



# **Cboe Japan Multicast Market Data Feed Specification (Binary)**

**Cboe Japan Trading System**

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## 1 Introduction

Cboe Japan Trading System (“CTS”) is a high performance, low latency trading system. The information processed by CTS is highly valuable to all the market players including participants, data vendors as well as investors. Therefore, a market data feed is one of the key services that is provided by CTS to disseminate such information.

This crucial market data service is referred as Cboe Japan Multicast Market Data Feed. Through this market data feed, clients are able to receive orders and trade information in a real time fashion.

Cboe Japan Multicast Market Data are available in ASCII/Binary versions. This document describes the Binary version. Technical aspect of this data feed including the connection protocol, message types and message structures etc., are described in this document.

The Binary version use binary representation for numbers such as order reference in Market Data Messages. This representation provides more compact messages than the ASCII version. More importantly, the time precision is up to nanoseconds while the ASCII version provides only up to milliseconds.

Customers using the ASCII version should refer to the document “Cboe Japan Multicast Market Data Feed Specification”.

This document is meant to share information on these Cboe Japan venues:

- Alpha (Cboe Alpha or Chi-Alpha as the full name)
- Select (Cboe Select or Chi-Select as the full name)

### 1.1 Relevant documents

ITEM	TITLE	VERSION	DATE
1	JPCX-L3-D-016 Cboe Japan Multicast Market Data Feed Specification.docx	1.1-15	13-Dec-2021
2	JPCX-L3-D-037 Cboe Japan Snapshot Recovery Service Specification (Binary).docx	1.0-04	13-Dec-2021

Figure 1: Relevant Document(s)

### 1.2 Revision History

ITEM	REVISION HIGHLIGHT	DOCUMENT REFERENCE	CHANGE BY
1	Update Connection Parameter (IP Address / Port) Add Rendezvous Point for Production and Simulation Environment	2.5	Sam (version 1.0-1)
2	Update Connection Parameter (IP Address / Port) for Stream C and MMRS Server 3 Removed System Event ‘N’ and ‘R’	2.5, 6.2.1	Sam (version 1.0-2)
3	Update Bandwidth Recommendation to 200Mbps	2.5	Stanley (version 1.0-3)
4	Update Network Configuration in Simulation	2.5	Newton (version 1.0-4)
5	Re-branding – logo and name reference change Text description updates		Stanley (version 1.0-5)

Figure 2: Revision History

## 2 Overview

The Cboe Japan Multicast Market Data (Binary) consists of three data services:

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

The real-time multicast market data feed delivers market data in UDP multicast packet stream over the Cboe Japan Multicast Market Data (Binary) network. In our multicast market data network, we have multiple data streams published over the network for resilience purpose; thus carrying identical contents. By subscribing to these data streams, market data clients receive latest market data updates from the trading system.

The multicast message recovery service offers message recovery to market data clients. Clients can connect to designated MMRS-Bin server and request for past message retransmission. The recovery process is done over a TCP connection established by the request client to the MMRS-Bin server.

The snapshot recovery service offers snapshot recovery to market data clients. Clients can connect to designated SRS-Bin server and request for latest snapshot. The process is done over a TCP connection established by the request client to the SRS-Bin server.

The following diagram shows the overall delivery mechanism:

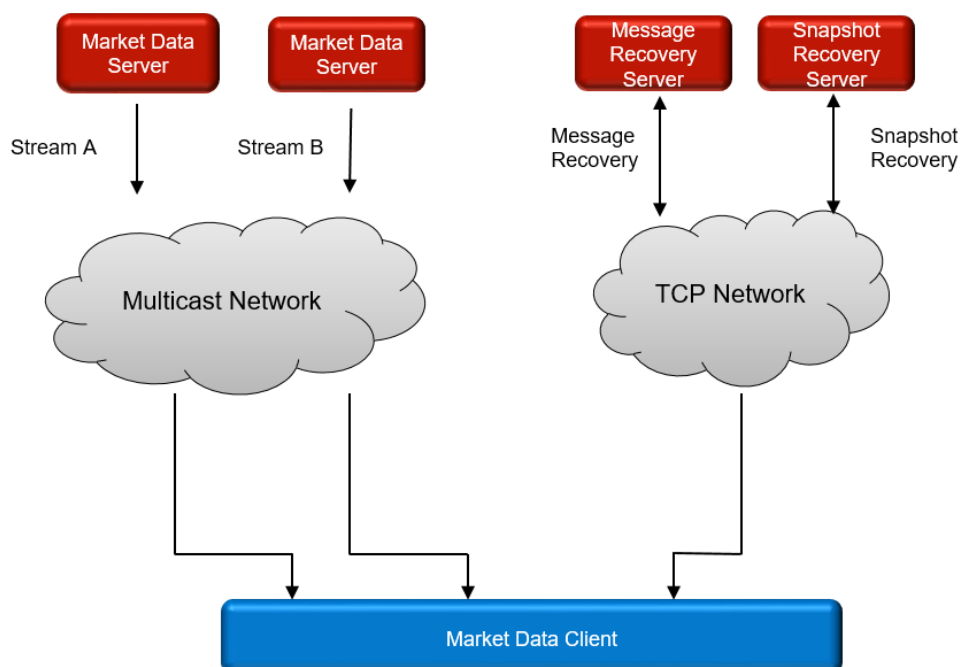


Figure 3: Cboe Japan Multicast Market Data (Binary) Delivery Mechanism

## 2.1 Real-Time Multicast Market Data Feed Service

The CHIXMMD-Bin feed delivers real-time market data in form of UDP packet streams. There are two streams published from the primary site for Production environment. They are published in different multicast addresses. Refer to section 'Network Configuration Parameters' for address details.

All data streams are identical in terms of market data content. They are identical at message level. However, the protocol allows packing of multiple messages into a UDP packet and different market data servers at different sites may apply 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 next message. Market data clients may use this sequence number to detect message gap and act on recovery accordingly.

There is regular heartbeat message published in each data stream to indicate line connection status. The heartbeat message itself does not increment message sequence number and does not carry market data update. It does carry the next expected sequence number so market data client can use it to detect missing of last data message. Normally heartbeat message is published in every second but may be skipped when a data stream is busy in high volume of message transmission. Market data clients need to be aware of this nature when determining their heartbeat monitoring scheme.

## 2.2 Multicast Message Recovery Service

Market data clients may use the service provided by MMRS-Bin Server to recover missing messages of the current trading day. This is done so by establishing a TCP connection to a designated MMRS-Bin server and following the protocols described in latter part of this specification to initiate the request. Client-side application would need to submit a Login Request together with the sequence number of the first missing message. After validation, the Recovery Server replays messages to the client starting from the requested message.

There is a time limit on a single recovery session. If the limit is reached, the server will terminate the connection. Market data client has to start a new session and continue from the last recovery point. Refer to section 'Network Configuration Parameter' for details on server address and recovery limit setting.

## 2.3 Snapshot Recovery Service

Market data clients may use the service provided by SRS-Bin Server for large-scale data recovery (e.g. Major outage or late joiners). This is done by establishing a TCP connection to a designated SRS-Bin server. Basically, the client application needs to submit a Login Request together with the mode = "0"/"1"/"2". After validation, the Snapshot Recovery Server replies the latest snapshot to the client.

The server will only reply the snapshot once for each connection. Just heartbeat message will be sent from the server once the snapshot is transferred. A client should send a Logout message to terminate the connection after received the complete snapshot or the server will disconnect the connection after a period

Please refer to Cboe Japan Snapshot Recovery Service Specification (Binary) for more detail

## 2.4 Operating Hours

The multicast feed will be operating from 05:00 to 18:00. During the operation hours, market data clients may expect to see market data update messages and regular heartbeat messages in the data streams.

## 2.5 Network Configuration Parameters

The following table summarizes network address & parameter configurations needed for accessing the multicast market data services.

### Network Address Summary

#### Production Environment

	Primary Data Centre (Alpha)	Primary Data Centre (Select)	Secondary Data Centre (Alpha)
<b>CHIXMMD-Bin Data Stream A</b>			
Multicast Group	233.249.234.14	233.249.234.24	-
Port Number	12111	12121	-
Rendezvous Point	110.50.74.21		-
<b>CHIXMMD-Bin Data Stream B</b>			
Multicast Group	233.249.234.15	233.249.234.25	-
Port Number	12211	12221	-
Rendezvous Point	110.50.74.22		-
<b>CHIXMMD-Bin Data Stream C</b>			
Multicast Group	-	-	233.249.234.16
Port Number	-	-	12311
Rendezvous Point	-		110.50.75.21
<b>MMRS-Bin Server 1</b>			
IP Address	110.50.74.26	110.50.74.35	-
Port Number	12112	12122	-
<b>MMRS-Bin Server 2</b>			
Multicast Group	110.50.74.27	110.50.74.36	-
Port Number	12212	12222	-
<b>MMRS-Bin Server 3</b>			
IP Address	-	-	110.50.75.66
Port Number	-	-	12312

Figure 4: Network Address Summary (Production Environment)

#### Simulation Environment

	Secondary Data Centre (Alpha)	Secondary Data Centre (Select)
<b>CHIXMMD-Bin Data Stream A</b>		
Multicast Group	233.249.234.147	233.249.234.157
Port Number	12401	12421
Rendezvous Point	110.50.75.21	
<b>CHIXMMD-Bin Data Stream B</b>		
Multicast Group	233.249.234.148	233.249.234.158

Port Number	12501	12521
Rendezvous Point	110.50.75.22	
<b>CHIXMMD-Bin Data Stream C</b>		
Multicast Group	233.249.234.119	-
Port Number	12601	-
Rendezvous Point	110.50.75.21	-
<b>MMRS-Bin Server 1</b>		
IP Address	110.50.75.153	110.50.75.155
Port Number	12402	12422
<b>MMRS-Bin Server 2</b>		
IP Address	110.50.75.157	110.50.75.159
Port Number	12502	12522
<b>MMRS-Bin Server 3</b>		
IP Address	110.50.75.40	-
Port Number	12602	-

**Figure 5: Network Address Summary (Simulation Environment)**

#### Bandwidth Recommendation

Market data clients are required to order line circuits with sufficient bandwidth to cater for market data volume published in our data streams. Below table provides guidelines on sizing the bandwidth calculation.

Note that all multicast data streams published in our data network carry identical content. For resilience purpose, market data clients are advised to subscribe to at least two data streams.

Market data client also need to make provision for message recovery service. Sufficient bandwidth should be arranged so that message recovery can be completed timely.

Multicast Data Stream <sup>1</sup> and Recovery	200Mbps
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**Figure 6: Minimum Bandwidth Recommendation**

#### CHIXMMD-Bin Parameters

Heartbeat message frequency	At least 1 in every 5 seconds
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**Figure 7: CHIXMMD-Bin Configuration Parameters**

#### MMRS-Bin Parameters

MMRS-Bin Server applies limit check in serving recovery request. If a request exceeds the preset 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	60 seconds
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<sup>1</sup> Bandwidth requirement of the multicast stream – the figure indicates the requirement for one multicast stream. If the client intended to subscribe to both streams from a single line, the figure should be doubled.



Figure 8: MMRS-Bin Configuration Parameters

### 3 Data Type

This section describes the available data types that are used in the Cboe Japan Multicast Market Data (Binary).

#### 3.1 Numeric

Numeric fields consist of digits which are ASCII coded. They are presented in right justification and are space-filled from the left.

#### 3.2 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.

#### 3.3 Prices

Price data fields are unsigned 8-byte big-endian binary encoded integer. After decoded, the last 7 digits are the decimal places and the remaining parts are digits. The maximum value of this type is 922,337,203,685.4775807 (0x7fffffffffffffff)

#### 3.4 Integer

Integer fields are unsigned big-endian (network byte order) binary encoded numbers. These fields are either 2 bytes, 4 bytes or 8 bytes. The maximum value of 2-byte integer is 32,767 (0x7fff), the maximum value of 4-byte integer is 2,147,483,647 (0x7fffffff), and the maximum value of 8-byte integer is 9,223,372,036,854,775,807 (0x7fffffffffffffff).

## 4 Real-Time Multicast Market Data Feed Protocol

The Real-time Multicast Market Data Feed protocol contains the definition of market data messages and the definition of the multicast packets. The market data messages describe the activities of the trading system. For example, order addition and trade execution are example activities in the trading system. Format of the market data messages are described in the next chapter.

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

### 4.1 Multicast Packet Layout

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

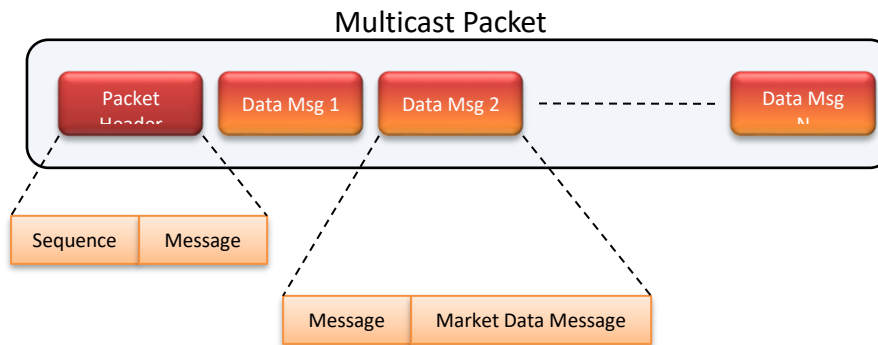


Figure 9: CHIXMMD-Bin Multicast Packet Layout

The following table describes the packet header layout.

PACKET HEADER				
NAME	OFFSET	LENGTH	VALUE	REMARKS
Sequence	0	4	Integer	Sequence number of the first message.
Message Count	4	2	Integer	Number of messages in the packet.

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	Integer	Length of the Market Data Message.
Market Data Message	Variable	Variable	Market Data Message	Content of the Market Data Message

## 4.2 Heartbeat Message

Heartbeat message is used in the multicast feed to indicate healthiness of the multicast feed. The message is delivered regularly by the Market Data Servers.

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

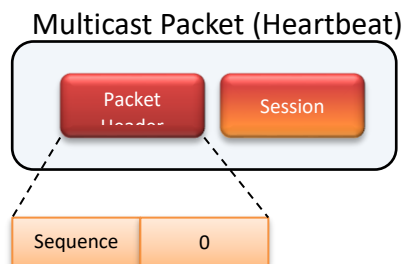


Figure 10: CHIXMMD-Bin Heartbeat Packet Layout

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

HEARTBEAT MESSAGE				
NAME	OFFSET	LENGTH	VALUE	REMARKS
Sequence	0	4	Integer	Sequence number of the next Market Data Message.
Message Count	4	2	Integer	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 this field to fill-in the Session field in the Login Request of the Recovery Service.

## 5 Multicast Message Recovery Protocol

### 5.1 Session

#### 5.1.1 Session Protocol

1. MMRS-Bin is built on a session layer on top of TCP/IP sockets. Sessions include sequenced and non-sequenced messages in which sequenced messages are the actual market data, while the non-sequenced messages are the session level interfaces that are not part of the market data feed.
2. Sequenced messages include buy and sell orders, order executions, order cancellation, etc.
3. Login, logout and heartbeat messages are the examples of non-sequenced messages.
4. Retrieving and recovering previous sequenced messages (actual market data feed) are possible.

#### 5.1.2 Session Initialisation

1. Session is initialised when client establishes a TCP session and sends a login packet.
2. When server received the login packet, it responds with a login accepted packet and starts transferring sequenced data, or it rejects the login and terminates the session (if appropriate).
3. If login packet is not received within 30 seconds, server will also terminate the session.

#### 5.1.3 Sequential Messaging

1. Each message is not literally assigned with a sequence number.
2. Since messages are transferred in sequence, the first message of a day can be considered assigned with the sequence number '1', and the succeeding sequenced messages are each assigned with the next sequence number. Hence, recovering a session is possible

#### 5.1.4 Recovery Scenario

The following diagram describes a typical recovery scenario:

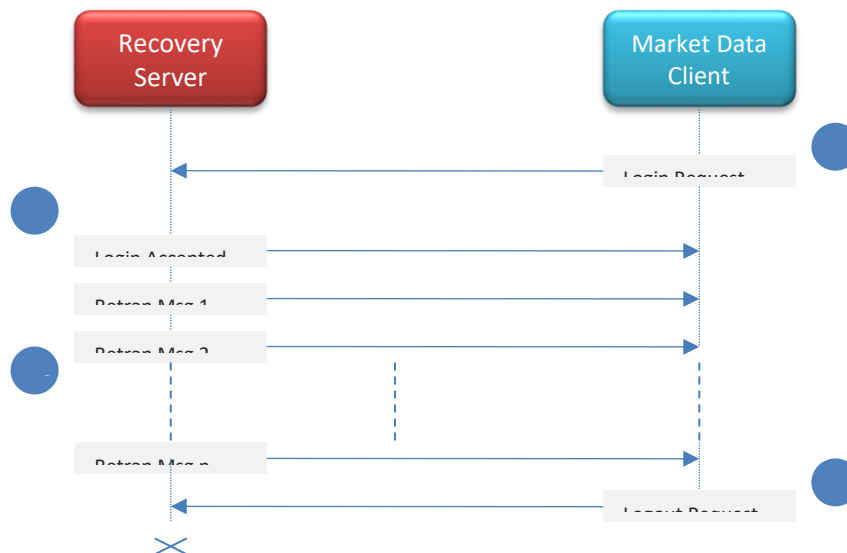


Figure 11: Example Recovery Scenario

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

Step 1: Market Data Client identified missing message(s) from the multicast stream and needs to recover the message using the recovery service. The client has to establish a TCP connection with the recovery server and format 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. A Login Accepted message will be replied to the client to indicate the request is accepted and message retransmission will start soon.

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

Step 4: When the client receives the necessary retransmissions, it should sent 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 on a single recovery session. If the limit is reached, the server will terminate the connection. Market data client has to start a new session and continue from the last recovery point. The recovery limit is described in the previous section 'Network Configuration Parameter'.

## 5.2 Session Message

### 5.2.1 Debug Message (Inbound)

- Debug Messages are used for giving useful information to developers assisting them in application development and troubleshooting. They are used during development processes only.

DEBUG MESSAGE				
Name	Offset	Length	Value	Remarks
Message Length	0	2	Integer	Message Length excluded this field
Message Type	2	1	“+”	Debug Message
Text	3	Variable	Alphanumeric	Free form text

### 5.2.2 Login Request (Outbound)

- Login Request Message is sent to the server when client tries to establish connection to the server by sending login request packet. It also allows session recovery by providing the sequence number when sending the login request packet.
- Since data is sent in ASCII, it must be padded with spaces; for example, the field lengths of Username and Sequence are 6 and 10 alphanumeric characters respectively, if Username is “JOHN”, it should be sent as “JOHN\_ \_”, and if the expected sequence number is 1, it should be sent as “\_ \_ \_ \_ \_ \_ \_ \_ \_ \_ 1” (“\_” represents a space).

LOGIN REQUEST MESSAGE				
NAME	OFFSET	LENGTH	VALUE	REMARKS
Message Length	0	2	Integer	Message Length excluded this field
Message Type	2	1	“L”	Login Request Message
Username	3	6	Alphanumeric	Username

Password	9	10	Alphanumeric	Password
Session	19	10	Alphanumeric	Login requested session ID. Leave this field blank for initial login; and provide Session ID for subsequent logins.
Sequence	29	10	Numeric	The next expected sequence number of the feed from which to start. "1" indicates starting from the beginning of the day. "0" indicates the last message generated by the system.

### 5.2.3 Login Accepted (Inbound)

- Login Accepted Message is used for acknowledging a login request packet sent by client upon successful login.

LOGIN ACCEPTED MESSAGE				
NAME	OFFSET	LENGTH	VALUE	REMARKS
Message Length	0	2	Integer	Message Length excluded this field
Message Type	2	1	"A"	Login Accepted Message
Session	3	10	Alphanumeric	The session ID currently logged into.
Sequence	13	10	Numeric	The next expected sequence number.
Comma	23	1	","	Separator
Messages Total	24	10	Numeric	The current total number of messages on the feed

### 5.2.4 Login Rejected (Inbound)

- Login Rejected Message is used for acknowledging the failure of a login request packet sent by client.

LOGIN REJECTED MESSAGE				
NAME	OFFSET	LENGTH	VALUE	REMARKS
Message Length	0	2	Integer	Message Length excluded this field
Message Type	2	1	"J"	Login Rejected Message
Reject Reason	3	1	"A" or "S"	Reason of the login rejection: "A" – Invalid username/password "S" – Invalid session ID

### 5.2.5 Logout Request (Outbound)

- Logout Request Message is used for sending session termination request to the server. Session will be closed immediately when receiving logout request packet sent by client.

LOGOUT REQUEST MESSAGE				
NAME	OFFSET	LENGTH	VALUE	REMARKS
Message Length	0	2	Integer	Message Length excluded this field
Message Type	2	1	"O"	Logout Request Message

### 5.2.6 Server Heartbeat Message (Inbound)

- If session is left idle for more than one second, server will send a heartbeat message.

SERVER HEARTBEAT MESSAGE				
NAME	OFFSET	LENGTH	VALUE	REMARKS
Message Length	0	2	Integer	Message Length excluded this field
Message Type	2	1	"H"	Server Heartbeat Message

### 5.2.7 Client Heartbeat Message (Outbound)

- Client Heartbeat Message is used for sending heartbeat messages to server from the client side on a regular interval. Since the server assumes the client is no longer active if it does not receive a heartbeat message from client for more than 15 seconds, the session will be terminated.

CLIENT HEARTBEAT MESSAGE				
NAME	OFFSET	LENGTH	VALUE	REMARKS
Message Length	0	2	Integer	Message Length excluded this field
Message Type	2	1	"R"	Client Heartbeat Message

### 5.2.8 Sequenced Data Message (Inbound)

- Sequenced Data Message is the message sent by the server which contains the actual market data. Since messages are transferred in sequence, the first sequenced data message of the current session can be considered assigned with the sequence number '1', and the succeeding sequenced messages are each assigned with the next sequence number. With the sequence number assigned to each message (implicitly), session recovery is possible.

SEQUENCED DATA MESSAGE				
NAME	OFFSET	LENGTH	VALUE	REMARKS
Message Length	0	2	Integer	Message Length excluded this field
Message Type	2	1	"S"	Sequenced Data Message
Data	3	Variable	Market Data Message	Sequenced data. Contains all messages of actual market data feed. A message with zero length indicates the end of the session and no more messages are available.

## 6 Market Data Messages

Cboe Japan Multicast Market Data Feed (Binary) contains a series of messages informing clients of the orders added to and removed from CTS and the execution of trades in CTS. CTS uses the same market data message format in both the multicast service and the recovery service.

### 6.1 Second Message

- Second Message will be sent for every second for which there is at least one payload.

SECOND MESSAGE				
NAME	OFFSET	LENGTH	VALUE	REMARKS
Time - second	0	4	Integer	The number of seconds since mid-night
Message Type	4	1	"T"	Second Message

### 6.2 System Event Message

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

SYSTEM EVENT MESSAGE				
NAME	OFFSET	LENGTH	VALUE	REMARKS
Time - nanosecond	0	4	Integer	The number of nanoseconds since last Second Message  Time Format: nnnnnn000
Message Type	4	1	"S"	System Event Message
Event Code	5	1	Alphanumeric	Please see System Event Codes below

#### 6.2.1 System Event Codes

SYSTEM EVENT CODE	DESCRIPTION	REMARKS
O	Start of Messages	This is the first message of the day
S	Start of Trading Session	This message indicates that CTS is open and accepting orders
E	End of System hours	This message indicates that CTS is closed and not accepting orders anymore. It is still possible to receive Broken Trade and Order Cancel messages after this.
C	End of Messages	This is the last message of the day



### 6.3 Add Order Message

- Add Order Message is used for acknowledging the acceptance of a visible order into the book in CTS. The message contains an Order Reference which is the unique key of the day assigned to the order by CTS.
- Add Order Message may be sent for accepting a revised order after the original order is cancelled. Please refer to [Section 6.6 Modification of Existing Orders](#) for detail.

ADD ORDER MESSAGE				
NAME	OFFSET	LENGTH	VALUE	REMARKS
Time - nanosecond	0	4	Integer	The number of nanoseconds since last Second Message  Time Format: nnnnnn000
Message Type	4	1	"A"	Add Order Message
Order Reference	5	4	Integer	Unique order reference number of the day.
Buy/Sell Indicator	9	1	"B" or "S"	"B" = Buy Order "S" = Sell Order
Shares	10	4	Integer	Total number of shares being added to the book. (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	14	6	Alphanumeric	Stock symbol (which is right-padded with spaces).
Price	20	8	Price	The display price of the order.
Display	28	1	"Y"	"Y" = displayed in quote

### 6.4 Order Execution Message

- When an order on the book is executed, either in whole or in part, an Order Execution Message is sent.

ORDER EXECUTION MESSAGE				
NAME	OFFSET	LENGTH	VALUE	REMARKS
Time - nanosecond	0	4	Integer	The number of nanoseconds since last Second Message  Time Format: nnnnnn000
Message Type	4	1	"E"	Order Execution Message
Order Reference	5	4	Integer	The reference key of the order which was executed.
Executed Shares	9	4	Integer	The number of shares executed on the trade.
Trade Reference	13	4	Integer	The unique trade reference number of the day.
Contra Order Reference	17	4	Integer	The reference key of the contra-order that was executed.
Tick Direction	21	1	Alphanumeric	The tick direction. Please refer to the Tick Direction Table.

### 6.4.1 Tick Direction Table

Tick Direction is available in Order Execution Message as supplementary information. It is determined by using the last trade price of the Cboe Japan Trading System.

TICK DIRECTION	DESCRIPTION
+	Trade price goes up
-	Trade price goes down.
0	Trade price no variation
U	Trade price no variation but higher than the previous different price.
D	Trade price no variation but lower than the previous different price.

### 6.5 Order Cancel Message

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

ORDER CANCEL MESSAGE				
NAME	OFFSET	LENGTH	VALUE	REMARKS
Time - nanosecond	0	4	Integer	The number of nanoseconds since last Second Message  Time Format: nnnnnn000
Message Type	4	1	"X"	Order Cancel Message
Order Reference	5	4	Integer	The reference number of the order which was cancelled. (Order Reference can be a reference of a previously sent Add Order Message.)
Cancelled Shares	9	4	Integer	Number of shares cancelled.

## 6.6 Modification of Existing Orders

- Modification of Price

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

- 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 currently. If the number of currently pending shares for an order reaches zero, the order will be removed from the book.

## 6.7 Trade Message

- When there is a trade realised against order quantity not visible on the book (partially hidden order), Trade Message is sent out. Trade Messages fill in the gaps of data feeds of orders that are executed with hidden order quantities.

*Note: Order Execution Messages and Trade Messages together provide a complete picture of all executions occurred in CTS. Trade Message does not affect the book and can be ignored for book-building.*

TRADE MESSAGE				
NAME	OFFSET	LENGTH	VALUE	REMARKS
Time - nanosecond	0	4	Integer	The number of nanoseconds since last Second Message  Time Format: nnnnnn000
Message Type	4	1	"P"	Trade Message
Order Reference	5	4	Integer	The Order Reference will always be set to 0 (zero)
Buy/Sell Indicator	9	1	Alphanumeric	The Buy/Sell indicator will always be set to "B"
Shares	10	4	Integer	Number of shares executed.
Stock	14	6	Alphanumeric	Stock symbol (right-padded with spaces)
Price	20	8	Price	Match price of the order
Trade Reference	28	4	Integer	Trade reference number generated for the trade.
Contra Order Reference	32	4	Integer	The Contra Order Reference will always be set to 0 (zero)

## 6.8 Broken Trade Message

- When an execution is broken in CTS, Broken Trade Message is sent out. If a trade is broken, it cannot be reverted.

*Note: Broken Trade Message only affects applications which build on a time-and-sales database or maintain cumulative volumes or high/low calculations. 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 nanosecond	-	0	4	Integer	The number of nanoseconds since last Second Message  Time Format: nnnnnn000
Message Type		4	1	"B"	Broken Trade Message
Trade Reference		5	4	Integer	The trade reference number of the execution that was broken. (The Trade Reference can be a previously sent Order Execution Message or Trade Message.)

## 6.9 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 with Trading Status set with 'T' – Trading or 'H' - Halted for each of the symbols trading on CTS. And then, the feed will send out stock status message with Trading Status set with 'A' or 'D' to indicate if Short Sell Price Check is activated or not for each of the symbols.

Subsequently, stock status messages will be sent when a stock is halted or is released for trading. Also, stock status messages will be sent when Short Sell Price check is activated for a stock.

Stock Status Message					
Name	Offset	Length	Value	Remarks	
Time nanosecond	-	0	4	Integer	The number of nanoseconds since last Second Message  Time Format: nnnnnn000
Message Type		4	1	"H"	Stock Trading Action Message
Stock		5	6	Alphanumeric	Stock Symbol
Trading State		11	1	Alphanumeric	"H" = Halted, "T"= Trading, "A" = "Short Sell Price Check activate", "D" = "Short Sell Price Check deactivate"
Reserved		12	1	Alphanumeric	Reserved for future use

## 7 Sample Data

### 7.1 Packet Message

#### 7.1.1 Single message within packet

MESSAGE TYPE	CHIXMMD-Bin FEED MESSAGE
Order Execution Message	00 00 1c e3 00 01 00 16 18 33 d8 b8 45 00 00 00  .....3.E...  15 00 00 03 e8 09 89 68 08 00 00 00 1e 55  .....h.....U

FIELD	HEX	MEANING
Sequence Number	00 00 1c e3	Decimal Value = 7395
Message Count	00 01	Decimal Value = 1
Message Length	00 16	Decimal Value = 22
Message	18 33 d8 b8 45 00 00 00 15 00 00 03 e8 09 89 68 08 00 00 00 1e 55	Nanosecond: 18 33 d8 b8 = 406051000 Message Type: "E" Order Reference: 00 00 00 15 = 21 Shares: 00 00 03 e8 = 1000 Trade Reference: 09 89 68 08 = 160000008 Contra Order Reference: 00 00 00 1e = 30 Tick Direction: 55 = U

#### 7.1.2 Multiple message within packet

MESSAGE TYPE	CHIXMMD-Bin FEED MESSAGE
Second Message and Add Order Message inside a packet	00 00 1c d7 00 02 00 05 00 01 0b 75 54 00 1d 04  .....uT...  97 c0 30 41 00 00 00 16 53 00 00 03 e8 32 35 33  .0A....S....253  31 20 20 00 00 00 02 54 0b e4 00 59  1 ....T...Y

FIELD	HEX	MEANING
Sequence Number	00 00 1c d7	Decimal Value = 7383
Message Count	00 02	Decimal Value = 2
Message Length	00 05	Decimal Value = 5
Message	00 01 0b 75 54	Time(Second): 68469 Message Type: T
Message Length	00 1d	Decimal Value = 29
Message	04 97 c0 30 41 00 00 00 16 53 00 00 03 e8 32 35 33 31 20 20 00 00 00 02 54 0b e4 00 59	Time(Nanosecond): 77054000 Message Type: A Order Reference: 22 Buy/Sell Indicator: S Shares: 1000 Stock: 2531 Price: 3000000000 Display: Y

### 7.1.3 Heartbeat message

MESSAGE TYPE	CHIXMMD-Bin 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

## 7.2 Market Data Message

### 7.2.1 Order Added and Fully Traded

ACTION	HEX	MEANING
Buy of 2531 with 1000 shares entered at 1000. Order Reference 1 assigned.	13 3d fa c8 41 00 00 01 42 00 00 03 e8 32 35 33 31 20 20 00 00 00 b2 d0 5e 00 59	Time(Nanosecond): 322829000 Message Type: A Order Reference: 1 Buy/Sell Indicator: B Shares: 1000 Stock: 2531 Price: 300000000 Display: Y
Matching buy order entered and order traded with Reference "140000001".	00 86 2b a8 45 00 00 01 00 00 03 e8 08 58 3b 01 00 00 00 02 2d	Time(Nanosecond): 008793000 Message Type: E Order Reference: 1 Executed Shares: 1000 Trade Reference: 140000001 Contra Order Reference: 2 Tick Direction: -

*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.*

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

ACTION	HEX	MEANING
Buy of 2531 with 1000 shares entered at 1000. Order Reference 3 assigned.	22 62 1f c0 41 00 00 03 42 00 00 03 e8 32 35 33 31 20 20 00 00 00 b2 d0 5e 00 59	Time(Nanosecond): 576856000 Message Type: A Order Reference: 3 Buy/Sell Indicator: B Shares: 1000 Stock: 2531 Price: 300000000 Display: Y
Matching sell order entered for 3000 shares of 2531. Order Execution Message is sent out with Order Reference "3" and Trade Reference "140000002".	05 4c 3b 50 45 00 00 03 00 00 03 e8 08 58 3b 02 00 00 00 04 44	Time(Nanosecond): 088882000 Message Type: E Order Reference: 3 Executed Shares: 1000 Trade Reference: 140000002 Contra Order Reference: 4 Tick Direction: D
Add the remaining share (2000) of the sell order onto the book.	05 4c 3b 50 41 00 00 04 53 00 00 07 d0 32 35 33 31 20 20 00 00 00 b2 d0 5e 00 59	Time(Nanosecond): 088882000 Message Type: A Order Reference: 4 Buy/Sell Indicator: S Shares: 2000 Stock: 2531

		Price: 3000000000 Display: Y
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### 7.2.3 Price Revision

ACTION	HEX	MEANING
Buy order of 2531 with 1000 shares entered. Order Reference "6" assigned. The display price is 300.	20 05 01 98 41 00 00 00 06 42 00 00 03 e8 32 35 33 31 20 20 00 00 00 00 b2 d0 5e 00 59	Time(Nanosecond): 537199000 Message Type: A Order Reference: 6 Buy/Sell Indicator: B Shares: 1000 Stock: 2531 Price: 3000000000 Display: Y
Price is revised to 301. An Order Cancel Message is sent out.	20 16 95 98 58 00 00 00 06 00 00 03 e8	Time(Nanosecond): 538351000 Message Type: X Order Reference: 6 Executed Shares: 1000
An Add Order Message is sent after the Order Cancel Message. The Order Reference is the same. The display price changes to 301.	20 16 95 98 41 00 00 00 06 42 00 00 03 e8 32 35 33 31 20 20 00 00 00 00 b3 68 f4 80 59	Time(Nanosecond): 538351000 Message Type: A Order Reference: 6 Buy/Sell Indicator: B Shares: 1000 Stock: 2531 Price: 3010000000 Display: Y

### 7.2.4 Reduction of Order Quantity

ACTION	HEX	MEANING
Buy order of 2531 with 1000 shares entered. Order Reference "6" assigned. The display price is 301.	20 16 95 98 41 00 00 00 06 42 00 00 03 e8 32 35 33 31 20 20 00 00 00 00 b3 68 f4 80 59	Time(Nanosecond): 538351000 Message Type: A Order Reference: 6 Buy/Sell Indicator: B Shares: 1000 Stock: 2531 Price: 3010000000 Display: Y
The order quantity is cut down by 100 shares. An Order Cancel Message is sent informing client about the change.	14 20 bd 90 58 00 00 00 06 00 00 00 64	Time(Nanosecond): 337690000 Message Type: X Order Reference: 6 Executed Shares: 100

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

### 7.2.5 Order Revised and Executed

ACTION	HEX	MEANING
A visible buy order of 2531 with 1000 shares is placed on the book with the display price of 300.	24 52 95 80 41 00 00 00 07 42 00 00 03 e8 32 35 33 31 20 20 00 00 00 00 b2 d0 5e 00 59	Time(Nanosecond): 609392000 Message Type: A Order Reference: 7 Buy/Sell Indicator: B Shares: 1000 Stock: 2531 Price: 3000000000 Display: Y
A visible sell order of 2531 with 1000 shares is placed on the book with the display price of 301.	35 04 e8 10 41 00 00 00 08 53 00 00 03 e8 32 35 33 31 20 20 00 00 00 00 b3 68 f4 80 59	Time(Nanosecond): 889514000 Message Type: A Order Reference: 8 Buy/Sell Indicator: S

		Shares: 1000 Stock: 2531 Price: 3010000000 Display: Y
The sell order is revised to the display price of 300. An Order Cancel Message is sent out.	13 2d 31 e8 58 00 00 00 08 00 00 03 e8	Time(Nanosecond): 321729000 Message Type: X Order Reference: 8 Executed Shares: 1000
The trade is executed. An Order Execution Message is sent out.	13 2d 31 e8 45 00 00 00 07 00 00 03 e8 08 58 3b 04 00 00 00 08 44	Time(Nanosecond): 321729000 Message Type: E Order Reference: 7 Executed Shares: 1000 Trade Reference: 140000004 Contra Order Reference: 8 Tick Direction: D

### 7.2.6 Trades On Partially Hidden Order (Iceberg)

ACTION	HEX	MEANING
A buy order of 2531 with 10000 shares is placed on the book with a visible quantity of 1000 shares. The display price is 301. An Add Order Message is sent out for the visible amount.	1b 47 fa 70 41 00 00 00 09 42 00 00 03 e8 32 35 33 31 20 20 00 00 00 00 b3 68 f4 80 59	Time(Nanosecond): 457702000 Message Type: A Order Reference: 9 Buy/Sell Indicator: B Shares: 1000 Stock: 2531 Price: 3010000000 Display: Y
A sell order of 500 shares is entered and crosses against the visible quantity of 1000 shares. 500 shares remain on the book.	0a 2c 9d 40 45 00 00 00 09 00 00 01 f4 08 58 3b 05 00 00 00 0a 2b	Time(Nanosecond): 170696000 Message Type: E Order Reference: 9 Executed Shares: 500 Trade Reference: 140000005 Contra Order Reference: 10 Tick Direction: +
A sell 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.	06 c9 13 68 45 00 00 00 09 00 00 01 f4 08 58 3b 06 00 00 00 0b 55	Time(Nanosecond): 113841000 Message Type: E Order Reference: 9 Executed Shares: 500 Trade Reference: 140000006 Contra Order Reference: 11 Tick Direction: U
A Trade Message is sent out for the hidden quantity of 3500 shares.	06 c9 13 68 50 00 00 00 00 42 00 00 0d ac 32 35 33 31 20 20 00 00 00 00 b3 68 f4 80 08 58 3b 06 00 00 00 00	Time(Nanosecond): 113841000 Message Type: P Order Reference: 0 Buy/Sell Indicator: B Shares: 3500 Stock: 2531 Price: 3010000000 Trade Reference: 140000006 Contra Order Reference: 0
The peak is refreshed onto the book. An Add Order Message is sent out for 1000 shares.	06 c9 13 68 41 00 00 00 0c 42 00 00 03 e8 32 35 33 31 20 20 00 00 00 00 b3 68 f4 80 59	Time(Nanosecond): 113841000 Message Type: A Order Reference: 12 Buy/Sell Indicator: B Shares: 1000 Stock: 2531 Price: 3010000000 Display: Y

### 7.2.7 Trade Cancellation (Bust)

ACTION	HEX	MEANING
A buy order of 2531 with 1000 shares is placed on the book. The display price is 301. An Add Order Message is sent out for the visible amount.	30 7c e3 38 41 00 00 00 0d 42 00 00 03 e8 32 35 33 31 20 20 00 00 00 00 b3 68 f4 80 59	Time(Nanosecond): 813491000 Message Type: A Order Reference: 13 Buy/Sell Indicator: B Shares: 1000 Stock: 2531



		Price: 301000000 Display: Y
An Order Execution Message is sent out on receiving a matching order. The Trade Reference is "140000007".	0a cf 5d 50 45 00 00 00 0d 00 00 03 e8 08 58 3b 07 00 00 00 0e 55	Time(Nanosecond): 181362000 Message Type: E Order Reference: 13 Executed Shares: 1000 Trade Reference: 140000007 Contra Order Reference: 14 Tick Direction: U
When the trade is cancelled by CTS operators, a Broken Trade.	19 4f 6a 78 42 08 58 3b 07	Time(Nanosecond): 424635000 Message Type: B Trade Reference: 140000007

### 7.2.8 Short Sell price check activated before trading hours

ACTION	HEX	MEANING
Stock Status Message indicates symbol 2531 is tradable.	00 39 53 c8 48 32 35 33 31 20 20 54 4e	Time(Nanosecond): 003757000 Message Type: H Stock: 2531 Trading State: T Reserved: N
Stock Status Message indicates short sell price check activated for symbol 2531	17 26 41 18 48 32 35 33 31 20 20 41 4e	Time(Nanosecond): 388383000 Message Type: H Stock: 2531 Short Sell Price State: A Reserved: N

### 7.2.9 Short Sell price check deactivated before trading hours

ACTION	HEX	MEANING
Stock Status Message indicates symbol 2914 is tradable.	01 de 7c 30 48 32 39 31 34 20 20 54 4e	Time(Nanosecond): 031358000 Message Type: H Stock: 2914 Trading State: T Reserved: N
Stock Status Message indicates short sell price check deactivated for symbol 2914	26 7e a1 28 48 32 39 31 34 20 20 44 4e	Time(Nanosecond): 645833000 Message Type: H Stock: 2914 Short Sell Price State: D Reserved: N

### 7.2.10 Short Sell price check activated during trading hours

ACTION	HEX	MEANING
Stock Status Message indicates short sell price check activated for symbol 2531	17 26 41 18 48 32 35 33 31 20 20 41 4e	Time(Nanosecond): 388383000 Message Type: H Stock: 2531 Short Sell Price State: A Reserved: N