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Document title

## **XDP OPENBOOK AGGREGATED CLIENT SPECIFICATION**

**NYSE AMERICAN OPENBOOK AGGREGATED    JULY 24, 2017**

**NYSE OPENBOOK AGGREGATED                4Q 2017**

Version

2.1a

Date

June 26, 2017

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## PREFACE

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### DOCUMENT HISTORY

| VERSION NO. | DATE       | CHANGE DESCRIPTION   |
|-------------|------------|--|
| 1.0         | 4/19/10    | Initial version  |
| 1.0b        | 6/23/2010  | <ul style="list-style-type: none"> <li>▪ Removed Firm index mapping messages.</li> <li>▪ Added "LastSeqNum" field to the Refresh Header message</li> <li>▪ Corrected Bloomberg code field sizes on the Symbol Index mapping message</li> </ul>   |
| 1.2         | 12/15/2010 | <ul style="list-style-type: none"> <li>▪ Removed Order ID description</li> <li>▪ Removed Time Reference description</li> <li>▪ Removed control message types not used on this feed</li> <li>▪ Corrected update message example on 2.1.6</li> <li>▪ Added Symbol Index Mapping FTP file</li> </ul>              |
| 1.2a        | 08/12/2011 | Updated artwork and minor edits throughout   |
| 1.3         | 05/30/2012 | Changed name to NYSE MKT throughout  |
|             | 09/03/2012 | Minor correction made to Date column for previous entry.   |
| 1.3a        | 10/15/2015 | Updated the location of Symbol Index File Mapping  |
| 2.1         | 3/29/2017  | Bumped version num to 2.1 to conform to Pillar migration<br>Removed all information that is now in the Common Client Specification<br>Updated with references to NYSE American   |
| 2.1a        | 6/26/2017  | Symbol Index message (type 3) conforms to the Common Client Spec<br>Exceptions to the Common Client Spec (no coding changes needed): <ul style="list-style-type: none"> <li>▪ Refresh Headers are 12 bytes in length</li> <li>▪ Refresh Response message has a non-standard structure, defined here</li> </ul> |

**REFERENCE MATERIAL**

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

[XDP Common Client Specification](#)

- [SFTI connectivity documents](#)
- [NYSE Symbology Specification](#)

**CONTACT INFORMATION****Service Desk**

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**FURTHER INFORMATION**

- [For additional product information please visit, our NYSE Real Time Market Data pages](#)
- [For updated capacity figures, visit our capacity pages at: http://www.nyxdata.com/capacity](http://www.nyxdata.com/capacity)
- [For details of IP addresses, download our IP Addresses spreadsheet](#)

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## 1. ABOUT SPECIFICATION VERSION 2.1

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### 1.1 CHANGES IN THE FEED

For the most part, this version of the OpenBook Aggregated Client Specification consists of document changes: improved organization and streamlining to align better with other XDP feed specifications.

**The one change in this version of the specification that requires feed handler changes is that the format of the Symbol Index Mapping message (message type 3) is changed to conform to the [XDP Common Client Specification](#). Starting with this release, please ensure that you are coded to the Common Client Spec standard for message type 3. No other feed handler changes are needed as a result of this new spec version.**

### 1.2 CHANGES TO THE DOCUMENT

Although OpenBook Aggregated is in XDP format, many sections of previous spec versions contained information that is already available in the XDP Common Client Specification. In this version, all material in that is available in the Common Client Specification has been removed.

With this version and going forward, this specification depends on the Common Client Specification like other XDP specifications do.

OpenBook Aggregated has a few features that differ from the standards in the Common Client Specification. These are explained below.

### 1.3 EXCEPTIONS TO THE XDP COMMON CLIENT SPECIFICATION

#### 1.3.1 Length of Refresh Header (message type 35)

Refresh Headers in packets published over the Aggregated refresh channels use the format shown in the Common Client Specification, except that only the first 12 bytes are published. Neither the full 16 byte structure nor the shortened 8 byte format is ever used in publishing refreshes for Aggregated.

#### 1.3.2 Format of Request Response messages (message type 11)

Request Response messages from the Aggregated Request Server differ in format from that shown in the Common Client Specification. The Aggregated format follows.

| FIELD NAME    | OFFSET | SIZE (BYTES) | FORMAT | DESCRIPTION  |
|---------------|--------|--------------|--------|--|
| Msg Size      | 0      | 2            | Binary | Size of the message: 21 Bytes  |
| Msg Type      | 2      | 2            | Binary | This field identifies the type of message<br>11 – Request Response message   |
| RequestSeqNum | 4      | 4            | Binary | The sequence number of the request message sent by the client. This can be used by the client to couple this response with the original request message. |
| SourceID      | 8      | 10           | ASCII  | The ID of the client making the request. This field is up to 9 characters, null terminated.  |

| FIELD NAME       | OFFSET | SIZE (BYTES) | FORMAT | DESCRIPTION  |
|------------------|--------|--------------|--------|--|
| <b>ProductID</b> | 18     | 1            | Binary | The unique ID of the feed for which the request was made (listed in the feed's client specification).  |
| <b>ChannelID</b> | 19     | 1            | Binary | The ID of the multicast channel for which the request was made.  |
| <b>Status</b>    | 20     | 1            | ASCII  | The reason why the request was rejected. Values: <ul style="list-style-type: none"> <li>▪ 0 – Message was accepted</li> <li>▪ 1 – Rejected due to an Invalid Source ID</li> <li>▪ 2 – Rejected due to invalid sequence range</li> <li>▪ 3 – Rejected due to maximum sequence range</li> <li>▪ 4 – Rejected due to maximum request in a day</li> <li>▪ 5 – Rejected due to maximum number of refresh requests in a day</li> <li>▪ 6 – Rejected. Requested SeqNum is too old. Use refresh to recover current state if necessary.</li> <li>▪ 7 – Rejected due to an Invalid Channel ID</li> <li>▪ 8 – Rejected due to an Invalid Product ID</li> <li>▪ 9 – Rejected due to: 1) Invalid MsgType, or 2) Mismatch between MsgType and MsgSize</li> </ul> |

## 2. OPENBOOK AGGREGATED FEED INFORMATION

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OpenBook Aggregated provides a once-a-second snapshot of the Exchange's limit-order book for all traded securities. OpenBook Aggregated lets traders see aggregate limit-order volume at every bid and offer price.

### 2.1 PRODUCT IDS

| EXCHANGE        | PRODUCTID | DESCRIPTION                       |
|-----------------|-----------|-----------------------------------|
| <b>NYSE</b>     | 1         | NYSE OpenBook Aggregated          |
| <b>American</b> | 50        | NYSE American OpenBook Aggregated |

### 3. ORDERBOOK SNAPSHOT/REFRESH MESSAGE - MSG TYPE 110

A Snapshot Update message provides the full depth of book for the symbol.

A Snapshot message 110 message is sent as a result of one of the following events:

- Start of day
- Refresh Request (sent only over refresh multicast group)
- System Restart

| FIELD NAME              | OFFSET | SIZE (BYTES) | FORMAT       | DESCRIPTION  |
|-------------------------|--------|--------------|--------------|--|
| <b>Msg Size</b>         | 0      | 2            | Binary       | Size of the message.<br>NYSE – 49 Bytes<br>NYSE MKT – 49 Bytes   |
| <b>Msg Type</b>         | 2      | 2            | Binary       | This field identifies the type of message<br>110 – Snapshot Message  |
| <b>SourceTime</b>       | 4      | 4            | Binary       | This field specifies the time when the msg was generated in the order book. The number represents the number of seconds in UTC time (EPOCH)  |
| <b>SourceTimeNS</b>     | 8      | 4            | Binary       | This field represents the nanosecond portion within the second in UTC time (EPOCH)   |
| <b>SymbolIndex</b>      | 12     | 4            | Binary       | This field identifies the numerical representation of the symbol. See <a href="#">Symbol Mapping</a>   |
| <b>Ultra LastSeqNum</b> | 16     | 4            | Binary       | To ease recovery of OpenBook Ultra customers, This field contains the last sequence number of the last message sent out of the OpenBook Ultra feed.                                  |
| <b>Symbol</b>           | 20     | 11           | ASCII String | This field contains the full symbol in NYSE Symbology. A sequence of characters representing the symbol, padded with NULLs. For more information, see <a href="#">NYSE Symbology</a> |
| <b>PriceScaleCode</b>   | 31     | 1            | Binary       | Price scale for price conversion of the symbol. See <a href="#">Price Formats</a> .  |
| <b>TradingStatus</b>    | 32     | 1            | ASCII        | This field indicates the market condition of the security.<br><br>Valid Values: <ul style="list-style-type: none"> <li>▪ P – Pre-Opening</li> <li>▪ E – Early Session</li> </ul>     |

| FIELD NAME            | OFFSET | SIZE (BYTES) | FORMAT | DESCRIPTION  |
|-----------------------|--------|--------------|--------|--|
|                       |        |              |        | <ul style="list-style-type: none"> <li>▪ O – Core Session</li> <li>▪ L – Late Session</li> <li>▪ C – Closed</li> <li>▪ H –Halted</li> </ul>                            |
| <b>RemainingCount</b> | 33     | 2            | Binary | Number of updates remaining in the event.  |
| <b>MPV</b>            | 35     | 2            | Binary | This field contains the minimum price variation  |
| <b>UpdateCount</b>    | 37     | 1            | Binary | Number of updates. Indicates number of times the following group of fields (Price, Volume, Side, NumOrders) will be repeated in the message.<br><br>Default value is 1 |
| <b>&gt;Price</b>      | 38     | 4            | Binary | This field contains the price point.. See <a href="#">Price Formats</a> . Use the Price scale from the symbol mapping index.   |
| <b>&gt;Volume</b>     | 42     | 4            | Binary | This field contains the total interest quantity in shares at a price point   |
| <b>&gt;Side</b>       | 46     | 1            | ASCII  | This field indicates the side of the order Buy/sell.<br><br>Valid Values: <ul style="list-style-type: none"> <li>▪ B – Buy</li> <li>▪ S – Sell</li> </ul>              |
| <b>&gt;NumOrders</b>  | 47     | 2            | Binary | This field contains the number of orders at the current price point  |

### 3.1 MESSAGE PROCESSING

A snapshot will be sent starting at a pre-defined time such as the start of day to provide details of any orders such as GTC orders (Good Til Cancelled), and exceptionally following an intraday service restart.

The following notes provide general guidelines for processing snapshot Messages. The client should not ascribe any importance to the order in which they are presented.

- Snapshot update Messages that span multiple packets must be processed as one complete message.
- For Snapshot update Messages that span multiple packets, if a packet is lost, then the whole message should be considered lost.
- Snapshot update messages contain all active price points regardless of prior period activity.



## 4. ORDERBOOK DELTA UPDATE MESSAGE - MSG TYPE 111

A Delta Update message provides information about price updates for symbol.

A Delta Update 111 message is sent as a result of one of the following events:

- New order
- New cancel
- New execution

| FIELD NAME              | OFFSET | SIZE (BYTES) | FORMAT | DESCRIPTION   |
|-------------------------|--------|--------------|--------|---|
| <b>Msg Size</b>         | 0      | 2            | Binary | Size of the message.<br>NYSE– 35 Bytes<br>NYSE MKT – 35 Bytes   |
| <b>Msg Type</b>         | 2      | 2            | Binary | This field identifies the type of message<br>111 – Event Update Message   |
| <b>SourceTime</b>       | 4      | 4            | Binary | This field specifies the time when the msg was generated in the order book. The number represents the number of seconds in UTC time (EPOCH)   |
| <b>SourceTimeNS</b>     | 8      | 4            | Binary | This field represents the nanosecond portion within the second in UTC time (EPOCH)  |
| <b>SymbolIndex</b>      | 12     | 4            | Binary | This field identifies the numerical representation of the symbol. See <a href="#">Symbol Mapping</a>  |
| <b>Ultra LastSeqNum</b> | 16     | 4            | Binary | To ease recovery of OpenBook Ultra customers, This field contains the last sequence number of the last message sent out of the OpenBook Ultra feed.   |
| <b>TradingStatus</b>    | 20     | 1            | ASCII  | This field indicates the market condition of the security.<br>Valid Values: <ul style="list-style-type: none"> <li>▪ P – Pre-Opening</li> <li>▪ E – Early Session</li> <li>▪ O – Core Session</li> <li>▪ L – Late Session</li> <li>▪ C – Closed</li> <li>▪ H –Halted</li> </ul> |
| <b>RemainingCount</b>   | 21     | 2            | Binary | Number of updates remaining in the event.   |
| <b>UpdateCount</b>      | 23     | 1            | Binary | Number of updates. Indicates number of times the following group of fields (Price, Volume,  |

| FIELD NAME | OFFSET | SIZE (BYTES) | FORMAT | DESCRIPTION   |
|------------|--------|--------------|--------|---|
|            |        |              |        | Side, and NumOrders) will be repeated in the message.<br>Default value is 1   |
| >Price     | 24     | 4            | Binary | This field contains the price point. See <a href="#">Price Format</a> . Use the Price scale from the symbol mapping index.                            |
| >Volume    | 28     | 4            | Binary | This field contains the total interest quantity in shares at a price point  |
| >Side      | 32     | 1            | ASCII  | This field indicates the side of the order Buy/sell.<br>Valid Values: <ul style="list-style-type: none"> <li>▪ B – Buy</li> <li>▪ S – Sell</li> </ul> |
| >NumOrders | 33     | 2            | Binary | This field contains the number of orders at the current price point   |

#### 4.1 MESSAGE PROCESSING

The following notes provide general guidelines for processing Delta Update Messages. The client should not ascribe any importance to the order in which they are presented.

Delta Update Messages that span multiple packets must be processed as one complete message.

For Delta Update Messages that span multiple packets, if a packet is lost, then the whole message should be considered lost.

All price points containing a zero (0) quantity should be removed as an active price point.

If no changes have occurred for a given symbol (e.g., an inactive stock) since the last publication, no Delta Update Message is generated.

## APPENDIX A: SCENARIOS

### A.1 SCENARIO 1 – SINGLE PRICE POINT UPDATE FOR THE SAME SYMBOL

#### New events:

A 100 share Buy Order entered at \$49.99 for stock ABC at 9:30:00am.

Existing Book

| #ORDERS | BUY | PRICE POINT | SELL | #ORDERS |
|---------|-----|-------------|------|---------|
|         |     | 50.02       | 400  | 4       |
|         |     | 50.01       | 200  | 1       |
|         |     | 50.00       | 300  | 1       |
| 1       | 500 | 49.99       |      |         |
| 1       | 300 | 49.98       |      |         |
| 3       | 600 | 49.97       |      |         |

New State of the Book

| #ORDERS | BUY | PRICE POINT | SELL | #ORDERS |
|---------|-----|-------------|------|---------|
|         |     | 50.02       | 400  | 4       |
|         |     | 50.01       | 200  | 1       |
|         |     | 50.00       | 300  | 1       |
| 2       | 600 | 49.99       |      |         |
| 1       | 300 | 49.98       |      |         |
| 3       | 600 | 49.97       |      |         |

#### OpenBook Update Message

| FIELD            | OFFSETS | SIZE (BYTES) | FORMAT | VALUE      |
|------------------|---------|--------------|--------|------------|
| Msg Size         | 0       | 2            | Binary | 35         |
| Msg Type         | 2       | 2            | Binary | 111        |
| SourceTime       | 4       | 4            | Binary | 1259832600 |
| SourceTimeNS     | 8       | 4            | Binary | 0          |
| SymbolIndex      | 12      | 4            | Binary | 24005      |
| Ultra LastSeqNum | 16      | 4            | Binary | 40000      |
| TradingStatus    | 20      | 1            | ASCII  | 0          |
| RemainingCount   | 21      | 2            | Binary | 0          |
| UpdateCount      | 23      | 1            | Binary | 1          |
| Price            | 24      | 4            | Binary | 4999       |
| Volume           | 28      | 4            | Binary | 600        |
| Side             | 32      | 1            | ASCII  | B          |
| NumOrders        | 33      | 2            | Binary | 2          |

**A.2 SCENARIO 2 – MULTIPLE PRICE POINT UPDATES FOR THE SAME SYMBOL**

**New events:**

A 100 share Buy Order entered at \$49.99 for stock ABC at 9:30:00am.

A 400 share Sell Order entered at \$50.00 for stock ABC at 9:30:00am.

**Existing Book**

| #ORDERS | BUY | PRICE POINT | SELL | #ORDERS |
|---------|-----|-------------|------|---------|
|         |     | 50.02       | 400  | 4       |
|         |     | 50.01       | 200  | 1       |
|         |     | 50.00       | 300  | 1       |
| 1       | 500 | 49.99       |      |         |
| 1       | 300 | 49.98       |      |         |
| 3       | 600 | 49.97       |      |         |

**New state of the Book**

| #ORDERS | BUY | PRICE POINT | SELL | #ORDERS |
|---------|-----|-------------|------|---------|
|         |     | 50.02       | 400  | 4       |
|         |     | 50.01       | 200  | 1       |
|         |     | 50.00       | 700  | 2       |
| 2       | 600 | 49.99       |      |         |
| 1       | 300 | 49.98       |      |         |
| 3       | 600 | 49.97       |      |         |

**OpenBook Update Message**

| FIELD            | OFFSETS | SIZE (BYTES) | FORMAT | VALUE      |
|------------------|---------|--------------|--------|------------|
| Msg Size         | 0       | 2            | Binary | 46         |
| Msg Type         | 2       | 2            | Binary | 111        |
| SourceTime       | 4       | 4            | Binary | 1259832600 |
| SourceTimeNS     | 8       | 4            | Binary | 0          |
| SymbolIndex      | 12      | 4            | Binary | 24005      |
| Ultra LastSeqNum | 16      | 4            | Binary | 40000      |
| TradingStatus    | 20      | 1            | ASCII  | 0          |
| RemainingCount   | 21      | 2            | Binary | 0          |
| UpdateCount      | 23      | 1            | Binary | 2          |
| Price            | 24      | 4            | Binary | 4999       |
| Volume           | 28      | 4            | Binary | 600        |
| Side             | 32      | 1            | ASCII  | B          |
| NumOrders        | 33      | 2            | Binary | 2          |
| Price            | 35      | 4            | Binary | 5000       |
| Volume           | 39      | 4            | Binary | 700        |
| Side             | 43      | 1            | ASCII  | S          |
| NumOrders        | 44      | 2            | Binary | 2          |

**A.3 SCENARIO 3 – SINGLE PRICE POINT UPDATES FOR THE DIFFERENT SYMBOLS**

**New events:**

100 share Buy Order entered at \$49.99 for stock ABC.

400 share Sell Order entered at \$30.00 for stock XYZ.

**ABC - Existing Book**

| #ORDERS | BUY | PRICE POINT | SELL | #ORDERS |
|---------|-----|-------------|------|---------|
|         |     | 50.02       | 400  | 4       |
|         |     | 50.01       | 200  | 1       |
|         |     | 50.00       | 300  | 1       |
| 1       | 500 | 49.99       |      |         |
| 1       | 300 | 49.98       |      |         |
| 3       | 600 | 49.97       |      |         |

**ABC - New state of the Book**

| #ORDERS | BUY | PRICE POINT | SELL | #ORDERS |
|---------|-----|-------------|------|---------|
|         |     | 50.02       | 400  | 4       |
|         |     | 50.01       | 200  | 1       |
|         |     | 50.00       | 300  | 2       |
| 2       | 600 | 49.99       |      |         |
| 1       | 300 | 49.98       |      |         |
| 3       | 600 | 49.97       |      |         |

**XYZ - Existing Book**

| #ORDERS | BUY | PRICE POINT | SELL | #ORDERS |
|---------|-----|-------------|------|---------|
|         |     | 30.02       | 900  | 3       |
|         |     | 30.01       | 600  | 2       |
|         |     | 30.00       | 800  | 4       |
| 1       | 100 | 29.99       |      |         |
| 1       | 200 | 29.98       |      |         |
| 3       | 300 | 29.97       |      |         |

**XYZ - New state of the Book**

| #ORDERS | BUY | PRICE POINT | SELL | #ORDERS |
|---------|-----|-------------|------|---------|
|         |     | 30.02       | 900  | 3       |
|         |     | 30.01       | 600  | 2       |
|         |     | 30.00       | 1200 | 5       |
| 1       | 100 | 29.99       |      |         |
| 1       | 200 | 29.98       |      |         |
| 3       | 300 | 29.97       |      |         |

**OpenBook Update Message**

| FIELD NAME   | OFFSET | SIZE (BYTES) | FORMAT | VALUE      |
|--------------|--------|--------------|--------|------------|
| Msg Size     | 0      | 2            | Binary | 35         |
| Msg Type     | 2      | 2            | Binary | 111        |
| SourceTime   | 4      | 4            | Binary | 1259832600 |
| SourceTimeNS | 8      | 4            | Binary | 0          |
| SymbolIndex  | 12     | 4            | Binary | 24005      |

| FIELD NAME       | OFFSET | SIZE (BYTES) | FORMAT | VALUE      |
|------------------|--------|--------------|--------|------------|
| Ultra LastSeqNum | 16     | 4            | Binary | 40000      |
| TradingStatus    | 20     | 1            | ASCII  | 0          |
| RemainingCount   | 21     | 2            | Binary | 0          |
| UpdateCount      | 23     | 1            | Binary | 1          |
| Price            | 24     | 4            | Binary | 4999       |
| Volume           | 28     | 4            | Binary | 600        |
| Side             | 32     | 1            | ASCII  | B          |
| NumOrders        | 33     | 2            | Binary | 2          |
| Msg Size         | 35     | 2            | Binary | 35         |
| Msg Type         | 37     | 2            | Binary | 111        |
| SourceTime       | 39     | 4            | Binary | 1259832600 |
| SourceTimeNS     | 43     | 4            | Binary | 0          |
| SymbolIndex      | 47     | 4            | Binary | 18006      |
| Ultra LastSeqNum | 51     | 4            | Binary | 28569      |
| TradingStatus    | 55     | 1            | ASCII  | 0          |
| RemainingCount   | 56     | 2            | Binary | 0          |
| UpdateCount      | 58     | 1            | Binary | 1          |
| Price            | 59     | 4            | Binary | 3000       |
| Volume           | 63     | 4            | Binary | 1200       |
| Side             | 67     | 1            | ASCII  | S          |
| NumOrders        | 68     | 2            | Binary | 5          |

**A.4 SCENARIO 4 – MULTIPLE PRICE POINT UPDATES FOR THE DIFFERENT SYMBOLS**

**New events:**

100 share Buy Order entered at \$49.99 for stock ABC.  
 200 share Buy Order entered at \$49.98 for stock ABC.  
 400 share Sell Order entered at \$30.00 for stock XYZ.  
 100 share Sell Order entered at \$30.02 for stock XYZ.

**ABC - Existing Book**

| #ORDERS | BUY | PRICE POINT | SELL | #ORDERS |
|---------|-----|-------------|------|---------|
|         |     | 50.02       | 400  | 4       |
|         |     | 50.01       | 200  | 1       |
|         |     | 50.00       | 300  | 1       |
| 1       | 500 | 49.99       |      |         |
| 1       | 300 | 49.98       |      |         |
| 3       | 600 | 49.97       |      |         |

**ABC - New state of the Book**

| #ORDERS | BUY | PRICE POINT | SELL | #ORDERS |
|---------|-----|-------------|------|---------|
|         |     | 50.02       | 400  | 4       |
|         |     | 50.01       | 200  | 1       |
|         |     | 50.00       | 300  | 2       |
| 2       | 600 | 49.99       |      |         |
| 2       | 500 | 49.98       |      |         |
| 3       | 600 | 49.97       |      |         |

**XYZ - Existing Book**

| #ORDERS | BUY | PRICE POINT | SELL | #ORDERS |
|---------|-----|-------------|------|---------|
|         |     | 30.02       | 900  | 3       |
|         |     | 30.01       | 600  | 2       |
|         |     | 30.00       | 800  | 4       |
| 1       | 100 | 29.99       |      |         |
| 1       | 200 | 29.98       |      |         |
| 3       | 300 | 29.97       |      |         |

**XYZ - New state of the Book**

| #ORDERS | BUY | PRICE POINT | SELL | #ORDERS |
|---------|-----|-------------|------|---------|
|         |     | 30.02       | 1000 | 4       |
|         |     | 30.01       | 600  | 2       |
|         |     | 30.00       | 1200 | 5       |
| 1       | 100 | 29.99       |      |         |
| 1       | 200 | 29.98       |      |         |
| 3       | 300 | 29.97       |      |         |

**OpenBook Update Message**

| FIELD NAME   | OFFSET | SIZE (BYTES) | FORMAT | VALUE      |
|--------------|--------|--------------|--------|------------|
| Msg Size     | 0      | 2            | Binary | 46         |
| Msg Type     | 2      | 2            | Binary | 111        |
| SourceTime   | 4      | 4            | Binary | 1259832600 |
| SourceTimeNS | 8      | 4            | Binary | 0          |

| FIELD NAME       | OFFSET | SIZE (BYTES) | FORMAT | VALUE      |
|------------------|--------|--------------|--------|------------|
| SymbolIndex      | 12     | 4            | Binary | 24005      |
| Ultra LastSeqNum | 16     | 4            | Binary | 40000      |
| TradingStatus    | 20     | 1            | ASCII  | O          |
| RemainingCount   | 21     | 2            | Binary | 0          |
| UpdateCount      | 23     | 1            | Binary | 2          |
| Price            | 24     | 4            | Binary | 4999       |
| Volume           | 28     | 4            | Binary | 600        |
| Side             | 32     | 1            | ASCII  | B          |
| NumOrders        | 33     | 2            | Binary | 2          |
| Price            | 35     | 4            | Binary | 4998       |
| Volume           | 39     | 4            | Binary | 500        |
| Side             | 43     | 1            | ASCII  | B          |
| NumOrders        | 44     | 2            | Binary | 2          |
| Msg Size         | 46     | 2            | Binary | 46         |
| Msg Type         | 48     | 2            | Binary | 111        |
| SourceTime       | 50     | 4            | Binary | 1259832600 |
| SourceTimeNS     | 54     | 4            | Binary | 0          |
| SymbolIndex      | 58     | 4            | Binary | 18006      |
| Ultra LastSeqNum | 62     | 4            | Binary | 28569      |
| TradingStatus    | 66     | 1            | ASCII  | O          |
| RemainingCount   | 67     | 2            | Binary | 0          |
| UpdateCount      | 69     | 1            | Binary | 2          |
| Price            | 70     | 4            | Binary | 3000       |
| Volume           | 74     | 4            | Binary | 1200       |
| Side             | 78     | 1            | ASCII  | S          |
| NumOrders        | 79     | 2            | Binary | 5          |
| Price            | 81     | 4            | Binary | 3002       |
| Volume           | 85     | 4            | Binary | 1000       |
| Side             | 89     | 1            | ASCII  | S          |
| NumOrders        | 90     | 2            | Binary | 4          |



**A.5 SCENARIO 5 – PRICE POINT DELETE**

**New events:**

A 500 share execution at \$49.99 for stock ABC at 9:30:00am.

**Existing Book**

| #orders | Buy | Price Point | Sell | #orders |
|---------|-----|-------------|------|---------|
|         |     | 50.02       | 400  | 4       |
|         |     | 50.01       | 200  | 1       |
|         |     | 50.00       | 300  | 1       |
| 1       | 500 | 49.99       |      |         |
| 1       | 300 | 49.98       |      |         |
| 3       | 600 | 49.97       |      |         |

**New state of the Book**

| #orders | Buy | Price Point | Sell | #orders |
|---------|-----|-------------|------|---------|
|         |     | 50.02       | 400  | 4       |
|         |     | 50.01       | 200  | 1       |
|         |     | 50.00       | 300  | 1       |
| 1       | 300 | 49.98       |      |         |
| 3       | 600 | 49.97       |      |         |

**OpenBook Update Message**

| FIELD NAME       | OFFSET | SIZE (BYTES) | FORMAT | VALUE      |
|------------------|--------|--------------|--------|------------|
| Msg Size         | 0      | 2            | Binary | 35         |
| Msg Type         | 2      | 2            | Binary | 111        |
| SourceTime       | 4      | 4            | Binary | 1259832600 |
| SourceTimeNS     | 8      | 4            | Binary | 0          |
| SymbolIndex      | 12     | 4            | Binary | 24005      |
| Ultra LastSeqNum | 16     | 4            | Binary | 40000      |
| TradingStatus    | 20     | 1            | ASCII  | 0          |
| RemainingCount   | 21     | 2            | Binary | 0          |
| UpdateCount      | 23     | 1            | Binary | 1          |
| Price            | 24     | 4            | Binary | 4999       |
| Volume           | 28     | 4            | Binary | 0          |
| Side             | 32     | 1            | ASCII  | B          |
| NumOrders        | 33     | 2            | Binary | 0          |