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## PREFACE

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### PURPOSE

This document provides details of the high availability and business continuity for the Optiq® trading chain components, including features and elements associated to the Order Entry Gateways (OEG) and Market Data Gateway (MDG) for the Exchange's Cash Markets.

This document is a supporting document for other technical specifications made available for Optiq, some of which are listed in the section Associated documents.

### ASSOCIATED DOCUMENTS

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The following list identifies the associated documents, which either should be read in conjunction with this document, or which provide other relevant information to the clients:

- Euronext Cash Markets – Optiq OEG Client Specifications – SBE Interface
- Euronext Cash Markets – Optiq OEG Client Specifications – FIX 5.0 Interface
- Euronext Cash Markets – Optiq TCS Client Specifications – SBE and FIX 5.0 Interface
- Euronext Cash Markets – Optiq Kinematics Specifications
- Euronext Cash Markets – Optiq & TCS Error List
- Euronext Cash Markets – Optiq OEG Connectivity Configuration Specifications
- Euronext Cash and Derivatives Markets – Optiq File Specification
- Euronext Cash and Derivatives Markets – Optiq MDG Client Specifications
- Euronext Cash Markets - OEG Cancel on Disconnect (CoD) Functional Overview

Clients are advised to also refer to the Euronext Rules and Regulations documents for more details.

For the latest version of documentation please visit <http://www.euronext.com/optiq>

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### DOCUMENT & REVISION HISTORY

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For the details of this and previous updates of this document please refer to the [Appendix](#) at the end of this document.

REVISION NO.	DATE	AUTHOR	CHANGE DESCRIPTION
1.2.0	April 2018	Euronext	Third update of the document with further clarifications for Optiq Step 2

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## 1. INTRODUCTION

The Optiq Order Entry Gateway (OEG) provides high-speed and real-time connection to the Exchange markets. This document provides information about the High Availability (HA) and Business Continuity mechanisms for the trading chain implemented in Optiq and details of:

- high availability and business continuity facilities supported by the Optiq trading chain
- features of the trading chain that support client's ability to:
  - manage their sessions in cases of trading chain recovery,
  - resynchronize with the Exchange if required
- recommended practices in different cases of failure

The scope of this version of the document covers high availability and Exchange business continuity for the Cash markets hosted on Optiq.

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### 1.1 GLOSSARY

This section provides a list of some terms & abbreviations commonly used in this document. Please note that some of these terms are described in more details in the dedicated sections within this document or in the associated Optiq specifications documents.

- **Order Entry Gateway (OEG):** is the software that manages the access for exchanges' clients, and acts as the private interface between the clients and the Optiq matching engine.
- **Market Data Gateway (MDG):** is the software that provides high-speed, real-time market data (public messages) for the Exchange's markets.
- **Matching Engine (ME):** is the software that manages the trading services for the Exchange's markets.
- **Optiq Segment:** defines a universe of instruments habitually sharing common trading properties. An Optiq Segment can contain one or several asset classes. An Optiq Segment access is setup through a Logical Access.
- **Partition:** is a technical subdivision of an Optiq Segment. An Optiq Segment may be comprised of at least one or several partitions, physically independent one from another, but connected to each other within the context of the Optiq Segment. Instruments may move from one partition to another within an Optiq segment.
- **Logical Access:** is an OEG (Order Entry Gateway) entry point, setup for clients to connect to a single Optiq Segment, containing the technical configuration for the client's connectivity. Multiple logical accesses can share the same SFTI line. Individual Logical Accesses are required for connection to the OEG and the Drop Copy gateways.
- **OE Session:** the individual physical connection, to a single Partition. A single Logical access may have as many OE sessions as there are partitions in the Optiq segment. The OE sessions connectivity rules are different for the OEG and Drop Copy gateways, for more details please review the *Euronext Cash Markets – Optiq OEG Connectivity Configuration Specifications* document.
- **Secure Financial Transaction Infrastructure (SFTI):** The SFTI Network is a wide area network, which provides clients with domestic and international financial markets connectivity from a single SFTI port.

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## 2. HIGH AVAILABILITY & BUSINESS CONTINITY IN OPTIQ

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### 2.1 MAIN CONCEPTS OF TRADING CHAIN RECOVERY IN OPTIQ

Section below provides high level description of the high availability and business continuity concepts and features in Optiq.

 **Important note:** Clients are strongly urged to review the explanations provided in the various OEG and MDG specification and kinematic documents in detail before continuing with this document.

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#### 2.1.1 High Availability (HA)

In the event of disruptive incident resulting in failure of a partition Optiq trading chain application will switch client system processing from being done on the Primary instance (or node) of this partition to its Mirror instance within the same environment. This is a case of a High Availability (HA) event / failover.

HA event occurring on the Exchange's trading system will at minimum encompass all components of a partition, including the Order Entry Gateway, Matching Engine and Market Data Gateway of that partition. In a segment containing multiple partitions, a single partition may go through an HA event independently from all of the other partitions within the segment.

The same IP address is used for the Primary and Mirror instances of the partition and the Exchange manages the switch between the instances via the recovery mechanism. This means no additional connectivity setup is required for the Primary and Mirror instances making the connectivity aspects of the switch transparent to the clients.

For the Production environment to facilitate the standard Exchange High Availability mechanism Primary and Mirror instances are hosted in a cluster. *(Clients will be provided details of what should be done for HA in the test environment, but concepts used should be similar to what is described in this document.)*

In case of disconnection, messages in throttling queue are dropped as if never received.

Intentional Increment of Sequence Number:

- In some cases when partition Primary instance fails over to the Mirror the message sequence number may be intentionally increments by a pre-defined number. This is being done specifically for cases of disruptive incidents (either HA or Business continuity) to guarantee delivery of full scope of messages for resynchronization and to reduce number of unexpected rejections of client Logon attempts.
- The latest values of this increment are provided in the section "Segment-Wide Configuration Settings" in the *Euronext Cash Markets – Optiq OEG Connectivity Configuration Specifications* document. For Day 1 of Optiq this value is set to 1000 for all trading segments. If any changes are done to this increment clients will be informed ahead of time. To simplify explanation throughout this document the increment used is 1000, however clients should review the Connectivity configuration document to have the most up to date setup.

The partition ID, as well as the Logical Access ID and assigned port remains unchanged between the Primary and Mirror. For MDG multicast groups and ports will not change either.

For MDG: When a market data source restarts and is not able to keep its sequential behaviour, the Market Data Gateway initiates a new start sequence for this source. The Market Data Gateway then sends an order

book retransmission sequence, and a list of corrected trades asynchronously inside the real-time channel used for trades. These messages are flagged as a retransmission (rebroadcast Indicator set to “1”).

In case of an HA event trade retransmission should be used to update the status of each trade that is resent, to complete trades not already taken into account, and even in certain cases, to indicate that some trades should be removed.

Please refer to the section “Book and Trades Retransmission” in the “*Euronext Cash and Derivatives Markets – Optiq MDG Client Specifications*” document for details retransmission of book and trade information.

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### 2.1.2 Business Continuity (DR Environment)

A Business Continuity event occurs when Exchange switches client systems processing from the production environment to its Back-up, or secondary site (DR environment). The DR environment provides redundant standby systems to be used upon the failure of the Exchange Production environment.

A business continuity event occurring on the Exchange’s trading system will encompass a whole market, including all the segments and partitions belonging to that market.

For the Business continuity mechanism data between Production and DR environments is continuously replicated, and the DR environment is online in standby mode.

While the partition ID, Logical Access ID and assigned port remains unchanged between the Production and DR environments, to ensure business continuity the IP addresses between the environments for each partition are different and defined with the rest of the connectivity details.

- Interaction with the throttling mechanism: In case of disconnection, messages in throttling queue are dropped as if never received.
- As mentioned above, in some cases of HA and Business continuity the message sequence number may be intentionally increments by a pre-defined number.

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### 2.1.3 Connectivity Details

Connectivity details, including the IP addresses for private messages, and the dedicated channels for the public messages for all available partitions per segment and environment, are defined in the *Euronext Cash Markets – Optiq OEG Connectivity Configuration Specifications* document, and are provided in the **CashStandingData** (9007) file.

#### Private Messages:

For private messages the connectivity details made available include information for the trading Order Entry gateways, as well as the Drop Copy gateways.

- **High Availability:** In case a disruptive incident, which results in an HA event, the same IP address is used for Primary and Mirror instances of the partition within the same environment. The IP address is set in the field *IPAddressPrimary* of the **CashStandingData** (9007) file and is provided in all environments.
- **Exchange Business Continuity:** For the case of Exchange Business Continuity event and switch of activity to the DR environment every partition has a specified & dedicated IP address. The DR IP address is set

in the field *IPAddressDR* of the **CashStandingData** (9007) file and the values of such IP addresses are provided only in the file produced for the Production environment.

In both cases, the port assigned to the Logical Access created for the client on the Optiq segment in question remains the same.

Clients must ensure that their connectivity to the DR environment is setup to the IP addresses provided in the *Euronext Cash Markets – Optiq OEG Connectivity Configuration Specifications* document, and are provided in the **CashStandingData** (9007) file.

#### Public Messages:

For public messages, standing data contains the IP addresses dedicated to the DR environment. Clients should ensure that all configurations for the DR environment are setup as described in the *Euronext Optiq Market Data Gateway Production or External User Acceptance Environment* document, and ready to use in case of a business continuity event.

The channels for market data are the same for both Production and DR environments, which allows to keep their configuration, and just change the source IP for the switch between the Production and DR environments.

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### 2.1.4 Messages Used for High Availability or Business Continuity

Optiq supports various messages that enable clients to manage their order book, and provide notification via public and private messages of events on the trading engine that impact it. The section below lists a sub-set of the messages that furthermore assist clients to run a smooth and safe recovery.

#### Private messages:

Message Name	SBE Message Code	FIX Message Code	Details
Instrument Synchronization List	50	U50	This message is not sent to Drop Copy
Synchronization Time	51	U51	This message is not sent to Drop Copy
Open Order Request	15	AF	This message is not sent to Drop Copy
Ownership Request	18	U18	While this message is not sent to the Drop Copy, the order acknowledgement messages sent to an OEG in response to this messages are sent to Drop Copy
Ownership Request Ack	17	U29	This message is not sent to Drop Copy

Notes below on the recovery message provide details that are referenced in this document. For full information about structure and behavior of messages clients should rereview the message specifications and kinematics documents.

#### Timestamps to Enable Synchronization

The timestamp that enables synchronization of clients with the OEG is provided in the **Synchronization Time** (51) / (FIX U51) message. The time stamp within the messages is provided with nanosecond granularity, and is the last known valid and stored state of the trading chain events for the *Resynchronization ID* assigned by the exchange to group instruments.

A single partition is setup with multiple different Resynchronization IDs. Synchronization Time messages are issued for each individual Resynchronization ID setup on the partition. Resynchronization ID used in message **Synchronization Time** (51) / (FIX U51) is unique across all partitions of an Optiq segment.

In case of a disrupting incident, using the timestamp provided in this message clients can identify messages sent to and from the OEG that should be discarded as they are not stored by the exchange, and will not be valid.

### Identifying Instruments Assigned to the Resynchronization ID

The first message provided upon client's connection to the OEG at the start of the session, and in case of a re-connection if client sends a Logon with the message sequence number of zero (0) / [one (1) for FIX] is **Instrument Synchronization List** (50) / (FIX U50).

This message contains the mapping between the Resynchronization ID and the instruments to which it is assigned.

A single Resynchronization ID is assigned to multiple instrument + EMM combinations (representing an Order Book) of the partition. A single instrument + EMM combination (an Order book) is always assigned one, and only one, Resynchronization ID.

The Resynchronization ID is assigned to the instruments before the start-up of the system, and may be different from one trading day to another. The mapping between a Resynchronization ID and the instruments assigned to it remain the same for the duration of the trading session, either in case of HA or Business Continuity events.

In case of multiple partitions, in order to determine which partition is sending the **Synchronization Time** (51) / (FIX U51) messages clients may use one of the two following options:

- Option 1: Link the instrument details (symbol index, partition) provided in the **CashStandingData** (9007) file with symbol Index provided in the **Instrument Synchronization List** (50) / (FIX U50) message;
- Option 2: Identify the partition ID that is stored within the Resynchronization ID field, based on the structure of the data, as described below
  - Resynchronization ID is constructed with the unique identifier of the partition included into the value. Partition ID, includes the Optiq Segment id, is up to 3 characters in length, and can be retrieved from the Resynchronization ID field by discarding the last two characters.

#### Example 1:

For segment "Equities" (1), first Partition ID (0), the Resynchronization ID sent: 1001

After the last two characters are discarded, the remaining value of 10 provides the unique partition ID.

#### Example 2:

*Please note: Segment Future Values doesn't currently exist and is provided here only to illustrate the possibility of 3 characters identify the partition.*

For segment "Future Values" (12), second Partition ID (0), the Resynchronization ID sent: 12009

After the last two characters are discarded, the remaining value of 120 provides the unique partition ID.

### Public messages:

MDG uses the following dedicated mechanisms to manage cases of disruptive incidents (HA or DR):

- Book retransmission,
- Trade retransmission, and
- Package flag & counters used in case of disruptive incidents (HA or DR)

Please refer to the dedicated sections for these topics, as well as Gap Detection and System Failures, in the *Euronext Cash and Derivatives Markets – Optiq MDG Client Specifications* document for details of messages and mechanisms used.

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## 2.2 DETECTING EXCHANGE TRADING CHAIN HA EVENT & MITIGATION

Different indicators may identify to clients that an HA event has affected the exchange trading chain partition, and its different states:

### Detecting Failover for Order Entry Gateways (OEG):

- One possible indication is unexpected drop of connection by the OEG.
  - Please note – an unexpected drop in connection may be caused by different events
  - If following this client is not able to reconnect to the OEG and / or no longer receives MDG messages, they should review standard cases of network and connectivity failure, as well as consult the Exchange Market Status page
- Another possible indication is reception of **Reject (07) / (FIX 8)** message from the OEG with status “System Unavailable” (*Error code: 5002*) from the partition.
  - Please note that such a message may be caused by different events, and should be investigated for root cause.
- Reception of the **Synchronization Time (51) / (FIX U51)** messages serves as confirmation of the switch to the Mirror instance.
- In case of a multi-partition segment, reception of the **Synchronization Time (51) / (FIX U51)** messages on one of the partitions may occur without client being disconnected, as it would indicate that an HA even has occurred on one of the other partitions

### Detecting Failover for Market Data Gateways (MDG):

The High Availability (HA) functionality failover to a Mirror for MDG can be identified by

- Period of silence in the real-time and snapshot channels, including lack of heartbeats until the failover to Mirror is completed
- Followed by the change of sequence in the Packet headers (the Packet Sequence Number restarts to “1” and bits between 1 and 3 in the “Packet Flags” field increase by “1”. Keep in mind that these 3 bits can overflow and it will result with a “0” again). In this case the rebroadcast indicator is also set to one (1).

For more details on this topic for MDG, please refer to the *Euronext Cash and Derivatives Markets – Optiq MDG Client Specifications* document.

### Risk Mitigation:

To mitigate the risk of an HA event, upon reception of the Synchronization Time messages client may use one of the following options for resynchronization:

- Follow the automated book resynchronization scenarios described in this document for the OEG;
- Obtain status of individual orders using the **Open Order Request (15) / (FIX AF)** messages;
- Use MDG automatic snapshot & retransmission mechanisms to reconcile data in their system;
  - To ensure full resynchronization of the order book, in conjunction with MDG resynchronization mechanisms, clients must use the recovery mechanisms provided for / by the OEG
- Cancel orders entered during the current trading session in the affected partition;

- Review Market Status page & contact market surveillance for further information

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### 3. RECOVERY & BUSINESS CONTINUITY CASES

This section provides description of the methods of handling of Exchange's trading chain and drop copy infrastructure for cases of:

- High Availability (HA) event, with switch of activity between Primary and Mirror instances of a partition
- Business Continuity event, with switch of activity for the whole market from Production to DR environment

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#### 3.1 HIGH AVAILABILITY (HA) FOR THE TRADING CHAIN

Cases below provide information on which messages are sent out by Optiq and the guidelines for clients on handling the event and associated mechanisms. The goals of the HA process in Optiq are to:

- Ensure the time of the disruptive incident to a minimum via streamlining and automation of the process
- Reduce loss of data to a minimum
- Provide clients with the means to recover in a smooth and automated manner

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##### 3.1.1 General Methodology (Single Partition)

If Exchange experience a disruptive incident resulting in failure of a partition, the scope of the failover to the Mirror instance encompasses all components of that partition, including the OEG, ME and MDG.

The segregation of Exchanges instruments into segments and partitions reduces the risk of unavailability to the subset of instruments hosted on the partition.

For management of disruptive incidents Exchange systems may be handled with two possible scenarios: Standard and Non-Standard.

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##### 3.1.1.1 Standard HA Scenario (Trading Chain)

In case of a standard HA scenario switch between Primary and Mirror instance of a trading chain partition will occur automatically.

In case of Standard HA event the impacted instruments are in state Halted, and order entry is not allowed.

In the unlikely event of a disruptive incident on the trading chain partition that follows a standard HA scenario Exchange expects the Mirror instance to become available for client reconnection within 30 seconds following occurrence of the incident on the Primary instance.

Clients are always informed of any disruptive incidents via the Market Status page.

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##### 3.1.1.2 Non-Standard HA Scenario (Trading Chain)

In case that switch between Primary and Mirror instances of a trading chain partition requires manual intervention, it will be handled via a non-standard HA scenario.

In case of Non-Standard HA event the impacted instruments are in state Halted, and order entry is not allowed.

In the unlikely event of a disruptive incident on the trading chain partition that follows a non-standard HA scenario clients will be provided with details via Market Status, including the expected time of availability of the Mirror, as well as the associated conditions and instructions.

### 3.1.1.3 Steps of the Standard HA Mechanism

- Exchange experiences disruptive incident which affects Primary instance of the partition & Mirror instance takes over the role of Primary instance  
In case of a disruptive incident all instruments of the partitions become effective active on the Mirror instance of the partition.
- Mirror generates **Synchronization Time** (51) / (FIX U51) messages
- Mirror triggers processing of Cancel on Disconnect (COD) mechanism for all messages / instruments hosted on the partition
- Clients reconnect to the Mirror
  - Clients will be able to reconnect transparently, without changing the IP address, port or partition ID to the Mirror instance. All other identifiers, including Symbol Indices of instruments remain the same as well. Order book event data between the Primary and Mirror instances is continuously synchronized to ensure minimum amount of data loss.
- Exchange sends messages facilitating resynchronization after the failover
  - In some cases when partition Primary instance fails over to the Mirror the message sequence number may be intentionally increments by 1000 \*. This is being done specifically for cases of HA to guarantee delivery of full scope of messages for resynchronization and to reduce number of unexpected rejections of client Logon attempts.

(\* Please review more details on the intentional increment value being a parameter in section “2.1.1 High Availability (HA). The latest values of this increment are provided in the section “Segment-Wide Configuration Settings” in the Euronext Cash Markets – Optiq OEG Connectivity Configuration Specifications document.)

- Resending of messages by the trading partition depends on the sequence number identified by the client upon re-connection, which may resend messages that have already been received by the clients. Clients are responsible for managing any duplicates that may occur as a result of resending of messages.
- Interaction with the throttling mechanism: In case of disconnection, messages in throttling queue are dropped as if never received.

The various cases of behavior by the OEG depend on the sequence number sent by the client in the **Logon** (100) / (FIX A) message when reconnecting to the partition, and are described below.

The cases listed below are identified using the following messages and fields.

SBE:

In Message **Logon** (100) field *Last Message Sequence Number* compared to field *Message Sequence Number* from any last messages sent by the OEG to client

	Sent by Client		Compared to by Exchange
Comparison	Field <i>Last Message Sequence Number</i> in <b>Logon</b> (100) message	= < >	Field <i>Message Sequence Number</i> from any last messages sent by the OEG to client

FIX:

In Message **Logon** (A) field *NextExpectedMsgSeqNum* (tag: 789) compared to field *MsgSeqNum* (34) incremented by 1 from any last messages sent by the OEG to client.

Exchange replies the same value provided in the *NextExpectedMsgSeqNum* (789) in the *MsgSeqNum* (34) of the **Logon** (A) messages sent by OEG to the client in case of successful connection.

	Sent by Client		Compared to by Exchange
Comparison	Field <i>NextExpectedMsgSeqNum</i> (tag: 789) in <b>Logon</b> (A) message	= < >	Field <i>MsgSeqNum</i> (34) from any last messages sent by the OEG to client

– Logon that does NOT Trigger a Resend of Messages Generated Before the Disruptive Incident

- ◆ No messages are sent for resynchronization of missed events
- ◆ **Synchronization Time** (51) / (FIX U51) messages are sent, followed by
- ◆ **Kill** (05) / (FIX 8) messages, if any, that were generated by CoD mechanism are sent

– Logon that Triggers Resend of Messages Generated Before the Disruptive Incident

- ◆ Exchange sends out messages associated to the market events that are known to the Exchange. Messages sent start from the number identified in the client’s Logon message ending with the last known message of the session, and the resent FIX messages have the field *PossDupFlag* (43) is set with value **Y** (Possible duplicate)
- ◆ **Synchronization Time** (51) / (FIX U51) messages are sent.  
*Clients are required to manage the rules associated to the time provided in these messages as identified in the guidelines section.*
- ◆ followed by **Kill** (05) / (FIX 8) messages, if any, that were generated by CoD mechanism are sent

– Logon that is Rejected

This case includes the possible intentional increment of message sequence number

- ◆ Exchange sends a rejection [**Logon Reject** (102) / (FIX 5)] message and drops the connection
- ◆ In order to assist clients in managing this case, Optiq provides the following facilities:
  - In SBE, the **Logon Reject** (102) message sent in this case will provide the field *Logon Rejection Code* is set to 3 (Invalid sequence number) and the field *Last Message Sequence Number* is set to the expected value, which is the max value that the client should set in their next logon
  - In FIX, the field *LastMsgSeqNumProcessed* (369), in the **Logout** (5) message, provides the last *MsgSeqNum* value received and processed by the OEG, and can be used as the indication of sequence number that may be used for resynchronization.

– Logon with “start of day” message sequence number

This case follows the normal mechanism used for the trading session start-up, with the message sequence number sent as zero (0) for SBE or one (1) for FIX.

- ◆ **Instrument Synchronization List** (50) / (FIX U50) message is sent, providing mapping between Resynchronization IDs and instruments assigned to them
- ◆ OEG sends out any messages associated to the market events from the start of the trading session, and ending with the last known message of the session
- ◆ **Synchronization Time** (51) / (FIX U51) messages are sent.  
*Clients are required to manage the rules associated to the time provided in these messages as identified in the guidelines section.*
- ◆ followed by **Kill** (05) / (FIX 8) messages, if any, that were generated by CoD mechanism are sent

## Other Messages

- As part of the resynchronization client's OE session will receive TCS messages that were sent during the failover, if any.
- MDG sends out the Snapshot messages, and follows processes defined for HA and start-up
  - Clients have the opportunity to resynchronize their systems with the MDG messages
  - Order and quotes cancelled (killed) by CoD mechanism are not resent via Market Data (MDG).
- Any data that has been received via the Drop Copy accesses is fully stored in Exchange system and was sent to the clearing partners

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### 3.1.1.4 Guidelines for Client Recovery (HA)

In case of a High Availability failover clients are advised to implement conservation measures listed below:

- If client Logon is rejected due to a sequence number sent to OEG being higher than the one known by the OEG, client is advised to discard any messages with the number that is out of range, and re-connect with the sequence number provided in exchange's response. To determine the sequence number provided exchange in response, and expected to be used in the next Logon are as follows:
  - For SBE
    - ◆ In **Logon Reject** (102) message exchange provides a field *Last Message Sequence Number*.  
This is the values expected to be provided by the client in the **Logon** (100) message in the field *Last Message Sequence Number*
  - For FIX
    - ◆ In the **Logout** (5) message exchange provides a field *MsgSeqNum* (34).  
In the next Logon message client should populate this value incremented by one (+1) in the field *NextExpectedMsgSeqNum* (789)
- Following a successful connection to the OEG
  - **Messages Sent to OEG (by client)**
    - ◆ Using standard resynchronization mechanism customer application must be able to detect any gaps in sequence numbers, that would be issued in one of the cases as identified above based on the Logon message. Please refer to the section "Sequence Number Management & Rejection" in the *Euronext Cash Markets – Optiq OEG Client Specifications – FIX 5.0 Interface* document.
    - ◆ Discard any messages sent to OEG that have a message sequence number that is higher than the one replied by the exchange.
  - **Messages Received from the OEG**
    - ◆ Process any messages that may be issued by resynchronization, if the sequence number provided in the Logon is in the case requiring this, and there are events requiring resynchronization.
    - ◆ **IMPORTANT:** Discard any messages received from the OEG before the disruptive incident, in which the *Book IN Time / BookINTime* (tag 21002) is superior to the timestamp provided in the field *Last Book IN Time / LastBookInTime* (tag 20031) of the **Synchronization Time** (51) / (FIX U51) messages for the associated instruments.

Note

While quote related messages may be part of the resynchronization messages, they are assumed to be no longer present in the market

- In this document when it is identified that one timestamp (t1) is superior to another (t2), it must be read that the numerical value of t1 is higher than that of t2, as timestamps are provided in numerical format of nanoseconds since Epoch

For Example:

t1 is the value in the field *Book In Time* in **Ack** (03) / (FIX 8) message. The message is received before the Synchronization Time (51) message, and its value is = 11:22:33.123456789

In SBE this value would be represented as 1516962153000640611

In FIX this value would be represented as 20180126-11:22:33.123456789

t2 is the value in field *Last Book IN Time* in **Synchronization Time** (51) / (FIX U51), and its value is = 11:22:33.000111333

In SBE this value would be represented as 1516962153000346644

In FIX this value would be represented as 20180126-11:22:33.000111333

As such

t1 is **superior** to t2

numerically represented as follows:

In SBE

t1 (1516962153000640611) > t2 (1516962153000346644)

In FIX

t1 (20180126-11:22:33.123456789) > t2 (20180126-11:22:33.000111333)

- ◆ Process cancellations, if any, triggered by the Cancel on Disconnect mechanism
- ◆ Customer applications must be able to identify and discard any duplicate messages / events
- Resynchronize with the MDG messages
- Proceed with trading on the Mirror

### 3.1.1.5 Detecting Duplicates

In case of a High Availability one of the client conservation measures is identification of the duplicate messages. Clients may detect duplicate Outbound messages (sent by the OEG to the client) using the following combination of fields in the messages listed below:

Trading Event	SBE		FIX	
	Message	Fields	Message	Fields
Trade	Fill (04)	- Firm ID - Symbol Index - EMM - Execution ID - Order Side	ExecutionReport (8)	- DeliverToCompID (tag 128) - SecurityID (tag 48) - EMM (tag 20020) - ExecID (tag 17) - Side (tag 54)
Order Creation	Ack (03)	- Firm ID - Symbol Index - EMM - Order ID - Order Side - Ack Type	ExecutionReport (8)	- DeliverToCompID (128) - SecurityID (48) - EMM (20020) - OrderID (37) - Side (54) - OrdStatus (39) - ExecType (150)
Quotes	Quote related messages may be part of the resynchronization messages, but they are assumed to be no longer present in the market			

*Note*

*Order Id / OrderID (31) field is being used for the identification of duplicates, because Client Order ID / CIOrdID (11) field is no longer checked by the exchange for uniqueness.*

---

### 3.1.2 Recovery of a Single, Stand-Alone Partition, in a Mono-Partition Segment

In a segment that is hosted on a single partition, an HA event of the partition means that the whole segment experiences an HA event.

The granularity of that event, as well as all the steps, behavior and messages associated to it, would be the same as described in the section “General Methodology of HA Mechanism (Single Partition)”.

---

### 3.1.3 Recovery of a Single Partition in a Multi-Partition Situation

In a segment that is hosted on multiple partitions an HA event of the partition means that the other partitions within the segment may continue their trading activity.

As partitions are cross-linked (meshed) the partitions that remain active will receive messages resulting from the HA event. While **Synchronization Time** (51) / U51 messages will be sent in all cases to all partitions, messages resulting from CoD will be sent to the cross-linked partitions only if there are orders that are in scope of the mechanism.

The granularity of the event, as well as all the steps, behavior and messages associated to it, would be similar to the one description provided in section “General Methodology of HA Mechanism (Single Partition)”, and the main differences for the case of multi-partition situation are provided below.

#### **Messages upon reconnection to Mirror**

The messages resent by the OEG will be sent to the OE session / partition which owned the order directly before the disconnection. This means that if multiple OE sessions reconnect to multiple failed over partitions, each will receive only messages that it owns, and there should be no duplicate Order or Trade messages sent to this and other OE sessions / partitions.

Behavior of cancellation messages triggered by CoD mechanism in this case is described in the *Euronext Cash Markets - OEG Cancel on Disconnect (CoD) Functional Overview* document. For details clients should review section “Multiple Meshed (cross-linked) partitions & associated cases”.

#### **TCS messages**

TCS unsolicited messages are sent to all partitions in the segment. Upon reconnection to the mirror partition, client’s OE session will receive TCS messages that were already sent to other OE session / partitions during the failover. TCS messages are not in scope of Cancel on Disconnect service.

---

### 3.1.4 Recovery of Multiple Partitions in a Multi-Partition Situation

In a segment that is hosted on multiple partitions an HA event may occur on more than one partition within the segment, however the remaining partitions may continue their trading activity.

As partitions are cross-linked (meshed) the partitions that remain active will receive messages resulting from the HA event. While **Synchronization Time** (51) / U51 messages will be sent in all cases to all partitions, messages resulting from CoD will be sent to the cross-linked partitions only if there are orders that are in scope of the mechanism.

In case all partitions of a segment experience a disruptive incident, the full scope of the segment is impacted, however this will not automatically trigger a business continuity event (i.e. a system will not failover to the DR environment).

In case client sends a correctly technically and functionally formatted message from one of the available partitions, to a partition that is failing over and before its Mirror is available, the OEG of the active partition would send a **Reject (07) / (FIX 8)** message with status “System Unavailable” (*Error code: 5002*).

- Please note that such a message may be caused by different events, and should be investigated for root cause.

The granularity of the event, as well as all the steps, behavior and messages associated to it, would be similar to the one description provided in section “General Methodology of HA Mechanism (Single Partition)”, and the main differences for the case of HA for multiple partitions within a segment are provided below.

### **Messages upon reconnection to Mirror**

As identified above, the Resynchronization ID is unique across the Optiq segment. This ensures that the information provided of the time of last known state by the OEG doesn't contain duplicates, in case of a disruptive incident affective multiple partitions.

Behavior of cancellation messages triggered by CoD mechanism in this case is described in the *Euronext Cash Markets - OEG Cancel on Disconnect (CoD) Functional Overview* document. For details clients should review section “Multiple Meshed (cross-linked) partitions & associated cases”.

### **TCS messages**

TCS unsolicited messages are sent to all partitions in the segment. Upon reconnection to the mirror partition, any OE sessions belonging to a Logical Access enabled to send and receive TCS messages will receive TCS messages that were already sent to the OE session / partitions during the failover. TCS messages are not in scope of Cancel on Disconnect service.

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## **3.2 RECOVERY FOR DROP COPY**

Drop Copy gateways follow recovery and resynchronization processes defined by the FIX protocol. Similarly to the trading OEG, cases of resynchronization of drop copy depend on the message sequence number provided by the client in the Logon message. Section below provides information on drop copy behavior and guidelines to clients for cases of exchange or client recovery.

Please note, as Drop Copy is available in FIX protocol only, only FIX references are provided for messages, fields, and values.

---

### **3.2.1 Recovery Following Drop Copy High Availability Event**

Drop Copy partitions are individual gateways that are not cross-linked between themselves and there is only one DC gateway to which a DC access can connect to. Failure of a the Primary instance of single DC gateway means all DC accesses associated to it can't receive messages targeted for it from other DC gateways until a restarted instance of this DC gateway becomes again available.

In the unlikely event that Drop copy gateway experiences a disruptive incident, and provided that the trading partition which is the source of the messages received by drop copy didn't experience a disruptive

incident, data of all events that occurred will be queued for the DC gateway, and can be resent to the client upon the DC gateway instance availability.

Additionally, any data that has been received as a resend of message via the Drop Copy accesses is fully stored in Exchange system and was sent to the clearing partners.

Clients may detect that the drop copy experienced a disruptive incident when they observe an unexpected drop of connection by the Drop copy gateway.

- Please note that an unexpected drop in connection may be caused by different events
- If following this client is not able to reconnection to the Drop copy gateway they should review standard cases of network and connectivity failure, as well as consult the Exchange Market Status page

In some cases when a DC gateway instance fails, and when the restarted instance becomes available the message sequence number may be intentionally increments by 1000 \*. This is being done specifically for cases of HA to guarantee delivery of full scope of messages for resynchronization and to reduce number of unexpected rejections of client Logon attempts. Clients need to be prepared to manage this intentional increment if and when it occurs.

(\* Please review more details on the intentional increment value being a parameter in section “2.1.1 High Availability (HA). The latest values of this increment are provided in the section “Segment-Wide Configuration Settings” in the Euronext Cash Markets – Optiq OEG Connectivity Configuration Specifications document.)

As for the OEG, resending of messages by the drop copy depends on the sequence number identified by the client upon re-connection, which may resend messages that have already been received by the clients. Clients are responsible for managing any duplicates that may occur as a result of resending of messages.

If the sequence number in client’s message (value of tag *NextExpectedMsgSeqNum* (789) in client’s **Logon** (A) message requires Drop Copy gateway to resend messages then:

- Resent messages will start from the Drop Copy message sequence value sent by client that triggered the resending, and continue until the last known stored message
- Resent messages will have the field *PossDupFlag* (43) is set with value **Y** (Possible duplicate)
- There is no message identifying “end of resending” of missed messages, however any messages that are sent after the last “stored” messages will not have *PossDupFlag* (43); [which is equivalent to *PossDupFlag* (43) being set to **N** (Original transmission (default))]
- As identified above, the sequence number may be intentionally incremented by 1000 \*

(\* Please review more details on the intentional increment value being a parameter in section “2.1.1 High Availability (HA). The latest values of this increment are provided in the section “Segment-Wide Configuration Settings” in the Euronext Cash Markets – Optiq OEG Connectivity Configuration Specifications document.)

- Drop copy doesn’t receive the synchronization messages that are used on the trading OEGs

The different cases of behavior by the Drop Copy gateway follow the standard FIX mechanisms, which depend on the sequence number sent by the client in the **Logon** (A) message when reconnecting to the Drop copy. The cases below mention the comparison to the sequence number of the outbound messages sent by drop copy, but the cases of message sequence number for the inbound messages is handled in the same manner as any other trading OEG.

- Logon that does NOT Trigger a Resend of Messages Generated Before the Disruptive Incident (DC gateway)
    - ◆ No messages are sent for resynchronization
  - Logon that Triggers Resend of Messages Generated Before the Disruptive Incident (DC gateway)
    - ◆ Exchange sends out messages associated to the market events that are known to the drop copy gateway. Messages will be flagged as identified above.
  - Logon that is Rejected (DC gateway)
    - ◆ Exchange sends as a rejection **Logout** (5) message with *SessionStatus* (1409) set to **10** (Received NextExpectedMsgSeqNum(789) is too high) and closes the connection
  - Logon with message sequence number field *NextExpectedMsgSeqNum* (789) equal to one (1) (DC gateway)
    - ◆ DC gateway sends out any messages associated to the market events from the start of the trading session, and ending with the last known message of the session.
- In cases where the resynchronization messages will be sent, they will include the full scope of messages for the current trading session, and for which the DC Logical access is setup (e.g. order, trades, TCS). Messages from previous trading sessions are not queued in Drop Copy.

---

### 3.2.1.1 Timelines for HA (Drop Copy)

In the unlikely event of a disruptive incident Exchange expects the restarted instance of Drop Copy gateway to become available for client reconnection within 5 minutes following occurrence of the incident on the Primary instance. Clients are always informed of any disruptive incidents via the Market Status page.

In case a disruptive incident on Drop Copy is deemed by the Exchange as requiring more time for recovery or further individual actions by Market Operations - clients will be provided with additional details via Market Status with the expected time of availability of the restarted DC gateway instance, as well as the associated conditions and instructions to clients.

---

### 3.2.2 Drop Copy Behavior After Client Disconnection

After resolving the issue that caused the disconnection by the client from the DC gateway, clients may reconnect to the gateway.

The Drop Copy server stores all the messages that it receives throughout the trading day. Therefore it can be used by a Drop Copy client to retrieve any messages that may have been missed while that client was not connected.

Upon client's re-connection to Drop Copy gateway resynchronization of drop copy messages will be handled in the same manner as the recovery of the DC gateway described above. It depends on the sequence numbers submitted by the DC Access in the **Logon** (A) message, and if the message sequence number received requires resending of the missed Drop Copy messages, the DC Access will receive all the missed messages.

As resending of messages by the drop copy depends on the sequence number identified by the client upon re-connection may result in resending of messages that have already been sent by the Exchange, clients are responsible for managing any duplicates that may occur as a result of this resending.

In cases where the resynchronization messages will be sent, they will include the full scope of messages for the current trading session, and for which the DC Logical access is setup (e.g. order, trades, TCS). Messages from previous trading sessions are not queued in Drop Copy gateway.

---

### 3.2.3 Message in Drop Copy After HA Event on a Trading Partition

Messages sent on recovery / resynchronization of clients with the OEG of a trading partition are not sent to the Drop Copy. However, copy of order messages are sent to the Drop Copy if client sends an **Ownership request** (U18) messages to the OEG.

---

## 3.3 RECOVERY AFTER CLIENT'S SYSTEM UNAVAILABILITY OR NETWORK DISCONNECTION FROM OPTIQ

For cases where client's system experiences a disruptive event and become unavailable or disconnects from Optiq the section below identifies functionalities available in the Exchange system to assist client in resynchronizing with the exchange after client's re-connection.

---

### 3.3.1 What Happens on Client Re-Connection

Resynchronization steps in case of client system unavailability are similar to the ones described for HA.

Upon client reconnection to the partition OEG sends information for the cases listed below, that depend on the information provided in the client's **Logon** (100) / (FIX A) message and follow similar behavior as the one described in section "Details of the HA Mechanism".

- Logon that does NOT Trigger a Resend of Messages Generated Before the Disruptive Incident
- Logon that Triggers Resend of Messages Generated Before the Disruptive Incident
- Logon that is Rejected
- Logon with message sequence number zero (0) / [one (1) for FIX], normal mechanism similar to the trading session start-up

---

### 3.3.2 Resynchronization Guidelines for Client Unavailability or Disconnection

After a client reconnects to the trading chain after unavailability of their system, or disconnection from the trading chain that didn't result from a disruptive incident on the Exchange systems, the resynchronization mechanism followed is the same as those described in this document.

The exception being that in such a case Synchronization Time (51) / (FIX 51) messages are not sent.

Client's disconnection will result in triggering of the Cancel on Disconnect mechanism.

### Segment with Multi-partitions

On a segment hosted on multiple partitions, and in the case of disconnection of an OE session, while another remains active, client may choose to continue with their trading activity through the remaining OE session. To receive information on all orders that are still in the book on the partition to which connection was lost, and to ensure receipt of all the unsolicited messages for such orders, clients can send an Ownership Request (18) / (FIX U18) message.

Behavior of cancellation messages triggered by CoD mechanism in this case is described in the *Euronext Cash Markets - OEG Cancel on Disconnect (CoD) Functional Overview* document. For details clients should review section “Multiple Meshed (cross-linked) partitions & associated cases”.

**For MDG:**

As real-time and snapshot market data is available from two different multicast groups in case of client system failure, the backup client system should continue to process the real-time and snapshot data sent by the second multicast group.

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## 3.4 EXCHANGE BUSINESS CONTINUITY

In the specific case of business continuity event affecting the Exchange's primary data center, trading activity would be switched to be done on the DR environment. Section below provides guidelines for the method used in case of Exchange business continuity event.

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### 3.4.1 Business Continuity Event

A Business Continuity event occurs when Exchange switches client systems processing from the production environment to its back-up site (DR environment). The DR environment provides redundant standby systems to be used upon the failure of the Exchange Production environment.

A business continuity event occurring on the Exchange's trading system will encompass a whole market, including all the segments and partitions belonging to that market.

Clients are always informed of any disruptive incidents and events via the Market Status page. Start of use of the DR environment will be after being announced to the clients. Until such an announcement is made clients are not able to connect to the DR gateways (OEG or Drop copy).

The standing data on the DR environment is identical to the one used on the Production environment, and the same files used on EFS are provided for the DR environment as for the Production.

While the partition and DC gateway ID, Logical Access ID and assigned port remains unchanged between the Production and DR environments, to ensure business continuity the IP addresses between the environments for each partition are different and defined with the rest of the connectivity details. Please review section "Connectivity Details" for more information.

In case of business continuity event Exchange trading system restarts in the DR environment with the last known context of trading events from the Production environment.

Overall mechanism of resynchronization is similar to the one described for High Availability events, with the following guidelines:

As identified for the HA events, in some cases when Production instance switches to the DR environment the message sequence number may be intentionally increments by 1000 \*. This is being done specifically to guarantee delivery of full scope of messages for resynchronization and to reduce number of unexpected rejections of client Logon attempts. Clients need to be prepared to manage this intentional increment if and when it occurs.

(\* Please review more details on the intentional increment value being a parameter in section "2.1.1 High Availability (HA). The latest values of this increment are provided in the section "Segment-Wide Configuration Settings" in the Euronext Cash Markets – Optiq OEG Connectivity Configuration Specifications document.)

The Resynchronization IDs for a partition and instruments assigned to them are identical between Production and DR environments, on the same segments and partitions. Clients may reuse the instrument list information obtained at the start of the session provided by message **Instrument Synchronization List (50) / (FIX U50)**, or follow the same processes as for HA event to obtain these messages on the DR environment.

In case of Business Continuity event all segments and partition will be started in the suspended trading state, where all the instruments are halted and order entry is not allowed.
--

As for the OEG, resending of messages by the OEG in the DR environment depends on the sequence number identified by the client upon re-connection, which may resend messages that have already been received by the clients.

As in Production, OEG will send out the **Synchronization Time** (51) / (FIX U51) messages to assist in resynchronization, using the same mechanism as identified elsewhere in this document. Clients are responsible for managing any duplicates that may occur as a result of resending of messages.

In the unlikely event of a business continuity event Exchange expects to be available for client re-connection in the DR environment within 2 hours following occurrence of the incident requiring switch to the DR.

Behavior of cancellation messages triggered by CoD mechanism in this case is the same as described in the *Euronext Cash Markets - OEG Cancel on Disconnect (CoD) Functional Overview* document.

### Public Messages

For public messages, standing data contains the IP addresses dedicated to the DR environment. Clients should ensure that all configurations for the DR environment are setup as described in the *Euronext Optiq Market Data Gateway Production or External User Acceptance Environment* document, and ready to use in case of a business continuity event.

The channels for market data are the same for both Production and DR environments, which allows to keep their configuration, and just change the source IP for the switch between the Production and DR environments.

### Drop Copy in DR Environment

Messages and overall functional mechanisms of Drop Copy in the DR environment will operate in the same manner as in Production.

Upon switch of the activity from the Production to DR environment Drop Copy gateways will become available, when the DR environment is announced as available to clients by the Market operations. Until such an announcement is made, access to the DR environment is possible only for telnet testing on a predefined port.

In DR environment drop copy is made available with a full resynchronization from the start of the session as follows:

- FIX Sequence Number will restart from value 1. Client must reconnect using **Logon** (A) message with fields *MsgSeqNum* (34) set to 1 and *NextExpectedSeqNum* (789) set to 1.
- All Drop Copy messages will be resent, that were persisted for that day's trading session
- The resent Drop Copy messages, and those that start being sent from the re-start of trading on the DR environment are not distinguished by any flag
- The message will be sent without any Gap in sequence numbers, and will not have the same sequence numbers as provided originally in the Production drop copy during that session.
- Resynchronization ID and time messages are not sent for Drop Copy, and are not used for resynchronization processes in DR environment.
- As all Drop Copy messages from start of session will be resent:

- Clients are advised to allocate sufficient time for processing of the messages. This time may vary depending on the amount of data that was processed by the drop copy during that associated trading session
- Clients must ensure that they discard any duplicates in their own systems using the combination of fields present in the messages as listed below

Trading Event	FIX	
	Message	Fields
Trade	ExecutionReport (8)	- DeliverToCompID (tag 128) - SecurityID (tag 48) - EMM (tag 20020) - ExecID (tag 17) - Side (tag 54)
Order Creation	ExecutionReport (8)	- DeliverToCompID (128) - SecurityID (48) - EMM (20020) - OrderID (37) - Side (54) - OrdStatus (39) - ExecType (150)
Quotes	Quote related messages are not in scope of Drop Copy	

*Note*

Order Id / OrderID (31) field is being used for the identification of duplicates, because Client Order ID / CIOrdID (11) field is no longer checked by the exchange for uniqueness.

### 3.4.2 Regularly Scheduled Business Continuity Tests

Regularly scheduled business continuity tests use the Production and DR environments during off-market hours to confirm Exchange’s and client’s ability to handle a Business Continuity event.

These tests are communicated ahead of time, using the standard Exchange communication channels, and are accompanied by

- specific instructions to clients for each individual test event
- dependencies and expected timelines of an even

## 3.5 HANDLING & AUTOMATION FOLLOWING SYNCHRONIZATION TIME (51) / (FIX U51) MESSAGES

### 3.5.1 Rules for handling various cases of message non-synchronization in case of HA or DR event

During re-synchronization processes it is possible that messages may be sent to the client:

- prior to the **Synchronization Time** (51) / (FIX U51) message, and are considered as messages that were generated (and possibly sent) before the disruptive incident. As such they may need to be discarded during the resynchronization process
- after to the **Synchronization Time** (51) / (FIX U51) message, and are considered as messages that are generated and sent after the disruptive incident (i.e. they should not be impacted by the disruptive incident and shouldn’t be discarded)

### 3.5.2 Detecting the case with Synchronization Time messages:

- Reception of the **Synchronization Time** (51) / (FIX U51) messages serves as confirmation of the switch to the Mirror instance, or in case of a Business continuity event, to Disaster Recovery environment. This means a disruptive incident has definitively caused a failover of the Optiq system to the Mirror.

*Please note: While these messages are also sent on re-connection to the Disaster Recovery environment, clients are made aware of switch to DR by other means as the switch to DR requires use of a different set of IP addresses.*

- In case of a multi-partition segment, and only in case of the HA event (switch to the Mirror instance), reception of the **Synchronization Time** (51) / (FIX U51) messages on one of the partitions may occur without client being disconnected, as it would indicate that an HA event has occurred on one of the other partitions

#### In this case clients must:

- Process any Application messages that may be issued by OEG for re-synchronization, as described in this doc (if any)
- **IMPORTANT:** Discard any messages received from the OEG prior to the receipt of the **Synchronization Time** (51) / (FIX U51) message in which the *Book IN Time / BookINTime* (tag 21002) is older (superior to) the timestamp provided in the field *Last Book IN Time / LastBookInTime* (tag 20031) of the **Synchronization Time** (51) / (FIX U51) messages for the associated instruments.
- Process cancellations, if any, triggered by the Cancel on Disconnect mechanism, which are sent after the **Synchronization Time** (51) / (FIX U51) message
- Customer applications must be able to identify and discard any duplicate messages / events, as identified elsewhere in this document
- Process any other “after the incident” messages

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### 3.5.3 Guidelines for Handling of Synchronization Time (51) / (FIX U51) messages

Automation below addresses outbound application messages

- Ack or QuoteAck

If a client previously received an **Ack** (03) / (FIX 8) or **Quote Ack** (09) / (FIX b) message with a *Book In Time / BookINTime* (tag 21002) superior to the *Last Book In Time / LastBookInTime* (tag 20031) in message **Synchronization Time** (51) / (FIX U51), then the Ack notification must be ignored

- The order (or Quote) is NOT present in the order book
- Client may choose to re-send the message

- Fill

Upon the reception of a **Synchronization Time** (51) / (FIX U51) message, if a client previously received a **Fill** (04) / (FIX 8) message with the *Trade Time / TransactTime* (tag 60) superior to the *Last Book In Time / LastBookInTime* (tag 20031) in message **Synchronization Time** (51) / (FIX U51), then

- the trade is considered as it has never happened (i.e. the quantity has not been traded, and the order may still be present in the order book for further execution)
- this **Fill** (04) / (FIX 8) message must be fully reversed in client system

- and the Order is still in the book (i.e. the order quantity of the discarded Fill may still be present in the order book for further execution.)
  - ◆ The order may be subject to Cancel on Disconnect, but until a valid Kill messages for this order is processed (i.e. Kill message that isn't discarded by the resynchronization process), it is still in the book, and can be matched against other orders

#### ■ Kill

If a client previously received a **Kill** (05) / (FIX 8) message with a *Book In Time/ BookINTime* (tag 21002) superior to the *Last Book In Time / LastBookInTime* (tag 20031) in message **Synchronization Time** (51) / (FIX U51), then the Kill notification must be ignored (meaning that the order may still present in the order book for further execution).

- The Order is still in the book
  - ◆ The order may be subject to Cancel on Disconnect, but until a valid Kill messages for this order is processed, it is still in the book, and can be matched against other orders
- Clients should assess if their CoD policy would automatically cancel the order on and if not, then they should re-submit the cancellation of that order

#### ■ Ownership Request Ack

If a client previously sent an **Ownership Request** (18) / (FIX U18) message before receiving **Synchronization Time** (51) / (FIX U51), then client should perform this operation again. Any **Ack** (03) / (FIX 8) messages resulting for the original **Ownership Request** (18) / (FIX U18) message should be processed as described above.

#### ■ Mass Cancel Ack

The instructions below are for clients that are (1) not using Cancel on Disconnect for all their orders and (2) sent **Mass Cancel** (13) / (FIX q) request immediately before the disruptive incident.

- If a client previously received two **Mass Cancel Ack** (14) / (FIX r) messages with the second one having *Total Affected Orders* set to zero (0) - there is no need resend the Mass cancel request upon re-connection
- In all other cases client should re-send the for the **Mass Cancel** (13) / (FIX q) request
- Any **Kill** (05) / (FIX 8) messages resulting for the original **Mass Cancel** (13) / (FIX q) message should be processed as described above.

#### ■ Collar Breach Confirmation

For an order that is rejected when it breaches collars during the incident, and was not yet confirmed such order doesn't enter the book. Depending on when the collar breach occurs relative to the incident clients may observe two behaviors:

- Reception of an **Ack** (03) / (FIX 8) messages, followed by a **Reject** (07) / (FIX 9) message, which still indicates that order never entered the book
- Reception of no messages associated to it upon re-connection, even if it the order would normally be in scope of Cancel on Disconnect

#### ■ Reject

- Rejection of new orders or quotes

If a client previously received a **Reject** (07) / (FIX 9) message for a new order, or **Reject** (07) / (FIX AG) message for a new Quote, with a *Book In Time / BookINTime* (tag 21002) superior to the *Last Book In Time / LastBookInTime* (tag 20031) in message **Synchronization Time** (51) / (FIX U51), then the original message is in the same state, it wasn't processed into the order book

– Rejection of Liquidity Provider Command

Reject of the liquidity provide command is sent via OEG using **Reject (07)** / (FIX Uy) messages. If a client previously received such a messages following submission of a Liquidity Provider command, with a *Book In Time / BookINTime* (tag 21002) superior to the *Last Book In Time / LastBookInTime* (tag 20031) in message **Synchronization Time (51)** / (FIX U51), then the command wasn't processed, and the impacted instrument remains in its state before the Liquidity Provider command message was sent.

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### 3.5.4 OEG messages for which no specific management required

■ Ask For Quote

If a client previously received a **Ask For Quote (33)** / (FIX UL) message with a *Book In Time/ BookINTime* (tag 21002) superior to the *Last Book In Time / LastBookInTime* (tag 20031) in message **Synchronization Time (51)** / (FIX U51), then instrument remains in non-tradeable state, as before the incident.

- In case of a disruptive incident no special additional processing is required for the Ask for Quote messages
- Until the Liquidity Provider is available with quotes on the instrument it will remain in non-tradeable state
- Client should send an **Quotes (8)** (FIX i) message, as for any other instrument on which they are the Liquidity Provider

■ Request For Execution

If a client previously received a **Request for Execution (34)** / (FIX UM) message with a *Book In Time/ BookINTime* (tag 21002) superior to the *Last Book In Time / LastBookInTime* (tag 20031) in message **Synchronization Time (51)** / (FIX U51), then message should be ignored.

- Client should complete the resynchronization of messages to assess if the RFE resulted in a trade or not
- Upon entry of quotes if there is a potential match that occurs after the Mirror is available, client should receive another Request For Execution message

■ User Notification

User Notification (39) / (FIX CB) messages do not require special automated management. If User notification is sent to client to inform them of a suspension, then client will receive this message again, upon attempts to send any additional messages after the failover.

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### 3.5.5 Handling of TCS specific messages

The TCS specific outbound acknowledgement and rejection messages listed below are not managed via the timestamp **Synchronization Time (51)** / (FIX U51).

■ Inbound messages

Any TCS specific inbound messages that did not receive an acknowledgement were not processed, and should be re-sent.

■ Outbound messages

Any TCS specific outbound messages that may have been sent to the client, will be re-sent as part of standard re-synchronization.

## 4. EXAMPLE OF HA MESSAGES & SEQUENCES

Examples below are a sub-set of possible cases that could occur, and cover simple case of a disruptive incident, with Standard HA scenario, affecting trading chain of a segment with a single partition.

For readability purposes, only 1 Resynchronization ID and associated messages are identified in the examples, even though system should have multiple per partition.

### 4.1 LOGON THAT DOES NOT TRIGGER A RESEND OF MESSAGES GENERATED BEFORE THE DISRUPTIVE INCIDENT

#### 4.1.1 Case 1: All messages before the incident are processed and sent. No messages in difference before and after the incident

##### 4.1.1.1 SBE Protocol

#	Received From Client / Inbound	Sent by Exchange / Outbound
1	<p>Prior to disconnection the last messages exchanged are:</p> <p><b>New Order (01) #5</b> &gt; Client Message Sequence Number = 100</p>	<p>&lt; <b>Ack (03)</b> for order #5 Message Sequence Number = 275</p>
2	Exchange experiences disruptive incident on segment: Funds (2) Partitions ID: 20	
3	<p>Client successfully reconnects to the Mirror</p> <p><b>Logon (100)</b> &gt; Last Message Sequence Number = 275</p>	<p>&lt; <b>Logon Ack (101)</b> Last Client Message Sequence Number = 100</p>
4	No messages are sent for resynchronization of missed events. <b>Synchronization Time (51)</b> messages are sent	<p>&lt; <b>Synchronization Time (51)</b> Message Sequence Number = 1276 Resynchronization ID = 0220xxxx Last Book IN Time = 11:22:33.123456789</p>
5	One order (#2) in client's book was submitted during the session, and is set with "default" value for CoD, as such gets cancelled	<p>&lt; <b>Kill (05)</b> for order #2 Message Sequence Number = 1277</p>
6	TCS message sent to client	<p>&lt; <b>Declaration Notice (42)</b> Message Sequence Number = 1278</p>
7	Client discards message for order #5, because value in <i>Book In Time</i> of <b>Ack (03)</b> message for order #5 is <u>superior to the value in <i>Last Book IN Time</i> in <b>Synchronization Time (51)</b> message</u>	
8	Client resynchronizes with MDG identifying no differences	
9	<p>Start trading on Mirror, with first message sent for order #6</p> <p><b>New Order (01) #6</b> &gt; Client Message Sequence Number = 101</p>	<p>&lt; <b>Ack (03)</b> for order #6 Message Sequence Number = 1279</p>

### 4.1.1.2 FIX Protocol

#	Received From Client / Inbound	Sent by Exchange / Outbound
1	<p>Prior to disconnection the last messages exchanged are:</p> <p><b>NewOrderSingle (D) #5</b> &gt;  <i>MsgSeqNum (34) = 100</i></p>	<p>&lt; <b>ExecutionReport (8)</b> to ack order #5  <i>MsgSeqNum (34) = 275</i></p>
2	<p>Exchange experiences disruptive incident on segment: Funds (2) Partitions ID: 20</p>	
3	<p>Client successfully reconnects to the Mirror</p> <p><b>Logon (A)</b> &gt;  <i>MsgSeqNum (34) = 101</i>  <i>NextExpectedMsgSeqNum (789) = 276</i></p>	<p>&lt; <b>Logon (A)</b>  <i>MsgSeqNum (34) = 1276</i>  <i>NextExpectedMsgSeqNum (789) = 102</i></p>
4	<p>No messages are sent for resynchronization of missed events. However, due to intentional increment of sequence number it is required to perform Gap Fill</p>	<p>&lt; <b>SequenceReset (4)</b> (For Gap fill)  <i>MsgSeqNum (34) = 276</i>  <i>NewSeqNo (36) = 1277</i></p>
5	<p><b>SynchronizationTime (U51)</b> messages are sent</p>	<p>&lt; <b>SynchronizationTime (U51)</b>  <i>MsgSeqNum (34) = 1277</i>  <i>ResynchronizationID (20030) = 0220xxxx</i>  <i>LastBookINTime (20031) = 11:22:33.123456789</i></p>
6	<p>One order (#2) in client's book was submitted during the session, and is set with "default" value for CoD, as such gets cancelled</p>	<p>&lt; <b>ExecutionReport (8)</b> to cancel order #2  <i>MsgSeqNum (34) = 1278</i></p>
7	<p>TCS message sent to client</p>	<p>&lt; <b>TradeCaptureReportAck (AR)</b>  <i>MsgSeqNum (34) = 1279</i></p>
8	<p>Client discards message for order #5, because value in <i>BookInTime (21002)</i> of <b>ExecutionReport (8)</b> message to acknowledge order #5 is <u>superior to the</u> value in <i>LastBookINTime (20030)</i> in <b>SynchronizationTime (U51)</b> message</p>	
9	<p>Client resynchronizes with MDG identifying no differences</p>	
10	<p>Start trading on Mirror, with first message sent for order #6</p> <p><b>NewOrderSingle (D) #6</b> &gt;  <i>MsgSeqNum (34) = 102</i></p>	<p>&lt; <b>ExecutionReport (8)</b> to ack order #6  <i>MsgSeqNum (34) = 1280</i></p>

## 4.1.2 Case 2: Some client messages before the incident are missed by the Exchange and some are discarded by client based on Timestamp comparison

### 4.1.2.1 SBE Protocol

#	Received From Client / Inbound	Sent by Exchange / Outbound
1	<p>Prior to disconnection the last messages exchanged are:</p> <p><b>New Order (01) #5</b> &gt; Client Message Sequence Number = <b>100</b></p> <p><b>New Order (01) #6</b> &gt; Client Message Sequence Number = <b>101</b></p>	<p>&lt; <b>Ack (03)</b> for order #5 Message Sequence Number = <b>275</b> Book In Time = <b>11:22:33.123456789</b></p>
2	Exchange experiences disruptive incident on segment: Funds (2) Partitions ID: 20	
3	<p>Client successfully reconnects to the Mirror</p> <p><b>Logon (100)</b> &gt; Last Message Sequence Number = <b>275</b></p>	<p>&lt; <b>Logon Ack (101)</b> Last Client Message Sequence Number = <b>100</b></p>
4	Based on the field <i>Last Client Message Sequence Number</i> in the <b>Logon Ack (101)</b> message, it appears that Exchange missed client message 101 for order #6. Client should wait for <b>Synchronization Time (51)</b> to assess the status of the order	
5	Order #6 was never processed by the Exchange, and no messages are sent for resynchronization of missed events. <b>Synchronization Time (51)</b> messages are sent	
		<p>&lt; <b>Synchronization Time (51)</b> Message Sequence Number = <b>1276</b> Resynchronization ID = 0220xxxx Last Book IN Time = <b>11:22:33.00011333</b></p>
6	No messages have been resent by the exchange before the <b>Synchronization Time (51)</b> message	
7	Client manages stale messages: As the value of <i>Book In Time</i> in <b>Ack (03)</b> message for order #5 is <u>superior to the Last Book IN Time</u> in <b>Synchronization Time (51)</b> message. Client discards this message.	
8	Client manages missed messages: As message 101 for order #6 was not resent, it was never processed by the Exchange. Client can choose to resend, or not, this message.	
8	<p>Start trading on Mirror, with first message sent for order #6</p> <p><b>New Order (01) #6</b> &gt; Client Message Sequence Number = <b>101</b></p>	<p>&lt; <b>Ack (03)</b> for order #6 Message Sequence Number = <b>1277</b></p>

### 4.1.2.2 FIX Protocol

#	Received From Client / Inbound	Sent by Exchange / Outbound
1	<p>Prior to disconnection the last messages exchanged are:</p> <p><b>NewOrderSingle (D) #5</b> &gt;  <i>MsgSeqNum (34) = 100</i></p> <p><b>NewOrderSingle (D) #6</b> &gt;  <i>MsgSeqNum (34) = 101</i></p>	<p>&lt; <b>ExecutionReport (8)</b> to ack order #5  <i>MsgSeqNum (34) = 275</i>  <i>BookInTime (21002) = 11:22:33.123456789</i></p>
2	Exchange experiences disruptive incident on segment: Funds (2) Partitions ID: 20	
3	<p>Client successfully reconnects to the Mirror</p> <p><b>Logon (A)</b> &gt;  <i>MsgSeqNum (34) = 102</i>  <i>NextExpectedMsgSeqNum (789) = 276</i></p>	<p>&lt; <b>Logon (A)</b>  <i>MsgSeqNum (34) = 1276</i>  <i>NextExpectedMsgSeqNum (789) = 101</i></p>
4	<p>Based on the field <i>NextExpectedMsgSeqNum (789)</i> in the Logon from Exchange, it appears that Exchange missed client message 101 for order #6. Client should wait for <b>SynchronizationTime (U51)</b> message to assess status of their orders.</p> <p>It is strongly recommend not to resend the message for order #6. If time constraint does not allow to wait for <b>SynchronizationTime (U51)</b> client should send a <b>SequenceReset (4)</b> for Gap Fill.</p> <p>No messages are sent by the Exchange for resynchronization of missed events. <b>SequenceReset (4)</b> messages are exchanged to fill the gap. Exchange sends the message automatically based by the intentional increment</p>	
	<p><b>SequenceReset (4)</b> for Gap fill &gt;  <i>MsgSeqNum (34) = 101</i>  <i>NewSeqNo (36) = 103</i></p>	<p>&lt; <b>SequenceReset (4)</b> for Gap fill  <i>MsgSeqNum (34) = 276</i>  <i>NewSeqNo (36) = 1277</i></p>
5	<b>SynchronizationTime (U51)</b> messages are sent	<p>&lt; <b>SynchronizationTime (U51)</b>  <i>MsgSeqNum (34) = 1277</i>  <i>ResynchronizationID (20030) = 0220xxxx</i>  <i>LastBookInTime (20031) = 11:22:33.000111333</i></p>
6	No messages have been resent by the exchange before the <b>SynchronizationTime (U51)</b> message	
7	Client manages stale messages: As the value of <i>BookInTime (21002)</i> in <b>ExecutionReport (8)</b> message for order #5 is <u>superior to the</u> <i>LastBookInTime (20031)</i> in <b>SynchronizationTime (U51)</b> message. Client discards this message.	
8	Client manages missed messages: As message 101 for order #6 was not resent, it was never processed by the Exchange. Client can choose to resend, or not, this message.	
10	<p>Client performs other resynchronization steps, and starts trading on Mirror, with first message sent for order #6</p> <p><b>NewOrderSingle (D) #6</b> &gt;  <i>MsgSeqNum (34) = 103</i></p>	<p>&lt; <b>ExecutionReport (8)</b> to ack order #6  <i>MsgSeqNum (34) = 1278</i></p>

## 4.2 LOGON THAT TRIGGERS RESEND OF MESSAGES GENERATED BEFORE THE DISRUPTIVE INCIDENT

### 4.2.1 Case 1: Client messages sent before the incident are sent before the Synchronization Time (51) message. Messages are checked using the Timestamps and some are discarded due to differences

#### 4.2.1.1 SBE Protocol

#	Received From Client / Inbound	Sent by Exchange / Outbound
1	<p>Prior to disconnection the last messages exchanged are:</p> <p><b>New Order (01) #5</b> &gt;  <i>Client Message Sequence Number = 100</i></p>	<p>&lt; <b>Ack (03) for order #5</b>  <i>Message Sequence Number = 275</i></p>
2	Exchange experiences disruptive incident on segment: Funds (2) Partitions ID: 20	
3	<p>Client successfully reconnects to the Mirror, but appears to have missed the Ack of order #5 sent at the moment of disruptive incident</p> <p><b>Logon (100)</b> &gt;  <i>Last Message Sequence Number = 274</i></p>	<p>&lt; <b>Logon Ack (101)</b>  <i>Last Client Message Sequence Number = 100</i></p>
4	Exchange sends out messages associated to the market events that occurred before the incident, but based on the sequence number provided by client appears to be missed, starting from the number identified in the client's Logon message	<p>&lt; <b>Ack (03) for order #5 (Resent for Resynchronization)</b>  <i>Message Sequence Number = 275</i></p>
5	Once sending of messages for resynchronization of missed events is completed <b>Synchronization Time (51)</b> messages are sent	<p>&lt; <b>Synchronization Time (51)</b>  <i>Message Sequence Number = 1276</i>  <i>Resynchronization ID = 0220xxxx</i>  <i>Last Book IN Time = 11:22:33.123456789</i></p>
6	One order (#2) in client's book was submitted during the session, and is set with "default" value for CoD, as such gets cancelled	<p>&lt; <b>Kill (05) for order #2</b>  <i>Message Sequence Number = 1277</i></p>
7	TCS message sent to client	<p>&lt; <b>Declaration Notice (42)</b>  <i>Message Sequence Number = 1278</i></p>
8	Client discards message for order #5, because value in <i>Book In Time</i> of <b>Ack (03)</b> message for order #5 is <u>superior to the</u> value in <i>Last Book IN Time</i> in <b>Synchronization Time (51)</b> message	
9	Client resynchronizes with MDG identifying no differences	
10	<p>Start trading on Mirror, with first message sent for order #6</p> <p><b>New Order (01) #6</b> &gt;  <i>Client Message Sequence Number = 101</i></p>	<p>&lt; <b>Ack (03) for order #6</b>  <i>Message Sequence Number = 1279</i></p>

### 4.2.1.2 FIX Protocol

#	Received From Client / Inbound	Sent by Exchange / Outbound
1	<p>Prior to disconnection the last messages exchanged are:</p> <p><b>NewOrderSingle (D) #5</b> &gt;  <i>MsgSeqNum (34) = 100</i></p>	<p>&lt; <b>ExecutionReport (8)</b> to ack order #5  <i>MsgSeqNum (34) = 275</i></p>
2	Exchange experiences disruptive incident on segment: Funds (2) Partitions ID: 20	
3	<p>Client successfully reconnects to the Mirror, but appears to have missed the Ack of order #5 sent at the moment of disruptive incident</p> <p><b>Logon (A)</b> &gt;  <i>MsgSeqNum (34) = 101</i>  <i>NextExpectedMsgSeqNum (789) = 275</i></p>	<p>&lt; <b>Logon (A)</b>  <i>MsgSeqNum (34) = 1276</i>  <i>NextExpectedMsgSeqNum (789) = 102</i></p>
4	Exchange sends out messages associated to the market events that occurred before the incident, but based on the sequence number provided by client appears to be missed, starting from the number identified in the client's Logon message	<p>&lt; <b>ExecutionReport (8)</b> to ack order #5 (Resent for Resynchronization)  <i>MsgSeqNum (34) = 275</i>  <i>PossDupFlag (43) = Y</i></p>
5	Once sending of messages for re-synchronization of missed events is completed, due to intentional increment of sequence number it is required to perform Gap Fill	<p>&lt; <b>SequenceReset (4)</b> (For Gap fill)  <i>MsgSeqNum (34) = 276</i>  <i>NewSeqNo (36) = 1277</i></p>
6	<b>Synchronization Time (U51)</b> messages are sent	<p>&lt; <b>SynchronizationTime (U51)</b>  <i>MsgSeqNum (34) = 1277</i>  <i>ResynchronizationID (20030) = 0220xxxx</i>  <i>LastBookINTime (20031) = 11:22:33.123456789</i></p>
7	One order (#2) in client's book was submitted during the session, and is set with "default" value for CoD, as such gets cancelled	<p>&lt; <b>ExecutionReport (8)</b> to cancel order #2  <i>MsgSeqNum (34) = 1278</i></p>
8	TCS message sent to client	<p>&lt; <b>TradeCaptureReportAck (AR)</b>  <i>MsgSeqNum (34) = 1279</i></p>
9	Client discards message for order #5, because value in <i>BookInTime (21002)</i> of <b>ExecutionReport (8)</b> message to acknowledge order #5 is <u>superior to the</u> value in <i>LastBookINTime (20030)</i> in <b>SynchronizationTime (U51)</b> message	
10	Client resynchronizes with MDG identifying no differences	
11	<p>Start trading on Mirror, with first message sent for order #6</p> <p><b>NewOrderSingle (D) #6</b> &gt;  <i>MsgSeqNum (34) = 102</i></p>	<p>&lt; <b>ExecutionReport (8)</b> to ack order #6  <i>MsgSeqNum (34) = 1280</i></p>

## 4.2.2 Case 2: Client messages sent before the incident are sent before the Synchronization Time (51) message. Messages are checked using the Timestamps and all are valid

### 4.2.2.1 SBE Protocol

#	Received From Client / Inbound	Sent by Exchange / Outbound
1	<p>Prior to disconnection the last messages exchanged are:</p> <p><b>New Order (01) #5</b> &gt; Client Message Sequence Number = 100</p> <p><b>New Order (01) #6</b> &gt; Client Message Sequence Number = 101</p>	<p>&lt; <b>Ack (03) for order #5</b> Message Sequence Number = 275</p>
2	Exchange experiences disruptive incident on segment: Funds (2) Partitions ID: 20	
3	<p>Client successfully reconnects to the Mirror</p> <p><b>Logon (100)</b> &gt; Last Message Sequence Number = 275</p>	<p>&lt; <b>Logon Ack (101)</b> Last Client Message Sequence Number = 100</p>
4	Based on the value in the field <i>Last Client Message Sequence Number</i> of the <b>Logon Ack (101)</b> message, it appears that Exchange missed client's message 101 for order #6. Client should wait for <b>Synchronization Time (51)</b> message to assess the status of their orders.	
5	Exchange sends out messages associated to the market events occurred before the incident but based on the sequence number provided by client. In this example it is illustrated by ack of message 101 for order #6	<p>&lt; <b>Ack (03) for order #6</b> Message Sequence Number = 1276 Book In Time = 11:22:33.000111333</p>
6	Once sending of messages for re-synchronization of missed events is completed <b>Synchronization Time (51)</b> messages are sent	<p>&lt; <b>Synchronization Time (51)</b> Message Sequence Number = 1277 Resynchronization ID = 0220xxxx Last Book IN Time = 11:22:33.123456789</p>
6	Client compares the data between messages received before <b>Synchronization Time (51)</b> messages to assess the status of their orders. As <i>Book In Time</i> of <b>Ack (03)</b> message for order #6 is <u>superior to the</u> <i>Last Book IN Time</i> in message <b>Synchronization Time (51)</b> no messages have to be discarded	
7	<p>Client performs other resynchronization steps, and starts trading on Mirror, with first message sent for order #7</p> <p><b>New Order (01) #7</b> &gt; Client Message Sequence Number = 102</p>	<p>&lt; <b>Ack (03) for order #7</b> Message Sequence Number = 1278</p>

### 4.2.2.2 FIX Protocol

#	Received From Client / Inbound	Sent by Exchange / Outbound
1	<p>Prior to disconnection the last messages exchanged are:</p> <p><b>NewOrderSingle (D) #5</b> &gt;  <i>MsgSeqNum (34) = 100</i></p> <p><b>NewOrderSingle (D) #6</b> &gt;  <i>MsgSeqNum (34) = 101</i></p>	<p>&lt; <b>ExecutionReport (8)</b> to ack order #5  <i>MsgSeqNum (34) = 275</i></p>
2	Exchange experiences disruptive incident on segment: Funds (2) Partitions ID: 20	
3	<p>Client successfully reconnects to the Mirror</p> <p><b>Logon (A)</b> &gt;  <i>MsgSeqNum (34) = 102</i>  <i>NextExpectedMsgSeqNum (789) = 276</i></p>	<p>&lt; <b>Logon (A)</b>  <i>MsgSeqNum (34) = 1276</i>  <i>NextExpectedMsgSeqNum (789) = 101</i></p>
4	<p>Based on the field <i>NextExpectedMsgSeqNum (789)</i> of the Exchange's Logon, it appears that Exchange missed client message 101 for order #6. Client should wait for <b>SynchronizationTime (U51)</b> message to assess status of their orders. It is strongly recommend not to resend the message for order #6. If time constraint does not allow to wait for <b>SynchronizationTime (U51)</b> client should send a <b>SequenceReset (4)</b> for Gap Fill.</p> <p>Exchange sends <b>SequenceReset (4)</b> to fill the gap caused by the automatic increment and sends out messages associated to the market events occurred before the incident. In this example it includes <b>ExecutionReport (8)</b> of message 101 for order #6</p>	<p>&lt; <b>SequenceReset (4)</b> for Gap Fill  <i>MsgSeqNum (34) = 276</i>  <i>NewSeqNo (36) = 1277</i></p> <p>&lt; <b>ExecutionReport (8)</b> to ack order #6  <i>MsgSeqNum (34) = 1277</i>  <i>BookInTime (21002) = 11:22:33.00011333</i></p>
5	<p>As advised, while awaiting the <b>SynchronizationTime (U51)</b> message client sends <b>SequenceReset (4)</b> message for GapFill</p> <p><b>SequenceReset (4)</b> for Gap Fill &gt;  <i>MsgSeqNum (34) = 101</i>  <i>NewSeqNo (36) = 103</i></p>	
6	<b>SynchronizationTime (U51)</b> messages are sent	<p>&lt; <b>SynchronizationTime (U51)</b>  <i>MsgSeqNum (34) = 1278</i>  <i>ResynchronizationID (20030) = 0220xxxx</i>  <i>LastBookInTime (20031) = 11:22:33.123456789</i></p>
7	Client compares the data between messages received before <b>SynchronizationTime (U51)</b> messages to assess the status of their orders. As <i>BookInTime (21002)</i> of <b>ExecutionReport (8)</b> for order #6 is <u>superior to the</u> <i>LastBookInTime (20031)</i> in message <b>SynchronizationTime (U51)</b> no messages have to be discarded	
8	<p>Client performs other resynchronization steps, and starts trading on Mirror, with first message sent for order #7</p> <p><b>NewOrderSingle (D) #7</b> &gt;  <i>MsgSeqNum (34) = 103</i></p>	<p>&lt; <b>ExecutionReport (8)</b> to ack order #7  <i>MsgSeqNum (34) = 1279</i></p>

### 4.3 LOGON THAT IS REJECTED

Please note that while this case could occur during a disruptive incident, it isn't specific to HA events

#### 4.3.1.1 SBE Protocol

#	Received From Client / Inbound	Sent by Exchange / Outbound
1	<p>Prior to disconnection the last messages exchanged are:</p> <p><b>New Order (01) #5</b> &gt;  <i>Client Message Sequence Number = 100</i></p>	<p>&lt; <b>Ack (03) for order #5</b>  <i>Message Sequence Number = 275</i></p>
2	Exchange experiences disruptive incident on segment: Funds (2) Partitions ID: 20	
3	<p>Client sends a Logon to the Mirror and gets rejected due to inconsistent sequence number</p> <p><b>Logon (100)</b> &gt;  <i>Last Message Sequence Number = 20000</i></p>	<p>&lt; <b>Logon Reject (102)</b>  <i>Logon Reject Code = 3 (Invalid sequence number)</i>  <i>Last Client Messages Sequence Number = 100</i>  <i>Last Message Sequence Number = 1275</i></p>

Connection is not established. Client can use the value provided in the field *Last Message Sequence Number* provided in the **Logon Reject (102)** messages. This is the max value that the client should set in their next logon.

### 4.3.1.2 FIX Protocol

#	Received From Client / Inbound	Sent by Exchange / Outbound
1	<p>Prior to disconnection the last messages exchanged are:</p> <p><b>NewOrderSingle (D) #5</b> &gt;  <i>MsgSeqNum (34) = 100</i></p>	<p>&lt; <b>ExecutionReport (8)</b> to ack order #5  <i>MsgSeqNum (34) = 275</i></p>
2	Exchange experiences disruptive incident on segment: Funds (2) Partitions ID: 20	
3	<p>Client send a Logon to the Mirror and gets rejected due to inconsistent sequence number</p> <p><b>Logon (A)</b> &gt;  <i>MsgSeqNum (34) = 101</i>  <i>NextExpectedMsgSeqNum (789) = 20000</i></p>	<p>&lt; <b>Logout (5)</b>  <i>SessionStatus (1409) = 10</i> (ReceivedNextExpectedMsgSeqNum(789) is too high)  <i>MsgSeqNum (34) = 1275</i>  <i>LastMsgSeqNumProcessed (369) = 100</i></p>

Connection is not established. Client can use the value provided in the field the *MsgSeqNum (34)*. This is the max value that the client should set in the field *NextExpectedMsgSeqNum (789)* for the resynchronization in their next logon.

## 4.4 LOGON WITH “START OF DAY” MESSAGE SEQUENCE NUMBER

### 4.4.1.1 SBE Protocol

#	Received From Client / Inbound	Sent by Exchange / Outbound
1	<p>Prior to disconnection the last messages exchanged are:</p> <p><b>New Order (01) #5</b> &gt;  <i>Client Message Sequence Number = 100</i></p>	<p>&lt; <b>Ack (03) for order #5</b>  <i>Message Sequence Number = 275</i></p>
2	Exchange experiences disruptive incident on segment: Funds (2) Partitions ID: 20	
3	<p>Client successfully reconnects to the Mirror, with the “Start of Day” messages sequence number</p> <p><b>Logon (100)</b> &gt;  <i>Last Message Sequence Number = 0</i></p>	<p>&lt; <b>Logon Ack (101)</b>  <i>Last Client Message Sequence Number = 100</i></p>
4	Exchange resends all messages from the beginning of the day, starting with the <b>Instrument Synchronization List (50)</b> message, which provides mapping between Resynchronization IDs and instruments assigned to them	<p>&lt; <b>Instrument Synchronization List (50)</b> (Resent for Resynchronization)  <i>Message Sequence Number = 1</i>  <i>Resynchronization ID = 0220xxxx</i>  <i>Symbol Index = 1xxxxxxx1</i>  <i>EMM = 1</i>  <i>Symbol Index = 1xxxxxxx2</i>  <i>EMM = 1</i>  <i>Symbol Index = 1xxxxxxx3</i>  <i>EMM = 1</i>  <i>Symbol Index = 1xxxxxxx4</i>  <i>EMM = 1</i></p> <p>&lt; Other messages from start of date till last know message are resent                      They are not indicated for readability purposes</p> <p>&lt; <b>Ack (03) for order #4</b> (Resent for Resynchronization)  <i>Message Sequence Number = 275</i></p>
5	Once sending of messages for resynchronization of missed events is completed <b>Synchronization Time (51)</b> messages are sent	<p>&lt; <b>Synchronization Time (51)</b>  <i>Message Sequence Number = 1275</i>  <i>Resynchronization ID = 0220xxxx</i>  <i>Last Book IN Time = 9786453123</i></p>
6	One order (#2) in client’s book was submitted during the session, and is set with “default” value for CoD, as such gets cancelled	<p>&lt; <b>Kill (05) for order #2</b>  <i>Message Sequence Number = 1276</i></p>
7	TCS message sent to client	<p>&lt; <b>Declaration Notice (42)</b>  <i>Message Sequence Number = 1277</i></p>
8	Client discards message for order #5, because value in <i>Book In Time</i> of <b>Ack (03)</b> message for order #5 is <u>superior to the</u> value in <i>Last Book IN Time</i> in <b>Synchronization Time (51)</b> message	
9	Client performs other resynchronization steps, and starts trading on Mirror, with first message sent for order #6	<p>&lt; <b>Ack (03) for order #6</b>  <i>Message Sequence Number = 1278</i></p>

### 4.4.1.2 FIX Protocol

#	Received From Client / Inbound	Sent by Exchange / Outbound
1	<p>Prior to disconnection the last messages exchanged are:</p> <p><b>NewOrderSingle (D) #5</b> &gt;  <i>MsgSeqNum (34) = 100</i></p>	<p>&lt; <b>ExecutionReport (8)</b> to ack order #5  <i>MsgSeqNum (34) = 275</i></p>
2	Exchange experiences disruptive incident on segment: Funds (2) Partitions ID: 20	
3	<p>Client successfully reconnects to the Mirror, with the “Start of Day” messages sequence number</p> <p><b>Logon (A)</b> &gt;  <i>MsgSeqNum (34) = 101</i>  <i>NextExpectedMsgSeqNum (789) = 1</i></p>	<p>&lt; <b>Logon (A)</b>  <i>MsgSeqNum (34) = 1275</i>  <i>NextExpectedMsgSeqNum (789) = 102</i></p>
4	Exchange resends all messages from the beginning of the day, starting with the <b>Instrument Synchronization List (U50)</b> message, which provides mapping between Resynchronization IDs and instruments assigned to them	<p>&lt; <b>InstrumentSynchronizationList (U50)</b> (Resent for Resynchronization)  <i>MsgSeqNum (34) = 2</i>  <i>PossDupFlag (43) = Y</i>  <i>ResynchronizationID (20030) = 0220xxxx</i>  <i>SecurityID (48) = 1xxxxxxx1</i>  <i>EMM (20020) = 1</i>  <i>SecurityID (48) = 1xxxxxxx2</i>  <i>EMM (20020) = 1</i>  <i>SecurityID (48) = 1xxxxxxx3</i>  <i>EMM (20020) = 1</i>  <i>SecurityID (48) = 1xxxxxxx4</i>  <i>EMM (20020) = 1</i></p> <p>&lt; Other messages from start of date till last know message are resent, which may include SequenceReset for Gap fill  They are not indicated for readability purposes</p> <p>&lt; <b>ExecutionReport (8)</b> to ack order #5 (Resent for Resynchronization)  <i>MsgSeqNum (34) = 275</i>  <i>PossDupFlag (43) = Y</i></p>
5	Once sending of messages for re-synchronization of missed events is completed, due to intentional increment of sequence number it is required to perform Gap Fill	<p>&lt; <b>SequenceReset (4)</b> (For Gap fill)  <i>MsgSeqNum (34) = 275</i>  <i>NewSeqNo (36) = 1276</i></p>
6	Once resending and Gap fill is completed <b>SynchronizationTime (U51)</b> messages are sent	<p>&lt; <b>SynchronizationTime (U51)</b>  <i>MsgSeqNum (34) = 1276</i>  <i>ResynchronizationID (20030) = 0220xxxx</i>  <i>LastBookINTime (20031) = 9786453123</i></p>
7	One order (#2) in client’s book was submitted during the session, and is set with “default” value for CoD, as such gets cancelled	<p>&lt; <b>ExecutionReport (8)</b> to cancel order #2  <i>MsgSeqNum (34) = 1277</i></p>
8	TCS message sent to client	<p>&lt; <b>TradeCaptureReportAck (AR)</b>  <i>MsgSeqNum (34) = 1278</i></p>
9	Client discards message for order #5, because value in <i>BookInTime (21002)</i> of <b>ExecutionReport (8)</b> message to acknowledge order #5 is <u>superior to the</u> value in <i>LastBookINTime (20030)</i> in <b>SynchronizationTime (U51)</b> message	
10	<p>Client performs other resynchronization steps, and starts trading on Mirror, with first message sent for order #6</p> <p><b>NewOrderSingle (D) #6</b> &gt;  <i>MsgSeqNum (34) = 102</i></p>	<p>&lt; <b>ExecutionReport (8)</b> to ack order #6  <i>MsgSeqNum (34) = 1279</i></p>

## APPENDIX A: REVISION HISTORY

### SUMMARY OF CHANGES

Version	Change Description
1.2.0	<p>Additional clarifications of document for Optiq Phase 2, including the following changes:</p> <ul style="list-style-type: none"> <li>• In section “2.1.4 Messages Used for High Availability or Business Continuity” corrected reference to the Partition 121 changed to 120</li> <li>• Clarified behavior in MDG in section “2.2 Detecting Exchange Trading Chain HA Event &amp; Mitigation”</li> <li>• Modified section “3.1.1.1 Standard HA Scenario (Trading Chain)” to identify that in case of an HA event trading chain will start Halted with order entry set to not allowed, and provided clarification in section</li> <li>• In section “3.1.1.4 Guidelines for Client Recovery (HA)” corrected <ul style="list-style-type: none"> <li>○ “since the beginning of the day” to “since Epoch”</li> <li>○ values used in the example for time</li> </ul> </li> <li>• Added clarification for messages in multi-partition segment in section “3.1.4 Recovery of Multiple Partitions in a Multi-Partition Situation”</li> <li>• Adjusted name of section 3.5.1 to “Rules for handling various cases of message non-synchronization in case of HA or DR event”</li> <li>• In section “3.5.3 Guidelines for Handling of Synchronization Time (51) / (FIX U51) messages” corrected description for management of Collar breach confirmation</li> </ul>
1.1.0	<p>Clarifications of document for Optiq Phase 2, including the following changes:</p> <ul style="list-style-type: none"> <li>• Added section “3.5 - Handling &amp; Automation Following Synchronization Time (51) / (FIX U51) Messages”</li> <li>• Replaced reference of “older” to superior to</li> <li>• Removed section “Work in Progress”</li> <li>• Updated Examples with clarification that messages Received From Client are Inbound, and messages sent by Exchange / Outbound</li> </ul>
1.0.0	First Release for Optiq Phase 2 (Cash markets migration to Optiq)

### DOCUMENT HISTORY

REVISION NO.	DATE	AUTHOR	CHANGE DESCRIPTION
1.2.0	April 2018	Euronext	Third update of the document with further clarifications for Optiq Step 2
1.1.0	March 2018	Euronext	Second version for Optiq Phase 2 including clarifications of document for previously provided and identified messages and mechanisms.
1.0.0	February 2018	Euronext	First Release for Optiq Phase 2 (Cash markets migration to Optiq)