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Framework for energy market communications –

Part 102: Energy market model example

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FRAMEWORK FOR ENERGY MARKET COMMUNICATIONS –

Part 102: Energy market model example

FOREWORD

1) The International Electrotechnical Commission (IEC) is a worldwide organization for standardization comprising all national electrotechnical committees (IEC National Committees). The object of IEC is to promote international co-operation on all questions concerning standardization in the electrical and electronic fields. To this end and in addition to other activities, IEC publishes International Standards, Technical Specifications, Technical Reports, Publicly Available Specifications (PAS) and Guides (hereafter referred to as "IEC Publication(s)"). Their preparation is entrusted to technical committees; any IEC National Committee interested in the subject dealt with may participate in this preparatory work. International, governmental and non-governmental organizations liaising with the IEC also participate in this preparation. IEC collaborates closely with the International Organization for Standardization (ISO) in accordance with conditions determined by agreement between the two organizations.
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The main task of IEC technical committees is to prepare International Standards. However, a technical committee may propose the publication of a technical report when it has collected data of a different kind from that which is normally published as an International Standard, for example "state of the art".

IEC 62325-102, which is a technical report, has been prepared by IEC technical committee 57: Power systems management and associated information exchange.

The IEC 62325 series cancels and replaces IEC 62195 (2000) and its amendment (2002). It constitutes a technical revision.

IEC 62195 (2000) dealt with deregulated energy market communications at an early stage. Its amendment 1 (2002) points out important technological advancements which make it possible to use modern internet technologies based on XML for e-business in energy markets as an alternative to traditional EDI with EDIFACT and X12. The new IEC 62325 framework series for energy market communications currently consisting of IEC 62325-101, IEC 62325-102, IEC 62325-501, and IEC 62325-502 follows this direction and replaces IEC 62195 together with its amendment.

The text of this technical report is based on the following documents:

Enquiry draft	Report on voting
57/705/DTR	57/722/RVC

Full information on the voting for the approval of this technical report can be found in the report on voting indicated in the above table.

This publication has been drafted in accordance with the ISO/IEC Directives, Part 2.

IEC 62325 consists of the following parts, under the general title *Framework for energy market communications*:

Part 101: General guidelines

Part 102: Energy market model example

Part 201: Glossary [1]

Part 3XX: (Titles are still to be determined) [2]

Part 401: Abstract service model [3]

Part 501: General guidelines for use of ebXML

Part 502: Profile of ebXML

Part 503: Abstract service mapping to ebXML [3]

Part 601: General guidelines for use of web services [3]

Part 602: Profile of Web Services [3]

Part 603: Abstract service mapping to web services [3]

The committee has decided that the contents of this publication will remain unchanged until the maintenance result date indicated on the IEC web site under "http://webstore.iec.ch" in the data related to the specific publication. At this date, the publication will be

- reconfirmed,
- withdrawn,
- replaced by a revised edition, or
- amended.

A bilingual edition of this document may be issued at a later date.

1 Under consideration. Because the technologies have an inherent own glossary within their standard definitions, this glossary is a placeholder for a glossary for future parts indicated with [2)] including energy market specific terms and definitions.

2 Under consideration. These parts for business content are mentioned for completeness only with a number space as placeholder. They extend the original scope and require an agreed new work item proposal for further work based on an overall strategy how to proceed.

3 Under consideration. These technical parts are mentioned for completeness with provisional title. They extend the original scope and require an agreed new work item proposal for further work.

INTRODUCTION

The market model depends on the market rules of the country or region. An incomplete list may include the legal and regulatory framework, business rules, technical market rules (network access, balance management, schedule management, congestion management), identification schemas of market participants and e-business objects, metering code (service and access to metering values), grid code (operation), distribution code (operation), and load profiles (synthetic and analytical). The model has to comply with these rules and should include all market participants and transactions to allow seamless communication.

This part of IEC 62325 deals with the UMM (UN/CEFACT modelling methodology) modelling of the energy market and its result, the business and information model. The model has been derived but is not identical with those from some existing markets. It serves as an informative *example* for business processes and associated information. For the purpose of the IEC 62325 series, and for reasons of space, the model has been simplified and shortened and is by no means complete. Some descriptions and modelling parts are derived from existing technology independent market models as EDIEL (http://www.ediel.org/), ETSO (www.edi.etso-net.org/, see ETSO Scheduling System (ESS)), ERCOT (http://www.ercot.com/, see Market Guide), VDEW (http://www.strom.de/, see Choice of Supplier). An other approach would be to derive variations and extensions of an existing model from artefacts in a registry/repository and business library.

Where the UML business model workflow is almost completely described, the other workflows are complete only with focus on specific business processes within process areas such as the process planning of scheduling and to some extent the process change of supplier. For simplicity in the collaborations and transactions, only business failures are shown and technical failures and business signals (as acknowledgements on the messaging level) are omitted.

The message content is based on a energy market specific vocabulary which can be shared over messages, business areas and business domains. Note that with the planned market extension of the CIM (Common Information Model, IEC 61970-301) model of the power system, the vocabulary for system operators may be derived in future from the extended CIM acting as a knowledge based market information model. This will be treated in future parts of the IEC 62325 series.

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FRAMEWORK FOR ENERGY MARKET COMMUNICATIONS –

Part 102: Energy market model example

1 Scope

This part of IEC 62325 defines a restricted (see introduction) *example* business model of the electricity market following the Open-edi reference model ISO/IEC 14662. Fundamental to the model is the division of the business transactions into the Business Operational View (BOV) and the Functional Service (FSV) with mapping of services between to ensure independence of the communication technology used.

Because energy markets vary, this model example is only informative. The main purpose of the model is to show how the modelling methodology can be applied to the energy market, and to serve as the base of technology-dependent configuration examples in other parts of the IEC 62325 series.

The model uses the UN/CEFACT modelling methodology UMM based on UML (Universal Modelling Language) for the Business Operational View, but other modeling methodologies may also be used. The modelling is done from the beginning for the whole market and its result is the "business process and information model" which can be taken as the input for the technology-dependent modelling in the design phase of systems and further for the Functional Service View. See IEC 62325-501 and future parts of the IEC 62325 series for this.

2 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

2.1 Generic Open-edi standards

ISO/IEC 14662, *Information technology – Open-edi reference model*

UN/CEFACT *Modelling Methodology (UMM)*, NO90 R10 or higher

UN/CEFACT *Modelling Methodology Meta Model*, NO90 R10 or higher

NOTE Work is in progress at UN/CEFACT regarding the "content" of business information exchange for example as Core Components (UN/CEFACT - Core Components Technical Specification), Core Component Library (CCL, accessible through an registry/repository), Catalogue of Core Components (including industry groups), Common Business Processes, UMM Business Library, XML message design rules (UN/CEFACT – XML Naming and Design Rules (Draft 2004)).

The energy market specific vocabulary can be derived from Core Components or/and an energy market information model.

2.2 Sectorial Open-edi standards

Market modelling based on this implies to some extent sectorial standards. At the moment, no references are given.

3 Terms, definitions and abbreviations

3.1 Terms and definitions

None.

3.2 Abbreviations

BIE	Business Information Entity
BOV	Business Operational View
CC	Core Component (based on BIE)
CIM	Common Information Model
DSO	Distribution System Operator
DUNS	Data Universal Numbering System (North America)
EAN	European Article Number (Europe)
EDI	Electronic Data Exchange
FOV	Functional Service View
ICT	Information and Communication Technology
ISO	Independent System Operator
IT	Information Technology
MIS	Market Identification Schema
UML	Unified Modelling Language
UMM	UN/CEFACT Modelling Methodology
SO	System Operator (Transmission, Distribution)
TSO	Transmission System Operator

4 Market guide

4.1 General

In the following, an informal and conceptual textual description of the electricity market called Market Guide is provided for basic understanding. The description is a not complete example. Real markets may differ. Note that different time intervals are used in energy markets for scheduling and metering.

Figure 1 shows a high-level presentation of the supply chain of energy with basically three main phases: in the *trading planning phase,* energy consumption is forecast and trading is planned. In the *trading operational phase,* energy is traded to meet the forecast, and respective generation resources are allocated. The implementation of the physical energy path from generation over the transmission and distribution network to consumption affords co-ordinated planning of balanced schedules in the *system operation planning phase* for generation, import/export and consumption. In the *system operation operational phase,* energy flows directly from the producer to the customer over the transmission and distribution network. System operation guarantees in this phase that generation meets consumption in real-time (balancing) and that the system is reliable. Many services are needed to support the core processes. In the *settlement phase,* for example, the settlement service provides the means to bill consumption and imbalances. Any imbalance of operation (difference between schedules and metered generation and consumption) is in the financial responsibility of the Balance-Responsible Parties (traders and others).

Additionally, supporting system operation services and energy services are necessary. Each business area has one or more market participants who initiate the business process and/or act as stakeholder responsible for the outcome of it. Exceptions to this are energy services, which may be outsourced and driven by various market participants following the value chain.

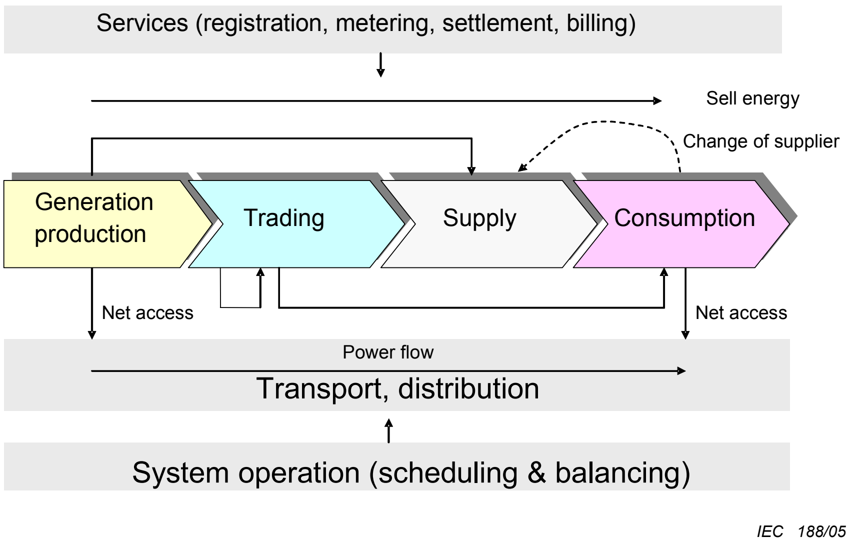

Figure 1 – Value chains and services in the energy market

4.2 Trading

There are two types of trading, bilateral contracts and trading on the spot market (power exchange). Bilateral trading may take place over an intermediate broker. Trading may also include seasonal products. Trading may afford a financial clearing of risks if one party is not able to fulfil the contract.

4.3 Supply

Suppliers represent competitive retailers that sell electricity directly to eligible customers who have the choice of supplier. Suppliers may be retail providers (without own distribution network) or distribution utilities in the role of suppliers. Suppliers will forecast their customer load and negotiate privately with traders to buy energy. Suppliers will communicate the resulting schedules to the transmission system operators (see 4.5).

With supply, many services are associated (see for example 4.6 and 4.7).

4.4 Customer management

The management of customers requires the business processes change of supplier, relocation of customer, metering and access to the metering values, change of meter, contract for new access to the network. Because some business processes are complicated, multi-party collaborations with shared market meta data, some markets have implemented a centralised clearing service for all these business processes within a region.

Suppliers interact with each other and the distribution service provider (providing network access) when they need to submit switching requests, where customers choose a new supplier. The switching requests are processed by working with metering service providers to obtain the initial and final meter reads, confirming switches with customers, and confirming the switch with the relevant suppliers once the switch is approved. Switch confirmations are also sent as notices to customers.

4.5 Scheduling and balancing

Scheduling and balancing of transmission system operators (TSO) follows two business processes: (1) planning of balanced scheduling, (2) operation. The first process involves the following three phases: schedule message validation, balance validation, and system validation.

The TSO is responsible for maintaining the real-time balance of consumption and generation and for the reliability of the electricity system within in its region. The TSO relies on the availability of generation capacity to provide balancing energy to maintain the electric system within allowable reliability limits. The provision of capacity and energy are competitive services that will be provided in the market. Generation units that can be on standby and available to be called upon to provide energy or loads that are available to be interrupted to relieve the need for additional energy may provide these services. These services needed for generation or load resources to ensure reliability are called ancillary services. There are two types of ancillary services: (1) generation reserve available to be used if needed to provide balancing energy or loads available to be interrupted reducing the need for additional capacity and (2) balancing energy to ensure that supply and demand are in balance or loads interrupted to avoid the need for additional energy.

The TSO will continuously monitor the amounts of reserve capacity available across the system to insure against unforeseen events, ranging from differences between scheduled and actual demand to the sudden loss of a generating unit or transmission facility. If the analysis identifies a difference, the TSO will procure a replacement reserve to ensure sufficient capacity to deal with the projected capacity inadequacy or congestion.

As the TSO moves closer to the real-time interval in which the energy will actually be delivered, it will continuously get additional information that improves its ability to forecast system conditions. For instance, as the day-ahead energy schedules are finalised for a given 24-hour period, scheduling entities will submit resource plans for generators that indicate the amounts of:

- Capacity, which is generation capacity that will be readily available if needed, but is not actually delivered to the grid as energy.
- Energy, which is the energy that will be generated and sent to the grid to meet the generators' contracted amounts of load.

After evaluating the effect on the power grid of forecasted loads, schedules, transmission system conditions and resource plans, the TSO will determine how much additional capacity needs to be reserved to assure the TSO will have resources that can provide balancing energy in real-time to maintain reliability. The TSO will procure the needed capacity services to ensure that it is able to serve the scheduled loads as well as relieve loading on transmission lines that appear to be constrained upon a study of the submitted schedules. The TSO will procure balancing energy typically about 10 min before the time of actual power flow, by which time the right amount can be predicted very accurately using short-term forecasting tools.

Replacement reserve ancillary service providers will submit balancing energy bids when they submit their Replacement Reserve capacity bids. Their balancing energy bids will go in the balancing energy bid stacks for the hours for which they were awarded to provide Replacement Reserve capacity service. Ancillary service providers will not, however, bid the capacity that they have sold to the TSO into the market for other capacity services.

The TSO will select and deploy balancing energy in the amount necessary to keep the system in balance and minimise the net energy needed in real time from regulation service providers.

A key feature of the competitive retail electricity market is that it will be based on bilateral transactions between buyers and sellers of energy. Balance Responsible Parties (traders, producers and suppliers) are required to turn into the TSO balanced energy schedules of load and energy required to generate and serve the load. The balance schedules are a result of bilateral trade between load and resource entities. The TSO only operates the electricity market as far as the TSO is needed to mitigate the energy imbalances. This is unlike some other markets, where power generating companies sell electricity into a "pool" and load serving entities (trades, suppliers) purchase from the same "pool" in an exchange where the amount of demand and supply sets market prices for buyers and sellers.

Traders and supplier acting also in the role of traders buying energy and producers selling energy will communicate operational information such as their bilaterally arranged balanced schedules of loads and resources to the TSO through their scheduling entities. The TSO will ensure that the power network can accommodate the schedules that were generated by the bilateral market.

The TSO makes an assessment of the ancillary services needed to accommodate the bilateral schedules and the scheduling entities are asked to either provide their share of these services from their own resources or let the TSO purchase these services from the market on their behalf. Market participants may self-provide all or part of their share of ancillary services. The TSO is uniquely positioned to identify the ancillary services needed to resolve system conditions such as capacity inadequacy and congestion, to maintain reliability, as shown in the previous section.

The TSO, in addition to the activities described above, will help market participants plan and manage their competitive market operations effectively by giving them timely information like forecasts of weather, load, losses, and ancillary services requirements.

For every settlement interval, the TSO will accept balanced schedules from Balance Responsible Parties (traders, producers and suppliers) that identify the source and destination of contracted power flows, as well as their amount and timing. TSO will compare the sum of these schedules to its own load forecasts, to determine balancing energy and ancillary services requirements.

The TSO will work with traders and suppliers to procure ancillary services through a series of markets, which the TSO will operate, and will deploy them as needed to ensure system reliability. If the submitted schedules ultimately result in congestion of the transmission system and the TSO needs to re-dispatch system resources to resolve the congestion, market participants will pay for the re-dispatching or congestion costs.

In order to settle with the balance-responsible parties, the Imbalance Settlement Responsible party will aggregate load and resource data for every settlement interval. He will then calculate the load imbalance as the difference between scheduled and the aggregated load data, to issue the appropriate credits and/or debits to balance-responsible parties. The same comparison is made between aggregated energy supplied from the resources provided by the Balance-Responsible parties and the scheduled energy to allocate the appropriate debits and/or credits due to the resource imbalance.

The TSO will also work with distribution network providers to manage the transmission system. Distribution network providers are also responsible for load and resource meters installation as well as submitting meter data for all loads and resource meters that are not directly polled by the TSO.

The TSO which acts as an ISO (Independent System Operator) may have a central premise clearing system that will facilitate for example the customer switching process (choice of supplier) by transmitting switch requests and meter consumption data between suppliers and distribution network providers and keeping track of the association between premises and suppliers. In the case where there is no central clearing system, the customer switching process is decentralised between the suppliers and the Distribution Network Providers.