Second edition
2003-07-01

Industrial automation systems — Manufacturing Message Specification —

Part 2: Protocol specification

Systèmes d'automatisation industrielle — Spécification de messagerie industrielle —

Partie 2: Spécification de protocole

Reference number
ISO 9506-1:2003(E)

PDF disclaimer

This PDF file may contain embedded typefaces. In accordance with Adobe's licensing policy, this file may be printed or viewed but shall not be edited unless the typefaces which are embedded are licensed to and installed on the computer performing the editing. In downloading this file, parties accept therein the responsibility of not infringing Adobe's licensing policy. The ISO Central Secretariat accepts no liability in this area.

Adobe is a trademark of Adobe Systems Incorporated.

Details of the software products used to create this PDF file can be found in the General Info relative to the file; the PDF-creation parameters were optimized for printing. Every care has been taken to ensure that the file is suitable for use by ISO member bodies. In the unlikely event that a problem relating to it is found, please inform the Central Secretariat at the address given below.

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

Published in Switzerland

Contents

Page

Foreword ... ix

Introduction ... x

1 Scope ... 1
1.1 Specifications ... 1
1.2 Procedures ... 1
1.3 Applicability ... 1
1.4 Conformance ... 1

2 Normative references ... 1

3 Definitions ... 2
3.1 Reference Model definitions ... 3
3.2 Service Convention definitions ... 3
3.3 Abstract Syntax Notation definitions ... 3
3.4 Other definitions ... 4

4 Abbreviations ... 7

5 Conventions ... 7
5.1 Service Conventions ... 7
5.2 Base of Numeric Values ... 7
5.3 Notation ... 7
5.4 Supporting Productions ... 7
5.5 Pass-through Parameters ... 8
5.6 Negative Confirmation ... 8
5.7 Modifiers to a Service Request ... 8
5.8 Presentation of Errors ... 9
5.9 Calling and Called MMS-user ... 9
5.10 Sending and Receiving MMS-user and MMPM ... 9
5.11 Requesting and Responding MMS-user ... 9
5.12 Client and Server of a Service ... 9
5.13 ASN.1 Definitions ... 9
5.14 Protocol Subset Notation ... 10
5.15 Determination of the effective protocol ... 10

6 Elements of Protocol Procedure ... 11
6.1 Descriptive Conventions ... 11
6.2 Entering and Leaving the MMS Environment ... 11
6.3 Operating in the MMS Environment ... 11
6.4 Handling of Error Conditions ... 16
6.5 The Reject Service and RejectPDU ... 17

7 MMS PDU ... 17
7.1 The Confirmed-RequestPDU ... 18
7.2 The Unconfirmed-PDU ... 30
7.3 The Confirmed-ResponsePDU ... 31
7.4 The Confirmed-ErrorPDU ... 42
7.5 Common MMS Types ... 45

8 Environment and General Management Protocol ... 48
8.1 Introduction ... 48
8.2 Initiate ... 48
8.3 Conclude ... 49
8.4 Abort ... 49
8.5 Cancel ... 49
8.6 Reject ... 50

9 Conditioned Service Response Protocol ... 51

9.3 DefineAccessControlList . . . 51
9.4 GetAccessControlListAttributes . . . 52
9.5 ReportAccessControlledObjects . . . 53
9.6 DeleteAccessControlList . . . 53
9.7 ChangeAccessControl . . . 54

10 VMD Support Protocol . . . 54
10.1 Introduction . . . 54
10.2 Status Response Parameter . . . 54
10.3 Status . . . 55
10.4 UnsolicitedStatus . . . 56
10.5 GetNameList . . . 56
10.6 Identify . . . 56
10.7 Rename . . . 57
10.8 GetCapabilityList . . . 57
10.9 VMDStop . . . 57
10.10 VMDReset . . . 58

11 Domain Management Protocol . . . 58
11.1 Introduction . . . 58
11.2 InitiateDownloadSequence . . . 58
11.3 DownloadSegment . . . 59
11.4 TerminateDownloadSequence . . . 59
11.5 InitiateUploadSequence . . . 60
11.6 UploadSegment . . . 60
11.7 TerminateUploadSequence . . . 61
11.8 RequestDomainDownload . . . 61
11.9 RequestDomainUpload . . . 61
11.10 LoadDomainContent . . . 62
11.11 StoreDomainContent . . . 62
11.12 DeleteDomain . . . 63
11.13 GetDomainAttributes . . . 63

12 Program Invocation Management Protocol . . . 64
12.1 Introduction . . . 64
12.2 CreateProgramInvocation . . . 64
12.3 DeleteProgramInvocation . . . 65
12.4 Start . . . 65
12.5 Stop . . . 66
12.6 Resume . . . 67
12.7 Reset . . . 67
12.8 Kill . . . 68
12.9 GetProgramInvocationAttributes . . . 68
12.10 Select . . . 69
12.11 AlterProgramInvocationAttributes . . . 69
12.12 ReconfigureProgramInvocation . . . 70

13 Unit Control Protocol . . . 70
13.1 Introduction . . . 70
13.2 Control Element . . . 70
13.3 InitiateUnitControlLoad service . . . 71
13.4 UnitControlLoadSegment service . . . 71
13.5 UnitControlUpload service . . . 72
13.6 StartUnitControl service . . . 72
13.7 StopUnitControl service . . . 73
13.8 CreateUnitControl service . . . 73
13.9 AddToUnitControl service . . . 74
13.10 RemoveFromUnitControl service . . . 74
13.11 GetUnitControlAttributes service . . . 74
13.12 LoadUnitControlFromFile service . . . 75
13.13 StoreUnitControlToFile service . . . 75
13.14 DeleteUnitControl service . . . 76

14.1 Conventions . . . 76
14.2 Protocol For Specifying Types . . . 77
14.3 Protocol For Specifying Alternate Access . . . 77
14.4 Protocol For Specifying Data Values . . . 78
14.5 Protocol for Specifying Access To Variables . . . 82
14.6 Read . . . 82
14.7 Write . . . 83
14.8 InformationReport . . . 83
14.9 GetVariableAccessAttributes . . . 83
14.10 DefineNamedVariable . . . 84
14.11 DeleteVariableAccess . . . 84
14.12 DefineNamedVariableList . . . 85
14.13 GetNamedVariableListAttributes . . . 85
14.14 DeleteNamedVariableList . . . 86
14.15 DefineNamedType . . . 86
14.16 GetNamedTypeAttributes . . . 86
14.17 DeleteNamedType . . . 87

15 Data Exchange Protocol . . . 87
15.1 Introduction . . . 87
15.2 ExchangeData . . . 87
15.3 GetDataExchangeAttributes . . . 88

16 Semaphore Management Protocol . . . 88
16.1 Introduction . . . 88
16.2 TakeControl . . . 89
16.3 RelinquishControl . . . 89
16.4 DefineSemaphore . . . 90
16.5 DeleteSemaphore . . . 90
16.6 ReportSemaphoreStatus . . . 90
16.7 ReportPoolSemaphoreStatus . . . 91
16.8 ReportSemaphoreEntryStatus . . . 91
16.9 AttachToSemaphore Modifier . . . 92

17 Operator Communication Protocol . . . 92
17.1 Introduction . . . 92
17.2 Input . . . 92
17.3 Output . . . 93

18 Event Management Protocol . . . 93
18.1 Introduction . . . 93
18.2 TriggerEvent . . . 93
18.3 EventNotification . . . 94
18.4 AcknowledgeEventNotification . . . 95
18.5 GetAlarmSummary . . . 95
18.6 GetAlarmEnrollmentSummary . . . 96
18.7 AttachToEventCondition . . . 97

19 Event Condition Protocol . . . 98
19.1 Introduction . . . 98
19.2 DefineEventCondition . . . 98
19.3 DeleteEventCondition . . . 98
19.4 GetEventConditionAttributes . . . 99
19.5 ReportEventConditionStatus . . . 100
19.6 AlterEventConditionMonitoring . . . 100

20 Event Action Protocol . . . 101
20.1 Introduction . . . 101
20.2 DefineEventAction . . . 101
20.3 DeleteEventAction . . . 102
20.4 GetEventActionAttributes . . . 102
20.5 ReportEventActionStatus . . . 103

21.2 DefineEventEnrollment . . . 104
21.3 DeleteEventEnrollment . . . 104
21.4 GetEventEnrollmentAttributes . . . 105
21.5 ReportEventEnrollmentStatus . . . 107
21.6 AlterEventEnrollment . . . 107
21.7 Supporting Productions . . . 108

22 Event Condition List Protocol . . . 108
22.1 Introduction . . . 108
22.2 DefineEventConditionList protocol . . . 108
22.3 DeleteEventConditionList protocol . . . 109
22.4 AddEventConditionListReference protocol . . . 109
22.5 RemoveEventConditionListReference protocol . . . 110
22.6 GetEventConditionListAttributes protocol . . . 110
22.7 ReportEventConditionListStatus protocol . . . 111
22.8 AlterEventConditionListMonitoring protocol . . . 111

23 Journal Management Protocol . . . 112
23.1 Introduction . . . 112
23.2 ReadJournal . . . 112
23.3 WriteJournal . . . 112
23.4 InitializeJournal . . . 113
23.5 ReportJournalStatus . . . 113
23.6 CreateJournal . . . 114
23.7 DeleteJournal . . . 114
23.8 Supporting Productions . . . 114

24 Mapping to Underlying Communication Services . . . 115
24.1 Mapping of PDUs . . . 115
24.2 M-ASSOCIATE Data . . . 115
24.3 Termination of Application Association . . . 116
24.4 Directly-Mapped Abort Service . . . 116
24.5 Construction of MMS PDUs . . . 116
24.6 Delivery of Service Primitives to an MMS-user . . . 116
24.7 Right to Send Data . . . 117
24.8 Reliable Underlying Service . . . 117
24.9 Flow Control . . . 117
24.10 Use of Presentation Contexts . . . 117
24.11 Abstract Syntax Definition . . . 117

25 Configuration and Initialization Statement . . . 117
25.1 Introduction . . . 117
25.2 CIS Part One: Initialization of the VMD . . . 118
25.3 CIS Part Two: Service and Parameter CBBs . . . 130

Annex A (normative) Relation of M-Services to ACSE and Presentation Services . . . 144
A.1 Mapping of M-services . . . 144
A.2 M-DATA service . . . 145
A.3 M-U-ABORT service . . . 145
A.4 M-P-ABORT service . . . 145
A.5 Use of Presentation Contexts . . . 145
A.6 Transfer Syntax Definition . . . 146
A.7 Application Context Name . . . 146

Annex B (normative) Abstract format for Configuration and Initialization . . . 148
B.1 SCI Part One: Initialization of the VMD . . . 148
B.2 Services and parameter CBBs . . . 156

Annex C (normative) File Access Protocol . . . 159
C.1 Introduction . . . 159
C.2 ObtainFile . . . 159

Annex D (informative) File Management Protocol . . . 161

D.3 FileRead ... 161
D.4 FileClose ... 162
D.5 FileRename ... 162
D.6 FileDelete ... 162
D.7 FileDirectory ... 163
D.8 FileAttributes ... 163

Annex E (informative) Scattered Access ... 164
E.1 Introduction ... 164
E.2 DefineScatteredAccess ... 164
E.3 GetScatteredAccessAttributes ... 164

Annex F (informative) REAL Data Type ... 166
F.1 Introduction ... 166
F.2 REAL Data ... 166
F.3 End of Module ... 166

Index ... 167

Figures

Figure 1 - Confirmed Service Request as seen by the Service Requester ... 12
Figure 2 - Confirmed Service Request as seen by the Service Responder ... 14
Figure 3 - Unconfirmed Service as seen by the Service Requester ... 15
Figure 4 - Unconfirmed Service as seen by the Service Responder ... 16

Tables

Table 1 - CIS Implementation Information ... 119
Table 2 - Capability Description ... 120
Table 3 - Predefined Access Control object ... 121
Table 4 - Predefined Domain object ... 122
Table 5 - Predefined Program Invocation object ... 123
Table 6 - Predefined Unit Control object ... 123
Table 7 - Unnamed Variable objects ... 124
Table 8 - Predefined Named Variable object ... 124
Table 9 - Predefined Named Variable List object ... 125
Table 10 - Predefined Named Type object ... 125
Table 11 - Predefined Data Exchange object ... 126
Table 12 - Predefined Semaphore object ... 126
Table 13 - Predefined Operator Station object ... 127
Table 14 - Predefined Event Condition object ... 127
Table 15 - Predefined Event Action object ... 128
Table 16 - Predefined Event Enrollment object ... 128
Table 17 - Predefined Event Condition List object ... 129
Table 18 - Predefined Journal object ... 129
Table 19 - Predefined Journal Entry object ... 130
Table 20 - Environment & General Management services ... 131
Table 21 - Environment & General Management parameters ... 131
Table 22 - Access Control services ... 132
Table 23 - Access Control parameter ... 132
Table 24 - VMD Support services ... 132
Table 25 - VMD Support parameters ... 133
Table 26 - Domain Management services ... 133
Table 27 - Domain Management parameters ... 134
Table 28 - Program Invocation Management services ... 134
Table 29 - Program Invocation Management parameters ... 135
Table 30 - Unit Control services ... 135
Table 31 - Variable Access services ... 136
Table 32 - Variable Access parameters ... 137

Table 35 - Semaphore Management services 138
Table 36 - Semaphore Management parameter 138
Table 37 - Operator Communication services 138
Table 38 - Operator Communication parameter 139
Table 39 - Event Management services 139
Table 40 - Event Condition services 139
Table 41 - Event Condition parameters 140
Table 42 - Event Action services 140
Table 43 - Event Enrollment services 140
Table 44 - Event Condition List services 141
Table 45 - Event Condition List parameter 141
Table 46 - Journal Management services 141
Table 47 - Errors parameters 142
Table 48 - File Access service 142
Table 49 - File Management services 142
Table 50 - File Management parameter 142
Table 51 - Scattered Access services 143
Table 52 - Scattered Access parameter 143

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 matter 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 9506-2 was prepared by the Technical Committee ISO/TC 184, *Industrial automation systems and integration*, Subcommittee SC 5, *Architecture, communications and integration frameworks*.

This second edition of ISO 9506-2 cancels and replaces the first edition (ISO 9506-2:2000), of which it constitutes a technical revision. It incorporates several technical corrections to ISO 9506-2:2000. The first edition of ISO 9506-2:2000 included corrections published in ISO/IEC 9506-2/Cor.1:1995 and in ISO/IEC 9506-2/Cor.2:1995, the additional services published in ISO/IEC 9506-2/Amd.1:1993, and in ISO/IEC 9506-2/Amd.2:1995, and the material published in ISO/TR 13345.

ISO 9506 consists of the following parts, under the general title *Industrial automation systems — Manufacturing Message Specification*:

— *Part 1: Service definition*
— *Part 2: Protocol specification*

devices. It is designed to be used both by itself and in conjunction with Companion Standards that describe the application of subsets of these services to particular device types.

The services provided by the Manufacturing Message Specification (MMS) range from simple to highly complex. It is not expected that all of these services will be supported by all devices. The subset to be supported is limited in some cases by Companion Standards, and in all cases may be limited by the implementor. Characteristics important in selection of a subset of services to be supported include:

a) applicability of the service to the device;

b) the complexity of services and requirements;

c) the complexity of provision of a particular class of service via the network versus the complexity of the device.

Security Considerations

When implementing MMS in secure or safety critical applications, features of the OSI security architecture may need to be implemented. This International Standard provides simple facilities for authentication (passwords) and access control. Systems requiring a higher degree of security will have to consider features beyond the scope of this International Standard. This International Standard does not provides facilities for non-repudiation.

Complexity of Services and Requirements

Some MMS services are quite complex and should be considered advanced functions. Devices used in very simple applications often will not require such advanced functions, and hence will not support such MMS services.

Keywords

Application Interworking
Application Layer Protocol
Information Processing Systems
Manufacturing Communications Network
Manufacturing Message Specification
Numerical Control System
Open Systems Interconnection
OSI Reference Model
Process Control System
Programmable Controller
Programmable Device
Robotics Control System
Virtual Manufacturing Device

General

This part of ISO 9506 is one of a set of standards produced to facilitate the interconnection of information processing systems. It is positioned within the application layer of the Open Systems Interconnection Environment as an Application Service Element (ASE) with respect to other standards by the Basic Reference Model for Open Systems Interconnection (ISO 7498).

The aim of Open Systems Interconnection is to allow, with a minimum of technical agreement outside the interconnection standards, the interconnection of information processing systems:

a) from different manufacturers;

b) under different managements;

c) of different levels of complexity;

d) of different ages.

Purpose

The purpose of this part of ISO 9506 is to define the Manufacturing Message Specification Protocol. It is most closely related to and lies within the field of application of the Manufacturing Message Specification Service Definition, ISO 9506-1. It uses services provided by the communication system that it employs for transferring its PDUs.

wide variety of applications. Thus, a minimally conforming implementation will not be suitable for use in all possible circumstances. It is important, therefore, to qualify all references to this part of ISO 9506 with statements of the options provided or required with statements of the intended purpose of provision or use.

NOTE The services of this part of ISO 9506 are generic, and intended to be referenced by Companion Standards, each of which is directed to a more specific class of application. The services of this part of ISO 9506 may also be used in a stand-alone manner (without the use of Companion Standards).

It should be noted that, as the number of valid protocol sequences is very large, it is not possible with current technology to verify that an implementation will operate the protocol defined in this part of ISO 9506 correctly under all circumstances. It is possible by means of testing to establish confidence that an implementation correctly operates the protocol in a representative sample of circumstances.

Edition

This part of ISO 9506 differs from the first edition of ISO 9506-2 by correcting several protocol errors related to the ASN.1 type definitions and modelling structures. It also corrects several typographical errors in that document.

This part of ISO 9506 differs from ISO/IEC 9506-2:1990 in the following ways:

a) The material in ISO/IEC TR 13345 to specify subsets of protocol for MMS has been incorporated into this part of ISO 9506.

b) All the material of Amendments 1 and 2 have been incorporated into the document, as well as the Technical Corrigenda.

c) The formal object model used in ISO 9506-1 provides some type definitions for the protocol specified in this part of ISO 9506. Hence, an IMPORT statement occurs in the ASN.1 module.

d) The services and protocol present in the Companion Standards already published, ISO/IEC 9506-3, ISO/IEC 9506-4, and ISO/IEC 9506-6, have been incorporated into the base standard.

   As a result of this incorporation, the need for separate abstract syntaxes for each of the Companion Standards has been removed. All Companion Standards can now operate in the single abstract syntax of the base standard, although using other abstract syntaxes remains a possibility for backward compatibility. The separate definition of a module in Clause 19 of the first edition of ISO/IEC 9506-2 is no longer needed and this clause has been removed.

e) The communication requirements of MMS have been generalized so that MMS is described with respect to an abstract set of services needed for its support. The relation between this abstract set of services and the services provided by the suite of OSI communication protocols is specified in an annex. This opens the possibility of having MMS operating correctly over alternate communication systems (such as reduced stack implementations) as long as the equivalent of these abstract services are provided.

f) The restrictions on the characters that can be used as an Identifier have been relaxed to allow an Identifier to begin with a numeric character and, by extension, to consist solely of numeric characters.

g) Many (but not all) occurrences of VisibleString have been replaced by a new production MMSString that provides the option of using an arbitrary string of characters taken from ISO 10646. Similarly, these more general strings may also be used as Identifiers. A new parameter CBB has been added to provide for negotiation of the use of these more general strings.

h) A new service, ReconfigureProgramInvocation, has been introduced into the clause on Program Invocation management. This service provides a technique of dynamically changing the constituent Domains of a running Program Invocation.

i) A new field was added to the object model of the Named Variable and the Named Type. This field may be used to describe the semantics associated with the Named Variable or Named Type. The field is either predefined or it has its value established as the name of the Named Type used to construct it in the DefineNamedVariable or DefineNamedType service. This field can be reported with the GetVariableAccessAttributes or GetNamedTypeAttributes service if **sem**, a new parameter CBB, has been negotiated.

k) The Real Data type has been removed from the document.

l) The Scattered Access has been removed from the base document and placed in an informative annex.

m) In accordance with the recommendations in ISO/IEC 8824-1, all occurrences of EXTERNAL in the protocol have been replaced with CHOICE { EXTERNAL, EMBEDDED PDV }.

n) The PICS of the first edition has been replaced by a clause providing configuration and initialization information. This clause provides initialization prescriptions for some fields (relatively few) of the VMD and subordinate objects, and provides a tabular report for initialization values of other fields as supplied by the implementor. A new annex (annex B) has been added that provides an ASN.1 module suitable for communicating the information contained in these tables.

Protocol

Because of the use of the ASN.1 object modelling technique, the protocol now exists in three separate modules, one that is part of the object model contained in ISO 9506-1, and two modules defined in this part of ISO 9506 that describes the content and structure of all valid PDUs. Despite the fact that the ASN.1 formulation appears different in some cases, nevertheless the PDUs produced through application of the first edition of ISO 9506 are identical with those produced by this edition. For this reason, this edition continues to be identified by the major version number one. (The minor version number has been changed to reflect all the new additions to the document.)

There are two exceptions to this statement that should be noted.

a) Syntactic extensions defined by the companion standards are now identified by new parameter CBBs instead of a separate abstract syntax. Therefore, for any use of MMS involving companion standard facilities, there is a change in the Initiate PDU. However, if the companion standard facilities are not used, the Initiate PDU remains the same as that defined by the first edition.

b) Some small changes have been made to the tagging in the ChangeAccessControl service (part of Amendment 2) to bring it into alignment with corresponding protocol in the GetNameList and Rename services.

c) Encoding of the PDUs using PER (ISO/IEC 8825-2) may not be completely compatible with PDUs generated by the first edition of ISO/IEC 9506:1990; this is because replacement of a type by a CHOICE containing that type will result in a different encoding using PER; BER encoding for these two situations is identical. Thus, if the PDUs contain any elements that are EXTERNAL, according to item m) above, they will be replaced by a CHOICE resulting in a different PER encoding.

ASN.1 Modules

The ASN.1 modules defined in ISO 9506 may be obtained from the SC 4 Secretariat in computer readable format. The modules are available in two forms: as published and with the IF - ENDIF brackets removed.

To obtain these files use the Internet location: <http://forums.nema.org:8080/~iso_tc184_sc5>