XML Technical Exchange

David Seidel

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Background and Purpose

- **Background**
  - **At AMG27**
    - **The AMG reviewed a proposal to use XML for DIFs**
    - **AMG supported the proposal**
  - **Comment submitted to draft 3 of OMT**
- **Purpose**
  - **Review discussion presented at AMG27**
  - **Discuss technical aspects of XML**
    - **What XML is**
    - **How HLA will use XML**
  - **Present XML experiments**

XML to Support HLA DIFs

- **Background**
  - HLA DIFs (OMT, FED) need to be updated to reflect changes in OMT tables
  - With the spec review for standardization, considered an option of using an industry standard

- **Current HLA DIF specification uses BNF**
  - Offers a great deal of flexibility
  - Well suited to early development phase
  - Allows/requires user to customize 'grammar' to particular needs of application

- **XML (Extensible Markup Language) provides an industry standard option**
  - We are beyond development phase with HLA DIFs
  - Good time to consider standard approaches

- **Conducted an assessment on advisability of using XML for HLA DIFs**
  - Technically
  - Business case perspective

XML Technical Assessment

- **What is XML?**
  - **Extensible Markup Language**
  - **Industry standard markup language**
  - **Cited in JTA as emerging standard**
- **Does XML do what we need to support HLA DIFS? How do we know?**
  - **Paper assessment indicated that XML could support current DIF capabilities (MITRE, ARL-UT)**
  - **Drafted an XML Document Type Definition (MITRE/GTRI)**
    - **DTD: method of tailoring XML to meet domain needs**
  - **Implemented an XML version of the "restaurant FOM" from OMT specification using the DTD (MITRE/GTRI)**
  - **Conducted an experiment (GTRI)**
    - **A freeware, validating XML parser was obtained from IBM (xml4j) and used to create a FED file generator tool**
    - **This tool, accepts XML FOMs and produces old-style FED files**
    - **The tool required 2 full days of effort and 753 lines of Java in addition to the freeware**
- **Result: XML is a good technical candidate for HLA DIFs**

XML Business Case Assessment

- **Why move to XML?**
  - **Leverage the collective ideas of industry beyond our community ('standards are as standards do')**
    - **Growing broad based population of XML users**
  - **Lower costs of maintenance**
    - **Use an available standard instead of maintaining our own**
  - **Access to a trained work force**
    - **Industry is using XML already, the HLA DIFs will be just another XML application**
  - **Access to free and commercial supporting software**
    - **Widespread use of XML is leading to XML support in existing products and availability of freeware support tools**
- **Possible risks and risk mitigation**
  - **XML dies out or moves away from our needs in future versions**
    - **We stay at this version, and redistribute (current) freeware tools**
  - **Freeware does not materialize as quickly as is expected**
    - **We supplement with freeware tools we develop (no difference than if we stayed on current course); lots of XML tools already available based on experiment**
- **Result: good business case for moving to XML**

Next Steps

- **Our draft DTD and implementation reviewed by industry experts**
  - **ArborText "passed" our DTD**

- **Unified HLA DIFs into single DIF**
  - **In Draft3 of OMT and IF Specs, OMT DIF is a superset of FED DIF**
  - **Experiment demonstrated that subsetting in XML is natural**
  - **Offers the opportunity for possible simplification in the specification ('less is more')**

- **Comment submitted to Draft 3 recommending XML based HLA DIFs**

- **Holding a technical exchange on XML and its application to HLA DIFs; discussion of experiments**

What is XML?

- **Looks like HTML**
- **Syntax but no semantics**
  - **Hierarchical**
  - **Generalized white space**
  - **Case sensitive**
- **Elements are tags surrounding text or other elements**
  <tag> text </tag>
  <tag/> (for empty elements)
- **Attributes describe an element from within**
  <tag attribute="text"> text </tag>
  <tag attribute="text"/>

```
<document
    author="George"
    editor="Harry">
    <chapter>
        <title>Chapter 1. Introduction</title>
        <header> Background </header>
        <paragraph> General information about
        our subject </paragraph>
        <paragraph> More information about
        our subject </paragraph>
    </chapter>
</document>
```

Syntax can be refined
Document Type Definition (DTD)

- **Each domain can specify its own refinements**
  - **Sequence of elements**
  - **Permissible element names**
  - **Permissible attributes**
  - **Required/optional elements and attributes**
  - **Required/optional repetition of elements**
  - **Restrictions on element/attribute values**
    - **choice**
    - **names**

```
<?xml version="1.0" encoding="UTF-8"?>
<!ELEMENT document (chapter+)>
    <!ATTLIST document
                author   CDATA #REQUIRED
                editor   CDATA #IMPLIED >
    <!ELEMENT chapter (title,(header,paragraph+)*)>
        <!ELEMENT title (#PCDATA)>
        <!ELEMENT header (#PCDATA)>
        <!ELEMENT paragraph (#PCDATA)>
```

How HLA XML will be used

- **OMT description**
  - **Function of current OMT DIF**
  - **Describe all aspects of object model relevant to federate or federation**

- **RTI initialization**
  - **Function of current FED**
    Must include
    - **MOM**
    - **objectRoot object class with privilegeToDelete attribute**
    - **interactionRoot interaction class**
    - **RTIprivate object and interaction classes**
  - **Describe aspects relevant to RTI**
  - **Ignore aspects not relevant to RTI**

- **Same file can be used for both functions**

Proposed HLA XML format

- **Hierarchical object/interaction class trees**
  - **Similar to FED mechanism**
- **Element content restricted to other elements only**
  - **No text inside elements**
  - **All values specified as XML attributes**

```
<objects>
    <objectClass name="ObjectRoot">
        <attribute name="privilegeToDelete"
            ownership="TransferAccept"/>
        <objectClass name="RTIprivate"/>
        <objectClass name="Employee"
            sharing="PublishSubscribe"
            semantics="A person working for the restaurant">
            <attribute name="Years_of_service"
                dataType="Years"
                updateType="Periodic"
                updateCondition="1/year"
                ownership="TransferAccept"
                sharing="PublishSubscribe"
                transport="Reliable"
                order="TimeStamp"
                semantics="Number of years the employee has worked for the restaurant"/>
        </objectClass>
    </objectClass>
</objects>
```

OMT XML Structure

- **Fixed sequence of elements**
- **Some elements required**
  - **identification**
  - **objects**
  - **interactions**

```xml
<?xml version="1.0"?>>
<!DOCTYPE omt SYSTEM "OMT.dtd">
<omt>
    <identification/>
    <objects>
    <interactions>
    <routing>
    <time>
    <tags>
    <dataTypes>
        <basicDataRepresentations>
        <simpleDataTypes>
        <enumeratedDataTypes>
        <arrayDataTypes>
        <fixedRecordDataTypes
        <variantRecordDataTypes>
        <encodingRepresentation>
    </dataTypes>
</omt>
```

HLA XML Details
Identification and Objects

```
<identification
    name="xxx"
    version="xxx"
    date="xxx"
    purpose="xxx"
    appDomain="xxx"
    sponsor="xxx"
    pocName="xxx"
    pocOrg="xxx"
    pocPhone="xxx"
    pocFax="xxx"
    pocEmail="xxx"
    references="xxx"
    other="xxx"/>
```

```
<objects>
    <objectClass
        name="ObjectRoot>
        <attribute
            name="privilegeToDelete"/>
        <objectClass
            name="RTIprivate"/>
        <objectClass
            name="Manager"/>
        <objectClass
            name="xxx"
            sharing="xxx"
            semantics="xxx">
            <attribute
                name="xxx"
                dataType="xxx"
                updateType="xxx"
                updateCondition="xxx"
                ownership="xxx"
                sharing="xxx"
                routingSpace="xxx"
                transport="xxx"
                order="xxx"
                semantics="xxx"/>
        </objectClass>
    </objectClass>
</objects>
```

HLA XML Details
Interactions, Routing, Time

```
<interactions>
    <interactionClass
        name="InteractionRoot">
        <interactionClass
            name="RTIprivate"/>
        <interactionClass
            name="Manager"/>
        <interactionClass
            name="xxx"
            sharing="xxx"
            routingSpace="xxx"
            transport="xxx"
            order="xxx"
            semantics="xxx"/>
            <parameter
                name="xxx"
                dataType="xxx"
                semantics="xxx"/>
        </interactionClass>
    </interactionClass>
</interactions>
```

```
<routing>
    <routingSpace
        name="xxx"
        semantics="xxx">
        <dimension
            name="xxx"
            dataType="xxx"
            normalization="xxx"
            semantics="xxx"/>
    </routingSpace>
</routing>
```

```
<time>
    <federationTime
        dataType="xxx"
        semantics="xxx"/>
    <lookahead
        dataType="xxx"
        semantics="xxx"/>
</time>
```

HLA XML Details
Tags, Basic data, Simple datatypes

```
<tags>
    <updateReflectTag
        dataType="xxx"
        semantics="xxx"/>
    <sendReceiveTag
        dataType="xxx"
        semantics="xxx"/>
    <deleteRemoveTag
        dataType="xxx"
        semantics="xxx"/>
    <ownershipTag
        dataType="xxx"
        semantics="xxx"/>
    <synchronizationPointTag
        dataType="xxx"
        semantics="xxx"/>
</tags>
```

```
<basicDataRepresentations>
    <basicData
        name="xxx"
        size="xxx"
        interpretation="xxx"
        encoding="xxx"/>
</basicDataRepresentations>
```

```
<simpleDataTypes>
    <simpleData
        name="xxx"
        representation="xxx"
        units="xxx"
        resolution="xxx"
        accuracy="xxx"
        min="xxx"
        max="xxx"
        semantics="xxx"/>
</simpleDataTypes>
```

HLA XML Details
Enumerated, Array, Fixed Record datatypes

```
<enumeratedDataTypes>
    <enumeratedData
        name="xxx"
        dataType="xxx"
        semantics="xxx">
        <enumerator
            name="xxx"
            value="xxx"/>
    </enumeratedData>
</enumeratedDataTypes>
```

```
<fixedRecordDataTypes>
    <fixedRecordData
        name="xxx"
        encoding="xxx"
        semantics="xxx">
        <field
            name="xxx"
            dataType="xxx"
            semantics="xxx"/>
    </fixedRecordData>
</fixedRecordDataTypes>
```

```
<arrayDataTypes>
    <arrayData
        name="xxx"
        dataType="xxx"
        cardinality="xxx"
        encoding="xxx"
        semantics="xxx"/>
</arrayDataTypes>
```

HLA XML Details
Variant record datatype, Encoding

```
<variantRecordDataTypes>
    <variantRecordData
        name="xxx"
        discriminant="xxx"
        dataType="xxx"
        encoding="xxx"
        semantics="xxx">
        <alternative
            value="xxx"
            name="xxx"
            dataType="xxx"
            semantics="xxx"/>
    </variantRecordData>
</variantRecordDataTypes>
```

```
<encodingRepresentations>
    <encodingRep
        name="xxx"
        encoding="xxx"
        semantics="xxx"/>
</encodingRepresentations>
```

OMT XML Structure