OMS

Open Metering System
Specification

Volume 3
Tertiary Communication and MUC

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Release

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1 Introduction

This document keeps the records and results of the Open Metering AG-2 with scope on the MUC functionality and tertiary communication.

The goal of this specification is more to describe the system architecture of the OMS-MUC than to set up a detailed technical specification.

This document is part of the Open Metering System Specification which consists of the following documents:

OMSGP	Open Metering System specification, Vol. 1 – General Part
OMSPC	Open Metering System Specification, Vol. 2 – Primary Communication
OMSTC	Open Metering System Specification, Vol. 3 – Tertiary Communication and MUC (this document).

Please refer to OMSGP for definitions, abbreviations and references.

For the latest issues of the Open Metering System Specification (OMSS) and other background information please visit the internet site www.openmetering.org .

The OMS-MUC Specification is intended to be widely aligned with European requirements for Smart Metering (e.g. Dutch Smart Metering Requirements). Variations may occur due to different targets like the metering infrastructure or meter index intervals as well as different national regulations.

2 Overview

The *Multi Utility Controller* (MUC) as a functional and logical unit and its communication to AMM back office systems (AMM-BO) is described in this Document. The physical outline and its position is not subject of this specification.

The MUC located between metering devices and the AMM back office systems is a system to provide data for billing and balancing purposes as well as to monitor the energy consumption of the consumer on a home display unit. In addition, the communication interface can be used to control remotely certain functions of the MUC and metering devices.

The ODC[1] of the tertiary interface provides OBIS coded sensor data to AMMBO.

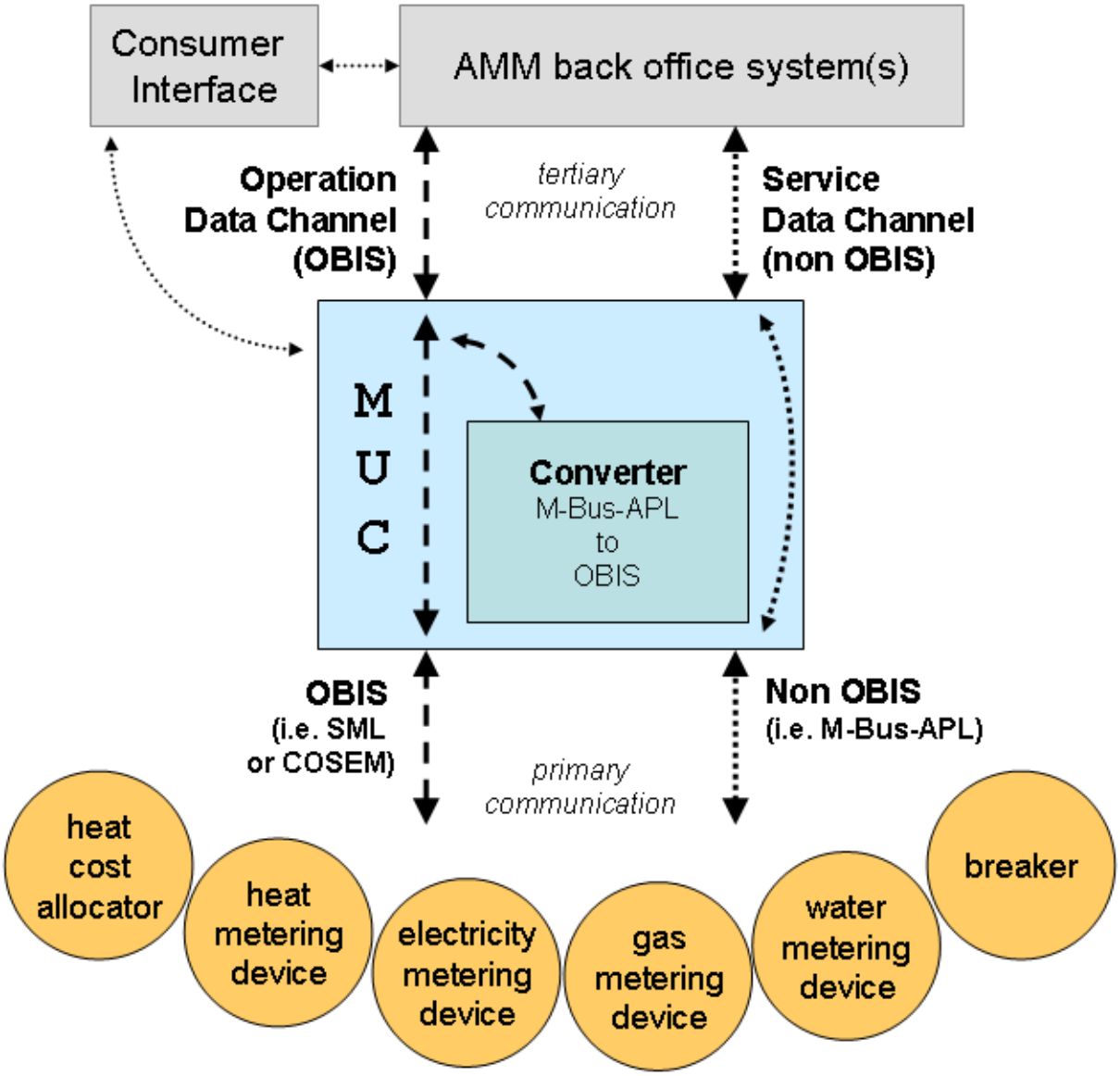

Fig. 1: System Overview

[1] Operation data channel

2.1 Communication

2.1.1 General

Fig. 1 shows the interfaces of the OMS-MUC system concept to provide data flow from the metering devices to the AMM back office.

2.1.2 Primary

The *primary communication interface* provides wired and wireless communication with metering devices.

Please refer to document [OMSPC] for a more detailed view on the metering devices.

2.1.3 Tertiary

The *tertiary communication interface* allows exchange of data with AMM back office systems.

Wide area communication to AMM back office systems as well as communication to the consumer is done via IP protocol V.4 (referring to RFC791) or higher.

2.2 Data Storage

The MUC data memory provides space for different features:

- Communication buffer (FIFO)
- Data memory for historic values and data logging
- Event log
- Configuration data

2.3 User and Access Management

[WORKITEM] to define user management]

Data access at the MUC is controlled at application level by a user management that identifies users by name and password to enable access only to those data objects assigned to the particular user.

2.4 Internal Clock

The MUC has an internal clock, which is used to mark the incoming data with timestamps.

The internal clock may be used as time base for connected sophisticated metering devices to synchronize their own clock.

2.5 Functional Description

The following part of this document describes requirements for the communication between

- MUC ↔ energy supplier (Energy trader and grid operator)
- MUC ↔ metering service provider and meter site operator
- MUC ↔ consumer.

Additionally, communication with monitoring systems for diagnosis is also described.

2.5.1 Communication Channels

Communication protocols for the Operating data channel are defined to use SML or DLMS/COSEM (see Fig. 2) always transferring OBIS coded values.

In tertiary communication, metering data are transported by the MUC to an AMM back office which allocates them to suppliers and providers.

Since battery powered meters have to use optimized data volume, some data processing has to be done on the MUC. Received non OBIS standard values from metering devices have to be processed by a converter in order to match the required AMM data format if not provided by the meter.

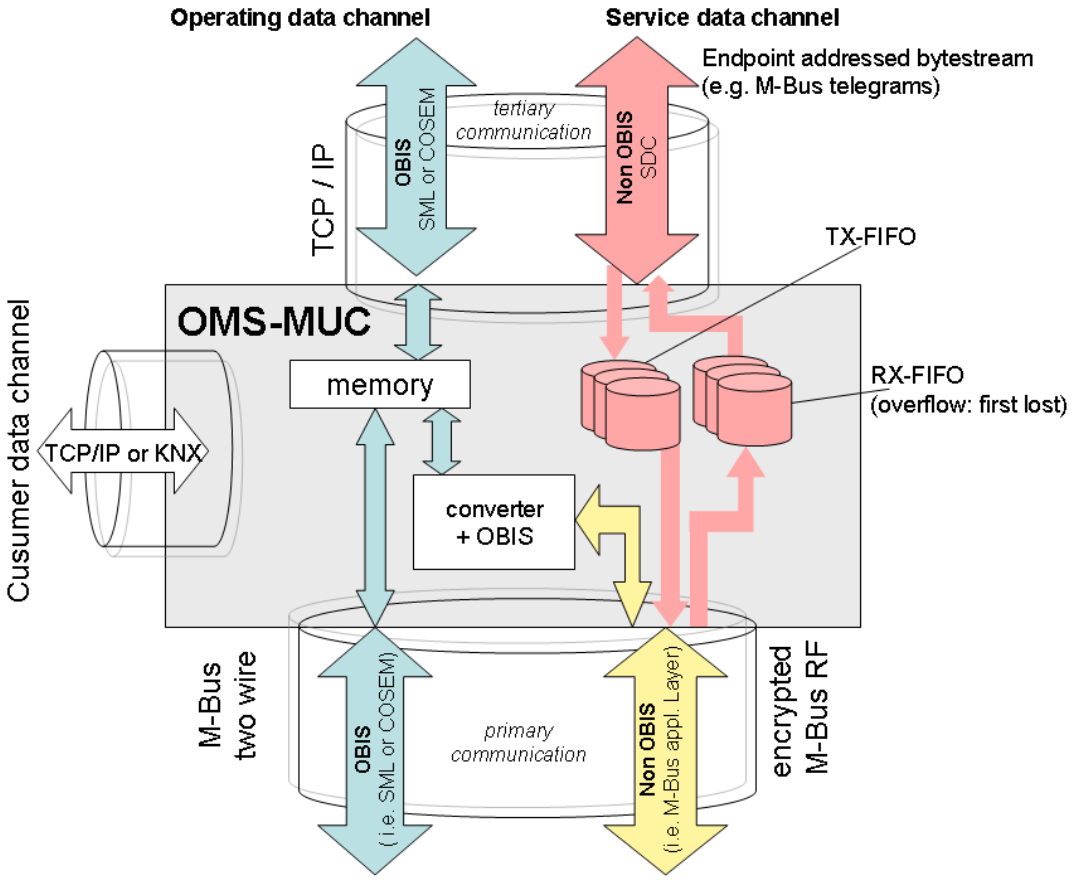

Fig. 2: Architecture of the OMS-MUC

A direct access to metering devices should also be possible. Therefore the tertiary communication was split up into two sub channels:

- The *operating data channel* (ODC) provides communication to AMM back office systems for billing or other purposes.
- The *service data channel* (SDC) provides access to service data of a metering site and messages sent by connected meters. In addition, connected systems which operate on the SDC can query metering devices by sending messages. The SDC has been introduced for servicing and for additional communication features.

The SDC consists of a bidirectional channel tunneled through the MUC. The bidirectional channel is built by a TX- and RX-FIFO (see Fig. 2).

[WORKITEM] A service data channel is proposed and will be specified in a further version of this specification.

2.5.2 M-BUS to OBIS Conversion

5 The MUC contains an M-Bus to OBIS converter to translate M-Bus standard data points into OBIS classification numbers.

A conversion table which matches M-Bus standard data points to OBIS numbers has been defined in [OBIS-ConvTab].

3 Specifications

3.1 Data Storage

The amount of meters to be managed by a single MUC is not defined by this specification.

Operational data points are defined by the OBIS conversion table [OBIS-ConvTab] which is based on the normative standards [EN 62056-61] and [EN13757-1] and aligned with the [DLMS- UA].

3.1.1 Interval Data

The MUC is defined to have ring buffers to store data for a certain amount of time. Hereby, the following minimum requirements have to be met:

- Daily metering data should be available for the last three months.
- Monthly data should be available for the last two years.
- Load profile data have to be available for the last three months.
- The event log stores the last 100 events as a generic profile data base.

Medium	**Interval time [min]**
Electricity	15
Gas supplied to the connected party	60
Heat, district heating	60
Water / Warm Water	1440
Heat cost allocators	1440
Heat / Cold (submetering)	1440

Table 1: Data Intervals

3.1.2 Data Types

Telegram types are defined in [OMSPC] to reduce transfer data volume.

It is important to ensure that Master data will not be lost, to provide them for AMMBO.

3.1.3 Status Information

[WORKITEM]

General

Status information is a generic term for additional information about the status of the metering installation. Status information can be requested via the tertiary interface and is also available via the consumer interface. In addition, the meter site operator has the possibility of reading status information on the service interface.

Status Information on the Consumer Interface

[WORKITEM]

Status Information via Tertiary Communication

[WORKITEM]

Error Messages

[WORKITEM]

Fraud Detection

[WORKITEM]

3.2 Interfaces

Open Metering conformity is given if the MUC provides

- a WAN interface for tertiary communication,
  like e. g. Ethernet / DSL, GPRS / UMTS, PLC

as well as one of the referenced interfaces for primary communication:

- Wired M-Bus (M-Bus) Master
  able to drive 6 M-Bus loads as described in OMSS Vol. 2.
- Local Bus (LO-Bus) as defined in EN 13757-6
- Wireless M-Bus (wM-Bus)
  It is agreed that wM-Bus meters may communicate on mode T1 or S1 unidirectional) and T2 / S2 (bidirectional back channel).

  [WORKITEM] No consensus within the open metering groups was found about the modes supported by the MUC.

  a. The MUC supports T1 and T2 or S1 and S2
  b. The MUC supports T1/T2 and S1/S2 in parallel
  c. The MUC supports T1/T2 and S1/S2 by a time slot method (which is not improved yet).

A MUC device not covering one of the above interfaces is not equal to the Open Metering System (OMS), but may achieve OMS conformance by an upgrade if designed in a modular concept.

Other interface types are optional and not specified by open metering

- extension port (Ethernet)
- RS232
- RS485
- PLC
- Zigbee
- KNX (consumer display, building automation, energy management)
- consumer interface
- and others

The physical characteristics of the mostly utilized wired interfaces will be defined in future in Annex C: Physical Interface Definitions of this document to provide a minimum of interoperability.

3.2.1 Service Data Channel (SDC)

The service data channel is a transparent channel providing simple communication of non OBIS-Data from the meter to the AMMBO but also from the AMMBO to the meter (if the meter does support bidirectional functionality).

The communication for the meter to the MUC is defined by OMSS Vol. 2. The physical and link layer of the tertiary communication is described within this document.

The SDC does not push data to the AMMBO. Data through the SDC are always to be requested by the AMMBO from the MUC.

[WORKITEM] To be defined:

- SDC mandatory or optional
- One FIFO per direction for all active meters or one FIFO for each active meter
- Number of received telegrams stored in the FIFO.

Data Readout

- Memory is organized as FirstIn FirstOut (FIFO) with overwriting
- Every received telegram will be stored

Data Transfer

- Memory is organized as FirstIn FirstOut without overwriting

3.3 Clock and Time Management

To ensure correct timestamps of metering data which is used for accounting and billing (like meter indexes), sophisticated metering devices must have an own internal clock. Accuracy of this device clock is defined to be better than 20ppm (compare EN/IEC62054-21:2004).

The internal clock is provided with a power reserve of 48 hours at minimum.

Timestamps are always given in UTC (coordinated universal time).

Clock synchronization is done by using the network time protocol NTPv4 (or higher) or equivalent (e.g. DCF77). NTP time should be requested as signed telegram for secure and tamper proof system operation.

The internal clock should not differ from absolute time more than 9 seconds. If the internal clock could not be synchronized for longer than 48 hours MUC time may not be used as synch time base. Failures of the MUC time synchronization have to be accounted for in the event log.

3.4 Data Flow through the MUC

As shown in Fig. 3 several data types are to be transferred by the MUC.

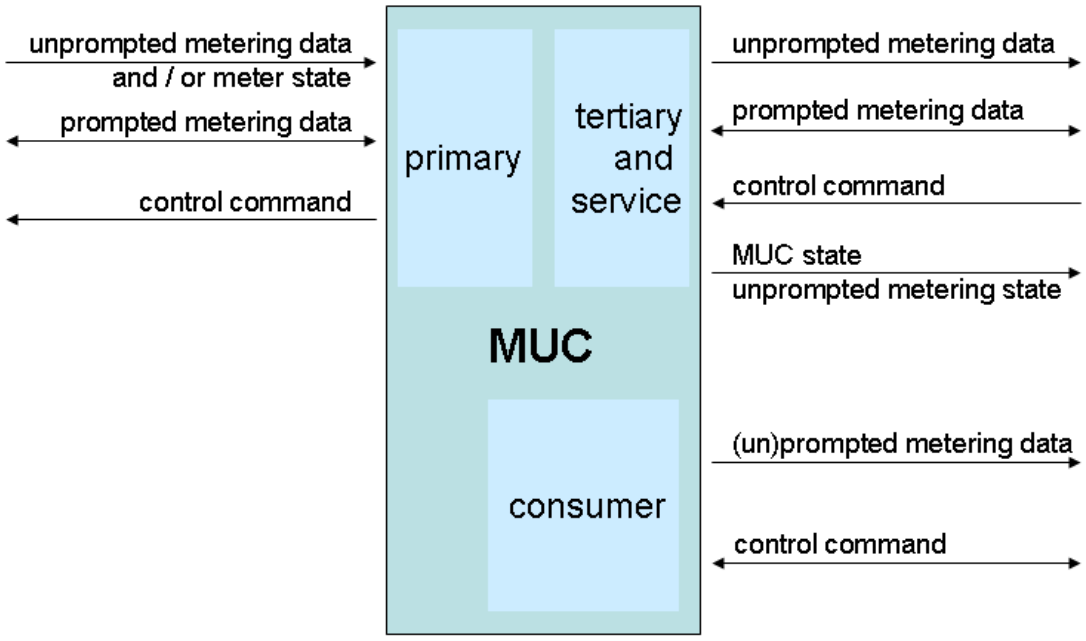

Fig. 3: Data Flow

Control commands are send from the AMMBO to the MUC to (e. g.):

- Request stored data
- Set operational parameters
- Send data or command to the consumer interface
- activate tasks to requests data from metering devices

Control commands are send from the AMMBO via the MUC to metering devices to (e. g.)

- Setting meter parameters like tariff definitions
- Request meter data or status information
- Switch actuators
- Synchronise a meter clock

Prompted Metering data are the reply of a metering device or MUC on request telegrams (pull operation).

Unprompted Metering data are sent by metering devices without request (push operation). Different telegram types may be sent due to battery lifecycle opportunities. On tertiary communication dynamic meter data always must be completed with the assigned static information (e.g. meter identification data).

3.5 Messages and Alarms

[WORKITEM] In case of events which are important for proper operation of the total system (alarm messages), the MUC has to report these events to the AMM back office system.

3.5.1 Message Priorities

[WORKITEM]

3.5.2 Message Recipients

[WORKITEM]

3.6 Security

Security techniques and protocols are not defined in this stage. Commonly used techniques should be used as listed in [WELM2004].

3.6.1 Encryption on Primary Communication

The Advanced Encryption Standard 128 (AES-128) was decided to be used if meter data are to be encrypted for secure data transfer on primary communication. Please refer to Vol.2 of the OMSS [OMSSPC] for details.

3.6.2 Encryption on Tertiary Communication

On the tertiary communication established IP security methods are used.

[WORKITEM] Details are to be specified.

3.6.3 Security Level

[WORKITEM] The security level to be provided by the OMS-MUC depends on the protection needs to be defined by a data protection analysis.

Service Level	Security Level
Super Admin / Key master	Setting and reset of encrytion and signature keys; setting of administrator account
Administrator	Access to all user definitions and rights management, read all status information
Metering Service Provider (MSP) Meter Site Operator	Read all metering devices; send command to metering devices; send command to MUC
Consumer (Home Display Unit, Building Automation System, Energy Management)	Read all assigned metering devices after login procedure

3.7 Data Access

[WORKITEM]

3.8 Users and Access Control

The MUC has to provide a sufficient number of user accounts. At least one Administrator for configuration purposes must be provided. The other users could be defined by the administrator. User accounts could be bundled by user groups.

A user account is defined by

- User name
- Password
- an optional public key
- access rights, related to data points

Access rights are defined by the attributes

- read
- write

No consensus was found about the attribute to limit the access by

- valid for a time period (from date/time, to date/time)

Alternatively the mandatory deletion of historic data was discussed when a user account is deleted.

In Annex B: User Concept Example a proposal of application is described.

3.9 Key Management

The Keys for encryption and access control are changeable by authorized change key commands.

Keys are organised in a tree structure. The depth of this structure may differ depending on the individual system and application.

On building up the key tree it shall be ensured always to use a method of same or higher order on the way from a brace to the root. By this the protection level of an adjacent key is limited by the protection level of root and / or the previous branch connection.

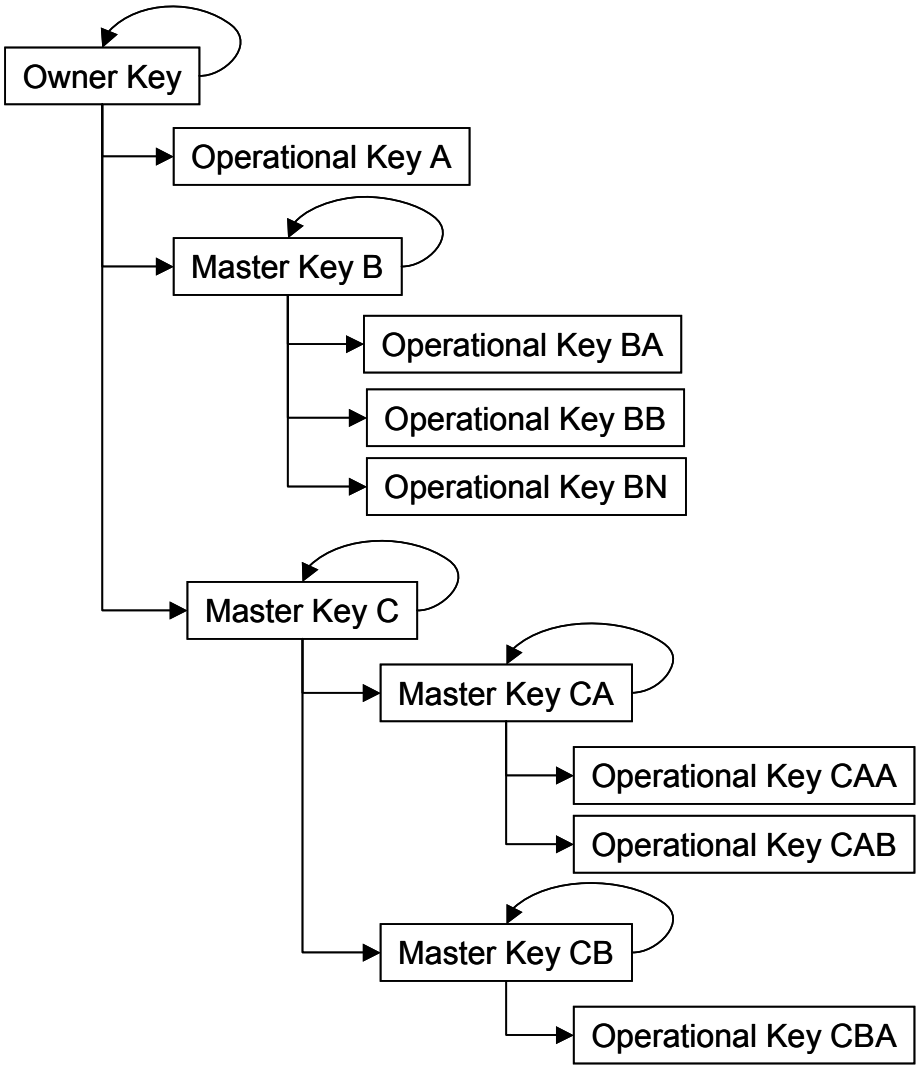

Fig. 4: Key Tree Structure

Owner Keys have to be individual for each component.

Different methods for key exchange and key usage may be used depending on the appliance.

Keys as described here are stored in a key memory (e.g. flash) managed by the application software. The key encryption key (KEK) is self-contained from this keys and substituted inside the encryption unit.

The key tree root is grounded by the owners master key (‚Owner Key'). This key should only be used to load additional keys into the OMS-MUC. The owner key must be changeable, authorized by itself since the owner may change within the period of use.

It is recommended to set a vendor-default-key on delivery state which should be changed by the owner within the field installation procedure. If the vendor-default-key is not set individually it must not be possible to load additional keys since the owner key has changed.

The key to authorize additional keys should not be used for data encryption to prevent decryption of a caught telegram by the included authorization key.

Therefore a key tree may be buildt up of two classes of keys:

- · Master Key
  - no data decryption feasible
  - only used for authorization of other keys
  - may be changed by itself (self authorization)
  - the owner is a master key
- · Operational Keys:
  - are used for data encrytion and decryption
  - are not able to authorized other keys
  - should not be changed by itself

So master keys are root and branches of the tree. Operational keys are the leaves.

The branches of a key tree may have different lengths

To authorize e.g. an software up- or download an operational key directly below the owner key could be reasonable.

On a MUC used bei several market partners a multilevel structure may be useful.

[WORKITEM] command definition OBIS coded

4 Annex A: Use Cases

[WORKITEM]

This annex shows Use Cases to be fulfilled by the OMS hard- and software.

They describe procedures for system installation, configuration, data acquisition, event handling, device control and clock synchronization.

4.1 Installation Process – MUC

Use Case	Start of operation
Actors	Central system (AMMBO) ERP system MUC Controller
Precondition	Parameters to connect to the AMM system are known by the MUC.
Scenario	MUC Controller establishes a connection to the AMM system and delivers the event „new installation“, passing its mater data. AMM system checks authentication and authorisation if applicable, replying a positive acknowledge to the MUC Controller. These acknowledge is indicated for the technician on site (by e.g. LED, display or feedback an a PDA). For the technician the installation procedure is finished then. The AMM System is setting up an account fort he new MUC Controller with status „pending“. The technician takes over the data (DeviceID, location and time of installation ...) of the new installed MUC to transfer them to the ERP System. REMARK: This process may be asynchron (da Monteur nicht „online“) to the MUC registration at the AMM System if the technician has no online connection. The ERP transmitts the MUC master and assignment data to the AMM System. The AMM System checks these master data with its device accounts on status „pending“. On correpondence the MUC acount will be assumed to the list of active devices.
Error conditions	no authentication – registration is not effected no authorisation - registration is not effected no connection to the AMM System – further proceeding beyond this definition no correspondence with the master data of devices in the field to devices at the ERP System - further proceeding beyond this definition
Notes	Even if metering devices are synchronous or asynchronous installed with the MUC, the procedure described in the Use Case „initiation of meter“ will be used.

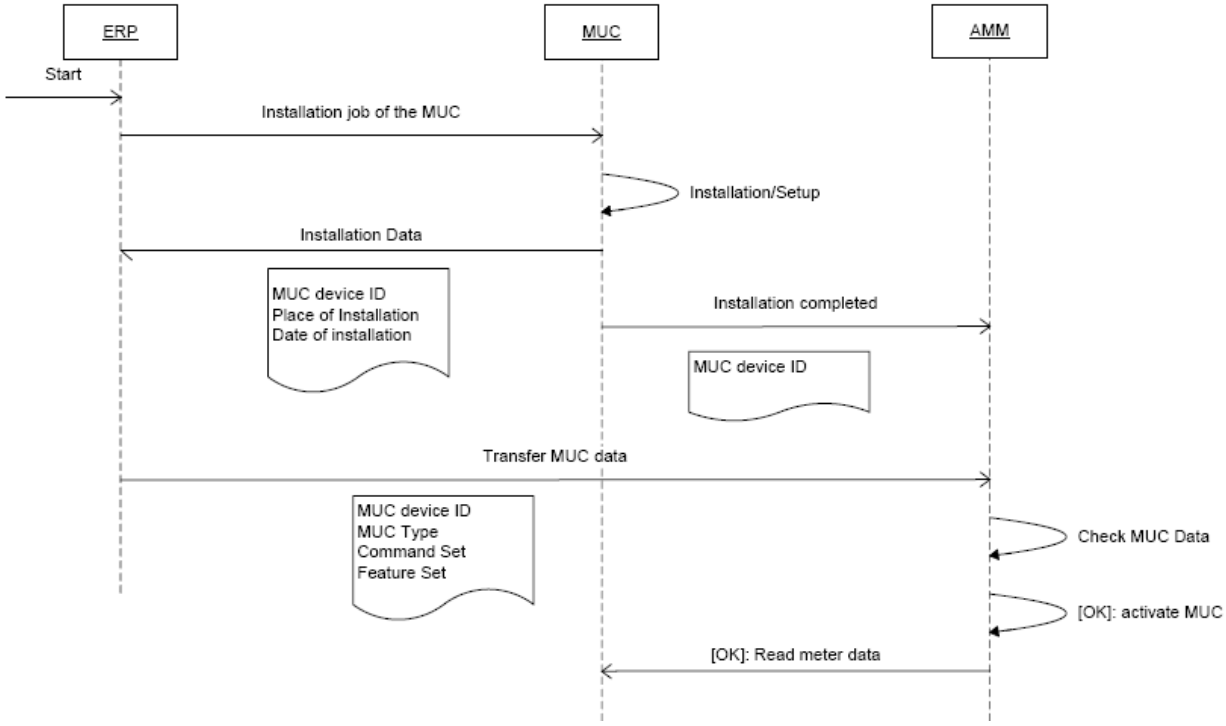

Fig. 5: Installation Process of the MUC

4.2 Installation Process – Meter – w/o Feedback

Use Case	Install meter with set up mode (push button), no feedback to technician
Actors	Metering devices (gas, water, electricity, heat, HCA, …) 2 MUC Controllers ERP AMM
Precondition	The MUC is already operating Device data are complete available at the ERP system.
Scenario	Meter installation. Technician gives acknowledge of meter installation to the ERP system. ERP sends meter master data and assignment to AMM. Start of installation mode (manual or automatically). The meter sends its installation data. Both MUCs receive new meter data and sends them to the AMM system.. AMM sends meter to MUC assignment to the assigned MUC by updating its list of active metering devices. AMM sends an update of the list of passive metering devices to the other MUC. The AMM System checks these master data with its device accounts on status „pending“. On correpondence the MUC acount will be assumed to the list of active devices.
Error conditions	MUC does not receive any data
Notes	

5

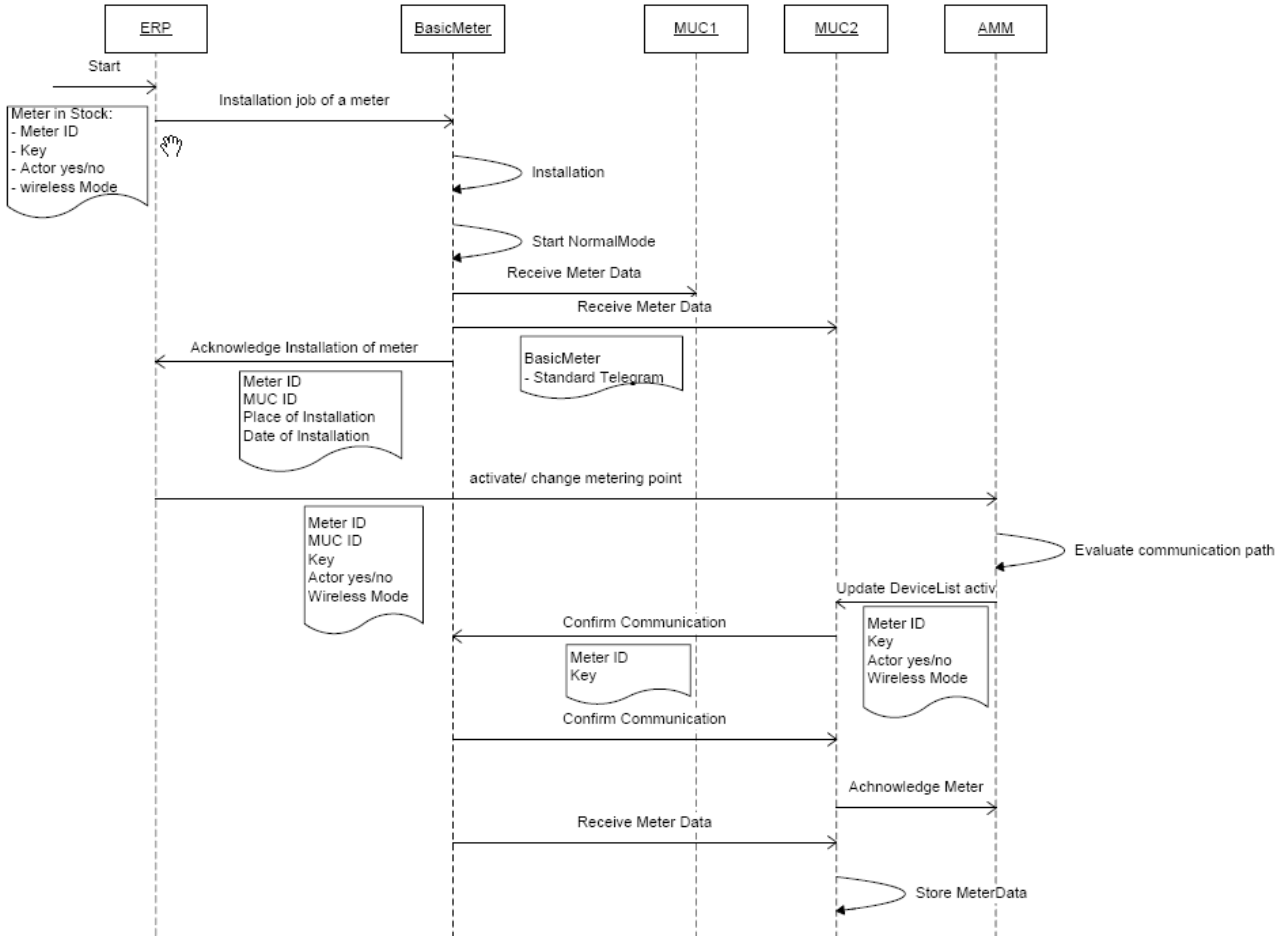

Fig. 6: Installation of Meter w/o Feedback

4.3 Installation Process – Basic Meter

In this Use Case the same preconditions are valid as described above.

Additional feedback scenarios are described below.

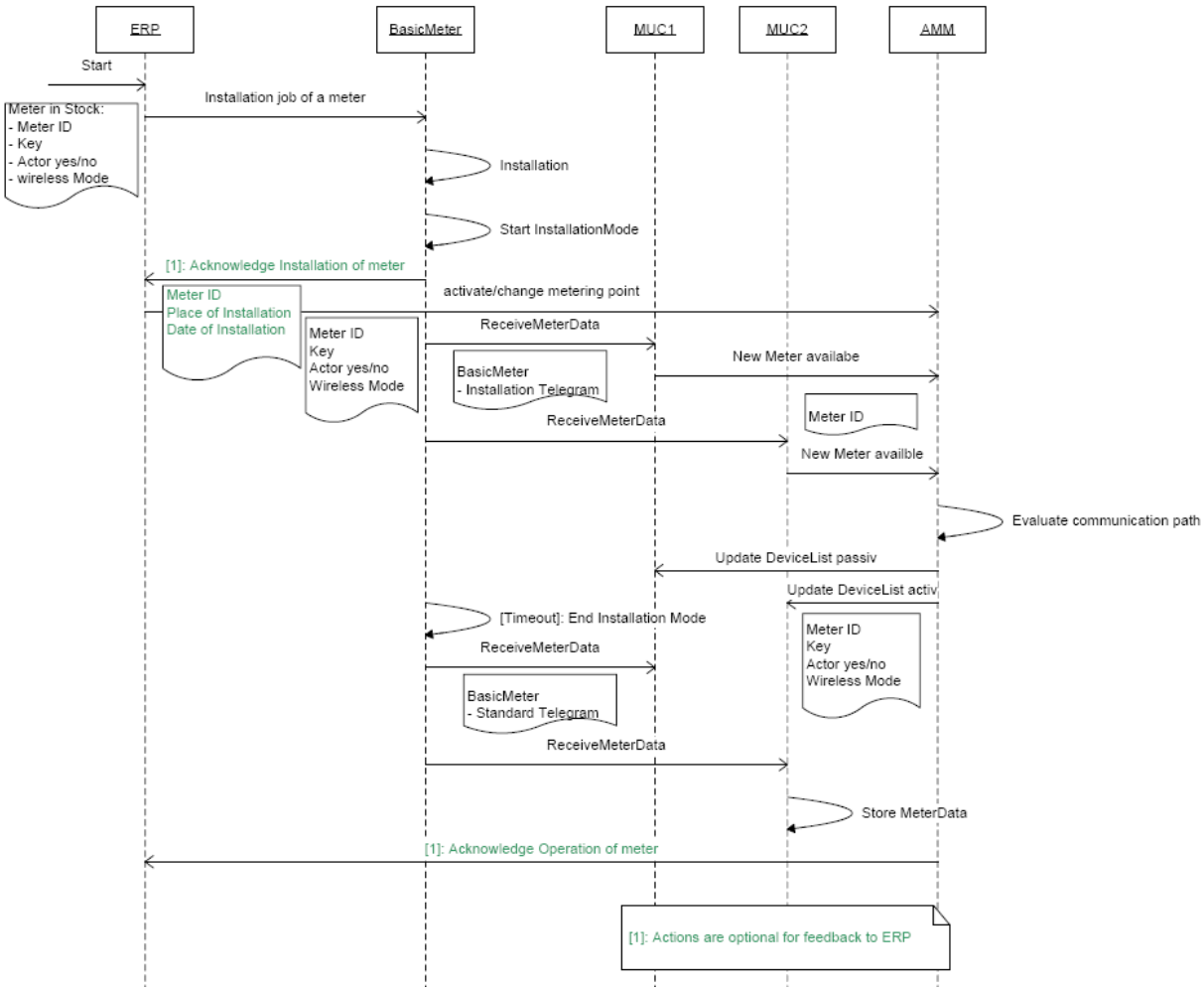

Fig. 7: Installation of Basic Meter

4.3.1 Feedback on PDA

Use case	**installation – with feedback to installer – local – feedback on PDA**
Metering device	gas/water/electricity/heat-meter
Pre condition	Follow steps 1 to 7 of the installation procedure. After step 7 the MUC is finished with the local installation of the meter.
Scenario	▪ The installer can use the PDA to read out the configuration via the local interface of the MUC ▪ The installer checks the local installation configuration like meter Ids, reception quality ...
Error scenario	▪ The MUC has been coupled to the wrong meter. ▪ The reception quality is not good enough. ▪ After key exchange the MUC can't decode the meter data.
Notes	With the help of a PDA the installer could identify many different problem. But this method requires a local interface for installation. It is only possible to verify the communication between the MUC and the meter. It is not possible to verify the complete installation up to the AMM back office.

4.3.2 Feedback on Meter

Use case	**installation – with feedback to installer – local – feedback on meter**
Metering device	gas/water/electricity/heat-meter
Pre condition	Follow steps 1 to 7 of the installation procedure. After step 7 the MUC is finished with the local installation of the meter.
Scenario	no feedback possible
Error scenario	▪ The MUC has been coupled to the wrong meter. ▪ The reception quality is not good enough. ▪ After key exchange the MUC can't decode the meter data.
Notes	As this is a simple basic meter and is not able to communicate in 2 ways, there is no possibility to give feedback of the successful installation to the meter

4.3.3 Feedback on MUC

Use case	**installation – with feedback to installer – local – feedback on PDA**
Metering device	gas/water/electricity/heat-meter
Pre condition	Follow steps 1 to 7 of the installation procedure. After step 7 the MUC is finished with the local installation of the meter.
Scenario	▪ The MUC can show either on a LED or a display, that the installation has been finished ▪ LED – only show successful installation ▪ Display – show meter ID, show reception strength
Error scenario	▪ The MUC has been coupled to the wrong meter. ▪ The reception quality is not good enough. ▪ After key exchange the MUC can't decode the meter data.
Notes	It is only possible to verify the communication between the MUC and the meter. It is not possible to verify the complete installation up to the AMM back office.

4.3.4 Optional Installation Mode for (Basic) Meters

The AG1 has defined an **optional** installation mode for (basic) meters.

- Start of installation mode
  - Pushbutton
  - Command using Service interface of meter (e.g. optical interface)
- Activities within installation mode
  - Transmit of special telegram ***SND_IR*** (SendInstallationRequest)
    - Transmit interval 30…60 sec
    - Transmit minimum 6 telegrams
    - Different C-Field (= 46)
    - Application Data not specified
  - Receive of special respond telegrams, transmitted by the MUC
    - ***SND_NKE***
      - Transmitted from all MUC that receives SND_IR
      - DataContent
        - Link Layer address: MUC ID
        - Application Layer address: Meter ID
        - optional RSSI value coded in status byte
    - ***SND_IC*** (SendInstallationConfirmed)
      - Transmit from the MUC
        - If Meter is assigned to
      - Different C-Field (=06)
      - DataContent
        - Link Layer address: MUC ID
        - Application Layer address: Meter ID
        - optional RSSI value coded in status byte
- Stop Conditions of installation mode
  - Transmit min. 6 telegrams SND_IR
  - Max time of installation mode = 1h
  - Received SND_IC telegram

Precondition: Basic Meter, Mapping meter to MUC not predefined

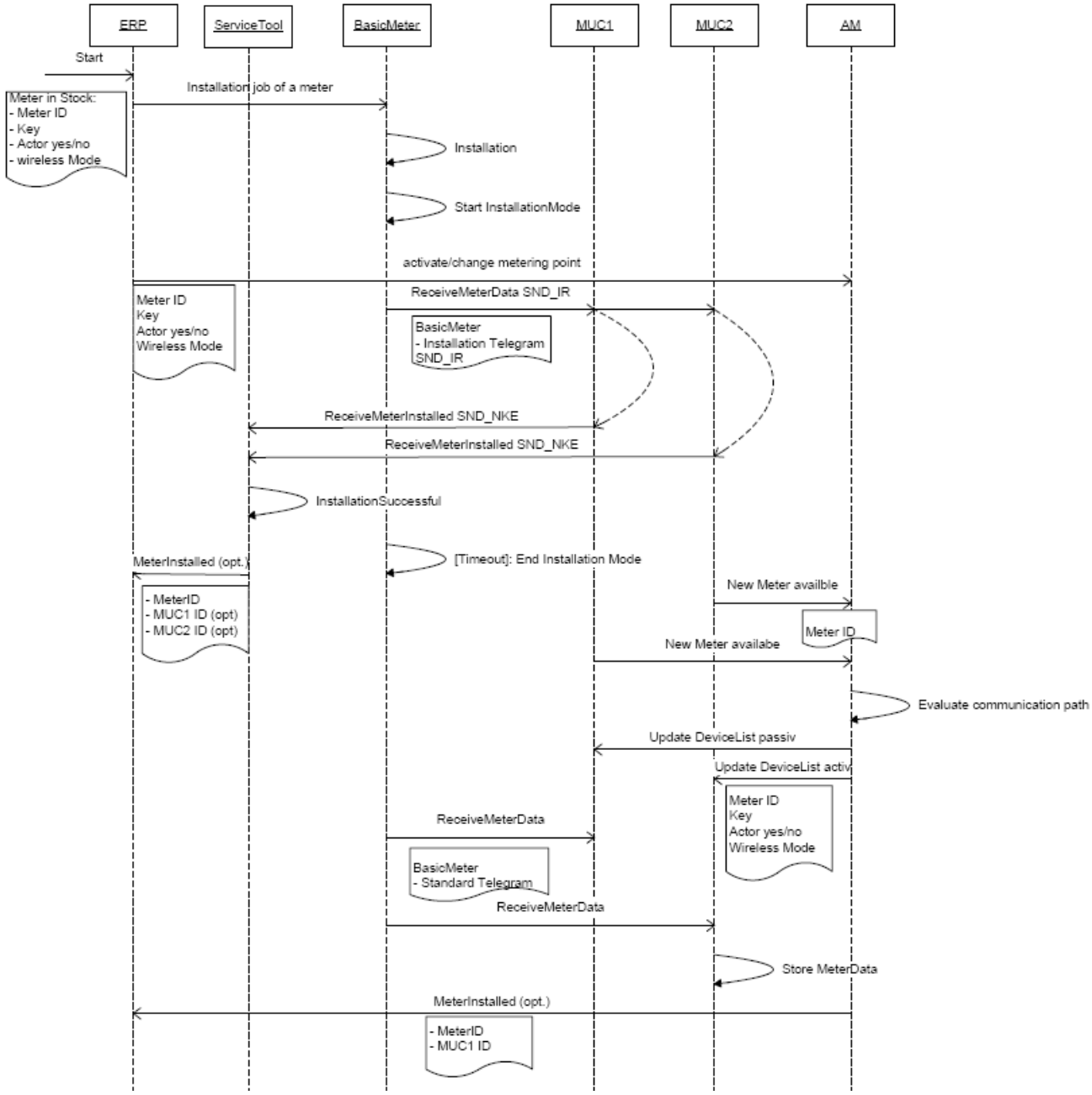

Fig. 8: Installation of Basic Meter

Precondition: Sophisticated Meter (implementing bidirectional communication). Mapping meter to MUC is defined before installation of meter.

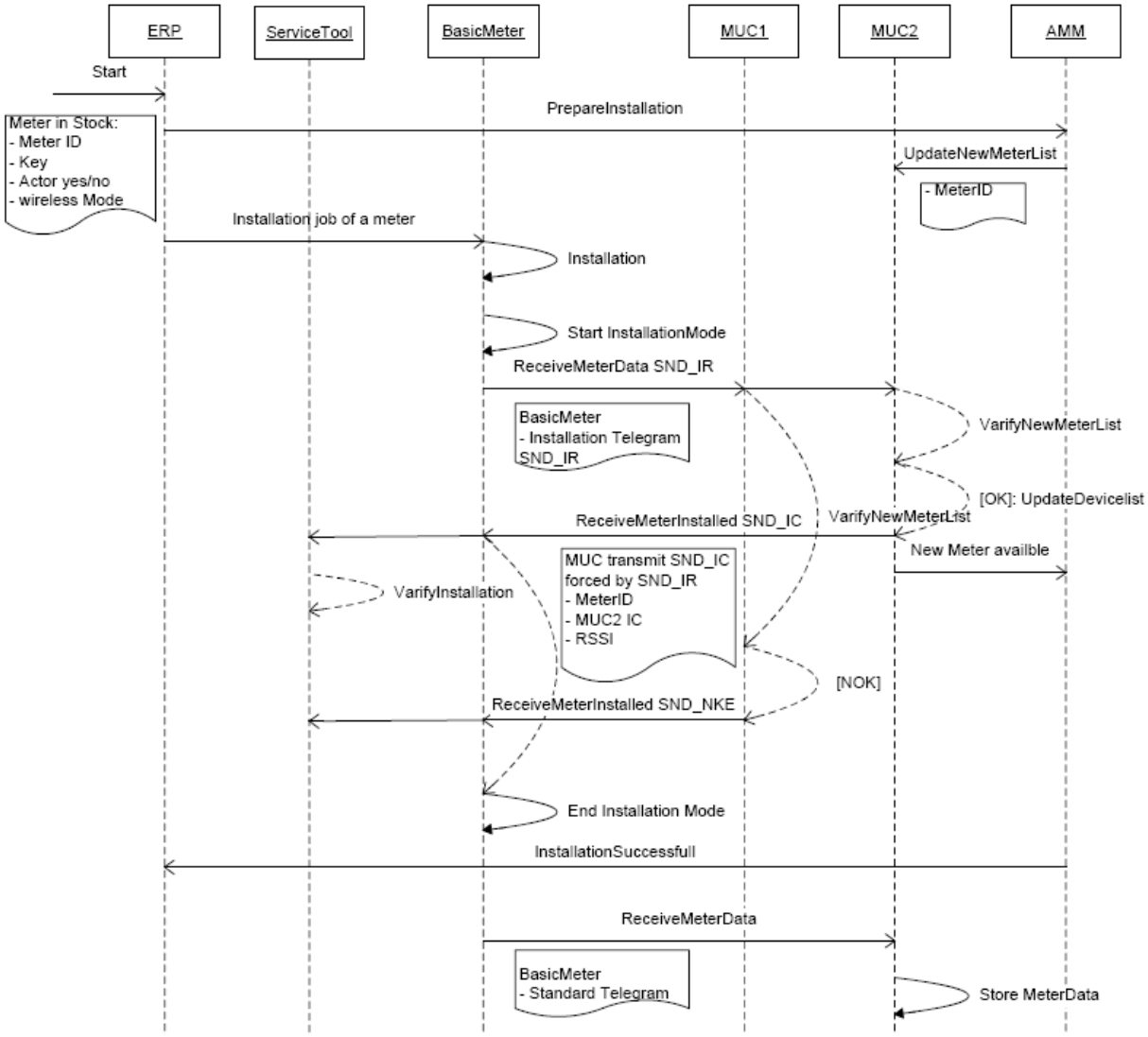

Fig. 9: Optional Installation Mode Soph. Meter

4.4 Configuration Process

[WORKITEM]

The UseCase Configuration describes the parameterisation of metering devices via the MUC. The configuration use case ensures authenticated read or write access to device parameters by the control center.

4.4.1 Write Parameter

Use Case	**Write Parameter**
Metering devices actuators	Gas- / water- / heat- / electricity- meter + HCA Gas / electricity breaker or limiter
Actors	MUC, metering devices, AMMBO
Pre condition	MUC and metering devices are assigned and active. The task is to change a parameter of a metering device.
Scenario	AMMBO sends write command to the MUC. MUC establishes a communication link to the metering device and sends the command. Metering device checks the authentication and authorisation for the command. ➔ Metering device writes the new parameter into its memory. ➔ Metering device sends acknowledge.
Error scenario	Authentication failed, Authorisation failed, selected parameter not permissible, not existing or not changeable: ➔ Denial of parameter write ➔ Metering device sends negative acknowledge.
Notes	The MUC only checks for a valid connection to the metering device. It does not check the configuration command, since e.g. authorisation is checked only at the end points. Anyway an acknowledge is generated. So the absence of it indicates a communication error.

4.4.2 Read Parameter

Use Case	**Read Parameter**
Metering devices actuators	Gas- / water- / heat- / electricity- meter + HCA Gas / electricity breaker or limiter
Actors	MUC, metering devices, AMMBO
Pre condition	MUC and metering devices are assigned and active. The task is to read a parameter of a metering device.
Scenario	AMMBO sends read parameter command to the MUC. MUC establishes a communication link to the metering device and sends the command. Metering device checks the authentication and authorisation for the command. ➔ Metering device reads the parameter. ➔ Metering sends the answer telegram including the parameter value.
Error scenario	Authentication failed, Authorisation failed, selected parameter not permissible or not existing: ➔ Denial of parameter read ➔ Metering device sends negative acknowledge
Notes	The MUC only checks for a valid connection to the metering device. It does not check the configuration command, since e.g. authorisation is checked only at the end points. Anyway an acknowledge is generated. So the absence of it indicates a communication error.

4.5 Data Acquisition

[WORKITEM]

These use cases describes data acquisition procedures between MUC and metering devices and between AMMBO and MUC.

4.5.1 MUC – Metering Device, Unidirectional (DA-1)

Use Case	**Data Acquisition – Metering Device – Generic – Register Value**
Metering devices	Gas- / water- / electricity- / heat- meter
Actors	metering device, MUC
Pre condition	The communication between metering device and the MUC via the primary communication is established. The identification of the metering device indicates it to be processed by the MUC. The metering device sends its data periodically to the MUC.
Scenario	The metering device sends a message via primary communication containing generic register value information. The MUC receives the message. The MUC checks the identification of the metering device to determine, whether the received message must be processed by the MUC. The MUC decodes the received message if necessary. The MUC identifies the register value out of the received message. The MUC checks the status for possible alarm actions and performs this actions. The MUC saves the received message in its internal memory.
Error scenario	The MUC receives a faulty message. ➔ The message will be ignored. The MUC can't decode the received message. ➔ An error state event will be generated and logged in the event log storage of the MUC.
Notes	The AMMBO can detect a permanent disturbance of the data acquisition through missing metering data.

4.5.2 MUC – Metering Device, Bidirectional (DA-2)

Use Case	**Data Acquisition – Metering Device – Generic – Register Value**
Metering devices	Gas- / water- / electricity- / heat- meter
Actors	MUC, metering device
Pre condition	The communication between metering device and the MUC via the primary communication is established. The MUC periodically initiates a data readout towards the metering device.
Scenario	MUC creates the request command (identification, register, and request). MUC encodes the transmitting message if necessary. MUC sends the command and waits for the answer. MUC receives the answer message. MUC checks the identification. MUC decodes the received message if necessary. MUC identifies the register value out of the received message. MUC saves the received message in its internal memory.
Error szenario	The MUC doesn't receive an answer (timeout). ➔ An error state event will be generated and logged in the event log storage of the MUC. The MUC receives a faulty message. ➔ The message will be ignored. The identification of the message is invalid. (MUC doesn't know the metering device). ➔ An error state event will be generated and logged in the event log storage of the MUC. The MUC can't decode the transmitted message. ➔ An error state event will be generated and logged in the event log storage of the MUC.
Notes	Every time the MUC sends a request it expects an answer of the metering device. The AMMBO can detect a permanent disturbance of the data acquisition through the missing metering data.

4.5.3 AMM Back Office – MUC, Pull Mode (DA-3)

Use Case	**Data Acquisition – Metering Device – Generic – Register Value**
Metering devices	Gas- / water- / electricity- / heat- meter
Actors	AMMBO, MUC
Pre condition	The AMMBO has established a connection to the MUC.
Scenario	The AMMBO sends a request command message to the MUC, to get the register value(s) of a certain metering device. MUC receives the request message. MUC decodes the request message if necessary. MUC identifies the request. MUC checks the access rights. MUC reads the requested register value(s) out of its internal memory. MUC builds the response message. MUC encodes the response message if necessary. MUC sends the response message to the AMMBO. AMMBO receives the message and processes it.
Error scenario	MUC receives a faulty command message ➔ The MUC sends an error message to the AMM back office. The MUC can't decode the message. ➔ The MUC sends an error message to the AMMBO (key could be corrupt). The MUC can't identify the request. ➔ The MUC sends an error message to the AMMBO. The MUC denies access to the data. ➔ The MUC sends a denied access response to the AMMBO. The MUC can't find the requested data. ➔ The MUC sends an error message to the AMMBO
Notes	In this case it is the request of the AMMBO system to read the register value(s) of a specific metering device. This is not a spontaneous action due to a change in the status! All requests of the AMMBO are directed towards the MUC. For data acquisition only the data of the MUC's internal memory will be used. The actuality of the data depends on the send intervals of the metering devices. The MUC does not start a new data read request.

4.5.4 AMM Back Office – MUC, Push Mode (DA-4)

Use Case	**Data Acquisition – Metering Device – Generic – Register Value**
Metering devices	Gas- / water- / electricity- / heat- meter
Actors	AMMBO
Pre condition	The MUC is configured to transmit its register values to the AMMBO in regular intervals.
Scenario	The MUC schedules a new register value push information to the AMMBO. The MUC establishes a connection to the AMMBO (if a constant connection is not available). The MUC builds a register value(s) message. The MUC encodes the message if necessary. The MUC sends the message to the AMMBO. The AMMBO receives the message and processes it.
Error scenario	The MUC can't find the configured data in its internal memory (wrong configuration). ➔ The MUC sends an error message to the AMM back office.
Notes	The latest read status of the metering device is used. The actuality of the data depends on the send intervals of the metering devices. The MUC does not start a new data read request.

4.6 Event Handling

Event handling scenarios are described for cases of communication problems or device problems to be written into the event log of the MUC.

4.6.1 MUC – Metering Device, Unidirectional (EH-1)

Use Case	**Data Acquisition – Metering Device – Generic – Status**
Metering devices	Gas- / water- / electricity- / heat- meter
Actors	metering device, MUC
Pre condition	The communication between metering device and the MUC via the primary communication is established. The identification of the metering device indicates it to be processed by the MUC. The metering device sends its data periodically to the MUC. The telegrams contain at least one generic status information of the metering device.
Scenario	Metering device sends a message via primary communication, containing generic status information. MUC receives the message. MUC checks the identification of the metering device to determine, whether the received message must be processed by the MUC. MUC decodes the received message if necessary. MUC identifies the status out of the received message. MUC checks the status for possible alarm actions and performs this actions. The MUC saves the received message in its internal memory.
Error scenario	The MUC receives a faulty message. ➔ The message will be ignored. The MUC can't decode received message. ➔ An error state event will be generated and logged in the event log storage of the MUC.
Notes	The AMMBO can detect a permanent disturbance of the data acquisition through the missing metering data.

5

4.6.2 MUC – Metering Device, Bidirectional (EH-2)

Use Case	**Data Acquisition – Metering Device – Generic – Status**
Metering devices Actuators	Gas- / water- / electricity- / heat- meter, Gas / electricity breaker or limiter
Actors	metering device, MUC
Pre condition	The communication between metering device and the MUC via primary communication is established. The MUC periodically initiates a data readout towards the metering device.
Scenario	MUC defines the request command (identification, status request). MUC encodes the transmitting message if necessary. MUC sends the message and waits for the answer. MUC receives the answer message. MUC checks the identification. MUC decodes the received message if necessary. MUC identifies the status out of the received message. MUC checks the status for possible alarm actions. MUC saves the received message in its internal memory.
Error scenario	The MUC doesn't receive an answer (timeout). ➔ An error state event will be generated and logged in the event log storage of the MUC. The MUC receives a faulty message. ➔ The message will be ignored. The identification of the message is invalid. (MUC doesn't know the metering device). ➔ An error state event will be generated and logged in the event log storage of the MUC. The MUC can't decode the transmitted message. ➔ An error state event will be generated and logged in the event log storage of the MUC.
Notes	Every time the MUC sends a request it expects an answer of the metering device. The AMMBO can detect a permanent disturbance of the data acquisition through the missing metering data.

4.6.3 AMM Back Office – MUC, Pull Mode (EH-3)

Use Case	**Data Acquisition – Metering Device – Generic – Status**
Metering devices Actuators	Gas- / water- / electricity- / heat- meter, Gas / electricity breaker or limiter
Actors	AMMBO, MUC
Pre condition	The AMMBO has established a connection to the MUC.
Scenario	AMMBO sends a request message to the MUC, to get the status of a certain metering device. MUC receives the request message. MUC decodes the request message if necessary. MUC identifies the request. MUC checks the access rights. MUC reads the requested status out of its internal memory. MUC builds the response message. MUC encodes the response message if necessary. MUC sends the response message to the AMMBO. AMMBO receives the message and processes it.
Error scenario	MUC receives a nonconforming request command message ➔ The MUC sends an error message to the AMMBO. The request data decryption by the MUC fails ➔ MUC sends an error message to the AMMBO (the internal decryption key could be wrong) Request with access right violations (authentication procedure fails) ➔ MUC sends a message “access right violation/authentication procedure fails” to the AMMBO MUC finds no current status message for this request within the log file ➔ MUC sends a “no status available” message to the AMM back office The MUC can’t identify the request. ➔ The MUC sends an error message to the AMMBO. The MUC denies access to the data. ➔ MUC sends a denied access response to the AMMBO.
Notes	In this use case the status is requested by the AMMBO from a specific metering device. This is not a spontaneous action due to a change in the status! All requests of the AMMBO are directed towards the MUC. For data acquisition only the data of the MUC’s internal memory will be used. The actuality of the data depends on the send intervals of the metering devices. The MUC does not start a new data read request. All AMM back office requests for a meter/actuator status are addressed to the MUC. For assembling the response, the MUC uses only the log file items. The MUC checks the log file item for being up-to-date over the date/time stamp.

4.6.4 AMM Back Office – MUC, Push Mode (EH-4)

Use Case	**Data Acquisition – Metering Device – Generic – Status**
Metering devices Actuators	Gas- / water- / electricity- / heat- meter, Gas / electricity breaker or limiter
Actors	AMMBO, MUC
Pre condition	The MUC is configured to signal an alarm event to the AMMBO in case of a specific change in the status of a metering device.
Scenario	The MUC detects a status change of a metering device. The MUC evaluates this status change as a request to rise an alarm to the AMMBO. The MUC establishes a connection to the AMMBO (if not a constant connection is available). The MUC builds an alarm message The MUC encodes the message if necessary. The MUC sends the alarm message to the AMMBO. The AMMBO receives the message and processes it.
Error scenario	
Notes	This is the spontaneous action due to the change in the status! The latest read status of the metering device is used. The actuality of the data depends on the send intervals of the metering devices. The MUC does not start a new data read request.

4.6.5 MUC – AMM Back Office (Error Message) (EH-5

Use Case	**Event Handling – Metering Device / Actuator – Generic**
Metering devices Actuator	Gas- / water- / electricity- / heat- meter, Gas / electricity breaker or limiter
Actors	AMMBO, MUC
Precondition	The MUC set-ups a communication link to the AMM back office
Scenario	AMM back office receives the message AMM back office verifies the identification AMM back office decrypt the message
Error scenario	AMM back office receives a nonconforming message ➔ AMM back office sends a retransmit request to the MUC
Notes	The purpose is the real-time message transfer from MUC to AMMBO in the case of a meter fatal error (measurement data are invalid for payment processes) or a actuator fatal error (actuator action may result in a security problem)

4.7 Control Commands

Use cases for control commands describe access to meter devices by a control center (AMMBO). This ensures the resources for cut-off or limitation of the OMS.

Please refer to OMSS Vol. 1 for definitions and recommendations on actuator devices.

4.7.1 Breaker Cut-Off (BR-1)

Use Case	**Cut-Off**
actors	AMMBO, MUC, Actuator (Breaker)
Pre condition	Breaker is installed behind the MUC. MUC and Breaker binding is done. MUC and Breaker are online. No communication is established. AMM is connected to MUC
Scenario	MUV receives disconnection command sent by AMMBO. MUC establishes primary communication to the breaker. MUC sends disconnection command to the breaker device Breaker validates authentication. ➔ Breaker sends acknowledge to MUC. ➔ MUC sends breaker acknowledge to AMMBO (push or pull). Breaker activates disconnection. ➔ All devices behind the breaker are without power/flow. MUC reads back the breaker status and stores the status in its internal memory. ➔ MUC stores event in its internal memory.
Error Scenario 1	Authentication fails ➔ Breaker ignores the command. ➔ MUC reads back the breaker status and stores the status in its internal memory ➔ MUC stores event in its internal memory
Error Scenario 2	Decryption fails ➔ Breaker ignores the command. ➔ MUC reads back the breaker status and stores the status in its internal memory
Error Scenario 3	MUC couldn't send the command: ➔ MUC will sends error message to AMMBO. ➔ AMMBO will retry to place the command again.
Notes	The actuator neither shall accept any reconnection of the disconnection device, by remote order from an end customer device (if such a device exists) nor by an external manual action on the disconnection device, until it receives a new authenticated order to reconnect from the AMMBO.

4.7.2 Read Breaker Status (BR-2)

Use Case	**Read Status**
actors	AMM, MUC Breaker
Pre condition	Breaker is installed behind the MUC. AMMBO is connected to MUC. Every meter readout task reads also the breaker status.
Scenario	AMM sends status read command to MUC MUC answers with the last read breaker status.
Note	

4.7.3 Enable, ON Through Customer (BR-3)

Use Case	**Enable Power-Up**
Actors	AMM, MUC Breaker, Customer
Pre condition	Breaker is installed behind the MUC Breaker state is disconnected MUC and Breaker binding is done. MUC and Breaker are online. No communication is established. AMMBO is connected to MUC.
Scenario	AMMBO sends „Enable Power UP“ command. MUC establishes primary communication to the breaker. MUC sends “Enable Power UP” command to Breaker Device. Breaker validates Authentication. Breaker sends command acknowledge to MUC. Breaker activates „Power UP Enable“. ➔ Customer activates reconnection manually. ➔ MUC reads back the breaker status and stores the status in its internal memory. ➔ MUC stores event in its internal memory.
Error Scenario 1	Authentication failed ➔ Breaker ignores the command. Breaker State is disconnected ➔ MUC reads back the breaker status and stores the status in its internal memory ➔ MUC stores the event in its internal memory
Error Scenario 2	Decryption failed ➔ Breaker ignores the command. Breaker State is disconnected ➔ MUC reads back the breaker status and stores the status in its internal memory
Error Scenario 3	MUC couldn’t send the command: ➔ MUC will sends error message to AMMBO. ➔ AMMBO will retry to place the command again.
Notes	Remote ON without customer interaction is not allowed.

4.8 Clock Synchronisation

The use case clock synchronisation describes the procedures to synchronize the internal clock of the MUC and of the meters (if equipped). All time deviations between the MUC time and the local time should be in line with the final WELMEC recommendations “Time depending consumption measurements for billing purposes” (currently as a draft), where the MUC can be seen as an auxiliary device.

4.8.1 Synchronization of MUC Device Clock (CS-1)

Use Case	**Synchronization of MUC Device Clock**
Actuator	MUC (incl. device clock) NTPv4 Server with asymmetrical signature
Precondition	NTP Server address(-es) are initialized (valid value). Key for verification of signature of NTP time is configured. MUC device clock synchronization interval is initialized (valid value).
Scenario	Synchronization interval has expired -> MUC device clock should be synchronized. MUC sends NTP request to NTP Server. MUC receives NTP response. Signature of received NTP response will be checked. NTP response will be decoded and the deviation between the internal clock will be checked. If deviation is inside allowed range of MUC since last update of time (deviation is <= 1% of measuring interval time in case of interval metering): ➔ internal MUC device clock will be synchronised ➔ Reset “Meter site synch timer”, ➔ allow synchronization of metering point ➔ Reset device status ‘ClockSynchError’ If deviation is outside the allowed range since last time synchronisation (deviation is > 1% of measuring interval time in case of interval metering) : a) ➔ Internal MUC device clock will be set immediately, and this event will be captured in the status belonging to the interval values and log-book if available. ➔ Reset of the ‘Meter site synch timer’. ➔ allow synchronization of metering point ➔ Reset device status ‘ClockSynchError’ or b) ➔ Reset of the ‘Meter site synch timer’ ➔ Internal MUC device clock will be stepwise synchronized with temporary controlled speed up or slow down within certain tolerance to correct deviation (no synchronisation of more than the allowed deviation per measuring period shall apply; the full synchronisation process can take several measuring periods). As long as the synchronisation is in process, no meter point shall be synchronized. ➔ Allow synchronization of metering point. ➔ Reset device status ‘ClockSynchError’.
Error condition	No message from NTP server was received, message is corrupt or signature is wrong: ➔ Enter a retry cycle to acquire the time from the NTP server (perhaps shorter than normal synchronization interval) ➔ Set device status ‘ClockSynchError’ after expiration of validity period after the last successful synchronization. ➔ Continue with the retry cycle for NTP time acquisition. Adjust of MUC device clock failed: ➔ Set device status ‘ClockSynchError’. ➔ Repeat of synchronization after defined time interval (perhaps shorter

	than normal synchronization interval). ➔ Prohibit synchronization of metering point to avoid meters to be set to wrong time. Long term synchronization not successful (“Meter site synch timer” > 48 hours): ➔ Prohibit synchronization of metering point Deviation outside expected accuracy ➔ repeat of synchronization ➔ repeated error condition ➔ Entry in to log-file
Remark	Device status discrimination between ▪ MUC device clock synchronization successful ▪ Synchronization of metering point is possible Date back of device clock is possible Entry into log file in case of error

4.8.2 Synchronization of Metering Device Clock, MUC is Active (CS-2)

Use Case	**Synchronization of metering point device clock, (MUC active)** **the MUC initiates the time synchronisation/ setting of the meter time**
Actuators	MUC (incl. device clock) Metering point
Precondition	MUC device clock is synchronized (synchronization of metering point is allowed) MUC ‘metering point synchronization interval’ is initialized (valid value). It is known which metering device needs synchronization of time (broadcast is not possible!). All authorisation parameters to access the meter (passwords, commands, protocols etc. must be available to the MUC and proper assigned.
Scenario	Synchronization interval has expired -> metering device clock should be synchronized. Check if MUC device clock is synchronized (see above: „Synchronization of MUC device Clock“) For every present metering device with time synchronization the MUC determines the current MUC system time. ➔ MUC sends command of time synchronization with current system time to metering point. ➔ Metering point receives and decodes the command (authenticity, authorization and structure of command). ➔ Metering point sets internal device clock with new time
Error condition	MUC device clock isn’t synchronous (synchronization of metering point forbidden): ➔ Synchronization of the metering device will not be performed. Authenticity, authorization fails and structure of command is faulty ➔ Device clock will not be set
Remark	

4.9 Service Data Chanel (SDC)

[WORKITEM] The SDC as well as this use cases are still in discussion.

4.9.1 Data Readout Using SDC (SD-1)

Precondition: The MUC configuration has a device list with meters that it is responsible for.

a. Meters using Push Mode

- The meter is transmitting its telegram
- The MUC will receive this telegram
- The MUC will validate the telegram and check if the emitting meter is a member of the device list

[if YES]

- The MUC will store the received telegram in its memory with additional data; at least the latest telegram per meter must be stored. If the meter transmits different telegram types (using the telegram type bits in the Signature field) each of these telegrams has to be stored separately. The telegrams will be stored in the format as received with additional data:
  - Time of receive (using MUC synchronized Clock)
  - RSSI value (optional)
- The AMMBO request meter data using service data channel
- If a valid telegram of the meter is in the memory available the data will be transmitted to the AMM including additional data as defined above. The meter telegrams stay unchanged.

b. Meters using Pull Mode

- The AMMBO request meter data using service data channel
- The MUC checks if valid meter data is available

[if NO]

- The MUC is requesting the data from the meter
- The received Meter data is stored within the MUC together with additional data (see above)
- The MUC will transmit the Meter data together with the additional information to the AMM

4.9.2 Data Transfer to the Meter Using SDC (SD-2)

Precondition: AMM knows the routing to the meter and the used primary communication method.

- The AMM will generate the command sequence that should be performed by the meter.
- The AMM will do encryption and signature (optional) as defined in [OMSPC].
- The AMM will transfer the command sequence to the MUC
- The MUC will store at least one command sequence together with one optional subsequent request per meter. If not enough memory is available the new command sequence will not overwrite an existing.
- The MUC will transfer the command sequence as received from the AMMBO to the meter using the proper primary communication methods (M-Bus, wM-Bus, …)
- A Feedback (OK or Error) is given to the AMMBO using SDC at the end of primary communication and the command sequence will be deleted in the memory

5 Annex B: User Concept Example

5.1 Data and Device Access

Data read out and access from or to MUC and metering devices are restricted by an access rights management.

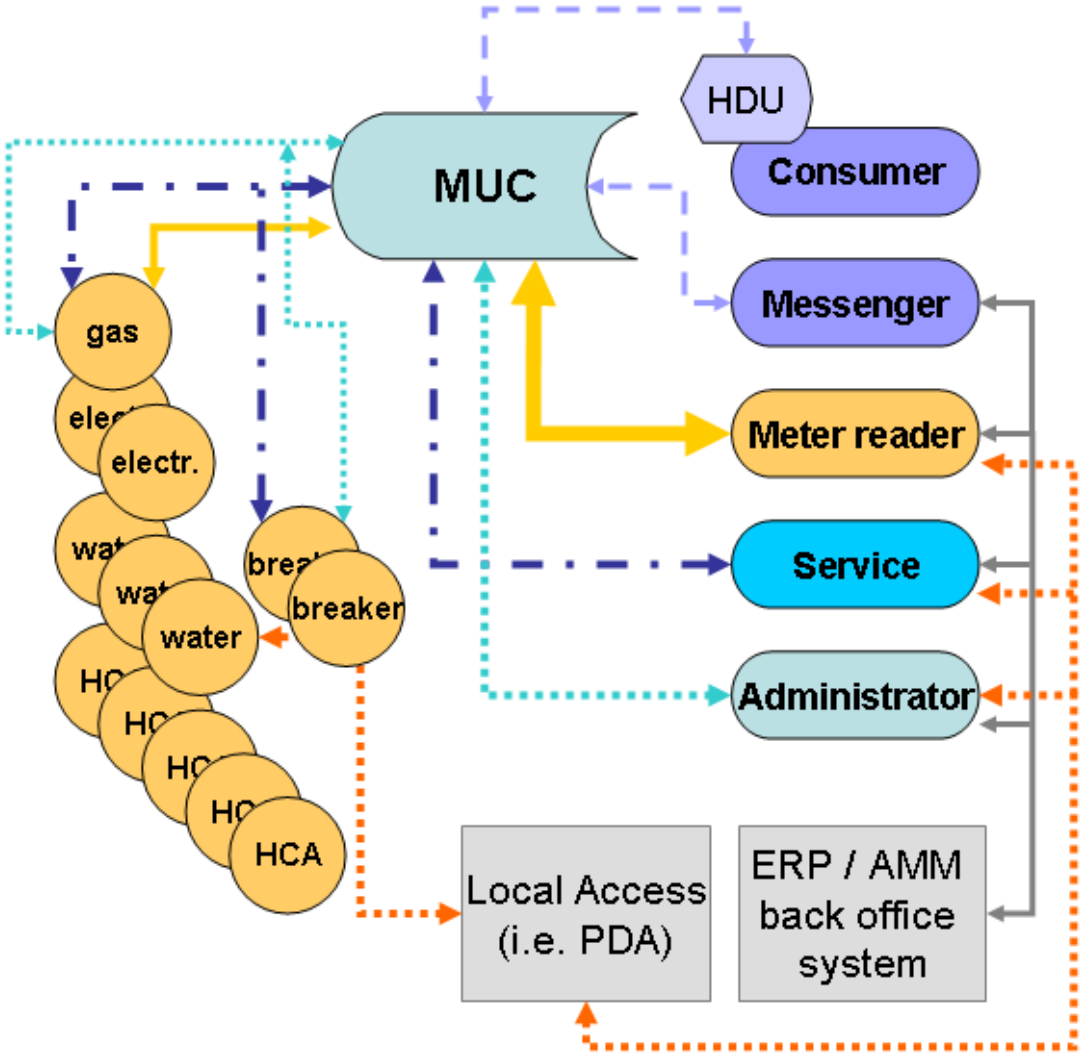

Fig. 10: Users and Data Access

5.2 User Data Fields

The user and access management uses the data fields

- User ID
- User name
- Password
- User group
- Assigned meters

5.3 User Types

5.3.1 Access to a Virgin MUC Device

- A virgin MUC provides a standard user account with a standard password that is only active as long as no users are configured for configuration purposes only:
  - Configuration of a new MUC
  - Set up users, access rights and passwords
  - Assign metering devices to MUC
  - Assign metering devices to meter readers
  - Assign AMM back office system

5.3.2 Access to a Equipped MUC

The MUC access is splitted into 5 levels:

User Group	Access rights	Number of Accounts
Consumer	• read stored data from assigned metering devices • read and operate home automation devices	1 - n
Meter reader	• read stored data and status information from MUC • call data from assigned metering devices	1 - n
Messenger	• Send data to consumers o Tariff information o delivery notes • Get data from consumer o Delivery order o Information request	1 - n
Service	• Restore alarm • set parameters • limited configuration and assignment • send command to actuator (protected by signature) • check communication with all assigned devices	1 - n
Administrator	• read and write configuration • add, change or delete users and access rights • write encryption code • write signature code	Only 1

5.3.3 Access to Sophisticated Metering Device

For access to sophisticated meters additional options are used:

Meter reader	• read stored data and status information from MUC • call data from assigned metering devices	1
Service	• Restore alarm • set parameters • limited configuration and assignment • send command to actuator (protected by signature) • check communication with all assigned devices	1
Administrator	• read and write configuration • add, change or delete users and access rights •	1

6 Annex C: Physical Interface Definitions

[WORKITEM]

6.1 M-Bus Connecting Terminal

6.2 RS485 Interface Connector

6.3 RS232 Interface Connector

6.4 CL1 Interface Connector