T7 Release 15.0

Functional Reference

– Part 2 –

Version	1
Date	August 17, 2026

Table of Contents

1. Introduction

T7 is the trading architecture developed by Deutsche Börse Group. It is a multi-exchange trading system that is used by derivatives and cash exchanges.

The document T7 Functional Reference describes the T7 system and is split into two parts:

- T7 Functional Reference Part 1:
    - Market structure
    - Trading states
    - Order and quote handling
    - Matching and trade management
    - Off-book trading
- T7 Functional Reference Part 2:
    - Complex instruments

1.1 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 at various places in this document in blue color to inform readers of specific configurations that affect 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; these should not be taken as actual values for these parameters.

Depending on the configuration parameter, its actual value 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 static reference data files available on the respective website:
    - For Eurex and EEX*:* *www.eurex.com*
    - For Deutsche Börse Xetra and Deutsche Börse Frankfurt:
      cashmarket.deutsche-boerse.com
- In circulars and other news published by the exchange.

1.2 Abbreviations and Further Reading

For abbreviations and for further reading about the T7 system, see the introductory chapters of part 1 of the T7 Functional Reference.

2. 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 3 - 11, which are dedicated to the individual complex instrument types.

2.1 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. Complex instruments have no ISIN assigned.

For certain types of complex instruments, a set of subtypes is defined. The exact meaning of "subtype" depends on the type of complex instrument and varies between the different types of complex instruments.

Example 2-1:

Trader A wishes to trade an OESX Butterfly strategy that consists of buying a quantity of 10 in the OESX Jun27 3400 C instrument, the same quantity in the OESX Jun27 3500 C instrument and selling a quantity of 20 in the OESX Jun27 3450 C instrument.

The appropriate complex instrument has three legs and its signature is

- *Leg 1: Buy 1 of OESX Jun27 3400 C*
- *Leg 2: Sell 2 of OESX Jun27 3450 C*
- *Leg 3: Buy 1 of OESX Jun27 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.

2.2 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 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 1.1 Usage Notes.*

Example 2-2:

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 2-3:

EEX generally does 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 10.2 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 labelled 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 has a different instrument identifier.

The exchange 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 is finally deleted in the end-of-day processing.

2.3 Trading of Complex Instruments

2.3.1 Overview

Once a complex instrument is created, orders and quotes as well as TES trades 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 following specific chapters, which are dedicated to the individual complex instrument types.

2.3.2 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 OCO orders, and no TSO orders.
- No Auction-Only orders of any kind.
- No Book-Or-Cancel orders.
- No Iceberg orders.

2.3.3 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 2-4:

Trader A wishes to trade several options instruments simultaneously:

1. *Buy 20 contracts of ODAX Jun27 12150 C at a price of 24.20.*
2. *Buy 15 contracts of ODAX Jun27 12200 C at a price of 8.00*
3. *Sell 35 contracts of ODAX Jun27 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 Jun27 12150 C, Ratio 4, Side Buy*
- *Leg 2: ODAX Jun27 12200 C, Ratio 3, Side Buy*
- *Leg 3: ODAX Jun27 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 determines 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 3.3.6 for details.

Example 2-4 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 Jun27 12150 C at a price of 24.10.*
2. *Buy 15 contracts of ODAX Jun27 12200 C at a price of 7.90*
3. *Sell 35 contracts of ODAX Jun27 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 2-5:

The futures spread CONF SPD Jun27 Sep27 is defined as buying a certain quantity in the CONF Jun27 instrument and simultaneously selling the same quantity in the CONF Sep27 instrument.

A buy order for the CONF SPD Jun27 Sep27 instrument with a quantity of 5 and a limit price of -5.7 requests to simultaneously buy at maximum 5 CONF Jun27 contracts and at the same time sell the same quantity of CONF Sep27 contracts, where the trade price per CONF Jun27 contract shall not be less than 5.7 lower than the price per CONF Sep27 contract.

A sell order for the CONF SPD Jun27 Sep27 instrument with a quantity of 5 and a limit price of -5.7 requests to simultaneously sell at maximum 5 CONF Jun27 contracts and at the same time buy the same quantity of CONF Sep27 contracts, where the trade price per CONF Jun27 contract shall not be more than 5.7 lower than the price per CONF Sep27 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 2-6:

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 (see the *T7 Functional Reference Part 1*, chapter *Stop Orders*, subchapter *Stop Order Triggering*).
- Leg execution prices do not serve as reference prices in the non-standard procedure of the Price Reasonability Check (see the *T7 Functional Reference Part 1*, chapter *Price Range Tables*, subchapter *Calculation of Price Ranges*).
- Leg execution prices are ignored when the condition for a volatility interruption is checked (see the *T7 Functional Reference Part 1*, chapter *Volatility Interruption Functionality for Derivatives Markets*). 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.

2.3.4 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 than the state of any of its leg instruments.

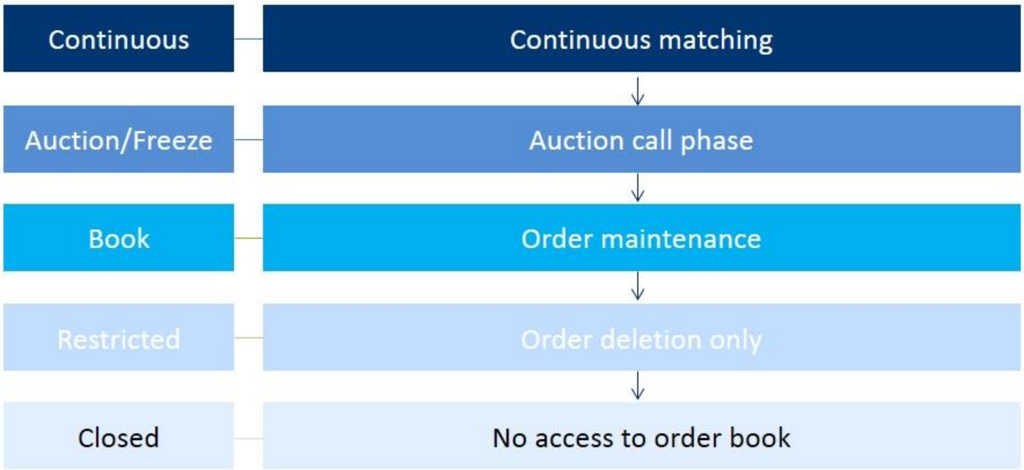

Figure 2-1: The instrument state hierarchy

<u>Example 2-7:</u>

All leg instruments are in the instrument state Continuous. The complex instrument is also in the instrument state Continuous.

<u>Example 2-8:</u>

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.

<u>Example 2-9:</u>

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.

> *<u>Configuration Data:</u>*
> *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 1.1 Usage Notes.*

<u>Example 2-10:</u>

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.

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.

Exceptions are inactivated complex instruments, which are always in the instrument state Closed without regard to the instrument states of the leg instruments.

2.3.5 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 2.3.4 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 the *T7 Functional Reference Part 1*, chapter *Order Book Uncrossings (Auctions)*. As an exception, there is a modified handling for complex instruments that are subject to synthetic matching. See chapter 3.4 for this.

2.3.6 Volatility Interruption

There is no volatility interruption functionality for complex instruments.

2.3.7 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 the *T7 Functional Reference Part 1*, chapter *Quote Validations*, subchapter *Minimum Quote Size*, is modified. For each leg of a complex instrument quote, the product of the leg ratio times the quote quantity must not be smaller than the minimum quote size.

2.3.8 Price Reasonability Check

In general, applications of the price range tables, as described in the *T7 Functional Reference Part 1*, chapter *Price Range Tables*, 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 the *T7 Functional Reference Part 1*, chapter *Price Reasonability Check*, subchapter *Reference Price Determination*, it is relevant to note that for complex instruments, the needed alternative reference price 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 2-11:

An order is entered for the NESG SPD Oct27 Dec27 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 Oct27 instrument at 65.25. There has been no trade in the NESG Dec27 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:

$$TP = 1 \times 65.25 - 1 \times 66.10 = -0.85$$

2.3.9 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 the *T7 Functional Reference Part 1*, chapter *Request for Quote*, is not done.

3. 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 2 apply for futures spreads, except if stated otherwise in the following.

3.1 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 contract date, the first leg, and selling the same quantity of the leg instrument with the later contract 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 contract date of instrument B is later than the contract date of instrument A.

There are two types of Futures Spreads, distinguished by different instrument subtypes:

- BSPD – Basis Spreads.
- SPD – Futures Calendar Spreads.

Basis Spreads are Futures Spreads with a near term leg containing a daily expiring futures contract. Calendar Spreads have a near-term leg containing a monthly expiring futures contract.

Depending on the product and on the market situation, the prices of futures spreads can be zero or negative.

3.2 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 3-1:

For the future on the Nestle stock NESG, Eurex creates automatically the futures spread instrument that combines the two simple instruments with the nearest contract dates. E.g. in the beginning of May 2026, the spread NESG SPD May26 Jun26 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 May26 Nov26.

For on-book trading, 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 setup 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).

3.3 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. Synthetic matching applies only to on-book trading.

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 the *T7 Functional Reference Part 1*, chapter *On-Book Matching*.

3.3.1 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 of simple instruments and futures spread instruments, T7 supports five ways of matching:

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 standard futures strategy instruments are available for a futures product, then there are also additional ways of synthetic matching of simple instruments and/or futures spread instruments with Condor or Butterfly instruments. These ways are described in chapter 7.3.2 on the synthetic matching of Condor and Butterfly instruments

If futures instruments are part of inter-product spread instruments, then they may be also subject to synthetic matching with inter-product spread instruments, which are described in chapter 8.5 on matching of inter-product spreads.

Direct matching is as described in the *T7 Functional Reference Part 1*, chapter *On-Book Matching*, *Matching Procedure in Continuous Trading*. 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.

3.3.1.1 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 15-1.

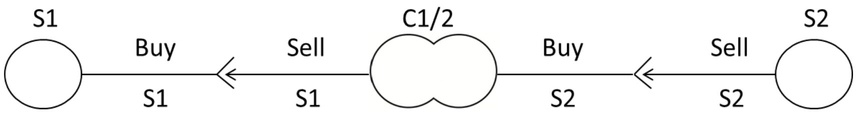

Figure 3-1: Example for a short synthetic match path.

In the following, the simple instrument with the earlier contract 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 contract 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 3-2:

Consider the example of an incoming simple instrument order in the product FVS (Futures on EURO STOXX 50 Volatility 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 Jan27 (S1) may be executed against a combination of book sell orders in the futures spread instrument FVS SPD Jan27 Feb27 (C1/2) and of book sell orders in the simple instrument FVS Feb27 (S2). The match path consists therefore of

- *the buy side of FVS Jan27,*
- *the sell side of FVS SPD Jan27 Feb27, i.e., sell FVS Jan27 and buy FVS Feb27,*
- *the sell side of FVS Feb27.*

Here,

1. *the buy side of the simple instrument FVS Jan27 is matched against the first leg of the sell side of the futures spread instrument FVS SPD Jan27 Feb27, which is selling FVS Jan27, and*
2. *the second leg of the sell side of the futures spread instrument FVS SPD Jan27 Feb27, which is buying FVS Feb27, is matched against the sell side of the simple instrument FVS Feb27.*

Example 3-3:

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 Jan27 Feb27 (C1/2) may be executed against a combination of book sell orders in the simple instrument FVS Jan27 (S1) and of book buy orders in the simple instrument FVS Feb27 (S2). The match path consists therefore of

- *the sell side of FVS Jan27,*
- *the buy side of FVS SPD Jan27 Feb27, i.e., buy FVS Jan27 and sell FVS Feb27,*
- *the buy side of FVS Feb27.*

Here,

1. *the sell side of the simple instrument FVS Jan27 is matched against the first leg of the buy side of the futures spread instrument FVS SPD Jan27 Feb27, which is buying FVS Jan27, and*
2. *the second leg of the buy side of the futures spread instrument FVS SPD Jan27 Feb27, which is selling FVS Feb27, is matched against the buy side of the simple instrument FVS Feb27.*

3.3.1.2 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.

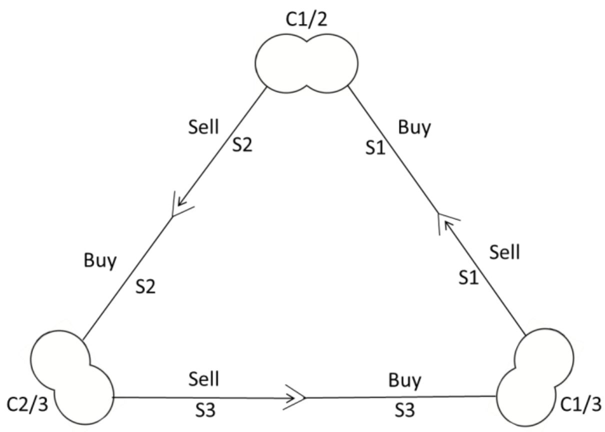

Figure 3-2: Example for a Triangle Match Path.

In the following, the leg instruments are S1, S2 and S3 in the order of their contract 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 3-4:

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 Jan27 Feb27 (C1/2) may be executed against a combination of book sell orders in the futures spread instrument FVS SPD Jan27 Mar27 (C1/3) and of book buy orders in the futures spread instrument FVS SPD Feb27 Mar27 (C2/3). The match path consists therefore of

- *the buy side of FVS SPD Jan27 Feb27, i.e., buy FVS Jan27 and sell FVS Feb27,*
- *the sell side of FVS SPD Jan27 Mar27, i.e., sell FVS Jan27 and buy FVS Mar27,*
- *the buy side of FVS SPD Feb27 Mar27, i.e., buy FVS Feb27 and sell FVS Mar27.*

Here,

1. *the first leg of the buy side of the futures spread instrument FVS SPD Jan27 Feb27, which is buying FVS Jan27, is matched against the first leg of the sell side of the futures spread instrument FVS SPD Jan27 Mar27, which is selling FVS Jan27, and*
2. *the first leg of the buy side of the futures spread instrument FVS SPD Feb27 Mar27, which is buying FVS Feb27, is matched against the second leg of the buy side of the futures spread instrument FVS SPD Jan27 Feb27, which is selling FVS Feb27, and*
3. *the second leg of the sell side of the futures spread instrument FVS SPD Jan27 Mar27, which is buying FVS Mar27, is matched against the second leg of the buy side of the futures spread instrument FVS SPD Feb27 Mar27, which is selling FVS Mar27.*

The exchange enables or disables the support of matching triangle match paths by product.

> *Configuration Data:*
> *The information 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 1.1 Usage Notes.*

3.3.1.3 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.

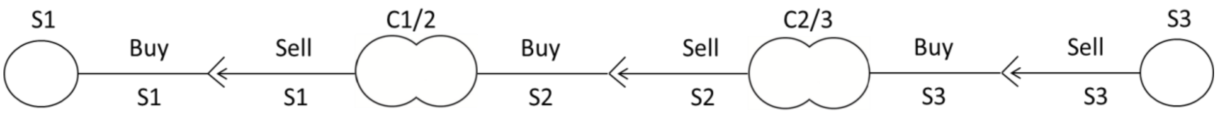

Figure 3-3: An example for a long synthetic match path.

In the following, the involved simple or leg instruments are S1, S2 and S3 in the order of their contract 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 15-3):
    - 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 3-5:

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 Jan27 (S1) may be executed against a combination of book sell orders in the futures spread instrument FVS SPD Jan27 Mar27 (C1/3), of book buy orders in the futures spread instrument FVS SPD Feb27 Mar27 (C2/3), and of book sell orders in the simple instrument FVS Feb27 (S2). The match path consists therefore of

- *the buy side of FVS Jan27,*
- *the sell side of FVS SPD Jan27 Mar27, i.e., sell FVS Jan27 and buy FVS Mar27,*
- *the buy side of FVS SPD Feb27 Mar27, i.e., buy FVS Feb27 and sell FVS Mar27,*
- *the sell side of FVS Feb27.*

Here,

1. *the buy side of the simple instrument FVS Jan27 is matched against the first leg of the sell side of the futures spread instrument FVS SPD Jan27 Mar27, which is selling FVS Jan27, and*
2. *the second leg of the sell side of the futures spread instrument FVS SPD Jan27 Mar27, which is buying FVS Mar27, is matched against the second leg of the buy side of the futures spread instrument FVS SPD Feb27 Mar27, which is selling FVS Mar27, and*
3. *the first leg of the buy side of the futures spread instrument FVS SPD Feb27 Mar27, which is buying FVS Feb27, is matched against the sell side of the simple instrument FVS Feb27.*

Example 3-6:

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 Jan27 Feb27 (C1/2) may be executed against a combination of book sell orders in the simple instrument FVS Jan27 (S1), of book buy orders in the futures spread instrument FVS SPD Feb27 Mar27 (C2/3), and of book buy orders in the simple instrument FVS Mar27 (S3). The match path consists therefore of

- *the sell side of FVS Jan27,*
- *the buy side of FVS SPD Jan27 Feb27, i.e., buy FVS Jan27 and sell FVS Feb27,*
- *the buy side of FVS SPD Feb27 Mar27, i.e., buy FVS Feb27 and sell FVS Mar27,*
- *the buy side of FVS Mar27.*

Here,

1. *the sell side of the simple instrument FVS Jan27 is matched against the first leg of the buy side of the futures spread instrument FVS SPD Jan27 Feb27, which is buying FVS Jan27, and*
2. *the second leg of the buy side of the futures spread instrument FVS SPD Jan27 Feb27, which is selling FVS Feb27, is matched against the first leg of the buy side of the futures spread instrument FVS SPD Feb27 Mar27, which is buying FVS Feb27, and*
3. *the second leg of the buy side of the futures spread instrument FVS SPD Feb27 Mar27, which is selling FVS Mar27, is matched against the buy side of the simple instrument FVS Mar27.*

3.3.2 Synthetic Pricing

3.3.2.1 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 3-7:

The following orders are in the order books of the product FVS (Futures on EURO STOXX 50 Volatility VSTOXX®):

- *Simple instrument FVS Feb27:*
    - *Sell 50 at a price of 23.55*

- *Futures spread FVS SPD Jan27 Feb27:*
  - *Sell 10 at a price of 1.05*
  - *Sell 20 at a price of 1.05*
- *Futures spread FVS SPD Jan27 Mar27:*
  - *Buy 40 at a price of 1.65*

These orders result in the following synthetic book paths:

1. *Simple instrument FVS Jan27: Sell 30 at a price of 24.60*

   by synthetic book path for matching along a short synthetic match path

   Sell FVS SPD Jan27 Feb27 ⊕ Sell FVS Feb27

   Price: $+24.60 = (+1.05 + 23.55)$

   Quantity: $30 = MIN\big((10 + 20), 50\big)$

2. *Simple instrument FVS Mar27: Sell 30 at a price of 22.95*

   by synthetic book path for matching along a long synthetic match path

   Buy FVS SPD Jan27 Mar27 ⊕ Sell FVS SPD Jan27 Feb27 ⊕ Sell FVS Feb27

   Price: $+22.95 = (-1.65 + 1.05 + 23.55)$

   Quantity: $30 = MIN(40, (10 + 20), 50)$

3. *Futures spread FVS SPD Feb27 Mar27: Buy 30 at a price of 0.60*

   by synthetic book path for matching along a triangle match path

   Sell FVS SPD Jan27 Feb27 ⊕ Buy FVS SPD Jan27 Mar27

   Price: $+0.60 = (-1.05 + 1.65)$

   Quantity: $30 = MIN\big((10 + 20), 40\big)$

3.3.2.2 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, while book market orders match at the best available price on their side (see the *T7 Functional Reference Part 1*, chapter *Market Order Matching with Market Order Matching Range*).

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 3-8:

The following orders are in the order books of the product FVS:

- *Simple instrument FVS Jan27:*
  - *Buy 30 at a price of 24.50*
  - *Buy 20 at a price of 24.50*
- *Simple instrument FVS Feb27:*
  - *Buy 20 at a price of 24.10*
  - *Buy 40 at a price of 24.10*
- *Simple instrument FVS Mar27:*
  - *Buy 10 at a price of 23.50*
  - *Buy 15 at a price of 23.50*
- *Futures spread FVS SPD Jan27 Feb27:*
  - *Buy 10 at a price of 0.40*
- *Futures spread FVS SPD Jan27 Mar27:*
  - *Buy 20 at a price of 1.00*
- *Futures spread FVS SPD Feb27 Mar27:*
  - *Buy 40 at a price of 0.65*

There are no sell orders in the order books.

The simple instrument FVS Jan27 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 Jan27*

    Price: $+24.50$

    Quantity: $50 = (30 + 20)$

  - *Buy FVS SPD Jan27 Feb27 ⊕ Buy FVS Feb27.*

    Price: $+24.50 = (+0.40 + 24.10)$

    Quantity: $10 = MIN\big(10\,,(20 + 40)\big)$

- *Buy FVS SPD Jan27 Mar27 ⊕ Buy FVS Mar27.*

  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 Jan27 Feb27 ⊕ Buy FVS SPD Feb27 Mar27 ⊕ Buy FVS Mar27.

  Price: $+24.55 = (+0.40 + 0.65 + 23.50)$

  Quantity: $10 = MIN\big(10\,, 40\,, (10 + 15)\big)$

  This price and quantity are not published by the market data interfaces, but are available for matching of incoming sell orders in the simple instrument FVS Jan27.

A sufficiently large sized incoming sell order for FVS Jan27 would match

- *10 at a price of 24.55 against the long synthetic match path Buy FVS SPD Jan27 Feb27 ⊕ Buy FVS SPD Feb27 Mar27 ⊕ Buy FVS Mar27*
- *15 at a price of 24.50 against the short synthetic match path Buy FVS SPD Jan27 Mar27 ⊕ Buy FVS Mar27 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.

3.3.3 Matching Procedure

The matching procedure for an incoming order is extended to include direct matching that had been described in the T7 Functional Reference, chapter Matching Procedure in Continuous Trading, 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 chapter 3.3.2).
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 3.3.4.

   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 3.3.2 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 3.3.5. 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 the *T7 Functional Reference Part 1*, chapter *Matching Procedure in Continuous Trading*. 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 3.3.4. 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.

3.3.4 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 3.3.3, in order to prioritize the book paths that allow matching along long synthetic match paths.

The sorting method in general gives preference to earlier contract 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 contract date. Futures spread instruments are sorted by comparing first the first legs' contract dates, and then by comparing the second legs' contract dates. The futures spread with the earlier contract date in the first leg comes first. If the first legs have the same contract date, then the futures spread with the earlier contract 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 contract date among the simple instruments on the book path. The book path, where in this way the earlier contract 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 contract date among the simple instruments on the book path. The book path, where in this way the earlier contract date 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 3-9:

Sorting synthetic book paths for matching along a short synthetic match path (equivalent to Buy FVS Jan27):

Position	Synthetic Book Path
1	Buy FVS SPD Jan27 Feb27 ⊕ Buy FVS Feb27
2	Buy FVS SPD Jan27 Mar27 ⊕ Buy FVS Mar27
3	Buy FVS SPD Jan27 Apr27 ⊕ Buy FVS Apr27

All sorting is done with comparison rule 1, i.e., according to the contract date of the simple instrument with the earliest contract date (FVS Feb27 expires before FVS Mar27, and FVS Mar27 expires before FVS Apr27).

Example 3-10:

Sorting synthetic book paths for matching along a long synthetic match path (equivalent to Sell FVS SPD Feb27 Mar27):

Position	Synthetic Book Path
1	Sell FVS Feb27 ⊕ (Sell FVS SPD Jan27 Mar27 ⊕ Buy FVS Jan27)
2	(Sell FVS Jan27 ⊕ Buy FVS SPD Jan27 Feb27) ⊕ Buy FVS Mar27
3	Sell FVS Feb27 ⊕ (Buy FVS SPD Mar27 Apr27 ⊕ Buy FVS Apr27)

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 contract date of the simple instrument with the later contract date (FVS Feb27 expires before FVS Mar27). 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 Jan27 expires before FVS Feb27).

Example 3-11:

Sorting synthetic book paths for matching along a long synthetic match path (equivalent to Buy FVS Jan27):

Position	Synthetic Book Path
1	Buy FVS SPD Jan27 Feb27 ⊕ Buy FVS SPD Feb27 Mar27 ⊕ Buy FVS Mar27
2	Buy FVS SPD Jan27 Apr27 ⊕ Sell FVS SPD Mar27 Apr27 ⊕ Buy FVS Mar27
3	Buy FVS SPD Jan27 Mar27 ⊕ Buy FVS SPD Mar27 Apr27 ⊕ Buy FVS Apr27

The synthetic book path at position 1 precedes the synthetic book path at position 2 because of comparison rule 3, here according to the contract date of the second leg of the higher prioritized futures spread instrument (FVS Feb27 expires before FVS Apr27). 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 Mar27 expires before FVS Apr27).

3.3.5 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 3.3.3.

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 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 1.1 Usage Notes.*

3.3.5.1 Direct Path First Allocation Method

In the Direct Path First allocation method, the book paths are sorted such, that

- first comes the direct book path,
- 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 3.3.4. 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.

3.3.5.2 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.

3.3.5.3 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 the *T7 Functional Reference Part 1*, chapter *Pro-Rata Allocation*.

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 the *T7 Functional Reference Part 1*, chapter *Pro-Rata Allocation*.

Any remaining quantity is then allocated to the book path that allows matching along a long synthetic match path.

3.3.6 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 currently published best buy price or higher than the currently 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 3.3.1.

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 chapter 2.3.3), 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 3-12:

The following orders are in the order books of the product FVS (Futures on EURO STOXX 50 Volatility VSTOXX®):

- *a buy order for the futures spread FVS SPD Jan27 Feb27 at a price of 0.40,*
- *a buy order for the futures spread FVS SPD Feb27 Mar27 at a price of 0.65,*
- *a buy order for the simple instrument FVS Mar27 at a price of 23.50,*
- *a buy order for the futures spread FVS SPD Mar27 Apr27 at a price of 0.60,*
- *a buy order for the simple instrument FVS Apr27 at a price of 22.95.,*

The simple instrument FVS Jan27 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 Mar27 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 Jan27 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 Jan27 is executed at a price of 24.55 against the first leg of the buy order for FVS SPD Jan27 Feb27,*
- *the second leg of the buy order for FVS SPD Jan27 Feb27 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 Feb27 Mar27,*
- *the second leg of the buy order for FVS SPD Feb27 Mar27 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 Mar27.*

Note that the execution in FVS Mar27 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 3-13:

The following orders are in the order books of the product FVS:

- *a sell order for the simple instrument FVS Jan27 at a price of 24.50,*
- *a buy order for the simple instrument FVS Mar27 at a price of 23.50,*
- *a buy order for the futures spread FVS SPD Feb27 Mar27 at a price of 0.65.*

The futures spread FVS SPD Jan27 Feb27 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 Jan27 Feb27 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 Jan27 Feb27 is executed at a price of 24.50 against the sell order for FVS Jan27,*
- *the first leg of the buy order for FVS SPD Feb27 Mar27 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 Jan27 Feb27,*
- *the second leg of the buy order for FVS SPD Feb27 Mar27 is executed at a price of 23.50 against the buy order on the simple instrument FVS Mar27.*

3.3.7 Market Orders in Synthetic Matching

3.3.7.1 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 chapter 3.3.2) 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 3-14:

The best prices for the instrument FVS Jan27 in the product FVS (Futures on EURO STOXX 50 Volatility 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 Jan27 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 Jan27 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 cannot be matched.*

3.3.7.2 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 3-15:

The best prices for the instrument FVS Jan27 are as given in example 3-14 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 Jan27.

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 3-14.

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 3-14.

3.3.7.3 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 3-16:

The following orders are in the order books of the product FVS:

- *a buy order for the futures spread FVS SPD Jan27 Feb27 at a price of 0.40,*
- *a buy order for the futures spread FVS SPD Feb27 Mar27 at a price of 0.65,*
- *a buy order for the simple instrument FVS Mar27 at a price of 23.50,*
- *a buy market order for the simple instrument FVS Mar27,*
- *a buy order for the futures spread FVS SPD Mar27 Apr27 at a price of 0.60,*
- *a buy order for the simple instrument FVS Apr27 at a price of 22.95.*

The simple instrument FVS Jan27 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 Mar27 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 Jan27 matches against the synthetic book path at the price of 24.55. The buy market order on the order book for FVS Mar27 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.

3.3.7.4 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 the *T7 Functional Reference Part 1*, chapter *Book Market Order Triggering by Incoming Orders*). 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 the *T7 Functional Reference Part 1*, chapter *Book Market Order Triggering by Incoming Orders*, 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 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.
- 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.

Example 3-17:

The order book situation of the order books of the product FVS is similar as in example 3-16, but additionally there are two sell market orders for FVS Jan27 and for FVS Mar27 on the order books:

- *a sell market order for the simple instrument FVS Jan27,*
- *a buy order for the futures spread FVS SPD Jan27 Feb27 at a price of 0.40,*
- *a buy order for the futures spread FVS SPD Feb27 Mar27 at a price of 0.65,*
- *a buy order for the simple instrument FVS Mar27 at a price of 23.50,*
- *a sell market order for the simple instrument FVS Mar27.*

The simple instrument FVS Jan27 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 Jan27 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 Jan27 is triggered. It can match until a price of

$$23.55 = MIN(24.20\,, (24.55 - 1.00))$$

The sell market order on the order book for FVS Mar27 is not triggered, even though there is an execution in that instrument, because FVS Mar27 is not the instrument of the incoming order.

3.4 Synthetic Uncrossing

3.4.1 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 2.3.5. 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.

3.4.2 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 the *T7 Functional Reference Part 1*, chapter *Order-Book Uncrossing (Auctions)*, subchapter *Uncrossing Procedure*.

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.

3.4.3 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 the 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 3.4.4.

The procedure determines an auction price for the futures spread instrument similar to the way that is described in the *T7 Functional Reference Part 1*, chapter *Order-Book Uncrossing (Auctions)*. 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 contract 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 contract date in the second leg gets the priority.

3.4.4 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.

3.4.5 Stop Order Triggering

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.

4. 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 2 apply for packs and bundles, except if stated otherwise in the following.

Set Up Information:
Eurex supports packs and bundles for selected money market futures products.
EEX and Nodal do not support packs and bundles for any product.

4.1 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 are quarterly contracts.
- The leg instruments are sorted with their contract 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 contract dates cover a timespan of one year in the case of packs or several years in the case of bundles, meaning that all quarterly contract dates 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 4-1:

A pack for the FEU3 money market future may have the following signature

- *Leg 1: Buy 1 of FEU3 Jun27*
- *Leg 2: Buy 1 of FEU3 Sep27*
- *Leg 3: Buy 1 of FEU3 Dec27*
- *Leg 4: Buy 1 of FEU3 Mar28*

A 2-year bundle for the FEU3 money market future may have the following signature

- *Leg 1: Buy 1 of FEU3 Sep27*
- *Leg 2: Buy 1 of FEU3 Dec27*
- *Leg 3: Buy 1 of FEU3 Mar28*
- *Leg 4: Buy 1 of FEU3 Jun28*
- *Leg 5: Buy 1 of FEU3 Sep28*
- *Leg 6: Buy 1 of FEU3 Dec28*
- *Leg 7: Buy 1 of FEU3 Mar29*
- *Leg 8: Buy 1 of FEU3 Jun29*

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 1.1 Usage Notes.

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	Contract date 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

4.2 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 cannot 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 5 about strips – provided that strips are enabled for the product.

4.3 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 2.3.3 for complex instruments in general.

For the pricing of Packs and Bundles, two methods are available:

- Average Net Change price notation
- Average price Notation

Which method applies, is published in the reference data.

4.3.1 Average Net Change Price Notation

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 relation 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 (see in the *T7 Functional Reference Part 1*, chapter *Price Condition and Limit Price* of orders, subchapter *Tick Size and Price Step Table*) of the leg instrument, with round half up as tiebreaker,
N	is the number of leg instruments of the packs and bundles instrument.

4.3.2 Average Price Notation

It is defined by the average of the leg instrument prices. The averaged price can be expressed by the formula

$$p_{avg} = \frac{1}{N} \times \sum_{i=1}^{N} p_i$$

where leg instruments are indexed by $i = 1, \ldots, N$ running over all N legs defining the pack, bundle or strip instrument, and the variable p_i is indicating the price of the i-th leg instrument.

4.4 Matching of Packs and Bundles

Set Up Information:
Eurex does not accept GTC or GTD orders for packs and bundles.

4.4.1 Direct Matching

T7 considers the pricing formula described in chapter 4.3, when creating leg trades and forwarding them to clearing, after a packs and bundles order has been executed.

Though only the Average Net price formula contains the leg instruments' previous day settlement prices, it is required for all price notations that previous day settlement prices are available for all leg instruments.

Apart from that, direct matching of packs and bundles follows the rules that have been described in the *T7 Functional Reference Part 1*, chapter *On-Book Matching*, on matching in general and in chapter 2.3 on matching for complex instruments.

4.4.2 Synthetic Matching

Additionally, T7 supports synthetic matching for Packs and Bundles. The exchange controls which Pack and Bundle instruments are enabled or disabled for synthetic matching.

4.4.2.1 Synthetic Matching Paths

T7 supports one synthetic match path for a given Pack or Bundle instrument. It is the path which contains all Simple Instruments that are the leg instruments of the involved Pack or Bundle instrument.

Synthetic matching of this match path is supported for an incoming simple instrument order or a Pack or Bundle order. The synthetic match paths are executed, if the involved Pack or Bundle instrument is enabled for synthetic matching.

4.4.2.2 Path Priority

For an incoming order that is matched at a given price level, there may be several book paths available for matching at the same price. There is the direct book path, which is the opposing side of the orderbook of the instrument to which the incoming order belongs. And there potentially is a multitude of synthetic book paths.

The matching of an incoming order against these book paths needs to be done in a defined sequence, following the priority rules as outlined in this document, but also depending on the configuration that is applied to the specific instrument type by the exchange. This chapter documents the priority rules in the context of synthetic matching with Pack and Bundle instruments.

Matching of Incoming Pack and Bundle Orders:

An incoming Pack or Bundle order can match against one synthetic book path consisting of the legs of the involved Pack or Bundle instrument. The exchange configures one of three path priority rules:

- Direct matching first
- Synthetic matching first
- Pro-rata allocation between the price-best book paths

Matching of Incoming Simple Instrument Orders:

The matching against synthetic book paths including Pack or Bundle orderbooks is treated as a part of Intra-Product Matching, following the definition given in chapter 8.5.3.

Matching against synthetic book paths that include Pack and Bundle orderbooks receive a lower priority than all matching against (intra-product) synthetic book paths that does not include these instruments. They are eligible for execution only after the direct book path and all synthetic book paths consisting of only Simple Instrument, Futures Spread and Standard Futures Strategy orderbook sides have been processed.

The potentially available synthetic book paths including Pack or Bundle orderbooks, are sorted according to the following priority rules:

1. The higher number of legs gets priority. Pack instruments have only four legs as opposed to minimum eight legs for a Bundle and so paths that include a Bundle instrument get priority over paths that include a Pack instrument.
2. If the first rule does not lead to a priority decision, then the paths are sorted depending on the contract dates of the first leg instruments of the involved Pack or Bundle instrument. The higher priority is given to the path with the earlier expiring 1st leg.

These criteria always lead to a priority decision since there cannot be two different Pack or Bundle instruments with the same matching number of legs and the same matching contract date of the first leg.

4.4.2.3 Publication of Synthetic Prices and Quantities

In the context of publication of synthetic prices, it is differentiated between synthetic paths of category 1 and synthetic paths of category 2. Synthetic prices and quantities of synthetic paths of category 1 are published via T7 market data interfaces while prices and quantities of synthetic paths of category 2 are not published.

T7 market data interfaces publish synthetic prices for enabled Packs and Bundle instruments, if they are at least as good as the best prices available in the outright orderbooks of the instruments (synthetic path of category 1).

However, T7 does not publish any synthetic prices for simple instruments, that are derived with the help of Pack or Bundle instrument orderbooks. Such prices are available only for matching but not for publication via market data interfaces (synthetic path of category 2).

4.4.2.4 Uncrossing Procedure

The normal uncrossing procedure for Packs and Bundles does not take synthetic matching possibilities into account. To prevent a synthetically crossed book situation directly after entering the Continuous instrument state, and before any new order transactions are accepted by the system, Pack and Bundle book orders are fed into the market in a defined sequence, as if they were incoming orders, allowing them to match synthetically where possible. This procedure mirrors closely the procedure applied to Standard Futures Strategy orders, to Futures Spread orders and to Inter-Product Spread orders as described in chapters 3.4.4 and 8.6.

5. Strips

This chapter outlines the specific features of strips in T7. The common features of complex instruments in T7 as described in chapter 2 apply for strips, except if stated otherwise in the following.

> *Set Up Information:*
> *Eurex supports strips for selected money market futures and Dividend futures products.*
> *EEX currently does not support strips for any product.*

5.1 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 contract 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 contract dates and they do not need to represent a gap-free sequence of contract dates.

> *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 5-1:

A technically valid strip for the FEU3 money market future may have the following signature

- *Leg 1: Buy 1 of FEU3 Jun27*
- *Leg 2: Buy 1 of FEU3 Sep27*
- *Leg 3: Buy 1 of FEU3 Jun28*
- *Leg 4: Buy 1 of FEU3 Dec28*
- *Leg 5: Buy 1 of FEU3 Mar29*

5.2 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 5.1, i.e., regarding the sequence of the leg instruments, their ratios and their sides. Failure to do so results in a rejection of the creation request.

5.3 Pricing of Strips

For the pricing of strips, there are two methods of pricing available: Either Average Net Change price notation, following exactly the same rules as for packs and bundles as described in chapter 4.3.

$$p_{avg\_net} = \frac{1}{N} \times \sum_{i=1}^{N} \left[p_i - TSROUND\left(p_i^{PDS}\right) \right]$$

Or Average price notation, according to the following rule:

$$p_{avg} = \frac{1}{N} \times \sum_{i=1}^{N} p_i$$

where

$p_{avg(\_net)}$	the price of the strip instrument, either Average or Average Net Change price notation.
p_i	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 (see the *T7 Functional Reference Part 1*, chapter *Price Condition and Limit Price* of orders, subchapter *Tick Size and Price Step Table*) of the leg instrument, with round half up as tiebreaker,
N	the number of leg instruments of the strip instrument.

Set Up Information:
The Average Net Change price notation is used by Eurex for Dividend futures and by Nodal for its commodity futures.
The Average price notation is used by Eurex for Short Term Interest Rate (STIR) futures.

5.4 Matching of Strips

For strips, T7 considers the pricing formula described above when creating leg trades and forwarding them to clearing.

Set Up Information:
Eurex does not accept GTC or GTD orders for strips.

Apart from that, the matching of strips follows the rules that have been described in the *T7 Functional Reference Part 1*, chapter *On-Book Matching*, on matching in general and in chapter 2.3 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.

6. Commodity Strips

This chapter outlines the specific features of Commodity Strips in T7. The common features of complex instruments in T7 as described in chapter 2 apply for Commodity Strips, except if stated otherwise in the following.

Commodity Strips were developed focusing on the trading of commodity products such as power futures.

Set Up Information:

- *Commodity Strips are used by Nodal only.*
- *Commodity Strips can have a maximum number of 144 legs.*

6.1 Definition

There are five instrument subtypes of Commodity Strips. They all have in common the following:

- All leg instruments must belong to futures products.
- All leg instruments belong to the same Commodity Group (see below).
- All legs have a leg ratio of 1.

6.1.1 Standard Commodity Strip (SCSTR)

The Standard Commodity Strip is used to trade commodity instruments for a sequence of consecutive expiry months, e.g. for all months of a quarter (sequence of three months) or for all months of a year (sequence of twelve months) or for any other chosen sequence of months. It is a calendar strip with all instruments on the Buy side. The instruments may belong to different products, all with the same expiration dates.

The display name is composed of the product long name, in case a single product is present in the strip (or the Strip Group name, in case multiple products are present in the strip), supplemented by the covered time span (from:to).

Example: PJM WH RT 24H 50MW–JAN27:DEC27

6.1.2 Non-Standard Commodity Strip (NCSTR)

The Non-Standard Commodity Strip represents a calendar strip with exactly two leg instruments, both on the Buy side. The instruments may belong to different products. If they are of the same product, then their expiration dates cannot be consecutive.

Not all Commodity Groups are allowed for Non-Standard Commodity Strips. It depends on the Commodity Group whether for Non-Standard Commodity Strips the products have to be part of the same Strip Group or not.

Set Up Information:
The Non-Standard Commodity Strip (NCSTR) subtype is planned to be used for Nodal's Environmental products.

6.1.3 Standard Commodity Spread (SCSPD)

The Standard Commodity Spread represents a spread of two Commodity Strips (Buy and Sell) with the same number of legs on both sides.

6.1.4 Custom Commodity Strips (CCSTR)

A Custom Commodity Strip has to fail either in the contiguity of its expiries, i.e., there is a gap between the expiries on one side, or it has to fail in its symmetry. Symmetry means:

- Different products must have an equal number of instruments.
- Different products on the same side must have instruments with the same expiries.
- The number of different products on Buy as well as Sell side must be the same if both sides are present.

There are only buy legs, otherwise it is a Custom Commodity Spread.

6.1.5 Custom Commodity Spreads (CCSPD)

A Custom Commodity Spread has to fail either in the contiguity of its expiries, i.e., there is a gap between the expiries on one side, or it has to fail in its symmetry.

There are both buy and sell legs, otherwise it is a Custom Commodity Strip.

6.2 Commodity Groups and Strip Groups

Commodity Groups are exchange-defined product pools for the purpose of defining Commodity Strips. All leg instruments of a Commodity Strip must be part of one and the same Commodity Group.

Strip Groups are exchange-defined subsets of products within a Commodity Group. The products of one side of a Commodity Strip have to correspond exactly to the products in the chosen Strip Group.

Commodity Group ID	Strip Group ID	Strip Group Name	Assigned Product's Long name
1	1	*PJM WH RT 24H 50MW*	*PJM WH RT OFF PK 50MW Monthly*
1	1	*PJM WH RT 24H 50MW*	*PJM WH RT PK 50MW Monthly*
1	2	*PJM JCPL RT 24H 50MW*	*PJM JCPL RT OFF PK 50MW Monthly*
1	2	*PJM JCPL RT 24H 50MW*	*PJM JCPL RT PK 50MW Monthly*

Example: Two Strip Groups with two products each, together in one Commodity Group.

6.3 Creation

The exchange may create Commodity Strip instruments of predictable popular demand, but generally participants can create Commodity Strips according to their needs.

The instrument subtype is automatically determined by T7 based on the legs of the complex instrument. If a duplicate Commodity Strip instrument is detected on creation, then the identifier of the existing instrument is returned.

6.4 Matching

Commodity strip matching is always direct matching.

6.5 Pricing

The pricing of Commodity Strips follows the average price notation, which is also used for the complex instrument type Strip (see chapter 5).

6.5.1 Single Sided Strip (SCSTR and NCSTR and CCSTR)

The price of a Standard or Non-Standard Commodity Strip instrument is related to the prices of its legs as follows:

$$P_{avg} = \left(\frac{1}{N}\sum_{i=1}^{N} p_i\right)$$

where:

P_{avg} :	Complex Instrument Price
N :	Number of Legs
p_i :	Price of the ith leg.

6.5.2 Standard Commodity Spread and Custom Commodity Spread (SCSPD and CCSPD)

The price of a Standard Commodity Spread or a Custom Commodity Spread instrument is related to the prices of its legs as follows:

$$P_{Spread} = \left(\frac{1}{N_{Buy}}\sum_{i=1}^{N_{Buy}} p_i\right) - \left(\frac{1}{N_{Sell}}\sum_{j=1}^{N_{Sell}} p_j\right)$$

where:

P_{Spread}:	Complex Instrument Price
N_{Buy} :	Number of Buy legs.
N_{Sell}:	Number of Sell legs.
p_i :	Price of the ith Buy leg.
p_j:	Price of the jth Sell leg.

7. 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 2 apply for standard futures strategies, except if stated otherwise in the following.

Set Up Information:
Eurex supports standard futures strategies for selected futures products.
EEX currently does not support standard futures strategies for any product.

7.1 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 has to comply with a strategy type template (also known as instrument subtype) 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 contract date.

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.

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 1.1 Usage Notes.

Set Up Information:
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*
Contract Date Rule	*n/a*	*Later than 1st leg*	*Later than 2nd leg*

Eurex defines a Futures Condor as

Short Name	*FCON*			
Number of Legs	*4*			
	1st Leg	**2nd Leg**	**3rd Leg**	**3rd Leg**
Ratio	*1*	*1*	*1*	*1*
Side	*Buy*	*Sell*	*Sell*	*Buy*
Contract Date Rule	*n/a*	*Later than 1st leg*	*Later than 2nd leg*	*Later than 3rd leg*

Example 7-1:

An example for a valid Futures Butterfly instrument is therefore the instrument with the signature:

- *Leg 1: FEU3 Jun27, Ratio 1, Side Buy*
- *Leg 2: FEU3 Sep27, Ratio 2, Side Sell*
- *Leg 3: FEU3 Dec27, Ratio 1, Side Buy*

An example for a valid Futures Condor instrument is therefore the instrument with the signature:

- *Leg 1: FEU3 Jun27, Ratio 1, Side Buy*
- *Leg 2: FEU3 Sep27, Ratio 1, Side Sell*
- *Leg 3: FEU3 Dec27, Ratio 1, Side Sell*
- *Leg 4: FEU3 Mar28, Ratio 1, Side Buy*

7.2 Creation of Standard Futures Strategies

Standard futures strategy instruments may be created by the exchange as well as by the 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. Any failure to do so results in the rejection of the creation request.

7.3 Matching of Standard Futures Strategies

7.3.1 Direct Matching

Direct matching of standard futures strategies follows the rules that have been described in the *T7 Functional Reference Part 1*, chapter *On-Book Matching*, on matching in general and in chapter 2.3 on matching for complex instruments, i.e., standard futures strategy orders and quotes match against orders and quotes of the same instrument.

7.3.2 Synthetic Matching for Condors and Butterflies

Additionally, T7 supports synthetic matching for the standard futures strategy types Condor and Butterfly. See chapter 7.1 above for the definition of these two strategy types.

The exchange controls which Condor and Butterfly instruments are enabled or disabled for synthetic matching. A specific Condor or Butterfly instrument is enabled for synthetic matching, if and only if all its leg instruments have an expiration date that does not exceed a maximum, which is defined by the exchange for a product.

7.3.2.1 Synthetic Matching Paths

T7 supports four synthetic match paths for any given Condor or Butterfly instrument.

For a Condor, the supported synthetic match paths are:

1. Condor instrument combined with
    - Simple instrument of the 1st Condor leg
    - Simple instrument of the 2nd Condor leg
    - Simple instrument of the 3rd Condor leg
    - Simple instrument of the 4th Condor leg
2. Condor instrument combined with
    - Simple instrument of the 1st Condor leg
    - Simple instrument of the 2nd Condor leg
    - Futures spread instrument, the legs of which are the same as the 3rd Condor leg and the 4th Condor leg
3. Condor instrument combined with
    - Futures spread instrument, the legs of which are the same as the 1st Condor leg and the 2nd Condor leg
    - Simple instrument of the 3rd Condor leg
    - Simple instrument of the 4th Condor leg
4. Condor instrument combined with
    - Futures spread instrument, the legs of which are the same as the 1st Condor leg and the 2nd Condor leg
    - Futures spread instrument, the legs of which are the same as the 3rd Condor leg and the 4th Condor leg

For a Butterfly, the supported synthetic match paths are:

1. Butterfly instrument combined with
    - Simple instrument of the 1st Butterfly leg
    - Simple instrument of the 2nd Butterfly leg (double quantity)
    - Simple instrument of the 3rd Butterfly leg
2. Butterfly instrument combined with
    - Simple instrument of the 1st Butterfly leg
    - Simple instrument of the 2nd Butterfly leg
    - Futures spread instrument, the legs of which are the same as the 2nd Butterfly leg and the 3rd Butterfly leg
3. Butterfly instrument combined with
    - Futures spread instrument, the legs of which are the same as the 1st Butterfly leg and the 2nd Butterfly leg
    - Simple instrument of the 2nd Butterfly leg
    - Simple instrument of the 3rd Butterfly leg

4. Butterfly instrument combined with
    - Futures spread instrument, the legs of which are the same as the 1st Butterfly leg and the 2nd Butterfly leg
    - Futures spread instrument, the legs of which are the same as the 2nd Butterfly leg and the 3rd Butterfly leg

Synthetic matching of these match paths is supported in all directions. This means that no matter whether the incoming order is a simple instrument order, a futures spread order or a Condor or a Butterfly order, the above listed synthetic match paths are executed, if all the involved complex instruments are enabled for synthetic matching.

7.3.2.2 Path Priority

For an incoming order that is matched at a given price level, there may be several book paths available for matching at the same price. There is the direct book path, which is the opposing side of the orderbook of the instrument to which the incoming order belongs. And there is potentially a multitude of synthetic book paths.

The matching of an incoming order against these book paths needs to be done in a defined sequence, following the priority rules as outlined in this document, but also depending on the configuration that is applied to the specific product by the exchange. This chapter documents the priority rules in the context of synthetic matching with Condor and Butterfly instruments.

<u>Matching of Incoming Condor and Butterfly Orders:</u>

The exchange defines per product whether for an incoming Condor or Butterfly order direct matching or synthetic matching is applied first.

The available synthetic book paths are those that relate to the four synthetic match paths listed in chapter 7.3.2.1 above. The sorting of the list in that chapter reflects the sequence in which the synthetic book paths are processed.

<u>Matching of Incoming Futures Spread Orders:</u>

Synthetic book paths including Condor or Butterfly orderbooks are processed only after all book paths of the synthetic and direct futures spread matching, as described in chapter 3.3, have been exhausted at the same price level.

The potentially available synthetic book paths including Condor or Butterfly orderbooks are sorted between them according to the following priority rules:

1. Matching against Condor or Butterfly orderbooks together with simple instrument orderbooks has the priority over matching against Condor or Butterfly orderbooks together with futures spread orderbooks.
2. If that rule does not lead to a priority decision, then matching against Butterfly instruments has the priority over matching against Condor instruments.
3. If both rules do not lead to a priority decision, then the paths are sorted depending on the expiration dates of the leg instruments of the involved Condor or Butterfly instruments. The higher priority is given to the path with the earlier expiring 1st leg. If that is equal, then the path with the earlier expiring 2nd leg has the higher priority. If also that is equal, then the path with the earlier expiring 3rd leg has the higher priority. If also that is equal, then the path with the

earlier expiring 4th leg has the higher priority.

Matching of Incoming Simple Instrument Orders:

The matching against synthetic book paths including Condor or Butterfly orderbooks is treated as a part of Intra-Product Matching, following the definition given in chapter 8.5.3. The corresponding setting for the product defines also the priority of synthetic matching with Condor and Butterfly orderbooks compared to synthetic matching with inter-product spreads.

The matching against synthetic book paths defined by the synthetic futures spread matching functionality as described in chapter 3.3, has always priority against synthetic book paths including Condor or Butterfly orderbooks.

The potentially available synthetic book paths including Condor or Butterfly orderbooks are sorted between them according to the following priority rules:

1. Matching against Condor or Butterfly orderbooks together with only simple instrument orderbooks has the priority over matching against Condor or Butterfly orderbooks together with futures spread orderbooks.
2. If that rule does not lead to a priority decision, then matching against Butterfly instruments has the priority over matching against Condor instruments.
3. If both rules do not lead to a priority decision, then the paths are sorted depending on the expiration dates of the leg instruments of the involved Condor or Butterfly instruments. The higher priority is given to the path with the earlier expiring 1st leg. If that is equal, then the path with the earlier expiring 2nd leg has the higher priority. If also that is equal, then the path with the earlier expiring 3rd leg has the higher priority. If also that is equal, then the path with the earlier expiring 4th leg has the higher priority.
4. There is a corner case where all these rules do not lead to a decision. In this case, the synthetic book path that includes a futures spread instrument, the leg instruments of which include the 3rd leg of the involved Butterfly instrument, has the priority over the synthetic book path that includes a futures spread instrument, the leg instruments of which include the 1st leg of the involved Butterfly instrument.

7.3.2.2.1 Special Cases with Order Bundling

In the case of the synthetic match path, where a Butterfly instrument is combined with the three simple instruments that are its legs, there are two special situations that need to be considered, which arise from the leg ratio of the 2nd leg being greater than 1.

Situation 1:

This situation can happen if the incoming order belongs to either the Butterfly instrument or to a simple instrument that is either the 1st leg or the 3rd leg of the Butterfly instrument. Assume the situation that the available quantity on the best price level in the orderbook of the simple instrument that is the 2nd leg of the Butterfly instrument is 1. As this quantity of 1 is not sufficient for a synthetic match with the Butterfly instrument, this quantity of 1 needs to be bundled with more quantity on a worse price level. The best-priced order with quantity 1 is thus called the “Bundle Order”.

In such a situation, T7 processes the synthetic match path as if the Bundle Order belonged to the second available price level in the orderbook, such that there is sufficient quantity on that level for the synthetic match. The Bundle Order is then also executed at the second price level, giving it an exceptional price advantage, that is normally not given to book orders. Nevertheless, when it comes to the order allocation of the executed quantity, the Bundle Order is still preferred over book orders on the second price level, in order to stick to the rule of price priority.

Situation 2:

This situation happens if the incoming order belongs to the simple instrument that is the 2nd leg of the Butterfly instrument. Assume the situation that there is already an order with quantity 1 for that instrument on the same side of the orderbook as the side of the incoming order. Assume further that the price of that book order is good enough for matching, but the quantity of 1 had been insufficient for a match to happen already before.

In this case, this book order becomes a “Bundle Order”, which means that it is bundled together with the incoming order to facilitate the synthetic match. The execution price remains the one that is calculated from the orderbooks of the Butterfly instrument and the other two leg instruments in the usual way. The executed quantity is then shared among the incoming order and the Bundle Order with strict price-time priority. I.e. the better priced order of the two gets allocated first, and if both have the same limit price, then the Bundle Order gets allocated first as it is the older order.

7.3.2.3 Publication of Synthetic Prices and Quantities

The T7 market data interfaces publish synthetic prices for enabled Condor and Butterfly instruments, if they are at least as good as the best prices available in the outright orderbooks of the instruments. Hence, synthetic book paths creating synthetic prices for Condor and Butterfly instruments belong to synthetic paths of category 1, as defined in chapter 4.4.2.3 above

However, T7 does not publish any synthetic prices for simple instruments or Futures Spread instruments, that are derived with the help of Condor or Butterfly instrument orderbooks. Such prices are available only for matching but not for publication via market data interfaces. These synthetic book paths belong to synthetic paths of category 2.

7.3.3 Uncrossing Procedure

Like for most complex instrument types, the normal uncrossing procedure for Standard Futures Strategies does not take synthetic matching possibilities into account. In order to prevent a synthetically crossed book situation directly after entering the Continuous instrument state, and before any new order transactions are accepted by the system, Condor and Butterfly book orders are fed into the market in a defined sequence, as if they were incoming orders, allowing them to match synthetically where possible. This procedure mirrors closely the procedure applied for Futures Spread orders and for Inter-Product Spread orders as described in chapters 3.4.4 and 8.6.

8. 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 2 apply for inter-product spreads, except if stated otherwise in the following.

Set Up Information:

Eurex offers the following types of inter-product spreads:

- *Index spreads*
- *Interest Rate Spreads*
- *TED spreads.*
- *IPS Box.*

EEX offers the following types of inter-product spreads:

- *Location Spreads between power futures of different market areas.*
- *Location Spreads between gas futures of different market areas.*
- *Spark Spreads between power futures and gas futures.*
- *Emission Futures Spreads (EMIS) between different emission allowance futures products.*
- *Basis Spreads between emission allowance spot products and futures products.*

In the future, more types of inter-product spreads may be added by these exchanges.

8.1 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.

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.

8.1.1 General characteristics of Inter-Product Spreads

The characteristics of inter-product spread instruments 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.

> *EEX Set Up Information:*
> *EEX mainly offers inter-product spreads that have two leg instruments with a leg ratio of 1, and the leg instruments have identical contract values. However, EEX also offers inter-product spreads, where one of the leg instruments has a leg ratio that is greater than 1. This is the case for Spark Spreads but also for some Location Spreads.*

Example 8-1:

EEX offers Location Spreads (instrument subtype LOCS) between German and Italian power futures, for example:

- *Leg 1: Buy 1 FDBM May27 (Italian Base Load month futures)*
- *Leg 2: Sell 1 DEBM May27 (German "Phelix" Base Load month futures)*

The related product pool is called FDBMDEBM. The T7 GUI refers to the inter-product spread that has the above-mentioned leg instruments as

FDBMDEBM LOCS 1 FDBM May27 - 1 DEBM May27

Example 8-2:

EEX offers Location Spreads (instrument subtype LOCS) between Dutch and French gas futures, for example:

- *Leg 1: Buy 24 G5BM May27 (French PEG Nord natural gas month futures)*
- *Leg 2: Sell 1 G3BM May27 (Dutch TTF natural gas month futures)*

The different leg ratios reflect the difference in the contract sizes of the leg instruments, which are caused by a difference in the underlying delivery rates, which are 1 MW/hour for Dutch TTF natural gas futures and 1 MW/day for French PEG Nord natural gas futures.

The related product pool is called G5BMG3BM. The T7 GUI refers to the inter-product spread that has the above-mentioned leg instruments as

G5BMG3BM LOCS 24 G5BM May27 - 1 G3BM May27

Example 8-3:

EEX offers Spark Spreads (instrument subtype DISS) between Austrian power futures and Dutch gas futures, for example:

- *Leg 1: Buy   1 ATBM May27 (Austrian power base load month futures)*
- *Leg 2: Sell   2 G3FM May27 (Dutch TTF natural gas financial month futures)*

The different leg ratios reflect approximately the energy conversion efficiency of a typical gas-fired power plant, such that the spread stands for the gross margin of such a power plant.

The related product pool is called ATBMG3FM. The T7 GUI refers to the inter-product spread that has the above-mentioned leg instruments as

ATBMG3FM DISS 1 ATBM May27 - 2 G3FM May27

8.1.2 TED spreads – General Concept

For TED spreads in T7, one leg refers to a fixed income futures contract with an underlying bond. The other leg refers to several consecutive short-term interest futures contracts. The time span covered by the consecutive short-term interest futures contracts is approximately identical to the remaining maturity of the underlying bond at the point in time when the corresponding fixed income futures leg expires.

The signature of a TED spread product is as follows.

- Leg 1 – "Fixed Income Leg": simple instrument of fixed income futures with contract date T and a buy/sell indicator identical to "buy"; the leg ratio is denoted by R^{FI}.
- Leg 2 – "Short-Term Interest Rate Leg": multi-leg instrument (bundle) of a short-term interest rate futures contract starting with the same expiration month of the fixed income contract date T and a buy/sell indicator identical to "sell"; the leg ratio is denoted by R^{ST}; it is assumed that the first instrument of the short-term leg (i.e., the first leg of the bundle) expires after the fixed income leg.

In case of a FGBS – FEU3 TED spread, a 2-year bundle is used on the short-term interest rate side as the multi-leg instrument.

Trading in a TED spread instrument is terminated on the first business day where the position limits become effective for the fixed income leg instrument, i.e., three trading days prior to the last trading day of the fixed income leg instrument. Consequently, the TED spread instrument is de-activated three business days prior to the contract date of the fixed income leg.

For the calculatory background of the setup of the leg ratios for TED Spreads see appendix 16.1.

Example 8-4:

As an example, the FGBS – FEU3 TED spread product valid in July / August 2027 contains the following TED spreads instruments:

Contract date	Leg 1: FGBS, simple inst leg ratio $\boldsymbol{R^{FI}} > \mathbf{1}$	Leg 2: FEU3, 2-yr Bundle Leg; leg ratio $\boldsymbol{R^{ST}} = \mathbf{1}$	Last Trading Day
Sep 2027	FGBS Sep27; contract date: 08.09.2027	Sep27, Dec27, Mar28, Jun28, Sep28, Dec28, Mar29, Jun29	03.09.2027

A new TED spread instrument is created shortly before the fixed interest rate leg instrument expires and before the last trading day of the active TED spread instrument is reached.

Example 8-5:

As an example, the following Dec 2027 TED spread instrument is created to succeed the Sep 2027 TED spread instrument mentioned above. Its creation day is assumed to be five business days before the fixed interest leg of the active TED spread instrument expires:

Contract date	Leg 1: FGBS, simple inst leg ratio $\boldsymbol{R^{FI}} > \mathbf{1}$	Leg 2: FEU3, 2-yr Bundle Leg; leg ratio $\boldsymbol{R^{ST}} = \mathbf{1}$	First / Last Trading Day
Dec 2027	FGBS Dec27; contract date: 08.12.2027	Dec27, Mar28, Jun28, Sep28, Dec28, Mar29, Jun29, Sep29	01.09.2027 / 03.12.2027

8.2 Creation of Inter-Product Spreads

Inter-product spread instruments are created by the exchange. They cannot be created by users.

8.3 Quantities of Inter-Product Spreads

Normally, inter-product spread instruments follow the same straight-forward quantity representation as other complex instruments, i.e., one lot in an inter-product spread instrument represents leg quantities as given by the leg ratios of the leg instruments.

Example 8-6:

Assume, the inter-product spread instrument FDBMDEBM LOCS FDBM May27 DEBM May27 is defined as

- *Leg 1: Buy 1 FDBM May27 (with a leg ratio of 1)*
- *Leg 2: Sell 1 DEBM May27 (with a leg ratio of 1)*

This means that buying 1 lot of the inter-product spread instrument FDBMDEBM LOCS FDBM May27 DEBM May27 is equivalent to buying 1 lot of FDBM May27 and selling 1 lot of DEBM May27.

T7 supports the application of a quantity scaling parameter to inter-product spreads. The quantities of such inter-product spreads have then to be interpreted as the quantities that result from the spread instrument's leg ratios, multiplied by the scaling factor. The reason for such a set-up is to reflect existing market usances regarding the quantity representation for the concerned inter-product spread instruments. Note that this implies that order and trade quantities in such inter-product spread instruments can only be multiples of the applied quantity scaling parameter.

Example 8-7:

Assume, the inter-product spread instrument G5BMG3BM LOCS G5BM May27 G3BM May27 is defined as

- *Leg 1: Buy 24 G5BM May27 (with a leg ratio of 24)*
- *Leg 2: Sell 1 G3BM May27 (with a leg ratio of 1)*

EEX applies a quantity scaling factor of 24 to this instrument, such that the quantity representation is in line with the quantities in the G5BM market, thus conforming to existing market usances.

This means that buying 24 lots of the inter-product spread instrument G5BMG3BM LOCS G5BM May27 G3BM May27 is equivalent to buying 24 lots of G5BM May27 and selling 1 lot of G3BM May27. It furthermore means that orders for that inter-product spread instrument can only be entered in integer multiples of 24 lots. E.g. 120 lots of G5BMG3BM LOCS G5BM May27 G3BM May27 are equivalent to 120 lots of G5BM May27 and 5 lots of G3BM May27. But the entry of a spread order with a quantity of 12 is rejected by the system, because that would be equivalent to half a contract in G3BM May27, and fractional quantities are not supported by trading and clearing systems.

8.4 Pricing of Inter-Product Spreads

8.4.1 Standard Price Relation

The inter-product spread functionality of T7 allows combining instruments that belong to very different products, specifically concerning the contract value. T7 is able to reflect such differences in the relation between the price of an inter-product spread instrument and the prices of its leg instruments.

However, in most cases there are no major differences in the contract values of the leg instruments, and the standard price relation for complex instruments as outlined in chapter 2.3.3 is applied.

Eurex Set Up Information:
Eurex offers Interest Rate Spreads between money market futures and Index Spreads between related index futures. These inter-product spreads generally have two legs, each with a leg ratio of 1. The standard price relation applies, i.e.

$$p_{IPS} = p_{leg\ 1} - p_{leg\ 2}$$

Eurex offers inter-product spreads of type IPS-Box between money market futures. These instruments are essentially calendar spreads of inter-product spreads, and are technically realized as four-legged instruments, each with a leg ratio of 1, with two leg instruments from each product. The standard price relation applies, i.e.

$$p_{IPS} = \left(p_{leg\ 1} - p_{leg\ 2}\right) - \left(p_{leg\ 3} - p_{leg\ 4}\right)$$

<u>EEX Set Up Information:</u>
Location Spreads, Emission Spreads and Basis Spreads as offered by EEX combine two leg instruments. These inter-product spreads generally have two legs, each with a leg ratio of 1. The standard price relation applies, i.e.

$$p_{IPS} = p_{leg\ 1} - p_{leg\ 2}$$

EEX offers Spark Spreads, which are spreads between a power leg instrument with a leg ratio of 1 and a gas leg instrument with a leg ratio of 2. Here, the standard price relation applies again, i.e.

$$p_{IPS} = p_{power} - 2 \times p_{gas}$$

8.4.2 Deviations from the Standard Price Relation

There are some cases where a modified price relation has to be applied.

8.4.2.1.1 Price Relation Without Leg Ratios

There are cases of inter-product spreads, where the leg instruments have different contract sizes, but are quoted in the same price units. In such cases, the leg ratios differ in the same way as the contract sizes, but the leg prices are still to be compared directly without a correction for the leg ratios. Here, a modified price relation is applied where all leg ratio parameters are set to 1.

<u>Example:</u>
In the gas markets, there are cases of location spreads between markets with different contract sizes. An example is the spread G5BMG3BM between the French (PEG) and the Dutch (TTF) gas markets, with one leg having a leg ratio 1 and the other leg having a leg ratio 24. But here, the prices are still quoted in the same way in €/MWh, and so the leg ratios are ignored in the price relation, leading to the same simple price relation as applied for the 1:1 location spreads, i.e.

$$p_{IPS} = p_{leg\ 1} - p_{leg\ 2}$$

.

8.4.2.1.2 Price Relation With Normalized Leg Ratios

There are cases of inter-product spreads, where all the leg instruments have enlarged leg ratios in order to enforce a round lot condition that is defined for at least one of the leg products. In such cases, the leg ratios that would have applied if no leg product had a round lot condition are multiplied with the round lot factor in order to obtain the leg ratios to be applied for the spread instruments. But in the price relation, these enlarged leg ratios are not applied. Instead, the normal leg ratio values are used.

<u>Example:</u>
Normally, a spark spread consists of a power leg with leg ratio 1 and a gas leg with leg ratio 2. If at least one of these leg products is subject to a round lot condition of 5 (MW), the spark spread would be set up with a leg ratio of 5 for the power leg and a leg ratio of 10 for the gas leg. This is done to preserve the integrity of the round lot condition for the affected leg product. However, in the price relation the factor of 5 is not applied on the leg ratios, and the

normalized leg ratios 1 and 2 are applied instead, leading to the same price relation as for other spark spread instruments, as already described above:

$$p_{IPS} = p_{power} - 2 \times p_{gas}$$

8.4.3 Pricing for TED spreads

There are two possible pricing methods for TED spreads:

- Average Net Price Notation, and
- Average Price Notation.

The Average Net Price Notation follows the formula:

$$prc^{TED} = \left({R^{FI}}/{n}\right) \cdot \left(prc^{FI} - prc^{FI\_Sttl}\right) - \left({R^{ST}}/{n}\right) \cdot \left(\sum_{i=1}^{n}\left(prc_i^{ST} - prc_i^{ST\_Sttl}\right)\right) \qquad (3a)$$

The Average Price Notation follows the formula:

$$prc^{TED} = \left({R^{FI}}/{n}\right) \cdot prc^{FI} - \left({R^{ST}}/{n}\right) \cdot \left(\sum_{i=1}^{n} prc_i^{ST}\right) \qquad (3b)$$

where the following terminology is used:

- prc^{FI}: leg trade price of the fixed income futures
- prc^{FI_Sttl}: settlement price of the fixed income futures of the previous business day
- R^{FI}: leg ratio of fixed income futures leg as calculated by equation (1)
- prc_i^{ST}: leg trade price of the i-th short-term interest rate futures with $i = 1, \dots, n$
- $prc_i^{ST\_Sttl}$: settlement price of the i-th short-term interest rate futures of the previous business day with $i = 1, \dots, n$
- R^{ST}: leg ratio of short-term interest rate side
- n: number of the consecutive short-term interest rate contracts involved in the corresponding TED spread; usually the relation is $n = 4 \cdot m$ with the number of years m covering the time span of the consecutive short-term interest rate futures legs.

In case of a FGBS – FEU3 TED spread, it is $n = 8$.

Please note that the price leg ratios $\left({R^{FI}}/{n}\right)$ and $\left({R^{ST}}/{n}\right)$ assume non-integer values and that the quantity leg ratios R^{FI} and R^{ST} are always given by integer values. Both aspects are considered in the price decomposition of a TED spread trade.

The TED spread Average Net Pricing convention in equation (3a) is based on the difference between the averaged net price change of the fixed income futures and the averaged net price change of the short-term interest rate leg futures involved in the corresponding TED spread instrument. The second term of equation (3a) is equivalent to the “averaged net change pricing” approach commonly applied for the pricing of packs and bundles in the short-term interest rate area. With the definition of the price prc_{m-yr}^{bundle} valid for a m-year bundle (which is also known by the T7 Trading Platform), it is

$$prc_{m-yr}^{bundle} = \left(1/n\right) \cdot \left(\sum_{i=1}^{n} \left(prc_i^{ST} - prc_i^{ST\_Sttl} \right) \right)$$

Thus, equation (3a) can be rewritten by

$$prc^{TED} = \left(R^{FI}/n \right) \cdot \left(prc^{FI} - prc^{FI\_Sttl} \right) - R^{ST} \cdot prc_{m-yr}^{bundle} \qquad (4)$$

8.5 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, but not for TED spreads, 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 the *T7 Functional Reference Part 1*, chapter *On-Book Matching,* subchapter *Definitions*.

8.5.1 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 2.3 for complex instruments in general.

8.5.2 Synthetic Matching

8.5.2.1 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 3.3.1. 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 8-8:

An incoming buy order for the simple instrument DEBM May27 is executed against a combination of book buy orders in an assumed inter-product spread instrument FDBMDEBM LOCS FDBM May27 DEBM May27 and of book sell orders in the simple instrument FDBM May27. The match path consists *therefore of*

- *the buy side of DEBM May27,*
- *the buy side of FDBMDEBM LOCS FDBM May27 DEBM May27, i.e., buy FDBM May27 and sell DEBM May27,*
- *the sell side of FDBM May27.*

Here,

1. *the incoming order on the buy side of the simple instrument DEBM May27 is matched against the second leg of the buy side of the inter-product spread instrument FDBMDEBM LOCS FDBM May27 DEBM May27, which is selling DEBM May27, and at the same time*
2. *the first leg of the buy side of the inter-product spread instrument FDBMDEBM LOCS FDBM May27 DEBM May27, which is buying FDBM May27, is matched against the sell side of the simple instrument FDBM May27.*

Synthetic matching of inter-product spread instruments with leg ratios that are not 1, requires special consideration concerning the quantities that are matched. The number of matched lots in a simple instrument that participates in a synthetic match, is equal to the number of matched lots of the spread instrument multiplied by the leg ratio of the corresponding leg and – if a quantity scaling factor is applied for the spread instrument – divided by the quantity scaling factor.

<u>Example 8-9:</u>

An incoming sell order with quantity 24 for the assumed inter-product spread instrument G5BMG3BM LOCS G5BM May27 G3BM May27 is executed against a combination of book buy orders in the simple instrument G5BM May27 and of book sell orders in the simple instrument G3BM May27. The match path consists therefore of

- *the buy side of G5BM May27,*
- *the sell side of G5BMG3BM LOCS G5BM May27 G3BM May27, which is defined as sell 24 lots of G5BM May27 and buy 1 lot of G3BM May27, but also subject to a quantity scaling factor of 24,*
- *the sell side of G3BM May27.*

Here,

1. *24 lots of the buy side of the simple instrument G5BM May27 are matched against the first leg of the sell side of the incoming inter-product spread order in the instrument G5BMG3BM LOCS G5BM May27 G3BM May27, which is selling 24 lots of G5BM May27 (spread order quantity 24 multiplied by leg ratio 24 and divided by quantity scaling factor 24), and at the same time*
2. *the second leg of the sell side of the inter-product spread instrument G5BMG3BM LOCS G5BM May27 G3BM May27, which is buying 1 lot of G3BM May27 (spread order quantity 24 multiplied by leg ratio 1 and divided by quantity scaling factor 24), is matched against 1 lot of the sell side of the simple instrument G3BM May27.*

If higher quantities are matched, then the leg ratios are taken into account proportionally. E.g. 120 lots of G5BMG3BM LOCS G5BM May27 G3BM May27 are matched against 120 lots of G5BM May27 and 5 lots of G3BM May27.

8.5.2.2 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 rules for the calculation of a synthetic price are generally the same as for Futures Spreads (chapter 3.3.2). T7 supports also other price relations between inter-product spreads and their leg instruments, which may be used in the future.

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 8-10:

The following orders are in the order books:

- *Simple instrument DEBM May27:*
    - *Buy 50 at a price of 30.55 €/MWh*
- *Location spread FDBMDEBM LOCS FDBM May27 DEBM May27:*
    - *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 FDBMDEBM LOCS FDBM May27 DEBM May27 ⊕ Buy DEBM May27

giving a synthetic buy price for the simple instrument FDBM May27

Price: $+47.30\ €/MWh = (+16.75\ €/MWh + 30.55\ €/MWh)$

Quantity: $30 = MIN\big((10+20), 50\big)$

8.5.2.3 Publication of Synthetic Prices and Quantities

T7 publishes synthetic prices and quantities for inter-product spread instruments as derived from the best prices and their related accumulated quantities in the leg instruments.

T7 furthermore publishes synthetic prices and quantities for simple instruments that are obtained with the help of inter-product spread instruments. Such prices and quantities are however published separately from synthetic prices that are derived with the help of futures spread instruments. If a simple instrument is a leg instrument with a leg ratio greater than 1, only integer multiples of this leg ratio can be matched synthetically. Published synthetic quantities with such restrictions are marked as *volume with quantity restriction* in the market data message. See the description of the *Top Of Book Implied* message in the *T7 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 3.3.2.

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.

8.5.3 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 3.3.3 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 3.3.3. 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 3.3.3 and to the book paths containing standard futures strategy instruments as discussed in chapter 7.3.2, 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. Intra-Product Matching First: T7 matches first the paths (with that price) containing instruments of the same product, following the rules described in chapter 3.3.3 and 7.3.2. And only when these paths are exhausted, then it matches the synthetic paths (with that price) that include inter-product spreads.
2. Inter-Product Matching First: Or it is the other way around, i.e., T7 matches first the synthetic paths (with that price) that include inter-product spreads, and only then all those paths that include instruments belonging to the same product.

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 3.3.3.

8.5.4 IPS for Fixed Income Futures: Possible Quantity Split on Price Decomposition

The decomposition procedure, which determines the leg execution prices, may in the case of inter-product spreads for Fixed Income Futures split the quantity of one of the legs and assign different prices to these quantities of the same leg.

The reason is that 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.

Eurex Set Up Information:
Eurex does not offer inter-product spreads for Fixed Income Futures.

Example 8-11:

Assume, an inter-product spread for Fixed Income Futures is created with the following signature:

- *Leg 1: Buy 5 FGBL Jun27 (Euro-Bund Futures)*
- *Leg 2: Sell 2 FGBX Jun27 (Euro-Buxl Futures)*

A match occurs for this instrument with an execution quantity of 1 and an execution price of 449.72.

Starting from the reference prices of the leg instruments respectively 165.70 for the first leg and 189.98 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: Buy FGBL Jun27 with a total leg execution quantity of 5*
  - *Leg execution price 165.71, executed leg instrument quantity 4*
  - *Leg execution price 165.72, executed leg instrument quantity 1*
- *Leg 2: Sell FGBL Jun27 with a total leg execution quantity of 2*
  - *Leg execution price 189.42, executed leg instrument quantity 2*

This distribution fits to the execution price of 449.72:

$$(4 \times 165.71 + 1 \times 165.72) - 2 \times 189.42 = 449.72$$

8.5.5 TED spread decomposition

A TED spread trade is decomposed first into the leg trade price of the fixed income leg and into the leg trade price of the bundle leg. Afterwards, a decomposition of the bundle price into leg trade prices of the involved short-term contracts is performed. Since the pricing of the bundle in the TED spread is equivalent to the pricing of a stand-alone bundle, the existing pack and bundle price decomposition of the T7 Trading Platform is used.

To ensure transparency on the leg level, an instrument subtype refers to the TED spread as a specific subtype of the instrument type IPS. The new instrument subtype is applied to all leg trades resulting from a TED spread trade. Consequently, it is possible to distinguish in the short-term interest rate futures between leg trades resulting from a TED spread IPS trade and those resulting from a bundle trade.

Please note that in accordance with equation (3a) and 3b in the TED spread pricing section, the leg trade prices on simple instrument level resulting from a TED spread trade decomposition reproduce exactly the traded TED spread price.

8.6 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 2.3.5. 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 8.5 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 3.4.4. The feed procedure for inter-product spreads applies the sorting by instrument ID as already applied in chapter 8.5.3. If futures spread instruments and inter-product spread instruments are uncrossed at the same time, futures spread orders are fed first.

9. 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 2 apply for standard options strategies, except if stated otherwise in the following.

9.1 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 contract date,
  - optionally a rule concerning the strike price.

Example 9-1:

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 Jun27 12150 C, Ratio 1, Side Sell*
- *Leg 2: ODAX Jun27 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 9-2:

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 contract 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 1.1 Usage Notes.*

9.2 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 results in a rejection of the creation request.

9.3 Matching of Standard Options Strategies

Matching of standard options strategies follows the rules that have been described in the *T7 Functional Reference Part 1*, chapter *On-Book Matching*, on matching in general and in chapter 2.3 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.

10. 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 2 apply for non-standard options strategies, except if stated otherwise in the following.

10.1 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.

Set Up Information:
Eurex supports non-standard options strategies for most options products. It allows for all these products a maximum of six 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.

10.2 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 normalizes the leg ratios. Normalization means that if all the leg ratios can be divided by the same integer number, T7 is doing so.

   Example 10-1:

   Trader A requests the creation of a non-standard options strategy instrument with the following signature:

- *Leg 1: ODAX Jun27 12150 C, Ratio 20, Side Buy*
- *Leg 2: ODAX Jun27 12200 C, Ratio 15, Side Buy*
- *Leg 3: ODAX Jun27 12250 C, Ratio 35, Side Sell*

T7 detects that all ratios can be divided by 5. It therefore accepts the creation request, but in fact create a non-standard options strategy instrument with the signature:

- *Leg 1: ODAX Jun27 12150 C, Ratio 4, Side Buy*
- *Leg 2: ODAX Jun27 12200 C, Ratio 3, Side Buy*
- *Leg 3: ODAX Jun27 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 creates 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 10-2:

   Trader B requests the creation of a non-standard options strategy instrument with the following signature:

   - *Leg 1: ODAX Jun27 12200 C, Ratio 2, Side Sell*
   - *Leg 2: ODAX Jun27 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 Jun27 12150 C, Ratio 1, Side Sell*
   - *Leg 2: ODAX Jun27 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.

10.3 Matching of Non-Standard Options Strategies

Matching of non-standard options strategies follows the rules that have been described in the *T7 Functional Reference Part 1*, chapter *On-Book Matching*, on matching in general and in chapter 2.3 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 10-3:

A non-standard options strategy is created with the following signature:

- *Leg 1: ODAX Jun27 12150 P, Ratio 5, Side Buy*
- *Leg 2: ODAX Jun27 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 Jun27 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 Jun27 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:

$$2.0 = (4 \times 0.9 + 1 \times 1.0) - 2 \times 1.3$$

11. Standard Options Volatility Strategies

This chapter outlines the specific features of standard Options Volatility Strategies in T7 (OVS). The common features of complex instruments in T7 as described in chapter 2 apply for Options Volatility Strategies, except if stated otherwise in the following. The adjective “standard” clarifies the difference of standard OVS to non-standard OVS. If no adjective is given, standard OVS are meant.

11.1 Definition of Standard Options Volatility Strategies

A standard Options Volatility Strategy is a complex instrument that consists of one or more options 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: RelatedMarketSegmentID).*

In general, the futures product is either the underlying of the options product or it has the same underlying as the options product.

> *Set Up Information:*
> *Eurex supports the instrument type Options Volatility Strategy for various products. For details see the Trading parameters as published on the Eurex Web site:*
>
> *Data > Trading Files > Product Parameter Files*
>
> *EEX does not support the instrument type Options Volatility Strategies.*

The signature of a standard 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 a standard 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 11.4 for the specific pricing rules for Options Volatility Strategy instruments.

The signature of a standard 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 contract date,
  - optionally a rule concerning the strike price,
- the side of the underlying leg,

Technically, standard Options Volatility Strategy types are realized as instrument subtypes.

> *Configuration Data:*
> *The list of available standard 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 1.1 Usage Notes.*

Example 11-1:

Eurex defines the Options Volatility Strategy type template for a 2x1 Ratio Put Spread versus Short Underlying as

Short Name	*RBER-U*	
Number of Options Legs	*2*	
	1st Leg	**2nd Leg**
Ratio	*1*	*2*
Side	*Sell*	*Buy*
Option Type	*Put*	*Put*
Contract date 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 9.1, the ratio of an option leg of a standard 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 11.3.1 for details.

The template of a standard 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 11.3.2 is not failed.

Example 11-2:

An example for a 2x1 Ratio Put Spread versus Short Underlying is:

OESX 100/200 RBER Jul27 3200-3000 vs S 17 FESX Sep27 @3260.0

which is defined with the following leg instruments:

- *Options Leg 1: OESX Jul27 3200 P, Ratio 100, Side Sell*
- *Options Leg 2: OESX Jul27 3000 P, Ratio 200, Side Buy*
- *Underlying Leg: FESX Sep27, Ratio 17, Side Sell*

Note that the option leg ratios defined in the template for the standard Options Volatility Strategy type RBER-U as given above have been multiplied by the same integer multiplier 100.

11.2 Creation and Deletion of Standard Options Volatility Strategies

The exchange does not create standard Options Volatility Strategy instruments. Options volatility strategy instruments are created by users.

When creating a standard 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 results 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 11.3.

Additionally, there are conditions that must be fulfilled for a standard Options Volatility Strategy instrument to be allowed to be traded on-book. 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 11.3.3.

- If a product is subject to validations for the delta neutrality of Options Volatility Strategies, additional more strict validations apply concerning the ratios of the options legs in relation to the ratio of the underlying leg. These validations are described in chapter 11.3.4.

These conditions are checked during creation, and if any of these conditions is not fulfilled, the instrument can only be created for off-book trading.

The conditions are, however, validated also during the lifetime of the instrument and if any of the conditions turns out to be not fulfilled anymore, then the instrument is automatically set to inactive for on-book trading, 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 for on-book trading by sending a new creation request, provided that the conditions above are fulfilled again.

Standard Options Volatility Strategy instruments become in this way instruments where each individual instrument is typically open for trading in the order book only for a short time. In any case, they become inactive for on-book trading latest when the product leaves the Trading product state, and they are in any case deleted in the end of day processing. GTD and GTC orders are therefore not supported for Options Volatility Strategy instruments.

11.3 Specific Validations

11.3.1 Options 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 Options 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.

> *Set Up Information:*
> *For most products, Eurex has configured the minimum Options Volatility Strategy multiplier with the value 100, and the maximum Options Volatility Strategy multiplier with the value 1000.*

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 11-3:

In the above presented example for a valid 2x1 Ratio Put Spread versus Short Underlying OESX 100/200 RBER Jul27 3200-3000 vs S 17 FESX Sep27 @3260.0, the applied options leg multiplier for the options 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 options leg multiplier.

11.3.2 Underlying Leg Ratio Rule

T7 requires that the underlying leg ratio is smaller than or equal to an overall 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 11-4:

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 Jul27 3200-3000 vs S 17 FESX Sep27 @3260.0, the applied options 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.

11.3.3 Underlying Leg Execution Price Rule

T7 requires that the underlying leg execution price, which is a fixed part of the signature of the standard 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 11-5:

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 cannot 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 Jul27 3200-3000 vs S 17 FESX Sep27 @3260.0 would therefore be accepted if the reference price is 3240.0, but not if the reference price is 3220.0.

11.3.4 Delta Neutrality Validation

The delta neutrality validation checks that the overall delta of a position in the defined strategy is near zero (perfect delta neutrality). Deviations from perfect delta neutrality are allowed only within a configured range. The position delta of an Options Volatility Strategy is the sum of the deltas of the underlying leg and the options legs, which by construction have opposite signs. The position delta considers the monetary value, which is associated with a price movement. As a consequence, the contract values of the involved option and Futures product must be taken into account in the calculation of the position delta. The delta for an option leg is based on an options price model using the most recent traded price of the underlying at the time of the requested creation of an Options Volatility Strategy.

The validation of the delta neutrality translates into maximum and minimum allowed underlying leg ratios as follows:

$$
\begin{aligned}
&\mathit{Maximum\ Underlying\ Leg\ Ratio}_{\mathit{Delta\ Neutrality}} \\
&\quad = \mathit{Option\ Leg\ Multiplier} \times \frac{\mathit{Contract\ Value\ (Option)}}{\mathit{Contract\ Value\ (Future)}} \\
&\quad \times (1 + \mathit{Max\ Delta\ Neutrality\ Deviation}) \\
&\quad \times \mathit{Abs}\left(\sum_{\mathit{Leg}\ i}^{\substack{\mathit{Strategy}\\ \mathit{Template}}} \mathit{BuySell}_i \times \mathit{Leg\ Ratio}_i \times \Delta_i^{theo} \right)
\end{aligned}
$$

$$Minimum\ Underlying\ Leg\ Ratio_{Delta\ Neutrality}$$

$$= Option\ Leg\ Multiplier \times \frac{Contract\ Value\ (Option)}{Contract\ Value\ (Future)}$$

$$\times (1 - Max\ Delta\ Neutrality\ Deviation\ )$$

$$\times Abs\left(\sum_{Leg\ i}^{\substack{Strategy\\Template}} BuySell_i \times\ Leg\ Ratio_i \times\ \Delta_i^{theo}\right)$$

where	$BuySell_i$	means +1 if the concerned leg is to buy in the strategy template and -1 if the concerned leg is to sell in the strategy template,
	Δ_i^{theo}	is the option theoretical delta of the concerned leg according to the options price model,
	$Max\ Delta\ Neutrality\ Deviation$	Is the maximum allowed deviation from perfect delta neutrality in percentage

Example 11-6:

A user wants to create a CALL-U Options Volatility Strategy for an option using the front month of the related futures product as underlying leg. Assume that:

- *the applicable maximum allowed deviation from perfect delta neutrality is 5% for the requested strategy,*
- *the futures contract value is 10 Euro and the options contract value is 10 Euro,*
- *having an option leg multiplier of 100, the requesting user sets the underlying leg ratio to 76,*
- *the current options theoretical delta is 0.783 at the time of requesting the strategy creation.*

This results in a maximum underlying leg ratio of 82.215 and a minimum underlying leg ratio of 74.385. The requested underlying leg ratio of 76 is within the allowed range for delta neutrality. The requested Options Volatility Strategy can be created for on-book trading.

11.4 Matching of Standard Options Volatility Strategies

Matching of Options Volatility Strategies follows largely the rules that have been described in the *T7 Functional Reference Part 1*, chapter *On-Book Matching*, on matching in general and in chapter 2.3 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 11-6:

There is an order to buy a quantity of 2 with a price limit at -6.5 in the order book of the above presented example OESX 100/200 RBER Jul27 3200-3000 vs S 17 FESX Sep27 @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:

- *Options Leg 1: Sell 200 OESX Jul27 3200 P at 46.1*
- *Options Leg 2: Buy 400 OESX Jul27 3000 P at 19.8*
- *Underlying Leg: Sell 34 FESX Sep27 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.

11.5 Quotes and Market Maker Protection

The quoting and the market maker protection functionalities are generally applied for the standard 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 2.3.7), only the option legs are considered, while the underlying leg instrument is ignored in this context.

12. Non-Standard Options Volatility Strategies

This chapter outlines the specific features of Non-Standard Options Volatility Strategies (NOVS) in T7. They combine features of Non-Standard Options Strategies as described in chapter 10, and of standard Options Volatility Strategies (OVS) as described in chapter 11. Their features apply also for NOVS, except if stated otherwise in the following. The common features of complex instruments in T7 are described in chapter 2.

Set Up Information:
Eurex supports Non-Standard Options Volatility Strategies for most options products.
EEX does not support the instrument type Non-Standard Options Volatility Strategies.

12.1 Definition of Non-Standard Options Volatility Strategies

The Non-Standard Options Volatility Strategies provide more flexibility than Standard Options Volatility Strategies by allowing a non-standard Options Strategy not covered by a strategy template of OVS to be hedged by the corresponding futures underlying leg instrument.

Like an OVS instrument, an NOVS instrument has a signature of several options leg instruments from the same options product to which the strategy instrument itself belongs, and, additionally, of the underlying futures leg instrument. The exchange defines which underlying futures products are allowed for which options product. The configuration of the underlying futures products related to the options product is the same for OVS and NOVS. T7 does not require a specific sorting of the leg instruments.

The exchange defines by product concerning the options legs:

- a maximum for the number of options legs,
- a maximum and a minimum for the options leg ratios,
- a maximum for how much the ratio of one options leg may exceed the ratio of another options leg of the same instrument.

Non-Standard Options Volatility Strategy instruments are created for the current day only, therefore GTC or GTD are not allowed as order validity.

Set Up Information:
Eurex allows a maximum of six options legs. The options leg ratio has a maximum of 9999 depending on the product and a minimum of 100. The ratio of one options leg cannot be greater than four times the ratio of a different leg of the same instrument.
For details see the Trading parameters as published on the Eurex Web site:

Data > Trading Files > Product Parameter Files

Apart from belonging to the same product, the options 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.

Example 12-1:

An example for an NOVS 3x5 Ratio Put Spread versus Short Underlying is:

OESX 300/500 Jul28 3200-3000 vs S 17 FESX Sep28 @3260.0

which is defined with the following leg instruments:

- *Options Leg 1: OESX Jul28 3200 P, Ratio 300, Side Sell*
- *Options Leg 2: OESX Jul28 3000 P, Ratio 500, Side Buy*
- *Underlying Leg: FESX Sep28, Ratio 17, Side Sell @3260.0*

12.2 Creation of Non-Standard Options Volatility Strategies

The exchange does not create NOVS. Non-standard OVS are created by users. When a user requests the creation of a NOVS, T7 may decide to modify the requested signature or even the instrument type as follows:

- Inversion of sell-only Strategies: If a user requests a non-standard OVS instrument the options legs of which have all Sell as the side, then T7 changes the side to Buy for all the options legs. This prevents the creation of instruments that can have only negative prices.
- Detection of standard OVS: T7 does not allow creating a non-standard OVS instrument that could have been created as a standard OVS instrument. In this case, T7 creates it as the appropriate standard OVS instrument. This may involve changing the sequence of legs, and it may involve switching the sides of all legs.

Contrary to standard OVS, there is no normalization of non-standard OVS.

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.

12.3 Specific Validations of Non-Standard Options Volatility Strategies

Each leg ratio $R_i^{NOS}, i = 1, \dots, n$ of the n options legs of an NOVS are considered to provide a relationship between these options leg ratios $R_i^{NOS}, i = 1, \dots, n$, the delta values $\delta_i, i = 1, \dots, n$ of each options leg, and the underlying futures leg ratio R_{NOVS}^{undr}, in the following way.

$$R_{NOVS}^{undr} = \left| \sum_{i=1}^{n} BS_i \cdot \delta_i \cdot R_i^{NOS} \right| \cdot \frac{CV_{Opt}}{CV_{Fut}} \qquad (1)$$

where $BS_i, i = 1, \dots, n$ denotes the buy/sell indicator of each options leg and $CV_{Opt}$and CV_{Fut} the contract value of the options respectively futures instrument.

Equation (1) might be denoted as *delta-neutrality formula* of NOVS instruments.

To align with OVS, Equation (1) can be rewritten in the following way.

$$R_{NOVS}^{undr} = |\delta_{NOS}| \cdot \langle R_{NOS} \rangle \cdot \frac{CV_{Opt}}{CV_{Fut}} \qquad (2)$$

with the definition of the delta value δ_{NOS} of the options part of the NOVS given by

$$\delta_{NOS} = \frac{\langle \delta_{NOS} \cdot R_{NOS} \rangle}{\langle R_{NOS} \rangle}$$

where the mean leg ratio $\langle R_{NOS}\rangle$ and the mean delta-weighted leg ratio $\langle \delta_{NOS} \cdot R_{NOS}\rangle$ will be given by

$$\langle R_{NOS}\rangle = \frac{1}{n} \cdot \{ \textstyle\sum_{i=1}^{n} R_i^{NOS} \} \quad \text{and} \quad \langle \delta_{NOS} \cdot R_{NOS}\rangle = \textstyle\sum_{i=1}^{n} BS_i \cdot \delta_i \cdot R_i^{NOS}$$

For OVS, the options multiplier ensures a meaningful underlying futures quantity and controls the delta granularity of the options part.

Similar arguments hold for NOVS taking into account that each leg ratio $R_i^{NOS}, i = 1, \dots, n$ of the options part of an NOVS instrument needs to be inside a minimum leg quantity R_{min} and a maximum leg quantity R_{max}, which is valid for all options legs of an NOVS instrument, i.e.

$$R_{min} \le R_i^{NOS} \le R_{max} \quad \text{for} \quad i = 1, \dots, n$$

The submission of an NOVS instrument not compliant with the minimum and maximum leg quantity will be rejected.

By introducing a delta tolerance denoted by $\delta_{NOS}^{tol} > 0$, the delta-neutrality formula of NOVS as expressed by Equation (2) will be used for a delta validation applied to NOVS instruments to ensure their inner consistency:

$$\left(\delta_{NOS}^{min} - \delta_{NOS}^{tol}\right) \cdot \frac{CV_{Opt}}{CV_{Fut}} \le R_{NOVS}^{undr} / \langle R_{NOS}\rangle \le \left(\delta_{NOS}^{max} + \delta_{NOS}^{tol}\right) \cdot \frac{CV_{Opt}}{CV_{Fut}} \qquad (3)$$

The minimum and maximum delta values δ_{NOS}^{min} and δ_{NOS}^{max} will be given by

$$\delta_{NOS}^{min} = \sum_{i=1, BS_i=+1}^{n} \delta_i^{min} \cdot R_i^{NOS} - \sum_{i=1, BS_i=-1}^{n} \delta_i^{max} \cdot R_i^{NOS}$$

$$\delta_{NOS}^{max} = \sum_{i=1, BS_i=+1}^{n} \delta_i^{max} \cdot R_i^{NOS} - \sum_{i=1, BS_i=-1}^{n} \delta_i^{min} \cdot R_i^{NOS}$$

with leg-specific minimum and maximum delta values δ_i^{min} and δ_i^{max}, $i = 1, \dots, n$, respectively, provided by Eurex.

In case a trader enters an NOVS instrument with an underlying futures leg quantity R_{NOVS}^{undr}, with a mean leg ratio $\langle R_{NOS}\rangle$, and with the minimum and maximum delta values δ_{NOS}^{min} and δ_{NOS}^{max}, which do not satisfy Equation (3), the creation of such an NOVS instrument is rejected.

Please note that Equation (3) assumes positive minimum and maximum delta values with $0 < \delta_{NOS}^{min} - \delta_{NOS}^{tol} < \delta_{NOS}^{max} + \delta_{NOS}^{tol}$. Due to an always positive value of $R_{NOVS}^{undr} / \langle R_{NOS}\rangle$, Equation (3) will need to be adapted accordingly in case of $\delta_{NOS}^{min} - \delta_{NOS}^{tol} < \delta_{NOS}^{max} + \delta_{NOS}^{tol} < 0$ or in case of $\delta_{NOS}^{min} - \delta_{NOS}^{tol} \le 0 \le \delta_{NOS}^{max} + \delta_{NOS}^{tol}$.

12.4 Matching of Non-Standard Options Volatility Strategies

As for OVS, pricing and matching of NOVS instruments exclusively refers to its options part and the price and quantity R_{OVS}^{undr} of the underlying futures leg is included in the instrument signature analogously to OVS.

However, in contrast to OVS, there is no options multiplier affecting the legs of the options part of an NOVS. Due to the lack of the options multiplier, the price composition of NOVS follows a different approach than the existing OVS. For OVS the options multiplier allows to normalize strategy prices. For NOVS the individual leg ratios are considered for calculating the prices. Therefore, the prices of a NOVS will generally be larger than a comparable OVS strategy roughly by the factor of the options multiplier applied on OVS.

Matching of NOVS follows the rules that have been described in chapter 7 on matching in general and in chapter 13.3 on matching for complex instruments. T7 supports no synthetic matching for NOVS, i.e., NOVS orders and quotes match only against orders and quotes of the same instrument.

As for NOS, the decomposition procedure, which determines the leg execution prices, may in the case of NOVS split the quantity of one of the legs and assign different prices to these quantities of the same leg.

Example 12-2:

A non-standard Options Volatility Strategy instrument is created with the following signature:

- *Options Leg 1: OESX Jul28 3200 P, Ratio 500, Side Buy*
- *Options Leg 2: OESX Jul28 3000 P, Ratio 200, Side Sell*
- *Underlying Leg: FESX Sep28, Ratio 17, Side Sell @3260.0*

A match occurs for this instrument with an execution quantity of 1 and an execution price of 200.

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: OESX Jun28 3200 P with a total leg execution quantity of 500*
  - *Leg execution price 0.9, executed leg instrument quantity 400*
  - *Leg execution price 1.0, executed leg instrument quantity 100*
- *Leg 2: OESX Jun28 3000 P with a total leg execution quantity of 200*
  - *Leg execution price 1.3, executed leg instrument quantity 200*

This distribution fits to the execution price of 200:

$$200 = (400 \times 0.9 + 100 \times 1.0) - 200 \times 1.3$$

The delta tolerance δ_{NOS}^{tol} is also used to verify that the underlying futures leg of an NOVS will have the correct buy/sell indicator BS_{NOVS}^{undr}. Therefore, it will be validated that

$$BS_{NOVS}^{undr} = \text{Sell} \quad \text{for} \quad \delta_{NOS} \geq \delta_{NOS}^{tol}$$

or

$$BS_{NOVS}^{undr} = \text{Buy} \quad \text{for} \quad \delta_{NOS} \leq (-1) \cdot \delta_{NOS}^{tol}$$

In case of $(-1) \cdot \delta_{NOS}^{tol} < \delta_{NOS} < \delta_{NOS}^{tol}$, a dedicated buy/sell indicator $\mathrm{BS}_{\mathrm{NOVS}}^{\mathrm{undr}}$ will not be enforced for such an NOVS instrument.

13. TRF Strategies

TRF Strategies are complex instruments that support TRF instruments as leg instruments. Note that other complex instrument types generally do not support TRF instruments as leg instruments. The signature of a TRF strategy complies with a strategy type template that is defined by the exchange.

T7 supports several variants of two kinds of TRF strategy types:

- Delta-neutral TRF Strategies.
- TRF Forward Implied Spreads.

Set Up Information:
Enabled for Eurex.

13.1 Delta-Neutral TRF Strategies

Users can define delta-neutral TRF Strategies (cf. Appendix 16.3) as a complex instrument, traded on-book and off-book, which allow delta neutral hedging of TRF trades. TRF Strategies resemble Options Volatility Strategies (OVS). There are two legs:

- a TRF instrument.
- a related Futures instrument.

TRF strategies are supported for delta-neutral TAM and TAC trading. Delta-neutral TAM trading is achieved by fixing the Basis in the strategy definition. In the context of delta-neutral TRF strategies, the Basis denotes the arithmetical difference between the futures' trade price and the cash index level. For delta-neutral TAC, the Basis is not required because the index close published by the index provider is directly used for the calculation of the final clearing prices.

Additionally, delta-neutral TRF strategies allow the futures leg price of the strategy to be set at market level. This is the most recent traded price in the corresponding futures order book, as is common practice in the Interdealer Broker (IDB) market. However, it is also possible to define the price of the futures leg on strategy creation and set it to a fixed value in the strategy definition.

The delta-neutral TRF strategies can be broken down in four variants (instrument subtypes):

- On the one hand, differentiating between delta-neutral TAM and delta-neutral TAC,
- and in parallel, choosing between a fixed futures price and a futures price at market level.

Name	1st Leg Buy	2nd Leg Sell	Basis	Futures price	Preliminary Clrg. Price	TES[1]	CLOB
Delta-neutral TAM Fixed	TRF	Regular Futures	Yes	Fixed	No	Yes	Yes
Delta-neutral TAM Market	TRF	Regular Futures	Yes	Market	No	No	Yes
Delta-neutral TAC Fixed	TRF	MOC Futures	No	Fixed	Yes[2]	Yes	Yes
Delta-neutral TAC Market	TRF	MOC Futures	No	Market	Yes[14]	No	Yes

Please note that if the underlying leg price is not in line with the applicable price step table of the underlying product, or if the price is zero or negative though this is not allowed for the product, then in these two cases TES trading is not possible, and so the strategy creation is rejected.

> *Set Up Information:*
> *Eurex currently supports two kinds of related futures products: Regular futures and MOC futures. The exchange defines the eligible product pairs, and its subtypes based on a common underlying.*

13.2 TRF Forward Implied Spreads

TRF Forward Implied Spreads (FIS) facilitate the trading of TRF calendar spreads, for both on-book as well as off-book trading. They are created by users following one of the exchange defined instrument subtype templates.

The number of legs is fixed at two: Both legs have to belong to the same product but with different expiries. A TRF FIS consists of an anchor leg with the near dated expiry and a negotiable leg with the far dated expiry. On strategy creation, the creating user chooses between a fixed price strategy type or a market price strategy type.

- When choosing **Fixed**, the creating user defines a fixed leg trade price for the anchor leg instrument.
- When choosing **Market**, it is the T7 system that will automatically apply a current market reference price at the time of the trade as the trade price of the anchor leg instrument.

This distinction between Fixed and Market, and, in case of Fixed, the pre-defined price of the anchor leg, are part of the immutable strategy definition, whereas the price of the negotiable leg serves as the price of the strategy. Thus, the quotation is not based on a net traded spread but rather on an outright individual price of the negotiable leg, which is the far dated expiry. Thus, the TRF FIS pricing notation

[1] Only delta neutral TRF strategies with a fixed futures price do support block trading (TES).

[2] Preliminary clearing prices apply to both legs. The TRF which is traded as TAC, as well as the MOC futures.

differs fundamentally from the notation applied for existing calendar spreads at Eurex (instrument type Futures Spread).

TRF FIS can be traded as TAM or TAC. In the case of a TAM strategy, the creating user has to specify a cash index level (CustomUnderlying) on strategy creation which becomes part of the strategy definition.

TRF FIS strategies are differentiated by four different instrument subtypes having a shared common structure. See the characteristics of each instrument subtype in the following table:

TRF FIS Name	1st Leg Buy (Negotiable)	2nd Leg Sell (Anchor)	Custom Underlying	Anchor Leg Price	Preliminary Clearing Price	TES	CLOB
FTAM-TF	TRF (far dated expiry)	TRF (near dated expiry)	Yes	Fixed	No	Yes	Yes
FTAM-TM	TRF (far dated expiry)	TRF (near dated expiry)	Yes	Market	No	No	Yes
FTAC-TF	TRF (far dated expiry)	TRF (near dated expiry)	No	Fixed	Yes	Yes	Yes
FTAC-TM	TRF (far dated expiry)	TRF (near dated expiry)	No	Market	Yes	No	Yes

The legs will be traded either both as TAM or both as TAC. In the TAM case, the custom underlying value is applied to both leg instruments.

14. Flexible Instruments

This chapter outlines the features of flexible instruments in T7. Flexible instruments are available only for off-book trading on T7.

14.1 Definition of a Flexible Instrument

TES trading in T7 supports off-book trading of tailor-made futures and options contracts termed as flexible instruments. This allows traders to customize their trades to meet their individual needs.

The signature of Flexible Options Instruments is defined by the following attributes:

- Product Id,
- Call/Put code,
- Expiration date including the day,
- Strike price,
- Exercise style (European or American style),
- Settlement Method (Cash or Physical settled).

The signature of Flexible Futures Instruments is defined by the following attributes:

- Product Id,
- Expiration date including the day,
- Settlement Method (Cash or Physical settled).

As defined in the *T7 Functional Reference Part 1*, chapter *Market Structure*, subchapter *Flexible Instruments*, some of these instrument attributes can be flexibly selected by the user while defining the flexible instrument.

Example 14-1:

A TES trader can select the attributes as follows to define a flexible instrument on ODAX.

- *Product – ODAX*
- *Call/Put code – C*
- *Expiration date – 08DEC27*
- *Strike price – 10560.00*
- *Exercise style – American*
- *Settlement Method – Cash*

14.2 Creation of Flexible Instruments

Before TES trades can be submitted for a flexible instrument, the flexible instrument must be created. Flexible instruments can be created by users at any time during trading hours, provided that the exchange has configured a corresponding TES profile (see the *T7 Functional Reference Part 1*, chapter *TES Profile*, for the product, the instrument type Flex and the corresponding TES type.

Configuration Data:
The information which Exercise style and Settlement method are supported for a product, is provided in the Flexible Instrument Configuration file published on the Eurex website.

When a flexible instrument is created, T7 assigns a new instrument identifier to the flexible instrument and also provides the flexible symbol in the response. The instrument identifier, flexible symbol and the signature of the new flexible instrument are disseminated to the market participants on the public reference data and market data feeds.

If a user requests the creation of a flexible instrument that already exists, the instrument is not created again. Instead, T7 returns the identifier of the already existing instrument. The instrument Identifier for the flexible instrument is valid only for the current business day. If a new flexible instrument with the same signature is created on another day, this new flexible instrument has a different instrument identifier.

When the signature of a requested flexible instrument is the same as the signature of an existing standard instrument, then the request for creation is rejected.

The relation between the last trading day and the expiration day of an instrument is defined on the product level and holds in the same way for both regular instruments and flexible instruments. This means that in case the last trading day is prior to the expiration day for regular instruments, then the last trading day and the expiration day of a flexible instrument differ by the same amount as for the regular instruments.

The expiration day can be any exchange day (with some special exchange defined exceptions). Please note that a TES trader creating a flexible instrument always specifies the expiration day and not the last trading day.

15. Scaled Instruments

Based on the normal simple instruments defined by the exchange, users can create intraday new instruments which differ from normal instruments by having a user-defined round lot size. These instruments are called *scaled instruments*. They can be created as simple or as complex instruments. Scaled instruments can be traded only in multiples of their round lot size. The round lot size is called the *Quantity Scaling Factor* of the scaled instrument.

If the scaled instrument to be created already exists, then no new scaled instrument is created, but the identifier of the existing scaled instrument is returned. The identifier and other attributes of the new scaled simple instrument are disseminated to the market participants on the reference data and market data feeds.

Set Up Information:

Scaled Instruments are supported for derivatives markets only.

Scaled instruments are enabled for Nodal. The exchange defines the allowed scaling factors. The exchange also defines maximum limits for the numbers of scaled instruments per product, business unit, or session.

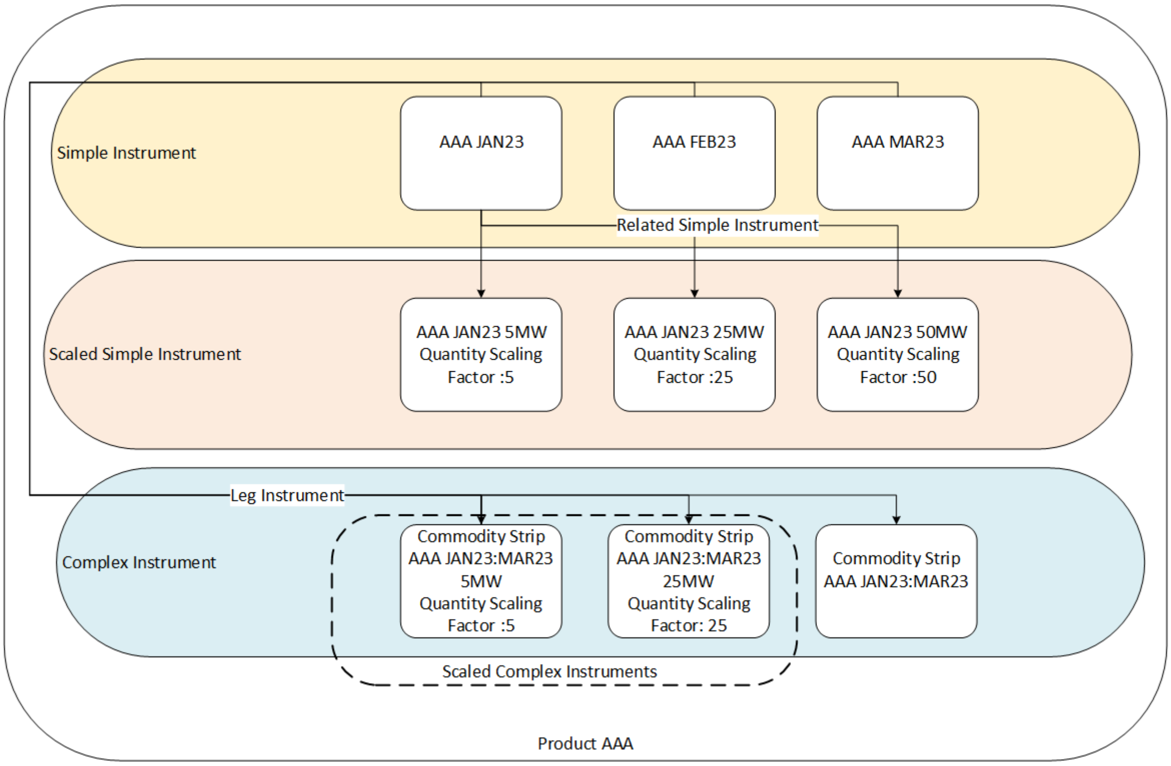

Figure 15-1: The relation of simple, scaled simple, and scaled complex instruments

The users enter orders or TES trades for scaled instruments with the same side, price, and quantity, as if they entered the orders or TES trades for a normal non-scaled instrument, but the quantity has to comply with the round lot size condition of the scaled instrument. Scaled instruments support only direct matching. Synthetic prices are not supported.

Scaled instruments, for which there are no orders in the book which need to be carried forward to the next business day, will be deleted in the end-of-day processing.

15.1 Scaled simple instruments

Simple scaled instruments have an instrument type *Scaled Simple Instrument*. The instrument state of a scaled simple instrument is generally the same as that of the related simple instrument.

Simple scaled instruments get a display name consisting of the display name of the related simple instrument and the quantity scaling factor, followed by the unit of measure of the product, if applicable. The instrument mnemonic consists of the mnemonic of the related simple instrument followed by the quantity scaling factor.

Example:

The display name for the scaled instrument based on the simple instrument AAA JAN27 with a quantity scaling factor of 5 is: AAA JAN27 5MW

The instrument mnemonic for the scaled instrument based on AAA SI 20271227 CS is this mnemonic followed by the quantity scaling factor 5: AAA SI 20271227 CS 5.

Trades in scaled simple instruments result in trades of the related simple instruments.

Example:

For the scaled simple instrument AAA JAN27 50MW, the trade Buy 50@101.25 results in a trade for the related simple instrument AAA JAN27: Buy 50@101.25.

15.2 Scaled complex instruments

Based on normal exchange-defined simple instruments as its legs, users can create intraday a new scaled complex instrument with a Quantity Scaling Factor. It is not necessary that the related scaled simple instruments, or the related non-scaled complex instrument exists, before the scaled complex instrument can be created, as the scaled complex instrument has no relation to such instruments but relates directly to normal simple instruments as leg instruments. It is ensured that the traded quantities of the leg instruments will comply with the round lot size according to the Quantity Scaling Factor of the scaled complex instrument.

Please note that there is no extra instrument type for scaled complex instruments.

> *Configuration Data:*
> *Nodal supports scaled complex instruments for the following complex instrument types: Futures Spreads, Commodity Strips, Inter Product Spreads.*

For the instrument mnemonic, the quantity scaling factor is appended to the instrument mnemonic of the non-scaled complex instrument. For Commodity Strips, a display name is generated appending the quantity scaling factor and the unit of measure, if present.

Example:

Corresponding to the complex instrument AAI AUG27-SEP27 SPD, the instrument mnemonic AAI AUG27-SEP27 SPD 50MW is created for the scaled complex instrument.

Trades in scaled complex instruments are directly decomposed into trades of the related normal simple instruments.

Example:

Scaled complex instrument	Trades in the simple instruments
AAI AUG27-SEP27 SPD 50MW Buy 100@10.0	*AAI AUG27 Buy 100@110.0*
	AAI SEP27 Sell 100@100.0

16. Appendix

This appendix contains detailed descriptions of the design of some special products that are supported by T7.

16.1 TED Spreads – Leg Ratios

Supplementing chapter 8 about Inter-Product Spreads and especially TED Spreads, this appendix describes the calculatory background of the setup of the leg ratios for TED Spreads.

The valuation of the TED spreads is based on the DV01 approach which also determines the leg ratios of the fixed income and short-term interest rate leg of the TED spread.

The leg ratio R^{FI} of the fixed income side is calculated by the following equation:

$$R^{FI} = ROUND\left(R^{ST} \cdot \frac{FN^{ST}}{FN^{FI}} \cdot \frac{\mathrm{m}}{ForModD^{FI}}\right) \qquad (1)$$

The function $ROUND$ is introduced to ensure an integer value of the leg ratio R^{FI}.

Based on equation (1), the following TED spread instrument parameters have to be known upfront:

- leg ratio R^{ST} of the short-term interest side which is assumed to be $R^{ST} = 1$
- future notional FN^{ST} of the short-term interest rate leg; for FEU3, $FN^{ST} = 1\ 000\ 000\ EUR$
- future notional FN^{FI} of the fixed income leg; for FGBS, $FN^{FI} = 100\ 000\ EUR$
- forward modified duration $ForModD^{FI}$ of the fixed income leg
- time span in number of years m covered by the short-term interest rate leg; for the FGBS – FEU3 TED spread, $m = 2$.

The forward modified duration $ForModD^{FI}$ of the fixed income leg refers to the CTD bond in the basket of the corresponding fixed income futures and is given by the following generic equation

$$ForModD^{FI} = \frac{\left(\sum_{l=1}^{m} \frac{CF_l \cdot t_l}{(1 + y_{CTD})^{t_l}}\right)}{PV_{forw}} = \frac{\left(\sum_{l=1}^{m} \frac{CF_l \cdot t_l}{(1 + y_{CTD})^{t_l}}\right)}{prc^{FI} \cdot CV} \qquad (2)$$

with

- m: number of cash flows of the CTD at the contract date of the corresponding fixed income futures instrument
- CF_l for $l = 1, \dots, m$: bond cash flow
- $t_l, l = 1, \dots, m$: bond cash flow period on the contract date of the corresponding fixed income futures
- y_{CTD}: the yield y_{CTD} resulting from the CTD bond forward price
- PV_{forw}: forward price of the corresponding fixed income futures
- CV: conversion factor of the corresponding fixed income futures

The forward price PV_{forw} is given by $PV_{forw} = prc^{FI} \cdot CV$ with the price prc^{FI} and the conversion factor CV of the corresponding fixed income futures.

Taking a FGBS – FEU3 TED spread as an example, typical values of the leg ratio R^{FI} of the fixed income leg is 10 or 11.

In case of a change of the leg ratio R^{FI} as defined by equation (1) because of a change in the forward modified duration $ForModD^{FI}$, a new TED spread instrument with a changed leg ratio R^{FI} is created in the T7 trading platform on short notice and is available for trading in parallel to the already existing TED spread instrument with the unchanged leg ratio.

16.2 Variance Futures

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 lifetime.

> *Set Up Information:*
> *Eurex offers the variance futures product EVAR with the EURO STOXX 50® index as underlying index. See https://www.eurex.com/ex-en/markets/vol/variance-futures for more information.*
> *EEX does not offer variance futures.*

16.2.1 General concept

The overall lifetime of a variance futures instrument is characterized by the number of business days denoted by T, while the elapsed lifetime 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

$$
\begin{aligned}
\sigma_{real}^2(1,t) &= 10000 \times \frac{A}{t} \times \sum_{i=1}^{t} ln^2\left(\frac{S_i^{und}}{S_{i-1}^{und}}\right) \\
&= \frac{t-1}{t} \times \sigma_{real}^2(1,t-1) + 10000 \times \frac{A}{t} \times ln^2\left(\frac{S_t^{und}}{S_{t-1}^{und}}\right)
\end{aligned}
$$

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.

16.2.2 Trading and Clearing

Considering the trading conventions in the OTC variance swap market, the general concept of an on-exchange traded variance futures 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 with one single trading notification with the final trade price in the (P_t, Q_t) clearing notation; the conversion from matched (σ, v)-values into (P_t, Q_t)-values does not depend on the business day t. For on-book trading the calculation uses the last underlying price available at the point in time a match event occurs. For off-book trading, the calculation is based on a user-provided underlying price. The entered price is validated to be within the current intraday daily low and high price of the underlying. The discount factor and the Accumulated Return of Modified Variation Margin is omitted in the conversion. The standard variance σ_0^2 is set to the value 400 for all trading days.
- 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.

16.2.3 Price conversions

Immediately at the event of a trade, the *trade price* is converted as follows:

$$\hat{P}_{\tau\geq 1,t} = \frac{(T-\tau)\cdot\ \sigma_{strike}^2 + \tau \cdot \tilde{\sigma}_{real,t}^2(\tau)}{T} -\ \sigma_0^2 + C$$

where

$\hat{P}_{\tau\geq 1,t}$ = Clearing price (trade price in clearing notation)

σ_{strike}^2 = Volatility strike (trade price in trading notation)

$\tilde{\sigma}_{real,t}^2(\tau)$ = Intraday realized Variance (pertaining to day τ)

σ_0^2 = Standard variance set to 400

C = Clearing price offset

T = Total trading days

τ = Counter of elapsed trading days

For the conversion of on-book trades, the market underlying price is set to the most recent up-to-date underlying price at the time of a trade event. For TES trades, the market underlying price is specified by the initiator of a trade (custom underlying price) and disclosed to the trade counterparties. The custom underlying price must be within the current intraday daily low and high prices of the underlying.

At the end of the day, the *settlement price* is converted as follows. At that time, the intraday realized variance of the day corresponds to the realized variance of the day.

$$\hat{S}_\tau = \frac{T-\tau}{T} \cdot \sigma_{sttl,\tau}{}^2 + \frac{\tau}{T} \cdot \sigma^2_{real}(\tau) - \sigma_0^2 + C$$

where

$\hat{S}_\tau$ = Settlement price in clearing notation (pertaining to day τ)

$\sigma_{sttl,\tau}$ = Settlement volatility (settlement price in trading notation, pertaining to day τ)

$\sigma^2_{real}(\tau)$ = Realized variance (pertaining to day τ)

σ_0^2 = Standard variance set to 400

C = Clearing price offset

T = Total trading days

τ = Counter of elapsed trading days

16.3 Total Return Futures

16.3.1 Total Return Futures Basics

Total Return Futures (TRF) enable participants to hedge risks associated with the total returns of an underlying index, security, or fixed income instrument and the costs associated with the replication of the related underlying cash or basket instruments. The TRF concept used in T7 is designed to align with the OTC total returns market to support hedging between OTC and listed contracts and to provide an on-exchange alternative for the OTC trading. Apart from certain convention changes, the accumulated variation margin payments of a Total Return Futures position replicate the cash flow of a total return derivative position.

Total Return Futures contracts are associated with an underlying. They replicate the daily performance of a Total Return Swap corresponding to the contract expiration. The daily performance depends on the underlying price variation, the daily distribution, the daily payment of a funding rate and the amount contributed by the traded TRF spread.

The buyer of a Total Return Futures is the receiver of the total return (distribution + underlying price movement) and the payer of the funding rate plus the traded TRF spread.

The seller of a Total Return Futures is the payer of the total return (distribution + underlying price movement) and the receiver of the funding rate plus the traded TRF spread.

The exchange can define for a certain ETRF product and per TES type, that TES trades are allowed only as part of a basket.

> *Set Up Information:*
> *On T7, Total Return Futures are traded exclusively on Eurex.*
> *Eurex offers index TRF, fixed income TRF, and equity basket TRF. An example is the equity index Total Return Futures product TESX on the EURO STOXX 50® index with EONIA® as funding rate.*

16.3.2 Trading Notation versus Clearing Notation

Trading of Total Return Futures is done with all prices being expressed in a trading notation. The trading notation of Total Return Futures is an interest rate spread given in basis points, denoted as the TRF Spread. This applies to order limit prices, to trade prices, as well as to published market prices.

However, the clearing system (C7) applies a clearing notation, the traded futures price. T7 thus performs a price conversion before forwarding a trade to the clearing system. Both the trade price in trading notation and the trade price in clearing notation are available to users in the trade information of T7.

Note that in general, prices in trading notation and clearing notation have different tick sizes for the same product.

The dualism of trading notation and clearing notation holds also for settlement prices. In general, for Total Return Futures, the exchange determines settlement prices in trading notation, which are then converted to settlement prices in clearing notation that are applied in the clearing system. The settlement prices in trading notation play a role on the next day in price validations as, e.g., described in the *T7 Functional Reference Part 1*, chapter *Price Reasonability Check*.

The difference between trading notation and clearing notation applies only to prices. For Total Return Futures, there is no difference of the traded quantities between trading notation and clearing notation.

The relation between the trading price and the clearing price depends on conversion parameters like the underlying price (*UL price*) and accrued amounts since the product launch. They are completed by the traded basis calculated from the *TRF Spread* entered by traders as the trading price, as follows:

$$Clearing\ Price\ =\ UL\ price\ +\ Accrued\ Distribution\ -\ Accrued\ Funding\ +\ Traded\ Basis$$

with

$$Traded\ Basis\ =\ UL\ price\ *\ TRF\ Spread\ *\ 0.0001\ *\ (\ Days\ to\ Maturity\ /\ Annualisation\ Factor\ )$$

where

$Clearing\ Price$	is the trade price in clearing notation.
$UL\ price$	is the value of the underlying to be applied, normally the close price of the same day (see following chapters).
$Accrued\ Distribution$	is the accumulated daily distribution since the product launch.
$Accrued\ Funding$	is the accumulated daily funding interest since the product launch.
$TRF\ Spread$	is the trade price in trading notation, an interest rate spread given in basis points (1 bp = 0.0001).
$Days\ to\ Maturity$	is the number of calendar days until the instrument expiration.
$Annualisation\ Factor$	is the number applied in calculations to represent the number of days per year (e.g. 360).

On the morning of every trading day, the exchange determines the Daily Distribution and the Daily Funding, and with that obtains the values for the Accrued Distribution and the Accrued Funding, which are applied on that day.

The *UL price* parameter contains normally the close price of the underlying of that day. As this close price is not yet known during trading hours, a preliminary value is used during the day, and trades are updated later with the actual close price when it becomes available. See chapter 16.3.4 for more details. Alternatively, in off-book trading users may choose to define the *UL price* parameter value themselves, see chapter 16.3.5 Trade-At-Market (TAM).

The calculation parameters are available in real-time in T7's reference data interface and on the T7 Trader GUI. There is furthermore a dedicated report about Total Return Futures parameters.

16.3.3 Split of daily trading session

The daily trading session for a TRF product can be split into a morning and an afternoon session. This allows trading in products, for which the daily interest rate, required to calculate the Accrued Funding, becomes available only during the day.

The morning session will apply to the Accrued Funding taken over from the previous business day which was based on the previous day's interest rate. Between morning and afternoon session, the

Accrued Funding will be updated on the basis of the current day's interest rate, and the afternoon trading session will use the updated Accrued Funding to derive the preliminary clearing prices.

Please note that this procedure applies for Trade-at-Close ("TAC"). To support Trade-at-Market ("TAM"), the respective TRF products can be traded off-book in the morning session where the clearing prices of TAM trades are calculated with the previous day's value of the Accrued Funding and are not updated with the current day's value of the Accrued Funding which is available for TAM trading in the afternoon session.

Set Up Information:
The split of trading session is used for MSCI Total Return Futures, for which the US interest rate is required, which is provided only around 14:00 h CET.

16.3.4 Preliminary Trades and Final Trades

Total Return Futures instruments are defined such that the *UL price* parameter to be applied in the price conversion from the trading notation to the clearing notation is the close price of the underlying on the day of the trade. As normally, this close price is not yet known at the time of the trade, T7 creates a preliminary trade by applying a preliminary *UL price* parameter value. Normally, the close price of the previous day is used for the price conversion of preliminary trades.

Preliminary trades are binding trades with only the final clearing price not being known yet. They are marked as preliminary trades, and they are forwarded to clearing in the same way as normal trades.

Once the underlying close price is known by T7, all preliminary trades are converted to final trades. To this end, the trade prices in clearing notation are recalculated, this time with the actual underlying close price. The finalized trades are marked as such, and they are again forwarded to clearing.

This procedure holds for both on-book trading and off-book trading (block trades).

16.3.5 Trade-At-Market (TAM)

For off-book trading, in addition to block trading of Total Return Futures, T7 offers the TES type TAM (Trade-At-Market), which is exclusively available for Total Return Futures.

Normal block trading of Total Return Futures instruments follows the above-described principles, that trades are understood to be converted with the underlying close price of the same day as *UL price* parameter, and consequently follow the procedure with preliminary and final trades as outlined in chapter 16.3.4.

With a TAM trade, users specify themselves the value of the *UL price* parameter to be applied in the conversion formula, already at the time of the TES trade entry. Consequently, TAM trades do not require a later finalization of the clearing price and are thus not marked as preliminary after entry.

The specified underlying price is validated against a range around the previous day's underlying closing price of the underlying asset. If the specified underlying price is outside this range, the trade entry, modification, amendment, or substitution is rejected.

16.3.6 Corporate Action Handling

For Equity TRF products (ETRF, i.e., Total Return Futures on single stocks), corporate actions on the underlying stock may require a correction of TRF specific parameters. Such a correction is done in the morning before trading starts, after the corporate action has been done (ex-date). The correction is realized through a multiplication of the following previous day's TRF parameters with the applicable R-Factor:

- Accrued Distribution.
- Accrued Funding.
- Underlying Close Price.

16.3.7 TRF Strategies

The instrument type TRF Strategy allows users to define complex instruments with TRF instruments as leg instruments. TRF strategies can be traded on-book and off-book. Available instrument subtypes facilitate calendar spread trading for TRFs or support delta neutral hedging of TRF trades. For more information see chapter 13.

17. Change log

Version	Date	Changes
15.0 Version 1	August 17, 2026	• The T7 Functional Reference has been split into two parts. • 8.4 Pricing of IPS: Configurable leg Ratio values for EEX Spark Spreads and EEX Location Gas Spreads.