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, more and more shares of energy generation are being replaced by renewable sources that are dependent on wind and weather. The energy system must be able to deal with this variable supply, amongst others by intelligently exploiting demand side flexibility.

"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 ~~consent~~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 the 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 participations 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, operated in the European Community.

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 ~~actively observe~~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 (household) **appliances**:

- White goods: washing machines, tumble driers, washer-driers, dishwashers;
- Heating, ventilation, and air conditioning (HVAC); ~~Heat pumps (delivering heat/cold through air or water), local space heaters, water heaters (electric storage, heat pump storage, electric instantaneous), ventilation;~~

and the following **use cases**:

- Flexible start ~~for White Goods (or other devices)~~
- 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 mapping of use cases to the appliances.

3. Aim

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

This ~~helps~~ will help to improve the environmental impact of energy use over the whole energy system, contribute to grid stability/security of supply, economic optimization, or other objectives ~~by~~ through the ~~increasing~~ 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 signing the Code of Conduct has implemented the applicable use cases for the specific ESA according to Annex 1 and Annex 2.

b) Ensure that **most** models of ESA placed on the Union market as of three years after signing the Code of Conduct have implemented the applicable use cases for the specific ESA according to Annex 1 and Annex 2. The exact up-take of number of models of ESA ("**most**") will be clarified in the next version of the CoC.

c) 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).

d) 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 EU Cybersecurity Act[1] and EU Data Act[2].

e) 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).

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

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

h) Publish the Code of Conduct signed form (Annex 5) on the manufacturer website.

i) Indicate the compliance with the Code of Conduct when registering new ESA models in the EPREL database. If this compliance is achieved through additional equipment (such as a dongle) attached to the appliance then only the model that includes both appliance and dongle, when placed on the market, can be considered compliant with 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 nor depends on such versions. When a new version of the

[1] https://digital-strategy.ec.europa.eu/en/policies/cybersecurity-act
[2] https://www.eu-data-act.com/

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 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 ~~for White Goods~~	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 ~~n/a~~	M	M	O	O ~~n/a~~
• **local space heaters**	O ~~n/a~~	M	M	O	O ~~n/a~~
• **water heaters (electric storage, heat pump storage, electric instantaneous)**	O ~~n/a~~	M	M	O	O ~~n/a~~
• **ventilation**	n/a	M	O ~~M~~	O ~~n/a~~	O ~~n/a~~

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

Table A1.1. Mapping of use cases to white goods and heating/cooling/ventilation appliances. A description of the use cases can be found in Chapter 7 of EN 50631-1.

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

Note 1:

The use cases and core data elements are described in EN50631-1:2023. The SAREF and SAREF4ENER representations are described in detail in ETSI TS 103 264 – v3.1.1 (2020-02) and ETSI TS 103 410-1 – V1.1.2 (2020-05).

Note 2:

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/

Table A2.1. Prefixes used throughout Appendix 2.

1. Use Case: Flexible Start ~~for White Goods~~

The Flexible Start use case offers flexibility by programming the ~~Energy Smart White Good~~ 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 ~~Energy Smart White Good~~ ESA.

While the ~~Energy Smart White Good~~ 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 ~~Energy Smart White Good~~ 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 ~~Energy Smart White Good~~ 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.

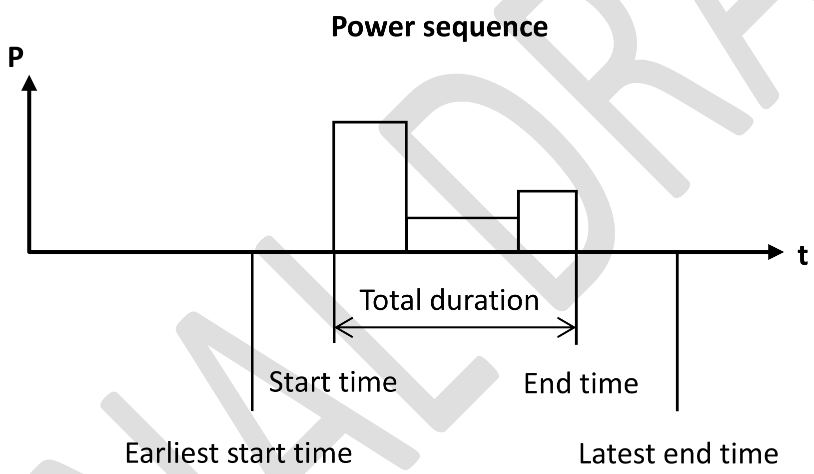

Figure A2.1. Properties of a scheduled power sequence

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 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 The *Flexible Start* use case requires following core data elements:

Core data elements:	Description	Value	SAREF triple representation
Power Profile	Expresses the demand of the ESA		?powerprofile rdf:type s4ener:PowerProfile .
Remote Controllable	Permission for the whole Power Profile to be modified. If set to “false”, the server does NOT PERMIT modifications by a client.	Boolean “true” or “false”	?powerprofile s4ener:nodeRemoteControllable ?nodeRemoteControllable .
Supports Reselection	If set to true, this smart appliance permits selection of an optional power sequence to become the new preferred power sequence multiple times.	Boolean “true” or “false”	?powerprofile s4ener:supportsReselection ?supportsReselection .
Alternatives	Opens the possibility to demand more than 1 group of subsequent power sequences at a time. However: this use case is limited to 1 Alternatives Group		?alternativesgroup rdf:type s4ener:AlternativesGroup .
Alternatives ID	PRIMARY IDENTIFIER of “alternatives” groups The cardinality is “(0..1)”: At maximum one “alternatives” instance is permitted in this Use Case.	Integer 0 or 1	?alternativesgroup s4ener:alternativesGroupID ?alternativesID.
Power Sequences per Alternatives Group	Allows to offer more than 1 power sequence per group, e.g. offering 3 power sequences for ECO, normal, fast mode. One power sequence needs to be the preferred one. The Energy Manager can select another one to become the new preferred power sequence.		?powerSequence rdf:type s4ener:PowerSequence .
Sequence ID	Each power sequence includes	Integer	?powerSequence s4ener:sequenceID ?sequenceID .

State	An information about actual status	String “scheduled” or “inactive” or “invalid” or “running” or “paused”	?powerSequence saref:hasState ?state .
Active Slot Number	If state is set to “running” or “paused” this element contains the currently active slot number.	Integer	?powerSequence s4ener:activeSlotNumber ?activeSlotNumber .
Sequence Remote Controllable	Is the sequence remote controllable by the Energy Manager or is the power sequence only informative, e.g. manual operation	Boolean “true” or “false”	?powerSequence s4ener:sequenceRemoteControllable ?sequenceRemoteControllable .
Start Time	Actual start time of the power sequence	String Date Time	?powerSequence s4ener:hasStartTime ?startTime .
End Time	Actual end time of the power sequence	String Date Time	?powerSequence s4ener:hasEndTime ?endTime .
Earliest Start Time	Earliest start time	String Date Time	?powerSequence s4ener:hasEarliestStartTime ?earliestStartTime .
Latest End Time	Latest end time	String Date Time	?powerSequence s4ener:hasLatestEndTime ?latestEndTime .
Is Pausable	Allowed to be paused by the Energy Manager during runtime, e.g. interrupt heating phase	Boolean “true” or “false”	?powerSequence s4ener:isPausable ?isPausable .
Is Stoppable	Allowed to be stopped by the Energy Manager during runtime	Boolean “true” or “false”	?powerSequence s4ener:isStoppable ?isStoppable .
Value Source	The source of the power/energy values (measured/calculated/empirical) If not set the source of forecasted values is undefined.	String “measured Value” or “calculated Value” or “empirical Value”	?powerSequence s4ener:valueSource ?valueSource .

Power Time Slot	No of slots, each representing a specific demand in a phase of the runtime like pre-washing, heating, …		?powerSequence saref:consistsOf ?slot_1 . ?slot_1 rdf:type s4ener:Slot .
Slot Number	Each slot includes	Integer	?slot_1 s4ener:slotNumber ?slotNumber_1 .
Default Duration	Duration of the slot	String Duration	?slot_1 s4ener:hasDefaultDuration ?defaultDuration_1 .
Power Min	Min power consumption, if applicable “W” SHALL be assumed as unit for the value implicitly if not set explicitly in power unit	Number	?slot_1 saref:consistsOf ?powerMin_1 . ?powerMin_1 rdf:type s4ener:PowerMin ; saref:relatesToMeasurement ?measurementMin_1 . ?measurementMin_1 rdf:type saref:Measurement ; saref:isMeasuredIn om:watt ; saref:hasValue ?valueMin_1 .
Power	Typical consumption of the slot	Number	?slot_1 saref:consistsOf ?power_1 . ?power_1 rdf:type s4ener:Power ; saref:relatesToMeasurement ?measurement_1 . ?measurement_1 rdf:type saref:Measurement ; saref:isMeasuredIn om:watt ; saref:hasValue ?value_1 .
Power Max	Max power consumption, if applicable	Number	?slot_1 saref:consistsOf ?powerMax_1 . ?powerMax_1 rdf:type s4ener:PowerMax ; saref:relatesToMeasurement ?measurementMax_1 . ?measurementMax_1 rdf:type saref:Measurement ; saref:isMeasuredIn om:watt ; saref:hasValue ?valueMax_1 .

Table A2.2. Mapping of Flexible Start use case with SAREF triples.

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.

The *Monitoring of Power Consumption* use case requires following core data elements:

a) Measurement of AC Power Total

Core data elements:	**Description**	**Value**	**SAREF triple representation**
Measurement Id	Enables the identification of different measurands on one feature.	Integer	
Measurement Type	To identify which type of measurand is measured.	String “power”	
Commodity Type	If a measurand of a commodity is measured, the type of commodity is stated here.	String “electricity”	
Unit	The unit, which is used for the value. It is always related to the normal value.	String “W”	
Value Type	It is possible to model different types of measurement values.	String, e.g. “value”	
Value	The measurement value itself, i.e. the magnitude according to " value Type".	Number	
Electrical Connection Id	Electrical connection, this information belongs to.	Integer	
Power Supply Type	States whether the electrical connection is of type "ac" or "dc".	String “ac”	
Voltage Type	Specifies which kind of electricity is measured ("ac" or "dc").	String “ac”	
AC Measurement Type	This element states the kind of AC measurement is done (e.g. "real").	String “real”	

AC Measurement Type	This element states the kind of AC measurement is done (e.g. "real").	String “real”	

Table A2.3. Mapping of the Measurement of the AC Power Total of the Monitoring of Power Consumption use case with SAREF triples.

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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 ~~Controllable System~~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.

The *Limitation of Power Consumption* use case requires following core data elements:

a) Configure Active Power Limit

i. Generic Information content for Active Power Limit Description

Core data elements:	**Description**	**Value**	**SAREF triple representation**
Limit Id	Identifier for the limit.	Integer	
Limit Type	The Limit Type shall be interpreted in the following way (following the passive sign convention; if the active sign convention is applied in the Use Case, the logic shall be vice versa).	String, e.g. “sign Dependent Abs Value Limit”	
Limit Category	Describes how important the limit is.	String, e.g. ”obligation”	
Measurement Id	This is a foreign identifier.	Integer	
Unit	The unit, which is used for the limit value, is denoted with this element.	String, e.g. “W”	
Scope Type	A certain meaning of the limit.	String “active Power Limit”	

Table A2.5 Mapping of the generic information description from the Active Power Limit mechanism of the Limitation of Power Consumption use case with SAREF triples.

ii. Generic Information content for Active Power Limit Data

Core data elements:	Description	Value	SAREF triple representation
Limit Id	Identifier for the limit.	Integer	
Is Limit Changeable	States whether the limit may be changed by a client or not.	Boolean, e.g. “true” | “false”	
Is Limit Active	Indicates whether the limit is currently active or not.	Boolean, e.g. “true” | “false”	
Time Period	The period where the limit shall be active.	Duration	
Value	The actual limit.	Number	

Table A2.6. Mapping of the generic information data from the Active Power Limit mechanism of the Limitation of Power Consumption use case with SAREF triples.

b) Failsafe and Heartbeat

i. Generic Information content for Failsafe Consumption Active Power Limit/ Failsafe Duration Minimum

Core data elements:	Description	Value	SAREF triple representation
Key Id	Enables the identification of different keys.	Integer	
Key Name	A certain key name.	String, e.g. “failsafe Consumption Active Power Limit”	
Value Type	Different value types are possible, but only one may be chosen.	String, e.g. “scaled Number”	
Unit	The unit in which the value of the key is given.	String, e.g. “W”	

Table A2.7. Mapping of the generic information from the Failsafe mechanism of the Limitation of Power Consumption use case with SAREF triples.

ii. Generic Information content for Heartbeat

Core data elements:	**Description**	**Value**	**SAREF triple representation**
Timestamp	The time of creation of the data. Absolute or Relative Time Type	Date Time	
Heartbeat Counter	An incrementing counter of the heartbeat. The value of the heartbeat counter element shall be increased after every heartbeat timeout	Integer	
Heartbeat Timeout	A period.	Duration “⩽ 60s”	

Table A2.8. Mapping of the generic information from the Heartbeat mechanism of the Limitation of Power Consumption use case with SAREF triples.

c) Constraints

i. Generic Information content for constraints

Core data elements:	**Description**	**Value**	**SAREF triple representation**
Electrical Connection Id	Electrical connection, this characteristic information belongs to.	Integer	
Parameter Id	Relation to the according parameter this characteristic belongs to.	Integer	
Characteristic Id	Identifier of this characteristic for the given parameter Id.	Integer	
Characteristic Context	Context, the characteristic is valid for.	String, e.g. “entity”	
Characteristic Type	The type of the characteristic.	String, e.g. “power Consumption Nominal Max”	

Value	The value for this characteristic.	Number	
Unit	The unit of this characteristic.	String, e.g. “W”	

197 Table A2.9. Mapping of the generic information from the constraints mechanism of the Limitation of the Power Consumption use case with SAREF triples.

4. Use Case: Incentive Table based Power Consumption Management

This Use Case aims at adjusting the operation process of an Energy Consumer such that higher-level constraints or optimization goals are met. Examples for optimization goals are the reduction of the electricity costs associated with an operation process, the reduction of the carbon footprint (CO_2 emission, e.g.) associated with an operation process, compliance with constraints of higher grid levels, and the coordinated realization of demand response set points from higher-level aggregators.

The following mechanisms are utilized within this Use Case:

a) Announcement of negotiation options

b) Negotiation of Committed Data/ Preliminary Data

c) Unsolicited Update of Committed Incentive Table/ Committed Power Plan

The *Incentive Table based Power Consumption Management* use case requires following core data elements:

a) Generic Information content for Device Configuration

Core data elements:	Description	Value	SAREF triple representation
Key Id	The key identifier.	Integer	
Key Name	A certain key name.	String, e.g. “incentives Simulation Cycles Max”	
Value Type	A type for the value	String, e.g. “duration”	
Value	The actual value belonging to the key Id.	duration	

Table A2.10. Mapping the content for the Device Configuration of the Incentive Table based Power Consumption Management use case with SAREF triples.

b) Generic Information content for Incentive Table

Core data elements:	Description	Value	SAREF triple representation
Tariff Description	Tariff description		
Tariff Id	Allows the identification of a incentive table.	Integer	
Tariff Writeable	Whether the incentive table is writeable by a client or not can be denoted in this element.	Boolean, e.g. “true” or “false”	
Update Required	If update required is "true", the server expects the responsible client to update the writeable or changeable data related to the same identifier.	Boolean, e.g. “true” or “false”	
Scope Type	A scope type for the incentive table can be stated here.	String, e.g.	

		"simple Committed Incentive Table"	
Slot Id Support	slot ID needs to be supported	Boolean "true"	
Tier	Allows to describe tiers and the incentives and boundaries that are used by the tier.		
Tier Description	Tier description		
Tier Id	Allows identification of a tier within an incentive Table.	Integer	
Tier Type	The tier has a cost incentive that MAY vary over time.	String, e.g. "dynamic Cost"	
Boundary Description			
Boundary Id	Allows identification of a boundary within an incentive Table.	Integer	
Boundary Type	Allows to define the type of the boundary.	String, e.g. "power Boundary"	
Boundary Unit	Allows to define the unit of the boundary values.	String, e.g. "W"	
Incentive Description			
Incentive Id	Allows identification of an incentive within a incentiveTable.	Integer	
Incentive Type	Allows to define the type of the incentive.	String, e.g. "absolute Cost"	
Tariff Constraints			

Max Tiers Per Tariff	If set, the incentive Table SHALL NOT include more tiers than given in max Tiers Per Tariff.	$\geqslant 3$	
Max Boundaries Per Tier	If set, the related instance SHALL NOT include more “boundary” instances than given in Max Boundaries Per Tier.	$\geqslant 1$	
Max Incentives Per Tier	If set, the tier within the incentive Table SHALL NOT include more incentives than given in Max Incentives Per Tier.	$\geqslant 1$	
Incentive Slot Constraints			
Slot Count Max	If set, the incentive Table SHALL NOT include more slots than given in slot Count Max.		
Incentive Slot	Allows to describe incentive slot.		
Time Interval	Time period of the incentive Slot.		
Time Slot Id	Allows identification of an incentive Slot within an incentive Table.		
Start Time	Absolute start time.	Date Time	
End Time	Absolute end time.	Date Time	

Table A2.11. Mapping the content for the Incentive Table of the Incentive Table based Power Consumption Management c use case with SAREF triples.

c) Generic Information content for Time Series

Core data elements:	**Description**	**Value**	**SAREF triple representation**
Time Series Id	Allows the identification of a time Series.	Integer	
Time Series Type	Allows to define which time Series type is supported.	String, e.g. “Plan”	

Time Series Writeable	Allows to define if the time Series is writeable.	Boolean, e.g. “false”	
Unit	Allows to describe the unit of the value, if the value has a unit.	String, e.g. “W”	
Scope Type	Specifies a more detailed meaning of the time series.	String, e.g. “committed Power Plan”	
Time Series Slot	Allows to define slots of a time Series.		
Time Series Slot Id	Allows identification of a time Series Slot within a time Series.	Integer	
Time Period	Allows to define a time Period of a time Series Slot and to model time gaps between slots.		
Start Time	Define the start time of time Period.	Date Time	
Duration	Allows to define a duration of a time Series Slot.	Duration	
Value	Defines the expected value during a time Series Slot.		
Number	⩾0	⩾0	

217 Table A2.12. Mapping the content for the Time Series of the Incentive Table based Power Consumption Management c use case with SAREF triples.

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

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

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

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

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

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

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

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

Core data elements:	**Description**	**Value**	**SAREF triple representation**
Power Profile	Expresses the demand of the ESA		?powerprofile rdf:type s4ener:PowerProfile .
Remote Controllable	Permission for the whole Power Profile to be modified. If set to “false”, the server does NOT PERMIT modifications by a client.	Boolean “false”	?powerprofile s4ener:nodeRemoteControllable ?nodeRemoteControllable .
Supports Reselection	If set to true, this smart appliance permits selection of an optional power sequence to become the new preferred power sequence multiple times.	Boolean “false”	?powerprofile s4ener:supportsReselection ?supportsReselection .
Alternatives	Opens the possibility to demand more than 1 group of subsequent power sequences at a time. However: this use case is limited to 1 Alternatives Group		?alternativesgroup rdf:type s4ener:AlternativesGroup .
Alternatives ID	PRIMARY IDENTIFIER of “alternatives” groups The cardinality is “(0..1)”: At maximum one “alternatives” instance is permitted in this Use Case.	Integer 1	?alternativesgroup s4ener:alternativesGroupID ?alternativesID.
Power Sequences per Alternatives Group	Allows to offer more than 1 power sequence per group, e.g. offering 3 power sequences for ECO, normal, fast mode. One power sequence needs to be the preferred one. The Energy Manager can select another one to become the new preferred power sequence.		?powerSequence rdf:type s4ener:PowerSequence .
Sequence ID	Each power sequence includes	Integer	?powerSequence s4ener:sequenceID ?sequenceID .
State	An information about actual status	String “scheduled” or “inactive” or	?powerSequence saref:hasState ?state .

		“invalid” or “running” or “paused”	
Active Slot Number	If state is set to “running” or “paused” this element contains the currently active slot number.	Integer	?powerSequence s4ener:activeSlotNumber ?activeSlotNumber .
Sequence Remote Controllable	Is the sequence remote controllable by the Energy Manager or is the power sequence only informative, e.g. manual operation	Boolean “false”	?powerSequence s4ener:sequenceRemoteControllable ?sequenceRemoteControllable .
Start Time	Actual start time of the power sequence ? = **now**	String Date Time	?powerSequence s4ener:hasStartTime ?startTime .
End Time	Actual end time of the power sequence = **End Time**	String Date Time	?powerSequence s4ener:hasEndTime ?endTime .
Earliest Start Time	Earliest start time = **now**	String Date Time	?powerSequence s4ener:hasEarliestStartTime ?earliestStartTime .
Latest End Time	Latest end time = **End Time**	String Date Time	?powerSequence s4ener:hasLatestEndTime ?latestEndTime .
Is Pausable	Allowed to be paused by the Energy Manager during runtime, e.g. interrupt heating phase	Boolean “false”	?powerSequence s4ener:isPausable ?isPausable .
Is Stoppable	Allowed to be stopped by the Energy Manager during runtime	Boolean “false”	?powerSequence s4ener:isStoppable ?isStoppable .
Value Source	The source of the power/energy values (measured/calculated/empirical) If not set the source of forecasted values is undefined.	String “measuredValue” or “calculatedValue” or “empiricalValue”	?powerSequence s4ener:valueSource ?valueSource .

Power Time Slot	No of slots, each representing a specific demand in a phase of the runtime like pre-washing, heating, …		?powerSequence saref:consistsOf ?slot_1 . ?slot_1 rdf:type s4ener:Slot .
Slot Number	Each slot includes	Integer	?slot_1 s4ener:slotNumber ?slotNumber_1 .
Default Duration	Duration of the slot	String Duration	?slot_1 s4ener:hasDefaultDuration ?defaultDuration_1 .
Power Min	Min power consumption, if applicable “W” SHALL be assumed as unit for the value implicitly if not set explicitly in power unit	Number	?slot_1 saref:consistsOf ?powerMin_1 . ?powerMin_1 rdf:type s4ener:PowerMin ; saref:relatesToMeasurement ?measurementMin_1 . ?measurementMin_1 rdf:type saref:Measurement ; saref:isMeasuredIn om:watt ; saref:hasValue ?valueMin_1 .
Power	Typical consumption of the slot	Number	?slot_1 saref:consistsOf ?power_1 . ?power_1 rdf:type s4ener:Power ; saref:relatesToMeasurement ?measurement_1 . ?measurement_1 rdf:type saref:Measurement ; saref:isMeasuredIn om:watt ; saref:hasValue ?value_1 .
Power Max	Max power consumption, if applicable	Number	?slot_1 saref:consistsOf ?powerMax_1 . ?powerMax_1 rdf:type s4ener:PowerMax ; saref:relatesToMeasurement ?measurementMax_1 . ?measurementMax_1 rdf:type saref:Measurement ; saref:isMeasuredIn om:watt ; saref:hasValue ?valueMax_1 .

Table A2.13. Mapping of Manual Operation use case with SAREF triples.

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#
XML Schema Definition	Vocabulary of common datatypes	xsd	http://www.w3.org/2001/XMLSchema#
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	A vocabulary of terms to give additional meaning to data	om	http://www.ontology-of-units-of-measure.org/resource/om-2/

Table A3.1. Prefixes used throughout Appendix 3.

A3.1 - 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 SPINE IoT data model/protocol (EN50631-3-1 and EN50631-4-1) with the corresponding SAREF and SAREF4ENER triples.

SPINE IoT power sequence in Json	SAREF triple representation
# Alternatives of Powersequences	?powerSequence rdf:type s4ener:PowerSequence .
sequenceId: 1	?powerSequence s4ener:sequenceID “1”^^xsd:unsignedInt .
state: scheduled	?powerSequence saref:hasState s4ener:Scheduled .
activeSlotNumber: 0	?powerSequence s4ener:activeSlotNumber “0”^^xsd:unsignedInt .
sequenceRemoteControllable: true	?powerSequence s4ener:sequenceRemoteControllable “true”^^xsd:boolean .
startTime: "2021-06-24T12:00:00Z"	?powerSequence s4ener:hasStartTime “2021-06-24T12:00:00Z”^^xsd:dateTime .
endTime: "2021-06-24T13:40:00Z"	?powerSequence s4ener:hasEndTime “2021-06-24T13:40:00Z”^^xsd:dateTime .
earliestStartTime: "2021-06-24T06:20:00Z"	?powerSequence s4ener:hasEarliestStartTime “2021-06-24T06:20:00Z”^^xsd:dateTime .
latestEndTime: "2021-06-24T19:00:00Z"	?powerSequence s4ener:hasLatestEndTime “2021-06-24T19:00:00Z”^^xsd:dateTime .
isPausable: false	?powerSequence s4ener:isPausable “false”^^xsd:boolean .
isStoppable: false	?powerSequence s4ener:isStoppable “false”^^xsd:boolean .
valueSource: ”empiricalValue”	?powerSequence s4ener:valueSource “empiricalValue”^^xsd:string .
powerTimeSlots	?powerSequence saref:consistsOf ?slot_1 . ?slot_1 rdf:type s4ener:Slot .
slotId: 1	?slot_1 s4ener:slotNumber “1”^^xsd:unsignedInt .
defaultDuration: "00:23:00"	?slot_1 s4ener:hasDefaultDuration “PT23M”^^xsd:duration .
powerMin: 1800	?slot_1 saref:consistsOf ?powerMin_1 . ?powerMin_1 rdf:type s4ener:PowerMin ; saref:relatesToMeasurement ?measurementMin_1 . ?measurementMin_1 rdf:type saref:Measurement ; saref:isMeasuredIn om:watt ; saref:hasValue “1800”^^xsd:unsignedInt .
power: 2000	?slot_1 saref:consistsOf ?power_1 . ?power_1 rdf:type s4ener:Power ; saref:relatesToMeasurement ?measurement_1 . ?measurement_1 rdf:type saref:Measurement ; saref:isMeasuredIn om:watt ;

			saref:hasValue “2000”^^xsd:unsignedInt .
		powerMax:2500	?slot_1 saref:consistsOf ?powerMax_1 . ?powerMax_1 rdf:type s4ener:PowerMax ; saref:relatesToMeasurement ?measurementMax_1 . ?measurementMax_1 rdf:type saref:Measurement ; saref:isMeasuredIn om:watt ; saref:hasValue “2500”^^xsd:unsignedInt .
		slotId: 2	?slot_2 s4ener:slotNumber “2”^^xsd:unsignedInt .
		powerMin: 200	?slot_2 saref:consistsOf ?powerMin_2 . ?powerMin_2 rdf:type s4ener:PowerMin ; saref:relatesToMeasurement ?measurementMin_2 . ?measurementMin_2 rdf:type saref:Measurement ; saref:isMeasuredIn om:watt ; saref:hasValue “200”^^xsd:unsignedInt .
		power: 220	?slot_2 saref:consistsOf ?power_2 . ?power_2 rdf:type s4ener:Power ; saref:relatesToMeasurement ?measurement_1 . ?measurement_2 rdf:type saref:Measurement ; saref:isMeasuredIn om:watt ; saref:hasValue “220”^^xsd:unsignedInt .
		powerMax: 250	?slot_2 saref:consistsOf ?powerMax_2 . ?powerMax_2 rdf:type s4ener:PowerMax ; saref:relatesToMeasurement ?measurementMax_2 . ?measurementMax_2 rdf:type saref:Measurement ; saref:isMeasuredIn om:watt ; saref:hasValue “250”^^xsd:unsignedInt .

Table A3.2. Mapping of SPINE IoT protocol to SAREF triples.

A3.2 - Example of SAREF4x triples with …

“Work in progress”

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 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.

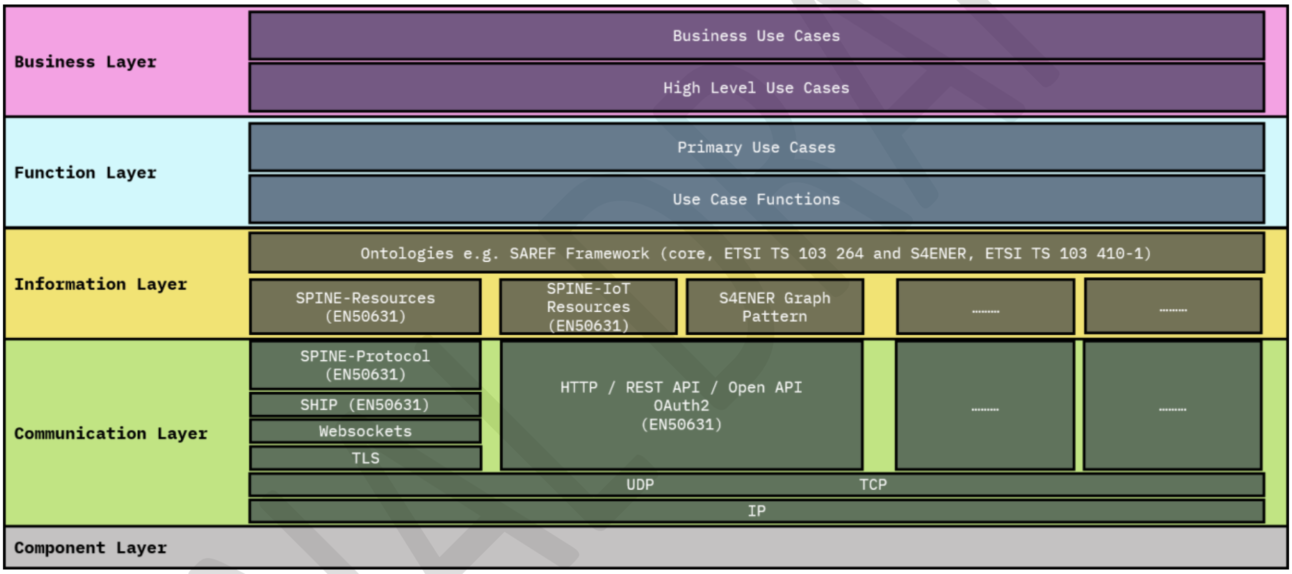

Figure A4.1. Code of Conduct reference layer model,
(based on SGAM layer model and CENELEC standard EN50631, 2023)

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.

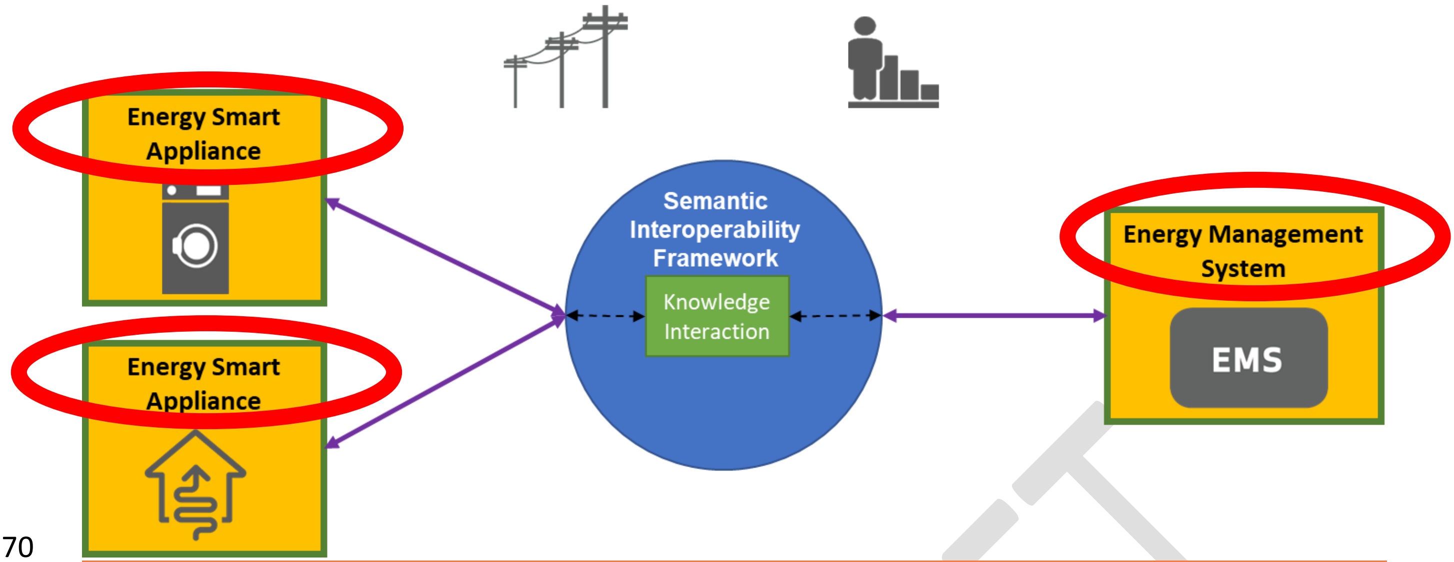

Figure A4.2. Semantic Interoperability

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 framework.

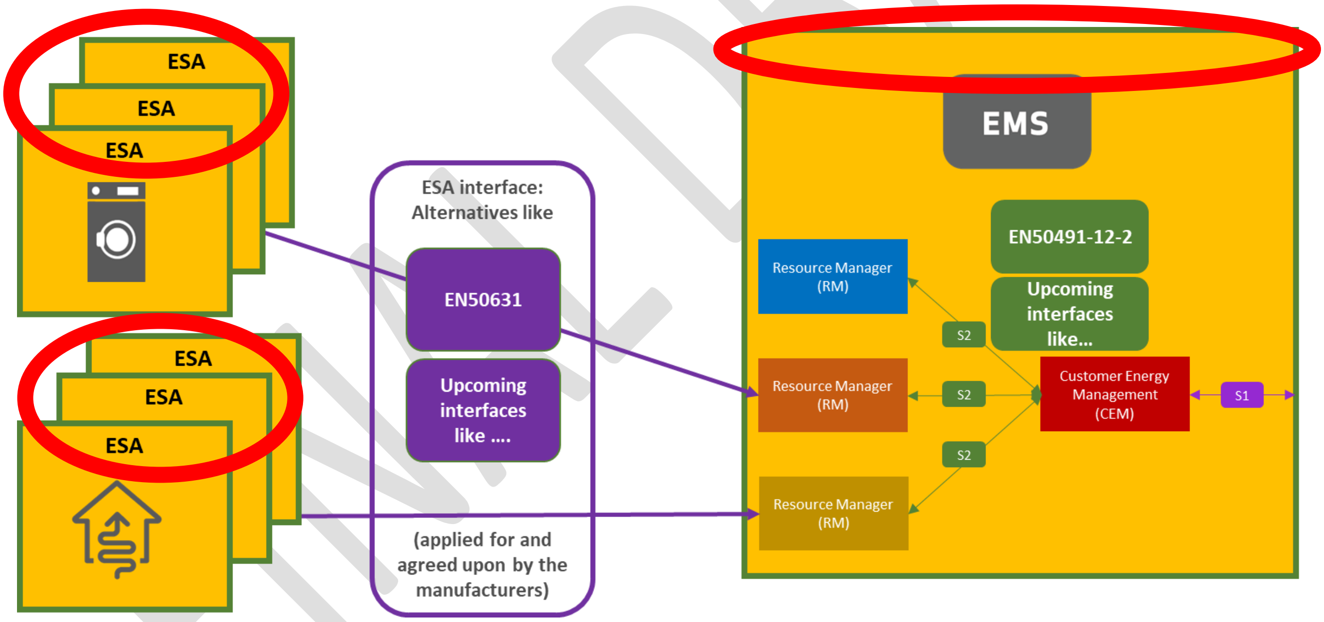

Figure A4.3. ESA interface.

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

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

a. Physically in the ~~device~~ ESA;

b. Represented as digital twin in the manufacturer cloud;

c. Represented as digital twin in a dongle/adapter, connected with the ESA.~~, attached to the physical device.~~

Implementation b & c should be clearly referenced in the EPREL database as mandatory to make the ESA CoC compliant.

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 3 “Commitment” for the products described in Chapter 1 “Appliances” it places on the market as of one year after the date of signing.

The organisation, through regular upgrade reports, will keep the European Commission informed on the implementation of 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:

XX
European Commission - DG XX

E-mail: