

Recommendation

ITU-T Q.5011 (06/2024)

SERIES Q: Switching and signalling, and associated measurements and tests

Signalling requirements and protocols for IMT-2020 –
Signalling requirements and architecture of IMT-2020

Signalling requirements and interfaces of edge-aided energy management agent at intelligent edge computing

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Switching and signalling, and associated measurements and tests

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For further details, please refer to the list of ITU-T Recommendations.

Recommendation ITU-T Q.5011

Signalling requirements and interfaces of edge-aided energy management agent at intelligent edge computing

Summary

Recommendation ITU-T Q.5011 describes the Signalling requirements and interfaces of edge-aided energy management agent at intelligent edge computing. This Recommendation focuses on the signalling functionality of the edge-aided energy management agent (EEMA) and interfaces among EEMAs.

History *

Edition	Recommendation	Approval	Study Group	Unique ID
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Edge-aided energy management agent, intelligent edge computing.

* To access the Recommendation, type the URL <https://handle.itu.int/> in the address field of your web browser, followed by the Recommendation's unique ID.

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Recommendation ITU-T Q.5011

Signalling requirements and interfaces of edge-aided energy management agent at intelligent edge computing

1 Scope

This Recommendation describes signalling requirements and interfaces of edge-aided energy management agent (EEMA) to support cooperative energy management and demand response services at intelligent edge computing (IEC). It describes the following details:

- Hierarchical and distributed EEMA frameworks;
- Signalling requirements for signalling context and functionality; and
- Reference interfaces.

2 References

The following ITU-T Recommendations and other references contain provisions which, through reference in this text, constitute provisions of this Recommendation. At the time of publication, the editions indicated were valid. All Recommendations and other references are subject to revision; users of this Recommendation are therefore encouraged to investigate the possibility of applying the most recent edition of the Recommendations and other references listed below. A list of the currently valid ITU-T Recommendations is regularly published. The reference to a document within this Recommendation does not give it, as a stand-alone document, the status of a Recommendation.

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|----------------------|--|
| [ITU-T Q.5001] | Recommendation ITU-T Q.5001 (2018), <i>Signalling requirements and architecture of intelligent edge computing</i> . |
| [ITU-T Q.5008] | Recommendation ITU-T Q.5008 (2023), <i>Signalling requirements and architecture to support artificial intelligence-based vertical services in future networks including IMT2020 and beyond</i> . |
| [ITU-T Y.2070] | Recommendation ITU-T Y.2070 (2015), <i>Requirements and architecture of the home energy management system and home network services</i> . |
| [ISO/IEC 15067-3-30] | ISO/IEC 15067-3-30:2024, <i>Information technology – Home electronic system (HES) application model – Part 3-30: Energy management agent functional requirements and interfaces</i> . |

3 Definitions

3.1 Terms defined elsewhere

This Recommendation uses the following terms defined elsewhere:

3.1.1 energy management agent (EMA) [b-ISO/IEC 15067-3]: Set of control functions that manage energy consumption as an agent for the customer.

3.1.2 artificial intelligence (AI) platform [ITU-T Q.5008]: A full stack of technologies that enables AI service providers to support automated AI modelling and services for the AI based applications.

3.1.3 machine learning [b-ITU-T Y.3172]: Processes that enable computational systems to understand data and gain knowledge from it without necessarily being explicitly programmed.

NOTE – Federated and reinforcement learning are examples of machine learning types.

3.2 Terms defined in this Recommendation

This Recommendation defines the following terms:

3.2.1 edge-aided energy management agent (EEMA): A software entity that enables energy management capabilities based on artificial intelligence (AI) and machine learning technologies in an intelligent edge computing (IEC) environment.

3.2.2 client EEMA: An edge-aided energy management agent (EEMA) that acts as a client to another EEMA.

3.2.3 server EEMA: An edge-aided energy management agent (EEMA) that acts as a server to other EEMAs.

4 Abbreviations and acronyms

This Recommendation uses the following abbreviations and acronyms:

AI	Artificial Intelligence
AMI	Advanced Metering Infrastructure
API	Application Program Interface
BEMS	Building Energy Management System
CRUD	Create, Read, Update and Delete
DER	Distributed Energy Resources
DERMS	Distributed Energy Resource Management System
DR	Demand Response
DRP	DR Service Provider
EEMA	Edge-aided Energy Management Agent
EEMAF	Edge-aided Energy Management Agent Framework
EMA	Energy Management Agent
EMAP	Energy Management Agent Interworking Protocol
EMS	Energy Management System
EV	Electric Vehicle
EVCSMS	Electric Vehicle Charging System Management System
FEMS	Factory Energy Management System
FRL	Federated and Reinforcement Learning
HEMS	Home Energy Management System
HGW	Home Gateway
HN	Home Network
ID	Identifier
IEC	Intelligent Edge Computing
OpenADR	Open Automated Demand Response
QoS	Quality of Service

5 Conventions

None.

6 Framework of Edge-aided Energy Management Agents in the intelligent edge computing environment

6.1 Overview

This Recommendation describes edge-aided energy management agent (EEMA), a software entity that enables energy management capabilities [ISO/IEC 15067-3-30] based on artificial intelligence (AI) and machine learning technologies [ITU-T Q.5008], to support cooperative energy management and demand response (DR) services in the intelligent edge computing (IEC) environment [ITU-T Q.5001]. This Recommendation specifies hierarchical and distributed EEMA frameworks (EEMAFs) for the integration of various energy systems in remotely connected homes and buildings [ITU-T Y.2070]. An EEMA provides energy management services based on AI and machine learning technologies. AI based services need to collect, analyse and process energy data for their own use in an EEMAF [ITU-T Q.5008]. These EEMAs communicate with each other in an EEMAF to optimize energy management among energy systems. An EEMAF enables a wide range of benefits including decreased bandwidth and reduced latency by applying the intelligent data-processing functions for mission critical energy management services. It can also provide a faster response and greater quality of service (QoS) in comparison with cloud computing.

This EEMAF architecture supports application developers by allowing them to develop EEMA without deep knowledge of multiple interfaces and communications protocols. Moreover, the architecture can be applied to other application services such as electric vehicles (EVs) and security management.

6.2 EEMA framework architecture

Figure 6-1 shows a conceptual diagram of edge-aided EEMAF. EEMAF is integrated with application servers and energy systems/devices to support cooperative energy management and DR services.

- Energy systems/devices

Energy systems/devices include various substations for consumption, generation, transmission and distribution from grid to home. Within a home, energy systems/devices may include home appliances, distributed energy resources (DERs), EV charging stations and storage batteries.

- Application server

An application server is a software system providing the application functionality needed for the effective operation of energy management services. An application server includes a DR service provider (DRP), home energy management systems (HEMSs), building EMSs (BEMSs), factory EMSs (FEMSs), DER management system (DERMS) or EV charging system management system (EVCSMS). Application server may also include advanced metering infrastructure (AMI), energy market and open-data portal (e.g., weather, temperature, atmosphere) with a range of energy management programs in the cloud and edge computing environments.

- EEMAF

EEMAF is a service framework that provides cooperative energy and device management services by applying the intelligent data-processing functions for mission critical energy management services. The energy systems and devices can be represented as abstracted resources by the home gateway (HGW) or energy management agent (EMA) [b-ISO/IEC 15045-1] [b-ISO/IEC 15067-3].