**1. RECOMMENDED ACTION: EFFECT OF EC VOTE TO ACCEPT RECOMMENDED ACTION:**

|  |  |  |  |
| --- | --- | --- | --- |
| X | Accept as requested | X | Change to Existing Practice |
|  | Accept as modified below |  | Status Quo |
|  | Decline |  |  |

**2. TYPE OF DEVELOPMENT/MAINTENANCE**

|  |  |
| --- | --- |
| **Per Request:** | **Per Recommendation:** |
| X | Initiation | X | Initiation |
|  | Modification |  | Modification |
|  | Interpretation |  | Interpretation |
|  | Withdrawal |  | Withdrawal |
|  |  |  |  |
| X | Principle | X | Principle |
| X | Definition | X | Definition |
| X | Business Practice Standard | X | Business Practice Standard |
|  | Document |  | Document |
|  | Data Element |  | Data Element |
|  | Code Value |  | Code Value |
|  | X12 Implementation Guide |  | X12 Implementation Guide |
|  | Business Process Documentation |  | Business Process Documentation |

**3. RECOMMENDATION**

**SUMMARY:**

The UCAIug OpenADE Task Force submitted a request for the initiation of NAESB Model Business Practices on July 29, 2010 (R10008) to standardize the interface which allows for the exchange of Energy Usage Information between designated parties. The UCAIug OpenADE Task Force provided the artifacts on which these Model Business Practices were based.

These Model Business Practices will build on the NAESB Energy Usage Information (EUI) Model and, subject to the Governing Documents and any requirements of the Applicable Regulatory Authority, will help enable Retail Customers to share Energy Usage Information with Third Parties who have acquired the right to act in this role. This Energy Services Provider Interface (ESPI) will provide a consistent method for Retail Customers to authorize a Third Party to gain access to Energy Usage Information. Doing so will help enable Retail Customers to choose Third Party products to assist them to better understand their energy usage and to make more economical decisions about their usage. ESPI will contribute to the development of an open and interoperable method for Third Party authorization and machine-to-machine exchange of Retail Customer Energy Usage Information.

**Recommended Standards:**

# REQ.21 ENERGY SERVICES PROVIDER INTERFACE

## EXECUTIVE SUMMARY

This document establishes the Model Business Practices for the Energy Services Provider Interface (ESPI). For Retail Customers to better realize the benefits of the Smart Grid, Retail Customer Energy Usage Information should be made available in a timely manner to the Retail Customer and to the Authorized Third Parties chosen by the Retail Customer.

ESPI encompasses a variety of interactions between Retail Customers, Distribution Companies, and Third Parties. In a business environment where best practices are voluntary, Model Business Practices should be applied within the context of regulatory requirements and agreements. These Model Business Practices define ESPI as a specific available interface, but any obligation to use it would be established by Governing Documents and Applicable Regulatory Authority rules and regulations, and not by these Model Business Practices.

These Model Business Practices are not intended to apply to the Data Custodian’s disclosure, collection, use and handling of Energy Usage Information in connection with the Data Custodian’s or its agents’ utility services, product or service fulfillment or billing and collection activities.

## INTRODUCTION

The North American Energy Standards Board (NAESB) is a voluntary non-profit organization comprised of members from all aspects of the natural gas and electric industries. Within NAESB, the Retail Electric Quadrant (REQ) and the Retail Gas Quadrant (RGQ) focus on issues impacting the retail sale of energy to Retail Customers. REQ / RGQ Model Business Practices are intended to provide guidance to Distribution Companies, Suppliers, and other Market Participants involved in providing energy service to Retail Customers. The focus of these Model Business Practices is the Energy Services Provider Interface.

The purpose of ESPI is to provide a consistent and broadly applicable interface to enable Retail Customer authorization of exchange of EUI from Data Custodians to Third Parties. It is anticipated that Third Parties will desire to offer Retail Customers raw and/or enriched analysis of EUI. This information is expected to reside with a Data Custodian. It is desired that the Third Party can provide this service only through the request or direction of the Retail Customer and in coordination with the Data Custodian. ESPI describes the mechanisms by which this orchestrated exchange may be enabled. Note that the decision to implement ESPI should be applied within the context of existing policies, practices and the requirements of the Applicable Regulatory Authority.

For the purpose of the descriptions of interactions in ESPI, actions of contracted agents of a Distribution Company are considered the actions of the Distribution Company. However, ESPI is not necessarily intended to apply specifically to interactions between contracted agents of Distribution Company and the corresponding Distribution Company.

These Model Business Practices are voluntary and do not address policy issues that are the subject of state legislation or regulatory decisions. These voluntary Model Business Practices have been adopted by NAESB with the realization that, as the industry evolves, additional and amended Model Business Practices may be necessary. Any industry participant seeking additional or amended Model Business Practices (including principles, definitions, data elements, process descriptions, and technical implementation instructions) should submit a request to the NAESB office, detailing the change, so that the appropriate process may take place to amend the Model Business Practice.

## BUSINESS PROCESSES AND PRACTICES

## Overview

## REQ.21.1 Principles

**REQ.21.1.1** The processes for ESPI should minimize the complexity associated with authorizing Third Parties to access Retail Customers’ Energy Usage Information.

**REQ.21.1.2** The processes associated with ESPI are subject to and should be consistent with any related requirements established by the Governing Documents and Applicable Regulatory Authority.

## REQ.21.2 Definitions

REQ.21.2.B Technical Definitions

**REQ.21.2.B.**1 **Third Party:** An Entity which provides some service to a Retail Customer based on Energy Usage Information for the Retail Customer to which it does not have direct access and over which it has no direct authority other than: the Data Custodian and its contracted agents, the Applicable Regulatory Authority, ISOs or other regional entities.

**REQ.21.2.B.2 Authorized Third Party:** A Third Party that is permitted to receive EUI in accordance with applicable law, regulation, the Governing Documents and any requirements of the Applicable Regulatory Authority and has met the requirements of the Applicable Regulatory Authority and Governing Documents to utilize the Energy Services Provider Interface.

**REQ.21.2.B.3 Energy Service Provider Interface:** A standardized machine-to machine interface that permits a Data Custodian to share, at the Retail Customer’s request or direction, a broad set of that Retail Customer’s Energy Usage Information held by that Data Custodian with Authorized Third Parties.

**REQ.21.2.B.5 Data Custodian:** A Data Custodian holds Retail Customer Energy Usage Information and will share this information with Authorized Third Parties only in accordance with the Governing Documents, any requirements of the Applicable Regulatory Authority and, subject to the Governing Documents and the requirements of the Applicable Regulatory Authority, at the request or direction of the Retail Customer. A Data Custodian typically has direct access to the Energy Usage Information (e.g., by directly acquiring electricity usage data from a meter). A Data Custodian may be a Distribution Company.

**REQ.21.2.B.6Energy Usage Information*:*** Any information and data from a smart meter identifiable to an individual Retail Customer concerning that Retail Customer’s energy usage, which may be made available pursuant to the Governing Documents consistent with any requirements of the Applicable Regulatory Authority.

REQ.21.2.C Acronyms

| **Abbreviation / Acronym**  | **Meaning** |
| --- | --- |
| ADE | Automatic Data Exchange |
| ESPI | Energy Services Provider Interface |
| EUI | Energy Usage Information |
| NISTIR | National Institute of Standards and Technology Interagency Report |
|  |  |

## REQ.21.3 Model Business Practices

REQ.21.3.1 General Practices for Energy Services Provider Interface (ESPI)

**REQ.21.3.1.1** To the extent required by the Applicable Regulatory Authority or as otherwise agreed by the Data Custodian consistent with any requirements of the Applicable Regulatory Authority, Authorized Third Parties and Data Custodians should exchange specified data related to the Retail Customer’s EUI at the Authorized Third Party’s or Retail Customer’s request or direction pursuant to the requirements as set forth in this NAESB REQ.21, subject to the Governing Documents. This NAESB REQ.21 does not compel the exchange of all data points, however data points exchanged claiming to comply with NAESB REQ.21 should comply with the format and structure defined herein.

**REQ.21.3.1.2** The ESPI relationship requires a set of agreements between a Retail Customer-Authorized Third Party, a Retail Customer-Data Custodian, and an Authorized Third Party-Data Custodian to help ensure that the appropriate information is provided as needed and other information access is restricted.

**REQ.21.3.1.3** A Third Party should not be able to access EUI from a Data Custodian, except as permitted or required by the Governing Documents, the Applicable Regulatory Authority or, subject to the Governing Documents and the requirements of the Applicable Regulatory Authority, as otherwise requested or directed by the Retail Customer.

**REQ.21.3.1.4** Subject to the Governing Documents and Applicable Regulatory Authority, ESPI should enable a Retail Customer to share EUI for such Retail Customer with Authorized Third Parties who have acquired the right to act in this role.

**REQ.21.3.1.6** All information exchanged by ESPI should be secure in accordance with the security recommendations referenced herein. Such recommendations are subject to the relevant Governing Documents and any requirements of the Applicable Regulatory Authority.

**REQ.21.3.1.7** A Retail Customer should have the ability to request or direct the Data Custodian to release EUI for such Retail Customer to an Authorized Third Party who has acquired the right to act in this role, subject to the Governing Documents and Applicable Regulatory Authority.

**REQ.21.3.1.8** Subject to the Governing Documents and any requirements of the Applicable Regulatory Authority, a Retail Customer should have the ability to request or direct that multiple Authorized Third Parties have limited, time-based access to specified EUI, with any default expiration for such access established by such Governing Documents or any requirements of the Applicable Regulatory Authority.

**REQ.21.3.1.9** Subject to the Governing Documents and any requirements of the Applicable Regulatory Authority, a Retail Customer should have the ability to designate a specific expiration date, extend any specific expiration date, or indicate an open-ended access timeframe other than the default access period.

**REQ.21.3.1.10** A system conforming to ESPI should have the capability to support the Retail Customers’ ability to select or revoke which Authorized Third Parties are permitted access to EUI for that Retail Customer.

**REQ.21.3.1.11** A system conforming to ESPI should have the capability to notify the relevant Authorized Third Parties, Data Custodian(s) and Retail Customer(s) when access has been granted, access has been changed, or access has been revoked or otherwise terminated for a UsagePoint.

**REQ.21.3.1.12** A system conforming to ESPI should be consistent with any guidelines around security and authorization for Third Party data access as determined to be applicable by the Governing Documents or any requirements of the Applicable Regulatory Authority.

**REQ.21.3.1.13** Absent compelling reasons, such as addressing security vulnerabilities,future versions of ESPI should be backwards compatible, including provisions for exchanging versioning information and negotiating interface capabilities.

**REQ.21.3.1.14** Any Third Party wishing to access EUI via ESPI must establish and maintain a trusted relationship with each Data Custodian who provides an ESPI compliant system. Subject to the Governing Documents and Applicable Regulatory Authority, both the Data Custodian and the Authorized Third Party should disallow EUI access requests from Entities who are not Authorized Third Parties.

**REQ.21.3.1.15** Subject to the Governing Documents and any requirements of the Applicable Regulatory Authority, confidentiality should be maintained during communications of any EUI.

**REQ.21.3.1.16** Subject to the Governing Documents and any requirements of the Applicable Regulatory Authority, a Third Party must be an Authorized Third Party to utilize the Data Custodian’s ESPI compliant system and must maintain its status as an Authorized Third Party. In the case of a transfer, merger, reorganization or sale of or involving an Authorized Third Party, the Data Custodian is not required to notify the Retail Customer of the transfer, merger, reorganization or sale and a new authorization, request or direction is not required for the Distribution Company to continue to disclose the EUI to the transferee, subsequent owner or successor of the Authorized Third Party.

**REQ.21.3.1.17** If it exists within a jurisdiction, a list of Third Parties who have been authorized by the Applicable Regulatory Authority or the Data Custodian to use ESPI in accordance with and subject to the Governing Documents and any requirements of the Applicable Regulatory Authority should be made available by the Applicable Regulatory Authority or the Data Custodian, as applicable.

**REQ.21.3.1.18** Subject to the Governing Documents and Applicable Regulatory Authority, EUI shouldbe made availableto Authorized Third Parties (as directed by the Retail Customer) in a reasonable and timely fashion. It is recognized that a Data Custodian providing EUI directly from the smart meter or before the data is validated for billing purposes can only provide the EUI as that data is registered by or recorded in the smart meter. Retail Customers and the Third Parties to which such data is disclosed should acknowledge that there are inherent limitations in EUI disclosed before the Data Custodian has verified and validated it for billing purposes. Further, these Model Business Practices do not establish or recommend any intervals at or for which EUI will or should be provided or available.

**REQ.21.3.1.19** When the required Authorized relationship described in this recommendation for an Entity is revoked or otherwise terminated, access to EUI by such Entity via ESPI should not be granted.

**REQ.21.3.1.20** Participants in ESPI and their relationships should be identified by globally unique identifiers.

**REQ.21.3.1.21** Upon dissolution of any of the required trusted relationships for an Entity, any ESPI relationships should be terminated and parties notified via a defined method.

**REQ.21.3.1.22** If and when the relationships upon which the exchange of EUI or criteria change resulting in a change in or loss of the ability to exchange the EUI data, pursuant to these Model Business Practices and/or as agreed to among any two or more of the parties, all affected parties should be notified via a defined method.

**REQ.21.3.1.23** Interoperable and widely supported technologies should be used to help ensure adoption regardless of which development and deployment platforms are used.

**REQ.21.3.1.24** The technologies chosen should be well specified, with active communities, tools, and/or frameworks available.

**REQ.21.3.1.25** To the extent required by the Applicable Regulatory Authority, Authorized Third Parties and Data Custodians should follow privacy guidance recommended in NAESB REQ.22, "Third Party Access to Smart Meter-based Information", subject to Governing Documents and any requirements of the Applicable Regulatory Authority.

**REQ.21.3.1.26** This Model Business Practice only applies to applications that assert conformance to it. It is not intended to be applicable for all customer information transfers to Authorized Third Parties but rather, only those transfers between applications conforming to ESPI; provided not all data elements must be used in order to be ESPI conformant.

**REQ.21.3.1.27** Future versions of ESPI and extensions employed by Authorized Third Parties and Data Custodians to exchange a Retail Customer’s EUI at the Retail Customer’s request where not specified by ESPI, should conform to NAESB REQ.18, as EUI may be updated from time to time.

## REQ.21.4 Models

## REQ.21.4.1 Profile of REQ.18 Energy Usage Information Model

The following model represents the implementable profile for ESPI of NAESB PAP10 EUI model. Note that associations stereotyped <<link>> are marked as Non-navigable, since they are actually represented using atom:link. Additionally, the “[0..1]” indications after data types in the textual descriptions following the diagrams indicates multiplicity. [0..1] indicates optional, and [1..1] (which is assumed if not specified) indicates expected. However, these don’t mean the field is always expected or needed. When an element is expected it is only expected if the containing class is present.

These diagrams and model element descriptions are the basis for the formal definition of the ESPI XML types used in the message exchanges, and the section below is generated from the UML model, which can be obtained from the NAESB office upon request. The following diagrams provide an overview of the structure of the information objects, and following the diagrams is a listing of every class and attribute along with their definitions. These definitions and descriptions are also included in the XML Schema (XSD), which is also generated from the model and available from the NAESB office. For completeness of this document, the text of the schema is also included in Section “REQ.21.6.5 XML Schema”.

**Figure** :

**Figure** :

**Figure** :

**Figure** :

**Figure** :

**Figure** :

**Figure** :

**BatchItemInfo**

| **Name** | **Type** | **Description** |
| --- | --- | --- |
| **operation** | *UInt8 [0..1]* | Specifies the operation requested of this item. 0=Create1=Read2=Update3=Delete |
| **name** | *HexBinary16 [0..1]* |  |
| **statusCode** | *UInt16 [0..1]* | Indicates the status code of the associated transaction. 200 - Ok201 - Created204 - No Content301 - Moved Permanently302 - Redirect304 - Not Modified400 - Bad Request401 - Unauthorized403 - Forbidden404 - Not Found405 - Method Not Allowed410 - Gone500 - Internal Server Error |
| **statusReason** | *String256 [0..1]* |  |

**Object**

|  |  |  |
| --- | --- | --- |
| **Name** | **Type** | **Description** |
| **extension** | *anyType [0..\*]* |  |

**ServiceStatus**

|  |  |  |
| --- | --- | --- |
| **Name** | **Type** | **Description** |
| **currentStatus** | *UInt8*  | The current status of the service. 0 = Unavailable1 = Normal, operational |

**Subscription**

**ApplicationInformation**

| **Name** | **Type** | **Description** |
| --- | --- | --- |
| **thirdPartyName** | *String64 [0..1]* |  |
| **thirdPartyEmail** | *String64 [0..1]* |  |
| **thirdPartyPhone** | *String32 [0..1]* |  |
| **thirdPartyApplicationName** | *String32 [0..1]* |  |
| **thirdPartyApplicationDescription** | *String256 [0..1]* |  |
| **thirdPartyApplicationWebsite** | *anyURI [0..1]* |  |
| **thirdPartyApplicationLogo** | *anyURI [0..1]* |  |
| **thirdPartyApplicationType** | *UInt8 [0..1]* | A code indicating the type of the application. Defined types are:1 - Web Application2 - Desktop Application3 - Mobile Application |
| **thirdPartyApplicationUse** | *UInt8 [0..1]* | A code indicating the expected use of the application. Defined uses are:1 - Energy management2 - Comparisons3 - Government4 - Academic5 - Law enforcement |
| **thirdPartyApplicationStatus** | *UInt8 [0..1]* | A code indicating the current status of the application. Defined statuses are:1 - Development2 - Review / Test3 - Production (Live)4 - Retired (Remove) |
| **thirdPartyDefaultOAuthCallback** | *anyURI [0..1]* |  |
| **thirdPartyDefaultBatchResource** | *anyURI [0..1]* |  |
| **thirdPartyDefaultNotifyResource** | *anyURI [0..1]* |  |
| **dataCustodianThirdPartyId** | *String32 [0..1]* |  |
| **dataCustodianThirdPartySecret** | *String32 [0..1]* |  |
| **dataCustodianDefaultSubscriptionResource** | *anyURI [0..1]* |  |
| **dataCustodianDefaultBatchResource** | *anyURI [0..1]* |  |
| **dataCustodianApplicationStatus** | *UInt8 [0..1]* | A code indicating the current status of the application. This value is provided by dataCustodian, cannot be modified.Defined statuses are:1 - Review2 - Production (Live)3 - On hold 4 - Revoked |

**Authorization**

| **Name** | **Type** | **Description** |
| --- | --- | --- |
| **authorizationServer** | *anyURI [0..1]* |  |
| **authorizedPeriod** | *DateTimeInterval [0..1]* |  |
| **accessToken** | *String32 [0..1]* |  |
| **publishedPeriod** | *DateTimeInterval [0..1]* |  |
| **resource** | *anyURI [0..1]* |  |
| **status** | *UInt8 [0..1]* | The status of this authorization. 0 - Revoked1 - Active |
| **thirdParty** | *String32 [0..1]* |  |

**IdentifiedObject**

**ElectricPowerQualitySummary**

A summary of power quality events. This information represents a summary of power quality information typically required by customer facility energy management systems. It is not intended to satisfy the detailed requirements of power quality monitoring. All values are as defined by measurementProtocol during the period. The standards typically also give ranges of allowed values; the information attributes are the raw measurements, not the "yes/no" determination by the various standards. See referenced standards for definition, measurement protocol and period.

| **Name** | **Type** | **Description** |
| --- | --- | --- |
| **flickerPlt** | *Int48 [0..1]* | A measurement of long term Rapid Voltage Change in hundredths of a Volt.flickerPlt is derived from 2 hours of Pst values (12 values combined in cubic relationship).  |
| **flickerPst** | *Int48 [0..1]* | flickerPst is a value measured over 10 minutes that characterizes the likelihood that the voltage fluctuations would result in perceptible light flicker. A value of 1.0 is designed to represent the level that 50% of people would perceive flicker in a 60 watt incandescent bulb. The value reported is represented as an integer in hundredths.  |
| **harmonicVoltage** | *Int48 [0..1]* |  |
| **longInterruptions** | *Int48 [0..1]* |  |
| **mainsVoltage** | *Int48 [0..1]* |  |
| **measurementProtocol** | *UInt8 [0..1]* | A reference to the source standard used as the measurement protocol definition. Examples are:0 = "IEEE1519-2009"1 = "EN50160" |
| **powerFrequency** | *Int48 [0..1]* |  |
| **rapidVoltageChanges** | *Int48 [0..1]* |  |
| **shortInterruptions** | *Int48 [0..1]* |  |
| **summaryInterval** | *DateTimeInterval*  |  |
| **supplyVoltageDips** | *Int48 [0..1]* |  |
| **supplyVoltageImbalance** | *Int48 [0..1]* |  |
| **supplyVoltageVariations** | *Int48 [0..1]* |  |
| **tempOvervoltage** | *Int48 [0..1]* |  |

**ElectricPowerUsageSummary**

| **Name** | **Type** | **Description** |
| --- | --- | --- |
| **billingPeriod** | *DateTimeInterval [0..1]* | The billing period to which the included measurements apply |
| **billLastPeriod** | *Int48 [0..1]* |  |
| **billToDate** | *Int48 [0..1]* |  |
| **costAdditionalLastPeriod** | *Int48 [0..1]* | Additional charges from the last billing period, in hundred-thousandths of the currency specified in the ReadingType for this reading. (e.g., 840 = USD, US dollar). |
| **currency** | *CurrencyCode [0..1]* |  |
| **currentBillingPeriodOverAllConsumption** | *SummaryMeasurement [0..1]* | The total consumption for the billing period |
| **currentDayLastYearNetConsumption** | *SummaryMeasurement [0..1]* |  |
| **currentDayNetConsumption** | *SummaryMeasurement [0..1]* |  |
| **currentDayOverallConsumption** | *SummaryMeasurement [0..1]* | Overall energy consumption for the current day |
| **peakDemand** | *SummaryMeasurement [0..1]* | Peak demand recorded for the current period |
| **previousDayLastYearOverallConsumption** | *SummaryMeasurement [0..1]* | The amount of energy consumed on the previous day one year ago interpreted as same day of week same week of year (see ISO 8601). |
| **previousDayNetConsumption** | *SummaryMeasurement [0..1]* | Net consumption for the previous day |
| **previousDayOverallConsumption** | *SummaryMeasurement [0..1]* | The total consumption for the previous day |
| **qualityOfReading** | *QualityOfReading [0..1]* |  |
| **ratchetDemand** | *SummaryMeasurement [0..1]* | The current ratchet demand value for the ratchet demand period |
| **ratchetDemandPeriod** | *DateTimeInterval [0..1]* | The period over which the ratchet demand applies |
| **statusTimeStamp** | *TimeType*  |  |

**ServiceCategory**

|  |  |  |
| --- | --- | --- |
| **Name** | **Type** | **Description** |
| **kind** | *ServiceKind*  | Service classificationExamples are:0 - electricity1 - gasThe list of specific valid values per the standard are itemized in ServiceKind. |

**UsagePoint**

|  |  |  |
| --- | --- | --- |
| **Name** | **Type** | **Description** |
| **status** | *UInt8 [0..1]* | Specifies the current status of this usage point.Valid values include:0 = off1 = on |
| **roleFlags** | *HexBinary16 [0..1]* | Specifies the roles that this usage point has been assigned.Bit 1 - isMirrorBit 2 - isPremisesAggregationPointBit 3 - isPEVBit 4 - isDERBit 5 - isRevenueQualityBit 6 - isDCBit 7-16 - Reserved |

**HexBinary128**

**HexBinary16**

**Int48**

**String256**  «XSDsimpleType»

Character string of max length 256

**String32**

**String64**  «XSDsimpleType»

Character string of max length 64

**UInt16**

**UInt32**

**UInt48**

**UInt8**

**AccumulationBehaviourType**

Valid values include:

0 = Not Applicable

1 = BulkQuantity

3 = Cumulative

4 = DeltaData

6 = Indicating

9 = Summation

12 = Instantaneous

**CommodityType**

Valid values include:

0 = Not Applicable

1 = Electricity metered value

4 = Air

7 = NaturalGas

8 = Propane

9 = PotableWater

10 = Steam

11 = WasteWater

12 = HeatingFluid

13 = CoolingFluid

**ConsumptionTierType**

Valid values include:

0 = Not Applicable

1 = Block Tier 1

2 = Block Tier 2

3 = Block Tier 3

4 = Block Tier 4

5 = Block Tier 5

6 = Block Tier 6

7 = Block Tier 7

8 = Block Tier 8

9 = Block Tier 9

10 = Block Tier 10

11 = Block Tier 11

12 = Block Tier 12

13 = Block Tier 13

14 = Block Tier 14

15 = Block Tier 15

16 = Block Tier 16

**CurrencyCode**

Follows codes defined in ISO 4217. Full list at tiny.cc/4217.

0 - Not Applicable

36 - Australian Dollar

124 - Canadian Dollar

840 - US Dollar

978 - Euro

**DataQualifierType**

Valid values include:

0 = Not Applicable

2 = Average

8 = Maximum

9 = Minimum

12 = Normal

**DateTimeInterval**

|  |  |  |
| --- | --- | --- |
| **Name** | **Type** | **Description** |
| **start** | *TimeType*  |  |
| **duration** | *UInt32*  |  |

**FlowDirectionType**

Valid values include:

0 = Not Applicable

1 = Forward

19 = Reverse

**KindType**

Valid values include:

0 = Not Applicable

3 = Currency

4 = Current

5 = CurrentAngle

7 = Date

8 = Demand

12 = Energy

15 = Frequency

37 = Power

38 = PowerFactor

40 = QuantityPower

54 = Voltage

55 = VoltageAngle

64 = DistortionPowerFactor

155 = VolumetricFlow

**PhaseCode**

Valid values include:

0 = Not Applicable

129 = Phase AN

128 = Phase A

132 = Phase AB

64 = Phase BN

64 = Phase B

32 = Phase CN

32 = Phase C

224 = Phase ABC

66 = Phase BC

40 = Phase CA

512 = Phase S1

256 = Phase S2

768 = Phase S1S2

513 = Phase S1N

257 = Phase S2N

769 = Phase S1S2N

**PowerOfTenMultiplierType**

Valid values include:

0 = None

1 = deca=x10

2 = hecto=x100

-3 = mili=x10-3

3 = kilo=x1000

6 = Mega=x106

-6 = micro=x10-3

9 = Giga=x109

**QualityOfReading**

List of codes indicating the quality of the reading, using specification:

0 - valid: data that has gone through all required validation checks and either passed them all or has been verified

7 - manually edited: Replaced or approved by a human

8 - estimated using reference day: data value was replaced by a machine computed value based on analysis of historical data using the same type of measurement.

9 - estimated using linear interpolation: data value was computed using linear interpolation based on the readings before and after it

10 - questionable: data that has failed one or more checks

11 - derived: data that has been calculated (using logic or mathematical operations), not necessarily measured directly

12 - projected (forecast): data that has been calculated as a projection or forecast of future readings

13 - mixed: indicates that the quality of this reading has mixed characteristics

14 - raw: data that has not gone through the validation, editing and estimation process

15 - normalized for weather: the values have been adjusted to account for weather, in order to compare usage in different climates

16 - other: specifies that a characteristic applies other than those defined

17 - validated: data that has been validated and possibly edited and/or estimated in accordance with approved procedures

18 - verified: data that failed at least one of the required validation checks but was determined to represent actual usage

**ServiceKind**

Valid values include:

0 - electricity

1 - gas

2 - water

4 - pressure

5 - heat

6 - cold

7 - communication

8 - time

**SummaryMeasurement**

|  |  |  |
| --- | --- | --- |
| **Name** | **Type** | **Description** |
| **powerOfTenMultiplier** | *PowerOfTenMultiplierType [0..1]* |  |
| **timeStamp** | *TimeType [0..1]* |  |
| **uom** | *UomType [0..1]* |  |
| **value** | *UInt48 [0..1]* |  |

**TOUType**

Valid values include:

0 = NotApplicable

1 = TOU A

2 = TOU B

3 = TOU C

4 = TOU D

5 = TOU E

6 = TOU F

7 = TOU G

8 = TOU H

9 = TOU I

10 = TOU J

11 = TOU K

12 = TOU L

13 = TOU M

14 = TOU N

15 = TOU O

**TimeAttributeType**

Valid values include:

0 = Not Applicable

1 = 10-minute

2 = 15-minute

4 = 24-hour

5 = 30-minute

7 = 60-minute

11 = Daily

13 = Monthly

15 = Present

16 = Previous

24 = Weekly

32 = ForTheSpecifiedPeriod

79 = Daily30minuteFixedBlock

**TimeType**

**UomType**

Valid values include:

0 = Not Applicable

5 = A (Current)

29 = Voltage

31 = J (Energy joule)

33 = Hz (Frequency)

38 = Real power (Watts)

42 = m3 (Cubic Meter)

61 = VA (Apparent power)

63 = VAr (Reactive power)

65 = Cos? (Power factor)

67 = V² (Volts squared)

69 = A² (Amp squared)

71 = VAh (Apparent energy)

72 = Real energy (Watt-hours)

73 = VArh (Reactive energy)

106 = Ah (Ampere-hours / Available Charge)

119 = ft3 (Cubic Feet)

122 = ft3/h (Cubic Feet per Hour)

125 = m3/h (Cubic Meter per Hour)

128 = US gl (US Gallons)

129 = US gl/h (US Gallons per Hour)

130 = IMP gl (Imperial Gallons)

131 = IMP gl/h (Imperial Gallons per Hour)

132 = BTU

133 = BTU/h

134 = Liter

137 = L/h (Liters per Hour)

140 = PA(gauge)

155 = PA(absolute)

169 = Therm

**IntervalBlock**

|  |  |  |
| --- | --- | --- |
| **Name** | **Type** | **Description** |
| **interval** | *DateTimeInterval [0..1]* |  |

**IntervalReading**

|  |  |  |
| --- | --- | --- |
| **Name** | **Type** | **Description** |
| **cost** | *UInt48 [0..1]* | Specifies a cost associated with this reading, in hundred-thousandths of the currency specified in the ReadingType for this reading. (e.g., 840 = USD, US dollar) |
| **timePeriod** | *DateTimeInterval [0..1]* | The date time and duration of a reading. If not specified, readings for each "intervalLength" in ReadingType are present. |
| **value** | *UInt48 [0..1]* |  |

**MeterReading**

**ReadingQuality**

|  |  |  |
| --- | --- | --- |
| **Name** | **Type** | **Description** |
| **quality** | *QualityOfReading*  | Quality, to be specified if different than ReadingType.defaultQuality.The specific format is specified per the standard is defined in QualityOfReading. |

**ReadingType**

| **Name** | **Type** | **Description** |
| --- | --- | --- |
| **accumulationBehaviour** | *AccumulationBehaviourType [0..1]* | Code indicating how value is accumulated over time for Readings of ReadingType. The list of valid values per the standard are defined in AccumulationBehaviorType.Examples are:0 = Not Applicable1 = BulkQuantity3 = Cumulative |
| **commodity** | *CommodityType [0..1]* | Code for commodity classification of Readings of ReadingType. The valid values per the standard are defined in CommodityType.Examples are:0 = Not Applicable1 = Electricity secondary metered value (a premise meter is typically a secondary meter)2 = Electricity primary metered value4 = Air7 = NaturalGas |
| **consumptionTier** | *ConsumptionTierType [0..1]* | Code for consumption tier associated with a Reading of ReadingType. The valid values are define in ConsumptionTierType.Examples are:0 = Not Applicable1 = Block Tier 12 = Block Tier 2 |
| **currency** | *CurrencyCode [0..1]* | Code for the currency for costs associated with this ReadingType. The valid values per the standard are defined in CurrencyCode.Examples are:0 - Not Applicable36 - Australian Dollar124 - Canadian Dollar840 - US Dollar978 - Euro |
| **dataQualifier** | *DataQualifierType [0..1]* | Code describing a salient attribute of Readings of ReadingType. Valid values per the standard are defined in DataQualifierType.Examples are:0 = Not Applicable2 = Average |
| **defaultQuality** | *QualityOfReading [0..1]* | Default value to be used if no value of ReadingQuality.quality is provided. Specific format and valid values per the standard are specified in QualityOfReading. |
| **flowDirection** | *FlowDirectionType [0..1]* | Direction associated with current related Readings. valid values per the standard are defined in FlowDirectionType.Examples are:0 = Not Applicable1 = Forward19 = Reverse |
| **kind** | *KindType [0..1]* | Code for general classification of a Reading of ReadingType. Valid values per the standard are defined in KindType.Examples are:0 = Not Applicable3 = Currency8 = Demand |
| **intervalLength** | *UInt32 [0..1]* |  |
| **phase** | *PhaseCode [0..1]* | Code for phase information associated with Readings of ReadingType. Valid values per the standard are defined in PhaseCode.Examples are:0 = Not Applicable129 = Phase AN128 = Phase A132 = Phase AB |
| **powerOfTenMultiplier** | *PowerOfTenMultiplierType [0..1]* | Code for the power of ten multiplier which, when used in combination with the uom, specifies the actual unit of measure for Readings of ReadingType. Valid values per the standard are defined in PowerOfTenMultiplierType.Examples are:0 = None1 = deca=x102 = hecto=x100-3 = mili=x10-3 |
| **timeAttribute** | *TimeAttributeType [0..1]* | Code used to specify a particular type of time interval method for Readings of ReadingType. Valid values per the standard are defined in TimeAttributeType.Examplesare:0 = Not Applicable1 = 10-minute2 = 15-minute |
| **tou** | *TOUType [0..1]* | Code for the TOU type of Readings of ReadingType. valid values per the standard are defined in TOUType.Examples are:0 = NotApplicable1 = TOU A2 = TOU B |
| **uom** | *UomType [0..1]* | Code for the base unit of measure for Readings of ReadingType. Used in combination with the powerOfTenMultiplier to specify the actual unit of measure. Valid values per the standard are defined in UomType.Examples are:0 = Not Applicable5 = A (Current)29 = Voltage |

REQ.21.4.2 Additional Models in Support of Services

**REQ.21.4.2.2 Authorization**

An authorization is a Customer grant of Authorized Third Party access to specific resources. The attributes of this object are listed below. The structure and format of these fields are defined by OAuth.

* Information consumer (Third Party) identifier (Consumer Key)
* Resource subject (Scope)
Specifies the resource to which access from the information provider is granted by the customer to the information consumer.
* Authentication Token (Access Token)
One or more token / secret pairs proving the identity of the requester to be the Customer associated with the resource. Different methods may be defined against which token / secret pairs are created and verified.
* Authorized period
* Status (e.g., requested, valid, invalid, error, unavailable)

## REQ.21.5 Related Model Business Practices

REQ.21.5.1 Conformance to REQ.18 Energy Usage Information Model

ESPI services conform to REQ.18 Energy Usage Information Model (PAP10), due to the ability to directly transform between the models without loss of precision and without external inputs. The ESPI model uses the same concept names and structures as NAESB PAP10 EUI.

REQ.21.6 Technical Implementation

REQ.21.6.1 Protocol Specifications

ESPI endpoints implement the following protocol aspects.

REQ.21.6.1.1 Security

Providers of ESPI services, including both Data Custodian and Third Party, protect their systems, networks, and interface endpoints against threats, as recommended in NISTIR and Security Profile For Third Party Data Access.

REQ.21.6.1.1.1 Encryption

Establishment of mutually-authenticated encrypted channels is performed using HTTP/S, as documented in IETF RFC 2818, over which EUI may be securely transferred between Data Custodian and Authorized Third Party.

REQ.21.6.1.1.2 User Authorization

OAuth, as documented in IETF RFC 5849, is used for authorization grant and access by Retail Customers and Authorized Third Parties to shared Data Custodian resources. This protocol results in access tokens that are used to subscribe to specific user EUI or to request it immediately, if supported.

REQ.21.6.2 Communication Specifications

This section defines the expected behavior of implementations using the ESPI RESTful style. This style uses HTTP methods as verbs and URIs as nouns. Use of HTTPS compression options is recommended.

During initial configuration, the Data Custodian issues the Authorized Third Party an ID (key) and secret required by RFC 5849. If supported, ESPI service providers may make available an "ApplicationInformation" feed and allow applications to be created, updated, and deleted using AtomPub methods. They may require trusted credentials for access.

ESPI endpoints expose resources as described by Atom, IETF RFC 4287.

* Representations are identified as media type “application/atom+xml”
* ESPI namespace and types (“http://naesb.org/espi”) are used for objects in <content> element
* espi:mRID is implemented by atom:id
	+ UUIDs are used, as specified in IETF RFC 4122
* espi:description is implemented by atom:title
* atom:published and atom:updated are used
* Associated objects use atom:link (rel=“related”)

The following addressable objects (specializations of IdentifiedObject) are defined by the ESPI schema, and can be made available using AtomPub feeds.

* UsagePoint
* ReadingType
* IntervalBlock
* MeterReading
* Subscription
* ElectricPowerUsageSummary
* ElectricPowerQualitySummary
* Authorization
* ApplicationInformation

Links shall use the following tags and values to convey link types.

|  |  |  |
| --- | --- | --- |
| **Association** | **rel** | **type** |
| UsagePoint 🡪 MeterReading | related | application/atom+xml |
| UsagePoint 🡪 ElectricPowerQualitySummary | related | application/atom+xml |
| UsagePoint 🡪 ElectricPowerUsageSummary | related | application/atom+xml |
| MeterReading 🡪 IntervalBlock | related | application/atom+xml |
| MeterReading 🡪 ReadingType | related | application/atom+xml |

ESPI endpoints use HTTP and/or HTTPS, IETF RFC 2616 and 2818, to expose ESPI resources using the method conventions in Atom Publishing Protocol, IETF RFC 5023.

URIs are kept as short as possible, and do not exceed 255 bytes.

Relative URIs may be used when resources are on the same host. Additional definition regarding URIs and HTTP/S follow the IETF specifications.

A URI example is provided below.

* https://espi.datacustodian.com/{third\_party\_id}/Batch

Since all URIs are opaque references, there is no mandated form. However, it may be useful to organize them hierarchically, in order to define URIs for the appropriate containers (feeds), and to manage permissions. URIs should be as persistent as possible, but they may change. atom:id, however, does not change, even if the resource is moved or replicated. Clients accessing out-of-date URIs may be redirected, but if they are not, may need to request the current preferred resource location.

The following query parameters are used to filter the resources returned by a feed. These use typical “?name=value[&…]” syntax.

* published-max, published-min
* updated-max, updated-min
* max-results
* start-index

Date and time values for the above parameters use RFC 3339 format.

REQ.21.6.3 Examples

The following examples show the creation, retrieval, update, and deletion of an object within a feed.

Upon authorization of a resource, the OAuth “scope” attribute contains the URI of the resource. With it, the client can request a subscription to it as in the example below. Note that this URI is a reference to the target resource of the subscription (i.e., the resource being subscribed to). The Subscription object identifier is not specified, since it is assigned by the Data Custodian. Note also that signed OAuth parameters are included in the header to prove authorization.

POST /Subscription HTTP/1.1

Host: espi.datacustodian.com

Content-Type: application/atom+xml

Content-Length: 320

<?xml version="1.0" encoding="UTF-8"?>

<entry xmlns="http://www.w3.org/2005/Atom"

 xsi:schemaLocation="http://naesb.org/espi espi.xsd"

 xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance">

 <link rel="related" href="/User/9b6c7063"/>

 <content>

 <Subscription xmlns="http://naesb.org/espi"/>

 </content>

</entry>

The server may refuse this request, if valid authorization was not provided, in which case result “401 Not Authorized” or similar, is returned.

If the request is accepted, the server responds with the full resource representation, as in the response example below.

HTTP/1.1 200 OK

Content-Type: application/atom+xml

Content-Length: 508

<?xml version="1.0" encoding="UTF-8"?>

<entry xmlns="http://www.w3.org/2005/Atom"

 xsi:schemaLocation="http://naesb.org/espi espi.xsd"

 xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance">

 <id>urn:uuid:e69c4c25-2885-4de0-a3d8-d29b5f823b79</id>

 <link rel="self" href="/Subscription/7f23"/>

 <link rel="related" href="/User/9b6c7063"/>

 <content>

 <Subscription xmlns="http://naesb.org/espi"/>

 </content>

 <published>2012-01-23T05:11:38Z</published>

 <updated>2012-01-23T05:11:38Z</updated>

</entry>

Retrieval of the object is performed using GET. The example below shows the request – the response is the same as the response to POST above.

GET /Subscription/7f23 HTTP/1.1

Host: espi.datacustodian.com

Deletion uses DELETE, as in the example below. Again, authorization parameters are included.

DELETE /Subscription/7f23 HTTP/1.1

Host: espi.datacustodian.com

Response is simply the status of the request, as below.

HTTP/1.1 200 OK

Batch processing involves inclusion of the “Batch” attributes with regular objects in a list, as in the example below. This example shows delivery of new objects.

<?xml version="1.0" encoding="UTF-8"?>

<feed

 xmlns=”http://www.w3.org/2005/Atom”

 xsi:schemaLocation=”http://naesb.org/espi espi.xsd”

 xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance">

 <id>urn:uuid:046638c0-8701-11e0-9d78-0800200c9a66</id>

 <title>ThirdPartyX Batch Feed</title>

 <updated>2012-05-21T18:01:00Z</updated>

 <link rel="self" href="/83e269c1"/>

 <entry>

 <id>urn:uuid:c990b150-8320-11e0-9d78-0800200c9a66</id>

 <link rel="self" href="/ThirdParty/83e269c1/Batch"/>

 <entry>

 <id>urn:uuid:c990b150-8320-11e0-9d78-0800200c9a66</id>

 <link rel="self" href="/User/9b6c7063/UsagePoint/01"/>

 <link rel="up" href="/User/9b6c7063/UsagePoint"/>

 <link rel="related" href="/User/9b6c7063/UsagePoint/01/MeterReading"/>

 <title>Elm St.</title>

 <content>

 <UsagePoint xmlns="http://naesb.org/espi">

 <ServiceCategory>

 <kind>0</kind>

 </ServiceCategory>

 </UsagePoint>

 </content>

 <published>2012-05-21T18:01:00Z</published>

 <updated>2012-05-21T18:01:00Z</updated>

 </entry>

 <entry>

 <id>urn:uuid:f2034e91-8320-11e0-9d78-0800200c9a66</id>

 <link rel="self" href="/User/9b6c7063/UsagePoint/01/MeterReading/01"/>

 <link rel="up" href="/User/9b6c7063/UsagePoint/01/MeterReading"/>

 <link rel="related" href="/User/9b6c7063/UsagePoint/01/MeterReading/01/IntervalBlock"/>

 <link rel="related" href="/ReadingType/07"/>

 <title>Hourly Energy Consumption</title>

 <content>

 <MeterReading xmlns="http://naesb.org/espi"/>

 </content>

 <published>2012-05-21T18:01:00Z</published>

 <updated>2012-05-21T18:01:00Z</updated>

 </entry>

 <entry>

 <id>urn:uuid:f2034e93-8320-11e0-9d78-0800200c9a66</id>

 <link rel="self" href="/User/9b6c7063/UsagePoint/01/MeterReading/01/IntervalBlock/0173"/>

 <link rel="up" href="/User/9b6c7063/UsagePoint/01/MeterReading/01/IntervalBlock"/>

 <title/>

 <content>

 <IntervalBlock xmlns="http://naesb.org/espi">

 <interval>

 <duration>86400</duration>

 <start>1325397600</start>

 </interval>

 <IntervalReading>

 <cost>3000000</cost>

 <timePeriod>

 <duration>3600</duration>

 <start>1325397600</start>

 </timePeriod>

 <value>383</value>

 </IntervalReading>

 <IntervalReading>

 <cost>3000000</cost>

 <timePeriod>

 <duration>3600</duration>

 <start>1325401200</start>

 </timePeriod>

 <value>427</value>

 </IntervalReading>

 </IntervalBlock>

 </content>

 <published>2012-05-21T18:01:00Z</published>

 <updated>2012-05-21T18:01:00Z</updated>

 </entry>

 <entry>

 <id>urn:uuid:2557def0-8321-11e0-9d78-0800200c9a66</id>

 <link rel="self" href="/ReadingType/07"/>

 <link rel="up" href="/ReadingType"/>

 <title>Energy Delivered (kWh)</title>

 <content>

 <ReadingType xmlns="http://naesb.org/espi">

 <accumulationBehaviour>4</accumulationBehaviour><!--DeltaData-->

 <commodity>1</commodity><!--Electricity-->

 <consumptionTier>0</consumptionTier><!--N/A-->

 <currency>0</currency><!--N/A-->

 <dataQualifier>12</dataQualifier><!--Normal-->

 <flowDirection>1</flowDirection><!--Forward-->

 <kind>12</kind><!--Energy-->

 <phase>0</phase><!--N/A-->

 <powerOfTenMultiplier>3</powerOfTenMultiplier><!--kilo-->

 <timeAttribute>0</timeAttribute><!--N/A-->

 <tou>0</tou><!--N/A-->

 <uom>72</uom><!--Watt hours-->

 </ReadingType>

 </content>

 <published>2012-05-21T18:01:00Z</published>

 <updated>2012-05-21T18:01:00Z</updated>

 </entry>

</feed>

REQ.21.6.4 Conformance

Conformant Data Custodian implementations include the following:

* Subscriptions (Optional)
	+ Accept POST to Subscription, Batch resource
	+ Allow subscriptions to authorized resources
* Delivery (Optional)
	+ Accept GET to Batch resource, specific to each Authorized Third Party.
	+ Support POST to Authorized Third Party Notification resource
	+ Support POST to Authorized Third Party Batch resource
	+ Support GET of resources directly

Conformant Third Party implementations include the following:

* Subscriptions (Optional)
	+ Submit POST requests to Subscription, Batch resource
	+ Sign requests with access tokens
* Delivery (Optional)
	+ Submit GET request to Batch resource
	+ Accept POST to Authorized Third Party Notification resource
	+ Accept POST to Authorized Third Party Batch resource
	+ GET resources directly

All conformant implementations include the following:

* Security
	+ Server certificates and mutually authenticated HTTPS
	+ Send and/or accept requests to OAuth endpoints
* Content
	+ The information elements or subset thereof to be transferred are to be negotiated between parties.
	+ Information elements with the meaning defined herein to be transferred use the format and structure defined herein.
	+ Additional information elements not defined herein are placed in extension elements as defined by the ESPI schema herein, use a namespace different from the ESPI schema herein, and are optional.
	+ It is recommended that any additional information elements included in an implementation be submitted for consideration in future versions of ESPI.

Retail Customers, Data Custodians, and Authorized Third Parties, subject to requirements of the Applicable Regulatory Authority and the Governing Documents, may also use the methods described in this Model Business Practice to exchange other non Energy Usage Information Model Information. Examples may include other NIST Priority Action Plan data models, Smart Energy Profile 2.0 messages, etc. provided both the Data Custodian and Authorized Third Party have implemented and configured their systems to process the information. This may allow Data Custodians and Authorized Third Parties to offer customers another interface for receiving Data Custodian programs like demand response, billing communications, and pricing signals.

REQ.21.6.5 XML Schema

The following is the XML Schema (espi.xsd) definition used to declare the format of the ESPI types. This is the official normative version of these definitions. A separate version of this file, in plain text, appropriate for machine reading, can be obtained through the NAESB office.

<?xml version="1.0" encoding="utf-8"?>

<xs:schema xmlns:xs="http://www.w3.org/2001/XMLSchema" xmlns="http://naesb.org/espi" targetNamespace="http://naesb.org/espi" elementFormDefault="qualified" attributeFormDefault="unqualified" version="0.04">

 <xs:import namespace="http://www.w3.org/2005/Atom" schemaLocation="atom.xsd"/>

 <xs:complexType name="ApplicationInformation">

 <xs:annotation>

 <xs:documentation>Contains information about a Third Party Application requesting access to the DataCustodian services. Information requested may include items such as Organization Name, Website, Contact Info, Application Name, Description, Icon, Type, default Notification and Callback endpoints, and may also include agreement with terms of service.</xs:documentation>

 </xs:annotation>

 <xs:complexContent>

 <xs:extension base="IdentifiedObject">

 <xs:sequence>

 <xs:element name="dataCustodianApplicationStatus" minOccurs="0" maxOccurs="1" type="UInt8">

 <xs:annotation>

 <xs:documentation>A code indicating the current status of the application. This value is provided by dataCustodian, cannot be modified.

Defined statuses are:

1 - Review

2 - Production (Live)

3 - On hold

4 - Revoked</xs:documentation>

 </xs:annotation>

 </xs:element>

 <xs:element name="dataCustodianDefaultBatchResource" minOccurs="0" maxOccurs="1" type="xs:anyURI">

 <xs:annotation>

 <xs:documentation>The default endpoint for Batch requests. This value is provided by dataCustodian, updated in approved applications objects, cannot be modified by Third Party.</xs:documentation>

 </xs:annotation>

 </xs:element>

 <xs:element name="dataCustodianDefaultSubscriptionResource" minOccurs="0" maxOccurs="1" type="xs:anyURI">

 <xs:annotation>

 <xs:documentation>The default endpoint for Subscription requests. This value is provided by dataCustodian, updated in approved applications objects, cannot be modified by Third Party.</xs:documentation>

 </xs:annotation>

 </xs:element>

 <xs:element name="dataCustodianThirdPartyId" minOccurs="0" maxOccurs="1" type="String32">

 <xs:annotation>

 <xs:documentation>A key to be associated with this application, to be provided in OAuth requests. This value is provided by dataCustodian, and cannot be modified.</xs:documentation>

 </xs:annotation>

 </xs:element>

 <xs:element name="dataCustodianThirdPartySecret" minOccurs="0" maxOccurs="1" type="String32">

 <xs:annotation>

 <xs:documentation>A secret to be associated with this application, used to sign OAuth requests. This value is provided by dataCustodian, and cannot be modified.</xs:documentation>

 </xs:annotation>

 </xs:element>

 <xs:element name="thirdPartyApplicationDescription" minOccurs="0" maxOccurs="1" type="String256">

 <xs:annotation>

 <xs:documentation>A description of the application.</xs:documentation>

 </xs:annotation>

 </xs:element>

 <xs:element name="thirdPartyApplicationLogo" minOccurs="0" maxOccurs="1" type="xs:anyURI">

 <xs:annotation>

 <xs:documentation>The link to the logo image for the application. Size greater than 180 x 150 may be cropped or reduced.</xs:documentation>

 </xs:annotation>

 </xs:element>

 <xs:element name="thirdPartyApplicationName" minOccurs="0" maxOccurs="1" type="String32">

 <xs:annotation>

 <xs:documentation>The name of the application to which access will be granted.</xs:documentation>

 </xs:annotation>

 </xs:element>

 <xs:element name="thirdPartyApplicationStatus" minOccurs="0" maxOccurs="1" type="UInt8">

 <xs:annotation>

 <xs:documentation>A code indicating the current status of the application.

Defined statuses are:

1 - Development

2 - Review / Test

3 - Production (Live)

4 - Retired (Remove)</xs:documentation>

 </xs:annotation>

 </xs:element>

 <xs:element name="thirdPartyApplicationType" minOccurs="0" maxOccurs="1" type="UInt8">

 <xs:annotation>

 <xs:documentation>A code indicating the type of the application.

Defined types are:

1 - Web Application

2 - Desktop Application

3 - Mobile Application</xs:documentation>

 </xs:annotation>

 </xs:element>

 <xs:element name="thirdPartyApplicationUse" minOccurs="0" maxOccurs="1" type="UInt8">

 <xs:annotation>

 <xs:documentation>A code indicating the expected use of the application.

Defined uses are:

1 - Energy management

2 - Comparisons

3 - Government

4 - Academic

5 - Law enforcement</xs:documentation>

 </xs:annotation>

 </xs:element>

 <xs:element name="thirdPartyApplicationWebsite" minOccurs="0" maxOccurs="1" type="xs:anyURI">

 <xs:annotation>

 <xs:documentation>The link to the main page of the application.</xs:documentation>

 </xs:annotation>

 </xs:element>

 <xs:element name="thirdPartyDefaultBatchResource" minOccurs="0" maxOccurs="1" type="xs:anyURI">

 <xs:annotation>

 <xs:documentation>The default endpoint for asynchronous delivery of Batch data using push.</xs:documentation>

 </xs:annotation>

 </xs:element>

 <xs:element name="thirdPartyDefaultNotifyResource" minOccurs="0" maxOccurs="1" type="xs:anyURI">

 <xs:annotation>

 <xs:documentation>The default endpoint for Third Party notification of Batch data availability, that is then requested from the Data Custodian via the Batch resource.</xs:documentation>

 </xs:annotation>

 </xs:element>

 <xs:element name="thirdPartyDefaultOAuthCallback" minOccurs="0" maxOccurs="1" type="xs:anyURI">

 <xs:annotation>

 <xs:documentation>The default redirect back to the application after authorization grant.</xs:documentation>

 </xs:annotation>

 </xs:element>

 <xs:element name="thirdPartyEmail" minOccurs="0" maxOccurs="1" type="String64">

 <xs:annotation>

 <xs:documentation>The e-mail address of the organization to which access will be granted. (For debugging - not to be shared with customers)</xs:documentation>

 </xs:annotation>

 </xs:element>

 <xs:element name="thirdPartyName" minOccurs="0" maxOccurs="1" type="String64">

 <xs:annotation>

 <xs:documentation>The name of the organization to which access will be granted.</xs:documentation>

 </xs:annotation>

 </xs:element>

 <xs:element name="thirdPartyPhone" minOccurs="0" maxOccurs="1" type="String32">

 <xs:annotation>

 <xs:documentation>The phone number of the organization to which access will be granted. (For debugging - not to be shared with customers)</xs:documentation>

 </xs:annotation>

 </xs:element>

 </xs:sequence>

 </xs:extension>

 </xs:complexContent>

 </xs:complexType>

 <xs:complexType name="Authorization">

 <xs:annotation>

 <xs:documentation>Represents a permission granted by an owner for access to a resource.</xs:documentation>

 </xs:annotation>

 <xs:complexContent>

 <xs:extension base="IdentifiedObject">

 <xs:sequence>

 <xs:element name="accessToken" minOccurs="0" maxOccurs="1" type="String32">

 <xs:annotation>

 <xs:documentation>Contains the access token associated with this authorization.</xs:documentation>

 </xs:annotation>

 </xs:element>

 <xs:element name="authorizationServer" minOccurs="0" maxOccurs="1" type="xs:anyURI">

 <xs:annotation>

 <xs:documentation>Contains the URI link to the authorization endpoint associated with this authorization.</xs:documentation>

 </xs:annotation>

 </xs:element>

 <xs:element name="authorizedPeriod" minOccurs="0" maxOccurs="1" type="DateTimeInterval">

 <xs:annotation>

 <xs:documentation>Restricts access to requests or subscriptions within this date time interval.</xs:documentation>

 </xs:annotation>

 </xs:element>

 <xs:element name="publishedPeriod" minOccurs="0" maxOccurs="1" type="DateTimeInterval">

 <xs:annotation>

 <xs:documentation>Restricts access to the objects within the associated resource that were published within this date time interval.</xs:documentation>

 </xs:annotation>

 </xs:element>

 <xs:element name="resource" minOccurs="0" maxOccurs="1" type="xs:anyURI">

 <xs:annotation>

 <xs:documentation>Contains the identifier of the resource, same as was specified in OAuth "scope".</xs:documentation>

 </xs:annotation>

 </xs:element>

 <xs:element name="status" minOccurs="0" maxOccurs="1" type="UInt8">

 <xs:annotation>

 <xs:documentation>The status of this authorization.

0 - Revoked

1 - Active</xs:documentation>

 </xs:annotation>

 </xs:element>

 <xs:element name="thirdParty" minOccurs="0" maxOccurs="1" type="String32">

 <xs:annotation>

 <xs:documentation>Contains the identifier for the Third Party.</xs:documentation>

 </xs:annotation>

 </xs:element>

 </xs:sequence>

 </xs:extension>

 </xs:complexContent>

 </xs:complexType>

 <xs:complexType name="IntervalBlock">

 <xs:annotation>

 <xs:documentation>Time sequence of Readings of the same ReadingType.</xs:documentation>

 </xs:annotation>

 <xs:complexContent>

 <xs:extension base="IdentifiedObject">

 <xs:sequence>

 <xs:element name="interval" minOccurs="0" maxOccurs="1" type="DateTimeInterval">

 <xs:annotation>

 <xs:documentation>Specifies the time period during which the contained readings were taken.</xs:documentation>

 </xs:annotation>

 </xs:element>

 <xs:element name="IntervalReading" type="IntervalReading" minOccurs="0" maxOccurs="unbounded" />

 </xs:sequence>

 </xs:extension>

 </xs:complexContent>

 </xs:complexType>

 <xs:complexType name="IntervalReading">

 <xs:annotation>

 <xs:documentation>Specific value measured by a meter or other asset. Each Reading is associated with a specific ReadingType.</xs:documentation>

 </xs:annotation>

 <xs:complexContent>

 <xs:extension base="Object">

 <xs:sequence>

 <xs:element name="cost" minOccurs="0" maxOccurs="1" type="UInt48">

 <xs:annotation>

 <xs:documentation>Specifies a cost associated with this reading, in hundred-thousandths of the currency specified in the ReadingType for this reading. (e.g., 840 = USD, US dollar)</xs:documentation>

 </xs:annotation>

 </xs:element>

 <xs:element name="ReadingQuality" type="ReadingQuality" minOccurs="0" maxOccurs="unbounded" />

 <xs:element name="timePeriod" minOccurs="0" maxOccurs="1" type="DateTimeInterval">

 <xs:annotation>

 <xs:documentation>The date time and duration of a reading. If not specified, readings for each "intervalLength" in ReadingType are present.</xs:documentation>

 </xs:annotation>

 </xs:element>

 <xs:element name="value" minOccurs="0" maxOccurs="1" type="UInt48">

 <xs:annotation>

 <xs:documentation>Value in units specified by ReadingType</xs:documentation>

 </xs:annotation>

 </xs:element>

 </xs:sequence>

 </xs:extension>

 </xs:complexContent>

 </xs:complexType>

 <xs:complexType name="MeterReading">

 <xs:annotation>

 <xs:documentation>Set of values obtained from the meter.</xs:documentation>

 </xs:annotation>

 <xs:complexContent>

 <xs:extension base="IdentifiedObject" />

 </xs:complexContent>

 </xs:complexType>

 <xs:complexType name="ReadingQuality">

 <xs:annotation>

 <xs:documentation>Quality of a specific reading value or interval reading value. Note that more than one Quality may be applicable to a given Reading. Typically not used unless problems or unusual conditions occur (i.e., quality for each Reading is assumed to be 'Good' (valid) unless stated otherwise in associated ReadingQuality).</xs:documentation>

 </xs:annotation>

 <xs:complexContent>

 <xs:extension base="Object">

 <xs:sequence>

 <xs:element name="quality" minOccurs="1" maxOccurs="1" type="QualityOfReading">

 <xs:annotation>

 <xs:documentation>Quality, to be specified if different than ReadingType.defaultQuality.

The specific format is specified per the standard is defined in QualityOfReading.</xs:documentation>

 </xs:annotation>

 </xs:element>

 </xs:sequence>

 </xs:extension>

 </xs:complexContent>

 </xs:complexType>

 <xs:complexType name="ReadingType">

 <xs:annotation>

 <xs:documentation>Characteristics associated with all Readings included in a MeterReading.</xs:documentation>

 </xs:annotation>

 <xs:complexContent>

 <xs:extension base="IdentifiedObject">

 <xs:sequence>

 <xs:element name="accumulationBehaviour" minOccurs="0" maxOccurs="1" type="AccumulationBehaviourType">

 <xs:annotation>

 <xs:documentation>Code indicating how value is accumulated over time for Readings of ReadingType. The list of valid values per the standard are defined in AccumulationBehaviorType.

Examples are:

0 = Not Applicable

1 = BulkQuantity

3 = Cumulative</xs:documentation>

 </xs:annotation>

 </xs:element>

 <xs:element name="commodity" minOccurs="0" maxOccurs="1" type="CommodityType">

 <xs:annotation>

 <xs:documentation>Code for commodity classification of Readings of ReadingType. The valid values per the standard are defined in CommodityType.

Examples are:

0 = Not Applicable

1 = Electricity secondary metered value (a premise meter is typically a secondary meter)

2 = Electricity primary metered value

4 = Air

7 = NaturalGas</xs:documentation>

 </xs:annotation>

 </xs:element>

 <xs:element name="consumptionTier" minOccurs="0" maxOccurs="1" type="ConsumptionTierType">

 <xs:annotation>

 <xs:documentation>Code for consumption tier associated with a Reading of ReadingType. The valid values are define in ConsumptionTierType.

Examples are:

0 = Not Applicable

1 = Block Tier 1

2 = Block Tier 2</xs:documentation>

 </xs:annotation>

 </xs:element>

 <xs:element name="currency" minOccurs="0" maxOccurs="1" type="CurrencyCode">

 <xs:annotation>

 <xs:documentation>Code for the currency for costs associated with this ReadingType. The valid values per the standard are defined in CurrencyCode.

Examples are:

0 - Not Applicable

36 - Australian Dollar

124 - Canadian Dollar

840 - US Dollar

978 - Euro</xs:documentation>

 </xs:annotation>

 </xs:element>

 <xs:element name="dataQualifier" minOccurs="0" maxOccurs="1" type="DataQualifierType">

 <xs:annotation>

 <xs:documentation>Code describing a salient attribute of Readings of ReadingType. Valid values per the standard are defined in DataQualifierType.

Examples are:

0 = Not Applicable

2 = Average</xs:documentation>

 </xs:annotation>

 </xs:element>

 <xs:element name="defaultQuality" minOccurs="0" maxOccurs="1" type="QualityOfReading">

 <xs:annotation>

 <xs:documentation>Default value to be used if no value of ReadingQuality.quality is provided.

Specific format and valid values per the standard are specified in QualityOfReading.</xs:documentation>

 </xs:annotation>

 </xs:element>

 <xs:element name="flowDirection" minOccurs="0" maxOccurs="1" type="FlowDirectionType">

 <xs:annotation>

 <xs:documentation>Direction associated with current related Readings. valid values per the standard are defined in FlowDirectionType.

Examples are:

0 = Not Applicable

1 = Forward

19 = Reverse</xs:documentation>

 </xs:annotation>

 </xs:element>

 <xs:element name="intervalLength" minOccurs="0" maxOccurs="1" type="UInt32">

 <xs:annotation>

 <xs:documentation>Default interval length specified in seconds for Readings of ReadingType.</xs:documentation>

 </xs:annotation>

 </xs:element>

 <xs:element name="kind" minOccurs="0" maxOccurs="1" type="KindType">

 <xs:annotation>

 <xs:documentation>Code for general classification of a Reading of ReadingType. Valid values per the standard are defined in KindType.

Examples are:

0 = Not Applicable

3 = Currency

8 = Demand</xs:documentation>

 </xs:annotation>

 </xs:element>

 <xs:element name="phase" minOccurs="0" maxOccurs="1" type="PhaseCode">

 <xs:annotation>

 <xs:documentation>Code for phase information associated with Readings of ReadingType. Valid values per the standard are defined in PhaseCode.

Examples are:

0 = Not Applicable

129 = Phase AN

128 = Phase A

132 = Phase AB</xs:documentation>

 </xs:annotation>

 </xs:element>

 <xs:element name="powerOfTenMultiplier" minOccurs="0" maxOccurs="1" type="PowerOfTenMultiplierType">

 <xs:annotation>

 <xs:documentation>Code for the power of ten multiplier which, when used in combination with the uom, specifies the actual unit of measure for Readings of ReadingType. Valid values per the standard are defined in PowerOfTenMultiplierType.

Examples are:

0 = None

1 = deca=x10

2 = hecto=x100

-3 = mili=x10-3</xs:documentation>

 </xs:annotation>

 </xs:element>

 <xs:element name="timeAttribute" minOccurs="0" maxOccurs="1" type="TimeAttributeType">

 <xs:annotation>

 <xs:documentation>Code used to specify a particular type of time interval method for Readings of ReadingType. Valid values per the standard are defined in TimeAttributeType.

Examplesare:

0 = Not Applicable

1 = 10-minute

2 = 15-minute</xs:documentation>

 </xs:annotation>

 </xs:element>

 <xs:element name="tou" minOccurs="0" maxOccurs="1" type="TOUType">

 <xs:annotation>

 <xs:documentation>Code for the TOU type of Readings of ReadingType. valid values per the standard are defined in TOUType.

Examples are:

0 = NotApplicable

1 = TOU A

2 = TOU B</xs:documentation>

 </xs:annotation>

 </xs:element>

 <xs:element name="uom" minOccurs="0" maxOccurs="1" type="UomType">

 <xs:annotation>

 <xs:documentation>Code for the base unit of measure for Readings of ReadingType. Used in combination with the powerOfTenMultiplier to specify the actual unit of measure. Valid values per the standard are defined in UomType.

Examples are:

0 = Not Applicable

5 = A (Current)

29 = Voltage</xs:documentation>

 </xs:annotation>

 </xs:element>

 </xs:sequence>

 </xs:extension>

 </xs:complexContent>

 </xs:complexType>

 <xs:complexType name="IdentifiedObject">

 <xs:annotation>

 <xs:documentation>This is a root class to provide common naming attributes for all classes needing naming attributes</xs:documentation>

 </xs:annotation>

 <xs:complexContent>

 <xs:extension base="Object">

 <xs:sequence>

 <xs:element name="BatchItemInfo" type="BatchItemInfo" minOccurs="0" maxOccurs="1" />

 </xs:sequence>

 </xs:extension>

 </xs:complexContent>

 </xs:complexType>

 <xs:complexType name="ServiceCategory">

 <xs:annotation>

 <xs:documentation>Category of service provided to the customer.</xs:documentation>

 </xs:annotation>

 <xs:complexContent>

 <xs:extension base="Object">

 <xs:sequence>

 <xs:element name="kind" minOccurs="1" maxOccurs="1" type="ServiceKind">

 <xs:annotation>

 <xs:documentation>Service classification

Examples are:

0 - electricity

1 - gas

The list of specific valid values per the standard are itemized in ServiceKind.</xs:documentation>

 </xs:annotation>

 </xs:element>

 </xs:sequence>

 </xs:extension>

 </xs:complexContent>

 </xs:complexType>

 <xs:complexType name="UsagePoint">

 <xs:annotation>

 <xs:documentation>Logical point on a network at which consumption or production is either physically measured (e.g., metered) or estimated (e.g., unmetered street lights).</xs:documentation>

 </xs:annotation>

 <xs:complexContent>

 <xs:extension base="IdentifiedObject">

 <xs:sequence>

 <xs:element name="roleFlags" minOccurs="0" maxOccurs="1" type="HexBinary16">

 <xs:annotation>

 <xs:documentation>Specifies the roles that this usage point has been assigned.

Bit 1 - isMirror

Bit 2 - isPremisesAggregationPoint

Bit 3 - isPEV

Bit 4 - isDER

Bit 5 - isRevenueQuality

Bit 6 - isDC

Bit 7-16 - Reserved</xs:documentation>

 </xs:annotation>

 </xs:element>

 <xs:element name="ServiceCategory" type="ServiceCategory" minOccurs="0" maxOccurs="1" />

 <xs:element name="status" minOccurs="0" maxOccurs="1" type="UInt8">

 <xs:annotation>

 <xs:documentation>Specifies the current status of this usage point.

Valid values include:

0 = off

1 = on</xs:documentation>

 </xs:annotation>

 </xs:element>

 </xs:sequence>

 </xs:extension>

 </xs:complexContent>

 </xs:complexType>

 <xs:complexType name="ElectricPowerQualitySummary">

 <xs:annotation>

 <xs:documentation>A summary of power quality events. This information represents a summary of power quality information typically required by customer facility energy management systems. It is not intended to satisfy the detailed requirements of power quality monitoring. All values are as defined by measurementProtocol during the period. The standards typically also give ranges of allowed values; the information attributes are the raw measurements, not the "yes/no" determination by the various standards. See referenced standards for definition, measurement protocol and period.</xs:documentation>

 </xs:annotation>

 <xs:complexContent>

 <xs:extension base="IdentifiedObject">

 <xs:sequence>

 <xs:element name="flickerPlt" minOccurs="0" maxOccurs="1" type="Int48">

 <xs:annotation>

 <xs:documentation>A measurement of long term Rapid Voltage Change in hundredths of a Volt.

flickerPlt is derived from 2 hours of Pst values (12 values combined in cubic relationship).</xs:documentation>

 </xs:annotation>

 </xs:element>

 <xs:element name="flickerPst" minOccurs="0" maxOccurs="1" type="Int48">

 <xs:annotation>

 <xs:documentation>flickerPst is a value measured over 10 minutes that characterizes the likelihood that the voltage fluctuations would result in perceptible light flicker. A value of 1.0 is designed to represent the level that 50% of people would perceive flicker in a 60 watt incandescent bulb.

The value reported is represented as an integer in hundredths.</xs:documentation>

 </xs:annotation>

 </xs:element>

 <xs:element name="harmonicVoltage" minOccurs="0" maxOccurs="1" type="Int48">

 <xs:annotation>

 <xs:documentation>A measurement of the Harmonic Voltage during the period. For DC, distortion is with respect to a signal of zero Hz.</xs:documentation>

 </xs:annotation>

 </xs:element>

 <xs:element name="longInterruptions" minOccurs="0" maxOccurs="1" type="Int48">

 <xs:annotation>

 <xs:documentation>A count of Long Interruption events (as defined by measurementProtocol) during the summary interval period.</xs:documentation>

 </xs:annotation>

 </xs:element>

 <xs:element name="mainsVoltage" minOccurs="0" maxOccurs="1" type="Int48">

 <xs:annotation>

 <xs:documentation>A measurement of the Mains [Signaling] Voltage during the summary interval period in uV.</xs:documentation>

 </xs:annotation>

 </xs:element>

 <xs:element name="measurementProtocol" minOccurs="0" maxOccurs="1" type="UInt8">

 <xs:annotation>

 <xs:documentation>A reference to the source standard used as the measurement protocol definition.

Examples are:

0 = "IEEE1519-2009"

1 = "EN50160"</xs:documentation>

 </xs:annotation>

 </xs:element>

 <xs:element name="powerFrequency" minOccurs="0" maxOccurs="1" type="Int48">

 <xs:annotation>

 <xs:documentation>A measurement of the power frequency during the summary interval period in uHz.</xs:documentation>

 </xs:annotation>

 </xs:element>

 <xs:element name="rapidVoltageChanges" minOccurs="0" maxOccurs="1" type="Int48">

 <xs:annotation>

 <xs:documentation>A count of Rapid Voltage Change events during the summary interval period</xs:documentation>

 </xs:annotation>

 </xs:element>

 <xs:element name="shortInterruptions" minOccurs="0" maxOccurs="1" type="Int48">

 <xs:annotation>

 <xs:documentation>A count of Short Interruption events during the summary interval period</xs:documentation>

 </xs:annotation>

 </xs:element>

 <xs:element name="summaryInterval" minOccurs="1" maxOccurs="1" type="DateTimeInterval">

 <xs:annotation>

 <xs:documentation>Interval of summary period</xs:documentation>

 </xs:annotation>

 </xs:element>

 <xs:element name="supplyVoltageDips" minOccurs="0" maxOccurs="1" type="Int48">

 <xs:annotation>

 <xs:documentation>A count of Supply Voltage Dip events during the summary interval period</xs:documentation>

 </xs:annotation>

 </xs:element>

 <xs:element name="supplyVoltageImbalance" minOccurs="0" maxOccurs="1" type="Int48">

 <xs:annotation>

 <xs:documentation>A count of Supply Voltage Imbalance events during the summary interval period</xs:documentation>

 </xs:annotation>

 </xs:element>

 <xs:element name="supplyVoltageVariations" minOccurs="0" maxOccurs="1" type="Int48">

 <xs:annotation>

 <xs:documentation>A count of Supply Voltage Variations during the summary interval period</xs:documentation>

 </xs:annotation>

 </xs:element>

 <xs:element name="tempOvervoltage" minOccurs="0" maxOccurs="1" type="Int48">

 <xs:annotation>

 <xs:documentation>A count of Temporary Overvoltage events (as defined by measurementProtocol) during the summary interval period</xs:documentation>

 </xs:annotation>

 </xs:element>

 </xs:sequence>

 </xs:extension>

 </xs:complexContent>

 </xs:complexType>

 <xs:complexType name="ElectricPowerUsageSummary">

 <xs:annotation>

 <xs:documentation>Summary of usage for a billing period</xs:documentation>

 </xs:annotation>

 <xs:complexContent>

 <xs:extension base="IdentifiedObject">

 <xs:sequence>

 <xs:element name="billingPeriod" minOccurs="0" maxOccurs="1" type="DateTimeInterval">

 <xs:annotation>

 <xs:documentation>The billing period to which the included measurements apply</xs:documentation>

 </xs:annotation>

 </xs:element>

 <xs:element name="billLastPeriod" minOccurs="0" maxOccurs="1" type="Int48">

 <xs:annotation>

 <xs:documentation>The amount of the bill for the previous billing period , in hundred-thousandths of the currency specified in the ReadingType for this reading (e.g., 840 = USD, US dollar).</xs:documentation>

 </xs:annotation>

 </xs:element>

 <xs:element name="billToDate" minOccurs="0" maxOccurs="1" type="Int48">

 <xs:annotation>

 <xs:documentation>The bill amount related to the billing period as of the date received, in hundred-thousandths of the currency specified in the ReadingType for this reading. (e.g., 840 = USD, US dollar).</xs:documentation>

 </xs:annotation>

 </xs:element>

 <xs:element name="costAdditionalLastPeriod" minOccurs="0" maxOccurs="1" type="Int48">

 <xs:annotation>

 <xs:documentation>Additional charges from the last billing period, in hundred-thousandths of the currency specified in the ReadingType for this reading. (e.g., 840 = USD, US dollar).</xs:documentation>

 </xs:annotation>

 </xs:element>

 <xs:element name="currency" minOccurs="0" maxOccurs="1" type="CurrencyCode">

 <xs:annotation>

 <xs:documentation>The ISO 4217 code indicating the currency applicable to the bill amounts in the summary. See list at http://tiny.cc/4217</xs:documentation>

 </xs:annotation>

 </xs:element>

 <xs:element name="currentBillingPeriodOverAllConsumption" minOccurs="0" maxOccurs="1" type="SummaryMeasurement">

 <xs:annotation>

 <xs:documentation>The total consumption for the billing period</xs:documentation>

 </xs:annotation>

 </xs:element>

 <xs:element name="currentDayLastYearNetConsumption" minOccurs="0" maxOccurs="1" type="SummaryMeasurement">

 <xs:annotation>

 <xs:documentation>The amount of energy consumed one year ago interpreted as same day of week same week of year (see ISO 8601).</xs:documentation>

 </xs:annotation>

 </xs:element>

 <xs:element name="currentDayNetConsumption" minOccurs="0" maxOccurs="1" type="SummaryMeasurement">

 <xs:annotation>

 <xs:documentation>Net consumption for the current day (delivered - received)</xs:documentation>

 </xs:annotation>

 </xs:element>

 <xs:element name="currentDayOverallConsumption" minOccurs="0" maxOccurs="1" type="SummaryMeasurement">

 <xs:annotation>

 <xs:documentation>Overall energy consumption for the current day</xs:documentation>

 </xs:annotation>

 </xs:element>

 <xs:element name="peakDemand" minOccurs="0" maxOccurs="1" type="SummaryMeasurement">

 <xs:annotation>

 <xs:documentation>Peak demand recorded for the current period</xs:documentation>

 </xs:annotation>

 </xs:element>

 <xs:element name="previousDayLastYearOverallConsumption" minOccurs="0" maxOccurs="1" type="SummaryMeasurement">

 <xs:annotation>

 <xs:documentation>The amount of energy consumed on the previous day one year ago interpreted as same day of week same week of year (see ISO 8601).</xs:documentation>

 </xs:annotation>

 </xs:element>

 <xs:element name="previousDayNetConsumption" minOccurs="0" maxOccurs="1" type="SummaryMeasurement">

 <xs:annotation>

 <xs:documentation>Net consumption for the previous day</xs:documentation>

 </xs:annotation>

 </xs:element>

 <xs:element name="previousDayOverallConsumption" minOccurs="0" maxOccurs="1" type="SummaryMeasurement">

 <xs:annotation>

 <xs:documentation>The total consumption for the previous day</xs:documentation>

 </xs:annotation>

 </xs:element>

 <xs:element name="qualityOfReading" minOccurs="0" maxOccurs="1" type="QualityOfReading">

 <xs:annotation>

 <xs:documentation>Indication of the quality of the summary readings</xs:documentation>

 </xs:annotation>

 </xs:element>

 <xs:element name="ratchetDemand" minOccurs="0" maxOccurs="1" type="SummaryMeasurement">

 <xs:annotation>

 <xs:documentation>The current ratchet demand value for the ratchet demand period</xs:documentation>

 </xs:annotation>

 </xs:element>

 <xs:element name="ratchetDemandPeriod" minOccurs="0" maxOccurs="1" type="DateTimeInterval">

 <xs:annotation>

 <xs:documentation>The period over which the ratchet demand applies</xs:documentation>

 </xs:annotation>

 </xs:element>

 <xs:element name="statusTimeStamp" minOccurs="1" maxOccurs="1" type="TimeType">

 <xs:annotation>

 <xs:documentation>Date/Time status of this UsageSummary</xs:documentation>

 </xs:annotation>

 </xs:element>

 </xs:sequence>

 </xs:extension>

 </xs:complexContent>

 </xs:complexType>

 <xs:simpleType name="HexBinary128">

 <xs:annotation>

 <xs:documentation>A 128-bit field encoded as a hex string (32 characters / 16 octets)</xs:documentation>

 </xs:annotation>

 <xs:restriction base="xs:hexBinary">

 <xs:maxLength value="16" />

 </xs:restriction>

 </xs:simpleType>

 <xs:simpleType name="HexBinary16">

 <xs:annotation>

 <xs:documentation>A 16-bit field encoded as a hex string (4 characters / 2 octets)</xs:documentation>

 </xs:annotation>

 <xs:restriction base="xs:hexBinary">

 <xs:maxLength value="2" />

 </xs:restriction>

 </xs:simpleType>

 <xs:simpleType name="String256">

 <xs:annotation>

 <xs:documentation>Character string of max length 256</xs:documentation>

 </xs:annotation>

 <xs:restriction base="xs:string">

 <xs:maxLength value="256" />

 </xs:restriction>

 </xs:simpleType>

 <xs:simpleType name="String32">

 <xs:annotation>

 <xs:documentation>Character string of max length 32</xs:documentation>

 </xs:annotation>

 <xs:restriction base="xs:string">

 <xs:maxLength value="32" />

 </xs:restriction>

 </xs:simpleType>

 <xs:simpleType name="String64">

 <xs:annotation>

 <xs:documentation>Character string of max length 64</xs:documentation>

 </xs:annotation>

 <xs:restriction base="xs:string">

 <xs:maxLength value="64" />

 </xs:restriction>

 </xs:simpleType>

 <xs:simpleType name="UInt16">

 <xs:annotation>

 <xs:documentation>Unsigned integer, max inclusive 65535 (2^16-1), same as xs:unsignedShort</xs:documentation>

 </xs:annotation>

 <xs:restriction base="xs:unsignedShort" />

 </xs:simpleType>

 <xs:simpleType name="UInt32">

 <xs:annotation>

 <xs:documentation>Unsigned integer, max inclusive 4294967295 (2^32-1), same as xs:unsignedInt</xs:documentation>

 </xs:annotation>

 <xs:restriction base="xs:unsignedInt" />

 </xs:simpleType>

 <xs:simpleType name="UInt48">

 <xs:annotation>

 <xs:documentation>Unsigned integer, max inclusive 281474976710655 (2^48-1), restriction of xs:unsignedLong</xs:documentation>

 </xs:annotation>

 <xs:restriction base="xs:unsignedLong">

 <xs:maxInclusive value="281474976710655" />

 </xs:restriction>

 </xs:simpleType>

 <xs:simpleType name="UInt8">

 <xs:annotation>

 <xs:documentation>Unsigned integer, max inclusive 255 (2^8-1), same as xs:unsignedByte</xs:documentation>

 </xs:annotation>

 <xs:restriction base="xs:unsignedByte" />

 </xs:simpleType>

 <xs:simpleType name="Int48">

 <xs:annotation>

 <xs:documentation>Signed integer, max inclusive 281474976710655 (2^48-1), restriction of xs:long</xs:documentation>

 </xs:annotation>

 <xs:restriction base="xs:long">

 <xs:maxInclusive value="281474976710655" />

 </xs:restriction>

 </xs:simpleType>

 <xs:complexType name="AccumulationBehaviourType">

 <xs:annotation>

 <xs:documentation>Valid values include:

0 = Not Applicable

1 = BulkQuantity

3 = Cumulative

4 = DeltaData

6 = Indicating

9 = Summation

12 = Instantaneous</xs:documentation>

 </xs:annotation>

 <xs:simpleContent>

 <xs:extension base="UInt8" />

 </xs:simpleContent>

 </xs:complexType>

 <xs:complexType name="CommodityType">

 <xs:annotation>

 <xs:documentation>Valid values include:

0 = Not Applicable

1 = Electricity metered value

4 = Air

7 = NaturalGas

8 = Propane

9 = PotableWater

10 = Steam

11 = WasteWater

12 = HeatingFluid

13 = CoolingFluid</xs:documentation>

 </xs:annotation>

 <xs:simpleContent>

 <xs:extension base="UInt8" />

 </xs:simpleContent>

 </xs:complexType>

 <xs:complexType name="ConsumptionTierType">

 <xs:annotation>

 <xs:documentation>Valid values include:

0 = Not Applicable

1 = Block Tier 1

2 = Block Tier 2

3 = Block Tier 3

4 = Block Tier 4

5 = Block Tier 5

6 = Block Tier 6

7 = Block Tier 7

8 = Block Tier 8

9 = Block Tier 9

10 = Block Tier 10

11 = Block Tier 11

12 = Block Tier 12

13 = Block Tier 13

14 = Block Tier 14

15 = Block Tier 15

16 = Block Tier 16</xs:documentation>

 </xs:annotation>

 <xs:simpleContent>

 <xs:extension base="UInt8" />

 </xs:simpleContent>

 </xs:complexType>

 <xs:complexType name="CurrencyCode">

 <xs:annotation>

 <xs:documentation>Follows codes defined in ISO 4217. Full list at tiny.cc/4217.

0 - Not Applicable

36 - Australian Dollar

124 - Canadian Dollar

840 - US Dollar

978 - Euro</xs:documentation>

 </xs:annotation>

 <xs:simpleContent>

 <xs:extension base="UInt8" />

 </xs:simpleContent>

 </xs:complexType>

 <xs:complexType name="DataQualifierType">

 <xs:annotation>

 <xs:documentation>Valid values include:

0 = Not Applicable

2 = Average

8 = Maximum

9 = Minimum

12 = Normal</xs:documentation>

 </xs:annotation>

 <xs:simpleContent>

 <xs:extension base="UInt8" />

 </xs:simpleContent>

 </xs:complexType>

 <xs:complexType name="DateTimeInterval">

 <xs:annotation>

 <xs:documentation>Interval of date and time. End is not included because it can be derived from the start and the duration.</xs:documentation>

 </xs:annotation>

 <xs:complexContent>

 <xs:extension base="Object">

 <xs:sequence>

 <xs:element name="duration" minOccurs="1" maxOccurs="1" type="UInt32">

 <xs:annotation>

 <xs:documentation>Duration of the interval, in seconds.</xs:documentation>

 </xs:annotation>

 </xs:element>

 <xs:element name="start" minOccurs="1" maxOccurs="1" type="TimeType">

 <xs:annotation>

 <xs:documentation>Date and time that this interval started.</xs:documentation>

 </xs:annotation>

 </xs:element>

 </xs:sequence>

 </xs:extension>

 </xs:complexContent>

 </xs:complexType>

 <xs:complexType name="FlowDirectionType">

 <xs:annotation>

 <xs:documentation>Valid values include:

0 = Not Applicable

1 = Forward

19 = Reverse</xs:documentation>

 </xs:annotation>

 <xs:simpleContent>

 <xs:extension base="UInt8" />

 </xs:simpleContent>

 </xs:complexType>

 <xs:complexType name="KindType">

 <xs:annotation>

 <xs:documentation>Valid values include:

0 = Not Applicable

3 = Currency

4 = Current

5 = CurrentAngle

7 = Date

8 = Demand

12 = Energy

15 = Frequency

37 = Power

38 = PowerFactor

40 = QuantityPower

54 = Voltage

55 = VoltageAngle

64 = DistortionPowerFactor

155 = VolumetricFlow</xs:documentation>

 </xs:annotation>

 <xs:simpleContent>

 <xs:extension base="UInt8" />

 </xs:simpleContent>

 </xs:complexType>

 <xs:complexType name="PhaseCode">

 <xs:annotation>

 <xs:documentation>Valid values include:

0 = Not Applicable

129 = Phase AN

128 = Phase A

132 = Phase AB

64 = Phase BN

64 = Phase B

32 = Phase CN

32 = Phase C

224 = Phase ABC

66 = Phase BC

40 = Phase CA

512 = Phase S1

256 = Phase S2

768 = Phase S1S2

513 = Phase S1N

257 = Phase S2N

769 = Phase S1S2N</xs:documentation>

 </xs:annotation>

 <xs:simpleContent>

 <xs:extension base="UInt16" />

 </xs:simpleContent>

 </xs:complexType>

 <xs:simpleType name="PowerOfTenMultiplierType">

 <xs:annotation>

 <xs:documentation>Valid values include:

0 = None

1 = deca=x10

2 = hecto=x100

-3 = mili=x10-3

3 = kilo=x1000

6 = Mega=x106

-6 = micro=x10-3

9 = Giga=x109</xs:documentation>

 </xs:annotation>

 <xs:restriction base="xs:byte" />

 </xs:simpleType>

 <xs:complexType name="QualityOfReading">

 <xs:annotation>

 <xs:documentation>List of codes indicating the quality of the reading, using specification:

0 - valid: data that has gone through all required validation checks and either passed them all or has been verified

7 - manually edited: Replaced or approved by a human

8 - estimated using reference day: data value was replaced by a machine computed value based on analysis of historical data using the same type of measurement.

9 - estimated using linear interpolation: data value was computed using linear interpolation based on the readings before and after it

10 - questionable: data that has failed one or more checks

11 - derived: data that has been calculated (using logic or mathematical operations), not necessarily measured directly

12 - projected (forecast): data that has been calculated as a projection or forecast of future readings

13 - mixed: indicates that the quality of this reading has mixed characteristics

14 - raw: data that has not gone through the validation, editing and estimation process

15 - normalized for weather: the values have been adjusted to account for weather, in order to compare usage in different climates

16 - other: specifies that a characteristic applies other than those defined

17 - validated: data that has been validated and possibly edited and/or estimated in accordance with approved procedures

18 - verified: data that failed at least one of the required validation checks but was determined to represent actual usage</xs:documentation>

 </xs:annotation>

 <xs:simpleContent>

 <xs:extension base="UInt8" />

 </xs:simpleContent>

 </xs:complexType>

 <xs:complexType name="ServiceKind">

 <xs:annotation>

 <xs:documentation>Valid values include:

0 - electricity

1 - gas

2 - water

4 - pressure

5 - heat

6 - cold

7 - communication

8 - time</xs:documentation>

 </xs:annotation>

 <xs:simpleContent>

 <xs:extension base="UInt8" />

 </xs:simpleContent>

 </xs:complexType>

 <xs:complexType name="TimeAttributeType">

 <xs:annotation>

 <xs:documentation>Valid values include:

0 = Not Applicable

1 = 10-minute

2 = 15-minute

4 = 24-hour

5 = 30-minute

7 = 60-minute

11 = Daily

13 = Monthly

15 = Present

16 = Previous

24 = Weekly

32 = ForTheSpecifiedPeriod

79 = Daily30minuteFixedBlock</xs:documentation>

 </xs:annotation>

 <xs:simpleContent>

 <xs:extension base="UInt8" />

 </xs:simpleContent>

 </xs:complexType>

 <xs:simpleType name="TimeType">

 <xs:annotation>

 <xs:documentation>Time is a signed 64-bit value representing the number of seconds since 0 hours, 0 minutes, 0 seconds, on the 1st of January, 1970.</xs:documentation>

 </xs:annotation>

 <xs:restriction base="xs:long" />

 </xs:simpleType>

 <xs:complexType name="TOUType">

 <xs:annotation>

 <xs:documentation>Valid values include:

0 = NotApplicable

1 = TOU A

2 = TOU B

3 = TOU C

4 = TOU D

5 = TOU E

6 = TOU F

7 = TOU G

8 = TOU H

9 = TOU I

10 = TOU J

11 = TOU K

12 = TOU L

13 = TOU M

14 = TOU N

15 = TOU O</xs:documentation>

 </xs:annotation>

 <xs:simpleContent>

 <xs:extension base="UInt8" />

 </xs:simpleContent>

 </xs:complexType>

 <xs:complexType name="UomType">

 <xs:annotation>

 <xs:documentation>Valid values include:

0 = Not Applicable

5 = A (Current)

29 = Voltage

31 = J (Energy joule)

33 = Hz (Frequency)

38 = Real power (Watts)

42 = m3 (Cubic Meter)

61 = VA (Apparent power)

63 = VAr (Reactive power)

65 = Cos? (Power factor)

67 = V² (Volts squared)

69 = A² (Amp squared)

71 = VAh (Apparent energy)

72 = Real energy (Watt-hours)

73 = VArh (Reactive energy)

106 = Ah (Ampere-hours / Available Charge)

119 = ft3 (Cubic Feet)

122 = ft3/h (Cubic Feet per Hour)

125 = m3/h (Cubic Meter per Hour)

128 = US gl (US Gallons)

129 = US gl/h (US Gallons per Hour)

130 = IMP gl (Imperial Gallons)

131 = IMP gl/h (Imperial Gallons per Hour)

132 = BTU

133 = BTU/h

134 = Liter

137 = L/h (Liters per Hour)

140 = PA(gauge)

155 = PA(absolute)

169 = Therm</xs:documentation>

 </xs:annotation>

 <xs:simpleContent>

 <xs:extension base="UInt8" />

 </xs:simpleContent>

 </xs:complexType>

 <xs:complexType name="SummaryMeasurement">

 <xs:annotation>

 <xs:documentation>An aggregated summary measurement reading.</xs:documentation>

 </xs:annotation>

 <xs:complexContent>

 <xs:extension base="Object">

 <xs:sequence>

 <xs:element name="powerOfTenMultiplier" minOccurs="0" maxOccurs="1" type="PowerOfTenMultiplierType">

 <xs:annotation>

 <xs:documentation>The multiplier part of the unit of measure, e.g. "kilo" (k)</xs:documentation>

 </xs:annotation>

 </xs:element>

 <xs:element name="timeStamp" minOccurs="0" maxOccurs="1" type="TimeType">

 <xs:annotation>

 <xs:documentation>The date and time (if needed) of the summary measurement.</xs:documentation>

 </xs:annotation>

 </xs:element>

 <xs:element name="uom" minOccurs="0" maxOccurs="1" type="UomType">

 <xs:annotation>

 <xs:documentation>The units of the reading, e.g. "Wh"</xs:documentation>

 </xs:annotation>

 </xs:element>

 <xs:element name="value" minOccurs="0" maxOccurs="1" type="UInt48">

 <xs:annotation>

 <xs:documentation>The value of the summary measurement.</xs:documentation>

 </xs:annotation>

 </xs:element>

 </xs:sequence>

 </xs:extension>

 </xs:complexContent>

 </xs:complexType>

 <xs:complexType name="BatchItemInfo">

 <xs:annotation>

 <xs:documentation>Includes elements that make it possible to include multiple transactions in a single (batch) request.</xs:documentation>

 </xs:annotation>

 <xs:complexContent>

 <xs:extension base="Object">

 <xs:sequence>

 <xs:element name="name" minOccurs="0" maxOccurs="1" type="HexBinary16">

 <xs:annotation>

 <xs:documentation>An identifier for this object that is only unique within the containing collection.</xs:documentation>

 </xs:annotation>

 </xs:element>

 <xs:element name="operation" minOccurs="0" maxOccurs="1" type="UInt8">

 <xs:annotation>

 <xs:documentation>Specifies the operation requested of this item.

0=Create

1=Read

2=Update

3=Delete</xs:documentation>

 </xs:annotation>

 </xs:element>

 <xs:element name="statusCode" minOccurs="0" maxOccurs="1" type="UInt16">

 <xs:annotation>

 <xs:documentation>Indicates the status code of the associated transaction.

200 - Ok

201 - Created

204 - No Content

301 - Moved Permanently

302 - Redirect

304 - Not Modified

400 - Bad Request

401 - Unauthorized

403 - Forbidden

404 - Not Found

405 - Method Not Allowed

410 - Gone

500 - Internal Server Error</xs:documentation>

 </xs:annotation>

 </xs:element>

 <xs:element name="statusReason" minOccurs="0" maxOccurs="1" type="String256">

 <xs:annotation>

 <xs:documentation>Indicates the reason for the indicated status code.</xs:documentation>

 </xs:annotation>

 </xs:element>

 </xs:sequence>

 </xs:extension>

 </xs:complexContent>

 </xs:complexType>

 <xs:complexType name="Object">

 <xs:annotation>

 <xs:documentation>Superclass of all object classes to allow extensions.</xs:documentation>

 </xs:annotation>

 <xs:sequence>

 <xs:element name="extension" minOccurs="0" maxOccurs="unbounded" type="xs:anyType">

 <xs:annotation>

 <xs:documentation>Contains an extension.</xs:documentation>

 </xs:annotation>

 </xs:element>

 </xs:sequence>

 </xs:complexType>

 <xs:complexType name="ServiceStatus">

 <xs:annotation>

 <xs:documentation>Contains the current status of the service.</xs:documentation>

 </xs:annotation>

 <xs:complexContent>

 <xs:extension base="Object">

 <xs:sequence>

 <xs:element name="currentStatus" minOccurs="1" maxOccurs="1" type="UInt8">

 <xs:annotation>

 <xs:documentation>The current status of the service.

0 = Unavailable

1 = Normal, operational</xs:documentation>

 </xs:annotation>

 </xs:element>

 </xs:sequence>

 </xs:extension>

 </xs:complexContent>

 </xs:complexType>

 <xs:complexType name="Subscription">

 <xs:annotation>

 <xs:documentation>Defines the parameters of a subscription between Third Party and Data Custodian.</xs:documentation>

 </xs:annotation>

 <xs:complexContent>

 <xs:extension base="IdentifiedObject" />

 </xs:complexContent>

 </xs:complexType>

 <xs:element name="ApplicationInformation" type="ApplicationInformation" />

 <xs:element name="Authorization" type="Authorization" />

 <xs:element name="IntervalBlock" type="IntervalBlock" />

 <xs:element name="IntervalReading" type="IntervalReading" />

 <xs:element name="MeterReading" type="MeterReading" />

 <xs:element name="ReadingQuality" type="ReadingQuality" />

 <xs:element name="ReadingType" type="ReadingType" />

 <xs:element name="IdentifiedObject" type="IdentifiedObject" />

 <xs:element name="ServiceCategory" type="ServiceCategory" />

 <xs:element name="UsagePoint" type="UsagePoint" />

 <xs:element name="ElectricPowerQualitySummary" type="ElectricPowerQualitySummary" />

 <xs:element name="ElectricPowerUsageSummary" type="ElectricPowerUsageSummary" />

 <xs:element name="AccumulationBehaviourType" type="AccumulationBehaviourType" />

 <xs:element name="CommodityType" type="CommodityType" />

 <xs:element name="ConsumptionTierType" type="ConsumptionTierType" />

 <xs:element name="CurrencyCode" type="CurrencyCode" />

 <xs:element name="DataQualifierType" type="DataQualifierType" />

 <xs:element name="DateTimeInterval" type="DateTimeInterval" />

 <xs:element name="FlowDirectionType" type="FlowDirectionType" />

 <xs:element name="KindType" type="KindType" />

 <xs:element name="PhaseCode" type="PhaseCode" />

 <xs:element name="QualityOfReading" type="QualityOfReading" />

 <xs:element name="ServiceKind" type="ServiceKind" />

 <xs:element name="TimeAttributeType" type="TimeAttributeType" />

 <xs:element name="TOUType" type="TOUType" />

 <xs:element name="UomType" type="UomType" />

 <xs:element name="SummaryMeasurement" type="SummaryMeasurement" />

 <xs:element name="BatchItemInfo" type="BatchItemInfo" />

 <xs:element name="Object" type="Object" />

 <xs:element name="ServiceStatus" type="ServiceStatus" />

 <xs:element name="Subscription" type="Subscription" />

</xs:schema>

# Appendices

This section contains informative descriptions, use cases and diagrams used by the committee in developing the Model Business Practices. These Appendices are not normative.

# A. Overview

The scope of these Model Business Practices includes authorization by the Retail Customer and the Automatic Data Exchange of the EUI to the Authorized Third Party in accordance with parameters (e.g., term of access, type of data, quantity of data, etc.) determined by the Retail Customer subject to the Governing Documents and Applicable Regulatory Authority. The diagram below shows the logical components involved in this authorization and data exchange process. Note that while the authorization process shown in this figure is made using a web browser, the services provided by the Authorized Third Party are not required to use a web browser to deliver such services.

**Figure : Overview of Logical Components**

# B. Use Cases

This section presents a superset of the use cases that are informative of the EUI access relationship between Data Custodians and Authorized Third Parties. Alternative use cases are presented for certain activities that can be achieved in different ways, such as the delivery of shared resource information by push or by pull.

The concept of a Shared Resource Key is used throughout these use cases. A Shared Resource Key is a token used to uniquely identify an instance of an Authorized Third Party EUI access relationship (i.e., each Retail Customer-Data Custodian-Authorized Third Party combination for a particular resource will have a unique Shared Resource Key). A Shared Resource Key, in and of itself, contains no information that can be linked to a specific Retail Customer and so can be freely shared among all three roles without unnecessary disclosure of sensitive information. Once the relationship is established, inclusion of a Shared Resource Key in an interaction is sufficient to identify a specific Authorized Third Party EUI access relationship.

These Use Cases are illustrative, do not impose any obligations and are subject to the Governing Documents and the requirements of the Applicable Regulatory Authority. All statements of steps and preconditions should be interpreted to follow this constraint.

Each use case contains the following sections:

* Use Case Description: This is a summary of the use case, describing the overall purpose.
* Pre-Conditions: These are conditions that must be true for the use case to be successfully executed.
* Invariant Conditions: These are properties that will be true any time the use case is initiated, regardless of whether it terminates successfully.
* Post-Conditions:These are properties that will be true only if the use case terminates successfully. This requires that all preconditions and all condition checks (e.g., for validity of a request) be satisfied during execution of the use case.
* Basic Path Scenario: This defines the series of steps undertaken by each role during successful execution of the use case. The scenario is depicted graphically in a Unified Modeling Language (UML) sequence diagram and each step is summarized in text.

The following use cases are informative and not normative.

**Figure :** ESPI Use Case Diagram

**1: Authorized Third Party Establishes Relationship With Data Custodian**

**Figure :** Authorized Third Party Establishes Relationship With Data Custodian

**Description**

An Authorized Third Party service provider wants to register with a Data Custodian to provide services to Retail Customers with EUI stored by the Data Custodian.

**Pre-Condition:** Authorized Third Party had demonstrated that it meets eligibility, security and privacy requirements.

**Post-Condition:** A Shared Identity Key is generated to allow the Authorized Third Party to identify its identity to Data Custodian.

**Post-Condition:** The Authorized Third Party has permission to get specified EUI from the Data Custodian with permission of a Retail Customer.

**Scenario:** Basic Path

1. The Authorized Third Party wishes to provide value added services to Retail Customers with EUI stored by the Data Custodian.
2. Authorized Third Party requests that the Data Custodian establish relationship.
3. Authorized Third Party provides proof that they meet the applicable requirements for eligibility, data security and privacy protection.
4. Authorized Third Party provides description of the services it wishes provide for Retail Customers.
5. The Data Custodian generates an Identity Key for the Authorized Third Party. Authorized Third Party will use this key to identify itself during Use Cases 2 through 12.
6. The Data Custodian adds the Authorized Third Party to its list of available services it presents to Retail Customers in Use Case 2.
7. Authorized Third Party adds Data Custodian to its list of Data Custodians it presents in Use Case 2.
8. Authorized Third Party persists the Identity Key.
9. As needed, Authorized Third Party checks their ability to connect to the service, and obtains the current status of the service.

**2: Retail Customer Authorizes Authorized Third Party Resource Access via Data Custodian**

**Figure :** Retail Customer Authorizes Authorized Third Party Resource Access via Data Custodian

**Description**

A Retail Customer wants to grant permission for a Data Custodian to share a particular EUI resource with a Authorized Third Party. The Retail Customer initiates the process through the Data Custodian.

**Pre-Condition:** Retail Customer has established accounts with Data Custodian and Authorized Third Party.

**Pre-Condition:** Authorized Third Party has an established account with Data Custodian.

**Pre-Condition:** Data Custodian and Authorized Third Party have published and made Retail Customer aware of their privacy policy related to collection and handling of customer information.

**Post-Condition:** A Shared Resource Key is generated to allow all three roles to refer to the same shared resource. This key is known to all three roles.

**Post-Condition:** The Authorized Third Party has the Retail Customer's permission to get the specified EUI from the Data Custodian.

**Post-Condition:** The Data Custodian sends the Retail Customer confirmation of establishment of the Authorized Third Party EUI access relationship.

**Scenario:** Basic Path

1. The Retail Customer decides to grant permission for the Data Custodian to share his EUI with the Authorized Third Party
2. (Optional) Retail Customer finds his appropriate Data Custodian from Authorized Third Party, and navigates to the appropriate place to begin establishment of sharing relationship.
3. Retail Customer requests that the Data Custodian establish a new EUI access relationship.
4. Data Custodian presents the Retail Customer with a list of resources that can be shared with Third Parties. Any additional attributes (e.g., duration for which permission should be granted) that can be selected are also presented.
5. Retail Customer selects a resource to share, sets any available attributes for the relationship, and specifies an Authorized Third Party. Selecting these parameters and completing the interaction indicates permission for the Data Custodian to grant the specified Authorized Third Party access to the specified shared resource.
6. The relationship will only be created if the Data Custodian accepts the selections for the Authorized Third Party (e.g., a Data Custodian may constrain access to certain resource attributes depending on resource sensitivity).
7. Data Custodian generates a Shared Resource Key (Request Token) to begin creation of this relationship and provides it to the Authorized Third Party. Each Shared Resource Key is unique to the relationship between a Retail Customer, Data Custodian, Authorized Third Party, and specific EUI.
8. Authorized Third Party requests authorization of the token by the Retail Customer, via the Data Custodian.
9. Retail Customer authenticates with Data Custodian and authorizes the Request Token.
10. Authorized Third Party exchanges the authorized Request Token for an Access Token from the Data Custodian.
11. Authorized Third Party and Data Custodian persist the Authorization, associating it with its identity of the Retail Customer.

**3: Retail Customer Modifies Resource Authorization**

**Figure :** Retail Customer Modifies Resource Authorization

**Description**

The Retail Customer has an existing Authorized Third Party EUI access relationship with a particular Data Custodian and Authorized Third Party and wants to either extend or restrict the permissions associated with that relationship.

**Pre-Condition:** Retail Customer has established a Authorized Third Party EUI access relationship with the Data Custodian and the Authorized Third Party with respect to a particular resource, resulting in a unique Shared Resource Key identifying the relationship.

**Post-Condition:** Future interactions between the Data Custodian and the Authorized Third Party with respect to the specified resource are constrained by the modified permissions.

**Post-Condition:** The Authorized Third Party handles any EUI not allowed by the termination of the relationship in the manner specified in any service agreements among the parties in the relationship.

**Post-Condition:** The Data Custodian sends the Retail Customer confirmation of modification of the permissions of the Authorized Third Party EUI access relationship.

**Scenario:** Basic Path

1. Retail Customer chooses to modify relationship permissions with the Data Custodian.
2. Data Custodian presents the Retail Customer with a list of resources that are shared with Third Parties. If the Retail Customer may only grant access to one resource, S2 and S3 may be skipped.
3. Retail Customer chooses particular resource whose permissions she wishes to modify.
4. Data Custodian provides available resource attributes and current settings to Retail Customer.
5. Retail Customer chooses new settings.
6. The new permissions governing the relationship will apply only if the Data Custodian accepts the selections for the Authorized Third Party (e.g., a Data Custodian may constrain access to certain resource attributes depending on resource sensitivity).
7. Data Custodian persists the new permissions, which will be used from this point forward to constrain the relationship (until further changed or the relationship is terminated).
8. Data Custodian notifies Authorized Third Party that permissions have changed (identifying the resource by its Shared Resource Key). This notification may be immediate or deferred (e.g., as part of a resource push from Use Case 8, perhaps as part of a header).
9. Data Custodian notifies Retail Customer that permissions have been changed.
10. The Authorized Third Party handles any EUI not allowed by the modification of the resource authorization in the manner specified in any service agreements among the parties in the relationship.

**4: Retail Customer Revokes Resource Authorization**

**Figure :** Retail Customer Revokes Resource Authorization

**Description**

The Retail Customer has an existing Authorized Third Party EUI access relationship with a particular Data Custodian and Authorized Third Party and wants to terminate that relationship.

**Pre-Condition:** Authorized Third Party has an established account with Data Custodian.

**Pre-Condition:** Retail Customer has established an Authorized Third Party EUI access relationship with the Data Custodian and the Authorized Third Party with respect to a particular resource, resulting in a unique Shared Resource Key identifying the relationship.

**Post-Condition:** Both the Authorized Third Party and the Data Custodian delete the Shared Resource Key for the relationship and no future interactions are permitted for that relationship.

**Post-Condition:** The Authorized Third Party handles any EUI not allowed by the termination of the relationship in the manner specified in any service agreements among the parties in the relationship.

**Post-Condition:** The Data Custodian sends the Retail Customer confirmation of termination of the Authorized Third Party EUI access relationship.

**Scenario:** Basic Path

1. Retail Customer requests that Data Custodian terminate the EUI access relationship.
2. Data Custodian presents the Retail Customer with a list of resources for which there are valid relationships with Third Parties. If the Retail Customer only has one valid relationship, S2 and S3 may be skipped.
3. Retail Customer chooses a resource whose relationship is to be terminated.
4. Data Custodian terminates the relationship, deleting the appropriate Shared Resource Key from its list of valid relationships.
5. Data Custodian notifies Authorized Third Party that the relationship has been terminated (identifying the relationship by its Shared Resource Key).
6. Data Custodian notifies Retail Customer that the relationship has been terminated.
7. The Authorized Third Party handles any EUI not allowed by the termination of the relationship, in the manner specified in any service agreements among the parties in the relationship.

**5: Data Custodian Revokes Resource Authorization**

**Figure :** Data Custodian Revokes Resource Authorization

**Description**

The Retail Customer has an existing Authorized Third Party EUI access relationship with a particular Data Custodian and Authorized Third Party. The Data Custodian wants to terminate the relationship (for whatever reason).

**Pre-Condition:** Authorized Third Party has an established account with Data Custodian.

**Pre-Condition:** Retail Customer has established an Authorized Third Party EUI access relationship with the Data Custodian and the Authorized Third Party with respect to a particular resource, resulting in a unique Shared Resource Key identifying the relationship.

**Post-Condition:** Both the Authorized Third Party and the Data Custodian delete the Shared Resource Key for the relationship and no future interactions are permitted for that relationship.

**Post-Condition:** The Authorized Third Party handles any EUI provided to the Authorized Third Party during the relationship not allowed by the termination of the relationship in the manner specified in any service agreements among the parties in the relationship.

**Post-Condition:** The Data Custodian sends the Retail Customer notification of termination of the Authorized Third Party EUI access relationship.

**Scenario:** Basic Path

1. Data Custodian decides to terminate relationship with Authorized Third Party.
2. Data Custodian notifies Retail Customer of termination decision; no acknowledgement or confirmation is required.
3. Data Custodian notifies Authorized Third Party of termination of the relationship, identifying the relationship by a Shared Resource Key.
4. The Authorized Third Party handles any EUI provided to the Authorized Third Party during the relationship not allowed by the termination of the relationship, in the manner specified in any service agreements among the parties in the relationship.

**6: Authorized Third Party Terminates Relationship**

**Figure :** Authorized Third Party Terminates Relationship

**Description**

The Retail Customer has an existing Authorized Third Party EUI access relationship with a particular Data Custodian and Authorized Third Party. The Authorized Third Party determines that it no longer wants to provide services to the Retail Customer and terminates the relationship.

**Pre-Condition:** Authorized Third Party has an established account with Data Custodian.

**Pre-Condition:** Retail Customer has established an Authorized Third Party EUI access relationship with the Data Custodian and the Authorized Third Party with respect to a particular resource, resulting in a unique Shared Resource Key identifying the relationship.

**Post-Condition:** Both the Authorized Third Party and the Data Custodian delete the Shared Resource Key for the relationship and no future interactions are permitted for that relationship.

**Post-Condition:** The Authorized Third Party handles any EUI provided to the Authorized Third Party during the relationship not allowed by the termination of the relationship in the manner specified in any service agreements among the parties in the relationship.

**Post-Condition:** The Data Custodian sends the Retail Customer notification of termination of the Authorized Third Party EUI access relationship.

**Scenario:** Basic Path

1. Authorized Third Party decides to terminate an Authorized Third Party EUI access relationship.
2. Authorized Third Party notifies Data Custodian of termination of relationship, identifying the relationship by the Shared Resource Key.
3. An invalid request (e.g., specification of a Shared Resource Key not associated with the Authorized Third Party) will not be accepted.
4. Data Custodian deletes Shared Resource Key, terminating the relationship.
5. Data Custodian notifies the Retail Customer of termination of the relationship. No acknowledgement or confirmation is required.
6. The Authorized Third Party handles any EUI provided to the Authorized Third Party during the relationship not allowed by the termination of the relationship, in the manner specified in any service agreements among the parties in the relationship.

**7: Authorized Third Party Establishes Subscription with Data Custodian - Asynchronous**

**Figure :** Authorized Third Party Establishes Subscription with Data Custodian - Asynchronous

**Description**

The Retail Customer has an existing Authorized Third Party EUI access relationship with a particular Data Custodian and Authorized Third Party. The Authorized Third Party establishes a *subscription* indicating the circumstances (i.e., an agreed-upon schedule and/or specification of special events) under which the Data Custodian should provide the Authorized Third Party with the relevant EUI.

Depending on the services offered by a Data Custodian, the subscription may indicate the circumstances under which the Data Custodian will send EUI or only notification that EUI is available (i.e., whether the Data Custodian supports a push or pull model). Subscriptions may be parameterized, if supported by the Data Custodian, to define preferred delivery criteria (e.g., new EUI whenever available or only once per day).

**Pre-Condition:** Authorized Third Party has an established account with Data Custodian.

**Pre-Condition:** Retail Customer has established an Authorized Third Party EUI access relationship with the Data Custodian and the Authorized Third Party with respect to a particular resource, resulting in a unique Shared Resource Key identifying the relationship.

**Post-Condition:** The Data Custodian records a valid subscription on behalf of the Authorized Third Party. Future EUI availability triggers satisfying the subscription will result in the appropriate information being sent to the Authorized Third Party.

**Post-Condition:** Data Custodian sends the Authorized Third Party confirmation of its subscription request

**Post-Condition:** Data Custodian sends the Retail Customer notification of the Authorized Third Party's subscription request

**Scenario:** Basic Path

1. Authorized Third Party requests that the Data Custodian establish a new subscription.
2. Authorized Third Party provides Data Custodian with information defining the subscription request. At a minimum, this information includes a Shared Resource Key identifying the resource whose EUI is to be shared. The information may include additional subscription parameters, as supported by the Data Custodian.
3. The subscription will not be accepted if the Shared Resource Key is invalid.
4. The Data Custodian saves the subscription information, associating the subscription with the Shared Resource Key and the Authorized Third Party.
5. The Data Custodian notifies the Authorized Third Party that the subscription request was successful. No acknowledgement or confirmation is required.
6. The Data Custodian notifies the Retail Customer that the Authorized Third Party has completed a subscription for their EUI. No confirmation is required, as the Authorized Third Party already has permissions as indicated by the valid Shared Resource Key. If the subscription is not acceptable to the Retail Customer, Use Case 3 can be exercised to modify permissions for the Authorized Third Party.

**8: Authorized Third Party Requests EUI from Data Custodian - Asynchronous**

**Figure :** Authorized Third Party Requests EUI from Data Custodian - Asynchronous

**Description**

The Retail Customer has an existing Authorized Third Party EUI access relationship with a particular Data Custodian and Authorized Third Party. The Authorized Third Party requests specific EUI to be delivered with next transfer.

**Pre-Condition:** Authorized Third Party has an established account with Data Custodian

**Pre-Condition:** Retail Customer has established an Authorized Third Party EUI access relationship with the Data Custodian and the Authorized Third Party with respect to a particular resource, resulting in a unique Shared Resource Key identifying the relationship.

**Post-Condition:** The Data Custodian records the request on behalf of the Authorized Third Party. Future EUI availability triggers will result in the appropriate information being sent to the Authorized Third Party.

**Post-Condition:** Data Custodian sends the Authorized Third Party confirmation of its EUI request.

**Scenario:** Basic Path

1. Authorized Third Party decides to request EUI from the Data Custodian.
2. Data Custodian checks validity of request.
3. Data Custodian queues request for next asynchronous transfer.
4. Data Custodian sends confirmation to Authorized Third Party.

**9: Data Custodian Sends (Pushes) EUI to Authorized Third Party - Asynchronous**

**Figure :** Data Custodian Sends (Pushes) EUI to Authorized Third Party - Asynchronous

**Description**

The Retail Customer has an existing Authorized Third Party EUI access relationship with a particular Data Custodian and Authorized Third Party. The Authorized Third Party has established a subscription for receiving the relevant EUI from the Data Custodian. This EUI is sent (pushed) to the subscribed Authorized Third Party by the Data Custodian when an event triggers indicates a need to push new EUI.

Conditions observable to the Data Custodian change, causing an EUI availability trigger to be checked to see if there is a need to push EUI to the Authorized Third Party. Such triggers can be caused by any of the following observable changes

* New EUI is received by the Data Custodian
* A new subscription is received by the Data Custodian
* A pre-defined interval has elapsed
* A request for EUI has been received from a Authorized Third Party

**Pre-Condition:** Authorized Third Party has an established account with Data Custodian.

**Pre-Condition:** Retail Customer has established an Authorized Third Party EUI access relationship with the Data Custodian and the Authorized Third Party with respect to a particular resource, resulting in a unique Shared Resource Key identifying the relationship.

**Pre-Condition:** A subscription by the Authorized Third Party to receive EUI from the Data Custodian has been established.

**Post-Condition:** The Data Custodian sends EUI to the subscribed Authorized Third Party.

**Post-Condition:** Only EUI specifically requested or modified and in a subscription is sent to the Authorized Third Party.

**Scenario:** Basic Path

1. An EUI availability trigger is received by the Data Custodian.
2. Data Custodian determines the Shared Resource Keys associated with the EUI availability trigger. It then determines if there are any subscriptions associated with the Shared Resource Key and whether the conditions of the subscription are satisfied (i.e., if it is time to send out EUI). If so, it proceeds to S3.
3. Data Custodian determines the Authorized Third Party associated with the subscriptions. This includes a check that the Authorized Third Party is still in a valid relationship with the Data Custodian and any other relevant checks prior to releasing EUI to that Authorized Third Party.
4. Data Custodian provides EUI to Authorized Third Party.
5. Authorized Third Party retains EUI for the period specified by EUI retention requirements.

**10: Data Custodian Notifies Authorized Third Party of EUI Availability - Asynchronous**

**Figure :** Data Custodian Notifies Authorized Third Party of EUI Availability - Asynchronous

**Description**

The Retail Customer has an existing Authorized Third Party EUI access relationship with a particular Data Custodian and Authorized Third Party. The Authorized Third Party has established a subscription for receiving the relevant EUI from the Data Custodian. An Authorized Third Party is notified when new EUI satisfying its subscription parameters is available.

Conditions observable to the Data Custodian change, causing an EUI availability trigger to be checked to see if there is a need to notify an Authorized Third Party of EUI availability. Such triggers can be caused by any of the following observable changes.

* New EUI is received by the Data Custodian
* A new subscription is received by the Data Custodian
* A pre-defined interval has elapsed
* A request for EUI has been received from an Authorized Third Party

**Pre-Condition:** Authorized Third Party has an established account with Data Custodian

**Pre-Condition:** Retail Customer has established an Authorized Third Party EUI access relationship with the Data Custodian and the Authorized Third Party with respect to a particular resource, resulting in a unique Shared Resource Key identifying the relationship.

**Pre-Condition:** Data Custodian has EUI relevant to the Authorized Third Party

**Post-Condition:** The Data Custodian has EUI (e.g., electricity usage data) that is available for access by the Authorized Third Party

**Post-Condition:** The Data Custodian sends the Authorized Third Party notification of availability of EUI

**Scenario:** Basic Path

1. An EUI availability trigger event is received by the Data Custodian.
2. Data Custodian determines the Shared Resource Keys associated with the EUI availability trigger. The Data Custodian then determines if there are any subscriptions associated with the Shared Resource Key and whether the conditions of the subscription are satisfied (i.e., if it is time to notify a Authorized Third Party). If so, it proceeds to S3.
3. Data Custodian determines the Authorized Third Party associated with subscriptions. This includes a check that the Authorized Third Party is still in a valid relationship with the Data Custodian and any other relevant checks prior to determining that it is appropriate to send EUI to that Authorized Third Party
4. Data Custodian notifies the Authorized Third Party of the availability of EUI associated with the Shared Resource Key. Note that notification can take different forms. Notification could be sent asynchronously as soon as the trigger is evaluated. Notification for several resources could be bundled for delivery to a common Authorized Third Party. Notification could be queued, awaiting the next scheduled interaction with the Authorized Third Party (e.g., as part of a response to a regular pull from the Authorized Third Party). No mechanism or timing is specified.

**11: Authorized Third Party Receives (Pulls) Requested EUI from Data Custodian - Asynchronous**

**Figure :** Authorized Third Party Receives (Pulls) Requested EUI from Data Custodian - Asynchronous

**Description**

The Retail Customer has an existing Authorized Third Party EUI access relationship with a particular Data Custodian and Authorized Third Party. The Authorized Third Party requests the relevant subscribed and requested EUI from the Data Custodian, who replies with the EUI if the request is valid.

**Pre-Condition:** Authorized Third Party has an established account with Data Custodian

**Pre-Condition:** Retail Customer has established an Authorized Third Party EUI access relationship with the Data Custodian and the Authorized Third Party with respect to a particular resource, resulting in a unique Shared Resource Key identifying the relationship.

**Pre-Condition:** Data Custodian has EUI relevant to the Authorized Third Party

**Post-Condition:** The Data Custodian replies with the requested EUI.

**Post-Condition:** Only the requested EUI is provided by the Data Custodian

**Scenario:** Basic Path

1. Authorized Third Party receives notification or periodically attempts to pull EUI from the Data Custodian.
2. Data Custodian checks validity of request.
3. Data Custodian replies with requested and subscribed EUI to Authorized Third Party.
4. Authorized Third Party persists EUI for use in performing services for Retail Customer.

**12: Authorized Third Party Requests EUI from Data Custodian - Synchronous**

**Figure :** Authorized Third Party Requests EUI from Data Custodian - Synchronous

**Description**

The Retail Customer has an existing Authorized Third Party EUI access relationship with a particular Data Custodian and Authorized Third Party. The Authorized Third Party directly requests specific EUI from the Data Custodian, who replies with the requested EUI synchronously if the request is valid.

**Pre-Condition:** Authorized Third Party has an established account with Data Custodian

**Pre-Condition:** Retail Customer has established an Authorized Third Party EUI access relationship with the Data Custodian and the Authorized Third Party with respect to a particular resource, resulting in a unique Shared Resource Key identifying the relationship

**Pre-Condition:** Authorized Third Party requests authorized EUI

**Post-Condition:** The Data Custodian replies with the requested EUI.

**Post-Condition:** Only the requested EUI is provided by the Data Custodian.

**Scenario:** Basic Path

1. Authorized Third Party decides to pull EUI from the Data Custodian.
2. Authorized Third Party specifies the EUI being requested. The request must contain the Shared Resource Key. It may also contain parameters (e.g., the period over which the specified EUI is requested), if permitted by Data Custodian.
3. Data Custodian checks validity of request (e.g., Shared Resource Key is still valid and registered with this Authorized Third Party or validity of any additional parameters).
4. Data Custodian sends requested EUI to Authorized Third Party.
5. Authorized Third Party persists EUI for use in performing services for Retail Customer.

# C. ESPI Abstract Services

This section provides definition of the abstract services used in the use cases. These are the services that will be specified fully for the ESPI Model Business Practice specification. The services are named using the following conventions, since not all are intended to be fully standardized.

* Underscore before the method name means “to be done, but not standardized”
* Underscore after the method name means “optional”

**Figure** : *-* Logical Service Interfaces

**DataCustodian**

**Operations**

| **Method** | **Notes** | **Parameters** |
| --- | --- | --- |
| **\_CreateThirdPartyId()**  |  | ApplicationInformation [] ApplicationInformation |
| **ReadServiceStatus()**  |  |  |
| **CreateRequestToken()**  |  | Authorization [] authRequest |
| **Authorize()**  |  | Authorization [] authorization |
| **CreateAccessToken()**  |  | Authorization [] authRequest |
| **\_ReadAuthorizationList()**  |  | RetailCustomerId [] customerID |
| **\_UpdateAuthorization()**  |  | Authorization [] authorization |
| **CreateSubscription()**  |  | Authorization [] authorization |
| **DeleteSubscription()**  |  | Authorization [] authorization |
| **RequestData()**  |  | Authorization [] authorization |
| **ReadData()**  |  | BatchLocation [] batch |
| **ReadData\_()**  |  | Authorization [] authorizationDateTimeInterval [] requestedInterval |

**RetailCustomer**

**Operations**

| **Method** | **Notes** | **Parameters** |
| --- | --- | --- |
| **\_UpdateAuthorizationNotification()**  |  | Authorization [] authorization |

|  |  |  |
| --- | --- | --- |
|  |  |  |

**Authorized ThirdParty**

**Operations**

| **Method** | **Notes** | **Parameters** |
| --- | --- | --- |
| **\_ReadDataCustodianList()**  |  | RetailCustomerId [] reatilCustomerID |
| **\_RequestAuthorization()** boolean | This method represents the delivery of the request to authorize an access grant. The normal flow implements this using a URL redirect, but other methods may be possible.  | Authorization [in] authorization |
| **ProvideAuthorization()**  |  | Authorization [] authorization |
| **NotifyUpdateAuthorization\_()**  |  | Authorization [] authorization |
| **NotifyData\_()**  |  | BatchList [] batchList |
| **UpdateData\_()**  |  | Batch [] data |

The following table contains a listing of these Logical Interface Operations, along with the expected Physical Operation for informative purposes. Physical operation names in parentheses are passed programmatically.

| **Actor**  | **Description** | **Logical** | **Physical** |
| --- | --- | --- | --- |
| Data Custodian | Ability to get service status | ReadServiceStatus | ServiceStatus |
| Data Custodian | Initiate signed request\_token request per RFC 5849 | CreateRequestToken | request\_token |
| Data Custodian | Initiate signed authorize request per RFC 5849 | Authorize | authorize |
| Data Custodian | Initiate signed access\_token request per RFC 5849 | CreateAccessToken | access\_token |
| Data Custodian | Update existing authorization  | NotifyUpdateAuthorization\_ | Authorization |
| Data Custodian | Revoke existing authorization (Retail Customer) | NotifyUpdateAuthorization\_ | Authorization |
| Data Custodian | Terminate existing authorization via service | UpdateAuthorization | Authorization |
| Data Custodian | Request subscription to authorized resource | CreateSubscription | Subscription (from config) |
| Data Custodian | Request authorized data resource(s) | RequestData | (request\_token scope) |
| Data Custodian | Receive requested and subscribed EUI | ReadData | (dataCustodianDefaultBatchResource) |
| Data Custodian | Request and receive authorized EUI | ReadData\_ | (request\_token scope) |
| Third Party | Initiate callback specified in request\_token per RFC 5849 | ProvideAuthorization | (request\_token callback) |
| Third Party | Revoke existing authorization (Data Custodian) | NotifyUpdateAuthorization\_ | Authorization |
| Third Party | Send requested and subscribed EUI | UpdateData\_ | (thirdPartyDefaultBatchResource) |
| Third Party | Notify requested and subscribed EUI is available | NotifyData\_ | (thirdPartyDefaultNotifyResource) |

## Logical Information Model

This section contains descriptions of the data elements used in the abstract services.

**Figure** : ESPI Logical Information Model

**AccessToken**

**ApplicationInformation**

**Authorization**

| **Name** | **Type** | **Description** |
| --- | --- | --- |
| **thirdPartyID** | *ThirdPartyId* |  |
| **requestToken** | *Token* |  |
| **accessToken** | *Token* |  |
| **data** | *DataResource* |  |
| **validityInterval** | *DateTimeInterval* |  |

**Batch**

**BatchList**

**BatchLocation**

|  |  |  |
| --- | --- | --- |
| **Name** | **Type** | **Description** |
| **reference** | *String* |  |

**CurrentStatus**

|  |  |  |
| --- | --- | --- |
| **Name** | **Type** | **Description** |
| **normal** |  |  |
| **unavailable** |  |  |
| **terminated** |  |  |

**DataCustodianId**

**DataResource**

|  |  |  |
| --- | --- | --- |
| **Name** | **Type** | **Description** |
| **operation** | *byte* |  |

**RequestToken**

**RequestorID**

**RetailCustomerId**

**ServiceStatus**

|  |  |  |
| --- | --- | --- |
| **Name** | **Type** | **Description** |
| **currentStatus** | *CurrentStatus* |  |

**Subscription**

**ThirdPartyId**

**Token**

**UsagePointList**

# D. Model Conformance Information

The following table provides information about the elements included in ESPI and their relation to the NAESB PAP10 Energy Usage Information Model as well as the IEC TC57 CIM Model. Harmonization across these models is a goal of this recommendation, as is aligning with other usage information interfaces, including Smart Energy Profile 2.0.

| **PAP10 EUI Model Element** | **Type** | **ESPI Model Element** | **Type** | **CIM Notes** |
| --- | --- | --- | --- | --- |
| CustomerAuthorisation.name | String | (OAuth) access\_token |  | N/A |
| CustomerAuthorisation.validityInterval | DateTimeInterval | (OAuth 2.0) expires\_in  |  | N/A |
| UsagePoint.name | String | UsagePoint entry.id | URN | Same |
| UsagePoint.description | String | UsagePoint entry.title | String | Same |
|  |  | UsagePoint.status | UInt8 | connectionState |
| ServiceCategory.kind | ServiceKind | ServiceCategory.kind | ServiceKind | Same |
| ServiceKind.electricity |  | ServiceKind 0 |  | (encoded) |
| ServiceKind.gas |  | ServiceKind 1 |  | (encoded) |
| ServiceKind.water |  | ServiceKind 2 |  | (encoded) |
| MeterReading.name | String | MeterReading entry.id | URN | Same |
|  |  | MeterReading entry.title | String | Same |
| ReadingType.name | String | ReadingType entry.id | URN | Same |
|  |  | ReadingType entry.title | String | Same |
| ReadingType.defaultQuality | QualityOfReading | ReadingType.defaultQuality | QualityOfReading | Recommended extension |
| ReadingType.direction | ReadingDirection | ReadingType.flowDirection | FlowDirectionType | Same |
| ReadingType.intervalLength | Duration | ReadingType.intervalLength | UInt32 | Recommended extension |
| ReadingType.kind | ReadingKind | ReadingType.kind | KindType | measurementKind |
| ReadingType.multiplier | UnitMultiplier | ReadingType.powerOfTenMultiplier | PowerOfTenMultiplierType | Recommended extension |
| ReadingType.unit | UnitSymbol | ReadingType.uom | UomType | unit |
|  |  | ReadingType.accumulationBehaviour | AccumulationBehaviourType | accumulation |
|  |  | ReadingType.dataQualifier | DataQualifierType | Recommended extension |
|  |  | ReadingType.tou | TOUType | Same |
|  |  | ReadingType.currency | CurrencyCode | Same |
|  |  | ReadingType.commodity | CommodityType | Same |
|  |  | ReadingType.consumptionTier | ConsumptionTierType | Same |
|  |  | ReadingType.phase | PhaseCode | phases |
|  |  | IntervalBlock entry.id | URN | Recommended extension |
|  |  | IntervalBlock entry.title | String | Recommended extension |
|  |  | IntervalBlock.interval | DateTimeInterval | Recommended extension |
| Reading.cost | Float | Reading.cost | UInt48 | Recommended extension |
| Reading.timeStamp | AbsoluteDateTime | Reading.timePeriod | DateTimeInterval | Same |
| Reading.value | Float | Reading.value | UInt48 | Same |
| ReadingQuality.quality | QualityOfReading | ReadingQuality.quality | QualityOfReading | Recommended extension |
| DateTimeInterval.start | AbsoluteDateTime | DateTimeInterval.start | TimeType | Same |
| DateTimeInterval.duration | Duration | DateTimeInterval.duration | UInt32 | Uses "end" instead of "duration" |
| QualityOfReading.estimated |  | QualityOfReading 8 |  | (encoded) |
| QualityOfReading.raw |  | QualityOfReading 1 |  | (encoded) |
| QualityOfReading.validated |  | QualityOfReading 0 |  | (encoded) |
| ReadingDirection.forward |  | FlowDirectionType 1 |  | (encoded) |
| ReadingDirection.reverse |  | FlowDirectionType 19 |  | (encoded) |
| ReadingKind.energy |  | FlowDirectionType 12 |  | (encoded) |
| ReadingKind.power |  | FlowDirectionType 37 |  | (encoded) |
| ReadingKind.demand |  | FlowDirectionType 8 |  | (encoded) |
| UnitMultiplier.micro |  | PowerOfTenMultiplierType -6 |  | (encoded) |
| UnitMultiplier.m |  | PowerOfTenMultiplierType -3 |  | (encoded) |
| UnitMultiplier.c |  | PowerOfTenMultiplierType -2 |  | (encoded) |
| UnitMultiplier.d |  | PowerOfTenMultiplierType -1 |  | (encoded) |
| UnitMultiplier.k |  | PowerOfTenMultiplierType 3 |  | (encoded) |
| UnitMultiplier.M |  | PowerOfTenMultiplierType 6 |  | (encoded) |
| UnitMultiplier.G |  | PowerOfTenMultiplierType 9 |  | (encoded) |
| UnitMultiplier.T |  | PowerOfTenMultiplierType 12 |  | (encoded) |
| UnitMultiplier.none |  | PowerOfTenMultiplierType 0 |  | (encoded) |

**4. SUPPORTING DOCUMENTATION**

**a. Description of Request:**

**b. Description of Recommendation:**

**c. Business Purpose:**

**d. Commentary/Rationale of Subcommittee(s)/Task Force(s):**

Please see the ESPI Minutes posted on the ESPI web page: http://www.naesb.org/espi\_task\_force.asp