XML Strategies for the CICS Transaction Server Environment

Dennis Weiand
IBM

Tuesday, August 3, 2010
Session 6903
Abstract

- As the use of XML continues to become more prevalent, knowing the options available in the CICS Transaction Server environment become increasingly important. CICS's Web service support, CICS's TRANSFORM API command, COBOL's PARSE verb, and Java parsers are some of the available options, but each of them are surrounded with many details. This session is intended to discuss the various XML usage options in the CICS Transaction Server environment, with a focus on using mapping level capabilities for dealing with common XML-related issues such as string handling and occurring item. Use of zAAP processors for offloading some of the XML parsing will also be discussed.
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Agenda

- Parsing Options
- Places where we parse and generate XML in CICS
  - Web services support
  - EXEC CICS TRANSFORM
  - RESTful Requests
  - ATOM
  - CICS Dynamic scripting
- Common issues when using CICS’s built-in parsing capability
  - xsd:String
  - Occurring Items
  - Adding headers on Web service requests
  - xsd:any and xsd:anyType
  - Multiple Containers
XML Parsing Options on z/OS

- **XMLSS (z/OS XML System Services)**
  - General-purpose, validating parser, can handle huge messages
  - Parsing is zAAP eligible
- **XML Toolkit (XML4C** – can work with XMLSS)
- **IBM’s Java 6** comes with XML4J and XL TXE-J (Java is zAAP eligible)
  - **XML4J**
    - Based on Apache Xerces-J 2.9.0
    - Validating Parser
    - Supports JAXP
  - **XL TXE-J**
    - Non-validating Parser
- **COBOL PARSE** verb
  - With XMLSS compile option is zAAP eligible (Enterprise COBOL V4.1+)
  - Interactions with XMLSS improved in Enterprise COBOL V4.2
- **PLISAXA/PLISAXB/PLISAXC** subroutines
- **Special-purpose**
  - CICS’s ‘shredder’ – non-validating, fast
- **Custom/RYO**
  - Special-built code for your XML vocabulary could be fast
XML In CICS Applications

- Process XML before getting to CICS
- CICS Web services
- SCA (when exposing component or composite as a Web service)
- EXEC CICS TRANSFORM
- RESTful Interfaces
- ATOM
- Event Processing
  - WBE Format
  - CBE Format
  - Custom Adapter
- Dynamic Scripting
  - ATOM Feeds
  - From Java, PHP, Groovy

Each are discussed on upcoming pages
XML Conversion outside of CICS

- **Endpoint of Web service in WAS or ESB**
  - Receive Web service request outside CICS, then communicate to CICS using CICS TG, WOLA, WMQ, etc
- **WebSphere Message Broker or WESB**
  - Request received by ESB – ESB communicates to CICS
- **WebSphere Transformation eXtender**
  - Used to extend capabilities of ESB
  - Industry Transformation Packs
    - SEPA, SWIFT, HIPA EDI, ACORD, more
- **DataPower**
  - Appliance – can be used for XML transformation
- **DB2 pureXML**
  - DB2 understands XML

**Abbreviations:**
- **WAS** = WebSphere Application Server
- **WESB** = WebSphere Enterprise Services Bus
- **WebSphere TX** = WebSphere Transformation eXtender
Leave the XML processing to DB2

- **DB2 – pureXML – DB2 9.1+**
  - Store XML with no parsing, mapping or conversion
  - Can be modified using XPath (DB2 V10.1)
  - See developerWorks article for more info on a CICS/DB2 pureXML web service
  - See DB2 InfoCenter for more information on pureXML

- **Using CICS with DB2 pureXML**
CICS’ Web Service Support

Service Requester

SOAP message

HFS
- pipeline config
- WSDL

CICS Web service assistant

Language structure

CICS TS

TCP/IP SERVICE
- CSOL
- CWXN

URIMAP
- dynamic install

PIPECONE
- WEB SERVICE
- Business Logic

Pipeline
- data mapping
- handlers
CICS’ Web Service Support

CICS TS V4.1 Initial parse by z/OS XML System Services (zAAP Eligible)

Data elements Body of SOAP envelope done by:
- CICS (DFHPITP)
- RDz Generated code
- Your Code
XML with CICS Web Services Assistant

- Batch utilities (DFHWS2LS and DFHLS2WS)
- Initial parse before pipeline processing
  - Done by XMLSS in CICS TS V4.1; zAAP eligible
  - Parse of application specific data in body not zAAP eligible

```
Service Requester
```

```
IDE tools
```

```
DFHLS2WS Batch
```

```
WSDL
```

```
WSBind file
```

```
language Structure representing COMMAREA or Container(s) (COBOL, PL/I, C, C++)
```

```
CICS Web services
```

```
pipeline
```

```
SOAP body
```

```
DFHPITP
```

```
HLL data structure
```

```
business logic
```

```
`WEBSERVICE resource`
```

```
`create`
```

```
`generate`
```
XML with CICS Web Services Assistant

- Batch utilities (DFHWS2LS and DFHLS2WS)
- Initial parse before pipeline processing
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Body of SOAP envelope parsed by:
- CICS (DFHPITP)

CICS TS V4.1 Initial parse by z/OS XML System Services (zAAP Eligible)
RDz “Interpretive XML Conversion”

- Rational Developer for System z (RDz)
  - Run wizards at workstation – COBOL/PLI input
- Initial parse before pipeline processing
  - Done by XMLSS in CICS TS V4.1; zAAP eligible
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Body of SOAP envelope parsed by:
- CICS (DFHPITP)
RDz “Compiled XML Conversion”

- RDz generates ‘converter’ programs that contain a COBOL parse verb
  - zAAP eligible when compiled with Enterprise COBOL v4.1 or higher
    - Needs XMLSS compile option
  - Can be used with CICS TX V3 or V4
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    - Needs XMLSS compile option
  - Can be used with CICS TX V3 or V4

Body of SOAP envelope parsed by:
- RDz-generated COBOL
  - zAAP eligible if Enterprise COBOL V4.1+ and XMLSS opt
XML with CICS Web Services Assistant
XML-ONLY=TRUE

- Can specify XML-ONLY=True with CICS Web Services Assistant or RDz
- MAPPING-LEVEL=2.1 or higher
- SOAP message passed to you, you can use:
  - COBOL PARSE verb, Java (XML4J or others), pass data to DB2 pureXML, use vendor product, or use CICS’s TRANSFORM verb
XML with CICS Web Services Assistant
XML-ONLY=TRUE

- Can specify XML-ONLY=True with CICS Web Services Assistant or RDz
- SOAP message passed to you, you can use:
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SCA: Service Component Architecture

- Provide capability to easily develop flexible and reusable CICS application components
  - Rapid assembly and deployment of new Services
  - Express existing applications as re-usable components

- Separation of bindings from application code allows flexible infrastructure changes

- Reduce skills and effort required to view and manage business applications
SCA: Service Component Architecture

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Component exposed as XML-based service, promoted as interface to composite
EXEC CICS TRANSFORM

- Available with CICS TS V4.1
- XML to Language Structure or vice versa
- Uses an XSDBind file
  - Created with the CICS XML Assistant or RDz
  - Installed using a BUNDLE resource
  - XSDBind also used with ATOM feeds (not in BUNDLE)
- Can ask for document root element name
- Can request validation
  - Starts Java program for validation
- Can use “interpretive XML conversion” approach
- Can use “compiled XML conversion” approach
  - RDz V7.6+
RESTful Interfaces

- Similar in concept to hyperlinked data
- Lightweight data transfer that leverage the HTTP protocol
- Representational State Transfer
  - Nouns (URLs) indicate what is being worked on
  - Verbs (GET, PUT, POST, DELETE) indicate the action to be performed (List, Create, Read, Update, Delete)
- Format of results is not defined
  - Popular formats of returned data are XML and JSON
- Approaches in CICS
  - CICS WEB API
  - ATOM Feed (CICS TS V4.1 and SupportPac CA8K)
  - PHP (SupportPac CA1S)
  - CICS Dynamic Scripting
## REST request

<table>
<thead>
<tr>
<th>Request URI</th>
<th>HTTP Method</th>
<th>Event</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Collection URI</strong>, e.g.:</td>
<td>GET</td>
<td>List</td>
</tr>
<tr>
<td><a href="http://xyz.com/prefix/myResource">http://xyz.com/prefix/myResource</a></td>
<td>POST</td>
<td>Create</td>
</tr>
<tr>
<td></td>
<td>PUT</td>
<td>putCollection</td>
</tr>
<tr>
<td></td>
<td>DELETE</td>
<td>deleteCollection</td>
</tr>
<tr>
<td><strong>Member URI</strong>, e.g.:</td>
<td>GET</td>
<td>Retrieve</td>
</tr>
<tr>
<td><a href="http://xyz.com/prefix/myResource/resourceID">http://xyz.com/prefix/myResource/resourceID</a></td>
<td>POST</td>
<td>postMember</td>
</tr>
<tr>
<td></td>
<td>PUT</td>
<td>update</td>
</tr>
<tr>
<td></td>
<td>DELETE</td>
<td>delete</td>
</tr>
</tbody>
</table>
REST simple sample

- **Request**
  
  GET /mortgage/231677 HTTP/1.1  
  Host: www.example.com  
  Accept-Language: en  
  Charset: UTF-8

- **Response**
  
  HTTP/1.1 200 OK  
  Language: en_us  
  Charset: UTF-8  
  Content-Type: text/json  
  {
  "principal":"238000",  
  "rate":"3.5",  
  "type":"5/1 ARM"
  }

  or

  HTTP/1.1 200 OK  
  Language: en_us  
  Charset: UTF-8  
  Content-Type: text/xml  
  <mortgage><principal>238000</principal><rate>3.5</rate><type>5/1 ARM</type></mortgage>
XML with RESTful Interfaces

- **REST** leverages the HTTP Protocol
- **Request - Response** data commonly in XML or JSON
  - XML layout can be documented in an XSD
- **Receive request - return response**
  - CICS Dynamic Scripting or SupportPac CA1S
  - CICS Web Support (EXEC CICS WEB commands)
    - You create the XML:
      - `COBOL GENERATE verb, CICS TRANSFORM verb, CICS DOCUMENT API, read the XML from DB2, whatever`
    - EXEC CICS WEB SEND
- **Can use ATOM** Support to provide RESTful interface
  - CICS TS V4.1 ATOM support or SupportPac CA8K
  - CICS Dynamic Scripting
HTTP request with XML

- **REST is more than just returning XML**
  - REST leverages the HTTP protocol, uses HTTP status codes, uses HTTP architected headers, uses commonly accepted approaches to adding filters or search criteria
- **CICS TRANSFORM** verb
  - XML content documented in an XSD
- **COBOL PARSE and GENERATE** verbs
- **Java** classes
- **CICS DOCUMENT API**
- Get the XML from **DB2**
- **Whatever** (COBOL string verb / RYO Assembler)
XML with ATOM Feeds

- Expose **VSAM file, TS Queue, or program** as ATOM feed
- Provides a RESTful interface documented in **RFC5023**
- ATOM feeds have a **defined set of XML tags**
  - As per the ATOM Publishing Format (**RFC4287**)  
  - **General tags** (author, etc) values
    - From your ATOM configuration file
    - From file (using ‘unstructured’ content)
- **Data values** formulated based on XSDBind file
  - Created with CICS XML Assistant or RDz
  - Same as with TRANSFORM, but not in a BUNDLE
- **Data** (in the content tag in the entry tag) can be documented in an XSD
- **Dynamic Scripting**
XML with ATOM Feeds

- **ATOM configuration file contains**
  - Default values for required tags such as ‘author’
  - Describes SERVICE, CATEGORY, COLLECTION or FEED
  - Contains paths for feed or collection, plus more

- **XSDBind file contains**
  - Data layout information so CICS knows how to encapsulate the data in XML tags
XML with ATOM Feeds

- **ATOM configuration file contains**
  - Default values for required tags such as ‘author’
  - Describes SERVICE, CATEGORY, COLLECTION or FEED
  - Contains paths for feed or collection, plus more

- **XSDBind file contains**
  - Data layout information so CICS knows how to encapsulate the data in XML tags

For Feed-related tags, CICS uses XMLSS

Data XML parsing and generation is based on XSDBind file created with CICS XML Assistant or RDz:
- CICS Parses/generates
- RDz Converter program
  - zAAP eligible when compiled with Enterprise COBOL V4.1+
<?xml version="1.0" encoding="utf-8"?>
<feed xmlns="http://www.w3.org/2005/Atom">
  <title>Example Feed</title>
  <subtitle>A subtitle.</subtitle>
  <link href="http://example.org/feed/" rel="self"/>
  <link href="http://example.org/"/>
  <updated>2003-12-13T18:30:02Z</updated>
  <author>
    <name>John Doe</name>
    <email>johndoe@example.com</email>
  </author>
  <id>urn:uuid:60a76c80-d399-11d9-b91c-0003939e0af6</id>
  <entry>
    <title>Atom-Powered Robots Run Amok</title>
    <link href="http://example.org/2003/12/13/atom03"/>
    <id>urn:uuid:1225c695-cfb8-4ebb-aaaa-80da344efa6a</id>
    <updated>2003-12-13T18:30:02Z</updated>
    <summary>Some text.</summary>
    <content><data_content_here/></content>
  </entry>
</feed>
ATOM: Example XML

<?xml version="1.0" encoding="utf-8"?>
<feed xmlns="http://www.w3.org/2005/Atom">
  <title>Example Feed</title>
  <subtitle>A subtitle.</subtitle>
  <link href="http://example.org/feed/" rel="self"/>
  <link href="http://example.org/"/>
  <updated>2003-12-13T18:30:02Z</updated>
  <author>
    <name>John Doe</name>
    <email>johndoe@example.com</email>
  </author>
  <id>urn:uuid:60a76c80-d399-11d9-b91c-0003939e0af6</id>
  <entry>
    <title>Atom-Powered Robots Run Amok</title>
    <link href="http://example.org/2003/12/13/atom03"/>
    <id>urn:uuid:1225c695-cfb8-4ebb-aaaa-80da344efa6</id>
    <updated>2003-12-13T18:30:02Z</updated>
    <summary>Some text.</summary>
    <content>data_content_here</content>
  </entry>
</feed>

Data for tags required by the ATOM RFC are taken from the ATOM configuration file or from a data file when using ‘unstructured’ content.

Same as above.

XSDBind file or converter program used to generate XML from data in TSQ, FILE, or program.
CICS Event Processing Adapters

CICS TS v4.1

Existing Business Logic

Capture Point

EXEC CICS SIGNAL EVENT

EVENT DISPATCHER

Transactions Security Dispatching Monitoring

CICS Event

Sent to one of

EVENT CAPTURE

EP Adapter Interfaces

‘WMQ’ EP Adapter

‘HTTP’ EP Adapter

‘Transaction Start’ EP Adapter

‘TS queue’ EP Adapter

Custom EP Adapter

EXEC CICS SIGNAL EVENT

CICS Event Tooling: Create & Deploy Event Binding

CICS Event Tooling: Create & Deploy Event Binding

CBE

XML

CEI

WBM

WBE

XML

WBE

XML

WBE

XML

WBM

Any format

Anywhere

SHARE in Boston
CICS Event Processing Adapters

- **Output ONLY**
  - CICS generates XML
  - You could create your own XML

---

**CICS TS v4.1**

**EXEC CICS SIGNAL EVENT**

**EVENT DISPATCHER**

- Event Capture
- Existing Business Logic
- Internal Event

**CICS Event Tooling:**
- Create & Deploy Event Binding

**EP Adapter Interfaces**

- WBM
- CBE
- XML
- WBE
- CICS Transactions
- Security
- Dispatching
- Monitoring

**EP Adapter Interfaces:**

- WMQ
- HTTP
- Transaction Start
- TS queue
- Custom
- Any format

CICS generates XML anywhere.
Common Issues: xsd:string

- Mapping level 1.0: assumed to be 255 bytes
- Mapping level 1.1: xsd:string > 32767 mapped to container
- Mapping level 1.2: DEFAULT-CHAR-MAXLENGTH
  - Allowed you to set the length assumption
- Mapping level 1.2: CHAR-VARYING
  - NO: string mapped to fix-length field (same as 1.0)
  - NULL: string mapped to fix-length field with null delimiter
  - yes: generates a field for the length and a field for the container
    - Could specify DEFAULT-CHAR-MAXLENGTH=32768 to have any xsd:string mapped to a container
- Mapping level 1.2: CHAR-VARYING-LIMIT
  - Point at which we map xsd:string to a container
  - CHAR-VARYING-LIMIT=0 will have any xsd:string mapped to a container
- Mapping level 2.1: CHAR-VARYING=COLLAPSE is the default
xsd:string – example 1

```xml
<element name="getHelloString">
    <complexType>
        <sequence>
            <element name="aString" nillable="true" type="xsd:string"/>
        </sequence>
    </complexType>
</element>
```

DFHWS2LS: MAPPING-LEVEL=2.1

05 getHelloString.
   10 aString-length PIC S9999 COMP-5 SYNC.
   10 aString PIC X(255).
   10 attr-nil-aString-value PIC X DISPLAY.

EXEC CICS GET CONTAINER(CONTAINERID) INTO(getHelloString) RESP(RESP-FLD) RESP2(RESP2-FLD) END-EXEC.
If Resp-Fld NOT = DFHRESP(NORMAL) EXEC CICS ABEND ABCODE('DDW0') END-EXEC End-If.

• Would add code here to check if nillable flag set, * If not nil, would do the next line
String 'The input value was:'
aString(1:aString-length)
Delimited by size into MY-Message.

This is just one way of working with an xsd:string. There are additional ways. This approach only allows for a maximum xsd:string size of 255. Could use DEFAULT-CHAR-MAXLENGTH to indicate the max allowed length.
xsd:string – example 2

```xml
<element name="getHelloString">
  <complexType>
    <sequence>
      <element name="aString" nillable="true" type="xsd:string"/>
    </sequence>
  </complexType>
</element>
```

DFHWS2LS:
MAPPING-LEVEL=2.1
CHAR-VARYING-LIMIT=0

This is just one way of working with an xsd:string. There are additional ways. This approach accommodates an xsd:string of any length.
Common Issues: occurring items

- WSDL may contain `minoccurs` and `maxoccurs`
- DFHWS2LS generates
  - A field for the number of occurrences
  - A field for a container name
  - The container holds all occurrences
- **Mapping level 2.1**
  - Allows you to generate in-line occurring elements
  - `INLINE-MAXOCCURS-LIMIT` (point at which occurs is not in-line)
  - Supports occurring at group level
    - `xsd:sequence`, `xsd:choice`, and `xsd:all`
Occurring items - getOvenInfo

- Scenario – oven info from specified warehouse

A Warehouse (#12345)

- Ovens
  - Amana
    - Model Am123
    - Model Am987
  - Maytag
    - Model MA876
    - Model Ma345
    - Model Ma765
  - TVs
- Refrigerators

Warehouse #12345

Ovens
- Maytag, distributor=Joes Oven Supply
  - Model MA876, price=200, inStock=3
  - Model MA345, price=389, inStock=60
  - Model MA765, price=1200, inStock=9

Amana, distributor=Ovens-are-us
- Model AM123, price=50, inStock=450
- Model AM987, price=487, inStock=67
Occurring Items – get Oven Info

One occurrence of a Model
Model MA876 modelid, price, number in stock

Multiple occurrences of a model
Maytag-Models
- MA876 info
- MA345 info
- MA765 info

Amana-Models
- AM123 info
- AM987 info

Warehouse #12345
Ovens
- Maytag, distributor=Joes Oven Supply
  Model MA876, price=200, inStock=3
  Model MA345, price=389, inStock=60
  Model MA765, price=1200, inStock=9
- Amana, distributor=Ovens-are-us
  Model AM123, price= 50, inStock=450
  Model AM987, price=487, inStock=67
Occurring Items – getOvenInfo

```
03 brand.  06 theName-length PIC S9999 COMP-5 SYNC.  06 theName PIC X(40).
06 distributor-length PIC S9999 COMP-5 SYNC.  06 distributor PIC X(40).
06 model-num PIC S9(9) COMP-5 SYNC.  06 model-cont PIC X(16).
```

The brand name and distributor are strings, max length is 40, but real string length is in the field that ends in -length.

The model-num is the count of models (for Maytag this was 3)

The model-cont will be the name of the container holding the information about the models

Maytag-Models

<table>
<thead>
<tr>
<th>Maytag info</th>
<th>Amana info</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maytag</td>
<td>Amana</td>
</tr>
</tbody>
</table>

And there are multiple Brands

**Brand-Info**

<table>
<thead>
<tr>
<th>Maytag info</th>
<th>Amana info</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maytag</td>
<td>Amana</td>
</tr>
</tbody>
</table>

**Warehouse #12345**

**Ovens**

- Maytag, distributor=Joes Oven Supply
  - Model MA876, price=200, inStock=3
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  - Model AM123, price=50, inStock=450
  - Model AM987, price=487, inStock=67
Occurring Items - getOvenInfo

06 ovenStock.
  09 brand-num PIC S9(9) COMP-5 SYNC.
  09 brand-cont PIC X(16).

Hmm!

OVEN-INVENTORY

2 Brand-Info

Maytag info Amana info

Maytag-Models

MA876 info MA345 info MA765 info

Amana-Models

AM123 info AM987 info

Warehouse #12345
Ovens

  Maytag, distributor=Joes Oven Supply
    Model MA876, price=200, inStock=3
    Model MA345, price=389, inStock=60
    Model MA765, price=1200, inStock=9
  Amana, distributor=Ovens-are-us
    Model AM123, price=50, inStock=450
    Model AM987, price=487, inStock=67
Occurring Items - getOvenInfo

• A different way to look at it.

These are in a container whose name is stored with Ovens

Warehouse #12345
Ovens

- Maytag, distributor=Joes Oven Supply
  - Model MA876, price=200, inStock=3
  - Model MA345, price=389, inStock=60
  - Model MA765, price=1200, inStock=9

- Amana, distributor=Ovens-are-us
  - Model AM123, price=50, inStock=450
  - Model AM987, price=487, inStock=67

These are in a container whose name is stored with Maytag

These are in a container whose name is stored with Amana
Common Issues: xsd:any xsd:anyType

- **Supported in mapping level 2.1**
- **xsd:any** – a way of specifying undefined content in a Web service message
  - Any well-formed XML
  - One xsd:any per scope, but it can have multiple occurrences
- **xsd:anyType** – base data type from which all simple and complex data types are derived
  - Similar to the way that all Java objects inherit from “Object”
- Generates a field for a container name for data
  - The specified container will contain the data for that element
- Generates a field for a container name for the XMLNSs
  - The specified container will contain the XML namespaces used in the elements data
- Elements with Abstract=”true” are treated like xsd:any
Common Issues: Custom Headers

- Want to specify custom header information based on information in the business logic program.
  - Business logic program (or wrapper) must use channels and containers.
  - Business logic program places information to be placed in the header into a container on the current channel (before INVOKE WEBSERVICE).
- Header handler GETs information from the current channel:
  - Constructs a SOAP header.
  - Places the SOAP header in the DFHHEADER container.
  - CICS places the header in the SOAP message.

![Diagram of CICS Web services pipeline](image)
Mapping Level 3.0 – Multiple Containers

- DFHLS2WS has REQUEST-CHANNEL= and RESPONSE-CHANNEL=
- Bottom-up
- These point to a channel description document

A container can have a single element – great for Java (or other languages)

```xml
<channel name="fund" xmlns=http://www.ibm.com/xmlns/prod/CICS/channel>
  <container name="id" type="char" use="required"/>
  <container name="name" type="char" use="optional"/>
  <container name="rating" type="char" use="optional"/>
  <container name="price" type="char" use="optional"/>
</channel>
```

A container can have a language structure

```xml
<channel name="fund" xmlns=http://www.ibm.com/xmlns/prod/CICS/channel>
  <container name="fundAdmin" type="char" use="required">
    <structure location="//WSPOT01.CICSLAB.UTIL(FUNDADMIN)"/>
  </container>
  <container name="fundHistory" type="char" use="optional">
    <structure location="//WSPOT01.CICSLAB.UTIL(FUNDSRY)"/>
  </container>
</channel>
```
Summary

• Parsing Options
• Places where we parse and generate XML in CICS
  • Web services support
  • EXEC CICS TRANSFORM
  • RESTful Requests
  • ATOM
  • CICS Dynamic scripting
• Common issues when using CICS’s built-in parsing capability
  • xsd:String
  • Occurring Items
  • Adding headers on Web service requests
  • xsd:any and xsd:anyType
  • Multiple Containers
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  - http://www.w3.org/XML/

- **COBOL:**

- **JAVA**
  - http://publib.boulder.ibm.com/infocenter/javasdk/v6r0/
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- **Java XML/XSLT for z/OS Performance**

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