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IEEE Standard for Ubiquitous Green Community Control Network: Control and Management

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IEEE Standard for Ubiquitous Green Community Control Network: Control and Management

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Abstract: This standard describes network gateway access, control, and management; specifies control and management requirements; defines the system architecture, communication sequences, and enhanced functions for the protocols defined in IEEE 1888™, “Ubiquitous Green Community Control Network Protocol”; and extends the protocols and interfaces based on the requirements. This standard shall provide enhanced protocols, workflows, and message formats for the network gateway under control and management, such as registration, access, control, event handling, configuration, status querying, etc.

Keywords: access, configuration, control, event handling, IEEE 1888.1™, management, running status

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Introduction

This introduction is not part of IEEE Std 1888.1-2013, IEEE Standard for Ubiquitous Green Community Control Network: Control and Management.

In an IEEE 1888 network, there are components [such as an application (APP), a gateway (GW) and storage, etc.] and sensors/actuators. GWs and sensors/actuators are the most popular facilities used in Ubiquitous Green Community Control Networks (UGCCNets). Sensors/actuators are data terminals that “generate” physical data or “accept” command data. GWs are used to relay data between sensors/actuators and other components, and data translation may be made during the transmission. GWs could be provided by different vendors or suppliers with different functions; therefore, they need to be managed to operate collaboratively. In this case, a consistent protocol, which is the essential task of this standard, is required.

This standard is based on IEEE Std 1888-2011 protocols, enhancing the management and control functionality of the network by extending the interfaces, protocols, and message formats, and focuses on the GW-related workflows for access, control, configuration, registration, running status, event handling, etc. Three aspects are included in this specification:

- a) Specifying system architecture to manage and control GWs and the connected sensors/actuators
- b) Providing methods to monitor GWs
- c) Describing the communication processes that facilitate the operation abilities

In order to achieve effective network operation management, the management and control unit (MCU), which is responsible for the management of components (such as GW) access, control, and configuration, is introduced.

This document is organized as follows:

- Clause 4 specifies the general system architecture and typical communication sequences
- Clause 5 and Clause 6 describe the MCU and GW, respectively, which are key nodes in the GW control and management process
- Clause 7 focuses on the access, configuration, control, and management processes of the GW
- Clause 8 and Clause 9 describe the relevant interfaces and data structures that are extensions of IEEE Std 1888-2011
- Clause 10 describes the compatibility with IEEE Std 1888-2011
- Clause 11 describes the security considerations

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1. Overview

1.1 Scope

Based on the IEEE 1888™ protocols, this standard describes network gateway central access control and management policy through the extension of existing interface protocols, message formats, and interactive processing in ubiquitous green community control networks (UGCCNets). This standard extends the definition of the original interface protocols and message formats and mainly specifies the network gateway signal flow for access control, registration management, state querying, event reporting, remote management, etc.

1.2 Purpose

This standard aims to provide open and standardized network gateway management interface protocols for service providers, system integrators, equipment manufacturers, etc., through the extension of the original interface protocol in order to be able to remotely control and monitor the network gateway and other facilities in green communities, such as heating, ventilation, and air conditioning (HVAC); lighting systems; energy equipment; and so on.

2. Normative references

The following referenced documents are indispensable for the application of this document (i.e., they must be understood and used, so each referenced document is cited in text and its relationship to this document is explained). For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments or corrigenda) applies.

IEEE Std 1888TM-2011, IEEE Standard for Ubiquitous Green Community Control Network Protocol.^{1,2}

3. Definitions, acronyms, and abbreviations

For the purposes of this document, the following terms and definitions apply. The *IEEE Standards Dictionary Online* should be consulted for terms not defined in this clause.³

3.1 Definitions

management and control unit (MCU): Works as the central management unit for an IEEE 1888 network to provide services to other components and control/manage resources.

operation administration and maintenance (OAM): A module in an MCU that operates and maintains gateway (GW) and connected sensors/actuators.

operation service provider (OSP): A module in an MCU that provides services to components for common requests.

resource access manager (RAM): A module in an MCU that manages access control of components under MCU management.

3.2 Acronyms and abbreviations

AC module	access control module
ACL	access control list
APP	application
GML	gateway (GW)-Management List
GW	gateway
HVAC	heating, ventilation, and air conditioning
MCU	management and control unit
MIB	management information base

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NAT	network address translator
OAM	operation administration and maintenance
OSP	operation service provider
QoS	quality of service
RAM	resource access manager
SNMP	simple network management protocol
UGCCNet	ubiquitous green community control network
W3C	World Wide Web Consortium ⁴
XML	extensible markup language

4. Architecture

4.1 General

In a ubiquitous green community control network (UGCCNet), management and control of components is necessary. On one hand, effective management and control of components can improve the system operations and provide end users with cost-effective operation. On the other hand, gateways (GWs) are generally deployed in buildings (e.g., offices, hotels, schools, stores, homes, factories, etc.) that have restricted access. It is necessary, for example, to be able to check the health of such GWs and connected sensor/actuator devices efficiently. It is also important to change the configuration of GWs, storage, and applications (APPs) without accessing restricted areas. Thus, this specification addresses the general management and control of UGCCNet components.

To realize such management and control, this standard identifies the following requirements:

- a) Making the GWs and connected devices, such as configurations, status, and events, manageable and controllable
 - 1) Getting the configuration and running status from the components (especially GWs)
 - 2) Setting the configuration and running status to the components (especially GWs)
 - 3) Notifying the changes of running status from the components (especially GWs)
 - 4) Managing the session control in WRITE, FETCH, and TRAP procedures
 - 5) Allowing bidirectional communication, e.g., allowing the management and control of components deployed in a private network segment behind a network address translator (NAT)

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- b) Providing services to components for different requirements
 - 1) Defining control and management services that process data from multiple sensor data sources
 - 2) Sending control signals to multiple actuators
- c) Preventing unauthorized components (such as APP, GW, storage, etc.) or devices from accessing the network and making control commands execute correctly in the system
 - 1) Providing the management of access control at the component level
 - 2) Only allowing GWs and connected sensors/actuators to be accessed in the network
- d) Providing primitive information to realize an extendable system to keep interoperability and backward compatibility
 - 1) Providing an extendable management and control information model and an access control model
 - 2) Allowing component-to-component communication defined in IEEE Std 1888-2011
 - 3) Providing examples of component information models for management and control, simple network management protocol (SNMP) management information base (MIB), and format of the access control list (ACL).

The management rule of data status (e.g., the rule of marking the acquired sensor data “reliable”) and accounting of UGCCNet components (e.g., the logging and centralized management of APP’s direct access to GWs) will be covered by future standards.

4.2 System architecture

To implement control and management functionality and to meet operation requirements, the management and control unit (MCU) is introduced to the system, taking the administration role for controlling and managing UGCCNet components (especially GWs) and GW-connected sensor/actuator devices.

The system architecture identified for management and control is shown in Figure 1. This figure mainly focuses on the illustration of the network communications related to this specification. The communications of IEEE Std 1888-2011 are also supported in this network.

The MCU manages multiple GWs, storage, and APPs that are deployed at remote sites. This document calls the components under the control of MCU “managed” components, e.g., managed GWs, and, the set of components managed by the MCU are called “managed domain.” As for the other GWs, storage, and APPs that are not under the control of the MCU, this document sometimes explicitly calls them “unmanaged,” e.g., unmanaged APPs. The typical communications of management and control around the MCU are shown in Figure 1.