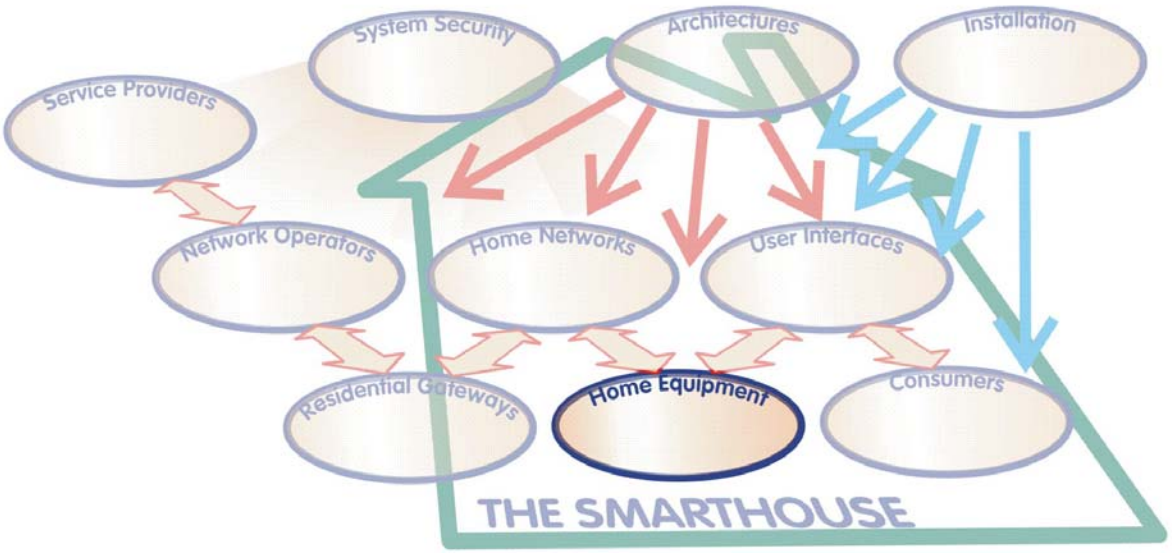
1.1 Home Equipment (HE)



- **Figure 3.7 – The Home Equipment Section in relation to the SmartHouse**

1.1.1 Introduction

The vision of the SmartHouse project is a home where consumer products are interconnected to deliver applications and services not possible from stand-alone devices. Connected appliances require network capabilities to exchange commands and data that are clearly and precisely defined. The goal of defining the communications network and associated messages is to achieve interoperability. Interoperability is the prerequisite for the operation of networked devices in a coordinated manner to provide new functions and services for users.

Interoperability is particularly challenging because of the wide diversity in Home Equipment. Examples of such equipment include appliances, lighting fixtures, switches and sensors. These devices are typically organized into smaller systems to provide a common application such as heating, lighting, or entertainment. The terms "application domain" and "cluster" describe such smaller collections of related equipment and devices.

SmartHouse examines methods for achieving interoperability among devices in the clusters and among these clusters. Various international, regional, and national standards for interoperability are referenced and recommended.

The SmartHouse Code of Practice and the referenced standards accommodate Home Equipment and clusters that are developed by a variety of manufacturers. These manufacturers are expected to follow (apply) this Code of Practice because providing interoperable products enables new business opportunities in the growing home systems and products industry.

Even more important will be this SmartHouse Code of Practice and Home Equipment section for the SmartHouse System Designer. It is him who in the end practically sells these Smart products. He will be closest to those who will exploit the Smart Home Equipment, networks and related services.

Therefore this section of the SmartHouse Code of Practice guides and assists him in his planning and towards his clients, i.e. Investors, Service providers, Architects, Contractors, Installers, but also Users, such as Consumers and operators, when preparing for the introduction and installation of electronic SmartHouse Home Equipment (SmartHouse-HE).

Equipment in the home is one of the larger areas for this Code of Practice since, ultimately, it covers everything to do with any connected electronic appliance and (installed) device within the home.

Each item of equipment has to be described, addressed, communicate and work within whatever appropriate home network is installed. Communications depend on the service requirements of any particular device and there will be a mixture of speeds and priorities.

Note: There is a comprehensive set of Usage Case Analyses in C.3.

1.1.2 Scope

The role of the Home Equipment Section in this Code of practice is to support interoperability of heterogeneous devices in the home. The rationale behind it is to enable a spirit of cooperation in the creation of new smart house services and applications and consequently new business opportunities.

The Home Equipment Section also highlights the benefits of the SmartHouse technologies in achieving advanced applications and/or services, increasing the user friendliness, and bringing remote services into all application fields, taking into account the need of evolution of the services provided in a home in time.

Scope of the Home Equipment section is to:

a)Identify equipment & business groupings (Clusters) covered in this work group and the applications/services covered

b) Identify current standards for the groupings identified above

c) Review current standards, identify any gaps and provide recommendations for future work to fill the gaps

d) Liase with the 'NTE and Gateways' and 'Home Networks and Media' in particular, but with all the other sections

1.1.3 Methodology

The following Methodology will be applied to achieve the Scope.

a) Describe Usage Cases, as seen from the end user perspective, to present possible examples of use of the various Home Equipment

b) Summarize functional requirements in functionality sets to be provided by the SmartHouse

c) Analyse available and standards under development to verify if the functional requirements (point b) are covered

d) If any gap is detected between the functional requirements and the standardization work, the gap will be highlighted for further work, outside the remit of SmartHouse.

1.1.4 Usage cases

1.1.4.1 Usage cases introduction

Equipment in the home is becoming increasingly more complex and this complexity is being resolved by intelligence. This intelligence is mainly in the form of computing devices and these (microprocessors) can be found in anything from the TV to the refrigerator to the toaster. The result of such "intelligent devices" in the home is that they are potentially able to communicate. This in turn is the prerequisite for the large gamut of upcoming services which may now be offered to the dwellers: they can from now on live in a SmartHouse environment.

The fact of this intelligence is both an opportunity and a threat. It brings benefits to the SmartHouse because the equipment can collaborate and work together in many ways that will help the consumer. It also brings complexity in that there will be a growing number of sub-systems that will interact with one another and the confusion that can result if this complexity is not understood.

Home Equipment varies in its level of intelligence and the demands that it makes on other resources, therefore, the requirements of Home Entertainment equipment is greatly different to that of white goods but they may need to collaborate in delivering certain services such as energy management. The fact that equipment may be managed remotely is an opportunity for a Service Provider and a benefit for the user.

This section faces the issues of increased complexity and aims to explain how this can be handled by classifying equipment into clusters of equipment belonging to an appropriate collection or application domain. Such clustering should reflect existing market structures and business preferences both at service industry, at Home Equipment manufactures and at the professionally trained System Designers. Only when these market driven elements fit together will the Home Equipment suit, i.e. enable delivery and usage of the client's bouquet of services. To find such a market related partitioning, it seems natural to follow the example at relevant open Home Equipment Fairs and Conventions. The following subdivision for the SmartHouse systems' design uses such a result:

Consumer electronics (CE): A world of information and entertainment without limits — permitting the client to enjoy external services, which are providing content for home audio and video entertainment, information communication and e-mailing via Internet, which are using cost efficient interactive digitalized terrestrial, satellite and cable broadband links, wired or wireless home networks, which permit transmission of sound (voice and audio) and video images, which enable the provision of different available e-Commerce and e-Government services as well as information of different kind to every part of the home and/or to the SmartHouse extensions, such as garden and car.

Communications: The home is anywhere one wants it to be — contact the home data on the move, work at home, call up services or offers on the Internet: The latest in modern communications makes it all possible.

Domestic appliances: The comfort of the modern home — easy programmable washing machines, remotely monitored dishwashers, appliances which are both more reliable and more cost efficient.

Home automation: Get the expected consumer services, save money with ease and feel secure — using convenient light and shading concepts with e.g. automatic lights off, ensuring proper energy management, also by capitalizing on the utilities remote meter reading and tariff control, meeting legal energy performance requirements by extending the potential of heating, ventilation and air-conditioning control, integrating safety and increase its potential in case of e.g. reduced mobility, ensuring security features such as controlled accessibility, the networked home offers users all kinds of ways for enhanced comfort and safety and to save energy.

Security systems: Security at home and while one is away — remote-controlled video monitoring systems, capitalizing e.g. on cost efficient [web] cameras of door communication systems for outdoor and indoor surveillance and networked alarm systems, capitalizing on Home Automation components, help minimize the risk of intrusion.

Telematics: Assisting the [remote] maintenance of household equipment, the car, medical assistance to the dwellers and information — enjoy tele-maintenance, telemedicine and tele-care services to assist the client and in particularly elderly and less mobile, enabling a long independent life in the comfort of the normal home.

1.1.4.2 Usage case methodology

Having classified all devices into Clusters of Equipment, it is now important to present the relationship of devices within each Cluster and among Clusters. To this end a usage case description format is chosen which in its systematic and uniform way will be assist the SmartHouse System Designer in his planning and inform his clients, i.e. Investors, Service providers, Architects, Contractors, Installers, (but also Users, such as Consumers and operators), when preparing for the introduction and installation of electronic SmartHouse Home Equipment (SmartHouse-HE).

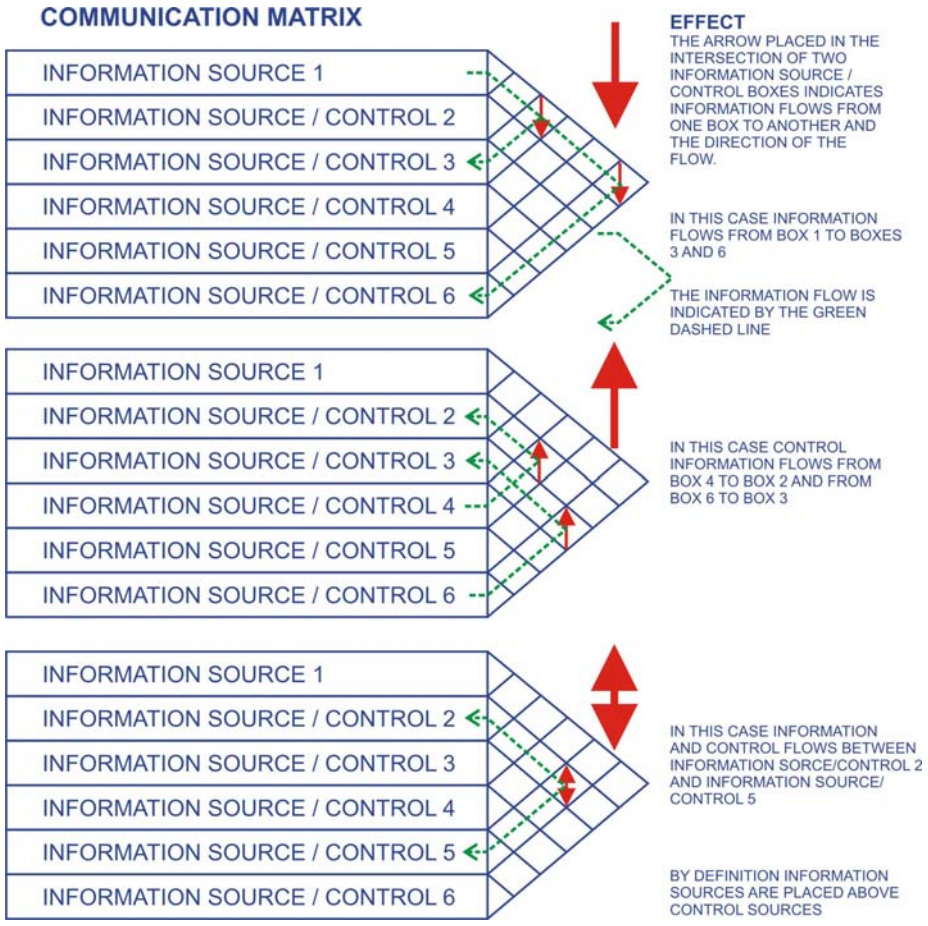
Only such a uniform approach will generate the necessary transparency to enable

- starting the SmartHouse with any HE cluster or part thereof, which results from the [potential] SmartHouse user's initial interest in [a] specific SmartHouse service and related application(s) and their functions, i.e. the pivot service[s] and application[s],
- possible extension(s) of such an initial design at any later stage by subsequent addition of more parts, additional clusters and even SmartHouse system designs which are under the responsibility of other trades
- broad generation of synergies, an important element to convince any party concerned about the cost effectiveness of the SmartHouse technology.

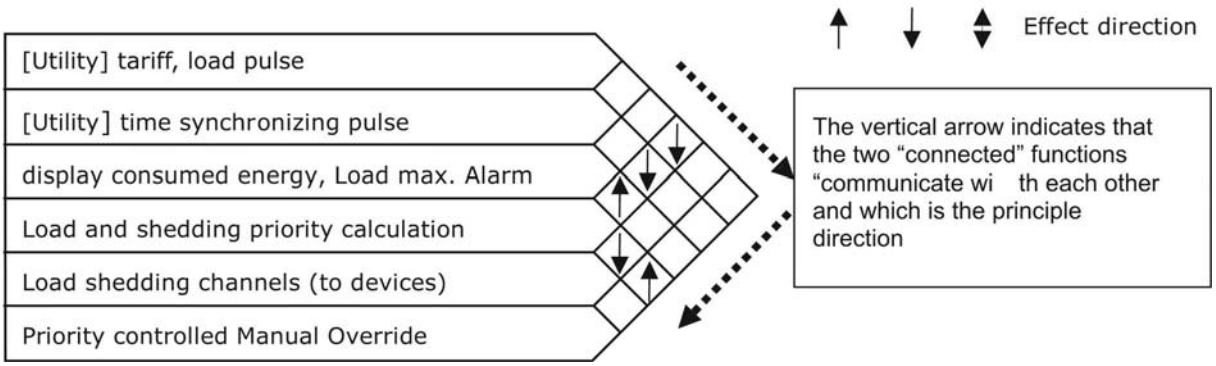
To achieve this objective, each typical Usage case presentation:

- is based on an [implicit but open ended] collection of related but manufacturer independent SmartHouse applications and functions, which are listed in a table - The Cluster Usage Case: Applications and Functions Table
- has a Cluster Communication Matrix to assist the designer to widen the System design process of a specific installation and establish the necessary Interoperability considerations for the proper deployment of the selected technology. Moreover this matrix will enable the client to check the proper operation of his system(s).

NOTE Note: see below for instructions on how to read and fill in such a Usage Case



- **Figure 3.7.1 – Description of Communication matrix**



- **Figure 3.7.2 – Example Communication matrix**

- It consists of the Object description set(s), preferably in an Excel tabular form of the relevant trade and cluster of the Home equipment concerned. The Cluster Usage Case Objects Table
- These Cluster Object Case forms constitute the System Designer's Case tool. By completing such Object matrices and tables for the specific System Design Case he is able to
  - identify all necessary devices and related software applications according to required functions
  - obtain the total count of all related equipment (Bill of materials)
  - quantify the required System Design time for e.g. drafting the required deployment plans on the basis of agreed planning and installation methods and their appropriate graphical presentation with standardised symbols and carrying out the necessary installation and commissioning.

As the usage cases are (necessarily) typified it will be easy for any system designer to re-employ and/or re-arrange such collections of Applications (and their functions), e.g. when enhancing features or when geographically extending a given system design or when adapting such a collection for a design according to another client's needs.

Usage cases can in principle be presented both in relation to a trade (e.g. lighting, heating, electrical energy distribution, Consumer Electronics, information and communication networks) and/or in relation to a location (e.g. [integrated] room management in a SmartHouse environment). Both are necessary as the former helps in the preparation of the necessary building bricks and the latter shows how to generate the expected synergies.

1.1.5 SmartHouse Home Equipment Usage case clusters

In order

- to address the increased complexity and aims of the SmartHouse Home Equipment environment
- to encourage the different trades [potentially] involved with the SmartHouse
- to explain to the [overall] SmartHouse System Designer how he can plan to integrate such clusters into one specific SmartHouse

It is only appropriate to subdivide this vast area of possible SmartHouse applications by classifying equipment into clusters of equipment in the same domain. Such clustering should reflect existing market structures and business preferences both at service industry, at Home Equipment manufactures, at the professionally trained System Designers and last but not least the trade relation of the subsequently required contractors and installers. Only when these market driven elements fit together will the Home Equipment suit, i.e. enable the delivery and usage of the client's bouquet of services. To properly reflect these markets, it is only natural to follow the examples at relevant open Home Equipment Fairs and Conventions.

Hence these typical SmartHouse-Home Equipment Usage Cases are arranged into the following 6 groups of clusters in subsequent chapters and described in accordance with the principles above:

- Communications [external]
- Consumer Electronics [and in-House communication]
- Home Automation Usage cases (examples)
- [electrical] Load management

    Lighting control

    Shutter control

    Heating (& Cooling) control

    Ventilation control

    Central Functions & Gateway function(s)

    Household Appliances

    SmartHouse Security Systems

    Telematics

For the sake of brevity, only two Clusters are detailed in the following: in line with the CENELEC TC205 scope, a typical Home Automation (HBES) Cluster “Lighting Control” and the “Household Appliances” Cluster. The remaining Clusters are grouped and fully detailed in Appendix A.1 .

1.1.6 Home Automation Usage cases: example lighting control

Home Automation is achieved by proper deployment of HBES technology. HBES, i.e. in full “Home and Building Electronic Systems”, as standardized by CENELEC TC205 defines the set of requirements for controlling and automating SmartHouse processes according to users needs. Such a radically decentralized and distributed approach makes use of these so-called BUS networks.

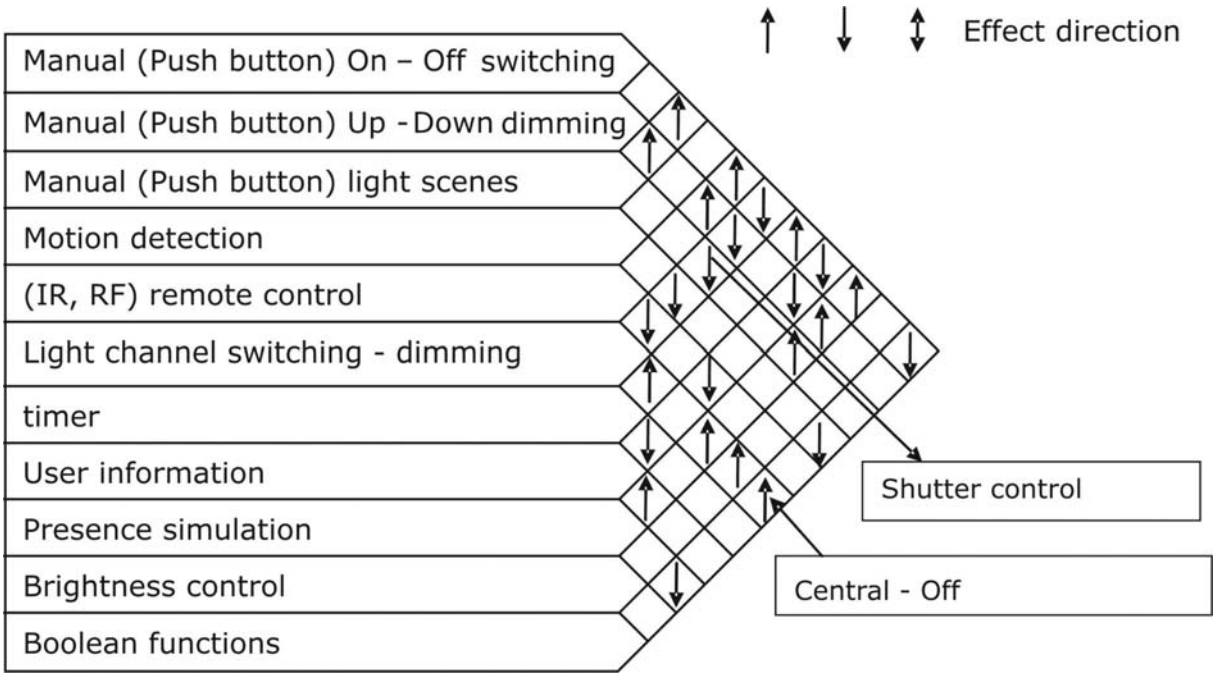
Such BUS Networks do not only provide a powerful standardized intercommunication at runtime between the devices’ [process or “Functional Block”] objects but also an enhanced set of services and mechanisms for network management, i.e. network configuration and commissioning.

As visible from the different HE-HBES Usage Cases this free Bus communication among all the networked devices helps to generate synergies by exploiting the available tight interaction between the distributed application functions, i.e. the expected Usage application. Moreover more applications become possible by just adding only one or few devices or often by merely updating a device’s application software. Powerful interworking models with their standardized data-point types and these “Functional Block” objects, support the System Design.

1.1.6.1 Lighting control usage case: Application(s) and functions

Applications	Functions	
manual (Push button) switching	On - Off command	one to n switches at different places
and/or	Start - Stop Dimming command	push button for up and down dimming; serves normally also for On - Off
(IR, RF) remote control	Light scene(s) **control**	push button activates the controller(s) pre-programmed light scenes; **possible interaction with shutter(s)**
Motion detection	[temporary] On command	normally directly combined with timing function
Light channel(s)	lighting load switching or dimming	light channel(s) being switched on and off and/or dimmed up or down by actuator; a channel connects either directly to a lamp [and/or its transformer] or via a controllable socket
timer	delayed switch-Off	timing function normally incorporated in Light channel actuator
User Information	Display	LED [or more sophisticated display] to signal "Light-On" status at specific place(s)
Presence simulation	automatic Light On - Off, Dim Value	automatic On – Off / Dim Value according Presence Simulator memory
brightness control	light level sensing	sensing (selected) illumination level
	illumination level control	interworks with dimming actuator;, and **possibly interaction with shutter(s)**
boolean functions	controlling interaction between different input signals	interaction between automatic and manual (override) signals; can be incorporated in actuators; particular important for a **Central – Off / Presence simulation**

1.1.6.2 Lighting control usage case: Communication matrix



1.1.6.3 Lighting control usage case objects

		SmartHouse Rooms and associated areas																
		one story appartment / multistory house (select as appropriate)																
For the specific design, complete this Lighting Control matrix by marking rooms and areas as appropriate plus amount of applications & functions (==> devices) The Excel sheet permits to immediately calculate required equipment totals and related design, installation and commissioning time		distribution panels	porch / entrance	staircase	corridor	night corridor	living	kitchen	storage	sleeping	bathroom	children 1	children 2	cellar 1	cellar 2	terasse / balcony	attic	garden
foreseen applications	**and functions**																	
manual (Push button) switching	On - Off command																	
and/or	Start - Stop Dimming command																	
(IR, RF) remote control	Light scene(s) **control;** possible interaction with shutter(s)																	
Motion detection	[temporary] On command																	
Light channel(s)	lighting load switching or dimming																	
Timer	delayed switch-Off																	
User Information	Display																	
Presence simulation	On – Off / Dim according Presence Simulator memory																	
brightness control	light level sensing																	
	illumination level control; possible interaction with shutter(s)																	
Boolean functions	controlling interaction between different input signals and **Central-Off / Presence simulation**																	

1.1.7 SmartHouse household appliances usage case

This cluster relates to the SmartHouse deployment of smart, net-workable Household Appliances such as oven and hobs, dishwashers, washing machines, fridges, deep freezers, water heaters but also future smaller smart devices such as coffee makers.

Concerning commissioning of SmartHousehold appliances

It is understandable that the user and consumer does not see or even not accept that the process of connecting and putting into operation of his SmartHousehold Appliance should necessarily require a professional Installer. Hence, except for the appliances and systems for which the customer should be trained in using them (eg. alarm systems, etc..), the SmartHouse CoP Installation Section will not cover the Household Appliances' Putting-into-service .

Normally the user expects nothing more than to plug the appliance into an electrical socket and to have it work. Although the appliance usage guide or leaflet must instruct for specific equipment such as oven and hobs how to connect them to electrical mains – required for safety reasons and (exceptionally for an electrician) how to connect, where required, household appliances to water and sewage pipes (normally requiring a plumber for anything else) the user expects that the SmartHouse environment to find and enrol these Smart appliances automatically. I.e. there must be Plug-and-Play provisions for starting basic

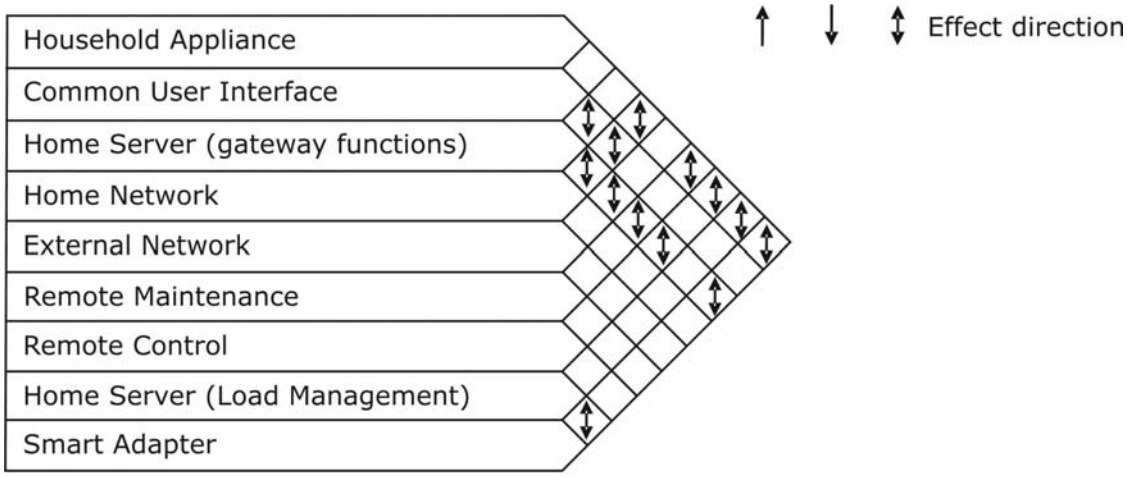
operation. Instructions on setting operational parameters shall be amply given in the accompanying instructions for use.

In order to have SmartHousehold Appliances work such a way, their SmartHouse Design Usage is equally required for their proper linking into the SmartHouse environment. But it must stay practically invisible to the end user and must therefore take place before at the appliances manufacturer. It's the latter that must then provide only the rest such relating to some parameter setting and operation.

1.1.7.1 SmartHouse usage case household appliances: Applications and functions

Applications	**Functions**	
Common User Interface	User interaction with the household appliances..	Monitoring of all connected household appliances Local control of appliance
Remote Maintenance	Regular maintenance program, and problem solution are carried out remotely at first and, only if needed, a technician is sent to the house	Requirements in the house: - In-house network availability - A gateway to the remote service point is needed - Status information, directly from Household appliance, if applicable, or from an information relay (a Smart Adapter, for instance)
Remote control	Household appliances are remotely controlled	Requirements in the house: - In-house network availability - A gateway to the remote service point is needed Status information, directly from Household appliance, if applicable, or from an information relay (a Smart Adapter, for instance)

1.1.7.2 SmartHouse usage case household appliances: Communication matrix



1.1.7.3 SmartHouse-household appliances usage case objects

For Specific Design complete this Household Appliances Usage matrix by marking selected appliances and linked applications and functions, as appropriate. **Placement of an appliance is in principle irrelevant to any Smart operation;** **However for the Home owner / users sake there should be an indication of their localization** **Excel sheet permits user to calculate Design, installation and commissioning totals**		**Identification of 'participating' electrical Household appliances**																	
		fixed (socket) connected appliances												mobile appliances					
		Home Server	fridge	deep-freezer	oven & hobs		storage water heater	accumulation heater	washing machine	dishwasher				ironing machine	smoothing iron	fan heating device	hair dryer(s)	coffee maker	
Indication of localization ➔																			
Applications	**Functions**																		
Common User interface																			
Remote Control																			
Remote Monitoring																			
Home Server	Load Management																		

1.1.8 Business requirements

In this sector there is fierce competiton between manufacturers. In many cases the business case, and therefore the will to utilise systems that collaborate in services to their equipment, is counter intuitive. This CoP is concerned with bringing understanding as well as technical knowledge into the market. Therefore it is appropriate that in this sector in particular the business requirements should be discussed. The following observations can be made on business as it is practiced:

- Home Equipments are often categorised. For instance a washing machine would be categorised as a white goods appliance or possibly more generally as a household appliance. A TV would be categorised as a consumer electronics device or maybe as a Digital Media Player. Or an intrusion detector would be categorised as a security device.
- Manufacturers of devices belonging to a given category are in general competitors. They will often agree on things to foster competition (e. g. white goods manufacturers have agreed on an energy level consumption level A, B, C). They therefore agree on some code of practice for the item they have agreed upon.
- Manufacturers of devices belonging to a given category often share the same culture and sometimes the same concerns concerning their industry. They are involved in the same value chain. Actors of these value chains participate to common initiatives e.g. within an association. For instance, consumer electronics manufacturers have created the DVB-MHP and DLNA initiatives. Likewise, actors in the home and building are involved in the Konnex association. The way those initiatives are launched are typical of the industry ecosystem to which the manufacturers of a given category belong. As a consequence there might be competing/parallel/redundant initiatives (e.g. a manufacturer could participate to several initiatives with overlapping objectives).

- Manufacturers of devices belonging to different categories often have very different cultures and industry concerns. Their value chains are different. For instance the life cycle in the consumer electronics industry could be several months (e.g. a mobile phone) versus several years in the case of household appliances (e.g. a boiler).

The following analysis can be made on interworking needs:

- Devices within a given category will have more specialised interworking requirements, e.g. a specialised remote diagnosis capability, a specialised control capability and so forth.
- Manufacturers of devices within the same category are likely to prefer that competition is also possible at the interworking capability level, meaning that some interworking capabilities might be richer from one manufacturer to another for the same type of device. For instance HDTV A could provide more recording capability than HDTV B. This means that different interworking profiles might be needed.
- In some categories, upward compatibility requirements could be more stringent precisely because of the device life cycle. Devices are put in the market in 10 years might still have to interwork with devices manufactured today.
- Devices belonging to different categories will have more general interworking requirements
    - From an application perspective. For instance clock information could be at the general level. Or an intrusion detector could provide only limited information capability to application controllers which are not part of their category.
    - From a business liability/guarantee perspective. Devices are guaranteed by their manufacturers. A "wild" interworking approach where a device from any category can access all interworking capabilities of a device of another category would likely be a recipe for disaster. Cascaded failures (e.g. device A interworks in an improper way with device B provoking the failure of B) would ruin the reputation of a brand. Further their could also be policy/regulation requirements which are only enforced on one category (e.g. some interworking capabilities could be forbidden for security devices).
- Different categories could need very similar devices. There are a number of devices of common interest such as a user interface (PDA, TV display, mobile phone), or a gateway, or a clock.
- Devices of different categories could need transversal applications for instance energy management application capabilities.

1.1.8.1 Resulting business requirements

In order to identify business requirements, we now use the term cluster to identify the following couple:

- an application domain to which a device belongs
- an interworking initiative typically represented by an organisation representing stakeholders of the application domain

The following business requirements are therefore defined:

	Business Level	Duties
B.1	*Top Level Neutral Organization* . A top level neutral (with respect to other clusters?) organisation is required to co-ordinate the work on interworking specification provided by different clusters	*Top Level Neutral Organization.* The top level neutral organization should provide (i) a code of practice, (ii) It should allow negotiations between different clusters, (iii) It specifies and maintains the specification for devices of common interest, (iv) It coordinates the specification promoted by clusters with a transversal scope (e.g. an energy management initiative to save energy in Europe could become an interworking specification requirement to all other clusters), (v) It should allow the dynamic creation of new clusters and a smooth integration of the interworking specification provided by those clusters
B.2	*Cluster Level Organization.* A cluster organization representing the interest of stakeholders of an application area is required to co-ordinate the work on interworking specification in the associated application domain.	*Cluster Level Organization.* The Cluster Level organization should (i) It specifies the intra-cluster interworking specification (the part that is specialized) (ii) It specifies the inter-cluster interworking specification (the part that is general) in coordination with the top level organization (iii) It specifies interworking policies, such as interworking rights, interworking profiles (mandatory versus proprietary), compatibility of interworking versions (iv) It specifies and enforces its value chain regulation requirements (certification, marking)

1.1.9 Relevant standards, developing standards and specifications

Compliance of Home Equipment to agreed, preferably, European Standards or at least drafts, in case of default, to internationally accepted Specifications or, sometimes even to some major industry de-facto standards, are not only essential due to legal constraints in Europe in safety matters (e.g. Low Voltage Directive, EMC Directive) but also to come close to interoperability of processes and objects in Home Equipment with other processes within SmartHouse equipment and/or remote services.

To guarantee true interoperability, certification systems are a prerequisite: they assess and ascertain compliance to the necessary extent of given equipment usage profiles.

Unfortunately such extensive interoperability certification is not [yet] current practice of the day-to-day deployment of Home Equipment. It is therefore up to the skill of the SmartHouse System Designer to properly select a SmartHouse's equipment according his client's needs and applicable standards. During the design process, during which the different functions are to be detailed, compliance statements are to be prepared as an important ingredient to assist ultimate Usage case.