

London Stock Exchange

MIT301 - Guide to Market Data Services

Issue 10.1

4 February 2015



Contents

1.0	Introduction	5
1.1	Purpose	5
1.2	Readership	5
1.3	Document Series	5
1.4	Document History	6
1.5	Enquiries	8

2.0	Service Overview	9
2.1	Data sets	9
2.2	Instrument Identification	10
2.3	Reference Data	11
2.4	Trading status	11

3.0	Interface Overview	13
3.1	Message formats	13
3.2	Level 2-MITCH	13
3.3	Message dissemination and recovery	17

Disclaimer

The London Stock Exchange Group has taken reasonable efforts to ensure that the information contained in this publication is correct at the time of going to press, but shall not be liable for decisions made in reliance on it. The London Stock Exchange Group will endeavour to provide notice to customers of changes being made to this document, but this notice cannot be guaranteed. Therefore, please note that this publication may be updated at any time. The information contained is therefore for guidance only.

1.0 Introduction

1.1 Purpose

The purpose of this document is to provide an overview of the full range of market data services available on the Millennium Exchange platform.

1.2 Readership

This document outlines the market data services available on Millennium Exchange. Customers should note that this document does not include information on the Group Ticker Plant services and should instead consult the Group Ticker Plant guides.

When read in conjunction with the message specifications it is intended that these documents provide the necessary information customers require to develop to the real time market data services.

This document is particularly relevant to trading, market data and technical staff within our member firms, information vendors and other market participants interested in receiving London Stock Exchange market data.

1.3 Document Series

This document is part of series of documents providing a holistic view of trading and information services available from the London Stock Exchange.

The current series of documents are set out below:

- MIT201 - Guide to the Trading System
- MIT202 – FIX Trading Gateway (FIX 5.0)
- MIT203 – Native Trading Gateway Specification
- MIT204 – Post Trade Gateway (FIX 5.0) Specification
- MIT205 – Drop Copy Gateway (FIX 5.0) Specification
- **MIT301 - Guide to Market Data Services (this document)**
- MIT303 – Level 2-MITCH Specification
- MIT304 - Regulatory News Service Specification
- MIT401 – Guide to Reference Data Services
- MIT501 – Guide to Testing Services

- MIT502 - Guide to Application Certification
- MIT503 - Certification Report
- MIT601 – Guide to Trading Services Disaster Recovery
- MIT701 – Guide to Sponsored Access
- MIT801 – Reject Codes

This series principally covers non-regulatory information. It does not override or supersede the Rules of the London Stock Exchange, the AIM Rules or Admission and Disclosure Standards and is intended to be read in conjunction with these Rules documents and the Millennium Exchange Parameters document.

1.4 Document History

This document has been through the following iterations:

Issue	Date	Description
1.0	1 February 2010	First issue of this document published via the Exchange's website and distributed to customers.
2.0	29 March 2010	Updated to reflect changes in some areas of functionality.
3.0	5 May 2010	Third issue of this document published via the London Stock Exchange's website and distributed to clients.
4.0	11 June 2010	Fourth issue of this document published via the London Stock Exchange's website and distributed to clients.
5.0	19 July 2010	Fifth issue of this document published via the London Stock Exchange's website and distributed to clients.
6.0	20 September 2010	Sixth issue of this document published via the London Stock Exchange's website and distributed to clients.

7.0	3 December 2010	Seventh issue of this document published via the London Stock Exchange's website and distributed to clients.
7.1	19 January 2011	Updated to include minor changes highlighted.
8.0	23 May 2011	Updated to include minor changes highlighted.
8.1	31 October 2011	Updated to reflect the changes in market data channel mapping following the introduction of the 3 rd partition to CDS.
8.2	5 December 2011	Updated to reflect changes in market data channel mapping following the introduction of the 3 rd partition to Production.
9.0	9 December 2011	Updated to support product enhancements being delivered as part of Functional Release Q1 2012
9.1	15 March 2012	Minor corrections applied.
9.2	14 May 2012	New LoadID/Multicast Channel ID mappings added.
9.3	25 July 2012	Updated to remove legacy LoadID/Multicast channel ID mappings.
10.0	24 July 2013	Updated to reflect changes to the FIX-FAST market data protocol availability
10.1	4 February 2015	Rebrand of full depth market data protocol to Level 2-MITCH.

In subsequent issues, where amendments have been made to the previous version these changes will be identified using a series of side bars as illustrated opposite.

1.5 Enquiries

Please contact either Client Technology Services (UK) or your Technical Account Manager if you have any questions about the Millennium Exchange services outlined in this document. Client Technology Services (UK) can be contacted at:

- Telephone: +44 (0)20 7797 3939
- Email: londontam@londonstockexchange.com

2.0 Service Overview

The Millennium Exchange market data solution provides a rich set of real-time data services. Further information follows in this document.

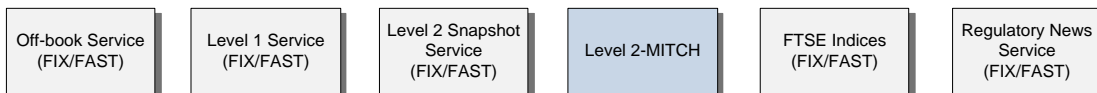
In July 2013 the Group's FIX-FAST market data protocol was decommissioned for all real-time data services with the exception of RNS. This document has been updated to remove references to legacy services including the off-book, Level 1, Level 2 snapshot and indices services. The Group Ticker Plant, introduced in late 2012, provided a suite of new real-time data services to reflect the impending decommission of FIX-FAST.

2.1 Data sets

The existing data sets and levels will remain following the migration to Millennium Exchange. For reference, these are listed below:

- Off-book (UK, European and International)
- Level 1 (UK, European and International)
- Level 2 full-depth (UK, European and International)
- Regulatory News Service
- FTSE indices (UK and International)
- Daily Official List (DOL)

Level 2-MITCH



The Level 2-MITCH service has been designed for those customers who are focused on microsecond performance and streaming order updates. It will provide an ultra-low latency feed with details of every visible order on the book and all trades (on and off-book). Every message will include a microsecond timestamp originating from the matching engine.

Price/Time priority on the Level 2-MITCH feed should be determined through the combination of the microsecond timestamp and the sequence number.

The details published on each order have been streamlined to include only the price, volume, side of the order and Member ID (for named orders and quotes). Each order will also include an order id, unique across participants and days. This will allow clients to identify their orders within the market data feed.

In addition to this the concept of an order modify message has been introduced to improve the efficiency of the service where all order modifications are treated as a delete and an add; The new Level 2-MITCH feed will provide details of an adjustment to the price or volume of an order as a modification, with confirmation of whether the modification meant the order lost price/time priority.

Due to the use of the MITCH protocol the Level 2-MITCH service will only publish a limited set of data which will include both on and off book trades, individual order and quote details, order execution messages and indicative uncrossing prices and volumes. In an enhancement to standard MITCH implementations, the Level 2-MITCH service will also support the publication of official Opening and Closing prices via the 'Statistics' message. As well as the price the message will also state method of calculation, for example mid of the BBO.

The service will deliver additional information on market activity including the use of the Trade ID field which will be consistent across all of the orders involved in a single execution. A separate Trade message will also be used to publish non-visible order executions.

The service will not publish an aggregated best price or include the added value statistical data published in the Level 1 or Level 2 Snapshot services.

Regulatory News Service (RNS)



The Regulatory News Service continues to disseminate news stories as a distinct data set. Further information on the service, including the message formats, is available in the document MIT304 – Regulatory News Service Specification.

Daily Official List (DOL)

The Daily Official List is no longer published in the form of real time messages but instead will be published as a series of flat files.

Specifically this information will be:

- Instrument ID
- DOL Low Price
- DOL High Price
- DOL Update Time
- DOL Update Date

The files will be .txt and published daily after 17:30 to an FTP server. Further information on access to the service will be published in a separate document.

2.2 Instrument Identification

As outlined in the document MIT201 – Guide to the Trading System the current approach to guaranteeing uniqueness across instruments through the use of a 4-way key (*ISIN, Segment, Country of Register and Currency*) has been replaced with a single unique identifier per instrument.

The numeric symbol is used on all market data messages to uniquely identify an instrument and will remain constant for the life of a stock. The unique symbol can be used to map back to industry standard identifiers such as ISIN and SEDOL.

2.3 Reference Data

Each market data service publishes its own distinct set of instrument data specific to the stocks available on that channel. The following information will be published each morning:

- Instrument ID (unique identifier)
- Instrument status
- ISIN
- SEDOL
- Segment
- Previous Closing Price
- Currency
- ISIN of underlying instrument (if relevant)

The full reference data set is published separately via a daily flat file. This allows future enhancements and enrichments to be implemented with the least amount of impact and provide clients with greater flexibility in how they assimilate reference data. Further information on the Reference Data Service is available in MIT401 – Guide to Reference Data Services.

2.4 Trading status

The real time status of an instrument is disseminated on each of the associated real time feeds. Millennium Exchange does not disseminate the specific period schedule of each instrument but instead disseminates a finite set of streamlined statuses.

The status of an instrument indicates at what stage of the period schedule an instrument currently resides and includes the following values:

- Halt
- Pause
- Opening auction call
- Pre-mandatory quote period
- Start trade reporting
- Continuous trading
- Mandatory quote period
- Closing auction call
- Post mandatory quote period
- Closing auction call
- Post-close
- End trade reporting

-
- EDSP auction call
 - Periodic auction call
 - AESP auction call
 - Resume auction call
 - End of Post Close
 - Closing Price Publication
 - Closing Price Crossing

If the uncrossing of a scheduled auction is extended or shortened due to a market event a revised security status is disseminated with the reason for the extension and the new uncrossing time.

When an instrument is halted, the reason for the halt is provided within the updated status message.

3.0 Interface Overview

The use of a proprietary fixed width protocol will be replaced with recognised industry standard formats to aid clients in their development and maintenance of connectivity solutions, whilst also ensuring the most efficient use of available bandwidths.

3.1 Message formats

The market data services on Millennium Exchange will broadcast a combination of protocols dependant on the service, MITCH and the Group Ticker Plant.

Please note that going forward the timestamps in all messages are published in UTC.

3.2 Level 2-MITCH

The Level 2-MITCH feed on Millennium Exchange is a stream of fixed-width binary messages providing details of all orders and trades in real time. In line with other implementations the feed is version controlled with the initial implementation detailed in this document providing a baseline at version 1.0.

The following application messages are published on the MITCH feed:

Time	Sent each second by the server to provide a baseline for individual message timestamps.
System Event	Sent to indicate the start and end of day.
Symbol Directory	Used on all channels to provide instrument details including the unique instrument ID, ISIN and the instrument status.
Symbol Status	Indicates the change in status of an instrument.
Add Order	Provides details of a new visible order being added to the order book.
Add Attributed Order	Provides details of a new named order or quote being added to the order book.
Order Deleted	Indicates that an order has been cancelled and should be deleted.
Order Modified	Indicates that the quantity or price of an order has been updated and whether it has subsequently retained price/time priority.
Order Book Clear	Indicates to participants that all orders for a particular instrument should be removed.

Order Executed	Indicates that an order was fully or partially executed at its current displayed price.
Order Executed with Price/Size	Indicates an order was fully or partially executed at a price different to its display price.
Trade	Provides details of a trade involving a hidden order type or the non-displayed portion of an iceberg order.
Auction Trade	Provides execution details of an auction uncrossing including the price and associated volume.
Off-book Trade	Provides details of a trade negotiated away from the order book and reported to the Exchange.
Trade Break	Indicates if a previously published trade is cancelled.
Auction Info	Provides information on the uncrossing price and volume, as well as the size and side of any potential imbalance.
Statistics	Provides official Opening and Closing prices for each instrument

Full details on the packet composition, data types and message formats are outlined in the document MIT303 – Level 2-MITCH Specification.

Each message or block of messages always contains a unit header including the Market Data Group (unique channel ID) and Sequence Number of the first message. In addition to this all application messages state the message type and the time in microseconds since the last Time message.

An individual Time message is published for each second that an Application Message is disseminated to the market. The Time message contains a reference for timestamps included in subsequent Application Messages, published as a nanosecond offset from the Time message. The offset is accurate to the microsecond and can be used to build an order book in price/time priority.

During 2 seconds of inactivity, and at 2 second intervals thereafter, on a particular multicast channel a Heartbeat message – A Unit Header message with a Message count of 0' - is published to demonstrate that the end to end connectivity is still active.

Start of day

Clients should manually clear down their order books before the start of the trading day. Clients will receive a number of Symbol directory messages, indicating the status of instruments – either suspended or active.

Following dissemination of Symbol directory messages, clients will receive a number of Add Order messages to enable the repopulation of the order book.

Clients will then receive a number of Security Status messages. These messages will indicate the status of an instrument as they move into the opening auction.

Symbol directory

At the beginning of a trading day a Symbol Directory message is broadcast for all instruments within the system, including those with a status of suspended or Inactive. Symbol Directory messages for instruments with an effective date in the future are not published.

The status of an instrument is defined in the field 'Status'. If this field contains a space it will indicate that the instrument is active. Further changes in instrument status during the day are published using the Symbol Status message.

If an instrument is suspended/unsuspended during the trading day an updated Symbol Directory message is published on the relevant multicast channel.

Security Status

As an instrument transitions through its various states during the trading day a Symbol Status message is immediately published with the new state identified in the field 'Trading Status'.

A status update may apply to either the on or off-book state of an instrument and this will be indicated in the field 'Book Type'. For example, if the field 'Trading Status' = 'T' and the 'Book Type' = 2 this indicates that trade reporting has begun for this instrument.

For instruments that have both a quote and order book, e.g. SETsqx, the field 'Flags' indicates if the status change applies to the quote book.

When an instrument is halted the Symbol Status message is published with a value of 'H' in the 'Trading Status' field and the reason for the halt defined in the field 'Halt Reason'. When trading is resumed a Symbol Status message is published with the status indicating Resume Auction Call (f) or Start Trade Reporting (T) for on-book and off-book trading respectively with the relevant 'Book Type'.

In a situation where a scheduled auction call is extended, for example due to a price monitoring extension, a Symbol Status message is disseminated with the current status of the instrument in the field 'Trading Status' and the reason for the extension stated in the field 'Session Change Reason'. The time of the revised uncrossing is communicated in the field 'New End Time'.

Order book management

Each time an anonymous order is added to the order book of an instrument an Add Order (Message Type=0x41) message is published with details of the side, price and displayed quantity stated in the 'Side', 'Price' and 'Quantity' fields respectively. A unique identifier, 'Order ID', is published on all new orders and is referenced in subsequent order book updates, e.g. modify, delete, etc.

Where market orders reside on the book these are indicated by the presence of the Market Order flag in 'Flags' field (Bit 4) and a zero 'Price' field.

In the case of a named order or an executable/firm quote being added to the order book the 'Add Attributed Order' message will be published. This includes the same information as the 'Add Order' message, with the addition of the 'Attributed' field which will include the identity of the firm. Firm Quotes is indicated by the population of the 5th bit of the 'Flags' field.

When an order is deleted from the book the 'Order Deleted' message is published with the original identifier published in the 'Order ID' field.

If an order's price or volume is modified an 'Order Modified' message is disseminated with the revised price and quantity along with the original Order ID. If the modification has resulted in the order losing price/time priority this is indicated in the 0th bit of the 'Flags' field. Where an order has lost price/time priority it should be placed at the bottom of the relevant price level based on the revised timestamp in the 'Time' field.

Trades

On-book executions at the displayed price of the order are published in the 'Order Executed' message. The quantity specified in the 'Executed Quantity' field should be deducted from the original displayed quantity of the order. The 'Order Executed' message does not contain a price and this should be inferred from the original limit price of the order, identified by the 'Order ID' field.

All executed orders include a 'Trade ID' field which will be unique for each transaction within a day and allow participants to identify their own trades as it will match the ID published on the trade capture reports.

Where an order executes at a different price to its displayed price (e.g. during an auction) an 'Order Executed with Price/Size' message is published and will include the additional fields 'Price', 'Displayed Quantity' and 'Printable'.

The 'Price' field contains the executed price, and the 'Displayed Quantity' indicates the remaining quantity on the book post execution. This should be used to update the current displayed volume on the order book. The 'Printable' field indicates if the trade should update time and sales displays and any added value statistics.

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.

Please note that following the introduction of the Closing Price Crossing Session, the Exchange may issue a combination of both Order Executed and Order Executed with Price/Size messages to uncross the book at the start of this new session. The combination of these messages will be determined by the nature of the execution. Each message should result in a subsequent action to remove an order from the book – each execution will result in at least two messages. Clients should note the 'Printable' field in the Order Executed with Price/Size messages to ensure trades are not double counted.

In situations where non-visible orders execute on the book the details will be published in the 'Trade' message.

Trades completed during an auction are published in the 'Auction Trade' message and include information on the type of auction as well as the price and total volume executed. In addition to this an 'Order Executed with Price/Size' message will be published for all displayed volume executed during the auction. To ensure there is no duplication the 'Printable' field will be 'N' to indicate that these messages should not contribute to time and sales displays. This is the only scenario where the 'Printable' field will be populated with the value 'N'.

Off-book trades reported and published on Millennium Exchange are published in the 'Off-book Trade' message. In addition to the price, quantity and Trade ID the message specifies the Trade Type and Time of the transaction. Where a trade was negotiated on a different date to its publication the 'Trade Date' field states the original date of the negotiation.

In situations where a trade is cancelled a 'Trade Break' message is published with the Trade ID of the cancelled trade.

Indicative Uncrossing Price

During an auction call the indicative auction price and volume are published in the 'Auction Info' message. This message is re-published each time a change occurs in one of these values.

3.3 Message dissemination and recovery

All feeds continue to disseminate data on multicast channels, however these will be active/active with a primary feed published on a client's primary network path and an identical secondary feed published on the resilient path. The sequence numbers across both feeds are consistent, allowing clients to subscribe to both feeds and arbitrage any potential loss of messages.

Multicast channels

The multicast channels are grouped by product and level of service. Each channel will have its own unique identifier.

The exact multicast address and port for each channel is published in the Technical Library.

The Level 2-MITCH multicast channels are distributed across a number of addresses within a multicast range. The allocation of instruments to channels will be based on liquidity and a given instrument or set of instruments may move from one channel to another. Instruments within the same segment may be split across multiple channels in the future. The Exchange will provide 1 week notice ahead of any change to the production instrument/channel allocation.

Due to this approach the Service Codes on the Level 2-MITCH feed will be single character letters.

The table below outlines the initial proposed distribution of instruments across channels.

Market Data Group	Channel Name
A	FTSE 100 full depth - Group A
B	FTSE 100 full depth - Group B
C	FTSE 250 full depth
D	Structured Products full depth - <i>(ETFs, ETCs & Covered Warrants)</i>
E	Miscellaneous full depth
F	European full depth
G	International full depth
H ... Z	Reserved for future use

The Secondary (B) feed will carry lowercase market data groups on MITCH services.

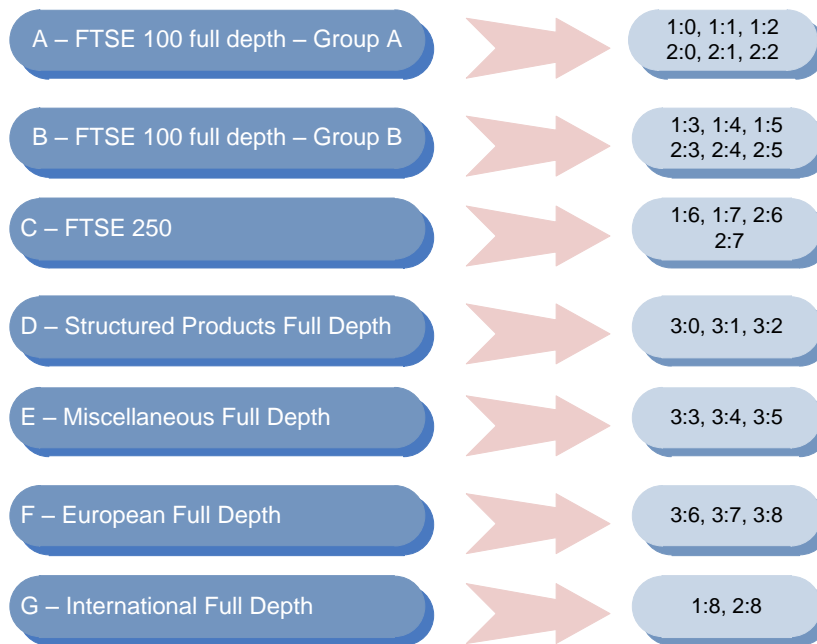
Current Production and CDS Multicast channel allocation

An instrument will be allocated to both Production and CDS multicast channels via a combination of the 'Multicast Channel ID' and 'LoadID.' Both the Multicast Channel ID and LoadID will be published in the daily Instrument file of the Reference Data Service (See Section 2.3 Reference Data), and should be used to identify to which multicast channel an instrument is assigned to.

Each Load ID/Multicast Channel ID combination maps to a Level 2-MITCH service.

The initial Load ID/Multicast Channel ID to channel mapping is outlined below.

LoadID/Multicast Channel ID to Level 2-MITCH Channel



Clients should note that following the functional release Q1 2012 the reference data package was enhanced to indicate to which channel an instrument is assigned to. This removes the requirement for clients to manually map using the above information.

Message Replay and Recovery

Millennium Exchange offers a message re-request function:

Replay Channel – The replay channel stores the last 65,000 messages disseminated on a channel and should be used by clients to recover from a small-scale data loss on a particular channel.

Recovery Channel – The recovery channel should be used by clients to recover from a large-scale data loss, i.e. major outage, and provide the client with a snapshot of the order book for the active instruments in a channel.

Each multicast channel has its own dedicated instance of both a Replay and a Recovery service; each service is accessible by individual TCP sessions to dedicated IP addresses.

A client is required to log-in to a service using a CompID and password. The same username can be used on both Replay and Recovery services across the Level 2-MITCH channels; however, it may only be logged in to one service at a time. Clients will be able to request multiple usernames for each of their applications.

Clients should only establish a connection to a Replay or Recovery service if they wish to submit a request. Once a TCP session is established and confirmation of a successful log-on is received clients will need to submit a request within 5 seconds or the session will be terminated by the server.

Millennium Exchange can be configured to limit both the number of log-ins and the number of requests for a particular log-on. Once a limit is reached no further requests/log-ins will be permitted for that username for the remainder of the trading day. The Exchange will have the ability to reset these counters on request in exceptional circumstances.

Full details of system parameters, including log on limits, can be found in the Market Data Parameters document. This document can be found here:

<http://www.londonstockexchange.com/products-and-services/millennium-exchange/technicalinformation/technicalinformation.htm>

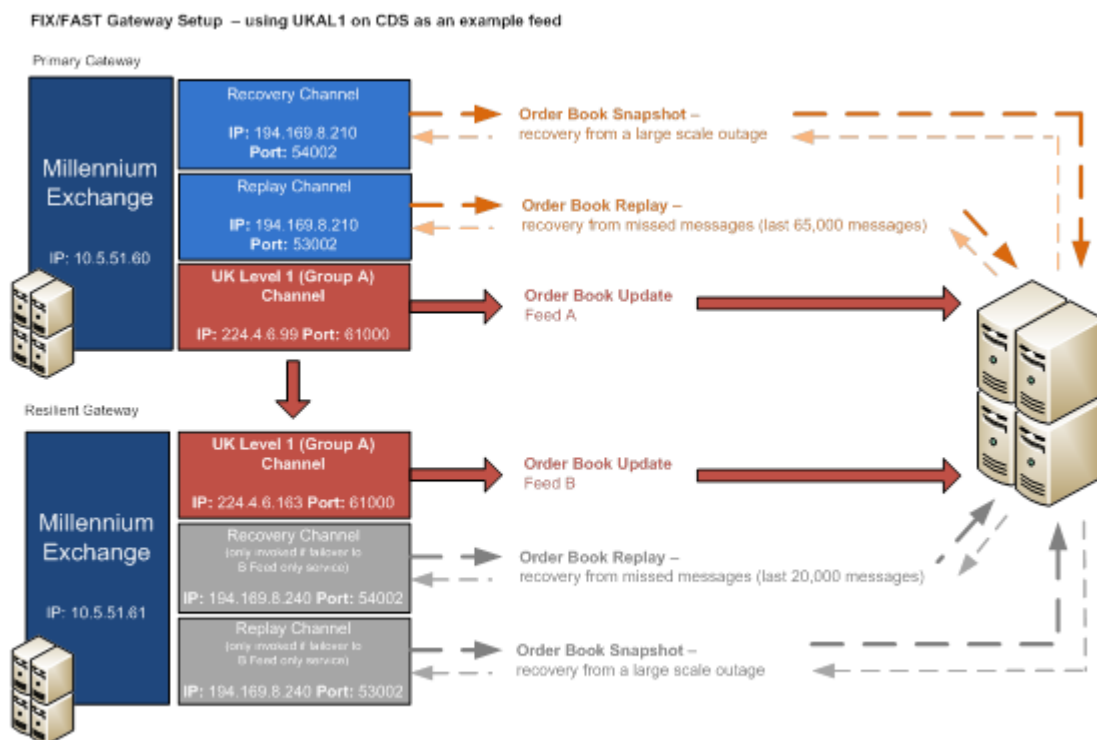


Figure 1 - Example FIX/FAST Gateway set-up with UKAL1 on Pilot CDS

In normal circumstances, clients should connect to the Primary Level 2-MITCH Replay and Recovery services using the primary set of IP addresses and ports.

Further information on the specific Level 2-MITCH Replay and Recovery Services are available in MIT303 – Level 2-MITCH Specification.

Component failures

In the unlikely event of a component failure the following behaviour will occur:

Primary feed failure

In the event of the primary feed failing the secondary feed will continue to disseminate market data updates and will resume the role of the primary market data feed. The Replay and Recovery services will be activated on the secondary feed and clients should use the resilient IP and Port configuration to access these services. Please note that sequence numbers will be reset to 1 on the secondary feed.

It will be necessary for the Millennium Exchange Market Data Gateway to resynchronise its order book in this situation and therefore all existing order books will be cleared down using an 'Order Book Clear' message on Level 2-MITCH. All active orders on the book will be disseminated via 'Add Order' or 'Add Attributed Order' messages.

Secondary feed failure

In the event of a secondary feed failing the primary feed will continue to disseminate market data updates without any interruption to service however clients will not be able to arbitrate between the primary and secondary feeds until the service is reinstated.

Primary Data Centre Failure

In the unlikely event of the Primary Data Centre failure, the Group will take actions to invoke the Secondary Data Centre. This will be clearly communicated to clients.

Upon Invocation, the Group will launch market data services with the Secondary Feed operating as master and passive Replay and Recovery services live on the Secondary Feed only. Whilst the Group will endeavour to continue to disseminate multicast market data to clients via the Primary feed, this cannot be guaranteed and will be dependant upon the nature of the failure and the reasons for Secondary Data Centre invocation.

Copyright © February 2015 London Stock Exchange plc.
Registered in England and Wales No. 2075721.

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

London Stock Exchange and the coat of arms device are registered trade marks of London Stock Exchange plc.

London Stock Exchange

10 Paternoster Square

London EC4M 4LS

T: +44(0) 20 7797 1000

www.londonstockexchange.com



London
Stock Exchange