aan Ontvangers

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Accompanying letter

Specification use case DALI-box

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1 Introduction

1.1 Purpose

This document supports the DALI-specification (refer Annex 3, 4 and 5). The main purpose is to describe the right context for the specifications.

1.2 Grid topology

The figure below shows a schematic illustration of the distribution grid of Enexis. The type of substations which is applicable for this tender is marked.

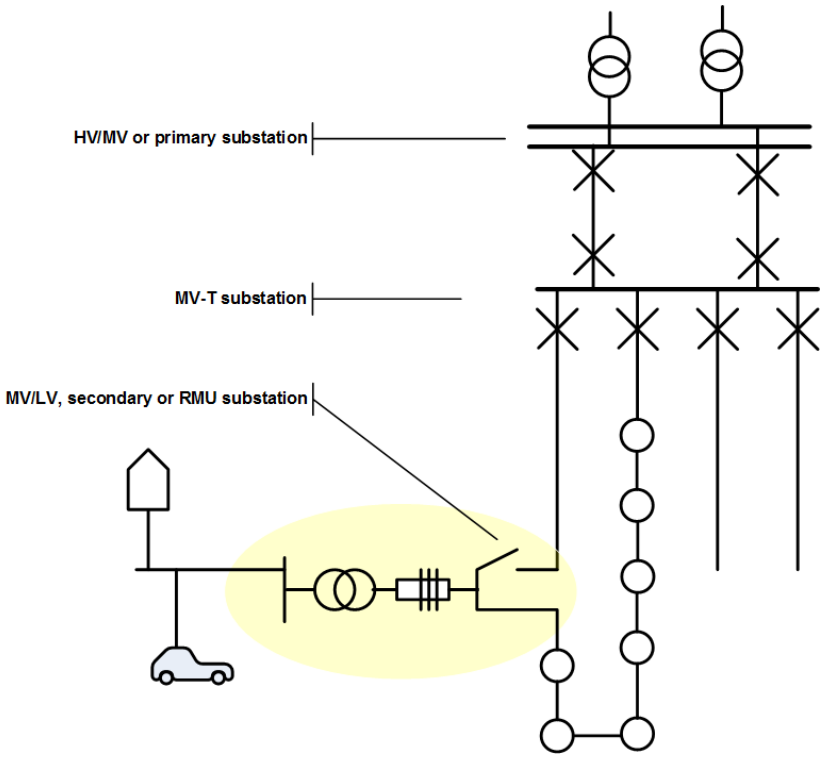


Figure 1: Schematic illustration of DALI Secondary Substations in Enexis Distribution Grid.

1.3 Need for tender

Enexis intends to furthermore smarten its secondary substations. This plan is a next wave in its Distribution Automation strategy and complementary to previously tendered DA MV-D boxes (strategic positions in MV-D grid; in general 3 out of average 20 secondary substations). As the needed functionality for automating is less compared to the previous DA MV-D tender, this program is called Distribution Automation Light or abbreviated DALI.
In order to achieve this automation strategy a contract for DALI-boxes is needed.
To be able to validate return on investments, to reduce risks and to optimize automation solutions if relevant, the total need for DALI-boxes (approx. 30.000; no rights can be derived from this figure) will be divided into two or more tenders which will be published during upcoming years.

Prior to this tender a DALI pilot has been performed during the 4th quarter of 2015. Information regarding this pilot is made available over www.enexis.nl/DALI. Please be aware that requirements in this tender differ substantially compared to the mentioned pilot and the link should only be used for informational purposes. No rights can be derived from the publications.

1.4 Application description

The purpose of DALI-boxes is to facilitate below mentioned use-cases:

- Remote control of Public Street Lights and Tariff signals (alternative for actual Ripple Control solution)
- Remote monitoring Load management and subsequent gridanalitics
- Remote monitoring Short circuit indicators for SAIDI-reduction

A schematic of the DALI-box is visualized in figure 2.

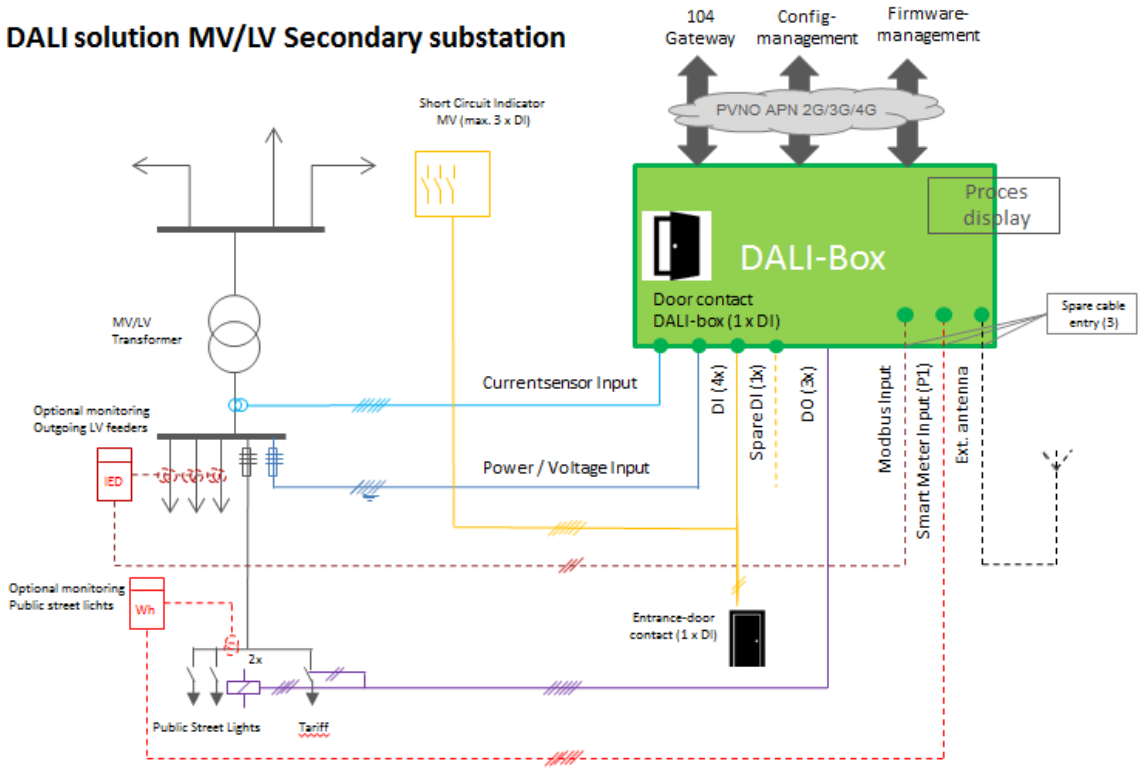


Figure 2: DALI-box in secondary substation

1.5 IT/OT-domain

The DALI-boxes are positioned inside Enexis secondary substations. The IT/OT-domain in which the DALI-boxes will operate is visualized in figure 3.

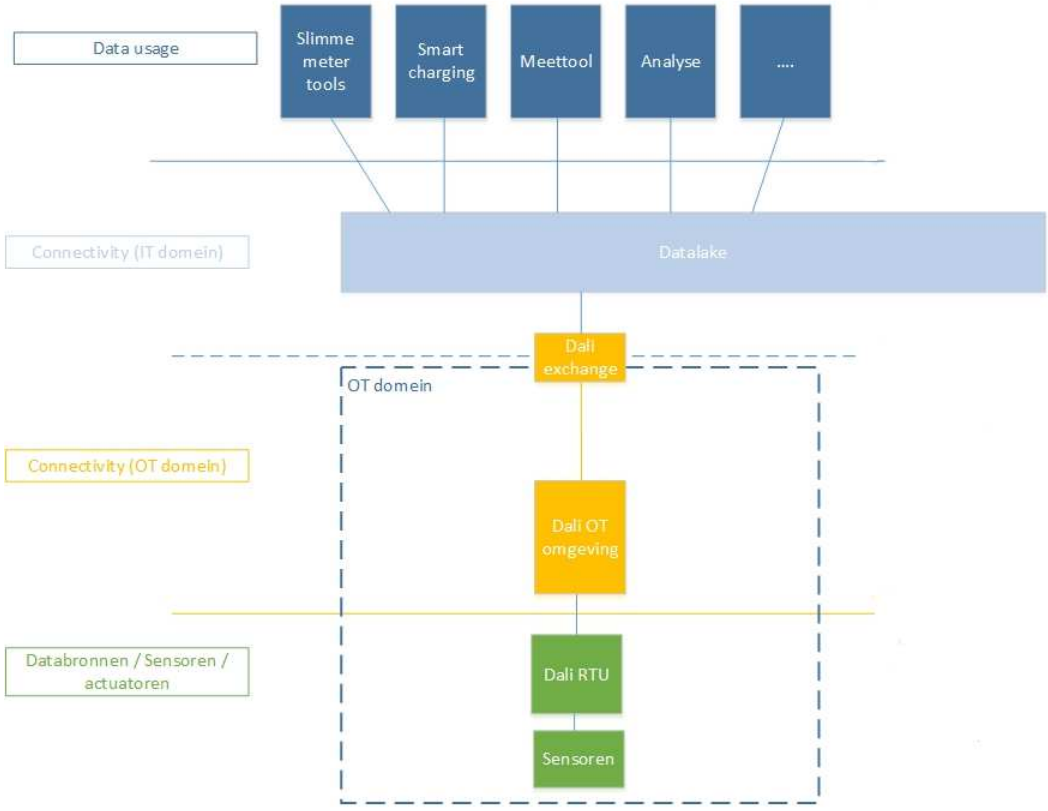


Figure 3: IT/OT domain DALI

1.6 Processes and responsibilities

This paragraph describes the process of standardization, implementation and the roll-out process with the following actors:

- **Asset Management:** Adapting standards and providing forecasts
- **Engineer E&A:** Preparing the projects and (internally) ordering the needed products
- **Grid Automation:** Responsible for the (remote) configuration of DALI-boxes, the communication between the substation and the central OT systems.
- **Procurement:** Responsible for forecasts, contracts, warranty, etc.
- **Logistics:** Responsible for supply chain management and stock levels in Enexis distribution center located in the cities Best and Hoogeveen.
- **Core-users:** Contact for technical issues and more complex questions that cannot be solved by Commissioning engineers.
- **Commissioning engineer:** Responsible for commissioning DALI-boxes.
- **Supplier:** The providing party for DA-boxes

1.6.1 Standardization and implementation

After selection of one supplier the standardization and implementation process will start. First the products to be delivered will be finalized. Also the system-engineers (Grid automation department) will follow a training in order for them to understand the functionality of the used products/components in basic, can engineer and commission systems, can manage security-, firmware en software-patches and are able to perform a basic fault diagnosis independently. After soft- and hardware is completely standardized and central configuration-systems are installed, the implementation will start. For implementation-purposes ≤16 core users (field staff) will be trained to commission and maintain the DALI boxes. Core users will finally transfer their knowledge to a broader group of internal field technicians.

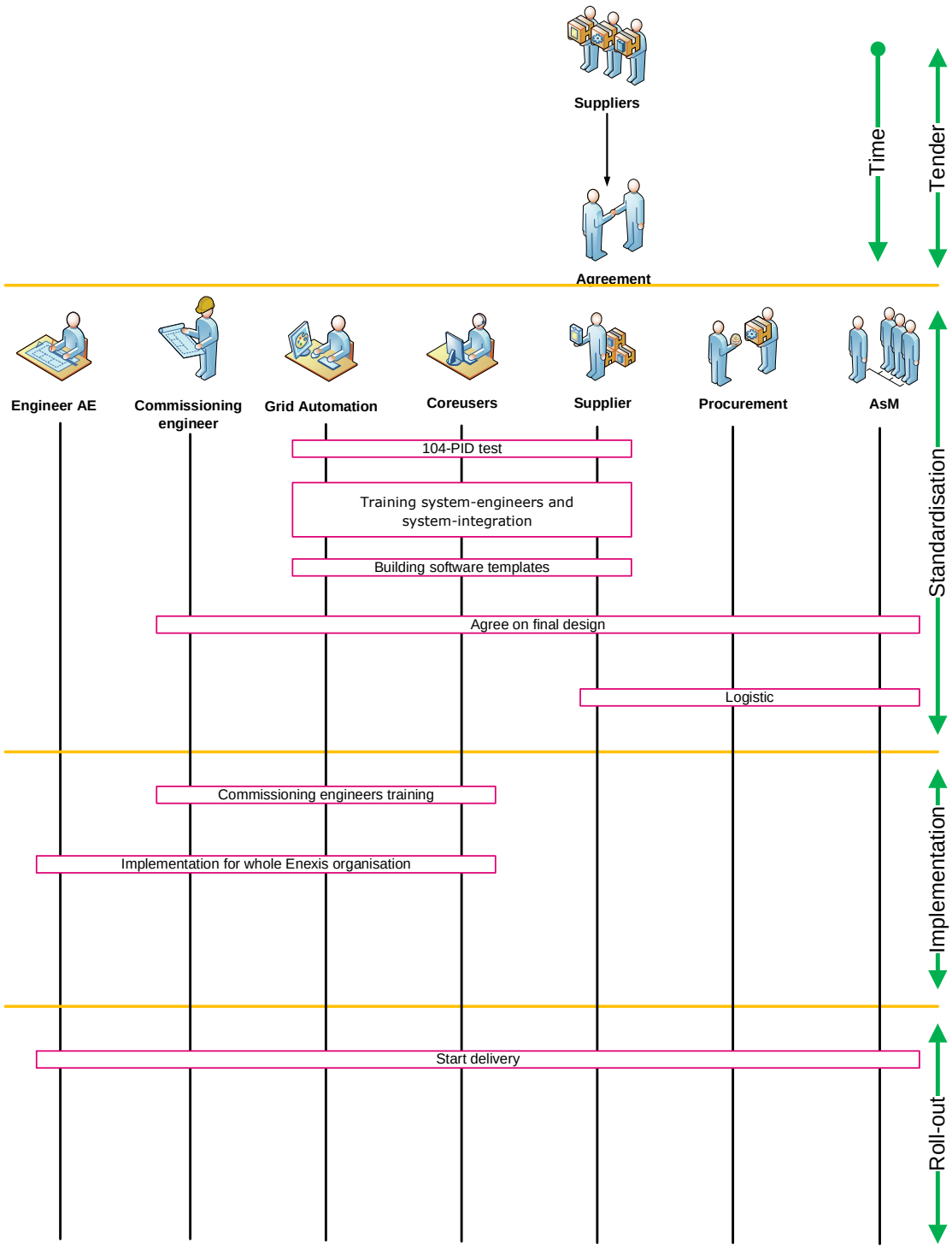

Suppliers
Agreement
Time
Tender
Engineer AE
Commissioning engineer
Grid Automation
Coreusers
Supplier
Procurement
AsM
104-PID test
Training system-engineers and system-integration
Building software templates
Agree on final design
Logistic
Standardisation
Commissioning engineers training
Implementation for whole Enexis organisation
Implementation
Start delivery
Roll-out

Figure 4

1.6.2 Roll-out process

When the offered product is standardized and implemented, the process will be as illustrated in figure 5.

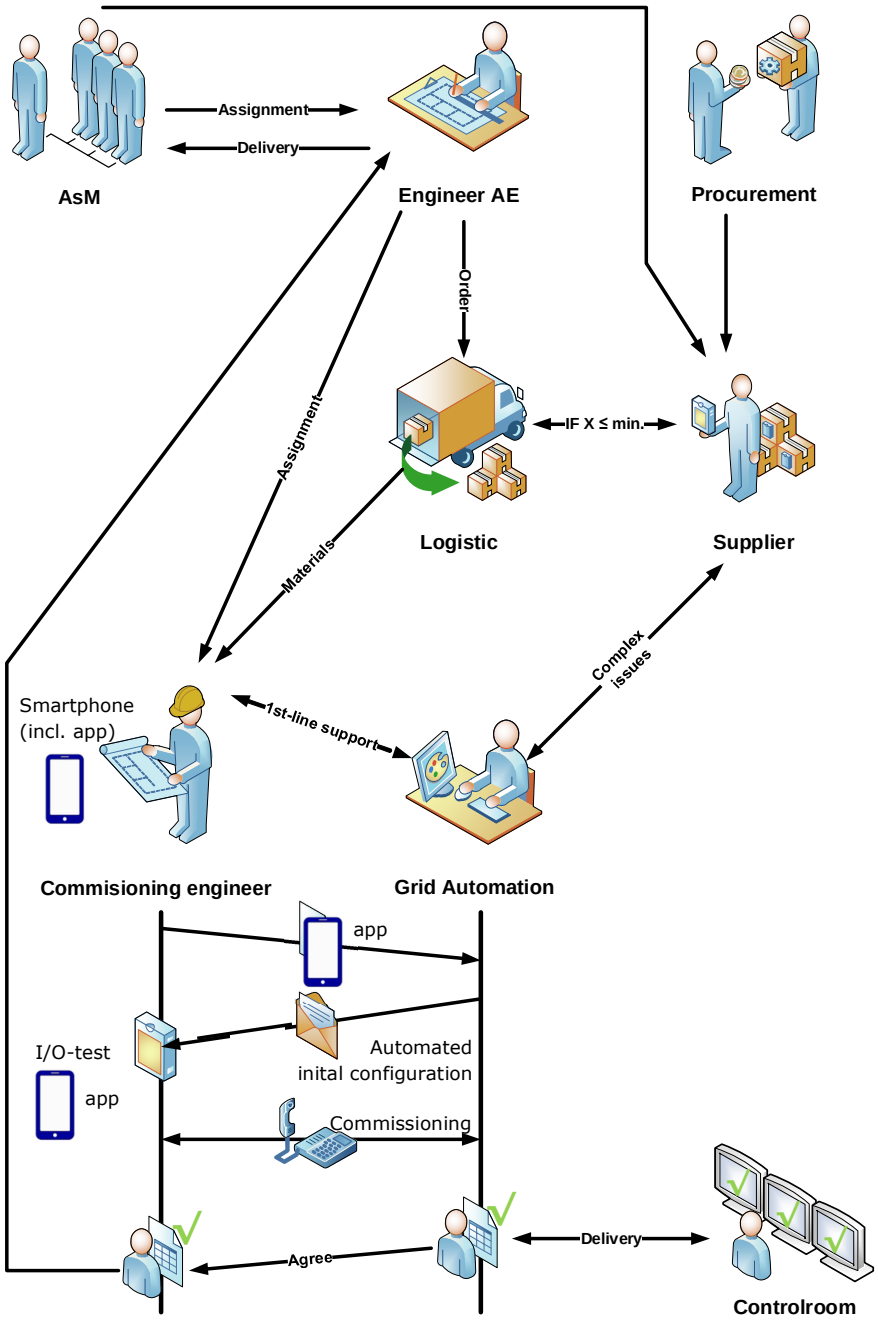


Figure 5: Schematic description of roll-out process DALI-Boxes

Note: Scada System-engineers from the centralized Grid Automation department will be responsible for remote commissioning and management (incl. fault diagnosis) of the DALI-boxes. These activities will be performed by ≤10 engineers using dedicated computers. Commissioning engineers or field technicians will not gain local access to the DALI-boxes over configuration-tools (web interface or configuration-software). The offer must facilitate above mentioned working procedures.

Detailed description of commissioning/initial configuration of DALI-Box

Components:

- DALI-RTU = DALI-box
- Management system/tools
- Commissioning system/tools
- Central system (Enexis)
- VPN system/IPsec-router (Enexis)
- DMZ (Enexis)
- Default (off-factory) configuration of DALI-box

RTU is configured with basic settings in order to reach the commissioning system during the first commissioning process (RTU will be directly shipped from warehouse to secondary substation). When first booted, the DALI-RTU connects to the network over the default (Enexis) APN and looks for the preconfigured commissioning system. It then fetches some basic settings from this commissioning system (see further). At this time, there is only a connection between the DALI-RTU and commissioning system.

Commissioning (commissioning process):

During a preliminary inspection-visit to a MV/LV-station, a mechanic makes an inventory of some specific settings for this station. Together with a Grid Automation engineer (SCADA system-engineer) the following data for this specific station will be prepared:

- Key: Station name (e.g. TNL.123456 or ABC.DEFGH or 123.456)
- Currentsensor: Transfer ratio of transformers (e.g. 1000/1)
- Connectivity: IP-address
- Connectivity: IP-sec keys
- Connectivity: Addresses of relevant servers (Management/NTP/VPN/DNS)
- Short-circuit indicators: Availability: which MV-feeder(s) is(/are) supported with this function.
- Configuration Specific I/O settings for IEC60870-5-104Connectivity:
- RTU LAN port Enable/disable

It must be possible to prepare these settings centrally at the commissioning system (provided by tenderer) or in any other system. The commissioning system needs to fetch these parameters from a simple plain text file (csv, XML or JSON format to be defined by supplier and handed over to Enexis). This file will be filled with information by Enexis and located at a known location in a DMZ. An alternative solution is that tenderer develops an import function in the commissioning system for the file mentioned above.

When the DALI-RTU is installed in a specific station, the commissioning engineer will make a match between the Station name and DALI-RTU serial#. This can be done in 2 ways:

1. Manually by reading out Serial# and station name and passing this information (by phone) to a SCADA system-engineer who in turn enters this information via a user interface to the commissioning system;
2. Automatically by scanning a QR code with the RTU serial# in an (Enexis provided) app and matching this with a specific station. Enexis will pass this information (near) real time at the same location and format as the other configuration parameters via the DMZ.

When the DALI-RTU now boots, it can connect itself to the commissioning system and identify itself by serial#. It then downloads the settings as described above and reboots.

The commissioning-system also needs to be able to export all parameters from RTU's as mentioned above in the same format to the DMZ after the commissioning of the DALI-RTU was successful. This information can then be used by other processes.

VPN server/IPsec-router:

When initial settings are performed by the commissioning-system and the DALI-RTU is rebooted, the RTU can connect to the VPN server/IP-sec router using the correct credentials. After that, the RTU is connected to the internal DALI-network and traffic can then be routed to the relevant domains.

Management-system:

The management-system (provided by tenderer) is connected to the internal DALI-network and will manage all firmware updates, patches and changes in configuration of the RTU's. For configuration-data this system can contact the DMZ (in the same manner as described for the commissioning system).

Central system:

The central system is also connected to the DALI-network. Once the VPN of the DALI-RTU is established, the central system (or RTU, depending on used protocol) will establish a connection and perform further settings: tariff program, public lighting programs and measurement thresholds/time intervals.

Note: different systems/tools can be hosted on one server with virtualization.

2 Scope of delivery

The supplier is asked to deliver complete constructed boxes. Creativity will be awarded to get a compact solution. Enexis expects supplier to ship pre-configured/pre-installed DALI-boxes as part of the delivery. Besides the hardware, the needed software for Enexis employees to remotely deploy, manage, configure, and troubleshoot the DA-boxes have to be delivered. Finally there will be (minimal) need for specialized support.

2.1 Local hardware for usage in secondary substations

The following hardware is part of the tender. The numbers in parentheses are the estimated need.

Hardware

- DALI-box (approx. 4.000)
- Separate (mobile) external display, in case a display is not part of the DALI-box.

Spare parts and/or extension parts

- Last Gasp unit (Power-cap or battery)

Tenderer must provide a drawing of the Technical solution for above mentioned hardware in its offer

2.2 Central tools/systems

The following tools/systems are part of the tender.

- Software tools to commission and manage DALI-boxes centrally and to update multiple DALI-boxes at once.
- Software to manage firmware of DALI-boxes centrally and to update multiple DALI-boxes at once.

Tenderer must provide an offer for hardware (server(s)), including installation and commissioning, to operate the central software-tools.

Relevant specifications for central server(s) is/are:

- Mounting type: rack mounted (Enexis does the hosting in an own datacenter)
- Power supply: redundant power supply
- Supported platform (OS): no preferences
- Type of platform: virtualisated platform (i.e. VMware)
- Remote desktop or client functionality

OUT of scope is software to define switching programs for Public Street Lights and Tariff outputs.
In order to implement this tooling by Enexis, tenderer should provide detailed information regarding data-formats used, up-front system integration activities are being performed.

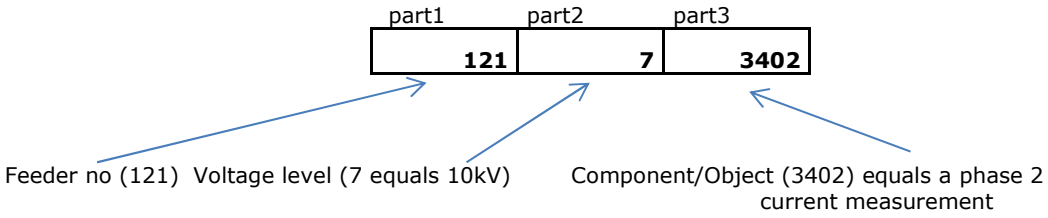
2.3 Support

During operation the supplier will be occasionally asked for expertise.
To secure future delivery of firmware updates, security-patches, spare parts and/or additional functionality Enexis is willing to agree about a elementary service-contract.

3 Configuration

3.1 104-mapping details

For 104-addresses a standard format is used by Enexis. The first part of the address is used for the bay/feeder number, the second for the voltage level and the last for the component/object.



Annex 1: Details using 104 and/or JSON

Overview of protocols used for different requirements depending on IEC60870-5-104 and/or JSON protocol.

Choice	2.1.2 System Monitoring messages	2.2.2.3 Street Light program	2.2.2.5 Street Light direct control	2.2.3.2 Tariff program	2.2.3.4 Tariff direct control	2.2.3.5 Tariff selection of source	2.3.1.1 Data processing – events and alarms (DI) messages
104	Message: 104	Config file: over FTPS (server on Dali-box, client is central system, upload from central system to dali-box)	Message: 104	Config file: over FTPS (server on Dali-box, client is central system, upload from central system to dali-box)	Message: 104	Config file: over FTPS (server on Dali-box, client is central system, upload from central system to dali-box)	Message: 104
JSON	Message: JSON	Settings: JSON message	Message: JSON	Settings: JSON message	Message: JSON	Settings: JSON message	Message: JSON

Choice	2.3.2.1 Load management – daily summary of measurements	2.3.2.2 Load management - measurements configuration	2.3.2.3 Load management – historical data	2.3.3.1 Street Light status change (DO)	2.3.4.1 Tariff status change (DO)	2.4.1 Local syslog transfer	2.4.2 SNMP
104	Message: 104	Message: 104 Config file: over FTPS (server on Dali-box, client is central system, upload from central system to dali-box)	File-transfer: FTPS (server on Dali-box, client is central system, download by central system from dali-box)	Message: 104	Message: 104	File-transfer: FTPS (server on Dali-box, client is central system, download by central system from dali-box)	SNMP
JSON	Message: JSON	Message: JSON Settings: JSON message	Request-message (incl FTP credentials and info): JSON File transfer: SFTP (client on Dali-box, upload from Dali-box to Central system/server)	Message: JSON	Message: JSON	Request-message (incl FTP credentials and info): JSON File transfer: SFTP (client on Dali-box, upload from Dali-box to Central system/server)	SNMP

Choice	2.5.1 Timekeeping						
104	NTP						
JSON	NTP						

Note on configuration files used for 2.2.2.3, 2.2.3.2, 2.2.3.5 and 2.3.2.2 (all used when 104 is used): these files should be 4 separate files, plain text or XML and its contents should be clearly defined by supplier.

Note on transferring files over SFTP used for 2.3.2.3 and 2.4.1: Since the files transferred can be substantial in size, compressing these files before transmission is required (using open compression tools as gzip).

Annex 2: External connector terminal-definition Enexis

To be supported external connectors:

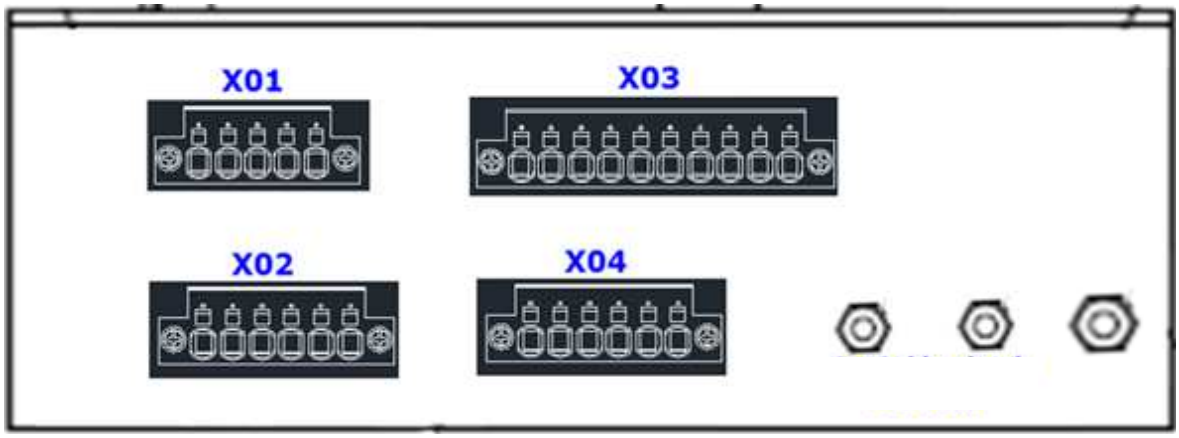
X01: Voltage INPUT (5 pole)

X02: Current sensor INPUT (6 pole)

X03: Digital inputs (10 pole)

X04: Public street light and Tariff INPUT/OUTPUT (6 pole)

Example terminal positions on bottom DALI-box:



Terminal assignments:

X01: Pin 1: U L1
Pin 2: U L2
Pin 3: U L3
Pin 4: Neutral
Pin 5: Earth

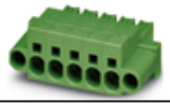
X02: Pin 1: L1/S1
Pin 2: L1/S2
Pin 3: L2/S1
Pin 4: L2/S2
Pin 5: L3/S1
Pin 6: L3/S2

X03: Pin 1: Contact SCI (Short Circuit Indicator) 1-1
Pin 2: Contact SCI 1-2
Pin 3: Contact SCI 2-1
Pin 4: Contact SCI 2-2
Pin 5: Contact SCI 3-1

Pin 6: Contact SCI 3-2.
Pin 7: External (entrance) door-contact 1-1
Pin 8: External (entrance) door-contact 1-2
Pin 9: Spare DI 1-1
Pin 10: Spare DI 1-2

X04: Pin 1: Public Street Lights – Night powersupply INPUT (PN)
Pin 2: Public Street Lights – Night control OUTPUT (N).
Pin 3: Public Street Lights – Evening(/Morning) powersupply INPUT (PA)
Pin 4: Public Street Lights – Evening(/Morning) control OUTPUT (A).
Pin 5: Tariff powersupply INPUT (PT)
Pin 6: Tariff control OUTPUT (P).

Connector specification (Phoenix contact or similar):

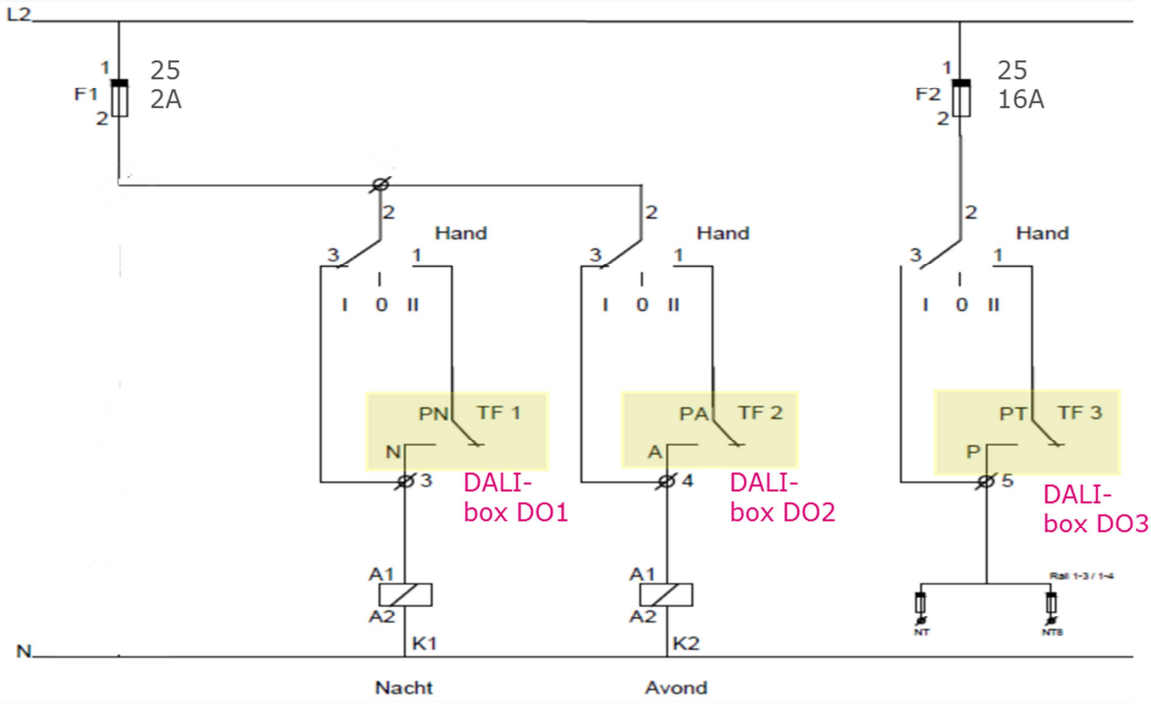
Outside connection method: Push-in spring connection			
Item number	Description	number	Photo
1996155	Phoenix female connector SPC 5/5-STF-7,62	1	
1996168	Phoenix female connector SPC 5/6-STF-7,62	2	
1996207	Phoenix female connector SPC 5/10-STF-7,62	1	

Inside connection method: Screw connection			
Item number	Description	number	Photo
1840586	Phoenix male connector DFK-PC 4/5-GF-7,62	1	
1840599	Phoenix male connector DFK-PC 4/6-GF-7,62	2	
1840638	Phoenix male connector DFK-PC 4/10-GF-7,62	1	

Item number	Description	
1701967	Coding profile CP-PC-RD, for plugging into the coding ribs	

Annex 3: Wiring diagram Evening/morning and Night control public street lights

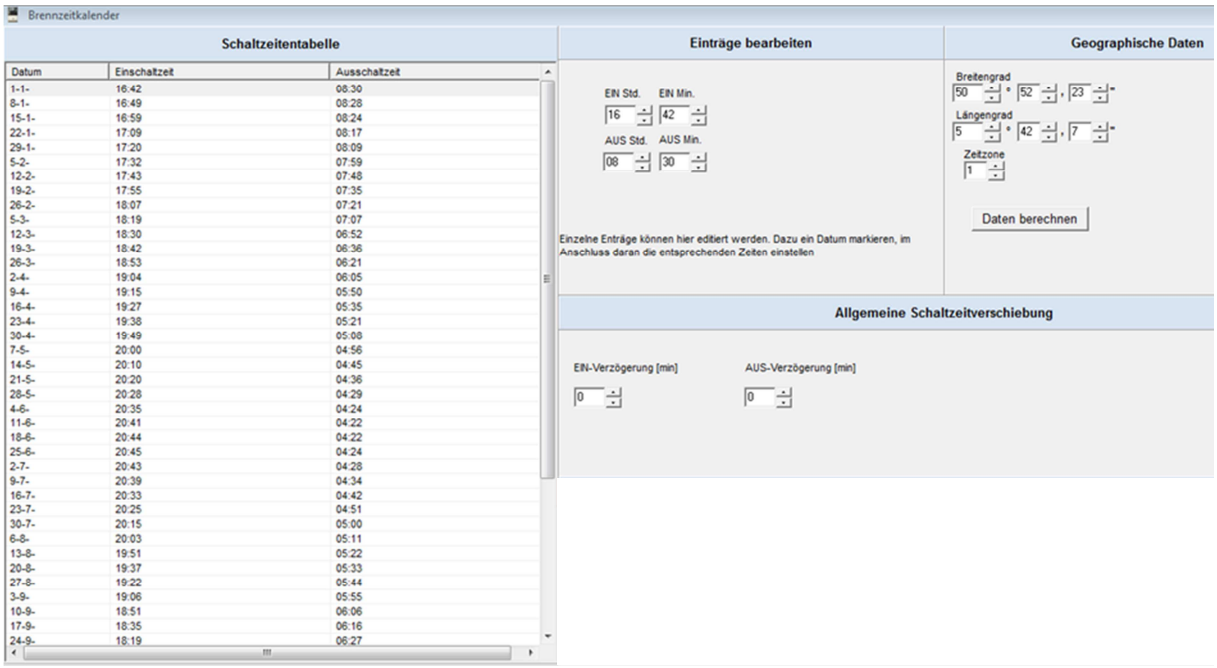
Schematic refers to wiring outside DALI-box.



Annex 4: Example (central) functionality for control public street lights

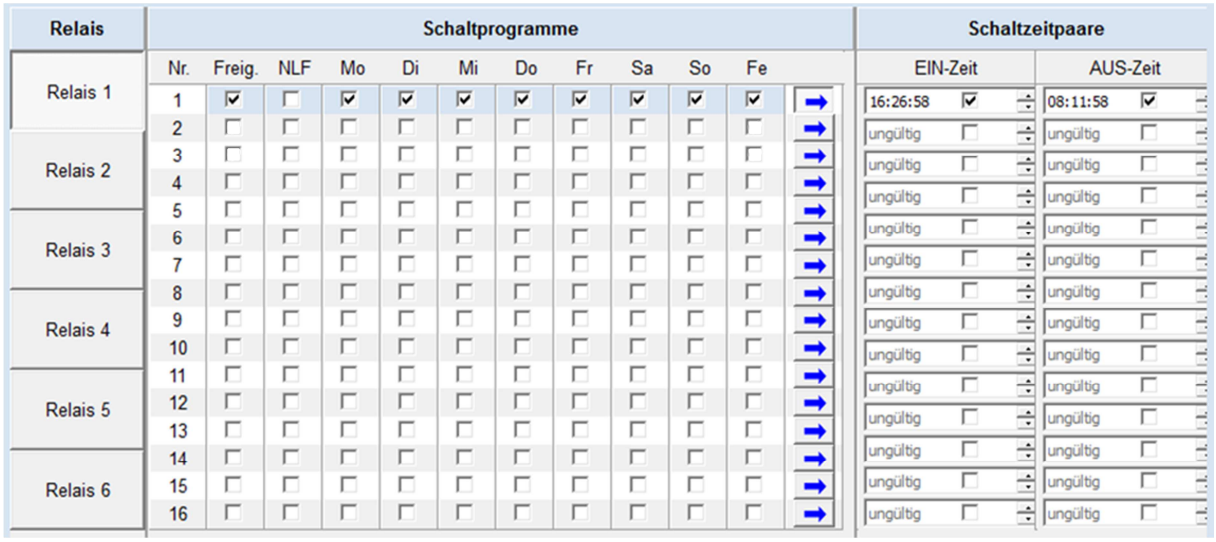
Functionality specifying astro-calender and offset-time (relative to astro-time) for IN/OUT-control of public street lights. Astro-calender can be defined:

- by means of specifying geographic coordinates
- by manual entry of switch table.



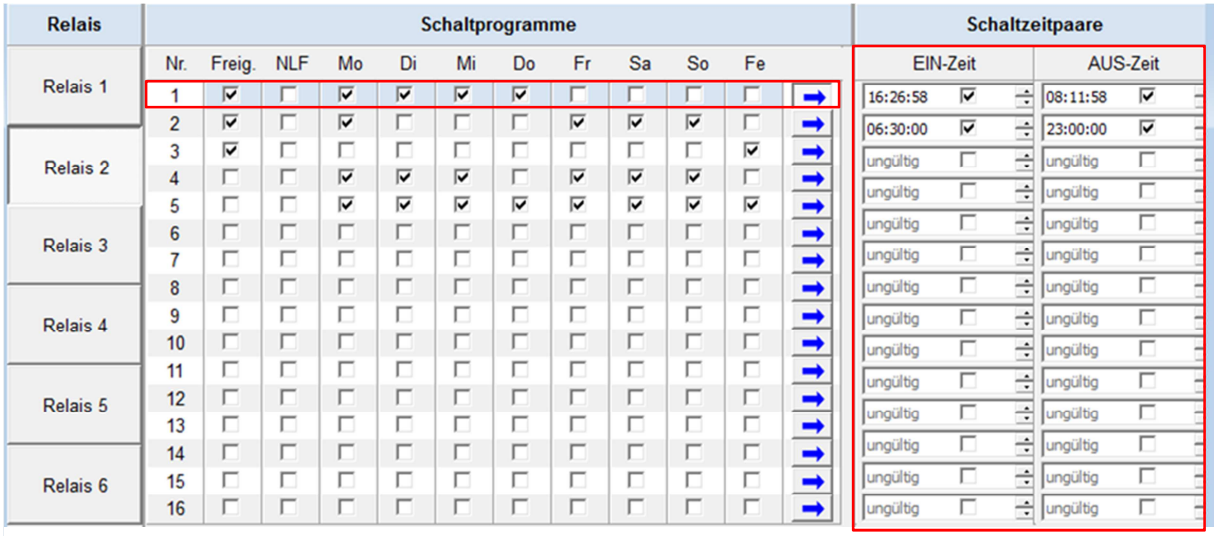
Functionality specifying switch-program for Night lights (Relay 1) for specific region:

- Night lights continuous IN from sunset to sunrise for all type of days (“working”- days, weekend days and holidays).

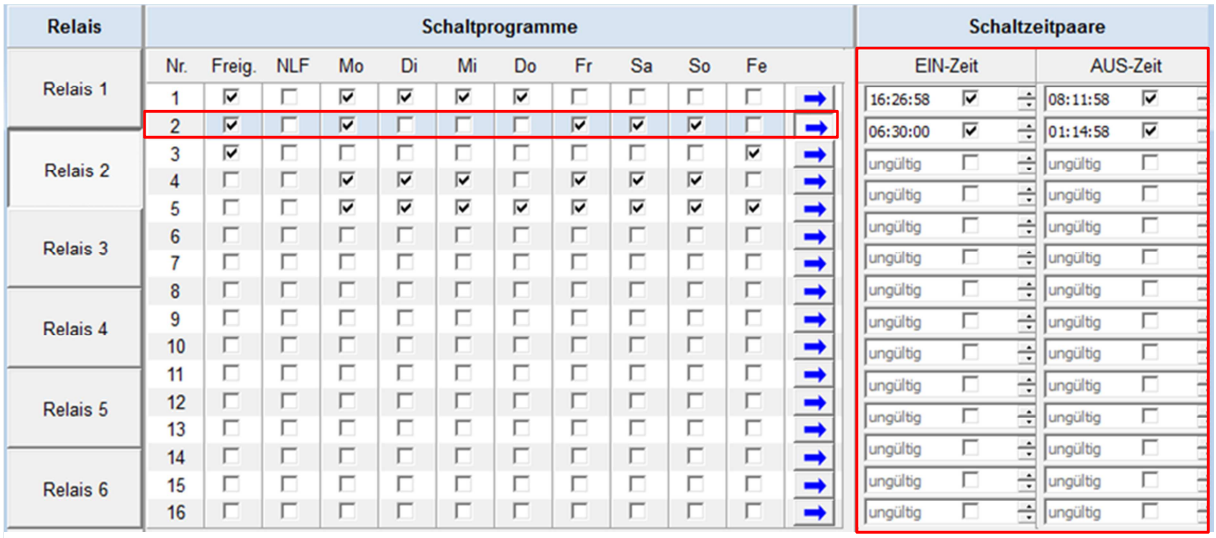


Functionality specifying switch-program for Evening/morning lights (Relay 2) for specific region:

- Evening/morning lights IN during "working"-days from sunset (16:26:58) until 23:00 and from 06:30 until sunrise (08:11:58).



- Evening/morning lights IN during weekend-days from sunset (16:26:58) until 01:14:58 and from 06:30:00 until sunrise (08:11:58).
- Switch-program Evening/morning lights during holidays ("Fe") are different (not shown).



Example of Public Light Programs that have to be performed:

ID	Order	On switching	Off switching	Repeat
001	Lighting astronomical	6 minutes after sun going down	12 minutes before sunset	
002	Evening / night lighting 1	06:00 or astr.on +30	22:30 * not on Christmas day and new year's even	
003	Evening / night lighting 2	06:30 or astr.on +30	23:00 * not on Christmas day and new year's even	
004	Evening / night lighting 3	07:04 or astr.on +30	23:30 * not on Christmas day and new year's even	
005	Evening / night lighting 4	09:00 or astr.on +30	23:59 * not on Christmas day and new year's even	
006	Peak (on) – low (off) domestical	07:00 working days	21:00 07:00 weekend and public holidays	11:30 working day H 14:30 working day H
007	Water heaters 1	21:10 06:50 weekend and public holidays	06:50 working days	21:20 working day H 22:32 working day H
008	Water heaters 2	21:15 06:50 weekend and public holiday	06:50 working days	21:20 working day H 22:32 working day H
009	Peak (on) – low (off) hours	07:00 working days	23:00 working days 07:00 weekend and public holidays	
010	Night tariff industrial	07:00 working days	23:00 working days 07:00 weekend and public holidays	
011	cos phi	07:00 working days	23:00 working days 07:00 weekend and public holidays	
012	Day - night (7.00-21.00)	07:00 working days	21:00 working days 07:00 weekend and public holidays	
013	Heaters	21:15 06:50 weekend and public holidays	06:50 working days	21:20 working day H 22:32 working day H
014	cumulative	00:10 1e off even months	00:10 1e off uneven months	
015	Synchronization	01:00	01:05	