# 移動パケット通信網における 加入者情報提供型付加サービスに関する検討

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本論文では、移動パケット通信システムにおける付加サービスの定義に基づき、それらを提供するためのシステムアーキテクチャを提示している。特に、加入者情報提供型の付加サービスに関し、その要求条件を明確にするとともに、それらを満足するために必要なアーキテクチャならびにメカニズムに関して検討した結果を報告している。

# A Supplementary Service with Subscriber Information Offering In a Mobile Packet Data Network

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In this article, based upon the general supplementary service definition, architectures of supplementary services are shown. In particular, we mainly discuss an information offering system for a mobile packet data network, in which we clarify the system requirements and show an architecture and mechanisms for the system.

## 1. INTRODUCTION

Until now, cellular systems have expanded based on mobile phone and circuit switched data services. Depending on the demand for growth of data communications services like the Internet or Intranet, the introduction of mobile packet data services, suitable for bursty data transmission, are being build or are in the planning stage. Some mobile packet data systems (MPDSs) for cellular systems have been standardized and it is envisaged that IMT-2000 systems will be constructed based on these systems. Service enhancement is an consideration issue.

In this article, we focus on the supplementary service (SS) provided by a mobile packet data network (MPDN) as one of service enhancement. Based upon the general SS definition, SS architecture is shown. In particular, we mainly discuss MPDS information offering system with the system requirements and mechanisms.

## 2. MOBILE PACKET DATA SYSTEMS

### 2.1 Overview of MPDSs

Personal Digital Cellular (PDC) is a 2nd-generation cellular system in Japan and it has more than 34 million subscribers. There are two standards for packet data services in PDC[1]. One is PDC Mobile

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Packet Data Communications system (PDC-P) and the service based on PDC-P has already commercialized in 1997[2]. The other is the Mobile-IP based system (PDC-MobileIP) which utilizes a Mobile IP protocol for the packet routing. Though the system has not implemented in PDC, a system based on the Mobile IP protocol is one of the candidate systems for IMT-2000.

Global System for Mobile communications (GSM) has already been introduced in more than 200 countries and regions, and it is the defacto-standard of the 2nd-generation cellular systems. General Packet Radio Services (GPRS)[3] is a packet system for GSM and phase 1 standardization has already completed. Universal Mobile Telecommunication System (UMTS), which is one of the IMT-2000 systems, will support packet services with the GPRS based architecture.

### 2.2 MPDS Network Architecture

The above three systems has the similar network structure and it is generally considered that the network is subdivided into two networks. One is the Core Network (CN) , which consists of serving nodes (SVNs) and gateway nodes (GWNs) for packet routing and location registers (LRs) for subscriber information management. The other is the Radio Access Network (RAN) which consists of plural Base-station Sub-Systems (BSSs) for radio resources management. MPDS users communicate with mobile hosts (MHs) through mobile terminals (MTs). The general architecture of a mobile packet data network (MPDN) is shown in Fig.1.

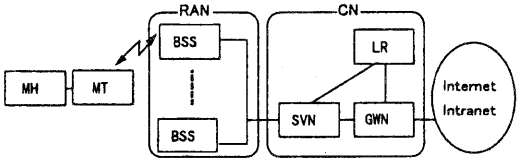


Fig.1 Architecture of an MPDN

## 3. MPDS SERVICES

In current standardization, MPDS's basic capability is mainly discussed. While supplementary services provided by a network are not fully categorized. In this section, MPDS's services are classified.

### 3.1 MPDS Basic Services

The fundamental aim of an MPDN is to provide packet transmission for an MH. The capability is realized by MPDN network- and below layer functions and the capabilities are independent of types of application, upper-layer protocols and transmitted data type. An MPDS provides the following basic services:

(1) Point-to-point communication

The point-to-point (PTP) service provides capability for transmitting packets between an MH and others. To support various types of communications such as client-server, peer-to-peer and notification,

an MPDN should support not only bi-directional packet transmission but also uni-directional transmission.

(2) point-to-multipoint communication

The point-to-multipoint (PTM) service provides capability for distributing packets from end server to appropriate MH users efficiently. In this service, a multiple distribution is initiated by a single message from a server. The message contains a group and/or location identifier in order to transmit packets to appropriate users who belong to a specific user-group and/or are in a specific geographical area.

(3) QoS control

Quality of service (QoS) controls are an important network capability to support multimedia applications. The QoS control service provides capability for utilizing QoS control procedures with end-end communications.

(4) Roaming

The roaming service provides capability for permitting an MPDS subscriber to utilize services even if the subscriber roams outsides the home MPDN. Virtual Home Environment (VHE) is an advanced concept for IMT-2000 which provides capability for offering the same service in a visited network as in the subscriber's home network. Though the VHE was originally designed for circuit switched services, it is expected to apply to an MPDN as well.

### 3.2. MPDS Supplementary Services

Today, various types of multimedia content, applications, terminals, and communication protocols are utilized in the area of data communications. MPDS basic service set is not enough to support all potential requirements from users, terminals and applications. We present three major SSs and discuss them.

(1) SS with packet transmission control

From the MPDS user's point of view, it is desirable that the user can control packet transmission depending on the user's requirements. To realize this capability, MPDS should provide services which forward and restrict packet transmission depending on a communication party, the user's state and location, types of utilizing applications, etc.

(2) SS with multimedia object manipulation

To improve the performance of communication protocols over wireless connections is also effective for MPDS users. This SS processes or converts multimedia objects appropriately to match the available bandwidth, terminal characteristics and user requirements.

(3) SS with subscriber information offering

A user application can be enhanced

by utilizing information offered by an MPDS. Such information includes location and a state of an MT, charging information, etc. Applications and hosts can make an appropriate decision prior to sending packets based on the information.

## 4. MPDN ARCHITECTURES FOR SSs

In this section, some architecture for providing SSs are shown. Considerations in each architecture are clarified.

### 4.1 Architecture for SS with Packets Transmission Control

An architecture for SS with packet transmission control is shown in Fig.2. There are two types of procedures for the SS. One is a procedure which is processed by a routing function in an SVN and/or a GWN, and it controls the whole packet transmission for a subscriber independent of types of applications. The other is a procedure which is processed by an application gateway, and it controls application-specific packet transmission for a subscriber.

Both the routing function and application gateway carry out the control procedure depending on subscriber information which indicates the subscriber's requirements for the control. The subscriber information is managed based on a subscriber identifier assigned by an MPDS. Consequently, the routing function and application gateway must access address information which manages the correspondence between the subscriber identifier and an address assigned to an MH utilized by the subscriber.

In the case that control will be carried out depending on the MT's state and/or location, a procedure for reflecting variations of these in the control process is required.

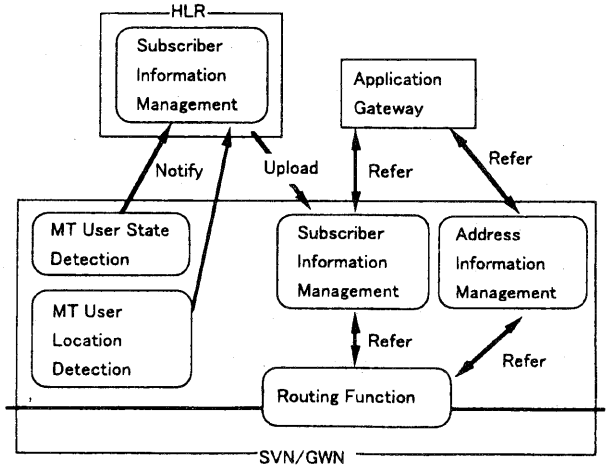


Fig.2 Architecture for SS with packet transmission control.

### 4.2 Architecture for SS with Multimedia Object Processing

An architecture for SS with multimedia object processing is shown in Fig.3. The basic architecture for the SS has already been provided in the Mobile Application Support Environment (MASE)[4]. In the MASE, the gateway server (GS) acts as a mediator between the wireless and fixed network. A multimedia object, which is acquired from a remote content server, is processed by an object processing function in the GS to match the current network bandwidth and terminal characteristics (ex. Display size). After this adaptation is performed, the processed object is transferred from the GS to the MH requesting the object.

In this case, MASE in the MH and the GS must know the current characteristics of the MH and the network. Traders act as coordinators of this characteristic information between an MH and a GS, and they guarantee the consistency of the information.

### 4.3 Architecture for SS with Subscriber Information Offering

An architecture for SS with subscriber Information offering is shown in Fig.4. To provide the SS, an application server with the following functions is needed:

(1) Access receipt function to receive access requests from applications.

(2) Information access function to access to appropriate information resources based on the request.

(3) Access control function to limit an access depending on requirements of a subscriber who will offer his information.

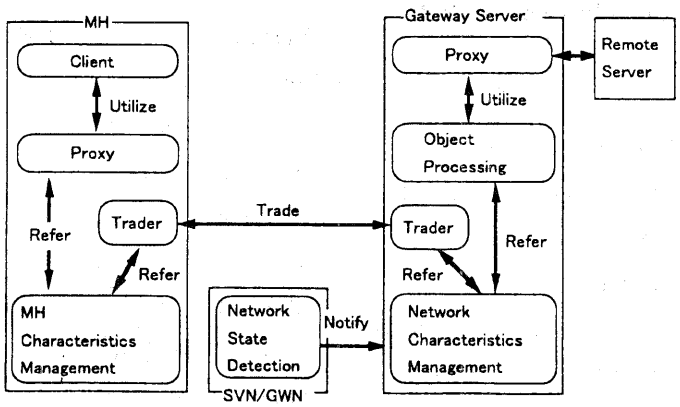


Fig.3 Architecture of SS with multimedia object processing.

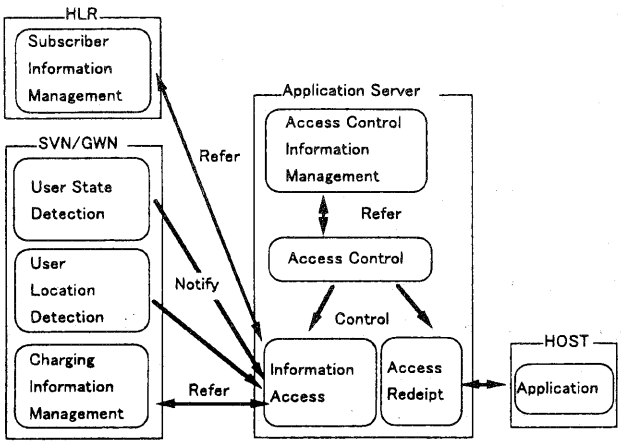


Fig.4 Architecture for SS with subscriber information offering.

## 5. MPDN-IOS

Among SSs discussed in the previous section, we focus on an MPDN subscriber information offering system (MPDN-IOS) providing capability for utilizing MPDN subscriber information (MPDN-SI) such as packet-reachability state, location information and information for charging. In the next section, the proposed architecture and procedures of the MPDN-IOS are shown.

### 5.1 System Requirements

The MPDN-IOS should meet the following requirements:

(1) Essential requirements
   a) efficient use of network resources
   b) security for offering of MPDN-SI

(2) Functional requirements
   a) support application-specific logic and processes to deal with various applications efficiently.
   b) support various types of access controls for making MPDS subscribers reflect their different needs for offering information.

### 5.2 Architecture of MPDN-IOS

The architecture of the proposed MPDN-IOS is illustrated in Fig.5. The MPDN-IOS consists of Information Offering Function (IOF) and Service Programs (SPs).

In the MPDN-IOS, each user application (UA) hoping for an MPDN-IOS service must access the system through the Each SP is managed by an individual subscriber of the MPDS, and is run within the MPDN-IOS under the responsibility of the subscriber.

The Service Programs Processing Engine (SPPE) and Service Program

Manager (SPM) are functions for the processing and management of SPs. These functions should support procedures for the acquisition, authentication, security check and running of SPs.

The main procedures built into SPs are capabilities for communicating with a UA and for accessing MPDN-IOS services. UA developers are able to put various UA-dependent functions into SPs. By introducing SPs, the MPDS-IOS have the following effects:

(1) By processing SPs on the MPDN-IOS side, efficient usage of network resources between an MPDN-IOS and a UA.

(2) By processing SPs on the MPDN-IOS side, the offering of unnecessary MPDN-SI to the UA is restricted.

(3) As an SP is administrated by its subscriber, MPDN-SI from the SP to a UA is always open to the subscriber.

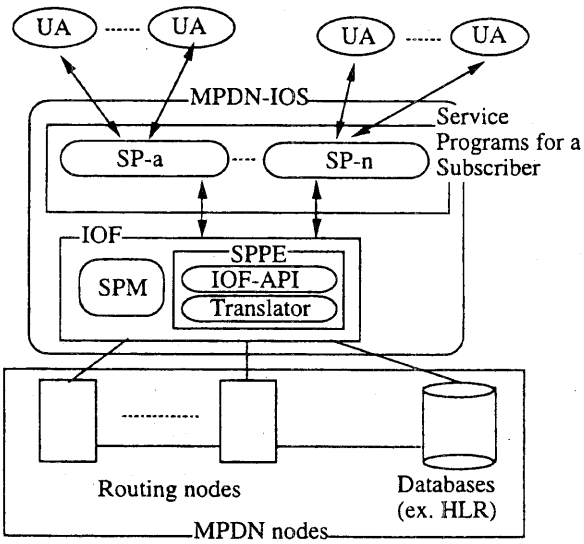


Fig. 5 Architecture of MPDN-IOS.

### 5.3 Mechanisms in the MPDN-IOS

To cope with the above functional requirements, we furthermore introduce the following two mechanisms:

#### 5.3.1 Information Offering Function APIs

In order to abstract complicated procedures for accessing MPDN nodes for acquiring MPDN-SI, an MPDN-IOS provides common interfaces by which MPDN-IOS users may access MPDN-IOS services. These interfaces are provided to UA developers as application programming interfaces (APIs). An SP loaded into the SPPE can utilize these Information Offering Function APIs (IOF-APIs) with abstract API names. A translator in the SPPE translates an IOF-API name into

appropriate commands for MPDN node accesses and also processes collected MPDN-SI into IOF information which can be utilized by SPs.

### 5.3.2 Methods for Access Control

The MPDN-IOS provides the following types of access control procedures related to an SP. By providing these access control procedures, MPDN subscribers can easily indicate their intention of offering information. It is expected that more subscribers will allow UAs to utilize their information.

(1) Access control depending on type of UA
(2) Access control depending on type of offered MPDN-SI
(3) Access control depending on specific user groups
(4) Automatic access control adaptation depending on subscriber's location and state

## 6. CONCLUSIONS

We explained and clarified MPDS services, and some types of MPDS supplementary services were defined. Basic architectures were also shown from the network function point of view. Furthermore, we proposed an MPDN-IOS which provides the capability of SS with subscriber information offering.

An experimental MPDN-IOS is under construction based on Java™. In the future, we will also construct experimental systems for providing capability for other type of SS.

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