Market Data Technical Specifications

15 August 2022

Version 1.3.2

Table of Contents

Version History

Version	Date	Comments
1.0	01 September 2017	Initial Version
1.1	06 February 2018	Styling update
1.2	14 November 2018	Rebrand
1.3	30 July 2020	Addition of AoD, MaC and trade types – LIS and Benchmark Cross
1.3.1	10 February 2021	Fixed formatting errors and corrected message definition for AoD and MaC
1.3.2	15 August 2022	Updated message format for Security Definition and Security Status messages

1 Introduction

A2X Markets (A2X) provides its market data to trading Members and market data

vendors via a number of IP multicast feeds. These feeds consist of real-time order and trade feeds publishing continuously throughout the trading day and snapshot feeds publishing order book data at regular intervals. Additionally, message replay servers are available to offer message gap recovery if required.

This document describes the protocol and message formats for these market data feeds.

1.1 Connectivity

A2X offers both WAN-shaped and Gig-shaped versions of the market data feed for recipients to use depending on the nature of their connectivity to the A2X data centres. Furthermore, A2X offers more than one channel for receiving the market data (for example, two channels from the primary data centre for a particular data stream and a further channel for this stream from the secondary data centre).

The current details of the network configuration, multicast address information and login credentials for the replay service, for both production and test feeds, can be provided by the A2X connectivity team.

1.2 Enquiries / Support

Please contact the A2X support team at support@a2x.co.za for any questions relating to this document.

2 Service Description

2.1 Real Time Market Data Feed

The A2X market data servers monitor trading activity on the system and convert these events into market data messages.

This data is anonymised, so that the messages do not include any information identifying the trading Members involved.

Continuous order-and-trade market data is published using the following messages:

- Order Add
- Order Modify
- Order Cancel
- Trade Report
- Trade Bust

Auction on Demand (AoD) phases are published with a separate message:

- AoD Update

The Market at Close (MaC) phase introduces a new message, purely for the purpose of the MaC:

- MaC Update

Order and Trade reference numbers are assigned by A2X and are unique for the day. Note that a particular order reference can appear multiple times on the market data stream and always represents the same order within the trading system.

The security identifier on the market data messages is a numeric value. A2X provides a security reference data file for recipients to interpret this security id, giving information such as Uniform MTF code, ISIN, currency and MIC for the security. Another reference data file is provided defining the tick tables that apply to the securities. These reference data files are made available for download pre-market open and will be updated daily to reflect securities admitted to or removed from trading and any relevant corporate actions.

Reference data to identify the securities traded on A2X and to provide tick table information is also published on the feed at the start of the day, before market open, using the following messages:

- Tick Table Data
- Security Definition

Note that rarely a Security Definition may be published during the trading day if changes or corrections to the data are necessary.

As the trading status of a security changes, either due to market opening or closing or due to A2X applying a trading halt or regulatory suspension, this update is published using a Security Status message.

Each of these messages on a particular feed carries a sequence number for the day's trading session. The first message of the day is sequence number 1, and this value is incremented with each message published on the data feed.

During trading hours, a Heartbeat message is sent if no trading data has been published for a period of one second. The Heartbeat message carries the sequence number of the next expected trading data message, and so can be used to detect gaps in periods of low trading activity. It does not itself cause the sequence number of the data stream to be incremented.

Heartbeat messages are also sent during periods of technical connectivity pre and post market hours to help recipients check their multicast connectivity.

2.2 Snapshot Feed

In addition to the continuous real-time feed, an order book snapshot is published at fixed intervals (10 seconds) on a separate feed, providing the full book depth of each traded security.

There is a snapshot feed corresponding to each of the market-split continuous feeds. The first message of each snapshot publication is a Snapshot Start message, identifying the sequence number in the continuous stream at the time this snapshot was captured.

For each of these securities, a Book Status message is published reporting the status of the security and identifying the number of open orders in that security followed by a series of Book Entry messages for each of these orders. If there are currently no open orders for a particular security, then the Book Status message carries an entries value of 0 (zero) and there will be no Book Entry messages.

The snapshot feed may be used together with the continuous feed as a way to establish and then maintain a view of the A2X order book as a starting point for a recipient who has missed the market open and connects during the trading day. The snapshot may be used similarly to recover from an outage and to reconstruct the state of the book on re-connecting to the market data feed.

The snapshot data may also be used by a recipient to verify that they are correctly processing the continuous feed to construct an accurate representation of the order book.

2.3 Replay Service

To allow recipients to recover specific messages that may have been missed from the continuous feed, A2X offers a TCP/IP replay service for each feed. This service is provided over TCP/IP and recipients wishing to use it should contact A2X to request login credentials.

On connecting to a replay server, the recipient should send a Login message. The server will send back a Replay Response indicating acceptance, or else will drop the connection if not authenticated. A connection to a replay server can either be maintained from the beginning of the day or opened as needed.

To recover missed messages, the recipient should send a Replay Request message. The replay server validates the request and will respond with the requested range of market data

messages. If the request cannot be serviced then a Replay Response will be sent to explain the failure of the request.

3 Market Data Message Formats

This section provides details of the message formats used within the A2X market data feeds. This includes data types, multicast packet header, message header and message fields and descriptions.

3.1 Data Types

In all messages, 1-byte packing is used and all integers are represented in little-endian format.

Data Type	Size	Value
u8	1	unsigned integer 0 - 255
u16	2	unsigned integer 0 - 65,535
u32	4	unsigned integer 0 - 4,294,967,295
u64	8	unsigned integer 0 - 2^64 - 1
char(*n*)	n	Left justified ascii string, padded with zero (0x00) to length n
price	8	unsigned integer representing price with 5 decimal places implied e.g. value 1462500 represents a price of 14.625
timestamp	8	unsigned integer representing elapsed time in nanoseconds since Unix epoch 00:00 UTC on 1st January 1970

3.2 Multicast Packet Structure

Each packet on the multicast feeds may carry more than one market data message. The structure is as follows:

- Packet Header u8 field message count - number of messages (n) in this packet
- Message 1
- Message 2
- ...
- Message n

The sequence number of each message in the feed is carried in the header of the individual market data messages.

The packet header 'message count' and the sequence number of the first message in the packet can be used together to check for dropped packets by recipients of the multicast data streams.

Note that if the packet is carrying a Heartbeat message then the next expected sequence number should not be incremented.

3.3 Message Header and Heartbeat

3.3.1 Message Header

All market data messages carry a standard message header, as follows:

Field Name	Type	Offset	Width	Comments
MsgType	u8	0	1	Message type identifier
length	u8	1	1	Length of market data message, including header
seqNo	u32	2	4	Sequence number of this message in the market data stream for the current trading day

3.3.2 Heartbeat Message

The Heartbeat message carries no data; it is simply a message header with msgType of 1. As the message carries no business data it does not affect stream sequence number. The seqNo field carries the sequence number of the next business data message expected on the multicast stream.

3.4 Continuous Data Feed Messages

3.4.1 Order Add Message

The Order Add message is published when order quantity is posted to the order book for a particular security:

Field Name	Type	Offset	Width	Comments
Header		0	6	msgType=2
securityId	u16	6	2	Numeric identifier of the relevant security
Side	u8	8	1	1 Buy Order 2 Sell Order
quantity	u32	9	4	Number of shares being added to the book
price	u64	13	8	The price of the order
orderRef	u32	21	4	Order reference number
timestamp	u64	25	8	Timestamp of this market data event

3.4.2 Order Cancel Message

The Order Cancel message is published when a visible order is removed from the book.

The order may have been cancelled by the trading Member or by the A2X support team, the market may have closed, or the order's time-in-force may have expired.

Field Name	Type	Offset	Width	Comments
Header		0	6	msgType=3
securityId	u16	6	2	Numeric identifier of the relevant security
orderRef	u32	8	4	Order reference number
timestamp	u64	12	8	Timestamp of this market data event

3.4.3 Order Modify Message

The Order Modify message is published when a visible order is modified by the client (change of price and/or quantity). The order reference number remains the same on order modification.

Note that on revision of quantity down the order retains its position in the book, otherwise the book is re-ordered.

Field Name	Type	Offset	Width	Comments
Header		0	6	msgType=4
securityId	u16	6	2	Numeric identifier of the relevant security
quantity	u32	8	4	Number of shares remaining in the book
price	u64	12	8	The price of the order
orderRef	u32	20	4	Order reference number
timestamp	u64	24	8	Timestamp of this market data event

3.4.4 Trade Message

Whenever an order trades, partially or fully, a Trade message is published.

Field Name	Type	Offset	Width	Comments
Header		0	6	msgType=5
securityId	u16	6	2	Numeric identifier of the relevant security
tradeType	u8	8	1	Code identifying type of trade (see below)
quantity	u32	9	4	Number of shares traded
price	u64	13	8	The execution price
orderRef	u32	21	4	Order reference number, for *tradeType* 1 (visible)
tradeRef	u32	25	4	Trade reference number

timestamp	u64	29	8	Timestamp of this market data event

The *tradeType* field is used to identify the category of this trade. Currently assigned codes are as follows, others may be added to correspond to new services or order types:

- 1 = a trade against visible order quantity in the continuous trading order book
- 2 = a trade against hidden or reserve quantity in the continuous trading order book
- 3 = Market at Close (MaC) Trade
- 4 = Large In Scale(LIS) Cross Trade
- 5 = Benchmark Cross Trade
- 6 = Auction on Demand (AoD) Trade

For a trade against visible order quantity, the traded quantity should be removed from the associated order in the order book. If the order has fully traded then it should be removed from the order book.
Note that if an incoming aggressive order trades against both the visible peak and hidden reserve portions of an iceberg order, this will result in two Trade messages on the feed. The first, for the visible portion, will carry *tradeType* 1 with an associated *orderRef* for the peak. The second, for the reserve portion, will carry *tradeType* 2 and *orderRef* zero as this reserve order quantity was not previously published to the feed. When the iceberg order is refreshed with a new peak, this will be published as an Order Add message with a new *orderRef* value.

3.4.5 Trade Bust Message

If a trade has been declared erroneous by A2X then a Trade Bust message is published.

Field Name	Type	Offset	Width	Comments
Header		0	6	msgType=6
securityId	u16	6	2	Numeric identifier of the relevant security
quantity	u32	8	4	Number of shares of the original trade
price	u64	12	8	The execution price of the original trade
tradeRef	u32	20	4	Trade reference of the busted trade
timestamp	u64	24	8	Timestamp of this market data event

3.4.6 Tick Table Data Message

A series of Tick Table Data messages are published pre-market to specify the dynamic tick tables and static ticks that apply to the securities traded on A2X. This data controls the valid price increments at which orders may be entered onto the A2X order book.

For dynamic tick tables, there are a set of messages carrying the id and name of the table; these define the tick size (price increment) that applies at increasing price levels. For static ticks there is a single message.

Field Name	Type	Offset	Width	Comments
Header		0	6	msgType=7
tickTableId	u8	6	1	Numeric identifier for this tick table or static tick
name	char(10)	7	10	Short name
threshold	u64	17	8	The price threshold at which this tick data applies
tickSize	u64	25	8	The tick size (price increment)

3.4.7 Security Definition Message

A series of Security Definition messages are published pre-market to identify the securities traded on A2X (those relevant to the particular feed e.g. Euronext securities). These messages allow the securityId field to be used on later trading related market data messages to associate with a particular security in the recipients system. Note that this message may be sent during the day if a change or correction is necessary for a particular security.

Field Name	Type	Offset	Width	Comments	
Header		0	6	msgType=8	
securityId	u16	6	2	Numeric identifier of the relevant security	
UMTF	char(6)	8	6	Uniform MTF code for the security	
ISIN	char(12)	14	12	ISIN for the security	
currency	char(3)	26	3	Trading currency for the security	
MIC	char(4)	29	4	MIC for the security's market of listing	
tickTableId	u8	33	1	Numeric identifier for this security's tick table	
flags	u16	34	2	Bit 0 – macEnabled	0 = Security is not enabled for the MaC 1 = Security is enabled for the MaC
				Bit 1 – testStock	0 = Security is not a test stock 1 = Security is a test stock
				Bit 2 – illiquid	0 = Security is liquid 1= Security is illiquid
				Bit 3	Reserved

Bit 4 – aodEnabled	0 = Security is not enabled for the AoD 1 = Security is enabled for the AoD
Bit 5-15	Reserved

3.4.8 Security Status Message

The Security Status message is published when the trading status of a security changes or when there is a change to the status of the market on A2X to which the security belongs.

Field Name	Type	Offset	Width	Comments	
Header		0	6	msgType=9	
securityId	u16	6	2	Numeric identifier of the relevant security	
tradingStatus	u8	8	1	1	Active
				2	Halted
				3	Suspended
				8	AoD Start
				24	AoD End
				See notes below	
marketFlags	u8	9	1	Bit 0 - trading	0 = Continuous Trading Closed 1 = Continuous Tradging Open
				Bit 1 – macOpen	0 = MaC is Closed 1 = MaC is Open
				Bit 2 – macRun	0 = MaC is not locked down 1 = MaC is locked down
				Bit 3-7	Reserved
timestamp	u64	10	8	Timestamp of this market data event	

If a security's *tradingStatus* is 'halted' (by A2X support for internal reasons) or 'suspended' (for regulatory reasons) then the security cannot be traded.
If a security's *tradingStatus* is 'active', orders for this security can only be entered if the market for this security on A2X is open.
If a security's tradingStatus is 'AoD start', this signals that an AoD order has entered an empty order book and triggered the AoD auction process for this security.
If a security's tradingStatus is 'AoD end', this signals that the auction order book has emptied for this security.

3.5 Auction On Demand (AoD) Data Feed Messages

AoD is available during the hours of continuous trading.

3.5.1 AoD Update Message

During the AoD this message is used to publish the indicative price and indicative matched volume. The first AoD update message signals the start of an auction.

Field Name	Type	Offset	Width	Comments
Header		0	6	msgType=17
securityId	u16	6	2	Numeric identifier of the relevant security
indicativePrice	u64	8	8	Indicative auction price
matchVol	u32	16	4	Indicative matched volume
timestamp	u64	20	8	Timestamp of this market data event

When indicativePrice = 0 and matchVol = 0, this indicates that the auction has finished.

3.5.2 AoD Trade Message

As provided in Section 3.4.4.

3.5.3 AoD Trade Bust Message

As provided in Section 3.4.5.

3.6 Market at Close (MaC) Data Feed Messages

3.6.1 MaC Update Message

During the MaC this message is used to publish the indicative price from the buy and sell order totals.

Field Name	Type	Offset	Width	Comments
Header		0	6	msgType=16
securityId	u16	6	2	Numeric identifier of the relevant security
indicativePrice	u64	8	8	Indicative auction price
closingBuyQty	u32	16	4	Total order quantity on the buy side during the closing market, otherwise set to 0
closingSellQty	u32	20	4	Total order quantity on the sell side during the closing market, otherwise set to 0
timestamp	u64	24	8	Timestamp of this market data event

Note that the matched quantity and unmatched quantity (imbalance) can be determined by comparing the closingBuyQty and closingSellQty values.

3.6.2 MaC Trade Message

As provided in Section 3.4.4.

3.6.3 MaC Trade Bust Message

As provided in Section 3.4.5.

3.6.4 MaC Security Status Message

As detailed in Section 3.4.8.

3.7 Snapshot Feed Messages

3.7.1 Snapshot Start Message

A Snapshot Start message is published as the first message in a snapshot to identify the sequence number in the continuous stream that this snapshot relates to. It also states the number of securities being reported in this snapshot.

Field Name	Type	Offset	Width	Comments
Header		0	6	msgType=10
streamSeqNo	u32	6	4	The sequence number of the last message in the continuous stream which relates to this snapshot
securityCount	u16	10	2	Number of securities reported in this snapshot
timestamp	u64	12	8	Timestamp of this snapshot

3.7.2 Book Status Message

A Book Status message is published to report the trading and market status of each security and the number of open orders on the order book for the security at the time of the snapshot.

Field Name	Type	Offset	Width	Comments
Header		0	6	msgType=11
securityId	u16	6	2	Numeric identifier of the relevant security
tradingStatus	u8	8	1	See Section 3.4.8 (Security Status message)
marketFlags	u8	9	1	See Section 3.4.8 (Security Status message)
entries	u16	10	2	Number of open orders in the book for this security

closingBuyQty	u32	12	4	Total order quantity on the buy side during the closing market, otherwise set to 0 (see note 3.4.9)
closingSellQty	u32	16	4	Total order quantity on the sell side during the closing market, otherwise set to 0 (see note 3.4.9)
indicativePrice	u64	20	8	Indicative auction price

3.7.3 Book Entry Message

An appropriate number of Book Entry messages is published after each Book Status message to provide details of each order and allow the book to be built. Orders are published in price, time priority for one side of the book and then the other>

Field Name	Type	Offset	Width	Comments
Header		0	6	msgType=12
securityId	u16	6	2	Numeric identifier of the relevant security
side	u8	8	1	1 Buy Order 2 Sell Order
quantity	u32	9	4	Number of open shares
price	u64	13	8	The price of the order
orderRef	u32	21	4	Order reference number

3.7.4 MaC Book Entry Message

During the MaC phase, A2X will publish the volume of the 5 best bid and offer orders per

security in chronological order using the MaC Book Entry Message. This message is a snapshot.

Field Name	Type	Offset	Width	Comments
Header		0	6	msgType=18
securityId	u16	6	2	Numeric identifier of the relevant security
side	u8	8	1	1 Buy Order 2 Sell Order
quantity	u32	9	4	Number of open shares
price	u64	13	8	The price of the order
orderRef	u32	21	4	Order reference number

3.8 Replay Service Messages

The replay service allows recipients to recover messages that they have missed from the continuous multicast feed via a dedicated TCP/IP connection, as described in Section 2.3.

Note that the seqNo field in the standard message header is not relevant for these replay service messages; A2X will set the field to zero and will ignore the field on messages from data recipients.

3.8.1 Login Message

If a recipient wishes to use the message replay service, they must first be authenticated by sending a Login message to the relevant replay server.

Field Name	Type	Offset	Width	Comments
Header		0	6	msgType=13
username	char(10)	6	10	As assigned by A2X for the recipient
password	char(10)	16	10	As assigned by A2X for the recipient

3.8.2 Replay Request Message

The recipient sends a Replay Request message to request a particular message or range of messages from the replay server.

Field Name	Type	Offset	Width	Comments
Header		0	6	msgType=14
beginSeqNo	u32	6	4	Stream seqNo of first message requested
endSeqNo	u32	10	4	Stream seqNo of last message requested

3.8.3 Replay Response Message

A2X will send a Replay Response message to the recipient to acknowledge a successful Login or to report problems with a Resend Request.

If a Login does not match a valid username or password then the connection is dropped without a response.

If a Resend Request is accepted, A2X will not send a Replay Response message but will simply send the requested messages over the TCP/IP connection to the recipient.

Field Name	Type	Offset	Width	Comments
Header		0	6	msgType=15

responseCode	u8	6	1	0	Login successful
				1	Bad beginSeqNo in Resend Request
				2	Bad endSeqNo in Resend Request