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Part 28: Implementation methods: XML representations of EXPRESS schemas and data, using XML schemas

Systèmes d'automatisation industrielle et intégration — Représentation et échange de données de produits —
Partie 28: Méthodes d'implémentation: représentations XML de schémas et de données EXPRESS en utilisant des schémas XML

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Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

International Standards are drafted in accordance with the rules given in the ISO/ IEC Directives, Part 2.

The main task of technical committees is to prepare International Standards. Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75% of the member bodies casting a vote.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights.

ISO 10303-28 was prepared by Technical Committee ISO TC184, *Industrial automation systems and integration*, Subcommittee SC4 *Industrial data*.

ISO 10303-28 constitutes a technical revision of ISO/TS 10303-28:2003, which is provisionally retained in order to support continued use and maintenance of implementations based on it, and to satisfy the normative references of other parts of ISO 10303.

ISO 10303 is organized as a series of parts, each published separately. The structure of ISO 10303 is described in ISO 10303-1.

Each part of ISO 10303 is a member of one of the following series: description methods, implementation methods, conformance testing methodology and framework, integrated generic resources, integrated application resources, application protocols, abstract test suites, application interpreted constructs, and application modules. This part of ISO 10303 is a member of the implementation methods series.

A complete list of parts of ISO 10303 is available from the following URL:

`http://www.tc184-sc4.org/titles/STEP_Titles.htm`

Introduction

ISO 10303 is an International Standard for the computer-interpretable representation of product information and for the exchange of product data. The objective is to provide a neutral mechanism capable of describing products throughout their life cycle. This mechanism is suitable not only for neutral file exchange, but also as a basis for implementing and sharing product databases and as a basis for archiving.

This part of ISO 10303 is a member of the implementation methods series. This part of ISO 10303 specifies means by which schemas specified using the EXPRESS language (defined in ISO 10303-11) and data governed by EXPRESS schemas can be represented as an XML document. This enables product data described in EXPRESS to be exchanged using XML and the many software tools developed to support XML technologies. It also permits product data sets so described to be readily incorporated into "electronic commerce" transactions represented in XML.

Readers of this part of ISO 10303 should have knowledge of the EXPRESS language, the XML Schema language, XML, and XML-related standards in order to understand its technical content.

For the representation of data corresponding to an EXPRESS schema, this part of ISO 10303 formally specifies the structure of conforming exchange documents using the XML Schema language. Some elements of those documents represent data sets conforming to EXPRESS schemas, and this part of ISO 10303 specifies the structure of those elements using XML Schema type definitions and element declarations that are derived from the EXPRESS schema declarations. This part of ISO 10303 also specifies the rules for encoding conforming data in XML to match the derived XML schema. In order to accommodate a number of conflicting requirements for the use of conforming exchange documents, this part of ISO 10303 also defines certain configuration directives that can be used to specify alternative structures in the derived XML schema and alternative encoding rules.

Several components of this part of ISO 10303 are available in electronic form. This access is provided through the specification of Universal Resource Locators (URLs) that identify the location of these files on the Internet. If there is difficulty accessing these files contact the ISO Central Secretariat, or contact the ISO TC 184/SC4 Secretariat directly at: sc4sec@tc184-sc4.org.

This part of ISO 10303 constitutes a technical revision of ISO/TS 10303-28:2003, which is provisionally retained to allow for the implementation of the Part 28 late binding. ISO/TS 10303-28:2003 was intended for trial use with emerging XML technologies, and although the fundamental capabilities remain the same, the underlying XML technologies have progressed, and this part of ISO 10303 uses technologies and features that were formerly unavailable or differently provided. This part of ISO 10303 therefore, is not "upwardly compatible" with ISO/TS 10303-28:2003. Neither a document nor a processor that conformed to ISO/TS 10303-28:2003 will conform to the specifications of this part of ISO 10303 without substantial modification.

The major technical changes from ISO/TS 10303-28:2003 are:

— This part of ISO 10303 specifies the structure of XML exchange documents using XML Schema, and specifies the mapping of the EXPRESS data model to an XML Schema data model. ISO/TS 10303-28:2003 specified the structure using Document Type Definitions (DTDs). It is expected that most future XML documents will be validated against an XML schema, instead of a DTD.

— The ISO/TS 10303-28:2003 mapping of EXPRESS schema text into a complex XML structure is no longer included in this part of ISO 10303; representation of an EXPRESS schema as a body of text is the only form retained.

— The ISO/TS 10303-28:2003 mapping of EXPRESS-modelled data sets designated the "late-binding" is not included in this part of ISO 10303.

— The ISO/TS 10303-28:2003 mapping of EXPRESS-modelled data sets designated the "ETEB" is not included as such. The major features of that binding, as they appear in the XML form of the data, are included in the "default mapping" in this part of ISO 10303. But this part of ISO 10303 makes use of an XML Schema feature that was not available in DTDs — context names — to simplify the names for the "accessor elements".

— The ISO/TS 10303-28:2003 mapping of EXPRESS-modelled data sets designated the "OSEB" is not included as such. The major features of that binding, as they appear in the XML form of the data, are included in the "attribute-content" mapping in this part of ISO 10303. But in this part of ISO 10303, there are several changes to the representation structures for aggregation data types and SELECT data types that provide for representation options and consistency across them.

— This part of ISO 10303 permits the use of XML Schema "simple list" structures to represent many values of aggregation data types, a feature that is not standardized in XML 1.0 and could not be specified in a DTD.

— Many separate options for re-configuring the EXPRESS schema, configuring the XML schema , and configuring the XML data are now supported by a configuration language, and support for that language is a mandatory feature of conforming processors.

Warning:

This part of ISO 10303 provides a specification intended to be implemented in software. Incompatibilities may result in machine-to-machine communication in the case of software developed on the basis of translations of this part of ISO 10303 into languages other than the official ISO languages. It is accordingly strongly recommended that any implementations be developed only on the basis of the texts in the official ISO languages.

Industrial automation systems and integration — Product data representation and exchange —

Part 28: Implementation methods: XML representations of EXPRESS schemas and data, using XML schemas

1 Scope

This part of ISO 10303 specifies use of the Extensible Markup Language (XML) to represent schemas specified using the EXPRESS data specification language, ISO 10303-11, and data that is governed by EXPRESS schemas. This part of ISO 10303 formally specifies the XML representation by specifying an overall XML schema for the exchange document and additional XML schemas that correspond to the EXPRESS schemas that govern the exchange data sets.

The following are within the scope of this part of ISO 10303:

— specification of the form of XML documents containing EXPRESS schemas and data governed by EXPRESS schemas (see Clause 5);

— for an arbitrary EXPRESS schema, specification of an XML schema that corresponds to the EXPRESS schema and formally describes the XML representation of data governed by that schema (see Clause 6);

— specification of the representation of values of EXPRESS data types as XML element content and as XML attribute values (see Clause 9);

— specification of the set of configuration directives that may be used to specify options for the structure of the XML representation of data sets that conform to EXPRESS schemas (see Clause 10).

The following are outside the scope of this part of ISO 10303:

— specification of XML Schema declarations or definitions that depend on the semantic intent, as distinct from the EXPRESS language statements, of any particular EXPRESS schema;

— specification of mappings from the XML Schema language to the EXPRESS language;

— specification of the mapping to an EXPRESS schema from an XML schema that has been derived from an EXPRESS schema.

2 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO/IEC 8824-1:2002, *Information technology – Abstract Syntax Notation One (ASN.1) – Part 1: Specification of basic notation*

ISO 10303-1:1994, *Industrial automation systems and integration – Product data representation and exchange – Part 1: Overview and fundamental principles*

ISO 10303-11:2004, *Industrial automation systems and integration – Product data representation and exchange – Part 11: Description methods: The EXPRESS language reference manual*

ISO 10303-22:1998, *Industrial automation systems and integration – Product data representation and exchange – Part 22: Implementation methods: Standard data access interface*

ISO 639-1:2002, *Codes for the representation of names of languages – Part 1: Alpha 2 code*

ISO 3166-1:2006, *Codes for the representation of names of countries and their subdivisions – Part 1: Country codes*

Uniform Resource Identifiers (URI): Generic Syntax. Internet Engineering Task Force RFC 2396 August 1998 [cited 2004-03-15]. Available from World Wide Web:
<http://www.ietf.org/rfc/rfc2396.txt>

Extensible Markup Language (XML) 1.0. World Wide Web Consortium Recommendation 4 February 2004 [cited 2004-03-15]. Available from World Wide Web:
<http://www.w3.org/TR/REC-xml>

Namespaces in XML. World Wide Web Consortium Recommendation 14 January 1999 [cited 2004-03-15]. Available from World Wide Web:
<www.w3.org/TR/REC-xml-names/>

XML Schema Part 1: Structures. World Wide Web Consortium Recommendation, 2 May 2001 [cited 2004-03-15]. Available from World Wide Web:
<http://www.w3.org/TR/xmlschema-1/>

XML Schema Part 2: Datatypes. World Wide Web Consortium Recommendation, 2 May 2001 [cited 2004-03-15]. Available from World Wide Web:
<http://www.w3.org/TR/xmlschema-2/>

Xpointer Framework Version 1.0. World Wide Web Consortium Recommendation 25 March 2003 [cited 2004-03-15]. Available from World Wide Web:
<http://www.w3.org/TR/xptr-framework/>

3 Terms, definitions, abbreviations, and conventions

3.1 Terms defined in ISO 10303-1

For the purposes of this document, the following terms defined in ISO 10303-1 apply.

— data;

— information.

3.2 Terms defined in ISO 10303-11

For the purposes of this document, the following terms defined in ISO 10303-11 apply.

3.2.1
data type
domain of values

NOTE Because two standards for specification of data types are used extensively in this part of ISO 10303, the term *data type* is always prefixed by "EXPRESS" or "XML Schema", to indicate the context in which each usage is to be understood.

3.2.2
EXPRESS attribute
property of an EXPRESS entity instance that is represented by a value of an EXPRESS data type and a name that indicates the role that value plays in characterizing the instance

3.2.3
EXPRESS data type
data type specified in the syntax of the EXPRESS language

3.2.4
EXPRESS entity instance ; entity instance
named unit of data that represents a unit of information within the domain defined by an entity data type

3.2.5
EXPRESS language element
concept in the EXPRESS language, and by extension, its syntactic representation

NOTE In general, the term "element" is used in this part of ISO 10303 to refer to the fundamental syntactic component of XML data structures.

3.2.6
fundamental type
EXPRESS data type used to determine the representation of values of a defined data type

NOTE Because a defined data type can be defined in terms of another defined data type, "fundamental type" is formally defined recursively as: "The fundamental type of a defined type is the fundamental type of the underlying type, and the fundamental type of a data type other than a defined type is the data type itself."

3.2.7
generalized data type
EXPRESS data type that is used to specify a generalization of certain other data types, and which can only be used in certain very specific contexts

3.2.8
independent entity instance
EXPRESS entity instance that appears in a schema instance and need not play a role in characterizing some other entity instance in the schema instance

NOTE A *dependent entity* instance is one that appears in a schema instance *because* it is (a component of) the value of an attribute of some other entity instance. An *independent entity* instance is one that does not have that rationale, although it may play such a role.

3.2.9
schema instance
set of EXPRESS entity instances, grouped for some purpose, that is governed by a single EXPRESS schema

3.2.10
underlying type
domain of values of a defined data type, as specified by the syntactic object `underlying_type` in the EXPRESS type declaration for the defined data type (cf. fundamental type)