XML Toolkit for z/OS

User's Guide

SA22-7932-08

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Note

Before using this information and the product it supports, be sure to read the general information under “Notices” on page 97.

Ninth Edition, 2009

This edition applies to Version 1 Release 10 of XML Toolkit for z/OS (5655-J51) and to all subsequent releases and modifications until otherwise indicated in new editions.

This is a major revision of SA22–7932–07.

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About this document

This document provides information you need to use V1.10.0 of XML Toolkit for z/OS®. It contains instructions on how to use the following components:

- XML Parser, C++ Edition
- XSLT Processor, C++ Edition

It also provides information on the z/OS specific classes in the XML Parser, C++ Edition which utilize the z/OS XML System Services component to parse XML documents. When the z/OS specific classes are used, a portion of the parse is performed by z/OS XML System Services, which can take advantage of the more competitive zAAP specialty engines (if present).

As of Toolkit V1.10.0, previous Toolkit releases will no longer be provided with the current Toolkit. To acquire a copy of a previous Toolkit release, you will need to order the V1.9.0 Toolkit, which comes bundled with Toolkit releases V1.8.0 and V1.7.0. Information on how to use Toolkit V1.8.0 and Toolkit V1.7.0 is available from the *XML Toolkit for z/OS User's Guide V1R8* and the *XML Toolkit for z/OS User's Guide V1R7*. Both documents can be downloaded from the following Web site:

`http://www-1.ibm.com/servers/eserver/zseries/software/xml/`

Who should use this User's Guide?

This document is for application programmers, system programmers, and end users working on a z/OS system and using the Toolkit.

This document assumes that readers are familiar with the z/OS system and with the information for z/OS and its accompanying products.

The Toolkit home page,

`http://www.ibm.com/servers/eserver/zseries/software/xml/`

offers information about the Toolkit releases, the Program Directory, and installation instructions.

What is in the User's Guide?

This document describes how to use the Toolkit XML Parser, C++ Edition and XSLT Processor, C++ Edition, and how to utilize the z/OS XML System Services parser. Using the document, you will:

- Receive an introduction to XML and the XML Toolkit.
  - Read about XML and its implications in today's world.
  - Learn about the components of the XML Toolkit.
  - Learn about the APIs that are implemented by the Toolkit.
  - Read about the process of validation.
  - Discover how to access data sets using XML.
- Understand how to use the XML Parser, C++ Edition in the XML Toolkit.
  - Learn about the C++ XML parser.
  - Review samples of how to use the C++ XML parser.
  - Understand how to use the z/OS specific parser classes that utilize the z/OS XML System Services component.
    - Learn about the z/OS specific parser classes.

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- Review the provided samples that use the z/OS specific parser classes.

- Understand how to use the XSLT Processor, C++ Edition in the XML Toolkit.
  - Learn about the C++ XSLT processor.
  - Review samples of how to use the C++ XSLT processor.
- Find out where you can learn more about the XML Toolkit and all its components.

Summary of changes

Summary of Changes
for SA22-7932-08
XML Toolkit Version 1 Release 10

This document contains information previously presented in *XML Toolkit for z/OS User's Guide*, SA22-7932-07, which supports XML Toolkit Version 1 Release 10.

New Information

- "Toolkit 64-bit support" on page 14
- "Deprecated DOM support" on page 14
- Chapter 5, "How to use the XML Parser, C++ Edition," on page 25
- Chapter 7, "How to use the XSLT Processor, C++ Edition," on page 49

Changed Information

- Chapter 4, "How to use Toolkit 31-bit XPLINK support," on page 23

This document contains terminology, maintenance, and editorial changes. Technical changes or additions to the text and illustrations are indicated by a vertical line to the left of the change.

Summary of Changes
for SA22-7932-07
XML Toolkit Version 1 Release 10

This document contains information previously presented in *XML Toolkit for z/OS User's Guide*, SA22-7932-06, which supports XML Toolkit Version 1 Release 9.

New Information

- An introduction to new support that allows XML Toolkit users performing validating parsing to indicate that z/OS XML System Services be used as an underlying parsing technology: "z/OS specific parser classes" on page 8
- Chapter 6, "How to use z/OS specific parser classes," on page 39

Changed Information

- Chapter 5, "How to use the XML Parser, C++ Edition," on page 25
- Chapter 6, "How to use z/OS specific parser classes," on page 39
- Chapter 7, "How to use the XSLT Processor, C++ Edition," on page 49

Deleted Information

Summary of Changes
for SA22-7932-06
XML Toolkit Version 1 Release 9

This document is a refresh of *XML Toolkit for z/OS User's Guide*, SA22-7932-05, which supports XML Toolkit Version 1 Release 9.

New Information

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- An introduction to new support that allows XML Toolkit users performing non-validating parsing to indicate that z/OS z/OS XML System Services be used as an underlying parsing technology: “z/OS specific parser classes” on page 8
- Chapter 6, “How to use z/OS specific parser classes,” on page 39

Changed Information

Deleted Information

Summary of Changes
for SA22-7932-05
XML Toolkit Version 1 Release 9

This document contains information previously presented in *XML Toolkit for z/OS User's Guide*, SA22-7932-04, which supports XML Toolkit Version 1 Release 8.

New Information

- Three new appendixes added: Appendix A, “Building samples for native MVS using JCL,” on page 67, Appendix B, “Calling XML Parser, C++ Edition from COBOL,” on page 73, andAppendix C, “Parser environment and instance reuse,” on page 83.
- New information added to each "How to use..." chapter.

Changed Information

Deleted Information

Chapter 1. Introduction

Why XML?

XML allows you to tag data in a way that is similar to how you tag data when creating an HTML file. XML incorporates many of the successful features of HTML, but was also developed to address some of the limitations of HTML. XML tags may be user-defined through a schema for later validation, which can either be a Document Type Definition (DTD) or a document written in the XML Schema language. In addition, namespaces can help ensure you have unique tags for your XML document. The syntax of XML has more restrictions than HTML, but this results in faster and cheaper browsing. The ability to create your own tagging structure gives you the power to categorize and structure data for both ease of retrieval and ease of display. XML is already being used for publishing, as well as for data storage and retrieval, data interchange between heterogeneous platforms, data transformations, and data displays. As it evolves and becomes more powerful, XML may allow for single-source data retrieval **and** data display.

The benefits of using XML vary but, overall, marked-up data and the ability to read and interpret that data provide the following benefits:

- With XML, applications can more easily read information from a variety of platforms. The data is platform-independent, so now the sharing of data between you and your customers can be simplified.
- Companies that work in the business-to-business (B2B) environment are developing DTDs and schemas for their industry. The ability to parse standardized XML documents gives business products an opportunity to be exploited in the B2B environment.
- XML data can be read even if you do not have a detailed picture of how that data is structured. Your clients will no longer need to go through complex processes to update how to interpret data that you send to them because the DTD or schema gives the ability to understand the information.
- Changing the content and structure of data is easier with XML. The data is tagged so you can add and remove elements without impacting existing elements. You will be able to change the data without having to change the application.

However, despite all the benefits of using XML, there are some things to be aware of. First of all, working with marked up data can be additional work when writing applications because it physically requires more pieces to work together. Given the benefits of using XML, this additional work up front can reduce the amount of work needed to make a change in the future. Second, although it is a recommendation developed by the World Wide Web Consortium (W3C), XML, along with its related technologies and standards including Schema, XPath, and DOM/SAX APIs, are still a developing technology.

APIs

DOM

The Document Object Model (DOM) specification is an object-based interface developed by the World Wide Web Consortium (W3C) that builds an XML document as a tree structure in memory. An application accesses the XML data through the tree in memory, which is a replication of how the data is actually structured. The DOM also allows you to dynamically traverse and update the XML document.

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DOM uses a set of C/C++ APIs to interact with the XML data.

The DOM API is ideal when you want to manage XML data or access a complex data structure repeatedly. The DOM API:

- Builds the data as a tree structure in memory.
- Parses an entire XML document at one time.
- Allows applications to make dynamic updates to the tree structure in memory.
- Allows applications to randomly access any item in the memory tree structure.
- Allows applications to generate an XML document by starting with an empty tree, populating it with the desired data, and then serializing it as an XML character document.

Using the DOM API preserves the structure of the document (and the relationship between elements) and does the parsing up front so that you do not have to do the parsing process over again each time you access a piece of data. If you choose to validate your document, you can be assured that the syntax of the data is valid when you are working with it. However, the DOM API requires additional memory to be allocated and freed, initialized and read, translating to increased machine cycles. In addition, the DOM API is, by nature, a four-step process:

1. The application invokes the parser, passing it an XML document.
2. The parser parses the entire document and builds a DOM tree structure in memory.
3. Completion status is returned to the application.
4. The application utilizes DOM APIs to access and optionally modify data in the DOM tree.

The following is a schematic of the DOM parsing model.

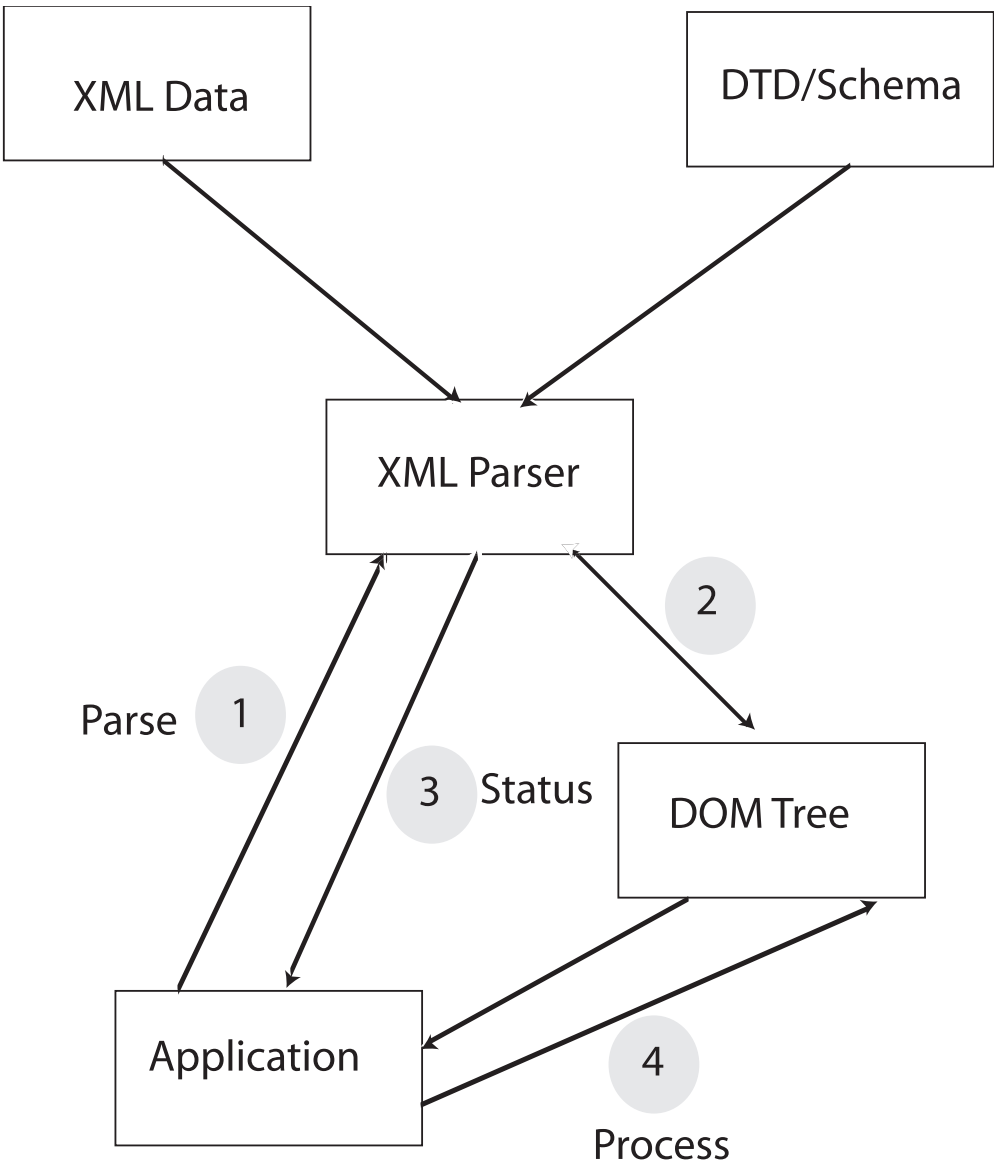

Figure 1. DOM Parsing Model

For information on the Toolkit support for DOM APIs, see the Interfaces and Specifications chart for Toolkit Parser on page 8.

SAX

The Simple API for XML (SAX) specification is an event-based interface developed by members of the XML-DEV mailing list. It uses the parser to access XML data as a series of events in a straight line, which means that the parser finds information in the XML document without retaining state (or context) information.

When writing applications using the SAX specification, you will use a set of C/C++ APIs to interact with the XML data.

The SAX API can provide faster and less costly processing of XML data when you do not need to access all of the data in an XML document. Part of the reason for this performance benefit not seen in DOM arises from the fact that SAX places more burden on the application than does DOM. Often, applications that might

naturally tend to be inclined to use DOM, instead use SAX and work around its limitations, in order to take advantage of those performance benefits. The SAX API does the following:

- Accesses data through a series of events, eliminating the need to build a tree structure in memory.
- Assists the application in determining the most efficient way to build an internal model.
- Allows you to access a small number of elements at one time rather than an entire document.

The SAX API is best for applications that need access to a subset of the data and do not need to understand its relationship to surrounding elements. SAX is also ideal for information that is both generated by and readable by a machine. However, SAX can only traverse the XML document in a single pass, which makes it more expensive when you want to access data repeatedly from an XML document. When it comes to saving needed information from the document or keeping its own understanding of relationships between elements (if that is important), SAX places more burden on the application than does DOM.

The SAX parsing model is a three-step process:

1. The application invokes the parser passing it an XML document. It also passes in the addresses of event handlers for the various SAX events.
2. The parser parses the document, calling the application's event handlers for each token encountered in the XML document.
3. When the document is complete, control is returned to the application.

The following is a schematic of the SAX parsing model.

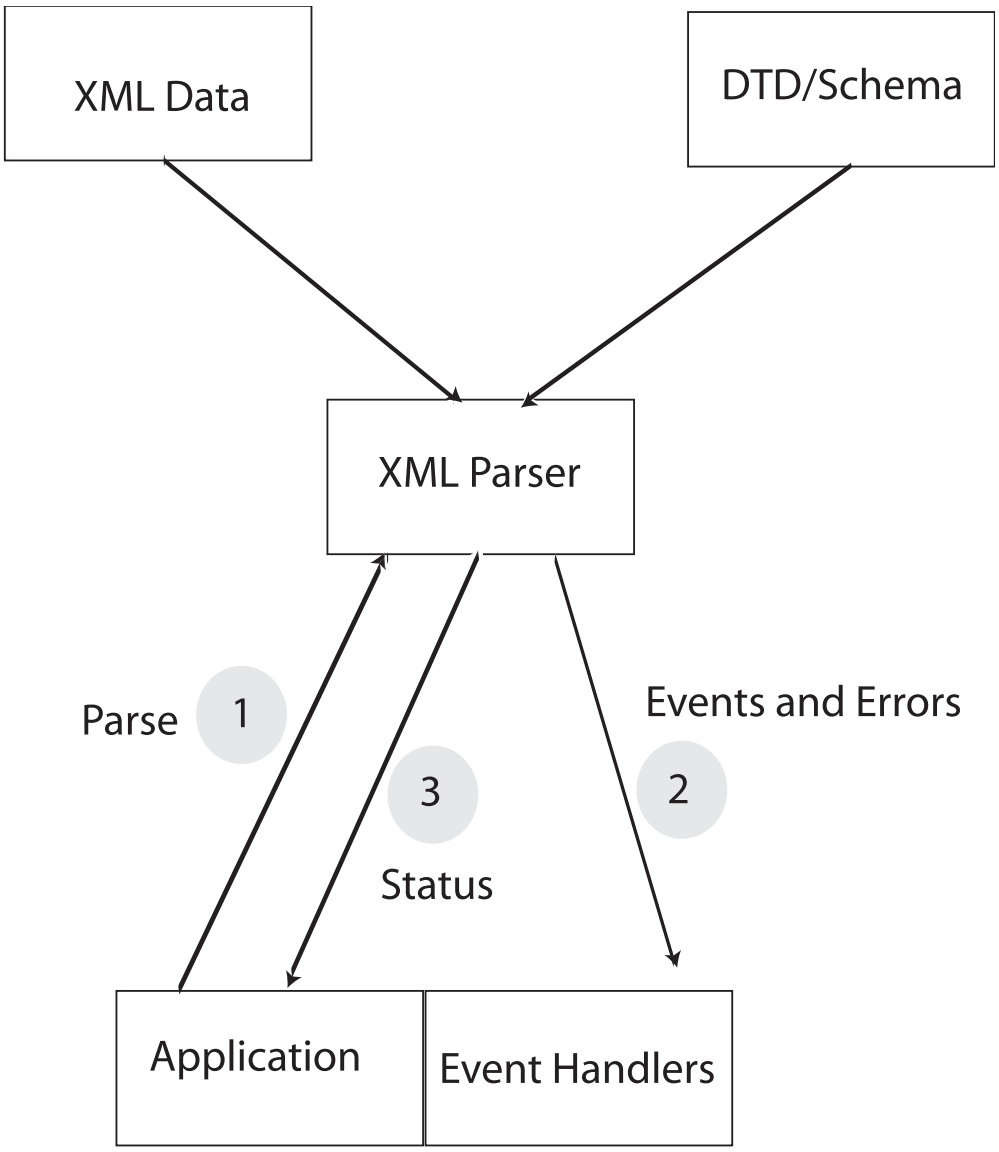

Figure 2. SAX Parsing Model

For information on the Toolkit support for SAX APIs, see the Interfaces and Specifications chart for Toolkit Parser on page 8.

DOM vs SAX

The DOM and SAX APIs can each parse documents efficiently given appropriate conditions. The following table summarizes and compares the characteristics of the DOM API with those of the SAX API:

Table 1. DOM vs SAX

	DOM	**SAX**
Type of Interface	Object based	Event based
Object Model	Created automatically	Must be created by application
Element Sequencing	Preserved	Can be preserved or not, depending on the application

Table 1. DOM vs SAX (continued)

	DOM	SAX
Speed of Initial Data Retrieval	Slower	Faster
Stored Information	Better for complex structures	Better for simple structures
Validation	Optional	Optional
Ability to update XML document	Yes (in memory)	No

XPath

XPath is a language for addressing parts of an XML document, designed to be used by XSLT and other XML-related technologies. It provides basic facilities for manipulation of strings, numbers and booleans. XPath is also designed so that it has a natural subset that can be used for matching (testing whether or not a node matches a pattern). For information on the Toolkit support for XPath, see the Interfaces and Specifications chart for Toolkit Processors on page 8.

Validation

A valid document is one that follows the XML syntax and also conforms to the rules of an associated DTD or XML Schema. (A well-formed document is one that follows the XML syntax.)

Validation is the process of comparing an XML document with a specified DTD or XML Schema. It ensures that the document uses only those tags that have been defined in the DTD or XML Schema as well as ensuring that it conforms to the element rules specified in the DTD or XML Schema.

Validation of an XML document is expensive in terms of machine cycles. If the document is received from a reliable source and the format of the document has been predetermined, validation may not be necessary. However, using validation ensures that only elements defined in the DTD or XML Schema are used and, therefore, the structure of the XML document remains consistent.

If you do not want to validate the document each time you access data, you can, as an example, code an application so that it may reject tags that it does not recognize and takes an appropriate error path. If you do this, you may want to use validation during testing and initial implementation of a new version of an application or temporarily until the source of a document has been accredited.

The following table summarizes the expected results of validation:

Table 2. Expected Validation Results

	Validate Against a DTD or XML Schema	Do Not Validate
Document Is Valid	Once validation is completed, parsing continues.	Validation is ignored and processing continues.
Document Is Not Valid	Validation will result in an error response that will help you determine the error. Parsing is discontinued.	Validation is ignored and processing continues.

XML Toolkit for z/OS

The XML Toolkit for z/OS (Toolkit) provides the base infrastructure to integrate vertical/industry-specific data formats, structures, schemas, and metadata to ensure industry compliance of data representation and content. Some of its key uses include categorizing and tagging data for exchange in disparate environments, as well as transforming ad hoc unstructured data to XML records, enabling you to search, cross-reference, and share records.

The Toolkit includes the XML Parser, C++ Edition. The XML Parser, C++ Edition is a port of IBM's XML4C parser. It is tested and packaged for use on z/OS. XML4C is based on open source code from the Xerces Apache project of the Apache Software Foundation.

The XML Parser, C++ Edition has a set of classes closely resembling the standard SAX2 and DOM classes with slight alterations. These changes allow the XML Parser, C++ Edition to utilize the z/OS XML System Services component to parse XML documents. When these z/OS specific classes are used, a portion of the parse is performed by z/OS XML System Services, gaining a raw performance improvement, along with the ability to take advantage of the more competitive zAAP specialty engines (if present).

The {fullpath to parser}/xml4c-5_7/doc/html directory (hence forth known as the 'XML Parser, C++ Edition product directory'), which can be accessed by a web browser, provides API documentation for XML Parser, C++ Edition. The APIDocs section contains detailed API descriptions.

In addition to the parser, the Toolkit also includes the XSLT Processor, C++ Edition. The XSLT Processor, C++ Edition is a port of IBM's XSLT4C XSLT processor (formerly known as LotusXSL-C++). It is tested and packaged for use on z/OS. The processor is an implementation of the W3C recommendations for XSL Transformations (XSLT) Version 1.0 and XML Path Language (XPath) Version 1.0. XSLT4C is based on open source code from the Xalan Apache project of the Apache Software Foundation. It allows users to transform XML documents into other formats.

The {fullpath to XSLT processor}/xslt4c-1_11/docs directory (hence forth known as the 'XSLT Processor, C++ Edition product directory'), which can be accessed by a web browser, provides API documentation for XSLT Processor, C++ Edition. The API Reference section contains detailed API descriptions.

The Toolkit includes z/OS world-class service and support.

For more information about the Toolkit product, visit the Toolkit Web site at:
`http://www.ibm.com/servers/eserver/zseries/software/xml/`

The following two tables presents a quick summary of the major features found in the XML Toolkit for z/OS. Symbols in the tables have the following meaning:

- "-": feature absent;
- "S": completely supported;
- "P": subset;
- "X": experimental.

Table 3. Interfaces and Specifications for the Toolkit Parser

Interfaces and Specifications	**C++ Edition parser**
DOM 1.0	S
DOM 2.0	S
DOM 3.0	P,X
SAX 1.0	S
SAX 2.0	S
XML 1.0	S
XML 1.1	S
XML Namespaces 1.0	S
XML Namespaces 1.1	S
XML Schema 1.0	S

Table 4. Interfaces and Specifications for the Toolkit Processor

Interfaces and Specifications	C++ Edition processor
XSL Transformations	S
XPATH 1.0	S
XML 1.1	S
XML Namespaces 1.1	S

Sample applications are provided with the Toolkit to help demonstrate its features. The procedures required to set up and configure these sample applications for MVS and z/OS UNIX environments are described in the chapters that follow.

z/OS specific parser classes

The capability exists within the XML Parser, C++ Edition that allows an application to take advantage of the z/OS XML System Services component. A set of z/OS specific parser classes have been implemented in the XML Parser, C++ Edition to provide this ability. These classes were created to closely mimic the existing SAX2 and DOM interfaces. They allow many applications to exploit the improved cost and performance characteristics of the z/OS XML System Services component with minimal changes to their code.

Figure 3 on page 9 illustrates the flow when using the existing open source parser (embedded in the XML Parser, C++ Edition). Applications may continue to use this existing parser functionality without modifications to their code.

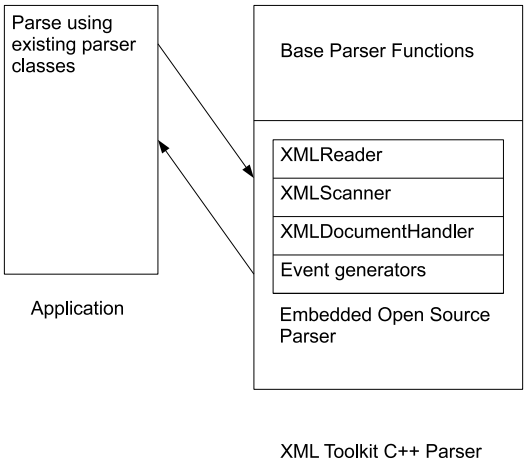

Figure 3. Open source parsing model

When an application does what is referred to as a “Parse using existing parser classes” in the application box, it will use the existing open source parser to parse the XML document. This consists of an XMLReader, an XML Scanner (which is configurable), the XMLDocumentHandler interface which feeds the results back to the application using an event generator that will either generate SAX callback events or create a DOM tree in memory.

Figure 4 on page 10 illustrates the flow when using the new capability provided by the z/OS specific parser classes. In order to take advantage of this functionality, minor code modifications are required.

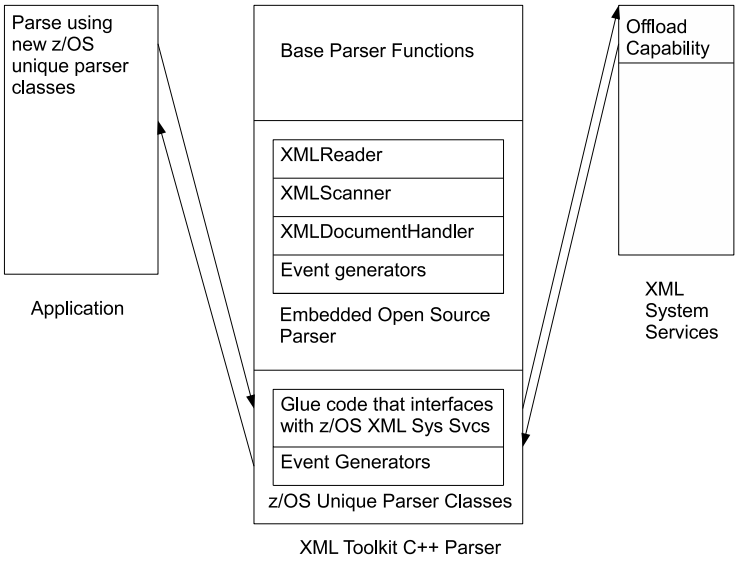

Figure 4. z/OS parsing model

When an application does what is referred to as a “Parse using z/OS specific parser classes”, the z/OS specific parser classes will invoke the z/OS XML System Services component to parse the XML document. The document is passed to z/OS XML System Services in one or more input buffers and will be returned in one or more output buffers. As output buffers are consumed by the new classes, the event generator will either generate SAX2 callbacks events or create a DOM tree in memory.

Note: This implementation does not have a configurable scanner nor does it implement the XMLDocumentHandler interface.

There are some benefits to using the classes that take advantage of z/OS XML System Services:

- z/OS XML System Services can take advantage of redirection of work to zAAP specialty engines, if present.
- Significant performance improvements are possible with the z/OS XML System Services non-validating parser. The performance of the z/OS XML System Services validating parser depend greatly on schema size and complexity, and as a result, performance improvements may or may not occur.

There are some significant differences in behavior in the z/OS specific parser classes that must be considered when deciding if you can use these. Not all of the functionality of the existing base parser classes exists in the z/OS specific parser classes. The functionality that is most widely used is implemented where possible given that z/OS specific parser classes must conform to the behavior of the z/OS XML System Services component:

- z/OS release 1.8 or higher is required.
- Validation using either an internal or external DTD is not supported.
- Validation using schemas is supported on z/OS release 1.9 or higher. However, there are significant differences between the way a validating parse is completed

using the open source parser versus using the newer z/OS specific parser classes, which use the z/OS XML System Services parser for parsing. The following figure illustrates a validating parse using the open source parser:

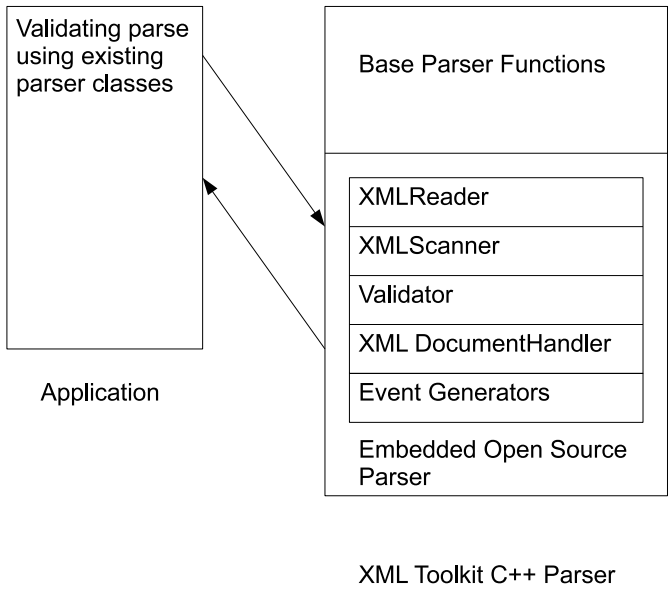

Figure 5. Validating parse with open source parser

In this case, the schemas are auto-detected by the parser, and no explicit action needs to be taken in order to have the schemas loaded. However, when using the new z/OS specific parser classes, the schemas must first be preprocessed into Optimized Schema Representations (OSRs), and then explicitly loaded into the parser by the application before the document is parsed. Because the z/OS XML System Services parser does not dynamically discover which schemas are required to validate a document, the schema must be predetermined before the parse begins. More information on OSRs and schemas in the context the z/OS XML System Services parser can be found in the *z/OS XML System Services User's Guide and Reference* located at http://www.ibm.com/servers/eserver/zseries/zos/xml/. The following figure illustrates the preprocess step that creates the OSR:

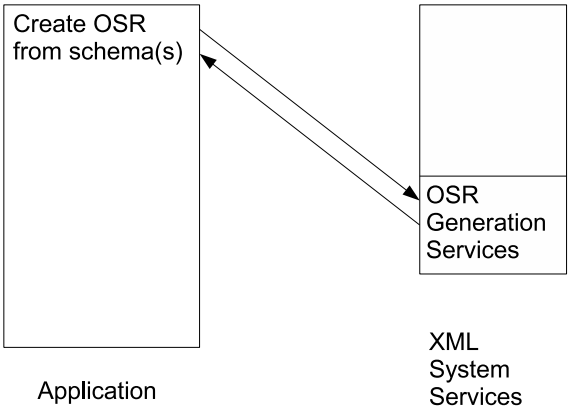

Figure 6. Preprocess step required to create the OSR

The next figure illustrates loading the OSR and doing the validating parse:

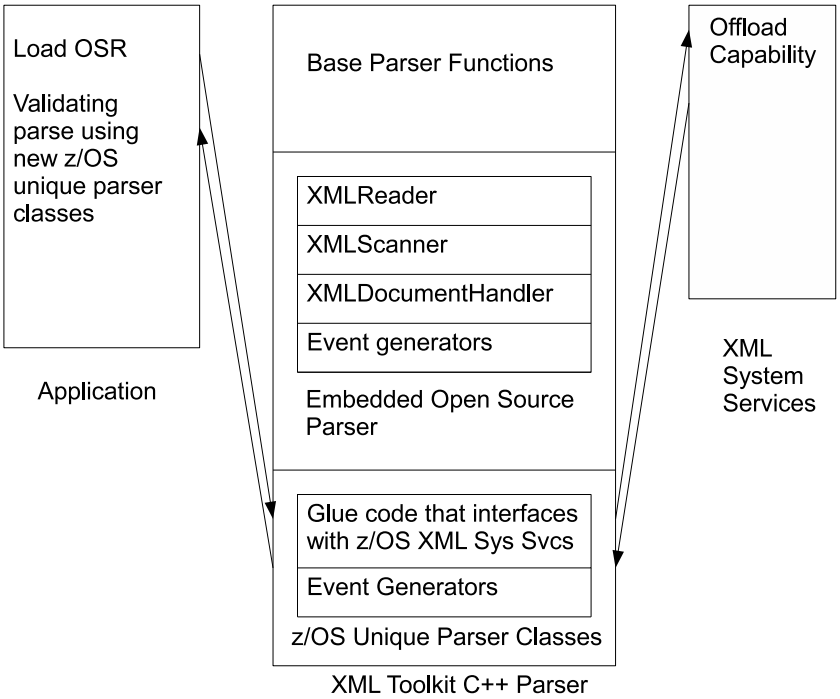

Figure 7. Loading OSR and validating parse

Some differences between the open source parser and the z/OS specific parser classes are as follows:

- Schema grammar caching is not supported.
- Some schema related features and properties are not supported or have required settings. See the accompanying API information provided in the XML Parser, C++ Edition product directory.
- Source offsets are supported on z/OS release 1.10 or higher. However, when the source offsets feature is enabled, there are differences in parsing behavior between the open source parser classes and z/OS specific parser classes. For a list of these differences and other information on source offsets, see "Source offsets" on page 39.

Other differences and considerations include the following:

- The z/OS XML System Services component is a namespace compliant parser only. You may not specify an option to make the parser non-namespace compliant.
- There is no implementation of the XML Entity Resolver. z/OS XML System Services will resolve entity references that are defined in the internal DTD and substitute the replacement text for the entity. However, there is no notification given to the application that this has happened (that is, the SAX2 startEntityReference and endEntityReference are not called).
- There is no ability to force namespaces to be URI conformant.
- Different error messages will be displayed when an XML document contains an error.
  - The new error messages provide an offset to the character in error, not a line and column number.
  - In most cases, the return and reason codes from z/OS XML System Services are displayed as opposed to a specific description of the error.
- SAX1 and deprecated DOM are not supported.
- The SAX2XMLFilter class is not supported.
- The XMLDocumentHandler interface is not implemented.
- The z/OS XML System Services C/C++ 31-bit APIs, which are called by the z/OS specific parser classes, are compiled XPLINK for optimum performance. You should build your 31-bit application using XPLINK and bind it with the XPLINK version of the 31-bit XML Parser, C++ Edition DLLs, otherwise you must set the following environment variable: :

  ```
  export _CEE_RUNOPTS="XPLINK(ON)"
  ```

  If you mix 31-bit non-XPLINK and XPLINK compiled code, there will be a significant performance degradation during execution. It is strongly recommended that when using the new z/OS specific parser classes, only 31-bit XPLINK compiled code is used. This will provide the best possible performance. If, however, your 31-bit application cannot be compiled XPLINK, you should use the 31-bit non-XPLINK version of the parser to avoid this performance penalty.

For more information on the z/OS specific parser classes, including the APIs, examples, and sample programs, see Chapter 6, "How to use z/OS specific parser classes," on page 39. More information on the z/OS XML System Services parser, including return and reason code descriptions, can be found in the *z/OS XML System Services User's Guide and Reference* located at http://www.ibm.com/servers/eserver/zseries/zos/xml/.

Toolkit 64-bit support

The XML Toolkit for z/OS provides support for 64-bit applications. 64-bit library files and sidedecks are provided for the XML Parser, C++ Edition and the XSLT Processor, C++ Edition. A listing of these files along with the build and run steps required to use 64-bit are presented in the following chapters: Chapter 5, “How to use the XML Parser, C++ Edition,” on page 25 and Chapter 7, “How to use the XSLT Processor, C++ Edition,” on page 49.

Note: 64-bit is pure XPLINK; there are no non-XPLINK library files or sidedecks associated with it. Therefore, when using 64-bit support, the build and run steps specifically for XPLINK versus non-XPLINK applications can be ignored.

Note: The APIs that support querying source offsets will return an unsigned long (64 bit) value in 64-bit mode:

- getSrcOffset() - in the following classes: SAX2XMLReader, zXercesDOMParser, zSAX2XMLReader, zDOMBuilder, XercesDOMParser, SAXParser, DOMBuilder
- getSrcOffsetEnd() - in the following classes: zXercesDOMParser, zSAX2XMLReader, zAttributes
- getSrcOffsetNameTagEnd() - in the following classes: zXercesDOMParser, zSAX2XMLReader
- getSrcOffsetStart() - in the following classes: zXercesDOMParser, zSAX2XMLReader, zAttributes

In 31-bit mode, these APIs return an unsigned int (32 bit) value.

Toolkit 31-bit support

The XML Toolkit for z/OS provides support for 31-bit XPLINK and non-XPLINK applications. 31-bit XPLINK and non-XPLINK library files and sidedecks are provided for the XML Parser, C++ Edition and the XSLT Processor, C++ Edition. A listing of these files along with the build and run steps required to use 31-bit are presented in the following chapters: Chapter 5, “How to use the XML Parser, C++ Edition,” on page 25 and Chapter 7, “How to use the XSLT Processor, C++ Edition,” on page 49.

Deprecated DOM support

The previously deprecated DOM code has been removed from the main XML Toolkit Parser DLL to reduce the DLL's footprint. If you want to use the deprecated DOM code, you will need to include the new sidedeck for the deprecated DOM code. The DLL and sidedeck names are listed in Table 6 on page 29 and Table 8 on page 33.

Note: Deprecated DOM support is not available for 64-bit mode.

Toolkit support for both z/OS UNIX System Services and MVS environments

The Toolkit supports applications running on both z/OS UNIX System Services and MVS environments. To better understand how the Toolkit provides this support, you need to recognize the differences between these two types of environments, and the applications supported on them. The following table provides an introductory comparison of these two environments:

Table 5. z/OS UNIX vs. MVS

	z/OS UNIX Environment	**MVS Environment**
Parallel Processing Model	pthreads	tasks
JES Batch Processing	posix enabled batch	non-posix batch
File access	HFS or data sets	data sets only
Command environment	UNIX shell or BPXBATCH	TSO or batch

For more information on how these environments compare, visit the following Web page:

`http://www.ibm.com/servers/eserver/zseries/zos/unix/release/ncomp2.html`

Chapter 2. How to access XML data

The XML parser (as well as the XSLT processor) was designed to utilize the Uniform Resource Identifiers (URI) standard to access files. This standard is described in RFC 2396 . Most APIs that need to access data support both absolute URIs and relative URIs, aside from the following exception: The XSLT processor output parameter only supports relative URIs.

How to access data sets

The URI design is based on a hierarchical file system naming scheme. Traditional MVS data set naming schemes do not fit directly within this scheme so some adaptation has been required in order to be able to access data sets from XML. Fortunately, there is a precedent for accessing data sets when running a C++ program from UNIX and that is to prefix the data set name with '//'. Here is an example:

```
//'USER1.SAMPLE.XML(PERSON1)'
//SAMPLE.XML(PERSON1)
```

The '//' tells a C++ program running from the UNIX APIs to look for the name as a data set rather than in an HFS. The single quotes tell it not to add on the user's default high level qualifier. In addition, if you are running from a batch or started task environment, the data set can be accessed using DD statements in the JCL. The following is an example:

```
//DD:SAMPFILE(PERSON1)
```

Where the following DD is also defined in the JCL:

```
//SAMPFILE DD   DSN=USER1.SAMPLE.XML,DISP=SHR,
//      VOL=SER=BPXLK2,UNIT=3390
```

All the examples above will access the same member of the same data set.

Relative URIs

In the cases where relative URIs are allowed, these data set definitions can be used instead of the traditional hierarchical file system parameters. Using this format, there is no 'path' distinction as in a hierarchical system. Here is an example invocation of the SAXCount sample program passing a data set name:

```
SAXCount '//sample.xml(person1)'
```

The quotes are needed so that UNIX doesn't see the parentheses as errors. MVS also has a convention of adding a default high level qualifier if one is present. If you don't want to have the default high level qualifier added on, use single quotes around the data set name and double quotes around the whole parameter:

```
SAXCount "//'user1.sample.xml(person1)'"
```

When used in batch, JCL requires single quotes around the parameters, so you must use a pair of single quotes:

```
PARM='/  //''user1.sample.xml(person2)'''
```

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You may have noticed that there is an extra '/' in the beginning of the parameters. This is required by JCL to separate run-time options from the parameters.

Absolute URIs

Data sets can also be specified using absolute URIs. (Note: The XSLT Processor, C++ Edition does not support absolute URIs). Since the convention for accessing data sets is to start with a '//' and this convention is also used to distinguish the absolute URIs with host names, you can only specify an absolute URI using the host format. The host name itself is still optional. Here are some examples:

```
SAXCount 'file:////sample.xml(person1)'
     SAXCount 'file://localhost//sample.xml(person1)'
     SAXCount "file:////'user1.sample.xml(person1)'"
     PARM='/ file:////''user1.sample.xml(person2)'''
```

In addition, when using XML in a batch or started task environment, you can use the **//DD:** format to access a data set that is defined by way of a DD statement. The following is an example:

```
SAXCount 'file:////dd:sampfile(person1)'
```

Considerations when using the Xalan C++ commands

Most interfaces that need to access data support both absolute URIs and relative URIs. The following are some known exceptions:

- The Xalan command output parameter only supports relative URIs.
- The Xalan command input parameters (for the XML file and the XSL file) support all URIs for UNIX files, but only absolute URIs for MVS data sets.

For more information on the Xalan command, see Chapter 8, “How to use the XML Toolkit command line utilities,” on page 61. For more information on Xalan itself, see “XML Toolkit for z/OS” on page 7.

DTDs, Schema and other embedded files

The conventions described above also apply to files which are referenced within XML documents, such as DTDs. Here is an example xml DOCTYPE statement to access a data set:

```
DOCTYPE personnel SYSTEM "file:////'USER1.SAMPLE.DTD(PERSON1)'"
```

Chapter 3. Encoding issues

The promise of XML is that it is portable and works on all platforms. Making this work effectively and efficiently requires program design that takes into account the specific situation pertinent to a particular application (for example, where the document originates, where it is likely to be processed, the performance requirements, the throughput requirements, where the document is stored and how it is likely to be accessed). Proper encoding of XML documents will require thought and consideration at application design time.

The following information is intended to give application programmers guidance on how to deal with encoding of XML documents on z/OS.

Encoding and XML

This section presents the encoding rules in a simple and straightforward manner as background to the discussion of encoding of XML on z/OS. It is not intended to reproduce the detail of the XML 1.0 specification or to cover every possible case.

The XML standard defines encoding fairly rigorously. If the document is not in UTF-8 or UTF-16, the encoding of the document must be specified using the *encoding=* attribute on the XML declaration. Also, even though it is possible for the encoding specified using the transport protocol to override the encoding declaration, it is strongly advised that the actual encoding of the document match the encoding specified on the encoding= attribute. Problems can occur if the document is converted from one code page to another without the *encoding=* attribute being changed. There are places where conversion takes place without the knowledge of the application programmer. Examples of these include file transfer using ftp (File Transfer Program) without the binary option and storing files in a database using DRDA.

Whenever possible, avoid letting these types of conversions take place so that mismatches do not occur. The XML parser for z/OS converts the document to Unicode for processing and is capable of handling many different code pages. Also, converting from one code page to another can cause loss of data if there are code points in the original code page that are not present in the target code page. Avoiding conversion prior to calling the parser results in the most efficient (from a performance perspective) and least error-prone solution. Conversion is expensive and if the document is converted before the parser is invoked, two conversions actually occur - once from the original code page and once to Unicode within the parser. Therefore, use the binary option on ftp and equivalent file transfer mechanisms.

XML is intended to be a portable data format. The truly portable encoding is Unicode. Therefore whenever possible, it is best to use Unicode as the encoding for XML documents. However, not all platforms provide easy to use facilities for handling Unicode. As a compromise, ASCII is another portable encoding that is better supported by way of facilities. It is recommended that XML documents intended for use on other platforms be encoded in US ASCII or UTF-8 or UTF-16. This also provides performance benefits because the XML parser is optimized for these encodings.

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XML and z/OS

The current XML W3C recommendation (XML 1.0) specification defines CR (Carriage Return), LF (Line Feed), and the combination CR-LF (Carriage Return followed by Line Feed) as acceptable end-of-line characters. These characters are to be converted to LF by the XML parser. Unfortunately, the XML 1.0 specification does not define NEL (New Line or Next Line) as acceptable.

This presents a problem on z/OS because the most common end-of-line character on z/OS is NEL. The C '\n' string converts to NEL, and editors and file I/O routines in the C runtime insert NEL to indicate end-of-line in byte oriented file systems like the HFS (Hierarchical File System). Therefore, if the XML document is created using C or C++ and the application programmer does not do any special programming to avoid it, the line ending character will be NEL. This is not recommended for XML documents because by nature, they are intended to be portable. The NEL is common on z/OS but not on other platforms and therefore is not portable.

Unfortunately, this means that the application programmer has to be aware of this fact and program around it. There are two options available to programmers writing code to create XML documents.

1. The simplest way to create portable XML documents is to use iconv() to convert them to ASCII or Unicode before sending them out of the application program. The runtime function iconv() will convert the NEL to LF in ASCII and the problem is therefore avoided.
2. Another option is to define a literal for LF and use it instead of the string '\n' to create line breaks. This approach works if the file will not be edited or otherwise manipulated on z/OS (remember, most mainframe editors insert NEL characters!). Also, if this file is edited on z/OS, the document will appear to be a single line (since there aren't any NEL characters in it) and therefore will not be very readable.

Note: This is not an issue in the native MVS environment where file systems are record oriented and typically do not require end of line characters.

If you need to edit or view the file on z/OS, it is best to convert it to ASCII and then use viascii (available at z/OS Unix Tools) to edit it.

For the other case, where the program is processing a received XML document, the situation is more complex. The fastest (and in some cases, the simplest) solution is to not convert the file into EBCDIC. If the file is in ASCII or Unicode, then it will have LF as the end-of-line indicator and there won't be any problem with the line ending. However, this is much more complex for a z/OS application program to deal with. Depending on the specific situation (for example, development/test vs production), conversion may or may not be required. However, the recommendation to avoid conversion if at all possible, still holds, especially in a production environment where the cost of conversion can be prohibitive. For development/test situations, where the file may have to be viewed or edited for debugging purposes, conversion may be the right answer. The parser converts all the data into Unicode so converting the data to EBCDIC after parsing is required. At this point, only data that is required needs to be converted, rather than the entire XML document. Note that converting small strings may be less efficient than converting larger strings. Also, handling Unicode or ASCII data in a z/OS program does require care in programming and isn't always simple. All these factors need to be considered in a set of trade-offs when designing the application.

If the file is in EBCDIC and has been created or modified on a z/OS system, then the line ending character is typically a NEL. The XML Parser, C++ Edition will accept XML documents that have a NEL as a line termination character. Even though these are non-compliant XML documents, the parser will normalize the line-endings to LF. However, because these documents are non-compliant, they may not be accepted by parsers on other platforms. In general, EBCDIC is not a portable encoding so IBM does not recommend using EBCDIC for XML documents going between platforms or on the Internet.

Note: XML 1.1 does support NEL

Avoiding conversion

Most transport protocols have mechanisms to avoid conversions. Here are some of the more common products used for transport and the options to turn off conversion (if they exist). Detailed descriptions of these options and their uses are in the documentation associated with each product.

File Transfer Program (FTP)
The binary option prevents FTP from converting the file.

MQSeries
Do not specify MQGMO_CONVERT option on the MQGET call.

DRDA It is not possible to turn off conversion except by using 'FOR BIT DATA' but this can have other side effects. The DB2 XML Extender has filters that convert LF to NEL and vice versa to ensure that the document is correct.

Chapter 4. How to use Toolkit 31-bit XPLINK support

Extra Performance Linkage (XPLINK) is a call linkage between programs that have the potential for a significant performance increase when used in an environment of frequent calls between small functions or subprograms. The Object Oriented aspect of C++ causes much C++ code to fall into this category.

Note: All references herein to XPLINK and non-XPLINK apply only to the 31-bit version of the Toolkit.

An XPLINK copy of the XML Parser, C++ Edition and the XSLT Processor, C++ Edition 31-bit library files and sidedecks are provided in addition to the non-XPLINK versions. A listing of these files along with the build and run steps required to use XPLINK are presented in the following chapters: Chapter 5, “How to use the XML Parser, C++ Edition,” on page 25 and Chapter 7, “How to use the XSLT Processor, C++ Edition,” on page 49.

Using Toolkit 31-bit XPLINK support

Under certain circumstances, it may be appropriate to use the XPLINK Toolkit code. If you have an existing application that is pure XPLINK and you need to do XML parsing or XSLT processing, you should see a performance improvement if you were previously using your XPLINK application with the 31-bit non-XPLINK Toolkit code. This is because when you use your XPLINK application with the 31-bit non-XPLINK Toolkit code, you incur a significant performance penalty each time you call the Toolkit. This performance penalty is a result of having to run through additional code to convert the XPLINK stack structure and register conventions to the format that the 31-bit non-XPLINK Toolkit expected. When the Toolkit finishes converting, there is additional overhead (another performance penalty) restoring the XPLINK environment upon return. As a result, you should see a significant benefit by calling XPLINK Toolkit code from your XPLINK application, since you'll be avoiding the performance penalties of having to do the XPLINK to non-XPLINK, and then back XPLINK code conversions.

If your application is non-XPLINK, then you should continue to use the 31-bit non-XPLINK Toolkit code. Calling the XPLINK Toolkit code from a 31-bit non-XPLINK application will most likely perform worse than if you continue to use the 31-bit non-XPLINK Toolkit code.

If you can convert your 31-bit non-XPLINK application to be 100 percent XPLINK, then you should see a significant benefit using the XPLINK XML Toolkit code.

For best results, you want all of the 31-bit code you are calling to be built using XPLINK. For example, you would not want to bind an XPLINK application with the XPLINK XML Parser, C++ Edition main DLL (libxml4c-5_7_0.xplink.dll) and the non-XPLINK deprecated DOM DLL (libxml4c-depdom5_7_0.dll).

For more information on XPLINK, refer to the *z/OS Language Environment Programming Guide* Chapter 3, "Using Extra Performance Linkage (XPLINK).

Building an XPLINK application

In order to build an XPLINK application, you need to specify the XPLINK compiler option (`-Wc,XPLINK`) during compilation. When link-editing your application, you must

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use the DFSMS binder and specify the XPLINK binder option (`-Wl,XPLINK`). You also need to include the XPLINK sidedeck on the bind step.

The 31-bit samples provided in the Toolkit are pre-built non-XPLINK. If you want to build an XPLINK version of them, you can set an environment variable that has been added in support of XPLINK. The environment variable, once set, will apply the correct compiler and binder options in the Makefile and the correct XPLINK sidedeck will also be included. To build an XPLINK copy of the samples, do the following:

```
export OS390_XPLINK=1
```

For the XSLT Processor, C++ Edition samples there is an extra step needed to pickup the correct version of the Standard C++ library (see Chapter 7, “How to use the XSLT Processor, C++ Edition,” on page 49 for more information).

Running an XPLINK application

If the initial program you call is compiled XPLINK, then Language Environment will initialize the enclave as an XPLINK environment. If your initial program is non-XPLINK, and you are calling an XPLINK program later on, then you need to specify the `XPLINK(ON)` runtime option so that calls may be made between XPLINK and non-XPLINK programs.

When you build the samples and use the OS390_XPLINK environment variable, `XPLINK(ON)` runtime options never needs to be set.

Chapter 5. How to use the XML Parser, C++ Edition

Samples have been provided to demonstrate the features of the XML Parser, C++ Edition. These samples use simple applications written on top of the SAX and DOM API's. See “Why XML?” on page 1 for more information on the APIs. The following samples can be found in the samples directory:

SAXCount
counts the elements, attributes, spaces and characters in an XML file

SAX2Count
same as SAXCount, except uses SAX 2.0

SAXPrint
parses an XML file and prints it out

SAX2Print
same as SAXPrint, except uses SAX 2.0

DOMCount
counts the elements, attributes, spaces and characters in an XML file

DOMPrint
parses an XML file and prints it out

MemParse
parses XML in a memory buffer, outputting the number of elements and attributes

Redirect
redirects the input stream for external entities

PParse
demonstrates progressive parsing

PSVIWriter
exposes the underlying PSVI of the parsed XML file

SCMPrint
parses an XSD file and prints information about the Schema Component Model

StdInParse
demonstrates streaming XML data from standard input

EnumVal
shows how to enumerate the markup declarations in a DTD validator

SEnumVal
shows how to enumerate the markup declarations in a Schema validator

CreateDOMDocument
creates a DOM tree in memory from scratch

C_sample
shows how to invoke the XML Parser, C++ Edition from a C program

Rule: These samples are only examples of how to exploit the XML Parser, C++ Edition. You will need to modify your own applications accordingly.

Pre-built versions of the samples for the z/OS UNIX environment are included in the Toolkit. These can be used to illustrate XML concepts, validate XML documents, and validate DTDs and schemas during development. See “Using the sample

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applications" on page 26 section for instructions on how to use these pre-built versions. Also, source code is provided in the Toolkit for all of the samples to aid developers in getting started with their applications.

Rule: The prebuilt 64-bit samples shipped with the Toolkit can be found in the `{fullpath to XML Parser}/xml4c-5_7/bin64` directory. The prebuilt 31-bit samples shipped with the Toolkit are the non-XPLINK versions and can be found in the `{fullpath to XML Parser}/xml4c-5_7/bin` directory. If you want to use the XPLINK versions of the 31-bit samples, then you must build your own copy of them.

The procedures for building and using your built samples differ depending on the target environment. The procedures for building your samples are outlined in sections "z/OS UNIX Environment" on page 29 and "Building sample applications for the MVS Environment" on page 32. The procedures for using your built samples are outlined in sections "Using your sample applications on the z/OS UNIX Environment" on page 31 and "Using your sample applications on the MVS Environment" on page 35

The XML Parser, C++ Edition component is installed in `/usr/lpp/ixm/IBM/xml4c-5_7` by default. It contains the following sub-directories:

/doc contains online APIs and design documentation

/include
used for building samples

/lib used for running the parser code

/bin used for the 31-bit samples

/bin64 used for the 64-bit samples

In addition to the sub-directories, the Toolkit includes the following data sets:

hlq.SIXMLOD1
used for running the parser code in an MVS environment

hlq.SIXMEXP
used to build applications for an MVS environment

Using the sample applications

Note: The pre-built samples can be run in a z/OS UNIX command environment.

Before running the samples, you must ensure that several environment variables are set properly. First, set up an environment variable to point to the location where the XML Toolkit, C++ Parser component was installed:

```
export XERCESCROOT=/usr/lpp/ixm/IBM/xml4c-5_7
```

Then type in the following command statements:

```
export LIBPATH=$XERCESCROOT/lib:$LIBPATH
export PATH=$XERCESCROOT/bin:$PATH
(use $XERCESCROOT/bin64 for 64-bit samples)
```

You are now set to run the sample applications. For example, to run the DOMPrint application from the *$XERCESCROOT/bin* directory, type the following command statement:

```
cd $XERCESCROOT/samples/data
DOMPrint -v=always -wenc=IBM-1047-s390 -wfpp=on personal.xml
(use "-v=auto" for personal-schema.xml)
```

This sample application will then parse the personal.xml file, construct the DOM tree, and invoke DOMWriter::writeNode() to serialize the resultant DOM tree back to an XML stream. The following is a sample output from DOMPrint:

```
<?xml version="1.0" encoding="IBM-1047-s390" standalone="no" ?>
<!DOCTYPE personnel SYSTEM "personal.dtd">
<personnel>

  <person id="Big.Boss">
    <name>
      <family>Boss</family>
      <given>Big</given>
    </name>
    <email>chief@foo.com</email>
    <link subordinates="one.worker two.worker three.worker four.worker five.worker"/>
  </person>

  <person id="one.worker">
    <name>
      <family>Worker</family>
      <given>One</given>
    </name>
    <email>one@foo.com</email>
    <link manager="Big.Boss"/>
  </person>

  <person id="two.worker">
    <name>
      <family>Worker</family>
      <given>Two</given>
    </name>
    <email>two@foo.com</email>
    <link manager="Big.Boss"/>
  </person>

  <person id="three.worker">
    <name>
      <family>Worker</family>
      <given>Three</given>
    </name>
    <email>three@foo.com</email>
    <link manager="Big.Boss"/>
  </person>

  <person id="four.worker">
    <name>
      <family>Worker</family>
      <given>Four</given>
    </name>
    <email>four@foo.com</email>
    <link manager="Big.Boss"/>
  </person>
```

```
  <person id="five.worker">
    <name>
      <family>Worker</family>
      <given>Five</given>
    </name>
    <email>five@foo.com</email>
    <link manager="Big.Boss"/>
  </person>


</personnel>
```

Help for each of the samples can be displayed by using the `-?` parameter. For example, to display help for the `MemParse` sample, type the following:

```
MemParse -?
```

This will display the following text:

```
Usage:
MemParse [options]
This program uses the SAX Parser to parse a memory buffer
containing XML statements, and reports the number of
elements and attributes found.

Options:
-v=xxx Validation scheme [always | never | auto*].
-n Enable namespace processing. Defaults to off.
-s Enable schema processing. Defaults to off.
-f Enable full schema constraint checking. Defaults to off.
-? Show this help.

* = Default if not provided explicitly.
```

Rule for running 64-bit samples

In order to run the 64-bit samples, the XML Parser, C++ Edition requires the run-time libraries provided by Language Environment, SCEERUN and SCEERUN2, to be made available in the program search order. The best way to do this is by adding the SCEERUN and SCEERUN2 data sets into the LNKLST. If you do not wish to add SCEERUN and SCEERUN2 to the LNKLST, access SCEERUN and SCEERUN2 data sets through STEPLIB.

Rule for running 31-bit non-XPLINK samples

In order to run the 31-bit non-XPLINK samples, the XML Parser, C++ Edition requires the run-time library provided by Language Environment, SCEERUN, to be made available in the program search order. The best way to do this is by adding SCEERUN data set in the LNKLST. If you do not wish to add SCEERUN to the LNKLST, access SCEERUN data set through STEPLIB.

Rule for running 31-bit XPLINK samples

In order to run the 31-bit XPLINK samples, the XML Parser, C++ Edition requires the run-time libraries provided by Language Environment, SCEERUN and SCEERUN2, to be made available in the program search order. The best way to do

this is by adding the SCEERUN and SCEERUN2 data sets into the LNKLST. If you do not wish to add SCEERUN and SCEERUN2 to the LNKLST, access SCEERUN and SCEERUN2 data sets through STEPLIB.

z/OS UNIX Environment

Building sample applications for the z/OS UNIX Environment

Before being able to build the provided samples, the system environment must be configured correctly. Doing so requires the use of the GNU make utility (gmake). To download gmake go to:

```
http://www.ibm.com/servers/eserver/zseries/zos/unix/bpxa1ty1.html#gmake
```

After you have downloaded gmake, issue the following command against the install file:

```
pax -rzf
```

This will place the gmake program into the `/bin` directory (the `/bin` directory was created by the `pax` command). For additional information on using gmake, see the IBM redbook Open Source Software for OS/390 UNIX, SG24-5944 available online at:

```
http://www-1.ibm.com/servers/eserver/zseries/zos/unix/redbook/index.html
```

Please note that all references to gmake refer to the GNU make utility.

Product files are required to build the XML Parser, C++ Edition on z/OS UNIX. These files and their descriptions are displayed in the following table:

Table 6. Product Files Required to Build Sample XML Applications for z/OS UNIX Environments

Product file name	Product file description
files in the `include` directory	C++ header files contained in the `include` directory. These are required in order to compile application code.
31-bit non-XPLINK product files	
libxml4c5_7_0.x	The definition side-deck contained in the `lib` directory that describes the XML Parser, C++ Edition external functions and the variables. This is required in order to bind application code.
libxml4c-depdom5_7_0.x	The definition side-deck that describes the previously deprecated DOM APIs; it is only required if you are using these APIs.
31-bit XPLINK product files	
libxml4c5_7_0.xplink.x	The definition side-deck contained in the `lib` directory that describes the XML Parser, C++ Edition external functions and the variables. This is required in order to use XPLINK to bind application code.

Table 6. Product Files Required to Build Sample XML Applications for z/OS UNIX Environments (continued)

Product file name	Product file description
libxml4c-depdom5_7_0.xplink.x	The definition side-deck that describes the previously deprecated DOM APIs; it is only required if you are using these APIs and compiling with XPLINK.
64-bit product files	
libxml4c5_7_0q.x	The definition side-deck contained in the `lib` directory that describes the XML Parser, C++ Edition external functions and the variables. This is required in order to bind application code.

Rules for invoking the XML Parser, C++ Edition in z/OS UNIX

Any application that is to invoke the XML Parser, C++ Edition parser under the z/OS UNIX System Services environment must include either the 31-bit non-libxml4c5_7_0.x (libxml4c5_7_0.xplink.x if using XPLINK) or 64-bit libxml4c5_7_0q.x, when they bind. The binder uses the definition side-deck to resolve references to functions and variables defined in libxml4c5_7_0.dll (libxml4c5_7_0.xplink.dll if using XPLINK) or libxml4c5_7_0q.dll.

If you are using the deprecated DOM APIs, you need to include the 31-bit libxml4c-depdom5_7_0.x sidedeck, or for XPLINK applications, the 31-bit libxml4c-depdom5_7_0.xplink.x sidedeck.

The next thing you need to do is set the XML4C root path. To set it correctly, issue the following command statement:

```
export XERCESCROOT=/usr/lpp/ixm/IBM/xml4c-5_7
```

Now, you need to obtain access to a copy of the samples directory to which you have write access. Unless you are a superuser, you normally will not have write access to the samples subdirectory that was shipped with the product. In this case, you will need to do the following:

1. Create a new directory that you have write access to, for example:

   ```
   cd $HOME
   mkdir mysamples
   ```

2. Set a new environment variable that contains the full path to this new directory, as follows:

   ```
   export XERCESCOUT=$HOME/mysamples
   ```

3. Copy the samples directory to your directory:

   ```
   cp -r /usr/lpp/ixm/IBM/xml4c-5_7/samples $XERCESCOUT
   ```

Since the `XERCESCOUT` environment variable is set, that copy of the samples subdirectory will be used. The binary files will be stored in a "bin" subdirectory.

After you have copied the samples directory, you need to set up environment variables. This is done through the following sequence:

```
unset _CXX_CXXSUFFIX
export CXX=c++
export CXXFLAGS="-2"
```

If debugging is desired, the *-g* option can be used instead of the *-2* option in the `export CXXFLAGS` statement.

The next statement is only required for building 31-bit XPLINK samples:

```
export OS390_XPLINK=1
```

The next statement is only required for building 64-bit samples:

```
export OS390_BIT64=1
```

Once the environment variables have been properly set, Makefiles must be created. The directory in which you create the Makefiles depends on where you are building the samples. If you have set the `XERCESCOUT` environment variable, type the following:

```
cd $XERCESCOUT/samples
configure
```

Finally, to build the samples, type the following in the directory in which you created the Makefiles:

```
export _CXX_CXXSUFFIX=cpp
export _CXX_CCMODE=1
gmake
```

After issuing the gmake command, the build process is completed. The samples are built into the `$XERCESCOUT/bin` directory. Proceed to the next section to see how to run your newly built sample applications.

Using your sample applications on the z/OS UNIX Environment

Library files are required to run XML Parser, C++ Edition on z/OS UNIX. These files can be found in the *$XERCESCROOT/lib* directory. The file names and their descriptions are displayed in the following table:

Table 7. Library Files Required to Run Sample XML Applications on z/OS UNIX

Library File Name	Library File Description
31-bit non-XPLINK library files	
libxml4c5_7_0.dll	XML Parser, C++ Edition library file
libxml4c5_7_0-depdom.dll	library file for the previously deprecated DOM API
libicudata38.0.dll, libicudata_stub38.0.dll, libicuuc38.0.dll, libicui18n38.0.dll	ICU library files
31-bit XPLINK library files	
libxml4c5_7_0.xplink.dll	XML Parser, C++ Edition library file
libxml4c-depdom5_7_0.xplink.dll	library file for the previously deprecated DOM API

Table 7. Library Files Required to Run Sample XML Applications on z/OS UNIX (continued)

Library File Name	Library File Description
libicudata38.1.xplink.dll, libicudata_stub38.1.xplink.dll, libicuuc38.1.xplink.dll, libicui18n38.1.xplink.dll	ICU library files
64-bit library files	
libxml4c5_7_0q.dll	XML Parser, C++ Edition library file
libicudata38.1q.dll, libicuuc38.1q.dll. libicui18n38.1q.dll	ICU library files

Before running the samples, you must ensure that several environment variables are set properly. First, set up an environment variable to point to the location where the XML Parser, C++ Edition component was installed:

```
export XERCESCROOT=/usr/lpp/ixm/IBM/xml4c-5_7
```

Then type in the following command statements:

```
export LIBPATH=$XERCESCROOT/lib:$LIBPATH
```

Then set the PATH to locate the samples you have just built:

```
export PATH=$XERCESCOUT/bin:$PATH
```

You are now set to run your sample applications. For example, to run the SAXCount application from the *$XERCESCOUT/bin* directory, type the following command statement:

```
SAXCount $XERCESCROOT/samples/data/personal.xml
```

This sample application will then count the number of elements, attributes, spaces and characters in the XML file personal.xml .

MVS Environment

Building sample applications for the MVS Environment

Before being able to build the provided samples, the system environment must be configured correctly. Doing so requires the use of the GNU make utility (gmake). To download gmake go to:

```
http://www.ibm.com/servers/eserver/zseries/zos/unix/bpxa1ty1.html#gmake
```

After you have downloaded gmake, issue the following command against the install file:

```
pax -rzf
```

This will place the gmake program into the `/bin` directory (the `/bin` directory was created by the `pax` command). For additional information on using gmake, see the IBM redbook *Open Source Software for OS/390 UNIX*, SG24-5944 available online at:

http://www-1.ibm.com/servers/eserver/zseries/zos/unix/redbook/index.html

Please note that all references to gmake refer to the GNU make utility.

Product files are required to build the XML Parser, C++ Edition on MVS. These files and their descriptions are displayed in the following table:

Table 8. Product Files Required to Build Sample XML Applications for MVS Environments

Product file name	Product file description	Data set name
files in the `include` directory	C++ header files contained in the `include` directory. These are required in order to compile application code.	
31-bit non-XPLINK product files		
IXM4C57X	Definition side-deck that describes the XML Parser, C++ Edition functions and the variables.	*hlq*.SIXMEXP
IXMDD57X	Definition side-deck that describes the previously deprecated DOM APIs; it is only required if you are using these APIs.	*hlq*.SIXMEXP
31-bit XPLINK product files		
IXM4C7AX	Definition side-deck that describes the XML Parser, C++ Edition functions and the variables. This is required in order to use XPLINK to bind application code.	*hlq*.SIXMEXP
IXMDD7AX	Definition side-deck that describes the previously deprecated DOM APIs; it is only required if you are using these APIs and XPLINK.	*hlq*.SIXMEXP
64-bit product file		
IXM4C7QX	Definition side-deck that describes the XML Parser, C++ Edition functions and the variables.	*hlq*.SIXMEXP

Rules for invoking the XML Parser, C++ Edition in native MVS

Any application that is to invoke the XML Parser, C++ Edition parser under the native MVS environment must include one of the following definition side-decks when they bind: IXM4C7QX (for 64-bit applications), IXM4C57X (for 31-bit non-XPLINK applications) or IXM4C7AX (for 31-bit XPLINK applications). The binder uses the definition side-deck to resolve references to functions and variables defined in IXM4C7QX, IXM4C57 or IXM4C7A. In addition to the above, any applications that wish to use previously deprecated DOM APIs must also include either of the following definition side-decks: IXMDD57X (for 31-bit non-XPLINK applications) or IXMDD7AX (for 31-bit XPLINK applications). The binder uses the definition side-deck to resolve references to functions and variables defined in the IXMDD57 or IXMDD7A.

Rules for building samples in native MVS

To be able to run the sample applications, you must first allocate a data set to hold the executables. The following is an example of a data set allocation:

```
userid.SAMPLES.rel.LOAD, 500 tracks on 3390, Record format:U,
Record Length: 0, Block size: 32760, ORG: PDSE,
Directory blocks: 0
```

You should allocate a minimum of 500 tracks.

The next thing you need to do is set the XML4C root path. To set it correctly, issue the following command statement:

```
export XERCESCROOT=/usr/lpp/ixm/IBM/xml4c-5_7
```

Now, you need to obtain access to a copy of the samples directory to which you have write access. Unless you are a superuser, you normally will not have write access to the samples subdirectory that was shipped with the product. In this case, you will need to do the following:

1. Create a new directory that you have write access to, for example:

   ```
   cd $HOME
   mkdir mysamples
   ```

2. Set a new environment variable that contains the full path to this new directory, as follows:

   ```
   export XERCESCOUT=$HOME/mysamples
   ```

3. Copy the samples directory to your directory:

   ```
   cp -r /usr/lpp/ixm/IBM/xml4c-5_7/samples $XERCESCOUT
   ```

Since the `XERCESCOUT` environment variable is set, that copy of the samples subdirectory will be used. The binary files are stored in the MVS data set pointed to by the LOADMOD environment variable. If `XERCESCOUT` is not set, the copy of the samples in the HFS that the product resides in will be used, and the binary files will be stored there.

After you have copied the samples directory, you need to set up environment variables. This is done through the following sequence:

```
export LOADMOD=userid.SAMPLES.rel.LOAD
export LOADEXP=hlq.SIXMEXP
export OS390BATCH=1
unset _CXX_CXXSUFFIX
export CXX=c++
export CXXFLAGS="-2"
```

If debugging is desired, the *-g* option can be used instead of the *-2* option in the `export CXXFLAGS` statement.

The next statement is only required if your building 31-bit XPLINK samples:

```
export OS390_XPLINK=1
```

The next statement is only required for building 64-bit samples:

```
export OS390_BIT64=1
```

Once the environment variables have been properly set, Makefiles must be created. Type the following:

```
cd $XERCESCOUT/samples
configure
```

.

You are now ready to build the samples. Type the following in the directory in which you created the Makefiles:

```
export _CXX_CXXSUFFIX=cpp
export _CXX_XSUFFIX_HOST=SIXMEXP
export _CXX_CCMODE=1
gmake
```

After you have issued the gmake command, the build process is completed. The built samples are placed into the *userid*.SAMPLES.*rel*.LOAD data set. Proceed to the next section to see how to run your newly built sample applications.

Using your sample applications on the MVS Environment

Library files are required to run XML Parser, C++ Edition on MVS. The following table is a list of library files required, a short description of the files, and the data set names of where these files are located.

Table 9. Library Files Required to Run Sample XML Applications on MVS

Library file name	Library file description	Library data set name
31-bit non-XPLINK library files		
IXM4C57	XML Parser, C++ Edition library file	*hlq*.SIXMLOD1
IXMDD57	previously deprecated DOM API library file	*hlq*.SIXMLOD1
IXMI38UC	ICU library file (explicitly loaded by IXM4C57)	*hlq*.SIXMLOD1
IXMI38DA	ICU library file	*hlq*.SIXMLOD1
IXMI38D1	ICU library file	*hlq*.SIXMLOD1
IXMI38IN	ICU library file	*hlq*.SIXMLOD1
31-bit XPLINK library files		
IXM4C7A	XML Parser, C++ Edition library file	*hlq*.SIXMLOD1
IXMDD7A	previously deprecated DOM API library file	*hlq*.SIXMLOD1
IXMI38XC	ICU library file (explicitly loaded by IXM4C7A)	*hlq*.SIXMLOD1
IXMI38XA	ICU library file	*hlq*.SIXMLOD1
IXMI38X1	ICU library file	*hlq*.SIXMLOD1
IXMI38XN	ICU library file	*hlq*.SIXMLOD1
64-bit library files		

Table 9. Library Files Required to Run Sample XML Applications on MVS (continued)

Library file name	Library file description	Library data set name
IXM4C7Q	XML Parser, C++ Edition library file	*hlq*.SIXMLOD1
IXMI38QC	ICU library file (explicitly loaded by IXM4C7Q)	*hlq*.SIXMLOD1
IXMI38QA	ICU library file	*hlq*.SIXMLOD1
IXMI38QN	ICU library file	*hlq*.SIXMLOD1

Before you run the samples, you must make sure that you have access to the library, SIXMLOD1. You can ask your system programmer to install SIXMLOD1 in LNKLST. If the SIXMLOD1 data set cannot be placed in LNKLST, you can STEPLIB the data set for each application that requires it. You can invoke the samples from TSO or a JCL job. For example, you can submit the following JCL to run SAXCount.

```
//USERJOB  JOB  MSGLEVEL=(1,1),CLASS=A
//TEST     EXEC PGM=SAXCOUNT,
//*  HFS file input
//   PARM='//usr/lpp/ixm/IBM/xml4c-5_7/samples/data/personal.xml'
//*
//*  DDNAME input
//*  PARM='///DD:XMLDATA(PERSONAL)'
//*  PARM='DD:XMLDATA(PERSONAL)'
//*
//*  Data set input
//*  PARM='"//''USERID.XML.DATA(PERSONAL)''"'
//*  PARM='"//XML.DATA(PERSONAL)"'
//*
//STEPLIB  DD   DSN=hlq.SIXMLOD1,DISP=SHR
//         DD   DSN=userid.SAMPLES.rel.LOAD,DISP=SHR
//*XMLDATA DD   DSN=userid.XML.DATA,DISP=SHR
/*
```

Multi-threading considerations

The following are multi-threading considerations for the XML Parser, C++ Edition.

Using UNIX pthreads

Within a program, an instance of the parser may be used without restriction from a single thread, or an instance of the parser can be accessed from multiple threads, provided the application guarantees that only one thread has entered a method of the parser at any one time.

When two or more parser instances exist in a process, the instances can be used concurrently, without external synchronization. That is, in an application containing two parsers and two threads, one parser can be running within the first thread concurrently with the second parser running within the second thread.

Similar rules apply to XML4C DOM documents. Multiple document instances may be concurrently accessed from different threads, but any given document instance can only be accessed by one thread at a time.

DOMStrings allow multiple concurrent readers. All DOMString const methods are thread safe, and can be concurrently entered by multiple threads. Non-const DOMString methods, such as `appendData()`, are not thread safe and the application must guarantee that no other methods (including const methods) are executed concurrently with them.

The application also needs to guarantee that only one thread has entered either the method `XMLPlatformUtils::Initialize()` or the method `XMLPlatformUtils::Terminate()` at any one time.

Using MVS multi-tasking

Care must be taken when using the parser in a multi-tasking environment within a single address space. Each task that wishes to use a parser must initialize its own parser environment using a call to `XMLPlatformUtils::Initialize()`. It follows then that each task must have its own parser instance and cannot share parser data structures, such as DOMString.

Chapter 6. How to use z/OS specific parser classes

This topic describes how to use the z/OS specific parser classes that will utilize z/OS XML System Services to parse an XML document, instead of the open source parser. Examples are provided to illustrate how to convert existing code to use this function.

Virtual classes are now available. Previously, the SAX2XMLReader class was instantiated when doing a SAX2 parse with the z/OS specific classes. The zXMLReaderFactory::createXMLReader() method gave you access to the z/OS specific classes needed. Now, a new zSAX2XMLReader virtual class is available which must be used. This extends the SAX2XMLReader class. The new methods are provided in order to support additional functionality, such as the ability to load an OSR file (see z/OS XML User's Guide for more details on using OSR files) and to obtain information on source offsets (see “Source offsets” for more details).

Previously, the DOMBuilder class was instantiated. The DOMImplementationRegistry::getDOMImplementation() method was passed a unique string (“zScanner LS”) to give you access to the z/OS specific classes. Now, a zDOMBuilder class is available which must be used. This extends the DOMBuilder class. It also provides methods to support additional functionality.

The zAbstractDOMParser and zXercesDOMParser classes now include methods to support additional functionality.

A zAttributes class is available providing methods for obtaining the source offsets for attributes.

For a complete description of the APIs, features and properties refer to the HTML documentation provided in the XML Parser, C++ Edition product directory. These APIs are documented in the API documentation ("APIDocs") section along with the rest of the XML4C APIs.

Source offsets

This topic provides information on source offset support. Source offset support provides an application the ability to obtain the following information:

- The starting offset of an XML element
- The ending offset of an XML element
- The ending offset of the start tag name in a given XML start element
- The starting offset of an attribute or namespace prefix within an XML element
- The ending offset of an attribute or namespace prefix within an XML element

With a SAX2 parse, these source offsets may be obtained in application event handlers for both progressive and non-progressive parses, or when control returns to the application during a progressive parse after a parseFirst or parseNext. With a DOM parse, these source offsets may be obtained only when the application receives back control during a progressive parse, that is, after parseFirst and parseNext completes.

When the source offsets feature is enabled, there are differences in parsing behavior between the open source parser classes and z/OS specific parser classes. These differences are as follows:

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- the open source parser classes provide only API getSrcOffset() to obtain source offset information. The z/OS specific parser classes provide 5 additional APIs: getSrcOffsetStart(), getSrcOffsetEnd(), getSrcOffsetStart(index), getSrcOffsetEnd(index), getSrcOffsetNameTagEnd().
- For source offsets to attributes whose values are defaulted from schema or internal DTD, the open source parser classes provide the offset within the containing XML element. The z/OS specific parser classes provide the offset from the beginning of the XML document. The same is true for substituted character data resulting from an ENTITY attribute in the DTD.
- During a progressive parse, for empty elements that contain no attributes, no namespace prefixes and no defaulted content, open source parser classes do not return control to the application. The z/OS specific parser classes do return control.
- For any character data or elements encountered following the root element during a progressive parse, the open source parser classes return control (for the SAX2 endDocument event or after a parseNext request) after the data following the root element is processed. The z/OS specific parser classes return control to the application for both the end of the root element and any subsequent character data or elements.
- For the SAX2 endDocument event handler with a call to getSrcOffset(), the open source parser classes include any characters following the root element; the z/OS specific parser classes do not.
- The following XMLElementDecl properties (for example, when queried in SAX2 startElement or endElement advanced event handlers) are not supported (that is, they return unpredictable results) by the z/OS specific parser classes:
  - getURI()
  - getId()
  - isDeclared()
  - isExternal()
  - getCreateReason()
  - getFormattedContentModel()
  - getDOMTypeInfoUri()
  - getDOMTypeInfoName()
- Source offsets returned by the open source parser classes for the end of internal DTD elements (for example, in a SAX2 endDTD event handler) refer to the end of the SYSTEM variant's value. The z/OS specific parser classes return the offset of the ">" that terminates the internal DTD element.
- Source offsets returned by the open source parser classes for the start of internal DTD elements (for example, in a SAX2 startDTD event handler) refer to the "[" that begins the internal subset. The z/OS specific parser classes return the offset of the "<" that starts the internal DTD element.
- The open source parser classes provide the ability to query the internal subset of the DTD using the getInternalSubset API; the z/OS specific parser classes do not support getInternalSubset.
- The open source parser classes's source offsets do not include any BOM bytes at the beginning of the XML document (that is, offset 0 is the byte following the BOM bytes). The z/OS specific parser classes include them (that is, offset 0 is the first byte of the BOM bytes).
- For a DOM progressive parse, open source parser classes do not store any DTD internal subset information in the DOM tree. The z/OS specific parser classes will store PI information if present in the DTD internal subset.

- For ENTITY substitution in XML elements, open source parser classes report both pre and post-substitution character lengths and offset information. The z/OS specific parser classes report offset information about the pre-substitution text and character data and length about the post-substitution text.
- The z/OS specific parser classes do not support the getSpecified() API for namespace prefix attributes. TRUE is always returned.

zSAX2XMLReader class

In order to use the z/OS specific parser classes to parse XML files using SAX2, you need to create an instance of the zSAX2XMLReader class. You need to use the z/OS specific zXMLReaderFactory::createXMLReader() method. This will give you access to the z/OS specific parser classes that will use the z/OS XML System Services to parse the XML document instead of the open source parser.

Using a zSAX2XMLReader class for a non-validating parse

The example below shows the code required to create an instance of zSAX2XMLReader that will use the z/OS specific parser classes to do a non-validating parse.

```
#include <xercesc/zparsers/zSAX2XMLReader.hpp>
#include <xercesc/zparsers/zXMLReaderFactory.hpp>
#include <xercesc/sax2/DefaultHandler.hpp>
#include <xercesc/util/XMLString.hpp>

#if defined(XERCES_NEW_IOSTREAMS)
#include <iostream>
#else
#include <iostream.h>
#endif

XERCES_CPP_NAMESPACE_USE

int main (int argc, char* args[]) {

    try {
        XMLPlatformUtils::Initialize();
    }
    catch (const XMLException& toCatch) {
        char* message = XMLString::transcode(toCatch.getMessage());
        cout << "Error during initialization! :\n";
        cout << "Exception message is: \n"
             << message << "\n";
        XMLString::release(&message);
        return 1;
    }

    char* xmlFile = "x1.xml";
    zSAX2XMLReader* parser = zXMLReaderFactory::createXMLReader();
    parser->setFeature(XMLUni::fgSAX2CoreValidation, false);
    parser->setFeature(XMLUni::fgSAX2CoreNameSpaces, true);

    DefaultHandler* defaultHandler = new DefaultHandler();
    parser->setContentHandler(defaultHandler);
    parser->setErrorHandler(defaultHandler);

    try {
        parser->parse(xmlFile);
    }
    catch (const XMLException& toCatch) {
        char* message = XMLString::transcode(toCatch.getMessage());
        cout << "Exception message is: \n"
             << message << "\n";
```

```
        XMLString::release(&message);
        return -1;
    }
    catch (const SAXParseException& toCatch) {
        char* message = XMLString::transcode(toCatch.getMessage());
        cout << "Exception message is: \n"
             << message << "\n";
        XMLString::release(&message);
        return -1;
    }
    catch (...) {
        cout << "Unexpected Exception \n" ;
        return -1;
    }

    delete parser;
    delete defaultHandler;
    return 0;
}
```

Using a zSAX2XMLReader class for a validating parse

The example below shows the code you need in order to create an instance of zSAX2XMLReader that will use the z/OS specific parser classes to do a validating parse. In this case, the OSR has to be explicitly loaded prior to doing the parse request.

```
#include <xercesc/zparsers/zSAX2XMLReader.hpp>
#include <xercesc/zparsers/zXMLReaderFactory.hpp>
#include <xercesc/sax2/DefaultHandler.hpp>
#include <xercesc/util/XMLString.hpp>

#if defined(XERCES_NEW_IOSTREAMS)
#include <iostream>
#else
#include <iostream.h>
#endif

XERCES_CPP_NAMESPACE_USE

int main (int argc, char* args[]) {

    try {
        XMLPlatformUtils::Initialize();
    }
    catch (const XMLException& toCatch) {
        char* message = XMLString::transcode(toCatch.getMessage());
        cout << "Error during initialization! :\n";
        cout << "Exception message is: \n"
             << message << "\n";
        XMLString::release(&message);
        return 1;
    }

    char* xmlFile = "x1.xml";
    char* osrFile = "x1.osr";
    zSAX2XMLReader* parser = zXMLReaderFactory::createXMLReader();
    parser->setFeature(XMLUni::fgSAX2CoreValidation, true);
    parser->setFeature(XMLUni::fgXercesSchemaFullChecking, true);
    parser->setFeature(XMLUni::fgXercesIdentityConstraintChecking, true);
    parser->setFeature(XMLUni::fgSAX2CoreNameSpaces, true);

    DefaultHandler* defaultHandler = new DefaultHandler();
    parser->setContentHandler(defaultHandler);
    parser->setErrorHandler(defaultHandler);

    // Load the OSR file into memory
```

```
    try {
        loadOSR(osrFile);
    }
    catch (const OutOfMemoryException&)
    {
        cout << "Error during OSR load, OutOfMemoryException!" << "\n";
        return -1;
    }
    catch (const XMLException& toCatch) {
        char* message = XMLString::transcode(toCatch.getMessage());
        cout << "Error during OSR load, Exception message is: \n"
             << message << "\n";
        XMLString::release(&message);
        return -1;
    }

    try {
        parser->parse(xmlFile);
    }
    catch (const XMLException& toCatch) {
        char* message = XMLString::transcode(toCatch.getMessage());
        cout << "Exception message is: \n"
             << message << "\n";
        XMLString::release(&message);
        return -1;
    }
    catch (const SAXParseException& toCatch) {
        char* message = XMLString::transcode(toCatch.getMessage());
        cout << "Exception message is: \n"
             << message << "\n";
        XMLString::release(&message);
        return -1;
    }
    catch (...) {
        cout << "Unexpected Exception \n" ;
        return -1;
    }

    delete parser;
    delete defaultHandler;
    return 0;
}
```

Using a zSAX2XMLReader class for non-validating parse with source offsets

The example below shows the code required to create an instance of zSAX2XMLReader that will use the z/OS specific parser classes to do a non-validating parse, taking advantage of the source offset support.

```
#include <xercesc/zparsers/zSAX2XMLReader.hpp>
#include <xercesc/zparsers/zXMLReaderFactory.hpp>
#include <xercesc/sax2/DefaultHandler.hpp>
#include <xercesc/util/XMLString.hpp>

#if defined(XERCES_NEW_IOSTREAMS)
#include <iostream>
#else
#include <iostream.h>
#endif

XERCES_CPP_NAMESPACE_USE

int main (int argc, char* args[]) {

    try {
        XMLPlatformUtils::Initialize();
```

```
        }
        catch (const XMLException& toCatch) {
            char* message = XMLString::transcode(toCatch.getMessage());
            cout << "Error during initialization! :\n";
            cout << "Exception message is: \n"
                 << message << "\n";
            XMLString::release(&message);
            return 1;
        }

        char* xmlFile = "x1.xml";
        zSAX2XMLReader* parser = zXMLReaderFactory::createXMLReader();
        parser->setFeature(XMLUni::fgSAX2CoreValidation, false);
        parser->setFeature(XMLUni::fgSAX2CoreNameSpaces, true);
        parser->setFeature(XMLUni::fgXercesCalculateSrcOfs, true);

        zSAX2SrcOffsetsHandler handler;
        zSAX2SrcOffsetsAdvHandler* advancedHandler = new zSAX2SrcOffsetsAdvHandler;
        parser->setContentHandler(&handler);

        try {
            parser->parse(xmlFile);
        }
        catch (const XMLException& toCatch) {
            char* message = XMLString::transcode(toCatch.getMessage());
            cout << "Exception message is: \n"
                 << message << "\n";
            XMLString::release(&message);
            return -1;
        }
        catch (const SAXParseException& toCatch) {
            char* message = XMLString::transcode(toCatch.getMessage());
            cout << "Exception message is: \n"
                 << message << "\n";
            XMLString::release(&message);
            return -1;
        }
```

The following is an incomplete event handler class that illustrates how to call the z/OS specific parser class APIs used to obtain source offset information. It only shows a constructor, destructor and startElement callback handler and does not attempt to do anything with the information returned from the APIs.

```
// ---------------------------------------------------------------------------
//  Handlers: Constructors and Destructor
// ---------------------------------------------------------------------------
zSAX2SrcOffsetsHandler::zSAX2SrcOffsetsHandler()
{
}

zSAX2SrcOffsetsHandler::~zSAX2SrcOffsetsHandler()
{
}

// ---------------------------------------------------------------------------
//zSAX2SrcOffsetsHandlers: Start Element Callback Handler
// ---------------------------------------------------------------------------
void zSAX2SrcOffsetsHandler::startElement(
     const XMLCh* const uri
   , const XMLCh* const localname
   , const XMLCh* const qname
   , const Attributes& attrs)
{
   #if defined (_LP64)
    unsigned long nextElementOffset = parser->getSrcOffset();
    unsigned long elementStartOffset = parser->getSrcOffsetStart();
    unsigned long elemenEndOffset = parser->getSrcOffsetEnd();
```

```
    unsigned long elementTagNameEndOffset = parser->getSrcOffsetNameTagEnd();
   #else
    unsigned int nextElementOffset = parser->getSrcOffset();
    unsigned int elementStartOffset = parser->getSrcOffsetStart();
    unsigned int elemenEndOffset = parser->getSrcOffsetEnd();
    unsigned int elementTagNameEndOffset = parser->getSrcOffsetNameTagEnd();
   #endif
  const zAttributes* zattrs = dynamic_cast<const zAttributes*>(&attrs);
   for(int i = 0; i < attrs.getLength(); i++)
   {
       printf( zattrs->getSrcOffsetStart(i) );  // offset of starting quote of attribute's value
       printf( zattrs->getSrcOffsetEnd(i);     // offset of ending quote of attribute's value
   }
);
    .
    .
    .
    .
    .
}
```

zXercesDOMParser class

The zXercesDOMParser class provides the ability to use the z/OS XML System Services to parse an XML document using the DOM interface.

Using a zXercesDOMParser class for a non-validating parse

The example below shows the code required to create an instance of the zXercesDOMParser class that will use the z/OS specific parser classes to do a non-validating parse.

```
#include <xercesc/zparsers/zXercesDOMParser.hpp>
#include <xercesc/dom/DOM.hpp>
#include <xercesc/sax/HandlerBase.hpp>
#include <xercesc/util/XMLString.hpp>
#include <xercesc/util/PlatformUtils.hpp>

#if defined(XERCES_NEW_IOSTREAMS)
#include <iostream>
#else
#include <iostream.h>
#endif

XERCES_CPP_NAMESPACE_USE

int main (int argc, char* args[]) {

    try {
        XMLPlatformUtils::Initialize();
    }
    catch (const XMLException& toCatch) {
        char* message = XMLString::transcode(toCatch.getMessage());
        cout << "Error during initialization! :\n"
             << message << "\n";
        XMLString::release(&message);
        return 1;
    }

    zXercesDOMParser* parser = new zXercesDOMParser();
    parser->setValidationScheme(zXercesDOMParser::Val_Never);
    parser->setDoNamespaces(true);
    ErrorHandler* errHandler = (ErrorHandler*) new HandlerBase();
    parser->setErrorHandler(errHandler);

    char* xmlFile = "x1.xml";
```

```
    try {
        parser->parse(xmlFile);
    }
    catch (const XMLException& toCatch) {
        char* message = XMLString::transcode(toCatch.getMessage());
        cout << "Exception message is: \n"
             << message << "\n";
        XMLString::release(&message);
        return -1;
    }
    catch (const DOMException& toCatch) {
        char* message = XMLString::transcode(toCatch.msg);
        cout << "Exception message is: \n"
             << message << "\n";
        XMLString::release(&message);
        return -1;
    }
    catch (...) {
        cout << "Unexpected Exception \n" ;
        return -1;
    }

    delete parser;
    delete errHandler;
    XMLPlatformUtils::Terminate();
    return 0;
}
```

Constructing a zDOMBuilder

DOMBuilder is an interface introduced by the W3C DOM Level 3.0 Abstract Schemas and Load and Save Specification. DOMBuilder provides the "Load" interface for parsing XML documents and building the corresponding DOM document tree from various input sources. The zDOMBuilder class extends the DOMBuilder class.

A zDOMBuilder instance is obtained from the DOMImplementationLS interface by invoking its createDOMBuilder method. To access the z/OS specific parser classes, the string passed in on the DOMImplementationRegistry::getDOMImplementation(const XMLCh *features) method needs to be the Unicode string “zScanner LS” instead of “LS” . This will result in your code using the z/OS specific parser classes, which will utilize z/OS XML System Services to parse the XML document instead of the open source parser.

Using a zDOMBuilder class for a non-validating parse

The example below shows the code required to create an instance of zDOMBuilder that will use the new z/OS specific parser classes.

```
#include <xercesc/dom/DOM.hpp>
#include <xercesc/util/XMLString.hpp>
#include <xercesc/util/PlatformUtils.hpp>
#include <xercesc/zparsers/zDOMBuilder.hpp>

#if defined(XERCES_NEW_IOSTREAMS)
#include <iostream>
#else
#include <iostream.h>
#endif

XERCES_CPP_NAMESPACE_USE
```

```
int main (int argc, char* args[]) {

    try {
        XMLPlatformUtils::Initialize();
    }
    catch (const XMLException& toCatch) {
        char* message = XMLString::transcode(toCatch.getMessage());
        cout << "Error during initialization! :\n"
             << message << "\n";
        XMLString::release(&message);
        return 1;
    }



        static const XMLCh gLS[] = {chLatin_z, chLatin_S, chLatin_c, chLatin_a, chLatin_n, chLatin_n,
                          chLatin_e, chLatin_r, chSpace, chLatin_L, chLatin_S,  chNull};

    DOMImplementation *impl = DOMImplementationRegistry::getDOMImplementation(gLS);
    zDOMBuilder* parser = ((DOMImplementationLS*)impl)->createDOMBuilder(DOMImplementationLS::MODE_SYNCHRONOUS, 0);

    // optionally you can set some features on this builder
    if (parser->canSetFeature(XMLUni::fgDOMValidation, false))
        parser->setFeature(XMLUni::fgDOMValidation, false);
    if (parser->canSetFeature(XMLUni::fgDOMNamespaces, true))
        parser->setFeature(XMLUni::fgDOMNamespaces, true);


    // optionally you can implement your DOMErrorHandler (e.g. MyDOMErrorHandler)
    // and set it to the builder
    MyDOMErrorHandler* errHandler = new myDOMErrorHandler();
    parser->setErrorHandler(errHandler);

   char* xmlFile = "x1.xml";
    DOMDocument *doc = 0;

    try {
        doc = parser->parseURI(xmlFile);
    }
    catch (const XMLException& toCatch) {
        char* message = XMLString::transcode(toCatch.getMessage());
        cout << "Exception message is: \n"
             << message << "\n";
        XMLString::release(&message);
        return -1;
    }
    catch (const DOMException& toCatch) {
        char* message = XMLString::transcode(toCatch.msg);
        cout << "Exception message is: \n"
             << message << "\n";
        XMLString::release(&message);
        return -1;
    }
    catch (...) {
        cout << "Unexpected Exception \n" ;
        return -1;
    }

    parser->release();
    delete errHandler;
    return 0;
}
```

Using samples for the z/OS specific parser classes

Samples have been provided below to enable use of the z/OS specific parser classes. The following samples are located in the zsamples directory:

zSAX2Count
This program creates a SAX2XMLReader object that will use z/OS XML System Services to parse the XML document(s). Upon completion of the parse, it prints the number of elements, attributes, spaces and characters found in each XML file.

zSAX2Print
This program creates a SAX2XMLReader object that will use z/OS XML System Services to parse an XML document. It then prints the data returned by the various SAX2 handlers for the specified XML file.

zDOMCount
This program invokes DOMBuilder to create a parser object that uses z/OS XML System Services to parse the input document(s). It then builds the DOM tree and prints the number of elements found in each XML file.

zDOMPParse
This program demonstrates the progressive parse capabilities of the parser using z/OS XML System Services to parse an XML document. It does a scanFirst() call followed by a loop which calls scanNext(). Upon completion of the scanNext() loop, it reports the number of elements encountered during the parse.

zDOMPrint
This program invokes the z/OS XML System Services parser to parse the input document and build the DOM tree. It then utilizes DOMWriter to serialize the DOM tree.

zMemParse
This program uses the z/OS XML System Services parser to parse a memory buffer containing XML statements. It reports the number of elements, attributes, spaces and characters encountered during the parse.

zPParse
This program demonstrates the progressive parse capabilities of the z/OS XML System Services parser. It does a parseFirst() call followed by a loop which calls parseNext(). Upon completion of the parseNext() loop, it reports the number of elements, attribute, spaces, and characters encountered during the parse.

Rule: These samples are only examples of how to use the specific z/OS parser classes. You will need to modify your own applications accordingly.

Pre-built versions of the samples for the z/OS UNIX environment are included in the Toolkit. The process for building and running these samples is the same as for the open source parser classes in XML Parser, C++ Edition. See Chapter 5, “How to use the XML Parser, C++ Edition,” on page 25 for more information on this.

Note: When following the instructions in Chapter 5, “How to use the XML Parser, C++ Edition,” on page 25, make sure to use the zsamples directory in place of the samples directory. Also, if you do not build the 31-bit zsamples using XPLINK, then the following environment variable needs to be set in order to prevent a failure:

```
export _CEE_RUNOPTS="XPLINK(ON)"
```

Chapter 7. How to use the XSLT Processor, C++ Edition

Samples have been provided to demonstrate the features of the XSLT Processor, C++ Edition. These samples use simple applications written on top of the SAX, DOM, and Xalan API's. See “Why XML?” on page 1 for more information on the APIs. The following samples can be found in the samples directory:

CompileStylesheet
: use a compiled stylesheet to perform a series of transformations

DocumentBuilder
: programmatically constructs an XML document, applies the `foo.xsl` stylesheet to this document, and writes the output to `foo.out`

ExternalFunctions
: implements, installs, and illustrates the usage of three extension functions

ParsedSourceWrappers
: performs a transformation with input in the form of a pre-built XercesDOM or XalanSourceTree

SerializeNodeSet
: serializes the node set returned by the application of an XPath expression to an XML document

SimpleTransform
: uses the `foo.xsl` stylesheet to transform `foo.xml`, and writes the output to `foo.out`

SimpleXPathAPI
: uses the XPathEvaluator interface to evaluate an XPath expression from the specified context node of an XML file and displays the nodeset returned by the expression

SimpleXPathCAPI
: uses the XPathEvaluator C interface to evaluate an XPath expression and displays the string value returned by the expression

StreamTransform
: processes character input streams containing a stylesheet and an XML document, and writes the transformation output to a character output stream

TraceListen
: trace events during a transformation

TransformToXercesDOM
: performs a simple transformation but puts the result in a Xerces DOMDocument

UseStylesheetParam
: set a stylesheet parameter that the stylesheet uses during the transformation

XalanSplitTransform
: reduces the memory usage when transforming large XML documents

XalanTransform
: uses the XalanTransformer class and the associated C++ API to apply an XSL stylesheet file to an XML document file and write the transformation output to either an output file or to a stream

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XalanTransformerCallback
returns transformation output in blocks to a callback function, which writes the output to a file

XPathWrapper
use this sample to find out what a given XPath expression returns from a given context node in an XML file

Rule: These samples are only examples of how to exploit the XSLT Processor, C++ Edition. You will need to modify your own applications accordingly.

Pre-built versions of the samples for the z/OS UNIX environment are included in the Toolkit. These can be used to illustrate XML concepts, validate XML documents, and validate DTDs and schemas during development. See "Using the sample applications" on page 50 section for instructions on how to use these pre-built versions.

Rule: The prebuilt 31-bit samples shipped with the Toolkit are the non-XPLINK versions. If you want to use the 31-bit XPLINK versions of these samples, you must build your own copy of them.

The procedures for building and using your built samples differ depending on the target environment. The procedures for building your samples are outlined in sections "Building sample applications for the z/OS UNIX Environment" on page 51 and "Building sample applications for the MVS Environment" on page 56. The procedures for using your built samples are outlined in sections "Using your sample applications on the z/OS UNIX Environment" on page 54 and "Using your sample applications on the MVS Environment" on page 59

The XSLT Processor, C++ Edition component is installed in `/usr/lpp/ixm/IBM/xslt4c-1_11` by default. It contains the following sub-directories:

/docs contains online APIs and design documentation

/include
used for building samples

/lib used for running the processor code

/bin used for the 31-bit samples

/bin64 used for the 64-bit samples

In addition to the sub-directories, the Toolkit includes the following data sets:

hlq.SIXLMOD1
used for running the processor code in an MVS environment

hlq.SIXMEXP
used to build applications for an MVS environment

Using the sample applications

Set up an environment variable to point to the location where the XSLT Processor, C++ Edition component was installed:

```
export XALANCROOT=/usr/lpp/ixm/IBM/xslt4c-1_11
```

You also need to set up an environment variable to point to the location where the XML Parser, C++ Edition component was installed. Here is how you do that:

```
export XERCESCROOT=/usr/lpp/ixm/IBM/xml4c-5_7
```

Next, type in the following command statements:

```
export LIBPATH=$XALANCROOT/lib:$XERCESCROOT/lib:$LIBPATH
export PATH=$XALANCROOT/bin:$PATH
(use the $XALANCROOT/bin64 directory for 64-bit samples)
```

You must now copy the sample files to a temporary directory. Here is how you do that:

```
mkdir $HOME/xslsamples
cd $HOME/xslsamples
cp $XALANCROOT/samples/SimpleTransform/foo.* .
```

You are now set to run the sample applications. For example, to run the SimpleTransform application, in the $XALANCROOT/samples/SimpleTransform/ directory type the following:

```
 SimpleTransform
```

This sample application will then use the `foo.xsl` stylesheet to transform `foo.xml`, and write the output to `foo.out`. The pre-built samples can be run in a z/OS UNIX command environment.

Rule for running 64-bit samples

In order to run the 64-bit samples, the XSLT Processor, C++ Edition requires the run-time libraries provided by Language Environment, SCEERUN and SCEERUN2, to be made available in the program search order. The best way to do this is by adding the SCEERUN and SCEERUN2 data sets into the LNKLST. If you do not wish to add SCEERUN and SCEERUN2 to the LNKLST, access SCEERUN and SCEERUN2 data sets through STEPLIB.

Rule for running 31-bit non-XPLINK samples

In order to run the 31-bit non-XPLINK samples, the XSLT Processor, C++ Edition requires the run-time library provided by Language Environment, SCEERUN, to be made available in the program search order. The best way to do this is by adding SCEERUN data set in the LNKLST. If you do not wish to add SCEERUN to the LNKLST, access SCEERUN data set through STEPLIB.

Rule for running 31-bit XPLINK samples

In order to run the 31-bit XPLINK samples, the XSLT Processor, C++ Edition requires the run-time libraries provided by Language Environment, SCEERUN and SCEERUN2, to be made available in the program search order. The best way to do this is by adding the SCEERUN and SCEERUN2 data sets into the LNKLST. If you do not wish to add SCEERUN and SCEERUN2 to the LNKLST, access SCEERUN and SCEERUN2 data sets through STEPLIB.

z/OS UNIX Environment

Building sample applications for the z/OS UNIX Environment

Next, the system environment must be configured correctly. Doing so requires the use of the GNU make utility (gmake). To download gmake go to:

http://www.ibm.com/servers/eserver/zseries/zos/unix/bpxa1ty1.html#gmake

After you have downloaded gmake, issue the following command against the install file:

```
pax -rzf
```

This will place the gmake program into the /bin directory (the /bin directory was created by the pax command). For additional information on using gmake, see the IBM redbook Open Source Software for OS/390 UNIX, SG24-5944 available online at:

http://www-1.ibm.com/servers/eserver/zseries/zos/unix/redbook/index.html

Please note that all references to gmake refer to the GNU make utility.

Product files are required to build the XSLT Processor, C++ Edition on z/OS UNIX. These files and their descriptions are displayed in the following table:

Table 10. Product Files Required to Build Sample XML Applications for z/OS UNIX Environments

Product file name	Product file description
31-bit non-XPLINK product files	
libxslt4c.1_11_0.x	the definition side-deck that describes the XSLT Processor, C++ Edition functions and the variables
libxml4c-5_7_0.x	The definition side-deck contained in the lib directory that describes the XSLT Processor, C++ Edition external functions and the variables. This is required in order to bind application code.
libxml4c-depdom5_7_0.x	The definition side-deck that describes the previously deprecated DOM APIs; it is only required if you are using these APIs.
31-bit XPLINK product files	
libxslt4c.1_11_0.xplink.x	The definition side-deck that describes the XSLT Processor, C++ Edition functions and the variables. This is required in order to use XPLINK to bind application code.
libxml4c-5_7_0.xplink.x	The definition side-deck contained in the lib directory that describes the XSLT Processor, C++ Edition external functions and the variables. This is required in order to use XPLINK to bind application code.
libxml4c-depdom5_7_0.xplink.x	The definition side-deck that describes the previously deprecated DOM APIs; it is only required if you are using these APIs and XPLINK.
64-bit product files	
libxslt4c.1_11_0q.x	the definition side-deck that describes the XSLT Processor, C++ Edition functions and the variables

Table 10. Product Files Required to Build Sample XML Applications for z/OS UNIX Environments (continued)

Product file name	Product file description
31-bit non-XPLINK product files	
libxml4c5_7_0q.x	The definition side-deck contained in the `lib` directory that describes the XSLT Processor, C++ Edition external functions and the variables. This is required in order to bind application code.

Rules for invoking the XSLT Processor, C++ Edition in z/OS UNIX

Any application that is to invoke the XSLT Processor, C++ Edition processor under the z/OS UNIX System Services environment must include libxslt4c.1_11_0q.x and libxml4c5_7_0q.x for 64-bit, or libxslt4c.1_11_0.x and libxml4c-5_7_0.x for 31-bit (libxslt4c.1_11_0.xplink.x and libxml4c-5_7_0.xplink.x if using XPLINK) when they bind. The binder uses the definition side-deck to resolve references to functions and variables defined in libxslt4c.1_11_0q.dll and libxml4c5_7_0q.dll for 64-bit, libxslt4c.1_11_0.dll and libxml4c-5_7_0.dll (libxslt4c.1_11_0.xplink.dll and libxml4c-5_7_0.xplink.dll if using XPLINK) for 31-bit.

If you are using the deprecated DOM APIs, you need to include the libxml4c-depdom5_7_0.x sidedeck, or for XPLINK applications, the libxml4c-depdom5_7_0.xplink.x sidedeck.

Now set up an environment variable to point to the location where the XSLT Processor, C++ Edition component was installed:

```
export XALANCROOT=/usr/lpp/ixm/IBM/xslt4c-1_11
```

You also need to set up an environment variable to point to the location where the XML Parser, C++ Edition component was installed. Here is how you do that:

```
export XERCESCROOT=/usr/lpp/ixm/IBM/xml4c-5_7
```

Next, you need to obtain access to a copy of the samples directory to which you have write access. Unless you are a superuser, you normally will not have write access to the samples subdirectory that was shipped with the product. In this case, you will need to do the following:

1. Create a new directory that you have write access to, for example:

   ```
   cd $HOME
   mkdir mysamples
   ```

2. Set a new environment variable that contains the full path to this new directory, as follows:

   ```
   export XALANCOUT=$HOME/mysamples
   ```

3. Copy the samples directory to your directory:

   ```
   cp -r /usr/lpp/ixm/IBM/xslt4c-1_11/samples $XALANCOUT
   ```

Since the `XALANCOUT` environment variable is set, that copy of the samples subdirectory will be used. The binary files will be stored in a "bin" subdirectory.

After you have copied the samples directory, you need to set up environment variables. This is done through the following sequence:

```
export CXX=c++
export CXXFLAGS="-2"
```

If debugging is desired, the *-g* option can be used instead of the *-2* option in the `export CXXFLAGS` statement.

The next statement is only required for building 64-bit samples:

```
export OS390_BIT64=1
```

The next statement is only required for building 31-bit XPLINK samples:

```
export OS390_XPLINK=1
```

Next, you need to set up some information for the 31-bit non-XPLINK Standard C++ Library sidedeck. Here is how you do that:

Note: The below export statement is not required if using 31-bit XPLINK or 64-bit; the contents of the *_CXX_PSYSIX* variable are loaded by default when using XPLINK. Also, if *_CXX_PSYSIX* was previously set and you are now building a 31-bit XPLINK or 64-bit version, unset the variable.

For z/OS 1.9 or higher releases:

```
export _CXX_PSYSIX=\
 "{_PLIB_PREFIX}.SCEELIB(C128N)":\
 "{_CLIB_PREFIX}.SCLBSID(IOSTREAM,COMPLEX)"
```

For z/OS 1.8 and earlier releases:

```
export _CXX_PSYSIX=\
"{_PLIB_PREFIX}.SCEELIB(C128N)":\
"{_CLIB_PREFIX}.SCLBSID(IOC,IOSTREAM,COMPLEX,COLL)"
```

where {_PLIB_PREFIX} and {_CLIB_PREFIX} are set to a default (for example, CEE and CBC, respectively) during custom installation, or using user overrides.

Rule: All three segments of the above example must be entered on the same command line.

Finally, to build the samples, type the following in the directory in which you created the Makefiles:

```
export _CXX_CXXSUFFIX=cpp
export _CXX_CCMODE=1
cd $XALANCOUT/samples
gmake
```

After issuing the gmake command, the build process is completed. The samples are built into the `$XALANCOUT/bin` directory.

Using your sample applications on the z/OS UNIX Environment

Library files are required to run XSLT Processor, C++ Edition on z/OS UNIX. These files can be found in the *$XALANCROOT/lib* and *$XERCESCROOT/lib* directories. The file names and their descriptions are displayed in the following table:

Table 11. Library Files Required to Run Sample XML Applications on z/OS UNIX

Library File Name	Library File Description
31-bit non-XPLINK library files	
libxslt4c.1_11_0.dll, libxslt4cMessages.1_11_0.dll	XSLT Processor, C++ Edition library files
libxml4c-5_7_0.dll	XML Parser, C++ Edition library file
libxml4c-depdom5_7_0.dll	library file for the previously deprecated DOM API
libicuuc38.1.dll, libicudata_stub38.1.dll, libicudata38.1.dll, libicui18n38.1.dll	ICU library files
31-bit XPLINK library files	
libxslt4c.1_11_0.xplink.dll, libxslt4cMessages.1_11_0.xplink.dll	XSLT Processor, C++ Edition library files
libxml4c-5_7_0.xplink.dll	XML Parser, C++ Edition library file
libxml4c-depdom5_7_0.xplink.dll	library file for the previously deprecated DOM API
libicudata38.1.xplink.dll, libicudata_stub38.1.xplink.dll, libicuuc38.1.xplink.dll, libicui18n38.1.xplink.dll	ICU library files
64-bit library files	
libxslt4c.1_11_0q.dll, libxslt4cMessages.1_11_0q.dll	XSLT Processor, C++ Edition library files
libxml4c5_7_0q.dll	XML Parser, C++ Edition library file
libicuuc38.1q.dll, libicudata38q.1q.x, libicui18n38.1q.dll	ICU library files

Before running the samples, you must ensure that several environment variables are set properly. First, set up an environment variable to point to the location where the XSLT Processor, C++ Edition component was installed:

```
export XALANCROOT=/usr/lpp/ixm/IBM/xslt4c-1_11
```

You also need to set up an environment variable to point to the location where the XML Parser, C++ Edition component was installed. Here is how you do that:

```
export XERCESCROOT=/usr/lpp/ixm/IBM/xml4c-5_7
```

Then type in the following command statements:

```
export LIBPATH=$XALANCROOT/lib:$XERCESCROOT/lib:$LIBPATH
export ICU_DATA=$XERCESCROOT/lib
```

Then set the PATH to locate the samples you have just built:

```
export PATH=$XALANCOUT/bin:$PATH
```

You are now set to run your sample applications. For example, to run the SimpleTransform application from the *$XALANCOUT/bin* directory, type the following command statement:

```
cd $XALANCOUT/samples/SimpleTransform
SimpleTransform
```

This sample application will then use the `foo.xsl` stylesheet to transform `foo.xml`, and write the output to `foo.out`.

MVS Environment

Building sample applications for the MVS Environment

Before being able to build the provided samples, the system environment must be configured correctly. Doing so requires the use of the GNU make utility (gmake). To download gmake go to:

`http://www.ibm.com/servers/eserver/zseries/zos/unix/bpxa1ty1.html#gmake`

After you have downloaded gmake, issue the following command against the install file:

```
pax -rzf
```

This will place the gmake program into the `/bin` directory (the `/bin` directory was created by the `pax` command). For additional information on using gmake, see the IBM redbook *Open Source Software for OS/390 UNIX*, SG24-5944 available online at:

`http://www-1.ibm.com/servers/eserver/zseries/zos/unix/redbook/index.html`

Please note that all references to gmake refer to the GNU make utility.

Product files are required to build the XSLT Processor, C++ Edition on MVS. These files and their descriptions are displayed in the following table:

Table 12. Product Files Required to Build Sample XML Applications for MVS Environments

Product file name	Product file description	Data set name
files in the `include` directory	C++ header files contained in the `include` directory. These are required in order to compile application code.	
31-bit non-XPLINK product files		
IXMLC21X	Definition side-deck that describes the XSLT Processor, C++ Edition functions and variables.	*hlq*.SIXMEXP
IXM4C57X	Definition side-deck that describes the XML Parser, C++ Edition functions and the variables.	*hlq*.SIXMEXP
IXMDD57X	Definition side-deck that describes the previously deprecated DOM APIs; it is only required if you are using these APIs.	*hlq*.SIXMEXP
31-bit XPLINK product files		

Table 12. Product Files Required to Build Sample XML Applications for MVS Environments (continued)

Product file name	Product file description	Data set name
IXMLX21X	Definition side-deck that describes the XSLT Processor, C++ Edition functions and variables.This is required in order to use XPLINK to bind application code.	*hlq*.SIXMEXP
IXM4C7AX	XPLINK definition side-deck that describes the XML Parser, C++ Edition functions and the variables. This is required in order to use XPLINK to bind application code.	*hlq*.SIXMEXP
IXMDD7AX	Definition side-deck that describes the previously deprecated DOM APIs; it is only required if you are using these APIs and XPLINK.	*hlq*.SIXMEXP
64-bit product files		
IXMLQ21X	Definition side-deck that describes the XSLT Processor, C++ Edition functions and variables.	*hlq*.SIXMEXP
IXM4C7QX	Definition side-deck that describes the XML Parser, C++ Edition functions and the variables.	*hlq*.SIXMEXP

Rule: Any 64-bit application that is to invoke the XSLT Processor, C++ Edition parser under the native MVS environment must include the IXMLQ21X and IXM4C7QX definition side-decks when they bind. The binder uses the definition side-decks to resolve references to functions and variables defined in the IXMLQ21 and IXM4C7Q. Any 31-bit non-XPLINK application that is to invoke the XSLT Processor, C++ Edition parser under the native MVS environment must include the IXMLC21X and IXM4C57X definition side-decks when they bind. The binder uses the definition side-decks to resolve references to functions and variables defined in the IXMLC21 and IXM4C57. Any XPLINK application that is to invoke the XSLT Processor, C++ Edition parser under the native MVS environment must include the IXMLX21X and IXM4C7AX definition side-decks when they bind. The binder uses the definition side-decks to resolve references to functions and variables defined in the IXMLX21 and IXM4C7A.

To be able to run the sample applications, you must first allocate a data set to hold the executables. **If you have already allocated a data set for XML Parser, C++ Edition, skip this step.** The following is an example of a data set allocation:

```
userid.SAMPLES.rel.LOAD, 500 tracks on 3390, Record format:U,
Record Length: 0, Block size: 32760, ORG: PDSE,
Directory blocks: 0
```

Rule: If you are building samples from multiple releases, you will need a unique PDSE for each release, for example: SAMPLES.**V1100** .LOAD for samples from Toolkit V1.10.0 and SAMPLES.**V190** .LOAD for samples from Toolkit V1.9.0.

Next, you must ensure that several environment variables are set properly. First, set up an environment variable to point to the location where the XSLT Processor, C++ Edition component was installed:

```
export XALANCROOT=/usr/lpp/ixm/IBM/xslt4c-1_11
```

You also need to set up an environment variable to point to the location where the XML Parser, C++ Edition component was installed. Here is how you do that:

```
export XERCESCROOT=/usr/lpp/ixm/IBM/xml4c-5_7
```

Then, you need to obtain access to a copy of the samples directory to which you have write access. Unless you are a superuser, you normally will not have write access to the samples subdirectory that was shipped with the product. In this case, you will need to do the following:

1. Create a new directory that you have write access to, for example:

   ```
   cd $HOME
   mkdir mysamples
   ```

2. Set a new environment variable that contains the full path to this new directory, as follows:

   ```
   export XALANCOUT=$HOME/mysamples
   ```

3. Copy the samples directory to your directory:

   ```
   cp -r /usr/lpp/ixm/IBM/xslt4c-1_11/samples $XALANCOUT
   ```

Since the `XALANCOUT` environment variable is set, that copy of the samples subdirectory will be used. The binary files are stored in the MVS data set pointed to by the LOADMOD environment variable.

After you have copied the samples directory, you need to set up environment variables. This is done through the following sequence:

```
export LOADMOD=userid.SAMPLES.rel.LOAD
export LOADEXP=hlq.SIXMEXP
export OS390BATCH=1
export CXX=c++
export CXXFLAGS="-2"
```

If debugging is desired, the *-g* option can be used instead of the *-2* option in the `export CXXFLAGS` statement.

The next statement is only required for building 64-bit samples:

```
export OS390_BIT64=1
```

The next statement is only required if you are building 31-bit XPLINK samples:

```
export OS390_XPLINK=1
```

Next, you need to set up some information for the 31-bit non-XPLINK Standard C++ Library sidedeck. Here is how you do that:

Note: The below export statement is not required if using XPLINK or 64-bit; the contents of the *_CXX_PSYSIX* variable are loaded by default when using XPLINK. Also, if *_CXX_PSYSIX* was previously set and you are now building an XPLINK version, unset the variable.

For z/OS 1.9 or higher releases:
```
export _CXX_PSYSIX=\
 "{_PLIB_PREFIX}.SCEELIB(C128N)":\
 "{_CLIB_PREFIX}.SCLBSID(IOSTREAM,COMPLEX)"
```
For z/OS 1.8 and earlier releases:
```
export _CXX_PSYSIX=\
"{_PLIB_PREFIX}.SCEELIB(C128N)":\
"{_CLIB_PREFIX}.SCLBSID(IOC,IOSTREAM,COMPLEX,COLL)"
```

where {_PLIB_PREFIX} and {_CLIB_PREFIX} are set to a default (for example, CEE and CBC, respectively) during custom installation, or using user overrides.

Rule:: All three segments of the above example must be entered on the same command line.

You are now ready to build the samples. The following sequence shows how to build the samples:

```
export _CXX_CXXSUFFIX=cpp
export _CXX_XSUFFIX_HOST=SIXMEXP
export _CXX_CCMODE=1
gmake
```

After you have issued the gmake command, the build process is now completed. The built samples are placed into the *userid*.SAMPLES.*rel*.LOAD data set.

Using your sample applications on the MVS Environment

Library files are required to run XSLT Processor, C++ Edition on MVS. The following table is a list of library files required, a short description of the files, and the data set names of where these files are located.

Table 13. Library Files Required to Run Sample XML Applications on MVS

Library file name	Library file description	Library data set name
31-bit non-XPLINK library files		
IXMLC21	XSLT Processor, C++ Edition library file	*hlq*.SIXMLOD1
IXMMSG21	XSLT Processor, C++ Edition message handling	*hlq*.SIXMLOD1
IXM4C57	XML Parser, C++ Edition library file	*hlq*.SIXMLOD1
IXMDD57	previously deprecated DOM API library file	*hlq*.SIXMLOD1
IXMI38UC	ICU library file	*hlq*.SIXMLOD1
IXMI38DA	ICU library file	*hlq*.SIXMLOD1
IXMI38D1	ICU library file	*hlq*.SIXMLOD1
IXMI38IN	ICU library file	*hlq*.SIXMLOD1

Table 13. Library Files Required to Run Sample XML Applications on MVS (continued)

Library file name	Library file description	Library data set name
64-bit library files		
IXMLQ21	XSLT Processor, C++ Edition library file	*hlq*.SIXMLOD1
	XSLT Processor, C++ Edition message handling	*hlq*.SIXMLOD1
IXM4C7Q	XML Parser, C++ Edition library file	*hlq*.SIXMLOD1
IXMI38QC	ICU library file	*hlq*.SIXMLOD1
IXMI38QA	ICU library file	*hlq*.SIXMLOD1
IXMI38QN	ICU library file	*hlq*.SIXMLOD1
31-bit XPLINK library files		
IXMLX21	XSLT Processor, C++Edition library file	*hlq*.SIXMLOD1
IXMMXG21	XSLT Processor, C++ Edition message handling	*hlq*.SIXMLOD1
IXM4C7A	XML Parser, C++ Edition library file	*hlq*.SIXMLOD1
IXMDD7A	previously deprecated DOM API library file	*hlq*.SIXMLOD1
IXMI38XC	ICU library file	*hlq*.SIXMLOD1
IXMI38XA	ICU library file	*hlq*.SIXMLOD1
IXMI38X1	ICU library file	*hlq*.SIXMLOD1
IXMI38XN	ICU library file	*hlq*.SIXMLOD1

Before you run the samples, you must make sure that you have access to the library, SIXMLOD1. You can ask your system programmer to install SIXMLOD1 in LNKLST. If the SIXMLOD1 data set cannot be placed in LNKLST, you can STEPLIB the data set for each application that requires it. You can invoke the samples from TSO or a JCL job. For example, you can submit the following JCL to run TRACELSN.

```
//USERJOB  JOB  MSGLEVEL=(1,1),CLASS=A
//TEST1    EXEC PGM=TRACELSN,
//*  HFS file input
//   PARM='/-tt'
//STEPLIB  DD   DSN=hlq.SIXMLOD1,DISP=SHR
//         DD   DSN=userid.SAMPLES.rel.LOAD,DISP=SHR
```

Chapter 8. How to use the XML Toolkit command line utilities

How to use the XSLT Processor, C++ Edition command line utility

To perform a transformation, you can call the XSLT Processor, C++ Edition from the command line. Xalan is a simple executable providing a command-line interface for performing XSLT transformations .The following describes how you can use Xalan to perform transformations:

1. Set *XALANCROOT* to be `/usr/lpp/ixm/IBM/xslt4c-1_11`
2. Set *XERCESCROOT* to be `/usr/lpp/ixm/IBM/xml4c-5_7`
3. Set the *PATH* to include `$XALANCROOT/bin`
4. Set the *LIBPATH* to include `$XALANCROOT/lib:$XERCESCROOT/lib`

Then from the command line, type the following:

```
Xalan
```

or

```
Xalan -?
```

to show all the options. The following is an example of the Xalan command line:

```
Xalan -o foo.out
         $XALANCROOT/samples/SimpleTransform/foo.xml
         $XALANCROOT/samples/SimpleTransform/foo.xsl
```

Rule:: All three segments of the above example must be entered on the same command line.

Here is a sample job for the Xalan command (IXMXAL21):

```
//XALAN1   JOB  REGION=0M,NOTIFY=&SYSUID
//STEP1    EXEC PGM=IXMXAL21,
//  PARM='/-e ibm-1047-s390 -o DD:OUTFILE DD:INXML DD:INXSL'
//STEPLIB  DD   DSN=hlq.SIXMLOD1,DISP=SHR
//INXML    DD   DSN=USER1.FOO.XML,DISP=SHR
//INXSL    DD   DSN=USER1.FOO.XSL,DISP=SHR
//OUTFILE  DD   DSN=USER1.FOO.OUT,DISP=SHR
//*
```

Here is a sample job for the 64-bit Xalan command (IXMXAQ21):

```
//XALAN2   JOB REGION=0M,NOTIFY=&SYSUID
//STEP1    EXEC PGM=IXMXAQ21,
//  PARM='/-e ibm-1047-s390 -o DD:OUTFILE DD:INXML DD:INXSL'
//STEPLIB  DD   DSN=hlq.SIXMLOD1,DISP=SHR
//INXML    DD   DSN=USER1.FOO.XML,DISP=SHR
//INXSL    DD   DSN=USER1.FOO.XSL,DISP=SHR
//OUTFILE  DD   DSN=USER1.FOO.OUT,DISP=SHR
//*
```

The following table lists the flags and arguments the Xalan executable can take (the flags are case insensitive) :

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Table 14. Flags and Arguments for the Xalan Executable

-a (Use stylesheet processing instruction, not the stylesheet argument)
-e encoding (Force the specified encoding for the output)
-i integer (Indent the specified amount)
-m (Omit the META tag in HTML output)
-o filename (Write transformation result to this file (rather than to the console))
-p name expr (Set a stylesheet parameter with this expression)
-u name expr (Disable escaping of URLs in HTML output)
-v (Validate the XML source document)
- (A dash as the 'source' argument reads from stdin. A dash as the 'stylesheet' argument reads from stdin. ('-' cannot be used for both arguments.))
-?(Show all options)

There is another XSLT Processor, C++ Edition command line utility available called testXSLT. Like Xalan, this command line utility can perform transformations. However, unlike Xalan, it has additional options which can be used to help debug stylesheets during development. The following describes how you can use testXSLT to perform transformations:

1. Set *XALANCROOT* to be `/usr/lpp/ixm/IBM/xslt4c-1_11`
2. Set *XERCESCROOT* to be `/usr/lpp/ixm/IBM/xml4c-5_7`
3. Set the *PATH* to include `$XALANCROOT/bin`
4. Set the *LIBPATH* to include `$XALANCROOT/lib:$XERCESCROOT/lib`

You can now call the testXSLT executable with the appropriate flags and arguments or enter

```
testXSLT -h
```

to show all the options. The following command line, for example, includes the **-IN**, **-XSL**, and**-OUT** flags with their accompanying arguments; the XML source document, the XSL stylesheet, and the output file:

```
testXSLT -IN $XALANCROOT/samples/SimpleTransform/foo.xml
         -XSL $XALANCROOT/samples/SimpleTransform/foo.xsl
         -OUT foo.out
```

Rule:: All three segments of the above example must be entered on the same command line.

Also, here is a sample job for the testXSLT command (IXMTST21):

```
//TSTXSLT1 JOB  REGION=0M,NOTIFY=&SYSUID
//STEP1    EXEC PGM=IXMTST21
//  PARM='/-IN FILE:////FOO.XML -XSL FILE:////FOO.XSL -OUT FOO.OUT'
//STEPLIB  DD   DSN=hlq.SIXMLOD1,DISP=SHR,
//*
```

Here is a sample job for the 64-bit testXSLT command (IXMTSQ21):

```
//TSTXSLT2 JOB  REGION=0M,NOTIFY=&SYSUID
//STEP1    EXEC PGM=IXMTSQ21
//  PARM='/-IN FILE:////FOO.XML -XSL FILE:////FOO.XSL -OUT FOO.OUT'
//STEPLIB  DD   DSN=hlq.SIXMLOD1,DISP=SHR,
//*
```

The following table lists the flags and arguments the testXSLT executable can take (the flags are case sensitive) :

Table 15. Flags and Arguments for the testXSLT Executable

-in inputxmlurl
-xsl xsltransformationurl
-out outputfilename
-h(Display list of command line options)
-? (Display list of command line options)
-v (Version info)
-qc (Quiet Pattern Conflicts Warnings)
-q (Quiet Mode)
-indent (Number of spaces to indent each level in output tree — default is 0)
-validate (Validate the XSL and XML input — default is not to validate)
-tt (Trace the templates as they are being called)
-tg (Trace each result tree generation event)
-ts (Trace each selection event)
-ttc (Trace the template children as they are being processed)
-xml (Use XML formatter and add XML header)
-nh (Don't write XML header) *The -XML flag must be set before use
-html (Use HTML formatter)
-noindent (turns off HTML indenting) *The -HTML flag must be set before use
-stripcdata (Strip CDATA sections of their brackets, but do not escape) *The -XML or -HTML flag must be set before use
-escapecdata (Strip CDATA sections of their brackets, and escape) *The -XML or -HTML flag must be set before use
-text (Use simple Text formatter)
-dom (Test for well-formed output — format to DOM then to XML for output)
-xst (Format to Xalan source tree, then to XML for output)
-xd (Use Xerces DOM instead of Xalan source tree)
-de (Disable built-in extension functions)
-en (Specify the namespace URI for Xalan extension functions; the default is `http://xml.apache.org/xslt`)
-param name expression (Set a stylesheet parameter)

Chapter 9. Where to go for more information

For more information on XML Toolkit for z/OS, visit the XML Toolkit Web site at:
`http://www.ibm.com/servers/eserver/zseries/software/xml/`

For more information on z/OS XML System Services, visit the z/OS XML System Services Web site at:
`http://www.ibm.com/servers/eserver/zseries/zos/xml/`

For additional information on the Apache XML project, visit the Apache Web site at:
`http://xml.apache.org/`

There are also two redbooks that you may find informative:

- *Using XML on z/OS and OS/390 for Application Integration*, which contains information on how to integrate XML technology with business applications on z/OS. This document can be accessed from the following link: http://publib-b.boulder.ibm.com/Redbooks.nsf/RedbookAbstracts/sg246285.html?Open
- *XML on z/OS and OS/390: Introduction to a Service-Oriented Architecture*, which provides a general introduction to the XML Toolkit in the first half, followed by a comprehensive introduction to services–oritented architecture (SOA) and Web Services. This document can be accessed from the following link: http://www.redbooks.ibm.com/redbooks/pdfs/sg246826.pdf

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Appendix A. Building samples for native MVS using JCL

Building XML Parser, C++ Edition samples for native MVS using JCL

The samples for the XML Parser, C++ Edition, which are included in the XML Toolkit for z/OS (XML Toolkit), reside in the product HFS. They may be compiled and linked into either an HFS or into a PDSE data set depending upon your preference. However, the instructions provided only deal with building the samples from the HFS using the gmake utility under z/OS UNIX System Services (z/OS UNIX). Alternatively, it is possible to copy the sample C++ source code and header files to PDSE data sets, and compile and link-edit them from TSO using JCL instead of using gmake from z/OS UNIX. All of the header files needed from the XML Toolkit will still have to be picked up out of the product HFS because of their long names and hierarchical structure.

In order to illustrate an application whose source code resides in data sets, we will use the source and header files for the SAXCount sample which reside in the `/usr/lpp/ixm/IBM/xml4c-5_7/samples/SAXCount` directory and copy them to data sets.

You first need to allocate the following PDSE data sets:

```
[userid].BATCH.CPP -- recfm=FB, lrecl=240, blksize=12960
[userid].BATCH.HPP -- recfm=FB, lrecl=240, blksize=12960
[userid].BATCH.JCL -- recfm=FB, lrecl=80, blksize=12960
[userid].BATCH.OBJ -- recfm=FB, lrecl=80, blksize=12960
[userid].BATCH.LOAD -- recfm=U, lrecl=0, blksize=32760
```

Then you need to copy the SAXCount.cpp and SAXCountHandlers.cpp files to the`[userid].BATCH.CPP` PDSE. Since the member names in a PDSE may not exceed 8 characters, you will need to rename the SAXCountHandlers.cpp part to SAXCONTH. For SAXCount.cpp, you can use a member name of SAXCOUNT. Since files in the HFS can have more than 80 byte records in them, a logical record length of 240 is used here to avoid truncating any code.

The corresponding header files (SAXCount.hpp and SAXCountHandlers.hpp) also need to be copied to the `[userid].BATCH.HPP` PDSE. Use SAXCONTH for the member name for the SAXCountHandlers.hpp member here too.

Once you have copied all of these files, you need to edit the SAXCOUNT member of the `[userid].BATCH.HPP` PDSE and change the following line:

```
#include "SAXCountHandlers.hpp"
```

to

```
#include "SAXConth.hpp"
```

This now refers to the 8 character name we copied the header file to in the PDSE. The next step is to copy the following JCL to the `[userid].BATCH.JCL` PDSE. This JCL will compile the SAXCOUNT and SAXCONTH members and store the object files in `[userid].BATCH.OBJ`.

```
//SAXCOMP  JOB MSGLEVEL=(1,1),REGION=0M,NOTIFY=&SYSUID.
//JOBLIB   DD  DSNAME=SYS1.CEE.SCEERUN,DISP=SHR
//         DD  DSNAME=SYS1.CEE.SCEERUN2,DISP=SHR
//         DD  DSNAME=SYS1.CBC.SCCNCMP,DISP=SHR
//STEP1    EXEC  PGM=CCNDRVR,PARM='/CXX OPTFILE(DD:OPTS),OBJ,LIST'
//OPTS     DD  *
  LANGLVL(EXTENDED)
```

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```
  NOSEARCH SEARCH(
          /usr/lpp/ixm/IBM/xml4c-5_7/include/,
          //'[userid].BATCH.+',
          //'SYS1.CEE.SCEEH.+',
          //'SYS1.CBC.SCLBH.+')
  DEFINE(OS390=1)
  DEFINE(_OPEN_THREADS=1)
  DEFINE(_XOPEN_SOURCE_EXTENDED=1)
/*
//SYSLIN   DD  DSNAME=&SYSUID..BATCH.OBJ(SAXCOUNT),DISP=SHR
//SYSPRINT DD  SYSOUT=A
//SYSIN    DD  DSNAME=&SYSUID..BATCH.CPP(SAXCOUNT),DISP=SHR
//SYSUT1   DD  DUMMY
/*
//STEP2    EXEC  PGM=CCNDRVR,PARM='/CXX OPTFILE(DD:OPTS),OBJ,LIST'
//OPTS     DD  *
  LANGLVL(EXTENDED)
  NOSEARCH SEARCH(
          /usr/lpp/ixm/IBM/xml4c-5_7/include/,
          //'[userid].BATCH.+',
          //'SYS1.CEE.SCEEH.+',
          //'SYS1.CBC.SCLBH.+')
  DEFINE(OS390=1)
  DEFINE(_OPEN_THREADS=1)
  DEFINE(_XOPEN_SOURCE_EXTENDED=1)
/*
//SYSLIN   DD  DSNAME=&SYSUID..BATCH.OBJ(SAXCONTH),DISP=SHR
//SYSPRINT DD  SYSOUT=A
//SYSIN    DD  DSNAME=&SYSUID..BATCH.CPP(SAXCONTH),DISP=SHR
//SYSUT1   DD  DUMMY
/*
```

In this JCL, if you allocated the data sets with your TSO userid and run from that ID, you can leave "&SYSUID" as the high-level qualifier. In the compiler options (under the OPTS DD statement), you need to change `[userid]` to the high-level qualifier of the `[userid].BATCH.HPP` data set. If your system does not use the “SYS1” prefix on the CEE.SCEEH and CBC.SCLBH data sets, you need to remove that qualifier as well. What this SEARCH option does is instruct the compiler to first look in `/usr/lpp/ixm/IBM/xml4c-5_7/include/` for header files, then in the `[userid].BATCH.HPP` data set, and so on and so forth.

The options could actually be stored in a data set and that data set name used on the OPTS DD statement, but the options are shown here to make the example complete. You can submit this job and it will create the SAXCOUNT and SAXCONTH object files in the `[userid].BATCH.OBJ` PDSE.

The next step is to link-edit (bind) these object files into an executable file. You can use the following JCL to accomplish this:

```
//SAXBIND     JOB MSGLEVEL=(1,1),REGION=0M,NOTIFY=&SYSUID.
//BIND1 EXEC PGM=IEWL,PARM='OPTIONS=OPTS'
//OPTS     DD *
    AMODE=31,RMODE=ANY
    DYNAM=DLL,ALIASES=NO,UPCASE=NO,
    LIST=NO,MAP=NO,XREF=NO,MSGLEVEL=4,
    REUS=RENT,EDIT=YES,AC=0,CALL=YES,CASE=MIXED
/*
//SYSLIB   DD DISP=SHR,DSN=SYS1.CEE.SCEELKEX
//         DD DISP=SHR,DSN=SYS1.CEE.SCEELKED
//         DD DISP=SHR,DSN=SYS1.CEE.SCEECPP
//         DD DISP=SHR,DSN=SYS1.CBC.SCLBSID
//SYSLIB1  DD DISP=SHR,DSN=SYS1.SIXMEXP
//SYSLIB2  DD DISP=SHR,DSN=&SYSUID..BATCH.OBJ
//SYSLMOD  DD DISP=SHR,DSN=&SYSUID..BATCH.LOAD
```

```
//SYSDEFSD DD DUMMY
//SYSPRINT DD SYSOUT=A
//SYSLIN   DD *
      INCLUDE SYSLIB(IOSTREAM)
      INCLUDE SYSLIB(COMPLEX)
      INCLUDE SYSLIB1(IXM4C57X)
      INCLUDE SYSLIB2(SAXCOUNT)
      INCLUDE SYSLIB2(SAXCONTH)
      ENTRY   CEESTART
      NAME    SAXCOUNT(R) RC=0
/*
```

In this JCL, you can also leave "&SYSUID" there as long as you are running this from your TSO ID and it matches the high-level qualifier you allocated these data sets under. On the SYSLIB DD statements, if "SYS1" is not the high-level qualifier for these data sets, you will need to remove or replace that. The SYSLIB1 DD statement assumes the side-decks for the XML Toolkit were installed as recommended and they are in `SYS1.SIXMEXP`. You can submit this JCL, and it should link-edit the SAXCOUNT and SAXCONTH object files into a single executable file called SAXCOUNT in `[userid].BATCH.LOAD`.

If you want to execute the SAXCOUNT executable, you can use the following JCL:

```
//SAXCOUNT JOB MSGLEVEL=1,REGION=0M,NOTIFY=&SYSUID.
//JOBLIB   DD   DSN=SYS1.SIXMLOD1,DISP=SHR
//         DD   DSN=&SYSUID..BATCH.LOAD,DISP=SHR
//TEST1    EXEC PGM=SAXCOUNT,
//    PARM='//usr/lpp/ixm/IBM/xml4c-5_7/samples/data/personal.xml'
/*
```

This JCL assumes that the XML Toolkit DLLs were installed as recommended to the `SYS1.SIXMLOD1` data set.

Building XSLT Processor, C++ Edition samples for native MVS using JCL

The samples for the XSLT Processor, C++ Edition, may also be built using JCL. This is very similar to the process for building the XML Parser, C++ Edition samples. You should review that section first. You will need to allocate the same MVS data sets. For the XSLT Processor we will use the SimpleTransform sample as an example. This resides in the `/usr/lpp/ixm/IBM/xslt4c-1_11/samples/SimpleTransform` directory.

The first thing you need to do is copy the SimpleTransform.cpp file to the `[userid].BATCH.CPP` PDSE. Since the member names in a PDSE may not exceed 8 characters, you will need to rename the SimpleTransform.cpp part to SMPLTRNS.

The corresponding header file (XalanMemoryManagerImpl.hpp) also needs to be copied to the `[userid].BATCH.HPP` PDSE. Use XALANMMI for the 8 character member name.

Once you have copied all of these files you need to edit the SMPLTRNS member of the `[userid].BATCH.CPP` PDSE and change the following line:

```
#include "XalanMemoryManagerImpl.hpp"
```

to

```
#include "XalanMMI.hpp"
```

This is so that this refers to the 8 character name we copied this header file to in the PDSE. The next step is to copy the following JCL to the [userid].BATCH.JCL PDSE. This JCL will compile the SMPLTRNS member and store the object file in [userid].BATCH.OBJ.

```
//SMPTCOMP    JOB MSGLEVEL=(1,1),REGION=0M,NOTIFY=&SYSUID.
//JOBLIB   DD  DSNAME=SYS1.CEE.SCEERUN,DISP=SHR
//         DD  DSNAME=SYS1.CEE.SCEERUN2,DISP=SHR
//         DD  DSNAME=SYS1.CBC.SCCNCMP,DISP=SHR
//STEP1    EXEC  PGM=CCNDRVR,PARM='/CXX OPTFILE(DD:OPTS),OBJ,LIST'
//OPTS     DD  *
  LANGLVL(EXTENDED)
  NOSEARCH SEARCH(./,
          /usr/lpp/ixm/IBM/xml4c-5_7/include/,
          /usr/lpp/ixm/IBM/xslt4c-1_11/include/,
          /usr/lpp/ixm/IBM/xslt4c-1_11/include/xalanc/Include/,
          /usr/lpp/ixm/IBM/xslt4c-1_11/include/xalanc/XSLT,
          //'[userid].BATCH.+',
          //'SYS1.CEE.SCEEH.+',
          //'SYS1.CBC.SCLBH.+')
  DEFINE(OS390=1)
  DEFINE(_OPEN_THREADS=1)
  DEFINE(_XOPEN_SOURCE_EXTENDED=1)
/*
//SYSLIN   DD  DSNAME=&SYSUID..BATCH.OBJ(SMPLTRNS),DISP=SHR
//SYSPRINT DD  SYSOUT=A
//SYSIN    DD  DSNAME=&SYSUID..BATCH.CPP(SMPLTRNS),DISP=SHR
//SYSUT1   DD  DUMMY
/*
```

The next step is to link-edit (bind) this object file into an executable file. You can use the following JCL to accomplish this:

```
//SMPTBIND JOB MSGLEVEL=(1,1),REGION=0M,NOTIFY=&SYSUID.
//BIND1 EXEC PGM=IEWL,PARM='OPTIONS=OPTS'
//OPTS     DD *
    AMODE=31,RMODE=ANY
    DYNAM=DLL,ALIASES=NO,UPCASE=NO,
    LIST=NO,MAP=NO,XREF=NO,MSGLEVEL=4,
    REUS=RENT,EDIT=YES,AC=0,CALL=YES,CASE=MIXED
/*
//SYSLIB   DD DISP=SHR,DSN=SYS1.CEE.SCEELKEX
//         DD DISP=SHR,DSN=SYS1.CEE.SCEELKED
//         DD DISP=SHR,DSN=SYS1.CEE.SCEECPP
//         DD DISP=SHR,DSN=SYS1.CEE.SCEELIB
//         DD DISP=SHR,DSN=SYS1.CBC.SCLBSID
//SYSLIB1  DD DISP=SHR,DSN=SYS1.SIXMEXP
//SYSLIB2  DD DISP=SHR,DSN=&SYSUID..BATCH.OBJ
//SYSLMOD  DD DISP=SHR,DSN=&SYSUID..BATCH.LOAD
//SYSDEFSD DD DUMMY
//SYSPRINT DD SYSOUT=A
//SYSLIN   DD *
      INCLUDE SYSLIB(IOSTREAM)
      INCLUDE SYSLIB(COMPLEX)
      INCLUDE SYSLIB(C128N)
      INCLUDE SYSLIB1(IXM4C57X)
      INCLUDE SYSLIB1(IXMLC21X)
      INCLUDE SYSLIB2(SMPLTRNS)
      ENTRY   CEESTART
      NAME    SMPLTRNS(R) RC=0
/*
```

In this JCL, you can also leave “&SYSUID.” there as long as you are running this from your TSO ID and it matches the high-level qualifier you allocated these data sets under. On the SYSLIB DD statements, if “SYS1” is not the high-level qualifier for these data sets, you will need to remove or replace that. The SYSLIB1 DD

statement assumes the side-decks for the XML Toolkit were installed as recommended and they are in SYS1.SIXMEXP. You can submit this JCL, and it should link-edit the SMPLTRNS object file into an executable file called SMPLTRNS in [userid].BATCH.LOAD.

If you want to execute the SMPLTRNS executable, you can use the following JCL:

```
//SMPLTRNS JOB  MSGLEVEL=(1,1),CLASS=5,REGION=0M,NOTIFY=&SYSUID.
//STEP1    EXEC PGM=SMPLTRNS
//STEPLIB  DD   DSN=&SYSUID..BATCH.LOAD,DISP=SHR
//         DD   DSN=SYS1.SIXMLOD1,DISP=SHR
//*
```

This JCL assumes that the XML Toolkit DLLs were installed as recommended to the SYS1.SIXMLOD1 data set.

Appendix B. Calling XML Parser, C++ Edition from COBOL

Source code samples

This appendix shows an example of invoking the XML Toolkit from a COBOL application. Enterprise COBOL provides its own built-in XML processing capability, but this support lacks certain functions that you may be interested in. For example, Enterprise COBOL lacks ability to validate an XML document based on a Document Type Definition (DTD) or an XML schema, and also does not provide XSLT transformation support. However, by utilizing XML Toolkit components that do provide such capability from your COBOL application, you may be able to achieve your desired goals. The samples provided in the XML Toolkit only illustrate how to invoke the XML Parser, C++ Edition, from a strictly C++ environment.

In the following example, the COBOL program “SAXParseFrontEnd” calls the “parse_validate” method in the SAXParse C++ sample code provided here, which in turn invokes the XML Parser, C++ Edition to do the actual validation of an XML file.

The COBOL code is illustrated in “SAXParseFrontEnd (SPFE) COBOL program” on page 73.

SAXParseFrontEnd (SPFE) COBOL program

```
Process pgmname(longmixed),dll,noexportall,outdd(sysprint)
    Identification division.
      Program-id 'SAXParseFrontEnd'.
    Data division.
     Working-storage section.
   *   1 fileName pic x(80) value z'/usr/lpp/ixm/IBM/xml4c-5_7/sample
   -       's/data/personal-schema.xml'.
       1 invalidFile pic x(12) value z'DD:INVALID'.
       1 rc comp-5 pic s9(9).
       1 fnlen comp pic 99.
    Procedure division.
   * parse_validate does a single validating parse of the XML file
   *
   * First, try a valid file from the samples/data directory
        Call 'parse_validate'
            using by value address of fileName
            returning rc
        Move 0 to tally
        Inspect fileName
            tallying tally for characters before x'00'
        If rc = 0
          Display '"' fileName(1:tally) '" is valid.'
        Else
          Display 'Error! '
              '"' fileName(1:tally) '" should have been valid.'
          Move rc to return-code
        End-if
   *
   * Next, try a well-formed but invalid file, accessed by DDNAME INVALID
        Call 'parse_validate'
            using by value address of invalidFile
            returning rc
        Move 0 to tally
        Inspect invalidFile
            tallying tally for characters before x'00'
        If rc = 0
          Display 'Error! The file in "'
```

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```
            invalidFile(1:tally) '" should have been invalid.'
          Move 8 to return-code
        Else
          Display 'The file in "'
            invalidFile(1:tally) '" is invalid.'
        End-if
        Goback.
    End program 'SAXParseFrontEnd'
```

The COBOL code in “SAXParseFrontEnd (SPFE) COBOL program” on page 73, first passes in by value, a null terminated string containing the fully qualified file path of an HFS file. “parse_validate” will return an integer indicating whether the XML file was valid or not valid.

The COBOL code will make a second call to “parse_validate”, also by value, which illustrates using a DDNAME instead of a file path in the HFS. In this case, the XML file passed in contains errors so validation will fail.

SAXParse.cpp

```
/*
 * Copyright 1999-2006 The Apache Software Foundation.
 *
 * Licensed under the Apache License, Version 2.0 (the "License");
 * you may not use this file except in compliance with the License.
 * You may obtain a copy of the License at
 *
 *      http://www.apache.org/licenses/LICENSE-2.0
 *
 * Unless required by applicable law or agreed to in writing, software
 * distributed under the License is distributed on an "AS IS" BASIS,
 * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.
 * See the License for the specific language governing permissions and
 * limitations under the License.
 */

// ---------------------------------------------------------------------------
//  Includes
// ---------------------------------------------------------------------------
#include <xercesc/parsers/SAXParser.hpp>
#include xercesc/util/OutOfMemoryException.hpp>
#include "SAXParse.hpp"
#include "stdio.h"

// ---------------------------------------------------------------------------
//  Function prototypes
// ---------------------------------------------------------------------------
extern "C"
{
int parse_validate(char * xmlFilePath);
}

// ---------------------------------------------------------------------------
// "parse_validate" will initialize the parser environment and do a single
//  parse of the XML document specified in the parameter list. It terminates
//  and cleans up the environment before exiting.
// ---------------------------------------------------------------------------

int parse_validate(char * xmlFilePath)
{
```

```
bool error_occurred = false;
bool warning_occurred = false;
unsigned long duration;

SAXParser * parser;
SAXParseHandlers * handler;

try
{
 // Initialize the XML4C system

 XMLPlatformUtils::Initialize();

}
catch (const OutOfMemoryException&)
{
 XERCES_STD_QUALIFIER cerr << "OutOfMemoryException during initialization!" << XERCES_STD_QUALIFIER endl;
 return 8;
}
catch (const XMLException& toCatch)
{
 XERCES_STD_QUALIFIER cerr << "Error during initialization! Message:\n"
  << StrX(toCatch.getMessage()) << XERCES_STD_QUALIFIER endl;
 return 8;
}
catch (...)
{
 XERCES_STD_QUALIFIER cerr << "Error during initialization!"
  << XERCES_STD_QUALIFIER endl;
 return 8;
}

// Create the parser instance and set the parser options

parser = new SAXParser;
parser->setDoNamespaces(true);
parser->setDoSchema(true);
parser->setValidationSchemaFullChecking(true);
parser->setValidationScheme(SAXParser::Val_Auto);
parser->cacheGrammarFromParse(false);
handler = new SAXParseHandlers();
parser->setErrorHandler(handler);

       //
       //  Kick off the parse and catch any exceptions.
       //

try
{
 const unsigned long startMillis = XMLPlatformUtils::getCurrentMillis();
 parser->parse(xmlFilePath);
 const unsigned long endMillis = XMLPlatformUtils::getCurrentMillis();
 duration = endMillis - startMillis;
}
catch (const OutOfMemoryException&)
{
 XERCES_STD_QUALIFIER cerr << "OutOfMemoryException during parsing!"
  << XERCES_STD_QUALIFIER endl;
 error_occurred = true;
}
catch (const XMLException& e)
{
 XERCES_STD_QUALIFIER cerr << "\nError during parsing: \n"
  << StrX(e.getMessage())
  << XERCES_STD_QUALIFIER endl;
 error_occurred = true;
}
```

```
 catch (...)
 {
  XERCES_STD_QUALIFIER cerr << "Error during parsing!"
   << XERCES_STD_QUALIFIER endl;
  error_occurred = true;
 }

 if (handler->getSawErrors()) {
  error_occurred = true;
 }

 if (handler->getSawWarning()) {
  warning_occurred = true;
 }

 // Print out the filename and time taken
 if (!error_occurred) {
  XERCES_STD_QUALIFIER cout << xmlFilePath << ": " << duration << " MS " << XERCES_STD_QUALIFIER endl;
 }

 delete handler;
 delete parser;

 XMLPlatformUtils::Terminate();

 if (error_occurred)
 {
  return 8;
 }
 else if (warning_occurred)
 {
  return 4;
 }
 else
 {
  return 0;
 }

 // return 0;
}
```

The C++ code that the COBOL code will invoke is illustrated in “SAXParse.cpp” on page 74. The “parse_validate” method is declared as “extern C” even though it is being invoked from COBOL. This is much easier than using “extern COBOL”. The only parameter is the null terminated string which contains the file name. The “parse_validate” routine will initialize the XML parser environment and then create a parser instance and error handler. If this is successful it will then set some parser features and then attempt to parse the file name passed in. If successful the caller will receive a zero in the return code parameter. If an error occurs a non-zero return code will be returned and an appropriate error message displayed.

The parser instance and error handler are deleted and the XML parser environment is terminated before returning to the caller.

“SAXParse.hpp” on page 77 contains the header file that corresponds to the SAXParse.cpp file.

SAXParse.hpp

```
/*
 * Copyright 1999-2006 The Apache Software Foundation.
 *
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 * you may not use this file except in compliance with the License.
 * You may obtain a copy of the License at
 *
 *      http://www.apache.org/licenses/LICENSE-2.0
 *
 * Unless required by applicable law or agreed to in writing, software
 * distributed under the License is distributed on an "AS IS" BASIS,
 * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.
 * See the License for the specific language governing permissions and
 * limitations under the License.
 */

// ---------------------------------------------------------------------------
//  Includes for all the program files to see
// ---------------------------------------------------------------------------
#include <string.h>
#include <stdlib.h>
#if defined(XERCES_NEW_IOSTREAMS)
#include <iostream>
#else
#include <iostream.h>
#endif
#include <xercesc/util/PlatformUtils.hpp>
#include <xercesc/parsers/SAXParser.hpp>
#include "SAXParHD.hpp"

// ---------------------------------------------------------------------------
//  This is a simple class that lets us do easy (though not terribly efficient)
//  transcoding of XMLCh data to local code page for display.
// ---------------------------------------------------------------------------
class StrX
{
public :
// -----------------------------------------------------------------------
//  Constructors and Destructor
// -----------------------------------------------------------------------
StrX(const XMLCh* const toTranscode)
{
 // Call the private transcoding method
 fLocalForm = XMLString::transcode(toTranscode);
}

~StrX()
{
 XMLString::release(&fLocalForm);
}

// -----------------------------------------------------------------------
//  Getter methods
// -----------------------------------------------------------------------
const char* localForm() const
{
 return fLocalForm;
}

private :
// -----------------------------------------------------------------------
//  Private data members
//
//  fLocalForm
//      This is the local code page form of the string.
// -----------------------------------------------------------------------
 char*   fLocalForm;
```

```
| };
|
| inline XERCES_STD_QUALIFIER ostream& operator<<(XERCES_STD_QUALIFIER ostream& target, const StrX& toDump)
| {
|  target << toDump.localForm();
|  return target;
| }
```

"SAXParseHandlers.cpp" contains the C++ code for the error handler (SAXParseHandlers.cpp).

SAXParseHandlers.cpp

```
/*
 * Copyright 1999-2006 The Apache Software Foundation.
 *
 * Licensed under the Apache License, Version 2.0 (the "License");
 * you may not use this file except in compliance with the License.
 * You may obtain a copy of the License at
 *
 *      http://www.apache.org/licenses/LICENSE-2.0
 *
 * Unless required by applicable law or agreed to in writing, software
 * distributed under the License is distributed on an "AS IS" BASIS,
 * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.
 * See the License for the specific language governing permissions and
 * limitations under the License.
 */

// ---------------------------------------------------------------------------
//  Includes
// ---------------------------------------------------------------------------
#include <xercesc/sax/SAXParseException.hpp>
#include <xercesc/util/XMLString.hpp>
#include <xercesc/util/XMLUniDefs.hpp>
#include "SAXParse.hpp"


// ---------------------------------------------------------------------------
//  SAXParseHandlers: Constructors and Destructor
// ---------------------------------------------------------------------------
SAXParseHandlers::SAXParseHandlers() :
 fSawErrors(false)
 ,fSawWarning(false)
{
}

SAXParseHandlers::~SAXParseHandlers()
{
}
// ---------------------------------------------------------------------------
//  SAXParseHandlers: Overrides of the SAX ErrorHandler interface
// ---------------------------------------------------------------------------
void SAXParseHandlers::error(const SAXParseException& e)
{
 fSawErrors = true;
 XERCES_STD_QUALIFIER cerr << "\nError at (file " << StrX(e.getSystemId())
  << ", line " << e.getLineNumber()
  << ", char " << e.getColumnNumber()
  << "): " << StrX(e.getMessage()) << XERCES_STD_QUALIFIER endl;
}
```

```
void SAXParseHandlers::fatalError(const SAXParseException& e)
{
 fSawErrors = true;
 XERCES_STD_QUALIFIER cerr << "\nFatal Error at (file " << StrX(e.getSystemId())
  << ", line " << e.getLineNumber()
  << ", char " << e.getColumnNumber()
  << "): " << StrX(e.getMessage()) << XERCES_STD_QUALIFIER endl;
}

void SAXParseHandlers::warning(const SAXParseException& e)
{
 fSawWarning = true;
 XERCES_STD_QUALIFIER cerr << "\nWarning at (file " << StrX(e.getSystemId())
  << ", line " << e.getLineNumber()
  << ", char " << e.getColumnNumber()
  << "): " << StrX(e.getMessage()) << XERCES_STD_QUALIFIER endl;
}

void SAXParseHandlers::resetDocument()
{
 fSawWarning = false;
 fSawErrors  = false;
}
```

SAXParseHandlers.cpp is similar to the existing SAXCount and SAXPrint samples in the Toolkit. In this example, only the error handler methods are implemented. Since this only illustrates the validation of an XML file, the default document handler callback methods are inherited, which will ignore the data returned.

"SAXParseHandlers.hpp" on page 79 contains the header file that corresponds to the SAXParseHandlers.cpp file.

SAXParseHandlers.hpp

```
/*
 * Copyright 1999-2006 The Apache Software Foundation.
 *
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 * you may not use this file except in compliance with the License.
 * You may obtain a copy of the License at
 *
 *      http://www.apache.org/licenses/LICENSE-2.0
 *
 * Unless required by applicable law or agreed to in writing, software
 * distributed under the License is distributed on an "AS IS" BASIS,
 * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.
 * See the License for the specific language governing permissions and
 * limitations under the License.
 */

// ---------------------------------------------------------------------------
//  Includes
// ---------------------------------------------------------------------------
#include <xercesc/sax/HandlerBase.hpp>

XERCES_CPP_NAMESPACE_USE

class SAXParseHandlers : public HandlerBase
{
public:
// -----------------------------------------------------------------------
```

```
//  Constructors and Destructor
// ---------------------------------------------------------------------
SAXParseHandlers();
~SAXParseHandlers();

// ---------------------------------------------------------------------
//  Handlers for the SAX ErrorHandler interface
// ---------------------------------------------------------------------
void warning(const SAXParseException& exception);
void error(const SAXParseException& exception);
void fatalError(const SAXParseException& exception);

bool getSawErrors() const
{
 return fSawErrors;
}

bool getSawWarning() const
{
 return fSawWarning;
}

void resetDocument();

private:
bool   fSawErrors;
bool   fSawWarning;
};
```

```
<?xml version="1.0" encoding="ibm-1140"?>
<personnel xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
  xsi:noNamespaceSchemaLocation=
  '/usr/lpp/ixm/IBM/xml4c-5_6/samples/data/personal.xsd'>

  <person id="Big.Boss" >
    <name><family>Boss</family> <given>Big</given></name>
    <email>chief@foo.com</email>
    <link subordinates="one.worker two.worker"/>
  </person>

  <person id="one.worker">
    <name><family>Worker</family> <given>One</given></name>
    <link manager="Big.Boss"/>
    <email>one@foo.com</email>
  </person>

  <person id="two.worker">
    <name><family>Worker</family> <given>Two</given></name>
    <email>two@foo.com</email>
    <link manager="Big.Boss"/>
    <phone>+1.123.555.1234</phone>
  </person>

</personnel
```

Figure 8. Non-valid XML file to be processed using DDNAME

The XML in Figure 8 should be copied to an MVS dataset so that it can be accessed by a DDNAME. The data set name, etc. are provided later in “Setup instructions” on page 82.

Compilation instructions

The JCL in Figure 9 can be used to compile, bind, and execute the COBOL and C++ code from the above section.

```
//CBLXMLVL JOB  MSGLEVEL=(1,1),REGION=0M,NOTIFY=&SYSUID,MSGCLASS=H
//ORDER    JCLLIB  ORDER=(SYS1.ADCOB.V3R3M0.SIGYPROC,SYS1.CBC.SCCNPRC)
//*STDORD  JCLLIB  ORDER=(CBC.SCCNPRC,IGY.V3R4M0.SIGYPROC)           !!!
//*
//*-- Compile C++ program parse_validate -------------------------------
//CPPSP    EXEC  CBCC,INFILE=[userid].BATCH.CPP(SAXPARSE),
//             PARM.COMPILE='/CXX OPTFILE(DD:OPTIONS)'
//COMPILE.OPTIONS  DD  *
  DEFINE(OS390=1) DEFINE(_OPEN_THREADS=1)
  DEFINE(_XOPEN_SOURCE_EXTENDED=1) EXPORTALL LANG(EXTENDED)
  SEARCH(
          /usr/lpp/ixm/IBM/xml4c-5_6/include/,
          //'[userid].BATCH.+',
          //'SYS1.CEE.SCEEH.+',
          //'SYS1.CBC.SCLBH.+')
/*
//*
//*-- Compile C++ class SAXParseHandlers and bind with parse_validate --
//CPPSPH   EXEC  CBCCB,INFILE=[userid].BATCH.CPP(SAXPARHD),
//             PARM.COMPILE='/CXX OPTFILE(DD:OPTIONS)',
//             BPARM='NOLIST,NOMAP,RMODE=ANY'
//COMPILE.OPTIONS  DD  *
  DEFINE(OS390=1) DEFINE(_OPEN_THREADS=1)
  DEFINE(_XOPEN_SOURCE_EXTENDED=1) LANG(EXTENDED)
  SEARCH(
          /usr/lpp/ixm/IBM/xml4c-5_6/include/,
          //'[userid].BATCH.+',
          //'SYS1.CEE.SCEEH.+',
          //'SYS1.CBC.SCLBH.+')
/*
//BIND.XML4C    DD DISP=SHR,DSN=SYS1.SIXMEXP
//BIND.SYSIN    DD  *
  INCLUDE XML4C(IXM4C56X)
/*
//BIND.SYSLMOD  DD  DSN=&&GOSET(SAXPARSE)
//BIND.SYSDEFSD DD  DSN=&&IMPXSET,UNIT=&TUNIT.,
//             DISP=(MOD,PASS),SPACE=(TRK,(3,3)),
//             DCB=(RECFM=FB,LRECL=80,BLKSIZE=3200)
//*
//*-- Compile, link and execute COBOL program SAXParseFrontEnd ---------
//CBLFE    EXEC IGYWCLG,
//             PARM.LKED='CASE=MIXED,DYNAM=DLL,RENT,NOLIST',GOPGM=SPFE,
//* IGYWCLG not properly customized; we shouldn't need the following !!!
//             LNGPRFX=SYS1.ADCOB.V3R3M0,LIBPRFX=SYS1.CEE
//COBOL.SYSIN   DD  DISP=SHR,DSN=[userid].BATCH.COBOL(SPFE)
//LKED.SYSLIN   DD
//              DD DSN=&&IMPXSET,DISP=(OLD,DELETE)
//LKED.SYSLMOD  DD DSN=&&GOSET(&GOPGM)
//GO.STEPLIB DD
//           DD  DSN=&&GOSET,DISP=(OLD,DELETE)
//           DD  DISP=SHR,DSN=SYS1.SIXMLOD1
//GO.SYSOUT  DD  SYSOUT=*
//GO.INVALID DD  DISP=SHR,DSN=[userid].BATCH.XML(INVALID)
//
```

Figure 9. JCL to compile, bind and run the sample code

This JCL uses catalogued JCL procedures to invoke the C++ Compiler, the COBOL compiler and the z/OS Binder.

The CBCC procedure will compile the SAXParse C++ code that contains “parse_validate”.

The CBCCB procedure will compile the SAXParseHandlers C++ code and then bind it into a DLL. This DLL will be linked with the XML Parser, C++ Edition's main DLL.

The IGYWCLG procedure will compile, link, and execute the COBOL SAXParseFrontEnd code.

Setup instructions

Several data sets will need to be allocated to copy the sample code into. You should substitute your actual USERID for `[userid]`.

```
[userid].BATCH.COBOL  --  recfm=FB, lrecl=240, blksize=12960 (contains COBOL code)
[userid].BATCH.CPP    --  recfm=FB, lrecl=240, blksize=12960 (contains C++ code)
[userid].BATCH.HPP    --  recfm=FB, lrecl=240, blksize=12960 (contains C++ header files)
[userid].BATCH.CNTL   --  recfm=FB, lrecl=80,  blksize=12960 (contains JCL)
[userid].BATCH.OBJ    --  recfm=FB, lrecl=80,  blksize=12960 (contains object code)
[userid].BATCH.LOAD   --  recfm=U,  lrecl=0,   blksize=32760 (contains executable code)
[userid].BATCH.XML    --  recfm=FB, lrecl=80,  blksize=12960 (contains actual XML data)
```

In order to compile, link, and run this sample you will need to copy the code, header files, JCL and XML file to the above MVS data sets.

- You will need to copy the SAXParseFrontEnd COBOL code to the SPFE member in `[userid]`.BATCH.COBOL.
- The SAXParse C++ code should be copied to the SAXPARSE member in `[userid]`.BATCH.CPP.
- The SAXParseHandlers C++ code should be copied to the SAXPARHD member in `[userid]`.BATCH.CPP.
- The SAXParse header file should be copied to the SAXPARSE member in `[userid]`.BATCH.HPP.
- The SAXParseHandlers header file should be copied to the SAXPARHD member in `[userid]`.BATCH.HPP.
- The invalid XML data from Figure 6 should be copied to the INVALID member in `[userid]`.BATCH.XML.

Once all of this is done, then the JCL in `[userid]`.BATCH.CNTL(SPFE) can be submitted to compile, link, and run this sample code.

Note: : This example is only intended to demonstrate the usage to the XML Toolkit from COBOL. It is not intended to have high performance characteristics. For more information on how to enhance the performance of this example, refer to the Performance section of theXML Toolkit Web site or the Persistent Parser example in Appendix C, “Parser environment and instance reuse,” on page 83.

Appendix C. Parser environment and instance reuse

This appendix shows you how a parser environment can be initialized and a parser instance created and saved for subsequent calls to parse documents. The overhead of initializing the environment and the creation of a parser instance (as well as the later termination overhead) can be spread across all subsequent parses instead of doing an initialize/parse/terminate sequence for each individual XML document.

In this example, the grammar may also be cached to enhance performance.

The "PersistParseFrontEnd.cpp" on page 83 code contains the main routine for this example. It accepts several command line parameters from the PersistParse command that control the settings used to create the parser instance as well as the file name to parse.

This code is referred to as a "Front End" because it differs from what the other samples in the Toolkit do in their main routine. Other samples normally process the command line arguments and then initialize the parser environment, create a parser instance, process the document and then terminate all in a single routine.

The purpose of this "Front End" module is to separate the initialization, parse, and terminate functions from the main routine and move them into separate methods in the PersistParse.cpp module. This way, the "Front End" code can process the command line arguments and then request the parser environment/instance be created by another method. When control returns to it, a pointer now exists that can be used subsequently to parse an indefinite number of documents using this existing environment and parser instance. When this environment is no longer needed, a single termination request can be performed.

The PersistParse command has a `-i` option that allows you to specify the number of times the document is to be parsed. This is intended to illustrate how the parser environment is initialized and terminated a single time and used across multiple parses. In more practical situations, you would use this feature to parse many different documents.

One thing to keep in mind when creating an application that needs to parse multiple documents is that since the parser instance is only created once, the options specified at the time of creation cannot be changed without terminating and re-initializing. For example, you cannot create a parser instance that does grammar caching and then process a few documents and then stop caching grammars.

"PersistParseFrontEnd.hpp" on page 87 contains the header file for the main routine "PersistParseFrontEnd.cpp" on page 83. "PersistParse.cpp" on page 88 contains the methods that initialize the environment and parser instance, parse the document, and terminate. "PersistParse.hpp" on page 90 contains the header file for the code in "PersistParse.cpp" on page 88. "PersistParseHandlers.cpp" on page 92 contains the error handler methods needed. "PersistParseHandlers.hpp" on page 93 contains the header file the code in "PersistParseHandlers.cpp" on page 92.

PersistParseFrontEnd.cpp

```
/*
 * Copyright 1999-2006 The Apache Software Foundation.
 *
```

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```
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 * you may not use this file except in compliance with the License.
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 *
 *      http://www.apache.org/licenses/LICENSE-2.0
 *
 * Unless required by applicable law or agreed to in writing, software
 * distributed under the License is distributed on an "AS IS" BASIS,
 * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.
 * See the License for the specific language governing permissions and
 * limitations under the License.
 */

// ---------------------------------------------------------------------------
//  Includes
// ---------------------------------------------------------------------------
#if defined(XERCES_NEW_IOSTREAMS)
#include "fstream"
#else
#include "fstream.h"
#endif
#include "PersistParseFrontEnd.hpp"
#include "stdio.h"

// ---------------------------------------------------------------------------
//  Function prototypes
// ---------------------------------------------------------------------------
int initialize_env(parmList *);
int validate_file(parmList *);
int terminate_env(parmList *);

// ---------------------------------------------------------------------------
//  Local helper methods
// ---------------------------------------------------------------------------
void usage()
{
    XERCES_STD_QUALIFIER cout << "\nUsage:\n"
            "    PersistParse [options]  <XML file>\n\n"
            "This program demonstrates how to initialize the parser\n"
            "environment and parser instance a single time and then\n"
            "reuse the saved environment on later parse requests. In this\n"
            "sample the -i option allows the file specified to be parsed\n"
            "multiple times.\n"

            "Options:\n"
            "    -v=xxx      Validation scheme [always | never | auto*].\n"
            "    -n          Enable namespace processing. Defaults to off.\n"
            "    -s          Enable schema processing. Defaults to off.\n"
            "    -f          Enable full schema constraint checking.\n"
            "                Defaults to off.\n"
            "    -gc         Cache Grammar from parse. Defaults to off.\n"
            "    -i nnn      Parse file in loop nnn times. Default is 1 time.\n"
     "    -?          Show this help.\n\n"
            "  * = Default if not provided explicitly.\n"
         << XERCES_STD_QUALIFIER endl;
}

// ---------------------------------------------------------------------------
//  Program entry point
// ---------------------------------------------------------------------------
int main(int argC, char* argV[])
{
 parmList SAXParms;
 int xercesc_rc = 0;

 // Initialize defaults in parameter block
```

```
SAXParms.valScheme          = SAXParser::Val_Auto;
SAXParms.doNamespaces       = false;
SAXParms.doSchema           = false;
SAXParms.schemaFullChecking = false;
SAXParms.doGrammarCaching   = false;
SAXParms.repeatParse        = false;
SAXParms.numParses          = 1;
SAXParms.errorOccurred      = false;
SAXParms.warningOccurred    = false;
SAXParms.xmlFile            = 0;
SAXParms.parser             = 0;
SAXParms.handler            = 0;


// If enough parameters not specified display help information
if (argC < 2)
{
 usage();
 return 4;
}

// Grab user parameter(s)

int parmInd;

for (parmInd = 1; parmInd < argC; parmInd++)
{
 // Break out on first parameter not starting with a dash
 if (argV[parmInd][0] != '-')
 {
  break;
 }

 // Watch for special case help request
 if (!strcmp(argV[parmInd], "-?"))
 {
  usage();
  return 4;
 }
 else if (!strncmp(argV[parmInd], "-v=", 3)
      ||  !strncmp(argV[parmInd], "-V=", 3))
 {
  const char* const parm = &argV;[parmInd][3];

  if (!strcmp(parm, "never"))
   SAXParms.valScheme = SAXParser::Val_Never;
  else if (!strcmp(parm, "auto"))
   SAXParms.valScheme = SAXParser::Val_Auto;
  else if (!strcmp(parm, "always"))
          SAXParms.valScheme = SAXParser::Val_Always;
  else
  {
   XERCES_STD_QUALIFIER cerr << "Unknown -v= value: " << parm << XERCES_STD_QUALIFIER endl;
   return 8;
  }
 }
else if (!strcmp(argV[parmInd], "-n")
     ||  !strcmp(argV[parmInd], "-N"))
 {
 SAXParms.doNamespaces = true;
 }
 else if (!strcmp(argV[parmInd], "-s")
      ||  !strcmp(argV[parmInd], "-S"))
 {
  SAXParms.doSchema = true;
 }
 else if (!strcmp(argV[parmInd], "-f")
```

```
      ||  !strcmp(argV[parmInd], "-F"))
  {
   SAXParms.schemaFullChecking = true;
  }
           else if (!strcmp(argV[parmInd], "-gc")
              ||  !strcmp(argV[parmInd], "-GC"))
  {
   SAXParms.doGrammarCaching = true;

      }
   else if (!strcmp(argV[parmInd], "-i"))
         {
   ++parmInd;
   if (parmInd >= argC)
   {
    XERCES_STD_QUALIFIER cerr << "Invalid -i option (missing # of iterations)" << XERCES_STD_QUALIFIER endl;
    return 8;
   }
   SAXParms.repeatParse = true;
   SAXParms.numParses = atoi(argV[parmInd]);
   if (SAXParms.numParses < 0)
   {
    XERCES_STD_QUALIFIER cerr << "Invalid -i option (negative # of iterations" << XERCES_STD_QUALIFIER endl;
    return 8;
   }
  }
  else
         {
             XERCES_STD_QUALIFIER cerr << "Unknown option '" << argV[parmInd]
                  << "', ignoring it\n" << XERCES_STD_QUALIFIER endl;
         }
     } // end - for ...

 //
 //  There should at least one parameter left, and that
 //  should be the file name.

 SAXParms.xmlFile = argV[parmInd];

 // "initialize_env" call will do the XMLPlatformUtils::Initialize() and
 // create a parser instance and error handler and store their addresses
 // in the parameter block for later use.

 xercesc_rc = initialize_env(&SAXParms;);
 if (xercesc_rc != 0)
 {
  return xercesc_rc;
 }

 // "validate_file" call will parse the input file either once or
 // a multiple number of times based on the "-i" parameter.

 int i = SAXParms.numParses;
 if (SAXParms.repeatParse)
 {
XERCES_STD_QUALIFIER cout << "-i parameter specified, doing parse " << SAXParms.numParses << " times" <<XERCES_STD_QUALIFIE
   }

   for(; i > 0 ; i--)
 {
  xercesc_rc = validate_file(&SAXParms;);
  if (xercesc_rc != 0)
  {
   break;
  }
 }
```

```
 // "terminate_env" call will delete the error handler and parser
 // instance and call XMLPlatformUtils::Terminate().

 terminate_env(&SAXParms;);

 if (SAXParms.errorOccurred)
  return 8;
 else
  return xercesc_rc;
}
```

PersistParseFrontEnd.hpp

```
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 */

// ---------------------------------------------------------------------------
//  Includes for all the program files to see
// ---------------------------------------------------------------------------
#include <string.h>
#include <stdlib.h>
#if defined(XERCES_NEW_IOSTREAMS)
#include <iostream>
#else
#include <iostream.h>
#endif
#include <xercesc/util/PlatformUtils.hpp>
#include <xercesc/parsers/SAXParser.hpp>
#include <xercesc/sax/HandlerBase.hpp>
#include "PersistParse.hpp"

// ---------------------------------------------------------------------------
//  The parmList structure is used to pass parameters to the methods
//  and to preserve the parser and handler pointers so that
//  the parser instance can be preserved across calls to avoid the
//  initialization costs.
// ---------------------------------------------------------------------------

struct parmList {
 SAXParser::ValSchemes valScheme;
 bool doNamespaces;
 bool doSchema;
 bool schemaFullChecking;
 bool doGrammarCaching;
 bool repeatParse;
 bool errorOccurred;
 bool warningOccurred;
 int numParses;
 char *  xmlFile;
 SAXParser * parser;
 PersistParseHandlers * handler;
};
```

PersistParse.cpp

```
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 */

// ---------------------------------------------------------------------------
//  Includes
// ---------------------------------------------------------------------------
#include <xercesc/internal/XMLGrammarPoolImpl.hpp>
#include <xercesc/util/OutOfMemoryException.hpp>
#include "PersistParseFrontEnd.hpp"
#include "stdio.h"


// ---------------------------------------------------------------------------
//  The "initialize_env" method initializes the XML environment and creates a
//  parser instance and error handler and stores their addresses in the
//  parameter block so that subsequent parse ("validate_file") calls can be made
//  without the overhead of creating the XML environment, parser instance, etc.
// ---------------------------------------------------------------------------

int initialize_env(parmList * reqBlock)
{

       XERCES_STD_QUALIFIER cout << "Processing initialize_env request" << XERCES_STD_QUALIFIER endl;

       try
       {
                // Initialize the XML4C system
                XMLPlatformUtils::Initialize();

         // Create the parser instance that can be used later on
         // Use options from parameter block to customize the parser.

         reqBlock->parser = new SAXParser;

                if (reqBlock->doNamespaces)
                {
          (reqBlock->parser)->setDoNamespaces(reqBlock->doNamespaces);
  }

                if (reqBlock->doSchema)
  {
          (reqBlock->parser)->setDoSchema(reqBlock->doSchema);
  }

                if (reqBlock->schemaFullChecking)
  {
          (reqBlock->parser)->setValidationSchemaFullChecking(reqBlock->schemaFullChecking);
  }

  if (reqBlock->doGrammarCaching)
```

```
  {
          (reqBlock->parser)->cacheGrammarFromParse(reqBlock->doGrammarCaching);
  }

         reqBlock->handler = new PersistParseHandlers();
         (reqBlock->parser)->setErrorHandler(reqBlock->handler);
       }
       catch (const OutOfMemoryException&)
       {
            XERCES_STD_QUALIFIER cerr << "OutOfMemoryException during initialization!"
                 << XERCES_STD_QUALIFIER endl;
            return 8;
       }
       catch (const XMLException& toCatch)
       {
            XERCES_STD_QUALIFIER cerr << "Error during initialization! Message:\n"
                 << StrX(toCatch.getMessage()) << XERCES_STD_QUALIFIER endl;
            return 1;
       }
       catch (...)
       {
            XERCES_STD_QUALIFIER cerr << "Error during initialization!"
                 << XERCES_STD_QUALIFIER endl;
            return 8;
       }
    return 0;

} // end -- "initialize_env"

// ---------------------------------------------------------------------------
//  The "validate_file" routine uses the previously established XML environment,
//  parser instance, and error handler to do the actual parse request.
// ---------------------------------------------------------------------------

int validate_file(parmList * reqBlock)
{
 int rc;
 XERCES_STD_QUALIFIER cout << "Processing validate_file request" << XERCES_STD_QUALIFIER endl;

 // Make sure we have valid values
 if (reqBlock->parser == 0 || reqBlock->handler == 0)
 {
  rc = initialize_env(reqBlock);
  if (rc != 0)
  {
   reqBlock->errorOccurred = true;
   return rc;
  }
 }

 unsigned long duration;

 reqBlock->errorOccurred = false;
 reqBlock->warningOccurred = false;
 (reqBlock->handler)->resetDocument();

 //  Kick off the parse and catch any exceptions.

 try
 {
  const unsigned long startMillis = XMLPlatformUtils::getCurrentMillis();
  (reqBlock->parser)->parse(reqBlock->xmlFile);
  const unsigned long endMillis = XMLPlatformUtils::getCurrentMillis();
  duration = endMillis - startMillis;
 }
 catch (const OutOfMemoryException&)
 {
```

```
 XERCES_STD_QUALIFIER cerr << "OutOfMemoryException during parsing!"
  << XERCES_STD_QUALIFIER endl;
 reqBlock->errorOccurred = true;
 return 8;
}
catch (const XMLException& e)
{
 XERCES_STD_QUALIFIER cerr << "\nError during parsing: \n"
  << StrX(e.getMessage())
  << XERCES_STD_QUALIFIER endl;
 reqBlock->errorOccurred = true;
 return 8;
}
catch (...)
{
 XERCES_STD_QUALIFIER cerr << "Error during parsing!"
  << XERCES_STD_QUALIFIER endl;
 reqBlock->errorOccurred = true;
 return 8;
}


if ((reqBlock->handler)->getSawErrors())
{
 reqBlock->errorOccurred = true;
 return 8;
}

if ((reqBlock->handler)->getSawWarning())
{
 reqBlock->warningOccurred = true;
 return 4;
}

// Print out the filename and time taken
if (!reqBlock->errorOccurred)
{
 XERCES_STD_QUALIFIER cout << reqBlock->xmlFile << ": " << duration << " ms " << XERCES_STD_QUALIFIER endl;
}

   return 0;
} // end -- "validate_file"

// ---------------------------------------------------------------------------
//  The "terminate_env" routine will delete the previously established error
//  handler and parser instance and then terminate the XML environment.
// ---------------------------------------------------------------------------
int terminate_env(parmList * reqBlock)
{
 XERCES_STD_QUALIFIER cout << "Processing terminate_env request" << XERCES_STD_QUALIFIER endl;

 delete reqBlock->handler;
 delete reqBlock->parser;

 XMLPlatformUtils::Terminate();

 return 0;
} // end -- "terminate_env"
```

PersistParseFrontEnd.hpp

```
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```

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 */

// ---------------------------------------------------------------------------
//  Includes for all the program files to see
// ---------------------------------------------------------------------------
#include <string.h>
#include <stdlib.h>
#if defined(XERCES_NEW_IOSTREAMS)
#include <iostream>
#else
#include <iostream.h>
#endif
#include <xercesc/util/PlatformUtils.hpp>
#include <xercesc/parsers/SAXParser.hpp>
#include "PersistParseHandlers.hpp"

// ---------------------------------------------------------------------------
//  This is a simple class that lets us do easy (though not terribly efficient)
//  trancoding of XMLCh data to local code page for display.
// ---------------------------------------------------------------------------
class StrX
{
public :
// ---------------------------------------------------------------------------
//  Constructors and Destructor
// ---------------------------------------------------------------------------
StrX(const XMLCh* const toTranscode)
{
 // Call the private transcoding method
 fLocalForm = XMLString::transcode(toTranscode);
}

~StrX()
{
 XMLString::release(&fLocalForm;);
}

// ---------------------------------------------------------------------------
//  Getter methods
// ---------------------------------------------------------------------------
const char* localForm() const
{
 return fLocalForm;
}

private :
// ---------------------------------------------------------------------------
//  Private data members
//
//  fLocalForm
//      This is the local code page form of the string.
// ---------------------------------------------------------------------------
char *   fLocalForm;
};

inline XERCES_STD_QUALIFIER ostream& operator<<(XERCES_STD_QUALIFIER ostream& target, const StrX& toDump)
```

```
{
 target << toDump.localForm();
 return target;
}
```

PersistParseHandlers.cpp

```
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 */

// ---------------------------------------------------------------------------
//  Includes
// ---------------------------------------------------------------------------
#include <xercesc/sax/SAXParseException.hpp>
#include <xercesc/util/XMLString.hpp>
#include <xercesc/util/XMLUniDefs.hpp>
#include "PersistParse.hpp"


// ---------------------------------------------------------------------------
//  PersistParseHandlers: Constructors and Destructor
// ---------------------------------------------------------------------------
PersistParseHandlers::PersistParseHandlers() :
 fSawErrors(false),fSawWarning(false)
{
}

PersistParseHandlers::~PersistParseHandlers()
{
}

// ---------------------------------------------------------------------------
//  PersistParseHandlers: Overrides of the SAX ErrorHandler interface
// ---------------------------------------------------------------------------
void PersistParseHandlers::error(const SAXParseException& e)
{
 fSawErrors = true;
 XERCES_STD_QUALIFIER cerr << "\nError at (file " << StrX(e.getSystemId())
  << ", line " << e.getLineNumber()
  << ", char " << e.getColumnNumber()
  << "): " << StrX(e.getMessage()) << XERCES_STD_QUALIFIER endl;
}

void PersistParseHandlers::fatalError(const SAXParseException& e)
{
 fSawErrors = true;
 XERCES_STD_QUALIFIER cerr << "\nFatal Error at (file " << StrX(e.getSystemId())
  << ", line " << e.getLineNumber()
  << ", char " << e.getColumnNumber()
  << "): " << StrX(e.getMessage()) << XERCES_STD_QUALIFIER endl;
}
```

```
void PersistParseHandlers::warning(const SAXParseException& e)
{
 fSawWarning = true;
 XERCES_STD_QUALIFIER cerr << "\nWarning at (file " << StrX(e.getSystemId())
  << ", line " << e.getLineNumber()
  << ", char " << e.getColumnNumber()
  << "): " << StrX(e.getMessage()) << XERCES_STD_QUALIFIER endl;
}

void PersistParseHandlers::resetDocument()
{
 fSawWarning = false;
 fSawErrors  = false;
}
```

PersistParseHandlers.hpp

```
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 */

// ---------------------------------------------------------------------------
//  Includes
// ---------------------------------------------------------------------------
#include <xercesc/sax/HandlerBase.hpp>

XERCES_CPP_NAMESPACE_USE

class PersistParseHandlers : public HandlerBase
{
public:
// ---------------------------------------------------------------------------
//  Constructors and Destructor
// ---------------------------------------------------------------------------
PersistParseHandlers();
~PersistParseHandlers();

// ---------------------------------------------------------------------------
//  Handlers for the SAX ErrorHandler interface
// ---------------------------------------------------------------------------
void warning(const SAXParseException& exception);
void error(const SAXParseException& exception);
void fatalError(const SAXParseException& exception);

bool getSawErrors() const
{
 return fSawErrors;
}

bool getSawWarning() const
{
 return fSawWarning;
}
```

```
void resetDocument();

private:
bool fSawErrors;
bool fSawWarning;
};
```

Appendix D. Accessibility

Accessibility features help a user who has a physical disability, such as restricted mobility or limited vision, to use software products successfully. The major accessibility features in z/OS enable users to:

- Use assistive technologies such as screen readers and screen magnifier software
- Operate specific or equivalent features using only the keyboard
- Customize display attributes such as color, contrast, and font size

Using assistive technologies

Assistive technology products, such as screen readers, function with the user interfaces found in z/OS. Consult the assistive technology documentation for specific information when using such products to access z/OS interfaces.

Keyboard navigation of the user interface

Users can access z/OS user interfaces using TSO/E or ISPF. Refer to *z/OS TSO/E Primer*, *z/OS TSO/E User's Guide*, and *z/OS ISPF User's Guide Vol I* for information about accessing TSO/E and ISPF interfaces. These guides describe how to use TSO/E and ISPF, including the use of keyboard shortcuts or function keys (PF keys). Each guide includes the default settings for the PF keys and explains how to modify their functions.

z/OS information

z/OS information is accessible using screen readers with the BookServer/Library Server versions of z/OS books in the Internet library at:

`http://www.ibm.com/servers/eserver/zseries/zos/bkserv/`

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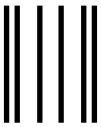

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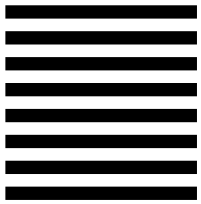

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