Energy Smart Appliances' Interoperability: Analysis on Data Exchange from State-of-the-art Use Cases

Supporting the development of policy proposals for energy smart appliances

Papaioannou, I. Andreadou, N. Tarramera Gisbert

JRC-C3 Delivered Tasks

2. Literature review → Ecodesign Preparatory work, Interconnect, SGTF EG1, ETSI Smart Appliances,, California Legislation, Energy Star Initiative, Energy@ Home, IEA EDNA, APPLiA, EEBUS, BRIDGE and more

3. Development of use cases → 36 Use Cases – 4 High Level Use Cases

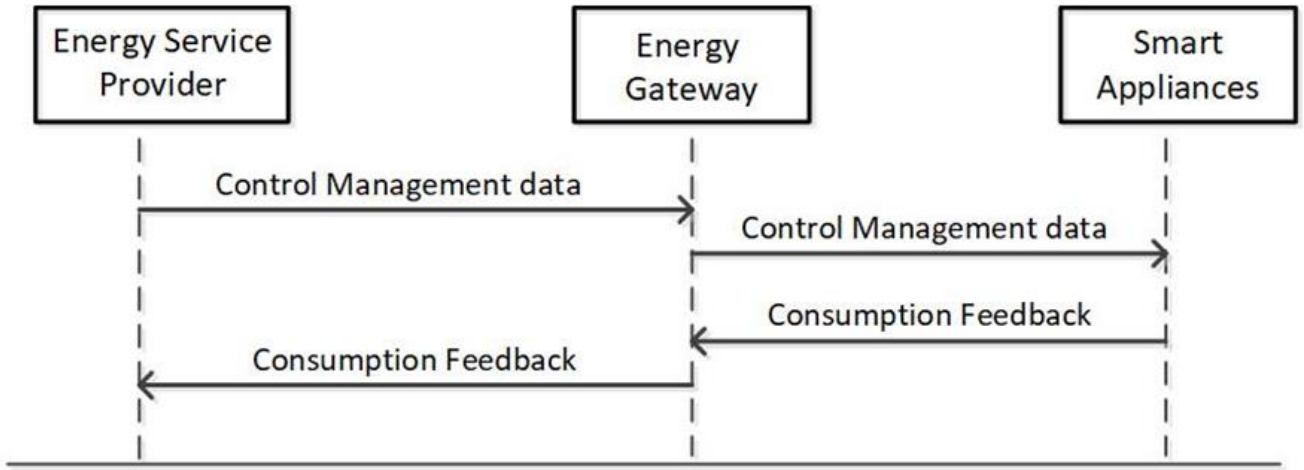
4. Defining the principles for data sharing among appliances → Actors/ Message exchange of smart appliances

Report can be found on: (https://ses.jrc.ec.europa.eu/sites/default/files/Energy_Smart_Appliances_Interoperability.pdf)

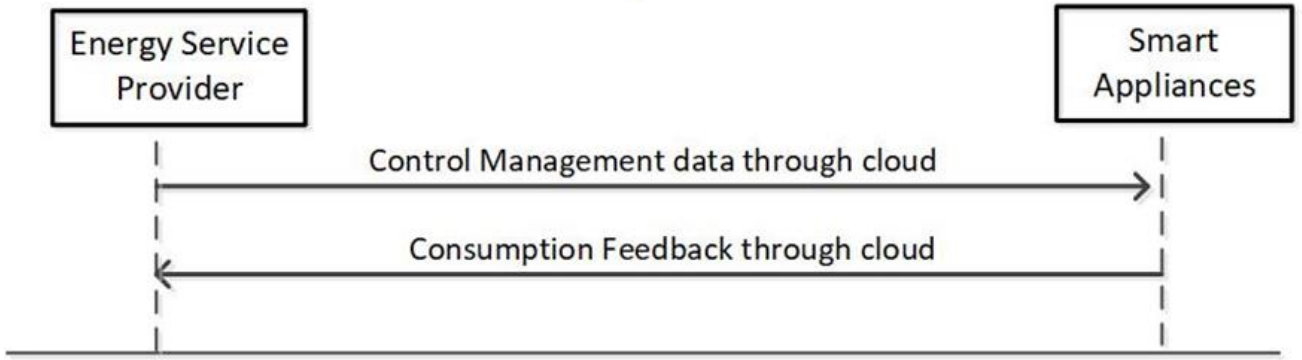
Deliverable 2-3-4 main messages

- Literature review
- Definition of Smart Appliances
- 4 Generic Use Cases from 36 Use Cases
- Definition of Actors and Information exchange
- Mapping the Information in SAREF

Use Cases for Energy Smart Appliances



a)

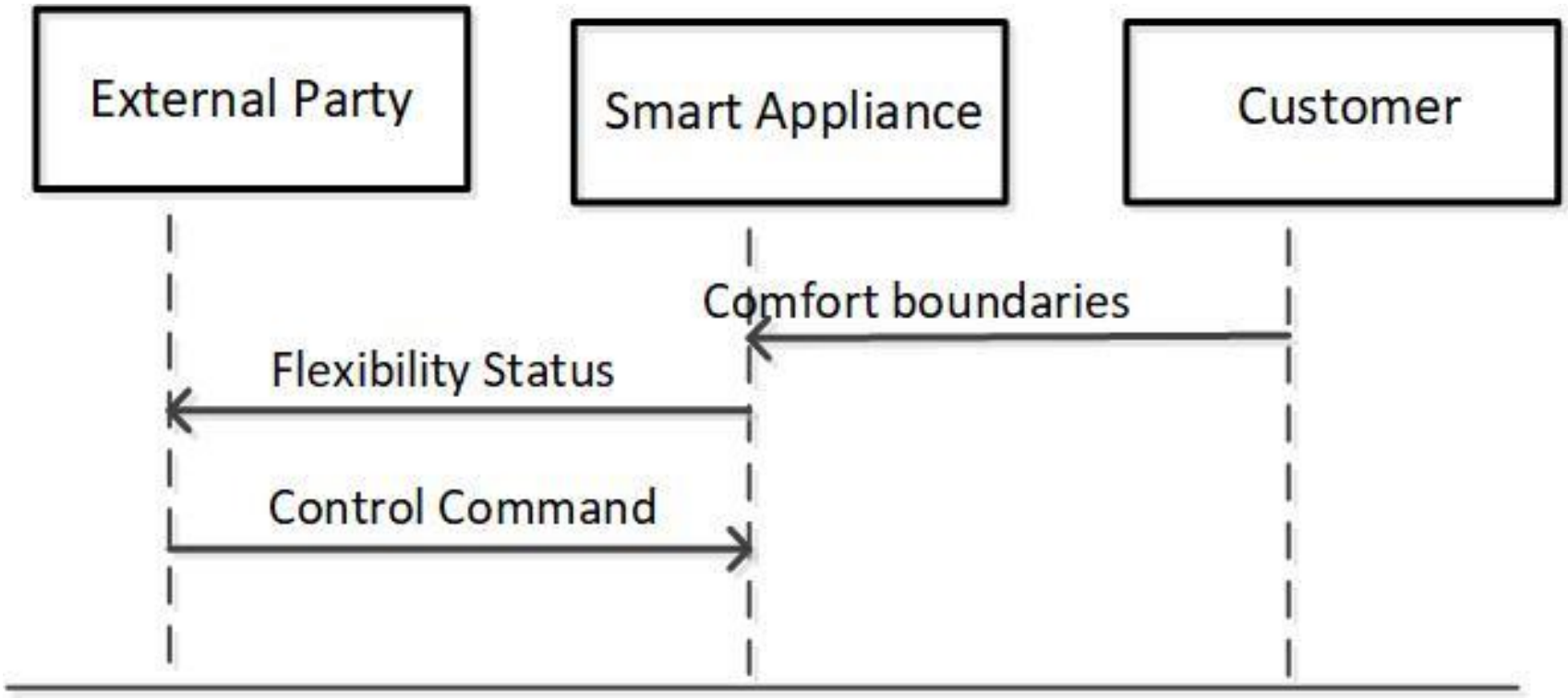


b)

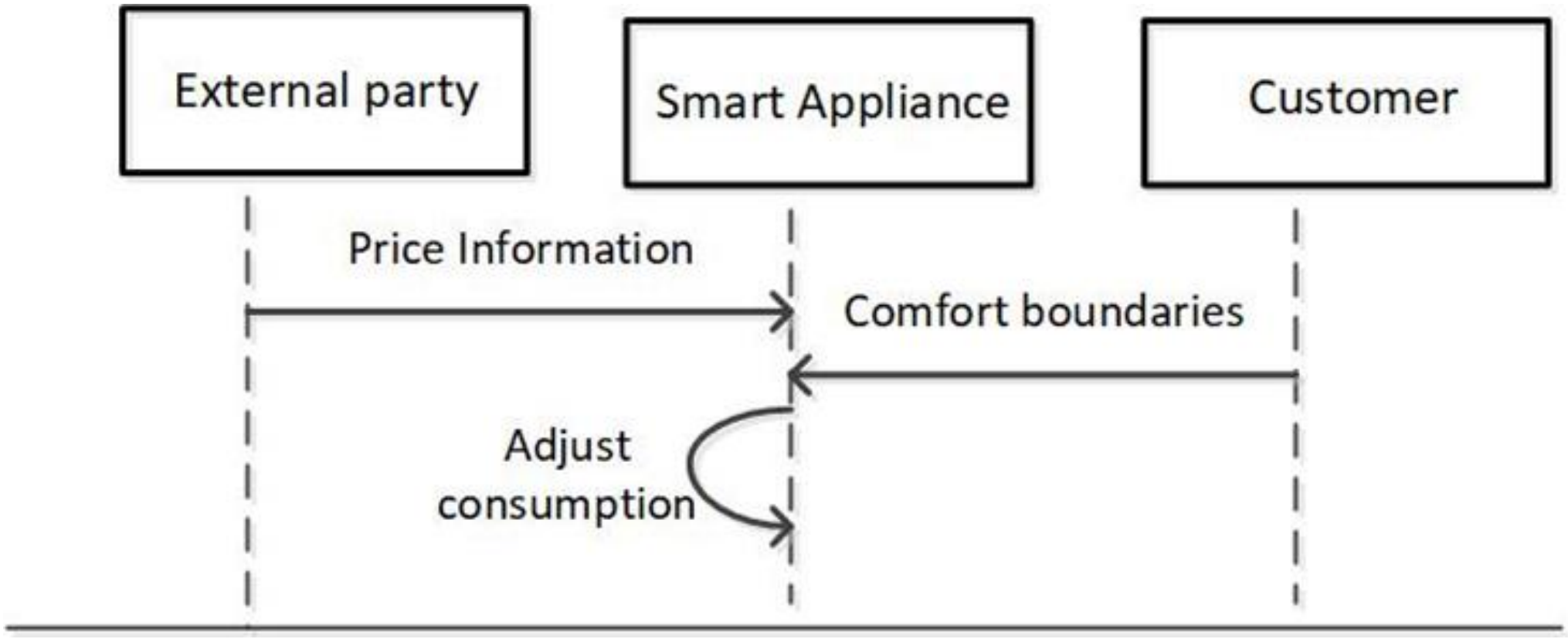
Use Cases from Preparatory study on Smart Appliances, Task 7

- Explicit Demand Response Use Cases
- Implicit Demand Response Use Cases
- Local optimal energy consumption Use Cases
- Standalone Demand Response Use Cases

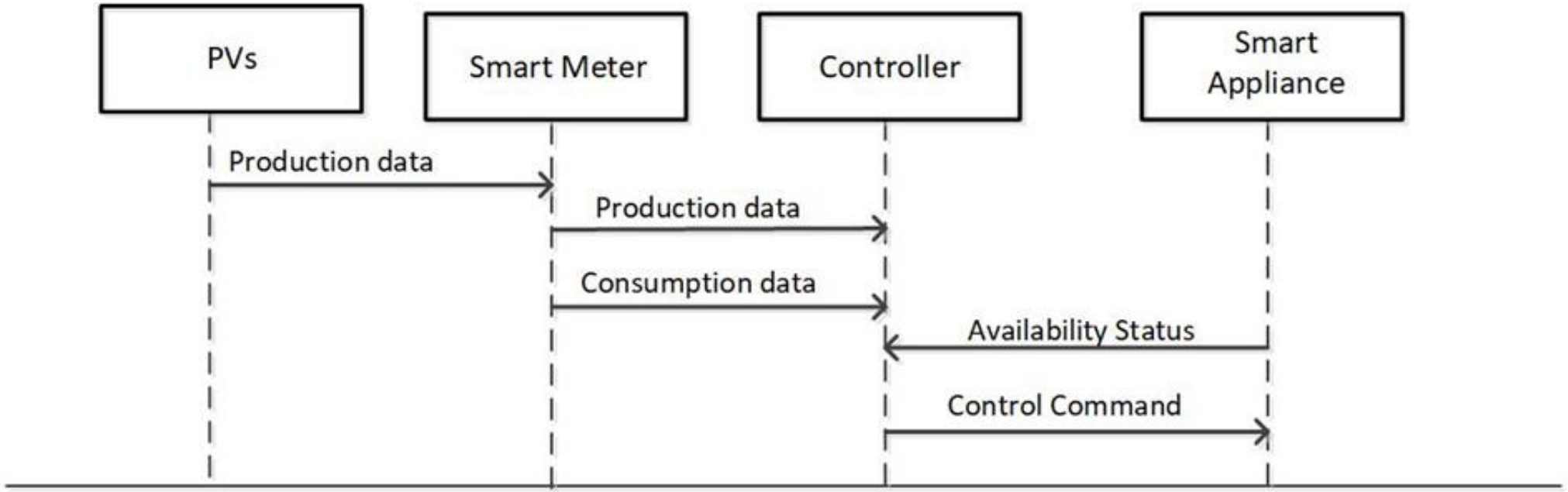
Explicit Demand Response Use Cases



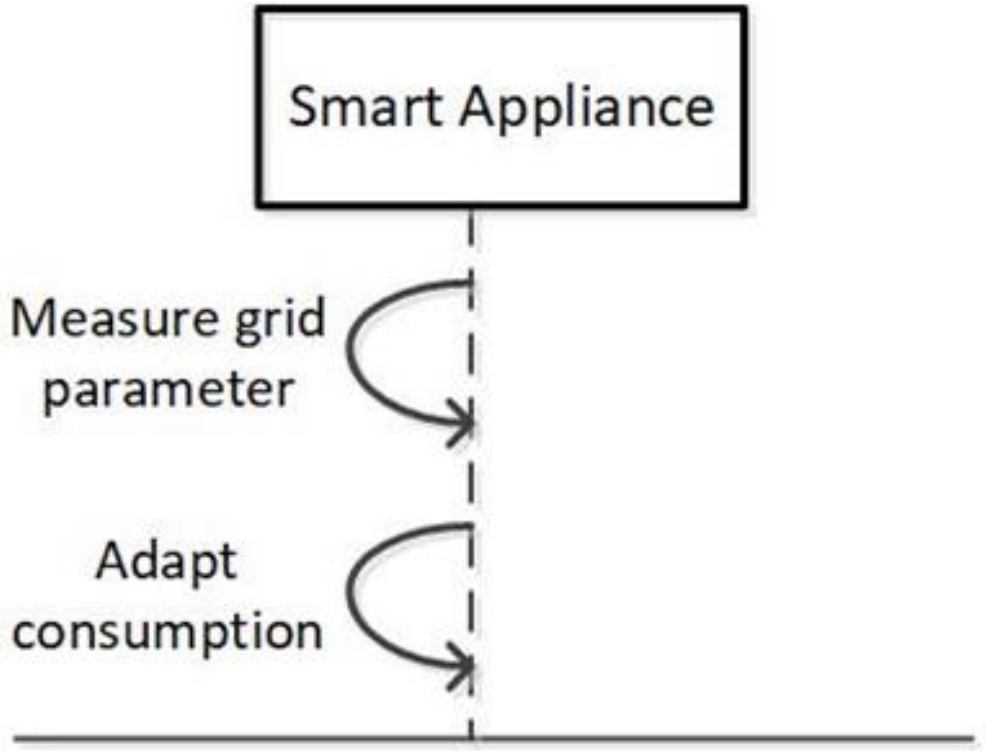
Implicit Demand Response Use Cases



Local optimal energy consumption UC



Standalone demand response Use Cases



Actors

- Device within house for control purposes (Home Energy Gateway, Home Gateway, Grid Appliance Controller, Home Energy Controller, Energy Management System (EMS), Central EMS, Building Acquisition Control System (BACS))
- Energy Service Provider (Energy Service Provider, Energy Company, Market Energy Company, Power System, DSO)
- Customer (Customer, flexibility owner)
- Device outside the house (Linear Pilot Backend, Signal Receiver, VPP – intelligent load manager, Smart Charging App etc)

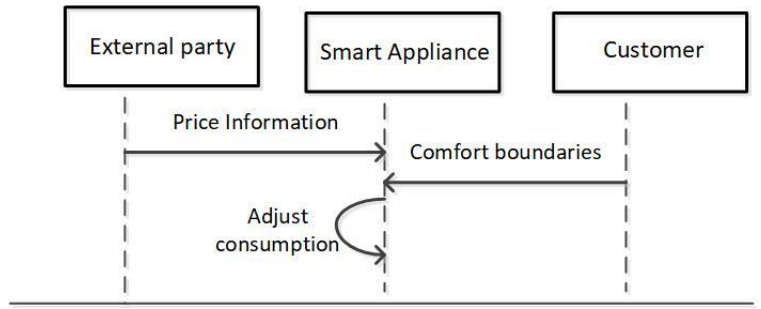
Smart Appliance <-> Device within home for control purposes (i.e. Home Energy Gateway, EMS, etc)	
Device within home for control purposes (i.e. Home Energy Gateway, EMS, etc) -> Smart Appliance	Smart Appliance -> Device within home for control purposes (i.e. Home Energy Gateway, EMS, etc)
Control management data: Switch on / Switch off commands; Time slot for being active/ non active; Time window duration; schedule of activation; override commands / stop activation; store energy command; energy reduction command	Data on energy consumed; data on energy produced
Control of flexibility: interrogation of the appliance if it has flexibility to offer; request flexibility	Availability status/ update of status
Information of overall consumption within the house	Feedback on control commands: the appliance is switched on/ off, etc (see the commands of control – previous column).
Warning messages: overall house consumption exceeds limits	Request of price information/ tariffs
Price information/ tariffs	

Smart Appliance <-> Energy Service Provider	
Energy Service Provider -> Smart Appliance	Smart Appliance -> Energy Service Provider
Control management data: Switch on / Switch off commands; Time slot for being active/ non active; Time window duration; schedule of activation; override commands / stop activation; store energy command; energy reduction command	Data on energy consumed; data on energy produced
Control of flexibility: interrogation of the appliance if it has flexibility to offer; request flexibility	Availability status/ update of status
Inform of emergency event, i.e. grid parameters are critical	Feedback on control commands: the appliance is switched on/ off, etc (see the commands of control – previous column).
Price information/ tariffs	Request of price information/ tariffs

Smart Appliance <-> Customer	
Customer -> Smart Appliance	Smart Appliance -> Customer
Comfort boundaries: time slots / duration of window for the appliances to be turned on/ off; temperature limits	Request of price information/ tariffs
User presence	Consumption/ generation data
Control actions: switch on and off the appliance	Information about flexibility to offer; information about control occurred by external actor/ device within the house
Activation of a non-smart appliance	Show emergency messages: appliance will turn off; overload takes place (consumption exceeds limits)

Smart Appliance <-> control point outside the house, owned / controlled by service provider	
Control point outside the house, owned / controlled by service provider -> Smart Appliance	Smart Appliance -> control point outside the house, owned / controlled by service provider
Control management data: Switch on / Switch off commands; Time slot for being active/ non active; Time window duration; schedule of activation; override commands / stop activation; store energy command; energy reduction command	Data on energy consumed; data on energy produced
Control of flexibility: interrogation of the appliance if it has flexibility to offer; request flexibility	Availability status/ update of status
Inform of emergency event, i.e. grid parameters are critical	Feedback on control commands: the appliance is switched on/ off, etc (see the commands of control – previous column).
Price information/ tariffs	Comfort boundaries: time slots / duration of window for the appliances to be turned on/ off; temperature limits
	Request of price information/ tariffs

SAREF		General Categorization of Use Cases			
Main Classes	Sub-Classes	Explicit Demand Response	Implicit Demand Response	Local Optimal Energy Consumption	Standalone Demand Response
Command	CloseCommand			O	
	GetCommand*			X	
	NotifyCommand	X	X	X	
	OffCommand	X		X	
	OnCommand	X		X	
	OpenCommand			O	
	PauseCommand			X	
	SetlevelCommand*			X	
	StartCommand			X	
	StepdownCommand			X	
	StepupCommand			X	
	StopCommand			X	
	ToggleCommand			X	
Commodity	Coal				
	Electricity	X	X	X	X
	Gas	X	X		
	Water				
Device* (Function related)	Actuator	X	O	X	
	Appliance*			O	X
	HVAC	X	X	X	
	Meter	X	X	X	
	Sensor*		X		
	Lighting	X	X	X	
	… others				
Feature Of Interest		X	X	X	X



Implicit Demand Response

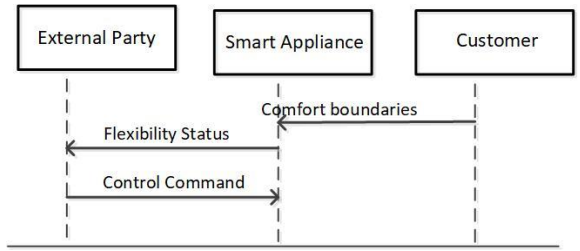
O → Class and/or subclass possibly involved in the specific example representing the UC

X → Class and/or subclass definitely involved in the specific example representing the UC

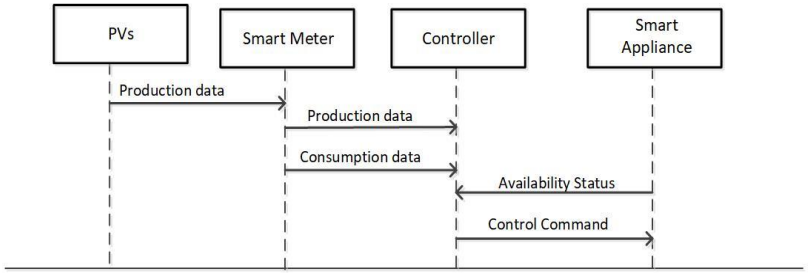
* SAREF subclass with additional, and more specific, sub-subclasses available.

** It is regarded as a subclass of the SAREF class Property in the SAREF ontology from TNO, but as a main class in Official ETSI portal for SAREF. The latter is adopted as reference; quotes 2021 instead of 2020.

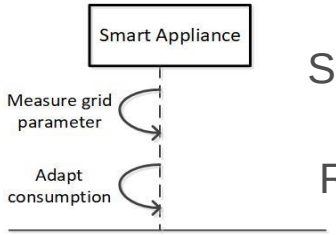
SAREF		General Categorization of Use Cases			
Main Classes	Sub-Classes	Explicit Demand Response	Implicit Demand Response	Local Optimal Energy Consumption	Standalone Demand Response
Function	ActuatingFunction*	X	O	X	X
	EventFunction		X	O	X
	MeteringFunction	X	X	X	X
	SensingFunction		X	O	X
Measurement		X	X	X	X
Profile		X	X	X	X
Property	Energy		X	X	X
	Humidity		O	O	
	Light	X	X	X	
	Motion		O	O	
	Occupancy		O	O	
	Power		X	O	
	Pressure				
	Price		X	O	X
	Smoke				
	Temperature	X	X	X	
Service	Switch on service	X		X	
State	MultiLevelState		X	X	X
	OnOffState*	X	X	X	X
	OpenCloseState*		O	O	X
	StartStopState*		X	X	X
Task		X	X	X	X
Time**		X	X	X	X
Unit Of Measurement	Currency		X	O	X
	EnergyUnit		X	X	X
	IlluminanceUnit	X	X	X	
	PowerUnit		X	O	
	PressureUnit				
	TemperatureUnit	X	X	X	



Explicit Demand Response



Local Optimal Energy Consumption



Standalone Demand Response

SAREF4ENER. Main scope is focused on demand response scenarios, by providing a tool for flexibility.

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Thank you

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