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colour inside

Information technology – Home electronic system (HES) interfaces – Part 3: Modular communications interface for energy management

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IEC Central Office
3, rue de Varembé
CH-1211 Geneva 20
Switzerland

Tel.: +41 22 919 02 11
Fax: +41 22 919 03 00
info@iec.ch
www.iec.ch

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CONTENTS

INFORMATION TECHNOLOGY – HOME ELECTRONIC SYSTEM (HES) INTERFACES –

Part 3: Modular communications interface for energy management

FOREWORD

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International Standard ISO/IEC 10192-3 was prepared by subcommittee 25: Interconnection of information technology equipment, of ISO/IEC joint technical committee 1: Information technology.

This International Standard has been approved by vote of the member bodies, and the voting results may be obtained from the address given on the second title page.

This publication has been drafted in accordance with the ISO/IEC Directives, Part 2.

A list of all parts in the ISO/IEC 10192 series, published under the general title *Information technology – Home electronic system (HES) interfaces*, can be found on the IEC and ISO websites.

IMPORTANT – The 'colour inside' logo on the cover page of this publication indicates that it contains colours, which are considered to be useful for the correct understanding of its contents. Users should therefore print this document using a colour printer.

INTRODUCTION

Utilities world-wide are investing heavily in smart grid infrastructures for energy that extend to homes and businesses with the goal of improving grid reliability and efficiency through increased consumer awareness and participation. This document provides a solution for grid connections within the home through a modular communications interface (MCI) enabling any product to connect to a variety of demand-response systems. Such systems may include Advanced Metering Infrastructure (AMI), Smart Energy Profile (SEP), IEC PAS 62746-10-1:2014 (OpenADR 2.0) and/or home or building networks such as protocols specified in the ISO/IEC 14543 series. The concept is simple: encourage manufacturers to build an MCI into their products that can accept a simple communications module. Consumers and programme managers are then free to select whatever communications solution works best for their particular environment.

The MCI is based on the ISO/IEC 8482 interface (commonly referenced as RS-485) and the Serial Peripheral Interface (SPI) supported by most silicon chips. The messages conveyed through the MCI to the end-device use either an externally specified command set (called the "Pass-Through mode") or the demand response (DR) application command set specified in this document as the Simple Protocol. The DR command set is intended for devices that cannot process one of the "pass-through" command sets. This document specifies options for the Pass-Through mode based on protocols commonly used in grid applications such as Internet Protocol (IP), IEC PAS 62746-10-1:2014 (OpenADR 2.0), SEP, and ISO/IEC 14543 series protocols. Network security is supported at the application layer in the Pass-Through mode in addition to network or application layer security.

The MCI specified in this document may use either of the following connectors:

- an AC powered form, which uses the ISO/IEC 8482 interface over a physical connector defined in this document;
- a DC powered form, which uses the Serial Peripheral Interface over a connector defined in ISO/IEC 24739-3. The use of this connector is discussed in Annex A and Annex B.

The MCI applies to devices that may include an energy management hub, an energy management controller, an energy management agent, a residential gateway, an energy services interface, a sensor, a thermostat, an appliance or other consumer products. A physical connection from a communication module to residential smart grid devices and options for a communications protocol including application messages are specified. The specific residential devices to use an MCI are not specified. For energy management the choice depends on the system and the network topology. If a hub topology is chosen, the MCI may be located on the hub. The connection between the hub and end-devices such as appliances is not specified.

Communication messages specified in this document for the DR command set support direct load control, time-of-use (TOU), critical-peak-pricing (CPP), real-time pricing (RTP), peak time rebates, various types of block rates, and a range of ancillary services. The functionality of the removable MCI modules can be tailored by utilities or other load managing entities to provide support for the unique needs in a given region or service territory without impacting the end-devices. Figure 1 illustrates the general concept of the MCI.

a) MCI on a controlled device **b) MCI on an energy management console**

Figure 1 – Illustrations of the modular communications interface (MCI) concept

This document enables a new generation of “smart grid ready” products that limit risks and constraints of proprietary communication technologies and evolving standards. This approach simplifies home area network (HAN) device and network interoperability, fosters programme and product innovation and opens DR programmes to a broader range of consumer products, while facilitating customer choice and a competitive market landscape.

INFORMATION TECHNOLOGY – HOME ELECTRONIC SYSTEM (HES) INTERFACES –

Part 3: Modular communications interface for energy management

1 Scope

This part of IEC 10192 specifies a UCM (Universal Communications Module) that transfers energy management data via a home network between an end-device and an energy management agent (specified in ISO/IEC 15067-3) or an energy service provider. This document specifies the mechanical, electrical and logical characteristics of the interfaces of UCM to an end-device (hereafter referred to as an SGD – Smart Grid Device) and a choice of interfaces to a home communications network.

This document specifies the physical and data-link characteristics of the interface between the UCM and the SGD, along with certain higher-layer and application layer elements as needed to assure interoperability over a broad range of device capabilities. It specifies a mechanism through which network, transport and application layer messages specified in other documents listed in this document may be passed through the interface. For those end-devices that cannot process one of the "pass-through" command sets, a Simple Protocol is specified according to the OSI (Open System Interconnect) reference model (ISO/IEC 7498-1) including application layer messaging for energy management.

The UCM specified in this document is intended to be installable by the purchaser, home occupant or professional installer. The connectors are integrated in a way that allows for easy, plug-in installation. However, the manufacturer may choose to pre-install a module during production or have installation handled by a manufacturer representative or professional installer.

The scope of this document does not include safety related construction, performance, marking or instruction requirements. UCM products should additionally comply with applicable product safety standard(s). Examples of such standards are presented in Annex G.

NOTE Some regulatory authorities require that appliances intended for participation in energy management, such as thermostats, be user installable.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO/IEC 8482, *Information technology – Telecommunications and information exchange between systems – Twisted pair multipoint interconnections*

ISO/IEC 14543-3-1, *Information technology – Home electronic system (HES) architecture – Part 3-1: Communication layers – Application layer for network based control of HES Class 1*

ISO/IEC 14543-4-3, *Information technology – Home electronic system (HES) architecture – Part 4-3: Application layer interface to lower communications layers for network enhanced control devices of HES Class 1*

ISO/IEC 14908-1, *Information technology – Control network protocol – Part 1: Protocol stack*

ISO/IEC 24739-3, *Information technology – AT attachment with packet interface-7 – Part 3: Serial transport protocols and physical interconnect (ATA/ATAPI-7 V3)*

ISO 4217, *Codes for the representation of currencies*

IEC PAS 62746-10-1:2014, *Systems interface between customer energy management system and the power management system – Part 10-1: Open Automated Demand Response (OpenADR 2.0b Profile Specification)*

3 Terms, definitions and abbreviated terms

3.1 Terms and definitions

3.1.1
average price
equivalent constant price for electricity as determined by the energy service provider

3.1.2
hot-swappable
connected and removed under load

3.1.3
Pass-Through mode
use of one of the following application layer protocols: Advanced Metering Infrastructure (AMI), Smart Energy Profile (SEP), IEC PAS 62746-10-1:2014 (OpenADR 2.0) and/or home or building networks specified in the ISO/IEC 14543 series

3.1.4
relative price
ratio of the current price to the average price, where "Average_Price" is calculated as specified in Annex F

3.1.5
smart grid device
end-device that is being informed of energy grid conditions

3.1.6
universal communications module
communications device that provides communication connectivity to a smart grid device

3.2 Abbreviated terms

AMI	Advanced Metering Infrastructure
AP	Average Price
ATA	Advanced Technology Attachment
CPP	Critical Peak Price
DR	Demand Response
HVAC	Heating, Ventilation and Air Conditioning
IP	Internet Protocol
LS	Least Significant
MS	Most Significant
OpenADR	Automated Demand Response specification from the OpenADR Alliance
PCB	Printed Circuit Board
PLC	Power Line Carrier

PoE	Power over Ethernet
RBDS	Radio Broadcast Data System
RDS	Radio Data System
SEP	Smart Energy Profile
SGD	Smart Grid Device
SPI	Serial Peripheral Interface (data transfer standard originally specified by Motorola (Freescale))
TVC	Time Varying Charges
UCM	Universal Communications Module
UTC	Universal Coordinated Time
0x00 to 0xFF	Two digit (8 bit) hexadecimal numbers ranging from 0 to 255 decimal
b0, b1 .. b15	Bit values within a hexadecimal number. b0 is the least significant bit.

4 Conformance

In order to conform to this document a UCM shall transfer energy management data between an end-device and an energy management agent or an energy service provider via a home network, provide an interface to the device (as specified in Clause 5 with a DC interface as specified in Annex A or an AC interface as specified in Annex C) and provide an interface to a home network as specified in Clause 6.

The messaging format shall be one of the protocols referenced in Clause 13 or the Simple Protocol specified in Clauses 7, 8, 9, 10, 11 and 12.

5 Physical/electrical Interface

5.1 Form factors

Two physical form factors are specified. End-device manufacturers may choose either, and communications module providers who wish to cover all products may offer two module versions. For both form factors, the communications protocol across the socket interface is the same, as described herein. Also in both cases, the power for the UCM is provided by the SGD. One form factor provides a low voltage DC supply and an SPI serial data interface. This form factor is specified in Annex A. This option might be attractive in cases where the end-device has no AC power source or when smaller socket size is required.

The second form factor provides AC service voltage for a single phase (typically 120 V or 240 V depending on the country and the appliance) and an ISO/IEC 8482-based serial interface. This form factor is specified in Annex C. This option might be attractive in cases where the end-device does not provide a DC power supply, where compatibility with PLC communications modules is desired or where communications module access to line frequency is needed.

NOTE 1 ISO/IEC 8482 was originally developed as RS-485 and TIA-485.

5.2 Removal and exchange of a UCM

It is assumed that UCMs will be removed or exchanged without turning off the SGD. Therefore, the UCM shall be hot-swappable.

5.3 Block diagram

Figure 2 shows the block diagram of the MCI.

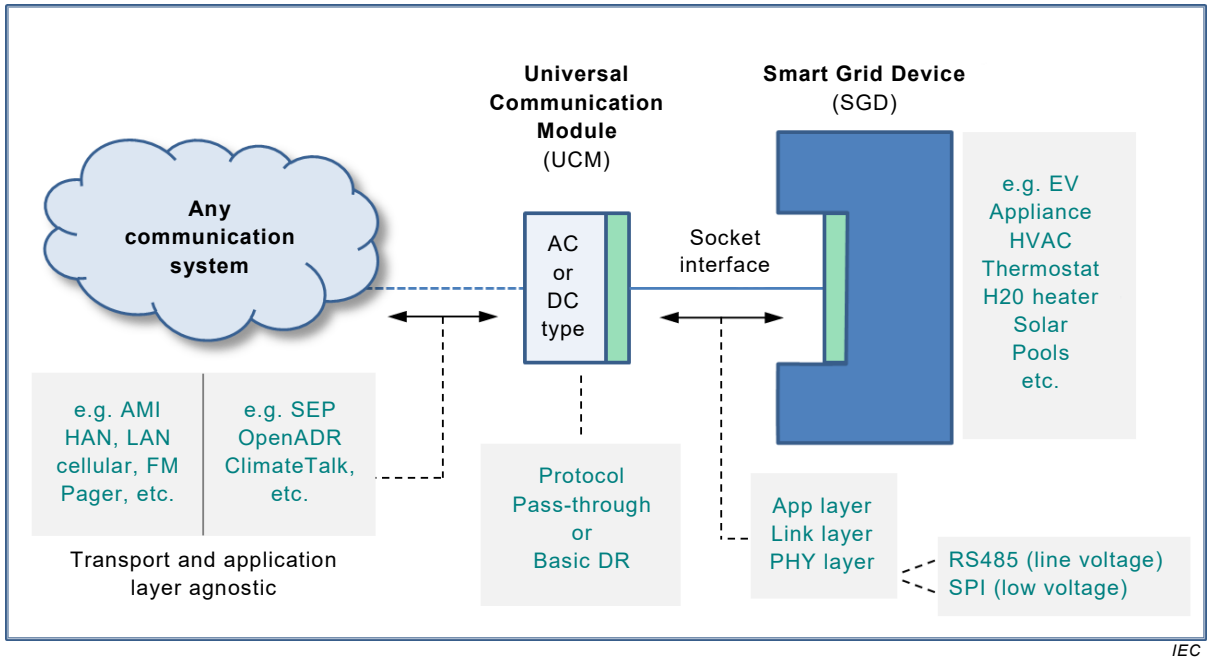

Figure 2 – Modular communications interface (MCI) block diagram

6 Serial protocol

6.1 Protocol data unit

This document defines an extensible serial protocol data unit that is manageable by the simplest of devices and also capable of being extended to accommodate more complex devices. The general message format is shown in Table 1.

Table 1 – Protocol data unit format

Message Type	Reserved shall be '0x0'	Payload length	Payload	Checksum
2 bytes	3 bits	13 bits	Variable	2 bytes

Conceptually the "payload" portion of the message can transport a range of protocols, with the "Message Type" field indicating which protocol and the checksum included ensuring link layer data integrity. There are 3 bits at the start of the third byte that are reserved for future work. These shall be held at 0 for compatibility with future revisions. This scheme provides a high level of flexibility and extensibility. A simple means is provided for SGDs and UCMs to discover which protocol each supports.

6.2 Message Type field

The "Message Type" bytes indicate the type of message, essentially indicating which communications protocol is represented in the payload. The "Message Type" values are specified in Table 2. Typical communication exchanges are presented in Clause 14.