An IMS based Inter-Working Solution for Multimedia Service in a Converged Network

Zhongwen Zhu
PDU Messaging, Ericsson Canada Inc. Montreal, Canada
E-mail: Zhongwen.zhu@ericsson.com

Abstract

In the evolution of traditional telecom network towards a converged next generation network, Inter-working is always challenging due to different name spaces and routing mechanism across different communities. Most existing Inter-working solutions are terminal based solutions. They require mobile phone or PC users to install multiple client-side applications on the devices, such as, Google talk client, Skype client, and MSN client, etc. In order to avoid too many client applications running on mobile terminals that normally have a limited resource, a network based Inter-working solution is desired.

An IMS based Inter-working solution for multi-media services is proposed. It enables an IMS subscriber make use of a single SIP user agent to communicate with the other users who might have communication means other than IMS based devices. The solution consists of two parts in the network: one is the conference like service that resides at the originating side and provides "forking service"; the other is the Inter-working gateway service that provides the protocol conversion service.

The detailed technical description of the proposed solution is described hereafter. The corresponding use cases are studied. The application of the solution to the Group Communication service, e.g. an ad-hoc group or pre-defined group multimedia service, is also discussed. The benefits of the proposed solution for end users and operators are highlighted respectively.

1. Introduction

With the help of rapid development in computer and network technologies, nowadays, people have more means to communicate with each other. Google talk, Skype, MSN, and Yahoo are some of the most popular communication methods existing in the public network. They are not only easy but also free to use. A traditional fixed line telephone operator is facing a big challenge from those internet service providers.

Although they don't have to face the same problem as fixed line telephone operators, mobile operators are under the pressure from their competitors, end users, and service/content providers as well as government regulation to open up their private network. Inter-working (IW) with those popular IP based communication approaches is considered to be one of the important steps towards that direction.

In the following sections, the challenge for Inter-working solution among different network domains is present. A new IMS based Inter-working solution is proposed to facilitate voice and data communication between different communities. The solution can be applied to not only "peer-to-peer" but also "one-to-many group" communication.

2. Inter-working Challenges

Most Internet based communication services, e.g. chat, Instant Messaging, etc., have their own private communities. Each service often has its own private protocol too. However, "Google talk" is one exception, which is built upon XMPP – an open standard protocol referring to [7-10].

Normally in order to communicate with each other, two partners have to register in the same community, e.g. Google domain. It also requires that two partners install the same client application, e.g. Google talk client, at their terminal devices. If two partners have different client applications installed, it is difficult to let one talk to the other. Then Inter-working or interoperability becomes a problem.

One solution for the Inter-working or interoperability problem is to install multiple client applications on a single device. It is so called "a client based Inter-working solution". Then the user has to make a decision on which client he/she is going to use for this call or messaging service. This requires that end users shall have certain knowledge on these new internet based communication methods. Obviously the solution is not suitable for many subscribers who are not so familiar with or care about communication technology.

In order to simplify end user experience, a network based Inter-working solution is desired. The solution shall be transparent to the sender who only needs to know recipient's identity.

3. An IMS based Inter-working Solution

3.1. Basic Concept

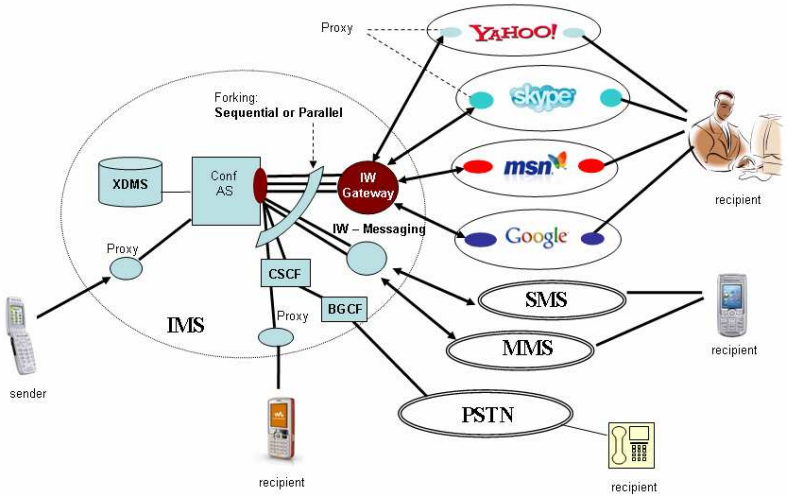

Figure 1 Overview of an IMS based Inter-working solution

The basic concept of the proposed solution is to use single SIP client application on a mobile phone or PC to make voice or data communication. This enables IMS users to talk or chat with their partners, who might have different communication methods other than IMS based devices, such as Skype, Google, or MSN.

A big advantage with this solution is: "*A caller is not required to select which address he/she shall use to communicate with a callee. The generic IMS based Inter-working solution shall pick up a right link (IMS to Google, or IMS to IMS, etc.) between a caller and a callee. This operation shall be agnostic to both caller and callee*"

The network view of the IMS based Inter-working solution is given in Figure 1. The solution consists of two parts: one is the application running on 3GPP [1] conference application server (AS); the other is the application running in Inter-working gateway. They are highlighted in dark red.

When he/she would like to make a voice call to his/her partner, a mobile user (SIP client) sends out SIP INVITE request towards the application running in conference AS with a list of recipient's address instead of only one specific recipient address used in traditional telephone service. These addresses are associated to one recipient and stored in the local phone book. In addition, SIP INVITE request shall also include a list of the sender's addresses, e.g. MSN, Google, or Skype's accounts.

The application in conference AS shall fork the SIP INVITE request based upon the list of the recipient's addresses sent by the sender. The forking operation can be done in an either sequential or parallel order as shown in Figure 1. After identifying that the recipient's address belongs to a specific domain in which the sender does have the same account, e.g. Google community, the application in conference AS shall send or forward SIP INVITE request towards IW gateway.

IW Gateway then sets up a voice connection with a callee on the behavior of the caller via Google's Proxy. The same mechanism is also applied to other social networking communities, such as Yahoo, MSN and Skype, etc. IW gateway is responsible for mapping both signaling and media flows across two different domains.

The sender's address information (Sip URI, Google account, etc.) can also be stored in network address book. The application running in conference AS shall be able to retrieve the sender's address information from the corresponding database server deployed in the network instead of taking it from the received SIP request.

The proposed solution is also suitable for Data communication.

3.2. Technical Description

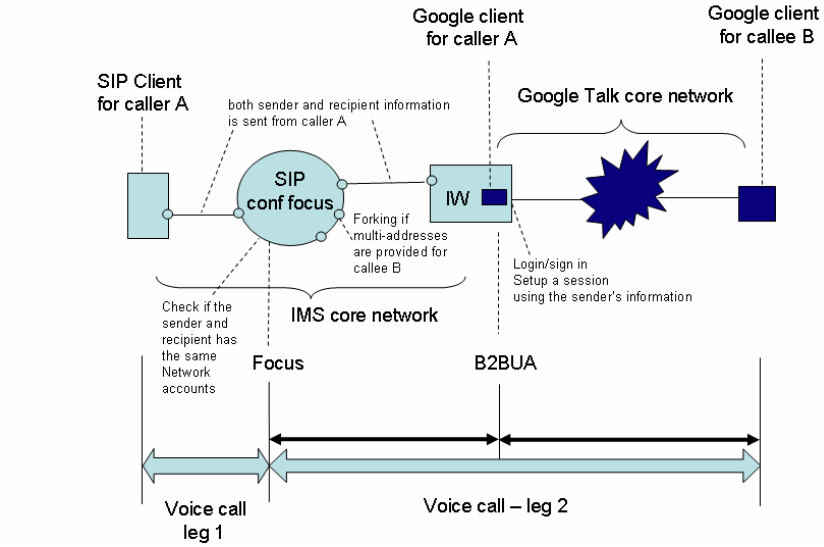

Figure 2 Signaling flows for the proposed IW Solution

The detailed technical description of the proposed solution is given in this section. The example of a voice call made from IMS to Google is described in Figure 2.

Caller A sends SIP INVITE request towards conference AS via IMS core network, which consists of CSCF, HSS and AS referring to [1]. The feature tag, like "+g.oma.sip-im" given in OMA SIMPLE specification [2], shall be defined to identify the service for the proposed solution. The client shall include both sender's and recipient's addresses in SIP request by following the format defined in IETF draft [4]. The examples of sender's and recipient's address list are given in Figure 3 and 4 respectively.

```
Content-Type: application/resource-lists+xml
  Content-Disposition: sender-address-list; handling=optional

  <?xml version="1.0" encoding="UTF-8"?>
  <resource-lists xmlns="urn:ietf:params:xml:ns:resource-lists">
   <list>
    <entry uri="sip:userA@operator.com"/>
    <entry uri="xmpp:userA@google.com"/>
    <entry uri="msn:userA@hotmail.com"/>
   </list>
  </resource-lists>
```

Figure 3 Example of sender's address list

In the conference AS, a special conference focus is created after SIP request [11] from the sender is received. Based upon the information shown in Figure 3 and 4, the conference focus selects one of recipient's addresses to send out the INVITE request.

```
Content-Type: application/resource-lists+xml
  Content-Disposition: recipient-address-list; handling=optional

  <?xml version="1.0" encoding="UTF-8"?>
  <resource-lists xmlns="urn:ietf:params:xml:ns:resource-lists">
   <list>
    <entry uri="sip:userB@operatorN.com"/>
    <entry uri="Tel:+123456789"/>
    <entry uri="xmpp:userB@google.com"/>
    <entry uri="msn:userB@hotmail.com"/>
   </list>
  </resource-lists>
```

Figure 4 Example of recipient's address list

Referring to the example shown in Figure 2, the conference focus identifies that this voice call requires IW with Google community. The conference focus sends SIP INVITE request towards IW-gateway. In SIP request, it includes Google's accounts for both sender and recipient. This is because IW gateway shall sign into Google network on the behavior of caller A. Then IW gateway is able to establish the connection with the recipient via Google core network.

The end-to-end voice communication (from IMS to Google) between the sender and the recipient is established via the conference focus. IW-gateway plays a B2BUA role in the call leg 2, which is issued by the conference focus referring to Figure 2. In fact the conference focus is one kind of conference switches that control both signaling and media flows.

It is noticed that when multiple recipient addresses are present in SIP INVITE request, the conference focus forks the SIP request to all the addresses appearing in the recipient's address list in a sequential way. As long as the connection between the conference focus and one of the recipient addresses is successfully set up, the forking operation of conference focus stops.

A parallel forking can also be chosen to set up a voice communication between a caller and a callee.

3.2.1. Operation in Conference Focus: The business logic used by the conference focus is given in Figure 5. In the control flow a sequential forking for a voice call is used as an example.

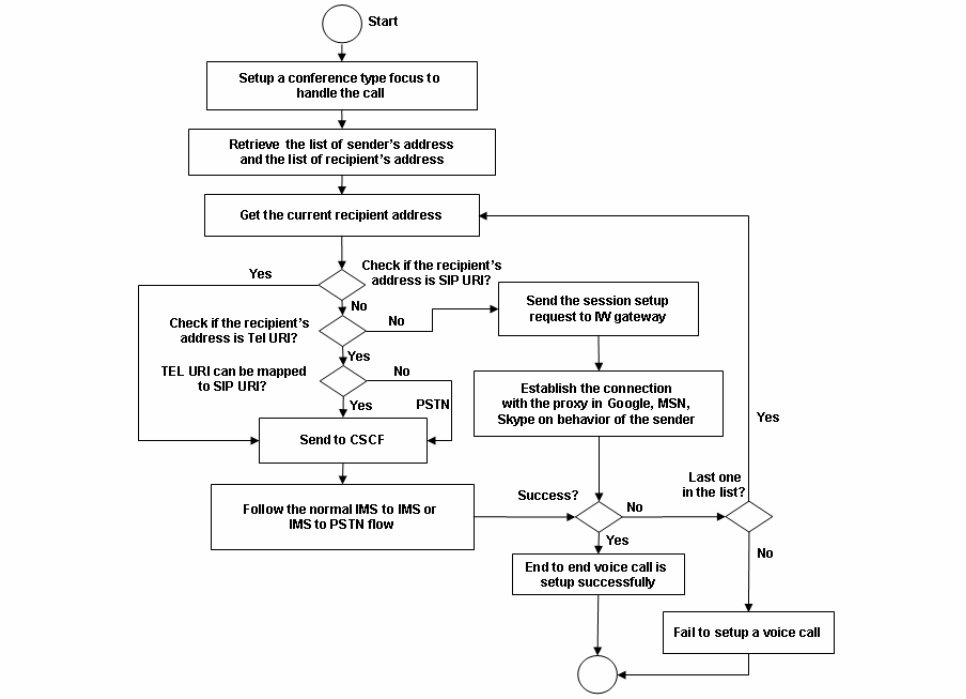

Figure 5. Basic flows for conference application server

A special conference focus is built up after SIP INVITE request is received. Then the conference focus retrieves one potential destination from a recipient list in the received SIP request to see if the inter-working is required or not. In case that the Inter-working is needed, the conference focus shall send the SIP request towards IW gateway. If the recipient's address is a traditional telephone number, the conference focus shall send the request to CSCF, which shall forward the request to BGCF to inter-work with PSTN eventually.

After receiving the first successful response from one of recipient's addresses, the conference focus shall terminate other outgoing call legs towards the other recipient addresses. Then it shall send SIP 200 OK response back to the caller. When the recipient receives the acknowledgement from the sender, an end-to-end voice call is set up through the conference focus.

The same mechanism is also applied for data communication.

3.2.2. Operation in IW Gateway: The business logic used by the Inter-working gateway is given in Figure 6. In the control flow a voice call setup (IW with Google) is used as an example.

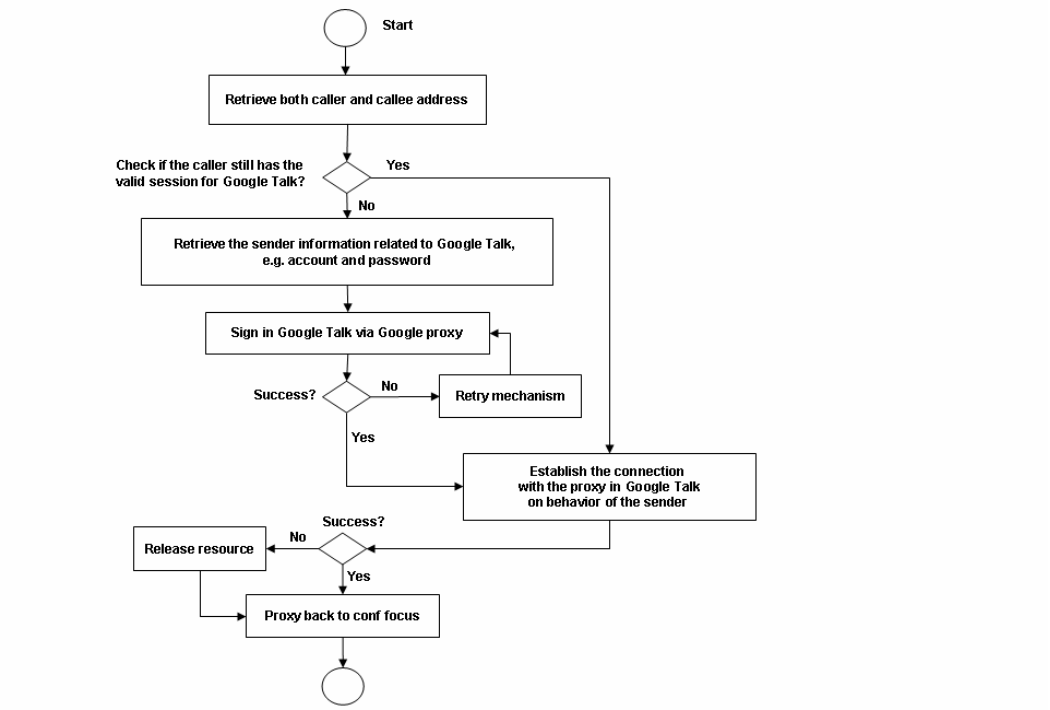

Figure 6. Basic flows for Inter-working Gateway

When the SIP request from the conference focus is received, IW gateway shall retrieve caller's Google account. Then it checks if the caller has still a valid session in Google network. If yes, the existing Google session can be re-used. The request is passed to the corresponding Google proxy. Otherwise IW gateway shall sign in the Google network on the behavior of the caller. Upon successful sign-in, IW gateway will establish the voice connection with the recipient via Google proxy.

When the positive response is received, the Inter-working gateway proxies the response back to the conference focus. Then the conference focus shall send SIP 200 OK response back to the caller. Eventually the dialog between caller and callee is set up successfully.

4. Group Communication Handling

The proposed IMS based Inter-working solution can be extended to handle a group communication, such as voice/video conference, one-to-many chat, one-to-many Instant Messaging, etc [2~3].

A group can be either "ad-hoc" or "pre-defined". For an "ad-hoc" group, a list of recipients is formed at the client terminal side by the sender, who picks each recipient from his/her contact list in the phone. But a "pre-defined group" is defined by either a subscriber or an operator. A group identity is normally given by a valid SIP URI and group information is stored in the network.

In a group communication service, the SIP request issued by the sender consists of group information. The conferences AS shall create a group conference focus as shown in Figure 7 after receiving the SIP request.

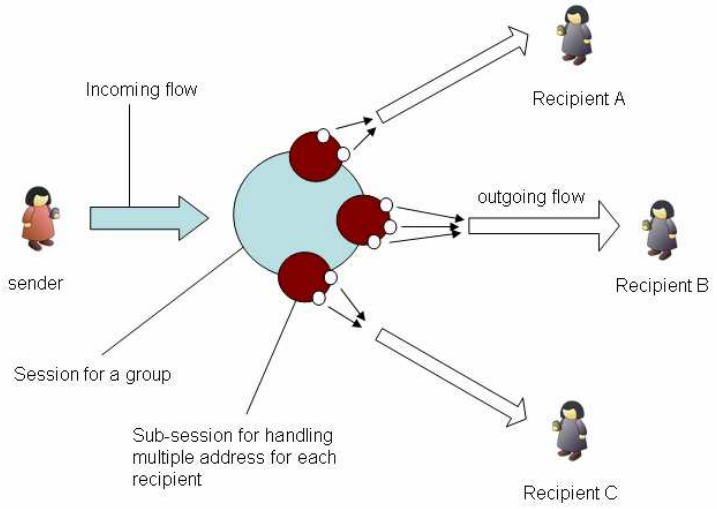

Figure 7. Example of Group Communication (pre-defined or ad-hoc)

Under the group conference focus session, a set of sub-sessions shall be generated for each recipient in the group. The sub-session is directly related to the conference focus required in one-to-one use case that is discussed in previous sections.

Normally the owner of a group session is either a subscriber who plays a sender role or an operator role. The owner controls the group session, e.g. start or terminate a session. Each participant in a group session is allowed to join or leave freely. Each participant shall also be able to subscribe to "Group conference status"; and to receive the notification whenever the conference status gets updated.

5. Discussion

In this section, the benefits of the proposed IMS based Inter-working solution for both end user and operator are discussed.

The solution brings a single and simple user friendly interface to service subscribers. The client application is able to include all the recipient's addresses into the outgoing SIP request after a recipient name in the local phone book is selected by the sender.

With this solution a simple SIP client can support multiple communication means, e.g. IMS, PSTN, MSN, Yahoo, Google, Skype, etc. A mobile user shall be easy to communicate with his/her partners registered in different domains or communities. It facilitates IMS users to communicate with their friends who have different communication methods other than IMS. Hence the voice and data traffics for the operator are expected to be increased significantly.

It is noticed that this solution handles the flow only from IMS to other Internet communities, Google, MSN, Yahoo, and Skype etc. The reverse flow is not supported. In fact

this is the good case for the operator to provide unique service to its subscribers. This leads to bring more subscribers into operator's domain.

6. Summary

An IMS based Inter-working solution is proposed for multimedia services in a converged network. It consists of two parts; one is the conference like service, and the other is the Inter-working gateway like service. The detailed technical description for the proposed solution is described. The solution can also be applied to "group communication service". The benefits of this solution for both end users and operators are discussed and highlighted.

Acknowledgement

This work is fund by Ericsson Canada Inc. under Ericsson DMMP technology leadership project (2008).

7. References

[1] TS 24.229 "IP multimedia call control protocol based on Session Initial Protocol and Session Description Protocol; stage 3", release 7.

[2] Open Mobile Alliance, "Instant Messaging using SIMPLE Architecture", version 1.0.

[3] Open Mobile Alliance, "Instant Messaging using SIMPLE", technical specification, version 1.0.

[4] Garcia-Martin, M. "Multiple-Recipient MESSAGE Requests in the Session Initiation Protocol", draft-ietf-sip-uri-list-message-01.txt

[5] Camarillo, G. "Conference Establishment Using Request-Contained Lists in the Session Initiation Protocol", draft-ietf-sip-uri-list-conferencing-01.txt.

[6] J. Rosenberg, "Extensible Markup Language (XML) Formats for Representing Resource Lists", RFC 4826

[7] Saint-Andre, P. "Extensible Messaging and Presence Protocol (XMPP); core", RFC 3920.

[8] Saint-Andre, P. "Extensible Messaging and Presence Protocol (XMPP); Instant Messaging and Presence", RFC 3921

[9] Saint-Andre, P. "Mapping XMPP to CPIM", RFC 3922.

[10] Saint-Andre, P. "Internationalized Resource Identifiers and URIs for XMPP", RFC4622.

[11] Rosenberg, J. et al. "Session Initial Protocol", RFC 3261

Authors

Dr. Zhongwen Zhu graduated from Free University of Brussels with a Ph. D degree in Applied Science in 1996. He joined Ericsson Canada as a system manager to develop the solution for converged telecom network in 2001.

His current research interests are: Multimedia application in IMS network, Security, Inter-working between different communities, Interoperability among different devices, License mechanism for multimedia application, distributed architectures, etc.