytes
Type	B4	Trade
Time Offset	10 84 D4 23	601,130,000 ns since last Time Message
Symbol	36 35 34 33 32 31	654321
Reserved	20 20	
Quantity	BC 02 00 00	700 contracts
Price	08 E2 01 00 00 00 00 00	\$12.34
Execution Id	34 2B 46 E0 BB 00 00 00	0AAP09VEC
Total Volume	40 42 0F 00 00 00 00 00	1,000,000 contracts
Trade Condition	20	Normal Trade (space)

Message 2: Single Side Update

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

7 Multicast Configuration

7.1 Production Environment Configuration

7.1.1 Limitations/Configurations

The following table defines the configuration for network and gap request limitations. These limitations are session based. CFE 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	CFE will send UDP messages up to 1500 bytes. Participants 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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7.1.2 Unit/Product Distribution

The following table describes the CFE symbol distribution across units.

Symbol Range Start	Unit
VX,VXT,VXM,VXMT	1
All Other Products	2

Note - CFE 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.

7.1.3 Multicast Routing Parameters

Data Center	Rendezvous Point
Primary Data Center C feed	74.115.128.164
Primary Data Center D feed	74.115.128.165
Secondary Data Center E feed	170.137.16.128

7.1.4 Address/Unit Distribution

The following tables describe the unit distribution across the CFE Multicast TOP feeds.

Primary Datacenter		WAN-Shaped [FCT] 74.115.133.96/29		WAN-Shaped [FDT] 74.115.133.104/29	
Unit	IP Port	Real-time MC	Gap Resp. MC	Real-time MC	Gap Resp. MC
1	30101	224.0.131.134	224.0.131.135	233.130.124.134	233.130.124.135
2	30102				

Note - CFE 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.

Secondary Datacenter		WAN-Shaped [FET] 170.137.16.80/29	
Unit	IP Port	Real-time MC	Gap Resp. MC
1	31101	233.182.199.2	233.182.199.3
2	31102		

Note - CFE 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.

7.2 Certification Environment Configuration

7.2.1 Unit/Product Distribution

The following table describes the CFE symbol distribution across units.

Symbol Range Start	Unit
VX,VXT,VXM,VXMT	1
All Other Products	2

Note - CFE 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.

7.2.2 Certification Multicast Routing Parameters

Data Center	Rendezvous Point
Primary Data Center feed	74.115.128.130

7.2.3 Address/Unit Distribution

The following tables describe the unit distribution across the certification CFE Multicast TOP feeds.

Primary Datacenter		WAN-Shaped [Cert] 174.136.160.16/28	
Unit	IP Port	Real-time MC	Gap Resp. MC
1	32101	224.0.74.198	224.0.74.199
2	32102		

Note - CFE 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 Connectivity

8.1 Supported Extranet Carriers

The WAN-Shaped feed will be made available to participants through extranet carriers that have completed their multicast implementation and certified with CFE on a per-market basis. CFE has certified a number of carriers defined in the [CFE Connectivity Manual](#) with respect to redistribution of CFE Multicast data feeds. For more information on receiving Multicast TOP through any of these providers, reach out to the vendor contact noted in the Extranet Providers section of the Connectivity Manual.

8.2 Bandwidth Recommendation

The WAN-shaped feeds require 100Mbps of bandwidth. CFE will use 90% of these respective bandwidths for Multicast TOP to allow participants to use the same physical connection for order entry if desired.

9 Support

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

9.1 Canned Test Data

Customers are strongly encouraged to capture their own test data from the Certification environment to ensure that their systems can correctly decode the TOP feed and all available message types. To assist firms with their own testing a TOP sample (taken from the Certification environment) is made available at the link below. Cboe does not guarantee that all message types will appear in test data and cautions that canned test data will be updated infrequently and may not fully reflect the current specification.

[CFE TOP Test Data](#) (last updated 1/4/18)

Revision History

Document Version	Date	Description
1.0.0	05/01/17	Initial version.
1.0.1	06/28/17	Updated description for <i>Report Symbol</i> , <i>Leg Offset</i> and <i>Variance Block Offset</i> fields in <i>Futures Instrument Definition</i> message. Updated descriptions of <i>Variance Futures</i> fields in <i>Futures Instrument Definition</i> message. Added <i>Execution Id</i> field to <i>TOP Trade</i> message. <i>TOP Trade</i> messages are no longer aggregated; a separate message is generated for every execution. Added <i>Price Limits</i> message.
1.0.2	07/11/17	Added <i>Rendevous Points</i> , <i>Source IP addresses</i> , and <i>Multicast IP addresses</i> .
1.0.3	08/08/17	Replaced <i>Binary Long Price</i> with <i>Binary Price</i> . Updated <i>Data Types</i> to include definition of <i>Binary Price</i> .
1.0.4	09/21/17	Renamed <i>Trade Date</i> message to <i>Time Reference</i> . Added <i>Epoch Time</i> field to <i>Time</i> message. Fixed discrepancies between <i>Spec</i> and <i>Example Messages</i> .
1.0.5	09/26/17	Corrected feed reference labels in section 8.
1.0.6	10/17/17	Added clarification on <i>Trading Status</i> messages for <i>Complex Instruments</i> going in and out of <i>Queuing</i> because of <i>Threshold Width</i> . Cboe branding/logo changes.
1.0.7	12/08/17	Removed <i>LegOffset = 93</i> value as this value is not possible to be sent. Price limits may apply during any trading hours subject to contract specifications.
1.0.8	12/11/17	Updated <i>Top Trade</i> examples to reflect correct message type.
1.0.9	12/29/17	<i>Trading Status</i> messages for <i>Complex instruments</i> transitioning in and out of <i>Queuing</i> on account of <i>Threshold Width</i> no longer suppressed. Removed associated commentary from <i>Trading Status</i> message section. Added “I=Inactive” as possible <i>Listing State</i> . Updated <i>Realized Variance</i> , <i>Discount Factor</i> , <i>Previous ARMVM</i> , and <i>Fed Funds Rate</i> to <i>Signed Binary</i> data type. Corrected the offsets for <i>Leg Ratio</i> and <i>Leg Symbol</i> .
1.0.10	01/10/18	Corrected examples for <i>TOP Trade</i> . Added <i>Canned Test Data</i> section.
1.0.11	01/17/18	<i>Block</i> and <i>ECRP trades</i> (<i>Trade Condition = B or E</i>) do not update <i>High Price</i> or <i>Low Price</i> .

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1.0.12	01/25/18	<p>Updated field description of <i>Symbol</i> to remove “padding” language. The <i>Symbol</i> field is always six characters, base 62.</p> <p><i>Price Limits</i> are included in a spin.</p> <p>Added Feed Hours and System Restart section.</p> <p>Clarified cases where the <i>Unit Clear</i> message would be sent.</p> <p>More specifics added to how <i>End of Day Summary</i> values are determined.</p> <p>If no <i>Trading Status</i> has been received for a <i>Symbol</i>, then the <i>Trading Status</i> is “S= Suspended”.</p>
1.0.13	02/01/18	Added links to certification and production symbol mapping files.
1.0.14	02/21/18	<p>Fixed discrepancy with the Secondary Data Center listed as CH4 instead of 400 S La Salle.</p> <p>Updated <i>Trade Condition</i> field values to demonstrate that some values are only sent for simple instruments.</p> <p>Additional clarifications added around daily restart based on customer feedback.</p>
1.0.15	03/01/18	Updated description of <i>High Price</i> and <i>Low Price</i> in <i>End of Day Summary</i> message.
1.1.0	03/22/18	<p>The <i>End of Day Summary</i> message will be enhanced and expanded to 65 bytes.</p> <ul style="list-style-type: none"> • <i>Total Volume</i> will be updated to include Block and ECRP volume. • <i>Block Volume</i> field will be added. • <i>ECRP Volume</i> field will be added. • <i>Bit Fields</i> field will be added. <p><i>End of Day Summary</i> example was updated.</p>
1.1.1	03/23/18	Updated effective date of <i>End of Day Summary</i> message change from 1.1.0 to be effective 06/03/18.
1.1.2	05/10/18	Clarified the cases when sequenced <i>Futures Instrument Definition</i> messages are sent.
1.1.3	11/08/18	<p>Updated Overview and and Multicast Routing Parameter sections with new Multicast Feed IDs (A to FC, B to FD, E to FE).</p> <p>Added note clarifying simple leg FID messages come before complex leg FID messages sent in Spin responses.</p> <p>Updated multicast feed ids in section 1.3 to follow standard naming convention.</p>
1.1.4	04/08/19	Updated Multicast Routing Parameter Data Center feed names to align with references in unit distribution table.
1.1.5	01/16/20	Clarified definition of <i>Time</i> message. <i>Time</i> messages are only sent when there is a new TOP message in a given second.
1.1.6	02/14/20	Added <i>Contract Date</i> field to <i>Futures Instrument Definition</i> message. Effective trade date 04/27/20.

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1.1.7	02/24/20	<i>Variance Offset</i> and <i>Leg Offset</i> values will be set at 45 as a result of the change to add <i>Contract Date</i> . Refer to <i>Futures Instrument Definition</i> message for more details.
1.1.8	04/07/20	Corrected WAN-Shaped feed IDs from "FAT and FBT" to "FCT and FDT" in Feed Connectivity Requirements section.
1.1.9	07/27/20	Updated symbols listed in Unit/Product Distribution tables to include VXT, VXM, and VXMT.