



OTC Markets Multicast Data Feeds

Technical Specification

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1. Introduction

1.1 Overview

This document provides a technical specification of OTC Markets Group's real-time multicast market data products. Each product provides access to a set of multicast channels carrying quote, trade and security reference data.

Each channel's data is published in duplicate on two separate multicast addresses, feed A and feed B, for high availability. Subscribers can request gap-fills or snapshots over a TCP socket-based connection.

Please visit <http://www.otcmarkets.com/services/market-data/realtime-data/overview> for more information about these products, and for the latest version of this document.

1.2 Multicast Products

OTC Markets Group currently offers five real-time multicast Market Data products.

- **Real-Time Level 1+:** Real-time OTC Link inside quote prices (bid & offer) and real-time OTC Link Trade information. Size is aggregated for the inside price. Market Participant source attribution is not provided. Please see the [OTC Markets Display Requirements document](#) for details regarding data display.
- **Real-Time Level 2+:** Real-time quote book data including market participant information, and real-time OTC Link Trade information. The RT Level 2+ License is our premium license, which allows subscribers access to all of our multi-cast channels. Please see the [OTC Markets Display Requirements document](#) for details regarding data display.
- **Real-Time Reference Prices:** Real-time OTC Link inside quote prices (bid & offer). Quote size information is not available. The license also includes access to real-time OTC Link trade data. The innovative RTR Price license allows our market data distributors to provide this data free to their public websites and market data terminal users that want to monitor real-time OTC market prices. There is no cost to distributors of our premium products. There is a monthly fee for websites and financial portals that do not re-sell our premium market data.
- **Real-Time Level 1+ with Global OTC data:** Real-time consolidated OTC Link/Global OTC inside quote prices (bid & offer) and real-time OTC Link Trade information. Size is aggregated for the inside price. Market Participant source attribution is not provided. Please see the [OTC Markets Display Requirements document](#) for details regarding data display.
- **Real-Time Level 2+ with Global OTC data:** Real-time OTC Link/Global OTC quote book data including market participant information, and real-time OTC Link Trade information. Global OTC data is top of book data from the Global OTC ATS. Please see the [OTC Markets Display Requirements document](#) for details regarding data display.

Access to security information (tiers, caveat emptor, etc.) is provided for all five products. Access to products containing [Global OTC](#) data requires a separate data agreement with ICE.

1.3 Product-Channel Mapping

Market data is published on a set of multicast channels. A product offers access to a subset of these multicast channels. The following table shows the channels available for each product.

The **X** marks the primary channel for a given product. The **O** marks optional channels that a product subscriber may additionally choose to receive. A blank cell notes that the channel is not available for the respective product. As an example, a Level 2 + product subscriber may choose to listen only to our Quote Book and Reference Data (w cusip) channels, even though they have access to all channels.

Access to Global OTC Channels requires the appropriate licensing and agreements with both OTC Markets and ICE.

Receiving all optional channels will result in significant duplication of data.

| Channel ¹ \ Product | OTC Markets Real-Time Reference Prices | OTC Markets Real-Time Level 1+ | OTC Markets Real-Time Level 1+ with Global OTC data | OTC Markets Real-Time Level 2+ | OTC Markets Real-Time Level 2+ with Global OTC data |
|---------------------------------------|--|--------------------------------|---|--------------------------------|---|
| Quote Book with Global OTC Channels | | | | | X |
| Quote Book Channels | | | | X | O |
| Quote Inside with Global OTC Channels | | | X | | O |
| Quote Inside Channels | | X | O | O | O |
| Quote Reference Price Channels | X | O | O | O | O |
| OTC Link Trade Channels | O | O | O | O | O |
| Reference Data Channels (w/ cusip) | O | O | O | O | O |
| Reference Data Channels (w/o cusip) | O | O | O | O | O |

Table 1: Product-Channel Mapping

¹ For redundancy, each channel is published twice, as an A feed and a B feed.

1.4 Multicast Channels

The following table describes the available multicast channels. Each set of channels consist of two real-time data channels and two snapshot data channels.

| Multicast Channel | Channel Description | Channel ID | |
|---------------------|--|------------|----------|
| | | Real Time | Snapshot |
| Quote Book Channels | All individual quote messages: price, size, qap, mmid, priceType, open/close indicator | 11 | 12 |

| | | | |
|---|--|----|----|
| Quote Book with Global OTC Channels | All individual quote messages: price, size, qap, mmid, priceType, open/close indicator. Includes top of book quotes from the Global OTC ATS. | 19 | 20 |
| Quote Inside Channels | OTC Link Best Bid and Offer: Best bid price, aggregate bid size, best offer price, aggregate offer size | 14 | 15 |
| Quote Inside with Global OTC Channels | Consolidated OTC Link/Global OTC Best Bid and Offer: Best bid price, aggregate bid size, best offer price, aggregate offer size | 21 | 22 |
| Quote Reference Price Channels | OTC Link Best Bid and Offer Prices: Best bid price, best offer price, bid and offer size set to 1. This is essentially equivalent to the Inside channel, but without the size information. | 17 | 18 |
| OTC Link Trade Channels ¹ | OTC Link Trade and Trade Statistic data. | 1 | |
| Reference Data Channels (with cusip) ² | Extended security (cusip, company name, etc.) information for market data recipients who own a cusip license. | 5 | 6 |
| Reference Data Channels (w/o cusip) ² | Extended security (company name, etc.) information for market data recipients who do not own a cusip license. | 7 | 8 |

Table 2: Channel Descriptions and IDs

¹ Snapshots are not supported, Gap fill recovery should be used

² An abbreviated set of Security reference data is also sent in-line on the quote book, inside, reference price and depth channels.

2. Connectivity

This section provides a high-level overview of client integration and connection functionality.

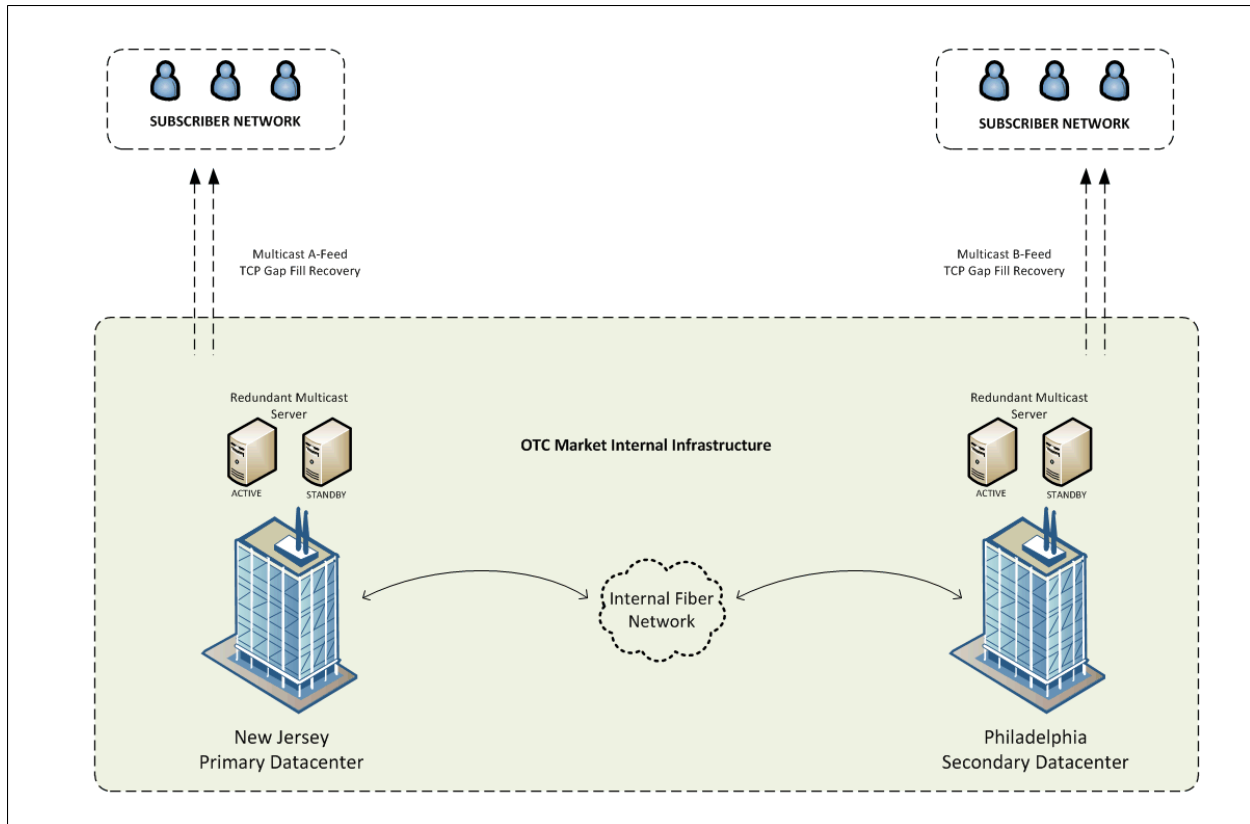
IP, Group and Port information for our production and certification environments may be found in our [Multi-cast Group documentation](#).

Clients should contact OTC Markets Group technical support or their designated network service provider to obtain technical details concerning connectivity.

2.1 Network Configuration

Because UDP is an unreliable message transport and it suffers from occasional packet loss, OTC Markets distributes each data feed using two multicast broadcasts channels. An “A” channel is published from our primary data center in Carlstadt, NJ, and a “B” channel is published from our secondary data center in Philadelphia, PA. Both data centers contain Feed Replay Servers, which can respond to Gap Fill and Snapshot requests sent by subscribers over TCP/IP. All the Feed Replay Servers contain identical information.

We have primary and standby data feed servers in our Carlstadt, NJ (A Feed) and Philadelphia, PA (B Feed) data centers. In the event of server failure in either location, the standby server will become primary and begin disseminating messages. The multicast groups and ports will remain consistent for both the primary and standby servers; however, source IPs will differ. Subscribers need to allow both the primary and standby server source IPs in order to take advantage of this redundancy. See our multicast group document for details on IPs, groups and ports: <http://www.otcmarkets.com/content/doc/binary-multi-cast-groups.pdf>



2.2 Bandwidth Recommendations

Connection via Extranet: Please refer to <http://www.otcmartets.com/services/market-data/realtime-data/specifications> for bandwidth requirements for each channel.

Direct Connection: Please refer to Connectivity Guide at: <http://www.otcmartets.com/content/doc/connectivity-guide.pdf>

2.3 Supported Carriers

Please refer to <http://www.otcmartets.com/services/market-data/realtime-data/connection> for a current list of supported carriers

2.4 Production and Certification Environment IP Endpoints and Multicast Groups

Please refer to <http://www.otcmartets.com/content/doc/binary-multi-cast-groups.pdf> for documentation on production and certification environment multicast groups, channels and source IPs.

3. Binary Channels

3.1 Binary Message Distribution

Each UDP multicast packet will contain a packet header. In the case where this header indicates it is a Heartbeat or Sequence Number Reset, the packet will contain no other messages. The SeqNum field will always contain the next expected sequence number not the current. For most packets, the PacketFlag field will be unset (zero), which indicates normal message traffic. In this case, the Messages field of the packet header will contain the number of messages contained in that packet.

Each message contained in the packet will contain a message header, which specifies the message type and message size. The message type and size fields should be used for decoding individual messages. It is important to note that future versions may append additional data fields to a message, thus proper use of the message size will be critical to ensuring backward compatibility.

Messages will be formatted in big endian, with each field having a fixed length and a fixed position.

3.1.1 Packet Header

| Field | Offset | Size | Format | Description |
|-------------|--------|------|------------------|--|
| PacketSize | 0 | 2 | Unsigned Integer | Size of packet + header size in bytes |
| SeqNum | 2 | 4 | Unsigned Integer | Sequence number of packet (channel specific). If heartbeat or if sequence number is being reset, will contain next expected sequence number. |
| PacketFlag | 6 | 1 | Bit map | see Packet flag definition |
| Messages | 7 | 1 | Unsigned Integer | Number of messages in packet |
| PacketMilli | 8 | 4 | Unsigned Integer | Milliseconds since local time midnight (EST/EDT) |

3.1.2 Packet Flag

| Bit | Name | Set | Clear |
|-----|---------------------------|----------------------|-------------------------|
| 0 | Heartbeat ¹ | No message in packet | Normal message contents |
| 1 | SeqNum Reset ² | No message in packet | Normal message contents |
| 2 | Reserved | | |
| 3 | Reserved | | |

| Bit | Name | Set | Clear |
|-----|----------|--|-------------------------|
| 4 | Reserved | | |
| 5 | Reserved | | |
| 6 | Replay | Packet contains replay messages | Normal message contents |
| 7 | Test | Packet contains test messages. Will not occur during normal market hours | Normal message contents |

¹ A Heartbeat is sent if no business level message has been published for more than a second. The heartbeats will continue to be sent in 1 second intervals until the next business level message is published.

² A SeqNumReset message will be sent at the start of day and in the scenario where a major outage leads to the feed generator application needing a fresh start. The message indicates that the channel sequence numbers are being reset to 1.

3.1.3 Message Header

| Field | Offset | Size | Format | Description |
|-----------------|--------|------|------------------|--|
| MessageSize | 0 | 2 | Unsigned Integer | Size of message + header size in bytes |
| MessageType | 2 | 1 | Unsigned byte | See Table 3: Message Type Values below |
| Message Payload | 3 | - | | |

| Message | Quote (Add, Delete, Spin) | Quote Update | Inside (Add, Delete, Spin) | Inside Update | Price Level (Add, Delete, Spin) | Price Level Update | Reference Price (Add, Delete, Spin) | Reference Price Update | Security | Start of Spin | End of Spin | Market Open | Market Close | Extended Security | Extended Security (No CUSIP) | Trade | Trade Statistic |
|---------|---------------------------|--------------|----------------------------|---------------|---------------------------------|--------------------|-------------------------------------|------------------------|----------|---------------|-------------|-------------|--------------|-------------------|------------------------------|-------|-----------------|
| Value | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 |

Table 3: Message Type Values

3.2 Binary Message To Channel Mapping

| Message Name | Message Type | Sent on Channel | Channel ID |
|-------------------------------------|--------------|--|-----------------------------|
| Quote (Add, Delete, Spin) | 1 | Quote Book & Quote Book with Global OTC Channels | 11,19 |
| Quote Update | 2 | Quote Book & Quote Book with Global OTC Channels | 11,19 |
| Inside (Add, Delete, Spin) | 3 | Quote Inside & Quote Inside with Global OTC Channels | 14,21 |
| Inside Update | 4 | Quote Inside Channel | 14,21 |
| Reference Price (Add, Delete, Spin) | 7 | Quote RT Reference Price Channel | 17 |
| Reference Price Update | 8 | Quote RT Reference Price Channel | 17 |
| Security Reference | 9 | | 11,12, 14,15 17,18,19,21 |
| Start of Spin | 11 | All channels | |
| End of Spin | 12 | All channels | |
| Market Open | 13 | All channels | |
| Market Close | 14 | All channels | |
| Extended Security | 15 | Reference Data Channels | 5 |
| Extended Security (no CUSIP) | 16 | Reference Data Channels | 6 |
| Trade | 17 | OTC Link Trade Channel | 1 |
| Trade Statistic | 18 | OTC Link Trade Channel | 1 |

3.3 Message Definitions

3.3.1 Start of Spin

This message appears on all quote channels and indicates the beginning of a spin message cycle.

| Field | Offset | Size | Format | Description |
|---------------------|--------|------|------------------|---|
| ChannelSeqNum | 0 | 4 | Unsigned Integer | Monotonically increasing message sequence number at the channel level |
| SpinType | 4 | 1 | Unsigned byte | 1 - Reference 2 - Market Data 3 - Opening |
| SpinStartTimeMilli | 5 | 8 | Unsigned Integer | Milliseconds since UTC epoch |
| SpinLastSeqNum | 13 | 4 | Unsigned Integer | Last sequence number applied to this spin |
| Message Size | | 17 | | |

3.3.2 End of Spin

This message appears on all quote channels and indicates the end of a spin message cycle.

| Field | Offset | Size | Format | Description |
|---------------------|--------|------|------------------|---|
| ChannelSeqNum | 0 | 4 | Unsigned Integer | Monotonically increasing message sequence number at the channel level |
| SpinType | 4 | 1 | Unsigned byte | 1 - Reference 2 - Market Data 3 - Opening |
| SpinMsgCt | 5 | 4 | Unsigned Integer | Total messages in spin |
| SpinEndTimeMilli | 9 | 8 | Unsigned Integer | Milliseconds since UTC epoch |
| SpinLastSeqNum | 17 | 4 | Unsigned Integer | Last sequence number applied to this spin |
| Message Size | | 21 | | |

3.3.3 Market Open

This message is sent out at 6 AM on all channels. The message can also be sent mid-day if a technical outage caused a temporary closure of the market.

| Field | Offset | Size | Format | Description |
|---------------------|--------|------|------------------|---|
| ChannelSeqNum | 0 | 4 | Unsigned Integer | Monotonically increasing message sequence number at the channel level |
| MarketOpen | 4 | 8 | Unsigned Integer | Milliseconds since UTC epoch |
| MarketClose | 12 | 8 | Unsigned Integer | Anticipated market close Milliseconds since UTC epoch |
| Message Size | | 20 | | |

3.3.4 Market Close

This message is sent out at 5 PM on all channels. The message can also be sent mid-day if a technical outage causes a temporary closure of the market.

| Field | Offset | Size | Format | Description |
|----------------------|--------|------|------------------|---|
| ChannelSeqNum | 0 | 4 | Unsigned Integer | Monotonically increasing message sequence number at the channel level |
| MarketCloseTimeMilli | 4 | 8 | Unsigned Integer | Milliseconds since UTC epoch midnight |

| Field | Offset | Size | Format | Description |
|---------------------|--------|------|------------------|-------------------------|
| MarketMsgCt | 12 | 4 | Unsigned Integer | Total day message count |
| Message Size | | 16 | | |

3.3.5 Security

The Security Message is included in all the quote channels and provides basic security attribute information. For complete security attribute information (e.g. CUSIP), please see Extended Security Message

| Field | Offset | Size | Format | Description |
|-----------------|--------|------|------------------|--|
| ChannelSeqNum | 0 | 4 | Unsigned Integer | Monotonically increasing message sequence number at the channel level |
| Symbol | 4 | 10 | ASCII | Ticker symbol. Fixed income symbols may not have a symbol. For these securities, the security ID or CUSIP (Reference Data Security Message) must be used as an identifier. |
| LastUpdateMilli | 14 | 8 | Unsigned Integer | Milliseconds from UTC epoch |
| SecurityAction | 22 | 1 | Unsigned Integer | 0x1 = Update 0x2 = Add 0x3 = Delete 0x4 = Spin |
| AssetClass | 23 | 1 | Unsigned Integer | 0x1 = Equity 0x2 = Fixed Income |
| SecurityID | 24 | 4 | Unsigned Integer | Unique security ID issued by OTC Markets |
| SecurityFlags | 28 | 1 | BitMap | See SecurityFlag definition |

| Field | Offset | Size | Format | Description |
|-----------------|--------|------|------------------|--|
| Tier | 29 | 1 | Unsigned Integer | The market tier assigned by OTC Markets Group. Valid values: 0 - No Tier 1 - OTCQX U.S. Premier 2 - OTCQX U.S. 5 - OTCQX International Premier 6 - OTCQX International 10 - OTCQB 11 - OTCBB Only 20 - OTC Pink Current 21 - OTC Pink Limited 22 - OTC Pink No Information 30 - Grey Market 50 – OTC Bonds Distributors must display with the price data, the market tier assigned in a manner acceptable to OTC Markets Group. Please see the Data Display Requirements document. Please see Appendix for a tier to primary market mapping table. |
| ReportingStatus | 30 | 1 | ASCII | A - Alternative Reporting Standard B - Bank/Thrift F - SEC Reporting G - International Reporting I - Insurance Company N -No Reporting O - Other Reporting Standard R - FINRA Reporting V - SEC Reporting - Investment Company W – SEC Reporting – Reg A |
| SecurityStatus | 31 | 1 | ASCII | A – Active Q – Quote Only S – Suspended H – Halted I – Internal Halt R – Revoked D – Deleted |
| Message Size | | 32 | | |

3.3.6 Security Flag

This flag notes security level attributes and is only included in the Security Message.

| Bit | Name | Set | Clear |
|-----|---|-----|-------|
| 0 | PiggybackFlag 15c2-11 "PiggyBack" exempt security status flag | Yes | No |
| 1 | CaveatFlag Indicates whether a Caveat Emptor warning has been applied to the security. | Yes | No |
| 2 | RegShoFlag Indicates if security is on Regulation SHO/NASD Rule 3210 Threshold Security List | Yes | No |
| 3 | UnsolicitedOnlyFlag Indicates if security may only be quoted Unsolicited. | Yes | No |
| 4 | BB Quoted Indicates if security is quoted on the OTC Bulletin Board interdealer quotation system | Yes | No |
| 5 | OTC Link ECN Eligible Indicates if security is eligible for trading on OTC Link ECN. | Yes | No |
| 6 | OTC Link Messaging Disabled | Yes | No |
| 7 | SaturationEligibleFlag Indicates if a security is eligible to have their quotes 'saturated.' Quote saturation is an OTC Link policy where quotes are removed from 'Inside Price' consideration due to a lack of responsiveness (to trade messages) by a participant. | Yes | No |

3.3.7 Quote (Add, Delete, Spin)

This message is sent on the Quote Book channel and the Quote Book with Global OTC data channel

An Opening Spin is sent early in the morning, during which all quotes across all securities are disseminated. All quotes will be in Closed state at this time. Most market participants close their quotes at the end of the day, and open them again the next morning. Others delete their quotes at the end of the day, and create them anew the next morning. The quotes for the latter will not be part of the daily opening spin.

| Field | Offset | Size | Format | Description |
|---------------|--------|------|------------------|---|
| ChannelSeqNum | 0 | 4 | Unsigned Integer | Monotonically increasing message sequence number at the channel level |
| QuoteID | 4 | 4 | Unsigned Integer | Unique Quote ID |

| Field | Offset | Size | Format | Description |
|---------------------|--------|------|------------------|---|
| QuoteAction | 8 | 1 | Unsigned Integer | 0x2 = Add 0x3= Delete 0x4= Spin |
| QuoteFlags | 9 | 1 | Bit map | see QuoteFlag definition |
| SecurityID | 10 | 4 | Unsigned Integer | OTC Markets security ID |
| MPID | 14 | 4 | ASCII | Market Participant ID owning the quote always 4 characters |
| AskPrice | 18 | 8 | Unsigned Integer | Price, 6 decimal places assumed |
| AskSize | 26 | 4 | Unsigned Integer | Number of shares |
| AskQAP | 30 | 1 | Integer | Specifies the access fee or rebate for the bid/offer. Positive Integers (1 to 30) indicate a rebate, and negative Integers (-1 to -30) indicate an access fee. 0 indicates no rebate or access fee. |
| AskTimeMilli | 31 | 8 | Unsigned Integer | Milliseconds from UTC epoch |
| BidPrice | 39 | 8 | Unsigned Integer | Price, 6 decimal places assumed |
| BidSize | 47 | 4 | Unsigned Integer | Number of shares |
| BidQAP | 51 | 1 | Integer | Specifies the access fee or rebate for the bid/offer. Positive Integers (1 to 30) indicate a rebate, and negative Integers (-1 to -30) indicate an access fee. 0 indicates no rebate or access fee. |
| BidTimeMilli | 52 | 8 | Unsigned Integer | Milliseconds from UTC epoch |
| QuoteReferenceID | 60 | 2 | Unsigned Integer | Numeric value (from 0 to 64,999), corresponds to FIX Tag 9670 which is assigned by the quote owner. Can be used for correlation purposes |
| ExtendedQuoteFlags | 62 | 1 | Bit Map | See ExtendedQuote Flag definition |
| Message Size | | 63 | | |

3.3.8 Quote Update

Quote update information for the Quote Book channel and the Quote Book with Global OTC data channel.

| Field | Offset | Size | Format | Description |
|---------------------|--------|------|------------------|---|
| ChannelSeqNum | 0 | 4 | Unsigned Integer | Monotonically increasing message sequence number at the channel level |
| QuoteID | 4 | 4 | Unsigned Integer | Quote ID refers back to original Quote Reference |
| QuoteFlags | 8 | 1 | Bit map | see QuoteFlag definition |
| Price | 9 | 8 | Unsigned Integer | Price, 6 decimal places assumed |
| Size | 17 | 4 | Unsigned Integer | Number of shares |
| QAP | 21 | 1 | Integer | Specifies the access fee or rebate for the bid/offer. Positive Integers (1 to 30) indicate a rebate, and negative Integers (-1 to -30) indicate an access fee. 0 indicates no rebate or access fee. |
| QuoteTimeMilli | 22 | 8 | Unsigned Integer | Milliseconds from UTC epoch |
| QuoteReferenceID | 30 | 2 | Unsigned Integer | Numeric value (from 0 to 64,999) corresponds to FIX Tag 9670, which is assigned by the quote owner. Can be used for correlation purposes |
| ExtendedQuoteFlags | 32 | 1 | Bit Map | See ExtendedQuoteFlag definition |
| Message Size | | 33 | | |

3.3.9 Quote Flag

This flag is part of two messages: The Quote Add/Delete/Spin message and the Quote Update message. Not all fields are applicable on every message - see table footnotes below.

| Bit | Name | Set | Clear |
|-----|----------------------------------|-------------|-------------|
| 0 | Update Side ¹ | Ask | Bid |
| 1 | State | Open | Closed |
| 2 | Ask Unsolicited | Unsolicited | Solicited |
| 3 | Ask Priced ² | Actual | Unpriced/BW |
| 4 | Ask BW (Bid Wanted) ² | BW | Unpriced |
| 5 | Bid Unsolicited ² | Unsolicited | Solicited |

| Bit | Name | Set | Clear |
|-----|------------------------------------|--------|-------------|
| 6 | Bid Priced ² | Actual | Unpriced/OW |
| 7 | Bid OW (Offer Wanted) ² | OW | Unpriced |

¹ Applicable for Update messages only. Ignore for other messages.

² Quotes can have one of three price types – Actual, Bid/Offer Wanted, or Unpriced. The Ask Price Type is represented by bits 3 and 4, and the Bid Price Type is represented by bits 6 and 7.

3.3.10 Extended Quote Flag

This flag is part of two messages: The Quote Add/Delete/Spin message and the Quote Update message.

The QuoteSaturatedFlag determines whether the quote (both bid and offer) should be considered for the inside price. If flag is set then the quote should NOT be considered for the inside.

The AutoEx Flags (Bid and Offer) note whether this quote is currently in 'AutoEx' mode. If the AutoEx flag is set for the respective quote side then a response to an OTC Link trade message will be immediate.

The National Market Securities (NMS) conditional quote flag indicates (1) the displayed quote size is a round lot at least two times greater than the minimum round lot size in the security and (2) a trade message relating to the quote cannot be sent or filled for less than the displayed size.

| Bit | Name | Set | Clear |
|-----|-------------------------|-----|-------|
| 0 | QuoteSaturatedFlag | Yes | No |
| 1 | BidAutoExFlag | Yes | No |
| 2 | OfferAutoExFlag | Yes | No |
| 3 | NMSConditionalQuoteFlag | Yes | No |
| 4 | Reserved | | |
| 5 | Reserved | | |
| 6 | Reserved | | |
| 7 | Reserved | | |

3.3.11 Inside (Add, Delete, Spin)

This message is sent on the Quote Inside Channel and the Quote Inside with Global OTC data channel

An insideID is generated for each inside bid or offer when it is newly created. This id is unique across all inside entries for all securities, across both bids and offers. For subsequent updates and deletes, this id should be used to look up the original inside entry. For updates, the Inside Update message, defined in next section, is published.

The price of an inside bid (offer) for a security is the highest bid price (lowest offer price) of all open bids (offers) for that security. The size of an inside bid (offer) is the aggregated size of all bids (offers) at the inside bid (offer) price.

For the Quote Inside with Global OTC data channel, the inside calculation will include data from the Global OTC ATS. The inside calculation for the Quote Inside channel will only include data from the OTC Link ATS.

| Field | Offset | Size | Format | Description |
|---------------------|--------|------|------------------|---|
| ChannelSeqNum | 0 | 4 | Unsigned Integer | Monotonically increasing message sequence number at the channel level |
| InsideID | 4 | 4 | Unsigned Integer | Unique Inside ID |
| InsideAction | 8 | 1 | Unsigned Integer | 0x2 = Add 0x3 = Delete 0x4 = Spin |
| QuoteFlags | 9 | 1 | Bit map | See Inside QuoteFlag definition |
| SecurityID | 10 | 4 | Unsigned Integer | OTC Markets security ID |
| AskPrice | 14 | 8 | Unsigned Integer | Price, 6 decimal places assumed |
| AskSize | 22 | 4 | Unsigned Integer | Number of shares |
| AskTimeMilli | 26 | 8 | Unsigned Integer | Milliseconds from UTC epoch |
| BidPrice | 34 | 8 | Unsigned Integer | Price, 6 decimal places assumed |
| BidSize | 42 | 4 | Unsigned Integer | Number of shares |
| BidTimeMilli | 46 | 8 | Unsigned Integer | Milliseconds since UTC epoch |
| AskNumPricedMP | 54 | 1 | Unsigned Integer | Number of market participants at Inside price level |
| BidNumPricedMP | 55 | 1 | Unsigned Integer | Number of market participants at Inside price level |
| Message Size | | 56 | | |

3.3.12 Inside Update

Quote update information for the Quote Inside channel and the Quote Inside with Global OTC data channel. Note that Size information is aggregated across participants at the inside price level.

Saturated quotes (See Quote Message and Extended Quote Flag) will not be considered for the inside price or size. If a market participant quote which is part of the inside becomes saturated, it will be removed from the inside and new quote inside update message will be created.

| Field | Offset | Size | Format | Description |
|---------------------|---------------|-------------|------------------|---|
| ChannelSeqNum | 0 | 4 | Unsigned Integer | Monotonically increasing message sequence number at the channel level |
| InsideID | 4 | 4 | Unsigned Integer | Inside ID refers back to original Inside Reference |
| QuoteFlags | 8 | 1 | Bit map | see Inside QuoteFlag definition |
| Price | 9 | 8 | Unsigned Integer | Price, 6 decimal places assumed |
| Size | 17 | 4 | Unsigned Integer | Number of shares |
| InsideTimeMilli | 21 | 8 | Unsigned Integer | Milliseconds from UTC epoch |
| NumPricedMP | 29 | 1 | Unsigned Integer | Number of market participants at Inside price level. |
| Message Size | | 30 | | |

3.3.13 Inside Quote Flag

This flag is part of two messages: The Inside Add/Delete/Spin message, the Inside Update message. Not all fields are applicable on every message - see table footnotes below.

| Bit | Name | Set | Clear |
|-----|--------------------------|----------------------------|------------------------------------|
| 0 | Update Side ¹ | Ask | Bid |
| 1 | State | Open | Closed |
| 2 | Reserved | | |
| 3 | Ask Priced | Actual | Unpriced |
| 4 | Ask Size OverFlow | Aggregated size exceeds 2B | Aggregated size does not exceed 2B |
| 5 | Reserved | | |
| 6 | Bid Priced | Actual | Unpriced |
| 7 | Bid Size OverFlow | Aggregated size exceeds 2B | Aggregated size does not exceed 2B |

¹ Applicable for Update messages only. Ignore for other messages.

3.3.14 Reference Price (Add, Delete, Spin)

This message is sent on the Reference Prices Channel. Size will always be set to 1.

| Field | Offset | Size | Format | Description |
|----------------------|--------|------|------------------|---|
| ChannelSeqNum | 0 | 4 | Unsigned Integer | Monotonically increasing message sequence number at the channel level |
| ReferencePriceID | 4 | 4 | Unsigned Integer | Unique Reference Price ID |
| ReferencePriceAction | 8 | 1 | Unsigned Integer | 0x2 = Add 0x3 = Delete 0x4 = Spin |
| QuoteFlags | 9 | 1 | Bit map | See Reference Price QuoteFlag definition |
| SecurityID | 10 | 4 | Unsigned Integer | OTC Markets security ID |
| AskPrice | 14 | 8 | Unsigned Integer | Price, 6 decimal places assumed |
| AskSize | 22 | 4 | Unsigned Integer | Always 1 |
| AskTimeMilli | 26 | 8 | Unsigned Integer | Milliseconds from UTC epoch |

| Field | Offset | Size | Format | Description |
|---------------------|--------|------|------------------|---------------------------------|
| BidPrice | 34 | 8 | Unsigned Integer | Price, 6 decimal places assumed |
| BidSize | 42 | 4 | Unsigned Integer | Always 1 |
| BidTimeMilli | 46 | 8 | Unsigned Integer | Milliseconds since UTC epoch |
| Message Size | | 54 | | |

3.3.15 Reference Price Update

Quote update information for the Reference Price channel. Note 'Size' will always be set to 1.

| Field | Offset | Size | Format | Description |
|---------------------|--------|------|------------------|---|
| ChannelSeqNum | 0 | 4 | Unsigned Integer | Monotonically increasing message sequence number at the channel level |
| ReferencePriceID | 4 | 4 | Unsigned Integer | Unique Reference Price ID |
| QuoteFlags | 8 | 1 | Bit map | See Reference Price QuoteFlag definition |
| Price | 9 | 8 | Unsigned Integer | Price, 6 decimal places assumed |
| Size | 17 | 4 | Unsigned Integer | Always 1 |
| TimeMilli | 21 | 8 | Unsigned Integer | Milliseconds from UTC epoch |
| Message Size | | 29 | | |

3.3.16 Reference Price Quote Flag

This flag is part of two messages: The Reference Price Add/Delete/Spin message, the Reference Price Update message, Not all fields are applicable on every message - see table footnotes below.

| Bit | Name | Set | Clear |
|-----|--------------------------|--------|----------|
| 0 | Update Side ¹ | Ask | Bid |
| 1 | State | Open | Closed |
| 2 | Reserved | | |
| 3 | Ask Priced | Actual | Unpriced |

| Bit | Name | Set | Clear |
|-----|------------|--------|----------|
| 4 | Reserved | | |
| 5 | Reserved | | |
| 6 | Bid Priced | Actual | Unpriced |
| 7 | Reserved | | |

¹ Applicable for Update messages only. Ignore for other messages.

3.3.17 Extended Security

| Field | Offset | Size | Format | Description |
|-----------------|--------|------|------------------|---|
| ChannelSeqNum | 0 | 4 | Unsigned Integer | Monotonically increasing message sequence number at the channel level |
| Symbol | 4 | 10 | ASCII | Ticker symbol |
| LastUpdateMilli | 14 | 8 | Unsigned Integer | Milliseconds from UTC epoch |
| SecurityAction | 22 | 1 | Unsigned Integer | 0x1 = Update 0x2 = Add 0x3 = Delete 0x4 = Spin |
| OTCIssuerID | 23 | 4 | Unsigned Integer | Unique issuer ID |
| SecurityDesc | 27 | 25 | ASCII | Description |
| ShortName | 52 | 25 | ASCII | Name of Security. |
| AssetClass | 77 | 1 | Unsigned Integer | 0x1 = Equity 0x2 = Fixed Income |

| Field | Offset | Size | Format | Description |
|---------------|--------|------|------------------|--|
| SecurityType | 78 | 5 | ASCII | Indicates type of security: CS - Common Stock PS - Preferred Stock RTS - Rights UTS - Units OS - Ordinary Shares ADR - American Depository Receipts GDR - Global Depository Receipts WTS - Warrants OTHER - Other Security Type FUND - Fund NYRS - New York Registry Shs SP - Structured Product ETF - Exchange-Traded Fund CORP – Corporate Bond AGEN – Agency Bond EQLK – Equity Linked Bond |
| PrimaryMarket | 83 | 3 | ASCII | Used to indicate which market or stock exchange the security primarily trades on: OP – OTC Link OB – OTCBB OBP – OTC Link and OTCBB G – Grey Market OY – OTC Bonds N – NYSE O – NASDAQ A – NYSE AMEX X – ARCA |
| SecurityID | 86 | 4 | Unsigned Integer | Unique security ID issued by OTC Markets |
| SecurityFlags | 90 | 2 | BitMap | See Extended SecurityFlag definition |

| Field | Offset | Size | Format | Description |
|-------------------|--------|------|------------------|---|
| Tier | 92 | 1 | Unsigned Integer | The market tier assigned by OTC Markets Group. Valid values: 0 - No Tier 1 - OTCQX U.S. Premier 2 - OTCQX U.S. 5 - OTCQX International Premier 6 - OTCQX International 10 - OTCQB 11 - OTCBB Only 20 - OTC Pink Current 21 - OTC Pink Limited 22 - OTC Pink No Information 30 - Grey Market 50 – OTC Bonds Distributors must display with the price data, the market tier assigned in a manner acceptable to OTC Markets Group. Please see the Data Display Requirements document. |
| ReportingStatus | 93 | 1 | ASCII | A - Alternative Reporting Standard B - Bank/Thrift F – SEC Reporting G - International Reporting I - Insurance Company N -No Reporting O - Other Reporting Standard R - FINRA Reporting V - SEC Reporting - Investment Company W – SEC Reporting – Reg A |
| Disclosure Status | 94 | 1 | Unsigned Integer | The current disclosure status of the issuer: 0 – No Disclosure Status 2 –Current Information 3 – Limited Information 4 – No Information |

| Field | Offset | Size | Format | Description |
|----------------------|--------|--|------------------|---|
| SecurityStatus | 95 | 1 | ASCII | A – Active Q – Quote Only S – Suspended H – Halted I – Internal Halt R – Revoked D – Deleted |
| ParValue | 96 | 8 | Unsigned Integer | 6 decimal places assumed. 0 should be read as null or 'not available'. |
| Coupon | 104 | 8 | Unsigned Integer | 6 decimal places assumed. Field only applies to fixed income (see AssetClass). 0 should be read as null or 'not available.' |
| MaturityDateMilli | 112 | 8 | Unsigned Integer | Milliseconds from UTC epoch. Field only applies to fixed income (see AssetClass). 0 should be read as null or 'not available.' |
| CallableDateMilli | 120 | 8 | Unsigned Integer | Milliseconds from UTC epoch. Field only applies to fixed income (see AssetClass). 0 should be read as null or 'not available.' |
| ADRRatio | 128 | 8 | Unsigned Integer | 6 decimal places assumed. Field only applies to equity securities (see AssetClass) where security type = ADR, GDR or NYRS. 0 should be read as null or 'not available.' |
| ADRLLevel | 136 | 15 | ASCII | Field only applies to equity securities (see AssetClass) where security type = ADR, GDR or NYRS. 0 should be read as null or 'not available.' |
| Security Detail Size | 151 | 1 | Unsigned Integer | Size of Security Detail field If zero Security Detail will not be present |
| Security Detail | 152 | Variable maximum 75 (SecurityDetail Size) | ASCII | Security Detail |
| Issuer Size | Varies | 1 | Unsigned Integer | Size of issuer name field. If zero Issuer Name will not be present |
| IssuerName | Varies | Variable maximum 75 (IssuerSize) | ASCII | Issuer Name |
| CUSIP | Varies | 9 | ASCII | |
| Message Size | | 161-324 | | |

3.3.18 Extended Security Flag

This flag notes security level attributes and is only included in the Security Message.

| Bit | Name | Set | Clear |
|-------|---|-----|-------|
| 0 | PiggybackFlag 15c2-11 "PiggyBack" exempt security status flag | Yes | No |
| 1 | CaveatFlag Indicates whether a Caveat Emptor warning has been applied to the security. | Yes | No |
| 2 | RegShoFlag Indicates if security is on Regulation SHO/NASD Rule 3210 Threshold Security List | Yes | No |
| 3 | UnsolicitedOnlyFlag Indicates if security may only be quoted Unsolicited. | Yes | No |
| 4 | SponsoredStatus | Yes | No |
| 5 | OTC Link ECN Eligible Indicates if security is eligible for trading on OTC Link ECN. | Yes | No |
| 6 | OTC Link Messaging Disabled | Yes | No |
| 7 | SaturationEligibleFlag Indicates if a security is eligible to have their quotes 'saturated.' Quote saturation is an OTC Link policy where quotes are removed from 'Inside Price' consideration due to a lack of responsiveness (to trade messages) by a participant. | Yes | No |
| 8 | Investment Grade Applies to fixed income only. Indicates if the security is Investment Grade. Status source is FINRA TRACE. | Yes | No |
| 9 | TradingFlat Applies to fixed income only. Indicates if the security is trading flat (no coupon) | Yes | No |
| 10 | Callable Applies to fixed income only. Indicates if the security is callable. | Yes | No |
| 11-15 | Reserved | | |

3.3.19 Extended Security (No CUSIP)

| Field | Offset | Size | Format | Description |
|---------------|--------|------|------------------|---|
| ChannelSeqNum | 0 | 4 | Unsigned Integer | Monotonically increasing message sequence number at the channel level |

| Field | Offset | Size | Format | Description |
|-----------------|--------|------|------------------|--|
| Symbol | 4 | 10 | ASCII | Ticker symbol |
| LastUpdateMilli | 14 | 8 | Unsigned Integer | Milliseconds from UTC epoch |
| SecurityAction | 22 | 1 | Unsigned Integer | 0x1 = Update 0x2 = Add 0x3 = Delete 0x4 = Spin |
| OTCIssuerID | 23 | 4 | Unsigned Integer | Unique issuer ID |
| SecurityDesc | 27 | 25 | ASCII | Description |
| ShortName | 52 | 25 | ASCII | Name of Security. If there is not ShortName, then text in the Issuer field should be used instead. |
| AssetClass | 77 | 1 | Unsigned Integer | 0x1 = Equity 0x2 = Fixed Income |
| SecurityType | 78 | 5 | ASCII | Indicates type of security: CS - Common Stock PS - Preferred Stock RTS - Rights UTS - Units OS - Ordinary Shares ADR - American Depository Receipts GDR - Global Depository Receipts WTS - Warrants OTHER - Other Security Type FUND - Fund NYRS - New York Registry Shs SP - Structured Product ETF - Exchange-Traded Fund CORP – Corporate Bond AGEN – Agency Bond EQLK – Equity Linked Bond |

| Field | Offset | Size | Format | Description |
|---------------|--------|------|------------------|---|
| PrimaryMarket | 83 | 3 | ASCII | Used to indicate which market or stock exchange the security primarily trades on: OP – OTC Link OB – OTCBB OBP – OTC Link and OTCBB G - Grey Market OY – OTC Bonds N – NYSE O – NASDAQ A – NYSE AMEX X – ARCA |
| SecurityID | 86 | 4 | Unsigned Integer | Unique security ID issued by OTC Markets |
| SecurityFlags | 90 | 2 | BitMap | See Extended SecurityFlag definition |
| Tier | 92 | 1 | Unsigned Integer | The market tier assigned by OTC Markets Group. Valid values: 0 - No Tier 1 - OTCQX U.S. Premier 2 - OTCQX U.S. 5 - OTCQX International Premier 6 - OTCQX International 10 - OTCQB 11 - OTCBB Only 20 - OTC Pink Current 21 - OTC Pink Limited 22 - OTC Pink No Information 30 - Grey Market 50 – OTC Bonds Distributors must display with the price data, the market tier assigned in a manner acceptable to OTC Markets Group. Please see the Data Display Requirements document. |

| Field | Offset | Size | Format | Description |
|-------------------|--------|------|------------------|---|
| ReportingStatus | 93 | 1 | ASCII | A - Alternative Reporting Standard B - Bank/Thrift F - SEC Filer G - International Reporting I - Insurance Company N -No Reporting O - Other Reporting Standard R - FINRA Reporting V - SEC Reporting - Investment Company W – SEC Reporting – Reg A |
| Disclosure Status | 94 | 1 | Unsigned Integer | The current disclosure status of the issuer: 0 – No Disclosure Status 2 –Current Information 3 – Limited Information 4 – No Information |
| SecurityStatus | 95 | 1 | ASCII | A – Active Q – Quote Only S – Suspended H – Halted I – Internal Halt R – Revoked D – Deleted |
| ParValue | 96 | 8 | Unsigned Integer | 6 decimal places assumed. 0 should be read as null or 'not available'. |
| Coupon | 104 | 8 | Unsigned Integer | 6 decimal places assumed. Field only applies to fixed income (see AssetClass). 0 should be read as null or 'not available.' |
| MaturityDateMilli | 112 | 8 | Unsigned Integer | Milliseconds from UTC epoch. Field only applies to fixed income (see AssetClass). 0 should be read as null or 'not available.' |
| CallableDateMilli | 120 | 8 | Unsigned Integer | Milliseconds from UTC epoch. Field only applies to fixed income (see AssetClass). 0 should be read as null or 'not available.' |

| Field | Offset | Size | Format | Description |
|----------------------|--------|---|------------------|---|
| ADRRatio | 128 | 8 | Unsigned Integer | 6 decimal places assumed. Field only applies to equity securities (see AssetClass) where security type = ADR, GDR or NYRS. 0 should be read as null or 'not available.' |
| ADRLevel | 136 | 15 | ASCII | Field only applies to equity securities (see AssetClass) where security type = ADR, GDR or NYRS. 0 should be read as null or 'not available.' |
| Security Detail Size | 151 | 1 | Unsigned Integer | Size of Security Detail field If zero Security Detail will not be present |
| Security Detail | 162 | Variable maximum 75 (SecurityDetail Size) | ASCII | Security Detail |
| Issuer Size | Varies | 1 | Unsigned Integer | Size of issuer name field. If zero Issuer Name will not be present |
| IssuerName | Varies | Variable maximum 75 (IssuerSize) | ASCII | Issuer Name |
| Message Size | | 152-317 | | |

3.3.20 Trade

The Trade Message is only sent on the Trade Channel.

A Trade Message is created for every trade that occurs on OTC Markets OTC Link ATS. Note: The OTC Link Trade Channel does not include all OTC equity trades. It only includes those trades negotiated on OTC Link.

| Field | Offset | Size | Format | Description |
|---------------|--------|------|------------------|---|
| ChannelSeqNum | 0 | 4 | Unsigned Integer | Monotonically increasing message sequence number at the channel level |
| TradeID | 4 | 4 | Unsigned Integer | Unique Trade ID |
| TradeAction | 8 | 1 | Unsigned Integer | 0x2 = Add |
| TradeFlags | 9 | 1 | Bit map | see TradeFlag definition |
| SecurityID | 10 | 4 | Unsigned Integer | OTC Markets security ID |

| Field | Offset | Size | Format | Description |
|---------------------|---------------|-------------|------------------|---|
| TradeStatus | 14 | 1 | Bit map | See TradeStatus definition |
| Deprecated | 15 | 4 | ASCII | Deprecated. Spaces will be sent in message. |
| Deprecated | 19 | 4 | ASCII | Deprecated. Spaces will be sent in message. |
| TradePrice | 23 | 8 | Unsigned Integer | Price, 6 decimal places assumed |
| TradeSize | 31 | 4 | Unsigned Integer | Number of shares |
| TradeTimeMilli | 35 | 8 | Unsigned Integer | Milliseconds from UTC epoch |
| Message Size | | 43 | | |

3.3.21 Trade Flag

| Bit | Name | Set | Clear |
|-----|------------|-----|-------|
| 0 | Deprecated | | |
| 1-7 | Reserved | | |

3.3.22 Trade Status

| Bit | Name | Set | Clear |
|-----|-----------|-----|-------|
| 0 | Irregular | Yes | No |
| 1-7 | Reserved | | |

3.3.23 Trade Statistics

The Trade Statistics message disseminates statistical data on trades occurring on OTC Link ATS as well as data for trades occurring away from OTC Link ATS as submitted by the respective market participant.

Data is sent out at the Security – Market Participant level.

Messages are sent out at set delayed intervals 15 or 60 minutes from 10:00 AM to 4 PM. The delay interval is set by the market participant. Depending on the interval set, the first message for a market participant will be sent out at 10:00 or 10:45. The first message will include all advertised trades from the start of trading until 9:45. The second publication is sent out 15 or 60 minutes later as determined by the market participant interval setting (i.e., 10:15 or 11:45). It includes accumulated volume up to the previous publication (i.e., 10:00 or 10:45).

At 4 PM and again at 5 PM all OTC Link ATS and market participant submitted trades up to that time, independent of delay interval and whether or not the trade was marked for advertisement, for all market participants and securities will be sent out.

| Field | Offset | Size | Format | Description |
|---------------|--------|------|------------------|---|
| ChannelSeqNum | 0 | 4 | Unsigned Integer | Monotonically increasing message sequence number at the channel level |
| SecurityID | 4 | 4 | Unsigned Integer | OTC Markets security ID |
| MMID | 8 | 4 | ASCII | Market Participant ID |

| Field | Offset | Size | Format | Description |
|---------------------|---------------|-------------|------------------|--|
| TotalAdvertVol | 12 | 8 | Unsigned Integer | Total advertised volume by the Market Participant for security. |
| TotalAdvertTrades | 20 | 4 | Unsigned Integer | Total number of advertised trades by the Market Participant for security. |
| TotalAdvertDoIVol | 24 | 8 | Unsigned Integer | Total Dollar Volume of advertised trades by Market Participant for security. |
| UpdateTimeMilli | 32 | 8 | Unsigned Integer | Milliseconds from UTC epoch |
| Message Size | | 40 | | |

4. Message Recovery

Since by its nature multicast distribution is unreliable, messages may be lost or delivered out of order. Therefore, the subscriber must implement message recovery processing. To aid in this processing three recovery mechanisms are provided:

1. Multicast Group Redundancy: The data for each product is distributed via two multicast groups (A/B) that are routed over separate network paths.
2. Gap Fills: A TCP socket based message recovery service is provided for any messages that are missed on both A and B feeds.
3. On-Demand Snapshots: Snapshots may be requested via TCP for all channels excluding the OTC Link Trade channel. Data will be delivered via the respective dedicated snapshot channel.

Note: A test/certification environment is available. Please refer to our 'Multicast Group' document at <http://www.otcmarkets.com/content/doc/binary-multi-cast-groups.pdf> for the correct IPs/ports.

4.1 A/B Feed Arbitration

The real time data for each product is distributed via two multicast groups (A/B) that are routed over separate network paths. The A channel is published from our primary data center in Carlstadt and the B channel is published out of our secondary data center in Philadelphia.

Each of the A and B channels will contain the identical message level traffic, but not identical packet level traffic. The message level sequence number can be used to detect gaps on an individual channel. If a gap is detected on one channel, the missing messages can be recovered from the other channel. This arbitration should be done at the message level, and not at the packet level.

Note that the Snapshot channels are also published from both Data Centers as A and B channels. However, the snapshot channels are not synchronized and cannot be arbitrated. If gaps are detected on a snapshot, must wait for/request another snapshot. There is no gap fill for snapshot data.

4.2 Gap Fill Recovery

The Recovery Server listens on a TCP socket for Gap Fill requests. Subscribers can use this service for requesting resends of missed market data messages from the multicast channels. The subscriber should initiate a TCP socket connection with the Recovery Server when a message gap is detected. After the replay request has been satisfied by the Recovery Server the TCP socket will be closed by the service.

Before requesting a resend of "missed" messages, the subscriber must make sure that the particular message or messages have indeed been missed, and have not simply been delivered out of order by the underlying UDP protocol. This procedure would entail keeping track of missed messages by using a combination of techniques e.g. tracking ApplSeqNum for gaps and setting a timer at the expiry of which, if the missing message or messages has not been received it is safe to assume the message or messages are lost and no longer available on the multicast stream. Another suggestion is to set a "gap tolerance" of 'N' messages -- a resend request should only be sent after receiving the Nth message (by sequence number) after the missed message.

The Recovery Server supports replay requests for missed messages from the real-time data multicast channels. Use field 1355 (RefApplID) in the Replay Request message to specify the channel being requested.

One Recovery Server is located in our primary data center (Carlstadt) from where the A feeds are published, and one Recovery Server is located in our secondary data center (Philadelphia) from where the B feeds are published. For gaps on the real-time channels, the gap fill request may be sent to either data center.

Gap Fill Restrictions: A single request is limited to a maximum of 2000 messages. To fill larger gaps, clients will need to send multiple requests or request a snapshot (See 5.3 Snapshot Recovery). The server will enforce throttling on the resend connection to prevent excessive resend activity on one client connection from negatively affecting the overall system. Therefore, requests may be queued if received at a rapid rate. Throttles are based on market conditions and may change over time.

The Gap Fill mechanism exists to enable subscribers to recover from short network or application outages. To recover from longer outages, the Snapshot Recovery mechanism should be used.

4.3 Snapshot Recovery

To assist in quick recovery after a system failure at a client, a snapshot request feature is available for the following market data channels:

1. Quote Book Channel
2. Quote Book with Global OTC Channel
3. Quote Inside Channel
4. Quote Inside with Global OTC Channel
5. Reference Price Channel
6. Extended Security (with CUSIP)
7. Extended Security (without CUSIP)

Requesting a Multicast Snapshot: Each real-time multicast feed channel has a corresponding dedicated snapshot channel. A snapshot request (Replay Request with 1347 = 1) can be sent on the TCP socket connection to the Recovery Server. On receiving the request, the Recovery Server will acknowledge the request by sending a Resend Request Ack on the TCP connection, and start publishing a snapshot on the appropriate multicast snapshot channel. The TCP connection will be closed after the Resend Request Ack has been sent. In some cases, the subscriber may start receiving the snapshot before the Ack is received. If a snapshot broadcast is in progress, the request snapshot will not begin until the in progress snapshot has completed.

Processing a Multicast Snapshot: Before sending a snapshot request message, the subscriber must buffer all messages on the appropriate product multicast channel. Once a complete snapshot refresh has been received, the subscriber/client can apply the buffered messages and then resume normal real-time message processing.



Quote Book Channel

- (6)Quote Update
(ChannelSeqNum=62 QuotelD=1)
- (4)Quote Update
(ChannelSeqNum=61 QuotelD=3)
- (3)Quote Update
(ChannelSeqNum=60 QuotelD=2)

Quote Book Snapshot Channel

- (8)End of Market Data spin
Last ChannelSeqNum=61
- (7)Quote Message
(ChannelSeqNum=61 QuotelD=3)
- (5)Quote Message
(ChannelSeqNum=60 QuotelD=2)
- (2)Quote Message
(ChannelSeqNum=59 QuotelD=1)
- (1)Start of Market Data Spin
Last ChannelSeqNum=61



Message Processing Timeline

- (1) Quote Book Spin begins indicating the last sequence number applied to this spin is 61
- (2) Quote Message arrives and is processed
- (3) Quote Update arrives and is buffered
- (4) Quote Update arrives and is buffered
- (5) Quote Message arrives and is processed
- (6) Quote Update arrives and is buffered
- (7) Quote Message arrives and is processed
- (8) Quote Book Spin completes
- (9) Quote Update (3) discarded message ChannelSeqNum < last ChannelSeqNum applied
- (10) Quote Update (4) discarded message ChannelSeqNum < = last ChannelSeqNum applied
- (11) Quote Update (6) applied message ChannelSeqNun > last ChannelSeqNum applied
- (12) Recovery complete normal processing resumes

4.4 Recovery Message Definitions

The following messages are supported on the TCP socket based resend channel:

- Replay Request
- Replay Request Ack
- Appropriate market data message (for gap fill requests)

The Replay Request and Replay Request Ack messages are formatted in a TAG=VALUE[SOH] FIX-like format. i.e. each field consists of four items:

1. The tag number
2. The = sign
3. The value
4. The SOH character

The messages are terminated by the final SOH character on the checksum field.

4.4.1 Replay Request

| Tag | Field Name | Required | Description |
|------|-----------------------|----------|---|
| 35 | Message Type | Y | BW |
| 49 | SenderCompID | Y | Message Sender |
| 1346 | ApplReqID | Y | Unique ID identifying this request. |
| 1347 | ApplReqType | N | 0 = Gap Fill Request 1 = Snapshot Request If this field is not present, value 0 (Gap Fill Request) is assumed |
| 1355 | RefApplID | Y | A unique id identifying the applicable channel for the request. Use IDs defined in Table 2: Channel Descriptions and IDs |
| 1182 | ApplBegSeqNo | Y | Application sequence number of first message in range to be resent. Not required for snapshot request. |
| 1183 | ApplEndSeqNo | Y | Application sequence number of last message in range to be resent. If request is for a single message ApplBeginSeqNo = ApplEndSeqNo. A maximum of 2000 messages can be requested per Gap Fill Request message. Not required for snapshot request. |
| 10 | Checksum ¹ | Y | Three byte checksum |

¹ Follow the standard FIX protocol algorithm in calculating the checksum. This consists of summing up the decimal value of the ASCII representation all the bytes up to the checksum field (which is last) and returning the value modulo 256.”

4.4.2 Resend Request Ack

| Tag | Field Name | Present | Description |
|------|------------------|-----------|---|
| 35 | Message Type | Always | BX |
| 59 | TargetCompID | Always | Message Recipient |
| 1346 | ApplReqID | Always | Identifier of the request associated with this ACK message |
| 1348 | ApplResponseType | Always | 0 – Request successfully processed 1 – Request limits exceeded 2 – Messages are not available 3 – User not entitled to application 4 – Badly formed request Field 58 may provide additional details. |
| 58 | Text | Sometimes | May contain additional descriptive detail about the response when 1348 is non-zero. |
| 1355 | RefApplID | Always | Echo back of the RefApplID received in the Request message. |
| 1182 | ApplBegSeqNo | Sometimes | Application sequence number of first message in range to be resent. Present if field 1348 = 0. |
| 1183 | ApplEndSeqNo | Sometimes | Application sequence number of last message in range to be resent. Present if 1348 = 0. |
| 10 | Checksum | Always | Three Byte Checksum |

If the Replay Request was for a Snapshot, the TCP socket connection will be terminated by the Recovery Server after the Replay Request Ack is sent.

If the Replay Request was for a Gap Fill, the appropriate messages will follow the Replay Request Ack.

Please use our replay server test/certification environment for testing. Details regarding the test environment may be found in our 'Multicast Group' document at <http://www.otcmartets.com/content/doc/binary-multi-cast-groups.pdf>.

5. Appendix

5.1 OTC Market Tier/BB Quoted – OTC Primary Market Mapping

The below table notes the mapping between the OTC Tier value, the BB Quoted value and the OTC Primary Market value. The Primary Market for OTC equity securities may be derived from the combination of OTC Tier and BB Quoted values noted below.

Note: The BB Quoted flag will always be set to No for No Tier (0), Grey Market (30) and OTC Bonds (50) tiers. It is not possible to quote these securities on the OTCBB.

| OTC Market Tier | BB Quoted | Primary Market Mapping |
|---|------------------|------------------------|
| OTCQX (1,2,5,6), OTCQB (10) and OTC Pink (20,21,22) | Yes | OTC Link/OTCBB (OBP) |
| OTCQX (1,2,5,6), OTCQB (10) and OTC Pink (20,21,22) | No | OTC Link (OP) |
| OTCBB Only (11) | Yes ¹ | OTCBB (OB) |

¹ BB Quoted value will always be Yes if OTC Market Tier is 'OTCBB Only'

Document Revision History

| Version | Description of Version | Date Completed |
|---------|---|----------------|
| 3.8 | Replaced 144A flag with OTCM ECN Eligible flag | 2017.07.28 |
| 3.7 | Amendment of UnsolicitedOnlyFlag definition. | 2017.05.26 |
| 3.6 | Addition of Quote Book and Quote Inside Channels containing Global OTC data | 2016.12.19 |
| 3.5 | Updated delay intervals for Trade Statistics message | 2016.07.01 |
| 3.4 | Clarified 'Saturation' concept for Inside messages | 2016.06.09 |
| 3.3 | Addition of Trade Statistic message, Addition of ExtendedQuoteFlag to Quote message, Addition of SaturationEligible Flag to Security Flag | 2015.10.01 |
| 3.2 | Updates for server redundancy | 2015.04.29 |
| 3.1 | Add State Open/Close flag for Insides and Reference Price | 2013.12.09 |
| 3.0 | New Binary Messages; removal of Price Depth Channel documentation | 2013.07.11 |
| 2.4 | Clarification of packet header timestamp Removed details regarding periodic snapshots | 2012.10.09 |
| 2.3 | Clarification regarding null symbols for fixed income securities. Added replay server test environment notation. | 2012.03.21 |
| 2.2 | Addition of BB Quoted flag to the Security Flag (3.3.6). Amendment of snapshot interval timing to every 10 minutes (from 3 minutes) | 2012.02.21 |
| 2.1 | Added specifications for snapshot request functionality. Added appendix section clarifying the tier to venue mapping. | 2011.12.12 |
| 2.0 | Added specifications for Ascii formatted Reference Data and Trade Data channels On Quote Flag field, renamed the QuoteType bit to QuoteSide. | 2011.10.06 |
| 1.0.9 | Made Security message compact by eliminating non-essential fields Added Number of marketmakers field to Inside and Price Level messages Added new value "SpinType=3" to Start of Spin and End of Spin messages | 2011.08.12 |
| 1.0.8 | Corrected offsets in Quote Add and Quote Update messages Specified that snapshots are sent every 3 minutes Marked the market open/close messages as non-optional Added restriction of max 2000 messages/request for Gap Fill | 2011.07.28 |

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| | Requests | |
| 1.0.7 | Flipped Solicited to Unsolicited in Quote Flag Switched SecurityStatus from int to char in Security Message | 2011.07.18 |
| 1.0.6 | Removed trader message and also trader id field from Quote Add message Removed Rank fields from Quote Add and Quote Update messages Added Gap Fill Request and Response message definitions Included Ascii channel descriptions in Product/Channel mapping for completeness Added MessagingDisabledFlag in Security message | 2011.07.08 |
| 1.0.5 | Add market maker ID to quote message Full messages for add, delete and spin only all updates single sided | 2011.06.20 |
| 1.0.4 | Change name of Reference Message Types Remove bid and ask market maker ID from Quote Full Update Correct Action field values Correct Spin message order / contents | 2011.06.17 |
| 1.0.3 | Wrong field size in Price Level Reference Wrong data type in Trade Reference | 2011.06.14 |
| 1.0.2 | Sequence number to Spin and Market open/close | 2011.06.03 |
| 1.0.1 | Multicast recovery clarification Spin last sequence number addition | 2011.05.25 |
| 1.0 | Initial Version | 2011.04.25 |