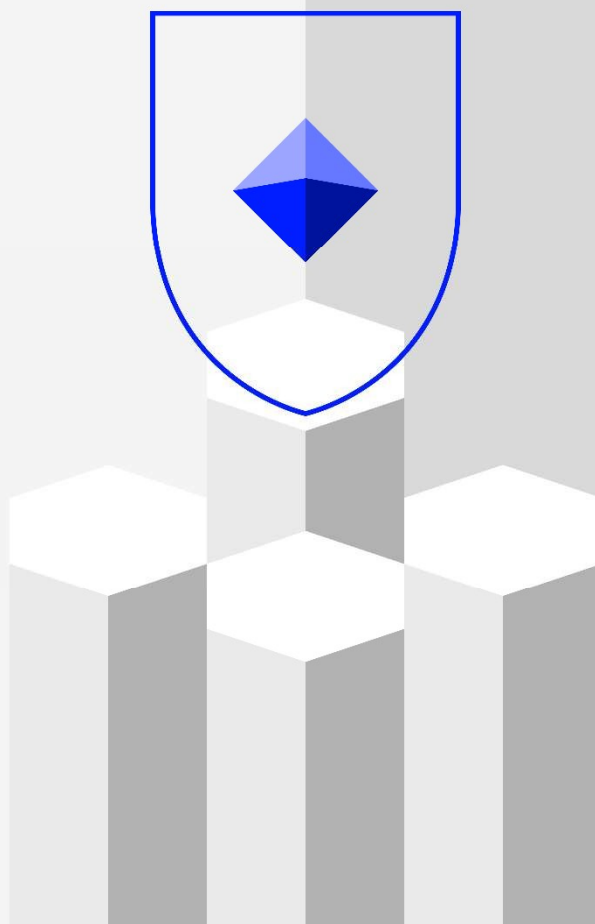


GROUP TICKER PLANT

GTP 001 – Product Guide

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**LONDON
STOCK
EXCHANGE**

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Guide disclaimer

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1.0 Introduction

The Group Ticker Plant of the Millennium Technology suite manages LSEG real time market data services under a common architecture. This product is managed with the aim to better support our clients, markets and our growing business.

The Group Ticker Plant consolidates all real-time market data services from varied technologies to a single, multi-asset class, low latency market data solution. The Ticker Plant delivers exceptional levels of performance, scalability, product resiliency and a rich set of innovative and traditional market data services.

Through several phases, market data delivery has been collapsed into a single, bespoke, binary protocol – based on our customer feedback and designed to achieve the best possible performance. Internally, we will also optimise our technologies to ensure our products can evolve in line with our industry, both in the short and long term.

This has been an exciting project for LSEG and our clients alike – we look forward to working with you, our customers and partners, as we continue to develop our product suite to deliver a better market experience.

2.0 Documentation

2.1 This Guide

The purpose of this document is to provide an overview of the various services delivered by the Group Ticker Plant.

It will be updated and reissued when appropriate to do so.

2.2 Readership

This document is particularly relevant to trading, market data and technical teams within Member Firms, information vendors and other market participants who currently receive or are interested in receiving London Stock Exchange Group market data.

When read in conjunction with other Group Ticker Plant documents it is intended to provide all required information to develop to, and interact with, our real-time information systems.

2.3 Document series

This guide, **GTP001 – Product Guide**, forms part of the documentation library supporting LSEG clients interacting with the Group Ticker Plant. For information, the full series of currently available documentation is outlined below:

- **GTP001 – Product Guide** (this document)
- GTP002 – Technical Guide
- GTP003 – Statistics Guide
- GTP004 – Parameters Guide
- GTP005 – Testing Guide

The full library of Group Ticker Plant documentation can be found at:

<https://www.lseg.com/areas-expertise/technology/group-technology/group-ticker-plant>

2.4 Document history

This document has been subject to the following iterations:

Issue	Date	Description
1.0	27 June 2012	The first issue of this document
2.0	24 August 2012	The second issue of this document with the following alterations: 4.3.3 – Inclusion of further information on channel content.
3.0	15 November 2012	The third issue of this document with the following alterations: 3.1.2 – Clarification to snapshot building instructions. 3.1.5 – Reference to GTP005 – External Sources Guide included. 4.3.3 – Minor clarifications to Instrument Distribution.
4.0	8 February 2013	3.1.6 – Inclusion of FTSE low latency detail.
4.1	6 March 2014	3.1.1 – Inclusion of GTP Lite incremental service details.
5.0	13 August 2013	Multiple changes to document issued to support Phase 2.0 services.
6.0	17 April 2014	Document baselined following customer feedback on Phase 2.0 services and to support the inclusion of EuroTLX and GTP Lite services.
7.0	29 July 2014	The seventh issue of this document to include minor updates and corrections as highlighted.
8.0	19 September 2014	Additional description added to section 3.1.3 as highlighted.

Issue	Date	Description
9.0	25 June 2015	Updated to include Phase 2.0 product details.
10.0	21 October 2015	Updated to reflect corrections identified.
11.0	8 July 2016	Updated to reflect corrections identified.
12.0	10 March 2017	Updated to include TRADEcho market data channels.
12.1	22 May 2017	Software Release 1.4.0.7: 4.4.2 – Added system event to available recovery requests
13.0	22 May 2017	MiFID Changes: 3.1.3 – Added details for indicative quote information 4.4.2 – Added indicative quote information to available recovery requests
13.1	13 December 2017	Decommission of FTSE low latency service in production – 19 Dec – and CDS – 18 Dec. Removed FTSE low latency
13.2	3 January 2018	4.3.3 – Updated Spanish MIC code from XMCE to XMAD
13.3	6 June 2018	4.3.3 – Updated MIC code from XMAS to XAMS
13.4	22 August 2018	3.1.3 – Added trade summary
13.5	25 October 2018	3.1.3 – Added clarification on RFQ quotes publication on Level Two incremental service 3.1.7 – Added section for TRADEcho service 4, 4.4.1, 4.4.2 – Sections updated 3.1.3 – Added clarification on CPX
13.6.1	17 January 2019	3.1.3 – Added Turquoise™ market for trade summary
13.7	26 May 2020	3.1.3 – Updated the description for the trade summary, removing some previous limitations.
14.2	10 August 2020	<u>Changes for Release 1.4.5.0</u> 4.2, 4.3 – Rewritten to update the system architecture changes to the PDC and SDC.
14.3	30 September 2020	3.1.7 – Added TRADEcho hard Brexit APAs category
14.4	1 December 2020	All sections – Removed content related to Borsa Italiana and associated venues
14.5	1 February 2021	3.1 – Level One incremental service is now available for the Turquoise MTF
14.6	1 August 2021	Added a new section 3.1.8 – Analytics, additional statistics on order book activity
14.7	15 October 2021	3.1.8 – Stated that the analytics service ends each day at the market close for each respective venue.
15.0	17 January 2024	4.3.3 Instrument Distribution - changes to how instruments are allocated across Market Data Gateway channels 3.1.3 Level 2 incremental service - extended functionality of Trade Summary is described 3.1.3 Level 2 incremental service – Description of RFQ Partial PreTrade Transparency is removed Section “5. Product failure” was removed from GTP002 and merged with respective section in GTP001 – “4.0 System overview.” Sections ‘3.15 Announcements’ and ‘4.5 Group Ticker Plant failure’ are removed
15.1	25 January 2024	4.3.3 Instrument Distribution – table content is reworded. 3.1.3 Level 2 incremental service – description of new functionality related to Transact Time and Trade Summary is enhanced

Issue	Date	Description																														
15.2	28 February 2024	4.2, 4.2.1 – Added sections “Operation during service interruption on supported market” and “Partition Suspension” 3.1.3 - Added clarification about GTD orders transact time at the beginning of trading day 3.1.3 - Removed information related to implied orders since they are not applicable to LSEG trading venues. 4.4.2 – Clarified formulation in section ‘Instrument identification’																														
15.3	26 November 2024	4.2.1 – Partition Suspension – description of GTP operation during service interruption on supported market is extended with clarification for Turquoise 4.0 – System overview – removed outdate line related to Borsa Italiana associated venue																														
16.1	12 December 2024	All sections – Removed content related to FTSE Russell Indices Update																														
17.1	01 July 2025	3.1.6, 3.1.7 – TRADEcho section is split into two distinct parts - TRADEcho SI Quotes and TRADEcho MiFID II Trade Reporting - to highlight that they are independent services 4.4.3 - new SI Quote channels are added																														
17.2	17 July 2025	Naming of Turquoise titles was updated due to re-branding <table><tr><th>Previous Names</th><th>Rebranded Names</th></tr><tr><td>Turquoise®</td><td>Turquoise</td></tr><tr><td>Turquoise Europe™</td><td>Turquoise Europe</td></tr><tr><td>Turquoise Lit™</td><td>Turquoise Lit</td></tr><tr><td>Turquoise Lit Order Books™</td><td>Turquoise Lit Order Books</td></tr><tr><td>Turquoise Plato™</td><td>Turquoise Dark</td></tr><tr><td>Turquoise Plato Order Books™</td><td>Turquoise Dark Order Books</td></tr><tr><td>Turquoise Plato Block Discovery™</td><td>Turquoise Block Discovery</td></tr><tr><td>Turquoise Block Insights™</td><td>Turquoise Block Insights</td></tr><tr><td>Turquoise Plato Uncross™</td><td>Turquoise Dark Uncross</td></tr><tr><td>Turquoise Plato Dark-Lit Sweep™</td><td>Turquoise Dark-Lit Sweep</td></tr><tr><td>Turquoise Plato Continuous™</td><td>Turquoise Dark Continuous</td></tr><tr><td>Turquoise Plato Trade at Last™</td><td>Turquoise Dark Trade at Last</td></tr><tr><td>Turquoise Plato Lit Auctions™</td><td>Turquoise Periodic Auctions</td></tr><tr><td>Turquoise Plato Lit Auctions Order Books™</td><td>Turquoise Periodic Auctions Order Books</td></tr></table>	Previous Names	Rebranded Names	Turquoise®	Turquoise	Turquoise Europe™	Turquoise Europe	Turquoise Lit™	Turquoise Lit	Turquoise Lit Order Books™	Turquoise Lit Order Books	Turquoise Plato™	Turquoise Dark	Turquoise Plato Order Books™	Turquoise Dark Order Books	Turquoise Plato Block Discovery™	Turquoise Block Discovery	Turquoise Block Insights™	Turquoise Block Insights	Turquoise Plato Uncross™	Turquoise Dark Uncross	Turquoise Plato Dark-Lit Sweep™	Turquoise Dark-Lit Sweep	Turquoise Plato Continuous™	Turquoise Dark Continuous	Turquoise Plato Trade at Last™	Turquoise Dark Trade at Last	Turquoise Plato Lit Auctions™	Turquoise Periodic Auctions	Turquoise Plato Lit Auctions Order Books™	Turquoise Periodic Auctions Order Books
Previous Names	Rebranded Names																															
Turquoise®	Turquoise																															
Turquoise Europe™	Turquoise Europe																															
Turquoise Lit™	Turquoise Lit																															
Turquoise Lit Order Books™	Turquoise Lit Order Books																															
Turquoise Plato™	Turquoise Dark																															
Turquoise Plato Order Books™	Turquoise Dark Order Books																															
Turquoise Plato Block Discovery™	Turquoise Block Discovery																															
Turquoise Block Insights™	Turquoise Block Insights																															
Turquoise Plato Uncross™	Turquoise Dark Uncross																															
Turquoise Plato Dark-Lit Sweep™	Turquoise Dark-Lit Sweep																															
Turquoise Plato Continuous™	Turquoise Dark Continuous																															
Turquoise Plato Trade at Last™	Turquoise Dark Trade at Last																															
Turquoise Plato Lit Auctions™	Turquoise Periodic Auctions																															
Turquoise Plato Lit Auctions Order Books™	Turquoise Periodic Auctions Order Books																															
17.3	11 November 2025	Clarity and accuracy improvements: 4.3.2 – Operation from the Primary Data Centre following isolated hardware failure – Enhanced description of failure behaviour 4.4.3 – Instrument Distribution – added Channel P (Private Securities Market) and included a note that testing instruments may not conform to the distribution guidelines 3.1.2 – Level 2 snapshot incremental – Removed outdated note stating that no MBP Level 2 Snapshot channel F is provisioned, as this has not been the case since 29 April 2024.																														
17.4	03 March 2026	Clarity and accuracy improvements: 3.1.3 – Level 2 incremental service – Clarified the interpretation of Delete Order messages Please note that the above modifications are highlighted in amber within the document, indicating non-material changes intended to improve clarity and documentation quality. Material changes are highlighted in red																														

In subsequent issues of this document, where amendments have been made, these changes are indicated through the use of **red text**.

2.5 Enquiries

For further information on Group Ticker Plant, please contact either your Technical Account Manager or the Client Technology Services (UK):

- Telephone: (+44) 207 797 3939
- Email: londontam@lseg.com

Please contact LSEG's market data team for further information regarding data licensing for this service by emailing marketdata@lseg.com

Further information can also be found on our project websites:

<https://www.lseg.com/areas-expertise/technology/group-technology/group-ticker-plant>

3.0 Service overview

The Group currently broadcasts real-time data in several different protocols. The protocol by which real-time data is broadcast is dependent upon asset class being traded, the core technology underpinning the market, and the nature of the client's interaction with the service.

The Group Ticker Plant supports a number of different asset classes – cash equities, fixed income (both bonds and warrants) and derivatives – and in an effort to ensure the new protocol is intuitive, performant and generic, some data sets have been removed. All business-critical information remains present and new functional enhancements and data sets have been introduced following customer feedback and market trends.

3.1 Service lines

The Group Ticker Plant is enhanced overtime in phases. Each go-live phase sees either additional service lines or markets introduced to the core product.

Group Ticker Plant delivers the following service lines:

- Level One incremental service
- Level 2 10 depth snapshot service
- Level 2 incremental service with indicative quotes
- Reference data
- TRADEcho SI Quotes
- TRADEcho MiFID II Trade Reporting
- Analytics



Figure One: Service lines offered by Group Ticker Plant.

The following markets are currently supported:

- London cash equity markets (including IOB, EQS and the order book for retail bonds) (London Stock Exchange)
- Turquoise cash equity markets
- TRADEcho SI Quotes
- TRADEcho MiFID II Trade Reporting

Customers should note that the Turquoise cash equity market introduced at Phase Two is only provided as a Level One incremental service and Level Two full-depth incremental data service.

In a similar design to that of Millennium Exchange, Group Ticker Plant data services are disseminated via multicast, broadcast in UDP network packets, and delivered over several load balanced IP multicast channels. These IP multicast channels are supported by TCP/IP replay and recovery services.

There is no concept of Prime, Duplicate or Standard data delivery on the new Group Ticker Plant.

3.1.1 Level 1 incremental service

Level 1 Incremental Service	Level 2 Snapshot Service	Level 2 Incremental Service	Reference Data	TRADEcho SI Quotes	TRADEcho MIFID II Trade Reporting	Analytics
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The Group Ticker Plant Level One service is publishing an aggregated best bid and offer, both quantity and price for applicable order types. Market orders are also aggregated, and their total cumulative size is disseminated. As an incremental service, any change to the consolidated best bid and offer – whether a modify, deletion, addition or execution of a contributing order – results in the dissemination of the entire best bid and offer details. All values for the Level One service are contained within a single message type.

In addition to the dissemination of the best bid and offer, the Level One service delivers all executions, both on and off book, as trade reports. All on book trades (AT and PT trades), auction uncrossing trades (UT trades) and trade breaks are delivered in a single message type. This message includes the executed price (or yield if the instrument is traded in yield), the executed quantity, the transaction time as stamped by the matching engine, and the auction type (if applicable). Off-book executions reported to supported venues are published in the off-book trade message. This message includes the transaction time, traded quantity, traded price and trade date. Further details are included in **GTP002 – Technical Guide**.

The Level One service also broadcasts a rich range of derived information – LSEG's statistics package. Whilst continuing to broadcast all derived information published across our legacy market data products, the Group Ticker Plant introduces a new set of statistics. Indicative auction information, when applicable, is disseminated as a statistic on the Group Ticker Plant. For information, the statistics supported are detailed below:

- Volume (on book only and all trades)
- VWAP (on book only and all trades)
- Number of trades (on book only and all trades)
- Turnover (on book only and all trades)
- Trade High and Low (on book only, off book only and all trades)
- The 52-week trade high and low closing best bid and best offer

The Level One service also publishes the official opening and closing price as reported by supported venues. This value is published in real-time and includes the underlying method of calculation.

Further information on our statistics and their derivation method is included in **GTP003 – Statistics Guide**.

The Level One service also disseminates the real-time trading status for an instrument and any system event information deemed relevant to market data clients.

3.1.2 Level 2 snapshot service

Level 1 Incremental Service	Level 2 Snapshot Service	Level 2 Incremental Service	Reference Data	TRADEcho SI Quotes	TRADEcho MIFID II Trade Reporting	Analytics
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LSEG supports a Level Two snapshot service. This snapshot service line provisions clients a 10-depth snapshot of the order book. All markets broadcast snapshots at 150 millisecond intervals. This service is not designed for those clients who require full visibility of the order book or a microsecond latency sensitive service – instead being made available to support users sensitive to the bandwidth requirements of a full book incremental market data product.

The Level Two snapshot service line is made available in two different formats: market by order (MBO) and market by price (MBP). Provisioned over two separate market data channels, the two market data products are provisioned to clients subject to the correct commercial arrangements being in place. Further details on the two snapshot services are included below:

- Market by order – the MBO snapshot product issues clients the top 10 individual orders for both the bid and offer sides of an order book for a given security.

- Market by price – the MBP snapshot product issues clients the top 10 price levels for both the bid and offer sides of an order book for a given security.

Snapshots are issued at the advertised intervals to clients. If no change occurs in the order book for this duration, no new snapshot is provided.

Unlike legacy market data snapshot services, the Group Ticker Plant snapshot services are built by processing multiple individual messages. Clients should process all messages received in chronological order, using the message sequence number, to ensure an accurate build of the order book.

The MBO snapshot should be built by processing the first 'add order' message which contains the best priced buy order. This message also contains the total number of buy orders to be disseminated (a maximum of 10). The following nine buy orders are provided as several 'add order short' messages. If no buy side orders exist on the order book, an 'add order' message with a depth of zero ('0') is sent. The buy side snapshot is always disseminated first. Clients should then expect to receive an 'add order' message which contains the best priced sell order. In a similar method to that of the buy side, this message contains the total number of sell orders to be disseminated (maximum of 10). These orders are then disseminated as several 'add order short' messages. If no sell side orders exist, an 'add order' message with a depth of zero ('0') is disseminated. Both the add order and add order short messages contain the order ID as reported by the execution venue – this allow clients to track their orders on the market data product. If no orders exist on either side of the order book, an 'order book clear' message is disseminated by the server.

The MBP snapshot should be built in a similar way to that of the market by order snapshot. Clients should process the first 'add order MBP' message which contains the best available buy price. This first update consolidates the order volume at this price point. It also provides the number of orders collapsed at this first price point and the total number of price points to be disseminated to form the book (a maximum of 10). Clients should process the following 'add order short MBP' messages to build the remaining price points of the buy side MBP order book. If no buy side price points exist on the order book, an 'add order MBP' message with a depth of zero ('0') is sent. The buy side snapshot is always be disseminated first.

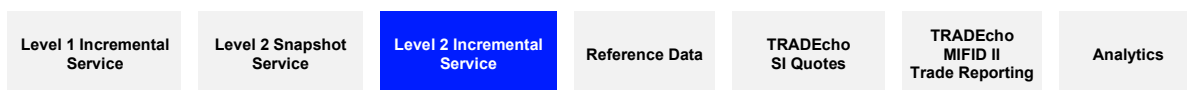
Following the dissemination of these price points, clients receive an 'add order MBP' message for the sell side of the MBP order book. This will, as per the buy side, contain the best price point of the sell side. Also contained in this message are the number of orders collapsed into the order and the total number of price levels to be communicated (a maximum of 10) to build the sell side of the MBP order book. Clients then receive the 'add order short MBP' messages. If no sell side price points exist, an 'add order MBP' message with a depth of zero ('0') is disseminated. If no price points exist on either side of the order book, an 'order book clear' message is disseminated by the server.

The Group Ticker Plant always disseminates add order and add order short messages for both MBO and MBP order books in chronological order, in the aforementioned sequence.

Clients should also note that as the MBO and MBP snapshot services are provisioned by dedicated gateways, these cannot be guaranteed to be aligned at all times. Whilst operating independently, both are configured to the same source feed, and both operate with the same time interval between snapshots.

The Level Two snapshot service also includes all statistical, trade, reference data, instrument status and event information as contained in the Level One service and as described in section 3.1.1 of this document.

3.1.3 Level 2 incremental service



The Level Two incremental service publishes all order book updates including order add, modify and delete messages. Order book management and post-trade management is done through two distinct message types – the order executed with price/size message does not feature on the Group Ticker Plant service lines.

The Group Ticker Plant broadcasts an 'add order incremental' message each time a visible order is added to the order book. A unique identifier, the order ID, is applied and should be used to identify all future actions to be applied to that order. In an enhancement versus that of legacy market data products, the Group Ticker Plant explicitly identifies the public order type to facilitate client order book interaction. Should the order be deleted from the matching engine, due to market participant deletion or execution, a 'delete order' message is disseminated. The Group Ticker Plant disseminates a 'modify order' message should any attributes of the order be changed, as a result of partial execution or market participant instruction.

Clients should note that a Delete Order message reflects the removal of an order from the visible order book at that time. Depending on an order's specific characteristics and its interaction with the rest of the order book, an order may be removed from the visible book but then subsequently become visible again later on the same trading day. At market close, all open orders are removed from the order book and a final Delete Order message is disseminated, with the exception of Good-Till-Date (GTD) orders.

A new field Transaction Time has been added to 'add order incremental', 'modify order', 'delete order' messages, representing the transaction execution timestamp.

On LSE, carried forward GTD orders that are restored on the book in the morning via 'add order incremental' will contain the 'TransactTime' disseminated with the last 'execution report' published through FIX or NAT trading interface so for GTD-order restoration time, clients are advised to additionally refer to the field 'Timestamp' which contains time when the message was published by GTP.

If private RFQ book is applicable to a tradable product, RFQ quotes are published according to the RFQ transparency regime. In case of Full Post Trade Transparency regime – individual RFQ quotes are transmitted via the 'add order incremental' messages attached to the RFQ book. Each message contains the particular RFQ ID identifying the RFQ session, when multiple RFQ sessions are running concurrently. This is the regime applicable to LSEG venues.

In a similar regime to that of the Level One incremental and Level Two snapshot services, all executions on the matching engine results in dissemination of trade messages. As described previously, in addition to trade messages, the Level Two incremental service will also disseminate 'order delete' and 'order modify' messages to customers, which should be applied to ensure order books represent the current state of the matching engine.

On Level Two incremental feed, the GTP is also implementing a consolidated message (Trade Summary) which disseminates summary information prior to individual trade.

Trade Summary is published immediately in advance of any individual Trade message or set of Trade messages generated from a single matching engine event in regular trading. The transaction execution timestamp provided in to 'add order incremental', 'modify order', 'delete order' messages will match the timestamp of the associated Trade Summary message, allowing customers to link these messages.

Trade Summary contains a summary of aggregated executed and expired volume, and the furthest price at which volume is depleted as part of the event. The Trade Summary message also contains the new best bid and offer price/quantity as of the completion of the trade execution.

On LSE, trades resulting from triggered Stop orders and Stop Limit orders and having the same original passive side do not generate a separate Trade Summary message but has their traded volume included in it until the direction of execution changes. Every time the passive side changes a new trade summary message is disseminated and trade volumes in that direction is included in it. Additionally, in a scenario where the passive side changes, the best bid/offer information in the preceding Trade Summary will be filled with -1, as the subsequent Trade Summary will contain more recent information about the book.

For e.g., aggressing order A1 (side = buy) takes out two passive visible orders → trade summary (TS1: side = sell).

The traded price triggers one stop order (side = buy) which executes at price P2 → the traded quantity of that is included in the above-mentioned trade summary (TS1).

The traded price P2 triggers two stop orders one after the other (side = sell), both of which execute at P3 and P4 respectively → new trade summary (TS2: side = buy) has the total traded quantity of the two stop orders.

The traded price P3 triggers two more stop orders one after the other (side = buy), both of which execute at P5 and P6 → new trade summary (TS3: side = sell) has the total traded quantity of the two stop orders.

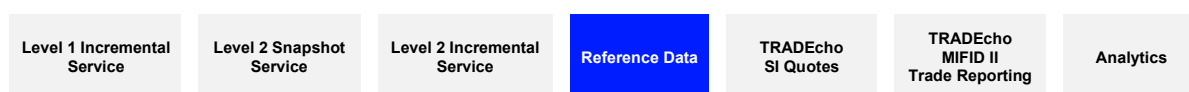
Clients should also note that:

1. Trade Summary is not published for cancellations and amendments of trades
2. Trade Summary is only applicable for trades during regular trading and closing price crossing session, and not to auction trades.

This functionality is available for London Stock Exchange and Turquoise Lit order books.

LSEG's Level Two incremental service also includes all indicative quote, statistical, trade, reference data, instrument status and event information as included as part of the Level One and Level Two snapshot service lines.

3.1.4 Reference data



The Group Ticker Plant disseminates an enriched package of reference data. When used in conjunction with the Group's sFTP/FTP reference data packages, it is intended that all information required to trade and manage securities are provided to clients. Further information on the Group's sFTP/FTP reference data packages can be found in:

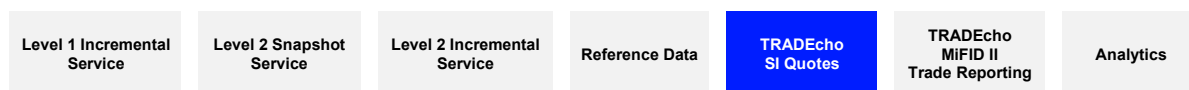
- MIT401 – Guide to Reference Data Services for London Stock Exchange venue
- MIT501 – Guide to Reference Data Services for Turquoise venue

Each market data service publishes a generic set of reference data, irrespective of the asset class to which a security belongs. This information is contained within the instrument directory message and is disseminated each morning. The following information is an example of what is actively transmitted:

- Instrument
- ISIN
- Allowed book types
- Segment
- Source venue

Clients are also able to target the TCP/IP recovery service to request asset-specific reference data packaged in the instrument directory equities/derivatives/fixed income messages. The content of these messages is available in **GTP002 – Technical Guide**.

3.1.5 TRADEcho SI Quotes



The Group Ticker Plant supports the dissemination of SI quotes submitted to TRADEcho APA over dedicated service lines. The service lines provide SI quotes of **equity** instruments listed on London Stock Exchange and a subset of instruments from other trading venues

For instruments which are available on TRADEcho APA and on electronic book on London Stock Exchange venues, GTP provides the same source venue identification code.

3.1.6 TRADEcho MiFID II Trade Reporting

Level 1 Incremental Service	Level 2 Snapshot Service	Level 2 Incremental Service	Reference Data	TRADEcho SI Quotes	TRADEcho MiFID II Trade Reporting	Analytics
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The Group Ticker Plant supports the dissemination of MiFID II Trade Reports submitted to TRADEcho APA over dedicated service lines.

The following information is made available over the TRADEcho service lines:

- Reference data, intra-day status updates of off-book trade reporting sessions and trades statistics, limited to products listed on London Stock Exchange venues.
- Publish off-book trade reports when eligible for publication, for the global ESMA FIRDS instruments database as reported to TRADEcho APA.
- Publish trade reports segregated for either UK or European TRADEcho APA's following a hard Brexit scenario.

For instruments which are traded both off-book on TRADEcho APA and on electronic book on London Stock Exchange venues, GTP provides the same source venue identification code.

Further information on off-book statistics and their derivation method is included in **GTP003 – Statistics Guide**.

3.1.7 Analytics service

Level 1 Incremental Service	Level 2 Snapshot Service	Level 2 Incremental Service	Reference Data	TRADEcho SI Quotes	TRADEcho MiFID II Trade Reporting	Analytics
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The analytics service is intended to provide additional statistics related to securities trading activity. This service publishes a snapshot of statistics every one second for each instrument available on London Stock Exchange, Turquoise and Turquoise Europe markets. The service tracks the Level Two incremental service for these markets and publishes statistics after the fact, keeping to the periodicity of an update per second. Any hidden orders do not contribute to the statistics. The message contains a limited set of statistics at launch; however, this may be extended to include further information on consultation with market data clients and Member Firms.

The analytics service is a value-added service and will be provisioned to clients subject to the correct commercial arrangements being in place. Please contact LSEG's market data team for further information on how to access this service (marketdata@lseg.com).

Each snapshot message published by the analytics service contains the message length, message type, timestamp, instrument, source venue, a start time and end time in addition to the statistics. Technical details of the analytics service by GTP can be found in **GTP 002 – Technical Guide**.

- The statistics are calculated for the electronic (normal) order book only.
- The statistics initialise to zero at the start of the day.
- The statistics reset to zero at the end of the day.
- If there is no activity on the order book for a particular instrument and all the statistics published on the message in a given period are zero, the analytics gateway will cease publication of the analytics message for that instrument until there is a subsequent period with activity in the order book such that at least one of the statistics is not zero, leading the gateway to publish the message.
- If the market operations for a source venue forcefully re-publishes the order book, this updates the statistics, even though it is a re-publication of already published orders.
- The service ends each day at the Market Close for each respective venue.

For further details on the statistics, please refer **GTP 003 – Statistics Guide**.

The Group Ticker Plant hosts an instance of the analytics service per each channel of London Stock Exchange, Turquoise and Turquoise Europe Markets. Each instance of the analytics service provides:

-
- Real-Time multicast feed
 - Replay TCP/IP feed
 - Recovery TCP/IP feed

The analytics service also includes all reference data, instrument status and system event information in addition to the analytics messages. These are provided over the real-time, replay and recovery feeds. The analytics message is not available on the recovery feed at present, but is likely to be included in the future.

The service provides a primary feed and a secondary feed and adheres to the resiliency model for non-Level Two incremental services, the details of which are discussed under 'system overview' – section 4 of this document.

4.0 System overview

The interfaces, protocols and architecture used by the Group Ticker Plant differ considerably to those currently employed by LSEG's Millennium Exchange or other production environments.

LSEG has invested in designing an intuitive, performant protocol, generic in nature which we hope aids client development and provides a design which can easily evolve as further service lines or markets are introduced. Whilst the protocol is not an industry standard such as FIX-FAST, we believe it is simpler and supports the needs of our clients and markets to a greater degree.

The Group Ticker Plant is deployed to the London primary data centre (PDC) estate and operates with a secondary data centre (SDC) estate.

The London site provides market data for:

- London Stock Exchange
- Turquoise cash equity markets
- TRADEcho APA

4.1 Message formats

The various messages of LSEG protocols support publication of all service lines for all supported markets. Some messages may not be broadcast for all supported markets. Where this is the case, it is clearly identified in **GTP002 – Technical Guide**.

4.2 Operation during service interruption on supported market

4.2.1 Partition Suspension

In the event that a trading partition is suspended, clients will be notified with an 'instrument status' message where 'trading status' is set to 'J' (Halt – Matching partition Suspended). During this system state any interaction with active orders is not permitted. A subsequent 'Instrument status' where 'trading status' is set to 'H' (halt session) will indicate that the system has been brought back to operational state, allowing order cancellations while new orders and amendments will continue to be rejected.

As the restoration process continues, Clients will subsequently be notified about the end time of the halt session via 'instrument status' where trading status is set to 'H' and 'new end time' is defined, indicating when the market will recommence the process to restore normal service.

The session in which the instrument resumes in after the halt session, depends on the trading service, for example in LSE, order-driven securities will recommence with a resume auction call. For more details on outage management for London Stock Exchange, clients should refer to section "Service Interruptions Protocol" in "MIT201 - Guide to the Trading system".

For Turquoise, securities will be restored to normal service by resuming the trading session at a scheduled time, which will be communicated by Turquoise. Please refer to Turquoise Trading Service Description – section 13.5 for more details.

4.3 System Architecture

4.3.1 Normal Operation

Each multicast channel has a primary and secondary gateway at the Primary Data Centre (PDC) and a primary and secondary gateway at the Secondary Data Centre (SDC). The gateways at SDC are in cold standby mode, ready to be activated on Site Invocation. Each set of gateways at either site will operate in an active-standby configuration where the standby gateway will take over service on failure of the active gateway.

GTP publishes two multicast feeds for each channel, known as the primary feed and the secondary feed. The primary feed will be sent via the client's primary connection and the secondary feed will be sent via the client's secondary connection. The primary connection to clients is made available through the Primary Data Centre (PDC) and the secondary connection is made available through the Secondary Data Centre (SDC).

For the Level 2 Incremental Services for London Stock Exchange, Turquoise, both the primary and secondary feed will be generated by the active gateway. For all other services, the primary feed will be generated by the active gateway and the secondary feed will be published by the standby gateway.

The market data messages published in the primary feed are identical to those published in the secondary feed. This includes consistent sequence numbering which facilitates feed arbitration against any message loss. While messages disseminated are identical, the network transport-packing algorithm operates independently and UDP packets may therefore contain different message combinations. Clients are strongly advised to ensure all systems are configured to subscribe to both primary and secondary market data feeds.

Each market data feed contains an identifier known as the Market Data Group. During normal operational state, the primary and secondary market data feeds will be in upper case (except for TRADEcho, where this field is populated with numbers from one to eight as can be seen on the table specified in section 4.3.3).

In normal operation, clients should connect to and make all replay and recovery requests to the primary gateway.

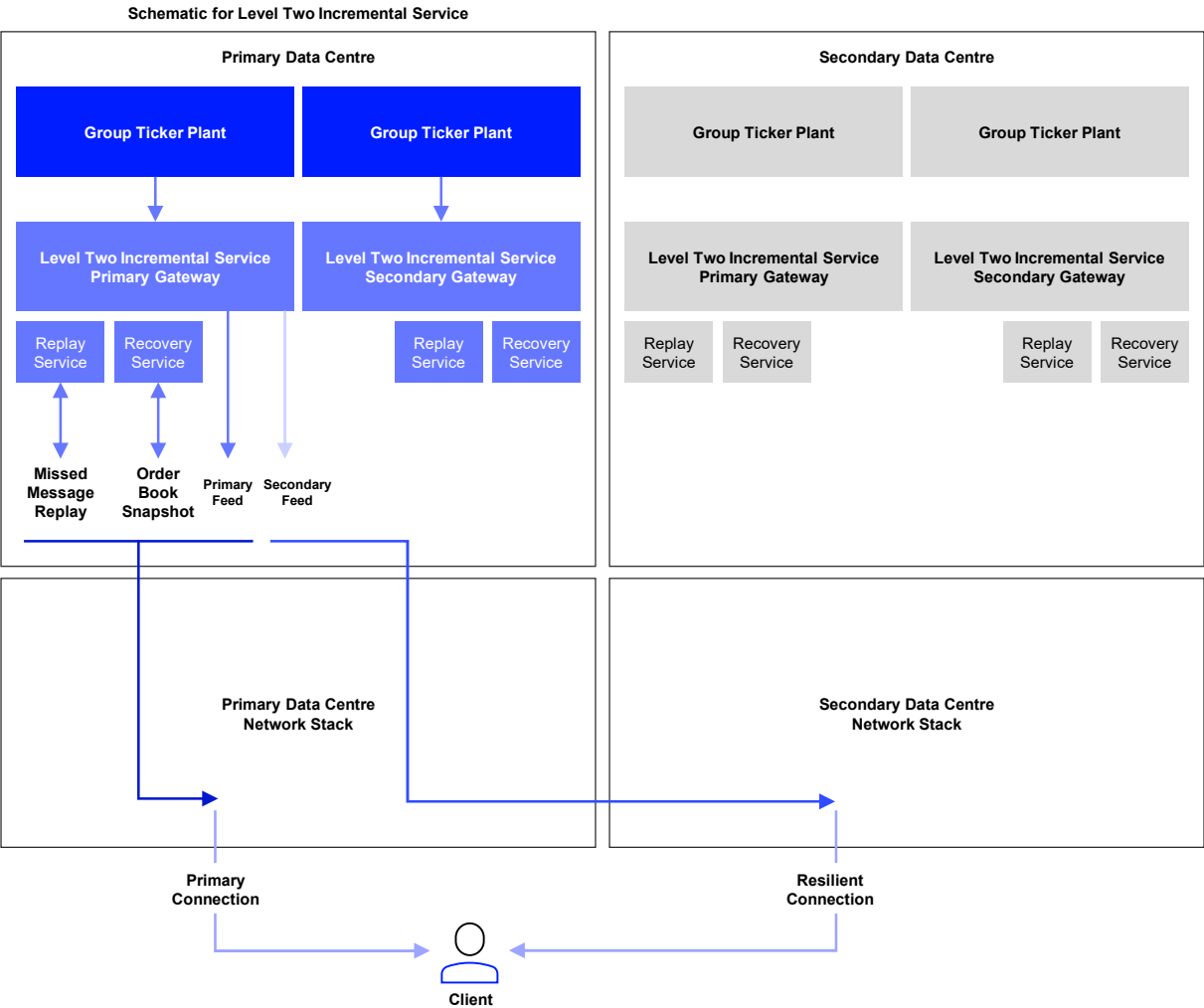


Figure 1a: Schematic of Group Ticker Plant architecture during normal operations – Level 2 incremental service¹

¹ Level 2 incremental services for London Stock Exchange and Turquoise

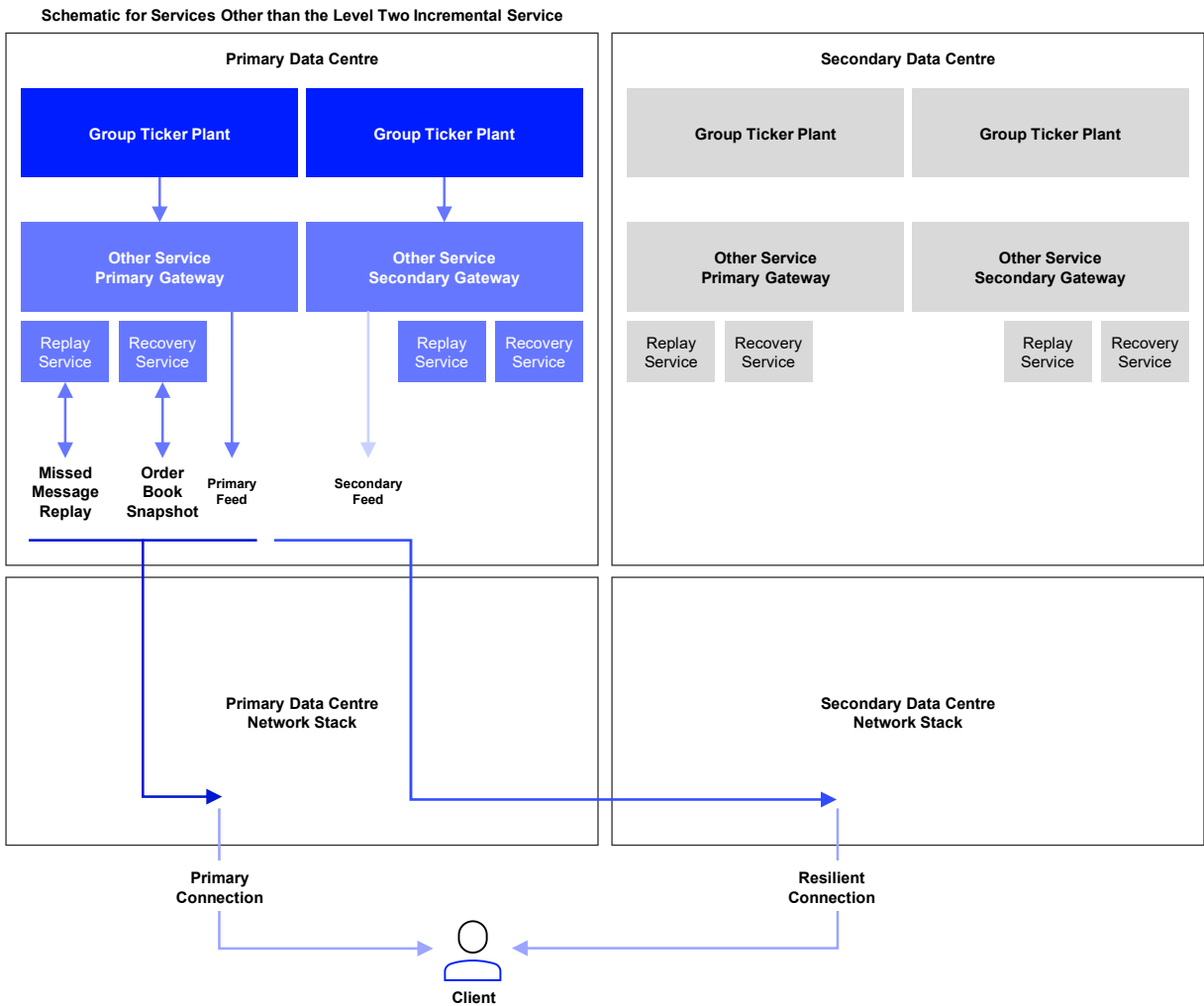


Figure 1b: Schematic of Group Ticker Plant architecture during normal operations – Other Services²

² All services other than the Level 2 incremental services for London Stock Exchange and Turquoise

4.3.2 Operation from the Primary Data Centre following isolated hardware failure

The GTP system at PDC is designed to be resilient against isolated hardware failure. Should there be an isolated hardware failure, standby components will take over and GTP will continue to operate as normal, seamless to the client.

In limited circumstance, GTP may broadcast an Order Book Clear message for an affected instrument followed by an order book snapshot, so clients can rebuild their order book accordingly.

On failure of the Primary Market Data Gateway, client should expect the following behaviour:

1. **Market Data Group ID** - In case of any primary gateway failure, its Market Data Group will be changed to the lowercase letter (or to the relevant character, e.g., on TRADEcho Channels).
2. **Market Data Re-publication** - The sequence number will **be reset to 1** and market data will be re-published to clients:
 - a. **Order Book** – A current snapshot of the order book will be sent:
 - for **Level 2 Incremental services** in **LSE** and **Turquoise** - starting with an *Order Book Clear* message
 - for **all other services** - starting with an *Order Book Clear* message if the order book is empty at the time of publication
 - b. **Trades** – Some trades executed prior to the failover may be re-published. Clients are advised to filter out duplicates using a combination of:
 - **Trade ID / Transaction Identification ID**
 - **Cancellation / Modification flags** (CANC / AMND)
 - **Transaction Time**
 - c. **Statistics** - Clients may observe **updated statistics** reflecting the latest values from the Exchange.
 - d. **System and Instrument Statuses** - These will not be re-published unless a change occurred during the failover and was not published by the primary gateway.
3. **If only Level 2 Incremental service in LSE or Turquoise fails**, the re-publication described in **point 2** applies to the other services within the same Market Data Group (Level 1, Level 2 Snapshot, etc.). However, the Market Data Group ID and sequence number reset will **not** affect other services
4. **Multicast Feed Continuity**
 - a. **Figure 2a:** If only the Level 2 Incremental service in LSE or Turquoise fails, **all services (including Level 2 Incremental)** will continue to publish both the **Primary** and **Secondary** Multicast feeds.
 - b. **Figure 2b:** If any service **other than** Level 2 Incremental in LSE or Turquoise fails, only the **Secondary Multicast feed** of the failed gateway will remain available.

Figures 2a and 2b can be found on the following pages.
5. **Replay and Recovery Feeds Continuity** - Clients should use replay and recovery services on the secondary gateway starting from the point of Market Data Group ID change.

Please refer to the **GTP005 – Testing Guide** for instructions on participating in failure-scenario simulations in the Customer Development Service (CDS) environment

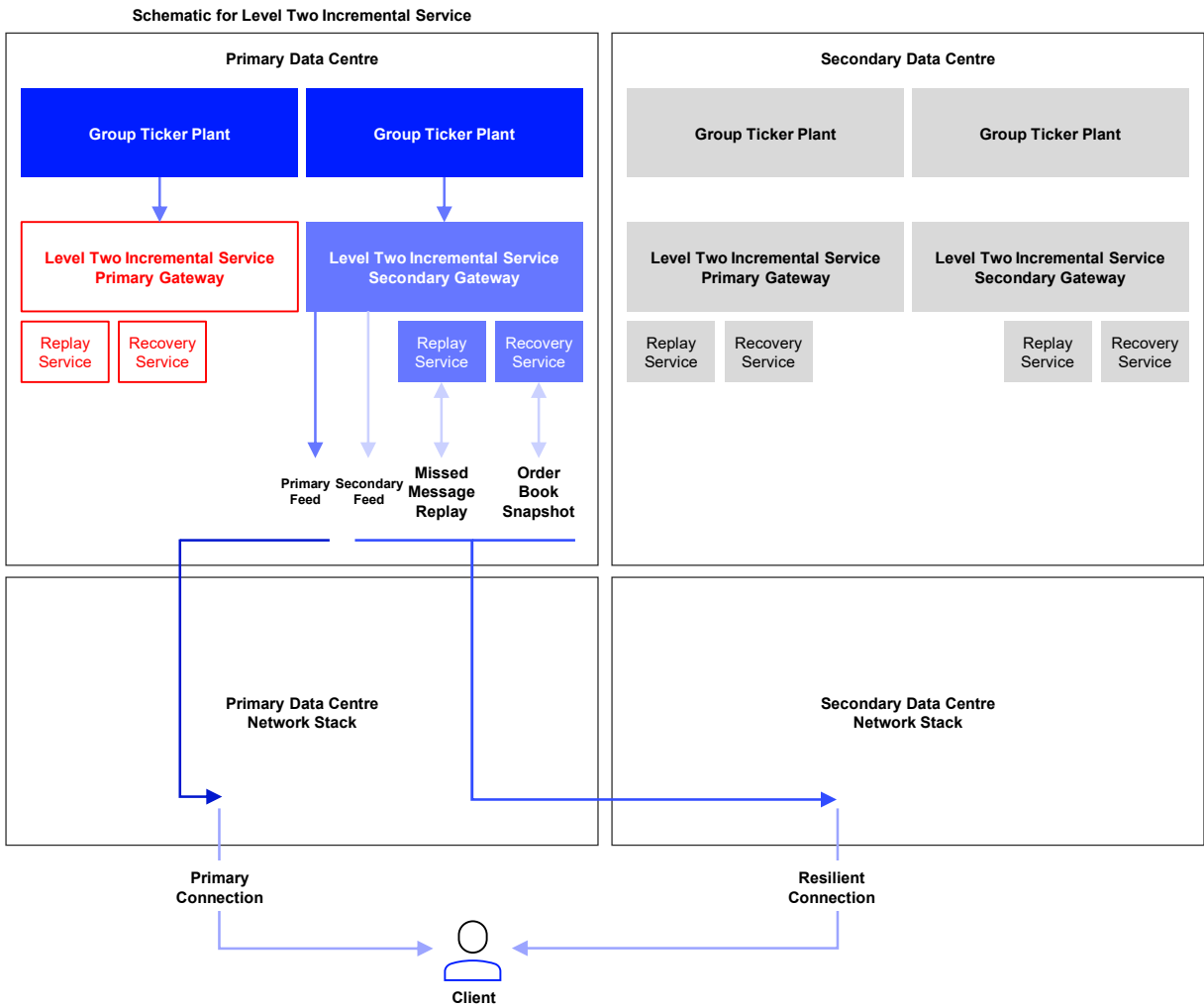


Figure 2a: Schematic of Group Ticker Plant architecture following primary gateway failover – Level 2 incremental service³

³ Level 2 incremental services for London Stock Exchange and Turquoise

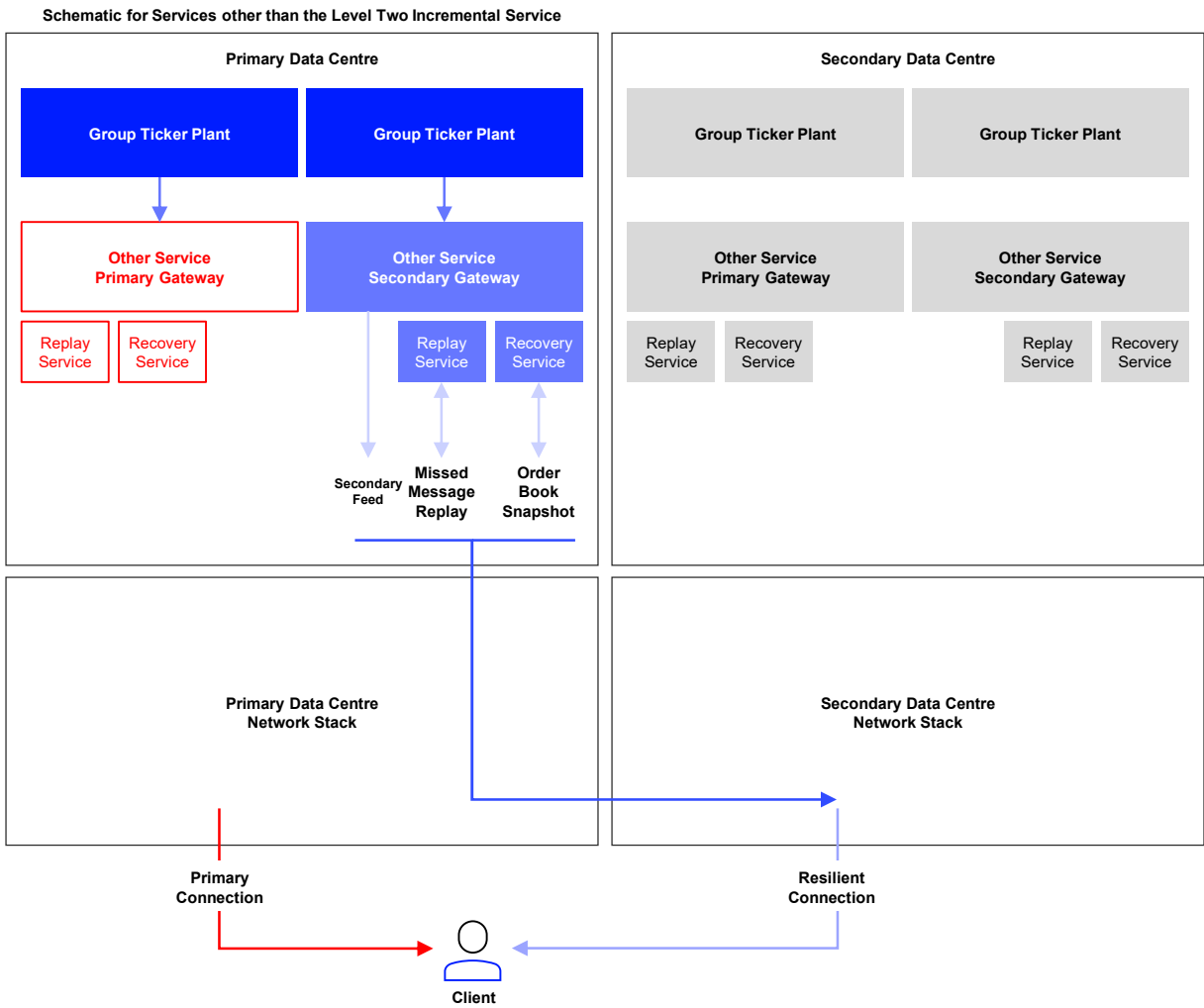


Figure 2b: Schematic of Group Ticker Plant architecture following primary gateway failover– Other Services⁴

⁴ All services other than the Level 2 incremental services for London Stock Exchange and Turquoise

4.3.3 Secondary Gateway failure

Should the secondary market data gateway fail for any reason, clients should continue to process market data as disseminated by the primary market data gateway. The primary market data gateway will not be impacted by the failure of the secondary market data gateway.

After the failure of the secondary market data gateway, the primary and secondary multicast feeds will continue to be published for the Level 2 Incremental services for London Stock Exchange, Turquoise.

Clients will no longer be able to arbitrate between the primary and secondary market data feeds after failure of the secondary market data gateway for all other service lines (i.e., excluding the Level 2 Incremental Services for London Stock Exchange, Turquoise), as the secondary multicast feed will become unavailable.

Dependent upon the nature of the failure, the secondary market data gateway may or may not be reinstated at a later time. Clients should contact the Group for further guidance.

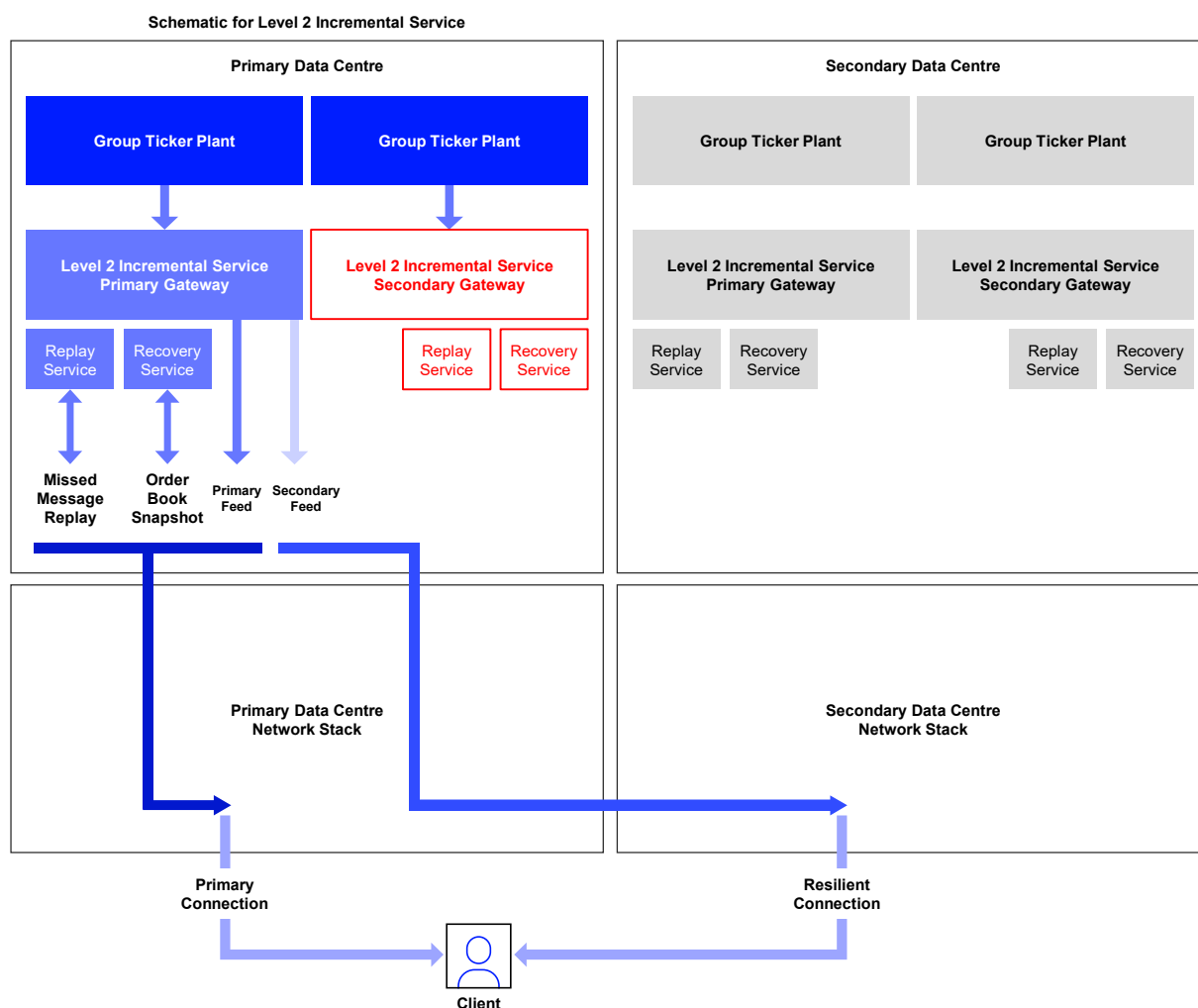


Figure 3a: Schematic of Group Ticker Plant architecture following secondary gateway failure – Level 2 Incremental Service⁵

⁵ Level 2 Incremental Services for London Stock Exchange, Turquoise

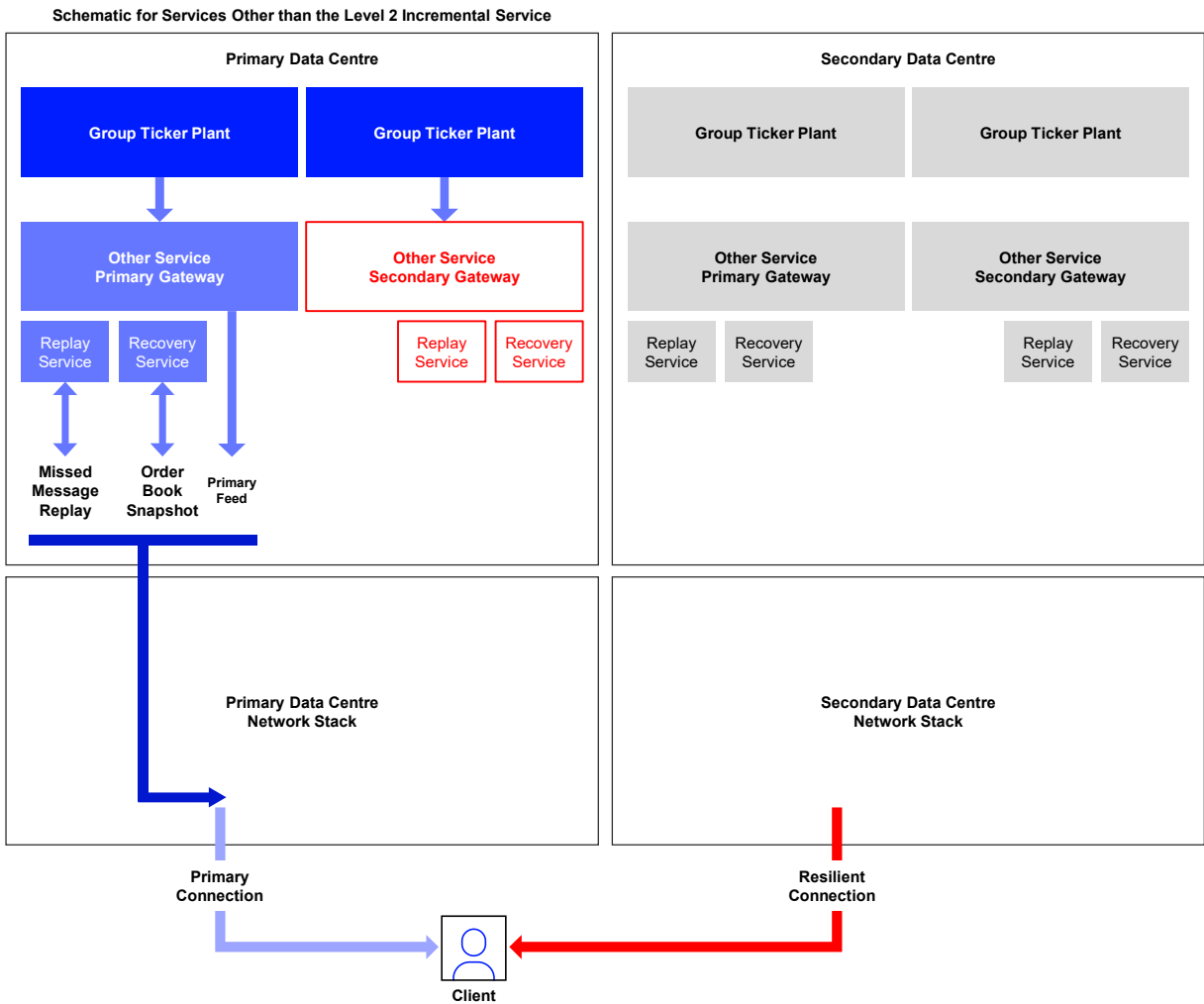


Figure 3b: Schematic of Group Ticker Plant architecture following secondary gateway failure – Other Services⁶

⁶ All services other than the Level 2 Incremental Services for London Stock Exchange, Turquoise

4.3.4 Operation from the Secondary Data Centre

In the event of a disaster causing multiple hardware failures, such that the system at PDC is no longer useable, clients will be notified of the invocation of disaster recovery procedures. GTP gateways at SDC will be activated and all Market Data will be re-published to clients on all channels on start of service from SDC. Whilst Order Books may or may not be cleared at the discretion of LSEG, all trades and other market data will be made available at the SDC.

The process of invoking the GTP system at the secondary data centre involves the following considerations:

- Message sequence numbers will be reset to 1
- When the GTP system at the secondary data centre starts up, it will broadcast an order book snapshot for all instruments configured on the Group Ticker Plant, unless an order book has been emptied during the failover, in which case it will disseminate an Order Book Clear message
- Clients should not use the recovery services unless necessary
- Trades executed, statistics calculated, and instrument status messages sent prior or during failover will be available through the recovery service

The GTP system at SDC is a replica of that at the primary and operates in exactly the same way. The only exception is that, if the PDC has been completely lost, it will not be possible to send the primary feed via the client's primary connection.

When operating from SDC, the Market Data Group will be published in uppercase when the Primary Gateway at SDC is active. This is the same behaviour as can be expected in the PDC.

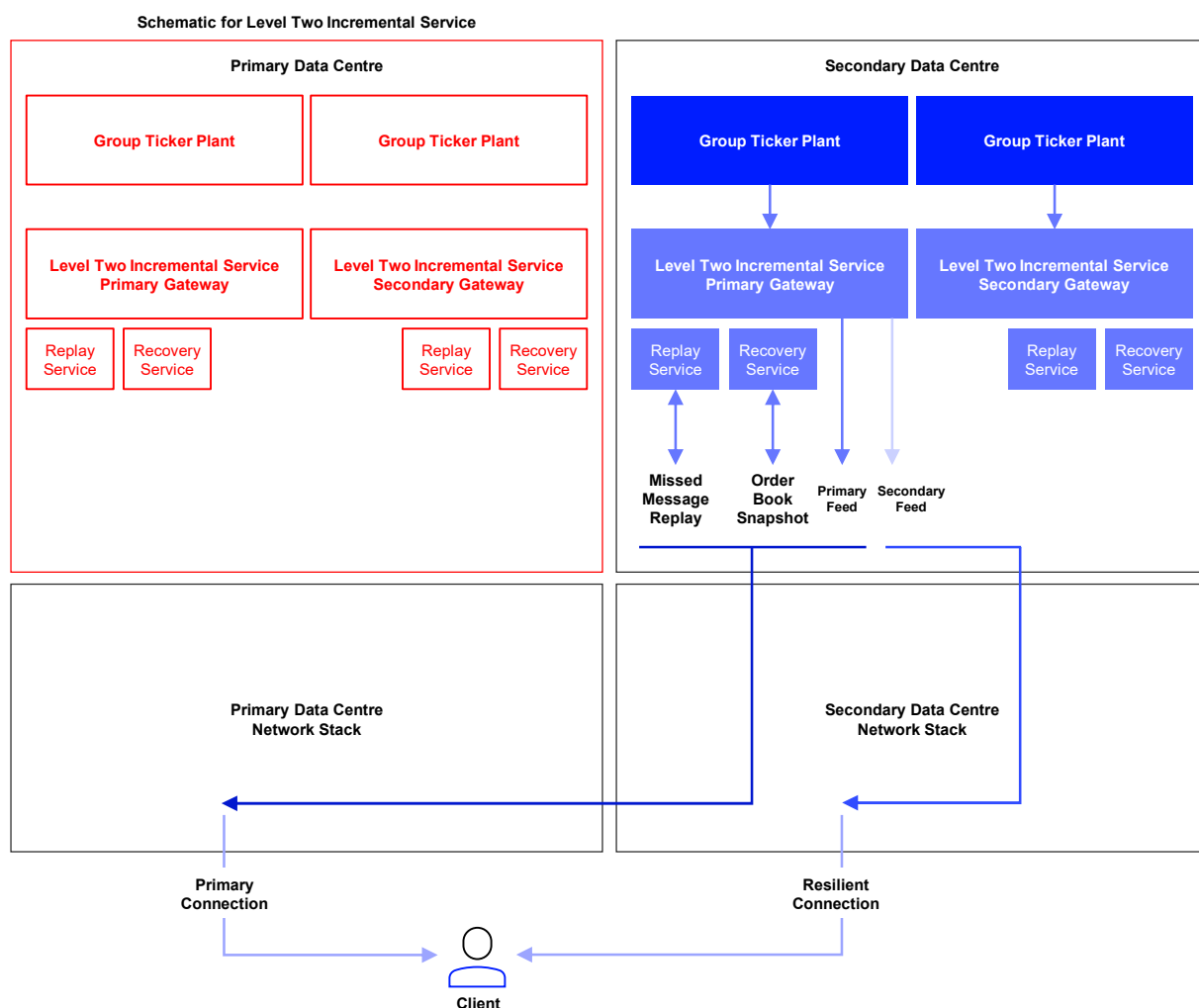


Figure 4a: Schematic of Group Ticker Plant architecture following a failover from the Primary Data Centre to the Secondary Data Centre – Level 2 incremental service⁷
Schematic for Services Other than the Level Two Incremental Service

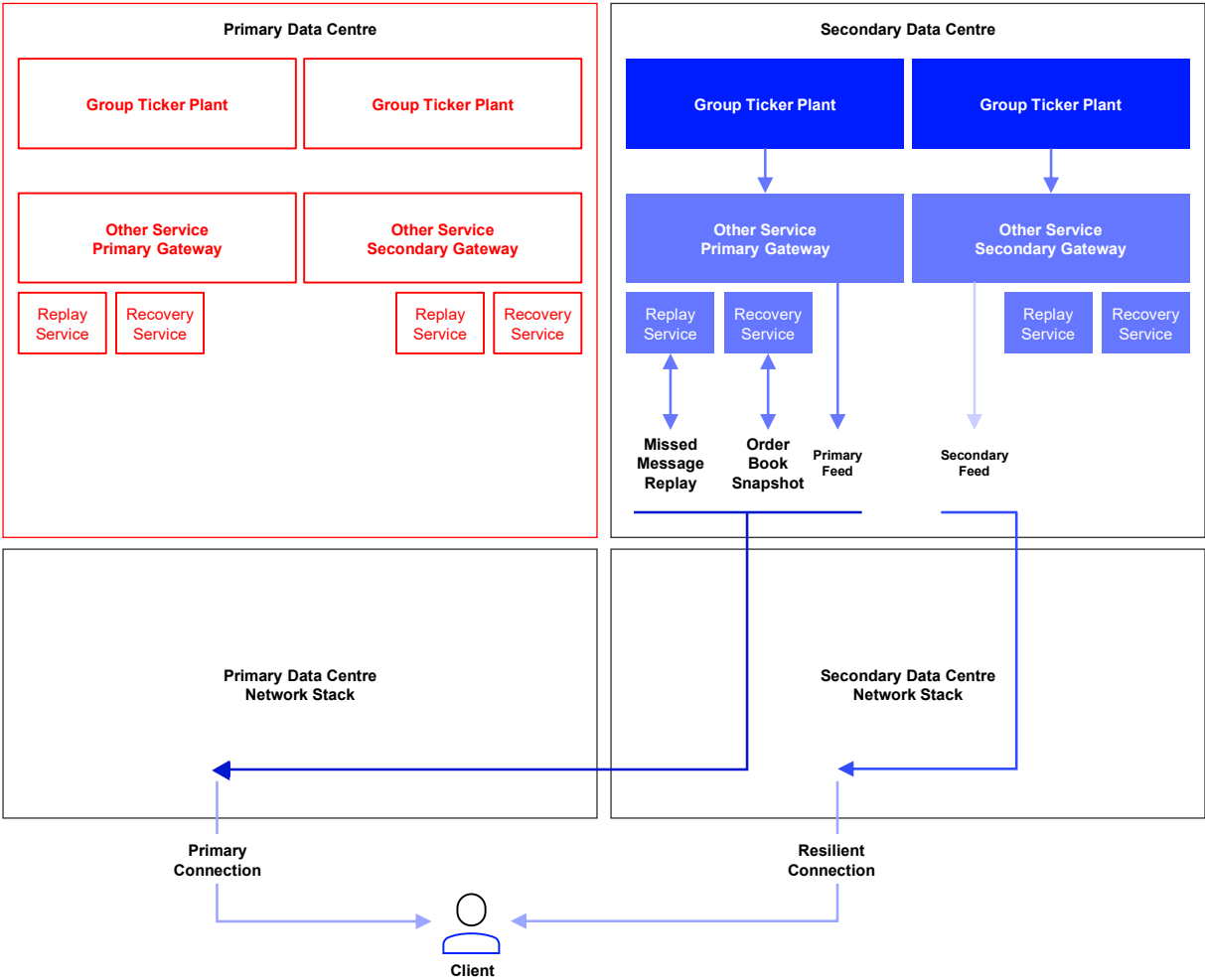


Figure 4b: Schematic of Group Ticker Plant architecture following a failover from the Primary Data Centre to the Secondary Data Centre – Other Services⁸

⁷ Level 2 incremental services for London Stock Exchange and Turquoise
⁸ All services other than the Level 2 incremental services for London Stock Exchange and Turquoise

4.4 Real-time channel

Our real-time channel is the primary mechanism by which market data is published to customers. Market data is published on clients' primary and resilient (secondary) connections to the GTP – the data provisioned on primary connections is always faster than data provisioned on secondary connections.

The market data messages published on client secondary connections are identical to that published on primary connections – this includes consistent sequence numbering which facilitates client arbitration against any message loss. Whilst messages disseminated are identical, the network transport packing algorithm operates independently and UDP packets may therefore contain different message combinations. Clients are strongly advised to ensure all systems are configured to subscribe to both primary and secondary market data feeds.

Instruments are configured on only one real-time channel at any one time. Instruments may change channel inter-day, but do not change real-time channel intra-day. Clients should identify which channel an instrument is assigned to by using the instrument directory messages published each morning.

Each application message disseminated on the real-time channel contains a sequence number. Sequence numbers are reset each trading day to one ('1') and increment by one as each application message is built and subsequently disseminated by the market data gateways.

During periods of inactivity the real-time channels issue Heartbeat messages every two seconds. Receipt of Heartbeat messages should assist clients in maintaining connection to the real-time channels during periods of limited message dissemination.

4.4.1 Throttling

In an improvement versus the existing Millennium Exchange market data products, the Group Ticker Plant supports 'intelligent throttling' to the real-time data multicast channels. Messages deemed non-latency sensitive are packaged in multi-message per UDP packet format and issued to clients. Those messages deemed to be latency sensitive are either packaged in single message per UDP packet and immediately issued to clients or packaged alongside non-latency sensitive messages if this is the quickest route to publication. Full details of messages and classifications can be found in **GTP002 – Technical Guide**.

Intelligent throttling is a further attempt by LSEG to ensure efficient data publication during all periods of trading activity.

4.4.2 Instrument identification

The Group Ticker Plant will introduce a new set of unique instrument identifiers which will exist for the life of the instrument. This identifier – the GTP instrument identifier – should be used by clients in all interactions with the Group Ticker Plant, including replay and recovery services.

The GTP instrument identifier is unique across trading venues. Clients should use the GTP instrument identifier and source venue combination to accurately manage their market data.

Provided in the daily instrument directory messages, the GTP instrument identifier is provided alongside the source market's proprietary identification mechanism, thus allowing clients to map to LSEG information and trading products and to industry standards such as ISIN.

4.4.3 Instrument distribution

The Group Ticker Plant distributes real-time market data over multiple load balanced IP multicast channels. The channels have been carefully configured to ensure clients can subscribe to the required asset classes cleanly, whilst ensuring LSEG architecture is managed to ensure performance, scalability and resiliency.

The table below outlines the distribution of instruments across channels:

Market Data Group when Primary/Secondary gateway is active	Source Venue	Channel Content
A/a	London Stock Exchange	FTSE 100
B/b	London Stock Exchange	ETFs / ETCs / ETNs - 1
C/c	London Stock Exchange	Other Main Market Equity & Miscellaneous
D/d	London Stock Exchange	ETFs / ETCs / ETNs - 2
E/e	London Stock Exchange	AIM
F/f	London Stock Exchange	European
G/g	London Stock Exchange	International
H/h	London Stock Exchange	Fixed Income and Securitised Derivatives
J/j	London Stock Exchange	ETFs / ETCs / ETNs - 3
P/p	London Stock Exchange	Private Securities Market
T/t	Turquoise (TGHL)	XLON, AIMX, XLOM, MTAA
U/u	Turquoise (TGHL)	XNGS, XNMS, XNYS, XSWX, XHEL, XMAD, XSTO, XCSE, XBRU, XDUB, WBAH, XBUD, XOSL, XPRA, XWAR, XAMS, XLIS, XLUX, ALXB, XETR, XPAR, ALXP, ALXL, MTAH, XPRM
V/v	Turquoise Europe (TGHE)	XBRU, XDUB, XBUD, XWAR, XLUX, XETR
W/w	Turquoise Europe (TGHE)	XLIS, ALXB, XPAR, ALXP, ALXL, XSWX
X/x	Turquoise Europe (TGHE)	XCSE, MTAA, XPRA, XAMS, MTAH
Y/y	Turquoise Europe (TGHE)	XHEL, XMAD, XSTO, WBAH, XOSL, XPRM
1/5	TRADEcho	SI quoting
2/6	TRADEcho	Trades
3/7	TRADEcho	SI quoting
4/8	TRADEcho	Trades
L/l	TRADEcho	SI Quoting
M/m	TRADEcho	SI Quoting
N/n	TRADEcho	SI Quoting
O/o	TRADEcho	SI Quoting

** Please note that instruments from the testing group, such as the TSET segment, may not conform to the above distribution guidelines and clients are advised to disregard them*

Whilst each service line is supported by a dedicated multicast channel, the market data group is similar across order book service lines – i.e., the Level One and Level Two snapshot product supporting the FTSE 250 data set both carry the market data group identifier of 'C' and 'c' for primary and secondary connections respectively.

Network topology, including multicast source addresses and port details are available in **GTP004 – Parameters Guide**.

4.5 Recovering from data loss

The Group Ticker Plant market data gateways are built to facilitate client recovery from small- or large-scale data loss through use of either the TCP/IP replay or recovery services. Further detail on these services is included in sections 4.4.1 and 4.4.2 of this document.

In an improvement versus the existing Millennium Exchange Level Two ITCH replay and recovery services, clients are no longer be issued a password for replay or recovery services. Instead, validation is done on Comp ID and incoming IP address combination.

4.5.1 Replay service

Each market data gateway is constructed to include a replay service. In a similar setup to Millennium Exchange, the replay service allows clients to request a finite number of missed application messages. The replay service stores the last 65,000 messages disseminated on the real-time channel, available to clients recovering from a small-scale data loss.

Replay services are only available on the primary market data feed unless a component failure occurs.

For a detailed description of message types recoverable from the replay service, please refer to **GTP002 – Technical Guide**.

4.5.2 Recovery service

Each market data gateway (apart from the Analytics service line) also provisions a recovery service. The recovery channel, in a similar setup to that of the existing Millennium Exchange solution, facilitates client recovery from a large-scale data loss. The recovery service is also available for clients to request additional information that is not available on the real-time multicast channels.

The recovery service permits the requests of:

- A snapshot of the order book for any active or inactive instrument in the market data group. The snapshot is of either the Level Two incremental, MBP, MBO or Level One service line, dependent upon the recovery service targeted by the request
- All trades reported for the trading day (both on and off book), with the exclusion of trade summary messages where available
- A snapshot of an instrument's current statistics
- The current trading status of an instrument
- The full set of reference data for an instrument
- The most recent system event message

For a detailed description of message types recoverable from the recovery service, please refer to **GTP002 – Technical Guide**.

Recovery services are only made available on the primary market data feed unless a component failure occurs.