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Information technology - Home Electronic System (HES) architecture - Part 4-304: Application protocol for electric vehicle supply equipment (EVSE) charger and dischargers and controllers

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FOREWORD

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ISO/IEC 14543-4-304 has been prepared by subcommittee 25: Interconnection of information technology equipment, of ISO/IEC joint technical committee 1: Information technology. It is an International Standard.

The text of this International Standard is based on the following documents:

Draft	Report on voting
JTC1-SC25/3322/CDV	JTC1-SC25/3347/RVC

Full information on the voting for its approval can be found in the report on voting indicated in the above table.

The language used for the development of this International Standard is English.

The list of all currently available parts of the ISO/IEC 14543 series, under the general title *Information technology - Home Electronic System (HES) architecture*, can be found on the IEC website and ISO website.

This document was drafted in accordance with ISO/IEC Directives, Part 2, and developed in accordance with ISO/IEC Directives, Part 1, available at www.iec.ch/members_experts/refdocs and www.iso.org/directives.

INTRODUCTION

The ISO/IEC 14543 series provides networking capability for a wide range of appliances, equipment, sensors, etc. in the home, including lighting, heating, and cooling. This part of ISO/IEC 14543 specifies the detailed procedures and behaviours of both electric vehicle supply equipment (EVSE) charger and dischargers and controllers at the application level of communications based on ISO/IEC 14543-4-3. This document specifies the message structure, sequences, and protocol of the application layer for networked enhanced control devices (NECDs) used in the Home Electronic System (HES). Some services are targeted for communications between devices. Other services are exclusively reserved for management purposes. Some services can be used for both management and run-time communications. This document is applicable for energy management services involving EVSE charger and dischargers and related devices.

Figure 1 shows the relationship between IEC 62394, ISO/IEC 14543-4-3 and ISO/IEC 14543-4-304. ISO/IEC 14543-4-3 specifies the message structure, sequences and protocol for general-purpose communications used in network enhanced control devices of the Home Electronic System (HES) Class 1. ISO/IEC 14543-4-3 provides the common interfaces for the use-level process and the services such as energy management, remote maintenance, and other services for easily building a system consisting of multi-vendor devices and equipment. IEC 62394 specifies the detailed lists of control commands on NECD objects (see ISO/IEC 14543-4-3). Annex A shows terms and NECD protocol frame format on ISO/IEC 14543-4-3 and IEC 62394.

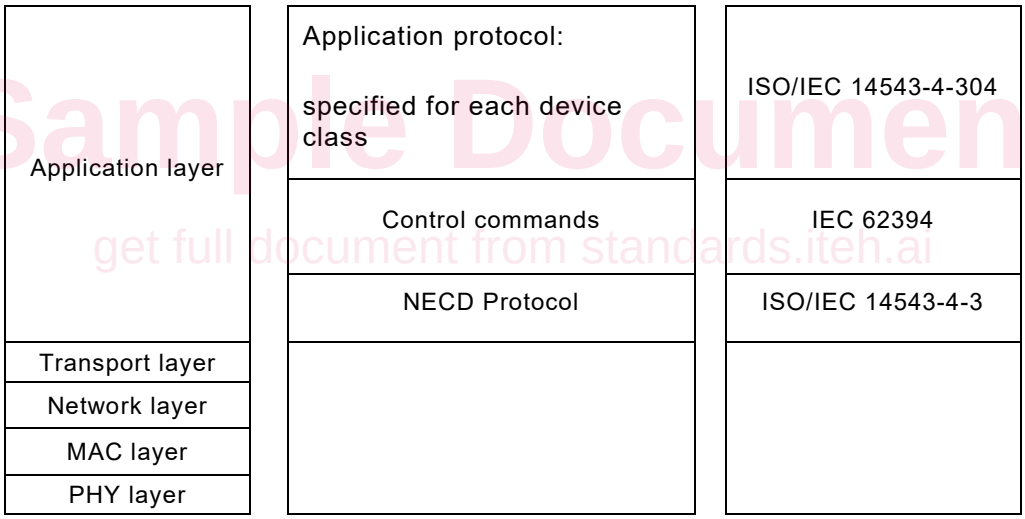


Figure 1 – Relationship between IEC 62394, ISO/IEC 14543-4-3, and ISO/IEC 14543-4-304

ISO/IEC 14543-4-3 is a general-purpose communications specification that applies to a variety of devices. ISO/IEC 14543-4-3 is the basis for this document, which specifies detailed procedures and behaviours for pre-packaged system solutions that include EVSE charger and dischargers and related devices. The procedures and behaviours specified in this document can be used for energy flow inside a home or energy flow between the grid and a home.

In order to enhance interoperability, it is important to specify how to implement ISO/IEC 14543-4-3 for each device and controller at the application level such as command sequences, timeout requirements, required combinations of acceptable commands, minimum subset of IEC 62394 properties, etc.

This document applies to the communication link in yellow between charging station (EVSE charger and discharger) and energy management system (EMS) as shown in Annex B.

1 Scope

This part of ISO/IEC 14543 specifies an application-layer protocol important for ensuring interoperability among the products of various manufacturers regarding communications between electric vehicle supply equipment (EVSE) charger and dischargers and controllers. It uses the network enhanced communications device (NECD) protocol specified in ISO/IEC 14543-4-3. This protocol is based on UDP using IPv4 or IPv6 (TCP is optional).

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.

IEC 62394, *Service diagnostic interface for consumer electronics products and networks - Implementation for ECHONET*

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*

3 Terms, definitions, and abbreviated terms

3.1 Terms and definitions

For the purposes of this document the following terms and definitions apply.

ISO and IEC maintain terminology databases for use in standardization at the following addresses:

– IEC Electropedia: available at https://www.electropedia.org/
– ISO Online browsing platform: available at https://www.iso.org/obp

3.1.1
controller
network enhanced control device (NECD) node that sends NECD requests (Get and SetC) to another NECD node

Note 1 to entry: A controller in this document can be used as a part of a customer energy manager (CEM) specified in IEC 63380-1.

Note 2 to entry: A controller in this document can be used with an energy management agent (EMA) specified in ISO/IEC 15067-3.

Note 3 to entry: A controller in this document can be used with a resource manager (RM) specified in IEC 63402-1.

3.1.2
device object
network enhanced control device (NECD) object other than a node profile object

Note 1 to entry: In this document, "device object" refers to electric vehicle charger/discharger object only.

[SOURCE: ISO/IEC 14543-4-302:2023, 3.1.3, modified – In Note 1 to entry, "storage battery" has been replaced with "electric vehicle charger/discharger".]

3.1.3
electric vehicle
EV
vehicle that is powered by an electric motor that draws electricity from a battery and is capable of being charged from an external source

Note 1 to entry: In this document, "electric vehicle" refers to both a vehicle that is only powered by an electric motor that draws electricity from a battery and a vehicle that is powered by an electric motor that draws electricity from a battery and by an internal combustion engine.

Note 2 to entry: In this document, "electric vehicle" refers to both a vehicle that contains a device that converts alternating current (AC) voltage to direct current (DC) voltage or DC voltage to AC voltage (e.g. inverter) and a vehicle that does not contain a device that converts AC voltage to DC voltage or DC voltage to AC voltage.

3.1.4
electric vehicle supply equipment
EVSE
device that transfers electricity between electric vehicle and home or grid

Note 1 to entry: In this document, "electric vehicle supply equipment" refers to both a device that contains a device that converts alternating current (AC) voltage to direct current (DC) voltage or DC voltage to AC voltage (e.g. inverter) and a device that does not contain a device that converts AC voltage to DC voltage or DC voltage to AC voltage.

Note 2 to entry: In this document, "electric vehicle supply equipment" refers to a device that supports primarily single-family residential applications.

3.1.5
electric vehicle supply equipment charger and discharger
EVSE charger and discharger
electric vehicle supply equipment that includes a communications interface of NECD protocol and is capable of transferring electricity both from home or grid to electric vehicle (EV) and from EV to home or grid

3.1.6
NECD protocol

protocol used in network enhanced control device (NECD) communications

[SOURCE: ISO/IEC 14543-4-302,2023, 3.1.5]

3.1.7
node profile
description of objects implemented in each node

[SOURCE: ISO/IEC 14543-4-302:2023, 3.1.6]

3.1.8
remote control
control from outside the home

[SOURCE: ISO/IEC 14543-4-302:2023, 3.1.9]

3.1.9
response wait time
time between a controller request to an electric vehicle supply equipment charger and discharger and the response from an electric vehicle supply equipment charger and discharger

3.1.10
super class
properties that are inherited and implemented in all device objects

[SOURCE: ISO/IEC 14543-4-302:2023, 3.1.11]

3.2 Abbreviated terms

AC	alternating current
DC	direct current
DNOJ	destination NECD object
EV	electric vehicle
EVSE	electric vehicle supply equipment
IP	internet protocol
NDATA	NECD data
NDT	NECD property value data
NECD	network enhanced control device
NHD	NECD header
NPC	NECD property code
NSV	NECD service
OPC	object property counter
PDC	property data counter
SNOJ	source NECD object
TID	transaction ID
UDP	user datagram protocol

4 Conformance

EVSE charger and dischargers and controllers of HES Class 1 that claim conformance to this document shall:

– send, receive, and process sequences and procedures as specified in Clause 7.

– provide application services and properties specified in 6.2, 6.3, and 6.4 as needed by EVSE charger and dischargers and controllers for which the application is intended.

5 Configuration

This document is necessary for ensuring interoperability between the products of different manufacturers in connection with application communications between EVSE charger and dischargers and controllers, using the NECD protocol as an application protocol via UDP (TCP) and IPv6 communications.

Figure 2 shows the physical configuration in this document and the path and direction of electricity and communication. As shown in Figure 2, this document considers the electricity that is transferred both from home or grid to EV and from EV to home or grid. This document does not specify any requirement about the connector, data, and electricity between EV and EVSE. Any type of connector, data, and electricity can be used between EV and EVSE that are referred to in this document.

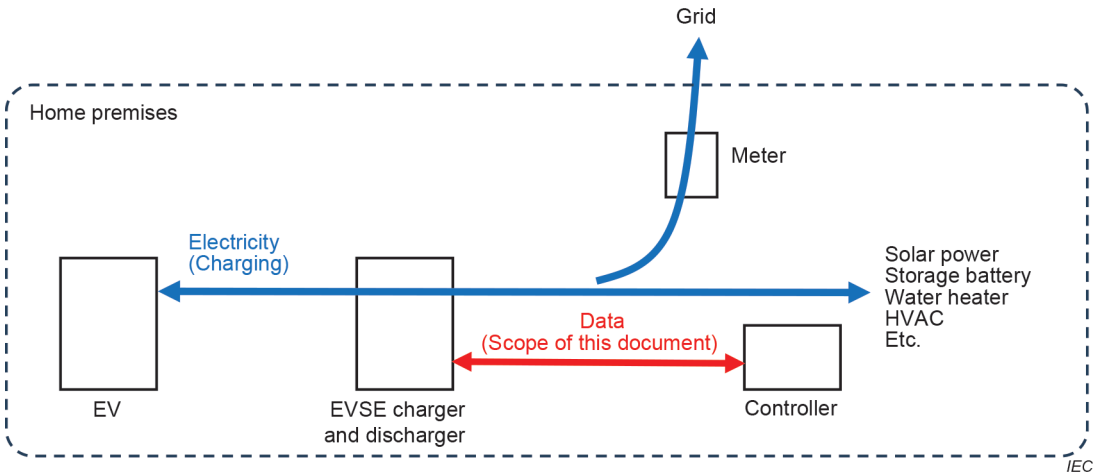
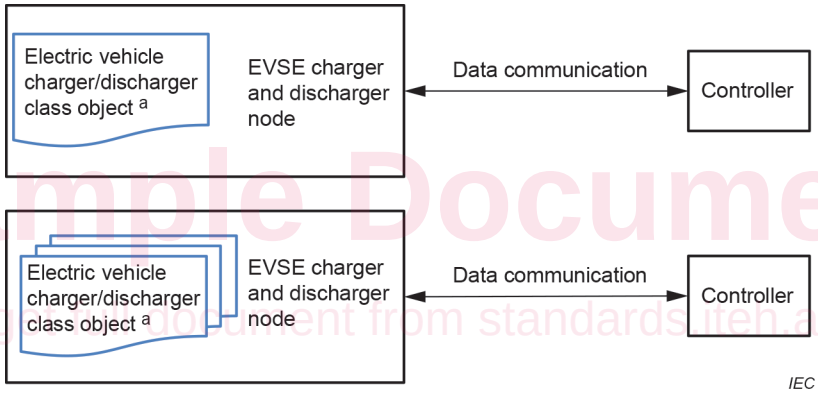


Figure 2 – Physical configuration, and the path and direction of electricity and communication

Figure 3 shows the configurations assumed in this document.



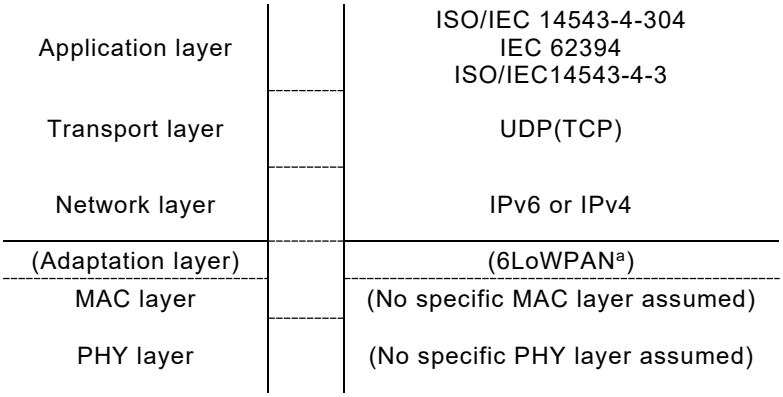
[a] "Electric vehicle charger/discharger class object" is a device object specified in IEC 62394.

Figure 3 – Connection configurations

The upper illustration in Figure 3 shows the case where a single device object is installed in a single node. The lower illustration shows the case where multiple device objects are installed in a single node. The latter case occurs when multiple EVSE charger and discharger units are attached to a single communications unit. In this case, there are multiple electric vehicle charger/discharger class objects in a single EVSE charger and discharger node (i.e. at a single IP address). Controllers shall support nodes that configure multiple device objects in a single node.

Controllers shall be capable of handling multiple nodes and objects. The maximum number of nodes and objects to be handled is implementation-dependent on the controllers. In the environment where multiple controllers exist in the same network, an EVSE charger and discharger shall respond to the latest command from any controller.

Figure 4 shows the assumed network stack for operating the NECD protocol in this document. NECD protocol operation is assumed as an application protocol on UDP(TCP) and IPv6. TCP installation is optional. As a rule, the stack uses IPv6; however, IPv4 is allowed depending on the market trends for migration from IPv4 to IPv6.



[a] Depends on transmission media using IPv6.

Figure 4 – Assumed network stack

Connection processing specific to each lower layer communications medium that is necessary in advance of the start of NECD communications is out of the scope of this document. In this document, application communications using the NECD protocol are specified on the assumption that connection processing specific to those communications media is complete.

6 Application layer

6.1 General

The NECD protocol shall be used at the application layer. All nodes that conform to this document shall support all mandatory functions specified in ISO/IEC 14543-4-3.

6.2 NECD objects

EVSE charger and dischargers shall have the NECD objects shown in Table 1. Controllers shall have the NECD objects shown in Table 2.

Table 1 – NECD objects for EVSE charger and dischargers

NECD object	Class group code	Class code	Class name	Instance code
EVSE charger and discharger	0x02	0x7E	Electric vehicle charger/discharger	0x01 to 0x7F
	0x0E	0xF0	Node profile	0x01

NOTE 1 Instance code 0x00 is designated to specify all instances of the same class in a node.

Table 2 – NECD objects for controllers

NECD object	Class group code	Class code	Class name	Instance code
Controller	0x05	0xFF	Controller	0x01 to 0x7F
	0x0E	0xF0	Node profile	0x01

NOTE 2 Instance code 0x00 is designated to specify all instances of the same class in a node.

6.3 NECD services

EVSE charger and dischargers and controllers shall support the NECD services shown in Table 3.

Table 3 – NECD services

NSV code	NECD service content	Symbol	Sender
0x51	Property value write "response-not-possible" response	SetC_SNA	EVSE charger and discharger
0x52	Property value read "response-not-possible" response	Get_SNA	EVSE charger and discharger
0x61	Property value write request (response required)	SetC	Controller
0x62	Property value read request	Get	Controller
0x71	Property value write response	Set_Res	EVSE charger and discharger
0x72	Property value read response	Get_Res	EVSE charger and discharger
0x73	Property value notification	INF	Controller and EVSE charger and discharger

6.4 Object-specific NECD properties

EVSE charger and dischargers shall install the NECD properties of a device object shown in Table 4 and Table 5. NECD properties of a node profile object shall support at least the mandatory properties.

Controllers shall send requests to the device object properties shown in Table 4 and Table 5.

Table 4 – NECD properties of device object (super class)

Property name	NPC	Units	Access rule		Announcement at status change	Remarks
			Get	Set		
Installation location	0x81	—	M	M	M	
Standard version information	0x82	—	M	—	—	
Identification number	0x83	—	O	—	—	
Fault status	0x88	—	M	—	M	
Manufacturer code	0x8A	—	M	—	—	
Status change announcement property map	0x9D	—	M	—	—	
Set property map	0x9E	—	M	—	—	
Get property map	0x9F	—	M	—	—	
M: mandatory, O: optional, —: not supported						

Table 5 – NECD properties of device object

Property name	NPC	Units	Access rule		Announcement at status change	Remarks
			Get	Set		
Operation status	0x80	—	M	—	M	
Dischargeable capacity of vehicle mounted battery 1	0xC0	Wh	M	—	—	a, b, g
Remaining dischargeable capacity of vehicle mounted battery 1	0xC2	Wh	M	—	—	a, c, g
Remaining dischargeable capacity of vehicle mounted battery 3	0xC4	%	M	—	—	c, g
Rated charge capacity	0xC5	W	M	—	—	a
Rated discharge capacity	0xC6	W	M	—	—	a
Vehicle connection and chargeable/dischargeable status	0xC7	—	M	—	M	
Minimum/maximum charging electric power	0xC8	W	M	—	—	a
Minimum/maximum discharging electric power	0xC9	W	M	—	—	a
Minimum/maximum charging current	0xCA	0.1A	M	—	—	a
Minimum/maximum discharging current	0xCB	0.1A	M	—	—	a
Charger/discharger type	0xCC	—	M	—	—	
Vehicle connection confirmation	0xCD	—	—	M	—	d
Chargeable capacity of vehicle mounted battery	0xCE	Wh	M	—	—	a, b
Remaining chargeable capacity of vehicle mounted battery	0xCF	Wh	M	—	—	a, b
Used capacity of vehicle-mounted battery 1	0xD0	Wh	M	—	—	a, b, g, h
Operating mode setting	0xDA	—	M	M	M	e
Charging method	0xDC	—	M	O	M	
Discharging method	0xDD	—	M	O	M	
Remaining stored electricity of vehicle-mounted battery 1	0xE2	Wh	M	—	—	a, f, g
Remaining stored electricity of vehicle-mounted battery 3	0xE4	%	M	—	—	f, g
Vehicle ID	0xE6		M	—	—	

M: mandatory, O: optional, —: not supported

[a] These properties are calculated as AC.

[b] These properties are mandatory only when applicable information is provided by the EV that connects to the EVSE charger and discharger. When the EVSE charger and discharger cannot reply, the EVSE charger and discharger shall reply Get_SNA [0x52].

[c] One of them is mandatory when applicable information is provided by the EV that connects to the EVSE charger and discharger.

[d] This property is mandatory only when property value of "Charger/discharger type" property [0xCC] is "DC_type AA (charging only)" (0x21), "DC_type AA (charging/discharging possible)" (0x22), or "DC_type AA (discharging only)" (0x23).

[e] When EVSE charger and discharger receives a write request of property value "Preparation" (0x48) from controllers, the EVSE charger and discharger shall not renew its property value to "Preparation" (0x48).

[f] One of them is mandatory when applicable information is provided by the EV that connects to the EVSE charger and discharger.

[g] The number at the end of the property name (1 or 3) does not express the difference of the physical battery but expresses the difference of the unit. "1" is expressed in watt-hours (Wh) and "3" is expressed as a percentage (%).

[h] "Used capacity" is the same as "useable capacity".

The details of the properties shown in Table 4 and Table 5 are specified in IEC 62394 "Electric vehicle charger/discharger class specifications". If a discrepancy between IEC 62394 and this document exists, the description in this document applies.

The properties shown in Table 4 and Table 5 are used for energy management and other general purposes, and therefore should not be relied on for billable purposes.

The NECD properties shown in Table 5 involving measurements are expressed in AC units whether the EVSE charger and discharger exchanges AC power with EV or exchanges DC power with EV.

Fault status of EVSE charger and dischargers shall be shown in "Fault status" property [0x88] as true or false. EVSE charger and dischargers can describe details of the fault status by using other fault NECD properties ("Manufacturer’s fault code" property [0x86] and "Fault description" property [0x89]) as specified in IEC 62394.

6.5 Application operation

6.5.1 General

6.5.2 to 6.5.7 specify the operations on EVSE charger and dischargers and controllers at the application level.

6.5.2 Continuous requests

A request from a controller and the corresponding response from an EVSE charger and discharger is a basic unit of communications, i.e. an EVSE charger and discharger returns a single response to a single request. Controllers that issue continuous requests to an EVSE charger and discharger shall be designed with a response wait time defined in Table 6. When receiving a response, the time is reset, and the controller can send a new request.

If a controller resends or continuously sends requests in an interval shorter than a response wait time value specified in Table 6, it is possible that EVSE charger and dischargers do not accept the requests, do not renew the values to respond, or are not able to renew the values correctly. "Continuous requests" means continued requests to the same EVSE charger and discharger node, not to the same EVSE charger and discharger instance.

6.5.3 Response wait time value for controllers

The values of response wait times, which count the time from a controller’s request until the response from the targeted EVSE charger and discharger, are specified in Table 6.

Table 6 – Response wait time values for controllers

Parameter name	Value
Response wait time	At least 20 [s]

EVSE charger and dischargers shall respond within the time specified in Table 6, in case the received request’s OPC is 1 or in case the EVSE charger and discharger processes operations specified in Clause 7 only. In case the request’s DNOJ instance code is all-instance designation code [0x00], the targeted EVSE charger and discharger shall return the first response frame within the time specified in Table 6.