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Information and documentation — Open Systems Interconnection — Search and Retrieve Application Protocol Specification —

Part 1: Protocol specification

*Information et documentation — Interconnexion de systèmes ouverts
(OSI) — Spécification du protocole d'application pour la recherche
documentaire —*

Partie 1: Spécification du protocole



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Foreword

ISO (the International Organization for Standardization) is a world-wide 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.

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.

International Standard ISO 10163-1 was prepared by Technical Committee ISO/TC 46, *Information and documentation*.

Annexes A to E form an integral part of this International Standard. Annexes F and G are for information only.

ISO 10163 consists of the following parts, under the general title *Information and documentation — Open Systems Interconnection — Search and Retrieve Application Protocol Specification*:

— *Part 1: Protocol specification*

Introduction

This International Standard is one of a set of International Standards produced to facilitate the interconnection of computer systems. It is related to other International Standards in the set as defined by the Reference Model for Open Systems Interconnection (ISO 7498). The Reference Model subdivides the area of standardization for interconnection into a series of layers of specification, each of manageable size.

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:

- from different manufacturers;
- under different managements;
- of different levels of complexity; and
- of different technologies.

This International Standard provides a complete protocol specification for Search and Retrieve (SR) communication. The SR protocol operates in the Application Layer and allows the parties involved in an SR activity to progress through the activity in an orderly and defined way.

The SR protocol has been designed to support the SR services defined in ISO 10162, the SR Service Definition.

This International Standard is one of a number of related International Standards supporting the interconnection of library systems. These International Standards can be used by themselves or in a cooperative manner to support library applications requiring a mixture of communications services. For example, ISO 10160 and ISO 10161 which support interlibrary loan may be used in conjunction with the SR protocol to obtain the loan of items. The control and management of interactions among such bibliographic applications are local

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matters that are outside the scope of this International Standard. The architecture for the combined use of several application service elements is defined in Application Layer Structure ISO 9545.

A number of additional protocol functions have been identified for future study and standardization; see Annex A of ISO 10162.

The specification technique used in this international standard is consistent with techniques used in defining other OSI protocols. Within most of this document, the technique is self-explanatory. The Abstract Syntax of the SR Application Protocol Data Units (APDU) is defined by means of the ASN.1 specification technique specified in ISO 8824.

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1 Scope

This International Standard defines the protocol procedures for an SR application-service-element (ASE). It specifies the behaviour which must be exhibited by a system in order to take part in the provision of the ISO search and retrieve service as defined in ISO 10162.

It provides a formal statement of the rules of behaviour of each of the two entities participating in SR communication. It states:

- a) the actions to be taken on receiving request service primitives issued by an SR service-user;
- b) the actions to be taken on receiving application-protocol-data-units (APDUs);
- c) the actions to be taken as a result of events within the local system.

It provides a definition (in clause 8) of the abstract syntax required to convey the SR protocol APDUs.

It states the conformance requirements to be met by implementors of this protocol (in clause 9).

The scope of the SR protocol is restricted to the interconnection of systems; it does not specify or restrict the possible implementation of interfaces within a computer system. Computer systems may range from stand-alone workstations to mainframes.

This International Standard is primarily intended for use by systems supporting information retrieval services for organizations such as libraries, information utilities, and union catalogue centers.

2 Normative references

The following standards contain provisions which, through reference in this text, constitute provisions of this International Standard. At the time of publication, the editions indicated were valid. All standards are subject to

revision, and parties to agreements based on this International Standard are encouraged to investigate the possibility of applying the most recent editions of the standards indicated below. Members of IEC and ISO maintain registers of currently valid International Standards.

ISO 2709:1981, *Documentation — Format for bibliographic information interchange on magnetic tape*.

ISO 7498:1984, *Information processing systems — Open Systems Interconnection — Basic Reference Model*.

ISO/TR 8509:1987, *Information processing systems — Open Systems Interconnection — Service conventions*.

ISO 8649:1989, *Information processing systems — Open Systems Interconnection — Service definition for the Association Control Service Element*.

ISO 8650:1988, *Information processing systems — Open Systems Interconnection — Protocol specification for the Association Control Service Element*.

ISO 8777:—¹⁾ *Documentation — Commands for interactive text searching*.

ISO 8822:1988, *Information processing systems — Open Systems Interconnection — Connection oriented presentation service definition*.

ISO/IEC 8824:1988, *Information processing systems — Open Systems Interconnection — Specification of Abstract Syntax Notation One (ASN.1)*.

ISO/IEC 8825:1988, *Information processing systems — Open Systems Interconnection — Specifications of Basic Encoding Rules for Abstract Syntax Notation One (ASN.1)*.

ISO/IEC 9545:1989, *Information processing systems — Open Systems Interconnection — Application Layer Structure*.

1) To be published.

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ISO/IEC 9834-1:—²⁾ *Information processing systems — Open Systems Interconnection — Registration Authorities.*

ISO 10162:—²⁾ *Information and documentation — Open Systems Interconnection — Search and Retrieve Service Definition.*

3 Definitions

3.1 Reference Model Definitions

This International Standard makes use of the following terms defined in ISO 7498.

application-entity: The aspects of an application-process pertinent to OSI.

application-protocol-data-unit: A unit of data specified in an application-protocol and consisting of application-protocol-information and possibly application-user-data.

presentation service: A capability of the Presentation Layer and the layers beneath it, which is provided to application-entities at the boundary between the Presentation and the Application Layer.

application-process: An element within a real open system which performs the information processing for a particular application.

N-layer: A subdivision of the OSI architecture, constituted by subsystems of the same rank (N).

transfer syntax: The concrete syntax used in the transfer of data between open systems.

3.2 Application Layer Structure Definitions

This International Standard makes use of the following terms defined in ISO/IEC 9545.

application-association, association: A cooperative relationship between two application-entity-invocations for the purpose of communication of information and coordination of their joint operation. This relationship is formed by the exchange of application-protocol-control-information using the Presentation-Service.

application-context: A set of rules shared in common by two application-entity-invocations in order to enable their cooperative operation.

application-context-definition: The description of an application-context.

application-service-element: A set of application-functions that provides a capability for the interworking of application-entity-invocations for a specific purpose.

3.3 Abstract Syntax Notation One Definitions

This International Standard makes use of the following terms defined in ISO 8824.

type: A name set of values.

simple type: A type defined by directly specifying the set of its values.

structured type: A type defined by reference to one or more other types.

component type: One of the types referenced when defining a structured type.

value: A distinguished member of a set of values.

3.4 Presentation Service Definitions

This international standard makes use of the following terms defined in ISO 8822.

abstract syntax: The specification of Application Layer data or application-protocol-control-information by using notation rules which are independent of the encoding technique used to represent them.

4 Abbreviations

ACSE	Association Control Service Element
APDU	Application-protocol-data-unit
ASE	Application-service-element
ASN.1	Abstract Syntax Notation One
OSI	Open Systems Interconnection
SR	Search and Retrieve
SRPM	Search and Retrieve protocol machine
PCI	Protocol control information

2) To be published.

5 Overview of the Search and Retrieve Protocol

5.1 Services Supported by the SR Protocol

This International Standard specifies the protocol which supports the Search and Retrieve Service defined in ISO 10162.

5.2 Services Assumed by SR Protocol

The protocol assumes the services of the Association Control Service Element ISO 8649. The services required are:

- a) A-Release: orderly association release, where both sides agree to the release and there is no loss of data in transit. The SR-release service is directly mapped to this service without any SR protocol information.
- b) A-Abort: association abort, which allows either origin or target, at any time, to explicitly terminate the association, immediately and unconditionally. Data in transit may be lost. The SR-abort service is directly mapped to this service without any SR protocol control information.

It is assumed that the SR user will handle the Association Control Services required to establish an association (A-Associate) with an application context encompassing the SR service.

The communication service that supports this SR protocol is a connection-oriented service using the P-DATA service, defined in ISO 8822 in an established application-association, in combination with the ACSE, ISO 8649.

An SR system establishes application-associations as necessary with the remote SR systems with whom it is engaged in SR activity. The SR application-service-element (ASE) may then use the P-DATA service defined in ISO 8822 directly to transmit SR APDUs. This provides a connection-oriented interaction between SR systems. A single application-association can be used to send a series of SR APDUs relating to multiple searches. A single system can be engaged in multiple application-associations with multiple remote systems simultaneously.

This International Standard defines a basic application context for Search and Retrieve in combination with ACSE, registered in C.2.1.

5.3 SR Protocol Model

In the abstract, the operation of the SR protocol is modelled by the interaction of two SR protocol machines (SRPMs). The two SRPMs communicate by exchanging SR APDUs through use of the services available at their lower boundary. At their upper boundary the SRPMs provide services to their service users.

6 SR Protocol Data Units

The SR Protocol Data Units are complex data types defined by an abstract syntax definition (see clause 8). This definition includes named parameters corresponding to those parameters in the SR Service carried directly by SR-PCI and any other parameters necessary for the operation of the protocol.

A transfer syntax of these data types is obtained by applying the Basic Encoding Rules for Abstract Syntax Notation One (ASN.1) ISO 8825.

This clause lists the APDUs used in the SR application and describes the use and meaning of the APDUs.

INITIALIZE – used by the origin to initialize communication with a target for subsequent SR activity.

INITIALIZE RESPONSE – used by the target to reply to the origin regarding proposals made in the Initialize APDU.

SEARCH – used by the origin to request a search by the target for records that meet certain criteria.

SEARCH RESPONSE – used by the target to inform the origin of the result of the search request.

PRESENT – used by the origin to request records from a result set on the target.

PRESENT RESPONSE – used by the target to send requested result set records to the origin.

DELETE-RESULT-SET – used by the origin to request deletion of a result set on the target.

DELETE-RESULT-SET RESPONSE – used by the target to tell the origin the outcome of the delete-result-set request.

7 Elements of Procedure

Each of the Initialize, Search, Present, and Delete-result-set request service primitives results in the preparation and transmission of the APDU of the corresponding name. The receipt of an Initialize, Search, Present, or Delete-result-set APDU results in a corresponding indication service primitive.

7.1 Initialize and Initialize Response APDUs

On the Initialize APDU, the origin proposes values for the parameters, and the target may propose alternative values in the Initialize Response APDU for some of the parameters. If so, the origin must either accept the alternative values proposed by the target or else terminate communication (see 7.6).

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7.1.1 Protocol Version

The protocol version consists of a string of Boolean values, each value representing a version. The first value set to "on" indicates version 1 is available, the second value set to "on" indicates version 2 is available, and so on. Values higher than the highest known version should be ignored. Both the Initialize and Initialize Response APDUs include a value string corresponding to the supported versions. The highest common version is selected for use. If there are no versions in common, the Initialize Response APDU should indicate a value of "reject" for the parameter Initialization-status.

7.1.2 Options

On the Initialize APDU, the parameter Options specifies either "will use" or "will not use" for the services listed below. On the Initialize Response APDU the target specifies "will support" or "will not support" for each of these services:

- search
- present
- delete-result-set

If the target specifies "will support" for a particular service, then the origin may assume that the service will be available and may use the service during the association, even if the origin had specified "will not use" for that service.

7.1.3 Preferred-message size and Maximum-message-size

Both the Initialize APDU and the Initialize Response APDU contain Preferred-message-size and Maximum-message-size, specified in bytes. Maximum-message-size must be greater than or equal to Preferred-message-size. Note that the purpose of this distinction between Preferred-message-size and Maximum-message-size is to allow the transfer of normal length records to proceed in a routine fashion, with convenient buffer sizes, but to also provide for the transfer of an occasional exceptionally large database record without requiring the origin to continually allocate and hold local buffer space for worst-case records. The target may propose values different from those proposed by the origin in which case the values in the Initialize Response APDU override those in the Initialize APDU, and the origin may abort the connection if those values are not acceptable. Usage of these parameters is specified in 7.7.

7.1.4 Initialization-status

The target indicates whether or not it accepts the association by specifying a value of "accept" or "reject" respectively in the parameter Initialization-status of the Initialize Response APDU. If "reject" is indicated, the origin is expected to terminate communication with an SR-release or SR-abort (see 7.6).

7.1.5 User Information-field

The parameter User-information-field may optionally be included on either the Initialization or Initialization Response APDU. It contains information supplied by the user; the definition of such information is outside the scope of this International Standard.

7.1.6 Implementation Parameters

Any of the following implementation-related parameters may optionally be included in either the Initialize or Initialize Response APDUs:

- Implementation-id: a unique identifier for the origin (or target) implementation.
- Implementation-name: a descriptive name for the origin (or target) implementation.
- Implementation-version: a descriptive name for the origin (or target) implementation version.

7.1.7 Authentication

The origin may provide information for use by the target in authenticating the origin. The need for such information and its form and content are a matter of prior, private agreement between the origin and the target. If the target requires authentication information and the origin either does not supply the information or supplies invalid information, the target may either reject the initialization request by returning an Initialization-status value of "reject", or the target may abort the entire association through use of the Association Control A-Abort service.

7.2 Search and Search Response APDUs

7.2.1 Database-id

The target designates, by agreement outside the scope of this International Standard, what databases may be specified on a Search APDU, and also in what combinations they may be specified. For example, a target might specify that databases A, B, and C may be searched individually, and that A and B may be searched in combination (but not A and C, nor B and C).

The parameter Database-id in the Search APDU is a set of one or more database names. If the specified combination of databases is not supported by the target, the Search Response APDU will include a diagnostic, such as "combination of specified databases not supported", and the value of the parameter Search-Status will be "failure".

7.2.2 Proposed-result-set-id and Replace-indicator

The parameter Proposed-result-set-id specifies a name to be given to the result set which will be created by the query, so that it may be subsequently referenced within the same association. If a result set with the same name already exists at the target, then the action taken depends on the value of the parameter Replace-indicator, as follows:

- If the value of Replace-indicator is “on”, then prior to processing the query, the existing result set whose name is specified by the parameter Proposed-result-set-id will be deleted, and a new result set by that name created. The initial content of the result set is null. If no records are found by the query, the result set remains null.
- If the value of Replace-indicator is “off”, the search is not processed, an error diagnostic is included in the Search Response APDU, the value of the parameter Search-Status is “failure”, and the existing result set whose name is specified by the parameter Proposed-result-set-id is left unchanged.

If a result set does not exist with the name specified by the parameter Proposed-result-set-id, then a result set by that name is created by the target, and the parameter Replace-indicator is ignored. The initial content of the result set is null.

A target system need not support, in general, the naming of result sets by the origin (see, however, conformance statement requirements in 9.3). However, a target system must support at least the result set whose name is “default”. If the origin specifies “default” as Proposed-result-set-id, then Replace-indicator must be “on”.

A result set which is created by a Search APDU (that is, specified by the parameter Proposed-result-set-id) may be referenced in a subsequent Present APDU or as an operand in a subsequent Search APDU (for example, in an RPN query). If a result set is created with the name “default”, that result set remains available for reference from the time it is created until the end of the association during which it is created, or until:

- another “default” result set is created, because the name “default” is specified as Proposed-result-set-id in a subsequent Search APDU, or
- it is unilaterally erased or deleted by the target.

If a result set is created with any name other than “default”, that result set remains available for reference from the time it is created until it is deleted in one of the following ways:

- by a Delete-result-set APDU
- implicitly, because a result set was specified by the same name in a Search APDU, during the current association, and the value of the parameter Replace-indicator was “on”

- unilaterally by the target (at any time)
- by termination of the association.

7.2.3 Small-set-upper-bound, Large-set-lower-bound, Medium-set-present-number, and Number-of-records-found

The parameters Small-set-upper-bound, Large-set-lower-bound, and Medium-set-present-number are included in the Search APDU. Number-of-records-found is returned in the Search Response APDU, and is the number of database records identified by the result set (its value is zero, if the result set is empty).

The result set is considered either a “small-set”, a “medium-set”, or a “large-set”, depending on the values of these four parameters. The result set is a small-set if Number-of-records-found is not greater than Small-set-upper-bound. The result set is a large-set if Number-of-records-found is larger than or equal to Large-set-lower-bound. Otherwise, the result set is a medium-set.

NOTE 1 The result set is a medium set only when Number-of-records-found is greater than Small-set-upper-bound and less than Large-set-lower-bound. Therefore the result set cannot be a medium set if Large-set-lower-bound is only larger than Small-set-upper bound by one.

If the query results in a small-set, all database records identified by the result set are to be returned to the origin (subject to possible message size constraints, see 7.7). If the query results in a large-set, no database records are to be returned. (Large-set-lower-bound must be greater than small-set-upper-bound. If the origin does not want any records returned in the response regardless of the value of Number-of-records-found, the origin sets Large-set-lower-bound to 1 and Small-set-upper-bound to zero). If the query results in a medium-set, the maximum number of database records to be returned is specified by Medium-set-present-number.

7.2.4 Small-set-record-composition and Medium-set-record-composition

A record composition name specifies a particular subset of the elements in a database record which are to compose the Response APDU records. The specified subset is made up of components of the abstract-syntax description of the database records and is, therefore, a formal subset of that abstract-syntax-definition. Record composition names are specified, along with their definitions, for a given database, by the target, outside of this standard. The target specifies a default record composition name for each database.

The parameters Small-set-record-composition and Medium-set-record-composition describe the preferred record composition of the records expected in the search response APDU. If the query results in a small-set, then Small-set-

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record-composition pertains. If the query results in a medium-set, then Medium-set-record-composition pertains.

Each of the parameters is a set of one or more pairs of a database name and associated record composition name. For each database record returned in a Search (or Present) Response APDU, if the given database is specified (as a component of one of the pairs comprising the pertaining record composition parameter) then the response record should be composed according to the corresponding record composition name. If not, the response record should be composed according to the default record composition name for that database. If a record composition name is specified which is not valid for the corresponding database, then the Search Response APDU will include a diagnostic, such as "record composition name not valid for database", and the value of the parameter Search-Status will be "failure".

Each of the parameters Small-set-record-composition and Medium-set-record-composition may alternatively consist of a single record composition name (from those defined by the target system), with no database specified. In that case, for each database record returned in a Search (or Present) Response APDU:

- if the specified record composition name is valid for the given database, the record should be composed according to that record composition name;
- if the specified record composition name is *not* valid for the given database, the record should be composed according to the default record composition name for that database.

A target system must always recognize the character string "F" as a record composition name to mean "full record". When a "full record" is requested, the target returns all of the elements stored in its database for the requested record. For a given record, the set of elements included in a "full record" in one database might not be the same set of elements included in a "full record" in another database. (The target may use "F" as the default record composition.)

7.2.5 Query-type and RPN-query

The parameter Query-type in the Search request identifies the form and structure used to express the query contained in the query field. This International Standard currently recognizes three Query-types. Query-type 0 is reserved for private use; the syntax and semantics of this type are privately agreed upon by the users. Query-type 1 is the form of Reverse Polish Notation query specified here. Query-type 2 is the syntax and semantics of the FIND command specified in ISO 8777. Other query-types may be added. The remainder of this clause specifies procedures when Query-type is 1, "RPN-query".

The RPN query has the following structure:

```
RPN-query ::= argument |
              argument + argument + operator
argument   ::= operand | RPN-query
operand    ::= attribute-set + term | Result-set-id
operator    ::= AND | OR | AND-NOT
```

Where

```
::=      means "is defined as",
|        means "or",
+        means "followed by", and + has precedence
          over | (i.e., + is evaluated before |).
```

NOTES

- 2 "RPN-query" is recursively defined; it is either
 - a) "operand", or
 - b) "argument + argument + operator".
 In case b), each occurrence of "argument" can be replaced by either a) or b) and so on. A structure composed of operators and operands conforms to the RPN query structure if and only if it is possible, by repeatedly replacing occurrences of b) with a), to reduce the structure to a).
- 3 "operand" is either
 - a) attribute-set + term; or
 - b) Result-set-id.
 In either case it represents a set of database records. For a) it is the set of database records obtained by evaluating the specified attribute-set and term against the collection of databases specified in the Search APDU (see note 4). For b) it is the set of database records represented by the result set for which Result-set-id was specified as the value of the parameter Proposed-result-set-id in a previous Search APDU.
- 4 Different attribute sets will be defined and registered (annex D defines and registers attribute-set bib-1). An example of an attribute-set/term combination is 'title word/evangeline'; in this case, evaluation of attribute-set/term against a database would result in the identification of all of the records in the database for which the access point 'title word' contains the value 'evangeline'.

Evaluation of operands and operators is illustrated by the use of a stack. The query is evaluated left-to-right. Each query-term is one of the following:

- a) Attribute-set + Term
- b) Result-set-id
- c) Operator

Whenever a) is encountered, it is evaluated against the collection of databases specified in the Search request, and the result is put on the stack. Whenever b) is encountered, it is put on the stack.

Whenever c) is encountered, the last two items (i.e. sets, see note 3 above) that have been put on the stack are pulled off and the operator is applied as follows:

- if operator is AND, the result is the intersection of the two sets,
- if operator is OR, the result is the union of the two sets,
- if operator is AND-NOT, the result is the set of elements in the first set (i.e., the first of the two sets to have been placed on the stack) which are not in the second set.

The resulting set is then put on the stack.

When evaluation of the query is complete (i.e. all query-terms have been processed) there will be one item remaining on the stack (otherwise the query is in error) which is the result of the query.

7.2.6 Number-of-records-returned and Next-result-set-position

These two parameters are included in the Search Response APDU. Number-of-records-returned is the total number of records, both database and diagnostic, returned in the Search Response APDU.

Next-result-set-position specifies the position within the result set of the next record following the last database or surrogate diagnostic record being returned (or zero, if the last database or surrogate diagnostic record in the result set is being returned).

NOTE 6 Records are identified within the result set beginning with 1.

7.2.7 Records

After processing the search, the target attempts to retrieve the first N records identified by the result set, to be included in the Search Response APDU (N depends on the parameters described in 7.2.3). For each record which cannot be returned, a surrogate diagnostic record is substituted. Thus the parameter Records is one of the following:

- N database and/or surrogate diagnostic records,
- a number of database and/or surrogate diagnostic records, which is less than N because of message size constraints (see 7.7),
- a single (non-surrogate) diagnostic record indicating that the search cannot be processed, and why it cannot be processed, or
- a single (non-surrogate) diagnostic record indicating that records cannot be presented, and why not, e.g., "record composition name not valid for database".

The order of occurrence of records (database and/or surrogate diagnostic) within the parameter Records is according to the order in which they are identified by the result set. Each database or surrogate diagnostic record may optionally

be accompanied by the name of the database in which the record resides. However, the database name must accompany the first database or surrogate diagnostic record being returned, and must accompany any record coming from a database different from its immediate predecessor.

7.2.8 Search-status

The parameter Search-status in the Search Response APDU assumes one of the following two values:

- | | | |
|---------|---|---------------------------------------|
| success | – | Search completed successfully. |
| failure | – | Search did not complete successfully. |

A value of "success" does not imply that the expected database and/or surrogate diagnostic records are being returned as part of the response (see Present-status, 7.2.9). (Note also, a value of "success" does not imply that any records were located by the search). A value of "failure" does imply that none of the expected database and/or surrogate diagnostic records is being returned. In the latter case, the target returns a single diagnostic record indicating that the search cannot be processed.

7.2.9 Result-set-status and Present-status

These two parameters of the Search Response APDU are status descriptors necessary to dissambiguate certain situations that can occur during search and present operations.

Result-set-status occurs if and only if the value of Search-status is "failure", and its value is one of the following:

- | | |
|---------|---|
| subset | Partial, valid results available. |
| interim | Partial results available, not necessarily valid. |
| none | No results available (result set is null). |

Present-status occurs if and only if the value of Search-status is "success", and its value is one of the following:

- | | |
|-----------|---|
| success | All of the expected database (or surrogate diagnostic) records are available. |
| partial-1 | Not all of the expected records can be returned because the request was terminated by the target due to access-control. |
| partial-2 | Not all of the expected records can be returned because the request was terminated by the target due to maximum message size (see 7.7). |
| partial-3 | (Reserved for future use.) |
| partial 4 | Not all of the expected records can be returned because the request was terminated by the target due to resource-control. |
| failure | None of the expected database (or surrogate diagnostic) records can be returned. A single diagnostic is returned, which is not a surrogate for a database record. |