●Technology Reports●

Business Expansion to Products with Built-in Communication Functions —Prepaid Plans—

*NTT DOCOMO began to provide prepaid plans together with the December 2011 release of the PlayStation® Vita[*1] handheld game console featuring a built-in FOMA communication module. The idea here was to provide introductory plans that would make it easy for users to experience NTT DOCOMO's data communication services. This article describes NTT DOCOMO's approach to solving the issues that arise when expanding its business to products with built-in communication functions and presents key technologies— automatic plan activation, time-based charging and effective period processing—essential to the development of these prepaid plans.*

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1. Introduction

The recent appearance of a diverse array of products with built-in communication functions is stimulating the mobile data communication market. Typical of these products are tablet computers and dedicated e-book readers for which existing mobile-phone hardware configurations and service models do not apply.

NTT DOCOMO has been involved for some time in the provision of products with built-in DoPa or FOMA communication modules in collabora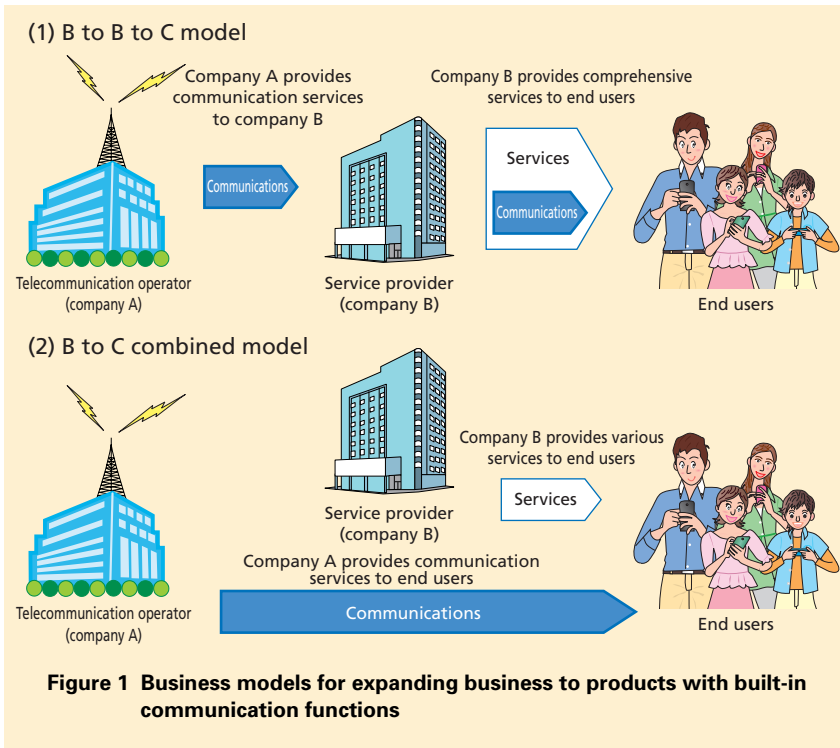tion with various partners, but it has been resigned to the fact that a desirable number of circuit contracts have not been acquired in relation to consumer-oriented products under existing schemes.

To address this problem, NTT DOCOMO developed new prepaid plans by solving a variety of technical issues and began to offer these plans together with the December 2011 release of the PlayStation Vita handheld game console having a built-in FOMA communication module. These plans use a time-based charging method that even first-time data-communication users can easily understand.

In this article, we present an overview of three key technologies— plan activation, time-based charging, and effective period processing—essential to the development of these plans.

2. Business Models and Associated Issues

As shown in **Figure 1**, there are two business models describing how operators other than telecommunication operators can provide products with built-in communication functions and related services to end users. These are the B to B to C model in

*1 **PlayStation®**: A registered trademark of Sony Computer Entertainment Inc.

(1) B to B to C model

Company A provides communication services to company B

Company B provides comprehensive services to end users

Communications

Services

Communications

Telecommunication operator (company A)

Service provider (company B)

End users

(2) B to C combined model

Company B provides various services to end users

Services

Company A provides communication services to end users

Communications

Telecommunication operator (company A)

Service provider (company B)

End users

Figure 1 Business models for expanding business to products with built-in communication functions

which a service provider bundles devices/services/communications all together as a single package and the B to C combined model in which a telecommunication operator and service provider collaborate to provide devices/services/communications (example: communications provided by NTT DOCOMO and services and devices provided by another operator).

In the B to B to C model, services are provided to the user in a form that includes communication fees as part of one purchased product or one entered contract. Here, however, an operator that provides services with communications included on a widespread basis in the consumer market may be overburdened with the responsibilities of a

telecommunication operator, at least in Japan.

In contrast, the B to C combined model is a collaborative effort in which each operator makes best use of its own area of specialty, existing assets and know-how. Speedy market entry and a synergistic effect can be expected with this model. On the other hand, it means that the user must undertake separate procedures for purchasing a device, entering a service contract, and entering a communications contract. This may be too troublesome for some people and hinder the acquisition of new users. Additionally, adding a communication function to an existing device or service can easily generate unease in users who might be prone to say "Isn't the fee for

the communications portion too expensive?" This as well may hinder the acquisition of new users.

In the case of PlayStation Vita, the B to C combined business model has been adopted (Sony Computer Entertainment handles device sales and service provision, and NTT DOCOMO provides communications contracts). To make this collaboration a success, NTT DOCOMO worked to solve existing technical issues placing prime importance on "How to make the use of its communication service as simple and reliable as possible."

Specifically, NTT DOCOMO adopted an "Automatic Activation Method" to simplify to the utmost the procedure for making a contract and the procedure for plan activation. It also adopted a prepaid, time-based charging model that even first-time users of data communication can intuitively understand.

3. Automatic Plan Activation

To achieve procedures for making a contract and performing plan activation that are as hassle-free as possible for users, two key functions have been developed. The first function enables the system to store prepaid contract information in the supplied Subscriber Identity Module (SIM)[*2] beforehand to signify a provisional plan-activated state. The second function automatically performs activation in the event that

the first packet connection from the PlayStation Vita console (hereinafter referred to as "mobile device") with that SIM inserted is successful.

The outstanding feature of these functions is that plan activation can be automatically initiated through simple user operations since the SIM is sold as part of the device. If, however, the device in question is being sold in large quantities (such as on the day of its initial release), there is the fear that a large number of new users will attempt their first packet connection all within a relatively short time period. There is consequently the need for a type of centralized automatic plan activation processing that can prevent congestion-related delays from occurring. We have solved this issue by managing contract status at an IP Service Control Point (IPSCP)[*3]

in the core network[*4], which can be expected to have high real-time characteristics and distributed processing over a large number of network devices.

The actual procedure is shown in **Figure 2**. First, before initiating automatic plan activation, the prepaid contract information is written onto the SIM and a provisional plan-activate Service Order (SO) is submitted to the IPSCP from the ALl Around DOCOMO INformation system (ALADIN)[*5] (Fig. 2(1)). Next, the mobile device (with the SIM tied to that prepaid contract information inserted) sends out an initial packet transmission request when prompted by a Graphical User Interface (GUI) operation such as "turn power ON" to initiate a communication-contract opening procedure (Fig. 2(2)). Then, on receiving this packet transmis-

sion request from the mobile device, the Serving General packet radio service Support Node (SGSN)[*6] determines that it is an initial packet transmission request in a provisional plan-activated state (Fig. 2(3)). It therefore continues with packet transmission processing (Fig. 2(4)) and performs contract automatic activation processing (Fig. 2(5)). In short, using a successful initial packet transmission as a starting point, the IPSCP and SGSN causes the prepaid contract information stored in a provisional plan-activated state to move into a genuine plan-activated state.

4. Time-based Charging

To make it easy for users to intuitively understand how they are being charged for communications, we have adopted a method that treats the time so far used for wireless communications as communication time and simply subtracts that time from the total allowed communication time granted beforehand by each prepaid plan (**Figure 3**).

This method supports a service format that determines whether packet communications may be performed according to allowed communication time under a prepaid plan and that also determines if communications should be suspended while packet transmission is in progress according to allowed communication time. Accordingly, there is a need for a function that can determine allowed communication time
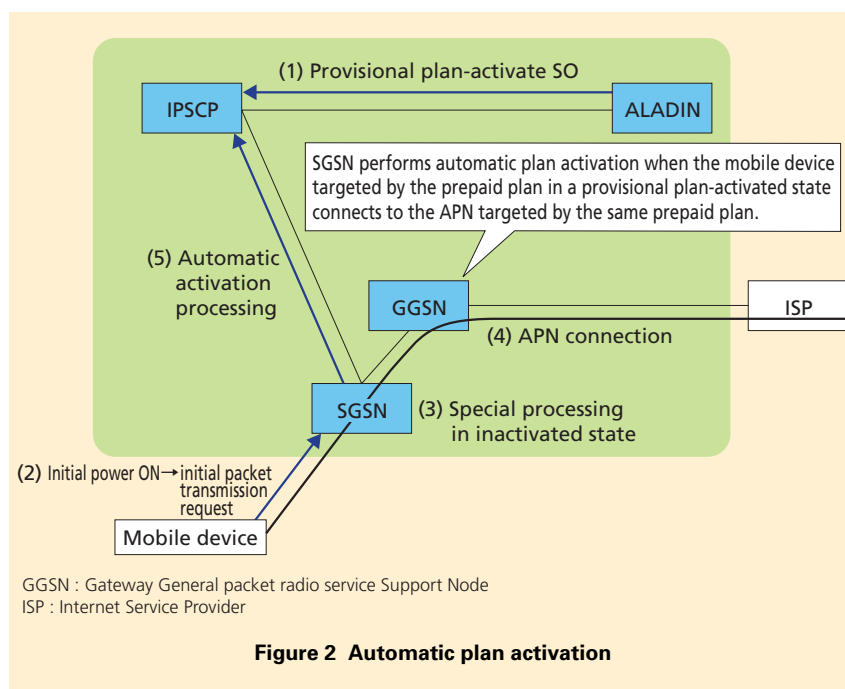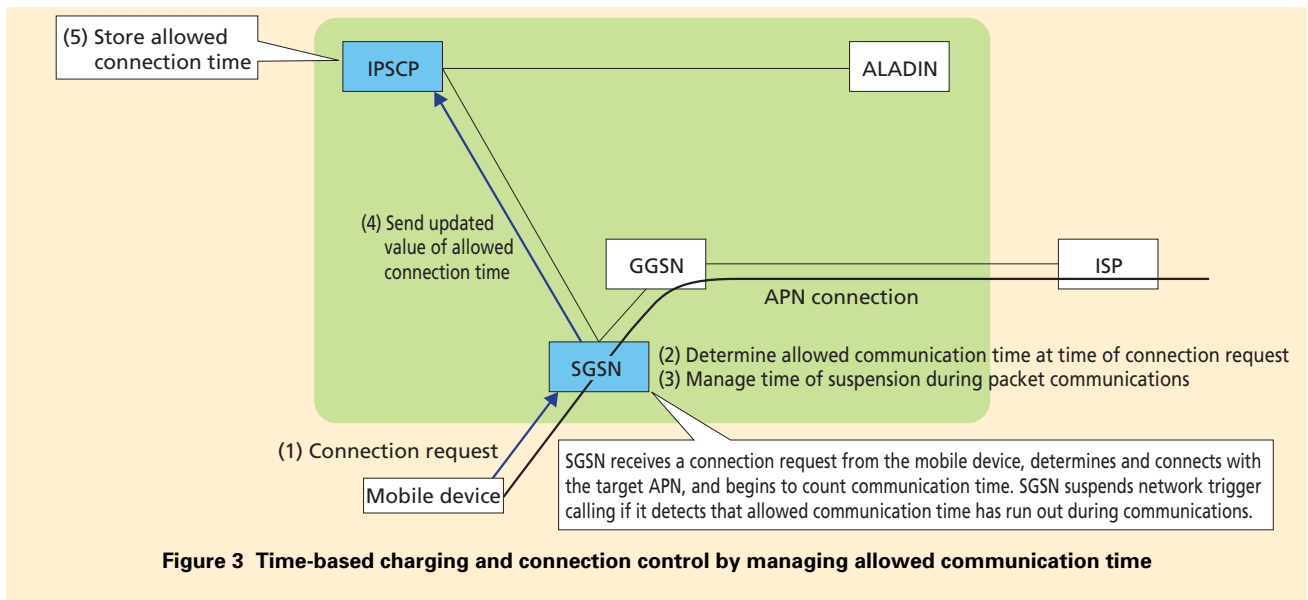

Figure 2 Automatic plan activation

(1) Provisional plan-activate SO

IPSCP

ALADIN

SGSN performs automatic plan activation when the mobile device targeted by the prepaid plan in a provisional plan-activated state connects to the APN targeted by the same prepaid plan.

(5) Automatic activation processing

GGSN

ISP

(4) APN connection

SGSN

(3) Special processing in inactivated state

(2) Initial power ON→initial packet transmission request

Mobile device

GGSN : Gateway General packet radio service Support Node
ISP : Internet Service Provider

Figure 3 Time-based charging and connection control by managing allowed communication time

at the time of a connection request and a function that can suspend communications according to allowed (remaining) communication time while packet transmission is in progress.

In the case of real-time management of allowed communication time at the IPSCP, the SGSN must access IPSCP both when communications begin and when communications terminate so that packet transmission can be allowed or denied, communication start time can be stored, and subtraction processing against allowed communication time can be performed. Such operations, however, may drive excessive traffic toward the IPSCP. Thus, with the aim of reducing traffic, the proposed method divides up functions into those that require the exchanging of signals with the IPSCP and those that do not, thereby enabling connection request processing to be completed at

the SGSN.

In more detail, both the IPSCP and SGSN store the same allowed communication time in standby state. Then, when receiving a connection request (Fig. 3(1)) from the mobile device, the SGSN determines whether it should enable packet communications based on the locally stored allowed communication time (Fig. 3(2)), and if so, saves the communication start time. There is no need to access the IPSCP at this time (**Figure 4** [I]). Later, however, the SGSN uses the occasion of a circuit cutoff (such as when detecting that allowed communication time has run out or when receiving a cutoff request from the mobile device) to subtract used communication time from allowed communication time based on the communication start time and to synchronize such information with the IPSCP (Fig. 4 [II]).

Additionally, by using a function that ties allowed communication time to an Access Point Name (APN)[*7] (connection destination), we have made it possible to manage allowed communication time over multiple APNs and to therefore support multiple APNs in accordance with service characteristics. In this way, we have provided a function that enables users to experience the outstanding features of NTT DOCOMO data communication services (**Figure 5**). We have also equipped the system with a function that treats communications with an APN used for making various types of settings as exempt from subtraction processing against allowed communication time. Thus, even if the effective period of the prepaid plan in question has expired and the mobile device is in a state with no right to packet communications, the user can still submit a contract renewal applica-

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tion via mobile communications.

Furthermore, if packet communications has been disallowed because allowed communication time has run out or the effective period has expired, the mobile device will be notified of that event and the user will be recommended to renew the contract.

5. Effective Period Processing

In addition to communication control based on allowed communication time, the proposed method also incorporates an effective period within which the user has the right to use whatever communication time remains. The use of such an effective period makes it possible to prevent a phone number from being kept in an active state even though it is not being used. This would hold true even in the case of a circuit in which time associated with the prepaid communications fee still remains due to lost opportunities of using the time granted.

Specifically, an effective period is initiated using the automatic plan activation processing described above as a starting point. Using this effective period, we have equipped the proposed method with a function for denying packet communications at SGSN when a packet transmission is attempted after the effective period has expired and a function for immediately suspending communications through interfacing between IPSCP and SGSN when the effective period expires while packet communications are in progress (**Figure 6**).
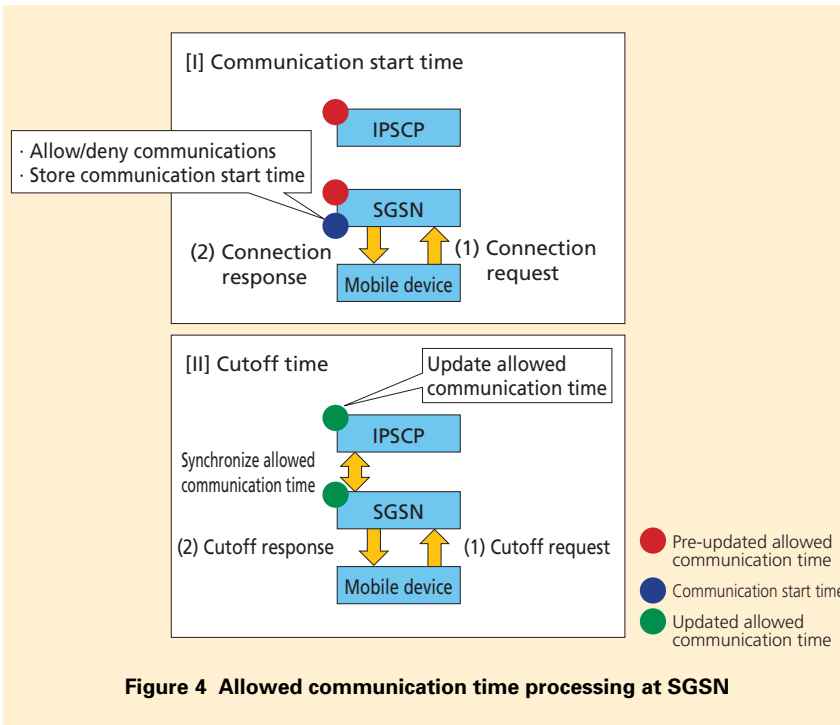

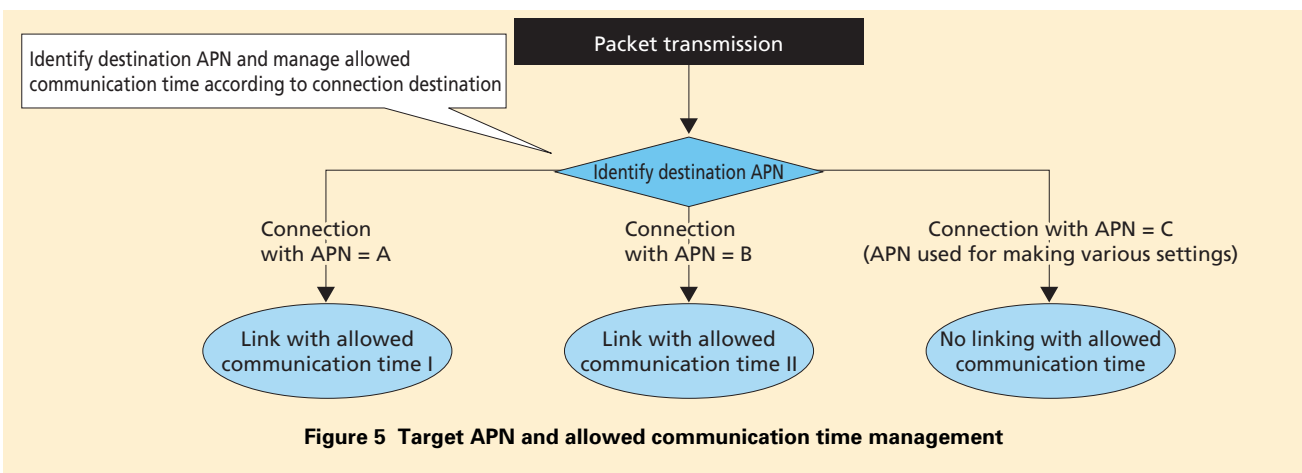**Figure 4 Allowed communication time processing at SGSN**

Figure 5 Target APN and allowed communication time management
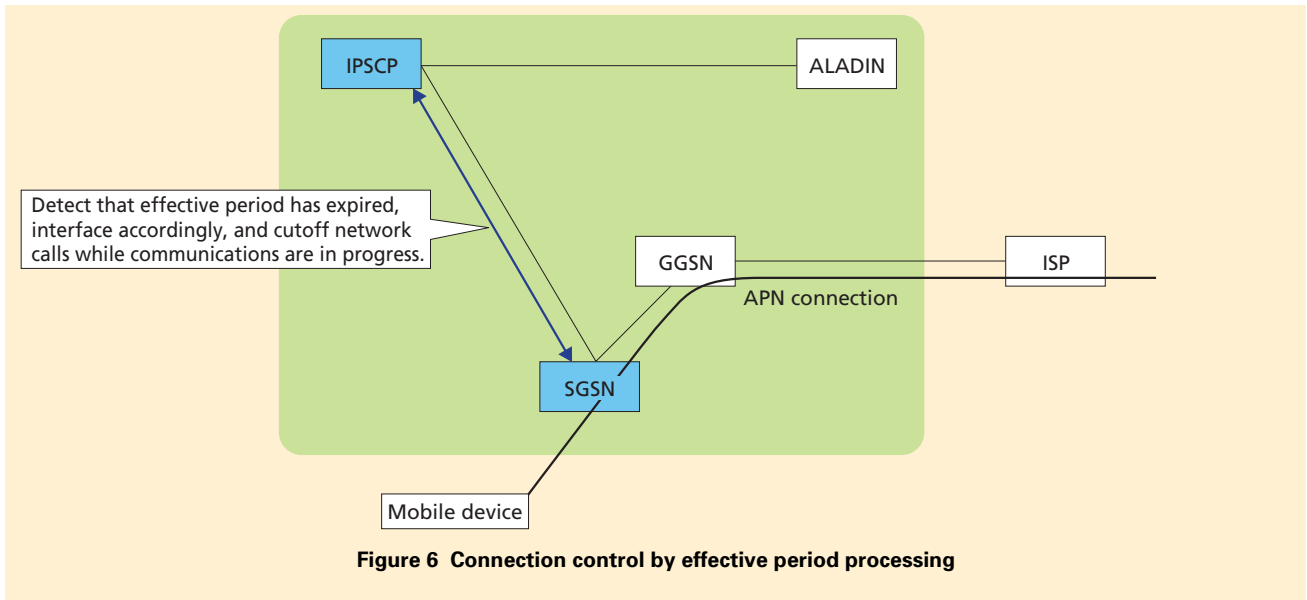
Figure 6 Connection control by effective period processing

6. Conclusion

This article provided an overview of the technologies needed to solve specific issues surrounding the expansion of NTT DOCOMO business to products with built-in communication functions.

Looking forward, NTT DOCOMO realizes that it cannot develop this market for products with built-in communication functions on its own—active collaboration with a variety of industries and operators is vital to achieving a high synergistic effect.

Collaboration with other industries will continue to present difficult issues for which no prior examples exist, but NTT DOCOMO is committed to solving those issues through ingenuity and to proposing new lifestyles making use of the best that communications has to offer.