Integration Profile 61850 Send Asset Configurations

Version 00.10

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Document Information	
Title	
Editor	IES Team
Authors	IES Team
Description	
Last Changes	22.06.2018
sClassification	☐ **RED** – Sensible Information, Access only for: ☐ **YELLOW** – Restricted, Access only for: ☐ **GREEN** – for project-internal usage ☒ WHITE – public

Version History			
Version	**Date**	**Changes from**	**Comment**

Acknowledgements
This paper is a result of the IES project funded by the Austrian Climate and Energy Fund, administrated by the Austrian Research Promotion Agency (FFG) under contract number 853693. It has been prepared in the course of work-packages two, three and four to outline the big picture and to identify the different interoperability issues of smart energy systems. The editors would like to thank all the contributing team members of the IES project for their invaluable contribution of knowledge, experience and support toward a better joint understanding of the complexities involved in safe and smart energy systems.

Table of Content

1 About the Document

A **Technical Framework** represents a technical specification, which is integrated into a predefined document structure. Please note that a technical framework does not equal a new standard. It rather describes the normalised use and application of existing standards and practices to avoid interoperability issues. Integration Profiles state constraints/recommendations that define how to apply standards and good practice to realise a specific feature of a Business Function in an important interoperability fashion. The technical framework is embedded in a business domain overview, which is accessible from the project homepage at http://www.iesaustria.at. The concept is based on the IHE technical framework that subdivides a technical framework into two part: volume 1 for an informative and volume 2 for a normative description. This document describes volume 2.

The document structure of the technical framework is as follows:

Volume 1:

- Business Case Overview (informative)
  - Typical use cases
  - Relevant meta-actors
  - Related standards
- Business Functions (informative)
  - Describe the interoperability issues with the IEC 62559 Use Case Methodology
  - Use Case diagrams

Volume 2:

- Integration Profiles (informative and normative)
  - Technical solution for a specific interoperability issue from the Business Function
  - Definition of transactions that are needed
  - Definition of actors that are involved
- Transactions (normative)
  - Specification of actors that shall be implemented
  - Specification of the IT standards and how options/variants shall be used

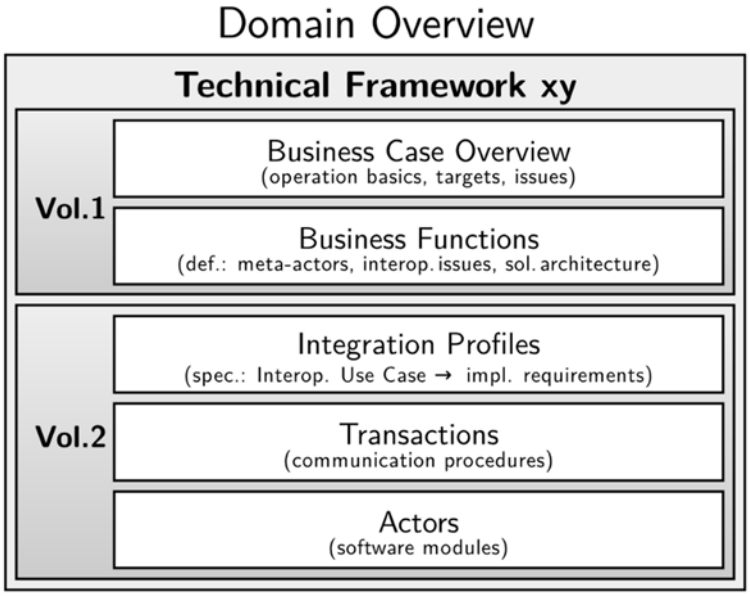


Figure 1: Structure of the Document (IES Technical Framework Template)

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.

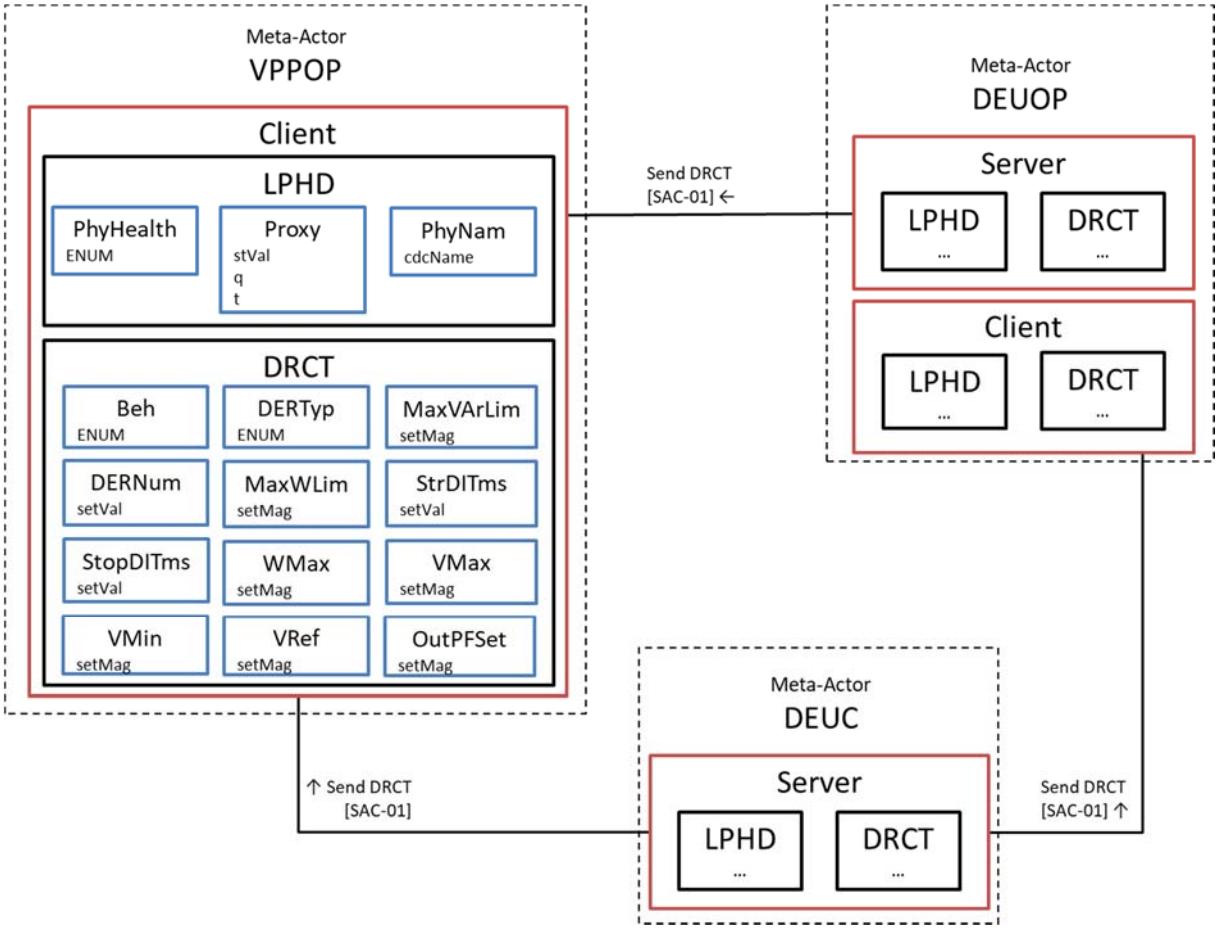
3 Integration Profile: 61850 Send Asset Configurations

The profile “Send Asset Configurations” describes the interoperability issue for exchanging asset information and settings from the Distributed Energy Unit Controller (DEUC) to the Distributed Energy Operator (DEUOP) and Virtual Power Plant Operator (VPPOP). The format of the exchanged information and the exchange per se are specified by the used standard series IEC 61850. The different communication relations and the used communication standard lead to the following actors-transactions relations in **Fehler! Verweisquelle konnte nicht gefunden werden.**, which are introduced in this Section. The implementation strategy of the transactions is described in Section **Fehler! Verweisquelle konnte nicht gefunden werden.**.

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

Integration Profile	Depends on	Dependency Type	Purpose
61850 Send Asset Configurations (SAC)	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
61850 Send Asset Configurations (SAC)	Set/Get 61850 Data Attribute/Object	Each SPS Actor shall transmit data attributes/objects to another actor	Transmitting the content of the LN from client to server or vice versa
61850 Send Asset Configurations (SAC)	Establish a secure connection	Client shall initiate a secure connection with the server.	Communication via a secure path

3.1 Actors/Transactions



Actors	Transaction	Optionality	Section
Client	Send DRCT [SAC-01]	R	
Server	Send DRCT [SAC-01]	R	

3.1.1 Actor Descriptions and Actor Profile Requirements

See the definition of actors in Section 3 of Volume 1.

3.1.1.1 Client

The Client is the actor that initiates a communication over a TPKT channel, being a “Transport Service on top of the TCP (IETF RFC 1006), to the Server. Either it wants to send some information, or it wants to request some information. If a TPKT channel to the Server 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.

3.1.1.2 Server

The Server honours the request from the Client by contributing to the connection setup, receiving the sent message, responding adequately to the received message. The Server either simple receives the sent information or response to a received request. Latter can be the execution of an internal task or replying some information to the Client via message in return.

3.1.2 Transactions

3.1.2.1 Send DRCT

The LNs LPHD and DRCT reflects/holds/represents/provides/mirrors/… the control features, characteristics and capabilities of an IED (Intelligent Electrical Device). The transaction “Send DRCT” specifies the transmission of this information from an IED (i.e., a DEUC/DEUOP) to a controller instance (i.e., a DEUOP/VPPOP). The actual information flow follows after a request from the controller has been received. The client of the VPPOP/DEUOP pulls the data from the server of the DEUOP/DEUC. However, the complete transmission of all the parts of the LN DRCT shall be assured by the entity holding the information because the receiving side has not necessarily the information on which parts it needs to receive. The data representing an IED is commonly stored in a SCD file. This file may be transferred on a physical medium, or, as assumed here, as a Byte-block via a TLS 1.2 encrypted virtual TPKT circuit over TCP/IP.

3.2 Actor Options

The actor options for the VPPOP, DEUOP and DEUC are already described in the Integration Profile “61850 Send Planned Schedule”.

3.3 Information Flow Process

The transmission of an IED configuration from the server to the client is achieved by a sequence of transaction steps, as exemplarily shown in **Fehler! Verweisquelle konnte nicht gefunden werden.**. The detailed process flow is shown in **Fehler! Verweisquelle konnte nicht gefunden werden.** and the detailed specification of the steps, i.e., transferred data objects and common data classes used per step, can be found in Section **Fehler! Verweisquelle konnte nicht gefunden werden.**.

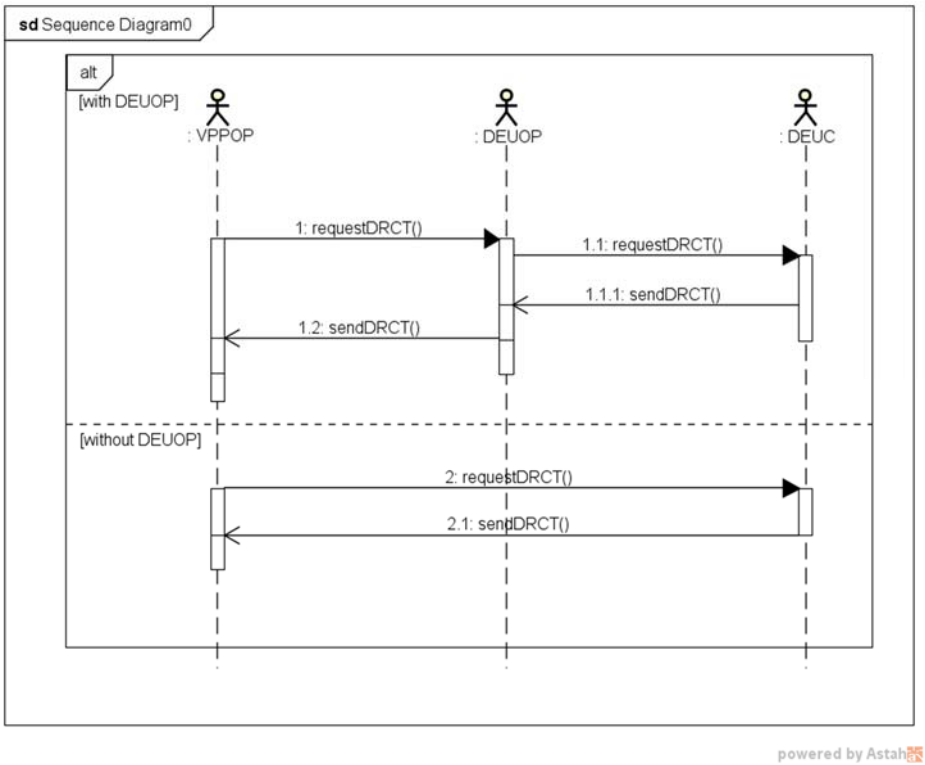


Figure 2: Sequence Diagram for "Send DRCT"

3.4 Communication Requirements

The message type within the Integration Profile “Send Asset Configurations” is a low speed message (Type 3, cf. IEC 61850-5). The message contains complex messages that shall be time-tagged. This message type should be used for slow speed auto-control functions, transmission of event records, or reading or changing set-points. The transmission delay shall be less than 500 ms with TCP/IP, such that time-tagged asset configurations may belong to this type. The transmission is not time-critical for a VPP that participates on the Energy Exchange based on previous day advertisements.

To utilize real-time communication GOOSE embeds information directly into Ethernet frames, skipping the random delay burdened TCP/IP layers. This is a different method that can be used within the reach of a LAN. Only, assumed impractical for typical VPP scenarios.

4 Transactions

4.1 Transaction: Send DRCT

4.1.1 Scope

Before a VPP can interact at the electric energy market and power system, the VPPOP has to group DEUs to a VPP together. For the VPPOP as a plant operator, it is important to know the settings of each single DEU to organize schedules and the general participation at the electric energy market as well as the power grid to supply or consume energy. At this point, the interoperability issue is the data exchange from the DEUC to the DEUOP/VPPOP to share their settings via a secure connection. Before, the transaction of the data exchange can be executed, the DEUC has to create the message and transfers the values to the SCD file of the VPPOP/DEUOP.

4.1.2 Actor Roles

Role	Description	Actor
Client	The client is the transaction initiator that starts and sends or requests the values of the SCD file to a receiving server actor via TCP/IP. If specified, the client 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: VPPOP, DEUOP
Server	The server is the transaction responder that receives the values of the SCD file or the request. In case a secure connection is required, it cooperates with the client in establishing security.	The following actors may play the role of the server: DEUOP, DEUC

4.1.3 Referenced Standards

- IEC 61850-7-420 (logical nodes)
- IEC 61850-7-2 (data objects, services)
- IEC 61850-5 (protocol requirements)
- IEC 62351 – TLS 1.2

4.1.4 Interaction Diagrams

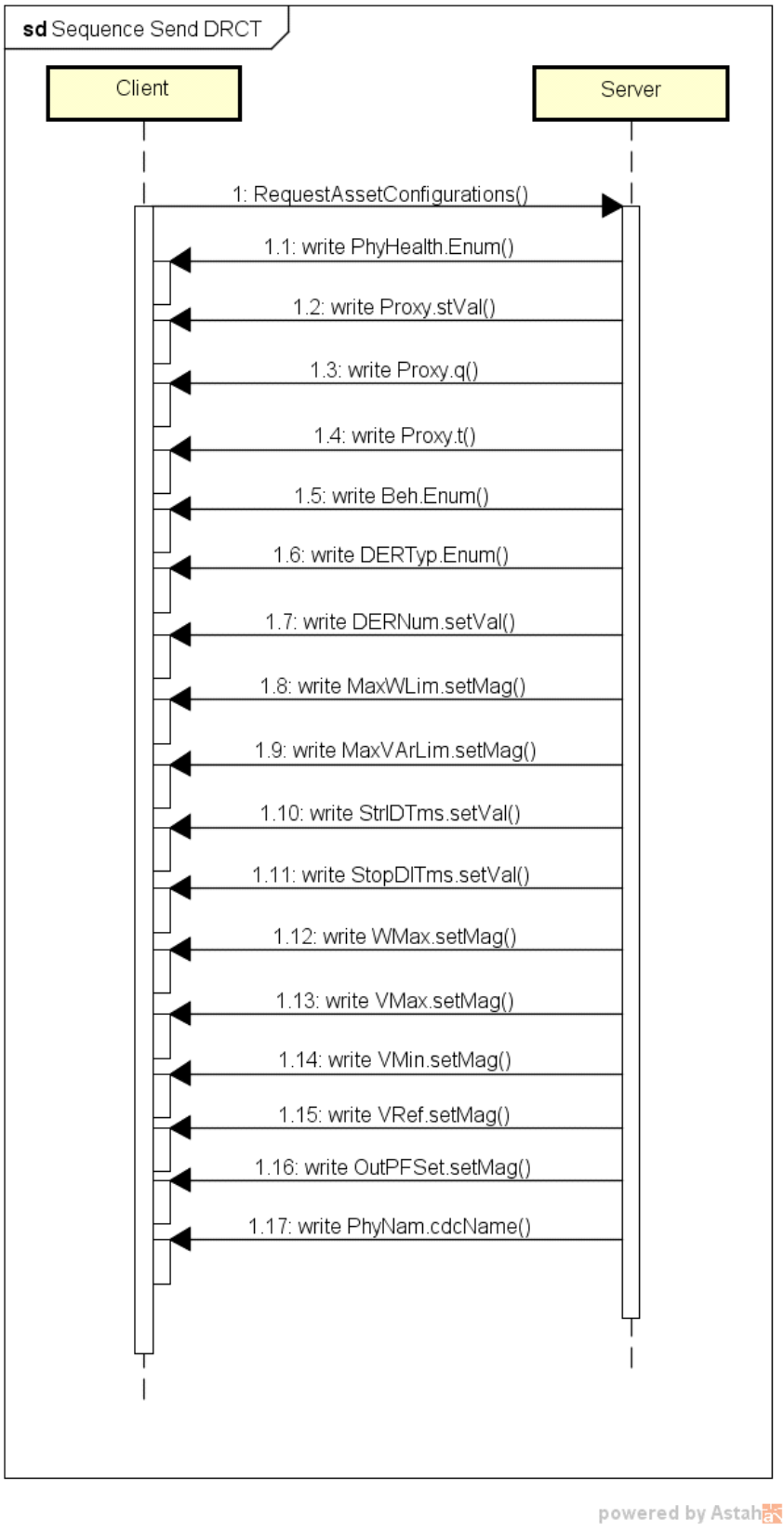


Figure 3: Data flow for Send DRCT

4.1.4.1 Establish Secure Connection

A secure connection between client and server is established by the functional Integration Profile “Establish a secure connection”.

4.1.4.2 Request asset configurations

4.1.4.2.1 Triggering Event

The VPPOP/DEUOP wants to group DEUC together for a common operation on the energy market; therefore, it requests asset configuration from a DEUC.

4.1.4.2.2 Message Semantics

The VPPOP/DEUOP client requests the values for the data objects LPHD$PhyNam, LPHD$PhyHealth, LPHD$Proxy, DRCT$Beh, DRCT$DERNum, DRCT$DERTyp, DRCT$MaxWLim, DRCT$MaxVArLim, DRCT$StrDITmp, DRCT$StopDITmp, DRCT$WMax, DRCT$Vmax, DRCT$VMin, DRCT$VRef, and DRCT$OutPFSet via the secure TCP/IP connection from the DEUC server.

4.1.4.2.3 Expected Action

The DEUC got the request from the VPPOP/DEUOP.

4.1.4.3 Create message

4.1.4.3.1 Triggering Event

The client triggers the server to receive the SCD file. A secure connection between the client and server addressed in the SCD file has been created or is already established.

4.1.4.3.2 Message Semantics

Table 2: LPHD & DRCT Data Objects

Logical Device	**Logical Node**	**Data Object**	**Common data class**	**Data Attribute**	**Functional Constraint**	**Description**
DEUC / DEUOP / VPPOP	LPHD	PhyNam	DPL	cdcName	EX	Name of the physical device. Details are written in IEC 61850-7-1.
		PhyHealth	ENS	EnumType	ST	The current health status of the device. Its status can be: Ok, Warning, or Alarm.
		Proxy	SPS	stVal	ST	Indicates if the LN is a proxy, i.e. stVal is only a Boolean.
				q	ST	Quality of the proxy
				t	ST	TimeStamp of the proxy
	DRCT	Beh	ENS	EnumType	ST	The current status of the logical device. Its behaviour can be: on, on-blocked, test, test/blocked, or off.
		DERNum	ING	setVal	SP	Number of DER units connected to the controller
		DERTyp	ENG	EnumType	ST	Type of DER unit: virtual or mixed DER, reciprocating engine, fuel cell, photovoltaic system, combined heat and power, unknown, other.

		MaxWLim	ASG	setMag	SP	Analogue value for the nominal max output power
		MaxVArLim	ASG	setMag	SP	Analogue value for the nominal max output reactive power
		StrDITms	ING	setVal	SP	Nominal time delay before starting or restarting
		StopDITms	ING	setVal	SP	Nominal time delay before stopping
		WMax	ASG	setMag	SP	Analogue value for the setting for maximum active power and reference value for functions
		VMax	ASG	setMag	SP	Analogue value for the setDERpoint for maximum voltage
		VMin	ASG	setMag	SP	Analogue value for the setpoint for minimum voltage
		VRef	ASG	setMag	SP	Analogue value for the reference voltage for functions using grid voltage as input
		OutPFSet	ASG	setMag	SP	Analogue value for the setpoint for maintaining fixed power factor.

The SCD file has to contain at least the following LN type for implementing the transaction:

```
<LNodeType desc="DER controller characteristics" lnClass="DRCT" id="DRCT">
        <DO desc="Behaviour" name="Beh" type="ENS_BehaviourModeKind"/>
        <DO desc="Name plate" name="NamPlt" type="LPL_lnNs"/>
        <DO desc="Number of DER units connected to controller or number of units connected to an ECP"
name="DERNum" type="ING"/>
        <DO desc="Type of DER unit managed by controller or connected at the ECP" name="DERTyp"
type="ENG_DERUnitKind"/>
        <DO desc="Nominal max output power at controller or ECP" name="MaxWLim" type="ASG"/>
        <DO desc="Nominal max output reactive power at controller or ECP" name="MaxVArLim" type="ASG"/>
        <DO desc="Nominal time delay before starting or restarting" name="StrDITms" type="ING"/>
        <DO desc="Nominal time delay before stopping" name="StopDITms" type="ING"/>
        <DO desc="Setting for maximum active power and reference value for functions" name="WMax"
type="ASG"/>
        <DO desc="Setpoint for maximum voltage" name="VMax" type="ASG"/>
        <DO desc="Setpoint for minimum voltage" name="VMin" type="ASG"/>
        <DO desc="Reference voltage for functions using grid voltage as input" name="VRef" type="ASG"/>
        <DO desc="Setpoint for maintaining fixed power factor" name="OutPFSet" type="ASG"/>
</LNodeType>
```

The SCD file header and the values of the LN types are available in the prior transaction “Send FSCH” (see Section **Fehler! Verweisquelle konnte nicht gefunden werden.**) or in the IEC 61850-7-3 standard.

4.1.4.3.3 Expected Actions

The server updated its SCD file.

4.1.4.4 Transmit message

The server writes the values to the SCD file of the client via the secure TCP/IP connection that was established in the step 4.1.4.1. The data transmission is specified in the functional Integration Profile Set/Get 61850 Data Attribute/Object.

4.1.5 Security considerations

For a secure transmission, a connection via TLS 2 (Transport Layer Security 2) is mandatory (cf. **Fehler! Verweisquelle konnte nicht gefunden werden.**). Aspects for authentication/authorization and logging as described 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
DRCT	LN: DER Controller
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
MMS	Manufacturing Message Specification
SCD	Substation Configuration Description
SCL	Substation Configuration description Language
SCSM	Specific Communication Service Mapping
SGAM	Smart Grid Architecture Model
SO	System Operator
TCP/IP	Transmission Control Protocol/Internet Protocol
TLS	Transport Layer Security
TPKT	Transport Packet
UCMR	Use Case Management Repository
VPP	Virtual Power Plant
VPPOP	VPP Operator

6 References

[1] IEC, “IEC 61850-7-420 -Communication networks and systems for power utility automation - Part 7-420: Basic communication structure - Distributed energy resources logical nodes.” .

[2] IEC, “IEC 61850-7-4 Edition 2.0 - Communication networks and systems for power utility automation - Part 7-4: Basic communication structure - Compatible logical node classes and data object classes.” 2016.

[3] IEC, “IEC 61850-8-1: Communication networks and systems in substations - Part 8-1: Specific Communication Service Mapping (SCSM) - Mappings to MMS (ISO 9506-1 and ISO 9506-2) and to ISO/IEC 8802-3.” 2004.

[4] ISO/IEC 88241: 1999, Information technology – Abstract Syntax Notation One (ASN. 1) ITU X.690 (07/2002), Information technology

[5] RFC 5246: The Transport Layer Security (TLS) Protocol Version 1.2 – Communication security over the Internet

[6] IEC 62351: Power systems management and associated information exchange - Data and communications security

[7] IEC 61850-5: Communication requirements for functions and device models.