ATTIC: A Case Study of Directory-Enabled Course Management

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ABSTRACT

Academic Technology Tools for Instructional Computing (ATTIC) is Drew University's system of shared file space, collaborative groups, discussions, email lists, and Web pages that are automatically configured for every faculty and student, using an industry-standard, Lightweight Directory Access Protocol (LDAP) compliant directory (Novell eDirectory 8.5.) ATTIC services are provided by a heterogeneous environment of NetWare 5.1 and Linux systems and rely on LDAP integration and scripting in Perl, PHP, and Python.

ATTIC leverages the ubiquitous computing program at Drew and takes advantage of every faculty member and student having a network account. Standard group objects are used to store information and membership of courses, and are used to control access to space on a NetWare fileserver, and directory-enabled Web interfaces to course data. The emphasis is on automation–nightly updates of registration data are used to update LDAP and filesystem structures nightly without operator intervention, and LDAP-based authentication, access control, and directory information provides a customized interface to students and faculty based on their network identity.

This session will describe how the ATTIC system was created and its current feature set. We'll show how LDAP is set up to provide secure access to information. We'll see how the session manager is used to provide common authentication to multiple web servers. A detailed analysis of the file system and directory structure will be provided, as well as an example of integration with an administrative information system. We'll also discuss future plans including integration with commercial courseware packages.

Keywords

course tools, directory, LDAP, file sharing, collaboration.

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1. HISTORY

Academic Technology Tools for Instructional Computing (ATTIC) was first conceived in the early summer of 1998 after communications between Neil Clarke and Mike Richichi. The original basic idea was to provide shared file space for every course offered at Drew, with instructors being able to store files in the space, and students able to retrieve files respectively. Drew's environment consisted of Novell NetWare servers running NDS, and it was planned to leverage the NDS environment to control and enumerate access to these spaces.

The idea was refined after attendance at the 1998 Novell Technology Transfer Partners (TTP) conference when Richichi saw numerous other universities' solutions to the ideas of directory-enabled course management. Although no code or direct structures were used from these presentations, the inspiration of the concepts cannot be underestimated in the implementation.

In Fall of 1998 the first rollout of ATTIC course services was offered. This consisted of individual directories for each course, and NDS group objects with each student in the course, and organizational role objects for each course with occupants of each instructor in the course. Directories were also created for assignment hand-in and grading, and for course web pages.

ATTIC was incredibly successful and led to a barrage of enhancement and improvement requests–some of which were in the initial design discussions, and some which enabled new functionality. The current ATTIC implementation environment contains the original directory spaces, accessible through the NetWare client and through a Web interface, a Web-based discussion system, chat rooms for every course, and a Web interface that consolidates course information for students and faculty into a single interface.

2. DESIGN PHILOSOPHY

The basic goal of ATTIC was not to completely duplicate functionality of commercially available course tools like WebCT[1] or BlackBoard[2], but to provide services that were fully integrated into existing local-area network and web services offered at Drew. Thus, the decision was made to place all configuration and authentication information into the network directory or a standards-based database.

Drew's current registration system is a legacy package from which ATTIC data is received as a series of text files containing information about students, instructors, and courses. Originally, this data was parsed on the fly and a Caldera OpenLinux system was used to directly create structures into NDS. The current implementations of ATTIC first parse the data into an SQL-compliant database (now, MySQL[3], with Oracle in the future,) and data is placed into the directory by Perl scripts that read the SQL databases and use LDAP to place data into eDirectory. It is hoped that this system will be easily adaptable to any future registration systems, possibly with SQL calls reading the registration database directly. At the very least, the parsing of administrative data is isolated from the creation of directory-specific course structures.

The ATTIC data model is simple. Drew's eDirectory tree currently has all students in a single organizational unit underneath the "Drew" organization. Faculty are grouped into separate OUs based on academic department. Course objects are stored under a "courses" organizational unit, with additional OUs for each course term, in a campus standard format (i.e., FA2001 is "Fall, 2001".) This allows both for multiple identical course numbers (they are recycled every term or every academic year) as well as easy identification of a course by it's fully qualified domain name.

Courses are currently represented by two objects–a group object that has just the course identifier as its canonical name, and an organizational role object with is the course identifier with the suffix "-instr" appended to the canonical name. Course identifiers at Drew consist of a 2-5 letter department identifier, a 1-3 character alphanumeric course number, and a 1-3 character alphanumeric section number. The registration system lists courses either as "DEPT*NUM*SEC or DEPT NUM SEC depending on the report generated; it was decided to standardize on DEPT-NUM-SEC as the standard for the directory due to potential delimiter issues with asterisks or spaces. Thus, for an example course (Elementary Underwater Basketweaving I, BSKT-1-001), offered in Fall 2001, course objects would be the following:

cn=BSKT-1-001,ou=FA2001,ou=courses,o=Drew

cn=BSKT-1-001-instr,ou=FA2001,ou=courses,o=Drew

The former object is a group object. It has a "Member" attribute filled with each of the students in the class, as well as the instructor(s), and the latter is the organizational role object, with an "occupant" attribute filled with the instructor(s) of the course. As eDirectory is a full-featured directory with granular access control, the course organizational role has full access to the course group object to modify it in any way, and this right is assumed by course instructors (whose user objects have a "securityEquals" attribute that includes all course instructor objects they are assigned to–just as all students in the course have a "securityEquals" attribute value for each course for which they're registered. This referential integrity is fundamental to the proper operation of the directory and the proper application of access control rights.) There are also additional attributes of the group object used; namely, the "description" attribute which contains the full name of the course, a "homePage" attribute which is populated with the URL of the course home page, if present; and a custom attribute defining that the group object has an associated course forum (see below.) With these basic structures in the directory, all other ATTIC services are defined relative to them.

The SQL database of courses is only read for initial LDAP directory configuration. All subsequent services that need course and registration information read LDAP or eDirectory directly. This allows us to use any standard LDAP interfaces, or write user programs in any scripting or other language that supports LDAP. It is this simplicity and commonality of access that makes the ATTIC system easy to manage, and makes additional services easy to implement.

3. SERVICES OFFERED

3.1 Shared File Space

The first and still most commonly used feature of ATTIC is the shared file space for each course. This space is created by scripts that read the LDAP tree for the current term, and set up directories named after the CN of the course object. This directory has ACLs that permit read-only access to the students in the course and full read-write access to the course instructors, by assigning rights to the course and course instructor objects described above. All faculty and students have a drive letter (K:) mapped to the term directory, and their access rights mean they only see directories for the courses they are teaching or taking as appropriate; in fact, the methodology supports instructors who are also taking classes by intrinsic application of these access control rights.

Initially, course subdirectories were created automatically for web pages, an archive of the course mailing list (see below) and student inboxes and outboxes. Although instructors had full rights to create additional subdirectories, they at first did not do so on their own. It was later decided to add an additional directory entitled "reserve" where reserve readings could be placed, and to better educate faculty on their ability to organize the course drive space. Faculty can also enabled shared or collaborative access to course directories by simply assigning additional rights to a folder to the course group object.

Another feature worth mentioning is the inbox and outbox directories. These are designed to allow students to hand in and instructors to return work electronically. Both the inbox and outbox have rights assignments blocking the standard read-only access to the course. Inside the directories are subfolders for each student in the class; the inbox has write-only rights, the outbox read-only, assigned explicitly to each student. The course instructor object still has full rights. It was originally intentioned that the instructors would receive things like papers, with the fact that the inbox was write once for students enabling a "virtual door" they could slide papers under before a given deadline, with time stamping enforcing assignment deadlines.

Some instructors, however, found the need to have to examine directories for assignments manually to be cumbersome, and thus a web interface was created (see below.) In addition, we found that instructors still liked to grade physical copies of papers, and did not wish to print out multiple student papers with their own printers, preferring to distribute the printing time and costs among their students, thus the inbox is not often used for traditional papers. Where it has come into its own are for assignments that are best expressed in an electronic format, such as graphical presentations, computer graphics, programming assignments, web pages, etc.

3.2 Course Web Pages

Many courses wish to have Web pages that are either an online syllabus or a collaborative project that is a core component of the course, or some combination thereof. Utilizing cross-platform solutions detailed in "Supporting Ubiquitous Computing Through Directory Enabled Technologies"[4] in these proceedings, we also provide Web pages through the Apache web server on a Linux system connected to the NetWare course volume through ncpfs. A Perl script manually dredges the file space several times a day, and generates an automatic index of current course pages, as well as sets the "homePage" attribute of the course group object, which is then used in other interfaces.

3.3 Course Mailing Lists

Another common desire is the ability for an instructor to easily email their entire course, or allow for the ability for a course mailing list discussion. ATTIC provides automatic course mailing lists for this purpose.

The current system runs on a Linux system running majordomo. Course mailing lists are generated by Perl scripts that read the LDAP tree, and create majordomo configuration files and mailing list files for each course on a nightly basis. Course instructors are given moderator access to the list via standard Majordomo interfaces to modify the list. Lists are archived locally on the Linux system, and copied to the course web page directory nightly by mHonArc[5] to a HTML list archive, which is access controlled to the course. Posting to the mailing lists is restricted to course members, who send email to dept-num-sec@courses.drew.edu to send mail.

It is hoped that this system will be replaced with functionality provided by the Novell Internet Messaging System (NIMS) in the near future, which will automatically use existing group objects to create the course mailing lists.

3.4 ATTIC Web Services

In Fall of 2000 the first ATTIC web interfaces were offered. These leveraged and extended the existing ATTIC filesystem and directory structures, and provided new services.

The core to these services is the Session Manager, described in [1] in more detail. Session Manager provides single sign-on to all ATTIC services with the user's standard eDirectory password. ATTIC web services are provided by CGI scripts written in Perl, PHP, or Python, depending on the needs and programmers involved. Although this may seem counterproductive, the common interface of LDAP means that the code is actually very similar and well integrated.

When users authenticate to attic.drew.edu, they see a view of all courses they're either registered for or teaching, with a note by them if they're the instructor. They then get a series of buttons dependent on what the course has available and their role. All courses have a roster, mailing list, forum, and chat room. If reserve readings have been put in the course reserve directory, an "eReserves" button will appear; if there is a course web page, the LDAP attribute of the course object will be read and there will be a "Home Page" button. If you are the instructor of a course, you will get an additional button that will give you a sorted list of all assignments turned into the inbox–sorted either by date and time or by student.

3.4.1 Course Roster

The course roster simply reads each member of the LDAP course group, and then returns certain directory information on those objects like name, email address, major and minor, etc. The LDAP lookup is done on behalf of the authenticated user, which allows us to do things like block access to student phone numbers if the student has requested a hold on that information. Such holds are enforced with LDAP ACLs on the student's user object, and an LDAP lookup enforces those rights.

3.4.2 Course Forum

The forum is a custom application that uses the LDAP groupMembership property, and the "drewForumsHasForum" attribute of a given group to present online discussion boards for each group. Since forums.drew.edu is also Session Manager enabled, users only see forums for which they are members of the corresponding group.

3.4.3 Course Chatroom

The course chatrooms use the commercial ChatBlazer[6] product with a scripted page that performs an auto login to a given course chatroom, under the Session Manager-authenticated web server. This limits access to the chat room to people currently enrolled in the course. Instructors can schedule times they'll be available in the chat room, or allow for informal discussion.

3.4.4 eReserves Viewer

The eReserves viewer reads a MySQL table generated hourly by scanning all reserve directories for the current term, and returns a list of all reserve readings for the class, sortable by date, and filename. Both file:// and http:// links are provided for local area network or Web based access to the file. Instructors also see a file upload box from which they can upload files into the reserve directory automatically.

3.4.5 Inbox Viewer

The inbox viewer is only visible to the instructor, and reads a similarly generated MySQL table of scanned inbox entries for the course, which the instructor can also sort. The file dates and times also allow for a quick check to see if files were turned in on time. There is currently no functionality for automatically placing graded files in a student's outbox via the Web interface, although that is a considered enhancement.

4. USAGE OF ATTIC FUNCTIONALITY

ATTIC has been one of the most successful technology projects that the Department of Academic Technology has undertaken. Statistics indicate that approximately 30% of all course sections have some ATTIC functionality implemented; however, this includes multiple lab sections and other redundant course section information (like cross-listed courses,) and we estimate the percentage of actual courses using ATTIC in the neighborhood of 50%. Nearly all students have at least one course using some of the ATTIC functionality, and they have often demanded that instructors use the ATTIC facilities for online course materials.

Our Faculty Lab [7] has numerous requests for digitization of academic papers into PDF files for use as online reserves, and this has in many cases replaced traditional library based reserves. We have 60-100 courses per term with Web pages, which is significant since there are about 300 active course sections in a given term.

Most importantly, ATTIC was a major factor in getting more faculty and students using the network. Even though all students at Drew receive a laptop computer and network access, there was a low adoption rate of usage of provided web and local area network services until ATTIC was created. Now students and faculty consider their network drives and Academic Technology-provided services critical to their professional and academic activities.

Providing a framework as well has been interesting as we collaborate with faculty through our faculty development program and examine the innovative ways faculty use the shared spaces to enhance learning. It's important to note that Drew is not primarily using these services for distance learning applications, but for enhancement of the traditional liberal arts classroom experience. Most of our faculty find the augmentation of their traditional classroom teaching with an online component to be particularly powerful, and are constantly combining the methodologies in exciting ways.

5. FUTURE ENHANCEMENTS

The challenge to creating your own online course tools is that you're now a software vendor, and your user community expects enhancements and upgrades as if they were using a commercial package. Development of ATTIC services is never-ending, and we have plenty of projects to keep us busy.

For Fall of 2001 we will have voting booth/survey functionality built in for every course. Course instructors and/or students will be able to generate survey forms that will store data in a MySQL database, and they will be able to receive the results in CSV format for further offline analysis in a spreadsheet or statistical package.

It is also our hope to enhance the course group and course instructor objects further with LDAP auxiliary classes, thus further leveraging the power of the directory. The concept is to have the course group object extended to contain additional information about the course (times and room numbers, for instance,) and enable configuration parameters for the course that affect how directory and mailing list structures for the course are created.

The ATTIC system as designed also has no allowance for people who do not have accounts in the campus eDirectory tree. There frequently is the desire to allow visiting scholars access to online course materials. We anticipate meeting this need by allowing course instructors to create temporary, limited access accounts in the eDirectory tree for those purposes. Such accounts would have less access than the average Drew person, and only permit access to a given courses' NDS objects and course materials. Much testing will be needed to make sure such a system is secure and reliable.

Finally, as mentioned in Section 2, it was not our goal to replace the functionality of commercially available courseware packages like WebCT or Blackboard. We hope that we can modify the ATTIC system, and work with vendors to leverage our existing infrastructure of authentication, file storage, and access control with these systems if we so desire, thus gaining the benefits of these packages without additional administrative work and generation of additional authentication databases and access control mechanisms.

6. CONCLUSIONS

Providing ATTIC services to the Drew community was a critical step in the growth and implementation of our local area network and web services. ATTIC is tightly integrated with our existing authentication and access control infrastructure (since we've standardized on Novell eDirectory,) and this integration simplifies the end-user experience for our customers by allowing us to enable single authentication and consistent nomenclature across systems and interfaces. Since ATTIC services are created automatically for every course section, instructors do not need to waste time at the beginning of each term creating or asking for network spaces to be created, and by providing a reasonable cross-section of services, it is hoped that the needs of a majority of faculty and students can be met with an automated, standardized system.

Utilizing standard interfaces like LDAP and SQL enable us to easily create new services and functionality, leverage existing programming tools and interfaces, as well as possibly integrate commercial systems and services in the future. By keeping it simple and flexible, we have created a system that the majority of campus uses regularly to enhance the traditional classroom experience. It is our design goal to make new services offered under the ATTIC umbrella just as simple and flexible, thus providing an easy transition for our user community.

7. REFERENCES

[1] WebCT, http://www.webct.com/.

[2] BlackBoard, http://www.blackboard.com/.

[3] MySQL, http://www.mysql.com/.

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[5] mHonArc, http://www.mhonarc.org/

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