INVESTORS EXCHANGE DEEP SPECIFICATION

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Table of Contents

OVERVIEW 3

TRANSPORT PROTOCOL OPTIONS 3

ARCHITECTURE 3

DATA TYPES 4

NETWORK DETAILS 5

ADMINISTRATIVE MESSAGE FORMATS 7

TRADING MESSAGE FORMATS 17

AUCTION MESSAGE FORMATS 25

APPENDIX A: FLAGS 28

APPENDIX B: BITWISE REPRESENTATION 30

APPENDIX C: STATE DIAGRAMS 43

REVISION HISTORY 46

OVERVIEW

Participants of Investors Exchange ("IEX" or the "Exchange") may use DEEP to receive real-time depth of book quotations and last sale information direct from IEX. Participants may use DEEP to receive auction information during auctions for IEX-listed securities. DEEP also supports several security-related administrative messages and provides event controls, such as start of day and end of day, to participants.

The depth of book quotations received via DEEP provide an aggregated size of resting displayed orders at a price and side, and do not indicate the number or size of individual orders at any price level. Non-displayed orders and non-displayed portions of reserve orders are not represented in DEEP. DEEP also provides last trade price and size information. Trades resulting from either displayed or non-displayed orders matching on IEX are reported. Routed executions are not reported.

Subscribers with bandwidth concerns may consume top of book market data via the IEX TOPS protocol.

DEEP provides short sale restriction status, trading status, operational halt status, and security event information via security-related administrative messages. For IEX-listed securities, DEEP provides current price, size, imbalance information, auction collar information, and other relevant information about upcoming auctions. Lastly, DEEP provides event information about the market and data feed via administrative messages.

DEEP cannot be used to enter orders. For order entry, refer to the IEX FIX Specification.

For ordering information, contact IEX Market Operations at 646.343.2300 or marketops@iextrading.com or simply submit completed IEX Data Agreements and Forms. Please see the IEX Connectivity Manual for additional information.

TRANSPORT PROTOCOL OPTIONS

For direct data feed subscribers, IEX provides DEEP using the IEX Transport Protocol (IEX-TP) on UDP multicast for sequenced delivery. Additionally, IEX provides retransmission of DEEP data (i.e., gap fills) using IEX-TP on TCP or UDP unicast. See the IEX Transport Specification for details on sequenced delivery and requesting delivery of missed data.

Protocol Identification on IEX-TP

- Message Protocol ID: 0x8004
- Channel ID: 1

ARCHITECTURE

DEEP is made up of a series of sequenced messages. Each message is variable in length based on the message type. IEX reserves the right to add message types and grow the length of any messages without notice. Subscribers should develop their decoders to deal with unknown message types and messages that grow beyond the expected length. Messages will only be grown to add additional data to the end of a message or to add additional flag values at the end of a flags field. The messages that make up the data feed are delivered using a lower level protocol that takes care of sequencing and delivery guarantees. Note that a Message Length field is provided with every message as part of framing defined in IEX-TP.

DATA TYPES

- String: Fixed-length ASCII byte sequence, left justified and space filled on the right
- Long: 8 bytes, signed integer
- Price: 8 bytes, signed integer containing a fixed-point number with 4 digits to the right of an implied decimal point
- Integer: 4 bytes, unsigned integer
- Byte: 1 byte, unsigned integer
- Timestamp: 8 bytes, signed integer containing a counter of nanoseconds since POSIX (Epoch) time UTC
- Event Time: 4 bytes, unsigned integer containing a counter of seconds since POSIX (Epoch) time UTC

All binary fields are in **little endian** format.

Note that each byte is represented by two hexadecimal digits in the examples within this specification.

Timestamp Relationships

Timestamps establish a total ordering of a *happened-before* relationship within the IEX Trading System. If Message A has a lower Timestamp than Message B, then the event causing Message A happened before (i.e., preceded) the event causing Message B. Messages with the same Timestamp (regardless of Message Type or Symbol) were caused by the same event and may be interpreted to have happened simultaneously and atomically within the IEX Trading System.

For a given <Message Type, Symbol> pairing, the subsequence of messages matching this <Message Type, Symbol> pairing on the data feed will have a progression of Timestamps which either remain equal (due to simultaneity) or increase (due to precedence) — within this subsequence Timestamps will never decrease.

No progression of Timestamps between messages having different Symbols may be expected. No progression of Timestamps between messages having the same Symbol but different Message Type may be expected, except in the following circumstance:

- The receipt of a Security Event Message for a given security implies that all preceding Price Level Update Messages for the same security have been transmitted.

NETWORK DETAILS

Multicast Addresses

SITE	XC Type	Group	Port	Source IP Subnet
IEX POP (Equinix NY5)	Primary (A)	233.215.21.4	10378	23.226.155.128/28
	Secondary (B)	233.215.21.132	10378	23.226.155.192/28
Disaster Recovery (Equinix CH4)	Tertiary (C)	233.215.21.68	10378	23.226.155.176/28
IEX Testing Facility ("ITF") (Equinix NY5)	ITF (I)	233.215.21.241	32001	23.226.155.8/29

Unicast Gap Fill Details

Gap Fill Server Configuration

- Supported Retransmission Protocol(s): TCP and UDP
- Maximum UDP Retransmission Response: 1,000 messages per Retransmission Request
- Maximum TCP Retransmission Response: N/A (there is no limit to the retransmission response via TCP)
- Supported Request Type(s): Sequenced Messages

UDP Gap Fill Server Addresses

SITE	XC Type	Server	Port
IEX POP (Equinix NY5)	Primary (A)	23.226.155.168	11378
	Secondary (B)	23.226.155.232	11378
Disaster Recovery (Equinix CH4)	Tertiary (C)	23.226.155.248	11378
IEX Testing Facility (Equinix NY5)	ITF (I)	23.226.155.18	33001

TCP Gap Fill Server Addresses

SITE	XC Type	Server	Port
IEX POP (Equinix NY5)	Primary (A)	23.226.155.169	11378
	Secondary (B)	23.226.155.233	11378
Disaster Recovery (Equinix CH4)	Tertiary (C)	23.226.155.249	11378
IEX Testing Facility (Equinix NY5)	ITF (I)	23.226.155.19	33001

PIM RP Configuration Examples

SITE	XC Type	PIM RP Statement Sample*
IEX POP (Equinix NY5)	Primary (A)	ip pim rp-address x.x.x.x 233.215.21.0/28
	Secondary (B)	ip pim rp-address y.y.y.y 233.215.21.128/28
Disaster Recovery (Equinix CH4)	Tertiary (C)	ip pim rp-address z.z.z.z 233.215.21.64/28
IEX Testing Facility (Equinix NY5)	ITF (I)	ip pim rp-address i.i.i.i 233.215.21.240/29

* x.x.x.x, y.y.y.y, z.z.z.z, and i.i.i.i in above samples refer to respective IEX-side BGP Peer IPs.

Please note that this is only one of several ways to configure multicast. Additionally, RP IPs are not advertised at this time.

IEX statically subscribes and floods individual data feed multicast groups to applicable direct data feed subscribers on cross-connects designated A, B, C, or I.

Network Prefixes Advertised

SITE	XC Type	Market Data Unicast Prefixes Advertised
IEX POP (Equinix NY5)	Primary (A)	23.226.155.128/28 (Multicast Sources) 23.226.155.160/28 (Gap Fill Servers)
	Secondary (B)	23.226.155.192/28 (Multicast Sources) 23.226.155.224/28 (Gap Fill Servers)
Disaster Recovery (Equinix CH4)	Tertiary (C)	23.226.155.176/28 (Multicast Sources) 23.226.155.240/28 (Gap Fill Servers)
IEX Testing Facility (Equinix NY5)	ITF (I)	23.226.155.8/29 (Multicast Source) 23.226.155.0.16/29 (Gap Fill Servers)

ADMINISTRATIVE MESSAGE FORMATS

System Event Message – S (0x53)

The System Event Message is used to indicate events that apply to the market or the data feed.

There will be a single message disseminated per channel for each System Event type within a given trading session.

Field Name	Offset	Length	Type	Description/Notes
Message Type	0	1	Byte	'S' (0x53) – System Event
System Event	1	1	Byte	System event identifier
Timestamp	2	8	Timestamp	Time stamp of the system event

Total Message Data length is 10 bytes. See Appendix B for the bitwise representation.

System Event

- 'O' (0x4f): *Start of Messages* – Outside of heartbeat messages on the lower level protocol, the start of day message is the first message sent in any trading session.
- 'S' (0x53): *Start of System Hours* – This message indicates that IEX is open and ready to start accepting orders.
- 'R' (0x52): *Start of Regular Market Hours* – This message indicates that DAY and GTX orders, as well as market orders and pegged orders, are available for execution on IEX.
- 'M' (0x4d): *End of Regular Market Hours* – This message indicates that DAY orders, market orders, and pegged orders are no longer accepted by IEX.
- 'E' (0x45): *End of System Hours* – This message indicates that IEX is now closed and will not accept any new orders during this trading session. It is still possible to receive messages after the end of day.
- 'C' (0x43): *End of Messages* – This is always the last message sent in any trading session.

Timestamp

The time of the update event as set by the IEX Trading System logic.

Example

```
Message Type            53                      // S = System Event
System Event            45                      // End of System Hours
Timestamp               00 a0 99 97 e9 3d b6 14 // 2017-04-17 17:00:00.000000000
```

Security Directory Message – D (0x44)

IEX disseminates a full pre-market spin of Security Directory Messages for all IEX-listed securities. After the pre-market spin, IEX will use the Security Directory Message to relay changes for an individual security.

Field Name	Offset	Length	Type	Description/Notes
Message Type	0	1	Byte	'D' (0x44) – Security Directory
Flags	1	1	Byte	See Appendix A for flag values
Timestamp	2	8	Timestamp	Time stamp of the security information
Symbol	10	8	String	Security identifier
Round Lot Size	18	4	Integer	Number of shares that represent a round lot
Adjusted POC Price	22	8	Price	Corporate action adjusted previous official closing price
LULD Tier	30	1	Byte	Indicates which Limit Up-Limit Down price band calculation parameter is to be used

Total Message Data length is 31 bytes. See Appendix B for the bitwise representation.

Timestamp

The time of the update event as set by the IEX Trading System logic.

Symbol

IEX-listed security represented in Nasdaq Integrated symbology.

Round Lot Size

The number of shares that represent a round lot for the security.

Adjusted POC Price

The corporate action adjusted previous official closing price for the security (e.g., stock split, dividend, rights offering), where the decimal portion is zero filled on the right. The decimal point is implied by position and does not explicitly appear in the field. For example, 123400 = $12.34. When no corporate action has occurred, the Adjusted POC Price will be populated with the previous official close price. For new issues (e.g., an IPO), this field will be the issue price.

LULD Tier

- 0 (0x0): Not applicable
- 1 (0x1): Tier 1 NMS Stock
- 2 (0x2): Tier 2 NMS Stock

Example

```
Message Type                44                          // D = Security Directory
Flags                       80                          // Test security, not an ETP,
                                                           not a When Issued security
Timestamp                   00 20 89 7b 5a 1f b6 14     // 2017-04-17 07:40:00.000000000
Symbol                      5a 49 45 58 54 20 20 20     // ZIEXT
Round Lot Size              64 00 00 00                 // 100 shares
Adjusted POC Price          24 1d 0f 00 00 00 00 00     // $99.05
LULD Tier                   01                          // Tier 1 NMS Stock
```

Trading Status Message – H (0x48)

The Trading Status Message is used to indicate the current trading status of a security. For IEX-listed securities, IEX acts as the primary market and has the authority to institute a trading halt or trading pause in a security due to news dissemination or regulatory reasons. For non-IEX-listed securities, IEX abides by any regulatory trading halts and trading pauses instituted by the primary or listing market, as applicable.

IEX disseminates a full pre-market spin of Trading Status Messages indicating the trading status of all securities. In the spin, IEX will send out a Trading Status Message with "T" (Trading) for all securities that are eligible for trading at the start of the Pre-Market Session. If a security is absent from the dissemination, firms should assume that the security is being treated as operationally halted in the IEX Trading System.

After the pre-market spin, IEX will use the Trading Status Message to relay changes in trading status for an individual security. Messages will be sent when a security is:

- Halted
- Paused*
- Released into an Order Acceptance Period*
- Released for trading

* The paused and released into an Order Acceptance Period status will be disseminated for IEX-listed securities only. Trading pauses on non-IEX-listed securities will be treated simply as a halt.

Field Name	Offset	Length	Type	Description/Notes
Message Type	0	1	Byte	'H' (0x48) –Trading Status
Trading Status	1	1	Byte	Trading status identifier
Timestamp	2	8	Timestamp	Time stamp of the trading status
Symbol	10	8	String	Security identifier
Reason	18	4	String	Reason for the trading status change

Total Message Data length is 22 bytes. See Appendix B for the bitwise representation.

Trading Status

Trading Status will be set to "H" (Trading Halt) when a non-IEX-listed security is paused by the listing exchange.

- 'H' (0x48): Trading halted across all US equity markets
- 'O' (0x4f): Trading halt released into an Order Acceptance Period on IEX (IEX-listed securities only)
- 'P' (0x50): Trading paused and Order Acceptance Period on IEX (IEX-listed securities only)
- 'T' (0x54): Trading on IEX

Timestamp

The time of the update event as set by the IEX Trading System logic.

Symbol

Security represented in Nasdaq Integrated symbology.

Reason

IEX populates the Reason field for IEX-listed securities when the Trading Status is "H" (Trading Halt) or "O" (Order Acceptance Period). For non-IEX-listed securities, the Reason field will be set to "NA" (Reason Not Available) when the Trading Status is "H" (Trading Halt). The Reason will be blank when the Trading Status is "P" (Trading Pause and Order Acceptance Period) or "T" (Trading).

- Trading Halt Reasons
  - T1: Halt News Pending
  - IPO1: IPO Not Yet Trading
  - IPOD: IPO Deferred
  - MCB3: Market-Wide Circuit Breaker Level 3 – Breached
  - NA: Reason Not Available
- Order Acceptance Period Reasons
  - T2: Halt News Dissemination
  - IPO2: IPO Order Acceptance Period
  - IPO3: IPO Pre-Launch Period
  - MCB1: Market-Wide Circuit Breaker Level 1 – Breached
  - MCB2: Market-Wide Circuit Breaker Level 2 – Breached

Example

```
Message Type              48                      // H = Trading Status
Trading Status            48                      // H = Trading Halted
Timestamp                 ac 63 c0 20 96 86 6d 14 // 2016-08-23 15:30:32.572715948
Symbol                    5a 49 45 58 54 20 20 20 // ZIEXT
Reason                    54 31 20 20             // T1 = Halt News Pending
```

State Diagram

See Appendix C for a state diagram illustrating the potential Trading Status and Reason transitions.

Retail Liquidity Indicator Message – I (0x49)

DEEP broadcasts a real-time Retail Liquidity Indicator Message each time there is an update to IEX's eligible retail liquidity interest during the trading day. Prior to the start of trading, IEX publishes a "no interest indicator" (Retail Liquidity Indicator is set to '0x20') for all symbols in the IEX Trading System.

Field Name	Offset	Length	Type	Description/Notes
Message Type	0	1	Byte	'I' (0x49) - Retail Liquidity Indicator Message
Retail Liquidity Indicator	1	1	Byte	Retail Liquidity Indicator identifier
Timestamp	2	8	Timestamp	Time stamp of the Retail Liquidity Indicator Message
Symbol	10	8	String	Security identifier

Total Message Data length is 18 bytes. See Appendix B for the bitwise representation.

Retail Liquidity Indicator

- [space] (0x20) - Retail indicator not applicable
- 'A' (0x41) - Buy interest for Retail

'B' (0x42) - Sell interest for Retail

- 'C' (0x43) - Buy and sell interest for Retail

Timestamp

The time an event triggered the Retail Liquidity Indicator Message as set by the IEX Trading System logic.

Symbol

Security represented in Nasdaq Integrated symbology.

Example

```
Message Type                    49                          // I = Retail Liquidity
                                                            Indicator Message

Retail Liquidity Indicator      41                          // A = Buy Interest for Retail


Timestamp                       ac 63 c0 20 96 86 6d 14     // 2016-08-23 15:30:32.572715948

Symbol                          5a 49 45 58 54 20 20 20     // ZIEXT
```

Operational Halt Status Message – O (0x4f)

The Exchange may suspend trading of one or more securities on IEX for operational reasons and indicates such operational halt using the Operational Halt Status Message.

IEX disseminates a full pre-market spin of Operational Halt Status Messages indicating the operational halt status of all securities. In the spin, IEX will send out an Operational Halt Message with "N" (Not operationally halted on IEX) for all securities that are eligible for trading at the start of the Pre-Market Session. If a security is absent from the dissemination, firms should assume that the security is being treated as operationally halted in the IEX Trading System at the start of the Pre-Market Session.

After the pre-market spin, IEX will use the Operational Halt Status Message to relay changes in operational halt status for an individual security.

Field Name	Offset	Length	Type	Description/Notes
Message Type	0	1	Byte	'O' (0x4f) – Operational Halt Status
Operational Halt Status	1	1	Byte	Operational halt status identifier
Timestamp	2	8	Timestamp	Time stamp of the operational halt status
Symbol	10	8	String	Security identifier

Total Message Data length is 18 bytes. See Appendix B for the bitwise representation.

Operational Halt Status

- 'O' (0x4f): IEX specific operational trading halt
- 'N' (0x4e): Not operationally halted on IEX

Timestamp

The time of the update event as set by the IEX Trading System logic.

Symbol

Security represented in Nasdaq Integrated symbology.

Example

```
Message Type              4f                      // O = Operational Halt Status
Operational Halt Status   4f                      // O = Operationally halted on IEX
Timestamp                 ac 63 c0 20 96 86 6d 14 // 2016-08-23 15:30:32.572715948
Symbol                    5a 49 45 58 54 20 20 20 // ZIEXT
```

Short Sale Price Test Status Message – P (0x50)

In association with Rule 201 of Regulation SHO, the Short Sale Price Test Message is used to indicate when a short sale price test restriction is in effect for a security.

IEX disseminates a full pre-market spin of Short Sale Price Test Status Messages indicating the Rule 201 status of all securities. After the pre-market spin, IEX will use the Short Sale Price Test Status Message in the event of an intraday status change.

The IEX Trading System will process orders based on the latest short sale price test restriction status.

Field Name	Offset	Length	Type	Description/Notes
Message Type	0	1	Byte	'P' (0x50) – Short Sale Price Test Status
Short Sale Price Test Status	1	1	Byte	Reg. SHO short sale price test restriction status
Timestamp	2	8	Timestamp	Time stamp of the short sale price test status
Symbol	10	8	String	Security identifier
Detail	18	1	Byte	Detail of the Reg. SHO short sale price test restriction status

Total Message Data length is 19 bytes. See Appendix B for the bitwise representation.

Short Sale Price Test Status

- 0 (0x0): Short Sale Price Test Not in Effect
- 1 (0x1): Short Sale Price Test in Effect

Timestamp

The time of the update event as set by the IEX Trading System logic.

Symbol

Security represented in Nasdaq Integrated symbology.

Detail

IEX populates the Detail field for IEX-listed securities; this field will be set to "N" (Detail Not Available) for non-IEX-listed securities.

- [space] (0x20): No price test in place
- 'A' (0x41): Short sale price test restriction in effect due to an intraday price drop in the security (i.e., Activated)
- 'C' (0x43): Short sale price test restriction remains in effect from prior day (i.e., Continued)
- 'D' (0x44): Short sale price test restriction deactivated (i.e., Deactivated)
- 'N' (0x4e): Detail Not Available

Example

```
Message Type                    50                      // P = Short Sale Price Test Status
Short Sale Price Test Status    01                      // Short Sale Price Test in Effect
Timestamp                       ac 63 c0 20 96 86 6d 14 // 2016-08-23 15:30:32.572715948
Symbol                          5a 49 45 58 54 20 20 20 // ZIEXT
Detail                          41                      // A = Short Sale Price Test Activated
```

State Diagram

See Appendix C for a state diagram illustrating the potential Short Sale Price Test Status and Detail transitions.

Security Event Message – E (0x45)

The Security Event Message is used to indicate events that apply to a security. A Security Event Message will be sent whenever such event occurs for a security.

Field Name	Offset	Length	Type	Description/Notes
Message Type	0	1	Byte	'E' (0x45) – Security Event
Security Event	1	1	Byte	Security event identifier
Timestamp	2	8	Timestamp	Time stamp of the security event
Symbol	10	8	String	Security identifier

Total Message Data length is 18 bytes. See Appendix B for the bitwise representation.

Security Event

- 'O' (0x4f): *Opening Process Complete* – This message indicates that the Opening Process is complete in this security and any orders queued during the Pre-Market Session are now available for execution on the IEX Order Book for the subject security.
- 'C' (0x43): *Closing Process Complete* – For non-IEX-listed securities, this message indicates that IEX has completed canceling orders from the IEX Order Book for the subject security that are not eligible for the Post-Market Session. For IEX-listed securities, this message indicates that the closing process (e.g., Closing Auction) has completed for this security and IEX has completed canceling orders from the IEX Order Book for the subject security that are not eligible for the Post-Market Session.

Timestamp

The time of the update event as set by the IEX Trading System logic.

Symbol

Security represented in Nasdaq Integrated symbology.

Example

```
Message Type            45                      // E = Security Event
Security Event          4f                      // O = Opening Process Complete
Timestamp               00 f0 30 2a 5b 25 b6 14 // 2017-04-17 09:30:00.000000000
Symbol                  5a 49 45 58 54 20 20 20 // ZIEXT
```

TRADING MESSAGE FORMATS

Price Level Update Message – 8 (0x38), 5 (0x35)

DEEP broadcasts a real-time Price Level Update Message each time a displayed price level on IEX is updated during the trading day. When a price level is removed, IEX will disseminate a size of zero (i.e., 0x0) for the level.

Field Name	Offset	Length	Type	Description/Notes
Message Type	0	1	Byte	'8' (0x38) – Price Level Update on the Buy Side '5' (0x35) – Price Level Update on the Sell Side
Event Flags	1	1	Byte	Identifies event processing by the System
Timestamp	2	8	Timestamp	Time stamp of the price level update
Symbol	10	8	String	Security identifier
Size	18	4	Integer	Aggregate quoted size
Price	22	8	Price	Price level to add/update in the IEX Order Book

Total Message Data length is 30 bytes. See Appendix B for the bitwise representation.

Event Flags

Event Flags identifies when the IEX Trading System logic completes processing an event (e.g., a taking order). The IEX best bid and offer ("IEX BBO") may be accurately calculated by a recipient when the Event Flags is ON (i.e., 0x1). See below for additional details regarding consuming Price Level Update Messages and updating the IEX BBO.

- 0 (0x0): Order Book is processing an event (i.e., Order Book is in transition)
- 1 (0x1): Event processing complete (i.e., Order Book transition complete)

Timestamp

The time an event triggered the price level update as set by the IEX Trading System logic.

Symbol

Quoted security represented in Nasdaq Integrated symbology.

Price

Price level of the update, where the decimal portion is zero filled on the right. The decimal point is implied by position and does not explicitly appear in the field. For example, 123400 = $12.34.

Size

Aggregate quoted size at the price level represented in number of shares.

Example

```
Message Type            38                      // 8 = Price Level Update on the Buy Side
Event Flags             01                      // Event processing complete
Timestamp               ac 63 c0 20 96 86 6d 14 // 2016-08-23 15:30:32.572715948
Symbol                  5a 49 45 58 54 20 20 20 // ZIEXT
Size                    e4 25 00 00             // 9,700 shares
Price                   24 1d 0f 00 00 00 00 00 // $99.05
```

Consuming Price Level Update Messages and Updating the IEX BBO

Each symbol should be considered to have an independent Order Book. The following bullet-point statements are to be read as "within a given symbol," unless otherwise specified. Therefore, when an Order Book is said to be "transitioning" it is the Order Book of a particular symbol and not all Order Books across all symbols.

- Given a singular update to an Order Book (i.e., an event) (e.g., an aggressively priced order entering the Order Book), the System may need to affect multiple price levels atomically (i.e., at once). The Order Book, along with the IEX BBO in such symbol, should be considered to have atomically transitioned from the state immediately prior to the Order Book transaction ("atomic update") to the state immediately subsequent to the transaction, but not to every state in between.
- Atomic updates to a given symbol's Order Book are described in DEEP by a series of zero or more Price Level Update Messages with the Event Flags OFF (i.e., 0x0), followed by a Price Level Update Message ("PLU") with the Event Flags ON (i.e., 0x1) (e.g., PLU 0x0, PLU 0x0, . . ., PLU 0x1).
- When there are updates to multiple price levels that must occur as part of a single transaction to a given symbol's Order Book (e.g., multiple price levels' shares being exhausted via a single active order's execution), each PLU transmitted, except for the last one, will have Event Flags OFF, and Event Flags will be ON in the final PLU of the transaction.
- For each update to an Order Book, there will be exactly one final PLU with the Event Flags ON, but there is no guarantee to have received preceding PLUs with an Event Flags OFF. In the case, where only a single price level is being updated atomically, there will be a single PLU transmitted with Event Flags ON, without any preceding PLUs transmitted with Event Flags OFF (i.e., PLUs with an Event Flags OFF are only transmitted when multiple price levels must be affected atomically).
- A PLU with Event Flags OFF begins an atomic event (note that one or more Trade Report Message may proceed a PLU that is part of the same atomic event). A PLU with Event Flags ON ends a transaction. If no transaction was ongoing when the PLU with Event Flags ON arrived, then such PLU both begins and ends a transaction.
- The Order Book should be considered to retain its BBO from prior to the transaction during the processing of the transaction. Once the transaction is complete, then the IEX BBO should be derived. This ensures that the transactional update has taken place atomically (i.e., that an in-transition IEX BBO, which never truly existed, is not seen/acted upon).

Example

1. Order Book for symbol ZIEXT
   - Sell 100 @ 25.30
   - Sell 100 @ 25.20

- Sell 100 @ 25.10
- Buy 100 @ 25.00
- Buy 100 @ 24.90

IEX BBO: Buy 100 @ 25.00 x Sell 100 @ 25.10

2. Price Level Update on the Sell Side received: Event Flags: 0x0, Price: 25.10, Shares: 0
   - Sell 100 @ 25.30
   - Sell 100 @ 25.20
   - Buy 100 @ 25.00
   - Buy 100 @ 24.90

   IEX BBO: Buy 100 @ 25.00 x Sell 100 @ 25.10 (Reason: ZIEXT Order Book is in transition)

3. Price Level Update on the Sell Side received: Event Flags: 0x1, Price: 25.20, Shares: 0
   - Sell 100 @ 25.30
   - Buy 100 @ 25.00
   - Buy 100 @ 24.90

   IEX BBO: Buy 100 @ 25.00 x Sell 100 @ 25.30 (Reason: ZIEXT Order Book transition complete)

Trade Report Message – T (0x54)

Trade Report Messages are sent when an order on the IEX Order Book is executed in whole or in part. DEEP sends a Trade Report Message for every individual fill.

Field Name	Offset	Length	Type	Description/Notes
Message Type	0	1	Byte	'T' (0x54) – Trade Report
Sale Condition Flags	1	1	Byte	See Appendix A for flag values
Timestamp	2	8	Timestamp	Time stamp of the trade
Symbol	10	8	String	Security identifier
Size	18	4	Integer	Trade volume
Price	22	8	Price	Trade price
Trade ID	30	8	Long	IEX Generated Identifier. Trade ID is also referenced in the Trade Break Message.

Total Message Data length is 38 bytes. See Appendix B for the bitwise representation.

Timestamp

The time an event triggered the trade (i.e., execution) as set by the IEX Trading System logic.

Symbol

Traded security represented in Nasdaq Integrated symbology.

Size

Size of the trade represented in number of shares.

Price

Execution price, where the decimal portion is zero filled on the right. The decimal point is an implied by position (always 4 decimal places) and does not explicitly appear in the field. For example, 123400 = $12.34.

Trade ID

IEX generated trade identifier. A given trade is uniquely identified within a day by its Trade ID.

Example

```
Message Type              54                      // T = Trade Report
Sale Condition Flags      00                      // Non-ISO, Regular Market Session, Round or
                                                     Mixed Lot, Trade is subject to Rule 611,
                                                     execution during continuous trading
Timestamp                 c3 df f7 05 a2 86 6d 14 // 2016-08-23 15:31:23.662974915
Symbol                    5a 49 45 58 54 20 20 20 // ZIEXT
Size                      64 00 00 00             // 100 shares
Price                     24 1d 0f 00 00 00 00 00 // $99.05
Trade ID                  96 8f 06 00 00 00 00 00 // 429974
```

Official Price Message – X (0x58)

Official Price Messages are sent for each IEX-listed security to indicate the IEX Official Opening Price and IEX Official Closing Price. The latest IEX Official Opening (Closing) Price sent by IEX overrides previously disseminated IEX Official Opening (Closing) Price(s).

Field Name	Offset	Length	Type	Description/Notes
Message Type	0	1	Byte	'X' (0x58) – Official Price
Price Type	1	1	Byte	Price type identifier
Timestamp	2	8	Timestamp	Time stamp of the official price determination
Symbol	10	8	String	Security identifier
Official Price	18	8	Price	Official opening or closing price, as specified

Total Message Data length is 26 bytes. See Appendix B for the bitwise representation.

Price Type

- 'Q' (0x51) – IEX Official Opening Price.
- 'M' (0x4d) – IEX Official Closing Price.

Timestamp

The time an event triggered the official price calculation (e.g., auction match) as set by the IEX Trading System logic.

Symbol

Security represented in Nasdaq Integrated symbology.

Official Price

IEX Official Opening or Closing Price of an IEX-listed security, as specified, where the decimal portion is zero filled on the right. The decimal point is an implied by position (always 4 decimal places) and does not explicitly appear in the field. For example, 123400 = $12.34.

Example

```
Message Type          58                      // X = Official Price
Price Type            51                      // Q = IEX Official Opening Price
Timestamp             00 f0 30 2a 5b 25 b6 14 // 2017-04-17 09:30:00.000000000
Symbol                5a 49 45 58 54 20 20 20 // ZIEXT
Official Price        24 1d 0f 00 00 00 00 00 // $99.05
```

Trade Break Message – B (0x42)

Trade Break Messages are sent when an execution on IEX is broken on that same trading day. Trade breaks are rare and only affect applications that rely upon IEX execution based data.

Field Name	Offset	Length	Type	Description/Notes
Message Type	0	1	Byte	'B' (0x42) – Trade Break
Sale Condition Flags	1	1	Byte	See Appendix A for flag values
Timestamp	2	8	Timestamp	Time stamp of the trade break
Symbol	10	8	String	Security identifier
Size	18	4	Integer	Trade break volume
Price	22	8	Price	Trade break price
Trade ID	30	8	Long	IEX trade identifier of the trade that was broken. Trade ID refers to the previously sent Trade Report Message.

Total Message Data length is 38 bytes. See Appendix B for the bitwise representation.

Timestamp

The time an event triggered the trade break as set by the IEX Trading System logic.

Symbol

Traded security represented in Nasdaq Integrated symbology.

Size

Size of the trade represented in number of shares.

Price

Execution price, where the decimal portion is zero filled on the right. The decimal point is an implied by position (always 4 decimal places) and does not explicitly appear in the field. For example, 123400 = $12.34.

Trade ID

IEX generated trade identifier of the broken trade. A given trade is uniquely identified within a day by its Trade ID.

Example

```
Message Type              42                        // B = Trade Break

Sale Condition Flags      00                        // Non-ISO, Regular Market Session, Round or
                                                       Mixed Lot, Trade is subject to Rule 611,
                                                       execution during continuous trading

Timestamp                 b2 8f a5 a0 ab 86 6d 14   // 2016-08-23 15:32:04.912754610

Symbol                    5a 49 45 58 54 20 20 20   // ZIEXT

Size                      64 00 00 00               // 100 shares

Price                     24 1d 0f 00 00 00 00 00   // $99.05

Trade ID                  96 8f 06 00 00 00 00 00   // 429974
```

AUCTION MESSAGE FORMATS

Auction Information Message – A (0x41)

DEEP broadcasts an Auction Information Message every one second between the Lock-in Time and the auction match for Opening and Closing Auctions, and during the Display Only Period for IPO, Halt, and Volatility Auctions. Only IEX-listed securities are eligible for IEX Auctions. See the IEX Auction Process Specification for details regarding IEX Auctions and IEX Auction Information.

Field Name	Offset	Length	Type	Description/Notes
Message Type	0	1	Byte	'A' (0x41) – Auction Information
Auction Type	1	1	Byte	Auction type identifier
Timestamp	2	8	Timestamp	Time stamp of the auction information
Symbol	10	8	String	Security identifier
Paired Shares	18	4	Integer	Number of shares paired at the Reference Price using orders on the Auction Book
Reference Price	22	8	Price	Clearing price at or within the Reference Price Range using orders on the Auction Book
Indicative Clearing Price	30	8	Price	Clearing price using Eligible Auction Orders
Imbalance Shares	38	4	Integer	Number of unpaired shares at the Reference Price using orders on the Auction Book
Imbalance Side	42	1	Byte	Side of the unpaired shares at the Reference Price using orders on the Auction Book
Extension Number	43	1	Byte	Number of extensions an auction received
Scheduled Auction Time	44	4	Event Time	Projected time of the auction match
Auction Book Clearing Price	48	8	Price	Clearing price using orders on the Auction Book
Collar Reference Price	56	8	Price	Reference priced used for the auction collar, if any
Lower Auction Collar	64	8	Price	Lower threshold price of the auction collar, if any
Upper Auction Collar	72	8	Price	Upper threshold price of the auction collar, if any

Total Message Data length is 80 bytes. See Appendix B for the bitwise representation.

Auction Type

- 'O' (0x4f): Opening Auction
- 'C' (0x43): Closing Auction
- 'I' (0x49): IPO Auction
- 'H' (0x48): Halt Auction
- 'V' (0x56): Volatility Auction

Timestamp

The time of the update event as set by the IEX Trading System logic.

Symbol

IEX-listed security represented in Nasdaq Integrated symbology.

Shares

Size of the paired shares or imbalance shares represented in number of shares.

Price

Reference, clearing, or collar price, where the decimal portion is zero filled on the right. The decimal point is an implied by position (always 4 decimal places) and does not explicitly appear in the field. For example, 123400 = $12.34. If the Collar Reference Price, Lower Auction Collar, and Upper Auction Collar are not utilized (e.g., a Halt Auction), the value will be set to 0

Imbalance Side

The side of the imbalance:

- 'B' (0x42): buy-side imbalance
- 'S' (0x53): sell-side imbalance
- 'N' (0x4e): no imbalance

Extension Number

Total number of automatic extensions an IPO, Halt, or Volatility Auction has received.

Scheduled Auction Time

Projected time of the auction match represented in seconds since POSIX (Epoch) time UTC.

Example

```
Message Type                41                      // A = Auction Information
Auction Type                43                      // C = Closing Auction
Timestamp                   dd c7 f0 9a 1a 3a b6 14  // 2017-04-17 15:50:12.462929885
Symbol                      5a 49 45 58 54 20 20 20 // ZIEXT
Paired Shares               a0 86 10 00             // 100,000 shares
Reference Price             24 1d 0f 00 00 00 00 00 // $99.05
Indicative Clearing Price   18 1f 0f 00 00 00 00 00 // $99.10
Imbalance Shares            10 27 00 00             // 10,000 shares
Imbalance Side              42                      // B = buy-side imbalance
Extension Number            00                      // 0 extensions
```

Continued on next page.

Scheduled Auction Time	80 e6 f4 58	// 2017-04-17 16:00:00
Auction Book Clearing Price	0c 21 0f 00 00 00 00 00	// $99.15
Collar Reference Price	c0 1c 0f 00 00 00 00 00	// $99.04
Lower Auction Collar	a4 99 0d 00 00 00 00 00	// $89.13
Upper Auction Collar	dc 9f 10 00 00 00 00 00	// $108.95

APPENDIX A: FLAGS

Security Directory: Flags

Definition

Bit	Name	Description
7	T: Test Security Flag	0: Symbol is not a test security 1: Symbol is a test security
6	W: When Issued Flag	0: Symbol is not a when issued security 1: Symbol is a when issued security
5	E: ETP Flag	0: Symbol is not an ETP (i.e., Exchange Traded Product) 1: Symbol is an ETP

Usage

T	W	E	Mask	Meaning
X			Flags & 0x80	Test security
	X		Flags & 0x40	When issued security
		X	Flags & 0x20	ETP

Trade Report & Trade Break: Sale Condition Flags

Definition

Bit	Name	Description
7	F: Intermarket Sweep Flag	0: Non-Intermarket Sweep Order 1: Intermarket Sweep Order ("ISO")
6	T: Extended Hours Flag	0: Regular Market Session Trade 1: Extended Hours Trade (i.e., Form T sale condition)
5	I: Odd Lot Flag	0: Round or Mixed Lot Trade 1: Odd Lot Trade
4	8: Trade Through Exempt Flag	0: Trade is subject to Rule 611 (Trade Through) of SEC Reg. NMS 1: Trade is not subject to Rule 611 (Trade Through) of SEC Reg. NMS*
3	X: Single-price Cross Trade Flag	0: Execution during continuous trading 1: Trade resulting from a single-price cross

* Applied when the taking order was an ISO that traded through a protected quotation, OR the NBBO was crossed at the time of the trade, OR the trade occurred through a self-helped venue's quotation, OR the trade was a single-price cross.

Usage

F	T	I	8	X	Mask	Meaning
X					Flags & 0x80	Trade resulted from an ISO
	X				Flags & 0x40	Trade occurred before or after the Regular Market Session (i.e., Form T)
		X			Flags & 0x20	Trade is less than one round lot
			X		Flags & 0x10	Trade is not subject to Trade Through Rule 611 of SEC Reg. NMS*
				X	Flags & 0x08	Trade resulted from a single-price cross

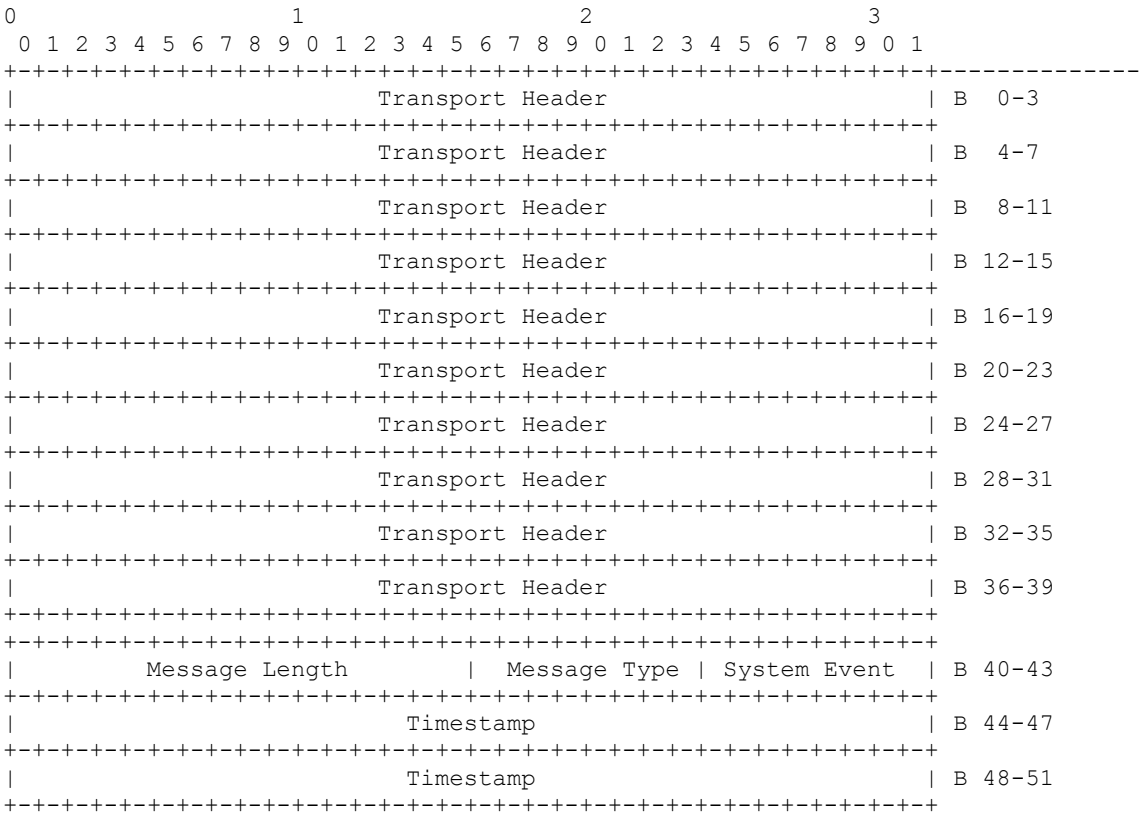
* Applied when the taking order was an ISO that traded through a protected quotation, OR the NBBO was crossed at the time of the trade, OR the trade occurred through a self-helped venue's quotation, OR the trade was a single-price cross.

Trade Eligibility Guidelines

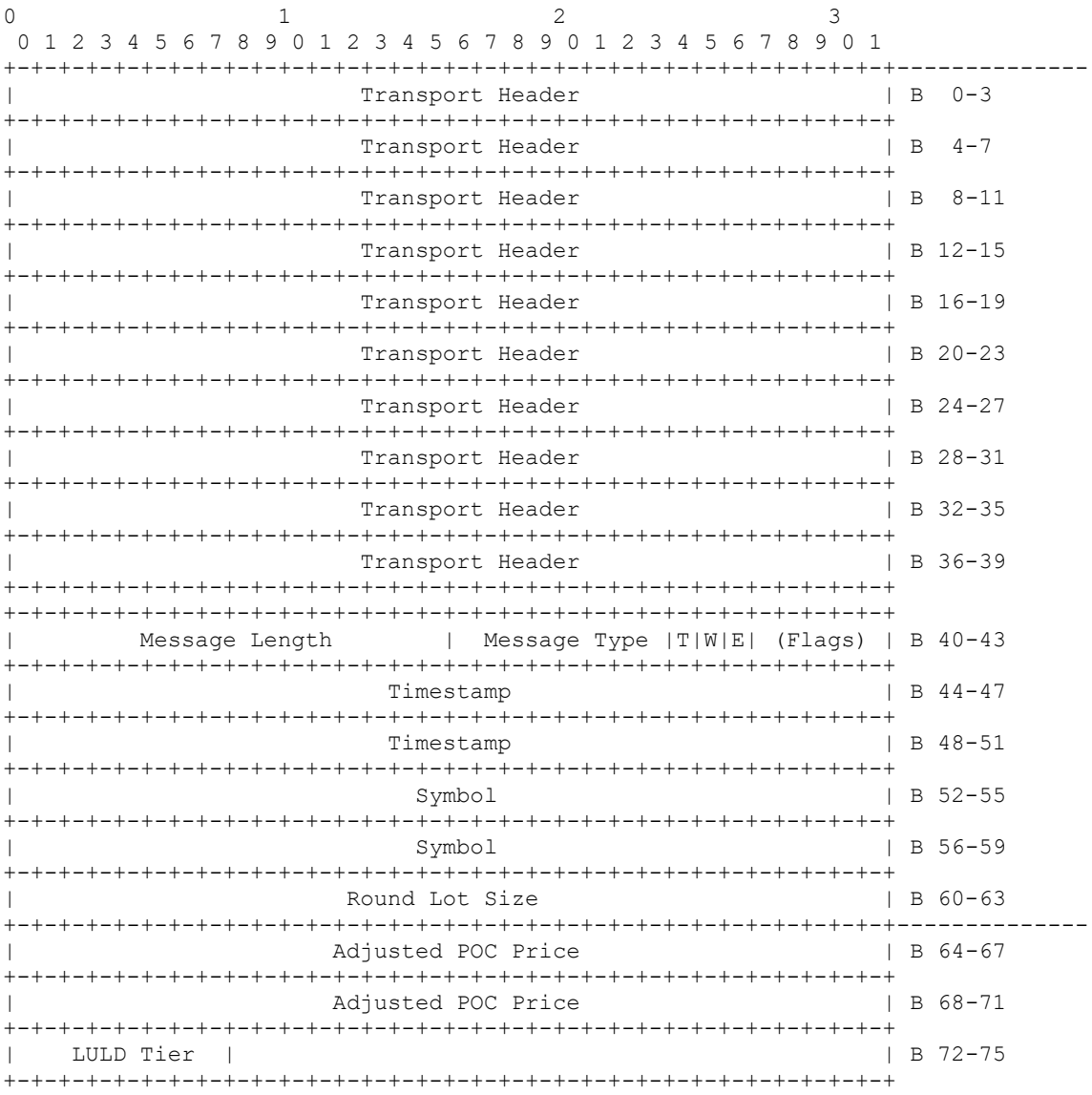
- Last Sale Eligible
  - Intermarket Sweep Flag: 0 or 1
  - Extended Hours Flag: 0
  - Odd Lot Flag: 0
  - Trade Through Exempt Flag: 0 or 1
  - Single-price Cross Trade Flag: 0 or 1
- High/Low Price Eligible
  - Intermarket Sweep Flag: 0 or 1
  - Extended Hours Flag: 0
  - Odd Lot Flag: 0
  - Trade Through Exempt Flag: 0 or 1
  - Single-price Cross Trade Flag: 0 or 1
- Volume Eligible
  - Intermarket Sweep Flag: 0 or 1
  - Extended Hours Flag: 0 or 1
  - Odd Lot Flag: 0 or 1
  - Trade Through Exempt Flag: 0 or 1
  - Single-price Cross Trade Flag: 0 or 1

APPENDIX B: BITWISE REPRESENTATION

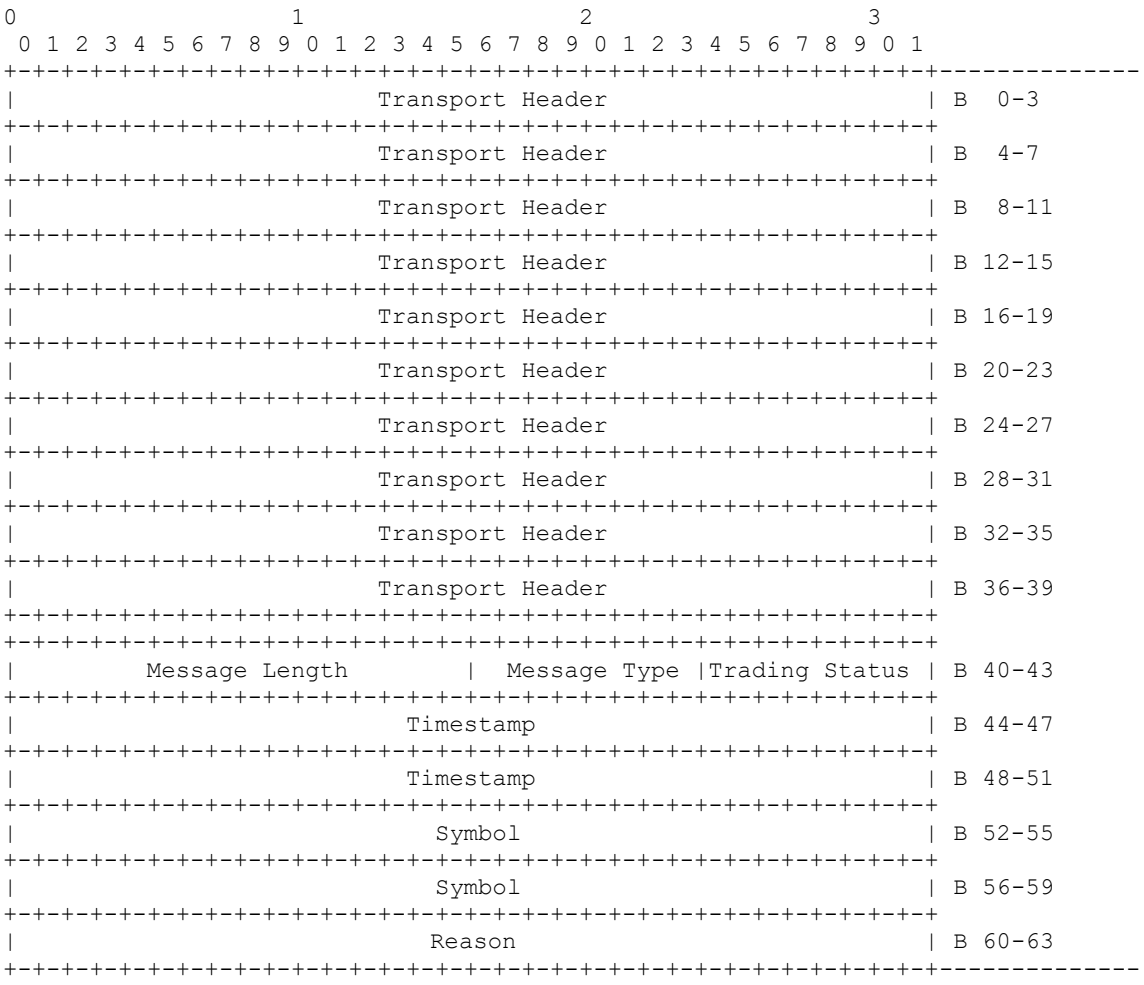
System Event Message in a Single Segment



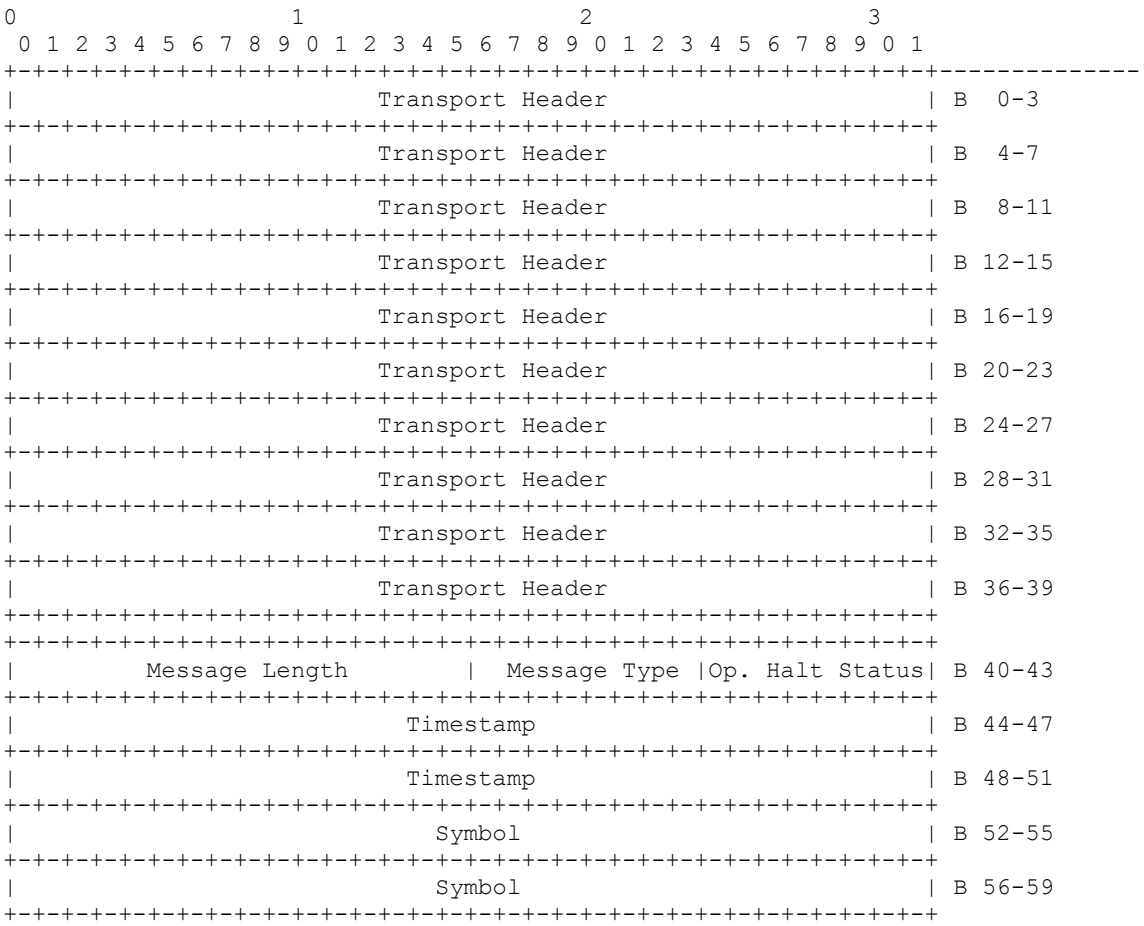
Security Directory Message in a Single Segment



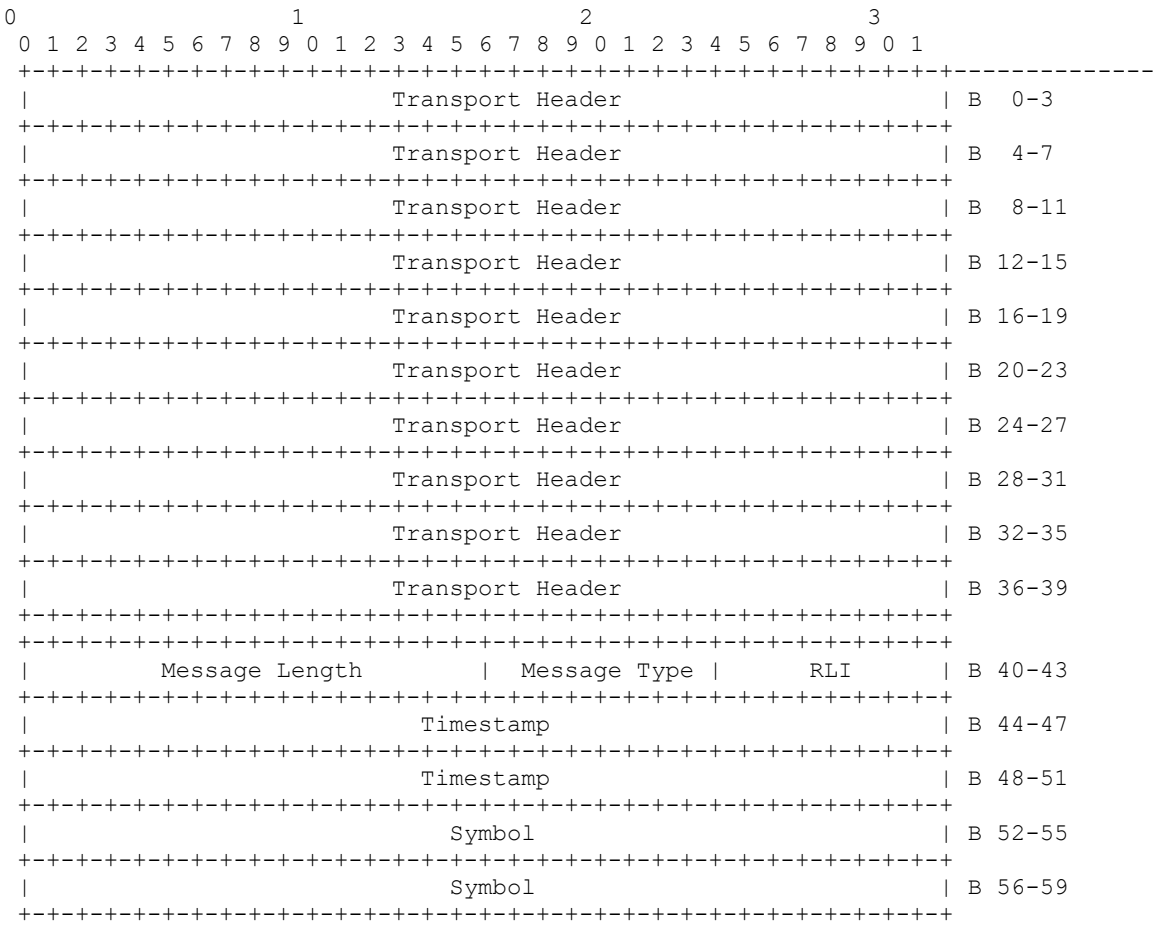
Trading Status Message in a Single Segment



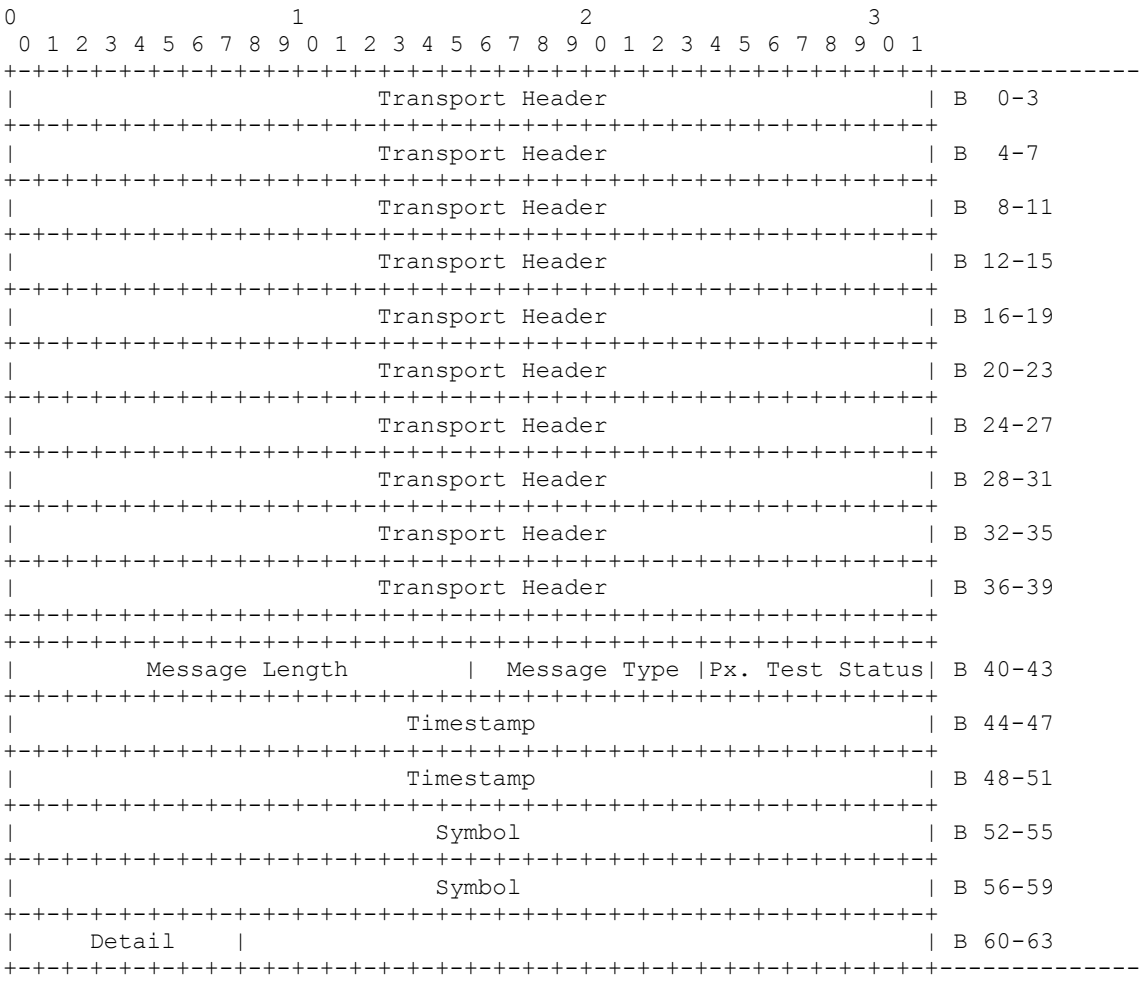
Operational Halt Status Message in a Single Segment



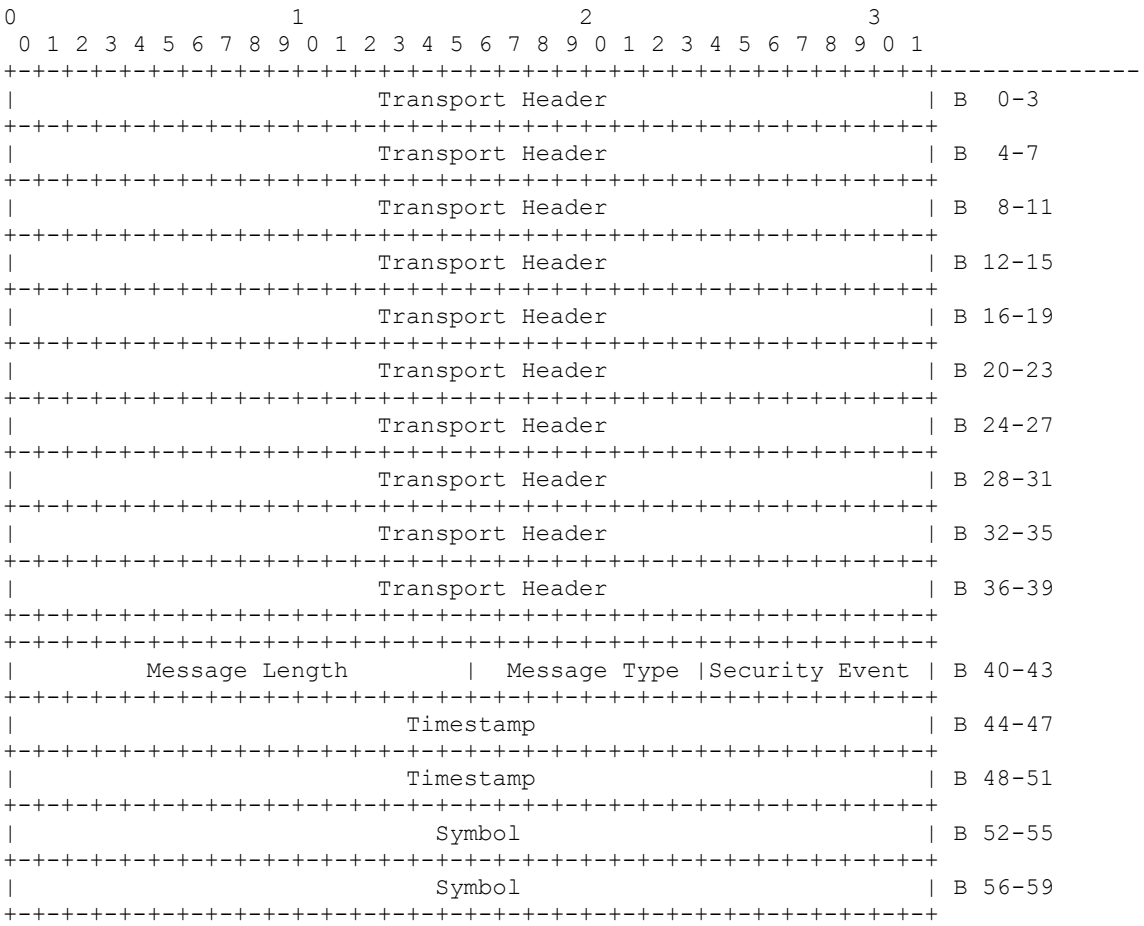
Retail Liquidity Indicator (“RLI”) Message in a Single Segment



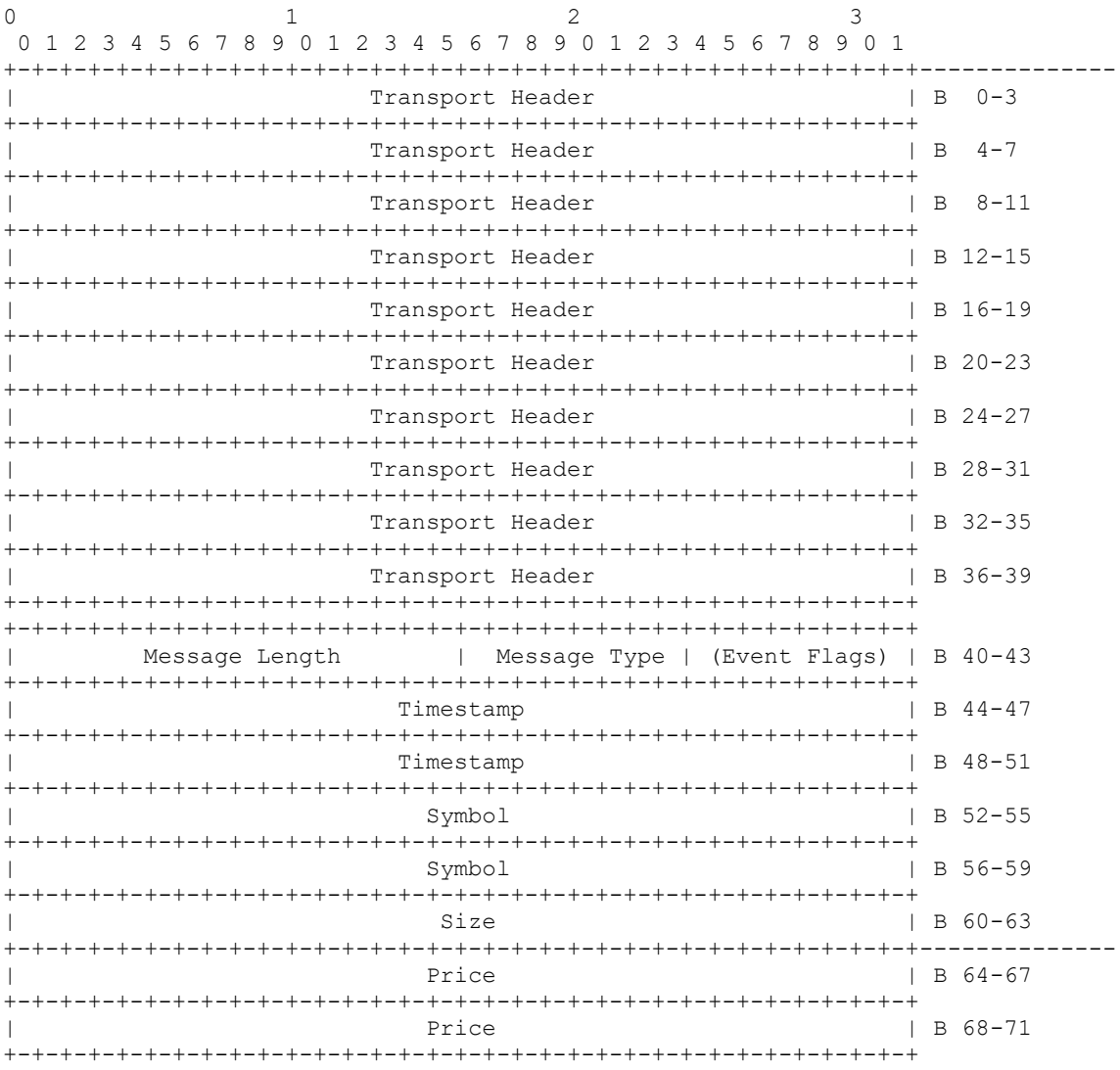
Short Sale Price Test Status Message in a Single Segment



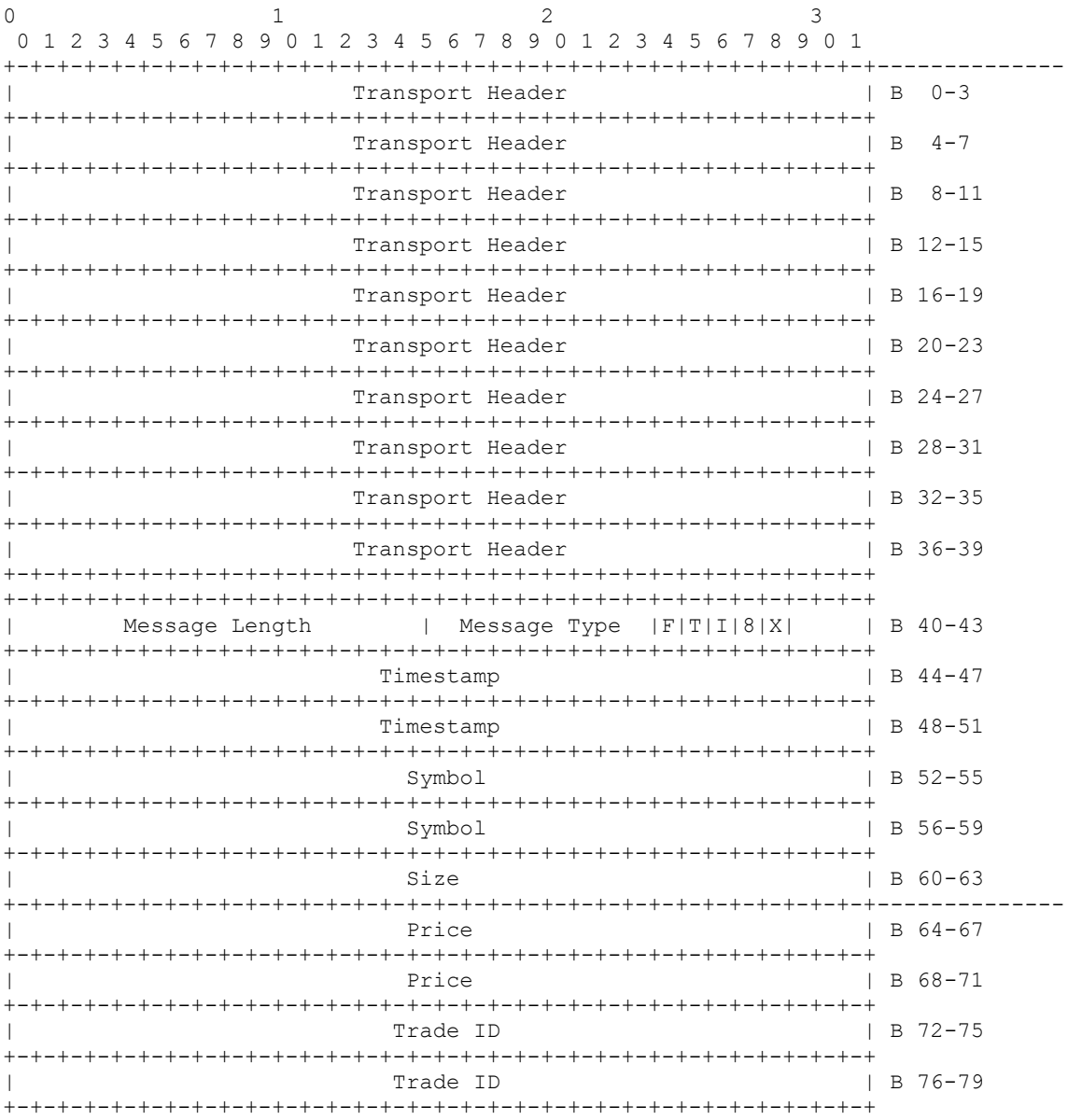
Security Event Message in a Single Segment



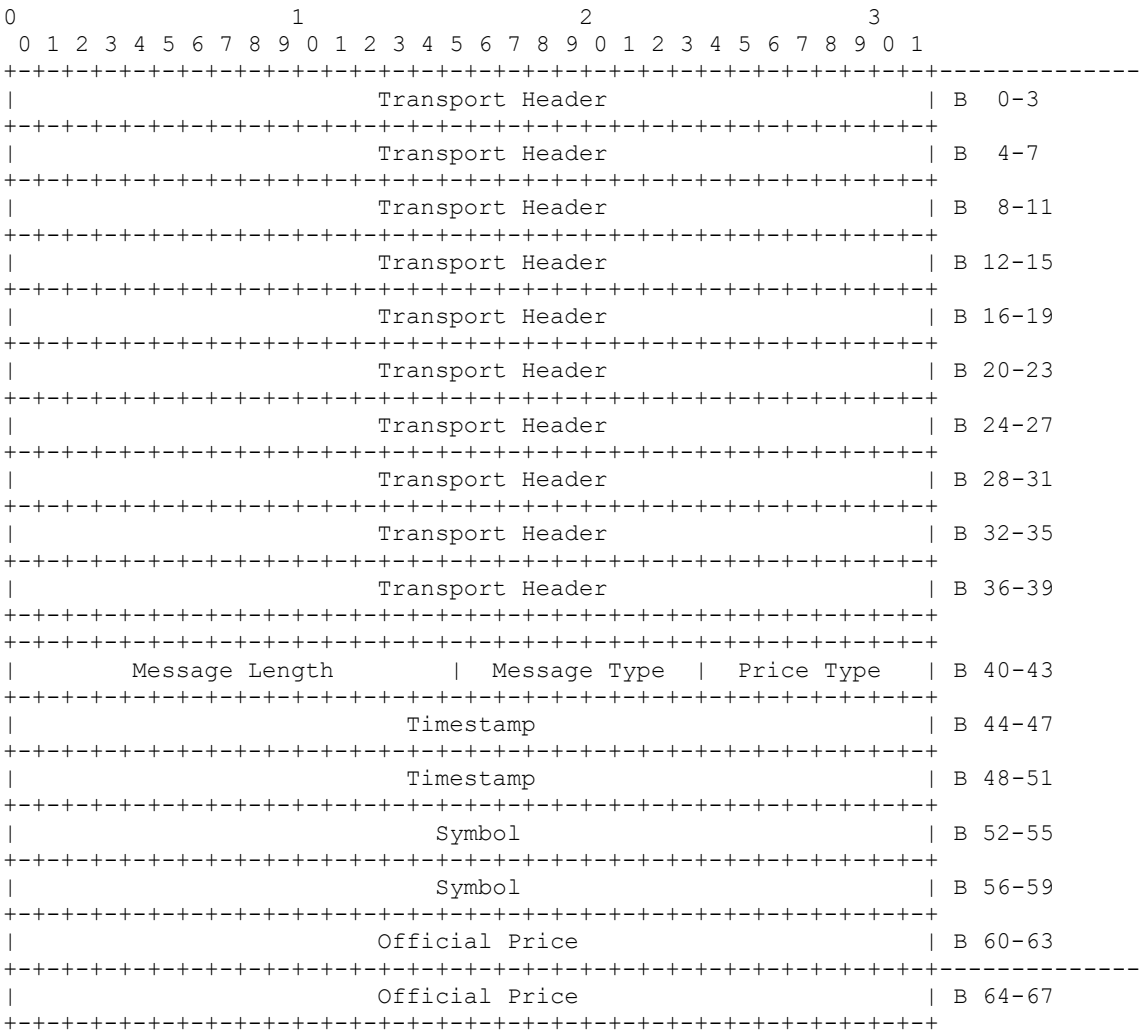
Price Level Update Messages in a Single Segment



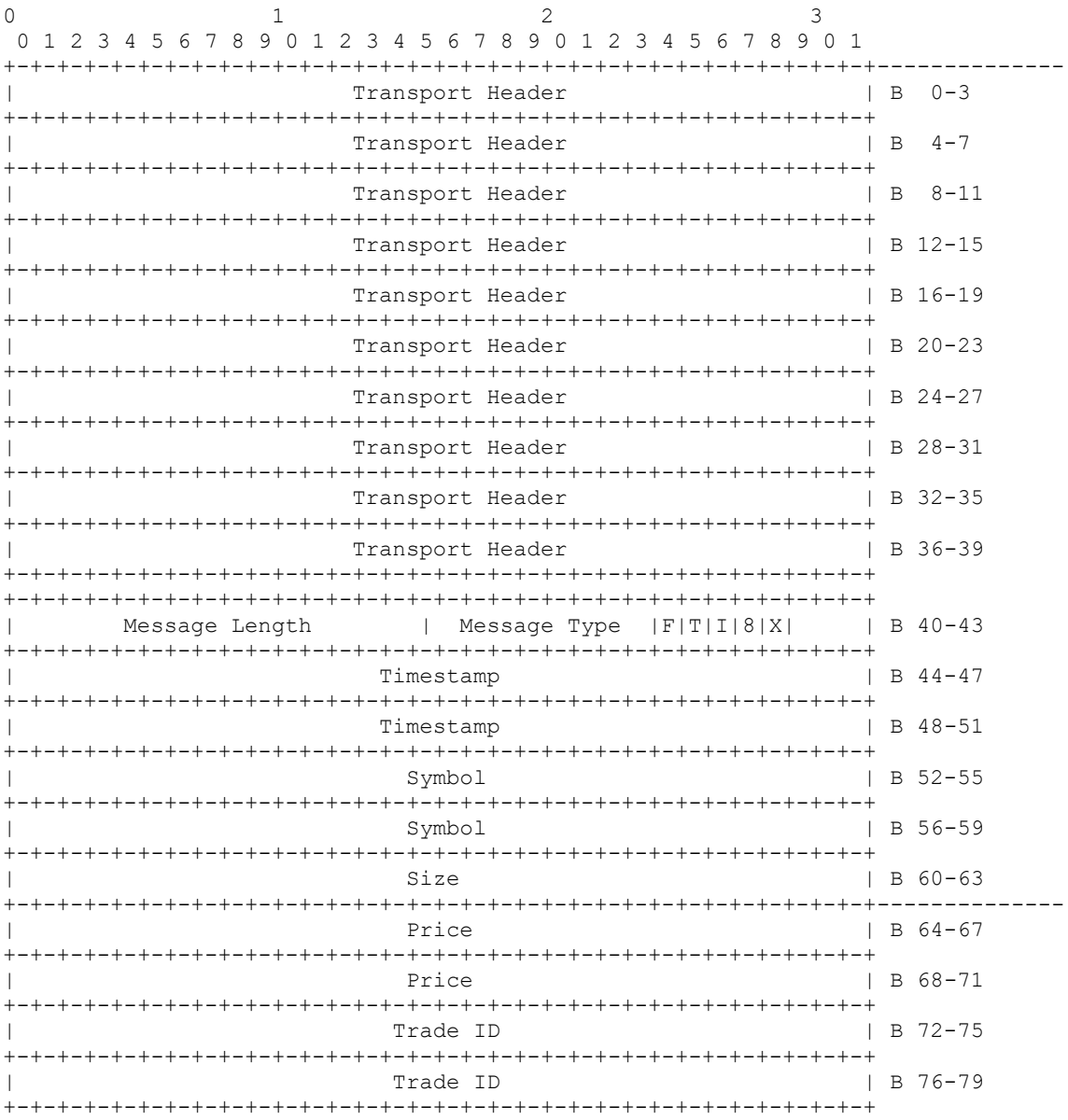
Trade Report Messages in a Single Segment



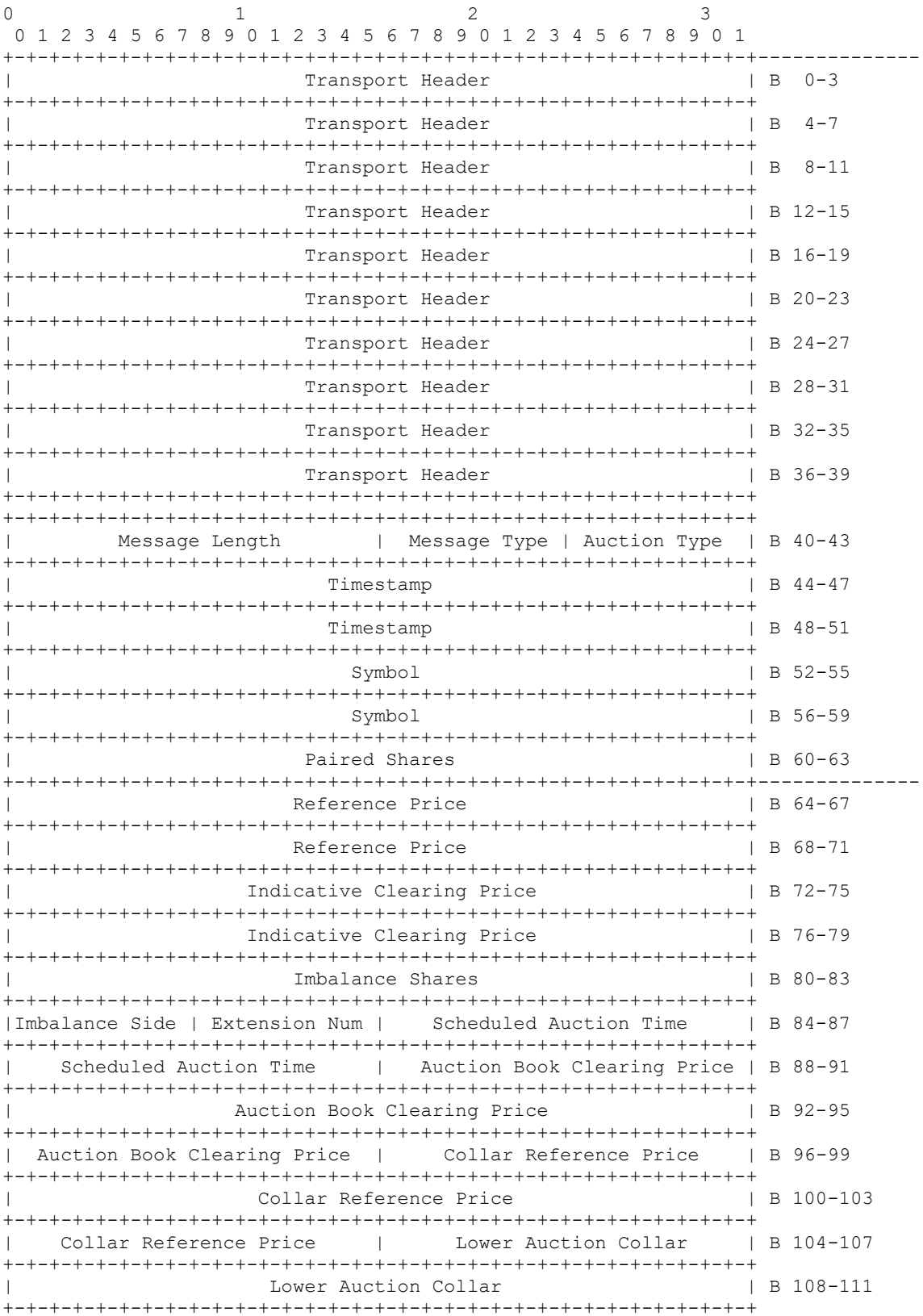
Official Price Messages in a Single Segment



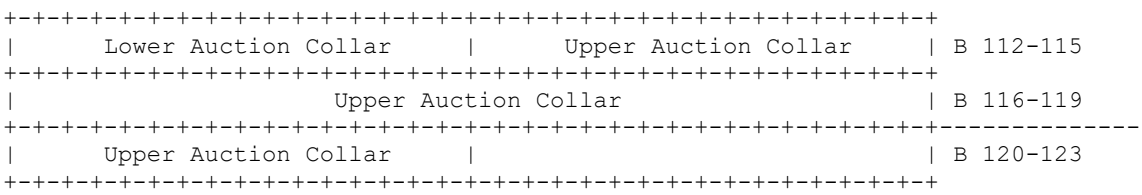
Trade Break Messages in a Single Segment



Auction Information Messages in a Single Segment

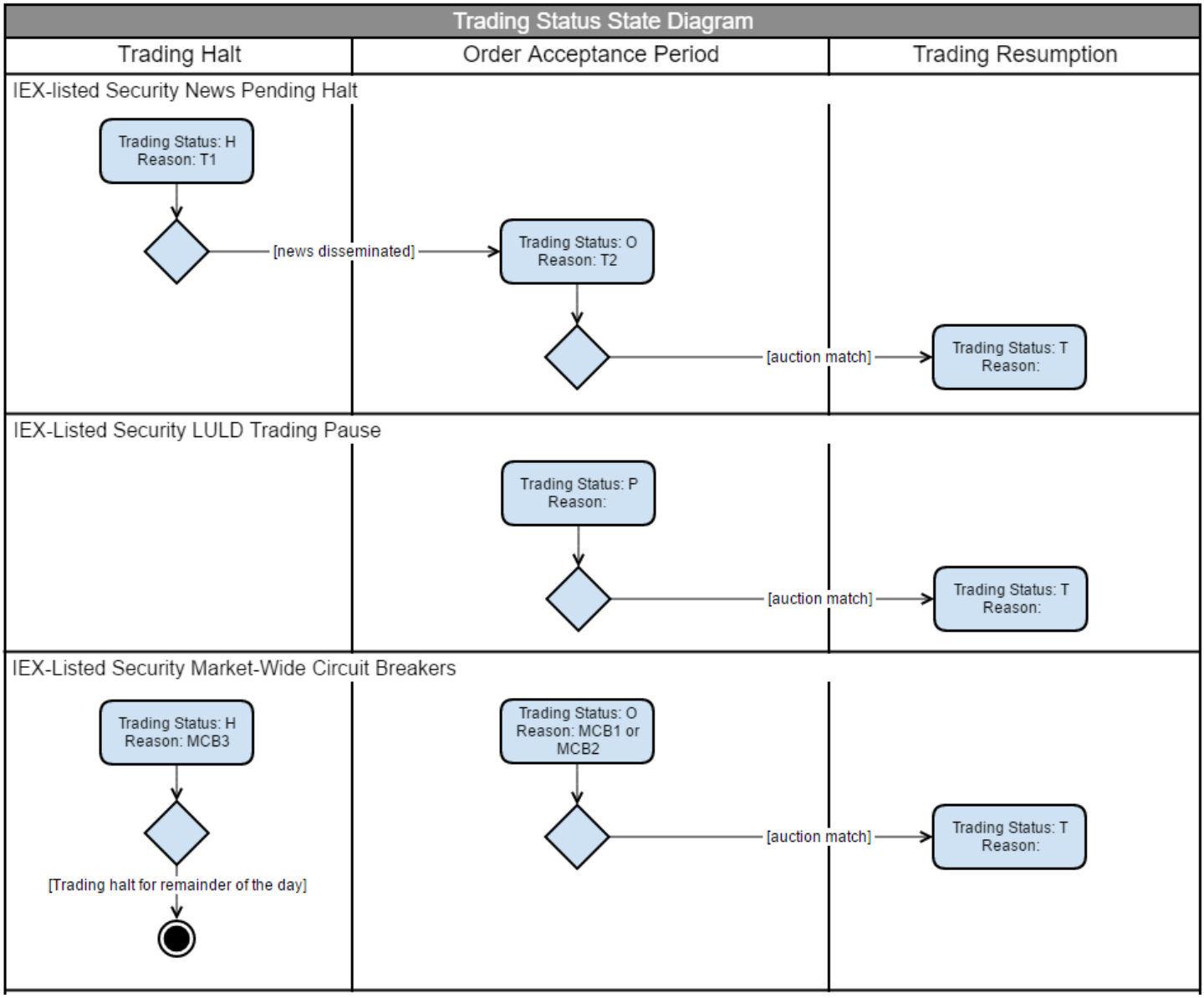


Continues on next page.

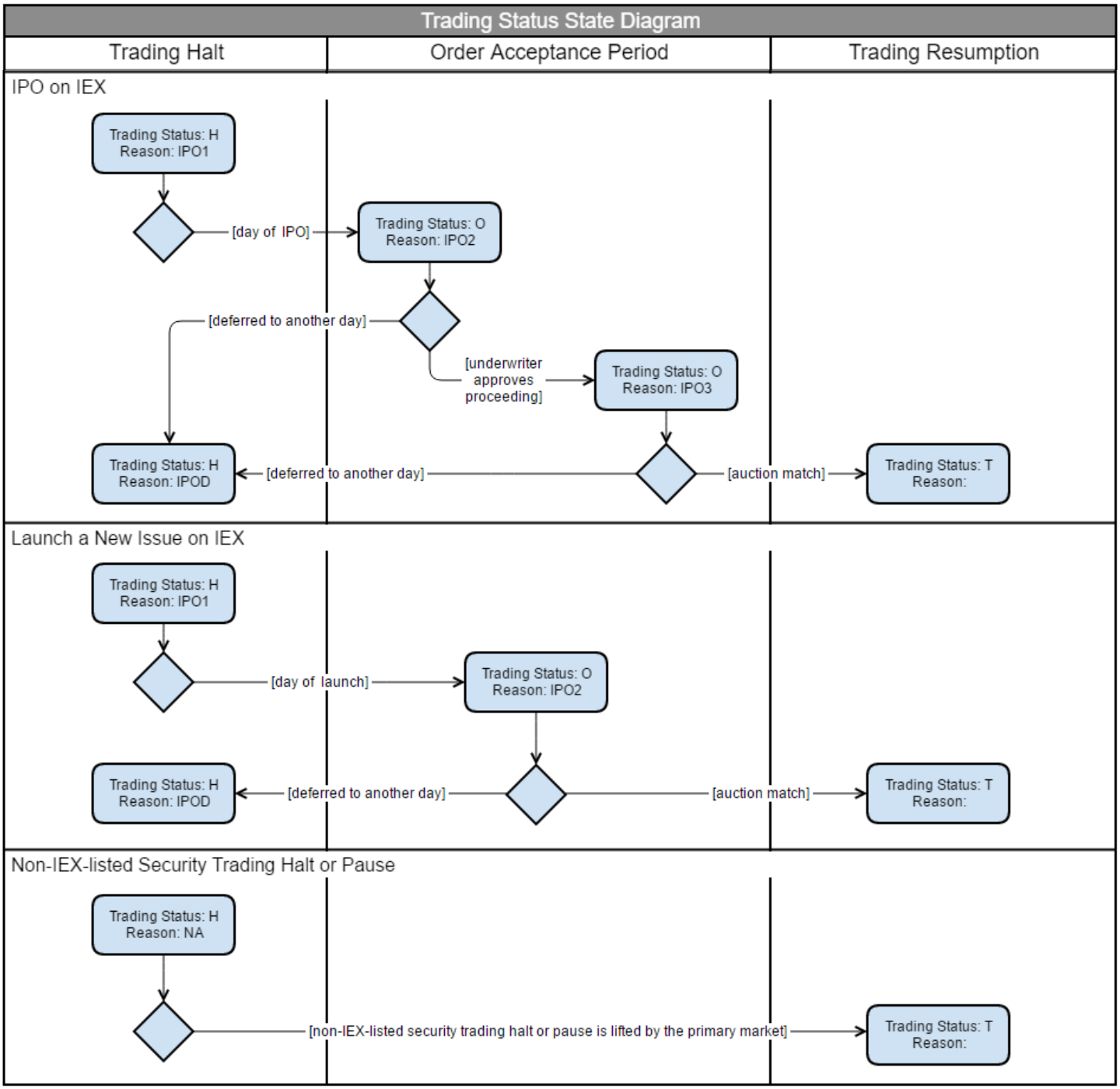

Lower Auction Collar
Upper Auction Collar
B 112-115
Upper Auction Collar
B 116-119
Upper Auction Collar
B 120-123

APPENDIX C: STATE DIAGRAMS

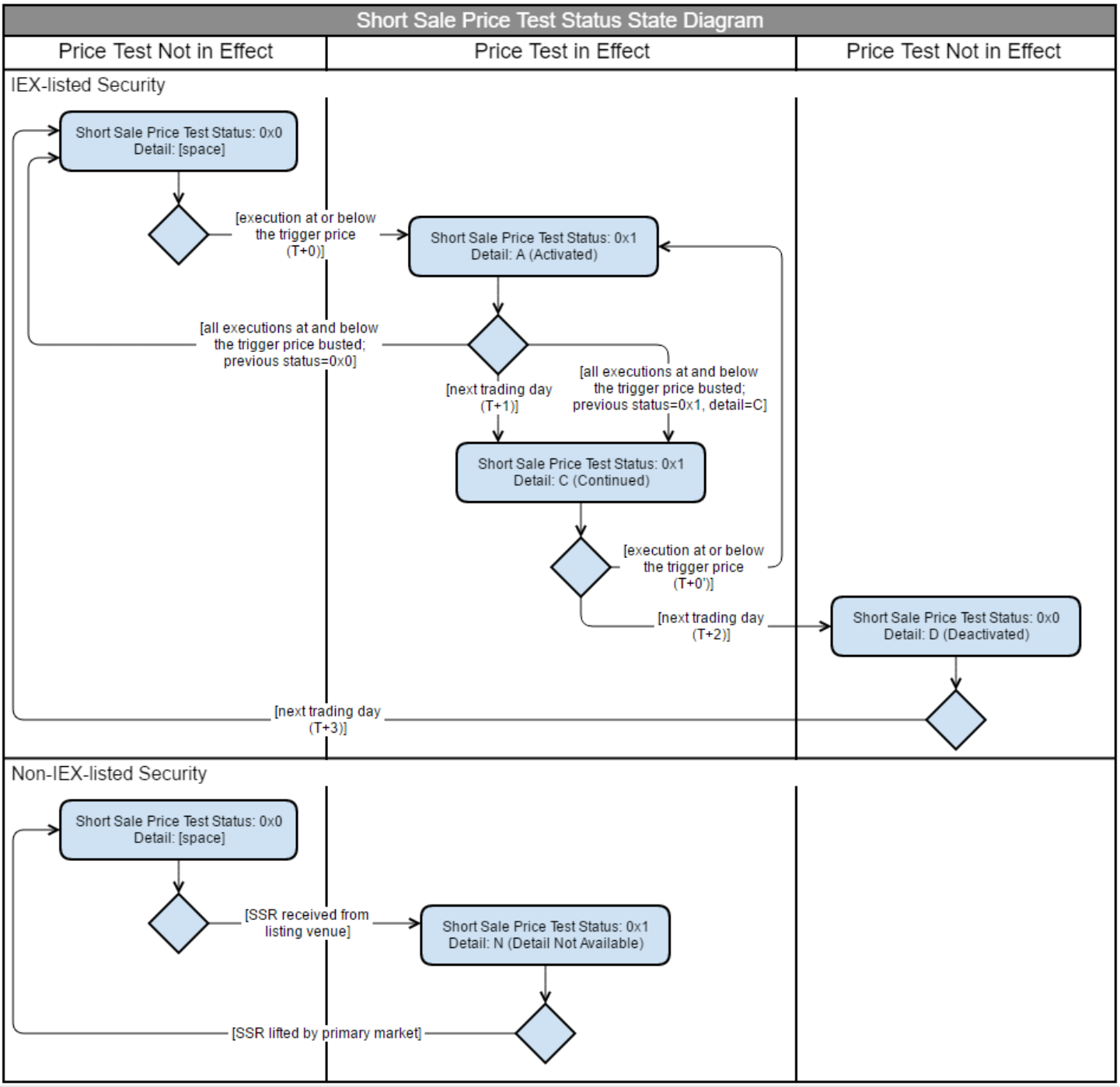
Trading Status Messages



Continues on next page.


Trading Status State Diagram
Trading Halt
Order Acceptance Period
Trading Resumption
IPO on IEX
Trading Status: H
Reason: IPO1
[day of IPO]
Trading Status: O
Reason: IPO2
[deferred to another day]
[underwriter approves proceeding]
Trading Status: O
Reason: IPO3
Trading Status: H
Reason: IPOD
[deferred to another day]
[auction match]
Trading Status: T
Reason:
Launch a New Issue on IEX
Trading Status: H
Reason: IPO1
[day of launch]
Trading Status: O
Reason: IPO2
Trading Status: H
Reason: IPOD
[deferred to another day]
[auction match]
Trading Status: T
Reason:
Non-IEX-listed Security Trading Halt or Pause
Trading Status: H
Reason: NA
[non-IEX-listed security trading halt or pause is lifted by the primary market]
Trading Status: T
Reason:

Short Sale Price Test Status Messages



REVISION HISTORY

Version	Date	Change
1.00	April 19, 2017	Initial document
1.01	April 26, 2017	Identified a case in Timestamp Relationships where the progression of Timestamps between messages having the same Symbol but different Message Type may be expected.
1.02	May 9, 2017	Updated the Source IP Subnets in the Multicast Addresses table. Updated the ITF Gap Fill Server Address Port numbers.
1.03	June 30, 2017	Minor wording change to Trading Status = 'O' (0x4f).
1.04	August 1, 2017	Added sections to detail consuming Price Level Update Messages and updating the IEX BBO. Added clarity to the usage of Collar Reference Price, Lower Auction Collar, and Upper Auction Collar in the Auction Information Message.
1.05	December 20, 2017	Added message type identifier to the headings of each section. Removed IEX Official Opening Price Determination and IEX Official Closing Price Determination sections from the Trade Report Message details, as it was determined to be an incorrect methodology. Added an Official Price Message 'X' (0x58).
1.06	February 27, 2018	Clarified the Reason descriptions in the Trading Status Message to remove NewIssue from IPO1, IPO2, and IPOD. Clarified that a receiver may request an unlimited retransmission via TCP.
1.07	October 5, 2021	Added interim Retail Liquidity Indicator message details with highlights.
1.08	October 19, 2021	Removed interim highlights. Added full support for Retail Liquidity Indicator message and associated details.