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Virtual Hybrid Communications – A Telecom Infrastructure for the Metaverse

Vincent Verdot, Adel Saidi and **Lionel Fournigault**

Alcatel-Lucent Bell Labs, France

Abstract

More and more people dive into Virtual Worlds, experiencing the reality of parallel universes in almost every sector. Moreover, these virtual environments actually generate "real money" directly but also indirectly by selling virtual goods. Yet the current landscape consists in a huge number of siloed Virtual Worlds. We believe that addressing this lack of interoperability could greatly improve the user experience, ease the deployment of new worlds and open up market opportunities.

Bell Labs' Applications domain is contributing with Virtual Hybrid Communications, a mature Web technology based on communication hyperlinks that enables the bridging of real and virtual worlds. This technology allows people to remain connected to legacy telecom infrastructures wherever they are (in real or virtual) and to safely expose their communication means without disclosing any personal detail (name, phone number, etc). Thanks to open and standard API, it will also allow virtual service providers and Telecom operators to provide efficient communication solutions and innovative services.

1. An almost perfect context

More people dive into Virtual Worlds (800m registered accounts early 2010, with about 20% quarter-on-quarter increase in 2009 (KZero Worldswide, 2011)) experiencing the reality of parallel universes in almost every sector: (serious) gaming, socializing, gambling, dating, education, events/promotions, sports, music, fashion, TV, etc. Moreover, these virtual environments actually generate "real money": $5B as total revenue for the overall market in 2011 (plus $9B for virtual goods) and $8B expected by 2012 (plus $14B).

But these results would be even better if the development of virtual environments were rationalized. Indeed the recent "Virtual" industry suffers from its vertical development; a number of technologies are repeatedly "reinvented". That's the case of (inter-human) telecommunication mechanisms, different for every world and so not interoperable. That is a critical issue as social interactions are the essence of VW. Humans need to share, to exchange, to communicate, and the technical limitations of "isolated" worlds are pragmatically not acceptable regarding the end-user experience.

In Bell Labs, we believe that easing the deployment of efficient communication solution through existing legacy infrastructures would benefit to all the actors of the Virtual industry: users, service providers and telecom operators. But designing hybrid telecommunications is not an easy task.

2. The Challenge of Hybrid Telecommunications

If we consider the telecommunication facet of Virtual Worlds (VW), players need to communicate with "outside," friends and relatives who are not necessarily connected or existing in their current world. This need is partially fulfilled thanks to workarounds such as communication applications simultaneously launched with the VW client, typically instant messaging or IP telephony programs, *e.g.* Skype (Skype, 2011), Windows Live Messenger (Windows Live Messenger, 2011) or Google Talk (Google Talk, 2011). The problem is that people need to agree on a common solution, create a new dedicated account for every single game to ensure privacy and install other applications in addition to their 3D client.

Other solutions, hardware or software, were also released for player communities to address this issue, most famous ones are TeamSpeak (TeamSpeak, 2011), Ventrilo (Ventrilo, 2011) or Mumble (Mumble, 2011). These approaches are more adapted to gamers than the previous workaround, *e.g.* enabling n-to-n audio chats, but the players still need to install additional packages and agree on the protocol (server address, ports, passwords, etc).

Finally, system-wide solutions like Steam (Digital Game Distributor (Steam, 2011)) or GameSpy Arcade (GameSpy Arcade, 2011) propose integrated community and communication solutions in their offer as they identified the users' wishes and the market potential in term of free advertising. Of course these solutions are limited to the limited number of games and are not connected to legacy communication infrastructures.

The presence of such workarounds, dedicated software packages and emerging game features proves there is an actual need but the current approaches do not offer a satisfactory answer regarding the end-users' experience. The number of different approaches also illustrates the lack of a unified solution for Virtual-Real inter-human communication. Indeed, the current landscape consists in a hundreds of siloed, separated, Virtual Worlds: 800+ expected by early 2012 (KZero Worldswide, 2011). The main

research challenge we face is how to connect people who are potentially located in heterogeneous environments. This "hybrid communication" problem reflects a real need for all actors of virtual worlds: users, service providers (*e.g.* game editors, 3D developers), and third parties (*e.g.* telecom operators).

2.1 Customers

Providing intra-world communication features is just obvious as virtual environments mostly rely on social interactions and they naturally propose the appropriate internal methods to achieve so (text and audio chats, private messaging, etc). Users interact within the VW environment but they also need to connect with the "outside", with people not connected or simply not existing in the same virtual place.

But connecting worlds implies connecting identities which must be handled very carefully, *e.g.* "SupaNoobKilla" may not be the most appropriate ID to use with your boss. Moreover, used communication modes and protocols may disclose personal details such as your voice, your face, your name, your phone number, etc. To support and encourage interactions, mandatory in a VW, it is critical to deliver safe communication solutions. So we must simultaneously ensure privacy and reach-ability, the communication means exposure and their control.

2.2 Service Providers

Integrating generic and interoperable communication functions would be a great advantage for developers, accelerating the deployments, easing the maintenance and most of all connecting their users to an unlimited number of potential new customers (through viral advertising such as experienced in Steam, Xbox Live or PlayStation Network). Moreover, providing a turn-key communication solution would allow virtual service providers to keep focused on their business core (gaming, e-learning, tourism, etc) while transparently connecting to other worlds, real or virtual.

2.3 Third Parties

Finally, third-parties, typically telecom operators could benefit from the openness of the model, leveraging new revenue opportunities. Without any specific knowledge, they could easily extend their own network to virtual environments, and propose new services such as community-based offers.

Thus, they could propose immersive communication features for professional presentations or e-learning applications, dedicated platforms (in the cloud) for gamers or even the transfer of chat messages (voice or text) to SMS. With a generic hybrid communication technology opportunities are endless for telecom operators who could finally get a share of the big (virtual) cake.

3. Using the Web as a "Pivot World"

Considering Bell Labs research works on telecommunication technologies between heterogeneous environments (Web, Fixed and Mobile networks as discussed in (Verdot et al., 2009) and (Verdot, Burnside, & Bouché, 2011)), we are in position to propose similar solutions adapted to the intrinsic characteristics of Virtual Worlds.

The previously developed technologies (*cf.* live experimentation Dundal.com (Dundal, 2010)) were realized generically enough to be extended to different use cases (here the virtual environments). We introduced the concept of "communication hyperlink" which consists in associating a URI (unique hyperlink) to any real communication mean (mobile phone, email address, instant messaging account, etc), cf. Figure 1.

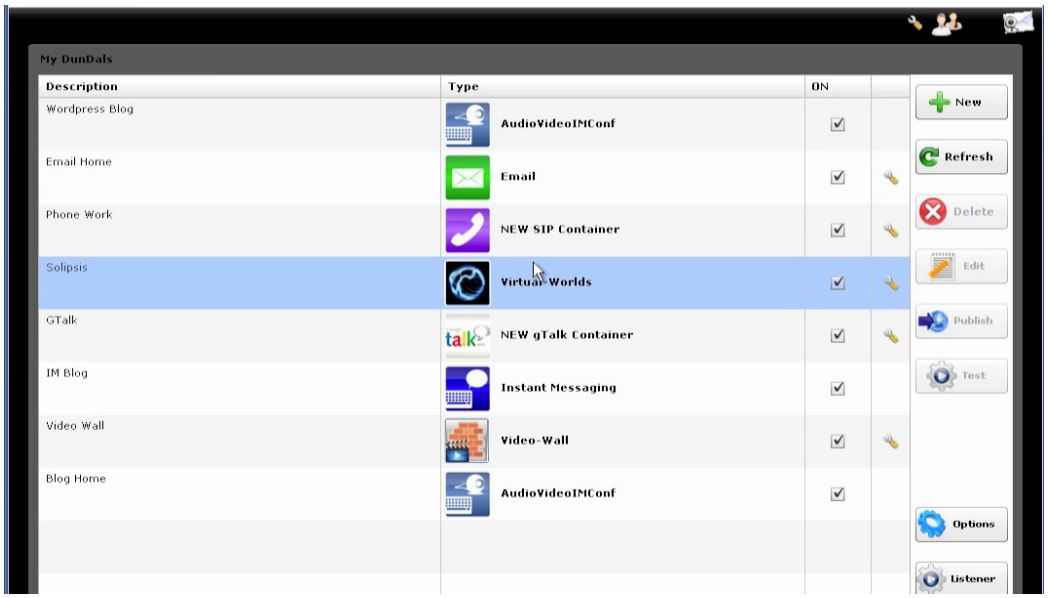

Figure 1: Communication Hyperlinks dashboard (Dundal experiment)

Then through a set of API, third-party applications (aka mashups) can establish and control communication sessions based on these hyperlinks. When consumed through a browser, the communication hyperlinks direct the user to embedded web applications that deliver the communication logic. This concept is comprehensively described in (Boussard et al., 2009) and it suits perfectly with Virtual Worlds' communication requirements which can be summarized as follows, cf. Table 1.

Table 1: Virtual Worlds' communication requirements

Privacy safe	Personal details are not disclosed (no phone number, no identity… the communication hyperlink is interpreted by the server which plays the role of secured proxy).
Pure Web approach	Based on Web technologies, the service can be easily embedded into applications through HTTP connectivity.
Full control	The publisher can modify at any time the properties and the configuration of his COM hyperlinks. So a hyperlink may be linked to any communication mean (Phone, SIP, Email, IM, Web-based COM app, etc).
Open model	A set of API allow third-party applications (aka Communication Mashups) to handle the COM hyperlinks.

This solution is generic, *i.e.* it would be implemented the same way in different Virtual Worlds as far as the underlying rendering engine is able to handle Web textures (quite common nowadays, *e.g.* Second Live, nevertheless a non Web-compatible platform could also use our technology but the integration will be less straightforward, *e.g.* World of Warcraft).

The generality of the approach is conferred by the Web, used as an interoperable pivot world. Considering that everything can be represented as an URI, we associate 3D objects (actually we paint them) with Communication Hyperlinks, which finally consists in a specific URI that can be interpreted by our Web service: Dundal.

Our strategy was to adapt this pure Web communication technology to the intrinsic properties of virtual environments and so guarantee a satisfactory user experience. Thus, we focused on specific constraints inherent to Virtual Worlds: intuitive interaction with objects (here the consumption and the production of communication), identity protection and seamless integration (inputs and outputs). If the privacy and usage aspects were already addressed by using communication hyperlinks, the seamless integration was the most challenging facet of this new technology due to the lack of standardization.

Indeed, audio-video communication is technically straightforward in a "material" world, relying on concrete input and output components, typically the microphone, the speakers, the camera and the screen. But what happens if one or more of these components are virtual, like that's the case in 3D environments. How to access to a virtual microphone or camera's data and how to play it in a virtual speaker or display? Multimedia aspects of a virtual world are handled by inner mechanisms which may vary from an application to another. We cannot impose how inputs and outputs are managed within a virtual environment as the corresponding multimedia engines usually depend on the world requirements (physics vs. quality, etc). Instead, we propose a set of API that can be accessed by the virtual world application to register its own multimedia output streams, subscribe to incoming input streams and control the communication signalling. Thus, the VW application can adopt any multimedia engine, using our technology via the provided API to transparently interoperate with other worlds (virtual or real). The proposed architecture is described in next section.

4. Implementation and User Experience

The solution consists of two parts: a Web service holding of the communication hyperlink platform plus the Virtual Hybrid Communication mash up (actually a dedicated application that handles VW functions), and a virtual world interface composed of two interfaces (Web and media) to handle the signalling messages and the multimedia steams (cf. Figure 2).

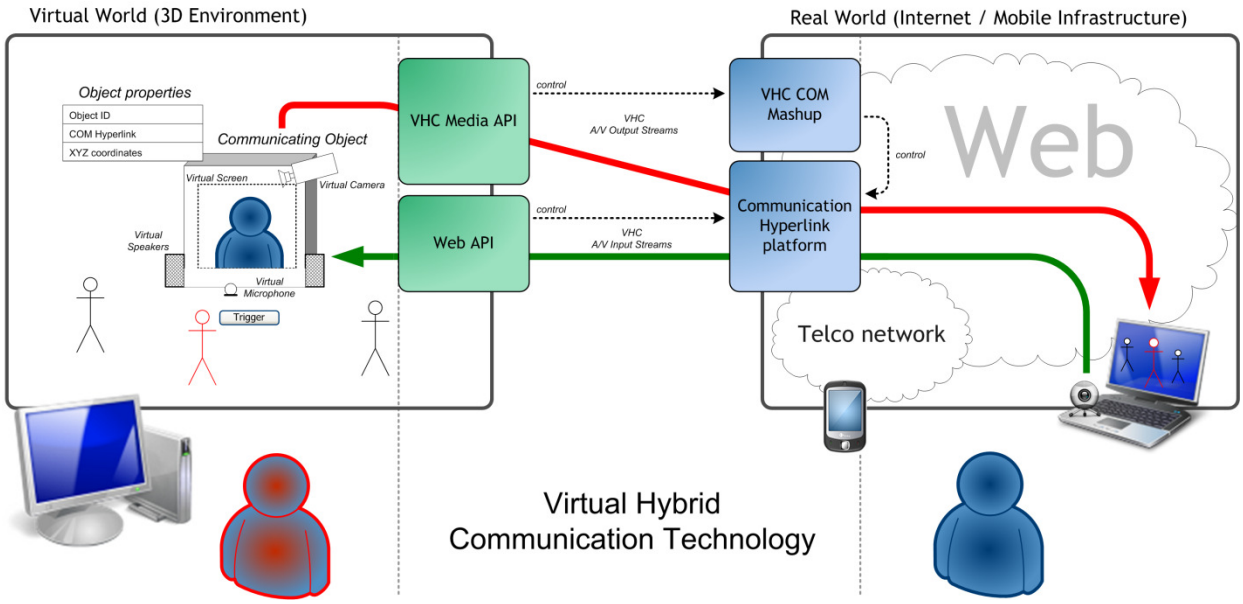

Figure 2: Virtual Hybrid Communication technology.

We will not go into the details of the communication hyperlink platform in this document as it was comprehensively described in (Verdot, Burnside, & Bouché, 2011); however we can summarize its three main components as follows.

4.1 The Web Exposure Framework (WEF)

The WEF is a flexible Web communication model based on hyperlinks. It enables the ability to bind an URI to a specific communication mean (phone, email, instant messaging, etc). It also controls the service delivery between the caller and his correspondent and may be requested to modify the communication properties (*e.g.* changing the hyperlink's communication type).

4.2 The Web Media Gateway (WMG)

The WMG is a network component which ensures the physical interconnection of heterogeneous environments (e.g. Web, mobile, etc). If necessary it re-encodes and repackages incoming data streams to guarantee the interoperability between heterogeneous systems (*e.g.* different media codecs, transport protocols, etc), cf. (Boussard et al., 2009) and (Verdot et al., 2009).

4.3 A Unified API

The API is the exposed part of the system, a fine-grained interface allowing external applications to fully and generically control the multimedia communications (signaling and media streams). This set of API is open to developers and was documented in (Communication Mashups, 2010).

Within the virtual world, "communicating objects" are created, associated to a communication hyperlink generated in the external platform through the API. The innovative part of the solution resides on the client side, *i.e.* in the virtual domain. The Web approach allows seamlessly and generically managing the VW inputs (typically audio, video streams and the corresponding control messages for a videocall). However, it is not possible to let this Web component (the one integrated into the VW) handling the media streams as they are... virtual. The Web component can only capture “real” inputs: the computer’s microphone, camera, etc but it is not even aware he is actually instantiated within a virtual environment. So only the platform (the VW application, client and/or server) produces those streams and registers them to the VHC platform via the provided API. Then, the Hybrid Communication service dispatches these data flows and the corresponding signaling messages external clients (mobile phone, IM server, another virtual world, a Web page, etc).

Several prototypes of this platform were implemented. We tested various hybrid multimedia communication scenarios with the open source world platform Solipsis (Solipsis, 2010) in collaboration with Orange Labs and Artefact0. We modified the in-world modeller to add new properties to created objects, such as the ability to associate them a communication hyperlink (cf. Figure 3). Thus, we created communicating objects by adding them a Web communicating texture without unveiling the actual communication identifier (*e.g.* phone number). Simply by clicking on one of these objects, the user was connected in audio-video with his correspondent (the one who created the object) on his computer (Web application) or on his phone (IP or legacy), cf. Figure 4. This proof of concept demonstrated the ease of creation and consumption of communication objects within a virtual environment through our API. It also showed that multimedia communications may be delivered between heterogeneous environment, interconnecting virtual and real worlds.

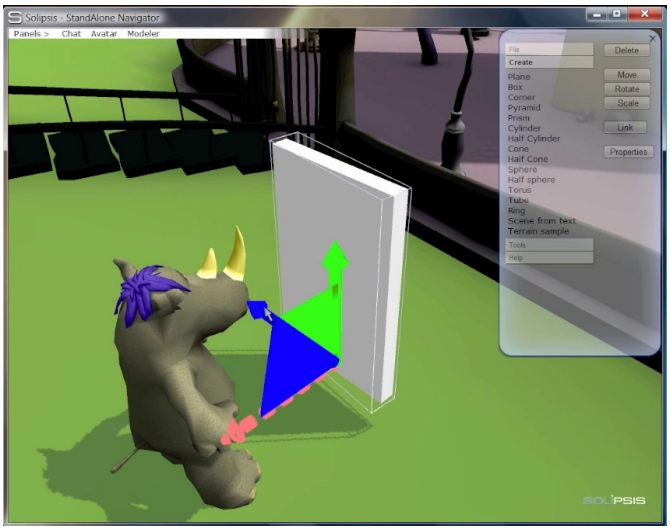

Figure 3: Solipsis' in-word modeller

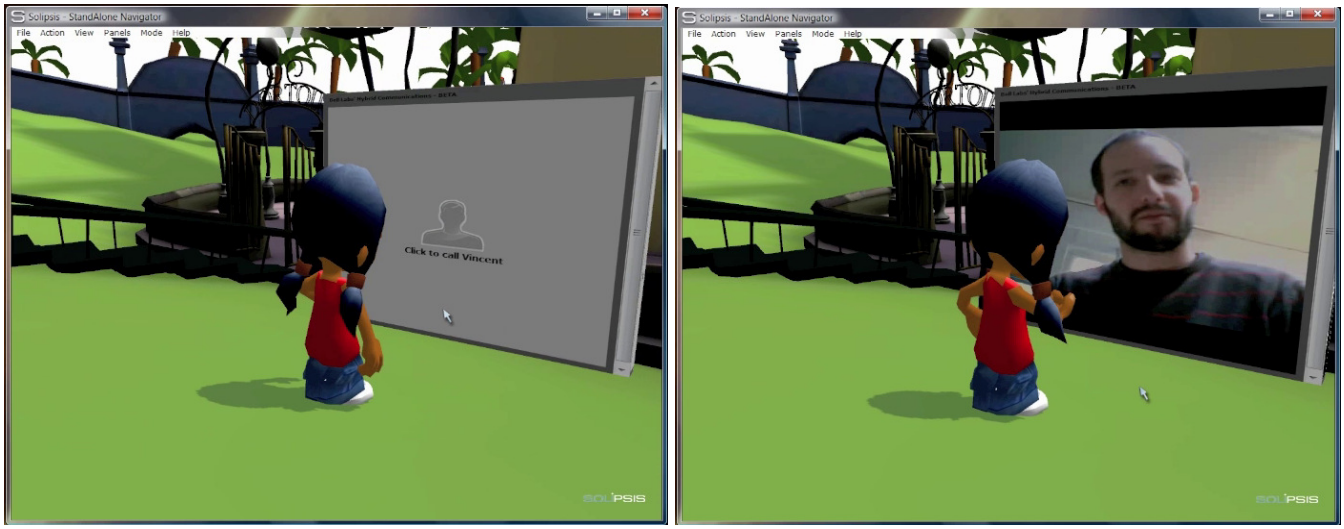

Figure 4: Communicating object (before and in-call)

In collaboration with La Cité des Sciences (famous museum in Paris), we also experienced bidirectional multimedia telecommunication between real and virtual worlds through a mobile terminal in a virtual museum / tourism scenario, cf. Figure 5.

Figure 5: Hybrid multimedia telecommunication from a mobile terminal

Finally, we also implemented another prototype in a different scenario to prove the flexibility of our communication solution. We connected the massively multiplayer online game World of Warcraft with the instant messaging service Google Talk, cf. Figure 6. Players communicate within this game through a textbox as audio-video objects would not fit within the game's theme (heroic fantasy). We implemented a game's plug-in that uses our API to manage textual communication between the virtual environment and an IM application. This proof of concept proved the flexibility of our model and the generality of the API that enable multimedia communications between worlds while preserving their intrinsic constraints.

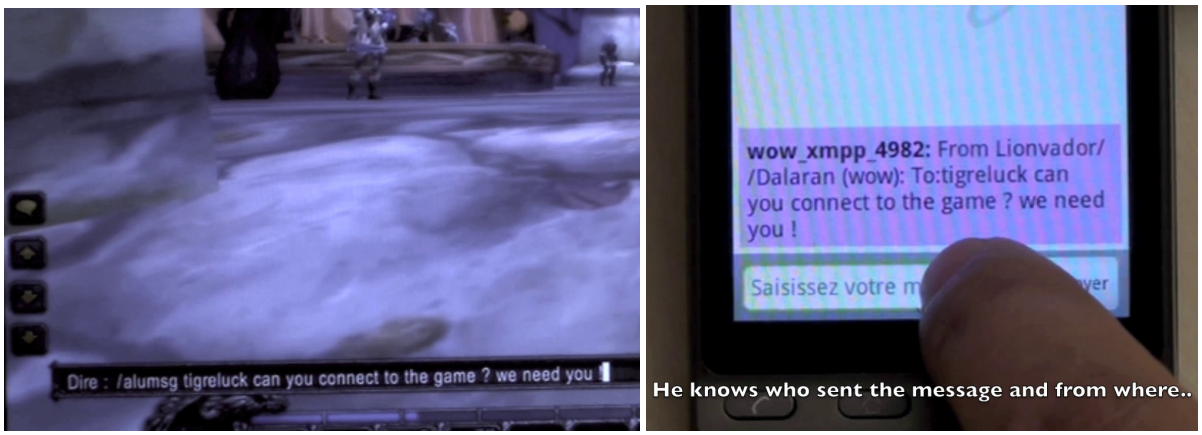

Figure 6: World of Warcraft in-world text chat to instant messaging

5. Conclusion

The Hybrid Communication technology benefits from the previous works realized in Bell Labs Application Research domain on connecting heterogeneous environments. The presented architecture and the set mechanisms based on the Web as an interoperable pivot allow a painless and efficient integration of communication features in a virtual world's platform. These telecommunication functions are convenient, fully configurable, protects users' privacy and last but not least, can be seamlessly bound to any communication mean: email, phone number, instant messaging, SMS, Web-based Communication, etc.

This technology was successfully experimented in several scenarios and platforms (Solipsis, World of Warcraft). It proved the concept and brought really interesting results on the generality and the ability for the end-users to safely expose his real communication means in virtual environments. Comprehensive end-user experimentation is planned for the next months to evaluate usability and communication objects design and so identify the interaction requirements for such communicating objects that open windows between parallel but different worlds.

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