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IEEE Standard Data Model for Nanoscale Communication Systems

STANDARDS

IEEE Communications Society

Developed by the
Edge, Fog, Cloud Communications with IOT and Big Data Standards Committee

IEEE Std 1906.1.1™-2020

IEEE

IEEE Standard Data Model for Nanoscale Communication Systems

Developed by the

Edge, Fog, Cloud Communications with IOT and Big Data Standards Committee
of the
IEEE Communications Society

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IEEE SA Standards Board

Abstract: A set of YANG modules describing nanoscale communication systems and their associated physical quantities in conformance with IEEE Std 1906.1-2015—a common framework for all nanoscale communication technologies—are comprised by this data model. Physics unique to the nanoscale are represented by the model. The physics are referred to as *non-standard,* required by IEEE Std 1906.1-2015. Remote configuration and management for remote simulation, operation, and analysis of nanoscale communication systems are defined by the model. A self-describing data structure is defined by the model for datastores and repositories of nanoscale communication experimental data enabling a common understanding of the data from a wide variety of nanoscale communication media and technologies. Augmentation of the IEEE Std 1906.1-2015 common core components with details specific to the physics of the nanoscale communication system is allowed by the model. Techniques used by the model facilitate reuse and augmentation. In addition, extensions to IEEE Std 802.1Q and Internet Engineering Task Force (IETF) interfaces—allowing reusability within existing networks, which implies a macroscale to nanoscale interface, and defines nanoscale communication as a feature for bridge ports as defined in IEEE Std 802.1—are provided. The model is composed of simple, required core components while allowing optional, device-specific components and metrics to be added. There is conformity with best practices as defined by the IEEE 802 YANG editors' coordination committee and IETF RFC 6087, and consideration of coexistence and interoperability with existing domain models and tools, such as the Systems Biology Markup Language (SBML).

Keywords: communication networks, communication standards, communication systems, data model, IEEE 1906.1, molecular communication, multi-scale network, nanobioscience, nanobiotechnology, nanobots, nanodevice, nanoelectrochemical systems, nanoelectromechanical systems, nanofluidics, nanomedicine, nanophysics, nanopositioning, nanoscale, nanoscale communication framework, nanoscale devices, nanosensors, nanostructured materials, nanotechnology, nanotube devices, nanowires, network management, quantum mechanics, simulation, standards development, YANG

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Introduction

This introduction is not part of IEEE Std 1906.1.1-2020, IEEE Standard Data Model for Nanoscale Communication Systems.

IEEE Standard 1906.1™-2015 provides a clear, universal definition, metrics, and conceptual framework to solidify and guide development of practical nanoscale communication systems in any media. IEEE Std 1906.1.1 enhances the aforementioned standard by creating a common data model, specified in yet another next generation (YANG) language, that conforms to IEEE Std 1906.1-2015 for nanoscale communication systems.

The IEEE 1906.1.1 YANG data model defines a common network management and configuration data model for nanoscale communication systems designed to fulfill several goals:

- Helps guide conformance with IEEE Std 1906.1-2015
- Uses a self-describing data structure for management and control of nanoscale communication systems
- Represents fundamental physics impacting IEEE 1906.1 systems
- Defines configuration and management for simulation and analysis
- Defines a self-describing data structure used in repositories of nanoscale communication experimental data

A standard network and management and configuration data model enables efficient understanding and use of nanoscale systems and simulations. The data model addresses the problem caused by the continuing development of many tools for nanoscale communication simulation, emulation, and data analysis that have different interfaces and cannot easily be composed into more useful toolchains.

The data model also addresses the problem that nanoscale systems and tools make different assumptions about what data to collect and how to compare performance among a wide variety of different underlying nanoscale communication media and technologies. This common data model is needed to accurately and fairly compare nanoscale communication systems while serving as human and machine-readable documentation of nanoscale communication systems.

This data model also addresses the lack of YANG data models dealing with small-scale communication system interaction directly with nanoscale physics by providing a data model for relevant fundamental physics and the System of International Units.

Repositories, such as IEEE DataPort™ (https://ieee-dataport.org/), of experimental data from small-scale communication systems require clear and accurate documentation for the data to be meaningful from a wide variety of media and technologies to an equally wide variety of researchers and disciplines. This common data model provides a self-describing data model that addresses this purpose.

A reader new to the topic is invited to begin by first reading Annex A for concrete, simple examples.

Contents

IEEE Standard Data Model for Nanoscale Communication Systems

1. Overview

1.1 Scope

This standard defines a common yet another next generation (YANG) (IETF RFC 7950) data model for IEEE 1906.1 nanoscale communication systems.

1.2 Purpose

The YANG data model defines a common network management and configuration data model for nanoscale communication systems. In so doing, it fulfills several purposes:

- It enforces requirements to conform to IEEE Std 1906.1™-2015.
- It describes nanoscale communication systems.
- It represents the fundamental physics impacting IEEE 1906.1 systems.
- It defines configuration and management for simulation and analysis.
- It defines a self-describing data structure used in repositories of nanoscale communication experimental data.

A standard network, management, and configuration data model enables efficient understanding and use of IEEE 1906.1 systems and simulations. A standard data model is needed to ensure that systems and simulations conform to IEEE Std 1906.1-2015. A standard data model is also needed to serve as human and machine-readable documentation of IEEE 1906.1 systems. Because small-scale communication systems interact directly with nanoscale physics, a data model is needed that represents fundamental physics. A common data model is needed to accurately and fairly compare IEEE 1906.1 systems. Repositories of experimental data from small-scale communication systems require clear and accurate documentation for the data to be meaningful. This common data model provides a self-describing data model that addresses this purpose.