



Application Development

# The CHX Book Feed Interface Specification

Version 1.07, Revised 04/12/2011

## Revision History

Date/Version	Initials	Revision
10/11/2007 v 1.00	JAC	Initial document
10/23/2007 v 1.01	JAC	<p>Clarified that a single TCP/IP connection will handle the Retransmission message requests, responses, and retransmitted Book Feed messages. Also added note that idle connections would be disconnected after 10 minutes.</p> <p>Retransmission message changes:</p> <ul style="list-style-type: none"> <li>▪ Retransmission Session Control and Recovery messages use the Retransmission Message Header.</li> <li>▪ SOURCE_ID moved from Retransmission Message Header to Recovery messages.</li> <li>▪ Retransmission Request Start Sequence Number has same length as End Sequence Number.</li> <li>▪ Dropped Subscriber Transmission Request Number from Retransmission Request Response message.</li> <li>▪ Dropped Retransmission Heartbeat messages.</li> </ul>
10/25/2007 v 1.02	JAC	<p>Retransmission message changes:</p> <ul style="list-style-type: none"> <li>▪ Removed obsolete references to Retransmission Heartbeat Message and Subscriber Transmission Request Number.</li> <li>▪ Fixed Retransmission message offsets</li> <li>▪ Removed idle Book Feed Recovery connection disconnect.</li> </ul>
11/29/2007 v 1.03	RJG	Added bandwidth information
06/18/2008 v 1.04	JAC	Stock Event message changes. Eliminated Stock Open and Stock Close. Added Stock Resume.
08/04/2009 v 1.05	JAC	Updated Retransmission Request Response comments.
01/28/2010 v 1.06	JAC	Updated Cross Trade Message Types: Early Session and Extended Session added; Opening Cross eliminated.
04/12/2011 v 1.07	JAC	<p>Updated trading day hours and trading sessions.</p> <p>Fixed Trade Reference ID offset in Delete Trade message.</p> <p>Note 1: The price included in the Add Order, Execute Order, Modify Order, and Delete Order message is the order's display price.</p> <p>Note 2: Subscribers can use the Book Feed to identify the displayable orders at each price point in the CHX Matching System. The ability to identify the priority of each order is no longer supported.</p>

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## 1. Introduction

The CHX Book Feed is a real-time multicast distribution of the CHX Matching System order activity for subscribers who want a fast, comprehensive view of the displayable liquidity at the CHX. System Event, Stock Event, and trade activity messages are also provided for subscribers interested in a more extensive view of Matching System activity.

This document contains the technical specifications for the CHX Book Feed Interface.

## 2. Bandwidth

Given existing messaging levels, bandwidth of 1.5 Mb/sec (T1) should be adequate and provide headroom for growth. Book Feed subscribers should note that messaging rates and therefore adequate bandwidth are subject to change without notice from CHX. Book Feed subscribers are solely responsible for monitoring, determining and acquiring adequate bandwidth to meet subscriber needs.

## 3. Session

The CHX Book Feed will be distributed via multiple multicast groups. Primary and secondary feeds will be provided to improve message reliability.

Subscribers will be allowed to request a retransmission of missed messages. The Message Recovery Request message will be sent to CHX via a TCP/IP connection. The retransmitted messages will be delivered to the subscriber through the same TCP/IP connection.

The CHX Book Feed will start distributing data at the beginning of the CHX trading day and will stop distributing data at the end of the CHX trading day. Typically, this will be 6:00 AM to 4:30 PM CT (Central Time).

The CHX Book Feed messages will be generated during the Early, Regular, Extended, and Late Trading Sessions.

Each CHX Book Feed message will have a Common Message Header. This header will contain a Source ID and Transmission Sequence Number which will uniquely identify each new message. Each trading day the Transmission Sequence Number will start at one (1) and will increment by one (1) for each new message.

Session Control messages, like the Heartbeat message, do not increment the Transmission Sequence number.

## 4. Data Types

### 4.1 Alpha

Alpha fields are ASCII, left justified and NUL (ASCII 0) padded. The values will be limited to the standard printable ASCII characters found in the range 0 – 127.

#### 4.1.1 Order Reference ID

An Order Reference ID is assigned to each order. This ID will be unique for the day.

Order senders using the DAS (Direct Access Server) interface will be able to link the Order ID on their Execution Reports with the Order Reference ID found on the Book Feed messages. For example, an Execution Report Order ID might be MEL01:242:1:20071004 and the Order Reference ID on the Book Feed message would be MEL01:242:1.

#### 4.1.2 Symbol

Stock Symbol (and Suffix) are right padded with spaces. Symbol and Suffix are formatted as *Symbol.Suffix*

## 4.2 Numeric

All numeric data will be in binary format.

Please note that different machine architectures may store data using different byte orders; i.e., Big Endian vs. Little Endian. The CHX Book Feed will provide binary data in Big Endian order which is the network standard.

## 4.3 Prices

All prices will be in binary format. Prices are represented as whole integers. The decimal price can be determined by dividing the price by the Denominator Code.

The Denominator Code is a one character alpha field. The following table shows the allowable Denominator Code values.

### 4.3.1 Denominator Code Table

Denominator Code	Value	Value as power of 10
0	N/A	N/A
1	10	10 <sup>1</sup>
2	100	10 <sup>2</sup>
3	1,000	10 <sup>3</sup>
4	10,000	10 <sup>4</sup>
5	100,000	10 <sup>5</sup>
6	1,000,000	10 <sup>6</sup>

Examples:

- Price is 1234 and the Denominator Code is 2. The decimal price = 1234 divided by 100 = 12.34.
- Price is 123 and the Denominator Code is 1. The decimal price = 123 divided by 10 = 12.3 or 12.30.
- Price is 12 and the Denominator Code is 0. The denominator code is 0, no division is necessary. The decimal price = 12 or 12.00.

## 4.4 Timestamps

Timestamps will be in binary format. Time will be represented as the number of milliseconds past midnight GMT (Greenwich Mean Time).

CHX Book Feed Algorithm for Time:

$(((\text{Hours} \times \text{Seconds/hour}) + (\text{minutes} \times \text{seconds/minute}) + \text{seconds}) \times 1000) + \text{milliseconds}$

Example:

12:34:56.789 GMT will be converted by the CHX Book Feed to  
 $(((\text{12} \times \text{3600}) + (\text{34} \times \text{60}) + \text{56}) \times \text{1000}) + \text{789} = \text{45,296,789}$ .

Client Algorithm for Time:

$\text{Combined Time}/\text{1000} = \text{Seconds}$

Example:

45296789/1000 = 45296.789. The number before the decimal (e.g. 45296) is the time in seconds. The number after the decimal (e.g. .789) is the millisecond time.

## 5. Message Formats

### 5.1 Multicast Message Header

All of the CHX Book Feed multicast messages contain a Multicast Message Header. The header contains the Message Length, Message Type, Message Version, Source ID, Transmission Sequence Number, Message Code, and Timestamp.

The Message Version will allow subscribers to upgrade to future upgrades of the CHX Book Feed at their own convenience.

The Timestamp is in GMT (Greenwich Mean Time).

Name	Offset	Length	Data Type	Comments
Message Length	0	2	Numeric	Message length including the Multicast Message Header length.
Message Type	2	1	Numeric	10 = Heartbeat Message – multicast 20 = Transmission Sequence Number Reset Message 30 = System Event Message 31 = Stock Event Message 40 = Add Order Message 41 = Execute Order Message 42 = Delete Order Message 43 = Modify Order Message 50 = Match Trade Message 51 = Cross Trade Message 52 = Delete Trade Message
Message Version	3	1	Alpha	Message Version Number. Currently only version 1 is supported.
Source ID	4	1	Numeric	Book Feed Source identifier
Transmission Sequence Number	5	4	Numeric	Transmission level sequence number.
Message Code	9	1	Alpha	'0' = Original message. '1' = Retransmitted message
Timestamp	10	4	Timestamp	See Timestamps in the Data Types section.

## 5.2 Session Messages

### 5.2.1 Heartbeat Message

The Heartbeat message is sent to all subscribers on a 1 second interval.

Name	Offset	Length	Data Type	Comments
Message Header	0	14		See Multicast Message Header.

### 5.2.2 Transmission Sequence Number Reset Message

The Transmission Sequence Number Reset Message will be sent when a Transmission Sequence Number gap has occurred. This message may be sent as the result of a system problem which requires resetting the current Transmission Sequence Number or when the Transmission Sequence Number has reached its maximum value and needs to be rolled over to its minimum value.

Name	Offset	Length	Data Type	Comments
Message Header	0	14		See Multicast Message Header.
Next Transmission Sequence Number	14	4	Numeric	Next Transmission Sequence Number expected.

## 5.3 Event Messages

### 5.3.1 System Event Message

The System Event message is sent to notify the CHX Book Feed subscribers of CHX System events.

The Start of Day System Event will be the first CHX Book Feed message sent each day.

The End of Day System Event will be the last CHX Book Feed message sent each day.

The CHX System Problem System Event will notify the subscriber that CHX is experiencing technical difficulties.

The CHX System Problem Cleared System Event will notify the subscriber that technical problems have been resolved and the CHX Systems are operating normally.

Subscribers are encouraged to sign up for email notifications about the system status of the Chicago Stock Exchange. See Trading Information + Trading Updates + System Status at [www.chx.com](http://www.chx.com)

Name	Offset	Length	Data Type	Comments
Message Header	0	14		See Multicast Message Header.
Event Code	14	1	Alpha	'S' = Start of Day 'E' = End of Day 'P' = CHX System Problem 'C' = CHX System Problem Cleared

### 5.3.2 Stock Event Message

The Stock Event message is sent to notify the CHX Book Feed subscribers of stock specific events.

The Stock Event message will be sent whenever the Matching System halts or resumes a stock for the Regular Trading session.

Name	Offset	Length	Data Type	Comments
Message Header	0	14		See Multicast Message Header.
Stock	14	8	Alpha	See Symbol in Data Types section
Event Code	22	1	Alpha	'H' = Stock Halted 'R' = Stock Resumed

## 5.4 Order Messages

### 5.4.1 Add Order Message

The Add Order message is sent whenever a new order has been accepted, inserted into the book and is displayable by the Matching System.

The following orders will NOT be included in the order messages that are part of the CHX Book Feed:

- Rejected Orders
- Incoming orders which match entirely
- Incoming orders which partially match and the remainder of the order is cancelled
- Undisplayed orders
- Undisplayed portion of reserve orders
- Cross orders

Matched orders which involve a resting undisplayed order and cross orders will be reflected in the CHX Book Feed as trade messages (see below).

All displayable odd lot, round lot and mixed lot orders will be included in the CHX Book Feed. The CHX displayed quote at the SIAC or NASDAQ SIP may or may not contain the entire quantity of the odd lot and mixed lot orders. The Matching System aggregates all displayable orders at the top of book price point, then rounds the total down to the nearest round lot quantity before sending the CHX quote to SIAC or the NASDAQ SIP (CQS, UQDF). For example, if the Matching System

has an odd lot order for 25 shares, a round lot for 200, and a mixed lot order for 125 at the top of the book, the Matching System will only quote 300 shares of the 350 shares. If subscribers want to reconcile the CHX Book Feed with the CHX displayed quote, they will need to replicate the order display logic described above.

Each Order Sender's Trading Account will be configured to specify whether by default they want their orders to be attributed or anonymous in the CHX Book Feed. The Trading Account attribution setting can be overridden on each individual order. Please refer to the CHX FIX Specification or CHX DAS Specification for more information on setting anonymity on an order by order basis.

Name	Offset	Length	Data Type	Comments
Message Header	0	14		See Multicast Message Header.
Stock	14	8	Alpha	See Symbol in Data Types section
Order Reference ID	22	20	Alpha	See Order Reference ID in Data Types section
Shares	42	4	Numeric	Total number of shares added to the book.
Price	46	4	Price	The display price for the order.
Price Denominator Code	50	1	Alpha	See Denominator Code Table.
Side	51	1	Alpha	'B' = Buy Order 'S' = Sell Order
Attributed	52	4	Alpha	If the order is attributed the Attributed field will contain the original Trading Account ID; otherwise if the order is anonymous the field will contain 'ANON'.

## 5.4.2 Execute Order Message

The Execute Order message is sent whenever a displayed order in the Matching System is executed. The Book Feed subscriber may receive multiple execute order messages for any order in the Matching System.

Name	Offset	Length	Data Type	Comments
Message Header	0	14		See Multicast Message Header.
Stock	14	8	Alpha	See Symbol in Data Types section
Order Reference ID	22	20	Alpha	See Order Reference ID in Data Types section
Shares	42	4	Numeric	Total number of shares executed.
Price	46	4	Price	The display price of the order.

Name	Offset	Length	Data Type	Comments
Price Denominator Code	50	1	Alpha	See Denominator Code Table
Side	51	1	Alpha	'B' = Buy Order 'S' = Sell Order
Trade Reference ID	52	12	Numeric	If the resting order was matched, this field will contain the Trade Reference ID assigned to the trade. This ID will be unique for the day.
Trade Price	64	4	Numeric	Price of Execution.
Trade Price Denominator Code	68	1	Alpha	See Denominator Code Table

### 5.4.3 Modify Order Message

The Modify Order message is sent whenever an order in the Matching System is modified *without* changing it's priority in the Matching System. This typically occurs if the order was cancel changed to reduce volume.

The Modify Order message contains a New Order Reference ID and an Original Order Reference ID. Any future activities on this order will be referenced by the New Order Reference ID.

Name	Offset	Length	Data Type	Comments
Message Header	0	14		See Multicast Message Header.
Stock	14	8	Alpha	See Symbol in Data Types section
Original Order Reference ID	22	20	Alpha	See Order Reference ID in Data Types section
Shares	42	4	Numeric	Shares remaining on the original order before change
Price	46	4	Price	The display price of the order.
Price Denominator Code	50	1	Alpha	See Denominator Code Table
Side	51	1	Alpha	'B' = Buy Order 'S' = Sell Order
New Order Reference ID	52	20	Alpha	See Order Reference ID in Data Types section
New Shares	72	4	Numeric	New shares for order

## 5.4.4 Delete Order Message

The Delete Order message is sent whenever a Matching System displayed order is removed from the book. Typically this is the result of an order being completely canceled.

An order can be deleted as the result of a cancel request, a cancel/change request, an order expiration, a regulatory trading halt (if the order has been identified as a cancel on halt order), or a CHX system halt.

Name	Offset	Length	Data Type	Comments
Message Header	0	14		See Multicast Message Header.
Stock	14	8	Alpha	See Symbol in Data Types section
Order Reference ID	22	20	Alpha	See Order Reference ID in Data Types section
Shares	42	4	Numeric	Number of shares canceled
Price	46	4	Price	The display price of the deleted order.
Price Denominator Code	50	1	Alpha	See Denominator Code Table.
Side	51	1	Alpha	'B' = Buy Order 'S' = Sell Order

## 5.5 Trade Messages

Trade messages are sent as the result of matched order activity which involves a resting undisplayed order or as the result of cross activity.

Trade messages are not required to maintain a copy of the Matching System book; i.e., subscribers can maintain a copy of the Matching System book by processing only the CHX Book Feed order messages.

Trade messages allow subscribers to reconcile differences between time-and-sales information and the CHX Book Feed messages as the trade messages include executions of undisplayed orders which are not included in the CHX Book Feed.

### 5.5.1 Match Trade Message

The Match Trade message is sent whenever a resting undisplayed order is matched in the Matching System.

Multiple Match Trade messages may be received for orders which are executed in parts. Order matches can involve odd lot orders, the odd lot portion of mixed lot orders, undisplayed orders, or the undisplayed portion of a reserve order.

The Match Trade message will only be sent for the resting order of the match trade.

Name	Offset	Length	Data Type	Comments
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Message Header	0	14		See Multicast Message Header.
Stock	14	8	Alpha	See Symbol in Data Types section
Trade Reference ID	22	12	Numeric	Trade Reference ID assigned to each trade. This ID will be unique for the day.
Shares	34	4	Numeric	Number of shares.
Price	38	4	Price	Price of the trade.
Price Denominator Code	42	1	Alpha	See Denominator Code Table.

## 5.5.2 Cross Trade Message

The Cross Trade message is sent whenever a cross order is executed in the Matching System.

Name	Offset	Length	Data Type	Comments
Message Header	0	14		See Multicast Message Header.
Stock	14	8	Alpha	See Symbol in Data Types section
Trade Reference ID	22	12	Numeric	Trade Reference ID assigned to each trade. This ID will be unique for the day.
Shares	34	4	Numeric	Number of shares.
Price	38	4	Price	Price of the trade.
Price Denominator Code	42	1	Alpha	See Denominator Code Table.
Type	43	1	Alpha	'E' = Early Session Cross 'I' = Regular Session Cross 'T' = Extended Session Cross 'C' = Late Session Cross

## 5.5.3 Delete Trade Message

The Delete Trade message is sent whenever a Matching System trade is 'busted' at the CHX.

The Trade Reference identifies the original trade in case cumulative calculations maintained by the subscriber such as Daily High and Low, Daily Volume, or Historical Time-and-Sales need to be adjusted.

Name	Offset	Length	Data Type	Comments
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Message Header	0	14		See Multicast Message Header.
Stock	14	8	Alpha	
Trade Reference ID	22	12	Numeric	See Symbol in Data Types section

## 5.6 Retransmission Message Header

All of the CHX Book Feed Retransmission messages contain a Retransmission Message Header. The header contains the Message Length, Message Type, Message Version, Source ID, and Timestamp.

The Message Version will allow subscribers to upgrade to future upgrades of the CHX Book Feed at their own convenience. Currently, there is only one version of the CHX Book Feed.

The Timestamp is in GMT (Greenwich Mean Time).

Name	Offset	Length	Data Type	Comments
Message Length	0	2	Numeric	Message length including the Multicast Message Header length.
Message Type	2	1	Numeric	1 = Login Request Message 2 = Login Accepted Message 3 = Login Rejected Message 4 = Logoff Request Message 60 = Retransmission Request Message 61 = Retransmission Request Response Message
Message Version	3	1	Alpha	Message Version Number. Currently only version 1 is supported.
Timestamp	4	4	Timestamp	See Timestamps in the Data Types section.

## 5.7 Retransmission Session Control Messages

Session Control messages are used to maintain the CHX Book Feed retransmission connection. Session Control messages do not update the Transmission Sequence Number and will not be retransmitted.

### 5.7.1 Login Request Message

The Login Request message is sent by the CHX Book Feed subscriber to start the retransmission TCP/IP session.

If a Login Request message is not received within 30 seconds of the initial connection, a Login Reject message will be sent.

If the Login Request does not contain the correct Message Version in the Multicast Message Header, a Login Reject message will be sent.

Name	Offset	Length	Data Type	Comments
Message Header	0	8		See Retransmission Message Header.
Logon ID	8	4	Alpha	Subscriber identifier.

## 5.7.2 Login Accepted Message

The Login Accepted message is sent to the subscriber to acknowledge a successful login.

The Login Accepted message contains only the message header.

## 5.7.3 Login Reject Message

The Login Reject message is sent to the subscriber in response to an invalid Login Request message or a login timeout. The Reject Reason Code field will explain why the Login Request was rejected. The Login Reject will cause the CHX Book Feed connection to be closed.

Name	Offset	Length	Data Type	Comments
Message Header	0	8		See Retransmission Message Header
Reject Reason Code	8	1	Alpha	'V' = Invalid Version Number 'T' = Connection Timeout

## 5.7.4 Logoff Request Message

The Logoff Request message is sent by the subscriber to end a session and disconnect from the CHX Book Feed.

The Logoff Request message contains only the message header.

## 5.8 Recovery Messages

### 5.8.1 Retransmission Request Message

The Retransmission Request message is sent by the subscriber whenever messages need to be recovered.

Name	Offset	Length	Data Type	Comments
Message Header	0	8		See Retransmission Message Header.
Source ID	8	1	Numeric	Book Feed Source identifier
Start Sequence Number	9	4	Numeric	First message requested in the retransmission sequence.
End Sequence Number	13	4	Numeric	Last message requested in the retransmission sequence

### 5.8.2 Retransmission Request Response Message

The Retransmission Request Response message is sent to the subscriber to acknowledge and update the subscriber of the status of retransmission request.

Name	Offset	Length	Data Type	Comments
Message Header	0	8		See Retransmission Message Header
Source ID	8	1	Numeric	Book Feed Source identifier
Request Response	9	1	Numeric	0 = Request Accepted 1 = Request Rejected – Permission Denied 2 = Request Rejected – Invalid range 3 = Request Rejected – Exceeded maximum range 4 = Request Rejected – Exceeded maximum requests