



**The power of
integration**



Utility Integration Solutions, Inc.

IEC CIM, Enterprise Architect, Profiles and CIMTool

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Introduction



- The purpose of this presentation is to provide an overview of the IEC CIM and common usage within IEC TC57
- Topics covered will include:
 - IEC CIM Brief Overview
 - Use of Enterprise Architect
 - Exporting CIM using XMI
 - Contextual Profiles
 - Eclipse and CIMTool
 - Creating a profile in CIMTool

IEC CIM



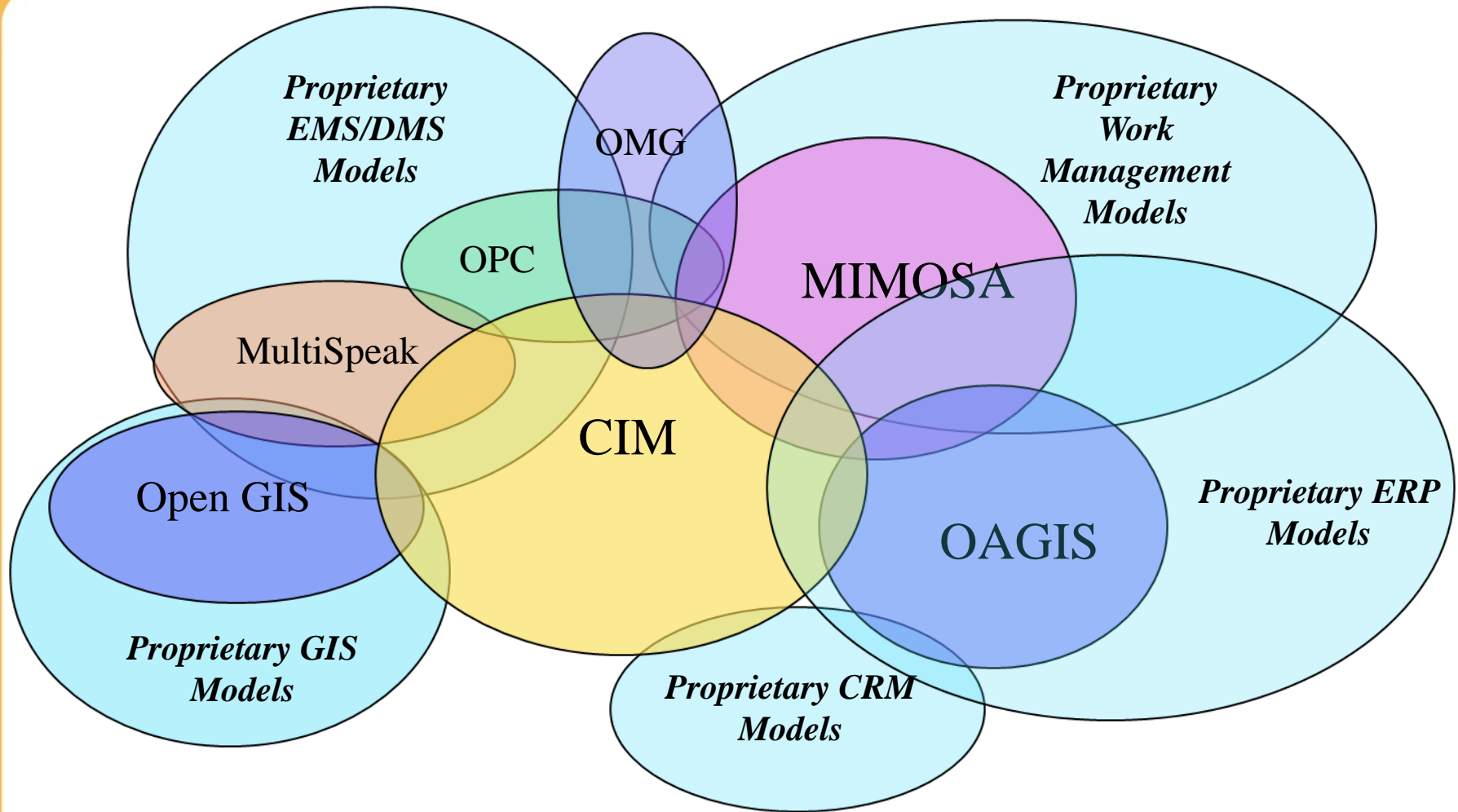
- Key standards:
 - IEC 61970-301 (Core CIM, transmission focus)
 - IEC 61968-11 (Distribution extensions)
- Standards that leverage the CIM:
 - IEC 61970-552-4 (CIM XML Model Exchange Format)
 - IEC 61970-452 (CIM Transmission Network Model Exchange Profile)
 - IEC 61968-13 (CIM RDF Model Exchange Format for Distribution)
 - IEC 61968-9 (Integration of Metering Systems)
- Key efforts in progress:
 - (IEC TC57) XML NDR
 - IEC62325-301 (CIM Market Extensions)

What is the CIM?



- Common Information Model as standardized through IEC TC57
- Focus is the electricity domain, covering transmission, distribution, markets, generation and related business processes
- Is a UML model with many packages, where some are currently designated as 'informative'
- Provides an ontology used for standardization of information exchanges by other IEC TC57 standards
- The CIM is being extended on an ongoing basis

CIM in a Federation of Ontologies



CIM Maintenance



- CIM Model Manager (CMM) is appointed by the CIM Users Group for an annual term, but through rotation may serve multiple terms
- CMM is a member of IEC TC57 WG13 and is required to attend all meetings
- CMMs to date have included:
 - Kurt Hunter, Siemens
 - Lars-Ola Osterlund, ABB
 - Kendall Demaree, Alstom
- Other TC57 working groups have model managers that closely coordinate efforts with the CMM:
 - Tanja Kostic, ABB for WG14
 - Margaret Goodrich, SISCO for WG16
- CIM UML is freely available from CIM UG site in EAP and XMI formats
- Updates to the CIM occur using a managed process

Enterprise Architect



- CIM was originally maintained using Rose
- Needed a free or low cost UML tool to allow CIM to be exploited by a wider audience
- After comparing a dozen tools, selected EA
- CIM migration to EA completed in 2008
- CIM now released using EAP format and XMI
- EA also used for sequence diagrams to document use cases

CIM in EA



iec61970cim14v13_iec61968cim10v30_combined - EA

File Edit View Project Diagram Element Tools Add-Ins Settings Window Help

Logical Diagram: "InheritanceHierarchy" created: 5/8/2008 2:13:38 PM modified: 12/8/2008 6:36:12 PM 100% 1000 x 1000

```
graph TD
    Core_IdentifiedObject[Core:: IdentifiedObject] --> Core_PowerSystemResource[Core:: PowerSystemResource]
    Core_PowerSystemResource --> Core_ConnectivityNodeContainer[Core:: ConnectivityNodeContainer]
    Core_PowerSystemResource --> TapChanger[TapChanger]
    Core_PowerSystemResource --> VoltageControlZone[VoltageControlZone]
    Core_ConnectivityNodeContainer --> Core_Equipment[Core:: Equipment]
    Core_ConnectivityNodeContainer --> Core_EquipmentContainer[Core:: EquipmentContainer]
    Core_Equipment --> CompositeSwitch[CompositeSwitch]
    Core_Equipment --> HeatExchanger[HeatExchanger]
    Core_Equipment --> PowerTransformer[PowerTransformer]
    Core_EquipmentContainer --> Plant[Plant]
    Core_EquipmentContainer --> Line[Line]
    Core_EquipmentContainer --> Core_Substation[Core:: Substation]
    Core_EquipmentContainer --> Core_VoltageLevel[Core:: VoltageLevel]
    Core_EquipmentContainer --> Core_Bay[Core:: Bay]
    Core_ConductingEquipment[Core:: ConductingEquipment] --> Core_Equipment
    Core_ConductingEquipment --> Conductor[Conductor]
    Conductor --> SeriesCompensator[SeriesCompensator]
    Conductor --> TransformerWinding[TransformerWinding]
    Conductor --> DCLineSegment[DCLineSegment]
    Conductor --> ACLineSegment[ACLineSegment]
    Core_ConductingEquipment --> EnergySource[EnergySource]
    Core_ConductingEquipment --> RectifierInverter[RectifierInverter]
    Core_ConductingEquipment --> EnergyConsumer[EnergyConsumer]
    Core_ConductingEquipment --> Ground[Ground]
    Core_ConductingEquipment --> BusbarSection[BusbarSection]
```

Project Browser

- Wires
 - Datatypes
 - DocumentationExampleInheritance
 - InheritanceHierarchy
 - LineModel
 - MutualCoupling
 - NamingHierarchyPart1
 - NamingHierarchyPart2
 - RegulatingEquipment
 - Schedules
 - TransformerModel
 - VoltageControl
 - ACLineSegment
 - Breaker
 - BusbarSection
 - CompositeSwitch
 - <<Datatype>> CompositeSwitchType
 - Conductor

Properties

General Settings

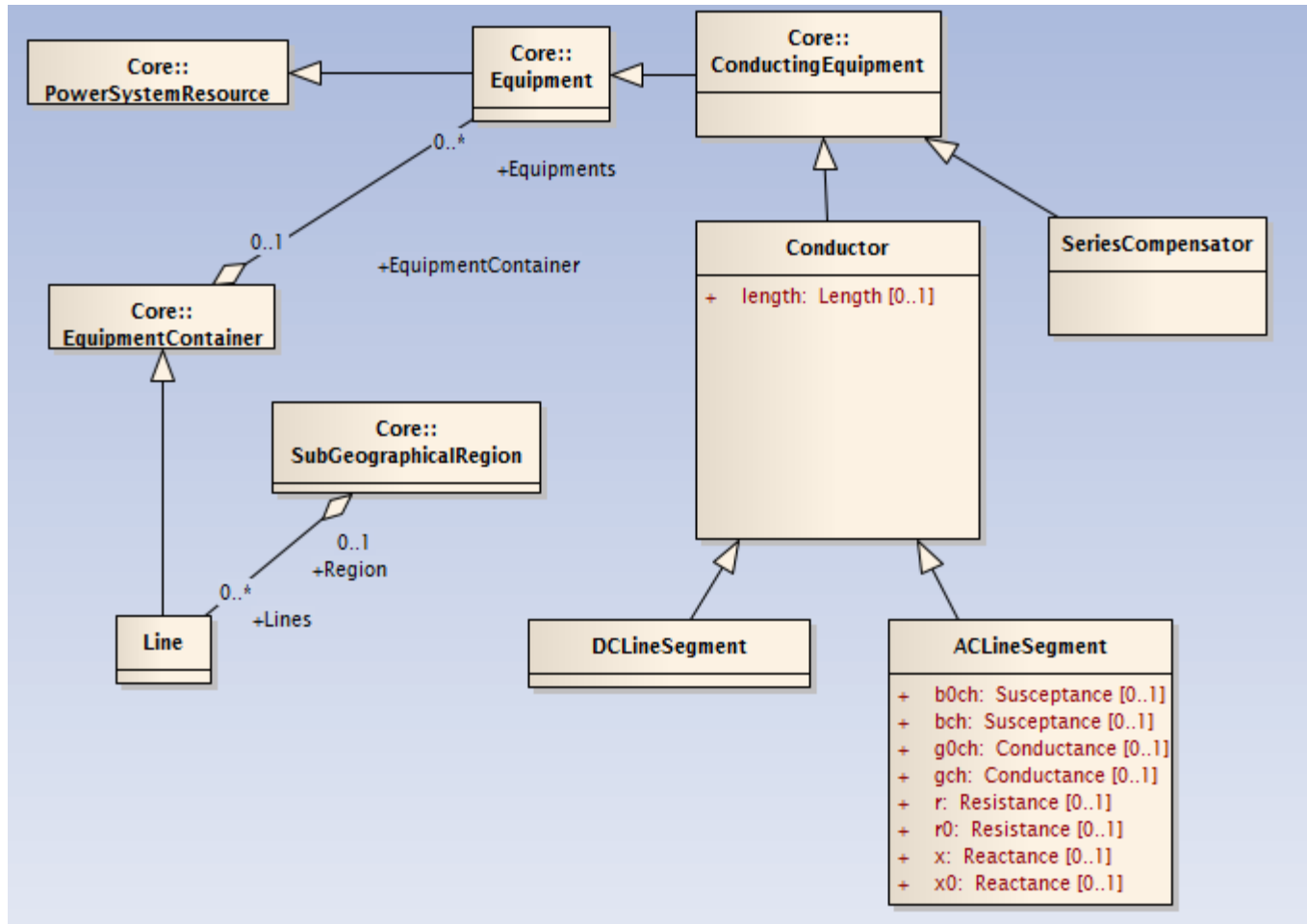
Name	
Scope	
Type	
Stereotype	
Alias	
Complexity	
Version	
Phase	
Language	
Filename	

Start Page *InheritanceHierarchy

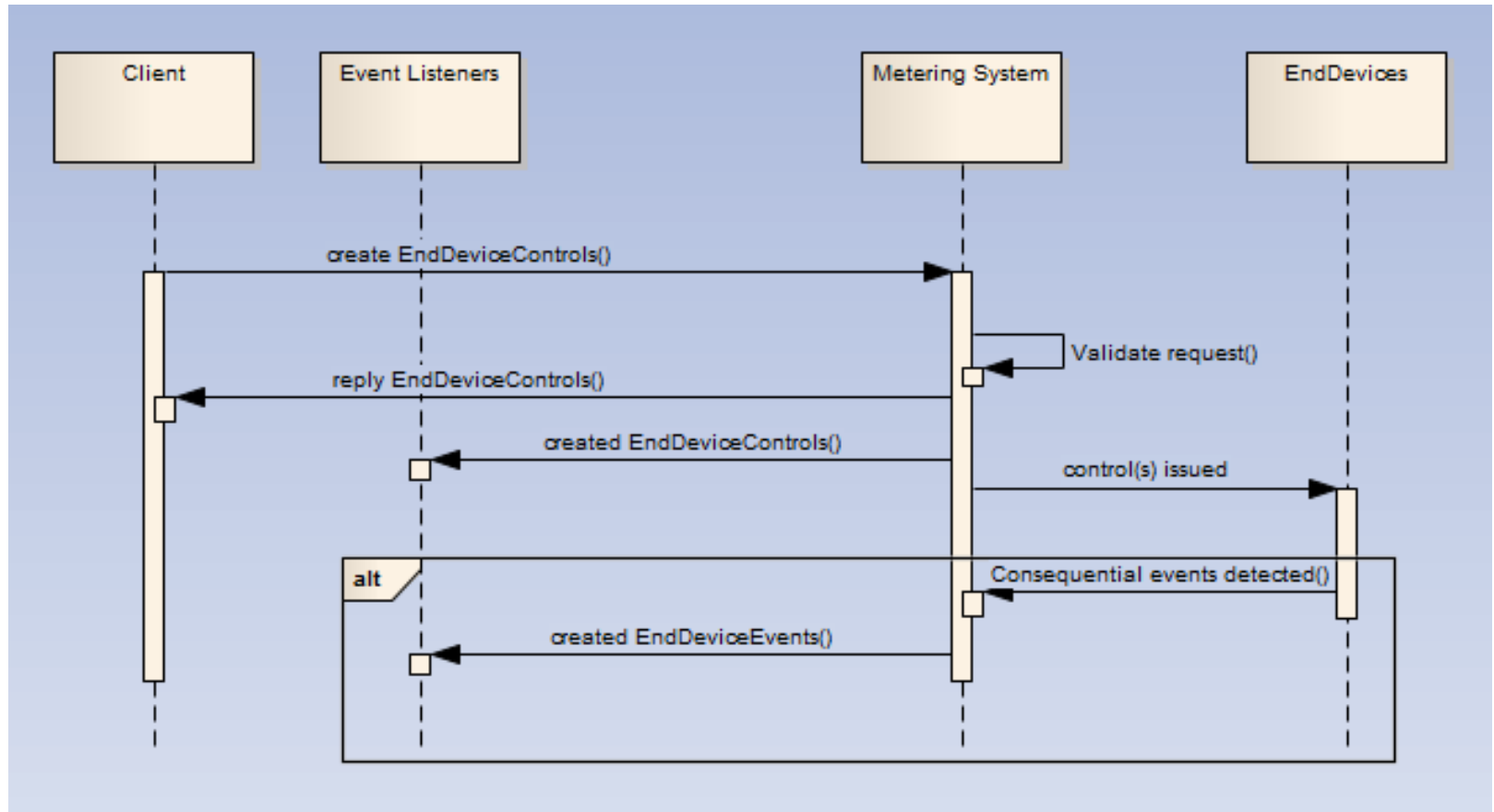
InheritanceHierarchy

[-] [CAP] [NUM] [SCRL] [WAN]

Class Diagram in EA



Sequence Diagram in EA



Exporting XMI from UML Tool

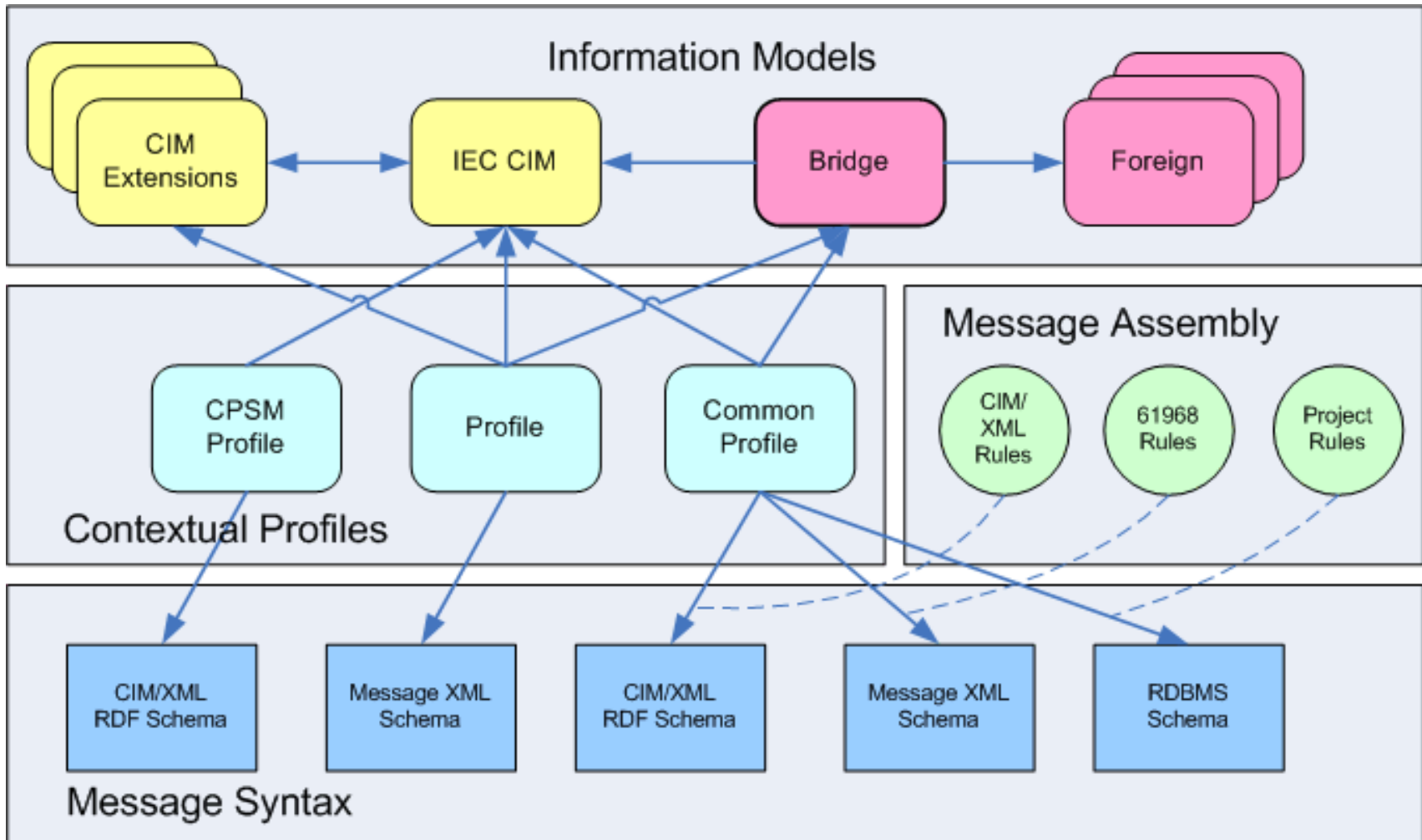
- Use export options shown to the right
- Export as UML 1.4
- Unselect 'Enable full EA Roundtrip'
- Select 'Unisys/Rose format' option
- Enter file name for XMI file
- Click on Export button
- This XMI is used as a 'schema' within CIMTool

The screenshot shows the UML Tool interface with the 'Export Package to XMI' dialog box open. The dialog box contains the following fields and options:

- Root Package: ERCOT_1.13
- Filename: F:\work\CIM\ERCOT_113.xmi
- Stylesheet: (Optional stylesheet to post process XMI content)
- General Options:
 - Export Diagrams
 - Export Alternate Images
 - Format XMI Output
 - Write Log file
 - Use DTD
 - Generate Diagram Images
- For Export to Other Tools:
 - Enable full EA Roundtrip
 - XMI Type: UML 1.4 (XMI 1.2)
 - Unisys/Rose Format
 - Exclude EA Tagged Values
- Warning: These options are for exporting EA model elements to other tools only.
- Buttons: View XML, Export, Close, Help

The background shows a UML diagram with classes like 'CIMCore::ConductingEquipment', 'Conductor', 'ConductorType', and 'WireArrangement'.

Information Models and Profiles



What is a Contextual Profile?



- The set of classes, attributes and relationships in a contextual profile (a.k.a. profile) is a subset of the classes, attributes and relationships found in a schema
- The cardinality of a relationship in a profile is either the same or more restrictive than the relationship in the schema
- A profile is often given a name (e.g. CPSM)
- Each profile will have an assigned namespace
- Profiles are also known as ‘contextual models’
- Within CIMTool, profiles are managed using an OWL format, where a .owl extension is used
- Important to note that OWL is based upon RDF
- Profiles can be realized in a variety of forms, including but not limited to RDFS, XML Schema and HTML

What is Eclipse?



- Eclipse is a freely available, open source, integrated development environment (IDE) found at <http://eclipse.org>
- Think of Eclipse as a ‘workbench’
- Eclipse is most commonly used for enterprise software development using Java, but it is extendible
- Eclipse capabilities are extended by a wide number of available ‘plug-ins’, developed by a wide number of sources
- Plugins available include:
 - CIMTool
 - XML Schema Editor
 - UML Editors
 - C, C++ compilers
 - ... and much, much more
- Many commercial products are now delivered as Eclipse plug-ins



What is CIMTool?



- CIMTool is a free Eclipse plug-in, developed by Arnold DeVos of Langdale Consultants, with aid from a number of companies
- CIMTool provides the means to:
 - Define profiles from a UML model
 - Import profiles from a spreadsheet
 - Validate profiles
 - Validate instance files against a profile
 - Validate incremental files against an instance file and a profile
 - Generate XML schemas from a profile
 - Generate RDF schemas from a profile
 - ... and more

CIMTool

Installing CIMTool



- CIMTool is installed as a plug-in from a remote site
- Using the Eclipse update facility:
 1. Start Eclipse
 2. Find the update facility in the menus: 'Help > Software Updates > Find and Install...'
 3. Select 'Search for new features to install' option and then select 'Next'
 4. Select 'New Remote Site ...'
 5. On 'New Update Site' dialog set name='CIMTool' and URL='<http://files.cimtool.org>', then click 'OK'
 6. Verify that the new site is now in the list and checked, and then click 'Finish'
 7. On 'Search Results' dialog, check the box for CIMTool and then click 'Next'
 8. Accept the license terms and click 'Next'
 9. Click 'Finish' and wait for download to complete
 10. On 'Feature Verification' dialog select 'Install All' and wait
 11. When asked to restart Eclipse, click 'Yes'
 12. Eclipse will then restart with the latest CIMTool plug-in installed
- You can also download a zip file with Eclipse and CIMTool

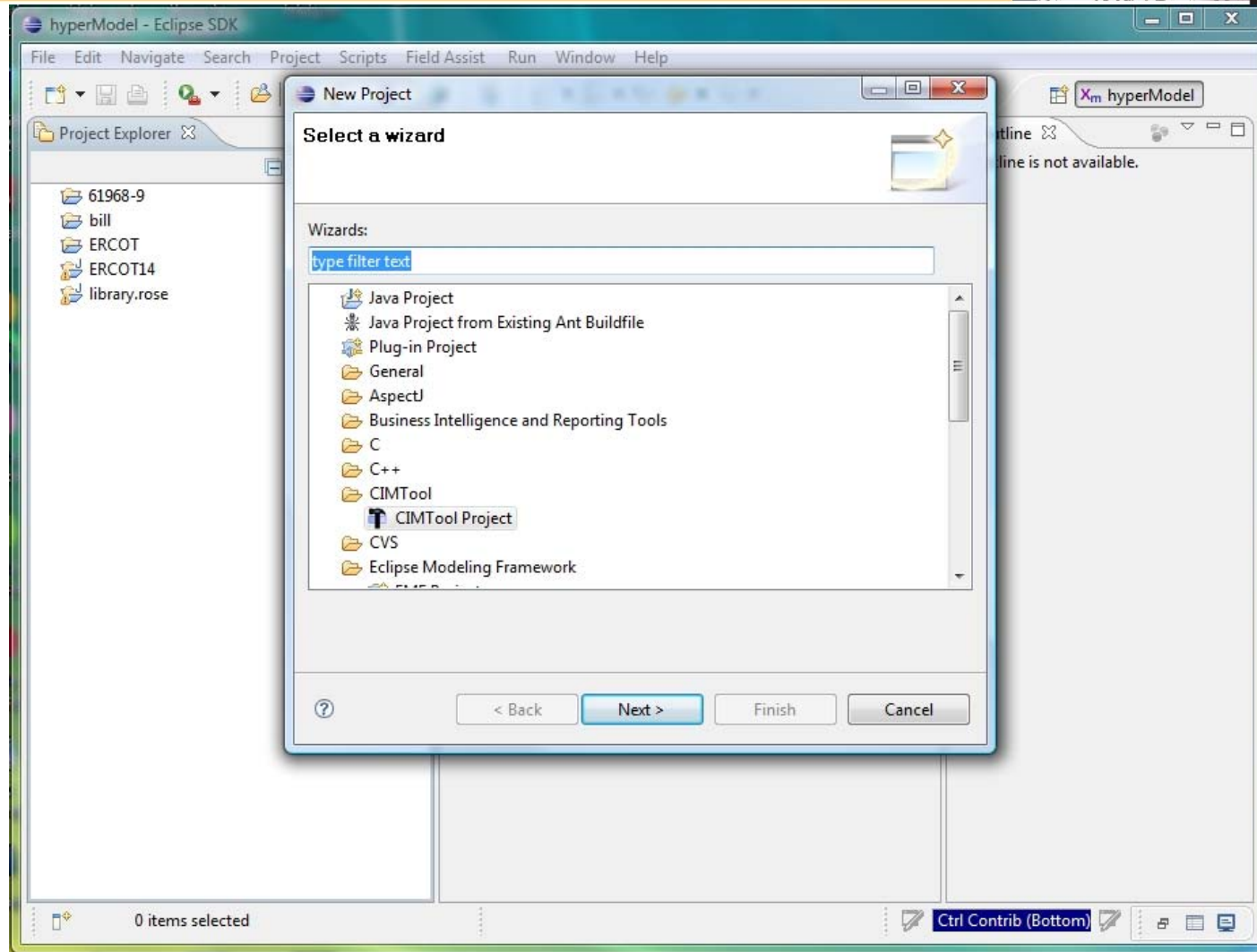
CIMTool Projects



- Each Eclipse project has a named folder in the Eclipse workspace directory
- Each CIMTool project will have four sub-folders:
 - **Incremental**: for CIM XML incremental files in RDF format with a .xml extension
 - **Instances**: for CIM XML instance files in RDF format with a .xml extension
 - **Profiles**: for profile definitions, where
 - Profile definitions are stored in an OWL format
 - Log files, which may identify errors, are text files with a .log extension
 - Depending upon the usage of CIMTool, there may also be HTML, RDFS and XSD files
 - **Schema**: for the CIM model in XMI format with a .xmi extension
- Folders and files that have errors may include a red X on their associated icon

Creating a New CIMTool Project

- Select 'File > New > Project'
- Select 'CIMTool Project' option
- Click 'Next'



Schema Import within CIMTool



- Schemas are imported when creating a new CIMTool project
- Schemas can also be added to supplement an existing schema
- Schemas can also replace an existing schema, as in the case of a new CIM version

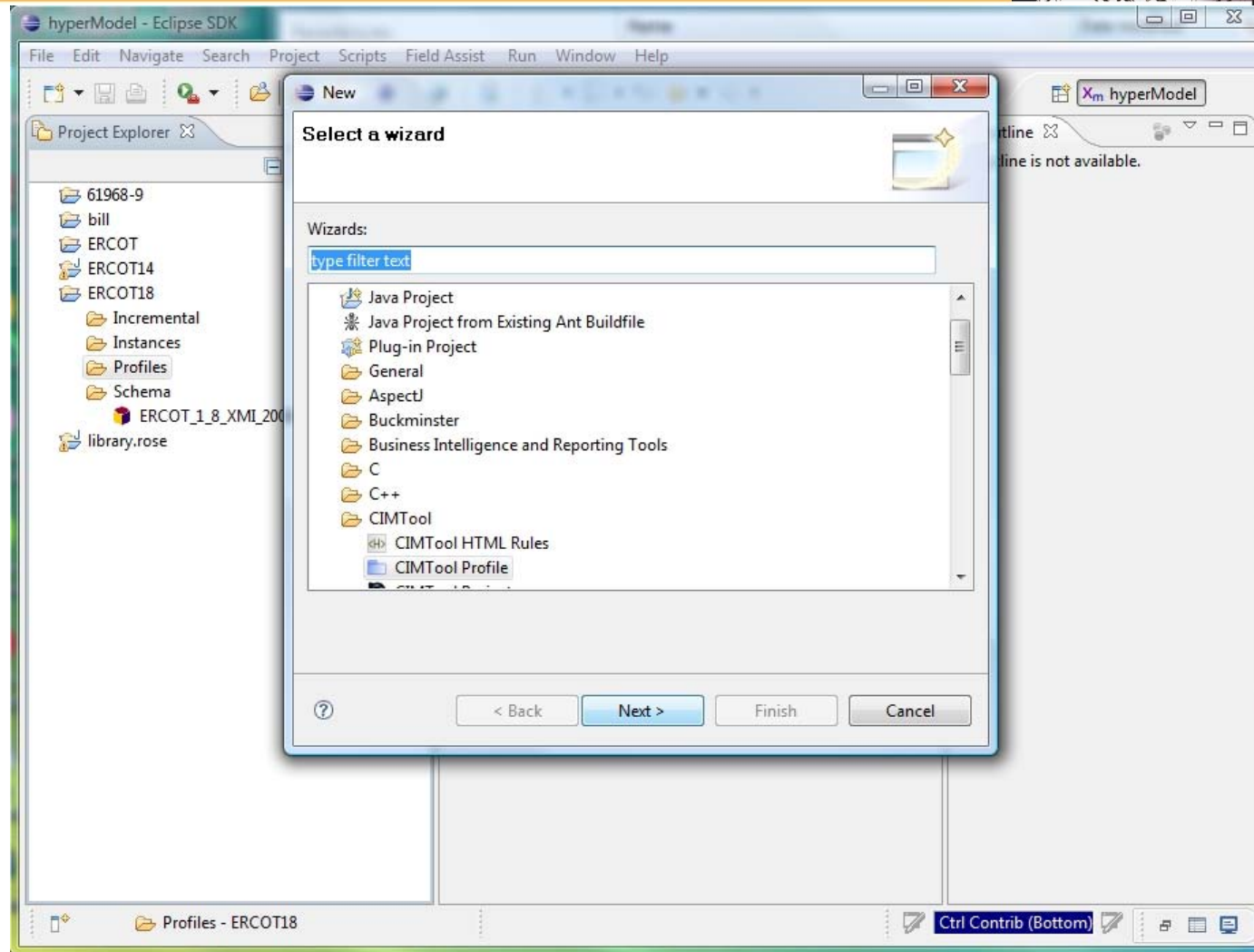
Creating a New Profile



- There are three ways to create a new profile:
 1. Create it from scratch within CIMTool
 2. Import an OWL profile previously constructed using CIMTool
 3. Import the profile from a data dictionary spreadsheet
- Once created, profiles are stored in the 'Profiles' folder of the project
- A project may have many profiles
- Each profile will have a namespace
- This following slides describe the creation of a new profile using the edit capabilities within CIMTool

Creating a New Profile

1. Select 'File > New > Other ...'
2. Select 'CIMTool Profile' option
3. Click 'Next'



Creating a New Profile

- Click on checkbox for the desired project
- Determine a unique name for the profile that will not conflict with other profile names, then using the name:
 - Set the profile name
 - Set namespace URI
 - Set envelope element name
- Click 'Finish'

New Profile

Create a new OWL profile definition.

Namespace URI:

Project

- 61968-9FDIS
- CIGRE
- CIM12
- EA import test
- ERCOT116
- Extensions
- IEC61968-9
- library.rose
- MDM

Profile name:

Envelope Element Name

Example Profile



Java - 61968-9FDIS/Profiles/EndDeviceEvents.owl - Eclipse SDK

File Edit Source Refactor Navigate Search Project Run SOA Field Assist Window Help

Manage container

Package Explorer Hierarchy

- 61968-9FDIS
 - Incremental
 - Instances
 - Profiles
 - EndDeviceAssets.owl
 - EndDeviceControls.owl
 - EndDeviceControls.xsd
 - EndDeviceEvents.owl**
 - EndDeviceEvents.xsd
 - MeterReadings.owl
 - Schema
 - iec61970cim13v18_iec61968cim10v17_...
- CIGRE
- CIM12
- EA import test
- ERCOT116
- Extensions
- IEC61968-9
- library.rose
- MDM
- test

EndDeviceControls.owl *EndDeviceEvents.owl »1

EndDeviceEvent

Select members of this class. Make this class concrete

- mRID 0..1
- category 1..1
- createdDateTime 1..1
- reason 0..1
- severity 0..1
- userID 0..1
- Assets 1..1
- status 0..1

- DeviceFunction
- MeterReading
- SuperClass: ActivityRecord

Outline

- EndDeviceEvents
 - EndDeviceEvent
 - mRID 0..1
 - category 1..1
 - createdDateTime 1..1
 - reason 0..1
 - severity 0..1
 - userID 0..1
 - Assets 1..1
 - Asset
 - mRID 1..1
 - status 0..1

Add/Remove Hierarchy Detail Stereotypes Summary

Problems @ Javadoc Declaration

4 errors, 30 warnings, 0 others

Description	Resource	Path
Errors (4 items)		
Warnings (30 items)		

EndDeviceEvents.owl - 61968-9FDIS/Profiles Ctrl Contrib (Bottom)

Selecting XSD Generation

- XSD generation must be selected on the Summary tab for the profile
- Other options such as HTML generation may be selected concurrently

The screenshot displays a software interface for configuring an OWL profile. The main window is titled '*MeterReadings.owl' and shows the 'Summary' tab. The 'Location' is set to '/IEC61968-9/Profiles/MeterReadings.owl' and the 'Namespace' is 'http://iec.ch/TC57/2007/profile#'. A 'Reorganize and Repair' button is visible. Below this, a section titled 'Build the following from this profile:' contains a list of builders with checkboxes. The 'Builder for html' and 'Builder for xsd' are checked, while others are unchecked. To the right, an 'Outline' panel shows a tree view of the profile's elements, including 'MeterAsset', 'MeterReading', 'Reading', 'timeStamp 1..1', 'value 0..1', 'ReadingQuality 0..n', 'ReadingType 1..1', 'ReadingType', and 'ServiceDeliveryPoint mRID 1.1'. At the bottom, a tab bar shows 'Add/Remove', 'Element Detail', 'Stereotypes', and 'Summary'.

Viewing XSD in Eclipse

A screenshot of the Eclipse IDE interface. The title bar reads "Java - 61968-9FDIS/Profiles/EndDeviceEvents.xsd - Eclipse SDK". The menu bar includes File, Edit, Navigate, Search, Project, Run, XSD, SOA, Field Assist, Window, and Help. The toolbar contains various icons for file operations and development tools. The Package Explorer on the left shows a project structure with folders for Instances and Profiles, and a list of files including owl, xsd, and xsdt files. The main editor area displays the XSD schema for "EndDeviceEvents.xsd" with a schema URI of "http://iec.ch/TC57/2007/EndDeviceEvents#". It shows a tree view with Directives, Elements (containing "EndDeviceEvents : EndDeviceEvents"), and Types (containing "EndDeviceEvent" and "EndDeviceEvents"). The Outline view on the right shows a hierarchical tree of the schema elements and attributes. The Problems view at the bottom indicates "4 errors, 31 warnings, 0 others".

Java - 61968-9FDIS/Profiles/EndDeviceEvents.xsd - Eclipse SDK

File Edit Navigate Search Project Run XSD SOA Field Assist Window Help

Manage container

Package Explorer Hierarchy

Instances

Profiles

- CustomerMeterDataSet.owl
- CustomerMeterDataSet.xsd
- CustomerMeterDataSet.xsd-xsdt
- EndDeviceAssets.owl
- EndDeviceAssets.xsd
- EndDeviceAssets.xsd-xsdt
- EndDeviceControls.owl
- EndDeviceControls.xsd
- EndDeviceControls.xsd-xsdt
- EndDeviceEvents.owl
- EndDeviceEvents.xsd
- EndDeviceEvents.xsd-xsdt
- GetMeterReadings.owl
- GetMeterReadings.xsd
- GetMeterReadings.xsd-xsdt
- MeterReadings.owl
- MeterReadings.xsd
- MeterReadings.xsd-xsdt
- MeterReadSchedule.owl
- MeterReadSchedule.xsd
- MeterReadSchedule.xsd-xsdt

Schema

- CIGRE
- CIM12

EndDeviceEvents.xsd

Schema : http://iec.ch/TC57/2007/EndDeviceEvents#

Directives

Elements

- EndDeviceEvents : EndDeviceEvents

Types

- EndDeviceEvent
- EndDeviceEvents

Outline

- Elements
 - EndDeviceEvents : EndDeviceEvents
 - EndDeviceEvents
 - sequence
 - EndDeviceEvent [0..*] : EndDev
- Attributes
- Types
 - EndDeviceEvent
 - sequence
 - mRID [0..1] : string
 - category [1..1] : string
 - createdDateTime [1..1] : dateTime
 - description [0..1] : string
 - reason [0..1] : string
 - severity [0..1] : string
 - userID [0..1] : string
 - Assets [1..1]
 - status [0..1]
 - EndDeviceEvents
 - sequence
 - EndDeviceEvent [0..*] : EndDev

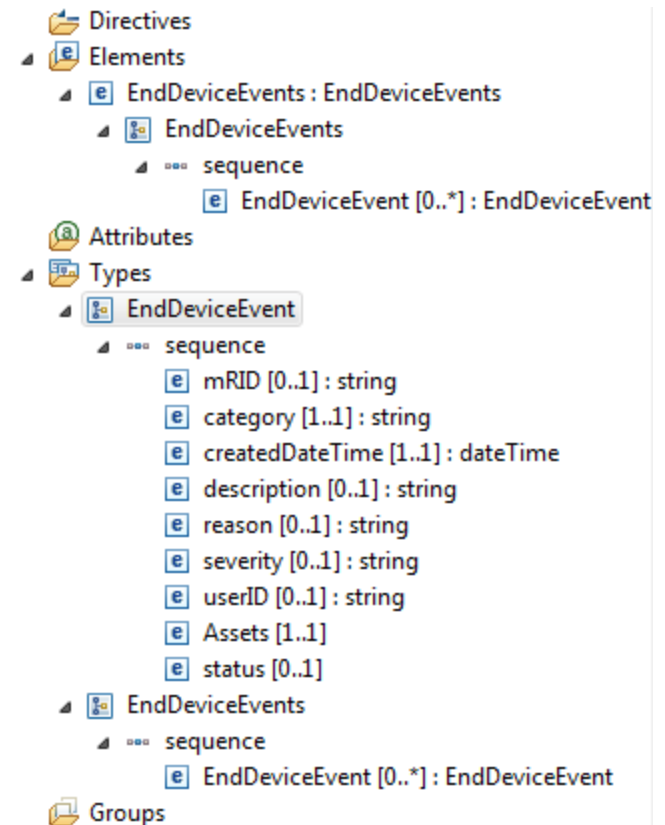
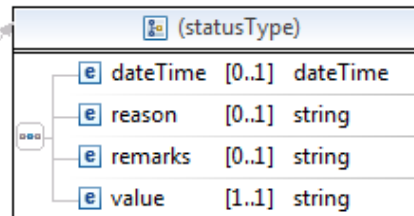
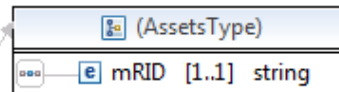
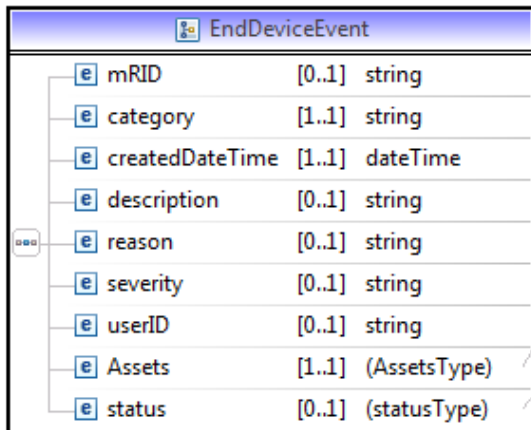
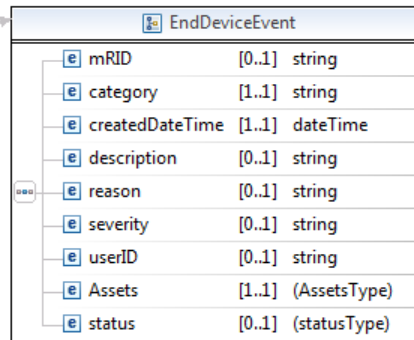
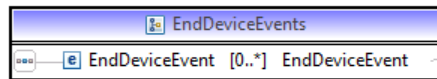
Problems @ Javadoc Declaration

4 errors, 31 warnings, 0 others

Description	Resource	Path
Errors (4 items)		

Ctrl Contrib (Bottom)

Viewing XSD in Eclipse



Where Do I Get ...

- CIMTool and Eclipse:
 - <http://eclipse.org>
 - <http://cimtool.org>
- CIM UML:
 - <http://www.ucaiug.org/CIMug>
- Enterprise Architect:
 - <http://www.sparxsystems.com>
- IEC Standards:
 - <http://www.iec.ch>



More Information

- UISOL web site: <http://uisol.com>
- E-mail: sneumann@uisol.com

