(4) Seamless and Ubiquitous Service Support

Kenichi Yamazaki, Hiroyuki Kasai, Yoko Kikuta, Norihiro Kawasaki and Tsutomu Yokoyama

As new services in the future, much expectation is placed on seamless and ubiquitous services. NTT DoCoMo is also conducting research aimed at supporting these services in the IP-based IMT network Platform (IP²). This article outlines the seamless and ubiquitous services and reviews the seamless technologies in detail.

1. Introduction

In recent years, communication terminals have diversified and become much smaller, including PC, Personal Digital Assistants (PDAs) and mobile phones, and it is becoming more natural for these terminals to be connected to networks. Computers, which used to be available on a one-unit-per-person basis, are now around us in large numbers and many of them are already being networked with each other. The idea of supporting humans by such omnipresent ("ubiquitous" in Latin) networks and computers is referred to as a ubiquitous network or ubiquitous computing [1]. We are conducting research aimed at providing services in such conditions in the IP-based IMT network Platform (IP²).

This article classifies and defines the term "ubiquitous", which is ambiguously used currently, and discusses the IP² service support functions. It then describes the seamless technologies required for its implementation in detail.

2. Seamless and Ubiquitous Services

2.1 Ubiquitous Services Classification

There is no clear definition for the term "ubiquitous", which is frequently being used nowadays. Broadly speaking, we think there are two concepts. The first is based on the idea that "communication services should be made available smoothly regardless of time and place." In an environment consisting of various access methods, terminal capabilities and communication media, the key is to absorb a sort of "seam" resulting from their differences in the environment in which services are provided. Accordingly, this concept may be called "seamless", and services provided under this concept as "seamless services."

The second is based on the idea of "embedding wireless tags and other ultra-small terminals in the real world and offering services using such terminals to support users engaged in activities in the physical world." This is literally "ubiquitous" (in the narrow sense).

Figure 1 shows these two concepts classified by the diversity and the size (grading) of the target nodes. As ubiquitous services in the broad sense cannot be provided without fulfilling both seamless and ubiquitous properties, there are many cases in which the two are intentionally mixed up. Technically, however, they should be distinguished from each other.

Seamless services are services that are available anywhere and anytime, bringing about more opportunities to provide services. For example, if you can freely transfer services from a fixed terminal to a mobile terminal, you can use services that previously had to be given up upon moving. Ubiquitous services lead to an expansion in the scope of communications. Although wireless tags and sensors are not expected to justify the level of subscription fees as high as existing services, it has the

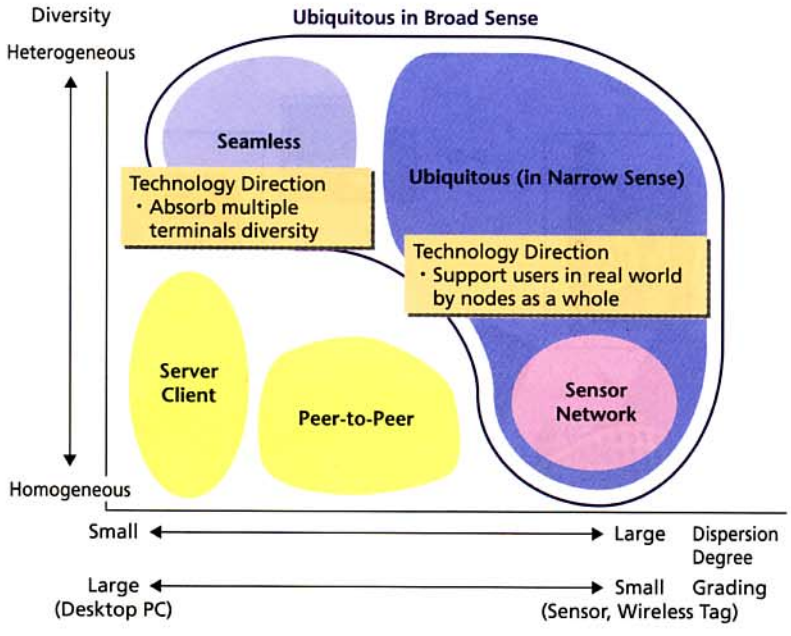

Figure 1 Seamless and Ubiquitous Classification

potential to develop a market different from conventional businesses aimed at increasing traffic. Put differently, these services are expected to cultivate new communication markets in the future.

2.2 Service Support Objectives

IP^2 offers the Service Support PlatForm (SSPF) focusing on supporting xSP (Internet/Application/Content Service Provider), who provide the new services mentioned above. The principal objectives of SSPF are as follows.

(1) Provide service components that enable xSP (especially small- and medium-sized vendors and individuals) to quickly and easily build services, and encourage more players to provide services over IP^2.

(2) Provide functions unique to the Network Control PlatForm (NCPF) to xSP via SSPF. Thereby, add IP^2-unique properties to services provided over the Internet and offer high value-added services.

(3) Provide novel service components such as those with seamless and ubiquitous properties ahead of the competition and cultivate a new market.

The following sections discuss the technologies in detail focusing on "seamless service" and explain how SSPF coordinates with NCPF.

3. Seamless Service Support

3.1 Seamless Services Requirements

The following are the requirements for fulfilling seamless services.

Firstly, it is imperative that the appropriate access method can be chosen without cutting off communications. This is referred to as a "network seamless service", as discussed in [3]. Secondly, it is vital that a service can be transferred to an arbitrary terminal when the terminal in use no longer suits the Quality of Service (QoS) or if a more suitable terminal is found in conjunction with the user's movement. This is referred to as a "device seamless service". Thirdly, the content must be adapted to the environment according to changes therein, such as the terminal and the user's state. This is referred to as a "content seamless service". The seamless concept is classified into these three, and the following is a description of device and content seamless service.

Figure 2 shows an example of a seamless service, showing how a videophone service reception is sustained while changing the devices and contents. If a user transfers the videophone service that he/she had been receiving from a fixed phone at home to a mobile terminal, he/she can sustain the videophone service even while he/she is out. Moreover, the user can sustain the service even in buses and other public transport by converting the transmitted/received voice into text information.

3.2 Technical Issues and Approach of Seamless Services

As explained above, a device seamless service requires service transfer technologies to transfer services from an arbitrary terminal to another terminal in a seamless style, whereas for a content seamless service, service adaptation technologies are important to make services change according to the situation

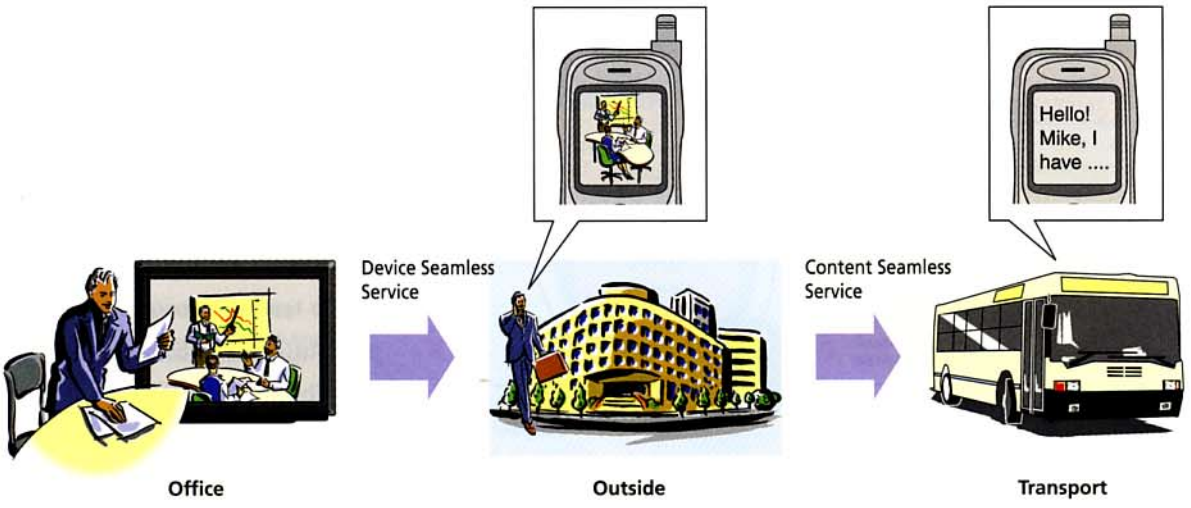

Figure 2 Seamless Service Example

(the device capabilities of the terminal being used, the application being used, the properties of the network being accessed, etc.). SSPF supports seamless services by offering these functions in the form of components. In this section, we compare our method with conventional methods, and describe the technical issues.

A number of solutions have already been proposed with respect to the aforementioned issues, based on a proxy between the content server and the terminal (**Figure 3** (a)). In this method, the session between the content server and the terminal ("application session") goes through a proxy, meaning that services are transferred simply by switching the application session between the proxy and the source/destination terminal. Also, service adaptation such as media conversion can be implemented easily within the proxy, as the application session can be directly manipulated. This method, however, requires a proxy function preparation with respect to each service protocol, resulting in the lack of versatility.

For this reason, we are proposing a method that makes the network give instructions to the terminals only in regard to processes such as the disconnection and reconnection of the application sessions, and establish an application session between the content server and the terminal on an individual basis (Figure 3 (b)). In this method, services are transferred by acquiring information on the interim service state from the source terminal, transmitting it to the destination terminal via the service transfer control server and giving instructions to resume the service. Service adaptation is implemented by collating the information on the environment of the source terminal with that of the destination terminal at the server, and determining the appropriate application to be used, content information, and so on. In order for this method to be realized, it is necessary for the applications to be equipped with an Application Programming Interface (API) for acquiring the service state. For example, we can use ActiveX in Microsoft Windows ™, whereas mobile terminals must have an API designed for this purpose.

3.3 Service State Description

In this method, information on the interim service state and information on the environment are important, and information consisting of these two is defined as "service state" [4]. Specifically, information on the interim service state includes information on applications, URL of content, information on content attributes (e.g. image size, bit rate), progress information (e.g. elapsed time), access history information and layout information. Information on the environment includes informa-

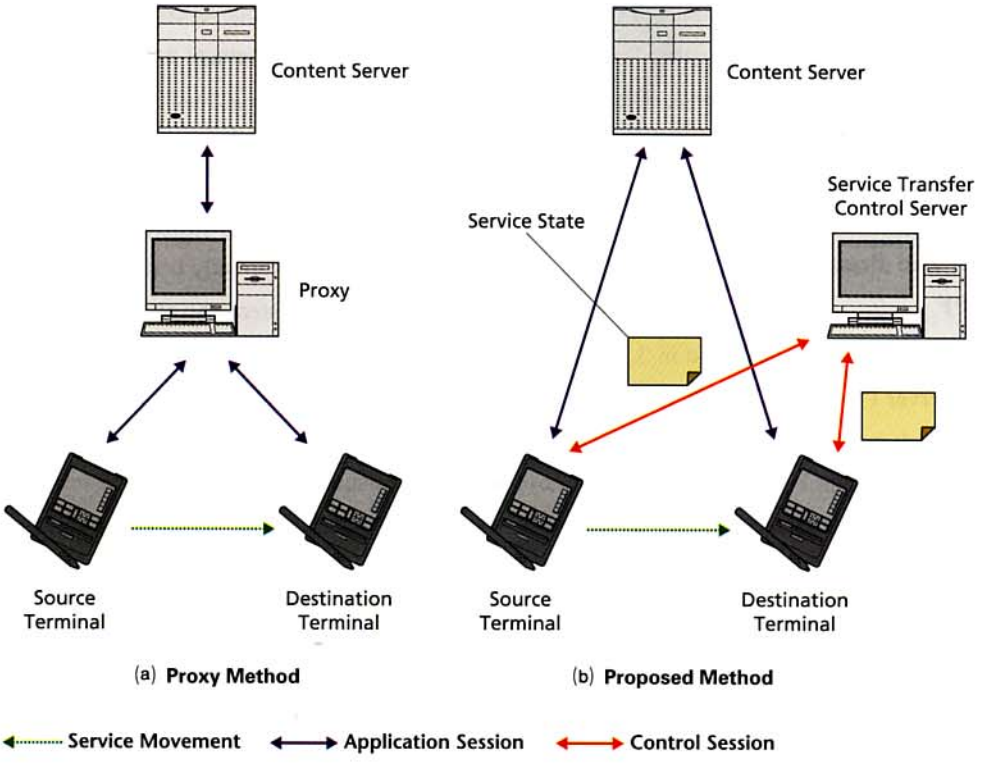

Figure 3 Service Transfering Method

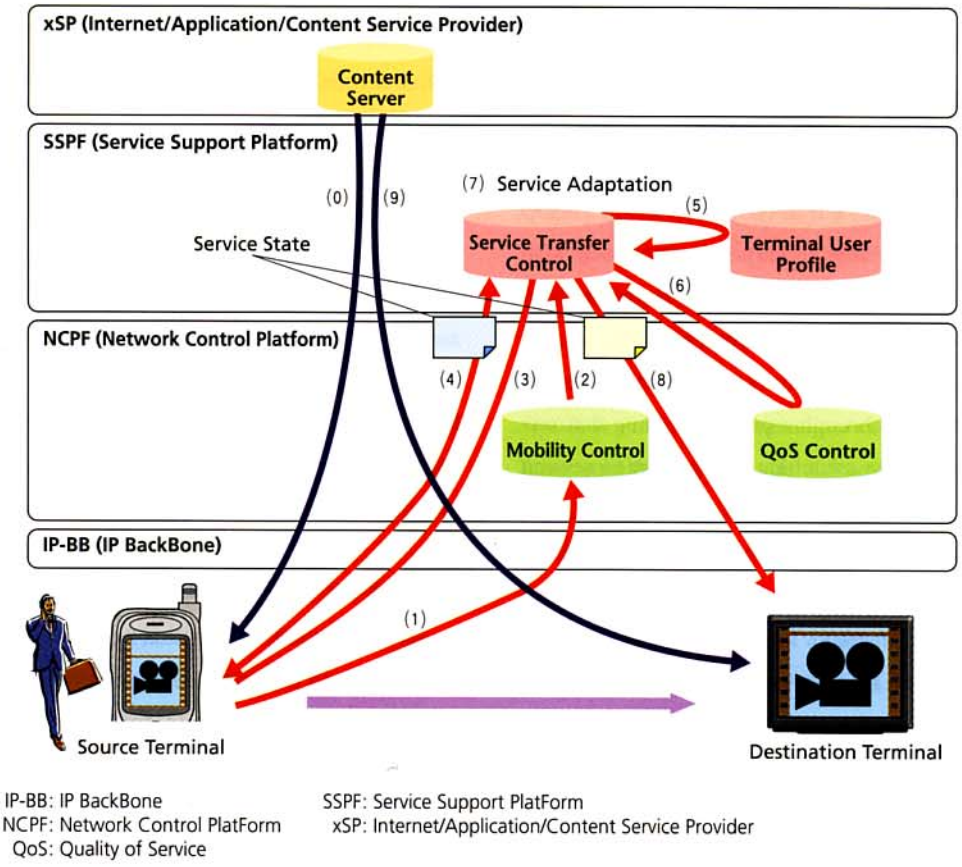

Figure 4 Configuration and Processing Sequence of Seamless SSPF

tion on the device capabilities (e.g. display resolution, type of Central Processing Unit (CPU)), network information (e.g. used bandwidth, error rate) and so forth. As for the description method, we designed an XML Schema for service state description, in which the structural description based on XML provides extensibility.

3.4 Configuration and Processing Sequence of Seamless SSPF

In SSPF for seamless services, as described in 3.2, the service transfer control server ("control server") is primarily in charge of sequence control: it implements the terminals control including application session control, and service adaptation by liaising with various profile DB (e.g. device profile DB, user profile DB).

Figure 4 shows the configuration and the basic sequence of SSPF, presuming that the source terminal accesses "http://docomo.com/neko_small.rv" using Real Networks RealPlayer™ to receive a video streaming service. The following is a description of the processes involved in transferring the service to the destination terminal and playing it back on Microsoft Windows Media Player™.

(1) Register the location associated with the user's movement.

(2) Transmit the movement notice based on mobility control in NCPF.

(3) The control server issues a service state request to the source terminal.

(4) The source terminal acquires, from the application, the state of the service currently being received (in this example, the URL of the content, the elapsed playback time, the application being used and the image size), generates a service state description and sends it back to the control server.

(5) The control server acquires the device capabilities of the destination terminal (the display resolution and the applications that can be used) from the profile server.

(6) Acquire network information (available bandwidth of the destination terminal) from NCPF.

(7) Re-compose new service state description based on this information and the service state description referred to in (4). Specifically, as the application used in the source terminal was RealPlayer™, select Windows Media Player ™ as the streaming application that can be used in the destination

terminal, and choose "http://docomo.com/neko_large.asf", which is the URL of the content suitable for the Video Graphics Array (VGA) display resolution with reference to the display performance and the available bandwidth of the destination terminal.

(8) Transmit the recomposed service state description to the destination terminal.

(9) The destination terminal analyzes the received service state description and executes a service restarting process to resume the service.

As such, this method is distinctive in that the control server executes service transfer control and generates the service adaptation information associated with it, and the terminal merely launches and exits the application according to the control server's instructions. This makes it possible to add a new value called "service transfer" to the network, independently of applications. In other words, from the xSP's point of view, seamless services can be provided to users without changing the applications.

4. Conclusion

This article described seamless and ubiquitous services, which are highly promising services in the future, and the service support technologies that assist them. In regard to seamless services, we will study the methods for the service transfer of real-time communication services and so-called stand-alone applications. Enhancements in service adaptation functions will enable service transfer across terminals with substantially different capabilities. Of note, we intend to report on ubiquitous services (in the narrow sense) currently subject to research on a separate occasion.

GLOSSARY

API: Application Programming Interface
CPU: Central Processing Unit
IP^2: IP-based IMT network Platform
IP-BB: IP BackBone
NCPF: Network Control PlatForm
PDA: Personal Digital Assistant
QoS: Quality of Service
SSPF: Service Support PlatForm
VGA: Video Graphics Array
xSP: Internet/Application/Content Service Provider

REFERENCES

[1] M.Weiser: "The Computer for the Twenty-First Century", Scientific American, pp.94-104, Sep.1991.

[2] H.Yumiba, K.Imai, and M.Yabusaki: "IP-based IMT Network Platform", IEEE Personal Communication Magazine, Vol.8, No.5, pp.18-23, Oct.2001.

[3] Yabusaki, et al: Special Article (1) IP^2 Network Architecture Overview, NTT DoCoMo Technical Journal Vol.4, No.4, pp.5-11, Mar. 2003.

[4] Kawasaki, et al: Service State Specification for Seamless Service Environments, the Information Processing Society of Japan (IPSJ) FIT 2002, M-43, Sep. 2002.