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Document title

## **NYSE BONDS DEPTH OF BOOK CLIENT SPECIFICATION**

Version

4.01

Date

28 Oct 2014

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## PREFACE

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### DOCUMENT HISTORY

The following table provides a description of all changes to this document.

VERSION NO.	DATE	CHANGE DESCRIPTION
3.00	11/17/2005	Added FIX FAST information
3.01	01/05/2006	Changed bond message content for add, modify, and delete messages
3.02	01/10/2006	Changed bond message content for add, modify, delete, imbalance, and system event
3.03	03/06/2006	Reorganization and copy edits. Spec name change. Bond symbology clarification and new fields in application messages for bonds.
3.04	03/10/2006	Adjusted Auction Times
3.05	03/13/2006	Adjusted alignments
3.06	05/17/2006	Change System Event message type and add Halt and Unhalt Codes for Bonds
3.07	06/05/2006	Removed Trading Action Codes 6 & 7 for Bonds
3.08	08/07/2006	Added new Trading Action Codes 6-10
3.09a	04/29/2010	Formatted into new template
3.10	04/24/2012	Minor updates to Appendix and throughout
	09/04/2012	Rebranded with new NYSE Technologies template
4.0	04/16/2014	Removed references to NYSE ArcaBook for Equities. Rebranded to NYSE Bonds trading platform and NYSE Bonds data feed.
4.01	10/28/2014	Simplified document introduction. Added support for AON and Min Quantity orders: Add & Mod msg types: <ol style="list-style-type: none"> <li>1. changed reserved QuoteCond field to OrderType field</li> <li>2. added MinimumQuantity field</li> </ol>

### REFERENCE MATERIAL

The following lists the associated documents, which either should be read in conjunction with this document or which provide other relevant information for the user:

- [SFTI US Technical Specification](#)
- [SFTI US Customer Guide](#)
- [NYSE Symbology](#)

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**FURTHER INFORMATION**

- For additional product information, visit: <http://www.nyxdata.com/Data-Products/NYSE-ArcaBook>
- For updated capacity figures, visit our capacity pages at: <http://www.nyxdata.com/capacity>
- For details of IP addresses, visit our IP address pages at: <http://www.nyxdata.com/ipaddresses>
- For a full glossary, visit: <http://www.nyxdata.com/glossary/>

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## 1. INTRODUCTION

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NYSE ArcaBook is a real-time binary data feed that disseminates order/consolidated book information from the NYSE Bonds market. NYSE ArcaBook allows subscribers to produce and display the NYSE Bonds open order book, consolidated book or ticker. Order routing algorithms can also use NYSE ArcaBook data.

This specification is for developers that wish to write applications that interface with the NYSE Bonds market.

### 1.1 NYSE BONDS INTERFACE

This API is message-based, using fixed length messages over the TCP IP protocol with binary numeric and fixed length ASCII fields. Binary values are in network order (Big-Endian) format.

The interface contains the following categories of messages:

- Session Management, to manage connections
- Application Messages, to disseminate order and order modification data

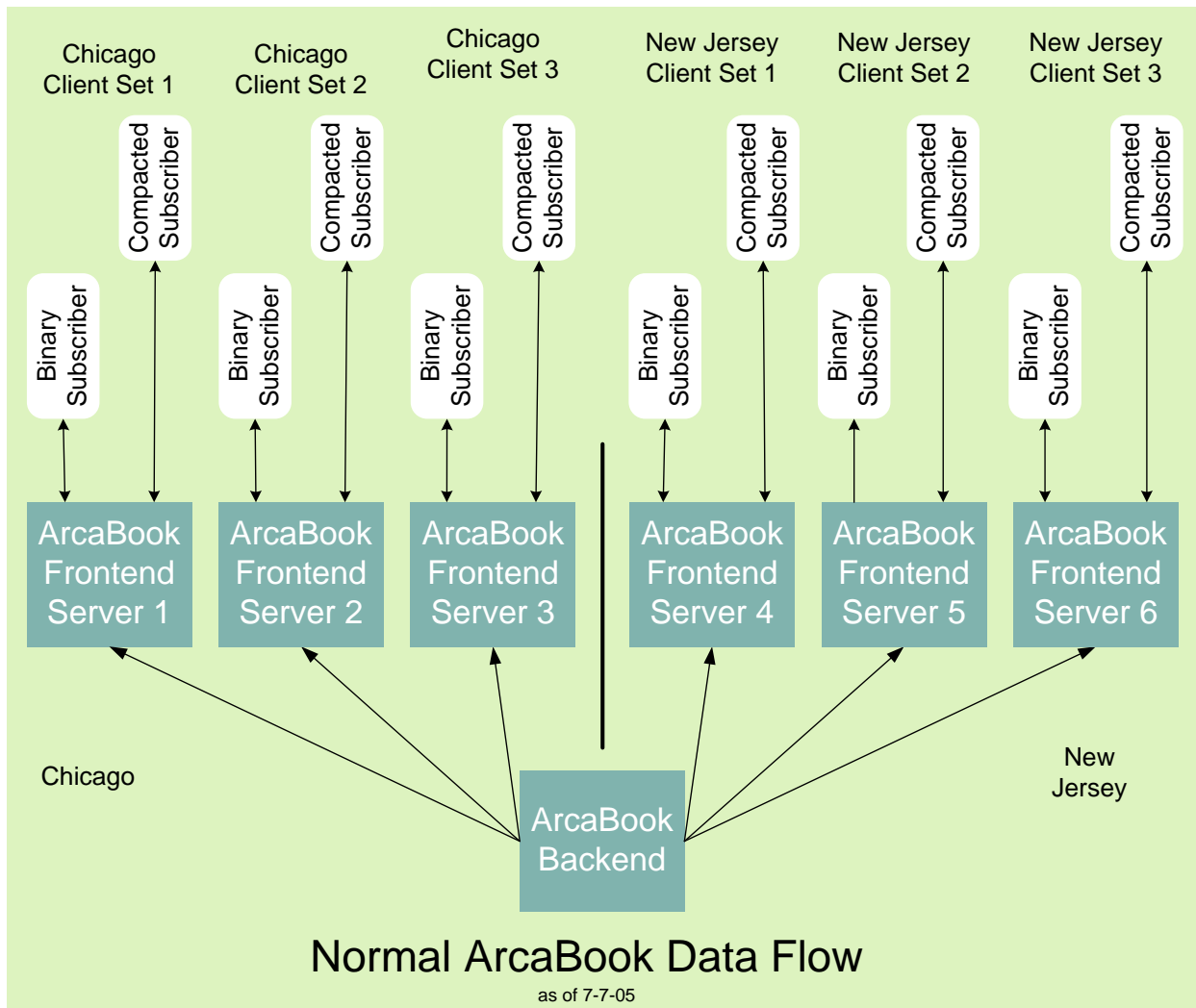
#### 1.1.1 NYSE Bonds API Certification

Subscribers must certify their NYSE Bonds subscription clients with NYSE Bonds platform. NYSE Bonds provides an IP address, port number, username, and password to use for testing. To schedule a test, please contact the Service Desk.

### 1.2 SYSTEM ARCHITECTURE

NYSE Bonds platform has several instances of NYSE Bonds depth of book data running in both its New Jersey and Chicago data centers. Subscribers connect to an IP address and port on one of these instances for either the binary data feed or the FAST compacted data feed as shown in Figure 1 below.

Figure 1 Normal NYSE ArcaBook Data Flow



## 2. COMMUNICATION

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### 2.1 ACCESS

NYSE Bonds clients connect via TCP/IP to a predefined IP address and port for either the binary data feed or the FAST compacted feed.

Clients may connect to both a primary connection and a secondary connection to assist in recovery. Clients must log in before NYSE Bonds begins broadcasting data to them.

Clients supply NYSE Bonds platform with their IP address and port and request either the binary or FAST compacted data feed. NYSE Bonds supplies clients with the:

- IP address for the data feed the client has requested
- Port for the data feed the client has requested
- A username
- A password

NYSE Bonds is accessible from 3:30a.m EST to 8:00p.m EST. NYSE Bonds may be accessible prior to or after these times depending on start- and end-of-day processing.

### 2.2 SESSIONS

NYSE Bonds begins accepting connections at the beginning of NYSE Bond exchange's trading day and shuts down after the close of the NYSE Bonds. Once NYSE Bonds exchange begins accepting orders, NYSE Bonds begins broadcasting to clients that have logged in.

Clients must log in within five seconds after establishing a TCP/IP connection or NYSE Bonds closes the connection. Each user ID may have only one client session active at any given time with NYSE Bonds.

Once clients have successfully logged in, NYSE Bonds immediately sends messages starting from the sequence number the client specified in the Login message. This sequence number must be between zero (0) and the most current sequence number assigned by NYSE Bonds. To begin receiving current updates, a client logs in with a starting sequence number of zero (0).

Clients may close the client session with the Logoff message or they may simply close the TCP/IP socket.

#### 2.2.1 TCP/IP Connections

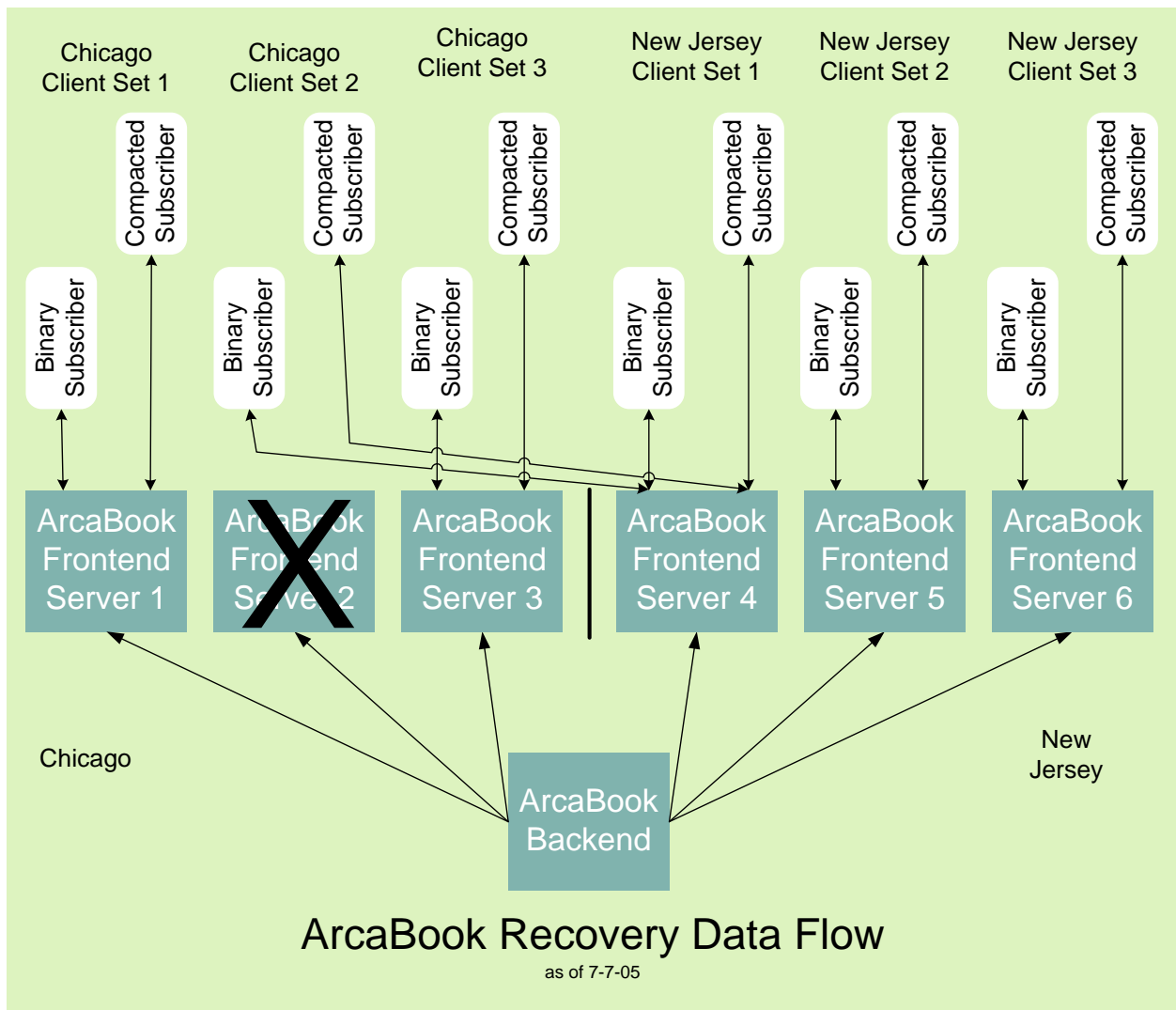
NYSE Bonds sends Heartbeat messages during periods of client inactivity to verify the TCP/IP connection is still active. Clients must respond with a Heartbeat Response message or NYSE Bonds will close the connection. Clients may use the Test Request message to test the connection to NYSE Bonds.

When an NYSE Bonds TCP/IP connection fails, clients must reconnect and log in again. Clients can specify the sequence number of the last message they received to ensure data integrity. If the requested sequence number is greater than zero (0) in a login message, NYSE Bonds begins sending messages from the requested sequence number.

### 2.3 RECOVERY

Subscribers are assigned a primary IP address to connect to NYSE Bonds (see [Figure 1](#)). Subscribers with connections to both NYSE Bonds in Chicago and New Jersey data centers may also be issued a secondary IP address to connect to for recovery purposes.

This diagram shows the NYSE Bonds data flow after connections are rerouted because of a failure. Message sequence numbers may be different in each data center.





### 3. MESSAGES

NYSE Bonds messages sent from the server begin with a four byte standard header, indicating the type of message and the length of the message body, followed by fixed length fields specific to a given message. Outbound messages do **not** end with a termination character. Data may be numeric or alphanumeric (see [Data Types](#) for more information).

**Table 1 NYSE ArcaBook Standard Message Header**

NYSE ARCABOOK MESSAGE HEADER	OFFSET	LENGTH	TYPE	NOTES AND VALUE
Message Body Length	0	2	Numeric	0-76 (value excludes 4 byte header)
Message Type	2	1	Alpha	Character indicating the type of message
Padding	3	1	Alpha	Not used

Client messages do **not** use the standard header. They should use alpha data (ASCII) and should end with the message terminating character <ETX>. Table 2 lists NYSE Bonds messages and message types by the sending system.

**Table 2 NYSE Bonds Client and Server Messages**

	CLIENT MESSAGES (TYPE)	SERVER MESSAGES (TYPES)
Session management messages	Login (L)	
		Login Accepted (Q)
		Login Rejected (R)
	Logoff (O)	
		Heartbeat (H)
	Heartbeat Response (H)	
	Test Request (T)	
		Test Response (S)
Application messages for bonds		Add Order (N)
		Modify Order (C)
		Delete Order (K)
		Imbalance (W)
		System Event (Y)

#### 3.1 DATA TYPES

All numeric fields, **except** Price Scale Code and Auction Time, are in unsigned binary. Price Scale Code and Auction Time are alphanumeric. All alphanumeric fields are left justified and null padded. Alphanumeric fields may not terminate in a null character if their full length is used for data.

Binary data is in network Endian (Big-Endian) format. Depending on their machine architecture, clients may have to perform conversions to properly process the incoming network byte order.

### 3.1.1 Sequence Numbers

Sequence Numbers are assigned to application messages and are four byte integers. These numbers start at one (1) at the beginning of a trading session and increment for each new message. Clients may use sequence numbers to recover missed messages. See [Recovery](#) for more information.

### 3.1.2 Prices

Prices are four byte integers in binary. The decimal position can be determined from the value in the Price Scale Code field. To determine the decimal price, divide the whole integer price by the denominator value shown in Table 3.

- Example 1: Whole integer price is 1350 and the price scale code is 2. The decimal price =  $1350 \div 100 (10^2) = 13.50$ .
- Example 2: Whole integer price is 135000 and the price scale code is 4. The decimal price =  $135000 \div 10,000 (10^4) = 13.50$ .
- Example 3: Whole integer price is 25 and the price scale code is 0. No division is necessary ( $10^0 = 1$ ). The result is a price of 25 (same 25.00).

**Table 3: Price Scale Codes**

PRICE SCALE CODE	DENOMINATOR VALUE	DENOMINATOR VALUE (FACTOR OF 10)
0	N/A	N/A
1	10	$10^1 (101)$
2	100	$10^2 (102)$
3	1,000	$10^3 (103)$
4	10,000	$10^4 (104)$
5	100,000	$10^5 (105)$
6	1,000,000	$10^6 (106)$

**Note:** Price Scale Code of 0 indicates that the whole integer price in the price field is the actual price and no conversion or division is necessary.

### 3.1.3 Timestamps

The timestamp field is a four byte integer that provides time in milliseconds starting from Midnight (00:00:00:000) of the trading day. NYSE Bonds computes timestamps as:

Seconds x 1000 + milliseconds

For example, the timestamp for 10:00:00:.376 is converted to

$(36000 \times 1000) + 376 = 36000376$ .

Clients can reverse this algorithm to obtain the number of seconds and milliseconds in a NYSE ArcaBook timestamp.

### 3.2 SYMBOLOGY

The symbology used for the Stock or Symbol fields in order messages depends on the type of security. This is directly related to the System Code field in a message which indicates the trading platform that processed this order.

- Bond orders for System Code = F (ArcaEx Fixed Income/Bond) use these identifiers:
  - CUSIP/ISIN for clients who satisfy licensing requirements. By default CUSIP data is not disseminated in messages and will be left null. CUSIP data is only disseminated to clients that request this by contacting the Service Desk.
  - NYSE Bond Symbol is a unique identifier for the bond assigned by NYSE®. See the Securities Master file at <http://www.nyxdata.com> for information correlating these symbols to bonds traded on NYSE Arca.

### 3.3 BOND PRICE TYPES

Generally, the price of a bond order is expressed as a percentage of par. However, some bonds may express price in other manners such as yield-to-maturity.

The type of pricing used for bonds is not included in NYSE Bonds messages. Clients can determine this from the Securities Master file at <http://www.nyxdata.com>.

### 3.4 BINARY VERSUS COMPACTED FORMATS

The fixed length message formats specified in Sections 4 and 5 represent the original binary versions of messages for NYSE Bonds. For clients that request the FAST compacted data feed, the compacted message must be de-compacted to obtain the binary format of the message. Clients must also track the previous values of each field in order to properly reconstitute data that has been omitted from a compacted message. See [FIX FAST Protocol](#) for details.

## 4. SESSION MANAGEMENT MESSAGES

NYSE Bonds uses these messages to begin and end sessions, to define subscriptions, to recover messages after disconnections and to test the TCP/IP connections. See [Sessions](#) and [Recovery](#) for more information on session management.

### 4.1 LOGIN MESSAGE

Clients send this message to authenticate the subscriber and specify which types of order data the session is subscribing to (e.g. ArcaEx Bonds).

Clients can subscribe to any number of order data feeds. If the message does not specify any subscriptions, NYSE Bonds returns a Login Rejected message and closes the connection.

**Note:** If a client chooses to change subscriptions intraday (by disconnecting the original session and sending a new Login message with different subscriptions), the sequence numbers from the new NYSE Bonds session will not be the same as the sequence numbers from the original session.

Clients also specify a starting message sequence number which can request either current data (0) or messages beginning from a specific sequence number (for recovery). If this field is null or blank or the number specified is greater than NYSE Bonds' current sequence number, NYSE Bonds simply begins sending current messages. If this field is negative, NYSE Bonds returns a Login Rejected message and closes the connection.

See [Sessions](#) for more information.

**Table 4 Login Message Format**

Note: The Listed, ETF, OTC, and Global OTC subscriptions are for legacy ArcaBook for Equities data. Clients should only send a Login Message for NYSE Bonds data.

LOGIN MESSAGE	OFFSET	SIZE (BYTES)	FORMAT	DESCRIPTION
Message Type	0	1	Alpha	'L'
Username	1	8	Alpha	Username
Password	9	10	Alpha	Password
Sequence Number	19	10	Alpha/Numeric	Recovery sequence number or 0 to receive current updates. 0 – 2147483647
Listed Subscription	29	1	Alpha	'Y' - Yes 'N' - No
ETF Subscription	30	1	Alpha	'Y' - Yes 'N' - No
OTC Subscription	31	1	Alpha	'Y' - Yes 'N' - No
Global OTC Subscription	32	1	Alpha	'Y' - Yes 'N' - No

LOGIN MESSAGE	OFFSET	SIZE (BYTES)	FORMAT	DESCRIPTION
<b>Bond Subscription</b>	33	1	Alpha	'Y' - Yes 'N' - No
<b>ETX</b>	34	1	Numeric	Message Terminating Character

#### 4.2 LOGIN ACCEPTED MESSAGE

NYSE Bonds sends this message to indicate a successful login. This message also includes the current version of NYSE Bonds.

**Table 5 Login Accepted Message Format**

LOGIN ACCEPTED MESSAGE	OFFSET	SIZE (BYTES)	FORMAT	DESCRIPTION
<b>Message Body Length</b>	0	2	Numeric	Length excluding the standard header.
<b>Message Type</b>	2	1	Alpha	'Q'
<b>Padding</b>	3	1	Alpha	Not used
<b>Login Accepted Message Body</b>				
<b>Version ID</b>	4	5	Alpha	Version of NYSE ArcaBook protocol (vv.vv)
<b>Padding</b>	9	1	Alpha	Not used

#### 4.3 LOGIN REJECTED MESSAGE

NYSE Bonds sends this message in response to a Login message when:

- The Login Message failed authentication.
- The client connected to NYSE Bonds but failed to log in within 5 seconds.
- The client did not subscribe to any order data feeds.
- The sequence number in the Login message was invalid
- NYSE Bonds has no available connections
- A timeout occurred

After sending this message, NYSE Bonds closes the socket connection.

**Table 6 Login Rejected Message Format**

LOGIN REJECTED MESSAGE	OFFSET	SIZE (BYTES)	FORMAT	DESCRIPTION
Message Body Length	0	2	Numeric	Length excluding the standard header.
Message Type	2	1	Alpha	'R'
Padding	3	1	Alpha	Not used
<b>Login Rejected Message Body</b>				
Reject Code	4	1	Alpha	'A' - Not Authorized 'M' - Maximum Server Connections Reached 'R' - Invalid Subscription 'S' - Invalid Sequence 'T' - Timeout
Padding	5	1	Alpha	Not used

**4.4 LOGOFF MESSAGE**

Clients send this message to close a session. This message only has a message type.

**Table 7 Logoff Message Format**

LOGOFF MESSAGE	OFFSET	SIZE (BYTES)	FORMAT	DESCRIPTION
Message Type	0	1	Alpha	'O'
ETX	1	1	Numeric	Message Terminating Character

**4.5 HEARTBEAT REQUEST MESSAGE**

NYSE Bonds sends this message every 60 seconds during periods of **client** inactivity. This prevents some firewalls from timing out the TCP/IP connection. Clients must respond with a Heartbeat Response. This message only has a message type.

**Table 8 Heartbeat Request Message Format**

HEARTBEAT REQUEST MESSAGE	OFFSET	SIZE (BYTES)	FORMAT	DESCRIPTION
Message Body Length	0	2	Numeric	Always zero (0). There is no message body.
Message Type	2	1	Alpha	'H'
Padding	3	1	Alpha	Not used

#### 4.6 HEARTBEAT RESPONSE MESSAGE

Clients send this message in response to a Heartbeat Request message. If clients do not respond within 60 seconds of NYSE Bonds sending a Heartbeat request, NYSE Bonds closes the connection. This message only has a message type.

**Table 9 Heartbeat Response Message Format**

HEARTBEAT RESPONSE MESSAGE	OFFSET	SIZE (BYTES)	FORMAT	DESCRIPTION
Message Type	0	1	Alpha	'H'
ETX	1	1	Numeric	Message Terminating Character

#### 4.7 TEST REQUEST MESSAGE

Clients can send this message to regularly signal or to test that the TCP/IP connection to NYSE Bonds is open. Clients can specify a text message for NYSE Bonds to echo back.

**Table 10 Test Request Message Format**

TEST REQUEST MESSAGE	OFFSET	LEN	SIZE (BYTES)	FORMAT
Message Type	0	1	Alpha	'T'
Test Message	1	20	Alpha	Optional text to be echoed
ETX	21	1	Numeric	Message Terminating Character

#### 4.8 TEST RESPONSE MESSAGE

NYSE Bonds sends this message in response to a Test Request message. If the Test Request message specifies text, NYSE Bonds echoes this text back to the client.

**Table 11 Test Response Message Format**

TEST RESPONSE MESSAGE	OFFSET	SIZE (BYTES)	FORMAT	DESCRIPTION
Message Body Length	0	2	Numeric	20 bytes (value excludes 4 byte header)
Message Type	2	1	Alpha	'S'
Padding	3	1	Alpha	Not used
<b>Test Response Message Body</b>				
Test Message	4	20	Alpha	Text sent in Test Request message

## 5. APPLICATION MESSAGES

NYSE Bonds does not send order messages (Add, Modify or Delete Order) for orders that are entered in NYSE Bonds exchange order books during Pre-Open (7:30am to 8:00am EST) or for Odd Lot quotes.

### 5.1 ADD ORDER MESSAGE

NYSE Bonds sends this message for a new open order. The order reference number is a unique identifier for an order within one order book (per trading platform indicated by system code). The sequence number is a unique identifier for the NYSE Bonds message across all trading platforms (system codes).

For attributed orders, NYSE Bonds includes the appropriate market maker ID (MMID) in the Quote ID field. The MMID is the first four letters of a firm's ETPID. For example, if Broker Dealer ABCDE designates that an order should be attributed, the QuoteID for the order becomes AABCD. For orders that are not attributed, the Quote ID field is ARCA.

ADD BOND ORDER MESSAGE	OFFSET	SIZE (BYTES)	FORMAT	DESCRIPTION
Message Body Length	0	2	Numeric	76 bytes (value excludes 4 byte header)
Message Type	2	1	Alpha	'N'
Padding	3	1	Alpha	Not used
<b>Add Order Message Body for Bonds</b>				
Time	4	4	Numeric	Message creation timestamp.
Sequence Number	8	4	Numeric	1 – 2147483647
Order Reference Number	12	4	Numeric	The unique reference number per system code assigned to this new order
Quantity	16	4	Numeric	The size of the order.
Price	20	4	Numeric	The limit price of the bond order. See <a href="#">Bond Price Types</a> .
Price Scale Code	24	1	Alpha/Numeric	See <a href="#">Prices</a> for details
Exchange Code	25	1	Alpha	'N' - NYSE listed bond Blank - any other bond
System Code	26	1	Alpha	'F' - Bonds
Buy/Sell Indicator	27	1	Alpha	'B' - Buy order 'S' - Sell order
Flat Pricing	28	1	Alpha	'F' - flat pricing is in effect Blank - interest pricing is in effect
Trading Action	29	1	Numeric	The current state of trading:



ADD BOND ORDER MESSAGE	OFFSET	SIZE (BYTES)	FORMAT	DESCRIPTION
				1 - Called 2 - De-listed 3 - Ex-interest 4 - missed an interest payment 5 - Bankrupt 6 - Late Filing 7 - Below Listing Standards 8 - Late Filing and Below Listing Standards 9 - Bankrupt and Late Filing 10 - Bankrupt and Below Listing Standards
<b>Security Type</b>	30	1	Numeric	The type of bond. Additional types will be supported in future releases. 1 - corporate bonds
<b>Order Type Indicator</b>	31	1	Numeric	0 – Unspecified 1 – All or None 2 – Minimum Quantity
<b>NYSE Bond Symbol</b>	32	22	Alpha	A NYSE Bonds -specific identity for this bond. See <a href="#">Symbology</a> for more information
<b>CUSIP/ISIN</b>	54	14	Alpha	CUSIP/ISIN for the bond. This field is null unless clients have requested the data and have a license.
<b>Quote ID</b>	68	5	Alpha	'A'+MMID - attributed 'ARCAX' - non-attributed Bonds quote
<b>Padding</b>	73	3	Alpha	Not used
<b>Minimum Quantity</b>	76	4	Numeric	For Order Type Indicator = 0, 0. For Order Type Indicator = 1, the quantity of the order. Order Type Indicator = 2, the minimum quantity of the order.

## 5.2 MODIFY ORDER MESSAGE

NYSE Bonds sends this message when an order in an NYSE Bonds book is modified. The order reference number refers to the original order sent in the add order message. The following events trigger a modify order message.

- The price of an order changes
- The size of an order changes
- An order is partially filled
- An order is routed to an away market with some shares remaining in the NYSE Bonds book

Note: If an away market declines the NYSE Bonds preference, a Modify Order message is sent to “add” the declined shares back to the NYSE Bonds book.

MODIFY BOND ORDER MESSAGE	OFFSET	SIZE (BYTES)	FORMAT	DESCRIPTION
Message Body Length	0	2	Numeric	76 bytes (value excludes 4 byte header)
Message Type	2	1	Alpha	'C'
Padding	3	1	Alpha	Not used
<b>Modify Order Message Body for Bonds</b>				
Time	4	4	Numeric	Message creation timestamp in milliseconds since Midnight.
Sequence Number	8	4	Numeric	1 – 2147483647
Order Reference Number	12	4	Numeric	The unique reference number per order book (system code) assigned to the original order
Quantity	16	4	Numeric	The size of the order
Price	20	4	Numeric	The limit price of the bond order. See <a href="#">Bond Price Types</a> .
Price Scale Code	24	1	Alpha/Numeric	See <a href="#">Prices</a> for details
Exchange Code	25	1	Alpha	'N' - NYSE listed bond Blank - any other bond
System Code	26	1	Alpha	'F' - Bonds
Buy/Sell Indicator	27	1	Alpha	'B' - Buy order 'S' - Sell order
Flat Pricing	28	1	Alpha	'F' - flat pricing is in effect Blank - interest pricing is in effect
Trading Action	29	1	Numeric	The current state of trading:

MODIFY BOND ORDER MESSAGE	OFFSET	SIZE (BYTES)	FORMAT	DESCRIPTION
				1 - Called 2 - De-listed 3 - Ex-interest 4 - Missed an interest payment 5 - Bankrupt 6 - Late Filing 7 - Below Listing Standards 8 - Late Filing and Below Listing Standards 9 - Bankrupt and Late Filing 10 - Bankrupt and Below Listing Standards
<b>Security Type</b>	30	1	Numeric	The type of bond. Additional types will be supported in future releases.  1 - corporate bonds
<b>Order Type Indicator</b>	31	1	Numeric	0 – Unspecified 1 – All or None 2 – Minimum Quantity
<b>NYSE Bond Symbol</b>	32	22	Alpha	A NYSE Bonds -specific identity for this bond. See <a href="#">Symbology</a> for more information
<b>CUSIP/ISIN</b>	54	14	Alpha	CUSIP/ISIN for the bond. This field is null unless clients have requested the data and have a license.
<b>Quote ID</b>	68	5	Alpha	‘A’+MMID - attributed ‘ARCAX’ - non-attributed Bonds quote
<b>Padding</b>	73	3	Alpha	Not used
<b>Minimum Quantity</b>	76	4	Numeric	For Order Type Indicator = 0, 0.  For Order Type Indicator = 1, the quantity of the order.  For Order Type Indicator = 2, the minimum quantity of the order.

### 5.3 DELETE ORDER MESSAGE

The Delete Order message is sent when an order is taken off of the NYSE Bonds open order book. The following events will trigger the transmission of a delete order message.

- An order is cancelled
- An order expires
- An order is routed to an away market. Note: If the away market declines the NYSE Bonds preference, an Add Order message with the original order reference number will be sent to return the order to the NYSE Bonds book.
- An order is filled

DELETE BOND ORDER MESSAGE	OFFSET	SIZE (BYTES)	FORMAT	DESCRIPTION
Message Body Length	0	2	Numeric	60 bytes (value excludes 4 byte header)
Message Type	2	1	Alpha	'K'
Padding	3	1	Alpha	Not used
<b>Delete Order Message Body for Bonds</b>				
Time	4	4	Numeric	Message creation timestamp in milliseconds since Midnight.
Sequence Number	8	4	Numeric	1 – 2147483647
Order Reference Number	12	4	Numeric	The unique reference number per order book (system code) assigned to the original order
Exchange Code	16	1	Alpha	'N' - NYSE listed bond Blank - any other bond
System Code	17	1	Alpha	'F' - Bonds
Buy/Sell Indicator	18	1	Alpha	'B' - Buy order 'S' - Sell order
Flat Pricing	19	1	Alpha	'F' - flat pricing is in effect Blank - interest pricing is in effect
Trading Action	20	1	Numeric	The current state of trading: 1 - Called 2 - De-listed 3 - Ex-interest 4 - Missed an interest payment 5 - Bankrupt 6 - Late Filing 7 - Below Listing Standards

DELETE BOND ORDER MESSAGE	OFFSET	SIZE (BYTES)	FORMAT	DESCRIPTION
				8 - Late Filing and Below Listing Standards 9 - Bankrupt and Late Filing 10 - Bankrupt and Below Listing Standards
<b>Security Type</b>	21	1	Numeric	The type of bond. Additional types will be supported in future releases. 1 - corporate bonds
<b>Order Type</b>	22	1	Numeric	0 – Unspecified 1 – All or None 2 – Minimum Quantity
<b>NYSE Bond Symbol</b>	23	22	Alpha	A NYSE Bonds -specific identity for this bond. See <a href="#">Symbology</a> for more information
<b>CUSIP/ISIN</b>	45	14	Alpha	CUSIP/ISIN for the bond. This field is null unless clients have requested the data and have a license.
<b>Quote ID</b>	59	5	Alpha	'A'+MMID - attributed 'ARCAX' - non-attributed Bonds quote

#### 5.4 IMBALANCE MESSAGE

NYSE Bonds sends this message in response to orders submitted during pending auctions. The message is sent between:

- 3:30am and 4:00am EST at the conclusion of the Opening Auction
- 4:00am and 9:30am EST at the conclusion of the Market Order Auction
- 3:00pm and 4:00pm EST at the conclusion of the Closing Auction

These times are subject to change. NYSE Bonds also disseminates imbalance information for Halt Auctions.

##### 5.4.1 Market Order Imbalance

The Market Order Imbalance is the imbalance of any remaining Market Orders (or Market-on-Close orders for the Closing Auction) that cannot execute in a Market Order or Closing Auction. Calculation of match size and indicative match price remain unchanged.

##### 5.4.2 Total Imbalance

The Total Imbalance is the net imbalance of orders at the indicative match price for all orders eligible for the next upcoming Auction. This includes Market (or Market-on-Close) and Limit Orders. Display of match size and indicative match price remain unchanged.

For auctions, the total imbalance volume and market imbalance volume will be negative for a sell imbalance.

BOND IMBALANCE MESSAGE	OFFSET	SIZE (BYTES)	FORMAT	DESCRIPTION
<b>Message Body Length</b>	0	2	Numeric	76 bytes (value excludes 4 byte header)
<b>Message Type</b>	2	1	Alpha	'W'
<b>Padding</b>	3	1	Alpha	Not used
<b>Imbalance Message Body for Bonds</b>				
<b>Time</b>	4	4	Numeric	Message creation timestamp in milliseconds from Midnight.
<b>Sequence Number</b>	8	4	Numeric	1 – 2147483647
<b>Match Quantity</b>	12	4	Numeric	The indicative match volume
<b>Total Imbalance</b>	16	4	Numeric	The total imbalance volume
<b>Market Imbalance</b>	20	4	Numeric	The market imbalance volume
<b>Price</b>	24	4	Numeric	The indicative match price
<b>Price Scale Code</b>	28	1	Alpha/Numeric	See <a href="#">Prices</a> for details
<b>Exchange Code</b>	29	1	Alpha	'N' - NYSE listed bond Blank - any other bond
<b>System Code</b>	30	1	Alpha	'F' - Bonds
<b>Auction Type</b>	31	1	Alpha	'O' - Open 'M' - Market 'H' - Halt 'C' - Closing
<b>Flat Pricing</b>	32	1	Alpha	'F' - flat pricing is in effect Blank - interest pricing is in effect
<b>Trading Action</b>	33	1	Numeric	The current state of trading: 1 - Called 2 - De-listed 3 - Ex-interest 4 - Missed an interest payment 5 - Bankrupt 6 - Late Filing 7 - Below Listing Standards 8 - Late Filing and Below Listing Standards

BOND IMBALANCE MESSAGE	OFFSET	SIZE (BYTES)	FORMAT	DESCRIPTION
				9 - Bankrupt and Late Filing 10 - Bankrupt and Below Listing Standards
<b>Security Type</b>	34	1	Numeric	The type of bond. Additional types will be supported in future releases. 1 - corporate bonds
<b>Quote Condition</b>	35	1	Numeric	Reserved for future use.
<b>NYSE Bond Symbol</b>	36	22	Alpha	A NYSE Bonds specific identity for this bond. See <a href="#">Symbology</a> for more information
<b>CUSIP/ISIN</b>	58	14	Alpha	CUSIP/ISIN for the bond. This field is null unless clients have requested the data and have a license.
<b>Auction Time</b>	72	4	Alpha/Numeric	Projected Auction Time (hhmm)

## 5.5 SYSTEM EVENT MESSAGE

NYSE Bonds sends this message to indicate a special system event to an order book. The Event Code field indicates what type of event has occurred. The System Code field indicates which order book is affected.

Event Code - 'C' indicates that all orders in the affected book (System Code) have been cancelled. This order book should be treated like a new day. Event Code - 'S' is not yet in use. This event code will indicate that all orders in the affected book for the corresponding Symbol have been cancelled.

The message also includes the next sequence number that subscribers should expect from NYSE Bonds. Generally this is the current sequence number + 1 but the sequence numbers may restart at 1.

SYSTEM EVENT MESSAGE	OFFSET	SIZE (BYTES)	FORMAT	DESCRIPTION
<b>Message Body Length</b>	0	2	Numeric	52 bytes (value excludes 4 byte header)
<b>Message Type</b>	2	1	Alpha	'Y'
<b>Padding</b>	3	1	Alpha	Not used
<b>System Event Message Body for Bonds</b>				
<b>Time</b>	4	4	Numeric	Message creation timestamp in milliseconds from Midnight.
<b>Sequence Number</b>	8	4	Numeric	The sequence number of this message. 1 – 2147483647
<b>Next Expected Sequence Number</b>	12	4	Numeric	The sequence number that subscribers should expect for the next NYSE Bonds message. 1 – 2147483647

SYSTEM EVENT MESSAGE	OFFSET	SIZE (BYTES)	FORMAT	DESCRIPTION
<b>Event Code</b>	16	1	Alpha	What type of event has occurred. 'C' - Clear Book by System Code 'S' - Clear Book by Symbol (reserved for future use) 'H' - Halt Symbol 'U' - UnHalt Symbol
<b>System Code</b>	17	1	Alpha	Which order book is affected: 'F' - Bonds
<b>NYSE Bond Symbol</b>	18	22	Alpha	A NYSE Bonds specific identity for this bond. See <a href="#">Symbology</a> for more information
<b>CUSIP/ISIN</b>	40	14	Alpha	CUSIP/ISIN for the bond. This field is null unless clients have requested the data and have a license.
<b>Padding</b>	54	2	Alpha	Not Used



## 6. FIX FAST PROTOCOL

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### 6.1 OVERVIEW

Subscribers receive the NYSE Bonds real-time data feed in the FAST Protocol. This protocol is a standard method for compacting real-time market data resulting in reduced bandwidth. The complete FAST specification is available at:

<http://fixprotocol.org/documents/1766/FAST%20SERDES%20Specification%200.5%202005-07-28.zip> and <http://fixprotocol.org/documents/1536/BMF%20Specification%200.14.zip>

Note: prior to downloading the FIX specifications, subscribers must register with the Fix Protocol Organization at <http://fixprotocol.org/register/>

The FAST Protocol uses two main approaches to reduce bandwidth:

- **Omit Redundant Fields** This uses two FAST features:
  - FAST Templates that specify the FAST field encoding to control field omission and reconstitution. Field encoding schemes define whether fields can be omitted and how they should be interpreted if omitted.
  - For example, Copy encoding specifies that if a field is not present, you should use a copy of the field from the previous message. Increment encoding specifies that you should use the previous value and increment it by some constant (usually 1). A field defined with an encoding scheme of None means that it will always be present.
  - Presence Map that indicates which fields are actually present in a message.
- **Variable Length Fields** That compact the bits used to represent a field's value. This uses continuation bit encoding to separate the fields. Only the first seven bits of a byte transmit data. The high bit is the continuation bit that indicates whether data for the field continues or stops. When the high bit is set, this is called a stop bit and indicates the end of the variable length field.

### 6.2 A FAST MESSAGE

A FAST message consists of a minimum of a one byte Presence Map (pmap) followed by zero or more bytes of field data, as shown below:

FastMessage ::= < pmap { pmap } > < { field } >

The pmap may be more than one byte and also uses continuation bit encoding (it ends in a stop bit). The pmap sets individual bits to either 1 or 0 to indicate if a specific field is present in the FAST message.

A field within a FAST message can represent one of four data types:

- Signed integer
- Unsigned integer
- ASCII string
- Bitmap

All fields are variable length, ending in a stop bit.

### 6.3 THE NYSE BONDS FAST IMPLEMENTATION

The NYSE Bonds FAST implementation reduces bandwidth requirements by up to 50%. Each message within the FAST NYSE Bonds data feed has a minimum of three bytes: a Presence Map of at least one byte and a Message Type field of two byte. Note that there may be more than one byte in the pmap, but there will always be at least one. The encoding scheme of None for the message type field guarantees that it will be present in every message.

### 6.4 SAMPLE SOURCE CODE

To help subscribers process the NYSE Bonds FAST feed, NYSE Arca provides a single, C language routine, `AB_FastDecode()`, to decode NYSE Bonds FAST messages into NYSE Bonds binary messages. The following pseudo code, which includes use of the `AB_FastDecode` routine, describes the decoding process:

```

Define some variables to hold our input buffer and results
Integer length
Integer result
Byte buffer[2048]
ArcaBookMessage message;

Process until we are told to stop ..
Do

    Call the decode routine, we decode the FAST message in
    "buffer" and place the result in "message", "length" will
    contain the number of bytes we processed in "buffer".
    result = ABFastDecode(buffer, length, message)

    Check the result code
    If result == AB_OK Then
        process the ArcaBook message, and
        advance the buffer to buffer + length
        ProcessMessage(message)
    Else If result == AB_INCOMPLETE_ERROR Then
        buffer did not contain a full FAST message, so
        read up to 2048 bytes from the TCP socket
        and place the result into buffer
        length = SocketRead(buffer,1024)
    Else
        We encountered some other error
        ProcessError(result)
    End

While Stop == False

```

The pseudo code above is a very basic example. Please see the provided C source code for a full, working example.

### 6.5 FIELD TEMPLATE INFORMATION

The FAST template for each message indicates which fields may be omitted from a message and how clients should interpret omitted fields. NYSE Bonds FAST messages use the message type as the FAST template ID. Once clients have parsed the message type, the rest of the message can be parsed based on the template shown in the following table.

Table 12 NYSE Bonds FAST Message Template

FIELD ID	FIELD NAME	IN MESSAGES OF TYPE	FAST TYPE	ENCODING
0	AB_MSG_TYPE	All	ASCII	None
1	AB_TIME	A, D, M, I and V	Unsigned32	Copy
2	AB_SEQUENCE	A, D, M, I and V	Unsigned32	Increment
3	AB_ORDER_REF	A, D, and M	Unsigned32	Increment
	AB_MATCH_QTY	I		
	AB_EXPECTED_SEQUENCE	V		
4	AB_SHARES	A and M	Unsigned32	Copy
	AB_IMBALANCE	I		
5	AB_PRICE	A, M and I	Unsigned32	Copy
6	AB_PRICE_SCALE	A, M and I	ASCII	Copy
7	AB_EXCH_CODE	A, D, M and I	ASCII	Copy
	AB_EVENT_CODE	V		
8	AB_SYS_CODE	A, D, M, I and V	ASCII	Copy
9	AB_BUY_SELL	A, D, M and I	ASCII	Copy
10	AB_STOCK	A, D, M, I and V	ASCII	Copy
11	AB_QUOTE_ID	A, D and M	ASCII	Copy
	AB_AUCTION_TIME	I		
12	AB_MKT_IMBALANCE	I	Unsigned32	None
	AB_BITMAP	Any except A, D, M, I and V	Bitmap	

Note: Field IDs that have several Field Names only occur once in a given message.