



Energy Management Object Preview

By Rick Blair (Schneider Electric) &
Rich Morgan (Rockwell Automation)

Technical Track

Definition of Terms

States

Attributes

Services

Implementation Considerations

Definition of Terms

- ▶ Managed Entity – Device that supports Energy Management object
- ▶ Energy Management Client (Client) – Application that controls Managed Entities via instances of Energy Management Objects
- ▶ Managed Instance – An instance of an Energy Management object

Definition of Terms Continued

- ▶ Energy Management State (State) – Conditions defining Managed Instance behavior
- ▶ Curtailment Level (Level) – Collection of power level data defining a reduced power condition
- ▶ Pass Code – Client-created 32-bit unsigned integer that must be present in all Energy Management object specific service requests

Energy Management

Energy saving opportunities during production

Managed Entity can contain one or more Managed Instances

Uses curtailment levels to manage energy usage

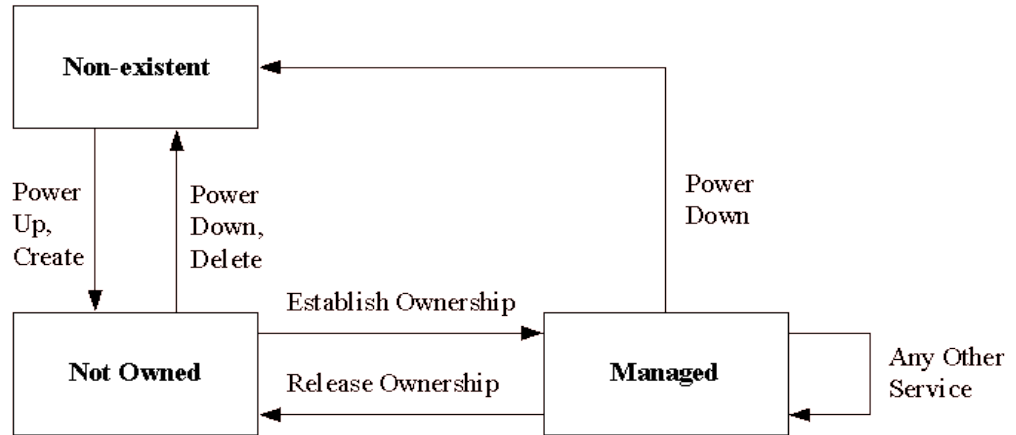
Altered production during power saving Levels

Energy Management States

Three States

Nonexistent

- ▶ Power is off or
- ▶ Not created



Not owned

- ▶ Default state on power up or creation
- ▶ Energy management not possible in this state
- ▶ Client issues service request to establish ownership between itself and Managed Instance

Energy Management States

Managed

- ▶ Energy management possible

- ▶ Energy Management Client can:
 - Check status
 - Command to a Curtailment Level
 - Execute Curtailment Level services
 - Release ownership

Instance Attributes

9 Attributes

Instance Attributes

9 Attributes

- ▶ Curtailment Levels Array

Array of Curtailement Levels



Curtailment Levels Array

7 Members

Curtailment Levels Array

7 Members

- ▶ ID

Unique number
assigned to each
Level in the array

Curtailment Levels Array

7 Members

- ▶ ID
- ▶ Data Object Path

Path to Data Object Data Object is

- ▶ Transition instructions
- ▶ Vendor-specific content
- ▶ e.g. use File Object

Curtailment Levels Array

7 Members

- ▶ ID
- ▶ Data Object Path
- ▶ Data Object Validity Check

**Manage integrity
between
Managed
Instance and
Data Object
Vendor-specific**

Curtailment Levels Array

7 Members

- ▶ ID
- ▶ Data Object Path
- ▶ Data Object Validity Check
- ▶ Capabilities

4 Fields

- ▶ Hide Data Object Association
- ▶ Protected From Deletion
- ▶ Protected From Modification
- ▶ Data Object Unnecessary

Curtailment Levels Array

7 Members

- ▶ ID
- ▶ Data Object Path
- ▶ Data Object Validity Check
- ▶ Capabilities
- ▶ Status

2 Fields

- ▶ Data Status
- ▶ Level Unavailable

Curtailment Levels Array

7 Members

- ▶ ID
- ▶ Data Object Path
- ▶ Data Object Validity Check
- ▶ Capabilities
- ▶ Status
- ▶ Percent Power

Expected power in
percentage of full
power

1 – 10000 =

0.01% - 100.00%

Curtailment Levels Array

7 Members

- ▶ ID
- ▶ Data Object Path
- ▶ Data Object Validity Check
- ▶ Capabilities
- ▶ Status
- ▶ Power
- ▶ Description

**Multi-language text
string to describe
Level**

Instance Attributes

9 Attributes

- ▶ Curtailment Levels Array
- ▶ Number of Curtailment Levels

Number of Curtilment Levels in Curtilment Levels array

Instance Attributes

9 Attributes

- ▶ Curtailment Levels Array
- ▶ Number of Curtailment Levels
- ▶ Instance Capabilities

1 Field

- ▶ Curtailment Level Array Read Only

Instance Attributes

9 Attributes

- ▶ Curtailment Levels Array
- ▶ Number of Curtailment Levels
- ▶ Instance Capabilities
- ▶ Instance Status

7 Fields

- ▶ Matching ID
- ▶ Present State
- ▶ In Transition
- ▶ Management Unavailable
- ▶ Curtailment Level Array Full
- ▶ Level Mismatch
- ▶ Capture in Progress

Instance Attributes

9 Attributes

- ▶ Curtailment Levels Array
- ▶ Number of Curtailment Levels
- ▶ Instance Capabilities
- ▶ Instance Status
- ▶ Present Curtailment Level ID

**Level at which
Managed
Instance is
currently
operating**

Instance Attributes

9 Attributes

- ▶ Curtailment Levels Array
- ▶ Number of Curtailment Levels
- ▶ Instance Capabilities
- ▶ Instance Status
- ▶ Present Curtailment Level ID
- ▶ Present Expected Power

**Calculated power
based on Level**

Instance Attributes

9 Attributes

- ▶ Curtailment Levels Array
- ▶ Number of Curtailment Levels
- ▶ Instance Capabilities
- ▶ Instance Status
- ▶ Present Curtailment Level ID
- ▶ Present Expected Power
- ▶ Client Path

CIP path to owning client

Instance Attributes

9 Attributes

- ▶ Curtailment Levels Array
- ▶ Number of Curtailment Levels
- ▶ Instance Capabilities
- ▶ Instance Status
- ▶ Present Curtailment Level ID
- ▶ Present Expected Power
- ▶ Client Path
- ▶ Uncurtailed Power

**Power in kWh
when operating
with no
curtailment**

Instance Attributes

9 Attributes

- ▶ Curtailment Levels Array
- ▶ Number of Curtailment Levels
- ▶ Instance Capabilities
- ▶ Instance Status
- ▶ Present Curtailment Level ID
- ▶ Present Expected Power
- ▶ Client Path
- ▶ Uncurtailed Power
- ▶ Options

1 Field

- ▶ Power Up Curtailment Level

Object Specific Services

Establish_Ownership

Change_Ownership

Release_Ownership

Energy_Management

Energy_Management_ Query

Capture_Level

Remove_Level

Revise_Level

Read_Level

Write_Level

Associate_Level

Disassociate_Level

Ownership Services

Establish_Ownership

- ▶ Used to establish ownership relationship between Energy Management Client and instance
- ▶ Transitions device to Managed state

Change_Ownership

- ▶ Allows an owning client to change Pass Code and Owner Path
- ▶ Only allowed in Managed state

Release_Ownership

- ▶ Used to clear ownership relationship between Energy Management Client and instance
- ▶ Only allowed in Managed state
- ▶ Transitions instance to Not Owned state

Energy_Management Services

Energy_Management_Query service

- ▶ Used to test the contents of an Energy_Management service request without executing
- ▶ Can also be used to check ownership

Energy_Management service

- ▶ Used to command instance to a curtailment level
 - Equal or below, equal, equal or above

Request contains command and Requested Curtailment Level

If device cannot find level that satisfies request, no action taken

Curtailment Level Services

Capture_Level

- ▶ Saves current operating configuration to curtailment level

Revise_Level

- ▶ Allows modification of curtailment level content

Remove_Level

- ▶ Removes a curtailment level from instance

Curtailment Level Services

Read_Level

- ▶ Provides backup capability for curtailment levels

Write_Level

- ▶ Provides restore capability for curtailment levels

Associate_Level

- ▶ Establish link between Managed Instance and Data Object instance

Disassociate_Level

- ▶ Remove link between Managed Instance and Data Object instance

Implementation Candidates

Simple Device

Highly Configurable Device

Energy Management Client

Energy Management Object

- ▶ Completes CIP Energy Object triangle
- ▶ Provides common interface to manage energy usage
- ▶ Provides proxy capabilities for to non-CIP devices