World Play: Playing Internationally in Real-time

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ABSTRACT

Funded by CANARIE Inc., the ENJEUX–S project (ENvironnement évolué de JEUX éducatifs et de Simulations en ligne) aims to develop a real-time communication interface that enriches the environments of educational games and simulations developed in the SAGE project. This interface allows for the exploration of a wealth of real-time interpersonal communications in educational situations which utilize online games and simulations. The elements of the interface are built on a Web services environment which rests on a SOA architecture. This novel approach permits universal broadcasting of games and simulations over the Web without any prior loading of software, assuring an increased accessibility of services, the interoperability of platforms and the re-utilization of components. The advances of the *User-Controlled Light Paths* (UCLP) CAnet*4 fiber optics network guarantee the ENJEUX-S project the instantaneity of communications and a wider visibility. The project is part of ongoing research being carried out by the SAGE network. In this paper, we present a brief description of SAGE project games and simulations, the ENJEUX-S interface and its architecture.

Keywords
Communication interface, Educational games, Simulations, Generic game shells, Web services, SOA (*Services-Oriented Architecture*), Synchronism.

INTRODUCTION

Online educational games and simulations, like video games on the Internet, are more and more demanding in bandwidth, in proportion to the integration of multimedia and communication components. The advances in the CAnet*4 technology in the domain of fiber optics and high-speed links with the possibility of completely optical routing via *User-Controlled Light Paths* (UCLP) as well as optical bridges, permit the experimenting of applications that facilitate instantaneous and simultaneous exchange of data.

It is in this context that the **EN**vironment for Educational Games (Fr: **JEUX**) and online **S**imulations (ENvironnement évolué de JEUX éducatifs et de Simulations en ligne, or ENJEUX–S) project has been financed by CANARIE Inc. The project goal is to develop a real-time communication interface based on the Web Services model that will enrich the environments of educational games and simulations developed in the SAGE project. By integrating the communication components in real time (video, voice, sound, chat, white board and online access management) into the environments of educational games and simulations on the Internet, the interface introduces the dimension of telepresence. This integration, which is one of the originalities of the project, permits the exploring of rich educational situations (retroactivity, direct dialogue, immediate assistance, shared strategies, help, etc.), where the real world meets the virtual world to exploit situations in 2D or 3D, simple or complex. The development of this interface also has the objective to increase the communication and interaction capacity of generic multi-station game and simulation shells developed within the SAGE[1] university portal as well as existing games and simulations.

[1] SAGE stands for **S**imulation **a**nd **G**aming **E**nvironment for learning. It was translated from the French acronym ApprentisSAGE-JeS (Apprentis**sage** par les **j**eux **e**t **s**imulations).

The ENJEUX-S project (http://enjeux.savie.ca**)** is part of the ongoing work of the Canadian research network SAGE. In this short paper we present a brief description of the ENJEUX-S interface, its architecture, and the design stages on which its development is based.

In this paper, we present a brief description of SAGE project games and simulations, the ENJEUX-S interface and its architecture.

1. SAGE PROJECT GAMES AND SIMULATIONS

In the SAGE project, two generic shell prototypes will be developed:

- a generic Internet game environment allowing the development of games adapted to health-related fields;
- simulations conceived from real or adapted clinical cases which allow to make a learning based on an approach by resolution of problems.

To understand developments envisaged in the ENJEUX-S Project, it is necessary to explain the central concept of generic shells designed by a research team using a game application.

1.1 The generic shell structure

The shell is based on a computer structure which implies a conflict, a set of rules which govern player movements and the criteria allowing to end a game by establishing who has won. This structure can be easily adapted to a wide range of objectives and educational contents ». (Stolovitch and Thiagarajan, 1980; Sauvé and Chamberland, 2003; Sauvé et al.; 2002; 2003). This computer structure was developed from existing game which can be decomposed into two main parts:

- The "frame" determines the way the game is played: rules, game and player movements, challenges to be met by players and winning strategies which they can implement. As for constructing the shell, a game is emptied of content to reveal its specific underlying structure. The structure, once it has been clearly defined and analyzed, becomes a "frame" which can be programmed so as to become a generic shell.

- The content has to do with the information dealt with in the game: in the case of an educational game, content refers to set objectives and planned competencies which will be developed through practice, by playing the game. So, when the game has been elaborated, simple mechanisms allow the designers to insert new contents with predetermined objectives to generate a new educational game adapted to a particular target population. Once the contents have been integrated, the environment automatically generates the on-line game. Currently, the environment generates on-line games which can be played at individual workstations.

The innovative aspect of these generic shells for games and simulations is that teachers or trainers can, in less than 90 minutes, add their own learning contents to the shell while being perfectly compatible with the game or simulation frame. It is this fundamental characteristic, the interchangeability of content, that makes this computerized game or simulation shell such an interesting educational tool. By using different contents, teachers can build many new games or simulations, compatible with various target populations and educational levels, from the same game or simulation generic shell which can serve any number of different educational purposes: memorization, understanding, training, evaluation, research, brainstorming, collaborative work, etc.

1.2 Shell Re-engineering

The SAGE team is currently reengineering existing game shells to migrate from the current single-player gaming environment towards a distributed, multiplayer environment [Figure 1]. This environment will support on-line multi-user functions and will offer various types of transactional and interpersonal interactivity. With regard to SAGE team simulations, the generic shell concept is examined to establish how it will allow for the integration of real or adapted clinical cases using a problem solving-based learning approach. Eventually, development work will permit migration of the educational games and simulations developmental and experimental technological environment

based on the Customer / Web model towards the model Web (WebServices) services which will offer immediate access to users via the Canadian Ca*Net 4 wideband network. These shells allow teachers to develop, quickly and in a user-friendly way, simulations and educational games adapted to their training or educational needs in various contexts.

2. THE ENJEUX-S INTERFACE

Combining the functionalities of collaborative work (Villardier *et al*., 2003; Probst *et al*., 2004), ENJEUX-S offers an environment that activates, among others (1) online games and simulations, (2) games developed by means of the generic shells of the *Carrefour virtuel de jeux éducatifs*[2] (Virtual Crossroads of Educational Games), and (3) games and simulations of the SAGE portal. Functional, easily accessible and completely transparent to the user, ENJEUX-S uses Web services for the management and operation of online games and simulations, and real-time communication services (videoconferencing, audio and keyboard chat) to support a collaborative work environment between users. The only equipment required is a Web camera, headphones and a high-speed Internet connection to be transported into a virtual world of games and simulations. No downloading of special software is required.

Among other things, the ENJEUX-S interface allows players to communicate between themselves privately, or in public during the unfolding of the game by means of specific functionalities. This real-time communication may be

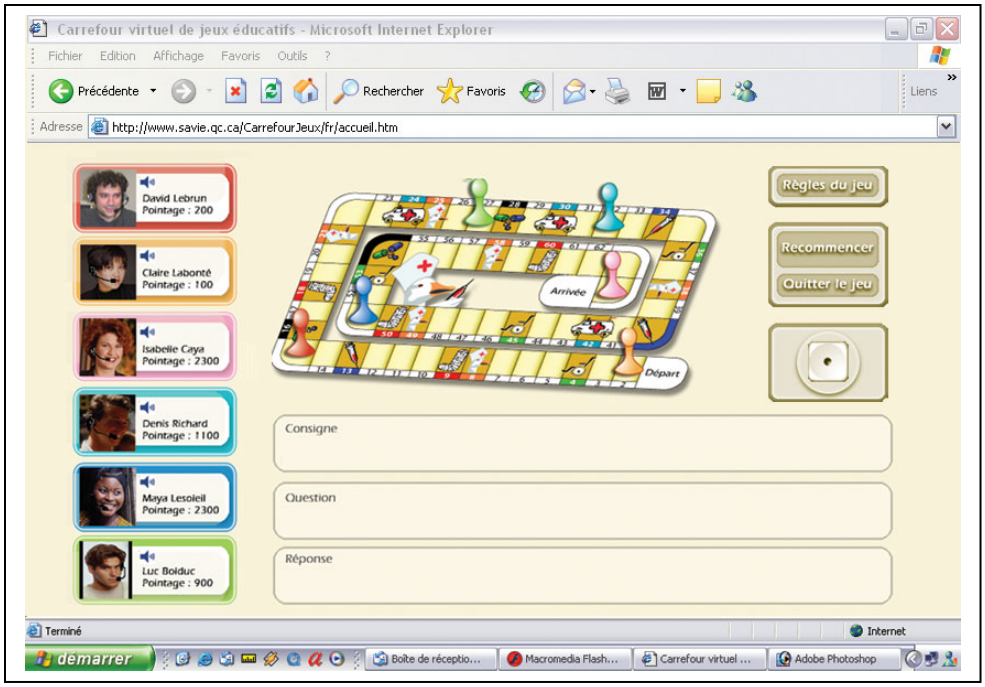

Figure 1. A simulated screenshot of the collaborative ENJEUX-S environment

done in audio or video/audio modes, in addition to video chat on demand. Each player can also, at any time, access a white board that provides information on the evolution of the game according to certain parameters: list of active players, tally, unfolding of the game, rules, configuration of the environment of other online players, etc. This interface [Figure 1] also offers different display modes (skin) that allow players to adapt themselves to the game or simulation context, and that can be parameterized by them according to their needs. Studies are underway currently to develop translucent objects in Flash, which would be superimposed on the background of the interface that

[2] Five generic game shells have been developed by a team of researchers of the Centre d'expertise et de recherche of SAVIE thanks to funding from the following granting institutions: NSERC (Telelearning Centre of excellence), 1995-1999; Bureau des technologies d'apprentissage (HRDC), 2000-2002; Francommunautés virtuelles (Industry Canada), 2000-2001; Fonds Inukshuk (2002-2004). A sixth shell will be developed with a SSHRC-INÉ grant (2003-2007).

constitutes the game proper. This hypothesis would permit players to continue playing without exiting or loss of continuity of the ongoing game and to remain in full contact with the other players. On the graphical level, this solution offers the advantage of an improved visibility of the game or the simulation, while conserving all the elements of the audiovisual communication.

3. THE WEB SERVICES ARCHITECTURAL MODEL

The ENJEUX-S team has built an architecture that is essentially inspired by the development of Web services based on the SOA (*Services-Oriented Architecture*) model for the management and operation of games and simulations, and communication services (middleware) to support a collaborative work environment between users.

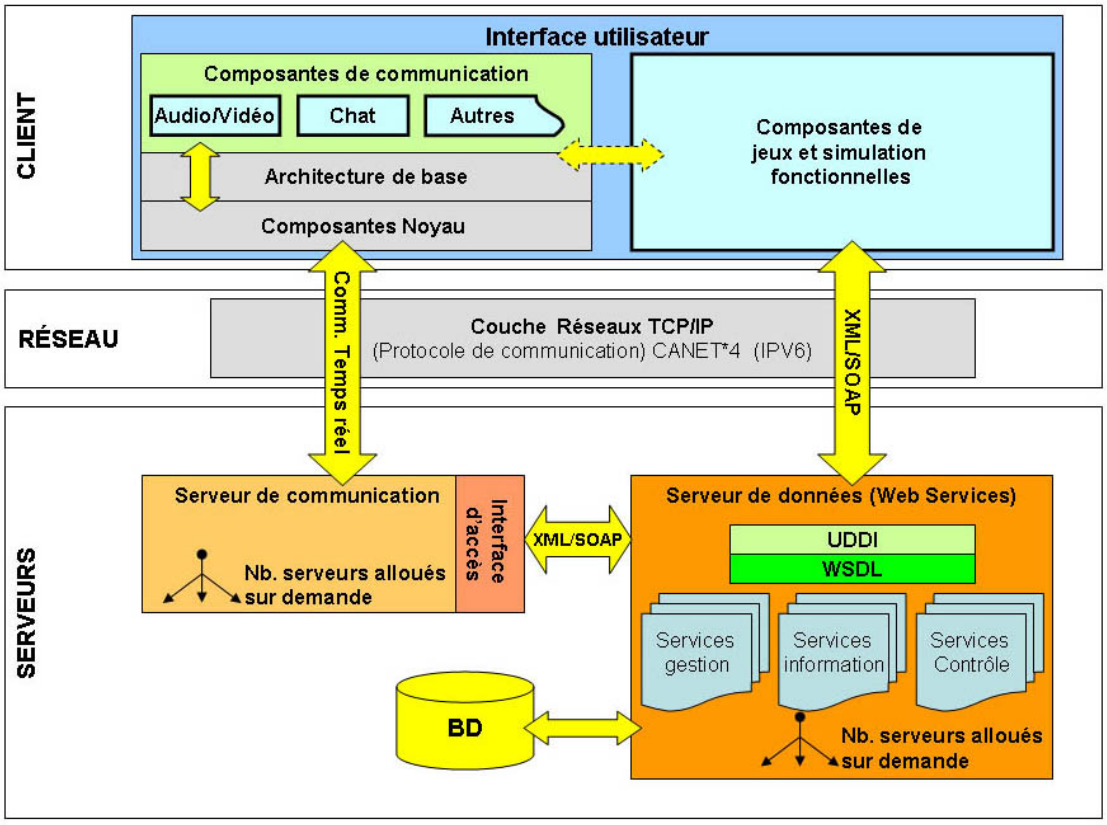

Figure 2. Model of the SOA Architecture of ENJEUX-S

The diagram in Figure 2 shows the details of the SOA architectural model. This model is based on a series of hierarchical layers:

(1) a **client** layer representing essentially the user interface, which contains two types of components - real-time communication components, and game and simulation components;

(2) a **network** layer that transfers the data to the servers; and

(3) a **server** layer containing different types of servers: a *communications server* for the purpose of managing and transmitting in real-time the communications flow (video, audio, data) between participants, as well as a *data server* (Web services) that executes the tasks or requests in a database. The database contains information on the participants and the unfolding of games and simulations (profile, authentication of participants, rules, movements of actors and objects, tally, etc.). Between the layers, the XML/SOAP language provides for encapsulation during an information exchange between two distant and different systems where a data conversion into a universal language is required. This encapsulation is done during the exchange of information in both directions between the client and the server, hence its representation in the links connecting certain components of the architecture. Let us examine in greater detail these components.

The **client layer** is composed of two types of components :

- The real-time communication components (videoconferencing, audio and keyboard chat), developed with Flash in this project, are based on an underlying framework *(Component Framework)* that structures the functionalities of each communication component and links them to the nucleus *(Core Object Model)*, which manages the peripheral devices (microphone, camera, screen capture, etc.) and the main classes of the operating system using the FlashCom technology of Macromedia.
- The functional game and simulation components constitute the central portion of the client interface. They are composed of two types of products: (1) existing online games and simulations, the integration of which is transparent (independently of their development platform) and straightforward in our enhanced framework, and (2) games and simulations obtained from generic shells of SAVIE and the SAGE project.

The **network layer** uses the communication protocols and services of CA*net4 of CANARIE. This layer offers a bandwidth management with a multimedia and multipoint quality of service in real-time, while ensuring the reliability and the security of the network. Furthermore, it facilitates the transactional and interpersonal interactions between a large number of users of online games and simulations, which is what the SAGE project is looking for. It also allows interoperability with international high-speed networks.

The **server layer** integrates two types of servers:

- The communications server is based on the Macromedia solution of the Flash Communication MX Server which ensures the management of exchanges between the users and the communicational components developed in the project. An *access interface* connects the communications server to the data server in order to perform management tasks or requests.
- The data server (Web services*)*, developed for this project, acts as intermediary between client requests and the ENJEUX-S database. It offers *management* services by processing requests related to the management of groups, of profiles and of user identification. As far as *information* services are concerned, they correspond to the requests of the various components of the architecture. A number of *control* services permit the management of certain actions made by the users during games or simulations. These last services are limited to the control of games or simulations developed within the SAGE project and which take into account our architecture.

4. THE DESIGN OF THE ENJEUX-S INTERFACE

In the first place our project is based on a collaborative approach (Desgagné, 1997; Miles & Huberman, 2003) and a participative procedure (Floch'lay, 1997; Mayer *et al.*, 2000). This approach, which is primarily based on the collaboration between the researchers and the parties implicated in the formative evaluation of the interface, guides the evaluation protocol in order to associate the medium to the elaboration and the validation of the interface on the one hand, and on the other hand in the data collection process it favors the point of view of those who are users.

The development of ENJEUX-S [Figure 3] is based on an adaptation of McGriff's (2000) iterative pedagogical design model (analysis, design, development, experimentation and evaluation), of the technique of testing with experts (Perron and Bordeleau, 1994), and of a sample of the target public produced by Sauvé *et al*., (2002, 2004) during the development of generic shells for educational games. The ENJEUX-S interface was developed by adapting the *ADDIE* (analyze, design, develop, implement, and evaluate) iterative design model (McGriff, 2000), with a feedback obtained by using the *Learner Verification and Revision* model (Sauvé *et al.*, 2002) with both experts and small samples of the target audiences as illustrated in Figure 3.

Analysis

- Analysis of the target clientele and the experimentation contexts.
- Identification of the objects and functionalities forming the interface.

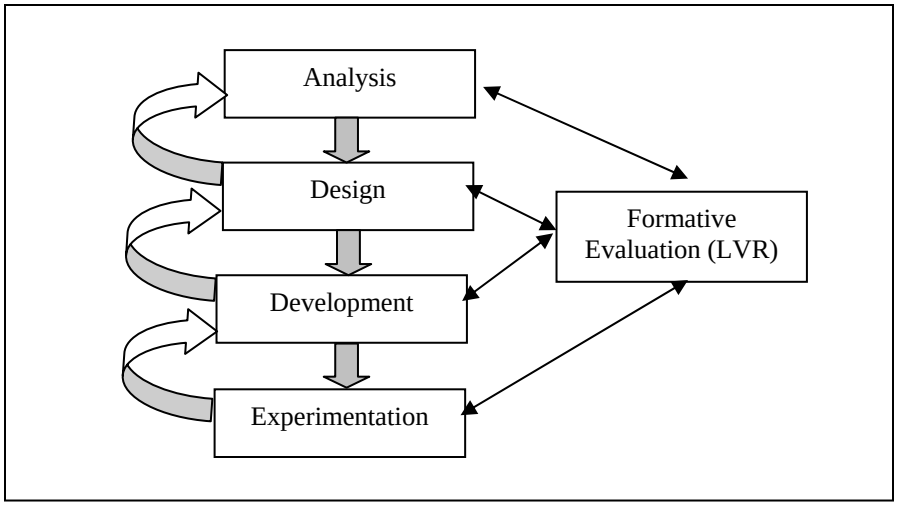

Figure 3. Iterative Design Model for Generic Game Shells

- Pedagogical and technological specifications of the ENJEUX-S interface.
- Validation by the researchers and partners associated with the project.

Design

- Scenarization of the conceptual model of the interface and validation by the members of the SAGE network.
- Writing of technical specifications.
- Infographic sketches of the environment.
- Scenarization of the screen pages and functionalities.
- Validation by the researchers and the partners associated with the project.

Development

The Object-Oriented programming approach (*Document Object Mode)* was adopted for the development of the interface. It facilitates, among others: (1) the rapid development of the application and its updating (Olsen, 1995); (2) the continuous revision and correction of the environment during its elaboration and technological evolution; (3) the testing of some of the parameters of the final system in a reduced amount of time, and (4) the optimization of variable parameters in real-time, the evaluation of ideas (subjective or other) and the convincing of the various potential partners of the final product's usefulness (Lauwereins, 1995; Wirth, 1995). These are its main steps:

- Infographic design of the environment.
- Programming of the different functionalities.
- Functional integration tests of the ENJEUX-S interface with existing games and simulations, and those developed with the generic shells produced by SAVIE and the SAGE network.
- Parameterizing of the translation matrix.
- Establishment of the indicators of the functionalities.
- Technological Beta tests (technical team).
- Benchmark testing of the functionalities (with the partners associated with the project)
- Development of contextual help menus and self-instructional tools for the environment.
- Language adaptation of the interface and validation with samples of the target clienteles.

The use of standards defined by W3C (XML, SOAP, WSDL and UDDI) allowed us to develop objects corresponding to the norms and standards of accessibility, interoperability, reusability, durability and adaptability. These norms meet those of the Canadian computer industry. They permit to envisage a complete ubiquity of services, making them accessible and transparent to the majority of users. To access a game or a simulation, the

players no longer need to download software and other components, but they simply type the URL address of the site.

Implementation and Formative Evaluation

- Development of the methodological framework.
- Development of experimentation tools and validation with the targeted public.
- Establishment of experimentation sites and work calendars.
- Experimentation in the various environments.
- Gathering and analysis of data for the codification of programming changes.
- Final programming of all revisions.
- Last validation of the functionalities with the partners

CONCLUSION

At the completion of the ENJEUX-S project, an enhanced environment integrating multi-station games and simulations will have been developed, accessible through Web services that offer real-time communication components. Combining the functionalities of collaborative working, the "**EN**vironnement évolué de **JEUX** and de **S**imulations" (ENJEUX-S) will provide a work area that activates, among others, (1) online games and simulations, (2) games developed by means of the generic shells of the *Carrefour virtuel de jeux éducatifs* (Virtual Crossroads of Educational Games), and (3) games and simulations of the SAGE portal. Functional, easily accessible and completely transparent to the user, our environment uses Web services for the management and operation of online games and simulations, and real-time communication services (videoconferencing, audio and keyboard chat) to support a collaborative work environment between users. The only equipment required is a Web camera, headphones and a high-speed Internet connection in order to be transported into a virtual world of games and simulations. No downloading of special software is required.

In a second phase of development, we shall emphasize the development of the ubiquity to export the shells of games on environments nomads and on the development of a new generation of immersibles interfaces 3D. The objective of these developments is to make even more real the environment of games and simulations. To realize these developments, we shall create scenes in 3D in which will evolve the objects of communications (video cat) developed in the first phase of the project STAKES and the virtual avantars) persons who will reproduce the actions of each of the players.

Canada will profit from this project because it brings together private and public partners with a view to promote the Canadian expertise in this domain, as well as the visibility of its research and educational communities at the international level.

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