

IEEE Standard for Exchanging Information Between Networks Implementing IEC 61850 and IEEE Std 1815™ [Distributed Network Protocol (DNP3)]

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- H. Lee Smith, who was the past Chair of WG C14 and who passed away in 2015.
- National Institute of Standards and Technology (NIST).
- Smart Grid Interoperability Panel (SGIP).
- DNP User Group.
- Electric Power Research Institute (EPRI).

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Abstract: This document specifies the standard approach for mapping between IEEE Std 1815™ [Distributed Network Protocol (DNP3)] and IEC 61850 (Communications Networks and Systems for Power Utility Automation). Two primary use cases are addressed: a) mapping between an IEEE 1815-based master and an IEC 61850-based remote site and b) mapping between an IEC 61850-based master and an IEEE 1815-based remote site. Mapping aspects included in the standard are: conceptual architecture; general mapping requirements; the mapping of Common Data Classes, Constructed Attribute Classes and Abstract Communication Service Interface (ACSI); cyber security requirements, the architecture of a gateway used for translation and requirements for embedding mapping configuration information into IEC 61850 System Configuration Description Language (SCL) and DNP3 Device Profile. This standard addresses a selection of features, data classes, and services of the two standards.

Keywords: automation, communications, DNP3, evolution, feeder, gateway, IEC 61850, IEEE 1815™, mapping, network, power system, substation, upgrade, utility

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Introduction

This introduction is not part of IEEE Std 1815.1-2015, IEEE Standard for Exchanging Information Between Networks Implementing IEC 61850 and IEEE Std 1815™ [Distributed Network Protocol (DNP3)].

This standard has been developed to address requirements identified by the Smart Grid Interoperability Panel (SGIP). The SGIP is a public/private partnership initiated in 2009 by the National Institute of Standards and Technology (NIST) of the United States of America. NIST initiated the SGIP to support NIST in fulfilling its responsibility, under the U.S. Energy Independence and Security Act of 2007, to coordinate standards development for the Smart Grid. The term “Smart Grid” is used by the SGIP to refer to a power system that uses information and communication technology to make the delivery of electricity more efficient, reliable, secure, and resilient while minimizing costly investments in new generation capacity.

The purpose of the SGIP is to define requirements for the communication protocols and other common specifications that are considered essential to the creation of a Smart Grid. It coordinates development of these standards with collaborating organizations such as IEEE. The development of the IEEE Project Allocation Request (PAR) for this standard and the use case requirements found in Clause 5 of this standard were initiated through a Priority Action Plan (PAP) of the SGIP. The SGIP identifies a PAP to address either a gap where a new standard or standard extension is needed, or an overlap where two complementary standards have non-equivalent methods of addressing the same Smart Grid function.

In this case, the SGIP created a working group to address PAP12, titled “Mapping IEEE Std 1815 (DNP3) to IEC 61850 Objects.” The charter for PAP12 is stated as follows (in italics):

“IEEE Std 1815 (DNP3 – Distributed Network Protocol) is the de facto communication protocol used at the distribution and transmission level in the North American power grid. However, DNP3 is not fully capable of enabling all foreseen Smart Grid functions. Nevertheless the Smart Grid must accommodate and build upon the legacy systems of today’s power grid. The tasks of this PAP include developing IEEE Std 1815 (DNP3) and IEC 61850 mapping documents including guidelines for achieving interoperable integration of equipment using DNP3 with equipment using IEC 61850 by Q4 - 2011.

Bridging the power delivery communication standards from current standards to more feature rich standards will accelerate the implementation of the Smart Grid. Expected benefits include reduced capital and lifecycle costs, improved reliability and the enablement of new applications.”

With this purpose in mind, the members of the PAP12 Working Group began by sponsoring and assisting the adoption of DNP3 as IEEE Std 1815™-2010. It was important to complete this step so that the eventual mapping standard (this document) would describe the mapping between two officially recognized standards, not one standard and a “de facto” standard.

In parallel with this work, the PAP12 Working Group helped to initiate IEEE Std 1815.1™. Members of the PAP12 Working Group developed the PAR that created IEEE project P1815.1 and the IEEE Substations Committee Working Group C14 that was responsible for it. Members of the PAP12 Working Group also developed the use cases, use case diagrams, and the requirements for this standard as described in Clause 5. PAP12 members are providing coordination between Working Group C14 and Substations Committee Working Group C12 so that any changes required to IEEE Std 1815 that would facilitate the mapping to IEC 61850 can be incorporated as quickly as possible.

The intent of IEEE WG C14 and the PAP12 Working Group is to submit the final version of IEEE Std 1815.1 to the appropriate working group of the International Electrotechnical Commission (IEC) with the proposal that it be recognized as a “dual logo” standard. In this way, the mapping rules will be captured as an official part of both the IEEE Std 1815 series of standards and the IEC 61850 series of standards.

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IEEE Standard for Exchanging Information Between Networks Implementing IEC 61850 and IEEE Std 1815™ [Distributed Network Protocol (DNP3)]

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1. Overview

1.1 Scope

This document specifies the standard approach for mapping between IEEE Std 1815™, IEEE Standard for Electric Power Systems Communications – Distributed Network Protocol (DNP3)^{1,2,3} and IEC 61850, Communication networks and systems for power utility automation.⁴

Two primary use cases are addressed:

- Mapping between an IEEE Std 1815-based master and an IEC 61850-based server.
- Mapping between an IEC 61850-based client and an IEEE Std 1815-based outstation.

¹ Information on normative references can be found in Clause 2.

² IEEE publications are available from the Institute of Electrical and Electronics Engineers (<http://standards.ieee.org/>).

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Mapping aspects included in the standard are: conceptual architecture; general mapping requirements; the mapping of Common Data Classes, Constructed Attribute Classes and Abstract Communication Service Interface (ACSI); cyber security requirements, the architecture of a gateway used for translation and requirements for embedding mapping configuration information into IEC 61850 System Configuration Language (SCL) and DNP3 Device Profile. This standard addresses a selection of features, data classes, and services of the two standards.

1.2 Objective

The objective of this standard is to document and make available requirements for exchanging data between IEEE Std 1815 and IEC 61850 protocols using a gateway. While a primary focus of this standard is for the electric utility industry, other industries that deliver energy and water could also use this document if they also plan to use both IEEE Std 1815 and IEC 61850 in their systems. The intent of this standard is to meet the goals established by the U.S. National Institute of Standards and Technology (NIST) for a Smart Grid:

- Provide a standard way to map between two standards from recognized standards institutions.
- Provide interoperability within hundreds of operational systems and between thousands of IEEE Std 1815 and IEC 61850 devices.

Vendors may use this standard to implement and test their gateway products and be assured of a high degree of interoperability. Users may use this document to specify their respective systems. System integrators may use this standard to assist in system integration and testing of user systems utilizing both protocols and gateways.

1.3 Background

IEC 61850 covers multiple aspects of a Supervisory Control and Data Acquisition (SCADA) system:

- a) The definition of data structures. These data structures contain the information about the current state of the system (e.g., status information, measurements), the information required to operate the system, as well as parameters that can change the behavior of the system. These data structures are implemented in the devices.
- b) The definition of communication services to access the data including the protocols to realize these communication services.
- c) The definition of a model that describes the configuration of the system. That model is used during the system design to exchange information between different engineering tools.

IEEE Std 1815 covers the same aspects, but does not provide the same level of detail with regard to the data structures.

IEC 61850 uses a hierarchical object model, in which the different objects are identified with a name that also provides information about the semantic (meaning and usage) of the data.

IEEE Std 1815 uses numbers to identify the objects and does not define the semantic behind the objects.

1.4 Purpose and intended use

This standard defines rules and methods for the exchange of information between networks implementing IEC 61850 and IEEE Std 1815™-2012 by describing the following: