Cboe Titanium Cboe Futures Exchange Options Multicast TOP Specification

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Contents

Introduction

Overview

This specification is the standard Multicast TOP specification for Options to be used for the Cboe Futures Exchange (CFE) platform.

CFE participants may use the CFE Options 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 Options 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 Options Multicast PITCH protocol.

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

Complete depth of book market data can be received via the CFE Options 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.

Table 1. CFE OOF TOP Feed Descriptions

EXCHANGE	SHAPING	SERVED FROM DATA CENTER (PRIMARY/ SECONDARY)	MULTICAST FEED ID
CFE	WAN	Primary	OFCT
CFE	WAN	Primary	OFDT
CFE	WAN	Secondary	OFET

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.

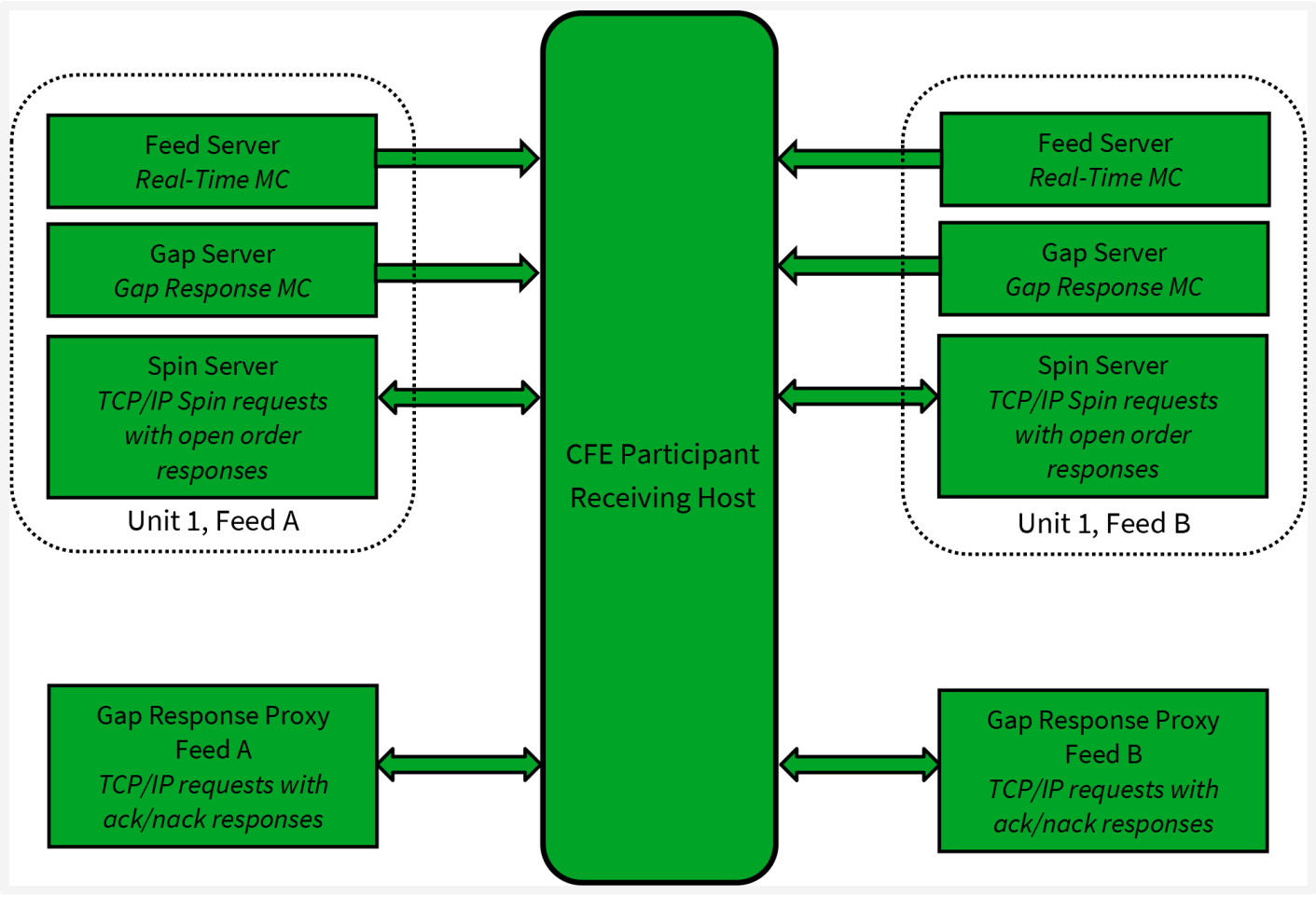
Feed Connectivity Requirements

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 OFCT and OFDT 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 Options 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 Options 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:



Symbol Ranges, Units, and Sequence Numbers

Products are separated into units by a product distribution. 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.

Futures Specific Symbol Processing

CFE has implemented a simple symbol mapping mechanism (**`OOF Symbol Mapping`** message) for the Options Multicast TOP feed to map a six character feed symbol to a specific options contract.

CFE has also implemented a complex symbol mapping mechanism (**`Complex Instrument Definition Expanded`** message) for the Options Mutlicast TOP feed to map a six character feed Complex Instrument ID (CID) to the complex instrument definition. A complex instrument definition consists of two or more option legs.

This simple and complex symbol mapping significantly reduces the size of the Options Multicast PITCH 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 Options Multicast PITCH feed.

Real-time symbol mapping messages are available on each unit's multicast feed. **`OOF Symbol Mapping`** messages are un-sequenced and **`Complex Instrument Definition Expanded`** messages can be both sequenced and un-sequenced. Un-sequenced messages are sent from pre-market through the end of trading in a continuous loop. 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.

Complex instruments may be occasionally created intra-day. In these cases, the **`Complex Instrument Definition Expanded`** 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 Options Multicast TOP feed, a downloadable file with current Production and Certification mappings is available via the CFE website.

Gap Request Proxy and Message Retransmission

Requesting delivery of missed sequenced data is achieved by establishing a TCP connection to a CFE 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* message 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 acknowledgments 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 acknowledgment from the GRP.

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** message 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 **Single Side Update**, **Two Side Update**, **OOF Symbol Mapping**, **Complex Instrument Definition Expanded**, **Trading Status**, **Settlement**, **Time Reference**, **Time**, and **End Of Day Summary** 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** message sequence number is the participant's reference point which they send in their **Spin Request** message, 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.

Participants can also use the Spin Server to request a spin of all **OOF Symbol Mapping** and **Complex Instrument Definition Expanded** messages by sending an **Instrument Definition Request** message. The Spin Server can only process one spin at a time. Customers will need to wait for a **Spin Finished** message or **Instrument Definition Finished** message before submitting another request.

Spin Server Usage Example on page 46 shows an example flow of messages between a participant and CFE's Multicast TOP feed and Spin Server.

Participants are required to send Heartbeat messages to CFE no less than every 5 seconds, even while a spin response is in progress. Failure to do so is the most common cause of Participant difficulties while processing spin responses, especially during periods of high market activity. CFE recommends that Participants send a heartbeat every second in order to stay well within this heartbeat requirement.

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.

Message Format

The messages that make up the TOP protocol are delivered using CFE's **`Sequenced Unit Header`** message header which handles sequencing and delivery integrity. All messages delivered via multicast as well as to/from the GRP or Spin Server will use the **`Sequenced Unit Header`** message 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.

Data Types

The following field types are used within the **`Sequenced Unit Header`** message 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).
- **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.

Trade Date

The term "Trade Date" is synonymous with the term "Business Date". The term Trade Date is used here to match identically-named fields in the CFE FIX and BOE specifications.

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`** message 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.

CFE Sequenced Unit Header Message Fields

The CFE **`Sequenced Unit Header`** message header is used for all CFE Option Multicast TOP messages as well as messages to and from the GRP and Spin Servers.

Sequenced and un-sequenced data may be delivered using the **`Sequenced Unit Header`** message 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`** message 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 **`Heartbeat`** messages.

Table 2. Sequenced Unit Header

FIELD	OFFSET	LENGTH	VALUE/TYPE	DESCRIPTION
Hdr Length	0	2	Binary	Length of entire block of messages. Includes this header and messages following *Hdr Count*.
Hdr Count	2	1	Binary	Number of messages to follow this header.
Hdr Unit	3	1	Binary	Unit that applies to messages included in this header.
Hdr Sequence	4	4	Binary	Sequence of first message to follow this header.
Total Length = 8 bytes				

Heartbeat Messages Message Fields

The CFE **`Sequenced Unit Header`** message 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.

`Heartbeat` messages 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. **`Heartbeat`** messages 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. This also applies when the participant is receiving a spin from the Spin Server, the **`Heartbeat`** messages must continue to be sent from the participant to the Spin Server. With the exception of **`Time`** messages, each message reflects the order addition, order deletion, order modification or execution of an order in the system.

TOP Messages

TOP messages generally reflect the update of the top of book or execution of an order in the system. In addition, TOP messages also provide symbol status and time information.

Time Reference Message Fields

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 subsequent **`Time`** messages for the same unit will the 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.

Table 3. Time Reference

FIELD NAME	OFFSET	LENGTH	TYPE/(VALUE)	DESCRIPTION
Length	0	1	Binary	*Length* of this message including this field.
Message Type	1	1	0xB1	**`Time Reference`** message
Midnight Reference	2	4	Binary	Midnight Central Time reference time for subsequent **`Time`** messages, expressed as number of whole seconds since the Epoch (Midnight January 1, 1970 UTC).
Time	6	4	Binary	Number of whole seconds from midnight Central Time.
Time Offset	10	4	Binary	Nanosecond offset from last unit timestamp.
Trade Date	14	4	Binary Date	Current Trade Date
Total Length = 18 bytes				

Time Message Fields

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).

Table 4. Time

FIELD NAME	OFFSET	LENGTH	TYPE/(VALUE)	DESCRIPTION
Length	0	1	Binary	*Length* of this message including this field.
Message Type	1	1	0x20	**`Time`** message
Time	2	4	Binary	Number of whole seconds from midnight Central Time.
Epoch Time	6	4	Binary	Number of whole seconds since the Epoch (Midnight January 1, 1970 UTC).
Total Length = 10 bytes				

Unit Clear Message Fields

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`** message header. It would be distributed in rare recovery events such as a data center fail-over.

Table 5. Unit Clear

FIELD NAME	OFFSET	LENGTH	TYPE/(VALUE)	DESCRIPTION
Length	0	1	Binary	*Length* of this message including this field.
Message Type	1	1	0x97	**`Unit Clear`** message
Time Offset	2	4	Binary	Nanosecond offset from last unit timestamp.
Total Length = 6 bytes				

OOF Symbol Mapping Message Fields

An **`OOF Symbol Mapping`** message is used to map the 6 character multicast feed symbol field and options on futures name to the option contract and future underlying. The option contract is comprised of the strike price, put/call flag, options expiration date, and future underlying. The future underlying is comprised of the futures product and futures expiration date, which map to a futures symbol.

This message can be sent either as a sequenced message or as an unsequenced message. It is sent as a sequenced message at system startup upon the beginning of a trading session or if an instrument is created or modified during a trading day. A new sequenced message may also be sent for a symbol that does not visibly change any attribute. A continuous loop of unsequenced symbol mapping messages (sequence = 0) is sent throughout the day at variable rates as bandwidth allows. The *Time Offset* field should be ignored on unsequenced messages.

`OOF Symbol Mapping` messages are included in a spin response and will be disseminated before **`Complex Instrument Definition Expanded`** messages.

Table 6. OOF Symbol Mapping

FIELD NAME	OFFSET	LENGTH	TYPE/(VALUE)	DESCRIPTION
Length	0	1	Binary	*Length* of this message including this field
Message Type	1	1	0xF9	**`OOF Symbol Mapping`** message.
Time Offset	2	4	Binary	Nanosecond offset from last unit timestamp.
Feed Symbol	6	6	Printable ASCII	Option symbol. Six character, base 62.
Futures Product	12	8	Printable ASCII	Underlying futures contract product name.
Futures Expiration	20	4	Binary Date	Underlying futures contract expiration date.
Futures Symbol	24	6	Printable ASCII	Underlying Cboe-formatted futures contract symbol. Six character, base 62.
Strike Price	30	8	Binary Price	Option contract strike price.
Call Put Indicator	38	1	Alphanumeric	`C` = Call `P` = Put
Options Expiration	39	4	Binary Date	Options contract expiration date.
Options on Futures Name	43	16	Alphanumeric	Textual symbol description comprising options product symbol, underlying futures expiration, put/call and the option strike price with two digits to the right of the decimal point. For example "UX1A/X4 C2000" represents the 20.00 strike Call option on the UX1A product with underlying futures expiration X4".
Symbol Condition	59	1	Alphanumeric	`N` = Normal `C` = Closing Only
Total Length = 60 bytes				

Complex Instrument Definition Expanded Message Fields

A **`Complex Instrument Definition Expanded`** message represents a complex instrument that is available to place orders.

This message can be sent either as a sequenced message or as an unsequenced message. It is sent as a sequenced message at system startup upon the beginning of a trading session or if an instrument is created or modified during a trading day. A new sequenced message may also be sent for a symbol that does not visibly change any attribute. A continuous loop of unsequenced symbol mapping messages (sequence = 0) is sent throughout the day at variable rates as bandwidth allows. The *Time Offset* field should be ignored on unsequenced messages.

The **`Complex Instrument Definition Expanded`** message will contain two or more repeating groups of leg definitions. There is a limit of 16 leg definitions.

`Complex Instrument Definition Expanded` messages are included in a spin response.

Table 7. Complex Instrument Definition Expanded

FIELD NAME	OFFSET	LENGTH	TYPE/(VALUE)	DESCRIPTION
Length	0	1	Binary	*Length* of this message including this field.
Message Type	1	1	0x9A	**`Complex Instrument Definition Expanded`** message
Time Offset	2	4	Binary	Nanosecond offset from last unit timestamp.
Complex Instrument Id	6	6	Printable ASCII	Complex Instrument Id. Six character, base 62.
Complex Instrument Underlying	12	8	Printable ASCII	Complex Instrument Underlying right padded with spaces.
Complex Instrument Type	20	4	Alphanumeric	4 character field; each field describes a characteristic. **Character 1: Complex Option Type** O = All legs are options **Characters 2-4: Reserved**
Leg Count	24	1	Binary	The number of legs in the complex instrument. The maximum number of legs is 16.
The following fields repeat *Leg Count* times for multi-leg strategies. *Leg Index* is zero-based.				
Leg Symbol	25 + Leg Index * 13	8	Printable ASCII	Option Symbol of leg. Six character, base 62.
Leg Ratio	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.
Leg Security Type	37 + Leg Index * 13	1	Alphanumeric	O = Leg is an Option instrument
Total Length = *25* + (*Leg Count* * *13*) bytes				

Trading Status Message Fields

The **`Trading Status`** message is used to indicate the current trading status of a symbol. A **`Trading Status`** message will be sent for all symbols as they transition through various trading states. If a **`Trading Status`** message has not been received for a symbol, then the *Trading Status* for the symbol should be assumed to be H = Halted. The following summarizes the *Trading Status* values for options in the CFE system:

- H = Halted state. This state is used for Supervisory Halts initiated by the Trade Desk. Orders are not being accepted in this state.
- Q = Queuing state. This state is used when orders are being accepted for queuing. The Queuing state is used during the pre-open for all symbols. It is also used for spread instruments that may not be tradeable due to Threshold Width.
- T = Trading state. This state is used when the symbol is available for trading.

CFE will send a *Trading Status* of Q once orders can be accepted for queuing in preparation for the open. At or after the opening time, CFE will send a *Trading Status* of T as symbols are opened for trading. Once trading is done for the day CFE will send a *Trading Status* of H indicating the symbol is Halted.

Table 8. Trading Status Message Fields

FIELD NAME	OFFSET	LENGTH	TYPE/(VALUE)	DESCRIPTION
Length	0	1	Binary	*Length* of this message including this field
Message Type	1	1	0x31	**`Trading Status`** message
Time Offset	2	4	Binary	Nanosecond offset from last unit timestamp
Symbol	6	6	Printable ASCII	Six character, base 62.
Reserved1	12	2	Binary	Reserved
Trading Status	14	1	Alpha	H = Halted Q = Queuing T = Trading
Reserved2	15	3	Binary	Reserved
Total Length = 18 bytes				

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 GRP.

Single Side Update Message Fields

`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)`** message and **`Single Side Update (Short)`** message. 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.

Table 9. Single Side Update (Short)

FIELD NAME	OFFSET	LENGTH	TYPE/(VALUE)	DESCRIPTION
Length	0	1	Binary	*Length* of this message including this field.
Message Type	1	1	0xB4	**`Single Side Update (Short)`** message
Time Offset	2	4	Binary	Nanosecond offset from last unit timestamp.
Symbol	6	6	Printable ASCII	Six character, base 62 symbol.
Side	12	1	Alphanumeric	`B` = Bid side `S` = Ask side
Price	13	2	Binary Short Price	Price (may be a zero or negative price for some instruments).
Quantity	15	2	Binary	Number of contracts on the inside book (a zero value denotes the *Price* is invalid).
Total Length = 17 bytes				

Table 10. Single Side Update (Long)

FIELD NAME	OFFSET	LENGTH	TYPE/(VALUE)	DESCRIPTION
Length	0	1	Binary	*Length* of this message including this field.
Message Type	1	1	0xB5	**`Single Side Update (Long)`** message
Time Offset	2	4	Binary	Nanosecond offset from last unit timestamp.
Symbol	6	6	Printable ASCII	Six character, base 62 symbol.
Side	12	1	Alphanumeric	`B` = Bid side `S` = Ask side
Price	13	8	Binary Price	Price (may be a zero or negative price for some instruments).

FIELD NAME	OFFSET	LENGTH	TYPE/(VALUE)	DESCRIPTION
Quantity	21	4	Binary	Number of contracts on the inside book (a zero value denotes the *Price* is invalid).
Total Length = 25 bytes				

Two Side Update Message Fields

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

`Two Side Update` messages come in two variants: **`Two Side Update (Long)`** message and **`Two Side Update (Short)`** message. 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.

Table 11. Two Side Update (Short)

FIELD NAME	OFFSET	LENGTH	TYPE/(VALUE)	DESCRIPTION
Length	0	1	Binary	*Length* of this message including this field.
Message Type	1	1	0xB6	**`Two Side Update (Short)`** Message
Time Offset	2	4	Binary	Nanosecond offset from *Unit Timestamp* in this message.
Symbol	6	6	Printable ASCII	Six character, base 62 symbol.
Bid Price	12	2	Binary Short Price	Bid price (may be a zero or negative price for some instruments).
Bid Quantity	14	2	Binary	Number of contracts on the bid side of the inside book (a zero value denotes the *Bid Price* is invalid).
Ask Price	16	2	Binary Short Price	Ask price (may be a zero or negative price for some instruments).
Ask Quantity	18	2	Binary	Number of contracts on the ask side of the inside book (a zero value denotes the *Ask Price* is invalid).
Total Length = 20 bytes				

Table 12. Two Side Update (Long)

FIELD NAME	OFFSET	LENGTH	TYPE/(VALUE)	DESCRIPTION
Length	0	1	Binary	*Length* of this message including this field.
Message Type	1	1	0xB7	**`Two Side Update (Long)`** Message
Time Offset	2	4	Binary	Nanosecond offset from *Unit Timestamp* in this message.
Symbol	6	6	Printable ASCII	Six character, base 62 symbol.
Bid Price	12	8	Binary Price	Bid price (may be a zero or negative price for some instruments).

FIELD NAME	OFFSET	LENGTH	TYPE/(VALUE)	DESCRIPTION
Bid Quantity	20	4	Binary	Number of contracts on the bid side of the inside book (a zero value denotes the *Bid Price* is invalid).
Ask Price	24	8	Binary Price	Ask price (may be a zero or negative price for some instruments).
Ask Quantity	32	4	Binary	Number of contracts on the ask side of the inside book (a zero value denotes the *Ask Price* is invalid).
Total Length = 36 bytes				

TOP Trade Message Fields

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.

Table 13. TOP Trade

FIELD NAME	OFFSET	LENGTH	TYPE/(VALUE)	DESCRIPTION
Length	0	1	Binary	*Length* of this message including this field.
Message Type	1	1	0xB8	**TOP Trade** message
Time Offset	2	4	Binary	Nanosecond offset from last unit timestamp.
Symbol	6	6	Printable ASCII	Six character, base 62 symbol.
Quantity	12	4	Binary	Incremental number of contracts executed or corrected (see *Trade Condition*).
Price	16	8	Binary Price	The execution price of the order.
Execution Id	24	8	Binary	CFE generated day-unique execution identifier of this trade. *Execution Id* is also referenced in the **Trade Break** message.
Total Volume	32	4	Binary	Total number of contracts traded on the current business day (may decrease if the *Trade Condition* field indicates a canceled trade).
Trade Condition	36	1	Alphanumeric	(Space) = Normal trade O = Opening trade[1] S = Spread trade[1] B = Block trade [1]Sent for simple (non-spread) symbols only.
Total Length = 37 bytes				

End of Day Messages

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

Settlement Message Fields

`Settlement` messages are used to provide information concerning indicative, approved, or corrected daily and final settlement prices for CFE products. An indicative daily settlement price (*Issue* = *I*) is calculated by the system and sent immediately after an instrument closes trading but before the settlement price is approved. An approved settlement price (*Issue* = *S*) is sent once the CFE Trade Desk approves a settlement price for an instrument. If there is an error in the approved settlement price, then it may be re-issued (*Issue* = *R*).

`Settlement` messages will be included in a spin response.

Table 14. Settlement

FIELD NAME	OFFSET	LENGTH	TYPE/(VALUE)	DESCRIPTION
Length	0	1	Binary	*Length* of this message including this field.
Message Type	1	1	0xB9	**`Settlement`** message
Time Offset	2	4	Binary	Nanosecond offset from last unit timestamp.
Symbol	6	6	Printable ASCII	Six character, base 62 symbol.
Trade Date	12	4	Binary Date	Trade Date for the settlement.
Settlement Price	16	8	Binary Price	Settlement Price
Issue	24	1	Alphanumeric	I = Indicative Settlement S = Initial Settlement R = Re-issued Settlement
Total Length = 25 bytes				

End of Day Summary Message Fields

The **`End of Day Summary`** message is sent out right after trading ends for a symbol. No more market data update messages will follow an **`End of Day Summary`** message 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 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. complex instruments). 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.

Table 15. End of Day Summary

FIELD NAME	OFFSET	LENGTH	TYPE/(VALUE)	DESCRIPTION
Length	0	1	Binary	*Length* of this message including this field.
Message Type	1	1	0xBA	**`End of Day Summary`** message
Time Offset	2	4	Binary	Nanosecond offset from last unit timestamp.
Symbol	6	6	Printable ASCII	Six character, base 62 symbol.
Trade Date	12	4	Binary Date	Trade Date for the message.
Open Interest	16	4	Binary	Prior Trade Date Open Interest for this symbol.
High Price	20	8	Binary Price	The higher of highest bid price and highest trade price for the day. Block trades (*Trade Condition* = B or E) do not update *High Price*.
Low Price	28	8	Binary Price	The lower of lowest offer price and lowest trade price for the day. Block trades (*Trade Condition* = B or E) do not update *Low Price*.
Open Price	36	8	Binary Price	The first trade on the day (in any session) will set the *Open Price* for the day (valid only if *Total Volume* > 0). Block trades (*Trade Condition* = B or E) do not update *Open Price*.
Close Price	44	8	Binary Price	The last trade on the day (in any session) will set the *Close Price* for the day (valid only if *Total Volume* > 0). Block trades (*Trade Condition* = B or E) do not update *Close Price*.
Total Volume	52	4	Binary	Total number of contracts traded for the day, including Block trades.
Block Volume	56	4	Binary	Total number of block contracts traded for the day.
ECRP Volume	60	4	Binary	Always zero.

FIELD NAME	OFFSET	LENGTH	TYPE/(VALUE)	DESCRIPTION
Summary Flags	64	1	Bit Field	Bit 0 = *High Price* Valid - Set if *High Price* is a valid value. Bit 1 = *High Price* is bid- Set if *High Price* was set by the highest bid (rather than a trade). Bit 2 = *Low Price* Valid - Set if *Low Price* is a valid value. Bit 3 = *Low Price* is offer - Set if *Low Price* was set by the lowest offer (rather than a trade). Bit 4 = Open/Close Valid - Set if both. *Open Price* and *Close Price* fields contain valid values Bit 5-7 = Reserved
Total Length = 65 bytes				

End of Session Message Fields

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.

Table 16. End of Session

FIELD NAME	OFFSET	LENGTH	TYPE/(VALUE)	DESCRIPTION
Length	0	1	Binary	*Length* of this message including this field.
Message Type	1	1	0x2D	**`End of Session`** message
Timestamp	2	4	Binary	Nanosecond offset from last unit timestamp.
Total Length = 6 bytes				

Gap Request Proxy Messages

The following messages are used for initializing a TCP/IP connection to the 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.

Login Message Fields

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.

Table 17. Login

FIELD	OFFSET	LENGTH	VALUE/TYPE	DESCRIPTION
Length	0	1	Binary	*Length* of this message including this field.
Message Type	1	1	0x01	**`Login`** message
SessionSubId	2	4	Alphanumeric	*SessionSubId* supplied by CFE.
Username	6	4	Alphanumeric	*Username* supplied by CFE.
Filler	10	2	Alphanumeric	(space filled)
Password	12	10	Alphanumeric	*Password* supplied by CFE.
Total Length = 22 bytes				

Login Response Message Fields

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.

Table 18. Login Response

FIELD	OFFSET	LENGTH	VALUE/TYPE	DESCRIPTION
Length	0	1	Binary	*Length* of this message including this field.
Message Type	1	1	0x02	**`Login Response`** message
Status	2	1	Alphanumeric	Accepted or reason for reject.
Total Length = 3 bytes				
Login Response - Status Codes				
'A'	Login Accepted			
'N'	Not authorized (Invalid Username/Password)			
'B'	Session in use			
'S'	Invalid Session			

Gap Request Message Fields

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.

Table 19. Gap Request

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

Gap Response Message Fields

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.

Table 20. Gap Response

FIELD	OFFSET	LENGTH	VALUE/TYPE	DESCRIPTION
Length	0	1	Binary	*Length* of this message including this field.
Message Type	1	1	0x04	**`Gap Response`** message
Unit	2	1	Binary	*Unit* the gap was requested for.
Sequence	3	4	Binary	*Sequence* of first message in request.
Count	7	2	Binary	*Count* of messages requested.
Status	9	1	Alphanumeric	Accepted or reason for reject*.
Total Length = 10 bytes				
Gap Response - Status Codes				
'A'	Accepted			
'O'	Out of range (ahead of sequence or too far behind)			
'D'	Daily gap request allocation exhausted			
'M'	Minute gap request allocation exhausted			
'S'	Second gap request allocation exhausted			
'C'	Count request limit for one gap request exceeded			
'I'	Invalid Unit specified in request			
'U'	Unit is currently unavailable			

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

Spin Messages

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 Login Message Fields on page 32.

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 Login Response Message Fields on page 33.

Heartbeat

Heartbeat messages must be sent once every 5 seconds in order to keep the client's connection to the spin server alive. Heartbeat messages are sent using the **`Sequenced Unit Header`** message header as described in CFE Sequenced Unit Header Message Fields on page 15 and Heartbeat Messages Message Fields on page 16.

Spin Image Available Message Fields

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

Table 21. Spin Image Available

FIELD NAME	OFFSET	LENGTH	TYPE/(VALUE)	DESCRIPTION
Length	0	1	Binary	*Length* of this message including this field.
Message Type	1	1	0x80	**`Spin Image Available`** message
Sequence	2	4	Binary	Spin is available which is current through this sequence number.
Total Length = 6 bytes				

Spin Request Message Fields

The **`Spin Request`** message is used by a user's process to request transmission of a spin of the unit's order book. See to Spin Servers on page 10 for more complete details regarding ***Sequence*** specification as well as buffering requirements.

Table 22. Spin Request

FIELD NAME	OFFSET	LENGTH	TYPE/(VALUE)	DESCRIPTION
Length	0	1	Binary	*Length* of this message including this field.
Message Type	1	1	0x81	**`Spin Request`** message
Sequence	2	4	Binary	Sequence number from a **`Spin Image Available`** message received by the participant.
Total Length = 6 bytes				

Spin Response Message Fields

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

Table 23. Spin Response

FIELD NAME	OFFSET	LENGTH	TYPE/(VALUE)	DESCRIPTION
Length	0	1	Binary	*Length* of this message including this field.
Message Type	1	1	0x82	**`Spin Response`** message
Sequence	2	4	Binary	Sequence number from a **`Spin Image Available`** message received by the participant.
Order Count	6	4	Binary	Number of **`Add Order`** messages which will be contained in this spin.
Status	10	1	Alphanumeric	Accepted or reason for reject*.
Total Length = 11 bytes				
Spin Response - Status Codes				
'A'	Accepted			
'O'	Out of Range (*Sequence* requested is greater than *Sequence* available by the next spin).			
'S'	Spin already in progress (only one spin can be running at a time).			

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

Spin Finished Message Fields

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`** message 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.

Table 24. Spin Finished

FIELD NAME	OFFSET	LENGTH	TYPE/(VALUE)	DESCRIPTION
Length	0	1	Binary	*Length* of this message including this field.
Message Type	1	1	0x83	**`Spin Finished`** message
Sequence	2	4	Binary	Sequence number from the **`Spin Request`** message.
Total Length = 6 bytes				

Instrument Definition Request Message Fields

The **`Instrument Definition Request`** message is used to request transmission of this unit's OOF Symbol Mappings and Complex Instrument Definitions. All **`OOF Symbol Mapping`** messages will be sent before **`Complex Instrument Definition Expanded`** messages. Refer to Spin Servers on page 10 for more complete details regarding *Sequence* specification as well as buffering requirements.

Table 25. Instrument Definition Request

FIELD NAME	OFFSET	LENGTH	TYPE/(VALUE)	DESCRIPTION
Length	0	1	Binary	*Length* of this message including this field
Message Type	1	1	0x84	**`Instrument Definition Request`** message
Sequence	2	4	Binary	Must be 0. Only the current Symbol Mappings and Complex Instrument Definitions are available.
Total Length = 6 bytes				

Instrument Definition Response Message Fields

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

Table 26. Instrument Definition Response Message Fields

INSTRUMENT DEFINITION RESPONSE				
FIELD NAME	OFFSET	LENGTH	TYPE/(VALUE)	DESCRIPTION
Length	0	1	Binary	*Length* of this message including this field
Message Type	1	1	0x85	**`Instrument Definition Response`** message
Sequence	2	4	Binary	Will always be 0.
Instrument Count	6	4	Binary	Number of **`OOF Symbol Mapping`** and **`Complex Instrument Definition Expanded`** messages (if applicable) which will be contained in this spin
Status	10	1	Alphanumeric	Accepted or reason for reject
Total Length = 11 bytes				
Instrument Definition Response - Status Codes				
'A'	Accepted			
'O'	Out of Range (*Sequence* must be 0)			
'S'	Spin already in progress (only one spin can be running at a time)			

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

Instrument Definition Finished Message Fields

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

Table 27. Instrument Definition Finished

FIELD NAME	OFFSET	LENGTH	TYPE/(VALUE)	DESCRIPTION
Length	0	1	Binary	*Length* of this message including this field
Message Type	1	1	0x86	**`Instrument Definition Finished`** message
Total Length = 2 bytes				

Spin Server Usage Example

The following diagram shows the exchange of messages over time between a participant and CFE's Options Multicast TOP feed and Spin Server. Note that while the example may seem to imply **`Two Side Update`** messages only would be sent on a Spin, this is not the case. **`OOF Symbol Mapping`**, **`Complex Instrument Definition Expanded`**, **`Trading Status`**, and **`Settlement`** messages may be sent at the beginning of the spin session and **`Single Side Update`**, **`Time`** and **`Time Reference`** messages may be found mixed between **`Two Side Update`** messages according to their timestamps. **`End Of Day Summary`** messages are sent after **`Single Side Update`** and **`Two Side Update`** messages.

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.

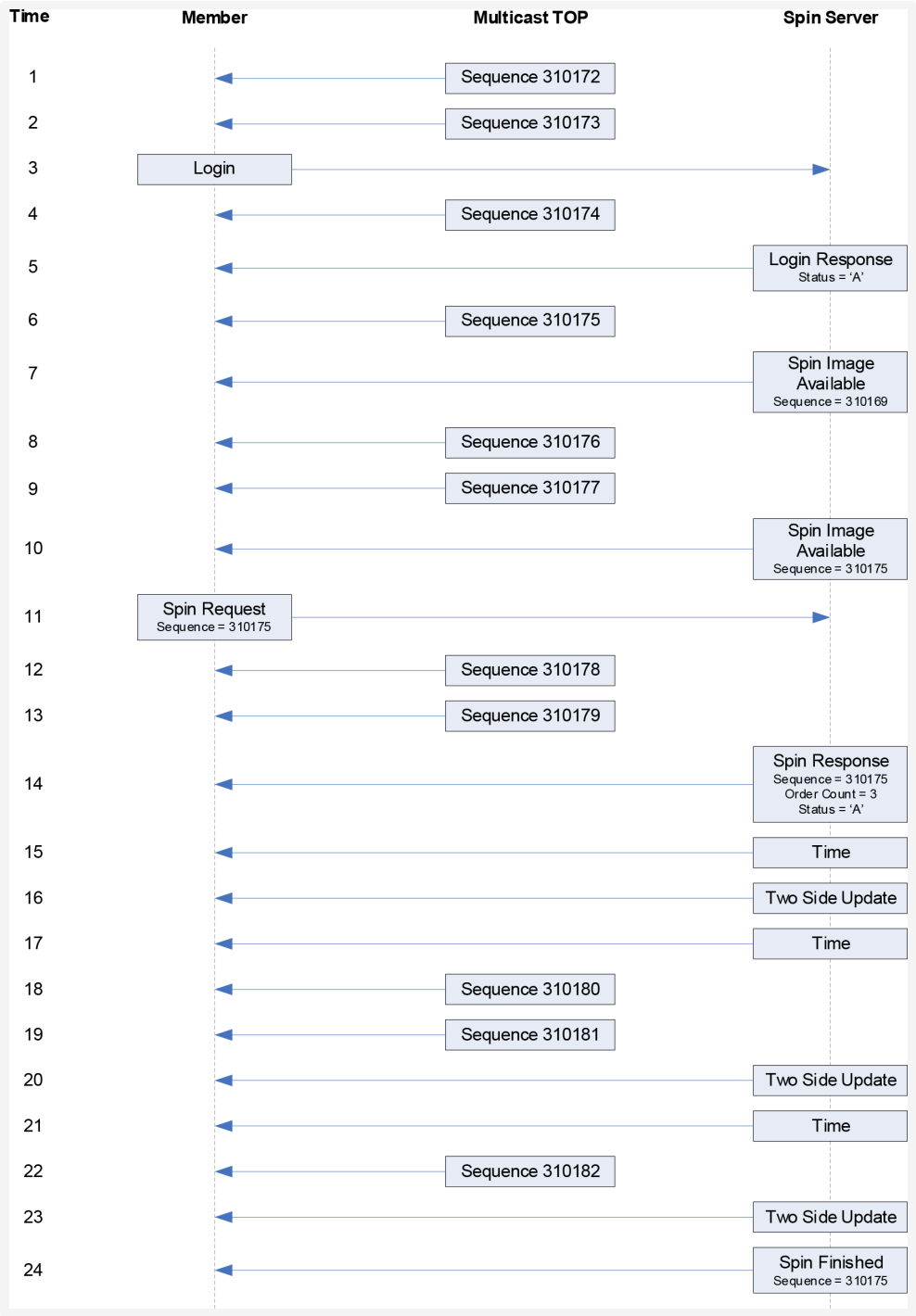
At time 10, the participant receives a **`Spin Image Available`** message which is useful since it would be a spin of all orders up to and including sequence 310175 and the participant has all messages after 310175 cached.

At time 11, the participant sends a **`Spin Request`** message 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`** message and indicates that three symbols will be sent.

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

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



Message Types

Gap Request Proxy Messages

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

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
```

TOP Messages

```
0x20        Time
0x2D        End of Session
0x31        Trading Status
0x97        Unit Clear
0x9A        Complex Instrument Definition Expanded
0xB1        Time Reference
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
0xF9        OOF Symbol Mapping
```

Message Examples

Each of the following message types must be wrapped by a sequenced or un-sequenced unit header as described in CFE Sequenced Unit Header Message Fields on page 15. Note that in the message examples, each byte is represented by two hexadecimal digits.

Login Message Example

Table 28. Login Message Example

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"

Login Response Message Example

Table 29. Login Response Message Example

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

Gap Request Message Example

Table 30. Gap Request Message Example

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

Gap Response Message Example

Table 31. Gap Response Message Example

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

Spin Image Available Message Example

Table 32. Spin Image Available Message Example

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

Spin Request Message Example

Table 33. Spin Request Message Example

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

Spin Response Message Example

Table 34. Spin Response Message Example

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

Spin Finished Message Example

Table 35. Spin Finished Message Example

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

Instrument Definition Request Message Example

Table 36. Instrument Definition Request Message Example

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

Instrument Definition Response Message Example

Table 37. Instrument Definition Response Message Example

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

Instrument Definition Finished Message Example

Table 38. Instrument Definition Finished Message Example

Length	02	2 bytes
Type	86	Instrument Definition Finished

Time Reference Message Example

Table 39. Time Reference Message Example

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

Time Message Example

Table 40. Time Message Example

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

Unit Clear Message Example

Table 41. Unit Clear Message Example

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

OOF Symbol Mapping Message Example

Table 42. OOF Symbol Mapping Message Example

Length	3C	60 bytes
Type	F9	Symbol Mapping Message
Time Offset	18 D2 06 00	447,000 ns since last Time Message
Feed Symbol	41 42 43 31 32 33	ABC123
Futures Product	56 58 20 20 20 20 20 20	VX
Futures Expiration	8A D8 34 01	20240522
Futures Symbol	44 45 46 34 35 36	DEF456
Strike Price	2C 40 02 00 00 00 00 00 00	14.7500
Call Put Ind	50	P = Put
Options Expiration	7A D8 34 01	20240506
Options on Futures Name	55 58 21 41 2F 4B 34 20 50 31 34 37 35 20 20 20 20 20	UX1A/K4 P1475
Symbol Condition	4E	N = Normal

Complex Instrument Definition Expanded Message Example

Table 43. Complex Instrument Definition Expanded Message Example

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 Instrument Underlying	5A 56 5A 5A 54 20 20 20	ZVZZT
Complex Instrument Type	4F 00 00 00	O = All Legs are Options
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 Type	4F	Option Leg
Leg Symbol	30 30 30 30 30 32 20 20	000002
Leg Ratio	01 00 00 00	1 = Buy 1
Leg Security	4F	

Trading Status Message Example

Table 44. Trading Status Message Example

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

Single Side Update (Short) Message Example

Table 45. Single Side Update (Short) Message Example

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	7B 00	$1.23
Quantity	64 00	100 contracts

Single Side Update (Short, Negative Price) Message Example

Table 46. Single Side Update (Short, Negative Price) Message Example

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

Single Side Update (Long) Message Example

Table 47. Single Side Update (Long) Message Example

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

Two Side Update (Short) Message Example

Table 48. Two Side Update (Short) Message Example

Length	14	20 bytes
Type	B6	Two Side Update (Short)
Time Offset	30 FA D3 29	701,758,000 ns since last Time Message
Symbol	30 31 32 33 34 35	012345
Bid Price	AA 05	$14.50
Bid Quantity	64 00	100 contracts
Ask Price	C3 05	$14.75
Ask Quantity	C8 00	200 contracts

Two Side Update (Long) Message Example

Table 49. Two Side Update (Long) Message Example

Length	24	36 bytes
Type	B7	Two Side Update (Long)
Time Offset	30 FA D3 29	701,758,000 ns since last Time Message
Symbol	30 31 32 33 34 35	012345
Bid Price	68 36 02 00 00 00 00 00	$14.5000
Bid Quantity	64 00 00 00	100 contracts
Ask Price	2C 40 02 00 00 00 00 00	$14.7500
Ask Quantity	C8 00 00 00	200 contracts

TOP Trade Message Example

Table 50. TOP Trade Message Example

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

TOP Trade (Condition = Trade Break) Message Example

Table 51. TOP Trade (Condition = Trade Break) Message Example

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

Settlement Message Example

Table 52. Settlement Message Example

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

End of Day Summary Message Example

Table 53. End of Day Summary Message Example

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	00 00 00 00	Always zero
Summary Flags	15	High Price Valid 0x01 Low Price Valid 0x04 Has Open/Close 0x10

End of Session Message Example

Table 54. End of Session Message Example

Length	06	6 bytes
Type	2D	End of Session
Time Offset	08 5C 44 25	625,237,000 ns since Last Time Message

Sequenced Unit Header with 2 Messages

Table 55. 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	7B 00	$1.23
Quantity	64 00	100 contracts

Multicast Configuration

Production Environment Configuration

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.

Table 56. Production Environment - Network and Gap Request Limitations/Configurations

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.

CFE OOF Unit/Product Distribution

The following table describes the CFE Options on Futures symbol distribution across units based on underlying futures product:

Table 57. CFE OOF Production/Certification Environment - Unit/Product Distribution

UNDERLYING FUTURES	UNIT
VX	1
IBHY, IBIG	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.

Effective 02/03/25 in production and 11/11/24 in certification, the CFE Options on Futures symbol distribution across units based on underlying futures product will be as follows:

Table 58. CFE OOF Production/Certification Environment - Unit/Product Distribution

UNDERLYING FUTURES	UNIT
VX	1
IBHY, IBIG	2
N/A	3
N/A	4

Multicast Routing Parameters

Table 59. Production Environment - 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

Address/Unit Distribution

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

Table 60. Production Environment - Address/Unit Distribution (Primary Datacenter)

PRIMARY DATACENTER		WAN-SHAPED [OFCT] 74.115.133.96/29		WAN-SHAPED [OFDT] 74.115.133.104/29	
UNIT	IP PORT	REAL-TIME MC	GAP RESP. MC	REAL-TIME MC	GAP RESP. MC
1	30101	224.0.62.18	224.0.62.19	224.0.73.18	224.0.73.19
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.

Table 61. Production Environment - Address/Unit Distribution (Secondary Datacenter)

SECONDARY DATACENTER		WAN-SHAPED [OFET] 170.137.16.80/29	
UNIT	IP PORT	REAL-TIME MC	GAP RESP. MC
1	31101	233.19.3.2	233.19.3.3
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.

Effective 02/03/25, the unit distribution across the CFE OOF Multicast TOP feeds will be as follows:

Table 62. Production Environment - Address/Unit Distribution (Primary Datacenter)

PRIMARY DATACENTER		WAN-SHAPED [OFCT] 74.115.133.96/29		WAN-SHAPED [OFDT] 74.115.133.104/29	
UNIT	IP PORT	REAL-TIME MC	GAP RESP. MC	REAL-TIME MC	GAP RESP. MC
1	30101	224.0.62.18	224.0.62.19	224.0.73.18	224.0.73.19
2	30102				
3	30103				
4	30104				

Table 63. Production Environment - Address/Unit Distribution (Secondary Datacenter)

SECONDARY DATACENTER		WAN-SHAPED [OFET] 170.137.16.80/29	
UNIT	IP PORT	REAL-TIME MC	GAP RESP. MC
1	31101	233.19.3.2	233.19.3.3
2	31102		

SECONDARY DATACENTER		WAN-SHAPED [OFET] 170.137.16.80/29	
UNIT	IP PORT	REAL-TIME MC	GAP RESP. MC
3	31103		
4	31104		

Certification Environment Configuration

Certification Multicast Routing Parameters

Table 64. Certification Environment - Multicast Routing Parameters

DATA CENTER	RENDEZVOUS POINT
Primary Data Center feed	74.115.128.130

CFE OOF Unit/Product Distribution

The following table describes the CFE Options on Futures symbol distribution across units based on underlying futures product:

Table 65. CFE OOF Production/Certification Environment - Unit/Product Distribution

UNDERLYING FUTURES	UNIT
VX	1
IBHY, IBIG	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.

Effective 02/03/25 in production and 11/11/24 in certification, the CFE Options on Futures symbol distribution across units based on underlying futures product will be as follows:

Table 66. CFE OOF Production/Certification Environment - Unit/Product Distribution

UNDERLYING FUTURES	UNIT
VX	1
IBHY, IBIG	2
N/A	3
N/A	4

Address/Unit Distribution

The following table describes the unit distribution across the certification CFE Multicast TOP feeds.

Table 67. Certification Environment - Address/Unit Distribution

PRIMARY DATACENTER		WAN-SHAPED [CERT] 174.136.160.16/28	
UNIT	IP PORT	REAL-TIME MC	GAP RESP. MC
1	32101	224.0.74.250	224.0.74.251
2	32102		
3	32103		
4	32104		

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.

Connectivity

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.

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.

Support

Please direct questions or comments regarding this specification to cfetradedesk@cboe.com.

Revision History

DOCUMENT VERSION	DATE	DESCRIPTION
1.0.0	07/29/22	Initial version.
1.0.1	09/09/22	Updated Production and Certification Environment Configuration sections. Updated OOF Symbol Mapping message, OOF Symbol Mapping Message Type, and OOF Symbol Mapping Example Message sections.
1.0.2	10/20/22	Added *Time Offset* to **`OOF Symbol Mapping`** message. **`OOF Symbol Mapping`** messages are included in spin responses and will be disseminated before **`Complex Instrument Definition Expanded`** messages. OOF Symbol Mapping and **`Complex Instrument Definition Expanded`** messages can be sent as a sequenced or unsequenced message.
1.0.3	01/19/23	Updated effective date for Options on Futures (effective 07/10/23).
1.0.4	06/28/24	Updated OOF Symbol Mapping *Options on Futures Name* description example and OOF Symbol Mapping example message.
1.0.5	11/04/24	Updated Unit/Product distribution based on underlying futures product. Clarified *Options on Futures Name* field description in **`OOF Symbol Mapping`** message. Added two new Matching Units, plus new port and IP information for Matching Units 2-4 (effective 02/03/25).
1.0.6	01/15/25	Updated with Cboe Titanium branding.