CBOE Application Programming Interface

Version 1.1.1.3

CBOE Streaming Market (CSM)

Programmer's Guide to Messages and Data Types for Streaming Current Market

CBOE PROPRIETARY INFORMATION

June 3, 2011

Front Matter

Disclaimer

Change Notices

The following change notices are provided to assist users of the CBOE Streaming Current Market features in determining the impact of changes to their applications.

Date	Version	Description of Change
6/03/11	1.1.1.3	New section: 1.4 CBSX Move
		Port information for CBSX in NJ
2/08/11	1.1.1.2	Addition of the TargetLocationID to the security definition message, pages 13 and 14.
		Updates to the Appendix A – CSM Feed Descriptions
		Normalized Security Trading States
		Normalized Trade Conditions
1/11/11	1.1.1.1	Additional product state definitions.
1/6/11	1.1.1	Text cleanup regarding streaming market and ticker data. Fixed put/call values. Modified trade condition text.
12/16/10	1.1	Text cleanup
12/6/10	1.0	Initial publication
12/6/10	0.3	Text cleanup, addition of multicast group information
11/17/10	0.2	Text cleanup
9/27/10	0.1	New document

Support and Questions Regarding This Document

Questions regarding this document can be directed to The Chicago Board Options Exchange at 312.786.7300 or via e-mail: api@cboe.com. The latest version of this document can be found at the CBOE web site http://systems.cboe.com.

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1. Introduction

CBOE Streaming Market feed will publish market quotes, orders and trades data feed over the CBOE Financial Network (CFN) using the message format defined in this document. Multicast is the network protocol used for this effort. To connect to the CFN network, refer to the CFN Network Specification document on the CBOE API website at https://systems.cboe.com/Auth/CFN.aspx.

1.1 System Overview

CBOE Streaming Market feed will distribute market data using a primary/secondary architecture with security classes spread over one or more multicast groups. The communication will be one way only with no mechanism for retransmission on demand. Messages will be encoded using the format defined in this document. CBOE will distribute the templates, over the API website at https://systems.cboe.com/Auth/CFN.aspx, to be used for encoding and decoding these messages. These templates will be static, and are not expected to change over the course of the trading day, or even over a software release. Clients can expect sufficient advance notice about any changes to these templates.

Outbound Data:
The data delivered to the firms will consist (minimally) of the following:

Current market (non-strategies and strategies)

- Quotes
- Best limit volume
- Best contingency volume if at, or better than, the best limit volume

Ticker (non-strategies and strategies)

- Trades.

Security definitions

In addition to the current market and ticker data, The CBOE Streaming Market feed will also supply a *security definition* feed. The security definition messages will be sent via a dedicated multicast group for each applicable exchange. The messages related to security definitions will be identifiable via a unique message id. The messages will identify the exchange's products by name and will also include the exchange's product ID. The CBOE Streaming Market feed will stream the current market and ticker data with the exchange's product id included and the recipients can use the security definitions to determine the specific product the update relates to. The CBOE Streaming Market feed currently supplies the security definitions by looping through all the products it knows about and pacing messages out to the multicast groups. Once it loops through all products the CBOE Streaming Market feed is aware of, it starts again at the top of its product list. Essentially, there is a continuous feed of paced security definition messages. The purpose of this is to allow for the recipient to attach to the CFN feed at any time and quickly get initialized with all the exchange's products it will receive data for.

Streaming Market and Ticker Data

The streaming market and ticker data will be delivered to the recipients via the CFN using multicast. The firms will be required to listen to multiple multicast groups to get the entire CBOE, CFE, CBSX, ONE, and CBOE2 product set. The following rules will apply to multicast group product assignment:

- Security definitions will be sent over one multicast group dedicated to each exchange. The data will be available for CBOE, CBSX, ONE Chicago, CBOE Futures, and CBOE2. This will be done so recipients can get data for only the exchange they are interested in.
- Current market and ticker data for non-strategies will be sent over a set of multicast groups dedicated to each exchange. The data will be available for CBOE, CBSX, ONE Chicago, CBOE Futures, and CBOE2. This will be done so recipients can get data for only the exchange they are interested in.
- Current market and ticker data for strategies will be sent over a set of multicast groups dedicated to each exchange. The data will be available for CBOE, ONE Chicago, CBOE Futures, and CBOE2. This will be done so recipients can get data for only the exchanges they are interested in.
- All products for a given product class will be delivered over the same multicast group intra-day. This means that all IBM series will show up on the same multicast group. Corporate actions (IBM1) will also show up on the same group. **Please note - Product class is not the same as underlying class. SPX and SPXW are different product classes and may be on different multicast groups.**
- Product-to-group mapping can change between days if the number of multicast groups changes.
- Refresh data for a product will be sent over the same multicast group the dynamic updates for the products are sent over.
- The number of multicast groups could change in the future depending on the amount of traffic that needs to be delivered. The change would happen if multicast groups are added or removed from the system's configuration.

Data Recovery:

The CBOE Streaming Market feed will publish refresh data for a product over the same multicast group that product's current market and ticker data was sent on.

Refreshes to the recipients will work in the following way:

- Refresh messages will be identified via a unique message type and template id.
- The configurable refresh interval will determine the duration of time between two consecutive refresh cycles. The new refresh cycle starts immediately after the previous one ends. Currently the refresh interval is set to approximately 2 min (120 sec).
- For each data feed the market refreshes are published continuously during the refresh interval. The rate of the publishing is determined by the number of products that need to be refreshed and the time between refresh cycles. The

refresh is required for product only if it has a valid market and this market have not been updated for longer than the refresh interval.

- For the refresh messages, there are two sequence numbers that need to be monitored. The *msgSeqNumber* sequence number in the standard header should be used to monitor for gaps in data. This value will not reset and will continue to be ascending as long as no other errors in the system have occurred. Additionally, there is an *ApplSeqNum* in the refresh message body. This sequence number should be monitored to determine when a refresh cycle begins.
- Every time a refresh starts, the message body *ApplSeqNum* sequence number associated with the refresh will begin again at 1 for any given multicast group. This will be a cue to the receiver that a new refresh cycle has just begun.
- For any given product no refresh message will be sent if the time elapsed since the last update is equal or less than the refresh interval. Therefore if the client has just begun listening to the market data feed, it needs to wait for 2 consecutive refresh cycle to make sure that it has a valid market for all products. By the end of second refresh cycle the new client should receive either a forced refresh or a regular update.

Outbound Data Format:

The outbound data format of the current market and ticker (Trades) data will be in a fixed byte proprietary record format. The data will consist of a mixture of ASCII and binary data. When possible, numeric data will be transmitted in binary form to keep the outbound messages as small as possible.

System Diagram

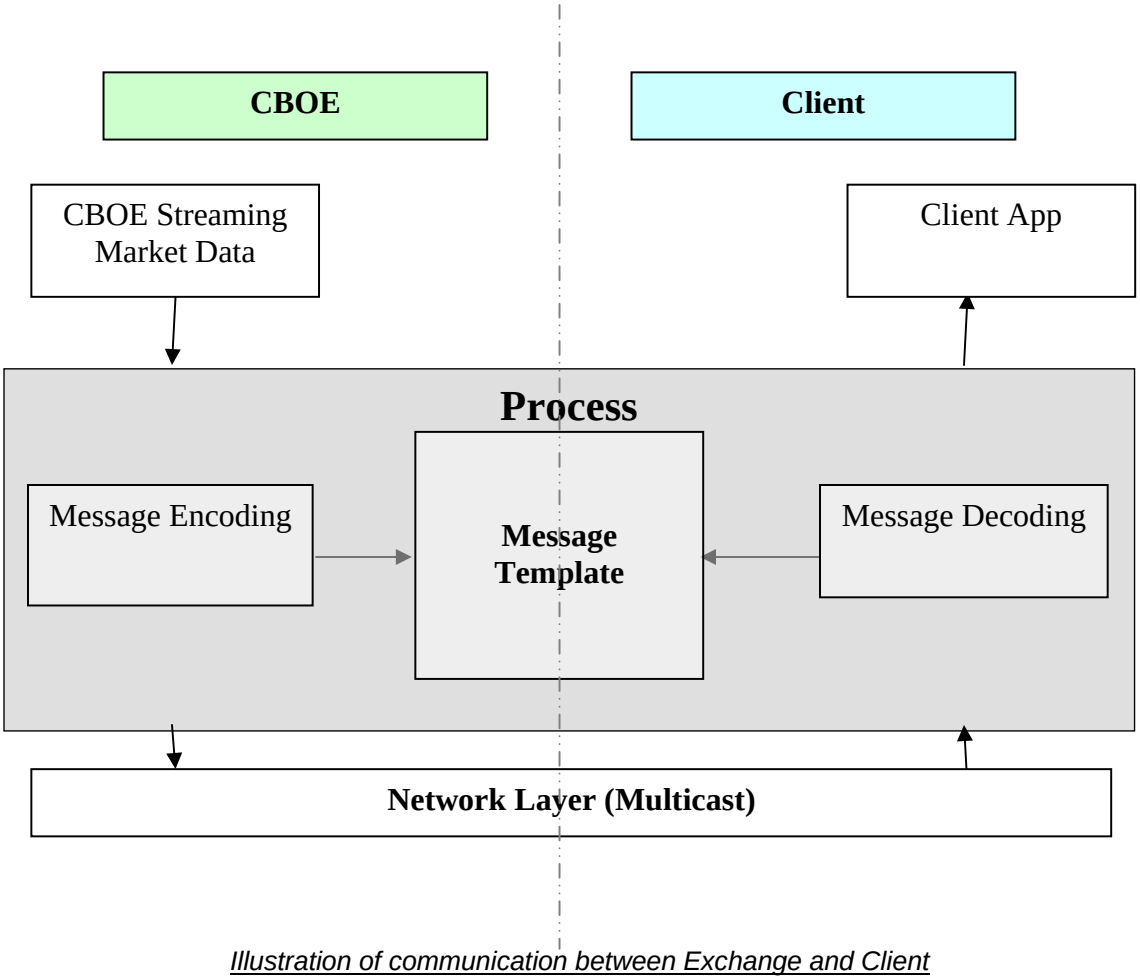

Illustration of communication between Exchange and Client

1.2 System Startup

The CBOE Streaming Current Market feed(s) will commence each day well before trading opens. A dedicated multicast channel will start publishing Security Definition Messages for products available on the channels. The Security Definition Message will continue to be published through out the day, in a cycle that will last approximately two minutes.

Current Market, Current Market Updates and Ticker messages are published on multiple multicast channels/groups that are different from Security Definitions multicast groups. These too will be published throughout the day.

1.3 System Availability

The system is expected to be available from 6:00 AM CST to 4:00 PM CST. The securities are expected to transition to Pre-open around 6:00 AM. Security Definition Messages, Current Market Messages and Current Market Update Messages will be published during these hours.

The markets open at following time:

Exchange	Product	Open	Close
CBOE	Interest Rate Options	7:20 AM CST	2:00 PM CST
CBOE	Equity Options	8:30 AM CST	3:00 PM CST
CBOE	Index Options	8:30 AM CST	3:15 PM CST
C2	Equity Options	8:30 AM CST	3:00 PM CST
C2	Index Options	8:30 AM CST	3:15 PM CST
CFE	Futures Options	7:20 AM CST	3:15 PM CST
CFE	Options on Futures	8:30 AM CST	3:15 PM CST
CBSX	Equity	7:30 AM CST	3:45 PM CST
OneChicago	Single Stock Futures	8:30 AM CST	3:05 PM CST
OneChicago	ETF Futures	8:30 AM CST	3:15 PM CST

1.4 CBSX Move

The primary data center for the CBSX exchange is currently in downtown Chicago. It will be moving to the Equinix NY4 data center in July, 2011. At that time the downtown Chicago data center will become the Disaster Recovery (DR) site for CBSX. New multicast groups, RPs and source networks have been added in this document for CBSX at NY4. The current multicast groups, RPs and source networks will continue to be used for CBSX DR after the move. Until the move is finished the new groups will only be available on scheduled weekends for testing. This document will be updated again after the move to reflect all the changes.

2. CBOE Streaming Current Market – Message Format

2.1 Message Packet

All data published from CBOE are sent in Multicast packets. One Multicast packet contains multiple messages.

One data packet is composed of multiple messages:

Message #1	Message #2	Message #3	…	Message #N

2.2 Message Format

The following is a message composed of multiple fields:

Field #1	Field #2	Field #3	Field #4	…	…	Field #N

The first four fields could be considered a message header.

2.2 Standard Message Header

The first field of a message is one byte of numeric Template ID referring to the message. The Template ID is defined in a template file and indicates which type of message it is, and which template is used to decode the message, value of the field and type of message is as following:

Template ID Value	**Type of Message in block**
101	Current Market Refresh (Full refresh/snapshot)
102	Current Market Update (Update)
103	Security Definition
104	Ticker (Trades)

Field #2 to #4 fields consist of: a single byte string Message Type ID, a Message Sequence Number and a Sending Time (the time that the CBOE application publishes this message on the multicast feed). The sending time is the millisecond timestamp from midnight, January 1, 1970 UTC. Below is description of those fields:

Field ID	**Field Name**	**Type**	**Length (Bytes)**	**Comments**
35	*MsgType*	Single Byte String	1	"d" = Security Definition "W" = Current Market Refresh "X" = Current Market Update or ticker

34	MsgSeqNumber	uInt32	4	Sequence Number
52	SendingTime	uInt64	8	Sending Time

2.3 Message Sequence Numbers

Every message disseminated over the Streaming Current Market feed will have a message sequence number. Sequence numbers are unique by multicast group. This is an integer increment over the message sequence number from the preceding message. Firms are expected to decode every message that they receive, and process the sequence numbers on these messages. Firms must ensure that the sequence numbers maintain continuity. Gaps as well as resets in sequence numbers are considered as error conditions. Clients are required to take appropriate recovery action anytime that a gap or reset is detected on the message sequence numbers that breaks the continuity of the message sequence numbers. In such cases, Current Markets for existing securities need to be processed before proceeding to process further Refresh messages.

2.4 Error Handling, Fail over and Recovery from Gap/Reset in Message Sequence Numbers

Gaps in message sequence numbers will be the result of a dropped packet (or packets) on the data feed. In a scenario, where a Gap or Reset is detected, all subsequent Refresh messages, across all product securities on that multicast feed are suspect and should be marked as such till the recovery process for each product has been completed.

Resets in sequence numbers will be the result of a Streaming Current Market process failure. In such a case, the market data feed on the primary process is disabled, and the backup process takes over. This will result in a complete reset of the sequence numbers, and firms will need to update the sequence numbers on their end to take account of this change.

In either case of a gap or reset, firms will need to initiate a recovery process for each security on that feed. The Security Definitions for a security are not expected to change and firms can ignore these when initiating a recovery.

3. Messages

3.1 Security Definition Message

The MDSecurityDefinition message is published on a dedicated multicast group/channel.

Security definitions are delivered as they are published from the exchange. Information about the total number of products for a particular class will not be disseminated. Clients are expected to build the complete product set by aggregating across all messages for that class.

The MDSecurityDefinition messages for each class will be transmitted approximately every two minutes – clients will have the opportunity to synchronize the product set at such times and ensure that they have the complete set. This should take care of the needs of the late joiners, who may have missed certain messages. It is also possible that clients may drop transmitted packets and miss certain MDSecurityDefinition messages. Dropped packets in general are indicated by missing sequence numbers – and clients can re-synchronize every two minutes to recover from such situations.

Information about new products that are added to classes during the course of the trading day will be disseminated via MDSecurityDefinition messages. For this reason, it is important that the firms should process the all MDSecurityDefinition that they receive.

For each exchange, strategies and non-strategies will be disseminated over different multicast groups. The corresponding security definitions will be included in each multicast group.

For strategies, the leg security definitions will be included on the same multicast group as the security definition of the strategy.

The Security Definition message fields are as follows:

Field ID	Field Name	Type	Length (Bytes)	Comments
	Standard Header			See Header With MessageType = “d”
167	SecurityType	String		possible values are OPT = Options FUT = Futures CS = Common Stock INDX = Indexes MLEG = Strategies
207	SecurityExchange	Single	1	Following possible value

Field ID	Field Name	Type	Length (Bytes)	Comments
		Byte String		C = CBOE O = One Chicago W = CBSX F = CFE/COF 2 = CBOE2 Options
55	Symbol	String		Symbol of the class
143	TargetLocationID	String		TargetLocationID – A numerical index that indicates over which multi-cast group the market data for a given security will be delivered. The relationship between the TargetLocationID and the actual multicast group IP can be found in Appendix A. The TargetLocationID is unique within a CSM feed (CBOE Non Strategy, CBOE Strategy, CBSX Non Strategy, etc.)
48	SecurityID	uInt32	4	class/product
541	MaturityDate	uInt64	8	Expiring like options. Format is "YYYYMMDD" This field is required for options and futures
202	StrikePrice	Decimal	5	First byte represents the exponent and the rest 4 bytes represent the mantissa This field is required for options
201	PutOrCall	uInt32	1	0 = Put 1 = Call This field is required for options
	Legs	Sequence Field of legs		A sequence Field contains one or more legs information, See below.

The Legs sequence field has following sub fields (For detailed format information, refer to the Fields Data Types section in this document):

Field ID	Field Name	Type	Length (Bytes)	Comments
555	NoLegs	Length (unsigned integer)	1	Num. of Legs in a strategy product. Only used for products that contain legs such as strategies. The assumption is the length of the sequence will not be more than 256
Following Fields Repeats NoLegs times for MLEG – Strategies				
623	LegRatioQty	uInt32	4	Leg ratio
602	LegSecurityID	uInt32	4	SecurityID of the leg
624	LegSide	String		Leg Side “B” = buy “S” = sell

Template: CBOE MDSecurityDefinition

The corresponding message template for the CBOE MDSecurityDefinition is as following:

```
<template name="MDSecurityDefinition" id="103">
      <string name="MessageType" id="35" byteLength="1" value="d" />
      <uInt32 name="MsgSeqNum" id="34" byteLength="4"/>
      <uInt64 name="SendingTime" id="52" byteLength="8" />
      <string name="SecurityType" id="167"/>
      <string name="SecurityExchange" id="207" byteLength="1"/>
      <string name="Symbol" id="55"/>
      <string name="TargetLocationID" id="143" />
      <uInt32 name="SecurityID" id="48"/>
      <uInt64 name="MaturityDate" id="541" byteLength="8"/>
      <decimal name="StrikePrice" id="202" byteLength="5"/>
      <uInt32 name="PutOrCall" id="201"  byteLength="1"/>
      <sequence name="Legs">
            <length name="NoLegs" id="555" />
            <uInt32 name="LegRatioQty" id="623"/>
            <uInt32 name="LegSecurityID" id="602"/>
            <string name="LegSide" id="624" byteLength="1"/>
       </sequence>
</template>
```

3.2 Current Market Refresh Message

Each Current Market Refresh message is a full refresh/snapshot message, that contains current market information for only one security along with the quantities and volume types for that particular security. Current Market Refresh messages will be published at the system start time. Current Market Refresh messages contain a refresh sequence number (ApplSeqNum) that will be set per line and reset to 1 (one) when refresh is completed. The *ApplSeqNumber* sequence number is different than the *msgSeqNumber* sequence number in the standard header. The *ApplSeqNumber* is used to identify the current location in a refresh cycle. This sequence number will reset to 1 when a refresh cycle begins.

The Current Market message fields are as follows:

Field ID	**Field Name**	**Type**	**Length (Bytes)**	**Comments**
	Standard Header			See Message Header With MessageType = "W"
48	SecurityID	uInt32	4	class/product ID
326	SecurityTradingStatus	uInt32	1	Trading status of the security 2 = Market Halted 17 = Market Open 18 = Market Closed 22 = Market in Opening Rotation 23 = Fast Market 24 = Strategy Market in Opening Rotation 25 = Strategy Market Quotes Non-Firm 26 = Market Suspended (Quotes are not firm) Everything else is invalid.
1181	ApplSeqNum	UInt32	4	Sequence number for snapshot message, will be set per line and reset to 1 (one) when refresh is completed
	MDEntries	Sequence Field		

The `MDEntries` sequence field has the following sub fields (For detailed sequence field format information, refer to the Fields Data Types section in this document):

Field ID	Field Name	Type	Length (Bytes)	Comments
268	NoMDEntries	Length (unsigned integer)	1	Num. of market data in this message. The assumption is the length of the sequence will not be more than 255
Following Fields Repeats NoMDEntries times				
269	MDEntryType	String	1	Quote Type: 0 = Bid 1 = Ask
270	MDEntryPx	Decimal	5	Quote Price: First byte represents the exponent and the rest 4 bytes represent the mantissa
271	MDEntrySize	Uint32	4	Quote Quantity
21001	MDVolumeType	Uint32	1	Volume Type: 0 = Total Limit 1 = Customer Limit 2 = All or None

Template: Current Market Message

The proposed Template for a Current Market is as shown:

```
<template name="CurrentMarket" id="101">
      <string name="MessageType" id="35" byteLength="1" value="W" />
      <uInt32 name="MsgSeqNum" id="34" byteLength="4"/>
      <uInt64 name="SendingTime" id="52" byteLength="8" />
      <uInt32 name="SecurityId" id="48" byteLength="4"/>
      <uInt32 name="SecurityTradingStatus" id="326" byteLength="1"/>
      <uInt32 name="ApplSeqNum" id="1181" byteLength="4"/>
      <sequence name="MDEntries">
            <length  name="NoMDEntries" id="268" byteLength="1"/>
            <string name="MDEntryType" id="269" byteLength="1"/>
            <decimal name="MDEntryPx" id="270" byteLength="5"/>
            <uInt32  name="MDEntrySize" id="271" byteLength="4"/>
            <uInt32  name="MDVolumeType" id="21001" byteLength="1"/>
      </sequence>
</template>
```

3.3 Current Market Update Message

The Current Market Update message contains real-time market updates of a security. Its fields are as follows:

Field ID	Field Name	Type	Length (Bytes)	Comments
	Standard Header			See Message Header With MessageType = "X"
48	SecurityID	Uint32	4	class/product ID
326	SecurityTradingStatus	Uint32	1	Trading status of the security 2 = Market Halted 17 = Market Open 18 = Market Closed 22 = Market in Opening Rotation 23 = Fast Market 24 = Strategy Market in Opening Rotation 25 = Strategy Market Quotes Non-Firm 26 = Market Suspended (Quotes are not firm) Everything else is invalid.
	MDEntries	Sequence Field		See Below.

The `MDEntries` sequence field has following sub fields (For detailed sequence field format information, refer to the Fields Data Types section in this document):

Field ID	Field Name	Type	Length (Bytes)	Comments
268	NoMDEntries	Length (unsigned integer)	1	Num. of market data in this message. The assumption is the length of the sequence will not be more than 256
Following Fields Repeats NoMDEntries times				
269	MDEntryType	String	1	Quote Type: 0 = Bid 1 = Ask
270	MDEntryPx	decimal	5	Quote Price: First byte represents the exponent and the rest 4 bytes represent the mantissa
271	MDEntrySize	Uint32	4	Quote Quantity
21001	MDVolumeType	Uint32	1	Volume Type: 0 = Total Limit 1 = Customer Limit 2 = All or None

Template: Current Market Update Message

The proposed Template for a Current Market Update is as shown:

```
<template name="CurrentMarketUpdate" id="102">
      <string name="MessageType" id="35" byteLength="1" value="X" />
      <uInt32 name="MsgSeqNum" id="34" byteLength="4"/>
      <uInt64 name="SendingTime" id="52" byteLength="8" />
      <uInt32 name="SecurityId" id="48" byteLength="4"/>
      <uInt32 name="SecurityTradingStatus" id="326" byteLength="1"/>
      <sequence name="MDEntries">
            <length  name="NoMDEntries" id="268" byteLength="1"/>
            <string name="MDEntryType" id="269" byteLength="1"/>
            <decimal name="MDEntryPx" id="270" byteLength="5"/>
            <uInt32  name="MDEntrySize" id="271" byteLength="4"/>
            <uInt32  name="MDVolumeType" id="21001" byteLength="1"/>
      </sequence>
</template>
```

3.4 Ticker Message (trades)

Each Ticker message will contain trade information for only one security. The Ticker messages will be published from the system start time.

The Ticker message fields are as follows:

Field ID	Field Name	Type	Length (Bytes)	Comments
	Standard Header			See Message Header With MessageType = "X"
48	SecurityID	uInt32	4	class/product ID
	MDEntries	Sequence Field		See below

The `MDEntries` sequence field has following sub fields (For detailed sequence field format information, refer to the Fields Data Types section in this document):

Field ID	Field Name	Type	Length (Bytes)	Comments
268	NoMDEntries	Length (unsigned integer)	1	Num. of market data in this message. The assumption is the length of the sequence will not be more than 256
Following Fields Repeats NoMDEntries times				
269	MDEntryType	String	1	2 = Trade
270	MDEntryPx	decimal	5	Price: First byte represents the exponent and the rest 4 bytes represent the mantissa
271	MDEntrySize	uInt32	4	Size of trade
277	TradeCondition	string		Trade Condition: *See Trade Conditions below:*

Template: Ticker Message

The proposed Template for a Ticker message is as shown:

```
<template name="Ticker" id="104">
      <string name="MessageType" id="35" byteLength="1" value="X" />
      <uInt32 name="MsgSeqNum" id="34" byteLength="4"/>
      <uInt64 name="SendingTime" id="52" byteLength="8" />
      <uInt32 name="SecurityId" id="48" byteLength="4"/>
      <sequence name="MDEntries">
            <length  name="NoMDEntries" id="268" byteLength="1"/>
            <string name="MDEntryType" id="269" byteLength="1"/>
            <decimal name="MDEntryPx" id="270" byteLength="5"/>
            <uInt32  name="MDEntrySize" id="271" byteLength="4"/>
            <string  name="TradeCondition" id="277" />
      </sequence>
</template>
```

The following trade conditions will be used to populate the values of TradeCondition field (277):

Description	**Value**
CANCEL TRADE	= "CANC"
OUT OF SEQUENCE TRADE	= "OSEQ"
CANCEL LAST TRADE	= "CNCL"
LATE REPORTED TRADE	= "LATE"
CANCEL OPENING TRADE	= "CNCO"
OPENING TRADE	= "OPEN"
CANCEL ONLY TRADE	= "CNOL"
OPENING LATE TRADE	= "OPNL"
REOPENING TRADE	= "REOP"
COMPLEX ORDER TRADE	= "SPRD"
COMBO TRADE	= "CMBO"
SWEEP_PREFIX	= "SWEP"
AUCTION TRADE	= "AUCT"
BENCHMARK TRADE	= "BNMT"
BLOCK TRADE PREFIX	= "BLKT"
EXCHANGE FOR PHYSICAL TRADE	= "EXPH"
GWAP TRADE	= "GWAP"

The following trade conditions will be used to populate the values of TradeCondition field (277):

Value	Description
Blank (Regular Trade)	Indicates that the transaction was a regular sale and was made without stated conditions.
CANC	Transaction previously reported (other than as the last or opening report for the particular option contract) is now to be cancelled.
OSEQ	Transaction is being reported late and is out of sequence; i.e., later transactions have been reported for the particular option contract.
LATE	Transaction is being reported late, but is in the correct sequence; i.e., no later transactions have been reported for the particular option contract.
CNCO	Transaction was the first one (opening) reported this day for the particular option contract. Although later transactions have been reported, this transaction is now to be cancelled.
REOP	Transaction is a reopening of an option contract in which trading has been previously halted. Prefix appears solely for information; process as a regular transaction.
SPRD	Transaction represents a trade in two options in the same class (a buy and a sell in the same class). Prefix appears solely for information; process as a regular transaction.
CMBO	Transaction represents the buying of a call and the selling of a put for the same underlying stock or index. Prefix appears solely for information; process as a regular transaction.
SPIM	Transaction was the execution of an order which was “stopped” at a price that did not constitute a Trade-Through on another market at the time of the stop. Process like a normal transaction except don’t update “last”.
ISOI	Transaction was the execution of an order identified as an Intermarket Sweep Order. Process like normal transaction.
BNMT	Transaction reflects the execution of a “benchmark trade”. A “Benchmark Trade” is a trade resulting from the matching of “Benchmark Orders”. A “Benchmark Order” is an order for which the price is not based, directly or indirectly, on the quote price of the option at the time of the order’s execution and for which the material terms were not reasonably determinable at the time a commitment to trade the order was made. Process like a normal transaction except don’t update “last”.
BLKT	Block Trade
EXPH	Exchange Future for Physical (Futures Only)

4. Template and Field

4.1 Message Format Template

This format is an encoding/decoding algorithm which serializes data.
Templates define the content and characteristics of the data to be encoded or decoded.

The message template is a fundamental component of message exchange. Basic rule is both the sender (encoder) and the receiver (decoder) should use the same template. CBOE uses different XML based templates for different message types.

In general, a template is used to specify the structure, data types and field operators of a message type. Here is a simple example of a XML based template.

```
<template name="CurrentMarket" id = “101”>          → Start of new template
<string name="MessageType" id="35" byteLength="1" value="W" />
                                                    → Defines a String Data Type Field,
                                                    The id which represents the fix Tag is
                                                    not transferred on the wire.

<uInt32 name="MsgSeqNum" id=”34”>
</uInt32>
<sequence name="MDEntries">                         → Defines the start repeating group
<length name=" NoMDEntries” id =”268"/>             → Length of repeating group
<string name="Symbol" id=”55”>
</string>
<int32 name="Quantity” id=”53
</int32>
</sequence>                                         → End repeating group
</template>                                         → End template
```

4.2 Field Data Types

A field within a template will have one of the following Data Types indicating the required decoding action. All fields are mandatory.

4.2.1 STRING Field: used to represent ASCII binary encoding of a string. There are two types of encoding/decoding:

1. If byteLength attribute of a field is defined as "1", for example:
   <string name="MessageType" id="35" byteLength="1" value="X" />
   it is a single byte string, which is a ASCII character.

2. If no byteLength attribute is define for the field, for example:
   <string name="Symbol" id="55"/>
   The format of the field is the unsigned byte indicate the length of string, following by String text of Binary:

Length of String (1 byte)	String

4.2.2 INTEGER field: All integer fields are in big endian format. This format is only used for unsigned integer.

Unsigned Integer: used to represent unsigned integers using the 8-bit binary encoding. There are two types defined in Template:

1. uInt32: unsigned 32-bit integer. Also the "<length…/>" is an uInt32.
   If byteLength attribute is 1, for example:
   <uInt32 name="PutOrCall" id="201" byteLength="1"/>
   It is 8-bit unsigned integer.

2. uInt64: unsigned 64-bit integer.

The table below shows the min and max values for different integer data types.

Type	Min	Max
UInt32 with byteLength="1"	0	255
uInt32	0	4,294,967,295
uInt64	0	18,446,744,073,709,551,615

4.2.3 DECIMAL field: used to represent a floating point number as exponent and mantissa. The exponent is a signed integer used to express precision and the mantissa is a signed integer used to express the value. The numerical value is obtained by multiplying

the mantissa with the base-10 power of the exponent expressed as: number = mantissa * 10exp. The exponent and mantissa is decoded as a single, composite field. CBOE uses single composite decimal fields.

Apart from the above data types CBOE uses sequence to represent repeating groups.

4.2.4 SEQUENCE Field: Contains a group of fields with above data types in a particular order. Length field associate to a sequence is the first field, which determines the number of groups within a repeating group. The length field is encoded as an unsigned integer.

Sequence Field format is shown as:

Length field	SubField #1	SubField #2	…	SubField #N	SubField #1	SubField #2	…	SubField #N	…

5. How to Decode CBOE Streaming Current Market Messages

- CBOE Market data for options is sent as UDP Multicast datagram packets
- CBOE publishes Security definition; Full refresh and Incremental refresh messages CBOE uses different templates for different message types.
- A UDP multicast packet contains more than one message.
- First decode template id if present for the current message. If the template Id is not present, it is error condition.
- Load the appropriate template needed to decode the current message.
- Decode each field in the order as defined by the template.
- If there is a mismatch between the template and message, throw error and discard the message.

6. Appendix A – Port Information

CBOE Non Strategy Primary Groups

Group	Description	A or B	Port	RP	Source Networks
233.65.120.96/28	CBOE CSM Non Strategy Prod A Groups	A			
233.65.120.96	CBOE Market Data 0	A	64900	170.137.255.124	170.137.1.128/26
233.65.120.97	CBOE Market Data 1	A	64901	170.137.255.124	170.137.1.128/26
233.65.120.98	CBOE Market Data 2	A	64902	170.137.255.124	170.137.1.128/26
233.65.120.99	CBOE Market Data 3	A	64903	170.137.255.124	170.137.1.128/26
233.65.120.100	CBOE Market Data 4	A	64904	170.137.255.124	170.137.1.128/26
233.65.120.101	CBOE Market Data 5	A	64905	170.137.255.124	170.137.1.128/26
233.65.120.102	CBOE Market Data 6	A	64906	170.137.255.124	170.137.1.128/26
233.65.120.103	CBOE Market Data 7	A	64907	170.137.255.124	170.137.1.128/26
233.65.120.104	CBOE Market Data 8	A	64908	170.137.255.124	170.137.1.128/26
233.65.120.105	CBOE Market Data 9	A	64909	170.137.255.124	170.137.1.128/26
233.65.120.106	*Reserved for future use*	A	64910	170.137.255.124	170.137.1.128/26
233.65.120.107	*Reserved for future use*	A	64911	170.137.255.124	170.137.1.128/26
233.65.120.108	*Reserved for future use*	A	64912	170.137.255.124	170.137.1.128/26
233.65.120.109	*Reserved for future use*	A	64913	170.137.255.124	170.137.1.128/26
233.65.120.110	*Reserved for future use*	A	64914	170.137.255.124	170.137.1.128/26
233.65.120.111	CBOE Securities Definition	A	64916	170.137.255.124	170.137.1.128/26

CBOE Strategy Primary Groups

Group	Description	A or B	Port	RP	Source Networks
233.65.120.144/31	CBOE CSM Strategies Prod A Groups	A			
233.65.120.144	CBOE Strategies Market Data 0	A	64950	170.137.255.124	170.137.1.128/26
233.65.120.145	CBOE Strategies Securities Definition	A	64952	170.137.255.124	170.137.1.128/26

CBOE Non Strategy Backup Groups

Group	Description	A or B	Port	RP	Source Networks
233.65.120.112/28	CBOE CSM Non Strategy Prod B Groups	B			
233.65.120.112	CBOE Market Data 0	B	64932	170.137.255.125	170.137.9.128/26
233.65.120.113	CBOE Market Data 1	B	64933	170.137.255.125	170.137.9.128/26
233.65.120.114	CBOE Market Data 2	B	64934	170.137.255.125	170.137.9.128/26
233.65.120.115	CBOE Market Data 3	B	64935	170.137.255.125	170.137.9.128/26
233.65.120.116	CBOE Market Data 4	B	64936	170.137.255.125	170.137.9.128/26
233.65.120.117	CBOE Market Data 5	B	64937	170.137.255.125	170.137.9.128/26
233.65.120.118	CBOE Market Data 6	B	64938	170.137.255.125	170.137.9.128/26
233.65.120.119	CBOE Market Data 7	B	64939	170.137.255.125	170.137.9.128/26
233.65.120.120	CBOE Market Data 8	B	64940	170.137.255.125	170.137.9.128/26
233.65.120.121	CBOE Market Data 9	B	64941	170.137.255.125	170.137.9.128/26
233.65.120.122	*Reserved for future use*	B	64942	170.137.255.125	170.137.9.128/26
233.65.120.123	*Reserved for future use*	B	64943	170.137.255.125	170.137.9.128/26
233.65.120.124	*Reserved for future use*	B	64944	170.137.255.125	170.137.9.128/26
233.65.120.125	*Reserved for future use*	B	64945	170.137.255.125	170.137.9.128/26
233.65.120.126	*Reserved for future use*	B	64946	170.137.255.125	170.137.9.128/26
233.65.120.127	CBOE Securities Definition	B	64948	170.137.255.125	170.137.9.128/26

CBOE Strategy Backup Groups

233.65.120.146/31	CBOE CSM Strategies Prod B Groups	B			
233.65.120.146	CBOE Strategies Market Data 0	B	64954	170.137.255.125	170.137.9.128/26
233.65.120.147	CBOE Strategies Securities Definition	B	64956	170.137.255.125	170.137.9.128/26

C2 Non Strategy Primary Groups

Group	Description	A or B	Port	RP	Source Networks
233.103.126.16/28	C2 CSM Non Strategy Prod A Groups	A			
233.103.126.16	C2 Market Data 0	A	64900	170.137.128.253	170.137.128.0/26
233.103.126.17	C2 Market Data 1	A	64901	170.137.128.253	170.137.128.0/26
233.103.126.18	C2 Market Data 2	A	64902	170.137.128.253	170.137.128.0/26
233.103.126.19	C2 Market Data 3	A	64903	170.137.128.253	170.137.128.0/26
233.103.126.20	C2 Market Data 4	A	64904	170.137.128.253	170.137.128.0/26
233.103.126.21	C2 Market Data 5	A	64905	170.137.128.253	170.137.128.0/26
233.103.126.22	C2 Market Data 6	A	64906	170.137.128.253	170.137.128.0/26
233.103.126.23	C2 Market Data 7	A	64907	170.137.128.253	170.137.128.0/26
233.103.126.24	C2 Market Data 8	A	64908	170.137.128.253	170.137.128.0/26
233.103.126.25	C2 Market Data 9	A	64909	170.137.128.253	170.137.128.0/26
233.103.126.26	*Reserved for future use*	A	64910	170.137.128.253	170.137.128.0/26
233.103.126.27	*Reserved for future use*	A	64911	170.137.128.253	170.137.128.0/26
233.103.126.28	*Reserved for future use*	A	64912	170.137.128.253	170.137.128.0/26
233.103.126.29	*Reserved for future use*	A	64913	170.137.128.253	170.137.128.0/26
233.103.126.30	*Reserved for future use*	A	64914	170.137.128.253	170.137.128.0/26
233.103.126.31	C2 Securities Definition	A	64916	170.137.128.253	170.137.128.0/26

C2 Strategy Primary Groups

Group	Description	A or B	Port	RP	Source Networks
233.103.126.32/31	C2 CSM Strategies Prod A Groups	A			
233.103.126.32	C2 Strategies Market Data 0	A	64950	170.137.128.253	170.137.128.0/26
233.103.126.33	C2 Strategies Securities Definition	A	64952	170.137.128.253	170.137.128.0/26

C2 Non Strategy Backup Groups

Group	Description	A or B	Port	RP	Source Networks
233.103.126.144/28	C2 CSM Non Strategy Prod B Groups	B			
233.103.126.144	C2 Market Data 0	B	64932	170.137.128.254	170.137.128.64/26
233.103.126.145	C2 Market Data 1	B	64933	170.137.128.254	170.137.128.64/26
233.103.126.146	C2 Market Data 2	B	64934	170.137.128.254	170.137.128.64/26
233.103.126.147	C2 Market Data 3	B	64935	170.137.128.254	170.137.128.64/26
233.103.126.148	C2 Market Data 4	B	64936	170.137.128.254	170.137.128.64/26
233.103.126.149	C2 Market Data 5	B	64937	170.137.128.254	170.137.128.64/26
233.103.126.150	C2 Market Data 6	B	64938	170.137.128.254	170.137.128.64/26
233.103.126.151	C2 Market Data 7	B	64939	170.137.128.254	170.137.128.64/26
233.103.126.152	C2 Market Data 8	B	64940	170.137.128.254	170.137.128.64/26
233.103.126.153	C2 Market Data 9	B	64941	170.137.128.254	170.137.128.64/26
233.103.126.154	*Reserved for future use*	B	64942	170.137.128.254	170.137.128.64/26
233.103.126.155	*Reserved for future use*	B	64943	170.137.128.254	170.137.128.64/26
233.103.126.156	*Reserved for future use*	B	64944	170.137.128.254	170.137.128.64/26
233.103.126.157	*Reserved for future use*	B	64945	170.137.128.254	170.137.128.64/26
233.103.126.158	*Reserved for future use*	B	64946	170.137.128.254	170.137.128.64/26
233.103.126.159	C2 Securities Definition	B	64948	170.137.128.254	170.137.128.64/26

C2 Strategy Backup Groups

Group	Description	A or B	Port	RP	Source Networks
233.103.126.160/31	C2 CSM Strategies Prod B Groups	B			
233.103.126.160	C2 Strategies Market Data 0	B	64954	170.137.128.254	170.137.128.64/26
233.103.126.161	C2 Strategies Securities Definition	B	64956	170.137.128.254	170.137.128.64/26

CBSX Primary Groups

Group	Description	A or B	Port	RP	Source Networks
233.65.120.140/31	CBSX Prod A Groups	A			
233.65.120.140	CBSX Market Data 0	A	64868	170.137.255.124	170.137.1.128/26
233.65.120.141	CBSX Securities Definition	A	64872	170.137.255.124	170.137.1.128/26

CBSX Backup Groups

Group	Description	A or B	Port	RP	Source Networks
233.65.120.142/31	CBSX Prod B Groups	B			
233.65.120.142	CBSX Market Data 0	B	64870	170.137.255.125	170.137.9.128/26
233.65.120.143	CBSX Securities Definition	B	64874	170.137.255.125	170.137.9.128/26

CBSX Primary Groups (Note: this is for when CBSX moves to NJ)

Group	Description	A or B	Port	RP	Source Networks
233.103.126.34/31	CBSX Prod A Groups	A			
233.103.126.34	CBSX Market Data 0	A	64868	170.137.128.253	170.137.128.0/26
233.103.126.35	CBSX Securities Definition	A	64872	170.137.128.253	170.137.128.0/26

CBSX Backup Groups (Note: this is for when CBSX moves to NJ)

Group	Description	A or B	Port	RP	Source Networks
233.103.126.162/31	CBSX Prod B Groups	B			
233.103.126.162	CBSX Market Data 0	B	64870	170.137.128.254	170.137.128.64/26
233.103.126.163	CBSX Securities Definition	B	64874	170.137.128.254	170.137.128.64/26

ONE Chicago Non Strategy Primary Groups

Group	Description	A or B	Port	RP	Source Networks
233.65.120.128/30	ONE Chicago Non Strategy Prod A Groups	A			
233.65.120.128	ONE Market Data 0	A	64848	170.137.255.124	170.137.1.128/26
233.65.120.129	ONE Market Data 1	A	64849	170.137.255.124	170.137.1.128/26
233.65.120.130	*Reserved for future use*	A	64850	170.137.255.124	170.137.1.128/26
233.65.120.131	ONE Securities Definition	A	64856	170.137.255.124	170.137.1.128/26

ONE Chicago Strategy Primary Groups

Group	Description	A or B	Port	RP	Source Networks
233.65.120.148/31	ONE Chicago Strategies Prod A Groups	A			
233.65.120.148	ONE Strategies Market Data 0	A	64958	170.137.255.124	170.137.1.128/26
233.65.120.149	ONE Strategies Securities Definition	A	64960	170.137.255.124	170.137.1.128/26

ONE Chicago Non Strategy Backup Groups

Group	Description	A or B	Port	RP	Source Networks
233.65.120.132/30	ONE Chicago Non Strategy Prod B Groups	B			
233.65.120.132	ONE Market Data 0	B	64852	170.137.255.125	170.137.9.128/26
233.65.120.133	ONE Market Data 1	B	64853	170.137.255.125	170.137.9.128/26
233.65.120.134	*Reserved for future use*	B	64854	170.137.255.125	170.137.9.128/26
233.65.120.135	ONE Securities Definition	B	64858	170.137.255.125	170.137.9.128/26

ONE Chicago Strategy Backup Groups

Group	Description	A or B	Port	RP	Source Networks
233.65.120.150/31	ONE Chicago Strategies Prod B Groups	B			
233.65.120.150	ONE Strategies Market Data 0	B	64962	170.137.255.125	170.137.9.128/26
233.65.120.151	ONE Strategies Securities Definition	B	64964	170.137.255.125	170.137.9.128/26

CBOE Futures Non Strategy Primary Groups

Group	Description	A or B	Port	RP	Source Networks
233.65.120.136/31	CBOE Futures Non Strategy Prod A Groups	A			
233.65.120.136	CFE Market Data 0	A	64860	170.137.255.124	170.137.1.128/26
233.65.120.137	CFE Securities Definition	A	64864	170.137.255.124	170.137.1.128/26

CBOE Futures Strategy Primary Groups

Group	Description	A or B	Port	RP	Source Networks
233.65.120.152/31	CBOE Futures Strategies Prod A Groups	A			
233.65.120.152	CFE Strategies Market Data 0	A	64966	170.137.255.124	170.137.1.128/26
233.65.120.153	CFE Strategies Securities Definition	A	64968	170.137.255.124	170.137.1.128/26

CBOE Futures Non Strategy Backup Groups

Group	Description	A or B	Port	RP	Source Networks
233.65.120.138/31	CBOE Futures Non Strategy Prod B Groups	B			
233.65.120.138	CFE Market Data 0	B	64862	170.137.255.125	170.137.9.128/26
233.65.120.139	CFE Securities Definition	B	64866	170.137.255.125	170.137.9.128/26

CBOE Futures Strategy Backup Groups

Group	Description	A or B	Port	RP	Source Networks
233.65.120.154/31	CFE Futures Strategies Prod B Groups	B			
233.65.120.154	CFE Strategies Market Data 0	B	64970	170.137.255.125	170.137.9.128/26
233.65.120.155	CFE Strategies Securities Definition	B	64972	170.137.255.125	170.137.9.128/26