



Multicast Market Data Feed Specification

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System response times may vary for a number of reasons including market conditions, trading volumes and system performance.

VERSION HISTORY

VERSION	DESCRIPTION	DATE
1.0	Add off-exchange messages Correct examples 5.2.7, 5.2.8, 5.2.11	03-06-2011
2.0	Key changes: For off-exchange trade reporting Add UTCTimestamp data type Add trade report type and transaction time fields in Off-Exchange Trade message For order book reset Add 'Z' and 'N' system event code	04-07-2011
2.1	Key changes: Removed section 5.2.3	15-08-2011
2.2	Key changes: Updated section 2.1 to publish a heartbeat message every 5 seconds	03-02-2012
2.3	Key changes Removal of "t" and "p" flags in section 4.9: Off Exchange Trade Message	27-02-2013
2.4	Key changes Updated the data type definition on the header fields in section 3. Update to Type S Trade Report description	16-08-2013
2.5	Key changes Support added to Trade Message for Market On Close (MOC) trades New system event code for MOC trades Support added to Trade Message for Broker Preferencing Removed reference to maximum messages on recovery stream	04-10-2013
3.0	Key changes Support visible MOC order in Section 4.3 and 4.4 Add Order Source and Trade Designation fields in Section 4.3: Add Order Message, Section 4.4: Order Execution Message and Section 4.8: Trade Message. Removal of "M" and "m" in Section 4.8: Trade Message Added the System Event Code for @Last Open Updated to describe treatment of Visible MOC Orders	01-07-2015
4.0	Key changes Support Attributed Market – Section 4.3, 4.4, 4.8 and 4.10 Support for ETF Trade Reports	01-07-2015
5.0	Key changes Introduction of Calculated Value Message	01-12-2015
5.1	Key changes Modify System Event Message type "S", "E", "V", "M", "H" and "R" to include field to define which markets are affected. Send multiple system event messages, one for each market that is affected Long Form VIXEN Calculated Value Message	28-06-2016
5.2	Key changes Value Generation Time field added in Calculated Value Message, indicating when the Calculated Value is generated QMF market support in Event Messages	12-09-2016
6.2	Key changes Remove Visible MOC Support (removal of System Event Code 'V' in section 4.2.2)	09-05-2019

1 Introduction

Cboe Australia (“Cboe”) provides a high performance, low latency trading system. The information processed by the Cboe trading system is made available to market participants and data vendors through the Cboe Market Data Feed (“Cboe MD Feed”).

This service provides clients with details concerning orders and trade information on a real time basis.

The Cboe MD Feed is available in both TCP (unicast) and multicast versions. This document describes the technical specification for the multicast version including the connection protocol, message types and message structures.

Customers using the TCP version should refer to the document “Market Data Feed Specification”.

For the purposes of clarification reference to “client” in this specification means a technology system.

1.1 Relevant documents

TITLE
Market Data Feed Specification
Technical Connectivity Guide
Order Type Overview

Figure 1: Relevant Document(s)

2 Overview

The Multicast CboeMD Feed consists of two data services:

- Real-time Multicast Market Data Feed (CHIXMMD)
- Multicast Message Recovery Service (MMRS)

The real-time multicast market data feed delivers market data in UDP multicast packets streamed over the multicast market data network. These multiple data streams provide network resiliency by all carrying identical content. By subscribing to these data streams, market data clients receive the latest market data updates from the trading system.

The multicast message recovery service offers message recovery to market data clients. Clients can connect to a designated MMRS server and request message retransmission. This recovery process is done over a TCP connection.

The two data services are available at the primary data centre site and one data service at the secondary data centre site for resilience purpose. Data streams published at the secondary site may be slightly slower than the primary site. Therefore market data clients may want to rely on primary site services and switch to secondary site services only when necessary.

The following diagram shows the overall delivery mechanism:

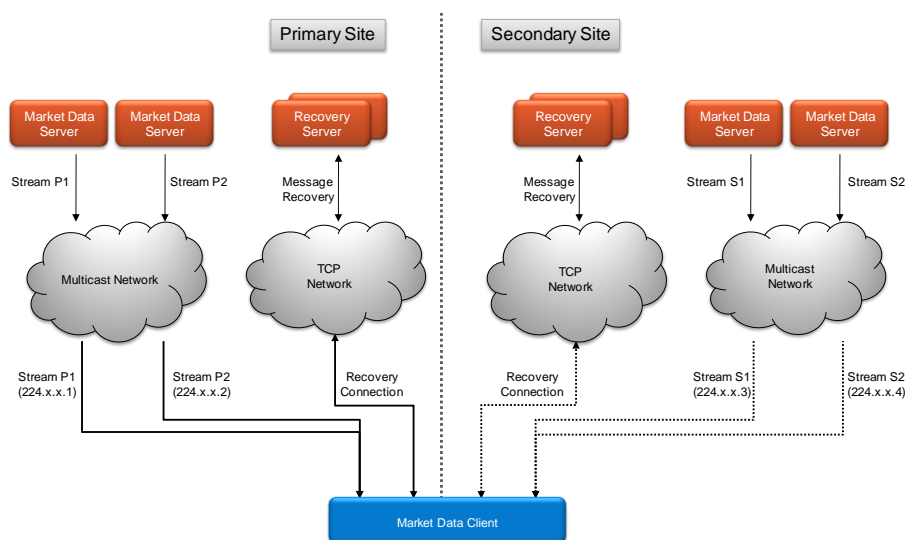


Figure 2: Multicast Market Data Delivery Mechanism

[Please Note: Only a single stream will be in place in the secondary site]

2.1 Real-Time Multicast Market Data Feed Service (CHIXMMD)

The CHIXMMD feed delivers real-time market data in the form of UDP packet streams. There are two streams published from the primary site and one from the secondary site. They are published using different multicast addresses. Refer to section 2.3 for address details.

All data streams contain identical market data content. The protocol supports multiple messages in a UDP packet and different market data servers at different sites may apply this packing differently. Therefore the streams may differ at UDP packet level. Market data clients need to be aware of this nature when processing the feed.

Every market data message carries a unique message sequence number which starts at 1 and increments by 1 in each subsequent message. Market data clients may use this sequence number to detect a message gap and recover accordingly in the event of connectivity loss.

There is a regular heartbeat of at least 1 message published in each data stream every 5 seconds to indicate line connection status. The heartbeat message does not increment the message sequence number and does not carry market data updates. It does carry the next expected sequence number so that a market data client can use it to detect missing message data. A heartbeat message is published every 5 seconds but may be skipped when a data stream is busy during high volume message transmission.

2.2 Multicast Message Recovery Service

Market data clients may use the service provided by MMRS Server to recover missing messages for the current trading day. This is done by establishing a TCP connection to a designated MMRS server and following the protocols described in this specification to initiate the request. In summary, the client application needs to submit a Login Request together with the sequence number of the first missing message. After validating this request, the Recovery Server replays messages to the client starting from the requested message.

Message volume replay is limited in a single recovery session. MMRS Server applies a limit check in serving recovery requests. If a request exceeds the pre-set limit, the server will disconnect the connection automatically. Market data clients are required to start a new session and continue from the last recovery point.

Session Time Limit	1 minute
--------------------	----------

Figure 3: MMRS Configuration Parameters

2.3 Network Configuration Parameters

Please refer to the Technical Connectivity Guide for detailed network configuration parameters.

3 Protocol

3.1 CHIXMMD Protocol

The Real-time Multicast Market Data Feed protocol contains market data messages multicast packets. The market data messages describe activities of the trading system. For example, new orders and trade information. Format of the market data messages is described in section 4.

The multicast packet definition describes how market data messages are encoded in a multicast packet.

3.1.1 Multicast Packet Layout

Each multicast packet contains a packet header followed by one or more data messages as illustrated in the following diagram.

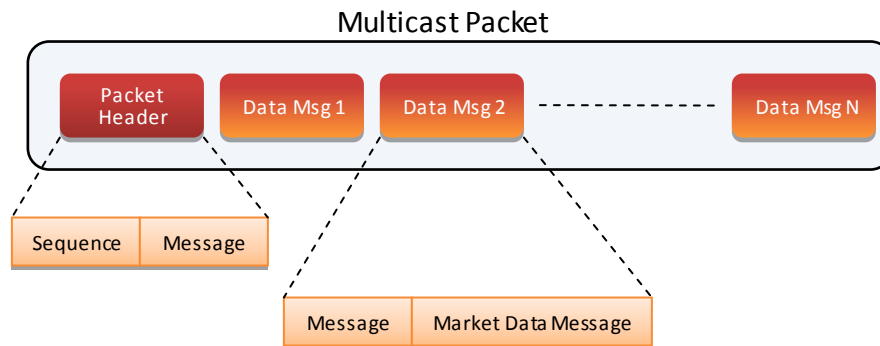


Figure 4: CHIXMMD Multicast Packet Layout

The following table describes the packet header layout.

PACKET HEADER				
NAME	OFFSET	LENGTH	VALUE	REMARKS
Sequence	0	4	Binary	Sequence number of the first message in big-endian order
Message Count	4	2	Binary	Number of messages in the packet in big-endian order

The following table describes the data message layout. The following layout may repeat in the multicast packet to deliver multiple data messages in one packet.

DATA MESSAGE				
NAME	OFFSET	LENGTH	VALUE	REMARKS
Length	Variable	2	Binary	Length of the Market Data Message in big-endian order
Market Data Message	Variable	Variable	Market Data Message	Content of the Market Data Message

3.1.2 Heartbeat Message

A heartbeat message is delivered in a single multicast packet and indicated by the message count value of zero in the packet header as below.

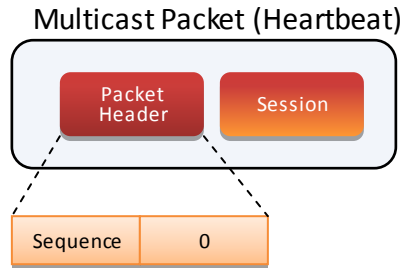


Figure 5: CHIXMMD Heartbeat Packet Layout

The following table describes the heartbeat message layout including the packet header.

HEARTBEAT MESSAGE				
NAME	OFFSET	LENGTH	VALUE	REMARKS
Sequence	0	4	Binary	Sequence number of the next Market Data Message in big-endian order
Message Count	4	2	0	A zero value indicating this is a heartbeat message
Session	6	10	Alphanumeric	Current Session value

The Session field contains the current session of the market data stream being delivered. Client applications should use the value delivered in this field to populate the Session field in the Login Request of the Recovery Service.

The Session field will not normally change during a trading day. In an exceptional circumstance, such as the trading system is restarted in the middle of the day, the session value may change. This will in turn result in the sequence number being reset to 1.

3.2 MMRS Protocol

The Multicast Message Recovery Service protocol follows the one used in the TCP version of CboeMD Feed in section 3.4. The protocol definition is described in the document “Market Data Feed Specification”.

The following diagram describes a typical recovery scenario:

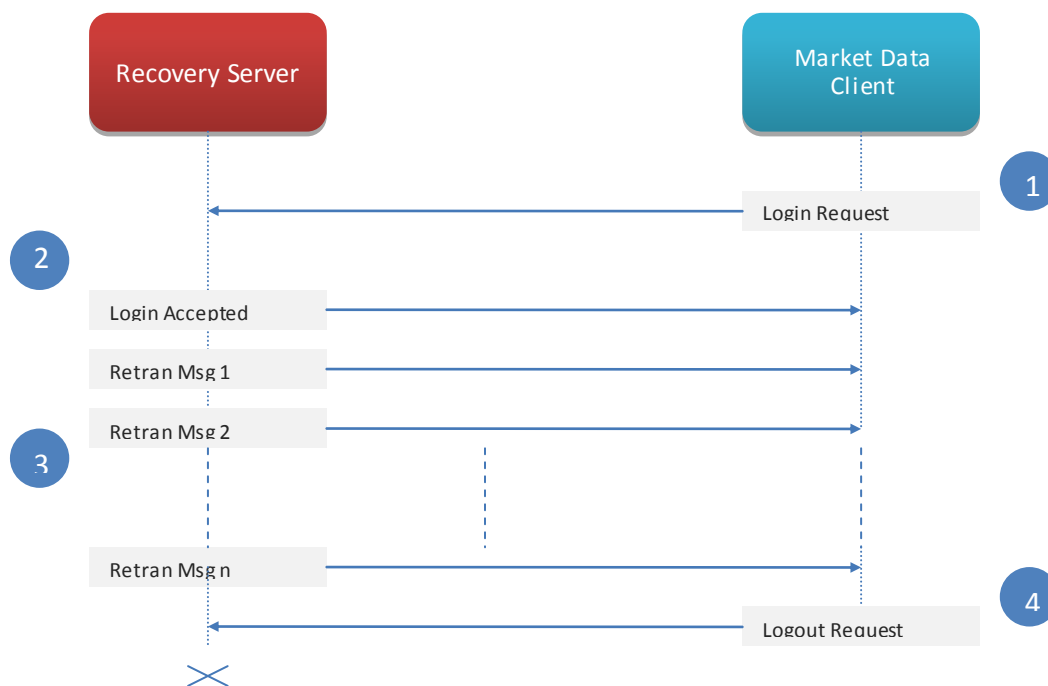


Figure 6: Example Recovery Scenario

In the diagram, there are 4 steps involved in the message recovery process.

Step 1: The client establishes a TCP connection with the recovery server and sends a Login Request message to request message retransmission.

Step 2: After receiving the login request, the Recovery Server will validate the user authentication information in the request. The session and message sequence number in the request will also be checked to ensure relevant messages are available for retransmission. A Login Accepted message will be sent to the client indicating the request has been accepted.

Step 3: The recovery server starts replaying the messages, starting from the one requested by the client.

Step 4: When the client receives the necessary retransmissions, it should send a Logout Request to disconnect the recovery session. After the request is sent, the client may close the TCP connection immediately.

There is a limit to the amount of message volume that can be replayed in a single recovery session. If the limit is reached, the server will terminate the connection. A new session can be started from the last recovery point. The recovery limit is described in the section ‘Network Configuration Parameters’.

The recovery server will disconnect a client when playback of the past messages finishes. This is different from the CHIXMD feed which would continue to broadcast the real-time messages.

4 Market Data Messages

CHIXMMD Feed contains a series of messages provide details of orders added to and removed from the Cboe order book, the execution of on-market trades plus Off-exchange trades reported to Cboe.

Long form messages are used when the display length of the price or the size of an order or execution is longer than the standard message permits. Long form message is sent per order/execution basis.

Cboe uses the same market data message format in both the multicast service and the recovery service.

4.1 Data Type

This section describes the available data types that are used in the Cboe Market Data Feed.

4.1.1 Numeric

Numeric fields consist of digits which are ASCII coded. They are presented in right justification and are space-filled from the left. Data fields of numeric data type include Sequence, Order Reference, Trade Reference, number of Shares, etc.

4.1.2 Alphanumeric

Alphanumeric text fields consist of alphabetical letters or digits (or both). They are presented in left justification and are padded with spaces to the right. Data fields of alphanumeric data type include Stock (symbol).

4.1.3 Prices

Price data fields are presented in digits and decimal places are allowed.

Standard prices are presented in maximum six digits with four decimal places. Long form prices are presented in maximum 12 digits with 7 decimal places. Spaces are padded from the left in front of the digits and zeros are padded after the last decimal place to the right. Decimal points do not present in the price field. They are recognised by their positions in the price fields.

4.1.4 Timestamp

Timestamp data fields are presented in digits in milliseconds past midnight local time.

4.1.4.1 UTCTimestamp

String fields representing date and time combination represented in UTC in the YYYYMMDDHHMMSSsss format. Valid values: YYYY = 0000-9999, MM = 01-12, DD = 01-31, HH = 00-23, MM = 00-59, SS = 00-60 (60 only if UTC leap second), sss=000-999 (indicating milliseconds).

4.1.4.2 LocalTimestamp

String fields representing date and time combination represented in Local Time in the YYYYMMDDHHMMSSsss format. Valid values: YYYY = 0000-9999, MM = 01-12, DD = 01-31, HH = 00-23, MM = 00-59, SS = 00-60 (60 only if UTC leap second), sss=000-999 (indicating milliseconds).

4.2 System Event Message

System Event Message is used for signalling an event which affects all systems of Cboe.

SYSTEM EVENT MESSAGE				
NAME	OFFSET	LENGTH	VALUE	REMARKS
Time Stamp	0	8	Numeric	Time Stamp
Message Type	8	1	"S"	System Event Message
Event Code	9	1	Alphanumeric	Please see System Event Codes below
Market ID	10	4	Alphanumeric	Right-padded with spaces. If no market ID available (which means the Event Code applies to the whole system), then filled with space.

4.2.1 Market IDs

MARKET ID	DESCRIPTION	REMARKS
AUS	Australia Stock Market	Cboe Continuous On-Market Trading
CXAW	Cboe Australia - Warrants	Cboe Warrants Trading
CXAE	Cboe Australia - ETF	Cboe ETF Trading
CXAR	Cboe Australia - TraCR	Cboe TraCR Trading
CXAQ	Cboe Australia – QMF	Cboe QMF Trading

4.2.2 System Event Codes

SYSTEM EVENT CODE	DESCRIPTION	REMARKS
O	Start of Messages	This is the first message of the day
S	Cboe Open	<p>This message indicates that Cboe is open for continuous on-market trading and accepting orders. Before the Cboe Open message you may receive Off-exchange Trade messages.</p> <p>Market ID field value is also provided in the event message which indicates which market this event belongs to.</p>
E	Cboe Close	<p>This message indicates that Cboe's continuous trading session is closed. Cboe will not accept any more orders, except Market on Close ("MOC") orders, for the continuous trading session. Clients may still receive a Trade Message for MOC executions, Broken Trade, Order Cancel and Off-Exchange Trade messages after this session state.</p> <p>Market ID field value is also provided in the event message which indicates which market this event belongs to.</p>
M	Cboe MOC Close	<p>This message indicates that MOC orders can no longer execute. Clients may still receive MOC Executions after this session state closes.</p> <p>Market ID field value is also provided in the event message which indicates which market this event belongs to.</p>
H	Cboe Halt	This message indicates that Cboe is halted. Cboe will not accept any order or Off-

		Exchange Trade Report during this period. Clients may still receive Broken Trade and Order Cancel messages during this period. Market ID field value is also provided in the event message which indicates which market this event belongs to.
R	Cboe Resume	This message indicates that Cboe is resumed from halted state and accepting orders and Off-Exchange Trade reports. Market ID field value is also provided in the event message which indicates which market this event belongs to.
C	End of Messages	This is the last message of the day.
Z	Reset Orderbook	This message indicates that Cboe has explicitly reset its order book for all securities.
N	No Operation	This message is a system reserved message. Recipients should ignore this message, but increase the next expected sequence.

4.3 Add Order Message

Add Order Message is used for acknowledging the acceptance of a visible order into the Cboe book. The message contains an Order Reference which is a unique key of the day assigned to the order by Cboe.

Add Order Message may be sent for accepting a revised order after the original order is cancelled. Please refer to [Section 4.6 Modification of Existing Orders](#) for detail.

ADD ORDER MESSAGE				
NAME	OFFSET	LENGTH	VALUE	REMARKS
Time Stamp	0	8	Numeric	Time Stamp
Message Type	8	1	"A"	Add Order Message
Order Reference	9	9	Numeric	Unique order reference number of the day.
Buy/Sell Indicator	18	1	"B" or "S"	"B" = Buy Order "S" = Sell Order
Shares	19	6	Numeric	Total number of shares being added to the book. For undisclosed order, number of shares is zero. (The number of shares added to the book may be less than the actual number of shares entered because part of the order may trade before being posted to the book).
Stock	25	6	Alphanumeric	Stock symbol (which is right-padded with spaces).
Price	31	10	Price	The display price of the order.
Display	41	1	"Y"	"Y" = displayed in quote
Order Source	42	1	"C"	"C" = Visible Limit order

LONG FORM ADD ORDER MESSAGE				
NAME	OFFSET	LENGTH	VALUE	REMARKS
Time Stamp	0	8	Numeric	Time Stamp
Message Type	8	1	"a"	Long Form Add Order Message
Order Reference	9	9	Numeric	Unique order reference number of the day.
Buy/Sell Indicator	18	1	"B" or "S"	"B" = Buy Order "S" = Sell Order
Shares	19	10	Numeric	Total number of shares being added to the book. For undisclosed order, number of shares is zero. (The number of shares added to the book may be less than the actual number of shares entered because part of the order may trade before being posted to the book).
Stock	29	6	Alphanumeric	Stock symbol (which is right-padded with spaces).
Price	35	19	Price	The displayprice of the order.
Display	54	1	"Y"	"Y" = displayed in quote
Order Source	55	1	"C"	"C" = Visible Limit order

ADD ORDER MESSAGE (ATTRIBUTED MARKET)				
NAME	OFFSET	LENGTH	VALUE	REMARKS
Time Stamp	0	8	Numeric	Time Stamp
Message Type	8	1	"F"	Add Order Message
Order Reference	9	9	Numeric	Unique order reference number of the day.
Buy/Sell Indicator	18	1	"B" or "S"	"B" = Buy Order "S" = Sell Order
Shares	19	6	Numeric	Total number of shares being added to the book. For undisclosed order, number of shares is zero. (The number of shares added to the book may be less than the actual number of shares entered because part of the order may trade before being posted to the book).
Stock	25	6	Alphanumeric	Stock symbol (which is right-padded with spaces).
Price	31	10	Price	The displayprice of the order.
Display	41	1	"Y"	"Y" = displayed in quote
Order Source	42	1	"C"	"C" = Visible Limit order
PID	43	5	Alphanumeric	Participant ID (which is right-padded with spaces)

LONG FORM ADD ORDER MESSAGE (ATTRIBUTED MARKET)				
NAME	OFFSET	LENGTH	VALUE	REMARKS
Time Stamp	0	8	Numeric	Time Stamp
Message Type	8	1	"f"	Long Form Add Order Message

Order Reference	9	9	Numeric	Unique order reference number of the day.
Buy/Sell Indicator	18	1	"B" or "S"	"B" = Buy Order "S" = Sell Order
Shares	19	10	Numeric	Total number of shares being added to the book. For undisclosed order, number of shares is zero. (The number of shares added to the book may be less than the actual number of shares entered because part of the order may trade before being posted to the book).
Stock	29	6	Alphanumeric	Stock symbol (which is right-padded with spaces).
Price	35	19	Price	The display price of the order.
Display	54	1	"Y"	"Y" = displayed in quote
Order Source	55	1	"C"	"C" = Visible Limit order
PID	56	5	Alphanumeric	Participant ID (which is right-padded with spaces)

4.4 Order Execution Message

When a visible order on the book is executed, either in whole or in part, an Order Execution Message is sent. Please note that this behaviour also occurs when the visible portion of an iceberg order is executed.

ORDER EXECUTION MESSAGE				
NAME	OFFSET	LENGTH	VALUE	REMARKS
Time Stamp	0	8	Numeric	Time Stamp
Message Type	8	1	"E"	Order Execution Message
Order Reference	9	9	Numeric	The unique order reference number of the order which was executed.
Executed Shares	18	6	Numeric	The number of shares executed on the trade.
Trade Reference	24	9	Numeric	The unique trade reference number of the day.
Contra Order Reference	33	9	Numeric	The unique order reference number of the contra order that matched with this order.
Order Source	42	1	"C"	"C" = Visible Limit Order

LONG FORM ORDER EXECUTION MESSAGE				
NAME	OFFSET	LENGTH	VALUE	REMARKS
Time Stamp	0	8	Numeric	Time Stamp
Message Type	8	1	"e"	Long Form Order Execution Message
Order Reference	9	9	Numeric	The unique order reference (if any) of the order which was executed. (Order Reference can be a reference of a previously sent Add Order Message, or of an order that was not previously displayed.)
Executed Shares	18	10	Numeric	The number of shares executed on this trade
Trade Reference	28	9	Numeric	The unique trade reference number of the day.
Contra Order Reference	37	9	Numeric	The unique order reference number of the contra order that matched with this order.
Order Source	46	1	"C"	"C" = Visible Limit Order

ORDER EXECUTION MESSAGE (ATTRIBUTED MARKET)				
NAME	OFFSET	LENGTH	VALUE	REMARKS
Time Stamp	0	8	Numeric	Time Stamp
Message Type	8	1	"G"	Order Execution Message
Order Reference	9	9	Numeric	The unique order reference number of the order which was executed.
Executed Shares	18	6	Numeric	The number of shares executed on the trade.
Trade Reference	24	9	Numeric	The unique trade reference number of the day.
Contra Order Reference	33	9	Numeric	The unique order reference number of the contra order that matched with this order.
Order Source	42	1	"C"	"C" = Visible Limit Order
Contra PID	43	5	Alphanumeric	Contra Participant PID (which is right-padded with spaces)

LONG FORM ORDER EXECUTION MESSAGE (ATTRIBUTED MARKET)				
NAME	OFFSET	LENGTH	VALUE	REMARKS
Time Stamp	0	8	Numeric	Time Stamp
Message Type	8	1	"g"	Long Form Order Execution Message
Order Reference	9	9	Numeric	The unique order reference (if any) of the order which was executed. (Order Reference can be a reference of a previously sent Add Order Message, or of an order that was not previously displayed.)
Executed Shares	18	10	Numeric	The number of shares executed on this trade
Trade Reference	28	9	Numeric	The unique trade reference number of the day.
Contra Order Reference	37	9	Numeric	The unique order reference number of the contra order that matched with this order.
Order Source	46	1	"C"	"C" = Visible Limit Order
Contra PID	47	5	Alphanumeric	Contra Participant PID (which is right-padded with spaces)

4.5 Order Cancel Message

When an order on the book is cancelled completely, the quantity of an order is reduced or the price of a pegged order is revised, an Order Cancel Message is sent out.

ORDER CANCEL MESSAGE				
NAME	OFFSET	LENGTH	VALUE	REMARKS
Time Stamp	0	8	Numeric	Time Stamp
Message Type	8	1	"X"	Order Cancel Message
Order Reference	9	9	Numeric	The unique order reference number of the order which was cancelled. (Order Reference can be a reference of a previously sent Add Order Message.)
Cancelled Shares	18	6	Numeric	Number of shares cancelled. For cancel undisclosed order, number of shares is always zero.

LONG FORM ORDER CANCEL MESSAGE				
NAME	OFFSET	LENGTH	VALUE	REMARKS
Time Stamp	0	8	Numeric	Time Stamp
Message Type	8	1	"X"	Long Form Order Cancel Message
Order Reference	9	9	Numeric	The unique order reference number of the order which was cancelled. (Order References can be a reference of a previously sent Add Order Message.)
Cancelled Shares	18	10	Numeric	Number of shares cancelled.

4.6 Modification of Existing Orders

4.6.1 Modification of Price

When the price on an existing order is modified, a Cancel Message for full quantity of the open order is sent out, followed by an Add Order Message which is assigned with the same Order Reference as the cancelled order.

4.6.2 Reduction of quantity

When there is a reduction of quantity on an existing order, a Cancel Message for the existing order is sent out which acknowledges the reduction of the number of shares pending in the referenced open order. If the number of currently pending shares for an order reaches zero, the order will be removed from the book.

4.7 Trade Message

When a trade occurs against order quantity not visible on the book (ie. a fully hidden Price Improvement order, the hidden portion of an iceberg order or an undisclosed order), or against a hidden MOC order, a Trade Message is sent out. Trade Messages fill in the gaps left when an order that is not visible on the book is executed.

Note: Order Execution Messages and Trade Messages together provide a complete picture of all executions that occur on Cboe. A Trade Message does not affect the book and can be ignored for book-building but can be used for time and sales and other execution based data aggregation.

Order Reference and Contra Order Reference are always set to 0 (zero) and the Buy/Sell Indicator to 'B'. This applies to the Long Form version as well.

TRADE MESSAGE				
NAME	OFFSET	LENGTH	VALUE	REMARKS
Time Stamp	0	8	Numeric	Time Stamp
Message Type	8	1	"P"	Trade Message resulting from hidden liquidity
Order Reference	9	9	Numeric	The order reference number will always be set to 0
Buy/Sell Indicator	18	1	"B"	The indicator value is always set to B
Shares	19	6	Numeric	Number of shares executed.
Stock	25	6	Alphanumeric	Stock symbol (right-padded with spaces)
Price	31	10	Price	Match price of the order
Trade Reference	41	9	Numeric	Trade reference number generated for the trade.
Contra Order Reference	50	9	Numeric	The contra order reference number will always be set to 0.

Trade Type	59	1	Alphanumeric	"B" = Broker Preferred Trade "N" = Trade resulting from normal matching logic
Trade Designation	60	1	Alphanumeric	"C" = CXAC (Limit) "P" = CXAP (Mid-Point) "N" = CXAN (Near Point) "F" = CXAF (Far Point) "M" = CXAM (MOC)

LONG FORM TRADE MESSAGE				
NAME	OFFSET	LENGTH	VALUE	REMARKS
Time Stamp	0	8	Numeric	Time Stamp
Message Type	8	1	"p"	Trade Message resulting from hidden liquidity
Order Reference	9	9	Numeric	The order reference number will always be 0
Buy/Sell Indicator	18	1	"B" or "S"	The indicator value is always set to B
Shares	19	10	Numeric	Number of shares executed.
Stock	29	6	Alphanumeric	Stock symbol (right-padded with spaces).
Price	35	19	Price	Match price of the order
Trade Reference	54	9	Numeric	Trade reference number generated for the trade.
Contra Order Reference	63	9	Numeric	. The contra order reference number will always be set to 0.
Trade Type	72	1	Alphanumeric	"B" = Broker Preferred Trade "N" = Trade resulting from normal matching
Trade Designation	73	1	Alphanumeric	"C" = CXAC (Limit) "P" = CXAP (Mid-Point) "N" = CXAN (Near Point) "F" = CXAF (Far Point) "M" = CXAM (MOC)

TRADE MESSAGE (ATTRIBUTED MARKET)				
NAME	OFFSET	LENGTH	VALUE	REMARKS
Time Stamp	0	8	Numeric	Time Stamp
Message Type	8	1	"J"	Trade Message resulting from hidden liquidity
Order Reference	9	9	Numeric	The order reference number will always be set to 0
Buy/Sell Indicator	18	1	"B"	The indicator value is always set to B
Shares	19	6	Numeric	Number of shares executed.
Stock	25	6	Alphanumeric	Stock symbol (right-padded with spaces)
Price	31	10	Price	Match price of the order
Trade Reference	41	9	Numeric	Trade reference number generated for the trade.
Contra Order Reference	50	9	Numeric	The contra order reference number will always be set to 0.
Trade Type	59	1	Alphanumeric	"B" = Broker Preferred Trade "N" = Trade resulting from normal matching logic

Trade Designation	60	1	Alphanumeric	“C” = CXAC (Limit) “P” = CXAP (Mid-Point) “N” = CXAN (Near Point) “F” = CXAF (Far Point) “M” = CXAM (MOC)
PID	61	5	Alphanumeric	Participant ID (which is right-padded with spaces)
Contra PID	66	5	Alphanumeric	Contra Participant ID (which is right-padded with spaces)

LONG FORM TRADE MESSAGE (ATTRIBUTED MARKET)				
NAME	OFFSET	LENGTH	VALUE	REMARKS
Time Stamp	0	8	Numeric	Time Stamp
Message Type	8	1	“j”	Trade Message resulting from hidden liquidity
Order Reference	9	9	Numeric	The order reference number will always be 0
Buy/Sell Indicator	18	1	“B” or “S”	The indicator value is always set to B
Shares	19	10	Numeric	Number of shares executed.
Stock	29	6	Alphanumeric	Stock symbol (right-padded with spaces).
Price	35	19	Price	Match price of the order
Trade Reference	54	9	Numeric	Trade reference number generated for the trade.
Contra Order Reference	63	9	Numeric	. The contra order reference number will always be set to 0.
Trade Type	72	1	Alphanumeric	“B” = Broker Preferred Trade “N” = Trade resulting from normal matching
Trade Designation	73	1	Alphanumeric	“C” = CXAC (Limit) “P” = CXAP (Mid-Point) “N” = CXAN (Near Point) “F” = CXAF (Far Point) “M” = CXAM (MOC)
PID	74	5	Alphanumeric	Participant ID (which is right-padded with spaces)
Contra PID	79	5	Alphanumeric	Contra Participant ID (which is right-padded with spaces)

4.8 Broken Trade Message

When an execution is broken on Cboe, a Broken Trade Message is sent out. If a trade is broken, it cannot be reinstated.

Note: Broken Trade Message only affects applications which build on a time-and-sales database or maintain cumulative volumes or high/low calculations. A Broken Trade Message has no effect on the book and it can be ignored for book-building.

Broken Trade Message				
Name	Offset	Length	Value	Remarks
Time Stamp	0	8	Numeric	Time Stamp
Message Type	8	1	“B”	Broken Trade Message

Trade Reference	9	9	Numeric	The trade reference number of the execution that was broken. (The Trade Reference is from a previously sent Order Execution Message or Trade Message.)
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4.9 Off-Exchange Trade Message

Off-Exchange Trade Message is sent once participants report an off-exchange trade to Cboe.

OFF-EXCHANGE TRADE MESSAGE				
NAME	OFFSET	LENGTH	VALUE	REMARKS
Time Stamp	0	8	Numeric	Time Stamp
Message Type	8	1	"Q"	Off-Exchange Trade Message
Shares	9	6	Numeric	Number of shares traded.
Stock	15	6	Alphanumeric	Stock symbol (right-padded with spaces)
Price	21	10	Price	Reported price of the trade
Trade Reference	31	9	Numeric	Trade reference number generated for the trade.
Trade Report Type	40	1	Alphanumeric	Trade report type of the Off-Exchange Trade message. Valid values: "B" – Block Trade "P" – Large Portfolio Trade "T" – Large Principal Transaction "S" – Trades With Price Improvement "L" – Permitted Trade During Post Trading Hours Period "M" – Permitted Trade During Pre Trading Hours Period "E" – Out Of Hours Trade "F" – ETF Trade Report for unit creations or redemptions
Transaction Time	41	17	UTCTimestamp	The date and time of Off-Exchange Trade as specified in the Trade Report submitted by the participant.

LONG FORM OFF-EXCHANGE TRADE MESSAGE				
NAME	OFFSET	LENGTH	VALUE	REMARKS
Time Stamp	0	8	Numeric	Time Stamp
Message Type	8	1	"q"	Long Form Off-Exchange Trade Message
Shares	9	10	Numeric	Number of shares traded.
Stock	19	6	Alphanumeric	Stock symbol (right-padded with spaces)
Price	25	19	Price	Reported price of the trade
Trade Reference	44	9	Numeric	Trade reference number generated for the trade.

Trade Report Type	53	1	Alphanumeric	Trade report type of the Off-Exchange Trade message. Valid values: "B" – Block Trade "P" – Large Portfolio Trade "T" – Large Principal Transaction "S" – Trades With Price Improvement "L" – Permitted Trade During Post Trading Hours Period "M" – Permitted Trade During Pre Trading Hours Period "E" – Out Of Hours Trade "F" – ETF Trade Report for unit creations or redemptions
Transaction Time	54	17	UTCTimestamp	The date and time of the Off-Exchange Trade as specified in the Trade Report submitted by the trading participant.

OFF-EXCHANGE TRADE MESSAGE (ATTRIBUTED MARKET)				
NAME	OFFSET	LENGTH	VALUE	REMARKS
Time Stamp	0	8	Numeric	Time Stamp
Message Type	8	1	"K"	Off-Exchange Trade Message
Shares	9	6	Numeric	Number of shares traded.
Stock	15	6	Alphanumeric	Stock symbol (right-padded with spaces)
Price	21	10	Price	Reported price of the trade
Trade Reference	31	9	Numeric	Trade reference number generated for the trade.
Trade Report Type	40	1	Alphanumeric	Trade report type of the Off-Exchange Trade message. Valid values: "B" – Block Trade "P" – Large Portfolio Trade "T" – Large Principal Transaction "S" – Trades With Price Improvement "L" – Permitted Trade During Post Trading Hours Period "M" – Permitted Trade During Pre Trading Hours Period "E" – Out Of Hours Trade "F" –ETF Trade Report for unit creations or redemptions
Transaction Time	41	17	UTCTimestamp	The date and time of Off-Exchange Trade as specified in the Trade Report submitted by the participant.
PID	58	5	Alphanumeric	Participant ID (which is right-padded with spaces)
Contra PID	63	5	Alphanumeric	Contra Participant ID (which is right-padded with spaces)

LONG FORM OFF-EXCHANGE TRADE MESSAGE (ATTRIBUTED MARKET)				
NAME	OFFSET	LENGTH	VALUE	REMARKS
Time Stamp	0	8	Numeric	Time Stamp
Message Type	8	1	"k"	Long Form Off-Exchange Trade Message
Shares	9	10	Numeric	Number of shares traded.
Stock	19	6	Alphanumeric	Stock symbol (right-padded with spaces)
Price	25	19	Price	Reported price of the trade
Trade Reference	44	9	Numeric	Trade reference number generated for the trade.

Trade Report Type	53	1	Alphanumeric	Trade report type of the Off-Exchange Trade message. Valid values: "B" – Block Trade "P" – Large Portfolio Trade "T" – Large Principal Transaction "S" – Trades With Price Improvement "L" – Permitted Trade During Post Trading Hours Period "M" – Permitted Trade During Pre Trading Hours Period "E" – Out Of Hours Trade "F" – ETF Trade Report for unit creations or redemptions
Transaction Time	54	17	UTC Timestamp	The date and time of the Off-Exchange Trade as specified in the Trade Report submitted by the trading participant.
PID	71	5	Alphanumeric	Participant ID (which is right-padded with spaces)
Contra PID	76	5	Alphanumeric	Contra Participant ID (which is right-padded with spaces)

4.10 Broken Off-Exchange Trade Message

When an off-exchange trade is broken on Cboe, a Broken Off-Exchange Trade Message is sent out. If a trade is broken, it cannot be reinstated.

BROKEN OFF-EXCHANGE TRADE MESSAGE				
NAME	OFFSET	LENGTH	VALUE	REMARKS
Time Stamp	0	8	Numeric	Time Stamp
Message Type	8	1	"C"	Broken Off-Exchange Trade Message
Trade Reference	9	9	Numeric	The trade reference number of the off-exchange trade that was broken. (The Trade Reference is from a previously sent Off-Exchange Trade Message.)

4.11 Stock Status Message

This message indicates the current trading status of a stock. At the start of day, the feed will send out a stock status message for each of the symbols trading on Cboe. Subsequently, stock status messages will be sent when a stock is halted or is released for trading.

Stock Status Message				
Name	Offset	Length	Value	Remarks
Time Stamp	0	8	Numeric	Time Stamp
Message Type	8	1	"H"	Stock Trading Action Message
Stock	9	6	Alphanumeric	Stock Symbol
Security Status	15	1	Alphanumeric	"T"= Active "H" = Halted "S"=Suspend
Reserved	16	1	Alphanumeric	Reserved for future use

4.12 Calculated Value Message

Cboe calculated market values will be conveyed through this message. This message will be sent regularly for each symbol that has calculated market value available. The frequency of these updates will be determined in agreement with the Issuers.

CALCULATED VALUE MESSAGE				
NAME	OFFSET	LENGTH	VALUE	REMARKS
Time Stamp	0	8	Numeric	Time Stamp
Message Type	8	1	"Y"	Calculated Value Message
Symbol	9	6	Alphanumeric	Symbol of the Calculated Value

Value Category	15	1	Alphanumeric	Category of the data conveyed in the "Value" field 1 – Closing Price 2 – iNAV values (ETF) 3 – Index values 4 – FX values 5 – EOD NAV from Issuer
Value	16	10	Price	Calculated Value
Value Generation Time	26	17	LocalTimestamp	Indicates when the Calculated Value is generated

LONG FORM CALCULATED VALUE MESSAGE				
NAME	OFFSET	LENGTH	VALUE	REMARKS
Time Stamp	0	8	Numeric	Time Stamp
Message Type	8	1	"y"	Long Form Calculated Value Message
Symbol	9	6	Alphanumeric	Symbol of the Calculated Value
Value Category	15	1	Alphanumeric	Category of the data conveyed in the "Value" field 1 – Closing Price 2 – iNAV values (ETF) 3 – Index values 4 – FX values 5 – EOD NAV from Issuer
Value	16	19	Price	Calculated Value
Value Generation Time	35	17	LocalTimestamp	Indicates when the Calculated Value is generated

5 Sample Data

5.1 Packet Message

5.1.1 Single message within packet

MESSAGE TYPE	CHIXMMD FEED MESSAGE
Trade Message	00 00 03 2f 00 01 00 3b 35 33 32 36 38 36 37 35 .../...;53268675 50 20 20 20 20 20 20 20 20 20 30 42 20 20 20 34 30 P 0B 40 30 56 4f 44 2e 4c 20 20 20 31 30 30 30 30 30 30 0VOD.L 1000000 30 31 36 30 30 30 30 30 30 35 20 20 20 20 20 20 0160000005 20 20 30 0

FIELD	HEX	MEANING
Sequence Number	00 00 03 2f	Decimal Value = 815
Message Count	00 01	Decimal Value = 1
Message Length	00 3b	Decimal Value = 59
Message	35 33 32 36 38 36 37 35 50 20 20 20 20 20 20 20 20 30 42 20 20 20 34 30 30 56 4f 44 2e 4c 20 20 20 31 30 30 30 30 30 30 30 31 36 30 30 30 30 30 30 35 20 20 20 20 20 20 20 20 30	ASCII String 53268675 P 0B 400VOD.L 10000000160000005 0

5.1.2 Multiple message within packet

MESSAGE TYPE	CHIXMMD FEED MESSAGE
Add Order, Order Execution and Order Cancel Message in one packet	00 00 03 1c 00 03 00 2a 35 33 30 36 31 34 33 35 *53061435 41 20 20 20 20 20 20 20 20 20 34 42 20 20 20 35 30 A 4B 50 30 56 4f 44 2e 4c 20 20 20 31 30 30 30 30 30 30 0VOD.L 1000000 30 59 00 2a 35 33 30 36 36 34 36 37 45 20 20 20 0Y.*53066467E 20 20 20 20 20 34 20 20 20 34 30 30 31 36 30 30 4 4001600 30 30 30 30 31 20 20 20 20 20 20 20 20 35 00 18 000001 5.. 35 33 30 36 38 34 35 32 58 20 20 20 20 20 20 20 53068452X 20 34 20 20 20 31 30 30 4 100

FIELD	HEX	MEANING
Sequence Number	00 00 03 1c	Decimal Value = 796
Message Count	00 03	Decimal Value = 3
Message Length	00 2a	Decimal Value = 42
Message	35 33 30 36 31 34 33 35 41 20 20 20 20 20 20 20 20 34 42 20 20 20 35 30 30 56 4f 44 2e 4c 20 20 20 31 30 30 30 30 30 30 30 59	ASCII String 53061435 A 4B 500VOD.L 10000000Y
Message Length	00 2a	Decimal Value = 42
Message	35 33 30 36 36 34 36 37 45 20 20 20 20 20 20 20 20 34 20 20 20 34 30 30 31 36 30 30 30 30 30 30 31 20 20 20 20 20 20 20 20 35	ASCII String 53066467E 4 400160000001 5
Message Length	00 18	Decimal Value = 24
Message	35 33 30 36 38 34 35 32 58 20 20 20 20 20 20 20 20 34 20 20 20 31 30 30	53068452X 4 100

5.1.3 Heartbeat message

MESSAGE TYPE	CHIXMMD FEED MESSAGE
Heartbeat Message	00 00 03 16 00 00 32 30 31 30 30 39 30 33 30 30 2010090300

FIELD	HEX	MEANING
Sequence Number	00 00 03 16	Decimal Value = 790
Message Count	00 00	Always zero
Session ID	32 30 31 30 30 39 30 33 30 30	ASCII String 2010090300

5.2 Market Data Message

5.2.1 Order Added and Fully Traded

ACTION	[CATEGORY]MD FEED MESSAGE
Sell of 100 RIM shares entered at 85.89. Order Reference 638 assigned.	38743037A 638S 100RIM 858900YC
Matching buy order entered and order traded with Reference "355".	38754246E 638 100 355 640C

Note: There is no Add Order Message for the matching buy order since it does not display on the book. Buyer needs to conjecture the execution price based on the limit of the original order since the Order Execution Message has no price indicated.

5.2.2 Order Added, Fully Traded and Remaining Quantity of Matching Order is Placed on Book

ACTION	[CATEGORY]MD FEED MESSAGE
Buy order of 111 RIM shares entered at 85.89. Order Reference "2" assigned.	46143332A 2B 111RIM 858900YC
Matching sell order entered for 112 shares of RIM. Order Execution Message is sent out with Order Reference "2" and Trade Reference "1".	46300560E 2 111 1 4C
Add the remaining share (1) of the sell order onto the book.	46300713A 4S 1RIM 858900YC

5.2.3 Price Revision

ACTION	[CATEGORY]MD FEED MESSAGE
Sell order of 1000 RIM shares entered. Order Reference "670" assigned. The display price is 85.88.	39465381A 670S 1000RIM 858800YC
Price is revised to 85.89. An Order Cancel Message is sent out.	39476527X 670 1000
An Add Order Message is sent after the Order Cancel Message. The Order Reference is the same. The display price changes to 85.89.	39476527A 670S 1000RIM 858900YC

5.2.4 Reduction of Order Quantity

ACTION	[CATEGORY]MD FEED MESSAGE
Sell order of 1000 RIM shares entered. Order Reference "671" assigned. The display price is 85.88.	39476527A 671S 1000RIM 858800YC
The order quantity is cut down by 100 shares. An Order Cancel Message is sent informing client about the change.	39483706X 671 100

Note: Client should calculate the remaining amount of the original order which is still open since Cboe currently does not support increase of total order quantity.

5.2.5 Order Revised and Executed

ACTION	[CATEGORY]MD FEED MESSAGE
A visible sell order of 1666 RIM shares is placed on the book with the display price of 85.89.	38821658A 642S 1666RIM 858900YC
A visible buy order of 1066 RIM shares is placed on the book with the display price of 85.88.	38841745A 644B 1066RIM 858800YC
The buy order is revised to the display price of 85.89. An Order Cancel Message is sent out.	38852664X 644 1066
The trade is executed. An Order Execution Message is sent out.	38852664E 642 1066 356 644C

5.2.6 Execution of Fully Hidden Order

ACTION	[CATEGORY]MD FEED MESSAGE
A hidden sell order of 777 RIM shares is placed on the book with the display price of 85.89.	[No message sent for hidden order.]
A visible buy order of 1000 shares is entered at 85.89. A Trade Message is sent out corresponding to the hidden order quantity. MIC Venue is Near Point	39067957P 0B 777RIM 858900 0NN
The remaining quantity of the buy order is added to the book.	39067957A 651B 223RIM 858900YC

5.2.7 Trades On Partially Hidden Order (Iceberg)

ACTION	[CATEGORY]MD FEED MESSAGE
A sell order of 10000 RIM shares is placed on the book with a visible quantity of 1000 shares. The display price is 85.89. An Add Order Message is sent out for the visible amount.	40792757A 2454S 1000RIM 858900YC
A buy order of 500 shares is entered and crosses against the visible quantity of 1000 shares. 500 shares remain on the book.	40812453E 2454 500 1953 2455C
A buy order for 4000 shares is entered and crosses against the iceberg. An Order Execution Message for the visible trade of 500 shares is sent out.	40825082E 2454 500 1954 2456C
A Trade Message is sent out for the hidden quantity of 3500 shares.	40825082P 0B 3500RIM 858900 1954 0NC
The peak is refreshed onto the book. An Add Order Message is sent out for 1000 shares.	40825082A 2457S 1000RIM 858900YC

5.2.8 Trade Cancellation (Bust)

ACTION	[CATEGORY]MD FEED MESSAGE
A sell order of 111 RIM shares is placed on the book. The display price is 85.89. An Add Order Message is sent out for the visible amount.	42119703A 4716S 111RIM 858900YC
An Order Execution Message is sent out on receiving a matching order. The Trade Reference is "4152".	42124752E 4716 111 4152 4717C
When the trade is cancelled by Cboe operators, a Broken Trade Message is sent out for both sides of the trade.	42204572B 4152 42204574B 4152

5.2.9 Long Form Messages (Execution of Visible Order)

ACTION	[CATEGORY]MD FEED MESSAGE
A buy order of 1,000,000 RBS1 shares entered at 80,000,000p. Order Reference "109" is assigned.	36417412a 109B 1000000RBS1 8000000000YC
An Order Execution Message is sent out on receiving a matching order. The Trade Reference is "28".	36447020e 109 1000000 28 110C

5.2.10 Long Form Messages (Execution On Hidden Order)

ACTION	[CATEGORY]MD FEED MESSAGE
Trade Message is sent out on receiving an execution on the hidden quantity. MIC Venue is Near Point	36447020p 0B 200000RBS1 8000000000 ONN

5.2.11 Long Form Messages (Cancellation of Visible Order)

ACTION	[CATEGORY]MD FEED MESSAGE
A buy order of 1,000,000 RBS1 shares entered at 80,000,000p. Order Reference "111" is assigned.	36417412a 111B 1000000RBS1 8000000000YC
The order is cancelled by Cboe and an Order Cancel Message is sent out.	36453536x 111 1000000

5.2.12 Undisclosed Order Added, Partially Traded, and then Fully Traded

ACTION	MD FEED MESSAGE
An undisclosed buy order of 10,000 XXX shares entered at 10.00. 0 share is displayed in the Add Order Message. Order Reference 8 assigned.	59709741A 8B 0XXX 100000YC
A visible sell order of 5000 XXX shares is entered at 10.00. A Trade Message is sent out for the traded quantity of 5000 shares.	59733491P 0B 5000XXX 100000140000005 0NC
Another visible sell order of 5000 XXX shares is entered at 10.00. A Trade Message is sent out for the traded quantity of 5000 shares.	59754241P 0B 5000XXX 100000140000006 0NC
The undisclosed order is then cancelled by Cboe and an Order Cancel Message with 0 shares is sent out	59754241X 8 0

5.2.13 Execution of Market On Close Order

ACTION	MD FEED MESSAGE
A Trade Message is sent out for MOC trade with quantity of 3500 shares and price of 85.89.	40825082P 0B 3500XXX 858900 1954 0NM

5.2.14 Long Form Messages (Execution of Market On Close Order)

ACTION	MD FEED MESSAGE
Trade Message is sent out for MOC trade with quantity of 200,000 and price of 800.	36447020p 0B 200000YYYY 8000000000 29 0NM

5.2.15 Execution of Broker Preferred Order

ACTION	MD FEED MESSAGE
A broker preferred sell order (hidden) of 1000 shares in XXX is placed on the book with a price of 85.89.	[No message sent for hidden order.]
A broker preferred buy order (hidden) of 3500 shares is entered at 85.89. A Trade Message is sent out for broker preferred trade with quantity of 1000 shares and price of 85.89. MIC Venue is Far Point	40825082P 0B 1000XXX 858900 1954 0BF
The remaining quantity of the buy order is added to the book.	[No message sent for hidden order.]

5.2.16 Long Form Messages (Execution of Broker Preferred Order)

ACTION	MD FEED MESSAGE
Trade Message is sent out for broker preferred trade with quantity of 200,000 and price of 800. MIC Venue is Far Point	36447020p 0B 200000YYYY 8000000000 29 0BF