Code of Conduct on energy management related interoperability of Energy Smart Appliances (V.1.0)

Content

1. Introduction

The energy supply in the EU is increasingly characterized by a decentralized supply landscape in which local (PV systems), regional (neighbourhoods, communities, DSOs) as well as supraregional supply elements must interlock. In addition, an increasing share of energy generation is being replaced by renewable sources that are dependent on the weather. The energy system must be able to deal with this variable supply, by intelligently exploiting demand side flexibility among other things.

"Energy Smart Appliances (ESA) are products that provide energy flexibility being capable of automatically (by means of machine-to-machine communication) optimising their consumption patterns (e.g. time or profile) in response to external stimuli, based on user permission."

Expectations are that Energy Smart Appliances (ESA) will contribute considerably to demand flexibility of households in the European Union in the near future, depending on their penetration level. This potential needs to be unlocked by EU energy and environmental policies. It is important that the Demand Side Flexibility of ESA is maximised by ensuring interoperability and allowing the participation of the relevant actors.

To help all parties to address the issue of Demand Side Flexibility ESA manufacturers are invited to sign this Code of Conduct. This Code of Conduct sets out the basic principles to be followed by all parties involved in developing and producing ESA that are placed on the EU market.

The chapters of this document include:

- the scope of this first version of the Code of conduct, which starts with HVAC and white goods, and a selection of uses cases;
- the list of commitments for signatories;
- the monitoring;
- the management of future version of this Code of Conduct, and;
- annexes that provide details on how to comply with this version, explanations, and additional informative material.

As energy flexibility cannot be exploited with standalone ESA, the other relevant actors (like energy management system providers, service providers, network operators, electric vehicle –EV– chargers, photovoltaic –PV– inverters, batteries, equipment and components, etc.) are invited to acknowledge and contribute to the development of this Code of Conduct with the goal to ensure the overall flexibility and interoperability of the energy system.

2. Scope

This Code of Conduct covers the following electrical **appliances** that have an energy label:

- White goods: washing machines, tumble driers, washer-driers, dishwashers;
- Heating, ventilation, and air conditioning (HVAC), including water heating;

and the following **use cases**:

- Flexible start
- Monitoring of Power Consumption
- Limitation of Power Consumption
- Incentive Table based Power Consumption Management
- Manual operation *(provisioning of necessary information in case of user driven manual operation of ESA)*

Annex 1 provides the link of use cases to the corresponding appliances.

3. Aim

The aim of this Code of Conduct is to increase the number of interoperable ESA that are placed on the Union market.

In the near future, the current Code of Conduct will help to improve the environmental impact of energy use over the whole energy system, contribute to grid stability/security of supply, economical optimization, or other objectives through the increase of Demand Side Flexibility.

4. Commitment

Signatories of this Code of Conduct agree to make all reasonable efforts to:

a) Ensure that at least one model of ESA placed on the Union market as of one year after the official signature event of the first version of the Code of Conduct has implemented the applicable use cases for the specific ESA according to Annex 1 and Annex 2.

b) Ensure the implementation of interoperability profiles based on standardised Open Application Programming Interface / Open Communication Protocol to enable the information exchange for the applicable use cases (see point a).

c) Apply state of the art and open security mechanisms for the open communication protocol used (see point b) to: (1) secure the communication, (2) support the installation, administration and configuration (including the assignment of the system roles), (3) ensure proper authorisation for accessing the ESA, and (4) provide the control over the usage of private data, in accordance with the relevant EU legislation in force.

d) Ensure that all relevant information elements used in the implemented use cases (see point a) as well as in the open protocol (see point b) have a corresponding SAREF representation, fully compliant with the SAREF framework of ontologies according to the technical specification ETSI TS 103 264 (SAREF core) and ETSI TS 103 410 series (SAREF extensions) (see Annex 2).

e) Provide end-users with information on the use cases, including the conditions needed to use them, how to activate them and the benefits.

f) Cooperate with the European Commission and Member States authorities in an annual review of the Code of Conduct.

g) Indicate the compliance with the Code of Conduct when registering new ESA models in the EPREL database.

The implementation of the capabilities of Energy Smart Appliances can be realized in one of the following ways:

a. Physically in the ESA;

b. Represented as digital twin in the manufacturer cloud;

c. Represented as digital twin in a dongle/adapter, connected to the ESA.

The signatories commit to make their best efforts to indicate any of the above ways and the implemented use cases of the ESA in EPREL by selecting the corresponding option, (e.g. tick box, or similar).

They also commit to make their best efforts to indicate the ways for implementing the capabilities of Energy Smart Appliances in any technical promotional material where there is reference to the Code of Conduct.

Each version of the Code of Conduct, once published, is a standalone document that supersedes all previous versions, and neither refers to nor depends on such versions. When a new version of the Code of Conduct comes into force, it is assumed that all signatories will remain signatories for the new version. However, any signatory may withdraw from the new version of the Code of Conduct with no penalty.

5. Monitoring and updating

The status of the Code of Conduct will be discussed at least once a year by the signatories, the European Commission, Member States and their representatives, facilitated by the European Commission in order to:

a) Evaluate the level of compliance and the effectiveness of the Code of Conduct in achieving its aim.

b) Evaluate the current Code of Conduct and the need for future developments (such as additional ESA and uses cases) with a view to agreeing actions and/or amendments to the Code of Conduct.

Annexes

Annex 1 - Mapping of use cases to Energy Smart Appliances

	Flexible Start	Monitoring of Power Consumption	Limitation of Power Consumption	Incentive Table based Power Consumption Management	Manual operation
White goods					
• **washing machines, tumble driers, washer-driers, dishwashers**	M	O	O	n/a	M
Heating, cooling, and ventilation appliances					
• **heat pumps (delivering heat/cold through air or water)**	O	M	M	O	O
• **local space heaters**	O	M	M	O	O
• **water heaters**	O	M	M	O	O
• **ventilation**	n/a	M	O	O	O

M: mandatory; O: optional, n/a: not applicable

Table A1.1. Mapping of use cases to white goods and heating/cooling/ventilation appliances that have an energy label.

Annex 2 - Use Cases, minimal core data elements and SAREF / SAREF4x representation

Note 1:
The SAREF and SAREF4ENER representations are described in detail in
ETSI TS 103 264 (actual version) and
ETSI TS 103 410-1 (actual version).

Note 2:
The use cases are standardized in international standards. The use cases in this version of Code of Conduct make use of CENELEC EN50631:2023 - Household appliances network and grid connectivity, Part 1 – 4.

Note 3:
These are prefixes used throughout Annex 2.

Name	Description	Prefix:	URL:
Resource Description Framework	A vocabulary of terms to give additional meaning to data	rdf	http://www.w3.org/1999/02/22-rdf-syntax-ns#
SAREF Ontology	Core model to describe smart appliances	saref:	https://saref.etsi.org/core/
SAREF for Energy extension	Extension to SAREF for energy usage	s4ener	https://saref.etsi.org/saref4ener/
Ontology of Measurement	Vocabulary of units of measure	om	http://www.ontology-of-units-of-measure.org/resource/om-2/
Time Ontology	Vocabulary of Date and Time	time	http://www.w3.org/2006/time
XML Schema Definition	Vocabulary of common datatypes	xsd	http://www.w3.org/2001/XMLSchema#

Table A2.1. Prefixes used throughout Appendix 2.

1. Use Case: Flexible Start

The Flexible Start use case offers flexibility by programming the ESA to get the work done between the **earliest start time**, e.g. 11:00 am and a **latest end time**, e.g., 8:00 pm. The Energy Manager evaluates the overall situation at home and then chooses the best **start time** for the ESA.

While the ESA has not yet started, the Energy Manager can change its start time at any time. To be able to find optimal start times for the ESA, the Energy Manager needs to know it's expected "power sequence" (time-dependent power consumption) with constraints such as its **earliest start time**, **latest end time**, and **interrupt options (pausable, stoppable)**.

The ESA may also offer the Energy Manager to select an alternative power sequence like an Eco mode with longer runtime but reduced power consumption or a fast mode with higher consumption in a shorter runtime.

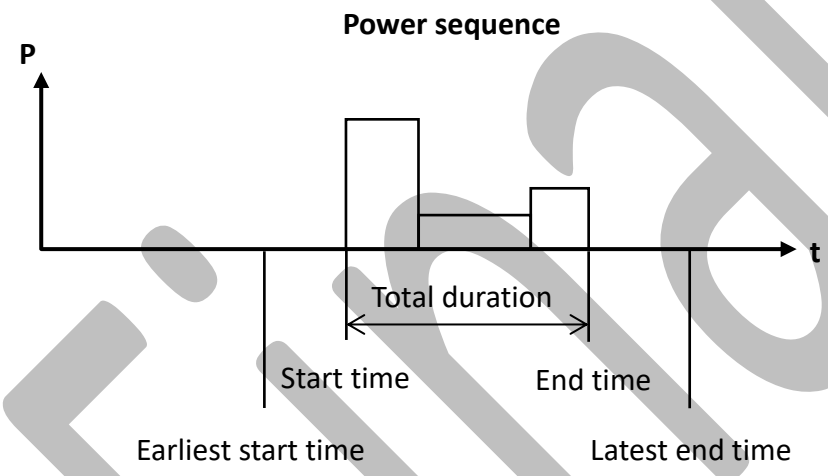

Figure A2.1. Properties of a scheduled power sequence

a) Flexible start for White Goods.

White Goods are the main users of the Flexible Start use case, because the use case fits the basic operation of white goods.

b) Flexible start for Heat Pumps, local space heaters or water heaters.

Heat pumps and electrical boilers can use the flexible start use case to support the generation of domestic hot water. It is easier to implement compared to the incentive table-based use case and provides still great flexibility to the energy manager.

145 SAREF triple representation for the use case *Flexible Start* with following core data elements:

SAREF triples	Value	Description
?esa rdf:type saref:Device .		Device description
?esa saref:isUsedFor ?commodity .		
?commodity rdf:type saref:Electricity .	saref:Electricity	Commodity = Electricity
?esa saref:makesMeasurement ?commodityProperty .		
? commodityProperty saref:relatesToProperty ?power .		
?power rdf:type saref:Power .	saref:Power	Property = Power
?esa saref:hasProfile ?powerProfile .		Power Profile belongs to the device
?powerprofile rdf:type s4ener:PowerProfile .		
?powerprofile s4ener:isRemoteControllable ?nodeRemoteControllable .	xsd:boolean: {“true”, “false”}	Energy Manager is allowed to remotely control the Power Profile node
?powerprofile s4ener:supportsReselection ?supportsReselection .	xsd:boolean: {“true”, “false”}	Power Profile node allows re-selection of power sequences by the Energy Manager, if allowed by the device
?powerProfile saref:consistsOf ?alternativesgroup .		Power Profile consists of Alternative Groups
?alternativesgroup rdf:type s4ener:AlternativesGroup .		
?alternativesgroup saref:hasIdentifier ?alternativesID .	xsd:string	Identifies the actual Alternative Group max. 1 Alternatives Group supported in this use case
?alternativesgroup saref:consistsOf ?powerSequence .		Each Alternative Group consist of min. 1 Power Sequence but allows multiple parallel Power Sequences for different purposes such as an ECO mode, a normal mode and a fast mode with corresponding sequences and slots
?powerSequence rdf:type s4ener:PowerSequence .		
?powerSequence saref:hasIdentifier ?sequenceID .	xsd:string	Identifies the actual Sequence in the corresponding Alternative Group

?powerSequence saref:hasState ?powerSequenceState .	One of the codelist elements {s4ener:Scheduled, s4ener:Inactive, s4ener:Invalid, s4ener:Running, s4ener:Paused, S4ener:ScheduledPaused, S4ener:Pending, S4enerCompleted}	Identifies the state of the power sequence
?powerSequence s4ener:activeSlotNumber ?activeSlotNumber .	Integer	Lists the active Slot for the corresponding Power Sequence: if inactive, activeSlotNumber = 0
?powerSequence s4ener:isRemoteControllable ?sequenceRemoteControllable .	xsd:boolean: {“true”, “false”}	Energy Manager is allowed to remotely control this Power Sequence - requires general permission of remote control of the Power Profile node
?powerSequence s4ener:hasStartTime ?startTime .	xsd:dateTime	DateTime
?powerSequence s4ener:hasEndTime ?endTime .	xsd:dateTime	DateTime
?powerSequence s4ener:hasEarliestStartTime ?earliestStartTime .	xsd:dateTime	DateTime
?powerSequence s4ener:hasLatestEndTime ?latestEndTime .	xsd:dateTime	DateTime
?powerSequence s4ener:isPausable ?isPausable .	xsd:boolean {“true”, “false”}	Energy Manager is allowed to remotely pause this Power Sequence - requires general permission of remote control of the Power Profile node and this Power Sequence
?powerSequence s4ener:isStoppable ?isStoppable .	xsd:boolean: {“true”, “false”}	Energy Manager is allowed to remotely stop this Power Sequence - requires general permission of remote control of the Power Profile node and this Power Sequence
?powerSequence s4ener:hasValueSource ?valueSource .	One of the codelist elements {s4ener:Measured, s4ener:Calculated, s4ener:Empirical}	Additional information about the quality of value source
?powerSequence saref:consistsOf ?powerSequenceSlot . ?powerSequenceSlot rdf:type s4ener:Slot .		Each Power Sequence consists of min 1 slot, describing the demand of energy by time and the power values.

?powerSequenceSlot saref:hasIdentifier ?powerSequenceSlotNumber .	xsd:string	Identifies the specific slot in the corresponding Power Sequence
?powerSequenceSlot s4ener:hasDefaultDuration ?powerSequenceSlotDefaultDuration .	xsd:duration	Defines the duration of the specific slot
?powerSequenceSlot s4ener:hasSlotValue ?powerSequenceSlotPower . ?powerSequenceSlotPower rdf:type saref:Measurement . ?powerSequenceSlotPower saref:relatesToProperty?powerSequenceSlotProperty . ?powerSequenceSlotPower s4ener:hasUsage ?powerSequenceSlotPowerType . ?powerSequenceSlotPower saref:isMeasuredIn om:watt . ?powerSequenceSlotPower saref:hasValue ?powerSequenceSlotValue .	 s4ener:Power One of the codelist elements {s4ener:Expected, s4ener:Minimum, s4ener:Maximum} xsd:decimal	Defines the expected, minimum or maximum Power demand for the specific slot, measured in Watt

146 Table A2.2. SAREF triple representation for the core elements of the use case *Flexible Start*.

2. Use Case: Monitoring of Power Consumption

Within an overall energy management concept, it is important for the customer connectivity manager to know about the electrical power consumption or production of connected devices. This holds valid not only for complex energy consumers that are manageable through incentive tables or power sequences, but also for simple devices that may be switched on and off or are even un-configurable but need to be considered as energy consumers within the house or premises.

The more complex energy consumers that offer flexibility via power sequences or accept incentives to adapt their power consumption according to the recommendations of an Energy Manager, often predict their power consumption but may deviate therefrom. To track the real power consumption, this Use Case may be used.

Additionally, the consumed energy, the current consumption, the voltage and the frequency may be offered by the ESA.

ESA may be connected to more than one phase of the grid connection point of the house or premises. In this case, the power measurands can be provided for the individual phases, but a device is not obliged to offer these phase-specific values. The current and voltage values are always phase-specific and are only provided if the ESA is aware of its individual connected phases.

164 SAREF triple representation for the use case *Monitoring of Power Consumption* with following core data elements:

SAREF triples	Value	Description
?esa rdf:type saref:Device		Device description
?esa saref:isUsedFor ?commodity		In this use case: Commodity = Electricity
?commodity rdf:type saref:Electricity	saref:Electricity	Mandatory in this use case
?esa saref:makesMeasurement ?monitoring_of_power_consumption		Device makes a measurement
?monitoring_of_power_consumption saref:relatesToProperty ?power		In this use case measurement of power
?power rdf:type saref:Power	saref:power	Mandatory in this use case
?monitoring_of_power_consumption saref:isMeasuredIn ?unit	om:watt	Device makes a measurement in unit of measure (Watt)
?monitoring_of_power_consumption saref:hasValue ?value	xsd:decimal	Measurement value

165 Table A2.3. SAREF triple representation for the core elements of the use case *Monitoring of Power Consumption*.

3. Use Case: Limitation of Power Consumption

This Use Case describes the management of the maximum power consumption of an ESA like a heat pump to support grid stabilization, prevention of overload in the low-voltage distribution network as well as the prevention of exceeding the maximum value of the grid connection point (technical or contractual).

The following mechanisms are utilized within this Use Case:

a) Active Power Limit: The Active Power Limit allows to set a limit for the maximum active (real) power consumption of an ESA. The Active Power Limit is typically used to improve grid stability by reducing the consumption or production of the ESA. The Active Power Limit may have a validity-duration of the limit.

b) Failsafe and Heartbeat: If the ESA does not receive any Heartbeats from the EMS for more than a defined time (e.g. due to interrupted connectivity), the Failsafe Power Limits are used as fallback. They are intended to prevent overloads in case of connectivity problems or during the soft start after a (local) blackout situation. The Failsafe Power Limits are initially configured in the ESA and may be updated by the EMS. The Controllable System SHALL remain in the failsafe state for at least the duration specified in the configuration value Failsafe duration minimum.

c) Constraints: the nominal maximum active power consumption of the ESA and the contractual nominal maximum power consumption limit can be exchanged but - being optional - will not be handled here specifically.

186 SAREF triple representation for the use case *Limitation of Power Consumption* with following core data elements:

SAREF triples	Value	Description
?esa rdf:type saref:Device		Device description
?esa s4ener:receivesPowerLimit ?powerlimit		
?powerlimit rdf:type s4ener:PowerLimit		
?powerLimit s4ener:hasIdentifier ?powerLimitIdentifier	xsd:string	Identifier of actual Power Limit
?powerlimit s4ener:isChangeable ?powerLimitIsChangeable	xsd:boolean: {“true”, “false”}	The relationship between the power limit and the boolean datatype value indicating whether the power limit is changeable.
?powerlimit s4ener:isObligatory ?powerLimitIsObligatory	xsd:boolean: {“true”, “false”}	The relationship between the power limit and the boolean datatype value indicating whether the power limit is obligatory.
?powerlimit s4ener:hasPowerLimitDuration ?powerLimitDuration	xsd:duration	The relationship between the power limit and the duration datatype value indicating the duration of the power limit.
?powerlimit s4ener:isActive ?powerlimitIsActive	xsd:boolean: {“true”, “false”}	Power Limit is active
?powerlimit s4ener:hasDataPoint ?powerLimitConsumptionMax		The relationship between the power limit and its maximum consumption value expressed as saref:Measurement
?powerLimitConsumptionMax rdf:type saref:Measurement		
?powerLimitConsumptionMax saref:isMeasuredIn ?powerLimitConsumptionMaxUnit	om:watt	The unit, which is used for the limit value.
?powerLimitConsumptionMax saref:hasValue ?powerLimitConsumptionMaxValue	xsd:decimal	The actual limit.
?esa s4ener:isBoundTo ?contractualPowerLimit		The relationship between saref:Device and s4ener:ContractualPowerLimit
?contractualPowerLimit rdf:type s4ener:ContractualPowerLimit		
?contractualPowerLimit s4ener:hasDataPoint ?contractualPLConsumptionMax		The relationship between the contractual power limit and its maximum consumption value expressed as saref:Measurement
?contractualPLConsumptionMax rdf:type saref:Measurement		
?contractualPLConsumptionMax saref:isMeasuredIn ?contractualPLConsumptionMaxUnit	om:watt	The unit, which is used for the measurement value.

?contractualPLConsumptionMax saref:hasValue ?contractualPLConsumptionMaxValue	xsd:decimal	The value itself.
?esa s4ener:isProtectedBy ?nominalPowerLimit		
?nominalPowerLimit rdf:type s4ener:NominalPowerLimit		The limit is defined in the specification by the manufacturers) and limited by a s4ener:FailsafePowerLimit.
?nominalPowerLimit s4ener:hasDataPoint ?nominalPLConsumptionMax		The nominal maximum (active) power the related functionality can consume, as specified in the manufacturer's data sheet.
?nominalPLConsumptionMax rdf:type saref:Measurement		
?nominalPLConsumptionMax saref:isMeasuredIn ?nominalPLConsumptionMaxUnit	om:watt	The unit, which is used for the nominal power consumption value.
?nominalPLConsumptionMax saref:hasValue ?nominalPLConsumptionMaxValue	xsd:decimal	The value itself.
?esa saref:hasState ?failSafeState	s4ener:FailsafeState	In case the communication between a device and the energy manager is interrupted, the device enters a fail-safe state (s4ener:FailsafeState).
?failsafeState s4ener:hasFailsafeDuration ?failsafeStateDuration	xsd:duration	The relationship between the failsafe power limit and the datatype value indicating its duration.
?failsafeStateDuration s4ener:isChangeable ?failsafeStateDurationIsChangeable	xsd:boolean: {“true”, “false”}	The relationship between the failsafe duration and the boolean datatype value indicating whether the failsafe duration is changeable.
?esa s4ener:isLimitedWith ?failsafePowerLimit		
?failsafePowerLimit rdf:type s4ener:FailsafePowerLimit		The failsafe values
?failsafePowerLimit s4ener:hasUsage ?failsafePLConsumption	One of the codelist elements {s4ener:Expected, s4ener:Minimum, s4ener:Maximum}	Typical, minimum and maximum Failsafe Power Limit
?failsafePLConsumptionMax rdf:type saref:Measurement		
?failsafePLConsumptionMax saref:isMeasuredIn ?failsafePLConsumptionMaxUnit	om:watt	The unit, which is used for the failsafe value.
?failsafePLConsumptionMax saref:hasValue ?failsafePLConsumptionMaxValue	xsd:decimal	The failsafe consumption max value.
?failsafePLConsumptionMax s4ener:isChangeable ?failsafePLConsumptionMax IsChangeable	xsd:boolean: {“true”, “false”}	The relationship between the failsafe power limit and the boolean datatype value indicating whether the failsafe power limit is changeable.

187 Table A2.4. SAREF triple representation for the core elements of the use case *Limitation of Power Consumption*.

188 *4.* Use Case: Incentive Table based Power Consumption Management

189 This Use Case aims at adjusting the operation process of an Energy Consumer such that higher-
190 level constraints or optimization goals are met. Examples for optimization goals are the reduction
191 of the electricity costs associated with an operation process, the reduction of the carbon footprint
192 (CO2 emission, e.g.) associated with an operation process, compliance with constraints of higher
193 grid levels, and the coordinated realization of demand response set points from higher-level
194 aggregators.

195 The following mechanisms are utilized within this use case:

196 a) Announcement of negotiation options (Incentive Table)

197 b) Negotiation of Committed Data/ Preliminary Data (Power Plan)

198 An update of the Committed Incentive Table or/and Committed Power Plan can be initiated at any
199 time before the defined cycle starts.

200 SAREF triple representation for the use case *Incentive Table based Power Consumption Management* with following core data elements:

201 a) Incentive table

SAREF triples	Value	Description
?esa rdf:type saref4ener:Device		Device description
?esa saref:hasProfile ?incentiveBasedProfile		Can be employed in devices that use an incentive table
?incentiveBasedProfile rdf:type s4ener:IncentiveBasedProfile		
?incentiveBasedProfile saref:hasIdentifier ?incentiveBasedProfileId	xsd:string	Allows the identification of an incentive table.
?incentiveBasedProfile s4ener:isChangeable ?incentiveBasedProfileIsChangeable	xsd:boolean: {“true”, “false”}	The incentive-based power profile is changeable.
?incentiveBasedProfile s4ener:requiresUpdate ?incentiveBasedProfileRequiresUpdate	xsd:boolean: {“true”, “false”}	The incentive-based power profile is required update.
?incentiveBasedProfile s4ener:hasScopeType ?incentiveBasedProfileScopeType	One of the codelist elements {s4ener:Committed, s4ener:Preliminary}	A scopeType for the incentive table can be stated here.
?incentiveBasedProfile s4ener:hasIncentiveType ?incentiveBasedProfileIncentiveType	One of the codelist elements {s4ener:RelativeCost, s4ener:AbsoluteCost, s4ener:CO2Emission or, s4ener:RenewableEnergyPercentage}	Allows to define the type of the incentive.
?incentiveBasedProfile s4ener:hasSlot ?incentiveTableSlot		The time is split into slots.
?incentiveTableSlot rdf:type s4ener:IncentiveTableSlot		
?incentiveTableSlot saref:hasIdentifier ?incentiveTableSlotId	xsd:string	Allows identification of an incentive slot within an incentive table.
?incentiveTableSlot s4ener:hasEffectivePeriode ?incentiveTableTimeSlotInterval		Time period of the incentive slot.
?incentiveTableTimeSlotInterval time:hasBeginning ?incentiveTableTimeSlotBeginning	xsd:dateTime	Start time of the incentive slot.
?incentiveTableTimeSlotInterval time:hasEnd ?incentiveTableTimeSlotEnd	xsd:dateTime	End time of the incentive slot.
?incentiveTableSlot s4ener:hasIncentive ?incentive		
?incentive rdf:type s4ener:Incentive		

?incentive saref:hasIdentifier ?incentiveId	xsd:string	Allows identification of an incentive within a tier.
?incentive saref:isMeasuredIn ?incentiveUnit	One of the codelist elements {s4ener:EuroPerKilowattHour, s4ener:KilogramPerKilowattHour, om:percent}	Unit of the incentive.
?incentive saref:hasValue ?incentiveValue	xsd:decimal	The value of the incentive.
?incentive s4ener:hasLowerBoundary ?incentiveLowerBoundary		The boundary list defines the boundaries of a tier. The boundary range of different tiers within an incentive slot defined by lower boundary value and upper boundary value.
?incentiveLowerBoundary saref:isMeasuredIn ?incentiveLowerBoundaryUnit	om:watt	The unit of the lower boundary value.
?incentiveLowerBoundary saref:hasValue ?incentiveLowerBoundaryValue	xsd:decimal	The value of the lower boundary value.
?incentive s4ener:hasUpperBoundary ?incentiveUpperBoundary		The boundary list defines the boundaries of a tier. The boundary range of different tiers within an incentive slot defined by lower boundary value and upper boundary value.
?incentiveUpperBoundary saref:isMeasuredIn ?incentiveUpperBoundaryUnit	om:watt	The unit of the upper boundary value.
?incentiveUpperBoundary saref:hasValue ?incentiveUpperBoundaryValue	xsd:decimal	The value of the upper boundary value.

202 Table A2.5. SAREF triple representation for the core elements of the use case *Incentive Table based Power Consumption Management (Incentive Table)*.

b) Power Plan

SAREF triples	Value	Description
?esa rdf:type saref4ener:Device		Device description
?esa saref:hasProfile ?incentiveBasedProfile		Can be employed in devices that use an incentive table
?incentiveBasedProfile rdf:type s4ener:IncentiveBaseProfile		
?incentiveBasedProfile s4ener:hasPowerPlan ?powerPlan		Power plan allocation
?powerPlan rdf:type s4ener:PowerPlan		
?powerPlan saref:hasIdentifier ?powerPlanId	xsd:string	Allows identification of power plan
?powerPlan s4ener:isWritable ?powerPlanIsWritable	xsd:boolean: {“true”, “false”}	Allows to define if the power plan is writeable
?powerPlan s4ener:hasScopeType ?powerPlanScopeType	One of the codelist elements {s4ener:Committed, s4ener:Preliminary}	Specifies a more detailed meaning of the power plan
?powerPlan s4ener:hasTimeSeries ?powerPlanTimeSeries		Allows to define slots of a power plan
?powerPlanTimeSeries saref:hasIdentifier ?powerPlanTimeSeriesId	xsd:string	Allows identification of a power plan slot within a power plan.
?powerPlanTimeSeries s4ener:hasEffectivePeriode ?powerPlanTimeSeriesSlotInterval	time:Interval	Allows to define a time period of a power plan slot and to model time gaps between slots
?powerPlanTimeSeriesSlotInterval time:hasBeginning ?powerPlanTimeSeriesSlotBeginning	xsd:dateTime	The start time of the slot
?powerPlanTimeSeriesSlotInterval time:hasEnd ?powerPlanTimeSeriesSlotEnd	xsd:dateTime	End time = start time of upcoming slot
?powerPlanTimeSeries s4ener:hasUsage ?powerPlanTimeSeriesUsage	One of the codelist elements {s4ener:Minimum, s4ener:Expected, s4ener:Maximum}	
?powerPlanTimeSeries saref:relatesToProperty ?powerPlanTimeSeriesProperty	{s4ener:Power}	
?powerPlanTimeSeries s4ener:hasDataPoint ?powerPlanDataPoint		
?powerPlanDataPoint saref:isMeasuredIn ?powerPlanDataPointUnit	om:watt	The power plan unit
?powerPlanDataPoint saref:hasValue ?powerPlanDataPointValue	xsd:decimal	Defines the expected value during a power plan slot

Table A2.6. SAREF triple representation for the core elements of the use case *Incentive Table based Power Consumption Management (Power Plan)*.

205 *5.* Use Case: Manual Operation (provisioning of necessary information in case of user driven
206 manual operation of ESA)

207 The main intention of the Use Case Manual Operation is to inform the Energy Manager about the
208 consumption demand, if the user has started an ESA manually.

209 a) Manual Operation of White Goods, capable to offer Flex Start for White Goods

210 The only difference between a washing cycle offered by a manually started ESA and a
211 washing cycle with a flexibility offer is that, in the former case, the Energy Manager cannot
212 change the start time of the washing machine.

213 In this case, the Core Data Element Remote Control is “false” and the Start Time / Earliest
214 Start Time are “now”.

215 b) Manual Operation of HVAC Units (Heat Pumps, Electrical Heaters, Water Heaters &
216 Ventilation units).

217 HVAC ESA’s running and acting on demand response use cases (flexible start, power
218 monitoring, power limitation, incentive table-based power consumption…) can be
219 overruled by manual customer interactions initiated through room, unit or app controllers.
220 These customer interactions can result in new space heating, domestic hot water or
221 ventilation requests.

222 The *Manual Operation* use case requires following core data elements:

223 The manual operation in this Code of Conduct is relevant for the Flexible Start use case, see use case 1.

SAREF triples	Value	Description
?esa rdf:type saref:Device .		Device description
?esa saref:isUsedFor ?commodity		
?commodity rdf:type saref:Electricity	saref:Electricity	Commodity = Electricity
?esa saref:makesMeasurement ?commodityProperty		
? commodityProperty saref:relatesToProperty ?power		
?power rdf:type saref:Power	saref:Power	Property = Power
?esa saref:hasProfile ?powerProfile .		Power Profile belongs to the device
?powerprofile rdf:type s4ener:PowerProfile .		
?powerprofile s4ener:isRemoteControllable ?nodeRemoteControllable .	xsd:boolean: {"false"} (1)	During manual operation the Energy Manager is NOT (2) allowed to remotely control the Power Profile node
?powerprofile s4ener:supportsReselection ?supportsReselection .	xsd:boolean: {"false"} (1)	Power Profile node does NOT (2) allow re-selection of power sequences by the Energy Manager
?powerProfile saref:consistsOf ?alternativesgroup .		Power Profile consists of Alternative Groups
?alternativesgroup rdf:type s4ener:AlternativesGroup .		
?alternativesgroup saref:hasIdentifier ?alternativesID .	xsd:string	Identifies the actual Alternative Group max. 1 Alternatives Group supported in this use case
?alternativesgroup saref:consistsOf ?powerSequence .		Each Alternative Group consist of min. 1 Power Sequence but allows multiple parallel Power Sequences for different purposes such as an ECO mode, a normal mode and a fast mode with corresponding sequences and slots
?powerSequence rdf:type s4ener:PowerSequence .		
?powerSequence saref:hasIdentifier ?sequenceID .	xsd:string	Identifies the actual Sequence in the corresponding Alternative Group

?powerSequence saref:hasState ?powerSequenceState .	Codelist element {“s4ener:Running”} (1)	Identifies the state of the power sequence
?powerSequence s4ener:activeSlotNumber ?activeSlotNumber .	Integer	Lists the active Slot for the corresponding Power Sequence: if inactive, activeSlotNumber = 0
?powerSequence s4ener:isRemoteControllable ?sequenceRemoteControllable .	xsd:boolean: {“false”} (1)	Energy Manager is NOT (2) allowed to remotely control this Power Sequence - requires general permission of remote control of the Power Profile node
?powerSequence s4ener:hasStartTime ?startTime .	xsd:dateTime (1)	DateTime = NOW (2)
?powerSequence s4ener:hasEndTime ?endTime .	xsd:dateTime	DateTime
?powerSequence s4ener:hasEarliestStartTime ?earliestStartTime .	xsd:dateTime	DateTime
?powerSequence s4ener:hasLatestEndTime ?latestEndTime .	xsd:dateTime	DateTime
?powerSequence s4ener:isPausable ?isPausable .	xsd:boolean {“false”} (1)	Energy Manager is NOT (2) allowed to remotely pause this Power Sequence - requires general permission of remote control of the Power Profile node and this Power Sequence
?powerSequence s4ener:isStoppable ?isStoppable .	xsd:boolean: {“false”} (1)	Energy Manager is NOT (2) allowed to remotely stop this Power Sequence - requires general permission of remote control of the Power Profile node and this Power Sequence
?powerSequence s4ener:hasValueSource ?valueSource .	One of the codelist elements {s4ener:Measured, s4ener:Calculated, s4ener:Empirical}	Additional information about the quality of value source
?powerSequence saref:consistsOf ?powerSequenceSlot . ?powerSequenceSlot rdf:type s4ener:Slot .		Each Power Sequence consists of min 1 slot, describing the demand of energy by time and the power values.
?powerSequenceSlot saref:hasIdentifier ?powerSequenceSlotNumber .	xsd:string	Identifies the specific slot in the corresponding Power Sequence
?powerSequenceSlot s4ener:hasDefaultDuration ?powerSequenceSlotDefaultDuration .	xsd:duration	Defines the duration of the specific slot
?powerSequenceSlot s4ener:hasSlotValue ?powerSequenceSlotPower . ?powerSequenceSlotPower rdf:type saref:Measurement . ?powerSequenceSlotPower saref:relatesToProperty?powerSequenceSlotProperty .	s4ener:Power	Defines the expected, minimum or maximum Power demand for the specific slot, measured in Watt, if available

?powerSequenceSlotPower s4ener:hasUsage ?powerSequenceSlotPowerType . ?powerSequenceSlotPower saref:isMeasuredIn om:watt . ?powerSequenceSlotPower saref:hasValue ?powerSequenceSlotValue .	One of the codelist elements {s4ener:Expected, s4ener:Minimum, s4ener:Maximum} xsd:decimal	

(1) Changed core element referred to the Flexible Start. Its value is in this use case not variable but fixed.

(2) Definition modification due to (1)

Table A2.7. SAREF triple representation for the core elements of the use case *Manual Operation.*

Annex 3 - Examples of SAREF4x triples with different protocols (informative)

Note 1:

These are prefixes used throughout Annex 3.

Name	Description	Prefix:	URL:
Resource Description Framework	A vocabulary of terms to give additional meaning to data	rdf	http://www.w3.org/1999/02/22-rdf-syntax-ns#
SAREF Ontology	Core model to describe smart appliances	saref:	https://saref.etsi.org/core/
SAREF for Energy extension	Extension to SAREF for energy usage	s4ener	https://saref.etsi.org/saref4ener/
Ontology of Measurement	Vocabulary of units of measure	om	http://www.ontology-of-units-of-measure.org/resource/om-2/
Time Ontology	Vocabulary of Date and Time	time	http://www.w3.org/2006/time
XML Schema Definition	Vocabulary of common datatypes	xsd	http://www.w3.org/2001/XMLSchema#

Table A3.1. Prefixes used throughout Annex 3

A.3.1. Mapping to EN 50631

1. Flexible start

SAREF triples	Value	EN50631 data elements	EN50631 value + constraints
?esa rdf:type saref:Device .		deviceId	String
		entityId	Integer
?esa saref:isUsedFor ?commodity			
?commodity rdf:type saref:Electricity	saref:Electricity		
?esa saref:makesMeasurement ?commodityProperty			
? commodityProperty saref:relatesToProperty ?power			
?power rdf:type saref:Power	saref:Power		
?esa saref:hasProfile ?powerProfile .			
?powerprofile rdf:type s4ener:PowerProfile .			
?powerprofile s4ener:isRemoteControllable ?nodeRemoteControllable .	xsd:boolean: {“true”, “false”}	nodeRemoteControllable	Boolean: {“true”, “false”}
?powerprofile s4ener:supportsReselection ?supportsReselection .	xsd:boolean: {“true”, “false”}	supportsReselection	Boolean: {“true”, “false”}
?powerProfile saref:consistsOf ?alternativesgroup .			
?alternativesgroup rdf:type s4ener:AlternativesGroup .			
?alternativesgroup saref:hasIdentifier ?alternativesID .	xsd:string	alternativesID	Integer
?alternativesgroup saref:consistsOf ?powerSequence .			
?powerSequence rdf:type s4ener:PowerSequence .			
?powerSequence saref:hasIdentifier ?sequenceID .	xsd:string	sequenceId	Integer
?powerSequence saref:hasState ?powerSequenceState .	One of the codelist elements {s4ener:Scheduled,	state	String {“scheduled”, “inactive”, “invalid”, “running”, “paused”}

	s4ener:Inactive, s4ener:Invalid, s4ener:Running, s4ener:Paused, S4ener:ScheduledPaused, S4ener:Pending, S4enerCompleted}		
?powerSequence s4ener:activeSlotNumber ?activeSlotNumber .	Integer	activeSlotNumber	Integer
?powerSequence s4ener:isRemoteControllable ?sequenceRemoteControllable .	xsd:boolean: {“true”, “false”}	sequenceRemoteControllable	Boolean: {“true”, “false”}
?powerSequence s4ener:hasStartTime ?startTime .	xsd:dateTime	startTime	xsd:dateTime
?powerSequence s4ener:hasEndTime ?endTime .	xsd:dateTime	endTime	xsd:dateTime
?powerSequence s4ener:hasEarliestStartTime ?earliestStartTime .	xsd:dateTime	earliestStartTime	xsd:dateTime
?powerSequence s4ener:hasLatestEndTime ?latestEndTime .	xsd:dateTime	latestEndTime	xsd:dateTime
?powerSequence s4ener:isPausable ?isPausable .	xsd:boolean {“true”, “false”}	isPausable	Boolean: {“true”, “false”}
?powerSequence s4ener:isStoppable ?isStoppable .	xsd:boolean: {“true”, “false”}	isStoppable	Boolean: {“true”, “false”}
?powerSequence s4ener:hasValueSource ?valueSource .	One of the codelist elements {s4ener:Measured, s4ener:Calculated, s4ener:Empirical}	valueSource	String {“MeasuredValue”, “CalculatedValue”, “EmpiricalValue”}
?powerSequence saref:consistsOf ?powerSequenceSlot . ?powerSequenceSlot rdf:type s4ener:Slot .			
?powerSequenceSlot saref:hasIdentifier ?powerSequenceSlotNumber .	xsd:string	slotId	Integer
?powerSequenceSlot s4ener:hasDefaultDuration ?powerSequenceSlotDefaultDuration .	xsd:duration	defaultDuration	xsd:duration

?powerSequenceSlot s4ener:hasSlotValue ?powerSequenceSlotPower . ?powerSequenceSlotPower rdf:type saref:Measurement . ?powerSequenceSlotPower saref:relatesToProperty?powerSequenceSlotProperty .	s4ener:Power	{powerMin, power, powerMax}	Number
?powerSequenceSlotPower s4ener:hasUsage ?powerSequenceSlotPowerType .	{s4ener:Expected, s4ener:Minimum, s4ener:Maximum}		
?powerSequenceSlotPower saref:isMeasuredIn om:watt . ?powerSequenceSlotPower saref:hasValue ?powerSequenceSlotValue .	xsd:decimal		

234 Table A3.2. Mapping of the *Flexible Start* use case with SAREF triples on EN 50631.

2. Monitoring of Power Consumption

SAREF triples	Value	EN50631 data elements	EN50631 value + constraints
?esa rdf:type saref:Device			
?esa saref:isUsedFor ?commodity		commodityType	String, "electricity"
?commodity rdf:type saref:Electricity	saref:Electricity		
?esa saref:makesMeasurement ?monitoring_of_power_consumption			
?monitoring_of_power_consumption saref:relatesToProperty ?power		measurementType	String, "power"
?power rdf:type saref:Power	saref:power		
?monitoring_of_power_consumption saref:isMeasuredIn ?unit	om:watt	unit	String, e.g. “W”
?monitoring_of_power_consumption saref:hasValue ?value	xsd:decimal	value.number value. scale	Number Scale

Table A3.3. Mapping of the *Monitoring of Power Consumption* use case SAREF triples on EN 50631.

3. Limitation of Power Consumption

SAREF triples	Value	EN50631 data elements	EN50631 value + constraints
?esa rdf:type saref:Device			
?esa s4ener:receivesPowerLimit ?powerlimit			
?powerlimit rdf:type s4ener:PowerLimit			
?powerLimit s4ener:hasIdentifier ?powerLimitIdentifier	xsd:string		
?powerlimit s4ener:isChangeable ?powerLimitIsChangeable	xsd:boolean: {“true”, “false”}	isLimitChangeable	Boolean: {“true”, “false”}
?powerlimit s4ener:isObligatory ?powerLimitIsObligatory	xsd:boolean: {“true”, “false”}	limitCategory	String: "obligation"
?powerlimit s4ener:hasPowerLimitDuration ?powerLimitDuration	xsd:duration	timePeriod. endTime	Duration
?powerlimit s4ener:isActive ?powerlimitIsActive	xsd:boolean: {“true”, “false”}	isLimitActive	Boolean: {“true”, “false”}
?powerlimit s4ener:hasDataPoint ?powerLimitConsumptionMax		Scope Type	String: "activePowerLimit"
?powerLimitConsumptionMax rdf:type saref:Measurement			
?powerLimitConsumptionMax saref:isMeasuredIn ?powerLimitConsumptionMaxUnit	om:watt	unit	String: e.g. “W”
?powerLimitConsumptionMax saref:hasValue ?powerLimitConsumptionMaxValue	xsd:decimal	value. Number value. scale	Number Scale
?esa s4ener:isBoundTo ?contractualPowerLimit			
?contractualPowerLimit rdf:type s4ener:ContractualPowerLimit			
?contractualPowerLimit s4ener:has DataPoint ?contractualPLConsumptionMax		characteristicType	String: "contractualConsumptionNominalMax"
?contractualPLConsumptionMax rdf:type saref:Measurement			

?contractualPLConsumptionMax saref:isMeasuredIn ?contractualPLConsumptionMaxUnit	om:watt	unit	String: e.g. “W”
?contractualPLConsumptionMax saref:hasValue ?contractualPLConsumptionMaxValue	xsd:decimal	value. Number value. scale	Number Scale
?esa s4ener:isProtectedBy ?nominalPowerLimit			
?nominalPowerLimit rdf:type s4ener:NominalPowerLimit			
?nominalPowerLimit s4ener:has DataPoint ?nominalPLConsumptionMax		characteristicType	String: "powerConsumptionNominalMax"
?nominalPLConsumptionMax rdf:type saref:Measurement			
?nominalPLConsumptionMax saref:isMeasuredIn ?nominalPLConsumptionMaxUnit	om:watt	unit	String: e.g. “W”
?nominalPLConsumptionMax saref:hasValue ?nominalPLConsumptionMaxValue	xsd:decimal	value.Number value.Scale	Number Scale
?esa saref:hasState ?failSafeState	s4ener:FailsafeState		
?failsafeState s4ener:hasFailsafeDuration ?failsafeStateDuration	xsd:duration	keyName value. duration	String: "failsafeDurationMinimum" duration
?failsafeStateDuration s4ener:isChangeable ?failsafeStateDurationIsChangeable	xsd:boolean: {“true”, “false”}	isValueChangeable	Boolean: {“true”}
?esa s4ener:isLimitedWith ?failsafePowerLimit			
?failsafePowerLimit rdf:type s4ener:FailsafePowerLimit			
?failsafePowerLimit s4ener:hasUsage ?failsafePLConsumptionMax	{s4ener:Expected}	keyName	String, "failsafeConsumptionActivePowerLimit"
?failsafePLConsumptionMax rdf:type saref:Measurement			
?failsafePLConsumptionMax saref:isMeasuredIn ?failsafePLConsumptionMaxUnit	om:watt	unit	String: e.g. “W”

?failsafePLConsumptionMax saref:hasValue ?failsafePLConsumptionMaxValue	xsd:decimal	value. Number value. scale	Number Scale
?failsafePLConsumptionMax s4ener:isChangeable ?failsafePLConsumptionMax IsChangeable	xsd:boolean: {“true”, “false”}	isValueChangeable	Boolean: {“true”}

238 Table A3.4. Mapping of the *Limitation of the Power Consumption* use case with SAREF triples on EN 50631.

4. Incentive Table based Power Consumption Management

a) Incentive table

SAREF triples	Value	EN50631 data elements	EN50631 value + constraints
?esa rdf:type saref4ener:Device			
?esa saref:hasProfile ?incentiveBasedProfile		incentiveTableDescription	Container list.
?incentiveBasedProfile rdf:type s4ener:IncentiveBasedProfile			
?incentiveBasedProfile saref:hasIdentifier ?incentiveBasedProfileId	xsd:string	incentiveTableDescription. tariffDescription. tariffId	Identifier
?incentiveBasedProfile s4ener:isChangeable ?incentiveBasedProfileIsChangeable	xsd:boolean: {“true”, “false”}	incentiveTableDescription. tariffDescription. tariffWriteable	Boolean: {“true”, “false”}
?incentiveBasedProfile s4ener:requiresUpdate ?incentiveBasedProfileRequiresUpdate	xsd:boolean: {“true”, “false”}	incentiveTableDescription. tariffDescription. updateRequired	Boolean: {“true”, “false”}
?incentiveBasedProfile s4ener:hasScopeType ?incentiveBasedProfileScopeType	One of the codelist elements {s4ener:Committed, s4ener:Preliminary}	incentiveTableDescription. tariffDescription. scopeType	String: "simpleCommittedIncentiveTable", "simplePreliminaryIncentiveTable"
?incentiveBasedProfile s4ener:hasIncentiveType ?incentiveBasedProfileIncentiveType	One of the codelist elements {s4ener:RelativeCost, s4ener:AbsoluteCost, s4ener:CO2Emission or, s4ener:RenewableEnergyPercentage}	tier. incentiveDescription. incentiveType	String: "absoluteCost", "renewableEnergyPercentage", "co2Emission"
?incentiveBasedProfile s4ener:hasSlot ?incentiveTableSlot		incentiveSlot	
?incentiveTableSlot rdf:type s4ener:IncentiveTableSlot			
?incentiveTableSlot saref:hasIdentifier ?incentiveTableSlotId	xsd:string	incentiveSlot. timeInterval. timeSlotId	Integer
?incentiveTableSlot s4ener:hasEffectivePeriode ?incentiveTableTimeSlotInterval		incentiveSlot. timeInterval	

?incentiveTableTimeSlotInterval time:hasBeginning ?incentiveTableTimeSlotBeginning	xsd:dateTime	incentiveSlot. timeInterval. startTime. dateTime	dateTime
?incentiveTableTimeSlotInterval time:hasEnd ?incentiveTableTimeSlotEnd	xsd:dateTime	incentiveSlot. timeInterval. endTime. dateTime	dateTime
?incentiveTableSlot s4ener:hasIncentive ?incentive			
?incentive rdf:type s4ener:Incentive			
?incentive saref:hasIdentifier ?incentiveId	xsd:string	incentiveSlot. tier. incentive. incentiveId	
?incentive saref:isMeasuredIn ?incentiveUnit	One of the codelist elements {s4ener:EuroPerKilowattHour, s4ener:KilogramPerKilowattHour, om:percent}	tier. incentiveDescription. unit	The cost refers to String: "currency" per "unit" (EUR/Wh, e.g.), "pct" percentage 0%-100%, "kg/Wh"
?incentive saref:hasValue ?incentiveValue	xsd:decimal	incentiveSlot.tier.incentive. value.scale	
?incentive s4ener:hasLowerBoundary ?incentiveLowerBoundary		incentiveSlot. tier. boundary	
?incentiveLowerBoundary saref:isMeasuredIn ?incentiveLowerBoundaryUnit	om:watt	tier. incentiveDescription. unit	String: e.g. “W”
?incentiveLowerBoundary saref:hasValue ?incentiveLowerBoundaryValue	xsd:decimal	incentiveSlot. tier. boundary. lowerBoundaryValue. number incentiveSlot. tier. boundary. lowerBoundaryValue. scale	Number Scale
?incentive s4ener:hasUpperBoundary ?incentiveUpperBoundary			
?incentiveUpperBoundary saref:isMeasuredIn ?incentiveUpperBoundaryUnit	om:watt		
?incentiveUpperBoundary saref:hasValue ?incentiveUpperBoundaryValue	xsd:decimal		

241 Table A3.5. Mapping of the *Incentive Table based Power Consumption Management (Incentive Table)* use case with SAREF triples on EN 50631**.**

242 b) Power Plan

SAREF triples	Value	EN50631 data elements	EN50631 value + constraints
?esa rdf:type saref4ener:Device			
?esa saref:hasProfile ?incentiveBasedProfile			
?incentiveBasedProfile rdf:type s4ener:IncentiveBaseProfile			
?incentiveBasedProfile s4ener:has PowerPlan ?powerPlan		TimeSeries. timeSeriesDescriptionListData. timeSeriesDescriptionData	
?powerPlan rdf:type s4ener:PowerPlan			
?powerPlan saref:hasIdentifier ?powerPlanId	xsd:string	timeSeriesId	Integer
?powerPlan s4ener:isWritable ?powerPlanIsWritable	xsd:boolean: {“true”, “false”}	timeSeriesWriteable	Boolean: {“true”, “false”}
?powerPlan s4ener:hasScopeType ?powerPlanScopeType	One of the codelist elements {s4ener:Committed, s4ener:Preliminary}	scopeType	String: "committedPowerPlan", "preliminaryPowerPlan"
?powerPlan s4ener:hasTimeSeries ?powerPlanTimeSeries		timeSeriesSlot	
?powerPlanTimeSeries saref:hasIdentifier ?powerPlanTimeSeriesId	xsd:string	timeSeriesSlot. timeSeriesSlotId	Integer
?powerPlanTimeSeries s4ener:hasEffectivePeriode ?powerPlanTimeSeriesSlotInterval	time:Interval	timeSeriesSlot. timePeriod	dateTime
?powerPlanTimeSeriesSlotInterval time:hasBeginning ?powerPlanTimeSeriesSlotBeginning	xsd:dateTime	timeSeriesSlot. timePeriod. startTime	dateTime
?powerPlanTimeSeriesSlotInterval time:hasEnd ?powerPlanTimeSeriesSlotEnd	xsd:dateTime		optional
?powerPlanTimeSeries s4ener:hasUsage ?powerPlanTimeSeriesUsage	One of the codelist elements {s4ener:Minimum, s4ener:Average, s4ener:Maximum}		Not used in EN50631 Represented via minValue and maxValue if requested

?powerPlanTimeSeries saref:relatesToProperty ?powerPlanTimeSeriesProperty	{s4ener:Power}		
?powerPlanTimeSeries s4ener:hasDataPoint ?powerPlanDataPoint			
?powerPlanDataPoint saref:isMeasuredIn ?powerPlanDataPointUnit	om:watt	unit	String: “W”
?powerPlanDataPoint saref:hasValue ?powerPlanDataPointValue	xsd:decimal	timeSeriesSlot. value. Number timeSeriesSlot. minValue. Number timeSeriesSlot. maxValue. number	Number Scale minValue and maxValue are optional

243 Table A3.6. Mapping of the *Incentive Table based Power Consumption Management (Power Plan)* use case with SAREF triples on EN 50631.

244 5. Manual Operation

SAREF triples	Value	EN50631 data elements	EN50631 value + constraints
?esa rdf:type saref:Device .		deviceId	String
		entityId	Integer
?esa saref:isUsedFor ?commodity			
?commodity rdf:type saref:Electricity	saref:Electricity		
?esa saref:makesMeasurement ?commodityProperty			
? commodityProperty saref:relatesToProperty ?power			
?power rdf:type saref:Power	saref:Power		
?esa saref:hasProfile ?powerProfile .			
?powerprofile rdf:type s4ener:PowerProfile .			
?powerprofile s4ener:isRemoteControllable ?nodeRemoteControllable .	xsd:boolean: {“false”}	nodeRemoteControllable	Boolean: {“false”}
?powerprofile s4ener:supportsReselection ?supportsReselection .	xsd:boolean: {“false”}	supportsReselection	Boolean: {“false”}
?powerProfile saref:consistsOf ?alternativesgroup .			
?alternativesgroup rdf:type s4ener:AlternativesGroup .			
?alternativesgroup saref:hasIdentifier ?alternativesID .	xsd:string	alternativesID	Integer
?alternativesgroup saref:consistsOf ?powerSequence .			
?powerSequence rdf:type s4ener:PowerSequence .			
?powerSequence saref:hasIdentifier ?sequenceID .	xsd:string	sequenceId	Integer
?powerSequence saref:hasState ?powerSequenceState .	Codelist element {s4ener:Running}	state	String {“running”}
?powerSequence s4ener:activeSlotNumber ?activeSlotNumber .	Integer	activeSlotNumber	Integer

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?powerSequence s4ener:isRemoteControllable ?sequenceRemoteControllable .	xsd:boolean: {“false”}	sequenceRemoteControllable	Boolean: {“false”}
?powerSequence s4ener:hasStartTime ?startTime .	xsd:dateTime	startTime	xsd:dateTime
?powerSequence s4ener:hasEndTime ?endTime .	xsd:dateTime	endTime	xsd:dateTime
?powerSequence s4ener:hasEarliestStartTime ?earliestStartTime .	xsd:dateTime	earliestStartTime	xsd:dateTime
?powerSequence s4ener:hasLatestEndTime ?latestEndTime .	xsd:dateTime	latestEndTime	xsd:dateTime
?powerSequence s4ener:isPausable ?isPausable .	xsd:boolean {“false”}	isPausable	Boolean: {“false”}
?powerSequence s4ener:isStoppable ?isStoppable .	xsd:boolean: {“false”}	isStoppable	Boolean: {“false”}
?powerSequence s4ener:hasValueSource ?valueSource .	One of the codelist elements {s4ener:Measured, s4ener:Calculated, s4ener:Empirical}	valueSource	String {“MeasuredValue”, “CalculatedValue”, “EmpiricalValue”}
?powerSequence saref:consistsOf ?powerSequenceSlot . ?powerSequenceSlot rdf:type s4ener:Slot .			
?powerSequenceSlot saref:hasIdentifier ?powerSequenceSlotNumber .	xsd:string	slotId	Integer
?powerSequenceSlot s4ener:hasDefaultDuration ?powerSequenceSlotDefaultDuration .	xsd:duration	defaultDuration	xsd:duration

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?powerSequenceSlot s4ener:hasSlotValue ?powerSequenceSlotPower . ?powerSequenceSlotPower rdf:type saref:Measurement . ?powerSequenceSlotPower saref:relatesToProperty?powerSequenceSlotProperty . ?powerSequenceSlotPower s4ener:hasUsage ?powerSequenceSlotPowerType . ?powerSequenceSlotPower saref:isMeasuredIn om:watt . ?powerSequenceSlotPower saref:hasValue ?powerSequenceSlotValue .	 s4ener:Power One of the codelist elements {s4ener:Expected, s4ener:Minimum, s4ener:Maximum} xsd:decimal	{powerMin, power, powerMax}	Number

247 Table A3.7. Mapping of the *Manual Operation* use case with SAREF triples on EN 50631.

A3.2 - Example of SAREF4x triples with protocol SPINE-IoT

As an example, for the use case Flexible start for white goods, equipped with real data, the following table maps the SAREF and SAREF4ENER triples with the corresponding SPINE IoT data model/protocol (EN50631-3-1 and EN50631-4-1).

SAREF triple representation	**SPINE IoT Json representation**
?powerSequence rdf:type s4ener:PowerSequence . ?powerSequence s4ener:sequenceID “1”^^xsd:string . ?powerSequence saref:hasState s4ener:Scheduled . ?powerSequence s4ener:activeSlotNumber “0”^^xsd:unsignedInt . ?powerSequence s4ener:sequenceRemoteControllable “true”^^xsd:boolean . ?powerSequence s4ener:hasStartTime “2021-06-24T12:00:00Z”^^xsd:dateTime . ?powerSequence s4ener:hasEndTime “2021-06-24T13:40:00Z”^^xsd:dateTime . ?powerSequence s4ener:hasEarliestStartTime “2021-06-24T06:20:00Z”^^xsd:dateTime . ?powerSequence s4ener:hasLatestEndTime “2021-06-24T19:00:00Z”^^xsd:dateTime . ?powerSequence s4ener:isPausable “false”^^xsd:boolean . ?powerSequence s4ener:isStoppable “false”^^xsd:boolean . ?powerSequence s4ener:valueSource s4ener:Empirical. ?powerSequence saref:consistsOf ?powerSequenceSlot . ?powerSequenceSlot rdf:type s4ener:Slot . ?powerSequenceSlot saref:hasIdentifier “1”^^xsd:string . ?powerSequenceSlot s4ener:hasDefaultDuration “PT23M”^^xsd:duration . ?powerSequenceSlot saref:hasSlotValue ?powerSequenceSlotPower. ?powerSequenceSlotPower rdf:type saref:Measurement ?powerSequenceSlotPower saref:relatesToProperty s4ener:Power . ?powerSequenceSlotPower s4ener:hasUsage s4ener:Minimum . ?powerSequenceSlotPower saref:isMeasuredIn om:watt . ?powerSequenceSlotPower saref:hasValue “1800”^^xsd:decimal . ?powerSequenceSlot saref:hasSlotValue ?powerSequenceSlotPower. ?powerSequenceSlotPower rdf:type saref:Measurement ?powerSequenceSlotPower saref:relatesToProperty s4ener:Power .	# Alternatives of Powersequences sequenceId: 1 state: scheduled activeSlotNumber: 0 sequenceRemoteControllable: true startTime: "2021-06-24T12:00:00Z" endTime: "2021-06-24T13:40:00Z" earliestStartTime: "2021-06-24T06:20:00Z" latestEndTime: "2021-06-24T19:00:00Z" isPausable: false isStoppable: false valueSource: ”empiricalValue” powerTimeSlots slotId: 1 defaultDuration: "00:23:00" powerMin: 1800 power: 2000 powerMax:2500 slotId: 2 defaultDuration: "00:58:00" powerMin: 200 power: 220 powerMax:250

?powerSequenceSlotPower s4ener:hasUsage s4ener:Expected . ?powerSequenceSlotPower saref:isMeasuredIn om:watt . ?powerSequenceSlotPower saref:hasValue “2000”^^xsd:decimal . ?powerSequenceSlot saref:hasSlotValue ?powerSequenceSlotPower. ?powerSequenceSlotPower rdf:type saref:Measurement ?powerSequenceSlotPower saref:relatesToProperty s4ener:Power . ?powerSequenceSlotPower s4ener:hasUsage s4ener:Maximum . ?powerSequenceSlotPower saref:isMeasuredIn om:watt . ?powerSequenceSlotPower saref:hasValue “2500”^^xsd:decimal . ?powerSequenceSlot saref:hasIdentifier “2”^^xsd:string . ?powerSequenceSlot s4ener:hasDefaultDuration “PT58M”^^xsd:duration . ?powerSequenceSlot saref:hasSlotValue ?powerSequenceSlotPower. ?powerSequenceSlotPower rdf:type saref:Measurement ?powerSequenceSlotPower saref:relatesToProperty s4ener:Power . ?powerSequenceSlotPower s4ener:hasUsage s4ener:Minimum . ?powerSequenceSlotPower saref:isMeasuredIn om:watt . ?powerSequenceSlotPower saref:hasValue “200”^^xsd:decimal . ?powerSequenceSlot saref:hasSlotValue ?powerSequenceSlotPower. ?powerSequenceSlotPower rdf:type saref:Measurement ?powerSequenceSlotPower saref:relatesToProperty s4ener:Power . ?powerSequenceSlotPower s4ener:hasUsage s4ener:Expected. ?powerSequenceSlotPower saref:isMeasuredIn om:watt . ?powerSequenceSlotPower saref:hasValue “220”^^xsd:decimal . ?powerSequenceSlot saref:hasSlotValue ?powerSequenceSlotPower. ?powerSequenceSlotPower rdf:type saref:Measurement ?powerSequenceSlotPower saref:relatesToProperty s4ener:Power . ?powerSequenceSlotPower s4ener:hasUsage s4ener:Maximum. ?powerSequenceSlotPower saref:isMeasuredIn om:watt . ?powerSequenceSlotPower saref:hasValue “250”^^xsd:decimal .	

253 Table A3.8. Mapping of SAREF triples to SPINE IoT protocol.

Annex 4 - Aim of Interoperability (informative)

To enable users to buy ESA from manufacturer A and replace them at any time without any restrictions with an equivalent appliance from manufacturer B, ESA must be interoperable to enable exchangeability. This requires common use cases and common information exchange. In order for current and future systems to be able to communicate with each other, common semantics are required with regard to the information that must be exchanged between the individual actuators in an interoperable manner.

This Code of Conduct therefore references the Smart Grid Architecture Model (SGAM) layer model of the Smart Grid Coordination Group (EU mandate M490, 2012 and 2014) and specifically the layers: “High Level Use Cases” (sublayer of the “Business Layer”), the “Functional Layer” and the “Information Layer”. This means that this Code of Conduct focusses on available and proven use cases from a selection of communication standards, like EN 50631, and the definition of information necessary to execute these use cases. This information is described in a human readable and semantically interoperable way in an ontology.

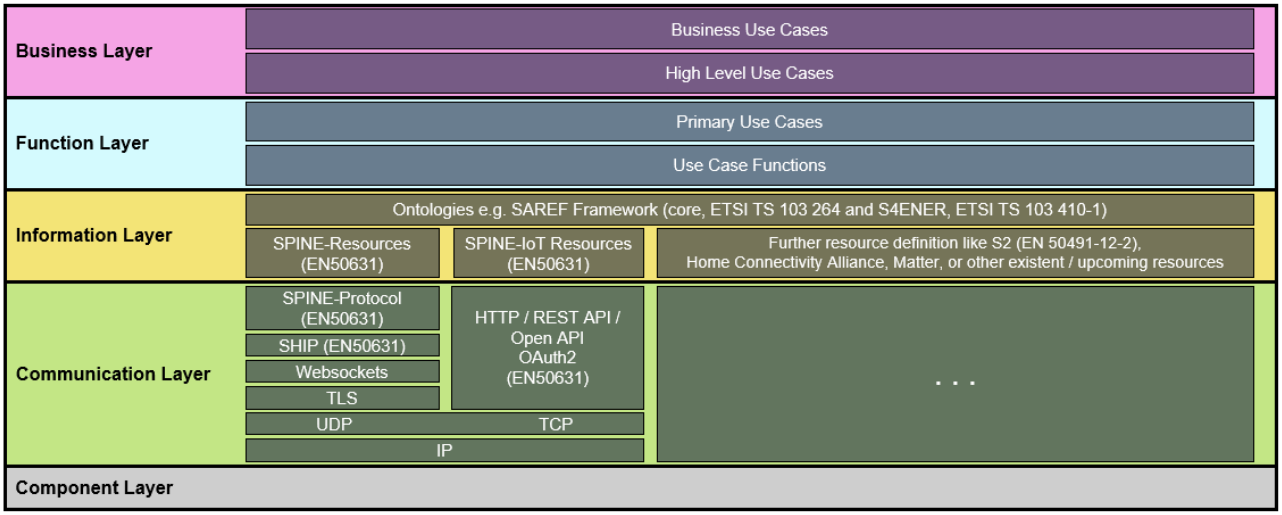

Figure A4.1. Code of Conduct reference layer model based on SGAM layer model ([1])

The SAREF (Smart Applications REFerence) ontology framework, driven by ETSI (European Telecommunication Standardization Institute) and the European Commission, is used at the Information Layer. It is chosen because it is a mature, living standard, open and actively managed solution to ensure interoperability on the long term. SAREF can be extended to cover other new use cases.

([1]) https://syc-se.iec.ch/wp-content/uploads/2019/10/SGCG_Methodology_SGAMUserManual.pdf

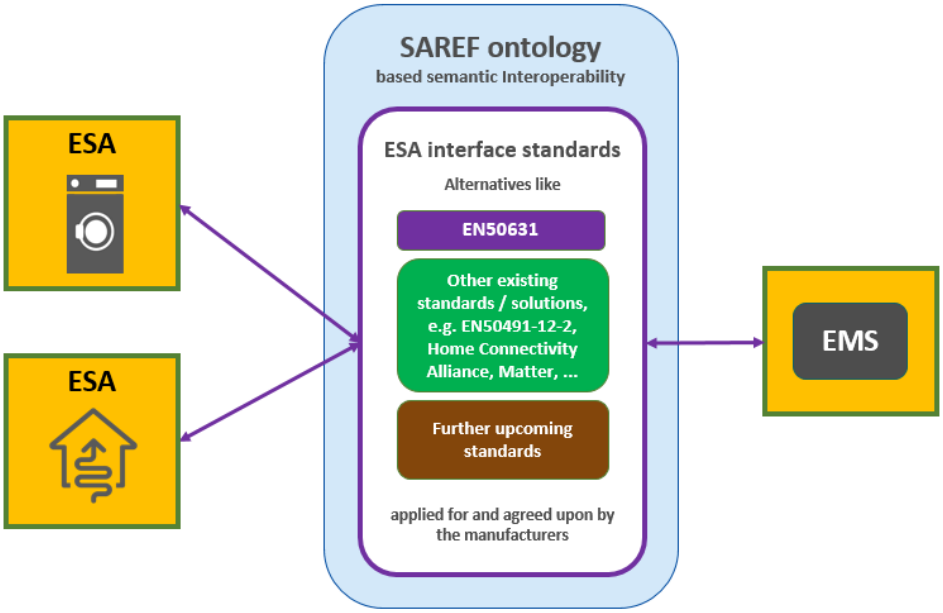

Figure A4.2. Semantic Interoperability at the level of Information Layer.

The Code of Conduct does not address the “Communication Layer”, although it is essential for the exchange of information. There are already a large number of communication standards and interfaces, and the future will show further developments. These can be mapped at the “Information Layer” using the SAREF ontology based semantic interoperability, see the Figure above.

This allows manufacturer to implement communication standards, e.g. EN50631, to be fully compliant with this Code of Conduct.

Annex 5 - Signing form

Code of Conduct on energy management related interoperability of Energy Smart Appliances

SIGNING FORM

The organisation …….
signs the Code of Conduct on Energy Smart Appliances and commits itself to abide to the principles described in Chapter 4 “Commitment” for the products it places on the market, which fall in the scope of this Code of Conduct described in Chapter 2 “Scope”.

The organisation, will inform the European Commission in writing, in case of its withdrawal from the Code of Conduct on Energy Smart Appliances. For the organisation,
person authorised to sign:

Name: ……
Function: ……
Address: ……
Tel: ……
Email: ……
Date: ……

Signature ……

Please send the signed form to: TBD

European Commission - DG XX (*TBD)*

E-mail: *TBD*