

Considering Value-added Services Using Smart TV in Cloud-Enabled Home Network System

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Abstract—We have been studying *Cloud HNS*, which is a new type of home network system using the cloud. In this paper, we consider value-added services that can be provided by introducing a smart TV as an appliance of Cloud HNS. First, we discuss requirements, role and benefits of a smart TV in the integration with Cloud HNS. Then, we propose concrete scenarios of value-added services achieved by the integration.

I. INTRODUCTION

With the recent advancement of contents delivery technologies, a smart TV has received a lot of attention as the next-generation TV. With a smart TV, a user can watch not only the traditional broadcasting media, but also on-demand streaming media services (e.g., Netflix, Youtube). The user can also extend features of the smart TV by installing favorite applications from the application markets.

Since a smart TV is one of household appliances, it can be coordinated with *other appliances* within a house, to provide a wider variety of services. Our group has been studying and developing a *home network system (HNS)*, which provides value-added services by networking household appliances and sensors. So we are interested in what value-added services are enabled by integrating a smart TV with HNS.

In a HNS, appliances (e.g., TV, air-conditioner, fan) and sensors (e.g., thermometer, hygrometer, human detector) are connected to a home network. Using these devices, a *home server* provides *HNS services*, including home energy management (HEMS), remote control and monitoring [1], context-aware service [2] and home security. In the conventional HNS, however, the appliances and services were tightly coupled. It was therefore difficult for users to flexibly choose favorite appliances and services. In addition, every user had to install and maintain a home server, which caused expensive cost.

In order to solve this problem, we have proposed a new type of HNS, called *Cloud HNS* [3]. Removing the expensive home server from the house, Cloud HNS provides basic features of HNS as a vendor-neutral cloud service. As a result, a user can use multi-vendor HNS services, and the cost of service provisioning and maintenance can be reduced, significantly.

In this paper, we propose value-added services that can be realized by integrating a smart TV with Cloud HNS. We first discuss requirements, role and benefits of a smart TV for the integration with Cloud HNS. We then propose concrete service scenarios achieved by the integration.

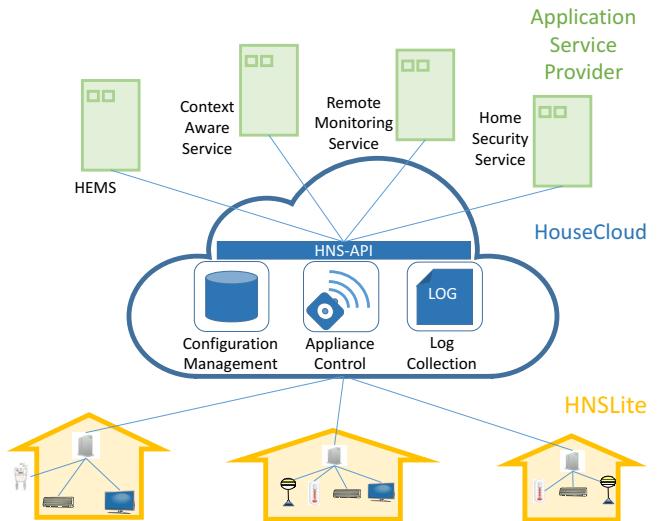


Fig. 1. A architecture of proposed Cloud HNS

II. CLOUD HNS [3]

Cloud HNS is a novel HNS architecture that delegates tasks of the conventional home server to the cloud. Cloud HNS aggregates and manages basic features of HNS (e.g., appliance controls, acquisition of sensor values, management of log data, etc.) as a *cloud service*. Service providers implement and provide HNS services using the cloud service. Therefore, the tight coupling among HNS devices and services can be resolved, which achieves multi-vendor HNS.

Figure 1 shows the architecture of Cloud HNS, consisting of three layers: *HNSLite*, *HouseCloud*, *ASP (Application Service Provider)*. *HNSLite* is a light-weight HNS that removes a home server from the conventional HNS. Instead of the home server, *HNSLite* installs a *thin terminal*, which simply works as a gateway between the home network and Cloud HNS.

HouseCloud aggregates distributed information and features of the conventional HNS, and provides them as abstract cloud services. It mainly provides the following three features:

F1: Configuration Management: *HouseCloud* manages static information for configuration of *HNSLite* deployed in individual houses. The information includes device list in the home, family structure and registered services.

F2: Appliance Control: *HouseCloud* abstracts the control of appliances in *HNSLite*, and provides it as a cloud service

to ASP, upon permission of the user. When control of an appliance is requested by a HNS service, HouseCloud converts the request into a command, sent to the appliance in HNSLite.

F3: Log Collection: HouseCloud gathers data from appliances and sensors, and accumulates the data as *house log*. Opt-in house log is provided to ASP for HNS services.

ASP implements and provisions HNS services. Information and operations required by each service are consumed as services through API of HouseCloud.

III. INTEGRATING SMART TV WITH CLOUD HNS

The integration a smart TV with Cloud HNS yields many advantages. Firstly, the system of the smart TV can be simplified, since various tasks can be delegated to the cloud. Secondly, provisioning and update of services become easy. A single update in the cloud makes all the smart TVs use the latest service. Thirdly, a smart TV can be orchestrated with other appliances. It is possible to share information of a smart TV with other appliances via the cloud for smart services.

We here summarize requirements for a smart TV to work as an appliance of Cloud HNS. The following three requirements are derived from features F1-F3 of HouseCloud, respectively.

R1: Leave Configuration to Cloud: The configuration information of a smart TV should be managed within HouseCloud. The information includes the type, model number, purchased date, installed applications, subscribed services, etc.

R2: Leave Control to Cloud: A smart TV should provide API by which HouseCloud can control the TV.

R3: Leave Log to Cloud: Log data of a smart TV should be managed in HouseCloud. It includes the history of controls, watched programs, channels, system status and errors, etc.

Moreover, a smart TV is expected as information interface that bridges every house and the cloud. So, it should facilitates two-way communication between home users and the cloud.

R4: Extend User Interface: A smart TV should implement a feature that displays information from HouseCloud. In addition, a smart TV should equip multi-modal input interface such as a touch sensor, a camera and a microphone.

IV. VALUE-ADDED SERVICES FOR/WITH SMART TV

Assuming that a smart TV is integrated with Cloud HNS, we propose value-added services for/with the smart TV.

A. Home Theater Service

Cloud HNS enables integrated control of a smart TV and other appliances. The home theater service automatically presents theater-like setting by controlling multiple appliances in a living room. Specifically, when a user operates the smart TV to watch a movie, the service turns off lights and closes a curtain automatically. In the case of using a Blu-ray Disc player, the service selects input source, dynamically. Moreover, based on user's history of watched movies and operations, the service performs personal adaptation so that the user can watch movies comfortably.

B. Context-Aware Contents Recommendation Service

Using the data collected from HNS, this service recommends video contents appropriate to the current situation (i.e., context). For example, when a user gets up, the service recommends a yoga program for smooth wake up. After the bath time, the service recommends a relax program. Thus, the service automatically tailors appropriate contents for each scene and that time, which aims to improve the quality of life and decision-making of the residents.

C. User support services using a virtual agent

Virtual Agent (VA) is an animated, human-like graphical chatbot program, which can interact with humans using speech recognition and synthesis technologies. VA can be also used as interactive user interface to control appliances in HNS. By installing the VA in a smart TV, it is possible to implement a service that helps user's daily life. A user can command the VA via voice, for example, "Turn off the lights in the bedroom", "Close the curtain", or "Prepare the bath". Then, the VA operates HNS on behalf of the user.

D. Home Security Service

This service shares regional crime reports in the cloud, notifies an alert with a smart TV, and controls security equipment in the house. For example, if a break and enter in neighborhood of a user is reported to the cloud, home security service notifies through a smart TV to the user. At the same time, the service automatically locks doors and windows, and turns on sensors for intruder detection.

E. Remote monitoring service

This service watches an elderly or vulnerable person living alone, with the help of a smart TV. During the normal operation, the service monitors the elderly person indirectly, by gathering device operations and sensor history from HNS of the elderly. If there are something abnormal or emergency, the service activates video phone application with the virtual agent, so that his/Her family can immediately perform appropriate actions through the smart TV.

V. CONCLUSION

In this paper, we propose to integrate a smart TV with Cloud HNS to implement value-added services. We also present several concrete service scenarios. The integration of a smart TV and Cloud HNS allows a wide range of services, which was difficult to achieve by the smart TV only. We are currently developing the remote monitoring service with the virtual agent, which will be published in our future publication.

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