Nasdaq Fixed Income Depth Lite

ITCH Book Level Protocol Specification

Revision 1.03
09 Feb 2020

Document History

Revision	Published	Summary of Changes
0.01	02/22/2019	Initial Proposal
0.02	03/04/2019	Added full book update, discretion and conflation description
0.03	03/07/2019	Added Volume message Added capability and description to conflate discretion orders into normal price levels.
0.04	04/02/2019	Removed Full Book Update Discretion counts as a price level, and the customer is responsible for maintaining the proper number of levels and discarding levels below what is specified
0.05	04/25/2019	Enhanced representation of repeating number of depth records Added Appendix A to address examples of Book Update Messages
1.00	06/10/2019	Provided further explanation on Trade messages concerning dark and discretion trades Added information on processing an update message in the depth order received
1.01	06/17/2019	Addition of Yield field added to P-Message Added information to address Glimpse Recover and Login
1.02	1/17/2019	Inclusion of 20Y security sector in issues as benchmark field
1.03	02/09/2020	Removed Discretion. Single-Field Price representation

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1 Overview

Nasdaq Fixed Income Treasury Book Level is an outbound-only direct data feed product, which does not support order entry. The Book Level feed contains data describing book level information and trade volumes that occur on the Nasdaq Fixed Income (NFI) US Treasury alternative trading system (ATS or System) and features the following data elements:

- **Reference Data** – Order book directory messages provide basic security data such as CUSIP, maturity, and coupon rate.
- **Event controls** – such as start of day, end of day, halts and market holidays
- **Book level messages** – Up to X levels of order book depth are published through a series of book level messages. Book level messages offer a combination of incremental updates and periodic full-depth updates so that customers can join the feed at any time.
- **Trade messages** – Trade messages will be used to update traded size.
- **Indicative messages** – Indicative messages will be used for reference data updates and low/high/open… indications and indicative pricing.

2 Architecture

The Book Level feed consists of a series of sequenced messages, each variable in length based on the message type. The messages are typically delivered by a lower level transport protocol that provides sequencing and delivery guarantees.

Nasdaq Fixed Income Treasury offers the Book Level data feed over SoupBin transport.

Nasdaq Fixed Income Treasury also offers Glimpse functionality for Book Level data to facilitate the retrieval of directory information in the middle of the session without replaying all messages for the session from the start of day. The Glimpse connection enables a user to get enough information to be current with the live stream. This is facilitated over a separate TCP Soupbin connection.

3 Data Types

All numeric fields are unsigned integers encoded in network order (big-endian) unless otherwise specified. All alpha fields are left justified and padded on the right with spaces.

Data Type	Size	Description
Alpha	Variable	Left justified and right padded
Numeric	1,2,4 or 8 bytes	Unsigned integer (unless otherwise specified) encoded in network order
Price	4 or 8 bytes	Signed integer encoded in network order supplied with an associated precision. The number of decimals is specified in the order book directory message.
Date	4 bytes	Unsigned integer encoded in network order. The value of the field is (year*10000) + (month*100) + day.YYYYMMDD

4 Message Formats

4.1 Timestamp – Nanoseconds

Timestamps will be sent in a nanosecond field inside the messages.

Timestamp	Message Type	Notes
Nanoseconds	Field within individual messages	Unix time (number of nanoseconds since 1970- 01-01 00:00:00 UTC). Timestamp will be represented in an 8-byte field with: 4 most significant bytes – seconds since Epoch 4 least significant bytes – nanos within second

4.2 Reference Data Messages

4.2.1 Order Book Directory (R)

At the start of each trading day, order book directory messages are sent for all active US Treasury securities in the ATS. Order book directory messages may also be sent intraday when existing securities are modified or new securities are added.

ORDER BOOK DIRECTORY (R)				
Name	**Offset**	**Length**	**Value**	**Notes**
Message Type	0	1	"R"	Order Book Directory Message
Timestamp - Nanoseconds	1	8	Numeric	Timestamp
Order book ID	9	4	Numeric	Unique identifier of an Order book. This identifier will stay constant until this security is no longer tradable.
Symbol	13	20	Alpha	Security symbol in the NFI ATS (e.g. 10Y_UST)
Security Description	33	16	Alpha	Instrument Description
CUSIP	49	9	Alpha	CUSIP code identifying security
Reserved	58	1	Numeric	Reserved
Product	59	1	Numeric	Values: 1 = US Treasury (Notes and Bonds) 2 = US Treasury Bills 3 = Reserved 4 = TIPS
Product Subtype	60	1	Numeric	Values: 1 = Benchmark 2 = Off-the-Run 3 = WI

Price Type	61	1	Alpha	Indicates "D" ('per unit' price type) • The security of this type trades as a percentage of par. The number of decimal places in the price is specified by the "Price Decimals" field. "Y" (price as percentage) • The security of this type trades in Yield. The number of decimal places in the price is specified by the "Price Decimals" field. "B" (Yield Spread) • The security of this type trades in basis points. The spread is specified by the "Price Decimals" field.
Price Decimals	62	2	Numeric	The number of decimals used in price or yield for this order book in NFI ATS.
Yield Decimals	64	2	Numeric	For securities that do not trade in Yield but will have yield published, this field describes number of decimals for yield field. If Yield Decimals is set to -1 then Yield field should be ignored in all messages for this security.
Coupon Decimals	66	2	Numeric	The number of decimals used in the Coupon field. If Coupon is not used, this field will be set to -1.
Quantity Multiplier	68	4	Numeric	The value used to derive the actual quantity represented in the respective size fields. NOTE: This value will be noted in actual size such as 1,000,000. Some previous market data protocols used 1 to represent 1,000,000.
Reserved	72	2	Numeric	Reserved
Maturity	74	4	Numeric	Maturity date
Coupon	78	4	Numeric	Coupon Rate
Dated Date	82	4	Numeric	Dated Date
Issue Date	86	4	Numeric	Issue Date
Auction Date	90	4	Numeric	Auction Date
Announcement Date	94	4	Numeric	Announcement Date
First Coupon Date	98	4	Numeric	First Coupon Date
Settlement Date	102	4	Numeric	Settlement Date
Index	106	4	Numeric	Index Reference Rate
Spread	110	4	Numeric	Spread Rate
Trading Features	114	2	Numeric	2 Byte field specifying features supported by this security. Supported features are represented by the corresponding bit being set. Bits in hex: 0x0001 – Reserved 0x0004 - indicative markets supported 0x0008 – Reserved 0x8000 – Test security 0x4000 – Non-tradable security
Minimum Entry Quantity	116	4	Numeric	The minimum visible quantity of the order allowed to be added to the book.
Minimum Quantity Increment	120	4	Numeric	The minimum increment for visible quantity of the order.

Issued as Benchmark	124	2	Numeric	For instruments initially issued as: 102 – 2Y 103 – 3Y 105 – 5Y 107 – 7Y 110 – 10Y 120 – 20Y 130 – 30Y 1 – 1M 2 – 2M 3 – 3M 6 – 6M 12 – 12M
Book Price Levels	126	1	Numeric	Maximum number of price levels to be published for this book. If a price level's priority exceeds this value as a result of the addition of new data, the client should discard it.
Price Tick Size	127	8	Numeric	The price tick for the instrument

4.2.2 Combination Order Book Directory (M)

The Combination Order Book Directory is a specialized directory message used when Combined order books are traded on the NFI ATS. It represents standard combinations defined by NFI, and may be used to represent customized strategies created by subscribers in the future.

Note: Intraday transmissions of this message can occur when new combination order books are added to the system. This would typically the case for customized combinations. When key field values such as ratios need to be updated subject to market conditions, this message will also be sent during the trading session when needed. Updates to existing combination order books may also be indicated by intraday Combination Order Book Directory messages.

COMBINATION ORDER BOOK DIRECTORY (M)				
Name	**Offset**	**Length**	**Value**	**Notes**
Message Type	0	1	"M"	Combination Order Book Directory Message
Timestamp - Nanoseconds	1	8	Numeric	Timestamp
Order book ID	9	4	Numeric	Unique identifier of an Order book. This identifier will stay constant until the security is no longer tradable.
Symbol	13	20	Alpha	UST security symbol in the NFI ATS
Security Description	33	16	Alpha	Instrument Description
CUSIP	49	9	Alpha	Where applicable
Reserved	58	1	Numeric	Reserved
Product	59	1	Numeric	Values: 1 = US Treasury Coupon Roll 2 = US Treasury Bill Roll 3 = Reserved 4 = TIPS Roll 5 = Reserved 6 = Curve / Butterflies
Price Type	60	1	Alpha	Indicates "D" ('per unit' price type) • The security of this type trades as a percentage of par. The number of decimal places in the price is specified by the "Price Decimals" field. "Y" (price as percentage) • The security of this type trades Yield. The number of decimal places in the price is specified by the "Price Decimals" field. "B" (Yield Spread) • The security of this type trades in basis points. The spread is specified by the "Price Decimals" field.
Price Decimals	61	2	Numeric	The number of decimals used in price or yield or spread for this order book in NFI system.
Yield Decimals	63	2	Numeric	For securities that do not trade in Yield but will have yield published, this field describes number of decimals for yield field. If Yield Decimals is set to -1, then Yield field should be ignored in all messages for this security.
Quantity Multiplier	65	4	Numeric	The value used to derive the actual quantity represented in the respective size fields. NOTE: This value will be noted in actual size such as 1,000,000. Some previous market data protocols used 1 to represent 1,000,000.
Book Price Levels	69	1	Numeric	Maximum number of price levels to be published for this book. If a price level's priority exceeds this value as a result of the addition of new data, the client should discard it.
Reserved	70	17	Numeric	Reserved

Number of Legs	87	1	Numeric	Number of legs for the strategy
Leg 1, Symbol	88	20	Alpha	Leg Symbol
Leg 1, Side	108	1	Alpha	Values: B = As Defined C = Opposite
Leg 1, DV01	109	2	Numeric	DV01 value of leg 1
Reserved	111	1	Numeric	Reserved
Leg 2, Symbol	112	20	Alpha	Leg Symbol
Leg 2, Side	132	1	Alpha	Values: B = As Defined C = Opposite
Leg 2, DV01	133	2	Numeric	DV01 value for leg 2
Reserved	135	1	Numeric	Reserved
Leg Ratio 1	136	2	Numeric	Leg ratio used for implied trading derived from DV01 values
Leg 3, Symbol	138	20	Alpha	Leg Symbol
Leg 3, Side	158	1	Alpha	Values: B = As Defined C = Opposite
Leg 3, DV01	159	2	Numeric	DV01 value of leg 3
Reserved	161	1	Numeric	Reserved
Leg Ratio 2	162	2	Numeric	The ratio used for implied trading that is applied for 3 leg combination instrument
Maximum Spread Tolerance 1	164	2	Numeric	The maximum spread defined for the short duration leg
Maximum Spread Tolerance 2	166	2	Numeric	The maximum spread defined for the middle duration leg
Trading Features	168	2	Numeric	2 Byte field specifying features supported by this security. Supported features are represented by the corresponding bit being set. Bits in hex: 0x0001 - Reserved 0x0002 - Security supports implied trading through legs. 0x0004 - Indicative markets supported 0x0008 - Reserved 0x8000 -Test Security 0x4000 -Non-tradable security
Minimum Entry Quantity	170	4	Numeric	The minimum visible quantity of the order allowed to be added to the book.
Minimum Quantity Increment	174	4	Numeric	The minimum increment for visible quantity of the order.
Price Tick Size	178	8	Numeric	The price tick for the instrument.
Reserved	186	14	Numeric	Reserved

4.3 Event and State Change Message

4.3.1 System Event Message (S)

The system event message type is used to signal a market or data feed handler event. The format is as follows:

SYSTEM EVENT MESSAGE (S)				
Name	**Offset**	**Length**	**Value**	**Notes**
Message Type	0	1	"S"	System Event Message
Timestamp	1	8	Numeric	Timestamp
Reserved	9	1	Numeric	Reserved
Event Code	10	1	Alpha	See System Event Codes below.
Event Reason	11	1	Alpha	Please see the System Event Reason Table
Order book ID	12	4	Numeric	Used to identify if the event applies to a single order book within the Trading System. Order book Code set to 0 if the event applies at a System level.

The system supports the following event codes on a daily basis on the data feed.

SYSTEM EVENT CODES – DAILY	
Code	**Explanation**
"O"	*Start of Messages.* Outside of time stamp messages, the start of day message is the first message sent in any trading day. This indicates the System is enabled.
"Q"	*Start of Trading Session hours*. This message is intended to indicate that NFI trading system is open and ready to trade
"M"	*End of Trading Session hours*. This message is intended to indicate that NFI trading session is closed and no orders are available for execution.
"C"	*End of Messages*. This is always the last message sent in any trading day. This indicates the system is disabled.

SYSTEM EVENT REASON	
Reason	**Explanation**
"I"	*Accepting/Holiday session starts.* This is applicable to Japan holidays
"A"	*Break.* This is applicable to potential breaks including UK Holidays
"B"	*Resumption after Break.* This is applicable potential breaks and resumptions including UK holidays
"H"	*Early Close. This indicates an early closing time for the ATS*
"R"	Regular start of the day or end of the day.

4.3.2 Order Book State Message (O)

The Order book state message relays information on state changes

ORDER BOOK STATE MESSAGE (O)				
Name	**Offset**	**Length**	**Value**	**Notes**
Message Type	0	1	"O"	Order book State Message.
Timestamp – Nanoseconds	1	8	Numeric	Timestamp
Order Book ID	9	4	Numeric	Order book identifier
Security Event Code	13	1	Alpha	See Security Event Code below

The order book supports the following event codes on a daily basis on the data feed.

SECURITY EVENT CODES – DAILY	
Code	**Explanation**
"O"	*Security is enabled for trading – enabled by default.*
"M"	*Security is disabled for trading* and will be reset with new directory message.
"H"	*Security is halted.*

4.4 Book Depth Update Message (U)

This message is used to send information regarding any of the top N price levels on each side of the order book, with N defined for a given instrument by the "Price Book Levels" field of its "R" or "M" directory message. The "U" message may contain multiple repeating items, each of which updates one side of one price level. All repeating items within the message relate to the same symbol. This feed will show the top N price levels of the book based on how many levels are configured for the instrument.

NFI will represent top of book price as level 1, next best price as level 2 and so on.

The client should discard every level past level N after the book update has been processed. NFI will not explicitly delete these levels; their removal is implied. For instance, the addition of a new top bid level will result in a single message:

- New bid level 1

Implied here is that all pre-existing bid levels will be pushed down one price level. Hence what exist as bid level 1 becomes bid level 2 so on and so forth. When processing this level adjustment, any bid level past N should be discarded.

When the "U" message is processed in its entirety it represents a consistent book state for specified transaction.

Every Update Action included in the "U" message must be processed and applied to the book in the order it is received. The Price level in every Update Action is dependent on this order. As an example, the removal of top two price levels will result in a "U" message with 2 actions:

- Delete level 1
- Delete level 1

Processing of first Update Action to delete level 1 will result in level 2 becoming new level 1. Thus the next Update Action refers to it as level 1 also.

The "U" message should be processed in its entirety to represent new book state. Partial processing of the message will result in inconsistent book state at best and in erroneous, potentially crossed book in the worst case.

4.4.1 Usage

Update Action "N" – New Price Level

When a new price level is created in the order book, a Depth Incremental message is sent with "Update Action" set to "N" (New). This indicates:

- The new price level information is to be inserted at the level specified in the message.
- All existing rows in the order book at this level or lower are to be pushed down.
- There is no explicit instruction to delete the bottom price level (defined in the instrument's "R" or "M" directory message) when inserting a new price level. The price level that falls below the maximum number of price levels for this instrument should be deleted.

The field “Price Level” is used to identify which price level is to be inserted. In the specific case where the “Price Level” is set to 1:

- The Price level is to be inserted at the top of the appropriate bid or offer stack,
- As a sanity check, the client should check that there are no prices better than this price level, and if any exist then they should be deleted. Note this condition would generally indicate that the client has mishandled an earlier message, and should not present itself in normal operation.

Update Action “C” – Change Price Level

If a Depth Incremental message is sent with “Update Action” set to “C” (Change), this indicates:

- All fields for the existing side and price level specified should be updated according to the message contents
- No information for any other price level should be altered.

Update Action “D” – Delete Price Level

If a Depth Incremental message is sent with “Update Action” set to “D” (Delete), this indicates:

- The indicated price Level is to be deleted.
- All lower (worse) price levels move up.

Update Action “F” – Delete From Price Level

When a Depth Incremental message is sent with “Update Action” set to “F” (Delete From), this indicates:

- All price levels starting at the indicated price level are to be deleted.
- Note that if the Price Level is set to 1, this message will clear the book on one side.

Examples of how this message is to be processed are provided in “Appendix A – Depth Incremental Message Examples” in this specification.

4.4.2 Message Specification (U)

This message will be generated by the NFI ATS.

NOTE: Quantity, Order Count, Price, and Yield are not present for update actions set to “D” and “F”.

BOOK DEPTH UPDATE MESSAGE (U)					
	Name	**Offset**	**Length**	**Value**	**Notes**
	Message Type	0	1	“U”	Book Depth Update
	Timestamp – Nanoseconds	1	8	Numeric	Timestamp
	Order book ID	9	4	Numeric	Unique Order book identifier of an instrument
	Transaction ID	13	4	Numeric	Last Transaction ID corresponding to the transaction ID for last request included in this update.
	Number of depth records	17	1	Numeric	The number of Update Action updates included in this message (as repeating group)
Repeated Number of Depth Records Fields	Update Action	18	1	Alpha	The type of action. Values: “N” = New Level “C” = Change Level “D” = Delete Level “F” = Delete From
	Side	19	1	Alpha	The type of level. Values: “B” = Buy order “S” = Sell order
	Level	20	1	Numeric	The numeric order of the price level where 1 is the best price level.
	Quantity	21	4 or 0	Numeric	The visible quantity available at this price level.
	Order Count	25	4 or 0	Numeric	Number of visible orders on this level representing above quantity.
	Price	29	8 or 0	Price	The display price of this level. Note: Negative value is supported for spread trades and instruments trading in yield
	Yield	37	4 or 0	Price	The display yield of this level. Optional field. If Yield Decimals was set to -1 then this field should be ignored.

4.5 Trade Messages

4.5.1 Trade Publish Message (P)

The Trade Publish Message provides execution details for traded volume on a given instrument, and updates total traded volume from start of the day. There is no distinction for dark trades in this feed.

Some dark trades will be published on this stream with all like dark trades in a trade sweep combined.

Other non-visible order types which execute will also be published on this stream with all of these trades in a trade sweep combined with visible trades at the same price level.

TRADE PUBLISH MESSAGE (P)				
Name	**Offset**	**Length**	**Value**	**Notes**
Message Type	0	1	"P"	Trade Publish Message
Timestamp - Nanoseconds	1	8	Numeric	Timestamp
Order book ID	9	4	Numeric	Unique Order book identifier
Transaction ID	13	4	Numeric	Transaction ID corresponding to the transaction ID of the last request included in this update.
Executed Quantity	17	4	Numeric	The quantity executed since the previous update.
Total volume traded	21	4	Numeric	Total volume traded since start of trading session
Trade Price	25	8	Price	The most recent execution price. Value is set to 0 for instruments with delayed updates.
Trade Flag	33	1	Numeric	0x01 - Delayed Update (Real time if not set)
Trade Yield	34	4	Price	The yield corresponding to the trade price. Value is set to 0 for instruments with delayed updates. If Yield Decimals was set to -1 then this field should be ignored.

4.5.2 Volume Message (V)

This message will publish daily volume information and traded price information. This message will be sent out in the following cases:

- After first price for the day. This is the only time when Open Price and Open Yield will be set. It will remain the same for the rest of the day. On first trade all prices will be set to the same value.
- Every time trade occurs that sets new high for the day.
- Every time trade occurs that sets new low for the day.

It will be sent out with a Transaction ID matching that of the most recent transaction for the designated order book to indicate that it provides information up to that point.

VOLUME MESSAGE (V)				
Name	**Offset**	**Length**	**Value**	**Notes**
Message Type	0	1	"V"	Volume/Traded Price notification
Timestamp - Nanoseconds	1	8	Numeric	Timestamp
Order book ID	9	4	Numeric	Unique Order book identifier
Transaction ID	13	4	Numeric	Transaction ID of the last request included in this update.
Volume	17	4	Numeric	Volume traded during this session up to this snapshot including hidden transactions. If volume is zero then Last/High/Low/Open should be ignored.
Open Price	21	8	Price	First Trade price of the day.
Open Yield	29	4	Price	The yield for Open price. Optional field. If Yield Decimals was set to -1 then this field should be ignored.
High Price	23	8	Price	High Price of the day.
High Yield	41	4	Price	The yield for High price. Optional field. If Yield Decimals was set to -1 then this field should be ignored.
Low Price	45	8	Price	Low Price of the day.
Low Yield	53	4	Price	The yield for Low price. Optional field. If Yield Decimals was set to -1 then this field should be ignored.
Last Price	57	8	Price	The most recent execution price.
Last Yield	65	4	Price	The yield for the Last Price. Optional field. If Yield Decimals was set to -1 then this field should be ignored.

4.6 Indicative Pricing Message (Q)

This message will publish closing and reference prices throughout the day, and it may also be used to provide implied pricing for curve trading in the future. It may be updated periodically through a trading session as needed.

This message will not be repeated, but it can be re-captured using Glimpse. The previous close price will not be republished multiple times.

INDICATIVE PRICING MESSAGE (Q)				
Name	**Offset**	**Length**	**Value**	**Notes**
Message Type	0	1	"Q"	Indicative pricing Message
Timestamp – Nanoseconds	1	8	Numeric	Timestamp
Order book ID	9	4	Numeric	Unique Order book identifier of an instrument
Price	13	8	Price	The indicative price for the designated order book, according to the type designated below
Yield	21	4	Price	The yield for indicative price. Optional field. If Yield Decimals was set to -1 then this field should be ignored.
Type	25	2	Alpha	Indicate indicative price type. : "0B" = Bid "0A" = Ask "0P" = Indic Previous Close "0T" = Indic Asia Close (02:00 EST) "0L" = Indic London Close (11:00 EST) "0N" = Indic NY Close (15:00 EST) "XB" = Remove Indicative Bid "XA" = Remove Indicative Ask

5 Update Processing

5.1 Data Conflation

Book level updates may be set to be conflated by the ATS, in which case not every order update will result in a new message being generated. In general, depending on the overall system configuration and a given security's configuration, the following describes conflation rules:

- Updates will be sent on a periodic basis if the top-level prices for the security have changed
- Size updates for levels below 1 will be conflated.
- Price changes for levels below 1 will generally be conflated.
- Price changes to level 1 will always be published.
- In general, individual size changes to level 1 will be published. Nasdaq reserves the right to conflate these updates depending on bandwidth restrictions and materiality of changes.
- Multiple executions for the same transaction will be conflated into a single execution update unless multiple price levels are traded.

6 Glimpse for Depth Lite Feed

6.1 Recovery/Intraday Connection

The NFI Depth Lite market data feed has a mechanism for out-of-band recovery: NFI Glimpse Depth Lite. Glimpse is a point to point connection that provides direct data feed customers with a snapshot of the current state of the order books of the market data feed they are receiving. In this instance the NFI Depth Light order books. Glimpse for Depth Lite uses the same message format as NFI Depth Light. The Glimpse connection is established through a separate port connection than NFI Depth Lite. Connecting to Glimpse intraday obtains a snapshot of;

- Basic reference data for each order book including intra-day updates up until the time of login.
- Current trading state of each order book.
- All displayable levels for each order book.
- An End of Snapshot message providing the Depth Lite sequence number to use.

The snapshot of the live stream is taken at the point in time when the user connects and logs in to Glimpse. The snapshot is tagged with a sequence number, the point which one can listen to the live stream.

6.2 Login Request Packet (L)

The Login Request Packet is of the exact same structure as referenced in the SoupBinTCP document made available to users. Please note that Glimpse users must login to SoupBinTCP with Requested Sequence Number set 1 to correctly receive data and that Requested Sequence Number field is in ASCII format with left padded spaces.

LOGIN REQUEST PACKET (L)				
Name	**Offset**	**Length**	**Value**	**Notes**
Message Type	0	2	Numeric	Number of bytes after this field until next packet.
Message Type	2	1	"L"	Login Request Packet
Username	3	6	Alpha	Username padded with spaces on the right for a specified total length.
Password	9	10	Alpha	Password padded with spaces on the right for a specified total length.
Requested Session	19	10	Alpha	Specifies the session the client would like to log into, or all blanks to log into the currently active session. Padded with spaces on the left for a specified total length.
Requested Sequence Number	29	20	Numeric	Must be set to sequence 1 padded with spaces on the left for specified total length when logging into Glimpse. This field is to be populated using ASCII characters.

6.3 End of Snapshot Message (G)

The end of snapshot message reflects the NFI Depth Lite sequence number at the time when the GLIMPSE spin was requested (logged in to the Soup connection).

To maintain an up to date book level display, clients should begin to process NFI Depth Lite messages following the sequence number stated in this snapshot message.

END OF SNAPSHOT MESSEGE (G)				
Name	**Offset**	**Length**	**Value**	**Notes**
Message Type	0	1	"G"	End of Snapshot message.
Sequence Number	1	20	Numeric	NFI Depth Lite sequence number in ASCII format right-justified when the NFI Glimpse Depth Lite snapshot was taken. To keep the order book current, client should process the NFI Depth Lite messages following the message sequence number reflected in this snapshot message.

Appendix A – Book Depth Update Message Examples

A.1 – Price Level Adjustments (New Update, Change Update and Conflation)

Example 1:

For this example, assume NFI is configured to publish up to **Book Level 3** for a given instrument (shown in the order book's R Directory message).

1) New BID Order is entered at price 1000078125000 (100-00 1/4) for 10
➔ NFI will publish New price level 1 with price 1000078125000, quantity 10 and order count 1

2) New BID Order is entered at price 1000156250000 (100-00 1/2) for 2M
➔ NFI will publish New price level 1 with price 1000156250000, quantity 2 and order count 1
➔ NOTE: The existing 1000078125000 bid should move to level 2

3) New BID Order is entered at price 1000000000000 (100-00) for 7M
➔ NFI will publish New price level 3 with price 1000000000000, quantity 7 and order count 1

4) New BID Order is entered at price 1000000000000 (100-00) for 13M
➔ NFI may conflate this update into the next incremental message

5) New BID Order is entered at price 1000078125000 (100-00 1/4) for 8M
➔ NFI may conflate this update into the next incremental message

6) Conflation time arrives, i.e. the next incremental message is sent:
➔ NFI will publish a message with 2 update records, and update records count set to 2
    ➔ Update to price level 2 with price 1000078125000, quantity 18 and order count 2
    ➔ Update to price level 3 with price 1000000000000, quantity 20 and order count 2

7) New BID Order is entered at price 1000234375000 (100-00 3/4) for 5M
➔ NFI will publish a message with 1 update record, and update records count set to 1
    ➔ New price level 1 with price 1000234375000, quantity 5 and order count 1
    ➔ NOTE: The existing 1000156250000 bid at level 1 should move to level 2 and the existing 1000078125000 bid at level 2 should move to level 3.
    ➔ The 1000000000000 bids should be dropped from tracking. That bid may still exist in the NFI ATS order book, but the Book Level Data Feed will no longer track it, since its price level is now greater than 3.

A.2 – Update Action = New Level

The orderbookID described in the scenario from example 1 leaves us with the present state of book below:

Book State 1: State of order book after steps in example 1

OrderBookID = 123456789						
BID				ASK		
Level	Price	Yield	Size	Price	Yield	Size
1	100-006	2.119	5			
2	100-00+	2.121	2			
3	100-002	2.212	18			

Example 2:

A new book update message comes in which consist of;

- A new ASK(Sell) price level 1 at price 25614 (100-01 3/4) for 12M

Notes;

- The empty Ask(Offer) side of the book will be populated with a price level

A new book level update on the ASK (Sell) side Book Depth Update Message.

Book Depth Update Message			
Name	Offset	Value	Hex Value
Message Type	0	"U"	55
Timestamp – Nanoseconds	1	2019-04-04 19:39:08.13746921	5C A6 95 9C 00 D1 C2 E9
Order book ID	9	123456789	07 5B CD 15
Transaction ID	13	2696	00 00 0A 88
Number of depth records	17	1	01
Update Action	18	"N" (New)	4E
Side	19	"S" (Sell)	53
Level	20	1	01
Quantity	21	12	00 00 00 0C
Order Count	25	1	00 00 00 01
Price	29	1000546875000	00 00 00 E8 F5 3D B6 78
Yield	37	2113	00 00 08 41

Network byte stream of Book Depth Update Message (in hex):

- 55 5C A6 95 9C 00 D1 C2 E9 07 5B CD 15 00 00 0A 88 01 4E 53 01 00 00 00 0C 00 00 00 01 00 00 00 E8 F5 3D B6 78 00 00 08 41

Book State 2: State of order book after new update message in example 2

OrderBookID = 123456789						
BID				ASK		
Level	Price	Yield	Size	Price	Yield	Size
1	100-006	2.119	5	100-016	2.113	12
2	100-00+	2.121	2			
3	100-002	2.212	18			

A.3 – Update Action = Multi Level New Level

Example 3:

A new book update message comes in which consist of;

- A new ASK(Sell) price level 2 update at price 1000605468750 (100-01 [15/16]) for 5M
- A new ASK(Sell) price level 3 update at price 1000781250000 (100-02 ½) for 10M

Notes;

- This update includes multiple price levels in one message
- These price levels will be added to the order book

A new book level update on the ASK (Sell) side Book Depth Update Message.

Book Depth Update Message			
Name	**Offset**	**Value**	**Hex Value**
Message Type	0	"U"	55
Timestamp – Nanoseconds	1	2019-04-04 19:39:12.771335801	5C A6 95 A0 2D F9 A6 79
Order book ID	9	123456789	07 5B CD 15
Transaction ID	13	2701	00 00 0A 8D
Number of depth records	17	2	01
Update Action	18	"N" (New)	4E
Side	19	"S" (Sell)	53
Level	20	2	02
Quantity	21	5	00 00 00 05
Order Count	25	2	00 00 00 02
Price	29	1000605468750	00 00 00 E8 F4 13 B0 86
Yield	37	2114	00 00 08 42
Update Action	41	"N" (New)	4E
Side	42	"S" (Sell)	53
Level	43	3	03
Quantity	44	10	00 00 00 10
Order Count	48	3	00 00 00 03
Price	52	1000781250000	00 00 00 E9 03 35 FD D0
Yield	60	2108	00 00 08 3C

Network byte stream of Book Depth Update Message (in hex):

- 55 5C A6 95 A0 2D F9 A6 79 07 5B CD 15 00 00 0A 8D 01 4E 53 02 00 00 00 05 00 00 00 02 00 00 00 E8 F8 BB C8 4E 00 00 08 42 4E 53 03 00 00 00 10 00 00 00 03 00 00 00 E9 03 35 FD D0 00 00 08 3C

Book State 3: State of order book after new update message in example 3

OrderBookID = 123456789						
BID				**ASK**		
Level	**Price**	**Yield**	**Size**	**Price**	**Yield**	**Size**
1	100-006	2.119	5	100-016	2.113	12
2	100-00+	2.121	2	100-02*	2.114	5
3	100-002	2.212	18	100-02+	2.108	10

A.4 – Update Action = New Level (Top of Book)

Example 4:

A new book update message comes in which consist of;

- A new ASK(Sell) price level 1 at price 1000527347500 (100-01 [11/16]) for 5M

Notes;

- The price level 1 update
- This update at price level 1 will go to the top of the book
- This leads to the other price levels needing to be pushed down
- Any price level which is past the published level (in this example price level 3) will no longer be part of the order book

A new book level update on the ASK (Sell) side Book Depth Update Message.

Book Depth Update Message			
Name	**Offset**	**Value**	**Hex Value**
Message Type	0	"U"	55
Timestamp – Nanoseconds	1	2019-04-04 19:44:31.586935520	5C A6 96 DF 22 FB EC E0
Order book ID	9	123456789	07 5B CD 15
Transaction ID	13	2750	00 00 0A BE
Number of depth records	17	1	01
Update Action	18	"N" (New)	4E
Side	19	"S" (Sell)	53
Level	20	1	01
Quantity	21	5	00 00 00 05
Order Count	25	1	00 00 00 01
Price	29	1000527347500	00 00 00 E8 F4 13 BF 2C
Yield	37	2113	00 00 08 41

Network byte stream of Book Depth Update Message (in hex):

- 55 5C A6 96 DF 22 FB EC E0 07 5B CD 15 00 00 0A BE 01 4E 53 01 00 00 00 05 00 00 00 01 00 00 00 E8 F4 13 BF 2C 00 00 08 41

Book State 4: State of order book after new update message in example 4

OrderBookID = 123456789						
BID				**ASK**		
Level	**Price**	**Yield**	**Size**	**Price**	**Yield**	**Size**
1	100-006	2.119	5	100-016*	2.113	5
2	100-00+	2.121	2	100-016	2.114	12
3	100-002	2.212	18	100-02*	2.108	5

A.5 – Update Action = Multi Level Change Level and Delete Level

Example 5:

A new book update message comes in which consist of;

- A change ASK(Sell) price level 2 from size 12M to 29M and from an order count of 1 to 5
- A delete Ask(sell) price level 3

Notes;

- When update action = Delete; the Quantity, Order Count, Price and Yield bytes are not used or reserved in the message

A new book level update on the ASK (Sell) side Book Depth Update Message.

Book Depth Update Message			
Name	**Offset**	**Value**	**Hex Value**
Message Type	0	"U"	55
Timestamp – Nanoseconds	1	2019-04-04 19:44:31.586942905	5C A6 96 DF 22 FC 09 B9
Order book ID	9	123456789	07 5B CD 15
Transaction ID	13	2752	00 00 0A 8A
Number of depth records	17	2	02
Update Action	18	"C" (Change)	43
Side	19	"S" (Sell)	53
Level	20	2	02
Quantity	21	29	00 00 00 1D
Order Count	25	5	00 00 00 05
Price	29	25616	00 00 64 10
Yield	37	2113	00 00 08 41
Update Action	38	"D" (Delete)	44
Side	39	"S" (Sell)	53
Level	40	3	03

Network byte stream of Book Depth Update Message (in hex):

- 55 5C A6 96 DF 22 FC 09 B9 07 5B CD 15 00 00 0A 8A 02 43 53 02 00 00 00 1D 00 00 00 05 00 00 00 E8 F8 BB C8 4E 00 00 08 41 44 53 03

Book State 5: State of order book after new update message in example 5

OrderBookID = 123456789						
BID				**ASK**		
Level	**Price**	**Yield**	**Size**	**Price**	**Yield**	**Size**
1	100-006	2.119	5	100-016*	2.113	5
2	100-00+	2.121	2	100-016	2.114	29
3	100-002	2.212	18			

A.6 – Update Action = Delete From

Example 6:

A new book update message comes in which consist of;

- A delete from ASK(Sell) price level 1

Notes;

- When update Action = Delete From; Quantity, Order Count, Price and Yield bytes are not used or reserved in the message
- When update Action = Delete From; the price level specified and any price levels below it are to be deleted

A new book level update on the ASK (Sell) side Book Depth Update Message.

Book Depth Update Message			
Name	**Offset**	**Value**	**Hex Value**
Message Type	0	"U"	55
Timestamp – Nanoseconds	1	2019-04-04 19:44:32.122460545	5C A6 96 E0 07 4C 99 81
Order book ID	9	123456789	07 5B CD 15
Transaction ID	13	2753	00 00 0A C1
Number of depth records	17	1	01
Update Action	18	"F" (Delete From)	46
Side	19	"S" (Sell)	53
Level	20	1	01

Network byte stream of Book Depth Update Message (in hex):

- 55 5C A6 96 DF 22 FC 09 B9 07 5B CD 15 00 00 0A 8A 02 43 53 02 00 00 00 1D 00 00 00 05 00 00 64 10 00 00 00 08 41 44 53 03

Book State 6: State of order book after new update message in example 6

OrderBookID = 123456789						
BID				ASK		
Level	**Price**	**Yield**	**Size**	**Price**	**Yield**	**Size**
1	100-006	2.119	5			
2	100-00+	2.121	2			
3	100-002	2.212	18			