Johannesburg Stock Exchange

Trading and Information Solution

JSE Specification Document
Volume 05 – Market Data Gateway (MITCH – UDP)

Version	3.08
Release Date	23 July 2018
Number of Pages	78 (Including Cover Page)

1 DOCUMENT CONTROL

1.1 Table of Contents

1.2 Document Information

Drafted By	Trading and Market Services: TMS Trading
Status	Final
Version	3.08
Release Date	23 July 2018

1.3 Revision History

Date	Version	Description
08 July 2011	1.00	Initial draft
30 November 2011	1.01	JSE Specification Updates
13 March 2012	1.02	Updates to include the new Futures Closeout Auction
20 June 2012	1.03	Updates and clarifications added to specifications
05 July 2013	2.00	Functionality updates related to the 2013 product upgrade
08 August 2013	2.01	Applied minor document corrections - Corrected the type of the LENGTH field from Uint8 to Uint16 - Corrected Volatility auction call field value from 'E' to 'e'
4 November 2013	2.02	Minor document corrections
21 February 2014	2.03	Functionality updates for the introduction of the JSE Colocation service
22 February 2014	2.04	Minor typing correction to the Market Data Groups for the un-throttled MITCH Gateway for the JSE market.
22 August 2014	2.05	Naming convention change to MITCH
29 February 2016	3.00	Integrated Trading and Clearing Project changes. Equity Market Enhancements: • Hidden Order functionality enhanced • Introduction of On Book Cross Order Trade • Introduction of EOD Volume Auction
13 April 2016	3.01	Updated section 8.9.1 with correct offset values
4 August 2016	3.02	Update to Trading Reason Codes Updated the top of the book offsets Added limitation on Auction info message Updated field description for Halt Reason field. Updated Trading Reason Codes Updated Reserved field Updated Notional Exposure, Notional Delta Exposure, Open Interest field descriptions Enumeration Y added to the Open Close Indicator field
23 September 2016	3.03	Update to data type for Turnover field in Extended Statistics message
31 January 2017	3.04	Off book trade times updated Information related to PUBLISH_INACTIVE_INSTRUMENTS configuration removed

6 February 2017	3.05	Inactive and Suspended enumerations added to Symbol Status field.
4 October 2017	3.06	8.9.19 Description of Notional Exposure field updated. 5.2.6 , 5.3.2 Message details for MITCH Order Depth Service and MITCH Top of the Book service added
07 November 2017	3.07	8.9.21 Corrected the offset in the Top of Book message
23 July 2018	3.08	5.1.12 Updated to include new Derivative Symbol Directory updates 8.9.3 New fields added to Symbol Directory message to disseminate additional information for derivative instruments 8.9.3 Link to segments removed

1.4 References

None

1.5 Contact Details

JSE Limited
Trading and Market Services Division
One Exchange Square
Gwen Lane, Sandown
South Africa
Tel: +27 11 520 7000

www.jse.co.za

Trading and Market Services ITAC Queries
Email: ITACTradingAPI@jse.co.za

1.6 Definitions, Acronyms and Abbreviations

Automated Trades (ATs)	On Book trades executed during continuous trading.
Auction Call	The trading session immediately prior to an uncrossing (i.e. opening, closing, etc.). During this session orders are accumulated for execution in the auction and information on the indicative auction price is disseminated at a regular interval.
Client	A Recipient connected to the Recovery or Replay channel of the market data feed.
FTP	File Transfer Protocol
Indicative Auction Information	The Indicative Auction Price (if any) and the Indicative Auction Volume (if any) at the Indicative Auction Price
IPv4	IPv4 is a connectionless protocol for use on packet-switched Link Layer networks (e.g., Ethernet). It operates on a best effort delivery model in that it does not guarantee delivery, nor does it assure proper sequencing or avoidance of duplicate delivery. These aspects, including data integrity, are addressed by an upper layer transport protocol (e.g., Transmission Control Protocol).
JSE	Johannesburg Stock Exchange.
MBO	Market By Order (i.e. order depth), all the orders in the book will be disseminated on the feed. Time priority will be considered. Therefore the orders will be individually disseminated in terms of time priority.
MBP	Market By Price (i.e. price depth), the aggregated volume of orders in the book based for each price point will be disseminated on the feed.
NSX	Namibian Stock Exchange
Orders	Executable order in the order book.
Off Book Trade	A trade negotiated outside the System yet reported to the System, in accordance with the JSE rules and directives.
On Book Trade	An Automatic Trade which is a trade automatically executed in the System which can either be an Automated Trade or an Uncrossing Trade.
Recipient	A subscriber to the Real-Time multicast (UDP) channel of the market data feed who connects to the replay and recovery channels for recovery.
SAST	South African Standard Time (GMT+2)
Server	The MITCH market data Gateway at the JSE for the JSE and NSX markets
SS	Snapshot
Trade Reporting	The reporting of an Off Book trade.

TCP/IP	Transmission Control Protocol is a connection-oriented protocol, which means that it requires handshaking to set up end-to-end communications. Once a connection is set up user data may be sent bi-directionally over the connection. • *Reliable* – TCP manages message acknowledgment, retransmission and timeout. Multiple attempts to deliver the message are made. If it gets lost along the way, the server will re-request the lost part. In TCP, there's either no missing data, or, in case of multiple timeouts, the connection is dropped. • *Ordered* – if two messages are sent over a connection in sequence, the first message will reach the receiving application first. When data segments arrive in the wrong order, TCP buffers the out-of-order data until all data can be properly re-ordered and delivered to the application. • *Heavyweight* – TCP requires three packets to set up a socket connection, before any user data can be sent. TCP handles reliability and congestion control. • *Streaming* – Data is read as a byte stream, no distinguishing indications are transmitted to signal message (segment) boundaries.
UDP	UDP is a simpler message-based connectionless protocol. Connectionless protocols do not set up a dedicated end-to-end connection. Communication is achieved by transmitting information in one direction from source to destination without verifying the readiness or state of the receiver. • *Unreliable* – When a message is sent, it cannot be known if it will reach its destination; it could get lost along the way. There is no concept of acknowledgment, retransmission or timeout. • *Not ordered* – If two messages are sent to the same recipient, the order in which they arrive cannot be predicted. • *Lightweight* – There is no ordering of messages, no tracking connections, etc. It is a small transport layer designed on top of IP. • *Datagrams* – Packets are sent individually and are checked for integrity only if they arrive. Packets have definite boundaries which are honored upon receipt, meaning a read operation at the receiver socket will yield an entire message as it was originally sent. *No congestion control* - UDP itself does not avoid congestion, and it's possible for high bandwidth applications to trigger congestion collapse, unless they implement congestion control measures at the application level.
Uncrossing Trades (UTs)	On Book trades executed during any auction uncrossing.
VWAP	Volume weighted average price.
CPP Session	Closing Price Publication is the session where the Closing Price is calculated and published to the Market

CPX Session	Closing Price Cross is the session where automated trading can occur at the Closing Price calculated during the CPP session
Cross Order Trade	A trade resulting from the submission of a Cross Order by market participants that results only in a trade and has no impact to orders.
Pegged Order	A hidden order pegged to the mid-point of the best bid and offer price or pegged to the best bid(offer) for instrument
Pegged Limit Order	A pegged order with a stop price also known as a hard limit.
EOD Volume Auction Uncrossing	A dark auction call which is triggered at end of the day after the CPX session. The uncrossing will happen at the closing price.

2 OVERVIEW

The market data feed is a stream of fixed width binary messages which provides the following real-time information for each instrument traded on the *Equity* and *Derivatives/Bonds* Markets.

(i) Order depth for the entire order book. The feed provides information on the side, price and displayed quantity of each order in the order book.

(ii) Price, volume, trade type, date and time for each executed On Book trade that is published to the market.

(iii) Price, volume, trade type, date and time of each confirmed Off Book trade.

(iv) Indicative Auction Information which is the auction uncrossing price and the associated trade volume.

(v) Official previous closing price, opening price and closing price .

(vi) Trading status of the instrument.

(vii) News

(viii) Extended Statistics

In addition, each feed enables participants to download the Symbol Directory messages for all instruments.

The above services will be provided to Clients via the Market Data Gateways listed in section 13. Clients need to meet the required minimum bandwidth per Gateway in order to subscribe to the un-throttled Gateway.

The un-throttled MITCH Gateway will not be available or be published via the JSE London Point of Presence (PoP) due to the large bandwidth requirement for this feed, however all international and local clients, who connect directly to the JSE in Johannesburg and have the required bandwidth, will be allowed to subscribe to this Gateway.

3 SYSTEM ARCHITECTURE

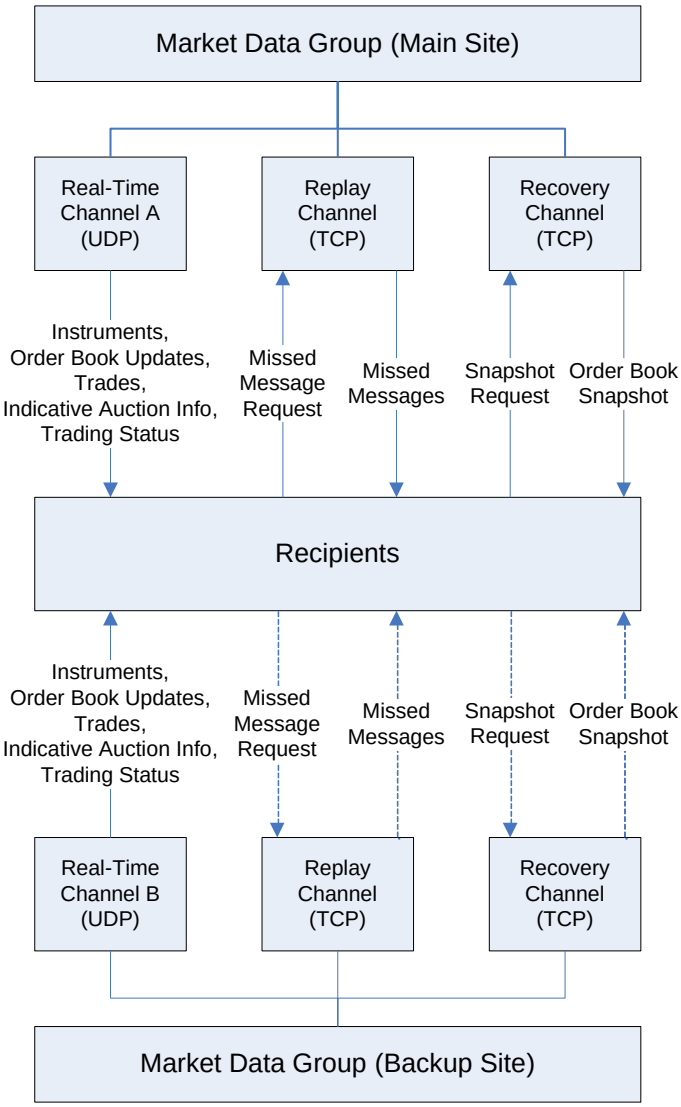
The market data feed is load balanced by market data group.

While each group will contain multiple instruments, each instrument is assigned to just one market data group. Although the group an instrument is assigned to may change from day to day, it will not change within a day.

Each market data group includes a multicast Real-Time channel for the dissemination of real time market data.

Two TCP recovery channels are available per market data group: Replay and Recovery.

While a recipient may connect to the Replay channel to recover from a small data loss, it should use the Recovery channel after a large data loss (i.e. late joiner or major outage).



3.1 Real-Time Channel

The Real-Time channel is the primary means of disseminating market data. Real-time updates to instruments and all market data supported by the feed are available on this multicast channel.

The list of active instruments in the market data group is broadcast at the start of the trading day via the Symbol Directory message. The details of instruments created during trading hours as well as updates of the trading status of instruments are also disseminated via the Symbol Status message.

Real-time updates to order books and indicative auction information are published along with the details of each trade (Order Executed, Order Executed With Price/Size, Trade, Auction Trade and Off-Book Trade.). The official opening price, previous close and closing price of each instrument will also be disseminated on this channel. The Previous Close is disseminated via the Symbol Directory message. The Opening and Closing Prices are disseminated via the Statistics message. Announcements will also be disseminated via this channel.

The Extended Statistics message, which provides clients with more detailed statistics like High Price, Low Price, VWAP etc is also published on this channel..

Each application message includes a sequence number which is incremented by one for every message disseminated on the Real-Time channel within a particular market data group. The sequence numbers of each is reset to 1 at the start of each day.

The server will send a Heartbeat message to exercise the communication line during periods of inactivity. A Heartbeat will be sent every HEART_BEAT <2> seconds when the Real-Time channel is inactive.

Recipients have access to two identically sequenced Real-Time feeds: one from the main site (Feed A) and one from the backup feed (Feed B). It is recommended that Recipients process both feeds and arbitrate between them to minimise the probability of a data loss.The sequence numbers of both feeds will be identical. However, those connected at the main site should consider the additional latency of Feed B.

3.2 Replay Channel

The TCP Recovery channel should be used by Recipients to recover from a small-scale data loss.

The Replay channel permits recipients to request the retransmission of a limited number of messages already published on the Real-Time channel.

The Replay channel supports the retransmission of the last REPLAY_CACHE_SIZE<250,000> messages published on the Real-Time channel. The channel does not support the retransmission of messages published on the Recovery channel or from previous trading days.

While a Replay channel is available from the backup feed, it will only be activated in the unlikely event of an outage at the main site.

3.3 Recovery Channel

The TCP Recovery channel should be used by Recipients to recover from a large-scale data loss (i.e. Later joiner or major outage).

The Recovery channel permits recipients to request a snapshot of the order book and statistics for any active instrument in the market data group as well as the current trading status. In addition, it enables recipients to request the retransmission of the trades published during the last MAX_TRADE_HISTORY_DURATION *<60>* minutes on the Real-Time channel. Furthermore it is possible to request the retransmission of the MAX_ANNOUNCEMENT_COUNT last <10,000>market announcements that were published by the system. It also enables recipients to download the list of active instruments in the market data group. This channel may be used by recipients to recover from a large-scale data loss.

While a Recovery channel is available from the backup feed, it will only be activated in the unlikely event of an outage at the main site.

4 MESSAGE OVERVIEW

The market data feed utilises the MITCH application messages described below to disseminate instruments and market data for the Equity, Derivative and Bond Markets of JSE and Equity Market of NSX.

Message	Description	Usage (By Channel)		
		Real-Time	Recovery	Replay
Time	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.	√	×	√
System Event	Sent by the server to indicate the start and end of the day.	√	×	√
Symbol Directory	Used to disseminate information (e.g. Instrument ID, segment, ISIN, etc.) on each instrument. The previous closing price of each instrument is also disseminated.	√	√	√
Symbol Status	Indicates the trading session (e.g. opening auction call, continuous trading, etc.) that currently applies to an instrument.	√	√	√
Add Order	Sent to indicate that a visible limit or market order is added to the order book.	√	√	√
Add Attributed Order	Indicates that an attributable limit order is added to the order book. The identity of the submitting firm is included in the message. Only applicable for Derivatives/Bonds markets.	√	√	√
Order Deleted	Sent to indicate that the remainder of a visible order is cancelled.	√	×	√

Order Modified	Indicates that the quantity or price of a visible order has been updated. The message will include an indication whether the order has retained or lost its time priority.	√	×	√
Order Book Clear	Sent to instruct Recipients to remove all orders from the order book for the specified instrument.	√	×	√
Order Executed (Automated Trade)	Indicates that the visible portion of an order is fully or partially filled at its displayed price. The executed quantity is included in the message.	√	×	√
Order Executed With Price/ Size (Automated Trade)	Sent if a visible order is fully or partially filled at a price that is different from its displayed price. The executed quantity and price is included in the message along with an indication of whether the trade should update time and sales and statistics displays.	√	×	√
Trade (Automated)	Sent if a hidden Pegged or Pegged limit order is fully or partially filled and therefore results in a trade.	√	×	√
Auction Trade	Sent to report details of any auction trades (e.g. opening, closing, etc.). The message indicates the price and bulk volume associated with the auction trades.	√	×	√
Off Book Trade	Sent to report the details of a trade negotiated outside the System yet reported to the System in accordance with the JSE Rules and Directives.	√	×	√
Trade Break	Indicates that a previously published trade (On Book or Off Book) is cancelled.	√	×	√
Recovery Trade	Used to disseminate the details of missed On Book and Off Book trades on the Snapshot channel.	×	√	×

Auction Info	Used to disseminate the indicative auction price and the tradable quantity (volume) at this price.	√	×	√
Statistics	Used to disseminate the official opening and closing prices.	√	√	√
Extended Statistics	Used to disseminate the High Price, Low Price, VWAP, Volume, Turnover and Number of Trades.	√	√	√
News	Used to publish market operations announcements.	√	×	√
Top Of Book	Used to communicate the best bid and the best offer prices and sizes of an order book in Top of Book service	√	√	×

5 SERVICE DESCRIPTION

5.1 Overview of a Trading Day

5.1.1 Trading on the Order Book

The regular trading day for On Book trading will, for each instrument, consist of many sessions: Start of Trading, Opening Auction, Continuous Trading, Intraday Auction, Halt, Halt and Close, Pause, Closing Auction, *Closing Price Publication, Closing Price Cross,* Post-Close etc. The start time for each of these sessions may vary from one set of instruments to another. The Symbol Status message will be published on the Real-Time channel to indicate when a particular session has commenced for an instrument with a Book Type of "1".

5.1.2 Trade Reporting

The JSE is open for the reporting of Off Book trades depending on the Market from *7:00* to *18:30* SAST each trading day. Please refer to Volume 00 for all trading cycles per market.

Off Book trades can be reported for suspended instruments. Hence Off Book statistics will be published for such suspended instruments even after publishing its closing price upon suspension.

At the start of the reporting period a Symbol Status message, with a Trading Status of "T" and a Book Type of "2", will be broadcast for each instrument for which trade reporting is permitted.

Similarly, at the end of the trade reporting period a Symbol Status message, with a Trading Status of "v" and a Book Type of "2", will be broadcast for each such instrument.

A Symbol Status message, with a Trading Status of Market Close "c" and a Book Type of "2", will be broadcast for each such instrument at the market close.

5.1.3 Start of Day

The market data feed begins at the Start of Day. Recipients should aim to join the feed at this time SEC_DEF_DELAY_FROM_SOD *<One>* minute 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.

5.1.4 List of Instruments

A Symbol Directory message will be broadcast for each active, inactive and suspended instrument on the Real-Time channel at the Start of Day and each time an instrument is modified intra-day.

The official previous closing price of each instrument will also be published via the Symbol Directory message at the Start of Day.

This will be subsequent to the System Event message indicating Start of Day. There will be no Symbol Directory message published for inactive instruments.

5.1.5 Ex-Marker and Annotation Information

The Ex-Marker and Annotation information will be broadcast real time through the Symbol Directory message via the "Corporate Action" field.

If Ex-Marker and Annotation information associated with an instrument are updated during the inter-day period, the notification to the market will be published at market start of the next trading day.

If Ex-Marker and Annotation information associated with an instrument are updated during the intra-day period, the notification to the market will be published real time at the time of associating the Corporate Action Indicators with the instrument.

The Ex-Marker and Annotation information with regard to a particular instrument will be disseminated in a particular format as described below.

<Ex-MarkerID(XX)><EffectiveFromDate(YEARMMDD)><EffectiveToDate(YEARMMDD)>

As a single instrument may contain multiple Ex-Markers and/or Annotations, the “Corporate Action” field will publish the information in a string format delimited by a space as per the example below.

GT2011041920110520 XD2011010520110705

5.1.6 Trading Status

The Symbol Status message will disseminate the trading status changes of each instrument real time as and when the instrument moves from one session to another during the trading day. Symbol Status message will also indicate whether the status changes take place in the normal order book, bulletin book, negotiations order book or off book.

5.1.7 Trading Halt

An instrument may be halted from trading during the day.

Trading in an instrument can be halted manually by JSE Market Operations. Trading of an instrument being manually halted could be resumed via the current trading status for On Book trading and to the Off Book trading session (e.g. Start Trade Reporting) for trade reporting.

The Symbol Status message will be published to indicate when a particular instrument is halted manually. The Symbol Status message will be published with Halt (H) as the Trading Status. The reason for the halt and whether it applies to On Book trading or Off Book trade reporting will be specified in the Halt Reason and Book Type fields respectively.

When trading is resumed a Symbol Status message will be published with the appropriate status (i.e. Re-Opening Auction Call (f), Regular Trading (T), etc.) or Start Trade Reporting (T) for on book trading and trade reporting respectively with the relevant Book Type.

An instrument could also be halted automatically as a result of a circuit breaker breach. Trading of such an instrument could be resumed by moving to continuous trading.

The Symbol Status message will be published to indicate when a particular instrument is halted automatically. The Symbol Status message will be published with Halt (H) as the Trading Status. The reason for the halt will be specified in the Halt Reason field. The end time of the halt will be specified in the New End Time field.

When trading is resumed for Off Book trade reporting a Symbol Status message will be published with the current Trading Status of Start Trade Reporting (T) and Book Type of Off Book (2).

When an instrument is halted clients will not be able to submit new orders or amend open orders of the halted instrument. However open orders can be cancelled. A trading halt will not be carried forward to the next trading day.

5.1.8 Pause

JSE Market Operations may also manually trigger the pause session during the day. Trading of an instrument being paused can be resumed to the current trading status.

The Symbol Status message will be published to indicate when a particular instrument is paused. The Symbol Status message will be published with Pause (I) as the Trading Status.

When trading is resumed a Symbol Status message will be published with the current trading status.

5.1.9 Trading 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 only applies to On Book trading.

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.

If the suspension is lifted during the trading day recipients will receive a Symbol Directory message with a space in the Status field. Separate Symbol Status messages will also be published if On Book trading and/or Off Book trade reporting is enabled for the instrument.

5.1.10 Market Close

For active, inactive and suspended instruments Symbol Status messages will be disseminated at the market close.

5.1.11 Intra-Day Trading Session Updates

5.1.11.1 Extension of an Auction Call Session

An auction call session (Volatility, Intra-Day, etc.) may be extended due to a market order imbalance or if the current auction price is significantly different from the last sale. An auction call session could also be extended or even shortened manually by JSE Market Operations.

Upon such events, a Symbol Status message will be broadcast with the Session Change Reason of 1 (Extended by Market Ops) or 2 (Shortened by Market Ops) or 3 (Market Order Imbalance) or 4 (Price Outside Range) in the field Session Change Reason. The message will indicate whether the change applies to On Book trading or Off Book trade reporting and this message will also include the new time at which the auction will take place in the New End Time field and the current instrument status in Trading Status.

5.1.11.2 Adjustment of other trading sessions by Market Operations

JSE Market Operations may manually extend or shorten a particular trading session. In such a case, a Symbol Status message will be broadcast with the Session Change Reason of 1 (Extended by Market Ops) or 2 (Shortened by Market Ops) in the field Session Change Reason. The message will indicate whether the change applies to On Book trading or Off Book trade reporting and this message will also include the new time at which the session will end in the New End Time field and the current instrument status in Trading Status.

5.1.11.3 Automatic trading session updates

A trading session (Regular Trading, Opening Auction Call, etc.) may be changed automatically to another session (Volatility Auction Call, Halt) due to a circuit breaker breach caused by volatile trading. In such a case, a Symbol Status message will be broadcast with the Session Change Reason of 5 (Circuit Breaker Tripped) in the field Session Change Reason. The message will indicate whether the change applies to On Book trading or Off Book trade reporting and this message will also include the new time at which the session will end in the New End Time field and the current instrument status in Trading Status.

5.1.12 New Instruments

New instruments may be created during the trading day. In such a case, the server will publish a Symbol Directory message to notify recipients of the details of the new instrument

(symbol, segment, underlying, expiration date, etc.). Separate Symbol Status messages will also be published depending on how many order books are attached to the instrument.

Symbol Directory messages disseminated on MITCH gateway instances configured to distribute market data for derivative instruments will have additional fields compared to the Symbol Directory message disseminated for equity instruments. These fields will contain additional information to easily distinguish between derivative instruments.

5.1.13 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 at End of Day. Clients will be unable to login to these channels after this time.

5.2 Order Book Management (Order Depth)

The market data feed provides Recipients with the order depth for the entire order book. It provides the side, price and displayed quantity of each active order. The MITCH feed is based on Market By Order. Clients must build the order book sequence using the price and time.

Details of all active orders will be sent at the start of the first session in which the order book is published i.e. at the start of the Start of Trading session. There after the order book updates will be sent incrementally real time.

5.2.1 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. On receipt of this message Recipients should add the order to the order book.

The message also includes an identifier of the order which will be referenced on all future updates (e.g. executed, deleted, modified, etc.) for the order. The recipients will be able to identify their own orders with this Order ID while ensuring anonymity as the same Order ID will also be tagged in the execution reports carrying the relevant order information in the FIX or Native Trading Gateways. The MITCH messages will represent this Order ID in binary while the Trading Gateways will represent the same Order ID in Hexadecimal. Order IDs are unique across instruments and trading days.

This Order ID will further be tagged for leg trades that occur as a result of a trade in a strategy instrument. Within the corresponding Execution Report message sent via the Drop Copy Gateway the SecondaryOrderID (198) field will be populated. Market Orders

The displayed quantity of each market order is disseminated during a Pre-Auction session via the Add Order message. Such a message will include a price of zero and an indication that the order is a market order via the Flags field of Market Order (1=Yes). On receipt of this message Recipients should add the order to the order book.

5.2.1.1 Attributed Orders

The Add Attributed Order message will be used in the case of an attributed order. The identity of the firm that submitted the order will be included in the message. This is applicable only for derivative and bond instruments.

5.2.2 Quotes

Quote message will be handled as two separate buy and sell orders. Buy side of the quote is added to the order book before sell side. Once a Quote is added, an Add Order message for the buy side will be sent which will be followed by an Add Order message for the sell side.

5.2.3 Deleting an Order

An Order Deleted message will be used to notify recipients if a displayed order is cancelled or expired. The Order ID identifier of the order will be included in the message. On receipt of this message recipients should remove the order from the order book. It is also used in scenarios when an existing order in the book is modified in such a way that the order executes with the passive side. If the order has any remaining quantity after the execution, it is added back to the order book via the Add Order message or the Add Attributed Order message (in the case of an attributed order).The same Order ID identifier of the order will be included in the message.

5.2.4 Modifying an Order

An Order Modified message will be sent if the display quantity of an order or its price is changed 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. On receipt of this message Recipients should update the order in the order book with the new values received. Order Modified message will be used when a quote is modified by the user.

5.2.5 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 executed price. The execution price will be the limit price of the order as indicated in the last Add Order, Add Attributed Order or Order Modified message sent for it.

An Order Executed With Price/Size message will be sent if a displayed order is fully or partially filled at a price different from its displayed price (e.g. during an auction). 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 in the Printable field 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.

5.2.6 Messages

Messages used when order book is published as an order depth service:

Message	Trade Condition or Type
Order Executed	Any execution to a visible portion of an order. • A message is only generated for the passive order that was executed. • The order ID will be stamped in the message. • A message will not be generated for the aggressive order.
Order Executed with Price/Size	Any execution where the price of the trade is different to the price of the order. In addition, during the Closing Price Cross trading session for passive orders in a book with their order IDs that gets executed due to an aggression. When an auction takes place, this message is generated for each displayed order that was executed, (both passive and aggressive) with their respective order IDs, with the Printable field set to 'No'. The message is not used in continuous trading.
Trade	Any execution to a non-visible portion of an order.

Auction Trade	Any auction trade.
Off-Book Trade	Any off-book trade.
Trade Break	When a trade is cancelled.

5.3 Order Book Management (Top of Book)

5.3.1 Top of Book

The Top of Book message will be used to communicate the best bid and the best offer prices and sizes of an order book in the Top of Book service. Separate Top of Book messages are used to communicate best bid details and best offer details. The Action field of the message will denote if the top of book of the specified side should be updated or deleted. If the Action field is set to Update (1), then the clients should repaint their top of book picture of the specified side with the information provided in the message. This could mean that a new price is present or that the limit or market visible quantity at top of book has changed. If for a given side there are no visible market and limit order quantities, then the Top of Book message will be published with an Action of Delete (2).

5.3.2 Messages

Messages used when order book is published as a Top-Of-Book service:

Message	Trade Condition or Type
Trade	Any execution to either a visible or non-visible portion of an order.
Auction Trade	Any auction trade.
Off-Book Trade	Any off-book trade.

5.4 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, Auction Trade and Off-Book Trade messages published by the server.

Each of the above messages will include a Trade ID identifier of the trade which will be referenced if a trade is ever cancelled. The recipients will be able to identify their own trades with this Trade ID while ensuring anonymity as the same Trade ID will also be tagged in the trade capture reports carrying the relevant trade information in the Post Trade Gateway. The MITCH messages will represent this Trade ID in binary while the Post Trade Gateway will represent the same Trade ID in Hexadecimal. The Trade IDs used for a particular type of trade (i.e. On Book or Off Book) are unique across instruments and days. However, an On Book trade and an Off Book trade may have the same Trade ID but the prefix ensures uniqueness i.e. currently On Book and Off Book trade IDs are prefixed with the values ‘T’ and ‘N’, thereby ensuring uniqueness. In MITCH, these prefixes are normally removed when converting these trade IDs to binary format. In such a scenario, the trade IDs may therefore be the same for an On Book and Off Book trade and the JSE suggests that the prefix is somehow retained to ensure uniqueness.

5.4.1 Execution of Hidden Quantity

The Trade message is sent whenever a hidden Pegged or Pegged Limit order is fully or partially filled during regular trading. This message will also be used to inform the market of

any Cross Order Trades that appear in the market. An Order Executed or Order Executed With Price/Size message will not be published for hidden order executions.

5.4.2 Execution of Multi-Legged (Strategy) Instruments

Trade messages are sent for the leg instruments of a multi-legged instrument as a result of the execution of two explicit orders in the strategy (multi-legged) instrument. The Trade Condition Flag in the Trade message will be set to Yes.

Order Executed With Price/Size message or Order Executed message is sent for the executions of the Strategy instrument.

5.4.3 Auctions

Each displayed order executed in the auction will be updated via an Order Executed With Price/Size message irrespective of whether or not it was executed at its displayed price. The Printable field of each such message will be “N” to indicate to Recipients that they should not update time and sales and statistics displays as the Auction Trade message is published with the Auction statistics.

The executions that take place during an auction will be reported as a single bulk print via the Auction Trade message. This message will include details of the type of auction (i.e. opening, closing, Volatility, Intra-Day etc.), the auction price and the total volume executed.

The EOD Volume Auction will only publish an Auction Trade message at the end of the auction period and no Auction information as all activity within this auction period will not be visible to the market.

5.4.4 Off Book Trades

The details of privately negotiated trades confirmed by JSE will, after the applicable delay, be disseminated via the Off Book Trade message. In addition to the instrument, price, quantity and Trade ID, this message will include the trade type as well as the date and time the trade was agreed between the firms.

5.4.5 Trade Cancellations

A Trade Break message will be sent if a trade is cancelled by the JSE or by members as approved by JSE Surveillance. The message will include the Trade ID of the cancelled trade along with an indication whether it is an On Book, Negotiated Trade or Off Book trade. A trade cancellation is final. Once a trade is cancelled it cannot be reinstated.

If a trade is executed during a session where trade publication is disabled and is cancelled during a session where it is enabled, recipients will not receive a Trade Break message. If a trade is executed during a session where trade publication is enabled and is cancelled during a session where it is disabled or when there is no session, recipients will receive a Trade Break message. For On Book trades, the original session would be the session the trade took place in. For Off Book trades, the original session would be the session the trade was published in.

Details of trade corrections are not disseminated on the market data feed. The JSE will not be using trade correction functionality.

5.5 Indicative Auction Information

The market data feed provides Recipients with the indicative price as well as the indicative executable auction volume for each auction (i.e. opening, closing, etc.) via the Auction Info message. The indicative auction price is disseminated along with the executable volume.

Indicative auction info message does not contain information about the imbalance quantity as required by JSE although the millennium system supports it. Therefore if the imbalance quantity is updated, the system will still generate an auction information message however no information related to the imbalance quantity is disseminated in the message.

The update frequencies and times are configurable and may be changed with due notice to Recipients. Indicative Auction Information will be published real time during the following auction call sessions:

(a) Opening Auction Call
(b) Intra-day Auction Call
(c) Volatility Auction Call
(d) Re-Opening Auction Call
(e) Closing Auction Call
(f) FCO Auction Call

If an indicative auction price does not exist (i.e. the order book is not locked or crossed) the Imbalance Direction field of the message will be “Insufficient Orders for Auction” i.e. “O”.

Note: EOD Volume Auction will not disseminate any Auction Info messages.

5.6 Statistics

The market data feed provides Recipients with the official opening and closing prices for each instrument via the Statistics message. The method used to compute the opening/closing price (e.g. auction, last sale, mid-point, etc.) will be specified in the Open Close Indicator field. Statistics calculated will be rounded down to three decimal places.

In the unlikely that event the opening or closing price needs to be corrected by JSE Market Operations, a Statistics message will be transmitted with the corrected value. The message will include a negative value in the Price field if a previously published price is to be cleared. If a correction is published the Open/Close Price Indicator will be set to F=Manual.

Trade Cancellations and Corrections performed may update the official opening and closing prices for each instrument and will be reflected via the Statistics message.

The Market data feed will also provide High Price, Low Price, VWAP, Volume, Turnover and Number of Trades via the Extended Statistics message. The fields will include a negative value in the relevant fields (i.e. High Price, Low Price etc.) if a previously published value is to be cleared. Statistics will not be updated for cross orders.

The Open Interest for derivatives products will also be published via the Extended Statistics message. This field must only be used if populated with a value as the JSE will only be updating this field periodically.

A negative value will be published if the previously published price is cleared due to trade cancellations clearing the statistic.

5.7 Market Operations Announcements

JSE Market Operations announcements are included in the market data feed. In addition to the actual text of the announcement and an associated headline or subject, recipients are provided with its urgency, the time it was generated and the list of instruments and underlying instruments, if any, to which the announcement relates.

Market Operations Announcements are disseminated via the News message.

6 CONNECTIVITY

6.1 Transmission Standards

6.1.1 Multicast Channels

The Real-Time 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.

6.1.2 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.

6.2 Interface User Ids (CompIDs)

The Interface User ID (CompID) and the IP address of each client wishing to connect to the Recovery and Replay channels must be registered with JSE before communications can begin. Each Interface User ID (CompID) will be assigned a password on registration.

The same Interface User ID (CompID) can be used to login to Recovery and Replay channels across market data groups. A client could also use the same Interface User ID (CompID) to login to the Recovery and Replay Channels of both FAST and MITCH feeds.

However, an Interface User ID (CompID) may, at any particular time, only be logged into one TCP channel across all market data groups. (This means that the Interface User ID cannot login to other TCP channels of other market data groups nor can it login to another TCP channel in the same market data group at the same time. i.e. cannot login to the Recovery and Replay channels at the same time.)

6.3 Passwords

Each new Interface User ID (CompID) will be assigned a password on registration. Clients will not be required to change the password on first use.

6.4 Gateway Subscriptions

The market data feed for the JSE Equity, Derivative and Bond Markets is provided via both a throttled and un-throttled Gateway. Clients who are subscribed to the un-throttled Gateway should ensure they receive the market data updates via an un-restricted line. i.e. un-throttled output message rate requires adequately sized bandwidth.

The market data feed for the NSX Equity Market is only provided via a throttled gateway.

See section 13 – Market Data Gateways, for a complete list of gateways allocated to all markets.

Market data services provided via the throttled and un-throttled Gateways will be the same on both Gateways including the replay and recovery functionality, the only difference is that they will publish at different output rates as per throttled or un-throttled configuration.

6.5 Production IP Addresses and Ports

The feed is load balanced by market data group. While each group will contain multiple instruments, each instrument is assigned to just one market data group. Although the group an instrument is assigned to may change from day to day, it will not change within a day. The Symbol Directory messages available on the Real-Time channel of the various market data groups may be utilized by recipients to identify the instruments assigned to each group.

Market Data groups are a logical grouping and do not affect the Market data services. Initially, the only market data grouping that will be implemented for instruments is by the relevant market. (i.e. JSE and NSX). The Market Data Group identifiers will be assigned as below. Clients are required to specify the Market Data Group identifier accordingly on performing Replay Request message via the Replay Channel based on the server the client is connected to.

Throttled Gateway:

Market Data Group	Replay Channel	
	Primary	Secondary
Equity Market		
JSE	*1*	*2*
NSX	*3*	*4*
Derivative Markets		
JSE_EDM-F	*9*	*A*
JSE_EDM-L1	*B*	*C*
JSE_FXM JSE_BONDS -F	*F*	*G*
JSE_FXM JSE_BONDS -L1	*H*	*I*
JSE_CDM JSE_IRM -F	*L*	*M*
JSE_CDM JSE_IRM -L1	*N*	*O*

Un-throttled Gateway:

Market Data Group	Replay Channel	
	Primary	Secondary
Equity Market		
JSE	*5*	*6*
Derivatives Markets		
JSE_EDM	*7*	*8*

JSE_FXM *JSE_BONDS*	*D*	*E*
JSE_CDM *JSE_IRM*	*J*	*K*

The IP addresses and ports of the production servers for both the throttled and un-throttled gateways will be detailed in a consolidated JSE Production Market Facing Client document. The JSE will assign each registered client to one of the primary IP addresses and ports and one of the secondary IP addresses and ports.

6.6 Failover and Recovery

The JSE Market will have a resilient solution at the primary site. For all TCP/IP connections clients will be given two IP addresses, a Primary and Backup address for the Production SiteThe IP addresses for the Disaster Recovery Site will be the same, as the JSE will implement a NAT-ing of services. Clients should use the Production Site IP addresses until directed that a site failover has been invoked.On unexpected disconnection from the Production 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 Production Site secondary gateway – and this should then be retried a further 3 times. After six failed connection attempts (3 on each gateway) the client should contact JSE Market Ops for guidance.

In case a successful connection is made with the secondary gateway and reconnection is required on unexpected disconnection, it is expected that the client should try to reconnect to the last successful IP (secondary gateway) three times and then attempt to connect to the primary gateway three times. If the six connection attempts (3 on each gateway) fail, the client should contact JSE Market Ops for guidance.

7 RECOVERY

7.1 Recipient Failures

Recipients have access to two identically sequenced Real-Time feeds: one from the main site (Feed A) and one from the backup feed (Feed B). Recipients should process both feeds and arbitrate between them to minimise the probability of a data loss.

A message loss can be detected using the Sequence Number field included in the Unit Header of each message on the Real-Time channel. If a gap in sequence numbers is detected on the Real-Time channel, 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.

7.1.1 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 Real-Time channel. The channel supports the retransmission of the last REPLAY_CACHE_SIZE *<250,000>* messages published on the Real-Time channel.

Each Interface User ID (CompID) may login to the Replay channel of a particular market data group up to USER_MAX_LOGINS_FOR_REPLAY_CHANNEL *<1000>* times each day. The total number of Replay Requests that a client may send for a particular market data group is also limited to USER_MAX_REQUESTS_FOR_REPLAY_CHANNEL to *<1000>* each day.

Recipients may request the JSE to 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.

While a client may submit multiple Replay Requests, it may not have more than USER_MAX_CONCURR_REQUESTS_FOR_REPLAY_CHANNEL *<10>* concurrent unprocessed requests at any point in time. If a client submits multiple requests on the Replay channel, they will be processed serially (i.e. one at a time). Active requests of multiple clients will be served on a FIFO basis. Clients are unable to cancel outstanding Replay Requests.

If consecutive LOGIN requests are sent by an Interface User ID (CompID) within a time span of MINIMUM_LOGIN_DELAY <10> milliseconds, the System will treat this Interface User ID as a potential Denial of Service attack. If this behavior of consecutive LOGIN requests is repeated 3 times by an Interface User, the Gateway will apply a delay of 1 second in the response message to the LOGIN message to prevent rapid login attempts. Until the response is sent to the Interface User, the Interface User will be maintained in the System in a 'Pending State' and will not be able to Login to the Replay Channel until the delayed response is sent.

7.1.1.1 Establishing a Connection

The client should use the relevant IP address and port details as outlined in the JSE Client Enablement Information Form (CEIF) 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 Interface User ID (CompID) in the Username, password and IP address of the client. The server will validate the Interface User ID (CompID), password and IP address of the client.

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 Interface User ID (CompID), IP address or invalid password 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 an invalid or expired password, a locked Interface User ID (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 already logged into the Replay channel USER_MAX_LOGINS_FOR_REPLAY_CHANNEL *<1000>* times during 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".

The Replay channel supports only MAX_CONCURRENT_LOGINS_FOR_REPLAY_CHANNEL *<150>* concurrent logins across all clients per gateway. Once the number of active logins has reached this limit, the server will reject login requests from additional clients with a Login Response and then break the TCP/IP connection. The Status of such a Login Response message will be "d".

If a Login Request is not received within USER_MAX_IDLING_TIME *<5>* seconds of the establishment of a TCP/IP connection or a Replay Request is not received within USER_MAX_IDLING_TIME *<5>* seconds of a successful logon, the server will break the TCP/IP connection with the client.

Each time the TCP/IP connection is terminated, it will increment the counter of the amount of times each Interface User ID (CompID) has logged in to the Replay channel.

A second attempt to log in by an already logged in client will be rejected via a Status of "Failed (Other)" i.e. 'e' in the Replay Response message.

A second attempt to log in to the same Market Data Replay channel or to a Market Data Replay channel of a different Market Data Group, by an already logged in CompID will be rejected immediately by breaking the TCP/IP connection without sending a Login Response. No message is sent to the client in this case, as the client is not authenticated. The original session is not affected by this disconnection.

At any point in time the Replay channel can queue only *_CONCURRENT_*LOGINS_FOR_REPLAY_CHANNEL *<150>* unprocessed requests from a client. The server will reject any further Snapshot Request messages via a Snapshot Response message. The Status of such a message will be "c".

7.1.1.2 Heartbeats

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

7.1.1.3 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 REPLAY_CACHE_SIZE *<250,000>* messages published on the Real-Time 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.

7.1.1.4 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. The First Message and Count fields of the Replay Response will always be zero if the response is 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 Real-Time channel. As the header on the Replay Channel will only carry the sequence number of the first message, the framing of the replayed messages inside of Unit Headers may differ between the original transmission and the retransmission.

A retransmission request cannot be cancelled once it has been submitted.

7.1.1.5 Termination of the Connection

If the client does not send a Logout Request and terminate the connection within USER_MAX_IDLING_TIME *<5>* seconds of the retransmission of the last missed message, the server will break the TCP/IP connection with the client.

The server will terminate the TCP/IP connection if the number of messages that are buffered for a client exceeds USER_MAX_BUFFERED_COUNT *<1,000>*.

7.1.2 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).

The Channel permits clients to request a snapshot of the order book and statistics for the active instruments in the market data group as well as their current trading status. It also enables recipients to download the list of active and suspended instruments in the market data group.

In addition, it enables Recipients to request the retransmission of trades published during the last MAX_TRADE_HISTORY_DURATION *<60>* minutes on the Real-Time channel. It also enables recipients to download the list of active instruments in the market data group. Furthermore it enables the recipients to request the retransmission of the last MAX_ANNOUNCEMENT_COUNT *<10,000>* market announcements published on Real Time channel.

Each Interface User ID (CompID) may login to the Recovery channel of a particular market data group up to USER_MAX_LOGINS_FOR_SNAPSHOT_CHANNEL *<500>* times each day. The total number of Snapshot Request messages that a client may submit for a particular market data group is also limited to USER_MAX_REQUESTS_FOR_SNAPSHOT_CHANNEL *<500>* each day.

Recipients may request JSE to 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.

While a client may submit multiple Snapshot Requests, it may not have more than USER_MAX_CONCURR_REQUESTS_FOR_SNAPSHOT_CHANNEL *<10>* concurrent unprocessed requests at any point in time. If a client submits multiple concurrent requests, they will be processed serially (i.e. one at a time). Active requests of multiple clients will be served on a FIFO basis. Clients are unable to cancel outstanding Snapshot Requests.

7.1.2.1 Establishing a Connection

The client should use the relevant IP address and port details as outlined in the JSE Client Enablement Information Form (CEIF) to establish a TCP/IP session with the Recovery channel. The client should initiate a connection by sending the Login Request message. The client should identify itself by specifying its Interface User ID (CompID) in the Username field. The server will validate the Interface User ID (CompID), password and IP address of the client.

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 Interface User ID (CompID), IP address or invalid password 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 Interface User ID (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 already logged into the Recovery channel USER_MAX_LOGINS_FOR_SNAPSHOT_CHANNEL *<500>* times during 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 message will be "b".

The Recovery channel supports only MAX_CONCURRENT_LOGINS_FOR_SNAPSHOT_CHANNEL _CONCURRENT_LOGINS_FOR_REPLAY_CHANNEL *<150>* concurrent logins across all clients. Once the number of active logins has reached this limit, the server will reject login requests from additional clients with a Login Response and then break the TCP/IP connection. The Status of such a Login Response message will be "d".

If a Login Request is not received within USER_MAX_IDLING_TIME *<5>* seconds of the establishment of a TCP/IP connection or a Snapshot Request is not received within USER_MAX_IDLING_TIME *<5>* seconds of a successful logon, the server will break the TCP/IP connection with the client.

A second attempt to log in by an already logged in client will be rejected via a Status of "Failed (Other)" i.e. 'e' in the Snapshot Response message.

A second attempt to log in to the same Market Data Snapshot channel or to a Market Data Snapshot channel of a different Market Data Group, by an already logged in CompID will be rejected immediately by breaking the TCP/IP connection without sending a Login Response. No message is sent to the client in this case, as the client is not authenticated. The original session is not affected by this disconnection.

At any point in time the Recovery channel can queue only *_CONCURRENT_*LOGINS_FOR_REPLAY_CHANNEL *<150>*unprocessed requests from a client. The server will reject any further Snapshot Request messages via a Snapshot Response message. The Status of such a message will be "c".

7.1.2.2 Heartbeats

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

7.1.2.3 General Event Model

Once connected to the Recovery channel, clients may use the Snapshot Request message to download the list of active and suspended instruments, request a snapshot of an order book, statistics or trading status or download the trades published during the last MAX_TRADE_HISTORY_DURATION *<60>* minutes or recover the last MAX_ANNOUNCEMENT_COUNT *<10,000>* market announcements.. The Snapshot Type field of the message should be used to indicate the nature of the request.

The server will transmit a Snapshot Response to indicate whether the request is accepted or rejected. A Status other than "A" will indicate that the request is rejected.

If the request is successful, a series of application messages (e.g. Add Order, Symbol Directory, Recovery Trade, etc.) will then be disseminated to serve the request.

A Snapshot Complete message will be sent once all application messages have been transmitted in response to a request. Snapshot Complete messages may also be sent prior to the final Snapshot Complete to indicate that all messages relating to a particular sub book or instrument have been transmitted.

A Snapshot Request may optionally include a Request ID which, if specified, will be included in each Snapshot Response and Snapshot Complete sent in response to it.

7.1.2.4 Instrument List

A Snapshot Request with a Snapshot Type of Instrument (2) may be used to request the details of all active and suspended instruments in the market data group or those in the group from a particular segment. The request will be deemed as one for all instruments if it does not contain a value in the Segment field. The Sequencer Number, Instrument ID, Sub Book and Last Trade Time fields of the request will be ignored by the server when processing a snapshot request for an instrument list.

The server will send a Snapshot Response to indicate whether the request is accepted or rejected. The Sequence Number and Order Count fields of this message should be ignored as these fields should be used when processing Order Book snapshots, which require the Gateway to send out sequence numbers and order counts so that the order book can be built. These fields are not required for other snapshot updates and therefore these fields should be ignored for any other updates.

If the request is successful, the server will then disseminate a series of Symbol Directory messages. Each such message will provide the details of a requested instrument.

The server will transmit a Snapshot Complete once the details of all instruments are disseminated. The message will include the appropriate value in the Segment field if the request was for a particular segment. In addition the message will include the sequence number of the Real-Time channel with which the instrument snapshot was synchronised. The Symbol, Instrument ID, Sub Book and Trading Status fields of the message should be ignored when processing a snapshot request for an instrument list.

The Snapshot Response will be immediately followed a Snapshot Complete if there are no active or suspended instruments for the specified segment.

7.1.2.5 Requesting Order Book Snapshots

Order books are maintained per sub book of an instrument (e.g. Regular or Off Book) A Snapshot Request with a Snapshot Type of Order Book (0) may be used to request a snapshot of the current order book for one of the following:

(i) All sub books for all instruments in a specified segment.

(ii) All sub books for a single instrument.

(iii) Multiple sub books for a single instrument.

(iv) A single instrument and sub book combination.

The JSE currently supports three sub books per instrument: Regular (On Book), Off Book and negotiated trades. An order book request that includes the Off Book or negotiated trades sub book will be rejected.

A request that relates to a single sub book of an instrument may include the sequence number of the Real-Time multicast channel from which the client can build its order book. The sequence number, if any, included in such a Snapshot Request is validated by the server against the sequence number with which its current order book snapshot is synchronised. In the unlikely event the sequence number included in the Snapshot Request is higher than that with which the server's current order book snapshot is synchronised, the request will be rejected. The Snapshot Response transmitted in such an event will include a Status of "O".

The value in the Sequence Number field of a Snapshot Request is ignored by the server if the request relates to more than one sub book.

7.1.2.6 Response to an Order Book Snapshot Request for an Instrument

The server will send a Snapshot Response to indicate whether a Snapshot Request for an Instrument is accepted or rejected. The Sequence Number and Order Count fields of the Snapshot Response will be zero and should be ignored if the request is rejected.

The Snapshot Response will, if the request is accepted, include the message sequence number of the Real-Time channel with which the instrument's order book snapshot will be synchronised. This sequence number will be equal to or higher than the one, if any, included in the Snapshot Request. The response will also include the total number of active orders for the requested instrument. The client should buffer all messages on the Real-Time channel for the order book with sequence numbers greater than that specified in the Snapshot Response. Each order that is sent out is MBO. The orders are sent out based on Price Time priority

If the request is successful, the server will disseminate a snapshot of the current order book for the requested instrument via a series of Add Order and Add Attributed Order messages. Order book snapshots for the requested instrument will be transmitted serially (i.e. one book at a time). 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).

The server will transmit the Snapshot Complete message once the details of all active orders for the instrument are disseminated. The message will include the sequence number of the Real-Time channel with which the order book snapshot was synchronised and the instrument and sub book to which it relates. It will also include the current trading status of the instrument in the sub book. The client may begin processing the buffered messages for the instrument from the Real-Time channel once the order book snapshot is processed.

7.1.2.7 Response to an Order Book Snapshot Request for a Segment

The server will send a Snapshot Response to indicate whether a Snapshot Request for a segment is accepted or rejected. The Sequence Number and Order Count fields of the Snapshot Response will be zero and should be ignored if 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 series of Add Order and Add Attributed Order messages. Each such message will represent a single active order and will not include a sequence number (orders will be in price time priority sequence). If a particular price point contains multiple orders, they will be disseminated in terms of their time priority (i.e. the oldest order first as the oldest order within a price point has the higher priority).

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 all active orders for a particular instrument's order book are disseminated. This message will include the sequence number of the Real Time channel with which the order book snapshot for the instrument was synchronised. While such a Snapshot Complete will include the instrument and sub book to which it relates, it will not include a value in the Segment field. The segment is only specified in the final Snapshot Complete message once the details of all instruments belonging to the segment are disseminated. It will also include the current trading status of the book. The client may begin processing the buffered messages for the instrument from the Real-Time channel once its order book snapshot is processed. A Snapshot Complete message will be sent if On Book trading is enabled for an instrument even if there are no active orders for it. A Snapshot Complete message will not be sent if On Book trading is disabled for an instrument.

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.

The Sequence Number, Instrument ID, Sub Book and Trading Status fields of the message should be ignored.

7.1.2.8 Statistics Snapshots

Statistics are maintained per sub book of an instrument (i.e. Regular, Off Book or Negotiated Trades). A Snapshot Request with a Snapshot Type of Statistics (4) may be used to request a snapshot of the statistics for one of the following:

(i) All sub books for all instruments in a specified segment.

(ii) All sub books for a single instrument.

(iii) Multiple sub books for a single instrument.

(iv) A single instrument and sub book combination.

The request will be deemed as one for a segment if it contains a value in the Segment field (the contents, if any, of the Instrument ID and Sub Book fields will be ignored). It will be deemed as one for all sub books of an instrument if it only contains a value in the Instrument ID field.

As the server currently only supports statistics for the Regular book, the results of a statistics request for all sub books for a particular instrument and the Regular book of the instrument will be identical. A statistics request that includes the Off Book sub book will be rejected.

The server will send a Snapshot Response to indicate whether the request is accepted or rejected. The Sequence Number and Order Count fields of this message should be ignored as these are not required for the statistics messages.

If the request is successful, the server will then disseminate a snapshot of the statistics for each requested sub book via a series of Statistics and Extended Statistics messages. A separate message will be published for each type of statistic (e.g. opening price, closing price, etc.) and a separate Extended Statistics message will be published for each sub book.

Statistics snapshots for the requested sub books will be transmitted serially (i.e. one sub book at a time). The server will transmit a Snapshot Complete message once all statistics for a particular sub book are disseminated. The message will include the sequence number of the Real-Time channel with which the statistics snapshot was synchronised and the instrument and sub book to which it relates. It will also include the current trading status of the sub book. The client may begin processing the buffered messages for the instrument from the Real-Time channel once the statistics snapshot is processed. The Segment field of the message should be ignored. Only a Snapshot Complete message will be transmitted for a sub book if there are no statistics for it (i.e. no trades for the day).

In the case of segment level request, the server will also transmit a Snapshot Complete message once the statistics for all sub books in the requested segment are disseminated. This final Snapshot Complete will include an indication of the segment to which it relates.

The Sequence Number, Instrument ID, Sub Book and Trading Status fields of the message should be ignored.

7.1.2.9 Missed Trades

A Snapshot Request with a Snapshot Type of Trades (3) may be used to request missed trades for all instruments in a particular segment or for a single instrument. The ability to request missed trades for a particular instrument and sub book combination is not currently available[1]. The request must include the sending time of the last trade on the Real-Time channel processed by the client in the Last Trade Time field. If the sending time is not specified, the snapshot response will denote that the request is rejected due to invalid time formats. The 'Status' field will denote the value of 'e' Failed (Other). The request will be deemed as one for a segment if it contains a value in the Segment field (the contents, if any, of the Instrument ID field will be ignored).

The server only caches the trades published during the last MAX_TRADE_HISTORY_DURATION <*60*> minutes on the Real-Time channel. If the request includes a Last Trade Time that is prior to that of the oldest trade in the server's cache, all eligible trades in the cache will be retransmitted. Clients will not be able to recover trades that are not in the server's cache.

[1] The Sub Book field is ignored by the server if the Snapshot Request is for missed trades.

The server will send a Snapshot Response to indicate whether the request is accepted or rejected. The Sequence Number and Order Count fields of this message should be ignored as they are not required.

If the request is successful, the server will then disseminate the continuous trades, auction trades, Off Book trades and trade cancellations missed by the client via a series of Recovery Trade messages.

Trades for the requested instruments will be transmitted serially (i.e. one instrument at a time). The server will transmit a Snapshot Complete once all trades for a particular instrument are disseminated. The message will indicate the instrument to which it relates. In addition the message will include the sequence number of the Real-Time channel with which the missed trades snapshot was synchronized. The, Segment, Sub Book and Trading Status fields of the message should be ignored. Only a Snapshot Complete message will be transmitted for an instrument if there are no trades for it in the server's cache.

In the case of segment level request, the server will also transmit a Snapshot Complete message once trades for all instruments in the requested segment are disseminated. This final Snapshot Complete will include an indication of the segment to which it relates. The Sequence Number, Instrument ID, Sub Book and Trading Status fields of the message should be ignored as they are not required.

7.1.2.10 Trading Status

Trading status is maintained per sub book of an instrument (i.e. Regular, Off Book or negotiated trades). A Snapshot Request with a Snapshot Type of Instrument Status (1) may be used to request the trading status for one of the following:

(i) All sub books for all instruments in a specified segment.

(ii) All sub books for a single instrument.

(iii) Multiple sub books for a single instrument.

(iv) A single instrument and sub book combination.

The request will be deemed as one for a segment if it contains a value in the Segment field (the contents, if any, of the Instrument ID and Sub Book fields will be ignored). It will be deemed as one for all sub books of an instrument if it only contains a value in the Symbol field.

The server will send a Snapshot Response to indicate whether the request is accepted or rejected. The Sequence Number and Order Count fields of this message should be ignored.

If the request is successful, the status of each instrument for each requested sub book will be disseminated via a series of Symbol Status messages. Each such message will include the applicable Trading Status and a Session Change Reason of Unavailable (9).

The server will transmit a Snapshot Complete message after the Symbol Status for a particular sub book. The Snapshot Complete will include the sequence number of the Real-Time channel with which the trading status was synchronised and the instrument and sub book to which it relates. The Segment and Trading Status fields of the message should be ignored.

In the case of segment level request, the server will also transmit a Snapshot Complete message once the trading status for all instruments for all sub books in the requested segment are disseminated. This final Snapshot Complete message will include an indication of the segment to which it relates. The Sequence Number, Instrument ID, Sub Book and Trading Status fields of the message should be ignored.

7.1.2.11 Requesting Missed Market Operations Announcements

A Snapshot Request with a Snapshot Type of News (5) may be used to request missed market operations announcements published by the server. The request should include the sending time of the last announcement on the Real-Time channel processed by the client in the Recover From Time field.

The server only caches the last MAX_ANNOUNCEMENT_COUNT <10,000> market announcements published on the Real-Time channel. If the request includes a Recover From Time that is prior to that of the oldest announcement in the server's cache, all eligible announcements in the cache will be retransmitted. Clients are unable to recover announcements not in the server's cache.

The server will send a Snapshot Response to indicate whether the request is accepted or rejected. The Sequence Number and Order Count fields of this message should be ignored.

If the request is successful, the server will then disseminate market operations announcements missed by the client via a series of News messages.

Announcements will be transmitted serially. The server will transmit a Snapshot Complete once all qualifying announcements are disseminated. The message will include the sequence number of the Real-Time channel with which the announcements snapshot was synchronised. A Snapshot Complete message will be transmitted if there are no announcements in the server's cache.

7.1.2.12 **Termination of the Connection**

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

7.2 Failures at JSE

7.2.1 Snapshots on the Real-Time Channel

In the unlikely event of an outage at the JSE, Recipients may be required to refresh their order book and statistics displays for one or more instruments.

In such a scenario the server will, on the Real-Time channel, broadcast an Order Book Clear message for each affected instrument. In such an event Recipients must discard the contents of their order book and statistics displays for these instruments.

The server will then transmit a series of Add Order, Add Attributed Order, Statistics and Extended Statistics messages, on the Real-Time channel, to disseminate the current order book and statistics for each affected instrument.

7.2.2 Resetting Sequence Numbers

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

Trades executed just prior to and during the failover or restart may not be published on the Real-Time channel once it resumes. Clients may, if required, recover these trades from the Recovery channel.

It should be noted that the system disseminates the full order book and statistics snapshot (as per section 7.2.1) but recipients will need to recover trades separately if they wish to do so.

8 MESSAGE FORMATS

This section provides details on the data types, unit header, nine administrative messages and seventeen 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).

8.1 Packet Composition

The Unit Header is used to deliver all administrative and application messages to and from the server on all three 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.

8.2 Sequence Numbers

All application messages transmitted by the server on the Real-Time 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 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 un-sequenced. The Unit Header used to transport all such messages, other than a Heartbeat, will include a Sequence Number of zero.

8.3 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 the 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 determine the time at which an active order was submitted from the messages transmitted on the Recovery channel.

8.4 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.
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.

All Reserved Fields with Alpha Data Type will be populated with Spaces (Hex 0x20). All other Reserved Fields will be populated with Hex 0x00.

8.5 Message Overview

8.5.1 Administrative Messages

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

8.5.2 Application Messages

Applications messages may only be sent by the server.

Name	Message Type		Usage
	ASCII	Hex	
Time	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.
System Event	S	0x53	Sent to indicate the start and end of the day.
Symbol Directory	R	0x52	Used to disseminate information (e.g. Instrument ID, segment, ISIN, underlying, etc.) on each instrument. The previous closing price of each instrument is also disseminated.
Symbol Status	H	0x48	Indicates the trading session (e.g. pre-opening, continuous trading, etc.) that currently applies to an instrument.
Add Order	A	0x41	Sent to indicate that a limit or market order is added to the order book.

Name	Message Type	Usage	
Add Attributed Order	F	0x46	Indicates that an attributable limit order is added to the order book. The identity of the submitting firm is included in the message.
Order Deleted	D	0x44	Sent to indicate that the remainder of a displayed order is cancelled.
Order Modified	U	0x55	Indicates that the displayed quantity or price of a displayed order has been updated. The message will include an indication whether the order has retained or lost its time priority.
Order Book Clear	y	0x79	Sent to instruct Recipients to remove all orders from the order book for the specified instrument.
Order Executed	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.
Order Executed With Price/ Size	C	0x43	Sent if a displayed order is fully or partially filled at a price that is different from its displayed price. The executed quantity and price is included in the message along with an indication of whether the trade should update time and sales and statistics displays.
Trade	P	0x50	Sent if a hidden Pegged or Pegged limit order is fully or partially filled. Sent for the leg instruments of a multi-legged instrument as a result of the execution of two explicit orders in the strategy (multi-legged) instrument. In such scenarios the Trade Condition Flag will be set to Yes.
Auction Trade	Q	0x51	Sent to report details of an auction (e.g. opening, closing, etc.). The message indicates the price and bulk volume associated with the auction.
Off Book Trade	x	0x78	Sent to report the details of a trade negotiated outside the System yet reported to the System in accordance with the JSE Rules and Directives.
Trade Break	B	0x42	Indicates that a previously reported trade (On Book or Off Book) is cancelled.
Recovery Trade	v	0x76	Used to disseminate the details of missed On Book and off-book trades on the Snapshot channel.
Auction Info	I	0x49	Used to disseminate the indicative auction price and the tradable quantity (volume) at this price.
Statistics	w	0x77	Used to disseminate the official opening and closing prices.
Extended Statistics	€	0x80	Used to disseminate the High Price, Low Price, VWAP, Volume, Turnover and Number of Trades.

Name	Message Type	Usage	
News	u	0x75	Used to publish market operations announcements.
Top of Book	q	0x71	Used to communicate the best bid and the best offer prices and sizes of an order book

8.6 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.

8.7 Administrative Messages (Client – Initiated)

8.7.1 Login Request

Field	Offset	Length	Type	Description
Length	0	*2*	UInt16	Length of message including this field.
Message Type	2	1	Byte	**Hex** **Meaning** 0x01 Login Request
Username	3	6	Alpha	CompID assigned to the client.
Password	9	10	Alpha	Password assigned to the CompID.

8.7.2 Replay Request

Field	Offset	Length	Type	Description
Length	0	2	UInt16	Length of message including this field.
Message Type	2	1	Byte	**Hex** **Meaning** 0x03 Replay Request
Market Data Group	3	1	Byte	Identity of the market data group the replay request relates to.
First Message	4	4	UInt32	Sequence number of the first message in range to be retransmitted.
Count	8	2	UInt16	Number of messages to be resent

8.7.3 Snapshot Request

Field	Offset	Length	Type	Description
Length	0	*2*	UInt16	Length of message including this field.
Message Type	2	1	Byte	**Hex** **Meaning** 0x81 Snapshot Request
Sequence Number	3	4	UInt32	Sequence number from which the client can build the order book. This is only required for instrument level requests
Segment	7	6	Alpha	Segment the request relates to. The field should contain only spaces if it does not relate to a segment.
Instrument ID	13	4	UInt32	JSE unique numeric Instrument Identifier. Instrument the request relates to. The field should contain only spaces if it does not relate to an instrument and the Segment field is populated.
Reserved	17	1	Byte	Reserved field
Reserved	18	1	Byte	Reserved field

Sub Book	19	1	Bit Field	**Bit**	**Name**	**Meaning**
				0	Regular	0: No 1: Yes
				1	Off Book	0: No 1: Yes
				5	Bulletin Board	0: No 1: Yes
				6	Negotiated Trades	0: No 1: Yes
				Bit '0' is the rightmost bit in the array of bits. This bit can be either set to '0' or '1'. The '0' or '1' value meanings are denoted here.		
Snapshot Type	20	1	UInt8	**Value**	**Meaning**	
				0	Order Book	
				1	Instrument Status	
				2	Instrument	
				3	Trades	
				4	Statistics	
				5	News	
				8	Top of Book	
Recover From Time	21	8	Time	Sending time of the last processed trade specified in terms of local time for the server (i.e. SAST) with regards to Trades (3) or the last received announcement with regards to News (5). This field is ignored if the Snapshot Type is not Trades (3) or News (5).		
Request ID	29	4	UInt32	Optional identifier of the request. This is a user input field which can be used to track the requests sent via the Recovery channel.		

8.7.4 Logout Request

Field	Offset	Length	Type	Description	
Length	0	*2*	UInt16	Length of message including this field.	
Message Type	*2*	1	Byte	**Hex**	**Meaning**
				0x05	Logout Request

8.8 Administrative Messages (Server – Initiated)

8.8.1 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 Real-Time channel. However, the next expected sequence number will be included in the Sequence Number to enable Recipients to detect gaps on the Real-Time channel.

8.8.2 Login Response

Field	Offset	Length	Type	Description
Length	0	*2*	UInt16	Length of message including this field.
Message Type	2	1	Byte	**Hex** / **Meaning** 0x02 Login Response
Status	3	1	Byte	Status of the login request. **Value** / **Meaning** A Login Accepted a CompID Inactive/Locked b Login Limit Reached c Service Unavailable d Concurrent Limit Reached e Failed (Other)

8.8.3 Replay Response

Field	Offset	Length	Type	Description
Length	0	*2*	UInt16	Length of message including this field.
Message Type	2	1	Byte	**Hex** / **Meaning** 0x04 Replay Response
Market Data Group	3	1	Byte	Identity of the market data group the replay request relates to.
First Message	4	4	UInt32	Sequence number of the first message in range to be retransmitted. This will be zero if Status is not “A”.
Count	8	2	UInt16	Number of messages to be resent. This will be zero if Status is not “A”.

Status	10	1	Byte	Status of the replay request. **Value** **Meaning** A Request Accepted D Request Limit Reached I Invalid Market Data Group O Out of Range U Replay Unavailable c Concurrent Limit Reached d Unsupported message type e Failed (Other)

8.8.4 Snapshot Response

Field	Offset	Length	Type	Description
Length	0	*2*	UInt16	Length of message including this field.
Message Type	2	1	Byte	**Hex** **Meaning** 0x82 Snapshot Response
Sequence Number	3	4	UInt32	Sequence number with which the snapshot is synchronised.This will be zero if Status is not “A”. Ignore if Snapshot Type is not Order Book (0).
Order Count	7	4	UInt32	Number of orders that will be transmitted in the snapshot.This will be zero if Status is not “A”. Ignore if Snapshot Type is not Order Book (0).
Status	11	1	Byte	Status of the snapshot request. **Value** **Meaning** A Request Accepted O Out of Range U Snapshot Unavailable a Segment, Instrument ID or Sub Book Invalid or Not Specified b Request Limit Reached c Concurrent Limit Reached d Unsupported message type e Failed (Other)

Snapshot Type	12	1	UInt8	**Value** **Meaning** 0 Order Book 1 Instrument Status 2 Instrument 3 Trades 4 Statistics 5 News 8 Top of Book
Request ID	13	4	UInt32	Identifier, if any (optional), of Snapshot Request. This is a user input field which can be used to track the requests sent via the Recovery channel.

8.8.5 Snapshot Complete

Field	Offset	Length	Type	Description
Length	0	2	UInt16	Length of message including this field.
Message Type	2	1	Byte	**Hex** **Meaning** 0x83 Snapshot Complete
Sequence Number	3	4	UInt32	Sequence number with which the snapshot is synchronised.
Segment	7	6	Alpha	Segment the snapshot relates to. The field will contain only spaces if it does not relate to a segment.
Instrument ID	13	4	UInt32	JSE unique numeric Instrument Identifier. Instrument the snapshot relates to. The field will contain only spaces if it does not relate to an instrument.
Reserved	17	1	Byte	Reserved field
Reserved	18	1	Byte	Reserved field

<table>
<tr>
<td>Sub Book</td>
<td>19</td>
<td>1</td>
<td>Bit Field</td>
<td>
<table>
<tr><th>Bit</th><th>Name</th><th>Meaning</th></tr>
<tr><td>0</td><td>Regular</td><td>0: No
1: Yes</td></tr>
<tr><td>1</td><td>Off-Book</td><td>0: No
1: Yes</td></tr>
<tr><td>5</td><td>Bulletin Board</td><td>0: No
1: Yes</td></tr>
<tr><td>6</td><td>Negotiated Trades</td><td>0: No
1: Yes</td></tr>
</table>
</td>
</tr>
<tr>
<td>Trading Status</td>
<td>20</td>
<td>1</td>
<td>Byte</td>
<td>
This will only be indicated if the message is sent as a book level complete and the Snapshot Type is Order Book (0) or Statistics (4).
<table>
<tr><th>Value</th><th>Meaning</th></tr>
<tr><td>H</td><td>Halt</td></tr>
<tr><td>T</td><td>Continuous Trading</td></tr>
<tr><td>a</td><td>Opening Auction Call</td></tr>
<tr><td>b</td><td>Post-Close</td></tr>
<tr><td>c</td><td>Market Close</td></tr>
<tr><td>d</td><td>Closing Auction Call</td></tr>
<tr><td>e</td><td>Volatility Auction Call</td></tr>
<tr><td>E</td><td>EOD Volume Auction Call</td></tr>
<tr><td>f</td><td>Re-Opening Auction Call</td></tr>
<tr><td>I</td><td>Pause</td></tr>
<tr><td>p</td><td>Futures Close Out</td></tr>
<tr><td>s</td><td>Closing Price Cross</td></tr>
<tr><td>u</td><td>Intra-Day Auction Call</td></tr>
<tr><td>v</td><td>End of Trade Reporting</td></tr>
<tr><td>w</td><td>No Active Session</td></tr>
<tr><td>x</td><td>End of Post Close</td></tr>
<tr><td>y</td><td>Start of Trading</td></tr>
<tr><td>z</td><td>Closing Price Publication</td></tr>
</table>
</td>
</tr>
</table>

<table>
<tr><td>Snapshot Type</td><td>21</td><td>1</td><td>UInt8</td><td><table><tr><th>Value</th><th>Meaning</th></tr><tr><td>0</td><td>Order Book</td></tr><tr><td>1</td><td>Instrument Status</td></tr><tr><td>2</td><td>Instrument</td></tr><tr><td>3</td><td>Trades</td></tr><tr><td>4</td><td>Statistics</td></tr><tr><td>5</td><td>News</td></tr><tr><td>8</td><td>Top of Book</td></tr></table></td></tr>
<tr><td>Request ID</td><td>22</td><td>4</td><td>UInt32</td><td>Identifier, if any (optional), of Snapshot Request.
This is a user input field which can be used to track the requests sent via the Recovery channel.</td></tr>
</table>

8.9 Application Messages

8.9.1 Time

Field	Offset	Length	Type	Description
Length	0	2	UInt16	Length of message including this field.
Message Type	2	1	Byte	**Hex** **Meaning** 0x54 Time
Seconds	3	4	UInt32	Number of seconds since midnight. Midnight will be in terms of the local time for the server (i.e. SAST).

8.9.2 System Event

Field	Offset	Length	Type	Description
Length	0	2	UInt16	Length of message including this field.
Message Type	2	1	Byte	**Hex** **Meaning** 0x53 System Event
Nanosecond	3	4	UInt32	Nanoseconds since last Time message.
Event Code	7	1	Byte	**Value** **Meaning** C End of Day O Start of Day

8.9.3 Symbol Directory

Field	Offset	Length	Type	Description
Length	0	2	UInt16	Length of message including this field.
Message Type	2	1	Byte	**Hex** **Meaning** 0x52 Symbol Directory
Nanosecond	3	4	UInt32	Nanoseconds since last Time message.
Instrument ID	7	4	UInt32	JSE unique numeric Instrument Identifier.
Reserved	11	1	Byte	Reserved field.
Reserved	12	1	Byte	Reserved field.
Symbol Status	13	1	Alpha	**Value** **Meaning** H Halted S Suspended a Inactive This field will contain a space if the instrument is active.
ISIN	14	12	Alpha	International Securities Identifying Number
Symbol	26	25	Alpha	Symbol of an instrument.
TIDM	51	12	Alpha	Tradable Instrument Display Mnemonic
Segment	63	6	Alpha	Segment the instrument is assigned to. ~~Please refer to Section 8.9.1 for the valid segments.~~
Previous Close Price	69	8	Price	Previous Close Price of the Instrument
Expiration Date	77	8	Date	Date an instrument expires or matures. This field will contain only spaces if the instrument is not a derivative or fixed income instrument.
Underlying	85	25	Alpha	Symbol of the underlying instrument. This field will contain only spaces if the instrument is not a derivative.
Strike Price	110	8	Price	Strike price of an option. The price will be zero if the instrument is not an option.
Option Type	118	1	Alpha	**Value** **Meaning** C Call Option P Put Option This field will contain a space if the instrument is not an option.
Issuer	119	6	Alpha	Issuer of the instrument. This field will contain all spaces if the instrument is not a fixed income instrument.

<table>
<tr><td>Issue Date</td><td>125</td><td>8</td><td>Date</td><td>Date instrument was issued. This field will contain all spaces if the instrument is not a fixed income instrument.</td></tr>
<tr><td>Coupon</td><td>133</td><td>8</td><td>Price</td><td>Rate of interest applied to the face value. This is a percentage field (e.g. 0.05 represents 5%). The price will be zero if the instrument is not a fixed income instrument.</td></tr>
<tr><td>Flags</td><td>141</td><td>1</td><td>Bit Field</td><td><table><tr><th>Bit</th><th>Name</th><th>Meaning</th></tr><tr><td>0</td><td>Inverse Order Book</td><td>0: No
1: Yes</td></tr></table></td></tr>
<tr><td>Sub Book</td><td>142</td><td>1</td><td>Bit Field</td><td><table><tr><th>Bit</th><th>Name</th><th>Meaning</th></tr><tr><td>0</td><td>Regular</td><td>0: No
1: Yes</td></tr><tr><td>1</td><td>Off Book</td><td>0: No
1: Yes</td></tr><tr><td>5</td><td>Bulletin Board</td><td>0: No
1: Yes</td></tr><tr><td>6</td><td>Negotiated Trades</td><td>0: No
1: Yes</td></tr></table></td></tr>
<tr><td>Corporate Action</td><td>143</td><td>189</td><td>Alpha</td><td>Contains Ex-Marker and/or Annotation information (if any) associated with an instrument.
Please refer to Section 11 for valid Ex-Markers and Annotations. See section 4.1.5 for the format of this field.</td></tr>
<tr><td>Leg 1 Symbol</td><td>332</td><td>25</td><td>Alpha</td><td>Symbol of Leg 1 instrument.
This field will contain only spaces if the instrument is not a multi-legged instrument
(This field will only be available for Symbol Directory messages disseminated via MITCH gateway instances configured to distribute market data for derivative instruments)</td></tr>
<tr><td>Leg 2 Symbol</td><td>357</td><td>25</td><td>Alpha</td><td>Symbol of Leg 2 instrument.
This field will contain only spaces if the instrument is not a multi-legged instrument
(This field will only be available for Symbol Directory messages disseminated via MITCH gateway instances configured to distribute market data for derivative instruments)</td></tr>
</table>

Contract Multiplier	382	8	Price	Defines the multiplier of the instrument. This field will contain 0 value if the instrument does not have a contract multiplier (i.e. Underlying Instrument) (This field will only be available for Symbol Directory messages disseminated via MITCH gateway instances configured to distribute market data for derivative instruments)
Settlement Method	390	1	Alpha	Defines the settlement method of the underlying contract Value: C = Cash; P = Physical This field will contain only spaces if the instrument does not have a settlement method (i.e. only applicable for Futures, Options and Forward Forwards) (This field will only be available for Symbol Directory messages disseminated via MITCH gateway instances configured to distribute market data for derivative instruments)
Instrument Sub Category	391	30	Alpha	Defines the instrument sub category for which the instrument belongs. (This field will only be available for Symbol Directory messages disseminated via MITCH gateway instances configured to distribute market data for derivative instruments)

8.9.4 Symbol Status

Field	Offset	Length	Type	Description
Length	0	2	UInt16	Length of message including this field.
Message Type	2	1	Byte	Hex: 0x48 — Meaning: Instrument Status
Nanosecond	3	4	UInt32	Nanoseconds since last Time message.
Instrument ID	7	4	UInt32	JSE unique numeric Instrument Identifier.
Reserved	11	1	Byte	Reserved field
Reserved	12	1	Byte	Reserved field

<table>
<tr><td>Trading Status</td><td>13</td><td>1</td><td>Byte</td><td><table><tr><th>Value</th><th>Meaning</th></tr><tr><td>H</td><td>Halt</td></tr><tr><td>T</td><td>Regular Trading/Start Trade Reporting</td></tr><tr><td>a</td><td>Opening Auction Call</td></tr><tr><td>b</td><td>Post-Close</td></tr><tr><td>c</td><td>Market Close</td></tr><tr><td>d</td><td>Closing Auction Call</td></tr><tr><td>e</td><td>Volatility Auction Call</td></tr><tr><td>E</td><td>EOD Volume Auction Call</td></tr><tr><td>f</td><td>Re-Opening Auction Call</td></tr><tr><td>I</td><td>Pause</td></tr><tr><td>p</td><td>Futures Close Out</td></tr><tr><td>s</td><td>Closing Price Cross</td></tr><tr><td>u</td><td>Intra-Day Auction Call</td></tr><tr><td>v</td><td>End Trade Reporting</td></tr><tr><td>w</td><td>No Active Session</td></tr><tr><td>x</td><td>End of Post Close</td></tr><tr><td>y</td><td>Start of Trading (This indicates that continuous trading or an opening auction is about to take place)</td></tr><tr><td>z</td><td>Closing Price Publication</td></tr></table></td></tr>
<tr><td>Flags</td><td>14</td><td>1</td><td>Bit Field</td><td>Reserved for future use.</td></tr>
<tr><td>Reason</td><td>15</td><td>4</td><td>Alpha</td><td>The reason code for thechange in session.
This field will contain only spaces if the reason is unknown.
Please refer to Section 10 for an explanation of the reason codes.</td></tr>
<tr><td>Session Change Reason</td><td>19</td><td>1</td><td>UInt8</td><td><table><tr><th>Value</th><th>Meaning</th></tr><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>5</td><td>Circuit Breaker Tripped</td></tr><tr><td>9</td><td>Unavailable (recovery service only)</td></tr></table></td></tr>
</table>

<table>
<tr><td>New End Time</td><td>20</td><td>8</td><td>Time</td><td>New session end time specified in terms of local time for server (i.e. SAST). The field will contain only spaces if Session Change Reason is “0” or “9”.</td></tr>
<tr><td>Book Type</td><td>28</td><td>1</td><td>UInt8</td><td><table><tr><th>Value</th><th>Meaning</th></tr><tr><td>1</td><td>On Book</td></tr><tr><td>2</td><td>Off Book</td></tr><tr><td>9</td><td>Bulletin Board</td></tr><tr><td>11</td><td>Negotiated Trades</td></tr></table></td></tr>
</table>

8.9.5 Add Order

Field	Offset	Length	Type	Description
Length	0	2	UInt16	Length of message including this field.
Message Type	2	1	Byte	**Hex** / **Meaning**: 0x41 Add Order
Nanosecond	3	4	UInt32	Nanoseconds since last Time message,.
Order ID	7	8	UInt64	Unique identifier of the order.
Side	15	1	Byte	**Value** / **Meaning**: B Buy Order; S Sell Order
Quantity	16	4	UInt32	Displayed quantity of the order.
Instrument ID	20	4	UInt32	JSE unique numeric Instrument Identifier.
Reserved	24	1	Byte	Reserved field
Reserved	25	1	Byte	Reserved field
Price	26	8	Price	Limit price of the order.
Flags	34	1	Bit Field	**Bit** / **Name** / **Meaning**: 4 Market Order — 0: No, 1: Yes; 5 Bulletin Board — 0: No, 1: Yes

8.9.6 Add Attributed Order

Field	Offset	Length	Type	Description
Length	0	2	UInt16	Length of message including this field.
Message Type	2	1	Byte	**Hex** / **Meaning**: 0x46 Add Attributed Order
Nanosecond	3	4	UInt32	Nanoseconds offset from the last Time message.
Order ID	7	8	UInt64	Unique identifier of the order.
Side	15	1	Byte	**Value** / **Meaning**: B Buy Order; S Sell Order
Quantity	16	4	UInt32	Displayed quantity of the order.
Instrument ID	20	4	UInt32	JSE unique numeric Instrument Identifier.
Price	24	8	Price	Limit price of the order.
Attribution	32	11	Alpha	Identity of firm that submitted the order.

Flags	43	1	Bit Field	**Bit**	**Name**	**Meaning**
				0	Regular	0: No 1: Yes
				5	Bulletin Board	0: No 1: Yes

8.9.7 Order Deleted

Field	Offset	Length	Type	Description
Length	0	2	UInt16	Length of message including this field.
Message Type	2	1	Byte	**Hex** **Meaning** 0x44 Order Deleted
Nanosecond	3	4	UInt32	Nanoseconds since last Time message,.
Order ID	7	8	UInt64	Unique identifier for the order.

8.9.8 Order Modified

Field	Offset	Length	Type	Description
Length	0	2	UInt16	Length of message including this field.
Message Type	2	1	Byte	**Hex** **Meaning** 0x55 Order Modified
Nanosecond	3	4	UInt32	Nanoseconds since last Time message.
Order ID	7	8	UInt64	Unique identifier for the order.
New Quantity	15	4	UInt32	New displayed quantity of the order.
New Price	19	8	Price	New limit price of the order.
Flags	27	1	Bit Field	**Bit** **Name** **Meaning** 0 Priority Flag 0: Priority Lost 1: Priority Retained

8.9.9 Order Book Clear

Field	Offset	Length	Type	Description
Length	0	2	UInt16	Length of message including this field.
Message Type	2	1	Byte	**Hex** **Meaning** 0x79 Order Book Clear
Nanosecond	3	4	UInt32	Nanoseconds since last Time message.
Instrument ID	7	4	UInt32	JSE unique numeric Instrument Identifier.

Sub Book	11	1	UInt8	**Value** **Meaning** 1 Regular 2 Off Book 9 Bulletin Board 11 Negotiated Trades
Book Type	12	1	Byte	**Value** **Meaning** 0 MBO 1 Top of Book

8.9.10 Order Executed

Field	Offset	Length	Type	Description
Length	0	2	UInt16	Length of message including this field.
Message Type	2	1	Byte	**Hex** **Meaning** 0x45 Order Executed
Nanosecond	3	4	UInt32	Nanoseconds since last Time message.
Order ID	7	8	UInt64	Unique identifier for the order.
Executed Quantity	15	4	UInt32	Quantity executed.
Trade ID	19	8	UInt64	Unique identifier of the trade.
LastOptPx	27	8	Price	Converted price of the executed volatility of the options instrument.
Volatility	35	8	Price	Converted volatility of the executed price of the options instrument.
Underlying Reference Price	43	8	Price	Underlying Reference Price related to converted value calculated upon an options instrument trade execution.

8.9.11 Order Executed With Price/Size

Field	Offset	Length	Type	Description
Length	0	2	UInt16	Length of message including this field.
Message Type	2	1	Byte	**Hex** **Meaning** 0x43 Order Executed With Price/Size
Nanosecond	3	4	UInt32	Nanoseconds since last Time message.
Order ID	7	8	UInt64	Unique identifier for the order.
Executed Quantity	15	4	UInt32	Quantity executed.
Display Quantity	19	4	UInt32	Displayed quantity of the order after the execution.
Trade ID	23	8	UInt64	Unique identifier of the trade.
Printable	31	1	Byte	**Value** **Meaning** N Non-Printable Y Printable
Price	32	8	Price	Price at which the order was executed.
LastOptPx	40	8	Price	Converted price of the executed volatility of the options instrument.
Volatility	48	8	Price	Converted volatility of the executed price of the options instrument.
Underlying Reference Price	56	8	Price	Underlying Reference Price related to converted value calculated upon an options instrument trade execution.

8.9.12 Trade

Field	Offset	Length	Type	Description
Length	0	2	UInt16	Length of message including this field.
Message Type	2	1	Byte	**Hex** **Meaning** 0x50 Trade
Nanosecond	3	4	UInt32	Nanoseconds since last Time message,
Executed Quantity	7	4	UInt32	Quantity executed.
Instrument ID	11	4	UInt32	JSE unique numeric Instrument Identifier.
Reserved	15	1	Byte	Reserved field
Reserved	16	1	Byte	Reserved field
Price	17	8	Price	Executed price.
Trade ID	25	8	UInt64	Unique identifier of the trade.
Sub Book	33	1	UInt8	**Value** **Meaning** 1 Regular 11 Negotiated Trades
Flags	34	1	Bit-Field	**Bit** **Name** **Meaning** 0 Trade Condition Flag 0:No 1: Yes (Leg trades of a synthetic trade) 1 Crossed Order Trade 0:No 1: Yes
Trade Sub Type	35	4	Alpha	Type of RFQ trade. Only applicable if Sub book value 11. **Value** **Meaning** 0001 RG - Regular 0002 EP – Exchange for Physical 0003 RP - Repo 0004 SR - Sharia
LastOptPx	39	8	Price	Converted price of the executed volatility of the options instrument.
Volatility	47	8	Price	Converted volatility of the executed price of the options instrument.
Underlying Reference Price	55	8	Price	Underlying Reference Price related to converted value calculated upon an options instrument trade execution.

8.9.13 Auction Trade

Field	Offset	Length	Type	Description
Length	0	2	UInt16	Length of message including this field.

Message Type	2	1	Byte	**Hex** **Meaning** 0x51 Auction Trade
Nanosecond	3	4	UInt32	Nanoseconds since last Time message.
Quantity	7	4	UInt32	Quantity executed in auction.
Instrument ID	11	4	UInt32	JSE unique numeric Instrument Identifier.
Reserved	15	1	Byte	Reserved field
Reserved	16	1	Byte	Reserved field
Price	17	8	Price	Price of auction.
Trade ID	25	8	UInt64	Unique identifier of the trade.
Auction Type	33	1	Byte	**Value** **Meaning** C Closing Auction O Opening Auction A Volatility E Re-Opening Auction K Intra-Day Auction L Futures Close out Auction D EOD Volume Auction Call
LastOptPx	34	8	Price	Converted price of the executed volatility of the options instrument.
Volatility	42	8	Price	Converted volatility of the executed price of the options instrument.
Underlying Reference Price	50	8	Price	Underlying Reference Price related to converted value calculated upon an options instrument trade execution.

8.9.14 Off Book Trade

Field	Offset	Length	Type	Description
Length	0	2	UInt16	Length of message including this field.
Message Type	2	1	Byte	**Hex** **Meaning** 0x78 Off Book Trade
Nanosecond	3	4	UInt32	Nanoseconds since last Time message.
Executed Quantity	7	4	UInt32	Quantity executed.
Instrument ID	11	4	UInt32	JSE unique numeric Instrument Identifier.
Reserved	15	1	Byte	Reserved field
Reserved	16	1	Byte	Reserved field
Price	17	8	Price	Executed price.
Trade ID	25	8	UInt64	Unique identifier of the trade.
Off Book Trade Type	33	4	Alpha	Type of Off Book trade. Please refer to Section 9 for the valid Off Book trade types.
Trade Time	37	8	Time	Time the Off Book trade was agreed between the firms in terms of the local time for the server (i.e. SAST).
Trade Date	45	8	Date	Date the Off Book trade was agreed between the firms.
LastOptPx	53	8	Price	Converted price of the executed volatility of the options instrument.
Volatility	61	8	Price	Converted volatility of the executed price of the options instrument.
Underlying Reference Price	69	8	Price	Underlying Reference Price related to converted value calculated upon an options instrument trade execution.

8.9.15 Trade Break

Field	Offset	Length	Type	Description
Length	0	2	UInt16	Length of message including this field.
Message Type	2	1	Byte	**Hex** **Meaning** 0x42 Trade Break
Nanosecond	3	4	UInt32	Nanoseconds since last Time message.
Trade ID	7	8	UInt64	Unique identifier of the cancelled trade.
Trade Type	15	1	Byte	**Value** **Meaning** T On Book Trade N Off Book Trade R Negotiated Trades

8.9.16 Recovery Trade

Field	Offset	Length	Type	Description
Length	0	2	UInt16	Length of message including this field.
Message Type	2	1	Byte	**Hex** **Meaning** 0x76 Recovery Trade
Nanosecond	3	4	UInt32	Nanoseconds offset from the last Time message.
Executed Quantity	7	4	UInt32	Quantity executed.
Instrument ID	11	4	UInt32	JSE unique numeric Instrument Identifier.
Reserved	15	1	Byte	Reserved field
Reserved	16	1	Byte	Reserved field
Price	17	8	Price	Executed price.
Trade ID	25	8	UInt64	Unique identifier of the trade.
Auction Type	33	1	Byte	**Value** **Meaning** C Closing Auction A Volatility Auction O Opening Auction E Re-Opening Auction K Intra-Day Auction L Futures Close out Auction D EOD Volume Auction Call This field will contain a space if the trade is not an auction trade.
Off Book/RFQ Trade Type	34	4	Alpha	Type of Off Book or RFQ trade. This field will contain only spaces for On Book trades. Please refer to Section 09 for the valid off book trade types
Trade Time	38	8	Time	Time trade was executed. The time is specified in terms of the local time for the server (i.e. SAST).
Trade Date	46	8	Date	Date the off-book trade was executed. This field will contain only spaces for On Book trades.
Action Type	54	1	Byte	**Value** **Meaning** C Cancelled Trade N Trade

Sub Book	55	1	UInt8	**Value** **Meaning** 1 Regular 2 Off-Book 11 Negotiated Trades
Flags	56	1	Bit-Field	**Bit** **Name** **Meaning** 0 Trade Condition Flag 0:No 1: Yes (Leg trades of a synthetic trade) 1 Crossed Order 0:No 1: Yes
LastOptPx	57	8	Price	Converted price of the executed volatility of the options instrument.
Volatility	65	8	Price	Converted volatility of the executed price of the options instrument.
Underlying Reference Price	73	8	Price	Underlying Reference Price related to converted value calculated upon an options instrument trade execution.

8.9.17 Auction Info

Field	Offset	Length	Type	Description
Length	0	2	UInt16	Length of message including this field.
Message Type	2	1	Byte	**Hex** **Meaning** 0x49 Indicative Auction Information
Nanosecond	3	4	UInt32	Nanoseconds since last Time message.
Paired Quantity	7	4	UInt32	Quantity that will be matched at the indicative price.
Reserved	11	4	UInt32	JSE unique numeric Instrument Identifier.
Imbalance Direction	15	1	Byte	**Value** **Meaning** O Insufficient Orders for Auction
Instrument ID	16	4	UInt32	JSE unique numeric Instrument Identifier.
Reserved	20	1	Byte	Reserved field
Reserved	21	1	Byte	Reserved field
Price	22	8	Price	Indicative auction price.

Auction Type	30	1	Byte	**Value** **Meaning** C Closing Auction O Opening Auction A Volatility E Re-Opening Auction K Intra-Day Auction L Futures Close out Auction

8.9.18 Statistics

Field	Offset	Length	Type	Description
Length	0	2	UInt16	Length of message including this field.
Message Type	2	1	Byte	**Hex** **Meaning** 0x77 Statistics
Nanosecond	3	4	UInt32	Nanoseconds since last Time message.
Instrument ID	7	4	UInt32	JSE unique numeric Instrument Identifier.
Reserved	11	1	Byte	Reserved field
Reserved	12	1	Byte	Reserved field
Statistic Type	13	1	Alpha	**Value** **Meaning** O Opening Price C Closing Price
Price	14	8	Price	Opening or Closing price.

Open Close Indicator	22	1	Alpha	**Value** / **Meaning** A – UT B – AT C – Mid of BBO D – Last AT E – Last UT F – Manual H – VWAP I – Previous Close J – Zero U – Best Bid V – Best Offer Y – Reference Price
Sub Book	23	1	UInt8	**Value** / **Meaning** 1 – Regular 2 – Off Book 9 – Bulletin Board

8.9.19 Extended Statistics

Field	Offset	Length	Type	Description
Length	0	2	UInt16	Length of message including this field.
Message Type	2	1	Byte	**Hex** / **Meaning** 0x80 – Extended Statistics
Nanosecond	3	4	UInt32	Nanoseconds offset from the last Time message.
Instrument ID	7	4	UInt32	JSE unique numeric Instrument Identifier.
High Price	11	8	Price	High Price of the instrument. Will be set to a negative value if the value is not set or withdrawn.

Low Price	19	8	Price	Low Price of the instrument. Will be set to a negative value if the value is not set or withdrawn.
VWAP	27	8	Price	VWAP of the instrument. Will be set to a negative value if the value is not set or is withdrawn.
Volume	35	4	UInt32	Volume of the instrument. Will be set to zero if the value is not set or is withdrawn.
Turnover	39	8	Price*	Turnover of the instrument. Will be set to a negative value if the value is not set or is withdrawn.
Number of Trades	47	4	UInt32	Number of trades for this instrument. Will be set to zero if the value is not set or is withdrawn.
Reserved Field	51	8	Alpha	Reserved for future use
SubBook	59	1	UInt8	Order Book for which Extended Statistics are published. **Value** **Meaning** 1 Regular 2 Off-Book 11 Negotiated Trades
Notional Exposure	60	8	Price	Notional exposure will be set to a negative value if the value is not set or withdrawn.
Notional Delta Exposure	68	8	Price	Notional exposure updated by the delta of the option based on trade executions. Will be set to a negative value if the value is not set or withdrawn.
Open Interest	76	8	Price	Open Interest of the specified instrument. Will be set to a negative value if the value is not set or withdrawn.

* - Generally, fields of data type 'Price' will have an eight byte integer field with eight implied decimal places. There is an exception for the Turnover field where the field will have an eight byte integer field with four implied decimal places.

8.9.20 News

Field	Offset	Length	Type	Description
Length	0	2	UInt16	Length of message including this field.
Message Type	2	1	Byte	**Hex** **Meaning** 0x75 News
Nanosecond	3	4	UInt32	Nanoseconds since last Time message.
Time	7	8	Time	Time the announcement was published. Time will be specified in terms of the local time for the server SAST (i.e. not UTC).

Urgency	15	1	Byte	**Value** **Meaning** 0 Regular 1 High Priority 2 Low Priority
Headline	16	100	Alpha	Headline or subject of the announcement.
Text	116	750	Alpha	Text of the announcement.
Instruments	866	100	Alpha	Pipe separated list of instruments of the instruments for which the announcement has been sent for.
Underlyings	966	100	Alpha	Pipe separated list of symbols of the underlyings announcement relates to.

8.9.21 Top of Book

Field	Offset	Length	Type	Description
Length	0	2	UInt16	Length of message including this field.
Message Type	2	1	Byte	**Hex** **Meaning** 0x71 Top of Book
Nanosecond	3	4	UInt32	Nanoseconds offset from the last Time message.
instrument ID	7	4	UInt32	JSE unique numeric Instrument Identifier.
Reserve Field	11	2	UInt16	Reserved for future use
Sub Book	13	1	Bit-Field	**Bit** **Name** **Meaning** 0 Regular 0: No 1: Yes 5 Bulletin Board 0: No 1: Yes
Action	14	1	Byte	**Value** **Meaning** 1 Update 2 Delete
Side	15	1	Byte	**Value** **Meaning** B Buy S Sell
Price	16	8	Price	Best price for the particular side.

Quantity	24	4	UInt32	Cumulative visible size at best price. This will be set to zero on a delete action.
Market Order Quantity	28	4	UInt32	Cumulative visible size of market orders.
Reserved Field	32	2	-	Reserved for future use.

9 OFF BOOK TRADE TYPES

TrdSubType Value	Description
17	LC – Off Book Post Contra Trade (cancellation of previous day's published Off Book trade)
24	PC – On Book Post Contra Trade (cancellation of a previous day's On Book trade)
2001	BT - Block Trade
2002	CF - Corporate Finance Trade
2003	LT - Late Trade (After hours trade)
2004	NX - Namibia Trade
2005	OD - Delta Trade
2006	OP - Off Order Book Principal Trade
2007	OX - Option Exercised
2008	TX - Trade Option Exercised
2009	PF - Portfolio Trade
2011	WX - Warrant Exercised
2013	GU – Give Up Trade
3001	BK – Book Build
3015	NC – Off Book Post Contra Trade non-published (cancellation of previous day's non-published Off Book trade) This trade type will never be published via the market data, it is only valid via the Post Trade Gateway when cancelling a non-published trade.
4001	NT - A generic reported trade that provides the ability to be linked to other reported trades for the purposes of billing and valuations downstream. A new field will be required to link these.
4002	TI - Trade by a member as a result of an off market bookbuild, where additional bonds have been issued
4003	PT - Trade by a member as a result of an off market bookbuild on the listing of a new bond
4004	ST - A trade by a member where it is back to back with an OTC transaction
4005	BX - When the owner of an OTC option which is not traded in the secondary market exercises his or her right to buy or sell bonds
4006	BV - Trade by a member where the member is the buyer and seller on behalf of 2 different clients
4007	RO - Trade by a member for a repurchase agreement or sell/buy back.
4008	RR - Trade by a member for a reverse repurchase agreement.

4009	GI - A transaction where a member trades in a single equity security as a principal with another member, who trades either as an agent on behalf of a client or as a principal for that member's own account. The purpose is to pass a trade that has been executed by the first member ("executing member") on the same day or the previous day to the second member ("receiving member") at the price of the original trade. The trade that is given up to the receiving member must have originally been executed by the executing member with the intention of giving it up to the receiving member.
4010	EP - A transaction negotiated privately in which a Futures contract for a physical item is exchanged for an actual physical good.
4011	ER - This involves the exchange of OTC positions for future positions
4012	PO - PCT Trades in currency derivatives concluded by a market maker with a professional client
4013	DT - A trade type that hedges derivative exposures in the same market where the derivative exposure sits. A trade type that hedges derivative exposures in the same market where the derivative exposure sits.
4014	LD - A Late trades concluded by a trading member after trading hours.
4015	RT - Roll trade which give effect to the closing out of positions in the expiring contract to a contract with a new expiry date.
4016	SO - Structured option trades include two or more strikes and are agreed on a wholesale basis and will be linked via a field allowing these trades to be identified for regulatory purposes
4017	NO - Net-offs result when a client builds up opposite positions through various accounts with in the same member or multiple members. The client then wishes to consolidate these positions, representing both long and short position of the same expiry/contract.
4018	NS -Non Standard Structured trades that include two or more legs and are agreed on a wholesale basis and will be linked via a field allowing these trades to be identified for regulatory or valuation purposes. Non-standard strategies include those strategies that do not form part of the following list of standard JSE strategies: Inverse Calendar Spreads Forward Forwards Splits Delta Options Butterflies Condors Straddles Strangles Call/Put Calendar Spreads
4019	CD - Contracts for difference report only trades
4020	SR - Structured trades that include two or more legs and are agreed on a wholesale basis and will be linked via a field allowing these trades to be identified for regulatory or valuation purposes. These standard JSE strategies include:Inverse Calendar SpreadsForward ForwardsSplitsDelta Options ButterfliesCondorsStraddlesStranglesCall/Put Calendar Spreads

4021	BS - Occurs when a trader quotes a Bond instrument as a spread over another reference Bond instrument. However when trading a Bond Spread trade, the trader does not trade in both bond instruments
4022	TB - In instances where an on book trade has been cancelled, the JSE may ask traders to recapture 2 new off book trades. The reason is to ensure that certain market counterparties are not prejudiced due to the initial cancellation. The first off book trade will be a recapture of the incorrect original trade which was subsequently cancelled. The second off book trade will be reported to the trading system at an adjusted price (as determined by the JSE) giving the relevant compensation to the parties that are not responsible for the original error. Both off book trades that are captured will be Trade Bust off book trade types.
4023	PA - Similar concept to the trade bust trade type. When a trade is captured at the incorrect price and both traders wish to recapture the original trade at the correct price then the original trade should be cancelled and a new off book trade type of PA (Price Adjust) is captured at the correct price.
4024	RP

10 TRADING REASON CODES

Code	Reason
9998	Matching partition suspended
9999	System suspended
Space	Reason not available
1	System Issues Being Experienced
2	Company Announcement Expected
3	Company Requested Halt
4	Company Requested Suspension
5	JSE Initiated Halt/Suspension
101	Instrument-level circuit breaker tripped
102	Instrument status is halted

11 CORPORATE ACTION INFORMATION

11.1 Valid Ex-Markers

Ex-Marker Code	Description
GT	Green Triangle – Declared Payment (dividend or other type of payment) still to be paid
XD	Ex-Dividend or other payment

11.2 Valid Annotations

Annotation Code	Description
A^	Adverse Auditors Opinion Expressed
D^	Disclaimed Annual Audit Opinion
E^	Annual Audit Report “Emphasis of matter” paragraph
OT	Orange Triangle – Caution in dealing in shares
Q^	Qualified Annual Audit Opinion
R^	Failure to Provide Annual Compliance Certificate
RE	Red Square – Company Violation of the JSE Rules
SV	Shareholder Spread Violation
TA	Tax Applicable
Note: The Exchange may amend these values at any time following one month’s prior written notice to clients. Single characters on Ex-Markers and Annotations will be right padded with a space as denoted above with the ‘^’ symbol.	

12 Appendix

12.1 Conversion of Order ID

The Order ID assigned by the matching engine is converted to binary on publishing through the market data feed. The Order ID received through the order management gateways can be mapped to the Order ID received through the market data gateway based on the below conversion.

To convert FIX Order ID to MITCH Order ID:

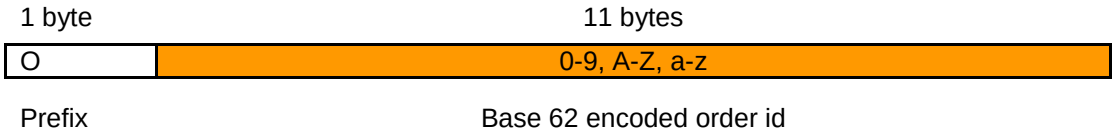
Step 1 – Remove leading O (prefix)

Step 2 – Convert using base 62 using the base 62 conversion table below.

Step 3 – Convert to binary

Order ID format (in ASCII)

The composition of the Order IDs assigned by the matching system is given below. This Order ID is specified as ASCII printable characters and will not exceed 12 bytes.



E.g.

OrderID in FIX (ASCII base 62 characters)	O04Xj7Wu76ta
OrderID in MITCH gateway (Binary ID converted to decimal)	61512470073704470

Steps to follow:

- Remove the prefix from the ASCII order ID - "O" → 04Xj7Wu76ta
- Convert using base 62 conversion in to decimal as depicted below
- Note: Please refer to the base 62 conversion table attached below
- Convert the decimal value to binary.

FIX Order ID (ASCII Character)	Corresponding decimal value	Base 62^x	value	Multiplied decimal value
a	36	62^0	1	36
t	55	62^1	62	3,410
6	6	62^2	3,844	23,064
7	7	62^3	238,328	1,668,296
u	56	62^4	14,776,336	827,474,816
W	32	62^5	916,132,832	29,316,250,624
7	7	62^6	56,800,235,584	397,601,649,088
j	45	62^7	3,521,614,606,208	158,472,657,279,360
X	33	62^8	218,340,105,584,896	7,205,223,484,301,568

4	4	62^9	13,537,086,546,263,552	54,148,346,185,054,208
0	0	62^10	839,299,365,868,340,224	-
OrderID in MITCH gateway in Decimal				**61,512,470,073,704,470**

Note

- Please use 64 bit integer data types for the calculation else integers will overflow
- Excel also rounds the value since its using a 64 bit float data type for the calculation

Base 62 mapping table

0	0	20	K	40	e	60	y
1	1	21	L	41	f	61	z
2	2	22	M	42	g		
3	3	23	N	43	h		
4	4	24	O	44	i		
5	5	25	P	45	j		
6	6	26	Q	46	k		
7	7	27	R	47	l		
8	8	28	S	48	m		
9	9	29	T	49	n		
10	A	30	U	50	o		
11	B	31	V	51	p		
12	C	32	W	52	q		
13	D	33	X	53	r		
14	E	34	Y	54	s		
15	F	35	Z	55	t		
16	G	36	a	56	u		
17	H	37	b	57	v		
18	I	38	c	58	w		
19	J	39	d	59	x		

12.2 Conversion of Trade ID

The Trade ID assigned by the matching engine is converted to binary on publishing through the market data feed. The Order ID received through the post trade gateway can be mapped to the Trade ID received through the market data gateway based on the below conversion.

To convert FIX Trade Match ID to MITCH Trade ID:

Step 1 – Remove leading (prefix)

Step 2 - Convert using base 62

Step 3 – Convert to binary

Trade ID format (ASCII)

1 Byte	9 bytes
T/M	0-9, A-Z, a-z
Prefix	Base 62 encoded Trade id

E.g.:

ASCII trade id for FIX	T5DIF33YV0
Binary trade id (decimal) for MITCH	1138517709214786

Steps to follow:

- Remove the prefix from the ASCII order ID - "T" → 5DIF33YV0
- Convert using base 62 conversion in to decimal as depicted below
- Note: Please refer to the base 62 conversion table attached below
- Convert the decimal value to binary.

FIX Trade ID (ASCII Character)	Corresponding decimal value	Base 62^x	value	Multiplied decimal value
0	0	62^0	1	0
V	31	62^1	62	1,922
Y	34	62^2	3,844	130,696
3	3	62^3	238,328	714,984
3	3	62^4	14,776,336	44,329,008
F	15	62^5	916,132,832	13,741,992,480
I	18	62^6	56,800,235,584	1,022,404,240,512
D	13	62^7	3,521,614,606,208	45,780,989,880,704
5	5	62^8	218,340,105,584,896	1,091,700,527,924,480
Trade ID in MITCH gateway in Decimal				1,138,517,709,214,786

Note

- Please use 64 bit integer data types for the calculation else integers will overflow
- Excel also rounds the value since its using a 64 bit float data type for the calculation

13 MARKET DATA GATEWAYS

One service refers to a single market data gateway partition instance. i.e. primary and mirror services (also known as A Feed and B Feed) hosted as primary and mirror gateway instances. The Un-throttled Services will publish a higher maximum bandwidth value than the Throttled Service, however the data published will be identical.

Protocol	Markets	No of Un-throttled GWs	Un-throttled services	No of Throttled GW	Throttled services
MITCH	EQM	1	1. Full depth MBO with statistics of ALL - EQM (Un-Throttled)	2	1. Full depth MBO with statistics of ALL – JSE (Throttled) 2. Full depth MBO with statistics of ALL – NSX (Throttled)
	EDM	1	1 x Full depth MBO with statistics of ALL – EDM (Un-Throttled)	2	1. Full depth MBO with statistics of ALL – (Throttled) 2. Level 1 [Book Depth 1] with statistics of ALL – (Throttled)
	FX, IRD, Spot Bonds	1	1. Full depth MBO with statistics of ALL - FX, IRD, Bonds (Un-Throttled)	2	1. Full depth MBO with statistics of ALL– (Throttled) 2. Level 1 [Book Depth 1] with statistics of ALL – (Throttled)
	Commodities	1	1 x Full depth MBO with statistics of ALL – Commodities (Un-Throttled)	2	1. Full depth MBO with statistics of ALL– (Throttled) 2. Level 1 [Book Depth 1] with statistics of ALL – (Throttled)