

TQ401 · TECHNICAL SPECIFICATION

# Turquoise Equities Level-2 ITCH UDP Market Data

ISSUE 2.2 · 5 AUGUST 2011

# Contents

<b>1 INTRODUCTION</b>	<b>4</b>
1.1 Purpose	4
1.2 Readership	4
1.3 Document Series	4
1.4 Document History	5
1.5 Enquiries	6
<b>2. CONNECTIVITY</b>	<b>7</b>
2.1 Transmission Standards	7
2.1.1 Multicast Channels	7
2.1.2 Unicast Channels	7
2.2 ComplIDs	7
2.3 Failover and Recovery	7
<b>3 SERVICE DESCRIPTION</b>	<b>8</b>
3.1 Overview of a Trading Day	8
3.1.1 Start of Day	8
3.1.2 List of Instruments	8
3.1.3 Trading Status	9
3.1.4 Trading Halt	9
3.1.5 Instrument Suspension	9
3.1.6 End of Day	10
3.2 Order Book Management	10
3.2.1 Adding an Order	10
3.2.1.1 Identifying Own Orders	11
3.2.2 Deleting an Order	11
3.2.3 Modifying an Order	11
3.2.4 Executions	11
3.3 Time and Sales	12
3.3.1 Execution of Hidden Quantity	12
3.3.2 Off-Book Trades	13
3.3.3 Trade Cancellations	13
<b>4 RECOVERY</b>	<b>14</b>
4.1 Recipient Failures	14
4.1.1 Replay Channel	14
4.1.1.1 Establishing a Connection	14
4.1.1.2 Heartbeats	15
4.1.1.3 Requesting Missed Messages	15
4.1.1.4 Response to a Retransmission Request	15
4.1.1.5 Termination of the Connection	16
4.1.2 Recovery Channel	16
4.1.2.1 Establishing a Connection	16

4.1.2.2 Heartbeats.....	17
4.1.2.3 Requesting Order Book Snapshots.....	17
4.1.2.4 Response to a Snapshot Request for an Instrument .....	17
4.1.2.5 Response to a Snapshot Request for a Segment .....	18
4.1.2.6 Termination of the Connection.....	19
4.2 Service Interruptions.....	19
4.2.1 Snapshots on the Multicast Channel.....	19
4.2.2 Resetting Sequence Numbers .....	19
<b>5 MESSAGE FORMATS.....</b>	<b>20</b>
5.1 Packet Composition .....	20
5.2 Sequence Numbers .....	20
5.3 Timestamps .....	20
5.4 Data Types.....	21
5.5 Message Overview .....	22
5.5.1 Administrative Messages .....	22
5.5.2 Application Messages .....	23
5.6 Unit Header .....	24
5.7 Administrative Messages (Client - Initiated).....	24
5.7.1 Login Request.....	24
5.7.2 Replay Request .....	24
5.7.3 Snapshot Request .....	25
5.7.4 Logout Request .....	25
5.8 Administrative Messages (Server - Initiated) .....	25
5.8.1 Heartbeat .....	25
5.8.2 Login Response .....	26
5.8.3 Replay Response .....	26
5.8.4 Snapshot Response.....	27
5.8.5 Snapshot Complete .....	28
5.9 Application Messages .....	28
5.9.1 Time .....	28
5.9.2 System Event .....	29
5.9.3 Symbol Directory.....	29
5.9.4 Symbol Status.....	30
5.9.5 Add Order .....	31
5.9.6 Order Deleted .....	31
5.9.7 Order Modified .....	32
5.9.8 Order Book Clear.....	32
5.9.9 Order Executed.....	33
5.9.10 Order Executed with Price/Size .....	33
5.9.11 Trade .....	34
5.9.12 Off-Book Trade.....	34
5.9.13 Trade Break .....	35
<b>6 SEGMENTS.....</b>	<b>36</b>
<b>7 APPENDIX A - EXECUTION MESSAGES.....</b>	<b>37</b>
<b>8 APPENDIX B - HALT REASON CODES .....</b>	<b>39</b>

# 1 Introduction

Turquoise provides real-time Level-2 market data via the ITCH UDP protocol.

The market data feed is a stream of fixed width binary messages which provides the following real-time information:

- (i) Order depth for the entire order book for the Integrated (I) order book. The feed provides information on the side, price and displayed quantity of each order in the order book.
- (ii) Price and volume for each executed on-book trade for both the Integrated (I) order book and Dark Midpoint (M) order book.
- (iii) Price, volume, date and time of each confirmed off-book trade if those trades require reporting under FSA regulations.
- (iv) Trading status of each instrument

The feed also includes a daily download of the instrument list at Turquoise.

## 1.1 Purpose

The purpose of this document is to provide full details of the Level-2 ITCH UDP Market Data service including message types and fields.

## 1.2 Readership

This document outlines the detailed message types and fields for the Level-2 ITCH feed as well as details on how to connect to the Replay and Recovery services available at Turquoise.

This document is particularly relevant to technical staff within the MTF's member firms, information vendors and other market participants interested in receiving Turquoise market data.

## 1.3 Document Series

This document is part of series of documents providing a holistic view of full trading and information services available from Turquoise.

For reference the full range of documents is outlined below:

- TQ101 - Guide to Migration
- TQ102 - Guide to Connectivity

- TQ201 - Trading Gateway (FIX 5.0) Specification
- TQ202 - Post Trade Gateway (FIX 5.0) Specification
- TQ203 - Drop Copy Gateway (FIX 5.0) Specification
- TQ301 - Trading Gateway (Native) Specification
- **TQ401 - ITCH Level-2 Market Data Specification (this document)**
- TQ501 - Guide to Reference Data Services
- TQ601 - Guide to Certification

## 1.4 Document History

This document has been through the follow iterations:

Issue	Date	Description
R1 1.0	17 March 2010	First issue of this document published.
R1 1.1	9 April 2010	Updated to include Service Description.
R2 1.0	24 May 2010	First issue of CDS release 2 document published.
R2.1 1.0	9 July 2010	Second issue of document published.
R2.1 1.1	9 August 2010	Change in description for Establishing a Connection. Value added to reflect inactive status of instrument for a Symbol Directory message. Execution messages added as Appendix A.
R2.1 1.2	7 September 2010	Updated Trade Break message. Changed Sequence Number in Snapshot Request message to a Reserved Field as this is not validated.
R2.1 1.3	14 September 2010	Added status “e” to Replay Response and Snapshot Response. Execution of a Hidden Quantity - description clarified. Instrument Suspension - description clarified. Added details of status “e” to sections 4.1.1.1 and 4.1.2.1
R2.1 1.4	12 October 2010	Added details of Trade Match ID allocation to Appendix A.
R2.1 1.5	15 October 2010	Added halt reason codes as Appendix B.
1.6	25 November 2010	Updated Replay message cache size from 20,000 to 65,000 messages.
1.7	24 December 2010	Update to section 5.3 Timestamps
1.8	14 January 2011	Added new values to Session Change Reason under Symbol Status message
1.9	21 January 2011	Added details of Symbol Status message dissemination to sections 4.1.2.4 and 4.1.2.5
2.0	16 May 2011	Revision of market data segments in section 6

2.1	24 May 2011	Added Symbol Status value of w (No Active Session) to 5.9.4
2.2	5 August 2011	Removed reference to market order under 'Add Order' message usage in section 5.5.2

## 1.5 Enquiries

Contact Technical Account Management at Turquoise for any functional queries regarding the services outlined in this document. Technical Account Management can be contacted Monday to Friday between 07:15UK and 17:45UK:

- Telephone: +44 (0)20 7382 7699

# 2 Connectivity

## 2.1 Transmission Standards

### 2.1.1 Multicast Channels

The multicast channel utilises UDP over IP version 4 (IPv4) Ethernet standards. UDP header information is as defined in the IETF RFC 791 (IPv4) and RFC 768 (UDP) transmission standards. Each UDP packet will contain just one [Unit Header](#).

### 2.1.2 Unicast Channels

The Recovery and Replay channels utilise TCP over IP version 4 (IPv4) Ethernet standards. TCP header information is as defined in the IETF RFC 793 standard and IPv4 is as defined in the RFC 791 standard.

## 2.2 ComplDs

The ComplD of each client wishing to connect to the Recovery and Replay channels must be registered with Turquoise before communications can begin. Each ComplD will be assigned a password on registration.

The same ComplD could be used to login to Recovery and Replay channels across market data groups.

A ComplD may, at any particular time, only be logged into one TCP channel across all market data groups.

## 2.3 Failover and Recovery

Turquoise will have a resilient solution at the primary site. For all TCP/IP connections clients will be given two pairs of IP addresses, a pair (Primary and Backup) for the primary site and a pair (Primary and Backup) for the secondary site. Clients will be directed to use the primary site pair until directed that a site failover has been invoked. Following this the secondary site pair should be used.

On unexpected disconnection from the primary site primary gateway a client should try to reconnect 3 times to the primary gateway with a time out value of three seconds on each connection before attempting to connect to the primary site secondary gateway. This should then be retried a further 3 times. After six failed connection attempts (3 on each gateway) the client should contact Turquoise for guidance.

# 3 Service Description

## 3.1 Overview of a Trading Day

### 3.1.1 Start of Day

Turquoise's normal trading hours can be found in the Trading Service Description. The market data feed itself will be available prior to market open to allow Turquoise participants to establish a connection and download the [Symbol Directory](#) before continuous trading begins. Specific times for the market data feed availability are defined in the Guide to Connectivity.

The regular trading day will, for each instrument, consist of a single trading session for both the Integrated and Dark Midpoint order books. The start and end times of each of these order books differs based on the market and are detailed in the Trading Service Description. The [Symbol Status](#) message will be published on the multicast channel to indicate when the trading session has commenced for an instrument.

The Integrated order book will be opened for Trading and Trade Reporting. Recipients will be informed of start of trading in the Integrated order book via the [Symbol Status](#) message with Target Book set to Integrated Book (I) and Book Type set to On-Book (1). For start of Trade Reporting the Target Book will be set to Integrated Book (I) and Book Type set to Off-Book (2).

The Dark Midpoint book will only have a Trading session and this will be indicated in the [Symbol Status](#) message with Target Book set to Dark Midpoint Book (M) and Book Type set to On-Book (1).

Two minutes after the Start of Day, a [System Event](#) message will be published with the Event Code "O". Outside the [Time](#) message, this will be the first application message for the day.

### 3.1.2 List of Instruments

A [Symbol Directory](#) message will be broadcast for each active and suspended instrument on the multicast channel at the Start of Day. This will be subsequent to the [System Event](#) message indicating Start of Day.

The system will publish separate [Symbol Directory](#) messages for the Integrated book and Dark Midpoint book. Recipients can distinguish the two books by using the 'Target Book' field.

### 3.1.3 Trading Status

A [Symbol Status](#) message will also be broadcast for each active tradable instrument just after the dissemination of the [Symbol Directory](#) message at the start of day.

The message will be broadcast for each active instrument with the Trading Status 'T'.

Similar to the [Symbol Directory](#), the system will publish separate [Symbol Status](#) messages for the Integrated book and the Dark Midpoint book. Recipients can distinguish the two books with the 'Target Book' field.

For the Integrated book the Trading Status must be interpreted with the Book Type value to determine whether the specified Trading Status is applicable for Trading or Trade Reporting. The Book Type will be set to On-Book (1) for Trading and Off-Book (2) for Trade Reporting.

For the Dark Midpoint order book the Book Type will always be On-Book (1).

Subsequently, [Symbol Status](#) messages will be used to disseminate status changes in real time.

### 3.1.4 Trading Halt

An instrument may be halted and resumed during the trading day.

The [Symbol Status](#) message will be published to indicate when a particular instrument is halted. The [Symbol Status](#) message will be published with Halt (H) as the Trading Status.

When trading is resumed a [Symbol Status](#) message will be published with the status indicating Regular Trading (T).

This needs to be interpreted together with the Book Type message to identify if the halt/resumption is related to Trading or Trade Reporting.

The [Symbol Status](#) message publishing a halt will also indicate the reason for the halt in the Halt Reason field. When an instrument is halted clients will not be able to submit new orders or amend open orders on the halted instrument. Open orders can be cancelled. A trading halt will not be carried forward to the next trading day.

### 3.1.5 Instrument Suspension

An instrument may be suspended during or outside trading hours. The suspension may be lifted later in the day or it may be carried forward to subsequent trading days. The [Symbol Directory](#) message will be published with a Status of "S" if an instrument is suspended during trading hours.

A suspension of an instrument is only applicable for on-book trading in the Integrated and Dark Midpoint books. It does not prohibit off book trading reporting in the Integrated book. When an instrument is suspended all open orders will be deleted and clients will not be able to submit new orders until the suspension is lifted.

If, at the start of a trading day, an instrument is still in a suspended state it will be included in the [Symbol Directory](#) messages published by the server but not the [Symbol Status](#) messages. If the suspension is lifted during the trading day recipients will receive a [Symbol Directory](#) message with a space in the Status field. A separate [Symbol Status](#) message will also be published if trading is enabled for the instrument.

### **3.1.6 End of Day**

The market data feed will stop at end of day. A [System Event](#) message will be published with the Event Code "C". This will be the last application message for the day.

All open TCP/IP connections to the Recovery or Replay channels will be disconnected by the server. Clients will be unable to login to these channels after this time.

## **3.2 Order Book Management**

The market data feed will provide recipients with the order depth for the entire Integrated order book. It provides the side, price and displayed quantity of each active order. There will be no order depth provided for the Dark Midpoint order book.

### **3.2.1 Adding an Order**

An [Add Order](#) message will be sent each time a new visible order is added to the order book. The message includes the side, price and displayed quantity of the order.

The message also includes an identifier (Order ID) of the order which will be referenced on all future updates (e.g. executed, modified, deleted etc.) for the order.

### 3.2.1.1 Identifying Own Orders

Using the Order ID mentioned above, recipients will be able to identify their own orders on the market data feed. This same Order ID will be tagged in the corresponding execution reports sent via the FIX Trading Gateway, Drop Copy Gateway (SecondaryOrderID) and the Native Trading Gateway (SecondaryOrderID).

The Order ID will be represented in 8 byte binary format in both the ITCH and Native Trading Gateway messages but will be represented in 16 character ASCII hexadecimal format in the FIX Trading and Drop Copy Gateway messages. Market data recipients connecting to the FIX Trading and Drop Copy Gateways for order management will have to do a hexadecimal to binary conversion (or vice versa) to identify own orders.

Note that the field called Order ID on native execution reports (and FIX tag 37 on FIX Trading, Drop Copy and Post Trade Gateway execution reports) is also derived from the ITCH Order ID by conversion to a base62 ASCII character string, with the addition of an 'O' prefix.

### 3.2.2 Deleting an Order

An [Order Deleted](#) message will be used to notify recipients if a displayed order is cancelled or expired. The Order ID of the order will be included in the message.

### 3.2.3 Modifying an Order

An [Order Modified](#) message will be sent if the display quantity of an order changes, its price changes or if an order loses time priority. The message will include the applicable display quantity and price as well as an indication of whether the order has retained or lost its time priority. A modification will not result in the order being assigned a new Order ID.

### 3.2.4 Executions

An [Order Executed](#) message will be sent whenever a displayed order is fully or partially filled at its displayed price. On receipt of this message recipients should deduct the quantity specified in the field Executed Quantity from the quantity displayed for the order in the order book. The [Order Executed](#) message does not contain an explicit price. The execution price will be the limit price of the order as indicated in the last [Add Order](#) or [Order Modified](#) message sent for it.

An [Order Executed with Price/Size](#) message will be sent if the displayed quantity of an order after an execution cannot be derived from the executed quantity (e.g. replenishment of an iceberg order). On receipt of this message recipients should change the quantity displayed for the order in the order book to that specified in the field Display Quantity.

The message contains an explicit execution price and an instruction as to whether or not the trade should update time and sales and statistics displays.

As an order may be filled in multiple executions, recipients may receive several [Order Executed](#) and [Order Executed with Price/Size](#) messages for a particular order. The effect of each message is cumulative. When the displayed quantity of an order reaches zero it should be removed from the order book.

## 3.3 Time and Sales

Recipients may build time and sales and statistics displays by combining the execution information received via the [Order Executed](#), [Order Executed with Price/Size](#), [Trade](#) and [Off-Book Trade](#) messages published by the server.

Each of the above messages will include a day-unique identifier of the trade which will be referenced if a trade is ever cancelled. Trade Match IDs will not be sequential. Trade Match ID in ITCH matches exactly with the Trade Match ID field on native execution reports. It also matches with the TradeMatchID (880) on FIX Trading and Drop Copy execution reports but this is in base 62 with a T/M prefix (T being on-book, M being off-book) and needs the prefix to be removed before converting to an 8 byte integer for comparison.

The same Trade Match ID will be stamped in base 62 format in the TradeID (1003) of the Trade Capture Report published via the Post Trade Gateway. Recipients will be able to identify own trades by comparing the Trade Match ID published via market data with the TradeID (1003) published via the Post Trade Gateway. Recipients are expected to perform a binary to base 62 conversion (or vice versa) in order to compare the two identifiers. The Trade Match ID published via the market data system will be in binary format.

### 3.3.1 Execution of Hidden Quantity

The [Trade](#) message is sent whenever the non-displayed portion of an iceberg order or a hidden order is fully or partially filled during regular trading. An [Order Executed](#) or [Order Executed with Price/Size](#) message will not be sent in such a scenario.

If both the displayed and non-displayed quantity of an iceberg order is partially filled by an incoming order, the server will transmit three messages: an [Order Executed with Price/Size](#) message for the displayed portion, a [Trade](#) message for the non-displayed portion (after the replenishment) and an [Order Executed](#) message for the partial execution of the replenished visible quantity.

If both the displayed and non-displayed quantity of an iceberg order is entirely filled by an incoming order, with no further executions on the replenished visible quantity, the server will transmit two messages: an [Order Executed with Price/Size](#) message for the displayed portion and a [Trade](#) message for the non-displayed portion (after the replenishment).

### **3.3.2 Off-Book Trades**

Details of trades done outside off-book and reported to Turquoise will be disseminated via the [Off-Book Trade](#) message.

### **3.3.3 Trade Cancellations**

A [Trade Break](#) message will be sent if a trade is cancelled in the system. The message will include the Trade Match ID of the cancelled trade. A trade cancellation is final and once cancelled, it cannot be reinstated. Details of trade corrections are not disseminated on the market data feed.

# 4 Recovery

## 4.1 Recipient Failures

Recipients have access to two identically sequenced multicast feeds: Feed A and Feed B. Recipients may process both feeds and arbitrate between them to minimise the probability of a data loss.

If a gap in sequence numbers is detected on the multicast channel that is not recoverable by arbitrating between the two feeds, the recipient should assume that some or all of the order books maintained on its systems are incorrect and initiate one of the recovery processes outlined below.

### 4.1.1 Replay Channel

The TCP Replay channel should be used by recipients to recover from a small-scale data loss. It permits clients to request the retransmission of a limited number of messages already published on the multicast channel. The channel supports the retransmission of the last 65,000 messages published.

Each CompID may login to the Replay channel of a particular market data group up to a limited number of times each day. The total number of [Replay Requests](#) that a client may send for a particular market data group is also limited. Recipients may request that Turquoise reset its login and request counts. This feature is intended to help manage an emergency situation and should not be relied upon as a normal practice.

If a client submits multiple requests on the Replay channel, they will be processed serially (i.e. one at a time). Clients are unable to cancel outstanding [Replay Requests](#).

#### 4.1.1.1 Establishing a Connection

The client should use the relevant IP address and port to establish a TCP/IP session with the Replay channel. The client should initiate a session by sending the [Login Request](#) message. The client should identify itself by specifying its CompID in the Username field.

The server will validate the CompID, password and IP address. Once the client is authenticated, the server will respond with a [Login Response](#) message with the Status "A".

The client must wait for the server's [Login Response](#) before sending additional messages. Messages received from the client before the exchange of logons will be ignored.

If a logon attempt fails because of an invalid CompID, invalid password, invalid IP address or if a message is sent prior to the login being established, the server will break the TCP/IP connection with the client without sending a [Login Response](#) message.

If a logon attempt fails because of a locked CompID or if logins are not currently permitted, the server will send a [Login Response](#) and then break the TCP/IP connection with the client.

If a client has exceeded the number of permitted log-ons for the current day, the server will reject any new logon attempt with a [Login Response](#) and then break the TCP/IP connection. The Status of such a [Login Response](#) message will be “b”.

If a [Login Request](#) is not received within 5 seconds of the establishment of a TCP/IP connection or a [Replay Request](#) is not received within 5 seconds of a successful logon, the server will break the TCP/IP connection with the client.

If a customer attempts to log on to the Replay channel while already logged in a Replay Response with status “e” will be sent.

#### **4.1.1.2 Heartbeats**

The server will not send heartbeats on the Replay channel during periods of inactivity.

#### **4.1.1.3 Requesting Missed Messages**

Once connected to the Replay channel, clients may use the [Replay Request](#) message to request the retransmission of missed messages. The request should include the sequence number of the first message in the range to be retransmitted along with the number of messages to be retransmitted.

The retransmission request will be serviced from the server’s cache of the last 65,000 messages published on the multicast channel. If the retransmission request includes one or more messages that are not in the server’s cache, the entire request will be rejected and no messages will be retransmitted.

#### **4.1.1.4 Response to a Retransmission Request**

The server will respond to the [Replay Request](#) with a [Replay Response](#) message to indicate whether the retransmission request is successful or not. A Status other than “A” will indicate that the request has been rejected.

In the case of a successful request, the server will retransmit the requested messages immediately after the [Replay Response](#). The sequence numbers of the retransmitted messages will be the same as when they were first disseminated on the multicast channel. The framing of the replayed messages inside of [Unit Headers](#) may differ between the original transmission and the retransmission.

#### 4.1.1.5 Termination of the Connection

If the client does not send a [Logout Request](#) and terminate the connection within 5 seconds of the retransmission of the last missed message, the server will break the TCP/IP connection with the client.

#### 4.1.2 Recovery Channel

The TCP Recovery channel should be used by recipients to recover from a large-scale data loss (i.e. late joiner or major outage). It permits clients to request a snapshot of the order book for the active instruments in the market data group.

Each CompID may login to the Recovery channel of a particular market data group up to a limited number of times each day. The total number of [Snapshot Request](#) messages that a client may submit for a particular market data group is also limited. Recipients may request that Turquoise reset its login and request counts. This feature is intended to help manage an emergency situation and should not be relied upon as a normal practice.

If a client submits multiple requests on the Recovery channel, they will be processed serially (i.e. one at a time). Clients are unable to cancel outstanding [Snapshot Requests](#).

##### 4.1.2.1 Establishing a Connection

The client should use the relevant IP address and port to establish a TCP/IP session with the Recovery channel. The client should initiate a session by sending the [Login Request](#) message. The client should identify itself by specifying its CompID in the Username field. The server will validate the CompID, password and IP address.

Once the client is authenticated, the server will respond with a [Login Response](#) message with the Status "A".

The client must wait for the server's [Login Response](#) before sending additional messages. Messages received from the client before the exchange of logons will be ignored.

If a logon attempt fails because of an invalid CompID, invalid password, invalid IP address or if a message is sent prior to the login being established, the server will break the TCP/IP connection with the client without sending a [Login Response](#) message.

If a logon attempt fails because of a locked CompID or if logins are not currently permitted, the server will send a [Login Response](#) and then break the TCP/IP connection with the client.

If a client has exceeded the number of permitted log-ons for the current day, the server will reject any new logon attempt with a [Login Response](#) and then break the TCP/IP connection. The Status of such a [Login Response](#) message will be “b”. If a [Login Request](#) is not received within 5 seconds of the establishment of a TCP/IP connection or a [Snapshot Request](#) is not received within 5 seconds of a successful logon, the server will break the TCP/IP connection with the client.

If a customer attempts to log on to the Recovery channel while already logged in a [Replay Response](#) with status “e” will be sent.

At a particular point of time the Snapshot Channel can queue a limited number of unprocessed requests from a client. The server will reject any further Snapshot Request messages via a [Snapshot Response](#) message with status “c”.

#### **4.1.2.2 Heartbeats**

The server will not send heartbeats on the Recovery channel during periods of inactivity.

#### **4.1.2.3 Requesting Order Book Snapshots**

Once connected to the Recovery channel, clients may use the [Snapshot Request](#) message to request a snapshot of the current order book for all instruments in a specified segment or for a particular instrument. If a client specifies both the Segment and Instrument ID in the [Snapshot Request](#) message, it will be taken as a request for the stated segment. A client may submit multiple [Snapshot Requests](#).

#### **4.1.2.4 Response to a Snapshot Request for an Instrument**

The server will transmit a [Snapshot Response](#) to indicate whether a [Snapshot Request](#) for an instrument is accepted or rejected. A status other than “A” will indicate that the request is rejected.

If the request is successful, the server will disseminate a snapshot of the current order book for each of the requested instruments via series of [Add Order](#) messages. Each such message will represent a single active order and will not include a sequence number. If a particular price point contains multiple orders, they will be disseminated in terms of their time priority (i.e. the oldest order first).

Following the [Add Order](#) messages, a [Symbol Status](#) message will be sent indicating the trading status of that particular instrument. The Session Change Reason field within this message will contain the value 9.

The server will transmit the [Snapshot Complete](#) message once the details of all active orders are disseminated. The message will include the sequence number with which the order book snapshot was synchronised and the segment or instrument to which it relates. The client may begin processing the buffered messages from the multicast channel once the order book snapshot is processed.

In a situation where the instrument has an empty order book, the system will respond with only a [Snapshot Complete](#) message.

#### **4.1.2.5 Response to a Snapshot Request for a Segment**

The server will transmit a [Snapshot Response](#) to indicate whether a [Snapshot Request](#) for a segment is accepted or rejected. A status other than “A” will indicate that the request is rejected.

If the request is successful, the server will disseminate a snapshot of the current order book for all instruments in the requested segment via a series of [Add Order](#) messages.

Each such message will represent a single active order and will not include a sequence number. If a particular price point contains multiple orders, they will be disseminated in terms of their time priority (i.e. the oldest order first).

Following the [Add Order](#) messages, a [Symbol Status](#) message will be sent indicating the trading status of that particular instrument. The Session Change Reason field within this message will contain the value 9.

Order book snapshots for the requested instruments will be transmitted serially (i.e. one instrument at a time). The server will transmit a [Snapshot Complete](#) message once the details of all active orders for a particular instrument are disseminated. This message will include the sequence number with which the order book snapshot for the instrument was synchronised. While such a [Snapshot Complete](#) will include the instrument to which it relates, it will not include a value in the Segment field.

The client may begin processing the buffered messages for the instrument from the multicast channel once its order book snapshot is processed.

The server will also transmit a [Snapshot Complete](#) message once the details of all active orders for all instruments in the requested segment are disseminated. The Sequence Number field of the message will be zero. While the final [Snapshot Complete](#) will include an indication of the segment to which it relates, it will not include a value in the Symbol field.

#### **4.1.2.6 Termination of the Connection**

If the client does not send a [Logout Request](#) and terminate the connection or submit another [Snapshot Request](#) within 5 seconds of the transmission of the [Snapshot Complete](#) message, the server will break the TCP/IP connection with the client.

## **4.2 Service Interruptions**

### **4.2.1 Snapshots on the Multicast Channel**

In the unlikely event of an outage at Turquoise, recipients may be required to refresh their order book for one or more instruments. In such a scenario the server will, on the multicast channel, broadcast an [Order Book Clear](#) message for the order book of each affected instrument. In such an event recipients must remove all orders from the order book maintained for these instruments.

The server will then transmit a series of [Add Order](#) messages on the multicast channel to disseminate the current picture of each order book.

### **4.2.2 Resetting Sequence Numbers**

If the market data feed is, in the unlikely event of an outage, failed over to the backup site or is restarted, the message sequence number of the multicast channel will be reset to 1. In such a case, messages sent on the multicast channel prior to the resetting of sequence numbers will not be available for retransmission on the Replay channel.

# 5 Message Formats

This section provides details on the data types, unit header, nine administrative messages and thirteen application messages utilised by the server. For each message, a description of each field is provided along with the applicable data type, offset and length (in bytes).

## 5.1 Packet Composition

The [Unit Header](#) is used to deliver all administrative and application messages to and from the server on all four channels. A [Unit Header](#) may contain zero, one or more payload messages. While a [Unit Header](#) may contain multiple application messages, it will never contain more than one administrative message. A [Unit Header](#) will not contain both administrative and application messages.

## 5.2 Sequence Numbers

All application messages transmitted by the server on the multicast and Replay channels are sequenced. The [Unit Header](#) only contains the sequence number of the first message. Each subsequent message in the [Unit Header](#) will have an implied sequence number one greater than the previous message. The sequence number of the first message of the next [Unit Header](#) can be determined by adding the value in the Message Count field of the [Unit Header](#) to the value in its Sequence Number field.

The application messages sent by the server on the Recovery channel as well as all administrative messages transmitted by both the server and the client are unsequenced. The [Unit Header](#) used to transport all such messages, other than a [Heartbeat](#), will include a Sequence Number of zero.

## 5.3 Timestamps

Application messages on the Real-Time channel will include an indication of when they were transmitted. The server will, on the Real-Time channel, transmit a [Time](#) message for every second for which at least one application message is generated. The time specified in this message serves as a reference for the times specified in all other application messages. The timestamps in all other messages are specified as a nanosecond offset from the most recent Time message. The [Time](#) message is not transmitted during periods where no application messages are generated for the Real-Time channel.

The retransmission of messages on the Replay channel will include the [Time](#) messages originally broadcast on the Real-Time channel (i.e. with the same timestamp).

While [Time](#) messages will be included when an order book snapshot is provided on the Recovery channel, the times in these messages will be different from those published when the active orders were originally disseminated on the Real-Time channel. Clients are unable to estimate the time at which an active order was submitted from the messages transmitted on the Recovery channel.

## 5.4 Data Types

The fields of the various messages utilised by the server will support the data types outlined below.

Data Type	Length	Description
Alpha	Variable	These fields use standard ASCII character bytes. They are left justified and padded on the right with spaces. An empty alpha field is filled with spaces.
Bit Field	1	A single byte used to hold up to eight 1-bit flags. Each bit will represent a Boolean flag. The 0 bit is the lowest significant bit and the 7 bit is the highest significant bit.
Byte	1	A single byte used to hold one ASCII character.
Date	8	Date specified in the YYYYMMDD format using ASCII characters.
Time	8	Time specified in the HH:MM:SS format using ASCII characters.
Price	8	Signed Little-Endian encoded eight byte integer field with eight implied decimal places.
UInt8	1	8 bit unsigned integer.
UInt16	2	Little-Endian encoded 16 bit unsigned integer.
UInt32	4	Little-Endian encoded 32 bit unsigned integer.
UInt64	8	Little-Endian encoded 64 bit unsigned integer.

## 5.5 Message Overview

### 5.5.1 Administrative Messages

Name	Message Type		Usage
	ASCII	Hex	
<a href="#">Heartbeat</a>	-	-	Used by the server, on the multicast channel, to exercise the communication line during periods of inactivity.
<a href="#">Login Request</a>	(soh)	0x01	Used by the client to login to the Replay or Recovery channel.
<a href="#">Login Response</a>	(stx)	0x02	Used by the server to accept or reject a login request to the Replay or Recovery channel.
<a href="#">Logout Request</a>	(enq)	0x05	Used by the client to logout of the Replay or Recovery channel.
<a href="#">Replay Request</a>	(etx)	0x03	Used by the client to request a retransmission of messages on the Replay channel.
<a href="#">Replay Response</a>	(eot)	0x04	Used by the server to respond to a retransmission request on the Replay channel.
<a href="#">Snapshot Request</a>	▣	0x81	Used by the client to request for a snapshot of the current order book on the Recovery channel.
<a href="#">Snapshot Response</a>	,	0x82	Used by the server to respond to a snapshot request on the Recovery channel.
<a href="#">Snapshot Complete</a>	<i>f</i>	0x83	Used by the server to indicate that the transmission of an order book snapshot is complete.

## 5.5.2 Application Messages

Application messages may only be sent by the server.

Name	Message Type		Usage
	ASCII	Hex	
<a href="#">Time</a>	T	0x54	Sent by the server for every second for which at least one application message is generated. This message is not transmitted during periods where no other application messages are generated.
<a href="#">System Event</a>	S	0x53	Sent to indicate the start and end of the day.
<a href="#">Symbol Directory</a>	R	0x52	Used to disseminate information (e.g. symbol, segment, ISIN etc.) on each instrument.
<a href="#">Symbol Status</a>	H	0x48	Indicates the trading session (e.g. continuous trading) that currently applies to an instrument.
<a href="#">Add Order</a>	A	0x41	Sent to indicate that a limit order is added to the Integrated order book.
<a href="#">Order Deleted</a>	D	0x44	Sent to indicate that the remainder of a displayed order is cancelled.
<a href="#">Order Modified</a>	U	0x55	Indicates that the displayed quantity or price of a displayed order has been updated. The message will include an indication of whether the order has retained or lost its time priority.
<a href="#">Order Book Clear</a>	y	0x79	Sent to instruct recipients to remove all orders from the order book for the specified instrument.
<a href="#">Order Executed</a>	E	0x45	Indicates that the displayed portion of an order is fully or partially filled at its displayed price. The executed quantity is included in the message.
<a href="#">Order Executed with Price/ Size</a>	C	0x43	Sent if the displayed quantity of an order after an execution cannot be derived from the executed quantity. The executed quantity and price is included in the message along with an indication of whether the trade should update time and sales displays.
<a href="#">Trade</a>	P	0x50	Sent if the non-displayed portion of an iceberg order or a hidden order is fully or partially filled.
<a href="#">Off-Book Trade</a>	x	0x78	Sent to report the details of a privately negotiated trade.
<a href="#">Trade Break</a>	B	0x42	Indicates that a previously reported traded is cancelled.

## 5.6 Unit Header

Field	Offset	Length	Type	Description
Length	0	2	UInt16	Length of the message block including the header and all payload messages.
Message Count	2	1	UInt8	Number of payload messages that will follow the header.
Market Data Group	3	1	Byte	Identity of the market data group the payload messages relate to. This field is not validated for client initiated messages.
Sequence Number	4	4	UInt32	Sequence number of the first payload message.
Payload	8	Variable	-	One or more payload messages.

## 5.7 Administrative Messages (Client - Initiated)

### 5.7.1 Login Request

Field	Offset	Length	Type	Description				
Length	0	1	UInt8	Length of message including this field.				
Message Type	1	1	Byte	<table border="1"> <thead> <tr> <th>Hex</th> <th>Meaning</th> </tr> </thead> <tbody> <tr> <td>0x01</td> <td>Login Request</td> </tr> </tbody> </table>	Hex	Meaning	0x01	Login Request
Hex	Meaning							
0x01	Login Request							
Username	2	6	Alpha	ComplD assigned to the client.				
Password	8	10	Alpha	Password assigned to the ComplD.				

### 5.7.2 Replay Request

Field	Offset	Length	Type	Description				
Length	0	1	UInt8	Length of message including this field.				
Message Type	1	1	Byte	<table border="1"> <thead> <tr> <th>Hex</th> <th>Meaning</th> </tr> </thead> <tbody> <tr> <td>0x03</td> <td>Replay Request</td> </tr> </tbody> </table>	Hex	Meaning	0x03	Replay Request
Hex	Meaning							
0x03	Replay Request							
Market Data Group	2	1	Byte	Identity of the market data group the replay request relates to.				
First Message	3	4	UInt32	Sequence number of the first message in range to be retransmitted.				
Count	7	2	UInt16	Number of messages to be resent				

### 5.7.3 Snapshot Request

Field	Offset	Length	Type	Description				
Length	0	1	UInt8	Length of message including this field.				
Message Type	1	1	Byte	<table border="1"> <thead> <tr> <th>Hex</th> <th>Meaning</th> </tr> </thead> <tbody> <tr> <td>0x81</td> <td>Snapshot Request</td> </tr> </tbody> </table>	Hex	Meaning	0x81	Snapshot Request
Hex	Meaning							
0x81	Snapshot Request							
ReservedField1	2	4	UInt32	Reserved for future use.				
Segment	6	6	Alpha	Segment the request relates to. The field should contain only spaces if the MTF Common Symbol field is populated.				
MTF Common Symbol	12	6	Alpha	MTF Common Symbol for the instrument the request relates to. The field should contain only spaces if the Segment field is populated. If a segment is specified then any value in this field will be ignored.				
Target Book	18	1	Byte	<table border="1"> <thead> <tr> <th>Value</th> <th>Meaning</th> </tr> </thead> <tbody> <tr> <td>I</td> <td>Integrated Book</td> </tr> </tbody> </table>	Value	Meaning	I	Integrated Book
Value	Meaning							
I	Integrated Book							

### 5.7.4 Logout Request

Field	Offset	Length	Type	Description				
Length	0	1	UInt8	Length of message including this field.				
Message Type	1	1	Byte	<table border="1"> <thead> <tr> <th>Hex</th> <th>Meaning</th> </tr> </thead> <tbody> <tr> <td>0x05</td> <td>Logout Request</td> </tr> </tbody> </table>	Hex	Meaning	0x05	Logout Request
Hex	Meaning							
0x05	Logout Request							

## 5.8 Administrative Messages (Server - Initiated)

### 5.8.1 Heartbeat

A [Unit Header](#) with a Message Count of zero will be used by the server as a [Heartbeat](#) message. Such a message will never increment the sequence number of the multicast channel. However, the next expected sequence number will be included in the Sequence Number to enable recipients to detect gaps on the multicast channel.

### 5.8.2 Login Response

Field	Offset	Length	Type	Description																
Length	0	1	UInt8	Length of message including this field.																
Message Type	1	1	Byte	<table border="1"> <thead> <tr> <th>Hex</th> <th>Meaning</th> </tr> </thead> <tbody> <tr> <td>0x02</td> <td>Login Response</td> </tr> </tbody> </table>	Hex	Meaning	0x02	Login Response												
Hex	Meaning																			
0x02	Login Response																			
Status	2	1	Byte	Status of the login request. <table border="1"> <thead> <tr> <th>Value</th> <th>Meaning</th> </tr> </thead> <tbody> <tr> <td>A</td> <td>Login Accepted</td> </tr> <tr> <td>N</td> <td>Invalid Password</td> </tr> <tr> <td>a</td> <td>CompID Inactive/Locked</td> </tr> <tr> <td>b</td> <td>Login Limit Reached</td> </tr> <tr> <td>c</td> <td>Service Unavailable</td> </tr> <tr> <td>d</td> <td>Concurrent Limit Reached</td> </tr> <tr> <td>e</td> <td>Failed (other)</td> </tr> </tbody> </table>	Value	Meaning	A	Login Accepted	N	Invalid Password	a	CompID Inactive/Locked	b	Login Limit Reached	c	Service Unavailable	d	Concurrent Limit Reached	e	Failed (other)
Value	Meaning																			
A	Login Accepted																			
N	Invalid Password																			
a	CompID Inactive/Locked																			
b	Login Limit Reached																			
c	Service Unavailable																			
d	Concurrent Limit Reached																			
e	Failed (other)																			

### 5.8.3 Replay Response

Field	Offset	Length	Type	Description				
Length	0	1	UInt8	Length of message including this field.				
Message Type	1	1	Byte	<table border="1"> <thead> <tr> <th>Hex</th> <th>Meaning</th> </tr> </thead> <tbody> <tr> <td>0x04</td> <td>Replay Response</td> </tr> </tbody> </table>	Hex	Meaning	0x04	Replay Response
Hex	Meaning							
0x04	Replay Response							
Market Data Group	2	1	Byte	Identity of the market data group the replay request relates to.				
First Message	3	4	UInt32	Sequence number of the first message in range to be retransmitted. This will be zero if Status is not "A".				
Count	7	2	UInt16	Number of messages to be resent. This will be zero if Status is not "A".				

Status	9	1	Byte	Status of the replay request.
				<b>Value</b> <b>Meaning</b>
				A   Request Accepted
				D   Request Limit Reached
				I   Invalid Market Data Group
				O   Out of Range
				U   Replay Unavailable
				d   Unsupported message type
e   Failed (other)				

### 5.8.4 Snapshot Response

Field	Offset	Length	Type	Description																		
Length	0	1	UInt8	Length of message including this field.																		
Message Type	1	1	Byte	<table border="1"> <tr> <td><b>Hex</b></td> <td><b>Meaning</b></td> </tr> <tr> <td>0x82</td> <td>Snapshot Response</td> </tr> </table>	<b>Hex</b>	<b>Meaning</b>	0x82	Snapshot Response														
<b>Hex</b>	<b>Meaning</b>																					
0x82	Snapshot Response																					
ReservedField1	2	4	UInt32	Reserved for future use.																		
ReservedField2	6	4	UInt32	Reserved for future use.																		
Status	10	1	Byte	Status of the snapshot request. <table border="1"> <tr> <td><b>Value</b></td> <td><b>Meaning</b></td> </tr> <tr> <td>A</td> <td>Request Accepted</td> </tr> <tr> <td>O</td> <td>Out of Range</td> </tr> <tr> <td>U</td> <td>Snapshot Unavailable</td> </tr> <tr> <td>a</td> <td>Segment or Symbol Not Specified</td> </tr> <tr> <td>b</td> <td>Request Limit Reached</td> </tr> <tr> <td>c</td> <td>Concurrent Limit Reached</td> </tr> <tr> <td>d</td> <td>Unsupported message type</td> </tr> <tr> <td>e</td> <td>Failed (other)</td> </tr> </table>	<b>Value</b>	<b>Meaning</b>	A	Request Accepted	O	Out of Range	U	Snapshot Unavailable	a	Segment or Symbol Not Specified	b	Request Limit Reached	c	Concurrent Limit Reached	d	Unsupported message type	e	Failed (other)
<b>Value</b>	<b>Meaning</b>																					
A	Request Accepted																					
O	Out of Range																					
U	Snapshot Unavailable																					
a	Segment or Symbol Not Specified																					
b	Request Limit Reached																					
c	Concurrent Limit Reached																					
d	Unsupported message type																					
e	Failed (other)																					

## 5.8.5 Snapshot Complete

Field	Offset	Length	Type	Description				
Length	0	1	UInt8	Length of message including this field.				
Message Type	1	1	Byte	<table border="1"> <thead> <tr> <th>Hex</th> <th>Meaning</th> </tr> </thead> <tbody> <tr> <td>0x83</td> <td>Snapshot Complete</td> </tr> </tbody> </table>	Hex	Meaning	0x83	Snapshot Complete
Hex	Meaning							
0x83	Snapshot Complete							
Sequence Number	2	4	UInt32	Sequence number with which the snapshot is synchronised.				
Segment	6	6	Alpha	Segment the snapshot relates to. The field will contain only spaces if it does not relate to a segment.				
MTF Common Symbol	12	6	Alpha	MTF Common Symbol for the instrument the request relates to. The field should contain only spaces if it does not relate to an instrument.				
Target Book	18	1	Byte	<table border="1"> <thead> <tr> <th>Value</th> <th>Meaning</th> </tr> </thead> <tbody> <tr> <td>I</td> <td>Integrated Book</td> </tr> </tbody> </table>	Value	Meaning	I	Integrated Book
Value	Meaning							
I	Integrated Book							

## 5.9 Application Messages

### 5.9.1 Time

Field	Offset	Length	Type	Description				
Length	0	1	UInt8	Length of message including this field.				
Message Type	1	1	Byte	<table border="1"> <thead> <tr> <th>Hex</th> <th>Meaning</th> </tr> </thead> <tbody> <tr> <td>0x54</td> <td>Time</td> </tr> </tbody> </table>	Hex	Meaning	0x54	Time
Hex	Meaning							
0x54	Time							
Seconds	2	4	UInt32	Number of seconds since midnight. Midnight will be in terms of the local time for the server (i.e. not UTC).				

## 5.9.2 System Event

Field	Offset	Length	Type	Description						
Length	0	1	UInt8	Length of message including this field.						
Message Type	1	1	Byte	<table border="1"> <thead> <tr> <th>Hex</th> <th>Meaning</th> </tr> </thead> <tbody> <tr> <td>0x53</td> <td>System Event</td> </tr> </tbody> </table>	Hex	Meaning	0x53	System Event		
Hex	Meaning									
0x53	System Event									
Nanosecond	2	4	UInt32	Nanoseconds since last <a href="#">Time</a> message.						
Event Code	6	1	Byte	<table border="1"> <thead> <tr> <th>Value</th> <th>Meaning</th> </tr> </thead> <tbody> <tr> <td>C</td> <td>End of Day</td> </tr> <tr> <td>O</td> <td>Start of Day</td> </tr> </tbody> </table>	Value	Meaning	C	End of Day	O	Start of Day
Value	Meaning									
C	End of Day									
O	Start of Day									

## 5.9.3 Symbol Directory

Field	Offset	Length	Type	Description						
Length	0	1	UInt8	Length of message including this field.						
Message Type	1	1	Byte	<table border="1"> <thead> <tr> <th>Hex</th> <th>Meaning</th> </tr> </thead> <tbody> <tr> <td>0x52</td> <td>Symbol Directory</td> </tr> </tbody> </table>	Hex	Meaning	0x52	Symbol Directory		
Hex	Meaning									
0x52	Symbol Directory									
Nanosecond	2	4	UInt32	Nanoseconds since last <a href="#">Time</a> message.						
MTF Common Symbol	6	6	Alpha	MTF Common Symbol for the instrument.						
Status	12	1	Alpha	<table border="1"> <thead> <tr> <th>Value</th> <th>Meaning</th> </tr> </thead> <tbody> <tr> <td>S</td> <td>Suspended</td> </tr> <tr> <td>a</td> <td>Inactive</td> </tr> </tbody> </table> <p>This field will contain a space if the instrument is active.</p>	Value	Meaning	S	Suspended	a	Inactive
Value	Meaning									
S	Suspended									
a	Inactive									
ISIN	13	12	Alpha	Instrument identification number.						
ReservedField1	25	12	String	Reserved for future use.						
Segment	37	6	Alpha	Segment the instrument is assigned to.						
ReservedField2	43	6	Alpha	Reserved for future use.						
Currency	49	3	Alpha	ISO Currency Code						
Target Book	52	1	Byte	<table border="1"> <thead> <tr> <th>Value</th> <th>Meaning</th> </tr> </thead> <tbody> <tr> <td>I</td> <td>Integrated Book</td> </tr> <tr> <td>M</td> <td>Dark Midpoint Book</td> </tr> </tbody> </table>	Value	Meaning	I	Integrated Book	M	Dark Midpoint Book
Value	Meaning									
I	Integrated Book									
M	Dark Midpoint Book									
Security Exchange	53	4	Alpha	Market Identifier Code						
Previous Close Price	57	8	Price	Previous Close Price of the instrument.						

## 5.9.4 Symbol Status

Field	Offset	Length	Type	Description														
Length	0	1	UInt8	Length of message including this field.														
Message Type	1	1	Byte	<table border="1"> <thead> <tr> <th>Hex</th> <th>Meaning</th> </tr> </thead> <tbody> <tr> <td>0x48</td> <td>Symbol Status</td> </tr> </tbody> </table>	Hex	Meaning	0x48	Symbol Status										
Hex	Meaning																	
0x48	Symbol Status																	
Nanosecond	2	4	UInt32	Nanoseconds since last <a href="#">Time</a> message.														
MTF Common Symbol	6	6	Alpha	MTF Common Symbol for the instrument.														
Trading Status	12	1	Byte	<table border="1"> <thead> <tr> <th>Value</th> <th>Meaning</th> </tr> </thead> <tbody> <tr> <td>H</td> <td>Halted</td> </tr> <tr> <td>T</td> <td>Regular Trading / Start Trade Reporting</td> </tr> <tr> <td>t</td> <td>End Trade Reporting</td> </tr> <tr> <td>c</td> <td>Closed</td> </tr> <tr> <td>w</td> <td>No Active Session</td> </tr> </tbody> </table>	Value	Meaning	H	Halted	T	Regular Trading / Start Trade Reporting	t	End Trade Reporting	c	Closed	w	No Active Session		
Value	Meaning																	
H	Halted																	
T	Regular Trading / Start Trade Reporting																	
t	End Trade Reporting																	
c	Closed																	
w	No Active Session																	
ReservedField1	13	1	Bit Field	Reserved for future use.														
Halt Reason	14	4	Alpha	See Appendix B. This field will contain only spaces if Trading Status is not "H".														
Session Change Reason	18	1	UInt8	<table border="1"> <thead> <tr> <th>Value</th> <th>Meaning</th> </tr> </thead> <tbody> <tr> <td>0</td> <td>Scheduled Transition</td> </tr> <tr> <td>1</td> <td>Extended by Market Ops</td> </tr> <tr> <td>2</td> <td>Shortened by Market Ops</td> </tr> <tr> <td>3</td> <td>Market Order Imbalance</td> </tr> <tr> <td>4</td> <td>Price Outside Range</td> </tr> <tr> <td>9</td> <td>Unavailable</td> </tr> </tbody> </table>	Value	Meaning	0	Scheduled Transition	1	Extended by Market Ops	2	Shortened by Market Ops	3	Market Order Imbalance	4	Price Outside Range	9	Unavailable
Value	Meaning																	
0	Scheduled Transition																	
1	Extended by Market Ops																	
2	Shortened by Market Ops																	
3	Market Order Imbalance																	
4	Price Outside Range																	
9	Unavailable																	
New End Time	19	8	Time	New time the session will end. The field will contain only spaces if Session Change Reason is "0". New End Time will be in terms of the local time for the server (i.e. not UTC)														

Book Type	27	1	UInt8	Indicates if the trading status update is for regular trading (On-Book) or trade reporting (Off-Book). <b>Value Meaning</b> 1 On-Book 2 Off-Book
Target Book	28	1	Byte	<b>Value Meaning</b> I Integrated Book M Dark Midpoint Book

### 5.9.5 Add Order

Field	Offset	Length	Type	Description
Length	0	1	UInt8	Length of message including this field.
Message Type	1	1	Byte	<b>Hex Meaning</b> 0x41 Add Order
Nanosecond	2	4	UInt32	Nanoseconds since last <a href="#">Time</a> message.
Order ID	6	8	UInt64	Unique identifier of the order.
Side	14	1	Byte	<b>Value Meaning</b> B Buy Order S Sell Order
Quantity	15	4	UInt32	Displayed quantity of the order.
MTF Common Symbol	19	6	Alpha	MTF Common Symbol for the instrument.
Price	25	8	Price	Limit price of the order.
ReservedField1	33	1	Bit Field	Reserved for future use.
Target Book	34	1	Byte	<b>Value Meaning</b> I Integrated Book

### 5.9.6 Order Deleted

Field	Offset	Length	Type	Description
Length	0	1	UInt8	Length of message including this field.
Message Type	1	1	Byte	<b>Hex Meaning</b> 0x44 Order Deleted
Nanosecond	2	4	UInt32	Nanoseconds since last <a href="#">Time</a> message.
Order ID	6	8	UInt64	Identifier for the order.
ReservedField1	14	1	Bit Field	Reserved for future use.

### 5.9.7 Order Modified

Field	Offset	Length	Type	Description						
Length	0	1	UInt8	Length of message including this field.						
Message Type	1	1	Byte	<table border="1"> <thead> <tr> <th>Hex</th> <th>Meaning</th> </tr> </thead> <tbody> <tr> <td>0x55</td> <td>Order Modified</td> </tr> </tbody> </table>	Hex	Meaning	0x55	Order Modified		
Hex	Meaning									
0x55	Order Modified									
Nanosecond	2	4	UInt32	Nanoseconds since last <a href="#">Time</a> message.						
Order ID	6	8	UInt64	Identifier for the order.						
New Quantity	14	4	UInt32	New displayed quantity of the order.						
New Price	18	8	Price	New limit price of the order.						
Flags	26	1	Bit Field	<table border="1"> <thead> <tr> <th>Bit</th> <th>Name</th> <th>Meaning</th> </tr> </thead> <tbody> <tr> <td>0</td> <td>Priority Flag</td> <td>0: Priority Lost 1: Priority Retained</td> </tr> </tbody> </table>	Bit	Name	Meaning	0	Priority Flag	0: Priority Lost 1: Priority Retained
Bit	Name	Meaning								
0	Priority Flag	0: Priority Lost 1: Priority Retained								

### 5.9.8 Order Book Clear

Field	Offset	Length	Type	Description				
Length	0	1	UInt8	Length of message including this field.				
Message Type	1	1	Byte	<table border="1"> <thead> <tr> <th>Hex</th> <th>Meaning</th> </tr> </thead> <tbody> <tr> <td>0x79</td> <td>Order Book Clear</td> </tr> </tbody> </table>	Hex	Meaning	0x79	Order Book Clear
Hex	Meaning							
0x79	Order Book Clear							
Nanosecond	2	4	UInt32	Nanoseconds since last <a href="#">Time</a> message.				
MTF Common Symbol	6	6	Alpha	MTF Common Symbol for the instrument.				
ReservedField1	12	1	Bit Field	Reserved for future use.				
Target Book	13	1	Byte	<table border="1"> <thead> <tr> <th>Value</th> <th>Meaning</th> </tr> </thead> <tbody> <tr> <td>I</td> <td>Integrated Book</td> </tr> </tbody> </table>	Value	Meaning	I	Integrated Book
Value	Meaning							
I	Integrated Book							

### 5.9.9 Order Executed

Field	Offset	Length	Type	Description				
Length	0	1	UInt8	Length of message including this field.				
Message Type	1	1	Byte	<table border="1"> <thead> <tr> <th>Hex</th> <th>Meaning</th> </tr> </thead> <tbody> <tr> <td>0x45</td> <td>Order Executed</td> </tr> </tbody> </table>	Hex	Meaning	0x45	Order Executed
Hex	Meaning							
0x45	Order Executed							
Nanosecond	2	4	UInt32	Nanoseconds since last <a href="#">Time</a> message.				
Order ID	6	8	UInt64	Identifier for the order.				
Executed Quantity	14	4	UInt32	Quantity executed.				
Trade Match ID	18	8	UInt64	Unique identifier of the trade.				

### 5.9.10 Order Executed with Price/Size

Field	Offset	Length	Type	Description						
Length	0	1	UInt8	Length of message including this field.						
Message Type	1	1	Byte	<table border="1"> <thead> <tr> <th>Hex</th> <th>Meaning</th> </tr> </thead> <tbody> <tr> <td>0x43</td> <td>Order Executed with Price/Size</td> </tr> </tbody> </table>	Hex	Meaning	0x43	Order Executed with Price/Size		
Hex	Meaning									
0x43	Order Executed with Price/Size									
Nanosecond	2	4	UInt32	Nanoseconds since last <a href="#">Time</a> message.						
Order ID	6	8	UInt64	Identifier for the order.						
Executed Quantity	14	4	UInt32	Quantity executed.						
Display Quantity	18	4	UInt32	Displayed quantity of the order after the execution.						
Trade Match ID	22	8	UInt64	Unique identifier of the trade.						
Printable	30	1	Byte	<table border="1"> <thead> <tr> <th>Value</th> <th>Meaning</th> </tr> </thead> <tbody> <tr> <td>N</td> <td>Non-Printable</td> </tr> <tr> <td>Y</td> <td>Printable</td> </tr> </tbody> </table>	Value	Meaning	N	Non-Printable	Y	Printable
Value	Meaning									
N	Non-Printable									
Y	Printable									
Price	31	8	Price	Price at which the order was executed.						

### 5.9.11 Trade

Field	Offset	Length	Type	Description						
Length	0	1	UInt8	Length of message including this field.						
Message Type	1	1	Byte	<table border="1"> <thead> <tr> <th>Hex</th> <th>Meaning</th> </tr> </thead> <tbody> <tr> <td>0x50</td> <td>Trade</td> </tr> </tbody> </table>	Hex	Meaning	0x50	Trade		
Hex	Meaning									
0x50	Trade									
Nanosecond	2	4	UInt32	Nanoseconds since last <a href="#">Time</a> message.						
Executed Quantity	6	4	UInt32	Quantity executed.						
MTF Common Symbol	10	6	Alpha	MTF Common Symbol for the instrument.						
Price	16	8	Price	Executed price.						
Trade Match ID	24	8	UInt64	Unique identifier of the trade.						
ReservedField1	32	1	Byte	Reserved for future use.						
Target Book	33	1	Byte	<table border="1"> <thead> <tr> <th>Value</th> <th>Meaning</th> </tr> </thead> <tbody> <tr> <td>I</td> <td>Integrated Book</td> </tr> <tr> <td>M</td> <td>Dark Midpoint Book</td> </tr> </tbody> </table>	Value	Meaning	I	Integrated Book	M	Dark Midpoint Book
Value	Meaning									
I	Integrated Book									
M	Dark Midpoint Book									

### 5.9.12 Off-Book Trade

Field	Offset	Length	Type	Description				
Length	0	1	UInt8	Length of message including this field.				
Message Type	1	1	Byte	<table border="1"> <thead> <tr> <th>Hex</th> <th>Meaning</th> </tr> </thead> <tbody> <tr> <td>0x78</td> <td>Off-Book Trade</td> </tr> </tbody> </table>	Hex	Meaning	0x78	Off-Book Trade
Hex	Meaning							
0x78	Off-Book Trade							
Nanosecond	2	4	UInt32	Nanoseconds since last <a href="#">Time</a> message.				
Executed Quantity	6	4	UInt32	Quantity executed.				
MTF Common Symbol	10	6	Alpha	MTF Common Symbol for the instrument.				
Price	16	8	Price	Executed price.				
Trade Match ID	24	8	UInt64	Unique identifier of the trade.				
Trade Type	32	4	Alpha	<b>This field will contain a space.</b>				
Trade Time	36	8	Time	Time off-book trade was executed.				
ReservedField1	44	8	Date	Reserved for future use.				
ReservedField2	52	4	String	Reserved for future use.				
ReservedField3	56	8	String	Reserved for future use.				
ReservedField4	64	5	String	Reserved for future use.				
ReservedField5	69	1	String	Reserved for future use.				

### 5.9.13 Trade Break

Field	Offset	Length	Type	Description				
Length	0	1	UInt8	Length of message including this field.				
Message Type	1	1	Byte	<table border="1"> <thead> <tr> <th>Hex</th> <th>Meaning</th> </tr> </thead> <tbody> <tr> <td>0x42</td> <td>Trade Break</td> </tr> </tbody> </table>	Hex	Meaning	0x42	Trade Break
Hex	Meaning							
0x42	Trade Break							
Nanosecond	2	4	UInt32	Nanoseconds since last <a href="#">Time</a> message.				
Trade Match ID	6	8	UInt64	Identifier of the cancelled trade.				
ReservedField1	14	1	Byte	Reserved for future use.				

## 6 Segments

Segment	Description	Market Data Group
XLON	London Stock Exchange	1
XPAR	NYSE Euronext Paris	2
XETR	Deutsche Börse - Xetra	3
XCSE	OMX Copenhagen	4
XHEL	OMX Helsinki	
XMCE	Bolsa de Madrid	
XSTO	OMX Stockholm	
XSWX	Swiss Exchange	
XVTX	Six Swiss Exchange AG	
MTAA	Borsa Italiana	5
XOSL	Oslo Bors	
WBAH	Vienna Stock Exchange	
XDUB	Irish Stock Exchange	
ARCX	NYSE Arca	
XBUD	Budapest Stock Exchange	
XNGS	Nasdaq Global Select Market	
XNMS	Nasdaq Global Market	
XNYS	New York Stock Exchange	
XPRA	Prague Stock Exchange	
XAMS	NYSE Euronext Amsterdam	6
XBRU	NYSE Euronext Brussels	
XLIS	NYSE Euronext Lisbon	
XLUX	Bourse de Luxembourg	

## 7 Appendix A - Execution Messages

The below table provides examples of executions and the relevant ITCH messages associated with these executions.

In the 'Existing Qty' column, the first number represents the visible quantity of an order with the number in brackets representing the hidden quantity of that order i.e. **VisibleQty (HiddenQty) @ Price**.

In some of the examples there is more than one order in the 'Existing Qty' column. These are represented as O1 and O2. These order identifiers are reflected under the 'ITCH Message(s)' column to indicate which order the particular message refers to.

Trade Match IDs are shown as (T1), (T2) etc. Where a Trade Match ID appears twice, participants should assume that both messages are valid and are not duplicates.

Order Modified messages marked with an asterisk(\*) are used to denote that the time priority of that order has been lost.

Event	Example Quantities		ITCH Message(s)
	Existing Qty	Incoming Qty	
Partial fill of fully visible order (for a single side)	200 (0) @ 10	100 @ 10	• <a href="#">Order Executed</a>
Complete fill of fully visible order (for a single side)	200 (0) @ 10	200 @ 10	• <a href="#">Order Executed</a>
Partial fill of hidden order (for a single side)	0 (200) @ 10	100 @ 10	• <a href="#">Trade</a>
Complete fill of hidden order (for a single side)	0 (200) @ 10	200 @ 10	• <a href="#">Trade</a>
Partial fill of the visible quantity of an iceberg order (for a single side)	200 (100) @ 10	100 @ 10	• <a href="#">Order Executed</a>

Complete fill of the visible quantity of an iceberg order (for a single side)	200 (100) @ 10	200 @ 10	<ul style="list-style-type: none"> <li>• <a href="#">Order Executed with Price/Size</a></li> </ul>
Complete fill of iceberg order (for a single side)	200 (100) @ 10	300 @ 10	<ul style="list-style-type: none"> <li>• <a href="#">Order Executed</a> (T1)</li> <li>• <a href="#">Trade</a> (T1)</li> </ul>
Complete fill of visible quantity and partial fill of hidden quantity of an iceberg order <b>(Scenario 1)</b> (for a single side)	200 (400) @ 10	300 @ 10	<ul style="list-style-type: none"> <li>• <a href="#">Order Executed with Price/Size</a> (T1)</li> <li>• <a href="#">Trade</a> (T2)</li> </ul>
Complete fill of visible quantity and partial fill of hidden quantity of an iceberg order <b>(Scenario 2)</b> (for a single side)	200 (400) @ 10	500 @ 10	<ul style="list-style-type: none"> <li>• <a href="#">Order Executed with Price/Size</a> (T1)</li> <li>• <a href="#">Order Executed</a> (T2)</li> <li>• <a href="#">Trade</a> (T2)</li> </ul>
Multiple iceberg orders on the order book	(O1) 200 (200) @ 10 (O2) 200 (200) @ 10	300 @ 10	<ul style="list-style-type: none"> <li>• <a href="#">Order Executed with Price/Size</a> (O1)</li> <li>• <a href="#">Order Modified</a> (O1)*</li> <li>• <a href="#">Order Executed</a> (O2)</li> </ul>
Multiple iceberg orders on the order book	(O1) 200 (200) @ 10 (O2) 200 (200) @ 10	500 @ 10	<ul style="list-style-type: none"> <li>• <a href="#">Order Executed with Price/Size</a> (O1) (T1)</li> <li>• <a href="#">Order Modified</a> (O1)*</li> <li>• <a href="#">Order Executed with Price/Size</a> (O2) (T2)</li> <li>• <a href="#">Order Modified</a> (O2)*</li> <li>• <a href="#">Order Executed</a> (O1) (T3)</li> </ul>
Multiple iceberg orders on the order book	(O1) 200 (200) @ 10 (O2) 200 (200) @ 10	600 @ 10	<ul style="list-style-type: none"> <li>• <a href="#">Order Executed with Price/Size</a> (O1) (T1)</li> <li>• <a href="#">Order Modified</a> (O1)*</li> <li>• <a href="#">Order Executed with Price/Size</a> (O2) (T2)</li> <li>• <a href="#">Order Modified</a> (O2)*</li> <li>• <a href="#">Order Executed</a> (O1) (T3)</li> <li>• <a href="#">Order Executed</a> (O2) (T4)</li> </ul>
Multiple iceberg orders on the order book	(O1) 200 (200) @ 10 (O2) 200 (200) @ 10	800 @ 10	<ul style="list-style-type: none"> <li>• <a href="#">Order Executed</a> (O1) (T1)</li> <li>• <a href="#">Trade</a> (O1) (T1)</li> <li>• <a href="#">Order Executed</a> (O2) (T2)</li> <li>• <a href="#">Trade</a> (O2) (T2)</li> </ul>

## 8 Appendix B - Halt Reason Codes

Reject Code	Description
1	System Problem
2	Fast Market
3	News Pending
9998	Matching Partition Suspended
9999	System Suspended
Space	Reason Unavailable

Copyright © Turquoise Global Holdings Limited.  
Registered in England and Wales No. 06132421.

Turquoise Global Holdings Limited has used all reasonable efforts to ensure that the information contained in this publication is correct at the time of going to press, but shall not be liable for decisions made in reliance on it.

London Stock Exchange is a registered trade mark of London Stock Exchange plc.  
Turquoise is a registered trade mark of Turquoise Global Holdings Limited.

Turquoise Global Holdings Limited.

10 Paternoster Square  
London EC4M 7LS  
Telephone: +44 (0)20 7797 1000

<http://www.tradeturquoise.com>