Guide to New Trading System

Oslo Børs cash equities, derivatives and fixed income markets

10 MARCH 2020

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IMPORTANT NOTE

This document has been produced by Oslo Børs to assist customers in the use of the Optiq® platform on the Oslo Børs market places. Part of the documentation is based on documentation from Euronext. For more details, please see references in the appendix.

If you have any general queries relating to this document, please email:

oslomigration@euronext.com

or as a backup the following email adresses will also be monitored:

technicalsupport@oslobors.no

clientsupport@euronext.com

Further copies of this document can also be downloaded from the Oslo Børs website
https://www.oslobors.no/ob_eng/Oslo-Boers/Trading/Delta/Optiq

Or on the Oslo Project page on Connect:

https://www.euronext.com/optiq

DISCLAIMER

This document has been prepared on the basis of the best information available. Oslo Børs has taken reasonable efforts to ensure that the information in this publication is correct at the time of publication, but shall not be liable for decisions made in reliance on it. Oslo Børs will seek to provide notice to customers of changes being made to this document, but this notice cannot be guaranteed. Therefore, please note that this publication may be updated at any time. The information contained is therefore for guidance only. This document does not form part of the contractual documentation between the Oslo Børs and its customers.

CHANGE LOG

This document can be updated at any time, and has been through the following iterations:

Issue	Date	Description
3.0	10 March 2020	Initial document release for the Optiq® migration.

Please note that only the latest issue of this document will be available from the Oslo Børs website. Details of the changes made in each issue of the document are described in the appendix.

1   INTRODUCTION

Following the acquisition of Oslo Børs VPS ASA by Euronext in June 2019, Oslo Børs is planning to migrate from the current trading system delivered by the London Stock Exchange Group, to Optiq® the Euronext in-house developed trading system. As a part of Euronext, Oslo Børs aims to strengthen its competitive position by migrating to this new technology, and is pleased to offer customers a trading system of the highest standard that offers all the functions one might expect from a state-of-the-art trading platform.

1.1 PURPOSE

The purpose of this document is to give an overview of the services provided for the Oslo Børs equities, derivatives and fixed income markets on the Optiq® platform and related Euronext systems.

1.2 READERSHIP

This document describes how to connect to the Optiq® platform, and aims to give the reader an understanding of the various interfaces provided. The emphasis is put on the changes impacting existing Oslo Børs customers, comparing today's functionality with the functionality available on Optiq® and related Euronext systems.

Messages from any of the interfaces are highlighted in **bold text** in this document. Fields within messages are indicated by use of *italic* letters. References to other documents in the series are indicated by use of _underlined italic_ letters.

1.3 DOCUMENT SERIES

This document is a part of a series of documents providing a holistic view of full trading and information services available from Oslo Børs post the migration to the Optiq® platform and related Euronext systems.

The current series of documents are outlined below, please note that the documents will be updated as the migration project progresses, in which case a notification will be given using the usual channels:

Saturn Specifications and background documentation

- Euronext Global Reporting Solution - Saturn Interface User Guide
- Euronext Saturn Web Services Specifications
- OBOE – Euronext Off-Book On-Exchange trades publication - Market Model overview

- Saturn example of OBOE upload file
- Short Long Code Management (SLC Manager)

Optiq® Order Entry Gateway (OEG) Technical Documentation
- Euronext Markets – Optiq® OEG Client Specifications - SBE Interface
  - ♦ Template name : OEG_BINARY_SBE_INPUT_<version>: Sample version: 300
- Euronext Markets – Optiq® OEG Client Specifications - FIX 5.0 Interface
- Euronext Markets – Optiq® & TCS Error List
- Euronext Markets - Optiq® Drop Copy Service
- Euronext Markets - Optiq® OEG Connectivity Specifications
  - ♦ Document includes notes on Throttling and High Availability/Business Continuity
- Self-Trade Prevention Functional Overview

Cash Market Documentation
- Euronext Cash Markets – Optiq® Kinematics Specifications

Derivatives Market Documentation
- Euronext Derivatives: How the Market Works
- Euronext Derivatives Markets – Optiq® Kinematics Specifications

Market Data Gateway (MDG) & File Technical Documentation
- Euronext Markets – Optiq® MDG Client Specifications
  - ♦ Template file name: MDG_BINARY_SBE_INPUT_<version>: Sample version: 300
- Euronext Markets – Optiq® File Specifications
- Euronext Optiq® Market Data Gateway Production Environment
- Euronext Optiq® Market Data Gateway External User Acceptance Environment

The latest version of the documentation series can be found on:

https://connect2.euronext.com/en/it-documentation (sign-in required)

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2 CUSTOMER COMMUNICATIONS

From the beginning of the migration project, our intention is to communicate both following the Euronext standards as used in previous Euronext projects, as well as using the Oslo Børs standard from previous Oslo Børs projects.
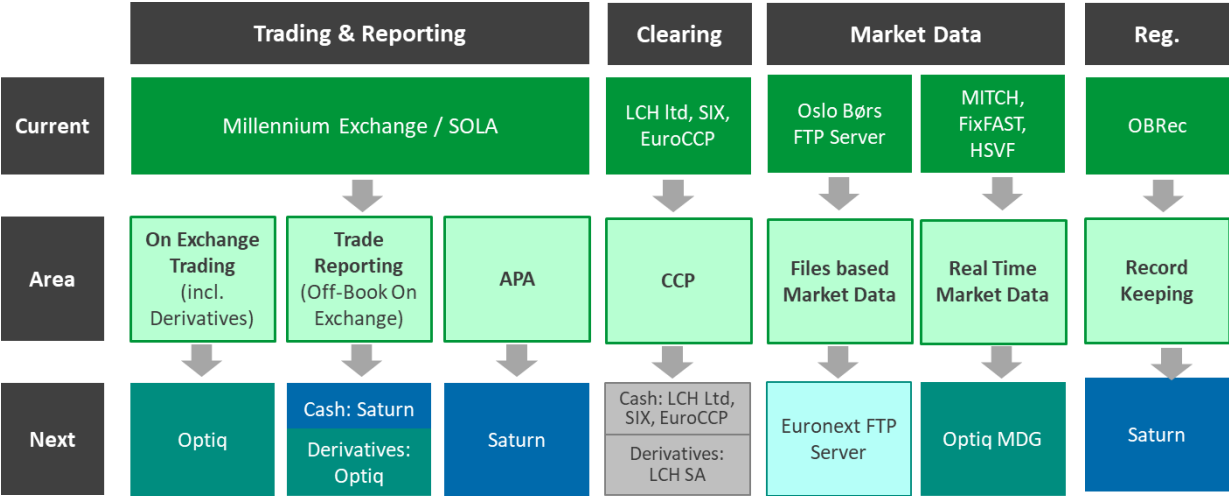
On the Euronext side, project related announcements will be published via the Euronext Customer Portal (https://connect2.euronext.com/) as Info Flashes, and will be emailed to customers having subscribed to 'Exchange Info-flashes'. Additionally, a dedicated Oslo Migration page will be set up, found here https://www.euronext.com/optiq. Also, operational notices will be issued from time to time, informing the customers about new releases, bug fixes etc.

On the Oslo Børs side, this means that we will publish any project related announcements on our Delta web-site (https://www.oslobors.no/ob_eng/Oslo-Boers/Trading/Delta) as well as via email to the recipients that has registered to receive the Delta announcements.

The intention is that once the initial migration is completed, then subsequent projects will use the Euronext model for customer communications.

3 HIGH LEVEL SCOPE FOR THE OSLO BØRS MIGRATION PROJECT

At a high level the migration of Oslo Børs to Optiq® and other relevant Euronext Systems can be depicted as follows:

	Trading & Reporting			Clearing	Market Data		Reg.
Current	Millennium Exchange / SOLA			LCH ltd, SIX, EuroCCP	Oslo Børs FTP Server	MITCH, FixFAST, HSVF	OBRec
Area	On Exchange Trading (incl. Derivatives)	Trade Reporting (Off-Book On Exchange)	APA	CCP	Files based Market Data	Real Time Market Data	Record Keeping
Next	Optiq	Cash: Saturn / Derivatives: Optiq	Saturn	Cash: LCH Ltd, SIX, EuroCCP / Derivatives: LCH SA	Euronext FTP Server	Optiq MDG	Saturn

All products listed / available for trading on both Millennium Exchange and SOLA will be available also after the migration to Optiq®, with the exception of the Forwards and Tailor-made contracts in the derivatives market, and the reported OTC derivatives trades currently reported via Edge.

Optiq® and other relevant Euronext systems will be located in the Euronext data centres, with the primary data centre in Basildon, whereas the secondary datacentre is near Paris. This means that the connectivity infrastructure for all Oslo Børs customers will change, which is described in more detail in section 5 Enablement later in this document.

4 INTERFACES

4.1 TRADING

Similarly to Millennium Exchange and SOLA, Optiq® offers a binary and a FIX based API for trading activities.

The binary API is provided by the Optiq® Order Entry Gateway (OEG) and is called the SBE Interface, named so from using the Simple Binary Encoding (SBE) Mechanism a market standard developed by the FIX Trading Community.

The FIX API is also provided by the Optiq® Order Entry Gateway (OEG) and is unsurprisingly called the FIX interface.

The two interfaces cover largely the same functionality, with specific market maker functionality for the Derivatives market only being available on SBE.

4.2 MARKET DATA

As a part of the migration the number of market data protocols will be reduced from 3 to 1, with all market data being disseminated using the Optiq® MDG protocol, which also utilizes the SBE mechanism.

The Optiq® MDG protocol is multicast based, with an A and B stream similarly to what users of e.g. the MITCH protocol is accustomed to. The recovery mechanisms in the Optiq® MDG protocol is different to what the users of MITCH are accustomed to, in that there is only one recovery mechanism that is based on Multicast.

Market Data from Optiq® will be provided in different channels, similarly to the current situation from Oslo Børs, but the Trade Only multicast channels will no longer be supported.

The majority of Market Data channels will be shared with the other Euronext markets, while some new ones will be dedicated to the Oslo Børs markets.

The Channel Types and Channel ID's that are available to each customer depend on the available bandwidth on customer connections to the SFTI® Network and the services that were selected in the SFTI® order form. Depending on the Asset Class, the following Optiq MDG channel types are made available to customers:

1. Pre-trade

      a. BBBO – Best Bid and Offer

      b. FBMU – Full Book using Market Update message (includes Best Bid and Best Offer)

      c. FBOU – Full Book using Order Update message (includes Best Bid and Best Offer)

2. Post Trade – REFT – Reference Data and Full Trade Information

3. Indices – REFI – Reference Data and Index messages

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Please read chapter 2.1 TYPE OF MARKET DATA CHANNELS of the *Euronext Markets – Optiq MDG Client Specifications* for more details.

4.3 REFERENCE DATA

Similarly to the current solutions provided by Oslo Børs, a subset of the referential data will be provided through selected Market data channels, while the more complete set of referential data will be provided through files. Please note that while today, the reference data files are available in the evening, the reference data files provided by Optiq® will be available early in the morning for the trading day in question. Also note that a single set of reference data files per Euronext segment (Equities, Fixed Income, Warrants and certificates, ETFs, Equity Derivatives and Index Derivatives) will be produced, covering all the Euronext markets, including Oslo Børs.

See the *Euronext Markets – Optiq File specifications* document for details.

4.4 TRADE REPORTING / APA

Trade Reporting for Cash, including Fixed Income, both Off-Book On Exchange (OBOE) or via the Euronext APA, will be done through the Euronext Saturn solution. Similarly as for Equity Trade Reporting today in Millennium Exchange, one of the parties in the trade will report the trade, while both parties will receive a confirmation from Saturn. To send the confirmation message to the party not reporting the trade, is a customisation of Saturn introduced with the Oslo Børs migration project, and might not be available in the test environment from day 1 of the testing period.

The reported trades will published through Market Data Gateway (MDG), the OBOE trades will be published on the same channel as the lit order book (also called the Central Order Book (COB)), while the APA trades will be published on a dedicated channel.

See the *Euronext Saturn Web Services Specifications* documents for further details.

For Derivatives trade reporting will be done through the wholesales facility, supporting Large-In-Scale trades only, please see *Euronext Derivatives: How the Market Works* for details.

4.5 RECORD KEEPING

The Oslo Børs Record Keeping service will be discontinued following the migration of the Oslo Børs markets to Optiq® and other relevant Euronext Systems, and will be replaced by the SLC Manager (a part of the Saturn solution) as currently used by Euronext. See *Short Long Code Management (SLC Manager)* for further details.

4.6 NON REAL-TIME MARKET DATA

The current Non real-time market data products will migrate to the corresponding Euronext advanced data services products and infrastructure. Current customers of these products will be contacted by Euronext during the migration project, and will be given a guidance on how their needs will be covered by the advanced data services products. Customers can also contact products@oslobors.no for further details.

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5 ENABLEMENT

5.1 CONNECTIVITY PROVIDERS / OPTIONS

Optiq® and the other relevant Euronext systems will be hosted in the Basildon datacentre as well as a datacentre near Paris, meaning that the connectivity infrastructure will have to change, depending on the location of the datacentres used by the customers.

For customers based in Oslo/Norway, FNN will continue to provide the services from the Oslo Børs markets as today.

For customers based in the rest of Scandinavia, it is / will be possible to connect to SFTI via their POP in the Lunda datacentre. It is at this stage (as per 10.03.2020) not likely that VFN will continue to provide access to the Oslo Børs markets as today.

Customers outside the Scandinavian region should connect to the Oslo Børs markets via SFTI. The key contact from SFTI is Rupesh Patel which can be reached on Tel: +44 203 142 0848, Mob: +44 7930 322 260 or email rupesh.patel@theice.com.

5.2 OPTIQ® SET-UP

Euronext's connectivity model improves performance and stability by offering order entry sessions through logical accesses which connect to dedicated partitions in individual Optiq® segments.

EXAMPLE: DIAGRAM OF ORDER ENTRY SESSIONS, PARTITIONS AND SEGMENTS ON EQUITIES AND FUNDS:
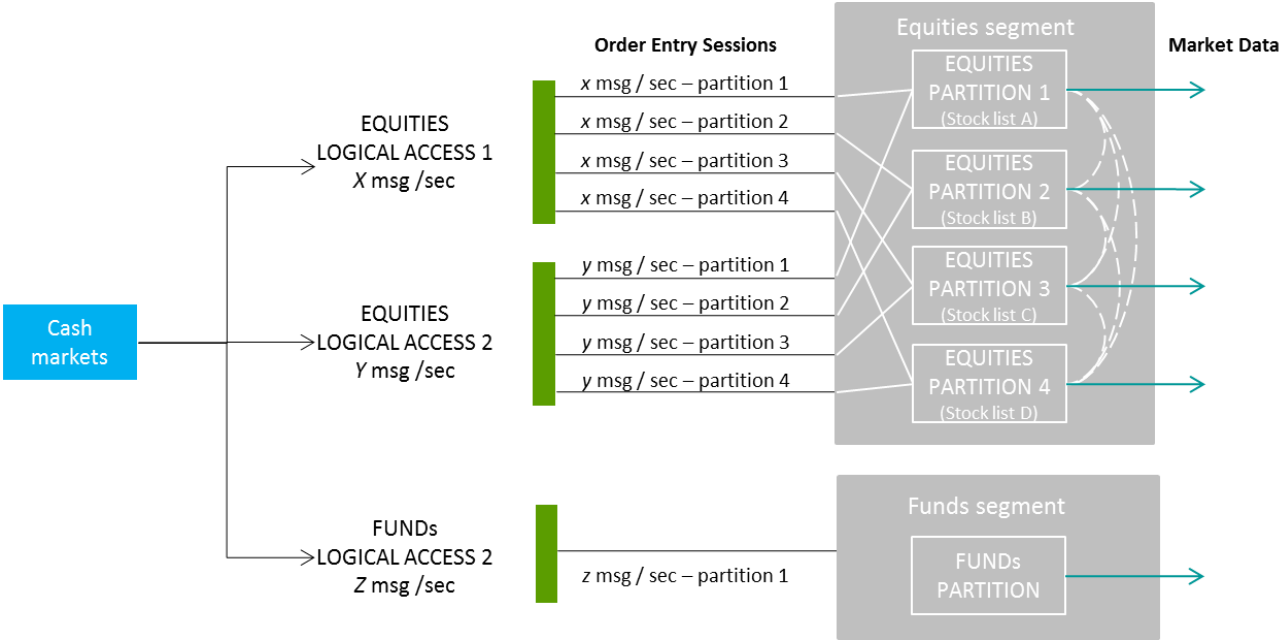
In Optiq® segments with multiple partitions, it is also possible to use a single Order Entry Session towards all partitions, also called the mesh set-up, but do note that such cross-partition access will incur additional response times, and is not available for the market makers in the derivatives market. For further details see the *Euronext Markets - Optiq® OEG Client Specifications – SBE Interface* or *Euronext Markets - Optiq® OEG Client Specifications – FIX Interface* documents.

High reliability, significantly increased throughput and latency performance with minimal standard deviation, improved flexibility in delivery of new functionalities and products, shorter time to market as well as the improved resiliency will be ensured within Optiq® in part by the introduction of the new instrument segmentation through Optiq® Segment.

More details are available in the current version of _Euronext Markets – Optiq OEG Connectivity Specifications_ document.

5.3 SATURN SET-UP

Trade Reporting for Cash, including Fixed Income, both Off-Book On Exchange (OBOE) or via the Euronext APA, will be done through the Euronext Saturn solution , a Web Service protected by authentication and authorisation mechanisms. To access the service, a client is required to log on to the system. The web service agents and the passwords are managed by the Saturn application.

In addition, Saturn will use certificate based mutual authentication that refers to two parties authenticating each other through verifying the provided digital certificate so that both parties are assured of the other others' identity.

The Saturn solution offers a web interface, REST API and a file upload feature supporting csv files, accessible via internet. Euronext is in the process of rolling out a FIX and/or JSON based API for selected Saturn services.

For further information, see _Euronext Global Reporting Solution – Saturn web_ services.

5.4 MARKET DATA CHANNELS

As the recovery mechanism for the Optiq® market data channels is multicast based, there is no need to set up dedicated sessions towards the market data channels. As today, an enablement at the network level is necessary, to ensure that the market data channels the user have subscribed to is delivered to the clients infrastructure.

6 FUNCTIONAL CHANGES

This section outlines the main functional changes from the Millennium Exchange to the Optiq® platform. It is divided in a common section applicable to the equities, derivatives and fixed income asset classes, and separate sections for each.

Moving to Optiq® and other relevant Euronext systems, means that Oslo Børs members are a part of the Euronext single liquidity pool.

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6.1 COMMON FOR ALL ASSET CLASSES

6.1.1 NEW FUNCTIONALITY

6.1.1.1 STOP LOSS/MARKET/QUOTES ORDERS

Unlike today, with the migration to Optiq®, Oslo Børs will support Stop Limit, Stop Market and Stop On Quote orders. See the _Trading Manual for the Optiq Trading PLatform_ for details.

6.1.2 CHANGED FUNCTIONALITY

6.1.2.1 TICKERS / MNEMONIC

For the equities instruments, the current Symbol/Ticker will be replaced by the field **Mnemonic** in Optiq® MDG. The maximum length of the mnemonic field is 5 characters, which is less than what is currently available in the Symbol/Ticker field in Millennium Exchange. Additionally, the mnemonic field must be unique across all the Euronext markets.

For the equities, indices and ETF instruments, some Tickers/Symbols will change due to these limitations. For Fixed Income instruments, the current tickers/symbols will be provided in the field "Product Designation" in Optiq® MDG. For ETN, Warrants and Derivatives instruments the naming convention will change, which will be further documented at a later stage in the migration project.

6.1.2.2 MESSAGE THROTTLING

Optiq® support two models of message throttling, one similar to the throttling mechanism in Millennium Exchange, where orders are rejected when the limit is breached. The other model only available in Optiq® allow some buffering in the system, allowing activity for up to one second to be stored in a queue, which will then be processed as soon as possible while observing the throttle limit for that session.

See _Euronext Markets - Optiq OEG Connectivity Specifications_ for further details.

6.1.2.3 CANCEL ON DISCONNECT/LOG OFF

In Optiq® if an order should be cancelled on Disconnect/Log Off is handled at the individual order level and the orders behave the same way in the case of a disconnect or a log off, unlike the set-up in Millennium exchange where it is configured at the CompID level, and then the user can opt out on individual orders.

For further information see _Euronext Markets - Optiq OEG Connectivity_ Specifications.

6.1.2.4 SELF-EXECUTION PREVENTION (SEP) / SELF TRADE PREVENTION (STP)

In Optiq® Self Execution prevention is available for certain types of activity and is called Self Trade Prevention (STP). In the equities market it is available for liquidity providers, whereas in the derivatives market it is available for liquidity providers as well as for activity where account type is house.

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As today, the users can decide if the incoming or resting order should be cancelled, depending on the setting on the incoming order.

For further information see *Euronext Markets – Optiq Self-Trade Prevention (STP)*

6.1.2.5 MARKET ORDER BEHAVIOUR

Unlike in Millennium Exchange, Market orders in the Cash market on Optiq® can be entered both during the call and continuous trading phases. In the event that an order is matching against market orders only on the other side of the book, the price is determined as the best price of the following:

- The last traded price (or the reference price if the instrument is not traded yet that day)
- The best limit price on the market order side
- The incoming order price (if the incoming order has a limit price)

The best price is the higher price if the incoming order is a sell order and the lowest price if the incoming order is a buy order.

In the Derivatives market on Optiq® Market orders cannot rest in the order book, and hence is not permitted during the call trading phases. For further details see *Euronext Derivatives: How the Market Works.*

6.1.2.6 MICRO AUCTION

The current market maker protection model in Millennium Exchange called Micro Auctions, will be replaced by Euronext model, where the market maker will be given a short time period to adjust the quotes in the event of a potential match. If the market makers does nothing, the match will take place after a short delay.

For further details see: *Euronext Cash Markets – Structured Product (incl. Warrants &Certificates and Structured Notes) Hybrid Market Model (aka Request For Execution Market Model)*

6.1.2.7 ICEBERG ORDERS

In the cash market, iceberg orders behave largely the same way in Optiq® as today in Millennium Exchange, with the notable difference that when the hidden portion of multiple iceberg orders are matched, the volume is not pro-rated in Optiq®, but rather Optiq® simulates the entire matching sequence, and then aggregates the resulting trades.

Iceberg orders are not available in the derivatives market on Optiq®.

6.1.2.8 ORDER EXPIRATION MESSAGES

Optiq® will publish execution reports indicating the expiry of DAY orders prior to shutting down the system in the evening. For GTD and GTC orders, the execution reports indicating their expiry will be published early morning on the day following the orders expiration. However, as Optiq® will be up and running on selected public holidays in Norway even though the market is closed, the expiration messages can be sent on a public holiday in Norway.

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6.1.3 DISCONTINUED FUNCTIONALITY

6.1.3.1 GOOD TILL TIME AND PASSIVE ONLY ORDERS

'Good Till Time' (GTT) and Passive only orders are not available on Optiq®.

6.1.3.2 PRICE BANDS

The price band mechanism rejecting orders more that 50% off the static reference price is not available on Optiq®.

6.2 ASSET CLASS EQUITIES

6.2.1 NEW FUNCTIONALITY

6.2.1.1 BEST OF BOOK (BOB)

Euronext's Best of Book service helps retail brokers meet MiFID best execution requirements within a single platform for all liquid stocks traded across Euronext, saving brokers the need to connect to multiple platforms. Euronext is also looking to extend this service to the ETFs as well.

It is achieved by dedicated liquidity providers that offers process improvements for the retail flow. The service is Simple, Impartial, Safe and Transparent.

See https://euconsumer.euronext.com/en/best-of-book for further information on the service.

6.2.1.2 PREFERENCING

The current solution for preferencing will be replaced by the Euronext Internal Matching System (IMS). As today, IMS can be used even if the users also uses self-execution prevention.

For further information see _Euronext Markets – Optiq Self-Trade Prevention (STP)_.

6.2.2 CHANGED FUNCTIONALITY

6.2.2.1 ETN/ETFS AND WARRANTS TRADING SCHEDULE

The trading schedule for ETN/ETFs and Warrants listed at Oslo Børs will remain unchanged with two minor exceptions. First order entry prior to the opening auction that currently starts at 08:15 CET, will after the migration to Optiq® start at 07:15 CET, secondly the opening auction uncross will take place at 09:05, as opposed to currently sometime between 09:00:00 and 09:00:30.

6.2.3 DISCONTINUED FUNCTIONALITY

6.2.3.1 NORTH SEA AND OSLO BØRS LIT AUCTIONS

The Oslo Børs North Sea dark pool (MIC codes: XOSD, XOAD) and the Oslo Børs Lit Auctions (Periodic Batch Auction) (MIC codes: XOSA, XOAA) will be discontinued when Oslo Børs migrate to Optiq® and related Euronext systems.

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6.2.3.2 PEGGED /RESERVE ORDERS

Currently Pegged and reserve orders are not activated on Optiq®. The functionality is available, and can be activated at a later stage if it attracts sufficient customer demand. For a description of the Pegged / reserve Order functionality see *Large in Scale Features on the Central Order Book - Overview* for further details.

6.3 ASSET CLASS DERIVATIVES

6.3.1 NEW FUNCTIONALITY

6.3.1.1 OPENING AUCTION

When migrating to Optiq®, Oslo Børs will introduce an Opening Auction in the derivatives instruments occurring at 09:01, ensuring that the opening auction of the underlying instrument is executed prior to the opening auction for the derivatives instruments.

6.3.1.2 CASH SETTLED SINGLE-STOCK FUTURES

At the time of migration to Optiq® or shortly thereafter, Oslo Børs will introduce cash settled single-stock futures in the Norwegian market when migrating to Optiq®, in addition to the physically settled futures.

6.3.1.3 EURONEXT RISKGUARD

Euronext RiskGuard (ERG) aims to provide Risk Managers at Clearing Member firms and Trading Member firms with the ability to set pre-trade risk controls in order to manage their customers' or trading firm's risk exposure in real-time. It complements the Members' and Clearing Members' own pre-trade risk management systems already in place, see *Euronext Derivatives: How the Market Works* for details.

6.3.1.4 TRADING SAFEGUARDS

To protect market participants from temporary disorderly price fluctuations, all orders and quotes upon entry are checked by the Exchange to ensure that their price is within acceptable limits, or **Collars**. See *Euronext Derivatives: How the Market Works* for details.

6.3.2 CHANGED FUNCTIONALITY

6.3.2.1 MARKET MAKER PROTECTION

The Market Maker Protection functionality implemented in Optiq® is aimed at preventing too many simultaneous trade executions on quotes provided by a Market Maker, offering additional control of the market risk. Also note that the Market Maker (**Quotes (08)** message) functionality is only available in the SBE Order Entry interface.

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Functionally, this is very similar to the Market Maker functionality currently available in SOLA, but the implementation is naturally different. See *Euronext Derivatives: How the Market Works* and *Euronext Markets – Optiq® OEG Client Specifications - SBE Interface* for details.

6.3.2.2 MIC CODE

When migrating to Optiq® and other relevant Euronext systems, the Oslo Børs derivatives market will change the MIC code to: XOBD.

6.3.3   DISCONTINUED FUNCTIONALITY

Tailor Made contracts currently reported through EDGE and Forward contracts currently traded on SOLA, will be discontinued when the market is migrated to Optiq®. Furthermore the possibility to use deferred publication for large reported trades will be discontinued, as well as the iceberg order type.

6.4 ASSET CLASS FIXED INCOME

The future market model for the Oslo Børs Fixed income market is currently being reviewed with the involvement of the current Oslo Børs members, but has not been finalised at the time of the publication of this document. The changes between the current market model and the future market model will be included in subsequent versions of this document.

7   SITE FAILOVER/DISASTER RECOVERY

In the unlikely event that a site failover is needed, the process in Optiq® is different from the current process in Millennium Exchange. In Optiq®, when the system start on the secondary site, the trading will resume from when the issue occurred, with both active orders and trades being available on the secondary site. As today, the start of the Oslo Børs market will be managed in a way allowing the participants to validate the status of their orders and trades prior to commencing the trading.

For further details see: *Euronext Markets - Optiq OEG Connectivity Specifications.*

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