Eurex Exchange’s T7

Functional Reference

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1. Introduction

Eurex Exchange's T7 is the new trading architecture developed by Deutsche Börse Group. It is a multi exchange trading system that is used by the following exchanges for derivatives trading:

- Eurex
- EEX European Energy Exchange

Eurex Exchange's T7 offers a wide range of derivatives trading functionality. It is highly configurable and can be adapted to the needs of the individual markets, on any level, from the entire market down to individual instrument groups.

On the technical side, Eurex Exchange's T7 provides an outstanding level of reliability and availability, and at the same time it is characterized by a high throughput capacity and by low latency.

Eurex Exchange's T7 is a pure trading system. Trades executed on this platform are forwarded to the clearing and settlement systems.

1.1 Content of this document

This document provides a detailed description of the business functionality that is available in Eurex Exchange's T7. It especially focuses on the following:

- Market structure
- Trading states
- Order and quote handling
- Matching and trade management
- Complex instruments

The document is targeted at everyone that needs detailed information on the business functionality that is implemented in Eurex Exchange's T7. It is targeted especially at traders that need detailed information on the processing on the exchange side, but also, for example, at designers of advanced trading front end applications.

There is no information in this document on participant and user maintenance. For more information on this topic please refer to the *Participant and User Maintenance Manual.*

Since Eurex Exchange's T7 is a trading system without any clearing and settlement functionality, this document does not contain any information on clearing and settlement.

This document focuses on the business logic. For detailed information on how to communicate with the system, please refer to the documentation on GUIs, trading interfaces, data interfaces and reports.

1.2 Usage Notes

This document describes the available business logic as implemented in the system. Not every business functionality is available for all products or even markets. Set up information which is related to specific exchanges or products has been added to various places to inform readers of specific configurations that impact the availability of specific functionalities.

Even though care has been taken to represent the actual configuration settings at the time of publication, these configuration settings are subject to change. Especially the values of the

configuration parameters given in various examples throughout this document, they should not be taken as actual values for these parameters.

Depending on the parameter, the actual values of the configuration parameters can be found in one of the following places

- In the contract specifications as published by the exchange,
- In the reference data stream of the T7 system,
- In the Product and Instrument Files available on the Eurex website:
    - For Production*:* *www.eurexchange.com* > *Technology* > *Eurex Exchange's T7* > *Documents* > *Products and instruments*,
    - For Simulation: *www.eurexchange.com* > *Technology* > *Eurex Exchange's T7* > *System documentation* and click on the relevant release and then on Simulation

1.3 Further reading

The following documents on Eurex Exchange's T7 provide additional information to complement the information that is contained in this document:

- *Functional and Interface Overview*
- *Participant and User Maintenance – Manual*
- *Eurex Trader and Admin GUI – User Manual*
- *Eurex Enhanced Trading Interface – Manual*
- *Eurex Market and Reference Data Interfaces – Manual*
- *Eurex Extended Market Data Service – Manual*
- *Eurex Enhanced Order Book Interface – Manual*

These and other documents providing information on Eurex Exchange's T7 can be found on the web site of Eurex by navigating to the topic *Technology* > *Eurex Exchange's T7* > *System Documentation* and then clicking on the relevant release 3.0:

http://www.eurexchange.com/exchange-en/technology/t7/system-documentation/release-30/

2. Fundamental Concepts

This chapter introduces the fundamental concepts that define the structure of the markets and their participants in Eurex Exchange's T7.

2.1 Participant Structure

2.1.1 Overview

The participant hierarchy in T7 has three levels:

1. The member firm is called a Participant.
2. Different units in a member firm, e.g. trading desks that trade independently from each other, are called Business Units.
3. A business unit has one or more Users, that represent individual people, typically traders, and each business unit has one or more Sessions. A Session is a permanently registered connection channel to the exchange. Any request that is sent to the exchange, e.g. the entry of an order, is always sent by a logged-on user through a connected session.

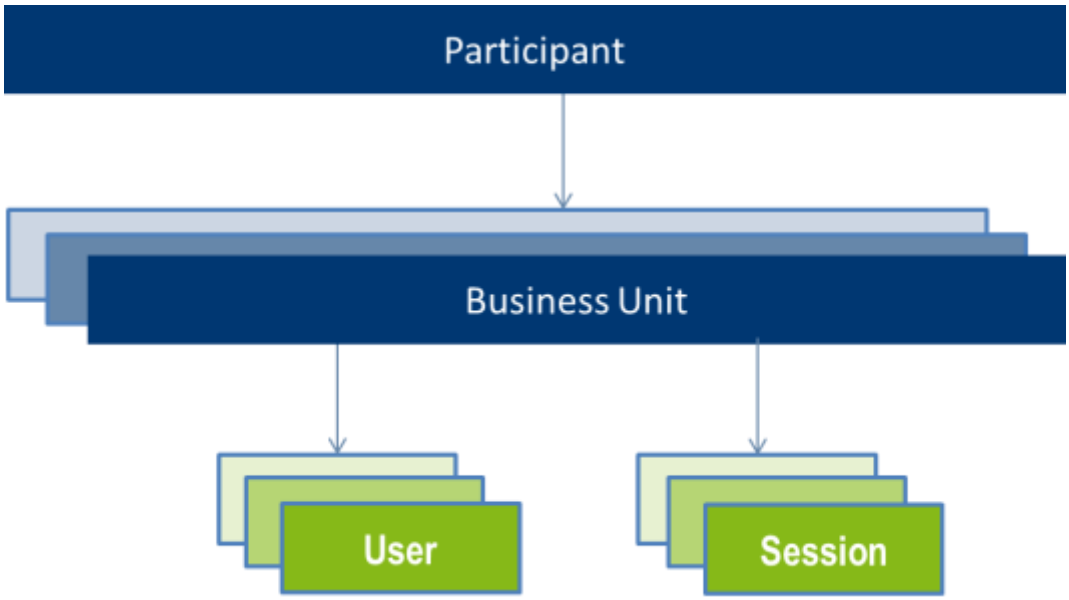


Figure 2-1: The participant hierarchy in T7

2.1.2 Participant and Business Unit

A member firm of the exchange is set up as a participant. In order to trade in T7, a participant must have at least one Trading Business Unit set up. The business logic of T7 makes use of the business unit rather than of the participant.

If an exchange member wishes to have several trading desks that trade independently, it is possible to have several trading business units being set up for the same participant. In T7, different trading business units trade completely independently from each other. For example users from different trading business units cannot access each other's orders or quotes, even if these users belong to the same participant.

Eurex and EEX Set Up Information:

Currently, Eurex and EEX allow only one trading business unit per participant. Additional business units per participant may be made available at a point later in time.

However, the trades of all business units of a participant are sent to the clearing house in the name of the participant; the Eurex member. The clearing house does not distinguish between business units.

A Clearing Member of the exchange has a specific Clearing Business Unit that receives trade information for the trades of all own trading business units, as well as for the trades of the trading business units of related Non-Clearing Members.

Clearing members as well as Service Providers, that are not trading members, but that have access to the system, are also set up as participants in T7.

2.1.3 User

A user is a person, such as a trader or an administrator that interacts with T7. A user can also be a machine, like an order routing system or a quote machine. Every request that reaches T7 must carry the identifier of a user, which executes the request. And every order and every quote in T7 must carry the identifier of a user, which owns the order. Eurex requires that for every user in the system, there is a real person that assumes the legal responsibility for the request, order or quote.

Every user of T7 belongs to exactly one business unit.

The ownership of an order and thus the permission to modify or delete that order depends on who is the order's Owning User. In general, the user who entered an order is the owning user of that order. See chapter 4.2 for details on the maintenance of orders.

A user may be given the User Level of a Supervisor. A Supervisor User may modify or delete an order, if the owning user and the supervisor user belong to the same business unit.

Several users may be set up as belonging to the same Trader Group. One or several of these users may be given the user level Head Trader. A Head Trader User may modify or delete an order, if the owning user and the head trader user belong to the same trader group.

Example 2-1:

The user structure of business unit XYZFR is illustrated in figure 2-2. XYZFR has set up two trader groups but has also users without a trader group.

- *In the trader group GRP1 there are the users A, B and C, of which only user A is given the user level Head Trader. User A can thus access orders that belong to users B and C, while users B and C can access only their own respective orders.*
- *In the trader group GRP2, all users D, E and F are given the user level Head Trader, and can therefore access each other's orders.*
- *User G has the user level Supervisor and can thus access the orders of everyone in the business unit, independent of any trader groups.*

- *User H with the Head Trader level and user I with the normal Trader level do not belong to any trader group. Therefore they cannot access each other's orders or the orders of anybody else. In addition, nobody can access their orders except for Supervisor user G. In fact, having the Head Trader level is meaningless for user H as long as user H does not belong to any trader group.*

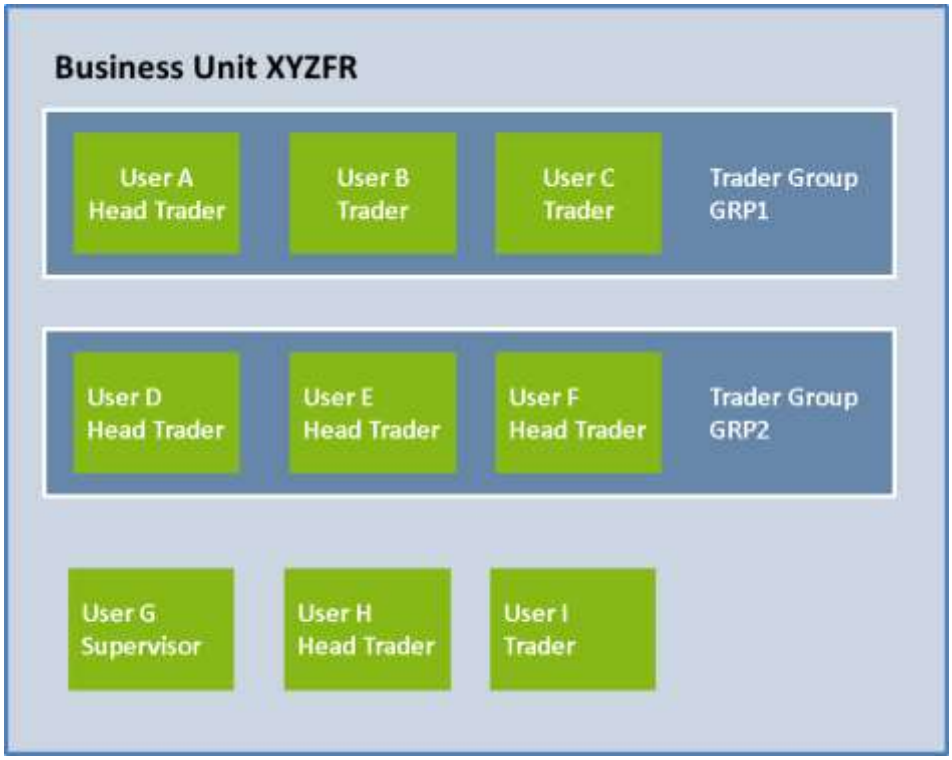


Figure 2-2: Illustration of the user structure of example business unit XYZFR as explained in the text.

Contrary to the case of orders, the owning user of a quote is only of legal relevance. The permission to modify or to delete a quote does in no way depend on the owning user or his trader group, and being a supervisor user or a head trader user is of no relevance for the maintenance of quotes.

2.1.4 Session

A Session is a permanently registered connection channel to T7.

A session is set up for and belongs to exactly one business unit. In order to send requests to T7, a user must use a session that is connected to T7 and that belongs to the same business unit as the user. Besides that, there is no further relationship between users and sessions, i.e. a user does not belong to a specific session and a session does not belong to a specific user.

The ownership of a quote depends entirely on the quote's owning session. The owning session of a quote is the session through which the quote had been entered. A session can only have one quote per instrument, and the entry of a new quote results in the replacement of the quote that belonged to the same session. See chapter 5.2 and 5.3 for details on the ownership and the maintenance of quotes.

Also orders know the concept of the owning session. While permissions to maintain orders depend mainly on the owning user, there are some restrictions with respect to the owning session as well.

They are described in chapter 4.2.4 on order ownership.

A clearing business unit does not actively participate in trading, and therefore it needs only a Listening Session that allows it to receive the trade information being sent out by T7.

2.2 Market Structure

2.2.1 Markets, Products and Instruments

In T7, trading is organized into Instruments. An order always refers to the buying or selling of a specified quantity of a certain instrument. T7 supports the trading of futures contracts and option series, which are set up by the exchange as instruments.

Example 2-2:

An example for an instrument is FDAX Jun16, which is the futures contract on the DAX index that expires in June 2016. A trader that wants to buy 20 contracts of this futures contract, places a buy order with a quantity of 20 in the instrument FDAX Jun16.

An example for an options instrument is ODAX Jun16 12000 C, which is the call option on the DAX index with a strike of 12000 that expires in June 2016.

Instruments of the same type that refer to the same underlying, are grouped together to form Products. In T7, every tradable instrument must belong to a product.

A futures product normally contains all futures instruments for the same underlying that differ only in the expiry date. An options product normally contains all call options instruments and all put options instruments that differ only in the expiry date, the strike price or the version number.

Note however, that for convenience an exchange may assign similar instruments with the same underlying to different products.

Example 2-3:

The instruments ODAX Jun16 12100 C and ODAX Sep16 11900 P belong to the same product ODAX. However, the Weekly DAX Option ODX1 Jun16 12100 C belongs to a different product ODX1 though it differs from ODAX Jun16 12100 C only in the expiry date.

Instruments of the same product are traded in the same way, i.e. trading parameters and trading schedules are defined for products or groups of products rather than for individual instruments.

A product has a trading state, but also every instrument has its own individual trading state. Usually, all instruments of a product have the same trading state that depends first of all on the trading state of the product. Nevertheless, in special circumstances, an individual instrument's state may differ from the states of the other instruments of the product. See chapter 3 for information on the trading states of products and instruments.

In T7, an exchange with its own trading rules, its own products and its own market supervision is represented as a Market. T7 is able to operate multiple markets in parallel on one technical system. Each product and thus each instrument belong to a specific market.

Exchange participants are in general thought of as members of one specific exchange. Nevertheless, T7 does not technically restrict a participant to one specific market. Instead, it allows exchanges to

grant participants and individual users access to their products, independent of the participants' exchange membership.

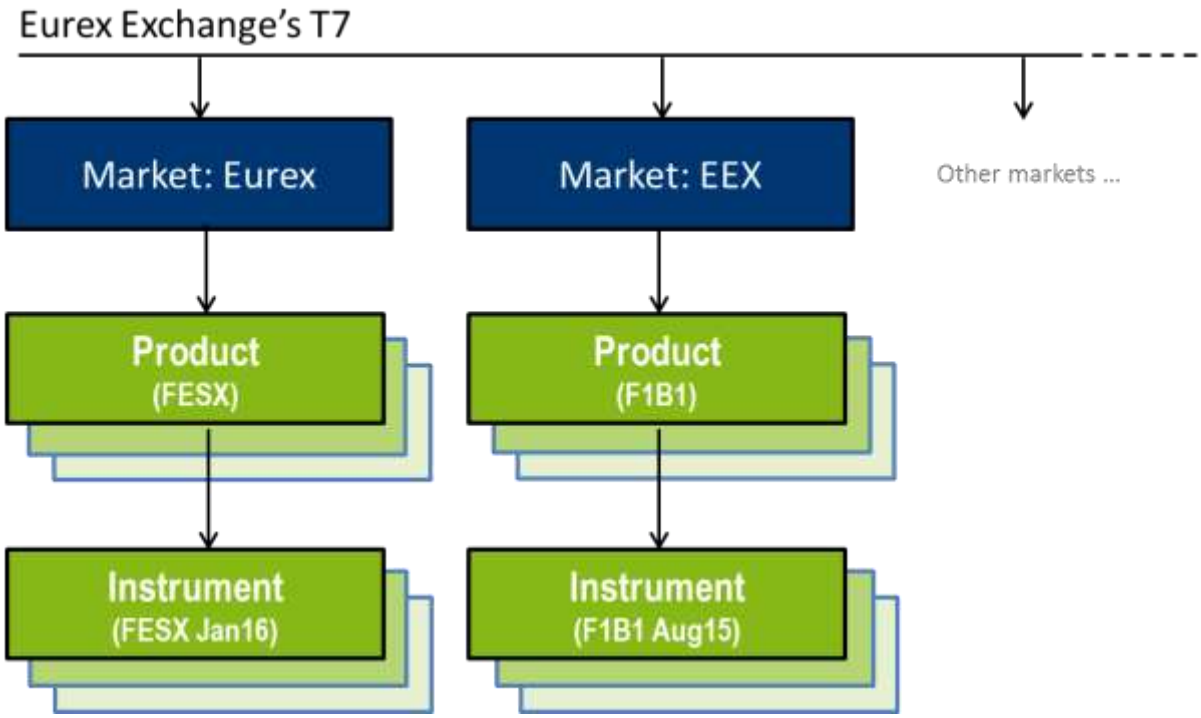


Figure 2-3: The market hierarchy in T7

For details concerning the handling of participants' and users' access to products, please refer to the document *Participant and User Maintenance Manual*.

Example 2-4:

Eurex and the European Energy Exchange (EEX) are hosted on the same system, each being set up as an own market with its own products. Participants are either Eurex members or EEX members.

2.2.2 Complex Instruments

The instruments that are futures contracts or option series are called Simple Instruments in order to distinguish them from Complex Instruments. A complex instrument is an instrument that facilitates the simultaneous trading of two or more simple instruments at a net price, with the guarantee that either all or none of the involved simple instruments get executed.

The simple instruments that make up a complex instrument are referred to as the Leg Instruments of the complex instrument.

Currently, T7 supports the following types of complex instruments:

- Futures Spreads are calendar spread combinations for futures.
- Packs and Bundles allow to simultaneously buy or sell all quarterly contracts of a futures product that expire in a time span of one or more years.
- Strips are similar to Packs and Bundles, but allow a more flexible choice of leg instruments.

- Standard Futures Strategies are multi-leg futures strategies that conform to a strategy type which is pre-defined by the exchange.
- Inter-Product Spreads are spreads between contracts of different futures products.
- Standard Options Strategies are multi-leg options strategies that conform to a strategy type which is pre-defined by the exchange.
- Non-standard Options Strategies are multi-leg options strategies that are freely defined by the users.
- Options Volatility Strategies are strategies of a predefined type that combine one or more options series with the underlying which is represented by a futures instrument.

Support of more types of complex instruments may be added in the future.

The Instrument Type distinguishes the various types of complex instruments from each other and from simple instruments. There are a number of functionalities for which instrument types play an important role. For example, a number of quoting functionalities like market maker protection work on a scope that encompasses all instruments that belong to the same product and instrument type.



Figure 2-4: The Instrument Types

Not all complex instrument types are available for all products. The exchange enables or disables the support of the various complex instrument types on a by product basis.

Example 2-5:

Eurex supports the instrument type Options Volatility Strategy for equity index options products, but not for equity options products.

Before T7 accepts orders for a complex instrument, the complex instrument must be created. Some complex instruments are created by interested users by way of sending corresponding creation requests to T7. But there are also complex instruments which are created automatically by the exchange.

Example 2-6:

The options strategy OGBL BUL Jun16 160.0 - 165.0 is defined as buying the OGBL Jun16 160.0 C series and simultaneously selling the same quantity of the OGBL Jun16 165.0 C series. The first user that wishes to trade this strategy has to create the complex instrument first, before he can send an order for the strategy. The instrument type is Standard Options Strategy.

The spread FGBL SPD Sep16 Dec16 is defined as buying the FGBL Sep16 contract and simultaneously selling the same quantity of the FGBL Dec16 contract. The corresponding instrument has an instrument type of Futures Spread. Eurex creates it automatically, once the FGBL Mar16 contract has expired.

The specific behavior of complex instruments, especially the various complex instrument types and the ways they are created and traded, is explained in detail in chapters 10 – 18.

3. Trading States

3.1 Overview

Trading states give a structure to the business day. They control what activities are available to traders and what functions T7 will perform during each period.

T7 has both Product States and Instrument States. While product states give a structure to the business day and control general access to the system, instrument states control order and quote maintenance and execution, and they also control the availability of public market data.

3.2 Instrument States

Instrument states control

- If order and quote maintenance is possible and to what extent,
- What order book information is published by the exchange,
- If orders and quotes are executed.

Figure 3-1 displays the instrument states and their hierarchy in terms of market activity. The following chapters describe each instrument state in detail.

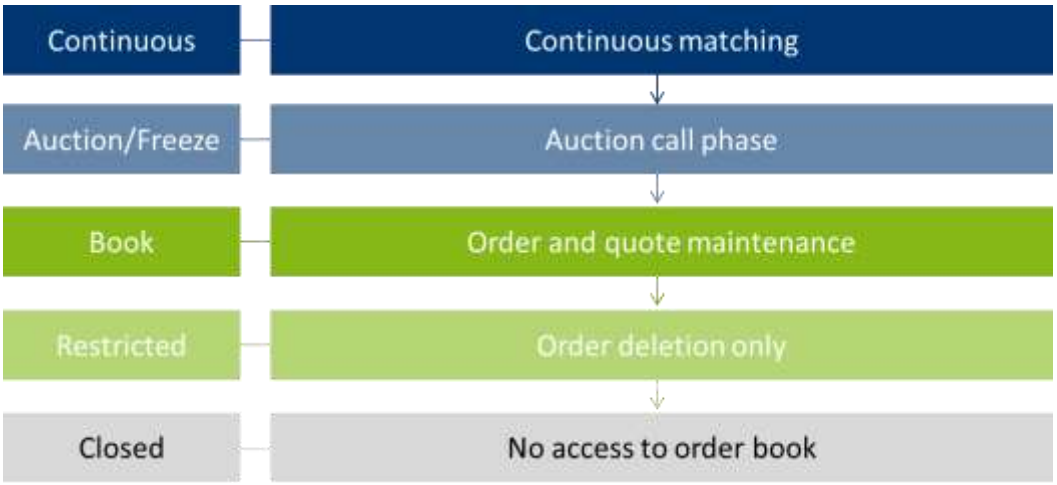


Figure 3-1: The instrument state hierarchy

3.2.1 Instrument State Continuous

The instrument state Continuous is the state where continuous trading takes place.

In the instrument state Continuous

- Order maintenance is possible.
- Quote maintenance is possible.
- Public market data in price-level aggregated form for a limited number of price levels is published by the exchange. For instruments with synthetic matching, this includes synthetic price information on the best available price level.
- Price and quantity information on an order-by-order basis is published by the exchange for selected products.
- There is continuous matching of orders and quotes.
- Trade data is published by the exchange.

3.2.2 Auction Instrument States

There are four auction instrument states that represent the auction call phases of various types of auctions.

1. Opening Auction: An opening auction occurs each time before continuous trading starts. This happens normally only once a day in the morning. But if under exceptional circumstances trading is halted and re-started during the day, there is an opening auction again before continuous trading resumes.
2. Closing Auction: For some products, there is a closing auction, either at the end of the continuous trading phase, or during the day to determine an auction price as a basis for a settlement price. There can be only one closing auction per day.
3. Volatility Auction**:** A volatility interrupt results in a volatility auction. See chapter 7.6 for information on volatility interrupts.
4. Intraday Auction: An auction that does not fit into the other three categories is an intraday auction. This will occur only for special products.

Configuration Data:

The information, whether there is a closing auction for a product, is available in the Trading Parameters File, which is part of the Products and Instruments Files on the Eurex website, see chapter 1.2 Usage Notes.

In an auction instrument state

- Order maintenance is possible,
- Quote maintenance is possible,
- Only top of book market data is published by the exchange, i.e. either the best buy and sell prices or the potential auction price,
- No trading occurs, but at the end of an auction instrument state, an order book uncrossing may occur, potentially resulting in an auction trade which is published by the exchange.

3.2.3 Auction Freeze Instrument States

An auction freeze state is a state where the exchange market supervision has frozen the market during an auction call phase, in order to control the order book situation. Like for the auction

instrument states described above, for each type of auction, there is one auction freeze instrument state.

1. Opening Auction Freeze.
2. Closing Auction Freeze.
3. Volatility Auction Freeze.
4. Intraday Auction Freeze.

In an auction freeze state

- No order entry or modification is possible,
- No immediate order deletion is possible, but order deletion requests will result in the order being marked as pending deletion (see below),
- No quote entry or replacement is possible,
- No immediate quote deletion is possible, but quote deletion requests will result in the quote being marked as pending deletion,
- Only top of book market data is published by the exchange, i.e. either the best buy and sell prices or the potential auction price,
- No trading occurs, but at the end of an auction freeze instrument state, an order book uncrossing may occur, potentially resulting in an auction trade which is published by the exchange.

During an auction freeze state, any activity that changes the order book is not possible. Nevertheless, a trader may send requests to delete orders or quotes in an auction freeze state. T7 will not delete the orders or quotes immediately, but rather mark them as pending deletion. Orders and quotes that are marked as pending deletion are automatically deleted by the system, once the instrument enters a different instrument state.

It is important to note that orders and quotes that are marked as pending deletion, will still participate in an auction trade that is done at the end of the auction freeze state. Therefore, sending a deletion request for an order or a quote during an auction freeze state does not prevent the order or quote from being matched in the auction trade that ends the auction freeze state. It only guarantees that any remainder of the order or quote is deleted right afterwards.

3.2.4 Instrument State Book

The instrument state Book is the state where traders can maintain their orders and quotes, but no matching takes place.

In the instrument state Book

- Order maintenance is possible.
- Quote maintenance is possible.
- No public market data is published by the exchange.
- No matching occurs.

3.2.5 Instrument State Restricted

The instrument state Restricted is a state where traders are only allowed to delete their orders.

In the instrument state Restricted

- No order entry and no order modification is possible, but order deletion is supported.
- No quote maintenance is possible and there are no quotes in the order book.
- No public market data is published by the exchange.
- No matching occurs.

T7 does not support the presence of quotes in the order book during the instrument state Restricted. Therefore, all quotes of an instrument are automatically deleted by T7, when the instrument enters the state Restricted.

3.2.6 Instrument State Closed

The instrument state Closed is the state where no access to the order book is available.

In the instrument state Closed

- Maintenance of individual orders is not possible, but requests that require the deletion of all orders in a specified scope are still processed, provided that the product state allows access to the system at all.
- No quote maintenance is possible and there are no quotes in the order book.
- No public market data is published by the exchange.
- No matching occurs.

T7 does not support the presence of quotes in the order book during the instrument state Closed. Therefore, all quotes of an instrument are automatically deleted by the system when the instrument enters the state Closed.

3.3 Product States

Product states give a structure to the business day. They also control the general access to T7. In general, the instrument state changes with the product state.

Figure 3-2 displays the sequence of product states and the related instrument states for a normal trading day. The following chapters describe each product state in detail.

3.3.1 Start Of Day

The product state Start Of Day represents the time in the morning before activity starts. Members have no access to the order books in this product state. All instruments are in the instrument state Closed.

3.3.2 Pre-Trading

The product state Pre-Trading occurs in the morning before trading starts. It is typically a time where traders may maintain their orders prior to the start of trading. No matching occurs in this phase.

Normally, instruments are in the instrument state Book.

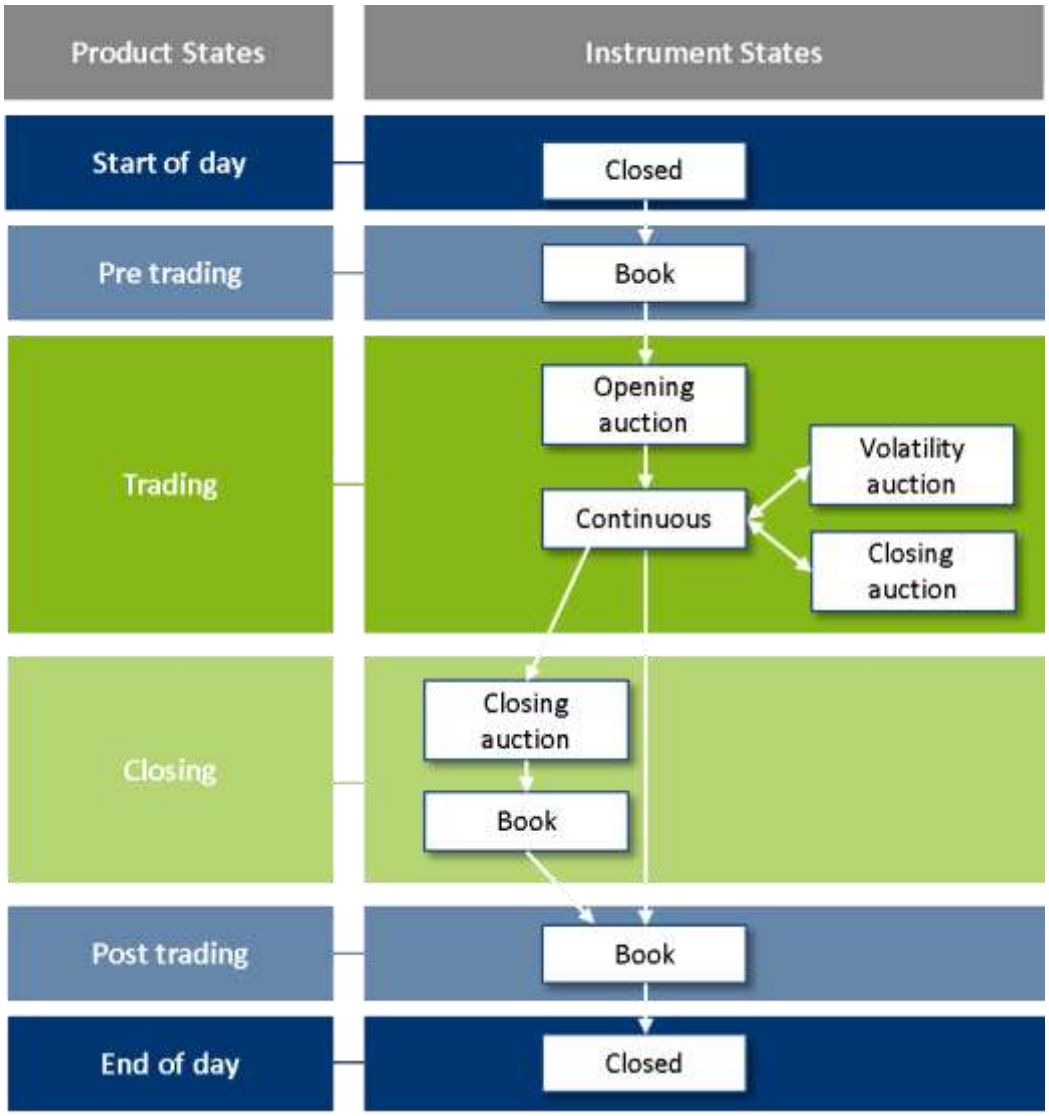


Figure 3-2: The sequence of product states and the related instrument states for a normal Eurex trading day

3.3.3 Trading

The product state Trading represents the trading phase. The standard procedure for the product state Trading is that after an initial opening auction call phase, the instruments are in the continuous trading phase, possibly interrupted by volatility auction call phases.

Thus normally, instruments are in the instrument state Continuous, or they are in an auction or auction freeze instrument state.

3.3.4 Closing

The product state Closing is a short phase that sits between Trading and Post-Trading. It covers the time between the end of continuous trading and the end of the last auction, typically a closing auction.

The product state Closing ends automatically when there is no more running auction in any of the product's instruments. The end of the product state Closing marks the moment when trades can no longer occur for the affected product for the rest of the day.

For products that have no closing auctions at the end of the continuous trading phase, the product state Closing has zero duration, except if there was an auction running at the time when Closing started.

Normally, instruments are in an auction or auction freeze instrument state, or they are in the instrument state Book.

3.3.5 Post-Trading

The product state Post-Trading terminates the trading session of a business day. It is typically a time where traders can maintain their orders in preparation of the next trading day. No matching occurs in this phase.

Normally, instruments are in the instrument state Book.

3.3.6 End Of Day

The product state End Of Day represents the time in the evening that is reserved for the end-of-day processing by the exchange. Members have no access to the order books in this product state.

All instruments are in the instrument state Closed.

3.3.7 Halt

Market Supervision may halt the market if it judges that market conditions or technical conditions impair the integrity of the market. In such a case, a product will be set to the product state Halt. In the product state Halt, no matching occurs and order book access is restricted.

All instruments are in the instrument state Restricted.

3.3.8 Holiday

The product state Holiday applies to products that are not open for trading on that day, even though the exchange is open. Members have no access to the order books for a product that is in the product state Holiday.

All instruments are in the instrument state Closed.

3.4 Fast Market

An exchange declares a Fast Market for a product when an especially volatile market situation is expected. During a Fast Market, the following price and quantity validations may be relaxed, depending on the product specific settings as decided by the exchange:

- The Minimum Quote Size may be lower (ch.5.4.2).
- The Price Range may be enlarged (ch.6.1.2), which implies that:
    - The Price Reasonability Check may be relaxed (ch.6.2),
    - The Maximum Quote Spread for double-sided quotes may be enlarged (ch.6.4),
    - The Market Order Matching Range (ch.7.3.1) may be enlarged, and
    - The conditions for the acceptance of requests for an RfQ (ch.5.6) are stricter.

- The Extended Price Range may be enlarged (ch.6.1.2); which implies that the Extended Price Range Validation is relaxed (ch.6.3).
- The conditions for a Volatility Interrupt to occur are relaxed (ch.7.6).

In T7, Fast is a special status of the product that the exchange can set independently of the product and instrument states. This allows, for example to have a product to be set to Fast Market already early in the morning before trading starts, without any impact on the sequence and timing of the product states.

3.5 Listing Status

The Listing Status of an instrument is a general status that controls whether an instrument is currently available for trading, or whether for some reason, it is not available for trading. The listing status exists in addition to the instrument state that had been described before. The listing status of an instrument that can be traded is Active. An instrument that is not tradable has a listing status of Expired or of Suspended, as explained in the following.

3.5.1 Intra-day Expiry

Instruments that expire during the trading day, rather than at the end of the trading day, will upon expiration acquire the listing status Expired as opposed to Active.

The instrument state of an instrument with a listing status Expired is either Restricted or Closed, depending on the product state.

3.5.2 Instrument Suspension

The market supervision of an exchange may suspend an instrument intraday. A suspended instrument will acquire the listing status Suspended as opposed to Active.

The instrument state of an instrument with a listing status Suspended is either Restricted or Closed, depending on the product state.

3.5.3 Intra-day Inactivation

Market supervision may decide to inactivate a complex instrument during the day. An inactive complex instrument cannot be traded anymore.

The instrument state of a complex instrument with a listing status Inactive is Closed.

3.6 End-of-Day Processing

The End-of-day product state ends with the end-of-day processing. During the end-of-day processing, T7 regularly performs the following clean-up activities:

- Deletion of expired orders. All GFD orders and all GTD orders with an expiry date before the next trading day are deleted by T7.
- Deletion of orders of expired instruments. All orders of expired instruments or of complex instruments with an expired leg instrument are deleted by T7.
- Deletion of expired instruments. T7 deletes expired instruments and all complex instruments that have an expired leg instrument.

- Clean-up of temporary complex instruments. T7 deletes those complex instruments that have no more orders in the order book. An exception to this is complex instruments that have been created by the exchange.

The exchange market supervision may furthermore delete orders under special circumstances, as e.g. in the case of corporate actions of an underlying stock.

4. Orders

This chapter starts with the characteristics and the maintenance of orders in general, especially Regular Orders. Special types of orders, as Stop Orders, One-Cancels-the-Other Orders, Book-Or-Cancel Orders and Closing-Auction-Only Orders, are dealt with further down in this chapter. Quotes are described in chapter 5.

4.1 Order Attributes

4.1.1 Limit Price

An order can be either a Limit Order or a Market Order.

Limit orders have a limit price. The limit price indicates the maximum price at which a buy order is allowed to match, or the minimum price at which a sell order is allowed to match.

Market orders are orders that have no limit price. They are only allowed for simple instruments. Since market orders are not protected by their limit price, there are other mechanisms that give market orders some protection against unreasonable trade prices. First of all, market orders are protected by price limits that depend on current market conditions. They are described in chapter 7.3. Furthermore, the market data feeds of T7 publish no information about the presence of market orders. Market orders are hidden orders.

The Tick Size defines the minimum increment for trade prices in a product. Any trade price is an integer multiple of the tick size.

A valid limit price must be a valid price as defined by the Price Step Table that is relevant for the instrument. A price step table defines price intervals and the size of the price step for each price interval. Inside each price interval, valid limit prices are those that can be obtained by adding an integer multiple of the price step to the lower end of the price interval. Price steps are always integer multiples of the tick size, and therefore, valid limit prices are always integer multiples of the tick size. But not every multiple of the tick size is a valid limit price.

Example 4-1:

The tick size is 0.01. The price step table defines the first price interval to range from 0.01 to 10.00 with a price step of 0.01, and a second price interval from 10.00 to infinity with a price step of 0.10.

Then 9.98, 9.99 and 10.00 are valid limit prices, and so are 10.10, 10.20, 10.30 etc., but 10.01 is not a valid limit price. An order with a limit price of 10.01 would be rejected by T7.

In general, trade prices are prices that are also valid limit prices. However in the context of matching of complex instruments, it is possible that trade prices occur that are not valid limit prices according to the price step table.

Configuration Data:

The price step tables are published by T7's Reference Data Interface in the product snapshot message (RDI message group name: TickRules).

4.1.2 Quantity

The Total Quantity of an order is provided by the user that enters the order.

T7 provides the Open Quantity of an order, which is the part of the total quantity that is still available for matching, and the Accumulated Executed Quantity, which is the part of the total quantity that has already been matched. During the life time of an order, the total quantity of the order is always equal to the sum of the open order quantity and the accumulated executed quantity. When an order is deleted, the total quantity of the order is equal to the sum of the deleted order quantity and the accumulated executed quantity.

4.1.3 Order Validity

The Order Validity limits the life time of the order. T7 supports the following values for the Order Validity:

- Good-For-Day (GFD) orders are deleted automatically in the next end-of-day processing.
- Good-Till-Cancelled (GTC) orders are automatically deleted only after the instrument has expired.
- Good-Till-Date (GTD) orders carry an expiry business date and are automatically deleted in the end-of-day processing, if the next business date is later than the specified expiry business date.
- Immediate-Or-Cancel (IOC) orders are deleted automatically after having been processed on entry, without ever going to the order book.

4.1.4 Order Identification

When a new order is accepted by T7, the system assigns it an Exchange Order ID. The exchange order ID is guaranteed to be unique among all orders and quotes of the same product that have an open quantity on the same business day.

The entering user may optionally assign a Client Order ID to the order. The client order ID is verified by T7 to be unique across the instrument and session scope in the order book at the time of order entry. The client order ID is however not verified to be unique for IOC orders.

When modifying or deleting an order, the user identifies the order either with the exchange order ID or with the client order ID if available. The user may or may not assign a new client order ID to the order with each order modification or deletion. The exchange order ID remains in any case unchanged for the entire life time of the order, i.e. an order modification does not result in a change of the exchange order ID, even if the time priority of the order is changed.

4.1.5 Time Stamps

T7 sets the Entry Time Stamp of an order when the order is entered. It is for informational purpose only. Any modification of an order has no impact on the entry time stamp of the order.

Furthermore, T7 sets and maintains the Priority Time Stamp. The priority time plays a role in the order allocation during matching. The priority time stamp of an order is updated in a number of well-defined situations:

- Modification of the limit price, or conversion of a market order to a limit order or vice versa.

- Modification of the total order quantity such that it is increased.
- Triggering of a stop order or an OCO order.
- Modification of the stop price of a stop order or an OCO order.
- Activation of a closing-auction-only order.

4.1.6 Technical Order Attributes

Persistent and Non-Persistent Orders

Any order can be entered either as Persistent order or as Non-Persistent order.

Non-persistent orders are automatically deleted in the following situations:

- The product state is changed to Halt.
- A volatility interrupt has occurred.
- The owning session is disconnected.
- A technical back end partition overload condition has been detected.

Persistent orders are persisted in a database of T7. This prevents persistent orders from being lost in case of a technical system failure. During the restart after a system failure, T7 will re-load the persistent orders from the database. The priority time stamp of these orders remains unchanged.

A non-persistent order is processed without the extra step of being persisted in a database. As opposed to persistent orders, non-persistent orders will not be re-loaded to the order book after a system failure, i.e. they will be definitively lost. Non-persistent orders cannot be entered with an order validity GTC or GTD, and therefore they cannot survive until the next business day.

Lean Orders

Any order can be flagged as a 'Lean' order.

For lean orders, the receipt of status information messages is restricted to the session, through which the order had been entered. Furthermore, only such information messages may be recovered via a retransmission request that is about executions and about events, which were not solicited by the owner of the order.

For an order that is not flagged as a lean order, the receipt of status information messages is not restricted to the session, through which the order had been entered, and information messages about all events regarding the order may be recovered via a retransmission request.

T7 does not accept orders that are both lean and persistent. Orders that are entered through a high-frequency session must always be lean and non-persistent.

See the *Eurex Enhanced Trading Interface Manual* for more information on the different types of sessions in T7, on receiving information messages about order events, including retransmission of such messages, and in general on the technical aspects of order maintenance.

4.1.7 Other Attributes

The user may provide a Cross ID for an order which prevents the matching against identically tagged orders or quotes of the same business unit by means of the self-match prevention functionality (see chapter 7.7).

Several order attributes, which are sent by the user, are not directly relevant to the order matching but serve other purposes, e.g. in the post-trade processing, or to satisfy requirements of the regulator. These are:

- The Trading Capacity distinguishing proprietary, agency and market-making orders,
- Clearing related attributes like Clearing Account, Take-Up Member, and Open-Close Indicator,
- Free Format Text fields,
- A Regulatory Information attribute for use by the trading surveillance office,
- A Country Code indicating the real origin of the order.
- A Rate Identifier according to FIA guidelines.
- Other information that is needed in the context of trading the Eurex/KRX link product or Eurex/TAIFEX link products.

See chapter 8.2 for more information on the handling of clearing related attributes, of free format text fields and of attributes containing information related to the cooperation between Eurex and other exchanges.

4.2 Order Maintenance

4.2.1 Order entry

On order entry, T7 validates that the order attributes, which are relevant for trading, contain valid values. Orders with invalid attribute values are rejected.

The entered total order quantity must not violate the Transaction Size Limits that have been configured for the product and for the entering business unit or user.

Depending on various conditions, the limit price of a limit order may be validated with the Price Reasonability Check (see chapter 6.2) or with the Extended Price Range Validation (see chapter 6.3).

Entry of orders is possible during the instrument states Book and Continuous, and during auction instrument states. During the instrument states Closed and Restricted, and during auction freeze instrument states, order entry is not possible.

If the instrument state is Book or an auction state, an incoming order is written to the book without matching. IOC orders are deleted instead of being written to the book.

In the instrument state Continuous, an incoming order will be possible if first matched against orders and quotes on the opposite side of the order book. See chapter 7.1 for the matching rules in continuous trading. The open quantity and the accumulated executed quantity of the order are determined. Any remainder is written to the order book, except for an IOC order which is deleted instead.

4.2.2 Order modification

A user can modify an order that rests on the order book. The modification request must identify the order with the help of its client order ID – if available – or of its exchange order ID.

See chapter 4.2.4 on order ownership and who is allowed to modify a specific order.

The user may modify the limit price and may modify the total order quantity. A new limit price and a

new total order quantity are subject to the same validations as for order entry.

The accumulated executed quantity is carried forward to the modified order while the open order quantity gets recalculated if the total order quantity is modified. An attempt to modify the total quantity of an order to a value below the already executed quantity results in the deletion of the order.

The priority time stamp of an order is updated, when:

- The limit price of the order is changed, or
- A market order is modified to become a limit order or vice versa, or
- The total order quantity is increased.

The modification of any other order attribute has no impact on the time priority of an order.

If the instrument state is Continuous, and if any of the above listed conditions for the update of the priority time stamp is fulfilled, then T7 will make a fresh attempt to match the modified order as if for a new incoming order.

Note that a fresh attempt to match a book order, the quantity of which has been changed, is irrelevant for limit orders, but it could result in a match in the case of a book market order. See chapter 7.3 for details.

The following attributes of an order can not be modified:

- Instrument identifier
- Side (Buy or Sell)
- Technical order attributes *Persistent* and *Lean* (see ch.4.1.5 above)

Furthermore, orders cannot be modified to change their category as defined in ch.4.7.1 below.

If the user wishes to modify any of these attributes of the order, the user would have to delete the existing order and place a new one.

4.2.3 Order deletion

A user can delete an order that rests on the order book. The deletion request must identify the order with the help of its Client Order ID – if available – or its Exchange Order ID. Furthermore, T7 supports the deletion of all of a user's orders in a product or in an instrument with one request.

See chapter 4.2.4 on order ownership and who is allowed to delete a specific order.

During an auction freeze state, a deletion request for an order results in this order being marked as pending deletion, rather than being deleted right away. See chapter 3.2.3 for details.

4.2.4 Ownership concept

Every order is attributed an owning user, an owning session and an owning business unit. On order entry, the user who entered the order becomes the owning user of the order, his business unit becomes the owning business unit, and the session through which the order was entered, becomes the owning session of the order.

In general, only the owning user of an order can modify or delete the order. Exceptions are the following two cases:

- A user that is not the owning user can modify or delete the order, if he is configured as a

Supervisor user and belongs to the owning business unit.

- A user that is not the owning user can modify or delete the order, if the user is configured as a Head Trader and belongs to the same trader group as the owning user.

In any case, the modification of an order by a Supervisor or a Head Trader does not modify the ownership of the order, i.e. the order keeps its original owning user.

In general, the modification or the deletion of an individual order is possible through any session that belongs to the owning business unit. However, the modification of an individual order through a session that is not the owning session is not permitted in the following cases:

- If the order is a lean order (see chapter 4.1.6 above).
- If the session, through which the modification request is entered, is a high-frequency session. (See the *Eurex Enhanced Trading Interface Manual* for information on the different types of sessions in T7.)

These restrictions do not apply to order deletion.

4.2.5 Regulatory Algorithm Identifier

T7 supports that order maintenance requests are enriched by a regulatory algorithm identifier if required by the trading surveillance office.

4.2.6 Book Order Count Limits

T7 supports various pre-trade limits that restrict the number of orders for a product that a business unit or a session may have at any given moment in the order book. The aim is to help participants to prevent the accidental massive submission of orders from algorithmic trading or order routing machines. The orders, which are counted, include all types of orders and quotes on the order book, even inactive orders and quotes.

If a limit is exceeded for a product and a business unit or session, further entry or modification of orders and quotes by that business unit or session for that product is prevented by the system, until the number of orders has been considerably reduced. This affects all types of orders and quotes, including IOC orders.

Note that the system checks the counters only at the end of a transaction. It is therefore possible in the context of quote mass transactions (see chapter 5.3.1) that a limit gets exceeded by a number of quotes, which are added in the same mass request.

There are large general limits defined by the exchange for business units and for sessions. Additionally, participants may define tighter limits for their specific business units and for their specific sessions:

- Limits that are applicable for specific products. This type of limit is supported only for a small number of products.
- Limits that are applicable for futures products, if no such limit has been set up for the specific product.
- Limits that are applicable for options products, if no such limit has been set up for the specific product.

Configuration Data:

The Trading Parameters File, which is part of the Products and Instruments Files on the Eurex website, see chapter 1.2 Usage Notes, contains the information, for which products the setting of product specific limits is supported.

Eurex and EEX Set Up Information:

Currently, after a limit had been exceeded, Eurex and EEX re-enable order entry when the related book order count falls below 70% of the limit.

4.3 Stop Orders

4.3.1 Overview

A stop order is an order that is initially inactive. It is not able to match and it is not included in the public market data. When the market reaches the price level that is given by the stop price of the stop order, then the stop order is triggered, i.e. it is converted to an active regular order and, if possible, matched according to the rules for incoming regular orders.

A buy stop order is normally placed at a stop price above the current market price, and a sell stop order is normally placed at a stop price below the current market price.

There is no guarantee that a triggered stop order is matched immediately after it is triggered. It is treated just as any incoming regular order and will be placed on the order book, if it cannot be matched.

A stop order can be a Stop Limit Order or a Stop Market Order. A triggered stop limit order is converted to a limit order, and a triggered stop market order is converted to a market order.

Eurex and EEX Set Up Information:

Currently, Eurex and EEX support only stop market orders for futures and no stop orders at all for options.

4.3.2 Stop Order Maintenance

A stop order must have a stop price. The stop price is used to determine under which condition the stop order is triggered. See chapter 4.3.3 below for the rules on stop order triggering.

A stop limit order additionally must have a limit price. This limit price is the limit price of the limit order that the stop limit order is converted to when being triggered.

A stop market order has no limit price. Upon being triggered, it is converted to a market order. Validations that are specific to market orders, as e.g. the validation against a market order specific order size limit, are in the same way applied to stop market orders on entry.

Both the limit price and the stop price must be valid prices in respect to the rules for limit prices as outlined in chapter 4.1.1.

The stop price and the limit price can be modified, but the stop order looses its time priority in this case. The same happens, if a stop market order is modified to become a stop limit order or vice versa.

A stop order can be entered with an order validity of GFD, GTC or GTD. The entered order validity continues to apply after the order has been triggered.

When a stop order is entered, then the stop price of the stop order is validated against the current market prices. Only buy stop orders the stop price of which is greater than the Best Available Buy Price, and sell stop orders the stop price of which is smaller than the Best Available Sell Price, are accepted and saved as stop orders on the order book. The best available price is normally given by the limit price of the best limit order on the order book side. For the case of synthetic matching, its definition is given in chapter 11.3.2.

The handling of stop orders that fail this validation is defined for each product by the exchange. Depending on the configuration of the product, they are either rejected, or they are immediately converted to regular orders.

Eurex and EEX Set Up Information:

Currently, Eurex and EEX always reject stop orders, which fail the entry validation of the stop price against current market prices. This applies to all products where stop orders are supported.

The same validation is applied for a modification request, if the stop price or, in case of a stop limit order, the limit price is modified, or if the quantity of the stop order is increased. A rejection of the modification request means here that the stop order remains on the order book unchanged.

4.3.3 Stop Order Triggering

When stop orders are triggered they are converted to incoming regular orders and treated as such thereafter. However at this point, there is no Price Reasonability Check and no Extended Price Range Validation for triggered stop limit orders. The priority time stamp is updated. The Exchange Order ID is not modified.

Stop orders are triggered one by one in separate transactions. They are always triggered at the end of the transaction which creates the triggering condition.

Example 4-2:

An incoming sell order matches against the order book at the price levels 80, 75 and then 70. The first match at 80 creates the condition for triggering a stop order on the book. T7 will first complete the matching of the incoming order at 75 and 70, and process the triggering of the stop order afterwards.

If the incoming order causes a volatility interrupt while attempting to match at 70, the instrument state change to the volatility auction is done first and the processing of the stop order that got triggered by the match at 80, is done last.

T7 supports two types of trigger conditions, triggering based on the last trade price, and triggering based on the best buy or best sell price. The methods are described in the following.

1. Stop order triggering based on the last trade price:

   During the product state Trading, a new trade price can trigger stop orders. The cause of the trade is of no relevance, i.e. the trade could be caused by a matching incoming order, by an auction trade or by another stop order that is triggered and matched itself. The only exception is that stop orders are not triggered by leg trade prices resulting from the decomposition of

pure complex instrument trades.

A buy stop order is triggered, if the new trade price is higher than or equal to the stop price of the stop order. A sell stop order is triggered, if the new trade price is lower than or equal to the stop price of the stop order.

Note that prices of trades that occur outside the product state Trading do not trigger stop orders. Consequently, stop orders are never triggered by a closing auction trade in the product state Closing.

2. Stop order triggering based on the best buy / sell price:

   During the instrument state Continuous, a best buy price or best sell price can trigger stop orders. This applies also to best buy and best sell prices resulting immediately after an auction, if the instrument state Continuous follows the auction.

   A buy stop order is triggered, if the new best buy price is higher than or equal to the stop price of the stop order. A sell stop order is triggered, if the new best sell price is lower than or equal to the stop price of the stop order.

   Synthetic prices (see ch.11.3.2) are not taken into account for the triggering of stop orders.

Stop order triggering based on the last trade price is applied for all products for which stop orders are supported. The exchange defines by product, whether stop order triggering based on the best buy /sell price is additionally applied.

Eurex and EEX Set Up Information:

Currently, Eurex and EEX apply exclusively triggering based on the last trade price.

4.3.4 Triggering Priority

At the end of a transaction, several buy and/or sell stop orders can be triggered and each triggered stop order can potentially match again and trigger new stop orders. Hence a triggering priority must be established. No special priority is given to the stop market orders compared to the stop limit orders or the One-Cancels-the-Other (OCO) orders (see chapter 4.4 below). Also, the limit price of a stop limit order does not play a role for the trigger priority. In the following, stop market orders, stop limit orders and OCO orders are all referred to as stop orders.

Buy and sell stop orders of the same instrument can be thought of as saved on the book on two separate lists sorted by stop price and priority time ("stop order book"). Buy orders with the lowest stop prices are listed first on the buy stop order list. Sell orders with the highest stop prices are listed first on the sell stop order list. When two stop orders have the same stop price, the older order is listed first.

When several stop orders of both lists (Buy and Sell) can be triggered, they are triggered one after the other in a round-robin processing. The first stop order of the buy stop order list is triggered first. Then the first stop order of the sell stop order list is triggered, and then the second stop order on the buy stop order list and so on.

It is also possible that stop orders in more than one instrument are triggered in one transaction, e.g. in state change transactions, in mass quote transactions or due to synthetic matching. The lists of triggered buy or sell stop orders are then be created for each of the affected instruments, and the

above-described round-robin processing is extended to the stop order lists of all affected instruments. I.e. first the first buy stop order of the first instrument is triggered, and then the first sell stop order of the first instrument, then the first buy stop order of the second instrument, and so on until all stop orders that are the first on their respective list are triggered. And then the procedure continues with all stop orders that are second on their respective list.

It is possible that the execution of a triggered stop order leads to the triggering of additional stop orders. In the case of synthetic matching, this could happen even in a different instrument. In such a situation, the additional stop orders are immediately added to their respective lists of triggered stop orders, and they are immediately considered in the round-robin processing.

The processing continues until all stop orders have been triggered in all the instruments. Any new incoming orders or quotes are processed only afterwards.

Example 4-3:

Assume the following stop order lists for two FESX instruments. Assume further that in this example, the numeric order IDs happen to reflect the sequence of order entry and thus the time priority of the orders. (Note however that in general, T7 does not guarantee such a correlation.)

FESX Jun16				*FESX Sep16*			
Buy Stop Orders		*Sell Stop Orders*		*Buy Stop Orders*		*Sell Stop Orders*	
Order ID	*Stop Price*	*Order ID*	*Stop Price*	*Order ID*	*Stop Price*	*Order ID*	*Stop Price*
1	*3253*	*5*	*3256*	*4*	*3244*	*2*	*3246*
3	*3255*	*6*	*3256*	*8*	*3245*	*7*	*3245*

Assume that a match event with trade prices of 3255 for FESX Jun16 and of 3245 for FESX Sep16 occurs, such that all listed stop orders are triggered.

The triggering of the stop orders would be processed in the sequence: 1, 5, 4, 2, 3, 6, 8, and 7.

4.4 One-Cancels-the-Other Orders

4.4.1 OCO Order Functionality

A One-Cancels-the-Other (OCO) order is an order that combines the behavior of a regular limit order with that of a stop market order.

An OCO order has both a limit price and a stop price. On entry, it first behaves exactly like a regular limit order. It can match like a regular limit order, and it contributes to the published market data.

The stop price defines a trigger condition just as for stop orders. Once the trigger condition is fulfilled, the OCO order behaves like a stop market order, i.e. it gets a new priority timestamp and is converted to an incoming market order. The limit price does not apply anymore. When several stop orders and OCO orders are triggered, T7 does not distinguish between stop orders and OCO orders when working out the sequence of processing.

An OCO order that fulfills the trigger condition on entry is rejected by the system. I.e. contrary to stop orders, immediate conversion to regular market orders is in general not supported for OCO orders.

Though the name One-Cancels-the-Other may suggest otherwise, T7 treats an OCO order as one single order, and not as two orders that are linked. This is also reflected by an OCO order having only one Exchange Order ID that does not change throughout its life time, and specifically not when the OCO order is triggered.

4.4.2 OCO Order Maintenance

OCO orders are mandatorily entered with a limit price and with a stop price. Both the limit price and the stop price must be valid prices in respect of the rules for limit prices as outlined in chapter 4.1.1.

On entry, the stop price and the limit price are validated as follows, and entry of the OCO order is rejected, if any of these conditions is not fulfilled:

- The stop price of a buy OCO order must be higher than the best available buy price.
- The stop price of a sell OCO order must be lower than the best available sell price.
- The stop price of a buy OCO order must be higher than its limit price.
- The stop price of a sell OCO order must be lower than its limit price.

The best available price is normally given by the limit price of the best limit order on the order book side. For the case of synthetic matching, its definition is given in chapter 11.3.2.

The same condition is checked for the modification of an OCO order.

The Price Reasonability Check and the Extended Price Range Validation apply to the limit price of an OCO order in the same way as for a regular limit order.

An OCO order looses its priority when its limit price is modified, when its stop price is modified, or when its quantity is increased.

Validations that are specific to market orders, as e.g. the validation against a market order specific order size limit, are in the same way applied to OCO orders on entry.

OCO orders can be entered with an order validity of GFD, GTC or GTD. The entered order validity continues to apply after the order is triggered.

4.5 Book-Or-Cancel Orders

BOC orders are orders that are never matched on entry.

BOC orders which could be partially or fully executed upon entry are immediately deleted without execution. BOC orders that are not executable on entry are accepted and written to the order book.

In all other aspects, BOC orders are treated as regular limit orders. Specifically, it is possible to modify a BOC order in the order book such that it can be executed immediately. The matching will take place as if it were a normal regular order.

BOC market orders are not supported. BOC orders must have a limit price.

4.6 Closing-Auction-Only Orders

Closing-Auction-Only orders are orders that are active only in the instrument states Closing Auction and Closing Auction Freeze. In all other instrument states, they are inactive, i.e. they can be entered, modified or deleted, but they are not available for matching and they do not contribute to the published market data.

When the instrument enters the Closing Auction state, all Closing-Auction-Only orders become automatically active, and they receive a new priority timestamp. The Closing-Auction-Only orders participate then in the closing auction as any regular order.

Unexecuted Closing-Auction-Only orders are not automatically deleted by T7 after the Closing Auction is terminated. Instead, they become inactive.

EEX Set Up Information:

EEX has no closing auction for its products and therefore does not support Closing-Auction-Only orders.

Eurex Set Up Information:

Eurex allows for Closing-Auction-Only orders only an order validity of GFD.

Closing-Auction-Only orders can be market orders or limit orders. The Price Reasonability Check and the Extended Price Range Validation are never applied for Closing-Auction-Only orders.

4.7 Order Profiles

4.7.1 Specific Order Maintenance Rules for Order Categories

All orders that are supported by T7 fall in exactly one of the categories of the following list:

- Normal limit and market orders
- Closing-Auction-Only Orders
- Book-Or-Cancel (BOC) Orders
- Stop Orders
- One-Cancels-the-Other (OCO) Orders

T7 does not support orders that fall in more than one of these categories.

Example 4-4:

It is not possible to enter an OCO order with a BOC restriction.

Furthermore, it is not possible to modify an order so that it changes the category in this list.

Example 4-5:

It is not possible to modify a Stop order to become an OCO order, nor to modify it to become a normal limit or market order. But it is possible to modify a Stop Limit order to become a Stop Market order.

4.7.2 Definition and Assignment of Order Profiles

T7 categorizes orders according to Order Profiles. The exchange defines these order profiles and enables or disables them for individual products.

When defining order profiles, the order types and order restrictions play a role, which are used internally by T7. T7 distinguishes

1. The following internal order types:
    - Regular
    - Stop
    - One-Cancels-the-Other (OCO)
2. The following optional internal order restrictions:
    - Closing-Auction-Only (CAO)
    - Book-Or-Cancel (BOC)

Example 4-6:

A normal limit order has an internal order type Regular and no internal order restriction.

A Book-Or-Cancel order has an internal order type Regular and an internal order restriction BOC. An order with internal order type Stop and an internal order restriction BOC would theoretically be possible, but has been explicitly excluded by the rules outlined in chapter 4.7.1 above.

Note that this notation has been designed to support in an optimal way the business functionality of T7 and therefore differs from the notation used in the external interfaces of the system, which follows the FIX standard.

The following table shows how order profiles look, and which order profiles are applied by Eurex:

Order Profile	Order Profile Attributes									
	Internal Order Types & Restrictions					Allowed Price Condition		Allowed Order Validity		
	Regular	Stop	OCO	CAO	BOC	Limit	Market	IOC	Day	GTD/GTC
Limit Order	✓					✓		✓	✓	✓
Market Order	✓						✓	✓	✓	✓
Closing Auction Limit Order	✓			✓		✓			✓	
Closing Auction Market Order	✓			✓			✓		✓	
Book-Or-Cancel Order	✓				✓	✓			✓	✓
Stop Limit Order		✓				✓			✓	✓
Stop Market Order		✓					✓		✓	✓
One-Cancels-the-Other Order			✓			✓			✓	✓

Configuration Data:

The available order profiles and the assignment of order profiles to products are available in the Products and Instruments Files on the Eurex website, see chapter 1.2 Usage Notes.

Eurex Set Up Information:

Eurex supports stop market orders, OCO orders, BOC orders and closing-auction-only orders exclusively for futures products, but not for options products. Stop limit orders are currently not supported for any product.

The following table shows the assignment of order profiles to products at Eurex:

Order Profile	*All Options Products*	*Futures Products with Closing Auction*	*Futures Products w/o Closing Auction*
Limit Order	✓	✓	✓
Market Order	✓	✓	✓
Closing Auction Limit Order		✓	
Closing Auction Market Order		✓	
Book-Or-Cancel Order		✓	✓
Stop Limit Order			

Order Profile	*All Options Products*	*Futures Products with Closing Auction*	*Futures Products w/o Closing Auction*
Stop Market Order		✓	✓
One-Cancels-the-Other Order		✓	✓

4.7.3 Complex Instrument Orders

T7 accepts for complex instruments only limit orders with any order validity. Market orders as well as orders with any specific internal order type (Stop Orders, OCO Orders) or restriction (Closing-Auction-Only Orders, BOC Orders) are not supported for complex instruments.

Technically, T7 assigns order profiles independently per instrument type. However currently, the only order profile supported for complex instruments in any product is the Limit Order profile.

4.8 Cross Announcement

The Cross Announcement functionality serves to announce a Cross Trade or a Pre-Arranged Trade to the market. A cross trade is a trade where an exchange participant trades against an own order in the order book. In a pre-arranged trade, orders from at least two participants are executed against each other as previously negotiated.

When a user enters a cross announcement, specifying the instrument and the quantity, T7 publishes this information to the market. The corresponding matching orders must then be entered within a certain time frame. See the *Conditions for Trading at Eurex Deutschland and Eurex Zürich* for more information.

5. Quotes

5.1 Quote Characteristics

A Quote is a special kind of order with some specific functionality and a minimal set of attributes. Typically, quotes are sent as pairs of buy and sell quotes, also referred to as Double-Sided Quotes. T7 supports also Single-Sided Quotes, where only a buy quote or only a sell quote is entered for an instrument.

In general, quotes are used for market-making purposes.

A quote in T7 belongs to the session through which it had been entered. A session can only have one buy quote and one sell quote per instrument. If a quote is entered through a session that already has a quote on the same side of the same instrument's order book, then the old quote is replaced by the new one.

A quote must have a limit price. There is no such thing as a market quote without a price limit.

Quotes do not carry clearing related information. But trades resulting from the execution of quotes may be automatically enriched with such information by T7. See chapter 8.2.3 for details.

5.2 Quote Ownership

A quote in T7 is owned by the session through which it had been entered. An old quote is replaced by a new one, if the new quote is sent through the session that owns the old quote.

Each quote has also an owning user which is the one that entered the quote, but the owning user is only of legal relevance. That means that if a user owns a quote on the book and then enters a new quote for the same instrument through a different session, the new quote will be added alongside the old one, rather than replacing it.

However, if a user enters a quote through a session that has already a quote in the order book, then the old quote is replaced by the new quote, even if the old quote had been entered by a different user.

Example 5-1:

There is a quote in the book with owning session 1000 and owning user XYZLOLTR001.

1. *User XYZLOLTR001 enters a new quote through the same session 1000.*

   → The old quote is replaced by the new quote.

2. *User XYZLOLTR002 enters a new quote through the same session 1000.*

   → The old quote is replaced by the new quote.

3. *User XYZLOLTR001 enters a new quote through the other session 1001.*

   → The old quote remains in the book alongside the new quote, because they are owned by different sessions.

Replacing a quote is thus only possible through the session that owns the quote. T7 does not support a way to replace a quote that is owned by a different session.

5.3 Quote Maintenance

5.3.1 The Mass Quote Request

Users maintain individual quotes using Mass Quote Requests. A mass quote request is a list of requests to enter, replace or delete individual single-sided or double-sided quotes.

Traders may supply a Mass Quote Identifier when entering quotes, which takes the place of the client order identifier known for orders. The mass quote identifier identifies the mass quote request and is therefore the same for all quotes contained in the same mass quote request.

In the instrument state Continuous, the entry or the replacement of a quote implies that T7 attempts to execute the incoming quote against the order book. The sequence of the processing of the individual requests in the mass quote request is of relevance only in the case that quotes are executed on entry, e.g. in the context of market maker protection (see the corresponding remarks in chapter 5.5.4), or in the context of synthetic matching (see chapter 11.3).

The requests that are contained in a single mass quote request are processed by T7 in a two-step approach. In the first step, all quotes are logically entered into the book, thereby replacing any old quotes. In the second step, T7's matching engine picks out those quotes that improved the best price on their order book, and attempts to match them as incoming quotes, one after the other, in the sequence, in which they occurred in the mass quote request. In case of a double-sided quote, the buy side is processed before the sell side.

5.3.2 Quote Entry

A user may enter quotes in Quote Entry Mode.

When a new quote is entered in quote entry mode for a specific side in a specific instrument, and if there is no quote belonging to the same session already on that side of the order book for that instrument, then the new quote is simply added.

If there is already an old quote belonging to the same session on that side of the order book for that instrument, then the new quote replaces the old quote. The entered quantity of the new quote becomes the open quantity, while the accumulated executed quantity of the new quote is initialized to zero.

Nevertheless, the new quote will receive the priority timestamp of the old replaced quote, if the price remains the same, and if the new quantity is not higher than the old quote's remaining open quantity. In all other cases, the entry time of the quote defines its time priority.

5.3.3 Quote Modification

Alternatively, T7 supports the entry of quotes in Quote Modification Mode, which adheres to rules that resemble those valid for order modification.

When a new quote is entered in quote modification mode for a specific side in a specific instrument, and if there is no quote belonging to the same session already on that side of the order book for that instrument, then the new quote is not added by T7.

If there is already an old quote belonging to the same session on that side of the order book for that instrument, then the new quote replaces the old quote. The entered quantity of the new quote becomes the total quantity of the new quote, and the accumulated executed quantity of the old quote is taken over as starting value for the accumulated executed quantity of the new quote.

The open quantity of the new quote is then derived as the total quantity of the new quote minus the accumulated executed quantity of the old quote.

In case that the total quantity of the new quote is not greater than the accumulated executed quantity of the old quote, the request to enter a new quote is automatically interpreted as a request to delete the old quote, and no new quote is entered.

Like in quote entry mode, the new quote will receive the priority timestamp of the old replaced quote, if the price remains the same, and if the new open quantity is not higher than the old quote's open quantity. In all other cases, the entry time of the quote defines its time priority.

5.3.4 Quote Deletion on Request

It is possible to delete an individual quote that rests on the order book. The deletion request identifies the quote by side and instrument, and assumes that the quote is meant that belongs to the same session as the one through which the deletion request is sent. It is not possible to delete an individual quote through a different session.

In addition to the deletion of individual quotes with a mass quote request, T7 supports also a special Delete All Quotes Request, which allows the deletion of all quotes at once, which belong to a specified session in a product. Such a request can be sent through any session that belongs to the same business unit.

During an auction freeze instrument state, just as for orders, T7 cannot delete quotes as this would change the order book situation. Like for orders, a request to delete a quote during an auction freeze state is accepted by T7, but the quote is merely marked as pending deletion. The handling of quotes that are marked as pending deletion is identical to the handling of orders in this situation as described in chapter 4.2.3.

5.3.5 Automatic Quote Deletion

Quotes are deleted automatically in the following situations:

- The instrument enters the state Restricted or the state Closed.
- The product enters the state Halt.
- A Volatility Interrupt occurs.
- The owning session gets disconnected.
- In the case of certain risk protection events that require the deletion of all orders and quotes.
- A technical back end partition overload condition has been detected
- A technical failure requires a restart of the central matching engine.

Quotes are always considered as having an order validity of Good-For-Day. However, since quotes are always deleted when the instrument enters one of the instrument states Restricted or Closed, they are in any case already deleted when the End-Of-Day processing starts.

5.3.6 Quote Deactivation

It is possible to deactivate or reactivate all quotes of a session that belong to the same product and optionally to the same instrument type. The deactivation or reactivation is always valid for all the quotes of a session for the specified product and instrument type. It is not possible to deactivate or

reactivate individual quotes.

The scope of a deactivation and of the market maker protection parameters set by the market maker (see chapter 5.5 below) must be the same, i.e.

- Either quotes are activated or deactivated and market maker protection limits are defined for all quotes in a product independent of the instrument type,
- Or all that is done independently for each different instrument type.

The deactivation or reactivation of the quotes of a session can be requested through any session that belongs to the same business unit. Additionally, an automatic deactivation of quotes is triggered in case of a violation of a Market Maker Protection limit (see chapter 5.5 below).

When a session's quotes are inactive, it means that they do not participate in matching and T7 does not take them into account for the calculation of market prices. However, inactive quotes can still be maintained just like active quotes. A trader can thus continue to perform normal quote maintenance, like adding, modifying, and deleting individual quotes, while all the session's quotes for the product and instrument type, including new ones remain inactive, even if all the price validations are done for inactive quotes in the same way as for active quotes.

Note: It is preferable to consider inactive quotes or active quotes as being a status of the owning session in respect to a specific product and optionally instrument type, and this status of the session then affects the behavior of its quotes. In this way it is easy to understand that quotes being active or inactive is a status that exists independently from quotes actually being on the order book. If a trader deactivates the quotes, and then deletes them all, and then later enters new quotes, then these new quotes will still be inactive as long as the trader did not send a reactivation request.

When the quotes of a session are reactivated, T7 does the following for each quote one after the other:

1. The priority timestamp of the quote is updated.
2. The Extended Price Range Validation is applied, provided that the necessary conditions are fulfilled (see chapter 6.3). If the quote exceeds the allowed price range, it is deleted. There is however, no Price Reasonability Check for quotes being reactivated.
3. If the instrument state is Continuous and the quote is executable, the quote is matched as if it were an incoming quote.
4. From then on, if the quote has still an open quantity, it is treated as any active quote on the order book.

T7 processes quote reactivation requests asynchronously, i.e. with a small time delay. This has the effect that a quote reactivation request might be surpassed by another order or quote maintenance request that arrived shortly later. What concerns quote deactivation requests, they are processed without delay immediately upon arrival, the same as it is done for all other order or quote maintenance requests.

In general, T7 processes a buy quote before the sell quote of the same instrument. This can be of relevance e.g. if the reactivation of a buy quote which turns out to be immediately executable, triggers a buy market order on the book (chapter 7.3.5), before the corresponding sell quote is reactivated. At that moment, the session's sell quote for the same instrument is not yet reactivated and thus not yet eligible to match against the triggered market order.

For futures products with synthetic matching, the sequence in which the quotes of different instruments are reactivated can be relevant. T7 follows these principles:

- Quotes of simple instruments are always processed before quotes of complex instruments, i.e. futures contracts before futures spreads.
- For simple instruments, quotes for an instrument with an earlier expiry date are processed before quotes for an instrument with a later expiry date.
- The sequence of processing of instruments that cannot be distinguished by the above rules merely follows the value of the technical instrument identifier in T7. The assignment of technical instrument identifiers by T7 does not follow any rule.

The status of a session's quotes being active or inactive is persistent. It survives all situations when quotes are deleted intra-day, including session disconnect and a technical failure of the central Matching Engine. Quotes being entered after such an event are still inactive, if quotes had been inactive before the event. However at the start of day, all sessions are set to having active quotes, even if they had their quotes being inactive at the end of the previous trading day.

5.3.7 Safeguards

The user may provide a cross ID which prevents the matching against identically tagged orders or quotes of the same business unit by means of the self-match prevention functionality, see chapter 7.7.

In any case, T7 applies the following rules in order to prevent unwanted matching between quotes of the same session or to remove unwanted quotes from the order book:

1. A crossed double-sided quote is rejected by T7.
2. If a new single-sided quote is executable against the same session's old quote on the contra-side of the same instrument's order book, then the old quote is deleted by T7 and the new quote is added. Here the decision if a quote is executable or not does not depend on whether the instrument state would actually allow the execution of the quotes, but is entirely based on the limit price of the buy quote being greater than or equal to the limit price of the sell quote.
3. When many quotes are sent in one mass quote request, they are processed in sequence. T7 prevents a new quote matching against an old quote that is due to be replaced or to be deleted by the same request. This includes explicitly cases of synthetic matching of quotes in different instruments. However, matching against an old quote in a different instrument is not prevented, if that old quote is not due to be replaced or deleted by the same request.
4. If the entry or the deletion of an individual quote is rejected by T7, then T7 rejects both sides of the new quote and it deletes both sides of the session's old quote in the affected instrument.

5.3.8 Regulatory Algorithm Identifier

T7 supports that quote maintenance requests are enriched by a regulatory algorithm identifier if required by the trading surveillance office.

5.4 Quote Validations

5.4.1 Standard Limit Price Validations

The limit price of a quote is subject to the same validations as the limit price of an order:

- It must comply with the price step table that is relevant for the instrument.
- The entering user may request, that the limit prices of the quotes are validated with the Price Reasonability Check. See chapter 6.2 for the details of the Price Reasonability Check.
- Quotes that are not validated with the Price Reasonability Check are tested with the Extended Price Range Validation, provided that this validation is enabled for the product. See chapter 6.3 for the details of the Extended Price Range Validation.

5.4.2 Minimum Quote Size

When a quote is entered, the total quantity of a quote must be greater than or equal to the Minimum Quote Size which is defined individually for each product by the exchange.

The quantity being relevant here is the total quantity of the quote and not its open quantity (see chapter 4.1.2 for the definitions of these terms).

Due to partial executions, the open quantity of a quote may fall below the value of the Minimum Quote Size, but this is not considered to be a violation of the Minimum Quote Size. It is even possible to enter a new replacing quote in Quote Modification Mode (see chapter 5.3.3 above), leaving the open quantity below the Minimum Quote Size, as long as the total quote size remains greater than or equal to the Minimum Quote Size.

The Minimum Quote Size may have a different value during a Fast Market. Typically during a Fast Market, quoting requirements are relaxed, and so the Minimum Quote Size is likely to be lower.

If a quote was successfully entered during a Fast Market, and then the Fast Market ends, the total quantity of that quote is at that point no longer re-tested. It may remain on the order book, even if its total quantity is less than the Minimum Quote Size outside a Fast Market. However, any new quotes are tested again against the value of the Minimum Quote Size outside a Fast Market, even if entered in Quote Modification Mode.

Configuration Data:

The information on minimum quote sizes is published by T7's Reference Data Interface in the product snapshot message (RDI group message name: QuoteSizeRules).

5.4.3 Mandatory Double-Sided Quotes

The exchange may require, depending on the product and the instrument type, that quotes are entered as double-sided quotes.

Configuration Data:

The information, whether quotes for a product are required to be double-sided, is published by T7's Reference Data Interface in the product snapshot message (RDI field name: QuoteSideIndicator). The information is also available in the Trading Parameters File, which is part of the Products and Instruments Files on the Eurex website, see chapter 1.2 Usage Notes.

Eurex and EEX Set Up Information:

Currently, Eurex and EEX do not require double-sided quotes for any product.

If quotes have to be entered as double-sided quotes, then single-sided quotes are rejected, and double-sided quotes are accepted only if the price difference between the buy side and the sell side of the quote does not exceed the Maximum Quote Spread. See chapter 6.4 for the detailed rules including the calculation of the Maximum Quote Spread.

5.5 Market Maker Protection

5.5.1 Overview

T7 offers a Market Maker Protection (MMP) mechanism, which can prevent too many quotes of a market maker matching during a short period of time. The exchange enables or disables this feature on a by product basis.

Configuration Data:

The information, whether market maker protection is enabled for a product, is available in the Trading Parameters File, which is part of the Products and Instruments Files on the Eurex website, see chapter 1.2 Usage Notes.

For the MMP, T7 calculates for each session and each product, several statistics on the traded volumes of the session's quotes. There are four different types of statistics available, the Volume statistic, the Delta statistic, the Vega statistic and the Percent statistic. A detailed description of these statistics is available in chapter 5.5.2 below.

For the calculation of the statistics, only trades are taken into account that occurred in a time window before the last trade. The size of this time window is configured by the market maker.

Depending on the settings that the market maker defined, the statistics are calculated for the traded volume of a session's quotes in a product

1. Either for all trades of the session's quotes in the product, independent of the instrument type.
2. Or independently for each instrument type, for all trades of quotes in instruments that belong to the specific instrument type.

A market maker must ensure that for one session and product, market maker protection and quote deactivation is always done on the same scope, i.e. either independently for each instrument type, or product-wide for all instrument types.

The traded volumes that are counted for quotes in complex instruments are always the traded volumes in the leg instruments.

Example 5-2:

A market maker has configured market maker protection to work instrument type specific for the product OESX. A quantity of 10 of a buy quote in a Call Butterfly standard options strategy for the product OESX is executed. The result of this is a quantity of 10 being bought in the first leg, a quantity of 20 being sold in the second leg and a quantity of 10 being bought in the third leg. The Volume

statistic counts all traded leg volumes and is therefore increased by 40 (=10+20+10). Thus the session's Volume statistic for the instrument type Standard Options Strategy is increased by 40 for the product OESX. The Volume statistic for the instrument type Simple Instrument is not affected, because the quote was a quote for an instrument with the instrument type Standard Options Strategy.

To make use of this mechanism, a market maker must define a set of MMP limit values that correspond to the four different statistics described above, and the size of the time window must also be defined so that it can be applied for the calculation of the statistics. The market maker may define one such set of limit values to be applied to all the session's quotes in the whole product independent of the instrument type. Or alternatively, the limits can be defined independently for each instrument type. The market maker can freely choose, whether any limits are defined at all, and if so for which instrument types and for which statistics.

When a quote is executed, T7 checks whether the owning session has relevant limits defined and if so, it compares the limits with the corresponding traded volume statistics. If one of the limits is exceeded, T7 automatically triggers a quote deactivation that applies to the same scope as the violated limit. If a specific instrument type limit is exceeded, the quotes for that instrument type are deactivated. And if a product wide limit is exceeded, then the quotes in all instrument types are deactivated.

Example 5-2 continued:

Assume now that the market maker that owns the Call Butterfly quote had configured market maker protection to work product-wide for the product OESX. The configured Volume limit is 50 for OESX and the time window size is 2 seconds. One second before the trade in the Call Butterfly instrument, his quote in the simple instrument OESX Jun16 3250 C traded 20 lots, which brought the session's product wide Volume statistic to 20. The new trade of the Call Butterfly quote increases the product wide Volume statistic to 60 (=20+40). This exceeds the configured limit of 50. The session's quotes for OESX are deactivated, and since it was a product wide limit that was exceeded, this happens for the session's quotes for simple instruments, for standard options strategies, for non-standard options strategies and for options volatility strategies.

There is no specific reset action required to allow the session to bring its quotes back into the market after they have been deactivated due to an exceeded MMP limit. A normal reactivation request is enough. The market maker protection limits are again valid immediately after the reactivation.

5.5.2 MMP Statistics Definitions

The four MMP statistics represent four different methods of counting the traded contracts.

The Volume statistic counts the total number of traded contracts.

The Delta statistic holds for futures the difference between the number of bought futures contracts and the number of sold futures contracts. For options, T7 first computes the difference between the number of bought call contracts and the number of sold call contracts. Then it computes the difference between the number of bought put contracts and the number of sold put contracts. Finally, it calculates the Delta statistic as the difference between the two differences.

The Vega statistic holds the number of bought contracts minus the number of sold contracts. It is available only for options, because for futures there would be no difference to the Delta statistic.

For Options, the Volume, Delta and Vega statistics can thus be represented as formulas:

Volume = #BC + #BP + #SC + #SP

Delta = (#BC – #SC) – (#BP – #SP)

Vega = (#BC + #BP) – (#SC + #SP)

where #BC is the number of bought call contracts, #BP is the number of bought put contracts, #SC is the number of sold call contracts and #SP is the number of sold put contracts.

For Futures, these statistics can be represented as follows:

Volume = #BF + #SF

Delta = #BF – #SF

Vega N/A

where #BF is the number of bought futures contracts, and #SF is the number of sold futures contracts.

The Delta statistics and the Vega statistics can be negative. Therefore, it is the absolute values of the Delta statistics and of the Vega statistics that are checked against their respective limits.

The Percent statistic sums up a value that is calculated comparing the traded volume of the quote to the original total size of the quote. For complex instruments it is important to note that it is the traded volume of the quote in the complex instrument itself and not the traded leg volumes that are considered for the Percent statistic.

The idea of the Percent statistic is to have a volume statistics that however gives equal weight to quotes with different quantities in different instruments.

The Percent statistic is defined as:

$$Percent\ Statistic\ = \sum Round\ (\ 100\ \times Traded\ Quantity\ \div Total\ Quote\ Size\ )$$

where the summing is done over all the executions of the session's quotes.

The calculated percentage value for each executed volume is rounded to the nearest integer value (e.g. 2.4% is rounded to 2%, and 2.5% is rounded to 3%), before being added to the Percent statistic.

Example 5-3:

A session's Percent limit for simple instruments in the product OESX is set to 240. Consider three quotes being executed in the sequence as given by the following table.

Side and Instrument	*Total quote size*	*Open at time of execution*	*Size of execution*	*Added to Percent statistic*	*Resulting Percent statistic*
Buy OESX Jun16 3200 C	*100*	*100*	*100*	*100 %*	*100 %*
Sell OESX Jun16 3050 P	*50*	*50*	*40*	*80 %*	*180 %*
Buy OESX Jun16 3400 C	*30*	*20*	*15*	*50 %*	*230 %*
Sell OESX Jun16 3050 P	*50*	*10*	*10*	*20 %*	*250 %*

With the last execution the Percent limit of 240 is exceeded and quotes are deactivated.

Note that the sell quote in the instrument OESX Jun16 3050 P is executed twice. The example illustrates how the Percent statistic compares the quantity being executed to the total quote size rather than to the open quantity at the moment of execution.

5.5.3 Maintenance of the Limits

The MMP limit sets are permanently stored and applied by T7, until they are modified. They can be changed at any moment while the system is accessible.

After a limit modification, there is no check if the new limit is already exceeded. The new values will be taken into account only at the next time that a quote is matched.

The MMP limits are not obligatory. If there is no limit set, T7 does no limit check. Also, if limits are set, but an individual limit has a zero value, the corresponding statistic is not checked by T7. In this way, it is possible to make use of only one or only some of the limits.

The time interval can be set to zero, however this means that the MMP is effectively switched off, even if some limits are defined. It does specifically *not* mean that the MMP reacts if and only if the matching of a single incoming order already exceeds a limit.

5.5.4 Additional Rules for MMP

Exclusion of uncrossing trades

The MMP takes into account only trades that have been executed during the instrument state Continuous. Auction uncrossing trades and in general uncrossing trades when entering the Continuous state, are not taken into account for the MMP statistics. However, trades resulting from a subsequent stop order triggering are taken into account, the same as trades resulting from feeding orders as part of the uncrossing procedure which is done in some cases for complex instruments while entering the instrument state Continuous as described in chapter 11.4.4.

Reset of statistic after limit violation

A statistic value is reset to zero when the corresponding limit is exceeded. If a limit is exceeded, and the affected quotes are reactivated faster than the size of the time window, the trades before the limit were exceeded are no longer taken into account.

Deactivation only after processing of the incoming order is complete

A deactivation due to MMP takes place only after the matching of an incoming order or quote has been completed. If in a synthetic matching situation, an incoming order matches synthetically against several of a session's quotes in different instruments, all these executions are performed, and the quote deactivation is done only afterwards, even if it was already the first of the executions that led to a violation of an MMP limit.

Deactivation during mass quote request processing

Quotes that are sent together in one mass quote request are in this context considered independent incoming orders. Any quote of the incoming mass quote request can be matched and cause a violation of a limit of the session that entered the mass quote request. The consequence of this is a quote deactivation, immediately after the processing of the matching quote and before the processing of the remaining quotes of the mass quote request.

Example 5-4:

A market maker enters a mass quote request with double-sided quotes in the following sequence:

1.	*OESX Jun16 3300 C*	*Buy 100@14.00*	*Sell 100@14.60*
2.	*OESX Jun16 3350 C*	*Buy 100@5.20*	*Sell 100@5.80*
3.	*OESX Jun16 3400 C*	*Buy 100@1.80*	*Sell 100@2.30*
4.	*OESX BUL Jun16 3300 – 3400*	*Buy 100@11.90*	*Sell 100@12.60*

The market maker's quote machine didn't calculate the prices well and so all the sell quotes in the mass quote request happen to be fully executable on entry. The market maker had set 100 as a limit for the Volume statistic of simple instruments and again 100 as a limit for the Volume statistic of standard options strategies. He did not set any product wide limit.

The first quote matches fully with a quantity of 100, which is equal to the limit but does not exceed the limit. Then the second quote matches fully with a quantity of 100, which brings the session's Volume statistic for simple instruments to 200, thus exceeding the corresponding limit of 100. An immediate deactivation for the session's quotes in simple instruments is triggered. The third quote enters the book but is already inactive and so does not match. The fourth quote is not inactive since it does not belong to a simple instrument. It matches fully, which brings the Volume statistic for standard options strategies to 200, a volume of 100 coming from each leg. This finally triggers a deactivation for the session's quotes in standard options strategies.

Deactivation during processing of a reactivation

The situation is similar for the reactivation of the quotes of a session. Quotes being reactivated are processed one after the other like independent incoming orders. That means that if the reactivation of quotes leads to an execution of such a quote, then this might cause an MMP limit to be violated and

thus to an immediate renewed deactivation of the quotes. The reactivation processing is in this case no longer continued for the remaining quotes that had not yet been processed.

5.6 Request For Quote

A Request for Quote (RfQ) is a request that is directed to market makers, which indicates trading interest in a specific instrument. An RfQ can be single-sided or double-sided, and it can optionally carry a quantity. Market makers are informed about an RfQ through the Market Data Interface.

An RfQ is generated either automatically by T7 or on request of a user of the system. The exchange determines by product whether RfQs are supported at all, and if so whether automatic RfQ generation is supported.

Automatic RfQs

If supported for the product, an automatic RfQ is generated, if an incoming market order does not match at entry at all and is written to the order book. Furthermore, an automatic RfQ is generated, if a Stop Market order or an OCO order is triggered and is not immediately matched, not even partially, when being triggered.

Automatic RfQs are generated only if all of the following conditions are fulfilled:

- The instrument state is Continuous.
- There had been no other RfQ for the same instrument shortly before.
- The spread between the best buy price and the best sell price is not narrow enough, or alternatively, the quantity of the best price is not high enough.

An automatic RfQ is always double-sided and carries no quantity.

User Requested RfQs

A user request for an RfQ is accepted only if all of the following conditions are fulfilled:

- The instrument state is Continuous or an auction state.
- There had been no other RfQ for the same instrument shortly before.
- The same user has not entered more than a maximum number of requests for an RfQ for instruments of the product in the last time.
- The spread between the best buy price and the best sell price is not narrow enough, or alternatively, the quantity of the best price is not high enough.

The actual values of the involved time windows, maximum numbers, price spreads and minimum quantities, to be applied for the above conditions depend on configuration parameters that are set by the exchange on a by product basis. The values may also differ during a Fast Market, when quoting requirements may be more relaxed, and thus conditions for the acceptance of requests for an RfQ are stricter.

Configuration Data:

The values of the parameter that controls whether RfQs are supported and of the parameters that limit the frequency of RfQs, are available in the Trading Parameters File, which is part of the Products and

Instruments Files on the Eurex website, see chapter 1.2 Usage Notes.

6. Price Range Tables and their Applications

6.1 Price Range Table Basics

6.1.1 Functionality Overview

T7 makes extensive use of price range tables. The standard Price Range Tables are used to calculate price ranges that are applied for the following purposes:

- The Price Reasonability Check can be used by traders to test the reasonability of their order's or quote's limit price on entry. It is described in chapter 6.2.
- The Market Order Matching Range helps to protect market orders by setting a limit to the trade price at which a market order is executable. The procedure is described in chapter 7.3.
- The Maximum Quote Spread Validation limits the allowed price spread between the buy side and the sell side of a double sided quote, for products where double-sided quotes are mandatory. See chapter 6.4 for details.

The Extended Price Range Tables are used by T7 to force the limit price of incoming orders and quotes to a crude price check, the Extended Price Range Validation, if they have not been validated by the Price Reasonability Check already. See chapter 6.3 below.

6.1.2 Calculation of Price Ranges

A price range table enables the calculation of a price range depending on a reference price. The table consists of a list of consecutive price intervals together with the parameters to be applied for the calculation of the price range, if the reference price falls into the price interval. There are two parameters, the Absolute Price Range Parameter and the Percent Price Range Parameter.

The price range is then calculated depending on the reference price as

$$Price\ Range\ (Reference\ Price) = APR + |Reference\ Price| \times \frac{PPR}{100}$$

where the values for the Absolute Price Range Parameter APR and the Percent Price Range Parameter PPR are taken from the table entry for the price interval that contains the reference price.

Price range tables contain only entries for positive reference prices. In case of a negative reference price, the absolute value of the reference price has to be used, i.e. the value without the minus sign.

During a Fast Market, the price range calculated from the standard Price Range Table or the Extended Price Range Table is increased:

$$Price\ Range\ Fast = Price\ Range\ \times \left(1 + \frac{Fast\ Percentage}{100}\right)$$

where $Price\ Range$ is the price range being calculated as given above, and $Fast\ Percentage$ is a parameter that depends on the product and may differ for the standard price range and the extended price range.

A calculated price range is never rounded, but applied with its exact value.

Example 6-1:

For the options series on the Nokia stock NOA3 that expire in the next 24 months, Eurex has set up the following standard price range tables

Price Interval Start	*Price Interval End*	*Absolute Price Range Parameter*	*Percent Price Range Parameter*
0.00	*1.00*	*0.10*	*0*
1.00	*5.00*	*0*	*10*
5.00	*maximum price*	*0.50*	*0*

The corresponding Fast Market Percentage parameter is set to 100.

This enables a calculation of the price ranges for a few sample reference prices as follows:

Reference Price	*Calculation*	*Resulting Price Range*
0.27	$0.10 + 0.27 \times 0 \div 100$	*0.10*
1.00	$0 + 1.00 \times 10 \div 100$	*0.10*
3.50	$0 + 3.50 \times 10 \div 100$	*0.35*
5.00	$0.50 + 5.00 \times 0 \div 100$	*0.50*
7.80	$0.50 + 7.80 \times 0 \div 100$	*0.50*

During a Fast Market, the values for the price range are doubled:

$$Price\ Range\ Fast = Price\ Range\ \times\ (1 +\ 100/100) = Price\ Range \times 2$$

6.1.3 Availability of Price Range Tables

Standard Price Range Tables and Extended Price Range Tables are set up by product and by instrument type. Standard Price Range Tables for simple instruments are even defined by instrument, as the price ranges may depend on the expiration of the instrument.

Standard Price Range Tables are always available for all products, while the Extended Price Range Validation and thus the related tables are not available for all products.

There is an independent version of the Extended Price Range Tables to be applied for the validation of stop limit orders that are not triggered on entry or modification.

Configuration Data:

The standard price range tables for a specific product are published by T7's Reference Data Interface in the product snapshot message (RDI group message name: PriceRangeRules). The identifier of the relevant standard price range table for a specific instrument is then available in T7's Reference Data Interface's instrument snapshot message (RDI group message name: PriceRangeRules).

The value of the fast percentage parameter to be applied on a standard price range during a fast market is published by T7's Reference Data Interface in the product snapshot message (RDI field

name: FastMarketPercentage). It is also available in the Trading Parameters File, which is part of the Products and Instruments Files on the Eurex website, see chapter 1.2 Usage Notes.

The extended price range tables are available as part of the Products and Instruments Files on the Eurex website, see chapter 1.2 Usage Notes. Related information including the assignment of products to these tables are available in the Trading Parameters File, which is part of the Products and Instruments Files.

6.2 Price Reasonability Check

6.2.1 Procedure

When a user enters or modifies a limit order or a quote, the user can optionally request T7 to perform a Price Reasonability Check on the limit price of the order or quote, and to reject the order or quote, if it fails the check.

The check is performed exclusively in the instrument state Continuous.

The check leads to a rejection of the order or quote, if the limit price of a buy order or quote exceeds a given reference price by more than the standard price range as given in chapter 6.1 above, or if the given reference price exceeds the limit price of a sell order or quote by that amount. The price range is always calculated on basis of the reference price, and not on the basis of the limit price to be checked. I.e. the condition for rejection is

$$Buy\ Limit\ Price\ > Reference\ Price + Price\ Range\ (Reference\ Price)$$

or

$$Sell\ Limit\ Price < Reference\ Price - Price\ Range\ (Reference\ Price).$$

It is possible that no reference price is available and that therefore the price reasonability check can not be done. The user has the choice of whether in this case, the order or quote will be rejected or accepted without a price reasonability check.

6.2.2 Reference Price Determination

For the determination of the reference price, there is a standard procedure, and there is a non-standard procedure for the case that the condition for the standard procedure is not fulfilled. If neither procedure can be applied, then no price reasonability check is done.

In the Standard Procedure, the reference price is the best available price on the side that is opposite to the side of the order to be tested. I.e. for a buy order or quote, the reference price is the best sell price, and for a sell order or quote, the reference price is the best buy price.

The condition for the standard procedure to be applied is that both a best buy price and a best sell price are available, and that the price difference between the best buy price and the best sell price must be smaller than or equal to the price range being applied.

The exception is if there is no best buy price available, then the smallest allowed limit price for the instrument is used instead of the missing best buy price. This is relevant for instruments that have a market price close to zero, and for which a limit price at or below zero is not admitted, like out-of-the-money option series.

The best buy price or best sell price are here understood as the best price as being published in the market data feed. Usually, this is the best limit price available on the order book. But for synthetically

traded products, this may be a synthetic price. See chapter 11.3 for synthetic matching and for the publication of synthetic prices.

If the above-mentioned price spread condition for the standard procedure cannot be fulfilled, then the Non-Standard Procedure is applied. For the non-standard procedure, an alternative reference price must be available. Depending on the product, this is either the last trade price or a theoretical price. If no such price is available, the previous day's settlement price[1] is used instead. If neither a last trade price or theoretical price, nor the previous day's settlement price is available, then there is no alternative reference price available, and the non-standard price reasonability check cannot be performed.

The following table lists which price is being used as the reference price for the price reasonability check in the non-standard procedure. Here, BBP stands for Best Buy Price, and BSP stands for Best Sell Price. TP stands for the alternative reference price, i.e. the Last Trade Price or the Theoretical Price, whichever has to be applied, or in case of non-availability, the previous day's settlement price.

BBP Available	BSP Available	Market Price Condition	Reference price to test incoming buy order	Reference price to test incoming sell order
Yes	Yes	BBP ≤ TP ≤ BSP	TP	TP
		TP < BBP < BSP	BSP	BBP
		BBP < BSP < TP	BSP	BBP
No	Yes	TP ≤ BSP	BSP	TP
		BSP < TP	BSP	BSP
Yes	No	BBP ≤ TP	TP	BBP
		TP < BBP	BBP	BBP
No	No	n/a	TP	TP

Note that in the case of an order modification, the best price being applied in this chapter may be derived from the old limit price of the same order that is being modified. And in the case of quote replacement, the best price may be derived from the old quote which is being replaced by the new quote.

Stop limit orders can also be subject to the Price Reasonability Check. However, for those stop limit orders that are not triggered directly on entry or modification, the reference price to be applied is the stop price of the order itself. The reason is that at the point of order entry, the stop price is the best guess for the market price prevailing at the yet unknown future point in time when the stop order will be triggered.

[1] For Variance Futures (see ch.20.1), the previous day's settlement price in trading notation is applied here, i.e. the previous day's settlement volatility.

6.2.3 Product Settings

T7 allows the exchange to determine by product, whether the Price Reasonability Check is supported at all, and which type of price is used in the non-standard procedure.

Configuration Data:

The values of the parameters that control the settings for the price reasonability check are available in the Trading Parameters File, which is part of the Products and Instruments Files on the Eurex website, see chapter 1.2 Usage Notes.

6.3 Extended Price Range Validation

When a user enters or modifies a limit order or a quote, T7 performs the Extended Price Range Validation on the limit price of the order or quote, if the following conditions are fulfilled:

- The Extended Price Range Validation is enabled for the product and the instrument type.
- The limit price of the order or the quote is not being checked with the Price Reasonability Check, no matter if it is not done because it has not been requested or because the available market price information is not sufficient or because the check is disabled.
- The instrument state is Continuous.

The Extended Price Range Validation leads to a rejection of the order or quote, if the limit price of a buy order or quote exceeds the best sell price by more than the extended price range as given in chapter 6.1 above, or if the best buy price exceeds the limit price of a sell order or quote by that amount. The extended price range is always calculated on the basis of the best price to which the limit price is compared, and not on the basis of the limit price itself. The condition for rejection is:

$$Buy\ Limit\ Price\ > Best\ Sell\ Price + Extended\ Price\ Range\ (Best\ Sell\ Price)$$

or

$$Sell\ Limit\ Price < Best\ Buy\ Price - Extended\ Price\ Range\ (Best\ Buy\ Price).$$

The best buy price or best sell price are here understood as the best price as being published in the market data feed. Usually, this is the best limit price available on the order book. But for synthetically traded products, this may be a synthetic price. See chapter 11.3 for synthetic matching and for the publication of synthetic prices.

It is possible that there is no such best price to which the limit price of the order or quote should be compared. In this case, the Extended Price Range Validation cannot be done, and is skipped.

Stop limit orders can also be subject to the Extended Price Range Validation. However, there is a specific Extended Price Range Table for stop orders to be applied here. Furthermore, for those stop limit orders that are not triggered directly on entry or modification, the best buy price or the best sell price in the formula above is substituted with the stop price of the stop order itself. The reason is that at the point of order entry, this is the best estimate for the market price prevailing at the yet unknown future point in time when the stop order will be triggered.

6.4 Maximum Quote Spread Validation

If the exchange requires that quotes have to be entered as double-sided quotes, then single-sided quotes are rejected, and double-sided quotes are accepted only if the price difference between the buy side and the sell side of the quote does not exceed the Maximum Quote Spread.

The Maximum Quote Spread is determined either as being equal to the Price Range being calculated on basis of the price of the buy quote, or as being equal to the Price Range being calculated on basis of the price of the sell quote, whichever Price Range value turns out to be larger:

$$Maximum\ Quote\ Spread = max[Price\ Range\ (BuyQuote\ Price), Price\ Range\ (Sell\ Quote\ Price)]$$

The double-sided quote is rejected, if the quote spread is greater than the Maximum Quote Spread, i.e.:

$$Sell\ Quote\ Price - Buy\ Quote\ Price > Maximum\ Quote\ Spread$$

As an exception, the entry of a single-sided sell quote is admitted, even if double-sided quotes are mandatory, if the difference between the limit price of the sell quote and the minimum price of the instrument is smaller than the Maximum Quote Spread, i.e.:

$$Sell\ Quote\ Price - Minimum\ Price < Maximum\ Quote\ Spread$$

This is to allow the entry of single-sided sell quotes for out-of-the-money options, for which market makers may consider that even the minimum price is too high for a buy quote.

7. Matching

7.1 Definitions

Orders

For the matching process, T7 treats orders and quotes identically. Therefore, throughout this chapter, the term Order is generally applied to both orders and quotes.

Matching

Matching is the procedure of finding pairs or groups of orders that are executed against each other.

In its simplest form, there is one buy order and one sell order that are both executed at the same execution price and with the same quantity. However in general, several orders on the buy side can be executed against several orders on the sell side. The execution price is the same for all involved orders and the accumulated executed quantity on the buy side must equal the accumulated executed quantity on the sell side. T7 informs the owners of the orders with an execution confirmation, and then creates a trade and forwards this trade to the clearing system.

Direct Matching and Synthetic Matching

The matching of orders that all belong to the same instrument is called Direct Matching. In Synthetic Matching[2], orders of different simple and complex instruments are executed against each other. T7 supports synthetic matching for futures spreads and for inter-product spreads. Synthetic matching is not described in this chapter. Synthetic matching of futures spreads is described in chapter 11.3, and synthetic matching of inter-product spreads is described in chapter 15.4.2. This chapter describes direct matching.

Incoming Orders and Book Orders

The matching procedure makes a difference between Incoming Orders and Book Orders. Strictly speaking, an incoming order is an order that is in the process of being entered, and a book order is an order that is on the order book already.

In the context of matching however, book orders are sometimes treated as incoming orders. These cases are

- Orders that are being modified such that the price is improved,
- Quotes that are reactivated,
- Market orders that are triggered (see chapters 7.3.4 and 7.3.5),
- Stop orders and OCO orders that are triggered (see chapters 4.3 and 4.4),
- Futures spread orders and inter-product spread orders that are fed into the market after an uncrossing (see chapters 11.4.4 and 15.5).

In this chapter therefore, the term *Incoming Order* is applied not only to actual incoming orders, but extended also to book orders given in the above list.

[2] The term Implied Matching is a widely used synonym for Synthetic Matching. Eurex applies the term Synthetic Matching. There is no subtle difference of meaning intended.

Full Match and Partial Match

An order will match fully if its entire open quantity is executed. Since there is nothing left to match, a fully matched book order is removed from the order book, and a fully matched order that is in the process of being entered, is not written to the book.

Or an order matches partially, if not all its open quantity is executed. In this case an order that was already on the order book remains on the order book, and an order that is in the process of being entered and is not an IOC order, is written to the order book. The quantity that was executed is removed from the open quantity and added to the accumulated executed quantity.

It is possible for a single order to get involved in multiple executions at different points in time. For example, an order may be partially executed upon entry, while the remaining open order remains in the order book. The open portion may then be executed a minute later, an hour later, or even days later.

Continuous Trading and Uncrossing

T7 supports essentially two different matching procedures:

1. Continuous Trading: In the instrument state Continuous, the matching engine of T7, attempts to execute an incoming order in the extended sense as described above, immediately against orders on the book. The rules for Continuous Trading are described in chapter 7.2 below.
2. Uncrossing: An auction phase usually ends with an uncrossing procedure that may result in an auction trade. Orders at both sides of the order book are executed against each other at one single auction price, so that afterwards the order book is uncrossed, i.e. there are no longer two orders left on the order book that can be executed against each other. For complex instruments, an uncrossing is done when the instrument state is switched to Continuous without going through an auction phase. The rules for uncrossing are described in chapter 7.4 below.

Order Allocation

Allocation is the procedure to distribute a given quantity among a group of recipients that are able to receive more than is available. In the context of matching, Order Allocation refers to the distribution of a quantity that is available for matching to several orders, the accumulated quantity of which exceeds the quantity that is available for matching.

T7 supports three different order allocation methods which are described in detail in chapter 7.5 below. They are

- The Time allocation method,
- The Pro-Rata allocation method and
- The Time-Pro-Rata allocation method.

The exchange defines by product and by instrument type, which order allocation method is applied in continuous trading and which is applied in auction trades.

Eurex Set Up Information:

Currently, Eurex generally applies the same allocation method for auction trades and in continuous trading. For most products, the Time allocation method is applied. The Time-Pro-Rata allocation

method and the Pro-Rata allocation method are applied in the case of a few specific products, as e.g. the Time-Pro-Rata allocation method in case of the money market future FEU3.

EEX Set Up Information:

Currently, EEX generally applies the Time Allocation method for all products.

Configuration Data:

The information on which order allocation method is applied, is published by T7's Reference Data Interface in the product snapshot message (RDI group message name: MatchRules). It is also available in the Trading Parameters File, which is part of the Products and Instruments Files on the Eurex website, see chapter 1.2 Usage Notes.

7.2 Continuous Trading

7.2.1 Matching Procedure in Continuous Trading

Continuous trading is the matching procedure that is exclusively applied in the instrument state Continuous.

In continuous trading, the matching engine of T7 attempts to execute a single incoming order, incoming in the extended sense as explained in chapter 7.1 above, against book orders on the other side of the order book of the same instrument.

To be executable against a book order, the incoming order must be:

- Either an order to buy at a price at or above the limit price of the sell book order,

or

- An order to sell at a price at or below the limit price of the buy book order.

For market orders there are special rules, which are explained in detail in chapter 7.3 below.

In T7, the procedure for matching an incoming order against several book orders, in any case follows a strict price priority.

The following steps are repeated by the matching engine of T7, for each available limit price level on the order book, until either the quantity of the incoming order is exhausted, or until no more orders on the order book are executable against the incoming order:

1. It finds the best available limit price level on the side of the order book that opposes the incoming order. This is the highest price for the buy side and the lowest price for the sell side.
2. It distributes the remaining available quantity of the incoming order to the book orders at this price level, according to the applicable order allocation method.
3. When all available book orders on the price level have been matched, the price level is exhausted, and the matching engine of T7 continues with the next best available price level.

If at the end, there are no more orders left on the order book against which the incoming order can be executed, and if the incoming order still has a remaining open quantity, then the incoming order is written to the order book, if it was not there already.

The allocation method applied in step 2, matters only if the remaining quantity of the incoming order is

less than the accumulated quantity of the book orders at this price level.

Example 7-1:

Assume that during the instrument state Continuous, the buy order book for FESX Jun16 contains four orders which are listed in the order of their entry time:

- *Order 1: buy 20 contracts at price 3125*
- *Order 2: buy 30 contracts at price 3124*
- *Order 3: buy 10 contracts at price 3125*
- *Order 4: buy 5 contracts at price 3123*

An incoming sell limit order (Order 5, sell 100 contracts at price 3124) is partially executed in two match steps at two trade prices against the buy order book in the following way:

- *First match step at price 3125:*
  - *20 contracts are executed against order 1 at price 3125*
  - *10 contracts are executed against order 3 at price 3125*
- *Second match step at price 3124:*
  - *30 contracts are executed against order 2 at price 3124*

Order 4 is not executed since its limit price 3123 is lower than the limit price 3124 of the incoming sell order. The remaining quantity 40 of the incoming sell order is written to the sell order book.

If the quantity of the incoming sell order had been 25 instead of 100, then the sell order would have been fully matched in one match step at price 3125 against order 1 and order 3. While the distribution of the total executed quantity of 25 among the equally priced orders 1 and 3 depends on the configured allocation method (see below), order 2 is in any case not executed because of its lower price priority.

The limit price of the book order to be matched becomes the execution price. An incoming order may thus match at various execution prices, depending on the limit prices of the book orders that it is executed against.

7.2.2 Match Event Structure

Match Event

The matching of a single incoming order against possibly many orders on the book at various price levels constitutes a Match Event.

Match Step

A match event is subdivided into Match Steps. In direct matching, which is described in this chapter, a match step comprises all matching at a specific price level.

The precise definition of a match step is that it comprises all matching where all the matched book orders are allocated in one distribution step per involved instrument. This however gains relevance only in synthetic matching, where several match steps per price level are possible (see chapter 11.3), and can thus be ignored in this chapter.

Match Step Identifier

Each match step has a Match Step Identifier that is unique on a product level for the business day.

The match step identifier is included in the publicly distributed trade volume reporting data, and at the same time, the match step identifier is also contained in the order execution messages that are received by the owners of the involved orders. In this way, participants are given the ability to link their own order execution information with the public trade volume reporting data.

7.3 Market Order Matching in Continuous Trading

7.3.1 The Market Order Matching Range

Market orders are entered by traders in order to be matched at any price as long as this is the best available price. Like limit orders they may be saved on the book when they cannot match.

The Market Order Matching Range helps to protect market orders against unfair trades. It is applied by defining a price interval around the current market price, outside which a market order is not allowed to match. See the exact rules in the chapters that follow.

Therefore it is possible that in a continuous trading phase, market orders are saved on the book, even if the opposite side of the order book is not empty.

The Market Order Matching Range is identical to the Price Range that is defined in chapter 6.1.2 above. This includes that its value depends on a reference price, and that the value may depend on whether there is a Fast Market or not. Chapter 6.1.2 above applies without changes to the calculation of the Market Order Matching Range.

7.3.2 Matching of Incoming Market Orders

An incoming market buy order can match against orders on the sell order book, if the execution price is not greater than the best buy price plus the Market Order Matching Range, where the Market Order Matching Range is calculated with the best buy price as the reference price.

If there is no best buy price available, then the instrument's minimum price is used instead. This is relevant mainly for out-of-the-money options series.

An incoming market sell order can match against orders on the buy order book, if the execution price is not smaller than the best sell price minus the Market Order Matching Range, where the Market Order Matching Range is calculated with the best sell price as the reference price.

Continuing the use of the definition given in chapter 7.1 above, the term incoming includes

- Orders that are modified from being limit orders to being market orders,
- Triggered stop market orders and triggered OCO orders.

In the case that the instrument supports synthetic matching, the best price that is applied here is the published best price. See chapter 11.3.2 for details on synthetic matching and published best prices.

If the order book situation is such that an incoming market order cannot or can no longer match at a price inside the Market Order Matching Range, then depending on whether it is an IOC order or not, the remaining part of the incoming market order is either cancelled or it is saved on the book, even if there are still orders on the opposite side of the order book.

Example 7-2:

For FESX Jun16, the market order matching range is 10, independent of the price to which it refers.

The sell order book contains the following orders:

- *Order 1: sell 20 contracts at price 3125*
- *Order 2: sell 10 contracts at price 3130*
- *Order 3: sell 30 contracts at price 3132*

The buy order book contains the following orders:

- *Order 4: buy 15 contracts at price 3120*
- *Order 5: buy 30 contracts at price 3118*

A buy market order is entered:

- *Order 6: buy 60 contracts without price limit (market order)*

The best available buy price is 3120. The incoming buy market order can therefore match until a price of 3130, which is determined as the best buy price plus the market order matching range, i.e. 3120 + Range (3120) = 3130.

The incoming buy market order is thus executed against order 1 at price 3125 and against order 2 at price 3130. But it is not executed against order 3 because of the market order matching range. The order is instead written to the order book with a remaining quantity of 30.

7.3.3 Matching of Book Market Orders

If there are one or more book market orders resting on the side of the order book that is opposite to the side of the incoming order, then these book market orders are executed at a trade price that is equal to the best available limit price on the side of the resting market orders.

This means that the execution price, at which a book market order that faces an incoming order is allowed to match, is not extended by the Market Order Matching Range.

In case that synthetic matching is supported, this best available limit price can be a synthetic price, which may differ from the best limit price taken from orders in the same instrument and even from the published best price. See chapter 11.3.2 for details on synthetic pricing.

If there is no such best limit price available, resting buy market orders can still be matched at the instrument's minimum price, which is relevant mainly for out-of-the-money options series.

When book market orders are matched at the same price as the best priced book limit orders, the book market orders are matched together with the best priced book limit orders in one single match step. However, in the order allocation, these market orders and limit orders are allocated separately, and the market orders are allocated first.

Example 7-2 continued (1):

The buy order book for FESX Jun16 contains now the following orders:

- *Order 6: buy 30 contracts without price limit (market order)*
- *Order 4: buy 15 contracts at price 3120*
- *Order 5: buy 30 contracts at price 3118*

And the sell order book contains the following order:

- *Order 3: sell 30 contracts at price 3132*

A limit order to sell 10 contracts at price 3115 is entered. It is fully executed against book market order 6 at the best available buy price of 3120 which is the limit price of order 4.

7.3.4 Book Market Order Triggering by Incoming Orders

An incoming limit order or market order on the same side as a book market order cannot be matched before that book market order.

The term incoming order also applies here to the following:

- Orders that are being modified such that the limit price is improved.
- Quotes that are reactivated.
- Stop orders and OCO orders that are triggered (see chapters 4.3 and 4.4),
- Futures spread orders that are fed into the market after an uncrossing (see chapter 11.4.4).

Thus, in case that an incoming order could be executed, but that there are one or several market orders in the book on the same side as the executable incoming order, then all these book market orders are triggered one after the other, before the incoming order is processed.

The condition for the triggering to occur is strictly that the incoming order would match, at least if the book market order triggering would not be done first. The mere fact that there is an incoming order, or that this order has a better limit price than the currently available best buy price is not sufficient for triggering book market orders.

Market order triggering means that based on the time priority, the book market orders are re-processed one after the other as incoming orders. Compared to the handling of real incoming market orders, the Market Order Matching Range is applied for triggered market orders in a different way as follows, but only if the incoming order is a limit order:

- If the incoming order is a buy limit order, then the execution price of a triggered buy market order cannot be both higher than the incoming order's limit price, and higher than the best available sell price plus the Market Order Matching Range, where the Market Order Matching Range is calculated with the best available sell price as the reference price.
- If the incoming order is a sell limit order, then the execution price of a triggered sell market order cannot be both lower than the incoming order's limit price, and lower than the best available buy price minus the Market Order Matching Range, where the Market Order Matching Range is calculated with the best available buy price as the reference price.

In case that synthetic matching is supported, the best available price can be a synthetic price, which may differ from the best limit price taken from orders in the same instrument and even from the published best price. See chapter 11.3.2 for details on synthetic pricing.

Note that contrary to the case of real incoming market orders, the Market Order Matching Range is here applied to the opposing order book side.

Example 7-2 continued (2):

The buy order book for FESX Jun16 contains now the following orders:

- *Order 6: buy 20 contracts without price limit (market order)*
- *Order 4: buy 15 contracts at price 3120*

- *Order 5: buy 30 contracts at price 3118*

And the sell order book contains:

- *Order 3: sell 30 contracts at price 3132*

Another buy market order is entered:

- *Order 8: buy 10 contracts without price limit (market order)*

The best available buy price is 3120 and the best available sell price is 3132. Their price difference is greater than the market order matching range of 10, and therefore the incoming market order cannot be matched. It is instead written to the order book.

Then a buy limit order is entered:

- *Order 9: buy 20 contracts at price 3130*

This incoming limit order is itself not executable and is therefore written to the order book without execution. Since it is not executable itself, the incoming limit order also does not trigger the book market orders. Therefore, even though the spread between the new best available buy price of 3130 and the best available sell price at 3132 is now smaller than the market order matching range of 10, the book market orders are not triggered and remain on the order book.

Finally, another buy limit order is entered:

- *Order 10, buy 10 contracts at price 3135*

This incoming buy limit order is executable and therefore triggers the book market orders 6 and 8. Their execution limit is now Max (3135 , 3132 + Range(3132)) = 3142.

The triggered book market orders 6 and 8 are thus executed against order 3 at the latter order's limit price of 3132. All three orders get fully executed, leaving the sell order book empty, and so the incoming limit order 10 is written to the order book.

In the case that the incoming order is a market order, the Market Order Matching Range is applied for the execution of the triggered book market order in the same way as for real incoming market orders, i.e.

- If the incoming order is a buy market order, then a triggered buy market order can match, if the execution price is not greater than the published best buy price plus the Market Order Matching Range, where the Market Order Matching Range is calculated with the published best buy price as the reference price. If there is no published best buy price available, it is substituted by the instrument's minimum price.
- If the incoming order is a sell market order, then a triggered sell market order can match, if the execution price is not smaller than the published best sell price minus the Market Order Matching Range, where the Market Order Matching Range is calculated with the published best sell price as the reference price.

In the case that the instrument supports synthetic matching, the published best price may be a synthetic price. See chapter 11.3.2 for details on synthetic matching and published best prices.

In the end, if all book market orders to be triggered have been processed, T7 processes the incoming order. Any stop orders that are triggered by the execution of the triggered book market orders, are processed only after the incoming order has been processed.

BOC orders (see chapter 4.5) never match on entry and therefore do not trigger book market orders.

7.3.5 Book Market Order triggering by Incoming Quotes

Incoming executable quotes trigger book market orders in the same way as incoming orders, see chapter 7.3.4 above. Additionally, quotes that are not executable on entry may trigger book market orders as well, if the conditions outlined in the following are fulfilled. The triggering of the book market orders takes place immediately after the incoming quote has been written to the order book. Where trades occur infrequently, this rule helps matching book market orders in quote driven markets.

The condition to be applied is that the spread of the incoming quote is smaller than or equal to the Price Range as defined in chapter 6.1.2. This condition depends on whether a market order is a buy order or a sell order, i.e. in the case of an incoming double-sided quote,

- buy market orders are triggered, if

  $Sell\ Quote\ Price - Buy\ Quote\ Price \leq Price\ Range\ (Buy\ Quote\ Price)$,

- and sell market orders are triggered if

  $Sell\ Quote\ Price - Buy\ Quote\ Price \leq Price\ Range\ (Sell\ Quote\ Price)$,

The condition is also considered to be fulfilled in the following cases:

- The same conditions are applied when quotes are reactivated rather than real incoming.
- The same conditions are applied when a single-sided quote is incoming, and the other side of the quote is already on the order book.

Additionally, in the case of a single-sided sell quote, the same condition is applied, but by calculating the spread using the instrument's minimum limit price instead of the missing buy quote price, i.e.

- buy market orders are triggered, if

  $Sell\ Quote\ Price - Minimum\ Price \leq Price\ Range\ (Minimum\ Price)$,

- and sell market orders are triggered if

  $Sell\ Quote\ Price - Minimum\ Price \leq Price\ Range\ (\ Sell\ Quote\ Price)$,

The triggering of the book market orders occurs immediately after the quote has been written to the order book. This means that the triggered market orders might match against the quote that triggered it at the limit price of the quote.

If there are market orders eligible to be triggered on both sides of the order book, then only the market orders are triggered on the side of the order book, where the accumulated quantity of market orders is higher. If the quantities on both sides are equal, only the buy market orders are triggered. This will then automatically result in the book market orders on the other side of the order book being fully matched by the triggered market orders.

The price limit for the execution of market orders that are triggered due to the conditions of this chapter is identical to the limit that is applied to incoming market orders. The rules are described in chapter 7.3.2 above.

Example 7-3:

Starting with an empty order book the following orders are entered for FESX Jun16:

- *Order 1: buy 20 contracts at price 3150*
- *Order 2: sell 10 contract at price 3165*

Then the following market orders are entered:

- *Order 3: buy 20 contracts without price limit (market order)*
- *Order 4: sell 20 contract without price limit (market order)*
- *Order 5: sell 10 contract without price limit (market order)*

The difference between the best buy price 3150 and the best sell price 3165 is greater than the market order matching range, which is always 10, no matter for which price it is calculated. Therefore all these market orders cannot be matched and are written to the order book.

Now a double-sided quote is entered:

- *Buy 10 contracts at price 3145 and sell 10 contracts at price 3155*

Both sides of the quote are not executable, and so both sides of the quote are written to the order book without execution.

But the difference between the sell quote price and the buy quote price is equal to the price range for both sides. Therefore, the entry of the double-sided quote triggers the market orders on both sides of the order book.

Since the accumulated quantity of sell market orders (20 + 10 = 30) is greater than the accumulated quantity of buy market orders (20), it is the sell market orders that are triggered.

- *The oldest sell market order 4 is triggered first. Its quantity of 20 is fully executed at price 3150 against the buy market order 3 which in this way gets fully executed as well.*
- *The next sell market order 5 is triggered afterwards. Its quantity of 10 is fully executed at price 3150 against the buy limit order 1 which has a better limit price than the buy quote.*

While all market orders get fully executed, the double-sided quote is not executed at all even though it triggered the execution of the book market orders.

7.4 Auctions and Order Book Uncrossing

7.4.1 Uncrossing Procedure

The uncrossing procedure executes one or more buy orders on the order book against one or more sell orders on the order book at one single execution price, so that:

1. The limit prices of the executed orders are not violated, and
2. Afterwards the order book is uncrossed, i.e. there are no longer two orders left on the order book that can be executed against each other.

The rules that are applied to determine the execution price for an uncrossing procedure are described in chapter 7.4.2 below.

The uncrossing procedure is normally applied at the end of an auction phase. An auction phase is a phase where the instrument state is an auction state, possibly alternating with an auction freeze state.

See chapters 3.2.2 and 3.2.3 for details on these instrument states.

Under exceptional circumstances however, an auction can be cancelled without an uncrossing being done.

Furthermore, the uncrossing procedure must be applied whenever an instrument's state is moved to the Continuous instrument state, even without a previous auction phase. For complex instruments which do not have an auction phase (see chapter 10.3.4), this is the standard case.

Since the main application of the uncrossing procedure is the generation of an auction trade at the end of an auction phase, the uncrossing trade is also called an Auction Trade, and the corresponding trade price is also called an Auction Price, even if no auction phase was involved.

An uncrossing trade is performed as one match event with a single match step (see ch.7.2.2 above for the definitions of these terms). It is reported as an auction trade in the public Trade Volume Reporting.

7.4.2 Auction Price Determination

All orders that are executed in a specific uncrossing procedure, are executed at the same execution price, irrespective of their limit price. This execution price is the auction price of the specific uncrossing procedure.

T7 determines the auction price so that the following two main objectives are reached:

1. Uncrossing: After the auction trade, there will be no two orders left in the order book that are executable against each other. As a consequence, the best sell price that is available after the execution of the auction trade is always higher than the corresponding best buy price. Market orders are considered as being executable against any limit order.
2. Price Continuity: The auction trade price will not be lower than the best buy price that is available after the execution of the auction trade, and it will not be higher than the best sell price that is available after the execution of the auction trade.

As a by-product of fulfilling these two objectives, the principle of Maximizing Executions is fulfilled as well, i.e. the auction price is a price for which the executed volume is maximized.

It is possible, that prices in a whole price range can reach the above objectives. In this case, T7 applies the following additional rules to decide on a single auction price:

3. If the range of possible prices is limited on both sides by limit prices of orders in the order book, then the following formula is applied to calculate the auction price:

$$AP = \frac{BMQ \times LoP + BLQ \times HiP + SLQ \times LoP + SMQ \times HiP}{BMQ + BLQ + SLQ + SMQ}$$

where AP is the auction price,

BMQ is the accumulated quantity of Buy market orders,

BLQ is the accumulated quantity of Buy limit orders, which can be executed at a price in the determined range,

SLQ is the accumulated quantity of Sell limit orders, which can be executed at a price in the determined range,

SMQ is the accumulated quantity of Sell market orders,

LoP is the lowest price of the determined range,

HiP is the highest price of the determined range,

If the resulting price is not a valid price according to the applicable price step table, then the auction price is rounded down to the next valid price.

4. If the range of possible prices is limited only on one side by the limit price of an order in the order book, than this limit price is chosen as the auction price.

Example 7-4:

For FESX Jun16, the order book contains three orders on each side as follows.

- *Buy order book:*
  - *Order 1: buy 5 contracts without price limit (market order)*
  - *Order 2: buy 20 contracts at price 3131*
  - *Order 3: buy 25 contracts at price 3127*
- *Sell order book:*
  - *Order 4: sell 10 contracts without price limit (market order)*
  - *Order 5: sell 15 contracts at price 3128*
  - *Order 6: sell 10 contracts at price 3132*

The main objectives Uncrossing and Price Continuity can be reached with any auction price in the range 3128 to 3131. Below the price 3128, sell order 5 cannot be matched anymore because of its price limit, which reduces the available quantity for the execution to 10. This in turn does not allow buy order 2 to be fully executed. Since the remainder of order 2 and order 5 are crossed, the objective of Uncrossing would not be reached. A similar reasoning applies to prices above 3131.

To select a single auction price in the interval between 3128.0 and 3131.0, the third rule is applied:

$$AP = \frac{5 \times 3128.0 + 20 \times 3131.0 + 15 \times 3128.0 + 10 \times 3131.0}{5 + 20 + 15 + 10} = 3129.8$$

The result is rounded down to 3129.0 as the next lower price consistent with the price step table. The executed quantity is 25.

There are situations where no auction price can be determined and therefore no auction trade is done:

- The order book is not crossed; there are no two orders that can be matched against each other.
- There are only market orders on both sides of the order book. In this case there is no limit price that could serve as a reference for the determination of the auction price. Therefore, no auction trade is done, and the uncrossing condition mentioned above is considered as fulfilled anyway.

7.4.3 Order Allocation in an Uncrossing Trade

The quantity to be matched in an uncrossing trade is either the accumulated quantity of buy orders that can be executed at the auction price, or it is the quantity of sell orders that can be executed at the auction price, whichever is lower. The traded quantity is allocated to the executable orders as follows:

- Orders with a limit price that is better than the auction price, higher in the case of buy orders and lower in the case of sell orders, are fully executed.
- Orders with a limit price that is equal to the auction price are allocated according to the applicable allocation procedure.
- Orders with a limit price that is worse than the auction price, lower in the case of buy orders and higher in the case of sell orders, are not executed at all.

Example 7-5:

For FESX Jun16, the order book contains the following orders:

- *Buy order book:*
  - *Order 1, buy 15 contracts at price 3126*
  - *Order 2, buy 10 contracts at price 3126*
  - *Order 3, buy 15 contracts at price 3125*
  - *Order 4, buy 20 contracts at price 3125*
- *Sell order book:*
  - *Order 5, sell 35 contracts at price 3124*

The determination of the auction price and quantity yields an execution of 35 contracts at an auction price of 3125. Prices below 3124 or above 3125 would not reach the objective of Uncrossing. A price of 3124 or between 3124 and 3125 would not reach the objective of Price Continuity. Only a price of 3125 reaches both objectives. The execution of the individual orders is then done as follows:

- *The better priced buy orders 1 and 2 with an accumulated quantity of 25 are fully executed at the auction price of 3125.*
- *The remaining quantity of 10 is distributed among the second best priced orders 3 and 4, depending on the configured allocation method. For FESX, this is the time allocation method. Therefore, the remaining quantity of 10 is entirely allocated to order 3 which has the higher time priority as compared to order 4.*
- *Sell order 5 is fully executed at the auction price of 3125 which is better than the order's price limit.*

7.5 Order Allocation Methods

7.5.1 Overview

An Order Allocation Method describes how a tradable quantity is shared amongst a group of eligible orders, if the tradable quantity is insufficient to allow all eligible orders to be fully executed.

T7 always observes a strict price priority. This means that an eligible limit order receives a share only, if all market orders and all limit orders with a better limit price are fully matched. Therefore, the different order allocation methods describe different ways on how to distribute a tradable quantity to be shared amongst orders of the same price level, if that tradable quantity is lower than the accumulated quantity of the orders at that price level.

Currently, T7 supports three order allocation methods which are explained in detail in the following subsections:

1. Pro-Rata Allocation: This allocation is based on the quantity ratio defined by the individual book order quantity divided by the total accumulated quantity of all price best book orders. The matched quantity of a book order is given by the multiplication of its quantity ratio and the quantity of the incoming order. In this way, all price best book orders are considered for execution. The Pro-Rata Allocation method is described in chapter 7.5.2.
2. Time-Pro-Rata Allocation: The price best orders are sequenced by their time priority. Orders with a higher time priority receive a higher matched quantity compared to the Pro-Rata Allocation at the expense of orders with a lower time priority. Compared to the Time Allocation, orders with a high time priority receive a lower matched quantity. Depending on the specific order book situation, it may be possible that not all price best orders are considered for execution and, consequently, the number of orders considered by the Time-Pro-Rata Allocation is smaller compared to the Pro-Rata Allocation. The Time-Pro-Rata Allocation method is described in chapter 7.5.3.
3. Time Allocation: The price best orders are sorted by their time priority. The first price best order is filled as much as possible and the remaining quantity of the incoming order is passed to the next price best order. Usually, the number of orders that receive a share in the case of the Time Allocation is smaller compared to the case of the Time-Pro-Rata Allocation or of the Pro-Rata Allocation. The Time Allocation method is described in chapter 7.5.4.

The enumeration of the different order allocation methods indicates an increase of the time sensitivity which is defined by the impact of the orders' time priority on the order allocation. While the Pro-Rata Allocation does not show any time sensitivity, the Time-Pro-Rata allocation may be characterized by a medium-scale time sensitivity. And the Time Allocation obviously has the strongest possible time sensitivity.

T7 allows the exchange to define by product and by instrument type which order allocation method is applied in continuous trading and which is applied for auction trades.

Another type of allocation is path allocation in synthetic matching, which is not to be confused with order allocation. Path allocation is described as part of the synthetic matching procedure for futures spread instruments in chapter 11.3.5.

7.5.2 Pro-Rata Allocation

The pro-rata allocation method first sorts the eligible orders by their open quantity, orders with larger open quantity coming first. If there are orders with the same open quantity, these are then sorted between them by their time priority, orders with an older time priority stamp preceding those with a newer priority time stamp.

It then calculates the allocated share for one eligible order after the other in the sequence that they have just been sorted, with the following procedure:

1. Divide the quantity of the order by the sum of the quantities of all eligible orders that are still left to receive an allocation.
2. Multiply the result by the remaining tradable quantity to be allocated among the eligible orders.

3. If the result is not an integer number, then round the result up to the next highest integer number. The result is the allocation for the concerned order.

This calculation of the allocated share can also be expressed with the help of a mathematical formula:

$$a_i = MIN\left[q_i, ROUNDUP\left[A_i \times \frac{q_i}{Q_i}\right]\right]$$

where a_i is the quantity that is allocated to the order at position i in the sorted list of eligible orders,

MIN is the minimum function, i.e. $MIN[X,Y]$ is either X or Y, whichever is smaller,

q_i is the open quantity of the order at position i in the sorted list of eligible orders,

$ROUNDUP$ means that the computed value is rounded up to the next higher integer number,

$A_i = \left(A - \sum_{k=1}^{i-1} a_k\right)$ is the quantity available to be allocated to the order at position i in the sorted list of eligible orders, which is given by the total quantity A to be allocated minus the sum of the quantities a_k that were already allocated to the orders, which are placed higher in the sorted list of eligible orders.

$Q_i = \sum_{k=i}^{n} q_k$ is the accumulated open quantity of all eligible orders that have not yet been allocated their share.

Note that the rounding effects may result in a slight preference of larger orders, and in case of equal open order quantities in a slight preference of older orders.

Example 7-6:

A quantity of 25 is to be allocated among three orders in the order book with a total open quantity of 90. Their time priority is given by the sequence in the following list, highest time priority first:

- *Order 1: Quantity 20*
- *Order 2: Quantity 20*
- *Order 3: Quantity 50*

For the Pro-Rata Allocation, these orders are sorted by quantity first. The two orders with the same quantity are then sorted by time priority. The allocation quantities are iteratively calculated.

Order Priority	Order Quantity	Allocation calculation	Result before rounding	Final allocation after rounding
Order 3	50	25 * 50 / 90	13.89…	14
Order 1	20	(25 - 14) * 20 / 40	5.5	6
Order 2	20	(25 – 14 - 6) * 20 / 20	5	5

The highest allocation goes to the largest order. The allocation for the two equal sized orders is nearly the same, but the rounding gives a slight precedence to the order with the higher time priority.

7.5.3 Time-Pro-Rata Allocation

Time-Pro-Rata Allocation Procedure

The procedure for the time-pro-rata allocation comprises of two allocations which are executed in two consecutive steps, first a basic allocation step and then a remainder allocation step. With the basic allocation, the quantity is distributed close to an Ideal Time-Pro-Rata Allocation formula. The basic allocation allocates only the integer parts of the Ideal Allocation Quantities leaving the accumulated fractional shares for allocation in the remainder allocation.

In detail, the procedure works as follows:

1. Basic Allocation Step:
    i. Calculate the Ideal Allocation Quantity for each order according to the Ideal Time-Pro-Rata Allocation that is described further below.
    ii. The ideal allocation quantity is a number which is not subject to any integer requirements. Therefore, round down the ideal allocation quantities to the next integer value. The rounded value is allowed to be zero. This gives the allocation quantities of the basic allocation for each order.
    iii. If, by chance, all of the ideal allocation quantities have been integer numbers already, the allocation quantities of the basic allocation constitute already the final order match quantities and the procedure is finished. Or there is a remaining quantity that needs to be allocated in the remainder allocation step as follows.
2. Remainder Allocation Step:
    i. The remaining quantity that is to be allocated is obtained by subtracting the quantities that have been allocated in the basic allocation step from the total quantity to be allocated.
    ii. The remaining quantity is then distributed according to the Remainder Allocation Procedure which is described further below. For this allocation, only orders are considered which have a non-zero open quantity remaining after the basic allocation. This gives the allocation quantities of the remainder allocation for each order. Due to the design of the allocation procedure, each book order receives, at most, one additional unit of quantity in the remainder allocation.
    iii. The allocation quantities of the basic allocation and the remainder allocation are added up to give the final order match quantities.

The following two sub-chapters describe in detail the two allocation methods that are part of the time-pro-rata allocation procedure as described above.

Ideal Time-Pro-Rata Allocation

This sub-chapter describes the determination of the ideal allocation quantities, which constitutes the sub-step i of the basic allocation step as described above.

The ideal time-pro-rata allocation calculates the ideal allocation quantities in an iterative procedure. To this end, the orders are sorted in descending time priority, i.e. older orders that have the higher time priority come first.

The procedure then iterates over the eligible orders one after the other to determine the ideal allocation quantity for each order applying the following formula:

$$\tilde{a}_i = MIN\left[q_i, \left(\tilde{A}_i \times \left(1 - \left(1 - \frac{q_i}{Q_i}\right)^2\right)\right)\right]$$

where $\tilde{a}_i$ is the ideal allocation quantity for the order at position i in the sorted list of eligible orders,

MIN is the minimum function, i.e. $MIN[X,Y]$ is either X or Y, whichever is smaller,

q_i is the open quantity of the order at position i in the sorted list of eligible orders,

$\tilde{A}_i = \left(A - \sum_{k=1}^{i-1} \tilde{a}_k\right)$ is the total quantity A available to be allocated minus the sum of the ideal allocation quantities $\tilde{a}_k$ of the orders, which are placed higher in the sorted list of eligible orders.

$Q_i = \sum_{k=i}^{n} q_k$ is the accumulated open quantity of those eligible orders, for which the ideal allocation quantity still needs to be calculated.

Note that the values of the ideal allocation quantities are in general not integer numbers. The calculation of the above formula and thus the result of the time-pro-rata allocation procedure itself, may therefore be influenced by the arithmetic precision that is applied.

Remainder Allocation Procedure

This sub-chapter describes the remainder allocation procedure, which is applied in the sub-step ii of the remainder allocation step as described above. The remainder allocation procedure distributes the quantity that remains to be allocated after the basic allocation step.

Only orders that have not been already fully allocated in the basic allocation step, are considered in the remainder allocation procedure. First, the remainder allocation procedure sorts these orders by quantity, and then by priority time. This means, larger orders come in any case before smaller orders, and only if orders have the same quantity, then the order with the older priority time stamp comes first. The quantity considered in this sorting procedure is the open quantity of the order available for the entire time-pro-rata allocation, and not only what is left after the basic allocation step.

The remainder allocation procedure then distributes the remaining quantity by going through this list from the beginning to the end, and allocating a quantity of 1 to each order, until the remaining quantity is exhausted. That means if there are N Orders in the list and the remaining quantity to be distributed is K, then the first K Orders receive an allocation of 1, while the last $N - K$ orders receive nothing in the remainder allocation procedure.

Example 7-7:

A quantity of 25 is to be allocated among three orders in the order book with a total open quantity of 90. Their time priority is given by the sequence in the following list, highest time priority first:

- *Order 1, Quantity 20*
- *Order 2, Quantity 20*
- *Order 3, Quantity 50*

In the Basic Allocation Step, the orders are sorted by time priority. The ideal allocation quantities are

calculated in full precision for all orders. Finally, the ideal allocation quantities are rounded down to get final allocation quantities of the Basic Allocation Step.

Order Priority	*Order Quantity*	*Ideal Allocation Quantity*	*Rounded Allocated Quantity*
Order 1	*20*	*9.87…*	*9*
Order 2	*20*	*7.40…*	*7*
Order 3	*50*	*7.71…*	*7*
Sum	*90*	*25*	*23*

The difference between the total quantity to be allocated, and the sum of the rounded allocation quantities of the Basic Allocation Step turns out to be $25 - 23 = 2$*. This is the remaining quantity that is distributed in the Remainder Allocation Step.*

In the Remainder Allocation Step, the orders are sorted by quantity first. The two orders with the same quantity are then sorted by time priority. The remainder quantity of 2 is now allocated one by one to the orders sorted in this way.

Order Priority	*Order Quantity*	*Basic Allocations*	*Remainder Allocated*	*Total Allocated*
Order 3	*50*	*7*	*1*	*8*
Order 1	*20*	*9*	*1*	*10*
Order 2	*20*	*7*	*0*	*7*
Sum	*90*	*23*	*2*	*25*

The result shows that both the time priority and the order size play a role in the allocation. The higher time priority of Order 1 gives it a bigger share than Order 3. But since the order size matters as well, Order 3 gets still a bigger share than Order 2, notwithstanding the lower time priority. The last table below compares the results of the three allocation methods for the current example.

Order Priority	*Order Quantity*	*Time Allocation*	*Time-Pro-Rata Allocation*	*Pro-Rata Allocation*
Order 1	*20*	*20*	*10*	*6*
Order 2	*20*	*5*	*7*	*5*
Order 3	*50*	*0*	*8*	*14*

7.5.4 Time Allocation

The time allocation method first sorts the eligible orders by their priority time stamp, orders with an older priority time stamp coming first.

It then determines the allocation for one eligible order after the other in the sequence that they have just been sorted. Each order receives an allocated quantity that is equal to its open quantity, provided that the quantity left to be allocated after the previous orders in the list got their share, is sufficient. If that quantity is not sufficient, then the order is allocated whatever remaining quantity was left to be allocated. In this way, it is possible that orders, which are last in the list, receive nothing.

Note that the term "Time Allocation" is a synonym of the term "Price-Time Allocation". The term "Time Allocation" is applied here, because price priority is something that is a common feature of all

matching procedures in T7, independent of the order allocation method. What distinguishes the time allocation method from other order allocation methods is the priority time being the only criteria for the allocation among orders of the same price level.

This calculation of the allocated share can also be expressed with the help of a mathematical formula:

$$a_i = MIN[q_i , A_i]$$

where a_i is the quantity that is allocated to the order at position i in the sorted list of eligible orders,

MIN is the minimum function, i.e. $MIN[X,Y]$ is either X or Y, whichever is smaller,

q_i is the open quantity of the order at position i in the sorted list of eligible orders,

$A_i = \left(A - \sum_{k=1}^{i-1} a_k \right)$ is the quantity available to be allocated to the order at position i in the sorted list of eligible orders, which is given by the total quantity to be allocated A minus the sum of the quantities that were already allocated to the orders, which have a higher priority.

Example 7-8:

A quantity of 25 is to be allocated among three orders in the order book with a total open quantity of 90. Their time priority is given by the sequence in the following list, highest time priority first:

- *Order 1, Quantity 20*
- *Order 2, Quantity 20*
- *Order 3, Quantity 50*

For the time allocation, these orders are sorted by time priority. The first order is fully allocated. The remaining quantity is given to the second order, and since nothing is left, the third order receives nothing.

Order Priority	*Order Quantity*	*Quantity Available To be Allocated*	*Allocated Quantity*
Order 1	*20*	*25*	*20*
Order 2	*20*	*25 – 20 = 5*	*5*
Order 3	*50*	*25 – 20 – 5 = 0*	*0*

Since order 3 has the lowest time priority, it receives nothing, even though it is the largest order.

7.6 Volatility Interrupt

7.6.1 Overview

The Volatility Interrupt is a special mechanism that is applied during continuous trading, in order to prevent large deviations of execution prices in a short period of time.

To this end, T7 compares each execution price to recent execution prices in the same instrument, and if the price difference is considered excessively large, it stops continuous trading and automatically starts a volatility auction in the affected instrument or in the affected product.

The exchange enables or disables the Volatility Interrupt functionality by product. It is applied only to trading in simple instruments. There is no Volatility Interrupt for complex instruments.

Configuration Data:

The information, whether the volatility interrupt functionality is enabled for a product at all and if so for which instrument, and whether a volatility auction is started in all instruments of the product or only in the affected instrument, is available in the Trading Parameters File, which is part of the Products and Instruments Files on the Eurex website, see chapter 1.2 Usage Notes.

EEX Set Up Information:

Currently, EEX does not support Volatility Interrupts for any product.

Eurex Set Up Information:

Currently, Eurex supports Volatility Interrupts for many futures products, including most bond and index futures.

7.6.2 Procedure

Before T7 executes an incoming order at a new execution price, the central matching engine checks the new execution price against all execution prices in the same instrument that occurred in a short time interval before the current transaction. This includes the executions of the incoming order that have already occurred at different prices.

If T7 finds an execution price in that time interval, which differs too much from the new execution price, then a Volatility Interrupt is applied as follows:

1. The execution at the offending new execution price and any further executions of the incoming order are prevented.
2. The instrument state is changed to Volatility Auction. Depending on the instrument where the volatility condition is detected, the state change is done either only for the concerned instrument or for all simple instruments of the product. Exceptions for the latter case are simple instruments that are neither in the state Continuous, nor in an auction state or an auction freeze state, e.g. expired instruments. Complex instruments may also change their states, due to the automatic dependency of their states on the states of their leg instruments (see ch.10.3.4).
3. The incoming order is written to the book, or in case of an IOC order it is cancelled. Executions of that order that had been done at other prices before the condition was detected remain valid.
4. All quotes and all non-persistent orders are deleted for the simple instruments that are moved to the state Volatility Auction. Only persistent orders are kept. And the same happens to all quotes and non-persistent orders of all the complex instruments that have at least one leg instrument, the state of which is moved to Volatility Auction.

The prevention of the offending execution means in effect, that the cause of a Volatility Interrupt is not visible in the public trade volume reporting.

7.7 Self-Match Prevention

Self-match prevention is an optional functionality which allows a business unit to prevent that certain own orders of the same instrument match against each other. Self-match prevention is supported during continuous trading, but not in any matches in an auction or order book uncrossing. Self-match prevention is not supported for synthetic matching, i.e. it does not prevent matches between orders of different instruments as described in chapters 11.3 and 15.4.2.

When an incoming order (in the extended sense as defined in chapter 7.1) and a book order would match against each other, T7 checks whether they are owned by the same business unit and whether they carry the same user supplied cross ID. If that is the case, the match between the two orders is prevented and the quantity which would have matched is removed from the order quantity, for both the incoming order and the book order. For a book order that would have partially matched, the total order quantity is reduced by the quantity that would have matched, and the remainder remains on the book. A book order that would have fully matched is deleted.

For the incoming order, if there is still a remaining open quantity left after its quantity is reduced by the prevented match quantity, then this remainder of the incoming order is allowed to match further but only on the same price level. It is also possible that further matches on that price level are again prevented due to self-match prevention. After matching completed on that price level, any remaining open quantity left for the incoming order is cancelled, effectively preventing the incoming order to match on further price levels.

Eurex Set Up Information:

Eurex supports self-match prevention for selected products. Eurex publishes in the Functional Product and Instrument file whether self-match prevention is enabled for a product.

EEX Set Up Information:

Currently, EEX does not support the self-match prevention functionality.

Example 7-9:

The buy order book for the instrument FESX Jun16 contains the following book orders which are listed in the order of their time priority:

- *Order 1: buy 20 contracts at price 3125 Business Unit ID=2345*
- *Order 2: buy 15 contracts at price 3124 Cross ID=12345 Business Unit ID=1111*
- *Order 3: buy 10 contracts at price 3125 Cross ID=67890 Business Unit ID=3456*
- *Order 4: buy 5 contracts at price 3123 Business Unit ID=4567*
- *Order 5: buy 5 contracts at price 3124 Business Unit ID=5678*

There is an incoming sell limit order with a cross ID:
Order 6, sell 200 contracts at price 3123, Cross ID=12345, owned by Business Unit ID=1111

The incoming order is partially executed on the first price level 3125 against order 1 with 20 contracts and against order 3 with 10 contracts. Order 3 does have a cross ID, but it is of no relevance for this match, because the owning business unit of this order is not the same as the one of the incoming order. After that, the incoming order has a remaining open quantity of 170 contracts left, and matching continues on the next price level.

At the next price level 3124, the incoming order would match first against order 2. As order 2 is owned by the same business unit (Business Unit ID=1111) and carries the same cross ID (cross ID=12345) as the incoming order, the self-match prevention functionality is applied here. Book order 2 is deleted and the open quantity of the incoming order is reduced by 15. Then at the same price level, the matching of the incoming order continues with matching against order 5 with 5 contracts.

At that point, the incoming order has a remaining quantity of 150 and would normally continue to match at the next price level 3123. But as the incoming order had been subjected to self-match prevention, it is not allowed to match on further price levels. Instead the remaining open quantity of the incoming order is cancelled at this point, which prevents the execution of the incoming order on further price levels.

In total the effect on the orders is as follows:

- *Order 1 is fully matched with quantity 20 at price 3125.*
- *Order 3 is fully matched with quantity 10 at price 3125.*
- *Order 5 is fully matched with quantity 5 at price 3124.*
- *Order 2 is deleted due to self-match prevention.*
- *Order 4 remains unchanged in the book.*
- *The incoming order is executed with 35 contracts at prices 3125 and 3124. The remaining open quantity of the incoming order is deleted because of self-match prevention.*

8. Trade Management

8.1 Overview

T7 is a trading system, the purpose of which is to receive orders and quotes, and to match these, thereby creating trades. Finally, it forwards all created trades to the appropriate clearing system depending on the product.

T7 offers therefore no clearing functionality and only limited trade management functionality, which is described in this chapter.

The trade management functionality offered by T7 includes:

- For both orders and quotes, the automatic enrichment of trade items with the identification of the trading member and of the clearing member as known to the clearing system.
- For quotes and for a specific type of orders, the automatic enrichment of trade items with pre-defined values for clearing related information.
- A trade reversal and trade entry facility available exclusively to market supervision.

8.2 Handling of Clearing Related Information

8.2.1 Member Information for the Clearing System

T7 automatically adds to each trade item the corresponding information about the trading member and the clearing member as known to the clearing system that receives the trade.

The underlying assumption is that all the trades of a specific participant are cleared by the same clearing member.

8.2.2 Entering Clearing Related Information for Orders

On an order, it is possible to specify values for the following attributes that are not trading related and are forwarded in the trade items to the clearing system:

- Open/Close Indicator: The open/close indicator specifies whether the trade should be used to open a position or to close a position. For complex instruments, the open/close indicator is available independently for each leg of an order.
- Clearing Account: The clearing account is the position account used in the clearing system. It is also used by the Eurex clearing system to decide if a trade shall be given up to another member, or whether it shall be marked for give-up. For complex instruments, the clearing account is available independently for each leg of an order.
- Take-Up Member: The take-up member is the member as known to the clearing system, to which a trade will be given up.
- Text Fields: There are three printable text fields that can be freely used for various purposes.

T7 does not validate or modify the values of these attributes, but forwards them unchanged to the clearing system. The clearing system will then handle invalid data in an appropriate way.

8.2.3 Automatic Trade Enrichment

For quotes and also for orders, which are sent with a special small message layout, clearing related information as described above cannot be provided directly on the order or quote. Instead, participants can submit trade enrichment rules that are then used by T7's trade manager to fill clearing related attributes on trade items before sending them to the clearing system.

This automatic trade enrichment is available for quotes, and it is available for orders, which are sent with the small message layout. It is not available for orders, which are sent with the normal long message layout, which contains the fields for the clearing related attributes. See the document *Eurex Enhanced Trading Interface – Manual* for details on order message layouts.

The automatic trade enrichment is available for the following attributes:

- Open/Close Indicator
- Clearing Account
- Text Fields
- Take-up Member

Participants may submit several different trade enrichment rules to the exchange, identifying them with different integer numbers. For each order or quote, the trade items of which shall be automatically enriched, the identifier of the desired trade enrichment rule needs to be supplied on the order or quote.

If no trade enrichment rule with the supplied identifier exists, or if the desired trade enrichment rule contains no value for a specific attribute, T7 forwards the trade item to the clearing system without giving any value to this attribute. The clearing system may then set the clearing account and, in case of orders, the open/close indicator appropriately.

8.2.4 Additional Fields for Cooperation Products

The Eurex/KRX Link

In the context of a cooperation agreement between the Korea Exchange (KRX) and Eurex, participants may trade a specific product OKS2, the daily futures on the KOSPI 200 index option, on T7 as part of the Eurex market. Trades are then transferred through the Eurex clearing system to the KRX for clearing and settlement. For details please refer to the web page about the Eurex/KRX link on the Eurex web site.

Trades in this product must carry the related information about the KRX Member ID and about the KRX Beneficiary. The Eurex clearing system transports this information in the first of the three text fields. Therefore, for the OKS2 product this text field is not available to be used by members for their own purpose.

For orders with the normal message layout, the KRX Member ID and the KRX Beneficiary Account must be provided by the participant on the order already at the time of order entry.

Participants that enter orders with the small message layout or quotes in the OKS2 product, must have communicated the default KRX Member ID and the default KRX Beneficiary Account to the Eurex Member Services and Admissions in advance. Additionally, they may submit trade enrichment rules as described in chapter 8.2.3 above that contain specific values for the KRX Member ID and the KRX Beneficiary Account.

Trades in this product, that originate from the execution of orders with the small message layout or of

quotes, are then automatically enriched by T7, either with the information given in the specified trade enrichment rule, if available, or else with the previously submitted information about the default KRX Member ID and the default KRX Beneficiary Account.

The Eurex/TAIFEX Link

In the context of a cooperation agreement between TAIFEX, the Taiwan Futures Exchange, and Eurex, participants can trade daily futures contracts on TAIEX options and futures on T7 as part of the Eurex market. The Eurex TAIFEX products expire daily into obligations to deliver the corresponding options/futures positions into the TAIFEX market, prior to the market opening at TAIFEX, following the closing at Eurex Exchange. For details please refer to the announcements about the Eurex/TAIFEX link on the Eurex web site.

Trades in these products must carry the related information about the TAIFEX Member ID, the TAIFEX Branch ID and the TAIFEX Beneficiary. The Eurex clearing system transports this information in the first and in the third of the three text fields. For the TAIFEX link products, these two text fields are therefore not available to be used by members for their own purpose.

For orders with the normal message layout, the TAIFEX Member ID, the TAIFEX Branch ID and the TAIFEX Beneficiary must be provided by the participant on the order already at the time of order entry.

Participants that enter orders with the small message layout or quotes in the TAIFEX link products, must have communicated the default TAIFEX Member ID, the default TAIFEX Branch ID and the default TAIFEX Beneficiary to the Eurex Member Services and Admissions in advance. Additionally, they may submit trade enrichment rules as described in chapter 8.2.3 above that contain specific values for the TAIFEX Member ID, the TAIFEX Branch ID and the TAIFEX Beneficiary.

Trades in these products, that originate from the execution of orders with the small message layout or of quotes, are then automatically enriched by T7, either with the information given in the specified trade enrichment rule, if available, or else with the previously submitted information about the default TAIFEX Member ID, the default TAIFEX Branch ID and the default TAIFEX Beneficiary.

8.3 Trade Entry and Trade Reversal

In exceptional circumstances, a market supervision may decide to enter a trade directly into T7 without going through the normal order book matching procedure, or it may decide to reverse a trade that has already happened. An important use case is the reversal of mispriced trades.

Such events may have an effect on the trade statistics data that is published through the market data interfaces of T7. See chapter 9.3 for more information on this topic.

8.4 Conversion Procedure for Variance Futures

For Variance Futures, trading on T7 is performed in volatility σ as pricing information and in vega notional v as quantity information. The corresponding volatility-vega representation is denoted as (σ, v) trading notation. However, clearing of Variance Futures is performed in a different variance pricing notation, with futures price $\mathrm{P_t}$ and futures quantity $\mathrm{Q_t}$ which is denoted as $(\mathrm{P_t}, \mathrm{Q_t})$ clearing notation.

Each match in a variance futures instrument thus generates a trade in the (σ, v) trading notation, which is converted by T7 into the $(\mathrm{P_t}, \mathrm{Q_t})$ clearing notation. Trades are communicated to the clearing

system only in the (P_t, Q_t) clearing notation.

As the values for the conversion parameters are known only at the end of the trading day, T7 does a preliminary conversion at the time of the trade, leading to preliminary values for (P_t, Q_t), based on the previous day's values of the conversion parameters. The preliminary trade information is immediately communicated to the clearing system. At the end of the trading day, when the day's conversion parameter values have been approved, T7 calculates the final (P_t, Q_t) values and replaces the preliminary trades with the final trades.

For details on Variance Futures at Eurex, please refer to chapter 20.1 of this document and further on to the specific documentation on Variance Futures on the Eurex web site.

9. Market Data Publishing

T7 provides market data in several ways:

1. The Eurex Enhanced Market Data Interface (Eurex EMDI) provides price level aggregated market data without netting for high bandwidth customers. Without netting means that every single change to the market data is made visible, and every single match is reported individually. Price level aggregated market data means that Eurex EMDI delivers order book information in the form of the accumulated available quantities for price levels. The number of reported price levels is limited. For instruments with synthetic matching, this includes synthetic price and quantity information on the best available price level.
2. The Eurex Market Data Interface (Eurex MDI) provides price level aggregated market data with netting for low bandwidth customers. With netting means that changes of the order book information are aggregated over a time interval with a product dependent duration. And the same happens to the trade reporting, such that only snapshots of the general trade statistics are provided, but there is no reporting of every individual match. Like Eurex EMDI, also Eurex MDI delivers order book information in the form of accumulated available quantities for a limited number of price levels, including synthetic price and quantity information on the best price level where applicable.
3. The Eurex Enhanced Order Book Interface (Eurex EOBI) provides order-by-order market data without netting for high bandwidth customers. Order-by-order means that Eurex EOBI delivers order book information by reporting price and quantity data of each individual visible order. Eurex EOBI does not provide any price level aggregated data, and therefore also no information on synthetic prices.

The complete market data contains:

- Market state information, as e.g. product states and Instrument states.
- Best price and quantity information.
- Order book depth price and quantity information.
- Price, quantity and time priority of individual visible orders.
- Individual trade volume reporting.
- General trade statistics.
- Requests for Quotes and Cross Announcements.

For further details on the market data streams, especially on which data is contained in which stream, please refer to the *Eurex Market & Reference Data Interfaces Manual* and to the *Eurex Enhanced Order Book Interface Manual*.

Additionally, Eurex offers the Eurex Extended Market Data Service, which contains data on:

- Settlement prices
- Open interest
- Eurex order book trades and Eurex off-book trades

In this chapter the term *order* is generally applied to mean both orders and quotes.

9.1 Market State Information

The public market data contains the following information related to the general state of the market:

- Product states (see ch.3.3).
- Instrument states for simple instruments (see ch.3.2).
- Instrument states for complex instruments (see ch.10.3.4).
- Listing status for simple instruments (see ch.3.5).
- Fast market indicator (see ch.3.4).

9.2 Order Book Information

Published order book information gives an indication at which price an incoming order can be executed, and how much can be executed at that price. In general, public order book information is based exclusively on limit orders. Market orders on the order book may add to the available executable order volume, but this is never reflected in the published order book data, except for the potential auction price.

Orders that are not available for matching are ignored. Thus, for example stop orders are ignored before they are triggered, but OCO orders are considered, because they are available for matching before triggering.

The order book information that is published in the public market data depends on the instrument state:

- During the instrument state Continuous, T7 publishes:
    1. The order book depth prices and the related accumulated quantities. Only orders of the same instrument's order book are considered here, i.e. the order book depth data contains only direct prices and quantities but no synthetic prices and quantities.
    2. The best synthetic buy and sell prices and their related synthetic quantities, but only if the best synthetic buy or sell price is equal to or better than the corresponding best direct price in the order book depth data.
    3. Price, visible quantity and time priority for each visible order.
- During auction instrument states and during auction freeze instrument states, T7 publishes:
    1. Either a potential auction price, if an uncrossing at this moment would lead to an auction trade,
    2. Or the best buy and sell prices available in the order book without any quantity information. This price information contains only direct prices but no synthetic prices.
- During other instrument states, no order book information is published by T7.

The published best synthetic buy and sell prices and quantities, which are published for instruments with synthetic matching, take only limited synthetic matching opportunities into account. See chapter 11.3.2 for details on published best prices and quantities in a synthetic context. Thus, since not all synthetic matching opportunities are taken into account, it is possible that an incoming order is executed at a better price than had been published. And it is possible that at the published best

synthetic price, there is more synthetic quantity available for matching than indicated in the published market data.

The order book depth data shows the quantities that are available for matching at the best price level and at a limited number of further price levels. The exchange decides by product on the number of published price levels.

Order book depth data never takes synthetic matching opportunities into account. It provides therefore an undisturbed snapshot of the order book of an instrument, and it can thus be used by participants to calculate synthetic matching opportunities on their own, including such opportunities that are not taken into account in the published best prices. T7 supports synthetic matching for futures products. The related mechanisms are explained in detail in chapter 11.3.

The data on visible individual orders is complete, i.e. it can be used by participants to construct an unlimited order book depth and to calculate all existing synthetic matching opportunities. The individual orders can be identified through the combination of the instrument identifier, the side and the priority time stamp. However the owners of the individual orders remain undisclosed.

Maintenance of hidden orders, e.g. market orders, Closing-Auction-Only orders outside a closing auction or stop orders before being triggered, is not reported.

The Potential Auction Price is the auction price that would result, if an uncrossing would take place at this moment. See chapter 7.4 for details.

The order book information that is published during an auction instrument state or an auction freeze instrument state, i.e. either best buy and sell prices or a potential auction price, never considers synthetic matching opportunities, simply because there is in any case no synthetic matching in the uncrossing of simple instruments.

9.3 Trade Reporting

T7 publishes general trade statistics data as well as information on individual trades.

9.3.1 Trade Volume Reporting

The term Trade Volume Reporting refers to the publication of data about individual matches, which is available only in the Eurex Enhanced Market Data Interface. A single incoming order can be matched at several different prices, and at each price level, there can be several book orders or, in case of synthetic matching, even book paths involved.

Such a match event is structured into match steps, so that there is only one execution price for a single match step. And in synthetic matching, there is always only one execution price per involved instrument and match step. See chapter 7.2.2 for a description of match events and match steps. See chapter 11.3 on the extensions for synthetic matching of futures products.

The trade volume reporting publishes data about individual match steps.

In direct matching, i.e. not synthetic matching, the trade volume reporting consists of one data set per match step. A single trade volume reporting data set contains the following information:

- Match Step Identifier: The match step identifier provides a unique identification of the match step in the scope of the product. It is also reported in the private execution information that T7 sends to the owner of an executed order. It can thus be used to relate private information

about the executions of own orders to the public information given in the trade volume reporting.

- Execution Price: The execution price is the price at which the orders were executed.
- Execution Quantity: The execution quantity is the executed quantity in the match step for the instrument. This quantity may be shared among several orders.
- Aggressor Side: The Aggressor Side indicates the side of the incoming order. Here, the term incoming order is understood in the extended sense as explained in chapter 7.1. The aggressor side is not specified in auction trades.
- Aggressor Time Stamp: The Aggressor Time Stamp is reported only if a real incoming order is matched in the match step. It is not reported for auction trades, and it is not reported if the incoming order is a book order, as is the case for example for a triggered stop order. The aggressor time is the time when the incoming order arrived at the exchange backend ("Matching Engine In"). This arrival time may be slightly earlier than the transaction time of the match step. The arrival time is also provided in the response to order maintenance requests, and it can therefore be used to determine the difference between the arrival time of an own order and the arrival time of the incoming order in the match step.
- Number of Buy Orders: The number of buy orders that were executed in the match step.
- Number of Sell Orders: The number of sell orders that were executed in the match step.

The trade volume reporting reports also trades that have been entered directly by market supervision, without going through the normal order book matching procedure. They are marked accordingly.

A Trade Reversal is the deletion of a mispriced trade in T7. Trade reversals are reported in the trade volume reporting as well.

In synthetic matching, there is one additional data set per involved instrument, which carries the information about the synthetically matched trade volume. Such data set on synthetically matched volumes may carry contributions from more than one synthetic match path.

An execution price is reported only if an order of the concerned instrument was involved in the match step. Leg execution prices in a direct match between orders of a complex instrument are not reported in the trade volume reporting.

All the data sets that belong to the same match step have the same match step identifier. Data sets that report synthetically matched trade volumes can be easily identified by looking for data sets, where either the number of executed buy orders or the number of executed sell orders is zero. Generally in all synthetic matches, only one side of an order book is matched.

See the *Eurex Market & Reference Data Interfaces Manual* for examples on trade volume reporting.

9.3.2 Last Trade Price and Quantity

The trade volume reporting data as described in chapter 9.3.1 above is available only in the Eurex Enhanced Market Data Interface, which provides market data without netting. The Eurex Market Data Interface, which provides netted market data, reports only the execution price and the execution quantity of the last match step before the aggregated market data is sent out.

A customer using the netted data provided by the Eurex Market Data Interface receives the following data on individual matches:

- Last Trade Price: The Last Trade Price is the latest execution price that occurred either in continuous trading or as an auction price. If an incoming order matches at various price levels, this price reports the last executed price level. An execution price becomes a last trade price only, if an order of the concerned instrument was involved in the match. Leg execution prices in a direct match between orders of a complex instrument are not reported as last trade prices of the leg instruments.
- Last Trade Quantity: The Last Trade Quantity is the quantity that was executed in the last match step at the last trade price. If an incoming order matches at various price levels, this quantity contains therefore only the executed quantity at the last price level. And in a synthetic match event, it contains only the quantity that got executed in the very last match step, even if several match steps yielded the same trade price.

Not reported are prices of trades that had been entered directly by market supervision, without going through the normal order book matching procedure.

Trade reversals are also not reported as such, but they may affect the last trade price and quantity, if it was the last match that had been reversed.

9.3.3 General Trade Statistics

The general trade statistics are published by both market data interfaces. They are reported both for simple instruments and for complex instruments. The statistics strictly refer to trades of the same business day and contain the following data:

- Last Auction Trade Price: The Last Auction Trade Price is reported separately for each type of auction. It is the auction price of the last auction, so far for that day, for a given auction type, where an auction trade occurred. If an auction ends without an auction price, because the order book was not crossed, the content of this data is not changed, and so it may contain the auction price of an earlier auction.
- Opening Price: The Opening Price is the first trade price of the business day, at whatever point in time it occurred.
- Closing Price: The Closing Price is the last trade price of the business day, at whatever point in time it occurred. It becomes available only after the product has entered the product state Post-Trading.
- High Price: The High Price is the highest trade price of the instrument so far on that day.
- Low Price: The Low Price is the lowest trade price of the instrument so far on that day.
- Total Traded Quantity: The Total Traded Quantity is the sum of the quantities, which have been matched in the instrument's order book trading, accumulated over the current day. Included are first of all those match quantities, where orders of the instrument were involved on at least one side. For simple instruments, the Total Traded Quantity contains additionally the leg volumes resulting from direct matching in complex instruments.

As there is no auction phase for complex instruments, there is no last auction trade price reported for complex instruments. The auction price in an uncrossing of a complex instrument reported as a last trade price, but not as a last auction trade price.

Executed quantities of trades that had been entered directly by market supervision, without going through the normal order book matching procedure, are reflected in the total traded quantity, but not in

the other statistics.

Except for the last auction trade price, T7 automatically adjusts the general trade statistics data in case of such a trade reversal.

9.4 Other Public Market Data

T7 publishes information on the following:

- Requests for Quotes (see ch.5.6).
- Cross Announcements (see ch.4.8).

Finally, the Eurex Extended Market Data Service provides data about

- Settlement prices of the previous business day.
- Open interest of the previous business day.
- Eurex order book and Eurex off-book trade prices and quantities.

See the *Eurex Extended Market Data Service Manual* for detailed information on the Eurex Extended Market Data Service.

10. Complex Instruments

This chapter outlines the common features of complex instruments in T7. It concentrates on the features that are common to all types of complex instruments. Features that are specific to individual complex instrument types, especially their definitions, but also specific rules such as synthetic matching for futures spreads, are then explained in the corresponding chapters 11ff., which are dedicated to the individual complex instrument types.

10.1 Definition of a Complex Instrument

A complex instrument is an instrument that allows buying or selling two or more simple instruments simultaneously, using a single order in the same way that a simple instrument is traded.

The simple instruments that a complex instrument is composed of, are called the Legs of the complex instrument. Each leg of a given complex instrument has a Ratio, which determines the relative quantity of the leg which should be traded, and a Side, which specifies whether the leg should be bought or sold. In order to determine how many contracts of a leg should be traded, the leg's ratio is used as a multiplier for the order quantity.

The identifiers of the leg instruments, their ratios and their sides, together form the Signature of a complex instrument. The signature of a complex instrument describes the buy perspective, i.e. it describes which legs are bought or sold in which quantity if one unit of the complex instrument is bought.

Example 10-1:

Trader A wishes to trade an OESX Butterfly strategy that consists of buying a quantity of 10 in the OESX Jun16 3400 C instrument, the same quantity in the OESX Jun16 3500 C instrument and selling a quantity of 20 in the OESX Jun16 3450 C instrument.

The appropriate complex instrument has three legs and its signature is

- *Leg 1: Buy 1 of OESX Jun16 3400 C*
- *Leg 2: Sell 2 of OESX Jun16 3450 C*
- *Leg 3: Buy 1 of OESX Jun16 3500 C*

Trader A needs to enter a buy order with a quantity of 10 for this complex instrument.

This does not guarantee full execution, but it does guarantee that if the order is executed, all leg instruments are executed at the same time and that the executed quantities of the leg instruments relate to each other as given by the ratios in the signature. E.g. a partial execution of a quantity of 5 in this complex instrument means that the executed quantity is 5 for leg 1, 10 for leg 2 and 5 for leg 3.

10.2 Creation and Deletion of Complex Instruments

Before orders or quotes can be submitted for a complex instrument, the complex instrument must be created. Complex instruments that are not created by the exchange can be created by users at any time during trading hours, provided that the signature of a requested complex instrument complies with the rules as outlined in the respective chapters below for the different supported complex instrument types.

The exchange enables or disables the support of complex instruments by instrument type and product.

Configuration Data:

The information on which instrument types are supported for a product, is published by T7's Reference Data Interface in the product snapshot message (RDI group message name: FlexRules). It can also be found in the Trading Parameters File, which is part of the Products and Instruments Files on the Eurex website, see chapter 1.2 Usage Notes.

Example 10-2:

Eurex enables the instrument type Standard Options Strategy for all its options products. But the instrument type Options Volatility Strategy is disabled for a number of options products, e.g. for all equity options products.

The exchange may disallow users the creation of complex instruments in general or for specific instrument types.

Example 10-3:

EEX does generally not allow users to create complex instruments.

When a complex instrument is created, T7 assigns a new instrument identifier to the complex instrument. The identifier and the signature of the new complex instrument are disseminated to the market participants on the reference data and market data feeds.

If a user requests the creation of a complex instrument that already exists, the instrument is not created again. Instead, T7 returns the identifier of the already existing instrument. Depending on the instrument type, this may already happen, if T7 finds an existing instrument that is not equal but equivalent. See the corresponding instrument type specific chapters on the creation of complex instruments to find out about the existence of such specific rules for a particular instrument type. An example is chapter 17.2 on the creation of Non-Standard Option Strategies.

The exchange reserves itself the right to limit the number of complex instruments that are created through a single session for a product.

There are mainly two ways, how complex instruments are deleted:

1. T7 deletes a complex instrument automatically during end of day processing, if one of its leg instruments has expired.
2. Some complex instruments, and they include all user-created complex instruments, are labeled as *temporary*. Temporary complex instruments are deleted automatically during end of day processing, if there are no orders in the order book for this instrument which have to be carried forward to the next business day.

Complex instruments keep the same instrument identifier during their entire lifetime. However, the lifetime of a complex instrument ends when it is deleted. If after deletion of a complex instrument, a new complex instrument with the same signature is created on another day, this new complex instrument will have a different instrument identifier.

Market supervision may inactivate a complex instrument at any time during the day for various

reasons. When a complex instrument is inactivated, all orders and quotes in that instrument are deleted, and further order and quote entry is not possible. Once a complex instrument has become inactive, it can nevertheless be reactivated again on the same day by requesting the creation of a complex instrument with the same signature. If it is not reactivated during the same day, it will finally be deleted in the end of day processing.

10.3 Trading of Complex Instruments

10.3.1 Overview

Once a complex instrument is created, orders and quotes for the complex instrument can be entered, modified and deleted in the same way as for simple instruments. In general, they are also executed against each other like for simple instruments.

This chapter explains the differences from the trading of simple instruments. It concentrates on the features that are common to all types of complex instruments. Features that are specific to individual complex instrument types, such as synthetic matching for futures spreads, are then explained in the corresponding chapters 11ff., which are dedicated to the individual complex instrument types.

10.3.2 Supported Order Categories

For complex instruments, only quotes and regular limit orders are supported.

This means that for complex instruments there are

- No market orders.
- No stop orders.
- No One-Cancels-the-Other orders.
- No Closing-Auction-Only orders.
- No Book-Or-Cancel orders.

10.3.3 Net Price and Leg Execution Prices

The limit price of a buy order or quote in a complex instrument is the net price that the buyer is willing to pay if the executed quantities of the leg instruments are equal to the ratios of the leg instruments.

Example 10-4:

Trader A wishes to trade several options instruments simultaneously:

1. *Buy 20 contracts of ODAX Jun16 12150 C at a price of 24.20.*
2. *Buy 15 contracts of ODAX Jun16 12200 C at a price of 8.00*
3. *Sell 35 contracts of ODAX Jun16 12250 C at a price of 0.70*

The trader is therefore ready to pay the overall net price of

$$20 \times 24.20 + 15 \times 8.00 - 35 \times 0.70 = 579.50$$

First the trader creates a three-legged non-standard options strategy instrument with the following signature:

- *Leg 1: ODAX Jun16 12150 C, Ratio 4, Side Buy*
- *Leg 2: ODAX Jun16 12200 C, Ratio 3, Side Buy*

- *Leg 3: ODAX Jun16 12250 C, Ratio 7, Side Sell*

Then the trader places a buy order for that instrument with quantity 5 and a limit price of 115.90.

Only the overall net price limit of the order is guaranteed in the execution. T7 will determine the execution prices of the individual leg instruments so that they together result in the overall net execution price of the complex instrument as determined by the matching procedure. No specific leg execution prices are guaranteed.

As a mathematical expression, the standard price relation between the net price of a complex instrument and the prices of its leg instruments is the following:

$$p_{CI} = \sum_{all\ legs} BS_i \times R_i \times p_i$$

Here

p_{CI}	is the net price of the complex instrument.
BS_i	is +1 if the i-th leg instrument is defined as to be bought in the signature of the complex instrument, and it is -1 if the i-th leg instrument is defined as to be sold in the signature of the complex instrument.
R_i	is the leg ratio of the i-th leg instrument in the complex instrument's signature.
p_i	is the price of the i-th leg instrument.

In order to determine the leg execution prices from a given execution price in the complex instrument, T7 normally applies a decomposition procedure that compromises between the following goals:

1. Make every leg execution price close to the current market price.
2. Distribute a possible deviation from the current market price evenly among the legs.
3. Do this with a reasonably limited computational effort.

As an exception, the decomposition procedure is not applied in certain synthetic matching situations where leg execution prices are determined with the help of execution prices of simple instrument orders that are involved in the match step. See chapter 11.3.6 for details.

Example 10-4 continued:

Now, trader B enters a sell order that matches trader A's order fully, at a net execution price of 115.90. The leg execution prices are determined by T7 as

1. *Buy 20 contracts of ODAX Jun16 12150 C at a price of 24.10.*
2. *Buy 15 contracts of ODAX Jun16 12200 C at a price of 7.90*
3. *Sell 35 contracts of ODAX Jun16 12250 C at a price of 0.60*

This results in an overall price of 579.50 to be paid by trader A, and conforms to the net execution price of 115.90, even if the leg execution prices differ somewhat from what trader A had in mind.

Depending on the difference of the market prices of the involved leg instruments, the net limit and execution prices in a complex instrument can be zero or negative, even if the prices for the involved leg instruments are not. A negative execution price means in effect that the buyer receives money and

the seller pays money.

Example 10-5:

The futures spread CONF SPD Jun16 Sep16 is defined as buying a certain quantity in the CONF Jun16 instrument and simultaneously selling the same quantity in the CONF Sep16 instrument.

A buy order for the CONF SPD Jun16 Sep16 instrument with a quantity of 5 and a limit price of -5.7 requests to simultaneously buy at maximum 5 CONF Jun16 contracts and at the same time sell the same quantity of CONF Sep16 contracts, where the trade price per CONF Jun16 contract shall not be less than 5.7 lower than the price per CONF Sep16 contract.

A sell order for the CONF SPD Jun16 Sep16 instrument with a quantity of 5 and a limit price of -5.7 requests to simultaneously sell at maximum 5 CONF Jun16 contracts and at the same time buy the same quantity of CONF Sep16 contracts, where the trade price per CONF Jun16 contract shall not be more than 5.7 lower than the price per CONF Sep16 contract.

T7 prevents the entry of a complex order with a limit price that, if it were to become the execution price could not be decomposed into leg execution prices that are acceptable for clearing. In general this condition is relevant for complex instruments where the side is Buy for all the legs.

Example 10-6:

Consider a Strangle standard options strategy which consists of buying both a Call and a Put instrument, where both instruments are far out of the money. Assume the size of the price step to be equal to one tick. The leg execution prices must in any case be at least one tick above zero, to be accepted for clearing. In order to guarantee this, T7 accepts for a Strangle strategy order only limit prices that are at least two ticks above zero.

Leg execution prices are not eligible to be considered in the context of the following trade price related functionalities:

- Leg execution prices do not trigger stop orders (ch.4.3.3).
- Leg execution prices do not serve as reference prices in the non-standard procedure of the Price Reasonability Check (ch.6.2.2).
- Leg execution prices are ignored when the condition for a volatility interrupt is checked (ch.7.6.2). Neither is the price at which a leg is executed checked against previous trade prices in the leg instrument, nor is the execution price of a simple instrument order checked against the prices of previous leg executions.

10.3.4 Instrument States of Complex Instruments

A complex instrument has its own instrument state. The instrument state of a complex instrument is one out of the following:

- Continuous
- Book
- Restricted
- Closed

There are no auction states and no auction freeze states for complex instruments.

The instrument state of a complex instrument depends entirely on the instrument states of its leg instruments. The rule is that the instrument state of the complex instrument can never be higher in the hierarchy (see figure 3-1 on page 19) than the state of any of its leg instruments.

Example 10-7:

All leg instruments are in the instrument state Continuous. The complex instrument is also in the instrument state Continuous.

Example 10-8:

All leg instruments except one are in the state Continuous. One instrument is in an auction state. The complex instrument is in the instrument state Book. The reason is that there is no auction instrument state for complex instruments, so it must be in the next lower state.

Example 10-9:

All leg instruments but one are in the state Book. One instrument has expired and is in the instrument state Restricted. The complex instrument is in the state Restricted, which is the lowest of all the states of its leg instruments.

The exchange may disable the instrument state Book by instrument type for specific products.

Configuration Data:

The information whether the instrument state Book is supported for an instrument type in a product, is available in the Trading Parameters File, which is part of the Products and Instruments Files on the Eurex website, see chapter 1.2 Usage Notes.

Example 10-10:

All leg instruments are in the state Book. The state Book is however disabled for all complex instruments of the product. The complex instrument is in the state Restricted, which is the next lower state below Book.

Eurex Set Up Information:

Eurex allows the instrument state Book for the complex instruments of all futures products, but not for any complex instruments of any options products.

An exception are inactivated complex instruments, which are always in the instrument state Closed without regard to the instrument states of the leg instruments.

10.3.5 Uncrossing

There is no dedicated auction instrument state for complex instruments. If all the leg instruments of a complex instrument are in an auction instrument state, then the rules as given in chapter 10.3.4 above stipulate that the complex instrument is in the instrument state Book. A consequence is that in this situation, either potential auction prices or best buy and best sell prices are published for the leg instruments, which are in an auction instrument state, but no such prices are published for the

complex instrument, which is in the instrument state Book.

Nevertheless, whenever the instrument state of a complex instrument changes to Continuous, an uncrossing trade is done to ensure that the order book is not crossed during continuous trading. In general, the rules for the uncrossing complex instruments, including the determination of the uncrossing price and the order allocation, are exactly the same as those for simple instruments, which can be found in chapter 7.4. As an exception, there is a modified handling for complex instruments that are subject to synthetic matching. See chapter 11.4 for this.

10.3.6 Volatility Interrupt

There is no volatility interrupt functionality for complex instruments.

10.3.7 Minimum Quote Size

For complex instruments, the condition being tested in the validation of incoming quotes against the minimum quote size, as described for simple instruments in chapter 5.4.2, is modified. For each leg of a complex instrument quote, the product of the leg ratio times the order quantity must not be smaller than the minimum quote size.

10.3.8 Price Reasonability Check

In general, applications of the price range tables as described in chapter 6 are available for complex instruments as well, though different price ranges may be applied.

For the non-standard procedure of the price reasonability check, as described in chapter 6.2.2, it is relevant to note that for complex instruments, the alternative reference price that needs to be available, is in any case derived from the alternative reference prices of the leg instruments. For each leg the alternative reference price of the leg instrument is multiplied with the leg ratio, and then the results are added in case of buy legs and subtracted in case of sell legs, to obtain the alternative reference price of the complex instrument.

Example 10-11:

An order is entered for the NESG SPD Oct16 Dec16 futures spread instrument. There are no orders currently in the spread instrument's order book, so only the non-standard price reasonability check can be performed. There is a last trade price in the NESG Oct16 instrument at 65.25. There has been no trade in the NESG Dec16 instrument so far on this day, so the instrument's previous day's settlement price of 66.10 is applied instead. The alternative reference price is therefore:

$$TP = 1 \times 65.25 - 1 \times 66.10 = -0.85$$

10.3.9 Request For Quote

For complex instruments, the validation of RfQs concerning the spread between the best buy price and the best sell price, or alternatively, the quantity of the best price, as described for simple instruments in chapter 5.6, is not done.

11. Futures Spreads

This chapter outlines the specific features of futures spreads in T7. The common features of complex instruments in T7 as described in chapter 10 apply for futures spreads, except if stated otherwise in the following.

11.1 Definition of Futures Spreads

A Futures Spread instrument is a complex instrument with two leg instruments that belong to the same futures product, representing a calendar spread. Buying a certain quantity of a futures spread is defined as buying the same quantity of the leg instrument with the earlier expiry date, the first leg, and selling the same quantity of the leg instrument with the later expiry date, the second leg.

The signature of a futures spread can thus always be described as

- Leg 1: Instrument A, Ratio 1, Side Buy
- Leg 2: Instrument B, Ratio 1, Side Sell

where the expiration date of instrument B is later than the expiration date of instrument A.

Depending on the product and on the market situation, prices of futures spreads can be zero or negative.

11.2 Creation of Futures Spreads

The exchange may create automatically futures spread instruments of predictable popular demand. All other futures spread instruments that represent a combination of two existing simple instruments of the same futures product, can be created by the users.

Configuration Data:

The information, whether a specific futures spread instrument has been created automatically by the exchange or on request of a user, is published by T7's Reference Data Interface in the instrument snapshot message (RDI field name: MultiLegModel).

Example 11-1:

For the future on the Nestle stock NESG, Eurex creates automatically the futures spread instrument that combines the two simple instruments with the nearest expiration dates. E.g. in the beginning of May 2016, the spread NESG SPD May16 Jun16 is automatically available. All other possible futures spread instruments are not created automatically by the exchange, but can be created by users, e.g. the spread NESG SPD May16 Nov16.

T7 supports synthetic matching between different simple instruments and futures spread instruments. The exchange defines which futures spread instruments are enabled for synthetic matching. This set up is done for every possible futures spread instrument. When a futures spread instrument is created, that is set up for synthetic matching, then synthetic matching is available immediately upon creation of the instrument, even for user created instruments.

Configuration Data:

The information, whether a specific futures spread instrument is available for synthetic matching, is published by T7's Reference Data Interface, both in the instrument snapshot message and in the complex instrument update message for the futures spread instrument (RDI field name: ImpliedMarketIndicator).

11.3 Synthetic Matching in Continuous Trading

This chapter describes the synthetic matching for futures products with the help of futures spread instruments that are enabled for synthetic matching. Throughout this chapter, it is assumed that the involved futures spread instruments are enabled for synthetic matching.

Furthermore in this chapter, the term *order* always stands for both orders and quotes.

And finally, the term *incoming order* is always to be taken in the extended sense as explained in chapter 7.1 above.

11.3.1 Match Paths

This chapter explains how different simple instruments and futures spread instruments can be combined for synthetic matching. Prices are ignored in this chapter.

In continuous trading, T7 supports five ways of matching in futures products:

1. Direct matching of orders of the same simple instrument.
2. Direct matching of orders of the same futures spread instrument.
3. The Short Synthetic Match Path denotes synthetic matching of orders in two simple instruments and in one futures spread instrument, where the simple instruments are the leg instruments of the futures spread instrument.
4. The Triangle Match Path denotes synthetic matching of orders in three different futures spread instruments, where each of the leg instruments of an involved futures spread instrument is also a leg instrument of one of the other involved futures spread instruments.
5. The Long Synthetic Match Path denotes synthetic matching of orders in two simple instruments and in two futures spread instruments, where the futures spread instruments have exactly one leg instrument in common, and the simple instruments are the other leg instruments of the two futures spread instruments.

If futures instruments are part of inter-product spread instruments, there are two more ways of matching, which are described in chapter 15.4 on matching of inter-product spreads.

Direct matching is as described in chapter 7.2.1. An incoming order matches against orders on the other side of the order book of the same instrument. The three ways of synthetic matching are explained further in the following.

The general rule for a synthetic match path to be a valid match path, is that for each simple instrument that occurs in the match path, no matter whether the simple instrument occurs directly or whether it occurs as the leg of a futures spread instrument, the buy side and the sell side of the simple instrument must occur each exactly once.

The Short Synthetic Match Path

The short synthetic match path involves orders in two simple instruments, and in the futures spread instrument that has these two simple instruments as leg instruments, as symbolized in figure 11-1.

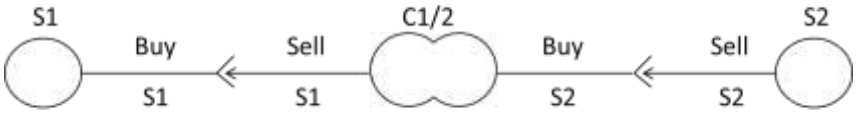


Figure 11-1: Example for a short synthetic match path.

In the following, the simple instrument with the earlier expiry date is called S1 and the other simple instrument is called S2. And the futures spread that has these simple instruments as legs is called C1/2. Since S1 has an earlier expiry date than S2, buying C1/2 means buying S1 and selling S2.

A possible short synthetic match path consists then of

- the buy side of S1,
- the sell side of C1/2, i.e. sell S1 and buy S2,
- the sell side of S2.

The only other possible short synthetic match path made out of S1, S2 and C1/2 has the side reversed for all instruments, i.e.

- the sell side of S1,
- the buy side of C1/2, i.e. buy S1 and sell S2,
- the buy side of S2.

T7 supports the matching of these synthetic match paths, no matter which of the three instruments the incoming order belongs to.

T7 furthermore supports the matching of these synthetic match paths, for a combination of any two simple instruments, as long as the combining futures spread instrument is enabled for synthetic matching.

Example 11-2:

Consider the example of an incoming simple instrument order in the product FVS (Futures on Mini VSTOXX ®) that matches along a short synthetic match path of the type

- *the buy side of S1,*
- *the sell side of C1/2,*
- *the sell side of S2.*

An incoming buy order for the simple instrument FVS Jan16 (S1) may be executed against a combination of book sell orders in the futures spread instrument FVS SPD Jan16 Feb16 (C1/2) and of book sell orders in the simple instrument FVS Feb16 (S2). The match path consists therefore of

- *the buy side of FVS Jan16,*
- *the sell side of FVS SPD Jan16 Feb16, i.e. sell FVS Jan16 and buy FVS Feb16,*
- *the sell side of FVS Feb16.*

Here,

1. *the buy side of the simple instrument FVS Jan16 is matched against the first leg of the sell side of the futures spread instrument FVS SPD Jan16 Feb16, which is selling FVS Jan16, and*
2. *the second leg of the sell side of the futures spread instrument FVS SPD Jan16 Feb16, which is buying FVS Feb16, is matched against the sell side of the simple instrument FVS Feb16.*

Example 11-3:

Consider the example of an incoming futures spread order in the product FVS that matches along a short synthetic match path of the type

- *the sell side of S1,*
- *the buy side of C1/2,*
- *the buy side of S2.*

An incoming buy order for the futures spread instrument FVS SPD Jan16 Feb16 (C1/2) may be executed against a combination of book sell orders in the simple instrument FVS Jan16 (S1) and of book buy orders in the simple instrument FVS Feb16 (S2). The match path consists therefore of

- *the sell side of FVS Jan16,*
- *the buy side of FVS SPD Jan16 Feb16, i.e. buy FVS Jan16 and sell FVS Feb16,*
- *the buy side of FVS Feb16.*

Here,

1. *the sell side of the simple instrument FVS Jan16 is matched against the first leg of the buy side of the futures spread instrument FVS SPD Jan16 Feb16, which is buying FVS Jan16, and*
2. *the second leg of the buy side of the futures spread instrument FVS SPD Jan16 Feb16, which is selling FVS Feb16, is matched against the buy side of the simple instrument FVS Feb16.*

The Triangle Match Path

The triangle match path involves orders in three futures spread instruments, where each of the futures spread instruments has one leg with one of the other instruments in common, and has the other leg with the other of the other instruments in common. In the graphic representation as shown below, this results in a triangle, thence the name of the match path.

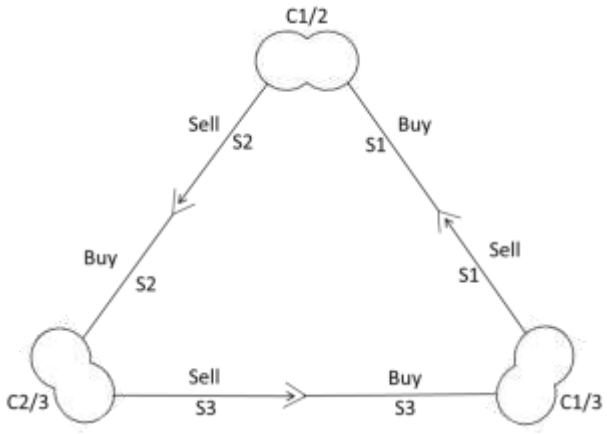


Figure 11-2: Example for a Triangle Match Path.

In the following, the leg instruments are S1, S2 and S3 in the order of their expiry dates. The futures spread instrument with the legs S1 and S2 is called C1/2. The others are then called C1/3, with the legs S1 and S3, and C2/3, with the legs S2 and S3.

A possible triangle match path consists then of

- the buy side of C1/2, i.e. buy S1 and sell S2,
- the sell side of C1/3, i.e. sell S1 and buy S3,
- the buy side of C2/3, i.e. buy S2 and sell S3.

The only other possible triangle match path made out of C1/2, C1/3 and C2/3 has the side reversed for all instruments, i.e.

- the sell side of C1/2, i.e. sell S1 and buy S2,
- the buy side of C1/3, i.e. buy S1 and sell S3,
- the sell side of C2/3, i.e. sell S2 and buy S3.

T7 supports the matching of these synthetic match paths, no matter to which of the three futures spread instruments the incoming order belongs.

T7 furthermore supports the matching of these synthetic match paths, for a combination of any three leg instruments, as long as all three combining futures spread instruments are enabled for synthetic matching.

Example 11-4:

Consider the example of an incoming futures spread order in the product FVS that matches along a triangle match path of the type

- *the buy side of C1/2,*
- *the sell side of C1/3,*
- *the buy side of C2/3.*

An incoming buy order for the futures spread instrument FVS SPD Jan16 Feb16 (C1/2) may be executed against a combination of book sell orders in the futures spread instrument FVS SPD Jan16 Mar16 (C1/3) and of book buy orders in the futures spread instrument FVS SPD Feb16 Mar16 (C2/3). The match path consists therefore of

- *the buy side of FVS SPD Jan16 Feb16, i.e. buy FVS Jan16 and sell FVS Feb16,*
- *the sell side of FVS SPD Jan16 Mar16, i.e. sell FVS Jan16 and buy FVS Mar16,*
- *the buy side of FVS SPD Feb16 Mar16, i.e. buy FVS Feb16 and sell FVS Mar16.*

Here,

1. *the first leg of the buy side of the futures spread instrument FVS SPD Jan16 Feb16, which is buying FVS Jan16, is matched against the first leg of the sell side of the futures spread instrument FVS SPD Jan16 Mar16, which is selling FVS Jan16, and*
2. *the first leg of the buy side of the futures spread instrument FVS SPD Feb16 Mar16, which is buying FVS Feb16, is matched against the second leg of the buy side of the futures spread instrument FVS SPD Jan16 Feb16, which is selling FVS Feb16, and*
3. *the second leg of the sell side of the futures spread instrument FVS SPD Jan16 Mar16, which is buying FVS Mar16, is matched against the second leg of the buy side of the futures spread instrument FVS SPD Feb16 Mar16, which is selling FVS Mar16.*

The exchange enables or disables the support of matching triangle match paths by product.

Configuration Data:

The information on whether triangle matching is supported for a product, is available in the Trading Parameters File, which is part of the Products and Instruments Files on the Eurex website, see chapter 1.2 Usage Notes.

The Long Synthetic Match Path

The long synthetic match path involves orders in two simple instruments and in two futures spread instruments. The two futures spread instruments have exactly one leg in common, and the other legs are the involved simple instruments. In the graphic representation, the long synthetic match path appears as the prolongation of the short synthetic match path as shown below.

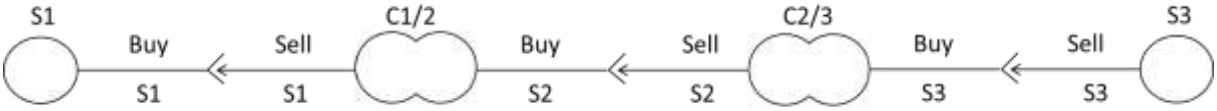


Figure 11-3: An example for a long synthetic match path.

In the following, the involved simple or leg instruments are S1, S2 and S3 in the order of their expiry dates. The complex instruments that can then be part of a long synthetic match path, are C1/2 with legs S1 and S2, C1/3 with legs S1 and S3, and C2/3 with legs S2 and S3. A long synthetic match path can be formed with any combination of two of these three futures spread instruments.

The following six synthetic match paths are possible:

1. Combining C1/2 and C1/3, first variant:
   - the buy side of S2,
   - the buy side of C1/2, i.e. buy S1 and sell S2,
   - the sell side of C1/3, i.e. sell S1 and buy S3,
   - the sell side of S3.
2. Combining C1/2 and C1/3, reversed variant:
   - the sell side of S2,
   - the sell side of C1/2, i.e. sell S1 and buy S2,
   - the buy side of C1/3, i.e. buy S1 and sell S3,
   - the buy side of S3.
3. Combining C1/2 and C2/3, first variant (as shown in figure 11-3):
   - the buy side of S1,
   - the sell side of C1/2, i.e. sell S1 and buy S2,
   - the sell side of C2/3, i.e. sell S2 and buy S3,
   - the sell side of S3.
4. Combining C1/2 and C2/3, reversed variant:
   - the sell side of S1,
   - the buy side of C1/2, i.e. buy S1 and sell S2,
   - the buy side of C2/3, i.e. buy S2 and sell S3,
   - the buy side of S3.

5. Combining C1/3 and C2/3, first variant:
    - the buy side of S1,
    - the sell side of C1/3, i.e. sell S1 and buy S3,
    - the buy side of C2/3, i.e. buy S2 and sell S3,
    - the sell side of S2.
6. Combining C1/3 and C2/3, reversed variant:
    - the sell side of S1,
    - the buy side of C1/3, i.e. buy S1 and sell S3,
    - the sell side of C2/3, i.e. sell S2 and buy S3,
    - the buy side of S2.

T7 supports the matching of these synthetic match paths, no matter to which of the instruments the incoming order belongs, as long as the instrument of the incoming order is part of the match path.

T7 furthermore supports the matching of these synthetic match paths, for a combination of any three leg instruments, as long as the two involved futures spread instruments are enabled for synthetic matching.

Example 11-5:

Consider the example of an incoming simple instrument order in the product FVS that matches along a long synthetic match path of the type

- *the buy side of S1,*
- *the sell side of C1/3,*
- *the buy side of C2/3,*
- *the sell side of S2.*

An incoming buy order for the simple instrument FVS Jan16 (S1) may be executed against a combination of book sell orders in the futures spread instrument FVS SPD Jan16 Mar16 (C1/3), of book buy orders in the futures spread instrument FVS SPD Feb16 Mar16 (C2/3), and of book sell orders in the simple instrument FVS Feb16 (S2). The match path consists therefore of

- *the buy side of FVS Jan16,*
- *the sell side of FVS SPD Jan16 Mar16, i.e. sell FVS Jan16 and buy FVS Mar16,*
- *the buy side of FVS SPD Feb16 Mar16, i.e. buy FVS Feb16 and sell FVS Mar16,*
- *the sell side of FVS Feb16.*

Here,

1. *the buy side of the simple instrument FVS Jan16 is matched against the first leg of the sell side of the futures spread instrument FVS SPD Jan16 Mar16, which is selling FVS Jan16, and*
2. *the second leg of the sell side of the futures spread instrument FVS SPD Jan16 Mar16, which is buying FVS Mar16, is matched against the second leg of the buy side of the futures spread instrument FVS SPD Feb16 Mar16, which is selling FVS Mar16, and*
3. *the first leg of the buy side of the futures spread instrument FVS SPD Feb16 Mar16, which is buying FVS Feb16, is matched against the sell side of the simple instrument FVS Feb16.*

Example 11-6:

Consider the example of an incoming futures spread order in the product FVS that matches along a long synthetic match path of the type

- *the sell side of S1,*
- *the buy side of C1/2,*
- *the buy side of C2/3,*
- *the buy side of S3.*

An incoming buy order for the futures spread instrument FVS SPD Jan16 Feb16 (C1/2) may be executed against a combination of book sell orders in the simple instrument FVS Jan16 (S1), of book buy orders in the futures spread instrument FVS SPD Feb16 Mar16 (C2/3), and of book buy orders in the simple instrument FVS Mar16 (S3). The match path consists therefore of

- *the sell side of FVS Jan16,*
- *the buy side of FVS SPD Jan16 Feb16, i.e. buy FVS Jan16 and sell FVS Feb16,*
- *the buy side of FVS SPD Feb16 Mar16, i.e. buy FVS Feb16 and sell FVS Mar16,*
- *the buy side of FVS Mar16.*

Here,

1. *the sell side of the simple instrument FVS Jan16 is matched against the first leg of the buy side of the futures spread instrument FVS SPD Jan16 Feb16, which is buying FVS Jan16, and*
2. *the second leg of the buy side of the futures spread instrument FVS SPD Jan16 Feb16, which is selling FVS Feb16, is matched against the first leg of the buy side of the futures spread instrument FVS SPD Feb16 Mar16, which is buying FVS Feb16, and*
3. *the second leg of the buy side of the futures spread instrument FVS SPD Feb16 Mar16, which is selling FVS Mar16, is matched against the buy side of the simple instrument FVS Mar16.*

11.3.2 Synthetic Pricing

Price and Quantity of a Synthetic Book Path

An incoming order can match synthetically against the order books of two or more different instruments as described in the previous chapter. The part of the match path that is obtained by removing the instrument of the incoming order, is called the Synthetic Book Path. It is in this way possible to say that in synthetic matching; an incoming order matches against a synthetic book path.

It is then possible, by using the best limit prices in the order books of a specific synthetic book path, to calculate the Best Synthetic Price for this specific synthetic book path. The incoming order that matches synthetically against this synthetic book path, is then executed at the best synthetic price of the synthetic book path.

The general rules for the calculation of a synthetic price are:

- A synthetic buy price is calculated as the sum of the prices of all involved buy order books minus the sum of the prices of all involved sell order books.
- A synthetic sell price is calculated as the sum of the prices of all involved sell order books minus the sum of the prices of all involved buy order books.

The Available Quantity of a specific synthetic book path is the quantity of the order book side that has the smallest quantity at the best price, among all order book sides that make up the synthetic book path.

Example 11-7:

The following orders are in the order books of the product FVS (Futures on Mini VSTOXX ®):

- *Simple instrument FVS Feb16:*
  - *Sell 50 at a price of 23.55*
- *Futures spread FVS SPD Jan16 Feb16:*
  - *Sell 10 at a price of 1.05*
  - *Sell 20 at a price of 1.05*
- *Futures spread FVS SPD Jan16 Mar16:*
  - *Buy 40 at a price of 1.65*

These orders result in the following synthetic book paths:

1. *Simple instrument FVS Jan16: Sell 30 at a price of 24.60*

   by synthetic book path for matching along a short synthetic match path

   Sell FVS SPD Jan16 Feb16 ⊕ Sell FVS Feb16

   Price: $+24.60 = (+1.05 + 23.55)$

   Quantity: $30 = MIN\big((10 + 20), 50\big)$

2. *Simple instrument FVS Mar16: Sell 30 at a price of 22.95*

   by synthetic book path for matching along a long synthetic match path

   Buy FVS SPD Jan16 Mar16 ⊕ Sell FVS SPD Jan16 Feb16 ⊕ Sell FVS Feb16

   Price: $+22.95 = (-1.65 + 1.05 + 23.55)$

   Quantity: $30 = MIN(40, (10 + 20), 50)$

3. *Futures spread FVS SPD Feb16 Mar16: Buy 30 at a price of 0.60*

   by synthetic book path for matching along a triangle match path

   Sell FVS SPD Jan16 Feb16 ⊕ Buy FVS SPD Jan16 Mar16

   Price: $+0.60 = (-1.05 + 1.65)$

   Quantity: $30 = MIN\big((10 + 20), 40\big)$

Best Available Price and Published Best Price

The public market data contains for both simple instruments and futures spread instruments, best synthetic buy prices and best synthetic sell prices, provided that such a synthetic price is at least as good as the corresponding best limit price on the respective instrument's order book side itself.

These best synthetic prices are derived by using only such synthetic book paths that allow synthetic matching along a short synthetic match path. Synthetic book paths that allow matching along a triangle match path or along a long synthetic match path, are not reflected in the public market data.

It must be therefore distinguished between the Best Available Price, which is the best price that is really available for an incoming order, and which may be given by any synthetic book path that allows matching along a supported match path, and the Published Best Price, which is the best price that is indicated in the public market data, and which does not take all the possible synthetic match paths into

account.

This distinction plays e.g. an important role in the handling of market orders, where the market order matching range for incoming market orders is taken in reference to the published best price (see ch.7.3.2), while book market orders match at the best available price on their side (see ch.7.3.3).

For the calculation of a published best quantity, T7 does not sum up the available quantities of all the short synthetic match paths, the synthetic price of which is equal to the published best price. Instead it takes the maximum among these quantities. This may often underestimate the available synthetic quantity, but it avoids an overestimation of the available synthetic quantity, which else would occur in some market situations.

Example 11-8:

The following orders are in the order books of the product FVS:

- *Simple instrument FVS Jan16:*
  - *Buy 30 at a price of 24.50*
  - *Buy 20 at a price of 24.50*
- *Simple instrument FVS Feb16:*
  - *Buy 20 at a price of 24.10*
  - *Buy 40 at a price of 24.10*
- *Simple instrument FVS Mar16:*
  - *Buy 10 at a price of 23.50*
  - *Buy 15 at a price of 23.50*
- *Futures spread FVS SPD Jan16 Feb16:*
  - *Buy 10 at a price of 0.40*
- *Futures spread FVS SPD Jan16 Mar16:*
  - *Buy 20 at a price of 1.00*
- *Futures spread FVS SPD Feb16 Mar16:*
  - *Buy 40 at a price of 0.65*

There are no sell orders in the order books.

The simple instrument FVS Jan16 has:

- *A best direct buy price of 24.50 with a quantity of 50, given by the orders in the own order book.*

  This price and quantity is published as the first level in the order book depth by the market data interface.

- *A published best buy price of 24.50 with a quantity of 70, given by the direct book path and by two synthetic book paths for matching along a short synthetic match path*

  - *Buy FVS Jan16*

    Price: $+24.50$

    Quantity: $50 = (30 + 20)$

- *Buy FVS SPD Jan16 Feb16 ⊕ Buy FVS Feb16.*

  Price: $+24.50 = (+0.40 + 24.10)$

  Quantity: $10 = MIN\big(10\,,(20 + 40)\big)$

- *Buy FVS SPD Jan16 Mar16 ⊕ Buy FVS Mar16.*

  Price: $+24.50 = (+1.00 + 23.50)$

  Quantity: $20 = MIN\big(20\,,(10 + 15)\big)$

All three book paths provide the same price. The quantities of the direct path and of the synthetic path with the highest quantity are added up:

Quantity: $70 = 50 + MAX(10\,,20)$

This price and quantity is published as the best buy price and quantity by the market data interfaces.

- *A best available buy price of 24.55 with a quantity of 10, given by the synthetic book path for matching along a long synthetic match path*

  Buy FVS SPD Jan16 Feb16 ⊕ Buy FVS SPD Feb16 Mar16 ⊕ Buy FVS Mar16.

  Price: $+24.55 = (+0.40 + 0.65 + 23.50)$

  Quantity: $10 = MIN\big(10\,,40\,,(10 + 15)\big)$

  This price and quantity is not published by the market data interfaces, but it is available for matching of incoming sell orders in the simple instrument FVS Jan16.

A sufficiently large sized incoming sell order for FVS Jan16 would match

- *10 at a price of 24.55 against the long synthetic match path Buy FVS SPD Jan16 Feb16 ⊕ Buy FVS SPD Feb16 Mar16 ⊕ Buy FVS Mar16*
- *15 at a price of 24.50 against the short synthetic match path Buy FVS SPD Jan16 Mar16 ⊕ Buy FVS Mar16 and*
- *50 at a price of 24.50 against the direct match path.*

Note that the two short synthetic match paths are partly not available anymore after the execution of the better priced long synthetic match path. Nevertheless, the incoming sell order matches at least the best published quantity of 70 at the best published price or better. See the following chapters for more details on matching in a synthetic context with futures spread instruments.

11.3.3 Matching Procedure

The matching procedure for an incoming order is extended to include direct matching that had been described in chapter 7.2.1, as well as synthetic matching in its various forms.

In order to have a unified description of direct matching and synthetic matching, direct matching is in the following referred to as matching of an incoming order against the Direct Book Path. A Book Path can in this way be the direct book path or a synthetic book path.

To be executable against a book path, an incoming limit order must be

- either an order to buy at a price that is at or above the available sell price,
- or an order to sell at a price that is at or below the available buy price.

If the incoming order is matched against one or more book paths, the various book paths compete against each other to be executed against the incoming order.

The procedure for matching an incoming order in synthetic matching, still follows a strict price priority. This means that a better priced book path has priority over a worse priced book path, no matter whether the book path is direct or synthetic, and irrespective of the type of a synthetic book path.

The following steps are repeated by T7's matching engine for each available price level, until either the quantity of the incoming order is exhausted, or until no more orders on the order book are executable against the incoming order.

1. It finds the best price level that is available to be matched by the incoming order. It is possible, that this price level is exclusively given by a synthetic book path, and even that this price level is better than the published best price (see ch.11.3.2).
2. In general, several different book paths can contribute to the same price level. In a first match step, the following book paths are matched, if they contribute to the current price level:
    - the direct book path,
    - synthetic book paths that can be matched by forming short synthetic match paths,
    - synthetic book paths that can be matched by forming triangle match paths,
    - one synthetic book path that can be matched by forming a long synthetic match path, and if there are more than one such book path available, the path is chosen that comes first after the paths have been sorted according to the sorting procedure that is outlined in chapter 11.3.4 below.

    The procedure involves two allocation steps which are performed one after the other:

    a. Path Allocation Step: The Accumulated Available Book Quantity is the sum of the available quantities of all book paths that are taken into account in this match step. See chapter 11.3.2 above for the determination of the available quantity of a synthetic book path.

       If the quantity of the incoming order that can be matched is smaller than the accumulated available book quantity, then the quantity of the incoming order is distributed to the competing book paths, following a specific Path Allocation Method. T7 supports a variety of path allocation methods for this purpose. They are described in chapter 11.3.5 below. The exchange defines by product, which path allocation method is applied.

    b. Order Allocation Step: The share that is given to a specific book path is then available to all order book sides that make up the book path. For each instrument on such a book path, this share needs then to be distributed among the eligible best priced orders. For this purpose, the order allocation method is applied that is normally used for that instrument, as described in chapter 7.2.1. It is in principle possible, that different instruments on the same book path have different order allocation methods. It is possible that the same instrument receives a share in more than one book path. Then the sum of all the shares for the instrument is allocated to the orders at once.
3. If the quantity of the incoming order is not yet exhausted, then the remaining book paths on the same price level are matched. These are the remaining book paths that can be matched by forming long synthetic match paths, if there had been more than one available in the previous step. To this end, these book paths are first sorted according to the path sorting procedure that is explained in chapter 11.3.4 below. Then they are executed as much as

possible, in separate match steps, one after the other.

Again, the share that is given to a specific book path is available to all order book sides that make up the book path. And again, for each instrument on such a book path, this share needs to be distributed among the eligible best priced orders, using the order allocation method that is normally used for the instrument. The order allocation is however applied inside each match step and not combining the quantities of different match steps. There is an own match step for each considered book path here, and therefore, if a specific order book side occurs in several book paths, then an order allocation is done for each of these book paths.

4. If all the book paths in step 2 and step 3 could be fully matched at the current price level, and the quantity of the incoming order is not yet exhausted, then the procedure is repeated with step 1 at the next available price level.

11.3.4 Sorting Book Paths

The path allocation methods that are described below require a method that is used to sort book paths of the same type. This sorting method is defined here. It is also applied in the synthetic matching procedure as described in chapter 11.3.3 above, in order to prioritize the book paths that allow matching along long synthetic match paths.

The sorting method in general gives preference to earlier expiry dates. To this end, it needs a rule to compare individual instruments that are part of the book paths. Here, simple instruments are compared to each other by giving priority to the simple instrument with the earlier expiry date. Futures spread instruments are sorted by comparing first the first legs' expiry dates, and then by comparing the second legs' expiry dates. The futures spread with the earlier expiry date in the first leg comes first. If the first legs have the same expiry date, then the futures spread with the earlier expiry date in the second leg comes first.

The sorting of the book paths is then done by performing the following comparisons one after the other, until a difference between the two paths to be compared is found:

1. If there are any simple instruments on each book path: For each book path, find the simple instrument with the earliest expiry date among the simple instruments on the book path. The book path, where in this way the earlier expiry date is found, gets the priority over the other book path.
2. If the first comparison step did not lead to a decision and if there are two simple instruments on each book path: For each book path, take the simple instrument with the later expiry date among the simple instruments on the book path. The book path, where in this way the earlier expiry is found, gets the priority over the other book path.
3. If the first two comparison steps did not lead to a decision: Compare all the futures spread instruments of the book paths according to the rule that is described above. The book path that turns out to have the highest prioritized futures spread gets the priority over the other book path.

Example 11-9:

Sorting synthetic book paths for matching along a short synthetic match path (equivalent to Buy FVS Jan16):

Position	Synthetic Book Path
1	Buy FVS SPD Jan16 Feb16 ⊕ Buy FVS Feb16
2	Buy FVS SPD Jan16 Mar16 ⊕ Buy FVS Mar16
3	Buy FVS SPD Jan16 Apr16 ⊕ Buy FVS Apr16

All sorting is done with comparison rule 1, i.e. according to the expiry date of the simple instrument with the earliest expiry date (FVS Feb16 expires before FVS Mar16, and FVS Mar16 expires before FVS Apr16).

Example 11-10:

Sorting synthetic book paths for matching along a long synthetic match path (equivalent to Sell FVS SPD Feb16 Mar16):

Position	Synthetic Book Path
1	Sell FVS Feb16 ⊕ (Sell FVS SPD Jan16 Mar16 ⊕ Buy FVS Jan16)
2	(Sell FVS Jan16 ⊕ Buy FVS SPD Jan16 Feb16) ⊕ Buy FVS Mar16
3	Sell FVS Feb16 ⊕ (Buy FVS SPD Mar16 Apr16 ⊕ Buy FVS Apr16)

The synthetic book path at position 1 precedes the synthetic book path at position 2 because of comparison rule 2, i.e. according to the expiry date of the simple instrument with the later expiry date (FVS Feb16 expires before FVS Mar16). Comparison rule 1 cannot distinguish these two synthetic book paths. The synthetic book path at position 3 is last in the list because of comparison rule 1 (FVS Jan16 expires before FVS Feb16).

Example 11-11:

Sorting synthetic book paths for matching along a long synthetic match path (equivalent to Buy FVS Jan16):

Position	Synthetic Book Path
1	Buy FVS SPD Jan16 Feb16 ⊕ Buy FVS SPD Feb16 Mar16 ⊕ Buy FVS Mar16
2	Buy FVS SPD Jan16 Apr16 ⊕ Sell FVS SPD Mar16 Apr16 ⊕ Buy FVS Mar16
3	Buy FVS SPD Jan16 Mar16 ⊕ Buy FVS SPD Mar16 Apr16 ⊕ Buy FVS Apr16

The synthetic book path at position 1 precedes the synthetic book path at position 2 because of comparison rule 3, here according to the expiry date of the second leg of the higher prioritized futures spread instrument (FVS Feb16 expires before FVS Apr16). Comparison rule 1 and 2 cannot distinguish these two synthetic book paths. The synthetic book path at position 3 is last in the list because of comparison rule 1 (FVS Mar16 expires before FVS Apr16).

11.3.5 Path Allocation

The path allocation is used to distribute the quantity of an incoming order among several book paths,

in the step 2.a of the synthetic matching procedure as described in chapter 11.3.3 above.

There are four types of book paths that play a role here:

- direct book paths,
- synthetic book paths that result in short synthetic match paths,
- synthetic book paths that result in triangle match paths,
- synthetic book paths that result in long synthetic match paths.

T7 supports three different path allocation methods:

1. the Direct Path First method,
2. the Synthetic Path First method,
3. the Pro-Rata method.

The exchange assigns a path allocation method to each individual product.

Configuration Data:

The information on which path allocation method is applied, is available in the Trading Parameters File, which is part of the Products and Instruments Files on the Eurex website, see chapter 1.2 Usage Notes.

Direct Path First Allocation Method

In the Direct Path First allocation method, the book paths are sorted such, that

- the direct book path comes first,
- then come the book paths that allow matching along a short synthetic match path,
- then come the book paths that allow matching along a triangle match path,
- and last comes the book path that allows matching along a long synthetic match path.

The book paths that allow matching along a short synthetic match path are sorted among themselves according to the sorting rule given in chapter 11.3.4 above. The same is done for the book paths that allow matching along a triangle match path.

At that point, all book paths are sorted. The allocation method then steps through the sorted list of book paths, and allocates as much quantity as possible to each book path, until the incoming quantity is exhausted. Allocating as much quantity as possible means here to allocate either all the remaining quantity of the incoming order, or the available quantity of the book path at the current price level, whichever quantity is smaller.

Synthetic Path First Allocation Method

The Synthetic Path First allocation method works like the Direct Path First allocation method. Only the sequence of book path types is modified such that

- the book paths that allow matching along a short synthetic match path come first,
- then come the book paths that allow matching along a triangle match path,
- then comes the direct book path,
- and the book path that allows matching along a long synthetic match path comes last.

Pro-rata Allocation Method

For the Pro-Rata path allocation method, the book paths are first sorted in the same way as for the Direct Path First allocation method. Note that this sorting differs from the sorting that is applied in the Pro-Rata order allocation method as given in chapter 7.5.2.

Then the quantity of the incoming order is allocated pro-rata to the sorted book paths, with the exception of the book path that allows matching along a long synthetic match path. The allocation is done in exactly the same way, as a quantity is allocated to orders with the Pro-Rata order allocation method that is described in chapter 7.5.2.

Any remaining quantity is then allocated to the book path that allows matching along a long synthetic match path.

11.3.6 Execution Prices

The execution price of an incoming order is the synthetic price of the book path that it is matched against. The execution price of a book order that is part of the matched book path, is its own limit price.

It can happen, both for incoming orders and for book orders, that they are matched at a price that is lower than the current published best buy price or higher than the current published best sell price for the instrument. The prerequisites for such a situation are that the published best price in question is a purely synthetic price, and that there is a synthetic match opportunity in the order book that is not executed by T7, because it would involve a match path that is not supported. T7 strictly executes only synthetic match paths that are of one of the types, which are listed in chapter 11.3.1 above.

In the case of a short synthetic match path or a long synthetic match path, the leg execution prices of the legs of the involved futures spread orders are determined by simple arithmetic with the help of the limit prices of the book orders.

In the case of a triangle match path, there is a specific decomposition procedure, similar to the case of direct matching of futures spread orders (see ch.10.3.3), which can be used to define the leg execution prices.

A match step may contain several different match paths with the same synthetic price. T7 determines order execution prices and leg execution prices in such a way, that inside a given match step, the execution price for a specific instrument is the same for all match paths of the match step, irrespective of the execution price being an order execution price or a leg execution price.

For short or long synthetic match paths, the order execution prices and leg execution prices are given by the limit prices of the involved orders without any degree of freedom. Therefore, a decomposition procedure is applied only in the case of incoming futures spread orders, and if and only if the match step contains a direct match and/or one or more triangle match paths, but no short or long synthetic match path.

Example 11-12:

The following orders are in the order books of the product FVS (Futures on Mini VSTOXX ®):

- *a buy order for the futures spread FVS SPD Jan16 Feb16 at a price of 0.40,*
- *a buy order for the futures spread FVS SPD Feb16 Mar16 at a price of 0.65,*
- *a buy order for the simple instrument FVS Mar16 at a price of 23.50,*
- *a buy order for the futures spread FVS SPD Mar16 Apr16 at a price of 0.60,*

- *a buy order for the simple instrument FVS Apr16 at a price of 22.95.,*

The simple instrument FVS Jan16 has therefore a best available buy price of 24.55 (= 0.40 + 0.65 + 23.50), which is given by the synthetic book path for matching along a long synthetic match path that corresponds to the first three orders in the list above.

And the simple instrument FVS Mar16 has a best available buy price of 23.55 (= 0.60 + 22.95), which is given by the synthetic book path for matching along a short synthetic match path that corresponds to the last two orders in the list above. This best available buy price is better than the direct buy price of 23.50, which is given by the third order in the list.

An incoming sell order for the simple instrument FVS Jan16 with a limit price of 24.50 is executed at an order execution price of 24.55 against the first of the synthetic book paths described above:

- *the incoming sell order of the simple instrument FVS Jan16 is executed at a price of 24.55 against the first leg of the buy order for FVS SPD Jan16 Feb16,*
- *the second leg of the buy order for FVS SPD Jan16 Feb16 is executed at a price of 24.15 (price of the first leg minus the price of the spread i.e. 24.55 – 0.40) against the first leg of the buy order for FVS SPD Feb16 Mar16,*
- *the second leg of the buy order for FVS SPD Feb16 Mar16 is executed at a price of 23.50 (price of the first leg minus the price of the spread i.e. 24.15 – 0.65) against the buy order for FVS Mar16.*

Note that the execution in FVS Mar 16 occurs at 23.50, which is lower than the best available buy price 23.55 for that instrument. Taking advantage of this better price would require matching a match path that is not supported by T7.

Example 11-13:

The following orders are in the order books of the product FVS:

- *a sell order for the simple instrument FVS Jan16 at a price of 24.50,*
- *a buy order for the simple instrument FVS Mar16 at a price of 23.50,*
- *a buy order for the futures spread FVS SPD Feb16 Mar16 at a price of 0.65.*

The futures spread FVS SPD Jan16 Feb16 has therefore a best available sell price of 0.35 (24.50 – 23.50 – 0.65), which is given by the synthetic book path for matching along a long synthetic match path that corresponds to the three orders in the list above.

An incoming buy order for the futures spread FVS SPD Jan16 Feb16 with a limit price of 0.40 is executed at an order execution price of 0.35 against this synthetic book path:

- *the first leg of the incoming buy order for FVS SPD Jan16 Feb16 is executed at a price of 24.50 against the sell order for FVS Jan16,*
- *the first leg of the buy order for FVS SPD Feb16 Mar16 is executed at a price of 24.15 (price of the first leg minus the execution price of the incoming order i.e. 24.50 – 0.35) against the second leg of the incoming buy order for FVS SPD Jan16 Feb16,*
- *the second leg of the buy order for FVS SPD Feb16 Mar16 is executed at a price of 23.50 against the buy order on the simple instrument FVS Mar16.*

11.3.7 Market Orders in Synthetic Matching

Incoming Market Orders

Incoming market orders can match synthetically just like incoming limit orders. For the calculation of the execution limit of an incoming market order, in the synthetic case the published best price (see ch. 11.3.2) is used rather than the best limit price on the order book side of the incoming order.

Therefore:

- The execution limit of an incoming buy market order is obtained by adding the Market Order Matching Range to the published best buy price, where the Market Order Matching Range is calculated using the published best buy price as reference price.
- The execution limit of an incoming sell market order is obtained by subtracting the Market Order Matching Range from the published best sell price, where the Market Order Matching Range is calculated using the published best sell price as reference price.

Example 11-14:

The best prices for the instrument FVS Jan16 in the product FVS (Futures on Mini VSTOXX ®) are as follows:

	Buy	*Sell*
Best Direct Price	*24.40*	*25.60*
Published Best Price	*24.50*	*25.60*
Best Available Price	*24.50*	*25.40*

The market order matching range for FVS is 1.00, independent of the reference price.

- *An incoming buy market order for FVS Jan16 can be matched until the published best buy price plus the market order matching range, i.e. 24.50 + 1.00 = 25.50. It can thus be matched at the best available sell price of 25.40.*
- *An incoming sell market order for FVS Jan16 can be matched until the published best sell price minus the market order matching range, i.e. 25.60 – 1.00 = 24.60. In the given situation, it can not be matched.*

Book Market Orders on the Direct Book Path

Book market orders that are on the direct book path for the incoming order, i.e. the incoming order and the book market orders belong to the same instrument, are executed at the best available price for the book market orders' side of the order book.

It is possible that the best available price is a synthetic price and is better than the price of the best limit order on the direct book path, and it is even possible that there are no limit orders at all on the direct book path. In these cases, the direct book path consists only of the market orders, and its price is equal to the best available price.

If there are limit orders on the direct book path, and if the best limit price is equal to the best available price, then the book market orders and the best limit orders are taken together in the direct book path.

However after the direct book path received its share in the path allocation, in the following order allocation, the market orders and the limit orders are allocated separately, and the market orders are allocated first.

Note that in synthetic matching, a book market order that belongs to the same instrument as the incoming order, can match against the incoming order, even if there are no limit orders on the same side of the same order book, if at the same time there is a synthetic book path against which the incoming order can match.

Example 11-15:

The best prices for the instrument FVS Jan16 are as given in example 11-14 above:

	Buy	*Sell*
Best Direct Price	*24.40*	*25.60*
Published Best Price	*24.50*	*25.60*
Best Available Price	*24.50*	*25.40*

There are market orders on both sides of the order book of FVS Jan16.

The sell book market orders can match against an incoming buy order of the same instrument at the best available sell price 25.40, provided that the incoming order can be executed at that price, which is the case for an incoming buy market order as was shown in the first part of example 11-14.

The buy book market orders could match against an incoming sell order of the same instrument at the best available buy price 24.50, if the incoming order were executable at that price, which is not the case for an incoming sell market order as was shown in the second part of example 11-14.

Book Market Orders on a Synthetic Book Path

Book market orders that are on an order book side, which belongs to a synthetic book path for the incoming order, are executed at the price that is the limit price of the best limit order on the book market orders' order book side.

The presence of market orders on the synthetic book path does not have any influence on the priority of that synthetic book path. As the book market orders are matched at the same price as the best book limit orders, the book market orders and the best limit orders are taken together in the synthetic book path, which then competes with other book paths in the path allocation, as if the market orders where limit orders.

However after the synthetic book path received its share, in the following order allocation, the market orders and the limit orders are allocated separately, and the market orders are allocated first.

The fact that the limit price of the best limit order determines the execution price of the book market order, has as a consequence that a book market order cannot be matched synthetically, if there is no limit order on the same side of the same order book, because no price can be determined for the book market order and thus for the synthetic book path.

Another consequence is that it is possible that a book market order is executed in a synthetic match at a price that is worse than the published best price for the instrument, because the published best price

may be a synthetic price that is better than the best limit price in the instrument's own order book.

Note that the behavior for a synthetic match of a book market order differs here from the behavior for a direct match, which was explained further above.

Example 11-16:

The following orders are in the order books of the product FVS:

- *a buy order for the futures spread FVS SPD Jan16 Feb16 at a price of 0.40,*
- *a buy order for the futures spread FVS SPD Feb16 Mar16 at a price of 0.65,*
- *a buy order for the simple instrument FVS Mar16 at a price of 23.50,*
- *a buy market order for the simple instrument FVS Mar16,*
- *a buy order for the futures spread FVS SPD Mar16 Apr16 at a price of 0.60,*
- *a buy order for the simple instrument FVS Apr16 at a price of 22.95.*

The simple instrument FVS Jan16 has therefore a best available buy price of 24.55 (= 0.40 + 0.65 + 23.50), which is given by the synthetic book path for matching along a long synthetic match path that corresponds to the first three orders in the list above.

And the simple instrument FVS Mar16 has a best available buy price of 23.55 (= 0.60 + 22.95), which is given by the synthetic book path for matching along a short synthetic match path that corresponds to the last two orders in the list above.

An incoming sell order for FVS Jan16 matches against the synthetic book path at the price of 24.55. The buy market order on the order book for FVS Mar16 is executed at 23.50, which is the price of the best limit order in the same order book, even though the published best price 23.55 is better.

Book Market Order Triggering

Book market order triggering refers to giving book market orders preference over an incoming order, if the book market order and the incoming order are on the same side of the order book (see chapter 7.3.4). In a synthetic market it is important to note, that book market order triggering is applied only to book market orders that belong to the same instrument as the incoming order. There is no book market order triggering for market orders in instruments that are not the incoming order's instrument. This means also, that there is no book market order triggering for market orders that belong to a leg instrument of an incoming futures spread order.

For instruments that are not the instrument of the incoming order, but that are part of a synthetic match path, this can result in situations, where book market orders are not considered for matching, even though orders in the same instrument are executed in a synthetic match.

The rule for the determination of the execution price limit of a triggered book market order as given in chapter 7.3.4 applies in the synthetic case the best available price, rather than just the best price of the opposing order book side, where the best available price as always can be given by any supported book path:

- If the incoming order is a limit order, then the execution price of a triggered buy market order can not be both higher than the incoming order's limit price, and higher than the best available sell price plus the Market Order Matching Range, where the Market Order Matching Range is calculated with the best available sell price as the reference price.
- The execution price of a triggered sell market order can not be both lower than the incoming

order's limit price, and lower than the best available buy price minus the Market Order Matching Range, where the Market Order Matching Range is calculated with the best available buy price as the reference price.

Example 11-17:

The order book situation of the order books of the product FVS is similar as in example 11-16, but additionally there are two sell market orders for FVS Jan16 and for FVS Mar16 on the order books:

- *a sell market order for the simple instrument FVS Jan16,*
- *a buy order for the futures spread FVS SPD Jan16 Feb16 at a price of 0.40,*
- *a buy order for the futures spread FVS SPD Feb16 Mar16 at a price of 0.65,*
- *a buy order for the simple instrument FVS Mar16 at a price of 23.50,*
- *a sell market order for the simple instrument FVS Mar16.*

The simple instrument FVS Jan16 still has a synthetic best available buy price of 24.55. The market order matching range for FVS is 1.00 independent of the reference price.

There is an incoming sell limit order for FVS Jan16 with a limit price of 24.20, which is executable against the best available buy price of 24.55.

Before the incoming order can match, the sell market order on the order book of FVS Jan16 is triggered. It can match until a price of

$$23.55 = MIN\big(24.20\,,(24.55 - 1.00)\big)$$

The sell market order on the order book for FVS Mar16 is not triggered, even though there is an execution in that instrument, because FVS Mar16 is not the instrument of the incoming order.

11.4 Synthetic Uncrossing

11.4.1 Procedure Overview

A complex instrument enters automatically the instrument state Continuous, when all its leg instruments have entered the instrument state Continuous. And when entering the instrument state Continuous, an uncrossing procedure is done for the complex instrument as described in chapter 10.3.5. For futures spread instruments that are enabled for synthetic matching, the uncrossing procedure is extended in order to account for the possibility that the order books are crossed synthetically.

In general, in one instrument state change transaction, more than one complex instrument may have to change its instrument state. It is furthermore possible that several or even all simple instruments of a product have their instrument state changed to Continuous inside one transaction. For the synthetic uncrossing procedure, the processing sequence of all these instruments is of relevance, because in synthetic matching, orders in different instruments compete for the same liquidity.

The synthetic uncrossing procedure for futures instruments comprises the following steps in the given sequence. The details for each step are described in the chapters that follow below.

1. Uncrossing trades and instrument state changes of all simple instruments, which have their instrument state changed to Continuous in the current transaction.
2. Synthetic uncrossing trades and instrument state changes of all futures spread instruments, which have to change their instrument state to Continuous, because of the instrument state

changes of the simple instruments in step 1.

3. Feeding of all futures spread orders, which belong to the futures spread instruments that changed their instrument state in step 2.
4. Triggering of stop orders.

Each of the four steps of the synthetic uncrossing procedure is completed for all affected instruments, before the next step is done. This means especially that

- If the instrument state of several simple instruments is changed to Continuous in one transaction, then the uncrossing trade of the simple instruments is done for all these simple instruments, before step 2 is started for any affected futures spread instrument.
- If there are several affected futures spread instruments, then the synthetic uncrossing trade is done for all these futures spread instruments, before step 3 is started for any affected futures spread instrument.
- Feeding of futures spread orders is completed for all affected futures spread instruments, before stop order triggering is processed.

11.4.2 Uncrossing Trades of Simple Instruments

The uncrossing procedure for a simple futures instrument is any case not synthetic, and therefore identical to the procedure that is described in chapter 7.4.1.

The reason is that in the moment of the uncrossing of a simple instrument, all complex instruments that have the simple instrument as a leg are considered as not being tradable yet.

It is possible that several simple futures instruments change their instrument state to Continuous in the same transaction. They are processed one after the other. But since this uncrossing is not synthetic, the sequence, in which the instruments are processed, is not of relevance and thus undefined.

11.4.3 Synthetic Uncrossing Trades of Futures Spread Instruments

For futures spread instruments that are enabled for synthetic matching, a synthetic uncrossing is done. The uncrossing trade includes here matching of the two sides of the order book of the concerned futures spread instrument, and in addition matching of the order books of the leg instruments by way of the short synthetic match path. Matching along the triangle match path or along the long synthetic match path is not considered at this point. These paths are considered in the feeding step that is described in chapter 11.4.4 below.

The procedure determines an auction price for the futures spread instrument similar to the way that is described in chapter 7.4. The differences are:

- The book path that allows matching futures spread orders against orders in the two leg instruments is considered. The objective of uncrossing includes here, that after the auction trade, the order books are uncrossed in a way that no more matching opportunities along a short synthetic match path exist.
- The objective of price continuity applies not only to the auction price of the futures spread lying between the best buy and sell prices of that instrument, but also to the leg execution prices lying between the best buy and sell prices of the respective leg instruments.

The order allocation for the futures spread orders follows the order allocation method that is configured for auction trades for the futures spread instruments of the product. But the order allocation for the leg instrument orders follows the order allocation method that is configured for continuous trading for the simple instruments of the product, because at this point, the leg instruments are

considered to be already in continuous trading.

If there are several futures spread instruments, the state of which has to be changed to Continuous, then the sequence, in which they are processed, is of relevance, due to the synthetic nature of the uncrossing trade. The futures spread instruments are processed in the usual sequence, i.e. the futures spread instrument that has the earlier expiry date in the first leg gets the priority, and if the futures spread instruments have the same first leg, then the futures spread instrument that has the earlier expiry date in the second leg gets the priority.

11.4.4 Feeding of Futures Spread Orders

Since the procedure for the synthetic uncrossing trade of futures spread instruments does not consider the triangle match paths and the long synthetic match paths, an additional feeding step is applied to ensure the order books to be synthetically uncrossed.

It consists of feeding all remaining orders of the futures spread instruments one after the other, attempting to match them synthetically like incoming orders, in order to resolve any synthetically crossed situations.

The sequence in which the futures spread orders are processed is

- All futures spread instruments in the same sequence as in the previous step, and for each of these:
    1. First all buy orders, sorted by price-time priority with prices in descending order,
    2. Then all sell orders, sorted by price-time priority with prices in ascending order.

In the order allocation, for all instruments including the futures spread instrument that is currently processed, the allocation method for continuous trading is applied.

11.4.5 Triggering of Stop Orders

It is possible that stop orders or OCO orders are triggered by the uncrossing procedure. The processing of such triggered stop orders and OCO orders is done only after the uncrossing of all instruments has been completely processed.

12. Packs and Bundles

This chapter outlines the specific features of packs and bundles in T7. The common features of complex instruments in T7 as described in chapter 10 apply for packs and bundles, except if stated otherwise in the following.

Eurex Set Up Information:

Eurex supports packs and bundles for selected money market futures products.

EEX Set Up Information:

EEX currently does not support packs and bundles for any product.

12.1 Definition of Packs and Bundles

Packs and bundles are complex instruments, the signatures of which comply with the following rules:

- All leg instruments belong to the same futures product.
- The leg instruments have expiration dates that represent a quarter of a year, i.e. the contract months March, June, September or December.
- The leg instruments are sorted with their expiration dates in ascending order.
- All legs are defined as Buy leg in the signature.
- All legs have a leg ratio of 1.

The leg instruments with their quarterly expirations cover a time-span of one year in the case of packs or several years in the case of bundles, meaning that all quarterly expirations of the respective time span are represented without any gaps.

As a consequence, packs always have four legs, and bundles have an integer multiple of four legs, i.e. 8 legs for a 2-year bundle, 12 legs for a 3-year bundle etc..

Example 12-1:

A pack for the FEU3 money market future may have the following signature

- *Leg 1: Buy 1 of FEU3 Jun16*
- *Leg 2: Buy 1 of FEU3 Sep16*
- *Leg 3: Buy 1 of FEU3 Dec16*
- *Leg 4: Buy 1 of FEU3 Mar17*

A 2-year bundle for the FEU3 money market future may have the following signature

- *Leg 1: Buy 1 of FEU3 Sep16*
- *Leg 2: Buy 1 of FEU3 Dec16*
- *Leg 3: Buy 1 of FEU3 Mar17*
- *Leg 4: Buy 1 of FEU3 Jun17*
- *Leg 5: Buy 1 of FEU3 Sep17*
- *Leg 6: Buy 1 of FEU3 Dec17*
- *Leg 7: Buy 1 of FEU3 Mar18*
- *Leg 8: Buy 1 of FEU3 Jun18*

Packs and bundles instruments have an instrument subtype, which defines the number of legs and thus the length of the covered time span. Since the instrument subtype of a pack typically indicates how distant the covered time period is from today, a pack instrument may change its instrument subtype during its lifetime.

Configuration Data:

The list of available packs and bundles instrument subtypes is available in the Instrument Subtypes File, which is part of the Products and Instruments Files on the Eurex website, see chapter 1.2 Usage Notes.

Eurex Set Up Information:

Eurex categorizes packs with a color scheme that is commonly known in money market futures trading. The colors indicate how far away the 1-year time period is that the pack covers.

Instrument subtype	*Short name*	*Expiration of the 1st leg instrument*	*Number of legs*
White Pack	*WHITE-P*	*within the next 12 months*	*4*
Red Pack	*RED-P*	*within the next 13-24 months*	*4*
Green Pack	*GREEN-P*	*within the next 25-36 months*	*4*
Blue Pack	*BLUE-P*	*within the next 37-48 months*	*4*
Gold Pack	*GOLD-P*	*within the next 49-60 months*	*4*

Bundles are categorized according to the time period that they cover.

Instrument subtype	*Short name*	*Time period covered*	*Number of legs*
2-Year Bundle	*BUNDLE2*	*24 months*	*8*
3-Year Bundle	*BUNDLE3*	*36 months*	*12*
4-Year Bundle	*BUNDLE4*	*48 months*	*16*
5-Year Bundle	*BUNDLE5*	*60 months*	*20*

12.2 Creation of Packs and Bundles

The exchange creates packs and bundles instruments in those futures products, for which packs and bundles are enabled. Packs and bundles instruments can not be created by users. A user that wishes to trade a packs and bundles instrument, which has not been created by the exchange, may consider creating a strip instead – see chapter 13 below about strips – provided that strips are enabled for the product.

12.3 Pricing of Packs and Bundles

For packs and bundles instruments, prices are expressed in a way that differs from the standard net price notation as described in chapter 10.3.3 for complex instruments in general.

The pricing convention applied for packs and bundles is Averaged Net Change Pricing. Prices in a

packs and bundles instrument depend on the differences between the leg instrument prices and their corresponding rounded previous day settlement prices, and the sum of these price differences is divided by the number of legs to obtain an average price difference.

Precisely, the relations between the price of a packs and bundles instrument and its leg instrument prices can be expressed as follows:

$$p_{P\&B} = \frac{1}{N} \times \sum_{i=1}^{N} \left[p_i - TSROUND\left(p_i^{PDS}\right) \right]$$

Here

$p_{P\&B}$	is the price of the packs and bundles instrument,
p_i	is the price of the i-th leg instrument,
p_i^{PDS}	is the previous day settlement price of the i-th leg instrument,
$TSROUND\left(p_i^{PDS}\right)$	means rounding the previous day settlement price to the next price that is in agreement with the tick size (ch.4.1.1) of the leg instrument, with round half up as tie-breaker,
N	is the number of leg instruments of the packs and bundles instrument.

12.4 Matching of Packs and Bundles

T7 considers the pricing formula described in chapter 12.3 above, when creating leg trades and forwarding them to clearing, after a packs and bundles order has been executed.

Since the price formula contains the leg instruments' previous day settlement prices, packs and bundles instruments can only be traded, if previous day settlement prices are available for all leg instruments.

Eurex Set Up Information:

Eurex does not accept GTC or GTD orders for packs and bundles.

Apart from that, matching of packs and bundles follows the rules that have been described in chapter 7 on matching in general and in chapter 10.3 on matching for complex instruments. T7 supports no synthetic matching for packs and bundles, i.e. packs and bundles orders and quotes match only against orders and quotes of the same instrument.

13. Strips

This chapter outlines the specific features of strips in T7. The common features of complex instruments in T7 as described in chapter 10 apply for strips, except if stated otherwise in the following.

Eurex Set Up Information:

Eurex supports strips for selected money market futures products.

EEX Set Up Information:

EEX currently does not support strips for any product.

13.1 Definition of Strips

A strip is a complex instrument similar to packs and bundles. Its signature must comply with the following rules:

- All leg instruments belong to the same futures product.
- All legs are defined as Buy leg in the signature.
- All legs have a leg ratio of 1.
- The leg instruments are sorted with their expiration dates in ascending order.

Note that contrary to packs and bundles, there are no further restrictions concerning the selection of leg instruments. Specifically they do not need to represent quarterly expirations and they do not need to represent a gap-free sequence of expirations.

Eurex Set Up Information:

Eurex requires that strips have at least 2 and at most 20 legs.

There are no instrument subtypes defined for strips.

Example 13-1:

A technically valid strip for the FEU3 money market future may have the following signature

- *Leg 1: Buy 1 of FEU3 Jun16*
- *Leg 2: Buy 1 of FEU3 Sep16*
- *Leg 3: Buy 1 of FEU3 Jun17*
- *Leg 4: Buy 1 of FEU3 Dec17*
- *Leg 5: Buy 1 of FEU3 Mar18*

13.2 Creation of Strips

The exchange does not create strips instruments. Strips instruments are created by users.

When creating a strips instrument, the user must adhere strictly to all the rules as outlined in chapter 13.1 above, i.e. regarding the sequence of the leg instruments, their ratios and their sides. Failure to do so will result in a rejection of the creation request.

Since the formula for the pricing of strips contains the leg instruments' previous day settlement prices, a specific strip instrument can only exist, if previous day settlement prices are available for all its leg instruments.

13.3 Pricing of Strips

For the pricing of strips, Averaged Net Change Pricing is applied, following exactly the same rules as for packs and bundles as described in chapter 12.3 above.

13.4 Matching of Strips

For strips, T7 considers the pricing formula described for packs and bundles in chapter 12.3 above, when creating leg trades and forwarding them to clearing.

Eurex Set Up Information:

Eurex does not accept GTC or GTD orders for strips.

Apart from that, matching of strips follows the rules that have been described in chapter 7 on matching in general and in chapter 10.3 on matching for complex instruments. T7 supports no synthetic matching for strips, i.e. strips orders and quotes match only against orders and quotes of the same instrument.

14. Standard Futures Strategies

This chapter outlines the specific features of standard futures strategies in T7. The common features of complex instruments in T7 as described in chapter 10 apply for standard futures strategies, except if stated otherwise in the following.

Eurex Set Up Information:

Eurex supports standard futures strategies for selected futures products.

EEX Set Up Information:

EEX currently does not support standard futures strategies for any product.

14.1 Definition of Standard Futures Strategies

A Standard Futures Strategy consists of two or more leg instruments that belong to the same futures product. The signature of a standard futures strategy complies with a strategy type template that is defined by the exchange.

A standard futures strategy type template contains

- the identifier and the name of the standard futures strategy type,
- the number of the legs,
- and for each leg
  - the ratio,
  - the side,
  - optionally a rule concerning the expiration date.

Example 14-1:

Eurex defines a Futures Butterfly as

Short Name	*FBUT*		
Number of Legs	*3*		
	1st Leg	*2nd Leg*	*3rd Leg*
Ratio	*1*	*2*	*1*
Side	*Buy*	*Sell*	*Buy*
Expiration Rule	*n/a*	*Greater than 1st leg*	*Greater than 2nd leg*

An example for a valid Futures Butterfly instrument is therefore the instrument with the signature:

- *Leg 1: FEU3 Jun16, Ratio 1, Side Buy*
- *Leg 2: FEU3 Sep16, Ratio 2, Side Sell*
- *Leg 3: FEU3 Dec16, Ratio 1, Side Buy*

In the templates, an exchange may also define minimum limit prices for certain strategy types, which are motivated by the wish to prevent the entry of obviously mispriced orders.

The list of templates of supported strategy types is valid for an entire market. For different markets, there are different lists of supported standard futures strategy templates.

Technically, standard futures strategy types are realized as instrument subtypes.

Configuration Data:

The list of available standard futures strategy types together with the information which of the types are available for Eurex, is available in the Instrument Subtypes File, which is part of the Products and Instruments Files on the Eurex website, see chapter 1.2 Usage Notes.

14.2 Creation of Standard Futures Strategies

The exchange does not create standard futures strategy instruments. Standard futures strategy instruments are created by users.

When creating a standard futures strategy instrument, the user must indicate its instrument subtype and adhere strictly to all the rules as given in the corresponding template, including the sequence of legs, their ratios and their sides. Failure to do so will result in a rejection of the creation request.

14.3 Matching of Standard Futures Strategies

Matching of standard futures strategies follows the rules that have been described in chapter 7 on matching in general and in chapter 10.3 on matching for complex instruments. T7 supports no synthetic matching for standard futures strategies, i.e. standard futures strategy orders and quotes match only against orders and quotes of the same instrument.

15. Inter-Product Spreads

This chapter outlines the specific features of inter-product spreads in T7. The common features of complex instruments in T7 as described in chapter 10 apply for inter-product spreads, except if stated otherwise in the following.

EEX Set Up Information:

EEX offers various types of inter-product spreads. They are currently

- *Location Spreads between power futures of different national market areas,*
- *Emission Spreads between different emission allowance certificate types,*
- *Basis Spreads between emission allowance spot products and futures products,*
- *Off-Peak Spreads between power base futures and peak futures that are equivalent to off-peak futures.*

More types of inter-product spreads may be added in the future.

Eurex Set Up Information:

Eurex currently does not offer any inter-product spreads.

15.1 Definition of Inter-Product Spreads

An inter-product spread is a complex instrument that consists of two or more leg instruments belonging to different futures products of the same market.

As an inter-product spread instrument cannot be attributed to one specific product, it belongs instead to a Product Pool. A Product Pool is simply a grouping of products that has been formed for the purpose of supporting and configuring inter-product spread instruments on this group of products.

Configuration Data:

T7's Reference Data Interface publishes information on product pools using the same product snapshot messages that are used for products. A product pool that supports inter-product spread instruments, can be recognized as such with the help of the RDI field MarketSegmentPoolType.

The characteristics of inter-product spread instruments in T7 are

- Two or more leg instruments
- All leg instruments are futures instruments
- At least two leg instruments belong to different products
- At least one Buy leg and at least one Sell leg
- Leg ratios can be any integer number up to 999

An inter-product spread instrument has an instrument subtype, which is however for informational purposes only, i.e. there are no templates defined for specific instrument subtypes of inter-product spreads.

There are no restrictions concerning the futures products that can be combined to form inter-product spreads other than that they have to belong to the same market. T7 supports specifically inter-product spreads with leg instruments that have strongly differing contract values.

EEX Set Up Information:

EEX currently offers only inter-product spreads that have two leg instruments with a leg ratio of 1. Most of these inter-product spreads have leg instruments with identical contract values. The possibility to have leg instruments with different contract values is made use of in the case of Off-Peak Spreads.

Example 15-1:

EEX creates Location Spreads (instrument subtype LOCS) between German and Italian power futures, for example:

- *Leg 1: Buy 1 FDBM May16 (Italian Base Load Month Futures)*
- *Leg 2: Sell 1 F1BM May16 (German "Phelix" Base Load Month Futures)*

The related product pool is called FDBMF1BM and the inter-product spread that has the above-mentioned leg instruments is referred to as

FDBMF1BM LOCS FDBM May16 F1BM May16

15.2 Creation of Inter-Product Spreads

Inter-product spread instruments are created by the exchange. They can not be created by users.

15.3 Pricing of Inter-Product Spreads

The inter-product spread functionality of T7 allows combining instruments that belong to very different products, specifically concerning the contract value. Such differences need in general to be reflected in the relation between the price of an inter-product spread instrument and the prices of its leg instruments.

T7 supports a number of different price relations, two of which are currently in use and described in the following sub-chapters.

15.3.1 Standard Price Relation

The standard net price relation for complex instruments is described in chapter 10.3.3 above. It is typically applied in cases, where there are no major differences in the contract values of the leg instruments.

EEX Set Up Information:

Location Spreads, Emission Spreads and Basis Spreads as currently offered by EEX combine two leg instruments with equal or similar contract values. The standard pricing relation is applied, exactly in the same way as for futures spread instruments, i.e.

$$p_{IPS} = p_{leg\,1} - p_{leg\,2}$$

15.3.2 Difference Price Relation

The difference price relation is applied for inter-product spreads, for which the deliverable of the first leg instrument includes the entire deliverable of the second leg instrument, and the inter-product spread is supposed to represent the part of the first leg's deliverable that is not contained in the second leg's deliverable. Such instruments have always two leg instruments each having a leg ratio of 1.

The difference price relation is defined as

$$p_{IPS} = \frac{1}{(S_1 - S_2)}(S_1 \times p_1 - S_2 \times p_2)$$

Here

p_{IPS}	is the net price of the inter-product spread.
S_i	is the contract size of the i-th leg instrument in the complex instrument's signature, as published by Eurex RDI in the field *ContractMultiplier* of the Instrument Snapshot Message.
p_i	is the price of the i-th leg instrument.

Example 15-2:

EEX creates Off-Peak Spreads (instrument subtype OFFP) between power base load futures and peak load futures, for example:

- *Leg 1: Buy 1 F1BM May16* $Contract\ Size = 31 \times 24\ MWh = 744\ MWh$
- *Leg 2: Sell 1 F1PM May16* $Contract\ Size = 22 \times 12\ MWh = 264\ MWh$

The first leg's deliverable is electrical power to be delivered in Germany at a constant rate of $1\ MWh$ *per hour throughout the entire month May 2016. The contract size reflects the number of hours in that month, i.e. 31 days with 24 hours per day. The second leg's deliverable is the same commodity, to be delivered at the same constant rate of* $1\ MWh$*, but only between 8 a.m. and 8 p.m., and excluding Saturdays and Sundays. The contract size considers therefore 12 hours per day on 22 days in that month that are not Saturday or Sunday.*

The related product pool is called F1BMF1PM and the inter-product spread that has the above-mentioned leg instruments is referred to as

F1BMF1PM OFFP F1BM May16 F1PM May16

The Off-Peak Spread between the two leg instruments is equivalent to an instrument with a deliverable covering exactly the times of the month May 2016 that are not covered by the peak load future.

The applied price relation is the difference price relation:

$$p_{OFFP} = \frac{1}{480\ MWh} \times (744\ MWh \times p_1 - 264\ MWh \times p_2)$$

15.4 Matching of Inter-Product Spreads

In continuous trading, T7 supports two ways of matching inter-product spreads:

- Direct matching of orders of the same inter-product spread instrument.
- Synthetic matching of orders in two simple instruments and in one inter-product spread instrument, where the simple instruments are the leg instruments of the inter-product spread instrument.

Additionally, like all complex instruments, inter-product spreads may match directly in the uncrossing procedure during the transition into a continuous trading phase.

In this chapter, the term *order* always stands for both orders and quotes. And the term *incoming order* is always to be taken in the extended sense as explained in chapter 7.1 above.

15.4.1 Direct Matching

Direct matching for inter-product spreads, i.e. matching of orders against each other that belong to the same inter-product spread instrument, follows the rules that have been described in chapter 10.3 for complex instruments in general.

If the difference price relation (ch.15.3.2) is applied, it can happen that in the decomposition of a spread trade, no leg trade prices can be found that are in agreement with the respective leg instruments' tick sizes. But leg trade prices must be in agreement with the tick sizes to be acceptable to the clearing house.

In such cases, T7 will create leg trades with rounded trade prices, which are in agreement with the tick sizes as required by the clearing house. The inevitable consequence is that the effective trade price of the inter-product spread, which results from these leg trade prices, differs by a small amount from the matched inter-product spread price. And it may thus also violate the limit price of an involved order by that small amount.

Example 15-2 continued (1):

In the above example of an Off-Peak Spread (instrument subtype OFFP) between German power base load futures and peak load futures, a buy and a sell spread order, both with a limit price of $27.55\ €/MWh$*, match at their limit price:*

$$p_{OFFP}^{match} = 27.55\ €/MWh$$

Depending on the current market prices in the leg instruments, and taking into account that trade prices in the leg instruments are required to be integer multiples of $0.01\ €/MWh$*, T7 may decompose this spread trade into leg trades as follows*

- *Leg 1: F1BM May16* $Leg\ Trade\ Price = 30.65\ €/MWh$
- *Leg 2: F1PM May16* $Leg\ Trade\ Price = 36.29\ €/MWh$

Applying the difference price relation, this results in an effective spread trade price that differs by a small amount from the spread match price:

$$p_{OFFP}^{eff} = \frac{1}{480\ MWh} \times (744\ MWh \times 30.65\ €/MWh - 264\ MWh \times 36.29\ €/MWh) = 27.548\ €/MWh$$

Note that this violates the limit of the involved sell order by $0.002\ €/MWh$*.*

15.4.2 Synthetic Matching

Synthetic Matching Basics

T7 supports synthetic matching of inter-product spread instruments. The procedures follow the lines of the procedures for synthetic matching of futures spreads, and also have to be seen in the context of these, because futures instruments may be subject to both synthetic matching with futures spreads and synthetic matching with inter-product spreads at the same time.

Synthetic matching of inter-product spreads is supported exclusively in the form of matching an inter-product spread instrument against its leg instruments. This way of matching corresponds to the Short Synthetic Match Path for futures spreads as described in chapter 11.3.1. Other ways of synthetic matching that combine one inter-product spread instrument with another inter-product spread instrument or any other complex instrument are not supported by T7.

Example 15-1 continued (1):

An incoming buy order for the simple instrument F1BM May16 may be executed against a combination of book buy orders in the inter-product spread instrument FDBMF1BM LOCS FDBM May16 F1BM May16 and of book sell orders in the simple instrument FDBM May16. The match path consists therefore of

- *the buy side of F1BM May16,*
- *the buy side of FDBMF1BM LOCS FDBM May16 F1BM May16, i.e. buy FDBM May16 and sell F1BM May16,*
- *the sell side of FDBM May16.*

Here,

1. *the incoming order on the buy side of the simple instrument F1BM May16 is matched against the second leg of the buy side of the inter-product spread instrument FDBMF1BM LOCS FDBM May16 F1BM May16, which is selling F1BM May16, and*
2. *the first leg of the buy side of the inter-product spread instrument FDBMF1BM LOCS FDBM May16 F1BM May16, which is buying FDBM May16, is matched against the sell side of the simple instrument FDBM May16.*

Example 15-2 continued (2):

An incoming sell order for the inter-product spread instrument F1BMF1PM OFFP F1BM May16 F1PM May16 may be executed against a combination of book buy orders in the simple instrument F1BM May16 and of book sell orders in the simple instrument F1PM May16. The match path consists therefore of

- *the buy side of F1BM May16,*
- *the sell side of F1BMF1PM OFFP F1BM May16 F1PM May16, i.e. sell F1BM May16 and buy F1PM May16,*
- *the sell side of F1PM May16.*

Here,

1. *the buy side of the simple instrument F1BM May16 is matched against the first leg of the sell side of the inter-product spread instrument F1BMF1PM OFFP F1BM May16 F1PM May16, which is selling F1BM May16, and*

2. *the second leg of the sell side of the inter-product spread instrument F1BMF1PM OFFP F1BM May16 F1PM May16, which is buying F1PM May16, is matched against the sell side of the simple instrument F1PM May16.*

Currently, exchanges offer only inter-product spreads with two legs that have leg ratios of 1. This document describes the synthetic matching only for such instruments. Synthetic matching of inter-product spread instruments with more than two legs or with leg ratios that are not 1, will be described in a later version of this document, when such instruments are set up by an exchange.

Price and Quantity of a Synthetic Book Path

An incoming order can match synthetically against the order books of two or more different instruments as described in the previous chapter. The part of the match path that is obtained by removing the instrument of the incoming order, is called the Synthetic Book Path. It is in this way possible to say that in synthetic matching; an incoming order matches against a synthetic book path.

It is then possible, by using the best limit prices in the order books of a specific synthetic book path, to calculate the Best Synthetic Price for this specific synthetic book path. The incoming order that matches synthetically against this synthetic book path, is then executed at the best synthetic price of the synthetic book path.

In the case of the standard price relation (ch.15.3.1), the rules for the calculation of a synthetic price are the same as for Futures Spreads (ch.11.3.2). In the case of the difference price relation (ch.15.3.2), the rules for the calculation of a synthetic price take the price relation into account.

In order to determine the quantity of a synthetic book path, the accumulated quantity at the best price level is determined for each constituent of the synthetic book path. The minimum of these accumulated quantities is then the quantity of the synthetic book path.

Example 15-1 continued (2):

The following orders are in the order books:

- *Simple instrument F1BM May16:*
  - *Buy 50 at a price of 30.55 €/MWh*
- *Location spread FDBMF1BM LOCS FDBM May16 F1BM May16:*
  - *Buy 10 at a price of 16.75 €/MWh*
  - *Buy 20 at a price of 16.75 €/MWh*

These orders result in the following synthetic book path

Buy FDBMF1BM LOCS FDBM May16 F1BM May16 ⊕ Buy F1BM May16

giving a synthetic buy price for the simple instrument FDBM May16

Price: $+47.30\ €/MWh = (+16.75\ €/MWh + 30.55\ €/MWh)$

Quantity: $30 = MIN\big((10 + 20), 50\big)$

Publication of Synthetic Prices and Quantities

T7 publishes synthetic prices and quantities for inter-product spread instruments as derived from best prices in the leg instruments.

T7 furthermore publishes synthetic prices for leg instruments that are obtained with the help of inter-product spread instruments. Such prices are however published separately from synthetic prices that are derived with the help of futures spread instruments. See the *Eurex Market and Reference Data Interfaces Manual* for technical details. Note that synthetic prices for leg instruments that are obtained with the help of inter-product spread instruments can be Best Available Prices but are never regarded as Published Best Prices in the sense of the description in chapter 11.3.2.

Published synthetic prices for futures instruments that are obtained with the help of inter-product spread instruments, may cross with each other or may cross published synthetic prices that are derived from the futures spread functionality. T7 flags such prices in the market data messages, but it does not resolve such situations by itself.

The application of the difference price relation may lead to synthetic prices for an instrument, which are not in agreement with the price step table of that instrument. T7 will in such cases publish rounded prices. Synthetic buy prices are rounded down and synthetic sell prices are rounded up to the next price that is in agreement with the price step table of the instrument.

Rounding of Synthetic Match Prices

This sub-chapter is of no relevance for instruments, for which the standard price relation is applied.

As stated above, the use of the difference price relation may lead to synthetic prices that are not in agreement with the price step table of the instrument. The impact on the matching differs depending on whether it is a synthetic price for a leg instrument or for an inter-product spread instrument.

In the case of an incoming inter-product spread order that matches against a synthetic inter-product spread book path, no rounding of the match price takes place. The match is executed at the exact calculated synthetic price, no matter whether this price is on a valid price step or not. The resulting leg trade prices are just the leg instrument prices that were applied in the calculation of the synthetic price of the book path.

Note that this behavior may imply a difference between the exact synthetic match price and the previously published rounded synthetic price.

Example 15-2 continued (3):

The following orders are in the order books:

- *Simple instrument F1BM May16:*
  - *Buy 30 at a price of 30.55 €/MWh*
  - *Buy 50 at a price of 30.55 €/MWh*
- *Simple instrument F1PM May16:*
  - *Sell 10 at a price of 36.40 €/MWh*

These orders result in the following synthetic book path

Buy F1BM May16 ⊕ Sell F1PM May16

giving a synthetic buy price for the off-peak spread F1BMF1PM OFFP F1BM May16 F1PM May16

Price: $+27.3325\ €/MWh = \frac{1}{480\ MWh} \times (744\ MWh \times 30.55\ €/MWh - 264\ MWh \times 36.40\ €/MWh)$

Quantity: $10 = MIN\big((30 + 50), 10\big)$

Note that in this example, the calculated synthetic price is not on a valid price step, i.e. not a multiple of 0.01 €/MWh. T7 publishes therefore a rounded synthetic buy price of 27.33 €/MWh.

Now an incoming sell order for F1BMF1PM OFFP F1BM May16 F1PM May16 with a limit price of 27.30 €/MWh matches against this synthetic book path. No rounding takes place. The match price for the incoming order is precisely 27.3325 €/MWh, and the leg trade prices are 30.55 €/MWh for F1BM May 16 and 36.40 €/MWh for F1PM May 16.

In the case of an incoming leg instrument order that matches against a synthetic book path, which contains an inter-product spread order, rounding is performed, if the synthetic price is not on a valid price step for that leg instrument. In case of a synthetic buy price, the match price is rounded down to the next lower price that is on a valid price step of the leg instrument. And in case of a synthetic sell price, the match price is rounded up to the next higher price that is on a valid price step of the leg instrument. The procedure is the same here as applied for the publication of synthetic prices as described above.

Note that the rounding gives a small price advantage to the inter-product spread orders that are part of the synthetic match.

Example 15-2 continued (4):

The following orders are in the order books:

- *Simple instrument F1BM May16:*
  - *Buy 30 at a price of 30.55 €/MWh*
  - *Buy 50 at a price of 30.55 €/MWh*
- *Off-peak spread F1BMF1PM OFFP F1BM May16 F1PM May16:*
  - *Sell 20 at a price of 27.50 €/MWh*

These orders result in the following synthetic book path

Buy F1BM May16 ⊕ Sell F1BMF1PM OFFP F1BM May16 F1PM May16

giving a synthetic buy price for the simple instrument F1PM May16

Price: $+36.09\overline{54}\ €/MWh = \frac{1}{264\ MWh} \times (744\ MWh \times 30.55\ €/MWh - 480\ MWh \times 27.50\ €/MWh)$

Quantity: $20 = MIN\big((30 + 50), 20\big)$

The calculated synthetic price is not on a valid price step, i.e. it is not a multiple of 0.01 €/MWh. T7 publishes therefore a rounded synthetic buy price of 36.09 €/MWh, which is the next lower valid price for that instrument.

Now an incoming sell order for F1PM May16 matches against the synthetic book path. The execution price of the incoming order is 36.09 €/MWh.

The execution price for the executed F1BM May 16 order is its limit price 30.55 €/MWh. This results in an effective execution price for the off-peak spread sell book order that is slightly better than its limit price:

$$p_{OFFP}^{eff} = \frac{1}{480\ MWh} \times (744\ MWh \times 30.55\ €/MWh - 264\ MWh \times 36.09\ €/MWh) = 27.503\ €/MWh$$

Contrary to direct matching as described in ch.15.4.1 above, rounding procedures in synthetic matching never lead to limit price violations.

15.4.3 Matching Procedure

The matching procedure for an incoming order in the context of synthetic matching of inter-product spread orders follows the description given in chapter 11.3.3 for futures spreads with only a few alterations as follows.

For incoming inter-product spread orders, there are at maximum two possible book paths:

- The direct book path,
- The synthetic book path that is formed by the leg instruments.

The matching of these two book paths is performed in independent match steps even in the case of equal price, in the same way as it is done for long synthetic match paths in the futures spread context as described in step 3 of the procedure in chapter 11.3.3. Which of the two is matched first in the case of equal price, depends on the configuration by the exchange.

For incoming leg instrument orders, additionally to the book paths containing futures spreads as listed in chapter 11.3.3, there are book paths that include inter-product spread instruments. In the case of equal price, depending on the configuration by the exchange, T7 chooses one of two procedures:

1. T7 matches first the paths (with that price) containing futures spreads, in the way described in chapter 11.3.3. And when these paths are exhausted, then it matches the synthetic paths (with that price) that include inter-product spreads.
2. Or it is the other way around, i.e. T7 matches first the synthetic paths (with that price) that include inter-product spreads, and then those that include futures spreads.

Matching of an incoming leg instrument order against several equally priced synthetic book paths that include inter-product spread instruments requires defining a priority rule among such book paths. T7 simply uses the technical (numeric) instrument ID of the involved inter-product spread instrument as the sorting criterion. Book paths that include inter-product spread instruments with a lower instrument ID are matched first.

The matching of several synthetic book paths that include inter-product spread instruments, is performed in independent match steps, in the same way as it is done for long synthetic match paths in the futures spread context as described in step 3 of the procedure in chapter 11.3.3.

15.5 Uncrossing of Inter-Product Spreads

Like all complex instruments, an inter-product spread instrument enters automatically the instrument state Continuous, when all its leg instruments have entered the instrument state Continuous. And when entering the instrument state Continuous, an uncrossing procedure is done for the inter-product spread instrument as described in chapter 10.3.5. Like for most other complex instrument types but contrary to the case of futures spreads, the uncrossing trade and the related price finding algorithm do not take the order books of the leg instruments into account. The observations made in chapter 15.4 concerning the rounding of leg trade prices and as a possible consequence, small limit price violations, hold for uncrossing trades in the same way.

Remaining synthetic crossed book situations are resolved before normal continuous trading starts. To this end, a feeding procedure for inter-product spread orders is applied, much in the same way as for futures spreads, as described in chapter 11.4.4. The feed procedure for inter-product spreads applies the sorting by instrument ID as already applied in chapter 0 above. If futures spread instruments and inter-product spread instruments are uncrossed at the same time, futures spread orders are fed first.

16. Standard Options Strategies

This chapter outlines the specific features of standard options strategies in T7. The common features of complex instruments in T7 as described in chapter 10 apply for standard options strategies, except if stated otherwise in the following.

16.1 Definition of Standard Options Strategies

A Standard Options Strategy consists of two or more leg instruments that belong to the same options product. The signature of a standard options strategy complies with a strategy type template that is defined by the exchange.

A standard options strategy type template contains

- the identifier and the name of the standard options strategy type,
- the number of the legs,
- and for each leg
  - the ratio,
  - the side,
  - Call or Put,
  - optionally a rule concerning the expiration date,
  - optionally a rule concerning the strike price.

Example 16-1:

Eurex defines a 2×1 Ratio Call Spread as

Short Name	*RBUL*	
Number of Legs	*2*	
	1st Leg	*2nd Leg*
Ratio	*1*	*2*
Side	*Sell*	*Buy*
Option Type	*Call*	*Call*
Expiration Rule	*n/a*	*same as 1st leg*
Strike Rule	*n/a*	*higher than for 1st leg*

An example for a valid 2×1 Ratio Call Spread instrument is therefore the instrument with the signature:

- *Leg 1: ODAX Jun16 12150 C, Ratio 1, Side Sell*
- *Leg 2: ODAX Jun16 12200 C, Ratio 2, Side Buy*

Apart from belonging to the same product, the leg instruments of a standard options strategy instrument must also have the same contract size. And, if they have a version number, they must all have the same version number.

In the templates, an exchange may also define minimum limit prices for certain strategy types, which are motivated by the wish to prevent the entry of obviously mispriced orders.

Example 16-2:

Eurex prevents the entry of negative limit prices for Bull strategies. In such a strategy, a call is bought and another call with the same expiration date and a higher strike price is sold. Since the market price of the former is never lower than the market price of the latter, the market price of the strategy must always be positive.

The list of templates of supported strategy types is valid for an entire market. For different markets, there are different lists of supported standard options strategy templates.

Technically, standard options strategy types are realized as instrument subtypes.

Configuration Data:

The list of available standard options strategy types together with the information which of the types are available for Eurex and which for EEX, is available in the Instrument Subtypes File, which is part of the Products and Instruments Files on the Eurex website, see chapter 1.2 Usage Notes.

16.2 Creation of Standard Options Strategies

The exchange does not create standard options strategy instruments. Standard options strategy instruments are created by users.

When creating a standard options strategy instrument, the user must indicate its instrument subtype and adhere strictly to all the rules as given in the template, including the sequence of legs, their ratios and their sides. Failure to do so will result in a rejection of the creation request.

16.3 Matching of Standard Options Strategies

Matching of standard options strategies follows the rules that have been described in chapter 7 on matching in general and in chapter 10.3 on matching for complex instruments. T7 supports no synthetic matching for standard options strategies, i.e. standard options strategy orders and quotes match only against orders and quotes of the same instrument.

17. Non-Standard Options Strategies

This chapter outlines the specific features of non-standard options strategies in T7. The common features of complex instruments in T7 as described in chapter 10 apply for non-standard options strategies, except if stated otherwise in the following.

17.1 Definition of Non-Standard Options Strategies

A Non-Standard Options Strategy consists of two or more leg instruments that belong to the same options product. The user can define freely the signature of a non-standard options strategy. There are no strategy type templates that are defined by the exchange for non-standard options strategies. And T7 does not require a specific sorting of the leg instruments.

The exchange however defines by product

- a maximum for the number of legs,
- a maximum for the leg ratios,
- a maximum for how much the ratio of one leg may exceed the ratio of another leg of the same instrument.

Eurex Set Up Information:

Eurex supports non-standard options strategies for most options products. It allows for all these products a maximum of five legs and a maximum value of 99 for the ratio. The ratio of one leg cannot be greater than 4 times the ratio of a different leg of the same instrument.

Apart from belonging to the same product, the leg instruments of a non-standard options strategy instrument must also have the same contract size. And, if they have a version number, they must all have the same version number.

17.2 Creation of Non-Standard Options Strategies

The exchange does not create non-standard options strategy instruments. Non-standard options strategy instruments are created by users.

When a user requests the creation of a non-standard options strategy instrument, T7 may decide to modify the requested signature or even the instrument type as follows:

1. Normalization:

   T7 will normalize the leg ratios. Normalization means that if all the leg ratios can be divided by the same integer number, T7 will do so.

   Example 17-1:

   Trader A requests the creation of a non-standard options strategy instrument with the following signature:

   - *Leg 1: ODAX Jun16 12150 C, Ratio 20, Side Buy*
   - *Leg 2: ODAX Jun16 12200 C, Ratio 15, Side Buy*
   - *Leg 3: ODAX Jun16 12250 C, Ratio 35, Side Sell*

T7 detects that all ratios can be divided by 5. It will therefore accept the creation request, but in fact create a non-standard options strategy instrument with the signature:

- *Leg 1: ODAX Jun16 12150 C, Ratio 4, Side Buy*
- *Leg 2: ODAX Jun16 12200 C, Ratio 3, Side Buy*
- *Leg 3: ODAX Jun16 12250 C, Ratio 7, Side Sell*

2. Inversion of Sell-only Strategies

   If a user requests a non-standard options strategy instrument the legs of which have all Sell as the side, then T7 changes the side to Buy for all legs.

   This prevents the creation of instruments that can have only negative prices.

3. Detection of Standard Options Strategies

   T7 does not allow creating a non-standard options strategy instrument that could have been created as a standard options strategy instrument. If a user requests the creation of a non-standard options strategy instrument, that could have been created as a standard options strategy instrument, then T7 will create it as the appropriate standard options strategy instrument. This may involve changing the sequence of legs, and it may involve switching the sides of all legs.

   Example 17-2:

   Trader B requests the creation of a non-standard options strategy instrument with the following signature:

   - *Leg 1: ODAX Jun16 12200 C, Ratio 2, Side Sell*
   - *Leg 2: ODAX Jun16 12150 C, Ratio 1, Side Buy*

   T7 detects that by inverting the sides and by changing the sequence of the legs, this instrument fits to the standard options strategy type 2×1 Ratio Call Spread. It therefore creates a standard options strategy instrument with the following signature:

   - *Leg 1: ODAX Jun16 12150 C, Ratio 1, Side Sell*
   - *Leg 2: ODAX Jun16 12200 C, Ratio 2, Side Buy*

   If T7 then detects that the appropriate standard options strategy instrument exists already, then it does not create a new instrument but simply returns the information about the already existing instrument.

4. Detection of the Existence of an Equivalent Non-Standard Options Strategy

   For all complex instruments, if a complex instrument with the same signature already exists, no new instrument is created, but the necessary information to trade the existing instrument is returned to the user that requested the creation of the complex instrument.

   For non-standard options strategies, this feature is extended to the point that T7 detects the existence of an equivalent non-standard options strategy instrument, and in this case does not create a new instrument but rather returns the information about the equivalent instrument. The equivalent instrument may have the legs in a different sequence, and it may have the sides of all legs inverted.

In any case, the user that requested the creation of a non-standard options strategy receives the identifier, the instrument type and the signature of the instrument, which was either created or found to exist already.

17.3 Matching of Non-Standard Options Strategies

Matching of non-standard options strategies follows the rules that have been described in chapter 7 on matching in general and in chapter 10.3 on matching for complex instruments. T7 supports no synthetic matching for non-standard options strategies, i.e. non-standard options strategy orders and quotes match only against orders and quotes of the same instrument.

The decomposition procedure, which determines the leg execution prices, may in the case of non-standard options strategies split the quantity of one of the legs and assign different prices to these quantities of the same leg.

The reason is, that for non-standard options strategies there are situations, where any possible assignment of a valid trade price to each of the legs, leads to leg execution prices that are unreasonably far from the current market price, and there are even situations, where it is outright impossible to decompose the order execution price in any valid way. Splitting the quantity of one leg and assigning different prices to the two split quantities, solves the problem. T7 therefore generally applies this method for non-standard options strategies, in order to improve the quality of the leg execution prices.

Example 17-3:

A non-standard options strategy is created with the following signature:

- *Leg 1: ODAX Jun16 12150 P, Ratio 5, Side Buy*
- *Leg 2: ODAX Jun16 12250 P, Ratio 2, Side Sell.*

A match occurs for this instrument with an execution quantity of 1 and an execution price of 2.0.

Starting from the reference prices of the leg instruments, respectively 0.8 for the first leg and 1.5 for the second leg, the decomposition procedure might split the execution of the first leg into two different leg execution prices as follows:

- *Leg 1: ODAX Jun16 12150 P with a total leg execution quantity of 5*
  - *Leg execution price 0.9, executed leg instrument quantity 4*
  - *Leg execution price 1.0, executed leg instrument quantity 1*
- *Leg 2: ODAX Jun16 12250 P with a total leg execution quantity of 2*
  - *Leg execution price 1.3, executed leg instrument quantity 2*

This distribution fits to the execution price of 2.0:

$$2.0 = (4 \times 0.9 + 1 \times 1.0) - 2 \times 1.3$$

18. Options Volatility Strategies

This chapter outlines the specific features of options volatility strategies in T7. The common features of complex instruments in T7 as described in chapter 10 apply for options volatility strategies, except if stated otherwise in the following.

18.1 Definition of Options Volatility Strategies

An Options Volatility Strategy is a complex instrument that consists of one or more option leg instruments and one additional underlying leg instrument.

The option leg instruments must all belong to the same options product, which is also the product that the options volatility strategy instrument belongs to. The underlying leg instrument is always a simple instrument from a futures product that is traded on T7 as well.

Configuration Data:

The information, to which futures product the instruments must belong that can be used as underlying leg, is published by T7's Reference Data Interface in the product snapshot message for the options product (RDI field name: RefMarketSegmentID).

In general, the futures product is either the underlying of the options product, or it has the same underlying as the options product.

Eurex Set Up Information:

Eurex supports the instrument type Options Volatility Strategy for equity index options products, but not for equity options products.

EEX Set Up Information:

EEX does not support the instrument type Options Volatility Strategy.

The signature of an options volatility strategy consists of the following items:

- For each option leg:
  - the instrument identifier
  - the side
  - the ratio
- For the underlying leg:
  - the instrument identifier
  - the side
  - the ratio
  - the leg execution price

The leg execution price of the underlying leg is part of the specific instrument's signature in addition to side and ratio. It is defined at the creation of an options volatility strategy instrument. If the creation of two options volatility strategy instruments is requested where all leg instruments and all sides and ratios are the same, and only the underlying leg execution prices are different, then they are still

created as different instruments.

The fact that it is part of the signature of the options volatility strategy instrument means that the leg execution price of the underlying leg is pre-determined and does not depend on the order execution price. Only the leg execution prices of the option leg instruments depend on the order execution price. See chapter 18.4 for the specific pricing rules for options volatility strategy instruments.

The signature of an options volatility strategy instrument must comply with an options volatility strategy type template that is defined by the exchange. An options volatility strategy type template contains

- the identifier and the name of the options volatility strategy type,
- the number of the option legs,
- for each option leg
  - the ratio,
  - the side,
  - Call or Put,
  - optionally a rule concerning the expiration date,
  - optionally a rule concerning the strike price,
- the side of the underlying leg,

Technically, options volatility strategy types are realized as instrument subtypes.

Configuration Data:

The list of available options volatility strategy types is available in the Instrument Subtypes File, which is part of the Products and Instruments Files on the Eurex website, see chapter 1.2 Usage Notes.

Example 18-1:

Eurex defines the options volatility strategy type template for a 2x1 Ratio Put Spread versus Short Underlying as

Short Name	*RBER-U*	
Number of Option Legs	*2*	
	1st Leg	*2nd Leg*
Ratio	*1*	*2*
Side	*Sell*	*Buy*
Option Type	*Put*	*Put*
Expiration Rule	*n/a*	*same as 1st leg*
Strike Rule	*n/a*	*lower than 1st leg*
Side of Underlying Leg	*Sell*	

As a difference to the case of standard options strategies that are described in chapter 16.1, the ratio of an option leg of an options volatility strategy instrument is a multiple of the ratio that is given in the

corresponding options volatility strategy type template. In order to comply with the template, the leg ratios of all the option legs of an options volatility strategy instrument must be obtained by multiplying all option leg ratios in the template with the same integer multiplier. See chapter 18.3.1 below for details.

The template of an options volatility strategy type does not provide any rule for the ratio of the underlying leg. The ratio of the underlying leg can thus be freely chosen, as long as the validation described in chapter 18.3.2 below is not failed.

Example 18-2:

An example for a 2x1 Ratio Put Spread versus Short Underlying is:

OESX 100/200 RBER Jul16 3200-3000 vs S 17 FESX Sep16 @3260.0

which is defined with the following leg instruments:

- *Option Leg 1: OESX Jul16 3200 P, Ratio 100, Side Sell*
- *Option Leg 2: OESX Jul16 3000 P, Ratio 200, Side Buy*
- *Underlying Leg: FESX Sep16, Ratio 17, Side Sell*

Note that the option leg ratios defined in the template for the options volatility strategy type RBER-U as given above have been multiplied by the same integer multiplier 100.

18.2 Creation and Deletion of Options Volatility Strategies

The exchange does not create options volatility strategy instruments. Options volatility strategy instruments are created by users.

When creating an options volatility strategy instrument, the user must indicate its instrument subtype and adhere to all the rules as given in the template. Failure to do so will result in a rejection of the creation request.

There are however special rules concerning the ratios of the option legs and concerning the ratio of the underlying leg that must be fulfilled. T7 validates during the creation of an options volatility strategy instrument, that these rules are not violated. Any violation leads to the rejection of the request for the creation of the options volatility strategy instrument. These rules are described in chapter 18.3 below.

Furthermore, there are two conditions that must be fulfilled for an options volatility strategy instrument to be allowed to be traded. These conditions are:

- All leg instruments, including the underlying leg instrument, must be in the instrument state Continuous.
- The underlying leg execution price, which is part of the signature of the options volatility strategy instrument, must be close to the current market price. The exact definition of this condition is given in chapter 18.3.3 below.

These two conditions are checked during creation, and if any of these conditions is not fulfilled, the instrument is not created.

The two conditions are however validated also during the life time of the instrument, and if any of the conditions turns out to be not fulfilled anymore, then the instrument is automatically set to inactive, with the consequence that all its orders and quotes are automatically deleted, and that further order and quote entry is inhibited. For technical efficiency, T7 may not detect immediately a situation that

requires the inactivation of an options volatility strategy instrument, but it is guaranteed, that T7 detects the situation and reacts accordingly before the next operation on the order book is done. Like other inactive complex instruments, an options volatility strategy instrument can be activated again by sending a new creation request, provided that the conditions above are fulfilled again.

Options volatility strategy instruments become in this way instruments, where each individual instrument is typically open for trading only for a short time. In any case, they become inactive latest when the product leaves the Trading product state, and they will in any case be deleted in the end of day processing. GTD and GTC orders are therefore not supported for options volatility strategy instruments.

18.3 Specific Validations

18.3.1 Option Leg Ratio Rule

T7 requires that the option leg ratios in the signature of an options volatility strategy instrument must be obtained by multiplying the ratios given in the options volatility strategy type template with a common Option Leg Multiplier.

The rules for the option leg multiplier are:

- The option leg multiplier must be the same for all the option legs of a specific options volatility strategy instrument. In this way the ratios between the option leg ratios remain the same as in the options volatility strategy type template.
- The option leg multiplier must be greater than or equal to the Minimum Options Volatility Strategy Multiplier, which is defined by the exchange.
- The option leg multiplier must be smaller than or equal to the Maximum Options Volatility Strategy Multiplier, which is defined by the exchange.

Eurex Set Up Information:

Currently, for most products, Eurex has configured both the minimum options volatility strategy multiplier and the maximum options volatility strategy multiplier with the value 100. This means, that 100 is the only allowed value for the option leg multiplier for these products.

Exceptions are the product ODAX and the related weekly options products, for which the minimum options volatility strategy multiplier is 250 and the maximum options volatility strategy multiplier is 500.

When processing the creation request for an options volatility strategy instrument, T7 may, if possible, reduce the requested ratios, as long as such a reduction does not violate any of the above mentioned rules, and as long as the ratios between the leg ratios, including the underlying leg ratio, are kept constant. This procedure is called Leg Ratio Normalization.

Example 18-3:

In the above presented example for a valid 2x1 Ratio Put Spread versus Short Underlying OESX 100/200 RBER Jul16 3200-3000 vs S 17 FESX Sep16 @3260.0, the applied option leg multiplier for the option legs is 100.

Since both the minimum options volatility strategy multiplier and the maximum options volatility strategy multiplier are set to 100 for the product OESX, 100 is the only allowed value for the option leg

multiplier.

18.3.2 Underlying Leg Ratio Rule

T7 requires that the underlying leg ratio is smaller than or equal to a Maximum Underlying Leg Ratio, which is calculated with the following formula:

$$Maximum\ Underlying\ Leg\ Ratio = ROUNDDOWN\left[Option\ Leg\ Multiplier \times Maximum\ Strategy\ Delta \times \frac{Contract\ Value\ (Option)}{Contract\ Value\ (Future)}\right]$$

where	$ROUNDDOWN$	means that the computed value is rounded down to the next lower integer number,
	$Option\ Leg\ Multiplier$	is the multiplier that is applied to the option leg ratios,
	$Maximum\ Strategy\ Delta$	reflects the maximum possible delta value of the option part of the options volatility strategy type,
	$Contract\ Value$	is the contract value that is given in the contract specifications of the product.

Example 18-4:

The contract value for both OESX and FESX is €10. The maximum strategy delta is 1. And in the above presented example for a valid 2x1 Ratio Put Spread versus Short Underlying OESX 100/200 RBER Jul16 3200-3000 vs S 17 FESX Sep16 @3260.0, the applied option leg multiplier for the option legs is 100. This gives a maximum underlying leg ratio of 100, which means that the requested underlying leg ratio of 17 is a valid underlying leg ratio.

18.3.3 Underlying Leg Execution Price Rule

T7 requires that the underlying leg execution price, which is a fixed part of the signature of the options volatility strategy instrument, is close to the current market price of the underlying leg instrument.

The current market price is assumed by T7 to be a reference price, which is the last trade price in the futures product. If the last trade price happened in an instrument that is different from the instrument that is the underlying leg instrument in the options volatility strategy instrument, then the reference price is corrected by the difference of the previous settlement prices of the two futures instruments.

If there is no last trade price at all for the futures product, or if any of the two previous settlement prices is not available, then the creation of the requested options volatility strategy instrument is not possible.

The allowed range around the reference price is a percentage, which is given by the Underlying Leg Deviation Percentage parameter that is defined by the exchange by product.

Example 18-5:

The underlying leg deviation percentage for OESX is defined as 1, i.e. the underlying leg execution price of an OESX options volatility strategy instrument can not differ by more than 1 percent from the reference price.

The above presented example for a 2x1 Ratio Put Spread versus Short Underlying instrument OESX 100/200 RBER Jul16 3200-3000 vs S 17 FESX Sep16 @3260.0 would therefore be accepted if the reference price is 3240.0, but not if the reference price is 3220.0.

18.4 Matching of Options Volatility Strategies

Matching of options volatility strategies follows largely the rules that have been described in chapter 7 on matching in general and in chapter 10.3 on matching for complex instruments. T7 supports no synthetic matching for options volatility strategies, i.e. options volatility strategy orders and quotes match only against orders and quotes of the same instrument.

Limit prices and execution prices have to be interpreted differently than for other complex instrument types:

1. They refer only to the option part of an options volatility strategy instrument. When decomposing an order execution price for an options volatility strategy, T7 distributes the value of the order execution price only among the option leg instruments. The underlying instrument receives in any case the leg execution price that is specified in the signature of the instrument.
2. They are to be understood as assuming the option leg ratios to be as given in the options volatility strategy template, and not as given in the signature of the instrument. This is taken into account by T7 when decomposing an order execution price into the option leg execution prices. The ratios that are given in the signature in the instrument are however applied as usual in the determination of the option leg execution quantities.

Example 18-6:

There is an order to buy a quantity of 2 with a price limit at -26.5 in the order book of the above presented example OESX 100/200 RBER Jul16 3200-3000 vs S 17 FESX Sep16 @3260.0.

The order is then fully matched at its limit price by an incoming sell order. The leg execution prices and quantities are determined as follows:

- *Option Leg 1: Sell 200 OESX Jul16 3200 P at 46.1*
- *Option Leg 2: Buy 400 OESX Jul16 3000 P at 19.8*
- *Underlying Leg: Sell 34 FESX Sep16 at 3260.0*

The order execution price is related to the leg execution prices as follows:

$$(-1) \times 1 \times 46.1 + (+1) \times 2 \times 19.8 = -6.5$$

Here, the leg execution price of the first leg has been multiplied by the template ratio 1 and by (-1), because the leg instrument is being sold, and the leg execution price of the second leg has been multiplied by the template ratio 2 and by (+1), because the leg instrument is being bought.

The underlying leg execution price is given by the signature of the instrument, and all the leg execution quantities are simply obtained as usual by multiplying the leg ratios in the instrument signature with the executed order quantity 2.

18.5 Quotes and Market Maker Protection

The quoting and the market maker protection functionalities are generally applied for the options volatility strategy instrument type in the same way as for the other instrument types.

However, for the calculation of the impact of options volatility strategy quotes on the MMP statistics, only the leg executions of the option leg instruments are considered. The leg execution volumes of the underlying leg instruments are ignored here.

In the same way, for the validation of the size of an incoming quote against the minimum quote size (see chapter 10.3.7), only the option legs are considered, while the underlying leg instrument is ignored in this context.

19. Risk Protection

The system offers a variety of functionalities that help participants to mitigate their risk:

- Transaction Size Limits enable the participant to restrict the quantity at order and quote entry on user level (see the *Participant and User Maintenance Manual*).
- Order Book Count Limits allow a participant to restrict the number of orders and quotes per product, that a specific business unit or session may have in the order book at any moment. See chapter 4.2.6 for more details.
- The Market Maker Protection functionality is described in chapter 5.5. It allows a market maker to define execution volume limits for his quotes. The system automatically deactivates his quotes if a limit is exceeded.
- A Manual Stop/Release of Trading functionality is available. The effect of this is on a participant level, on a business unit level, or for an individual user. A manual stop/release can be performed by an exchange participant, by a clearing member (via the existing Eurex interfaces), or by the clearing house.
- The Advanced Risk Protection functionality of Eurex is supported and can warn, slow or stop a participant if a predefined position limit is exceeded.
- Price validation functionalities for orders and quotes are described in chapter 6.

20. Appendix

20.1 Variance Futures

Variance futures on equity indexes represent a product class of Eurex that is supported by T7. A variance futures product enables participants to hedge risks associated with the variance of the corresponding underlying equity index. Each variance futures instrument considers the daily history of the underlying equity index during its life time.

The overall life time of a variance futures instrument is characterized by the number of business days denoted by T, while the elapsed life time of a variance futures instrument is denoted by t. When a variance futures instrument is regularly created after an expiration, the first trading day is represented by $t = 0$, the last trading day is represented by $t = T - 1$ and the expiration day is represented by $t = T$, indicating that no trading activities take place on the expiration day $t = T$.

For each business day t of a variance futures instrument (i.e. for each trading day and for the expiration day), a representative value of the underlying equity index is chosen as daily underlying observation S_t^{und} with $t = 0, \dots, T$. The realized variance $\sigma_{real}^2(1,t)$ valid at business day t covers the daily history of the variance futures instrument by taking into account the underlying observations $S_0^{und}, \dots, S_t^{und}$. It is defined by

$$\sigma_{real}^2(1,t) \;=\; 10000 \times \frac{A}{t} \times \sum_{i=1}^{t} ln^2\left(\frac{S_i^{und}}{S_{i-1}^{und}}\right)$$

$$= \frac{t-1}{t} \times \sigma_{real}^2(1,t-1) \;+ 10000 \times \frac{A}{t} \times ln^2\left(\frac{S_t^{und}}{S_{t-1}^{und}}\right)$$

The annualization factor A is normally chosen to be approximately the number of underlying observations in a year and commonly set to 252. The definition of the realized variance does not coincide with the classic mathematical definition of a variance, as it is market convention to omit the mean value in the calculation of the variance. Note furthermore that the volatility σ is expressed as a percentage, thence the factor of 10000 in the formula.

Considering the trading conventions in the OTC variance swap market, the general concept of an on-exchange traded variance future is based on the following aspects.

- Trading (i.e. order and quote maintenance, matching) is performed in volatility σ as pricing information and in vega notional $v = N_v \times U$ with the vega quantity N_v and the vega unit $U = 1000$ as quantity information. The corresponding volatility-vega representation is denoted as (σ, v) trading notation.
- Clearing (i.e. position keeping and margining) is performed in a variance pricing notation with futures price P_t and futures quantity Q_t, which is also denoted as (P_t, Q_t) clearing notation.
- Each match in a variance futures instrument generates a trade in the (σ, v) trading notation which is converted by T7 in real-time into the (P_t, Q_t) clearing notation; the conversion from matched (σ, v)-values into (P_t, Q_t)-values depends on the business day t; the trade is uploaded to the clearing system only in the (P_t, Q_t) clearing notation.

- The (P_t, Q_t) clearing notation takes into account the realized variance $\sigma^2_{real}(1,t)$, which is not considered in the (σ, v) trading notation.
- The accumulated daily variation margin payments in the (P_t, Q_t) clearing notation resulting from a variance futures position reproduces the cash flow of an OTC variance swap whose contract period is identical to the holding time of the futures position.

Thus, an on-exchange traded variance future is designed in that way that the (P_t, Q_t) clearing notation ensures a variation margin, which reproduces the cash flow of an OTC variance swap, while the (σ, v) trading notation is based on the common volatility-vega representation that is also used in the OTC variance swap market for price discovery.

The conversion from the (σ, v) trading notation into the (P_t, Q_t) clearing notation is based on the matched volatility σ and matched vega $v = N_v \times U$ of the trading notation. The variance futures clearing price P_t and variance futures clearing quantity Q_t in the (P_t, Q_t) clearing notation are given by the following conversion formulas:

$$\sigma^2_{trad}(t) \;=\; \frac{T-t}{T} \times \sigma^2 \;+\; \frac{t}{T} \times \sigma^2_{real}(1,\, t)$$

$$P_t(\sigma) \;=\; D_t \times \left(\, \sigma^2_{trad}(t) \,-\, \sigma_0^2 \,\right) \,-\, ARMVM_t \;+\; C$$

$$Q_t(\sigma, v) \;=\; ROUND\left\{\left(\frac{N_v \times U}{2\,\sigma}\right) \times \left(\frac{T}{T-t}\right)\right\}$$

with the following conversion parameters:

- The realized variance $\sigma^2_{real}(1,t)$ as defined above.
- The discount factor D_t defined by $D_t = exp(-r_t \times \Delta t/365)$, with the remaining life time Δt given in calendar days and with the interpolated interest rate r_t valid for the remaining life time of the variance futures instrument.
- The Accumulated Return of Modified Variation Margin

  $$ARMVM_t = ARMVM_{t-1} \times exp(r'_t \times \Delta t'/365) + (S_{t-1} - C) \times (exp(r'_t \times \Delta t'/365) - 1)$$

  with the time difference $\Delta t'$ of two consecutive business days given in calendar days, with the overnight interest rate r'_t representing the interest rate valid on the night before and with the previous day settlement price S_{t-1} in clearing notation. By definition, we have $ARMVM_0 = 0$ on the first trading day $t = 0$ of the instrument.
- The standard variance σ_0^2, which is set to the square of the settlement volatility σ_{sttl} at the end of the first trading day with a cap of 50^2, i.e.

  $$\sigma_0^2 = MIN\{\, \sigma^2_{sttl}(0);\; 50^2 \,\}$$

  The standard variance σ_0^2 for a variance futures instrument stays constant throughout the whole life time of the instrument.
- The clearing price offset $C = 3000$ to avoid negative futures prices.

During the trading day, participants can trade variance futures instruments like any other futures instruments by submitting orders or quotes. The limit of an order or quote is interpreted as volatility

strike σ (or simply as volatility σ), and the order or quote size is interpreted as vega quantity N_v, which results to the vega notional v by multiplying the vega quantity N_v with the vega unit U, i.e. by setting $v = N_v \times U$.

Once an order or quote has been executed at trading day t, the matched volatility σ and the matched vega quantity N_v are converted into the $(\widetilde{P}_t, Q_t)$ clearing notation with preliminary clearing price $\widetilde{P}_t(\sigma)$ and clearing quantity $Q_t(\sigma, v)$. While the clearing quantity is given by the corresponding conversion formula described above, the preliminary clearing price $\widetilde{P}_t(\sigma)$ is based on the conversion formula with the realized variance $\sigma^2_{real}(1, t-1)$, the discount factor D_{t-1} and the Accumulated Return on Modified Variation Margin $ARMVM_{t-1}$ valid on the previous business day $t-1$. Once the underlying observation S_t^{und}, the interpolated interest rate r_t and the overnight interest rate r_t' of the current business day t are known and, based on these input parameters, the realized variance $\sigma^2_{real}(1, t)$, the discount factor D_t and the Accumulated Return on Modified Variation Margin $ARMVM_t$ of the present business day t are calculated, the preliminary clearing price $\widetilde{P}_t(\sigma)$ is replaced by the final clearing price $P_t(\sigma)$ in accordance with the conversion formula described above.

21. Change log

Version	Date	Chapter	Change
V 2.5.0	15-Sep-2014	2.2.2, 12, 13, 14, 15	Added packs and bundles, strips, standard futures strategies and inter-product spreads.
		4.1.5	Added missing condition for a new priority time stamp.
		10.3.9	Less validations for RfQs in complex instruments
V 2.5.1	22-Oct-2014	all	Correction of bad chapter references
		20.1	Corrected the definition of the Accumulated Return of Modified Variation Margin in the context of Variance Futures
V 3.0.0	14-Sep-2015	10.2	Clarifications on the creation of complex instruments.
		7.7	Added Self-match Prevention
		15	Extensions to inter-product spreads