International Standard

ISO 17748-3

First edition
2026-09

Intelligent transport systems — Energy-based green ITS services for smart city mobility applications via nomadic and mobile devices —

Part 3: Data exchange requirements for electric vehicle (EV)-based demand response charging services

Systèmes de transport intelligents — Services STI écologiques basés sur l'énergie pour les applications de mobilité des villes intelligentes via des dispositifs nomades et mobiles —

Partie 3: Exigences en matière d'échange de données pour les services de recharge à la demande des véhicules électriques (VE)

Reference number
ISO 17748-3:2026(en)

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Published in Switzerland

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Foreword

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This document was prepared by Technical Committee ISO/TC 204, *Intelligent transport systems*.

A list of all parts in the ISO 17748 series can be found on the ISO website.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

Introduction

Renewable energy sources in the electric power system have been increasing as part of efforts to overcome the global climate crisis (see ISO Guide 84). Unlike traditionally concentrated electric power generation sources, renewable energy sources are distributed nationwide. Cities are getting smarter thanks to information and communication technologies. They are also growing larger as the urbanization rate (the share of a population living in urban areas) rapidly increases. The number of eco-friendly electric vehicles in the transportation sector is also increasing. These changes make the efficient use of electric energy pivotal in cities, especially smart cities, which need to take climate action to reach carbon neutrality.

This document is based on the assumption that a smart city has its own energy management system to operate the electric power grid that provides electric energy for its citizens. It defines data exchange requirements to support electric vehicle (EV)-based demand response (DR) services that utilize nomadic devices in smart cities.

This document considers two types of EV-based DR service. The first type reduces electric energy consumption in response to a reduction request event issued by the energy management system of the smart city. Such an event can be issued in consideration of a shortage of reserved power, or on days when naturally occurring fine dust is so severe that, in accordance with the environmental policy of the smart city, coal-fired power plants blamed for the fine dust emissions are not operated. In this case, EV owners who receive a demand reduction request message from a DR service provider via nomadic devices can stop charging their EVs or reduce the charging load of EVs that are currently being charged.

The second type of EV-based DR service increases demand on days when a grid-side imbalance event is forecast due to over-generation of electric power from renewable energy sources. In this case, EV owners who receive a demand increase request message from a DR service provider can go to a specified charging station and charge their EVs during a specified time period.

These services, interworking the energy and transportation sectors, will contribute to making cities safer, more comfortable and more sustainable.

Intelligent transport systems — Energy-based green ITS services for smart city mobility applications via nomadic and mobile devices —

Part 3:
Data exchange requirements for electric vehicle (EV)-based demand response charging services

1 Scope

This document specifies the data exchange requirements between related systems within the smart city for electric vehicle (EV)-based demand response (DR) services utilizing nomadic devices as follows:

— EV-based DR service for demand reduction, called “demand response” during the shortage of reserve on electric grid or in response to a fine dust warning issued according to an air quality forecast;

— EV-based DR for demand increase, called “reverse demand response”, instead of curtailment during excess electricity generation by renewable energy sources such as the sun and wind.

This document defines the requirements of main actors such as the EV, nomadic device, smart city cloud, charging station and service provider to support EV-based DR services.

This document also defines the data set and data processing procedure requirements for EV-based DR services.

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 15118-2, *Road vehicles — Vehicle-to-Grid Communication Interface — Part 2: Network and application protocol requirements*

ISO 15118-20, *Road vehicles — Vehicle to grid communication interface — Part 20: 2nd generation network layer and application layer requirements*

IEC 61851-1, *Electric vehicle conductive charging system — Part 1: General requirements*

IEC 62746-10-1, *Systems interface between customer energy management system and the power management system — Part 10-1: Open automated demand response*

IEC 63584, *Open Charge Point Protocol (OCPP)*

3 Terms and definitions and abbreviated terms

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:

— ISO Online browsing platform: available at https://www.iso.org/obp

— IEC Electropedia: available at https://www.electropedia.org/

3.1 Terms and definitions

3.1.1
payment meter
electricity meter with additional functionality that can be operated and controlled to allow the flow of energy according to agreed payment modes

3.1.2
customer baseline load
pattern of electric demand as usual, needed to measure performance of demand response program

3.1.3
demand response meter
meter installed by the service provider to measure load amount of the customer

3.1.4
electric vehicle supply equipment
equipment or a combination of equipment, providing dedicated functions to supply electric energy from a fixed electrical installation or supply network to an electric vehicle for power transfer

3.1.5
electric vehicle-based demand response
demand response activity by which the cost of charging electric vehicles is modified to cause consumers to shift consumption patterns

3.1.6
load increase amount
difference between the customer baseline load and the actual power consumption at each transaction time when the customer increases power load through participation in reverse demand response

3.1.7
load reduction amount
difference between the customer baseline load and the actual power consumption at each transaction time when the customer reduces power load through participation in reduction demand response

3.1.8
nomadic device
device that provides communications connectivity via equipment such as cellular telephones, mobile wireless broadband (e.g. WIMAX, HC-SDMA), WiFi, etc.

3.1.9
reverse demand response resources
demand response resources for large-scale transaction of power load increase

3.1.10
smart city cloud
advanced city platform using information and communication technology to intelligently network key functions of the city

3.1.11
standard demand response resources
demand response resources for large-scale transaction of power load reduction

3.1.12
virtual end node
client, energy management system, thermostat or other end device that accepts the OpenADR signal from a server like virtual top node

3.1.13
virtual top node
server that transmits OpenADR signals to end devices or other intermediate servers

3.2 Abbreviated terms

Abbreviation	Term
AC	alternating current
CBL	customer baseline load
CSMS	charging station management system
CSO	charging station operator
DC	direct current
DR	demand response
EMS	energy management system
EV	electric vehicle
EVSE	electric vehicle supply equipment
HTML	hypertext markup language
HTTP	hypertext transfer protocol
IP	internet protocol
ND	nomadic device
OCPP	open charge point protocol
OpenADR	open automated demand response
RRMSE	relative root mean squared error
TCP	transmission control protocol
TLS	transport layer security
VEN	virtual end node
VTN	virtual top node
WPT	wireless power transfer
XML	extensible markup language
XMPP	extensible messaging and presence protocol
YAML	yet another markup language

4 Supported EV-based DR services

4.1 DR service

In general, DR refers to the market participation behaviour of electricity users to change their normal load consumption patterns in response to market price signals or incentive mechanisms. The EV-based DR (IEC 63382-1) service is based on an incentive mechanism. By adjusting the charging load, problems such as mismatch between peak generation and peak load, peak regulating capacity and shortage of reserve capacity can be alleviated as shown in Figure 1. DR service is an action that the registered customers stop charging EVs or reduce charging load of EVs which are being charged during the time period specified in demand reduction request message from service provider.

Electricity is hard to store, so the balance between supply and demand in the electric power system needs to be maintained at any moment. Therefore, smart city cloud forecasts next day power demand a day ahead and notifies service providers of the DR event, and then service providers inform reduction event of registered