# Framework for Energy Efficiency Management

## draft-belmq-green-framework-04

GREEN WG Meeting
June 16 2025

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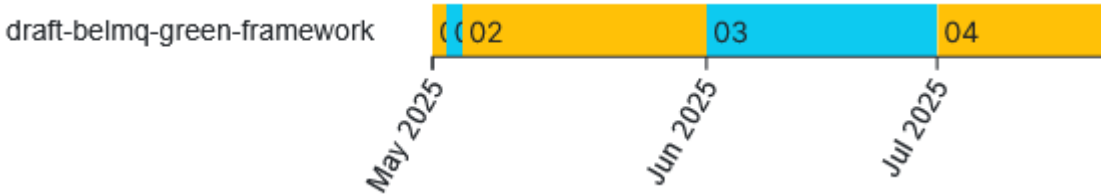
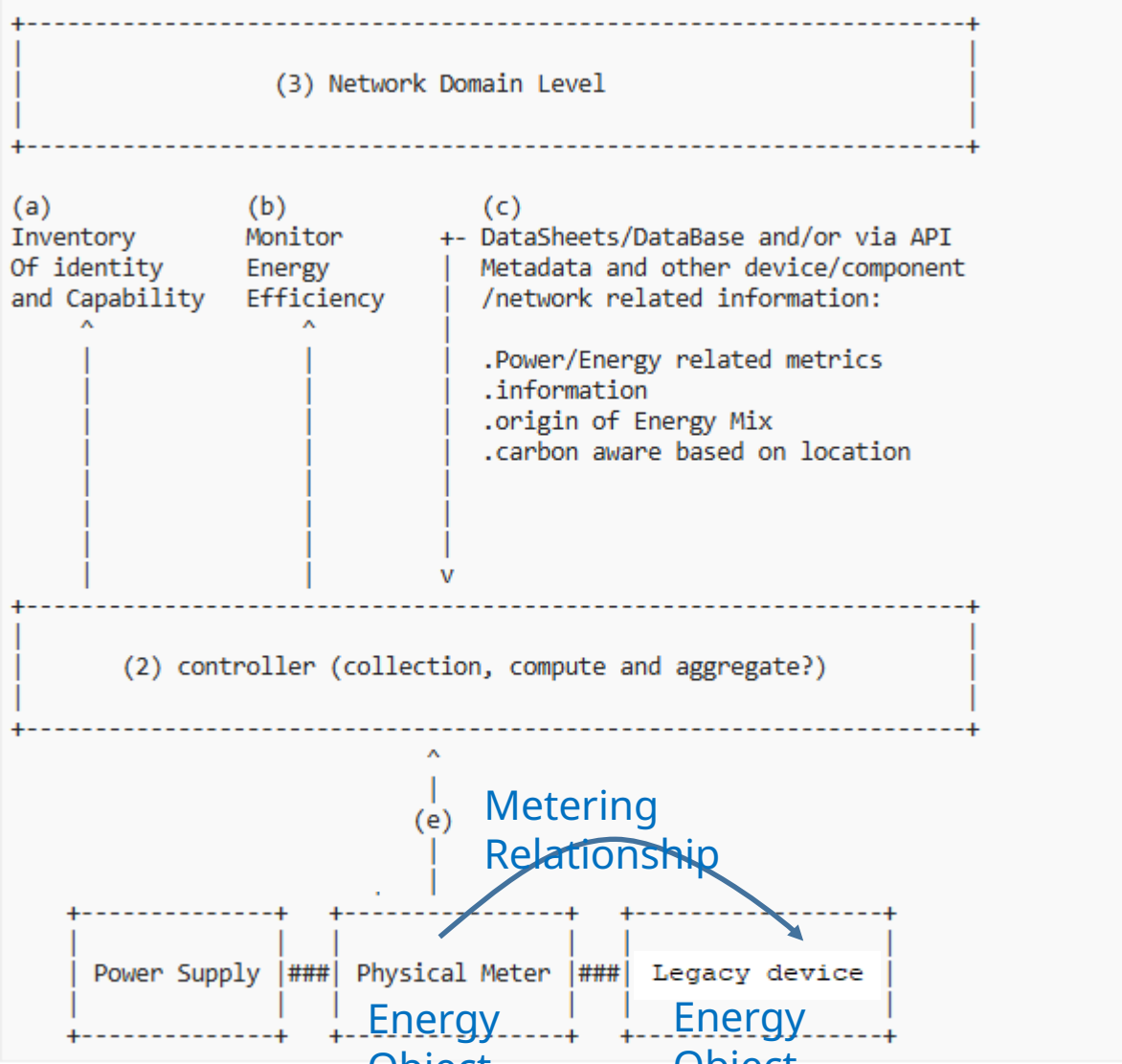


# Example: Physical Meter with Legacy Device

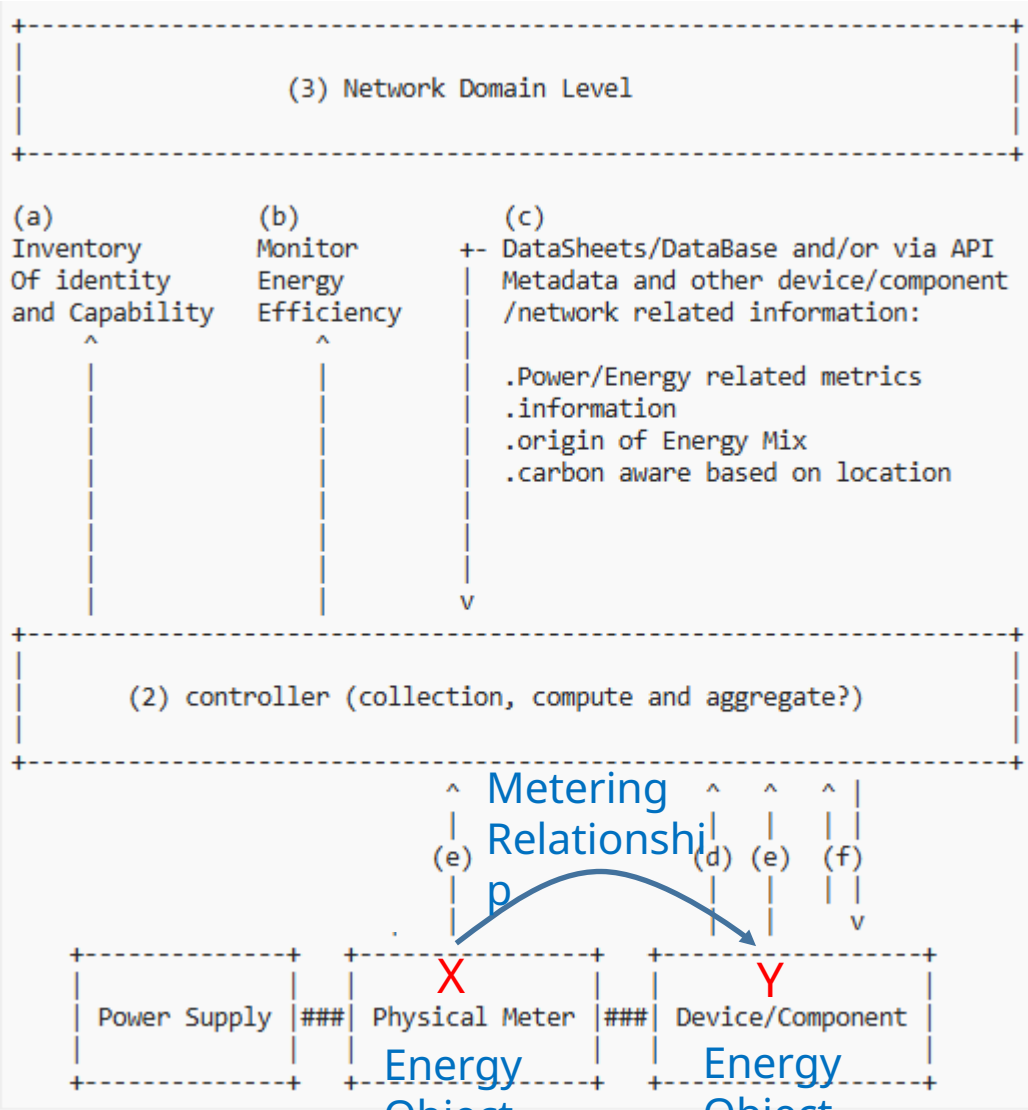
From the previous interim




- With legacy devices, the controller (or Network Domain Level) must know & report that the physical meter measures on the behalf of this legacy device.
- In other words, it must know & report that the Energy Object 1 reports on behalf of Energy Object 2
- Conclusion: « Controller must know which for which Energy Object(s) it measures power or energy. This is the Metering Relationship”
- No LLDP over energy distribution => so a manual process

# Example: Physical Meter with Newer Device

From the previous interim




ISSUE: double counting!

- Where to measure?
  - X or Y
  - The physical meter Energy Object or the device/component Energy Object?
- What if the controller can query both? => double-counting issue?
- The controller MUST NOT calculate the sum of all Power Interfaces
- The controller (or Network Domain Level) must know & report that the physical meter measures on the behalf of the device/component, based on (a)
- Conclusion: « Controller must know which for which Energy Object(s) it measures power or energy. This is the Metering

# Example: Power over Ethernet

From the previous interim & hackathon

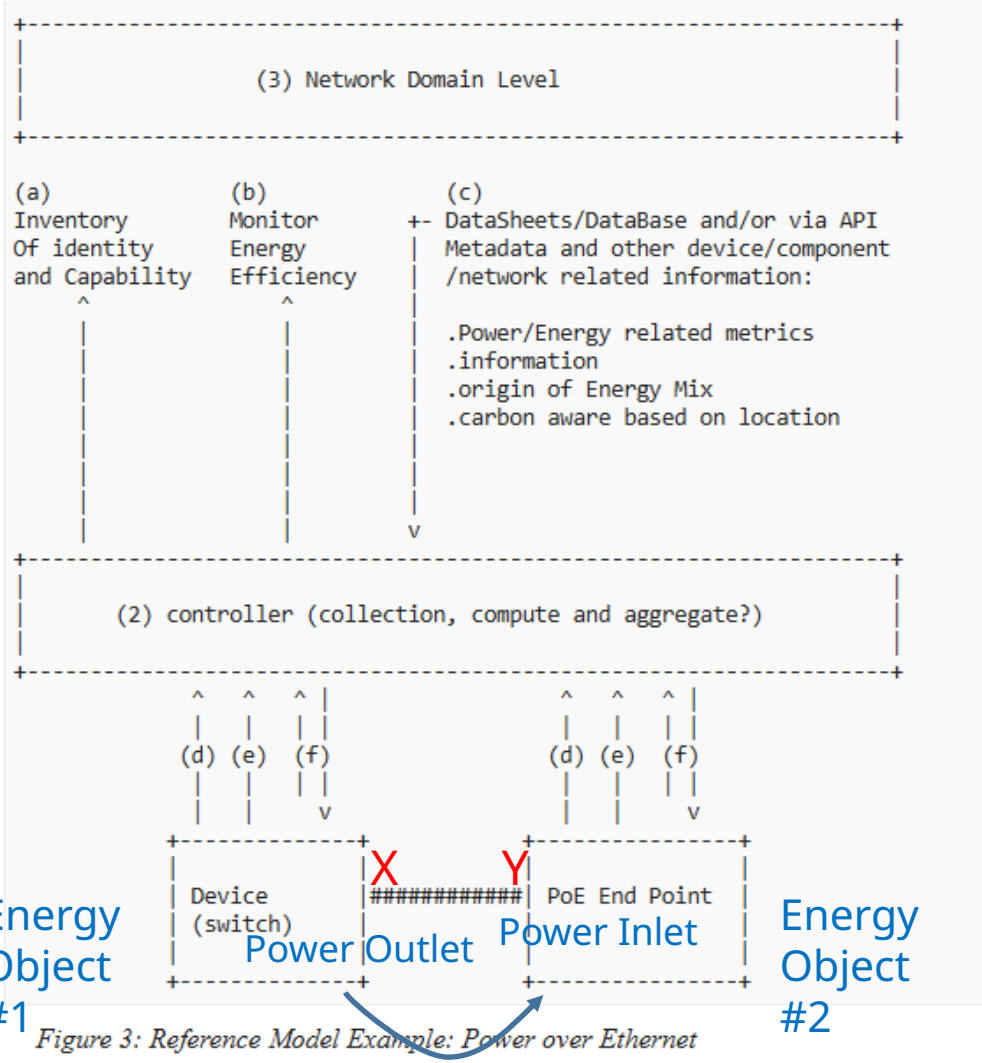



*Figure 3: Reference Model Example: Power over Ethernet*

NOTE: "###" is used to denote a transfer of energy.
"- >" is used to denote a transfer of information.

ISSUE: controller double counting?

- Same issue as before
- Power Outlet vs Power Inlet

ISSUE #2: who controls what?

- In this case, the PoE port on the switch controls the PoE End Point
- We might have two ways to control the PoE End Point:
  - Power on switch port
  - Power State on the PoE End Point (ex: low energy mode)
- To control the PoE End Point, the controller must know the Power Source Relationship between the two Energy Objects.

These are key differences with typical networking frameworks

# Example: Smart PDU

Hackathon

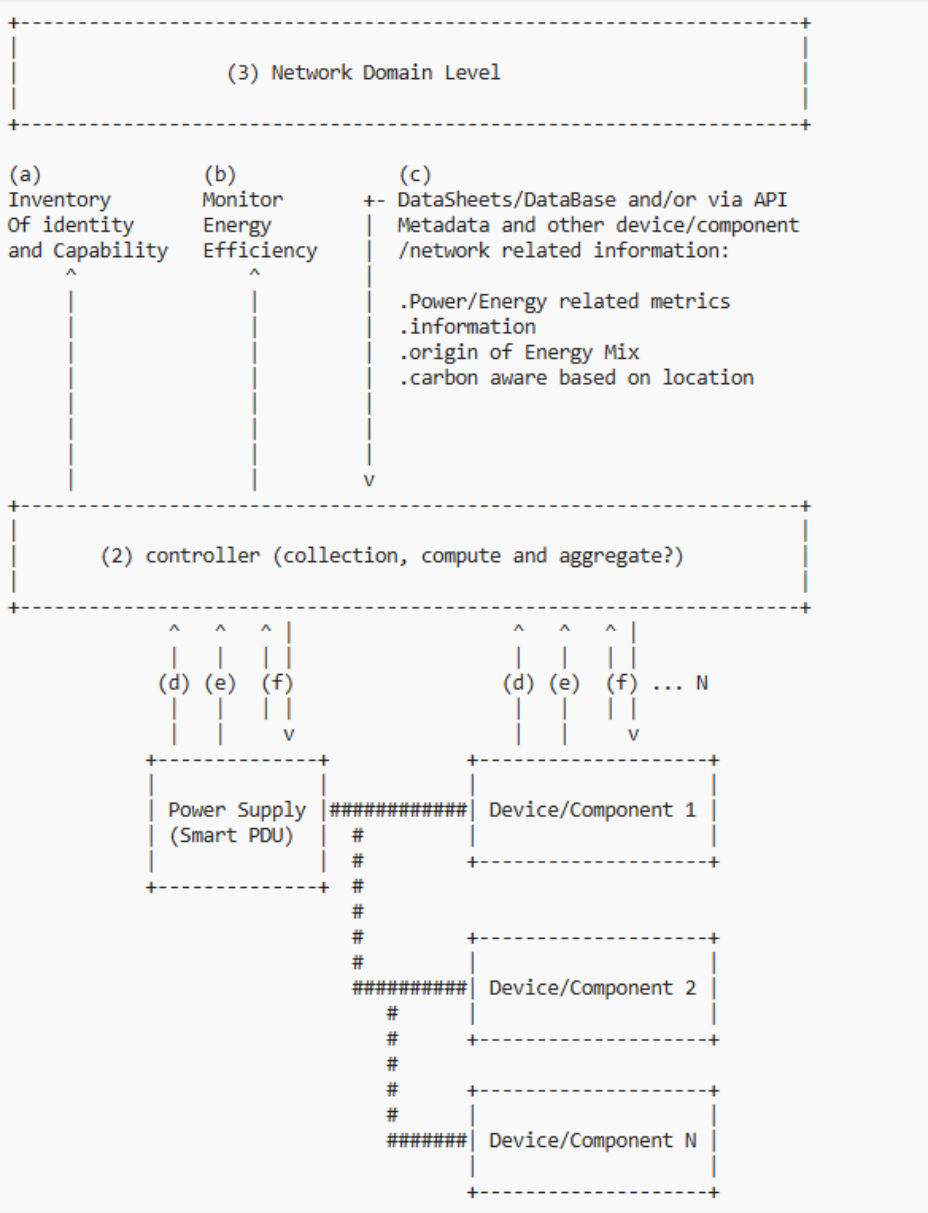
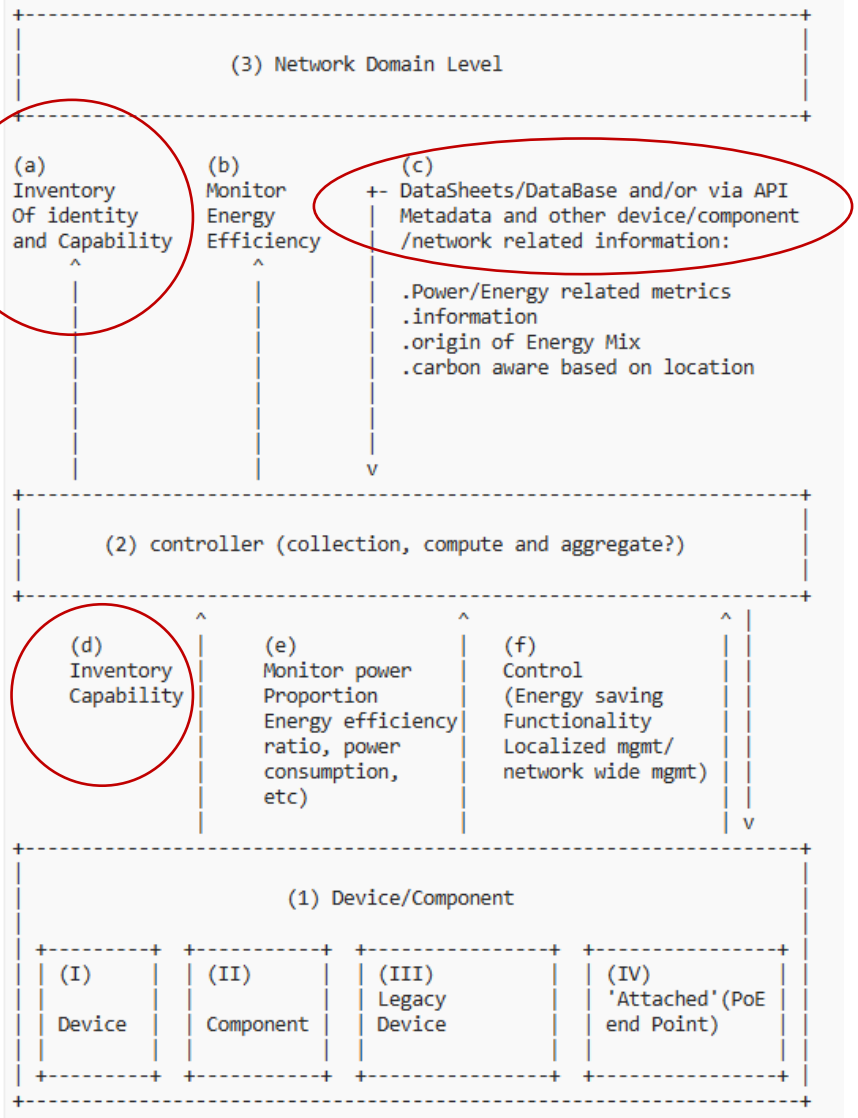



*Figure 5: Reference Model Example: Single Power Supply with Multiple Devices*

NOTE: "###" is used to denote a transfer of energy.
"- >" is used to denote a transfer of information.

# GREEN Reference Model

From the previous interim




Conclusion:

- Next to the physical topology, we need the power source & control topologies
- Inventory Capabilities include metering and power source relationships
- From which interface(s) (a), (c), and/or (d)… to be discussed in the framework document (might vary depending on the lifetime)

# New in draft-belmq-green-framework-03

### 4.3. Power State Set

The Energy Object contains a Power State Set attribute that represents the set of Power States a device or component supports.

A Power State describes a condition or mode of a device or component. While Power States are typically used for control, they may be used for monitoring only.

A device or component is expected to support at least one set of Power States consisting of at least two states: an on state and an off state.

The semantics of a Power State are specified by:

* The functionality provided by an Energy Object in this state.

* A limitation of the power that an Energy Object uses in this state.

* A combination of the first two.

The semantics of a Power State should be clearly defined. Limitation (curtailment) of the power used by an Energy Object in a state may be specified by:

* An absolute power value.

* A percentage value of power relative to the Energy Object's Nameplate Power.

* An indication of power relative to another Power State. For example, specify that power in state A is less than in state B.

* For supporting Power State management, an Energy Object provides statistics on Power States, including the time an Energy Object spent in a certain Power State and the number of times an Energy Object entered a Power State.

There are many existing standards describing device and component Power States. TO BE COMPLETED

# New in draft-belmq-green-framework-04


4.3. Power State Set
4.4. Power State Set Mapping and Intent
4.4.1. Capability Discovery
4.4.2. Intent Mapping
4.4.3. SLA Considerations
4.4.4. Open Issues
5. Conventions and Definitions

From the previous interim, as presented by the chairs

# Modelling Questions

1. **What level of dependence do/should models have on Framework?**
2. **What layers of models do we need, device, network, service, inventory, topology?**
3. **How much granularity in power control? (e.g., power states vs on/off)**
4. **Should control relate to intent or actual power usage?**
5. **How generic should the model be for components? (e.g., linecards vs optics, vs forwarding planes)**
6. **How to model power reported for other devices?**
7. **How does the data get aggregated together?**
8. **Accuracy of the data?**
9. **Time intervals for data reporting?**

In version 4

# Open Issues

- Discovering Capabilities
  - Enable automatic detection of power-saving features
  - Allow controllers to easily discover device-specific limits like transition time and duty cycle
- Understanding Capabilities
  - Explore if Energy Objects can support multiple sets of power states.
  - Make power states clearly described and understandable.
  - Represent these capabilities in a machine-readable format.
- Mapping Intents to Device Settings
  - Develop ways to translate high-level energy goals (like “save energy at low utilization”) into actual device configurations.
  - Create a standard method to describe this mapping across systems.
- Handling Transitions and Ensuring Safetly

- How to link the component to the Hardware YANG, IVY, SIMAP?

Big question: Should we focus first on monitoring, as well as discovering capabilities, as opposed to controller configuration?

# Questions: Power State

- #1. Do we want more than on/off?
  If yes, we need a variable "something"

- If yes #2: finite number of value/state versus a range (let's say 0 to 100)?

  - If finite number of value/state
    - power state is one solution (or energy saving mode)

  - If a range
    - this could be a single value with the range from 0 to 100 (as advocating on the mailing list)
      What is going to be the effect if I want to set it 42 and the component does not understand