NYSE

ArcaTrade Specification for Bonds

For the New York Stock Exchange

April 24, 2007
Version 1.07

Revision History

Date	Revision	Change Made by:	Synopsis of Change
10-10-2005	1.0 Draft	FLJ	New format.
11-29-2005	1.0 DraftV2	EStockland	Updated Introduction
12-01- 2005	1.0	WDuarte	Updated Recovery drawings.
12-07-2005	1.0	WDuarte	Updated message type field in Last Sales and Trade Bust and Corrections messages
01-05-2006	1.01	FLJ	Updated possible message types in standard header
01-06-2006	1.02	EStockland	Added fields to last sale and bust messages.
01-10-2006	1.03	FLJ	Added fields to last sale and bust messages.
03-06-2006	1.04	SMitchell	Copy edits and formatting. Changes for bond symbology and new fields for bond messages.
3-13-2006	1.05	FLJ	Adjusted alignments
3-27-2006	1.06	EStockland	Edited NYSE Bond Closing Price
4-24-2007	1.07	Dz	Section 5: updated Message Body Length = 64 (value excludes 4 byte header)

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1 Introduction

ArcaTrade is a real-time data feed that disseminates bond or option last sale information to subscribers for Archipelago® exchanges. ArcaTrade allows subscribers to produce and display the Archipelago last sale ticker.

Archipelago provides two ArcaTrade interfaces to meet different customer requirements:

Interface	Bonds	Options	Description
ArcaTrade for Bonds	✓		A data feed for bond trades and trade modifications.
ArcaTrade for Options		✓	A data feed for option trades and trade modifications.

This specification is for developers that wish to write applications that interface with ArcaTrade for Bonds.

Trade data only reflects trades that take place within Archipelago exchanges, rounded down to the nearest lot. Routed, mixed, and odd lot trades may be added to the feed at a later date.

ArcaTrade Interface

This interface 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 Endian (Bid Endian) format.

The interface contains the following categories of messages:

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

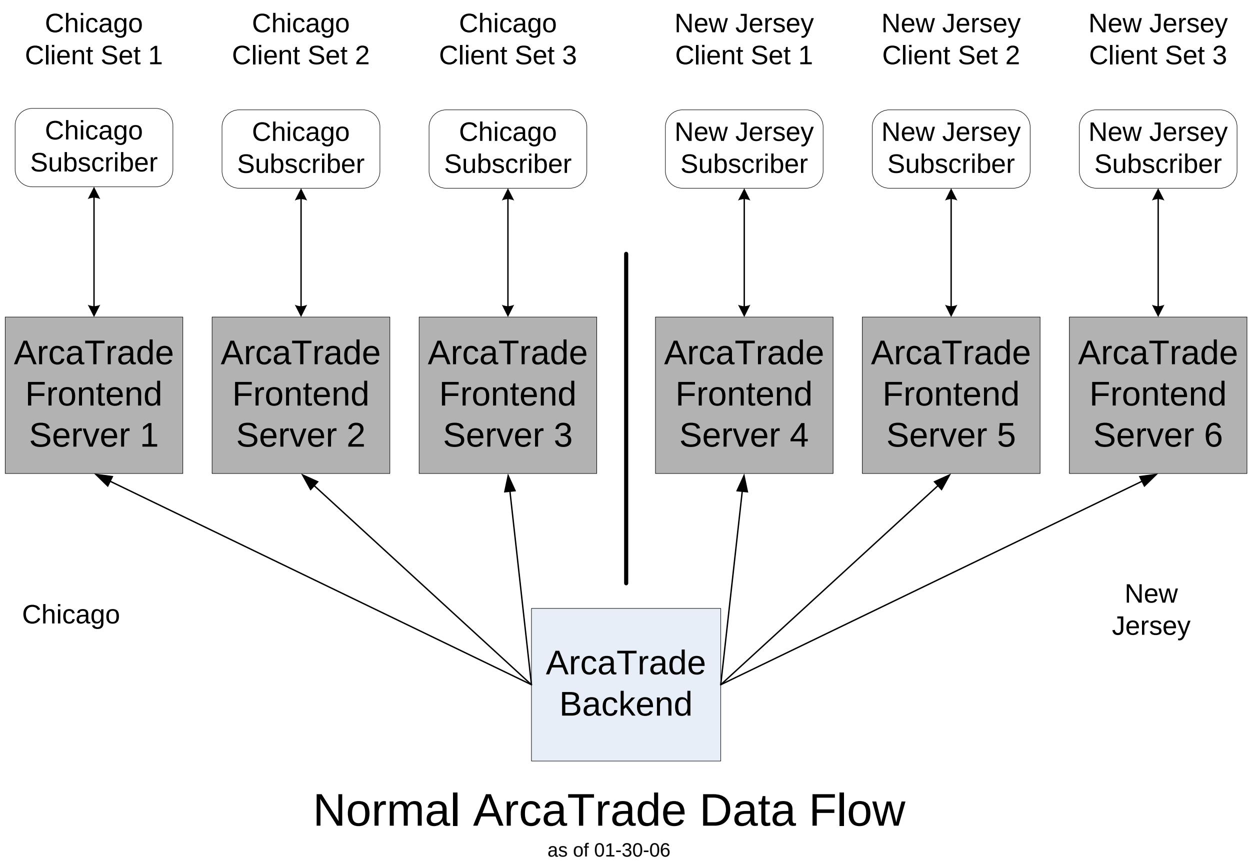
Archipelago API Certification

Subscribers must certify their ArcaTrade subscription clients with Archipelago. Archipelago provides an IP address, port number, username, and password to use for testing. To schedule a test, please call the FIX hotline at 888-689-7739 or email fix@archipelago.com.

System Architecture

Archipelago has several instances of ArcaTrade running in both its New Jersey and Chicago data centers. Subscribers connect to an IP address and port on one of these instances as shown in Figure 1 below.

Figure 1 Normal ArcaTrade Data Flow



2 Communication

Access

ArcaTrade clients connect via TCP/IP to a predefined IP address and port. Clients may connect to both a primary connection and a secondary connection to assist in recovery. Clients must log in before ArcaTrade begins broadcasting data.

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

- IP address
- Port
- Username
- Password

ArcaTrade is accessible from 3:30 am to 8:00 pm EST. ArcaTrade may be accessible prior to or after these times depending on start- and end-of-day processing.

Bandwidth Requirements

The recommended minimum bandwidth for ArcaTrade is 0.05 Megabits per second for the bond trade data currently available. As additional Archipelago trade data becomes available in ArcaTrade, the recommended bandwidth will increase substantially.

Archipelago offers connectivity to both its Chicago and New Jersey data centers. ArcaTrade clients are strongly recommended to implement redundant connectivity to ensure they continue to receive last sale data in the event of issues with their primary connection.

Sessions

ArcaTrade accepts connections at the beginning of Archipelago's trading day and shuts down after the close of Archipelago's exchanges. Once Archipelago exchanges begin trading, ArcaTrade begins broadcasting to clients that have logged in.

Clients must log in within 30 seconds after establishing a TCP/IP connection or ArcaTrade closes the connection. Each user ID may have only one client session active at any given time with ArcaTrade.

Once clients have successfully logged in, ArcaTrade 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 ArcaTrade. 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.

TCP/IP Connections

ArcaTrade 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 ArcaTrade will close the connection. Clients may use the Test Request message to test the connection to ArcaTrade.

When a 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, ArcaTrade begins sending messages from the specified sequence number.

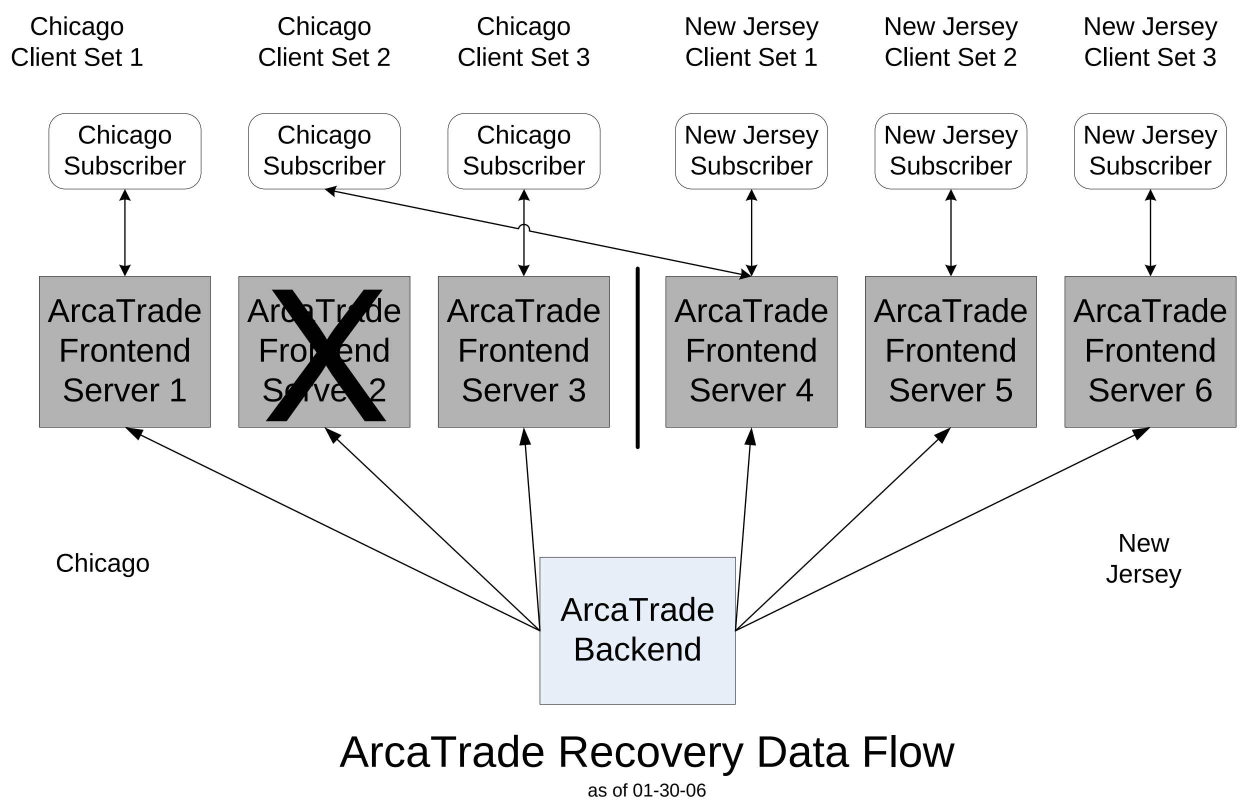
Recovery

Clients are assigned a primary IP address to connect to ArcaTrade (see Figure 1). Clients with connections to both Archipelago Chicago and New Jersey data centers may also be issued a secondary ArcaTrade IP address to connect to for recovery purposes.

> **Note:** once ArcaTrade data feeds include trade data from other markets (equities or options), ArcaTrade messages may **not** have the same sequence number in each data center.

Figure 2.shows an ArcaTrade data flow after connections are rerouted because of a failure.

Figure 2 Recovery ArcaTrade Data Flow



3 Messages

ArcaTrade 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 ArcaTrade Standard Header

ArcaTrade Message Header	Offset	Len	Type	Notes and Values
Message Body Length	0	2	Numeric	0 - 68 (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 ArcaBook messages and message types by the sending system.

Table 2 ArcaTrade Client and Server Messages

	Client Messages (Type)	Server Messages (Type)
Session management	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		Last Sale (X)
		Last Sale Bust/Correction (U)
		NYSE Bond Closing Price (Z)

Data Types

All numeric fields, **except** Price Scale Code and Auction Time, are 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.

Sequence Numbers

Sequence Numbers are four byte integers that are assigned to application messages. 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 the Recovery section for more information.

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 ÷ 100 (10^2) = 13.50.
- **Example 2:** Whole integer price is 135000 and the price scale code is 4. The decimal price = 135000 ÷ 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 (10^1)
2	100	10^2 (10^2)
3	1,000	10^3 (10^3)
4	10,000	10^4 (10^4)
5	100,000	10^5 (10^5)
6	1,000,000	10^6 (10^6)

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.

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. ArcaTrade computes timestamps as:

```
Seconds x 1000 + milliseconds
```

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

```
(36000 x 1000) + 376 = 36000376.
```

Symbology

ArcaTrade offers two ways to identify a corporate bond:

- CUSIP/ISIN is available 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 Client Services at ClientServices@archipelago.com or by calling 888-689-7739 (option 3).

- NYSE Bond Symbol is a unique identifier for the bond assigned by NYSE®. See the Securities Master file at http://www.archipelago.com for information correlating these symbols to bonds traded on the Archipelago Exchange®.

4 Session Management Messages

Clients and ArcaTrade use these messages to begin and end sessions, define data feed subscriptions, recover messages after disconnections and test the TCP/IP connection. See the Sessions and Recovery sections for more information on session management.

Login Message

Clients send this message to authenticate the subscriber and specify which types of trade data the session is subscribing to. Currently, only subscriptions to bond trades are available. If the message does not specify any subscriptions, ArcaTrade 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 ArcaTrade 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 ArcaTrade's current sequence number, ArcaTrade simply begins sending current messages. If this field is negative, ArcaTrade returns a Login Rejected message and closes the connection.

See also the Sessions section for more information.

Login Message	Offset	Len	Type	Notes and Values
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	Reserved for future use
ETF Subscription	30	1	Alpha	Reserved for future use
OTC Subscription	31	1	Alpha	Reserved for future use
ArcaEdge/BB Subscription	32	1	Alpha	Reserved for future use
Bond Subscription	33	1	Alpha	"Y" = Yes "N" = No
Options Subscription	34	1	Alpha	Reserved for future use
Padding	35	5	Alpha	Reserved for future use
ETX	40	1	Numeric	Message Terminating Character

Login Accepted Message

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

Login Accepted Message	Offset	Len	Type	Notes and Values
Message Body Length	0	2	Numeric	6 bytes (value excludes 4 byte header)
Message Type	2	1	Alpha	“Q”
Padding	3	1	Alpha	Not used
Login Accepted Message Body				
Version ID	4	5	Alpha	Version of ArcaTrade protocol (vv.vv)
Padding	9	1	Alpha	Not used

Login Rejected Message

ArcaTrade sends this message in response to a Login message when:

- The Login Message failed authentication or authorization.
- The client connected to ArcaTrade but failed to log in within 30 seconds.
- The client did not subscribe to any trade data feeds.
- The sequence number in the Login message was invalid
- ArcaTrade has no available connections

After sending this message, ArcaBook closes the socket connection.

Login Rejected Message	Offset	Len	Types	Notes and Values
Message Body Length	0	2	Numeric	2 bytes (value excludes 4 byte header)
Message Type	2	1	Alpha	“R”
Padding	3	1	Alpha	Not used
Login Rejected Message Body				
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

Logoff Message

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

Logoff Message	Offset	Len	Type	Notes and Values
Message Type	0	1	Alpha	“O”
ETX	1	1	Numeric	Message Terminating Character

Heartbeat Request Message

ArcaTrade 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.

Heartbeat Request Message	Offset	Len	Type	Notes and Values
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

Heartbeat Response Message

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

Heartbeat Response Message	Offset	Len	Type	Notes and Values
Message Type	0	1	Alpha	“H”
ETX	1	1	Numeric	Message Terminating Character

Test Request Message

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

Test Request Message	Offset	Len	Type	Notes and Values
Message Type	0	1	Alpha	“T”
Test Message	1	20	Alpha	Optional text to be echoed
ETX	21	1	Numeric	Message Terminating Character

Test Response Message

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

Test Response Message	Offset	Len	Type	Notes and Values
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
Test Response Message Body				
Test Message	4	20	Alpha	Text sent in Test Request message

5 Application Messages

Last Sale

ArcaTrade sends this message for the following trade events:

- An order partially trades
- An order completely trades

Last Sale Message	Offset	Len	Type	Notes and Values
Message Body Length	0	2	Numeric	64 bytes (value excludes 4 byte header)
Message Type	2	1	Alpha	"X"
Padding	3	1	Alpha	Not used
Last Sale Message Body				
Last Sale Time	4	4	Numeric	Time the trade occurred in milliseconds since Midnight.
Sequence Number	8	4	Numeric	1 – 2147483647
Trade Reference Number	12	4	Numeric	The unique reference number per trading platform (system code) assigned to this trade.
Quantity	16	4	Numeric	Number of bonds traded.
Price	20	4	Numeric	Trade price.
Price Scale Code	24	1	Alpha/Numeric	See Table 3 for details.
System Code	25	1	Alpha	"F" = Bonds Trading Platform
Exchange Code	26	1	Alpha	"N" = NYSE listed bond Blank = all other bonds
Trade Condition	27	1	Numeric	Reserved for future use.
Security Type	28	1	Numeric	The type of bond. Additional types will be supported in future releases. 1 = corporate bonds
NYSE Bond Symbol	29	22	Alpha	An Archipelago-specific identity for this bond. See the Symbology section for more information.
CUSIP/ISIN	51	14	Alpha	CUSIP/ISIN for the bond. This field is null unless clients have requested the data and have a license.
Padding	65	3	Alpha	Not used.

Trade Bust or Correction Message

ArcaTrade send this message when trades are busted or corrected. The Event Code field identifies the type of trigger for this message.

Trade Bust or Correction Message	Offset	Len	Type	Notes and Values
Message Body Length	0	2	Numeric	64 bytes (value excludes 4 byte header)
Message Type	2	1	Alpha	"U"
Padding	3	1	Alpha	Not used
Last Sale Message Body				
Last Sale Time	4	4	Numeric	Time the trade occurred in milliseconds since Midnight.
Sequence Number	8	4	Numeric	1 – 2147483647
Trade Reference Number	12	4	Numeric	The unique reference number per trading platform (system code) assigned to the trade that has been busted or modified.
Quantity	16	4	Numeric	Number of bonds busted or corrected.
Price	20	4	Numeric	Busted or corrected trade price.
Price Scale Code	24	1	Alpha/Numeric	See Table 3 for details.
System Code	25	1	Alpha	"F" = Archipelago Bonds
Event Code	26	1	Alpha	"B" = Trade Bust "C" = Trade Correction
Exchange Code	27	1	Alpha	"N" = NYSE listed bond Blank = all other bonds
Trade Condition	28	1	Numeric	Reserved for future use.
Security Type	29	1	Numeric	The type of bond. Additional types will be supported in future releases. 1 = corporate bonds
NYSE Bond Symbol	30	22	Alpha	An Archipelago-specific identity for this bond. See the Symbology section for more information.
CUSIP/ISIN	52	14	Alpha	CUSIP/ISIN for the bond. This field is null unless clients have requested the data and have a license.
Padding	66	2	Alpha	Not used.

NYSE Bond Closing Price

ArcaTrade sends this message during day-end processing with the final closing price and volume for a bond. The NYSE Bond Closing Price functionality is not supported at this time and will be implemented in a future release.

NYSE Bond Closing Price Message	Offset	Len	Type	Notes and Values
Message Body Length	0	2	Numeric	bytes (value excludes 4 byte header)
Message Type	2	1	Alpha	"Z"
Padding	3	1	Alpha	Not used

NYSE Bond Closing Price Message	Offset	Len	Type	Notes and Values
NYSE Bond Closing Price Message Body				
Closing Time	4	4	Numeric	Time the closing price was set in milliseconds since Midnight.
Sequence Number	8	4	Numeric	1 – 2147483647
Trade Reference Number	12	4	Numeric	The unique reference number per trading platform (system code) assigned to the closing price.
Quantity	16	4	Numeric	Number of bonds for the closing price
Closing Price	20	4	Numeric	The closing price
Price Scale Code	24	1	Alpha/Numeric	See Table 3 for details.
System Code	25	1	Alpha	"F" = Archipelago Bonds
Exchange Code	26	1	Alpha	"N" = NYSE listed bond Blank = all other bonds
Trade Condition	27	1	Numeric	Reserved for future use.
Security Type	28	1	Numeric	The type of bond. Additional types will be supported in future releases. 1 = corporate bonds
NYSE Bond Symbol	29	22	Alpha	An Archipelago-specific identity for this bond. See the Symbology section for more information.
CUSIP/ISIN	51	14	Alpha	CUSIP/ISIN for the bond. This field is null unless clients have requested the data and have a license.
Padding	65	3	Alpha	Not used.

