



NYSE EuronextSM

ArcaBook Multicast[®]

for

Equities

Customer Interface Specifications

Version 3.9

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Chapter 1 Introduction

1.0 Copyright/Trademark Statements

Copyright Statement

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Notice

Every effort was made to ensure that the information in this document was complete and accurate at the time of publication. However, information is subject to change without notice.

1.1 Document Information

Document History

The following outlines the evolution of this Customer Interface Specification.

Version	Date	Pages Affected*	Comments
Rev 0.1	02/01/07	All	Initial version for internal review.
Rev 0.2	03/03/07	All	Add Firm Index Mapping and Arca Fast (Compaction) Templates.
Rev 0.3	3/8/07	All	Added Multicast IP addresses.
Rev 1.0	3/28/07	All	Added Multicast test IP addresses.
Rev 1.1	4/18/07	Chapter 3 5.4 5.8, A.2, A.13 Append B – field info	Updates to IP addresses, added ETF port. Use of Comstock format. Retransmission response msg is 42 bytes. Updated field 13.
Rev 1.2	5/10/07	3.3 5.8, A.2, A.14, A.15	Corrected ArcaBook Fast Compacted Feed - ETF - Symbols R-Z port from 13009 to 13022. Removed RetransFlag values 3 and 4.
Rev 1.3	5/18/07	17,19, 28, 30, 32, 33	Clarified Request Multicast groups and added a message table.
Rev 1.4	6/1/07	Chapt. 3	Updates to IP addresses.
Rev 1.5	6/2/07	Chapt. 3	Added section 3.16 with TCP source IP addresses.
Rev 1.6	6/6/07	Chapt. 2 and Append B	Added bandwidth estimates (LX and refresh).
Rev 1.7	7/9/07	3.11	Corrected IP addresses.
Rev 1.8	7/10/07	3.10 5.12	Removed “retransmission” from description. Noted that Total Imbalance can be negative.
Rev 1.9	7/11/07	Chapt. 3	Modify ETF Symbol Ranges for load balancing. Specify 4 ranges for Listed and OTC and 2 for ETF. Clarified Refresh Section (Interval vs. Request based).
Rev 2.0	7/17/07 & 7/24/07	A.11 and A.12 Chapt. 2 Append D	Added information that SymbolIndex and FirmIndex can be zero to request all symbol mapping for the multicast group. Added communications access and retransmission information. Added some questions and answers.
Rev 2.1	8/6/07	5.9, 5.10, 5.11 Append A.2	Changed heartbeat response time from 5 seconds to 30 seconds. Changes Buy, Sell values from 0, 1 to B, S respectively.

Version	Date	Pages Affected*	Comments
Rev 2.2	8/21/07	<p>Chapt. 2 (Packet retransmission section)</p> <p>5.4, A.11, A.12, A.17, A.18</p> <p>5.8, A.2</p> <p>5.8, A.2</p> <p>5.9, 5.10, A.15</p> <p>Append D</p>	<p>Clarification on heartbeats - added bandwidth estimates for total # of packets and book messages (removed total # of messages estimate).</p> <p>Replaced filler field with "RetransmitMethod" to indicate Symbol Index and Firm Index Mapping to be sent to customers via TCP/IP or UDP. This change effective pending customer notice, anticipated in production in Nov. 2007.</p> <p>Updated messages sizes: Book Refresh, Add Order, Modify Order, Symbol and Firm Index Mapping Request</p> <p>Added message types: Firm Index Mapping and Request.</p> <p>Clarified what is included in Volume field (no Odd Lots).</p> <p>Added Q&A regarding ArcaEdge BB and Odd Lots, and regarding out of sequence packets.</p>
Rev. 2.3	12/3/07	<p>Chapt. 2 (Packet retransmission section)</p> <p>Chapt. 2 (Bandwidth section)</p> <p>3.8, 3.15</p> <p>4.3 (and 3.3)</p> <p>5.4, A.11, A.12, A.17, A.18</p> <p>5.4</p> <p>A.5</p> <p>A.6</p> <p>A.9</p> <p>A.11</p> <p>A.12</p> <p>Append B</p> <p>Append B, Table 1</p>	<p>Clarification that Recovery Server does not need "logon" (as previous versions of this specification noted); it requires heartbeat response.</p> <p>Updated bandwidth recommendations (current and 2008).</p> <p>Changed the interval time for refresh intervals.</p> <p>Moved 4.3 to 3.3 and clarified primary and secondary feed role.</p> <p>Replaced filler field with "Retransmit-Method".</p> <p>Clarified that Symbol Indices are not unique in each multicast group.</p> <p>Clarified that heartbeats will be sent via multicast servers also, not just TCP/IP servers.</p> <p>Clarified that only TCP/IP subscribers must respond to heartbeat requests with a heartbeat message.</p> <p>Corrected offsets for SessionID and FILLER.</p> <p>Added note for specifying zero in fields to request all symbols for a specific Multicast group.</p> <p>Added FILLER in body.</p> <p>Updated Sample Source Code, and added In Messages of Type in Field Template Information.</p> <p>FieldID 4 Encoding changed from Increment to Copy.</p>

Version	Date	Pages Affected*	Comments
Rev 2.4	1/23/08	Chapt.2 Chapt. 3-5 and Appendices 4.8, 5.2 A.3 A.5 A.8 B.3 D.9	Added new bandwidth requirements for compacted and noncompact feeds. Changed order in document (see * below) Added RetransFlag '6' for Failover Retransmission. Primary and secondary feeds are redundant and in sync with each other. Removed secondary request IPs for retransmission requests. Changed the interval refresh time for uncompact feed from 30 seconds to 15 seconds. Remove secondary request IPs for retransmission requests. Added Local failover event.
Rev 2.5	5/8/08	2.2 4.8, 5.2 4.9-4.11 5.10 5.10 5.14 5.15 5.16 Append. C D.9	Added note that a maximum of four source IDs can be assigned per firm. 1. Clarified that MsgSize values indicated are minimum size of the message body in bytes. Total MsgSize can vary with the number of bodies in the message. 2. Added new values '7', '8', '9' for RetransFlag. 3. Book Refresh Request size corrected from 74 to 38 bytes. 4. Changed Imbalance refresh message from '46' to '50'. Changed format for Side from Binary integer to ASCII character. Added note that SymbolIndex can be '0' (zero), to request all imbalances for a specific multicast group. Removed value of '1' from NumBodyEntries, as value can be '0' (zero) or other values. Clarified MsgSize to be size of original message sent (not necessarily '46' bytes). Changed MsgSize from '74' to '46'. Added values '6', '7', '8', '9' for RetransFlag. 1. Added "Memset message to zeros" within "While packet_size > 0". 2. Changed "offset = length + length" to "offset = length" (after last End). Added figure (not included in previous version).
Rev 2.6	6/12/08	A.11	Added correct TCP Source IP addresses.
Rev 2.7	6/18/08	4.8, 5.2	Corrected values for RetransFlag ('8' – End of Update, '9' – Only one packet in update).
Rev 2.8	7/21/08	2.5 Append. A and B	Increased bandwidth recommendations for 2008. ***PLEASE NOTE: 2008 recommendations are expected to be implemented on 8/18/08; until then, please use "Current" bandwidth (as indicated in section 2.5). Added two ETF channels (two primary, two secondary, where applicable).

Version	Date	Pages Affected*	Comments
Rev 2.9	8/13/08	2.5 Append. A and B	Update 2009 projected bandwidth estimates. Update retrans bandwidth for 2008. Remove reference to the new ETF channels until further.
Rev 3.0	8/21/08		Add ArcaEdge (BB) channel to L2.
Rev 3.1	10/8/08		Add new nonthrottle channels to L2. Increased bandwidth recommendations for 2008. Change threshold limits for retrans.Add
Rev 3.2	08/08/09	4.6	Add 64 bit orderid for Add, Modify, Delete, and Refresh messages. Added section 4.6 for the 64 bit orderid.
Rev 3.3	08/21/09		Updated compaction template to include AB_SYSTEM_ID, AB_MARKET_ID, and AB_BIT. Added new port ranges for PROD multicast groups.
Rev 3.4	08/25/09	4.6	Reverse the ordering of 64 bit ordered. Switch BIG_ENDIAN with LITTLE_ENDIAN
Rev 3.5	09/01/09	Append B	Updated channel ranges for CERT channels.
Rev 3.6	10/15/09	4.10	Corrected offset for orderid.
Rev 3.7	10/30/09	Append A	Updated port assignment
Rev 3.8	12/15/09	5	Update Message Size
Rev 3.9	1/11/10	20 and 28	Change the minimum packet size of a refresh to be 46

**Contact
Information**

NYSE Product/Account Questions
1-212-656-3800

NYSE Service Desk:
1-866-873-7422

NYSE ARCA Technical Support
FIX/Connectivity hotline
888-689-7739

**Additional
Product
Information**

For additional product information please visit
<http://www.nyxdata.com>

For updated capacity figures please visit our capacity pages at :
<http://www.nyxdata.com/capacity>

For additional support information on ArcaBook please visit our discussion
Board at:
[http://www.nyxdata.com/nysedata/Support/DiscussionBoard/tabid/108/view/t
opics/forumid/15/Default.aspx](http://www.nyxdata.com/nysedata/Support/DiscussionBoard/tabid/108/view/topics/forumid/15/Default.aspx)

For additional information on SFTI please visit
<http://www.nyse.com/technologies/sfti/1223635951074.html>

**Referenced
Documents**

Many of the general technical concepts referenced herein are detailed in the
following documents:

[*Data Distribution Model for IP Multicast Based Environment- Version 1.7;*](#)
[*SIAC Communication Engineering Planning and Development; 9 November*](#)
[*2000.*](#)

[*SFTI Customer Guide – Version 1.5; SIAC; 03/12/04*](#)

1.2 Terms and Definitions

Overview

The following section contains terms and definitions that are used throughout this document.

Terms	Definition
PDP Format	PDP format is a binary format that is used for NYSE Proprietary Data products such as NYSE LRPs. The format used in this feed is different than the format used for NYSE OpenBook.
Big Endian	Refers to which bytes are most significant in multi-byte data types. In big-endian architectures, the leftmost bytes are most significant. This byte order also corresponds to Network Byte Order.
Client	Synonymous with <i>Subscriber</i> .
Group ID	IP Multicast address for PDP data delivery.
MART	Message Archive and Retransmission – The PDP component that archives and retransmits PDP message packets.
Monotonical	Incrementally increase in value by one.
PDP	NYSE Proprietary Data Product.
Port Number	Socket port assigned to a feed.
Publisher	Generic name for any system/application generating PDP message products.
PDP_OB	Proprietary Data Products Order Book– The data publication engine of the PDP that ‘productizes’ and publishes PDP Orders message packets.
Recipient	Synonymous with <i>Subscriber</i> .
Sequence Number	A unique, sequential message ID that both ‘tags’ each message and allows recipients to identify message ‘gaps’ and request retransmission (if appropriate).
Subscriber	Any customer/client system that will subscribe to, and receive data products from, the PDP data engine (i.e. the PDP_OB).
MTU	Maximum Transfer Unit – The largest size of IP datagram that may be transferred on a given network. Most network implementations have a default setting of 1500 bytes.
SFTI	Secure Financial Transaction Infrastructure
NYSE	New York Stock Exchange
SIAC	Securities Industry Automation Corporation
ASCII	American Standard Code for Information Interchange

Chapter 2 – ArcaBook Communications and Order Book Impact Guide

Overview

This section gives an introduction to accessing ArcaBook Multicast for Equities, as well as suggested bandwidth message rates.

2.1 Access

To access ArcaBook Multicast for Equities, subscribers must join the multicast groups for primary feeds, as well as secondary feeds to assist in recovery. To request retransmissions of lost packets, subscribers must establish a TCP/IP connection (see “Retransmission of dropped packets” below). Please refer to Appendix D for diagrams that illustrate message processing and retrieval.

ArcaBook Multicast for Equities uses UDP (User Datagram Protocol). Data feeds for specific stocks are sent to different multicast addresses (see Chapter 3). This addressing scheme allows customers to subscribe to the specific data feeds they need. Data feeds types are:

Multicast Order Book
Multicast Retransmission
Multicast Refresh (Request Based)
Multicast Refresh (Interval Based)

Clients must supply NYSE Euronext with their IP address and port and request either the binary or FAST compacted data feed.

NYSE Euronext supplies subscribers with the following parameters:

- IP address for the data feed the client has requested
- Port for the data feed the client has requested
- Username

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

2.2 Packet Retransmission

In the event a packet is lost on the primary feed for a multicast group, clients can retrieve the lost packet from the secondary feed. UDP can at times be unreliable and may drop packets from both the primary and secondary data feeds. If a packet is lost from both the primary and secondary feeds, clients then make a TCP/IP request to have the packets resent. Packets are resent via the Retransmission Multicast Feed.

Subscribers have the option to connect to the TCP/IP Recovery Server to request dropped packets from the ArcaBook multicast feed. This method is highly recommended in order to maintain a stable and accurate order book. The Recovery Server accepts connections on predefined addresses and ports and requires a heartbeat reply before responding to requests (see next paragraph). It accepts primary and backup connections to assist recovery on the subscriber's end.

After a client establishes a TCP/IP connection, ArcaBook will immediately send a heartbeat request message to the client. Clients must respond to this request with a heartbeat response within a specific timeframe – otherwise, ArcaBook will close the connection. This timeframe is currently set to thirty seconds but is subject to change—so clients should make this configurable. (Clients will be informed of changes to the timeframe via customer notice.) Regardless of the timeframe, the client should respond immediately with a heartbeat response message. After receiving the initial heartbeat response, the Recovery Server will send heartbeats to the client every 30 seconds to ensure that the TCP/IP connection is live.

Note that the Source ID that the client specifies in the heartbeat response message will be validated by ArcaBook. Each Source ID may only be logged in once per port at any given time.

To define a Source ID for retransmission purposes, contact NYSE ARCA Technical Support – FIX/Connectivity hotline and provide the desired Source ID. The FIX/Connectivity team will evaluate and approve or disapprove Source IDs. In case of disapproval, a new Source ID must be defined. In case of approval, FIX/Connectivity will make the necessary updates on the ArcaBook side to add the Source ID and applicable rules. A maximum of four source IDs can be assigned per firm.

2.3 Refresh Server

The purpose of the Refresh multicast server is to give subscribers the ability to quickly “get back into the market” if they are “late joiners”. It also can be used if symbol sequence gaps are detected and subscribers need to know the current state of the book for that specific symbol.

The Refresh server sends a snapshot of the current state of the book for all symbols. Refreshes can be sent on a request basis or an interval based. Each has its own set of multicast groups.

Subscribers not interested in critical real-time processing may choose to receive only open order book information by joining the Interval Refresh. Please note that there is no packet recovery for Refresh.

2.4 Compaction

For the compaction multicast groups, book messages are compacted before transmission and several are transmitted in a single packet. Each packet has a header containing the packet size and sequence number. Packet headers are not compacted.

For subscribers using compaction (also known as “FIX Fast protocol”; see Appendix C) instead of binary, subscribers must expand compacted book messages before processing them.

2.5 Bandwidth

We recommend that the subscribers be able to handle the following message rates and sizes for ArcaBook Order Book traffic. If market condition changes intraday, bandwidth peaks can exceed the recommended rates to ensure integrity of the feed.

ArcaBook	Current	2010 projected
Peak message per second rate*	310,000	450,000
Packet size	Variable	Variable
Maximum number of packets in a day	300,000,000	500,000,000
Maximum total number of individual book messages in a day	1,250,000,000	2,000,000,000*

Non-compacted (Mbps):

OTC only*	13	22
LX only*	33.5	54.5
ETF only*	28	45.5
BB only*	2	3
All depth of book subscriptions (total)	77	125

Refresh Interval (all depth of book subscriptions)	40	65
--	----	----

Retransmission (all depth of book subscriptions)	40	65
--	----	----

Refresh Request (all depth of book subscriptions)	20	32.5
---	----	------

Compacted (Mbps):

OTC only*	8	13
LX only*	17	28
ETF only*	17	27
BB only*	1	2
All depth of book subscriptions (total)	43	70

Refresh Interval (all depth of book subscriptions)	30	48.75
--	----	-------

Retransmission (all depth of book subscriptions)	20	32.5
--	----	------

Refresh Request (all depth of book subscriptions)	10	16.25
---	----	-------

*** Notes**

- “Peak messages per second rate” represents an average of maximum core messages rates (including market open and close activity) for 2008.
- Peak message rate may be sustained for a couple of minutes.
- We project maximum total number of individual book messages in a day may reach 2 billion by end 2009.
- Individual feeds (OTC, LX, ETF, BB) are throttled as a group. Peaks may rise above recommended numbers provided above per feed.

Chapter 3 - ArcaBook Operational Information

3.1 Publication Period The following section specifies the frequency and publication period for each message type disseminated by the ArcaBook Product.

Message Type	Publication Period
ArcaBook Order Book Message	An ArcaBook message is generated based on events. Every quote will be transmitted based on that event. The transmission time for the update is between 3:30 am (EST) until market close (8 PM (EST) for most securities). Please check the NYSE website for any changes to trading hours.

3.2 Gap Detection The PDP Distribution System will assign all data packets a unique, sequential message ID. This will allow recipients to identify 'gaps' in the message sequence and, if appropriate, reconcile them 'locally' with an alternate feed or request retransmission of the missing/corrupted data packet.

For the ArcaBook product, each data stream will have its unique set of sequence numbers. In other words, the message sequence for ArcaBook A to C channels (OB_AC) is independent from the message sequence of ArcaBook D to J channel (OB_DJ) and so on. The following is an example of sequencing for each channel.

OB_AC : SeqNum=1, SeqNum=2, SeqNum=3, ..., SeqNum=n.
OB_DJ : SeqNum=1, SeqNum=2, SeqNum=3, ..., SeqNum=x.
OB_KQ : SeqNum=1, SeqNum=2, SeqNum=3, ..., SeqNum=m.
OB_RZ: SeqNum=1, SeqNum=2, SeqNum=3, ..., SeqNum=y.

If there is a gap in the sequence of any channel, it has to be recovered independently. Therefore, if there is a sequence number gap on channel OB_DJ, then the gap filling has to be done through the appropriate OB_DJ retransmission channel. The same is valid for the other channels.

Chapter 4 – ArcaBook Message Specifications

Overview ArcaBook that reflects the order/consolidated book information in each NYSE ARCA traded security.

4.1 Data Delivery format ArcaBook service uses the push-based publishing model. This means that data will be published based on its availability. Once an Order is available, it will be published to ArcaBook Subscribers.

4.2 General Processing Notes The following processing notes apply to the messages sent through the feed.

- All fields will be sent for every packet.
- Only field values will appear in the published messages (e.g., no names, ‘tags’, sizes will appear in the message). The field names that appear in the descriptions below are for reference purposes only.
- All the fields are contiguous, with reserved fields for alignment issues.
- All field sizes are fixed and constant.
- The source time referenced will be using Eastern Standard Time (EST).
- Binary fields are provided in *Big Endian* format.
- ASCII string fields are left aligned and null padded

4.3 Sequence Numbers All messages conform to the line level sequencing. Each channel A to C, D to J, K to Q, and R to Z has its own sequence number. Subscribers can use sequence numbers to determine the following:

- Missing (gapped) messages
- Unordered messages
- Duplicate messages

Clients should note that the packet sequence number per channel might restart from one following a failure recovery. A reset sequence number message will be sent to clients via the Multicast Groups to inform of such event.

4.4 Symbols

The symbology used for the Stock or Symbol fields in order messages depends on the type of security. This is directly related to the multicast groups, which indicates the trading platform that processed this order.

- Listed orders ArcaEx Listed uses Comstock symbology in the Stock field
- OTC and Bulletin Board orders for ArcaEx OTC and ArcaEdge BB use NASDAQ® symbology.

To ensure high throughput and low latency, symbols are identified using a Symbol Index Mapping Table. This is an ordered list from 1 to N of all symbols per multicast group. Symbol Indices are unique within the same source session id only (i.e., *not* unique in each multicast group). Session ID basically denotes the source trading engine. Subscribers can combine the symbol index with the source session id to create a unique global symbol key.

For example, symbols AA and GE may trade on session id 0 and IBM and SPY may trade on session id 1. AA and IBM may be assigned a symbol index of 1. The following algorithm can be used to create a consolidated-global symbol lookup table.

Session * SessionOffset + NYSE Arca Symbol index = Clients Global Symbol Index Table

Example:

AA = session 0, index 1
GE = session 0, index 5
IBM = session 1, index 1
SPY = session 1, index 250

AA = 0 * 0 + 1 = index 1
GE = 0 * 0 + 2 = index 2
IBM = 1 * 8000 + 1 = index 8001
SPY = 1 * 8000 + 250 = index 8250

Please note that this as example. Clients should determine their own mapping algorithm for creating a global symbol lookup table.

4.5 Prices

Prices in this feed are represented by two fields, separating the denominator and the numerator. All prices in the feed share a common denominator, which is represented in the PriceScaleCode.

The PriceScaleCode field value represents the common denominator for the following formula:

$$Price = \frac{Numerator}{10^{PriceScaleCode}}$$

For example, a price of 27.56 is represented by a Numerator of 2756 and a PriceScaleCode equals to 2.

4.6 OrderID

The OrderID will consist of multiple data values; the OrderID, MarketID, SessionID, and OrderBit. Depending upon the host bytes alignment the data structure will be different.

The OrderID will be a value of a 64 bit long. To convert it in a 32 bit processing environment the following example can be used. Note compaction will use the below structure. To byte align binary fields in a little endian system all 8 bytes must be aligned as a 64 bit long. The ID field will be unique per System and Market.

LITTLE ENDIAN System

Field Name	Offset	Size (Bytes)	Format	Description
ID	0	4	Binary Integer	Order ID
Market ID	4	2	Binary Integer	ID of the Originating market
System ID	6	1	Binary Integer	ID of the Originating System.
Bit	7	1	ASCII	FILLER

BIG ENDIAN System

Field Name	Offset	Size (Bytes)	Format	Description
Bit	7	1	ASCII	FILLER
System ID	6	1	Binary Integer	ID of the Originating System.
Market ID	4	2	Binary Integer	ID of the Originating market
ID	0	4	Binary Integer	Order ID

4.7 NYSE Arca Binary versus Compacted Formats

The fixed length message formats represent the original binary versions of messages for ArcaBook. With the FAST compacted data feed, these binary messages are compacted significantly resulting in as much as a 75% decrease in message size.

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 Appendix C – The [FIX FAST Protocol](#) section for details.

4.8 ArcaBook Data Messages

The following table contains a list of the message types in the ArcaBook feed. ArcaBook does not send order messages (Add, Modify or Delete Order) for orders that are entered in NYSE?ARCA order books during Pre-Open (7:30 am to 8:00 am EST) or for Odd Lot quotes.

Message Type	Description
NYSE Book	This message contains the main ArcaBook messages for Add, Modify, Delete

4.9 Message Header Format

All messages are preceded by a standard header format with the exception of the Order Book Refresh Message. The table on the next page describes the header fields of an NYSE ARCA Quote message.

Field	Offset	Size (Bytes)	Format	Description
MsgSize	0	2	Binary Integer	<p>This field indicates the minimum size of the message body in bytes. Total size can vary with the number of bodies in the message:</p> <p>Sequence Number Reset – '18 Bytes'</p> <p>Heartbeat Message – '14 Bytes'</p> <p>Heartbeat Response Message – '34 Bytes'</p> <p>Message Unavailable – '22 Bytes'</p> <p>Retransmission Request Message – '42 Bytes'</p> <p>Retransmission Response Message – '42 Bytes'</p> <p>Book Refresh Request Message – '38 Bytes'</p> <p>Imbalance Refresh Request Message – '38 Bytes'</p> <p>Book Refresh Message – '46 Bytes'</p> <p>Imbalance Refresh Message – '50 Bytes'</p> <p>Symbol Index Mapping Request Message – '38 Bytes'</p> <p>Symbol Index Mapping Message – '34 Bytes'</p> <p>Firm Index Mapping Request Message – '38 Bytes'</p> <p>Firm Index Mapping Message – '26 Bytes'</p> <p>Symbol Clear – '22 Bytes'</p> <p>Add Order Message - '50 Bytes'</p> <p>Modify Order Message - '50 Bytes'</p> <p>Delete Order Message - '42 Bytes'</p> <p>Imbalance Message – '50 Bytes'</p>
MsgType	2	2	Binary Integer	<p>This field identifies the type of message</p> <p>'1' – Sequence Number Reset</p> <p>'2' – Heartbeat Message</p> <p>'5' – Message Unavailable</p> <p>'10' – Retransmission Response message</p> <p>'20' – Retransmission Request Message</p> <p>'24' – Heartbeat Response Message</p> <p>'30' – Book Refresh Request Message</p> <p>'31' – Imbalance Refresh Request Message</p> <p>'32' – Book Refresh Message</p> <p>'33' – Imbalance Refresh Message</p> <p>'34' - Symbol Index Mapping Request Message</p> <p>'35' - Symbol Index Mapping Message</p> <p>'36' - Symbol Clear</p> <p>'37' – Firm Index Mapping Message</p> <p>'38' – Firm Index Mapping Request Message</p> <p>'99' – Generic Book Message for Add, Modify, Deletes, Imbalances</p>
MsgSeqNum	4	4	Binary	This field contains the message sequence number assigned by

			Integer	PDP for each product. It is used for gap detection. Also known as Line Sequence Number (LSN).
SendTime	8	4	Binary Integer	This field specifies the time message was created by PDP. The number represents the number of milliseconds since midnight of the same day.
ProductID	12	1	Binary Integer	'115' is the product value used in the PDP header to identify the ArcaBook feed
RetransFlag	13	1	Binary Integer	A flag that indicates whether this is an original, retransmitted, or 'replayed' message. Valid values include: '1' – Original message '2' – Retransmitted message '5' – Refresh Retransmission '6' – Failover Retransmission '7' – Start of Update '8' – End of Update '9' – Only one packet in update
NumBodyEntries	14	1	Binary Integer	The number of times the message body repeats in the message. For example, if the body consists of a field (named Volume) and the "NumBodyEntries" field is 2, the number of bytes in the message body will be 8
FILLER	15	1	ASCII String	This is a filler, reserved for future use

**4.10 Add
Message Body
Format**

The table below describes the body fields of an ArcaBook Add message (**MsgType = '100'**). ArcaBook sends this message for a new open order. For additional messages such as sequence number reset, retransmission etc, please refer to Chapt. 5.

Field Name	Offset	Size (Bytes)	Format	Description
SymbolIndex	16	2	Binary Integer	This field identifies the numerical representation of the symbol. User can combine this value with the session id to obtain a unique key.
MsgType	18	2	Binary Integer	This field identifies the type of message Message '100' – Add Order Message
SourceSeqNum	20	4	Binary Integer	This field contains the sequence number assigned by the source system to this message. The sequence number is unique only to a given stock. Hence orders for two different stocks may share the same source sequence number. Please note that the sequence number while it increases serially, it does not increase monotonically.
SourceTime	24	4	Binary Integer	This field specifies the quote generation time. The number in this field represents the number of milliseconds since midnight of the same day.
OrderID	28	8	Binary Integer	The Order ID identifies a unique order. Use in OrderID struct to create unique OrderID. See Section 4.6
Volume	36	4	Binary Integer	This field contains the size of the order. Please note we do not send Odd Lot (<100) quotes.
PriceNumerator	40	4	Binary Integer	This field specifies the price of the order.
PriceScaleCode	44	1	Binary Integer	See Section 4.5
Side	45	1	ASCII Character	This field indicates the side of the order Buy/sell. Valid Values: 'B' – Buy 'S' – Sell
ExchangeID	46	1	ASCII Character	The id of the originating exchange of the quote. Valid values: 'N' – NYSE (not used) 'P' – NYSE ARCA 'B' – NYSE ARCA BB
SecurityType	47	1	ASCII Character	This field specifies the security type for this message. Valid values: 'E' – Equity 'B' – BB
FirmIndex	48	2	Binary Integer	This field identifies the numerical representation of the firm sending the quote if attributed.
SessionID	50	1	Binary Integer	Identifies the Source Session of the Symbol.
FILLER	51	1	ASCII String	This is a filler, reserved for future use

4.11 Modify Message Body Format

The table below describes the body fields of an ArcaBook Modify message (**MsgType = '101'**). ArcaBook sends this message when an order in an ArcaBook is modified. The order id 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 ArcaBook.

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

Field Name	Offset	Size (Bytes)	Format	Description
SymbolIndex	16	2	Binary Integer	This field identifies the numerical representation of the symbol. User can combine this value with the session id to obtain a unique key. See section A.11 for more information
MsgType	18	2	Binary Integer	This field identifies the type of message Message '101' – Modify Order Message
SourceSeqNum	20	4	Binary Integer	This field contains the sequence number assigned by the source system to this message. The sequence number is unique only to a given stock. Hence orders for two different stocks may share the same source sequence number. Please note that the sequence number while it increases serially, it does not increase monotonically.
SourceTime	24	4	Binary Integer	This field specifies the quote generation time. The number in this field represents the number of milliseconds since midnight of the same day.
OrderID	28	8	Binary Integer	The Order ID identifies a unique order. Use in OrderID struct to create unique OrderID. See Section 4.6
Volume	36	4	Binary Integer	This field contains the size of the order. Please note we do not send Odd Lot (<100) quotes.
PriceNumerator	40	4	Binary Integer	This field specifies the price of the order.
PriceScaleCode	44	1	Binary Integer	See Section 4.5
Side	45	1	ASCII Character	This field indicates the side of the order Buy/sell. Valid Values: 'B' – Buy 'S' – Sell
ExchangeID	46	1	ASCII Character	The id of the originating exchange of the quote. Valid values: 'N' – NYSE (not used) 'P' – NYSE ARCA 'B' – NYSE ARCA BB
SecurityType	47	1	ASCII Character	This field specifies the security type for this message. Valid values: 'E' – Equity 'B' – BB
FirmIndex	48	2	Binary Integer	This field identifies the numerical representation of the firm sending the quote if attributed. See section A.12 for more information
SessionID	50	1	Binary Integer	Identifies the Source Session of the Symbol.
FILLER	51	1	ASCII String	This is a filler, reserved for future use

4.12 Delete Message Body Format

The table below describes the body fields of an ArcaBook Delete message (MsgType = '102'). ArcaBook sends this message when an order is taken off of the NYSE Arca 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 ARCA preference, an Add Order message with the original order id will be sent to return the order to the ArcaBook.
- An order is filled

Field Name	Offset	Size (Bytes)	Format	Description
SymbolIndex	16	2	Binary Integer	This field identifies the numerical representation of the symbol. User can combine this value with the session id to obtain a unique key. See section A.11 for more information
MsgType	18	2	Binary Integer	This field identifies the type of message Message '102' – Delete Order Message\
SourceSeqNum	20	4	Binary Integer	This field contains the sequence number assigned by the source system to this message. The sequence number is unique only to a given stock. Hence orders for two different stocks may share the same source sequence number. Please note that the sequence number while it increases serially, it does not increase monotonically.
SourceTime	24	4	Binary Integer	This field specifies the quote generation time. The number in this field represents the number of milliseconds since midnight of the same day.
OrderID	28	8	Binary Integer	The Order ID identifies a unique order. Use in OrderID struct to create unique OrderID. See Section 4.6
Side	36	1	ASCII Character	This field indicates the side of the order Buy/sell. Valid Values: 'B' – Buy 'S' – Sell
ExchangeID	37	1	ASCII Character	The id of the originating exchange of the quote. Valid values: 'N' – NYSE (not used) 'P' – NYSE ARCA 'B' – NYSE ARCA BB
SecurityType	38	1	ASCII Character	This field specifies the security type for this message. Valid values: 'E' – Equity 'B' – BB
SessionID	39	1	Binary Integer	Identifies the Source Session of the Symbol.
FirmIndex	40	2	Binary Integer	This field identifies the numerical representation of the firm sending the quote if attributed. See section A.12 for more information
FILLER	42	2	ASCII String	This is a filler, reserved for future use

**4.13 Imbalance
Message Body
Format**

The table below describes the body fields of an ArcaBook Imbalance message (**MsgType = '103'**). ArcaBook sends this message in response to orders submitted during pending auctions. The message is sent between:

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

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

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.

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.

Field Name	Offset	Size (Bytes)	Format	Description
SymbolIndex	16	2	Binary Integer	This field identifies the numerical representation of the symbol. User can combine this value with the session id to obtain a unique key. See section A.11 for more information
MsgType	18	2	Binary Integer	This field identifies the type of message Message '103' – Imbalance Message
SourceSeqNum	20	4	Binary Integer	This field contains the sequence number assigned by the source system to this message. The sequence number is unique only to a given stock. Hence orders for two different stocks may share the same source sequence number. Please note that the sequence number while it increases serially, it does not increase monotonically.
SourceTime	24	4	Binary Integer	This field specifies the quote generation time. The number in this field represents the number of milliseconds since midnight of the same day.
Volume	28	4	Binary Integer	The indicative match volume.
Total Imbalance	32	4	Binary Integer	The total imbalance volume. Please note the value can be negative.
Market Imbalance	36	4	Binary Integer	The market imbalance volume. Please note the value can be negative.
PriceNumerator	40	4	Binary Integer	The indicative match price.
PriceScaleCode	44	1	Binary Integer	See Section 4.5
Auction Type	45	1	ASCII Character	'O' = Open 'M' = Market 'H' = Halt 'C' = Closing
ExchangeID	46	1	ASCII Character	The id of the originating exchange of the quote. Valid values: 'N' – NYSE (not used) 'P' – NYSE ARCA 'B' – NYSE ARCA BB
SecurityType	47	1	ASCII Character	This field specifies the security type for this message. Valid values: 'E' – Equity 'B' – BB
SessionID	48	1	Binary Integer	Identifies the Source Session of the Symbol.
FILLER	49	1	ASCII String	This is a filler, reserved for future use
Auction Time	50	2	Binary Integer	Projected Auction Time (hhmm)

Chapter 5 – Common PDP Message Structure

Overview

In broad terms, there are two types of messages transmitted as part of this protocol: control and data. Control messages do not contain data per se; rather, they allow conversing parties to exchange session-specific information (e.g., ‘reset sequence number’). Data messages are product specific and, although they will adhere to the general specification, they are defined specifically in a later section.

5.1 General Processing Notes

The following processing notes apply to the messages described above.

- All fields will be sent for every packet.
 - Any physical packet will contain at most one message
 - Only field values will appear in the published messages (e.g., no names, ‘tags’, sizes will appear in the message). The field names that appear in the descriptions below are for reference purposes only.
 - All the fields are contiguous, i.e., there is no explicit (or implicit) ‘padding’ between fields regardless of the juxtaposed data types, sizes, and alignment issues.
 - All field sizes are fixed and constant.
 - The source time referenced will be using Eastern Standard Time (EST).
 - Binary fields are provided in *Big Endian* format.
 - All binary fields will be unsigned (unless otherwise specified)
 - ASCII string fields are left align, null padded.
-

5.2 Common Message Header Format

All PDP messages will contain a Common Message Header with the exception of the Order Book Refresh Message. This model is akin to that of an envelope/letter paradigm. The message header comprises envelope information; the message body comprises the letter. All correspondence will use the same envelope format regardless of content.

The intent of this design is to minimize development burden on behalf of Subscribers. That is, all Subscribers may implement line-level protocol processing once, and then need only develop parsing algorithms for messages of choice.

Field	Offset	Size (Bytes)	Format	Description
MsgSize	0	2	Binary Integer	This field indicates the minimum size of the message body in bytes. Total size can vary with the number of bodies in the message: Sequence Number Reset – '18 Bytes' Heartbeat Message – '14 Bytes' Sequence Number Reset – '18 Bytes' Heartbeat Message – '14 Bytes' Message Unavailable – '22 Bytes' Retransmission Request Message – '42 Bytes' Retransmission Response Message – '42 Bytes' Heartbeat Response Message – '34 Bytes' Book Refresh Request Message – '38 Bytes' Imbalance Refresh Request Message – '38 Bytes' Book Refresh Message – '46 Bytes' Imbalance Refresh Message – '50 Bytes' Symbol Index Mapping Request Message – '38 Bytes' Symbol Index Mapping Message – '34 Bytes' Firm Index Mapping Request Message – '38 Bytes' Firm Index Mapping Message – '26 Bytes' Symbol Clear – '22 Bytes' Add Order Message - '50 Bytes' Modify Order Message - '50 Bytes' Delete Order Message - '42 Bytes' Imbalance Message – '50 Bytes'
MsgType	2	2	Binary Integer	This field identifies the type of message '1' – Sequence Number Reset '2' – Heartbeat Message '5' – Message Unavailable '10' – Retransmission Response message '20' – Retransmission Request Message '24' – Heartbeat Response Message '30' – Book Refresh Request Message '31' – Imbalance Refresh Request Message '32' – Book Refresh Message '33' – Imbalance Refresh Message '34' - Symbol Index Mapping Request Message '35' - Symbol Index Mapping Message '36' - Symbol Clear '37' – Firm Index Mapping Message '38' – Firm Index Mapping Request Message '99' – Generic Book Message for Add, Modify, Deletes, Imbalances
MsgSeqNum	4	4	Binary Integer	This field contains the message sequence number assigned by PDP for each product. It is used for gap detection. Also known as Line Sequence Number (LSN).
SendTime	8	4	Binary Integer	This field specifies the time message was created by PDP. The number represents the number of milliseconds since midnight of the same day.

ProductID	12	1	Binary Integer	'115' is the product value used in the PDP header to identify the ArcaBook feed
RetransFlag	13	1	Binary Integer	A flag that indicates whether this is an original, retransmitted, or 'replayed' message. Valid values include: '1' – Original message '2' – Retransmitted message '5' – Refresh Retransmission '6' – Failover Retransmission '7' – Start of Update '8' – End of Update '9' – Only one packet in update
NumBodyEntries	14	1	Binary Integer	The number of times the message body repeats in the message. For example, if the body consists of a field (named Volume) and the "NumBodyEntries" field is 2, the number of bytes in the message body will be 8
FILLER	15	1	ASCII String	This is a filler, reserved for future use

5.3 Sequence Number Reset

This message is sent to ‘reset’ the Sequence Number at start of day, in response to failures, etc. Note that this message will contain a valid sequence number. The message format is shown below.

Field Name	Offset	Size	Format	Value	Description
Set forth below are the ‘header’ fields of the Sequence Number Reset Message					
MsgSize	0	2	Binary Integer	‘18’	Refer to section 5.2
MsgType	2	2	Binary Integer	‘1’	Refer to section 5.2
MsgSeqNum	4	4	Binary Integer		Refer to section 5.2
SendTime	8	4	Binary Integer		Refer to section 5.2
ProductID	12	1	Binary Integer	‘115’	Refer to section 5.2
RetransFlag	13	1	Binary Integer	‘1’	Refer to section 5.2
NumBodyEntries	14	1	Binary Integer	‘1’	Refer to section 5.2
FILLER	15	1	ASCII String		This is a filler, reserved for future use
Defined below are the ‘body’ fields of the Sequence Number Reset Message					
NextSeqNumber	16	4	Binary Integer		This field contains the sequence number value that the recipient should expect in the immediately succeeding data packet. Note that this message will contain its own valid sequence number in the header portion of the message.

5.4 Sequence Number Processing Notes

Sequence numbers normally begin at one (1) and increase monotonically with each subsequent message. There are two scenarios where the sequence number is reset (besides the start of day). First, if the value should exceed the maximum value that the SeqNum field may contain, it will be reset to one (1). Second, if PDP_OB has a failure and it recovers, it sends a sequence number reset message. The SeqNum field of that message will be set to one (1) and the NextSeqNumber field will be set to two (2). Please refer to Appendix (Processing Sequence Number Reset Messages) for a suggested way of processing.

5.5 Heartbeat Messages

Subscribers that choose to establish and remain connected to the ArcaBook Multicast servers (including multicast and TCP/IP) will receive heartbeat message to let them know that the connection is still alive.

Field Name	Offset	Size	Format	Value	Description
Set forth below are the 'header' fields of the Heartbeat Message					
MsgSize	0	2	Binary Integer	'14'	Refer to section 5.2
MsgType	2	2	Binary Integer	'2'	Refer to section 5.2
MsgSeqNum	4	4	Binary Integer		Refer to section 5.2
SendTime	8	4	Binary Integer		Refer to section 5.2
ProductID	12	1	Binary Integer	'115'	Refer to section 5.2
RetransFlag	13	1	Binary Integer	'1', '2', '5'	Refer to section 5.2
NumBodyEntries	14	1	Binary Integer	'0'	Refer to section 5.2
FILLER	15	1	ASCII String		This is filler, reserved for future use

5.6 Heartbeat Message Processing Notes

- Heartbeat messages will be sent with the same sequence number as the most recent message that was sent.
- Heartbeat messages will only contain the PDP Message Header with an empty body.
- TCP/IP only: Subscribers must respond to these heartbeat requests with a heartbeat message.

Please refer to C.3 Processing Heartbeat Messages for a suggest way of processing.

5.7 Heartbeat Response Message

This message will be sent by subscribers that choose to establish and remain connected to the TCP/IP retransmission/refresh server intraday. This message lets the NYSE know that the connection is still alive. Subscribers must respond to these heartbeat requests with a heartbeat response message

Field Name	Offset	Size	Format	Value	Description
Set forth below are the 'header' fields of the Heartbeat Response Message					
MsgSize	0	2	Binary Integer	'34'	Refer to section 5.2
MsgType	2	2	Binary Integer	'24'	Refer to section 5.2
MsgSeqNum	4	4	Binary Integer		Refer to section 5.2
SendTime	8	4	Binary Integer		Refer to section 5.2
ProductID	12	1	Binary Integer	'115'	Refer to section 5.2
RetransFlag	13	1	Binary Integer	'1'	Refer to section 5.2
NumBodyEntries	14	1	Binary Integer	'1'	Refer to section 5.2
FILLER	15	1	ASCII String		This is filler, reserved for future use
Defined below are the 'body' fields of the Heartbeat Response Message					
SourceID	16	20	ASCII String		This field represents the name of the source requesting retransmission. This field is null padded, left aligned

5.8 Retransmission Request Message This message is sent by Subscribers requesting missing messages. The MART will retransmit the appropriate message(s).

Field Name	Offset	Size	Format	Value	Description
Set forth below are the 'header' fields of the Generic Retransmission Request Message					
MsgSize	0	2	Binary Integer	'42'	Refer to section 5.2
MsgType	2	2	Binary Integer	'20'	Refer to section 5.2
MsgSeqNum	4	4	Binary Integer		Refer to section 5.2
SendTime	8	4	Binary Integer		Refer to section 5.2
ProductID	12	1	Binary Integer	'115'	Refer to section 5.2
RetransFlag	13	1	Binary Integer	'1'	Refer to section 5.2
NumBodyEntries	14	1	Binary Integer	'1'	Refer to section 5.2
FILLER	15	1	ASCII String		This is filler, reserved for future use
Defined below are the 'body' fields of the Generic Retransmission Request Message					
BeginSeqNum	16	4	Binary Integer		The beginning sequence number of the requested range of messages to be retransmitted.
EndSeqNum	20	4	Binary Integer		The end sequence number of the requested range of messages to be retransmitted.
SourceID	24	20	ASCII String		This field represents the name of the source requesting retransmission. This field is null padded, left aligned

5.9 Book Refresh Request This message will be sent by subscribers requesting a book refresh message. Subscribers shall send one request per symbol. It is imperative that the NumBodyEntries field be set to 1. It is also imperative that subscribers maintain a symbol index mapping. Please see section 5.11 for requesting Symbol Index Mapping.

Field Name	Offset	Size	Format	Value	Description
Set forth below are the 'header' fields of the Refresh Request Message					
MsgSize	0	2	Binary Integer	'38'	Refer to section 5.2
MsgType	2	2	Binary Integer	'30'	Refer to section 5.2
MsgSeqNum	4	4	Binary Integer		Refer to section 5.2
SendTime	8	4	Binary Integer		Refer to section 5.2
ProductID	12	1	Binary Integer	'115'	Refer to section 5.2
RetransFlag	13	1	Binary Integer	'1'	Refer to section 5.2
NumBodyEntries	14	1	Binary Integer	'1'	Refer to section 5.2
FILLER	15	1	ASCII String		This is filler, reserved for future use
Set forth below are the 'header' fields of the Refresh Request Message					
SymbolIndex	16	2	Binary Integer		This field identifies the numerical representation of the symbol. User can combine this value with the session id to obtain a unique key.
SessionID	18	1	Binary Integer		Identifies the Source Session of the Symbol
FILLER	19	1	ASCII String		This is filler, reserved for future use

Field Name	Offset	Size	Format	Value	Description
SourceID	20	20	ASCII String		This field represents the name of the source requesting retransmission. This field is null padded, left aligned

5.10 Imbalance Refresh Request This message will be sent by subscribers requesting an imbalance refresh. Subscribers shall send one request per symbol. It is imperative that the NumBodyEntries field be set to 1. It is also imperative that subscribers maintain a symbol index mapping. Please see section 5.11 for requesting Symbol Index Mapping.

Field Name	Offset	Size	Format	Value	Description
Set forth below are the ‘header’ fields of the Refresh Request Message					
MsgSize	0	2	Binary Integer	‘38’	Refer to section 5.2
MsgType	2	2	Binary Integer	‘31’	Refer to section 5.2
MsgSeqNum	4	4	Binary Integer		Refer to section 5.2
SendTime	8	4	Binary Integer		Refer to section 5.2
ProductID	12	1	Binary Integer	‘115’	Refer to section 5.2
RetransFlag	13	1	Binary Integer	‘1’	Refer to section 5.2
NumBodyEntries	14	1	Binary Integer		Refer to section 5.2
FILLER	15	1	ASCII String		This is filler, reserved for future use
Set forth below are the ‘header’ fields of the Refresh Request Message					
SymbolIndex	16	2	Binary Integer		This field identifies the numerical representation of the symbol. User can combine this value with the session id to obtain a unique key. SymbolIndex value can be zero, which is to request all imbalance for the multicast group.*
SessionID	17	1	Binary Integer		Identifies the Source Session of the Symbol
FILLER	18	1	ASCII String		This is filler, reserved for future use
SourceID	20	20	ASCII String		This field represents the name of the source requesting retransmission. This field is null padded, left aligned

* To request all imbalances for a specific multicast group, specify ‘0’ (zero) in the SymbolIndex and SessionID fields.

5.11 Symbol Index Mapping Request Message This message is sent by Subscribers requesting the Symbol index mapping.

Field Name	Offset	Size	Format	Value	Description
Set forth below are the ‘header’ fields of the Symbol Index Mapping Request Message					
MsgSize	0	2	Binary Integer	‘38’	Refer to section 5.2
MsgType	2	2	Binary Integer	‘34’	Refer to section 5.2
MsgSeqNum	4	4	Binary Integer		Refer to section 5.2
SendTime	8	4	Binary Integer		Refer to section 5.2
ProductID	12	1	Binary Integer	‘115’	Refer to section 5.2

Field Name	Offset	Size	Format	Value	Description
RetransFlag	13	1	Binary Integer	'1'	Refer to section 5.2
NumBodyEntries	14	1	Binary Integer	'1'	Refer to section 5.2
FILLER	15	1	ASCII String		This is filler, reserved for future use
Defined below are the 'body' fields of the Symbol Index Mapping Request Message					
SymbolIndex	16	2	Binary Integer		This field identifies the numerical representation of the symbol. SymbolIndex value can be zero, which is to request all symbol mapping for the multicast group.*
SessionID	18	1	Binary Integer		Identifies the Source Session of the Symbol.*
RetransmitMethod**	19	1	Binary Integer		'0' – retransmit via UDP (this is the default)** '1' – retransmit via TCP/IP connection**
SourceID	20	20	ASCII String		This field represents the name of the source requesting retransmission. This field is null padded, left aligned

* To request all symbols for a specific multicast group, specify '0' (zero) in the SymbolIndex and SessionID fields.

** RetransmitMethod is a field which gives customers the ability to specify if they want Symbol Index Mapping and/or Firm Index Mapping sent to them via TCP/IP or UDP.

5.12 Attributed Quote Firm Index Mapping Request Message This message is sent by Subscribers requesting the Firm index mapping.

Field Name	Offset	Size	Format	Value	Description
Set forth below are the 'header' fields of the Firm Index Mapping Request Message					
MsgSize	0	2	Binary Integer	'38'	Refer to section 5.2
MsgType	2	2	Binary Integer	'38'	Refer to section 5.2
MsgSeqNum	4	4	Binary Integer		Refer to section 5.2
SendTime	8	4	Binary Integer		Refer to section 5.2
ProductID	12	1	Binary Integer	'115'	Refer to section 5.2
RetransFlag	13	1	Binary Integer	'1'	Refer to section 5.2
NumBodyEntries	14	1	Binary Integer	'1'	Refer to section 5.2
FILLER	15	1	ASCII String		This is filler, reserved for future use
Defined below are the 'body' fields of the Firm Index Mapping Request Message					
FirmIndex	16	2	Binary Integer		This field identifies the numerical representation of the firm on attributed quotes. FirmIndex value can be zero, which is to request all firm mapping for the multicast group.
FILLER	18	1	ASCII String		This is filler, reserved for future use
RetransmitMethod*	19	1	Binary Integer		'0' – retransmit via UDP (this is the default)* '1' – retransmit via TCP/IP connection*
SourceID	20	20	ASCII String		This field represents the name of the source requesting retransmission. This field is null padded, left aligned

* RetransmitMethod is a field which gives customers the ability to specify if they want Symbol Index Mapping and/or Firm Index Mapping sent to them via TCP/IP or UDP.

5.13 Retransmission Response Message This message will be sent immediately via TCP/IP in response to the subscribers request for retransmission messages, i.e., Retransmission, refresh, Symbol Index Mapping and Firm Index Mapping. This message does not contain any information but an ACK or NAK of the request message.

Field Name	Offset	Size	Format	Value	Description
Set forth below are the 'header' fields of the NYSE Retransmission Response Message					
MsgSize	0	2	Binary Integer	'42'	Refer to section 5.2
MsgType	2	2	Binary Integer	'10'	Refer to section 5.2
MsgSeqNum	4	4	Binary Integer		Refer to section 5.2
SendTime	8	4	Binary Integer		Refer to section 5.2
ProductID	12	1	Binary Integer	'115'	Refer to section 5.2
RetransFlag	13	1	Binary Integer	'2'	Refer to section 5.2
NumBodyEntries	14	1	Binary Integer	'1'	Refer to section 5.2
FILLER	15	1	ASCII String		This is filler, reserved for future use
Defined below are the 'body' fields of the NYSE Retransmission Response Message					

Field Name	Offset	Size	Format	Value	Description
SourceSeqNum	16	4	Binary Integer		This field contains the request message sequence number assigned by the client. It is used by the client to couple the request with the response message.
SourceID	20	20	ASCII String		This field represents the name of the source requesting retransmission. This field is null padded, left aligned
Status	40	1	ASCII String		This is a flag that indicates whether the retransmissions request was accepted or rejected. Valid values: 'A' – Accepted 'R' – Rejected
Reject Reason	41	1	Binary Integer		This is a flag that indicates the reason why the request was rejected. Valid values: '0' – Message was accepted '1' – Rejected due to permissions '2' – Rejected due to invalid sequence range '3' – Rejected due to maximum sequence range '4' – Rejected due to maximum request in a day '5' – Rejected due to maximum number of refresh requests in a day
Filler	42	2	ASCII String		This is filler, reserved for future use.

5.14 Retransmission Message

Upon receipt of a valid retransmission request message, the requested message(s) will be sent. This message(s) has the same message format and content as the original messages sent by the PDP_OB, with the exception that the 'RetransFlag' in the header is set to the value of '2' or '5' depending on whether the retransmission is for a non-replay or a replay retransmission message, respectively.

Field Name	Offset	Size	Format	Value	Description
Set forth below are the 'header' fields of the Retransmitted Message					
MsgSize	0	2	Binary Integer	MsgSize of the original message sent by the PDP_OB	Refer to section 5.2
MsgType	2	2	Binary Integer		It will be the MsgType of the original message sent by the PDP_OB.
MsgSeqNum	4	4	Binary Integer		Refer to section 5.2
SendTime	8	4	Binary Integer		Refer to section 5.2
ProductID	12	1	Binary Integer	'115'	Refer to section 5.2
RetransFlag	13	1	Binary Integer	'2'	Refer to section 5.2
NumBodyEntries	14	1	Binary Integer	Same as original message	Refer to section 5.2
FILLER	15	1	ASCII String		This is filler, reserved for future use
All the 'body' fields of the Retransmitted Message are the same as the original message					

5.15 Book Refresh Message

On an interval basis and upon receipt of a valid refresh request message, a refresh of the book will be sent. Subscribers may choose to listen to the Interval Refresh Feeds which cycles through every symbol or choose to listen to the Refresh Request Feed. Interval-based refreshes and request based-refreshes will be sent on separate multicast groups. Note that this message(s) has a different packet header format than common PDP header.

Field Name	Offset	Size	Format	Value	Description
Set forth below are the 'header' fields of the Refresh Message					
MsgSize	0	2	Binary Integer	'46'	Refer to section 5.2
MsgType	2	2	Binary Integer	'32'	Book Refresh Message Type.
MsgSeqNum	4	4	Binary Integer		Unique Packet Sequence Number
SendTime	8	4	Binary Integer		Refer to section 5.2
ProductID	12	1	Binary Integer	'115'	Refer to section 5.2
RetransFlag	13	1	Binary Integer	'1', '5', '7', '8', '9'	Refer to section 5.2
NumBodyEntries	14	1	Binary Integer		Refer to section 5.2
FILLER	15	1	ASCII String		This is filler, reserved for future use
FILLER	16	1	ASCII String		This is filler, reserved for future use
SessionID	17	1	Binary Integer		Identifies the Source Session of the Symbol
SymbolIndex	18	2	Binary Integer		This field identifies the numerical representation of the symbol. User can combine this value with the session id to obtain a unique key.
CurrentRefreshMsgSeq	20	2	Binary Integer		Current Refresh Packet Sequence. Example: This may be 1 of 10 packets for the symbol being refreshed
TotalRefreshMsgSeq	22	2	Binary Integer		Total Refresh Packet Sequence for the refresh by symbol .
LastSourceSeqNum	24	4	Binary Integer		This field contains the last source sequence number assigned by the source system for this symbol... The sequence number is unique only to a given stock. Hence orders for two different stocks may share the same source sequence number. Please note that the sequence number while it increases serially, it does not increase monotonically.
LastMsgeSeq	28	4	Binary Integer		Refer to section A.2 This field contains the last message sequence number that contained the last message for this symbol.
Symbol	32	16	ASCII String		The Stock Symbol.
Defined below are the 'body' fields of the ArcaBook Refresh Message					
SourceSeqNum	48	4	Binary Integer		This field contains the sequence number assigned by the source system to this message. The sequence number is unique only to a given stock. Hence orders for two different stocks may share the same source sequence number. Please note that the sequence number while it increases serially, it does not increase monotonically.
SourceTime	52	4	Binary Integer		This field specifies the quote generation time. The number in this field represents the number of milliseconds since midnight of the same day.

Field Name	Offset	Size	Format	Value	Description
OrderID	56	8	Binary Integer		The Order ID identifies a unique order. Use in OrderID struct to create unique OrderID. See Section 4.6
Volume	64	4	Binary Integer		This field contains the size of the order. Please note we do not send Odd Lot (<100) quotes.
PriceNumerator	68	4	Binary Integer		This field specifies the price of the order.
PriceScaleCode	72	1	Binary Integer		See Section 4.5
Side	73	1	Binary Integer		This field indicates the side of the order Buy/sell. Valid Values: 'B' – Buy 'S' – Sell
ExchangeID	74	1	ASCII Character		The id of the originating exchange of the quote. Valid values: 'N' – NYSE (not used) 'P' – NYSE ARCA 'B' – NYSE ARCA BB
SecurityType	75	1	ASCII Character		This field specifies the security type for this message. Valid values: 'E' – Equity 'B' – BB
FirmIndex	76	2	Binary Integer		This field identifies the numerical representation of the firm sending the quote if attributed.
FILLER	78	2	ASCII String		This is filler, reserved for future use

5.16 Imbalance Refresh Message

Upon receipt of a valid imbalance refresh request message, a refresh of the current imbalance for the requested symbol will be sent. This message(s) has the same message header format as the common PDP header.

Field Name	Offset	Size	Format	Value	Description
Set forth below are the 'header' fields of the Imbalance Refresh Message					
MsgSize	0	2	Binary Integer	'50'	Refer to section 5.2
MsgType	2	2	Binary Integer	'33'	Imbalance Refresh Message Type.
MsgSeqNum	4	4	Binary Integer		Refer to section A.2 Last message Sequence Number that contained this update.
SendTime	8	4	Binary Integer		Refer to section 5.2
ProductID	12	1	Binary Integer	'115'	Refer to section 5.2
RetransFlag	13	1	Binary Integer	'5', '7', '8', '9'	Refer to section 5.2
NumBodyEntries	14	1	Binary Integer		Refer to section 5.2
FILLER	15	1	ASCII String		This is filler, reserved for future use
All the 'body' fields of the Imbalance Refresh Message are the same as the original message body.					

5.17 Symbol Index Mapping Message

This message is sent by NYSE Arca in response to a Symbol Index Request or sent automatically when there are intraday symbol additions.

Please note: This message will come back via TCP/IP or UDP as specified by the customer in the RetransmitMethod (see sections 5.11 and 5.12).

Field Name	Offset	Size	Format	Value	Description
Set forth below are the 'header' fields of the Symbol Index Mapping Message					
MsgSize	0	2	Binary Integer	'34'	Refer to section 5.2
MsgType	2	2	Binary Integer	'35'	Refer to section 5.2
MsgSeqNum	4	4	Binary Integer		Refer to section 5.2
SendTime	8	4	Binary Integer		Refer to section 5.2
ProductID	12	1	Binary Integer	'115'	Refer to section 5.2
RetransFlag	13	1	Binary Integer	'1', '2', '5', '7', '8', '9'	Refer to section 5.2
NumBodyEntries	14	1	Binary Integer		Refer to section 5.2
FILLER	15	1	ASCII String		This is filler, reserved for future use
Defined below are the 'body' fields of the Symbol Index Mapping Message					
SymbolIndex	16	2	Binary Integer		This field identifies the numerical representation of the symbol. User can combine this value with the session id to obtain a unique key.
SessionID	18	1	Binary Integer		Identifies the Source Session of the Symbol
FILLER	19	1	ASCII String		This is filler, reserved for future use
Symbol	20	16	ASCII String		The Stock Symbol.

5.18 Attributed Quote Firm Index Mapping Message

This message is sent by NYSE Arca in response to an Attributed Quote Firm Index Request or sent automatically when there are intraday firm additions.

Please note: This message will come back via TCP/IP or UDP as specified by the customer in the RetransmitMethod (see sections 5.11 and 5.12).

Field Name	Offset	Size	Format	Value	Description
Set forth below are the 'header' fields of the Firm Index Mapping Message					
MsgSize	0	2	Binary Integer	'26'	Refer to section 5.2
MsgType	2	2	Binary Integer	'37'	Refer to section 5.2
MsgSeqNum	4	4	Binary Integer		Refer to section 5.2
SendTime	8	4	Binary Integer		Refer to section 5.2
ProductID	12	1	Binary Integer	'115'	Refer to section 5.2
RetransFlag	13	1	Binary Integer	'1', '2', '5', '7', '8', '9'	Refer to section 5.2
NumBodyEntries	14	1	Binary Integer		Refer to section 5.2
FILLER	15	1	ASCII String		This is filler, reserved for future use
Defined below are the 'body' fields of the Firm Index Mapping Message					
FirmIndex	16	2	Binary Integer		This field identifies the numerical representation of the firm.
FILLER	18	5	ASCII String		This is filler, reserved for future use
Firm	23	5	ASCII String		The Attributed Firm.

5.19 Symbol Clear Message

This message is sent by NYSE Arca in response to issues with a specific symbol, i.e. system problems that corrupt order book or a local failover or DR situation(s).

Field Name	Offset	Size	Format	Value	Description
Set forth below are the 'header' fields of the Symbol Clear Message					
MsgSize	0	2	Binary Integer	'22'	Refer to section 5.2

Field Name	Offset	Size	Format	Value	Description
MsgType	2	2	Binary Integer	'36'	Refer to section 5.2
MsgSeqNum	4	4	Binary Integer		Refer to section 5.2
SendTime	8	4	Binary Integer		Refer to section 5.2
ProductID	12	1	Binary Integer	'115'	Refer to section 5.2
RetransFlag	13	1	Binary Integer	'1', '6'	Refer to section 5.2
NumBodyEntries	14	1	Binary Integer	'1'	Refer to section 5.2
FILLER	15	1	ASCII String		This is filler, reserved for future use

Defined below are the 'body' fields of the Symbol Clear Message

NextSeqNumber	16	4	Binary Integer		This field contains the source sequence number value that the recipient should expect in the immediately succeeding data packet for the specific symbol
SymbolIndex	20	2	Binary Integer		This field identifies the numerical representation of the symbol. User can combine this value with the session id to obtain a unique key.
SessionID	22	1	Binary Integer		Identifies the Source Session of the Symbol
FILLER	23	1	ASCII String		This is filler, reserved for future use

5.20 Retransmission message processing notes

- All Subscribers will receive retransmission messages through the retransmission channel.
- Due to the multicast nature, subscribers will receive 'all' retransmission messages, including messages that were not requested by them.
- Note that when a message for a particular symbol is retransmitted, a new message **for the same symbol** may be sent through the regular channel. This scenario is very likely to occur with busy symbols and may cause confusion as to which message contains the latest information on that symbol.

In order to resolve the conflict, the following qualification method should be applied:

- a. Check the MsgSeqNum field. A retransmitted message retains the same sequence number as the original message. Even refreshes are retransmitted with the original sequence numbers for the message they belonged to.
- b. The most current sequence number (SEQNUM) contains the latest information.
- c. If the SEQNUMS are the same: messages are the same, any of the two messages contains the same information.

Please refer to D.7 Processing of line level Retransmission Messages for a suggest way of processing.

5.21 Message Unavailable

This message will be sent to inform the subscribers of unavailability of a range of messages for which they may have requested retransmission via the Retransmission Multicast channels. Below is the message format.

Field Name	Offset	Size	Format	Value	Description
Set forth below are the 'header' fields of the NYSE Packet Unavailable Message					
MsgSize	0	2	Binary Integer	'22'	Refer to section 5.2
MsgType	2	2	Binary Integer	'5'	Refer to section 5.2

Field Name	Offset	Size	Format	Value	Description
MsgSeqNum	4	4	Binary Integer		Refer to section 5.2
SendTime	8	4	Binary Integer		Refer to section 5.2
ProductID	12	1	Binary Integer	'115'	Refer to section 5.2
RetransFlag	13	1	Binary Integer	'2'	Refer to section 5.2
NumBodyEntries	14	1	Binary Integer	'1'	Refer to section 5.2
FILLER	15	1	ASCII String		This is filler, reserved for future use
Defined below are the 'body' fields of the NYSE Packet Unavailable Message					
BeginSeqNum	16	4	Binary Integer		The beginning sequence number of the requested range of messages to be retransmitted.
EndSeqNum	20	4	Binary Integer		The end sequence number of the requested range of messages to be retransmitted.

Appendix A – ArcaBook Order Book IP Group Assignments

Overview The following chapter will provide you with all of the necessary connectivity information in order to subscribe to the ArcaBook Feed.

A.1 Multicast groups Due to capacity measures, the ArcaBook data feed will be split into four (4) data streams for Listed data, four (4) streams for OTC data, two (2) streams for ETF data, and one (1) for BB data. Each data stream will deliver a set of quotes for a certain range of symbols. The table below describes the categorization of the data feed.

Feed Name	Description
OB_AC	Listed Multicast Groups assigned to deliver quotes of symbols starting with letters A through C.
OB_DJ	Listed Multicast Groups assigned to deliver quotes of symbols starting with letters D through J.
OB_KQ	Listed Multicast Groups assigned to deliver quotes of symbols starting with letters K through Q.
OB_RZ	Listed Multicast Groups assigned to deliver quotes of symbols starting with letters R through Z.
OBO_AC	OTC Multicast Groups assigned to deliver quotes of symbols starting with letters A through C.
OBO_DJ	OTC Multicast Groups assigned to deliver quotes of symbols starting with letters D through J.
OBO_KQ	OTC Multicast Groups assigned to deliver quotes of symbols starting with letters K through Q.
OBO_RZ	OTC Multicast Groups assigned to deliver quotes of symbols starting with letters R through Z.
OBE_AM	ETF Multicast Groups assigned to deliver quotes of symbols starting with letters A through M.
OBE_NZ	ETF Multicast Groups assigned to deliver quotes of symbols starting with letters N through Z.
OBB_AZ	BB Multicast Groups assigned to deliver quotes of symbols starting with letters A through Z.

A.2 Joining Multicast groups

Recipient's applications/hosts will be responsible for issuing Multicast subscriptions to one or more of the Multicast Groups assigned to the PDP_OB product. In response to each authorized subscription request, SFTI network will complete the tasks associated with delivering the Multicast packets from the NYSE data source to the recipient's network.

The process of subscribing to a Multicast Group ID is also known as 'joining' a Multicast Group. Upon session termination, the subscriber's host system should issue an 'unjoin' message. This will terminate delivery of data to that host's local network. If an application/host terminates without issuing an 'unjoin' message, the network will eventually issue a 'timeout' for the Multicast Group subscription that will automatically terminate delivery of the Multicast packets to the host's local network.

A.3 Feeds

ArcaBook Book data is published using two sets of unique IP Multicast Group IDs ("Primary" and "Secondary")—the two will originate from the same distribution site. The feeds are redundant to each other, i.e., they are synchronized with each other. Each message from each feed contains the same packet sequence number.

A.4 Production IP addresses

The table below defines the IP/Multicast group and port assignments for all messages in the ArcaBook feed.

Listed and OTC data will be divided into 4 symbol ranges:
A to C, D to J, K to Q, R to Z.

ETF data will be divided into 2 symbol ranges:
A to M, N to Z.

BB data will be divided into 1 symbol range:
A to Z.

Please note multicast groups may be expanded in the future and symbol ranges modified in the future to balance the data volume.

Uncompacted ArcaBook Feed

ArcaBook	Type	IP	Port
Primary data Feed – Symbols A to C	Listed	224.1.2.128	13000
Primary data Feed– Symbols D to J	Listed	224.1.2.128	13001
Primary data Feed – Symbols K to Q	Listed	224.1.2.128	13002
Primary data Feed– Symbols R to Z	Listed	224.1.2.128	13003
Secondary data Feed – Symbols A to C	Listed	224.1.2.168	14000
Secondary data Feed– Symbols D to J	Listed	224.1.2.168	14001
Secondary data Feed – Symbols K to Q	Listed	224.1.2.168	14002

Secondary data Feed– Symbols R to Z	Listed	224.1.2.168	14003
Primary data Feed – Symbols A to C	OTC	224.1.2.129	13004
Primary data Feed– Symbols D to J	OTC	224.1.2.129	13005
Primary data Feed – Symbols K to Q	OTC	224.1.2.129	13006
Primary data Feed– Symbols R to Z	OTC	224.1.2.129	13007
Secondary data Feed – Symbols A to C	OTC	224.1.2.169	14004
Secondary data Feed– Symbols D to J	OTC	224.1.2.169	14005
Secondary data Feed – Symbols K to Q	OTC	224.1.2.169	14006
Secondary data Feed– Symbols R to Z	OTC	224.1.2.169	14007
Primary data Feed– Symbols A to M	ETF	224.1.2.130	13008
Primary data Feed– Symbols N to Z	ETF	224.1.2.130	13009
Secondary data Feed – Symbols A to M	ETF	224.1.2.170	14008
Secondary data Feed – Symbols N to Z	ETF	224.1.2.170	14009
Primary data Feed– Symbols A to Z	BB	224.1.2.131	13012
Secondary data Feed – Symbols A to Z	BB	224.1.2.171	14012

ArcaBook Fast Compacted Feed

ArcaBook	Type	IP	Port
Primary data Feed – Symbols A to C	Listed	224.1.2.133	13014
Primary data Feed– Symbols D to J	Listed	224.1.2.133	13015
Primary data Feed – Symbols K to Q	Listed	224.1.2.133	13016
Primary data Feed– Symbols R to Z	Listed	224.1.2.133	13017
Secondary data Feed – Symbols A to C	Listed	224.1.2.173	14014
Secondary data Feed– Symbols D to J	Listed	224.1.2.173	14015
Secondary data Feed – Symbols K to Q	Listed	224.1.2.173	14016
Secondary data Feed– Symbols R to Z	Listed	224.1.2.173	14017
Primary data Feed – Symbols A to C	OTC	224.1.2.134	13018
Primary data Feed– Symbols D to J	OTC	224.1.2.134	13019
Primary data Feed – Symbols K to Q	OTC	224.1.2.134	13020
Primary data Feed– Symbols R to Z	OTC	224.1.2.134	13021
Secondary data Feed – Symbols A to C	OTC	224.1.2.174	14018
Secondary data Feed– Symbols D to J	OTC	224.1.2.174	14019
Secondary data Feed – Symbols K to Q	OTC	224.1.2.174	14020

Secondary data Feed– Symbols R to Z	OTC	224.1.2.174	14021
Primary data Feed– Symbols A to M	ETF	224.1.2.135	13022
Primary data Feed– Symbols N to Z	ETF	224.1.2.135	13023
Secondary data Feed – Symbols A to M	ETF	224.1.2.175	14022
Secondary data Feed – Symbols N to Z	ETF	224.1.2.175	14023
Primary data Feed– Symbols A to Z	BB	224.1.2.136	13026
Secondary data Feed – Symbols A to Z	BB	224.1.2.176	14026

**A.5
Retransmission
Request IP
addresses**

The table below defines the TCP/IP retransmission request group and port assignments for all messages in the ArcaBook feed.

Listed and OTC Data will be divided into 4 symbol ranges:
A to C, D to J, K to Q, R to Z

ETF data will be divided into 2 symbol ranges:
A to M, N to Z.

BB data will be divided into 1 symbol ranges:
A to Z.

Please note multicast groups may be expanded in the future and symbol ranges modified in the future to balance the data volume.

Uncompacted ArcaBook Retransmission Request Feed

ArcaBook	Type	IP	Port
Retransmission Request for Symbols A to C	Listed	63.211.73.14	52001
Retransmission Request for Symbols D to J	Listed	63.211.73.14	52002
Retransmission Request for Symbols K to Q	Listed	63.211.73.14	52003
Retransmission Request for Symbols R to Z	Listed	63.211.73.14	52004
Retransmission Request for Symbols A to C	OTC	63.211.73.14	52005
Retransmission Request for Symbols D to J	OTC	63.211.73.14	52006
Retransmission Request for Symbols K to Q	OTC	63.211.73.14	52007
Retransmission Request for Symbols R to Z	OTC	63.211.73.14	52008
Retransmission Request for Symbols A to M	ETF	63.211.73.14	52009
Retransmission Request for Symbols N to Z	ETF	63.211.73.14	52010
Retransmission Request for Symbols A to Z	BB	63.211.73.14	52013

ArcaBook Fast Compacted Retransmission Request Feed

ArcaBook	Type	IP	Port
Retransmission Request for Symbols A to C	Listed	63.211.73.14	52015
Retransmission Request for Symbols D to J	Listed	63.211.73.14	52016
Retransmission Request for Symbols K to Q	Listed	63.211.73.14	52017
Retransmission Request for Symbols R to Z	Listed	63.211.73.14	52018
Retransmission Request for Symbols A to C	OTC	63.211.73.14	52019
Retransmission Request for Symbols D to J	OTC	63.211.73.14	52020
Retransmission Request for Symbols K to Q	OTC	63.211.73.14	52021
Retransmission Request for Symbols R to Z	OTC	63.211.73.14	52022
Retransmission Request for Symbols A to M	ETF	63.211.73.14	52023
Retransmission Request for Symbols N to Z	ETF	63.211.73.14	52024
Retransmission Request for Symbols A to Z	BB	63.211.73.14	52027

A.6 Retransmission IP addresses

The table below defines the IP/Multicast retransmission group and port assignments for all messages in the ArcaBook feed.

Listed and OTC Data will be divided into 4 symbol ranges:
A to C, D to J, K to Q, R to Z

ETF data will be divided into 2 symbol ranges:
A to M, N to Z.

BB data will be divided into 1 symbol ranges:
A to Z.

Please note multicast groups may be expanded in the future and symbol ranges modified in the future to balance the data volume.

Uncompacted ArcaBook Retransmission Feed

ArcaBook	Type	IP	Port
Primary Retransmission Feed for Symbols A to C	Listed	224.1.2.138	13028
Primary Retransmission Feed for Symbols D to J	Listed	224.1.2.138	13029
Primary Retransmission Feed for Symbols K to Q	Listed	224.1.2.138	13030
Primary Retransmission Feed for Symbols R to Z	Listed	224.1.2.138	13031

Secondary Retransmission Feed for Symbols A to C	Listed	224.1.2.178	14028
Secondary Retransmission Feed for Symbols D to J	Listed	224.1.2.178	14029
Secondary Retransmission Feed for Symbols K to Q	Listed	224.1.2.178	14030
Secondary Retransmission Feed for Symbols R to Z	Listed	224.1.2.178	14031
Primary Retransmission Feed for Symbols A to C	OTC	224.1.2.139	13032
Primary Retransmission Feed for Symbols D to J	OTC	224.1.2.139	13033
Primary Retransmission Feed for Symbols K to Q	OTC	224.1.2.139	13034
Primary Retransmission Feed for Symbols R to Z	OTC	224.1.2.139	13035
Secondary Retransmission Feed for Symbols A to C	OTC	224.1.2.179	14032
Secondary Retransmission Feed for Symbols D to J	OTC	224.1.2.179	14033
Secondary Retransmission Feed for Symbols K to Q	OTC	224.1.2.179	14034
Secondary Retransmission Feed for Symbols R to Z	OTC	224.1.2.179	14035
Primary Retransmission Feed for Symbols A to M	ETF	224.1.2.140	13036
Primary Retransmission Feed for Symbols N to Z	ETF	224.1.2.140	13037
Secondary Retransmission Feed for Symbols A to M	ETF	224.1.2.180	14036
Secondary Retransmission Feed for Symbols N to Z	ETF	224.1.2.180	14037
Primary Retransmission Feed for Symbols A to Z	BB	224.1.2.141	13040
Secondary Retransmission Feed for Symbols A to Z	BB	224.1.2.181	14040

ArcaBook Fast Compacted Retransmission Feed

ArcaBook	Type	IP	Port
Primary Retransmission Feed for Symbols A to C	Listed	224.1.2.143	13042
Primary Retransmission Feed for Symbols D to J	Listed	224.1.2.143	13043
Primary Retransmission Feed for Symbols K to Q	Listed	224.1.2.143	13044
Primary Retransmission Feed for Symbols R to Z	Listed	224.1.2.143	13045
Secondary Retransmission Feed for Symbols A to C	Listed	224.1.2.183	14042
Secondary Retransmission Feed for Symbols D to J	Listed	224.1.2.183	14043
Secondary Retransmission Feed for Symbols K to Q	Listed	224.1.2.183	14044
Secondary Retransmission Feed for Symbols R to Z	Listed	224.1.2.183	14045
Primary Retransmission Feed for Symbols A to C	OTC	224.1.2.144	13046
Primary Retransmission Feed for Symbols D to J	OTC	224.1.2.144	13047
Primary Retransmission Feed for Symbols K to Q	OTC	224.1.2.144	13048
Primary Retransmission Feed for Symbols R to Z	OTC	224.1.2.144	13049

Secondary Retransmission Feed for Symbols A to C	OTC	224.1.2.184	14046
Secondary Retransmission Feed for Symbols D to J	OTC	224.1.2.184	14047
Secondary Retransmission Feed for Symbols K to Q	OTC	224.1.2.184	14048
Secondary Retransmission Feed for Symbols R to Z	OTC	224.1.2.184	14049
Primary Retransmission Feed for Symbols A to M	ETF	224.1.2.145	13050
Primary Retransmission Feed for Symbols N to Z	ETF	224.1.2.145	13051
Secondary Retransmission Feed for Symbols A to M	ETF	224.1.2.185	14050
Secondary Retransmission Feed for Symbols N to Z	ETF	224.1.2.185	14051
Primary Retransmission Feed for Symbols A to Z	BB	224.1.2.146	13054
Secondary Retransmission Feed for Symbols A to Z	BB	224.1.2.186	14054

**A.7 Refresh
(Request
Based) IP
addresses**

These multicast IP addresses are for refreshes to the Order Book, Imbalances, Symbol Mappings, and Firm Mappings in response to the refresh request message. The data sent down the Refresh channel provides a current snapshot of the data. For example, customers can receive all open orders for specific symbols by issuing a refresh request via TCP/IP and then listening to the refresh group for the updated book messages. The table below defines the IP/Multicast group and port assignments for Refresh information.

Uncompacted ArcaBook Refresh Feed (Request Based)

Refresh Feed (Request Based)	Type	IP	Port
Primary Refresh Feed for Symbols A to C	Listed	224.1.2.158	13084
Primary Refresh Feed for Symbols D to J	Listed	224.1.2.158	13085
Primary Refresh Feed for Symbols K to Q	Listed	224.1.2.158	13086
Primary Refresh Feed for Symbols R to Z	Listed	224.1.2.158	13087
Secondary Refresh Feed for Symbols A to C	Listed	224.1.2.198	14084
Secondary Refresh Feed for Symbols D to J	Listed	224.1.2.198	14085
Secondary Refresh Feed for Symbols K to Q	Listed	224.1.2.198	14086
Secondary Refresh Feed for Symbols R to Z	Listed	224.1.2.198	14087
Primary Refresh Feed for Symbols A to C	OTC	224.1.2.159	13088
Primary Refresh Feed for Symbols D to J	OTC	224.1.2.159	13089
Primary Refresh Feed for Symbols K to Q	OTC	224.1.2.159	13090
Primary Refresh Feed for Symbols R to Z	OTC	224.1.2.159	13091
Secondary Refresh Feed for Symbols A to C	OTC	224.1.2.199	14088
Secondary Refresh Feed for Symbols D to J	OTC	224.1.2.199	14089

Secondary Refresh Feed for Symbols K to Q	OTC	224.1.2.199	14090
Secondary Refresh Feed for Symbols R to Z	OTC	224.1.2.199	14091
Primary Refresh Feed for Symbols A to M	ETF	224.1.2.160	13092
Primary Refresh Feed for Symbols N to Z	ETF	224.1.2.160	13093
Secondary Refresh Feed for Symbols A to M	ETF	224.1.2.200	14092
Secondary Refresh Feed for Symbols N to Z	ETF	224.1.2.200	14093
Primary Refresh Feed for Symbols A to Z	BB	224.1.2.161	13096
Secondary Refresh Feed for Symbols A to Z	BB	224.1.2.201	14096

ArcaBook Fast Compacted Refresh Compacted Feed (Request Based)

Refresh Feed (Request Based)	Type	IP	Port
Primary Refresh Feed for Symbols A to C	Listed	224.1.2.163	13098
Primary Refresh Feed for Symbols D to J	Listed	224.1.2.163	13099
Primary Refresh Feed for Symbols K to Q	Listed	224.1.2.163	13100
Primary Refresh Feed for Symbols R to Z	Listed	224.1.2.163	13101
Secondary Refresh Feed for Symbols A to C	Listed	224.1.2.203	14098
Secondary Refresh Feed for Symbols D to J	Listed	224.1.2.203	14099
Secondary Refresh Feed for Symbols K to Q	Listed	224.1.2.203	14100
Secondary Refresh Feed for Symbols R to Z	Listed	224.1.2.203	14101
Primary Refresh Feed for Symbols A to C	OTC	224.1.2.164	13102
Primary Refresh Feed for Symbols D to J	OTC	224.1.2.164	13103
Primary Refresh Feed for Symbols K to Q	OTC	224.1.2.164	13104
Primary Refresh Feed for Symbols R to Z	OTC	224.1.2.164	13105
Secondary Refresh Feed for Symbols A to C	OTC	224.1.2.204	14102
Secondary Refresh Feed for Symbols D to J	OTC	224.1.2.204	14103
Secondary Refresh Feed for Symbols K to Q	OTC	224.1.2.204	14104
Secondary Refresh Feed for Symbols R to Z	OTC	224.1.2.204	14105
Primary Refresh Feed for Symbols A to M	ETF	224.1.2.165	13106
Primary Refresh Feed for Symbols N to Z	ETF	224.1.2.165	13107
Secondary Refresh Feed for Symbols A to M	ETF	224.1.2.205	14106
Secondary Refresh Feed for Symbols N to Z	ETF	224.1.2.205	14107
Primary Refresh Feed for Symbols A to Z	BB	224.1.2.166	13110

Secondary Refresh Feed for Symbols A to Z	BB	224.1.2.206	14110
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A.8 Refresh (Interval Based) IP addresses

The table below defines the IP/Multicast interval based refresh group and port assignments for all the Refresh information. The data sent down the Refresh channel provides a current snapshot of the data. ArcaBook refresh messages are sent out on a configurable interval basis. The interval basis is up to 30 seconds for all symbols on the uncompact feed and up to 15 seconds for the compacted feed. (Please note the interval is "up to", implying that it can be less than the interval noted for each feed.)

Uncompact ArcaBook Refresh Feed (Interval Based)

Refresh Feed (Interval Based)	Type	IP	Port
Primary Refresh Feed for Symbols A to C	Listed	224.1.2.148	13056
Primary Refresh Feed for Symbols D to J	Listed	224.1.2.148	13057
Primary Refresh Feed for Symbols K to Q	Listed	224.1.2.148	13058
Primary Refresh Feed for Symbols R to Z	Listed	224.1.2.148	13059
Secondary Refresh Feed for Symbols A to C	Listed	224.1.2.188	14056
Secondary Refresh Feed for Symbols D to J	Listed	224.1.2.188	14057
Secondary Refresh Feed for Symbols K to Q	Listed	224.1.2.188	14058
Secondary Refresh Feed for Symbols R to Z	Listed	224.1.2.188	14059
Primary Refresh Feed for Symbols A to C	OTC	224.1.2.149	13060
Primary Refresh Feed for Symbols D to J	OTC	224.1.2.149	13061
Primary Refresh Feed for Symbols K to Q	OTC	224.1.2.149	13062
Primary Refresh Feed for Symbols R to Z	OTC	224.1.2.149	13063
Secondary Refresh Feed for Symbols A to C	OTC	224.1.2.189	14060
Secondary Refresh Feed for Symbols D to J	OTC	224.1.2.189	14061
Secondary Refresh Feed for Symbols K to Q	OTC	224.1.2.189	14062
Secondary Refresh Feed for Symbols R to Z	OTC	224.1.2.189	14063
Primary Refresh Feed for Symbols A to M	ETF	224.1.2.150	13064
Primary Refresh Feed for Symbols N to Z	ETF	224.1.2.150	13065
Secondary Refresh Feed for Symbols A to M	ETF	224.1.2.190	14064
Secondary Refresh Feed for Symbols N to Z	ETF	224.1.2.190	14065
Primary Refresh Feed for Symbols A to Z	BB	224.1.2.151	13068
Secondary Refresh Feed for Symbols A to Z	BB	224.1.2.191	14068

ArcaBook Fast Compacted Refresh Feed (Interval Based)

Refresh Feed (Interval Based)	Type	IP	Port
Primary Refresh Feed for Symbols A to C	Listed	224.1.2.153	13070
Primary Refresh Feed for Symbols D to J	Listed	224.1.2.153	13071
Primary Refresh Feed for Symbols K to Q	Listed	224.1.2.153	13072
Primary Refresh Feed for Symbols R to Z	Listed	224.1.2.153	13073
Secondary Refresh Feed for Symbols A to C	Listed	224.1.2.193	14070
Secondary Refresh Feed for Symbols D to J	Listed	224.1.2.193	14071
Secondary Refresh Feed for Symbols K to Q	Listed	224.1.2.193	14072
Secondary Refresh Feed for Symbols R to Z	Listed	224.1.2.193	14073
Primary Refresh Feed for Symbols A to C	OTC	224.1.2.154	13074
Primary Refresh Feed for Symbols D to J	OTC	224.1.2.154	13075
Primary Refresh Feed for Symbols K to Q	OTC	224.1.2.154	13076
Primary Refresh Feed for Symbols R to Z	OTC	224.1.2.154	13077
Secondary Refresh Feed for Symbols A to C	OTC	224.1.2.194	14074
Secondary Refresh Feed for Symbols D to J	OTC	224.1.2.194	14075
Secondary Refresh Feed for Symbols K to Q	OTC	224.1.2.194	14076
Secondary Refresh Feed for Symbols R to Z	OTC	224.1.2.194	14077
Primary Refresh Feed for Symbols A to M	ETF	224.1.2.155	13078
Primary Refresh Feed for Symbols N to Z	ETF	224.1.2.155	13079
Secondary Refresh Feed for Symbols A to M	ETF	224.1.2.195	14078
Secondary Refresh Feed for Symbols N to Z	ETF	224.1.2.195	14079
Primary Refresh Feed for Symbols A to Z	BB	224.1.2.156	13082
Secondary Refresh Feed for Symbols A to Z	BB	224.1.2.196	14082

A.9 Retransmission Request Thresholds

The table below summarizes the Retransmission request thresholds for the ArcaBook feed. The numbers below represent the thresholds per channel.

Capability	Description	Threshold	Action
------------	-------------	-----------	--------

Prevention of invalid subscribers	Incoming requests from subscribers that are not in the enabled subscriber's source ID list will not be honored. PDP subscribers will need a source ID, which is a string that uniquely identifies the subscriber of the retransmission requests. Please contact SIAC Customer Service or NYSE Arca Fix/Connectivity to get a unique source ID.	N/A	Request will not be processed.
Limitation of Requests for a large number of packets	Only retransmission requests for 250 packets or less will be honored.	250	Request will not be processed.
Limitation of Generic Requests	If the number of a subscriber's generic requests reaches the threshold number of requests per day, the subscriber will be blocked and its retransmission request will no longer be honored during that particular day.	10000	Subsequent retransmissions requests from that subscriber will be blocked.
Limitation of requests for refresh messages	Only refresh requests for 5000 messages or less will be honored.	5000	Request will not be honored.

A.10 Multicast group message

The table below outlines which messages types are sent over the multicast groups described in the previous pages.

ArcaBook Feed Type	Document Section	Message Type(s)
Primary/Secondary Multicast Data Feed	4.10	Add
Primary/Secondary Multicast Data Feed	4.11	Modify
Primary/Secondary Multicast Data Feed	4.12	Delete
Primary/Secondary Multicast Data Feed	4.13	Imbalance
Primary/Secondary Multicast Data Feed	5.3	Sequence Number Reset
Primary/Secondary Multicast Data Feed	5.5	Heartbeat
Primary/Secondary Multicast Data Feed	5.17	Symbol Index Mapping
Primary/Secondary Multicast Data Feed	5.18	Attributed Quote Firm Index Mapping
Primary/Secondary Multicast Data Feed	5.19	Symbol Clear
Primary/Secondary Retransmission Multicast Data Feed	5.5	Heartbeat
Retransmission Requests Multicast Data Feed	5.14	Retransmission (for any packet sent down in the primary feed except for Heartbeats)
Primary/Secondary Retransmission Multicast Data Feed	5.21	Message Unavailable
Primary/Secondary TCP/IP Retransmission Request	5.5	Heartbeat

Primary/Secondary TCP/IP Retransmission Request	5.7	Heartbeat Response
Primary/Secondary TCP/IP Retransmission Request	5.8	Retransmission Request
Primary/Secondary TCP/IP Retransmission Request	5.9	Book Refresh Request
Primary/Secondary TCP/IP Retransmission Request	5.10	Imbalance Refresh Request
Primary/Secondary TCP/IP Retransmission Request	5.11	Symbol Index Mapping Request
Primary/Secondary TCP/IP Retransmission Request	5.12	Attributed Quote Firm Index Mapping Request
Primary/Secondary TCP/IP Retransmission Request	5.13	Retransmission Response
Primary Multicast Refresh Feed (Interval Based)	5.5	Heartbeat

A.11 TCP Source IP addresses

The table below outlines the TCP Source IP addresses, applicable to each Port.

TCP Source IP Address ("A" Source)	TCP Source IP Address ("B" Source)
63.211.72.60	63.211.72.188
63.211.72.64	63.211.72.192
8.9.19.60	8.9.19.188
8.9.19.63	8.9.19.191

Appendix B – ArcaBook Order Book Test/Cert IP Group Assignments

B.1 ArcaBook Testing The following sections contain the IP/Multicast group assignments and Retransmission request assignments for the test service. Test can be run intra-day over different multicast groups than the production environment so that subscribers do not need to worry about incorrect data over the production lines.

B.2 Test IP Addresses The table below defines the test IP/Multicast group and port assignments for all messages in the ArcaBook feed.

Listed and OTC Data will be divided into 1 symbol ranges:
A to Z

ETF data will be divided into 1 symbol ranges:
A to Z.

BB data will be divided into 1symbol ranges:
A to Z.

Please note multicast groups may be expanded in the future and symbol ranges modified in the future to balance the data volume.

Test Uncompacted ArcaBook Feed

ArcaBook	Type	IP	Port
Primary data Feed - Symbols A to Z	Listed	224.1.2.252	19000
Secondary data Feed - Symbols A to Z	Listed	224.1.2.255	20000
Primary data Feed - Symbols A to Z	OTC	224.1.2.252	19004
Secondary data Feed - Symbols A to Z	OTC	224.1.2.255	20004
Primary data Feed - Symbols A to Z	ETF	224.1.2.252	19008
Secondary data Feed - Symbols A to Z	ETF	224.1.2.255	20008
Primary data Feed - Symbols A to Z	BB	224.1.2.252	19012
Secondary data Feed - Symbols A to Z	BB	224.1.2.255	20012

Test ArcaBook Fast Compacted Feed

ArcaBook	Type	IP	Port
----------	------	----	------

Primary data Feed - Symbols A to Z	Listed	224.1.2.252	19014
Secondary data Feed - Symbols A to Z	Listed	224.1.2.255	20014
Primary data Feed - Symbols A to Z	OTC	224.1.2.252	19018
Secondary data Feed - Symbols A to Z	OTC	224.1.2.255	20018
Primary data Feed - Symbols A to Z	ETF	224.1.2.252	19022
Secondary data Feed - Symbols A to Z	ETF	224.1.2.255	20022
Primary data Feed - Symbols A to Z	BB	224.1.2.252	19026
Secondary data Feed - Symbols A to Z	BB	224.1.2.255	20026

B.3 Test Retransmission Request IP addresses

The table below defines the test TCP/IP retransmission request group and port assignments for all messages in the ArcaBook feed.

Listed and OTC Data will be divided into 1 symbol ranges:
A to Z

ETF data will be divided into 1 symbol ranges:
A to Z.

BB data will be divided into 1symbol ranges:
A to Z.

Please note multicast groups may be expanded in the future and symbol ranges modified in the future to balance the data volume.

Test Uncompacted ArcaBook Feed

ArcaBook	Type	IP	Port
Retransmission Request for Symbols A to Z	Listed	63.211.73.162	52001
Retransmission Request for Symbols A to Z	OTC	63.211.73.162	52005
Retransmission Request for Symbols A to Z	ETF	63.211.73.162	52009
Retransmission Request for Symbols A to Z	BB	63.211.73.162	52013

Test ArcaBook Fast Compacted Feed

ArcaBook	Type	IP	Port
Retransmission Request for Symbols A to Z	Listed	63.211.73.162	52015
Retransmission Request for Symbols A to Z	OTC	63.211.73.162	52019
Retransmission Request for Symbols A to Z	ETF	63.211.73.162	52023
Retransmission Request for Symbols A to Z	BB	63.211.73.162	52027

**B.4 Test
Retransmission
IP addresses**

The table below defines the test IP/Multicast retransmission group and port assignments for all messages in the ArcaBook feed.

Listed and OTC Data will be divided into 1 symbol ranges:
A to Z

ETF data will be divided into 1 symbol ranges:
A to Z.

BB data will be divided into 1 symbol ranges:
A to Z.

Please note multicast groups may be expanded in the future and symbol ranges modified in the future to balance the data volume.

Test Uncompacted ArcaBook Feed

ArcaBook	Type	IP	Port
Primary Retransmission Feed for Symbols A to Z	Listed	224.1.2.252	19028
Secondary Retransmission Feed for Symbols A to Z	Listed	224.1.2.255	20028
Primary Retransmission Feed for Symbols A to Z	OTC	224.1.2.252	19032
Secondary Retransmission Feed for Symbols A to Z	OTC	224.1.2.255	20032
Primary Retransmission Request for Symbols A to Z	ETF	224.1.2.252	19036
Secondary Retransmission Request for Symbols A to Z	ETF	224.1.2.255	20036
Primary Retransmission Request for Symbols A to Z	BB	224.1.2.252	19040
Secondary Retransmission Request for Symbols A to Z	BB	224.1.2.255	20040

Test ArcaBook Fast Compacted Feed

ArcaBook	Type	IP	Port
Primary Retransmission Feed for Symbols A to Z	Listed	224.1.2.252	19042
Secondary Retransmission Feed for Symbols A to Z	Listed	224.1.2.255	20042
Primary Retransmission Feed for Symbols A to Z	OTC	224.1.2.252	19046
Secondary Retransmission Feed for Symbols A to Z	OTC	224.1.2.255	20046
Primary Retransmission Request for Symbols A to Z	ETF	224.1.2.252	19050
Secondary Retransmission Request for Symbols A to Z	ETF	224.1.2.255	20050
Primary Retransmission Request for Symbols A to Z	BB	224.1.2.252	19054
Secondary Retransmission Request for Symbols A to Z	BB	224.1.2.255	20054

B.5 Test Refresh (Request Based) IP addresses

These multicast IP addresses are for refreshes to the Order Book, Imbalances, Symbol Mappings, and Firm Mappings in response to the refresh request message. The data sent down the Refresh channel provides a current snapshot of the data. For example, customers can received all open orders for specific symbols by issuing a refresh request via TCP/IP and then listening to the refresh group for the updated book messages. The table below defines the IP/Multicast group and port assignments for Refresh information.

Test Uncompacted ArcaBook Refresh Feed (Request Based)

Test Refresh Feed (Request Based)	Type	IP	Port
Primary Refresh Feed for Symbols A to Z	Listed	224.1.2.252	19084
Secondary Refresh Feed for Symbols A to Z	Listed	224.1.2.255	20084
Primary Refresh Feed for Symbols A to Z	OTC	224.1.2.252	19088
Secondary Refresh Feed for Symbols A to Z	OTC	224.1.2.255	20088
Primary Refresh Feed for Symbols A to Z	ETF	224.1.2.252	19092
Secondary Refresh Feed for Symbols A to Z	ETF	224.1.2.255	20092
Primary Refresh Feed for Symbols A to Z	BB	224.1.2.252	19096
Secondary Refresh Feed for Symbols A to Z	BB	224.1.2.255	20096

Test ArcaBook Fast Compacted Refresh Feed (Request Based)

Test Refresh Feed (Request Based)	Type	IP	Port
Primary Refresh Feed for Symbols A to Z	Listed	224.1.2.252	19098
Secondary Refresh Feed for Symbols A to Z	Listed	224.1.2.255	20098
Primary Refresh Feed for Symbols A to Z	OTC	224.1.2.252	19102
Secondary Refresh Feed for Symbols A to Z	OTC	224.1.2.255	20102
Primary Refresh Feed for Symbols A to Z	ETF	224.1.2.252	19106
Secondary Refresh Feed for Symbols A to Z	ETF	224.1.2.255	20106
Primary Refresh Feed for Symbols A to Z	BB	224.1.2.252	19110
Secondary Refresh Feed for Symbols A to Z	BB	224.1.2.255	20110

B.6 Test Refresh (Interval based) IP addresses

The table below defines the test IP/Multicast interval based refresh group and port assignments for all the Refresh information. The data sent down the Refresh channel provides a current snapshot of the data. ArcaBook refresh messages are sent out on a configurable interval basis. The interval basis is up to 30 seconds for all symbols on the uncompact feed and up to 15 seconds for the compacted feed. (Please note the interval is "up to", implying that it can be less than the interval noted for each feed.)

Test Uncompact ArcaBook Refresh Feed (Interval Based)

Test Refresh Feed (Interval Based)	Type	IP	Port
Primary Refresh Feed for Symbols A to Z	Listed	224.1.2.252	19056
Secondary Refresh Feed for Symbols A to Z	Listed	224.1.2.255	20056
Primary Refresh Feed for Symbols A to Z	OTC	224.1.2.252	19060
Secondary Refresh Feed for Symbols A to Z	OTC	224.1.2.255	20060
Primary Refresh Feed for Symbols A to Z	ETF	224.1.2.252	19064
Secondary Refresh Feed for Symbols A to Z	ETF	224.1.2.255	20064
Primary Refresh Feed for Symbols A to Z	BB	224.1.2.252	19068
Secondary Refresh Feed for Symbols A to Z	BB	224.1.2.255	20068

Test ArcaBook Fast Compacted Refresh Feed (Interval Based)

Test Refresh Feed (Interval Based)	Type	IP	Port
Primary Refresh Feed for Symbols A to Z	Listed	224.1.2.252	19070
Secondary Refresh Feed for Symbols A to Z	Listed	224.1.2.255	20070
Primary Refresh Feed for Symbols A to Z	OTC	224.1.2.252	19074
Secondary Refresh Feed for Symbols A to Z	OTC	224.1.2.255	20074
Primary Refresh Feed for Symbols A to Z	ETF	224.1.2.252	19078
Secondary Refresh Feed for Symbols A to Z	ETF	224.1.2.255	20078
Primary Refresh Feed for Symbols A to Z	BB	224.1.2.252	19082
Secondary Refresh Feed for Symbols A to Z	BB	224.1.2.255	20082

B.7 TCP Source IP addresses

The table below outlines the TCP Source IP addresses, applicable to each Port listed in their respective sections.

TCP Source IP Address ("A" Source)	TCP Source IP Address ("B" Source)
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63.211.72.74

63.211.72.197

Appendix C – The FIX FAST Protocol

Overview

Subscribers can choose to receive the ArcaBook real-time data feed in the FAST Protocol. This protocol is a standard method for compacting real-time market data resulting in reduced bandwidth and reduced latency. 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.

The combination of field encoding templates and presence maps allows the contents of a message to be communicated fully while reducing the number of bytes on the wire.

- **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.

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.

The ArcaBook FAST Implementation

The ArcaBook FAST implementation reduces bandwidth requirements by up to 50%. Each message within the FAST ArcaBook 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.

Sample Source Code

To help subscribers process the ArcaBook FAST feed, NYSE Arca provides a single, C language routine, `AB_FastDecode()`, to decode ArcaBook FAST messages into ArcaBook 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
Integer packet_size
Short message_size
Short packet_type
Short offset

Byte buffer[2048]
ArcaBookMessage message;
Fast_State state

Process until we are told to stop ..
Do
    Get input buffer to process
    Get packet_size from input buffer
    Get packet_type from input buffer

    Malloc fastStatInit into the state

    If packet_type == Refresh message type
        offset = sizeof refresh packet header
    Else
        offset = sizeof packet header
    End

    packet_size = packet_size - offset

    While packet_size > 0

        buffer = buffer + offset
        Memset message to zeros
```

```

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
    Get message_size from decoded message
    ProcessMessage(message)
Else
    We encountered some other error
    ProcessError(result)
    Break;
End
offset = length
packet_size = packet_size - length

```

While Stop == False

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. ArcaBook 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 Table 1.

Table 1: ArcaBook FAST Message Template

Field ID	Field Name	In Messages of Type	FAST Type	Encoding
0	AB_MSG_TYPE	All NYSE Arca Outbound	Unsigned16	None
1	AB_STOCK_IDX	100,101,102,103,35,36	Unsigned16	Copy
2	AB_SEQUENCE	100,101,102,103,1,36,32	Unsigned32	Increment
3	AB_TIME	100,101,102,103,32	Unsigned32	Copy
4	AB_ORDER_ID	100,101,102,103,32	Unsigned32	Copy
	AB_IMBALANCE	103	Unsigned32	
5	AB_VOLUME	100,101,103,32	Unsigned32	Copy
6	AB_PRICE	100,101,103,32	Unsigned32	Copy
7	AB_PRICE_SCALE	100,101,103,32	Unsigned8	Copy
8	AB_BUY_SELL	100,101,102,103,32	ASCII	Copy
	AB_AUCTION_TYPE	103		
9	AB_EXCH_ID	100,101,102,103,32	ASCII	Copy
10	AB_SECURITY_TYPE	100,101,102,103,32	ASCII	Copy
11	AB_FIRM_ID	100,101,102,37,32	Unsigned16	Copy
	AB_AUCTION_TIME	103		
12	AB_SESSION_ID	100,101,102,103,35,36	Unsigned8	Copy
13	AB_MKT_IMBALANCE	103	Unsigned32	None

Field ID	Field Name	In Messages of Type	FAST Type	Encoding
	AB_SYMBOL_STRING	35	ASCII	
	AB_FIRM_STRING	37	ASCII	
	AB_BITMAP	Any except 1,32,35, 36,37,100,101,102,103	Bitmap	
14	AB_SYSTEM_ID	100,101,102,32	Unsigned8	Copy
15	AB_MARKET_ID	100,101,102,32	Unsigned16	Copy
16	AB_BIT	100,101,102,32	Unsigned8	Copy

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

Appendix D – Message Processing

Overview

The following chapter provides workflow diagrams to simplify how the NYSE Book messages should be processed

D.1 Processing of messages

The following is the recommended way of processing messages

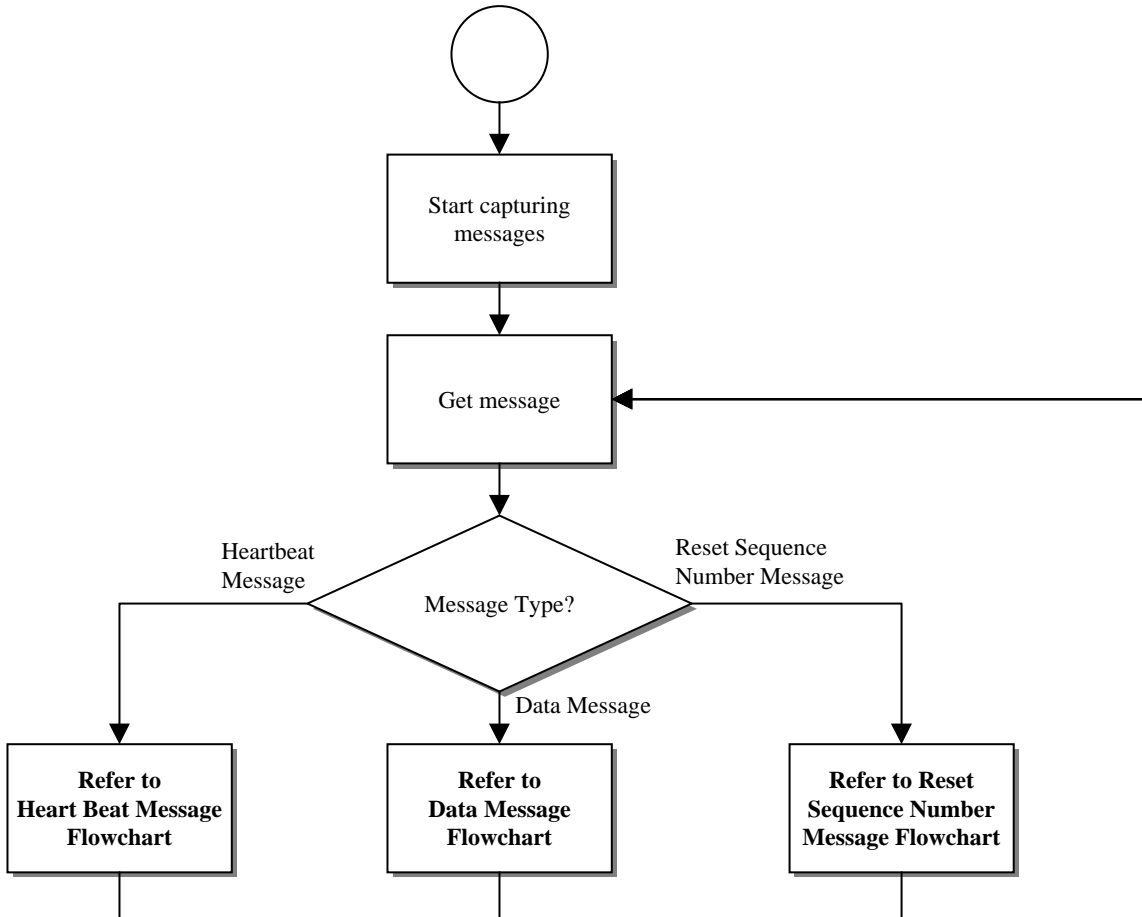


Figure 1. Processing of Messages

D.2 Processing of sequence number reset messages

The following is the recommended way of processing Sequence Number Reset Messages

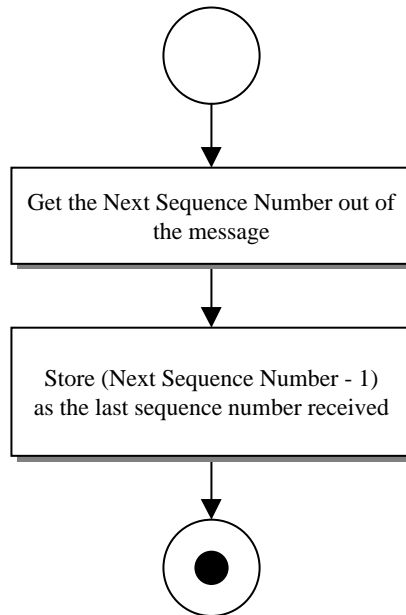


Figure 2. Processing of Sequence Number Reset Message

D.3 Processing of Heartbeat messages

The following is the recommended way of processing Heartbeat messages

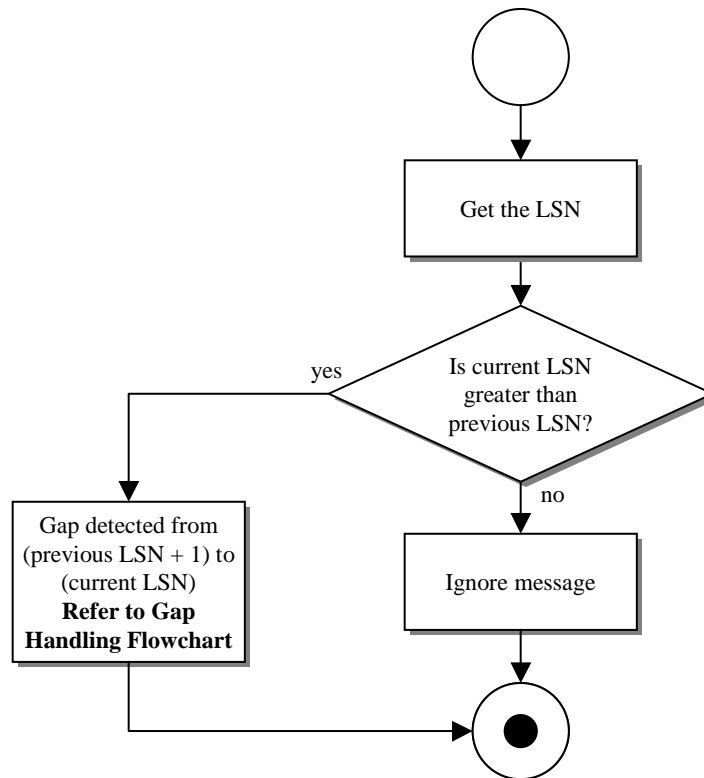


Figure 3. Processing of Heartbeat Messages

D.4 Processing of Heartbeat response messages

The following is the recommended way of processing Heartbeat messages

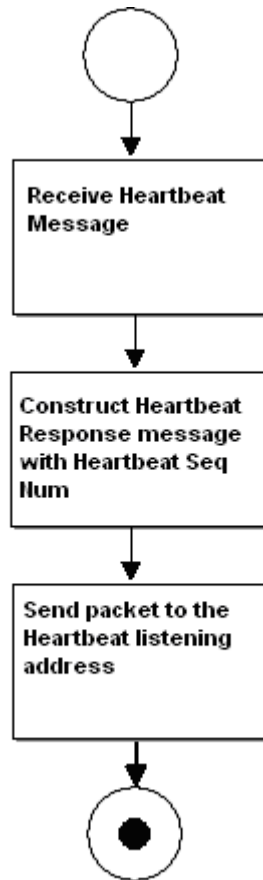


Figure 4. Processing of Heartbeat Response Messages

D.5 Processing of Data messages

The following is the recommended way of processing Data messages

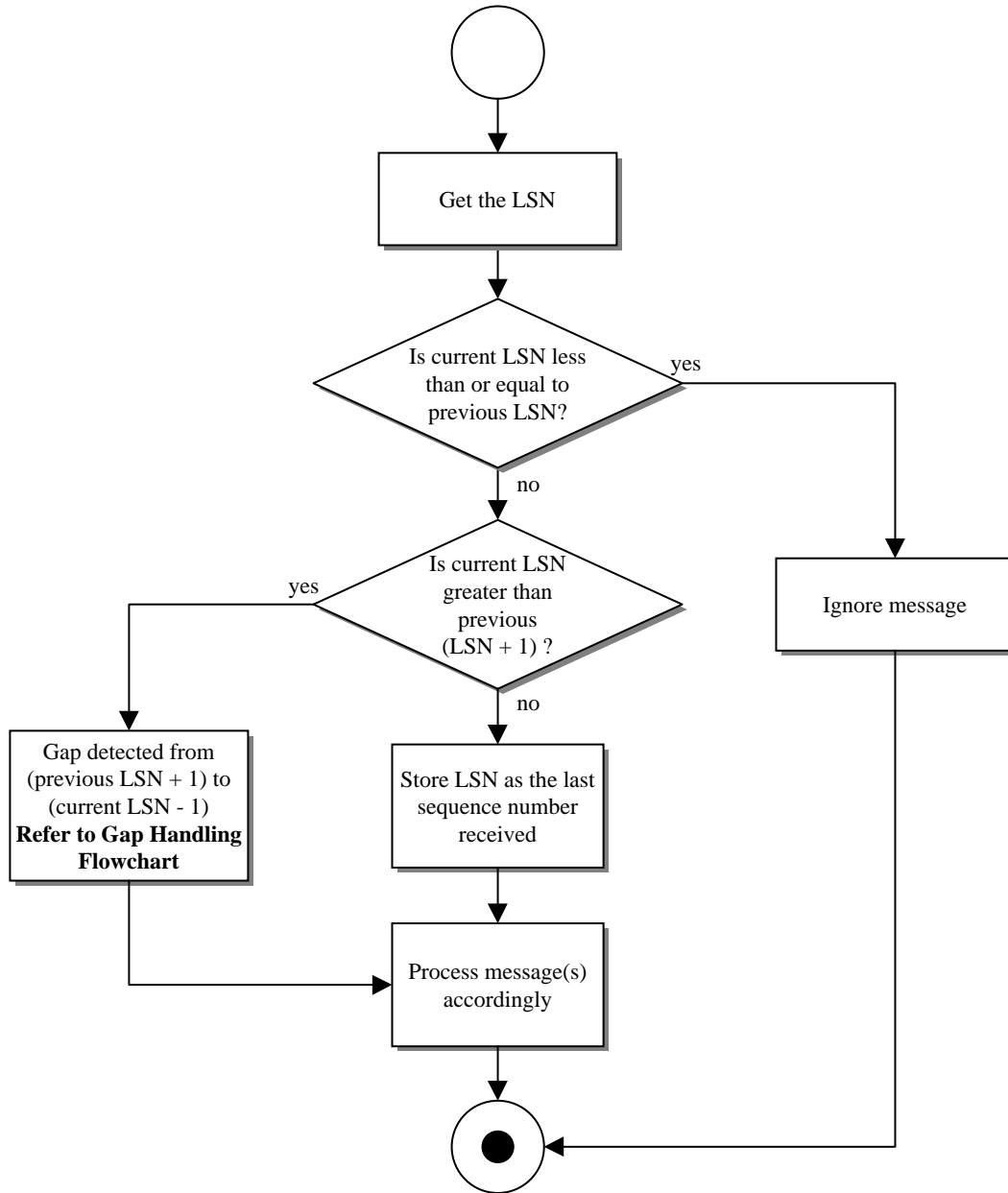


Figure 5. Processing of Data Messages

D.6 Processing of Gap handling

The following is the recommended way of handling message gaps

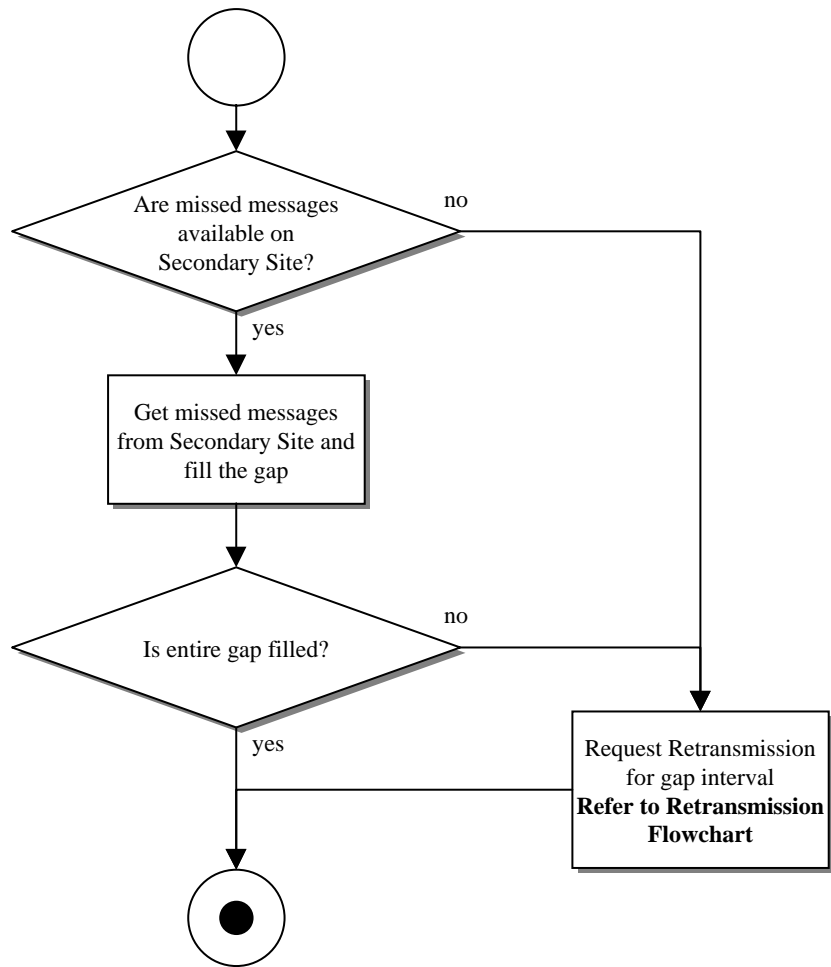


Figure 6. Processing of Gap Handling

D.7 Processing of line level retransmissions

The following is the recommended way of line level retransmissions

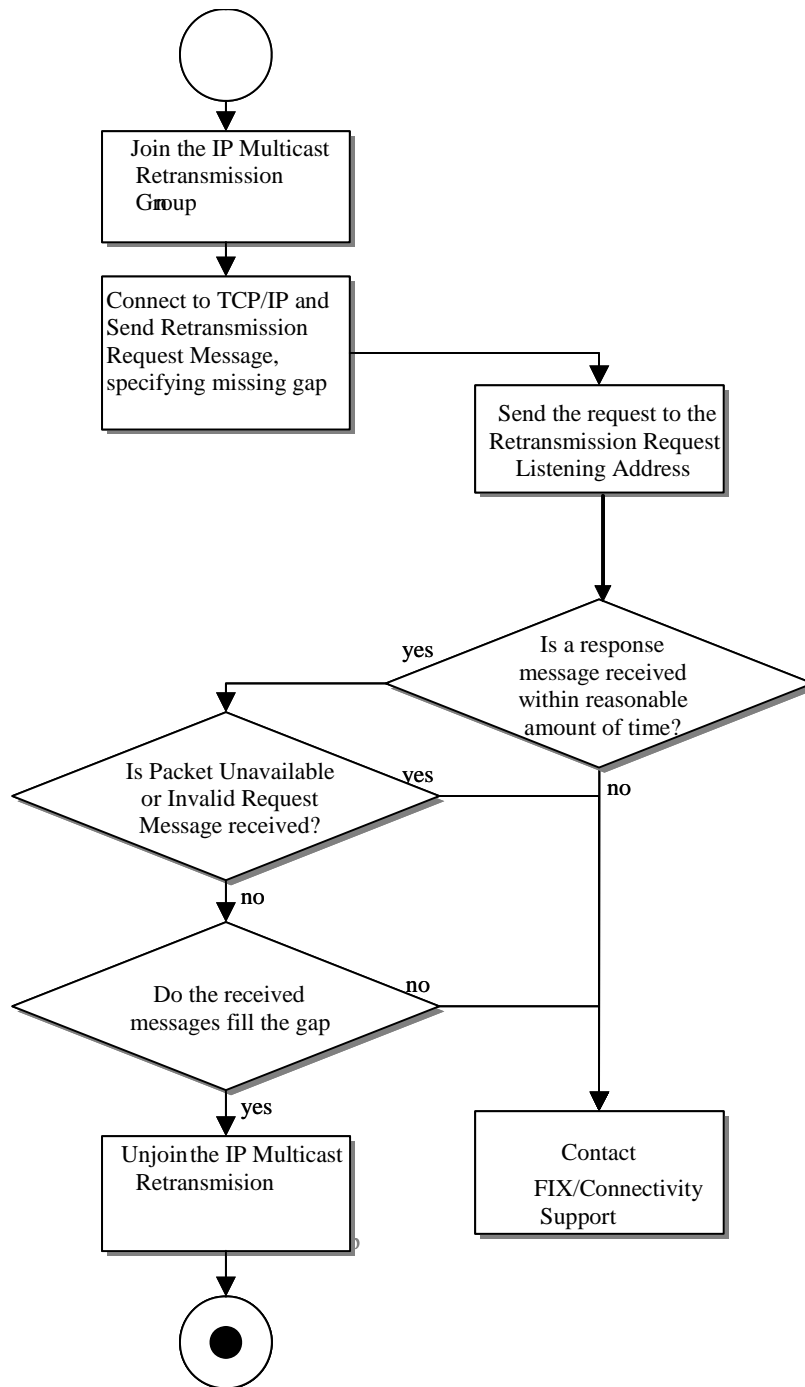


Figure 7. Processing of Line Level Retransmissions

D.8 Processing of Refresh messages

The following is the recommended way of processing Refresh messages (Request Based)

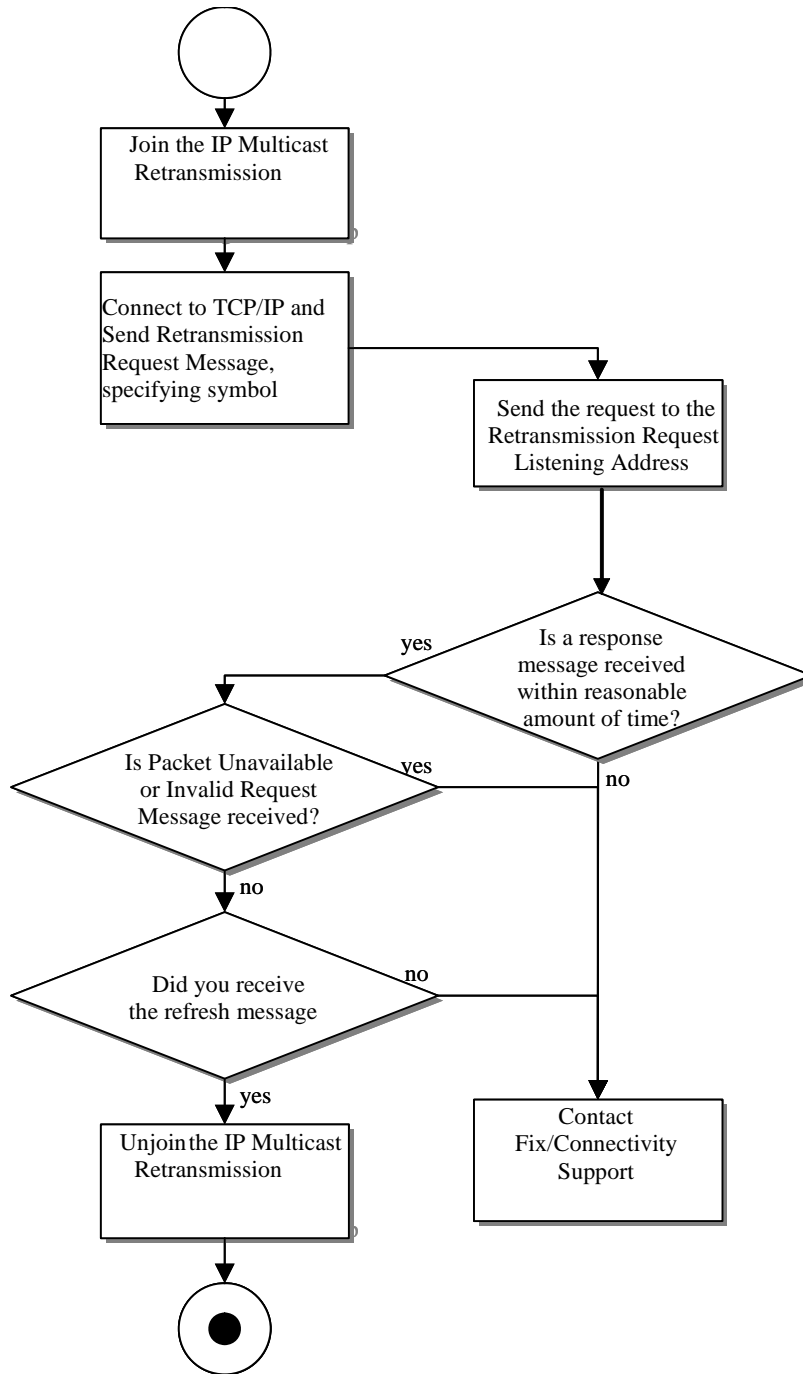


Figure 8. Processing of Refresh Messages

D.9 Local Failover

The following is the recommended way of Local Failover: Check the RetransFlag in the packet header for '6' – Failover Retransmission. This will indicate that a Local Failover has occurred and the Multicast process will restart.

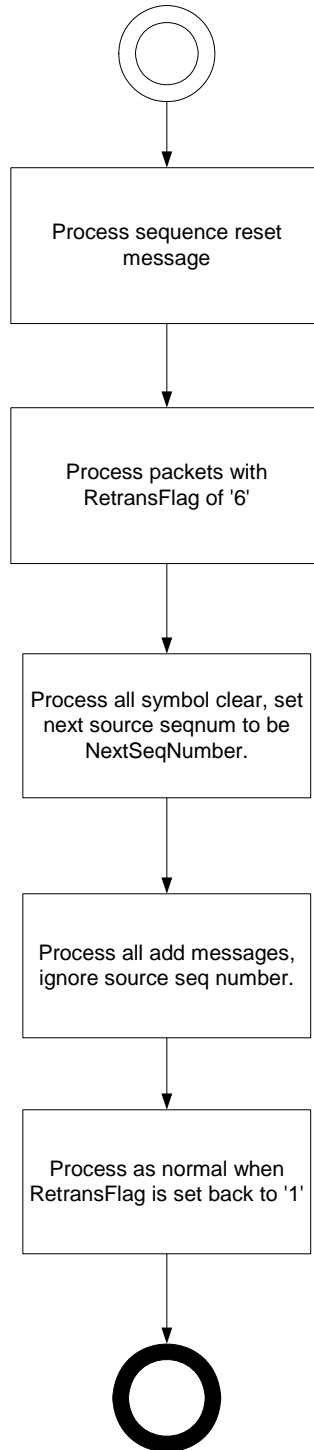
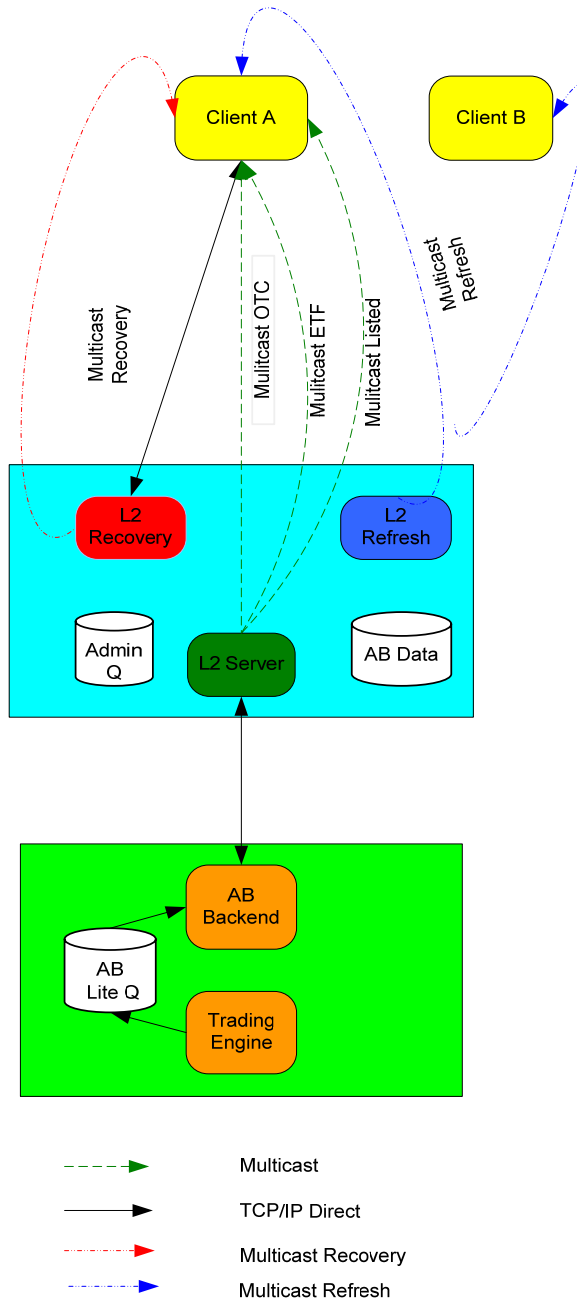


Figure 9. Local Failover

D.10 System Architecture

The following diagram illustrates basic data flow. Note that only one connection shown per multicast group and TCP/IP recovery for simplicity. Subscribers must join multiple groups and make multiple TCP/IP connections to receive data in its entirety.

ArcaBook Multicast Design



Appendix E – Frequently Asked Questions

Overview

The following section provides information to assist subscribers with frequently asked questions concerning the ArcaBook Product. For more up to date information please visit the ArcaBook discussion board on <http://www.nysedata.com/nysedata/Support/DiscussionBoard/tabid/108/view/topics/forumid/14/Default.aspx>

Q: Do I need to establish a TCP/IP connection? Do I need to do this on a daily basis?

A: Yes, a TCP/IP connection is needed for requesting retransmissions of any kind, e.g., dropped packets, book refresh, symbol mappings, etc.

Q: What is the process to define a Source ID for retransmission purposes?

A: Contact SIAC Support and provide the desired Source ID. SIAC Support will evaluate and approve or disapprove the Source ID. In case of disapproval, a new Source ID has to be defined. In case of approval, SIAC Support will make the necessary updates on the product provider side to add the Source ID and applicable rules.

Q: If I am interested in receiving quotes for IBM and MSFT only, how can I find out their symbol and/or firm IDs?

A: You can specify 0 (zero) for SymbolIndex to get all symbol mappings for a specific multicast channel. Similarly, you can specify 0 (zero) for FirmIndex to get all firm mappings. There are four symbol ranges for OTC and Listed, and two ranges for ETFs.

Q: Each time I receive a UDP message (add, modify, delete, etc.) with a new symbol ID, do I need to send a TCP/IP request of “Symbol Index Mapping Request” message (5.11) and then wait for a “Symbol Mapping Index” message (5.17) back?

A: Intraday symbol adds are sent down the primary feed so users can add them “on the fly” once received. If users receive an index they do not know about, a request should be made for that index. The mapping will be sent via the refresh multicast group.

Q: What is the average packet size?

A: The order book packet can vary between 18 and 1400 bytes long.

Q: What is the average message rate (messages per second) seen in a normal day for ArcaBook?

A: Refer to the ArcaBook Impact Guide in Chapter 2.

Q: What is the average number of messages seen in a normal day?

A: Refer to the ArcaBook Impact Guide in Chapter 2.

Q: Will retransmitted data ever come down the normal data feed?

A: No, retransmitted data will always be sent out on the designated retransmission IP/Multicast address/port.

Q: Are the Primary and Secondary feeds identical?

A: The feeds are not identical because they are distributed from 2 (two) different source addresses. However, the data content (such as symbol sequence numbers and message content) are the same and can be used to fill gaps.

Q: We continue to see gaps in the feed even though our network is isolated and our server is underutilized. What could it be?

A: Although collisions are very rare, it is possible to have message gaps due to them. However, it is more likely that your multicast receiver is gapping during a message burst. This may be due to a UDP buffer overflow. SIAC recommends that Subscribers increase the standard UDP buffer setting to capture this burst.

Q: We sent several retransmission requests during the day and they were fulfilled, but now our retransmission requests are no longer being filled. What could it be?

A: Please contact SIAC Support to reactivate your Retransmission ID, as your application may have reached the retransmission thresholds as specified in Appendix A.9.

Q: How do I request the Symbol Index Mapping?

A: Symbol mappings can be requested by establishing a TCP/IP connection to the Recovery/Retransmission Server. Subscribers must connect to the appropriate IP and port for the desired symbol range. Subscribers can populate the symbol index field 0 in order to receive the full symbol list that multicast group. The Symbol Index Mapping will be sent down the Refresh Multicast Group (Request Based).

Q: How are intraday symbol adds handled in reference to Symbol Index Mapping?

A: The index mapping for an intraday symbol add is sent down the appropriated multicast channel before any adds, modifies, deletes, or imbalances. This ensures subscribers can process inline without having to issue a request. If the mapping update is missed or dropped inline, subscribers may request the mapping through the Recovery Server.

Q: What is the purpose of the Refresh Server?

A: The purpose is to quickly give customers a current snapshot of the book. This is valuable in recovery situations, drop packets containing a specific symbol or interest, or for late joiners. Open Order Book messages for a specific symbol can be requested or subscribers can choose to listen to the Refresh Interval Based Feed. Currently the interval based feed cycles through the open order book for all symbols every 30 seconds.

Q: Does the Multicast feed include OTC BBs?

A: Currently no. We plan to create a Multicast feed for Bulletin Board issues from our ArcaEdge matching engine in 2008.

Q: Does ArcaBook send Odd Lot quotes?

A: No. For quotes less than 100 shares (<100), ArcaBook does not send a message. ArcaBook does send messages with Mixed Lots (>100).

Q: We notice out of sequence packets, what do we do in this situation?

A: Because of the nature of multicast, it is possible to receive packets out of sequence. To work around this, clients should make sure their code is able to wait until the next packet to determine if they gapped a message and to properly assemble the book if the packets were out of sequence. In the event of a gap, clients should have their code automatically request a retransmission to the retransmission server for the missed packet(s) or request and refresh automatically to ensure no messages are missed.

Q: Suppose I lose a message. I request retransmission of that message, which may take 10 ms or so for the full roundtrip of the request and the reply. However, the data is coming in fast. At 5,000 msg/s I would get 50 messages that I can't decode while waiting for the retransmission.

Are there any messages that are guaranteed to have all the fields, i.e., have no dependency on the previous messages, so that the system can start delivering new messages even while the retransmission is in progress?

A: If a packet is lost, the missing packet is not needed to decode messages in subsequent packets. Only messages within a packet are dependent on each other for successful decoding. Encoding does not spread across packets.