Beyond Content Portability:
Shifting Gears in Elearning Innovation

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The elearning revolution has been stalled for decades. Despite dramatic changes in the cost and power of technology, online learners today still see a sequence of media screen after media screen interrupted by the occasional quiz – the traditional computer-based training paradigm introduced 40 years ago, with graphics and video added. The learning management systems installed in corporations and schools track learners through the material and record their quiz scores, but offer teachers little insight into the learners' performance or problems. Learning, whether in a classroom or corporation, has not yet experienced the transformation in work processes, human resource requirements, time to market, productivity, and communications that the Internet has brought to the way we work, shop, and date.

Over the years, many prototype projects and pilot systems have shown tremendous potential to improve learning and reduce costs, only to be abandoned because technical barriers to deployment prevent broad adoption. While there are examples of wonderful educational innovations everywhere we look, they don't get commercialized or broadly adopted: successful pilots are never duplicated; new products don't succeed; and investors see Balkanized markets and unacceptable risks. Learners meanwhile see dated technology and boring online activities – nothing like what they have at home.

As we have all discovered, the Web is the ultimate knowledge resource and two-way communications medium. Informally, it is the first place we go to learn – to find what we need to know. It is not yet the place we go to teach. The Web has barely touched formal education and training. In particular, government educational technology initiatives often focus on putting the last generation of infrastructure in place. The result is underutilized technology – irrelevant to teachers and learners and unable to improve efficiency or quality. Among the ruins are gems of innovation, often with data showing their effectiveness, but they die in the lab.

The International Federation for Learning, Education, and Training Systems Interoperability, LETSI, is a community of people and organizations who see technology's potential to revolutionize the way we teach and learn online. This document describes LETSI's vision of a new architecture for elearning systems that will facilitate experimentation and the rapid spread of teaching tools and new business models. Accelerating broad adoption of innovations by removing technical barriers is key to seeing real world results.

LETSI's roadmap starts by creating standard protocols to allow today's cutting edge elearning projects that use technologies like mobile learning or multi-player games to exchange data with the enterprise systems already in places. Eventually LETSI's

architectural modernization will allow the plug-and-play introduction of new apps for teachers, learners, parents, tutors, administrators, and researchers.

What Problem is LETSI Solving?

Economic realities, demographic changes, and technological progress have made elearning an increasingly attractive option in education and training circles. The business models of some of the largest and fastest growing educational institutions are based on leveraging technology. Few students graduate from any school these days without having had some computer-based courses. In the corporate world, speed of change and cost of travel have made elearning an imperative.

While today's students live online and instinctively go to Google to find new knowledge, their actual experience of formal elearning is boring – think online traffic school. As a result, there has been precious little adoption of the thousands of local innovations by content creators, publishers, teachers, trainers, schools, and researchers – clever and potentially revolutionary innovations:

- Intelligent tutoring systems that combine programmed-in subject matter expertise with careful observation and infinite patience to offer truly individualized instruction;
- Individual or team-based immersive learning environments for exploration, rehearsal, and assessment;
- Social, collaborative, and project-based online learning activities;
- Mobile learning, for convenience and timeliness, on devices like the iPhone and iPad; and
- Online apps for teachers, tutors, and parents to plan and monitor the learner's activity online, as part of their social network.

LETSI has set out to accelerate the dissemination of elearning innovations by removing barriers to adoption. The solution requires architectural renovation.

The ideas presented here reflect a three-year collaboration of more than a hundred practitioners over the last three years – teachers, instructional designers, policy makers, administrators, entrepreneurs, engineers, and some of the world's experts on elearning software and standards. They have written white papers, participated in online discussion threads, attended workshops and weekly working group teleconferences, created software, and tested it. They discussed current practice and future possibilities, but in the end, they had to start by fixing an unforeseen consequence of an earlier approach.

Content Portability, Once a Solution, is Now the Problem

There are many barriers to adoption of innovative elearning technology. There's an entire literature on the subject. In LETSI's view, the key technological barrier is that, in order for learning activities to be used by teachers in schools and corporations today, they must be packaged in a format that runs on the school's local learning management system (LMS). Twenty years ago, this "content portability" idea solved

a big problem: content could be created anywhere and exported it into a "package" which would (theoretically) run on every organization's LMS.

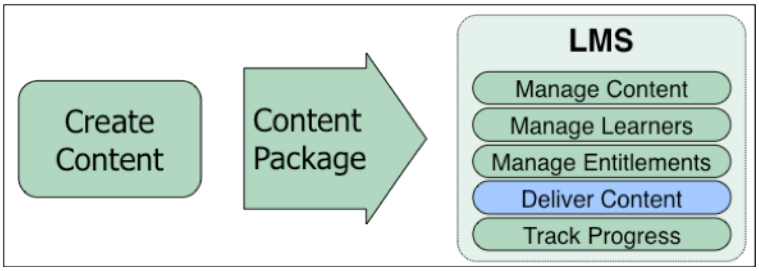

Figure 1. Today's Elearning Architecture. Learning materials exported as packages in SCORM or Common Cartridge and then imported into LMS, which in turn delivers the learner's experience.

The Content Portability approach predates the Internet. There are hundreds of LMSs used by companies and schools to manage their learning materials and their learners. Typical LMS functions include creating learning content and quizzes, creating lesson plans and scheduling assignments, tracking learner progress, keeping learner records, and even supporting an organization-wide collaboration environment. Educational publishers and custom course developers benefit from this model since they can "deliver content" to their customers in a standard format, to be stored in the customer's LMS and rendered faithfully for each learner.

Here's the rub: in order to package learning content into a standard format, so that it is portable across all the LMSs, some restrictive assumptions must be made about the nature of the experience that will be delivered by each LMS and the data that will be exchanged before, during and after the student's session. Current standards, like SCORM and IMS Common Cartridge, support the portability of traditional, single-learner, "click-next-to-continue" lessons. There's a place for this kind of learning activity, but technology has much more to offer these days.

Innovative online learning activities and tools can't reach a broad market because they can't be packaged for deployment on the installed learning management systems. Publishers and LMS vendors want to offer advanced learning activities, apps, and services, but then they are not portable – they are too complex, too distributed, or too data intensive. A new approach is needed.

On the Web, Activities Stay Put, and Can Evolve More Rapidly

Pre-web thinking is the cause of this problem. Google, for example, can add a new feature overnight for all users – no software downloads and installs. Compare overnight updates with the multi-month, million dollar upgrade process for enterprise software systems. As a result of the ability to introduce new ideas and variations quickly, web applications evolve in functionality much more rapidly than can the enterprise LMS.

At the same time, the hosted services model for software (called Software as a Service or SaaS) reduces initial costs and risks for adopters. Most of the major vendors now offer hosted LMS solutions for the same reasons:

- Low initial costs and low maintenance costs. No new hardware or IT staff required.
- Implementation and setup in days vs. weeks or months.
- Expandable as demand grows. International access automatic.
- Less vendor "lock in," since trying an alternative service is easy.
- Rapid evolution of web-based applications compared to enterprise software release cycles.
- Easier for innovators to introduce a new product, or even a new product category, so long as the new app can exchange data with the systems already in place.
- Data from one app can be made available to other systems and apps, like Firefox plugins and Facebook apps – a secondary channel for innovation.

As the LMS vendors adapt to the hosted services model, learning activities are being hosted on the web as well. While traditional learning materials may still be packaged for LMS-based delivery, new, more complex learning activities will be marketed as hosted services instead of "portable" content packages to be interpreted by each LMS.

Offering the learning activity itself a hosted web application will allow elearning technology and market structures to evolve much more rapidly. LETSI believes that left to the status quo, elearning will likely remain a technological backwater. Instead, by delivering the learner's experience on a website controlled by the activity's creator, restrictions on the nature of the experience are eliminated. We just need to create a few standard protocols to allow data exchange among independent delivery and management systems.

An Activity-Based Elearning Architecture

As the power of a more web-like software architecture became apparent, LETSI's working groups converged on a vision of independent learning activities coupled with web-based tools for teachers, administrators, tutors, and parents – all communicating with each other through standard web service calls. The core element of this architecture is the learning activity itself. An activity may involve one or more resources, including content objects, but the activity has a beginning and an end. (For example, using an immersive simulation in training might involve a training scenario, the underlying simulation engine, multiple learners taking different roles, and some initial conditions specified by the teacher.)

By moving from content portability to data exchange among activities, we enable a much cleaner modularization of the elearning architecture. Modularization will allow the introduction of new classes of learning activities and of tools for teachers and others. Each box in the figure below reflects a class of applications that might be created by software vendors, publishers, aggregators, and educational institutions.

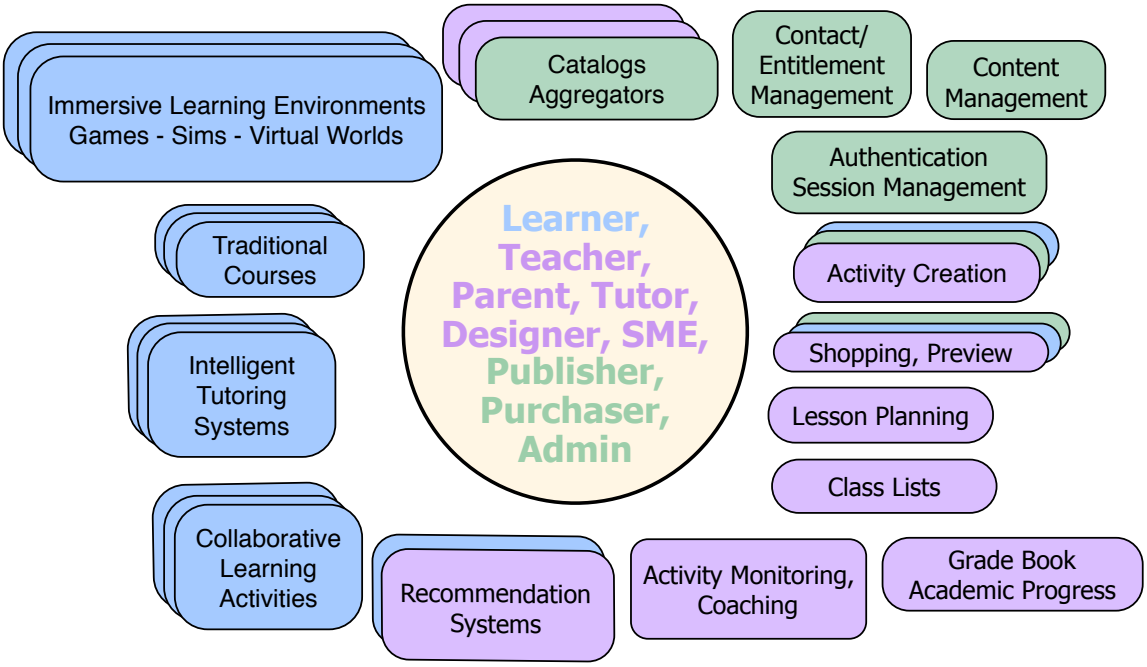

Figure 2. An Activity-Based Architecture. Learner activities, in blue, are hosted independently. They can be quite large, complex, multi-player, immersive, and intelligent. They keep their own detailed data about each learner's actions, reporting back progress to the learner's LMS, for example. Teachers (in purple) and administrators and publishers (in green) have their own set of apps for planning, assigning, selling, subscribing, managing, and recordkeeping.

The elearning world will look quite different on the web. In addition to the enterprise LMS, a wealth of new online and mobile applications will appear:

- Hosted learning activities of increasing complexity and engagement. Not only will these web applications be compelling multimedia events, but they will also maintain nuanced models of the learner over long periods of time. For example, a geometry homework tutoring system that works with a learner for the entire year's course, at his own pace, recognizing his learning style, strengths and weaknesses and keeping his teacher informed of his progress.
- Mobile and social learning activities that use web communications to coordinate and track multiple learners.
- Web apps and aggregation websites to help teachers find, preview, and integrate these web-based activities into their lesson plans. Some resources will be free, some may be available through trade associations and teachers' cooperatives, and some will be published commercially in online catalogs.
- Apps that help organizations and individuals shop publishers' catalogs and contract for specific learning materials. These tools will allow administrators

to preview, purchase, track, and evaluate both commercial materials and open educational resources.
- Apps that allow uploading and sharing of activities created by teachers and subject matter experts.
- Learning activities designed to allow teachers, tutors, and parents to observe and interact with learners online.
- Portal apps for students, parents, and independent tutors who don't have an institutional LMS.

LETSI's open standards for elearning data exchange will allow all of these apps to communicate with each other and with learning management systems, student information systems, talent management systems, and enterprise ERP and HR systems. The architecture makes no assumptions about institutional vs. independent learners and teachers, and it allows any web activity to be a managed learning activity so long as it is properly instrumented to handle web services and adheres to the appropriate protocols.

Of course, there is still a role for traditional computer-based training and for sharable lessons and courses created by teachers and by publishers. Current standards for portable content will continue to be used and they will evolve. But with a little ingenuity on the part of the publishers and authoring tool vendors, the web-hosted model could be extended to teachers and subject matter experts. For instance, a publisher's online plane geometry learning game could offer a "modding" facility so that teachers could create new scenarios, assign the activity to a student or a team with specific roles filled, monitor their progress in real time on an iPhone, and automatically record their status in their local LMS.

LETSI's Pilot Project – Runtime Web Services

LETSI's first project addressed several use cases that were of immediate concern to the SCORM community in 2008. During that year, LETSI initiated a solicitation of ideas about the future of SCORM and received over 100 white papers from all parts of the elearning world. We conducted an intense online discussion of the white papers over the summer and convened a workshop in Pensacola in October. Several working groups were initiated at that meeting and their work resulted in the LETSI Assumptions Document, published in January 2009 at letsi.org/assumptions.

Subsequently, a new working group was formed to solve the long-recognized problem of runtime communication between free standing learning activities and a traditional enterprise LMS. For example, an organization that used a simulator to run two pilots through multiple training scenarios had no standard way of sending performance data from the simulation software back to the central LMS. Hooking a freestanding learning activity to the enterprise learning management system required custom software work, thus precluding broad adoption of simulation technology for practice and assessment.

The working group's solution, based on early research at BBN Technologies, was to use modern web software techniques to create a new communication channel with

the LMS. These "web services" allowed the LMS to launch an independent learning activity and to accept SCORM data back on its completion. Very simple, but in the process much was learned, including some important realizations about the power of LETSI's approach:

- A general solution was worked out that allows all kinds of learning activities to share data, whether running in the browser, as an app on the learners PC, on a mobile device, or on a web server.
- A standard web security and authentication framework was added. Security issues in the original SCORM communication scheme were well known.
- The XML format for data was completely revamped. The original format specification, an accredited IEEE standard, had never once been implemented. LETSI's implementers discovered major problems.
- Mobile learning activities, where connections might be interrupted, could use the same web service transport mechanism to communicate back to the LMS when they reconnected to the web.
- Because the content could run independently, long-standing restrictions on the location of online resources in a content package were eliminated.
- Delivery of complex activities on multiple devices was no longer the responsibility of the LMS, but rather the content creators'.
- Since any new web app can communicate with the existing SCORM LMS infrastructure, educators, publishers, and entrepreneurs can more easily explore new ideas and new business models.

LETSI's Runtime Web Services working group has tested their solution on both the Java and .NET platforms, involving three LMSs and half a dozen content developers, one of whom was running a training app on an iPhone. We anticipate that developers who are dealing with the problem of runtime communication between a traditional LMS and standalone learning games, mobile devices, and intelligent tutoring systems will save time by using LETSI's initial spec. It is our expectation that as developers add functionality, they will contribute to the spec's continued evolution in LETSI's open working groups.

The SCORM runtime data framework, from which LETSI's work derives, is based on a set of IEEE Standards. The IEEE Learning Technology Standards Committee has been involved with LETSI's work from the beginning, and LETSI is in the process of proposing changes to the current standards based on the work of the Runtime Web Services working group. This pilot project also established the prototype for future LETSI projects: short and focused, involving agile software development and multi-platform testing. This type of collaboration with early adopters and software implementers will help standards organizations produce better standards faster.

An Incremental Approach to Disruptive Innovation

With the Runtime Web Services spec, LETSI has enabled freestanding learning activities to be launched by an enterprise LMS and report back SCORM data. This spec is a step in the right direction, but a truly open architecture of independent applications communicating via standard protocols is several steps away.

LETSI's next project, called Content as a Service, focuses on the market realities of publishers, catalogs, entitlements, and session management. The CaaS project still assumes the learner is using an enterprise LMS that manages records and entitlements (contracts with publishers). But no longer is the LMS involved in delivering the actual training – that is done at a remote website. The use case runs something like this:

1. An institution contracts with a publisher for a selection of learning activities. The publisher makes a catalog of the selected activities available, e.g. as a download to the LMS.
2. Learner logs into the LMS, selects an activity from the catalog (or from a teacher's assignments that incorporates activities in the catalog).
3. Learner is transferred to the publishers website, where the selected learning activity is launched.
4. Standard information about the student and contractual entitlements are passed along to the publisher's hosted learning activity.
5. Learner finishes the activity and is transferred back to the LMS to select another. Data about the learner's progress and performance are returned in standard format to the LMS.

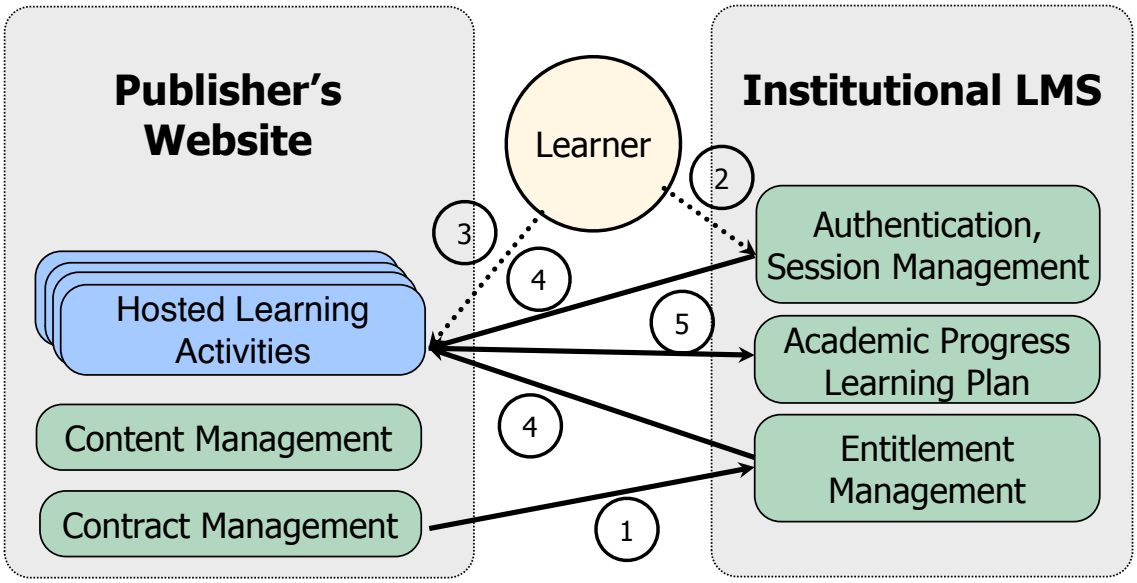

Figure 3. A simple use case for web hosted content, where a publisher's hosted learning activity is launched by the learner's LMS. The market may evolve so that the learner can just launch a learning activity, which will in turn contact her LMS or her teacher's iPhone app. In either case, the data to be exchanged will be the same.

Several new working groups are forming to review current practice and develop some of the data exchange protocols needed to enable an architecture based on independent, web-based apps – learning activities and authoring and management tools. The process is incremental, since we can't create all the protocols at once, and iterative, since as developers use LETSI's specifications they will naturally see room for extension and improvement.

The CaaS project will develop much of the infrastructure needed to support a world of independent, web-hosted learning activities. We will extend the IEEE data model, leaving SCORM as a special case of a more general model of student performance. Data exchange protocols for other key elements, including student information and community of practice competency standards, will be addressed in future projects.

Eventually, these data exchange specifications will support a learner-centric work flow where a learning activity is launched and then contacts the appropriate LMS, based on the learner's profile and input. Enabling this modular, activity-based architecture, supported by web service definitions for exchanging information about learners, teachers, activities, resources, competencies, and entitlements, is the ultimate goal of LETSI's work.

LETSI' Principles and Governance

LETSI is a spinoff of the SCORM community, the largest standards-based elearning community in the world. LETSI was formed in 2007 when the SCORM community began to realize SCORM was evolving too slowly to support the accelerating international adoption and continued evolution of elearning in markets unrelated to military training.

LETSI's founders and working group volunteers adopted a set of policies and principles designed to support open processes, fair representation of all stakeholders, transparent governance, and unrestricted intellectual property. LETSI intends to develop data exchange solutions that span disparate communities of practice (K-12 in different countries, higher education, corporate training, and professional certification). Each sector has its own community standards and work processes. LETSI expects to see its work adapted to the needs of each community, which in turn will test and certify conformance. LETSI has also arranged to work with the IEEE and ISO/IEC to produce accredited international standards based on LETSI's initial R&D when formal standards are appropriate.

LETSI is a new kind of organization that will hopefully improve the state of elearning standards. LETSI's part in the standards supply chain is the initial implementation and testing of data exchange specifications based on the best ideas from all market sectors. Each LETSI project is relatively short (to encourage broad participation by busy people), narrowly focused, open to all participants, and must include some who will implement and test the evolving spec on several different software platforms: software product vendors, IT staff, and systems integrators. LETSI's sponsors decide on project priorities.

LETSI is a program of the IEEE Industry Standards and Technology Organization, a non-profit support organization that allows standards groups to share common administrative and infrastructure resources. Thanks to the Internet, we are an international organization with multiple weekly working group teleconferences held at inconvenient times on all continents.

LETSI believes that the web will change the education and training landscape as dramatically as it has changed so many other aspects of our lives. We are sponsored by organizations that see the need for change, even disruptive change, and that support open standards for the web-based software architecture that will emerge.

Please send comments and inquiries to info@letsi.org.

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