

System Specification

Remote Commissioning Summary for Public Use

(Full Specification available to Participant & Promoter Members of the EnOcean Alliance)

ABSTRACT

This document serves as a basic overview of the contents of the Remote Commissioning. It contains an overview of the system specification for the remote commissioning process followed by the contents of the full system specification. In traditional automation systems, commissioning a building either initially, in a retro-fit situation or a repair scenario can mean having to have physical access to the receiver which is often difficult and can be time consuming and costly. Eliminating this need is one of the many benefits of Remote Commissioning. The full specification is available for participant or promoter members of the EnOcean Alliance in the members' only website.

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1. Introduction

The EnOcean Alliance's EnOcean Equipment Profiles (EEP) do an excellent job of promoting interoperability between EnOcean devices during the normal network operation. The scope of EEPs is limited to data transmission and does not account for use cases beyond already configured and operating EnOcean networks.

A core function of getting an EnOcean network operating is the commissioning process, linking and configuring devices - connecting sensors, relays and gateways to each other in order to achieve the desired functionality. EEPs define the telegrams for linking but not the process requirements. There are no standard telegrams or process for device configuration. This has led to fragmentation among devices and manufacturers that can cause confusion and frustration among installers. Ultimately this can reduce the quality of the customer's experience and increase the capital and operating expenses of an EnOcean network.

Remote commissioning defines an interoperable interface and process to manage EnOcean devices. Promoting a standard interface will promote ease of use for commissioning and performing maintenance on EnOcean networks. Implementing Remote Commissioning in EnOcean devices will reduce the complexity to install them, remove the need for physical access to configure them, and enable simple replacement of malfunctioning devices.

The commissioning process is currently fragmented among devices and manufacturers. This makes it extremely difficult for higher level software solutions to adequately control and configure devices. With the Remote Commissioning standard interface and processes the complexity of supporting EnOcean devices can be automated with software.

The focus of this systems specification is to provide guidance for product developers and managers of target and / or maintenance devices.

1.1. Remote Management Overview

This chapter summarizes the usage of Remote Management (ReMan).

ReMan enables a platform for EnOcean devices to be accessed and configured remotely. Remote Management defines the abstract structure of the commands and some basic rules. Part of Remote Management is also a basic set of standardized and mandatory commands called Remote Management Control Commands (RMCC). Then the abstract structure of a Remote Procedure Call (RPC) is defined. This generic structure can be used to define commands to perform tasks. In this document we focus on standardized commands to commission, configure and maintain remote EnOcean devices. In other words, Remote Management is the underlying specification we are using to enable Remote Commissioning.

ReMan can be implemented for both the EnOcean Radio Protocol (ERP) or for the serial interface (e.g. ESP3) stack.

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1.2. Remote Commissioning Overview

Remote Commissioning uses the available Remote Management technology to enable a standardized way of commission EnOcean devices. Its essential part consists of defining the respected RPC commands and processes (e.g. message flow, constraints, etc.). This summary description represents the Remote Commissioning Specification, which is available in Chapter 2.

Remote Commissioning will be used

- During commissioning of newly installed, greenfield, EnOcean networks to perform commissioning of direct and indirect devices links and configurations. - *Commissioning a new Installation*
- When modifications are done on functioning EnOcean networks, by adding and removing devices and/or changing devices' configuration parameters. - *Adjustments in a Live Network.*
- When replacing a non-operating device with a pre-commissioned, ready to install one. - *Service in Case of Device Failure.*
- When trouble shooting an operating EnOcean network. - *Maintenance of a Live Network.*
- Document and store the existing installation and device configurations

1.2.1. Commissioning a New Installation

1.2.2. Adjustments in a Live Network

1.2.3. Maintenance of a Live EnOcean Network

1.2.4. Service in Case of Device Failure

In this revision no special interface for security parameters is defined. However the parameter configuration interface can be used for this purpose.

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2. Remote Commissioning

This chapter includes the complete interface and process specification. This is structured into these three application areas:

- Remote Learn process
- Link Table functions – process and interface for link table management
- Configuration – process and interface for configuring parameters

In the case where a Remote Commissioning Acknowledge is expected but not received the Query Status Remote Management RMCC can be used to help determine the reason for failure.

2.1. Learn processes with remote commissioning

The traditional learn process consists of two distinct parts. An inbound device must enter into learn mode, a mode where it will accept new links via teach in/out telegrams, and an outbound device must transmit its teach telegram. The methods to transmit a teach telegram is most often a physical button press on a device, i.e. a teach button on a sensor. The same is true for putting an inbound device, i.e. an actuator, into the learn mode.

Remote commissioning removes the need for physical device access, and thus on device button presses for the inbound and outbound cases. In some cases the outbound device does not even need to be present or transmitting.

The Teach-in and Teach-out messages are two specific parts of the Learn process, which creates and removes logical radio links between devices on the application layer.

Without remote commissioning a teach process message is always triggered locally, which means the user must have physical access to the target devices and utilizes a physical interface to transmit a teach message. The teach process, when triggered locally, is the typical process used to create links in an EnOcean network and is not in the scope of this specification. It is defined in the application layer description of the EnOcean wireless standard.

In this specification we will focus on the remote teach process, we differ between:

- Remote learn process -
This process is similar to the local teach process, which is executed by teach message exchange. Remote management represents only the trigger for this action, it does not interfere with actual process.
This process has following applications:

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- Remote teach process inbound (in/out) (e.g. start learn mode on an inbound device)
- Remote teach process outbound (in/out) (e.g. trigger the transmission of a teach-in request)

Practically a learn mode on a controller is triggered remotely as well as the transmission of a teach-in request. The remote teach process on one device (inbound or outbound) can be combined with the local teach process on the other device (inbound or outbound). E.g. the learn process on a controller was started by remote commissioning but the teach-in request from the sensor was triggered locally by pressing the teach-in button.

After performing the remote teach process the link tables on the respected devices are changed according the result of the teach process.

■ Direct learn process.

This process utilizes the direct access to the actual link tables and editing them trough a commissioning device. It has the following applications:

- Direct teach process inbound (in/out). (e.g. add a complete row entry to the link table of incoming communication)
- Direct teach process outbound (in/out)

2.1.1. Remote teach process

As stated in section 2.1. we will discuss two options:

- Remote teach process inbound (in/out)
- Remote teach process outbound (in/out)

Remote teach process inbound (in/out)

An inbound device that supports remote teach-in/-out can receive a teach request telegram from multiple outbound devices and add them into its inbound link table. When set into a teach-in/-out mode, inbound devices shall receive and process teach-in/-out request messages and may answer them using a teach reply message according the defined application layer of the EnOcean standard.

With remote teach we define on an inbound device an explicit:

- Learn in mode – only teach-in requests from outbound devices are processed.
- Learn out mode - only teach-out requests from outbound devices are processed.

The inbound device can be only in one mode at a given moment, not in both at same time.

If the teach request message from the outbound device is a toggle message / is not explicit requesting teach-in or teach-out, then the learn mode of the inbound device defines the

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outcome of this situation. Example: If a magnet window contact sensor sends an 1BS teach request and the receiver is in learn-in mode, then the result is that the receiver learns in the sensor. If the sensor sends another teach request nothing happens, because the receiver is still in learn-in mode. To learn out the sensor the receiver must be set to learn-out mode and then the sensor transmits a teach request.

The remote teach process requires an outbound and inbound device to be functional at commissioning time. In this case the inbound device is put into learn mode remotely by a managing device and the outbound device is then locally or remotely triggered to send a teach telegram

The following steps are required to complete a remote inbound teach-in work flow:

- (1) upload link table to the inbound device (optional)
- (2) start explicit learn-in for one line item of link table
- (3) trigger device that shall be learned-in, either local or remote to send teach request
- (4) disable learn-in mode at the inbound device
- (5) download link table from the inbound device (optional)

In the case where an inbound device's link table already contains the ID of the device to be taught in, the same ID entry will be replaced by the one resulting from step (3) above. EEPROM and Channel need to correlate with the previously taught-in/-out device to complete a successful inbound teach-in/-out work flow.

Remote teach process outbound (in/out)

Outbound remote direct teach process only replaces the action of teach button pressing on the outbound device. All following actions are identical with the local triggered outbound teach process.

To perform an outbound remote teach, a device could have an outbound link table which will contain the EnOcean IDs of the devices to which it is linked with. In order to maintain link table integrity the below steps must be followed:

- (1) Set the inbound device to learn mode on and in the correct index (local or remote)
- (2) Trigger the outbound teach-in remotely.
- (3) Verify that the EnOcean ID of the inbound device has been added to the outbound link table of the outbound device.
- (4) Set the inbound device to learn mode off (local or remote).

2.1.2. Direct Teach process

As stated in section 2.1. we will discuss two options:

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- Direct teach process inbound (in/out)
- Direct teach process outbound (in/out)

Direct teach process inbound

This method is simple uploading link tables to the inbound device. Direct teach process is the most efficient method but requires additional knowledge about the outbound device, e.g. its EEP and ID. The outbound device does not have to be accessible or operating to be linked to the inbound device.

Direct teach process outbound

The procedure to perform a remote outbound via indirect pairing is to upload outbound link table to the outbound device.

The EEP and channel of each row of the outbound link table must match with the row of the inbound link table (of an inbound device) where the EnOcean ID of the devices is the unique reference to ensure link table integrity and consistence between the linked devices. This means the ID of the outbound device is listed in the inbound table of the inbound device and the inbound devices ID is listed in the outbound table of the outbound device.

When the outbound device is unidirectional and/or the used application protocol has unidirectional character the outbound device will not update the outbound link table because it is unaware of the ID, EEP, and channel of the inbound device and most probably the outbound device has no outbound link table at all. Only when linking bidirectional devices with bidirectional application protocol it is possible to do this automatically.

Process description

The Direct teach process consist of two essential parts:

- Getting the actual Link tables from the inbound and outbound device– if there are not known
- Changing the Link Tables of Inbound and Outbound device which are included in the teach process

2.1.3. Link Table definition

Having a standard definition of a link table will enable interoperability among devices that utilize remote commissioning. Devices supporting inbound and outbound teach-in maintain a link table for each direction. The Link Table definition is an abstract structure. It does not have to present as defined in physical memory. Remote management defines interfaces. Devices implementing Link Table must provide the interface to read and set the link table. The internal implementation of the Link table is completely depending on the developer of the particular device

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2.2. Remote Configuration

The Remote Configuration process is used to configure application specific parameters within a device. It is mandatory that a device is fully functional without performing the Remote Configuration Process. Thus the device must be provided with a default configuration enabled. In this way, configuration parameters reflect an extension of default functionality to enable additional applications through configuration.

A good example of a typical configuration parameter is the transmit interval of a line powered energy sensor. The device might come with a default configuration of three minutes. Using the remote configuration commands, the time can be adjusted so the device wakes up every five or ten minutes. Doing so will not influence the basic operation of the device, it will still measure and report an energy even directly out of the box. A device that needs to have the energy measurement enabled first using remote management does not follow this specification.

This Remote Configuration interface comes with the benefit that users (installers) do not need to know low level details of how to configure parameters such as which flash address they have to write. Implementation details are abstracted away and must be handled in firmware. This ensures interoperability between target devices and commissioning devices. A Device Description file will provide a devices details to a commissioning device.

The interoperable commissioning interface for a device's configuration is represented through RPCs. These RPCs are defined:

- Get Device Configuration
- Set Device Configuration
- Get Link Based Configuration
- Set Link Based Configuration

Two type of parameter set and get interfaces are available. The first is device level parameters. These are addressed with a single index and are parameters that are used to configure a target's functionality, e.g. transmission interval timer. The transmission interval timer has no logical connection to the inbound links

The second interface is for linked parameters. These parameters are referenced with a link table index and a parameter level index. Linked parameters control functionality associated with one or more devices in the link table. A simple example is when an outbound PTM210 based switch is linked to an inbound actuator. The switch function can be configured in a standard rocker mode, a toggle mode, or a momentary mode when linked to a target device. Multiple switches may be learned in but still operate in different switching modes. Which mode to use for each inbound switch needs to be defined via the linked parameters. In this case the linked parameter would be linked to the index that the switches are learned into, denoted by the appropriate RPS based EEP. Linked parameters can be thought of as extra columns in the link table that are inbound device specific. Linked parameters can also be used

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when each inbound link can have a unique value for some parameter regardless of the EEP used. Each link might have a priority parameter, the EEP is not relevant in this case.

A device may have one or neither of these types parameters depending on the configurability and complexity of the target device.

With these RPCs a commissioning tool can read or modify a targets current configuration remotely. The capabilities and format of each parameter is defined in the device description XML file. The manufacturer of a target device must provide a device description file to enable the configuration portion of Remote Commissioning

Configuration parameters are gettable and settable as single values or as a set. Each set command deals with a specific parameter. This enables users (e.g. installers or commissioners) to correct or adjust single values. Configuration parameters are split up into two different types:

- public
- private

Private can be used as a closed-source parameter, meaning that the description of the parameter is not available to the public. If a configuration of this kind of parameter is required by the user, the manufacturer can define the default value in the configuration file without disclosing its description or type. Public is an open-source parameter that follows the format of the GP data types and has its functionality shared with commissioners.

Process description

Please find bellow partial description of parameter configuration process. The key feature in description is the reference to device description file. For any kind of parameter configuration the device description file is required.

2.2.1. Configuration parameters description

Configuration parameters are specific for every device and are defined by the manufacturer. The configuration parameters list may not be fetched over the air interface from a particular device. The configuration parameters list must be available from the device description file. This should be supplied by the manufacture or a central authority.

The language to describe a target device's parameter is the Generic Profiles language. Every configuration parameter can be represented by a GP data channel, flag, or enumeration.

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Channel definition 'Data'							
Channel type	Signal type	Value type	Resolution	Engineering minimum	Scaling minimum	Engineering maximum	Scaling maximum
2 bits	8 bits	2 bits	4 bits	8 bits	4 bits	8 bits	4 bits

Figure 1 Channel DEFINITION 'DATA'

Common Remote Configuration Functions

The remote configuration process can be used to modify link information and parameters within a device. A remote configuration process, i.e. loading of configuration data to the device, takes some time; the duration being dependent on the amount of configuration data to be loaded to the device. Without a certain control of the process, the device may operate with inconsistent parameter settings, and therefore show unexpected behavior until the commissioning process is finished. In order to avoid operation with inconsistent configuration data settings, the remote configuration process may be gated with Control Commands.

Diagram, Insert diagram of flow full commissioning process. List of required commands for each use case

In addition to controlling when updated settings may be applied it may be useful to set a device back to its defaults.

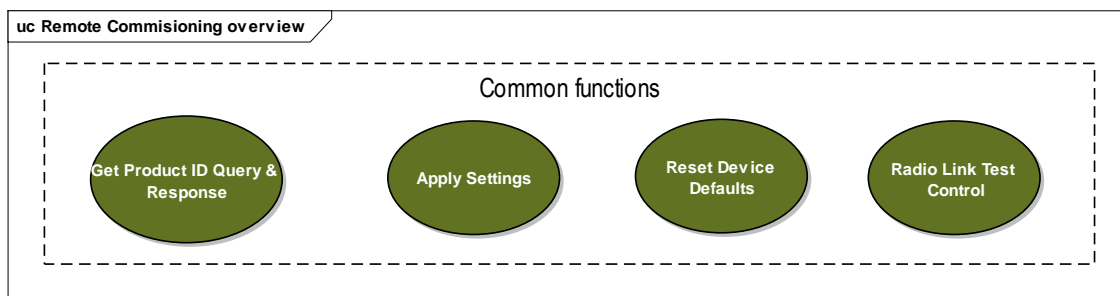


Figure 2 Common function telegram structures

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3. Documentation of EnOcean Networks Utilizing Remote Commissioning

Being able to read a target's link tables (both inbound and outbound) and parameters remotely using remote commissioning enables documentation of an EnOcean installation with ease.

All installations that implement remote commissioning should be documented to allow the execution of all use cases. When documentation is performed, it is mandatory to follow the structure and instructions described in this chapter.

Below is defined a standard method to document link tables and parameters of an EnOcean device.

Information to be documented

All the data stored in each device should be documented. This includes (if relevant):

- - Inbound Link Table
- - Outbound Link Table
- - Configuration Parameters
- - Target's Device Description File

Documentation process

The documentation of an installation needs to be split into two parts:

1. XML file (mandatory): where all the devices, their link tables and configuration parameters' values are included
2. MAP of the installation (optional): Drawing of the installation with the physical location of the devices written down. The following data should accompany each device:
 - a. Chip-ID (mandatory)
 - b. Base-ID (optional – if utilized)
 - c. Model (optional)
 - d. Name (optional)
 - e. Description (optional)

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4. Remote Commissioning application types

Devices supporting remote commissioning have two stereotypes:

- sensor stereotype – mostly outbound communication
- controller stereotype – mostly inbound communication

A device can support both stereotypes. Depending on the stereotype and application function also the remote commissioning features are implemented. A device does not have to support all features of remote commissioning. Only dependencies are defined (e.g. device must support get and set link table commands). The remote commissioning functionality is represented by Remote Procedure calls - RPC messages. To reflect the dependencies we define RPC bundles. A device manufacturer can choose which bundles he wants to support. These bundles are defined:

4.1. Remote Learn bundle

- Remote Set Learn Mode
- Trigger Outbound Remote Teach Request

4.2. Configuration parameters bundle

- Get Device Configuration Query & Response
- Set common Configuration Query

4.3. Remote Commissioning Mandatory commands bundle

- Apply Changes
- Get Product ID Query & Response
- Remote Commissioning Acknowledge

4.4. Remote Commissioning Optional commands bundle

- Reset Device Defaults
- Radio link test control

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5. Conforming Implementation

The Remote commissioning specification presents an interoperable way of commissioning any device. To ensure interoperability between various target and commissioning devices in the Alliance, Remote Commissioning features can be certified.

The EnOcean Alliance certification specification describes how the functionality will be tested. The tests main aim is not to functionally test the device implementation of functionalities or other device specific features, but to ensure compatibility in the interoperable Eco system of commissionable targets and commissioning tools. The target device and commissioned device will be developed by different companies and developers. This fact makes the urge of certify the Remote Commissioning interface even more.

Devices fulfilling the certification will carry a certified logo of the remote commissioning certification program. This way it will be presented that this devices is a certified part of the Eco system. Certification details and further description on this topic will be listed in the Remote Commissioning certification specification.