IBM

eserver

iSeries

DB2 Universal Database for AS/400 XML Extender Administration and Programming

Version 7

SC27-1172-00

iSeries

DB2 Universal Database for AS/400 XML Extender Administration and Programming

Version 7

SC27-1172-00

Note

Before using this information and the product it supports, please read the general information under "Appendix E. Notices" on page 249.

First Edition (May 2001)

This edition applies to Version 7 Release 1 of IBM DB2 Database Extenders for AS/400 Version 5 Release 1, 5722-DE1, and to all subsequent releases and modifications until otherwise indicated in new editions. This edition applies only to reduced instruction set computer (RISC) systems.

Contents

Tables

About XML Extender Administration and Programming (SC27-1172)

This section describes the following information:

Who should use this book

This book is intended for the following people:

- Those who work with XML data in DB2 applications and who are familiar with XML concepts. Readers of this document should have a general understanding of XML and DB2. To learn more about XML, refer to the following Web site:

  http://www.w3.org/XML

  To learn more about DB2, see the following Web site:

  http://www.ibm.com/software/data/db2/library
- DB2 database administrators who are familiar with DB2 administration concepts, tools, and techniques.
- DB2 application programmers who are familiar with SQL and with one or more programming languages that can be used for DB2 applications.

How to get a current version of this book

You can get the latest version of this book at the XML Extender Web site:

http://www.ibm.com/software/data/db2/extenders/xmlext/library.html

How to use this book

This book is structured as follows:

Part 1. Introduction
This part provides an overview of the XML Extender and how you can use it in your business applications. It contains a getting-started scenario that helps you get up and running.

Part 2. Administration
This part describes how to prepare and maintain a DB2 database for XML data. Read this part if you need to administer a DB2 database that contains XML data.

Part 3. Programming
This part describes how to manage your XML data. Read this part if you need to access and manipulate XML data in a DB2 application program.

Part 4. Reference
This part describes how to use the XML Extender administration commands, user-defined types, user-defined functions, and stored procedures. It also lists the messages and codes that the XML Extender issues. Read this part if you are familiar with the XML Extender concepts and tasks, but you need information about a user-defined type (UDT), user-defined function (UDF), command, message, metadata tables, control tables, or code.

Part 5. Appendixes
The appendixes describe the DTD for the document access definition, samples for the examples and getting started scenario, and other IBM XML products.

Conventions used in this book

This books uses the following conventions:

Bold	Bold text indicates: • Commands • Field names • Menu names • Push buttons
Italic	Italic text indicates: • Variable parameters that are to be replaced with a value • Emphasized words • First use of a glossary term
UPPERCASE	Uppercase letters indicate: • Data types • Column names • Table names
`Example`	Example text indicates: • System messages • Values you type • Coding examples

- Directory names
- File names
- Path names

How to read syntax diagrams

Throughout this book, the syntax of commands and SQL statements is described using syntax diagrams.

Read the syntax diagrams as follows:

- Read the syntax diagrams from left to right, from top to bottom, following the path of the line.

  The ▶▶— symbol indicates the beginning of a statement.

  The —▶ symbol indicates that the statement syntax is continued on the next line.

  The ▶— symbol indicates that a statement is continued from the previous line.

  The —▶◀ symbol indicates the end of a statement.

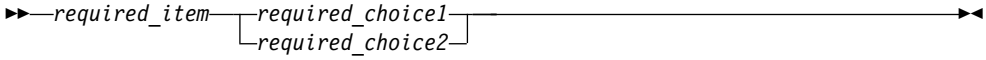
  Diagrams of syntactical units other than complete statements start with the ▶— symbol and end with the —▶ symbol.
- Required items appear on the horizontal line (the main path).

- Optional items appear below the main path.

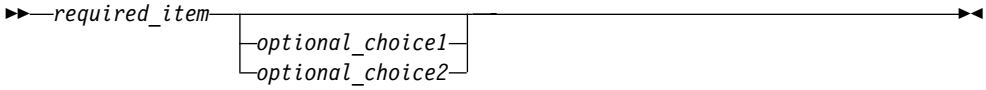
  If an optional item appears above the main path, that item has no effect on the execution of the statement and is used only for readability.

- If you can choose from two or more items, they appear vertically, in a stack.

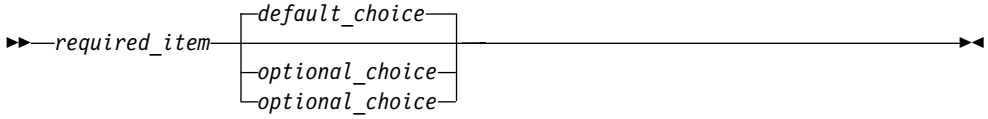
  If you *must* choose one of the items, one item of the stack appears on the main path.



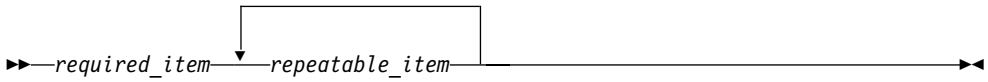
  If choosing one of the items is optional, the entire stack appears below the main path.



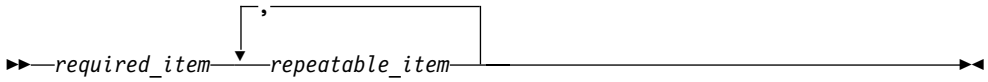
If one of the items is the default, it appears above the main path and the remaining choices are shown below.



- An arrow returning to the left, above the main line, indicates an item that can be repeated.



If the repeat arrow contains punctuation, you must separate repeated items with the specified punctuation.



A repeat arrow above a stack indicates that you can repeat the items in the stack.

- Keywords appear in uppercase (for example, `FROM`). In the XML Extender, keywords can be used in any case. Terms that are not keywords appear in lowercase letters (for example, *column-name*). They represent user-supplied names or values.
- If punctuation marks, parentheses, arithmetic operators, or other such symbols are shown, you must enter them as part of the syntax.

Related information

The following information resouces might be useful when using the XML Extender and related products:

- Use the XML Extender Web site for product-related information, updates, downloads, and documentation on other operating systems: http://www.ibm.com/software/data/db2/extenders/xmlext/
- *Integrating XML with DB2 XML Extender and DB2 Text Extender*, SG24-6130, for applications that use both XML and Text Extenders with DB2
- Use the iSeries Information Center as your starting point for looking up iSeries and AS/400e technical information. You can access the Information Center two ways:
  - From the following Web site:

    `http://www.ibm.com/eserver/iseries/infocenter`
  - From CD-ROMs that ship with your Operating System/400 order:

    SK3T-4091-00, iSeries Information Center:. This package also includes the PDF versions of iSeries manuals,

    SK3T-4092-00, iSeries Information Center: Supplemental Manuals, which replaces the Softcopy Library CD-ROM.

  The iSeries Information Center contains advisors and important topics such as CL commands, system application programming interfaces (APIs), logical partitions, clustering, Java, TCP/IP, Web serving, and secured networks. It also includes links to related IBM Redbooks and Internet links to other IBM Web sites such as the Technical Studio and the IBM home page.

  With every new hardware order, you receive the following CD-ROM information:
  - iSeries 400® Installation and Service Library CD-ROM, SK3T-4096-00. This CD-ROM contains PDF manuals needed for installation and system maintenance of an IBM @server iSeries 400 server.
  - iSeries 400 Setup and Operations CD-ROM, SK3T-4098-00. This CD-ROM contains IBM iSeries Client Access Express for Windows and the EZ-Setup wizard. Client Access™ Express offers a powerful set of client and server capabilities for connecting PCs to iSeries servers. The EZ-Setup wizard automates many of the iSeries setup tasks.

Operations Navigator

IBM iSeries Operations Navigator is a powerful graphical interface for managing your iSeries and AS/400e servers. Operations Navigator functionality includes system navigation, configuration, planning capabilities, and online help to guide you through your tasks. Operations Navigator makes operation and administration of the server easier and more productive and is the only user interface to the new, advanced features of the OS/400 operating system. It also includes Management Central for managing multiple servers from a central server. For more information on Operations Navigator, see the iSeries Information Center.

In this document, the use of the Operations Navigator, is limited to the Run SQL Scripts window, which is used for running sample programs and stored procedures. For information about setting up the Operations Navigator for use with the XML Extender, see

How to send your comments

Your feedback is important in helping to provide the most accurate and high-quality information. If you have any comments about this book or any other iSeries documentation, fill out the readers' comment form at the back of this book.

- If you prefer to send comments by mail, use the readers' comment form with the address that is printed on the back. If you are mailing a readers' comment form from a country other than the United States, you can give the form to the local IBM branch office or IBM representative for postage-paid mailing.
- If you prefer to send comments by FAX, use either of the following numbers:
  - United States, Canada, and Puerto Rico: 1-800-937-3430
  - Other countries: 1-507-253-5192
- If you prefer to send comments electronically, use one of these e-mail addresses:
  - Comments on books:

    RCHCLERK@us.ibm.com
  - Comments on the iSeries Information Center:

    RCHINFOC@us.ibm.com

Be sure to include the following:

- The name of the book.
- The publication number of a book.
- The page number or topic of a book to which your comment applies.

Part 1. Introduction

This part provides an overview of the XML Extender and explains how you can use it in your business applications.

Chapter 1. Introduction to the XML Extender

The IBM® DB2® Extenders™ family provides data and metadata management solutions to handle traditional data types and new, or non-traditional, types of data. The DB2 XML Extender helps you integrate the power of IBM's DB2 Universal Database for AS/400 with the flexibility of eXtensible Markup Language (XML).

DB2's XML Extender provides the ability to store and access XML documents, to generate XML documents from existing relational data, and to insert rows into relational tables from XML documents. XML Extender provides new data types, functions, and stored procedures to manage your XML data in DB2 Relational Databases (referred to as "RDB databases" or simply "databases" in this book.

The XML Extender is available for the following operating systems:

- Windows NT®
- AIX®
- Sun Solaris
- Linux
- NUMA-Q
- OS/390 and z/OS
- AS/400®

XML documents

There are many applications in the computer industry, each with its own strengths and weaknesses. Users today have the opportunity to choose whichever application best suits the need requirements of the task at hand. However, because users tend to share data between different applications, they are continually faced with the problem of replicating, transforming, exporting, or saving their data in formats that can be imported into other applications. Many of these transforming processes tend to drop some of the data, or they at least require that users go through the tedious process of ensuring that the data remained consistent. This manual checking consumes both time and money.

Today, one of the ways to address this problem is for application developers to write *Open Database Connectivity (ODBC)* applications, a standard application programming interface (API) for accessing data in both relational and nonrelational database management systems. These applications save the data in a database management system. From there, the data can be manipulated and presented in the form in which it is needed for another application. Database applications must be written to convert the data into a form that an application requires; however, applications change quickly and quickly become obsolete. Applications that convert data to HTML provide presentation solutions, but the data presented cannot be practically used for other purposes. If there were another method that separated the data from its presentation, this method could be used as a practical form of interchange between applications.

XML has emerged to address this problem. XML is an acronym for *eXtensible Markup Language*. It is extensible in that the language itself is a metalanguage that allows you to create your own language depending on the needs of your

enterprise. You use XML to capture not only the data for your particular application, but also the data structure. Although XML is not the only data interchange format, XML has emerged as the accepted standard. By adhering to this standard, applications can share data without first transforming it using proprietary formats.

XML applications

Because XML is now the accepted standard for data interchange, many applications are emerging that will be able to take advantage of it.

Suppose you are using a particular project management application and you want to share some of its data with your calendar application. Your project management application could export tasks in XML, which could then be imported as-is into your calendar application.In today's interconnected world, application providers have strong incentives to make an XML interchange format a basic feature of their application.

Why XML and DB2?

Although XML solves many problems by providing a standard format for data interchange, some challenges remain. When building an enterprise data application, you must answer questions such as:

- How often do I want to replicate the data?
- What kind of information must be shared between applications?
- How can I quickly search for the information I need?
- How can I have a particular action, such as a new entry being added, trigger an automatic data interchange between all my applications?

These kinds of issues can be addressed only by a database management system. By incorporating the XML information and meta-information directly in the database, you can more efficiently obtain the XML results that your other applications need. This is where the XML Extender can assist you. With the XML Extender, you can take advantage of the power of DB2 in many XML applications.

With the content of your structured XML documents in a DB2 database, you can combine structured XML information with traditional relational data. Based on the application, you can choose whether to store entire XML documents in DB2 as in user-defined types provided for XML data (XML data types), or you can map the XML content as base data types in relational tables. For XML data types, the XML Extender adds the power to search rich data types of XML element or attribute values, in addition to the structural text search that the DB2 Text Extender for AS/400 provides.

What XML Extender can do for your your applications:

- Compose or decompose contents of XML documents with one or more relational tables, using the XML collection method of storage and access

How XML and DB2 work together

XML Extender provides the following features to help you manage and exploit XML data with DB2:

- Administration tools to help you manage the integration of XML data in relational tables

- Storage and access methods for XML data within the database
- A data type definition (DTD) repository for you to store DTDs used to validate XML data
- A mapping file called the Document Access Definition (DAD), which is used to map XML documents to relational data

Administration tools

The XML Extender administration tools help you enable your database and table columns for XML, and map XML data to DB2 relational structures. The XML Extender provides the following administration tools for your use, depending on how you want to complete you administration tasks..

You can use the following tools to complete administration tasks for the XML Extender:

- The XML Extender administration wizards provide a graphical user interface for administration tasks.
- The **dxxadm** command can be run from the OS command line.
- Stored procedures can be run from the Operations Navigator.
- The XML Extender administration stored procedures allow you to invoke administration commands from a program.

Storage and access methods

XML Extender provides two storage and access methods for integrating XML documents with DB2 data structures: XML column and XML collection. These methods have very different uses, but can be used in the same application.

XML column method
This method helps you store intact XML documents in DB2. The XML column method works well for archiving documents. The documents are inserted into columns that are enabled for XML and can be updated, retrieved, and searched. Element and attribute data can be mapped to DB2 tables (side tables), which can be indexed for fast search.

XML collection method
This method helps you map XML document structures to DB2 tables so that you can either compose XML documents from existing DB2 data, or decompose XML documents, storing the untagged data in DB2 tables. This method is good for data interchange applications, particularly when the contents of XML documents are frequently updated.

DTD repository

The XML Extender allows your to store DTDs, the set of declarations for XML elements and attributes. When a database is *enabled* for XML, a DTD repository table (DTD_REF) is created. Each row of this table represents a DTD with additional metadata information. Users can access this table to insert their own DTDs. The DTDs are used for validating the structure of XML documents.

Document Access Definitions (DADs)

You specify how structured XML documents are to be processed by the XML Extender using a *document access definition (DAD)* file. The DAD file is an XML-formatted document that maps the XML document structure to a DB2 table. You use a DAD file both when storing XML documents in a column, or when

composing or decomposing XML data. The DAD file specifies whether you are storing documents using the XML column method, or defining an XML collection for composition or decomposition.

Location path

A *location path* specifies the location of an element or attribute within an XML document. The XML Extender uses the location path to navigate the structure of the XML document and locate elements and attributes.

For example, a location path of `/Order/Part/Shipment/Shipdate` points to the shipdate element, that is a child of the Shipment, Part, and Order elements, as shown in the following example:

```
<Order>
  <Part>
    <Shipment>
      <Shipdate>
...
```

Figure 1 shows an example of a location path and its relationship to the structure of the XML document.

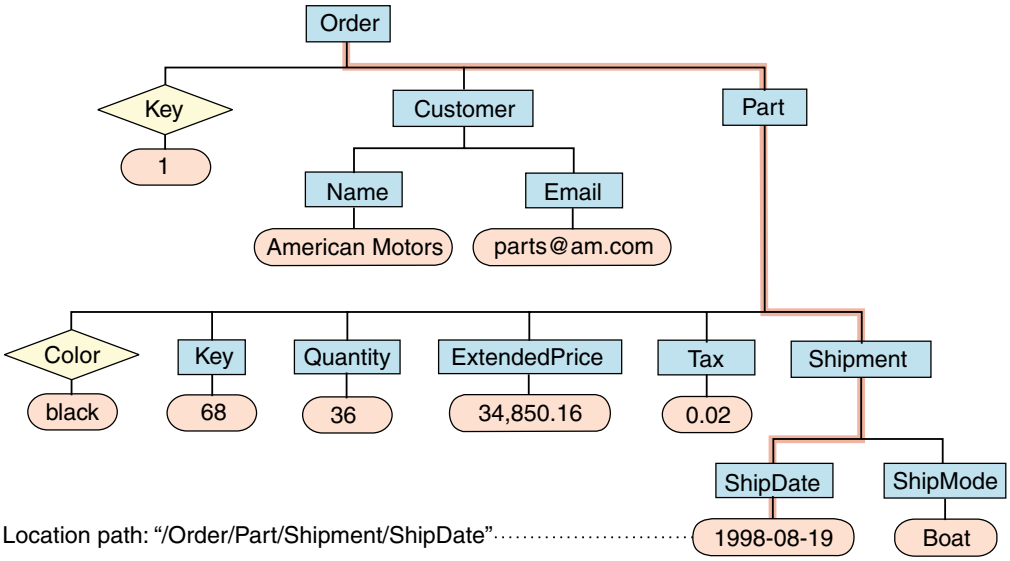


Figure 1. Storing documents as structured XML documents in a DB2 table column

The location path is used in the following situations:

- For XML columns:
  - To identify the elements and attributes to be extracted or updated when using the XML Extender user-defined functions.
  - To map the content of an XML element or attribute to a side table.
- For XML collections: To override values in the DAD file from a stored procedure.

To specify the location path, the XML Extender uses a subset of the *XML Path Language (XPath)*, the language for addressing parts of an XML document.

For more information about XPath, see the following Web page: For XPath, see:
`http://www.w3.org/TR/xpath`

See "Location path" on page 56 for syntax and restrictions.

XML collection: integrated data management

Relational data is either *decomposed* from incoming XML documents or used to *compose* outgoing XML documents. Decomposed data is the untagged content of an XML document stored in one or more database tables. Or, XML documents are composed from existing data in one or more database tables. If your data is to be shared with other applications, you might want to be able to compose and decompose incoming and outgoing XML documents and manage the data as necessary to take advantage of the relational capabilities of DB2. This type of XML document storage is called *XML collection*.

An example of an XML collection is shown in Figure 2.

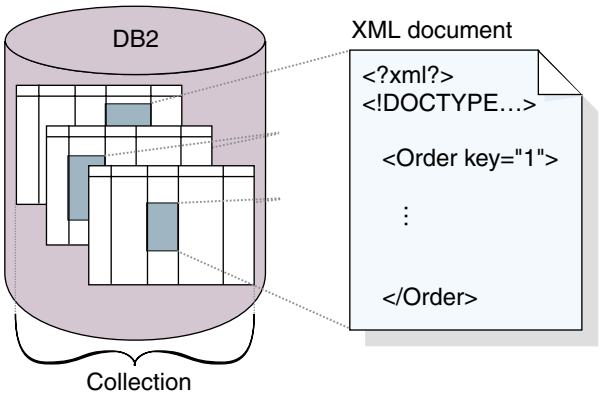


Figure 2. Storing documents as untagged data in DB2 tables

The XML collection is defined in a DAD file, which specifies how elements and attributes are mapped to one or more relational tables. The collection is a set of columns, associated with a DAD file, that contain the data in a particular XML document or set of XML documents. You can define a collection name by enabling it, and then refer to it by name when issuing a stored procedure to compose or decompose XML documents, called an enabled XML collection. The collection is given a name so that it is easily run with stored procedures when composing and decomposing the XML documents.

When you define a collection in the DAD file, you use one of two types of mapping schemes, *SQL mapping* or *RDB_node mapping*. that define the tables,

columns, and conditions used to associate XML data with DB2 tables.. SQL mapping uses SQL SELECT statements to define the DB2 tables and conditions used for the collection. RDB_node mapping uses an XPath-based relational database node, or RDB_node, which has child elements.

Stored procedures are provided to compose or decompose XML documents. The stored procedures use the qualifier **DB2XML**, which is the *schema name* of the XML Extender.

Chapter 2. Getting started with XML Extender

This chapter shows you how to get started using the XML Extender to access and modify XML data for your applications. By following the provided tutorial lessons, you can set up a database using provided sample data, map SQL data to an XML document, store XML documents in the database, and then search and extract data from the XML documents.

In the administration lessons, you use with XML Extender administration commands. You can accomplish these tasks with the XML Extender administration wizard, which is also described in this book. In XML data management lessons, you will use XML Extender-provided UDFs and stored procedures. Most of the examples in the rest of the book draw on the sample data that is used in this chapter.

Required: To complete the lessons in this chapter, you must have the following prerequisites installed:

- DB2 Universal Database for iSeries Version 5 Release 1
- Optional: Operations Navigator to run lessons samples

Additionally, you must set up the administration environment, as described in "Setting up the Getting Started environment" on page 38.

The lessons are as follows:

- Store an intact XML document in a DB2 table column
  - Plan the XML user-defined type (UDT) in which to store the document and the XML elements and attributes to be frequently searched.
  - Set up the database and tables
  - Enable the database for XML
  - Insert the DTD into the DTD repository table
  - Prepare a DAD for an XML column
  - Add a column of XML type to an existing table
  - Enable the new column for XML
  - Create indexes on the side tables
  - Store an XML document in the XML column
  - Search the XML column using XML Extender UDFs
- Create an XML document from existing data
  - Plan the data structure of the XML document
  - Set up the database and tables
  - Enable the database for XML
  - Prepare a document access definition (DAD) file for an XML collection
  - Compose the XML document from existing data
  - Retrieve the XML document from the database
- Clean up the database

Scenario for the lessons

In these lessons, you work for ACME Auto Direct, a company that distributes cars and trucks to automotive dealerships. You have been given the task to take information in an existing purchase order database, SALES_DB, and extract key information from it to be stored in XML documents.

Choosing a method to run the tutorial lessons

Several methods for running the scripts and commands are provided. You can use the Operations Navigator or the OS command line. See "Administration environment" on page 34 to learn more about the OS/400 administration environments.

- Use the Operations Navigator to run the getting started lessons as stored procedures in a Windows environment. See "Software requirements" on page 33 to learn how to install the Operations Navigator. See "Setting up the Operations Navigator interface" on page 37 to learn how to set up this environment.
- Use the OS command line to run scripts and SQL statements. For information about setting up sample programs for the OS command line, see "Preparing the sample programs for the OS/400 command line" on page 38.

Lesson: Store an XML document in an XML column

The XML Extender provides a method of storing and accessing whole XML documents in the database, called XML column. Using the XML column method, you can store the document using the XML file types, index the column in side tables, and then query or search the XML document. This storage method is particularly useful for archival applications in which documents are not frequently updated.

The scenario

You have been given the task of archiving sales data for the service department. The data is stored in XML documents that use the same DTD. The service department will use these XML documents when working with customer requests and complaints.

The service department has provided a recommended structure for the XML documents and specified which element data they believe will be queried most frequently. They would like the XML documents stored in the SALES_TAB table in the SALES_DB database and want be able to search them quickly. The SALES_DB table will contain two columns with data about each sale, and a third column to contain the XML document. This column is called ORDER.

You will determine the XML Extender-provided user-defined types (UDTs) in which to store the XML document, as well as which XML elements and attributes will be frequently queried. Next, you will set up the SALES_DB database for XML, create the SALES_TAB table, and enable the ORDER column so that you can store the intact document in DB2. You will also insert a DTD for the XML document for validation and then store the document as an XMLVARCHAR data type. When you enable the column, you will define side tables to be indexed for the structural search of the document in a document access definition (DAD) file, an XML document that specifies the structure of the side tables. To see samples of the DAD file, the DTD, and the XML document, see "Appendix B. Samples" on page 235.

The SALES_TAB is described in Table 1. The XML column to be enabled for XML, ORDER, is shown in italics.

Table 1. SALES_TAB table

Column name	Data type
INVOICE_NUM	CHAR(6) NOT NULL PRIMARY KEY
SALES_PERSON	VARCHAR(20)
ORDER	XMLVARCHAR

Planning

Before you begin working with the XML Extender to store your documents, you need to understand the structure of the XML document so that you can determine how to search the document. When planning how to search the document, you need to determine:

- The XML user-defined type in which you will store the XML document
- The XML elements and attributes that the service department will frequently search, so that their content can be stored in side tables and indexed to improve performance.

The following sections will describe how to make these decisions.

The XML document structure

The XML document structure for this lesson takes information for a specific order that is structured by the order key as the top level, then customer, part, and shipping information on the next level. The XML document is described in "XML document: getstart.xml" on page 236.

This lesson also provides a sample DTD for you to use in understanding and validating the XML document structure. You can see the DTD file in "XML DTD" on page 235.

Determining the XML data type for the XML column

The XML Extender provides XML user defined types in which you define a column to hold XML documents. These data types are:

- XMLVarchar: for small documents stored in DB2
- XMLCLOB: for large documents stored in DB2
- XMLFILE: for documents stored outside DB2

In this lesson, you will store a small document in DB2 and will, therefore, use the XMLVarchar data type.

Determining elements and attributes to be searched

When you understand the XML document structure and the needs of the application, you can determine which elements and attributes to be searched: such as the elements and attributes that will be searched or extracted most frequently, or those that will be the most expensive to query. The service department has indicated they will be frequently querying the order key, customer name, price, and shipping date of an order, and need quick performance for these searches. This information is contained in elements and attributes of the XML document structure. Table 2 on page 12 describes the location paths of each element and attribute.

Table 2. Elements and attributes to be searched

Data	Location path
order key	/Order/@key
customer	/Order/Customer/Name
price	/Order/Part/ExtendedPrice
shipping date	/Order/Part/Shipment/ShipDate

Mapping the XML document to the side tables

You will create a DAD file for the XML column, which is used to store the XML document in DB2. It also maps the XML element and attribute contents to DB2 side tables used for indexing, which improves search performance. In the last section, you saw which elements and attributes are to be searched. In this section, you learn more about mapping these element and attribute values to DB2 tables that can be indexed.

After identifying the elements and attributes to be searched, you determine how they should be organized in the side tables, how many tables and which columns are in what table. Typically, you organize the side tables by putting similar information in the same table. The structure is also determined by whether the location path of any elements can be repeated more than once in the document. For example in our document, the part element can be repeated multiple times, and therefore, the price and date elements can occur multiple times. Elements that can occur multiple times must each be in their own side tables.

Additionally, you also must determine what DB2 base types the element or attribute values should use. Typically, this is easily determined by the format of the data. If the data is text, choose VARCHAR; if the data is an integer, choose INTEGER; or if the data is a date, and you want to do range searches, choose DATE.

In this tutorial, you will map the elements and attributes to the following side tables:

ORDER_SIDE_TAB

Column name	Data type	Location path	Multiple occurring?
ORDER_KEY	INTEGER	/Order/@key	No
CUSTOMER	VARCHAR(16)	/Order/Customer/Name	No

PART_SIDE_TAB

Column name	Data type	Location path	Multiple occurring?
PRICE	DECIMAL(10,2)	/Order/Part/ExtendedPrice	Yes

SHIP_SIDE_TAB

Column name	Data type	Location path	Multiple occurring?
DATE	DATE	/Order/Part/Shipment/ShipDate	Yes

Getting started scripts and samples

For this tutorial, you use a set of scripts to set up your environment and perform the steps in the lessons. These scripts are in the *dxx_install* directory (where *dxx_install* is the directory where you installed the XML Extender files).

Table 3 lists the samples that are provided to complete the getting started tasks.

Table 3. List of the XML column lesson samples

Lesson description	OS command line scripts	Operations Navigator SQL Script File
Create and fill SALES_DB tables	C_SALESDB	C_SalesDb.sql
Insert the DTD getstart.dtd into the DTD_REF table	INSERTDTD	InsertDTD.sql
Creates SALES_TAB for XML column	C_SALESTAB	C_SalesTab.sql
Adds the ORDER column to SALES_TAB	ADDORDER	AddOrderCol.sql
Enables the ORDER column as an XML column	Manual command described in text	EnableCol.sql
Create indexes on side tables	C_INDEX	C_Index.sql
Inserts an XML document into the SALES_TAB XML column	INSERTXML	InsertXML.sql
Queries the XML document held in the sales_tab XML column through the side tables	Manual command described in text	QueryCol.sql
Removes sample tables and disables column	D_SALESDB and CLEANUPCOL	CleanupCol.sql

Setting up the lesson environment

In this section, you

- Enable the database.
- Create and populate the tables used for the lessons.

Enabling the database

To store XML information in the database, you need to enable it for the XML Extender. When you enable a database for XML, the XML Extender:

- Creates user-defined types (UDTs), user-defined functions (UDFs), and stored procedures.
- Creates and populates control tables with the necessary metadata that the XML Extender requires.
- Creates the DB2XML schema and assigns the necessary privileges.

To enable the database for XML: Use one of the following methods to enable the database.

- **Operations Navigator:** Enter the command:

  ```
  CALL &SCHEMA.QZXMADM('enable_db','&DBNAME');
  ```

- **OS command line:** Enter:

  ```
  CALL PGM(QDBXM.QZXMADM) PARM(enable_db &RDBDatabase)
  ```

Creating and populating the SALES_DB tables

To set up the lesson environment, create and populate the SALES_DB tables. These tables contain the tables described in the planning sections.

To create the tables, use one of the following methods:

- **Operations Navigator:** Run **C_SalesDb.sql**
- **OS command line:** Enter the following command:

```
RUNSQLSTM SRCFILE(DXXSAMPLES/SQLSTMT)
          SRCMBR(C_SALESDB)
```

Enabling the XML column and storing the document

In this lesson, you will enable a column for XML Extender and store an XML document in the column. For these tasks, you will:

1. Insert the DTD for the XML document into the DTD reference table, DTD_REF.
2. Prepare a DAD file that specifies the XML document location and side tables for structural search.
3. Add a column in the SALES_TAB table with an XML user-defined type of XMLVARCHAR.
4. Enable the column for XML.
5. Index the side tables for structural search.
6. Store the document using a user-defined function, which is provided by the XML Extender.

Storing the DTD in the DTD repository

You can use a DTD to validate XML data in an XML column. The XML Extender creates a table in the XML-enabled database, called DTD_REF. The table is known as the DTD reference and is available for you to store DTDs. When you validate XML documents, you must store the DTD in this repository. The tutorial DTD is *dxx_install*/dtd/getstart.dtd.

To insert the DTD:

Enter the SQL INSERT statement using one of the following methods:

- **Operations Navigator:** Run **InsertDTD.sql**
- **OS command line:** Enter:

```
RUNSQLSTM SRCFILE(DXXSAMPLES/SQLSTMT)
          SRCMBR(INSERTDTD)
```

Preparing the DAD file

The DAD file for the XML column has a simple structure. You specify that the storage mode is XML column, and you define the tables and columns for indexing.

In the following steps, elements in the DAD are referred to as *tags* and the elements of your XML document structure are referred to as *elements*. A sample of a DAD file similar to the one you will create is in *dxx_install*/dad/getstart_xcolumn.dad. It has some minor differences from the file generated in the following steps. If you use it for the lesson, note that the file paths might be different that for your environment, the <validation> value is set to NO, rather than YES.

To prepare the DAD file:

1. Open a text editor and name the file getstart_xcolumn.dad

   Note that all the tags used in the DAD file are case sensitive.

2. Create the DAD header, with the XML and the DOCTYPE declarations.

   ```
   <?xml version="1.0"?>
   <!DOCTYPE DAD SYSTEM "dxx_install/dtd/dad.dtd">
   ```

   The DAD file is an XML document and requires XML declarations.
3. Insert opening and closing <DAD></DAD> tags. All other tags are located inside these tags.
4. Insert opening and closing <DTDID></DTDID> tags with a DTD ID to specify a DTD if the document will be validated:

   ```
   <dtdid>dxx_install/dtd/getstart.dtd</dtdid>
   ```

   Verify that this string matches the value used as the first parameter value when inserting the DTD in the DTD reference table in "Storing the DTD in the DTD repository" on page 14. For example, the path you used for the DTDID might be different be different that the above string if you are working on a different machine drive.
5. Specify opening and closing <validation></validation> tags and a keyword YES or NO to indicate whether the XML Extender is to validate the XML document structure using the DTD you inserted into the DTD repository table.

   ```
   <validation>YES</validation>
   ```

   The value of <validation> must be in uppercase.
6. Insert opening and closing <Xcolumn></Xcolumn> tags to define the storage method as XML column.

   ```
   <Xcolumn>
   </Xcolumn>
   ```
7. Insert opening and closing <table></table> tags for each side table that is to be generated.

   ```
   <Xcolumn>
   <table name="order_side_tab">
   </table>
   <table name="part_side_tab">
   </table>
   <table name="ship_side_tab">
   </table>
   </Xcolumn>
   ```
8. Insert <column/> tags for each column that is to be included in the side tables. Each <column/> tag has four attributes:

- **name:** the name of the column
- **type:** the SQL data type of the column
- **path:** the location path of the corresponding element in the XML document, using XPath syntax. See "Location path" on page 56 for location path syntax.
- **multi-occurrence:** indication of whether the location path of the element can occur more than once in the XML document structure

```
<Xcolumn>
<table name="order_side_tab">
  <column name="order_key"
          type="integer"
          path="/Order/@key"
          multi_occurrence="NO"/>
  <column name="customer"
          type="varchar(50)"
          path="/Order/Customer/Name"
          multi_occurrence="NO"/>
</table>
<table name="part_side_tab">
  <column name="price"
          type="decimal(10,2)"
          path="/Order/Part/ExtendedPrice"
          multi_occurrence="YES"/>
</table>
<table name="ship_side_tab">
  <column name="date"
          type="DATE"
          path="/Order/Part/Shipment/ShipDate"
          multi_occurrence="YES"/>
</table>
</Xcolumn>
```

9. Ensure that you have a closing </Xcolumn> after the last </table> tag.
10. Ensure that you have a closing </DAD> after the </Xcolumn> tag.
11. Save the file as `getstart_xcolumn.dad`.

You can compare the file you have just created with the sample file, *dxx_install*`/dad/getstart_xcolumn.dad`. This file is a working copy of the DAD file required to enable the XML column and create the side tables. The sample files contain references to files that use absolute path names. Check the sample files and change these values for your directory paths.

Creating the SALES_TAB table

In this section you create the SALES_TAB table. Initially, it has two columns with the sale information for the order.

To create the table: Enter the following CREATE TABLE statement using one of the following methods:

- **Operations Navigator:** Run **C_SalesTab.sql**
- **OS command line:** Enter:

```
RUNSQLSTM SRCFILE(DXXSAMPLES/SQLSTMT)
          SRCMBR(C_SALESTAB)
```

Adding the column of XML type

Next, add a new column to the SALES_TAB table. This column will contain the intact XML document that you generated earlier and must be of XML UDT. The XML Extender provides multiple data types, described in "Chapter 11. XML Extender user-defined types" on page 147. In this tutorial, you will store the document as XMLVARCHAR.

To add the column of XML type:

Run the SQL ALTER TABLE statement using one of the following methods:

- **Operations Navigator:** Run **AddOrderCol.sql**
- **OS command line:** Enter:

```
RUNSQLSTM SRCFILE(DXXSAMPLES/SQLSTMT)
          SRCMBR(ADDORDER)
```

Enabling the XML column

After you create the column of XML type, you enable it for the XML Extender. When you enable the column, the XML Extender reads the DAD file and creates the side tables. Before enabling the column, you must:

- Determine whether you want to create a default view of the XML column, which contains the XML document joined with the side-table columns. You can specify the default view when querying the XML document. In this lesson, you will specify a view with the `-v` parameter.
- Determine whether you want to specify a primary key as the *ROOT ID*, the column name of the primary key in the application table and a unique identifier that associates all side tables with the application table. If you do not specify a primary key, the XML Extender adds the DXXROOT_ID column to the application table and to the side tables.

  The ROOT_ID column is used as key to tie the application and side tables together, allowing the XML Extender to automatically update the side tables if the XML document is updated. In this lesson, you will specify the name of the primary key in the command (INVOICE_NUM) with the `-r` parameter. The XML Extender will then use the specified column as the ROOT_ID and add the column to the side tables.
- Determine whether you want to specify a table space or use the default table space. In this lesson, you will use the default table space.

To enable the column for XML:

Run the **dxxadm enable_column** command, using one of the following methods:

- **Operations Navigator:** Run **EnableCol.sql**
- **OS command line:** Enter:

```
CALL QZXMADM/QZXMADM PARM(enable_column, dbname, Sales_Tab,Order,
  '/dxxsamples/dad/getstart_xcolumn.dad' '-v'  sales_order_view, '-r'  invoice_num)
```

  Where *dbname* is the name of your RDB database.

The XML Extender creates the side tables with the INVOICE_NUM column and creates the default view.

Important: Do not modify the side tables in any way. Updates to the side tables should only be made through updates to the XML document itself. The XML Extender will automatically update the side tables when you update the XML document in the XML column.

Viewing the column and side tables

When you enabled the XML column, you created a view of the XML column and side tables. You can use this view when working with the XML column.

To view the XML column and side-table columns: Submit the following SQL SELECT statement from the DB2 command line:

```
DB2 SELECT * FROM SALES_ORDER_VIEW
```

The view shows the columns in the side tables, as specified in the `getstart_xcolumn.dad` file.

Creating indexes on the side tables

Creating indexes on side tables allows you to do fast structural searches of the XML document. In this section, you create indexes on key columns in the side tables that were created when you enabled the XML column, ORDER. The service department has specified which columns their employees are likely to query most often. Table 4 describes these columns, which you will index:

Table 4. Side-table columns to be indexed

Column	Side table
ORDER_KEY	ORDER_SIDE_TAB
CUSTOMER	ORDER_SIDE_TAB
PRICE	PART_SIDE_TAB
DATE	SHIP_SIDE_TAB

To index the side tables:

Run the following CREATE INDEX SQL commands using one of the following methods:

- **Operations Navigator:** Run **C_Index.sql**
- **OS command line:** Enter:

```
RUNSQLSTM SRCFILE(DXXSAMPLES/SQLSTMT)
          SRCMBR(C_INDEX)
```

Command line:

Storing the XML document

Now that you have enabled a column that can contain the XML document and indexed the side tables, you can store the document using the functions that the XML Extender provides. When storing data in an XML column, you either use default casting functions or the XML Extender UDFs. Because you will be storing an object of the base type VARCHAR in a column of the XML UDT XMLVARCHAR, you will use the default casting function. See “Storing data” on page 104 for more information about the storage default casting functions and the XML Extender-provided UDFs.

To store the XML document:

1. Open the XML document *dxx_install*`/xml/getstart.xml`. Ensure that the file path in the DOCTYPE matches the DTD ID specified in the DAD and when inserting the DTD in the DTD repository. You can verify they match by querying the DB2XML.DTD_REF table and by checking the DTDID element in the DAD file. If you are using a different drive and directory structure than the default, you might need to change the path in the DOCTYPE declaration.
2. Run the SQL INSERT command, using one of the following methods:
   - **Operations Navigator:** Run **InsertXML.sql**
   - **OS command line:** Enter:

```
RUNSQLSTM SRCFILE(DXXSAMPLES/SQLSTMT)
          SRCMBR(INSERTXML)
```

To verify that the tables have been updated, run the following SELECT statements for the tables from the command line.

```
DB2 SELECT * FROM SALES_TAB

DB2 SELECT * FROM PART_SIDE_TAB

DB2 SELECT * FROM ORDER_SIDE_TAB

DB2 SELECT * FROM SHIP_SIDE_TAB
```

Searching the XML document

You can search the XML document with a direct query against the side tables. In this step, you will search for all orders that have a price over 2500.00.

To query the side tables:

Run the SQL SELECT statement, using one of the following methods:

- **Operations Navigator:** Run **QueryCol.sql**
- **DB2 command line:**

  Enter:

  ```
  select distinct sales_person from schemasales_tab S, part_side_tab P
     where price > 2500.00 and S.invoice_num = P.invoice_num;
  ```

The result set should show the names of the salespeople who sold an item that had a price greater than 2500.00.

You have completed the getting started tutorial for storing XML documents in DB2 tables. Many of the examples in the book are based on these lessons.

Lesson: Composing an XML document

This lesson teaches you how to compose an XML document from existing DB2 data.

The scenario

You have been given the task of taking information in an existing purchase order database, SALES_DB, and extracting requested information from it to be stored in XML documents. The service department will then use these XML documents when working with customer requests and complaints. The service department has requested specific data to be included and has provided a recommended structure for the XML documents.

Using existing data, you will compose an XML document, `getstart.xml`, from data in these tables.

You will also plan and create a DAD file that maps columns from the related tables to an XML document structure that provides a purchase order record. Because this document is composed from multiple tables, you will create an XML collection, associating these tables with an XML structure and a DTD. You use this DTD to define the structure of the XML document. You can also use it to validate the composed XML document in your applications.

The existing database data for the XML document is described in the following tables. The column names in *italics* are columns that the service department has requested in the XML document structure.

ORDER_TAB

Column name	Data type
ORDER_KEY	INTEGER
CUSTOMER	VARCHAR(16)
CUSTOMER_NAME	VARCHAR(16)
CUSTOMER_EMAIL	VARCHAR(16)

PART_TAB

Column name	Data type
PART_KEY	INTEGER
COLOR	CHAR(6)
QUANTITY	INTEGER
PRICE	DECIMAL(10,2)
TAX	REAL
ORDER_KEY	INTEGER

SHIP_TAB

Column name	Data type
DATE	DATE
MODE	CHAR(6)
COMMENT	VARCHAR(128)
PART_KEY	INTEGER

Planning

Before you begin working with the XML Extender to compose your documents, you need to determine the structure of the XML document and how it corresponds to the structure of your database data. This section will provide an overview of the XML document structure that the service department has requested, of the DTD you will use to define the structure of the XML document, and how this document maps to the columns that contain the data used to populate the documents.

Determining the document structure

The XML document structure takes information for a specific order from multiple tables and creates an XML document for the order. These tables each contain related information about the order and can be joined on their key columns. The service department wants a document that is structured by the order number as the top level, and then customer, part, and shipping information. They want the document structure to be intuitive and flexible, with the elements describing the data, rather than the structure of the document. (For example, the customer's name should be in an element called "customer," rather than a paragraph.) Based on their request, the hierarchical structure of the DTD and the XML document should be like the one described in Figure 3 on page 21.

After you have designed the document structure, you should create a DTD to describe the structure of the XML document. This tutorial provides an XML document and a DTD for you. You can see the DTD file in "Appendix B. Samples" on page 235. Using the rules of the DTD, and the hierarchical structure of the XML

document, you can map a hierarchical map of your data, as shown in Figure 3 .

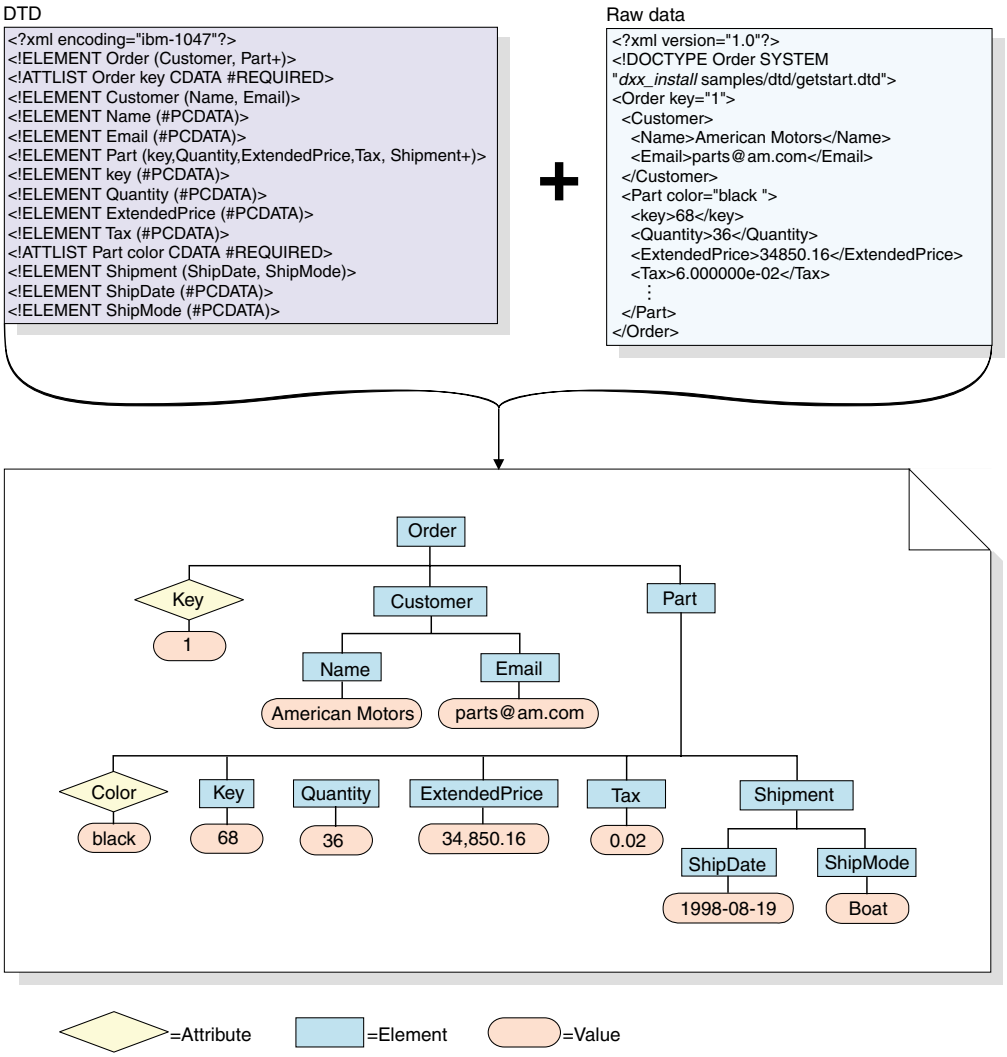


Figure 3. The hierarchical structure of the DTD and XML document

Mapping the XML document and database relationship

After you have designed the structure and created the DTD, you need to show how the structure of the document relates to the DB2 tables that you will use to populate the elements and attributes. You can map the hierarchical structure to specific columns in the relational tables, as in Figure 4 on page 22.

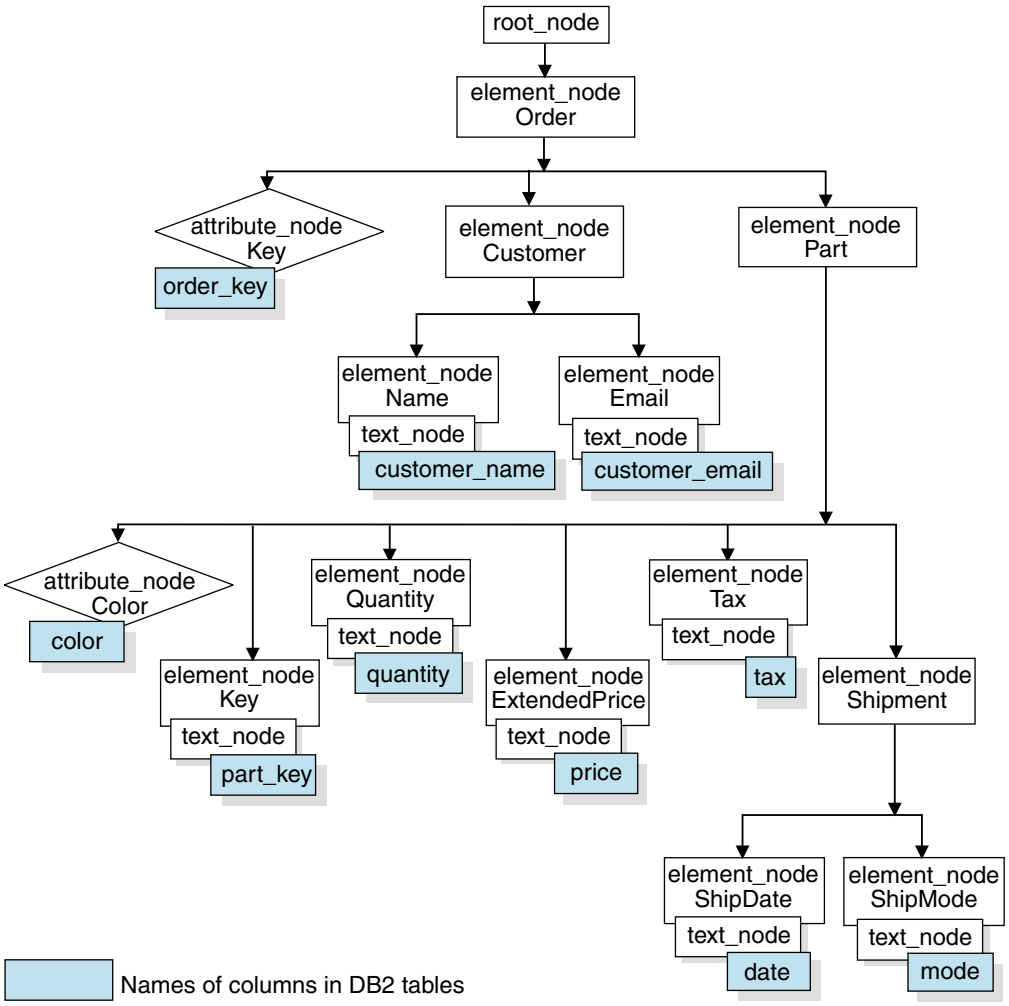


Figure 4. XML document mapped to relational table columns

This figure uses nodes to identify elements, attributes, and text within the XML document structure. These nodes are used in the DAD file and are explained more fully in later steps.

Use this relationship description to create DAD files that define the relationship between the relational data and the XML document structure.

In this tutorial, you will be creating a DAD file for the XML collection used to compose the document. The XML collection DAD file maps the tables with existing data to the XML document structure.

To create the XML collection DAD file, you need to understand how the XML document corresponds to the database structure, as described in Figure 4, so that you can describe from what tables and columns the XML document structure derives data for elements and attributes. You will use this information to create the DAD file for the XML collection.

Getting started scripts and samples

For this tutorial, we provide a set of scripts for you to use to set up your environment. These scripts are in the *dxx_install* directory (where *dxx_install* is the directory where you installed the XML Extender files).

Table 5 lists the samples that are provided to complete the getting started tasks.

Table 5. List of the XML collection lesson samples

Lesson description	OS command line scripts	Operations Navigator SQL Script File
Create and fill SALES_DB tables	C_SALESDB	C_SalesDb.sql
Composes an XML document and returns it to a result table	Manual command	Genxml_sql.sql
Removes sample tables and disables column	D_SALESDB and CLEANUPCLL	CleanupCllec.sql

Setting up the lesson environment

In this section, you:

- Enable the database.
- Create and populate the tables used for the lessons.

Enabling the database

To store XML information in the database, you need to enable it for the XML Extender. When you enable a database for XML, the XML Extender:

- Creates the user-defined types (UDTs), user-defined functions (UDFs), and stored procedures.
- Creates and populates control tables with the necessary metadata that the XML Extender requires.
- Creates the DB2XML schema and assigns the necessary privileges.

Important: If you have completed the XML column lesson and have not cleaned up your environment, you might be able skip this step.

To enable the database for XML: Use one of the following methods.

- **Operations Navigator:** Enter the command:

  ```
  CALL &Schema.QZXMADM('enable_db','&DBNAME');
  ```

- **OS command line:** Enter:

  ```
  CALL PGM(QDBXM.QZXMADM) PARM(enable_db &RDBDatabase)
  ```

Creating and populating the SALES_DB tables

To set up the lesson environment, create the populate the SALES_DB tables. These tables contain the tables described in the planning sections.

To create the tables: Use one of the following methods.

- **Operations Navigator:** Run **C_SalesDb.sql**
- **OS command line:** Enter the following command:

  ```
  RUNSQLSTM SRCFILE(DXXSAMPLES/SQLSTMT)
            SRCMBR(C_SALESDB)
  ```

Creating the XML collection: preparing the DAD file

Because the data already exists in multiple tables, you will create an XML collection, which associates the tables with the XML document. To create an XML collection, you define the collection by preparing a DAD file.

In "Planning" on page 20 you determined which columns are in the relational database where the data exists, and how the data from the tables will be structured in an XML document. In this section, you create the mapping scheme in the DAD file that specifies the relationship between the tables and the structure of the XML document.

In the following steps, elements in the DAD are referred to as *tags* and the elements of your XML document structure are referred to as *elements*. A sample of a DAD file similar to the one you will create is in *dxx_install*/dad/getstart_xcollection.dad. It has some minor differences from the file generated in the following steps. If you use it for the lesson, note that the file paths might be different than in your environment and you might need to update the sample file.

To create the DAD file for composing an XML document:

1. From the *dxx_install* directory, open a text editor and create a file called getstart_xcollection.dad.
2. Create the DAD header, using the following text:

   ```
   <?xml version="1.0"?>
   <!DOCTYPE DAD SYSTEM "dxx_install/dtd/dad.dtd">
   ```

   Change *dxx_install* to the XML Extender home directory.
3. Insert the <DAD></DAD> tags. All other tags are located inside these tags.
4. Specify <validation> </validation> tags to indicate whether the XML Extender validates the XML document structure when you insert a DTD into the DTD repository table. This lesson does not require a DTD and the value is NO.

   ```
   <validation>NO</validation>
   ```

   The value of the <validation> tags must be uppercase.
5. Use the <Xcollection></Xcollection> tags to define the access and storage method as XML collection. The access and storage methods define that the XML data is stored in a collection of DB2 tables.

   ```
   <Xcollection>
   </Xcollection>
   ```
6. After the <Xcollection> tag, provide an SQL statement to specify the tables and columns used for the XML collection. This method is called SQL mapping and is one of two ways to map relational data to the XML document structure. (See "Types of mapping schemes" on page 50 to learn more about mapping schemes.) Enter the following statement:

   ```
   <Xcollection
   <SQL_stmt>
      SELECT o.order_key, customer_name, customer_email, p.part_key, color, quantity,
      price, tax, ship_id, date, mode from order_tab o, part_tab p,
       (select db2xml.generate_unique()
        as ship_id, date, mode, part_key from ship_tab) as s
            WHERE o.order_key = 1 and
                  p.price > 20000 and
                  p.order_key = o.order_key and
                  s.part_key = p.part_key
            ORDER BY order_key, part_key, ship_id
   </SQL_stmt>
   </Xcollection>
   ```

   This SQL statement uses the following guidelines when using SQL mapping. Refer to Figure 4 on page 22 for the document structure.

- Columns are specified in top-down order, by the hierarchy of the XML document structure. For example, the columns for the order and customer elements are first, the part element are second, and the shipment are third.
- The columns for a repeating section, or non-repeating section, of the template that requires data from the database are grouped together. Each group has an object ID column: ORDER_KEY, PART_KEY, and SHIP_ID.
- The object ID column is the first column in each group. For example, O.ORDER_KEY precedes the columns related to the key attribute and p.PART_KEY precedes the columns for the Part element.
- The SHIP_TAB table does not have a single key conditional column, and therefore, the generate_unique user-defined function is used to generate the SHIP_ID column.
- The object ID columns are then listed in top-down order in an ORDER BY statements. The columns in ORDER BY should not be qualified by any schema and table name and should match the column names in the SELECT clause.

See "Mapping scheme requirements" on page 52 for requirements when writing an SQL statement.

7. Add the following prolog information to be used in the composed XML document:

   ```
   <prolog>?xml version="1.0"?</prolog>
   ```

   This exact text is required for all DAD files.

8. Add the <doctype></doctype> tags to be used in the XML document you are composing. The <doctype> tag contains the path to the DTD stored on the client.

   ```
   <doctype>!DOCTYPE Order SYSTEM "dxx_install/dtd/getstart.dtd"</doctype>
   ```

9. Define the root element of the XML document using the <root_node></root_node> tags. Inside the root_node, you specify the elements and attributes that make up the XML document.
10. Map the XML document structure to the DB2 relational table structure using the following three types of nodes:

    element_node
    Specifies the element in the XML document. Element_nodes can have child element_nodes.

    attribute_node
    Specifies the attribute of an element in the XML document.

    text_node
    Specifies the text content of the element and the column data in a relational table for bottom-level element_nodes.

    See "The DAD file" on page 48 for more information about these nodes. Figure 4 on page 22 shows the hierarchical structure of the XML document and the DB2 table columns, and indicates what kinds of nodes are used. The shaded boxes indicate the DB2 table column names from which the data will be extracted to compose the XML document.

    The following steps have you add each type of node, one type at a time.

    a. Define an <element_node> tag for each element in the XML document.

       ```
       <root_node>
       <element_node name="Order">
         <element_node name="Customer">
       ```

```
    <element_node name="Name">
    </element_node>
    <element_node name="Email">
    </element_node>
  </element_node>
  <element_node name="Part">
    <element_node name="key">
    </element_node>
    <element_node name="Quantity">
    </element_node>
    <element_node name="ExtendedPrice">
    </element_node>
    <element_node name="Tax">
    </element_node>
    <element_node name="Shipment" multi_occurrence="YES">
      <element_node name="ShipDate">
      </element_node>
      <element_node name="ShipMode">
      </element_node>
    </element_node> <!-- end Shipment -->
  </element_node> <!-- end Part -->
</element_node> <!-- end Order -->
</root_node>
```

Note that the <Shipment> child element has an attribute of multi_occurrence=″YES″. This attribute is used for elements without an attribute, that are repeated in the document. The <Part> element does not use the multi-occurrence attribute because it has an attribute of color, which makes it unique.

b. Define an <attribute_node> tag for each attribute in your XML document. These attributes are nested in their element_node. The added attribute_nodes are highlighted in bold:

```
<root_node>
<element_node name="Order">
  <attribute_node name="key">
  </attribute_node>
  <element_node name="Customer">
    <element_node name="Name">
    </element_node>
    <element_node names"Email">
    </element_node>
  </element_node>
  <element_node name="Part">
    <attribute_node name="color">
    </attribute_node>
    <element_node name="key">
    </element_node>
    <element_node name="Quantity">
    </element_node>

...

  </element_node> <!-- end Part -->
</element_node> <!-- end Order -->
</root_node>
```

c. For each bottom-level element_node, define <text_node> tags, indicating that the XML element contains character data to be extracted from DB2 when composing the document.

```
<root_node>
<element_node name="Order">
  <attribute_node name="key">
  </attribute_node>
  <element_node name="Customer">
```

```
    <element_node name="Name">
      <text_node>
      </text_node>
    </element_node>
    <element_node name="Email">
      <text_node>
      </text_node>
    </element_node>
  </element_node>
  <element_node name="Part">
    <attribute_node name="color">
    </attribute_node>
    <element_node name="key">
       <text_node>
       </text_node>
    </element_node>
    <element_node name="Quantity">
      <text_node>
      </text_node>
    </element_node>
    <element_node name="ExtendedPrice">
      <text_node>
      </text_node>
    </element_node>
    <element_node name="Tax">
      <text_node>
      </text_node>
    </element_node>
    <element_node name="Shipment" multi-occurence="YES">
      <element_node name="ShipDate">
        <text_node>
        </text_node>
      </element_node>
      <element_node name="ShipMode">
        <text_node>
        </text_node>
      </element_node>
    </element_node> <!-- end Shipment -->
  </element_node> <!-- end Part -->
</element_node> <!-- end Order -->
</root_node>
```

d. For each bottom-level element_node, define a <column/> tag. These tags specify from which column to extract data when composing the XML document and are typically inside the <attribute_node> or the <text_node> tags. Remember, the columns defined here must be in the <SQL_stmt> SELECT clause.

```
<root_node>
<element_node name="Order">
  <attribute_node name="key">
    <column name="order_key"/>
  </attribute_node>
  <element_node name="Customer">
    <element_node name="Name">
      <text_node>
        <column name="customer_name"/>
      </text_node>
    </element_node>
    <element_node name="Email">
      <text_node>
        <column name="customer_email"/>
     </text_node>
    </element_node>
  </element_node>
  <element_node name="Part">
    <attribute_node name="color">
```

```
      <column name="color"/>
    </attribute_node>
    <element_node name="key">
      <text_node>
        <column name="part_key"/>
      </text_node>
    <element_node name="Quantity">
      <text_node>
        <column name="quantity"/>
      </text_node>
    </element_node>
    <element_node name="ExtendedPrice">
      <text_node>
        <column name="price"/>
      </text_node>
    </element_node>
    <element_node name="Tax">
      <text_node>
        <column name="tax"/>
      </text_node>
    </element_node>
    <element_node name="Shipment" multi-occurence="YES">
      <element_node name="ShipDate">
        <text_node>
          <column name="date"/>
        </text_node>
      </element_node>
      <element_node name="ShipMode">
        <text_node>
          <column name="mode"/>
        </text_node>
      </element_node>
    </element_node> <!-- end Shipment -->
  </element_node> <!-- end Part -->
</element_node> <!-- end Order -->
</root_node>
```

11. Ensure that you have an ending </root_node> tag after the last </element_node> tag.
12. Ensure that you have an ending </Xcollection> tag after the </root_node> tag.
13. Ensure that you have an ending </DAD> tag after the </Xcollection> tag.
14. Save the file as `getstart_xcollection.dad`

You can compare the file you have just created with the sample file *dxx_install*`/dad/getstart_xcollection.dad`. This file is a working copy of the DAD file required to compose the XML document. The sample file contains location paths and file path names that might need to be changed to match your environment in order to be run successfully.

In your application, if you will use an XML collection frequently to compose documents, you can define a collection name by enabling the collection. Enabling the collection registers it in the XML_USAGE table and helps improve performance when you specify the collection name (rather than the DAD file name) when running store procedures. In these lessons, you will not enable the collection. To learn more about enabling collections, see "Enabling XML collections" on page 97.

Composing the XML document

In this step, you use the dxxGenXML() stored procedure to compose the XML document specified by the DAD file. This stored procedure returns the document as an XMLVARCHAR UDT.

To compose the XML document: Use one of the following methods:

- **Operations Navigator:** Run **Genxml_sql.sql**
- **OS command line:** Enter:

```
CALL DXXSAMPLES/GENX PARM(dbName,'/dxxsamples/dad/getstart_xcollection.dad',result_tab,doc,' ')
```

Tip: This lesson teaches you how to generate one or more composed XML documents using DB2 stored procedure's result set feature. Using a result set allows you to fetch multiple rows to generate more than one document. As you generate each document, you can export it to a file. This method is the simplest way to demonstrate using result sets. For more efficient ways of fetching data see the CLI examples in the DXXSAMPLES/QCSRC source file.

Cleaning up the tutorial environment

If you want to clean up the tutorial environment, you can run one of the provided scripts or enter the commands from the command line to:

- Disable the XML column, ORDER
- Drop tables created in the tutorial
- Delete the DTD from the DTD reference table

They do not disable or drop the SALES_DB database; the database is still available for use with XML Extender. You might receive error messages if you have not completed both lessons in this chapter. You can ignore these errors.

To clean up the tutorial environment: Run the cleanup command files, using one of the following methods:

Operations Navigator:

- To clean up the XML column environment, run **CleanupCol.sql**
- To clean up the XML collection environment, run **CleanupCllec.sql**

OS command line:

- To clean up the XML column environment:
  1. Enter:

```
RUNSQLSTM SRCFILE(DXXSAMPLES/SQLSTMT)
          SRCMBR(D_SALESDB)
```

  2. Enter:

```
RUNSQLSTM SRCFILE(DXXSAMPLES/SQLSTMT)
          SRCMBR(CLEANUPCOL)
```

- To clean up the XML collection environment:
  1. Enter:

```
RUNSQLSTM SRCFILE(DXXSAMPLES/SQLSTMT)
          SRCMBR(D_SALESDB)
```

  2. Enter:

```
RUNSQLSTM SRCFILE(DXXSAMPLES/SQLSTMT)
          SRCMBR(CLEANUPCLL)
```

Part 2. Administration

This part describes how to perform administration tasks for the XML Extender.

Chapter 3. Preparing to use the XML Extender: administration

This chapter describes the requirements for setting up and planning for the XML Extender administration tasks.

Set-up requirements

The following sections describe the administration and application development requirement for using this product, as well as how this development environment is set up. These sections include:

- "Software requirements"
- "The XML operating environment on OS/400"
- "Setting up the samples and development environment" on page 35
- "Setting up adminstration tools" on page 37
- "Setting up the Getting Started environment" on page 38

Software requirements

For administration:

- The XML Extender administration wizard, available in Windows, Linux, AIX, Sun Solaris, and NUMA-Q versions of the product.

  Wizard support for Version 7:
  The wizard is available as a download package from the XML Extender Web site:

  `http://www.ibm.com/software/data/db2/extenders/xmlext/downloads.html`

  Installation steps, configuration information, and software requirements are available at the Web site.

- Optionally, Operations Navigator V5R1, available with iSeries Client Access Express.

  To install Operations Navigator:

  – Go to http://www.ibm.com/eserver/iseries/infocenter
  – Download and upzip a CAE package for your operation system, storing it in *path*/CAInstall.
  – From a Windows command line, run the setup file:

    path/CAInstall/setup.exe

    Select all options except those requiring licenses.

The XML operating environment on OS/400

The following sections describe the XML operating environment for OS/400.

Application programming

All the XML Extender facilities supplied for application programs run in the OS/400 environment as stored procedures or user-defined functions (UDFs). Some of the UDFs that refer to the XMLFile data type, require access to an IFS system. The DB2 XML trace file, is also written to an IFS file.

Two C header files are provided for developing XML Extender applications. These files contain useful constants for calling the stored procedures and for the definitions of error codes. The header files are available in the following directories, after installation of the product:

- `/qibm/proddata/db2extenders/xml/include/dxx.h`
- `/qibm/proddata/db2extenders/xml/include/dxxrc.h`

To develop C++ applications with these headers, use the `INCDIR('/qibm/proddata/db2extenders/xml/include')` option on the **CRTCPPMOD** OS/400 command.

When the sample programs have been restored from the save files, these header files are also available as physical file members in DXXSAMPLES/H(DXX) and DXXSAMPLES/H(DXXRC). To use these header files, the DXXSAMPLES library must be in your library list.

Administration environment

When performing administration tasks in the OS/400 environment, you use the XML Extender adminstration wizard, the Qshell, the Operations Navigator, or the native operating system (OS) command line.

Administration wizard
: You can use either an administration wizard from Windows or UNIX client, or an OS/400 environment to complete administration tasks. See "Starting the administration wizard" on page 59 to learn how to use the administration wizard.

Qshell
: You can run the adminstration command, **dxxadm**, and its options, in the Qshell. The adminstration command is described in "Chapter 10. XML Extender administration command: **dxxadm**" on page 139, and provide options for managing XML column, XML collection, and databases for the XML Extender.

Operations Navigator
: You can call adminstration stored procedures in the Operations Navigator. The adminstration stored procedures are described in "Administration stored procedures" on page 177, and provide options for managing XML column, XML collection, and databases for the XML Extender.

OS command line
: You can run the adminstration program, QZXMADM, from the OS command line. This program uses the administration command parameters described in "Chapter 10. XML Extender administration command: **dxxadm**" on page 139, and provide options for managing XML column, XML collection, and databases for the XML Extender.

The following table summarizes the administration environment for the XML Extender.

Table 6. XML Extender stored procedures and commands

Environment	Qshell	Operations Navigator	OS command line
Sample files	DAD, DTD, and XML files are stored under the *dxx_install* directory. • *dxx_install*/dtd/dad.dtd • *dxx_install*/dtd/*.* • *dxx_install*/dad/*.* • *dxx_install*/xml/*.*	DAD, DTD, and XML files are stored under the *dxx_install* directory. • *dxx_install*/getstart.exe • *dxx_install*/dtd/dad.dtd • *dxx_install*/dtd/*.* • *dxx_install*/dad/*.* • *dxx_install*/xml/*.*	DAD, DTD, and XML files are stored under the *dxx_install* directory. • *dxx_install*/dtd/dad.dtd • *dxx_install*/dtd/*.* • *dxx_install*/dad/*.* • *dxx_install*/xml/*.*
Program executable files	DXXSAMPLES library, which is pointed to by symbolic links in *dxx_install*/*.	DXXSAMPLES library on OS/400; no executables on Windows or UNIX.	DXXSAMPLES library: • Sample SQL scripts in the SQLSTMT file • Sample CL source in the QCLSRC file • Sample C++ source in the QCSRC file
Command scripts	None	*.SQL files in *path*/DXXSAMPLES	DXXSAMPLES/SQLSTMT

Setting up the samples and development environment

The following sections describe how to set up the administration environment, depending on the approach you plan to use for your application

- For all environments - "Unpack and restore sample files and getting started files"
- For all environments - "Creating an SQL Collection (Schema) for the samples" on page 36
- For the administration environment of your choice:
  - When using the wizard - "Setting up the Wizard" on page 37
  - When using the Qshell command line - "Setting up the Qshell" on page 37
  - When using the Operations Navigator - "Setting up the Operations Navigator interface" on page 37
  - When using the OS command line - "Preparing the sample programs for the OS/400 command line" on page 38
- To run the getting started lessons - "Setting up the Getting Started environment" on page 38

Unpack and restore sample files and getting started files

The samples are shipped as two OS/400 Save File objects in the product directory. These files are:

QDBXM/QZXMSAMP1
Contains a SAVLIB save file for the DXXSAMPLES library. The library contains sample C and CL source code, C header files, and SQL statements for application development.

QDBXM/QZXMSAMP2
Contains a SAV save file of an IFS directory tree that will contain sample XML, DTD, and Data Access Definition (DAD) files, and a self-extracting `GetStart.exe` file to be used with the Operations Navigator.

The first step in preparing to use the adminstration environment is to have the OS/400 administrator unpack and restore these save files to your system.

The adminstrator should:

- Unpack QDBXM/QZXMSAMP1 Save File to restore Samples source code and SETUP program to your system.

  From the OS command line, enter:

  ```
  RSTLIB SAVLIB(DXXSAMPLES)
     DEV(*SAVF)
     SAVF(QDBXM/QZXMSAMP1)
  ```

  The RSTLIB command unpacks the save file in the DXXSAMPLES library and it contains the objects listed in Table 7:

Table 7. DXXSAMPLES library objects

Object	Type	Attribute	Description
SETUP	PGM	CLP	Compiles sample programs and Add IFS
H	FILE	PF-SRC	C Header files
QCLSRC	FILE	PF-SRC	Interface for Operations Navigator
QCSRC	FILE	PF-SRC	Sample programs
SQLSTMT	FILE	PF-SRC	SQL statements for samples

- Unpack QDBXM/QZXMSAMP2 Save File to restore XML files and GetStart.exe to the user's system.

  From the OS command line, enter:

  ```
  RST DEV('/qsys.lib/qdbxm.lib/qzxmsamp2.file')
     OBJ(('/QIBM/UserData/DB2Extenders/XML/Samples'))
  ```

  The RST DEV command restores the save file to the XML files to the IFS directory, `/QIBM/UserData/DB2Extenders/XML/Samples`.

A symbolic link, `/dxxsamples`, is created during the samples set up, and points to IFS directory, `/QIBM/UserData/DB2Extenders/XML/Samples`. The term *dxx_install* used throughout this book refers to either of these values.

Creating an SQL Collection (Schema) for the samples

You need to have a schema to run the samples because a set of stored procedures and tables with sample data will be created in this schema.

When creating an SQL schema, it is recommended that the name of the schema the user ID that you will use while running the samples because of default schema rules in SQL.

If you already have an SQL schema matching this user ID, you do not need to create a new schema.

To create the schema:

- From the OS command line, enter:

  ```
  STRSQL
  ```

An SQL session opens.

- From the SQL session, enter:

  ```
  CREATE SCHEMA UserId
  ```

  Where *UserId* is user ID that you are using while running the samples.

Setting up adminstration tools

The tools you can use for adminstration tools were described in "Administration environment" on page 34. You can choose any of these environments to perform the administration tasks. Some of these environments require set up to be used with the XML Extender administration commands, the stored procedures, and the samples. The following sections describe the set up requirements.

Setting up the Wizard

See the XML Extender Web site:

```
http://www-4.ibm.com/software/data/db2/extenders/xmlext/downloads.html
```

Setting up the Qshell

No set up required, except for installation of the Qshell option.

Setting up the Operations Navigator interface

You can use the Operations Navigator to run administration commands, SQL statements, stored procedures, and to complete the Getting Started lessons. If you plan to use the Operations Navigator, complete the following steps to download and build the sample programs. Building the sample programs prepares the environment for running the adminstration strored procedures and is required.

1. Download and unpack the `GetStart.exe` file.
   a. Create a directory on the Windows operating system, called *path*`/dxxsamples`. *path* is the drive and directory under which the `dxxsamples` directory is to be located.
   b. From a Windows command line, enter:

      ```
      FTP SystemId
      ```

      Where *SystemId* is the host name of the OS/400 system where you have restored the save file to the *dxx_install* directory.

      Enter the requested user ID and password.
   c. Enter the following FTP command to change to binary mode: `Binary`.
   d. Enter the following FTP command to move the gettting started exe file to the `dxxsamples` directory.:

      ```
      get dxx_install/getstart.exe  path/dxxsamples/getstart.exe
      ```
   e. Close the FTP session with the following command:

      ```
      exit
      ```
   f. From the *path*`/dxxsamples` directory, enter:

      ```
      GetStart.exe
      ```
2. Start the Operations Navigator.
3. Expand the tree for your OS/400 system, and right click **Database**. A menu is displayed.
4. From the menu, click **Run SQL Scripts**.
5. Open the *path*`/dxxsamples/setup.sql` script file.
6. Change all occurrences of `&SCHEMA` to the schema name you created in "Creating an SQL Collection (Schema) for the samples" on page 36:

a. Click the **Edit –> Replace** from the menu. The Search and Replace window opens.
b. From the Search and Replace window, replace all occurrences of `&SCHEMA` with your schema name.

7. Change all occurrences of `&DBNAME` to the RDB database name for the system where you will run the sample programs. To determine this name, run the **WRKRDBDIRE** command from the OS command line. From the list of registered databases, select the name with the remote address of *LOCAL.
   a. Click the **Edit –> Replace** from the menu. The Search and Replace window opens.
   b. From the Search and Replace window, replace all occurrences of `&DBNAME` with the local database name.
8. Save the setup.sql file
9. Repeat steps 5-8 for each sql file.
10. Open the *path*`/dxxsamples/Setup.sql` script file and click **Run all**.

You are now ready to begin the Getting Started lessons in "Chapter 2. Getting started with XML Extender" on page 9, using the Operations Navigator.

The sample programs you have just built can be used to enter adminstration commands and DB2 commands. See "Using the Operations Navigator" on page 62 to learn how to perform administration tasks using Operations Navigator.

Preparing the sample programs for the OS/400 command line

You can use the OS command line to run administration commands and to complete the Getting Started lessons.

To run administration commands, there is no set up.

If you plan to use the OS command line for the samples and getting started lessons, run SETUP to build all sample programs. From the OS command line, enter:

```
CALL DXXSAMPLES/SETUP
```

You are now ready to begin the Getting Started lessons in "Chapter 2. Getting started with XML Extender" on page 9.

Setting up the Getting Started environment

The following sections describe the required steps to set up the environment to perform the Getting Started lessons in "Chapter 2. Getting started with XML Extender" on page 9, which will help you use the provided samples for developing your own applications.

You can use the following environments to complete the Getting Started lessons:

- Operations Navigator
- OS command line
- DB2 command line

To use these environments, you must:

1. Restore the sample source code to the samples library. Use the steps in "Unpack and restore sample files and getting started files" on page 35.
2. Restore the XML sample files and the Getting Started executable to an IFS directory. Use the steps in "Unpack and restore sample files and getting started files" on page 35.
3. Create an SQL Schema (collection). Use the steps in "Creating an SQL Collection (Schema) for the samples" on page 36.
4. Set up the environment from which you will complete the adminstration tasks.
   - When using the Operations Navigator - "Setting up the Operations Navigator interface" on page 37
   - When using the OS command line - "Preparing the sample programs for the OS/400 command line" on page 38

Administration planning

When planning an application that uses XML documents, you first need to make the following design decisions:

- If you will be composing XML documents from data in the database
- If you will be storing existing XML documents, and if you want them to be stored as intact XML documents in a column or decomposed into regular DB2 data

After you make these decisions, you can then plan the rest of your administration tasks:

- Whether to validate your XML documents
- Whether to index XML column data for fast search and retrieval
- How to map the structure of the XML document to DB2 relational tables

How you use the XML Extender depends on what your application requires. As indicated in "Chapter 1. Introduction to the XML Extender" on page 3, you can compose XML documents from existing DB2 data and store XML documents in DB2, either as intact documents or as DB2 data. Each of these storage and access methods have different planning requirements. The following sections discuss each of these planning considerations.

Choosing an access and storage method

The XML Extender provides two access and storage methods to use DB2 as an XML repository: XML column and XML collection. You first need to decide which of the methods best matches your application needs for accessing and manipulating XML data.

XML column
: Stores and retrieves entire XML documents as DB2 column data. The XML data is represented by an XML column.

XML collection
: Decomposes XML documents into a collection of relational tables or composes XML documents from a collection of relational tables.

The nature of your application determines the type of access and storage method to use and how to structure your XML data. The following scenarios describe situations in which each access and storage method is the most appropriate.

When to use XML columns

Use XML columns in the following situations:

- The XML documents already exist or come from some external source and you prefer to store the documents in the native XML format. You want to store them in DB2 for integrity and for archival and auditing purposes.
- The XML documents are generally read, but not updated.
- You want to use file name data types to store the XML documents external to DB2 in the local or remote file system and to use DB2 for management and search operations.
- You need range search based on the values of XML elements or attributes, and you know what elements or attributes will frequently be the search arguments.
- The documents have elements with large text blocks and you want to use the DB2 Text Extender for structural text search while keeping the entire documents intact.

When to use XML collections

Use XML collections in the following situations:

- You have data in your existing relational tables and you want to compose XML documents based on a certain DTD.
- You have XML documents that need to be stored with collections of data that map well to relational tables.
- You want to create different views of your relational data using different mapping schemes.
- You have XML documents that come from other data sources. You care about the data but not the tags, and want to store pure data in your database. You want the flexibility to decide whether to store the data in some existing tables or in new tables.
- A small subset of your XML documents needs to be updated often, and update performance is critical.
- You need to store the data of entire incoming XML documents but often only want to retrieve a subset of them.

You use the document access definition (DAD) file to associate XML data with DB2 tables through these two access and storage methods. Figure 5 on page 41 shows how the DAD specifies the access and storage methods.

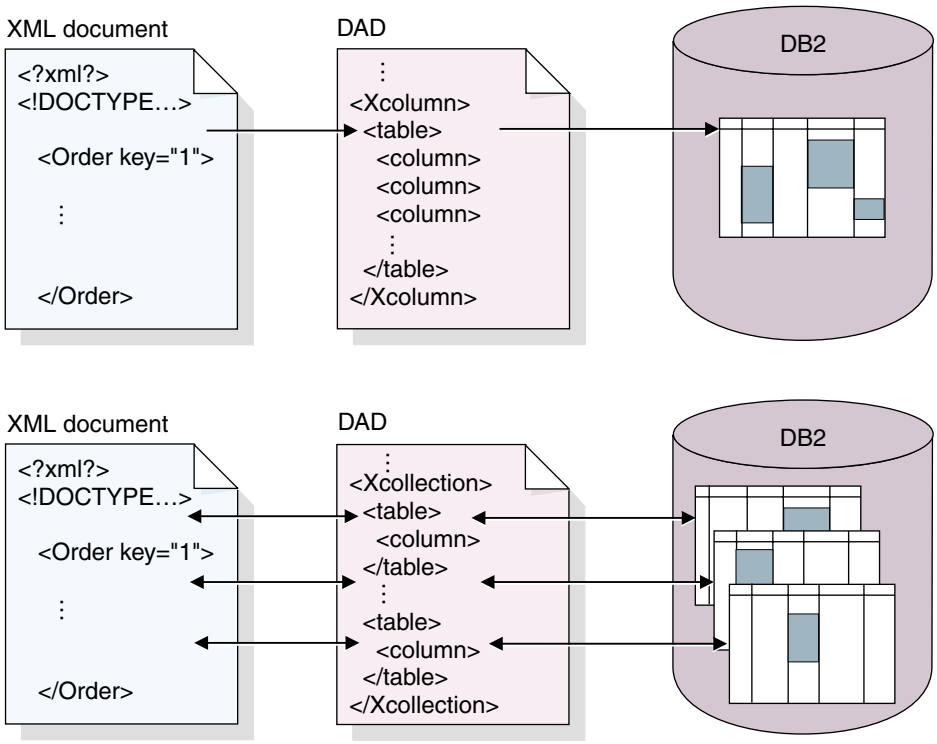


Figure 5. The DAD file maps the XML document structure to DB2 and specifies the access and storage method.

The DAD file is an important part of administering the XML Extender. It defines the location of key files like the DTD, and specifies how the XML document structure relates to your DB2 data. Most important, it defines the access and storage methods you use in your application.

Planning for XML columns

Before you begin working with the XML Extender to store your documents, you need to understand the structure of the XML document so that you can determine how to index elements and attributes in the document. When planning how to index the document, you need to determine:

- The XML user-defined type in which you will store the XML document
- The XML elements and attributes that your application will frequently search, so that their content can be stored in side tables and indexed to improve performance
- Whether or not to validate XML documents in the column with a DTD
- The structure of the side tables and how they will be indexed

Determining the XML data type for the XML column

The XML Extender provides XML user defined types in which you define a column to hold XML documents. These data types are described in Table 8 on page 42.

Table 8. The XML Extender UDTs

User-defined type column	Source data type	Usage description
XMLVARCHAR	VARCHAR(*varchar_len*)	Stores an entire XML document as VARCHAR inside DB2. Used for small documents stored in DB2.
XMLCLOB	CLOB(*clob_len*)	Stores an entire XML document as CLOB inside DB2. Used for large documents stored in DB2.
XMLFILE	VARCHAR(1024)	Stores the file name of an XML document in DB2, and stores the XML document in a file local to the DB2 server. Used for documents stored outside DB2.

Determining elements and attributes to be indexed

When you understand the XML document structure and the needs of the application, you can determine which elements and attributes to be searched. These are usally the elements and attributes that will be searched or extracted most frequently, or those that will be the most expensive to query. The location paths of each element and attribute can be mapped to relational tables (side tables) that contain the content of these objects, in the DAD file for XML columns. The side tables are then indexed.

For example, Table 9 shows an example of types of data and location paths of element and attribute from the Getting Started scenario for XML columns. The data was specified as information to be frequently searched and the location paths point to elements and attributes that contain the data. These location paths can then be mapped to side tables in the DAD file.

Table 9. Elements and attributes to be searched

Data	Location path
order key	/Order/@key
customer	/Order/Customer/Name
price	/Order/Part/ExtendedPrice
shipping date	/Order/Part/Shipment/ShipDate

Planning side tables

Side tables are DB2 subtables used to extract the content of an XML document that will be searched frequently. The location path of the element or attribute is mapped to a table and column, indexed, and used for searches. When the XML document is updated in the application table, the values in the side tables are automatically updated.

Figure 6 on page 43 shows an XML column with side tables.

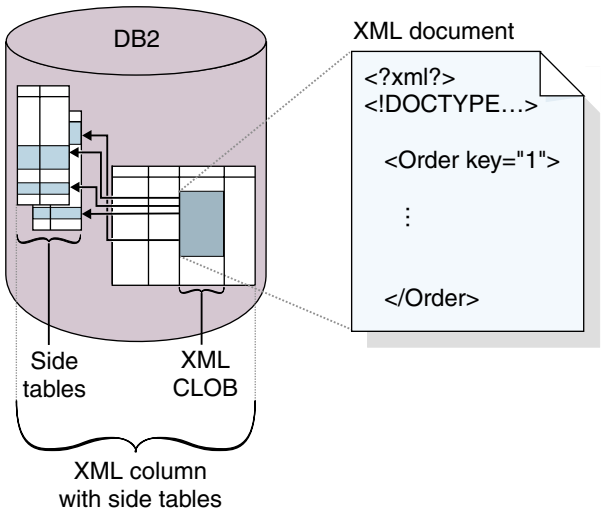


Figure 6. An XML column with side tables

When planning for side tables, you must consider how to organize the tables, how many tables to create, and whether to create a default view for the side tables. These decisions are partly based on several issues: whether elements and attributes can occur multiple times, and the requirements for query performance. Additionally, do not plan to update the side tables in any way; they will be automatically updated when the document is updated in the XML column.

Multiple occurrence: When using multiple occurring location paths, consider the following issues in your planning:

- For elements or attributes in an XML document that have *multiple occurrences*, you must create a separate side table for each XML element or attribute with multiple occurrences, due to the complex structure of XML documents. This means that elements or attributes that have multiple occurring location paths must be mapped to a table with only one column, the column for that location path. You cannot have any other columns in the table, whether or not they have multiple occurrence.
- When a document has multiple occurring location paths, XML Extender will add a column DXX_SEQNO of type INTEGER in each side table to keep track of the order of elements that occur more than once. With DXX_SEQNO, you can retrieve a list of the elements using the same order as the original XML document by specifying ORDER BY DXX_SEQNO in an SQL query.

The MANYROWS setting for multiple occurrence: The XML Extender uses an adjustable setting, called MANYROWS, to manage the maximum number of occurrences that are replicated to side tables. This setting requires some planning for your XML column application.

The XML Extender sets the maximum number of multiple occurrences at 2000. This value can be modified to improve performance, and must be modified if more than 2000 occurrences can be encountered in an XML document.

If your system will always encounter XML documents with a multiple occurrence of significantly less than 2000, for example less than 200, consider changing the setting to 200 rows, instead of 2000. This modification can provide a performance improvement for your XML-enabled columns queries.

If your system might encounter an XML document with a multiple occurrence of 2000 or more, then you must adjust this value higher than the anticipated number of occurrences to avoid loss of data.

For example, you might have two XML documents. The first document and the location path '/Flower/Type' has two occurrences, 'Rose' and 'Carnation'. It has significantly fewer occurrences that 2000. If this is typical of all of your XML column documents, and the documents are likely to have have many updates, reducing the value of MANYROWS to 10 would improve performance in the application.

```
----------------------------------------
<Flower>
    <Type>Rose</Type>
    <Type>Carnation</Type>
</Flower>
----------------------------------------
```

However, the second document and location path '/USCensus/Name' has millions of occurrences. By default, only the first 2000 would be replicated to the side tables. You would need to significantly increase value of MANYROWS to retrieve the full number of occurrences.

```
----------------------------------------
<USCensus>
<Name>Arrol   Aaron</Name>
          ...
<Name>Zack   Zywonkin</Name>
</USCensus>
----------------------------------------
```

To change the value of MANYROWS:

Alter the number of rows in the DB2XML.MANYROWS table. This table is created and initialized with 2000 rows when you enable a database for the XML Extender. It has one column of type INTEGER, with values from 0 to 1999. The number of rows in this table determines the value of MANYROWS.

- Delete rows to improve performance in cases where the number of multiple occurrences will be significantly lower than 2000.
- Add rows to the table to increase the number of occurrences which can be processed from an XML document location path.

  Because the number of rows in the DB2XML.MANYROWS table imposes a limit on the number of occurrences which can be processed from an XML document location path, it is important to raise this limit if the number of occurrences will exceed the limit.

Default views and query performance: When you enable an XML column, you can specify a default, read-only view that joins the application table with the side tables using a unique ID, called the ROOT ID. With the default view, you can search XML documents by querying the side tables. For example, if you have the application table SALES_TAB, and the side tables ORDER_TAB, PART_TAB and SHIP_TAB:

```
SELECT sales_person FROM sales_order_view
      WHERE price > 2500.00
```

The SQL statement returns the names of sales people in SALES_TAB who have orders stored in the column ORDER, and where the PRICE is greater than 2500.00.

The advantage of querying the default view is that it provides a virtual single view of the application table and side tables. However, the more side tables that are created, the more expensive the query. Therefore, creating the default view is only recommended when the total number of side-table columns is small. Applications can create their own views, joining the important side table columns.

Column name limit: For OS/400, the column size limit in a view is 10 characters. To use a longer name, you must generate the view manually or use alias names

Indexes for XML column data

An important planning decision is whether to index your XML column document. This decision should be made based on how often you need to access the data and how critical performance is during structural searches.

When using XML columns, which contain entire XML documents, you can create side tables to contain columns of XML element or attribute values, then create indexes on these columns. You must determine for which elements and attributes you need to create the index.

XML column indexing allows frequently queried data of general data types, such as integer, decimal, or date, to be indexed using the native DB2 index support from the database engine. The XML Extender extracts the values of XML elements or attributes from XML documents and stores them in the side tables, allowing you to create indexes on these side tables. You can specify each column of a side table with a location path that identifies an XML element or attribute and an SQL data type.

The XML Extender automatically populates the side table when you store XML documents in the XML column.

For fast search, create indexes on these columns using the DB2 *B-tree indexing* technology. The methods that are used to create an index vary on different operating systems, and the XML Extender supports these methods.

Considerations:

- For elements or attributes in an XML document that have *multiple occurrences*, you must create a separate side table for each XML element or attribute with multiple occurrences due to the complex structure of XML documents.
- You can create multiple indexes on an XML column.
- You can associate side tables with the application table using the ROOT ID, the column name of the primary key in the application table and a unique identifier that associates all side tables with the application table. You can decide whether you want the primary key of the application table to be the ROOT ID, although it cannot be the composite key. This method is recommended.

  If the single primary key does not exist in the application table, or for some reason you don't want to use it, the XML Extender alters the application table to add a column DXXROOT_ID, which stores a unique ID that is created at the insertion time. All side tables have a DXXROOT_ID column with the unique ID. If the primary key is used as the ROOT ID, all side tables have a column with the same name and type as the primary key column in the application table, and the values of the primary keys are stored.

- If you enable an XML column for the DB2 Text Extender, you can also use the Text Extender's structural-text feature. The Text Extender has *"section search"* support, which extends the capability of a conventional full-text search by allowing search words to be matched within a specific document context that is specified by location paths. The *structural-text index* can be used with the XML Extender's indexing on general SQL data types.

Validation

After you choose an access and storage method, you can determine whether to *validate* the XML documents that are stored in the column. You validate XML data using a DTD. The DTD is stored in the DTD repository, or can be stored in the file system that the DB2 server has access to.

Recommendation: Validate XML data with a DTD, unless you are storing XML documents for archival purposes. To validate, you need to have a DTD in the XML Extender repository. See "Storing a DTD in the DTD repository table" on page 66 to learn how to insert a DTD into the repository.

You can validate documents in the same XML column using different DTDs. In other words, you can have documents that have a similar structure, with similar elements and attributes, that call DTDs that are different. To reference multiple DTDs, use the following guidelines:

- The system ID of the XML document in the DOCTYPE definition must specify the DTD file using a full path name.
- You must specify YES for validation in the DAD file.
- At least one of the DTDs must be stored in the DTD_REF table. All of the DTDs can be stored in this table.
- The DTDs should have a common structure, with differences only in subelements.
- The DAD file should specify elements or attributes that are common to all of the DTDs referenced by documents in that column.

Important: Make the decision whether to validate before inserting XML data into DB2. The XML Extender does not support the validation of data that has already been inserted into DB2.

Considerations:

- If you do not choose to validate a document, the DTD specified by the XML document is not processed. It is important that DTDs be processed to resolve entity values and attribute defaults even when processing document fragments that cannot be validated.
- You do not need a DTD to store or archive XML documents.
- Validating your XML data might have a small performance impact.
- You can use multiple DTDs, but can only index common elements and attributes.

The DAD file

For XML columns, the DAD file primarily specifies how documents that are stored in an XML column are to be indexed, and is an XML-formatted document, residing at the client. The DAD file specifies a DTD to use for validating documents inserted into the XML column. The DAD file has a data type of CLOB. This file can be up to 100 KB.

The DAD file for XML columns contains an XML header, specifies the directory paths on the client for the DAD file and DTD, and provides a map of any XML data that is to be stored in side tables for indexing.

To specify the XML column access and storage method, you use the following tag in the DAD file.

<Xcolumn>
Specifies that the XML data is to be stored and retrieved as entire XML documents in DB2 columns that are enabled for XML data.

An XML-enabled column is of the XML Extender's UDT. Applications can include the column in any *user table*. You access the XML column data mainly through SQL statements and the XML Extender's UDFs.

You can use the XML Extender administration wizard or an editor to create and update the DAD.

Planning for XML collections

When planning for XML collections, you have different considerations for composing documents from DB2 data, decomposing XML document into DB2 data, or both. The following sections address planning issues for XML collections, and address composition and decomposition considerations.

Validation

After you choose an access and storage method, you can determine whether to validate your data. You validate XML data using a DTD. Using a DTD ensures that the XML document is valid and lets you perform structured searches on your XML data. The DTD is stored in the DTD repository.

Recommendation: Validate XML data with a DTD. To validate, you need to have a DTD in the XML Extender repository. See "Storing a DTD in the DTD repository table" on page 66 to learn how to insert a DTD into the repository. The DTD requirements differ depending on whether you are composing or decomposing XML documents. The following list describes these requirements:

- For composition, you can only validate generated XML documents against one DTD. The DTD to be used is specified in the DAD file.
- For decomposition, you can validate documents for composition using different DTDs. In other words, you can decompose documents, using the same DAD file, but call DTDs that are different. To reference multiple DTDs, you must use the following guidelines:
  - At least one of the DTDs must be stored in the DTD_REF table. All of the DTDs can be stored in this table.
  - The DTDs should have a common structure, with differences in subelements.
  - You must specify validation in the DAD file.
  - The SYSTEM ID of the XML document must specify the DTD file using a full path name.
  - The DAD file contains the specification for how to decompose the document, and therefore, you can specify only common elements and attributes for decomposition. Elements and attributes that are unique to a DTD cannot be decomposed.

Important: Make the decision whether to validate XML data before inserting XML data into DB2. The XML Extender does not support the validation of data that has already been inserted into DB2.

Considerations:

- You should use a DTD when using XML as interchange format.
- Validating your XML data might have a small performance impact.
- You can decompose only common elements and attributes when using multiple DTDs for decomposition.
- You can decompose all elements and attributes when using one DTD.
- You can use only one DTD for composition.

The DAD file

For XML collections, the DAD file maps the structure of the XML document to the DB2 tables from which you either compose the document, or to where you decompose the document.

For example, if you have an element called <Tax> in your XML document, you might need to map <Tax> to a column called TAX. You define the relationship between the XML data and the relational data in the DAD.

The DAD file is specified either while enabling a collection, or when you use the DAD file in XML collection *stored procedures*. The DAD is an XML-formatted document, residing at the client. If you choose to validate XML documents with a DTD, the DAD file can be associated with that DTD. When used as the input parameter of the XML Extender stored procedures, the DAD file has a data type of CLOB. This file can be up to 100 KB.

To specify the XML collection access and storage method, you use the following tag in the DAD file:

<Xcollection>
: Specifies that the XML data is either to be decomposed from XML documents into a collection of relational tables, or to be composed into XML documents from a collection of relational tables.

  An XML collection is a virtual name for a set of relational tables that contains XML data. Applications can enable an XML collection of any user tables. These user tables can be existing tables of legacy business data or tables that the XML Extender recently created. You access XML collection data mainly through the stored procedures that the XML Extender provides.

The DAD file defines the XML document tree structure, using the following kinds of nodes:

root_node
: Specifies the root element of the document.

element_node
: Identifies an element, while can be the root element or a child element.

text_node
: Represents the CDATA text of an element.

attribute_node
: Represents an attribute of an element.

Figure 7 on page 49 shows a fragment of the mapping that is used in a DAD file. The nodes map the XML document content to table columns in a relational table.

```
<?xml version="1.0"?>
<!DOCTYPE DAD SYSTEM "dxx_install/dtd/dad.dtd">
<DAD>
  ...
<Xcollection>
<SQL_stmt>
       ...
</SQL_stmt>
<prolog>?xml version="1.0"?</prolog>
<doctype>!DOCTYPE Order SYSTEM "dxx_install/sample/dtd/getstart.dtd"</doctype>
<root_node>
   <element_node name="Order">         --> Identifies the element <Order>
     <attribute_node name="key">       --> Identifies the attribute "key"
        <column name="order_key"/>     --> Defines the name of the column,
                                           "order_key", to which the element and
                                           attribute are mapped
     </attribute_node>
     <element_node name="Customer">    --> Identifies a child element of
                                           <Order> as <Customer>
        <text_node>                    --> Specifies the CDATA text for the element
                                             <Customer>
          <column name="customer">     --> Defines the name of the column, "customer",
                                             to which the child element is mapped
        </text_node>
     </element_node>
        ...
   </element_node>

      ...
<root_node>
</Xcollection>
</DAD>
```

Figure 7. Node definitions

In this example, the first two columns in the SQL statement have elements and attributes mapped to them.

You can use the XML Extender administration wizard or an editor to create and update the DAD file.

Mapping schemes for XML collections

If you are using an XML collection, you must select a *mapping scheme* that defines how XML data is represented in a relational database. Because XML collections must match a hierarchical structure that is used in XML documents with a relational structure, you should understand how the two structures compare. Figure 8 on page 50 shows how the hierarchical structure can be mapped to relational table columns.

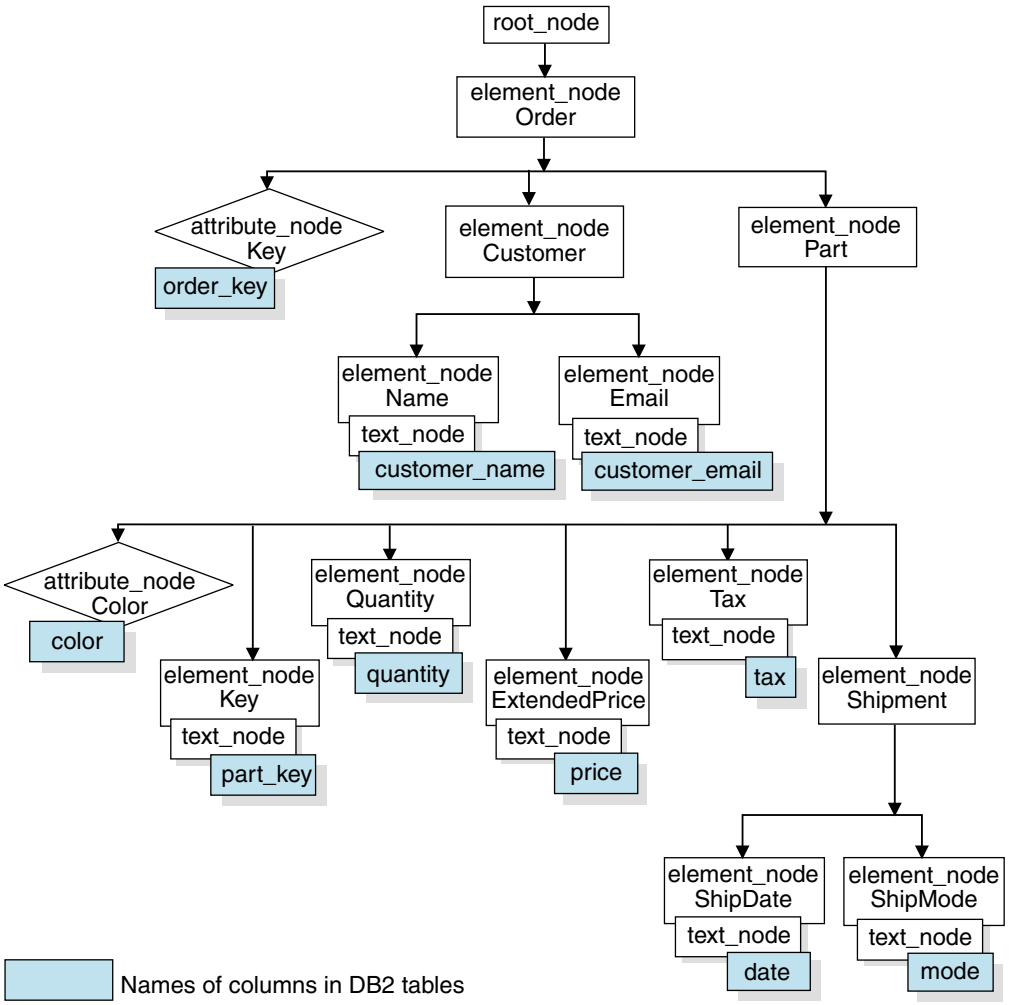


Figure 8. XML document structured mapped to relational table columns

The XML Extender uses the mapping scheme when composing or decomposing XML documents that are located in multiple relational tables. The XML Extender provides a wizard that assists you in creating the DAD file. However, before you create the DAD file, you must think about how your XML data is mapped to the XML collection.

Types of mapping schemes: The mapping scheme is specified in the <Xcollection> element in the DAD file. The XML Extender provides two types of mapping schemes: *SQL mapping* and *Relational Database (RDB_node) mapping*. Both methods use the XPath model to define the hierarchy of the XML document.

SQL mapping

Allows direct mapping from relational data to XML documents through a single SQL statement and the *XPath data model*. SQL mapping is used for composition; it is not used for decomposition. SQL mapping is defined with the SQL_stmt element in the DAD file. The content of the SQL_stmt is a valid SQL statement. The SQL_stmt maps the columns in the SELECT clause to XML elements or attributes that are used in the XML document. When defined for composing XML documents, the column names in the SQL statement's SELECT clause are used to define the value of an

attribute_node or a content of *text_node*. The FROM clause defines the tables containing the data; the WHERE clause specifies the *join* and search *condition*.

The SQL mapping gives DB2 users the power to map the data using SQL. When using SQL mapping, you must be able to join all tables in one SELECT statement to form a query. If one SQL statement is not sufficient, consider using RDB_node mapping. To tie all tables together, the *primary key* and *foreign key* relationship is recommended among these tables.

RDB_node mapping

Defines the location of the content of an XML element or the value of an XML attribute so that the XML Extender can determine where to store or retrieve the XML data.

This method uses the XML Extender-provided *RDB_node*, which contains one or more node definitions for tables, optional columns, and optional conditions. The tables and columns are used to define how the XML data is to be stored in the database. The condition specifies the criteria for selecting XML data or the way to join the XML collection tables.

To define a mapping scheme, you create a DAD with an <Xcollection> element. Figure 9 on page 52 shows a fragment of a sample DAD file with an XML collection SQL mapping that composes a set of XML documents from data in three relational tables.

```
<?xml version="1.0"?>
<!DOCTYPE DAD SYSTEM "dxx_install/dtd/dad.dtd">
<DAD>
  <dtdid>dxx_install/dad/getstart.dtd</dtdid>
  <validation>YES</validation>
  <Xcollection>
    <SQL_stmt>
       SELECT o.order_key, customer, p.part_key, quantity, price, tax, date,
              ship_id, mode, comment
         FROM order_tab o, part_tab p,
               (select db2xml.generate_unique()
               as ship_id, date, mode, from ship_tab) as
 s
        WHERE p.price > 2500.00 and s.date > "1996-06-01" AND
              p.order_key = o.order_key and s.part_key = p.part_key
    </SQL_stmt>
    <prolog>?xml version="1.0"?</prolog>
    <doctype>!DOCTYPE DAD SYSTEM "dxx_install/dtd/getstart.dtd"</doctype>
    <root_node>
   <element_node name="Order">
  <attribute_node name="key">
<column_name="order_key"/>
  </attribute_node>
  <element_node name="Customer">
  <text_node>
  <column name="customer"/>
  </text_node>
  <element_node>

...

  </element_node><!-end Part->
   </element_node><!-end Order->
    </root_node>
  </Xcollection>
</DAD>
```

Figure 9. SQL mapping scheme

The XML Extender provides several stored procedures that manage data in an XML collection. These stored procedures support both types of mapping, but require that the DAD file follow the rules that are described in "Mapping scheme requirements".

Mapping scheme requirements: The following sections describe requirements for each type of the XML collection mapping schemes.

Requirements when using SQL mapping

In this mapping scheme, you must specify the SQL_stmt element in the DAD <Xcollection> element. The SQL_stmt should contain a single SQL statement that can join multiple relational tables with the query *predicate*. In addition, the following clauses are required:

- **SELECT clause**
  - Ensure that the name of the column is unique. If two tables have the same column name, use the AS keyword to create an alias name for one of them.
  - Group the columns of the same table together, and use the logical hierarchical level of the relational tables. This means group the tables according to the level of importance as they map to the hierarchical structure of your XML document. In the SELECT clause, the columns

of the higher-level tables should proceed the columns of lower-level tables. The following example demonstrates the hierarchical relationship among tables:

```
SELECT o.order_key, customer, p.part_key, quantity, price, tax,
       ship_id, date, mode
```

In this example, `order_key` and `customer` from table ORDER_TAB have the highest relational level because they are higher on the hierarchical tree of the XML document. The `ship_id`, `date`, and `mode` from table SHIP_TAB are at the lowest relational level.

- Use a single-column candidate key to begin each level. If such a key is not available in a table, the query should generate one for that table using a table expression and the user-defined function, generate_unique(). In the above example, the `o.order_key` is the primary key for ORDER_TAB, and the `part_key` is the primary key of PART_TAB. They appear at the beginning of their own group of columns that are to be selected. Because the SHIP_TAB table does not have a primary key, one needs to be generated, in this case, `ship_id`. It is listed as the first column for the SHIP_TAB table group. Use the FROM clause to generate the primary key column, as shown in the following example.

- **FROM clause**
  - Use a table expression and the user-defined function, generate_unique(), to generate a single key for tables that do not have a primary single key. For example:

    ```
    FROM order_tab as o, part_tab as p,
           (select db2xml.generate_unique() as
           ship_id, date, mode from ship_tab) as s
    ```

    In this example, a single column candidate key is generated with the function, generate_unique() and given an alias named `ship_id`.
  - Use an alias name when needed to make a column distinct. For example, you could use `o` for ORDER_TAB, `p` for PART_TAB, and `s` for SHIP_TAB.
- **WHERE clause**
  - Specify a primary and foreign key relationship as the join condition that ties tables in the collection together. For example:

    ```
    WHERE p.price > 2500.00 AND s.date > "1996-06-01" AND
          p.order_key = o.order_key AND s.part_key = p.part_key
    ```
  - Specify any other search condition in the predicate. Any valid predicate can be used.
- **ORDER BY clause**
  - Define the ORDER BY clause at the end of the SQL_stmt.
  - Ensure that the column names match the column names in the SELECT clause.
  - Specify the column names or identifiers that uniquely identify entities in the entity-relationship design of the database. An identifier can be generated using a table expression and the function generate_unique, or a user-defined function (UDF).
  - Maintain the top-down order of the hierarchy of the entities. The column specified in the ORDER BY clause must be the first column listed for each entity. Keeping the order ensures that the XML documents to be generated do not contain incorrect duplicates.

– Do not qualify the columns in ORDER BY by any schema or table name.

Although the SQL_stmt has the preceding requirements, it is powerful because you can specify any predicate in your WHERE clause, as long as the expression in the predicate uses the columns in the tables.

Requirements when using RDB_node mapping

When using this mapping method, do not use the element SQL_stmt in the <Xcollection> element of the DAD file. Instead, use the RDB_node element in each of the top nodes for *element_node* and for each attribute_node and text_node.

- **RDB_node for the top element_node**

  The *top element_node* in the DAD file represents the root element of the XML document. Specify an RDB_node for the top element_node as follows:

  – Specify all tables that are associated with the XML documents. For example, the following mapping specifies three tables in the RDB_node of the element_node <Order>, which is the top element_node:

```
<element_node name="Order">
    <RDB_node>
        <table name="order_tab"/>
        <table name="part_tab"/>
        <table name="ship_tab"/>
        <condition>
           order_tab.order_key = part_tab.order_key AND
           part_tab.part_key = ship_tab.part_key
        </condition>
    </RDB_node>
```

    The condition element can be empty or missing if there is only one table in the collection.

  – If you are decomposing, or are enabling the XML collection specified by the DAD file, you must specify a primary key for each table. The primary key can consist of a single column or multiple columns, called a composite key. The primary key is specified by adding an attribute key to the table element of the RDB_node. When a composite key is supplied, the key attribute is specified by the names of key columns separated by a space. For example:

```
<table name="part_tab" key="part_key price"/>
```

    The information specified for decomposition is ignored when composing a document.

  – Use the orderBy attribute to recompose XML documents containing elements or attributes with multiple occurrence back to their original structure. This attribute allows you to specify the name of a column that will be the key used to preserve the order of the document. The orderBy attribute is part of the table element in the DAD file, and it is an optional attribute.

  You must explicitly spell out the table name and the column name.

- **RDB_node for each attribute_node and text_node**

  In this mapping scheme, the data resides in the attribute_node and text_node for each element_node. Therefore, the XML Extender needs to know from where in the database it needs to find the data. You need to

specify an RDB_node for each attribute_node and text_node, telling the stored procedure from which table, which column, and under which query condition to get the data. You must specify the table and column values; the condition value is optional.

- Specify the name of the table containing the column data. The table name must be included in the RDB_node of the top element_node. In this example, for text_node of element <Price>, the table is specified as PART_TAB.

```
<element_node name="Price">
    <text_node>
        <RDB_node>
            <table name="part_tab"/>
            <column name="price"/>
            <condition>
                 price > 2500.00
            </condition>
        </RDB_node>
    </text_node>
</element_node>
```

- Specify the name of the column that contains the data for the element text. In the previous example, the column is specified as PRICE.
- Specify a condition if you want XML documents to be generated using the query condition. In the example above, the condition is specified as `price > 2500.00`. Only the data meeting the condition is in the generated XML documents. The condition must be a valid WHERE clause.
- If you are decomposing a document, or are enabling the XML collection specified by the DAD file, you must specify the column type for each attribute_node and text_node. This ensures the correct data type for each column when new tables are created during the enabling of an XML collection. Column types are specified by adding the attribute type to the column element. For example,

  ```
  <column name="order_key" type="integer"/>
  ```

  The information specified for decomposition is ignored when composing a document.

With the RDB_node mapping approach, you don't need to supply SQL statements. However, putting complex query conditions in the RDB_node element can be more difficult.

Decomposition table size requirements

Decomposition uses RDB_node mapping to specify how an XML document is decomposed into DB2 tables by extracting the element and attribute values into table rows. The values from each XML document are stored in one or more DB2 tables. Each table can have a maximum of 1024 rows decomposed from each document.

For example, if an XML document is decomposed into five tables, each of the five tables can have up to 1024 rows for that particular document. If the table has rows for multiple documents, it can have up to 1024 rows for each document. If the table has 20 documents, it can have 20,480 rows, 1024 for each document.

Using multiple-occurring elements (elements with location paths that can occur more than once in the XML structure) affects the number of rows inserted for each document. For example, a document that contains an element <Part> that occurs

20 times, might be decomposed as 20 rows in a table. When using multiple occurring elements, consider that a maximum of 1024 rows can be decomposed into one table from a single document.

Location path

A *location path* defines the location of an XML element or attribute within the structure of the XML document. The XML Extender uses the location path in the following situations:

- To locate the elements and attributes to be extracted when using extraction UDFs
- To specify the mapping between an XML element or attribute and a DB2 column when defining the indexing scheme in the DAD for XML columns
- For structural text search, using the Text Extender
- To override the XML collection DAD file values in a stored procedure.

Figure 10 shows an example of a location path and its relationship to the structure of the XML document.

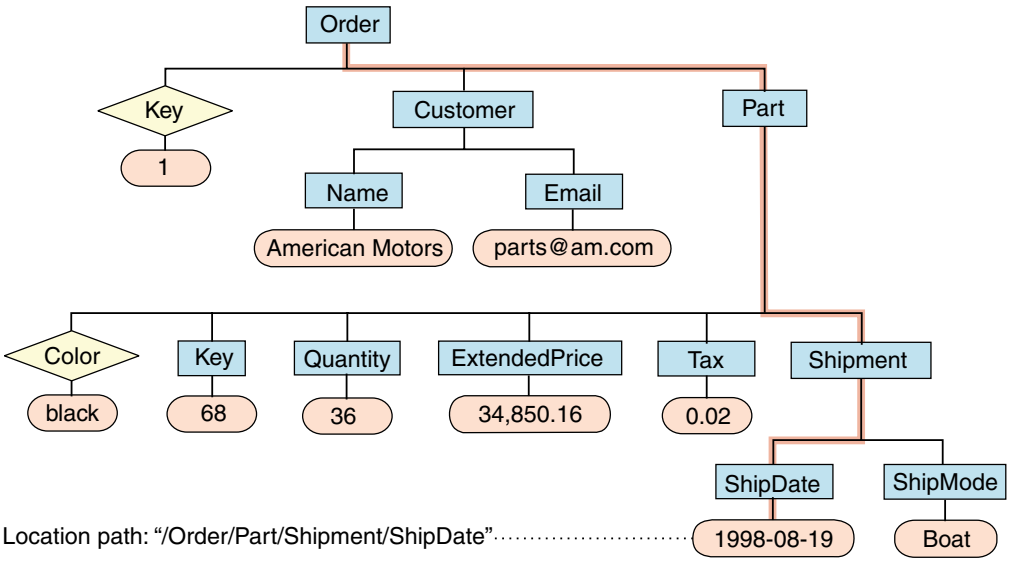


Figure 10. Storing documents as structured XML documents in a DB2 table column

Location path syntax

The following list describes the location path syntax that is supported by the XML Extender. A single slash (/) path indicates that the context is the whole document.

1. / Represents the XML *root element*, the element that contains all other elements in the document.

2. */tag1*
Represents the element *tag1* under root.

3. */tag1/tag2/..../tagn*
Represents an element with the name *tagn* as the child of the descending chain from root, *tag1*, *tag2*, through *tagn*-1.

4. *//tagn*
Represents any element with the name *tagn*, where double slashes (//) denote zero or more arbitrary tags.

5. */tag1//tagn*

Represents any element with the name *tagn*, a child of an element with the name *tag1* under root, where double slashes (//) denote zero or more arbitrary tags.

6. */tag1/tag2/@attr1*

Represents the attribute *attr1* of an element with the name *tag2*, which is a child of element *tag1* under root.

7. */tag1/tag2[@attr1="5"]*

Represents an element with the name *tag2* whose attribute *attr1* has the value 5. *tag2* is a child of element with the name *tag1* under root.

8. */tag1/tag2[@attr1="5"]/.../tagn*

Represents an element with the name *tagn*, which is a child of the descending chain from root, *tag1*, *tag2*, through *tagn*-1, where the attribute *attr1* of *tag2* has the value 5.

Wildcards: You can substitute an asterisk for an element in a location path to match any string. For example

```
/tag1/*/tagn/tagn+1 ?
```

Simple location path

Simple location path is the location path syntax used to specify elements and attributes for side tables, defined in the XML column DAD file. Simple location path is represented as a sequence of element type names that are connected by a single slash (/). The attribute values are enclosed within square brackets following its element type. Table 10 summarizes the syntax for simple location path.

Table 10. Simple location path syntax

Subject	Location path	Description
XML element	*/tag1/tag2/..../tagn-1/tagn*	An element content identified by the element named *tagn* and its parents
XML attribute	*/tag_1/tag_2/..../tag_n-1/tag_n/@attr1*	An attribute with name *attr1* of the element identified by *tagn* and its parents

Location path usage

The syntax of the location path depends in which context you use it to access the location of an element or attribute. Because the XML Extender uses one-to-one mapping between an element or attribute, and a DB2 column, it it restricts the syntax rules that are allowed in the DAD file and in functions. Table 11 on page 58 describes in which context the syntax options are used. The numbers that are specified in the "Location path supported" column refer to the syntax representations in "Location path syntax" on page 56.

Table 11. The XML Extender's restrictions using location path

Use of the location path	Location path supported
Element in the XML column DAD mapping for side tables	3, 6 (simple location path described in Table 10 on page 57)
Extracting UDFs	1-8[1]
Update UDF	1-8[1]
Text Extender's search UDF	3 – Exception: the root mark is specified without the slash. For example: `tag1/tag2/..../tagn`

[1] The extracting and update UDFs support location paths that have predicates with attributes, but not elements.

Chapter 4. Using the administration tools

To complete administration tasks, you can use one or more of the following tools:

- The XML Extender administration wizard for all administration tasks

> **Wizard support for Version 7:**
> The wizard is available as a download package from the XML Extender Web site:
>
> `http://www.ibm.com/software/data/db2/extenders/xmlext/downloads.html`
>
> Installation steps, configuration information, and software requirements are available at the Web site.

- The Operations Navigator for all administration tasks
- The OS command line to run adminstration commands
- The Qshell to run the **dxxadm** administration command options
- The DB2 command line to run SQL statements
- Custom applications using the XML Extender adminstration stored procedures

The following chapters show how to complete administration tasks using the following methods:

- XML Extender administration wizard. See "Starting the administration wizard" to learn how to set up and use the wizard.

  The wizard is available on the Windows, AIX, Sun Solaris, Linux, and NUMA-Q operating systems.
- The administration command syntax with instructions for converting this syntax to Operations Navigator, Qshell, and the OS command line environments.
- The DB2 command line to run SQL statements

The administration stored procedures are described in "Administration stored procedures" on page 177.

Starting the administration wizard

The following sections describe how to set up and invoke the XML Extender administration wizard.

Setting up the administration wizard

Ensure that you have followed the installation and configuration steps for the administration wizard in the readme file at the Web site.

Invoking the administration wizard

Follow these steps to invoke the XML Extender administration wizard.

1. Invoke the wizard.

   From the Windows Start menu, click **DB2 XML Extender->XML Extender Administration Wizard**.

   The administration wizard Logon window opens.

When you invoke the XML Extender administration wizard, the Logon window opens. Log in to the database that you want to use when working with XML data. XML Extender connects to the designated RDB database.

2. In the **Address** field, enter the fully-qualified JDBC URL to the data source to which you are connecting. The address has the following syntax:

   ```
   jdbc:as400://host_name/database_name
   ```

   Where *database_name* is the database to which you are connecting and storing XML documents.

   For example:

   ```
   jdbc:as400://host1.mycompany.com/mydb
   ```

3. In the **User ID** and **Password** fields, enter or verify the DB2 user ID and password for the database to which you are connecting.
4. In the **JDBC Driver** field, verify the JDBC driver name for the specified address using the following values:

   ```
   com.ibm.as400.access.AS400JDBCDriver
   ```

5. Click **Finish** to connect to the wizard and advance to the LaunchPad window.

The LaunchPad window provides access to five administration wizards. With these wizards, you can:

- Add a DTD to the DTD repository
- Work with DAD files for:
  - XML columns
  - XML collections
- Work with XML columns
- Work with XML collections

Using the DB2 command line

You use either the Interactive SQL Session utility or the Operations Navigator Run SQL Scripts window to enter SQL statements. In this document, "DB2 command line" refers to either of these interfaces. (To perform adminstration tasks, use either the Qshell or the OS command lines.)

To start the Interactive SQL session:

From your operating system command line, type:

```
STRSQL
```

A command interface opens, from which you can enter DB2 commands.

To ensure that the Interactive SQL Session works correctly for the DB2 commands used in the getting started lessons, verify that the SQL session parameters are set up correctly.

To specify or alter the settings:

- From the command line, enter `STRSQL`.
- When session has started, press **F13**.
- Select **1. session attributes** and press **Enter**.
- Verify that the following parameters are set with the shown values.

```
Statement processing . . . . .  *RUN
SELECT output  . . . . . .  . .  1
Naming convention  . . . . . .  *SQL
```

If the values are not correct, update the parameters with these values.

- Press **Enter** to save.
- Press **F3** to return to the Interactive SQL Session.

To start the Operations Navigator:

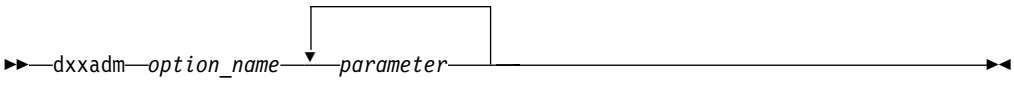
- Start the Operations Navigator.
- Expand the tree for your OS/400 system, and right click **Database**. A menu is displayed.
- From the menu, click **Run SQL Scripts**.

Using the OS command line

You use the OS command line to call programs that perform the XML Extender adminstration tasks, such as enabling a database. Use the DB2 command line to enter SQL statements.

To use the OS command line to run administration programs, you can use the syntax provided in this chapter under the "From the command line" sections, using the modifications described in the following examples.

When using a syntax diagram in the following format:

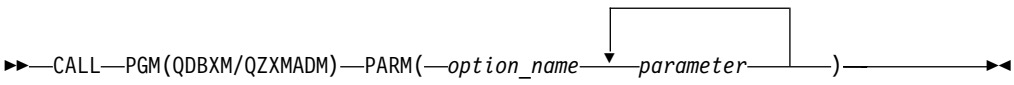


Where:

option_name
: Is the name of the adminstration task, such as enable_db.

parameter
: Is the list of task parameters for each option, such as *dbname*, *collection*, and *DAD_file*.

Use the following syntax in the OS command line:



For example:

```
CALL QDBXM/QZXMADM PARM(enable_column mydb 'myschema.mytable' 'mytable.xmlcolumn'
   'path/dad/mydad.dad' '-v' myview '-r' dxxroot)
```

Any parameters using numeric values, punctuation (such as a period or a minus sign), or a path name, must be enclosed in single quotes.

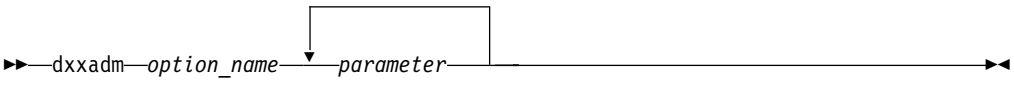
Using the Operations Navigator

You use the Run SQL Scripts utility, in the Operations Navigator, to call stored procedures that perform the XML Extender adminstration tasks, such as enabling a database. This utility can also be used to enter SQL statements.

Before using the Operations Navigator, you must complete the set up steps in "Setting up the Operations Navigator interface" on page 37.

To use the Operations Navigator to run administration stored procedures, you can use the syntax provided in this chapter under the "From the command line" sections, using the modifications described in the following examples.

When using a syntax diagram in the following format:

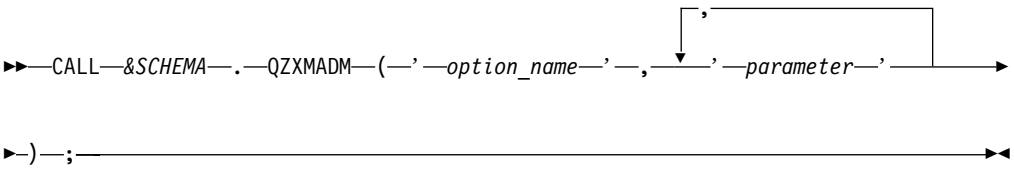


Where:

option_name
: Is the name of the adminstration task, such as enable_db.

parameter
: Is the list of task parameters for each option, such as *dbname*, *collection*, and *DAD_file*.

Use the following syntax in the Run SQL Scripts utility:



Where *&SCHEMA* is the schema you used when you created the samples. See "Creating an SQL Collection (Schema) for the samples" on page 36.

For example:

```
CALL MYSCHEMA.QZXMADM('enable_column', 'mydb', 'mytable', 'xmlcolumn', 'mydad',
    '-v myview', '-r dxxroot');
```

Using the Qshell command line

You use the Qshell command line to run the **dxxadm** command option, such as enable_db.

Use the syntax described in the "From the command line" to enter **dxxadm** command options. For example:

```
dxxadm enable_column SALES_DB sales_tab order getstart.dad
           -v sales_order_view -r invoice_num
```

This command line is used only for administration commands. Use the DB2 command line to enter SQL statements.

Chapter 5. Managing the database

The XML Extender administration tasks consist of enabling your database and table columns for XML and mapping XML data to DB2 relational structures. This chapter describes administration tasks for managing the database :

1. "Enabling a database for XML"
2. "Storing a DTD in the DTD repository table" on page 66
3. "Disabling a database for XML" on page 67

To complete the tasks in this chapter, you should be familiar with the concepts and planning tasks that are described in "Administration planning" on page 39.

In addition to choosing tools and setting up the database environment, you must define XML columns or XML collections. These tasks are described in the following chapters:

- "Chapter 6. Working with XML columns" on page 69
- "Chapter 7. Working with XML collections" on page 79

Enabling a database for XML

To store or retrieve XML documents from DB2 with XML Extender, you enable the database for XML. XML Extender enables the database you are connected to.

When you enable a database for XML, the XML Extender:

- Creates all the user-defined types (UDTs), user-defined functions (UDFs), and stored procedures
- Creates and populates control tables with the necessary metadata that the XML Extender requires
- Creates the DB2XML schema and assigns the necessary privileges

  The full name of an XML function is *schema-name.function-name*, where *schema-name* is an identifier that provides a logical grouping for SQL objects. You can use the full name anywhere you refer to a UDF or a UDT. You can also omit the schema name when you refer to a UDF or a UDT; in this case, DB2 uses the function path to determine the function or data type that you want.

Using the administration wizard

Use the following steps to enable a database for XML data:

1. Set up and start the administration wizard. See "Starting the administration wizard" on page 59 for details.
2. Click **Enable database** from the LaunchPad window to enable the current database.

   If a database is already enabled, only **Disable database** is selectable.

   When the database is enabled, you are returned to the LaunchPad window.

Using the command line

Enter **dxxadm** from the command line, specifying the database that is to be enabled.

Syntax:

Parameters:

dbName
The name of the RDB database that is to be enabled.

Example: Enables an existing database, called SALES_DB.

From the Qshell:

```
dxxadm enable_db SALES_DB
```

From the OS command line:

```
CALL QDBXM/QZXMADM PARM(enable_db SALES_DB)
```

From the Operations Navigator:

```
CALL MYSCHEMA.QZXMADM('enable_db', 'SALES_DB');
```

Storing a DTD in the DTD repository table

You can use a DTD to validate XML data in an XML column or in an XML collection. All DTDs are stored in the DTD repository table, a DB2 table called DTD_REF. It has a schema name of DB2XML. Each DTD in the DTD_REF table has a unique ID. The XML Extender creates the DTD_REF table when you enable a database for XML.

See "Planning for XML columns" on page 41 and "Planning for XML collections" on page 47 to learn more about using DTDs.

You can insert the DTD from the command line or by using the administration wizard.

Using the administration wizard

Use the following steps to insert a DTD:

1. Set up and start the administration wizard. See "Starting the administration wizard" on page 59 for details.
2. Click **Import a DTD** from the LaunchPad window to import an existing DTD file into the DTD repository of the current database. The Import a DTD window opens.
3. Type the DTD file name in the **DTD file name** field or click **...** to browse for an existing DTD file.
4. Type the DTD ID in the **DTD ID** field.

   The DTD ID is an identifier for the DTD and can be the path specifying the location of the DTD on the local system. The DTD ID must match the value that is specified in the DAD file for the <DTDID> element.

5. Optionally, type the name of the author of the DTD in the **Author** field.

   The XML Extender automatically displays the author's name if it is specified in the DTD.
6. Click **Finish** to insert the DTD into the DTD repository table, DB2XML.DTD_REF and return to the LaunchPad window.

From DB2 the command line

Issue an SQL INSERT statement for the DTD_REF table using the schema in Table 12:

Table 12. The column definitions for the DTD Reference table

Column name	Data type	Description
DTDID	VARCHAR(128)	Primary key (unique and not NULL). The primary key is used to identify the DTD and must be the same as the SYSTEM ID on the DOCTYPE line in each XML document, when validation is used. When the primary key is specified in the DAD file, the DAD file must follow the schema that is defined by the DTD.
CONTENT	XMLCLOB	The content of the DTD.
USAGE_COUNT	INTEGER	The number of XML columns and XML collections in the database that use this DTD to define a DAD.
AUTHOR	VARCHAR(128)	Author of the DTD, optional information for user to input.
CREATOR	VARCHAR(128)	The user ID that does the first insertion.
UPDATOR	VARCHAR(128)	The user ID that does the last update.

For example:

```
INSERT into DB2XML.DTD_REF values('dxx_install/dtd/getstart.dtd',
    DB2XML.XMLClobFromFile('dxx_install/dtd/getstart.dtd'), 0, 'user1',
    'user1', 'user1')
```

Important for XML collections: The DTD ID is a path specifying the location of the DTD on the local system. The DTD ID must match the value that is specified in the DAD file for the <DTDID> element.

Disabling a database for XML

You disable the database when you want to clean up your XML Extender environment and drop the XML Extender UDTs, UDFs, stored procedures, and administration support tables. XML Extender disables the database to which you are connected.

When you disable a database for XML, the XML Extender takes the following actions:

- Deletes all the user-defined types (UDTs), user-defined functions (UDFs), and stored procedures
- Deletes control tables with the metadata for the XML Extender
- Deletes the DB2XML schema.

Before you begin

Disable any XML columns or collections.

Using the administration wizard

Use the following steps to disable a database for XML data:

1. Set up and start the administration wizard. See "Starting the administration wizard" on page 59 for details.
2. Click **Disable database** from the LaunchPad window to disable the current database.

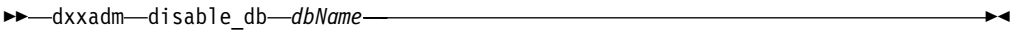
   If a database is not current enabled, only **Enable database** is selectable.

   When the database is disabled, you are returned to the LaunchPad window.

Using the command line

Enter **dxxadm** from the command line, specifying the database that is to be disabled.

Syntax:



Parameters:

dbName
The name of the RDB database that is to be disabled.

Example: disables an existing database, called SALES_DB.

From the Qshell:

```
dxxadm disable_db SALES_DB
```

From the OS command line:

```
CALL QDBXM/QZXMADM PARM(disable_db SALES_DB)
```

From the Operations Navigator:

```
CALL MYSCHEMA.QZXMADM('disable_db', 'SALES_DB');
```

Chapter 6. Working with XML columns

An XML column contains XML documents that can be updated, searched, and extracted, and is created as an XML user data type (such as XMLVARCHAR). To store XML documents in an XML column, you need to complete the following tasks:

- Create a document access definition (DAD) file. See "Creating or editing the DAD file".
- Create or alter the table in which the XML documents are stored. See "Creating or altering an XML table" on page 72.
- Enable a column for XML data. See "Enabling XML columns" on page 73.
- Index side tables. See "Indexing side tables" on page 77.

To drop the table that contains the XML column, disable the XML column. See "Disabling XML columns" on page 77.

Creating or editing the DAD file

To set up XML columns, you need to define the DAD file to access your XML data and to enable columns for XML data in an XML table. An important concept in creating the DAD is understanding location path syntax because it is used to map the element and attribute values that you want to index to DB2 tables. See "Location path" on page 56 to learn more about location path and its syntax.

When you specify a DAD file, you define the attributes and key elements of your data that need to be searched. The XML Extender uses this information to create side tables so that you can index your data to retrieve it quickly. See "The DAD file" on page 46 to learn about planning issues for creating the DAD file.

Before you begin

- Understand the hierarchical structure of your XML data so that you can define key elements and attributes for indexing and fast search.
- Prepare and insert the XML document's DTD into the DTD_REF table. This step is required for validation.

Using the administration wizard

Use the following steps to create a DAD file:

1. Set up and start the administration wizard. See "Starting the administration wizard" on page 59 for details.
2. Click **Work with DAD files** from the LaunchPad window to edit or create an XML DAD file. The Specify a DAD file window opens.

3. Choose whether to edit an existing DAD file or to create a new DAD file.
   - **To edit an existing DAD:**
     a. Click **...** to browse for an existing DAD file in the pull-down menu, or type the DAD file name in the **File name** field.
     b. Verify that the wizard recognizes the specified DAD file.
        – If the wizard recognizes the specified DAD file, **Next** is selectable, and XML column is displayed in the **Type** field.
        – If the wizard does not recognize the specified DAD file, **Next** is not selectable. Either retype the DAD file name in the **File name** field, or click **Open** to browse again for an existing DAD file. Continue until **Next** is selectable.
     c. Click **Next**.
   - **To create a new DAD:**
     a. Leave the **File name** field blank.
     b. From the **Type** menu, click **XML column**.
     c. Click **Next**.
4. Choose whether to validate your XML documents with a DTD from the Select Validation window.
   - To validate:
     a. Click **Validate XML documents with the DTD**.
     b. Select the DTD to be used for validation from the **DTD ID** menu.

     If XML Extender does not find the specified DTD in the DTD reference table, it searches for the specified DTD on the file system and uses it to validate.
   - Click **Do NOT validate XML documents with the DTD** to continue without validating your XML documents.
5. Click **Next**.
6. Choose whether to add a new side table, edit an existing side table, or remove an existing side table from the Side tables window.
   - **To add a new side table or side-table column:**

     To add a new side table, you define the columns in the table. Complete the following steps for each column in a side table.
     a. Complete the fields of the **Details** box of the Side tables window.
        1) **Table name**: Type the name of the table containing the column. For example:

           ```
           ORDER_SIDE_TAB
           ```
        2) **Column name**: Type the name of the column. For example:

           ```
           CUSTOMER_NAME
           ```
        3) **Type**: Select the type of the column from the menu. For example:

           ```
           XMLVARCHAR
           ```
        4) **Length (VARCHAR type only)**: Type the maximum number of VARCHAR characters. For example:

           ```
           30
           ```
        5) **Path**: Type the location path of the element or attribute. For example:

           ```
           /ORDER/CUSTOMER/NAME
           ```

           See “Location path” on page 56 for location path syntax.

6) **Multi occur**: Select **No** or **Yes** from the menu.

Indicates whether the location path of this element or attribute can be used more than once in a document.

Important If you specify multiple occurrence for a column, you can specify only one column in the side table.

b. Click **Add** to add a column.

c. Continue adding, editing, or removing columns for the side table, or click **Next**.

- **To edit an existing side-table column:**

  You can update a side table by changing the definitions of the existing columns.

  a. Click on the side-table name and column name you want to edit.

  b. Edit the fields of the **Details** box.

  c. Click **Change** to save changes.

  d. Continue adding, editing, or removing columns for each side table, or click **Next**.

- **To remove an existing side-table column:**

  a. Click on the side table and column you want to remove.

  b. Click **Remove**.

  c. Continue adding, editing, or removing side-tables columns, or click **Next**.

- **To remove an existing side table:**

  To remove an entire side table, you delete each column in the table.

  a. Click on each side-table column for the table you want to remove.

  b. Click **Remove**.

  c. Continue adding, editing, or removing side tables columns, or click **Next**.

7. Type an output file name for the modified DAD file in the **File name** field of the Specify a DAD window.
8. Click **Finish** to save the DAD file and to return to the LaunchPad window.

Using the command line

The DAD file is an XML file that can be created in any text editor.

Use the following steps to create a DAD file:

1. Open a text editor.

   The DAD file must be either stored in an Integrated File System (IFS) directory, or created as a physical file member with a link in the IFS directory pointing to the member.

2. Create the DAD file header, using the following syntax:

```
<?xml version="1.0"?>
<!DOCTYPE DAD SYSTEM "path/dtd/dad.dtd"> --> the path and file name of
       the DTD for the DAD file
```

3. Insert the <DAD></DAD> tags.
4. Inside the <DAD> tag, optionally specify the DTD ID identifier that associates the DAD file with the XML document DTD for validation:

```
<dtdid>path/dtd_name.dtd</dtdid> --> the path and file
                                     name of the DTD
                                     for your application
```

The DTD ID is required for validation and must match the DTD ID value used when inserting the DTD into the DTD reference table (DB2XML.DTD_REF).

5. Specify whether to validate (that is, to use the specified DTD to ensure that the XML document is a valid XML document). For example:

   ```
   <validation>YES</validation>   --> specify YES or NO
   ```

   If you specify YES, you must have specified a DTD ID in the previous step as well as inserted a DTD into the DTD_REF table.

6. Use the <Xcolumn> element to define the access and storage method as XML column.

   ```
   <Xcolumn>
   </Xcolumn>
   ```

7. Define each side table and the important elements and attributes to be indexed for structural search. Perform the following steps for each table. The following steps use examples taken from a sample DAD file shown in "DAD file: XML column" on page 237:

   a. Insert the <table></table> tags and the name attribute.

      ```
      <table name="order_tab">
      </table>
      ```

   b. After the <table> tag, insert a <column> tag and its attributes for each column in the table:

      - ***name***: the name of the column
      - ***type***: the type of column
      - ***path***: the location path of the element or attribute. See "Location path" on page 56 for location path syntax.
      - ***multi_occurrence***: an indication of whether this element or attribute can appear more than once in a document. Note that for a location path target that is an attribute, a value of "YES" indicates that the attribute appears more than once because the element to which the attribute is attached appears more than once.

      ```
      <table ...>
         <column name="order_key"
                 type="integer"
                 path="/Order/@key"
                 multi_occurrence="NO"/>
         <column name="customer"
                 type="varchar(50)"
                 path="/Order/Customer/Name"
                 multi_occurrence="NO"/>
      </table>
      ```

8. Ensure that you have an ending </table> tag after the last column definition.
9. Ensure that you have an ending </Xcolumn> tag after the last </table> tag.
10. Ensure that you have an ending </dad> tag after the </Xcolumn> tag.

Creating or altering an XML table

To store intact XML documents in a table, you must create or alter a table so that it contains a column with an XML user-defined type (UDT). The table is known as an *XML table*, a table that contains XML documents. The table can be an altered table or a new table. When a table contains a column of XML type, you can enable the column for XML.

You can alter an existing table to add a column of XML type using the administration wizard, or using the command line.

Using the administration wizard

1. Set up and start the administration wizard. See "Starting the administration wizard" on page 59 for details.
2. Click **Work with XML columns** from the LaunchPad window. The Select a task window opens.
3. Click **Add an XML Column**. The Add an XML column window opens.
4. Select the name of the table from the **Table name** pull-down menu, or type the name of the table you want to alter. For example:

   ```
   SALES_TAB
   ```
5. Type the name of the column to be added to the table in the **Column name** field. For example:

   ```
   ORDER
   ```
6. Select the UDT for the column from the **Column type** pull-down menu. For example:

   ```
   XMLVARCHAR
   ```
7. Click **Finish** to add the column of XML type.

Using the DB2 command line

Create or alter a table with a column of an XML type in the column clause of the CREATE TABLE or ALTER TABLE statement.

Example: In the sales application, you might want to store an XML-formatted line item order in a column called ORDER of an application table called SALES_TAB. This table also has the columns INVOICE_NUM and SALES_PERSON. Because it is a small order, you store it using the XMLVARCHAR type. The primary key is INVOICE_NUM. The following CREATE TABLE statement creates the table with a column of XML type:

```
CREATE TABLE sales_tab(
             invoice_num  char(6) NOT NULL PRIMARY KEY,
             sales_person     varchar(20),
             order            XMLVarchar)
```

Enabling XML columns

To store an XML document in a DB2 database, you must enable a column for XML. Enabling a column prepares it for indexing so that it can be searched quickly. You can enable a column by using the XML Extender administration wizard or using the command line. The column must be of XML type.

When the XML Extender enables an XML column, it:

- Reads the DAD file to optionally:
  - Validate the DAD file against the DTD for the DAD file.
  - Retrieve the DTD ID from the DTD_REF table, if specified.
  - Create side tables for indexing on the XML column.
  - Prepare the column to contain XML data.
- Optionally creates a *default view* of the XML table and side tables. The default view displays the application table and the side tables.

Column name limit: For OS/400, the column size limit in a view is 10 characters.

- Specifies a ROOT ID value, if one has not been specified.

After you enable the XML column, you can

- Create indexes on the side tables
- Insert XML documents in the XML column
- Query, update, or search the XML documents in the XML column.

Before you begin

- Create an XML table by creating or altering a DB2 table with a column of XML type.
- Create a DAD file specifying both the column to be enabled and the side tables to be created for indexing frequently searched elements and attributes.

Using the administration wizard

Use the following steps to enable XML columns:

1. Set up and start the administration wizard. See "Starting the administration wizard" on page 59 for details.
2. Click **Work with XML Columns** from the LaunchPad window to view the XML Extender column related tasks. The Select a Task window opens.
3. Click **Enable a Column** and then **Next** to enable an existing table column in the database.
4. Select the table that contains the XML column from the **Table name** field. For example:

   ```
   SALES_TAB
   ```

5. Select the column being enabled from the **Column name** field. For example:

   ```
   ORDER
   ```

   The column must exist and be of XML type.
6. Type the DAD path and file name in the **DAD file name** field, or click **...** to browse for an existing DAD file. For example:

   dxx_install/dad/getstart.dad
7. Optionally, type the name of an existing table space in the **Table space** field.

   The table space contains side tables that the XML Extender created. If you specify a table space, the side tables are created in the specified table space. If you do not specify a table space, the side tables are created in the default table space.
8. Optionally, type the name of the default view in the **Default view** field.

   When specified, the default view is automatically created when the column is enabled and joins the XML table and all of the related side tables.
9. Optionally, type the column name of the primary key in the application table in the **Root ID** field. This is recommended.

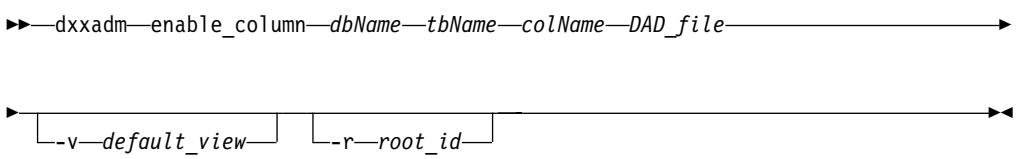
   The XML Extender uses the value of ROOT ID as a unique identifier to associate all side tables with the application table. If not specified, the XML Extender adds the DXXROOT_ID column to the application table and generates an identifier.
10. Click **Finish** to enable the XML column, create the side tables, and return to the LaunchPad window.

- If the column is successfully enabled, an `Enabled column is successful` message is displayed.
- If the column is not successfully enabled, an error box is displayed. Correct the values of the entry field until the column is successfully enabled.

Using the command line

To enable an XML column, enter the following command:

Syntax:



Parameters:

dbName
The name of the RDB database.

tbName
The name of the table that contains the column that is to be enabled.

colName
The name of the XML column that is being enabled.

DAD_file
The name of the file that contains the document access definition (DAD).

default_view
Optional. The name of the default view that the XML Extender created to join an application table and all of the related side tables.

root_id Optional, but recommended. The column name of the primary key in the application table and a unique identifier that associates all side tables with the application table. Known as ROOT_ID. The XML Extender uses the value of ROOT_ID as a unique identifier to associate all side tables with the application table. If the ROOT ID is not specified, the XML Extender adds the DXXROOT_ID column to the application table and generates an identifier.

Restriction: If the application table has a column name of DXXROOT_ID, but this column does not contain the value for *root_id*, you must specify the *root_id* parameter; otherwise, an error occurs.

Example: The following example enables a column using the command line. The DAD file and XML document can be found in "Appendix B. Samples" on page 235.

From the Qshell:

```
dxxadm enable_column SALES_DB myschema.sales_tab order getstart.dad
           -v sales_order_view -r INVOICE_NUMBER
```

From the OS command line:

```
CALL QDBXM/QZXMADM PARM(enable_column SALES_DB 'MYSCHEMA.SALES_TAB'
   ORDER 'getstart.dad' '-v' sales_order_view '-r' INVOICE_NUMBER)
```

From the Operations Navigator:

```
CALL MYSCHEMA.QZXMADM('enable_column', 'SALES_DB', 'MYSCHEMA.SALES_TAB',
   'ORDER', 'getstart.dad', '-v sales_order_view', '-r INVOICE_NUMBER');
```

In this example, the column ORDER is enabled in the table SALES_TAB. The DAD file is `getstart.dad`, the default view is sales_order_view, and the ROOT ID is INVOICE_NUM.

Using this example, the SALES_TAB table has the following columns:

Column name	INVOICE_NUM	SALES_PERSON	ORDER
Data type	CHAR(6)	VARCHAR(20)	XMLVARCHAR

The following side tables are created based on the DAD specification:

ORDER_SIDE_TAB:

Column name	ORDER_KEY	CUSTOMER	INVOICE_NUM
Data type	INTEGER	VARCHAR(50)	CHAR(6)
Path expression	`/Order/@key`	`/Order/Customer/Name`	N/A

PART_SIDE_TAB:

Column name	PART_KEY	PRICE	INVOICE_NUM
Data type	INTEGER	DOUBLE	CHAR(6)
Path expression	`/Order/Part/@key`	`/Order/Part/ExtendedPrice`	N/A

SHIP_SIDE_TAB:

Column name	DATE	INVOICE_NUM
Data type	DATE	CHAR(6)
Path expression	`/Order/Part/Shipment/ShipDate`	N/A

All the side tables have the column INVOICE_NUM of the same type, because the ROOT ID is specified by the primary key INVOICE_NUM in the application table. After the column is enabled, the value of the INVOICE_NUM is inserted into the side tables. Specifying the *default_view* parameter when enabling the XML column, ORDER, creates a default view, sales_order_view. The view joins the above tables using the following statement:

```
CREATE VIEW sales_order_view(invoice_num, sales_person, order,
                             order_key, customer, part_key, price, date)
     AS
     SELECT sales_tab.invoice_num, sales_tab.sales_person, sales_tab.order,
            order_tab.order_key, order_tab.customer,
            part_tab.part_key, part_tab.price,
            ship_tab.date
     FROM sales_tab, order_tab, part_tab, ship_tab
     WHERE sales_tab.invoice_num = order_tab.invoice_num
                AND sales_tab.invoice_num = part_tab.invoice_num
                AND sales_tab.invoice_num = ship_tab.invoice_num
```

Indexing side tables

After you have enabled an XML column and created the side tables, you can index the side tables. Side tables contain the XML data in columns you specified while creating the DAD file. Indexing these tables helps you improve the performance of the queries against the XML documents.

Before you begin

- Create a DAD file that specifies side tables for the XML document structure.
- Enable the XML column using the DAD file; which creates the side tables.

Creating the indexes

From the DB2 command line, use the DB2 CREATE INDEX command to index the side tables.

Example:

The following example creates indexes on four side tables:

```
CREATE INDEX KEY_IDX
      ON ORDER_SIDE_TAB(ORDER_KEY)

CREATE INDEX CUSTOMER_IDX
      ON ORDER_SIDE_TAB(CUSTOMER)

CREATE INDEX PRICE_IDX
      ON PART_SIDE_TAB(PRICE)

CREATE INDEX DATE_IDX
      ON SHIP_SIDE_TAB(DATE)
```

Disabling XML columns

Disable a column if you need to update a DAD file for the XML column, or if you want to delete the XML column or the table that contains the column. After the column is disabled, you can re-enable the column with the updated DAD file, delete the column, or other tasks. You can disable a column by using the XML Extender administration wizard or using the command line.

When the XML Extender disables an XML column, it:

- Deletes the column's entry from XML_USAGE table.
- Drops the side tables associated with this column.

Important: If you drop a table with an XML column, without first disabling the column, XML Extender cannot drop any side the tables associated with the XML column, which might cause unexpected results.

Before you begin

Ensure that the XML column to be disabled exists in the current DB2 database.

Using the administration wizard

Use the following steps to disable XML columns:

1. Set up and start the administration wizard. See "Starting the administration wizard" on page 59 for details.

2. Click **Working with XML Columns** from the LaunchPad window to view the XML Extender column related tasks. The Select a Task window opens.
3. Click **Disable a Column** and then **Next** to disable an existing table column in the database.
4. Select the table that contains the XML column from the **Table name** field.
5. Select the column being disabled from the **Column name** field.
6. Click **Finish**.
   - If the column is successfully disabled, an `Disabled column is successful` message is displayed.
   - If the column is not successfully disabled, an error box is displayed. Correct the values of the entry field until the column is successfully disabled.

Using the command line

To disable an XML column, enter the following command:

Syntax:

```
►►—dxxadm—disable_column—dbName—tbName—colName————————————————————►◄
```

Parameters:

dbName
The name of the RDB database.

tbName
The name of the table that contains the column that is to be disabled.

colName
The name of the XML column that is being disabled.

Example: The following example disables a column using the command line. The DAD file and XML document can be found in "Appendix B. Samples" on page 235.

From the Qshell:

```
dxxadm disable_column SALES_DB sales_tab order
```

From the OS command line:

```
CALL QDBXM/QZXMADM PARM(disable_column SALES_DB 'MYSCHEMA.SALES_TAB' ORDER)
```

From the Operations Navigator:

```
CALL MYSCHEMA.QZXMADM('disable_column', 'SALES_DB', 'MYSCHEMA.SALES_TAB', 'ORDER');
```

In this example, the column ORDER is disabled in the table SALES_TAB.

When the column is disabled, the side tables are dropped.

Chapter 7. Working with XML collections

XML collections are collections of tables that associated by a common XML document structure. The tables are either associated because they contain data that you will use to populate XML documents, or columns in which you will store data decomposed from XML documents.

Setting up XML collections requires creating a mapping scheme and optionally enabling the collection with a name that associates the DB2 tables with a DAD file. Although enabling the XML collection is not required, it does provide better performance.

To set up an XML collection, you must complete the following tasks:

- Create a document access definition (DAD) file. See "Creating or editing the DAD file for the mapping scheme"
- (Optional) Enable the collection. See "Enabling XML collections" on page 97.

To redefine or delete the collection, disable the XML collection. See "Disabling XML collections" on page 99.

Creating or editing the DAD file for the mapping scheme

Creating a DAD file is required when using XML collections. A DAD file defines the relationship between XML data and multiple relational tables. The XML Extender uses the DAD file to:

- Compose an XML document from relational data
- Decompose an XML document to relational data

You can use either of two methods to map the data between the XML tables and the DB2 table: SQL mapping and RDB_node mapping:

SQL mapping
: Uses an SQL statement element to specify the SQL query for tables and columns that are used to contain the XML data. SQL mapping can only be used for composing XML documents.

RDB_node mapping
: Uses an XML Extender-unique element, Relational Database node, or RDB_node, which specifies tables, columns, conditions, and the order for XML data. RDB_node mapping supports more complex mappings than an SQL statement can provide. RDB_node mapping can be used for both composing and decomposing XML documents.

The following sections describe how to create the DAD file, depending on the task and the method you are using:

- Compose documents with SQL mapping. See "Composing XML documents with SQL mapping" on page 80.
- Compose documents with RDB node mapping. See "Composing XML documents with RDB_node mapping" on page 85.
- Decompose documents with RDB node mapping. See "Decomposing XML documents with RDB_node mapping" on page 91.

Before you begin

- Map the relationship between your DB2 tables and the XML document. This step should include mapping the hierarchy of the XML document and specifying how the data in the document maps to a DB2 table.
- If you plan to validate the XML documents, insert the DTD for the XML document you are composing or decomposing into the DTD reference table, DB2XML.DTD_REF.

Composing XML documents with SQL mapping

Use SQL mapping when you are composing XML documents and want to use SQL.

Using the administration wizard

Use the following steps to create a DAD file using XML collection SQL mapping

To create a DAD file for composition using SQL mapping:

Use SQL mapping when you are composing XML documents and you want to use an SQL statement to define the table and columns from which you will derive the data in the XML document.

1. Set up and start the administration wizard. See "Starting the administration wizard" on page 59 for details.
2. Click **Work with DAD files** from the LaunchPad window. The Specify a DAD windows opens.
3. Choose whether to edit an existing DAD file or to create a new DAD file.

   To create a new DAD file:

   a. Leave the **File name** field blank.
   b. From the **Type** menu, select **XML collection SQL mapping**.
   c. Click **Next** to open the Select Validation window.

   To edit an existing DAD file:

   a. Type the DAD file name in the **File name** field, or click **...** to browse for an existing DAD file.
   b. Verify that the wizard recognizes the specified DAD file.
      - If the wizard recognizes the specified DAD file, **Next** is selectable and XML collection SQL mapping is displayed in the **Type** field.
      - If the wizard does not recognize the specified DAD file, **Next** is not selectable. Either retype the DAD file name, or click **...** to browse again for an existing DAD file. Correct the values of the entry field until **Next** is selectable.
   c. Click **Next** to open the Select Validation window.
4. In the Select Validation window, choose whether to validate your XML documents with a DTD.
   - To validate:
     a. Click **Validate XML documents with the DTD**.
     b. Select the DTD to be used for validation from the **DTD ID** menu.

     If XML Extender does not find the specified DTD in the DTD reference table, it searches for the specified DTD on the file system and uses it to validate.

- Click **Do NOT validate XML documents with the DTD** to continue without validating your XML documents.

5. Click **Next** to open the Specify Text window.
6. Type the prolog name in the **Prolog** field, to specify the prolog of the XML document to be composed.

   ```
   <?xml version="1.0" ?>
   ```

   If you are editing an existing DAD, the prolog is automatically displayed in the **Prolog** field.
7. Type the document type of the XML document in the **Doctype** field of the Specify Text window, pointing to the DTD for the XML document. For example:

   ```
   ! DOCTYPE ORDER SYSTEM "dxx_install/dtd/getstart.dtd"
   ```

   If you are editing an existing DAD, the document type is automatically displayed in the **Doctype** field.
8. Click **Next** to open the Specify SQL Statement window.
9. Type a valid SQL SELECT statement in the **SQL statement** field. For example:

   ```
   SELECT o.order_key, customer_name, customer_email, p.part_key, color, quantity,
     price, tax, ship_id, date, mode from order_tab o, part_tab p,
    (select db2xml.generate_unique()
     as ship_id, date, mode, part_key from ship_tab) as s
         WHERE o.order_key = 1 and
               p.price > 20000 and
               p.order_key = o.order_key and
               s.part_key = p.part_key
         ORDER BY order_key, part_key, ship_id
   ```

   If you are editing an existing DAD, the SQL statement is automatically displayed in the **SQL statement** field.
10. Click **Test SQL** to test the validity of the SQL statement.
    - If your SQL statement is valid, sample results are displayed in the **Sample results** field.
    - If your SQL statement is not valid, an error message is displayed in the **Sample results** field. The error message instructs you to correct your SQL SELECT statement and to try again.
11. Click **Next** to open the SQL Mapping window.
12. Select an element or attribute node to map from by clicking on it in the field on the left of the SQL Mapping window.

    Map the elements and attributes in the XML document to element and attribute nodes that correspond to DB2 data. These nodes provide a path from the XML data to the DB2 data.

    - **To add the root node:**
      a. Select the **Root** icon.
      b. Click **New Element** to define a new node.
      c. In the **Details** box, specify **Node type** as **Element**.
      d. Enter the name of the top level node in the **Node name** field.
      e. Click **Add** to create the new node.

         You have created the root node or element, which is the parent to all the other element and attribute nodes in the map. You can now add child elements and attributes to this node.
    - **To add a child element or attribute node:**

a. Click on a parent node in the field on the left to add a child element or attribute.

   If you have not selected a parent node, **New Element** is not selectable.

b. Click **New Element**.

c. Select the node type from the **Node type** menu in the **Details** box.

   The **Node type** menu displays only the node types that are valid at that point in the map:

   Element
   Represents an XML element defined in the DTD associated with the XML document. Used to associate the XML element with a column in a DB2 table. An element node can have attribute nodes, child element nodes, or text nodes. A bottom-level node has a text node and column name associated with it in the tree view.

   Attribute
   Represents an XML attribute defined in the DTD associated with the XML document. It is used to associate the XML attribute with a column in a DB2 table. An attribute node can have a text node and has a column name associated with it in the tree view.

   Text Specifies text content for an element or attribute node that has content to be mapped to a relational table. A text node has a column name associated with it in the tree view.

   Table Specifies the table name for an element or attribute value to be mapped to a relational table.

   Column
   Specifies the column name for an element or attribute value to be mapped to a relational table.

   Condition
   Specifies a condition for the column.

d. Type the node name in the **Node name** field in the **Details** box. For example:

   ```
   Order
   ```

e. If you specified **Attribute** , **Element** or **Text** for a bottom-level element as the Node type, select a column from the **Column** field in the **Details** box. For example:

   ```
   Customer_Name
   ```

   Restriction: New columns cannot be created using the administration wizard. If you specify **Column** as the node type, you can only select a column that already exists in your DB2 database.

f. Click **Add** to add the new node.

   You can modify a node later by clicking on it in the field on the left and making any needed modifications to it in the **Details** box. Click **Change** to update the element.

   You can also add child elements or attributes to the node by highlighting the node repeating the add process.

g. Continue editing the SQL map, or click **Next** to open the Specify a DAD window.

- **To remove a node:**

  a. Click on a node in the field on the left.

b. Click **Remove**.
c. Continue editing the SQL map, or click **Next** to open the Specify a DAD window.

Note that if you remove a bottom-level node, another element will become a bottom-level node and might need a column name defined for it.

13. Type the name of an output file for the modified DAD file in the **File name** field of the Specify a DAD window.
14. Click **Finish** to return to the LaunchPad window.

Using the command line

Use SQL mapping notation when you are composing XML document and want to use SQL.

The DAD file is an XML file that you can create using any text editor. The following steps show fragments from the samples appendix, "Document access definition files" on page 236. Please refer to these examples for more comprehensive information and context.

1. Open a text editor.

   The DAD file must be either stored in an Integrated File System (IFS) directory, or created as a physical file member with a link in the IFS directory pointing to the member.
2. Create the DAD header:

   ```
   <?xml version="1.0"?>
   <!DOCTYPE DAD SYSTEM "path/dad.dtd"> --> the path and file name of the DTD
         for the DAD
   ```
3. Insert the <DAD></DAD> tags.
4. After the <DAD> tag, specify the DTD ID that associates the DAD file with the XML document DTD.

   ```
   <dtdid>path/dtd_name.dtd> --> the path and file name
          of the DTD for your application
   ```
5. Specify whether to validate (that is, to use a DTD to ensure that the XML document is a valid XML document). For example:

   ```
   <validation>NO</validation>   --> specify YES or NO
   ```
6. Use the <Xcollection> element to define the access and storage method as XML collection. The access and storage methods define that the XML document will have content derived from data stored in DB2 tables.

   ```
   <Xcollection>
   </Xcollection>
   ```
7. Specify one or more SQL statements to query or insert data from or into DB2 tables. See "Mapping scheme requirements" on page 52 for guidelines. For example, you specify a single SQL query like in the following example:

   ```
   <SQL_stmt>
     SELECT o.order_key, customer_name, customer_email, p.part_key, color, quantity,
     price, tax, ship_id, date, mode from order_tab o, part_tab p,
      (select db2xml.generate_unique()
       as ship_id, date, mode, part_key from ship_tab) as s
           WHERE o.order_key = 1 and
                 p.price > 20000 and
                 p.order_key = o.order_key and
                 s.part_key = p.part_key
           ORDER BY order_key, part_key, ship_id
   </SQL_stmt>
   ```
8. Add the following prolog information:

   ```
   <prolog>?xml version="1.0"?</prolog>
   ```

This exact text is required.

9. Add the <doctype></doctype> tags. For example:

   ```
   <doctype>! DOCTYPE Order SYSTEM "dxx_install/dtd/getstart.dtd"</doctype>
   ```

   If you need to specify an encoding value for internationalization, add the ENCODING attribute and value. See "Appendix C. Code page considerations" on page 245 to learn about encoding issues in an client/server environment.

10. Define the root node using the <root_node></root_node> tags. Inside the root_node, you specify the elements and attributes that make up the XML document.

11. Map the elements and attributes in the XML document to element and attribute nodes that correspond to DB2 data. These nodes provide a path from the XML data to the DB2 data.

    a. Define an <element_node> for each element in your XML document that maps to a column in a DB2 table.

       ```
       <element_node name="name"></element_node>
       ```

       An element_node can have the following nodes:

       - attribute_node
       - child element_node
       - text_node

    b. Define an <attribute_node> for each attribute in your XML document that maps to a column in a DB2 table. See the example DTDs at the beginning of this section for SQL mapping, as well as the DTD for the DAD file in "Appendix A. DTD for the DAD file" on page 229, which provides the full syntax for the DAD file.

       For example, you need an attribute key for an element <Order>. The value of key is stored in a column PART_KEY.

       DAD file: In the DAD file, create an attribute node for key and indicate the table where the value of key is stored.

       ```
       <attribute_node name="key">
           <column name="part_key"/>
       </attribute_node>
       ```

       Composed XML document: The value of key is taken from the PART_KEY column.

       ```
       <Order key="1">
       ```

12. Create a <text_node> for every element or attribute that has content that will be derived from a DB2 table. The text node has a <column> element that specifies from which column the content is provided.

    For example, you might have an XML element <Tax> with a value that will be taken from a column called TAX:

    DAD element:

    ```
    <element_node name="Tax">
       <text_node>
       <column name="tax"/>
       </text_node>
    </element_node>
    ```

    The column name must be in the SQL statement at the beginning of the DAD file.

Composed XML document:

```
<Tax>0.02</Tax>
```

The value `0.02` will be derived from the column TAX.

13. Ensure that you have an ending </root_node> tag after the last </element_node> tag.
14. Ensure that you have an ending </Xcollection> tag after the </root_node> tag.
15. Ensure that you have an ending </DAD> tag after the </Xcollection> tag.

Composing XML documents with RDB_node mapping

Use RDB_node mapping to compose XML documents using a XML-like structure.

This method uses the <RDB_node> to specify DB2 tables, column, and conditions for an element or attribute node. The <RDB_node> uses the following elements:

- <table>: defines the table corresponding to the element
- <column>: defines the column containing the corresponding element
- <condition>: optionally specifies a condition on the column

The child elements that are used in the <RDB_node> depend on the context of the node and use the following rules:

If the node type is:	RDB child element is used:		
	Table	**Column**	**Condition**[1]
Root element	Y	N	Y
Attribute	Y	Y	optional
Text	Y	Y	optional

(1) Required with multiple tables

Using the administration wizard

To create a DAD for composition, using RDB_node mapping:

1. Set up and start the administration wizard. See "Starting the administration wizard" on page 59 for details.
2. Click **Work with DAD files** from the LaunchPad window. The Specify a DAD window opens.
3. Choose whether to edit an existing DAD file or to create a new DAD.

   To edit an existing DAD:

   a. Type the DAD file name in the **File name** field or click **...** to browse for an existing DAD.

   b. Verify that the wizard recognizes the specified DAD file.

      - If the wizard recognizes the specified DAD file, **Next** is selectable, and XML collection RDB node mapping is displayed in the **Type** field.
      - If the wizard does not recognize the specified DAD file, **Next** is not selectable. Either retype the DAD file name in the **File name** field or click **...** to browse again for an existing DAD file. Continue these steps until **Next** is selectable.

   c. Click **Next** to open the Select Validation window.

To create a new DAD:

a. Leave the **File name** field blank.
b. Select XML collection RDB_node mapping from the **Type** menu.
c. Click **Next** to open the Select Validation window.

4. In the Select Validation window, choose whether to validate your XML documents with a DTD.
   - To validate:
     a. Click **Validate XML documents with the DTD**.
     b. Select the DTD to be used for validation from the **DTD ID** menu.

     If XML Extender does not find the specified DTD in the DTD reference table, it searches for the specified DTD on the file system and uses it to validate.
   - Click **Do NOT validate XML documents with the DTD** to continue without validating your XML documents.
5. Click **Next** to open the Specify Text window.
6. Type the prolog name in the **Prolog** field of the Specify Text window.

   ```
   <?xml version="1.0" ?>
   ```

   If you are editing an existing DAD, the prolog is automatically displayed in the **Prolog** field.
7. Enter the document type of the XML document in the **Doctype** field of the Specify Text window.

   If you are editing an existing DAD, the document type is automatically displayed in the **Doctype** field.
8. Click **Next** to open the RDB Mapping window.
9. Select an element or attribute node to map from by clicking on it in the field on the left of the RDB Mapping window.

   Map the elements and attributes in the XML document to element and attribute nodes which correspond to DB2 data. These nodes provide a path from the XML data to the DB2 data.
10. **To add the root node:**
    a. Select the **Root** icon.
    b. Click **New Element** to define a new node.
    c. In the **Details** box, specify **Node type** as **Element**.
    d. Enter the name of the top level node in the **Node name** field.
    e. Click **Add** to create the new node.

       You have created the root node or element, which is the parent to all the other element and attribute nodes in the map. The root node has table child elements and a join condition.
    f. Add table nodes for each table that is part of the collection.
       1) Highlight the root node name and select **New Element**.
       2) In the **Details** box, specify **Node type** as **Table**.
       3) Select the name of the table from **Table name**. The table must already exist.
       4) Click **Add** to add the table node.
       5) Repeat these steps for each table.
    g. Add a join condition for the table nodes.

1) Highlight the root node name and select **New Element**.
2) In the **Details** box, specify **Node type** as **Condition**.
3) In the **Condition** field, enter the join condition using the following syntax:

```
table_name.table_column = table_name.table_column AND
table_name.table_column = table_name.table_column ...
```

4) Click **Add** to add the condition.

11. **To add an element or attribute node:**
    a. Click on a parent node in the field on the left to add a child element or attribute.
    b. Click **New Element**. If you have not selected a parent node, **New Element** is not selectable.
    c. Select a node type from the **Node type** menu in the **Details** box.

       The **Node type** menu displays only the node types that are valid at that point in the map. **Element** or **Attribute**.
    d. Specify a node name in the **Node name** field.
    e. Click **Add** to add the new node.
    f. **To map the contents of an element or attribute node to a relational table:**
       1) Specify a text node.
          a) Click the parent node.
          b) Click **New Element**.
          c) In the **Node type** field, select **Text**.
          d) Select **Add** to add the node.
       2) Add a table node.
          a) Select the text node you just created and click **New Element**.
          b) In the **Node type** field, select **Table** and specify a table name for the element.
          c) Click **Add** to add the node.
       3) Add a column node.
          a) Select the text node again and click **New Element**.
          b) In the **Node type** field, select **Column** and specify a column name for the element.
          c) Click **Add** to add the node.

          Restriction: New columns cannot be created using the administration wizard. If you specify Column as the node type, you can only select a column that already exists in your DB2 database.
       4) Optionally add a condition for the column.
          a) Select the text node again and click **New Element**.
          b) In the **Node type** field, select **Condition** and the condition with the syntax:

             ```
             column_name LIKE|<|>|= value
             ```

          c) Click **Add** to add the node.
    g. Continue editing the RDB map or click **Next** to open the Specify a DAD window.

12. **To remove a node:**
    a. Click on a node in the field on the left.
    b. Click **Remove**.

c. Continue editing the RDB_node map or click **Next** to open the Specify a DAD window.

13. Type in an output file name for the modified DAD in the **File name** field of the Specify a DAD window.
14. Click **Finish** to remove the node and return to the LaunchPad window.

Using the command line

The DAD file is an XML file that you can create using any text editor. The following steps show fragments from the samples appendix, "Document access definition files" on page 236. Please refer to these examples for more comprehensive information and context.

1. Open a text editor.

   The DAD file must be either stored in an Integrated File System (IFS) directory, or created as a physical file member with a link in the IFS directory pointing to the member.
2. Create the DAD header:

   ```
   <?xml version="1.0"?>
   <!DOCTYPE DAD SYSTEM "path/dad.dtd"> --> the path and file name of the DTD
           for the DAD
   ```
3. Insert the <DAD></DAD> tags.
4. After the <DAD> tag, specify the DTD ID that associates the DAD file with the XML document DTD.

   ```
   <dtdid>path/dtd_name.dtd> --> the path and file name of the DTD
           for your application
   ```
5. Specify whether to validate (that is, to use a DTD to ensure that the XML document is a valid XML document). For example:

   ```
   <validation>NO</validation>   --> specify YES or NO
   ```
6. Use the <Xcollection> element to define the access and storage method as XML collection. The access and storage methods define that the XML data is stored in a collection of DB2 tables.

   ```
   <Xcollection>
   </Xcollection>
   ```
7. Add the following prolog information:

   ```
   <prolog>?xml version="1.0"?</prolog>
   ```

   This exact text is required.
8. Add the <doctype></doctype> tags. For example:

   ```
   <doctype>! DOCTYPE Order SYSTEM "dxx_install/dtd/getstart.dtd"</doctype>
   ```

   If you need to specify an encoding value for internationalization, add the ENCODING attribute and value. See "Appendix C. Code page considerations" on page 245 to learn about encoding issues in an client/server environment.
9. Define the root node using the <root_node>. Inside the root_node, you specify the elements and attributes that make up the XML document.
10. Map the elements and attributes in the XML document to element and attribute nodes that correspond to DB2 data. These nodes provide a path from the XML data to the DB2 data.
    a. Define a root element_node. This element_node contains:
       - An RDB_node which specifies table_nodes with a join condition to specify the collection
       - Child elements
       - Attributes

To specify the table nodes and condition:

1) Create an RDB_node element: For example:

```
<RDB_node>
</RDB_node>
```

2) Define a <table_node> for each table that contains data to be included in the XML document. For example, if you have three tables, ORDER_TAB, PART_TAB, and SHIP_TAB, that have column data to be in the document, create a table node for each. For example:

```
<RDB_node>
<table name="ORDER_TAB">
<table name="PART_TAB">
<table name="SHIP_TAB"></RDB_node>
```

3) Optionally, specify a key column for each table when you plan to enable this collection. The key attribute is not normally required for composition; however, when you enable a collection, the DAD file used must support both composition and decomposition. For example:

```
<RDB_node>
<table name="ORDER_TAB" key="order_key">
<table name="PART_TAB" key="part_key">
<table name="SHIP_TAB" key="date mode">
</RDB_node>
```

4) Define a join condition for the tables in the collection. The syntax is

```
table_name.table_column = table_name.table_column AND
table_name.table_column = table_name.table_column ...
```

For example:

```
<RDB_node>
<table name="ORDER_TAB">
<table name="PART_TAB">
<table name="SHIP_TAB">
<condition>
   order_tab.order_key = part_tab.order_key AND
   part_tab.part_key = ship_tab.part_key
</condition>
</RDB_node>
```

b. Define an <element_node> tag for each element in your XML document that maps to a column in a DB2 table. For example:

```
<element_node name="name">
</element_node>
```

An element node can have one of the following types of elements:

- <text_node>: to specify that the element has content to a DB2 table; the element does not have child elements
- <attribute_node>: to specify an attribute. Attribute nodes are defined in the next step.

The text_node contains an <RDB_node> to map content to a DB2 table and column name.

RDB_nodes are used for bottom-level elements that have content to map to a DB2 table. An RDB_node has the following child elements:

- <table>: defines the table corresponding to the element
- <column>: defines the column containing the corresponding element and specifies the column type with the type attribute
- <condition>: optionally specifies a condition on the column

For example, you might have an XML element <Tax> that maps to a column called TAX:

XML document:

```
<Tax>0.02</Tax>
```

In this case, you want the value `0.02` to be a value in the column TAX.

```
<element_node name="Tax">
   <text_node>
      <RDB_node>
         <table name="part_tab"/>
         <column name="tax"/>
      </RDB_node>
   </text_node>
</element_node>
```

In this example, the <RDB_node> specifies that the value of the <Tax> element is a text value, the data is stored in the PART_TAB table in the TAX column.

See the example DAD files in "Document access definition files" on page 236 for RDB_node mapping, as well as the DTD for the DAD file in "Appendix A. DTD for the DAD file" on page 229, which provides the full syntax for the DAD file.

c. Optionally, add a type attribute to each <column> element when you plan to enable this collection. The type attribute is not normally required for composition; however, when you enable a collection, the DAD file used must support both composition and decomposition. For example:

```
<column name="tax" type="real"/>
```

d. Define an <attribute_node> for each attribute in your XML document that maps to a column in a DB2 table. For example:

```
<attribute_node name="key">
</attribute_node>
```

The attribute_node has an <RDB_node> to map the attribute value to a DB2 table and column. An <RDB_node> has the following child elements:

- <table>: defines the table corresponding to the element
- <column>: defines the column containing the corresponding element
- <condition>: optionally specifies a condition on the column

For example, you might want to have an attribute `key` for an element <Order>. The value of key needs to be stored in a column PART_KEY. In the DAD file, create an <attribute_node> for key and indicate the table where the value is to be stored.

DAD file:

```
<attribute_node name="key">
  <RDB_node>
    <table name="part_tab">
    <column name="part_key"/>
  <RDB_node>
</attribute_node>
```

Composed XML document:

```
<Order key="1">
```

11. Ensure that you have an ending </root_node> tag after the last </element_node> tag.
12. Ensure that you have an ending </Xcollection> tag after the </root_node> tag.
13. Ensure that you have an ending </DAD> tag after the </Xcollection> tag.

Decomposing XML documents with RDB_node mapping

Use RDB_node mapping to decompose XML documents. This method uses the <RDB_node> to specify DB2 tables, column, and conditions for an element or attribute node. The <RDB_node> uses the following elements:

- <table>: defines the table corresponding to the element
- <column>: defines the column containing the corresponding element
- <condition>: optionally specifies a condition on the column

The child elements that are used in the <RDB_node> depend on the context of the node and use the following rules:

If the node type is:	RDB child element is used:		
	Table	**Column**	**Condition**[1]
Root element	Y	N	Y
Attribute	Y	Y	optional
Text	Y	Y	optional

(1) Required with multiple tables

Using the administration wizard

1. Set up and start the administration wizard. See "Starting the administration wizard" on page 59 for details.
2. Click **Work with DAD files** from the LaunchPad window. The Specify a DAD windows opens.
3. Choose whether to edit an existing DAD file or to create a new DAD.

   To edit an existing DAD:

   a. Type the DAD file name in the **File name** field or click **...** to browse for an existing DAD.
   b. Verify that the wizard recognizes the specified DAD file.
      - If the wizard recognizes the specified DAD file, **Next** is selectable, and XML collection RDB node mapping is displayed in the **Type** field.
      - If the wizard does not recognize the specified DAD file, **Next** is not selectable. Either retype the DAD file name in the **File name** field or click **...** to browse again for an existing DAD file. Continue these steps until **Next** is selectable.
   c. Click **Next** to open the Select Validation window.

   To create a new DAD:

   a. Leave the **File name** field blank.
   b. Select XML collection RDB_node mapping from the **Type** menu.
   c. Click **Next** to open the Select Validation window.
4. In the Select Validation window, choose whether to validate your XML documents with a DTD.
   - To validate:

a. Click **Validate XML documents with the DTD**.
b. Select the DTD to be used for validation from the **DTD ID** menu.

   If XML Extender does not find the specified DTD in the DTD reference table, it searches for the specified DTD on the file system and uses it to validate.

- Click **Do NOT validate XML documents with the DTD** to continue without validating your XML documents.

5. Click **Next** to open the Specify Text window.
6. If you are decomposing an XML document only, ignore the **Prolog** field. If you are using the DAD file for both composition and decomposition, type the prolog name in the **Prolog** field of the Specify Text window. The prolog is not required if you are decomposing XML documents into DB2 data.

   ```
   <?xml version="1.0"?>
   ```

   If you are editing an existing DAD, the prolog is automatically displayed in the **Prolog** field.
7. If you are decomposing an XML document only, ignore the **Doctype** field. If you are using the DAD file for both composition and decomposition, enter the document type of the XML document in the **Doctype** field

   If you are editing an existing DAD, the document type is automatically displayed in the **Doctype** field.
8. Click **Next** to open the RDB Mapping window.
9. Select an element or attribute node to map from by clicking on it in the field on the left of the RDB Mapping window.

   Map the elements and attributes in the XML document to element and attribute nodes which correspond to DB2 data. These nodes provide a path from the XML data to the DB2 data.
10. **To add the root node:**
    a. Select the **Root** icon.
    b. Click **New Element** to define a new node.
    c. In the **Details** box, specify **Node type** as **Element**.
    d. Enter the name of the top level node in the **Node name** field.
    e. Click **Add** to create the new node.

       You have created the root node or element, which is the parent to all the other element and attribute nodes in the map. The root node has table child elements and a join condition.
    f. Add table nodes for each table that is part of the collection.
       1) Highlight the root node name and select **New Element**.
       2) In the **Details** box, specify **Node type** as **Table**.
       3) Select the name of the table from **Table name**. The table must already exist.
       4) Specify a key column for the table in the **Table key** field.
       5) Click **Add** to add the table node.
       6) Repeat these steps for each table.
    g. Add a join condition for the table nodes.
       1) Highlight the root node name and select **New Element**.
       2) In the **Details** box, specify **Node type** as **Condition**.

3) In the **Condition** field, enter the join condition using the following syntax:

```
table_name.table_column = table_name.table_column AND
table_name.table_column = table_name.table_column ...
```

4) Click **Add** to add the condition.

You can now add child elements and attributes to this node.

11. **To add an element or attribute node:**
    a. Click on a parent node in the field on the left to add a child element or attribute.

       If you have not selected a parent node, **New** is not selectable.
    b. Click **New Element**.
    c. Select a node type from the **Node type** menu in the **Details** box.

       The **Node type** menu displays only the node types that are valid at that point in the map. **Element** or **Attribute**.
    d. Specify a node name in the **Node name** field.
    e. Click **Add** to add the new node.
    f. **To map the contents of an element or attribute node to a relational table:**
       1) Specify a text node.
          a) Click the parent node.
          b) Click **New Element**.
          c) In the **Node type** field, select **Text**.
          d) Select **Add** to add the node.
       2) Add a table node.
          a) Select the text node you just created and click **New Element**.
          b) In the **Node type** field, select **Table** and specify a table name for the element.
          c) Click **Add** to add the node.
       3) Add a column node.
          a) Select the text node again and click **New Element**.
          b) In the **Node type** field, select **Column** and specify a column name for the element.
          c) Specify a base data type for the column in the **Type** field, to specify what type the column must be to store the untagged data.
          d) Click **Add** to add the node.

          Restriction: New columns cannot be created using the administration wizard. If you specify Column as the node type, you can only select a column that already exists in your DB2 database.
       4) Optionally add a condition for the column.
          a) Select the text node again and click **New Element**.
          b) In the **Node type** field, select **Condition** and the condition with the syntax:

             column_name LIKE|<|>|= *value*
          c) Click **Add** to add the node.

    You can modify these nodes by selecting the node, change the fields in the **Details** box, and clicking **Change**.

g. Continue editing the RDB map or click **Next** to open the Specify a DAD window.

12. **To remove a node:**
    a. Click on a node in the field on the left.
    b. Click **Remove**.
    c. Continue editing the RDB_node map or click **Next** to open the Specify a DAD window.
13. Type in an output file name for the modified DAD in the **File name** field of the Specify a DAD window.
14. Click **Finish** to remove the node and return to the LaunchPad window.

Using the command line

The DAD file is an XML file that you can create using any text editor. The following steps show fragments from the samples appendix, "Document access definition files" on page 236. Please refer to these examples for more comprehensive information and context.

1. Open a text editor.

   The DAD file must be either stored in an Integrated File System (IFS) directory, or created as a physical file member with a link in the IFS directory pointing to the member.
2. Create the DAD header:

   ```
   <?xml version="1.0"?>
   <!DOCTYPE DAD SYSTEM "path/dad.dtd"> --> the path and file name of the DTD
          for the DAD
   ```
3. Insert the <DAD></DAD> tags.
4. After the <DAD> tag, specify the DTD ID that associates the DAD file with the XML document DTD.

   ```
   <dtdid>path/dtd_name.dtd> --> the path and file name of the DTD
          for your application
   ```
5. Specify whether to validate (that is, to use a DTD to ensure that the XML document is a valid XML document). For example:

   ```
   <validation>NO</validation>   --> specify YES or NO
   ```
6. Use the <Xcollection> element to define the access and storage method as XML collection. The access and storage methods define that the XML data is stored in a collection of DB2 tables.

   ```
   <Xcollection>
   </Xcollection>
   ```
7. Add the following prolog information:

   ```
   <prolog>?xml version="1.0"?</prolog>
   ```

   This exact text is required.
8. Add the <doctype></doctype> tags. For example:

   ```
   <doctype>! DOCTYPE Order SYSTEM "dxx_install/dtd/getstart.dtd"</doctype>
   ```

   If you need to specify an encoding value for internationalization, add the ENCODING attribute and value. See "Appendix C. Code page considerations" on page 245 to learn about encoding issues in an client/server environment.
9. Define the root_node using the <root_node></root_node> tags. Inside the root_node, you specify the elements and attributes that make up the XML document.

10. After the <root_node> tag, map the elements and attributes in the XML document to element and attribute nodes that correspond to DB2 data. These nodes provide a path from the XML data to the DB2 data.
    a. Define a top level, root element_node. This element_node contains:
        - Table nodes with a join condition to specify the collection.
        - Child elements
        - Attributes

        To specify the table nodes and condition:

        1) Create an RDB_node element: For example:

```
<RDB_node>
</RDB_node>
```

        2) Define a <table_node> for each table that contains data to be included in the XML document. For example, if you have three tables, ORDER_TAB, PART_TAB, and SHIP_TAB, that have column data to be in the document, create a table node for each. For example:

```
<RDB_node>
<table name="ORDER_TAB">
<table name="PART_TAB">
<table name="SHIP_TAB"></RDB_node>
```

        3) Define a join condition for the tables in the collection. The syntax is:

```
table_name.table_column = table_name.table_column AND
table_name.table_column = table_name.table_column ...
```

        For example:

```
<RDB_node>
<table name="ORDER_TAB">
<table name="PART_TAB">
<table name="SHIP_TAB">
<condition>
   order_tab.order_key = part_tab.order_key AND
   part_tab.part_key = ship_tab.part_key
</condition>
</RDB_node>
```

        4) Specify a primary key for each table. The primary key consists of a single column or multiple columns, called a composite key. To specify the primary key, add an attribute key to the table element of the RDB_node. The following example defines a primary key for each of the tables in the RDB_node of the root element_node Order:

```
<element_node name="Order">
    <RDB_node>
         <table name="order_tab" key="order_key"/>
         <table name="part_tab" key="part_key price"/>
         <table name="ship_tab" key="date mode"/>
         <condition>
             order_tab.order_key = part_tab.order_key AND
             part_tab.part_key = ship_tab.part_key
         </condition>
    <RDB_node>
```

        The information specified for decomposition is ignored when composing an XML document.

        The key attribute is required for decomposition, and when you enable a collection because the DAD file used must support both composition and decomposition.

b. Define an <element_node> tag for each element in your XML document that maps to a column in a DB2 table. For example:

```
<element_node name="name">
</element_node>
```

An element node can have one of the following types of elements:

- <text_node>: to specify that the element has content to a DB2 table; in this case it does not have child elements.
- <attribute_node>: to specify an attribute; attribute nodes are defined in the next step
- child elements

The text_node contains an RDB_node to map content to a DB2 table and column name.

RDB_nodes are used for bottom-level elements that have content to map to a DB2 table. An RDB_node has the following child elements:

- <table>: defines the table corresponding to the element
- <column>: defines the column containing the corresponding element
- <condition>: optionally specifies a condition on the column

For example, you might have an XML element <Tax> for which you want to store the untagged content in a column called TAX:

XML document:

```
<Tax>0.02</Tax>
```

In this case, you want the value `0.02` to be stored in the column TAX.

In the DAD file, you specify an <RDB_node> to map the XML element to the DB2 table and column.

DAD file:

```
<element_node name="Tax">
   <text_node>
      <RDB_node>
         <table name="part_tab"/>
         <column name="tax"/>
      </RDB_node>
   </text_node>
</element_node>
```

The <RDB_node> specifies that the value of the <Tax> element is a text value, the data is stored in the PART_TAB table in the TAX column.

c. Define an <attribute_node> for each attribute in your XML document that maps to a column in a DB2 table. For example:

```
<attribute_node name="key">
</attribute_node>
```

The attribute_node has an RDB_node to map the attribute value to a DB2 table and column. An RDB_node has the following child elements:

- <table>: defines the table corresponding to the element
- <column>: defines the column containing the corresponding element
- <condition>: optionally specifies a condition on the column

For example, you might have an attribute key for an element <Order>. The value of key needs to be stored in a column PART_KEY.

XML document:

```
<Order key="1">
```

In the DAD file, create an attribute_node for key and indicate the table where the value of 1 is to be stored.

DAD file:

```
<attribute_node name="key">
  <RDB_node>
    <table name="part_tab">
    <column name="part_key"/>
  <RDB_node>
</attribute_node>
```

11. Specify the column type for the RDB_node for each attribute_node and text_node. This ensures the correct data type for each column where the untagged data will be stored. To specify the column types, add the attribute type to the column element. The following example defines the column type as an INTEGER:

```
<attribute_node name="key">
    <RDB_node>
        <table name="order_tab"/>
        <column name="order_key" type="integer"/>
    </RDB_node>
</attribute_node>
```

12. Ensure that you have an ending </root_node> tag after the last </element_node> tag.
13. Ensure that you have an ending </Xcollection> tag after the </root_node> tag.
14. Ensure that you have an ending </DAD> tag after the </Xcollection> tag.

Enabling XML collections

Enabling an XML collection parses the DAD file to identify the tables and columns related to the XML document, and records control information in the XML_USAGE table. Enabling an XML collection is optional for:

- Decomposing an XML document and storing the data in new DB2 tables
- Composing an XML document from existing data in multiple DB2 tables

If the same DAD file is used for composing and decomposing, you can enable the collection for both composition and decomposition.

You can enable an XML collection through the XML Extender administration wizard, using the **dxxadm** command with the enable_collection option, or you can use the XML Extender stored procedure dxxEnableCollection().

Using the administration wizard

Use the following steps to enable an XML collection.

1. Set up and start the administration wizard. See "Starting the administration wizard" on page 59 for details.
2. Click **Work with XML Collections** from the LaunchPad window. The Select a Task window opens.

3. Click **Enable a Collection** and then **Next**. The Enable a Collection window opens.
4. Select the name of the collection you want to enable in the **Collection name** field from the pull-down menu.
5. Type the DAD file name in the **DAD file name** field or click **...** to browse for an existing DAD file.
6. Optionally, type the name of a previously created table space in the **Table space** field.

   The table space will contain new DB2 tables generated for decomposition.
7. Click **Finish** to enable the collection and return to the LaunchPad window.
   - If the collection is successfully enabled, an `Enabled collection is successful` message is displayed.
   - If the collection is not successfully enabled, an error message is displayed. Continue the preceding steps until the collection is successfully enabled.

Using the command line

To enable an XML collection, enter the **dxxadm** command:

Syntax:

Parameters:

dbName
The name of the RDB database.

collection
The name of the XML collection. This value is used as a parameter for the XML collection stored procedures.

DAD_file
The name of the file that contains the document access definition (DAD).

tablespace
An existing table space that contains new DB2 tables that were generated for decomposition. If not specified, the default table space is used.

Example: The following example enables a collection called sales_ord in the database SALES_DB using the command line. The DAD file uses SQL mapping and can be found in "DAD file: XML collection - SQL mapping" on page 238.

From the Qshell:

```
dxxadm enable_collection SALES_DB sales_ord getstart_collection.dad
```

From the OS command line:

```
CALL QDBXM/QZXMADM PARM(enable_collection SALES_DB sales_ord
  'getstart_collection.dad')
```

From the Operations Navigator:

```
CALL MYSCHEMA.QZXMADM('enable_collection', 'SALES_DB', 'sales_ord',
  'getstart_collection.dad');
```

After you enable the XML collection, you can compose or decompose XML documents using the XML Extender stored procedures.

Disabling XML collections

Disabling an XML collection removes the record in the XML_USAGE table that identify tables and columns as part of a collection. It does not drop any data tables. You disable a collection when you want to update the DAD and need to re-enable a collection, or to drop a collection.

You can disable an XML collection through the XML Extender administration wizard, using the **dxxadm** command with the disable_collection option, or using the XML Extender stored procedure dxxDisableCollection().

Using the administration wizard

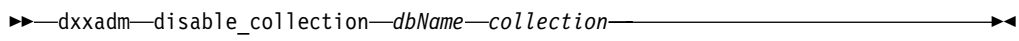
Use the following steps to disable an XML collection.

1. Set up and start the administration wizard. See "Starting the administration wizard" on page 59 for details.
2. Click **Work with XML Collections** from the LaunchPad window to view the XML Extender collection related tasks. The Select a Task window opens.
3. Click **Disable an XML Collection** and then **Next** to disable an XML collection. The Disable a Collection window opens.
4. Type the name of the collection you want to disable in the **Collection name** field.
5. Click **Finish** to disable the collection and return to the LaunchPad window.
   - If the collection is successfully disabled, an `Disabled collection is successful message` is displayed.
   - If the collection is not successfully disabled, an error box is displayed. Continue the preceding steps until the collection is successfully disabled.

Using the command line

To disable an XML collection, enter the **dxxadm** command:

Syntax:



Parameters:

dbName
The name of the RDB database.

collection
The name of the XML collection. This value is used as a parameter for the XML collection stored procedures.

Example:

From the Qshell:

```
dxxadm disable_collection SALES_DB sales_ord
```

From the OS command line:

```
CALL QDBXM/QZXMADM PARM(disable_collection SALES_DB sales_ord)
```

From the Operations Navigator:

```
CALL MYSCHEMA.QZXMADM('disable_collection', 'SALES_DB', 'sales_ord');
```

Part 3. Programming

This part describes programming techniques for managing your XML data.

Chapter 8. Managing XML column data

When using XML columns, you store an entire XML document as column data. This access and storage method allows you to keep the XML document intact, while giving you the ability to index and search the document, retrieve data from the document, and update the document. An XML column contains XML documents in their native format in DB2 as column data. After you enable a database for XML, the following user-defined types (UDTs) are available for your use:

XMLCLOB
XML document content that is stored as a character large object (CLOB) in DB2

XMLVARCHAR
XML document content that is stored as a VARCHAR in DB2

XMLFile
XML document that is stored in a file on a local file system

You can create or alter application tables using XML UDTs as column data types. These tables are known as XML tables. To learn how to create or alter a table for XML, see "Creating or altering an XML table" on page 72.

After you enable a column for XML, you can begin managing the contents of the XML column. After the XML column is created, you can perform the following management tasks:

- Store XML documents in DB2
- Retrieve XML data or documents from DB2
- Update XML documents
- Delete XML data or documents

To perform these tasks, you can use two methods:

- *Default casting functions*, which cast the SQL base type to the XML Extender user-defined types. A casting function converts instances of a data type (origin) into instances of a different data type (target).
- XML Extender-provided user-defined functions (UDFs)

This book describes both methods for each task.

User-defined types and user-defined function names

The full name of a DB2 function is: *schema-name.function-name*, where *schema-name* is an identifier that provides a logical grouping for the SQL objects. The schema name for XML Extender UDFs is DB2XML. The DB2XML schema name is also the qualifier for the XML Extender UDTs. In this book, references are made only to the function name.

You can specify UDTs and UDFs without the schema name if you add the schema to the function path. The function path is an ordered list of schema names. DB2 uses the order of schema names in the list to resolve references to functions and UDTs. You can specify the function path by specifying the SQL statement SET CURRENT FUNCTION PATH. This sets the function path in the CURRENT FUNCTION PATH special register.

For the XML Extender, it is a good idea to add the DB2XML schema to the function path. This allows you to enter XML Extender UDF and UDT names without having to qualify them with DB2XML. The following example shows how to add the DB2XML schema to the funct

ion path:

```
SET CURRENT FUNCTION PATH = DB2XML, CURRENT FUNCTION PATH
```

Important: Do not add DB2XML as the first schema in the function path if you log on as DB2XML; DB2XML is automatically set as the first schema when you log on as DB2XML. This generates an error condition because your function path will begin with two DB2XML schemas.

Writing user-defined functions using the DB2XML.ONEROW table

The DB2 for iSeries requires that user-defined functions appear in a SELECT clause to invoke the UDF and retrieve any result sets. To assist you in using this method of invoking UDFs, the XML Extender provides the DB2XML.ONEROW table for you to use in the FROM clause of the SELECT statement.

Important: Do not use or alter the contents of the ONEROW table. This use of the ONEROW table provides a mechanism to invoke the UDF once and return a result set.

The following example uses a select statement and the ONEROW table to insert the result set of the UDF into TABLE1:

```
INSERT into TABLE1
(SELECT db2xml.extractInteger(db2xml.XMLFile('/dxxsamples/xml/getstart.xml'),'/Order/@key')
   as OrderKey
   FROM db2xml.onerow);
```

The examples in the following sections do not use the ONEROW table. Use the above example as a model.

Storing data

Using the XML Extender, you can insert intact XML documents into an XML column. If you define side tables, the XML Extender automatically updates these tables. When you store an XML document directly, the XML Extender stores the base type as an XML type.

Task overview:

1. Ensure that you have created or updated the DAD file.
2. Determine what data type to use when you store the document.
3. Choose a method for storing the data in the DB2 table (casting functions or UDFs).
4. Specify an SQL INSERT statement that specifies the XML table and column to contain the XML document.

The XML Extender provides two methods for storing XML documents: default casting functions and storage UDFs.

Table 13 shows when to use each method.

Table 13. The XML Extender storage functions

Base type	**Store in DB2 as...**		
	XMLVARCHAR	**XMLCLOB**	**XMLFILE**
VARCHAR	XMLVARCHAR()	N/A	XMLFileFromVarchar()
CLOB	N/A	XMLCLOB()	XMLFileFromCLOB()
FILE	XMLVarcharFromFile()	XMLCLOBFromFile()	XMLFILE

Use a default casting function

For each UDT, a default casting function exists to cast the SQL base type to the UDT. You can use the XML Extender-provided casting functions in your VALUES clause to insert data. Table 14 shows the provided casting functions:

Table 14. The XML Extender default cast functions

Casting used in SELECT clause	Return type	Description
XMLVARCHAR(VARCHAR)	XMLVARCHAR	Input from memory buffer of VARCHAR
XMLCLOB(CLOB)	XMLCLOB	Input from memory buffer of CLOB or a CLOB locator
XMLFILE(VARCHAR)	XMLFILE	Only store file name

Example: The following statement inserts a cast VARCHAR type into the XMLVARCHAR type:

```
INSERT INTO sales_tab
VALUES('123456', 'Sriram Srinivasan', DB2XML.XMLVarchar(:xml_buff))
```

Use a storage UDF:

For each XML Extender UDT, a storage UDF exists to import data into DB2 from a resource other than its base type. For example, if you want to import an XML file document to DB2 as a XMLCLOB, you can use the function XMLCLOBFromFile().

Table 15 shows the storage functions provided by the XML Extender.

Table 15. The XML Extender storage UDFs

Storage user-defined function	Return type	Description
XMLVarcharFromFile()	XMLVARCHAR	Reads an XML document from a file on the server and returns the value of the XMLVARCHAR type.
XMLCLOBFromFile()	XMLCLOB	Reads an XML document from a file on the server and returns the value of the XMLCLOB type.
XMLFileFromVarchar()	XMLFILE	Reads an XML document from memory as VARCHAR, writes it to an external file, and returns the value of the XMLFILE type, which is the file name.
XMLFileFromCLOB()	XMLFILE	Reads an XML document from memory as CLOB or a CLOB locator, writes it to an external file, and returns the value of the XMLFILE type, which is the file name.

Example: The following statement stores a record in an XML table using the XMLCLOBFromFile() function as an XMLCLOB.

```
EXEC SQL INSERT INTO sales_tab(ID, NAME, ORDER)
    VALUES( '1234', 'Sriram Srinivasan,
      XMLCLOBFromFile('dxx_install/xml/getstart.xml'))
```

The preceding example imports the XML object from the file named *dxx_install*/xml/getstart.xml to the column ORDER in the table SALES_TAB.

Retrieving data

Using the XML Extender, you can retrieve either an entire document or the contents of elements and attributes. When you retrieve an XML column directly, the XML Extender returns the UDT as the column type. For details on retrieving data, see the following sections:

- "Retrieving an entire document" on page 108
- "Retrieving element contents and attribute values" on page 109

The XML Extender provides two methods for retrieving data: default casting functions and the Content() overloaded UDF. Table 16 shows when to use each method.

Table 16. The XML Extender retrieval functions

XML type	Retrieve from DB2 as...		
	VARCHAR	**CLOB**	**FILE**
XMLVARCHAR	VARCHAR	N/A	Content()
XMLCLOB	N/A	XMLCLOB	Content()
XMLFILE	N/A	Content()	FILE

Retrieving an entire document

Task overview:

1. Ensure that you have stored the XML document in an XML table and determine what data you want to retrieve.
2. Choose a method for retrieving the data in the DB2 table (casting functions or UDFs).
3. If using the overloaded Content() UDF, determine which data type is associated with the data that is being retrieved, and which data type is to be exported.
4. Specify an SQL query that specifies the XML table and column from which to retrieve the XML document.

The XML Extender provides two methods for retrieving data:

Use a default casting function

Use the default casting function provided by DB2 for UDTs to convert an XML UDT to an SQL base type, and then operate on it. You can use the XML Extender-provided casting functions in your SELECT statement to retrieve data. Table 17 shows the provided casting functions:

Table 17. The XML Extender default cast functions

Casting used in select clause	Return type	Description
varchar(XMLVARCHAR)	VARCHAR	XML document in VARCHAR
clob(XMLCLOB)	CLOB	XML document in CLOB
varchar(XMLFile)	VARCHAR	XML file name in VARCHAR

Example: The following example retrieves the XMLVARCHAR and stores it in memory as a VARCHAR data type:

```
EXEC SQL SELECT DB2XML.Varchar(ORDER) from SALES_TAB
```

Use the Content() overloaded UDF

Use the Content() UDF to retrieve the document content from external storage to memory, or export the document from internal storage to an *external file*, a file external to DB2, on the DB2 server.

For example, you might have your XML document stored as XMLFILE and you want to operate on it in memory, you can use the Content() UDF, which can take an XMLFILE data type as input and return a CLOB.

The Content() UDF performs two different retrieval functions, depending on the specified data type. It:

Retrieves a document from external storage and puts it in memory

You can use Content() to retrieve the XML document to a memory buffer or a CLOB *locator* (a host variable with a value that represents a single LOB value in the database server) when the document is stored as the external file . Use the following function syntax, where *xmlobj* is the XML column being queried:

XMLFILE to CLOB: Retrieves data from a file and exports to a CLOB locator.

```
Content(xmlobj XMLFile)
```

Retrieves a document from internal storage and exports it to an external file

You can also use Content() to retrieve an XML document that is stored inside DB2 as an XMLCLOB data type and export it to a file on the database server file system. It returns the name of the file of

VARCHAR type. Use the following function syntax, where *xmlobj* is the XML column that is being queried and *filename* is the external file. *XML type* can be of XMLVARCHAR or XMLCLOB data type.

XML type **to external file:** Retrieves the XML content that is stored as an XML data type and exports it to an external file.

```
Content(xmlobj XML type, filename varchar(512))
```

Where:

xmlobj Is the name of the XML column from which the XML content is to be retrieved; *xmlobj* can be of type XMLVARCHAR or XMLCLOB.

filename
Is the name of the file in which the XML data is to be stored.

In the example below, a small C program segment with *embedded SQL* (SQL statements coded within an application program) illustrates how an XML document is retrieved from a file to memory. This example assumes that the column ORDER is of the XMLFILE type.

```
EXEC SQL BEGIN DECLARE SECTION;
    SQL TYPE IS CLOB_LOCATOR xml_buff;
EXEC SQL END DECLARE SECTION;
EXEC SQL CONNECT TO SALES_DB
EXEC SQL DECLARE c1 CURSOR FOR
    SELECT Content(order) from sales_tab
               EXEC SQL OPEN c1;
do {
   EXEC SQL FETCH c1 INTO :xml_buff;
   if (SQLCODE != 0) {
      break;
      }
   else {
     /* do whatever you need to do with the XML doc in buffer */
     }
   }
EXEC SQL CLOSE c1;
EXEC SQL CONNECT RESET;
```

Retrieving element contents and attribute values

You can retrieve (extract) the content of an element or an attribute value from one or more XML documents (single document or collection document search). The XML Extender provides user-defined extracting functions that you can specify in the SQL SELECT clause for each of the SQL data types.

Retrieving the content and values of elements and attributes is useful in developing your applications, because you can access XML data as relational data. For example, you might have 1000 XML documents that are stored in the column ORDER in the table SALES_TAB. You can retrieve the names of all customers who have ordered items using the following SQL statement with the extracting UDF in the SELECT clause to retrieve this information:

```
SELECT extractVarchar(Order, '/Order/Customer/Name') from sales_order_view
       WHERE price > 2500.00
```

In this example, the extracting UDF retrieves the element <customer> from the column ORDER as a VARCHAR data type. The location path is

`/Order/Customer/Name` (see "Location path" on page 56 for location path syntax). Additionally, the number of returned values is reduced by using a WHERE clause, which specifies that only the contents of the <customer> element with a subelement <ExtendedPrice> has a value greater than 2500.00.

To extract element content or attribute values: Use the extracting UDFs listed in Table 18 by using the following syntax for or scalar functions:

```
extract retrieved_datatype(xmlobj, path)
```

Where:

retrieved_datatype
Is the data type that is returned from the extracting function; it can be one of the following types:

- INTEGER
- SMALLINT
- DOUBLE
- REAL
- CHAR
- VARCHAR
- CLOB
- DATE
- TIME
- TIMESTAMP
- FILE

xmlobj Is the name of the XML column from which the element or attribute is to be extracted. This column must be defined as one of the following XML user-defined types:

- XMLVARCHAR
- XMLCLOB as LOCATOR
- XMLFILE

path Is the location path of the element or attribute in the XML document (such as `/Order/Customer/Name`). See "Location path" on page 56 for location path syntax.

Important: Note that the extracting UDFs support location paths that have predicates with attributes, but not elements. For example, the following predicate is supported:

```
'/Order/Part[@color="black "]/ExtendedPrice'
```

The following predicate is not supported:

```
'/Order/Part/Shipment/[Shipdate < "11/25/00"]'
```

Table 18 shows the extracting functions, both in scalar and table format:

Table 18. The XML Extender extracting functions

Scalar function	Returned column name (table function)	Return type
extractInteger()	returnedInteger	INTEGER
extractSmallint()	returnedSmallint	SMALLINT
extractDouble()	returnedDouble	DOUBLE

Table 18. The XML Extender extracting functions (continued)

Scalar function	Returned column name (table function)	Return type
extractReal()	returnedReal	REAL
extractChar()	returnedChar	CHAR
extractVarchar()	returnedVarchar	VARCHAR
extractCLOB()	returnedCLOB	CLOB
extractDate()	returnedDate	DATE
extractTime()	returnedTime	TIME
extractTimestamp()	returnedTimestamp	TIMESTAMP

Scalar function example:

In the following example, one value is inserted with the attribute value of key = ″1″. The value is extracted as an integer and automatically converted to a DECIMAL type.

```
CREATE TABLE t1(key decimal(3,2));
INSERT into t1
   (SELECT db2xml.extractInteger(db2xml.XMLFile('/dxxsamples/xml/getstart.xml'), '/Order/@key')  a
     FROM db2xml.onerow) ;
SELECT * from t1;
```

Table function example:

In the following example, each key value for the sales order is extracted as an INTEGER

```
SELECT * from table(DB2XML.extractIntegers(DB2XML.XMLFile
   ('c:\dxx\samples\xml\getstart.xml'), '/Order/@key')) as x;
```

Updating XML data

With the XML Extender, you can update the entire XML document by replacing the XML column data, or you can update the values of specified elements or attributes.

Task overview:

1. Ensure that you have stored the XML document in an XML table and determine what data you want to retrieve.
2. Choose a method for updating the data in the DB2 table (casting functions or UDFs).
3. Specify an SQL query that specifies the XML table and column to update.

Important: When updating a column that is enabled for XML, the XML Extender automatically updates the side tables to reflect the changes. Do not update these tables directly without updating the original XML document that is stored in the XML column by changing the corresponding XML element or attribute value. Such updates can cause data inconsistency problems.

To update an XML document:

Use one of the following methods:

Use a default casting function

For each user-defined type (UDT), a default casting function exists to cast the SQL base type to the UDT. You can use the XML Extender-provided

casting functions to update the XML document. Table 14 on page 106 shows the provided casting functions and assumes the column ORDER is created of a different UDT provided by the XML Extender.

Example: Updates the XMLVARCHAR type from the cast VARCHAR type, assuming that `xml_buf` is a host variable that is defined as a VARCHAR type.

```
UPDATE sales_tab VALUES('123456', 'Sriram Srinivasan',
  DB2XML.XMLVarchar(:xml_buff))
```

Use a storage UDF

For each of the XML Extender UDTs, a storage UDF exists to import data into DB2 from a resource other than its base type. You can use a storage UDF to update the entire XML document by replacing it.

Example: The following example updates an XML document using the XMLVarcharFromFile() function:

```
UPDATE sales_tab
       set order = XMLVarcharFromFile('dxx_install/xml/getstart.xml')
     WHERE sales_person = 'Sriram Srinivasan'
```

The preceding example updates the XML object from the file named *dxx_install*/xml/getstart.xml to the column ORDER in the table SALES_TAB.

See Table 15 on page 106 for a list of the storage functions that the XML Extender provides.

To update specific elements and attributes of an XML document:

Use the Update() UDF to specify specific changes, rather than updating the entire document. Using the UDF, you specify a location path and the value of the element or attribute represented by the location path to be replaced. (See "Location path" on page 56 for location path syntax.) You do not need to edit the XML document: the XML Extender makes the change for you.

The Update UDF updates the entire XML file, and reconstructs the file based on information from the XML parser. See "How the Update function processes the XML document" on page 171 to learn how the Update UDF processes the document and for examples documents before and after they are updated.

Syntax:

```
Update(xmlobj, path, value)
```

Where:

xmlobj Is the name of the XML column for which the value of the element or attribute is to be updated.

path Is the location path of the element or attribute that is to be updated. See "Location path" on page 56 for location path syntax. See "Multiple occurrence" on page 172 to learn about considerations for multiple occurrence.

value Is the value that is to be updated.

Example: The following statement updates the value of the <Customer> element to the character string IBM, using the Update() UDF:

```
UPDATE sales_tab
       set order = Update(order, '/Order/Customer/Name', 'IBM')
   WHERE sales_person = 'Sriram Srinivasan'
```

Multiple occurrence:

When a location path is provided in the Update() UDF, the content of every element or attribute with a matching path is updated with the supplied value. This means that if a document has multiple occurring locations paths, the Update function replaces the existing values with the value provided in the *value* parameter.

Searching XML documents

Searching XML data is similar to retrieving XML data: both techniques retrieve data for further manipulation but they search by using the WHERE clause to define predicates as the criteria of retrieval.

The XML Extender provides several methods for searching XML documents in an XML column, depending on your application's needs. It provides the ability to search document structure and return results based on element content and attribute values. You can search a view of the XML column and its side tables, directly search the side tables for better performance, or use extracting UDFs with WHERE clauses. Additionally, you can use the DB2 Text Extender and search column data within the structural content for a text string.

With the XML Extender you can use indexes on side-table columns, which contain XML element content or attribute values that are extracted from XML documents, for high-speed searching. By specifying the data type of an element or attribute, you can search on SQL general data type or do range searches. For example, in our purchase order example, you could search for all orders that have an extended price of over 2500.00.

Additionally, you can use the DB2 UDB Text Extender to do structural text search or full text search. For example, you could have a column RESUME that contains resumes in XML format. You might want the name of all applicants who have Java skills. You could use the DB2 Text Extender to search on the XML documents for all resumes where the <skill> element contains the character string "JAVA".

The following sections describe search methods:

- "Searching the XML document by structure"
- "Using the Text Extender for structural text search" on page 115

Searching the XML document by structure

Using the XML Extender search features, you can search XML data in a column based on the document structure, that is on elements and attributes. To search the column data you use a SELECT statement in several ways and return a *result set* based on the matches to the document elements and attributes. You can search column data using the following methods:

- Searching with direct query on side tables
- Searching from a *joined view*
- Searching with extracting UDFs
- Searching on elements or attributes with multiple occurrence

These methods are described in the following sections and use examples with the following scenario. The application table SALES_TAB has an XML column named ORDER. This column has three side tables, ORDER_SIDE_TAB, PART_SIDE_TAB, and SHIP_SIDE_TAB. A default view, sales_order_view, was specified when the ORDER column was enabled and joins these tables using the following CREATE VIEW statement:

```
CREATE VIEW sales_order_view(invoice_num, sales_person, order,
                             order_key, customer, part_key, price, date)
     AS
     SELECT sales_tab.invoice_num, sales_tab.sales_person, sales_tab.order,
            order_side_tab.order_key, order_side_tab.customer,
            part_side_tab.part_key, ship_side_tab.date
     FROM sales_tab, order_side_tab, part_side_tab, ship_side_tab
     WHERE sales_tab.invoice_num = order_side_tab.invoice_num
                AND sales_tab.invoice_num = part_side_tab.invoice_num
                AND sales_tab.invoice_num = ship_side_tab.invoice_num
```

Searching with direct query on side tables

Direct query with subquery search provides the best performance for structural search when the side tables are indexed. You can use a query or subquery to search side tables correctly.

Example: The following statement uses a query and subquery to directly search a side table:

```
SELECT sales_person from sales_tab
   WHERE invoice_num in
     (SELECT invoice_num from part_side_tab
      WHERE price > 2500.00)
```

In this example, invoice_num is the primary key in the SALES_TAB table.

Searching from a joined view

You can have the XML Extender create a default view that joins the application table and the side tables using a unique ID. You can use this default view, or any view which joins application table and side tables, to search column data and query the side tables. This method provides a single virtual view of the application table and its side tables. However, the more side tables that are created, the more expensive the query.

Tip: You can use the root ID, or DXXROOT_ID (created by the XML Extender), to join the tables when creating your own view.

Example: The following statement searches a view

```
SELECT sales_person from sales_order_view
   WHERE price > 2500.00
```

The SQL statement returns the values of sales_person from the joined view sales_order_view table which have line item orders with a price greater than 2500.00.

Searching with extracting UDFs

You can also use the XML Extender's extracting UDFs to search on elements and attributes, when you have not created indexes or side tables for the application table. Using the extracting UDFs to scan the XML data is very expensive and should only be used with WHERE clauses that restrict the number of XML documents that are included in the search.

Example: The following statement searches with an extracting XML Extender UDF:

```
SELECT sales_person from sales_tab
     WHERE extractVarchar(order, '/Order/Customer/Name')
    like '%IBM%'
AND invoice_num > 100
```

In this example, the extracting UDF extracts </Order/Customer/Name> elements with the value of IBM.

Searching on elements or attributes with multiple occurrence

When searching on elements or attributes that have multiple occurrence, use the DISTINCT clause to prevent duplicate values.

Example: The following statement searches with the DISTINCT clause:

```
SELECT sales_person from sales_tab
            WHERE invoice_num in
              (SELECT DISTINCT invoice_num from part_side_tab
               WHERE price > 2500.00 )
```

In this example, the DAD file specifies that `/Order/Part/Price` has multiple occurrence and creates a side table, PART_SIDE_TAB, for it. The PART_SIDE_TAB table might have more than one row with the same invoice_num. Using DISTINCT returns only unique values.

Using the Text Extender for structural text search

When searching the XML document structure, the XML Extender searches element that are converted to general data types, but it does not search text. You can use the DB2 UDB Text Extender for structural or full text search on a column that is enabled for XML. The Text Extender supports XML document search in DB2 UDB version 6.1 or higher. Text Extender is available on Windows operating systems, AIX, and Sun Solaris.

Structural text search
: Searches text strings that are based on the tree structure of the XML document. For example, if you have the document structure of `/Order/Customer/Name` and you want to search for the character string "IBM" within the <Customer> subelement, you can use a structural text search. The document might also have the string IBM in a <Comment> subelement or as the name of part of a product. A structural text searches only in the specified elements for the string. In this example, only the documents which have IBM in the </Order/Customer/Name> subelement are found; the documents that have IBM in other elements but not in the </Order/Customer/Name> subelement are not returned.

Full text search
: Searches text strings anywhere in the document structure, without regard to elements or attributes. Using the previous example, all documents that have the string IBM would be returned regardless of where the character string IBM occurs.

To use the Text Extender search, you must install the DB2 Text Extender and enable your database and tables as described below. To learn how to use the Text Extender search, see the chapter on searching with the Text Extender's UDFs in *IBM DB2 Universal Database for iSeries: Text Extender Administration and Programming*.

Enabling an XML column for the Text Extender

Assuming that you have an XML-enabled database, use the following steps to enable the Text Extender to search the content of an XML-enabled column. For

example purposes, the database is named SALES_DB, the table is named ORDER, and the XML column names are XVARCHAR and XCLOB:

1. See the `install.txt` file on the Extenders CD to learn how to install the Text Extender.
2. Enter the **txstart** command from one of the following locations:
   - On UNIX operating systems, enter the command from the instance owner's command prompt.
   - On Windows NT, enter the command from the command window where DB2INSTANCE is specified.
3. Open the Text Extender command line window. This step assumes that you have database named SALES_DB and a table named ORDER, which has two XML columns named XVARCHAR and XCLOB. You might need to run the sample programs in `dxx/c`.
4. Connect to the database. At the **db2tx** command prompt, type:

   ```
   'connect to SALES_DB'
   ```
5. Enable the database for the Text Extender.

   From the **db2tx** command prompt, type:

   ```
   'enable database'
   ```
6. Enable the columns in the XML table for the Text Extender, defining the data types of the XML document, the language, code pages, and other information about the column.
   - For the VARCHAR column XVARCHAR, type:

     ```
     'enable text column order xvarchar function db2xml.varchartovarchar handle
     varcharhandle ccsid 850 language us_english format xml indextype precise
         indexproperty sections_enabled
     documentmodel (Order) updateindex update'
     ```
   - For the CLOB column XCLOB, type:

     ```
     'enable text column order xclob function db2xml.clob handle clobhandle
      ccsid 850 language us_english indextype precise updateindex update'
     ```
7. Check the status of the index.
   - For column XVARCHAR, type: `get index status order handle varcharhandle`
   - For column XCLOB, type: `get index status order handle clobhandle`
8. Define the XML document model in a document model INI file called `desmodel.ini`. This file is in: `/db2tx/txins000` for UNIX and `/instance//db2tx/txins000` for Windows NT and sections in an initialization file. For example, for the `textmodel.ini`:

   ```
   ;list of document models
   [MODELS]
   modelname=Order

   ; an 'Order' document model definition
   ; left side = section name identifier
   ; right side = section name tag

   [Order]
   Order = /Order
   Order/Customer/Name = /Order/Customer/Name
   Order/Customer/Email = /Order/Customer/Email
   Order/Part/Shipment/ShipMode = /Order/Part/Shipment/ShipMode
   ```

Searching for text using the Text Extender

The Text Extender's search capability works well with the XML Extender document structural search. The recommended method is to create a query that searches on the document element or attribute and uses the Text Extender to search the element content or attribute values.

Example: The following statements search an XML document text with the Text Extender. At the DB2 command window, type:

```
'connect to SALES_DB'
'select xvarchar from order where db2tx.contains(varcharhandle,
 'model Order section(Order/Customer/Name) "Motors"')=1'
'select xclob from order where db2tx.contains(clobhandle,
 'model Order section(Order/Customer/Name) "Motors"')=1'
```

The Text Extender Contains() UDF searches.

This example does not contain all of the steps that required to use the Text Extender to search column data. To learn about the Text Extender search concepts and capability, see the chapter on searching with the Text Extender's UDFs in *IBM DB2 Universal Database for iSeries: Text Extender Administration and Programming*..

Deleting XML documents

Use the SQL DELETE statement to delete an XML document row from an XML column. You can specify WHERE clauses to refine which documents are to be deleted.

Example: The following statements delete all documents that have a value for <ExtendedPrice> greater than 2500.00.

```
DELETE from sales_tab
       WHERE invoice_num in
          (SELECT invoice_num from part_side_tab
           WHERE price > 2500.00)
```

Limitations when invoking functions from Java Database (JDBC)

When using parameter markers in functions, a JDBC restriction requires that the parameter marker for the function must be cast to the data type of the column into which the returned data will be inserted. The function selection logic does not know what data type the argument might turn out to be, and it cannot resolve the reference.

As a result, JDBC cannot resolve the following code:

```
DB2XML.XMLdefault_casting_function(length)
```

You can use the CAST specification to provide a type for the parameter marker, such as VARCHAR, and then the function selection logic can proceed:

```
DB2XML.XMLdefault_casting_function(CAST(? AS cast_type(length))
```

Example 1: In the following example, the parameter marker is cast as VARCHAR. The parameter being passed is an XML document, which is cast as VARCHAR(1000) and inserted into the column ORDER.

```
String query = "insert into sales_tab(invoice_num, sales_person, order) values
    (?,?,DB2XML.XMLVarchar(cast (? as varchar(1000))))";
```

Example 2: In the following example, the parameter marker is cast as VARCHAR. The parameter being passed is a file name and its contents are converted to VARCHAR and inserted into the column ORDER.

```
String query = "insert into sales_tab(invoice_num, sales_person, order) values
    (?,?,DB2XML.XMLVarcharfromFILE(cast (? as varchar(1000))))";
```

Chapter 9. Managing XML collection data

An XML collection is a set of relational tables that contain data that is mapped to XML documents. This access and storage method lets you compose an XML document from existing data, decompose an XML document, and use XML as an interchange method.

The relational tables can be new tables that the XML Extender generates when decomposing XML documents, or existing tables that have data that is to be used with the XML Extender to generate XML documents for your applications. Column data in these tables does not contain XML tags; it contains the content and values that are associated with elements and attributes, respectively. Stored procedures act as the access and storage method for storing, retrieving, updating, searching, and deleting XML collection data.

The parameter limits used by the XML collection stored procedures are documented in "Appendix D. The XML Extender limits" on page 247.

You can increase the CLOB sizes for the stored procedures results as documented in "Increasing the CLOB limit" on page 176.

See the following sections for information on managing your XML collection:

- "Composing XML documents from DB2 data"
- "Decomposing XML documents into DB2 data" on page 128

Composing XML documents from DB2 data

Composition is the generation of a set of XML documents from relational data in an XML collection. You can compose XML documents using stored procedures. To use these stored procedures, you must create a DAD file, which specifies the mapping between the XML document and the DB2 table structure. The stored procedures use the DAD file to compose the XML document. See "Planning for XML collections" on page 47 to learn how to create a DAD file.

Before you begin

- Map the structure of the XML document to the relational tables that contain the contents of the element and attribute values.
- Select a mapping method: SQL mapping or RDB_node mapping.
- Prepare the DAD file. See "Planning for XML collections" on page 47 for complete details.
- Optionally, enable the XML collection.

Composing the XML document

The XML Extender provides two stored procedures, dxxGenXML() and dxxRetrieveXML(), to compose XML documents.

dxxGenXML()

This stored procedure is used for applications that do occasional updates or for applications that do not want the overhead of administering the XML data. The stored procedure dxxGenXML() does not require an enabled collection; it uses a DAD file instead.

The stored procedure dxxGenXML() constructs XML documents using data that is stored in XML collection tables, which are specified by the <Xcollection> element in the DAD file. This stored procedure inserts each XML document as a row into a *result table*. You can also open a cursor on the result table and fetch the result set. The result table should be created by the application and always has one column of VARCHAR, CLOB, XMLVARCHAR, or XMLCLOB type.

Additionally, if you specify the validation element in the DAD file as YES, the XML Extender adds the column DXX_VALID of INTEGER type, and inserts a value of 1 for a valid XML document and 0 for an invalid document.

The stored procedure dxxGenXML() also allows you to specify the maximum number of rows that are to be generated in the result table. This shortens processing time. The stored procedure returns the actual number of rows in the table, along with any return codes and messages.

The corresponding stored procedure for decomposition is dxxShredXML(); it also takes the DAD as the input parameter and does not require that the XML collection be enabled.

To compose an XML collection: dxxGenXML()

Embed a stored procedure call in your application using the following stored procedure declaration:

```
dxxGenXML(CLOB(100K)     DAD,              /* input */
          char() resultTabName,     /* input */
          char(30)           result_column, /* input */
          char(30)           valid_column,  /* input */
          integer        overrideType,      /* input */
          varchar(1024)  override,          /* input */
          integer        maxRows,           /* input */
          integer        numRows,           /* output */
          long           returnCode,        /* output */
          varchar(1024)  returnMsg)         /* output */
```

See "dxxGenXML()" on page 185 for the full syntax and examples.

Example: The following example composes an XML document:

```
#include "dxx.h"
#include "dxxrc.h"

EXEC SQL INCLUDE SQLCA;
EXEC SQL BEGIN DECLARE SECTION;
SQL TYPE is CLOB(100K) dad;    /* DAD */

char    result_tab[32];        /* name of the result table */
char    result_colname[32];    /* name of the result column */
char    valid_colname[32];     /* name of the valid column, will set to NULL */
char    override[2];           /* override, will set to NULL*/
short   overrideType;          /* defined in dxx.h */
short   max_row;               /* maximum number of rows */
short   num_row;               /* actual number of rows */
long    returnCode;            /* return error code */
char    returnMsg[1024];       /* error message text */
short   dad_ind;
short   rtab_ind;
short   rcol_ind;
short   vcol_ind;
short   ovtype_ind;
short   ov_ind;
short   maxrow_ind;
short   numrow_ind;
short   returnCode_ind;
short   returnMsg_ind;
EXEC SQL END DECLARE SECTION;

FILE   *file_handle;
long    file_length=0;

/* create table */
EXEC SQL CREATE TABLE xml_order_tab (xmlorder XMLVarchar);

/* initialize the DAD CLOB object. */
file_handle = fopen( "/dxx/dad/getstart_xcollection.dad", "r" );
if ( file_handle != NULL ) {
  file_length = fread ((void *) &dad.data,
                       1, FILE_SIZE, file_handle);
  if (file_length == 0) {
    printf ("Error reading dad file
             /dxx/dad/getstart_xcollection.dad\n");
    rc = -1;
    goto exit;
 } else
    dad.length = file_length;
}
```

```
else {
  printf("Error opening dad file  \n", );
  rc = -1;
  goto exit;
}
/* initialize host variable and indicators */
strcpy(result_tab,"xml_order_tab");
strcpy(result_colname, "xmlorder")
valid_colname = '\0';
override[0] = '\0';
overrideType = NO_OVERRIDE;
max_row = 500;
num_row = 0;
returnCode = 0;
msg_txt[0] = '\0';
dad_ind = 0;
rtab_ind = 0;
rcol_ind = 0;
vcol_ind = -1;
ov_ind = -1;
ovtype_ind = 0;
maxrow_ind = 0;
numrow_ind = -1;
returnCode_ind = -1;
returnMsg_ind = -1;

/* Call the store procedure */
EXEC SQL CALL "DB2XML.DXXGENXML" (:dad:dad_ind;
                                  :result_tab:rtab_ind,
                                  :result_colname:rcol_ind,
                                  :valid_colname:vcol_ind,
                                  :overrideType:ovtype_ind,:override:ov_ind,
                                  :max_row:maxrow_ind,:num_row:numrow_ind,
                                  :returnCode:returnCode_ind,:returnMsg:returnMsg_ind);

if (SQLCODE < 0) {
    EXEC SQL ROLLBACK;
  else
    EXEC SQL COMMIT;
}

exit:
  return rc;
```

The result table after the stored procedure is called contains 250 rows because the SQL query specified in the DAD file generated 250 XML documents.

dxxRetrieveXML()

This stored procedure is used for applications that make regular updates. Because the same tasks are repeated, improved performance is important. Enabling an XML collection and using the collection name in the stored procedure improves performance.

The stored procedure dxxRetrieveXML() works the same as the stored procedure dxxGenXML(), except that it takes the name of an enabled XML collection instead of a DAD file. When an XML collection is enabled, a DAD file is stored in the XML_USAGE table. Therefore, the XML Extender retrieves the DAD file and, from this point forward, dxxRetrieveXML() is the same as dxxGenXML().

dxxRetrieveXML() allows the same DAD file to be used for both composition and decomposition. This stored procedure also can be used for retrieving decomposed XML documents.

The corresponding stored procedure for decomposition is dxxInsertXML(); it also takes the name of an enabled XML collection.

To compose an XML collection: dxxRetrieveXML()

Embed a stored procedure call in your application using the following stored procedure declaration:

```
dxxRetrieveXML(char() collectionName,  /* input */
               char() resultTabName,   /* input */
          char(30)           result_column, /* input */
          char(30)           valid_column,  /* input */
               integer        overrideType,    /* input */
               varchar(1024)  override,        /* input */
               integer        maxRows,         /* input */
               integer        numRows,         /* output */
               long           returnCode,      /* output */
               varchar(1024)  returnMsg)       /* output */
```

See "dxxRetrieveXML()" on page 189 for full syntax and examples.

Example: The following example is of a call to dxxRetrieveXML(). It assumes that a result table is created with the name of XML_ORDER_TAB and it has one column of XMLVARCHAR type.

```
#include "dxx.h"
#include "dxxrc.h"

EXEC SQL INCLUDE SQLCA;
EXEC SQL BEGIN DECLARE SECTION;
char    collectionName[32];    /* name of an XML collection */
char    result_tab[32];        /* name of the result table */
char    result_colname[32];    /* name of the result column */
char    valid_colname[32];     /* name of the valid column, will set to NULL*/
char    override[2];           /* override, will set to NULL*/
short   overrideType;          /* defined in dxx.h */
short   max_row;               /* maximum number of rows */
short   num_row;               /* actual number of rows */
long    returnCode;            /* return error code */
char    returnMsg[1024];       /* error message text */
short   collectionName_ind;
short   rtab_ind;
short   rcol_ind;
short   vcol_ind;
short   ovtype_ind;
short   ov_ind;
short   maxrow_ind;
short   numrow_ind;
short   returnCode_ind;
short   returnMsg_ind;
EXEC SQL END DECLARE SECTION;

/* create table */
EXEC SQL CREATE TABLE xml_order_tab (xmlorder XMLVarchar);

/* initial host variable and indicators */
strcpy(collection, "sales_ord");
strcpy(result_tab,"xml_order_tab");
strcpy(result_col,"xmlorder");
valid_colname[0] = '\0';
override[0] = '\0';
overrideType = NO_OVERRIDE;
max_row = 500;
num_row = 0;
returnCode = 0;
msg_txt[0] = '\0';
collectionName_ind = 0;
```

```
rtab_ind = 0;
rcol_ind = 0;
vcol_ind = -1;
ov_ind = -1;
ovtype_ind = 0;
maxrow_ind = 0;
numrow_ind = -1;
returnCode_ind = -1;
returnMsg_ind = -1;

/* Call the store procedure */
EXEC SQL CALL "DB2XML.DXXRETRIEVE" (:collectionName:collectionName_ind,
                                    :result_tab:rtab_ind,
                                    :result_colname:rcol_ind,
                                    :valid_colname:vcol_ind,
                                    :overrideType:ovtype_ind,:override:ov_ind,
                                    :max_row:maxrow_ind,:num_row:numrow_ind,
                                    :returnCode:returnCode_ind,:returnMsg:returnMsg_ind);

if (SQLCODE < 0) {
    EXEC SQL ROLLBACK;
  else
    EXEC SQL COMMIT;
}
```

Dynamically overriding values in the DAD file

For dynamic queries you can use two optional parameters to override conditions in the DAD file: *override* and *overrideType*. Based on the input from *overrideType*, the application can override the <SQL_stmt> tag values for SQL mapping or the conditions in RDB_nodes for RDB_node mapping in the DAD.

These parameters have the following values and rules:

overrideType
This parameter is a required input parameter (IN) that flags the type of the *override* parameter. *overrideType* has the following values:

NO_OVERRIDE
Specifies not to override a condition in the DAD file.

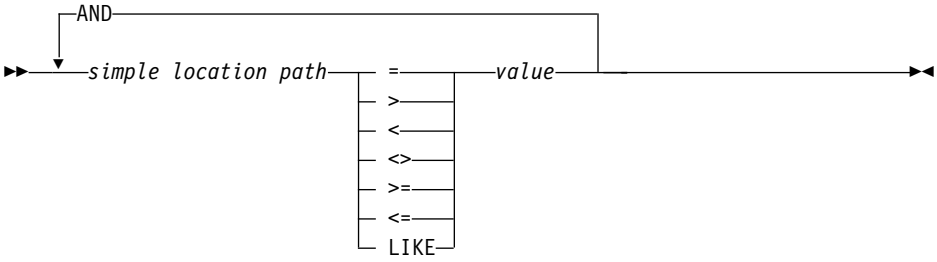
SQL_OVERRIDE
Specifies to override a condition in DAD file with an SQL statement.

XML_OVERRIDE
Specifies to override a condition in the DAD file with an XPath-based condition.

override
This parameter is an optional input parameter (IN) that specifies the override condition for the DAD file. The input value syntax corresponds to the value specified on the *overrideType*.

- If you specify NO_OVERRIDE, the input value is a NULL string.
- If you specify SQL_OVERRIDE, the input value is a valid SQL statement. ***Required:*** If you use SQL_OVERRIDE and an SQL statement, you must use the SQL mapping scheme in the DAD file. The input SQL statement overrides the SQL statement specified by the <SQL_stmt> element in the DAD file.
- If you use XML_OVERRIDE, the input value is a string which contains one or more expressions. ***Required:*** If you use XML_OVERRIDE and an expression, you must use the RDB_node mapping scheme in the DAD file.

The input XML expression overrides the RDB_node condition specified in the DAD file. The expression uses the following syntax:



Where:

simple location path
A simple location path using syntax defined by XPath; see Table 10 on page 57 for syntax.

operators
=, >, <, <>, >=, <=, and LIKE. Can have a space to separate the operator from the other parts of the expression.

value
A numeric value or a single quoted string.

You can have optional spaces around the operations; spaces are mandatory around the LIKE operator.

When the XML_OVERRIDE value is specified, the condition for the RDB_node in the text_node or attribute_node that matches the simple location path is overridden by the specified expression.

XML_OVERRIDE is not completely XPath compliant. The simple location path is only used to identify the element or attribute that is mapped to a column.

Examples:

The following examples show dynamic override using SQL_OVERRIDE and XML_OVERRIDE. Most stored procedure examples in this book use NO_OVERRIDE.

Example 1: A stored procedure using SQL_OVERRIDE.

```
#include "dxx.h"
#include "dxxrc.h"

EXEC SQL INCLUDE SQLCA;
EXEC SQL BEGIN DECLARE SECTION;
char    collectionName[32];    /* name of an XML collection */
char    result_tab[32];        /* name of the result table */
char    result_colname[32];    /* name of the result column */
char    valid_colname[32];     /* name of the valid column, will set to NULL*/
char    override[512];         /* override */
short   overrideType;          /* defined in dxx.h */
short   max_row;               /* maximum number of rows */
short   num_row;               /* actual number of rows */
long    returnCode;            /* return error code */
char    returnMsg[1024];       /* error message text */
```

```
short   collectionName_ind;
short   rtab_ind;
short   rcol_ind;
short   vcol_ind;
short   ovtype_ind;
short   ov_ind;
short   maxrow_ind;
short   numrow_ind;
short   returnCode_ind;
short   returnMsg_ind;
EXEC SQL END DECLARE SECTION;
float price_value;

/* create table */
EXEC SQL CREATE TABLE xml_order_tab (xmlorder XMLVarchar);

/* initial host variable and indicators */
strcpy(collection, "sales_ord");
strcpy(result_tab,"xml_order_tab");
strcpy(result_col,"xmlorder");
valid_colname[0] = '\0';

/* get the price_value from some place, such as from data */
price_value = 1000.00        /* for example */

/* specify the override */
sprintf(override,
        " SELECT o.order_key, customer, p.part_key, quatity, price,
                 tax, ship_id, date, mode
          FROM order_tab o, part_tab p,
              table(select db2xml.generate_unique()
              as ship_id, date, mode from ship_tab) s
          WHERE p.price > %d and s.date >'1996-06_01' AND
              p.order_key = o.order_key and s.part_key = p.part_key",
              price_value);

overrideType = SQL_OVERRIDE;max_row = 0;
num_row = 0;
returnCode = 0;
msg_txt[0] = '\0';
collectionName_ind = 0;
rtab_ind = 0;
rcol_ind = 0;
vcol_ind = -1;
ov_ind = 0;
ovtype_ind = 0;
maxrow_ind = 0;
numrow_ind = -1;
returnCode_ind = -1;
returnMsg_ind = -1;

/* Call the store procedure */
EXEC SQL CALL "DB2XML.DXXRETRIEVE" (:collectionName:collectionName_ind,
                                    :result_tab:rtab_ind,
                                    :result_colname:rcol_ind,
                                    :valid_colname:vcol_ind,
                                    :overrideType:ovtype_ind,:override:ov_ind,
                                    :returnCode:returnCode_ind,:returnMsg:returnMsg_ind);

if (SQLCODE < 0) {
    EXEC SQL ROLLBACK;
  else
    EXEC SQL COMMIT;
}
```

In this example, the <xcollection> element in the DAD file must have an <SQL_stmt> element. The *override* parameter overrides the value of <SQL_stmt>, by changing the price to be greater than 50.00, and the date is changed to be greater than 1998-12-01.

Example 2: A stored procedure using XML_OVERRIDE.

```
#include "dxx.h"
#include "dxxrc.h"

EXEC SQL INCLUDE SQLCA;
EXEC SQL BEGIN DECLARE SECTION;
char    collectionName[32];    /* name of an XML collection */
char    result_tab[32];        /* name of the result table */
char    result_colname[32];    /* name of the result column */
char    valid_colname[32];     /* name of the valid column, will set to NULL*/
char    override[256];         /* override, SQL_stmt*/
short   overrideType;          /* defined in dxx.h */
short   max_row;               /* maximum number of rows */
short   num_row;               /* actual number of rows */
long    returnCode;            /* return error code */
char    returnMsg[1024];       /* error message text */
short   collectionName_ind;
short   rtab_ind;
short   rcol_ind;
short   vcol_ind;
short   ovtype_ind;
short   ov_ind;
short   maxrow_ind;
short   numrow_ind;
short   returnCode_ind;
short   returnMsg_ind;
EXEC SQL END DECLARE SECTION;

/* create table */
EXEC SQL CREATE TABLE xml_order_tab (xmlorder XMLVarchar);

/* initial host variable and indicators */
strcpy(collection, "sales_ord");
strcpy(result_tab,"xml_order_tab");
strcpy(result_col,"xmlorder");
valid_colname[0] = '\0';
sprintf(override,"%s %s",
          "/Order/Part Price > 50.00 AND ",
          "/Order/Part/Shipment/ShipDate > '1998-12-01'");
overrideType = XML_OVERRIDE;
max_row = 500;
num_row = 0;
returnCode = 0;
msg_txt[0] = '\0';
collectionName_ind = 0;
rtab_ind = 0;
rcol_ind = 0;
vcol_ind = -1;
ov_ind = 0;
ovtype_ind = 0;
maxrow_ind = 0;
numrow_ind = -1;
returnCode_ind = -1;
returnMsg_ind = -1;

/* Call the store procedure */
EXEC SQL CALL "DB2XML.DXXRETRIEVE" (:collectionName:collectionName_ind,
                                    :result_tab:rtab_ind,
                                    :result_colname:rcol_ind,
                                    :valid_colname:vcol_ind,
                                    :overrideType:ovtype_ind,:override:ov_ind,
```

```
                                        :max_row:maxrow_ind,:num_row:numrow_ind,
                                        :returnCode:returnCode_ind,:returnMsg:returnMsg_ind);

if (SQLCODE < 0) {
    EXEC SQL ROLLBACK;
  else
    EXEC SQL COMMIT;
}
```

In this example, the <collection> element in the DAD file has an RDB_node for the root element_node. The *override* value is XML-content based. The XML Extender converts the simple location path to the mapped DB2 column.

Decomposing XML documents into DB2 data

To decompose an XML document is to break down the data inside of an XML document and store it in relational tables. The XML Extender provides stored procedures to decompose XML data from source XML documents into relational tables. To use these stored procedures, you must create a DAD file, which specifies the mapping between the XML document and DB2 table structure. The stored procedures use the DAD file to decompose the XML document. See "Planning for XML collections" on page 47 to learn how to create a DAD file.

Enabling an XML collection for decomposition

In most cases, you need to enable an XML collection before using the stored procedures. In the following cases, you are required to enable an XML collection:

- When decomposing XML documents into new tables, an XML collection must be enabled because all tables in the XML collection are created by the XML Extender when the collection is enabled.
- When keeping the sequence of elements and attributes that have multiple occurrence is important. The XML Extender only preserves the sequence order of elements or attributes of multiple occurrence for tables that are created during enablement of a collection. When decomposing XML documents into existing relational tables, the sequence order is not guaranteed to be preserved.

If you want to pass the DAD file spontaneously when the tables already exist in your database, you do not need to enable an XML collection.

Decomposition table size limits

Decomposition uses RDB_node mapping to specify how an XML document is decomposed into DB2 tables by extracting the element and attribute values and storing them in table rows. The values from each XML document are stored in one or more DB2 tables. Each table can have a maximum of 1024 rows decomposed from each document.

For example, if an XML document is decomposed into five tables, each of the five tables can have up to 1024 rows for that particular document. If the table has rows for multiple documents, it can have up to 1024 rows for each document. If the table has 20 documents, it can have 20,480 rows, 1024 for each document.

Using multiple-occurring elements (elements with location paths that can occur more than once in the XML structure) affects the number of rows . For example, a document that contains an element <Part> that occurs 20 times, might be decomposed as 20 rows in a table. When using multiple occurring elements, consider that a maximum of 1024 rows can be decomposed into one table from a single document.

Before you begin

- Map the structure of the XML document to the relational tables that contain the contents of the elements and attributes values.
- Prepare the DAD file, using RDB_node mapping. See "Planning for XML collections" on page 47 for details.
- Optionally, enable the XML collection.

Decomposing the XML document

The XML Extender provides two stored procedures, dxxShredXML() and dxxInsertXML, to decompose XML documents.

dxxShredXML()

This stored procedure is used for applications that do occasional updates or for applications that do not want the overhead of administering the XML data. The stored procedure dxxShredXML() does not required an enabled collection; it uses a DAD file instead.

The stored procedure dxxShredXML() takes two input parameters, a DAD file and the XML document that is to be decomposed; it returns two output parameters: a return code and a return message.

The stored procedure dxxShredXML() inserts an XML document into an XML collection according to the <Xcollection> specification in the input DAD file. The tables that are used in the <Xcollection> of the DAD file are assumed to exist, and the columns are assumed to meet the data types specified in the DAD mapping. If this is not true, an error message is returned. The stored procedure dxxShredXML() then decomposes the XML document, and it inserts untagged XML data into the tables specified in the DAD file.

The corresponding stored procedure for composition is dxxGenXML(); it also takes the DAD as the input parameter and does not require that the XML collection be enabled.

To decompose an XML collection: dxxShredXML()

Embed a stored procedure call in your application using the following stored procedure declaration:

```
dxxShredXML(CLOB(100K)    DAD,           /* input */
            CLOB(1M)      xmlobj,        /* input */
            long          returnCode,    /* output */
            varchar(1024) returnMsg)     /* output */
```

See "dxxShredXML()" on page 193 for the full syntax and examples.

Example: The following is an example of a call to dxxShredXML():

```
#include "dxx.h"
#include "dxxrc.h"

EXEC SQL INCLUDE SQLCA;
EXEC SQL BEGIN DECLARE SECTION;
SQL TYPE is CLOB(100K) dad;    /* DAD */

SQL TYPE is CLOB(100K) xmlDoc; /* input xml document */

long    returnCode;            /* return error code */
char    returnMsg[1024];       /* error message text */
short   dad_ind;
short   xmlDoc_ind;
short   returnCode_ind;
```

```
short   returnMsg_ind;
EXEC SQL END DECLARE SECTION;

FILE   *file_handle;
long    file_length=0;

/* initialize the DAD CLOB object. */
file_handle = fopen( "/dxx/dad/getstart_xcollection.dad", "r" );
if ( file_handle != NULL ) {
  file_length = fread ((void *) &dad.data;, 1, FILE_SIZE, file_handle);
  if (file_length == 0) {
    printf ("Error reading dad file getstart_xcollection.dad\n");
    rc = -1;
    goto exit;
 } else
    dad.length = file_length;
}
else {
  printf("Error opening dad file  \n");
  rc = -1;
  goto exit;
}

/* Initialize the XML CLOB object. */
  file_handle = fopen( "/dxx/xml/getstart_xcollection.xml", "r" );
  if ( file_handle != NULL ) {
    file_length = fread ((void *) &xmlDoc.data;, 1, FILE_SIZE,
                                  file_handle);
    if (file_length == 0) {
      printf ("Error reading xml file getstart_xcollection.xml \n");
      rc = -1;
      goto exit;
    } else
        xmlDoc.length = file_length;
  }
  else {
    printf("Error opening xml file \n");
    rc = -1;
    goto exit;
  }

/* initialize host variable and indicators */
returnCode = 0;
msg_txt[0] = '\0';
dad_ind = 0;
xmlDoc_ind = 0;
returnCode_ind = -1;
returnMsg_ind = -1;

/* Call the store procedure */
EXEC SQL CALL "DB2XML.DXXSHRED"  (:dad:dad_ind;
                                  :xmlDoc:xmlDoc_ind,
                                  :returnCode:returnCode_ind,
                                  :returnMsg:returnMsg_ind);

if (SQLCODE < 0) {
    EXEC SQL ROLLBACK;
  else
    EXEC SQL COMMIT;
}

exit:
  return rc;
```

dxxInsertXML()

This stored procedure is used for applications that make regular updates. Because the same tasks are repeated, improved performance is important.

Enabling an XML collection and using the collection name in the stored procedure improves performance. The stored procedure dxxInsertXML() works the same as dxxShredXML(), except that dxxInsertXML() takes an enabled XML collection as its first input parameter.

The stored procedure dxxInsertXML() inserts an XML document into an enabled XML collection, which is associated with a DAD file. The DAD file contains specifications for the collection tables and the mapping. The collection tables are checked or created according to the specifications in the <Xcollection>. The stored procedure dxxInsertXML() then decomposes the XML document according to the mapping, and it inserts untagged XML data into the tables of the named XML collection.

The corresponding stored procedure for composition is dxxRetrieveXML(); it also takes the name of an enabled XML collection.

To decompose an XML collection: dxxInsertXML()

Embed a stored procedure call in your application using the following stored procedure declaration:

```
dxxInsertXML(char() collectionName,   /* input */
             CLOB(1M)       xmlobj,           /* input */
             long           returnCode,       /* output */
             varchar(1024)  returnMsg)        /* output */
```

See "dxxInsertXML()" on page 196 for the full syntax and examples.

Example: The following is an example of a call to dxxInsertXML():

```
#include "dxx.h"
#include "dxxrc.h"

EXEC SQL INCLUDE SQLCA;
EXEC SQL BEGIN DECLARE SECTION;
char    collectionName[32];   /* name of an XML collection */
SQL TYPE is CLOB(100K) xmlDoc; /* input xml document */
long    returnCode;            /* return error code */
char    returnMsg[1024];       /* error message text */
short   collectionName_ind;
short   xmlDoc_ind;
short   returnCode_ind;
short   returnMsg_ind;
EXEC SQL END DECLARE SECTION;

FILE   *file_handle;
long    file_length=0;

/* initialize the DAD CLOB object. */
file_handle = fopen( "/dxx/dad/getstart_xcollection.dad", "r" );
if ( file_handle != NULL ) {
  file_length = fread ((void *) &dad.data;, 1, FILE_SIZE, file_handle);
  if (file_length == 0) {
    printf ("Error reading dad file getstart_xcollection.dad\n");
    rc = -1;
    goto exit;
 } else
    dad.length = file_length;
}
else {
  printf("Error opening dad file  \n");
  rc = -1;
  goto exit;
}

/* initialize host variable and indicators */
```

```
strcpy(collectionName, "sales_ord");
returnCode = 0;
msg_txt[0] = '\0';
collectionName_ind = 0;
xmlDoc_ind = 0;
returnCode_ind = -1;
returnMsg_ind = -1;

/* Call the store procedure */
EXEC SQL CALL "DB2XML.DXXINSERTXML" (:collection_name:collection_name_ind,
                                     :xmlDoc:xmlDoc_ind,
                                     :returnCode:returnCode_ind,
                                     :returnMsg:returnMsg_ind);

if (SQLCODE < 0) {
    EXEC SQL ROLLBACK;
  else
    EXEC SQL COMMIT;
}

exit:
  return rc;
```

Accessing an XML collection

You can update, delete, search, and retrieve XML collections. Remember, however, that the purpose of using an XML collection is to store or retrieve untagged, pure data in database tables. The data in existing database tables has nothing to do with any incoming XML documents; update, delete, and search operations literally consist of normal SQL access to these tables. If the data is decomposed from incoming XML documents, no original XML documents continue to exist.

The XML Extender provides the ability to perform operations on the data from an XML collection view. Using UPDATE and DELETE SQL statements, you can modify the data that is used for composing XML documents, and therefore, update the XML collection.

Considerations:

- To update a document, do not delete a row containing the primary key of the table, which is the foreign key row of the other collection tables. When the primary key and foreign key row is deleted, the document is deleted.
- To replace or delete elements and attribute values, you can delete and insert rows in lower-level tables without deleting the document.
- To delete a document, delete the row which composes the top element_node specified in the DAD.

Updating data in an XML collection

The XML Extender allows you to update untagged data that is stored in XML collection tables. By updating XML collection table values, you are updating the text of an XML element, or the value of an XML attribute. Additionally, updates can delete an instance of data from multiple-occurring elements or attributes.

From an SQL point of view, changing the value of the element or attribute is an update operation, and deleting an instance of an element or attribute is a delete operation. From an XML point of view, as long as the element text or attribute value of the root element_node exists, the XML document still exists and is, therefore, an update operation.

Requirements: To update data in an XML collection, observe the following rules.

- Specify the primary-foreign key relationship among the collection tables when the existing tables have this relationship. If they do not, ensure that there are columns that can be joined.
- Include the join condition that is specified in the DAD file:
  - For SQL mapping, in the <SQL_stmt> element
  - For RDB_node mapping, in the RDB_node of the root element node

Updating element and attribute values

In an XML collection, element text and attribute value are all mapped to columns in database tables. Regardless of whether the column data previously exists or is decomposed from incoming XML documents, you replace the data using the normal SQL update technique.

To update an element or attribute value, specify a WHERE clause in the SQL UPDATE statement that contains the join condition that is specified in the DAD file.

For example:

```
UPDATE SHIP_TAB
    set MODE = 'BOAT'
  WHERE MODE='AIR' AND PART_KEY in
    (SELECT PART_KEY from PART_TAB WHERE ORDER_KEY=68)
```

The <ShipMode> element value is updated from AIR to BOAT in the SHIP_TAB table, where the key is 68.

Deleting element and attribute instances

To update composed XML documents by eliminating multiple-occurring elements or attributes, delete a row containing the field value that corresponds to the element or attribute value, using the WHERE clause. As long as you do not delete the row that contains the values for the top element_node, deleting element values is considered an update of the XML document.

For example, in the following DELETE statement, you are deleting a <shipment> element by specifying a unique value of one of its subelements.

```
DELETE from SHIP_TAB
   WHERE DATE='1999-04-12'
```

Specifying a DATE value deletes the row that matches this value. The composed document originally contained two <shipment> elements, but now contains one.

Deleting an XML document from an XML collection

You can delete an XML document that is composed from a collection. This means that if you have an XML collection that composes multiple XML documents, you can delete one of these composed documents.

To delete the document, you delete a row in the table that composes the top element_node that is specified in the DAD file. This table contains the primary key for the top-level collection table and the foreign key for the lower-level tables.

For example, the following DELETE statement specifies the value of the primary key column.

```
DELETE from order_tab
   WHERE order_key=1
```

ORDER_KEY is the primary key in the table ORDER_TAB and is the top element_node when the XML document is composed. Deleting this row deletes one XML document that is generated during composition. Therefore, from the XML point of view, one XML document is deleted from the XML collection.

Retrieving XML documents from an XML collection

Retrieving XML documents from an XML collection is similar to composing documents from the collection.

To retrieve XML documents, use the stored procedure, dxxRetrieveXML(). See "dxxRetrieveXML()" on page 189 for syntax and examples.

DAD file consideration: When you decompose XML documents in an XML collection, you can lose the order of multiple-occurring elements and attribute values, unless you specify the order in the DAD file. To preserve this order, you should use the RDB_node mapping scheme. This mapping scheme allows you to specify an orderBy attribute for the table containing the root element in its RDB_node.

Searching an XML collection

This section describes searching an XML collection in terms of the following goals:

- **Generating XML documents using search criteria:**

  This task is actually composition using a condition. You can specify the search criteria using the following search criteria:

  – Specify the condition in the text_node and attribute_node of the DAD file

  – Specify the *overwrite* parameter when using the dxxGenXML() and dxxRetrieveXML() stored procedures.

    For example, if you enabled an XML collection, sales_ord, using the DAD file, `order.dad`, but you now want to override the price using form data derived from the Web, you can override the value of the <SQL_stmt> DAD element, as follows:

```
EXEC SQL INCLUDE SQLCA;
EXEC SQL BEGIN DECLARE SECTION;
       ...

EXEC SQL END DECLARE SECTION;

         float    price_value;

         /* create table */
         EXEC SQL CREATE TABLE xml_order_tab (xmlorder XMLVarchar);

         /* initialize host variable and indicators */
         strcpy(collection,"sales_ord");
         strcpy(result_tab,"xml_order_tab");
         overrideType = SQL_OVERRIDE;
         max_row = 20;
         num_row = 0;
         returnCode = 0;
         msg_txt[0] = '\0';
         override_ind = 0;
         overrideType_ind = 0;
         rtab_ind = 0;
         maxrow_ind = 0;
         numrow_ind = -1;
         returnCode_ind = -1;
         returnMsg_ind = -1;
```

```
        /* get the price_value from some place, such as form data */
        price_value = 1000.00         /* for example*/

        /* specify the overwrite */
        sprintf(overwrite,
               "SELECT o.order_key, customer, p.part_key, quantity, price,
                      tax, ship_id, date, mode
               FROM order_tab o, part_tab p,

(select db2xml.generate_unique()
                    as ship_id, date, mode from ship_tab) as s
               WHERE p.price > %d and s.date >'1996-06-01' AND
                   p.order_key = o.order_key and s.part_key = p.part_key",
                   price_value);

       /* Call the store procedure */
       EXEC SQL CALL DB2XML.dxxRetrieve(:collection:collection_ind,
               :result_tab:rtab_ind,
               :overrideType:overrideType_ind,:overwrite:overwrite_ind,
               :max_row:maxrow_ind,:num_row:numrow_ind,
               :returnCode:returnCode_ind,:returnMsg:returnMsg_ind);
```

The condition of price > 2500.00 in `order.dad` is overridden by price > ?, where ? is based on the input variable *price_value*.

- **Searching for decomposed XML data:**

  You can use normal SQL query operations to search collection tables. You can join collection tables, or use subqueries, and then do structural-text search on text columns. With the results of the structural search, you can apply that data to retrieve or generate the specified XML document.

Part 4. Reference

This part provides syntax information for the XML Extender UDTs, UDFs, and stored procedures. Message text is also provided for problem determination activities.

Chapter 10. XML Extender administration command: dxxadm

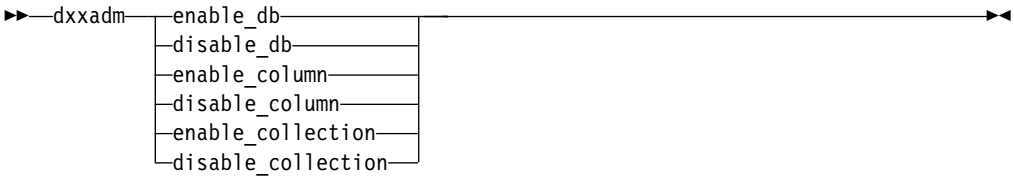
The XML Extender provides an administration command, **dxxadm**, for completing the following administration tasks from the Qshell or the OS command line.

- Enabling or disabling a database for the XML Extender
- Enabling or disabling an XML column
- Enabling or disabling an XML collection

You can run equivalent programs from the OS command line and stored procedures from the Operations Navigator . Examples of these alternate methods are provided with the command descriptions in this chapter. Full syntax for the alternate methods are described in "Using the OS command line" on page 61 and "Using the Operations Navigator" on page 62. You can also use the XML Extender administration wizard to complete the same tasks as described in administration chapters of this book.

High-level syntax

The following syntax diagram provides the high-level syntax of the **dxxadm** command. Descriptions of each option are provided in the following sections.



Administration

The following sections describe each of the **dxxadm** that are available to system programmers:

- "enable_db" on page 140
- "disable_db" on page 141
- "enable_column" on page 142
- "disable_column" on page 144
- "enable_collection" on page 145
- "disable_collection" on page 146

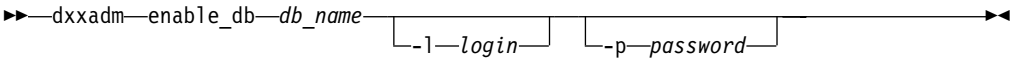
enable_db

Purpose

Enables XML Extender features for a database. When the database is enabled, the XML Extender creates the following objects:

- The XML Extender user-defined types (UDTs).
- The XML Extender user-defined functions (UDFs).
- The XML Extender DTD reference table, DTD_REF, which stores DTDs and information about each DTD. For a complete description of the DTD_REF table, see "DTD reference table" on page 199.
- The XML Extender usage table, XML_USAGE, which stores common information for each column that is enabled for XML and for each collection. For a complete description of the XML_USAGE table, see "XML usage table" on page 200.

Format



Parameters

Table 19. enable_db parameters

Parameter	Description
db_name	The name of the RDB database in which the XML data resides.
-l *login*	The user ID, which is optional, used to connect to the database, when specified. If not specified, the current user ID is used.
-p *password*	The password, which is optional, used to connect to the database, when specified. If not specified, the current password is used.

Examples

The following example enables the database SALES_DB.

From the Qshell:

```
dxxadm enable_db SALES_DB
```

From the OS command line:

```
CALL QDBXM/QZXMADM PARM(enable_db SALES_DB)
```

From the Operations Navigator:

```
CALL MYSCHEMA.QZXMADM('enable_db', 'SALES_DB');
```

disable_db

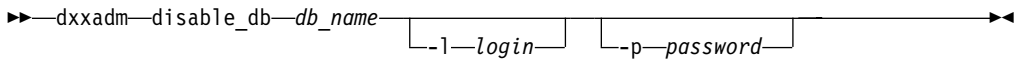
Purpose

Disables XML Extender features for a database, called "disabling a database". When the database is disabled, it can no longer be used by the XML Extender. When the XML Extender disables the database, it drops the following objects:

- The XML Extender user-defined types (UDTs).
- The XML Extender user-defined functions (UDFs).
- The XML Extender DTD reference table, DTD_REF, which stores DTDs and information about each DTD. For a complete description of the DTD_REF table, see "DTD reference table" on page 199.
- The XML Extender usage table, XML_USAGE, which stores common information for each column that is enabled for XML and for each collection. For a complete description of the XML_USAGE table, see "XML usage table" on page 200.

Important: You must disable all XML columns before attempting to disable a database. The XML Extender cannot disable a database that contains columns or collections that are enabled for XML. You must also drop all tables that have columns defined with XML Extender user-defined types, such as XMLCLOB.

Format



Parameters

Table 20. disable_db parameters

Parameter	Description
db_name	The name of the RDB database in which the XML data resides
-l *login*	The user ID, which is optional, used to connect to the database, when specified. If not specified, the current user ID is used.
-p *password*	The password, which is optional, used to connect to the database, when specified. If not specified, the current password is used.

Examples

The following example disables the database SALES_DB.

From the Qshell:

```
dxxadm disable_db SALES_DB
```

From the OS command line:

```
CALL QDBXM/QZXMADM PARM(disable_db SALES_DB)
```

From the Operations Navigator:

```
CALL MYSCHEMA.QZXMADM('disable_db', 'SALES_DB');
```

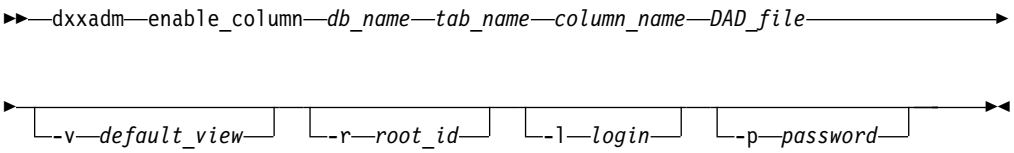
enable_column

Purpose

Connects to a database and enables an XML column so that it can contain the XML Extender UDTs. When enabling a column, the XML Extender completes the following tasks:

- Determines whether the XML table has a primary key; if not, the XML Extender alters the XML table and adds a column called DXXROOT_ID.
- Creates side tables that are specified in the DAD file with a column containing a unique identifier for each row in the XML table. This column is either the root ID that the user specified or the DXXROOT_ID that was named by the XML Extender.
- Creates a default view for the XML table and its side tables, optionally using a name you specify.

Format



Parameters

Table 21. enable_column parameters

Parameter	Description
db_name	The name of the RDB database in which the XML data resides.
tab_name	The name of the table in which the XML column resides.
column_name	The name of the XML column.
DAD_file	The name of the DAD file that maps the XML document to the XML column and side tables.
-v *default_view*	The name of the default view, which is optional, that joins the XML column and side tables.
-r *root_id*	The name of the primary key in the XML column table that is to be used as the root_id for side tables. The root_id is optional.
-l *login*	The user ID, which is optional, used to connect to the database, when specified. If not specified, the current user ID is used.
-p *password*	The password, which is optional, used to connect to the database, when specified. If not specified, the current password is used.

Examples

The following example enables an XML column.

From the Qshell:

```
dxxadm enable_column SALES_DB MYSCHEMA.SALES_TAB ORDER getstart.dad
   -v sales_order_view -r INVOICE_NUMBER
```

From the OS command line:

```
CALL QDBXM/QZXMADM PARM(enable_column SALES_DB 'MYSCHEMA.SALES_TAB'
   ORDER 'getstart.dad' '-v' sales_order_view '-r' INVOICE_NUMBER)
```

From the Operations Navigator:

```
CALL MYSCHEMA.QZXMADM('enable_column', 'SALES_DB', 'MYSCHEMA.SALES_TAB',
   'ORDER', 'getstart.dad', '-v sales_order_view', '-r INVOICE_NUMBER');
```

disable_column

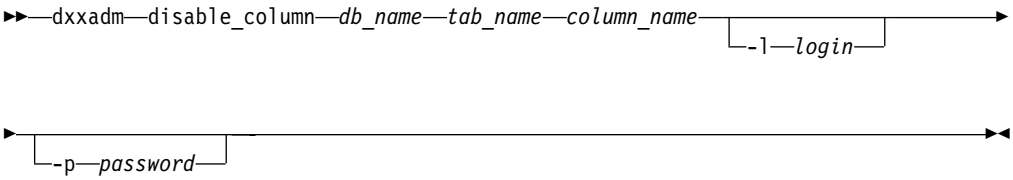
Purpose

Connects to a database and disables the XML-enabled column. When the column is disabled, it can no longer contain XML data types. When an XML-enabled column is disabled, the following actions are performed:

- The XML column usage entry is deleted from the XML_USAGE table.
- The USAGE_COUNT is decremented in the DTD_REF table.
- All triggers that are associated with this column are dropped.
- All side tables that are associated with this column are dropped.

Important: You must disable an XML column before dropping an XML table. If an XML table is dropped but its XML column is not disabled, the XML Extender keeps both the side tables it created and the XML column entry in the XML_USAGE table.

Format



Parameters

Table 22. disable_column parameters

Parameter	Description
db_name	The name of the RDB database in which the data resides.
tab_name	The name of the table in which the XML column resides.
column_name	The name of the XML column.
-l *login*	The user ID, which is optional, used to connect to the database, when specified. If not specified, the current user ID is used.
-p *password*	The password, which is optional, used to connect to the database, when specified. If not specified, the current password is used.

Examples

The following example disables an XML-enabled column.

From the Qshell:

```
dxxadm disable_column SALES_DB MYSCHEMA.SALES_TAB ORDER
```

From the OS command line:

```
CALL QDBXM/QZXMADM PARM(disable_column SALES_DB 'MYSCHEMA.SALES_TAB' ORDER)
```

From the Operations Navigator:

```
CALL MYSCHEMA.QZXMADM('disable_column', 'SALES_DB', 'MYSCHEMA.SALES_TAB', 'ORDER');
```

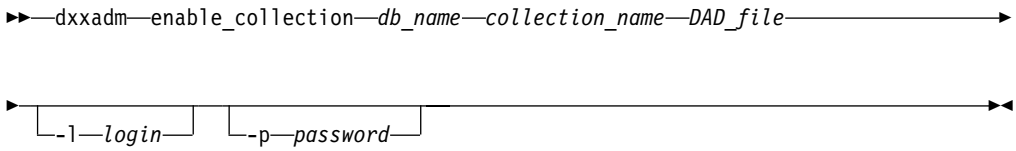
enable_collection

Purpose

Connects to a database and enables an XML collection according to the specified DAD. When enabling a collection, the XML Extender does the following tasks:

- Creates an XML collection usage entry in the XML_USAGE table.
- For RDB_node mapping, creates collection tables specified in the DAD if the tables do not exist in the database.

Format



Parameters

Table 23. enable_collection parameters

Parameter	Description
db_name	The name of the RDB database in which the data resides.
collection_name	The name of the XML collection.
DAD_file	The name of the DAD file that maps the XML document to the relational tables in the collection.
-l *login*	The user ID, which is optional, used to connect to the database, when specified. If not specified, the current user ID is used.
-p *password*	The password, which is optional, used to connect to the database, when specified. If not specified, the current password is used.

Examples

The following example enables an XML collection.

From the Qshell:

```
dxxadm enable_collection SALES_DB sales_ord getstart_xcollection.dad
```

From the OS command line:

```
CALL QDBXM/QZXMADM PARM(enable_collection SALES_DB sales_ord
  'getstart_collection.dad')
```

From the Operations Navigator:

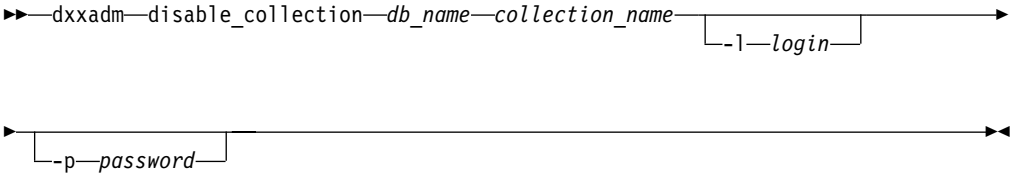
```
CALL MYSCHEMA.QZXMADM('enable_collection', 'SALES_DB', 'sales_ord',
  'getstart_collection.dad');
```

disable_collection

Purpose

Connects to a database and disables an XML-enabled collection. The collection name can no longer be used in the composition (dxxRetrieveXML) and decomposition (dxxInsertXML) stored procedures. When an XML collection is disabled, the associated collection entry is deleted from the XML_USAGE table. Note that disabling the collection does not drop the collection tables that are created during the enable_collection step.

Format



Parameters

Table 24. disable_collection parameters

Parameter	Description
db_name	The name of the RDB database in which the data resides.
collection_name	The name of the XML collection.
-l *login*	The user ID, which is optional, used to connect to the database, when specified. If not specified, the current user ID is used.
-p *password*	The password, which is optional, used to connect to the database, when specified. If not specified, the current password is used.

Examples

The following example disables an XML collection.

From the Qshell:

```
dxxadm disable_collection SALES_DB sales_ord
```

From the OS command line:

```
CALL QDBXM/QZXMADM PARM(disable_collection SALES_DB sales_ord)
```

From the Operations Navigator:

```
CALL MYSCHEMA.QZXMADM('disable_collection', 'SALES_DB', 'sales_ord');
```

Chapter 11. XML Extender user-defined types

The XML Extender user-defined types (UDTs) are data types that are used for XML columns and XML collections. All the UDTs have the schema name DB2XML. The XML Extender creates UDTs for storing and retrieving XML documents. Table 25 contains an overview of the UDTs.

Table 25. The XML Extender UDTs

User-defined type column	Source data type	Usage description
XMLVARCHAR	VARCHAR(*varchar_len*)	Stores an entire XML document as VARCHAR inside DB2.
XMLCLOB	CLOB(*clob_len*)	Stores an entire XML document as character large object (CLOB) inside DB2.
XMLFILE	VARCHAR(512)	Specifies the file name of the local file server. If XMLFILE is specified for the XML column, then the XML Extender stores the XML document in an external server file. The Text Extender cannot be enabled with XMLFILE. It is your responsibility to ensure integrity between the file content and DB2, as well as the side table created for indexing.

Where *varchar_len* and *clob_len* are specific to the operating system.

For DB2 UDB, *varchar_len* = 3K and *clob_len* = 2G.

These UDTs are used only to specify the types of application columns; they do not apply to the side tables that the XML Extender creates.

Chapter 12. XML Extender user-defined functions

The XML Extender provides functions for storing, retrieving, searching, and updating XML documents, and for extracting XML elements or attributes. Use XML user-defined functions (UDFs) for XML columns, but not for XML collections. All the UDFs have the schema name DB2XML, which can be omitted in front of UDFs.

The four types of XML Extender functions are: storage functions, retrieval functions, extracting functions, and an update function.

storage functions
Storage functions insert XML documents into a DB2 database. For syntax and examples, see "Storage functions" on page 150.

retrieval functions
Retrieval functions retrieve XML documents from XML columns in a DB2 database. For syntax and examples, see "Retrieval functions" on page 155.

extracting functions
Extracting functions extract and convert the element content or attribute value from an XML document to the data type that is specified by the function name. The XML Extender provides a set of extracting functions for various SQL data types. For syntax and examples, see "Extracting functions" on page 159.

update function
The Update() function modifies the element content or attribute value and returns a copy of an XML document with an updated value that is specified by the location path. The Update() function allows the application programmer to specify the element or attribute that is to be updated. For syntax and examples, see "Update function" on page 170.

generate_unique function
The generate_unique() function returns a unique key. For syntax and examples, see "Generate unique function" on page 173.

Table 26 provides a summary of the XML Extender functions.

Table 26. The XML Extender user-defined functions

Type	Function
Storage functions	"XMLVarcharFromFile()" on page 151
	"XMLCLOBFromFile()" on page 152
	"XMLFileFromVarchar()" on page 153
	"XMLFileFromCLOB()" on page 154
Retrieval functions	"Content(): retrieve from XMLFILE to a CLOB" on page 156
	"Content(): retrieve from XMLVARCHAR to an external server file" on page 157
	"Content(): retrieval from XMLCLOB to an external server file" on page 158
Extracting functions	"extractInteger()" on page 160
	"extractSmallint()" on page 161
	"extractDouble()" on page 162
	"extractReal()" on page 163
	"extractChar()" on page 164
	"extractVarchar()" on page 165
	"extractCLOB()" on page 166
	"extractDate()" on page 167
	"extractTime()" on page 168
	"extractTimestamp()" on page 169
Update function	"Update function" on page 170
Generate unique function	"Generate unique function" on page 173

When using parameter markers in UDFs, a Java database (JDBC) restriction requires that the parameter marker for the UDF must be casted to the data type of the column into which the returned data will be inserted. See "Limitations when invoking functions from Java Database (JDBC)" on page 117 to learn how to cast the parameter markers.

Storage functions

Use storage functions to insert XML documents into a DB2 database. You can use the default casting functions of a UDT directly in INSERT or SELECT statements as described in "Storing data" on page 104. Additionally, the XML Extender provides UDFs to take XML documents from sources other than the UDT base data type and convert them to the specified UDT.

The XML Extender provides the following storage functions:

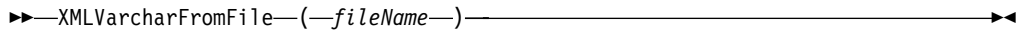
- "XMLVarcharFromFile()" on page 151
- "XMLCLOBFromFile()" on page 152
- "XMLFileFromVarchar()" on page 153
- "XMLFileFromCLOB()" on page 154

XMLVarcharFromFile()

Purpose

Reads an XML document from a server file and returns the document as an XMLVARCHAR type.

Syntax



Parameters

Table 27. XMLVarcharFromFile parameter

Parameter	Data type	Description
fileName	VARCHAR(512)	The fully qualified server file name.

Return type

XMLVARCHAR

Examples

The following example reads an XML document from a server file and inserts it into an XML column as an XMLVARCHAR type.

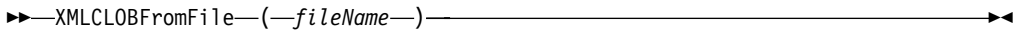
```
EXEC SQL INSERT INTO sales_tab(ID, NAME, ORDER)
   VALUES('1234', 'Sriram Srinivasan',
           XMLVarcharFromFile('dxx_install/xml/getstart.xml'))
```

In this example, a record is inserted into the SALES_TAB table. The function XMLVarcharFromFile() imports the XML document from a file into DB2 and stores it as a XMLVARCHAR.

XMLCLOBFromFile()

Purpose
Reads an XML document from a server file and returns the document as an XMLCLOB type.

Syntax



Parameters

Table 28. XMLCLOBFromFile parameter

Parameter	Data type	Description
fileName	VARCHAR(512)	The fully qualified server file name.

Return type
XMLCLOB as LOCATOR

Examples
The following example reads an XML document from a server file and inserts it into an XML column as an XMLCLOB type.

```
EXEC SQL INSERT INTO sales_tab(ID, NAME, ORDER)
   VALUES('1234', 'Sriram Srinivasan',
          XMLCLOBFromFile('dxx_install/xml/getstart.xml'))
```

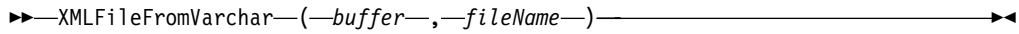
The column ORDER in the SALES_TAB table is defined as an XMLCLOB type. The preceding example shows how the column ORDER is inserted into the SALES_TAB table.

XMLFileFromVarchar()

Purpose

Reads an XML document from memory as VARCHAR, writes it to an external server file, and returns the file name and path as an XMLFILE type.

Syntax



Parameters

Table 29. XMLFileFromVarchar parameters

Parameter	Data type	Description
buffer	VARCHAR(3K)	The memory buffer.
fileName	VARCHAR(512)	The fully qualified server file name.

Return type

XMLFILE

Examples

The following examples reads an XML document from memory as VARCHAR, writes it to an external server file, and inserts the file name and path as an XMLFILE type in an XML column.

```
EXEC SQL BEGIN DECLARE SECTION;
      struct { short len; char data[3000]; } xml_buff;
EXEC SQL END DECLARE SECTION;

EXEC SQL INSERT INTO sales_tab(ID, NAME, ORDER)
  VALUES('1234', 'Sriram Srinivasan',
       XMLFileFromVarchar(:xml_buf, 'dxx_install/xml/getstart.xml'))
```

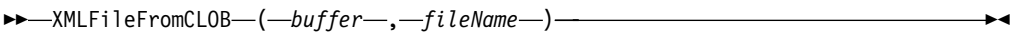
The column ORDER in the SALES_TAB table is defined as an XMLFILE type. The preceding example shows that if you have an XML document in your buffer, you can store it in a server file.

XMLFileFromCLOB()

Purpose

Reads an XML document as CLOB locator, writes it to an external server file, and returns the file name and path as an XMLFILE type.

Syntax



Parameters

Table 30. XMLFileFromCLOB() parameters

Parameters	Data type	Description
buffer	CLOB as LOCATOR	The buffer containing the XML document.
fileName	VARCHAR(512)	The fully qualified server file name.

Return type

XMLFILE

Examples

The following example reads an XML document as CLOB locator (a host variable with a value that represents a single LOB value in the database server), writes it to an external server file, and inserts the file name and path as an XMLFILE type in an XML column.

```
EXEC SQL BEGIN DECLARE SECTION;
     SQL TYPE IS CLOB_LOCATOR xml_buff;
EXEC SQL END DECLARE SECTION;

EXEC SQL INSERT INTO sales_tab(ID, NAME, ORDER)
   VALUES('1234', 'Sriram Srinivasan',
           XMLFileFromCLOB(:xml_buf, 'dxx_install/xml/getstart.xml'))
```

The column ORDER in the SALES_TAB table is defined as an XMLFILE type. If you have an XML document in your buffer, you can store it in a server file.

Retrieval functions

The XML Extender provides an *overloaded function* Content(), which is used for retrieval. This overloaded function refers to a set of retrieval functions that have the same name, but behave differently based on where the data is being retrieved. You can also use the default casting functions to convert an XML UDT to the base data type as described in "Retrieving an entire document" on page 108.

The Content() functions provide the following types of retrieval:

- **Retrieval from external storage at the server to a host variable at the client.**

  You can use Content() to retrieve an XML document to a memory buffer when it is stored as an external server file. You can use "Content(): retrieve from XMLFILE to a CLOB" on page 156 for this purpose.
- **Retrieval from internal storage to an external server file**

  You can also use Content() to retrieve an XML document that is stored inside DB2 and store it to a server file on the DB2 server's file system. The following Content() functions are used to store information on external server files:
  - "Content(): retrieve from XMLVARCHAR to an external server file" on page 157
  - "Content(): retrieval from XMLCLOB to an external server file" on page 158

The examples in the following section assume you are using the DB2 command shell, in which you do not need to type "DB2" at the beginning of each command.

Content(): retrieve from XMLFILE to a CLOB

Purpose

Retrieves data from a server file and stores it in a CLOB LOCATOR.

Syntax

Parameters

Table 31. XMLFILE to a CLOB parameter

Parameter	Data type	Description
xmlobj	XMLFILE	The XML document.

Return type

CLOB (*clob_len*) as LOCATOR

clob_len for DB2 UDB is 2G.

Examples

The following example retrieves data from a server file and stores it in a CLOB locator.

```
EXEC SQL BEGIN DECLARE SECTION;
     SQL TYPE IS CLOB_LOCATOR xml_buff;
EXEC SQL END DECLARE SECTION;

EXEC SQL CONNECT TO SALES_DB

EXEC SQL DECLARE c1 CURSOR FOR

     SELECT Content(order) from sales_tab
     WHERE sales_person = 'Sriram Srinivasan'

EXEC SQL OPEN c1;

do {
   EXEC SQL FETCH c1 INTO :xml_buff;
   if (SQLCODE != 0) {
      break;
      }
   else {
     /* do with the XML doc in buffer */
     }
   }

EXEC SQL CLOSE c1;

EXEC SQL CONNECT RESET;
```

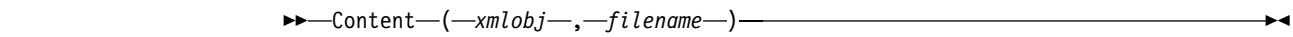
The column ORDER in the SALES_TAB table is of an XMLFILE type, so the Content() UDF retrieves data from a server file and stores it in a CLOB locator.

Content(): retrieve from XMLVARCHAR to an external server file

Purpose

Retrieves the XML content that is stored as an XMLVARCHAR type and stores it in an external server file.

Syntax



Important: If a file with the specified name already exists, the content function overrides its content.

Parameters

Table 32. XMLVarchar to external server file parameters

Parameter	Data type	Description
xmlobj	XMLVARCHAR	The XML document.
filename	VARCHAR(512)	The fully qualified server file name.

Return type

VARCHAR(512)

Examples

The following example retrieves the XML content that is stored as XMLVARCHAR type and stores it in an external server file.

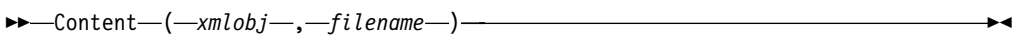
```
CREATE table app1 (id int NOT NULL, order DB2XML.XMLVarchar);
INSERT into app1 values (1, '<?xml version="1.0"?>
   <!DOCTYPE SYSTEM dxx_install/dtd/getstart.dtd"->
     <Order key="1">
        <Customer>
          <Name>American Motors</Name>
          <Email>parts@am.com</Email>
        </Customer>
        <Part color="black">
          <key>68</key>
          <Quantity>36</Quantity>
          <ExtendedPrice>34850.16</ExtendedPrice>
          <Tax>6.000000e-02</Tax>
          <Shipment>
              <ShipDate>1998-08-19</ShipDate>
              <ShipMode>AIR </ShipMode>
          </Shipment>
          <Shipment>
              <ShipDate>1998-08-19</ShipDate>
              <ShipMode>BOAT </ShipMode>
          </Shipment>
          </Part>
     </Order>');

SELECT DB2XML.Content(order, 'dxx_install/dad/getstart_column.dad')
  from app1 where ID=1;
```

Content(): retrieval from XMLCLOB to an external server file

Purpose

Retrieves the XML content that is stored as an XMLCLOB type and stores it in an external server file.

Syntax



Important: If a file with the specified name already exists, the content function overrides its content.

Parameters

Table 33. XMLCLOB to external server file parameters

Parameter	Data type	Description
xmlobj	XMLCLOB as LOCATOR	The XML document.
filename	VARCHAR(512)	The fully qualified server file name.

Return type

VARCHAR(512)

Examples

The following example retrieves the XML content that is stored as an XMLCLOB type and stores it in an external server file.

```
CREATE table app1 (id int NOT NULL, order DB2XML.XMLCLOB );

INSERT into app1 values (1, '<?xml version="1.0"?>
  <!DOCTYPE SYSTEM dxx_install/dtd/getstart.dtd"->
    <Order key="1">
      <Customer>
          <Name>American Motors</Name>
          <Email>parts@am.com</Email>
      </Customer>
      <Part color="black">
          <key>68</key>
          <Quantity>36</Quantity>
          <ExtendedPrice>34850.16</ExtendedPrice>
          <Tax>6.000000e-02</Tax>
          <Shipment>
              <ShipDate>1998-08-19</ShipDate>
              <ShipMode>AIR </ShipMode>
          </Shipment>
          <Shipment>
              <ShipDate>1998-08-19</ShipDate>
              <ShipMode>BOAT </ShipMode>
          </Shipment>
      </Part>
    </Order>');

SELECT DB2XML.Content(order, 'dxx_install/xml/getstart.xml')
from app1 where ID=1;
```

Extracting functions

The extracting functions extract the element content or attribute value from an XML document and return the requested SQL data types. The XML Extender provides a set of extracting functions for various SQL data types. The extracting functions take two input parameters. The first parameter is the XML Extender UDT, which can be one of the XML UDTs. The second parameter is the location path that specifies the XML element or attribute. Each extracting function returns the value that is specified by the location path.

The XML Extender provides the following extracting functions:

- "extractInteger()" on page 160
- "extractSmallint()" on page 161
- "extractDouble()" on page 162
- "extractReal()" on page 163
- "extractChar()" on page 164
- "extractVarchar()" on page 165
- "extractCLOB()" on page 166
- "extractDate()" on page 167
- "extractTime()" on page 168
- "extractTimestamp()" on page 169

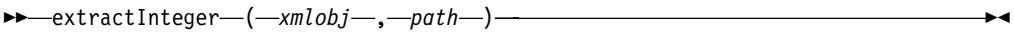
The examples in the following section assume you are using the DB2 command shell, in which you do not need to type "DB2" at the beginning of each command.

extractInteger()

Purpose

Extracts the element content or attribute value from an XML document and returns the data as INTEGER type.

Syntax



Parameters

Table 34. extractInteger function parameters

Parameter	Data type	Description
xmlobj	XMLVARCHAR, XMLFILE, or XMLCLOB	The column name.
path	VARCHAR	The location path of the element or attribute.

Return type

INTEGER

Examples

In the following example, one value is returned when the attribute value of key = ″1″. The value is extracted as an INTEGER.

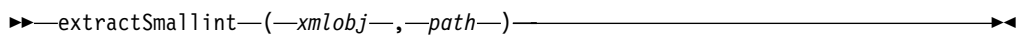
```
CREATE TABLE t1(key INT);
INSERT INTO t1 values (
    DB2XML.extractInteger(DB2XML.XMLFile('dxx_install/xml/getstart.xml'),
    '/Order/Part[@color="black "]/key'));
SELECT * from t1;
```

extractSmallint()

Purpose

Extracts the element content or attribute value from an XML document and returns the data as SMALLINT type.

Syntax



Parameters

Table 35. extractSmallint function parameters

Parameter	Data type	Description
xmlobj	XMLVARCHAR, XMLFILE, or XMLCLOB	The column name.
path	VARCHAR	The location path of the element or attribute.

Return type

SMALLINT

Examples

In the following example, the value of key in all sales orders is extracted as SMALLINT

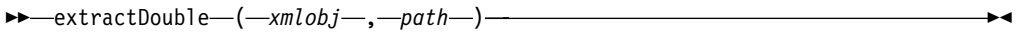
```
CREATE TABLE t1(key INT);
INSERT INTO t1 values (
    DB2XML.extractSmallint(b2xml.xmlfile('dxx_install/xml/getstart.xml'),
    '/Order/Part[@color="black "]/key'));
SELECT * from t1;
```

extractDouble()

Purpose

Extracts the element content or attribute value from an XML document and returns the data as DOUBLE type.

Syntax



Parameters

Table 36. extractDouble function parameters

Parameter	Data type	Description
xmlobj	XMLVARCHAR, XMLFILE, or XMLCLOB	The column name.
path	VARCHAR	The location path of the element or attribute.

Return type

DOUBLE

Examples

The following example automatically converts the price in an order from a DOUBLE type to a DECIMAL.

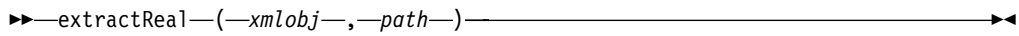
```
CREATE TABLE t1(price DECIMAL(9,2));
INSERT INTO t1 values (
    DB2XML.extractDouble(DB2XML.xmlfile('dxx_install/xml/getstart.xml'),
    '/Order/Part[@color="black "]/ExtendedPrice'));
SELECT * from t1;
```

extractReal()

Purpose

Extracts the element content or attribute value from an XML document and returns the data as REAL type.

Syntax



Parameters

Table 37. extractReal function parameters

Parameter	Data type	Description
xmlobj	XMLVARCHAR, XMLFILE, or XMLCLOB	The column name.
path	VARCHAR	The location path of the element or attribute.

Return type

REAL

Examples

In the following example, the value of ExtendedPrice is extracted as a REAL.

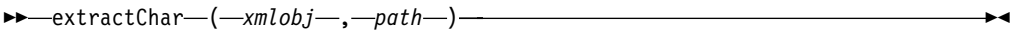
```
CREATE TABLE t1(price DECIMAL(9,2));
INSERT INTO t1 values (
    DB2XML.extractReal(DB2XML.xmlfile('dxx_install/xml/getstart.xml'),
    '/Order/Part[@color="black"]/ExtendedPrice'));
SELECT * from t1;
```

extractChar()

Purpose

Extracts the element content or attribute value from an XML document and returns the data as CHAR type.

Syntax



Parameters

Table 38. extractChar function parameters

Parameter	Data type	Description
xmlobj	XMLVARCHAR, XMLFILE, or XMLCLOB	The column name.
path	VARCHAR	The location path of the element or attribute.

Return type

CHAR

Examples

In the following example, the value of Name is extracted as CHAR.

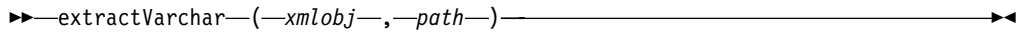
```
CREATE TABLE t1(name char(30));
INSERT INTO t1 values (
    DB2XML.extractChar(DB2XML.xmlfile('dxx_install/xml/getstart.xml'),
    '/Order/Customer/Name'));
SELECT * from t1;
```

extractVarchar()

Purpose

Extracts the element content or attribute value from an XML document and returns the data as VARCHAR type.

Syntax



Parameters

Table 39. extractVarchar function parameters

Parameter	Data type	Description
xmlobj	XMLVARCHAR, XMLFILE, or XMLCLOB	The column name.
path	VARCHAR	The location path of the element or attribute.

Return type

VARCHAR(4K)

Examples

In the following example, the value of Name is extracted as VARCHAR.

```
CREATE TABLE t1(name varchar(30));
INSERT INTO t1 values (
    DB2XML.extractVarchar(DB2XML.xmlfile('dxx_install/xml/getstart.xml'),
    '/Order/Customer/Name'));
SELECT * from t1;
```

extractCLOB()

Purpose

Extracts a fragment of XML documents, with element and attribute markup, content of elements and attributes, including sub-elements. This function differs from the other extract functions; they return only the content of elements and attributes. The extractClob(s) functions should be used to extract document fragments, whereas extractVarchar(s) and extractChar(s) should be used to extract simple values.

Syntax

Parameters

Table 40. extractCLOB function parameters

Parameter	Data type	Description
xmlobj	XMLVARCHAR, XMLFILE, or XMLCLOB	The column name.
path	VARCHAR	The location path of the element or attribute.

Return type

CLOB(10K)

Examples

In this example, all name element content and tags are extracted from a purchase order.

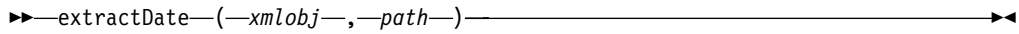
```
CREATE TABLE t1(name DB2XML.xmlclob);
INSERT INTO t1 values (
    DB2XML.extractClob(DB2XML.xmlfile('dxx_install/xml/getstart.xml'),
    '/Order/Customer/Name'));
SELECT * from t1;
```

extractDate()

Purpose

Extracts the element content or attribute value from an XML document and returns the data as DATE type.

Syntax



Parameters

Table 41. extractDate function parameters

Parameter	Data type	Description
xmlobj	XMLVARCHAR, XMLFILE, or XMLCLOB	The column name.
path	VARCHAR	The location path of the element or attribute.

Return type

DATE

Examples

In the following example, the value of ShipDate is extracted as DATE.

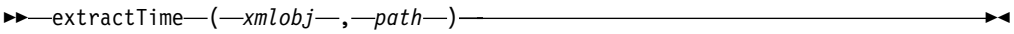
```
CREATE TABLE t1(shipdate DATE);
INSERT INTO t1 values (
    DB2XML.extractDate(DB2XML.xmlfile('dxx_install/xml/getstart.xml'),
    '/Order/Part[@color="red   "]/Shipment/ShipDate'));
SELECT * from t1;
```

extractTime()

Purpose

Extracts the element content or attribute value from an XML document and returns the data as TIME type.

Syntax



Parameters

Table 42. extractTime function parameters

Parameter	Data type	Description
xmlobj	XMLVARCHAR, XMLFILE, or XMLCLOB	The column name.
path	VARCHAR	The location path of the element or attribute.

Return type

TIME

Examples

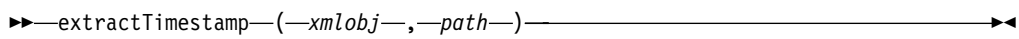
```
CREATE TABLE t1(testtime  TIME);
INSERT INTO t1 values (
    DB2XML.extractTime(DB2XML.XMLCLOB(
         '<stuff><data>11.12.13</data></stuff>'), '//data'));
SELECT * from t1;
```

extractTimestamp()

Purpose

Extracts the element content or attribute value from an XML document and returns the data as TIMESTAMP type.

Syntax



Parameters

Table 43. extractTimestamp function parameters

Parameter	Data type	Description
xmlobj	XMLVARCHAR, XMLFILE, or XMLCLOB	The column name.
path	VARCHAR	The location path of the element or attribute.

Return type

TIMESTAMP

Examples

```
CREATE TABLE t1(testtimestamp  TIMESTAMP);
INSERT INTO t1 values (
    DB2XML.extractTimestamp(DB2XML.XMLCLOB(
        '<stuff><data>1998-11-11-11.12.13.888888</data></stuff>'),
        '//data'));
SELECT * from t1;
```

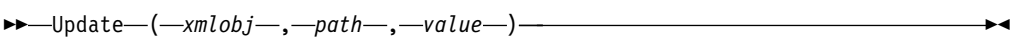
Update function

The Update() function updates a specified element or attribute value in one or more XML documents stored in the XML column. You can also use the default casting functions to convert an SQL base type to the XML UDT, as described in "Updating XML data" on page 111.

Purpose

Takes the column name of an XML UDT, a location path, and a string of the update value and returns an XML UDT that is the same as the first input parameter. With the Update() function, you can specify the element or attribute that is to be updated.

Syntax



Parameters

Table 44. The UDF Update parameters

Parameter	Data type	Description
xmlobj	XMLVARCHAR, XMLCLOB as LOCATOR	The column name.
path	VARCHAR	The location path of the element or attribute.
value	VARCHAR	The update string. **Restriction:** The Update function does not have an option to disable output escaping; the output of an extractClob (which is a tagged fragment) cannot be inserted using this function. Use textual values, only.

Important: Note that the Update UDF supports location paths that have predicates with attributes, but not elements. For example, the following predicate is supported:

```
'/Order/Part[@color="black "]/ExtendedPrice'
```

The following predicate is not supported:

```
'/Order/Part/Shipment/[Shipdate < "11/25/00"]'
```

Return type

Data type	Return type
XMLVARCHAR	XMLVARCHAR
XMLCLOB as LOCATOR	XMLCLOB

Example

The following example updates the purchase order handled by the salesperson Sriram Srinivasan.

```
UPDATE sales_tab
   set order = db2xml.update(order, '/Order/Customer/Name', 'IBM')
   WHERE sales_person = 'Sriram Srinivasan'
```

In this example, the content of `/Order/Customer/Name` is updated to `IBM`.

Usage

When you use the Update function to change a value in one or more XML documents, it replaces the XML documents within the XML column. Based on output from the XML parser, some parts of the original document are preserved, while others are lost or changed. The following sections describe how the document is processed and provide examples of how the documents look before and after updates.

How the Update function processes the XML document

When the Update function replaces XML documents, it must reconstruct the document based on the XML parser output. Table 45 describes how the parts of the document are handled, with examples.

Table 45. Update function rules

Item or Node type	XML document code example	Status after update
XML Declaration	`<?xml  version='1.0' encoding='utf-8' standalone='yes' >`	The XML declaration is preserved.

DOCTYPE Declaration	`<!DOCTYPE books SYSTEM "http://dtds.org/books.dtd" >`
	`<!DOCTYPE books PUBLIC "local.books.dtd"  "http://dtds.org/books.dtd" >`
	`<!DOCTYPE books>`
	`-Any of`
	`<!DOCTYPE books ( S ExternalID ) ? [ internal-dtd-subset ] >`
	`-Such as`
	`<!DOCTYPE books [ <!ENTITY mydog "Spot"> ] >? [ internal-dtd-subset ] >`
		The document type declaration is preserved:

Comments	`<!-- comment -->`	Comments are preserved outside the root element. Comments inside the root element are discarded.

Elements	`<books>`
	`content`
	`</books>`
		Elements are preserved.

Table 45. Update function rules (continued)

Item or Node type	XML document code example	Status after update
Attributes	`id='1' date="01/02/1997"`	Attributes of elements are preserved. • After update, double quotes are used to delineate values. • Data within attributes is escaped. • Entities are replaced.
Text Nodes	`This chapter is about my dog &mydoc;.`	Text nodes (element content) are preserved. • Data within text nodes is escaped. • Entities are replaced.

Multiple occurrence

When a location path is provided in the Update() UDF, the content of every element or attribute with a matching path is updated with the supplied value. This means that if a document has multiple occurring locations paths, the Update function replaces the existing values with the value provided in the *value* parameter.

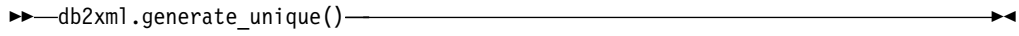
You can use specify a predicate in the *path* parameter to provide distinct locations paths to prevent unintentional updates. Note, that the Update UDF supports location paths that have predicates with attributes, but not elements. See "Parameters" on page 170 for more information.

Generate unique function

Purpose

The generate unique function returns a character string that is unique compared to any other execution of the same function. There are no arguments to this function (the empty parentheses must be specified). The result of the function is a unique value. The result cannot be null.

Syntax



Return value

VARCHAR(13)

Example

The following example uses db2xml.generate_unique() to generate a unique key for a column to be indexed.

```
<SQL_stmt>
SELECT o.order_key, customer_name, customer_email, p.part_key, color, quantity,
price, tax, ship_id, date, mode from order_tab o, part_tab p,
 (select db2xml.generate_unique()
  as ship_id, date, mode, part_key from ship_tab) as s
        WHERE o.order_key = 1 and
             p.price > 20000 and
             p.order_key = o.order_key and
             s.part_key = p.part_key
        ORDER BY order_key, part_key, ship_id
</SQL_stmt>
```

Chapter 13. XML Extender stored procedures

The XML Extender provides stored procedures (also called *procedures*) for administration and management of XML columns and collections. These stored procedures can be called from the DB2 client. The client interface can be embedded in SQL, ODBC, or JDBC. Refer to the section on stored procedures in the *DB2 UDB for iSeries SQL Programming* for details on how to call stored procedures.

The stored procedures use the schema DB2XML, which is the schema name of the XML Extender.

The XML Extender provides three types of stored procedures:

- "Administration stored procedures" on page 177, which assist users in completing administrative tasks
- "Composition stored procedures" on page 184, which generate XML documents using data in existing database tables
- "Decomposition stored procedures" on page 192, which break down or shred incoming XML documents and store data in new or existing database tables

Before calling stored procedures, you must follow the set up procedures for all environemnts in "Setting up the samples and development environment" on page 35. Sample stored procedures are located in `DXXSAMPLES/QCSRC`.

The parameter limits used by the XML collection stored procedures are documented in "Appendix D. The XML Extender limits" on page 247.

Specifying include files

Ensure that you include the XML Extender external header files in the program that calls stored procedures. The header files are located in the *dxx_install*`/include` directory. *dxx_install* is the installation directory for the XML Extender. It is operating system dependent. The header files are:

dxx.h The XML Extender defined constant and data types

dxxrc.h The XML Extender return code

The syntax for including these header files is:

```
#include "dxx.h"
#include "dxxrc.h"
```

Make sure that the path of the include files is specified in your makefile with the compilation option.

Calling XML Extenders stored procedures

In general, call the XML Extender using the following syntax:

`CALL DB2XML.`*function_entry_point*

Where:

function_entry_point
Specifies the arguments passed to the stored procedure.

In the CALL statement, the arguments that are passed to the stored procedure must be host variables, not constants or expressions. The host variables can have null indicators.

See samples for calling stored procedures in the DXXSAMPLES/QCSRC source file, and in the following sections of this book: "Composing the XML document" on page 28 and "Chapter 9. Managing XML collection data" on page 119. In the DXXSAMPLES/QCSRC source directory, SQC code files are provided to call XML collection stored procedures using embedded SQL.

Increasing the CLOB limit

The default limit for CLOB parameter when passed to a stored procedure is 1 MB. You can increase the limit by completing the following steps:

1. Drop each stored procedure. For example:

```
db2   "drop procedure DB2XML.dxxShredXML"
```

2. Create a new procedure with the increased CLOB limit. For example:

```
db2   "create procedure DB2XML.dxxShredXML(in     dadBuf      clob(100K),
                                           in     XMLObj      clob(10M),
                                           out    returnCode  integer,
                                           out    returnMsg   varchar(1024)
                                           )
       external name 'DB2XML.dxxShredXML'
       language C
       parameter style DB2DARI
       not deterministic
       fenced
       null call;
```

Administration stored procedures

These stored procedures are used for administration tasks, such as enabling or disabling an XML column or collection. They are called by the XML Extender administration wizard and the administration command **dxxadm**. These stored procedures are:

- dxxEnableDB()
- dxxDisableDB()
- dxxEnableColumn()
- dxxDisableColumn()
- dxxEnableCollection()
- dxxDisableCollection()

dxxEnableDB()

Purpose

Enables the database. When the database is enabled, the XML Extender creates the following objects:

- The XML Extender user-defined types (UDTs).
- The XML Extender user-defined functions (UDFs).
- The XML Extender DTD reference table, DTD_REF, which stores DTDs and information about each DTD. For a complete description of the DTD_REF table, see "DTD reference table" on page 199.
- The XML Extender usage table, XML_USAGE, which stores common information for each column that is enabled for XML and for each collection. For a complete description of the XML_USAGE table, see "XML usage table" on page 200.

Format

```
dxxEnableDB(char(dbName) dbName,       /* input */
            long           returnCode,   /* output */
            varchar(1024)  returnMsg)    /* output */
```

Parameters

Table 46. dxxEnableDB() parameters

Parameter	Description	IN/OUT parameter
dbName	The database name.	IN
returnCode	The return code from the stored procedure.	OUT
returnMsg	The message text that is returned in case of error.	OUT

dxxDisableDB()

Purpose

Disables the database. When the XML Extender disables the database, it drops the following objects:

- The XML Extender user-defined types (UDTs).
- The XML Extender user-defined functions (UDFs).
- The XML Extender DTD reference table, DTD_REF, which stores DTDs and information about each DTD. For a complete description of the DTD_REF table, see "DTD reference table" on page 199.
- The XML Extender usage table, XML_USAGE, which stores common information for each column that is enabled for XML and for each collection. For a complete description of the XML_USAGE table, see "XML usage table" on page 200.

Important: You must disable all XML columns before attempting to disable a database. The XML Extender cannot disable a database that contains columns or collections that are enabled for XML.

Format

```
dxxDisableDB(char(dbName)     dbName,       /* input */
                 long           returnCode,   /* output */
                 varchar(1024) returnMsg)    /* output */
```

Parameters

Table 47. dxxDisableDB() parameters

Parameter	Description	IN/OUT parameter
dbName	The database name.	IN
returnCode	The return code from the stored procedure.	OUT
returnMsg	The message text that is returned in case of error.	OUT

dxxEnableColumn()

Purpose

Enables an XML column. When enabling a column, the XML Extender completes the following tasks:

- Determines whether the XML table has a primary key; if not, the XML Extender alters the XML table and adds a column called DXXROOT_ID.
- Creates side tables that are specified in the DAD file with a column containing a unique identifier for each row in the XML table. This column is either the root_id that is specified by the user, or it is the DXXROOT_ID that was named by the XML Extender.
- Creates a default view for the XML table and its side tables, optionally using a name you specify.

Format

```
dxxEnableColumn(char(dbName) dbName,      /* input */
                char(tbName) tbName,      /* input */
                char(colName) colName,     /* input */
                CLOB(100K)     DAD,         /* input */
                char(tablespace) tablespace,  /* input */
                char(defaultView) defaultView, /* input */
                char(rootID) rootID,      /* input */
                long           returnCode,  /* output */
                varchar(1024)  returnMsg)   /* output */
```

Parameters

Table 48. dxxEnableColumn() parameters

Parameter	Description	IN/OUT parameter
dbName	The database name.	IN
tbName	The name of the table containing the XML column.	IN
colName	The name of the XML column.	IN
DAD	A CLOB containing the DAD file.	IN
tablespace	The table space that contains the side tables other than the default table space. If not specified, the default table space is used.	IN
defaultView	The name of the default view joining the application table and side tables.	IN
rootID	The name of the single primary key in the application table that is to be used as the root ID for the side table.	IN
returnCode	The return code from the stored procedure.	OUT
returnMsg	The message text that is returned in case of error.	OUT

dxxDisableColumn()

Purpose

Disables the XML-enabled column. When an XML column is disabled, it can no longer contain XML data types.

Format

```
dxxDisableColumn(char(dbName) dbName,      /* input */
                 char(tbName) tbName,      /* input */
                 char(colName) colName,     /* input */
                 long           returnCode,  /* output */
                 varchar(1024)  returnMsg)   /* output */
```

Parameters

Table 49. dxxDisableColumn() parameters

Parameter	Description	IN/OUT parameter
dbName	The database name.	IN
tbName	The name of the table containing the XML column.	IN
colName	The name of the XML column.	IN
returnCode	The return code from the stored procedure.	OUT
returnMsg	The message text that is returned in case of error.	OUT

dxxEnableCollection()

Purpose

Enables an XML collection that is associated with an application table.

Format

```
dxxEnableCollection(char(dbName) dbName,      /* input */
                    char(colName) colName,     /* input */
                    CLOB(100K)     DAD,         /* input */
                    char(tablespace) tablespace,  /* input */
                    long           returnCode,  /* output */
                    varchar(1024)  returnMsg)   /* output */
```

Parameters

Table 50. dxxEnableCollection() parameters

Parameter	Description	IN/OUT parameter
dbName	The database name.	IN
colName	The name of the XML collection.	IN
DAD	A CLOB containing the DAD file.	IN
tablespace	The table space that contains the side tables other than the default table space. If not specified, the default table space is used.	IN
returnCode	The return code from the stored procedure.	OUT
returnMsg	The message text that is returned in case of error.	OUT

dxxDisableCollection()

Purpose

Disables an XML-enabled collection, removing markers that identify tables and columns as part of a collection.

Format

```
dxxDisableCollection(char(dbName) dbName,      /* input */
                     char(colName) colName,     /* input */
                     long          returnCode,  /* output */
                     varchar(1024)  returnMsg)   /* output */
```

Parameters

Table 51. dxxDisableCollection() parameters

Parameter	Description	IN/OUT parameter
dbName	The database name.	IN
colName	The name of the XML collection.	IN
returnCode	The return code from the stored procedure.	OUT
returnMsg	The message text that is returned in case of error.	OUT

Composition stored procedures

The composition stored procedures dxxGenXML() and dxxRetrieveXML() are used to generate XML documents using data in existing database tables. The dxxGenXML() stored procedure takes a DAD file as input; it does not require an enabled XML collection. The dxxRetrieveXML() stored procedure takes an enabled XML collection name as input.

dxxGenXML()

Purpose

Constructs XML documents using data that is stored in the XML collection tables that are specified by the <Xcollection> in the DAD file and inserts each XML document as a row into the result table. You can also open a cursor on the result table and fetch the result set.

To provide flexibility, dxxGenXML() also lets the user specify the maximum number of rows to be generated in the result table. This decreases the amount of time the application must wait for the results during any trial process. The stored procedure returns the number of actual rows in the table and any error information, including error codes and error messages.

To support dynamic query, dxxGenXML() takes an input parameter, *override*. Based on the input *overrideType*, the application can override the SQL_stmt for SQL mapping or the conditions in RDB_node for RDB_node mapping in the DAD file. The input parameter *overrideType* is used to clarify the type of the *override*. For details about the *override* parameter, see "Dynamically overriding values in the DAD file" on page 124.

Format

```
dxxGenXML(CLOB(100K)     DAD,             /* input */
          char() resultTabName,   /* input */
          char(30)       result_column,   /* input */
          char(30)       valid_column,    /* input */
          integer        overrideType     /* input */
          varchar(1024)  override,        /* input */
          integer        maxRows,         /* input */
          integer        numRows,         /* output */
          long           returnCode,      /* output */
          varchar(1024)  returnMsg)       /* output */
```

Parameters

Table 52. dxxGenXML() parameters

Parameter	Description	IN/OUT parameter
DAD	A CLOB containing the DAD file.	IN
resultTabName	The name of the result table, which should exist before the call. The table contains only one column of either XMLVARCHAR or XMLCLOB type.	IN
overrideType	A flag to indicate the type of the following *override* parameter: • **NO_OVERRIDE**: No override. • **SQL_OVERRIDE**: Override by an SQL_stmt. • **XML_OVERRIDE**: Override by an XPath-based condition.	IN
override	Overrides the condition in the DAD file. The input value is based on the *overrideType*. • **NO_OVERRIDE**: A NULL string. • **SQL_OVERRIDE**: A valid SQL statement. Using this *overrideType* requires that SQL mapping is used in the DAD file. The input SQL statement overrides the SQL_stmt in the DAD file. • **XML_OVERRIDE**: A string that contains one or more expressions in double quotation marks separated by "AND". Using this *overrideType* requires that RDB_node mapping is used in the DAD file.	IN
maxRows	The maximum number of rows in the result table.	IN
numRows	The actual number generated rows in the result table.	OUT
returnCode	The return code from the stored procedure.	OUT
returnMsg	The message text that is returned in case of error.	OUT

Examples

The following example fragment assumes that a result table is created with the name of XML_ORDER_TAB, and that the table has one column of XMLVARCHAR type. A complete, working sample is located in `DXXSAMPLES/QCSRC(GENX)`.

```
#include "dxx.h"
#include "dxxrc.h"

EXEC SQL INCLUDE SQLCA;
EXEC SQL BEGIN DECLARE SECTION;
SQL TYPE is CLOB(100K) dad;    /* DAD */

char    result_tab[32];        /* name of the result table */
char    result_colname[32];    /* name of the result column */
char    valid_colname[32];     /* name of the valid column, will set to NULL */
```

```
char    override[2];           /* override, will set to NULL*/
short   overrideType;          /* defined in dxx.h */
short   max_row;               /* maximum number of rows */
short   num_row;               /* actual number of rows */
long    returnCode;            /* return error code */
char    returnMsg[1024];       /* error message text */
short   dad_ind;
short   rtab_ind;
short   rcol_ind;
short   vcol_ind;
short   ovtype_ind;
short   ov_ind;
short   maxrow_ind;
short   numrow_ind;
short   returnCode_ind;
short   returnMsg_ind;
EXEC SQL END DECLARE SECTION;

FILE   *file_handle;
long    file_length=0;

/* create table */
EXEC SQL CREATE TABLE xml_order_tab (xmlorder XMLVarchar);

/* initialize the DAD CLOB object. */
file_handle = fopen( "/dxx/dad/getstart_xcollection.dad", "r" );
if ( file_handle != NULL ) {
  file_length = fread ((void *) &dad.data;
, 1, FILE_SIZE, file_handle);
  if (file_length == 0) {
    printf ("Error reading dad file
             /dxx/dad/getstart_xcollection.dad\n");
    rc = -1;
    goto exit;
 } else
    dad.length = file_length;
}
else {
  printf("Error opening dad file  \n", );
  rc = -1;
  goto exit;
}
/* initialize host variable and indicators */
strcpy(result_tab,"xml_order_tab");
strcpy(result_colname, "xmlorder")
valid_colname = '\0';
override[0] = '\0';
overrideType = NO_OVERRIDE;
max_row = 500;
num_row = 0;
returnCode = 0;
msg_txt[0] = '\0';
dad_ind = 0;
rtab_ind = 0;
rcol_ind = 0;
vcol_ind = -1;
ov_ind = -1;
ovtype_ind = 0;
maxrow_ind = 0;
numrow_ind = -1;
returnCode_ind = -1;
returnMsg_ind = -1;

/* Call the store procedure */
EXEC SQL CALL "DB2XML.DXXGENXML" (:dad:dad_ind;
                                  :result_tab:rtab_ind,
                                  :result_colname:rcol_ind,
```

```
                                        :valid_colname:vcol_ind,
                                        :overrideType:ovtype_ind,:override:ov_ind,
                                        :max_row:maxrow_ind,:num_row:numrow_ind,
                                        :returnCode:returnCode_ind,:returnMsg:returnMsg_ind);

if (SQLCODE < 0) {
    EXEC SQL ROLLBACK;
  else
    EXEC SQL COMMIT;
}

exit:
  return rc;
```

dxxRetrieveXML()

Purpose

Enables the same DAD file to be used for both composition and decomposition. The stored procedure dxxRetrieveXML() also serves as a means for retrieving decomposed XML documents. As input, dxxRetrieveXML() takes a buffer containing the DAD file, the name of the created result table, and the maximum number of rows to be returned. It returns a result set of the result table, the actual number of rows in the result set, an error code, and message text.

To support dynamic query, dxxRetrieveXML() takes an input parameter, *override*. Based on the input *overrideType*, the application can override the SQL_stmt for SQL mapping or the conditions in RDB_node for RDB_node mapping in the DAD file. The input parameter *overrideType* is used to clarify the type of the *override*. For details about the *override* parameter, see "Dynamically overriding values in the DAD file" on page 124.

The requirements of the DAD file for dxxRetrieveXML() are the same as the requirements for dxxGenXML(). The only difference is that the DAD is not an input parameter for dxxRetrieveXML(), but it is the name of an enabled XML collection.

Format

```
dxxRetrieveXML(char() collectionName,   /* input */
               char() resultTabName,    /* input */
               char(30)       result_column,    /* input */
               char(30)       valid_column,     /* input */
               integer        overrideType,     /* input */
               varchar(1024)  override,         /* input */
               integer        maxRows,          /* input */
               integer        numRows,          /* output */
               long           returnCode,       /* output */
               varchar(1024)  returnMsg)        /* output */
```

Parameters

Table 53. dxxRetrieveXML() parameters

Parameter	Description	IN/OUT parameter
collectionName	The name of an enabled XML collection.	IN
resultTabName	The name of the result table, which should exist before the call. The table contains only one column of either XMLVARCHAR or XMLCLOB type.	IN
overrideType	A flag to indicate the type of the following *override* parameter: • **NO_OVERRIDE**: No override. • **SQL_OVERRIDE**: Override by an SQL_stmt. • **XML_OVERRIDE**: Override by an XPath-based condition.	IN
override	Overrides the condition in the DAD file. The input value is based on the *overrideType*. • **NO_OVERRIDE**: A NULL string. • **SQL_OVERRIDE**: A valid SQL statement. Using this *overrideType* requires that SQL mapping is used in the DAD file. The input SQL statement overrides the SQL_stmt in the DAD file. • **XML_OVERRIDE**: A string that contains one or more expressions in double quotation marks, separated by "AND". Using this *overrideType* requires that RDB_node mapping is used in the DAD file.	IN
maxRows	The maximum number of rows in the result table.	IN
numRows	The actual number of generated rows in the result table.	OUT
returnCode	The return code from the stored procedure.	OUT
returnMsg	The message text that is returned in case of error.	OUT

Examples

The following fragment is an example of a call to dxxRetrieveXML(). In this example, a result table is created with the name of XML_ORDER_TAB, and it has one column of XMLVARCHAR type. A complete, working sample is located in `DXXSAMPLES/QCSRC(RTRX)`.

```
#include "dxx.h"
#include "dxxrc.h"

EXEC SQL INCLUDE SQLCA;
EXEC SQL BEGIN DECLARE SECTION;
char    collectionName[32];    /* name of an XML collection */
char    result_tab[32];        /* name of the result table */
char    result_colname[32];    /* name of the result column */
```

```
char    valid_colname[32];     /* name of the valid column, will set to NULL*/
char    override[2];           /* override, will set to NULL*/
short   overrideType;          /* defined in dxx.h */
short   max_row;               /* maximum number of rows */
short   num_row;               /* actual number of rows */
long    returnCode;            /* return error code */
char    returnMsg[1024];       /* error message text */
short   collectionName_ind;
short   rtab_ind;
short   rcol_ind;
short   vcol_ind;
short   ovtype_ind;
short   ov_ind;
short   maxrow_ind;
short   numrow_ind;
short   returnCode_ind;
short   returnMsg_ind;
EXEC SQL END DECLARE SECTION;

/* create table */
EXEC SQL CREATE TABLE xml_order_tab (xmlorder XMLVarchar);

/* initial host variable and indicators */
strcpy(collection, "sales_ord");
strcpy(result_tab,"xml_order_tab");
strcpy(result_col,"xmlorder");
valid_colname[0] = '\0';
override[0] = '\0';
overrideType = NO_OVERRIDE;
max_row = 500;
num_row = 0;
returnCode = 0;
msg_txt[0] = '\0';
collectionName_ind = 0;
rtab_ind = 0;
rcol_ind = 0;
vcol_ind = -1;
ov_ind = -1;
ovtype_ind = 0;
maxrow_ind = 0;
numrow_ind = -1;
returnCode_ind = -1;
returnMsg_ind = -1;

/* Call the store procedure */
EXEC SQL CALL "DB2XML.DXXRETRIEVE" (:collectionName:collectionName_ind,
                                    :result_tab:rtab_ind,
                                    :result_colname:rcol_ind,
                                    :valid_colname:vcol_ind,
                                    :overrideType:ovtype_ind,:override:ov_ind,
                                    :max_row:maxrow_ind,:num_row:numrow_ind,
                                    :returnCode:returnCode_ind,:returnMsg:returnMsg_ind);

if (SQLCODE < 0) {
    EXEC SQL ROLLBACK;
  else
    EXEC SQL COMMIT;
}
```

Decomposition stored procedures

The decomposition stored procedures dxxInsertXML() and dxxShredXML() are used to break down or shred incoming XML documents and to store data in new or existing database tables. The dxxInsertXML() stored procedure takes an enabled XML collection name as input. The dxxShredXML() stored procedure takes a DAD file as input; it does not require an enabled XML collection.

dxxShredXML()

Purpose

Decomposes XML documents, based on a DAD file mapping, storing the content of the XML elements and attributes in specified DB2 tables. In order for dxxShredXML() to work, all tables specified in the DAD file must exist, and all columns and their data types that are specified in the DAD must be consistent with the existing tables. The stored procedure requires that the columns specified in the join condition, in the DAD, correspond to primary- foreign key relationships in the existing tables. The join condition columns that are specified in the RDB_node of the root element_node must exist in the tables.

The stored procedure fragment in this section is a sample for explanation purposes. A complete, working sample is located in `DXXSAMPLES/QCSRC(X)`.

Format

```
dxxShredXML(CLOB(100K)    DAD,           /* input */
            CLOB(1M)      xmlobj,        /* input */
            long          returnCode,    /* output */
            varchar(1024) returnMsg)     /* output */
```

Parameters

Table 54. dxxShredXML() parameters

Parameter	Description	IN/OUT parameter
DAD	A CLOB containing the DAD file.	IN
xmlobj	An XML document object in XMLCLOB type.	IN
returnCode	The return code from the stored procedure.	OUT
returnMsg	The message text that is returned in case of error.	OUT

Examples

The following fragment is an example of a call to dxxShredXML(). A complete, working sample is located in DXXSAMPLES/QCSRC(SHDX).

```
#include "dxx.h"
#include "dxxrc.h"

EXEC SQL INCLUDE SQLCA;
EXEC SQL BEGIN DECLARE SECTION;
SQL TYPE is CLOB(100K) dad;    /* DAD */

SQL TYPE is CLOB(100K) xmlDoc; /* input xml document */

long    returnCode;            /* return error code */
char    returnMsg[1024];       /* error message text */
short   dad_ind;
short   xmlDoc_ind;
short   returnCode_ind;
short   returnMsg_ind;
EXEC SQL END DECLARE SECTION;

FILE   *file_handle;
long    file_length=0;

/* initialize the DAD CLOB object. */
file_handle = fopen( "/dxx/dad/getstart_xcollection.dad", "r" );
if ( file_handle != NULL ) {
  file_length = fread ((void *) &dad.data;
, 1, FILE_SIZE, file_handle);
  if (file_length == 0) {
    printf ("Error reading dad file getstart_xcollection.dad\n");
    rc = -1;
    goto exit;
 } else
    dad.length = file_length;
}
else {
  printf("Error opening dad file  \n");
  rc = -1;
  goto exit;
}

/* Initialize the XML CLOB object. */
  file_handle = fopen( "/dxx/xml/getstart_xcollection.xml", "r" );
  if ( file_handle != NULL ) {
    file_length = fread ((void *) &xmlDoc.data;
, 1, FILE_SIZE,
                                  file_handle);
    if (file_length == 0) {
      printf ("Error reading xml file getstart_xcollection.xml \n");
```

```
      rc = -1;
      goto exit;
    } else
        xmlDoc.length = file_length;
  }
  else {
    printf("Error opening xml file \n");
    rc = -1;
    goto exit;
  }

/* initialize host variable and indicators */
returnCode = 0;
msg_txt[0] = '\0';
dad_ind = 0;
xmlDoc_ind = 0;
returnCode_ind = -1;
returnMsg_ind = -1;

/* Call the store procedure */
EXEC SQL CALL "DB2XML.DXXSHRED"  (:dad:dad_ind;
                                  :xmlDoc:xmlDoc_ind,
                                  :returnCode:returnCode_ind,
                                  :returnMsg:returnMsg_ind);

if (SQLCODE < 0) {
    EXEC SQL ROLLBACK;
  else
    EXEC SQL COMMIT;
}

exit:
  return rc;
```

dxxInsertXML()

Purpose

Takes two input parameters, the name of an enabled XML collection and the XML document that are to be decomposed, and returns two output parameters, a return code and a return message.

Format

```
dxxInsertXML(char() collectionName,   /* input */
             CLOB(1M)       xmlobj,           /* input */
             long           returnCode,       /* output */
             varchar(1024)  returnMsg)        /* output */
```

Parameters

Table 55. dxxInsertXML() parameters

Parameter	Description	IN/OUT parameter
collectionName	The name of an enabled XML collection.	IN
xmlobj	An XML document object in CLOB type.	IN
returnCode	The return code from the stored procedure.	OUT
returnMsg	The message text that is returned in case of error.	OUT

Examples

In the following fragment example, the dxxInsertXML() call decomposes the input XML document *dxxinstall*/xml/order1.xml and inserts data into the SALES_ORDER collection tables according to the mapping that is specified in the DAD file with which it was enabled with. A complete, working sample is located in DXXSAMPLES/QCSRC(INSX).

```
#include "dxx.h"
#include "dxxrc.h"

EXEC SQL INCLUDE SQLCA;
EXEC SQL BEGIN DECLARE SECTION;
char    collectionName[32];   /* name of an XML collection */
SQL TYPE is CLOB(100K) xmlDoc; /* input xml document */
long    returnCode;            /* return error code */
char    returnMsg[1024];       /* error message text */
short   collectionName_ind;
short   xmlDoc_ind;
short   returnCode_ind;
short   returnMsg_ind;
EXEC SQL END DECLARE SECTION;

FILE   *file_handle;
long    file_length=0;

/* initialize the DAD CLOB object. */
file_handle = fopen( "/dxx/dad/getstart_xcollection.dad", "r" );
if ( file_handle != NULL ) {
  file_length = fread ((void *) , &dad.data;
1, FILE_SIZE, file_handle);
  if (file_length == 0) {
    printf ("Error reading dad file getstart_xcollection.dad\n");
    rc = -1;
    goto exit;
 } else
    dad.length = file_length;
}
else {
  printf("Error opening dad file  \n");
  rc = -1;
  goto exit;
}

/* initialize host variable and indicators */
strcpy(collectionName, "sales_ord");
returnCode = 0;
msg_txt[0] = '\0';
collectionName_ind = 0;
xmlDoc_ind = 0;
```

```
returnCode_ind = -1;
returnMsg_ind = -1;

/* Call the store procedure */
EXEC SQL CALL "DB2XML.DXXINSERTXML" (:collection_name:collection_name_ind,
                                     :xmlDoc:xmlDoc_ind,
                                     :returnCode:returnCode_ind,
                                     :returnMsg:returnMsg_ind);

if (SQLCODE < 0) {
    EXEC SQL ROLLBACK;
  else
    EXEC SQL COMMIT;
}

exit:
  return rc;
```

Chapter 14. Administration support tables

When a database is enabled, a DTD reference table, DTD_REF, and an XML_USAGE table are created. The DTD_REF table contains information about all of the DTDs. The XML_USAGE table stores common information for each XML-enabled column. Each is created with specific PUBLIC privileges.

The parameter limits listed in the support tables are also documented in "Appendix D. The XML Extender limits" on page 247.

DTD reference table

The XML Extender also serves as an XML DTD repository. When a database is XML-enabled, a DTD reference table, DTD_REF, is created. Each row of this table represents a DTD with additional metadata information. Users can access this table, and insert their own DTDs. The DTDs in the DTD_REF table are used to validate XML documents and to help applications to define a DAD file. It has the schema name of DB2XML. A DTD_REF table can have the columns shown in Table 56.

Table 56. DTD_REF table

Column name	Data type	Description
DTDID	VARCHAR(128)	The primary key (unique and not NULL). It is used to identify the DTD. When it is specified in the DAD file, the DAD file must follow the schema that is defined by the DTD.
CONTENT	XMLCLOB	The content of the DTD.
ROW_ID	ROWID	An identifier of the row.
USAGE_COUNT	INTEGER	The number of XML columns and XML collections in the database that use the DTD to define their DAD files.
AUTHOR	VARCHAR(128)	The author of the DTD, optional 'information for the user to input.
CREATOR	VARCHAR(128)	The user ID that does the first insertion. The CREATOR column is optional.
UPDATOR	VARCHAR(128)	The user ID that does the last update. The UPDATOR column is optional.

Restriction: The DTD can be modified by the application only when the USAGE_COUNT is zero.

Privileges granted to PUBLIC

Privileges of INSERT, UPDATE, DELETE, and SELECT are granted for PUBLIC.

XML usage table

Stores common information for each XML-enabled column. The XML_USAGE table's schema name is DB2XML, and its primary key is (*table_name*, *col_name*). Only read privileges of this table are granted to PUBLIC. An XML_USAGE table is created at the time the database in enabled with the columns listed in Table 57.

Table 57. XML_USAGE table

Column name	Description
table_schema	For XML column, the schema name of the user table that contains an XML column. For XML collection, a value of "DXX_COLL" as the default schema name.
table_name	For XML column, the name of the user table that contains an XML column. For XML collection, a value "DXX_COLLECTION," which identifies the entity as a collection.
col_name	The name of the XML column or XML collection. It is part of the composite key along with the table_name.
DTDID	A string associating a DTD inserted into DTD_REF with a DTD specifid in a DAD file; this value must match the value of the DTDID element in the DAD. This column is a foreign key.
DAD	The content of the DAD file that is associated with the column or collection.
row_id	An identifier of the row.
access_mode	Specifies which access mode is used: 1 for XML collection, 0 for XML column
default_view	Stores the default view name if there is one.
trigger_suffix	Not NULL. For unique trigger names.
validation	1 for yes, 0 for no.

Do not add, modify or delete entries from the XML_USAGE table; it is for XML Extender internal use only.

Privileges granted to PUBLIC

For XML_USAGE, the privilege of SELECT is granted for PUBLIC. INSERT, DELETE, and UPDATE are granted to DB2XML.

Chapter 15. Troubleshooting

All embedded SQL statements in your program and DB2 command line interface (CLI) calls in your program, including those that invoke the DB2 XML Extender user-defined functions (UDFs), generate codes that indicate whether the embedded SQL statement or DB2 CLI call executed successfully.

Your program can retrieve information that supplements these codes. This includes SQLSTATE information and error messages. You can use this diagnostic information to isolate and fix problems in your program.

Occasionally the source of a problem cannot be easily diagnosed. In these cases, you might need to provide information to your Software Support Provider to isolate and fix the problem. The XML Extender includes a trace facility that records the XML Extender activity. The trace information can be valuable input to Software Service Provider. You should use the trace facility only under instruction from Software Service Provider.

This chapter describes how to access this diagnostic information. It describes:

- How to handle XML Extender UDF return codes.
- How to control tracing

It also lists and describes the SQLSTATE codes and error messages that the XML Extender might return.

Handling UDF return codes

Embedded SQL statements return codes in the SQLCODE, SQLWARN, and SQLSTATE fields of the SQLCA structure. This structure is defined in an SQLCA INCLUDE file. (For more information about the SQLCA structure and SQLCA INCLUDE file, see the *DB2 Application Development Guide*.)

DB2 CLI calls return SQLCODE and SQLSTATE values that you can retrieve using the SQLError function. (For more information about retrieving error information with the SQLError function, see the *CLI Guide and Reference*.)

An SQLCODE value of 0 means that the statement ran successfully (with possible warning conditions). A positive SQLCODE value means that the statement ran successfully but with a warning. (Embedded SQL statements return information about the warning that is associated with 0 or positive SQLCODE values in the SQLWARN field.) A negative SQLCODE value means that an error occurred.

DB2 associates a message with each SQLCODE value. If an XML Extender UDF encounters a warning or error condition, it passes associated information to DB2 for inclusion in the SQLCODE message.

Embedded SQL statements and DB2 CLI calls that invoke the DB2 XML Extender UDFs might return SQLCODE messages and SQLSTATE values that are unique to these UDFs, but DB2 returns these values in the same way as it does for other embedded SQL statements or other DB2 CLI calls. Thus, the way you access these values is the same as for embedded SQL statements or DB2 CLI calls that do not start the DB2 XML Extender UDFs.

See “SQLSTATE codes” on page 203 for the SQLSTATE values and the message number of associated messages that can be returned by the XML Extender. See “Messages” on page 207 for information about each message.

Handling stored procedure return codes

The XML Extender provides return codes to help resolve problems with stored procedures. When you receive a return code from a stored procedure, check the following file, which matches the return code with an XML Extender error message number and the symbolic constant.

```
DXX_INSTALL/include/dxxrc.h
```

You can reference the error message number in “Messages” on page 207 and use the diagnostic information in the explanation.

SQLSTATE codes

Table 58 lists and describes the SQLSTATE values that the XML Extender returns. The description of each SQLSTATE value includes its symbolic representation. The table also lists the message number that is associated with each SQLSTATE value. See "Messages" on page 207 for information about each message.

Table 58. SQLSTATE codes and associated message numbers

SQLSTATE	Message No.	Description
00000	DXX*nnnn*I	No error has occurred.
01HX0	DXXD003W	The element or attribute specified in the path expression is missing from the XML document.
38X00	DXXC000E	The XML Extender is unable to open the specified file.
38X01	DXXA072E	XML Extender tried to automatically bind the database before enabling it, but could not find the bind files
	DXXC001E	The XML Extender could not find the file specified.
38X02	DXXC002E	The XML Extender is unable to read data from the specified file.
38X03	DXXC003E	The XML Extender is unable to write data to the file.
	DXXC011E	The XML Extender is unable to write data to the trace control file.
38X04	DXXC004E	The XML Extender was unable to operate the specified locator.
38X05	DXXC005E	The file size is greater than the XMLVarchar size and the XML Extender is unable to import all the data from the file.
38X06	DXXC006E	The file size is greater than the size of the XMLCLOB and the XML Extender is unable to import all the data from the file.
38X07	DXXC007E	The number of bytes in the LOB Locator does not equal the file size.
38X08	DXXD001E	A scalar extraction function used a location path that occurs multiple times. A scalar function can only use a location path that does not have multiple occurence.
38X09	DXXD002E	The path expression is syntactically incorrect.
38X10	DXXG002E	The XML Extender was unable to allocate memory from the operating system.
38X11	DXXA009E	This stored procedure is for XML Column only.

Table 58. SQLSTATE codes and associated message numbers (continued)

SQLSTATE	Message No.	Description
38X12	DXXA010E	While attempting to enable the column, the XML Extender could not find the DTD ID, which is the identifier specified for the DTD in the document access definition (DAD) file.
38X14	DXXD000E	There was an attempt to store an invalid document into a table. Validation has failed.
38X15	DXXA056E	The validation element in document access definition (DAD) file is wrong or missing.
	DXXA057E	The name attribute of a side table in the document access definition (DAD) file is wrong or missing.
	DXXA058E	The name attribute of a column in the document access definition (DAD) file is wrong or missing.
	DXXA059E	The type attribute of a column in the document access definition (DAD) file is wrong or missing.
	DXXA060E	The path attribute of a column in the document access definition (DAD) file is wrong or missing.
	DXXA061E	The multi_occurrence attribute of a column in the document access definition (DAD) file is wrong or missing.
	DXXQ000E	A mandatory element is missing from the document access definition (DAD) file.
38X16	DXXG004E	A null value for a required parameter was passed to an XML stored procedure.
38X17	DXXQ001E	The SQL statment in the document access definition (DAD) or the one that overrides it is not valid. A SELECT statement is required for generating XML documents.
38X18	DXXG001E	XML Extender encountered an internal error.
	DXXG006E	XML Extender encountered an internal error while using CLI.
38X19	DXXQ002E	The system is running out of space in memory or disk. There is no space to contain the resulting XML documents.

Table 58. SQLSTATE codes and associated message numbers (continued)

SQLSTATE	Message No.	Description
38X20	DXXQ003W	The user-defined SQL query generates more XML documents than the specified maximum. Only the specified number of documents are returned.
38X21	DXXQ004E	The specified column is not one of the columns in the result of the SQL query.
38X22	DXXQ005E	The mapping of the SQL query to XML is incorrect.
38X23	DXXQ006E	An attribute_node element in the document access definition(DAD) file does not have a name attribute.
38X24	DXXQ007E	The attribute_node element in the document access definition (DAD) does not have a column element or RDB_node.
38X25	DXXQ008E	A text_node element in the document access definition (DAD) file does not have a column element.
38X26	DXXQ009E	The specified result table could not be found in the system catalog.
38X27	DXXQ010E	The RDB_node of the attribute_node or text_node must have a table.
	DXXQ011E	The RDB_node of the attribute_node or text_node must have a column.
	DXXQ017E	An XML document generated by the XML Extender is too large to fit into the column of the result table.
38X28	DXXQ012E	XML Extender could not find the expected element while processing the DAD.
	DXXQ016E	All tables must be defined in the RDB_node of the top element in the document access definition (DAD) file. Sub-element tables must match the tables defined in the top element. The table name in this RDB_node is not in the top element.
38X29	DXXQ013E	The element table or column must have a name in the document access definition (DAD) file.
	DXXQ015E	The condition in the condition element in the document access definition (DAD) has an invalid format.

Table 58. SQLSTATE codes and associated message numbers (continued)

SQLSTATE	Message No.	Description
38X30	DXXQ014E	An element_node element in the document access definition (DAD) file does not have a name attribute.
	DXXQ018E	The ORDER BY clause is missing from the SQL statement in a document access definition (DAD) file that maps SQL to XML.
38X31	DXXQ019E	The objids element does not have a column element in the document access definition (DAD) file that maps SQL to XML.
38X36	DXXA073E	The database was not bound when user tried to enable it.
38X37	DXXG007E	The server operating system locale is inconsistent with DB2 code page.
38X38	DXXG008E	The server operating system locale can not be found in the code page table.
38x33	DXXG005E	This parameter is not supported in this release, will be supported in the future release.
38x34	DXXG000E	An invalid file name was specified.

Messages

The XML Extender provides error messages to help with problem determination.

Error messages

The XML Extender generates the following messages when it completes an operation or detects an error.

DXXA000I Enabling column <*column_name*>**. Please Wait.**

Explanation: This is an informational messages.

User Response: No action required.

DXXA001S An unexpected error occurred in build <*build_ID*>**, file** <*file_name*>**, and line** <*line_number*>**.**

Explanation: An unexpected error occurred.

User Response: If this error persists, contact your Software Service Provider. When reporting the error, be sure to include all the message text, the trace file, and an explanation of how to reproduce the problem.

DXXA002I Connecting to database <*database*>**.**

Explanation: This is an informational message.

User Response: No action required.

DXXA003E Cannot connect to database <*database*>**.**

Explanation: The database specified might not exist or could be corrupted.

User Response:

1. Ensure the database is specified correctly.
2. Ensure the database exists and is accessible.
3. Determine if the database is corrupted. If it is, ask your database adminstrator to recover it from a backup.

DXXA004E Cannot enable database <*database*>**.**

Explanation: The database might already be enabled or might be corrupted.

User Response:

1. Determine if the database is enabled.
2. Determine if the database is corrupted. If it is, ask your database adminstrator to recover it from a backup.

DXXA005I Enabling database <*database*>**. Please wait.**

Explanation: This is an informational message.

User Response: No action required.

DXXA006I The database <*database*> **was enabled successfully.**

Explanation: This is an informational message.

User Response: No action required.

DXXA007E Cannot disable database <*database*>**.**

Explanation: The database cannot be disabled by XML Extender if it contains any XML columns or collections.

User Response: Backup any important data, disable any XML columns or collections, and update or drop any tables until there are no XML data types left in the database.

DXXA008I Disabling column <*column_name*>**. Please Wait.**

Explanation: This is an information message.

User Response: No action required.

DXXA009E Xcolumn tag is not specified in the DAD file.

Explanation: This stored procedure is for XML Column only.

User Response: Ensure the Xcolumn tag is specified correctly in the DAD file.

DXXA010E Attempt to find DTD ID <*dtdid*> **failed.**

Explanation: While attempting to enable the column, the XML Extender could not find the DTD ID, which is the identifier specified for the DTD in the document access definition (DAD) file.

User Response: Ensure the correct value for the DTD ID is specified in the DAD file.

DXXA011E Inserting a record into DB2XML.XML_USAGE table failed.

Explanation: While attempting to enable the column, the XML Extender could not insert a record into the DB2XML.XML_USAGE table.

User Response: Ensure the DB2XML.XML_USAGE table exists and that a record by the same name does not already exist in the table.

DXXA012E Attempt to update DB2XML.DTD_REF table failed.

Explanation: While attempting to enable the column, the XML Extender could not update the DB2XML.DTD_REF table.

User Response: Ensure the DB2XML.DTD_REF table exists. Determine whether the table is corrupted or if the administration user ID has the correct authority to update the table.

DXXA013E Attempt to alter table <*table_name*> **failed.**

Explanation: While attempting to enable the column, the XML Extender could not alter the specified table.

User Response: Check the privileges required to alter the table.

DXXA014E The specified root ID column: <*root_id*> **is not a single primary key of table** <*table_name*>**.**

Explanation: The root ID specified is either not a key, or it is not a single key of table *table_name*.

User Response: Ensure the specified root ID is the single primary key of the table.

DXXA015E The column DXXROOT_ID already exists in table <*table_name*>**.**

Explanation: The column DXXROOT_ID exists, but was not created by XML Extender.

User Response: Specify a primary column for the root ID option when enabling a column, using a different different column name.

DXXA016E The input table <*table_name*> does not exist.

Explanation: The XML Extender was unable to find the specified table in the system catalog.

User Response: Ensure that the table exists in the database, and is specified correctly.

DXXA017E The input column <*column_name*> does not exist in the specified table <*table_name*>.

Explanation: The XML Extender was unable to find the column in the system catalog.

User Response: Ensure the column exists in a user table.

DXXA018E The specified column is not enabled for XML data.

Explanation: While attempting to disable the column, XML Extender could not find the column in the DB2XML.XML_USAGE table, indicating that the column is not enabled. If the column is not XML-enabled, you do not need to disable it.

User Response: No action required.

DXXA019E A input parameter required to enable the column is null.

Explanation: A required input parameter for the enable_column() stored procedure is null.

User Response: Check all the input parameters for the enable_column() stored procedure.

DXXA020E Columns cannot be found in the table <*table_name*>.

Explanation: While attempting to create the default view, the XML Extender could not find columns in the specified table.

User Response: Ensure the column and table name are specified correctly.

DXXA021E Cannot create the default view <*default_view*>.

Explanation: While attempting to enable a column, the XML Extender could not create the specified view.

User Response: Ensure that the default view name is unique. If a view with the name already exists, specify a unique name for the default view.

DXXA022I Column <*column_name*> enabled.

Explanation: This is an informational message.

User Response: No response required.

DXXA023E Cannot find the DAD file.

Explanation: While attempting to disable a column, the XML Extender was unable to find the document access definition (DAD) file.

User Response: Ensure you specified the correct database name, table name, or column name.

DXXA024E The XML Extender encountered an internal error while accessing the system catalog tables.

Explanation: The XML Extender was unable to access system catalog table.

User Response: Ensure the database is in a stable state.

DXXA025E Cannot drop the default view <*default_view*>**.**

Explanation: While attempting to disable a column, the XML Extender could not drop the default view.

User Response: Ensure the administration user ID for XML Extender has the privileges necessary to drop the default view.

DXXA026E Unable to drop the side table <*side_table*>**.**

Explanation: While attempting to disable a column, the XML Extender was unable to drop the specified table.

User Response: Ensure that the administrator user ID for XML Extender has the privileges necessary to drop the table.

DXXA027E Could not disable the column.

Explanation: XML Extender could not disable a column because an internal trigger failed. Possible causes:

- The system is out of memory.
- A trigger with this name does not exist.

User Response: Use the trace facility to create a trace file and try to correct the problem. If the problem persists, contact your Software Service Provider and provide the trace file.

DXXA028E Could not disable the column.

Explanation: XML Extender could not disable a column because an internal trigger failed. Possible causes:

- The system is out of memory.
- A trigger with this name does not exist.

User Response: Use the trace facility to create a trace file and try to correct the problem. If the problem persists, contact your Software Service Provider and provide the trace file.

DXXA029E Could not disable the column.

Explanation: XML Extender could not disable a column because an internal trigger failed. Possible causes:

- The system is out of memory.
- A trigger with this name does not exist.

User Response: Use the trace facility to create a trace file and try to correct the problem. If the problem persists, contact your Software Service Provider and provide the trace file.

DXXA030E Could not disable the column.

Explanation: XML Extender could not disable a column because an internal trigger failed. Possible causes:

- The system is out of memory.
- A trigger with this name does not exist.

User Response: Use the trace facility to create a trace file and try to correct the problem. If the problem persists, contact your Software Service Provider and provide the trace file.

DXXA031E Unable to reset the DXXROOT_ID column value in the application table to NULL.

Explanation: While attempting to disable a column, the XML Extender was unable to set the value of DXXROOT_ID in the application table to NULL.

User Response: Ensure that the administrator user ID for XML Extender has the privileges necessary to alter the application table.

DXXA032E Decrement of USAGE_COUNT in DB2XML.XML_USAGE table failed.

Explanation: While attempting to disable the column, the XML Extender was unable to reduce the value of the USAGE_COUNT column by one.

User Response: Ensure that the DB2XML.XML_USAGE table exists and that the administrator user ID for XML Extender has the necessary privileges to update the table.

DXXA033E Attempt to delete a row from the DB2XML.XML_USAGE table failed.

Explanation: While attempting to disable a column, the XML Extender was unable to delete its associate row in the DB2XML.XML_USAGE table.

User Response: Ensure that the DB2XML.XML_USAGE table exists and that the administration user ID for XML Extender has the privileges necessary to update this table.

DXXA034I XML Extender has successfully disabled column <*column_name*>**.**

Explanation: This is an informational message

User Response: No action required.

DXXA035I XML Extender is disabling database <*database*>**. Please wait.**

Explanation: This is an informational message.

User Response: No action is required.

DXXA036I XML Extender has successfully disabled database <*database*>**.**

Explanation: This is an informational message.

User Response: No action is required.

DXXA037E The specified table space name is longer than 18 characters.

Explanation: The table space name cannot be longer than 18 alphanumeric characters.

User Response: Specify a name less than 18 characters.

DXXA038E The specified default view name is longer than 18 characters.

Explanation: The default view name cannot be longer than 18 alphanumeric characters.

User Response: Specify a name less than 18 characters.

DXXA039E The specified ROOT_ID name is longer than 18 characters.

Explanation: The ROOT_ID name cannot be longer than 18 alphanumeric characters.

User Response: Specify a name less than 18 characters.

DXXA046E Unable to create the side table <*side_table*>**.**

Explanation: While attempting to enable a column, the XML Extender was unable to create the specified side table.

User Response: Ensure that the administrator user ID for XML Extender has the privileges necessary to create the side table.

DXXA047E Could not enable the column.

Explanation: XML Extender could not enable a column because an internal trigger failed. Possible causes:

- The DAD file has incorrect syntax.
- The system is out of memory.
- Another trigger exists with the same name.

User Response: Use the trace facility to create a trace file and try to correct the problem. If the problem persists, contact your Software Service Provider and provide the trace file.

DXXA048E Could not enable the column.

Explanation: XML Extender could not enable a column because an internal trigger failed. Possible causes:

- The DAD file has incorrect syntax.
- The system is out of memory.
- Another trigger exists with the same name.

User Response: Use the trace facility to create a trace file and try to correct the problem. If the problem persists, contact your Software Service Provider and provide the trace file.

DXXA049E Could not enable the column.

Explanation: XML Extender could not enable a column because an internal trigger failed. Possible causes:

- The DAD file has incorrect syntax.
- The system is out of memory.
- Another trigger exists with the same name.

User Response: Use the trace facility to create a trace file and try to correct the problem. If the problem persists, contact your Software Service Provider and provide the trace file.

DXXA050E Could not enable the column.

Explanation: XML Extender could not enable a column because an internal trigger failed. Possible causes:

- The DAD file has incorrect syntax.
- The system is out of memory.
- Another trigger exists with the same name.

User Response: Use the trace facility to create a trace file and try to correct the problem. If the problem persists, contact your Software Service Provider and provide the trace file.

DXXA051E Could not disable the column.

Explanation: XML Extender could not disable a column because an internal trigger failed. Possible causes:

- The system is out of memory.
- A trigger with this name does not exist.

User Response: Use the trace facility to create a trace file and try to correct the problem. If the problem persists, contact your Software Service Provider and provide the trace file.

DXXA052E Could not disable the column.

Explanation: XML Extender could not disable a column because an internal trigger failed. Possible causes:

- The DAD file has incorrect syntax.
- The system is out of memory.
- Another trigger exists with the same name.

User Response: Use the trace facility to create a trace file and try to correct the problem. If the problem persists, contact your Software Service Provider and provide the trace file.

DXXA053E Could not enable the column.

Explanation: XML Extender could not enable a column because an internal trigger failed. Possible causes:

- The DAD file has incorrect syntax.
- The system is out of memory.
- Another trigger exists with the same name.

User Response: Use the trace facility to create a trace file and try to correct the problem. If the problem persists, contact your Software Service Provider and provide the trace file.

DXXA054E Could not enable the column.

Explanation: XML Extender could not enable a column because an internal trigger failed. Possible causes:

- The DAD file has incorrect syntax.
- The system is out of memory.
- Another trigger exists with the same name.

User Response: Use the trace facility to create a trace file and try to correct the problem. If the problem persists, contact your Software Service Provider and provide the trace file.

DXXA056E The validation value <*validation_value*> **in the DAD file is invalid.**

Explanation: The validation element in document access definition (DAD) file is wrong or missing.

User Response: Ensure that the validation element is specified correctly in the DAD file.

DXXA057E A side table name <*side_table_name*> **in DAD is invalid.**

Explanation: The name attribute of a side table in the document access definition (DAD) file is wrong or missing.

User Response: Ensure that the name attribute of a side table is specified correctly in the DAD file.

DXXA058E A column name <*column_name*> **in the DAD file is invalid.**

Explanation: The name attribute of a column in the document access definition (DAD) file is wrong or missing.

User Response: Ensure that the name attribute of a column is specified correctly in the DAD file.

DXXA059E The type <*column_type*> **of column** <*column_name*> **in the DAD file is invalid.**

Explanation: The type attribute of a column in the document access definition (DAD) file is wrong or missing.

User Response: Ensure that the type attribute of a column is specified correctly in the DAD file.

DXXA060E The path attribute <*location_path*> **of** <*column_name*> **in the DAD file is invalid.**

Explanation: The path attribute of a column in the document access definition (DAD) file is wrong or missing.

User Response: Ensure that the path attribute of a column is specified correctly in the DAD file.

DXXA061E The multi_occurrence attribute <*multi_occurrence*> **of** <*column_name*> **in the DAD file is invalid.**

Explanation: The multi_occurrence attribute of a column in the document access definition (DAD) file is wrong or missing.

User Response: Ensure that the multi_occurrence attribute of a column is specified correctly in the DAD file.

DXXA062E Unable to retrieve the column number for <*column_name*> **in table** <*table_name*>**.**

Explanation: XML Extender could not retrieve the column number for *column_name* in table *table_name* from the system catalog.

User Response: Make sure the application table is well defined.

DXXA063I Enabling collection <*collection_name*>**. Please Wait.**

Explanation: This is an information message.

User Response: No action required.

DXXA064I Disabling collection <*collection_name*>**. Please Wait.**

Explanation: This is an information message.

User Response: No action required.

DXXA065E Calling stored procedure <*procedure_name*> **failed.**

Explanation: Check the shared library db2xml and see if the permission is correct.

User Response: Make sure the client has permission to run the stored procedure.

DXXA066I XML Extender has successfully disabled collection <*collection_name*>**.**

Explanation: This is an informational message.

User Response: No response required.

DXXA067I XML Extender has successfully enabled collection <*collection_name*>**.**

Explanation: This is an informational message.

User Response: No response required.

DXXA068I XML Extender has successfully turned the trace on.

Explanation: This is an informational message.

User Response: No response required.

DXXA069I XML Extender has successfully turned the trace off.

Explanation: This is an informational message.

User Response: No response required.

DXXA070W The database has already been enabled.

Explanation: The enable database command was executed on the enabled database

User Response: No action is required.

DXXA071W The database has already been disabled.

Explanation: The disable database command was executed on the disabled database

User Response: No action is required.

DXXA072E XML Extender couldn't find the bind files. Bind the database before enabling it.

Explanation: XML Extender tried to automatically bind the database before enabling it, but could not find the bind files

User Response: Bind the database before enabling it.

DXXA073E The database is not bound. Please bind the database before enabling it.

Explanation: The database was not bound when user tried to enable it.

User Response: Bind the database before enabling it.

DXXA074E Wrong parameter type. The stored procedure expects a STRING parameter.

Explanation: The stored procedure expects a STRING parameter.

User Response: Declare the input parameter to be STRING type.

DXXA075E Wrong parameter type. The input parameter should be a LONG type.

Explanation: The stored procedure expects the input parameter to be a LONG type.

User Response: Declare the input parameter to be a LONG type.

DXXA076E XML Extender trace instance ID invalid.

Explanation: Cannot start trace with the instance ID provided.

User Response: Ensure that the instance ID is a valid AS/400 user ID.

DXXC000E Unable to open the specified file.

Explanation: The XML Extender is unable to open the specified file.

User Response: Ensure that the application user ID has read and write permission for the file.

DXXC001E The specified file is not found.

Explanation: The XML Extender could not find the file specified.

User Response: Ensure that the file exists and the path is specified correctly.

DXXC002E Unable to read file.

Explanation: The XML Extender is unable to read data from the specified file.

User Response: Ensure that the application user ID has read permission for the file.

DXXC003E Unable to write to the specified file.

Explanation: The XML Extender is unable to write data to the file.

User Response: Ensure that the application user ID has write permission for the file or that the file system has sufficient space.

DXXC004E Unable to operate the LOB Locator: rc=<*locator_rc*>.

Explanation: The XML Extender was unable to operate the specified locator.

User Response: Ensure the LOB Locator is set correctly.

DXXC005E Input file size is greater than XMLVarchar size.

Explanation: The file size is greater than the XMLVarchar size and the XML Extender is unable to import all the data from the file.

User Response: Use the XMLCLOB column type.

DXXC006E The input file exceeds the DB2 LOB limit.

Explanation: The file size is greater than the size of the XMLCLOB and the XML Extender is unable to import all the data from the file.

User Response: Decompose the file into smaller objects or use an XML collection.

DXXC007E Unable to retrieve data from the file to the LOB Locator.

Explanation: The number of bytes in the LOB Locator does not equal the file size.

User Response: Ensure the LOB Locator is set correctly.

DXXC008E Can not remove the file <*file_name*>**.**

Explanation: The file has a sharing access violation or is still open.

User Response: Close the file or stop any processes that are holding the file. You might have to stop and restart DB2.

DXXC009E Unable to create file to <*directory*> **directory.**

Explanation: The XML Extender is unable to create a file in directory *directory*.

User Response: Ensure that the directory exists, that the application user ID has write permission for the directory, and that the file system has sufficient space for the file.

DXXC010E Error while writing to file <*file_name*>**.**

Explanation: There was an error while writing to the file *file_name*.

User Response: Ensure that the file system has sufficient space for the file.

DXXC011E Unable to write to the trace control file.

Explanation: The XML Extender is unable to write data to the trace control file.

User Response: Ensure that the application user ID has write permission for the file or that the file system has sufficient space.

DXXC012E Cannot create temporary file.

Explanation: Cannot create file in system temp directory.

User Response: Ensure that the application user ID has write permission for the file system temp directory or that the file system has sufficient space for the file.

DXXD000E An invalid XML document is rejected.

Explanation: There was an attempt to store an invalid document into a table. Validation has failed.

User Response: Check the document with its DTD using an editor that can view invisible invalid characters. To suppress this error, turn off validation in the DAD file.

DXXD001E *<location_path>* **occurs multiple times.**

Explanation: A scalar extraction function used a location path that occurs multiple times. A scalar function can only use a location path that does not have multiple occurence.

User Response: Use a table function (add an 's' to the end of the scalar function name).

DXXD002E A syntax error occurred near position *<position>* **in the search path.**

Explanation: The path expression is syntactically incorrect.

User Response: Correct the search path argument of the query. Refer to the documentation for the syntax of path expressions.

DXXD003W Path not found. Null is returned.

Explanation: The element or attribute specified in the path expression is missing from the XML document.

User Response: Verify that the specified path is correct.

DXXG000E The file name *<file_name>* **is invalid.**

Explanation: An invalid file name was specified.

User Response: Specify a correct file name and try again.

DXXG001E An internal error occured in build *<build_ID>***, file** *<file_name>***, and line** *<line_number>***.**

Explanation: XML Extender encountered an internal error.

User Response: Contact your Software Service Provider. When reporting the error, be sure to include all the messages, the trace file and how to reproduce the error.

DXXG002E The system is out of memory.

Explanation: The XML Extender was unable to allocate memory from the operating system.

User Response: Close some applications and try again. If the problem persists, refer to your operating system documentation for assistance. Some operating systems might require that you reboot the system to correct the problem.

DXXG004E Invalid null parameter.

Explanation: A null value for a required parameter was passed to an XML stored procedure.

User Response: Check all required parameters in the argument list for the stored procedure call.

DXXG005E Parameter not supported.

Explanation: This parameter is not supported in this release, will be supported in the future release.

User Response: Set this parameter to NULL.

DXXG006E Internal Error CLISTATE=*<clistate>***, RC=***<cli_rc>***, build** *<build_ID>***, file** *<file_name>***, line** *<line_number>* **CLIMSG=***<CLI_msg>***.**

Explanation: XML Extender encountered an internal error while using CLI.

User Response: Contact your Software Service Provider. Potentially this error can be caused by incorrect user input. When reporting the error, be sure to include all output messages, trace log, and how to reproduce the problem. Where possible, send any DADs, XML documents, and table definitions which apply.

DXXG007E Locale <*locale*> is inconsistent with DB2 code page <*code_page*>.

Explanation: The server operating system locale is inconsistent with DB2 code page.

User Response: Correct the server operating system locale and restart DB2.

DXXG008E Locale <*locale*> is not supported.

Explanation: The server operating system locale can not be found in the code page table.

User Response: Correct the server operating system locale and restart DB2.

DXXG009E Placeholder

Explanation:

User Response:

DXXG010E Placeholder

Explanation:

User Response:

DXXG011E Placeholder

Explanation:

User Response:

DXXG012E Placeholder

Explanation:

User Response:

DXXG013E Placeholder

Explanation:

User Response:

DXXG014E Placeholder

Explanation:

User Response:

DXXG015E Placeholder

Explanation:

User Response:

DXXG016E Placeholder

Explanation:

User Response:

DXXG017E The limit for <*XML_Extender_constant*> **has been exceeded in build** <*build_ID*>**, file** <*file_name*>**, and line** <*line_number*>**.**

Explanation: The limit for the XML Extender constant named was exceeded in the code location specified by the build, file, and line number.

User Response: Check if your application has exceeded a value in the limits table in the XML Extender Administration and Programming Guide. If no limit has been exceeded, contact your Software Service Provider. When reporting the error, include all output messages, trace files, and information on how to reproduce the problem such as input DADs, XML documents, and table definitions.

DXXM001W A DB2 error occurred.

Explanation: DB2 encountered the specified error.

User Response: See any accompanying messages for futher explanation and refer to DB2 messages and codes documentation for your operating system.

DXXQ000E <*Element*> **is missing from the DAD file.**

Explanation: A mandatory element is missing from the document access definition (DAD) file.

User Response: Add the missing element to the DAD file.

DXXQ001E Invalid SQL statement for XML generation.

Explanation: The SQL statement in the document access definition (DAD) or the one that overrides it is not valid. A SELECT statement is required for generating XML documents.

User Response: Correct the SQL statement.

DXXQ002E Cannot generate storage space to hold XML documents.

Explanation: The system is running out of space in memory or disk. There is no space to contain the resulting XML documents.

User Response: Limit the number of documents to be generated. Reduce the size of each documents by removing some unnecessary element and attribute nodes from the document access definition (DAD) file.

DXXQ003W Result exceeds maximum.

Explanation: The user-defined SQL query generates more XML documents than the specified maximum. Only the specified number of documents are returned.

User Response: No action is required. If all documents are needed, specify zero as the maximum number of documents.

DXXQ004E The column <*column_name*> **is not in the result of the query.**

Explanation: The specified column is not one of the columns in the result of the SQL query.

User Response: Change the specified column name in the document access definition (DAD) file to make it one of the columns in the result of the SQL query. Alternatively, change the SQL query so that it has the specified column in its result.

DXXQ004W The DTD ID was not found in the DAD.

Explanation: In the DAD, VALIDATION is YES but the DTDID element is not specified. NO validation check is performed.

User Response: No action is required. If validation is needed, specify the DTDID element in the DAD file.

DXXQ005E Wrong relational mapping. The element <*element_name*> is at a lower level than its child column <*column_name*>.

Explanation: The mapping of the SQL query to XML is incorrect.

User Response: Make sure that the columns in the result of the SQL query are in a top-down order of the relational hierarchy. Also make sure that there is a single-column candidate key to begin each level. If such a key is not available in a table, the query should generate one for that table using a table expression and the DB2 built-in function generate_unique().

DXXQ006E An attribute_node element has no name.

Explanation: An attribute_node element in the document access definition(DAD) file does not have a name attribute.

User Response: Ensure that every attribute_node has a name in the DAD file.

DXXQ007E The attribute_node <*attribute_name*> has no column element or RDB_node.

Explanation: The attribute_node element in the document access definition (DAD) does not have a column element or RDB_node.

User Response: Ensure that every attribute_node has a column element or RDB_node in the DAD.

DXXQ008E A text_node element has no column element.

Explanation: A text_node element in the document access definition (DAD) file does not have a column element.

User Response: Ensure that every text_node has a column element in the DAD.

DXXQ009E Result table <*table_name*> does not exist.

Explanation: The specified result table could not be found in the system catalog.

User Response: Create the result table before calling the stored procedure.

DXXQ010E RDB_node of <*node_name*> does not have a table in the DAD file.

Explanation: The RDB_node of the attribute_node or text_node must have a table.

User Response: Specify the table of RDB_node for attribute_node or text_node in the document access definition (DAD) file.

DXXQ011E RDB_node element of <*node_name*> does not have a column in the DAD file.

Explanation: The RDB_node of the attribute_node or text_node must have a column.

User Response: Specify the column of RDB_node for attribute_node or text_node in the document access definition (DAD) file.

DXXQ012E Errors occurred in DAD.

Explanation: XML Extender could not find the expected element while processing the DAD.

User Response: Check that the DAD is a valid XML document and contains all the elements required by the DAD DTD. Consult the XML Extender publication for the DAD DTD.

DXXQ013E The table or column element does not have a name in the DAD file.

Explanation: The element table or column must have a name in the document access definition (DAD) file.

User Response: Specify the name of table or column element in the DAD.

DXXQ014E An element_node element has no name.

Explanation: An element_node element in the document access definition (DAD) file does not have a name attribute.

User Response: Ensure that every element_node element has a name in the DAD file.

DXXQ015E The condition format is invalid.

Explanation: The condition in the condition element in the document access definition (DAD) has an invalid format.

User Response: Ensure that the format of the condition is valid.

DXXQ016E The table name in this RDB_node is not defined in the top element of the DAD file.

Explanation: All tables must be defined in the RDB_node of the top element in the document access definition (DAD) file. Sub-element tables must match the tables defined in the top element. The table name in this RDB_node is not in the top element.

User Response: Ensure that the table of the RDB node is defined in the top element of the DAD file.

DXXQ017E The column in the result table <*table_name*> **is too small.**

Explanation: An XML document generated by the XML Extender is too large to fit into the column of the result table.

User Response: Drop the result table. Create another result table with a bigger column. Rerun the stored procedure.

DXXQ018E The ORDER BY clause is missing from the SQL statement.

Explanation: The ORDER BY clause is missing from the SQL statement in a document access definition (DAD) file that maps SQL to XML.

User Response: Edit the DAD file. Add an ORDER BY clause that contains the entity-identifying columns.

DXXQ019E The element objids has no column element in the DAD file.

Explanation: The objids element does not have a column element in the document access definition (DAD) file that maps SQL to XML.

User Response: Edit the DAD file. Add the key columns as sub-elements of the element objids.

DXXQ020I XML successfully generated.

Explanation: The requested XML documents have been successfully generated from the database.

User Response: No action is required.

DXXQ021E Table <*table_name*> **does not have column** <*column_name*>**.**

Explanation: The table does not have the specified column in the database.

User Response: Specify another column name in DAD or add the specified column into the table database.

DXXQ022E Column <*column_name*> **of** <*table_name*> **should have type** <*type_name*>**.**

Explanation: The type of the column is wrong.

User Response: Correct the type of the column in the document access definition (DAD).

DXXQ023E Column <*column_name*> **of** <*table_name*> **cannot be longer than** <*length*>**.**

Explanation: The length defined for the column in the DAD is too long.

User Response: Correct the column length in the document access definition (DAD).

DXXQ024E Can not create table <*table_name*>**.**

Explanation: The specified table can not be created.

User Response: Ensure that the user ID creating the table has the necessary authority to create a table in the database.

DXXQ025I XML decomposed successfully.

Explanation: An XML document has been decomposed and stored in a collection successfully.

User Response: No action is required.

DXXQ026E XML data <*xml_name*> **is too large to fit in column** <*column_name*>**.**

Explanation: The specified piece of data from an XML document is too large to fit into the specified column.

User Response: Increase the length of the column using the ALTER TABLE statement or reduce the size of the data by editing the XML document.

DXXQ028E Cannot find the collection <*collection_name*> **in the XML_USAGE table.**

Explanation: A record for the collection cannot be found in the XML_USAGE table.

User Response: Verify that you have enabled the collection.

DXXQ029E Cannot find the DAD in XML_USAGE table for the collection <*collection_name*>**.**

Explanation: A DAD record for the collection cannot be found in the XML_USAGE table.

User Response: Ensure that you have enabled the collection correctly.

DXXQ030E Wrong XML override syntax.

Explanation: The XML_override value is specified incorrectly in the stored procedure.

User Response: Ensure that the syntax of XML_override is correct.

DXXQ031E Table name cannot be longer than maximum length allowed by DB2.

Explanation: The table name specified by the condition element in the DAD is too long.

User Response: Correct the length of the table name in document access definition (DAD).

DXXQ032E Column name cannot be longer than maximum length allowed by DB2.

Explanation: The column name specified by the condition element in the DAD is too long.

User Response: Correct the length of the column name in the document access definition (DAD).

DXXQ033E Invalid identifier starting at <*identifier*>

Explanation: The string is not a valid DB2 SQL identifier.

User Response: Correct the string in the DAD to conform to the rules for DB2 SQL identifiers.

DXXQ034E Invalid condition element in top RDB_node of DAD: <*condition*>

Explanation: The condition element must be a valid WHERE clause consisting of join conditions connected by the conjunction AND.

User Response: See the XML Extender documentation for the correct syntax of the join condition in a DAD.

DXXQ035E Invalid join condition in top RDB_node of DAD: <*condition*>

Explanation: Column names in the condition element of the top RDB_node must be qualified with the table name if the DAD specifies multiple tables.

User Response: See the XML Extender documentation for the correct syntax of the join condition in a DAD.

DXXQ036E A Schema name specified under a DAD condition tag is longer than allowed.

Explanation: An error was detected while parsing text under a condition tag within the DAD. The condition text contains an id qualified by a schema name that is too long.

User Response: Correct the text of the condition tags in document access definition (DAD).

DXXQ037E Cannot generate <*element*> **with multiple occurrences.**

Explanation: The element node and its descendants have no mapping to database, but its multi_occurrence equals YES.

User Response: Correct the DAD by either setting the multi_occurrence to NO or create a RDB_node in one of its descendants.

Tracing

The XML Extender includes a trace facility that records XML Extender server activity. The trace file is not limited in size and can impact performance.

The trace facility records information in a server file about a variety of events, such as entry to or exit from an XML Extender component or the return of an error code by an XML Extender component. Because it records information for many events, the trace facility should be used only when necessary, for example, when you are investigating error conditions. In addition, you should limit the number of active applications when using the trace facility. Limiting the number of active applications can make isolating the cause of a problem easier. All active applications running under the specified user profile emit trace detail to the source file.

Use the **dxxtrc** command start or stop tracing. You must have SYSADM, SYSCTRL, or SYSMINT authority to issue the command. You can issue the command from the Qshell, Operations Navigator, or the OS command line.

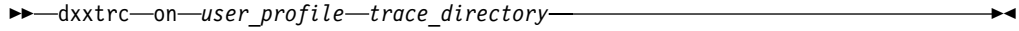
Starting the trace

Purpose

Records the XML Extender server activity. To start the trace, apply the `on` option to **dxxtrc**, along with the user profile and the name of an existing dirctory to contain the trace file. When the trace is turned on, the file, `dxx`*`INSTANCE`*`.trc`, is placed in the specified directory. *INSTANCE* is the numeric UID value assigned to the User Profile for which trace was started. The trace file is not limited in size.

Format

Starting the trace from the Qshell:



Starting the trace from the Operations Navigator:

```
call schema.QZXMTRC('on', 'user_profile', 'trace_directory');
```

Starting the trace from the OS command line:

```
call QDBXM/QZXMTRC PARM(on user_profile 'trace_directory')
```

Parameters

Table 59. Trace parameters

Parameter	Description
user_profile	The name of the user profile assocated with the job within which the XML Extender is running.
trace_directory	Name of an existing path and directory where the `dxx`*`INSTANCE`*`.trc` is placed. Required, no default.

Examples

The following examples show starting the trace, with file, `dxxdb2inst1.trc`, in the `/u/user1/dxx/trace` directory.

From the Qshell:

```
dxxtrc on user1 /u/user1/trace
```

From the Operations Navigator:

```
call myschema.QZXMTRC('on', 'user1', '/u/user1/trace');
```

From the OS command line:

```
call QDBXM/QZXMTRC PARM(on user1 '/u/user1/trace')
```

Stopping the trace

Purpose

Turns the trace off. Trace information is no longer logged. Because running the trace log file size is not limited and can impact performance, it is recommended to turn trace off in a production environment.

Format

Stopping the trace from the Qshell:

Stopping the trace from the Operations Navigator:

```
call schema.QZXMTRC('off', 'user_profile');
```

Stopping the trace from the OS command line:

```
call QDBXM/QZXMTRC PARM(off user_profile)
```

Parameters

Table 60. Trace parameters

Parameter	Description
user_profile	The name of the user profile assocated with the job within which the XML Extender is running.

Examples

This example shows that the trace facility is turned off.

```
dxxtrc user1 off
```

The following examples demonstrate stopping the trace.

From the Qshell:

```
dxxtrc off user1
```

From the Operations Navigator:

```
call myschema.QZXMTRC('off', 'user1');
```

From the OS command line:

```
call QDBXM/QZXMTRC PARM(off user1)
```

Part 5. Appendixes

Appendix A. DTD for the DAD file

This section describes the document type declarations (DTD) for the document access definition (DAD) file. The DAD file itself is a tree-structured XML document and requires a DTD. The DTD file name is `dxxdad.dtd`. Figure 11 shows the DTD for the DAD file. The elements of this file are described following the figure.

```
<?xml encoding="US-ASCII"?>

  <!ELEMENT DAD (dtdid?, validation, (Xcolumn | Xcollection))>
  <!ELEMENT dtdid (#PCDATA)>
  <!ELEMENT validation (#PCDATA)>
  <!ELEMENT Xcolumn (table*)>
  <!ELEMENT table (column*)>
  <!ATTLIST table name CDATA #REQUIRED
                              key CDATA #IMPLIED
                              orderBy CDATA #IMPLIED>
  <!ELEMENT column EMPTY>
  <!ATTLIST column
                      name CDATA #REQUIRED
                      type CDATA #IMPLIED
                      path CDATA #IMPLIED
                       multi_occurrence CDATA #IMPLIED>
  <!ELEMENT Xcollection (SQL_stmt?, objids?, prolog, doctype, root_node)>
  <!ELEMENT SQL_stmt (#PCDATA)>
  <!ELEMENT objids (column+)>
  <!ELEMENT prolog (#PCDATA)>
  <!ELEMENT doctype (#PCDATA | RDB_node)*>
  <!ELEMENT root_node (element_node)>
  <!ELEMENT element_node (RDB_node*,
                                        attribute_node*,
                                        text_node?,
                                        element_node*,
                                        namespace_node*,
                                        process_instruction_node*,
                                        comment_node*)>
  <!ATTLIST element_node
                     name CDATA #REQUIRED
                     ID CDATA #IMPLIED
                     multi_occurrence CDATA "NO"
                     BASE_URI CDATA #IMPLIED>
  <!ELEMENT attribute_node (column | RDB_node)>
  <!ATTLIST attribute_node
                     name CDATA #REQUIRED>
  <!ELEMENT text_node (column | RDB_node)>
  <!ELEMENT RDB_node (table+, column?, condition?)>
  <!ELEMENT condition (#PCDATA)>
  <!ELEMENT comment_node (#PCDATA)>
  <!ELEMENT namespace_node (EMPTY)>
  <!ATTLIST namespace_node
                      name CDATA #IMPLIED
                     value CDATA #IMPLIED>
  <!ELEMENT process_instruction_node (#PCDATA)>
```

Figure 11. The DTD for the document access definition (DAD)

The DAD file has four major elements:

- DTDID
- validation
- Xcolumn
- Xcollection

Xcolumn and Xcollection have child element and attributes that aid in the mapping of XML data to relational tables in DB2. The following list describes the major elements and their child elements and attributes. Syntax examples are taken from Figure 11 on page 229.

DTDID element

Specifies the ID of the DTD stored in the DTD_REF table. The `DTDID` points to the DTD that validates the XML documents or guides the mapping between XML collection tables and XML documents. `DTDID` is optional in DADs for XML columns and XML collections. For XML collection, this element is required for validating input and output XML documents. For XML columns, it is only needed to validate input XML documents. `DTDID` must be the same as the SYSTEM ID specified in the `doctype` of the XML documents.

Syntax: `<!ELEMENT dtdid (#PCDATA)>`

validation element

Indicates whether or not the XML document is to be validated with the DTD for the DAD. If YES is specified, then the `DTDID` must also be specified.

Syntax: `<!ELEMENT validation(#PCDATA)>`

Xcolumn element

Defines the indexing scheme for an XML column. It is composed of zero or more tables.

Syntax: `<!ELEMENT Xcolumn (table*)>Xcolumn` has one child element, `table`.

table element

Defines one or more relational tables created for indexing elements or attributes of documents stored in an XML column.

Syntax:

```
<!ELEMENT table (column+)>
 <!ATTLIST table name CDATA #REQUIRED
key CDATA #IMPLIED
orderBy CDATA #IMPLIED>
```

The `table` element has one attribute:

name attribute

Specifies the name of the side table

The `table` element has one child element:

key attribute

The primary single key of the table

orderBy attribute

The names of the columns that determine the sequence order of multiple-occurring element text or attribute values when generating XML documents.

column element

Specifies the column of the table that contains the value of a location path of the specified type.

Syntax:

```
<!ATTLIST column
                    name CDATA #REQUIRED
                    type  CDATA #IMPLIED
                    path  CDATA #IMPLIED
                    multi_occurrence CDATA #IMPLIED>
```

The `column` element has the following attributes:

name attribute

Specifies the name of the column. It is the alias name of the location path which identifies an element or attribute

type attribute

Defines the data type of the column. It can be any SQL data type.

path attribute

Shows the location path of an XML element or attribute and must be the simple location path as specified in Table 3.1.a (fix link) .

multi_occurrence attribute

Specifies whether this element or attribute can occur more than once in an XML document. Values can be YES or NO.

Xcollection

Defines the mapping between XML documents and an XML collection of relational tables.

Syntax: `<!ELEMENT Xcollection(SQL_stmt*, prolog, doctype, root_node)>Xcollection` has the following child elements:

SQL_stmt

Specifies the SQL statement that the XML Extender uses to define the collection. Specifically, the statement selects XML data from the XML collection tables, and uses the data to generate the XML documents in the collection. The value of this element must be a valid SQL statement. It is only used for composition, and only a single `SQL_stmt` is allowed. For decomposition, more than one value for `SQL_stmt` can be specified to perform the necessary table creation and insertion.

Syntax: `<!ELEMENT SQL_stmt  #PCDATA >`

prolog

The text for the XML prolog. The same prolog is supplied to all documents in the entire collection. The value of `prolog` is fixed.

Syntax: `<!ELEMENT prolog  #PCDATA>`

doctype

Defines the text for the XML document type definition.

Syntax: `<!ELEMENT doctype  #PCDATA | RDB_node>doctype` can be specified in one of the following ways:

- Define an explicit value. This value is supplied to all documents in the entire collection.
- When using decomposition, specify the child element, `RDB_node`, that can be mapped to and stored as column data of a table.

doctype has one child element:

RDB_node
Defines the DB2 table where the content of an XML element or value of an XML attribute is to be stored or from where it will be retrieved. The RDB_node has the following child elements:

table Specifies the table in which the element or attribute content is stored.

column
Specifies the column in which the element or attribute content is stored.

condition
Specifies a condition for the column. Optional.

root_node
Defines the virtual root node. root_node must have one required child element, element_node, which can be used only once. The element_node under the root_node is actually the root_node of the XML document.

Syntax: <!ELEMENT root_node(element_node)>

element_node
Represents an XML element. It must be defined in the DTD specified for the collection. For the RDB_node mapping, the root element_node must have a RDB_node to specify all tables containing XML data for itself and all of its child nodes. It can have zero or more attribute_nodes and child element_nodes, as well as zero or one text_node. For elements other than the root element no RDB_node is needed.

Syntax:

An element_node is defined by the following child elements:

RDB_node
(Optional) Specifies tables, column, and conditions for XML data. The RDB_node for an element only needs to be defined for the RDB_node mapping. In this case, one or more tables must be specified. The column is not needed since the element content is specified by its text_node. The condition is optional, depending on the DTD and query condition.

child nodes
(Optional) An element_node can also have the following child nodes:

element_node
Represents child elements of the current XML element

attribute_node
Represents attributes of the current XML element

text_node
Represents the CDATA text of the current XML element

attribute_node

Represents an XML attribute. It is the node defining the mapping between an XML attribute and the column data in a relational table.

Syntax:

The `attribute_node` must have definitions for a `name` attribute, and either a `column` or a `RDB_node` child element. `attribute_node` has the following attribute:

name The name of the attribute.

`attribute_node` has the following child elements:

Column

Used for the SQL mapping. The column must be specified in the SELECT clause of `SQL_stmt`.

RDB_node

Used for the RDB_node mapping. The node defines the mapping between this attribute and the column data in the relational table The table and column must be specified. The condition is optional.

text_node

Represents the text content of an XML element. It is the node defining the mapping between an XML element content and the column data in a relational table.

Syntax: It must be defined by a `column` or an `RDB_node` child element:

Column

Needed for the SQL mapping. In this case, the column must be in the SELECT clause of `SQL_stmt`.

RDB_node

Needed for the RDB_node mapping. The node defines the mapping between this text content and the column data in the relational table. The `table` and `column` must be specified. The condition is optional.

Appendix B. Samples

This appendix shows the sample objects that are used with examples in this book.

XML DTD

The following DTD is used for the `getstart.xml` document that is referenced throughout this book and shown in Figure 13 on page 236.

```
<!xml encoding="US-ASCII"?>

<!ELEMENT Order (Customer, Part+)>
<!ATTLIST Order key CDATA #REQUIRED>
<!ELEMENT Customer (Name, Email)>
<!ELEMENT Name (#PCDATA)>
<!ELEMENT Email (#PCDATA)>
<!ELEMENT Part (key,Quantity,ExtendedPrice,Tax, Shipment+)>
<!ELEMENT key (#PCDATA)>
<!ELEMENT Quantity (#PCDATA)>
<!ELEMENT ExtendedPrice (#PCDATA)>
<!ELEMENT Tax (#PCDATA)>
<!ATTLIST Part color CDATA #REQUIRED>
<!ELEMENT Shipment (ShipDate, ShipMode)>
<!ELEMENT ShipDate (#PCDATA)>
<!ELEMENT ShipMode (#PCDATA)>
```

Figure 12. Sample XML DTD: `getstart.dtd`

XML document: getstart.xml

The following XML document, `getstart.xml`, is the sample XML document that is used in examples throughout this book. It contains XML tags to form a purchase order.

```
<?xml version="1.0"?>
<!DOCTYPE Order SYSTEM "dxx_install/dtd/getstart.dtd">
<Order key="1">
  <Customer>
    <Name>American Motors</Name>
    <Email>parts@am.com</Email>
  </Customer>
  <Part color="black ">
    <key>68</key>
    <Quantity>36</Quantity>
    <ExtendedPrice>34850.16</ExtendedPrice>
    <Tax>6.000000e-02</Tax>
    <Shipment>
      <ShipDate>1998-08-19</ShipDate>
      <ShipMode>BOAT  </ShipMode>
    </Shipment>
    <Shipment>
       <ShipDate>1998-08-19</ShipDate>
       <ShipMode>AIR   </ShipMode>
    </Shipment>
  </Part>
  <Part color="red   ">
    <key>128</key>
    <Quantity>28</Quantity>
    <ExtendedPrice>38000.00</ExtendedPrice>
    <Tax>7.000000e-02</Tax>
    <Shipment>
      <ShipDate>1998-12-30</ShipDate>
      <ShipMode>TRUCK </ShipMode>
    </Shipment>
  </Part>
</Order>
```

Figure 13. Sample XML document: `getstart.xml`

Document access definition files

The following sections contain document access definition (DAD) files that map XML data to DB2 relational tables, using either XML column or XML collection access modes.

- "DAD file: XML column" on page 237
- "DAD file: XML collection - SQL mapping" on page 238 shows a DAD file for an XML collection using SQL mapping.
- "DAD file: XML - RDB_node mapping" on page 241 show a DAD for an XML collection that uses RDB_node mapping.

DAD file: XML column

This DAD file contains the mapping for an XML column, defining the table, side tables, and columns that are to contain the XML data.

```
<?xml version="1.0"?>
<!DOCTYPE Order SYSTEM "dxx_install/dad.dtd">
<DAD>
   <dtdid>dxx_install/dtd/getstart.dtd</dtdid>
   <validation>YES</validation>

   <Xcolumn>
     <table name="order_side_tab">
         <column name="order_key"
            type="integer"
            path="/Order/@key"
            multi_occurrence="NO"/>
         <column name="customer"
            type="varchar(50)"
            path="/Order/Customer/Name"
            multi_occurrence="NO"/>
     </table>
     <table name="part_side_tab">
         <column name="price"
            type="decimal(10,2)"
            path="/Order/Part/ExtendedPrice"
            multi_occurrence="YES"/>
     </table>
     <table name="ship_side_tab">
         <column name="date"
            type="DATE"
            path="/Order/Part/Shipment/ShipDate"
            multi_occurrence="YES"/>
     </table>

   </Xcolumn>

</DAD>
```

Figure 14. Sample DAD file for an XML column: getstart_xcolumn.dad

DAD file: XML collection - SQL mapping

This DAD file contains an SQL statement that specifies the DB2 tables, columns, and conditions that are to contain the XML data.

```
<?xml version="1.0"?>
<!DOCTYPE DAD SYSTEM "dxx_install/dtd/dad.dtd">
<DAD>
<validation>NO</validation>
<Xcollection>
<SQL_stmt>SELECT o.order_key, customer_name, customer_email, p.part_key, color, quantity,
   price, tax, ship_id, date, mode from order_tab o, part_tab p,
   (select db2xml.generate_unique(),
     as ship_id, date, mode, part_key from ship_tab) as
 s
         WHERE o.order_key = 1 and
               p.price > 20000 and
               p.order_key = o.order_key and
               s.part_key = p.part_key
         ORDER BY order_key, part_key, ship_id</SQL_stmt>
<prolog>?xml version="1.0"?</prolog>
<doctype>!DOCTYPE Order SYSTEM "dxx_install/dtd/getstart.dtd"</doctype>
```

Figure 15. Sample DAD file for an XML collection using SQL mapping: `order_sql.dad` (Part 1 of 2)

```
<root_node>
<element_node name="Order">
  <attribute_node name="key">
    <column name="order_key"/>
  </attribute_node>
  <element_node name="Customer">
    <element_node name="Name">
      <text_node><column name="customer_name"/></text_node>
    </element_node>
    <element_node name="Email">
      <text_node><column name="customer_email"/></text_node>
    </element_node>
  </element_node>
  <element_node name="Part">
    <attribute_node name="color">
      <column name="color"/>
    </attribute_node>
    <element_node name="key">
      <text_node><column name="part_key"/></text_node>
    </element_node>
    <element_node name="Quantity">
      <text_node><column name="quantity"/></text_node>
    </element_node>
    <element_node name="ExtendedPrice">
      <text_node><column name="price"/></text_node>
    </element_node>
    <element_node name="Tax">
      <text_node><column name="tax"/></text_node>
    </element_node>
    <element_node name="Shipment" multi_occurence="YES">
      <element_node name="ShipDate">
        <text_node><column name="date"/></text_node>
      </element_node>
      <element_node name="ShipMode">
        <text_node><column name="mode"/></text_node>
      </element_node>
    </element_node>
  </element_node>
</element_node>
</root_node>
</Xcollection>
</DAD>
```

Figure 15. Sample DAD file for an XML collection using SQL mapping: `order_sql.dad` (Part 2 of 2)

DAD file: XML - RDB_node mapping

This DAD file uses <RDB_node> elements to define the DB2 tables, columns, and conditions that are to contain XML data.

```
<?xml version="1.0"?>
<!DOCTYPE Order SYSTEM "dxx_install/dtd/dad.dtd">
<DAD>
   <dtdid>dxx_install/dtd/getstart.dtd</dtdid>
   <validation>YES</validation>
<Xcollection>
      <prolog>?xml version="1.0"?</prolog>
      <doctype>!DOCTYPE Order SYSTEM "dxx_install/dtd/getstart.dtd"</doctype>
      <root_node>
         <element_node name="Order">
           <RDB_node>
              <table name="order_tab"/>
              <table name="part_tab"/>
              <table name="ship_tab"/>
              <condition>
                order_tab.order_key = part_tab.order_key AND
                part_tab.part_key = ship_tab.part_key
              </condition>
           </RDB_node>
           <attribute_node name="key">
              <RDB_node>
                 <table name="order_tab"/>
                 <column name="order_key"/>
              </RDB_node>
           </attribute_node>
           <element_node name="Customer">
              <text_node>
                 <RDB_node>
                    <table name="order_tab"/>
                    <column name="customer"/>
                 </RDB_node>
              </text_node>
           </element_node>
           <element_node name="Part">
              <RDB_node>
                 <table name="part_tab"/>
                 <table name="ship_tab"/>
                 <condition>
                    part_tab.part_key = ship_tab.part_key
                 </condition>
              </RDB_node>
              <attribute_node name="key">
                 <RDB_node>
                    <table name="part_tab"/>
                    <column name="part_key"/>
                 </RDB_node>
              </attribute_node>
```

Figure 16. Sample DAD file for an XML collection using RDB_node mapping: `order_rdb.dad` (Part 1 of 3)

```
<element_node name="Quantity">
   <text_node>
      <RDB_node>
         <table name="part_tab"/>
         <column name="quantity"/>
      </RDB_node>
   </text_node>
</element_node>
<element_node name="ExtendedPrice">
   <text_node>
      <RDB_node>
         <table name="part_tab"/>
            <column name="price"/>
            <condition>
               price > 2500.00
            </condition>
      </RDB_node>
   </text_node>
</element_node>
<element_node name="Tax">
   <text_node>
      <RDB_node>
         <table name="part_tab"/>
         <column name="tax"/>
      </RDB_node>
   </text_node>
</element_node>
```

Figure 16. Sample DAD file for an XML collection using RDB_node mapping: `order_rdb.dad` (Part 2 of 3)

```
            <element_node name="shipment">
               <RDB_node>
                  <table name="ship_tab"/>
                  <condition>
                     part_key = part_tab.part_key
                  </condition>
               </RDB_node>
               <element_node name="ShipDate">
                  <text_node>
                     <RDB_node>
                        <table name="ship_tab"/>
                        <column name="date"/>
                        <condition>
                           date > "1966-01-01"
                        </condition>
                     </RDB_node>
                  </text_node>
               </element_node>
               <element_node name="ShipMode">
                  <text_node>
                     <RDB_node>
                        <table name="ship_tab"/>
                        <column name="mode"/>
                     </RDB_node>
                  </text_node>
               </element_node>
               <element_node name="Comment">
                  <text_node>
                     <RDB_node>
                        <table name="ship_tab"/>
                        <column name="comment"/>
                     </RDB_node>
                  </text_node>
               </element_node>
             </element_node> <! -- end of element Shipment>
           </element_node> <! -- end of element Part --->
         </element_node> <! -- end of element Order --->
       </root_node>
   </Xcollection>
</DAD>
```

Figure 16. Sample DAD file for an XML collection using RDB_node mapping: `order_rdb.dad` (Part 3 of 3)

Appendix C. Code page considerations

XML documents and other related files must be encoded properly for each client or server that accesses the files. The XML Extender makes some assumptions when processing a file, you need to understand how it handles code page conversions. The primary considerations are:

- Ensuring that the actual code page of the client retrieving an XML document from DB2 matches the encoding of the document.
- Ensuring that, when the document is processed by an XML parser, the encoding declaration of the XML document is also consistent with the document's actual encoding.
- Ensuring that the locales are configured properly.

For OS/400, the job, DB2 and the XML document must all have the same CCSID. The following section describes methods for ensuring that the CCSIDs are consistent.

Configuring locale settings

The XML Extender selects completion and error messages from a message catalog based on your locale settings. To receive the messages in your language, you must install the XML Extender message catalog, and have the locale set up correctly. XML Extender installs the message catalog for your language in the IFS directory, `/QIBM/ProdData/DB2Extenders/XML/MRI`*xxxx*, where *xxxx* is the language code.

For example, the message catalog for English, 2924, is installed in the directory: `/QIBM/ProdData/DB2Extenders/XML/MRI2924/dxx.cat`. To have the English 2924 message catalog selected by the XML Extender, set up the user profile, using the **WRKUSRPRF** commmand:

```
Language ID  . . . . . .  LANGID    ENU
Country ID . . . . . . .  CNTRYID   US
Coded character set ID . . . . .  CCSID     037
```

All instances of the XML Extender running under this user profile will use the MRI2924 message catalog.

Encoding declaration considerations

The *encoding declaration* specifies the code page of the XML document's encoding and appears on the XML declaration statement. When using the XML Extender, it is important to ensure that the encoding of the document matches the job and DB2.

Consistent encodings and encoding declarations

When an XML document is processed or exchanged with another system, it is important that the encoding declaration corresponds to the actual encoding of the document. Ensuring that the encoding of a document is consistent with the client is important because XML tools, like parsers, generate an error for an entity that includes an encoding declaration other than that named in the declaration.

The consequences of having different code pages are the following possible situations:

- A conversion in which data is lost might occur.
- The declared encoding of the XML document might no longer be consistent with the actual document encoding, if the document is retrieved by a client with a different code page than the declared encoding of the document.

Declaring an encoding

The default value of the encoding declaration is UTF-8, and the absence of an encoding declaration means the document is in UTF-8.

To declare an encoding value:

In the XML document declaration specify the encoding declaration with the name of the code page of the client. For example:

```
<?xml version="1.0" encoding="UTF-8" ?>
```

Preventing inconsistent XML documents

Use one of the following recommendations for ensuring that the XML document encoding is consistent with the client code page, before handing the document to an XML processor, such as a parser:

- When exporting a document from the database using the XML Extender UDFs, try one of the following techniques (assuming the XML Extender has exported the file, in the server code page, to the file system on the server):
  - Convert the document to the declared encoding code page
  - Override the declared encoding, if the tool has an override facility
  - Manually change the encoding declaration of the exported document to the document's actual encoding (that is, the server code page)
- When exporting a document from the database using the XML Extender stored procedures, try one of the following techniques (assuming the client is querying the result table, in which the composed document is stored):
  - Convert the document to the declared encoding code page
  - Override the declared encoding, if the tool has an override facility
  - Before running the stored procedure, have the client set the CCSID variable to force the client code page to a code page that is compatible with the encoding declaration of the XML document.
  - Manually change the encoding declaration of the exported document to the document's actual encoding (that is, the client code page)

Appendix D. The XML Extender limits

This appendix describes the limits for:

- XML Extender objects - Table 61
- values returned by user-defined functions - Table 62
- stored procedures parmeters - Table 63 on page 248
- administration support table columns - Table 64 on page 248

Table 61 describes the limits for XML Extender objects.

Table 61. Limits for XML Extender objects

Object	Limit
Maximum number of rows in a table in a decomposition XML collection	1024 rows from each decomposed XML document
Maximum characters in a column name specified in a default view	10 characters
Maximum bytes in XMLFile path name specified as a parameter value	512 bytes

Table 62 describes the limits values returned by XML Extender user-defined functions.

Table 62. Limits for user-defined function value

User-defined functions returned values	Limit
Maximum bytes returned by an extractCHAR UDF	254 bytes
Maximum bytes returned by an extractCLOB UDF	2 gigabytes
Maximum bytes returned by an extractVARCHAR UDF	4 kilobytes
Maximum number of instances of multiple occurence	The value of MANYROWS

Table 63 describes the limits for parameters of XML Extender stored procedures.

Table 63. Limits for stored procedure parameters

Stored procedure parameters	Limit
Maximum size of an XML document CLOB[1]	1 megabytes
Maximum size of a Document Access Definition (DAD) CLOB[1]	100 kilobytes
Maximum size of *collectionName*	30 bytes
Maximum size of *colName*	30 bytes
Maximum size of *dbName*	8 bytes
Maximum size of *defaultView*	128 bytes
Maximum size of *rootID*	128 bytes
Maximum size of *resultTabName*	18 bytes
Maximum size of *tablespace*	8 bytes
Maximum size of *tbName*[2]	18 bytes

Notes:

1. This size can be changed. See "Increasing the CLOB limit" on page 176 to learn how.
2. If the value of the *tbName* parameter is qualified by a schema name, the entire name (including the separator character) must be no longer than 128 bytes.

Table 64 describes the limits for the DB2XML.DTD_REF table.

Table 64. XML Extender limits

DB2XML.DTD_REF table columns	Limit
Size of AUTHOR column	128 bytes
Size of CREATOR column	128 bytes
Size of UPDATOR column	128 bytes
Size of DTDID column	128 bytes
Size of CLOB column	100 kilobytes

Names can undergo expansion when DB2 converts them from the client code page to the database code page. A name might fit within the size limit at the client, but exceed the limit when the stored procedure gets the converted name.

Appendix E. Notices

This information was developed for products and services offered in the U.S.A. IBM may not offer the products, services, or features discussed in this document in other countries. Consult your local IBM representative for information on the products and services currently available in your area. Any reference to an IBM product, program, or service is not intended to state or imply that only that IBM product, program, or service may be used. Any functionally equivalent product, program, or service that does not infringe any IBM intellectual property right may be used instead. However, it is the user's responsibility to evaluate and verify the operation of any non-IBM product, program, or service.

IBM may have patents or pending patent applications covering subject matter described in this document. The furnishing of this document does not give you any license to these patents. You can send license inquiries, in writing, to:

IBM Director of Licensing
IBM Corporation
North Castle Drive
Armonk, NY 10504-1785
U.S.A.

For license inquiries regarding double-byte (DBCS) information, contact the IBM Intellectual Property Department in your country or send inquiries, in writing, to:

IBM World Trade Asia Corporation
Licensing
2-31 Roppongi 3-chome, Minato-ku
Tokyo 106, Japan

The following paragraph does not apply to the United Kingdom or any other country where such provisions are inconsistent with local law:
INTERNATIONAL BUSINESS MACHINES CORPORATION PROVIDES THIS PUBLICATION "AS IS" WITHOUT WARRANTY OF ANY KIND, EITHER EXPRESS OR IMPLIED, INCLUDING, BUT NOT LIMITED TO, THE IMPLIED WARRANTIES OF NON-INFRINGEMENT, MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE. Some states do not allow disclaimer of express or implied warranties in certain transactions, therefore, this statement may not apply to you.

This information could include technical inaccuracies or typographical errors. Changes are periodically made to the information herein; these changes will be incorporated in new editions of the publication. IBM may make improvements and/or changes in the product(s) and/or the program(s) described in this publication at any time without notice.

Licensees of this program who wish to have information about it for the purpose of enabling: (i) the exchange of information between independently created programs and other programs (including this one) and (ii) the mutual use of the information which has been exchanged, should contact:

IBM Corporation
J74/G4
555 Bailey Avenue
P.O. Box 49023

San Jose, CA 95161-9023
U.S.A.

Such information may be available, subject to appropriate terms and conditions, including in some cases, payment of a fee.

The licensed program described in this information and all licensed material available for it are provided by IBM under terms of the IBM Customer Agreement, IBM International Program License Agreement, or any equivalent agreement between us.

Information concerning non-IBM products was obtained from the suppliers of those products, their published announcements or other publicly available sources. IBM has not tested those products and cannot confirm the accuracy of performance, compatibility or any other claims related to non-IBM products. Questions on the capabilities of non-IBM products should be addressed to the suppliers of those products.

All statements regarding IBM's future direction or intent are subject to change or withdrawal without notice, and represent goals and objectives only.

COPYRIGHT LICENSE:

This information contains sample application programs in source language, which illustrates programming techniques on various operating platforms. You may copy, modify, and distribute these sample programs in any form without payment to IBM, for the purposes of developing, using, marketing or distributing application programs conforming to the application programming interface for the operating platform for which the sample programs are written. These examples have not been thoroughly tested under all conditions. IBM, therefore, cannot guarantee or imply reliability, serviceability, or function of these programs.

Trademarks

The following terms are trademarks of the International Business Machines Corporation in the United States, or other countries, or both:

AS/400
AS/400e
Client Access
Client Access/400
DB2
DB2 Universal Database
IBM
IMS
iSeries
OS/2
OS/390
OS/400
VTAM
XML Extender 400

Java and all Java-based trademarks and logos are trademarks or registered trademarks of Sun Microsystems, Inc. in the United States, other countries, or both.

Microsoft, Windows, Windows NT, and the Windows logo are trademarks of Microsoft Corporation in the United States, other countries, or both.

UNIX is a registered trademark in the United States, other countries, or both and is licensed exclusively through X/Open Company Limited.

Other company, product, and service names may be trademarks or service marks of others.

Glossary

absolute location path. The full path name of an object. The absolute path name begins at the highest level, or ″root″ element, which is identified by the forward slash (/) or back slash (\) character.

access and storage method. Associates XML documents to a DB2 database through two major access and storage methods: XML columns and XML collections. See also *XML column* and *XML collection*.

administrative support tables. A tables used by a DB2 extender to process user requests on XML objects. Some administrative support tables identify user tables and columns that are enabled for an extender. Other administrative support tables contain attribute information about objects in enabled columns. Synonymous with metadata table.

API. See *application programming interface*.

application programming interface (API).

(1) A functional interface supplied by the operating system or by a separately orderable licensed program. An API allows an application program that is written in a high-level language to use specific data or functions of the operating system or the licensed programs.

(2) In DB2, a function within the interface, for example, the get error message API.

(3) In DB2, a function within the interface. For example, the get error message API.

attribute. See *XML attribute*.

attribute_node. A representation of an attribute of an element.

browser. See *Web browser*.

B-tree indexing. The native index scheme provided by the DB2 engine. It builds index entries in the B-tree structure. Supports DB2 base data types.

cast function. A function that is used to convert instances of a (source) data type into instances of a different (target) data type. In general, a cast function has the name of the target data type. It has one single argument whose type is the source data type; its return type is the target data type.

character large object (CLOB). A character string of single-byte characters, where the string can be up to 2 GB. CLOBs have an associated code page. Text objects that contain single-byte characters are stored in a DB2 database as CLOBs.

CLOB. Character large object.

column data. The data stored inside of a DB2 column. The type of data can be any data type supported by DB2.

compose. To generate XML documents from relational data in an XML collection.

condition. A specification of either the criteria for selecting XML data or the way to join the XML collection tables.

DAD. See *Document access definition*.

data interchange. The sharing of data between applications. XML supports data interchange without needing to go through the process of first transforming data from a proprietary format.

data source. A local or remote relational or nonrelational data manager that is capable of supporting data access via an ODBC driver that supports the ODBC APIs.

data type. An attribute of columns and literals.

datalink. A DB2 data type that enables logical references from the database to a file that is stored outside the database.

DBCLOB. Double-byte character large object.

decompose. Separates XML documents into a collection of relational tables in an XML collection.

default casting function. Casts the SQL base type to a UDT.

default view. A representation of data in which an XML table and all of its related side tables are joined.

distinct type. See *user-defined type*.

Document Access Definition (DAD). Used to define the indexing scheme for an XML column or mapping scheme of an XML collection. It can be used to enable an XML Extender column of an XML collection, which is XML formatted.

Document type definition (DTD). A set of declarations for XML elements and attributes. The DTD defines what elements are used in the XML document, in what order they can be used, and which elements can contain other elements. You can associate a DTD with a document access definition (DAD) file to validate XML documents.

double-byte character large object (DBCLOB). A character string of double-byte characters, or a

combination of single-byte and double-byte characters, where the string can be up to 2 GB. DBCLOBs have an associated code page. Text objects that include double-byte characters are stored in a DB2 database as DBCLOBs.

DTD. (1) . (2) See *Document type definition*.

DTD reference table (DTD_REF table). A table that contains DTDs, which are used to validate XML documents and to help applications to define a DAD. Users can insert their own DTDs into the DTD_REF table. This table is created when a database is enabled for XML.

DTD_REF table. DTD reference table.

DTD repository. A DB2 table, called DTD_REF, where each row of the table represents a DTD with additional metadata information.

EDI. Electronic Data Interchange.

Electronic Data Interchange (EDI). A standard for electronic data interchange for business-to-business (B2B) applications.

element. See *XML element*.

element_node. A representation of an element. An element_node can be the root element or a child element.

embedded SQL. SQL statements coded within an application program. See *static SQL*.

Extensible Stylesheet language (XSL). A language used to express stylesheets. XSL consists of two parts: a language for transforming XML documents, and an XML vocabulary for specifying formatting semantics.

Extensive Stylesheet Language Transformation (XSLT). A language used to transform XML documents into other XML documents. XSLT is designed for use as part of XSL, which is a stylesheet language for XML.

external file. A file that exists in a file system external to DB2.

foreign key. A key that is part of the definition of a referential constraint and that consists of one or more columns of a dependent table.

full text search. Using the DB2 Text Extender, a search of text strings anywhere without regard to the document structure.

index. A set of pointers that are logically ordered by the values of a key. Indexes provide quick access to data and can enforce uniqueness on the rows in the table.

Java Database Connectivity (JDBC). An application programming interface (API) that has the same characteristics as Open Database Connectivity (ODBC) but is specifically designed for use by Java database applications. Also, for databases that do not have a JDBC driver, JDBC includes a JDBC to ODBC bridge, which is a mechanism for converting JDBC to ODBC; JDBC presents the JDBC API to Java database applications and converts this to ODBC. JDBC was developed by Sun Microsystems, Inc. and various partners and vendors.

JDBC. Java Database Connectivity.

join. A relational operation that allows for retrieval of data from two or more tables based on matching column values.

joined view. A DB2 view created by the ″CREATE VIEW″ statement which join one more tables together.

large object (LOB). A sequence of bytes, where the length can be up to 2 GB. A LOB can be of three types: *binary large object* (BLOB), *character large object (CLOB)*, or *double-byte character large object (DBCLOB)*.

LOB. Large object.

local file system. A file system that exists in DB2

location path. Location path is a sequence of XML tags that identify an XML element or attribute. The location path identifies the structure of the XML document, indicating the context for the element or attribute. A single slash (/) path indicates that the context is the whole document. The location path is used in the extracting UDFs to identify the elements and attributes to be extracted. The location path is also used in the DAD file to specify the mapping between an XML element, or attribute, and a DB2 column when defining the indexing scheme for XML column. Additionally, the location path is used by the Text Extender for structural-text search.

locator. A pointer which can be used to locate an object. In DB2, the large object block (LOB) locator is the data type which locates LOBs.

mapping scheme. A definition of how XML data is represented in a relational database. The mapping scheme is specified in the DAD. The XML Extender provides two types of mapping schemes: *SQL mapping* and *relational database node (RDB_node) mapping*.

metadata table. See *administrative support table*.

multiple occurrence. An indication of whether a column element or attribute can be used more than once in a document. Multiple occurrence is specified in the DAD.

node. In database partitioning, synonymous with database partition.

object. In object-oriented programming, an abstraction consisting of data and the operations associated with that data.

odb2. A command line tool for UNIX Systems Services (USS).

ODBC. Open Database Connectivity.

Open Database Connectivity. A standard application programming interface (API) for accessing data in both relational and nonrelational database management systems. Using this API, database applications can access data stored in database management systems on a variety of computers even if each database management system uses a different data storage format and programming interface. ODBC is based on the call level interface (CLI) specification of the X/Open SQL Access Group and was developed by Digital Equipment Corporation (DEC), Lotus, Microsoft, and Sybase. Contrast with *Java Database Connectivity*.

overloaded function. A function name for which multiple function instances exist.

partition. A fixed-size division of storage.

path expression. See *location path*.

predicate. An element of a search condition that expresses or implies a comparison operation.

primary key. A unique key that is part of the definition of a table. A primary key is the default parent key of a referential constraint definition.

procedure. See *stored procedure*.

query. A request for information from the database based on specific conditions; for example, a query might be a request for a list of all customers in a customer table whose balance is greater than 1000.

RDB_node. Relational database node.

RDB_node mapping. The location of the content of an XML element, or the value of an XML attribute, which are defined by the RDB_node. The XML Extender uses this mapping to determine where to store or retrieve the XML data.

relational database node (RDB_node). A node that contains one or more element definitions for tables, optional columns, and optional conditions. The tables and columns are used to define how the XML data is stored in the database. The condition specifies either the criteria for selecting XML data or the way to join the XML collection tables.

result set. A set of rows returned by a stored procedure.

result table. A table which contains rows as the result of an SQL query or an execution of a stored procedure.

root element. The top element of an XML document.

root ID. A unique identifier that associates all side tables with the application table.

scalar function. An SQL operation that produces a single value from another value and is expressed as a function name, followed by a list of arguments enclosed in parentheses.

schema. A collection of database objects such as tables, views, indexes, or triggers. It provides a logical classification of database objects.

section search. Provides the text search within a section which can be defined by the application. To support the structural text search, a section can be defined by the Xpath's abbreviated location path.

side table. Additional tables created by the XML Extender to improve performance when searching elements or attributes in an XML column.

simple location path. A sequence of element type names connected by a single slash (/).

SQL collection. Referred to in this book as "schema". See *schema*.

SQL mapping. A definition of the relationship of the content of an XML element or value of an XML attribute with relational data, using one or more SQL statements and the XSLT data model. The XML Extender uses the definition to determine where to store or retrieve the XML data. SQL mapping is defined with the SQL_stmt element in the DAD.

static SQL. SQL statements that are embedded within a program, and are prepared during the program preparation process before the program is executed. After being prepared, a static SQL statement does not change, although values of host variables specified by the statement may change.

stored procedure. A block of procedural constructs and embedded SQL statements that is stored in a database and can be called by name. Stored procedures allow an application program to be run in two parts. One part runs on the client and the other part runs on the server. This allows one call to produce several accesses to the database.

structural text index. To index text strings based on the tree structure of the XML document, using the DB2 Text Extender.

subquery. A full SELECT statement that is used within a search condition of an SQL statement.

table space. An abstraction of a collection of containers into which database objects are stored. A

table space provides a level of indirection between a database and the tables stored within the database. A table space:

- Has space on media storage devices assigned to it.
- Has tables created within it. These tables will consume space in the containers that belong to the table space. The data, index, long field, and LOB portions of a table can be stored in the same table space, or can be individually broken out into separate table spaces.

text_node. A representation of the CDATA text of an element.

top element_node. A representation of the root element of the XML document in the DAD.

UDF. See *user-defined function*.

UDT. See *user-defined type*.

uniform resource locator (URL). An address that names an HTTP server and optionally a directory and file name, for example: http://www.ibm.com/data/db2/extenders.

UNION. An SQL operation that combines the results of two select statements. UNION is often used to merge lists of values that are obtained from several tables.

UNIX System Services. UNIX environment and services on OS/390. Also known as OpenEdition.

USS. See *UNIX System Services*.

URL. Uniform resource locator.

user-defined function (UDF). A function that is defined to the database management system and can be referenced thereafter in SQL queries. It can be one of the following functions:

- An external function, in which the body of the function is written in a programming language whose arguments are scalar values, and a scalar result is produced for each invocation.
- A sourced function, implemented by another built-in or user-defined function that is already known to the DBMS. This function can be either a scalar function or column (aggregating) function, and returns a single value from a set of values (for example, MAX or AVG).

user-defined type (UDT). A data type that is not native to the database manager and was created by a user. See *distinct type*.

user table. A table that is created for and used by an application.

validation. The process of using a DTD to ensure that the XML document is valid and to allow structured searches on XML data. The DTD is stored in the DTD repository.

valid document. An XML document that has an associated DTD. To be valid, the XML document cannot violate the syntactic rules specified in its DTD.

Web browser. A client program that initiates requests to a Web server and displays the information that the server returns.

well-formed document. An XML document that does not contain a DTD. Although in the XML specification, a document with a valid DTD must also be well-formed.

XML. eXtensible Markup Language.

XML attribute. Any attribute specified by the ATTLIST under the XML element in the DTD. The XML Extender uses the location path to identify an attribute.

XML collection. A collection of relational tables which presents the data to compose XML documents, or to be decomposed from XML documents. Can also be referred to as a "collection", which is not to be confused with an SQL collection.

XML column. A column in the application table that has been enabled for the XML Extender UDTs.

XML element. Any XML tag or ELEMENT as specified in the XML DTD. The XML Extender uses the location path to identify an element.

XML object. Equivalent to an XML document.

XML Path Language. A language for addressing parts of an XML document. XML Path Language (XPath) is designed to be used by XSLT. Every location path can be expressed using the syntax defined for XPath. The XPath subset implemented in XML Extender is called *location path* in this book

XML table. An application table which includes one or more XML Extender columns.

XML tag. Any valid XML markup language tag, mainly the XML element. The terms tag and element are used interchangeably.

XML UDF. A DB2 user-defined function provided by the XML Extender.

XML UDT. A DB2 user-defined type provided by the XML Extender.

XPath. A language for addressing parts of an XML document. The XPath subset implemented in XML Extender is called *location path* in this book

XPath data model. The tree structure used to model and navigate an XML document using nodes.

XSL. XML Stylesheet Language.

XSLT. XML Stylesheet Language Transformation.

Index

E

F

G

H

I

J

L

M

N

O

P

R

S

T

U

V

W

X

Readers' Comments — We'd Like to Hear from You

iSeries
DB2 Universal Database for AS/400 XML Extender
Administration and Programming
Version 7

Publication No. SC27-1172-00

Overall, how satisfied are you with the information in this book?

	Very Satisfied	Satisfied	Neutral	Dissatisfied	Very Dissatisfied
Overall satisfaction	☐	☐	☐	☐	☐

How satisfied are you that the information in this book is:

	Very Satisfied	Satisfied	Neutral	Dissatisfied	Very Dissatisfied
Accurate	☐	☐	☐	☐	☐
Complete	☐	☐	☐	☐	☐
Easy to find	☐	☐	☐	☐	☐
Easy to understand	☐	☐	☐	☐	☐
Well organized	☐	☐	☐	☐	☐
Applicable to your tasks	☐	☐	☐	☐	☐

Please tell us how we can improve this book:

Thank you for your responses. May we contact you? ☐ Yes ☐ No

When you send comments to IBM, you grant IBM a nonexclusive right to use or distribute your comments in any way it believes appropriate without incurring any obligation to you.

Name _____ Address _____

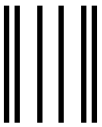
Company or Organization _____

Phone No. _____

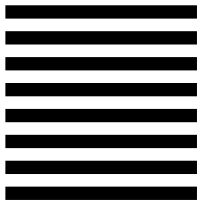
Readers' Comments — We'd Like to Hear from You
SC27-1172-00

Cut or Fold
Along Line

Fold and Tape | **Please do not staple** | Fold and Tape



NO POSTAGE
NECESSARY
IF MAILED IN THE
UNITED STATES



BUSINESS REPLY MAIL

FIRST-CLASS MAIL PERMIT NO. 40 ARMONK, NEW YORK

POSTAGE WILL BE PAID BY ADDRESSEE

International Business Machines Corporation
Department HHX/H3 PO Box 49023
SAN JOSE CA 95161-9023

Fold and Tape | **Please do not staple** | Fold and Tape

Cut or Fold
Along Line

Program Number: 5722-DE1

Printed in the United States of America
on recycled paper containing 10%
recovered post-consumer fiber.

SC27-1172-00