

# **NSX Depth of Book Feed Specification**

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## **Introduction**

The purpose of this document is to define the implementation of the DEPTH OF BOOK FEED protocol by the National Stock Exchange, Inc.<sup>sm</sup> (“NSX<sup>sm</sup>”). The National Stock Exchange has implemented the NSX DEPTH OF BOOK FEED, to allow its ETP Holders to receive its book feed. This document provides the layout of the messages and tags, as well as their interpretations for processing within NSX’s BLADE system.

Note - Messages and Tags absent from this document are NOT supported, and if sent will be “Ignored”.

## **NSX DEPTH OF BOOK FEED Certification**

Connectivity and certification to NSX will be performed according to the NSX ETP Holder Certification Specification document.

## **NSX DEPTH OF BOOK BANDWIDTH REQUIREMENTS**

NSX requires clients who subscribe to the Depth of Book feed a minimum bandwidth of 15Mbps. This requirement will ensure performance and efficiency

## ***NSX – Information***

NSX, the nation's first all-electronic stock exchange, is *the* low-cost provider of exchange services and a recognized alternative to the primary markets. NSX provides its ETP Holders with the ability to trade Tape A, B and C listed securities.

## ***Hours of Operation***

The National Stock Exchange allows trading between the hours of 8AM ET and 6:30 PM ET<sup>1</sup>. The DEPTH OF BOOK FEED will be active during these times.

## ***Supported Messages***

This specification differentiates the various message types into 2 categories: Session Level and Application Level. NSX supports the following message types:

### Session Level:

- Heartbeat
  - Client (Inbound)
  - Server (Outbound)
- Login Request (Inbound)
- Login Accepted (Outbound)
- Login Rejected (Outbound)
- Logout (Inbound)

### Application Level:

- Add Order
- Modify Order
  - Order Execution
  - Order Cancel

Note: No other message types are supported.

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<sup>1</sup> All times listed in this specification, unless otherwise indicated, are Eastern Time

## Session Messages

NSX will always serve as the “server” in its DEPTH OF BOOK FEED connections, and expects the ETP Holder’s systems to serve as “clients”. As such, clients will establish connectivity by first sending a Logon Message.

NSX Depth Of Book Feed is a lightweight point-to-point protocol, built on top of TCP/IP sockets that allow delivery of a set of sequenced messages from a server to a client in real-time.

### General Message Format (inbound/outbound)

Client and server communicate by exchanging a series messages delimited by a linefeed character (ASCII 10).

Each message:

- a single byte header which indicates the message type
- a variable length message body
- a terminating linefeed character (ASCII 10 decimal, 0x0A hex).

Message Type 1 char	Message Body Variable length	Delimiter 1 char ASCII 10
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### Message Structure

*Notes:*

Messages will be sent in a continuous sequence regardless of the underlying communication protocol. Messages will not necessarily respect message or message buffer boundaries. Multiple messages may be in one buffer, or a single message may span communication buffers. A message body should not be considered complete until a delimiter is seen.

The Standard Message Header is required on all messages. The table below outlines the Standard Header that NSX will support if received, and expects to be supported if sent.

**Login Request** (inbound)

The client must send a Login Request Message immediately upon establishing a new TCP/IP socket connection to the server.

<b>Login Request Message</b>				
<b>Name</b>	<b>Offset</b>	<b>Len</b>	<b>Value</b>	<b>Notes</b>
Message Type	0	1	"L"	Login Request Message
Username	1	6	Alphanumeric	Username
Password	7	10	Alphanumeric	Password
Requested Session	17	10	Alphanumeric	Specifies the session the client would like to log into, or all blanks to log into the currently active session.
Requested Sequence Number	27	10	Numeric	Specifies the next sequence number the client wants to receive upon connection, or 0 to start receiving the most recently generated message.
Terminating Linefeed	1	1	Linefeed Character	ASCII 10 decimal, 0x0A hex.

**Login Accepted** (outbound)

The NSX server will send a Login Accepted Message in response to receiving a valid Login Request from the client. This message will always be the first non-debug message sent by the server after a successful login request.

<b>Login Accepted Message</b>				
<b>Name</b>	<b>Offset</b>	<b>Len</b>	<b>Value</b>	<b>Notes</b>
Message Type	0	1	"A"	Login Accepted Message.
Session	1	10	Alpha-numeric	The session ID of the session that is now logged into. Left padded with spaces.
Sequence Number	11	10	Numeric	The sequence number of the next Sequenced Message to be sent. Left padded with spaces.
Terminating Linefeed	21	1	Linefeed Character	ASCII 10 decimal, 0x0A hex.

**Login Rejected** (outbound)

The NSX server sends this message in response to an invalid Login Request Message from the client. The server closes the socket connection after sending the Login Reject Message. The Login Rejected Message will be the only non-debug message sent by the server in the case of an unsuccessful login attempt.

<b>Login Reject Message</b>				
<b>Name</b>	<b>Offset</b>	<b>Len</b>	<b>Value</b>	<b>Notes</b>
Message Type	0	1	“J”	Login Rejected Message
Reject Reason Code	1	1	Alpha	Valid Value(s): A – Not Authorized S – Session not available
Terminating Linefeed	2	1	Linefeed Character	ASCII 10 decimal, 0x0A hex.

**Logout** (inbound)

The client may send a Logout Request Message to request the connection be terminated. Upon receiving a Logout Request Message, the server will immediately terminate the connection and close the associated TCP/IP socket.

<b>Logout Request Message</b>				
<b>Name</b>	<b>Offset</b>	<b>Len</b>	<b>Value</b>	<b>Notes</b>
Message Type	0	1	“O”	Logout Request Message
Terminating Linefeed	1	1	Linefeed Character	ASCII 10 decimal, 0x0A hex.

**Server Heartbeat** (outbound)

The server sends a Server Heartbeat Message anytime more than 1 second passes where no data has been sent to the client. The client can then assume that the link is lost if it does not receive anything for an extended period of time.

<b>Server Heartbeat Message</b>				
<b>Name</b>	<b>Offset</b>	<b>Len</b>	<b>Value</b>	<b>Notes</b>
Message Type	0	1	“H”	Server Heartbeat Message.
Terminating Linefeed	1	1	Linefeed Character	ASCII 10 decimal, 0x0A hex.

**Client Heartbeat** (inbound)

The client should send a Client Heartbeat Message anytime more than 1 second passes where no data has been sent to the server. The server can then assume that the link is lost if it does not receive anything for an extended period of time.

<b>Server Heartbeat Message</b>				
<b>Name</b>	<b>Offset</b>	<b>Len</b>	<b>Value</b>	<b>Notes</b>
Message Type	0	1	“R”	Server Heartbeat Message.
Terminating Linefeed	1	1	Linefeed Character	ASCII 10 decimal, 0x0A hex.

**Application Messages**

The DEPTH OF BOOK FEED distributor will send messages that will allow receivers to create their copy of the NSX book. The DEPTH OF BOOK FEED messages will be sent real-time to identify orders being added to the book, including odd-lot orders. Orders not entered into the book will not be reported, e.g., Market Orders.

The general rule of thumb is that each order in the book will generate at least 2 DEPTH OF BOOK FEED messages: the initial add, and at least 1 execution or cancel. An “Add” order will receive 1 “Execute” message for each contra party that the order executed against. If an order in the book is cancel replaced, then a cancel will be sent for the open shares, and an add for the new open quantity. Note: if the replace quantity is less than or equal to the previously executed quantity, then only a cancel will be sent, as the order will no longer have any open shares.

**Sequenced Data Message** (outbound)

The Sequenced Data Message acts as a wrapper to carry the true sequenced data messages (Application / DEPTH OF BOOK FEED messages) that are transferred from the server to the client. Each Sequenced Data Message carries one message from the higher-level protocol. The sequence number of each message is implied; the starting sequence number of the first Sequenced Data Message for a given TCP/IP connection is specified in the Login Accepted Message and the sequence number increments by 1 for each Sequenced Data Message transmitted.

In the case of connection failure, the client can reconnect to the server and request the next expected sequence number and pick up where it left off.

<b>Sequenced Data Message</b>				
<b>Name</b>	<b>Offset</b>	<b>Len</b>	<b>Value</b>	<b>Notes</b>
Message Type	0	1	“S”	Sequenced Data Message.
Message	1	Variable	Alpha-numeric	Defined by a higher-level protocol, but must not contain any embedded linefeeds. A Message with zero length is a special End of Session marker that indicates that there are no more messages available in this session.
Terminating Linefeed	Payload Len+1	1	Linefeed Character	ASCII 10 decimal, 0x0A hex.

**Add Order Message** (outbound)

An Add Order Message indicates that a new order has been accepted by the NSX system and added onto the displayable book. It includes a unique Order Reference Number assigned by NSX to the order.

**Important Note:**

Order Reference Number – is sent as a Base 36 representation of a long integer, and the method of base 36 is defined as 0-9 then A-Z (case is insensitive).

<b>Add Order Message</b>				
<b>Name</b>	<b>Offset</b>	<b>Len</b>	<b>Value</b>	<b>Notes</b>
Time Stamp	0	8	Numeric	Time Stamp.
Message Type	8	1	“A”	Add Order Message.
Order Reference Number	9	9	Numeric	The unique reference number assigned to this new order. Increasing, but not necessarily sequential.
Buy/Sell Indicator	18	1	Alpha	“B” = buy order. “S” = sell order.
Shares	19	6	Numeric	Total number of shares being added to the book (may be less than the number of shares entered).
Stock	25	6	Alpha	Stock symbol right side padded with spaces.
Price	31	10	Price	The limit price of the order, left side padded with spaces; last 4 digits represent the decimal portion.
Display	41	1	Alpha	“Y” - All orders are displayed - Default. “A” -

				ETP Holder Attribution.
Client Attribution	42	4	Alpha-Numeric	Represents the MPID of the ETP Holder; or 4 spaces if ETP Holder is anonymous. By default, all ETP Holders are anonymous.

**Order Cancel** (outbound)

This message is sent whenever an order on the book is modified as a result of being canceled in whole or in part.

<b>Order Cancel Message</b>				
<b>Name</b>	<b>Offset</b>	<b>Len</b>	<b>Value</b>	<b>Notes</b>
Time Stamp	0	8	Numeric	Time Stamp.
Message Type	8	1	"X"	Order Cancel Message.
Order Reference Number	9	9	Numeric	The reference number of the order being canceled or reduced. References a previously sent Add Order Message.
Canceled Shares	18	6	Numeric	The number of shares canceled.

**Order Execution** (outbound)

This message is sent whenever an order on the book is executed in whole or in part. The execution price is always equal to the limit price of the order as indicated in the Add Order Message.

<b>Order Execution Message</b>				
<b>Name</b>	<b>Offset</b>	<b>Len</b>	<b>Value</b>	<b>Notes</b>
Time Stamp	0	8	Numeric	Time Stamp.
Message Type	8	1	"E"	Order Executed Message.
Order Reference Number	9	9	Numeric	The reference number of the order that was executed. References a previously sent Add Order Message.
Executed Shares	18	6	Numeric	The number of shares executed.
Match Number	24	9	Numeric	The NSX generated day-unique Match Number of this execution.

**Appendix 1 – Symbology****NASDAQ Listed Securities**

## NSX Mapping of Tape-C 5th-Character Modifiers

Security Categorization	Tape-C Integrated Platform suffix symbology
Called	*
Class "A" when issued	.A#
Class "A" Called	.A*
Class "A"*	.A
Class "B"*	.B
Class Convertible	.A%
Convertible bond	%
Convertible called	%*
Emerging Company Marketplace	!
Partial Paid	@
Preferred	-
Preferred (class A) Convertible	-A%
Preferred (class A) when Distributed	-A\$
Preferred "A" called	-A*
Preferred "A" when issued	-A#
Preferred called	-*
Preferred Class "A"	-A
Preferred Class "B"	-B
Preferred when distributed	-\$
Preferred when issued	-#
Rights	^
Rights when issued	^#
TEST symbol	~
Units	=
Warrants	+
Warrants Class "A"	+A
Warrants Class "B"	+B
Warrant when issued	+#
When distributed	\$
When issued	#

## NYSE and AMEX Listed Securities

The following symbol suffixes are used to identify the security type.

Security Categorization	Suffix Symbology
Preferred	p
Preferred Class "A"	pA
Preferred Class "B"	pB
Class "A"	/A
Class "B"	/B
Preferred when distributed	p/WD
When distributed	/WD
Warrants	/WS
Warrants Class "A"	/WS/A
Warrants Class "B"	/WS/B
Called	/CL
Class "A" Called	/A/CL
Preferred called	p/CL
Preferred "A" called	pA/CL
Preferred "A" when issued	pAw
Emerging Company Marketplace	/EC
Partial Paid	/PP
Convertible called	/CV/CL
Rights	r
Units	/U
When issued	w
Rights when issued	rw
Preferred when issued	pw
Class "A" when issued	/Aw
Warrant when issued	/WSw