GIS to CIM Data Translation Template Reference Guide

Contents

© Esri 2013

Introduction

The purpose of this document is to provide information about a sample Common Information Model (CIM) XML data translation template which Esri has developed with Safe Software in order to provide a basic approach to translating data from an Esri geodatabase to the CIM XML format, where it can potentially then be shared between other enterprise systems.

Information provided will include a brief overview of CIM, an introduction to the data translation template and how it can be used within a GIS enterprise scenario, and a basic walk-through to guide a user through a simple test of its use.

What is the CIM?

CIM stands for the "Common Information Model" which for the electric power transmission and distribution industry, represents a set of open standards developed by the Electric Power Research Institute (EPRI) and the electric power industry, and which has been officially adopted by the International Electrotechnical Commission (IEC). One of the CIM's key objectives is to provide a way for application software to exchange information about the configuration and status of an electrical network.

The CIM is maintained as a Unified Modeling Language (UML) model, and defines a common set of electric data objects. Through the use of UML software such as Sparx Systems' Enterprise Architect, the CIM UML can be used to create design artifacts, such as XML / RDF schema which can then be used as a template for the exchange of data between integrated software applications and systems.

There are a number of IEC standards related to CIM, including:

- IEC 61970-301: Defines a core set of packages for the CIM, with focus on the needs of electricity transmission, where related applications include energy management system, SCADA, planning and optimization.

- IEC 61970-501 and 61970-452: Define an XML format for network model exchanges using RDF.

- IEC 61968: Defines a series of standards to extend the CIM to meet the needs of electrical distribution, where related applications include distribution management system, outage management system, planning, metering, work management, geographic information system, asset management, customer information systems and enterprise resource planning.

From the perspective of users of GIS (geographic information systems), the CIM provides a useful data exchange schema for electrical objects, and is of primary importance for electric utilities who have an enterprise GIS system which needs to interface with other applications / systems as part of their overall enterprise implementation, and also potentially those who may need to share their electrical network data between companies / agencies.

Enterprise GIS capabilities provide broad access to geospatial data and applications throughout the organization. The advantages to deploying an enterprise GIS include:

- Using a common infrastructure for building and deploying GIS solutions

- Extending geospatial capabilities to an enterprise community

- Improving capabilities of other enterprise systems by leveraging the value of geographic information

- Increasing overall operating efficiency using GIS across your organization

Geospatial information can also be integrated with other enterprise applications to enable distribution analysis and support key decision-support systems. The CIM model as a mechanism for enterprise system integration, can be of use in this process. Some key areas of data exchange would occur between GIS, DMS, SCADA, OMS, CIS, WMS and AMI.

How a CIM Translation Template Can Help

The CIM is extensive and complex, and the CIM RDF XML structure can likewise be very challenging to navigate. There are CIM standards websites online with different types of resources, and there can be a fairly significant learning curve associated with the materials. EPRI provides some very good resources such as their CIM Primer which walks through some of the main aspects which will be of concern for GIS users such as navigating CIM UML and the CIM RDF XML structure, generating XML schema, messaging and extending the CIM. Some resource links are found at the end of this document.

Given the complexities around CIM, Esri has worked with Safe Software to develop a proof of concept template for demonstrating the process of migrating GIS data to the CIM RDF XML structure. The demonstration is intended to provide users the ability to see how CIM XML for enterprise system integration purposes can be created. The CIM translation template process which this document will outline is just one way of performing translation to CIM XML. As using both the ArcGIS Data Interoperability extension and Safe's FME product are popular ways to move spatial data in and out of a geodatabase, it was identified as a good starting point for Esri GIS users to begin a review of CIM and some of the data translation considerations around it.

The CIM translation template consists of both an FME workspace and a Data Interoperability ETL (Extract, Transform, Load) tool, along with a sample dataset which has been referenced in the configuration so that the user can quickly test how the translation process works. The user can also further review the template's configuration and copy and modify it and/or build a new configuration which references another dataset. The template provides a framework by which the user can begin to envision how their own data can be tailored, configured and translated to the CIM.

How the Sample Template Works

In order to use the template, the user will require the following software:

o ArcGIS Desktop 10.1 SP1 (or higher) and the Esri Data Interoperability extension 10.1 SP1 (or higher)

Or:

o FME (Feature Manipulation Engine) Desktop 2012 SP1 (or higher) from Safe Software

As for the skillset involved, experience with the above software is of course recommended, although a high level of proficiency is not seen as necessary to simply run the template with the accompanying sample data and get the sample template to run and export CIM XML from a test geodatabase.

Proficiency will be required in order to perform actual configuration work based on the template, and will require expertise with the Data Workbench component which comes with FME and the Data Interoperability extension.   Again, this is needed if the user is looking to customize the workspace template to their own data.

As referenced in the Resources section at the end of this document, some basic training is available for the ArcGIS Data Interoperability extension through Esri's Training site, as well as FME through Safe's FME site.

Approach A: Walk-through for Setting up using a Spatial ETL Tool with the ArcGIS Data Interoperability Extension

The following are basic steps to follow when using the template with ArcGIS Desktop 10.1 SP1 (or higher) and the Esri Data Interoperability extension 10.1 SP1 (or higher).

Extract the Template Zipfile Package:
In order to maintain paths as currently defined in documents, files should be extracted to the following folder: C:\temp\GDB_to_CIM_Template\. To do this, place the accompanying zipfile, "GDB_to_CIM_Template.zip", in the C:\temp directory, and extract it at its location to a folder with the same name as the zipfile. This is usually the default option as seen in the following:

Select a Destination and Extract Files

Files will be extracted to this folder:

C:\temp\GDB_to_CIM_Template   [Browse...]

☑ Show extracted files when complete

Once extracted you will find four items in the C:\temp\GDB_to_CIM_Template\ folder as seen in the following:

Name	Date modified	Type	Size
Electric_Source_Sample.gdb	6/27/2013 4:37 PM	File folder	
ArcMap Document - CIM Template.mxd	6/27/2013 4:05 PM	ArcGIS ArcMap D...	1,047 KB
Data Interoperabililty - CIM Template.tbx	6/27/2013 3:48 PM	ArcGIS Toolbox	521 KB
FME Workspace - CIM Template.fmw	6/27/2013 4:18 PM	FMW File	523 KB

These four items include:

- **Electric_Source_Sample.gdb** – A sample file geodatabase containing electric distribution feature classes with features that can be converted to CIM XML with the tools provided in the template. The classes include:
    - Circuit Breaker
    - Fuse
    - Meters
    - Transformers
    - Primary Overhead
    - Primary Underground
    - Secondary Overhead

- **ArcMap Document – CIM Template.mxd** – An ArcMap document file containing the features from the above sample file geodatabase and a reference to Spatial ETL tool in a file-based toolbox. *Note*: This file is used if the user has ArcGIS Desktop and the Data Interoperability extension.

- **Data Interoperability – CIM Template.tbx** – A file-based toolbox containing a Spatial ETL tool with the CIM Template configuration for data translation of the above sample geodatabase to CIM XML. *Note*: This file is used if the user has ArcGIS Desktop and the Data Interoperability extension.

- **FME Workspace – CIM Template.fmw –** An FME Workspace file containing the same ETL configuration as the above toolbox, for data translation of the above sample geodatabase

to CIM XML. *Note*: This file is used if the user wants to use FME in place of ArcGIS Desktop and the Data Interoperability extension.

Launch ArcMap and Load MXD:
Once the above files are extracted at the "C:\temp\GDB_to_CIM_Template" folder location, launch ArcMap and open the ArcMap document file named "ArcMap Document – CIM Template.mxd". This will load the data in the sample file geodatabase, and make the ArcToolbox visible.

Add CIM Template Toolbox:
In ArcToolbox, add the Spatial ETL toolbox, navigating to the extraction folder as seen in the following:
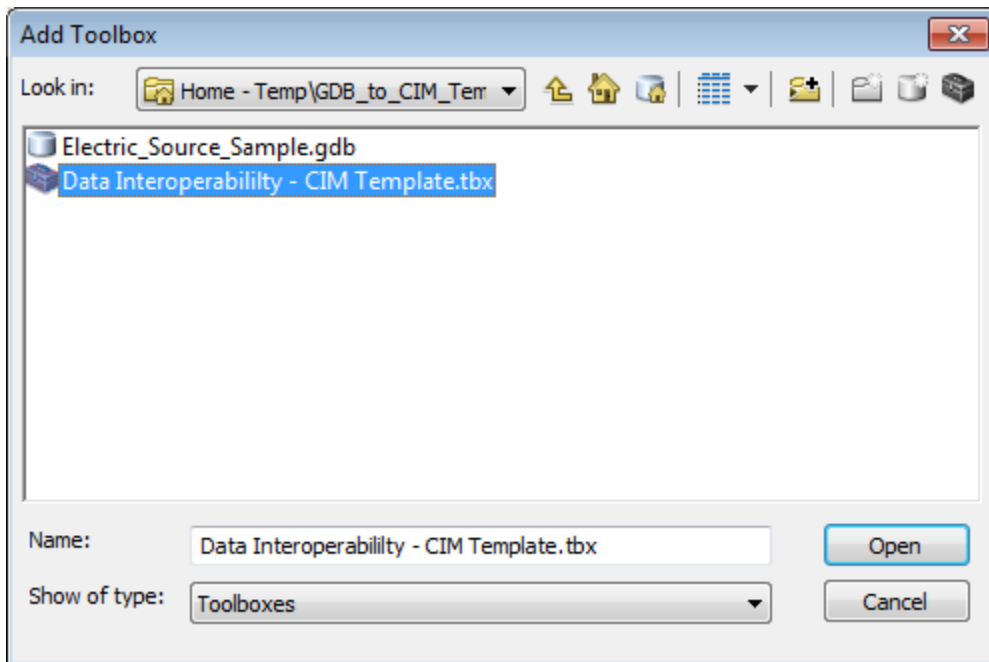

Once added, you will see the following new toolbox available – "Data Interoperability CIM Template" and once expanded you will find the Spatial ETL tool labeled "GDB to CIM XML Template":
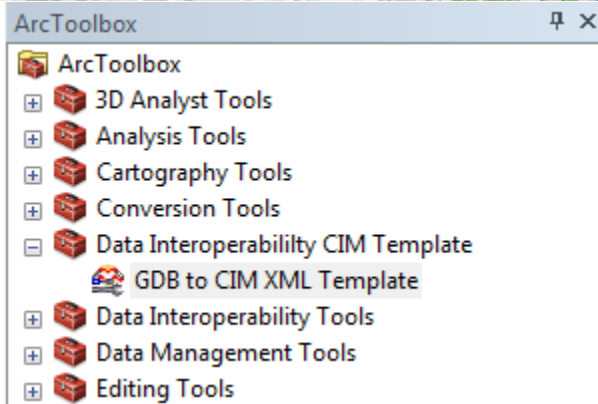
Run the Tool

At this point, you can open the tool like any standard geoprocessing tool by double-clicking or right-clicking and selecting "Open". The following shows the template tool dialog with the default locations set for both the input source file geodatabase and the output CIM XML file, which defaults to the main extraction folder. Press "OK" to accept the defaults.
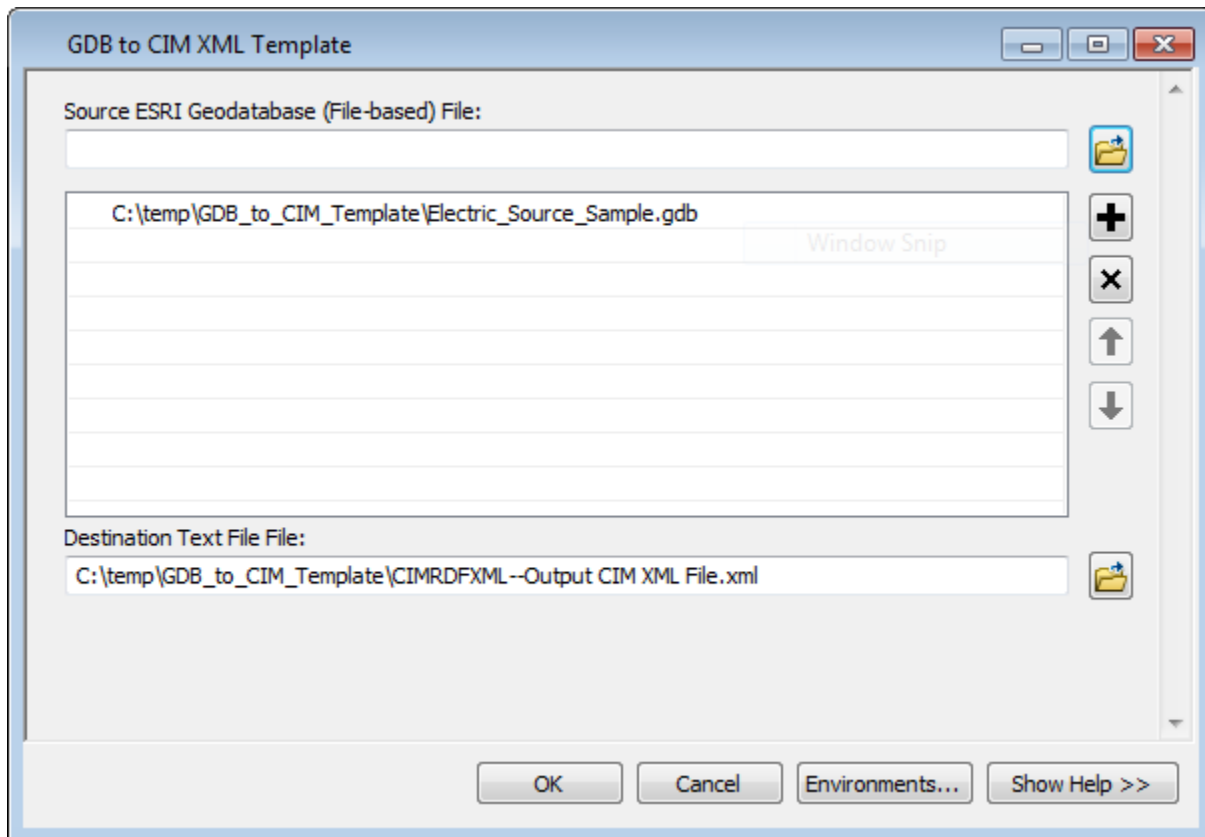
The tool will run for about 1 – 2 minutes depending on your machine and will show the following at the bottom of the ArcToolbox / ArcMap when completed:
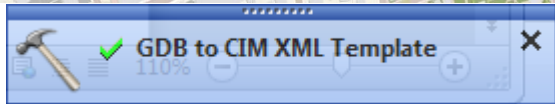
Review Results

After the tool runs, you can then click on the completion message box above to quickly move to the Results log in ArcToolbox:
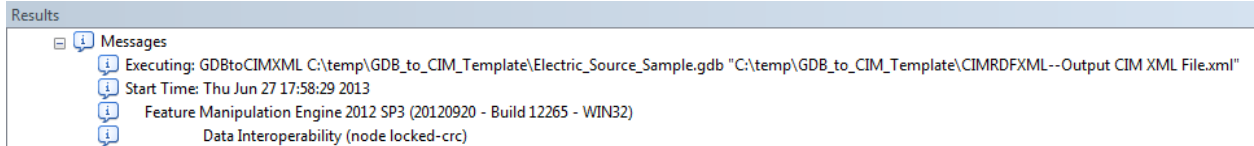

By scrolling to the bottom, you can see if the tool completed successfully. You should see the following messages if it did:

```
=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-
                 Features Read Summary
=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-
CircuitBreaker                    1
Fuse                      7
PrimaryOverhead                   160
PrimaryUnderground                  6
SecondaryOverhead                 479
Transformers                 32
====================================================================
Total Features Read               685
=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-
=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-
                 Features Written Summary
=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-
text_line                    1
====================================================================
Total Features Written            1
=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-
Translation was SUCCESSFUL with 0 warning(s) (1 feature(s) output)
Translation was SUCCESSFUL with 0 warning(s) (1 feature(s) output)
FME Session Duration: 25.8 seconds. (CPU: 6.6s user, 13.8s system)
END - ProcessID: 11412, peak process memory usage: 173384 kB, current process memory usage: 143316 kB
Translation was SUCCESSFUL
Succeeded at Thu Jun 27 17:59:04 2013 (Elapsed Time: 35.00 seconds)
```

Next, check the extraction folder to see if the file "CIMRDFXML--Output CIM XML File.xml" was created as seen here:

Name	Date modified	Type	Size
Electric_Source_Sample.gdb	6/27/2013 6:01 PM	File folder	
ArcMap Document - CIM Template.mxd	6/27/2013 4:05 PM	ArcGIS ArcMap D...	1,047 KB
CIMRDFXML--Output CIM XML File.xml	6/27/2013 5:59 PM	XML Document	1,255 KB
Data Interoperabililty - CIM Template.tbx	6/27/2013 3:48 PM	ArcGIS Toolbox	521 KB
FME Workspace - CIM Template.fmw	6/27/2013 4:18 PM	FMW File	523 KB

This default name for the file was configured in the ETL tool. You can now review the content of the XML file which was produced. Open, view or edit the created file in your XML tool of choice to examine the content produced by the tool:

```xml
<?xml version="1.0" encoding="UTF-8"?>
<rdf:RDF xmlns:rdf="http://www.w3.org/1999/02/22-rdf-syntax-ns#" xmlns:cim="http://iec.ch/TC57/2009/CIM-schema-cim14#">
    <!-- Add templates here -->
    <!-- Version Metadata -->
  <cim:IEC61970CIMVersion rdf:ID="IEC61970CIM14v12">
    <cim:IEC61970CIMVersion.version>IEC61970CIM14v12</cim:IEC61970CIMVersion.version>
    <cim:IEC61970CIMVersion.date>2010-12-28T00:00:00</cim:IEC61970CIMVersion.date>
  </cim:IEC61970CIMVersion>
  <rdf:Description rdf:about="#s1">
    <cim:Substation.Region rdf:resource="#sgr"/>
    <cim:IdentifiedObject.name>s1</cim:IdentifiedObject.name>
    <rdf:type rdf:resource="cim:#Substation"/>
  </rdf:Description>
  <rdf:Description rdf:about="#sgr">
    <cim:SubGeographicalRegion.Region rdf:resource="#gr"/>
    <cim:IdentifiedObject.name>sgr</cim:IdentifiedObject.name>
    <rdf:type rdf:resource="cim:#SubGeographicalRegion"/>
  </rdf:Description>
  <rdf:Description rdf:about="#gr">
    <cim:IdentifiedObject.name>gr</cim:IdentifiedObject.name>
    <rdf:type rdf:resource="cim:#GeographicalRegion"/>
  </rdf:Description>
    <!-- Base Voltages -->
    <!-- Base Voltage -->
  <rdf:Description rdf:about="#BaseVoltage_0.120">
    <cim:BaseVoltage.nominalVoltage>0.120</cim:BaseVoltage.nominalVoltage>
    <cim:IdentifiedObject.name>BaseVoltage_0.120</cim:IdentifiedObject.name>
    <rdf:type rdf:resource="cim:#BaseVoltage"/>
  </rdf:Description>
    <!-- Base Voltage -->
  <rdf:Description rdf:about="#BaseVoltage_0.720">
    <cim:BaseVoltage.nominalVoltage>0.720</cim:BaseVoltage.nominalVoltage>
    <cim:IdentifiedObject.name>BaseVoltage_0.720</cim:IdentifiedObject.name>
    <rdf:type rdf:resource="cim:#BaseVoltage"/>
  </rdf:Description>
    <!-- Distribution Line Segments -->
  <rdf:Description rdf:about="#1">
    <cim:Equipment.MemberOf_EquipmentContainer rdf:resource="#s1"/>
    <cim:Conductor.r>0.01</cim:Conductor.r>
    <cim:Conductor.x>5.0</cim:Conductor.x>
    <cim:Conductor.bch>0.0001</cim:Conductor.bch>
    <cim:ConductingEquipment.BaseVoltage rdf:resource="#"/>
    <cim:IdentifiedObject.name>1</cim:IdentifiedObject.name>
    <rdf:type rdf:resource="cim:#ACLineSegment"/>
  </rdf:Description>
```
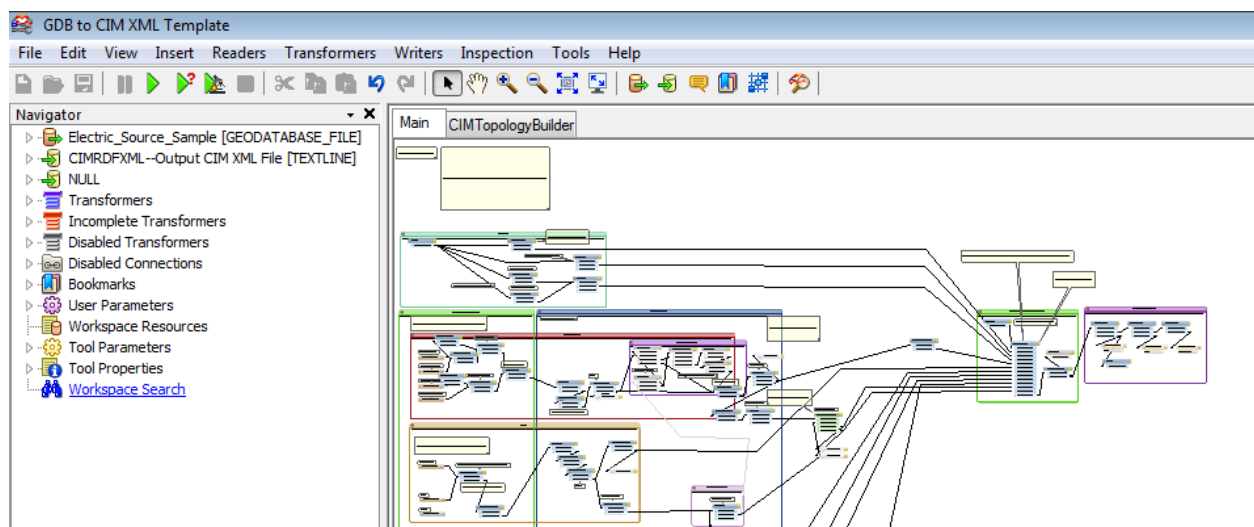
Review the Template Tool Configuration
To review the ETL tool configuration, right-click the tool in the toolbox and select "Edit":
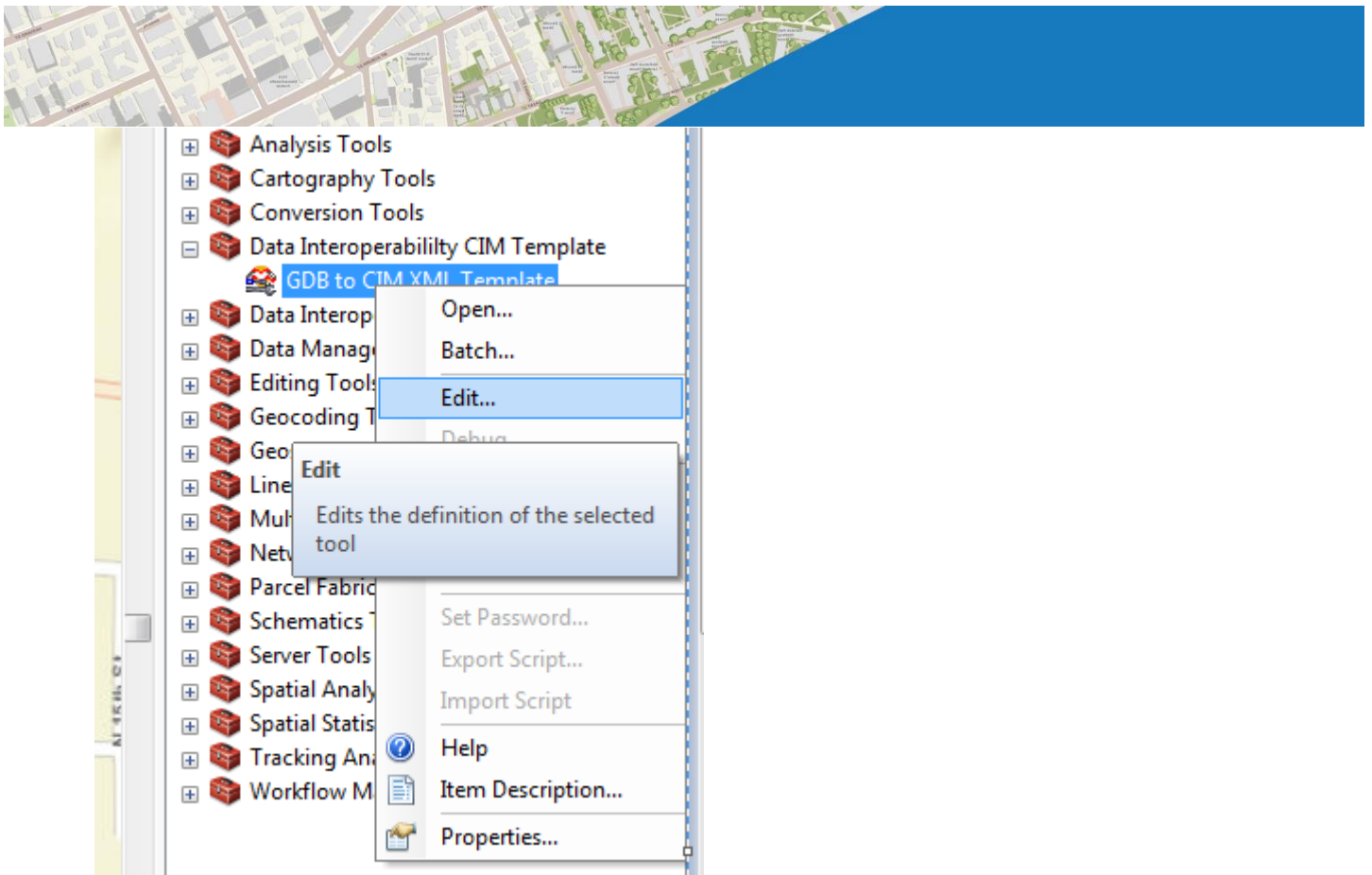
This brings up the Data Interoperability Workbench:

You can now explore the template's configuration, copy the tool and make modifications as desired based on the sample, or begin working with your own data.

This concludes the walk-through of the template based on the ArcGIS Data Interoperability extension.

Approach B: Walk-through for Setting up using FME

The following are basic steps to follow when using the template with FME (Feature Manipulation Engine) 2012 SP1 (or higher). Most of these steps are covered in Approach A for the ArcGIS Data Interoperability extension, although are repeated here so the user has a full procedure for use with FME in one section.

Extract the Template Zipfile Package:
In order to maintain paths as currently defined in documents, files should be extracted to the following folder: C:\temp\GDB_to_CIM_Template\. To do this, place the accompanying zipfile, "GDB_to_CIM_Template.zip", in the C:\temp directory, and extract it at its location to a folder with the same name as the zipfile. This is usually the default option as seen in the following:

Select a Destination and Extract Files

Files will be extracted to this folder:

| C:\temp\GDB_to_CIM_Template | Browse... |

☑ Show extracted files when complete

Once extracted you will find four items in the C:\temp\GDB_to_CIM_Template\ folder as seen in the following:

Name	Date modified	Type	Size
Electric_Source_Sample.gdb	6/27/2013 4:37 PM	File folder	
ArcMap Document - CIM Template.mxd	6/27/2013 4:05 PM	ArcGIS ArcMap D...	1,047 KB
Data Interoperabililty - CIM Template.tbx	6/27/2013 3:48 PM	ArcGIS Toolbox	521 KB
FME Workspace - CIM Template.fmw	6/27/2013 4:18 PM	FMW File	523 KB

These four items include:

- **Electric_Source_Sample.gdb** – A sample file geodatabase containing electric distribution feature classes with features that can be converted to CIM XML with the tools provided in the template. The classes include:
    - Circuit Breaker
   - Fuse
    - Meters
    - Transformers

- Primary Overhead
- Primary Underground
- Secondary Overhead

- **ArcMap Document – CIM Template.mxd** – An ArcMap document file containing the features from the above sample file geodatabase and a reference to Spatial ETL tool in a file-based toolbox. *Note*: This file is used if the user has ArcGIS Desktop and the Data Interoperability extension.

- **Data Interoperability – CIM Template.tbx** – A file-based toolbox containing a Spatial ETL tool with the CIM Template configuration for data translation of the above sample geodatabase to CIM XML. *Note*: This file is used if the user has ArcGIS Desktop and the Data Interoperability extension.

- **FME Workspace – CIM Template.fmw –** An FME Workspace file containing the same ETL configuration as the above toolbox, for data translation of the above sample geodatabase to CIM XML. *Note*: This file is used if the user wants to use FME in place of ArcGIS Desktop and the Data Interoperability extension.

Launch FME and Load FME Workspace:
Once the above files are extracted at the "C:\temp\GDB_to_CIM_Template" folder location, launch FME and open the FME Workspace file named "FME Workspace - CIM Template.fmw".

You will then see the FME workbench and the CIM Template configuration:
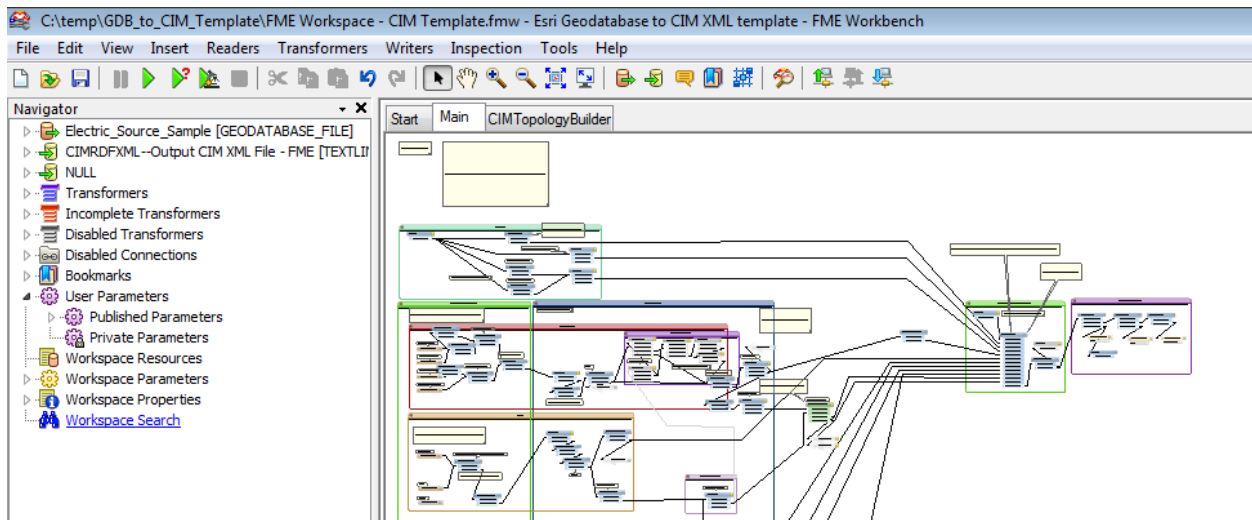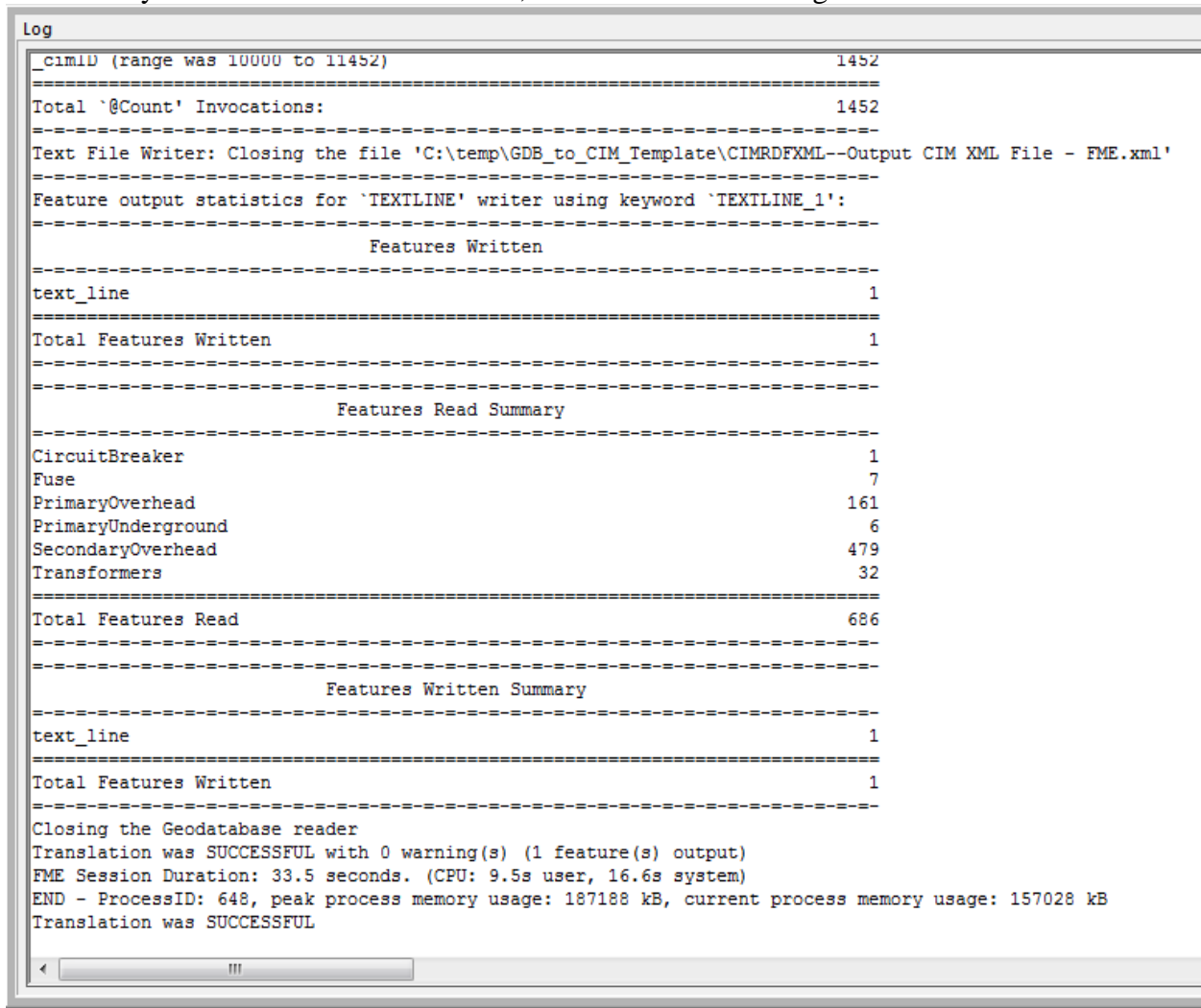

Run the Translation
At this point, you can run the translation as-is with all of the default values, as long as the files were extracted extracted to the "C:\temp\GDB_to_CIM_Template" folder location. To run the translation, press the first green "Run Translation" button on the FME toolbar:
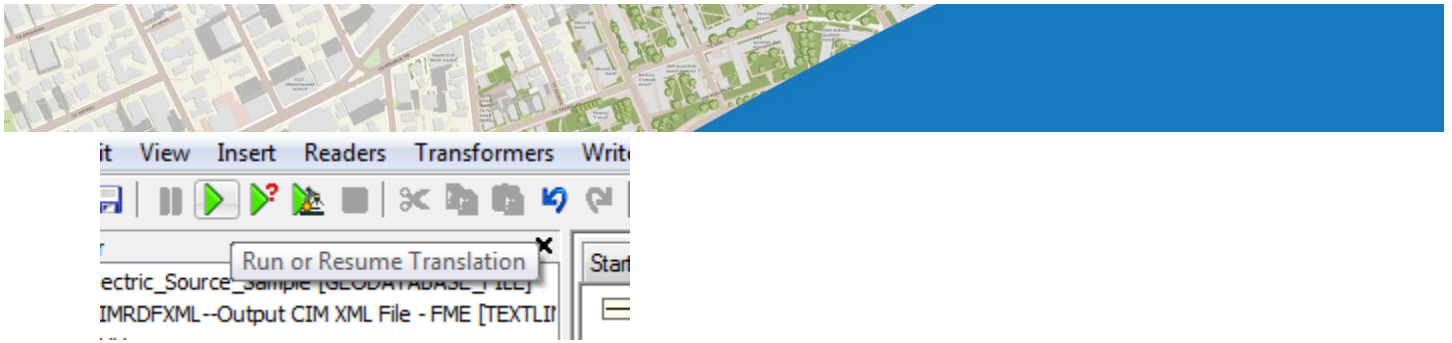
As the translation starts, the log window will appear and provide updates on progress. The tool will run for about 1 – 2 minutes depending on your machine and will show notes on the completion of the translation at the bottom of the log window.

Review Results

At the bottom of the log window, you will be able to determine if the translation completed successfully and an XML file was written, such as in the following:

```
Log

_cimID (range was 10000 to 11452)                                    1452
==========================================================================
Total `@Count' Invocations:                                          1452
=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-
Text File Writer: Closing the file 'C:\temp\GDB_to_CIM_Template\CIMRDFXML--Output CIM XML File - FME.xml'
=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-
Feature output statistics for `TEXTLINE' writer using keyword `TEXTLINE_1':
=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-
                              Features Written
=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-
text_line                                                               1
==========================================================================
Total Features Written                                                  1
=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-
=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-
                             Features Read Summary
=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-
CircuitBreaker                                                           1
Fuse                                                                     7
PrimaryOverhead                                                       161
PrimaryUnderground                                                      6
SecondaryOverhead                                                     479
Transformers                                                           32
==========================================================================
Total Features Read                                                   686
=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-
=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-
                            Features Written Summary
=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-
text_line                                                               1
==========================================================================
Total Features Written                                                  1
=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-
Closing the Geodatabase reader
Translation was SUCCESSFUL with 0 warning(s) (1 feature(s) output)
FME Session Duration: 33.5 seconds. (CPU: 9.5s user, 16.6s system)
END - ProcessID: 648, peak process memory usage: 187188 kB, current process memory usage: 157028 kB
Translation was SUCCESSFUL
```

Next, check the extraction folder to see if the file "CIMRDFXML--Output CIM XML File - FME.xml" was created as seen here:

This default name for the file was configured in the ETL tool. You can now review the content of the XML file which was produced. Open, view or edit the created file in your XML tool of choice to examine the content produced by the tool:

You can now explore the template's configuration, make a copy of the FME workspace and make modifications as desired based on the sample, or begin working with your own data.

This concludes the walk-through of the CIM template based on FME.

Resources

- CIM Links and Documents:
    - International Electrotechnical Commission (IEC) Smart Grid Standards
        - http://www.iec.ch/smartgrid/standards/
    - CIM Users Group
        - http://cimug.ucaiug.org/default.aspx
    - Electric Power Research Institute (EPRI) CIM documents
        - IntelliGrid Common Information Model Primer: Second Edition:

            http://www.epri.com/abstracts/Pages/ProductAbstract.aspx?ProductId=000000003002001040
        - CIM – MultiSpeak Harmonization:

            http://www.epri.com/abstracts/Pages/ProductAbstract.aspx?ProductId=000000000001026585
- Esri Data Interoperability Extension
    - Main site: http://www.esri.com/software/arcgis/extensions/datainteroperability
    - Training courses:
        - Go to Esri Training Site:

            http://training.esri.com/gateway/index.cfm and type "data interoperability" into the "Find Training" search box.
        - Free, sample course: "ArcGIS Data Interoperability Basics"

            http://training.esri.com/gateway/index.cfm?fa=catalog.webCourseDetail&courseid=1720
- Safe Software FME
    - Safe's FME Technology: http://www.safe.com/fme/
- CIMTool
    - A free open source tool that supports the Common Information Model (CIM) standards: http://wiki.cimtool.org/index.html

Disclaimer/Notice: This CIM XML data translation template and the information, documentation and materials related thereto are provided "AS IS" on a no-fee basis without warranty of any kind, express or implied, including, but not limited to, the warranties of merchantability or fitness for a particular purpose and non-infringement of intellectual property rights. The user bears all risk as to the quality and performance of the template and in no event will Esri be liable to the user for direct, indirect, special, incidental, or consequential damages related to the use or the results generated by the CMI template, even if Esri has been advised of the possibility of such damage. The user understands that: (1) the tool may not accommodate the user's specific data, (2) that the results generated may not comply with any industry standard or produce a complete, valid or accurate output, and (3) Esri is not obligated to develop or provide updates, support or maintenance for this CIM template.