

Intraday Operations Agreement – Exhibit 4: High Level Architecture
(including High Level Business Processes)

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**Exhibit 4 to the IDOA – High Level Architecture (including High
Level Business Processes)**

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1 Introduction

This chapter sets out the purpose of this document as well as its contents.

1.1. Contents and purpose of this document

This document is based on the result of the work of the M TF on the pre- and post-coupling processes for the Cross-border Intraday market Coupling. The work started out with generic versions of the High Level Architecture, the Logical model, the business process description and the Business Process Sequence Diagram. The term generic relates to the solution for Shipping and Nomination which was at the time of the design of these documents not yet decided. As an interim solution based on a border per border (option A/A+) solution for shipping and nomination using the principles of the day ahead is now decided, this document consolidates the HLA, the logical model, the business process description and the business process sequence diagram for this solution. It will be updated to reflect the evolution of the thinking of the project of the required high-level architecture and business process. It is a reference document for the project and will continue to be updated as the remaining issues are resolved or other adaptations or changes are agreed.

The objective of the HLA is to ensure that all required system interfaces with the XBID system and all information flows into and out of the XBID system are identified which must be supported by the XBID solution in order to connect all local implementation projects. It is important to note that all interfaces and information flows identified are optional for local implementation projects to the extent that it has been identified that at least one local implementation project needs the indicated interface and information flow. It is then up to each local implementation project to decide which interfaces and information flows are actually needed at the local implementation to deliver a consistent business process. This way, the HLA provides a functionally consistent and complete interface description for the XBID system which should cover the functional interface requirements of each local implementation project.

1.2. An information perspective on the solution

Among the many perspectives possible, the present document adopts one particular perspective on the Solution: that of information flows. This perspective can be labelled the information perspective. At a high level of abstraction, the document tries to answer the five questions below:

1. *Which automated systems* (the 'Systems') play a role in the Solution?
2. *Which human agents* (the 'Agents') play a role in the Solution?
3. *What information is produced* by any of the Systems and Agents in the Solution (only information relevant to the solution is taken into consideration)?
4. *What information is exchanged* between any of the Systems and Agents in the Solution (applying the same restriction as item 3)?
5. In *what sequence* is the information produced by and exchanged between the Systems and the Agents?

Other perspectives on the solution would include the following.

- The legal and governance perspective (concerned with roles and responsibilities, ownership, decision making and legal entities).
- The algorithmic perspective (concerned with the rules applied in the calculation of the market coupling result and other pieces of information).
- The IT perspective (concerned with the design and development of the Systems and the interfaces between them).
- The operational perspective (concerned with the procedures followed to operate the Systems).

These perspectives are not unrelated to the information perspective, but they are different. This document isn't concerned with them directly.

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2 High-level functional architecture and business process

This chapter contains the high-level functional architecture and business process.

2.1. Architecture overview

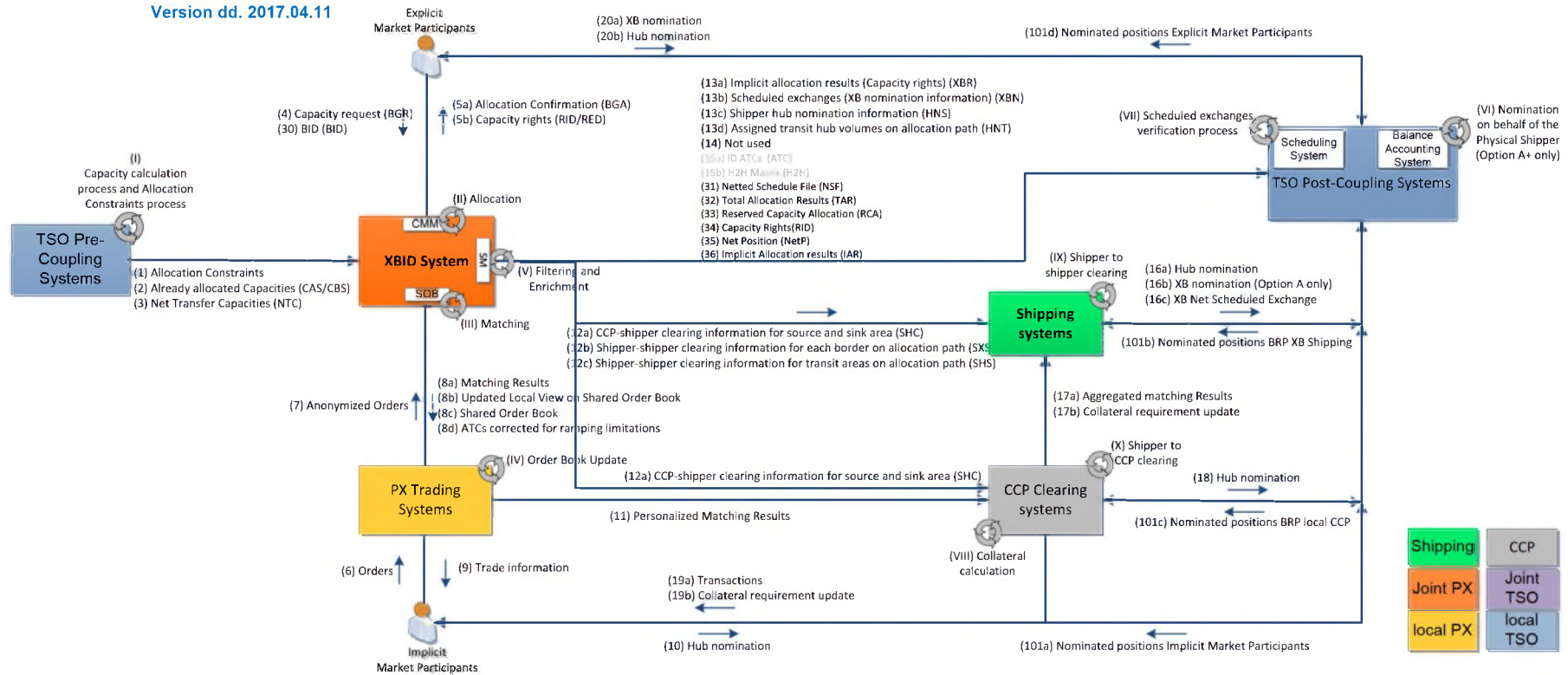
The architecture overview shown below was jointly drafted. It is explained in the following Articles of this chapter, which are devoted to:

- The Systems shown,
- The Processes shown,
- The Agents shown,
- The information produced and exchanged,
- The sequence in which the information is produced and exchanged,
- Several open questions regarding the information flows,
- A glossary, explaining the terms used in the diagram and the remaining text of this chapter.

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XBID - High Level Architecture
Shipping & Nomination Intermediate solution
(option A/A+)
 Version dd. 2017.04.11



DISCLAIMER: All references that could read as entities should be read as functional responsibilities.
Note: Flows labeled with three character abbreviations indicate flows going to/coming from CMM and SM

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2.2. Systems

In the architecture diagram, the automated systems ('Systems') that are expected to play a role in the Solution are indicated with rectangles. These systems may either be existing systems adapted to the Solution or systems to be newly built.

The Systems distinguished are logical or virtual systems. This means, they do not necessarily correspond to single software applications or to dedicated computer hardware. The latter entities belong to the IT perspective. In the information perspective, a System can be thought of as a set of information manipulation functions it is convenient to consider as a separate entity.

The following Systems are distinguished.

TSO Pre-Coupling Systems

The back-end systems of the TSOs involved are grouped together as the 'TSO Pre-coupling System'. This grouping is made on the assumption that these systems each manipulate essentially the same information. The TSO Pre-Coupling Systems support the TSO processes for ID capacity calculation and for determining the intraday capacity allocation constraints.

XBID System

The XBID System largely consists of three separate modules: the Capacity Management Module (CMM), the Shared Order Book (SOB) and the Shipping Module (SM).

Capacity Management Module (CMM)

The CMM keeps track of the available capacity and allocated capacity on each Scheduling Area Border in the coupled area. To this end it maintains a H2H matrix, which is the overview of the available capacity between each pair of hubs. In addition, it allocates capacity in response to implicit and explicit capacity requests.

Shared Order Book (SOB)

The SOB keeps track of the orders in each area and local order book views taking into account available capacities. It also performs the matching of orders across all order books and updates the order books accordingly.

Shipping Module (SM)

The SM contains rules deciding to which shippers any cross-border flow is assigned and filters and enriches the output of the XBID System accordingly before it is sent to the Physical and Financial Clearing systems and the TSO Post-Coupling Systems.

PX Trading Systems

The Trading Systems of the PXs involved are grouped together as the 'PX Trading Systems'. It includes the complementary solution to the XBID solution, used by each PX to support the market activities (optional trading solution or local trading solution). This grouping is made on the assumption that these systems each manipulate essentially the same information.

Among others the PX trading systems provide the following features:

- It shows to its market participants the local view, i.e., the order book that the market participants can view in each area according to the available capacity on the borders.
- It sends the orders (anonymized) to the SOB (XBID solution) received from their market participants. A 'trading solution client' is provided by the PXs to their market participants for their activities on the market (submit orders, receive trade information, etc...).
- It receives the required information from the XBID (matching results, local view, etc...).
- It provides the required information to the market participants and to its clearing system (CCP).

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TSO Post-Coupling systems

Scheduling Systems

The Scheduling systems are the TSO systems to schedule the flows on Scheduling Area Borders and net exchanges for load frequency control, to check consistency with adjacent TSOs on scheduled flows or cross-border nominations as well as to monitor the capacity allocation process.

Balance Accounting Systems

The Balance Accounting Systems are the systems that grant and register grid exchange rights of market parties and transfer of these rights between market parties for energy ownership transfer. The registered rights are compared with actual grid exchanges of the market parties and the difference is subject to imbalance settlement.

In case the transfer of rights is across a Scheduling Area border this requires a cross-border nomination in accordance to allocated capacity rights (or allocated capacities).

Usually the Balance Accounting systems are TSO systems, but in the UK these systems are operated by an independent party. In Austria Hub Nominations are handled by a third party (APCS).

Shipping Systems

The Shipping Systems take care of the physical and financial side of energy ownership transfer between CCPs including cross-border energy ownership transfer. They usually are CCP systems, but this is not necessarily the case, as they may also belong to a third party or a TSO. These systems receive information on power and money flows resulting from the matching in the XBID System. They each take care of the shipping on one or more borders and only need information on the flows across these borders. They are responsible for the information on nomination of these cross-border flows as well as their financial settlement with the CCPs on either side of the border.

CCP Clearing Systems

The CCP Clearing Systems represent the clearing party of the exchange trading and as such settle each transaction on the Local Trading Systems both physically and financially..

2.3. Agents

The Agents are represented in the diagram as abstract human figures.

Just like the Systems are abstract systems, the Agents distinguished are logical or virtual agents. An Agent is a non-automated* entity interacting with one or more Systems or other Agents in the information perspective on the Solution. An Agent is distinguished according to the role he plays. For instance, one human being could appear in the architecture as two different Agents (for instance, 'Operator' and 'Operations Manager' – a distinction not relevant in our solution, but possibly relevant in other solutions). Conversely, hundreds of human beings appear as a single agent ('Implicit Market Participant').

* Note that even if an agent actually is automated, e.g. a trading robot replacing a human trader, it still is an entity different to a System, because it displays behaviour that is not fully predictable (in this example: a trading strategy) in the context of this functional architecture.

The following Agents are distinguished.

Explicit Market Participants

An Explicit Market Participant is a market party that acquires ID capacity rights directly from the XBID System.

Implicit Market Participants

An Implicit Market Participant is an ID trading party on a Local Trading System (i.e. the PX Trading System), which can conclude a trade with an Implicit Market Participant in another area resulting in a cross-border flow of power and money. In such a case the cross-border capacity needed is allocated implicitly by the XBID system to support the transaction between these two Implicit Market Participants.

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2.4. Information produced and exchanged

The information produced and exchanged is represented in the diagram by arrows with a label. The small arrows with Arabic numerals point in the direction of the information flow. The circular arrows with Roman numerals indicate information produced in processes internal to a System. The label indicates the contents of the piece of information transferred or produced. The sequence of production and transfer of information is shown in [Article 2.5](#). The arrows are numbered accordingly.

It should be stressed that only flows of information are shown in the diagram and some of them may be optional in a particular area.

When designing the information flows, two principles have been guiding, which may be in conflict with each other:

- Information is preferably transferred from its original source to its final destination, avoiding additional transfers in between;
- Information is preferably transferred along existing interfaces, avoiding the addition of new interfaces.

Whenever these principles conflicted, the members of the M TF relied on their judgement to pick a solution. The detail regarding the information provided belong may differ throughout the different regions according to their local implementation.

2.4.1. Processes

(I) Capacity Calculation process and Allocation Constraints process

These are the processes that are carried out in the TSOs back-end systems for the purpose of calculating ID capacity and determining Allocation Constraints.

(II) Allocation

This is the process that allocates ID capacity

- a) To explicit market participants
- b) Implicitly to implicit market participants involved in a XB trade for which the matching between the involved orders requires the use of ID capacity on one or more Scheduling Area Borders with ID capacity allocation.

(III) Matching

This is the process that matches ID orders in the shared order book to a successful trade, using available cross-border capacities.

(IV) Order Book Update

This is the process that refreshes the local PXs order book by any change in the shared order book, e.g. change of ATC, matched orders, new or changed orders, etc.

(V) Filtering and enrichment

This is the process that filters the matched orders and allocated capacities on each step in each path of a successful XB trade to the TSO post-coupling systems, PX trading systems and Shipping systems concerned and enriches this information through application of local business rules with information on the shipper for each step in each path.

How much each CCP clearing system on each side of each Scheduling Area Border should receive from/provide to the shipper concerned should be specified in the business rules which are specific for each Scheduling Area Border.

(VI) XB Nomination on behalf of the Physical Shipper

This is the process where the TSOs balance accounting system takes care of the creation of the cross border nomination (on behalf of the Physical Shipper). The cross border nomination is created based on the information received from the XBID system (flow 13b (Scheduled Exchanges)). The XB Nomination on behalf of the Physical Shippers must be done at the latest at nomination gate closure time of the concerned delivery period.

The following local deviations are identified:

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- This might include the internal hub nomination towards the CCP (based on the information in flow 13c). (e.g. Germany)
- Cross border nominations of the Explicit Market Participants can be created on behalf, based on the information received in flow 13 (Explicit allocation Results (capacity rights)), replacing flow 20a (XB nomination). (e.g. Netherlands)

(VII) Scheduled Exchanges Verification Process

For a B2B physical clearing, Explicit and Implicit Allocation Results between the 2 involved Scheduling Areas have to be known by the TSO post-coupling systems. With this information TSOs check bilaterally information consistency between the allocated capacities on each side of the border.

(VIII) Collateral Calculation

This is the process that calculates the collaterals required by the CCP Clearing system to cover its counterparty risk (exposure) with:

- a) The implicit participants
- b) The shipping system.

(IX) Shipper to shipper clearing

This is the process that calculates and executes the financial settlement between two different shipping agents related to the cross-border energy ownership transfer. The financial settlement is created based on the following information received from the XBID system:

- a) flow 12b "Shipper-shipper clearing information for each border on allocation path (SXS)
- b) flow 12c "Shipper-shipper clearing information for transit areas on allocation path (SHS)

(X) Shipper to CCP clearing

This is the process that calculates and executes the financial settlement between a CCP and a shipping agent related to the energy ownership transfer within a hub (in source or sink areas). The financial settlement is created based on the information received from the XBID system: flow 12a "CCP-shipper clearing information for source and sink area" (SHC).

2.4.2. Information flows



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2.5. Sequence in which information is produced and exchanged

Please note that the envisaged sequence of the data flows and processes shown in the HLA is as indicated in the table below.

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ID	Step	Action	Produced by	Sent by	Received by	Predecessor
I	Capacity calculation process and Allocation Constraints process	Production	TSO Pre-coupling systems			-
1	Allocation constraints	Transfer		TSO Pre-coupling systems	XBID System (CMM)	I
2	Already Allocated Capacities (CAS/CBS)	Transfer		TSO Pre-coupling systems	XBID System (CMM)	I
3	Net Transfer capacities (NTC)	Transfer		TSO Pre-coupling systems	XBID System (CMM)	I
4	Capacity Request (BGR)	Transfer		Explicit Market Participants	XBID System (CMM)	1, 2 and 3
II	Allocation	Production	XBID System (CMM)			4 or III
5a	Allocation Confirmation (BGA)	Transfer		XBID System (CMM)	Explicit Market Participants	4 and II
5b	Capacity Rights (RID/RED)	Transfer		XBID System (CMM)	Explicit Market Participants	4 and II
6	Orders	Transfer		Implicit Market Participants	PX Trading Systems	-
7	Anonymized Orders	Transfer		PX Trading Systems	XBID System (SOB)	6
III	Matching	Production	XBID System (SOB)			7
II	Allocation	Production	XBID System (CMM)			III
V	Filtering and Enrichment	Production	XBID System			II or III
8a	Matching results	Transfer		XBID System (SOB)	PX Trading Systems	II and III and V
8b	Updated view on Shared Order Book	Transfer		XBID System (SOB)	PX Trading Systems	II and III
8c	Shared Order Book	Transfer		XBID System (SOB)	PX Trading Systems	II and III
8d	ATCs corrected for ramping limitations	Transfer		XBID System (SOB)	PX Trading Systems	II and III
IV	Order book update	Production	PX Trading Systems			8a
9	Trade information	Transfer		PX Trading Systems	Implicit Market Participants	8a

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10	Hub Nomination	Transfer		Implicit Market Participants	TSO Post-Coupling Systems	9
11	Personalized Matching Results	Transfer		PX Trading Systems	CCP Clearing systems	8a
12a	CCP-shipper clearing information for source and sink area (SHC)	Transfer		XBID System	Shipping Systems	V
12b	Shipper-shipper clearing information for each border on allocation path (SXS)	Transfer		XBID System	Shipping Systems	V
12c	Shipper-shipper clearing information for transit areas on allocation path (SHS)	Transfer		XBID System	Shipping Systems	V
13a	Implicit Allocation Results (Capacity rights) (XBR)	Transfer		XBID Systems	TSO Post-Coupling Systems	V
13b	Scheduled Exchanges (XB-nomination information) (XBN)	Transfer		XBID Systems	TSO Post-Coupling Systems	V
13c	Shipper hub nomination information (SHN)	Transfer		XBID Systems	TSO Post-Coupling Systems	V
13d	Assigned transit hub shipping volumes on Allocation Path(s) (SHT)	Transfer		XBID Systems	TSO Post-Coupling Systems	V
15a	ID ATCs	Transfer		XBID System (CMM)	TSO Post-Coupling Systems	II
15b	H2H Matrix	Transfer		XBID System (CMM)	TSO Post-Coupling Systems	II
16a	Hub Nomination	Transfer		Shipping Systems	TSO Post-Coupling Systems	12a and 12b
16b	XB nomination (option A only)	Transfer		Shipping Systems	TSO Post-Coupling Systems	12a and 12b
16c	XB Net Scheduled Exchange	Transfer		Shipping Systems	TSO Post-Coupling Systems	12a and 12b
17a	Aggregated matching results	Transfer		CCP Clearing system	Shipping Systems	11
VIII	Collateral calculation	Production	CCP Clearing system			11
17b	Collateral Requirement update	Transfer		CCP Clearing system	Shipping System	VIII

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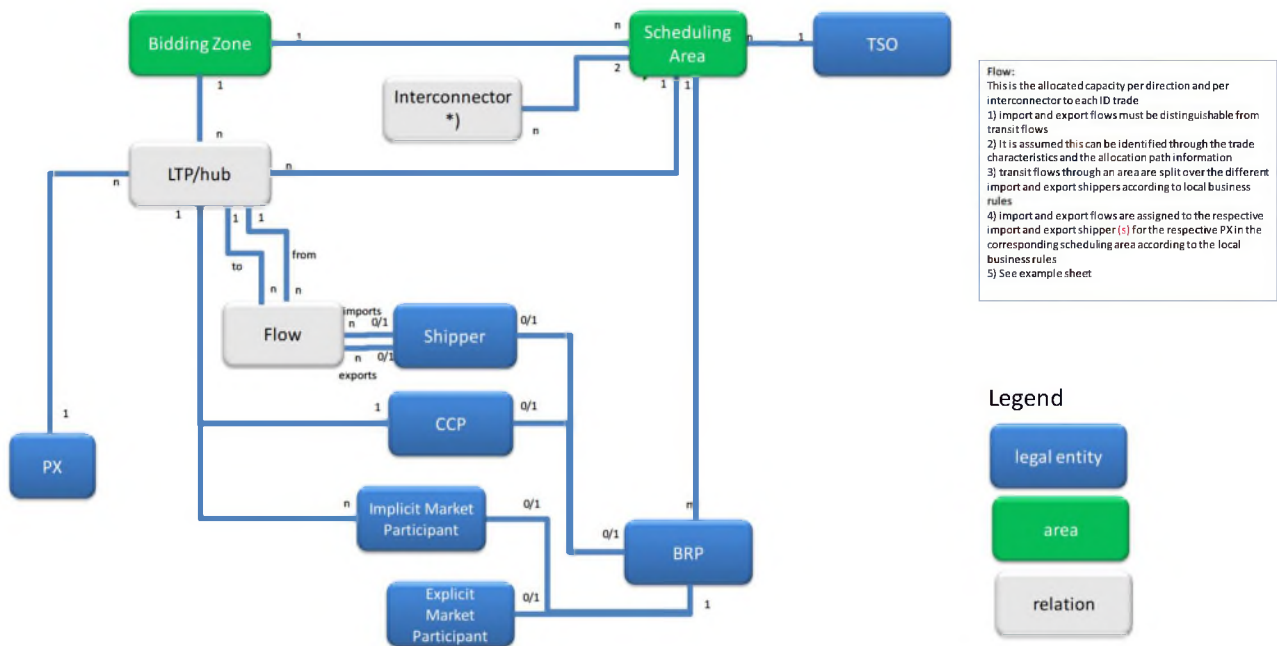
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18	Hub Nomination	Transfer		CCP Clearing system	TSO Post-Coupling Systems	11
VI	XB Nomination on behalf of the Physical Shipper (Option A+ only)	Production	TSO Post - Coupling Systems			13a
VII	Scheduled Exchanges verification process	Production	TSO Post-Coupling Systems			13b
19a	Transactions	Transfer		CCP Clearing system	Implicit Market Participants	11
19b	Collateral Requirement update	Transfer		CCP Clearing system	Implicit Market Participants	VIII
20a	XB Nomination	Transfer		Explicit Market Participants	TSO Post-Coupling System	3b
20b	Hub nomination	Transfer		Explicit Market Participants	TSO Post-Coupling System	3b
IX	Shipper to shipper clearing	Production	Shipping system			12
X	Shipper to CCP clearing	Production	CCP Clearing system			12
101a	Nominated positions Implicit Market Participants	Transfer		TSO Post-Coupling System	Implicit Market Participants	10
101b	Nominated positions BRP Shipper	Transfer		TSO Post-Coupling System	Shipping system	16a, 16b, VI, VII
101c	Nominated positions BRP local CCP	Transfer		TSO Post-Coupling System	CCP Clearing system	10, 16a, 18
101d	Nominated positions Explicit Market Participants	Transfer		TSO Post-Coupling System	Explicit Market Participants	20a, 20b, VI, VII

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2.6. Logical Model

The picture below shows the entity relationship diagram with the required functional entities and their mutual relations. The Glossary provides the necessary definitions.



Flow:
 This is the allocated capacity per direction and per interconnector to each ID trade
 1) Import and export flows must be distinguishable from transit flows
 2) It is assumed this can be identified through the trade characteristics and the allocation path information
 3) transit flows through an area are split over the different import and export shippers according to local business rules
 4) Import and export flows are assigned to the respective import and export shipper(s) for the respective PX in the corresponding scheduling area according to the local business rules
 5) See example sheet



*) Please note that each pair of scheduling areas can have more than one Interconnector

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3 Glossary

There are three relevant families of terminologies. This HLA, [REDACTED] terminology and CACM terminology. Hence this glossary contains a cross-reference between the terms used in the three families.

We agree to use the following HLA term in the functional architecture, in the sense indicated in this glossary. We try to avoid using other terms to refer to the same functional entities.

Related HLA term	[REDACTED]	CACM term	CACM definition	Comment
Algorithm	[REDACTED]	continuous trading matching algorithm	the algorithm used in continuous intraday coupling for matching orders	
Allocation constraints	[REDACTED]	allocation constraints	the constraints to be respected during capacity allocation to maintain the transmission system within operational security limits and have not been translated into cross-zonal capacity or that are needed to increase the efficiency of capacity allocation	
Bidding zone	[REDACTED]			[REDACTED]
Bidding zone border with capacity allocation on separate capacities	[REDACTED]			[REDACTED]
Bidding zone border with capacity allocation on single capacity	[REDACTED]			[REDACTED]
Block order	[REDACTED]	non-standard intraday product	a product for continuous intraday coupling not for constant energy delivery or for a period exceeding one hour with specific characteristics designed to reflect system operation practices or market needs, for example orders covering multiple market time units or products reflecting production unit startup costs	

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Related HLA term	CACM term	CACM definition	Comment
BRP			Balance Responsible Party. This is the Market Party on whose account the grid exchange rights are registered by the TSO balance accounting system as a result of Hub and XB nominations. The registered grid exchange rights are compared to measured grid exchanges of the Market Party and the difference is settled through Imbalance Settlement
Capacity Calculation	coordinated capacity calculator	the entity with the task of calculating cross-zonal capacity, at regional level or above and of managing the validation process of the capacity calculation	
CCP	central counter party	the entity with the task of entering into contracts with market participants, by novation of the contracts resulting from the matching process, and of organising the transfer of net positions resulting from capacity allocation with other central counter parties or shipping agents.	
CMM	capacity management module	a module for the intraday capacity calculation system containing up-to-date information on available cross-zonal capacity for the purpose of allocating cross-zonal capacity	
Flow			This is the allocated capacity per direction and per Scheduling Area Border to each ID trade and import/export shipper pair according to local shipping business rules
Hourly order	standard intraday product	a product for continuous intraday coupling for constant energy delivery and for a period not exceeding one hour	
Hub nomination			The process to submit information to account for exchange of grid infeed or grid withdrawal rights between Balance Responsible Parties within the same Scheduling Area
Import Shipper, Export Shipper	shipping agent	the entity with the task of transferring net positions between different central counter parties	The import and export shipper are assigned per scheduling area and per PX in that scheduling area according to local shipping business rules. The import shipper-export

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Related HLA term		CACM term	CACM definition	Comment
				shipper couple are equivalent to the CACM shipping agent. In the logical model both import and export shipper are contained in the Shipper entity
Interconnector				[REDACTED]
Scheduling Area Border				A border between two scheduling areas having one or more Interconnector(s)
LTP/hub				This is the functional entity of a PX operating in a specific scheduling area
Matching		matching	the trading mode through which sell orders are assigned to appropriate buy orders to ensure the maximisation of economic surplus for single day-ahead or intraday coupling	
Matching results		matched orders	all matched, buy and sell, orders within a trade made by the price coupling algorithm or the continuous trade matching algorithm	
NTC		coordinated net transmission capacity approach	the capacity calculation method based on the principle of assessing and defining ex ante a maximum energy exchange between adjacent bidding zones	
Order		order	an intention to purchase or sell energy or capacity expressed by a market participant subject to specified execution conditions	
Price		clearing price	the price determined by matching the highest accepted selling order and the lowest accepted buying order in the electricity market;	
PX		market operator	the entity with the task of operating or planning to operate a day-ahead market or a continuous intraday market	
		NEMO	a market operator designated by the competent authority to participate in single day-ahead or single intraday coupling	

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Related HLA term		CACM term	CACM definition	Comment
Scheduled Exchange			No equivalent term	an electricity ownership transfer between market participants in two different scheduling areas, for each market time unit and for a given direction
Scheduling area				<p>[REDACTED]</p> <p>[REDACTED]</p> <p>[REDACTED]</p> <p>[REDACTED]</p> <p>[REDACTED]</p> <p>[REDACTED]</p> <p>[REDACTED]</p> <p>[REDACTED]</p>
SOB		shared order book	a module in the continuous intraday coupling system collecting all matchable orders from the NEMOs participating in single intraday coupling and performing continuous matching of those orders	
Trade		trade	one or more matched orders	
XBID Market		single intraday coupling	an implicit cross-zonal capacity allocation mechanism which collects orders for each bidding zone from wholesale market participants and matches them continuously into contracts to deliver electricity while respecting cross-zonal capacity and allocation constraints, and is available in the intraday market timeframe once the day-ahead market allocation process has taken place;	
XBID System		scheduled exchange calculator	the entity with the task of calculating scheduled exchanges	Entity interpreted as functional entity
XB Nomination				The process to submit information to account for exchange of grid infeed or grid withdrawal rights between Balance Responsible Parties across a Bidding zone border (i.e. requiring allocated capacities)
XB Scheduling				The process to submit information to account for exchange of grid infeed or grid withdrawal rights between Balance Responsible Parties across a Scheduling area border

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