

PushTalk Service System

Naomasa Yoshida, Masaharu Nakagawa,

Makoto Nakayama, Youhei Ikai,

Miya Matsuda and Masanobu Yamagiwa

We have developed a system for providing the PushTalk service, which allows mobile terminals to be used for walkie-talkie-like half-duplex communication.

1. Introduction

The FOMA PushTalk service, which is expected to serve as a new communication tool in addition to voice and video communication, is now available.

FOMA voice communication until now has focused on one-to-one communication typified by circuit switching and data communication services have been provided with packet switching.

In contrast to that, the basic half-duplex one-to-many communication implemented by the PushTalk service enables only the single user who is pressing the call button at the moment to talk to multiple other users simultaneously. The PushTalk service adopts a best-effort packet switching voice service rather than circuit switching. In addition, multiplexing data and voice in the same packet circuit makes it possible to check the presence information, which indicates the call origination authorization status of the user, while a conversation is taking place.

We describe the architecture and functions for providing the PushTalk service, and explain the control methods.

2. Provision Conditions

The PushTalk service provides two service menus defined on the following two concepts depending on the target user.

1) Consumer Service Concept

Provide a new communication tool that allows the PushTalk service to be used freely.

2) Business-oriented Service Concept

In addition to the Consumer service, user group management, presence registration, browsing and other solutions that allow full use of the PushTalk service on a network are provided.

The detailed service provision conditions at the time the service begins are listed in **Table 1**.

3. PushTalk Implementation Method

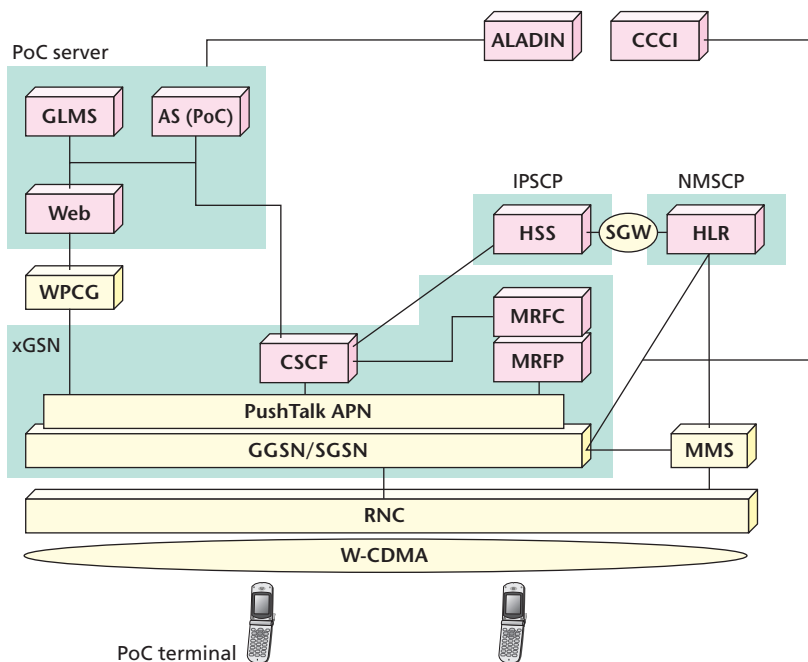
3.1 System Architecture

In implementing PushTalk, we adopted IP Multimedia Subsystem (IMS) functions. IMS is a platform for providing Internet Protocol (IP) multimedia services, including the voice via packet switching that is standardized by the 3rd Generation Partnership Project (3GPP). Future extension as an IP control platform that is independent of the access bearer is also expected. The network configuration and main functions of the

PushTalk service are shown in **Figure 1**. Session Initiation Protocol (SIP) call control and transmission control is assigned to the serving/gateway General packet radio service Support Node (xGSN), subscriber information management is assigned to the IP Service Control Point (IPSCP) and New Mobile Service Control Point (NMSCP), and the application functions are assigned to the Push-to-talk over Cellular (PoC) server and xGSN. The PoC server provides member and group list management and network phone book functions as the application functions for implementing PushTalk. The Media Resource

Table 1 Service provision conditions

		Consumer service	Business-oriented service
Form of provision		Basic service	Optional contract service
1-to-1 communication			
1-to-N communication (Maximum number of simultaneous calls, including the caller)		(5 persons)	(20 persons)
Group list management		Mobile terminal	Mobile terminal Network (network phone book)
Network phone book Group list editing and browsing from a PC/mobile terminal on the network		-	200 group maximum 1,000 person registration/contract 20 persons per group maximum
Presence	Presence during a call		
	User registration presence	-	
Target mobile terminal		902i	902i



Function block	Main functions	
CSCF	<ul style="list-style-type: none"> SIP registration SIP transmission (PoC call control) SIP application allocation PoC incoming call request (SMS Push) 	
MRFC	<ul style="list-style-type: none"> SIP termination and PoC call control (B2BUA control) MRFP control Call origination authority charges control 	
MRFP	<ul style="list-style-type: none"> Call origination authority management control Packet copying control 	
HSS HLR	Subscriber information management	
PoC server	AS (PoC)	<ul style="list-style-type: none"> Group ID management Network phone book Presence query, notification
	Web	Web customer control I/F
	GLMS	Member and group list management

ALADIN: ALI Around DoCoMo Information systems
 APN: Access Point Name
 CCCI: Customer CDR Collector for IMT2000
 GGSN: Gateway General packet radio service Support Node
 MMS: Mobile Multimedia switching System

RNC: Radio Network Controller
 SGSN: Serving General packet radio service Support Node
 SGW: Signaling GateWay
 WPCG: Wireless Protocol Conversion Gateway

Figure 1 Network configuration and main functions

Function Controller (MRFC) and Media Resource Function Processor (MRFP) executes PoC call control, packet copying control and call origination authority management control. The MRFC/MRFP receives the SIP request sent from the originating mobile terminal via the Call Session Control Function (CSCF), serving as the User Agent Server (UAS), and sends the SIP request as the User Agent Client (UAC) of the receiving mobile terminal. This operation is called Back-to-Back User Agent (B2BUA) processing and has the function of linking UAS and UAC.

At the IMS, SIP is used as the call control protocol. An overview of SIP control in the CSCF is shown in **Figure 2**. When a SIP message that was sent from a mobile terminal is received at the CSCF responsible for SIP call control in the network, the CSCF assigns processing to the various Application Servers (AS) based on the information downloaded from the Home Subscriber Server (HSS) that manages the subscriber information. This facilitates service expansion by localizing service-dependent processing to the AS.

3.2 Protocols

PushTalk implements over Transmission Control Protocol (TCP) or User Datagram Protocol (UDP)/IP various application protocols that have already been specified in standards such as IMS. SIP is used for call control and presence provision protocol during communication, which indicates user PushTalk participation status, etc. Real-time Transport Protocol (RTP) serves as the voice transmission protocol and RTP Control Protocol

(RTCP) is used for the call origination authority control that is required for half-duplex communication. In addition, a Web-based network phone book function is provided as a Business-oriented service, and the Hyper Text Transfer Protocol (HTTP) that is adopted in i-mode communication is used to provide that function.

3.3 Mobile Terminal System Configuration

The system configuration of a mobile terminal equipped with the PushTalk function is shown in **Figure 3**.

The core module for handling the PushTalk application processing is the PoC Engine that we have developed. The PoC Library executes call control, presence information control, call origination authority control, voice encoding and decoding and other such processing. Furthermore, when it is necessary to transmit data from a mobile terminal to the network and receive data at a mobile terminal from the network, the PoC Library implements that function by controlling the SIP, RTP, and RTCP protocol stack. Toolkit abstracts the services provided by the PoC Library that can be easily accessed with a Graphical User Interface (GUI).

Furthermore, this service is very easily-accessed by using a exclusive PushTalk button on the mobile terminal. That button is used to start up the PushTalk phone book or a dedicated PushTalk browser and to make a PushTalk call or to execute call origination authority control during a PushTalk session.

When call origination authority is obtained, the PoC Library activates the Digital Signal Processor (DSP) to convert the

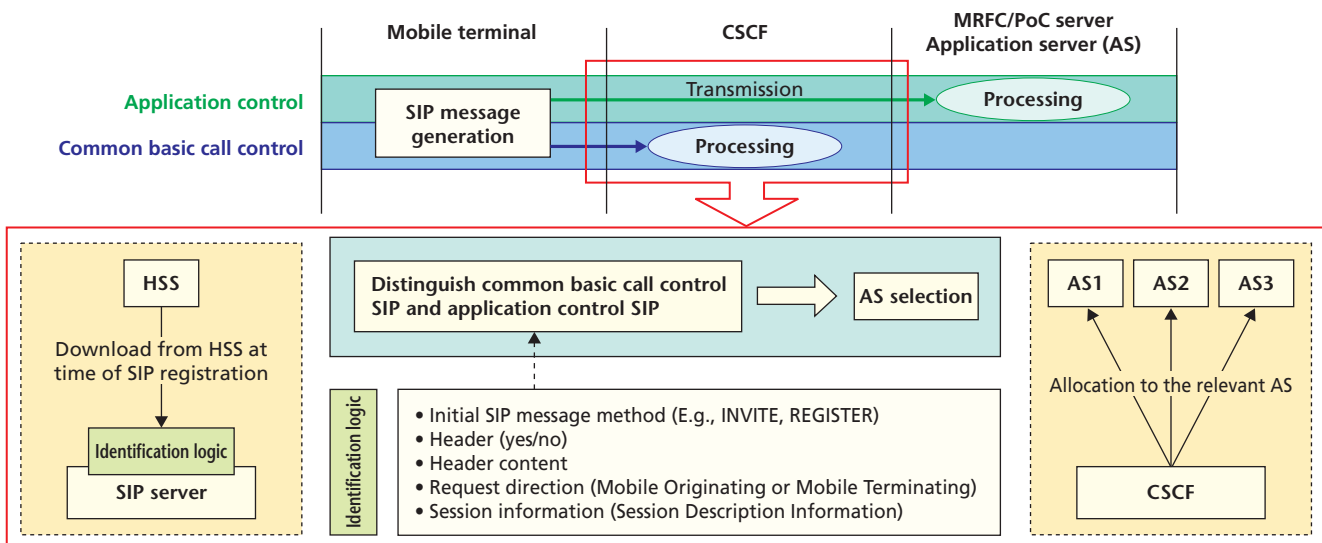


Figure 2 Overview of SIP control

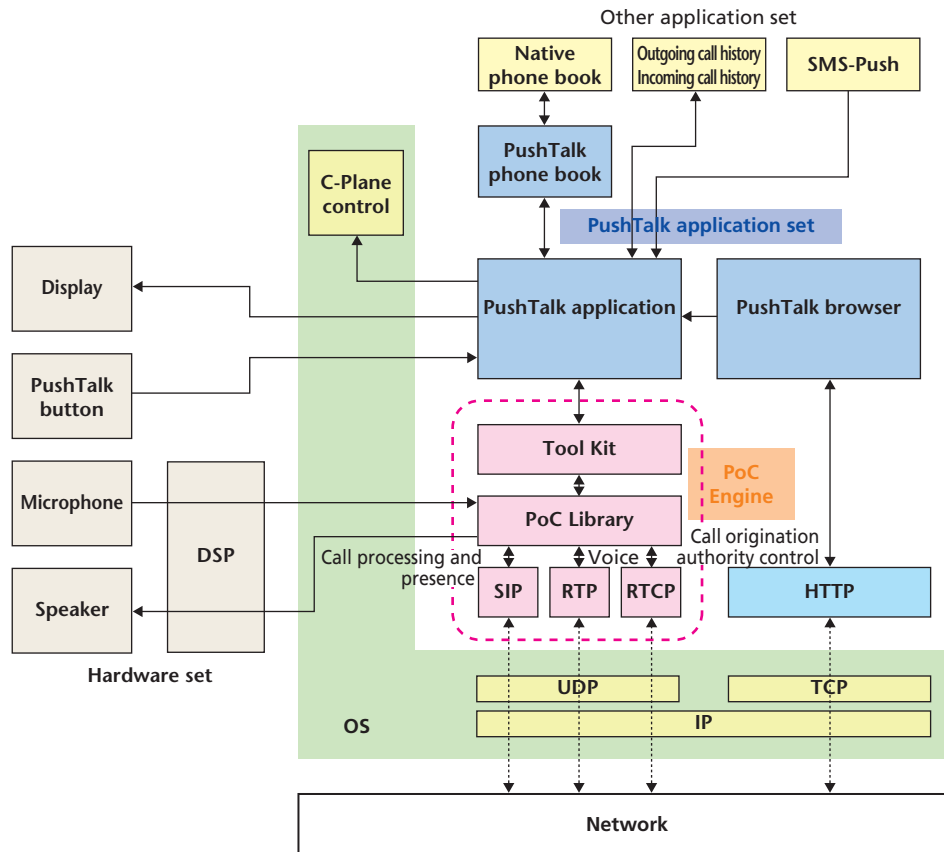


Figure 3 System configuration of the PushTalk function mobile terminal

voice input from the microphone to Advanced Multi Rate CODEC (AMR) data to be sent sequentially in RTP packet format to the network. When the RTP packets that contain the AMR data received from the network arrive at the terminating mobile terminal, the data is passed to the DSP for AMR data decoding and voice reproduction by a speaker.

PushTalk-capable mobile terminals also have a dedicated PushTalk browser that allows the user to access servers set up within the DoCoMo network to use network phone books.

4. Implemented Functions

4.1 Call Origination / Termination Control

PushTalk allows the user to make a call with a simple operation. The process is shown in **Figure 4**. After entering a phone number in the same way as with voice or video phone communication, or selecting another party from a mobile terminal phone book (native phone book or PushTalk phone book), network phone book, outgoing call history or incoming call history, the user presses the PushTalk button to execute call processing. At that time, the phone number is converted within the mobile terminal to the user address SIP Uniform Resource

Identifier (URI) used in PushTalk. In this way, there is no need for the user to be aware of a new PushTalk-specific ID. After the button is pressed, the mobile terminal first establishes a packet bearer session. It then uses the SIP REGISTER method to authenticate the CSCF and performs network registration. At this stage, the originating mobile terminal becomes able to make a PushTalk call and sends a SIP INVITE method to the network. The INVITE method is sent from the CSCF to the AS (PoC server). After checking that the maximum number of group members has not been exceeded and executing authentication processing, the method is sent to the MRFC. The MRFC that receives the INVITE reserves MRFP resources and sends the INVITE method for the terminating mobile terminal to the CSCF.

In one-to-many communication, the MRFC generates multiple INVITE methods and sends them to the users, thus allowing simultaneous reception by multiple mobile terminals. The CSCF queries the HSS for the terminating side user status and whether or not the terminating mobile terminal is registered with the network; if the terminating mobile terminal is not registered in the network, the CSCF sends a Short Message Service

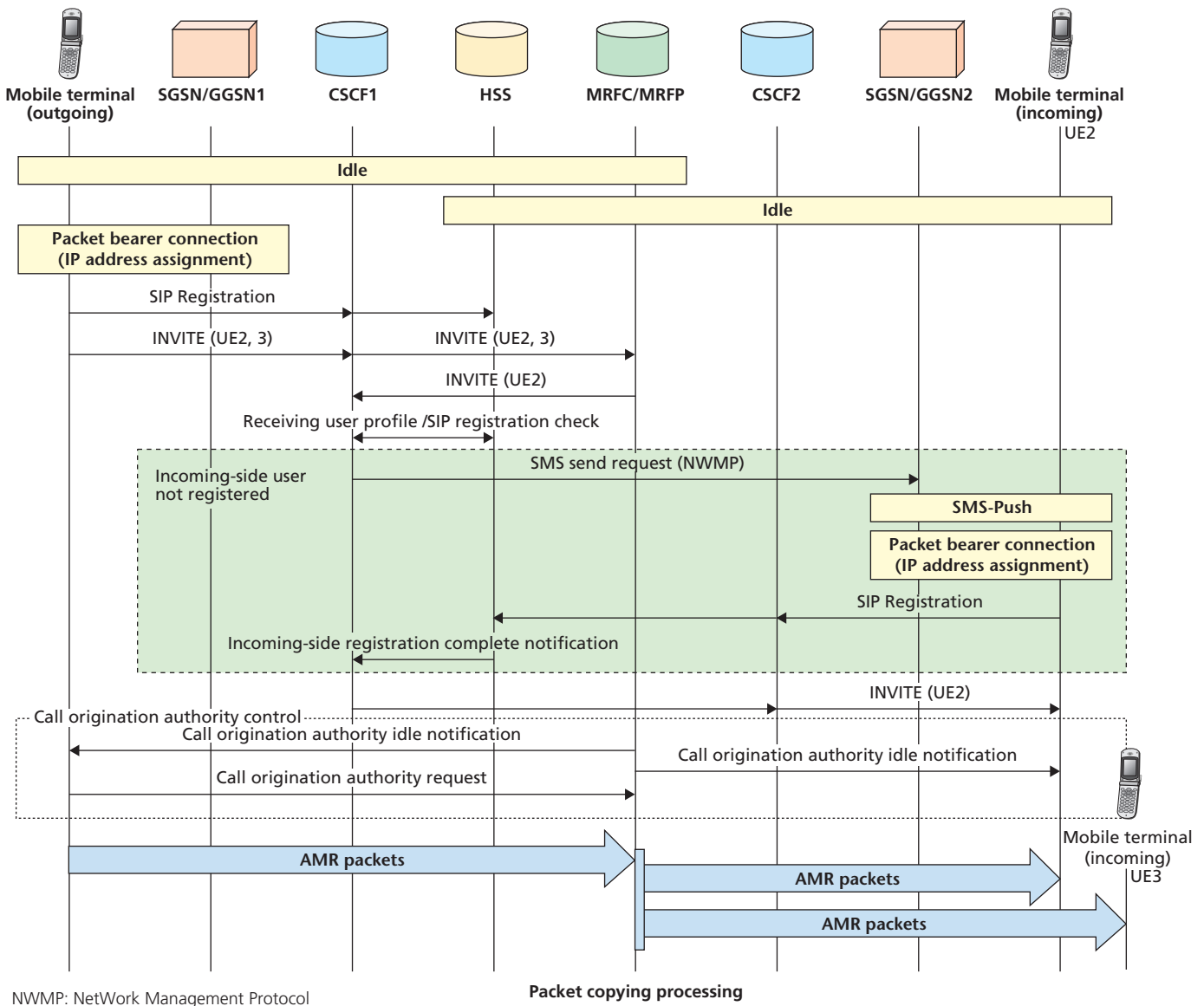


Figure 4 PushTalk call origination / termination processing

(SMS) Push to urge network registration of the terminating mobile terminal. In the PushTalk service, the receiving of calls is enabled even if the receiving terminal is in the idle state (no packet session has been established), taking the viewpoint of securing network resources under the assumption of simultaneous mutual mirroring with other services and accommodation of all DoCoMo users. After network registration, the terminating mobile terminal establishes the PushTalk session by responding to the received INVITE method.

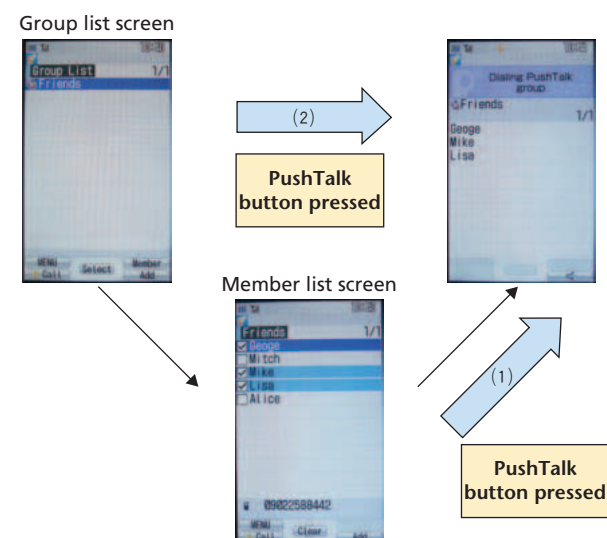
1) Mobile Terminal Phone Book Calls

A PushTalk call can also be made from the existing phone book of the mobile terminal (native phone book), but it is not possible to select multiple recipients in that case. For that reason, PushTalk mobile terminals have a special PushTalk phone

book in addition to the terminal's native phone book.

The PushTalk phone book includes two display screens, one for a member list and one for a group list (Figure 5). The member list is used to select the members to be called individually. It displays a list of all of the members that are registered in the PushTalk phone book. In this screen, there is a checkbox next to each member entry for selecting that member. Multiple members can be selected at the same time, making it possible to call the selected members simultaneously (Fig. 5 (1)). In addition, the group list can be used to call a previously registered group of users. By specifying a group, a call can be made to all of the members of that group without having to specify each member individually (Fig. 5 (2)).

2) Network Phone Book Calls



*The names in the terminal screen shown above are fictional and used for example only.

Figure 5 PushTalk phone book screen images

Corporate users require functions for large-scale group communication and sharing groups among users. Therefore, the Business-oriented service provides, in addition to the PushTalk phone book, a network phone book function for unified management of information over a network.

When calls are made from the network phone book, up to 20 persons that belong to a group, including the caller, can communicate with each other. That is more than is possible with the Consumer service.

The screen display at the time a call is made from the network phone book shows the names of the persons who are registered in the network phone book, regardless of what names are registered in the mobile terminal phone book. It is thus possible to display the names of the persons involved in the communication without registering the names in the mobile terminal phone book in advance. The network phone book function is described in detail in Section 4.4.

4.2 Call Origination Authority Control and Packet Copy Control

By operating the PushTalk button of the mobile terminal, the RTCP call origination authority control is executed. Only the user who is pressing the PushTalk button at the time is given call origination authority and the voice data is sent from the mobile terminal to the MRFP by RTP. The MRFP copies the received voice data on the IP layer and distributes it to the other members, thus accomplishing one-to-many communication.

When a particular user has call origination authority and another user requests that authority, a request denied signal is sent from the MRFP to the requesting user, and limiting call origination authority to one user at a time. When a particular user has held the call origination authority for a certain length of time, that user is notified with a release warning sound and the call origination authority is subsequently withdrawn to prevent one user's exclusive possession of the call origination authority.

4.3 Re-entry Control

When a call is made from the call history, the AS (PoC server) checks the PushTalk session, and if the session is continuing, it reconnects to that session. This process is called session re-entry.

In mobile communication, it may happen that a receiving participant in a PushTalk session unintentionally withdraws from a session because their call is dropped due to a weak wireless signal or other such reason. A re-entry control function is required to allow such users to re-join the on-going PushTalk session.

In the case of the incoming and outgoing call history for voice and video phone, only the other party's phone number, the call date and time, and whether or not number notification is enabled is recorded. For the PushTalk service, however, a unique ID that is sent to the mobile terminal from the PoC server is added to that recorded information. The ID uniquely specifies the PushTalk session, making re-entry possible. When a call is made from the incoming or outgoing call history of the mobile terminal, the mobile terminal sends this ID along with the associated member list.

The PoC server that receives the ID from the mobile terminal first determines whether or not that ID identifies a PushTalk session that is currently in progress and then determines whether or not there is a change in the members participating in the PushTalk session. If the session is in progress and there is no member change, a positive authentication result response is sent to the CSCF. The CSCF that has received the response connects the mobile terminal to the communication session, thus completing the re-entry. Furthermore, even if that PushTalk session has ended temporarily, it is handled as a new originating call and a new call is made to the members who were participating in that PushTalk session. This scheme is used in response to the user need that users who want to re-entry "want to speak with users who were engaged in a call."

4.4 Network Phone Book Function

1) Web Management Function

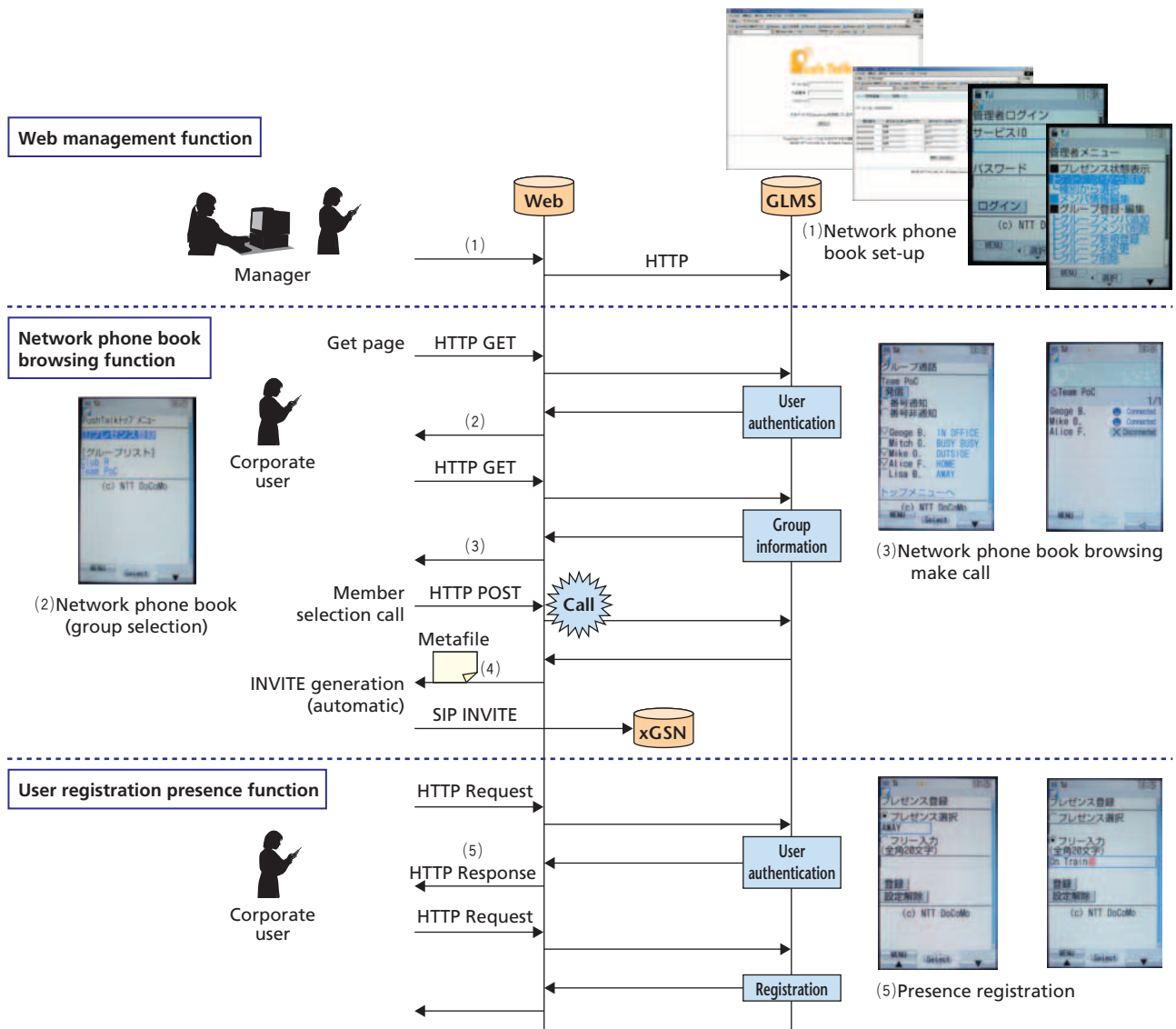
The network phone book is created by the Web server in HTML format, and the setting of the manager's display name, the creation of groups, the addition or deletion of group members, presence classification and other such tasks are done in advance via the Internet (Figure 6 (1)). Considering user convenience, that operation can be performed from a mobile terminal as well as from a personal computer. It is also possible to specify additional managers who can perform this operation as needed.

In addition to making these kinds of network phone book settings, the manager of the corporate users can also check the presence status of all of the group members by group or by a list

of users sorted by presence. This allows the manager to accomplish unified management of the status of company members who are out of the office and so on, thus improving the working efficiency of corporations.

2) Network Phone Book Browsing Function

The network phone book is viewed with a dedicated PushTalk browser by selecting a network connection from the PushTalk menu of the mobile terminal. User authentication is then executed on the server side and only the groups to which the user belongs are displayed (Fig. 6 (2)). Browsing the groups to which he or she belongs, the user can select the group to call and then obtain the group information from the servers. The user can then check the group member presence status, etc., and select the group members (Fig. 6 (3)).



*The names in the terminal screen shown above are fictional and for example only.
 **This function is provided only in Japanese at present.

Figure 6 Network phone book function

When the calling operation is performed, information on the members selected for the call and whether or not number notification is enabled are sent to the Group List Management Server (GLMS) by the HTTP POST method via the Web server. The metafile required for making a call is then returned from the server side to the originating mobile terminal (Fig. 6 (4)). This metafile is in text format and includes the group ID, the group name, a time stamp, the names and addresses of the called parties, whether or not number notification is enabled and other such information that is required for call origination processing. A mobile terminal that has received the metafile uses the information in the metafile to generate an SIP INVITE method and make the call.

3) User Registration Presence Function

When a user connects to the network phone book and selects presence registration, user authentication is performed on the server side and the presence status information that has previously been set is displayed (Fig. 6 (5)). Two methods of presence registration are available. One is selection of a presence class from those that have been pre-set by the user manager; the other is free entry by each user.

With this function, the presence classes can be customized for each company or each user, making services similar to a bulletin board or message board possible.

4.5 Contention with Optional Services

1) Calling Number Notification

The PushTalk service provides a function for protecting user privacy by allowing the caller or group members to select whether the number notification function is enabled or not enabled for communicating members. The setting for calling number notification can be done with the mobile terminal or the Web screen network phone book settings, corresponding to calls made from the mobile terminal phone book and calls made from the network phone book. For calls made from the mobile terminal phone book, the mobile terminal settings and the user selection at the time the call is made have priority; for calls made from the network phone book, the settings made with the Web screen have priority.

2) Drive Mode

In the same way as for existing services, when the drive mode is set at the time of PushTalk incoming call processing, suppression control for the incoming call sound is executed when the SIP INVITE method is received. Also, in the

PushTalk service, the fact that the device is in operation can be sent as presence information to the originating mobile terminal and to participating members during group communication by sending an error code that is assigned specially to the drive mode in the SIP acknowledgement.

3) Processing related to FOMA Circuit Switching Optional Services

The PushTalk service allows cooperation with some of the FOMA circuit switching optional services.

As an originating side user service, restriction process is implemented among the multi-number settings that provide additional number call originating and terminating functions in voice communication; as a terminating side user service, providing services that reflect user needs by the sharing of settings between the incoming call rejection list of annoying call blocking service and the calling ID service. This function is implemented by a query performed by the HSS, which manages the IMS subscriber information, to the Home Location Register (HLR), which manages the circuit switching optional service profile at the time of incoming call processing.

4) Control During i-mode Communication

It is possible to set whether or not the mobile terminal will accept PushTalk calls during i-mode communication. When this setting is for priority on i-mode, the PushTalk incoming call operation is not executed and the i-mode communication continues.

When the setting is for PushTalk incoming call priority, the i-mode communication is terminated (i.e., the i-mode communication packet bearer is released) at the time the SMS Push for PushTalk call termination is received and the procedure up to the PushTalk incoming call operation is executed automatically.

5. Conclusion

We have presented an overview of the PushTalk service and explained the control methods. These control methods are expected to increase the possibility of a new form of one-to-one or group communication.

In the future, we will continue with studies aimed at opening up and developing new possibilities of communication such as by adding participants during communication and other such expansions of the service, introducing multimedia services such as the incorporation of still images and video, and the sending and receiving of text during a PushTalk session.

ABBREVIATIONS

3GPP: 3rd Generation Partnership Project
AMR: Advanced Multi Rate CODEC
AS: Application Server
B2BUA: Back-to-Back User Agent
CSCF: Call Session Control Function
DSP: Digital Signal Processor
GLMS: Group List Management Server
GUI: Graphical User Interface
HLR: Home Location Register
HSS: Home Subscriber Server
HTTP: Hyper Text Transfer Protocol
IMS: IP Multimedia Subsystem
IP: Internet Protocol

IPSCP: IP Service Control Point
MRFC: Media Resource Function Controller
MRFP: Media Resource Function Processor
NMSCP: New Mobile Service Control Point
PoC: Push-to-talk over Cellular
RTCP: RTP Control Protocol
RTP: Real-time Transport Protocol
SIP: Session Initiation Protocol
SMS: Short Message Service
TCP: Transmission Control Protocol
UDP: User Datagram Protocol
URI: Uniform Resource Identifier
xGSN: serving/gateway General packet radio service Support Node