Interworking between P2PSIP Overlays and IMS Networks – Scenarios and Technical Solutions

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Abstract

This article provides a comparison of two of the most promising technologies which are supposed to be used for enabling communications over the Internet: IMS and P2PSIP. As their fields of adoptions are totally different – operators and mobile networks for the former, Internet and ephemeral communities for the latter – interoperability rather than competition seems to be the key for achieving a win-win situation. Right after introducing and comparing the technologies, the article will describe two scenarios where interworking may produce added value, and will discuss technical issues to be addressed in order to achieve effective interoperability.

1 Introduction

Telecom operators and Internet companies are today offering IP based real-time communication services following two very different approaches. In the first case, being the service meant to replace traditional telephony, the main focus is on requirements such as quality of service, high availability, and standard supplementary services, derived from PSTN and PLMN networks; consequently, in line with the evolution of the Next Generation Networks (NGN), the new architecture adopted (i.e. the IMS) is highly centralized, layered and oriented to a powerful and sophisticated service session control, and thus to a strong user profile management. On the other hand, much younger companies committed to the provision of services on the Internet, have started adding audio and video to their users' experience once limited to web browsing and file-sharing, exploiting the abundance of bandwidth today available at low cost. In this case, real-time communications – one of many kinds of complementary services – need in the first place to be as cheap as possible to the detriment of the quality.

While operators, for having both interoperable and multi-vendor networks, started adopting standard solutions from the very beginning, the first generation of applications for real-time communications over the Internet (e.g. MSN Messenger, ICQ, Skype) used to implement proprietary protocols and to establish closed communities. However, the IETF P2PSIP standardization effort represents a step in a common direction by two worlds which are often considered parallel and controversial, but which can actually profit by their co-existence and co-operation, extending their range in each other's domain.

	IMS	**P2PSIP**
Payment	Subscription based	Free / Advertising based
Quality	Guaranteed	Best effort
Interconnection with legacy networks	Transparently supported	None / Externally provided
Target	Home, Business	Web / Virtual communities

Table 1 *Comparison between services provided in IMS Networks and P2PSIP Overlays*

This article, right after distinguishing IMS, P2PSIP and their primary domains, describes two interworking scenarios highlighting some interesting opportunities for telecoms and service providers, and discusses technical issues to be addressed for achieving interoperability.

2 P2PSIP and IMS: applications vs. services

P2PSIP is a standardization effort born in the Internet Engineering Task Force (IETF), aiming to define a new protocol for enabling user devices to communicate using standard VoIP protocols like SIP and RTP in a peer-to-peer fashion, without depending on central servers. Adopting the approach of some of the most popular Internet applications (BitTorrent, Skype, FON), the main goal of such a protocol is to allow the

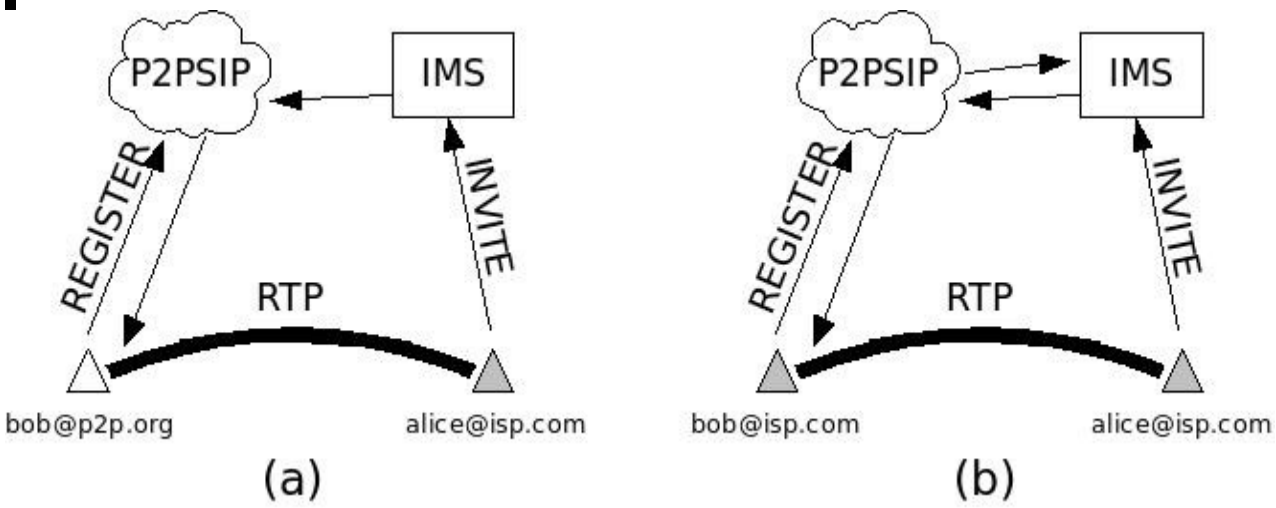

Figure 1 *Interworking between P2PSIP and IMS*

provision of communication services relying – partially or completely – on resources owned and shared by the users themselves. Consequently, any device with a network access and sufficient bandwidth can establish voice and multimedia sessions virtually with anyone on the Internet, simply running a P2PSIP application and joining an overlay, maintained either by even small service providers or by groups of users.

On the other hand, telecom operators are exploiting their packet networks with the IP Multimedia Subsystem (IMS) in order to, in the future, replace legacy switched telephony infrastructures. Such an approach, other than permitting the maintenance of only one infrastructure, allows providers to deploy their services in an "access agnostic" environment, extending their reachability at the maximum range. However, the new architecture needs to meet all the typical telco requirements related both to user experience and to legal regulation; thereby, the conversational services provided are pretty different from the peer-to-peer ones. Table 1 shows the main differences between services provided in IMS networks and in P2PSIP overlays.

A very long debate is going on about the nature of real-time communications; while traditional telephony operators still consider them as *conventional services*, Internet companies possibly interested in adopting P2PSIP see them as mere applications. Apart from religious arguments, it is becoming clear that both statements are true in different contexts. Applications, from email to VoIP, have boosted new kinds of relationships over the Internet, and are utilized mainly in virtual community and for *easy* communications; on the other hand, carrier grade services are needed in many real-life situations and are not likely to be replaced. The remainder of this document describes two levels of interworking between the two worlds, from which both of them can benefit.

3 Interworking scenarios

3.1 Interworking between P2PSIP and IMS clients

The most basic form of interworking is between clients registered respectively in a P2PSIP overlay and in an IMS network. Such kind of interaction, shown in Figure 1 (a), relies on the ability of clients in both IMS and P2PSIP networks to establish sessions with regular SIP user agents. As long as the networks have their entry points registered in the DNS – Interrogating Call Session Control Function (I-CSCF) for IMS, Proxy Peers as described in section 4 for P2PSIP – and no restrictive policies rule them, operations happen as in case of session establishment across different domains.

This type of interworking is useful for enabling communications among different contexts, but does not provide any technical enhancement to either of the two environments. Moreover, it is worth noting that, as shown in the example in Figure 1 (a), the P2PSIP user is registered in the overlay domain; since authentication policies in P2PSIP overlays are different from case to case, it is almost impossible to assert a minimum security level.

3.2 Interworking between P2PSIP and IMS networks

A more advanced interworking scenario is shown in the example in Figure 1 (b); in this case, the P2PSIP user agent,

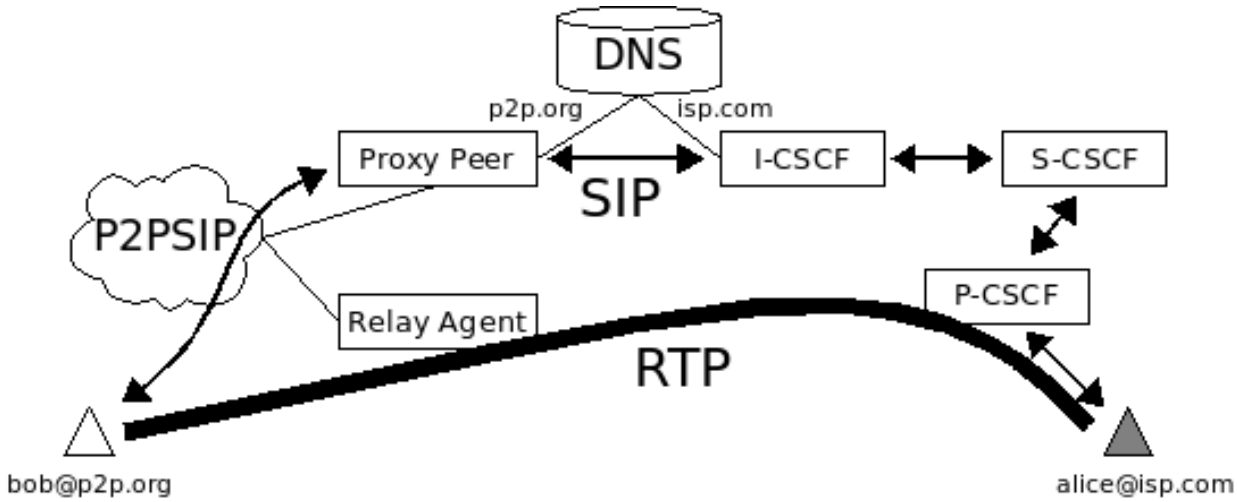

Figure 2 *Interworking between P2PSIP and IMS clients*

which has also a subscription with a IMS service provider, exploits the overlay for registering with its IMS home network. Once it is authenticated, the P2PSIP user agent can also transparently access all the IMS services the user is subscribed to (e.g. voice mail, push-to-talk) and can communicate with all the networks his IMS provider is interconnected with. In this way, an IMS user temporarily registered on a P2PSIP network would appear to his IMS Home Network as if he was on an IMS Visited Network; so his services and service logic are controlled and executed by control functions and application servers of his IMS home network.

As P2PSIP is particularly well-suited for ephemeral and limited environments whose popularity is esteemed to grow in the next years (e.g. free municipal wireless and ad-hoc networks), such kind of interworking can be a driver to extend the range of the IMS network. Moreover, for large P2PSIP networks where multimedia connectivity with the Internet is impeded by firewalls or by lack of bandwidth – a notable example are free municipal wireless networks – operators can easily deploy relay elements (i.e. STUN servers with relay capabilities) which, not only their subscribers, but also P2PSIP anonymous paying users can use along with standard tools for NAT traversal to effectively establish multimedia streams.

4 Interworking in P2PSIP

The main goal of peer-to-peer networks is to build distributed systems using resources such as bandwidth, storage and computation power, shared by participating peers. P2PSIP overlay peer protocols, in particular, aim to enable lookup services for clients initiating and managing SIP protocol sessions without relying on central servers. To enable P2PSIP overlays to fully interwork with conventional SIP domains – or, in this particular case, with IMS networks – some peers must provide more resources than those required for maintaining the simple overlay through the P2PSIP peer protocol. Indeed, connectivity with public domains requires some peers willing to share their ability to exchange messages with public hosts on the Internet and, even more important, to be registered in the public naming service (DNS) for a fully qualified domain name (FQDN) which uniquely identifies the overlay they participate in. Such peers (called Proxy Peers) has a role which is similar to the I-CSCF element in IMS.

In addition, since user agents registered in P2PSIP networks are likely to have restricted or no connectivity at all to other domains, in these cases media streams often need to be relayed when they have to reach endpoints in other domains. Such a functionality is thus provided by Relay Agents, which are supposed to be used in conjunction with standard tools for NAT traversal (i.e. STUN and ICE).

Provided that enough Proxy Peers and Relay Agents are available in the overlay for all user agents requiring them, as far as interoperability is concerned, P2PSIP domains are not different from conventional SIP domains.

5 Interworking in IMS

5.1 Session establishment with P2PSIP user agents

As release 7 of 3GPP IMS specifications natively defines

interoperability with non-3GPP SIP clients, interworking between IMS clients and P2PSIP user agents should be supported in any compliant deployment. However, in real-life scenarios some issues may threat proper interoperability:

- **IPv4/IPv6**: IMS networks were initially designed to work exclusively in IPv6 address space and thus require supplementary functionalities to deal with IPv4 network elements (as P2PSIP ones are likely to be). Such functionalities – Application Layer Gateway (IMS-ALG) and Translation Gateway (TrGW) – may not be present or enabled in early deployments.
- **NAT traversal**: P2PSIP nodes need to use NAT traversal techniques such as STUN and ICE, which require support on the user agents themselves to properly work. It is essential that IMS devices have such mechanisms enabled as mandated in release 7 of IMS specifications, even if they are not strictly required in communications between pure IMS handsets; otherwise, multimedia sessions would result in having poor support for NAT traversal and would end up being always relayed, even if direct connectivity were possible (thus consuming more resources than those actually needed).
- **Peering**: conventional agreements usually signed between service providers are not well suited to regulate peering with possibly uncontrolled peer-to-peer networks. On the other hand, too loose policies constitute a serious vulnerability and may open networks to unwanted traffic – spam and phishing in particular.

5.2 Registrations from non-IMS networks

Up to release 7 of 3GPP specifications, IMS user agents may register from outside their home network only through the Proxy Call Session Control Function (P-CSCF) of the visited network. Even if such a function in not explicitly implemented in P2PSIP overlays, Proxy Peers play a similar role, which, with some modifications, could satisfy IMS requirements. Main issues would be:

- **Link encryption**: IMS security model is based on the assumption that the signalling link between the user agent and the P-CSCF is secured at the IP layer (i.e. using IPSEC). Such an assumption is not valid in the P2PSIP case, where direct connectivity between user agents and Proxy Peers cannot be assumed.
- **Authentication**: authentication in 3GPP networks requires each user agent to be equipped with a Subscriber Identity Module (USIM and ISIM), while P2PSIP nodes are likely to be SIM-less devices or even computer programs, and thus need to use authentication methods like HTTP Digest (introduced in release 8 of IMS specifications).
- **Quality of Service**: Proxy Peers in P2PSIP overlays, differently from the P-CSCF in IMS, have no control over the bearer traffic used for multimedia communications and thus cannot take part in QoS resources authorization and negotiation. Therefore, when a user agent is registered in its home network from a P2PSIP overlay, it can only perform “best effort” communications.
- **Instability**: Proxy Peers, just as all resources in peer-to-peer environments, are subject to frequent failures and may require user agents to refresh their registration more often than what they would do when regularly roaming.

6 Conclusions

Real-time communications over the Internet happen today in various environment and use completely different technologies. Synergies and interoperability between diverse domains, rather than competition, are key factors for a fully connected world where users can always choose the most proper way for communicating. In such a scenario, both telco service providers and Internet companies can specialize in their own field, fostering each other’s own business.

Industrial standardization activities have been heading in this direction picking the SIP protocol as the base for all communication technologies, and have thus made it possible to let both centralized and peer-to-peer solutions interwork. However, this is only the beginning on the road: wide deployments are still missing and several issues still need to be addressed before end users be able to seamlessly communicate in completely different contexts.

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