

## Overview of SaaS platforms for smart home

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**Abstract:** An analysis of research in the field of "smart home". The key problems of the industry have been identified. Some of existing SaaS systems are reviewed, compared, and the strengths and weaknesses of each system are identified. The key characteristics of the smart home support system have been identified.

**Keywords:** Internet of Things, smart home, SaaS systems.

### Introduction

In the early 2000's, an average of one hundred people owned a smart device. We are currently approaching the condition when a man has a number of 10 smart devices. Thus we are witnessing a technological explosion of different fields of activity, and of course of the habitat environment. As the number of devices increases, so does the complexity of adjusting the interaction between them. It is for this reason that the creation of an universal SaaS platform for smart homes is a current and important task.

We now have the ability to choose smart home products from a variety of manufacturers such as Google, Amazon, Apple, and more. The development of such products is so complex that no giant has managed to take the lead in the market. Therefore, we can see that the outline of the definition of the smart home are still unclear. Therefore, the development of the smart home management software component is current.

The purpose of this paper is to study cloud platforms as part of the smart home management system.

### Problems of the industry and SaaS as overcoming these problems

First of all, let's clarify the terms that characterize the scope of our study.

A smart home is a collection of software and hardware that integrates and coordinates the work of all devices in the room, as well as allows us to manage them as a whole. The mini-system in the context of a smart home is a controller combined with a set of sensors and performers, it is the basic unit of a smart home.

A microcontroller is a specialized microprocessor system that includes a microprocessor, memory blocks for storing code and data, I / O ports and blocks with special functions (counters, comparators, ADCs, etc.). Software as a Service (SaaS) is software as a service, a model of licensing and distribution of software, when a provider creates a web application, deploys it and ensures its stable operation for remote use by customers over the Internet (see Figure 1) [1].

Platform as a Service (PaaS) is a category of cloud computing services that provides customers with a

platform to develop, run and manage applications without the hassle of building and maintaining infrastructure.

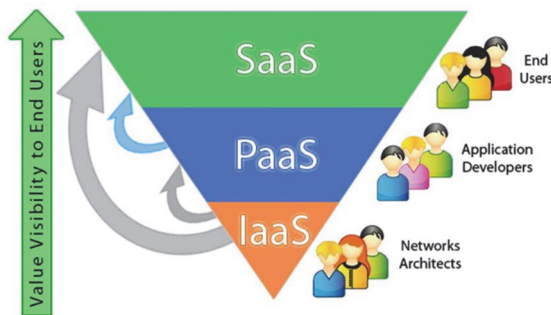


Figure 1. Cloud Computing Service hierarchy

Internet of Things (IoT) is a network of devices, such as vehicles and household appliances, containing electronics, software, actuators and connections that enable connection, interaction and data exchange.

A web service is a service provided by an electronic device to another electronic device through communication between them over the Internet.

The first issue that needs to be highlighted is the high connectivity of device software and hardware. These two parts are very interdependent and are distributed mostly together. In this respect, smart home devices today are very similar to personal computers of the 1970s and 1980s. Experience has shown that high connectivity between software and hardware has significant drawbacks, that is why personal computers have evolved into two interchangeable parts. It has become possible to replace software and hardware virtually independently of each other.

According to this analogy, it can be hypothesized that the future of smart devices for a smart home lies in this model. Yet so far it has not been widely used. The main reason for this situation is the greater difficulty for the end user when interacting with smart devices to update or modify them. If the end user can still handle the software update on a smart device, or the device will do it automatically, then installing other software on the device is a non-trivial task, and sometimes even

impossible. Using SaaS can make a big difference: if we bring software to the cloud and provide it as a service, installing new software will be easy to do.

Another issue to note is the lack of generally accepted requirements for the development of software that controls the operation of a smart device. For example, smart home management software solutions are mostly sold with devices. Having chosen one manufacturer, the client will be forced to work only with him, because it is difficult to combine devices from different manufacturers under one roof.

Another problem is the closed ecosystems of device manufacturers and the difference in their architecture.

Creating a SaaS platform to support smart home systems will overcome these problems, as well as provide a number of additional features:

- the implemented functionality will be easy to reuse in all other houses connected to the system;

- you can buy software in SaaS without buying new hardware;

- collection of analytical data and accumulation of experience on the basis of all houses connected to SaaS, which can be used to further improve the system and analyze its weaknesses.

- easy scaling of the system to any number of smart homes.

- increase the level of information security, as software in the form of SaaS will be automatically updated, and therefore, software vulnerabilities will be resolved as quickly as possible.

## Market overview of SaaS platforms for building a smart home

### Google Smart Home

Today, Google has one of the most developed smart home ecosystems. It all started with the launch of the Google Home smart speaker in 2017, which was created to compete with Amazon Alexa. Similar to the Alexa ecosystem, Google Smart Home has two types of devices: control and management.

Guides are devices with built-in Google Assistant

software that are able to receive human commands by voice and gesture and turn them into formalized commands for devices that can be touched by a dedicated team. Controlled - devices with some functionality that are able to execute formalized commands from the control device. Controlled devices may belong to the Google ecosystem or be third-party devices.

Unlike Amazon, Google's smart assistant is available not only in a smart speaker, but also in every smartphone with the Android operating system. This fact gives Google a significant advantage over Amazon, as it significantly expands the audience for which the threshold for entering the services of a smart home is almost zero.

Communication between devices is provided through the SaaS platform from Google, which has the following main components: Home Graph - a database that stores and provides contextual data about the house and its devices; device types determine which grammar should be recognized for the device; the declared capabilities of the devices determine the capabilities of the device type; purpose - a simple message format that describes how to execute a command, such as turning off the light; execution - a service that processes the intention and performs the appropriate action [2].

The Home Graph database stores information about the type of building (such as an apartment, house, or office), room (such as a kitchen, living room, or bathroom), and devices (such as a speaker, switch, or light bulb). Also, Home Graph can represent the concept of a house with a kitchen, which contains several types of smart devices from different manufacturers, such as lighting, kettle and stove. This information is available to Google Assistant when executing user queries in the appropriate context [3]. Status data, for example, if the kettle is switched on, is not stored in the long run - these are relative terms that are used and stored only in Home Graph. It is a logical map of a smart home. If the user enters the room and wants to turn on the lights and TV, then Home Graph

can simply say "hello Google, turn on the lights and TV" and not to mention the room where the user is now. Benefits of this system:

- implicit commands;
- implicit group positioning.

An important component of Google's Smart Home system is easy command execution. It allows users to control home devices using the Google Home speaker, Google Assistant on a smartphone or other device, and Google Nest Hub.

Google Home Speaker is a smart speaker that understands voice commands to interact with various functions (tasks, information, etc.) through Google Assistant software. The user has access to a large number of features from Google, and from various manufacturers of software or hardware. Google Home provides the same management capabilities, but through a graphical user interface. And with Google Assistant, you can control your voice from your smartphone, watch, laptop, TV and other devices.

The most functional way to control the home is the Google Nest Hub display, which extends the functionality of the Google Home speaker to the ability to receive information not only by sound but also on display, as well as control gestures and use the display for video calls or video surveillance. Gesture control can be especially useful if there is noise in the room and the system is unable to hear the user. This system also uses a camera to recognize people in the room to give them a personalized user experience.

To integrate with Google Smart Home, device manufacturers must provide a web service through which Google must send commands to devices. Google as a SaaS provides the ability to accept commands from the user, process natural language and generate formalized commands, and the device manufacturer must implement these formalized commands.

Google Smart Home's model of work is largely based on third-party services from device manufacturers, the system ensures the full operation of smart homes today.

## Muzzley

Muzzley positions itself as a SaaS solution that allows you to integrate all IoT devices into a single user interface. It simplifies the creation of a smart home by subjecting all smart devices to settings in the Muzzley application. Today, the system has more than ten thousand users, which allows it to work with more than two hundred devices from different manufacturers [4]. The main goal of the SaaS platform of Muzzley is to create an effective channel of communication between people and devices for the exchange of information or actions. The platform uses the concept of software services, not only to interact with devices, but the most common software services in the system are the Internet of Things devices. To become a software service in the Muzzley system, you must: obtain credentials from Muzzley, which will identify the software service; learn how to communicate using one of the HTTP or MQTT communication protocols.

The system supports two types of integration:

- Cloud-Cloud - the device manufacturer's service must register your device with Muzzley system and be ready to perform actions with your devices according to the command from the Muzzley service.
- Cloud-Device - the device asks its manufacturer's service to register it in the Muzzley service and already communicates directly with the Muzzley service with the received credentials.

It is worth noting that Muzzley is the only one of the considered systems that supports the integration of Cloud-Device with third-party devices. This approach, combined with the use of the MQTT protocol, makes this platform more resilient and faster than the others discussed in this section, but the lack of its own line of devices may be a weakness in competition with device manufacturers.

## Miotta

Miotta positions itself as a PaaS and SaaS solution for IoT. It is designed to control the interaction between

devices, data and people. The main goal of the system is to simplify the relationships between the components in order to speed up the development of new solutions. Miotta has created its own SaaS to develop security solutions using IoT devices. The best known solution is Horned.

To date, more than 100,000 Miotta devices have been connected to the company's servers, and more than 30,000 third-party API devices have been registered [5]. According to the Play Market, the Horned app has been installed more than 10,000 times.

Three types of interaction with API system are offered. You can use Miotta-Arp to control and manage your devices, create your own application to control and manage Miotta devices or your own.

The end-user interface is the Horned mobile application. It is a platform of services that provides security against thieves, video surveillance, health care, energy efficiency, automation and protection against emergencies. You can add and manage new devices in the application. It is possible to integrate with Dropbox, Google Home, Amazon Alexa. Easy to set up "if something" rules with smart devices is available. The application is available on Android, iOS and in a reduced form on the Apple Watch.

It can be concluded that the developers of Miotta have managed to implement an integrated ecosystem for a smart home based on the SaaS model, which already successfully ensures the operation of many smart homes.

## Conclusion

An analysis of smart home software support systems (CloudMQTT, Myotta, Google SmartHome), which are leaders among software developers, shows the lack of an acceptable integrated solution that would combine SaaS and PaaS services to meet the needs of home residents and end users, and developers of devices that ensure the operation of various smart home systems, as well as the need to develop a new software system.

This platform should combine the benefits of SaaS and

PaaS services, aimed at increasing profits from subscriptions to various blocks of home management functionality, from working with device manufacturers in the role of PaaS. It should optimize cloud-device and cloud-to-cloud integrations and implement APIs to configure http integration and MQTT device management.

The new platform should provide convenient capabilities for building a home management interface in the form of a web application or mobile application with the ability to support multiple homes of one user, accessible voice and gesture control. The module for supporting simple decision-making, subsystems for collecting and demonstrating statistical and analytical information should be effectively implemented.

The platform model should be similar to the

AppleAppStore or GooglePlayMarket model with a focus on a single smart device or smart home as a whole.

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