

Special Issue on i-mode Service Network System

i-mode is DoCoMo's brand new service that enables users to get various information from i-mode server through PDC mobile packet communications system (PDC-P system) only with simple operation of a mobile browser phone.

DoCoMo has newly developed an original data transfer protocol to make i-mode data transmission more efficient and protocol conversion functions between PDC-P and i-mode server.

This paper describes leading techniques applied to the network systems to realize i-mode service.

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Introduction

i-mode is the service to get various information with mobile terminal by connecting browser installed mobile terminal with information providing i-mode server via PDC mobile packet communication system (PDC-P system). Since i-mode handles relatively small amount of data, mainly text information, and i-mode server uses generic communication protocol, we have newly developed data transmission protocol to facilitate information transaction efficiently and also developed protocol conversion function to connect PDC-P system and i-mode server.

This article explains main network technologies to realize i-mode.

Development Background

There are three major network elements to configure i-mode network; PDC-P network to provide mobile packet communication environment [1], i-mode server which provides connection with contents and manage users, and Information Provider (IP). i-mode handles relatively small amount of data in PDC-P network. We have developed new data transmission protocol specific to i-mode communication, to make packet communication fee lower by reducing overhead generated by communication protocol, and to increase communication efficiency of network. On the other hand, about i-mode server and IP connection, by considering the connection via Internet, we decided to realize the communication with generic protocol based on TCP (Transmission

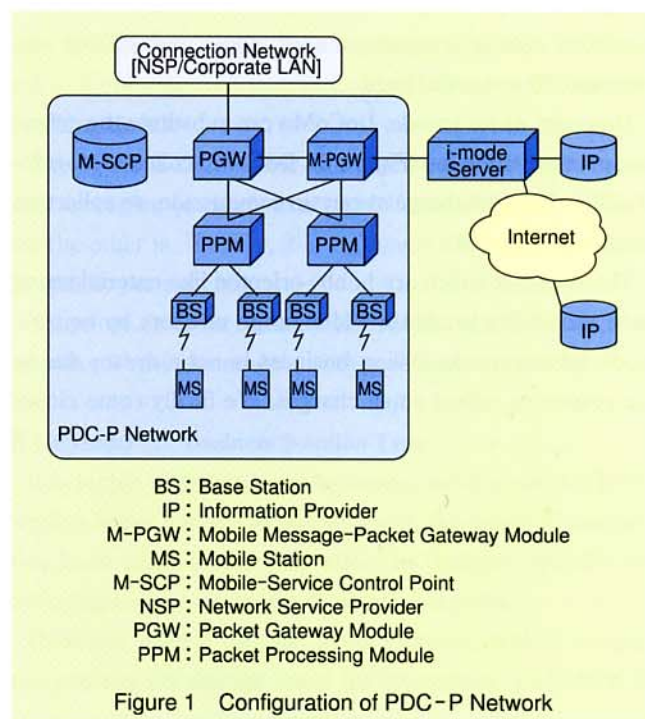
Control Protocol) / IP. Then it becomes necessary to have new function within the PDC-P network, to convert both protocols interactively. To realize this function, new node was developed as Mobile Message-Packet Gateway (M-PGW).

Function Overview

■ Network Configuration

(1) PDC-P network configuration

M-PGW is one of PDC-P network elements, which terminates communication protocols at mobile terminal and server respectively and also connects them mutually. Then i-mode



communication becomes available. Figure 1 shows PDC-P network configuration.

(2) Connection configuration between i-mode server and M-PGW

Multiple M-PGWs are installed in PDC-P network for traffic load distribution and reliability. Therefore, one i-mode server is connected with multiple M-PGWs.

On the other hand, i-mode server consists of multiple I-MAXs (Interface-Mobile Access Exchanges) [2], which have connective interface with M-PGWs directly. Like M-PGW, load distribution is considered, so each I-MAX is connected with all M-PGWs. Figure 2 shows the network configuration of i-mode server and M-PGW.

■ Connection Method

(1) Connection Method within PDC-P Network

With regards to connection between mobile station and M-PGW, by using connection destination selection function [3], the user can select connection destination when communication starts, and mobile station can be connected to several i-mode servers.

Original function of connection destination selection is that from user defined connection destination number, corresponding connection destination node number is converted and connection is established. But for i-mode service, as a method of load distribution within the network, multiple M-PGWs are set up to correspond to one connection destination number and among these M-PGWs, connection destination is selected consecutively. Then circuit connection is established [4] (Figure 3).

(2) Connection Method between M-PGW and i-mode server

Figure 4 shows the connection method between M-PGW and i-mode server. M-PGW establishes TCP connection with every corresponding I-MAX. So it is possible for M-PGW to communicate with arbitrary I-MAX. M-PGW realizes traffic load distribution toward I-MAX because mobile station selects destination I-MAX sequentially every time it has application communication.

■ Signaling System

(1) Protocol stack

Figure 5 shows the protocol stack of i-mode and packet communication service (DoPa*). The major difference between them is that i-mode uses newly developed TLP (Transport Layer Protocol). DoPa uses PPP, which has data link layer function in higher network bearer. On the other hand, i-mode uses simplified protocol stack and applies TLP,

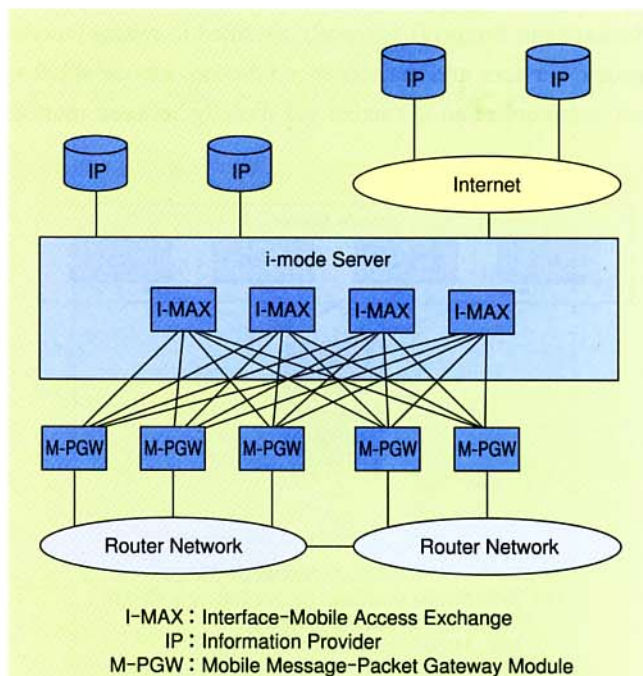


Figure 2 Network Configuration of i-mode Server and M-PGW

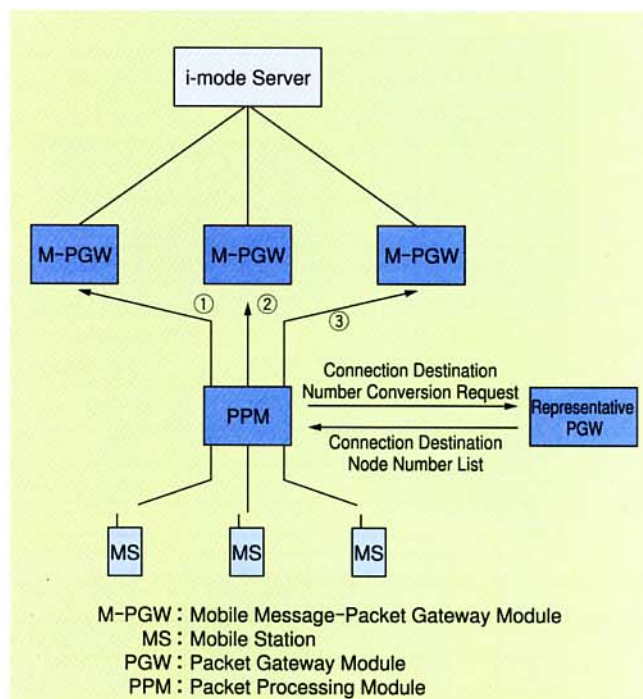


Figure 3 Connection Method between PPM and M-PGW

which has transport layer function in higher bearer, to reduce control data overhead and have efficient communication.

Also between M-PGW and i-mode server, UITP (User Information Transfer Protocol) and NWMP (Network

* DoPa : the service to connect data terminal with external network as Internet or corporate LAN via PDC-P network with PPP. Launched from March 1997.

Management Protocol) are newly specified to realize i-mode specific services and maintenance function. i-mode application communication is carried out directly between mobile

station and i-mode server with HTTP (Hyper Text Transfer Protocol). PDC-P network itself does not care its contents.

(2) Transmission protocol between mobile station and M-PGW

i-mode handles mainly text communication. This means handling data amount is relatively small. Under this environment, if you use generic transfer protocol, there is a concern to deteriorate communication efficiency according to the higher control signal ratio against user data signal. That is why newly developed TLP is used as transfer protocol within PDC-P network. TLP has simpler negotiation procedure and can contain control signal and user data together. So efficient data transfer is possible with fewer signals.

(3) Signaling system between M-PGW and i-mode server

① User Information Transfer Protocol (UITP)

i-mode server does user management with telephone number (MSN : Mobile Subscriber Number). However, the application communication between mobile station and i-mode server (or contents server) uses HTTP, generic

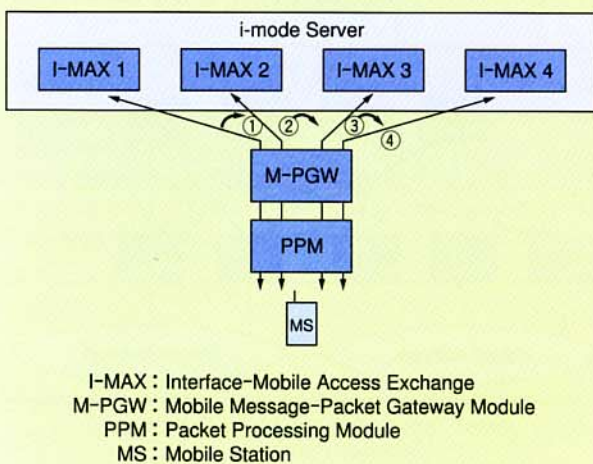
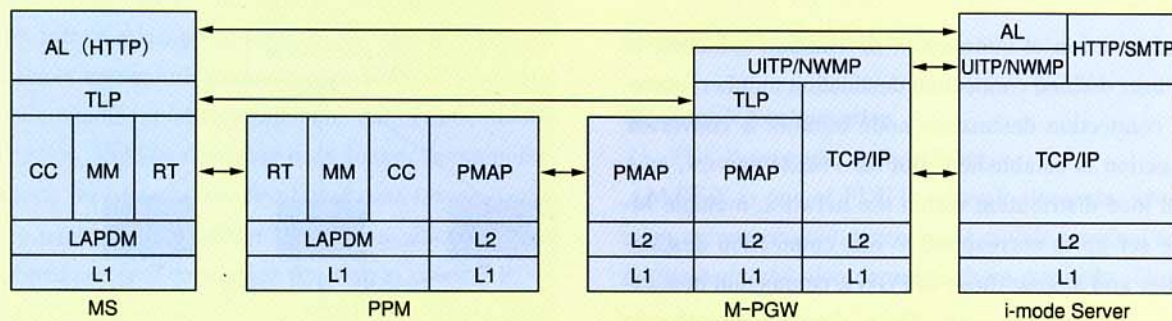
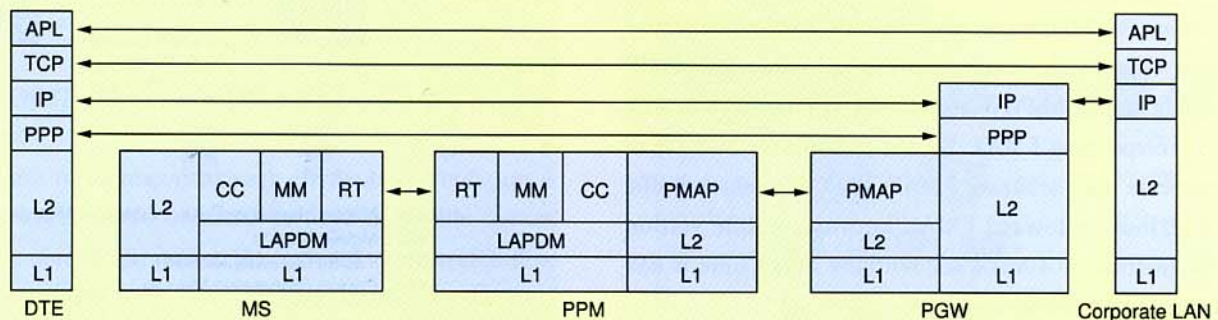


Figure 4 Circuit Selection Method between M-PGW and i-mode Server



(a) Protocol Stack of i-mode



(b) Protocol Stack of DoPa

APL : Application Layer
CC : Call Control
DTE : Data Terminal Equipment
HTTP : Hyper Text Transfer Protocol
IP : Information Provider
L1 : Layer1 (Physical Layer Protocol)
L2 : Layer2 (Data Link Layer Protocol)
MM : Mobility Management
MS : Mobile Station

NWMP : Network Management Protocol
PGW : Packet Gateway Module
PMAP : Packet Mobile Application Part
PPM : Packet Processing Module
PPP : Point to Point Protocol
RT : Radio Frequency Transmission Management
TCP : Transmission Control Protocol
TLP : Transfer Layer Protocol
UITP : User Information Transfer Protocol

Figure 5 Protocol Stack

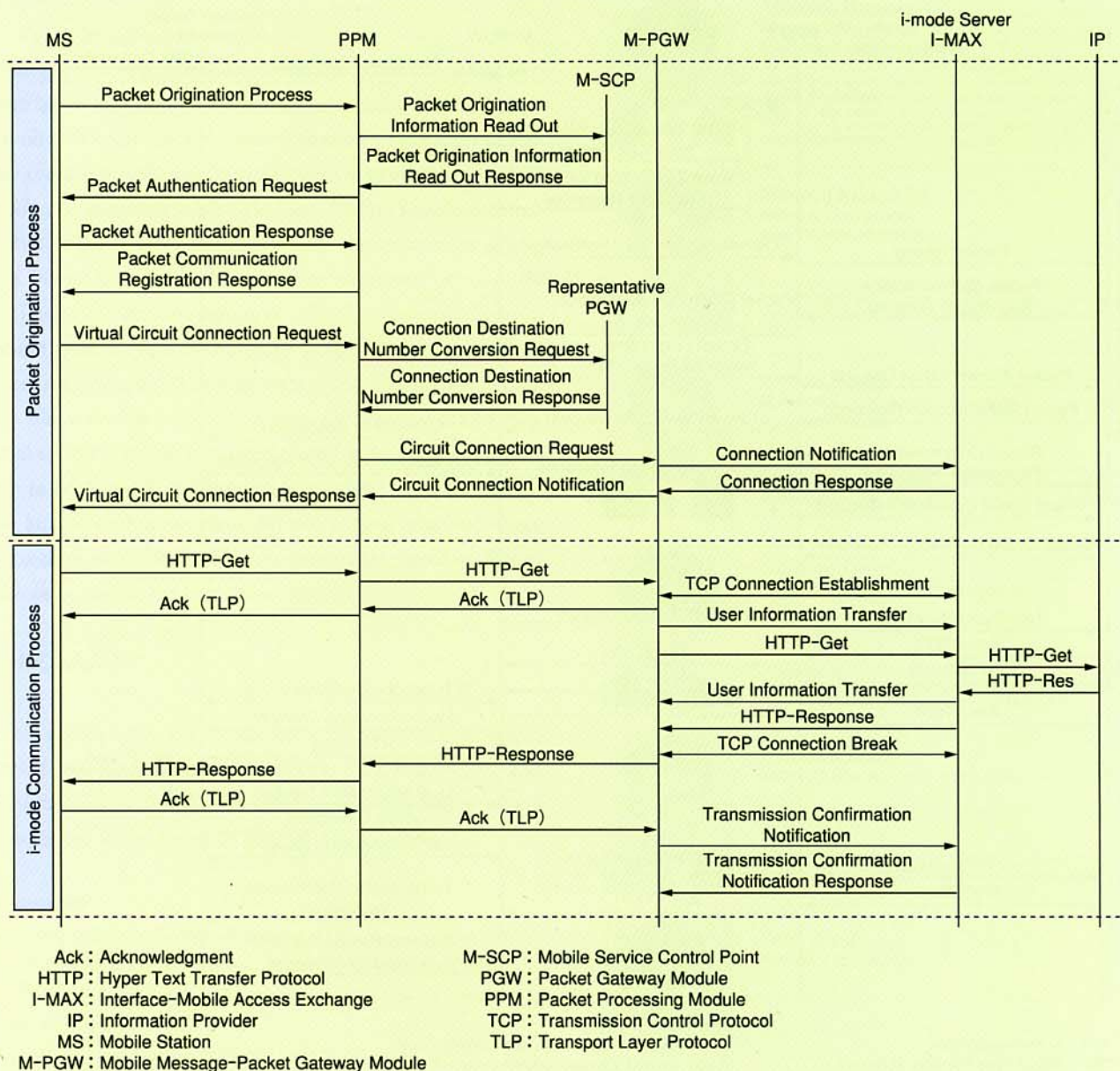


Figure 6 Sequence for Pull Type Services

communication protocol. So it is impossible to set up information such as MSN. Then UTP is newly specified between M-PGW and i-mode server and M-PGW sends subscriber information like MSN to i-mode server. From i-mode server, charging type or delivery confirmation request etc. are notified to M-PGW.

② Network Management Protocol (NWMP)

NWMP is specified to realize i-mode service function and maintenance function. There are signals for services like termination notification signal, with which i-mode server notifies PDC-P network about message delivery as e-mail, or connection notification signal, which tells packet communication status between mobile station and M-PGW

to i-mode server. As maintenance signal, there are circuit status management signal or connection test signal etc. between M-PGW and I-MAX.

■ i-mode Network Function

Information transfer between mobile station and contents server realizes i-mode service by using generic protocol HTTP. To provide this service as satisfactory network service, adequate network functions were also developed. Followings are the network functions equipped as M-PGW functions and realized with UTP and NWMP.

(1) Termination notification function

This is the function to notify message, such as e-mail, ter-

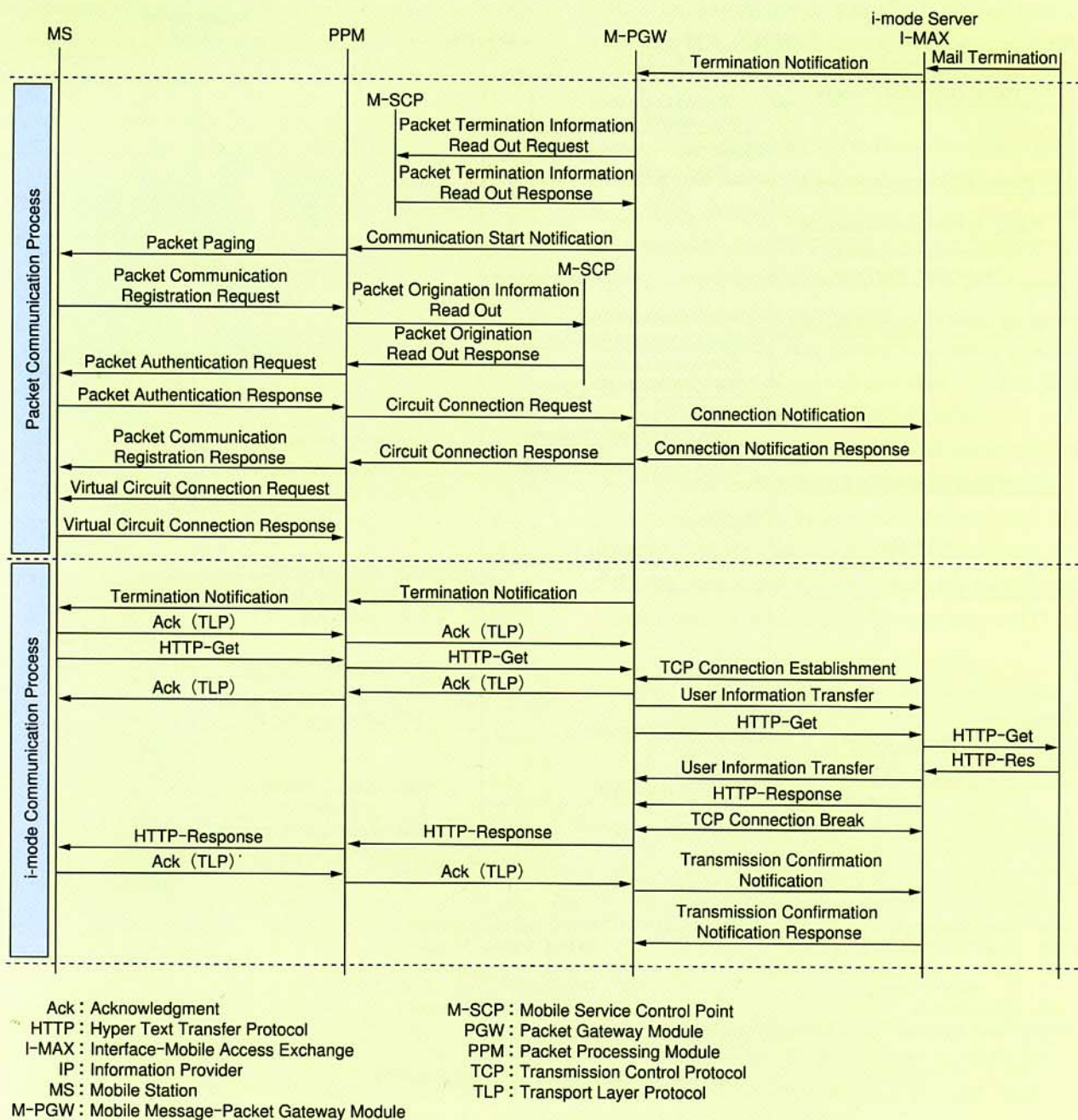


Figure 7 Sequence for Push Type Services

mination to mobile station. With the reception of message, i-mode server sends termination notification signal to M-PGW and M-PGW uses packet termination function of PDC-P system and selects circuit to have connection with mobile station and sends termination notification signal to mobile station.

(2) Connection notification function

This is the function to notify the start/end of packet communication by the user to i-mode server. When i-mode server sends termination notification signal, it confirms packet

communication status. When the user is during the communication, i-mode server sends the signal to corresponding M-PGW.

(3) Delivery confirmation function

When M-PGW receives data from i-mode server, this function tells i-mode server that data is correctly transferred to the mobile station. When i-mode server sends data to mobile station, it requests delivery confirmation against M-PGW. Then M-PGW performs delivery confirmation and reports the result to i-mode server.

■ Sequence Example

(1) Pull type service sequence

Pull type service is that user does operation according to i-mode menu and gets information. By pressing i-mode button of mobile station, packet communication origination procedure (connection destination selection) is executed, and then i-mode communication is carried out. During i-mode communication, PDC-P network repeats user packet transfer procedure. Figure 6 shows Pull type service sequence.

(2) Push type service sequence

Push type service is that with i-mode server activation, packet is terminated at mobile station and information is notified. When i-mode server transmits termination notification signal to M-PGW, packet communication termination procedure is performed and termination information is notified with i-mode communication. Mobile station gets necessary information according to the termination information. Figure 7 shows sequence for Push type services.

Conclusion

This article explains i-mode network system; connection method and signalling system within PDC-P network, and inter i-mode server signalling system. Network functions will be enhanced in the future to improve i-mode service.

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