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**Information technology — Open Systems
Interconnection — Remote Database
Access —**

Part 2:
SQL specialization

*Technologies de l'information — Interconnexion de systèmes ouverts
(OSI) — Accès aux bases de données à distance —*

Partie 2: Spécialisation SQL



Reference number
ISO/IEC 9579-2:1993(E)

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Foreword

ISO (the International Organization for Standardization) and IEC (the International Electrotechnical Commission) form the specialized system for worldwide standardization. National bodies that are members of ISO or IEC participate in the development of International Standards through technical committees established by the respective organization to deal with particular fields of technical activity. ISO and IEC technical committees collaborate in fields of mutual interest. Other international organizations, governmental and non-governmental, in liaison with ISO and IEC, also take part in the work.

In the field of information technology, ISO and IEC have established a joint technical committee, ISO/IEC JTC 1. Draft International Standards adopted by the joint technical committee are circulated to national bodies for voting. Publication as an International Standard requires approval by at least 75 % of the national bodies casting a vote.

International Standard ISO/IEC 9579-2 was prepared by Joint Technical Committee ISO/IEC JTC 1, *Information technology*, Subcommittee SC 21, *Open systems interconnection, data management and open distributed processing*.

ISO/IEC 9579 consists of the following parts, under the general title *Information technology — Open Systems Interconnection — Remote Database Access*:

- *Part 1: Generic Model, Service and Protocol*
- *Part 2: SQL specialization*

Introduction

Remote Database Access (RDA) International Standards are members of a set of International Standards produced to facilitate the interworking of computer systems. The RDA International Standards are positioned in the Application Layer of the Reference Model of Open Systems Interconnection (OSI) and are related to other Open Systems International Standards in the set, as defined in ISO 7498.

The goal of Remote Database Access is to allow, with a minimum of technical agreement outside the interconnection standards, the interconnection of applications and database systems:

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

An application may itself be a database system and therefore an RDA Specialization standard can be used to support multi-database system interworking.

This part of ISO/IEC 9579 is to be used together with ISO/IEC 9579-1 to provide remote data access to a database management system conforming to ISO/IEC 9075 (Database Language SQL).

Information technology — Open Systems Interconnection — Remote Database Access —

Part 2: SQL specialization

Section 1: Introduction

1.1 Scope

This part of ISO/IEC 9579 specifies the functionality of a database server within a distributed open systems environment and specifies the communication service and protocol for accessing its capabilities. The communications capabilities are positioned in the Application Layer of the Reference Model of Open Systems Interconnection (OSI).

This part of ISO/IEC 9579 complements ISO/IEC 9579-1 (RDA Generic) in order that the two parts together:

- a) define the capabilities of an RDA SQL database server supporting dialogues with clients.
- b) define a model of dialogues between the RDA SQL database server and remote users.
- c) define a model of a dialogue between an RDA client and an RDA server.
- d) define an abstract service for the RDA SQL ASE, which models the communications facilities supporting interaction between the RDA client and RDA server.
- e) define the RDA SQL ASE protocol to support the RDA SQL Service.
- f) define the characteristics of application-contexts which include the RDA SQL ASE.
- g) define application-contexts that support remote database access using SQL:
 - 1) RDA Basic application-context
 - 2) RDA TP application-context

This part of ISO/IEC 9579 does not specify individual implementations or products, nor does it constrain the implementation of entities and interfaces within a computer system.

This part of ISO/IEC 9579 does not define a programmatic interface. The RDA server includes a database capability as defined in ISO/IEC 9075 (Database Language SQL).

NOTES

- 1 The RDA client may contain an SQL application program but there is no requirement that the RDA client shall be an application program written to the ISO/IEC 9075 (Database Language SQL) application program interface.
- 2 ISO/IEC 9075:1989, the former International Standard for Database Language SQL, has been replaced by ISO/IEC 9075:1992. Both the current and former standards contain conformance rules, and the RDA SQL Specialization allows an RDA client to specify the desired level of conformance which it expects the RDA Server to support. Throughout this part of ISO/IEC 9579, "SQL" refers to the language statements permitted by the appropriate standard at the requested level of conformance.

1.2 Normative references

The following standards contain provisions which, through reference in this text, constitute provisions of this part of ISO/IEC 9579. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this part of ISO/IEC 9579 are encouraged to investigate the possibility of applying the most recent editions of the standards listed below. Members of ISO and IEC maintain registers of currently valid International Standards.

ISO/IEC 8824:1990, *Information technology - Open Systems Interconnection - Specification of Abstract Syntax Notation One (ASN.1)*.

ISO/IEC 8825:1990, *Information technology - Open Systems Interconnection - Specification of Basic Encoding Rules for Abstract Syntax Notation One (ASN.1)*.

ISO/IEC 9075:1992, *Information technology - Database Languages SQL*.

ISO/IEC 9579-1:1993, *Information technology - Open Systems Interconnection - Remote Database Access - Part 1: Generic*.

1.3 Definitions

For the purposes of this part of ISO/IEC 9579, the definitions given in ISO/IEC 9579-1 and the following definitions apply.

1.3.1 Terms defined in ISO/IEC 9075 (Database Language SQL)

This part of ISO/IEC 9579 uses the following terms defined in ISO/IEC 9075:1989 (Database Language SQL) or ISO/IEC 9075:1992 (Database Language SQL).

- a) applicable privileges
- b) Embedded SQL
- c) SQL-data
- d) SQLCODE
- e) SQLSTATE

In addition, this part of ISO/IEC 9579 references the following non-terminal production symbols from the SQL syntax, which represent a valid string of characters that can be derived from these production symbols according to the syntax rules in ISO/IEC 9075 (Database Language SQL) at the appropriate level of conformance.

- f) < close statement >
- g) < commit statement >
- h) < cursor name >
- i) < declare cursor >
- j) < delete statement: positioned >
- k) < delete statement: searched >
- l) < embedded variable name >
- m) < fetch statement >
- n) < grant statement >
- o) < host identifier >
- p) < indicator variable >
- q) < insert statement >
- r) < low >

- s) < open statement >
- t) < rollback statement >
- u) < schema definition >
- v) < select statement: single row >
- w) < SQL conformance >
- x) < SQL data statement >
- y) < SQL edition >
- z) < table definition >
- aa) < update statement: positioned >
- ab) < update statement: searched >
- ac) < variable specification >
- ad) < view definition >
- ae) < 1987 >
- af) < 1989 >
- ag) < 1992 >

1.3.2 Terms defined in this part of ISO/IEC 9579

1.3.2.1 SQL database resource: SQL-data and the schemas describing it, as defined in ISO/IEC 9075 (Database Language SQL).

1.3.2.2 RDA SQL statement: One of the non-terminals < schema definition >, < table definition >, < view definition >, < grant statement >, < SQL data statement >, < commit statement >, < rollback statement > and < declare cursor > as defined in ISO/IEC 9075 (Database Language SQL).

1.4 Abbreviations

For the purposes of this part of ISO/IEC 9579, the abbreviations given in ISO/IEC 9075 and ISO/IEC 9579-1 apply.

1.5 Conventions

This part of ISO/IEC 9579 adopts the conventions established in ISO/IEC 9579-1.

The RDA SQL Specialization is formally defined in an ASN.1 Module that is derived from the RDA Specialization module template defined in ISO/IEC 9579-1. The RDA SQL Specialization module provides definitions for those types listed in the template as being undefined by the Generic part of ISO/IEC 9579.

The structure of this part of ISO/IEC 9579 follows the requirements defined in ISO/IEC 9579-1 for defining specializations of the RDA Generic Service and Protocol.

In this part of ISO/IEC 9579, the RDA Generic parameters and data types named `specificXxxx...` and `SpecificXxxx...` are renamed to `sQLXxxx...` and to `SQLXxxx...`, respectively.

In the service parameter tables in 3.1, parameters which are defined by this specialization have values entered in the Req, Ind, Rsp or Cnf columns. Other service parameters in these tables which are copied from the RDA Generic to improve readability do not have entries in these columns.

The RDA SQL Specialization defines a means of communicating SQL database language statements and their parameters from an RDA client to an RDA server, and of returning the results of those statements. Database Language SQL is supported at various levels of conformance, determined by an object identifier defined in ISO/IEC 9075.

In this part of ISO/IEC 9579, the reference “ISO/IEC 9075 (Database Language SQL)” means any International Standard carrying the designation ISO/IEC 9075 and year of approval. The specific version (or versions) of that standard that is intended in each instance is determined, for the RDA client, by the SQL Conformance Level requested either when the RDA dialogue is initialized or when a data resource is opened, and, for the RDA server, by the SQL Conformance Level (or Levels) claimed in the Protocol Implementation Conformance Statement.

When the SQL Conformance Level specifies a year value of 1987 or 1989, the relevant International Standard is ISO/IEC 9075:1989; when the SQL Conformance Level specifies a year value of 1992, the relevant International Standard is ISO/IEC 9075:1992.

The term “SQL” is used throughout in a generic sense, intending to cover Database Language SQL at a particular conformance level as well as valid statements written within that conformance level.

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Section 2: Model

2.1 The RDA SQL Specialization Service model

2.1.1 Mapping to the general model of the RDA Service

This subclause relates the relevant concepts defined in section 2 of ISO/IEC 9579-1 to this RDA SQL Specialization.

The term **data resource**, defined in the ISO/IEC 9579-1, corresponds to SQL-data as defined in ISO/IEC 9075 (Database Language SQL). In this part of ISO/IEC 9579, this is called the **SQL database resource**.

The RDA client gains access to an SQL database resource at the RDA server by opening it. It is then available for use in requests for Database Language Services (see 3.1.5, "Database Language services" on page 10). Nested SQL database resources are not supported.

Closing an SQL database resource causes it to be made inaccessible to the RDA client; that is, unavailable for subsequent use in requests for Database Language Services.

An implementor shall provide an RDA server at which one or multiple SQL database resources are available.

2.1.2 Mapping to the Concepts of Database Language SQL

This subclause relates the relevant concepts defined in clause 4 of ISO/IEC 9075 (Database Language SQL) to the database model contained in the RDA server.

RDA SQL statements are executed by the database server exactly as if they were embedded in a host program local to the SQL database resource. Any exception condition or completion condition raised by the database server is returned to the RDA client.

NOTE— A <declare cursor> RDA SQL statement must have been executed or invoked at the RDA server prior to executing or invoking any <open statement> that uses the same cursor name.

Section 3: Service

3.1 The RDA SQL Specialization Service

This clause contains the expansion of the RDA Generic Service parameters which are specialization defined. These specifications are in addition to those specified in ISO/IEC 9579-1.

NOTE – The subclauses in this clause are elaborations of the corresponding subclauses in ISO/IEC 9579-1 and are numbered accordingly.

3.1.1 RDA Dialogue Management services

3.1.1.1 RDA Dialogue Initialization functional unit

3.1.1.1.1 R-Initialize Service

Table 1 lists the R-Initialize SQL Specific Service Parameters.

Table 1. R-Initialize SQL Specific Service Parameters				
	Req	Ind	Rsp	Cnf
<u>Request Parameters</u>				
sQLInitializeArgument	U	C(=)		
sQLConformanceLevelDefault	U	C(=)		
userData	C	C(=)		
<u>Result Parameters</u>				
sQLInitializeResult			U	C(=)
userData			C	C(=)

Request Parameters

sQLInitializeArgument:

This argument is used to negotiate the level of support desired by the RDA client.

sQLConformanceLevelDefault:

This parameter identifies the characteristics ("SQL level") of the Database Language SQL requested by the RDA client. The object identifiers specifying those characteristics are defined in ISO/IEC 9075:1992. This is the default SQL Conformance Level requested by the RDA client. If this parameter is omitted, there is no default established for the RDA client.

userData:

The meaning of this parameter is defined by the implementor of the RDA server.

Result Parameters

sQLInitializeResult:

This parameter contains information returned by the RDA server whose meaning is specific to this RDA SQL Specialization.

userData:

The meaning of this parameter is defined by the implementor of the RDA server.

Error Parameters

NOTE — None of the specific error parameters for this service are used in this Specialization.

3.1.1.2 RDA Dialogue Termination functional unit

3.1.1.2.1 R-Terminate Service

NOTE — None of the specific request, result or error parameters for this service are used in this Specialization.

3.1.2 RDA Transaction Management services

3.1.2.1 RDA Transaction Management functional unit

3.1.2.1.1 R-BeginTransaction Service

NOTE — There are no specific request, result or error parameters.

3.1.2.1.2 R-Commit Service

NOTE — There are no specific request, result or error parameters.

3.1.2.1.3 R-Rollback Service

NOTE — There are no specific request, result or error parameters.

3.1.3 RDA Control services

3.1.3.1 Cancel functional unit

3.1.3.1.1 R-Cancel Service

NOTE — None of the specific request, result or error parameters for this service are used in this Specialization.

3.1.3.2 Status functional unit

3.1.3.2.1 R-Status Service

NOTE — None of the specific request, result or error parameters for this service are used in this Specialization.

3.1.4 Resource Handling services

3.1.4.1 Resource Handling functional unit

3.1.4.1.1 R-Open Service

Table 2 lists the R-Open SQL Specific Service Parameters.

Table 2. R-Open SQL Specific Service Parameters				
	Req	Ind	Rsp	Cnf
<u>Request Parameters</u>				
sQLAccessControlData	U	C(=)		
sQLUsageMode	U	C(=)		
sQLOpenArgument	U	C(=)		
charSet	U	C(=)		
sQLConformanceLevel	U	C(=)		
<u>Result Parameters</u>				
sQLOpenResult			U	C(=)
charSet			U	C(=)
charSetNotSupported			U	C(=)
sQLConformanceLevel			C	C(=)
<u>Error Parameters</u>				
sQLOpenError			S	S(=)
invalidSQLConformanceLevel			S	S(=)
rDATransactionOpen			S	S(=)
sQLAccessControlViolation			S	S(=)
sQLDatabaseResourceAlreadyOpen			S	S(=)

Request Parameters

sQLAccessControlData:

Data supplied by the RDA client to authenticate the right to open the SQL database resource for the required usage.

sQLUsageMode:

This argument specifies the access mode to the SQL database resource. If "retrieval" mode is chosen then all the objects within that SQL database resource can be accessed for read-only purposes and any attempt to modify any object within that SQL database resource causes an error usageModeViolation. If "update" mode is chosen then update, insert and delete of the objects within that SQL database resource are permitted. The applicable privileges as defined in ISO/IEC 9075:1992 may further restrict the access to any of the objects within that SQL database resource irrespective of the sQLUsageMode. The default value for sQLUsageMode is "retrieval."

sQLOpenArgument:

This parameter contains information sent by the RDA client whose meaning is specific to SQL.

charSet:

This parameter uniquely identifies the specification of a coded character set. The character repertoire for character data associated with (described by) this parameter is the character repertoire specified in the identified coded character set specification. The character set identified by that specification shall be used by the RDA client as the default in this RDA dialogue for all RDA SQL Statements and their associated character data arguments accessing the SQL database resource opened by this RDA service.

NOTE— This default can be overridden by explicit specification, in an sQLDBLArgumentSpecification or an sQLDBLStatement, of a character set for a particular argument value or RDA SQL statement.

If this parameter is omitted, there is no default established for the RDA client.

NOTE— This means that a `charSet` parameter must be specified for every character data argument and `SQLDBLStatement` sent by the RDA client.

sQLConformanceLevel:

This parameter identifies the characteristics ("SQL level") of the Database Language SQL requested by the RDA client. The object identifiers specifying those characteristics are defined in ISO/IEC 9075:1992. This is the `sQLConformanceLevel` which the RDA client requests for all RDA SQL statements for this SQL database resource. This parameter shall be provided if no default was established by the RDA client on R-Initialize.

parentDataResourceHandle:

This parameter is not used in this Specialization.

Result Parameters

sQLOpenResult:

This parameter contains information returned by the RDA server whose meaning is specific to SQL.

charSet:

This parameter uniquely identifies the specification of a coded character set. The character repertoire for character data associated with (described by) this parameter is the character repertoire specified in the identified coded character set specification. The character set identified by that specification shall be used by the RDA server as the default in this RDA dialogue for all character data results that are associated with DBL statements accessing the SQL database resource opened by this RDA Service.

If the default character set declared by the RDA client in the `charSet` argument parameter is also supported for result parameters by the RDA server, then the RDA server declares the same default character set for itself by responding with the same character set identification.

NOTE— This default can be overridden by explicit specification, in an `SQLDBLResultSpecification`, of a character set for a particular result value.

If this parameter is omitted, there is no default established for the RDA server.

NOTE— This means that a `charSet` parameter must be specified for every character data result sent by the RDA server.

charSetNotSupported:

The character set declared by the RDA client is not supported by the RDA server.

NOTE— If the RDA server returns this parameter, the RDA client should close the SQL database resource and propose another default character set.

sQLConformanceLevel:

If the RDA server cannot provide the SQL level requested by the RDA client then this parameter identifies the characteristics ("SQL level") of the Database Language SQL that the RDA server will provide. The object identifiers specifying those characteristics are defined in ISO/IEC 9075:1992. If the RDA server does not support the `sQLConformanceLevel` requested by the RDA client, the RDA server returns the `sQLConformanceLevel` which the RDA server does support in this result parameter.

Error Parameters

sQLOpenError:

This parameter is used by the RDA server to report errors.

invalidSQLConformanceLevel:

The value of `sQLConformanceLevel` is not allowed. If the `sQLConformanceLevel` request parameter was supplied on the R-Open request, then the error refers to the value in that parameter. Otherwise it refers to the `sQLConformanceLevelDefault` request parameter value as supplied on the previous R-Initialize request.

rDATransactionOpen

The opening of an SQL database resource is not allowed within a transaction.

sQLAccessControlViolation:

The RDA client does not have the required authority to open the SQL database resource for the requested `sQLUsageMode`.

sQLDatabaseResourceAlreadyOpen

There is already an SQL database resource open.

3.1.4.1.2 R-Close Service

Table 3 lists the R-Close SQL Specific Service Parameters.

Table 3. R-Close SQL Specific Service Parameters				
	Req	Ind	Rsp	Cnf
Error Parameters				
sQLCloseError			S	S(=)
rDATransactionOpen			S	S(=)

Error Parameters**sQLCloseError:**

This parameter is used by the RDA server to report errors.

rDATransactionOpen

The closing of an SQL database resource is not allowed within a transaction.

3.1.5 Database Language services

There are no constraints on intermixing invocation (through R-InvokeDBL operations) and execution (through R-ExecuteDBL operations) of RDA SQL statements.

3.1.5.1 Immediate Execution DBL functional unit**3.1.5.1.1 R-ExecuteDBL Service**

Table 4 lists the R-ExecuteDBL SQL Specific Service Parameters.

Table 4. R-ExecuteDBL SQL Specific Service Parameters

	Req	Ind	Rsp	Cnf
<u>Request Parameters</u>				
sQLDBLStatement	M	M(=)		
sQLDBLArgumentSpecification	U	C(=)		
sQLDBLResultSpecification	U	C(=)		
dBLArguments				
singleArgument				
sQLDBLArgumentValues	U	C(=)		
multipleArgument				
listOfSQLDBLArgumentValues	U	C(=)		
<u>Result Parameters</u>				
sQLDBLResultSpecification			C	C(=)
listOfResultValues				
sQLDBLException			M	M(=)
sQLSTATE			C	C(=)
sQLCODE			C	C(=)
sQLErrorText			U	C(=)
sQLDBLResultValues			C	C(=)
<u>Error Parameters</u>				
sQLExecuteDBLError			S	S(=)
hostIdentifierError			S	S(=)
rDATransactionNotOpen			S	S(=)
sQLDBLArgumentCountMismatch			S	S(=)
sQLDBLArgumentTypeMismatch			S	S(=)
sQLDBLNoCharSet			S	S(=)
sQLDBLTransactionStatementNotAllowed			S	S(=)
sQLUsageModeViolation			S	S(=)

NOTE — The specificTerminationCode result parameter is not used in this Specialization.

Request Parameters

sQLDBLStatement:

This parameter contains the RDA SQL statement to be executed and is fully defined in 3.1.6.1, "sQLDBLStatement" on page 15.

sQLDBLArgumentSpecification:

This parameter consists of a list of SQL datatype descriptors and is fully defined in 3.1.6.2, "sQLDBLArgumentSpecification and sQLDBLResultSpecification" on page 16.

sQLDBLResultSpecification:

This parameter consists of a list of SQL datatype descriptors and is fully defined in 3.1.6.2, "sQLDBLArgumentSpecification and sQLDBLResultSpecification" on page 16.

sQLDBLArgumentValues:

This parameter consists of a list of the values of the argument parameters defined in the sQLDBLArgumentSpecification and is fully defined in 3.1.6.3, "sQLDBLArgumentValues and sQLDBLResultValues" on page 18.

listOfSQLDBLArgumentValues:

This parameter consists of multiple lists of the values of the argument parameters defined in the sQLDBLArgumentSpecification and is fully defined in 3.1.6.3, "sQLDBLArgumentValues and sQLDBLResultValues" on page 18.

Result Parameters

sQLDBLResultSpecification:

This parameter consists of a list of SQL datatype descriptors and is fully defined in 3.1.6.2, "sQLDBLArgumentSpecification and sQLDBLResultSpecification" on page 16.

sQLDBLException:

This defines the completion code for the execution of the RDA SQL statement. It is the method used by the RDA server to return SQL exceptions (exception conditions or completion conditions).

sQLSTATE:

An SQLSTATE value as defined in ISO/IEC 9075:1992 or by the RDA server in conformance with that specification.

sQLCODE:

An SQLCODE value as defined in ISO/IEC 9075 (Database Language SQL).

sQLErrorText:

Supplemental information describing the error or warning corresponding to the sQLSTATE value or the sQLCODE value.

sQLDBLResultValues:

This parameter consists of a list of the values of the result parameters defined in the sQLDBLResultSpecification and is fully defined in 3.1.6.3, "sQLDBLArgumentValues and sQLDBLResultValues" on page 18.

Error Parameters

sQLExecutedDBLError:

This parameter is used by the RDA server to report errors.

hostIdentifierError:

The RDA server detected an error in an SQL variable name in an RDA SQL statement.

rDATransactionNotOpen:

No transaction is open and an attempt was made to execute an operation containing an RDA SQL statement other than a < schema definition >, < table definition >, < view definition > or < grant statement >.

sQLDBLArgumentCountMismatch:

The number of entries in the sQLDBLArgumentValues parameter is not the same as in its associated sQLDBLArgumentSpecification parameter.

sQLDBLArgumentTypeMismatch:

The type of one or more entries in the sQLDBLArgumentValues parameter is not the same as in its associated sQLDBLArgumentSpecification parameter.

sQLDBLNoCharSet

There is no default character set for the SQL database resource and either the sQLDBLArgumentSpecification contains a descriptor for character data without the explicit specification of its character set or the sQLDBLStatement contains character data without the explicit specification of its character set.

sQLDBLTransactionStatementNotAllowed:

The content of sQLDBLStatement performs transaction management (e.g. SQL < commit statement > or SQL < rollback statement >) which is not permitted by the RDA SQL Specialization.

sQLUsageModeViolation:

The access mode of the SQL database resource associated with this request is in conflict with the RDA SQL statement specified.

3.1.5.2 Stored Execution DBL functional unit

3.1.5.2.1 R-DefinedDBL Service

Table 5 lists the R-DefinedDBL SQL Specific Service Parameters.

Table 5. R-DefinedDBL SQL Specific Service Parameters				
	Req	Ind	Rsp	Cnf
<u>Request Parameters</u>				
sQLDBLStatement	M	M(=)		
sQLDBLArgumentSpecification	U	C(=)		
sQLDBLResultSpecification	U	C(=)		
<u>Result Parameters</u>				
sQLDBLResultSpecification			C	C(=)
sQLDBLException			C	C(=)
sQLSTATE			C	C(=)
sQLCODE			C	C(=)
sQLErrorText			U	C(=)
<u>Error Parameters</u>				
sQLDefineDBLError			S	S(=)
hostIdentifierError			S	S(=)
sQLDBLNoCharSet			S	S(=)
sQLDBLTransactionStatementNotAllowed			S	S(=)
sQLUsageModeViolation			S	S(=)

Request Parameters

sQLDBLStatement:

This parameter contains the RDA SQL statement to be defined and is fully defined in 3.1.6.1, "sQLDBLStatement" on page 15.

sQLDBLArgumentSpecification:

This parameter consists of a list of SQL datatype descriptors and is fully defined in 3.1.6.2, "sQLDBLArgumentSpecification and sQLDBLResultSpecification" on page 16.

sQLDBLResultSpecification:

This parameter consists of a list of SQL datatype descriptors and is fully defined in 3.1.6.2, "sQLDBLArgumentSpecification and sQLDBLResultSpecification" on page 16.

Result Parameters

sQLDBLResultSpecification:

This parameter consists of a list of SQL datatype descriptors and is fully defined in 3.1.6.2, "sQLDBLArgumentSpecification and sQLDBLResultSpecification" on page 16.

sQLDBLException:

This defines the completion code for the execution of the RDA SQL statement. It is the method used by the RDA server to return SQL exceptions (exception conditions or completion conditions).

sQLSTATE:

An SQLSTATE value as defined in ISO/IEC 9075:1992 or by the RDA server in conformance with that specification.

sQLCODE:

An SQLCODE value as defined in ISO/IEC 9075 (Database Language SQL).

sQLErrorText:

Supplemental information describing the error or warning corresponding to the sQLSTATE value or the sQLCODE value.

Error Parameters

sQLDefinedDBLError:

This parameter is used by the RDA server to report errors.

hostIdentifierError:

The RDA server detected an error in an SQL variable name in an SQL statement.

sQLDBLNoCharSet:

There is no default character set for the SQL database resource and either the sQLDBLArgumentSpecification contains a descriptor for character data without the explicit specification of its character set or the sQLDBLStatement contains character data without the explicit specification of its character set.

sQLDBLTransactionStatementNotAllowed:

The content of sQLDBLStatement performs transaction management (e.g. SQL <commit statement> or SQL <rollback statement>) which is not permitted by the RDA SQL Specialization.

sQLUsageModeViolation:

The access mode of the SQL database resource associated with this request is in conflict with the RDA SQL statement specified.

3.1.5.2.2 R-InvokeDBL Service

Table 6 lists the R-InvokeDBL SQL Specific Service Parameters.

Table 6. R-InvokeDBL SQL Specific Service Parameters				
	Req	Ind	Rsp	Cnf
<u>Request Parameters</u>				
dBArguments				
singleArgument				
sQLDBLArgumentValues	U	C(=)		
multipleArgument				
listOfSQLDBLArgumentValues	U	C(=)		
<u>Result Parameters</u>				
sQLDBLResultSpecification			C	C(=)
listOfResultValues				
sQLDBLException			M	M(=)
sQLSTATE			C	C(=)
sQLCODE			C	C(=)
sQLErrorText			U	C(=)
sQLDBLResultValues			C	C(=)
<u>Error Parameters</u>				
sQLInvokeDBLError			S	S(=)
rDATransactionNotOpen			S	S(=)
sQLDBLArgumentCountMismatch			S	S(=)
sQLDBLArgumentTypeMismatch			S	S(=)
sQLUsageModeViolation			S	S(=)

NOTE — The specificTerminationCode result parameter is not used in this Specialization.

Request Parameters

sQLDBLArgumentValues:

This parameter consists of a list of the values of the argument parameters defined in the sQLDBLArgumentSpecification and is fully defined in 3.1.6.3, "sQLDBLArgumentValues and sQLDBLResultValues" on page 18.

listOfSQLDBLArgumentValues:

This parameter consists of multiple lists of the values of the argument parameters defined in the sQLDBLArgumentSpecification and is fully defined in 3.1.6.3, "sQLDBLArgumentValues and sQLDBLResultValues" on page 18.

Result Parameters**sQLDBLResultSpecification:**

This parameter consists of a list of SQL datatype descriptors and is fully defined in 3.1.6.2, "sQLDBLArgumentSpecification and sQLDBLResultSpecification" on page 16.

sQLDBLException:

This defines the completion code for the execution of the RDA SQL statement. It is the method used by the RDA server to return SQL exceptions (exception conditions or completion conditions).

sQLSTATE:

An SQLSTATE value as defined in ISO/IEC 9075:1992 or by the RDA server in conformance with that specification.

sQLCODE:

An SQLCODE value as defined in ISO/IEC 9075 (Database Language SQL).

sQLErrorText:

Supplemental information describing the error or warning corresponding to the sQLSTATE value or the sQLCODE value.

sQLDBLResultValues:

This parameter consists of a list of the values of the result parameters defined in the sQLDBLResultSpecification and is fully defined in 3.1.6.3, "sQLDBLArgumentValues and sQLDBLResultValues" on page 18.

Error Parameters**sQLInvokeDBLError:**

This parameter is used by the RDA server to report errors.

rDATransactionNotOpen:

No transaction is open and an attempt was made to execute an operation containing an RDA SQL statement other than a < schema definition >, < table definition >, < view definition > or < grant statement >.

sQLDBLArgumentCountMismatch:

The number of entries in the sQLDBLArgumentValues parameter is not the same as in its associated sQLDBLArgumentSpecification parameter.

sQLDBLArgumentTypeMismatch:

The type of entries in the sQLDBLArgumentValues parameter is not the same as in its associated sQLDBLArgumentSpecification parameter.

sQLUsageModeViolation:

The access mode of the SQL database resource associated with this request is in conflict with the RDA SQL statement specified.

3.1.5.2.3 R-DropDBL Service

NOTE — None of the specific request, result or error parameters for this service are used in this Specialization.

3.1.6 SQL statements, arguments and results

3.1.6.1 sQLDBLStatement

Table 7 lists the sQLDBLStatement parameter.

Table 7. sQLDBLStatement				
	Req	Ind	Rsp	Cnf
statementText	M	M(=)		
charSet	U	C(=)		

statementText:

This parameter is an encoded string containing the RDA SQL statement. The encoding of the RDA SQL statement shall be the encoding specified in the coded character set specification identified by the corresponding charSet parameter.

charSet:

This parameter uniquely identifies the specification of a coded character set. The character repertoire for the RDA SQL statement associated with (described by) this parameter is the character repertoire specified in the identified coded character set specification. If the parameter is omitted, then the character set is the default established by declaration during the execution of the R-Open service that opened the associated SQL database resource. If no default was established, then this charSet parameter must be specified.

3.1.6.2 sQLDBLArgumentSpecification and sQLDBLResultSpecification

Table 8 lists the sQLDBLArgumentSpecification and sQLDBLResultSpecification parameters.

Table 8. sQLDBLArgumentSpecification and sQLDBLResultSpecification				
	Req	Ind	Rsp	Cnf
listOfSQLDataTypeDescriptor	U	C(=)	U	C(=)
nullable			M	M(=)
colName			M	M(=)
typeDescriptor	M	M(=)	M	M(=)
characterType	S	S(=)	S	S(=)
charSet	U	C(=)	U	C(=)
length	M	M(=)	M	M(=)
fixedLengthEncoding	M	M(=)	M	M(=)
numericType	S	S(=)	S	S(=)
precision	M	M(=)	M	M(=)
scale	M	M(=)	M	M(=)
decimalType	S	S(=)	S	S(=)
precision	M	M(=)	M	M(=)
scale	M	M(=)	M	M(=)
integerType	S	S(=)	S	S(=)
precision	M	M(=)	M	M(=)
precisionBase	M	M(=)	M	M(=)

Table 8. sQLDBLArgumentSpecification and sQLDBLResultSpecification

	Req	Ind	Rsp	Cnf
smallIntType	S	S(=)	S	S(=)
precision	M	M(=)	M	M(=)
precisionBase	M	M(=)	M	M(=)
floatType	S	S(=)	S	S(=)
mantissaPrecision	M	M(=)	M	M(=)
maxExponent	M	M(=)	M	M(=)
realType	S	S(=)	S	S(=)
mantissaPrecision	M	M(=)	M	M(=)
maxExponent	M	M(=)	M	M(=)
doublePrecisionType	S	S(=)	S	S(=)
mantissaPrecision	M	M(=)	M	M(=)
maxExponent	M	M(=)	M	M(=)

NOTE — The Req and Ind columns apply when the listOfSQLDataTypeDescriptor is part of an Request parameter; the Rsp and Cnf columns apply when the list is part of a Result parameter.

listOfSQLDataTypeDescriptor:

Each item in the listOfSQLDataTypeDescriptor parameter defines a separate occurrence of an input or output <variable specification> within the sQLDBLStatement. The nth member of the list defines the SQL data type of the nth occurrence of a <variable specification> within the sQLDBLStatement.

nullable:

This parameter is "true" if the column is possibly nullable, "false" if it is known not nullable.

colName:

This parameter specifies the name of the result column. The colName parameter occurs within items in the listOfSQLDataTypeDescriptor that are returned by an RDA server as part of sQLDBLResultSpecification.

typeDescriptor:

This parameter defines the data type of the corresponding item in an sQLDBLArgumentValues or sQLDBLResultValues parameter. The nth descriptor refers to the nth data item.

characterType:

This parameter describes an item of character data.

charSet:

This parameter uniquely identifies the specification of a coded character set. The character repertoire for character data associated with (described by) this parameter is the character repertoire specified in the identified coded character set specification. If the parameter is omitted, then the character set is the default established by the declaration during the execution of the R-Open service that opened the associated SQL database resource. If no default was established, then this parameter must be specified.

length:

This parameter specifies the maximum number of characters allowed for the corresponding character data item.

fixedLengthEncoding

This parameter specifies whether an sQLValue of the characterType has SPACES removed from the end of the string for transmission. When this parameter has a value of "true" it specifies a fixed length encoding and no SPACES are removed from the corresponding sQLValue. When it has a value of "false" it specifies a variable length encoding and SPACES may be removed from the corresponding sQLValue. If a variable length encoding is specified, then the corresponding sQLValue transmitted is equivalent to the same sQLValue as if the sQLValue had been transmitted as a fixed length encoding and had been padded with SPACES at the end of the string.

numericType:

This parameter describes an item of numeric data.

precision:

For numericType, specifies the number of digits to a decimal base needed to represent the value transmitted.

scale:

For numericType, specifies a non-negative integer. If the scale is S then the value transmitted is multiplied by 10^{-S} to obtain the actual value.

decimalType:

This parameter describes an item of decimal data.

precision:

For decimalType, specifies the number of digits to a decimal base needed to represent the value transmitted.

scale:

For decimalType, specifies a non-negative integer. If the scale is S then the value transmitted is multiplied by 10^S to obtain the actual value.

integerType:

This parameter describes an item of integer data.

precision:

For integerType, specifies the number of digits to the base as specified in the precisionBase parameter needed to represent the value transmitted.

precisionBase:

For integerType, specifies the base used to count the number of digits when determining the precision which is represented.

smallIntType:

This parameter describes an item of small integer data.

precision:

For smallIntType, specifies the number of digits to the base as specified in the precisionBase parameter needed to represent the value transmitted.

precisionBase:

For smallIntType, specifies the base used to count the number of digits when determining the precision which is represented.

floatType:

This parameter describes an item of floating point data.

mantissaPrecision:

For floatType, a positive integer that specifies the number of significant binary digits in the mantissa.

maxExponent:

For floatType, a non-negative integer that specifies the maximum absolute value of the exponent. If maxExponent is E then the value of the exponent can range from $-E$ to $+E$.

realType:

This parameter describes an item of real data.

mantissaPrecision:

For realType, a positive integer that specifies the number of significant binary digits in the mantissa.

maxExponent:

For realType, a non-negative integer that specifies the maximum absolute value of the exponent. If maxExponent is E then the value of the exponent can range from $-E$ to $+E$.

doublePrecisionType:

This parameter describes an item of double precision data.

mantissaPrecision:

For doublePrecisionType, a positive integer that specifies the number of significant binary digits in the mantissa.

maxExponent:

For doublePrecisionType, a non-negative integer that specifies the maximum absolute value of the exponent.
If maxExponent is E then the value of the exponent can range from -E to +E.

3.1.6.3 sQLDBLArgumentValues and sQLDBLResultValues

Table 9 lists the sQLDBLArgumentValues and sQLDBLResultValues parameters.

Table 9. sQLDBLArgumentValues and sQLDBLResultValues				
	Req	Ind	Rsp	Cnf
listOfSQLValue	U	C(=)	U	C(=)
dataItem	U	C(=)	U	C(=)
characterItem	S	S(=)	S	S(=)
numericItem	S	S(=)	S	S(=)
decimalItem	S	S(=)	S	S(=)
integerItem	S	S(=)	S	S(=)
smallIntItem	S	S(=)	S	S(=)
floatItem	S	S(=)	S	S(=)
realItem	S	S(=)	S	S(=)
doublePrecisionItem	S	S(=)	S	S(=)
indicator	U	C(=)	U	C(=)

NOTE — The Req and Ind columns apply when the listOfSQLValue is part of an Request parameter; the Rsp and Cnf columns apply when the list is part of a Result parameter.

listOfSQLValue:

Each item in the listOfSQLValue parameter contains the value of a separate <variable specification> within the RDA SQL statement.

dataItem:

This parameter contains the value of the Data Variable (as defined in 3.1.6.4, "Referencing to parameters").

characterItem:

This parameter contains the value of a character Data Variable. The encoding of the character data shall be the encoding specified in the coded character set specification identified by the corresponding charSet parameter.

numericItem:

This parameter contains the value of a numeric Data Variable.

decimalItem:

This parameter contains the value of a decimal Data Variable.

integerItem:

This parameter contains the value of an integer Data Variable.

smallIntItem:

This parameter contains the value of a small integer Data Variable.

floatItem:

This parameter contains the value of a floating point Data Variable.

realItem:

This parameter contains the value of a real Data Variable.

doublePrecisionItem:

This parameter contains the value of a double precision Data Variable.

indicator:

This parameter contains the value of the <indicator variable>.

3.1.6.4 Referencing to parameters

An RDA SQL statement may contain references to parameters in the request and/or in the result response. Each parameter reference in the RDA SQL statement is replaced in the `sQLDBLStatement` by the `<embedded variable name>` `":H."`

Figure 1 shows how actual data is referenced:

SQLDBLStatement:

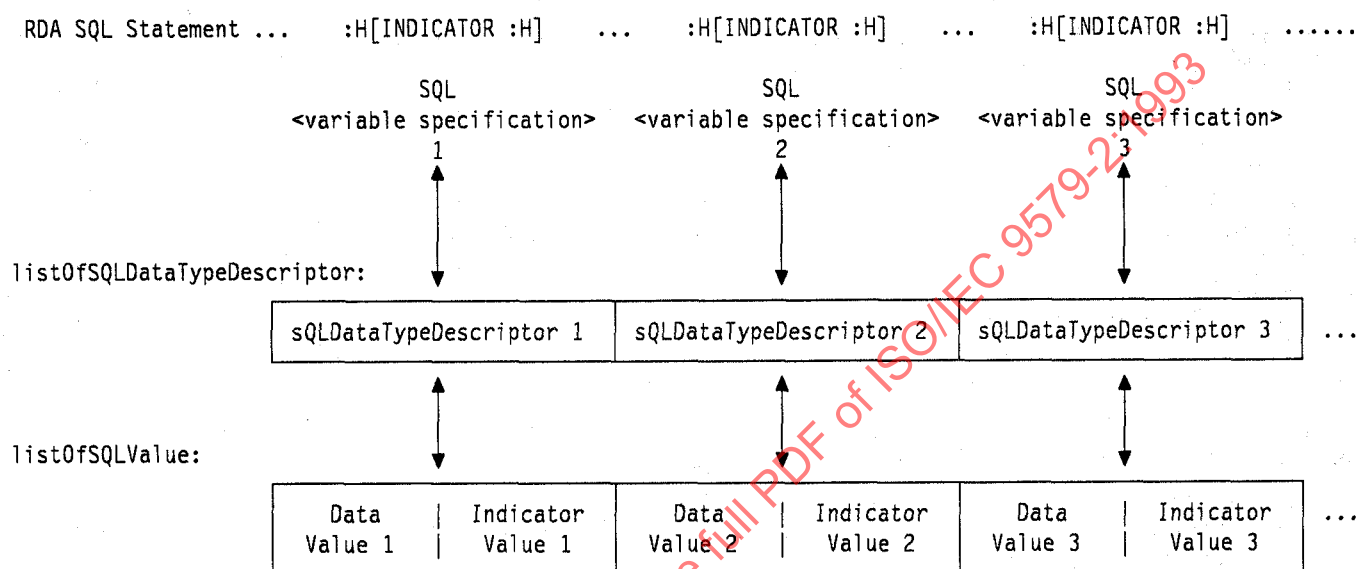


Figure 1 — Usage of Embedded SQL Variables

A **<variable specification>** contains either one **<embedded variable name>**, if no **<indicator variable>** is included, or two **<embedded variable name>**s, if an **<indicator variable>** is included. The first or only **<embedded variable name>** corresponds to the value of the Data Variable (**Data Value** in figure 1), the second corresponds to the value of the **<indicator variable>** (**Indicator Value** in figure 1).

If the **Data Value** is null, then it is omitted and the **Indicator Value** is included. If the **Indicator Value** is zero, then it is omitted and the **Data Value** is included.

There is a one-to-one correspondence between items in the `listOfSQLDataTypeDescriptor` and items in the `listOfSQLValue`. The `nth` item in the `listOfSQLDataTypeDescriptor` (the list of descriptors) corresponds to the `nth` item in the `listOfSQLValue` (the list of values). For each corresponding pair of items, the data type specified by the "...Type" subparameter of the `typeDescriptor` parameter corresponds with the data type specified by the "...Item" subparameter of the `dataItem` parameter; for example, `characterType` corresponds to `characterItem`, `numericType` corresponds to `numericItem`, etc.

3.2 Sequencing rules

3.2.1 RDA client sequencing rules

In addition to the sequencing rules defined in ISO/IEC 9579-1, the following sequencing rules apply:

- a) If the RDA client has successfully opened an SQL database resource, then the RDA client shall successfully close the SQL database resource before issuing another R-Open request on the RDA dialogue.
- b) If the RDA client requests the execution of an RDA SQL statement other than a <schema definition>, <table definition>, <view definition> or <grant statement>, then there shall be an RDA transaction open on the RDA dialogue.

3.2.2 RDA server sequencing rules

- There are no additional SQL specific sequencing rules for the RDA server.

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Section 4: Protocol

4.1 The RDA SQL Specialization server execution rules

This clause specifies entity attributes and server execution rules required by the Specialization which are in addition to those defined in ISO/IEC 9579-1.

4.1.1 RDA SQL Specialization dialogue-state model

The RDA SQL Specialization dialogue-state model is the RDA dialogue-state model defined in ISO/IEC 9579-1 with additional SQL Specialization attributes in the dialogue-state model entities. This clause of the RDA SQL Specialization defines the additional entity attributes.

4.1.1.1 RDA dialogue entity

In addition to the attributes defined in ISO/IEC 9579-1 this clause defines the following attributes for the RDA dialogue entity:

SQLConformanceLevelDefault:

An identifier, defined in ISO/IEC 9075:1992, used to identify the Database Language SQL International Standard for the DBL statements allowed to be used in the context of the RDA dialogue. This is the default SQL Conformance Level requested by the RDA client.

userData:

This attribute and any references to it from the server execution rules are defined by the implementor of the RDA server.

4.1.1.2 Opened data resource entity

In addition to the attributes defined in ISO/IEC 9579-1, this clause defines the following attributes for the opened data resource entity:

SQLConformanceLevel:

An identifier, defined in ISO/IEC 9075:1992, used to identify the Database Language SQL International Standard for the DBL statements allowed to be used in the context of the RDA dialogue. This is the SQL Conformance Level which will be valid for all RDA DBL operations for this open SQL database resource.

SQLUsageMode:

This attribute specifies the access mode to the SQL database resource.

retrieval: The SQL database resource can only be accessed for read-only purposes.

update: The SQL database resource can be accessed for update, insert and delete of objects within the SQL database resource.

clientDefCharSet:

This attribute specifies the default character set to be used by the RDA client for RDA SQL statements and for character data arguments that are associated with RDA SQL statements accessing the SQL database resource.

serverDefCharSet:

This attribute specifies the default character set to be used by the RDA server for character data results that are associated with RDA SQL statements accessing the SQL database resource.

4.1.1.3 Defined DBL entity

In addition to the attributes defined in ISO/IEC 9579-1, this clause defines the following attributes for the defined DBL entity:

sQLDBLArgumentSpecification:

The SQL data types of the arguments of the RDA SQL statement.

sQLDBLResultSpecification:

The SQL data types of the results of the RDA SQL statement.

sQLDBLStatement:

The RDA SQL statement defined.

4.1.1.4 RDA operation entity

There are no additional operation entity attributes required for the RDA SQL Specialization.

4.1.2 General server execution rules

There are no additional general server execution rules required for the RDA SQL Specialization.

4.1.3 RDA Dialogue Management services

4.1.3.1 RDA Dialogue Initialization functional unit

4.1.3.1.1 R-Initialize Service

Entity Manipulation Rules

The following defines the constraints on the initial values of the additional SQL Specialization attributes for the RDA dialogue entity:

Attribute	Initial Value
sQLConformanceLevelDefault	The sQLConformanceLevelDefault parameter value on the R-Initialize indication primitive if this parameter is provided. Otherwise, the initial value of the sQLConformanceLevelDefault attribute shall be set to "null."
userData	The userData parameter value on the R-Initialize indication primitive if this parameter is provided and it is supported by the RDA server. Otherwise, the initial value of the userData attribute shall be set to a value supported by the RDA server.

Result Rules

If a result is returned then the result parameters shall satisfy the following constraints:

Result Parameter	Constraints
userData	The value of the userData attribute in the RDA dialogue entity if it does not equal the value of the userData parameter in the R-Initialize indication. Otherwise, the userData parameter shall be omitted.

Error Rules

No additional error rules are required for the RDA SQL Specialization.

4.1.3.2 RDA Dialogue Termination functional unit

4.1.3.2.1 R-Terminate Service

No additional server execution rules are required for the RDA SQL Specialization.

4.1.4 RDA Transaction Management services

4.1.4.1 RDA Transaction Management functional unit

4.1.4.1.1 R-BeginTransaction Service

No additional server execution rules are required for the RDA SQL Specialization.

4.1.4.1.2 R-Commit Service

No additional server execution rules are required for the RDA SQL Specialization.

4.1.4.1.3 R-Rollback Service

No additional server execution rules are required for the RDA SQL Specialization.

4.1.5 RDA Control services

4.1.5.1 Cancel functional unit

4.1.5.1.1 R-Cancel Service

No additional server execution rules are required for the RDA SQL Specialization.

4.1.5.2 Status functional unit

4.1.5.2.1 R-Status Service

No additional server execution rules are required for the RDA SQL Specialization.

4.1.6 Resource Handling services

4.1.6.1 Resource Handling functional unit

4.1.6.1.1 R-Open Service

Entity Manipulation Rules

The following defines the constraints on the initial values of the additional SQL Specialization attributes for the opened data resource entity:

Attribute	Initial Value
sQLConformanceLevel	The sQLConformanceLevel parameter value on the R-Open indication primitive if this parameter is provided and it identifies an SQL level that is supported by the RDA server; else the sQLConformanceLevelDefault attribute value in the RDA Dialogue entity if it identifies an SQL level that is supported by the RDA server; otherwise, the initial value of the sQLConformanceLevel attribute shall be set to a value supported by the RDA server.
sQLUsageMode	The sQLUsageMode parameter value on the R-Open indication primitive if provided. Otherwise, this attribute contains the default value "retrieval."
clientDefCharSet	The charSet parameter value on the R-Open indication primitive. If the charSet parameter on the R-Open indication primitive is not provided, the initial value of the clientDefCharSet attribute shall be "null" (to indicate each descriptor for a character string and each RDA SQL statement sent by the RDA client shall include a character set identifier).
serverDefCharSet	If the RDA server can support for result parameters the character set identified by the value of the charSet parameter of the R-Open indication primitive, then that value; else if the RDA server decides to use some other character set that it supports as its default, then an object identifier identifying that character set; else "null" (to indicate that each descriptor for a character string returned by the RDA server shall include a character set identifier).

Result Rules

If a result is returned then the result parameters shall satisfy the following constraints:

Result Parameter	Constraints
sQLConformanceLevel	If the sQLConformanceLevel parameter was provided in the R-Open indication, the value of the sQLConformanceLevel attribute in the opened data resource entity if this value does not equal the value of the sQLConformanceLevel parameter in the R-Open indication; else, if the sQLConformanceLevel parameter was not provided in the R-Open indication, the value of the sQLConformanceLevel attribute in the opened data resource entity if this value does not equal the value of the sQLConformanceLevelDefault attribute in the RDA dialogue entity; otherwise, the sQLConformanceLevel parameter shall be omitted.
charSetNotSupported	"true" if the RDA server cannot support the character set identified by the charSet parameter in the R-Open indication primitive, otherwise "false."
charSet	If the serverDefCharSet attribute value of the opened data resource entity whose RDA dialogueID attribute identifies the current RDA dialogue and whose dataResourceHandle attribute equals the dataResourceHandle parameter of the R-Open indication primitive is not "null," then the value of the attribute. Otherwise, this parameter shall be omitted.

Error Rules

Error	Type	Predicate
invalidSQLConformanceLevel	M + P	The sQLConformanceLevel parameter value on the R-Open indication primitive, or if none was provided the sQLConformanceLevelDefault attribute value in the RDA dialogue entity, does not conform to one of the object identifier values specified in ISO/IEC 9075:1992 or if it does, it does not specify one of the following: • an <SQL edition> value of <1987> • an <SQL edition> value of <1989> • an <SQL edition> value of <1992> and an <SQL conformance> value of <low>
rDATransactionOpen	P	The rDATransactionStatus attribute of the RDA dialogue entity for the current RDA dialogue has the value of rDATransactionOpen.
sQLAccessControlViolation	M + P	The sQLAccessControlData parameter of the R-Open indication primitive, when used in conjunction with the identifyOfUser attribute of the RDA dialogue entity for the current RDA dialogue, fails to authorize the RDA client to open the SQL database resource specified by the dataResourceName parameter for the usage mode specified by the sQLUsageMode parameter.
sQLDatabaseResourceAlreadyOpen	M + P	There exists an opened data resource entity whose dialogueID attribute is that of the current RDA dialogue.

4.1.6.1.2 R-Close Service

Error Rules

Error	Type	Predicate
rDATransactionOpen	P	The rDATransactionStatus attribute of the RDA dialogue entity for the current RDA dialogue has the value of rDATransactionOpen.

4.1.7 Database Language services

4.1.7.1 Immediate Execution DBL functional unit

4.1.7.1.1 R-ExecuteDBL Service

The following rules shall be observed by the RDA server:

- An error shall be returned if no execution of the RDA SQL statement completes. Otherwise, the result shall be returned. The result includes one or more sQLDBLExceptions depending on the repetitionCount or the number of sQLDBLArgumentValues in the listOfsQLDBLArgumentValues.
- The effect of execution of RDA SQL statements by the database server is exactly the same as if they were embedded in a host program local to the SQL database resource. In addition, a <declare cursor> RDA SQL statement containing a <cursor name> must have been executed (via an R-ExecuteDBL operation) or invoked (via an R-InvokeDBL operation) at the RDA server prior to executing any <open statement> that uses the same <cursor name>.
- For each execution of the RDA SQL statement, an sQLDBLException returned by the SQL database resource shall be included in the result. The sQLDBLResultValues, if returned by the SQL database resource, shall also be included.

Entity Manipulation Rules

No additional entity manipulation rules are required for the RDA SQL Specialization.

Result Rules

If a result is returned then the result parameters shall satisfy the following constraints:

Result Parameter	Constraints
charSet	If the serverDefCharSet attribute of the opened data resource entity is "null," each character string in the sQLDBLResultValues parameter of the R-ExecuteDBL response primitives shall be accompanied by an object identifier in the charSet parameter in the corresponding item of listOfSQLDataTypeDescriptor.
sQLDBLException	If the RDA SQL statement contained in the sQLBLStatement parameter is not permitted by an implementation claiming conformance to ISO/IEC 9075 (Database Language SQL) at the level of conformance specified by the sQLConformanceLevel attribute of the opened data resource entity, an sQLDBLException may be returned. If the sQLConformanceLevel attribute of the opened data resource entity has an <SQL edition> value of <1987> or <1989>, an sQLDBLException shall contain an sQLCODE parameter, otherwise it shall contain an sQLSTATE parameter. Applicable sQLCODE values of the sQLCODE parameter are defined in conformance with ISO/IEC 9075:1989; applicable sQLSTATE values of the sQLSTATE parameter are defined in conformance with ISO/IEC 9075:1992.
colName	This parameter shall be specified within each item of listOfSQLDataTypeDescriptor that is part of an sQLDBLResultSpecification, otherwise it shall not be specified.

The following table defines R-ExecuteDBL use of SQL argument and result parameters.

Table 10 (Page 1 of 2). R-ExecuteDBL use of SQL argument and result parameters.				
RDA SQL statement to be Executed	ArgSpec	ArgVal	ResSpec	ResVal
<close statement>				
<commit statement> ¹				
<declare cursor>	C- > S (H) ⁶			
<delete statement: positioned>				

Table 10 (Page 2 of 2). R-ExecuteDBL use of SQL argument and result parameters.

RDA SQL statement to be Executed	ArgSpec	ArgVal	ResSpec	ResVal
< delete statement: searched >	C- > S (H)	C- > S (H)		
< fetch statement >			C- > S ²	C < -S
< insert statement >	C- > S (H)	C- > S (H)		
< open statement >	C- > S (H) ⁵	C- > S (H)	C < -S ³	
< rollback statement > ¹				
< select statement: single row >	C- > S (H)	C- > S (H)	C < - > S ⁴	C < -S
< update statement: positioned >	C- > S (H)	C- > S (H)		
< update statement: searched >	C- > S (H)	C- > S (H)		
< schema definition >				
< table definition >				
< view definition >				
< grant statement >				

LEGEND -

ArgSpec The sQLDBLArgumentSpecification parameter.

ArgVal The sQLDBLArgumentValues parameter.

ResSpec The sQLDBLResultSpecification parameter.

ResVal The sQLDBLResultValues parameter.

C- > S Parameter supplied by the RDA client.

C < -S Parameter returned by the RDA server.

(H) The RDA client must set this parameter if the RDA SQL statement contains host variables, except as noted below.

blank cells unspecified (i.e., not subject to conformance testing)

NOTES -

1. See the sQLDBLTransactionStatementNotAllowed error under the Error Rules below. The RDA client should use the transaction management services provided by RDA or TP depending on the application-context chosen.
2. The RDA client may optionally send the ResSpec, which will supercede the ResSpec sent on a previously executed (via an R-ExecuteDBL operation) or invoked (via an R-InvokeDBL operation) < fetch statement > using the same cursor or received from the RDA server on the corresponding < open statement > .
3. The ResSpec describes the ResVal that the subsequently executed (via an R-ExecuteDBL operation) or invoked (via an R-InvokeDBL operation) < fetch statement > using this cursor will return, but any ResSpec specified with such a < fetch statement > overrides this ResSpec.
4. The RDA client may optionally send the ResSpec, otherwise the RDA server shall return the ResSpec which describes the ResVal, if any.
5. The RDA client may optionally send the ArgSpec. If it is not specified, the RDA server shall use the ArgSpec sent on the previously executed (via an R-ExecuteDBL operation) or invoked (via an R-InvokeDBL operation) < declare cursor > statement that used the same cursor name.
6. The RDA client may optionally send the ArgSpec. If it is not specified, the RDA client shall send the ArgSpec on the subsequently executed (via an R-ExecuteDBL operation) or invoked (via an R-InvokeDBL operation) < open statement > that uses the same cursor name.

Error Rules

Error	Type	Predicate
hostIdentifierError	M + P	The < host identifier > of an < embedded variable name > of the RDA SQL statement is not "H".

Error	Type	Predicate
rDATransactionNotOpen	M + P	The RDA client requested the execution of an RDA SQL statement other than a < schema definition > , < table definition > , < view definition > or < grant statement > and the rDATransactionStatus attribute of the RDA dialogue entity for the current RDA dialogue has the value of rDATransactionNotOpen.
sQLDBLArgumentCountMismatch	M + P	The number of items in listOfSQLValue within the sQLDBLArgumentValues parameter is not the same as the number of items in listOfSQLDataTypeDescriptor within the sQLDBLArgumentSpecification parameter.
sQLDBLArgumentTypeMismatch	M + P	The type of one or more items in listOfSQLValue within the sQLDBLArgumentValues parameter is not the same as the corresponding item (or items) in listOfSQLDataTypeDescriptor within the sQLDBLArgumentSpecification parameter.
sQLDBLNoCharSet	M + P	The sQLDBLArgumentSpecification or the sQLDBLResultSpecification contains a descriptor for character data without the explicit specification of its character set or the sQLDBLStatement contains no explicit specification of its character set, and the charSet attribute of the opened data resource entity identified by the dataResourceHandle parameter is "null."
sQLDBLTransactionStatementNotAllowed	M + P	The RDA client requested the execution of an RDA SQL statement which performs transaction management (e.g. SQL < commit statement > or SQL < rollback statement >).
sQLUsageModeViolation	M + P	The sQLUsageMode attribute of the opened data resource entity identified by the dataResourceHandle parameter has a value of "retrieval" and the RDA SQL statement will modify one or more objects within the SQL database resource.

4.1.7.2 Stored Execution DBL functional unit

4.1.7.2.1 R-Defined DBL Service

Entity Manipulation Rules

The following defines the constraints on the initial values of the additional SQL Specialization attributes for the defined DBL entity.

Attribute	Initial Value
sQLDBLStatement	The sQLDBLStatement parameter value in the R-DefineDBL indication primitive.
sQLDBLArgumentSpecification	The sQLDBLArgumentSpecification parameter value on the R-DefineDBL indication primitive.
sQLDBLResultSpecification	The sQLDBLResultSpecification parameter value on the R-DefineDBL indication primitive.

Result Rules

If a result is returned then the result parameters shall satisfy the following constraints:

Result Parameter	Constraints
sQLDBLException	If the RDA SQL statement contained in the sQLBLStatement parameter is not permitted by an implementation claiming conformance to ISO/IEC 9075 (Database Language SQL) at the level of conformance specified by the sQLConformanceLevel attribute of the opened data resource entity, an sQLDBLException may be returned. If the sQLConformanceLevel attribute of the opened data resource entity has an <SQL edition> value of <1987> or <1989>, an sQLDBLException shall contain an sQLCODE parameter, otherwise it shall contain an sQLSTATE parameter. Applicable sQLCODE values of the sQLCODE parameter are defined in conformance with ISO/IEC 9075:1989; applicable sQLSTATE values of the sQLSTATE parameter are defined in conformance with ISO/IEC 9075:1992.

The following table defines R-DefineDBL use of SQL argument and result parameters.

Table 11 (Page 1 of 2). R-DefineDBL use of SQL argument and result parameters.		
RDA SQL statement to be Defined	ArgSpec	ResSpec
< close statement >		
< commit statement > ¹		
< declare cursor >	C->S (H) ⁴	
< delete statement: positioned >		
< delete statement: searched >	C->S (H)	
< fetch statement >		C->S ²
< insert statement >	C->S (H)	
< open statement >	C->S (H) ³	
< rollback statement > ¹		
< select statement: single row >	C->S (H)	C->S ²
< update statement: positioned >	C->S (H)	
< update statement: searched >	C->S (H)	
< schema definition >		
< table definition >		
< view definition >		
< grant statement >		
LEGEND ArgSpec The sQLDBLArgumentSpecification parameter. ResSpec The sQLDBLResultSpecification parameter. C->S Parameter supplied by the RDA client. C<-S Parameter returned by the RDA server. (H) The RDA client must set this parameter if the RDA SQL statement contains host variables, except as noted below. blank cells unspecified (i.e., not subject to conformance testing)		

Table 11 (Page 2 of 2). R-DefinedDBL use of SQL argument and result parameters.

RDA SQL statement to be Defined	ArgSpec	ResSpec
NOTES –		
1. See the sQLDBLTransactionStatementNotAllowed error under the error rules below. The RDA client should use the transaction management services provided by RDA or TP depending on the application-context chosen. 2. The RDA client may optionally send the ResSpec to be used when the RDA SQL statement is subsequently invoked (via an R-InvokeDBL operation). 3. The RDA client may optionally send the ArgSpec. If it is not specified, the RDA server shall use the ArgSpec sent on the previously executed (via an R-ExecuteDBL operation) or invoked (via an R-InvokeDBL operation) <declare cursor> statement that used the same cursor name. 4. The RDA client may optionally send the ArgSpec. If it is not specified, the RDA client shall send the ArgSpec on the subsequently executed (via an R-ExecuteDBL operation) or invoked (via an R-InvokeDBL operation) <open statement> that uses the same cursor name.		

Error Rules

Error	Type	Predicate
hostIdentifierError	M + P	The <host identifier> of an <embedded variable name> of the RDA SQL statement is not "H".
sQLDBLNoCharSet	M + P	The sQLDBLArgumentSpecification or the sQLDBLResultSpecification contains a descriptor for character data without the explicit specification of its character set or the sQLDBLStatement contains no explicit specification of its character set, and the charSet attribute of the opened data resource entity identified by the dataResourceHandle parameter is "null."
sQLDBLTransactionStatementNotAllowed	M + P	The RDA client requested the execution of an RDA SQL statement which performs transaction management (e.g. SQL <commit statement> or SQL <rollback statement>).
sQLUsageModeViolation	M + P	The sQLUsageMode attribute of the opened data resource entity identified by the dataResourceHandle parameter has a value of "retrieval" and the RDA SQL statement will modify one or more objects within the SQL database resource.

4.1.7.2.2 R-InvokeDBL Service

The following rules shall be observed by the RDA server:

- Execution of the operation uses the sQLDBLStatement, sQLDBLArgumentSpecification and sQLDBLResultSpecification attributes of the defined DBL entity identified by the commandHandle parameter.
- An error shall be returned if no execution of the RDA SQL statement completes. Otherwise, the result shall be returned. The result includes one or more sQLDBLExceptions depending on the repetitionCount or the number of sQLDBLArgumentValues in the listOfsQLDBLArgumentValues.
- The effect of execution of RDA SQL statements by the database server is exactly the same as if they were embedded in a host program local to the SQL database resource. In addition, a <declare cursor> RDA SQL statement containing a <cursor name> must have been executed (via an R-ExecuteDBL operation) or

invoked (via an R-InvokeDBL operation) at the RDA server prior to invoking any <open statement> that uses the same <cursor name>.

- For each execution of the RDA SQL statement, an sQLDBLException returned by the SQL database resource shall be included in the result. The sQLDBLResultValues, if returned by the SQL database resource, shall also be included.

Entity Manipulation Rules

No additional entity manipulation rules are required for the RDA SQL Specialization.

Result Rules

If a result is returned then the result parameters shall satisfy the following constraints:

Result Parameter	Constraints
charSet	If the serverDefCharSet attribute is "null," each character string in the sQLDBLResultValues parameter of the R-InvokeDBL response primitives shall be accompanied by an object identifier in the charSet parameter in the corresponding item of listOfSQLDataTypeDescriptor.
sQLDBLException	If the RDA SQL statement contained in the sQLBLStatement attribute of the defined DBL entity is not permitted by an implementation claiming conformance to ISO/IEC 9075 (Database Language SQL) at the level of conformance specified by the sQLConformanceLevel attribute of the opened data resource entity, an sQLDBLException may be returned. If the sQLConformanceLevel attribute of the RDA opened data resource entity has an <SQL edition> value of <1987> or <1989>, an sQLDBLException shall contain an sQLCODE parameter, otherwise it shall contain an sQLSTATE parameter. Applicable sQLCODE values of the sQLCODE parameter are defined in conformance with ISO/IEC 9075:1989; applicable sQLSTATE values of the sQLSTATE parameter are defined in conformance with ISO/IEC 9075:1992.
colName	This parameter shall be specified within each item of listOfSQLDataTypeDescriptor that is part of an sQLDBLResultSpecification, otherwise it shall not be specified.

The following table defines R-InvokeDBL use of SQL argument and result parameters.

Table 12 (Page 1 of 2). R-InvokeDBL use of SQL argument and result parameters.			
RDA SQL statement to be Invoked	ArgVal	ResSpec	ResVal
<close statement>			
<commit statement>			
<declare cursor>			
<delete statement: positioned>			
<delete statement: searched>	C->S (H)		
<fetch statement>		1	C<-S
<insert statement>	C->S (H)		
<open statement>	C->S (H)	C<-S ²	
<rollback statement>			
<select statement: single row>	C->S (H)	C<-S ³	C<-S
<update statement: positioned>	C->S (H)		

Table 12 (Page 2 of 2). R-InvokeDBL use of SQL argument and result parameters.

RDA SQL statement to be Invoked	ArgVal	ResSpec	ResVal
< update statement: searched >	C -> S (H)		
< schema definition >			
< table definition >			
< view definition >			
< grant statement >			
LEGEND - ArgVal The sQLDBLArgumentValues parameter. ResSpec The sQLDBLResultSpecification parameter. ResVal The sQLDBLResultValues parameter. C -> S Parameter supplied by the RDA client. C <- S Parameter returned by the RDA server. (H) The RDA client must set this parameter if the RDA SQL statement contains host variables. blank cells unspecified (i.e., not subject to conformance testing)			
NOTES - 1. The RDA server does not return any ResSpec, but uses the sQLDBLResultSpecification attribute of the defined DBL entity identified by the commandHandle parameter. If that attribute is "null," then the ResSpec returned on the execution (via an R-ExecuteDBL operation) or invocation (via an R-InvokeDBL operation) of the corresponding < open statement > is used. 2. The ResSpec describes the ResVal that the subsequently executed (via an R-ExecuteDBL operation) or invoked (via an R-InvokeDBL operation) < fetch statement > using this cursor will return, but any ResSpec specified with such a < fetch statement > overrides this ResSpec. 3. If the sQLDBLResultSpecification attribute of the defined DBL entity identified by the commandHandle parameter is "null," then the RDA server shall return the ResSpec which describes the ResVal, if any.			

Error Rules

Error	Type	Predicate
rDATransactionNotOpen	M + P	The RDA client requested the execution of an RDA SQL statement other than a < schema definition >, < table definition >, < view definition > or < grant statement > and the rDATransactionStatus attribute of the RDA dialogue entity for the current RDA dialogue has the value of rDATransactionNotOpen.
sQLDBLArgumentCountMismatch	M + P	The number of items in listOfSQLValue within the sQLDBLArgumentValues parameter is not the same as the number of items in listOfSQLDataTypeDescriptor within the sQLDBLArgumentSpecification attribute of the defined DBL entity identified by the commandHandle parameter.
sQLDBLArgumentTypeMismatch	M + P	The type of one or more items in listOfSQLValue within the sQLDBLArgumentValues parameter is not the same as the corresponding item (or items) in listOfSQLDataTypeDescriptor within the sQLDBLArgumentSpecification attribute of the defined DBL entity identified by the commandHandle parameter.

Error	Type	Predicate
sQLUsageModeViolation	M + P	The sQLUsageMode attribute of the opened data resource entity identified by the dataResourceHandle parameter has a value of "retrieval" and the RDA SQL statement will modify one or more objects within the SQL database resource.

4.1.7.2.3 R-DropDBL Service

No additional server execution rules are required for the RDA SQL Specialization.

4.2 Structure and encoding of RDA SQL APDUs

The RDA SQL data types are defined in this clause using the ASN.1 notation specified in ISO/IEC 8824:1990. The set of these RDA SQL APDUs defines the abstract syntax of the RDA SQL Presentation context. The transfer syntax for these RDA SQL APDUs is defined in the presentation context for the particular presentation connection.

4.2.1 Abstract Syntax Name

This part of ISO/IEC 9579 assigns the ASN.1 object identifier value

{ iso standard rda (9579) part-2 (2) abstract-syntax (1) version-1 (1) }

as an abstract syntax name for the set of presentation data values, each of which is a value of the ASN.1 type ISO9579-RDASQL.RDA-APDU. The corresponding ASN.1 object descriptor value shall be

"RDA-SQL-ABSTRACT-SYNTAX-V1"

The ASN.1 object identifier and object descriptor values

{ joint-iso-ccitt asn1 (1) basic-encoding (1) }

and

"Basic Encoding of a single ASN.1 type"

(assigned to an information object in ISO/IEC 8825:1990) can be used as a transfer syntax name with this abstract syntax name.

4.2.2 ASN.1 Module for RDA SQL Specialization ASE

The following represents the ASN.1 Module for the RDA SQL Specialization ASE and spans a number of pages.

RDA SQL Specialization ASE ASN.1 Module:

```
IS09579-RDASQL { iso standard rda (9579) part-2 (2) module (0) version-1 (1) }
```

```
--
-- *****
--
```

```
DEFINITIONS IMPLICIT TAGS ::= BEGIN
```

```
--
-- *****
--
```

```
IMPORTS
```

```
--
-- AP-title,
-- AE-qualifier,
-- AP-invocation-identifier,
-- AE-invocation-identifier
-- FROM ACSE-1 { joint-iso-ccitt standard acse (8650) }
```

```
--
-- ;
-- *****
--
```

```
-- RDA SQL APDU's
```

```
--
--
-- top level APDU CHOICE
```

```
RDA-APDU
```

```
::= CHOICE
```

{ r-Initialize-RI	[0] R-Initialize-RI,
r-Initialize-RC	[1] R-Initialize-RC,
r-Synchronize-RI	[2] R-Synchronize-RI,
r-Terminate-RI	[3] R-Terminate-RI,
r-Terminate-RC	[4] R-Terminate-RC,
r-BEGINTransaction-RI	[5] R-BEGINTransaction-RI,
r-BEGINTransaction-RC	[6] R-BEGINTransaction-RC,
r-Commit-RI	[7] R-Commit-RI,
r-Commit-RC	[8] R-Commit-RC,
r-Rollback-RI	[9] R-Rollback-RI,
r-Rollback-RC	[10] R-Rollback-RC,
r-Cancel-RI	[11] R-Cancel-RI,
r-Cancel-RC	[12] R-Cancel-RC,
r-Status-RI	[13] R-Status-RI,
r-Status-RC	[14] R-Status-RC,
r-Open-RI	[15] R-Open-RI,
r-Open-RC	[16] R-Open-RC,
r-Close-RI	[17] R-Close-RI,
r-Close-RC	[18] R-Close-RC,

r-ExecuteDBL-RI	[19] R-ExecuteDBL-RI,
r-ExecuteDBL-RC	[20] R-ExecuteDBL-RC,
r-DefineDBL-RI	[21] R-DefineDBL-RI,
r-DefineDBL-RC	[22] R-DefineDBL-RC,
r-InvokeDBL-RI	[23] R-InvokeDBL-RI,
r-InvokeDBL-RC	[24] R-InvokeDBL-RC,
r-DropDBL-RI	[25] R-DropDBL-RI,
r-DropDBL-RC	[26] R-DropDBL-RC

}

-- individual APDU definitions.

R-Initialize-RI	::= SEQUENCE
{ operationID	OperationID,
r-Initialize-req	[0] R-Initialize-Request
}	

R-Initialize-RC	::= SEQUENCE
{ operationID	OperationID,
res-or-err	CHOICE
{ r-Initialize-res	[0] R-Initialize-Result,
r-Initialize-err	[1] R-Initialize-Error
}	
}	

R-Synchronize-RI	::= SEQUENCE
{	
}	

R-Terminate-RI	::= SEQUENCE
{ operationID	OperationID,
r-Terminate-req	[0] R-Terminate-Request
}	

R-Terminate-RC	::= SEQUENCE
{ operationID	OperationID,
res-or-err	CHOICE
{ r-Terminate-res	[0] R-Terminate-Result,
r-Terminate-err	[1] R-Terminate-Error
}	
}	

R-BeginTransaction-RI	::= SEQUENCE
{ operationID	OperationID,
r-BeginTransaction-req	[0] NULL
}	

R-BeginTransaction-RC	::= SEQUENCE
{ operationID	OperationID,
r-BeginTransaction-err	[0] R-BeginTransaction-Error
}	

R-Commit-RI ::= SEQUENCE
 { operationID
 r-Commit-req
 }
 OperationID,
 [0] NULL

R-Commit-RC ::= SEQUENCE
 { operationID
 res-or-err
 { r-Commit-res
 r-Commit-err
 }
 }
 OperationID,
 CHOICE
 [0] R-Commit-Result,
 [1] R-Commit-Error

R-Rollback-RI ::= SEQUENCE
 { operationID
 r-Rollback-req
 }
 OperationID,
 [0] NULL

R-Rollback-RC ::= SEQUENCE
 { operationID
 res-or-err
 { r-Rollback-res
 r-Rollback-err
 }
 }
 OperationID,
 CHOICE
 [0] NULL,
 [1] R-Rollback-Error

R-Cancel-RI ::= SEQUENCE
 { operationID
 r-Cancel-req
 }
 OperationID,
 [0] R-Cancel-Request

R-Cancel-RC ::= SEQUENCE
 { operationID
 res-or-err
 { r-Cancel-res
 r-Cancel-err
 }
 }
 OperationID,
 CHOICE
 [0] R-Cancel-Result,
 [1] R-Cancel-Error

R-Status-RI ::= SEQUENCE
 { operationID
 r-Status-req
 }
 OperationID,
 [0] R-Status-Request

R-Status-RC ::= SEQUENCE
 { operationID
 res-or-err
 { r-Status-res
 r-Status-err
 }
 }
 OperationID,
 CHOICE
 [0] R-Status-Result,
 [1] R-Status-Error

R-Open-RI ::= SEQUENCE
 { operationID
 r-Open-req
 }

R-Open-RC ::= SEQUENCE
 { operationID
 res-or-err
 { r-Open-res
 r-Open-err
 }
 }

R-Close-RI ::= SEQUENCE
 { operationID
 r-Close-req
 }

R-Close-RC ::= SEQUENCE
 { operationID
 res-or-err
 { r-Close-res
 r-Close-err
 }
 }

R-ExecutedBL-RI ::= SEQUENCE
 { operationID
 r-ExecutedBL-req
 }

R-ExecutedBL-RC ::= SEQUENCE
 { operationID
 res-or-err
 { r-ExecutedBL-res
 r-ExecutedBL-err
 }
 }

R-DefineDBL-RI ::= SEQUENCE
 { operationID
 r-DefineDBL-req
 }

R-DefineDBL-RC ::= SEQUENCE
 { operationID
 res-or-err
 { r-DefineDBL-res
 r-DefineDBL-err
 }
 }

```

R-InvokeDBL-RI ::= SEQUENCE
{
    operationID      OperationID,
    r-InvokeDBL-req  [0] R-InvokeDBL-Request
}

R-InvokeDBL-RC ::= SEQUENCE
{
    operationID      OperationID,
    res-or-err       CHOICE
    {
        r-InvokeDBL-res  [0] R-InvokeDBL-Result,
        r-InvokeDBL-err  [1] R-InvokeDBL-Error
    }
}

R-DropDBL-RI ::= SEQUENCE
{
    operationID      OperationID,
    r-DropDBL-req    [0] R-DropDBL-Request
}

R-DropDBL-RC ::= SEQUENCE
{
    operationID      OperationID,
    res-or-err       CHOICE
    {
        r-DropDBL-res    [0] R-DropDBL-Result,
        r-DropDBL-err    [1] R-DropDBL-Error
    }
}

-- *****

R-Initialize-Request ::= SEQUENCE
{
    dialogueIDSuffix      [0] DialogueIDSuffix,
    identityOfUser        [1] VisibleString,
    userAuthenticationData [2] AuthenticationData OPTIONAL,
    controlServiceDataRequested [3] BOOLEAN DEFAULT FALSE,
    functionalUnitsRequested [4] FunctionalUnits,
    SQLInitializeArgument  [30] SQLInitializeArgument OPTIONAL
}

R-Initialize-Result ::= SEQUENCE
{
    controlServiceData [0] SEQUENCE
    {
        controlServicesAllowed [0] BOOLEAN DEFAULT TRUE,
        controlAuthenticationData [1] AuthenticationData OPTIONAL
    } OPTIONAL,
    functionalUnitsAllowed [1] FunctionalUnits,
    SQLInitializeResult    [30] SQLInitializeResult OPTIONAL
}

R-Initialize-Error ::= CHOICE
{
    accessControlViolation      AccessControlViolation,
    duplicateDialogueID        DuplicateDialogueID,
    invalidSequence            InvalidSequence,
    operationAborted           OperationAborted,
    userAuthenticationFailure  UserAuthenticationFailure
}

```

```

    }

-- *****

R-Terminate-Request      ::= NULL

R-Terminate-Result      ::= NULL

R-Terminate-Error       ::= CHOICE
{ duplicateOperationID   DuplicateOperationID,
  invalidSequence        InvalidSequence,
  operationAborted       OperationAborted,
  serviceNotNegotiated   ServiceNotNegotiated
}

-- *****

R-BeginTransaction-Error ::= CHOICE
{ duplicateOperationID   DuplicateOperationID,
  invalidSequence        InvalidSequence,
  operationAborted       OperationAborted,
  serviceNotNegotiated   ServiceNotNegotiated
}

-- *****

R-Commit-Result          ::= SEQUENCE
{ transactionResult      [0] ENUMERATED
  { committed            (0),
    rolledBack           (1)
  }
}

R-Commit-Error           ::= CHOICE
{ duplicateOperationID   DuplicateOperationID,
  invalidSequence        InvalidSequence
}

-- *****

R-Rollback-Error         ::= CHOICE
{ duplicateOperationID   DuplicateOperationID,
  invalidSequence        InvalidSequence
}

-- *****

R-Cancel-Request         ::= SEQUENCE
{ controlledDialogue     [0] SEQUENCE
  { dialogueIDClientInvocation [0] DialogueIDClientInvocation OPTIONAL,
    dialogueIDSuffix          [1] DialogueIDSuffix,
    controlAuthenticationData. [2] AuthenticationData
  }
}

```

```

    }
    listOfOperationID
  }
  OPTIONAL,
  [1] SEQUENCE OF OperationID OPTIONAL

R-Cancel-Result ::= NULL

R-Cancel-Error ::= CHOICE
{
  controlAuthenticationFailure ControlAuthenticationFailure,
  controlServicesNotAllowed ControlServicesNotAllowed,
  dialogueIDUnknown DialogueIDUnknown,
  duplicateOperationID DuplicateOperationID,
  invalidSequence InvalidSequence,
  operationAborted OperationAborted,
  serviceNotNegotiated ServiceNotNegotiated
}

-- *****

R-Status-Request ::= SEQUENCE
{
  controlledDialogue [0] SEQUENCE
  {
    dialogueIDClientInvocation [0] DialogueIDClientInvocation OPTIONAL,
    dialogueIDSuffix [1] DialogueIDSuffix,
    controlAuthenticationData [2] AuthenticationData
  }
  OPTIONAL,
  listOfOperationID [1] SEQUENCE OF OperationID OPTIONAL
}

R-Status-Result ::= SEQUENCE
{
  listOfStatusInformation [0] SEQUENCE OF StatusInformation OPTIONAL
}

R-Status-Error ::= CHOICE
{
  controlAuthenticationFailure ControlAuthenticationFailure,
  controlServicesNotAllowed ControlServicesNotAllowed,
  dialogueIDUnknown DialogueIDUnknown,
  duplicateOperationID DuplicateOperationID,
  invalidSequence InvalidSequence,
  operationAborted OperationAborted,
  serviceNotNegotiated ServiceNotNegotiated
}

-- *****

R-Open-Request ::= SEQUENCE
{
  dataResourceHandle [0] DataResourceHandle,
  dataResourceName [2] VisibleString OPTIONAL,
  sqlAccessControlData [3] AccessControlData OPTIONAL,
  sqlUsageMode [4] SQLUsageMode DEFAULT retrieval,
  sqlOpenArgument [30] SQLOpenArgument OPTIONAL
}

R-Open-Result ::= SEQUENCE

```

```

{ sQLOpenResult                                [30] sQLOpenResult OPTIONAL
}

R-Open-Error ::= CHOICE
{
  dataResourceAlreadyOpen      DataResourceAlreadyOpen,
  dataResourceNameNotSpecified DataResourceNameNotSpecified,
  dataResourceNotAvailable     DataResourceNotAvailable,
  dataResourceUnknown          DataResourceUnknown,
  duplicateDataResourceHandle  DuplicateDataResourceHandle,
  duplicateOperationID         DuplicateOperationID,
  invalidSequence              InvalidSequence,
  operationAborted             OperationAborted,
  operationCancelled           OperationCancelled,
  serviceNotNegotiated         ServiceNotNegotiated,
  sQLOpenError                 sQLOpenError
}

-- *****

R-Close-Request ::= SEQUENCE
{
  listOfDataResourceHandle [0] SEQUENCE OF DataResourceHandle OPTIONAL
}

R-Close-Result ::= SEQUENCE
{
  listOfCloseExceptions [0] SEQUENCE OF CloseException OPTIONAL
}

R-Close-Error ::= CHOICE
{
  duplicateOperationID      DuplicateOperationID,
  invalidSequence           InvalidSequence,
  operationAborted          OperationAborted,
  operationCancelled        OperationCancelled,
  serviceNotNegotiated      ServiceNotNegotiated,
  sQLCloseError             sQLCloseError
}

-- *****

R-ExecutedDBL-Request ::= SEQUENCE
{
  dataResourceHandle [0] DataResourceHandle OPTIONAL,
  sQLDBLStatement    [1] sQLDBLStatement,
  sQLDBLArgumentSpecification [2] sQLDBLArgumentSpecification OPTIONAL,
  sQLDBLResultSpecification [3] sQLDBLResultSpecification OPTIONAL,
  dBLArguments          CHOICE
  {
    singleArgument [4] SEQUENCE
    {
      repetitionCount [0] INTEGER DEFAULT 1,
      sQLDBLArgumentValues [1] sQLDBLArgumentValues OPTIONAL
    },
    multipleArgument [5] SEQUENCE
    {
      listOfsQLDBLArgumentValues [0] SEQUENCE OF sQLDBLArgumentValues
    }
  }
} OPTIONAL

```

}

```

R-ExecutedDBL-Result ::= SEQUENCE
{
  SQLDBLResultSpecification [1] SQLDBLResultSpecification OPTIONAL,
  listOfResultValues [2] SEQUENCE OF ResultValues OPTIONAL
}

```

```

R-ExecutedDBL-Error ::= CHOICE
{
  badRepetitionCount BadRepetitionCount,
  dataResourceHandleNotSpecified DataResourceHandleNotSpecified,
  dataResourceHandleUnknown DataResourceHandleUnknown,
  duplicateOperationID DuplicateOperationID,
  invalidSequence InvalidSequence,
  noDataResourceAvailable NoDataResourceAvailable,
  operationAborted OperationAborted,
  operationCancelled OperationCancelled,
  serviceNotNegotiated ServiceNotNegotiated,
  transactionRolledBack TransactionRolledBack,
  SQLExecuteDBLError SQLExecuteDBLError
}

```

-- *****

```

R-DefinedDBL-Request ::= SEQUENCE
{
  commandHandle [0] CommandHandle,
  dataResourceHandle [1] DataResourceHandle OPTIONAL,
  SQLDBLStatement [2] SQLDBLStatement,
  SQLDBLArgumentSpecification [3] SQLDBLArgumentSpecification OPTIONAL,
  SQLDBLResultSpecification [4] SQLDBLResultSpecification OPTIONAL
}

```

```

R-DefinedDBL-Result ::= SEQUENCE
{
  SQLDBLResultSpecification [0] SQLDBLResultSpecification OPTIONAL,
  SQLDBLException [1] SQLDBLException OPTIONAL
}

```

```

R-DefinedDBL-Error ::= CHOICE
{
  dataResourceHandleNotSpecified DataResourceHandleNotSpecified,
  dataResourceHandleUnknown DataResourceHandleUnknown,
  duplicateCommandHandle DuplicateCommandHandle,
  duplicateOperationID DuplicateOperationID,
  invalidSequence InvalidSequence,
  noDataResourceAvailable NoDataResourceAvailable,
  operationAborted OperationAborted,
  operationCancelled OperationCancelled,
  serviceNotNegotiated ServiceNotNegotiated,
  SQLDefinedDBLError SQLDefinedDBLError
}

```

-- *****

```

R-InvokeDBL-Request ::= SEQUENCE

```

```

{ commandHandle          [0] CommandHandle,
  dBLArguments
  { singleArgument
    { repetitionCount
      { SQLDBLArgumentValues
        [0] INTEGER DEFAULT 1,
        [1] SQLDBLArgumentValues OPTIONAL
      },
      multipleArgument
      { listOfSQLDBLArgumentValues
        [2] SEQUENCE
        [0] SEQUENCE OF SQLDBLArgumentValues
      }
    }
  }
}
OPTIONAL

```

```

R-InvokeDBL-Result ::= SEQUENCE
{ SQLDBLResultSpecification [0] SQLDBLResultSpecification OPTIONAL,
  listOfResultValues [2] SEQUENCE OF ResultValues OPTIONAL
}

```

```

R-InvokeDBL-Error ::= CHOICE
{ badRepetitionCount      BadRepetitionCount,
  commandHandleUnknown    CommandHandleUnknown,
  duplicateOperationID     DuplicateOperationID,
  invalidSequence         InvalidSequence,
  operationAborted         OperationAborted,
  operationCancelled       OperationCancelled,
  serviceNotNegotiated     ServiceNotNegotiated,
  transactionRolledBack    TransactionRolledBack,
  SQLInvokeDBLError       SQLInvokeDBLError
}

```

-- *****

```

R-DropDBL-Request ::= SEQUENCE
{ listOfCommandHandle [0] SEQUENCE OF CommandHandle OPTIONAL
}

```

```

R-DropDBL-Result ::= SEQUENCE
{ listOfDropDBLExceptions [0] SEQUENCE OF DropDBLException OPTIONAL
}

```

```

R-DropDBL-Error ::= CHOICE
{ duplicateOperationID     DuplicateOperationID,
  invalidSequence         InvalidSequence,
  operationAborted         OperationAborted,
  operationCancelled       OperationCancelled,
  serviceNotNegotiated     ServiceNotNegotiated
}

```

-- *****

--

-- Definitions of common types, ordered alphabetically

--

AuthenticationData ::= CHOICE
 { cstring [0] IA5String,
 ostring [1] OCTET STRING,
 bstring [2] BIT STRING
 }

CloseException ::= SEQUENCE
 { dataResourceHandle [0] DataResourceHandle,
 closeException CHOICE
 { dataResourceHandleUnknown [1] NULL
 }
 }

CommandHandle ::= INTEGER

DataResourceHandle ::= INTEGER

DialogueIDClientInvocation ::= SEQUENCE
 { apTitle [0] AP-title,
 aeQualifier [1] AE-qualifier,
 apInvocationID [2] AP-invocation-identifier,
 aeInvocationID [3] AE-invocation-identifier
 }

DialogueIDSuffix ::= CHOICE
 { ostring [0] OCTET STRING
 }

DropDBLException ::= SEQUENCE
 { commandHandle [0] CommandHandle,
 dropDBLException CHOICE
 { commandHandleUnknown [1] NULL
 }
 }

FunctionalUnits ::= BIT STRING
 { termination (0),
 transaction (1),
 cancel (2),
 status (3),
 resource (4),
 immediate-DBL (5),
 stored-DBL (6)
 }

OperationID ::= INTEGER

ResultValues ::= SEQUENCE
 { SQLDBLException [0] SQLDBLException,
 SQLDBLResultValues [1] SQLDBLResultValues OPTIONAL
 }

```

StatusInformation ::= SEQUENCE
{
  operationID          [0] OperationID,
  operationStatus      CHOICE
  {
    operationIDUnknown [1] NULL,
    awaitingExecution   [2] NULL,
    executing           [3] NULL,
    finished            [4] NULL,
    cancelled           [5] NULL,
    aborted             [6] VisibleString
  }
}

```

```
-- *****
```

```
--
```

```
-- Definitions of generic ASN.1 errors
```

```
--
```

```

AccessControlViolation ::= [APPLICATION 0] NULL
BadRepetitionCount      ::= [APPLICATION 1] NULL
CommandHandleUnknown    ::= [APPLICATION 2] NULL
ControlAuthenticationFailure ::= [APPLICATION 3] NULL
ControlServicesNotAllowed ::= [APPLICATION 4] NULL
DataResourceAlreadyOpen ::= [APPLICATION 5] SEQUENCE
{
  dataResourceHandle [0] DataResourceHandle
}
DataResourceHandleNotSpecified ::= [APPLICATION 6] NULL
DataResourceHandleUnknown      ::= [APPLICATION 7] NULL
DataResourceNameNotSpecified   ::= [APPLICATION 8] NULL
DataResourceNotAvailable       ::= [APPLICATION 9] ErrorDiagnostic
DataResourceUnknown            ::= [APPLICATION 10] NULL
DialogueIDUnknown              ::= [APPLICATION 11] NULL
DuplicateCommandHandle         ::= [APPLICATION 12] NULL
DuplicateDataResourceHandle    ::= [APPLICATION 13] NULL
DuplicateDialogueID            ::= [APPLICATION 14] NULL
DuplicateOperationID           ::= [APPLICATION 15] NULL
InvalidSequence                ::= [APPLICATION 16] SEQUENCE

```