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Condition monitoring and diagnostics of machines — Data processing, communication and presentation —

Part 3: Communication

Surveillance et diagnostic d'état des machines — Traitement, échange et présentation des données —

Partie 3: Échange

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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

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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 13374-3 was prepared by Technical Committee ISO/TC 108, *Mechanical vibration, shock and condition monitoring*, Subcommittee SC 5, *Condition monitoring and diagnostics of machines*.

ISO 13374 consists of the following parts, under the general title *Condition monitoring and diagnostics of machines — Data processing, communication and presentation*:

— *Part 1: General guidelines*

— *Part 2: Data processing*

— *Part 3: Communication*

The following part is planned:

— *Part 4: Presentation*

Introduction

The various computer software systems written for condition monitoring and diagnostics (CM&D) of machines that are currently in use cannot easily exchange data or operate in a plug-and-play fashion without an extensive communication infrastructure. The lack of an all-purpose communication system makes it difficult to integrate various CM&D sub-systems and provide a unified view of the condition of machinery to users. The intent of ISO 13374 is to provide the basic requirements for open CM&D software architecture in order to allow CM&D information to be processed, communicated and displayed by various software packages independent of platform-specific or hardware-specific protocols.

ISO 13374-1 gives a general overview of data processing, communication and presentation. ISO 13374-2 provides greater details of the data-processing methodology and requirements present in today's software-enhanced systems. This part of ISO 13374 provides the requirements of the data communication architecture for open CM&D systems.

Condition monitoring and diagnostics of machines — Data processing, communication and presentation —

Part 3: **Communication**

1 Scope

This part of ISO 13374 specifies requirements for data communication for an open condition monitoring and diagnostics (CM&D) reference information architecture and for a reference processing architecture. Software design professionals require communications to be defined for exchange of CM&D information between software systems. This part of ISO 13374 facilitates the interoperability of CM&D systems.

2 Normative references

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

ISO 8601, *Data elements and interchange formats — Information interchange — Representation of dates and times*

ISO 13372, *Condition monitoring and diagnostics of machines — Vocabulary*

ISO 13374-1:2003, *Condition monitoring and diagnostics of machines — Data processing, communication and presentation — Part 1: General guidelines*

ISO 13374-2:2007, *Condition monitoring and diagnostics of machines — Data processing, communication and presentation — Part 2: Data processing*

ISO/IEC 19501, *Information technology — Open Distributed Processing — Unified Modeling Language (UML) Version 1.4.2*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 13372 apply.

4 Open CM&D information architecture communication requirements

4.1 Overview

An information architecture describes all the data objects and their properties (or attributes), property data types, data object relationships, reference data, and data documents for a given system or application. As specified in ISO 13374-2, an open CM&D information architecture describes the content for each of the five layers shown in Figure 1.

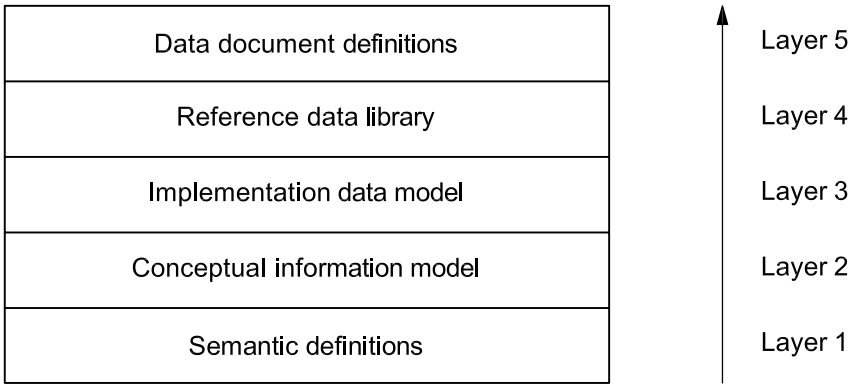

Figure 1 — CM&D Information architecture layers (from ISO 13374-2:2007)

During a communications exchange between applications in an open CM&D information architecture, the message content shall reference and validate against a defined layer 5 data document definition and comply with a defined layer 4 reference data library. Communication message implementations vary according to application requirements. Annex A details options for implementation.

4.2 Reference data library communication requirements

An open CM&D information architecture shall specify the method for communication receivers to access the defined layer 4 reference data library. The architecture shall also specify the methodology for the publication of updates from the reference data library owner to predefined subscribers.

4.3 Communications initiation requirements

An open CM&D information architecture shall specify the initiation requirements of the provider application for each method of communication the architecture includes. All date and time notations in the initiation information should reference back to a specific instant in time using the Gregorian (Common Era or CE) calendar, with a lexical representation based upon ISO 8601. Communication initiation shall also reference a defined layer 5 data document definition to which the subsequent message content complies.

4.4 Message content requirements

An open CM&D information architecture shall specify the message content requirements of the provider application for each method of communication the architecture includes. The message content definition shall reference the appropriate data document definition(s), along with the specific data format rendering of the document(s), including the compression and encryption utilized.

5 Open CM&D processing architecture communication requirements

5.1 Overview

A processing architecture describes all the interactions or transactions between modules internal to the software system itself, external to end-user interactions or external to other software system interactions. As specified in ISO 13374-1, an open CM&D processing architecture specification shall utilize the processing architecture shown in Figure 2.

This architecture is defined as blocks of data-processing functionality. After each block in the system has been properly configured, the basic data are converted into digital form in data acquisition (DA) and are processed in various ways as they are transformed into actionable information, resulting in advisory generation (AG). As the processing progresses from DA to AG, data from preceding blocks need to be transferred to subsequent blocks and additional information acquired from or sent to external systems. Similarly, as the data evolve into information, both standard technical displays and graphical presentation formats are required. In many

applications, data archiving is required in order to maintain a history of the output of each block. The DA, DM and SD blocks are responsible for assessing data quality. Output should be identified as good, bad or undetermined.

This part of ISO 13374 defines the communication requirements for any open CM&D processing architecture. With such an approach, the data-processing blocks from various suppliers can be integrated into a complete, functional system.

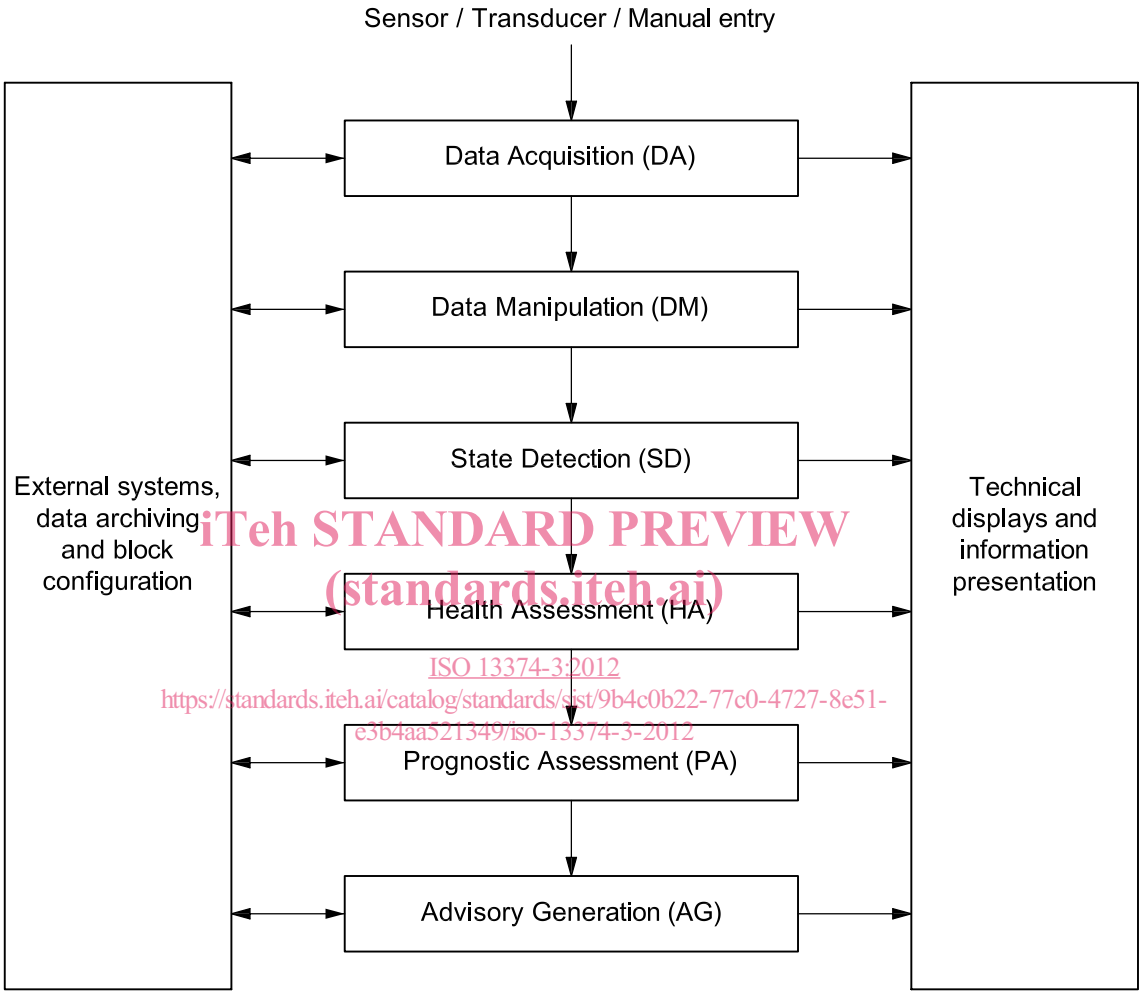

Figure 2 — Data-processing block diagram (from ISO 13374-1:2003)

5.2 Diverse technologies and UML representation

5.2.1 Introduction

There are normally different software and hardware environments as data come from sensors and are analysed by higher-level CM&D information systems. CM&D systems often start with data acquisition in embedded environments with real-time constraints. Information is then processed and refined in subsequent system blocks and made available for health assessment, prognostics, and advisory generation. These requirements currently lead to disparate technology choices. The technologies and software used by the “analysis-oriented” processing blocks (HA, PA and AG) are often different from those used in the “data-oriented” processing blocks (DA, DM and SD).

The amount of data communicated in the data-oriented blocks is vast compared to the small quantity of information generated by analysis-oriented blocks. The data-oriented blocks are normally designed for high-speed processing and often with real-time methodologies. For analysis-oriented blocks, results should be

timely, but are not usually required in milliseconds or real time. In addition, technology continues to evolve. Programming languages, network protocols, and data storage methods change over time.

An ISO/IEC 19501-compliant Unified Modelling Language (UML) model shall be specified to support the communications of the open CM&D data-processing architecture that holds the base information classes and interfaces required. As shown in Figure 3, the UML shall then be utilized to directly map into specific technologies such as XML-based web services or binary embedded system communications.

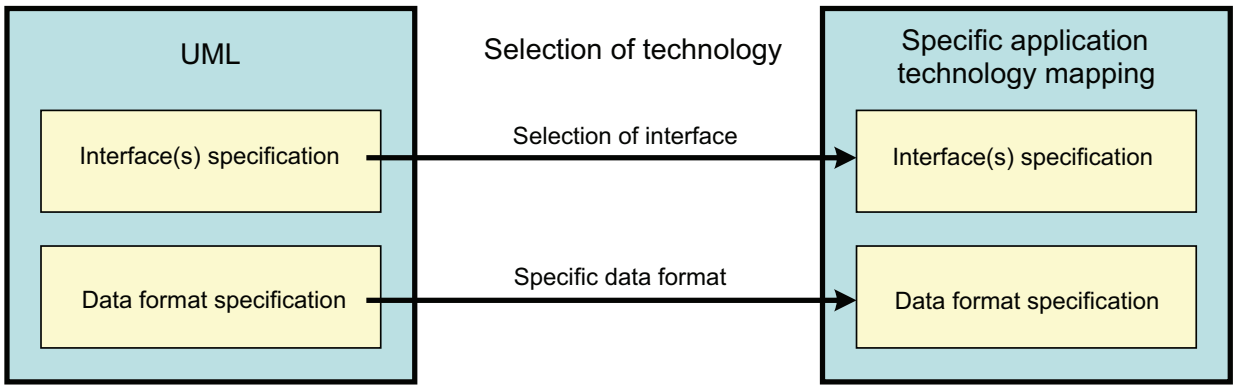

Figure 3 — UML to specific technology

5.2.2 Standard data content

When the content of the data is standardized, the conversion from one technology form to another becomes a simple one-to-one mapping effort. Thus, a binary formatted message in an embedded system can be converted using a generic adapter to an XML format when required.

5.2.3 Relationship to an information management system

In the design and management of operations of a CM&D data-processing system, it is important to have an information management system that is compliant with the open CM&D information architecture specified in Clause 4. The information management system holds not only the operational information, but also the metadata that describe the information that flows in a system. This can include the description and source of sensor signals and the processing performed on those signals. It can also include information about the agents, whether human or software, that perform analysis assessments.

These metadata enable engineering analysis and allow operational results to be used in higher-level enterprise application processing for business, logistics, and command and control decision making.

5.3 Interface types and general interaction

5.3.1 Introduction

The diverse set of technologies used in CM&D systems that use information provided by those systems requires multiple interface types. There are two major types of communication services: provider services and consumer (also called “DataUser”) services. Provider services collect and process information and provide results to interested users by some means. Consumer services utilize the provider’s CM&D data to deliver additional capabilities.

The CM&D processing system shall support the implementation of provider and/or consumer service(s). An EntryPoint shall provide the interface used for a particular service.

5.3.2 Provider interface

5.3.2.1 Introduction

All the arrows that flow downwards from the blocks defined in Figure 2 indicate data content from a provider interface. The data output of each block is a provider of information that interested consumers can receive. There are two major types of provider interfaces: synchronous and asynchronous. Systems may implement either or both types.

5.3.2.2 Synchronous interface

Providers that support the synchronous interface implement a direct call/return mechanism. A consumer block makes a call indicating which information it is interested in and the call does not return until the information requested is available. All of the requested information is then returned. A web service is a typical implementation of this type of interface. An example implementation is shown in Figure 4.

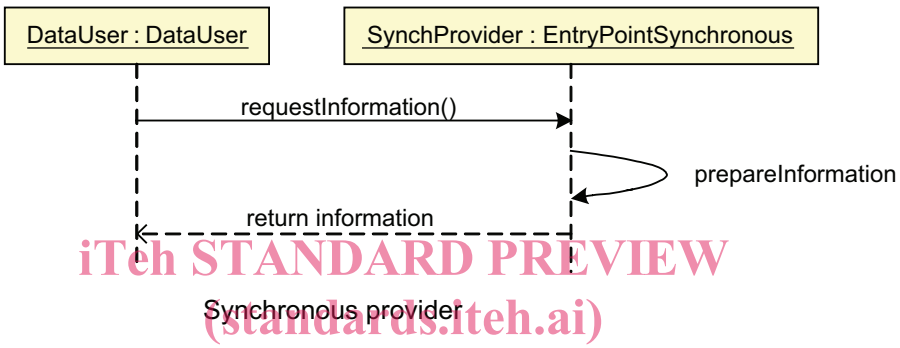

Figure 4 — Example implementation of a synchronous information request/response

In addition to processing a data request, the provider system shall support the ability for any data-processing block or external application to request processing modification. Configuration setups and threshold control are two examples. A synchronous provider shall perform the modification, if possible, and return a status (success or an error code) based on its ability to process the modification. An example implementation is shown in Figure 5.

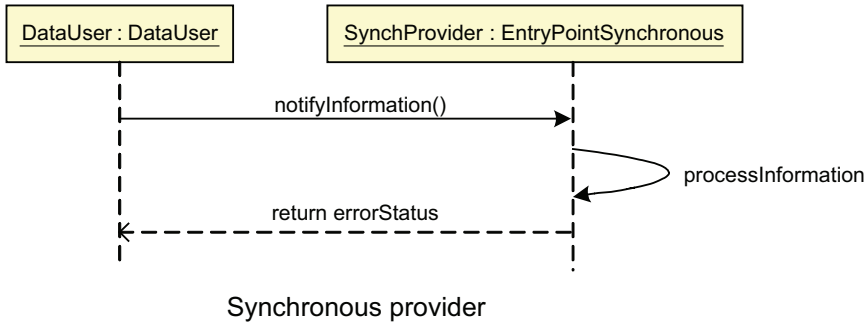

Figure 5 — Example implementation of a synchronous process modification request/response

5.3.2.3 Asynchronous interface

5.3.2.3.1 Introduction

An asynchronous interface implements a “call-but-do-not-wait” mechanism. An asynchronous interface shall allow a provider to send unsolicited information to consumers once the information about how to send