Integration of the MIT iLab architecture into the MITx platform

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Online laboratories ("iLabs") are experimental facilities that can be accessed through the Internet from a regular web browser. iLabs allow students and educators to carry out real experiments from anywhere at any time. iLabs enrich science and engineering education at universities and community colleges and enhance the attraction of STEM disciplines among middle and high school students. The iLab project at MIT is dedicated to the creation of a movement to develop and disseminate technology and pedagogy for sustainable and scalable iLabs so that they can be shared on a worldwide scale.

In the past year, the iLabs project team has been working to address the difficulty of providing students with effective hands-on laboratory experiences for science and engineering education in the context of Massive Open Online Courses (MOOCs). The ability to provide real laboratory experiences is one of the crucial components missing in MOOCs. Currently, we are developing an interface that allows the integration of the MIT iLab architecture and the MITx servers using the EDx platform. Our immediate goal is to enable the deployment of iLabs in residential MITx courses through a unified interface. This will allow iLabs to be used in online subjects designed for residential students and will provide us with valuable experience that will eventually allow us to target remote students at MOOC scale.

Our first step was to enable the integration of the iLab Shared Architecture (ISA) with open source learning management systems (LMSs). In this case, we are working with the EDx platform. The coupling of online labs with LMSs will allow a particular experiment to be customized for multiple educational environments and for the learning objectives of the lab experience to be carefully tracked and evaluated.

In order to accomplish this, we have redesigned and implemented how the users and groups in the iLabService Broker work. These changes support the automatic login from multiple user domains or authentication authorities. Authorities may be EDx or any other form of identity provider (such as Shibboleth) that is known to the iLab Service Broker and can authenticate itself to the service broker. Currently, authentication is limited to supporting the iLab ticket mechanism. We have created new management pages in the iLab Service Broker where administrators can define default groups for new users and configure auto-registration.

To support authorization and authentication from authorities and clients, two new iLab Web Service methods have been implemented:

- RequestAuthorization-- provides for the creation of tickets that will allow experiment clients from external authentication authorities to directly request access to experiment results, user scheduling for clients and other iLab resources. This has been used for SMS based scheduling and an Android client.
- LaunchLabClient-- is designed to be used for launching a client from an external LMS (EDx) using a SCORM package or other learning system package. The iLab Service Broker creates the
learning system package with the necessary authentication credentials for each client. This learning system object can then be embedded on an assignment page and used by the LMS to launch the experiment client. This package will be used by all authorized LMSs when launching the iLab experiment.

This is just the first step in enabling students to run iLab experiments from the EDx platform. We are currently working on additional changes to the iLab Share Architecture:

- Convert the current Microelectronics iLab and Elvis Java lab clients using the Google Web Toolkit (GWT) to JavaScript.
- Extend the iLab architecture to interface with the EDx/MITx system for user authentication and authorization.
- Develop mechanisms to submit iLab experimental results to the EDx Xqueue evaluation system.

Our goal is to demonstrate the integration of the Microelectronics iLab and the ELVIS iLabs for electrical engineering education in the EDx framework.

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