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## ► To cite this version:

Egidijus Kazanavicius, Darius Imbrasas, Mantas Razukas. Service Provisioning Framework for Digital Smart Home Services. 11th Conference on e-Business, e-Services, and e-Society (I3E), Oct 2011, Kaunas, Lithuania. pp.99-109, 10.1007/978-3-642-27260-8\_8 . hal-01560852

**HAL Id: hal-01560852**

**<https://hal.science/hal-01560852>**

Submitted on 12 Jul 2017

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# Service Provisioning Framework for Digital Smart Home Services

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**Abstract.** “Development and Management Framework of Smart Home Services (SNAPAS)” is an innovative system, which seeks to fill the market niche of Smart Home services and fully complies with the priorities of scientific development approved by the European Parliament and Council. Framework is characterized by an open component-based pluggable architecture, which provides new forms of interactive services in home environments, including the third-party service providers in the business model. SNAPAS is intended to develop, provide and control the services of Smart Home. Statistical research shows that the most important groups of Smart Home services are comfort, energy efficiency, and security. The most important are the energy efficiency services, because 76.3 % of all respondents would like to improve their heating system.

**Keywords:** smart home, service provisioning, distributed systems

## 1 Introduction

At the present time the systems and technologies of Smart Home are rapidly growing in popularity around the world. These systems include the automation of various housing areas such as accounting and control of consumed energy and resources, control of lighting and climate, security control, digital multimedia home systems, automated supervision of home environment and many others.

The increasing demand for such systems is in the countries of both North and South America, in Asia, Australia, Europe and Russia.

Development programs of Smart Home are even included in the priority fields of research in European Union countries. According to the 7th Framework Program, approved by European Parliament and by the European Council, research is divided into six specific programs, including “Collaboration” which includes the trend of information and communication technologies. The strategic goal of this trend is “To increase competitiveness of European industry and to provide the opportunity for Europe to manage and shape the future development of information and communication technologies (ICT) in such a way that it would satisfy the needs of its society and economy. Activity will consolidate the base of European science and

technology, will ensure its global leadership in ICT, will help to manage and stimulate innovations through ICT and will ensure that ICT progress was rapidly transformed into benefits for European citizens, business and industrial companies and government authorities”.

In this context “Development and Management Framework of Smart Home Services (SNAPAS)” is an innovative system, which seeks to fill the market niche of Smart Home services and fully complies with the priorities of scientific development approved by the European Parliament and Council, seeking to ensure competitiveness of Lithuania and Europe, satisfying the needs of its society and economy. “Development and Management Framework of Smart Home Services” is characterized by an open component-based pluggable architecture, which provides new forms of interactive services in home environments, including the third-party service providers in the business model (which is not yet in action worldwide).

## **2 Methodology for Smart Home Services Provisioning**

“Development and Management Framework of Smart Home Services” is intended to develop, provide and control the services of Smart Home. JSC “Elsis TS” is in the center of this system chain of service development and provision, i.e. it is the developer, provider and manager of Smart Home services, whereas end-users of Smart Home services are Smart Home residents.

The provider of Smart Home services will allow its customers to select different home services and will effectively manage the relationship between the customer-user and the providers of third party services.

SNAPAS is intended for several user groups. System users are grouped into four groups: end-users of Smart Home services; developers of Smart Home services; providers of Smart Home services; managers of Smart Home services.

Developers of Smart Home services are various organizations that are interested in providing their services to residents, using “Development and Management Framework of Smart Home Services”. Any company can be the developer of Smart Home services, provided that a tripartite agreement between the company, the service provider and the service manager is signed. Service developers can potentially be the organizations that already provide a range of services to residents by other means (not digital): companies providing energy resources, banks, operators of telecommunications, enterprises for distribution of information, television and radio operators, medical institutions, etc. The system allows service developers to develop, deploy and test their services remotely, via “on-line” mode and in real time, using special user friendly interfaces. The providers of Smart Home services will ensure system performance for the provision of services, by providing hosting. The group of service providers may consist of both Internet service and resource providers. These users will be able to monitor and manage the quality of services in real time. The managers of Smart Home services will provide supervision, installation, activation and deactivation of provided services. They will be able to perform all control operations remotely from the service center, which also receives information about system state in its separate parts in real time, also from homes of Smart Home’s

services' users. The system will automatically notify about various emergency situations, their cause and location.

Thus the system SNAPAS is designed to provide the end-user with innovative services from anywhere and at any time, by fully automating the process which is intended to develop and provision services of home automation, ensuring integration of these services with already existing systems and services. The system will ensure control and monitoring of services in real time and via "on-line" mode from anywhere and at any time, and also monitoring and control of service quality, and detection of emergency situations.

## **2.1 Scenario for Smart Home Services Provisioning**

Fig. 1 shows the scenario of development, control and provisioning of Smart Home services:

1. Service developers (which can be third party service developers) develop the services of Smart Home using "Development and Management Framework of Smart Home Services" by local or remote means. When developing a new service the developer has the possibility to test that service in the test environment of the SNAPAS system.

2. After the new service is created, service managers validate this service i.e. they check if this newly developed service meets all requirements of quality, security, content and others. Having ensured that the service meets these requirements, the service manager will make the final service configuration, setting the model of service provisioning (the payment model, the distribution model, etc.).

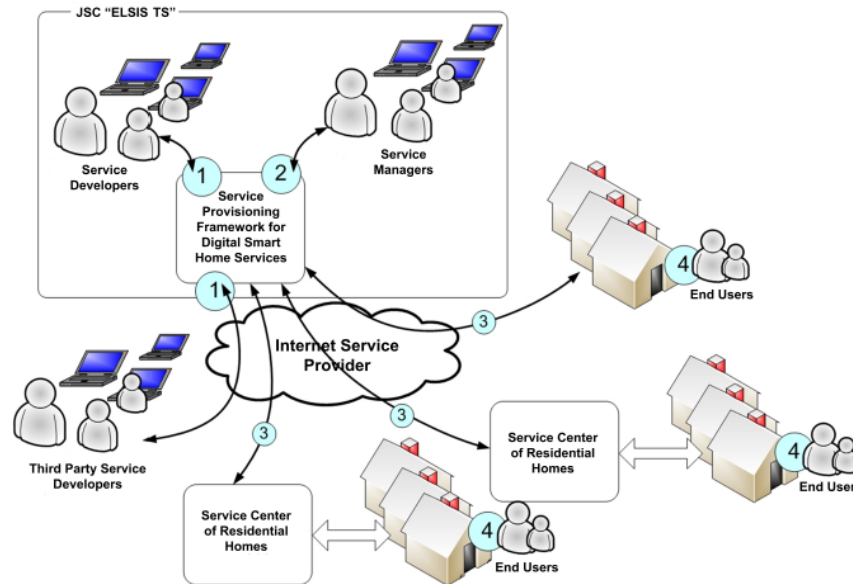
3. The newly developed, validated and configured service is automatically installed into service centers of residential homes or directly into residential homes remotely (via Internet or other) in accordance with the distribution model. In the case when residential houses belong to a block of residential houses with a neighborhood service center, services are automatically installed through that center. Otherwise, if there is no service center, the service is installed directly on the server at the end-user's home.

4. The new service is automatically integrated into the package of pre-existing services. The end-user can use this service free of charge for a period of time and if this service meets the customer's needs then it can be subscribed to interactively, using any terminal equipment (TV, PC, mobile devices, etc.) with a graphical interface.

"Development and Management Framework of Smart Home Services" develops and integrates different types of services, such as:

1. Comfort related services: lighting control, ventilation control, heating control, control of shutters, control of security systems, etc.
2. Entertainment services: media centre, digital TV, video rental (VoD), games, etc.
3. Residential environment services: home residents' health care services, health care services for elderly and disabled residents, services for environmental monitoring and determination of risk factors.

4. Services of supervision centers: tracking and control services of house engineering equipment, security services, Internet security services, heating control services (of the residential block), etc.
5. Other services whose need may arise in the future or services developed by third parties.



**Fig.1.** Scenario for development, control and provisioning of Smart Home services by JSC "Elsis TS"

SNAPAS features open architecture, i.e. it allows you to add new Smart Home services in real time, without changing the existing system architecture and structure. Smart Home end-users can try out, select and control the desired services as well as unsubscribe at any time interactively in real time. Such a solution is innovative in the world context, because until now global markets offer inflexible specialized solutions of certain companies, thus forcing the users to select standard services in advance without being able to easily abandon them later or subscribe to new services without changing the existing Smart Home system, which is costly and sometimes impossible.

Currently offered commercial Smart Home solutions are usually closed and do not allow third-parties to provide services, however a new product is being planned on the basis of which new business models will form, in which all interested third-parties will be allowed to provide Smart Home services on the basis of a pre-existing Smart Home infrastructure.

A versatile service stack and structure is defined in a way that allows immediate integration of new services without changing the existing system, whose engineering services will include control and monitoring of engineering house systems, the provision of digital interactive content and control of residential environment.

### **3 Statistical Market Research**

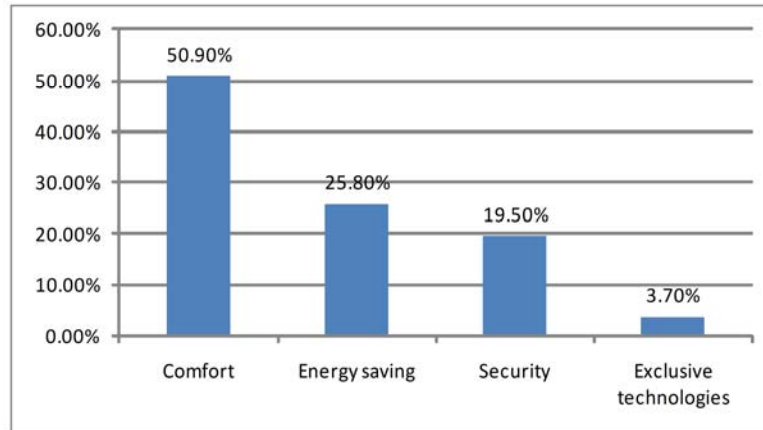
In order to assess the need and appeal to consumers of the system being developed, the evaluation of the Smart Home services system's conceptual solution was performed by taking part in the exhibition Namu pasaulis 2010 (Home World 2010). Evaluation of the conceptual solution by taking part in the exhibition Namu pasaulis 2010 (Home World 2010) was chosen due to the fact that many people who are interested in housing issues (construction, renovation, other solutions and innovations intended for modern homes) come to that exhibition. In order to properly evaluate the conceptual solution of Smart Home services, analysis of the Smart Home services system's concept was commissioned for the exhibition, which helped to discover the opinion of exhibition visitors about Smart Home services. In addition, the concept of the Smart Home service system was introduced to visitors and participants.

The questionnaire of 16 questions was approved, drawn in accordance with rules of "ICC/ESOMAR International Code of Marketing and Social Research Practice" and in accordance with all quality standards of social studies. It helped to understand and clarify the views and needs of potential Smart Home consumers, which made it easier to select specific applied research activities.

430 people participated in the survey. Thus the distribution error of overall responses with probability of 95 percent does not exceed 4.69 % (based on sample calculation formulas of T.Yamane and V.A. Jadov). The survey was carried out in accordance with quality standards of the World Association for Public Opinion Research (WAPOR) (WAPOR Code of Professional Ethics and Practices).

At the beginning of the survey subjects were asked whether they have heard of systems such as "smart home", "future home", "home automation", "intellectual home environment", etc. 70 % of respondents indicated that they heard of these systems, but could not specify how they function. 18.8 % claimed that they had not heard about such systems and did not know what it is and 11.2 % indicated that they were aware of these systems and had a lot of information about it.

Participants were asked to indicate the most important issue in terms of their housing. They were asked to lay out answers in order of priority. Slightly more than half of survey participants (50.9 %) indicated that convenience and comfort is an essential feature in terms of their housing. 25.8 % claimed that their priority is energy saving. 19.5 % claimed that the most important feature is security, and 3.7 % said introduction/possession of new, modern technologies in their homes.



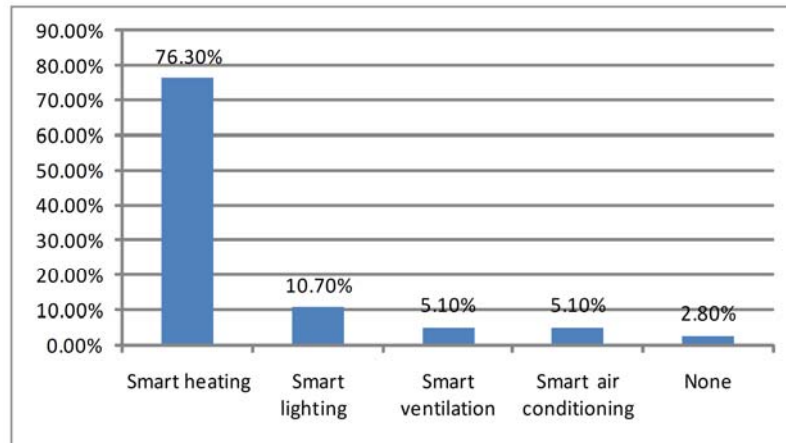
**Fig. 2.** Distribution of responses to the question “What is the most important to you in terms of your home“, in percentage, N=430

Subjects were also asked to indicate the most important home security service. Almost half of respondents (47.7 %) claimed that the most important is security against break-ins, and 38.8 % of respondents said fire safety. 7.7 % of respondents claimed that the key factor for them is protection against gas leakage, and 6 % said protection against water leakage.

86 % of survey participants indicated that heating control is/would be important for them. Control of lighting systems and other electrical appliances would be important for 63.3 % of respondents, control of ventilation/air conditioning is important for 50.5 % of respondents, and data acquisition from accounting devices on water, gas and electricity consumption as well as data submission is important for 39.3 %.

The study participants were also asked to give their opinion on how much energy they believe they can save using an energy regulation system. About half of survey participants claimed that it is possible to save up to 30 % of energy resources if an energy regulation system is used. Almost one third of respondents (30.9 %) believe that an energy regulation system can save up to 10 % of energy resources and 10.9 % of respondents think that they can save up to 50 % of energy resources. Some respondents (7.9 %) believe that an energy regulation system can save up to 5 % of energy resources.

According to the survey, 76.3 % of respondents claim that they would like to improve the heating system most of all in order to reduce the cost of consumed energy. 10.7 % of respondents would like to improve the lighting system most of all, 5.1 % of respondents claimed they would like to improve the ventilation system and the same percentage of respondents (5.1 %) would like to improve the air conditioning system in order to reduce costs. 2.8 % of respondents said that they would not like to improve any of the above systems in their homes.



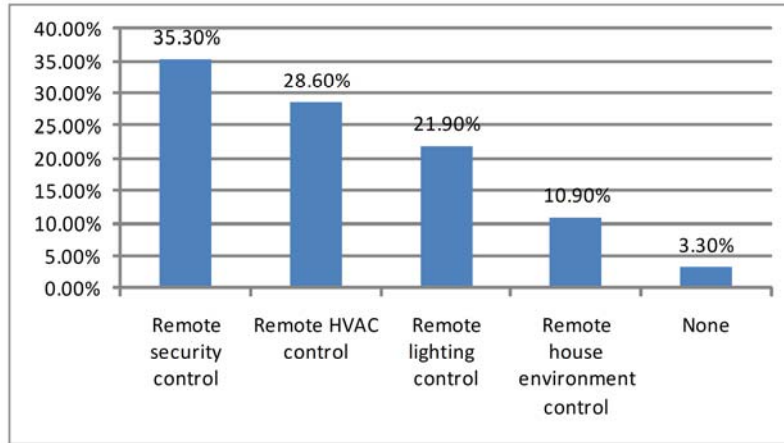
**Fig. 3.** Distribution of responses to the question “Which system would you like to improve in your home in order to reduce the cost of energy used”, in percentage, N=430

The study shows that more than one third of all respondents (35.3 percent) would like to remotely manage the security of their homes, i.e. they would like to receive notifications of burglary, fire, water, gas leaks, etc. 28.6 % of respondents said that they would like to control their home micro-climate (heating, ventilation/air conditioning) remotely in their homes, 21.9 % said that most of all they would like to control lighting and other electrical devices remotely in their homes.

10.9 % would like to control the home environment (yard, garage doors, lawn watering) remotely and 3.3 % of respondents said that they would not like to control any of these functions remotely in their homes.

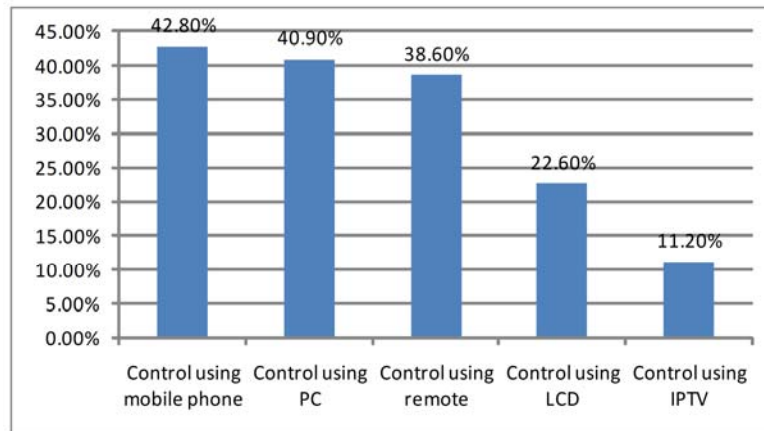
Respondents were also asked to indicate the most convenient way to control the above mentioned services. Those who said that they would not like to control any of these functions remotely were asked to imagine the most convenient way to remotely control any of these services. 42.8 % of respondents said that the most convenient way to control these services would be by telephone. 40.9 % of respondents indicated by computer as one of the most convenient way to control services remotely.





**Fig. 4.** Distribution of responses to the question “Which functions would you like to control remotely in your home“, in percentage, N=430

38.6 % of respondents indicated the remote control as one of the most convenient tools. According to the survey the least popular tool for remote service control is a menu on the TV screen.

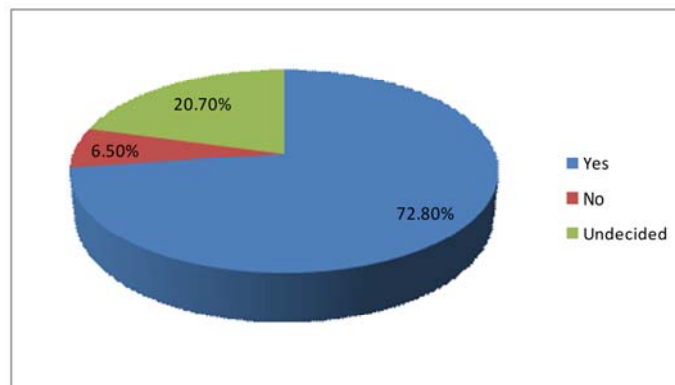


**Fig.5.** Distribution of responses to the question “Which is the most convenient way for you to control the above mentioned services“, in percentage, N=430

For 70.5 % of respondents, modern technologies in housing are mostly associated with automated control of housing and its devices. For 15.8 % of respondents modern technologies in housing are mostly associated with robots, performing a variety of household chores. For 10.2 % of respondents modern technologies in housing are mostly associated with the latest audio/video systems, and for 3.5 % of respondents with house/apartment decoration according to the modernist style (beginning of twentieth century- middle of twentieth century ).

46.7 % of respondents indicated that the most relevant service for them is automated control of lighting when being away from home (the simulation of someone being at home). 42.6 % stated that they would like to have a modern door, allowing people to enter the house without a key, displaying the people who are waiting at the door and allowing entry of guests while being anywhere in the house/flat. 40.2 % of respondents would like to have voice control of electrical appliances. According to the survey the least relevant services for the respondents would be e-health services (interactive upload of health data, e.g. blood pressure, cardiogram, ultrasound, from your house to your doctor before visiting him). Only 15.3 % of respondents are interested in such services. 11.9 % of respondents claimed that they would not want to have any service mentioned in the questionnaire in their homes.

72.8 % of survey participants indicated that they would like to use Smart Home services in their homes. 20.7 % of respondents said that they still do not know whether they would like to use Smart Home services in their homes and 6.5 % claimed that they would not like to use such services in their homes.



**Fig. 6.** Distribution of responses to the question “Do you wish to use Smart Home services in your home? “, in percentage, N=430

### 3.1 Market Research Summary

Even 81.2 % of respondents have heard of schemes such as “smart home“, “future home“, “home automation“, “intellectual home environment“, etc. and 11.2 % of them have a lot of information about it. The essential feature in terms of housing for slightly more than half of respondents is comfort, and for a quarter of the respondents is energy saving. Monitoring their own security burglar alarm system is/would be the most important for nearly half of respondents, and for 38.8 % it is fire safety. Heating control services is/would be important for 86 % of respondents. Control of lighting systems and other electrical appliances would be important for 63.3 % of respondents. Meteorological data (meteorological station) is the least relevant for all respondents (only 7.0 %). About half of survey participants believe that it is possible to save up to 30 % of energy resources if an energy regulation system is used and almost one third

of respondents believe that an energy regulation system could save up to 10 % of energy resources. 76.3 % of respondents would like to improve the heating system most of all in order to reduce the cost of consumed energy. More than one third of all respondents (35.3 %) would like to remotely manage the security of their homes, i.e. they would like to receive notifications of burglary, fire, water, gas leaks, etc. Telephone, computer and remote control were named as the most popular measures to control services remotely. The least popular measure is by a menu on the TV screen. For 70.5 % of respondents modern technologies in housing is mostly associated with automated control of housing and its devices. From all systems that are not widely known in Lithuania but are already in demand abroad, the greatest interest would be in simulation of being at home, a modern door which allows people to enter the house without any key, showing the people waiting at the door and allowing guests to enter while being at any spot of the house/flat as well as voice control of electrical appliances. 11.9 % of respondents claimed that they would not want to have any service mentioned in the questionnaire. 72.8 % of survey participants indicated that they would like to use Smart Home services in their homes, 6.5 % would not like to use them and 20.7 % still do not know.

## **4 Conclusions**

The above described results showed that the greatest interest in Smart Home services is among people 18-44 years old, applied research must be carried out while developing system interfaces oriented to the largest potential consumer group. The most important groups of Smart Home services are as was previously thought but with different priorities: comfort, energy efficiency, security. This confirms our understanding as well as the trend of applied research activity. The sequence of the main comfort services shows that when developing the SNAPAS concept the major focus is on remote data reading from accounting devices – TMT must be developed in a direction allowing the Smart Home system to effectively integrate this type of service. Another issue that emphasizes the importance of applied research of energy efficiency services is the fact that 76.3 % of all respondents would like to improve their heating system. Thus this area appears to be a big focus. Applied research must be carried out while developing system interfaces oriented to the most important tools that control Smart Home services. These tools are a telephone, a computer and remote control. Due to the fact that almost 73 % of survey participants wish to use Smart Home services in their homes, we can confidently claim that we have chosen the correct avenue of applied research and our work is meaningful.

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