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ISO copyright office
Case postale 56 CH-1211 Geneva 20
Tel. + 41 22 749 01 11
Fax + 41 22 749 09 47
E-mail copyright@iso.org
Web www.iso.org

Institute of Electrical and Electronics Engineers, Inc.
3 Park Avenue, New York NY 10016-5997, USA
E-mail stds.ipr@ieee.org
Web www.ieee.org

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IEEE Std 1451.1-1999

IEEE Standard for a Smart Transducer Interface for Sensors and Actuators—Network Capable Application Processor (NCAP) Information Model

Sponsor

TC-9 Committee on Sensor Technology
of the
IEEE Instrumentation and Measurement Society

Approved 26 June 1999

IEEE-SA Standards Board

Abstract: This standard defines an object model with a network-neutral interface for connecting processors to communication networks, sensors, and actuators. The object model containing blocks, services, and components specifies interactions with sensors and actuators and forms the basis for implementing application code executing in the processor.
Keywords: actuators, communication network, object model, sensors

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3 Park Avenue, New York, NY 10016-5997, USA

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Introduction

[This introduction is not part of IEEE Std 1451.1-1999, IEEE Standard for a Smart Transducer Interface for Sensors and Actuators—Network Capable Application Processor (NCAP) Information Model.]

The objective of the IEEE/NIST Working Group on transducer interface standards is to utilize existing control networking technology and develop standardized connection methods for Smart Transducers to control networks. Little or no changes would be required to use different methods of analog-to-digital (A/D) conversion, different microprocessors, or different network protocols and transceivers.

This objective is achieved through the definition of a common object model for the components of a Networked Smart Transducer, together with interface specifications to these components.

The Networked Smart Transducer model shows two key views of a smart transducer:

— Physical view
— Logical view

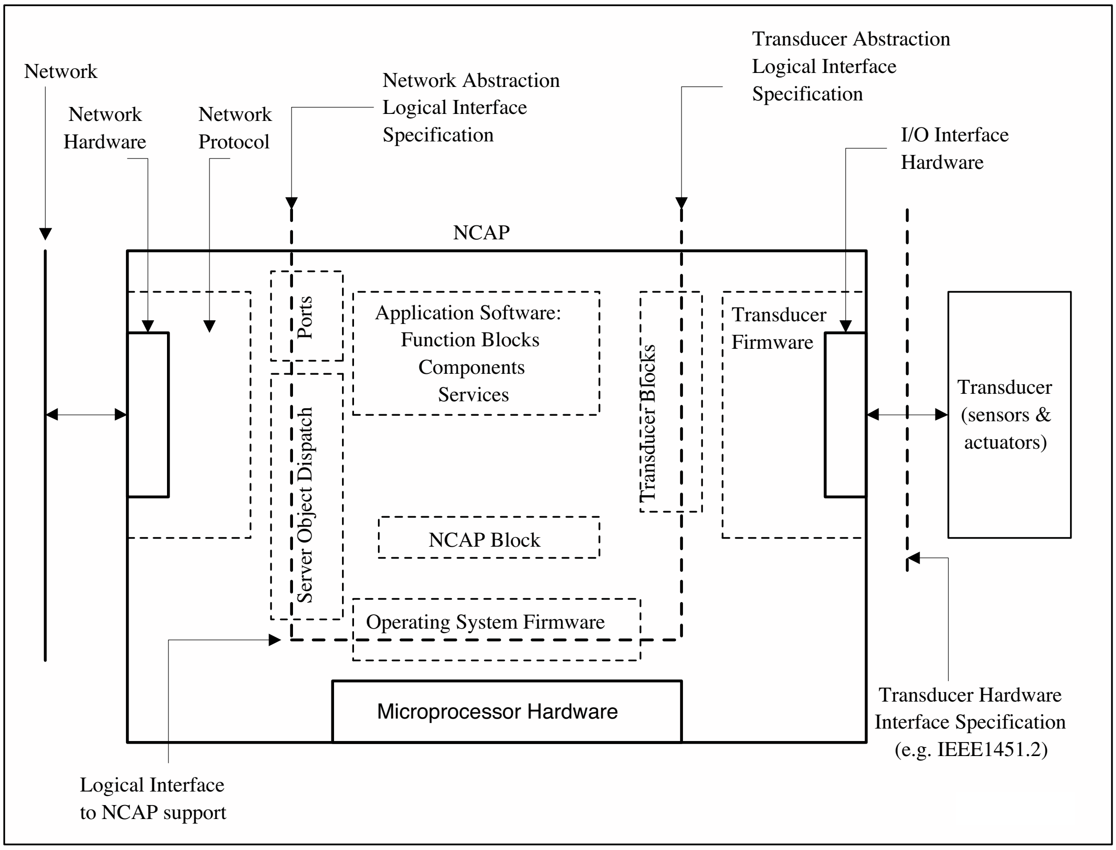

Figure 1—Networked Smart Transducer model

Physical view

The first view shows the physical components of the system. This view is indicated by components drawn in solid lines in Figure 1.

Figure 1 shows a model composed of sensors and actuators connected to form a transducer. The transducer is connected over an interface to a microprocessor or controller that is in turn interfaced to the network. The Hardware Interface Specification between the sensor/actuator and the rest of the device hardware, known as the network capable application processor (NCAP), is indicated by the rightmost thick, dashed line in the figure. A typical specification is described in the companion standard [IEEE Std 1451.2-1997].

The NCAP hardware consists of the microprocessor and its supporting circuitry as well as hardware implementing the physical layer of the attached network and the input/output (I/O) interface to the transducer, as shown in Figure 1.

Logical view

The second view is the logical view of the system and is indicated by components shown in dotted lines in Figure 1.

The logical components may be grouped into application and support components. The support components are the operating system, the network protocol, and transducer firmware components shown. The operating system provides an interface to applications, indicated by the dashed line labeled “Logical Interface to NCAP support.”

A second logical interface, labeled “Network Abstraction Logical Interface Specification,” consists of Port and Server Object Dispatch components defined in this standard. This interface provides an abstraction to hide communication details specific to a given network within a small set of communication methods. The details of this interface are defined by this standard.

The third logical interface, labeled “Transducer Abstraction Logical Interface Specification” performs the same abstraction function for the specifics of the transducer I/O hardware and firmware. In effect, this interface makes all such transducer interfaces look like I/O drivers. The details of this interface are defined by this standard.

Applications are modeled as Function Blocks in combination with Components and Services. The NCAP block provides application organization and support for the other blocks. All of these Blocks, Components, and Services are defined by this standard.

These interfaces are optional in the sense that not all must be exposed in an implementation.

NOTE—If support for interoperable transducers is not required, it is permissible to not use the IEEE1451.2 Interface Specification, or a similar transducer interface standard, but to still use the IEEE1451.1 object model. Similarly, if networking is not supported, or if the networking implementation is closed, it is not necessary to use IEEE1451.1 to still get the benefits of using IEEE1451.2 or a similar transducer interface standard.

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IEEE Standard for a Smart Transducer Interface for Sensors and Actuators—Network Capable Application Processor (NCAP) Information Model

1. Overview

This standard is divided into 16 clauses:

Clause	Purpose
1.	Provides the scope, purpose, and benefits of this standard
2.	Lists references to other standards that are referenced by this standard
3.	Provides definitions that are either not found in other standards or have been modified for use with this standard
4.	Provides conventions for the notation used in this standard
5.	Provides an overview of the information model specified by the standard
6.	Defines the datatypes used in this standard
7.	Defines object properties common to all objects specified in this standard
8.	Defines the top-level objects of an IEEE 1451.1 system
9.	Defines the Block classes
10.	Defines the Component classes
11.	Defines the Service classes
12.	Defines the properties of publications
13.	Defines standard publications
14.	Defines the encoding and decoding rules
15.	Defines the rules for memory management
16.	Defines requirements for conformance

Annexes are provided as follows:

Annex	Purpose
A	Provides an overview of the use of the object model
B	Provides a detailed explanation of client-server interactions
C	Provides a detailed explanation of publish-subscribe interactions
D	Provides detailed examples of the configuration of systems
E	Provides detailed considerations of interoperability
F	Defines a string character set required for certain strings
G	Defines a string language enumeration
H	Defines a Transducer Block for IEEE 1451.2 transducers
I	Bibliography

1.1 Scope

This standard defines an interface for connecting network-capable processors to control networks through the development of a common control network information object model for smart sensors and actuators.

The object model includes definitions of

— Transducer Blocks

— Function Blocks

— NCAP Blocks

This standard will not define individual device algorithms or specifics on what is implemented by using the model.

1.2 Purpose

Many control network implementations are currently available that allow transducers to be accessed over a network. The purpose of this standard is to provide a network-neutral application model that will reduce the effort in interfacing smart sensors and actuators to a network.

1.3 Benefits

A system designed and built in conformance to this standard is expected to provide the following benefits:

— A uniform design model for system implementation

— A uniform and network-independent set of operations for system configuration

— Defined network-independent models for communication

— Interoperability of all communications

— Defined network-independent models for implementing application functionality

— Portable application models

- A network-independent abstraction layer and encode-decode rules that isolate applications from the details of network communications
- A uniform information model for representing physical parametric data
- Uniform models for managing and representing event data, parametric data, and bulk data
- Uniform models for managing and representing time
- Uniform models for intranode concurrency management and components to manage internode concurrency
- Uniform models for memory management

2. References

This standard shall be used in conjunction with the publications and standards listed in this clause. The notation [document-designator] in this standard is a reference to the document in this clause denoted [document-designator].

2.1 General references

[IEEE 754]: IEEE Std 754-1985 (Reaff 1990), IEEE Standard for Binary Floating-Point Arithmetic.[1]

[IEEE 1451.2]: IEEE Std 1451.2-1997, IEEE Standard for a Smart Transducer Interface for Sensors and Actuators—Transducer to Microprocessor Communication Protocols and Transducer Electronic Data Sheet (TEDS) Formats.

2.2 References pertaining to String representation

The following standards shall be used in conjunction with the `StringCharacterSet` and `StringLanguage` enumerations (see 6.1.2).

ANSI X3.4 1986, Coded Character Set—7-bit American National Standard Code for Information Interchange.[2]

CNS 11643-1992, (Taiwan) Standard Interchange Code for Generally Used Chinese Characters.[3]

FSS-UTF, File System Safe Universal Transformation Format (FSS_UTF). X/Open CAE Specification C501 ISBN 1-85912-082.[4]

GB 2312-80 (PRC), China State Bureau of Standards. Coded Chinese Graphic Character Set for Information Interchange.[5]

[ISO 639]: ISO 639:1988-04-01 (E/F), Code for the Representation of Names of languages. Later editions of this standard shall not be used.[6]

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[1]IEEE publications are available from the Institute of Electrical and Electronics Engineers, 445 Hoes Lane, P.O. Box 1331, Piscataway, NJ 08855-1331, USA (http://www.standards.ieee.org/).

[2]ANSI publications are available from the Sales Department, American National Standards Institute, 11 West 42nd Street, 13th Floor, New York, NY 10036, USA (http://www.ansi.org/).

[3]This document is available on the World Wide Web at the following site: http://www.imc.org/rfc1922.

[4]This document is available by contacting X/Open company, Ltd.—USA, 3141 Fairview Park Drive., Suite 670, Falls Church, VA 22042-4501, USA.

[5]CSBS documents are available from the China State Bureau of Standards, P.O. Box 8010, 42 Hi Chun Road, Haidian District, Beijing 100088, China.

ISO/IEC 646:1991, Information technology—ISO 7-bit coded character set for information interchange.

ISO/IEC 2022: 1994, Information technology—Character code structure and extension techniques.

ISO/IEC 6429: 1992, Information technology—Control functions for coded character sets.

ISO/IEC 8859-1: 1998, Information technology—8-bit single-byte coded graphic character sets—Part 1: Latin alphabet No. 1.

ISO/IEC 8859-2: 1999, Information technology—8-bit single-byte coded graphic character sets—Part 2: Latin alphabet No. 2.

ISO/IEC 8859-3: 1999, Information technology—8-bit single-byte coded graphic character sets—Part 3: Latin alphabet No. 3.

ISO/IEC 8859-4: 1998, Information technology—8-bit single-byte coded graphic character sets—Part 4: Latin alphabet No. 4.

ISO/IEC 8859-5: 1999, Information technology—8-bit single-byte coded graphic character sets—Part 5: Latin/Cyrillic alphabet.

ISO/IEC 8859-6: 1999, Information technology—8-bit single-byte coded graphic character sets—Part 6: Latin/Arabic alphabet.

ISO/IEC 8859-7: 1987, Information processing—8-bit single-byte coded graphic character sets—Part 7: Latin/Greek alphabet.

ISO/IEC 8859-8: 1999, Information technology—8-bit single-byte coded graphic character sets—Part 8: Latin/Hebrew alphabet.

ISO/IEC 8859-9: 1999, Information technology—8-bit single-byte coded graphic character sets—Part 9: Latin alphabet No. 5.

ISO/IEC 8859-10: 1998, Information technology—8-bit single-byte coded graphic character sets—Part 10: Latine alphabet No. 6.

ISO/IEC 10646-1: 1993, Information technology—Universal multiple-octet coded character set (UCS)—Part 1: Architecture and basic multilingual plane.

ISO/IEC DIS 10646-2, Information technology—Universal multiple-octet coded character set (UCS)—Part 2: Ideographic character sets.

JIS X 0208:1997, Japanese Standards Association. Code of the Japanese Graphic Character Set for Information Interchange.[7]

JIS X 0212-1990, Japanese Standards Association. Code of Supplementary Japanese Graphic Character Set for Information Interchange.

KS X 1001:1992, Korea Bureau of Standards. Korean Graphic Character Set for Information Interchange.[8]

[6]ISO publications are available from the ISO Central Secretariat, Case Postale 56, 1 rue de Varembé, CH-1211, Genève 20, Switzerland/Suisse (http://www.iso.ch/). ISO publications are also available in the United States from the Sales Department, American National Standards Institute, 11 West 42nd Street, 13th Floor, New York, NY 10036, USA (http://www.ansi.org/).

[7]JIS documents are available from the Japanese Standards Association, 1-24, Akasaka 4-chome, Minato-Ka, Tokyo, Japan 107.

KS X 1002:1991, Korea Bureau of Standards. Korean Graphic Character Set for Information Interchange. (supplemental character set).

TIS 620-2533 1990, Character Codes for Computers.[9]

[8]KS documents are available from the Korean Bureau of Standards, 2 Chung-ang-dong Kwach'on-city, Kyonggi-do 171-11, Korea.

[9]TIS documents are available from the Thai Industrial Standards Institute, Rama 6 Street, Bangkok 10400, Thailand, (tel. 202-3348; fax 247-8739).