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# Dynamic load management in a smart home to participate in demand response events

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ABSTRACT

In future power systems, in the smart grid and microgrids operation paradigms, consumers can be seen as an energy resource with decentralized and autonomous decisions in the energy management. It is expected that each consumer will manage not only the loads, but also small generation units, heating systems, storage systems, and electric vehicles. Each consumer can participate in different demand response events promoted by system operators or aggregation entities. This paper proposes an innovative method to manage the appliances on a house during a demand response event. The main contribution of this work is to include time constraints in resources management, and the context evaluation in order to ensure the required comfort levels. The dynamic resources management methodology allows a better resources' management in a demand response event, mainly the ones of long duration, by changing the priorities of loads during the event. A case study with two scenarios is presented considering a demand response with 30 min duration, and another with 240 min (4 h). In both simulations, the demand response event proposes the power consumption reduction during the event. A total of 18 loads are used, including real and virtual ones, controlled by the presented house management system.



## 1. Introduction

In the new electrical networks operation paradigm, consumers will be seen as active resources with capability to manage their energy consumption, energy generation, and energy storage systems. To implement this vision, several approaches have been proposed with the main focus on the concepts of smart grids and microgrids [1]. The development of smart grids requires, at the same time, the development of new other concepts such as the smart meter or the smart home.

A smart home can be defined as a house which comprises a network communication between all devices of the house allowing the control, monitoring and remote access of all applications and services of the management system. The management system should include advanced functions, such as the management of electric vehicles, the interface with external operators, security functions, health care prevention, and among others [2,3]. According to [4], to be considered smart, a home should include three main elements: the internal communication network, intelligent control systems, and home automation. In our opinion, this concept should be extended in order to integrate external communications. In fact, the house management system should be capable of interacting with external entities such as services aggregators, utilities, and health entities, among others, making decisions according to these interactions. The automatic participation in demand response (DR) events is an interesting example. In DR events, the house management system should reduce the electricity consumption based not on internal information, but on the interaction with an external entity.

The complexity of the house management systems (HMS) should be significantly increased in a near future. HMS should be able to manage effectively the total consumption, distributed generation units, electric vehicles, and also the participation in demand response events. On the other hand, the HMS should consider the consumption efficiency, the minimization of the energy bill, and the required comfort levels in the operation context [5]. The smart home system should provide the required comfort level in each context considering the minimum energy consumption and the minimum operation costs, including the maintenance [6]. To improve the performance of the house management systems, it is necessary to include the ability to autonomously acquire

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**Fig. 1.** SHIM user interface.

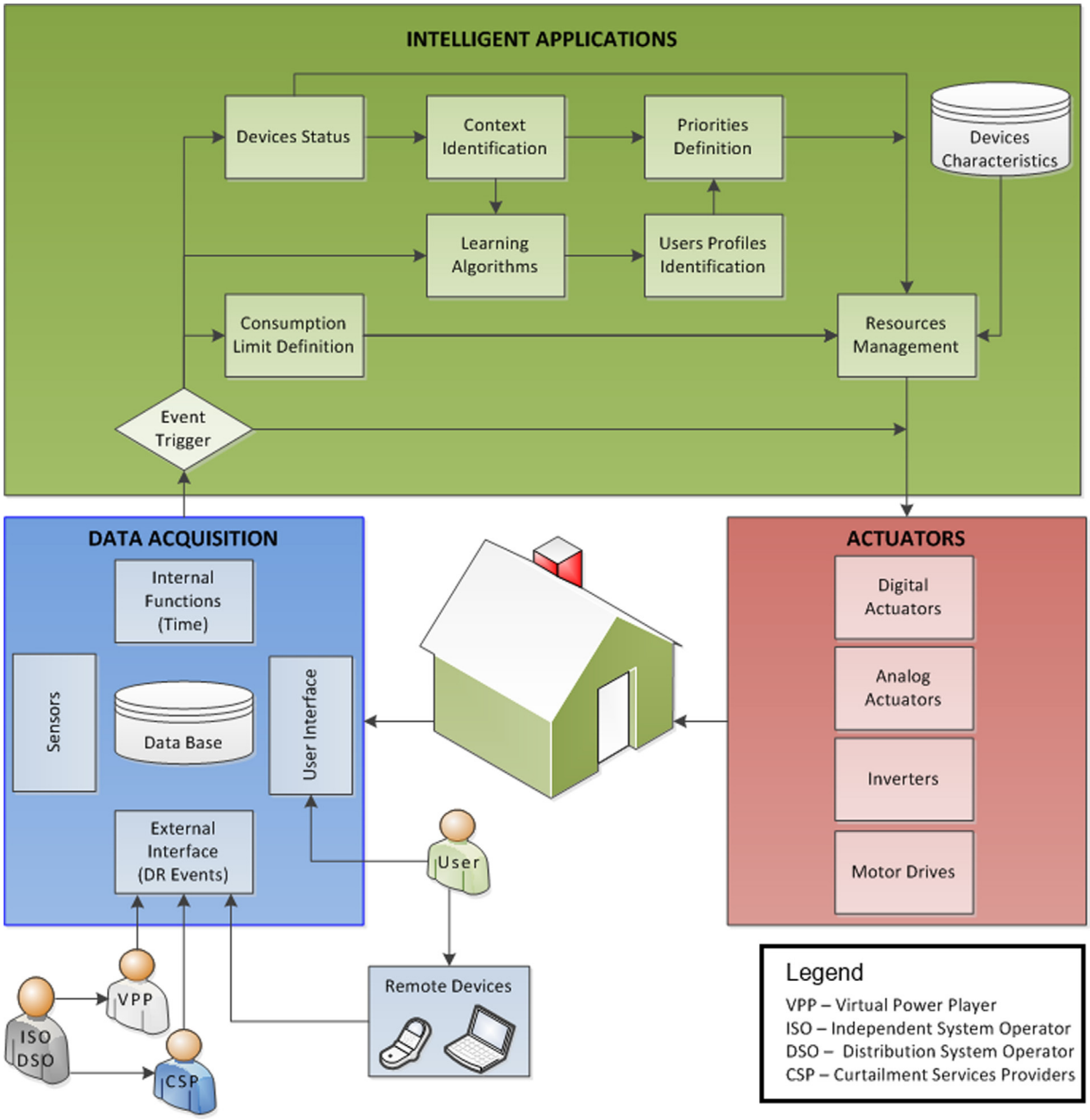


**Fig. 2.** Architecture of the intelligent energy management.