

Distributing Data via XML from ArcGIS

Oct 2011

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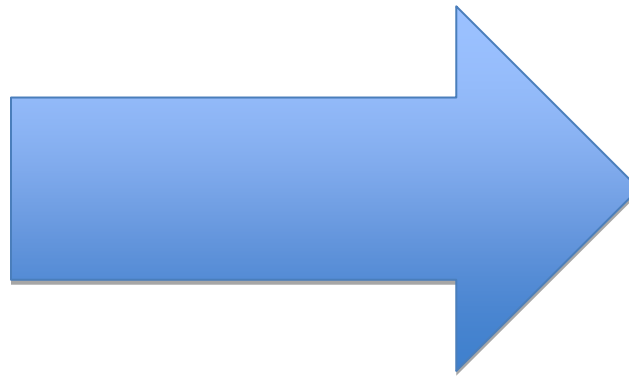


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XML

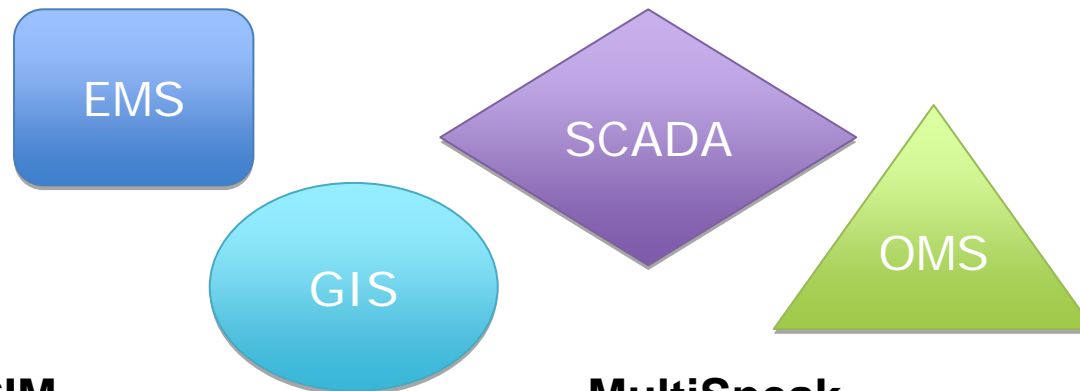


Reading or Writing XML



Make Data Available

in a standard format and data model to enable system integration and information exchange



IEC 61968 CIM

- Maintained by IEC TC57, WG14
- Based on CIM data model
- Covers distribution & transmission
- Usually RDF **XML** messages

MultiSpeak

- Developed by National Rural Electric Cooperative Association (NRECA)
- Covers electric distribution utilities
- Uses **XML** messages



Option #1

- **Leverage industry XML tools such as XSLT and XQuery**
 - Users must know these complex technologies.
 - Needs XML experts to maintain





Option #2

- **Custom code**
 - Users must know development languages
 - Need experts to maintain





Option #3

- **Make it Easy(er) – ETL Tool**
 - Minimal understanding of XML required
 - Focus on your domain expertise

*Esri Data Interoperability
Extension
Spatial ETL*



*FME Desktop
FME Workbench*

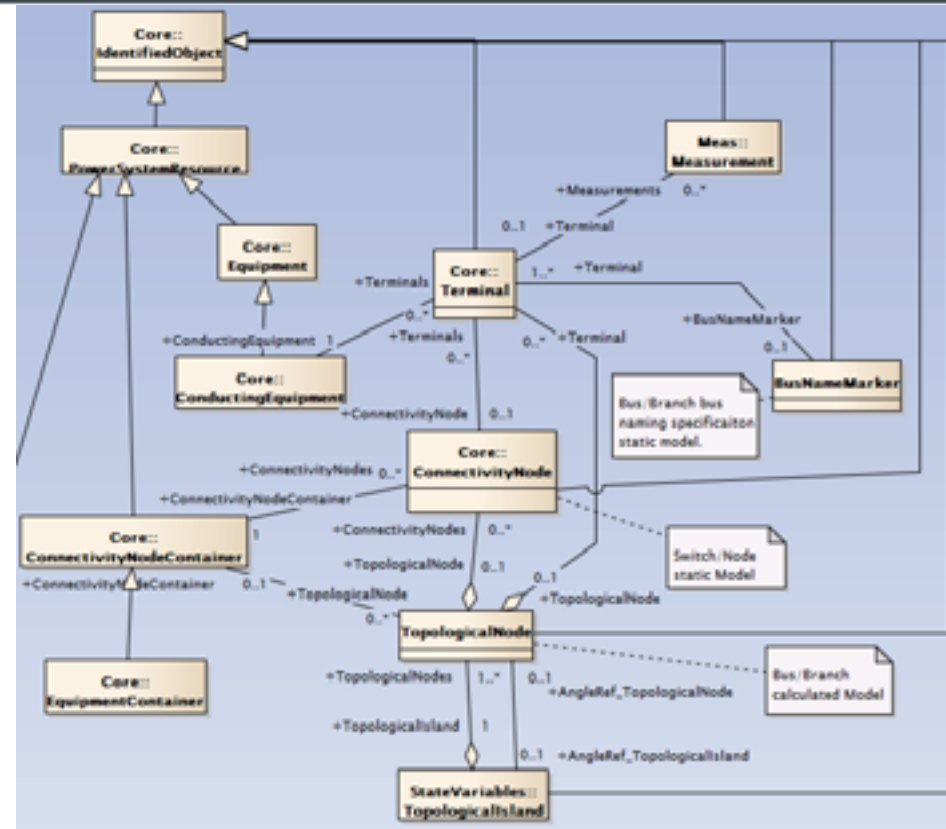


- Separate format issues (RDF & XML) from data modeling issues (GIS to CIM Schema Mapping)
- Map between an Electric GIS data model and CIM / Multispeak using an ETL tool
- Create XML data exchange messages for CIM/MultiSpeak using an ETL tool
- Avoids developing custom code
- Easier to maintain

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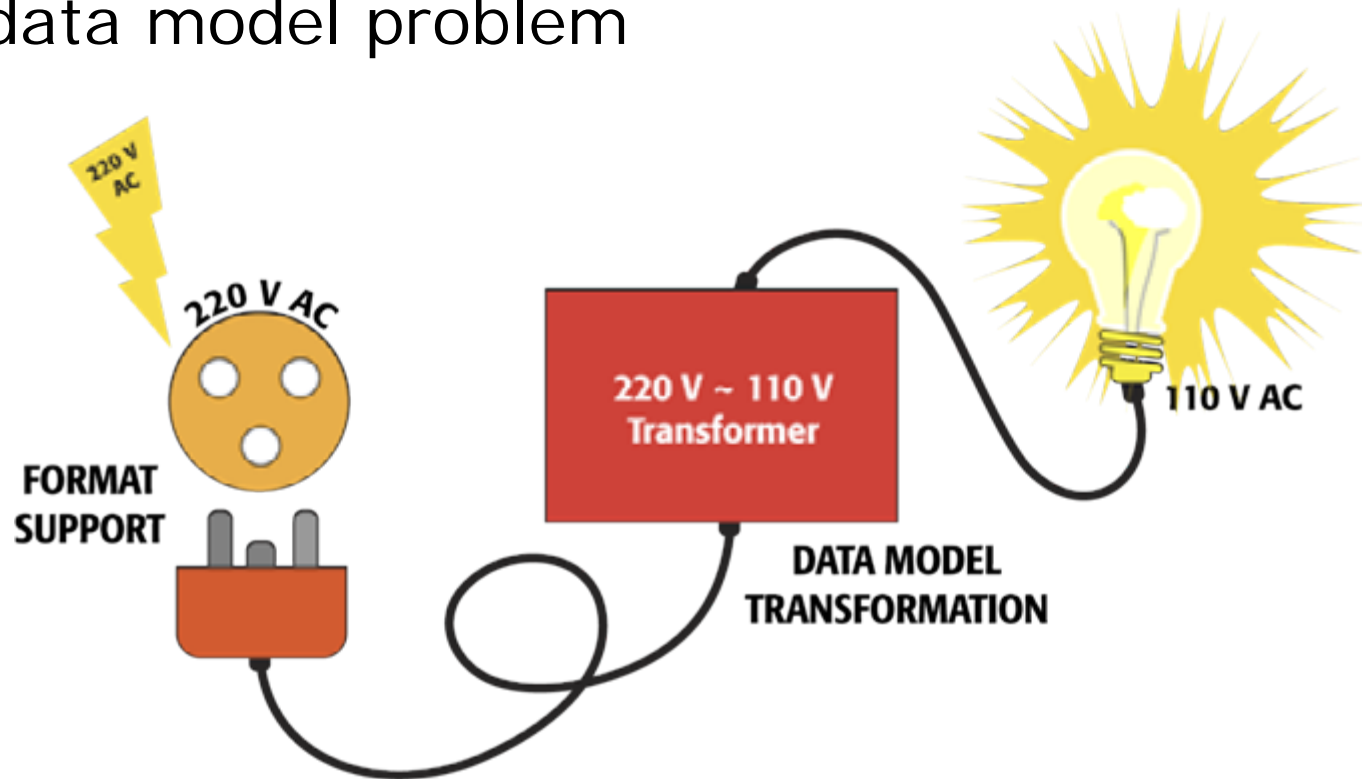


- UML data model from EA
- CIMTool for validation
- An “electric” model rather than a GIS model
- Complex data model
- Data can be transferred using RDF XML



```
<rdf:Description rdf:about="#cn2">
  <cim:ConnectivityNode.MemberOf_EquipmentContainer rdf:resource="#substation1"/>
  <cim:IdentifiedObject.name>cn2</cim:IdentifiedObject.name>
  <rdf:type rdf:resource="http://iec.ch/TC57/2007/CIM-schema-cim12#ConnectivityNode"/>
</rdf:Description>
```


- Working with XML requires solving:
 - the format problem **AND**
 - the data model problem



What we need!

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Span the gap between the GIS and XML data representations
using a Spatial ETL tool

Key challenges for XML interoperability

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- **GIS extract**
- **Schema Mapping**
- **Topology**
- **Create XML**

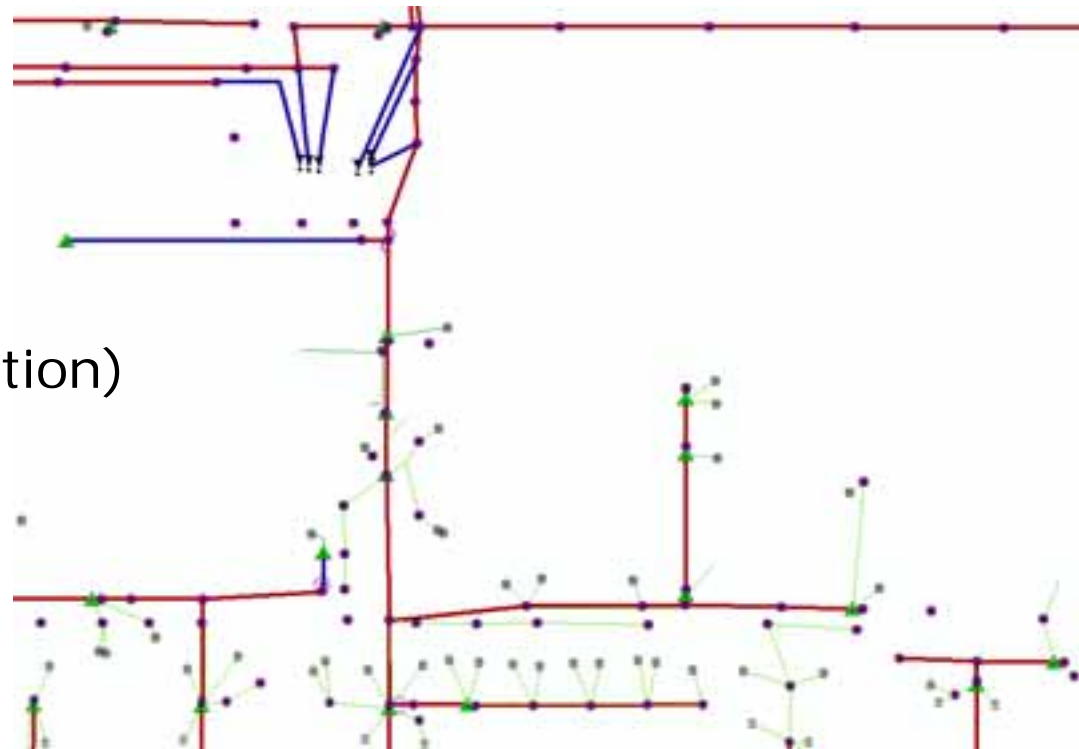
Challenge #1: GIS Extract

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■ GIS extract

- Requires a network trace or circuit query in the GIS
- Probably requires network validation
- May require extract of assets from a separate database
- Incremental changes (i.e. circuit reconfiguration) from a checkpoint or different alternatives



Challenge #2: Schema Mapping

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■ Schema Mapping

what we have



what we want

*You have to know
where you're going
i.e. DMS, OMS,
SCADA...*



Schema mapping can be one of the most time consuming tasks in an interoperability project

Cross-walk or schema table

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| | | | | Graphic | | | | | | |
|-------------------------------|-------|-------|--------|---------|----------|----------|----------|------------|---------------|----------------|
| | Level | Style | Weight | Colour | Group | Geometry | GIS | Geometry | Domain 1 | Domain Value 1 |
| R/W-Railway | 36 | 0 | 0 | 21 | PRIMARY | shape | row | area | row_type | Railway |
| R/W-Railway-Text | 36 | 0 | 0 | 21 | OPTIONAL | text | row | annotation | row_type | Railway |
| Hydro-Property-Line | 37 | 0 | 0 | 37 | PRIMARY | shape | lot | area | dist_lot_type | Lot |
| Hydro-Property-Line-Text | 37 | 0 | 0 | 37 | OPTIONAL | text | lot | annotation | dist_lot_type | Lot |
| R/W-Hydro-Line | 38 | 0 | 0 | 53 | PRIMARY | shape | row | area | row_type | Hydro |
| R/W-Hydro-Line-text | 38 | 0 | 0 | 53 | OPTIONAL | text | row | annotation | row_type | Hydro |
| R/W-Gas-Oil-Line | 39 | 0 | 0 | 69 | PRIMARY | shape | row | area | row_type | BC Gas |
| R/W-Gas-Oil-Line-Text | 39 | 0 | 0 | 69 | OPTIONAL | text | row | annotation | row_type | BC Gas |
| R/W-Telephone | 56 | 0 | 0 | 85 | PRIMARY | shape | easement | area | easement_type | Telephone |
| R/W-Telephone-Text | 56 | 0 | 0 | 85 | OPTIONAL | text | easement | annotation | easement_type | Telephone |
| Cadastral-S&PD-Tie-Point | 0 | 0 | 0 | 0 | PRIMARY | cell | corner | location | corner_type | S&PD Tie Point |
| Cadastral-S&PD-Tie-Point-Text | 57 | 0 | 0 | 101 | OPTIONAL | text | corner | annotation | corner_type | S&PD Tie Point |
| Muni-Easement-R/W-Line | 58 | 0 | 0 | 117 | PRIMARY | shape | easement | area | easement_type | Other |
| Muni-Easement-R/W-Line-Text | 58 | 0 | 0 | 117 | OPTIONAL | text | easement | annotation | easement_type | Other |

What is Schema Mapping?

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Mapping from source to destination for:

- Attribute Names
- Attribute Values (domains or enumerated lists)
- Attribute Types
- Feature Type Names
- Geometry Change
- Dataset Change

Schema mapping is easy(er) in an ETL tool

Very easy to maintain and make changes if data models or specifications change



AttributeRenamer Parameters

Transformer
Transformer Name: AttributeRenamer_EnergyConsumer

Attributes To Rename

| Old Attribute | New Attribute | Default Value |
|-------------------------|----------------------------|----------------|
| load_nominal_voltage_pp | _cim:BaseVoltage | 120 |
| identifier | _cim:EnergyConsumer_rdf:ID | |
| circuit_id | _cim:IdentifiedObject.Name | |
| | _cim:feature_type | EnergyConsumer |
| existing_phasing | _cim:Phases | A |
| | _cim:qfixed | 10.987 |
| | _cim:pfixed | 22.5 |
| | _cim:CustomerCount | 1 |

+ - Sort Import... Help OK Cancel



■ Topology

- Addition of new topological entities
 - Terminals
 - Connectivity Nodes
 - Transformer windings
 - Split complex edges
 - Others...

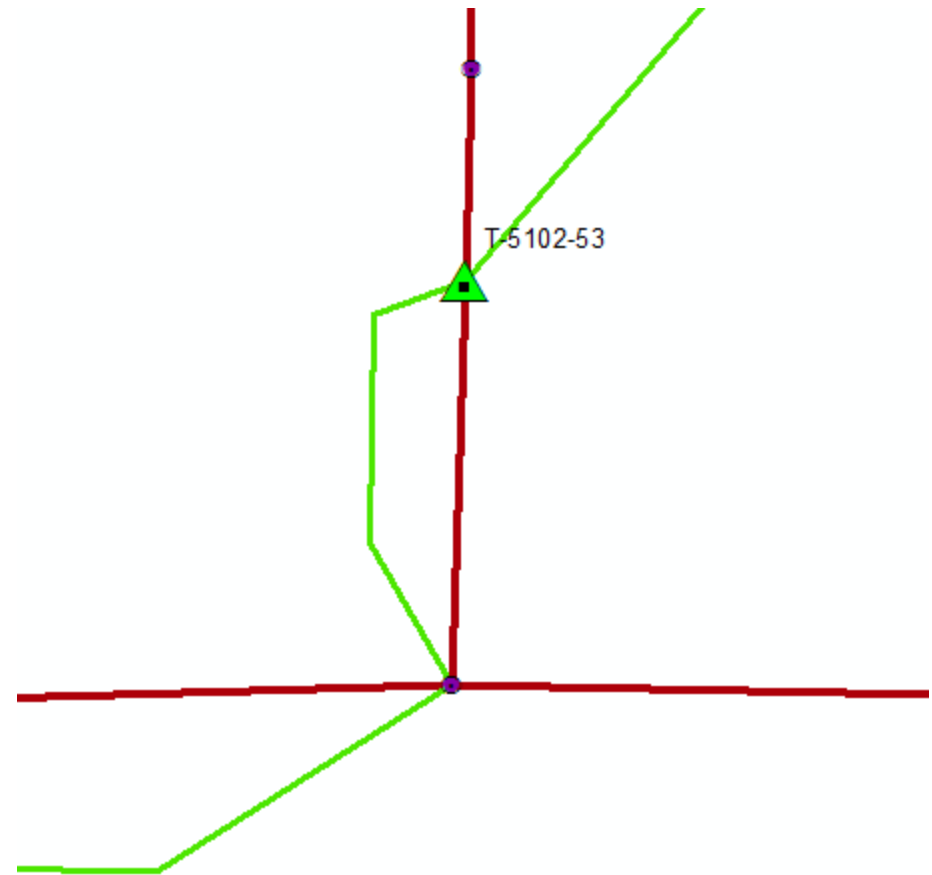


CIM Topology Example: Transformer

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- **GIS Transformer object**
 - GIS Transformers are a single point entity: Transformer

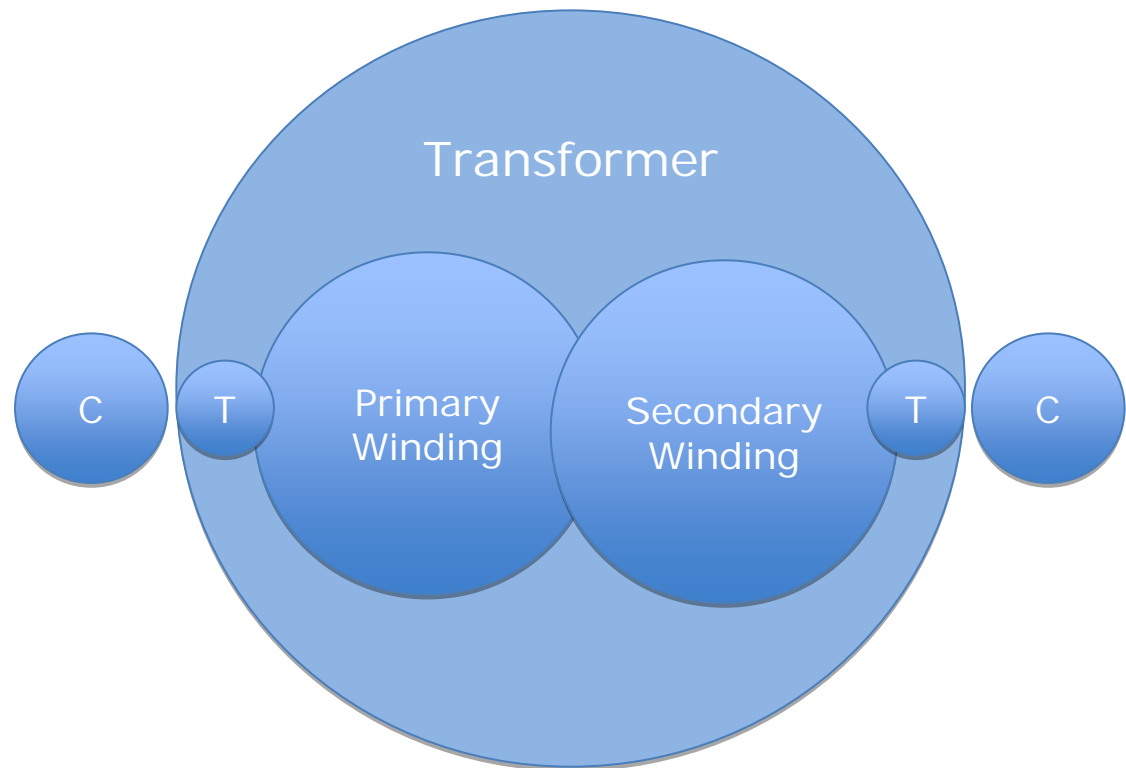


CIM Topology Example: Transformer

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- **CIM Transformer is multiple objects**
 - Transformer
 - Windings (primary & secondary)
 - Terminals
 - Connectivity Nodes





- **Create XML**
 - Create XML templates
 - Construct XML hierarchy – if it applies



CIM Distribution is a moving specification

Need a flexible approach to creating the XML when the specifications change

XML Expert Not Required!

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Writing CIM XML



XMLTemplator

- Convert FME feature attributes to XML

XMLFormatter

- Formats and beautifies XML documents

XMLValidator

- Ensures XML is valid





- **Template approach:**
 - Steal an example and reuse it
- **Sample XML:**
 - Source of XML templates

```
<?xml version="1.0" encoding="utf-8"?>
<rdf:RDF xmlns:cim="http://iec.ch/TC57/2008/CIM-schema-cim13#"
          xmlns:rdf="http://www.w3.org/1999/02/22-rdf-syntax-ns#">

  <cim:BaseVoltage rdf:ID="BaseVoltage_0.120">
    <cim:IdentifiedObject.name>BaseVoltage_0.120</cim:IdentifiedObject.name>
    <cim:BaseVoltage.nominalVoltage>0.12</cim:BaseVoltage.nominalVoltage>
  </cim:BaseVoltage>

  <cim:VoltageLevel rdf:ID="VoltageLevel_0.120">
    <cim:IdentifiedObject.name>VoltageLevel_0.120</cim:IdentifiedObject.name>
    <cim:VoltageLevel.BaseVoltage rdf:resource="#BaseVoltage_0.120"/>
    <cim:VoltageLevel.lowVoltageLimit>0.114</cim:VoltageLevel.lowVoltageLimit>
    <cim:VoltageLevel.highVoltageLimit>0.126</cim:VoltageLevel.highVoltageLimit>
  </cim:VoltageLevel>
</rdf:RDF>
```




■ Sample XML

```
<cim:BaseVoltage rdf:ID="BaseVoltage_0.120">
  <cim:IdentifiedObject.name>BaseVoltage_0.120</cim:IdentifiedObject.name>
  <cim:BaseVoltage.nominalVoltage>0.12</cim:BaseVoltage.nominalVoltage>
</cim:BaseVoltage>
```

■ Replace attribute values with Xquery statements

```
<cim:BaseVoltage rdf:ID="{fme:get-attribute("_cim:ID")}">
  <cim:IdentifiedObject.name>{fme:get-attribute("_cim:BaseVoltage")}
  </cim:IdentifiedObject.name>
  <cim:BaseVoltage.nominalVoltage>{fme:get-attribute("_cim:nominalVoltage")}
  </cim:BaseVoltage.nominalVoltage>
</cim:BaseVoltage>
```

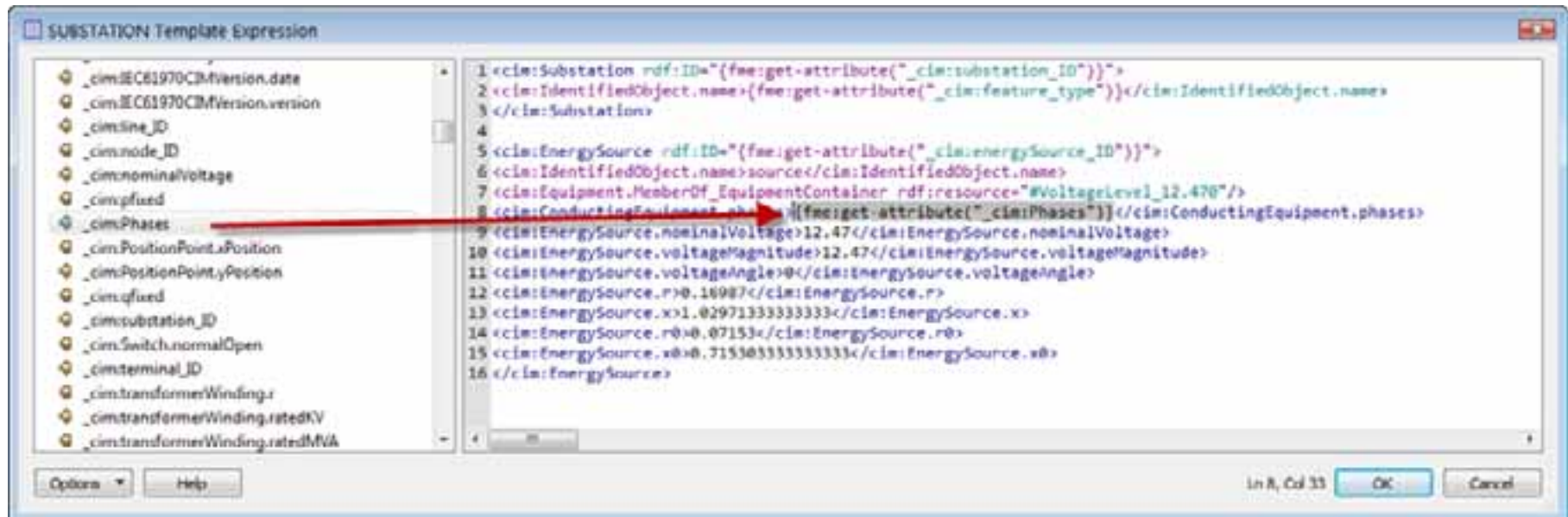




- Replace attribute values with Xquery statements

```
<cim:BaseVoltage rdf:ID="{fme:get-attribute("_cim:ID")}">
  <cim:IdentifiedObject.name>{fme:get-attribute("_cim:BaseVoltage")}
  </cim:IdentifiedObject.name>
  <cim:BaseVoltage.nominalVoltage>{fme:get-attribute("_cim:nominalVoltage")}
  </cim:BaseVoltage.nominalVoltage>
</cim:BaseVoltage>
```

- Make sure you have a good GUI to help you...





- Template approach to writing XML works well for:
 - Complex hierarchical XML
 - EU INSPIRE GML
 - Simple Relational or RDF XML
 - NEIM
 - MultiSpeak
 - CIM

Example CIM Output

```
<!-- 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:type>
</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:type>
</rdf:Description>
```



XML



Reading XML



- ETL Tool such as **Esri Data Interoperability Extension** or **FME Desktop** can simplify your XML woes:
 - Separate format issues (RDF XML) from data modeling issues (GIS to CIM Schema Mapping)
 - Covers all aspects of the ETL problem – format, schema mapping, topology
 - Template approach – reduces need to understand XML syntax

- Reduce maintenance of the ETL process

Question & Answer

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Thank You!

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- CIM Standards Overview And Its Role in the Utility Enterprise: CIM Users Group: Prague: Terry Saxton
- CIMTool: <http://wiki.cimtool.org/index.html>
- Distribution Common Information Model (CIM): Modeling of Two North American Feeders, EPRI report, 2009, L. King
- System Interfaces For Distribution:
 - Management Part 13 CIM RDF Model, I.E.C.
 - Part 11: Common Information Model (CIM) Extensions for Distribution