Open Metering System Technical Report 12

Transmission of Grid Status Data via wM-Bus; to meet BSI TR-03109-1 TAF for Retrieval of Grid Status Data

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RELEASE

Document History

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Preface

This document was prepared by a subgroup of the OMS Working Group 1 (OMS AG1) “primary communication”.

The document was primarily created to technically describe how the use-case “transmission of grid status data” (e.g. TAF10) according to the technical guideline BSI TR-03109-1 can be fulfilled for meters communicating via radio in the Local Metrological Network (LMN) of a Smart Meter Gateway (SMGW).

The stipulations made in this Technical Report for the M-Bus datagrams are not limited to the use of grid status data TAFs in the SMGW. They may also be implemented for other applications in which measuring devices are to transmit current measuring values by radio with sufficient rate to maintain short registration periods.

This is done in compliance with the restrictions that result from the permissible occupancy of the radio channel [EN13757-4], [REC70-03] and possible collisions with other devices in the same radio channel.

The document was submitted to the relevant authorities of BSI for comment before technical release. It was technically released in OMS AG1, submitted to the members of the OMS Group for comment and then published.

This document is freely available on the website of the OMS Group (www.oms-group.org).

NOTE: This document is only valid for data not falling under legal metrology. The frequent transmission of legal metrology data over M-Bus compact profile is described in [OMS-S2-R].

1 Introduction

In Germany, parts of the specification [OMS-S2] are part of the Technical Guideline of the Federal Office for Information Security BSI TR-03109-1 [BSI/TR03109]. This applies to the mandatory unidirectional radio communication in the Local Metrological Network (LMN) between the meter and the Smart Meter Gateway (SMGW).

The OMS Technical Report 07 [OMS-TR07] from 2020 described how the M-Bus compact profile could be used to have 15-min registration periods registered in the SMGW via radio in accordance with legal metrology.

The detail specification of [BSI/TR03109] version 2 demands the implementation of [OMS-TR07] in the SMGW as mandatory.

The amended German law on measuring point operation and data communication in intelligent energy networks (Metering Point Operation Act) [MsbG] from May 2023 requires that smart electricity metering systems shall also be capable to measure grid status data and to transmit this data regularly via the SMGW.

Grid status data according to the MsbG is defined as voltage and current values and phase angles as well as values that can be calculated or derived from them and that can be processed to determine the grid status. However, in most cases voltage values are sufficient for the monitoring of the grid. Therefore, these values are defined as minimum requirement, and further values may be transmitted additionally.

With the growing implementation of electricity meters with M-Bus radio according to [OMS-S2] which are also able to transmit M-Bus compact profiles according to [OMS-TR07] and [OMS-S2-R] there is the need to add the transmission of grid status data to the already described transmission of billing relevant measuring data.

As grid status data do not fall under legal metrology, there are no legal restrictions to be considered regarding acceptance windows or loss rate.

Therefore, the transmission of the M-Bus datagrams for grid status data do not follow a synchronous transmission scheme, as the M-Bus compact profile according to [OMS-TR07] does. They are placed in-between the transmissions necessary for legal metrology e.g. TAF7, following their own non-synchronous transmission scheme.

As in [OMS-TR07], a compromise between transmit duration and transmission interval shall be used, which makes collisions as unlikely as possible, transmits the required values with sufficient redundancy, and adheres to the duty cycle limit.

The following sections describe the solution proposal, how the datagram for grid status data is to be carried out and how the processing can be carried out in the SMGW.

This document primarily refers to [OMS-S2].

2 Glossary of Terms

This section contains terms and clarifications in addition to [OMS-S1-A], clause 3 References.

In this document, the modal auxiliaries “may”, “should” and “shall” are used as described in [OMS-S1-A]. The verbal form “must” is used as explained in Table 2.1.

Table 2.1 – Glossary table

Term	Description
A	**A**
acceptance window Δt_{AW}	Window, within which a measuring value is considered valid, based on compliance with the requirements for deviation from the legal time and the deviation of the actual length of the registration period from its target value according to [PTB-A50.7], 3.1.7 and [PTB-A50.8], 4.2.1.2 and 4.2.1.3.
actuality duration	M-Bus data value that contains the time difference between creating and sending a value. [EN13757-3]
B	**B**
C	**C**
compact profile	Data record with packed M-Bus data, element of the M-Bus compact profile.
D	**D**
Δt_{AW}	see acceptance window
Δt_{MP}	see measuring period
Δt_{RP}	see registration period
duty cycle	Fraction of one period (e.g. one hour), in which the transmitter is active.
DSO	Distribution System Operator
E	**E**
F	**F**
G	**G**
grid status data	Voltage and current values and phase angles as well as values that can be calculated or derived from them and that can be processed to determine the grid status [MsbG]
H	**H**
HCA	Heat Cost Allocator
I	**I**
J	**J**
K	**K**
L	**L**

Term	Description
M	**M**
measuring period Δt_{MP}	Interval of time a measuring device uses to determine a new measuring value (e.g. 2 seconds for updating the measuring value memory in the measuring device).
M-Bus compact profile	A possibility specified in [EN13757-3] Annex F to transmit a series of measuring values with a fixed time offset.
MsbG	Messstellenbetriebsgesetz – Metering Point Operation Act
must	Verbal form to express an external constraint used to indicate constraints or obligations defined outside of the document e.g. in [BSI/TR03109]. External constraints are not requirements of the document. They are given for the information of the user.
N	**N**
Non-synchronous transmission	Transmissions not following a nominal transmission interval t_{NOM}. Non-synchronous messages may be transmitted according to the timing rules of [EN13757-4]. See also [OMS-S2], 4.3.2.
O	**O**
P	**P**
Q	**Q**
R	**R**
registration period Δt_{RP}	Period for determining an energy measuring value for a load profile or meter reading profile.
S	**S**
Synchronous transmission	Synchronous transmissions follow a strict transmission time scheme. The transmission time scheme is based on a nominal transmission interval t_{NOM}, from which the individual transmission interval t_{ACC} is derived using [EN13757-4], 12.6.2. See also [OMS-S2], 4.3.2.
T	**T**
t_{ACC}	see transmission interval, individual
TAF	Tarifanwendungsfall – tariff use case [BSI/TR03109]
t_{NOM}	see transmission interval, nominal
transmission interval, individual t_{ACC}	Exact time between two subsequent synchronous or periodical transmissions which changes with each transmission. [EN13757-4]
transmission interval, nominal t_{NOM}	Average individual transmission interval between all synchronous or periodical transmissions (new, old or no data content) for wireless meters. [EN13757-4]
transmit duration	On-air time of a datagram or transmission over the radio channel.
U	**U**
UU	Utilisation Unit; a self-contained unit for residential or commercial purposes in a property.
V	**V**
W	**W**
X	**X**

Term	Description
Y	**Y**
Z	**Z**

3 References

For dated references only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

[BSI/TR03109]	Technische Richtlinie BSI TR-03109-1 Anforderungen an die Interoperabilität der Kommunikationseinheit eines intelligenten Messsystems, Version 2.0, Datum 2024-12-13, https://www.bsi.bund.de/DE/Themen/Unternehmen-und-Organisationen/Standards-und-Zertifizierung/Smart-metering/Smart-Meter-Gateway/TechnRichtlinie/TR_03109-1_node.html
[CEN/TR17167]	CEN/TR 17167:2023 Communication system for meters – Accompanying TR to EN 13757-2, -3 and 7, Examples and supplementary information
[CONSENTEC]	Standardisiertes Vorgehen für die Durchführung von Netzzustands-ermittlungen auf Basis von Echtzeit-Messwerten in der Niederspannung, Studie im Auftrag von Forum Netztechnik/Netzbetrieb im VDE (VDE FNN), 12. Dezember 2024, https://www.vde.com/resource/blob/2362498/eb3ec76a6b56d6bdb0427c7baa50ddcf/vde-fnn-studie-netzzustandsermittlung-niederspannung-data.pdf
[EN13757-2]	EN 13757-2:2018+A1:2023 Communication systems for meters – Part 2: Wired M-Bus communication
[EN13757-3]	EN 13757-3:2018 Communication systems for meters – Part 3: Application protocols
[EN13757-4]	EN 13757-4:2019 Communication systems for meters – Part 4: Wireless M-Bus communication
[EN13757-7]	EN 13757-7:2018 Communication systems for meters – Part 7: Transport and security services
[FNN_LH_BZ]	FNN-Hinweis Lastenheft Basiszähler Funktionale Merkmale v1.4.1, https://www.vde.com/resource/blob/2345790/e6c822aa22d51592aba388f6a5ceaed2/fnn-hinweis--lastenheft-basiszaehler---funktionale-merkmale---2018--data.pdf
[MsbG]	Gesetz über den Messstellenbetrieb und die Datenkommunikation in intelligenten Energienetzen (Messstellenbetriebsgesetz – MsbG), https://www.gesetze-im-internet.de/messbg/MsbG.pdf
[OMS-CT]	OMS-Conformance-Test-Specification 4.0 Release 8, https://oms-group.org/zertifizierung/
[OMS-DVGW]	Analyse der Funkkollisionen für BSI-konforme Gaszähler, OMS AG1 für DVGW G-PK-1-5-5 (Zukunft der Haushaltsgasmessung), Oktober 2017
[OMS-S1]	OMS Specification Volume 1, General Part, Issue 2.4.1, https://oms-group.org/spezifikationen/
[OMS-S1-A]	Annex A to Volume 1 General – Glossary of Terms used in or related to OMS, https://oms-group.org/spezifikationen/
[OMS-S2]	OMS Specification Volume 2, Primary Communication, Issue 5.0.1, https://oms-group.org/spezifikationen/
[OMS-S2-A]	Annex A to Volume 2: Primary Communication – OBIS-Code List – Release F, https://oms-group.org/spezifikationen/
[OMS-S2-B]	Annex B to Volume 2: Primary Communication – OMS-Data Point List – Release G, https://oms-group.org/spezifikationen/

[OMS-S2-R] Annex R to Volume 2: Primary Communication – Meter Reading Transmission via M-Bus Compact Profile; to meet BSI TR-03109-1 TAF7 – Release A, https://oms-group.org/spezifikationen/

[OMS-TR07] OMS Technical Report 07 – Meter Reading Transmission via M-Bus Compact Profile; to meet BSI TR-03109-1 TAF7, Version 1.0.1, https://oms-group.org/spezifikationen/

[REC70-03] ERC Recommendation 70-03 Relating to the use of Short Range Devices (SRD); Tromsø 1997, Subsequent amendments, 12 February 2021, https://docdb.cept.org/download/25c41779-cd6e/Rec7003e.pdf

4 Requirements from [BSI/TR03109]

4.1 General

[BSI/TR-03109] describes the requirements for the interoperability for the communication unit of smart metering systems and has been issued by the Federal Office for Information Security of Germany (BSI). Due to the German Metering Point Operation Act (MsbG) the requirements, described in [BSI/TR-03109], are mandatory for all Smart Meter Gateways (SMGW) in Germany.

[BSI/TR-03109] specifies the data communications for each of the physical interfaces, data logging, as well as further functional and non-functional aspects of the SMGW. The aspects of [BSI/TR-03109] that are relevant for the present OMS-TR are summarised in the following sections.

4.2 Possible Data Points for Grid Status Data

The SMGW can be used for tariffing and billing, however it can also be used to measure and communicate grid status data. One tariffing use case (TAF) in [BSI/TR03109] is explicitly designated for grid status data: “TAF10: Retrieval of grid status data”.

TAF10 enables the SMGW to capture and transmit grid status data. Meter values are transmitted periodically. If configured, the registration of meter values according to TAF10 starts as soon as a certain threshold is crossed. Also, the SMGW must be able to transmit one single meter value upon request by an eligible External Market Participant (EMT). For TAF10, the OBIS codes according to Table 4.1 must be supported by the SMGW.

Table 4.1 – Possible data points from meter to SMGW for TAF10

OBIS code	Quantity
1-0:36.7.0.255	Active power L_1 instantaneous value [a]
1-0:56.7.0.255	Active power L_2 Instantaneous value [a]
1-0:76.7.0.255	Active power L_3 instantaneous value [a]
1-0:16.7.0.255	Active power delta (import - export) (P), instantaneous value, total [a]
1-0:31.7.0.255	Current: L_1 phase
1-0:51.7.0.255	Current: L_2 phase
1-0:71.7.0.255	Current: L_3 phase
1-0:14.7.0.255	Supply frequency
1-0:81.7.1.255	Angle from $U(L_2)$ to $U(L_1)$
1-0:81.7.2.255	Angle from $U(L_3)$ to $U(L_1)$
1-0:81.7.4.255	Angle from $I(L_1)$ to $U(L_1)$
1-0:81.7.15.255	Angle from $I(L_2)$ to $U(L_2)$
1-0:81.7.26.255	Angle from $I(L_3)$ to $U(L_3)$
1-0:32.7.0.255	Voltage: L_1 phase
1-0:52.7.0.255	Voltage: L_2 phase
1-0:72.7.0.255	Voltage: L_3 phase
[a] Active power defined as |(QI + QIV)| - |(QII + QIII)|	

As stated above, the SMGW must support the reception and processing of the OBIS codes listed in Table 4.1, but it is by far not necessary to transmit all the above values from the meter. A basic set is sufficient. With that basic set, all other relevant values can be calculated. The basic set is outlined in clause 6.

NOTE: It is recommended to minimize the payload of a message, to reduce channel occupancy and to keep the duty cycle limits.

There are other TAFs in [BSI/TR03109], which contain a subset of the OBIS codes possible in TAF10. These are TAF9 and TAF14. They serve other purposes than the retrieval of grid status data.

TAF9 enables the SMGW to capture and transmit the current energy production. Meter values are transmitted periodically. If configured, the transmission of meter values according to TAF9 starts as soon as a certain threshold is reached. Also, it must be possible to transmit one single meter value upon request by an eligible External Market Participant (EMT). For TAF9, the SMGW must be able to capture the OBIS codes according to Table 4.2.

Table 4.2 – Possible data points from meter to SMGW for TAF9

OBIS code	Quantity
1-0:36.7.0.255	Active power L_1 instantaneous value [a]
1-0:56.7.0.255	Active power L_2 instantaneous value [a]
1-0:76.7.0.255	Active power L_3 instantaneous value [a]
1-0:16.7.0.255	Active power $\sum L_i$ instantaneous value [a]
[a] Active power defined as |(QI + QIV)| - |(QII + QIII)|	

TAF14 enables the SMGW to capture and transmit meter data for value added services. Meter values are transmitted periodically. If configured, the transmission of meter values according to TAF14 starts as soon as a certain threshold is reached. Also, it must be possible to transmit each meter value upon arrival at the SMGW. For TAF14, the OBIS codes according to Table 4.3 must be supported by the SMGW.

Table 4.3 – Possible data points from meter to SMGW for TAF14

OBIS code	Quantity
1-0:1.8.0.255	Meter reading active energy import
1-0:21.8.0.255	Meter reading import active energy for L_1
1-0:41.8.0.255	Meter reading import active energy for L_2
1-0:61.8.0.255	Meter reading import active energy for L_3
1-0:2.8.0.255	Meter reading export active energy
1-0:22.8.0.255	Meter reading export active energy for L_1
1-0:42.8.0.255	Meter reading export active energy for L_2
1-0:62.8.0.255	Meter reading export active energy for L_3
1-0:5.8.0.255	Meter reading import reactive energy inductive QI
1-0:6.8.0.255	Meter reading import reactive energy capacitive QII
1-0:7.8.0.255	Meter reading export reactive energy inductive QIII
1-0:8.8.0.255	Meter reading export reactive energy capacitive QIV
1-0:16.7.0.255	Active power $\sum L_l$ instantaneous value [a]
1-0:36.7.0.255	Active power L_1 instantaneous value [a]
1-0:56.7.0.255	Active power L_2 Instantaneous value [a]
1-0:76.7.0.255	Active power L_3 instantaneous value [a]
[a] Active power defined as $|(QI + QIV)| - |(QII + QIII)|$	

TAF9 with Table 4.2 and TAF14 with Table 4.3 are only listed for documentary purpose. The relevant TAF for grid status data is TAF10.

4.3 Temporal Resolution

The requirements regarding the temporal resolution are the same for TAF9, TAF10, and TAF14. The SMGW must support a registration and transmission period of 60 seconds; it may additionally support different registration and transmission periods.

For the registration of ad-hoc values, the SMGW must support a registration period of 60 seconds. It may additionally support different registration periods.

4.4 Transmission Security

The requirements regarding transmission security shall be the same as with every other unidirectional radio communication over the LMN. They are described in [BSI/TR03109].

4.5 Availability

There are no requirements regarding the availability of the grid status data in [BSI/TR03109], as the measurement values used as grid status data are not relevant for billing.

Technical recommendations for the availability of grid status data deemed as good practice by the grid operators (low-voltage DSO level) are not known.

5 Transmission Requirements

The TAF10 transmissions are required very frequently and in addition to possible TAF7 transmissions. The requirement for many data points results in a very long datagram. The longer the messages are, the more likely they are to be disrupted due to collision with other datagrams transmitted on the same channel. Therefore, the datagrams should be kept short, i.e. consist of only the necessary data points.

Also, the use of the channel should be limited so that other measuring devices and other applications can coexist on the same channel. Therefore, the transmission interval should be short enough to allow the intended use of the data transmitted, but not shorter.

Finally, the device shall ensure that it always complies with the legal requirements for the duty cycle, see [REC70-03].

Therefore, a compromise is chosen between the highest possible availability on the one hand and a low probability of collision in the radio channel on the other hand. This is done by limiting the possible data points as given in Table 4.1 to the data points listed in Table 6.1. With respect to transmit duration, data redundancy is kept to a simple redundancy i.e. the values for registration period *n* are sent with transmission *n* and again with transmission *n* + 1. The datapoints to realize redundant transmission in n + 1 shall be coded with storage number 3.The transmission interval is set to 60 seconds, not following a synchronous transmission scheme.

6 Specification

Grid status data shall be generated every 60 seconds. The TAF10 transmission is independent from the synchronous transmission. It shall be transmitted as a non-synchronous transmission (with a cleared bit S (according to [OMS-S2]). In case of collision due to parallel synchronous transmission, the synchronous transmission shall be preferred. The TAF10 message shall be transmitted every minute. The transmission time shall fluctuate with a random scatter. The fluctuations shall be evenly distributed over a period of at least ± 1 second. It is recommended to have a minimum deviation of at least the duration of the datagram transmission. The actuality duration of the most recent value shall not exceed 30 seconds. The actuality duration for the penultimate value shall not exceed 90 seconds.

As most of the meters will communicate unidirectional, the configuration and the content of the wM-Bus datagrams cannot be configured in field after installation. Therefore, a meter manufacturer / meter operator needs to know the required TAF in advanced. Table 6.1 specifies the minimum requirements of deliverable grid status data for TAF10.

Table 6.1 – Minimum requirement of data from meter to realise all OBIS codes for TAF10

OBIS code	Quantity
1-0:32.7.0.255	Voltage: L_1 phase
1-0:52.7.0.255	Voltage: L_2 phase
1-0:72.7.0.255	Voltage: L_3 phase

Every datagram shall contain the datapoint actuality duration DP1! according to [OMS-S2], Annex B to indicate the time difference between generating the measurement values and transmission. If the same message contains the redundant datapoints, the datapoint DP1!B shall be included.

An example with content is shown in Annex A.

7 Processing by the SMGW

7.1 General

The following is an informative description of how an SMGW processes the measuring values delivered over wM-Bus.

The goal is:

1. Reconstruction of the individual measuring values (i.e. meter readings) and time stamps of the measuring values.
2. Storage of the received and selected measuring values from the different datagrams.

The steps described here are limited to essential functionality. Details on measuring value reception and measuring value processing can be found in the referenced documents.

7.2 Reception of Measuring Values (SMGW OMS receiver)

If the SMGW receives an OMS datagram, it first creates the reception timestamp from the synchronised legal time. If the sender of the datagram is registered in the SMGW by means of a meter profile and thus their master key is known, it derives the corresponding keys to verify the integrity and authenticity and to decrypt the content data.

The decrypted data is interpreted as described in [OMS-S2]. The timestamps of the measuring values are reconstructed with the reception timestamp of the datagram and the actuality duration, being a datapoint in the datagram. The actuality duration is described in [OMS-S2].

With this actuality duration the SMGW can reconstruct the timestamp of each measuring value constructed by the meter, even if it differs from the sending timestamp of the meter. All new measuring values of the datagram are stored in the SMGW. If a measuring value is received repeatedly, e.g. with the following datagram, the SMGW determines that it has already stored the value for this timestamp and this OBIS code, and the redundant received measuring value is discarded.

If Grid Status Data are requested from the SMGW, best practice is to provide the last stored values instead of waiting for new ones.

The OBIS codes and therefore the measuring values can be assigned to the TAF profiles installed in the SMGW. For TAF9, TAF10 and TAF14 the SMGW requires the grid status data in a 60 second time interval (see also 4.3).

Based on the data provided by the meter, best practice is to calculate additional Grid Status Data by the SMGW if assigned by the TAF.

7.3 Lost Datagrams

Various reasons can lead to a datagram being lost during transmission. If a datagram is not received by the SMGW, the redundantly transmitted measuring value from the next datagram can be interpreted and stored. From each datagram, the SMGW stores all measuring values that have not yet been stored with their reconstructed timestamps, thus also the so far unknown redundantly transmitted measuring values.

If more than one consecutive datagram is not received and one or more measuring values cannot be reconstructed from redundantly transmitted data, then these measuring values are missing to fulfil the grid status data time interval in the SMGW. Missing measuring values for not billing relevant TAFs (e.g. TAF9, TAF10, TAF14) are not padded with replacement values by the SMGW.

8 Collision Scenarios and Data Availability

8.1 Description of the Simulation

Additionally, to the TAF7 datagrams, which are specified in [OMS-TR07], the TAF10 requires additional data points to be transmitted within the interval of a TAF7 interval.

The TAF10 data points shall be sent every minute with a redundancy of one. Overall, this makes two additional datagrams within two TAF7 datagrams. The TAF10 datagrams are not sent with a synchronous timing but the time shall jitter to reduce the possibility of collisions.

Figure 8.1 shows a possible timing for the TAF10 datagrams within an exemplary interval of 120 seconds of the TAF7 datagrams.

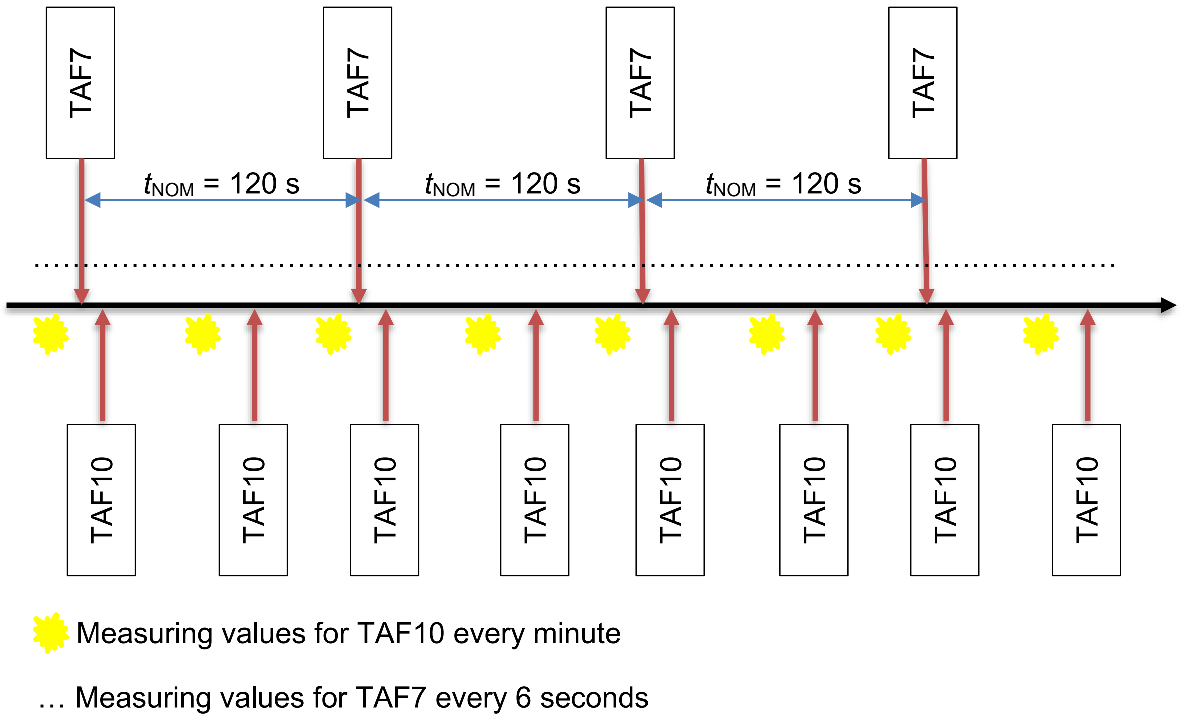

Figure 8.1 - Possible timing for the TAF10 intervals

For each meter in the simulation the TAF7 datagrams are distributed over a defined time period with a t_{NOM} of 120 seconds. The two TAF10 datagrams are inserted between two TAF7 datagrams. Here they are arbitrarily distributed between the measuring intervals.

Then the ratio of the received TAF10 and TAF7 datagrams is calculated.

Table 8.1 summarises the parameters used for the simulation. In the simulation the ratio of received E-meters is calculated for the following scenarios:

- The E-meter send only TAF7 datagrams.
- The E-meter send TAF7 and TAF10 datagrams. The ratio of the received TAF10 datagrams is calculated.
- The E-meter send TAF7 and TAF10 datagrams. The ratio of the received TAF7 datagrams that are disturbed by the TAF10 datagrams is calculated.

Table 8.1 – Meter values for the simulation

Type of meter	№ per UU [a]	№ per radio cell	Registration period Δt_{RP} [min]	Acceptance window Δt_{AW} [s]	Measuring interval [s]	Transmission interval t_{NOM} [s]	Data bytes (APL) [byte]	Gross payload encr. with CRC [byte]	Transmit duration [ms]	Mode
E-meter TAF7	1	40	15	9	6	120	112	241	19,92	C
E-meter TAF10			1	360	60	60	142	205	18,32	C
Gas meter	0,2	8	60	36		18	20	88	11,1	T
HCA	5	200	1.440	864		30	20	78	9,9	T
Water meter	2	80	1.440	864		30	20	88	11,1	T
Thermal energy meter	1	40	1.440	864		30	30	96	12,0	T
Smoke alarm	3	120		0		30	20	78	9,9	T
Jammer		4		xx		5			5,0	T
Total	**12,2**	**492**								

[a] Utilisation Unit; a self-contained unit for residential or commercial purposes in a property.

8.2 Result of the Simulation

In the simulation, the meters are randomly scattered in a predetermined room. Only the total number is varied. The number of individual meters is allocated proportionally. The simulation considers a more complex case with nine data values, instead of the three minimal required data values, as described in Table 6.1.

Since this is a statistical simulation, many simulations are averaged for the result.

Figure 8.2 shows the percentage of meters that do not arrive at the gateway:

- "TAF7 (without TAF10)" is the simulation with only TAF7 datagrams.
- "TAF10 (with TAF7)" is the simulation for the ratio of received TAF10 datagrams with TAF7 and TAF10 datagrams.
- "TAF7 (with TAF10)" is the simulation for the ratio of received TAF7 datagrams with TAF7 and TAF10 datagrams.

It can be clearly seen that under these simulation conditions, the TAF10 datagrams have a much worse reception-ratio than the TAF7 datagrams. Whereas the disturbance of the TAF7 datagrams due to the additional TAF10 datagrams is marginal.

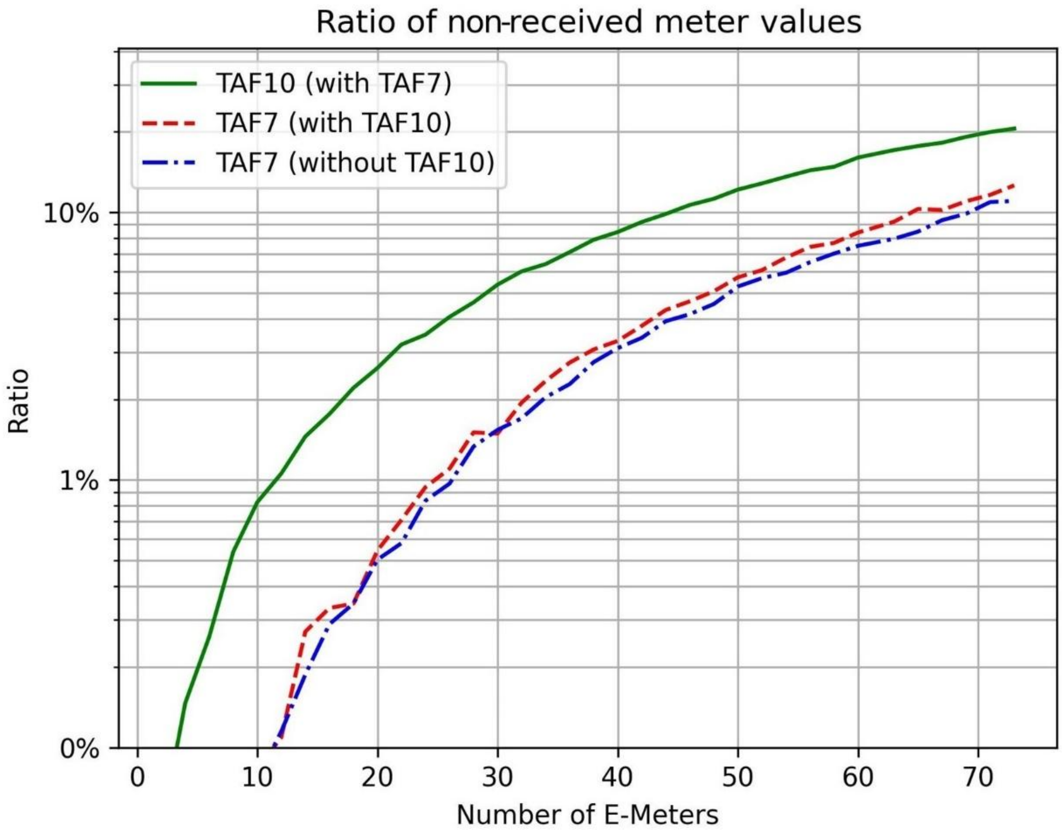

Figure 8.2 – Percentage of non-received electricity meter values

Annex

Annex A Datagram Example

In this example (see Table A.1) an electricity meter is used, which measures the grid status data values every second (measuring period) and stores the values every 60 seconds (registration period). This example shows a more complex scenario with nine data values, instead of the minimal required data values, that are described in Table 6.1. The datagram is sent out approximately every 60 seconds. The SMGW interprets the incoming data and stores the latest (newest) measuring values. If the measuring values in the datagram with the time stamp *t* - 1 minute are not already stored in the SMGW, those values are stored, too.

The radio datagram contains the following data points:

- Current values of voltage, current and phase angle ($\varphi_{I \to U}$) for all three phases (with storage number = 0)
- Preceding values (t – 1 min) of voltage, current and phase angle ($\varphi_{I \to U}$) for all three phases (with storage number = 3)
- Actuality duration (with storage number = 3)
- Error flag

The current and the preceding values shall be transmitted according to [OMS-S2-A]. The time offset between the last measurement and the radio transmission is recorded in the actuality duration (10 seconds in the example).

The transmission of the data point “error flag” is optional.

The transmission takes place in the OMS datagram with security profile B using a Master Key (MK) and the Encryption Session Key (K_{enc}) and MAC Session Key (K_{mac}) derived from it.

- MK = 00 01 02 03 04 05 06 07 08 09 0A 0B 0C 0D 0E 0F
- K_{enc} = 32 4B 96 96 E2 02 40 97 6D 26 B6 96 F8 B4 1A 3A
- K_{mac} = 82 FB D1 EB 2A 35 78 BC 2F 3E 5A 44 8A D3 D7 F5

Table A.1 – Example datagram

Byte №	Field name	Content	Bytes [hex] plain	Bytes [hex] AES coded
1	L Field	Length of data (195 bytes)		C3h
2	C-Field	SND-NR		44h
3	M-Field	Manufacturer code		A7h
4	M-Field	Manufacturer code		3Dh
5	A-Field	Ident No LSB (BCD)		67h
6	A-Field	Ident No (BCD)		45h
7	A-Field	Ident No (BCD) (= 01234567)		23h
8	A-Field	Ident No MSB (BCD)		01h
9	A-Field	Version (or Generation number)		01h
10	A-Field	Device type (Electricity meter)		02h
11	CRC1			77h
12	CRC1			60h
13	CI-Field	Extended Link Layer (short)		8Ch
14	CC-Field	Communication Control		20h
15	Access No.	ELL-Access number		0Ah
16	CI-Field	Authentication and Fragmentation layer		90h

Byte №	Field name	Content	Bytes [hex] plain	Bytes [hex] AES coded
17	AFLL	AFL Length (all AFL bytes after AFLL)		0Fh
18	FCL	Fragmentation Control Field (LSB)		00h
19	FCL	Fragmentation Control Field (MSB)		2Ch
20	MCL	Message Control Field		25h
21	MCR	Message Counter C (LSB)		00h
22	MCR	Message Counter C		00h
23	MCR	Message Counter C (...)		00h
24	MCR	Message Counter C (MSB)		00h
25	MAC	AES-CMAC (MSB)		D4h
26	MAC	AES-CMAC		70h
27	MAC	AES-CMAC		6Bh
28	MAC	AES-CMAC		B5h
29	CRC2			CAh
30	CRC2			E9h
31	MAC	AES-CMAC		CBh
32	MAC	AES-CMAC		99h
33	MAC	AES-CMAC		DCh
34	MAC	AES-CMAC (LSB)		12h
35	CI-Field	Transport Layer (short)		7Ah
36	Access No.	TPL-Access number		0Ah
37	Status	M-Bus state contents errors and alerts		00h
38	ConfigField	NNNNPIIIb		A0h
39	ConfigField	CCZMMMMMb		07h
40	CFE	0VDDKKKKb		10h
41	AES-Verify	Encryption verification	2Fh	A8h
42	AES-Verify	Encryption verification	2Fh	1Dh
43	DR1	Voltage on phase L1, instantaneous value	02h	88h
44	DR1	VIB	FDh	3Dh
45	DR1	V 10e-1	C8h	Ach
46	DR1	Extension	FCh	8Ch
47	CRC3			07h
48	CRC3			DFh
49	DR1	Phase L1	01h	2Eh
50	DR1	Current value (LSB: 230,2 V)	FEh	05h
51	DR1	Current value (MSB)	08h	E5h
52	DR2	Voltage on phase L2, instantaneous value	02h	17h
53	DR2	VIB	FDh	5Dh
54	DR2	V 10e-1	C8h	F4h
55	DR2	Extension	FCh	A4h
56	DR2	Phase L2	02h	38h
57	DR2	Current value (LSB: 230,4 V)	00h	6Fh
58	DR2	Current value (MSB)	09h	2Eh
59	DR3	Voltage on phase L3, instantaneous value	02h	FAh
60	DR3	VIB	FDh	1Bh
61	DR3	V 10e-1	C8h	29h

Byte №	Field name	Content	Bytes [hex] plain	Bytes [hex] AES coded
62	DR3	Extension	FCh	33h
63	DR3	Phase L3	03h	3Ch
64	DR3	Current value (LSB: 230,6 V)	02h	7Bh
65	CRC4			AFh
66	CRC4			8Dh
67	DR3	Current value (MSB)	09h	9Dh
68	DR4	Current on phase L1, instantaneous value	02h	98h
69	DR4	VIB	FDh	15h
70	DR4	A 10e-2	DAh	10h
71	DR4	Extension	FCh	86h
72	DR4	Phase L1	01h	ACh
73	DR4	Current value (LSB: 6,12 A)	64h	83h
74	DR4	Current Value (MSB)	02h	86h
75	DR5	Current on phase L2, instantaneous value	02h	2Bh
76	DR5	VIB	FDh	2Fh
77	DR5	A 10e-2	DAh	CCh
78	DR5	Extension	FCh	CFh
79	DR5	Phase L2	02h	09h
80	DR5	Current value (LSB: 6,23 A)	6Fh	BFh
81	DR5	Current value (MSB)	02h	0Dh
82	DR6	Current on phase L3, instantaneous value	02h	20h
83	CRC5			D1h
84	CRC5			79h
85	DR6	VIB	FDh	CAh
86	DR6	A 10e-2	DAh	F6h
87	DR6	Extension	FCh	5Dh
88	DR6	Phase L3	03h	3Fh
89	DR6	Current value (LSB: 6,34 A)	7Ah	51h
90	DR6	Current value (MSB)	02h	C8h
91	DR7	Angle between current and voltage on phase L1, instantaneous value	02h	85h
92	DR7	VIB	FBh	E0h
93	DR7	Phase I-U (current to voltage) [0,1°]	A3h	2Ch
94	DR7	Extension	FCh	E7h
95	DR7	Phase L1	01h	B1h
96	DR7	Current value (LSB: 1,0°)	0Ah	CBh
97	DR7	Current value (MSB)	00h	34h
98	DR8	Angle between current and voltage on phase L2, instantaneous value	02h	74h
99	DR8	VIB	FBh	0Fh
100	DR8	Phase I-U (current to voltage) [0,1°]	A3h	61h
101	CRC6			72h
102	CRC6			67h
103	DR8	Extension	FCh	03h
104	DR8	Phase L2	02h	94h
105	DR8	Current value (LSB: 2.0°)	14h	D2h

Byte №	Field name	Content	Bytes [hex] plain	Bytes [hex] AES coded
106	DR8	Current value (MSB)	00h	B8h
107	DR9	Angle between current and voltage on phase L3, instantaneous value	02h	9Dh
108	DR9	VIB	FBh	CFh
109	DR9	Phase I-U (current to voltage) [0,1°]	A3h	4Ch
110	DR9	Extension	FCh	99h
111	DR9	Phase L3	03h	5Ch
112	DR9	Current value (LSB: 3,0°)	1Eh	9Ah
113	DR9	Current value (MSB)	00h	6Eh
114	DR10	DIF (Storage number 0)	01h	53h
115	DR10	VIF (Actuality duration)	74h	02h
116	DR10	Value (10 s)	0Ah	18h
117	DR11	Voltage on phase L1, penultimate value	C2h	3Dh
118	DR11	Storage number 3	01h	24h
119	CRC7			95h
120	CRC7			21h
121	DR11	VIB	FDh	CCh
122	DR11	V 10e-1	C8h	51h
123	DR11	Extension	FCh	F8h
124	DR11	Phase L1	01h	10h
125	DR11	Current value (LSB: 230,2 V)	FEh	79h
126	DR11	Current value (MSB)	08h	72h
127	DR12	Voltage on phase L2, penultimate value	C2h	F6h
128	DR12	Storage number 3	01h	6Fh
129	DR12	VIB	FDh	60h
130	DR12	V 10e-1	C8h	14h
131	DR12	Extension	FCh	03h
132	DR12	Phase L2	02h	6Bh
133	DR12	Current value (LSB: 230,4 V)	00h	9Ah
134	DR12	Current value (MSB)	09h	C9h
135	DR13	Voltage on phase L3, penultimate value	C2h	4Ch
136	DR13	Storage number 3	01h	59h
137	CRC8			1Ah
138	CRC8			34h
139	DR13	VIB	FDh	DCh
140	DR13	V 10e-1	C8h	35h
141	DR13	Extension	FCh	BAh
142	DR13	Phase L3	03h	CDh
143	DR13	Current value (LSB: 230,6 V)	02h	83h
144	DR13	Current value (MSB)	09h	B1h
145	DR14	Current on phase L1, penultimate value	C2h	C1h
146	DR14	Storage number 3	01h	32h
147	DR14	VIB	FDh	CFh
148	DR14	A 10e-2	DAh	24h
149	DR14	Extension	FCh	96h

Byte №	Field name	Content	Bytes [hex] plain	Bytes [hex] AES coded
150	DR14	Phase L1	01h	6Ch
151	DR14	Current value (LSB: 6,12 A)	64h	50h
152	DR14	Current value (MSB)	02h	69h
153	DR15	Current on phase L2, penultimate value	C2h	BDh
154	DR15	Storage number 3	01h	0Eh
155	CRC9			58h
156	CRC9			96h
157	DR15	VIB	FDh	E8h
158	DR15	A 10e-2	DAh	29h
159	DR15	Extension	FCh	46h
160	DR15	Phase L2	02h	88h
161	DR15	Current value (LSB: 6,23 A)	6Fh	B2h
162	DR15	Current value (MSB)	02h	27h
163	DR16	Current on phase L3, penultimate value	C2h	23h
164	DR16	Storage number 3	01h	A3h
165	DR16	VIB	FDh	64h
166	DR16	A 10e-2	DAh	87h
167	DR16	Extension	FCh	C2h
168	DR16	Phase L3	03h	97h
169	DR16	Current value (LSB: 6,34 A)	7Ah	57h
170	DR16	Current value (MSB)	02h	78h
171	DR17	Angle between current and voltage on phase L1, penultimate value	C2h	4Bh
172	DR17	Storage number 3	01h	89h
173	CRC10			69h
174	CRC10			EEh
175	DR17	VIB	FBh	B0h
176	DR17	Phase I-U (current to voltage) [0,1°]	A3h	9Ah
177	DR17	Extension	FCh	6Dh
178	DR17	Phase L1	01h	E2h
179	DR17	Current value (LSB: 1,0°)	0Ah	5Ch
180	DR17	Current value (MSB)	00h	7Ah
181	DR18	Angle between current and voltage on phase L2, penultimate value	C2h	D1h
182	DR18	Storage number 3	01h	02h
183	DR18	VIB	FBh	48h
184	DR18	Phase I-U (current to voltage) [0,1°]	A3h	57h
185	DR18	Extension	FCh	7Ah
186	DR18	Phase L2	02h	53h
187	DR18	Current value (LSB: 2,0°)	14h	CEh
188	DR18	Current value (MSB)	00h	9Eh
189	DR19	Angle between current and voltage on phase L3, penultimate value	C2h	84h
190	DR19	Storage number 3	01h	21h
191	CRC11			07h
192	CRC11			51h

Byte №	Field name	Content	Bytes [hex] plain	Bytes [hex] AES coded
193	DR19	VIB	FBh	1Ah
194	DR19	Phase I-U (current to voltage) [0,1°]	A3h	D1h
195	DR19	Extension	FCh	F5h
196	DR19	Phase L3	03h	82h
197	DR19	Current Value (LSB: 3,0°)	1Eh	7Dh
198	DR19	Current Value (MSB)	00h	C0h
199	DR20	Actuality duration 70 seconds	C1h	BCh
200	DR20	Storage number 3	01h	42h
201	DR20	VIF (Actuality duration)	74h	32h
202	DR20	Value (70 s)	46h	C2h
203	DR21	DIF (2 Byte)	02h	F4h
204	DR21	VIF (Extension Table)	FDh	C9h
205	DR21	VIFE (Error Flags Field)	97h	FFh
206	DR21	VIFE (Standard conform data content)	1Dh	BEh
207	DR21	Value (LSB)	00h	6Fh
208	DR21	Value (MSB)	00h	4Bh
209	CRC12			C2h
210	CRC12			55h
211	Dummy	Fill Byte due to AES	2Fh	33h
212	Dummy	Fill Byte due to AES	2Fh	30h
213	Dummy	Fill Byte due to AES	2Fh	65h
214	Dummy	Fill Byte due to AES	2Fh	1Dh
215	Dummy	Fill Byte due to AES	2Fh	9Eh
216	Dummy	Fill Byte due to AES	2Fh	41h
217	Dummy	Fill Byte due to AES	2Fh	D6h
218	Dummy	Fill Byte due to AES	2Fh	2Eh
219	Dummy	Fill Byte due to AES	2Fh	25h
220	Dummy	Fill Byte due to AES	2Fh	34h
221	CRC13			D1h
222	CRC13			E1h

The colour coding of Table A.1 is as follows.

APL	Application Layer
TPL	Transport Layer
AFL	Authentication and Fragmentation Layer
ELL	Extended Link Layer
DLL	Data Link Layer

Annex B Amendment of the OBIS-Code List

In addition to [OMS-S2-A] (Release F), the OBIS codes for additional MB-Tags shall be defined (see Table B.1).

Table B.1 – Amendment to list of OBIS-Codes

Type	M/O/A	OBIS-Code	Description [8]	MB-Tag	
Electricity		**1**	**02h**		
Meter reading	O	1-0:5.8.0*255	Reactive energy import inductive QI, current value	RE3!	RE3!B
Meter reading	O	1-0:6.8.0*255	Reactive energy import capacitive QII, current value	RE4!	RE4!B
Meter reading	O	1-0:7.8.0*255	Reactive energy import inductive QIII, current value	RE5!	RE5!B
Meter reading	O	1-0:8.8.0*255	Reactive energy import capacitive QIV, current value	RE6!	RE6!B
Meter reading	O	1-0:14.7.0*255	Supply frequency, instantaneous value	FR1!	FR1!B
Meter reading	O	1-0:16.7.0*255	Active power delta (import - export) (P), instantaneous value, total [13]	PW8!	PW8!B
Meter reading	O	1-0:21.8.0*255	Meter reading import active energy for L1	EW4!	EW4!B
Meter reading	O	1-0:22.8.0*255	Meter reading export active energy for L1	EW7!	EW7!B
Meter reading	O	1-0:31.7.0*255	Current at phase L1, instantaneous value	CA1!	CA1!B
Meter reading	O	1-0:32.7.0*255	Voltage at phase L1, instantaneous value	VV1!	VV1!B

Meter reading	O	1-0:36.7.0*255	Active power L1, instantaneous value [13]	PW9!	PW9!B
Meter reading	O	1-0:41.8.0*255	Meter reading import active energy for L2	EW5!	EW5!B
Meter reading	O	1-0:42.8.0*255	Meter reading export active energy for L2	EW8!	EW8!B
Meter reading	O	1-0:51.7.0*255	Current at phase L2, instantaneous value	CA2!	CA2!B
Meter reading	O	1-0:52.7.0*255	Voltage at phase L2, instantaneous value	VV2!	VV2!B
Meter reading	O	1-0:56.7.0*255	Active power L2, instantaneous value 13	PW10!	PW10!B
Meter reading	O	1-0:61.8.0*255	Meter reading import active energy for L3	EW6!	EW6!B
Meter reading	O	1-0:62.8.0*255	Meter reading export active energy for L3	EW9!	EW9!B
Meter reading	O	1-0:71.7.0*255	Current at phase L3, instantaneous value	CA3!	CA3!B
Meter reading	O	1-0:72.7.0*255	Voltage at phase L3, instantaneous value	VV3!	VV3!B
Meter reading	O	1-0:76.7.0*255	Active power L3, instantaneous value 13	PW11!	PW11!B
Meter reading	O	1-0:81.7.1*255	Angle between voltage on phase L2 to L1, instantaneous value	PD1!	PD1!B
Meter reading	O	1-0:81.7.2*255	Angle between voltage on phase L3 to L1, instantaneous value	PD7!	PD7!B
Meter reading	O	1-0:81.7.4*255	Angle between current to voltage on phase L1, instantaneous value	PD8!	PD8!B
Meter reading	O	1-0:81.7.40*255	Angle between voltage to current on phase L1, instantaneous value	PD4!	
Meter reading	O	1-0:81.7.12*255	Angle between voltage on phase L3 to L2, instantaneous value	PD2!	

Meter reading	O	1-0:81.7.15*255	Angle between current to voltage on phase L2, instantaneous value	PD9!	PD9!B
Meter reading	O	1-0:81.7.20*255	Angle between voltage on phase L1 to L3, instantaneous value	PD3!	
Meter reading	O	1-0:81.7.26*255	Angle between current to voltage on phase L3, instantaneous value	PD10!	PD10!B
Meter reading	O	1-0:81.7.51*255	Angle between voltage to current on phase L2, instantaneous value	PD5!	
Meter reading	O	1-0:81.7.62*255	Angle between voltage to current on phase L3, instantaneous value	PD6!	

Annex C Amendment of the OMS-Data Point List

In addition to [OMS-S2-B] (Release G), extensions to some MB-Data-Tags and VIB-Types are defined (see Table C.1 and Table C.2).

Table C.1 – Amendment to list of MB-Data-Tags

Type / Encryption	**MB-Tag**	**Description**	**Data field**	**Tariff [T]**	**Func-tion [F]**	**Storage [X]**	**Final DIFE [FD]** [11]	**VIB-Type Reference**	Electricity (02h)	HCA (08h)	Cooling (0Ah;0Bh)	Comb. Heat/Cooling (0Dh)	Heat (04h;0Ch)	Gas (03h)	Cold Water (07h;16h)	Hot Water (06h;15h)	Breaker / Valve (20h; 21h)	Sensor Device
^	**CA**	**Current [A]**																
Meter reading	CA1!B	Current at phase L1, instantaneous value	INT, BCD	0	0	3	no	CA01	O									
Meter reading	CA2!B	Current at phase L2, instantaneous value	INT, BCD	0	0	3	no	CA02	O									
Meter reading	CA3!B	Current at phase L3,	INT, BCD	0	0	3	no	CA03	O									

		instantaneous value																
^	EW	Energy in Watt hour																
Meter reading	EW4!	Active enery import on L1	INT, BCD	0	0	0	no	EW10, EW11, EW12	O									
Meter reading	EW4!B	Active enery import on L1	INT, BCD	0	0	3	no	EW10, EW11, EW12	O									
Meter reading	EW5!	Active enery import on L2	INT, BCD	0	0	0	no	EW13, EW14, EW15	O									
Meter reading	EW5!B	Active enery import on L2	INT, BCD	0	0	3	no	EW13, EW14, EW15	O									
Meter reading	EW6!	Active enery import on L3	INT, BCD	0	0	0	no	EW16, EW17, EW18	O									
Meter reading	EW6!B	Active enery import on L3	INT, BCD	0	0	3	no	EW16, EW17, EW18	O									
Meter reading	EW7!	Active enery export on L1	INT, BCD	0	0	0	no	EW19, EW20, EW21	O									
Meter reading	EW7!B	Active enery export on L1	INT, BCD	0	0	3	no	EW19, EW20, EW21	O									

Meter reading	EW8!	Active enery export on L2	INT, BCD	0	0	0	no	EW22, EW23, EW24	O									
Meter reading	EW8!B	Active enery export on L2	INT, BCD	0	0	3	no	EW22, EW23, EW24	O									
Meter reading	EW9!	Active enery export on L3	INT, BCD	0	0	0	no	EW25, EW26, EW27	O									
Meter reading	EW9!B	Active enery export on L3	INT, BCD	0	0	3	no	EW25, EW26, EW27	O									
^	FR	Frequency																
Meter reading	FR1!B	Supply frequency, instantaneous value	INT, BCD	0	0	3	no	FR01	O									
^	PD	Phase in Degree																
Meter reading	PD1!	Angle between voltage on phase L2 to L1, instantaneous value	INT, BCD	0	0	0	no	PD01	O									
Meter reading	PD1!B	Angle between voltage on phase L2 to L1, instantaneous value	INT, BCD	0	0	3	no	PD01	O									

Meter reading	PD2!	Angle between voltage on phase L3 to L2, instantaneous value	INT, BCD	0	0	0	no	PD02	O										
Meter reading	PD3!	Angle between voltage on phase L1 to L3, instantaneous value	INT, BCD	0	0	0	no	PD03	O										
Meter reading	PD4!	Angle between voltage to current on phase L1, instantaneous value	INT, BCD	0	0	0	no	PD04	O										
Meter reading	PD5!	Angle between voltage to current on phase L2, instantaneous value	INT, BCD	0	0	0	no	PD05	O										
Meter reading	PD6!	Angle between voltage to current on phase L3, instantaneous value	INT, BCD	0	0	0	no	PD06	O										
Meter reading	PD7!	Angle between voltage on phase L3 to L1, instantaneous value	INT, BCD	0	0	0	no	PD07	O										

Meter reading	PD7!B	Angle between voltage on phase L3 to L1, instantaneous value	INT, BCD	0	0	3	no	PD07	O									
Meter reading	PD8!	Angle between current to voltage on phase L1, instantaneous value	INT, BCD	0	0	0	no	PD08	O									
Meter reading	PD8!B	Angle between current to voltage on phase L1, instantaneous value	INT, BCD	0	0	3	no	PD08	O									
Meter reading	PD9!	Angle between current to voltage on phase L2, instantaneous value	INT, BCD	0	0	0	no	PD09	O									
Meter reading	PD9!B	Angle between current to voltage on phase L2, instantaneous value	INT, BCD	0	0	3	no	PD09	O									
Meter reading	PD10!	Angle between current to voltage on phase L3, instantaneous value	INT, BCD	0	0	0	no	PD10	O									
Meter reading	PD10!B	Angle between current to voltage on phase L3, instantaneous value	INT, BCD	0	0	3	no	PD10	O									
	PW	**Power in Watt**																
Meter reading	PW8!B	Active power absolute (|P|), instantaneous value, total	INT, BCD	0	0	3	no	PW09, PW10	O									
Meter reading	PW9!	Active power L1, instantaneous value	INT, BCD	0	0	0	no	PW12, PW13	O									
Meter reading	PW9!B	Active power L1, instantaneous value	INT, BCD	0	0	3	no	PW12, PW13	O									
Meter reading	PW10!	Active power L2, instantaneous value	INT, BCD	0	0	0	no	PW14, PW15	O									
Meter reading	PW10!B	Active power L2, instantaneous value	INT, BCD	0	0	3	no	PW14, PW15	O									
Meter reading	PW11!	Active power L3, instantaneous value	INT, BCD	0	0	0	no	PW16, PW17	O									

Meter reading	PW11!B	Active power L3, instantaneous value	INT, BCD	0	0	3	no	PW16, PW17	O									
	RE	**Reactive Energy**																
Meter reading	RE3!	Reactive energy import inductive QI, current value	INT, BCD	0	0	0	no	RE05, RE06	O									
Meter reading	RE3!B	Reactive energy import inductive QI, current value	INT, BCD	0	0	3	no	RE05, RE06	O									
Meter reading	RE4!	Reactive energy import capacitive QII, current value	INT, BCD	0	0	0	no	RE07, RE08	O									
Meter reading	RE4!B	Reactive energy import capacitive QII, current value	INT, BCD	0	0	3	no	RE07, RE08	O									
Meter reading	RE5!	Reactive energy import inductive QIII, current value	INT, BCD	0	0	0	no	RE09, RE10	O									
Meter reading	RE5!B	Reactive energy import inductive QIII, current value	INT, BCD	0	0	3	no	RE09, RE10	O									
Meter reading	RE6!	Reactive energy import capacitive QIV, current value	INT, BCD	0	0	0	no	RE11, RE12	O									
Meter reading	RE6!B	Reactive energy import capacitive QIV, current value	INT, BCD	0	0	3	no	RE11, RE12	O									
	VV	**Voltage in Volt**																
Meter reading	VV1!B	Voltage at phase L1, instantaneous value	INT, BCD	0	0	3	no	VV01	O									
Meter reading	VV2!B	Voltage at phase L2, instantaneous value	INT, BCD	0	0	3	no	VV02	O									
Meter reading	VV3!B	Voltage at phase L3, instantaneous value	INT, BCD	0	0	3	no	VV03	O									

Table C.2 – Amendment to list of VIB Types

VIB-Type Reference	VIF / VIFE	Scaler+Unit/Type	Remark
EW	**Energy [kWh]**		
EW10	1000 0nnn 1111 1100 0000 0001	kWh 10e-6 … 10e+1	forward L1
EW11	1111 1011 1000 000n 1111 1100 0000 0001	kWh 10e+2 … 10e+3	forward L1
EW12	1111 1011 1000 000n 1111 1101 1111 1100 0000 0001	kWh 10e+5 … 10e+6	forward L1
EW13	1000 0nnn 1111 1100 0000 0010	kWh 10e-6 … 10e+1	forward L2
EW14	1111 1011 1000 000n 1111 1100 0000 0010	kWh 10e+2 … 10e+3	forward L2
EW15	1111 1011 1000 000n 1111 1101 1111 1100 0000 0010	kWh 10e+5 … 10e+6	forward L2
EW16	1000 0nnn 1111 1100 0000 0011	kWh 10e-6 … 10e+1	forward L3
EW17	1111 1011 1000 000n 1111 1100 0000 0011	kWh 10e+2 … 10e+3	forward L3
EW18	1111 1011 1000 000n 1111 1101 1111 1100 0000 0011	kWh 10e+5 … 10e+6	forward L3
EW19	1000 0nnn 1011 1100 1111 1100 0000 0001	kWh 10e-6 … 10e+1	backward L1
EW20	1111 1011 1000 000n 1011 1100 1111 1100 0000 0001	kWh 10e+2 … 10e+3	backward L1

EW21	1111 1011 1000 000n 1111 1101 1011 1100 1111 1100 0000 0001	kWh 10e+5 … 10e+6	backward L1
EW22	1000 0nnn 1011 1100 1111 1100 0000 0010	kWh 10e-6 … 10e+1	backward L2
EW23	1111 1011 1000 000n 1011 1100 1111 1100 0000 0010	kWh 10e+2 … 10e+3	backward L2
EW24	1111 1011 1000 000n 1111 1101 1011 1100 1111 1100 0000 0010	kWh 10e+5 … 10e+6	backward L2
EW25	1000 0nnn 1011 1100 1111 1100 0000 0011	kWh 10e-6 … 10e+1	backward L3
EW26	1111 1011 1000 000n 1011 1100 1111 1100 0000 0011	kWh 10e+2 … 10e+3	backward L3
EW27	1111 1011 1000 000n 1111 1101 1011 1100 1111 1100 0000 0011	kWh 10e+5 … 10e+6	backward L3
PD	**Phase in Degree [°]**		
PD07	1111 1011 1010 1010 1111 1100 0010 0111	° 10e-1	Volt_L3-L1
PD08	1111 1011 1010 0011 1111 1100 0000 0001	° 10e-1	Curr-Volt._L1
PD09	1111 1011 1010 0011 1111 1100 0000 0010	° 10e-1	Curr-Volt._L2
PD10	1111 1011 1010 0011 1111 1100 0000 0011	° 10e-1	Curr-Volt._L3
PW	**Power [W]**		
PW12	1010 1nnn 1111 1100 0000 0001	W 10e-3 … 10e+4	forward L1
PW13	1111 1011 1010 100n 1111 1100 0000 0001	W 10e+5 … 10e+6	forward L1
PW14	1010 1nnn 1111 1100 0000 0010	W 10e-3 … 10e+4	forward L2
PW15	1111 1011 1010 100n 1111 1100 0000 0010	W 10e+5 … 10e+6	forward L2
PW16	1010 1nnn 1111 1100 0000 0011	W 10e-3 … 10e+4	forward L3
PW17	1111 1011 1010 100n 1111 1100 0000 0011	W 10e+5 … 10e+6	forward L3

RE	Reactive Energy [kvarh]		
RE05	1111 1011 1000 001n 1111 1100 0000 1000	kvarh 10e0 … 10e+1	forward QI
RE06	1111 1011 1000 001n 1111 0nnn 1111 1100 0000 1000	kvarh 10e-6 … 10e+2	forward QI
RE07	1111 1011 1000 001n 1111 1100 0000 1001	kvarh 10e0 … 10e+1	forward QII
RE08	1111 1011 1000 001n 1111 0nnn 1111 1100 0000 1001	kvarh 10e-6 … 10e+2	forward QII
RE09	1111 1011 1000 001n 1111 1100 0000 1010	kvarh 10e0 … 10e+1	forward QIII
RE10	1111 1011 1000 001n 1111 0nnn 1111 1100 0000 1010	kvarh 10e-6 … 10e+2	forward QIII
RE11	1111 1011 1000 001n 1111 1100 0000 1011	kvarh 10e0 … 10e+1	forward QIV
RE12	1111 1011 1000 001n 1111 0nnn 1111 1100 0000 1011	kvarh 10e-6 … 10e+2	forward QIV