Smart Metering Data Exchange Tools

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Thanks to contributions and guidance from FutureDOS, Itron, Elster, Xtensible

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Outline

- Overview
  - Large Scale Metering
  - Data Model Relationships of Standards
- Narrowing of Scope to Energy Usage Information
- Object Models of the Meter Standards
- Use of XSD and XSLT for Transformations
- Tool Set Produced
  - Pairwise XSLTs to and from ESPI
    - C12.19, SEP2.0,COSEM
  - Small VBApp to Exercise XSLTs

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Overview

- Objective: To develop tools and documentation of the tools that shows how ANSI C12.19-2008 data tables can be accessed using IEC Common Information Model (CIM), IEC 61968 and IEC 61970, requests and IEC 62056 metering language, and Smart Energy Profile 2.0. These tools and reports are necessary to show how energy usage information in C12.19-2008 can be requested and utilized in an interoperable fashion from devices that use IEC CIM and metering language standards and devices using Smart Energy Profile 2.0.

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Possible Large Scale Metering

Large scale meter data aggregator has sources spanning multiple MDM domains each with different native metering protocols

IEC 61968-9

Data Normalization Layer

Meter Reading

ANSI C12.22

Meter Reading

IEC 62056

Meter Reading

SEP 2.0

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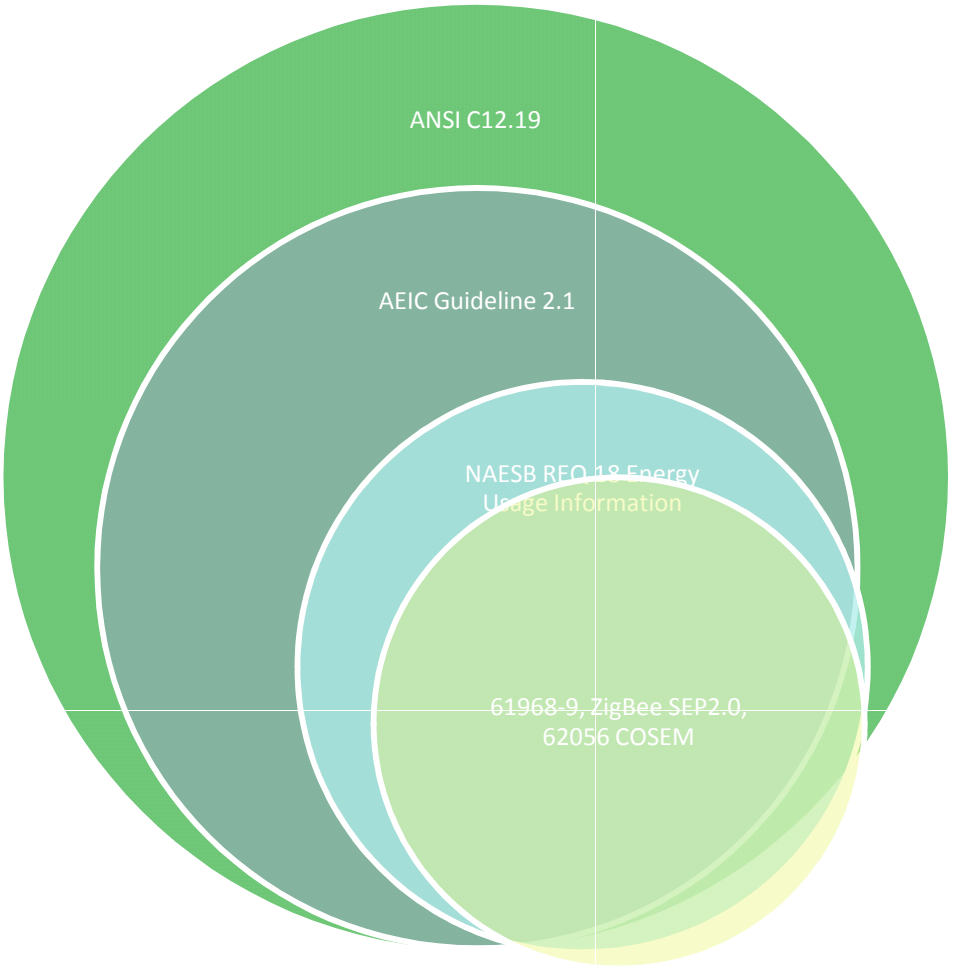
Data Model Relationships of the standards

Note: Reduced scope of information as we go from full ANSI Standard to AEIC to NAESB and focus on Energy Usage Data.

Also note, some data of other standards is outside scope of C12.19.

However, predominantly data from C12.19 is represented in ESPI, CIM, SEP, and COSEM



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Progression of the Work

Start with ANSI C12.19 2008

A profile of a C12.19 revenue meter based on the AEIC Guidelines version 2.1

A subset of this profile based on the NAESB REQ.21 ESPI (Green Button)

This set of C12.19 will be arranged within a defined profile set of tables as the basis for exchange with other standards.

- An EDL representation of data sets to be exchanged corresponding to this model.
- A mapping of this model to
  - 61968-9
  - ZigBee SEP2.0
  - 62056 – 61,62.
- XSLT files to convert data between pairs of standards
- Small VBA application to perform conversions

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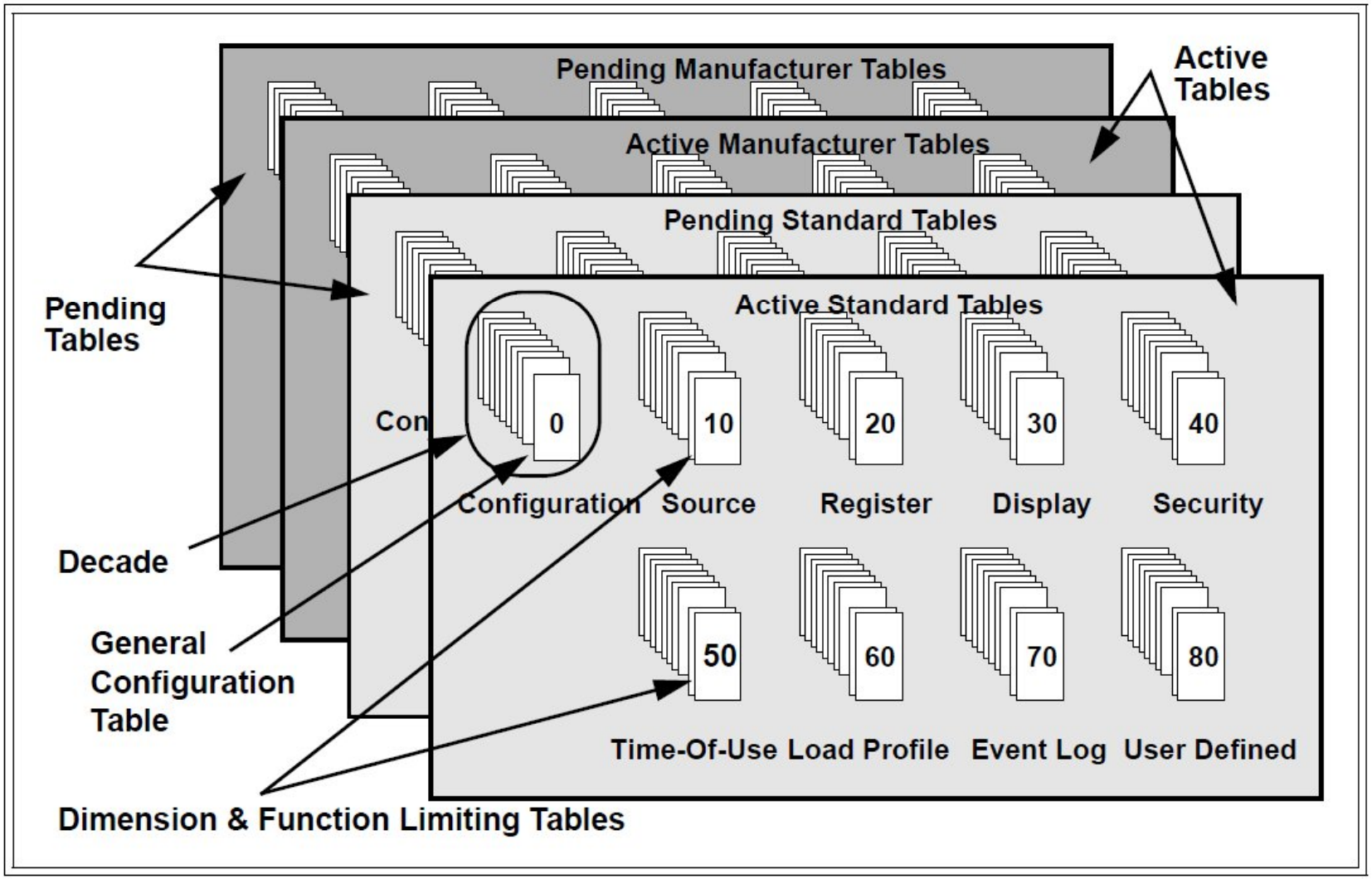
Length and Breadth of C12.19



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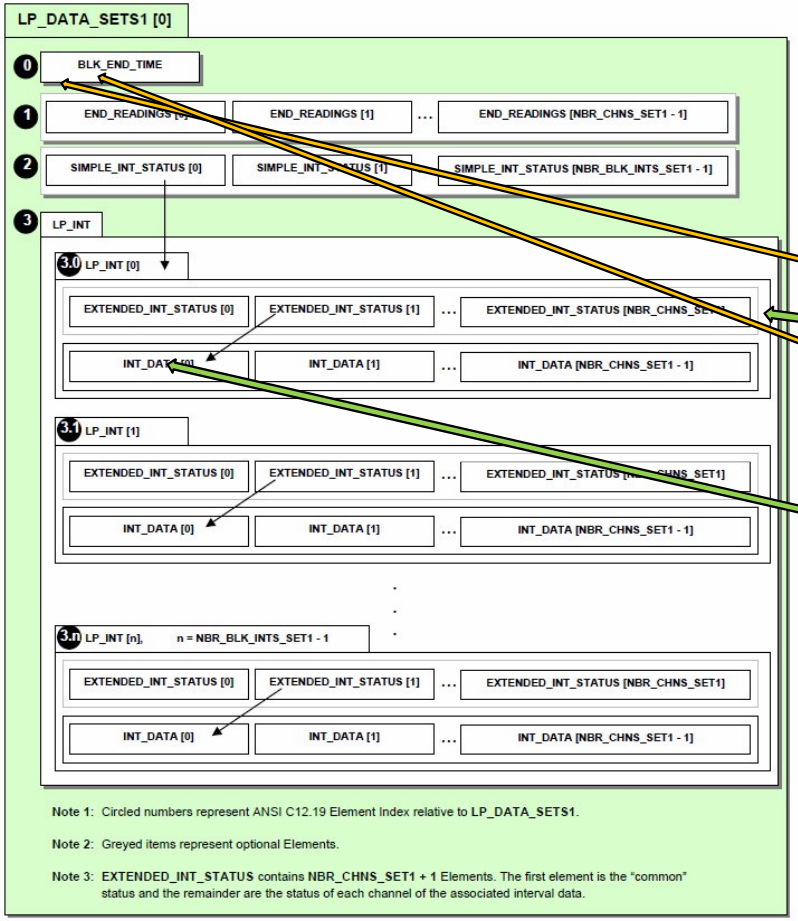
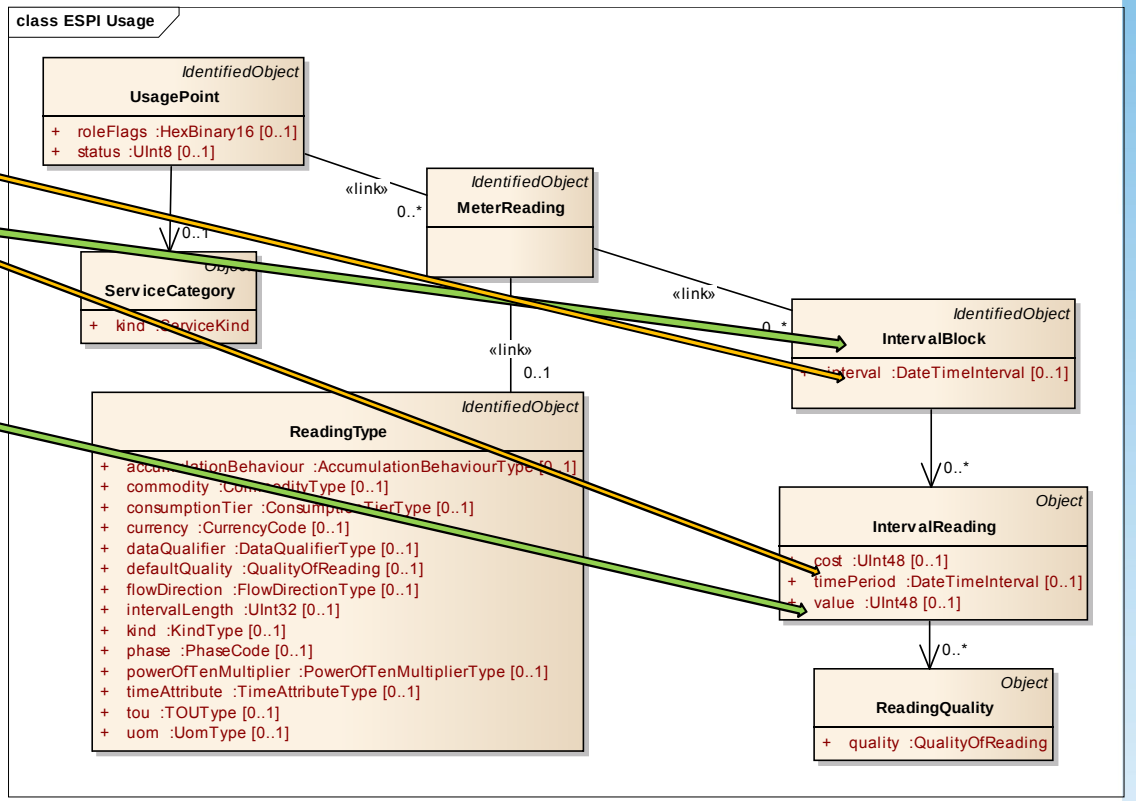
C12 vs ESPI Model*

* Note: Load Profile Shown, Register reads similar but not shown





Load Profile Model – from Future Dos

ANSI C12.19-2008 Load Profile Implementation Guide

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ESPI Model – from NAESB REQ21

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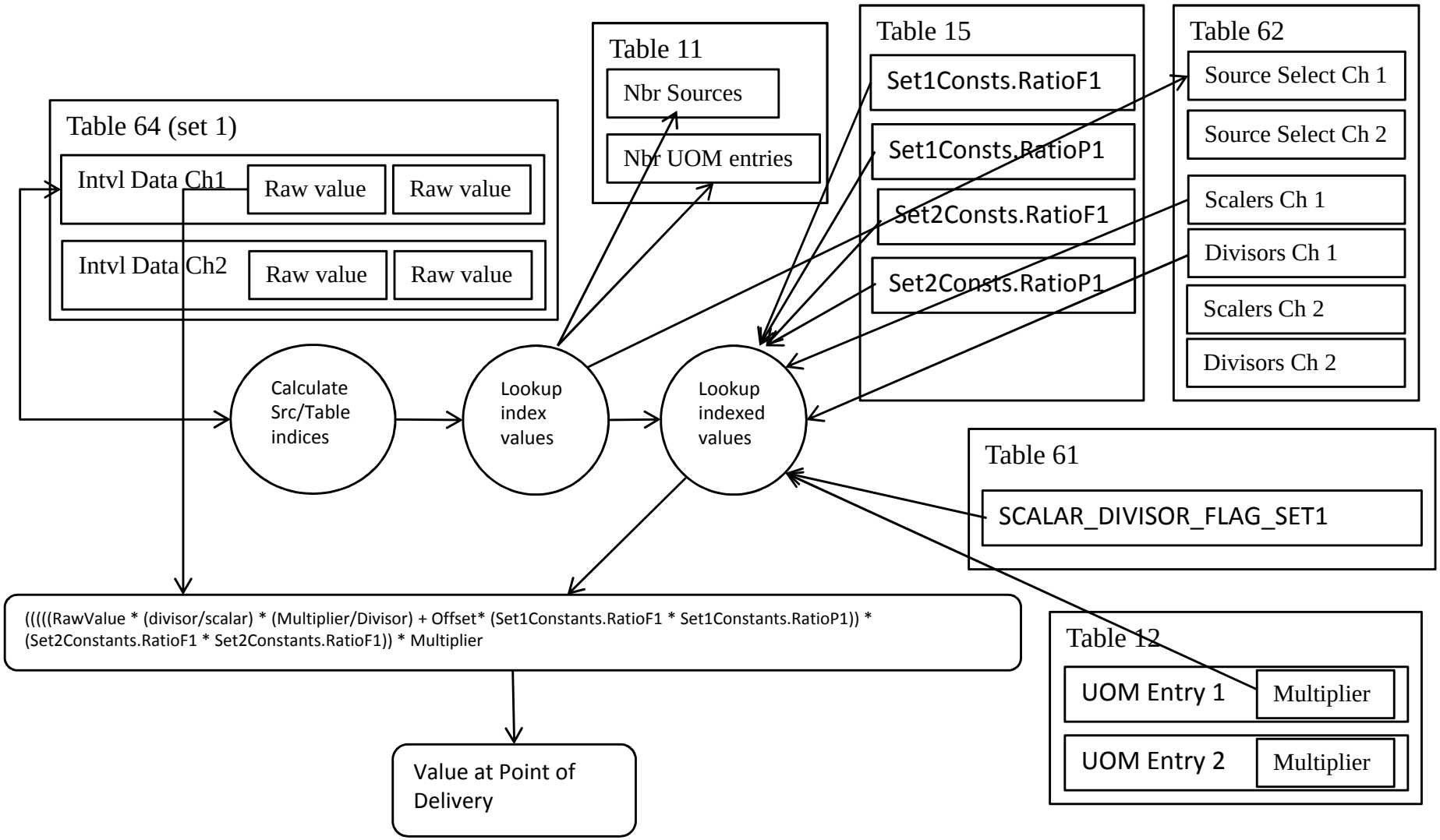
Annex K is Key to Translation: Load Profile raw interval value (from C12.19 Annex K and additional)



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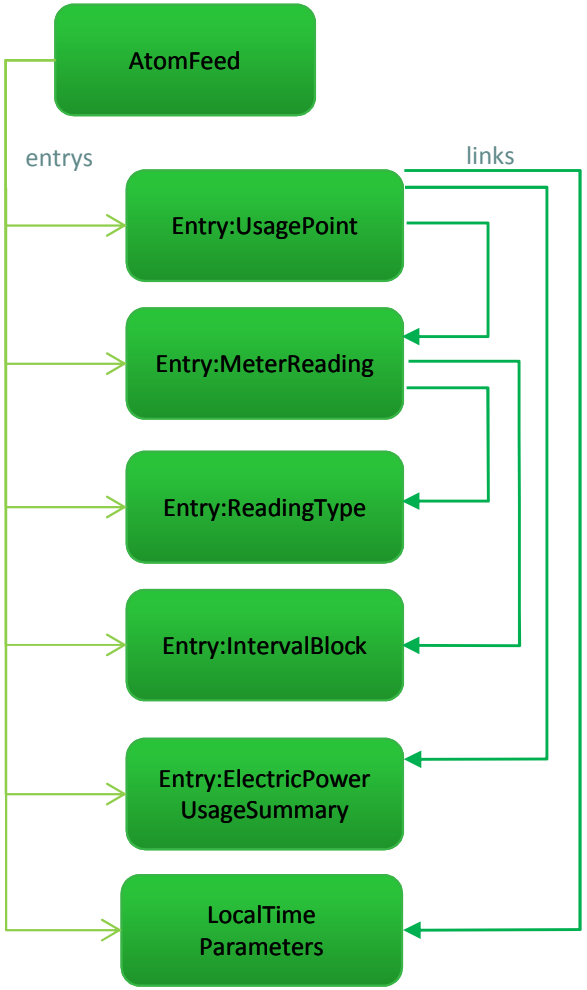
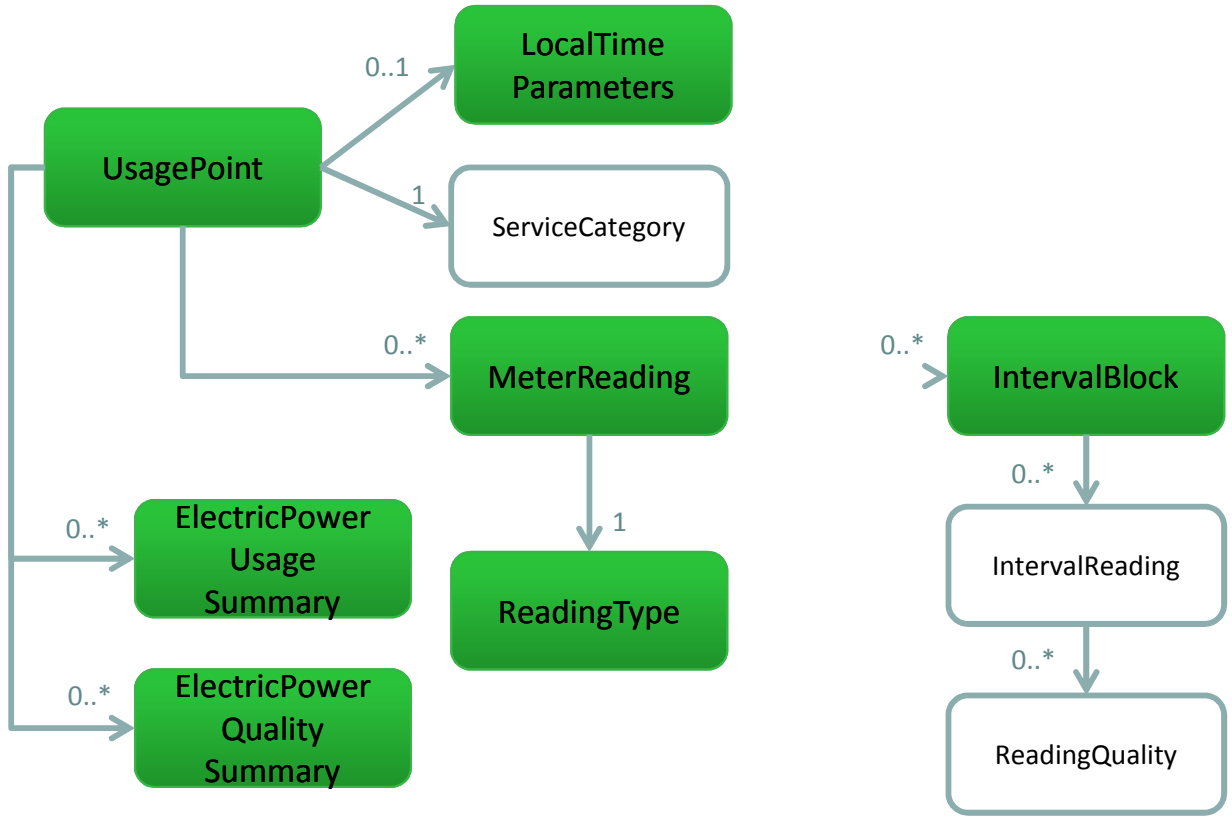
Structure of ESPI Data

Syntactic Model
Atom Feed View



Information Model
Profile View



Note: This information is multidimensional. Many different reading types, summaries, and readings possible. i.e. not “flat”

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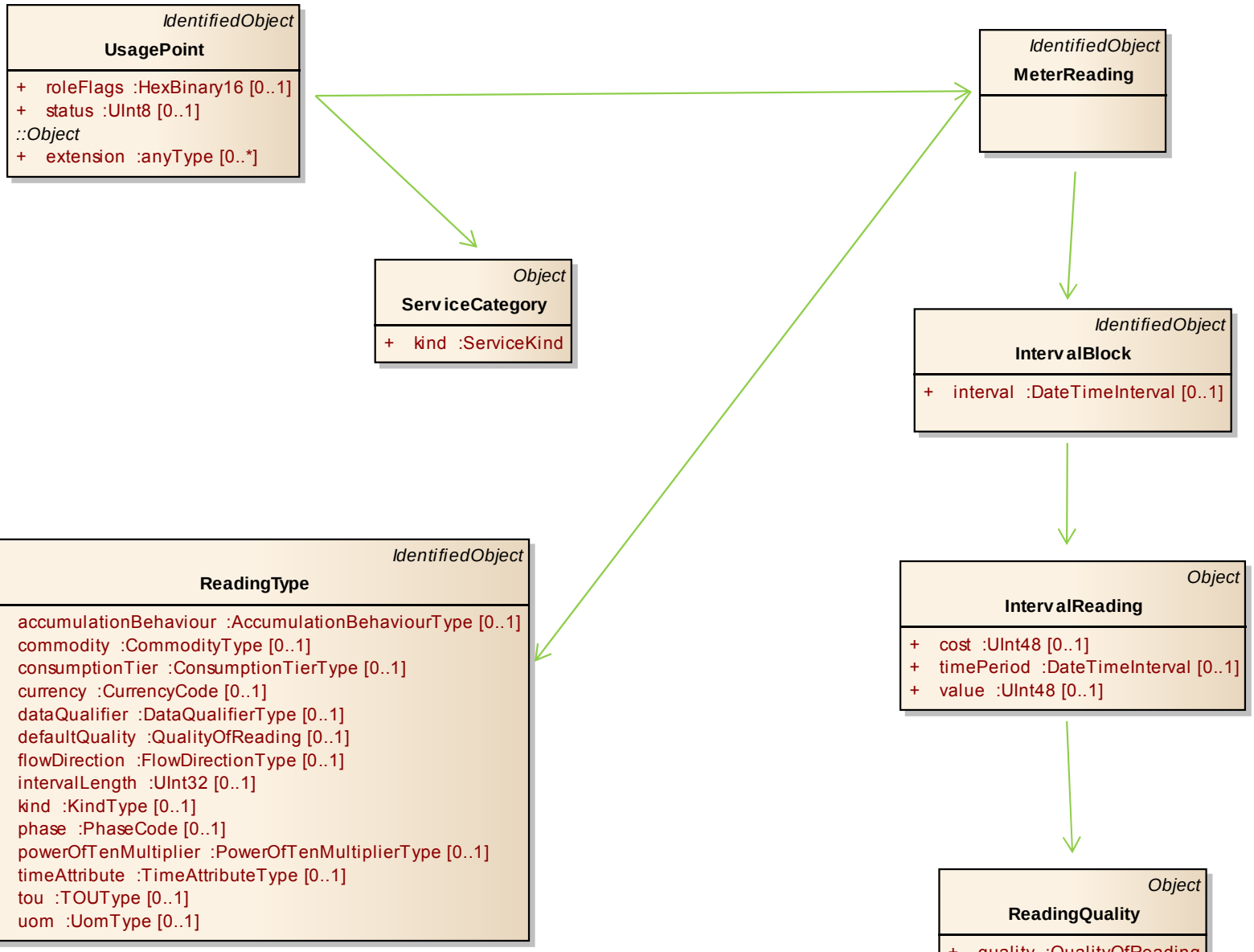
NAESB ESPI REQ.21



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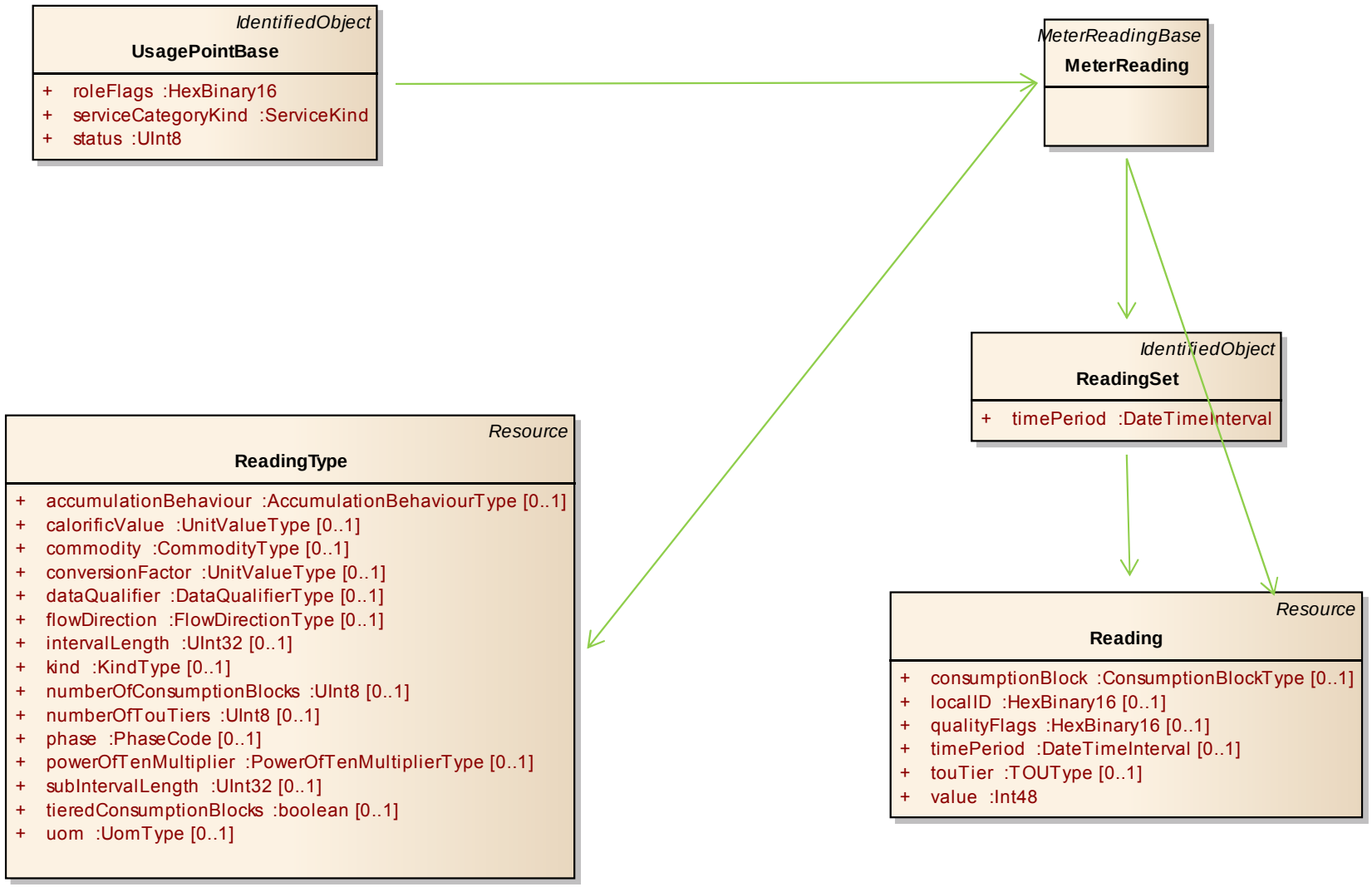
SEP 2.0 UML Model20120323



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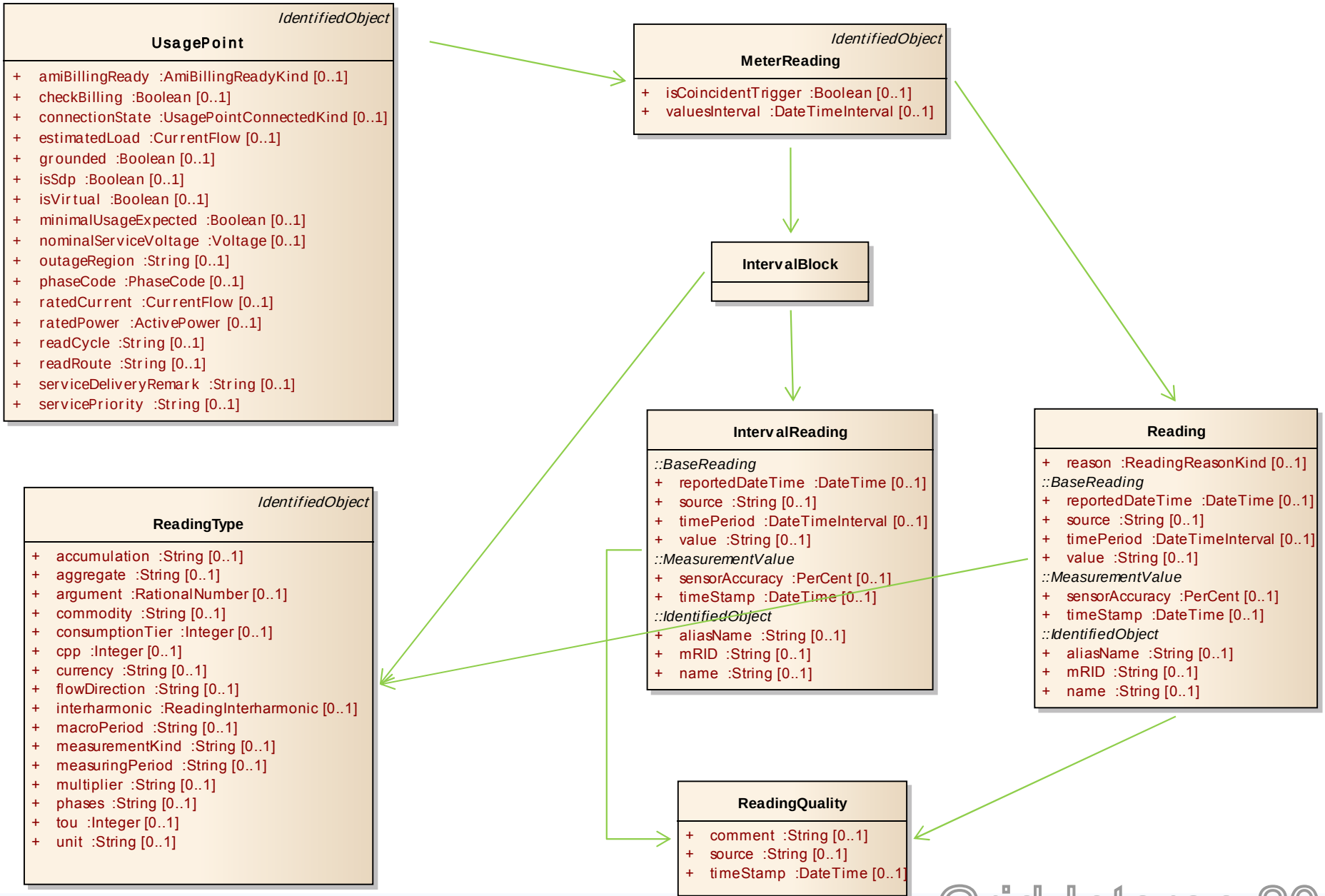

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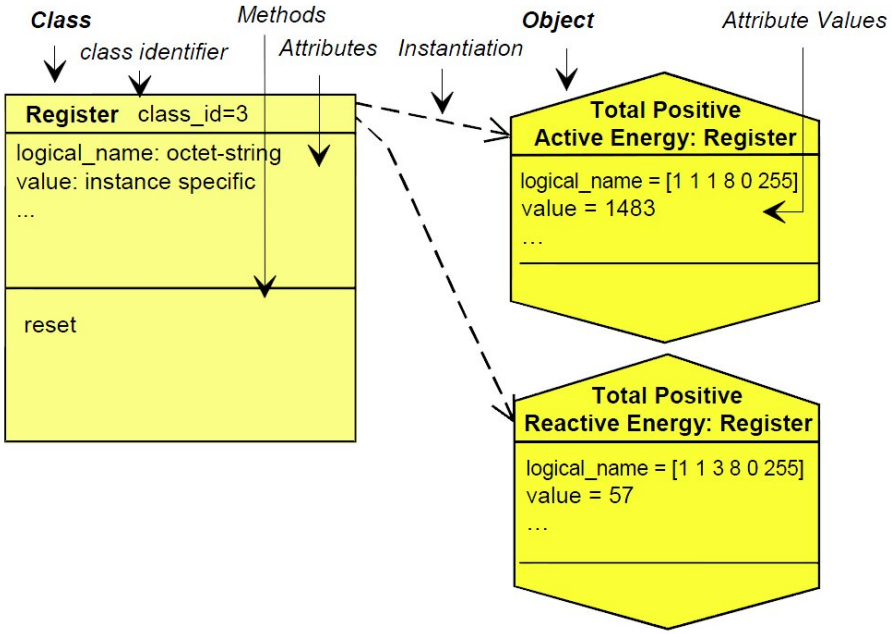
COSEM IEC 62056-6-1,2

COSEM Class/Object Model



A COSEM meter is a list of COSEM Objects each with a unique class and logical_name

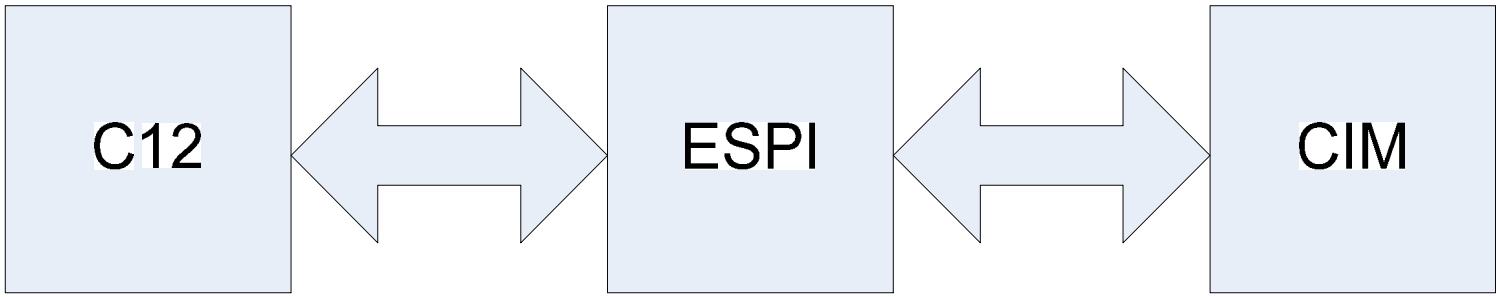
Class ID:Name	Attributes
0x01:Data	Contains data (Blue Book Section 4.3.1) logical_name:octet-string Obis Code value:CHOICE Contains the data value.
0x03:Register	Contains register data (Blue Book Section 4.3.2) logical_name:octet-string Obis Code value:CHOICE Contains the data value. scaler_unit: scale_unit_type
0x04:Extended Register	Contains register data with status and timestamp (Blue Book Section 4.3.3) logical_name: Obis Code value: Contains the data value scaler_unit: scale_unit_type status:CHOICE status of value capture_time: octet-string
0x05:Demand Register	Contains demand register data with status and timestamp (Blue Book Section 4.3.4) logical_name: Obis Code current_average_value:CHOICE last_average_value:CHOICE scaler_unit: scale_unit_type status:CHOICE status of value capture_time: octet-string start_time_current:octet-string period:double-long-unsigned number_of_periods:long-unsigned
0x07:Profile Generic	Load Profile (Blue Book Section 4.3.6) logical_name: Obis Code buffer:array contains the load profile readings (each one a class3 or class4 or class5 object) capture_objects: array (each one describes the contents of the buffer and is of type capture_object_definition) capture_period:double-long-unsigned seconds per interval sort_method:enum (1) fifo (first in first out), (2) lifo (last in first out), (3) largest, (4) smallest, (5) nearest_to_zero, (6) farest_from_zero sort_object: capture_object_definition used to allow sorting on a single subrecord structure item entries_in_use:double-long-unsigned how many entries in buffer are used profile_entries:double-long-unsigned how many total records in buffer are present

Using ESPI/PAP10 Energy Usage Information as Intermediate Model

C12.19 Data Model Restricted by AEIC Guidelines

ESPI Models Energy Usage Information The Payload of AMI

61968-9 defines Meter Data Request



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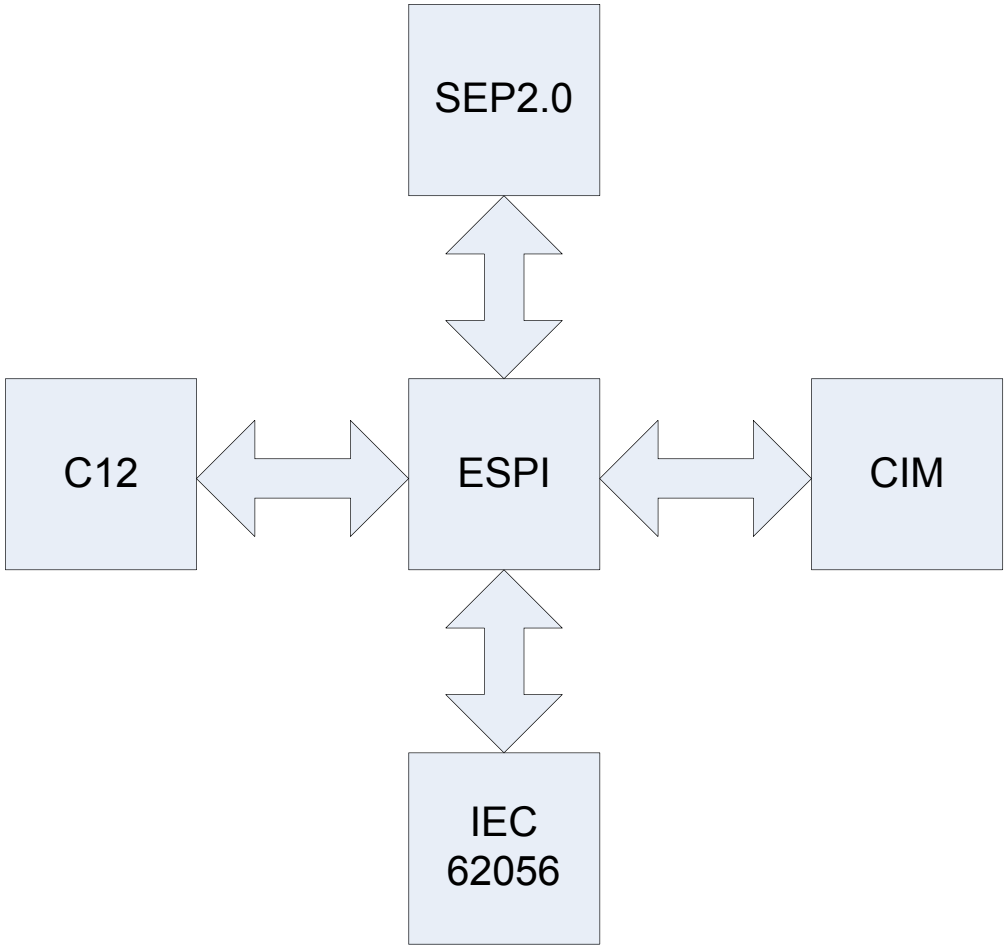
The Big Picture – repeating pattern with ESPI as intermediate format



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The Tool Set

- C12.19 EDL Schema
  - From PAP06 schemas from FutureDos
- Sample C12.19 Data
  - Built based on AEIC Guidelines
  - Constrained to EUI
  - Manually constructed in XMLSpy™
- XSLTs to Convert Data To and From the ESPI intermediate
  - C12.19 to ESPI
    - C12ToESPI.xslt transforms to ESPI XML (Green Button)
    - ESPIToC12.xslt transforms from ESPI to C12
  - CIM to ESPI
    - ESPIToCIM.xslt transforms from ESPI to CIM
    - CIMToESPI.xslt transforms from CIM to ESPI
  - SEP to ESPI
    - ESPIToSEP.xslt transforms from ESPI to SEP2
    - SEPToESPI.xslt transforms from SEP2 to ESPI
  - COSEM/62056 to ESPI
    - ESPIToCOSEM.xslt transforms from ESPI to COSEM
    - COSEMToESPI.xslt transforms from COSEM to ESPI
- SmartMeteringProcessor – small VBApp to invoke transformations

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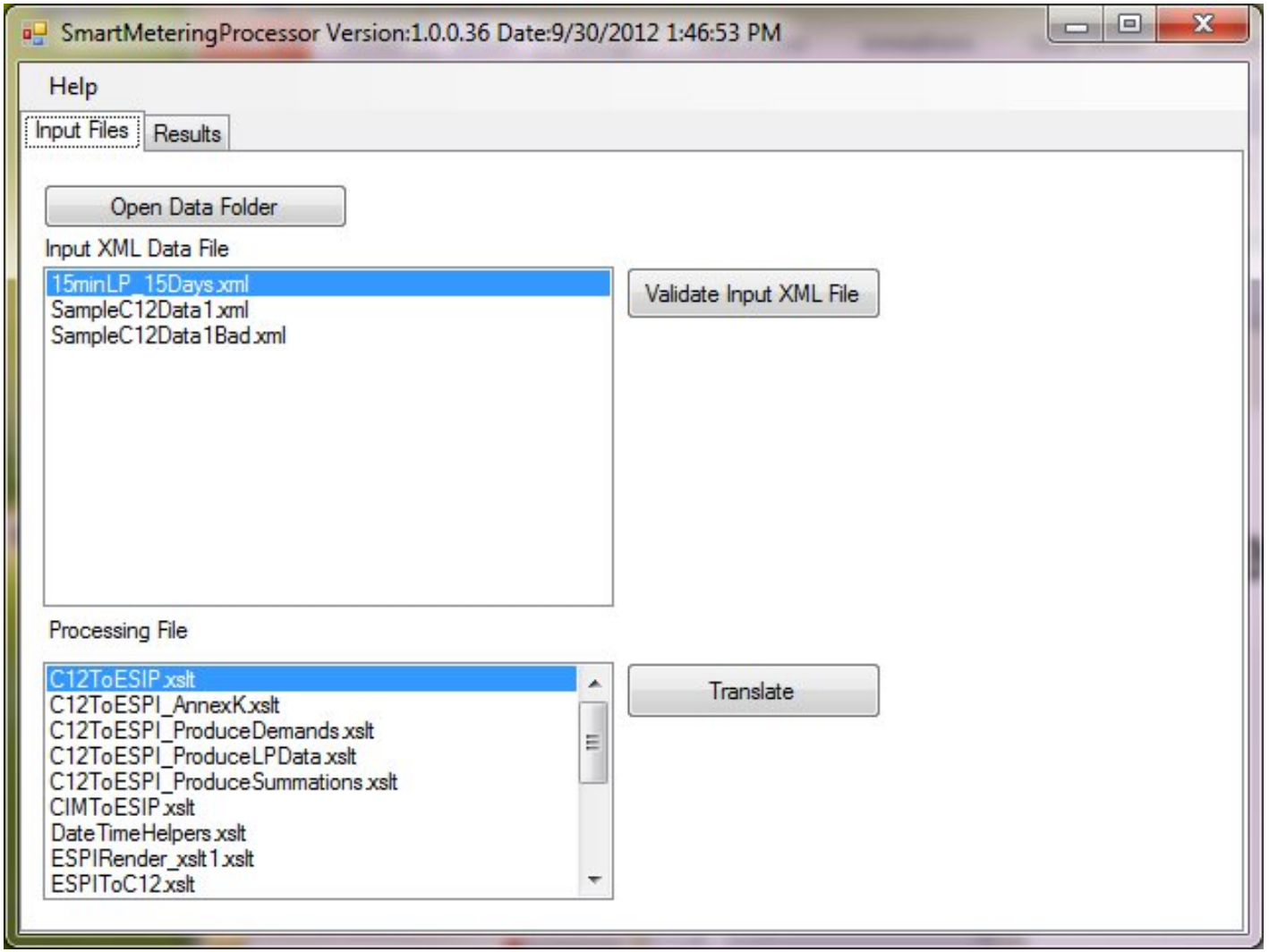
SmartMeteringProcessor Demo Application



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Questions