

Impact of MSRP protocol integration in e-learning platforms of universities

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Abstract— This paper discusses a solution for digital universities to extend the functionality of their e-learning platforms to improve, not only their delivery model of instructional content, but also their way of assessing the knowledge of the students. Indeed, this paper proposes a solution for the platform of Moodle, allowing to create virtual classes, integrating the sharing and the control of screens, the transfer of files independently of their type and their size, the video, the audio, chat, different actors. This solution integrates an audio and video knowledge assessment tool for language lesson modules and enables learners to learn to communicate.

Our solution is built around MSRP and WebSocket protocols, is used directly with current browsers as well as computers, smartphones and tablets.

Our solution has allowed, among other things, language teachers and STEM to perform work online and face-to-face as it should without necessarily resorting to the MCQ or be obliged to modify the tests to take into account the difficulties related to the evaluation of programming and networking lessons.

Keywords— *E-learning, STEM, evaluation, Learning Management System, Virtual classroom, MSRP, WebSocket*

I. INTRODUCTION

Today, with the development of ICT tools at the service of education (establishments interconnected by fiber optics, broad bandwidth Internet, establishment of pooling space, cloud computing,), the classical universities integrate Open Training and [1] and those already virtual must meet the challenges of the quality of communication and exchanges, especially during practical work in teaching-learning situations, in a context of state option to guide trainings to STEM [2].

Open and Distance Training, which initially interested professionals who wanted to complete their training, welcomes more and more young people as soon as they obtain their baccalaureate, which is why most higher education institutions

in Senegal give a great importance to this educational innovation in their training practice.

These young people need to be well trained in the fields, among others, of communication, and especially of STEM. To do this, many distance learning platforms exist and integrate tools, exchanges, self-evaluation and evaluation online [3]. This is the case for Moodle [4], which is used by many universities.

Certainly Moodle has a BigBlueButton plugin [5] allowing the creation of virtual classes integrating audio via the WEBRTC protocol [6], video, screen sharing using the flash that is disappearing [7]. The limitations of this solution lie in the remote control of computers that can be useful in the context of practical online work and the difficulty of entering mathematical formulas.

We believe that it would be better for universities' e-learning platforms include features such as:

- The transfer of large files regardless of their size or type,
- The share screens features in particular and resources in general.
- The possibility of remote control of computers.

Another problem encountered by e-learning, is the realization of practical work assessment of knowledge for students, in language streams and therefore our solution must take care of this issue.

For this, we propose in this paper, a solution based on MSRP [8] and WEBSOCKET [9] protocols to improve the efficiency and ease of use of e-learning platforms.

So the rest of this paper is organized as follows:

In Section II, we present the MRSP WebSocket protocol and the services offered. Section III describes the architecture of our solution. Section IV is reserved for the presentation of the results of our works and finally Section V is reserved for conclusion and perspectives.

II. MSRP WEBSOCKET PROTOCOL AND SERVICES OFFERED

A WebSocket is a web standard representing an application layer network protocol and a World Wide Web programming

interface to create full-duplex communication channels over a connection [10].

Nowadays, several technologies such as WebRTC use WebSocket to set up real-time communication tools accessible from a browser [11].

The MSRP is a protocol operating in connected mode using either the TCP transport protocol [12] or SCTP to exchange messages or files in the context of a session. The MSRP protocol places no restrictions on the size of the message or the type of content.

Two UETF recommendations define the MSRP protocol [13] [14].

The MSRP cannot establish a session itself, it relies on the SIP protocol to establish and release a multimedia session [15].

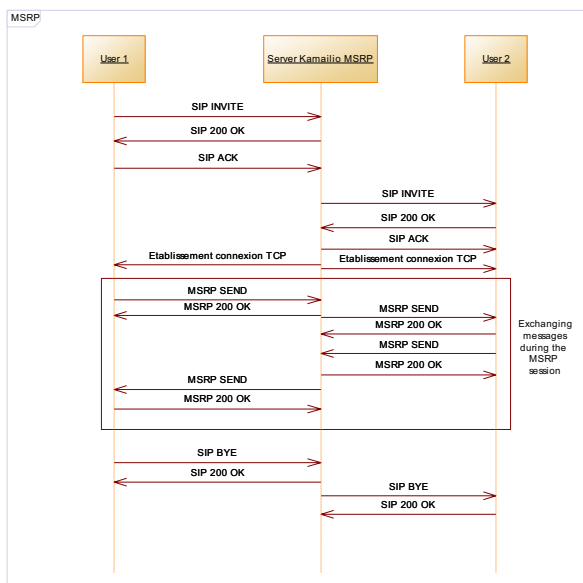


Figure 1: messaging session with MSRP

To be able to solve the problem of crossing of NAT known by the MSRP protocol, MSRP relay solutions are proposed and several implementations have been made in free software version, this is the case for the MSR Relay server [16].

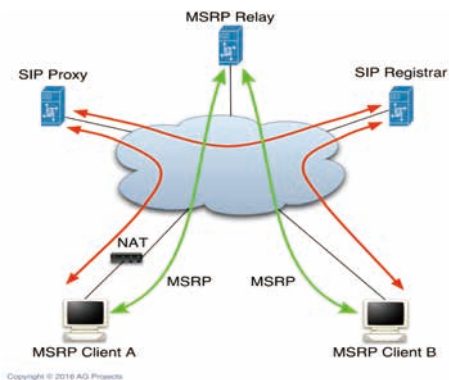


Figure 2: session message with MSRP Relay

III. ARCHITECTURE OF OUR SOLUTION

A. Solution Architecture

Figure 3 below shows the integration of our plugin into Moodle. This plugin uses an external TOIP server KAMAILIO [17] whose IP address will be parameterized in the configuration file of the module and is materialized on the same figure by:

- Presentation Lib: represents all the libraries of our plugin, which interacts with MSRP API [18].
- UI presentation: represents the views of our plugin

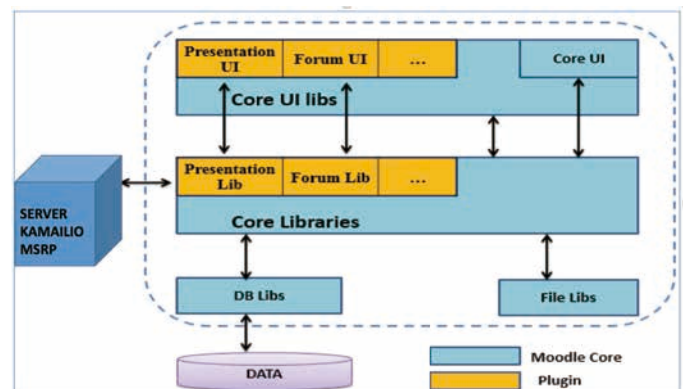


Figure 3: Architecture of the solution

B. How the solution works

The solution relies entirely on the coupling between the KAMAILIO TOIP server, the WebSocket protocols and the MSRP. The MSRP relay is also integrated in the solution to manage the problems related to crossing of NAT. Thanks to the loading and the activation of the modules, we defined rules of routing in case of transaction MSRP. Figure 4 describes the exchanges of messages between two users during a session MSRP to send big file or shares their screen; User 1 sends an instant message to User 2. The Kamailio MSRP WebSocket Server receives the message and sends it to the MSRP relay that routes the message to User 2.

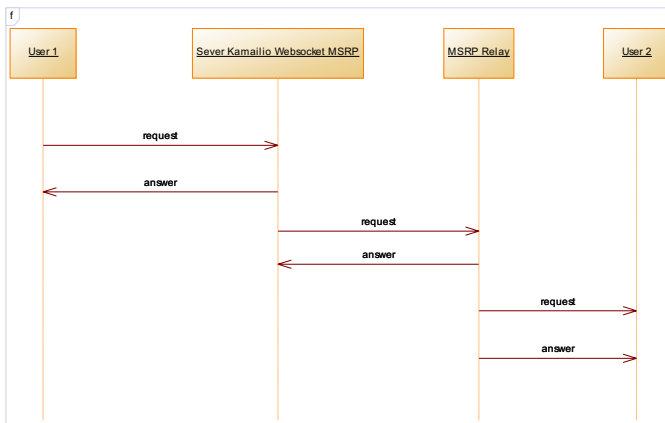


Figure 4: typical MSRP session 1

```

#!/ifdef WITH_MSRP
loadmodule "msrp.so"
loadmodule "htable.so"
loadmodule "cfgutils.so"
#endif
#!/ifdef WITH_WEBSOCKETS
loadmodule "xhttp.so"
loadmodule "websocket.so"
loadmodule "nathelper.so"

```

Figure 5: configuration Server loading modules

```

event_route[msrp:frame-in] {
    msrp_reply_flag("1");

    if ({{SIP}} == "MSRP" || {{SIP}} == "MSRP-REQ") {
        asproto = "MSRP" || "MSRP-REQ";
        xlog(L_WARN, "MSRP request received on SIP/n");
        msrp_reply("403", "Action not allowed");
        exit;
    }

    if (msrp_is_reply()) {
        msrp_reply();
    } else if (msrp_method() == "AUTH") {
        if (msrp_nextops() == 0) {
            msrp_reply();
            exit;
        }
    }

    if (www_authenticate("my_DOMAIN", "subscriber",
        "Svar(method)")) {
        if (auth_get_www_authenticate("my_DOMAIN", "1",
            msrp_reply("401", "Unauthorized",
                "Svar(wauth)");
        } else {
            msrp_reply("500", "Server Error");
            exit;
        }
    }

    if (SIP Expires) {
        Svar(expires) = (int) SIP Expires;
    }
}

```

Figure 6: MSRP transaction routing configuration

C. Description of Moodle

The term MOODLE is the acronym for Modular Object-Oriented Dynamic Learning Environment. Its development began in Australia in the 1990s by Martin Dougiamas. It is an e-learning platform, licensed under the GNU Public License (GPL), accessible via a web browser and used to manage online courses (document storage space, online activities and resources with students, registration and access rights management, tutoring, etc.) [19].

Several universities and organizations around the world have adopted this e-learning platform, as it offers a set of integrated tools designed, initially, on the basis of the pedagogical model called socioconstructivism [20].

Moodle is modular and consists of a kernel to which plugins are grafted as needed to provide additional features. Plugins benefit from a large number of services from the kernel such as generic access to the database, support for updates, inclusion of information in reports etc. Figure 2 below shows the architecture of Moodle.

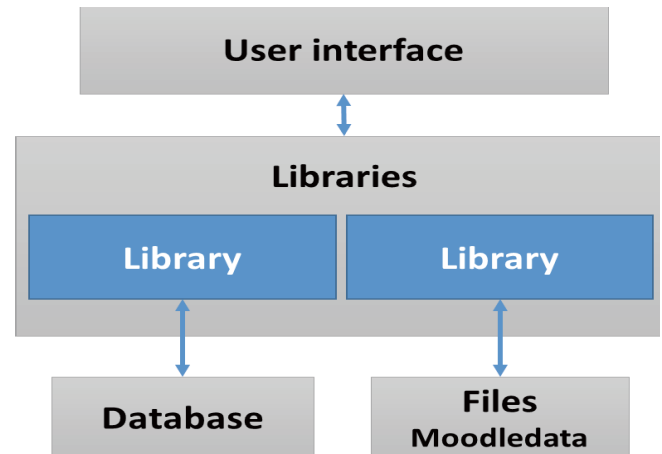


Figure 7: Moodle architecture

D. Moodle plugin development

A plugin or plug-in is a package that complements a host software to bring new features.

It can be positioned in a pedagogical sequence of a course. The following table shows some basic files of a Moodle plugin.

Tableau 1: Moodle basic files

Files /Folders	Description
version.php	It contains the following information: The declared version of the module; the minimum required version of Moodle for the plugin to work and cron settings (regular task).
index.html	Allows you to reach the list of instances of pedagogical objects in a class.
mod.html	Allows Moodle to reach the object editing screen.

icon.gif	the icon that appears in the class to symbolize the activity.
lib.php	Library functions where Moodle will look for various callbacks that provide the "standard" module information.
view.php	Allows you to make all the screens of the module.
Backup	Folder containing backup and restore information.

IV. RESULTS

A. Screen sharing

Figure 8 shows the invitation for screen sharing with the three options accept, reject, and occupy.

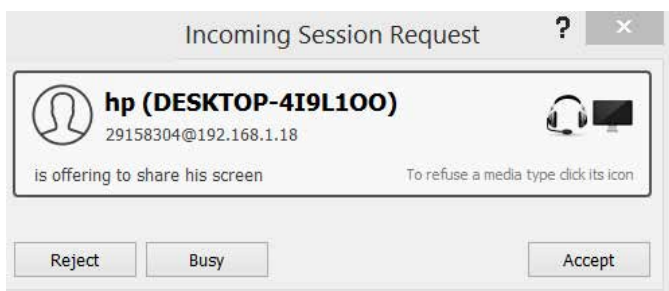


Figure 8: incoming session request

Figure 9 shows the sharing and remote control of a computer between trainer and learners. The teacher asks to take control of the learner's machine in order to show him how to handle.



Figure 9: Sharing and remote control of a computer

Figure 10 shows the sharing and remote control of a computer between trainer and learners integrating audio, video and chat.

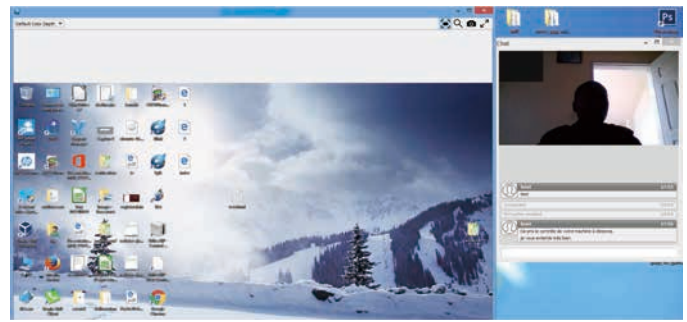


Figure 10: remote sharing and control integrating audio and video

It is important in training in the field of STEM to have a rich environment of practical work. Specific expensive software may not be accessible to remote learners Figure 11 below shows how to access through our platform to virtual machines containing specific software to enable the learners to practice.

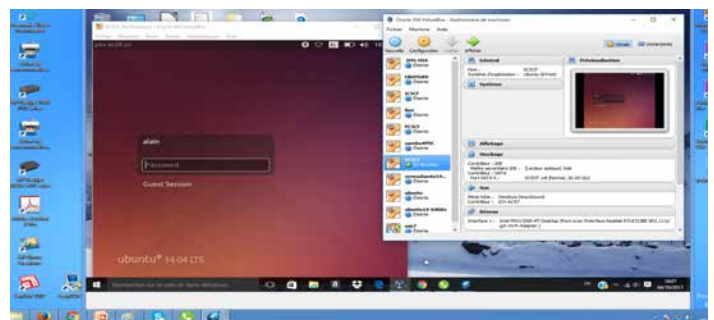


Figure 11: Remote access to a virtualization server for hands-on labs

Figure 12 shows access to the collaborative development environment from a browser. The actors can use environment and the others can access it and participate in a project under eclipse.

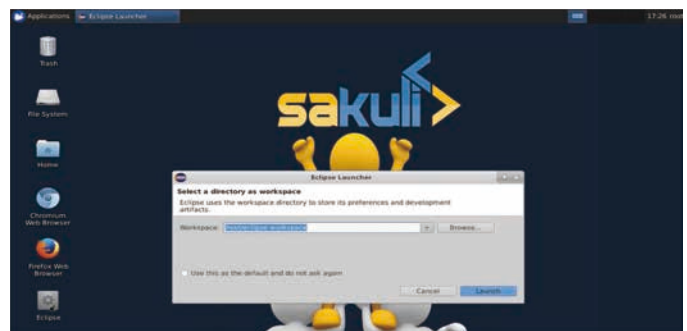


Figure 12: sharing development environment

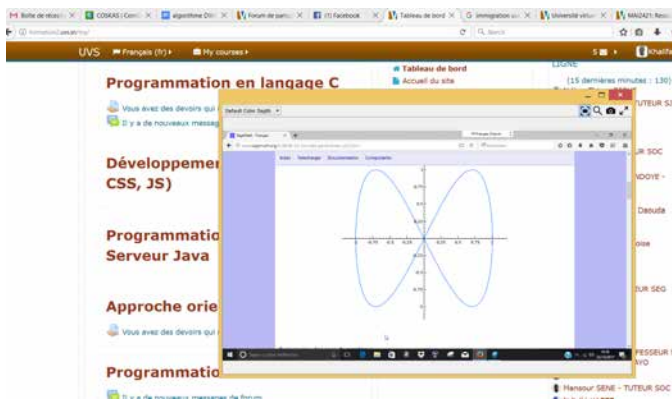


Figure 13: remote control of a learner's machine

Figure 13 shows a remote control of a learner's machine from a teacher through Moodle. The teacher shows the student how to use scientific computing software.

B. Transfer of large files

This feature allows you to send large files by drag and drop in our application.

The receiver is free to accept or refuse the file sent. In the case where the recipient then accepts, the file is downloaded to his terminal as shown in Figure 14.

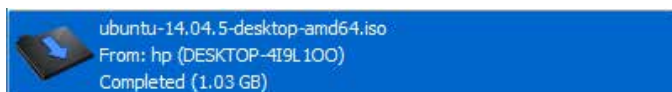


Figure 14: file receive

V. CONCLUSION AND PERSPECTIVE

In this paper, we have proposed a platform that essentially uses the MSRP and WebSocket protocols to enable digital university stakeholders to improve online labs. This solution allows the students of the Virtual University of Senegal who are already accustomed to the Moodle platform to be able to collaborate in real-time on practical work, as if they were physically together through the Moodle platform. It also allows players to exchange large files thanks to the flexibility of the MSRP protocol. This platform has also been experimented with Mathematics students for online tutorials requiring the massive use of mathematical symbols. Thanks to its real-time file transfer functionality and audio communication, it has enabled language teachers to measure the level of reading and pronunciation of students.

The use of the MSRP protocol through the WebSocket has enabled our solution to be easily integrated as a plugin into a Moodle e-learning platform already familiar to students.

In our experiments, we used twenty-four students, which allowed us to easily manage the quality of service to users. We plan to use the Computing Cloud and a load-balancing device

to manage the scalability, allowing the MOOCs to use our solution.

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