Information Appliance | Home-oriented Services | GPS Linking

Technology Reports

Next-generation Remote Appliance Control System for Residential Buildings

We have developed a prototype service platform for providing new home-oriented solutions that are expected to become a part of our infrastructure for everyday living. These solutions will combine home-oriented services like home-appliance control and mobile phone services like location retrieval.

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1. Introduction

Urban redevelopment projects are now underway in many parts of Japan with many large-scale structures such as high-rise condominium/apartment buildings being built. It is sometimes difficult, however, for residents in the upper floors of these buildings to make connections with their mobile terminals, and the In-building Mobile Communication System (IMCS) has been introduced to solve this issue and add value to the condominium/apartment in such buildings. Recently, though, services like NTT DOCOMO's Home U that enable users to connect to their home broadband networks to make calls and access mail from their terminals have begun to be provided. The availability of these services, for which individual users take responsibility, has made the owners of condominium /apartment buildings reluctant to introduce IMCS.

Nevertheless, the owners of these properties still wish to provide their residents with advanced services that can add value beyond countermeasures to "dead zones" and thereby differentiate their properties from others. This need has brought about an increasing array of Service Providers (SPs) providing remote appliance control services, security services, etc.

This increase in SPs has led to complications, though, as service contracts and service usage methods differ from one SP to the other, which is not advantageous for end users.

At the same time, both SPs and building owners have expressed a desire to provide compelling services as well as to simplify and lower the cost of collecting service usage fees from users.

In light of the above, we wanted to find a new value-enhancing solution, and to this end, we studied a business model that could solve the above issues surrounding end users, building owners and existing SPs while also generating ongoing non-traffic revenue[*1] for telecommunications carriers. We also developed a prototype system to implement this solution.

This article describes the concept of this solution and the functions that it provides.

2. Concept

Targeting mainly the owners of condominium/apartment buildings, the solution is a system that facilitates business in the Business to Business to Consumer (B2B2C)[*2]. The system is a

*1 **Non-traffic revenue**: Revenue obtained from sources other than network communications fees.
*2 **B2B2C**: A business model in which a company performs transactions with consumers indirectly by transacting with another company.

service provision platform that connects to multiple SPs, bundles the various services that these SPs provide, and provides new services (functions) by interlinking the services provided by the SPs and linking them with network services provided by a mobile operator.

The present state of providing services to condominium/apartment buildings and the image of providing services after implementing the proposed service is shown in **Figure 1**. At present, each SP provides services independently requiring the user to subscribe to and use multiples services. For the building owner who introduces these services, the provision of many services, while increasing the value of condominiums /apartments in his/her buildings, means more contracts to conclude with multiple SPs and more support operations for users. In short, matters become more complicated as the number of companies involved with the provision of services increases.

Plus, from a long-term perspective, there will always be new services to add to those that are already being provided to end users in the condominium/apartment building, and this calls for a mechanism that can be used on an ongoing basis over the long term.

The proposed solution incorporates the following two concepts with the aim of solving the above issues.

1) Unified Provision of Services

Using a service platform to integrate and unify the provision of multiple services provided by multiple SPs means greater convenience for the end user by requiring only one contract to be concluded and enabling a variety of services to be used via only one operation interface (Fig. 1 (b)). Similarly, for the building owner, it means a reduction in the work associated with concluding contracts and providing user support.

2) Mechanism for Simplifying SP Participation

The bundling of services not only integrates the provision of services as described above but can also achieve new functions that could not be provided by a single service by forming links between services. It is also advantageous for SPs since consigning the work of dealing with end users in forming contracts and collecting fees means a reduced burden on their side, which can act as an incentive to connect to the proposed platform. As the number of SPs increases and individual SP ser-

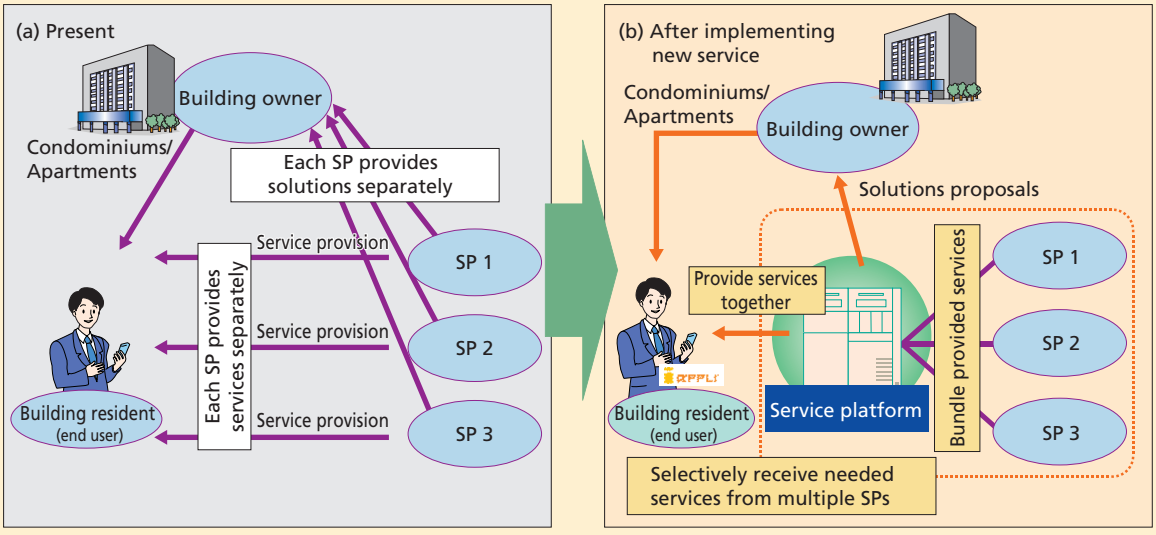


Figure 1 Service provision concept

vices evolve, linked services are apt to expand as well. It should be possible to provide new services at any time to end users who can be expected to use home-oriented services over a period spanning dozens of years.

3. Outline of Prototype System

3.1 System Configuration

The prototype system developed here connects to "Rusu Mode," a remote home-appliance control service provided by DOCOMO Systems, Inc. as an SP, and "Business mopera GPS Location," a mobile phone network service. System configuration is shown in **Figure 2**. In this system, a "residential server," which provides key functions like user and SP management and inter-service linking, connects to an "SP server group" consisting of servers operated by SPs. Here, the interface between a mobile terminal and a currently connected SP server is provided by an i-appli or browser on the terminal itself.

This system is not configured to provide a service from an SP server directly to the end user. Rather, it is configured so that, once the residential server receives a service from an SP server, it can link that service to other services or add new functions and provide the end user with an integrated service. When adding an SP or providing a new service from an existing SP, the system can perform linking with other services without modifying that SP server.

3.2 Functions for End Users

The functions of this system are achieved by linking SP services or by developing new functions on the residential server without any modification to SP servers.

1) Location (GPS)-linked Home-appliance Control Function

Existing remote home-appliance control services basically require that users take an active role in checking the state of home devices and operating those devices. Here, we can consider a case in which the user forgets to lock the door on leaving home, which means that the door will remain unlocked until the user realizes it creating a problem in terms of crime prevention. We therefore created a function for advising the user that he or she has forgotten to lock the door by linking the GPS location service provided by the Business mopera GPS Location service with door-lock-state monitoring provided by a remote home-appliance control ser-

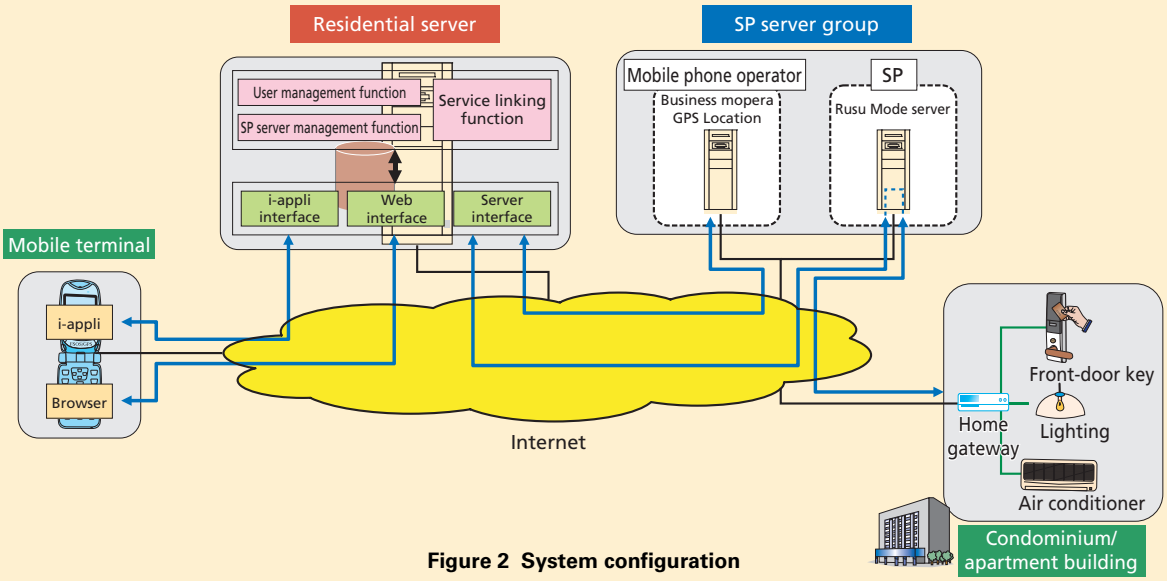


Figure 2 System configuration

vice as described above.

This function operates as follows. Once an unlocked state has existed for a certain amount of time, the residential server issues an instruction to the Business mopera GPS Location service requesting location information on the user's mobile terminal. Then, on receiving that data, the residential server compares it with the location information of the user's home, and if the distance of the user from the home has exceeded a previously established value, it determines that the user has forgotten to lock the door and either advises the user of such or automatically locks the door.

In addition to checking whether a user has forgotten to lock a door, this function can also be applied to checking, for example, whether the user has forgotten to turn off a certain appliance.

2) Multiple-appliance Automatic Control Functions

Situations like waking up, going to sleep, and going out are part of our daily lives, and each often requires that we perform some kind of operations on the same set of appliances. Simplifying such required operations could provide a great deal of convenience to users.

With this in mind, we used the prototype system to create the following three new functions based on SP services.

- Automatic control of appliances at a time set by the user

  Using an i-appli, the user registers information specifying what appliances (one or more may be set) are to be controlled in what way at what time. The i-appli sends this information to the residential server, which sends an appliance-control instruction to the SP server in question at the designated time.
- Simultaneous control multiple appliances with a single operation

  Using an i-appli batch-control button, the user registers information specifying what appliances (one or more may be set) are to be controlled in what way. Thereafter, pushing that button causes the i-appli to send home-appliance control signals to the residential server, which then sends home-appliance control instructions to the SP server in question.
- Automatic control of previously set appliances when going out or returning home (when locking or unlocking the front door)

  The user registers information beforehand with the residential server specifying what appliances are to be controlled in what way when locking or unlocking the front door. Then, when the user locks or unlocks the front door when going out or returning home, the SP server in question sends the residential server a notice that such an event has taken place (existing SP function). On receiving this notice, the residential server sends the SP server control signals with respect to the appliances registered beforehand.

3) Elderly-monitoring Notification Function

It is predicted the number of elderly people living alone will increase in the years to come with the advance of the aging society and the trend toward nuclear families. It is therefore thought that there will be an even greater need for services related to the safety and peace of mind of the elderly people themselves and the peace of mind of the family as well. The prototype system achieves a function that obtains the operation state of home appliances from an SP's remote home-appliance control service and checks whether the operating states of those appliances have changed. Then, in the event that there has been no use of certain designated devices for longer than a certain period, the function determines that something abnormal might have occurred to the resident of that home and sends out an abnormality notice to previously registered contacts like the family living elsewhere or a nursing firm.

Although examples already exist of elderly-monitoring services that make use of a specific home appliance, this system expands the concept to include multiple devices such as lighting, air conditioners, door locks, etc.

4) Operation by i-appli

User operation of existing remote home-appliance control services is typically achieved through mobile terminal browsers, or in other words, text-based

operation screens, which have presented problems in terms of viewing and ease-of-use. Considering that functions and advanced services will be increasing in the future, the need is felt for an operation interface that is even easier to understand and use.

By providing a user interface that uses an i-appli, the prototype system achieves a dynamic Graphical User Interface (GUI)[*3] making use of a function for "dynamically discovering connected devices and obtaining their attribute information" as found in Peer-to-peer Universal Computing Consortium communication protocol (hereinafter reffered to as "PUCC protocol"). Furthermore, by exploiting the freedom given in configuring i-appli screens, it becomes possible to provide a graphical operation interface that is easier to understand and to provide an interface that is customized to the needs of the target building and user preferences.

The i-appli operation interface is shown in **Figure 3**. To achieve an interface with high readability and visibility that anyone can intuitively understand and operate, the following characteristics were incorporated in this application.

- Divide the screen into separate areas with clearly defined roles.
- Display each appliance with a different icon to achieve good readability and change icon color according to device state to achieve good visibility.

Figure 3 i-appli screen

- To indicate the arrival of various types of notices and make their content easy to understand, place an icon for each type of notice in the upper part of the screen, make the icon corresponding to a newly arrived notice flash, and display the content of that notice by text in ticker fashion.
- Enable the batch-control icon area to be set as display/non-display for users who do not wish to use this function.

3.3 Functions for SPs

An important requirement for achieving this solution is the ability to connect to multiple SPs. However, the SPs to be connected and the services that they provide each have a different connection interface and control protocol meaning that a connection interface to the proposed system would have to be separately developed for each SP and service. The time and cost of such development would make connection difficult as the number of SPs increase.

The PUCC protocol was proposed at PUCC as a means of solving this issue [1][2].

The PUCC was founded by universities and vendors of home appliances, printers, home gateways, mobile terminals and other devices to establish technology that would enable various types of devices with different control protocols to interconnect seamlessly. The PUCC protocol proposed there is ranked as an upper-layer protocol to existing communication standards such as Bluetooth®[*4] and Transmission Control Protocol / Internet Protocol

*3 **GUI**: A type of user interface in which graphics are heavily used to present information to the user.

*4 **Bluetooth®**: A short-range wireless communication specification for wireless connection of mobile terminals, notebook computers, PDAs and other portable terminals.
Bluetooth is a registered trademark of Bluetooth SIG Inc. in the United States.

(TCP/IP). It constructs an overlay network on the application layer achieving interconnectivity among diverse devices and bridging various types of standards.

To adopt this PUCC protocol technology in our prototype system, we developed a function for making mutual conversions between the existing connection interface on the SP side and PUCC protocol (hereinafter referred to as "conversion module").

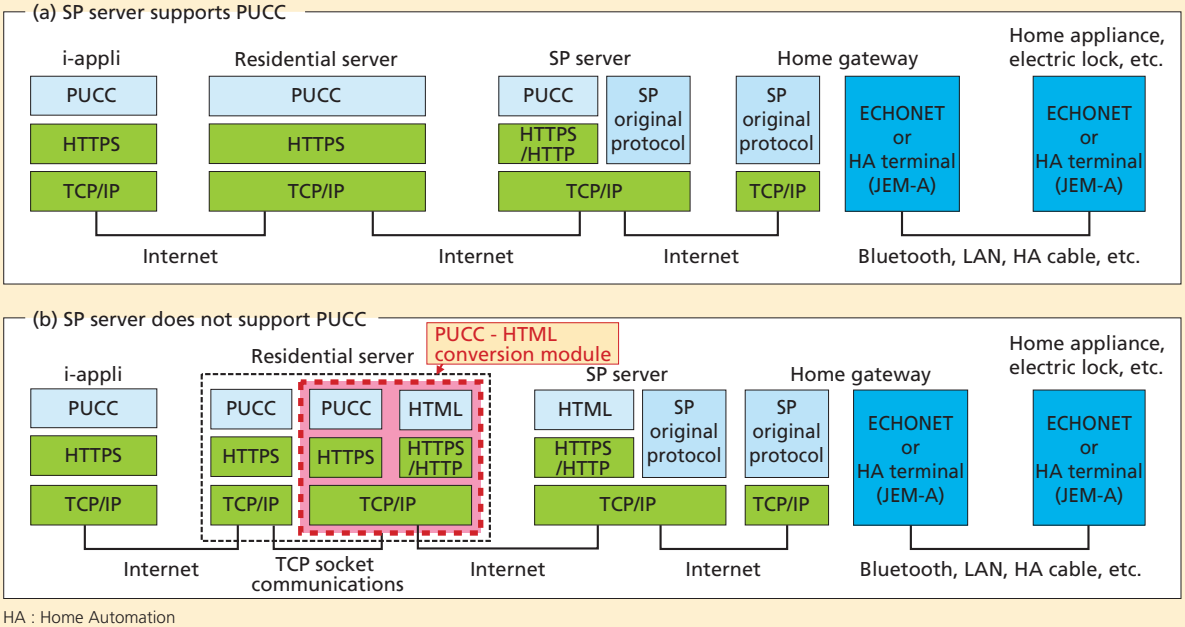
The basic protocol stack on the residential server is shown in **Figure 4** (a). Here, communications between applications on a mobile terminal and the residential server and between the residential server and SP servers are conducted by PUCC/HTTPS. In the current prototype system, however, we installed a conversion module on the residential server to make connections with an existing SP (Rusu Mode). The conversion module analyzes the Web interface (HTML/HTTP) of Rusu Mode and makes mutual conversions with the PUCC protocol format (PUCC/HTTPS) (Fig. 4 (b)).

Connecting to existing SPs other than Rusu Mode can also be supported by customizing the conversion module for each SP. NTT DOCOMO can also provide a conversion module to an SP for installing on the SP server thereby reducing the scale of development for the connection with residential server on the SP side.

Once PUCC support reaches a mature stage on the SP side, conversion modules will be unnecessary and making connections between residential servers and SP servers will be much simpler. This, in turn, should make it easier to expand SP services and to provide end users with an extensive lineup of services to choose from.

4. Conclusion

This article described the development of a prototype service provision platform targeting condominium/apartment buildings. The prototype system provides a mechanism for linking multiple services and functions such as location retrieval services, remote home-appliance control services, and i-appli, and achieves a platform that can



HA : Home Automation
LAN : Local Area Network

Figure 4 Protocol stack

provide new services with high added value not possible from existing SPs.

Looking forward, we will continue to develop and promote this system with an eye to expanding participation by SPs and to study methods for efficiently implementing connection interfaces to the system to make it easier for more SPs to interconnect.

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