Design Note:
Time Management

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Change History

Version Number	Status	Date of Issue	Reason for Change
0.1	For Review	21/09/2015	Initial draft submitted to DECC for comment on structure and high level content
0.2	For Review	13/10/2015	Updated following initial DECC functional review
0.3	For Review	30/10/2015	Updated following additional DECC functional input
0.4	For Review	25/11/2015	Updated based on feedback from EUK members
0.5	For Review	08/12/2015	Updated based on feedback from EUK members on additional material included at version 0.4
1.0	Approved	17/02/2016	Updated based on feedback from TBDG members and approved by TBDG.
1.1	Approved	21/04/2017	Updated to include revised introductory text and the document classification as per the SEC Policy Information Policy.

Whilst the content of Design Notes were subject to peer review and considered to be accurate at the time of their publication, changes may have since taken place that mean this is no longer the case. In any event, Design Notes should be considered to contain non-binding clarifications on the topic identified. In the event of any conflict or inconsistency between any Design Note and any relevant licence conditions, the SEC or any other relevant regulation, the relevant licence conditions, SEC and/or other relevant regulation shall take precedence over the Design Note.

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Contents

1. Purpose

This Design Note summarises how time is provided to, and managed on, Smart Metering Devices according to the requirements laid out in:

- the Smart Energy Code (SEC);

- the DCC User Interface Specification (DUIS);

- the Smart Metering Equipment Technical Specifications (SMETS);

- the Communications Hub Technical Specifications (CHTS); and

- the Great Britain Companion Specification (GBCS) and therefore in the required DLMS COSEM and ZigBee specifications.

2. Structure

Section 4 provides a summary as to:

- Why time is important on Devices;

- How time gets set and maintained on Devices; and

- How issues with the time on a Device can be identified and actions that can be taken.

Sections 5 and 6 expand on that summary, providing more detailed explanations and links to the relevant parts of regulatory documents.

3. Defined Terms

Defined Terms used in this document are those from the SEC, DUIS and GBCS. Their usage is prefixed by the SEC, DUIS or GBCS where two or more of the documents use the same term, but with different meaning.

Additional defined terms:

Term	Meaning
CSP	Communications Services Provider. An organisation providing the DCC with Communication Hubs and Wide Area Network (WAN) connection to those Communications Hubs.
Meter	Electricity Smart Metering Equipment (ESME) or Gas Smart Metering Equipment (GSME).
Supplier	In this document, Supplier always means the Responsible Supplier for the Meter (as defined in SEC Section A).
	For an ESME, this is the Supplier (SEC meaning) currently recorded in registration data against the ESME's import MPAN.
	For a GSME, this is the Supplier (SEC meaning) currently recorded in registration data against the GSME's MPRN[1].

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[1] The DCC holds the corresponding registration data.

4. Overview

4.1 Why time on Devices is Important

Under normal operating conditions[2], the Clocks on Meters and Communications Hubs (CHs) have to be accurate in the following senses:

- SMETS requires that Meters have Clocks and that, under normal operating circumstances, the time on those Clocks '*shall be capable of operating so as to be accurate to within 10 seconds'* of UTC (Coordinated Universal Time)[3]; and

- CHTS requires that Communications Hubs have Clocks and that, under normal operating circumstances, the time on those Clocks '*shall be capable of operating so as to be accurate to within 10 seconds'* of UTC.

Meters need accurate time because significant parts of the Critical functionality required for Meters, for example Time-of-use Tariffs, are dependent on time for their correct and predictable functioning. Such Critical functionality can, in almost all cases, only be configured and operated by the Meter's Supplier. Thus, time on Meters must be accurate, in terms of alignment with the Supplier's data centre systems' view of what the UTC time is[4].

Critical functionality on CHs can function predictably without reliance on time[5]. However, a CH is required to have accurate time and it has to make its time available to all other Devices on the same Smart Metering Home Area Network (SMHAN), including Meters. Meters will normally set their time to the CH's time at power on of the Clock[6] and will synchronise to it once every 24 hours, except in circumstances where the CH's time is, or may be, inaccurate.

Other Devices do not have as great a reliance on time as Meters, and are not required to have their own Clocks. However, they may have functionality that relies on time, for example to display Local Time. To support this, all Devices have access to the CH's time, so long as they have SMHAN communications with the CH (the CH shares both UTC time and Local Time over the SMHAN).

HAN Connected Auxiliary Load Control Switches (HCALCSs) have a different time related requirement, which is that they are required to have a Timer but are not required to have a Clock. This is because HCALCSs can get instructions from an ESME to open or close its switch for a specified period of time[7]. The Timer in the HCALCS allows it to obey the ESME instruction, even if it loses SMHAN communications and so loses access to the CH's time[8].

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2 SMETS does not define 'normal operating conditions'. However, as explained later, having power to the Device and the Communications Hub having sufficient WAN connectivity would be pre-requisites.
3 UTC is the primary time standard by which the world regulates Clocks and time
4There is no GB smart metering requirement for all organisations involved to synchronise their Clocks with each other or to UTC, so different organisations may have different views of UTC time. In all bar exceptional circumstances, these differences are likely to be small.
5 GBCS section 9.1.1
6 Clocks in Meters may not rely solely on power to the Meter (e.g. they may have a separate battery)
7 The ESME sends such instructions based on Commands sent to the ESME by its Supplier.
8 After the end of such a period, the HCALCS will default to opening its switch, if it does not receive a new instruction from the ESME as per SMETS section 8.5.1.2

4.2 How does time get set on Devices?

4.2.1 Communications Hubs

CHs get their time from their CSP via their WAN connection. This time is called 'Network Time'. As long as a CH has sufficient WAN connectivity[9] to maintain accuracy of its time in line with the CHTS requirement, it is required by GBCS[10] to share its time with other SMHAN Devices (otherwise it shares a value indicating that it does not have accurate time).

The DCC has to monitor the Network Time sources against an 'Independent Time Source' to make sure they do not materially differ from UTC[11] (and ensure they are corrected if they move materially away from UTC).

These two mechanisms mean that a CH's time will not normally materially differ from UTC, unless there are issues with WAN connectivity.

4.2.2 Meters

Meters will normally set their time to the CH's time at power on (with a status of 'unreliable') and will synchronise to it once every 24 hours, except in specified circumstances relating to actual or potential CH time problems[12].

When a Meter is first commissioned, the Meter's Supplier has to send to the DCC a 'Commission Device' Service Request containing an initial time and a tolerance period. This should lead to the Meter receiving a 'Set Clock' GBCS Command. This GBCS Command, if successful, updates the Meter's time to that of the CH, if that CH time is between the Supplier specified initial time and initial time plus tolerance period, and sets the Meter's time status to 'reliable'[13]. This means that Supplier set Critical functions on the Meter will work within the Supplier specified time tolerance.

If there are subsequent issues with the Meter's time (e.g. it is no longer synchronising to the CH because it is time is too far from the CH time), the Meter's Supplier can trigger, using the 'Synchronise Clock' Service Request, subsequent 'Set Clock' GBCS Commands to attempt to address such time related issues.

A problem with such 'Set Clock' GBCS Commands is that they can take longer to be delivered to the Meter than the 10 second accuracy required on the Meter's Clock. This is both because of WAN latency and because GSME normally only communicate once every 30 minutes.

To address this, the approach taken is:

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9 GBCS Section 9 requires sufficient WAN connectivity to be that which allows a Communications Hub to 'accurately maintain its time via its WAN interface to the tolerance required by the CHTS'. This sufficient level of connectivity might differ by CH, by WAN technology and by time synchronisation approach used over the WAN. For example, a Clock that keeps more accurate time may need to be synchronised with Network Time less frequently and so require less WAN connectivity to keep its Clock accurate.
10 GBCS section 7.4. Specifically, this requires the CHF to make available three ZigBee time related attributes to other SMHAN Devices, namely LocalTime, Time and TimeStatus.
11 SEC does not specify tolerances in terms of the meaning of 'materially different'. Rather it requires that the Independent Time Source is 'accurate' and that DCC can detect when 'the Network Time materially differs from the Independent Time Source.'
12 So where the Meter would need to change its time by more than 10 seconds, where there is no response or where the Communication Hub reports that it does not have accurate time.
13 If the Meter sets its Time Status to 'reliable' it will have set its time to the CH provided time.

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- for the Supplier to trigger a Set Clock GBCS Command containing the Supplier's current time and a future time (reflecting the Supplier specified tolerance period); and

- if, when the Meter receives the Command, the CH's time is between the two times specified in the Command (so within tolerance of the Supplier's time), the Meter aligns itself to the CH's time and treats its time as 'reliable'. Otherwise the Meter treats its time as 'unreliable'[14].

A Supplier sets the time tolerance period used in the Set Clock GBCS Command. DUIS allows this tolerance period to be between 0 and 86,400 seconds (so 1 day).

As a minimum, the tolerance period needs to be long enough to allow for the elapsed time between:

- the Supplier creating the 'Commission Device' or 'Synchronise Clock' Service Request; and

- the Meter receiving the corresponding 'Set Clock' GBCS Command.

For a Meter being installed, a tolerance period of the order of 30 seconds or greater may be appropriate to allow for WAN latency[15]. A similar tolerance period may be sufficient for an ESME throughout its life, since its SMHAN interface is turned on all of the time.

For a GSME during its life, if there is no human intervention to wake the GSME, a tolerance period of the order of 30 minutes or greater may be needed. This is because the GSME only turns on its SMHAN radio every 30 minutes without human intervention (some additional allowance for WAN latency may lead to a tolerance period of slightly greater than 30 minutes being used).

4.2.3 Other Devices

As mentioned earlier, Devices other than Meters and CHs are not required to have a Clock (although they are not barred from having a Clock). However, all Devices can access the time from the CH, where they have SMHAN communications and the CH has WAN communications.

For example, an IHD needs to display Local Time, updated no less frequently than every 10 seconds[16]. It can get this information, and updates to it, from the CH.

4.2.4 How issues with the time set on a Device can be identified and actions that can be taken

Meters on the same SMHAN can detect when there are issues with a CH's time, either because the CH is reporting that it does not have a valid time or because the CH time is significantly different from that on the Meter's Clock. Mechanisms for resolving CH time issue are CSP defined, and need to be undertaken by the CSP.

Potential issues with the time on a Meter can be identified by its Supplier by:

- Receipt of an Alert (with Alert Code 0x8F0C: '*Clock not adjusted (adjustment greater than 10 seconds)*') from the Meter saying it has failed to synchronise with the CH; or

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14 The definition and function of Time Statuses, such as 'reliable' and 'unreliable' are covered in section 5.3 of this document.
15 This assumes that the GSME can be instructed, by the installing engineer, to turn on its SMHAN radio as required during installation, and that it then immediately processes all Commands waiting for it. This is NOT required by the minimum functionality in SMETS and so this facility would need to be checked by the installing Supplier. SMETS does have a User Interface Command to 'Check for HAN Interface Commands' but that only requires immediate retrieval and execution of any waiting 'Add Credit' and 'Activate Emergency Credit' Commands.
16 SMETS 6.4.2.

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- Receipt of a GBCS time-stamped Response within a Service Response, such as one containing instantaneous register readings. Timestamps in such Responses contain the Meter's time status and its current time, at the point of sending the GBCS Response. A time status other than 'reliable', or a time value materially different than that expected, would indicate issues.

If the time issue is with the Meter alone, the Meter's Supplier can send a 'Synchronise Clock' Service Request, resulting in a 'Set Clock' GBCS Command. On receipt, the Meter will attempt to synchronise it's time with the CH time. If the issue is caused by a CH time problem, the CH problem would need to be resolved by the CSP first. A 'Set Clock' Response indicating the Meter failed to set a 'reliable' time might suggest that there is a CH time issue. In such circumstances a Supplier may raise an Incident with the DCC according to the Incident Management Policy, and / or look up incidents related to that CH via the DCC's Self Service Interface, along with the status of such incidents. This allows Suppliers to also know when such issues have been cleared and so address Meter Clock issues accordingly.

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5. Time Related Terms

5.1 UTC and Local Time

Coordinated Universal Time (UTC) is the primary time standard by which the world regulates clocks and time. It is not affected by daylight saving times, such as British Summer Time. UTC is based on International Atomic Time, which is regulated by atomic clocks and therefore accurate and precise.

Local Time is UTC time adjusted for British Summer Time. British Summer Time is a legally defined term and must be calculated in line with the Summer Time Order 2002[17].

A Device can calculate Local Time from UTC in the way specified in the Summer Time Order 2002. Therefore only UTC time needs to be set on any Device.

As required by SMETS and CHTS, UTC is to be used by Devices for the majority of their time dependent functionality. This means that, when Suppliers set time based configuration values, the settings must be in UTC. Therefore, Suppliers will need to adjust these configurations if they wish to use different UTC times during British Summer Time.

As per SMETS, examples of such configuration items using UTC include the Billing Calendar, the Non-Disablement Calendar, the Tariff Switching Calendar, and the Auxiliary Load Control Switch Calendar. Annex A summarises the structures used in these configuration items and illustrates their implementation in Service Requests, by way of Non-Disablement Calendar settings to a GSME and an ESME.

Generally, date-time stamps recorded are also in UTC, for example, in the Billing Data Log, Daily Read Log, Event Log and Security Log.

Local Time is used in a subset of cases, including the display of information to the Consumer, and for some logging of information, specifically in the (GPF) Cumulative and Historical Value Store, the Cumulative Current Day Value Store, the GPF Daily Gas Consumption Log and the Daily Consumption Log.

5.2 Network Time and Independent Time Source

G2.38 and G2.39 of the SEC place obligations on the DCC in terms of 'Network Time' and an 'Independent Time Source'.

The DCC has to establish and maintain one or more Network Time sources. There may be multiple Network Time sources, for example dependent on CSP and type of WAN.

A Network Time is made available by a CSP to each of its CHs, so that each CH can synchronise its Clock[18]. This allows CHs to maintain an accurate time, and so support Meter synchronisation to that accurate time.

The DCC has to ensure that the Network Time sources CSPs use to provide time to CHs do not materially differ from an Independent Time Source. If Network Time deviates from the Independent

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17 http://www.legislation.gov.uk/uksi/2002/262/contents/made
18 SEC G2.38 '"Network Time" means one or more time sources maintained by the DCC from which all Commissioned Communications Hub Functions synchronise time'

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Time Source, then the DCC are required to rectify the inaccuracy. The DCC can use an Independent Time Source of their choosing.

5.3   Time Status

Meters have to maintain a record of their Time Status, in line with GBCS section 9. Time Status may be one of the following three values:

Value	Meaning
Invalid	The Device has no meaningful time
Unreliable	The Device has a meaningful time but that time may not be accurate and needs to be affirmed / reaffirmed by the Supplier
Reliable	The Device has a meaningful time and that time has been affirmed by its Supplier

Source: GBCS table 9.1.2 1

Time on a Meter ideally needs to be 'reliable', as significant Meter functionality is time dependent.

5.4   Power On

When used in relation to time on Devices, 'power on' has a specific and potentially different meaning than for other aspects of Device functionality. Power on in relation to time means the Clock powering on, which is not necessarily the same as the Device powering on.

There is no requirement for Clocks in Devices to have an additional power source to that of the Device, but there is also no prohibition. So, for example, an ESME could have an internal battery which maintains power to the ESME's Clock even when there is no power to the ESME. Such an ESME might therefore have a time set before it is installed. Where a time is already set on a Meter when it is first installed, its Time Status would be 'Unreliable', since the status can only become 'Reliable' as part of the Meter processing a GBCS 'Set Clock' Command.

Such a Meter may maintain time across power cuts to a Consumer's premises, and so may be able to maintain its then current Time Status (depending on duration of the power cut).

This document should be read with that distinction in mind.

6. Time Management on Devices

This section explains how Devices' Clocks act when initially powered on, how Clocks on Devices may be set subsequently and how time on Devices is automatically managed.

6.1 Communications Hubs

6.1.1 Clock

CHTS 4.3 requires that a CH has a single Clock. That Clock is to be used by both the Devices within the CH, namely the Communication Hub Function (CHF) and the Gas Proxy Function (GPF). CHTS 4.4.1 requires that the CHF uses this Clock to make the 'CHF Date and Time' available to Devices on the SMHAN.

6.1.2 Power on

At power on, a CH is required (by GBCS section 9.1.3) to share on the SMHAN a time value meaning it does not have accurate time (specifically the value '0xFFFFFFFF').

When the CH subsequently establishes sufficient WAN connectivity, its time is set and maintained according to the requirements summarised in the next section. The time taken by a particular CH to establish sufficient WAN connectivity may depend on a number of factors. For example, where there has been a power loss across a large geographic area, there may be limitation on the rate at which CHs can re-establish links to the WAN in that area when power is restored. Thus, larger scale power restoration may mean somewhat longer times to re-establish links for all affected CH.

6.1.3 Maintaining and sharing CH time

Whenever a CH has sufficient WAN connectivity, GBCS section 9.1.3 requires that the CH synchronises it's time to the Network Time provided via its WAN interface [SEC G2.38 requires that the DCC provide Network Time sources against which CHs can synchronise their Clocks].

GBCS section 7.4 requires that CHs make their time available to all other Devices on the SMHAN, along with the Local Time reflecting any adjustment from UTC for British Summer Time[19]. The exception is when the CH does not have WAN connectivity sufficient to maintain accuracy of its time within the CHTS 10 seconds tolerance. This means it does not have access to the Network Time against which it can synchronise its Clock.

When a CH does not have a WAN connection sufficient to maintain time within the CHTS tolerance, the CH must share on the SMHAN a time value meaning it does not have accurate time (specifically the value '0xFFFFFFFF')[20].

Thus the time the CH shares on the SMHAN will either be:

- A value synchronised to the CSP provided Network Time (if the CH has a WAN connection sufficient for accurate time); or

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19 GBCS table 7.4 requirement
20 GBCS section 9.1.3 requirement

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- The value meaning it does not have accurate time (if the CH does not have a WAN connection sufficient for accurate time).

Mechanisms for maintaining CHs' time are CSP defined, and such maintenance needs to be undertaken by the CSP concerned.

Further information on the installation and commissioning of CHs is available in SEC Appendix I, the Communications Hubs Installation and Maintenance Support Materials document.

6.2   Meters

6.2.1   Power on

GBCS section 9.1.3 specifies what a Meter has to do when its Clock is powered on.

Specifically, the Meter will normally set its time to that of the CH and its time status to 'Unreliable'.

The exceptions are where the CH provides the time value meaning the CH does not have an accurate time or the CH does not provide a time value. In both exception cases the Meter marks its time status as 'Invalid'.

So, in normal circumstances, the Meter will set its time based on the CSP provided Network Time, and will set its Time Status to 'Unreliable'. Meters do not change their behaviour based on whether Time Status is 'Reliable' or 'Unreliable', and so time based Meter functionality will operate as it would if the status were 'Reliable'.

6.2.2   Commissioning of a Meter

The Commission Device Service Request[21] must be sent prior to any Meter having a Smart Metering Inventory (SMI) Status of 'commissioned'[22] and it can only be sent over the WAN. [Note, the GBCS Command produced by a 'Commission Device' Service Request cannot be delivered via a Hand Held Terminal (HHT), although all other GBCS Commands resulting from Service Requests to form an SMHAN, and configure Devices on it, can be delivered via a HHT].

The 'Commission Device' Service Request contains the same data items as the 'Synchronise Clock' Service Request. The GBCS 'Set Clock' Command, resulting from a 'Commission Device' Service Request is the same GBCS 'Set Clock' Command as that resulting from a 'Synchronise Clock' Service Request[23]. Thus, both Service Requests trigger the same processing on the Meter, which is described in the next section. Therefore, if a Supplier wishes to issue a 'Set Clock' GBCS Command to a Meter using a HHT, the Supplier can use the 'Synchronise Clock' Service Request to generate the GBCS Command.

6.2.3   Supplier instigated setting of a Meter's time

The 'Synchronise Clock' Service Request (and so the 'Commission Device' Service Request) includes the Supplier's current time and a tolerance period. This time and tolerance period are used when attempting to update the time on the Meter as per step 3, below.

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21 DCC User Interface Specification, Commission Device: section 3.8.90
22 Inventory and Enrolment subsidiary document, 4.12
23 DCC User Interface Specification, Synchronise Clock: section 3.8.60

The steps involved in a Supplier setting time on the Meter are as summarised in Figure 1 and detailed in the following text:
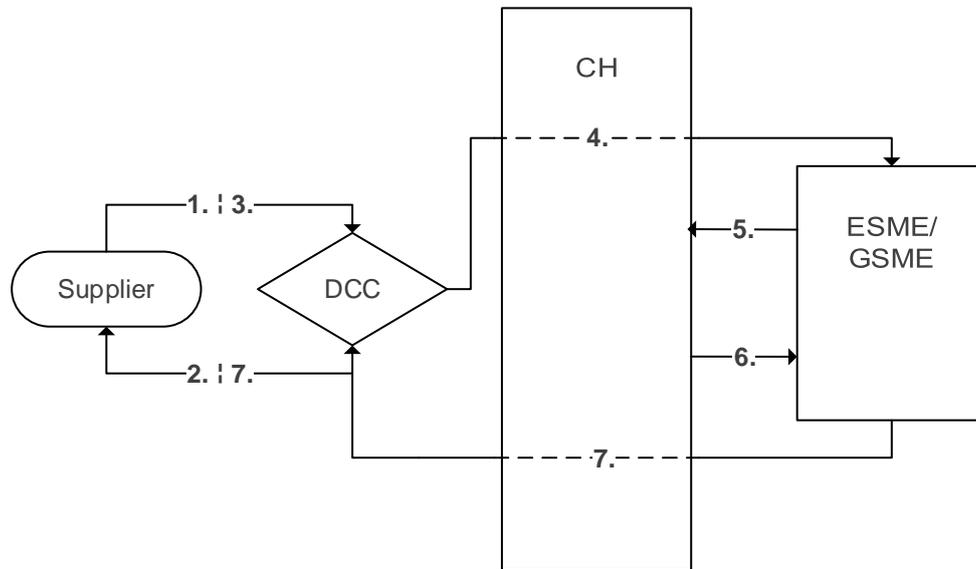

Figure 1: Setting the time on a Meter – Process Steps

1) The Supplier sends a 'Commission Device' / 'Synchronise Clock' Service Request to the DCC, containing the Supplier's current time and required tolerance period.

2) The DCC sends back to the Supplier a 'Pre-Command', containing a 'Set Clock' GBCS Command but without that GBCS Command having a Supplier Signature or a DCC Access Control Broker MAC.

3) The Supplier correlates the contents of the Pre-Command with the Service Request it sent to the DCC. If the two correlate, and the Supplier has undertaken all the checks it requires, the Supplier signs the 'Set Clock' GBCS Command payload and incorporates the signed GBCS Command payload in to a Signed Pre-Command, which it sends to the DCC.

4) The DCC applies anomaly detection, adds it's MAC to the signed GBCS Command payload, then sends the fully formed GBCS 'Set Clock' Command to the Meter[24]. The GBCS Command includes the Supplier's current time (as in the Service Request) and a later time reflecting that time plus tolerance period. On receipt, the Meter performs the authentication of the Command required by GBCS. Providing the Command is authenticated, the Meter undertakes the processing required by GBCS section 9.1.

5) The Meter requests the CH's time.

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24 The Use Case defining the GBCS 'Set Clock' Commands are in GBCS section 9.1. Both the 'Synchronise Clock' and 'Commission Device' Service Requests result, if successful, in a GBCS 'Set Clock' Command being sent to the Meter.

6) The Meter then attempts to adjust its current time:

    a. If the CH returns time to the Meter:

        i. Where the time returned by the CH falls between the two times specified in the GBCS 'Set Clock' Command, the Meter adopts the time provided by the CH (so the CSP's Network Time) and sets its Time Status to 'Reliable'; or

        ii. Where the time returned by the CH falls outside the two times specified in the GBCS 'Set Clock' Command, the Meter's time remains unchanged and its Time Status is set to 'Unreliable' (or remains 'Unreliable'); or

    b. Where the CH does not respond, or returns the value indicating it does not have accurate time, the Meter's time and Time Status remains unchanged, unless Time Status was previously 'Reliable'. In the latter case, the Meter sets its Time Status to Unreliable[25].

7) The Meter returns its current time and Time Status in the Response, which is passed to the Supplier by the DCC as part of a Service Response.

6.2.4 Maintenance of Time

SMETS sections 4.4.1 and 5.5.1 require that Meters can synchronise to their CH's time. Specifically, a Meter *'shall be capable of comparing its date and time with the Communications Hub Date and Time, and making adjustments to its date and time'*.

SMETS[26] requires a Meter not to attempt such synchronisation more than once in 24 hours and not to change the time where the Clock would change by more than 10 seconds.

GBCS section 9.1.3 requires Meters do attempt to synchronise once every 24 hours, as well as at initial power on. This daily synchronisation acts as a means to keep the Meter's time in trim with the Network Time provided to the CH. It is limited to once per 24 hours to prevent the Device's time from being rapidly 'dragged' away from the Supplier's UTC time.

The table below summarises the potential outcomes from the daily time synchronisation activity (as specified in GBCS section 9.1.3 and SMETS section 4.4.1 / 5.5.1):

Time provided by CH	Action	Resulting Meter Time Status
Differs by no more than 10s from the Meter's time.	The Device synchronises its time with CH and its Time status remains as Reliable.	Reliable
Differs by more than 10s from the Meter's time.	The Device does not change its time and sets its Time Status to Unreliable. If this is a change in Time Status, the Device sends an Alert to its Supplier. This means such an Alert will not be sent every day but rather only on the day when the time difference causes the Time Status to change to 'Unreliable'.	Unreliable

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25 GBCS 9.1.4.2 and 9.1.7.3
26 SMETS section 4.4.1 for GSME and section 5.5.1 for ESME

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0xFFFFFFFF[27] or no time provided	The Device will retry up to 3 times. If a retry is successful in returning a valid time, the Device will act according to the time discrepancy. Where 3 consecutive fails occur, the Device leaves its time unchanged and sets its Time Status to Unreliable. This might happen, for example, if the CH reboots.	Unreliable

6.2.5 How to Identify and Rectify Inaccurate Time

There are a number of ways to identify when a Meter has, or may have, inaccurate time, assuming there are WAN and SMHAN communications to the Meter.

Firstly, certain GBCS Use Cases require that a timestamp is provided in Responses from a Meter, such as those Use Cases to read instantaneous register values[28].

The format prescribed in GBCS section 7.2.7 for such timestamps provides information to Suppliers allowing them to detect problems with the Meter's time. Specifically, any Responses which require the inclusion of a timestamp according to their GBCS Use Case will include a 12 octet DLMS COSEM format timestamp in the Header of the Response[29]. The final byte in this timestamp could be used by Suppliers to check the Time Status of the Meter (GBCS table 9.1.4.2b details how to do this)[30]. A significant variance in the value of the time returned in the Response might also suggest problems with the Meter's time.

The second mechanism for detecting problems with a Meter's time is by way of an Alert sent to Suppliers with Alert Code 0x8F0C and meaning '*Clock not adjusted (adjustment greater than 10 seconds)*'. Where a Meter's time differs from the CH's by more than 10 seconds when it attempts to synchronise, the Meter sends an Alert to the Supplier, allowing the Supplier to take measures to rectify the discrepancy (see GBCS section 9.1.3).

Suppliers can use the DUIS 'Synchronise Clock' Service Request to address such issues. Note, as detailed in section 4.2.2 of this document, the tolerance period in such Service Requests for a GSME whose time is being corrected may need to be different than for an ESME. This is due to the fact that GSMEs are 'sleepy'. A GSME being 'sleepy' means that its SMHAN radio will not be active most of the time (it only activates once every 30 minutes). Therefore, the tolerance provided by the Supplier needs to reflect the extended latency. This may not be an issue during commissioning, as the installer can manually wake the GSME (although see footnote 15). Please see section 4.2.2 for indicative tolerance periods.

6.2.6 Time when there has never been a WAN connection

If there has never been a WAN connection, the CH will always report to other SMHAN Devices that it does not have an accurate time[31]. Therefore, any attempt to use the Set Time GBCS Command on a Meter would not lead to a change in the time reported by the Meter's Clock. The Meter would therefore continue to increase time based only on its internal Clock.

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27 Indicating that the CH has tried and failed to obtain time from the SM WAN.
28 Alerts which include time status are DLMS COSEM alerts from ESME and CHF.
29 Such date-time stamps are in the GBCS 'Grouping Header' structure (section 7.2.7) and the requirements is 'Where date-time is required for a Message, it shall be a 12 octet string as per the DLMS specification'. The Grouping Header structure is used in Responses from all Devices, and so all Meters.
30 MMC does not map the meaning of this final byte in to an XML attribute.
31 GBCS section 9.1.3 requirement.

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This should be factored in when considering whether to rely on time based Meter functionality for such Meters e.g. Time-of-use tariffs.

Factors to consider would include:

- the accuracy of the time on the Meter's Clock immediately prior to connecting to the SMHAN (so without remote time setting); and

- the accuracy of the Clock in the installed Meter, and the ability (or otherwise) of it to remain accurate across power failure to the Meter (for example, the Meter could have the ability to maintain power to the Clock through such power failures by way of, say, a battery. However, this is not a SMETS requirement for Meters).

6.3   HAN Connected Auxiliary Load Control Switch (HCALCS)

SMETS 8.3.1 requires that HCALCS have a Timer and that the Timer is capable of measuring a period of up to 24 hours with a minimum resolution of 1 minute. This is to allow the HCALCS to be controlled by an authorised ESME[32] (e.g. the ESME instructing the HCALCS to close the switch for 30 minutes). In most cases, this is the only understanding of time that an HCALCS needs to have.

However, a HCALCS must also support the GBCS 'Update Security Credentials' Command[33], and must hold Supplier Security Credentials[34]. Changing such Supplier Security Credentials can be future dated[35]. Therefore, the HCALCS needs to know when it has reached the future date-time specified in such Commands to update its Supplier Security Credentials. In this instance the HCALCS can utilise the time made available to it by the CH.

6.4   Prepayment Interface Device (PPMID)

PPMIDs are not required to have a Clock or a Timer. This does not prevent Manufacturers from producing PPMIDs with Clocks or Timers, nor does it prevent PPMIDs from utilising the time made available to them by the CH. PPMIDs do have to display Local Time[36], which the CH must make available to them.

PPMIDs do need to support the Update Security Credentials Command but do not need to know UTC time to process such Commands because PPMIDs:

- Do not hold Supplier Security Credentials[37] and so the Commands cannot be future dated; and

- Do not need to undertake time based checks on new security credentials they receive [GBCS section 4.3.2.8.2 states '*Device types which are not required to have a Clock, shall always undertake Certification Path Validation, excluding time checks'*].

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32 SMETS sections 8.5.1.2 and 5.6.4.1
33 GBCS section 13.3.2
34 GBCS section 4.3.2.5
35 GBCS table 13.3.4.3 states that 'executionDateTime' 'may only be present if credentialsReplacementMode is either supplierBySupplier or supplierByTransCoS
36 SMETS sections 7.4.4.2 and 6.4.2.2
37 GBCS table 4.3.2.5

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6.5 In-home Displays (IHDs)

IHDs are not required to have a Clock or a Timer. This does not prevent Manufacturers from producing IHDs with Clocks or Timers, nor does it prevent IHDs from utilising the time made available to them by the CH. IHDs do have to display Local Time[38], which the CH must make available to them.

IHDs do not have to support Update Security Credentials commands, and so do not have those time related requirements

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38 SMETS sections 7.4.4.2 and 6.4.2.2

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1. Annex A: time related SMETS Configuration Items

SMETS details requirements for a number of Configuration Items that drive recurring time based functionality on the Meter, not least the Billing Calendar, the Non-Disablement Calendar, the Tariff Switching Calendar, and the Auxiliary Load Control Switch Calendar.

The Billing Calendar is relatively straightforward in that it has a UTC start time (at which a Billing Data Log snapshot of values is taken) and a periodicity of daily, weekly or monthly. Subsequent snapshots are taken based on the UTC start time and periodicity.

The other SMETS Calendars use more complex structures, specifically one of two underlying structures in GBCS and DUIS:

- A calendar structure; or

- A schedule structure.

Both structures can be used in combination with a 'special days' structure.

1.1 Calendar structure

The calendar is a hierarchical structure which is broadly the same in both ZigBee and DLMS COSEM (and so on GSME and ESME). It is used on ESME and GSME for Tariff Switching Tables and on GSME only for Non-Disablement Calendars.

The hierarchy is:

- A calendar has a number of seasons (or season_profiles).

- A season uses a specified week (or week_profile) structure.

- A week has seven days in it (Monday to Sunday) and each of these days has a day_profile associated with it.

- A day_profile consists of a list of timed actions in a day.

- Each timed action has a time in a day (in UTC) and against each time, a specified action. For example, the possible actions in a Non-Disablement Calendar are to 'start' a period of non- disablement or 'stop' a period of non-disablement.

1.2 Schedule structure

DLMS COSEM has an additional structure called a 'schedule'. This structure is used on ESME only and only for ALCS Calendars and Non-Disablement Calendars.

A schedule is a list of timed actions (with each timed action being a UTC time in a day plus the associated action).

Each timed action has additional information associated with it:

- Which days (Monday to Sunday) the action is to happen on;

- Between which dates the action is to happen; and

- Which special days the action is to happen on.

1.3 Special days structure

Special days are list structures. Each entry in the list has the date of a special day and a link to the list of timed actions that should occur on that special day. Special days override the actions that would normally take place on that day according to the calendar / schedule in question.

A separate list of special days can be specified for each of Tariff Switching Tables, Non-Disablement Calendars and ALCS Calendars.

1.4 Examples

This annex provides an example for each of these structures by specifying Non-Disablement Calendar settings in a Service Request for each of:

- an ESME (where the Device and the Service Request use the schedule structure); and

- a GSME (where the Device and the Service Request use the calendar structure).

The underlying non-disablement requirements are specified below and are for the calendar year 2016. Scottish, English and Welsh bank holidays for 2016 are included as special days. British Summer Time is implemented by having three seasons: (1) the part of 2016 before the start of BST; (2) the part of 2016 when BST applies and (3) the part of 2016 after the end of BST. For the BST period, the UTC times are shifted by an hour so that the non-disablement times stay the same in Local Time. Such an approach would mean that a new Non-Disablement Calendar would need setting once a year. Other approaches are possible but the duration of applicability is likely to be limited, including, on GSME, by a maximum of three seasons and, on ESME, by a maximum of 22 timed actions.

The Update Prepay Configuration Service Request requires both Non-Disablement Calendar settings and certain prepayment financial values. Arbitrary values for the latter are in the Service Requests.

The Non-Disablement Calendar values used in the example Service Requests are derived from the table below.

Note that there is a value for midnight included for each of weekday, weekend and special days. This means that, should a Meter have its time reset to any point in a 24 hour period, it can reliably ascertain the state it should be in, in terms of non-disablement. The midnight value is required for GSME and is arguably prudent for ESME.

Parameter	Value	Note
week day non disablement start time 1	00:00:00	
week day non disablement stop time	08:00:00	
week day non disablement start time 2	18:00:00	
weekend non disablement start time 1	00:00:00	
weekend non disablement stop time	10:00:00	

weekend non disablement start time 2	16:00:00	
special day non disablement start time 1	00:00:00	
special day non disablement stop time	n/a	Non-disablement applies all day
special day non disablement start time 2	n/a	Non-disablement applies all day

The resulting Service Requests are in the following embedded documents.

Note the Service Requests are not signed but do have dummy data in the digest and signature fields to allow schema validation.

The Service Requests have been produced against the Schema version released by DCC to TBDG on 18th November 2015.

ESME example Service Request:

SR 2.1 scenario
A.0--ESME--dataset

GSME example Service Request:

SR 2.1 scenario
A.0--GSME--dataset

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