



BUSINESS MODELS AND DRIVERS FOR NEXT-GENERATION IMS SERVICES



Business Models and Drivers for Next-Generation IMS Services

Comprehensive Report

IEC
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This One



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International Engineering Consortium
300 West Adams Street, Suite 1210
Chicago, Illinois 60606-5114, USA
+1-312-559-4100 voice • +1-312-559-4111 fax
publications@iec.org • www.iec.org

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Introduction to IMS

The Next-Generation Network Architecture for the Telecom Industry

Rebecca L.J. Chen

Staff Software Engineer, China Software
Development Lab (CSDL)
IBM Taiwan

Elisa C.Y. Su

Staff Software Engineer, China Software
Development Lab (CSDL)
IBM Taiwan

Victor S.C. Chen

Software Engineer, China Software
Development Lab (CSDL)
IBM Taiwan

Yi-Hong Wang

Software Engineer, China Software
Development Lab (CSDL)
IBM Taiwan

Abstract

The Internet protocol multimedia subsystem (IMS) is the next "big thing" in the telecom industry. This third generation partnership project (3GPP) standardized next-generation network (NGN) architecture and integrates the services provided by the long-existing IP network with the mobility of portable digital devices, such as a 3G cellular phone. In this article, we will discuss how to create a useful telecom service using Parlay X Web services.

In order to provide you with the proper perspective for IMS and how it is used, we will offer an introduction to the overall IMS network architecture. We will consider: what is IMS? Why use it? Who is using IMS? Then, we will dive into the key aspect of IMS: Parlay X Web services. We will look at the functions that the services provide and how those services fit in the IMS world. Finally, we will give a real-world example that shows how to create a useful telecom service using Parlay X Web services.

1. Introduction of IMS

1.1 What is IMS?

IMS is a set of specifications that describes the NGN infrastructure and defines the IP-based tele-

com services. As mentioned by 3G Americas (2004, p.4), "IMS was designed to fill the gap between the existing traditional telecommunications technology and internet technology." Have you ever imagined that you can surf the Web, play an online game and chat about the game strategy with your ally no matter where you are using your 3G hand-held device? This is the vision of IMS. In other words, IMS provides the environment that cellular hand-held device can merge with all the IP based services available on Internet.

1.2 History of IMS

IMS was initially defined by the 3GPP, which is a collaboration of many telecommunications standards bodies for the evolution from the Global System for Mobile Communications (GSM) into 3G networks. IMS was first introduced in 3GPP Release 5, where the session initiation protocol (SIP) and IMS were described as part of an all-IP network. IMS was then further enhanced in 3GPP Release 6 and Release 7 to include additional features to inter-work with the wireless local area network (WLAN) and support fixed networks, etc.

IMS was initially defined for the cellular network, but it has been expanded in scope to other wireless technologies, fixed line, cable, and broadband by

other standards bodies. IMS has become the basis for all the telecom IP network evolution.

1.3 The Benefits of IMS

As previously mentioned, the objective of IMS is to offer IP-based Internet services everywhere using cellular technology, but you may already have experienced this by accessing Internet services by surfing the web, reading emails, or using instant messaging via your 2.5G and 3G cellular phone. As a result, one may wonder why we truly need IMS.

Let us look at the benefits of IMS over the existing cellular network infrastructure from four perspectives:

1. *IMS provides open standards which reduce the time and cost of creating new IMS services.* Nowadays, it is a time-consuming and expensive process to create new services on an existing telecommunication infrastructure. Service providers are looking for ways to reduce the time and costs to create a new multimedia service. The IMS infrastructure solves this problem by providing open standards to the service providers. The open standards offer reusable components and a standardized interface through which developers can easily and more effectively create a new IMS service. Thus, the IMS service providing market is not a monopoly market; it is an open market through which any provider who implements the standardized interface can provide the services.²
2. *IMS provides multimedia services with quality of service (QoS) enabled.* Today's IP network provides end-user "best" bandwidth, but it is not able to guarantee the quality of the bandwidth. The dramatically-increased bandwidth in the 3G cellular network provides a much faster and more reliable Internet access, compared to the 2.5G cellular network, but the 3G cellular network is still not able to guarantee the bandwidth. The packet transmission in the real-time 3G cellular network will be seriously impacted by the fluctuating bandwidth problem. IMS solves this problem by engaging QoS mechanisms. As summarized by 3G Americas (2004, p. 6), "QoS ensures that critical elements of IP transmission such as transmission rate,

gateway delay and error rates can be measured, improved and guaranteed in advance."³

3. *IMS allows service providers to appropriately charge multimedia sessions.* In the IMS infrastructure, service providers are able to charge end-user with appropriate service type, instead of charging by the number of bytes transferred that are commonly used in today's 3G network. For example, when a user initiates a videoconference with a 3G mobile device, it will generate a large amount of data traffic. It would be more reasonable if the service provider could charge the end-user by the time elapsed rather than the number of bytes transferred. IMS allows the service provider to identify the service type that is used by the end-user and select appropriate charging scheme based on different service types.⁴
4. *IMS allows users to experience all the services no matter where they are.* One of the problems that many people have experienced nowadays is that some of the services will not be available when they travel to another country. This problem can be easily solved by using IMS infrastructure since it provides telecommunication services based on IP network. As a result, as long as the users can connect to an IP network, they can experience all the services no matter where they are even when they are traveling.⁵

1.4 IMS Architecture

The IMS architecture supports a lot of services based on SIP protocols. As seen in *Figure 1*, the IMS architecture delivers multimedia services that can be accessed by users from various devices via IP network or traditional telephony systems. The underlying network architecture can be divided into three layers (device layer, transport layer, and control layer) and will be introduced from bottom to top.

1. **Device layer**—The IMS architecture provides diverse choices for users to choose the end-point devices. IMS devices such as computers, mobile phones, personal digital assistants (PDAs), digital phones, etc. are able to connect to an IMS infrastructure via an IP network. Other types of devices, such as traditional ana-

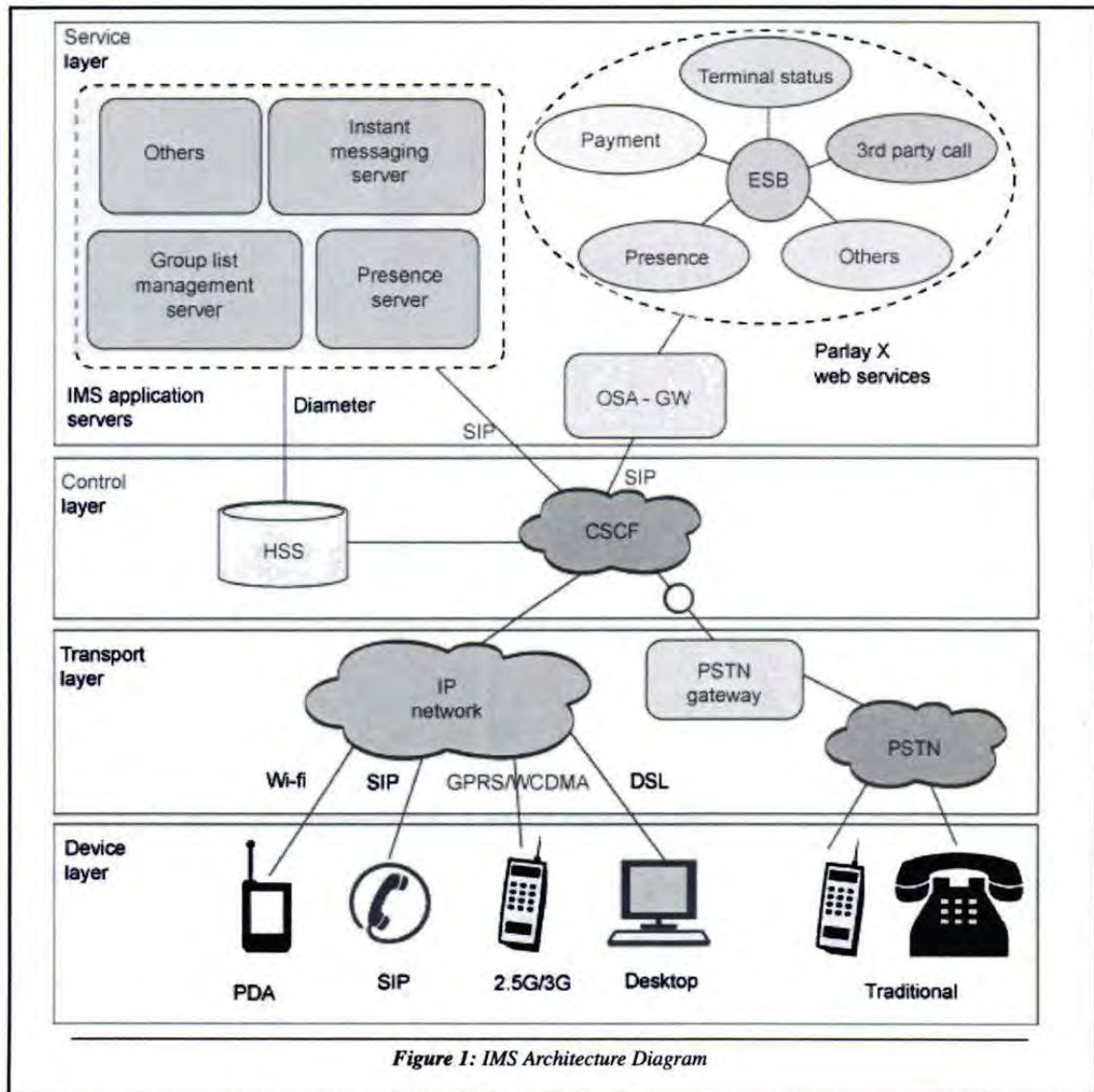


Figure 1: IMS Architecture Diagram

log telephones phones, are not able to connect to IP network directly, but IMS is able to establish the connection with these devices via public switched telephone network (PSTN) gateway.

2. Transport layer—This provides access network control for devices attached to the network. IMS devices connect to the IP network in the transport layer via a variety of transmission media, including wireless fidelity (Wi-Fi), digital subscriber line (DSL), cable, general packet radio service (GPRS), and wideband code

division multiple access (WCDMA), etc. In addition, IMS devices are able to communicate with the PSTN network through the PSTN gateway.

3. Control layer—Its main function is to provide switching and session control in IMS framework. The call session control function (CSCF), which is a SIP server, is one of the core elements in the control layer. CSCF is responsible of session control functions for IMS sessions. Another element in the control layer is the home subscriber server (HSS) that stores user

specific information related to subscription of services such as user profile, location information and security information.

4. Service layer—The three layers previously described provide an integrated and standardized network platform allowing service providers to offer a variety of multimedia services in the service layer. The services provided in the service layer are all run by application servers. The application servers are not only responsible for hosting and executing the services, but also providing the interface to the control layer. There are many application servers providing different services, and three core application servers of IMS as the following:

- The presence server collects, manages and distributes the real time availability and the means of communication information of users. It allows users to both publish their presence information and subscribe to the service in order to receive notification of changes of other users.
- The group list management server provides services to allow users or administrators to create, modify, delete and search the network based group definition and the associated lists of members. It also maintains the access permissions and other specific properties associated with the groups and the members. It is also used to provide the buddy lists for instant messaging or other services.
- The instant messaging (IM) server provides a real time communication service. The services allow users to send and receive messages that contain plain text, voice, and images etc.

Nowadays, service providers want to leverage existing resources such as presence, group list management, and IM service in order to productively create new services. However, it is not easy to find an application developer who has both information technology (IT) and telecommunication domain knowledge. The Parlay X Web services solved this problem by providing a set of simple-to-use, high-level, telecom-related Web service interfaces for both service creation and development. The appli-

cation developers can access and leverage the existing IMS services much easier through a web services interface. Web services are used because they have been widely adopted and understood by a large number of developers and programmers, and there are also a variety of development tools available. The Parlay X Web services are connected to the telecommunication network either via the open services access-gateway (OSA-GW) or directly through data service components over IP protocols.

1.5 Why IMS with Service Oriented Architecture (SOA)?

The IMS is a set of specifications that describes the NGN architecture for implementing IP-based telephony and multimedia services. The traditional telephony system or IP network is depicted as a silo structure which comprises proprietary black box solutions closely coupled with network equipment providers (NEPs) hardware. As such, the structure duplicates functions across multiple platforms. In other words, as seen in *Figure 2*, in order to create and deploy applications across different types of networks and types of access, it requires a set of unintegrated, but potentially similar, technologies across the silos of mobile, voice access, and data access. IMS provides the NGN that consolidates these technologies across the different types of access. It is crucial to support composite services to enable the reuse of existing service platforms and to enrich them with capabilities provided by the emerging IMS service platform. As seen in *Figure 2*, with the appropriate redesign, service providers and operators can transform today's networks of vertical silos into a horizontally integrated platform. The IMS architecture delivers multimedia services that can be accessed by a user from various devices via an IP network or a traditional telephony system.

As shown in *Figure 3*, solution providers could deliver an IMS-based multimedia services solution that focuses on service development, deployment, and execution or on the device, by contributing to a wide suite of applications and client software that enriches end-user quality of experience (QoE). Providing professional services capabilities to enable integration of business applications in the service management environment is also necessary. This focus on the service life cycle allows mobile

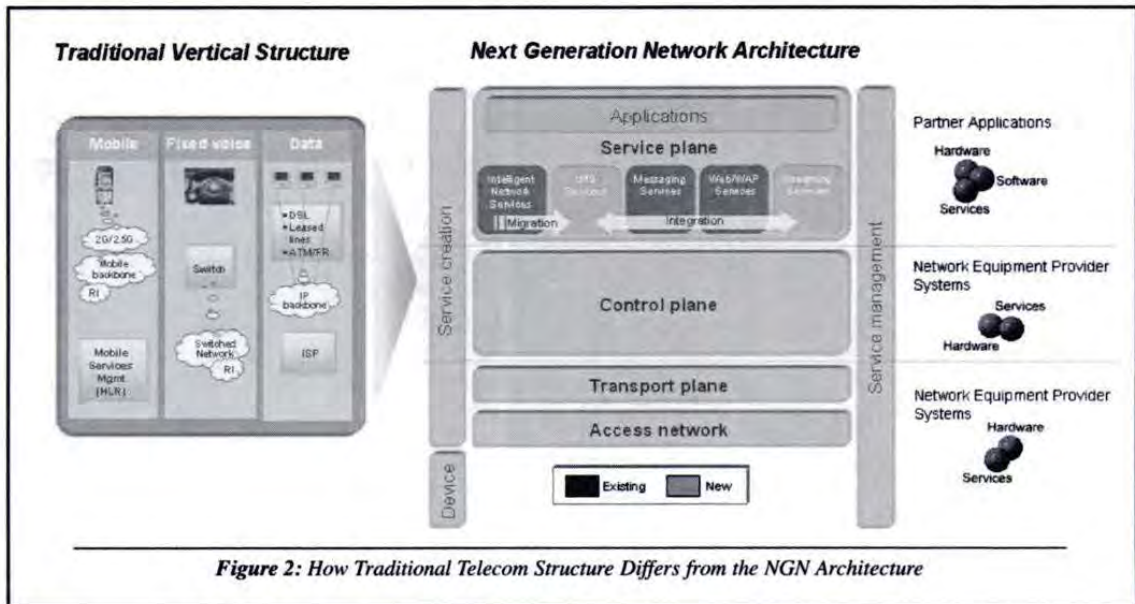


Figure 2: How Traditional Telecom Structure Differs from the NGN Architecture

network operators to select their best options for control and transport networks.

Solution providers can provide IMS-aware application middleware and supporting tooling, as well as services, to create end-to-end solutions. Its middleware solutions can utilize the product level service enablers for presence, group list management, and IMS/SIP application support which is all built on a

standards-based application server platform that has an integrated SIP application server. Creating end-to-end solutions through a strategy of cooperation with network equipment providers, which supply network transport, control elements, and device applications, along with third party application and content providers for application content has also become the industrial trend for IMS. Through integration with development tooling, a solution

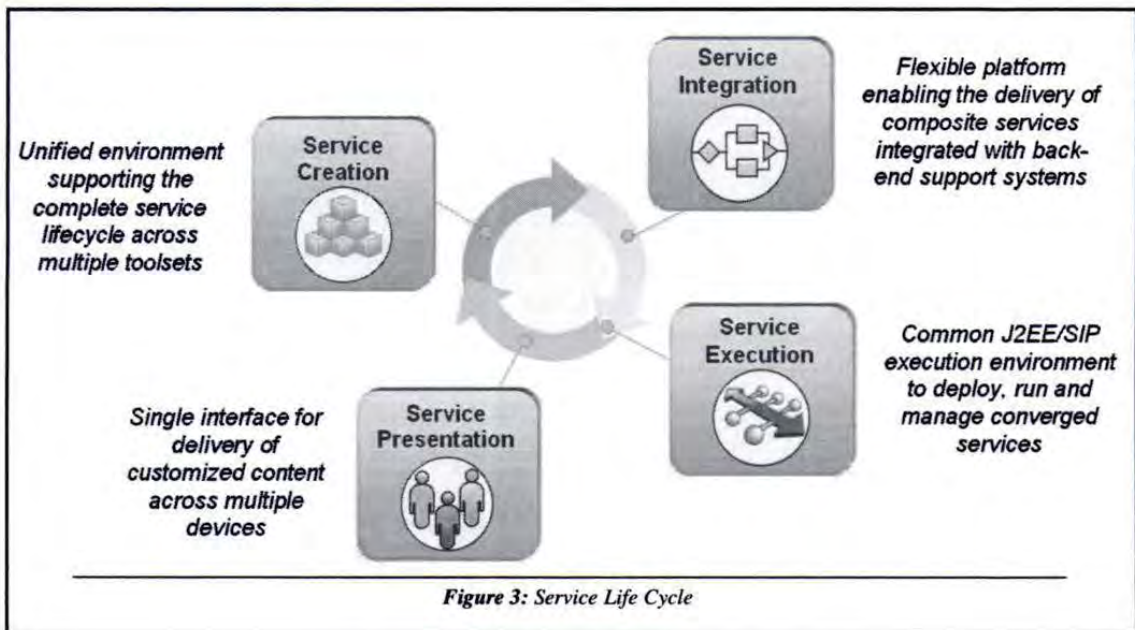


Figure 3: Service Life Cycle

provider can provide a robust build-and-deploy time capability for creating new IMS applications.

The application development community wants tooling and run-time support to allow them to compose services by making use of SOA and Web services (WS) technology. A solution provider can leverage both a service bus and business process integration in order to bring about service choreography and orchestration. If this strategy is built upon an application server with high-availability and scalability, the IMS solution will enable a rich set of converged IMS applications.

IMS solutions enable a rich personalization of telecom services, making it easier for end-users to get desired services in a consistent fashion. It also enables mobile network operators to control resources in flexible and easy-to-modify ways.

In the following section, we will further explain the Web services available within the IMS world, namely, Parlay X Web services.

2. IMS Parlay X Web Services

Basic knowledge on the macroscopic view of IMS is analogous to a rich toolbox with multifarious tools for the telecom industry, and Parlay X Web services is one of the most serviceable tools in this toolbox. *Figure 4* depicts a high-level view of the Parlay X Web services within the IMS architecture.

Now, what is Parlay? Parlay is a non-profit standard body established in 1998, consisting of numerous companies. The principal objective of Parlay is to formulate a common set of application programming interfaces (APIs) specifically for the telecom industry to create innovative services. Because of the sky-rocketing popularity of web services in 2000, Parlay 4.0 added a web services version of their interfaces. With the birth of Parlay X Web services, IT developers with no telephony knowledge can now make use of telecom services as if calling any ordinary web service: just make a simple function call from your Java program, you can instantly tap into the complex telecom world.

There are 17 Parlay X Web services at a developer's disposal in Parlay 4.0, and its richness enables

developers to create a vast ocean of innovative telecom services. The 17 Parlay X Web services are as follows:

0. Common (used for defining service exception and policy exception)
 1. Third party call
 2. Call notification
 3. Short messaging (SMS)
 4. Multimedia messaging (MMS)
 5. Payment
 6. Account management
 7. Terminal status
 8. Terminal location
 9. Call handling
 10. Audio call
 11. Multimedia conference
 12. Address list management
 13. Presence
 14. Message broadcast
 15. Geo-coding and mapping
 16. Application-driven QoS

2.1 Parlay X Web Service: Third Party Call

A Parlay X third party call Web service allows you to initiate a call connection between two phones. Through the exposed high-level web service interface, a developer is empowered to set-up a phone call between two arbitrary callers. A `makeCall` (agent1, agent2, ...) sets up the call connection between agents 1 and 2, this is shown in *Figure 5*.

If you successfully establish the SIP call between the two parties, a call identifier will be returned representing this specific call session. Passing the call identifier into the function `get call information` (`CallIdentifier`), you can retrieve information relevant to this call session, such as the call status, the duration of the session, the call start time, and termination cause, if the session has been terminated. This is shown in *Figure 6*:

Suppose you wish to end the call session between agent 1 and agent 2, you can issue an `endCall` (`CallIdentifier`) function call on the third party call Web service. Similarly, the `CallIdentifier` parameter uniquely represents a specific call session. This is depicted in *Figure 7*.

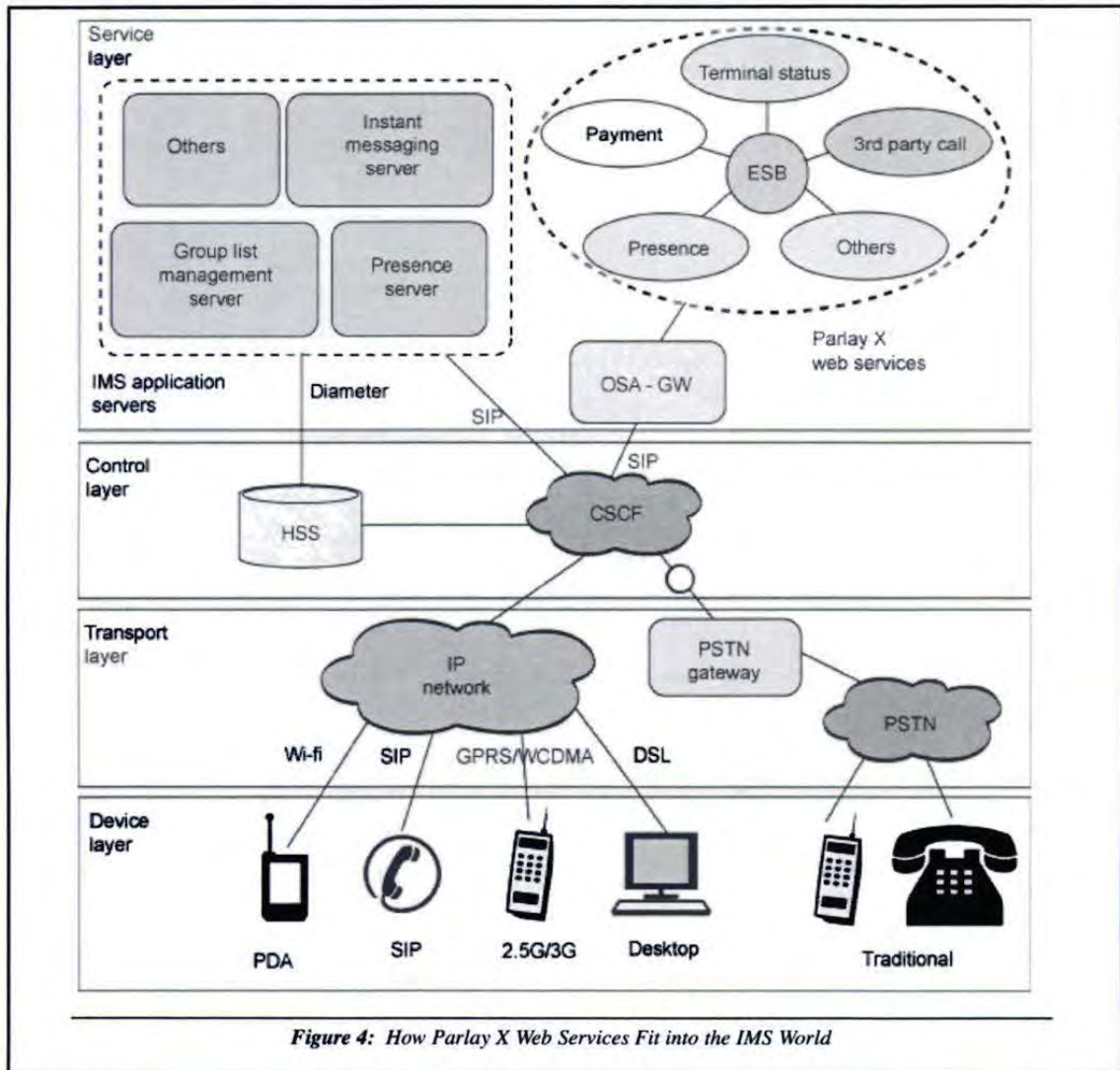


Figure 4: How Parlay X Web Services Fit into the IMS World

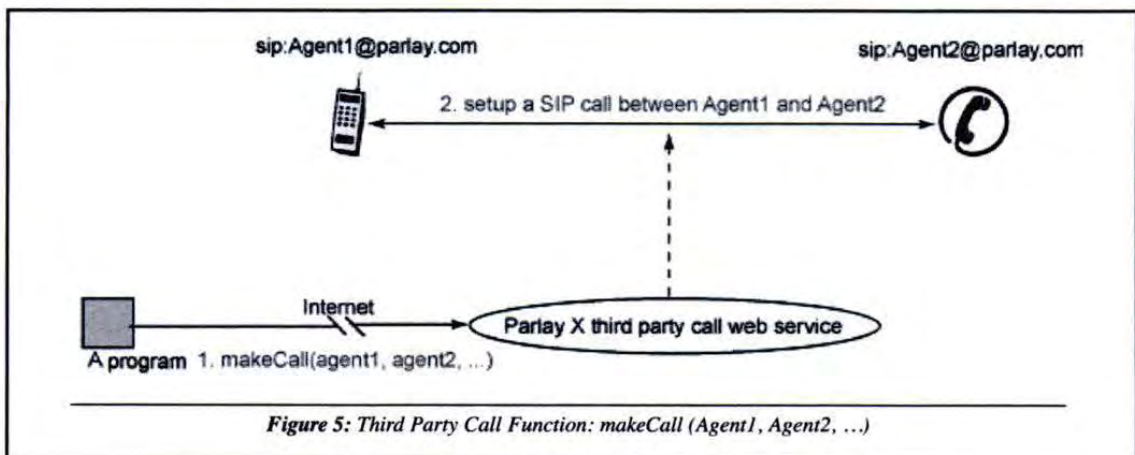
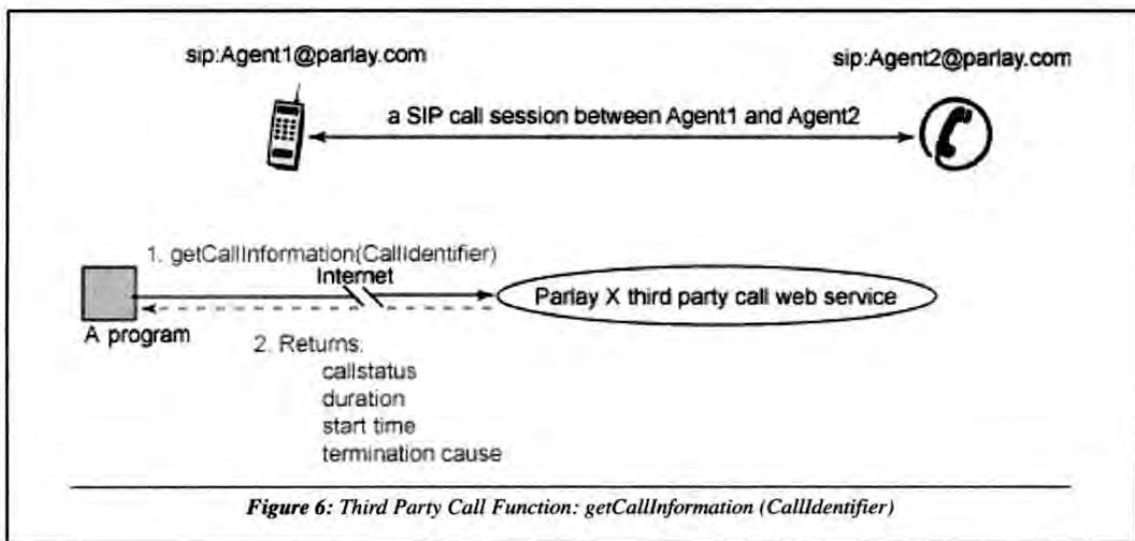
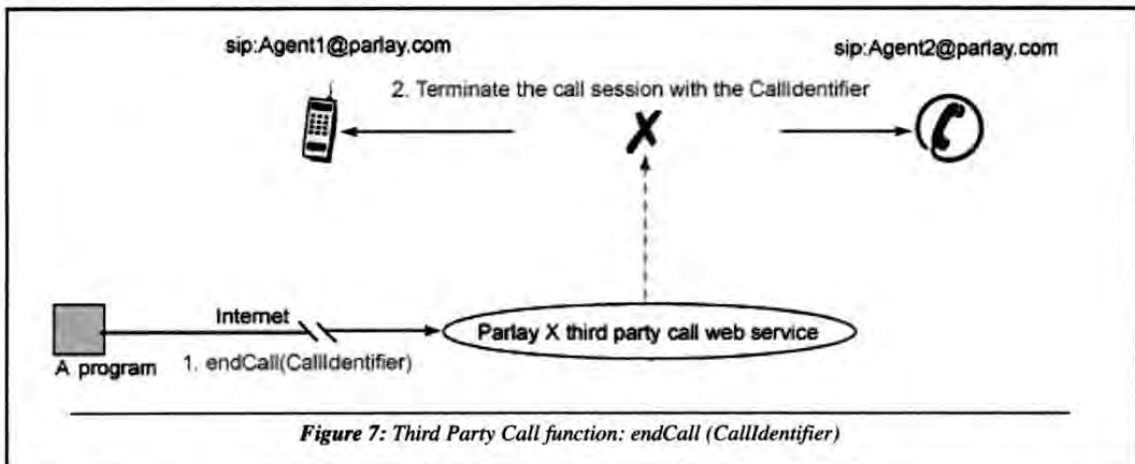


Figure 5: Third Party Call Function: makeCall (Agent1, Agent2, ...)



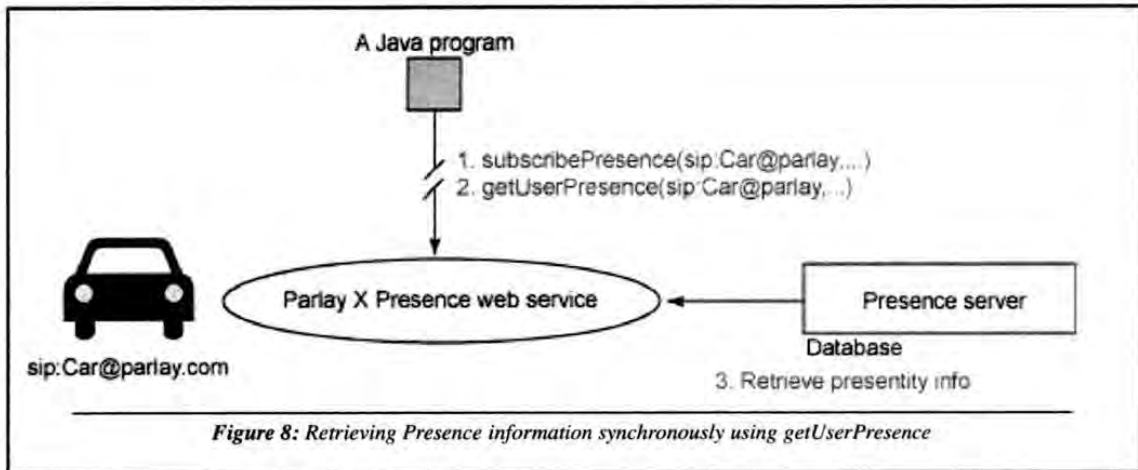
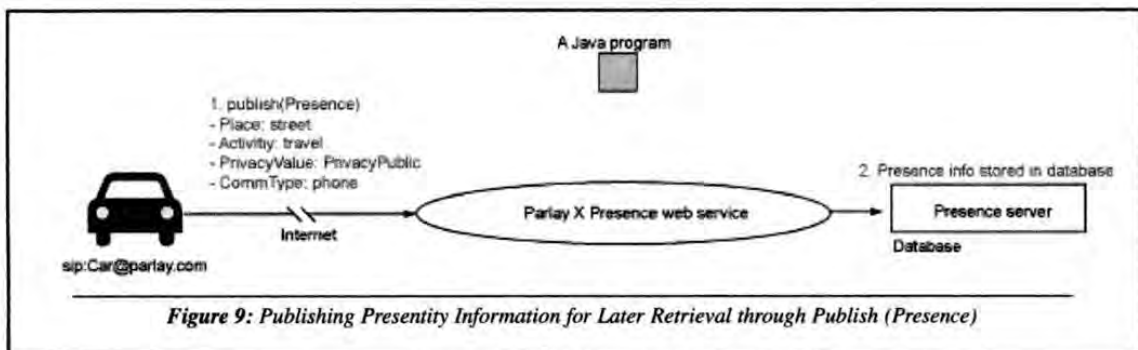
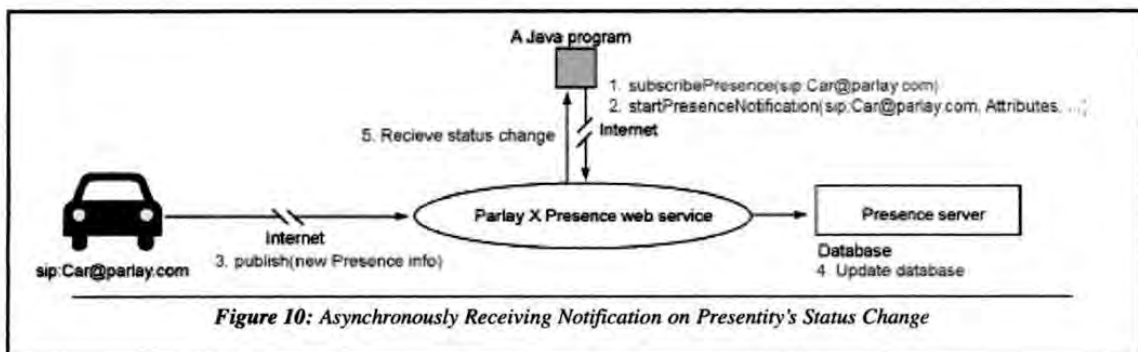
The last operation third party call gives a developer the ability to cancel a call, using the *cancelCall (CallIdentifier)* function. The difference between a cancel call and a stop call is that the former is used during the time period when the session has not been fully established after the *makeCall()* request, while the latter is used after the session has already been successfully established with the *makeCall* request().

2.2 Parlay X Web Service: Presence

The Parlay X presence Web service allows an application to subscribe to presence information about a presence entity, synchronously query a presentity's current presence information, asynchronously receive notification when the presentity changes its status, and unsubscribe to a presentity. A presentity

is an entity whose presence information is of interest. For instance, you can use a presence Web service to subscribe to your own car's on-board unit (OBU) using the Web services function *subscribePresence (presentity, attributes,...)*; the *presentity* parameter should be the URI pointing to the location of your OBU, such as a SIP universe resource identifier (URI). After a successful subscription, you then can issue a *getUserPresence (presentity, attributes)* to retrieve the latest presence information of your car's OBU synchronously. This is depicted in Figure 8.

At this point, you may wonder: how does the presence Web service know the latest presentity information of your car? This is achieved through another service call made by your car's OBU to the pres-



ence Web service: the publish (presence) method. The publish (presence) function allows your car's OBU to periodically publish its presence information, such as its location, status, current activity, preferred communication type, or privacy level to the presence Web service, which stores the information into a database. This flow is shown in Figure 9.

We have discussed how to publish presentity information, and how to both synchronously and asynchro-

nously retrieve the information. For example, if you want to get a notification asynchronously when your car changes its location, you will need to first call the web service function startPresenceNotification (presentity, attributes, etc.), and when the location status changes for your car, you will receive a notification with the latest modified changes, as seen in Figure 10.

When you call startPresenceNotification(), you also pass in a correlator that serves one important purpose: to later end this notification request. Through

the endPresenceNotification (correlator) web service call, your program can terminate the notification request specified by the correlator, thus you will stop receiving future notifications.

2.3 Parlay X Web Service: Terminal Status

The Parlay X terminal status Web service provides similar functionalities as the presence Web service, as it is simpler and solely allows you to query the status of an IMS terminal device. The Presence Web service provides a rich and complete set of presence information, sometimes too rich and too resource-heavy for a simple application that only cares whether a certain cell phone is currently on-line or off-line.

By calling on the terminal status Web service's `getStatus (TerminalAddr)` function, you can synchronously retrieve the current status of an IMS terminal. An IMS terminal might take the form of, say, a 3G phone. The status returned has exactly three types: reachable, unreachable and busy. *Figure 11* shows a sequence diagram on how this works.

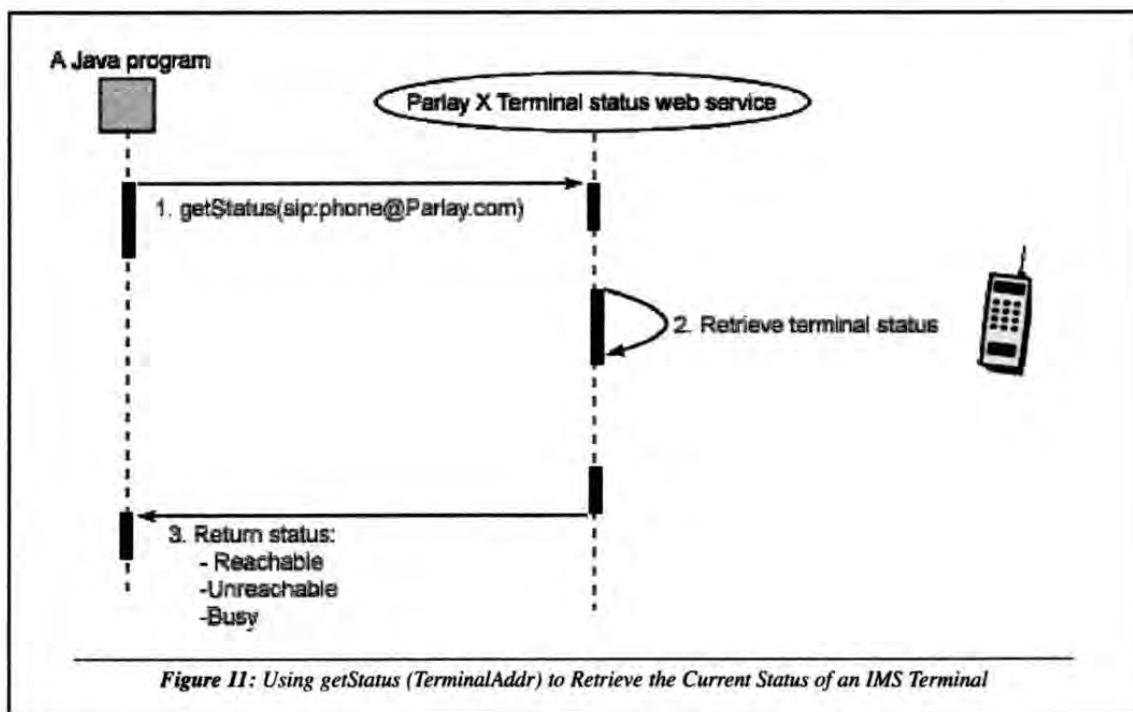
You can also obtain the status of an entire group of IMS terminals with one method Web service call,

with the `getStatusForGroup (TerminalAddr[])` function. By passing in a list of terminal devices' addresses, these devices' status can be queried, processed, and returned with a single call. For instance, we have a list A of SIP URIs consisting of `sip:phone1@parlay.com`, `sip:phone2@parlay.com` and `sip:phone3@parlay.com`, and we now pass list A into this method call, such as `getStatusForGroup(A)` and the return value will be another list B consisting of something like [busy, busy, reachable], indicating that phones 1 and 2 are busy at the moment, while phone 3 is reachable. This scenario is illustrated in *Figure 12*.

Finally, as in presence Web service, you are also allowed to receive notification asynchronously when the status of a specific IMS terminal changes; this can be done by using a startNotification, such as a `TerminalAddr`s or correlator function call to terminal status web service. Likewise, another endNotification (correlator) can be used to terminate any future notifications.

2.4 Parlay X Web Service: Payment

As noted previously, IMS can be seen as a huge toolbox filled with many tools for the telecom



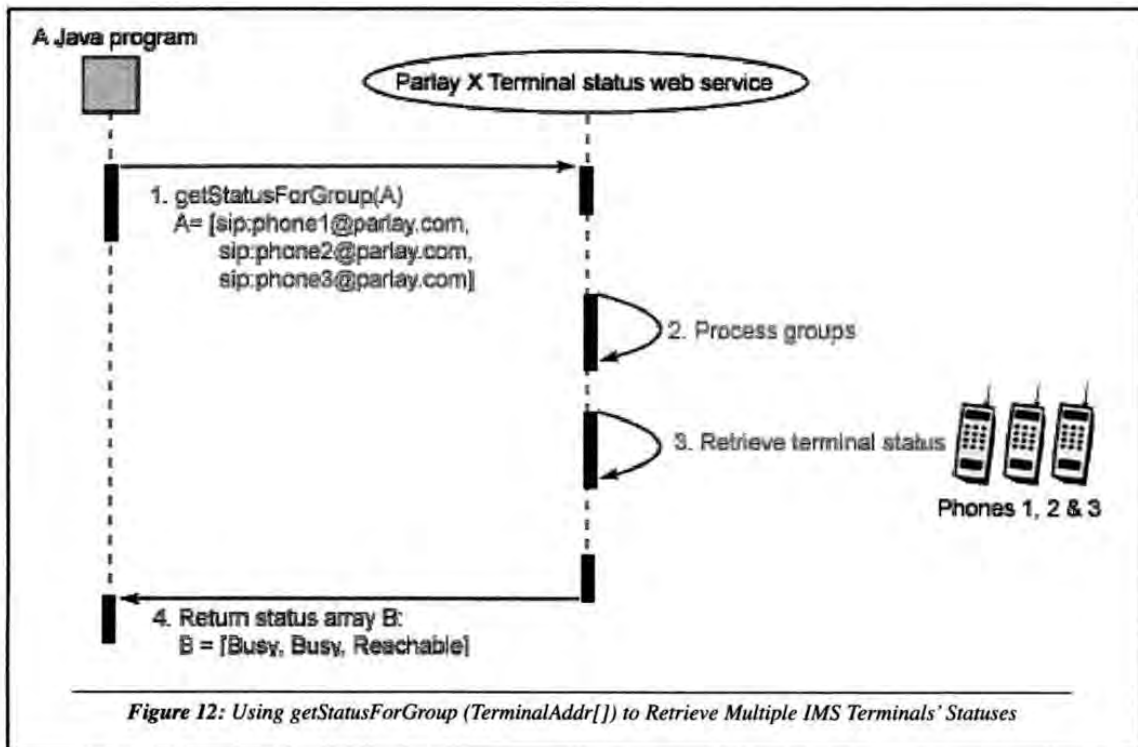


Figure 12: Using `getStatusForGroup (TerminalAddr[])` to Retrieve Multiple IMS Terminals' Statuses

industry, and as customers use the tools or the applications made from these tools, a solid payment mechanism will be needed to offer integrated billing. The Parlay X payment Web service supports payment and billing for contents in an open and web service-based fashion.

There are two modes for charging with the payment Web service: charge by amount and charge by volume. As the name implies, the former allows you to charge by quantity, while the latter allows you to charge by, for example, time. A request on the web service operation `chargeAmount (endUserID, ChargeInfo, etc.)` allows you to charge to `endUserID`, which usually is a SIP URI such as `sip:user@parlay.com`. Another call to a `refundAmount (endUserID, ChargeInfo, etc.)` allows you refund a certain amount from the previous charge.

Similarly, if you wish to charge a user by time, such as the time a user uses his cellular phone to watch video over 3G, you can issue a `chargeVolume (endUserID, volume, etc.)` request and a later refund using `refundVolume (endUserID, volume, etc.)`.

A common scenario for you to use a payment service is when your customer uses a web-based short messaging service (SMS) or multimedia messaging service (MMS). When the user successfully sends out a SMS or MMS, the payment Web service will then be invoked and the user will be charged and billed.

2.5 Parlay X Web Service: MMS and SMS

According to Forrester Research Inc., text and multimedia messaging revenue in the telecom market will have exceeding \$4.3 billion 2006,⁶ so an ambitious service provider should not omit the innovations spawned from SMS or MMS. Parlay X MMS and SMS provide Web service-based interfaces for an application to invoke, send, and receive SMS or MMS messages.

Let us begin with SMS. The function calls are relatively intuitive. If you wish to send out a SMS, you can invoke the web service method `sendSms (addresses, SenderName...Message)`. The `addresses` part indicates a list of recipients for this message, while the `message` parameter contains the message body itself. A `SmsID` will be returned by the call to

sendSms(), representing this specific SMS request. This is depicted in Figure 13.

After calling sendSms(), the getSmsDeliveryStatus(SmsID) can be invoked to confirm the delivery status for one of the following:

- DeliveredToNetwork
- DeliveryUncertain
- DeliveryImpossible
- MessageWaiting
- DeliveredToTerminal

Besides the traditional sendSms(), ring tones and logos can also be sent by using such methods as sendSmsRingtone and sendSmsLogo, respectively. The ring tone should be in RTX format while the image should be .jpeg, .gif or .png format.

MMS works more or less in the same fashion, using sendMessage() to send MMS messages and getMessageDeliveryStatus() to confirm the delivery. MMS messages include multimedia contents such as video, image or audio, which formed the basic services provided by most 3G operators.

2.6 Other Parlay X Web Services

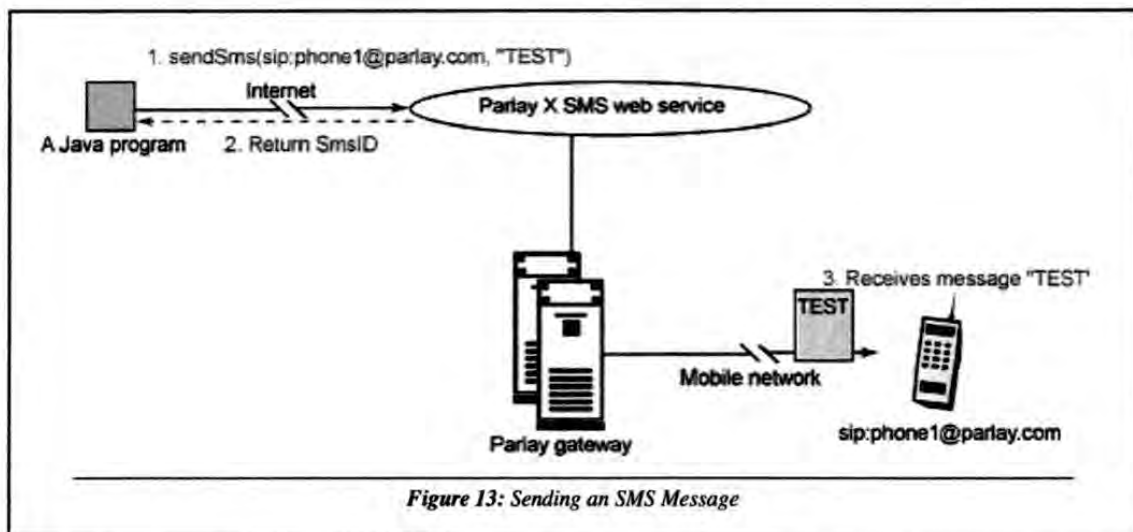
We have discussed how to use six of the Parlay X SOA Web services. The rest of the web services works in the same scheme, which allows your program to invoke a web service call, and each one provides different functionalities.

Table 1 describes how the Parlay X web services empowers your application.

3. Real World Application Using Parlay X Web Services in an IMS Environment

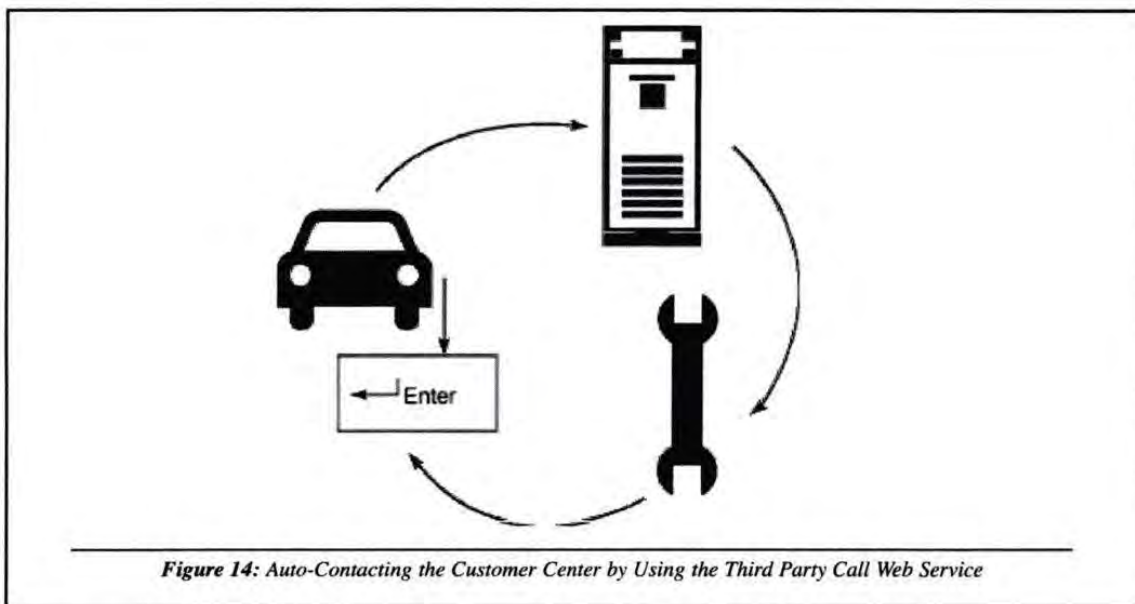
The automotive company could implement their customer service infrastructure by using ParlayX Web services technologies and install a device that has the ParlayX Web service client capability on each automobile. One of the ParlayX Web services that they could use is the third party call feature. For example, the automotive company could input customer's mobile phone number when customers register their cars. At any time, when customers have any questions, they would just need to click on the customer service button and the make call operation will initiate a call between the customer and customer service center. At any time during the call, the customer can click the done button to invoke the endCall operation and terminate the call.

As an example, this process can grant a mechanic at an oil change establishment an easy way to call a customer's cell phone when his or her car maintenance has completed. The customer provides a cell phone number when dropping off the car for the first time. When the mechanic completes the car's maintenance, he or she uses makeCall to initiate a call between the customer and a prerecorded message indicates that the car is ready for pickup. The mechanic does not have to even look up the cus-



IMS Parlay X Web services	Description
0. Common	Containing common info that cross other Parlay specs
1. Third Party Call	See section 2.1. Connect call between two terminals using your application.
2. Call Notification	Sends a status notification to your application when a caller makes a call, ends a call.
3. Short Messaging (SMS)	See section 2.5. Allows your application to send out a SMS, receive a SMS.
4. Multimedia Messaging (MMS)	See section 2.5. Allows your application to send out a MMS, receive a MMS.
5. Payment	See section 2.4. Online charging Mechanism.
6. Account Management	Support account query, management, account direct recharge or charge with vouchers.
7. Terminal Status	See section 2.3. Provide you with the status of an IMS Terminal.
8. Terminal Location	Provides the location of and terminal
9. Call Handling	Allows your application to decide how to handle a call. Block a call, forward a call, accept all calls, play audio for the incoming call... etc.
10. Audio Call	Provides a flexible way for the delivery of audio contents, e.g., voice extensible markup language (XML), WAV, text.
11. Multimedia Conference	Allows your application to create a multimedia conference, dynamically manage participants and manage the media used.
12. Address List Management	Manage groups and members. Create, delete, manage access rights... etc.
13. Presence	See section 2.2. Provide you with detailed location and presentity of the terminal.
14. Message Broadcast	Allows your application to broadcast a message to all the IMS terminals within a specified geographical range.
15. Geocoding and Mapping	Transform the coordinates of a terminal into a geographical location, such as an human readable address.
16. Application-driven QoS	Application-controlled QoS

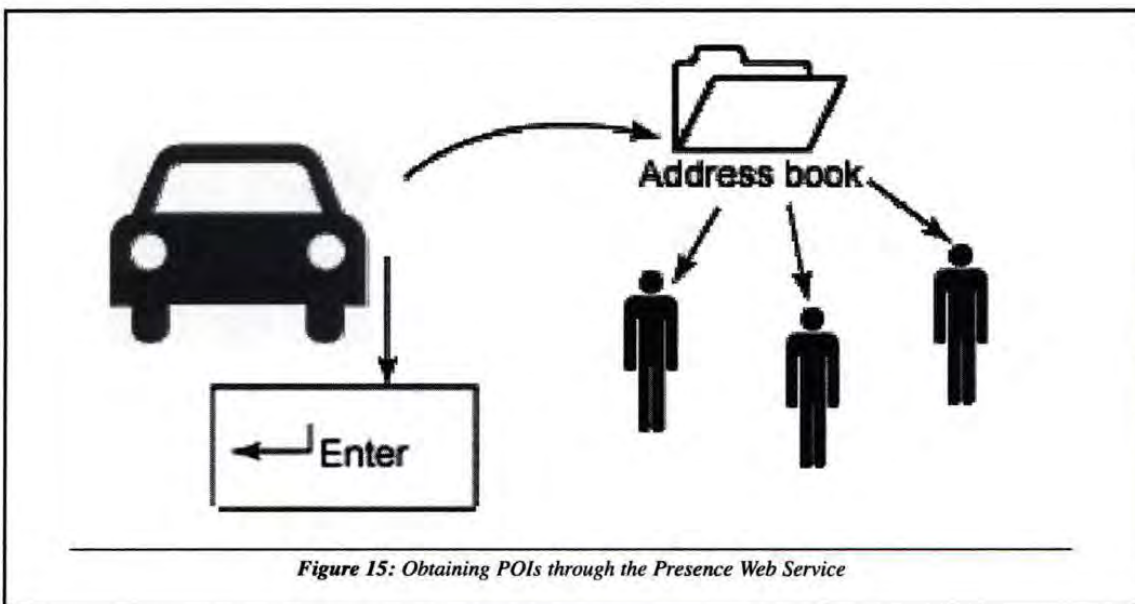
Table 1: Parlay X Web Services and Functionalities



customer's phone number, dial the phone, nor talk to the customer. If the call cannot be completed, the getCallInformation operation allows an automated system to retry failed numbers or to use another way to contact the customer.

For those cars that are telematically enabled, the Parlay X Web service, used for sending and receiving SMS messages, could be used to transmit the data between customer and the customer service

center. For example, the vehicle's key systems such as engine, antilock brakes, remaining oil life, etc. can be checked every month and the data sent back to the customer service center by using the sendSms operation. The customer could receive an automatic e-mail report about the car status. Between monthly reports, if the car is broken, the customer can push the diagnostics check button to force the system to invoke a sendSms operation to send the data to the customer service center, so the techni-



cian could do a quick problem determination by the message received and makeCall to the customer. The sendSms operation can also be used to send short message to customer to alert any abnormal status of the vehicle or to remind customers about scheduled maintenance.

In addition to customer service support, the ParlayX Web service may add a futuristic feature to an automobile. For example, a service provider could use the IMS ParlayX Web service technology to implement a service infrastructure platform to provide many services, such as traffic status, points of interest, on-sale information, restaurant, etc. When the car engine is started, the Parlay X Web service device could “publish” its active status to the service infrastructure platform via the presence supplier interface of the presence Parlay X Web service. Each automobile could use sendSms to send the current driving speed of the car to the service provider. The driver may subscribePresence for the things that he or she is interested in.

4. Conclusion

IMS is a state-of-the-art technology for the telecom industry and is analogous to a toolbox with a rich variety of tools for your application to tap easily into the telecom world. In other words, IMS uses Internet technologies to provide vast services and mobile technology to provide ubiquity. In the first section of this article, IMS was discussed from a macroscopic view—what it is, why it is important, and how it can be used. In the second section, we introduced Parlay X Web services, one of the most serviceable tools in this toolbox. We looked at some of the most interesting Parlay X Web services, how they work, and what they empower you to do. In the last section, we composed an innovative real-world telecom application using some of the Parlay X Web services we introduced in the second section.

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Notes

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