OTC Link ECN Multicast Data Feeds

Technical Specification

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Document Revision History

Version	Description of Version	Date Completed
.04	Updated Unsolicited Quote definition. Amended OTC Link ECN Eligible flag.	5/2017
.03	Add Link quote message definitions	5/2017
.02	Amendments to Market Open/Close, Security Message	5/2017
.01	Initial Version	4/2017

1. Introduction

1.1 Overview

This document provides technical specifications for OTC Markets Group's Electronic Communication Network ("OTC Link ECN") market data feeds.

OTC Link ECN publishes a complete Order by Order (Depth) feed as well as consolidated feeds that include OTC Link ATS and Global OTC quotes.

The 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 https://www.otcmarkets.com/services/market-data/realtime-data/overview for more information about these products, and for the latest version of this document.

Information on OTC Link ATS specific data feeds may be found here: http://www.otcmarkets.com/content/doc/otc-markets-multicast-spec.pdf

1.2 Data Licensing

OTC Markets Group offers a number of display and non-display licensing options for our market data. Subscribers to OTC Link ATS data licenses will not incur additional licensing fees or reporting obligations to use OTC Link ECN data.

OTC Markets offers the following OTC Link ECN data products:

- **OTC Link ECN Depth:** Real-time OTC Link ECN order by order and trade information. Market Participant source attribution is not provided. Please see the OTC Markets Display Requirements document for details regarding data display.
- **OTC Link ECN Depth & OTC Link ATS Depth:** Real-time OTC Link ECN order by order and trade information. Real-time OTC Link ATS quote book data including market participant information, and real-time OTC Link Trade information. Please see the OTC Markets Display Requirements document for details regarding data display.

  OTC Link ECN Depth & OTC Link ATS Depth (with Global OTC)[1]: Real-time OTC Link ECN order by order and trade information. Real-time OTC Link ATS quote book data including market participant information, and real-time OTC Link Trade information. OTC Link ATS quote data will also include Global OTC data. Please see the OTC Markets Display Requirements document for details regarding data display.

See fee schedule: http://www.otcmarkets.com/services/market-data/fee-schedule/overview

For licensing or fee questions, please contact us at marketdata@otcmarkets.com.

[1] Requires licensing with ICE/NYSE Market Data

1.3 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
OTC Link ECN Depth Channels	All individual order, trade and security messages.	24	25
OTC Link ECN Depth Channels + Link ATS	All individual order, trade, security and Link ATS quote messages	26	27
OTC Link ECN Depth Channels + Link ATS + Global OTC	All individual order, trade, security and Link ATS quote messages	28	29

Table 1: Channel Descriptions and IDs

2. Connectivity

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

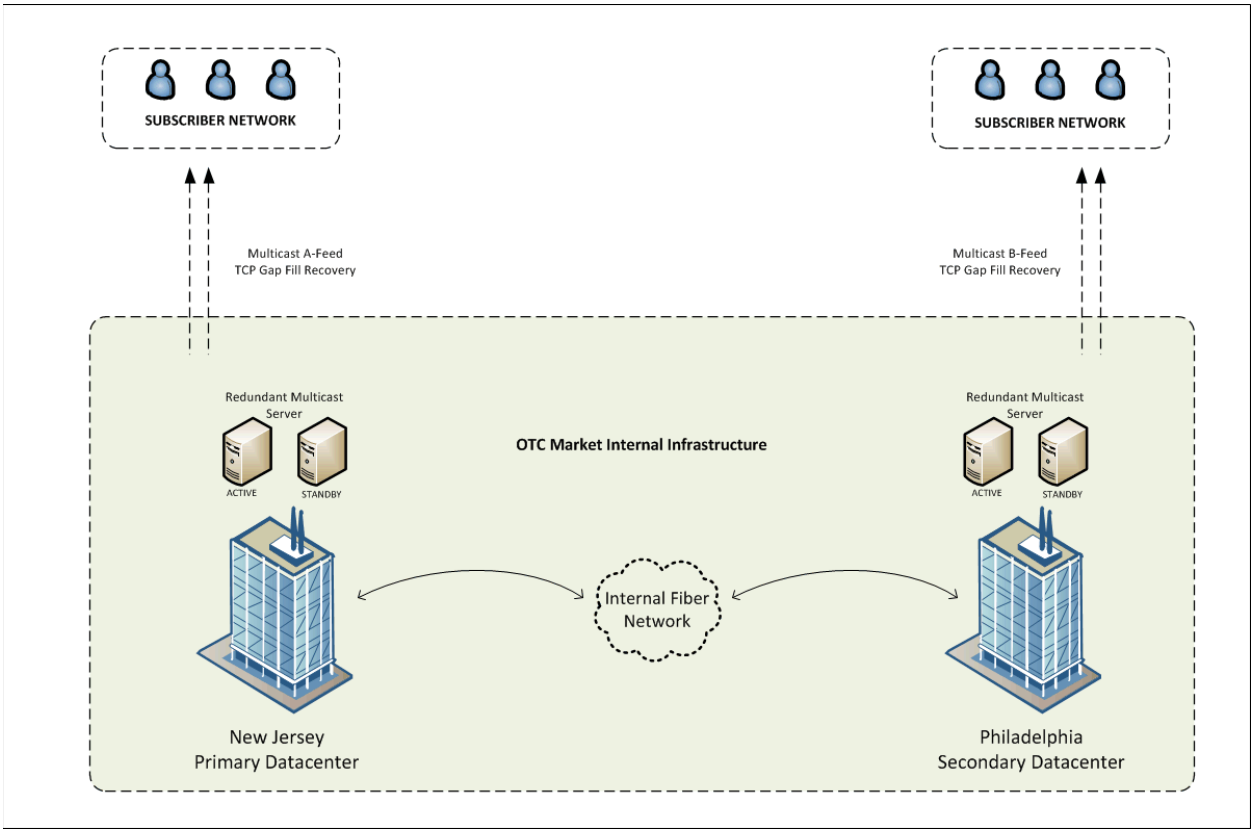
IP, Group and Port information for our production and certification environments may be found in our Multicast Group documentation.

Clients should contact OTC Markets Group technical support (techsupport@otcmarkets.com) 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: https://www.otcmarkets.com/content/doc//otcm-ecn-multicast-groups.pdf



2.2 Bandwidth Recommendations

Connection via Extranet: Please refer to https://www.otcmarkets.com/services/market-data/realtime-data/connection for bandwidth requirements for each channel.

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

2.3 Supported Carriers

Please refer to http://www.otcmarkets.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 https://www.otcmarkets.com/content/doc//otcm-ecn-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	Binary Integer	Size of packet + header size in bytes
SeqNum	2	4	Binary 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	Binary Integer	Number of messages in packet
PacketMilli	8	4	Binary 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		
4	Reserved		

Bit	Name	Set	Clear
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	Binary Integer	Size of message + header size in bytes
MessageType	2	1	Binary Byte	Size of message + header size in bytes
Message Payload	3	-		

Message	Security	Start of Spin	End of Spin	Market Open	Market Close	Order Add	Order Update	Order Delete	Order Execution	Trade	Trade Break	Link ATS Quote	Link ATS Quote Update
Value	9	11	12	13	14	20	21	22	23	24	25	26	27

Table 1: Message Type Values

3.2 Binary Message To Channel Mapping

Message Name	Message Type	Sent on Channel	Channel ID
Security	9	All channels	24,25,26,27,28,29
Start of Spin	11	All channels	24,25,26,27,28,29
End of Spin	12	All channels	24,25,26,27,28,29
Market Open	13	All channels	24,25,26,27,28,29
Market Close	14	All channels	24,25,26,27,28,29
Order Add	20	All channels	24,25,26,27,28,29
Order Update	21	All channels	24,25,26,27,28,29
Order Delete	22	All channels	24,25,26,27,28,29
Order Execution	23	All channels	24,25,26,27,28,29
Trade	24	All channels	24,25,26,27,28,29
Trade Break	25	All channels	24,25,26,27,28,29
Link ATS Quote	26	ECN Depth Channels & Link ATS, ECN Depth Channels & Link ATS with Global OTC	26,27,28,29
Link ATS Quote Update	27	ECN Depth Channels & Link ATS, ECN Depth Channels & Link ATS with Global OTC	26,27,28,29

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	Binary Integer	Monotonically increasing message sequence number at the channel level
SpinType	4	1	Binary Byte	1 - Reference 2 - Market Data 3 - Opening
SpinStartTimeMilli	5	8	Binary Integer	Milliseconds since UTC epoch
SpinLastSeqNum	13	4	Binary 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	Binary Integer	Monotonically increasing message sequence number at the channel level
SpinType	4	1	Binary Byte	1 - Reference 2 - Market Data 3 - Opening
SpinMsgCt	5	4	Binary Integer	Total messages in spin
SpinEndTimeMilli	9	8	Binary Integer	Milliseconds since UTC epoch
SpinLastSeqNum	17	4	Binary Integer	Last sequence number applied to this spin
Message Size		21		

3.3.3 Market Open

This message is sent out at 6 AM and 8 AM to note Market Open for OTC Link ATS and OTC Link ECN, respectively. The message can also be sent mid-day if a technical outage caused a temporary closure of a market. If a quote only session is mandated, multiple Market Open messages will be disseminated (applies to Link ATS only).

Field	Offset	Size	Format	Description
ChannelSeqNum	0	4	Binary Integer	Monotonically increasing message sequence number at the channel level
MarketOpen	4	8	Binary Integer	Milliseconds since UTC epoch
MarketClose	12	8	Binary Integer	Anticipated market close Milliseconds since UTC epoch
Venue	20	1	Binary Byte	1 – OTC Link ATS 2 – OTC Link ECN
QuoteOnly	21	1	Binary Byte	0 – Quoting and Trade Messaging enabled 1 – Quoting only (only pertains to OTC Link ATS), Quoting only status may be followed by another Market Open message where the value equals 0 – Quoting and Trade Messaging Enabled.
Message Size		22		

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	Binary Integer	Monotonically increasing message sequence number at the channel level
MarketCloseTimeMilli	4	8	Binary Integer	Milliseconds since UTC epoch midnight
Venue	20	1	Binary Byte	1 – OTC Link ATS 2 – OTC Link ECN
MarketMsgCt	12	4	Binary Integer	Total day message count
Message Size		16		

3.3.5 Security

The Security Message provides basic security attribute information for all OTC equity securities.

Field	Offset	Size	Format	Description
ChannelSeqNum	0	4	Binary Integer	Monotonically increasing message sequence number at the channel level
Symbol	4	10	Printable 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	Binary Integer	Milliseconds from UTC epoch
SecurityAction	22	1	Binary Integer	0x1 = Update 0x2 = Add 0x3= Delete 0x4= Spin
AssetClass	23	1	Binary Integer	0x1 = Equity 0x2 = Fixed Income
SecurityID	24	4	Binary Integer	Unique security ID issued by OTC Markets
SecurityFlags	28	1	Bit Field	See SecurityFlag definition

Field	Offset	Size	Format	Description
Tier	29	1	Binary 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	Printable 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	Printable 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 a 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 ATS 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 - 15	Reserved		

3.3.7 Order Add

Field	Offset	Size	Format	Description
Sequence Number	0	4	Binary Integer	Monotonically increasing message sequence number at the channel level
Time	4	4	Binary Integer	Milliseconds from midnight
Order Id	8	8	Binary Long	Day-specific identifier assigned to this order
Side Indicator	16	1	Printable ASCII	"B" = Buy Order "S" = Sell Order
Quantity	17	4	Binary Integer	Number of shares being added to the book
Symbol	27	14	Printable ASCII	Symbol right padded with spaces.

Field	Offset	Size	Format	Description
Price	41	8	Binary Long Price	The limit order price
Order Flags	49	2	Bit Field	TBD
Message Size		51		

3.3.8 Order Update

Field	Offset	Size	Format	Description
Sequence Number	0	4	Binary Integer	Monotonically increasing message sequence number at the channel level
Time	4	4	Binary Long	Milliseconds from midnight
Order Id	8	8	Binary Long	Order Id of a previously sent Add Order message that has been modified
Quantity	16	4	Binary Integer	Number of shares associated with this order after this modify (may be less than the number entered)
Price	20	8	Binary Long Price	The limit order price after this modify
Modify Flags	28	2	Bit Field	TBD
Message Size		30		

3.3.9 Order Delete

Field	Offset	Size	Format	Description
Sequence Number	0	4	Binary Integer	Monotonically increasing message sequence number at the channel level
Time	4	4	Binary Integer	Milliseconds from midnight
Order Id	8	8	Binary Long	Order Id of a previously sent Add Order message that has been deleted.
Message Size		16		

3.3.10 Order Flag

This flag is part of two messages: Order Add and Order Update

Bit	*Name*	Set	Clear
0 - 15	Reserved		

3.3.11 Order Execution

Field	Offset	Size	Format	Description
Sequence Number	0	4	Binary Integer	Monotonically increasing message sequence number at the channel level
Time	4	4	Binary Integer	Milliseconds from midnight
Order Id	8	8	Binary Long	Order Id of a previously sent Add Order message that was executed
Executed Quantity	16	4	Binary Integer	Number of shares executed
Remaining Quantity	20	4	Binary Integer	Number of shares remaining after the execution. Will be zero if fully filled.

Field	Offset	Size	Format	Description
Execution Id	24	8	Binary Long	System generated day- unique execution identifier of this execution. Execution Id is also referenced in the Trade Break message
Price	32	8	Binary Long Price	The execution price of the order
Message Size		40		

3.3.12 Trade (Non-Displayed Liquidity)

Executions performed against non-displayed liquidity will be noted in the Trade message.

Field	Offset	Size	Format	Description
Sequence Number	0	4	Binary Integer	Monotonically increasing message sequence number at the channel level
Time	4	4	Binary Integer	Milliseconds from midnight
Side Indicator	8	1	Printable ASCII	Always "B" = Buy Order regardless of resting side
Quantity	9	4	Binary Integer	Incremental number of shares executed
Symbol	13	14	Printable ASCII	Symbol right padded with spaces.
Price	27	8	Binary Long Price	The execution price of the order
Execution Id	35	8	Binary Long	System generated day- unique execution identifier of this trade. Execution Id is also referenced in the Trade Break message.
Reserved	35	8	Bit Field	Reserved
Message Size		51		

3.3.13 Link ATS Quote

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	Binary Integer	Monotonically increasing message sequence number at the channel level
QuoteID	4	4	Binary Integer	Unique Quote ID
QuoteAction	8	1	Binary Byte	0x2 = Add 0x3= Delete 0x4= Spin
QuoteFlags	9	1	Bit Map	see QuoteFlag definition
Symbol	10	14	Printable ASCII	Symbol right padded with spaces.
MPID	14	4	Printable ASCII	Market Participant ID owning the quote always 4 characters
AskPrice	18	8	Binary Long Price	6 decimal places assumed
AskSize	26	4	Binary Integer	Number of shares
AskQAP	30	1	Signed Binary	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	Binary Long	Milliseconds from UTC epoch
BidPrice	39	8	Binary Long Price	6 decimal places assumed
BidSize	47	4	Binary Integer	Number of shares
BidQAP	51	1	Signed Binary	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	Binary Long	Milliseconds from UTC epoch
QuoteReferenceID	60	2	Binary	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		73		

3.3.14 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	Binary Integer	Monotonically increasing message sequence number at the channel level
QuoteID	4	4	Binary Long	Quote ID refers back to original Quote Reference
Symbol	10	14	Printable ASCII	Symbol right padded with spaces.
MPID	14	4	Printable ASCII	Market Participant ID owning the quote always 4 characters
QuoteFlags	8	1	Bit Map	see QuoteFlag definition
Price	9	8	Binary Integer	Price, 6 decimal places assumed
Size	17	4	Binary Integer	Number of shares
QAP	21	1	Signed Binary	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	Binary Integer	Milliseconds from UTC epoch
QuoteReferenceID	30	2	Binary 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		47		

3.3.15 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

Bit	Name	Set	Clear
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
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 5,6 and 7.

3.3.16 Extended Quote Flag

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

Bit	Name	Set	Clear
0	QuoteSaturatedFlag Notes if quote should be considered for the inside price. Yes value means the quote should NOT be considered.	Yes	No
1	BidAutoExFlag Notes if quote is in AutoEx mode where a response to a trade message will be immediate	Yes	No
2	OfferAutoExFlag Notes if quote is in AutoEx mode where a response to a trade message will be immediate	Yes	No
3	NMSConditionalQuoteFlag**	Yes	No
4	Reserved		
5	Reserved		
6	Reserved		
7	Reserved		

**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.

3.3.17 Trade Break

Field	Offset	Size	Format	Description
Sequence Number	0	4	Binary Integer	Monotonically increasing message sequence number at the channel level
Time	4	4	Binary Integer	Milliseconds from midnight
Execution Id	8	8	Binary Long	System execution identifier of the execution that was broken. Execution Id refers to previously sent Order Executed or Trade message.
Message Size		16		

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 https://www.otcmarkets.com/content/doc//otcm-ecn-multi-cast-groups.pdf for the correct IPs/ports.

4.1 A/B Feed Arbitration

The real-time data for each feed 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 may 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 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 message 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.

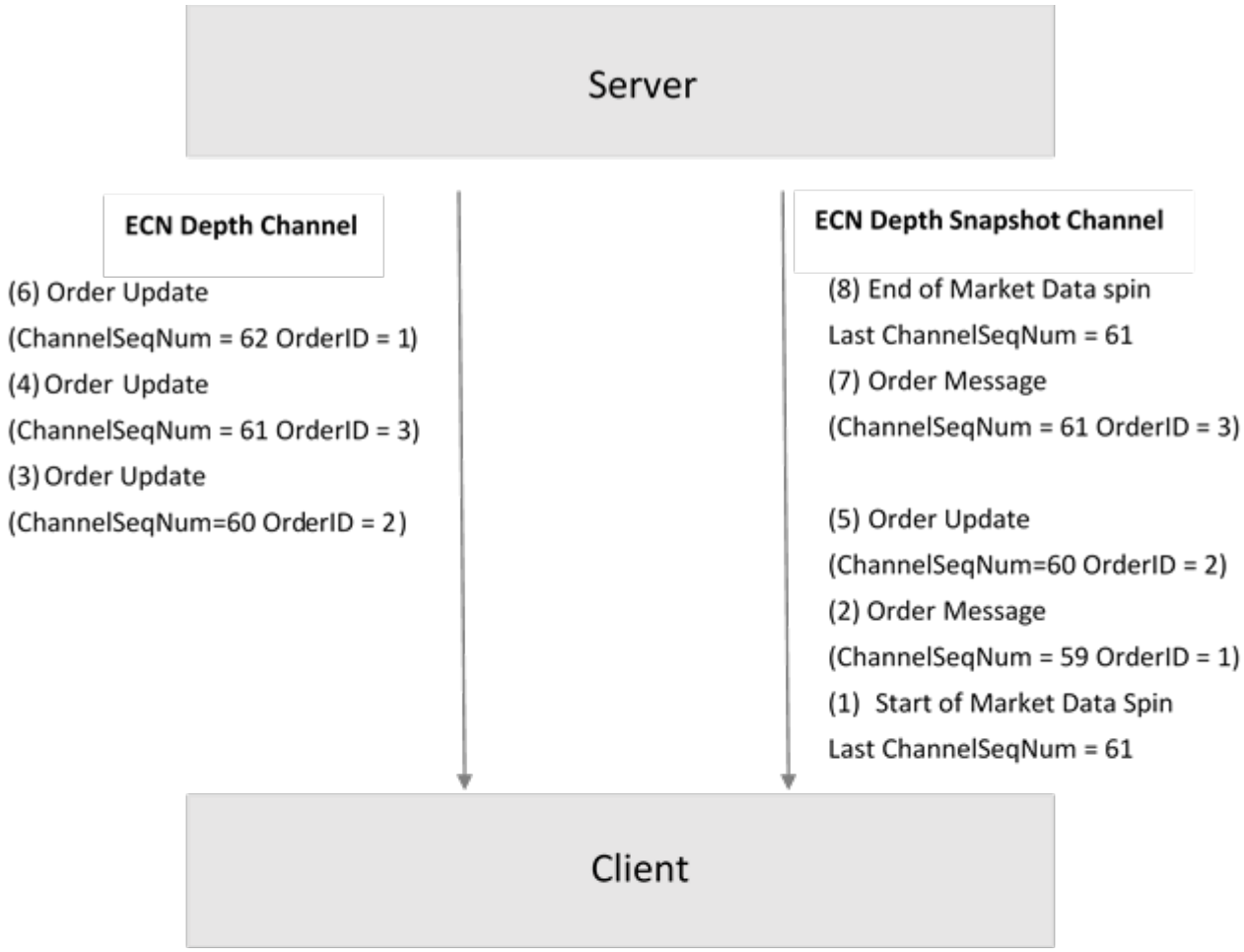
4.3 Snapshot Recovery

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. OTC Link ECN Depth Channel
2. OTC Link ECN & OTC Link ATS Channel
3. OTC Link ECN & OTC Link ATS with Global OTC Channel

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.



Message Processing Timeline

(1) Order Depth Spin begins indicating the last sequence number applied to this spin is 61
(2) Order Message arrives and is processed
(3) Order Update arrives and is buffered
(4) Order Update arrives and is buffered
(5) Order Message arrives and is processed
(6) Order Update arrives and is buffered
(7) Order Message arrives and is processed
(8) End of Spin
(9) Order Update (3) discarded | Message ChannelSeqNum < Last ChannelSeqNum applied
(10) Order Update (4) discarded | Message ChannelSeqNum < = Last ChannelSeqNum applied
(11) Order Update (6) applied | Message ChannelSeqNum > Last ChannelSeqNum applied
(12) Recover 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 1: 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 PRINTABLE 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 https://www.otcmarkets.com/content/doc//otcm-ecn-multi-cast-groups.pdf