



# **Cboe Japan Multicast Market Data Feed Specification**

**Cboe Japan Trading System**

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## 1 Introduction

Clients may use Binary version for more compact message and up to nanosecond time precision. 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 ASCII version. Technical aspect of this data feed including the connection protocol, message types and message structures etc., are described in this document.

The ASCII version use ASCII representation for Numeric fields and Price fields. The time precision is up to millisecond. Clients may use Binary version for more compact message and up to Nanosecond time precision. Please reference Cboe Japan Multicast Market Data Feed Specification (Binary version) for more detail.

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-035 Cboe Japan Multicast Market Data Feed 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 to add support for Tick Direction in Order Execution message	4.4, 4.4.1, 5.2.1, 5.2.2, 5.2.6, 5.2.7, 5.2.8	Eric (version 1.1-5)
2	Correct Sample in Trade Cancellation(Bust)	5.2.8	Eric (version 1.1-6)
3	Add Trading Status ‘A’ and ‘D’ to indicate Short Sell Price Check activate/deactivate for a symbol	4.9, 5.2.11, 5.2.12, 5.2.13	Eric (version 1.1-7)
4	Update the network configuration parameters (Production/Simulation Environments)	2,2.1,2.4	Eric (version 1.1-8)
5	Update the Multicast Group IP (Production/Simulation Environments)	2.4	Macus (version 1.1-9)
6	Correct Sample in Trades On Partially Hidden Order (Iceberg)	5.2.7	Ivan (version 1.1-10)
7	Change Icon. Correct header. Update Introduction. Add description for SRS. Add session protocol for MMRS	1, 1.1, 2, 2.3, 3,4	Sam (version 1.1-11)
8	Add Rendezvous Point for Production and Simulation Environment	2.5	Sam (version 1.1-12)
9	Add Connection Parameter for Stream C and MMRS Server 3	2.5	Sam (version 1.1-13)
10	Update Bandwidth Recommendation to 200Mbps	2.5	Sam (version 1.1-14)
11	Update new Network Configuration in Simulation	2.5	Newton

	Add Select market in Production and Simulation		(version 1.1-15)
12	Re-branding – logo and name reference change Text description updates		Stanley (version 1.1-16)

**Figure 2: Revision History**

## 2 Overview

The Clients may use Binary version for more compact message and up to nanosecond time precision. Market Data Multicast version consists of two data services:

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

The real-time multicast market data feed delivers market data in UDP multicast packet stream over Cboe Japan Multicast Market Data network. Clients may use Binary version for more compact message and up to nanosecond time precision. 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 server and request for past message retransmission. The recovery process is done over a TCP connection established by the request client to the MMRS server.

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

The following diagram shows the overall delivery mechanism:

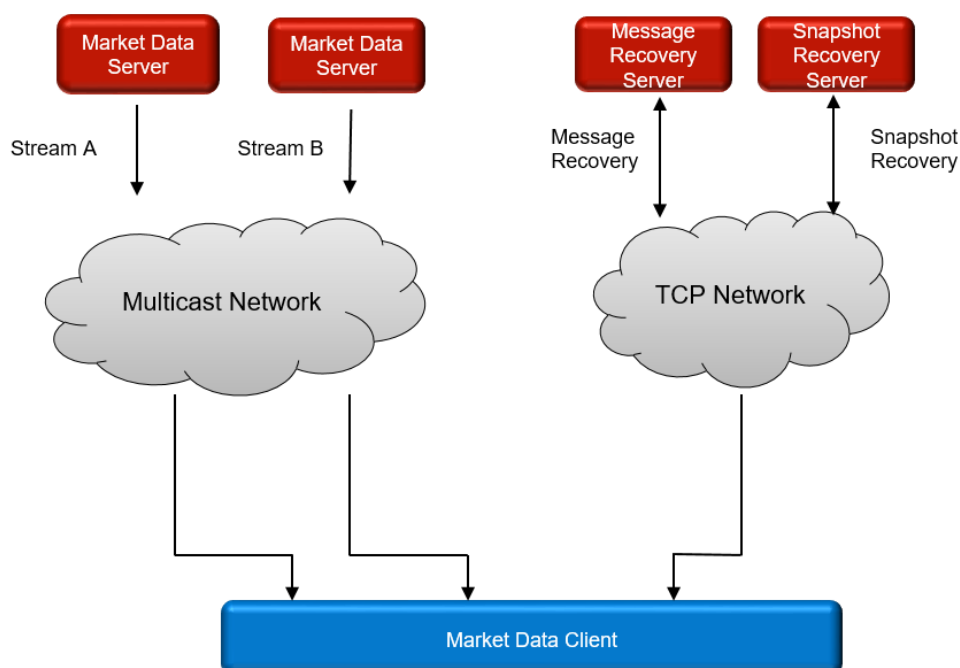


Figure 3: Multicast Market Data Delivery Mechanism

## 2.1 Real-Time Multicast Market Data Feed Service

The CHIXMMD 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 that 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 Server to recover missing messages of the current trading day. This is done by establishing a TCP connection to a designated MMRS 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 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 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 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 Data Stream A</b>			
Multicast Group	233.249.234.11	233.249.234.21	-
Port Number	10111	10121	-
Rendezvous Point	110.50.74.21		-
<b>CHIXMMD Data Stream B</b>			
Multicast Group	233.249.234.12	233.249.234.22	-
Port Number	10211	10221	-
Rendezvous Point	110.50.74.22		-
<b>CHIXMMD Data Stream C</b>			
Multicast Group	-	-	233.249.234.13
Port Number	-	-	10311
Rendezvous Point	-	-	110.50.75.21
<b>MMRS Server 1</b>			
IP Address	110.50.74.26	110.50.74.35	-
Port Number	10112	10122	-
<b>MMRS Server 2</b>			
IP Address	110.50.74.27	110.50.74.36	-
Port Number	10212	10222	-
<b>MMRS Server 3</b>			
IP Address	-	-	110.50.75.66
Port Number	-	-	10312

Figure 4: Network Address Summary (Production Environment)

#### Simulation Environment

	Secondary Data Centre (Alpha)	Secondary Data Centre (Select)
<b>CHIXMMD Data Stream A</b>		
Multicast Group	233.249.234.144	233.249.234.154
Port Number	11401	11421
Rendezvous Point	110.50.75.21	
<b>CHIXMMD Data Stream B</b>		
Multicast Group	233.249.234.145	233.249.234.155
Port Number	11501	11521



Rendezvous Point	110.50.75.22	
<b>CHIXMMD Data Stream C</b>		
Multicast Group	233.249.234.116	
Port Number	11601	
Rendezvous Point	110.50.75.21	
<b>MMRS Server 1</b>		
IP Address	110.50.75.153	110.50.75.155
Port Number	11402	11522
<b>MMRS Server 2</b>		
IP Address	110.50.75.157	110.50.75.159
Port Number	11502	11522
<b>MMRS Server 3</b>		
IP Address	110.50.75.40	-
Port Number	11602	-

**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 Parameters

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

#### MMRS Parameters

MMRS Server applies limit check in serving recovery request. 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	60 seconds
--------------------	------------

**Figure 8: MMRS Configuration Parameters**

<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.

## 3 Data Type

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

### 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. Data fields of numeric data type include Sequence, Order Reference, Trade Reference, number of Shares, etc.

### 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. Data fields of alphanumeric data type include Stock (symbol).

### 3.3 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.

### 3.4 Timestamp

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

## 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.

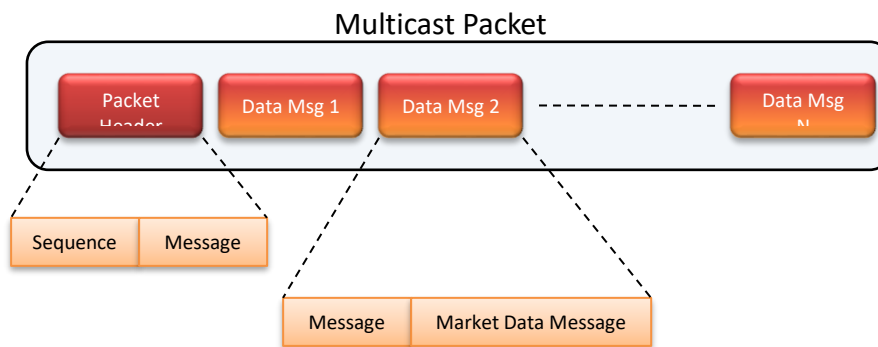


Figure 9: CHIXMMD Multicast Packet Layout

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. It is 32-bit big endian integer.
Message Count	4	2	Binary	Number of messages in the packet. It is 16-bit big endian integer.

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. It is 16-bit big endian integer.
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.

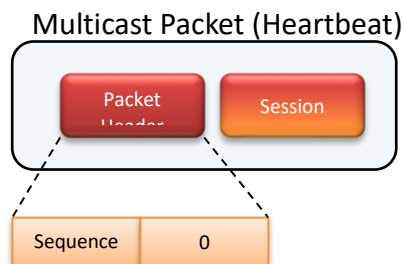


Figure 10: CHIXMMD Heartbeat Packet Layout

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. It is 32-bit big endian integer.
Message Count	4	2	Binary	A zero value indicating this is a heartbeat message It is 16-bit big endian integer.
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 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

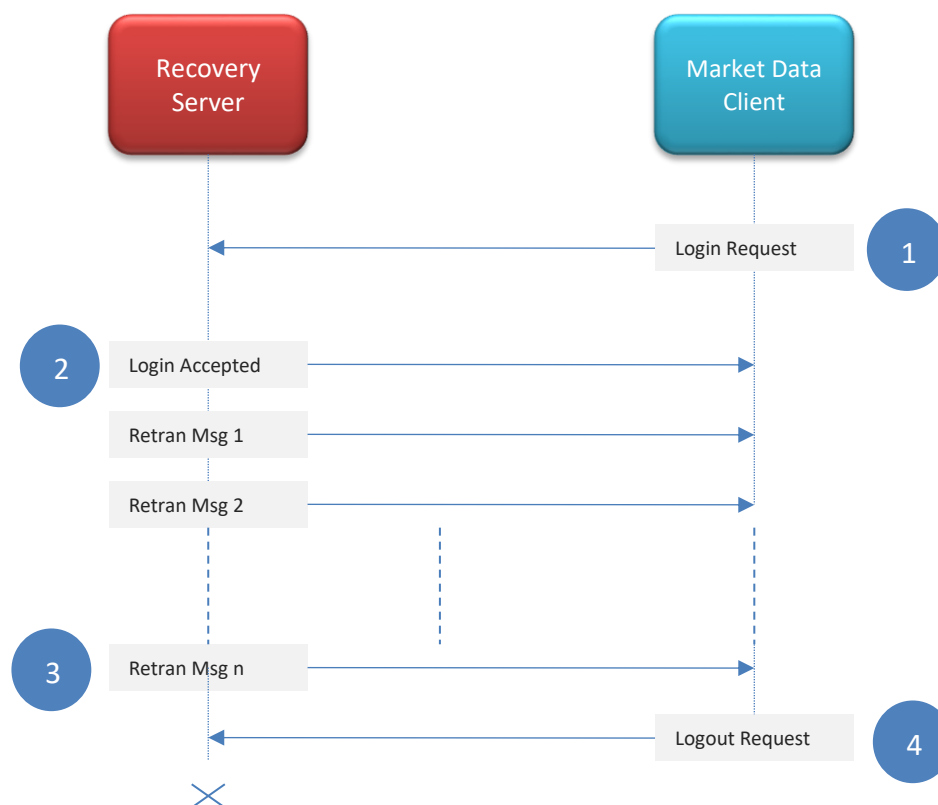
1. Session is initialised when client establishes a TCP session and sends a login packet.
2. When server received the login packet, it responds with a login accepted packet and starts transferring sequenced data, or it rejects the login and terminates the session (if appropriate).
3. If login packet 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 Type	0	1	“+”	Debug Message
Text	1	Variable	Alphanumeric	Free form text
Terminator	Text Length + 1	1	ASCII 10, Hex 0x0A	Message Terminator

### 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 Type	0	1	“L”	Login Request Message
Username	1	6	Alphanumeric	Username
Password	7	10	Alphanumeric	Password
Session	17	10	Alphanumeric	Login requested session ID. Leave this field blank for initial login; and provide Session ID for subsequent logins.
Sequence	27	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.
Terminator	37	1	ASCII 10, Hex 0x0A	Message Terminator

### 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 Type	0	1	"A"	Login Accepted Message
Session	1	10	Alphanumeric	The session ID currently logged into.
Sequence	11	10	Numeric	The next expected sequence number.
Comma	21	1	","	Separator
Messages Total	22	10	Numeric	The current total number of messages on the feed
Terminator	32	1	ASCII 10, Hex 0x0A	Message Terminator

### 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 Type	0	1	"J"	Login Rejected Message
Reject Reason	1	1	"A" or "S"	Reason of the login rejection: "A" – Invalid username/password "S" – Invalid session ID
Terminator	2	1	ASCII 10, Hex 0x0A	Message Terminator

### 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 Type	0	1	"O"	Logout Request Message
Terminator	1	1	ASCII 10, Hex 0x0A	Message Terminator



### 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 Type	0	1	"H"	Server Heartbeat Message
Terminator	1	1	ASCII 10, Hex 0x0A	Message Terminator

### 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 Type	0	1	"R"	Client Heartbeat Message
Terminator	1	1	ASCII 10, Hex 0x0A	Message Terminator

### 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 Type	0	1	"S"	Sequenced Data Message
Data	1	Variable	Alphanumeric	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.
Terminator	Data Length + 1	1	ASCII 10, Hex 0x0A	Message Terminator

## 6 Market Data Messages

Clients may use Binary version for more compact message and up to nanosecond time precision. Multicast Market Data Feed contains a series of messages informing clients of the orders added to and removed from CTS and the execution of trades in CTS.

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.

### 6.1 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 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

#### 6.1.1 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

## 6.2 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 a 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 6.5 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. (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

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. (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

### 6.3 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 Stamp	0	8	Numeric	Time Stamp
Message Type	8	1	"E"	Order Execution Message
Order Reference	9	9	Numeric	The reference key 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 reference key of the contra-order that was executed.
Tick Direction	42	1	Alphanumeric	The tick direction. Please refer to the Tick Direction Table.

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 reference key (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 reference key of the contra-order that was executed.
Tick Direction	46	1	Alphanumeric	The tick direction. Please refer to the Tick Direction Table.

### 6.3.1 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 Clients may use Binary version for more compact message and up to nanosecond time precision. 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.

## 6.4 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 Stamp	0	8	Numeric	Time Stamp
Message Type	8	1	"X"	Order Cancel Message
Order Reference	9	9	Numeric	The 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.

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 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.

## 6.5 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.

## 6.6 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 Stamp	0	8	Numeric	Time Stamp
Message Type	8	1	"P"	Trade Message
Order Reference	9	9	Numeric	The Order Reference will always be set to 0 (zero)
Buy/Sell Indicator	18	1	Alphanumeric	The Buy/Sell indicator will always be 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 will always be set to 0 (zero)

LONG FORM TRADE MESSAGE				
NAME	OFFSET	LENGTH	VALUE	REMARKS
Time Stamp	0	8	Numeric	Time Stamp
Message Type	8	1	"p"	Long Form Trade Message
Order Reference	9	9	Numeric	The Order Reference will always be set to 0 (zero)
Buy/Sell Indicator	18	1	Alphanumeric	The Buy/Sell indicator will always be 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 will always be set to 0 (zero)

## 6.7 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 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 can be a previously sent Order Execution Message or Trade Message.)

## 6.8 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 Stamp	0	8	Numeric	Time Stamp
Message Type	8	1	"H"	Stock Trading Action Message
Stock	9	6	Alphanumeric	Stock Symbol
Trading State	15	1	Alphanumeric	"H" = Halted, "T" = Trading, "A" = "Short Sell Price Check activate", "D" = "Short Sell Price Check deactivate"
Reserved	16	1	Alphanumeric	Reserved for future use



## 7 Sample Data

### 7.1 Packet Message

#### 7.1.1 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 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

#### 7.1.2 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 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 20 35 00 18  00001 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 1000000Y
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

### 7.1.3 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

## 7.2 Market Data Message

### 7.2.1 Order Added and Fully Traded

ACTION	CLIENTS MAY USE BINARY VERSION FOR MORE COMPACT MESSAGE AND UP TO NANOSECOND
Sell of 100 RIM shares entered at 85.89. Order Reference 638 assigned.	38743037A 638S 100RIM 858900Y
Matching buy order entered and order traded with Reference "355".	38754246E 638 100 355 640-

*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	CLIENTS MAY USE BINARY VERSION FOR MORE COMPACT MESSAGE AND UP TO NANOSECOND
Buy order of 111 RIM shares entered at 85.89. Order Reference "2" assigned.	46143332A 2B 111RIM 858900Y
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 4-
Add the remaining share (1) of the sell order onto the book.	46300713A 4S 1RIM 858900Y

### 7.2.3 Pegged/Market Order Added to Book

ACTION	CLIENTS MAY USE BINARY VERSION FOR MORE COMPACT MESSAGE AND UP TO NANOSECOND
Sell order of 100 RIM shares entered with a pegged order attribute. Order Reference "663" assigned. The display price is 85.89.	39323626A 663S 100RIM 858900Y

Each time when the price changes, an Order Cancel Message is sent out.	39329400X	663	100	
An Add Order Message is sent after the Order Cancel Message. The Order Reference is the same. The display price changes to 85.88.	39329400A	663S	100RIM	858800Y

Note: Same actions will be performed for CTS market orders.

#### 7.2.4 Price Revision

ACTION	CLIENTS MAY USE BINARY VERSION FOR MORE COMPACT MESSAGE AND UP TO NANOSECOND			
Sell order of 1000 RIM shares entered. Order Reference "670" assigned. The display price is 85.88.	39465381A	670S	1000RIM	858800Y
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	858900Y

#### 7.2.5 Reduction of Order Quantity

ACTION	CLIENTS MAY USE BINARY VERSION FOR MORE COMPACT MESSAGE AND UP TO NANOSECOND			
Sell order of 1000 RIM shares entered. Order Reference "671" assigned. The display price is 85.88.	39476527A	671S	1000RIM	858800Y
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 CTS currently does not support increase of total order quantity.

#### 7.2.6 Order Revised and Executed

ACTION	CLIENTS MAY USE BINARY VERSION FOR MORE COMPACT MESSAGE AND UP TO NANOSECOND			
A visible sell order of 1666 RIM shares is placed on the book with the display price of 85.89.	38821658A	642S	1666RIM	858900Y

A visible buy order of 1066 RIM shares is placed on the book with the display price of 85.88.	38841745A	644B	1066RIM	858800Y
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	356 644+

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

ACTION	CLIENTS MAY USE BINARY VERSION FOR MORE COMPACT MESSAGE AND UP TO NANOSECOND TIME				
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	858900Y	
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	2455-
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	2456D
A Trade Message is sent out for the hidden quantity of 3500 shares.	40825082P	0B	3500RIM	858900	1954 0
The peak is refreshed onto the book. An Add Order Message is sent out for 1000 shares.	40825082A	2457S	1000RIM	858900Y	

### 7.2.8 Trade Cancellation (Bust)

ACTION	CLIENTS MAY USE BINARY VERSION FOR MORE COMPACT MESSAGE AND UP TO				
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	858900Y	
An Order Execution Message is sent out on receiving a matching order. The Trade Reference is "4152".	42124752E	4716	111	4152	4717+
When the trade is cancelled by CTS operators, a Broken Trade .	42204572B	4152			

**7.2.9 Long Form Messages (Execution of Visible Order)**

<b>ACTION</b>	<b>CLIENTS MAY USE BINARY VERSION FOR MORE COMPACT MESSAGE AND UP TO NANOSECOND</b>
A buy order of 1,000,000 RBS1 shares entered at 80,000,000p. Order Reference "109" is assigned.	36417412a 109B 1000000RBS1 80000000000Y
An Order Execution Message is sent out on receiving a matching order. The Trade Reference is "28".	36447020e 109 1000000 28 110U

**7.2.10 Long Form Messages (Cancellation of Visible Order)**

<b>ACTION</b>	<b>CLIENTS MAY USE BINARY VERSION FOR MORE COMPACT MESSAGE AND UP TO NANOSECOND</b>
A buy order of 1,000,000 RBS1 shares entered at 80,000,000p. Order Reference "111" is assigned.	36417412a 111B 1000000RBS1 80000000000Y
The order is cancelled by CTS and an Order Cancel Message is sent out.	36453536x 111 1000000

**7.2.11 Short Sell price check activated before trading hours**

<b>ACTION</b>	<b>CLIENTS MAY USE BINARY VERSION FOR MORE COMPACT MESSAGE AND UP TO NANOSECOND</b>
Stock Status Message indicates symbol 9957 is tradable.	23412935H9957 TN
Stock Status Message indicates short sell price check activated for symbol 9957	27412896H9957 AN

**7.2.12 Short Sell price check deactivated before trading hours**

<b>ACTION</b>	<b>CLIENTS MAY USE BINARY VERSION FOR MORE COMPACT MESSAGE AND UP TO NANOSECOND</b>
Stock Status Message indicates symbol 9957 is tradable.	23412935H9957 TN
Stock Status Message indicates short sell price check deactivated for symbol 9957	27412896H9957 DN

**7.2.13 Short Sell price check activated during trading hours**

ACTION	CLIENTS MAY USE BINARY VERSION FOR MORE COMPACT MESSAGE AND UP TO NANOSECOND
Stock Status Message indicates short sell price check activated for symbol 2531	33403337H2531 AN