

Integration Profile 60870 Transfer Measured Values

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Table of Content

1	About the Document	4
2	Definitions.....	5
3	Integration Profile: 60870 Get Measured Values	6
3.1	Actors/Transactions	6
3.1.1	Actor Descriptions and Actor Profile Requirements	7
3.1.2	Transactions	7
3.2	Actor Options	7
3.3	Information Flow Process.....	8
3.4	Communication Requirements	9
4	Transactions.....	10
4.1	Transaction: Transfer Measured Values.....	10
4.1.1	Scope	10
4.1.2	Actor Roles	10
4.1.3	Referenced Standards	10
4.1.4	Interaction Diagrams	10
4.1.5	Security considerations	13
5	Abbreviations.....	14
6	References	15

1 About the Document

A **Functional Integration Profile** represents a particular technical specification that is integrated into a predefined document structure, a Technical Framework, as specified by IES (Integration the Energy System). The Technical Framework consists of introductory information on the application scenario it is intended for (Volume 1) and all the Integration Profiles and Functional Integration Profiles that specify the application scenario covered (Volume 2), as shown in Figure 1. A Functional Integration Profile, i.e., the specification of the application scenario, comprises a complete section in the second Volume of the Technical Framework, but shall be bundled into common operational Integration Profiles only, as sketched in **Fehler! Verweisquelle konnte nicht gefunden werden..**

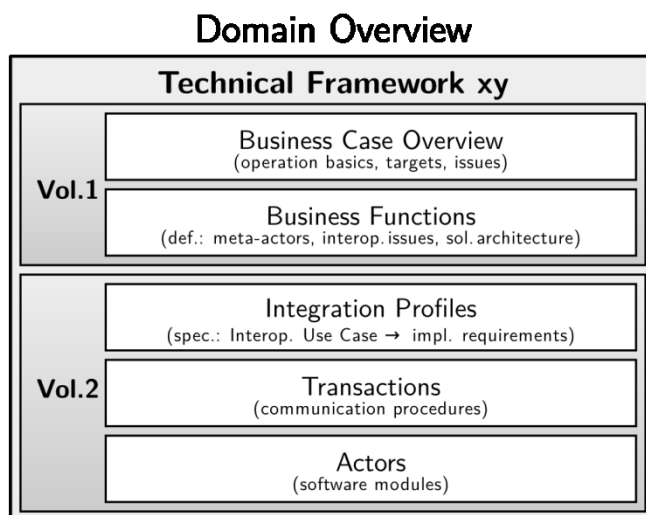


Figure 1: Structure of the IES Technical Framework – with focus on Integration Profiles

Please note that neither a Technical Framework, nor an Integration Profile or its sibling the Functional Integration Profile equal a new standard. This hierarchy of documents rather describes the normalised use and combined application of existing standards and good practices. It is intended to prevent interoperability issues when functionalities and features are implemented as specified by the individual parts constituting a Technical Framework. The individual parts may be reused in other Technical Frameworks to maximise synergies (multiple utilisation of same implementations).

2 Definitions

Actor

is a functional software component of a system that executes transactions with other actors as defined in an Integration Profile.

Business Case

is the economic viable application of an idea or technology.

Business Function

is a feature required to be realised for a Business Case to work.

Conformance Testing

is a standalone process to ensure that the implementation conforms to specified standards and profiles, i.e. the implementations outputs and response are checked against rules and patterns.

Integration Profile

is the specification required to realise a part of a Business Function (or combination thereof) in an interoperable fashion (normalised).

Interoperability Testing

is a process to check whether the system interacts effectively with foreign systems, i.e. when different vendors meet to test their interfaces against each other (e.g. Connectathon).

Interoperability Use Case

is a (part of a) Business Function that relies on data exchange between different actors according to an Integration Profile (i.e. where interoperability is required).

Meta-Actor

is the composition (grouping) of all the functional components (actors) that the Meta-Actor is required to integrate in order to perform all the Business Functions related to it (according to the Use Case Diagram). It could be a human operator, but typically it is a software component embedded in some device that provides an interface to some communication infrastructure.

Transaction

is the specification of a set of messages (1..n) exchanged between at least two actors that realise the Use Case specific information exchange (in one or both directions, in a strict or loose order) as specified by an Integration Profile.

Operational Use Case

is a (part of a) Business Function that describes an activity not involving any data exchange between actors. Operational Use Cases are mentioned in the Technical Framework, but not considered by Integration Profiles because per se they do not raise interoperability problems.

3 Integration Profile: 60870 Transfer Measured Values

The profile “60870 Transfer Measured Values” describes the interoperability issue for the data exchange of measured values of the power grid status from the DEUC or DEUOP to the VPPOP, DEUOP and DSO periodical. The content of the exchanged information depends on the Business Function, have a look at the description provided in Volume 1 of the IES Technical Framework. The format of the exchanged information and the exchange per se are specified by the used standards IEC 60870-5-101 and 60870-5-104. The different communication relations and the used communication standard lead to the following actors-transactions relations in Figure 2. The concrete implementation strategy of the transaction is described in Section 4.

Table 1: Dependencies among Integration Profiles (bundling with external IPs)

Integration Profile	Depends on	Dependency Type	Purpose
60870-5-104 Get Measured Values (GMV)	IHE – Audit Trail and Node Authentication	Each SPS Actor shall be grouped with IHE Secure Node or IHE Secure Application Actor	Required to manage audit trail of exchanged messages, node authentication and transport encryption
60870-5-104 Get Measured Values (GMV)	Establish a secure connection	Each transaction shall be done via a secure TLS 1.2 connection.	Before data exchange can be executed, a secure connection between client and server has to be created.

3.1 Actors/Transactions

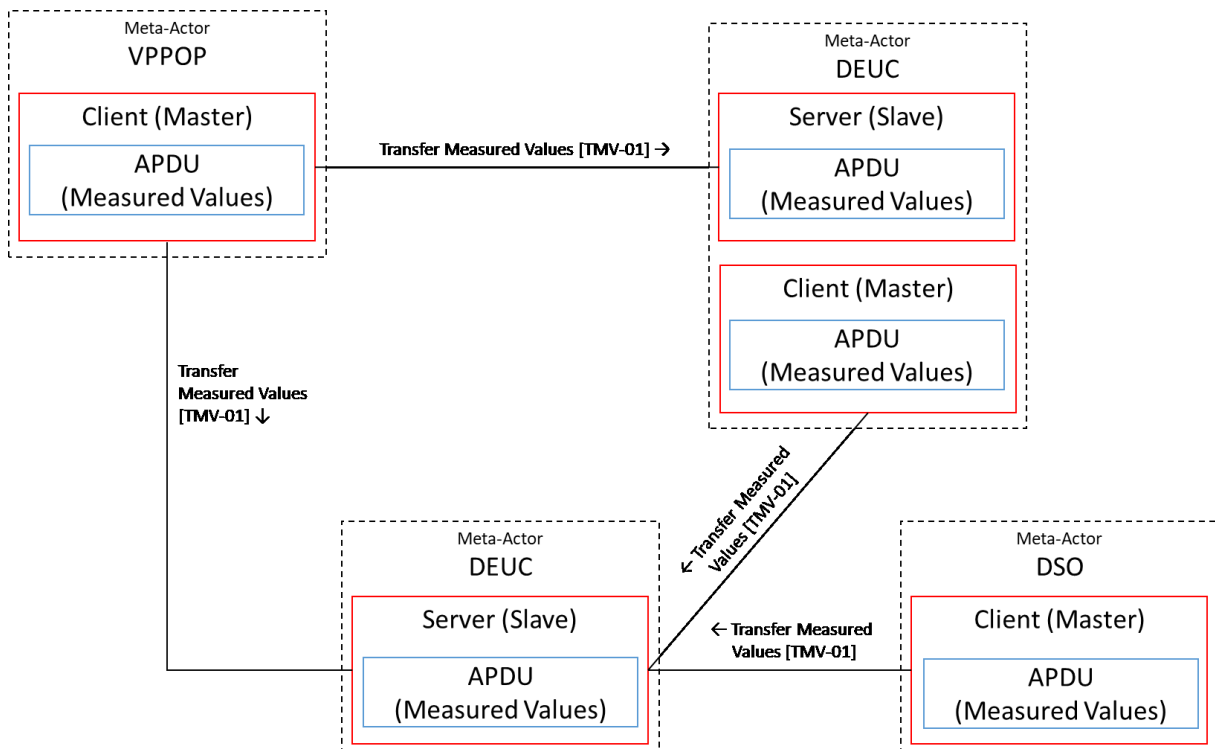


Figure 2: Actors/Transaction Diagram for transferring measured values: The dashed lines represent the grouping of actors into Meta-actors.

Table 2: Transactions for Get Measured Values

Actors	Transaction	Optionality	Section
Client (Master)	Transfer Measured Values [RMV-01]	R	3.1.2.1
Server (Slave)	Transfer Measured Values [RMV-01]	R	3.1.2.1

3.1.1 Actor Descriptions and Actor Profile Requirements

Some of the meta-actors/actors definitions are available in Section 3 of Volume 1.

3.1.1.1 Client

The Client (Master) is the actor that initiates a communication over a TCP channel to the Server (Slave). Either it wants to send some information, or it receives some information. If a TCP channel to the Server (Slave) is not already established, it initiates the connection setup with the Integration Profile “Establish a secure connection” and applies the bundled IHE ATNA Integration Profile to assure secure authorisation, encrypted data transport and adequate logging options. Also, the Client (Master) is now ready to receive data.

3.1.1.2 Server

The Server (Slave) honours the connection request from the Client (Master) by answering the request. The Server (Slave) is now ready to receive and send data. Latter can be the execution of a periodic or trigger-based data exchange to the Client (Master).

3.1.2 Transactions

3.1.2.1 Request Measured Values

The VPPPOP/DEUOP/DSO Client (Master) creates the connection to the Server (Slave) and got measured values from the DEUC Server (Slave) via a secure TLS 1.2 connection. The DEUC transfers the measured values periodical by single information objects described in IEC 60870-5-104 via bit sequences in the ASDU format I (informative) with monitor direction mode. The values for currents, voltages, powers and impedances in a three-phase system are transmitted.

3.2 Actor Options

Options that may be selected for each actor in this profile are listed in Table 3. Afterwards, the options are described and dependencies between options are specified. The actor options for the VPPPOP, DEUOP and DEUC are already described in the Integration Profile “61850 Send Planned Schedule”.

Table 3: Actor Options for Get Measured Values

Actor	Role	Option	Vol. & Section
VPPPOP	Aggregator	Market participant	IP “61850 Send Planned Schedule” Vol. 2, 3.2.1
	Operator (Client (Master))	Plant Operator	IP “61850 Send Planned Schedule” Vol. 2, 3.2.2
DEUOP	Controller (Server (Slave))	DEU Controller	IP “61850 Send Planned Schedule” Vol. 2, 3.2.3
	Operator (Client (Master))	Station Operator	IP “61850 Send Planned Schedule” Vol. 2, 3.2.4
DEUC	Controller (Server (Slave))	DEU Controller	IP “61850 Send Planned Schedule” Vol. 2, 3.2.5
DEU	Technical Unit	Producer	IP “61850 Send Planned Schedule” Vol. 2, 3.2.6

		Consumer	IP "61850 Send Planned Schedule" Vol. 2, 3.2.7
		Storage	IP "61850 Send Planned Schedule" Vol. 2, 3.2.8
DSO	Operator (Client (Master))	Grid Operator	Vol. 2, 3.2.1.1
	Controller (Server (Slave))	Balance Power Controller	Vol. 2, 3.2.1.2

3.2.1.1 Grid Operator

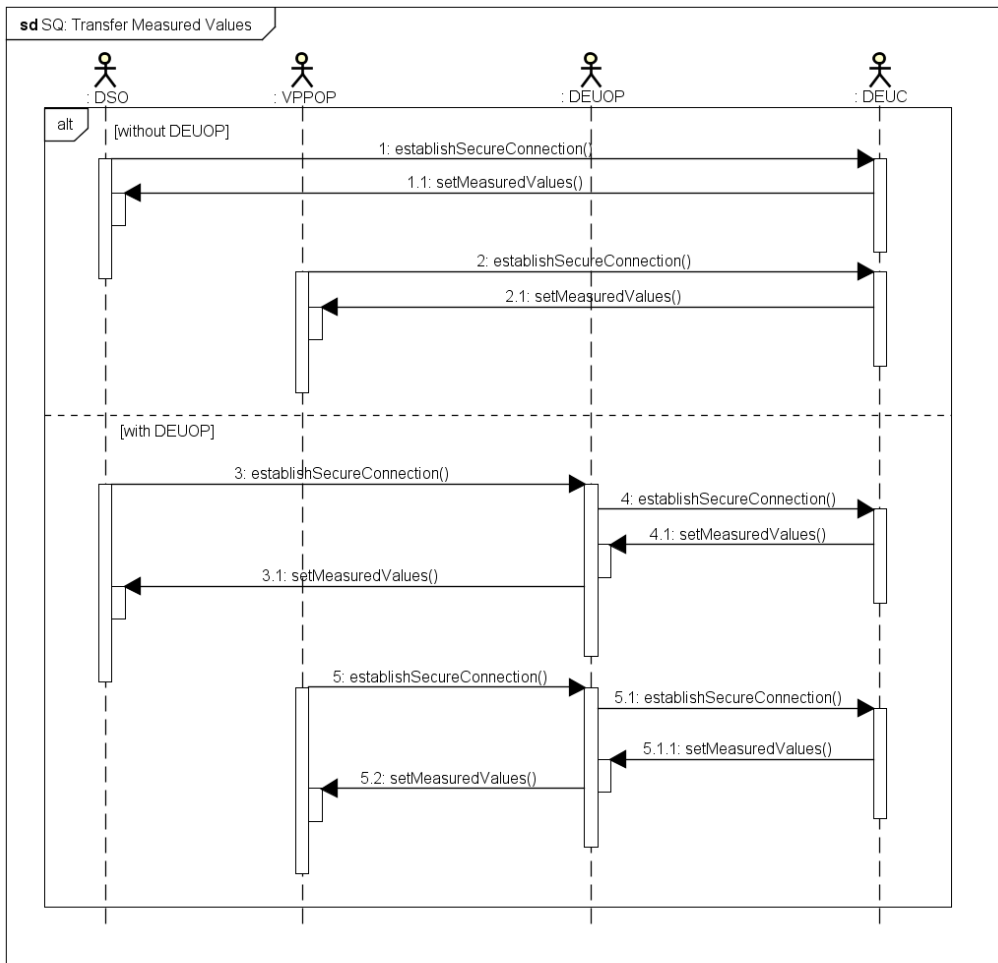
The DSO is responsible for the operation and expansion of the electric power grid that can be used by the energy producer and consumer to transport electricity from the generator to the customer.

3.2.1.2 Balance Power Controller

The DSO has to check the current status of the electric power grid at each time. Therefore, measured values from DEUC are used as well as own measurements and key performance indicators.

3.3 Information Flow Process

The transmission of measured values can be separated in the following two steps "establishSecureConnection" and "setMeasuredValues". The detailed message transmission is summarized in the transaction "Transfer Measured Values". Both steps are executed between the DEUC and the DEUOP/VPPOP/DSO or the DEUOP and VPPPOP/DSO. Messages of the transaction are always the same independent of the involved actors. The detailed description of the transaction, their information objects with exemplary values can be found in Section 4.1.4.2.



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Figure 3: Sequence Diagram for "Transfer Measured Values"

3.4 Communication Requirements

The duration of the data transfer shall be no longer than 5 sec between Client (Master) and Server (Slave). The measured values shall be transmitted periodical each 15 minutes. The communication between the actors shall be carried out in a closed user group with an encoded data transfer [7].

4 Transactions

4.1 Transaction: Transfer Measured Values

4.1.1 Scope

The DEUOP/DEUC provides measured values for the VPPOP/DSO/DEUOP to support these actors in their tasks at the power system. At this point, the interoperability issue is the data exchange for the measured values from the DEUC/DEUOP Server (Slave) to the VPPOP/DSO/DEUOP Client (Master) via a secure connection. Before, the transaction of the data exchange can be executed, the DEUC/DEUOP has to prepare the ASDUs with the information objects which will be transferred as single bit sequences to the DEUOP/VPPOP/DSO.

4.1.2 Actor Roles

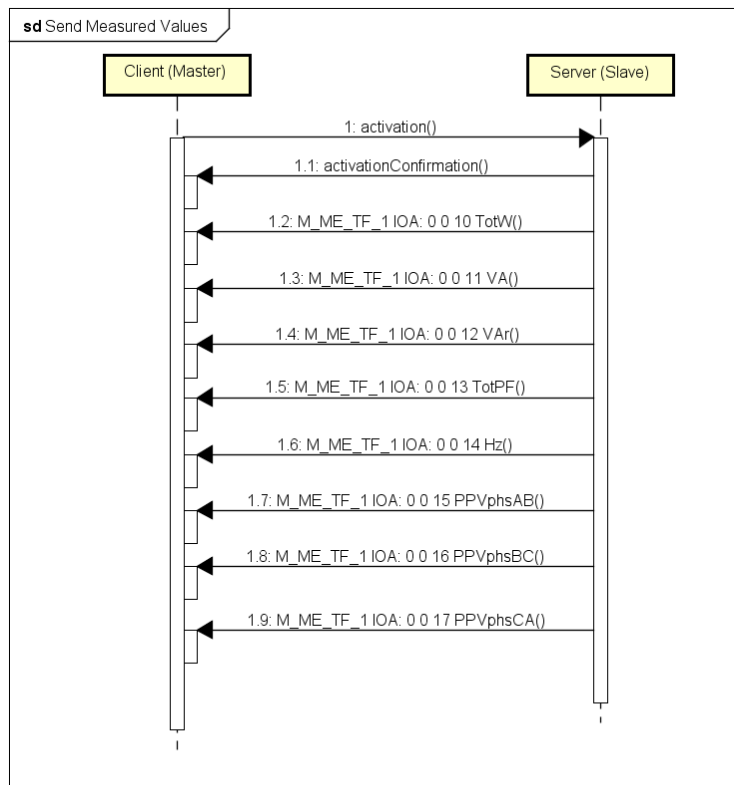
Role	Description	Actor
Client (Master)	The Client (Master) is the transaction initiator that starts and sends or requests the values of the APDU to a receiving server actor via TCP/IP. If specified, the Client (Master) uses the IHE ATNA profile to establish a secured connection before the data transmission actually starts, if it is not already in place.	The following actors may play the role of the Client (Master): VPPOP, DEUOP, DSO
Server (Slave)	The Server (Slave) is the transaction responder that receives the values of the APDU or the request. In case a secure connection is required, it cooperates with the Client (Master) in establishing security.	The following actors may play the role of the Server (Slave): DEUOP, DEUC

4.1.3 Referenced Standards

- IEC 60870-5-101 (coded bit serial data transmission – communication profiles)
- IEC 60870-5-104 (definition of application message types)

4.1.4 Interaction Diagrams

The transaction “Send Measured Values” includes the following steps to transmit measured values from the DEUC/DEUOP Server (Slave) to the VPPOP/DSO/DEUOP Client (Master). Therefore, the Client (Master) shall establish a secure connection, so that the Server (Slave) can periodical transmit the measured values to the Client (Master).



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Figure 4: Data flow for measured values

4.1.4.1 Establish secure connection

A secure connection between Client (Master) and Server (Slave) is established by the functional Integration Profile “Establish a secure connection”.

Triggering Event

The VPPOP/DSO/DEUOP wants to establish a secure connection to a DEUC/DEUOP.

4.1.4.1.1 Message Semantics

Have a look at the specification in “Establish a secure connection”.

4.1.4.1.2 Expected Action

TCP connection has established between VPPOP/DEUOP/DEUC and DEUC/DEUOP. Data transfer via IEC 60870-5-104 is possible.

4.1.4.2 Create message

4.1.4.2.1 Triggering Event

A secure connection between the Client (Master) and Server (Slave) addressed in the APDU has been created or is already established. The Server (Slave) sends the measured values periodical to the Client (Master), so no further trigger is needed.

4.1.4.2.2 Message Semantics

For the data exchange in monitor direction, the Server (Slave) has to create the APDU for the measured values to transmit the following data objects: TotW, TotVA, TotVAr, TotPF, Hz, and PPV to the Client (Master). The APDU structure is shown in Figure 5.

4.1.4.2.3 Expected Actions

The DEUC/DEUOP has prepared the information objects to provide the measured values for the VPPPOP/DSO/DEUOP.

4.1.4.3 Transmit message

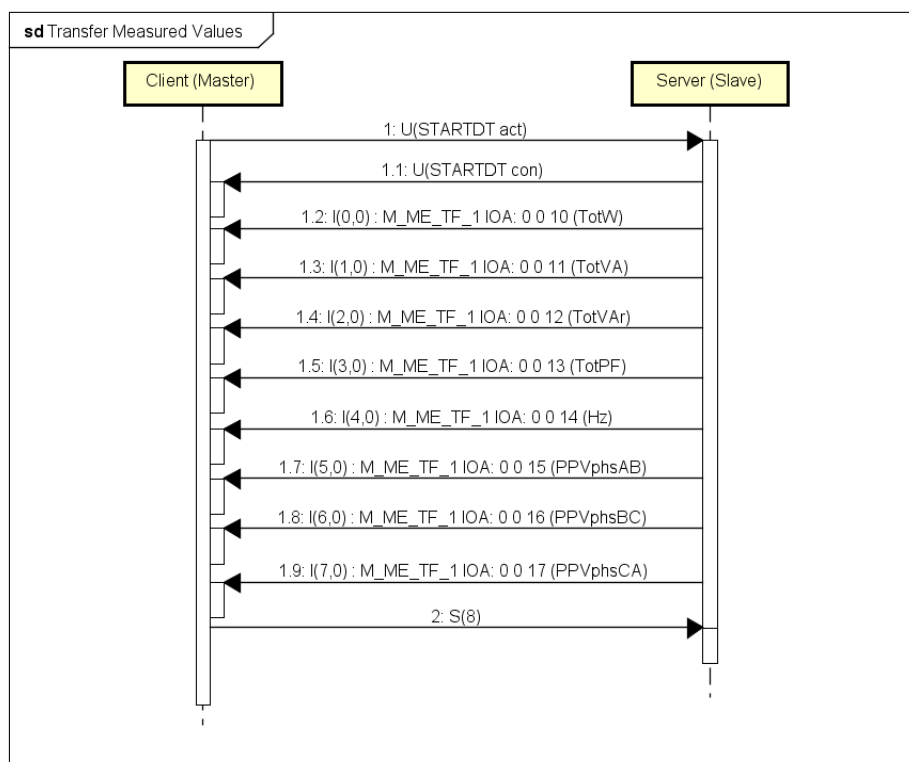
The Server (Slave) transfers the values of the information objects to the Client (Master) via the secure TCP/IP connection that was established in the step 4.1.4.1.

4.1.4.3.1 Triggering Event

The DEUC/DEUOP has prepared the ASDUs for the measured values to transfer these data as bit streams to the VPPPOP/DEUOP/DSO.

4.1.4.3.2 Message Semantics

The data exchanges between the Client (Master) and Server (Slave) with their control fields is shown in Figure 7.



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Figure 7: Transmit Message

4.1.4.3.3 Expected Actions

The VPPPOP/DEUOP/DSO got the measured values and confirms the receipt with a numbered supervisory function (S).

4.1.5 Security considerations

For a secure transmission, a connection via TLS 2 (Transport Layer Security 2) is mandatory (cf. [F_IP Establish-a-secure-connection.docx](#)). Aspects for authentication/authorization and logging as described in the IHE ATNA Profile shall also be considered for this transaction: http://wiki.ihe.net/index.php/Audit_Trail_and_Node_Authentication. The logging should contain parameters of the transmitter, receiver, time-stamp, and status of the transmission (successful or failing). Additional, reasons for the incorrect message transmission can be defined. A concrete schema for the logging still has to be defined. The logging and the schema are specified in the Functional Integration Profile "[Audit Trail Event](#)".

5 Abbreviations

ATNA	Audit Trail and Node Authentication
CDC	Common Data Classes
CIM	Common Information Model
DER	Distributed Energy Resource
DEU	Distributed Energy Unit
DEUC	Distributed Energy Unit Controller
DEUOP	Distributed Energy Unit Operator
DO	Data Objects
DSO	Distributed system operator
FFG	Austria Research Promotion Agency
GMV	Get Measured Values
GOOSE	Generic Object Oriented Substation Events
IEC	International Electrotechnical Commission
IES	Integrating the Energy System
IETF	Internet Engineering Task Force
IHE	Integrating the Healthcare
IP	Integration Profile
ISO	International Organization for Standardization
IT	Information Technology
LAN	Local Area Network
LD	Logical Device
LN	Logical Node
SCSM	Specific Communication Service Mapping
SGAM	Smart Grid Architecture Model
SO	System Operator
TCP/IP	Transmission Control Protocol/Internet Protocol
TLS	Transport Layer Security
UCMR	Use Case Management Repository
VPP	Virtual Power Plant
VPPOP	VPP Operator

6 References

- [1] IEC 60870-5-101: Transmission Protocols - companion standards especially for basic telecontrol tasks
- [2] IEC 60870-5-104: Transmission Protocols - Network access for IEC 60870-5-101 using standard transport profiles
- [3] ISO/IEC 88241: 1999, Information technology – Abstract Syntax Notation One (ASN. 1) ITU X.690 (07/2002), Information technology
- [4] RFC 5246: The Transport Layer Security (TLS) Protocol Version 1.2 – Communication security over the Internet
- [5] IEC 62351: Power systems management and associated information exchange - Data and communications security
- [6] IEC 61850-5: Communication requirements for functions and device models.
- [7] Mindestanforderungen an die Informationstechnik des Anbieters für die Erbringung von Sekundärregelung, VHPready, 2014.