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Operating System for Smart Services in Buildings

D9.6 Best Practice Results on Business and Pricing Models, Implementation Guidelines

WP9 Dissemination, Exploitation and Communication

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Terms, definitions, and abbreviated terms

BM	Business Model
BMC	Business Model Canvas
DSO	Distribution System Operators
GA	Grant Agreement
ICT	Information and Communication Technology
IoT	Internet of things
SRI	Smart Readiness Index
WoT	Web of Things

Executive Summary

Within the framework of this deliverable, it will be examined how the continuation of the DomOS standard can be assured after the end of the project. For this purpose, the different possible business models will be looked at in more detail.

For a better understanding of this deliverable, the theory of business models is explained in a first step. Then, the other market players are examined so that the value proposition and the unique selling proposition of domOS can be identified. This helps to differentiate domOS from the competition and thus to market the added value that domOS generates.

In order to develop the business models, the necessary roles are listed, and their responsibilities and tasks are described in general terms. Then, three different scenarios are elaborated and the tasks of the different roles in each scenario are listed. This so that in the last step, for each of the three scenarios, the corresponding Business Model were established.

1. Introduction

1.1. The domOS Project

The domOS project is based on 2 axes. The first, **technical** axis, has the objective of defining the guidelines for an open, secure, multi-service Internet of Things (IoT) ecosystem for smart buildings. In order that in-building gateways, which connect to local smart devices and the smart appliance of any type, IoT platforms, and applications operated by different parties can be integrated seamlessly. Building owners can enforce privacy rules, they can allow or forbid access to any measurement or control point. The second axis tries to develop appropriate **smart services** so that end customers can benefit from interconnection of the existing or new technology as easily as possible.

The aim of the technical part is to counteract the prevailing silo development and thus to benefit from synergies as well as of a simpler structure and control of the applications. In this way, the introduction of the domOS standard could promote communication between the devices and at the same time enable control via one device.

The fact that all smart appliances could understand a universal language and would therefore be capable of being interconnected would open up completely new possibilities in the field of **smart services**. The data of the individual devices could be read more easily, and programs could be developed and applied to all machines. From a market perspective, this development would open up completely new possibilities, as smart services could be developed and applied to practically all users who have smart appliances, without having to consider which brand or IoT-Platform they belong to.

These smart services could have different goals and benefits. However, one of the main goals of domOS is to increase the energy efficiency of households through smart services. Therefore, services linked to energy efficiency are the main focus of the smart services analysed in the framework of the project.

The different demonstration sites have defined different services in advance, which they would like to examine in more detail within the framework of the project. Table 1 illustrates the range of services proposed and analysed in the framework of the domOS project.

TABLE 1: SMART SERVICES DEFINED AND ANALYSED IN THE FRAMEWORK OF THE DOMOS PROJECT

	Sion	Paris	Neuchâtel	Aalborg	Skive
Energy Efficiency			Need-based heat generation control: gas boiler case	Adaptive District Heating control based on dynamic cost signals	Need-based heat generation control: heat pump case
Energy Flexibility	Management of electrical flexibility of space heating and domestic hot water Management of electrical flexibility of EV charging Integrated management of buildings and communities	Automated coaching for electricity consumption		Adaptive District Heating control based on dynamic cost signals	
User Empowerment	Automated coaching service for electricity Space heating performance assessment	Automated coaching service for electricity consumption		DH dashboard for occupants DH performance assessment	Temperature set point assignment by occupants
Energy Data Business	Electrical and multi-fluid smart metering Real-time acquisition of electrical measurement Real-time acquisition of energy data				
Non-Energy	OK home	Warning service based on detection of behaviour deviation of elderly people			

The energy services shown in Table 1 are offered by different Distribution System Operators (DSO). As they know better the specificities of their customers, their needs, and their purchasing power, it will be their task to identify the ideal business model per service.

However, the aim of this document is to develop a business model for the platform domOS. The different possible business strategies for domOS will be explored. The aim is to identify the Best Practice Results on Business and Pricing Models.

1.2. State of the domOS Project

At the time of writing this deliverable, the domOS project had already been in progress for a little over a year and a half. This has made it possible to better define the final domOS product, the market situation, the user's behaviour, their desires, goals, etc.

In order for domOS to develop further and decide on the final realization of the project, it is important to establish different businesses and pricing strategies, to analyse as well as to compare them in order to finally decide on the one best suited for domOS.

To ensure that the developed product is continued at the end of the project, the aim of this document is to show which business opportunities exist and how domOS can be introduced into the existing market. In a first step, the existing market is examined and the current players on the market, the market situation and possible opportunities and risks are identified. Subsequently, the possibilities of how domOS can be integrated, who can take care of domOS and how the continuation of the project can be ensured, are shown.

1.3. Structure of this Document

For better understanding, this document has been divided into several chapters and sub-chapters. In a first step, a brief overview of the current situation, with a focus on the political and economic situations, is given.

Chapter 3 summarizes the most important theory of the business model canvas, in order to create a common basis. In Chapter 4, the added value that domOS offers in comparison to other IoT ecosystems is examined in more detail. This will enable to identify the optimal positioning for domOS on the market and allows highlighting its added value in order to stand out from the competition.

To better understand the roles identified in Chapter 6, as well as their responsibilities and tasks, Chapter 5 examines the smart home technology and the necessary requirements for a smart home and smart services.

Chapter 7 examines the different forms of the business models, to identify whether they could be suitable for domOS. Those serve as a basis for the different business models established in Chapter 8. In the last chapter, Chapter 9, a summary is drawn.

1.4. Objectives of this Document

The aim of this document is to define the roles of the different actors and to elaborate possible business scenarios. These are then compared in order to identify the most suitable scenario and thus develop the necessary business model.

2. Influences on the Home Automatization Process

2.1. Political and Economic Impacts

Home automation can be influenced by various political and economic aspects. This could be shown very well with the development in the year 2022.

If a shortage of electronic components was already present in part because of the COVID 19 health crisis, the war in Ukraine may worsen the situation. Some chip manufacturers have their order books already full until the end of 2023. If this logistical problem poses a problem for the construction of the various home automation equipment, the current galloping inflation in the western economy could have another

impact. Indeed, the monetary creation has been much more important since 2020 in order to reduce the impact of the health crisis on the economy.

This abundance of liquidity is beginning to have an impact on prices, which continue to rise. For consumers, this translates into a significant decrease in purchasing power. Additional expenses for the purchase of equipment connected to all social classes may be compromised.

On the other hand, the European energy supply is threatened by its overdependence on imports from Russia and by its lack of long-term planning. The restrictions on Russian hydrocarbons following the invasion of Ukraine, the corrosion problems of the French nuclear park and the anticipated nuclear phase out in Germany are all problems that are increasing the price of gas, electricity, and gasoline. The risk of a shortage in the winter of 2023 is even beginning to be the focus of debate. In these conditions, the use of smart services to reduce or optimize consumption seems more interesting. However, the use of home automation can also make us less resilient in case of power cuts.

It seems that, on the one hand, the incentives for a quick home automation are present but, on the other hand, the production and price constraints may not allow a massive adoption in the next few years.

3. Elaboration of a Business Model

3.1. Definition Business Model

In order to find a long-term solution for a product or a service, it is necessary to develop the appropriate business model. In the context of this business model, the customer segments, the value proposition as well as the various tasks and cash flows are shown.

3.1.1. Business Model Canvas

The business models which will be developed within the framework of the project are based on the concept of the business model canvas (BMC) by Osterwalder et Pigneur (*Business Model Generation*, 2011). The model consists of a total of 9 building blocks. The individual blocks are explained in more detail below. Figure 1 shows how the BMC is structured and how the different building blocks are connected.

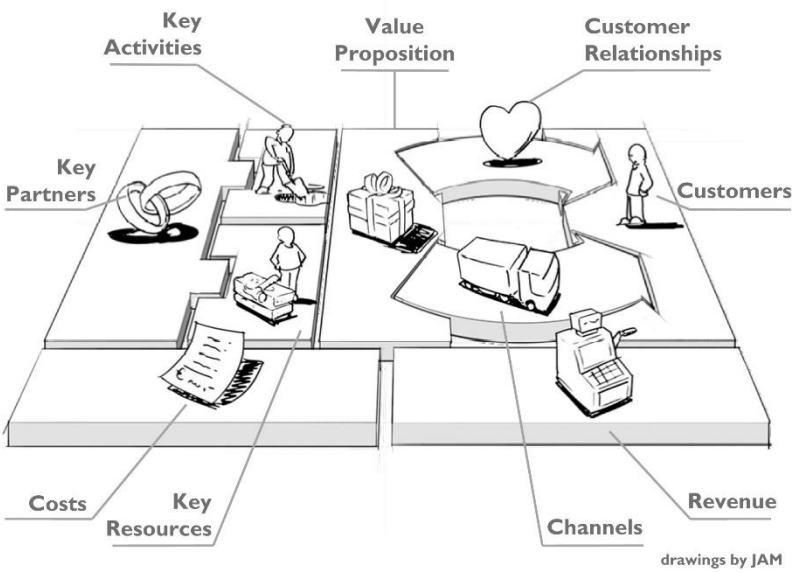

FIGURE 1: BUSINESS MODEL CANVAS (OSTERWALDER & PIGNEUR, 2011)

3.1.1.1. Value Proposition

The value proposition building block describes the package of products and services that creates value for a particular customer segment. The value proposition is the reason why customers turn to one company rather than another. It solves a customer's problem or fulfils a customer need. Each value proposition consists of a package of products and / or services that address the needs of a particular customer segment. The value proposition can differ a lot. It may be that the new product is better than the competition, that it makes work easier, that the new design stands out from the rest, etc.

3.1.1.2. Customer Segment

The customer segment building block defines the different groups of people or organizations that a company wants to reach and serve. Customers are the heart of any business model. Without customers, no company can survive for long, and no business model can be successful. In order to be able to respond to customer needs in the best possible way, it is important to identify the customer group as well as their needs. To be able to best define the needs, customers can be divided into different groups or segments. A business model can be based on a segment or a customer group. The different customer groups can differ in terms of needs, channels, relationships, profitability, or other factors.

3.1.1.3. Channels

The channel building block describes how a company reaches and addresses its customer segments to communicate a value proposition. Communication, distribution, and sales channels provide the interface between a company and its customers. Channels are customer touchpoints that play an important role in the customer experience. Channels define how the products and thus the value proposition is brought to the customer. This can be done either directly or through partners.

3.1.1.4. Customer Relationship

The customer relationships building block describes the types of relationships a company has with certain customer segments. The relationships can range from personal to automate. The relationship starts with the customer acquisition and includes the entire business processes, like customer care and sales enhancements.

3.1.1.5. Key Resources

The building block key resources describes the most important assets which are necessary for the functioning of a business model. These resources enable the company to create a value proposition and offer it on the markets to the appropriate customer segment. Resources can be physical, financial, intellectual, or human and can be owned or borrowed by the company.

3.1.1.6. Key Activities

The Key Activities building block describes the most important things a company needs to do to make its business model work. Every business model requires a set of key activities.

3.1.1.7. Key Partners

This part of the business model describes the key partnerships. The networks of suppliers, partners and other parties that contribute to the success of the business model are listed and described here.

3.1.1.8. Cost Structure

The cost structure describes all costs incurred in the execution of a business model. Creating and delivering value, maintaining customer relationships, and generating turnover are activities linked to costs that are associated with this building block. A distinction can be made between fixed and variable costs.

3.1.1.1. Revenue Stream

The Revenue Streams building block represents the income a company receives from each customer segment. It is therefore the turnover minus the costs.

For a business model to be successful, it must succeed in generating revenue. Thus, it must address the question of what value each customer segment is willing to pay. There are different sources of revenue (sale of assets, user fees, membership fees, rentals, licenses, etc.) which can be either one-time transaction revenues or recurring revenues on ongoing payments.

4. Objectives and domOS Value Proposition

In the domOS project, an IoT ecosystem is being designed that enables smart device integration on multiple IoT platforms. However, no own or new IoT platform will be designed. In order to be able to offer smart home services to the customer, various roles must be taken on and their interaction must be guaranteed. These roles and their responsibilities and tasks are examined in more detail in Chapter 6.

4.1. domOS Value Proposition

In order to develop an optimal business and pricing model for domOS, it is necessary to know the exact value proposition of the project. This is the only way to identify the added value of domOS for the various stakeholders and customer segments and therefore to define the associated financial flows. Figure 2 briefly summarizes the main points of the value proposition.

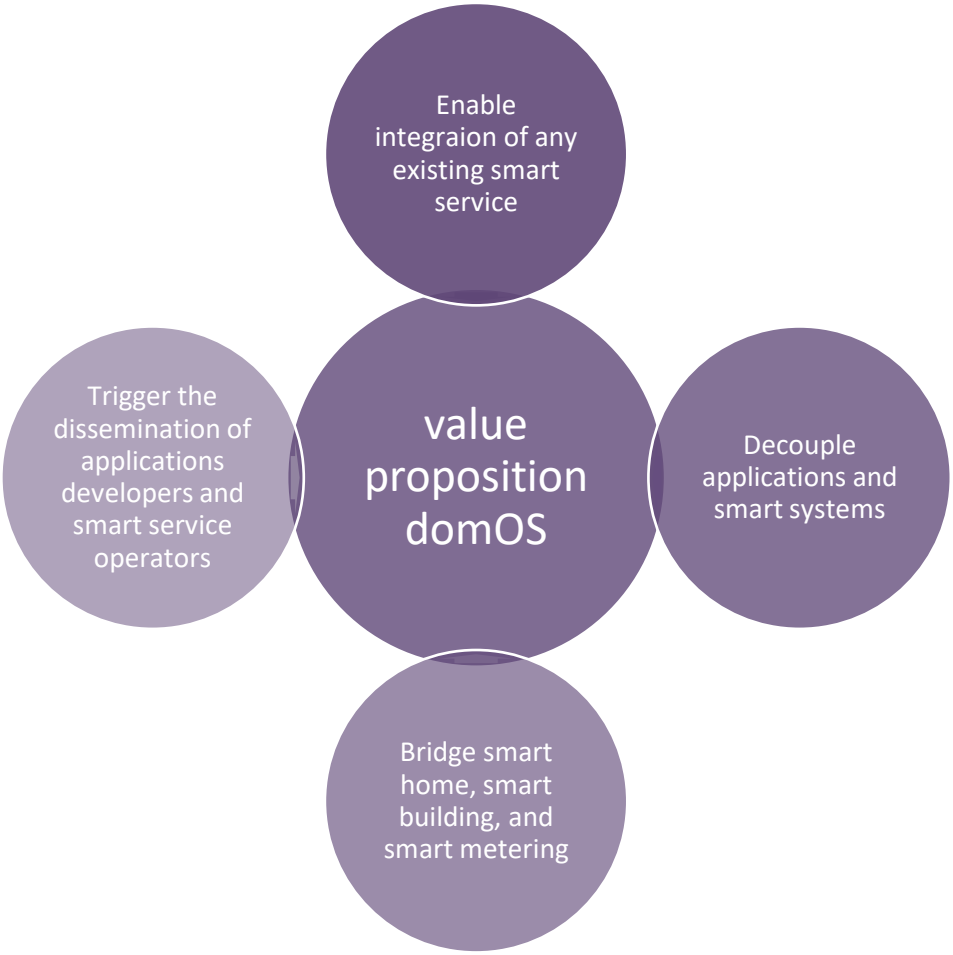

FIGURE 2: DOMOS VALUE PROPOSITION

The ecosystem developed by the domOS project seeks to promote the development of IoT services for building management. The platform offers many improvements on the market with the following added value propositions:

Providing a virtual connector that links the different intelligent systems of a smart building. The domOS ecosystem takes into account the diversity of communication protocols of the connected devices on the market and aims to achieve interoperability of all systems. In order to enable this interoperability, the devices will have to make available a digital file with the device specifications and the communication protocol parameters. Therefore, domOS promotes interoperability between different platforms with APIs available for applications and smart devices. In contrast to emerging technologies such as Matter or IFTTT

(see Section 5.1), domOS also aims to equip already installed and even older smart devices with the necessary communication protocols so that they can also be connected.

Allowing **decoupling between smart services and devices**. Currently a large part of the connected devices are technologically linked to the IoT platform of the manufacturer. domOS wants to change this paradigm in order to allow the development of more efficient and user-selectable smart services. The different roles required to provide smart services are separated from each other to create new opportunities.

Enabling better **transparency regarding access to user data** by smart services is also an important point of the domOS ecosystem. A tool will allow the user to monitor and control the access to his data by the smart service.

5. Smart Home Technology

Most people already have the necessary things for implementing a smart home: a smartphone, a tablet or a PC and an existing internet connection. Whereas in the past everything was controlled via permanently installed monitors, today this is done at the touch of a finger on the devices we use every day anyway. Often, all that is needed is a new application, then the Smart Home can also be controlled while on the move.

Just a few years ago, the standard for making a home intelligent was to have walls chiselled up and meters of data cables laid. That is no longer necessary today. In addition to permanently installed systems, wireless smart home solutions have increasingly established themselves. This means that people do not have to pay for an expensive installation right away, but can grow the system gradually, module by module.

One normally only speaks of a smart home when various sensors, switches, lights, and individual devices are linked together. Processes between them can then be automated. If such networking is planned, there is no way around a base station the size of a pocketbook. It coordinates all processes among each other. A multitude of such if-then scenarios ultimately turns a house into a smart home.

Anyone who currently decides on a wireless smart home system still must commit to a standard. The three most widespread include Zigbee, Z-Wave and Homematic, which are unfortunately not directly compatible with each other. However, this should not cause any problems in practice, as the product family is extensive in each case and the functions are also almost identical. Only when expanding the system must care be taken to remain true to the chosen standard.

5.1. Current Market Structure and Market Opportunities

The home automation has progressed rapidly in recent years and has found its way into practically all our homes. From the smart light bulb that can be controlled via the smartphone to the heat pump that can be programmed to consume electricity at the time the solar panels produce it, the variations are countless. However, as already mentioned several times, there are also drawbacks associated with smart home technology and the development is not yet optimal. One of the biggest problems that can currently be identified is silo development.

This means that big companies like Google, Amazon, Apple, have built their own ecosystem. By partnering with certain smart device manufacturers, they enable them to build their own bubble. This means that certain smart devices can only be connected to the corresponding ecosystems. This poses problems for customers but also for manufacturers since they must commit to a standard.

The best known such ecosystems include:

- **AWS:** Amazon Web service is a subsidiary of the amazon group specialized in cloud computing. The most popular services are web server rental and file hosting. They also offer an interface for connectivity of various IoT solutions. Secure connectivity to devices, storage and data analytics are all solutions offered by AWS (Amazon, 2021).
- **Amazon Alexa:** Is a virtual assistant in direct competition with Siri from Apple and Google Assistant from the eponymous brand. The assistant can be present on different accessories such as a connected speaker or a smart phone and plays the role of a smart hub in a connected home. The voice command can control the various connected accessories. Alexa plays an active role in optimizing the energy consumption of the building without active configuration of the user. The assistant can indeed turn off the lights and lower the heating set point if it believes that the user is no longer there or does not benefit from it (Home Connect, 2022).
- **Google Nest**: Consists of many modules such as Nest Learning Thermostat, Nest Secure, Nest Protect, etc... Some of the modules are therefore focused on security and surveillance while others are focused on thermal comfort, monitoring, and optimizing energy consumption. In order to benefit from the functionalities offered by these systems, connected objects must be purchased (control and display interface) (Google, 2020).
- **Google Home and google assistant:** They are respectively a hub application and a voice assistant, both for home automation. Google home plays a complementary role to google Nest more focused on the home automation hub part with management application and graphic visualization (Google, s. d.).
- **Apple home kit and Siri:** These are the corollaries of the Amazon and Google ecosystems set up by Apple with their home automation accessories and personal voice assistant (Apple, s. d.; Wendel, 2017).
- **Somfy:** Is one of the world leaders in the motorization and automation of openings in the home. Their main products concern blinds, doors and windows but also alarm and security systems. Unlike most of the devices available on the more general public ecosystems, Somfy bases its business model on a more restricted category of the population. With a higher entry price but also a greater impact on the energy of the building. The equipment produced by Somfy is also compatible with all other ecosystems and voice assistants most present on the market (Somfy, 2022).

These solutions allow certain devices to be connected to a smart home and allow and facilitate the communication and control of these devices. However, only a limited number of brands have access to these forms of communication and therefore only partially counteract the silo development.

On the other hand, it is also possible to identify complete ecosystems that, like domOS, try to counteract this silo development. Probably the best known are briefly listed and described below:

Project Matter (Project Connected Home over IP): Matter aims to improve communication between different vendors and ensure interoperability of home automation devices and wider IoT solutions. The project was initiated by Google, Amazon, Apple, Comcast, and Connectivity Standards Alliance but many other companies have already joined the project such as IKEA, Samsung, Huawei, Schneider, etc. In September 2021 more than 200 companies worldwide have joined the Matter working group.

The project responds to the identification that the fragmentation of the connected home was leading to negative consequences for consumer adoption due to lack of interoperability, high development costs due to lack of standardized communication protocols and the need for vendors to offer a multitude of connected objects fulfilling the same role in order to satisfy users on different platforms.

Matter will therefore be a standardized application layer that unifies the home automation industry. The standard is based on the Internet Protocol IP and allows for use via cloud technologies.

The project also plans to create bridges that will allow Matter devices to connect and interact with older devices that run on other communication systems such as the Zigbee network. A limitation of these bridges is that communication could take place between networks but not directly between devices on different networks (Higginbatham, 2021).

IFTTT: IFTTT is based on the "If This, Then That" principle. IFTTT is not limited to smart home hardware, but also integrates web services. This applies to time-controlled weather information as well as automatic posts on Slack. In this way, IFTTT brings it to a total of over 700 partner brands. No other IoT platform covers such a variety of hardware and services. The two-voice services Alexa and Google Assistant can also be linked with IFTTT (IFTTT, 2021).

Automations in IFTTT are called applets. They can be created in the app for Android and iOS and via a web interface. The focus is on simplicity. Therefore, additional options such as setting several conditions to which automation is linked are rather hidden. For a particularly quick start, users use templates from manufacturers and users who share their applets (Finnegan, 2020).

Figure 3 places the most important players in the market and domOS to visually illustrate the value proposition and uniqueness of domOS.

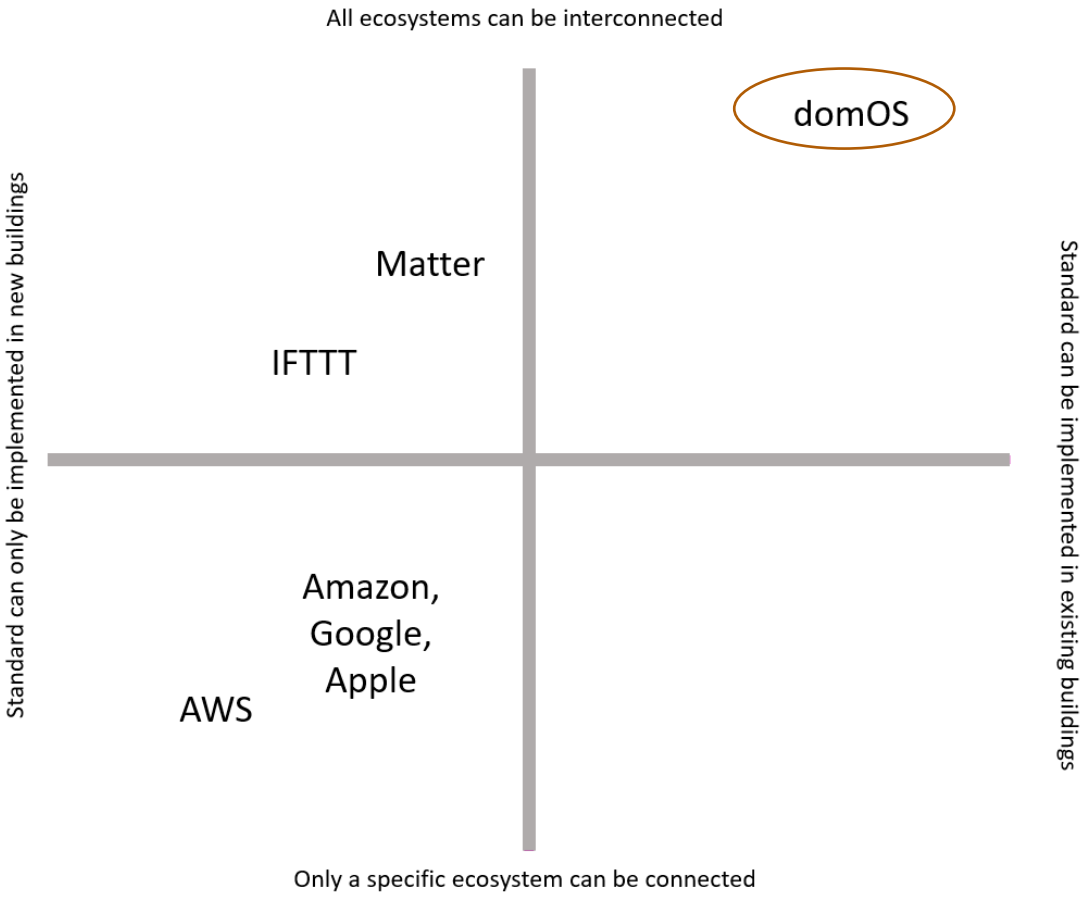

FIGURE 3: DOMOS VALUE PROPOSITION

As can be read from the graphic, domOS differs from the other players on the market in that, unlike Amazon, Google, Apple, etc., it demands integration of all smart devices. In addition, unlike Matter and IFTTT, domOS wants to be able to upgrade the installations already installed, so that it is not necessary to invest directly in new devices.

In addition, one of the main focuses of domOS is to promote energy efficiency. Since the lifespans of energy installations often last for many years, it is even more important that they can also communicate with the common standard so that maximum leverage can be used. Many of these older installations still communicate via Modbus. IFTTT or Matter, unlike domOS, have no ambition to update those installation in order to render them smart.

5.2. Functionalities of a Smart Service

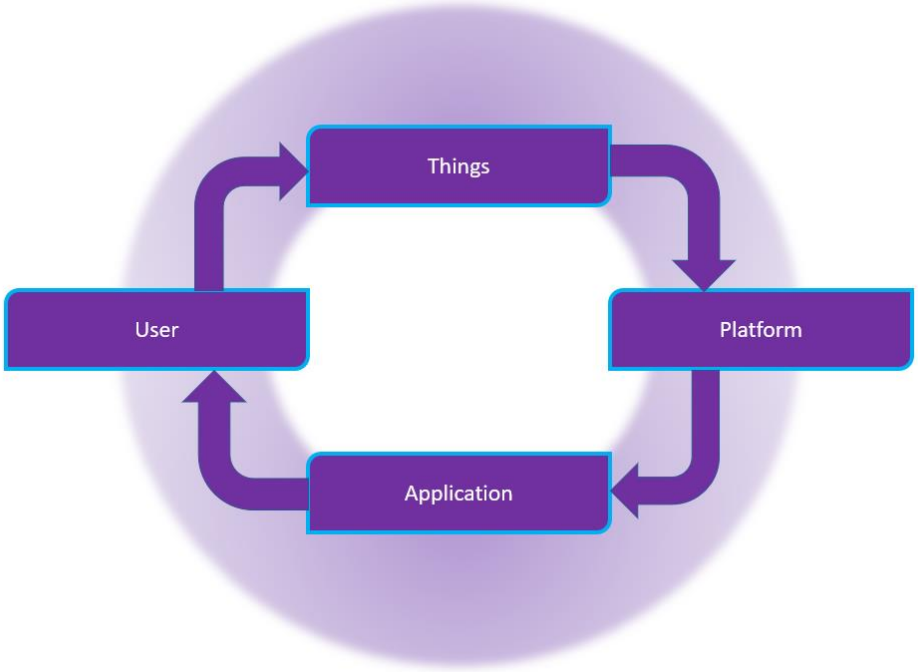

FIGURE 4: RELATIONSHIP BETWEEN THE DIFFERENT ELEMENTS

Figure 4 helps to understand the circular relationship between the different elements of a connected home.

The level of connectivity of objects is a key feature in assessing the ability of a building to collect data and run smart services. For some non-connected devices, a simple control switch can make the equipment partially connected and controllable. In the past, communication technologies were mainly wired in the building automation accessories. Today the most used protocols are wireless, which allows the addition of new devices as they are added and without major work. Some of the most popular protocols used today are Zig Bee, Z-Wave, WIFI and Bluetooth for short-range applications mainly in the building.

A centralized data element is often also necessary and/or practical. It allows data to be concentrated in one place and processed. This function can also be outsourced to an external server. The presence of a permanent physical equipment must be ensured in order to guarantee the connectivity of the devices at all times. An internet connection modem can provide this service and is already present in almost all homes.

An announcement in relation to the new Matter standard that some equipment will also be able to fulfil the role of smart hub has been published. This will be the case for some of Samsung's connected monitors and fridges.

Smart Service

When analyzing the economy in most countries, we can see that it is moving from a production economy toward a more service-orientated economy. This mean that instead of buying a good, the clients have the choice of paying for a specific service. For example, instead of investing in a new heating system, clients nowadays have the possibility to buy heat as a service, where they pay for a specific room temperature.

In order to understand the meaning of a smart service, firstly the term service has to be defined. “A service's intention is to undertake certain functions to provide value to the business “(Jones, 2005). A service is defined as an activity and therefore most of the time intangible. A smart service is a service which uses a smart product to carry out a service (Beverungen et al., 2019).

N. Balta-Ozkan et al. Groupe the smart home services into three groups, which are Energy consumption and management, safety and lifestyle and support. Figure 5 presents some of the main smart home services identify in the article.

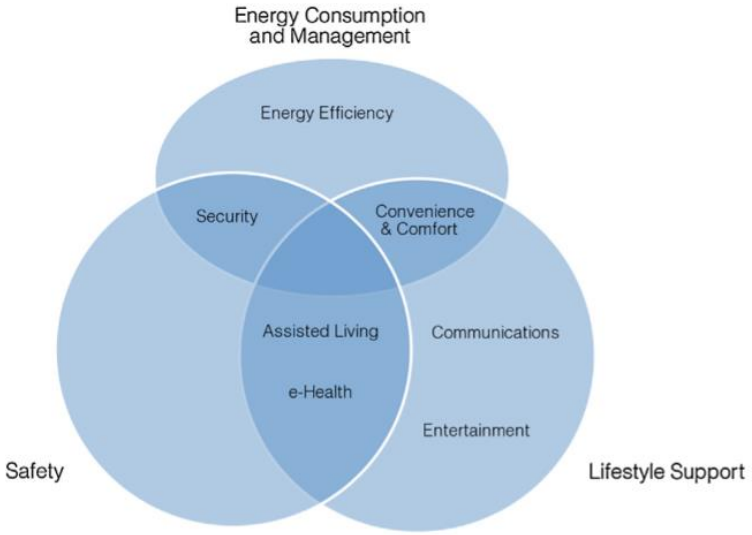

FIGURE 5: TYPES OF SMART HOME SERVICES (BALTA-OZKAN ET AL., 2014)

The main advantage of smart service compared to manual control is the evaluation of the data by a specialist. This way, a state-of-the-art optimization can be achieved in the different specific areas. A user should be able to define his own parameters for maximum comfort, such as the minimum and maximum temperature to be tolerated and the expected load level of his car in the morning to go to work. The smart service should be able to optimize the functioning of the different connected devices based on qualitative and quantitative indicators such as energy consumption and economic considerations, while considering the user parameters.

IoT Platform

The IoT Platform is the middleware between the hardware (thing or smart device) and the application. It can be seen as the connection between the physical object and the actionable end application. Therefore,

it connects the object to the cloud. At the same time, the security mechanisms and data processing tools are part of the platform and therefore of this step. The IoT platform facilitates the connection between the object and the end application and manages the different interaction between those two. The platform is responsible for the data collection, data analyze, security aspects, etc.

An IoT platform must mainly respond to 3 specific functions which are: connectivity between the different devices, network and system that make up the whole; storage and collection of data in order to guarantee their availability for smart services and monitoring; the ability to host application systems in order to guarantee the development of functionalities and smart services among others. The IoT platform is thus software and hardware element that allows the centralization of data and control of the connected home.

The domOS ecosystem is positioned at the same level as the IoT platform. It allows access and distribution of files that enable access to data but also control of connected devices. This interoperability offered by domOS can be freely integrated to different platforms and allows a standard use of the devices.

6. Actors for the Business Model

The aim of this sub-chapter is to define the structure of domOS, to identify the different roles implied in the ecosystem domOS as well as the responsibilities of each actor. As already defined in the previous deliverables, the domOS project splits the different roles and develops a layered model. This assures the decupling of applications and smart systems (see value proposition).

The domOS ecosystem aims to incorporate smart devices in new building or by retrofitting buildings into an ecosystem. Figure 6 was developed within the framework of Deliverable D2.3 and shows the planned structure of domOS.

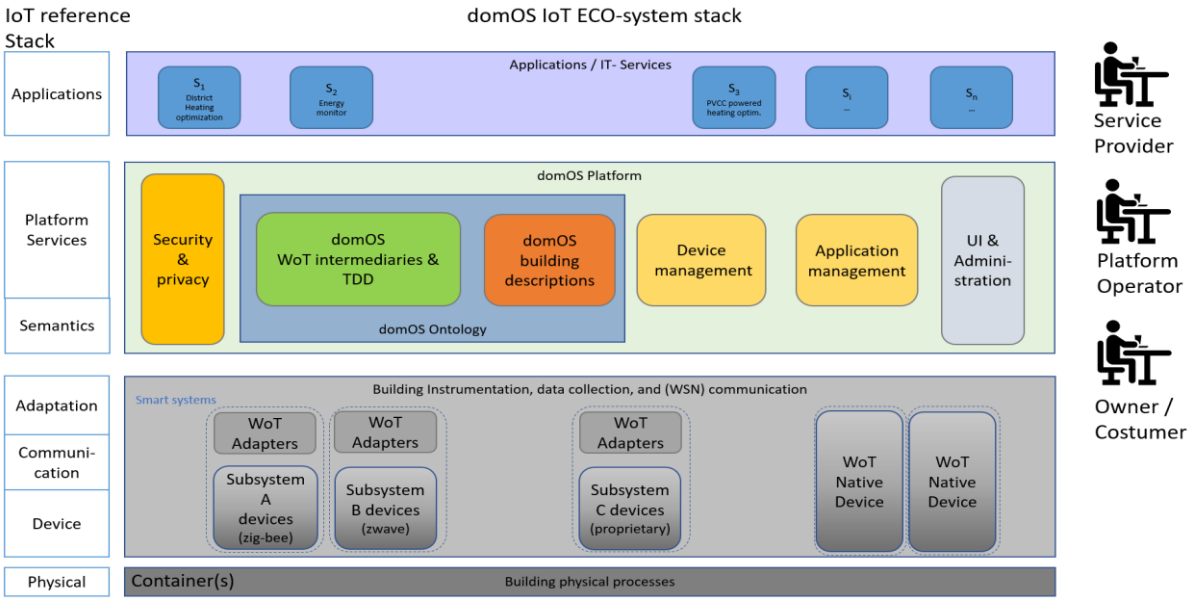

FIGURE 6: LAYERED MODEL OF THE DOMOS IOT ECO-SYSTEM

The following roles have also been listed in the previous deliverable and divided into four reference stacks (for more information regarding these, please refer to document D2.3):

- **Physical layer:** this layer refers to the physical processes and structure of the building.
- **Building instrumentation, data collection and communication:** the second layer provides the basis for the communication of the different devices. This includes the actuating and sensing capabilities, most of the time hosted by wireless sensor network devices. These are the basic requirements for a device to be able to communicate and thus be controlled. If necessary, WoT adapters layers are also added so that they are considered smart systems and can be used as such.
- **domOS Platform**: in the domOS platform layer, the necessary semantic annotation is added so that we can talk about domOS WoT things. The platform bridges the gap between the raw device and the application and provides a common, secure and privacy aware semantic interoperability layer.

In this deliverable, the roles are further subdivided and defined so that the different interactions between them and the business connections can be identified. In order to define the roles more precisely, the work done in the previous deliverables was also included. In those, the following 3 roles were identified. These will be explored in more detail in this deliverable in Chapter 7.

- **Service provider**; delivers a business service through an **application.** Applications are registered on the platform along with an application manifest. The service provider may need to approve the application activation for a given building owner, as this may require setting up a billing- and legal contract which is currently out-of-scope for the platform.
- **Building owner (customer)** is the owner of a container – normally its inhabitants. The owner deploys connected systems, activates services, and manages their security properties. For multi-apartment buildings, the housing association may take the role as owner, and then assumes the responsibility to get the required approval from the tenants.
- **Platform operator** is responsible for operating a platform instance on behalf of customers and service providers, i.e., deploys the platform, authenticates, and registers applications to be listed, manages users/owners, and oversees its correct operation

6.1. Smart Home, Smart Services and IoT. How is it All Connected?

We live in a multiconnected and automated world, where almost every part of our life has been impacted by the “smartness”. Lately, the smart home services are introduced to the market. For such smart services to function at all, however, various criteria must be met. For one, the end device must have the ability to collect data and to communicate it with the IoT. It must therefore be "smart service" ready and connected to the IoT at the same time. By connecting the device to the IoT, it can be controlled and monitored. The spread of ICT, IoT, bid data and artificial intelligence, as well as the simultaneous development towards a service economy, also led to the development of smart home services. At the same time, this connection and analysis of real-time data allows not only to automate certain commands, but also to control them.

6.2. Roles so That a Smart Service Can Be Offered

As explained above, there are various roles and tasks that need to be assured in order to provide a smart service to customers. The aim of this section is to describe the different roles. These are taken from the project's repository (see Figure 7) and described in detail. In Chapter 7, various business opportunities are then described. In each case, the functionality of the scenario is shown, and it is described which role assumes which function in this scenario. In addition, the associated financial flows are shown. In a final step, the various business strategies are compared with one another and possible advantages and disadvantages as well as risks and opportunities are identified.

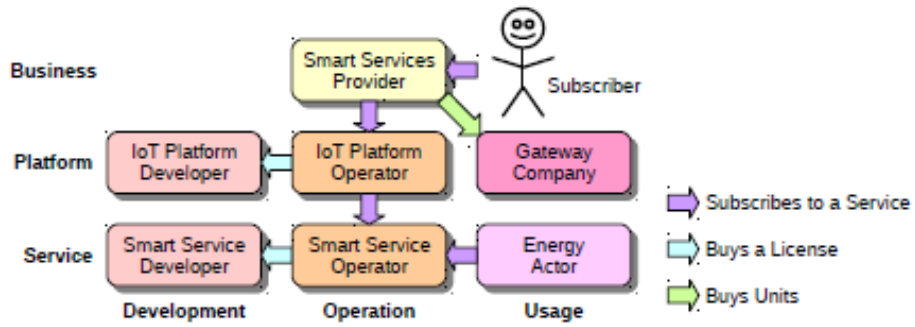

FIGURE 7: BUSINESS RELATION BETWEEN ROLES DEFINED IN THE REPOSITORY

Figure 8 shows the different interactions between the roles described in Table 2 and their functions.

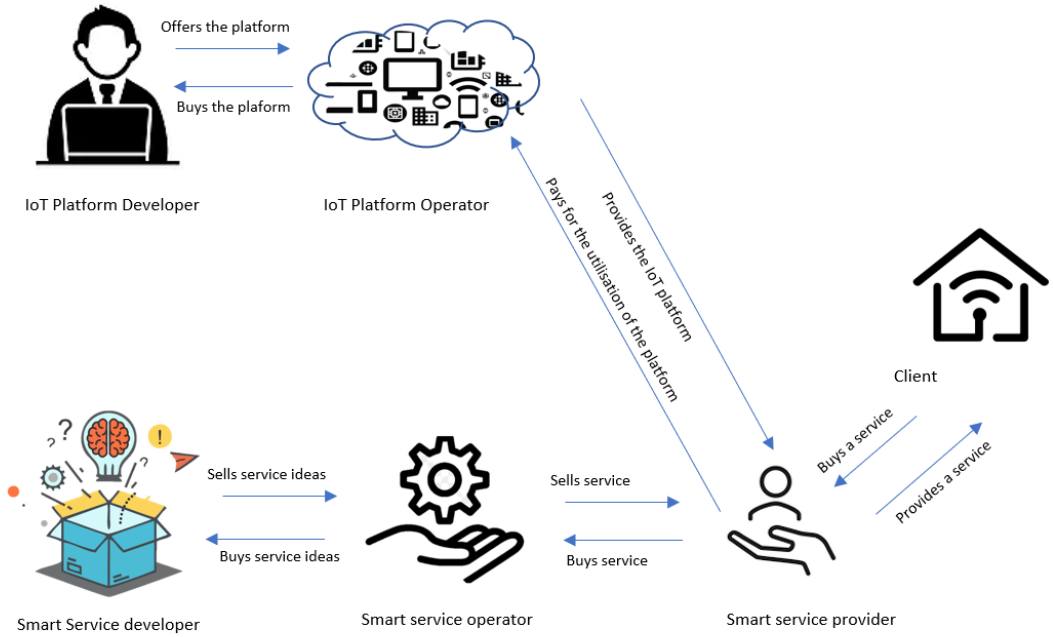

FIGURE 8: ROLES AND INTERACTIONS IN THE FRAMEWORK OF THE DOMOS PROJECT

TABLE 2: ROLES IN THE DOMOS ECOSYSTEM

Function	Role	Task	Responsibility
IoT Platform Developer	The IoT Platform Developer **develops the platform** that domOS can be connected onto and thus allows the interoperability of different IoT devices. If a smart hub is used, it also creates the platform. The development of new functionality and security updates is their responsibility.	The development of the cloud platform and/or smart hub and the continuous improvement of the products. New functionalities can be identified and requested by different actors.	The IoT developer is responsible for the part related to the development of the platform. The developer must be able to realize the functionalities requested by the different actors concerned. The issue of access security to the application is also essential in view of the sensitivity of the data and the controllable facilities.
IoT Platform Operator	The role of the IoT platform operator is to ensure the link between the IoT equipment installed at the customer's site and the platform. In the case where the platform is provided by a service in the cloud, it always ensures the proper functioning of the computer facilities on which the various services operate. **Maintenance, monitoring, and operation service are thus provided.** The Platform Operator can in some cases be substituted by a Smart Hub. In these cases, the maintenance request is non-existent, and the replacement of a defective box can be done by the customer. The management of the access security to the building data via the communication protocols of which domOS is part must be ensured. The transmission of information to the IoT Platform developer is ensured by the IoT Platform Operator. In case this role is fulfilled by a smart hub a direct communication between Smart Service Provider, Smart Service Operator and IoT Platform developer must be ensured. The use of smart hub and service can be exclusive or inclusive depending on the scenario.	The main tasks of the IoT Platform Operator are related to the operation of the elements that allow the provision of the service and the communication between the different actors. In the case of a Smart Hub this work is largely automated, and the risk of failure is low. In the case of cloud service, premises, servers, and personnel related to the IT department are necessary. In all cases the deployment of updates must be done by the IoT Platform Operator.	The Smart Service Operator's responsibilities are to ensure the availability of the service as well as the security of the data access via the platform. Depending on the scenario, the burden of communication between the actors may also be imposed on them.
Smart service operator	The Smart Service Operator manages the tracking of data and orders via the smart service. Depending on the situation and the type of smart service offered, the Smart Service Operator can take on several roles. The monitoring and control of the technical installations can be fully automated with a control for the customer or monitored and managed by specialists via the smart service. In the first case, the role of the smart service operator will be to guarantee the functionality of the smart service as well as the security of its use. In the second case, it is a monitoring and control service by specialists using the smart service that is provided. The optimal management from the point of view of comfort, energy efficiency and compliance with technical criteria will be ensured. It can also ensure the role of contact for the entities interacting with the smart service. The smart service operator can be specialized in a single technical field or integrated in all the technical elements of the building.	Their tasks consist in ensuring the optimal functioning of the technical elements, ensuring, and planning the maintenance operations to prevent risks. To do this, they analyse data from the sensors present on site through the smart service.	It ensures that the technical equipment works perfectly and that the maintenance operations that need to be done are done. It ensures a reduction in energy consumption and/or an increase in living comfort.

Smart service developer	The Smart Service Developer creates the useful smart service that meets a need. It ensures the development of new functionality and the operation of the smart service with the domOS compatible platform. These smart services use data from sensors on technical installations to report, detect malfunctions, place alerts, facilitate the optimization of operation through configurable rules. The use of artificial intelligence and machine learning is becoming more and more common in the development of smart services algorithms.	The tasks of the Smart Service developer include, developing the smart service and its operation in the platform environment. Designing a graphical interface and algorithms in order to process data efficiently. The functionalities offered by smart services can be diverse and varied. The services can be relatively simple with simple control rules depending on few factors. They can also be more complex like fault detection and diagnosis services.	The smart service developer is responsible for producing the smart service. The latter must meet the identified need and ensure the security of use.
Smart service provider	The Smart Service Provider offers the smart services on the market. He is the link between the customer and the smart service operator. He plays the role of contact intermediary with the customer. It allows the customer to have only one contact partner. It is with the smart service provider that the customer signs a contract. In the scenario where the price of the service is provided by the customer, the smart service provider ensures the reception of the invoices and the user concerning the good functioning of the provided service.	Promote the benefits of smart services to potential customers, guarantee the provision of the service against payment to the customer. The information provided by the customer is sent to the service provider who is the centralized contact point for customers.	The contractual part is handled by the smart service provider. It manages the payment, the service provision, and the customer contact.
Device user	The Device User has the IoT equipment and uses the different Smart Services available. From the point of view of the industry, its role is to adopt the products and technologies that are proposed to it in order to increase its comfort.	The purchase and eventual installation and configuration of home automation systems.	Use of the domotic equipment in accordance with the recommendations for use.

7. Business Model and Pricing Scenarios

Several different business models can be considered with an integration of the domOS project. In some scenarios, it is the “service provision” vision that prevails. The as a Service (aaS) models, relevant for this project, must be defined.

7.1. Possible Business Model

7.1.1. As a Service

There are different models aaS which refers to a business that is presented to a customer as a service. The most important ones which can be linked to a possible Business Model for domOS are listed and briefly explained below.

DaaS (Data as a Service)

DaaS companies provide the customer with access to data on demand. The pricing of DaaS companies is mainly established:

- Depending on the amount of data
- Depending on the use of the service by the customer

The nature of the data can make their prices vary. Thus, some data by their rarity/exclusivity or their acquisition costs will be more valued than more usual data.

CaaS (Control as a Service)

Is a cloud computing service that allows access via an interface to physical devices located remotely.

Within the domOS project and as for the DaaS model, pricing could be established according to one or more factors such as

- The number of controlled devices
- The electrical power of the device
- The energy consumption of the device (e.g., annual reference kWh)
- The type of equipment (heat pump, light, air conditioner, etc...)
- The duration of the control of the device

EaaS (Energy as a Service)

Another option of the as a service model is Energy as a Service. Here, the customer pays for an energy service without having to make any upfront capital investments. While the service provider tries to promote energy efficiency as much as possible so that less energy is consumed, leaving him with more profit, the customer has nothing to worry about.

HaaS (Heat as a Service)

Like the EaaS model, the HaaS business model aims to provide the customer with a service where the customer does not have to worry about anything. The service agreement relates on a guaranteed temperature instead of buying a fuel or paying for a specific number of kWh. It is possible that the service provider takes care of the installation at the beginning of the contract or that the customer does it himself. However, the maintenance and control of the installation is taken over by the service provider.

XaaS (Anything as a Service)

The above-mentioned aaS models are some of the most important in terms of domOS. However, there are no limits to this model, which is based on the subscription-based model. These as a service models enable companies to offer meaningful services on a daily basis and adapted to the respective customer segment.

7.1.2. Freemium

The Freemium business model could easily be applied to the smart service domain. The access to the basic functionalities of the smart service could be free. In the case of a heat pump, for example, setpoint temperatures could be set for different hours, IFTTT-type conditions could be set up by the user to promote self-consumption directly through the application. The user could then pay for the application or a subscription to access more specialized functions such as consumption optimization that would take into account internal and external variables such as the thermal inertia of the building and weather forecasts. Other services could also be provided such as contacting a specialist to configure the smart service via these premium options.

This business model is particularly well suited for application software because the distribution costs via the web are negligible. Moreover, it allows the customer to get a good visibility on the product before the purchase act. For non-paying users, an advertising system can also be set up in order to remunerate

the use. This last one can be integrated in a discreet way for example by proposing home automation equipment which can have a synergy with those already possessed.

Application for domOS

It is conceivable to finance domOS through one of the systems outlined above.

- DaaS: the standard domOS will make it possible to collect various data from smart devices. This data can then be offered to smart service operators so that they can develop the corresponding services. The revenues could enable domOS to further develop and maintain the standard.
- CaaS: as with the DaaS model, it is conceivable that smart service operators could be interested in controlling the smart devices. The standard domOS, by unifying the services and thus the accesses, would enable and greatly facilitate this process. It is therefore conceivable that the smart service operators would pay for such a solution, which would finance the development and maintenance of domOS.

8. Business Model for domOS

8.1. Possible Financial Streams

In order to ensure the continuity of the project, economic outlets for the domOS ecosystem must be found. The different financing models imagined are described below. These are all based on the assumption that the end-users decide to automate their homes and thus make use of the licences, subscriptions, connectivity, etc. Thus, it is ultimately the homeowners who bear the costs of domOS, as they are the main beneficiaries of this solution and the automatization associated with it.

- A financing by the final use in the form of license or subscription. The financing is direct or indirect for domOS. The use of the protocol which allows the interoperability of different manufacturers on the same platform brings an advantage for the smart service provider who uses and maintains the platform.
- A financing by the connected equipment providers with different other actors like the IoT Platform Operator and developer, the Smart service operator/provider/developer. The creation of an organization in charge of a connectivity standard, on the same business model as the Matter project. They guarantee the interoperability of their equipment. For equipment already installed and not compatible, software and hardware extension modules could be created and marketed.
- Indirect financing by the service provided. For example, in the context of savings on energy bills or in the case of financial gain via a smart service such as flexibility offers or, in the framework of energy performance contracts or more directly in the control of technical installations.
- Partial financing through the monetization of user data by the smart service operator, provider or even the platform operator.

The whole business model is part of a situation where the home automation market is not yet standardized and where old models cannot interact with the most used ecosystems. It is this framework that allows domOS to become the standard or to ensure a transition to the replacement of the whole connected object park. The starting situation is therefore heteroclite and composed of different non-connected devices, old generation devices without cross-platform compatibility and new generation devices stamped Matter.

8.2. Scenario 1

8.2.1. Business Model

In the case of the first business model, a service store type of operating system can be set up. For the user the platform would be accessible for free for example from a cell phone application or even a web platform. On the platform different products and services could be offered by the platform itself and through smart service operators or smart service providers.

In the case of a weakly connected house, measurement and home automation control accessories could be sold on the platform. For each smart service offered, the minimum accessories necessary for proper functioning would be listed. This type of model could work well for very complex smart services with high added value, for example in the optimized energy management of the building, but also for other services using advanced data processing and analysis. The customer is therefore responsible for the installation and investment in the connected equipment that will be found in his home.

The customer can interact with basic commands that he wants to apply to his installation such as temperature set points and simple rule applications.

The provision of smart services is ensured by the smart service access platform which acts as an intermediary. It also filters the smart services available on its platform in order to guarantee a quality of service of the desired standard. The customer therefore has only one point of contact for all the potential smart services he uses. The measurements and data collected by the smart devices as well as the control of the installations is done by the smart service via a cloud service provided by smart service access platform. The control is therefore not direct between the customer and the smart service developer. The communication to the customers is also done through the smart service access platform, for example the information about the maintenance operations to be done on the devices after analysis of the functioning by a smart service.

At the level of financial transactions, the smart service can set the price of the subscription or purchase of the service. The transaction goes through the smart service access provider who also receives a commission for the use of the platform and the insurance and customer contact service it provides.

An internet service provider could for example fulfill the roles of smart service provider, platform developer and platform operator. The necessary infrastructure and skills are already at least partially present internally. The subscription to the different smart services can easily be integrated in one of the different services offered such as internet subscription, telephone, smart TV, etc.

The creation and operation of smart services can be done by companies specialized in the field. The sale of the smart service subscription is done on the platform of the smart service provider.

The integration of the domOS system allows the smart service access provider to offer smart services that work on a multitude of connected accessories, even for older generation devices.

Standard domOS

In this case, the solution for the standard domOS could be as follows. The service store takes care of the standard domOS. When the customers log on to the platform, they can specify what smart devices they possess. They then could have the possibility to unlock the standard domOS, either for free or by paying a fee, for each device. As soon as they installed the standard, the smart device has the necessary communication basis, and the customers can connect the corresponding smart services.

The financial structure can take on different forms. It is conceivable that the service provider has to pay for the service to be offered on the platform. With these costs, the operator can build and maintain the platform. The maintenance of domOS can be paid by the eventual fees.

The business models for the smart services can be presented in different ways. However, the smart service providers are responsible for this and not domOS.

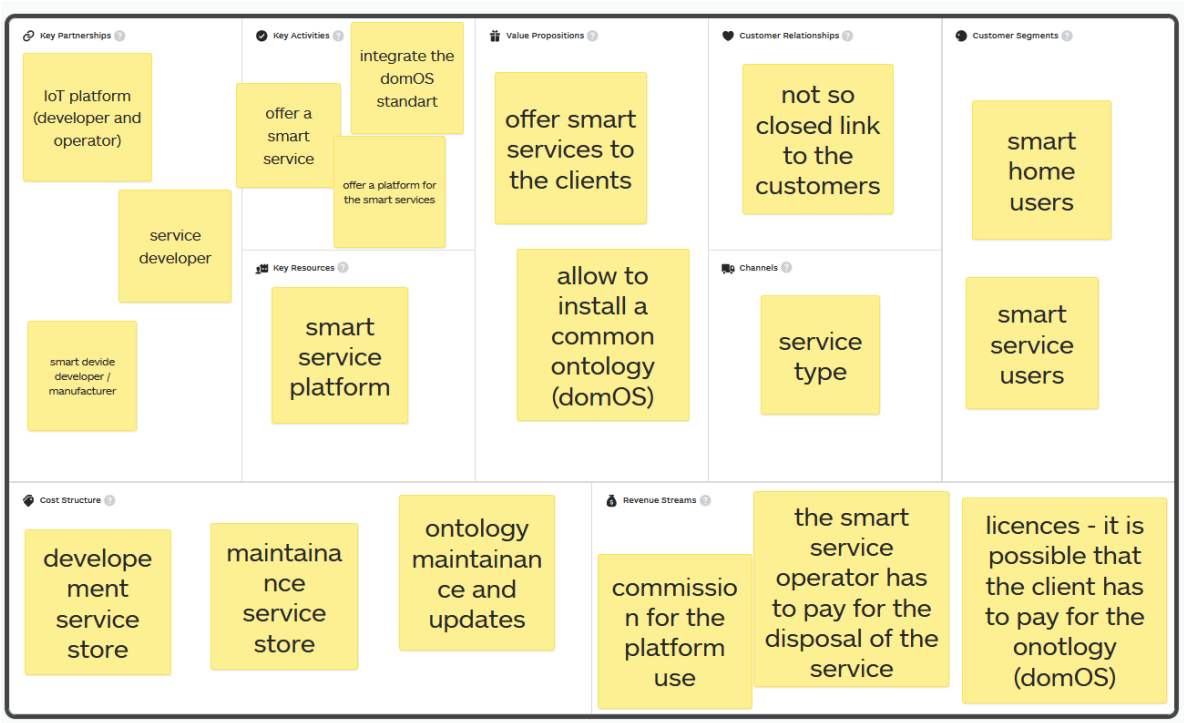

FIGURE 9: BUSINESS MODEL FOR THE STANDARD DOMOS IN SCENARIO 1

8.2.1. Structure

Figure 10 shows scenario 1 graphically for better understanding.

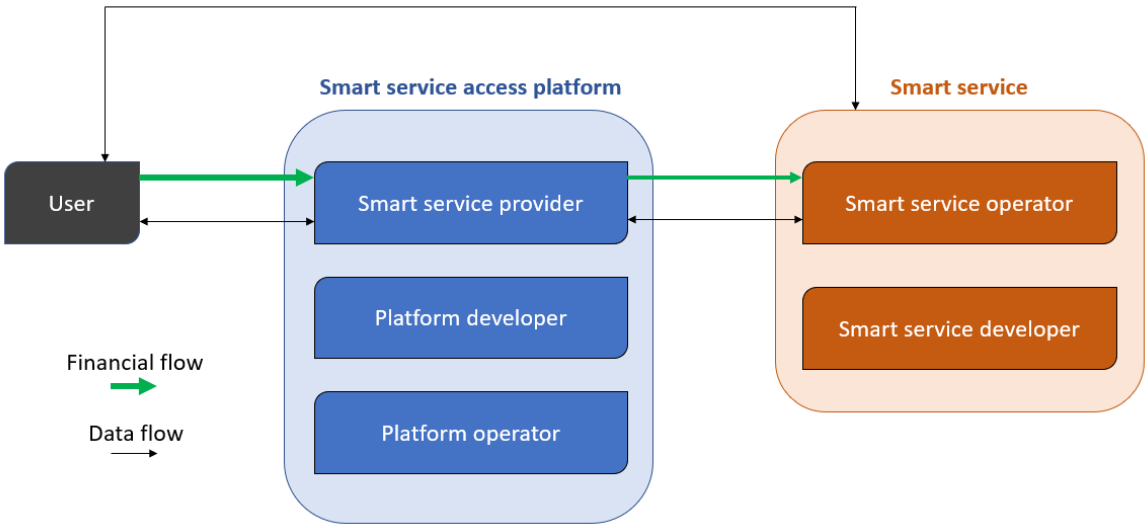

FIGURE 10: STRUCTURE OF SCENARIO 1

8.3. Scenario 2

8.3.1. Business Model

In case the management of the power grid with the new intermittent and decentralized production means as well as the new loads related to electric mobility become too much of a burden for the grid operators, flexibility services could be offered and remunerated to small or medium consumers.

In this scenario the structure would be similar of the one in the previous scenario. Most of the roles related to the smart service could be occupied by distribution network operators (DSO). This is because it is the DSO who takes care of the grid utilisation and therefore knows best when there is too much or too little electricity on the grid. In addition, it is also the DSO who can best use the flexibility gained (to balance his balance group or offer it on the markets (spot, primary, secondary, or tertiary).

In a context of a possible energy shortage, access to the main consumption equipment of a house can help to maintain the network and avoid random and total load shedding situations. A financial remuneration can be provided to the customer based on the amount of flexibility offered on the grid.

To do so, the customer must have an interruption potential. That is to say a connected system able to be controlled, to reduce the energy consumption or to event completely stop the consumption of the main loads of the house. Several businesses can be imagined from this structure.

Currently, the price of electricity is set annually by the distribution system operators. Historical off-peak and peak tariffs, based on in-band generation facilities such as run-of-river hydro and nuclear power plants and lower demand at night, are in place. Soon, it is possible that a more dynamic pricing system that better takes into account the constraints of intermittent generation could be implemented with the help of home automation. Different types of energy contracts could be considered in this business model.

A contract with an incorruptibility potential activated only in critical situations by the distribution network operator would allow the customer to benefit from preferential tariffs for example by providing a demand modulation service. In general, the tariffs specified in the contract could depend on the level of flexibility offered by the consumer. This measure of flexibility would depend on the magnitude and timing of the demand modulation offered by the customer. Hot water heating systems lend themselves particularly well to this type of use because the storage capacity is relatively large, and the time of heating does not really influence the level of service provided to the user.

Finally, an energy performance contract system where the network manager commits to a decrease of the consumption and more globally to a decrease of the energy bill with the customer through the control of his home automation devices. The different levels of services rendered such as the minimum temperature of the home must be defined in advance so that the savings do not degrade the customer's standard of living. For the company that provides this type of service, profits can be made on the flexibility of the installation, but it can also be remunerated on a portion of the savings made by the customer.

The use of the domOS system allows a centralized organization such as a distribution network operator to use many connected objects from different brands and ecosystems.

In this model, all the roles related to the smart service could be centralized by a single actor as seen before. This allows the customer to have only one point of contact regarding his energy supply.

Standard domOS

In order for such a system to function, it is necessary for the service operator to have access to and control over the various smart devices. This is where domOS comes into play. By introducing the domOS standard, the service provider can more easily create a smart service that can then be adopted by virtually all households.

As in the previous business model, the question is how the continuation of domOS is guaranteed and who is responsible for it. In this example, the responsibility would lie with the DSO. This is because the DSO needs as many devices as possible to be connected in order to use the flexibility and control the smart devices. Through the revenues that the DSO can generate through the flexibility services, the optimisation of the balance group or the sales on the markets, it can ensure the provision of the domOS standard.

FIGURE 11: BUSINESS MODEL FOR THE STANDARD DOMOS IN THE SCENARIO 2

8.3.2. Structure

As described in Section 7.3.1, in this scenario 2 most of the roles are taken over by the same role. As this is energy flexibility, it is conceivable that this is the DSO.

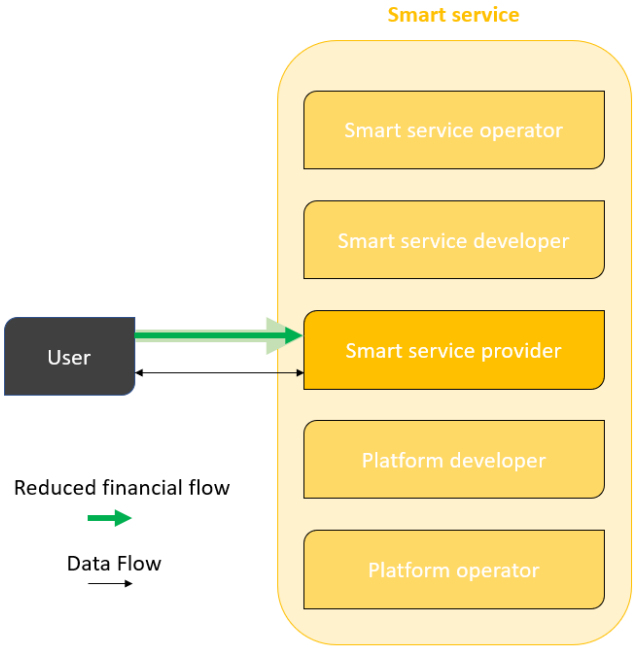

FIGURE 12: STRUCTURE OF SCENARIO 2

8.4. Scenario 3

8.4.1. Business Model

In a more decentralized scenario, each player can be independent and specialize in a particular area. Each role is thus filled by different companies. The risks and opportunities of the market can thus be shared between several players. Specialization in a defined role generally allows to be more efficient in its field of activity. It also allows for competition between several companies, which tends to promote service and cost improvement.

Here, too, it would be a good idea to have a central smart service platform that is operated by a single provider. The various smart home service providers can then offer their services on this central platform, while the smart service operators take care of the functioning and the data. Thus, it would be the smart service operator who takes care of the integration and further development of the standard domOS.

In this situation with a lot of competition between players, the choice for the user between the different smart services can be difficult. Freemium offers fit particularly well in this perspective. The free versions allow highlighting the quality of the service and its interface. Full versions could also be offered as a limited time trial to attract customers. Once they are familiar with the smart service, it will be easier to get them to sign a contract.

The fluidity of information transfer can also be optimized because each actor can communicate with another. In this case the smart service provider only plays the role of a marketplace where the different platforms and smart services can offer their services.

Platform domOS

As mentioned in the previous two scenarios, the aim of this document is to find the appropriate business model for the domOS platform. In this model, it is possible that domOS could be considered a European standard, as is the case with the Smart Readiness Index (SRI). The SRI was introduced for standardisation based on the European Energy Performance of Buildings Directive (EPBD). The SRI allows for rating the smart readiness of buildings, i.e., the capability of buildings (or building units) to adapt their operation to the needs of the occupant, also optimizing energy efficiency and overall performance, and to adapt their operation in reaction to signals from the grid (energy flexibility). As domOS will facilitate the implementation of smart services and could strongly support and drive the smart home sector, it will also have an important impact on SRI. Since domOS and SRI thus create important synergies, it is conceivable that these two areas could be combined and offered as a single service.

It would therefore be conceivable that the same players who are currently involved in the introduction of SRI would also promote the spread of domOS. This could support a holy approach and benefit from synergies.

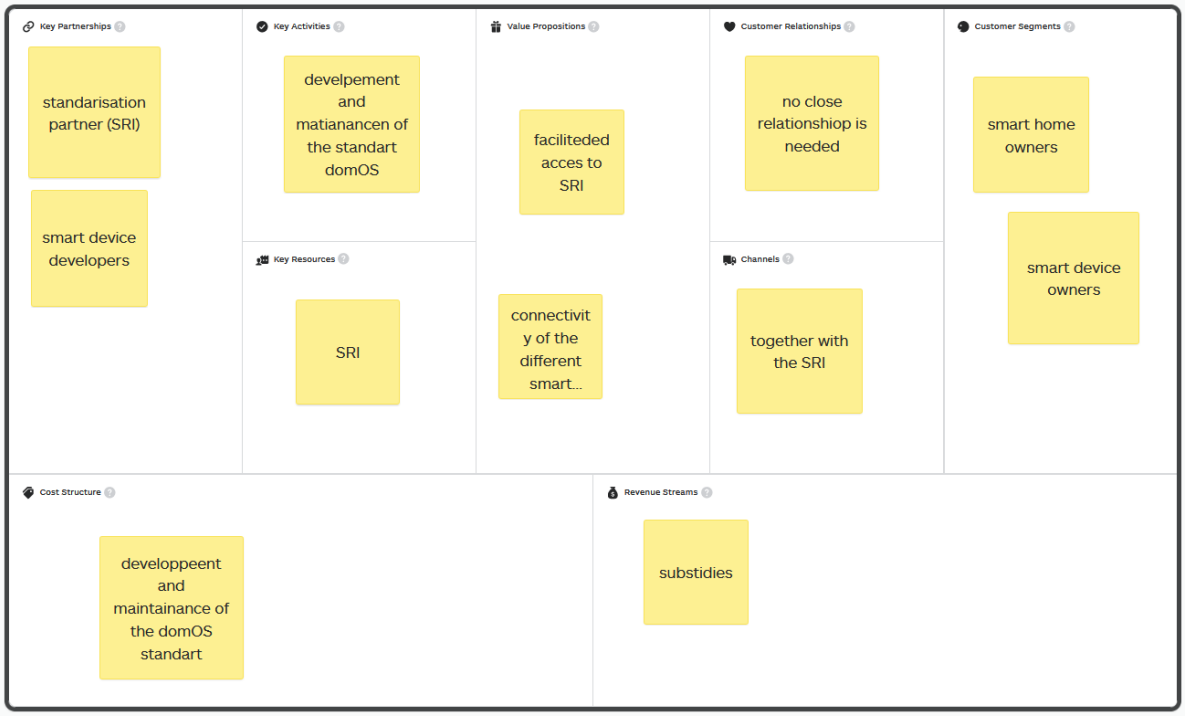

FIGURE 13: BUSINESS MODEL FOR THE STANDARD DOMOS IN THE SCENARIO 3

8.4.2. Structure

Figure 14 graphically illustrates the relationship between the different actuators.

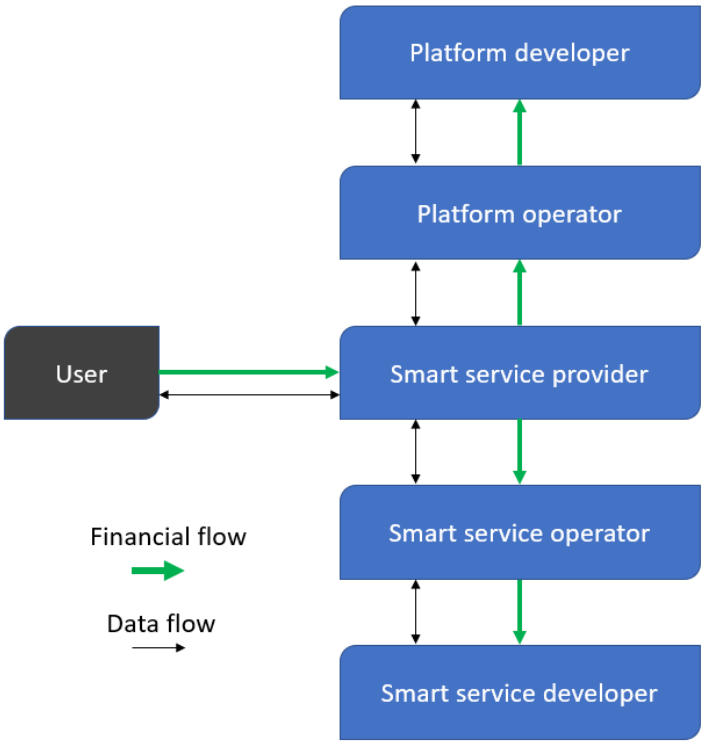

FIGURE 14: STRUCTURE OF SCENARIO 3

9. Conclusion

9.1. Structure

If the structure of the scenarios differs, the roles remain. Depending on the scenarios the structure or the degree of specialization and outsourcing of the service can vary greatly. The domOS layer can thus be under the responsibility of many different actors. To ensure adoption of domOS, there must be sufficient incentives to build consensus on its use. domOS could also be the object of a mandatory European standard as for the universal charger law. Thus, all home automation equipment sold on the European territory should eventually be domOS compatible. The objectives would be partly the same as for the universal wireline charger standard. Ease the life of the consumer who would no longer have to worry about the interoperability between home automation accessories. An environmental benefit by reducing the replacement of devices whose protocol is no longer compatible with current devices.

In the scenarios mentioned above, it is the homeowners who benefit from the domotization of their homes. Therefore, in these scenarios, it is also the homeowners who directly or indirectly pay the fees for the implementation and maintenance of domOS. This can take different forms, as investment costs or as a service model.

9.2. Business Model

The different proposals and scenarios for the business models of the domOS ecosystem can be exploited in parallel. The platform can thus be supported, developed, and maintained by different actors.

Depending on the different scenarios or models the services offered or proposed are not the same. The application store business model seems to be more suitable for applications that can be configured and controlled by the user. The automation and data processing for this model should be accessible to the user. Home automation equipment such as multimedia equipment, window and blind controls, access and lighting management lends itself well to this type of model.

A contractual service between the customer and the distribution network operator seems to be the most suitable for flexibility and energy production services. Models integrating solar panels, storage systems, notably via electric mobility and load shedding can be integrated into the network management. This could allow a better regulation of flows and solve problems related to the use of the power of the electrical network. From the point of view of smart service providers, other issues could be addressed such as grid congestion, voltage regulation and group balance.

The monetization and/or exploitation of data can be done in many different ways to achieve different goals. In the context of home automation applications on an application sales platform, the marketing issues of identification can be addressed more effectively. Smart service developers can take advantage of the data to optimize their product. The identification of expected and most used features, purchase factors, market segmentation are all criteria that can be analyzed on the basis of big data that would be available via a marketplace.

The development of measurement and control equipment could also allow the development of the project. By allowing connectivity and simple command control on many devices that do not yet benefit from this technology. We can imagine many simple devices that allow the monitoring of consumption as a connected ammeter that could be plugged into a socket or installed around a power cable. It would be possible to measure the power drawn from the network with the help of a software layer, as well as measure the energy consumed over time. Simple control devices such as switches or dimmers could allow a significant control of the different consumers of a house.

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