Case Study: Establishing Momentum for Implementing Directory & Public Key Infrastructure

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A Unit of the University System of Georgia
Doctoral/Research Universities – Extensive
Enrollment Fall 1999: 23,492
Degrees Conferred 1999: 5,096

GSU Facts: http://gsupublic-relations.gsu.edu/Facts/facts.html
Internet2 Member
Southeastern Universities Research Association (SURA) Member

Abstract

The “eUniversity” understands the strategic importance of a competitive ecommerce environment. Industry analysts, vendor strategies, and higher education groups like Internet2’s Middleware Initiative (http://www.internet2.edu/middleware/) provide analysis, strategic directions, best practices and roadmaps. Yet leveraging these resources to move your institution forward is challenging. This presentation documents a “year in the life” of one such implementation, including building awareness, creating a community of interest, aligning enterprise strategies, and participating in higher education initiatives. Ultimately, combining strategic resolve with pragmatic decisions to “do it” is what enables the tantalizing promise of directory and public key infrastructure to come within reach.
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Establishing a Strategic Initiative
Georgia State University recognized the competitive advantage of having an enterprise strategy for directories and PKI. Directories and PKI provide the scalable solutions for managing multiple identities, providing secure transactions, and supporting an increasingly mobile online population. This presentation addresses how GSU jump started the process and went from “talking to walking.”

GartnerGroup recommends that clients now move from investigating to establishing enterprise directory strategies. GartnerGroup’s Research Note Business Strategy Will Drive Directory Services advises:

“Pressures from intranet, extranet and E-commerce applications are increasing the need for an enterprise strategy for directories. This will not be easy to achieve, but tactical solutions will cause greater problems.” [GartnerGroup is] “now recommending that enterprises proactively plan for directory implementation as part of their overall Internet and electronic workplace strategies. Why this change of emphasis? Directories are moving from an incidental support role in workgroup systems toward the core of the required infrastructure.” [1]

The Burton Group, specializing in network infrastructure management, also advocates a strategic approach to directories to achieve long-term return on investment. The Burton Group analysis, Directory-Enabled Computing: The Directory’s Expanding Role, summarizes:

“Organizations once were forced to deal with special-purpose directory technology that isolated information and increased the management burden. Now, however, they can begin to build an enterprise directory infrastructure around general-purpose products… [that] can participate in an integrated enterprise directory infrastructure that reduces management overhead and supports a variety of applications. Customers must invest in and plan for that infrastructure now to take full advantage of these new roles as they mature.” [2]

As the 2001 began (and Year 2000 activities subsided), GSU’s CIO established Advanced Campus Services, defining strategic tasks in the announcement Advanced Campus Services Responsibility Portfolio:

“The Advanced Campus Services (ACS) unit… will have a broad, coordinating role in the establishment of standards, methods and processes to… investigate possible common solutions for addressing the next generation eUniversity environment…

“ACS leadership must advance the development of a university-wide consensus regarding directions and strategies to be adopted in these identified areas. Interfacing in planning processes that span other universities and the University System will be essential. This is because directory services, authentication services and universal solutions require broad, open solutions that may involve other institutions.

“Specific directions and detailed action plans must be developed and undertaken regarding:

• University-wide directory services and metadirectory solutions
• Public-private key infrastructure
• Definition of universal account creation, userids and password synchronization
• Universal e-mail solutions
• Interface to other electronic domains like the one-card and library patron systems” [3]

Fundamentally, given the importance of directories and PKI, GSU’s CIO ensured that an information technology unit was specifically charged with responsibility for implementing the needed infrastructure.
Such a specific charge enabled directory/PKI initiatives to take their place among other strategically important, and already established, projects at GSU. As many institutions in higher education may find familiar, GSU strategic projects include migrating student/financial aid to vendor-based applications, completing network upgrades for Internet2 (and addressing recurring technology refresh cycles), supporting newly implemented financial systems and deploying additional modules, providing support for educational technology initiatives, addressing student technology fee priorities, managing security in an increasingly complex environment, facing budget and staffing constraints… and more!

Yet, it’s not like directory and public key infrastructure are newly discovered. Indeed GSU has been attuned to higher education, vendor, industry analyst, and Internet2 dialogs. Directory and PKI issues have been recurring themes for GSU during the last several years:
- Conversion of white pages from CSO to LDAP technology has been “in the queue” since about 1998;
- Awareness is high that campus solutions to authentication/authorization are needed;
- GSU alignment with and leverage of vendor strategies – Novell NDS, SCT Banner “RLS” release, etc.;
- Provisioning a new student email solution is a pressure point from faculty and administrators;
- Administrative account management of identifiers remains a subject of audit findings;
- Data feed interfaces between legacy applications are complex, resulting in redundant solutions.

With this background, Advanced Campus Services was formed in February 2000 with two positions, a director and a project manager, created from “internal reallocation” – i.e. the CIO’s “own nickel.” With the CIO’s charge and assignment of portfolio responsibility, the goal was to educate ACS and other IT staff, discover resources, and move GSU from discussing the need and importance of directories and public key infrastructure to implementing the infrastructure.

**Early Steps – Education and Resource Discover**

As ACS began, “getting up to speed” was a relative concept in an information rich environment. The challenge was to discover “best practices” in a myriad of information resources. This ongoing process found several valuable resources.

- **Internet2 Middleware Initiative**[^1] is focused on deployment of identification, authentication, authorization, directories, and security services (“middleware”) for Internet2 Universities. The I2MI site offers resources and a “roadmap” for those who are implementing middleware services. The very definition of “Core Middleware” provides a ready-made reference framework as a context for a higher education enterprise’s infrastructure deployment:
  “These [following] five services are central to middleware as a whole.
  
  **Identifiers**  A set of computer-readable codes that uniquely specify a subject.
  **Authentication**  The process of a subject electronically establishing that it is, in fact, the subject associated with a particular identity.
  **Directories**  Central repositories that hold information and data associated with identities. These repositories are accessed by people and by applications to, for example, get information, customize generic environments to individual preferences, and route mail and documents.
  **Authorization**  Those permissions and workflow engines that drive transaction handling, administrative applications and automation of business processes.
  **Certificates** and public-key infrastructures (PKI)  Certificates and PKI are related to the previous four core middleware services in several important ways.” [4]

The extensive links to related resources – such as CREN, Federal PKI, Net@Edu, and other sites – the actively maintained minutes of I2MI meetings, and timely updates on activity, establishes this site as an authoritative hub for middleware development in higher education.

- **CREN**[^2] TechTalks provide live audio Webcasts (and archives) on topics relevant to networking and information technology. Interviews with technology experts from higher education provide informative “give and take” discussions about directories, PKI, and other timely topics that are directly relevant ACS’s directory and PKI mission.

• Federal PKI Technical Working Group <http://gits-sec.treas.gov/fpkitechwork.htm> has provided leadership in public key and directory technology for the Federal Government and offers a perspective for state and higher education implementations. Its Federal Bridge Certificate Authority model is especially relevant to the Internet2 Middleware Bridge CA model.

• Net@Edu “PKI for Networked Higher Education” <http://www.educause.edu/netatedu/groups/pki/> a working group of Educause has sponsored “a series of summit meetings that span higher education, industry, and government…” This project group will also prepare the “next stage” of discussions on the corresponding issues of re-engineering higher education to take advantage of the emerging technologies, and will actively involve the administrative computing community.” The group also supports the EDUCAUSE/Internet2 eduPerson task force (defining a standard LDAP object class of person attributes for higher education) and the Higher Education PKI (HEPKI) activities.

• The Burton Group <http://www.tbg.com/> Network Strategy Service is part of a GSU client subscription and provides technical analyses and recommendations on Directory Services.

• The GartnerGroup <http://gartner4.gartnerweb.com/public/static/home/home.html> provides access to research highlights and audio conferences via a subscription of the University System of Georgia (USG) central office.

• Internet Engineering Task Force (IETF) <http://www.ietf.org/> is the authoritative site of RFC specifications, including Lightweight Directory Access Protocol (RFCs 2251-2256) and “Internet X.509 Public Key Infrastructure Certificate Policy and Certification Practices Framework” (RFC 2527). These RFCs are grounding points and source documents for directories and PKI.

• The Directory Interoperability Forum, The Open Group's Directory Program <http://www.opengroup.org/directory>, “enables and promotes open and interoperable directories based on open standards” and offers resources related to industry groups’ work.

• Georgia Senate Bill 465, effective July 1, 2000, establishes the Georgia Technology Authority <http://www.gagta.com> as well as reaffirming the State of Georgia’s commitment to technology solutions for digital signatures in improving administrative services for Georgia:

> “All state agencies, authorities, and boards are authorized to establish pilot projects, which are to serve as models for the application of technology such as electronic signatures…. Such projects shall consider both commercial and government applications, [and] be inclusive of major categories of electronic signature technology… The pilot projects are intended to provide a proof of concept for the application of technology, such as electronic signatures, and to serve to educate the General Assembly and the public at large as to the benefits of electronic signatures…. One such pilot project may involve digital signatures and the use of a public key infrastructure established by a service provider.” [5]

Clearly, other states may have similar state legislated initiatives underway.

Discovering these resources online was a “hyper-activity,” tempered quickly by the volume of information. When the many links began leading back to each other, as is the wont of the web, a picture came into focus echoing issues familiar to GSU’s environment – the challenge of jump-starting the initiative, integrating disparate data sources, reallocating resources on the promise of future returns, implementing solutions for fundamentally hard problems. This recognition of parallels to others’ activity helped ACS sort through topics and focus on specific actions. Indeed, these internet resources served to put ACS’s mission into the larger context of community – ACS as a part of Information Technology at GSU, GSU as a member of the University System of Georgia, all within the context of higher education, state, federal, and industry initiatives. This context provided for alignment of enterprise strategies.

The importance of strategy alignment was re-enforced by recommendations coming from several workshops that The Burton Group conducted for the University System of Georgia. A directory workshop in October 1999 and a Public Key Infrastructure (PKI) Strategy Workshop in March 2000 had broad participation from six institutions (of 34) and the Board of Regents. The Burton Group recommended enterprise level action for the community:

“Major recommendations

CUMREC2001
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• The University System must begin implementation of the common directory infrastructure... The
long-term success and scalability of the [University System’s student, financial, and library
enterprise-wide] applications are dependent upon this happening immediately…
• Member institutions should not deploy PKI without a clear understanding of their directory plans.
And to create scalable and manageable inter-institutional capabilities, the University System must
build a directory infrastructure that binds the member institutions to a community, allowing them
to view each other as authoritative sources for information on their own students, faculty, and
services.” [6]
The Administrative Committee on Information Technology for the University System of Georgia endorsed
these recommendations during their Spring 2000 meeting.

An Annotated Chronology of Action
What follows is an annotated chronology of some of the more significant events of ACS’ “year one.”
These events have been important in setting goals, establishing relationships, forming organizational
structures, and defining activities that advanced the mission of ACS.

Initial Goals – March 2000
During March 2000 ACS defined high level performance objectives for the next year, intended to “ground”
ACS with some structured goals around which “other things” would grow:
• Issue White Paper on enterprise directory strategy
• Develop evaluation criteria and methodology for PKI
• Identify collaborative initiatives for directory or PKI
• Define common directory structure for “GSU Person”
• Draft policy and procedure for managing “GSU Person”
• Identify PKI funding requirements & sources
• Establish account management of administrative applications

SCT Summit Conference – March 18-22, 2000
A key focus of the conference was SCT’s upgrade path from relational technology to object based
technology with their “Relationship Leverage Solution” releases for alumni/development, student and
financial aid. Session topics included e-commerce/e-university issues such as directory services, resolving
identifiers, security, universal e-mail, single sign on, and technical integration with WebCT initiatives.
Like others, SCT is moving to new technology.

Establish Directory Strategy Approach – March 27, 2000
Prepared “Enterprise Directory Strategy & Recommendations” March 27, 2000, providing a summary of
directory and PKI issues. These 18 presentation slides gave an overview of basic strategy, defined
middleware, proposed a methodology for leveraging existing activities (internal and external), established
strategic goals, and provide a recommended reading list. This document was a level setting introduction
for the CIO, IT directors, and their staff.

Conference Call Renee Frost, U. Michigan – April 18, 2000
Following up on CIO Reid Christenberry’s suggestion, and his connection with Renee Frost, Project
Director for the Internet2 Middleware “Early Adopters” Project, ACS called Renee to discuss the I2
Middleware Project and GSU’s initiative. Renee provided insight and direction on how to proceed using
the Internet2 Middleware Initiative as a guideline and roadmap – which, indeed, is one of the I2MI’s goals.
ACS followed up with closer look at “Early Adopters” activities, applying them to GSU, especially in
regards doing campus profiles and identifier mappings.
GartnerGroup Decision Driver Tool for PKI vendor selection – April 20, 2000
An audio conference about GartnerGroup’s software tool for evaluation of PKI vendors led to a
demonstration by GartnerGroup for GSU, the Board of Regents, and Georgia Tech. The value of the tool
itself was appreciated – it presents a complex set of criteria in a way that facilitated weighting and
evaluation of criteria for an enterprise solution. Maybe more important was another opportunity to bring
together GSU, the Board of Regents, and Georgia Tech to discuss common goals – indeed, an enterprise
approach. At the very least the GartnerGroup Decision Driver module for PKI may provide an instrument
for facilitation of enterprise-wide consensus on what is important.

Conferences – Directories & PKI in Higher Education – May 2000
- Net@EDU PKI Working Group held a meeting May 7-9 in conjunction with the annual
  conference of the North American Strategic Consultants group. The PKI group worked on
  completing a matrix of needed security services and mechanisms begun earlier, and fleshed out the
  relationship between PKI and LDAP. A facilitated session, held jointly with the strategic
  consultants, addressed how to communicate technical ideas to key decision makers. The session
  was valuable in highlighting the similar issues that higher education institutions face in
  articulating a need for technical infrastructure and communicating that effectively to senior
  management. The recommended strategy sought to cast PKI needs in the context of an integrated,
  cost-effective solution – drivers included authentication and authorization for distributed/distance
  learning, access to online library resources, secure email services, management of web services,
  and interoperability of the eUniversity domain with eCommerce in government, higher education
  vendors, and commerce. The University System of Georgia appears to be working on PKI in
  manner similar to other institutions. Conference was very productive in establishing contacts with
  persons in Internet2 Middleware and other institutions (University Alabama at Birmingham,
  Georgetown…).
- Attended CUMREC Administrative Technology Conference, May 14-17, 2000 with attention to
  Internet2 middleware and other directory related sessions. Middleware topics were presented by
  Renee Frost (Internet2 Middleware Initiative: Early Harvest to Early Adopters and Beyond) and
  Mark Luker (Public Key Infrastructure and Digital Certificates) and others.

Organizational Structure for Enterprise Directory Deployment – May 22, 2000
May 22, 2000 established “Enterprise Directory Infrastructure Steering Group” comprised of the CIO,
directors of GSU Information Systems & Technology units (networking, educational technology, library
systems, strategic planning, and administrative applications), and ACS. The Steering Group members use a
discussion and consensus process to set overall scope, prioritize activities, and allocate the resources of
their units. Working Groups are convened to address specific activities:
- Data Stewards for GSU Person Working Group includes functional data stewards (human
  resources, student, alumni…) in establishing directory schema attributes. This includes reviewing
  the proposed “eduPerson” LDAP object class, identifying source data in GSU’s administrative
  applications, mapping data to directory attributes, considering synchronization and interface
  processes, and recommending enterprise directory policy.
- LDAP Design Technical Working Group includes senior staff for Novell and Unix systems
  technical support. The group will do the technical implementation for the schema design resulting
  from the Data Stewards for GSU Person Working Group and will establish back end services such
  as synchronization schedules, backups, replication, and user interfaces.

SURA Directory Proposal and Internet2 “PKILabs” – May 31-June 30, 2000
Drafted “Proposal for a Common Directory Implementation, Supporting Public Key Infrastructure for the
eUniversity” May 31, 2000. Review and discussion of a “common directory” proposal draft brought
several University System schools in contact with peers at Southern University Research Association
(SURA) schools. As a result, SURA submitted a collaborative response to an RFP issued by the Internet2
Middleware group. The RFP was not awarded to the SURA group, but the peer-to-peer collaboration and
discussions helped clarify mutual interests, and dialog would continue. During process, ACS connect
John Wandelt at Georgia Tech Research Institute. Wandelt’s GTRI lab has been participating with the Federal PKI Technical Working Group activities.

**White Paper Issued – July 2000**

ACS prepared “Enterprise Directory Infrastructure For a Community of Interest, A White Paper” [7] that placed Georgia State University’s directory and public key initiative in the context of its extended community. While there are many white papers in this area, the focus of this document was to provide a “close to home” perspective relating GSU’s activities to those of the University System of Georgia, higher education, and relevant State of Georgia and federal initiatives. This white paper followed through on the Net@EDU PKI Working Group meeting in May as far as stating the need for technical infrastructure and communicating it effectively.

**University System Vice Chancellor/CIO Commitment – August 17, 2000**

The original “common directory” proposal discussions from May 2000 evolved to the point that the University System’s Vice Chancellor/CIO requested restatement of the proposal for consideration as a University System level initiative. A two-page proposal called for the formation of a technical working group.

“The ‘Enterprise Directory Infrastructure Technical Working Group’ will undertake the following course of action:

- Convene a working group …[to] meet regularly, establish specific deliverables and deadlines for enterprise directory tasks, collaborate on implementation of a USG directory solution…
- Conduct campus profiles for the purpose of identifying existing directory initiatives, technology implementations, and related enterprise directory infrastructure issues…
- Recommend common directory design solutions for areas such as attribute definition, schema design, selection of unique identifiers, and synchronization & replication strategy…
- Establish an architectural model for the USG enterprise directory that accommodates expected differences in local campus directory solutions, and articulate how interoperability and scalability will be achieved.
- Identify policy, administrative, and business issues… and ensure that these are communicated… to the appropriate groups for resolution.
- Recommend specific resource or funding requirements…
- Explore opportunities for additional collaborative opportunities within the University System, the extended higher education, research, or Internet communities…
- Remain cognizant of the long-term objectives… that may include pilot implementations for advanced security, authentication, and authorization services.” [8]

**USG Technical Working Group – October 19, 2000**

Worked with University System in convening an Enterprise Directory Infrastructure Technical Working Group to follow through proposal made to Vice Chancellor/CIO. TWG’s first meeting, October 2000, established commitment to implement a consolidated LDAP directory for the research institutions (GSU, GaTech, UGA) and central office. The next several months will be engaged in discussions, exchange of ideas, exploring the boundaries of issues, and seeking consensus on approaches — the “forming, storming, norming” that leads to “performing.” Minutes of meetings capture discussion details, ensure that forward progress is maintained by keeping track of issues already visited, and serve as progress reports to respective institution CIOs.

**Conference “Networking” – Multi-campuses; ViDe; HEPKI-PAG; ArchiTech.**

Several conferences are significant, not just for the opportunities of professional development generally, and getting up to speed on directories and PKI specifically, but also for surfacing some ideas that are directly, or soon to be, relevant to GSU activities.
• Educause 2000 conference provided more in depth sessions on directories and PKI. A Birds Of a Feather session that addressed multi-campus issues was directly relevant to the USG Technical Working Group. Also, sessions on ViDe video conferencing are interesting from perspective of directory services (which are absent). – October 10-13, 2000

• University System of Georgia Annual Computing Conference was an opportunity to present two papers, Implementing Infrastructure for the eUniversity [9] and Why is PKI like Y2K? Future Lessons from the Past [10] to communicate progress on activities. Mary Trauner’s presentation on video conferencing (George Jetson – Can You Hear Me?) noted that next steps for building video conferencing infrastructure included a directory services item. – October 25-27, 2000

• Attended Internet2 conference and volunteered to participate with the Internet2 Middleware Higher Education PKI Policy Activity Group (HEPKI-PAG) chaired by Ken Klingentstein that, among other things, is drafting a higher education certificate policy and bridge certificate authority model. Also, became aware of European work in directories, especially SurfNet <http://www.surfnet.nl/> organization in the Netherlands. Also, Keith Hazelton mentioned “ArchiTech server” toolset for providing metadirectory services. – October 29-November 21, 2000

NSF Pre-proposal Submitted, GSU & UAB – November 29, 2000
Following through on original SURA proposal in May, facilitated collaborative response by GSU and UAB to NSF Advanced Network Infrastructure, Information Technology Research group proposal: JTR/SI - Integrating PKI with SIP-based IP Telephony to Create a Secured Scalable Infrastructure for Higher Education Medical Research. The basic concept was “to integrate and build an application toolkit that seamlessly ties a PKI infrastructure with voice-based IP communications.” [11]. While not invited to submit a full proposal, again the communication was positive and the NSF review comments gave some encouragement on the conceptual approach. The collaboration between ACS and Dr. Samir Chatterjee or GSU’s CIS department in the Robinson College of Business is a positive trend – IT and CIS certainly have areas of mutual interest and complementary skill.

GSU “person registry” Implemented for WebCT – December 2000-January 1, 2001
January 2001, working with IS&T units via the Enterprise Directory Infrastructure Steering Group, facilitated the deployment of the GSU “person registry” in support of WebCT provisioning. This is the culmination of months of activity since the initiation of ACS and the vision of “directories saving the world!” The “person registry” is what sits behind the directory itself and enables an integrated, synchronized view of the details of the campus’ population. After much discussion, design, and debate on resources for implementation, the light at the end of the tunnel resulted from discussion with Keith Hazelton and Bob Morgan at the Internet2 Fall 2000 conference as to a model for a “person registry.” Bob Morgan’s site <http://depts.washington.edu/cac/project/personreg/resource/> provided appropriate impetus, moving us to the “okay, let’s do it” phase.

Morgan’s “Phase I” list <http://depts.washington.edu/cac/project/personreg/resource/pr.phase1.tasks.html> was reviewed in November with the Steering Group, the Data Stewards for Person Working Group, and the LDAP Design Working Group, resulting in the draft of a GSU document showing our “person registry” design. In the end it was the WebCT provisioning need that became a prime driver. Faculty wanted WebCT accounts for students to be automated, an obvious improvement over entering ids based on a class list extracted from the legacy student system. The goal was decided: Implement a person registry construct to enable automatic provisioning of WebCT accounts by beginning of January 2001 term. This pragmatic goal served as the needed driver. A person registry was in place and provisioning the WebCT accounts in early January 2001.

Directory Proposal to SURA – January 8, 2001
Presented Directory Services Architecture for a Community of Interest Proposal Summary to SURA IT Committee January 8, 2001, outlining an approach to the I2MI “directory-of-directories” model that added the concept of custom directory services maintained for a specific community of interest. The feedback
from the SURA group resulted in a productive exchange of ideas, and helped in understanding more specific technical architecture planned for the “directory-of-directories” as well as how the basic idea of the custom directories was relevant. As a higher education knows, research ideas are fostered through collaborative communication. The directory-of-directories followed, in part, the line of investigation done by the European projects Terena Direct (<http://www.terena.nl/projects/direct/index.html>) and DESIRE (Development of a European Service for Information on Research and Education) (<http://www.desire.org/>) for handling scalability issues.

The DESIRE project followed up on Terena Direct’s work in building a “virtual root” LDAP server. DESIRE addresses the issue of distributed directories by building indexes and providing user interfaces to the indexes. DESIRE points out that “The use of directories as widely-distributed information services is becoming widespread since the introduction of Internet-based directory technologies like LDAP…. One issue that still remains open is the lack of an infrastructure that makes such distributed information more accessible to the end user. It will be necessary to build an index system that collects data from directory servers and thus makes them searchable. In a second step, such a service will be integrated into the Web-centred model, providing users with a single interface to resource discovery [12].”

The Terena Direct, the DESIRE, and the I2 “directory-of-directories” projects informed the approach proposed in the SURA proposal. Moreover, the discussion after the SURA proposal would encourage, and result in, further collaboration.

NSF Proposal Submitted for Directory Services – January 24, 2001

ACS submitted a NSF Advanced Network Infrastructure Information Technology Research small grant proposal ITR/SI – Scalable, Customized, Authoritative LDAP Directory Services for Communities of Interest on January 24, 2001. Proposal included Co-PI Dr. Sham Navathe, Georgia Tech College of Computing research faculty and further developed ideas originally proposed to SURA and refined from subsequent discussions. “Fundamentally, this proposal seeks to accomplish goals whereby directory services can be provided in an effective manner to communities of interest. We will investigate a meta-directory approach to build customized directories that can leverage local directories to the benefit of a community of interest. Custom directories can be implemented by providing web-based XML toolkit for user interfaces and tailoring automated mechanisms to select entries and attributes matching the specialized community from an otherwise very large and varied set of source directories. This permits users to have more effective, targeted, and knowledge based access to information that directly involves their community, avoids some scaling issues inherent in consolidating directories at an edu domain level, and enables the directory to assure users that entries are authoritative. Hosting services are proposed that will optimize the placement, performance, and management of directory servers that will represent the aggregation of entries drawn from sources that are distributed regionally, nationally, or worldwide [13].”

It remains to be seen what the outcome of this NSF proposal will be, but one can see how this proposal has evolved from previous collaborative proposals, and it forms a bridge to further endeavors. The importance of communication and collaboration is emphasized as a mechanism for advancing ideas, refining concepts, and implementing solutions.


ACS worked with representative Data Stewards and the GSU Security Officer to form the Account Process Working Group in January 2001 to address the GSU Internal Audit findings related to administrative account management. Outcome of this working group will be a consistent process for management of accounts accessing the administrative applications. While the audit findings could likely be addressed without any specific reference to an enterprise directory, it is clearly understood that the presence of an integrated directory greatly facilitates account management for individuals associated with the campus.
Indeed, this “directory-enabling” phenomenon is a valuable outcome. The Burton Group analysis in *Directory-Enabled Computing: The Directory’s Expanding Role* concludes:

> “The term ‘directory-enabled computing’ defines the directory’s role as a significant component of the enterprise computing infrastructure. That role is coming into sharper focus as products mature and the industry consolidates. Organizations once were forced to deal with special-purpose directory technology that isolated information and increased the management burden. Now, however, they can begin to build an enterprise directory infrastructure around general-purpose products… [that] can participate in an integrated enterprise directory infrastructure that reduces management overhead and supports a variety of applications.” [2]

**GartnerGroup PKI Tool and HEPKI-PAG – January 26, 2001**

With Brad Hildreth, GartnerGroup, and Tom Maier, BOR, demonstrated GartnerGroup’s Decision Driver tool for PKI for several Internet2 HEPKI-PAG members during January 26, 2001 conference call. Tool is being considered as a possible mechanism for 1) evaluating PKI vendors and 2) generating RFP. This is partly aligned to HEPKI-PAG’s work in evaluating PKI issues and identifying model RFPs as guideline for other institutions. Currently HEPKI-PAG and GartnerGroup are considering how well GartnerGroup tool addresses higher education concerns, including PKI interoperation, mobility, and open standards.

**“Person Registry” Implementation Team Weekly Status Meetings – February 15, 2001**

Drafted documentation of tasks required for implementation of “person registry” – the authoritative registry containing integrated “person” information for all GSU students, staff, and affiliates. Beginning Feb 15, 2001 weekly status meetings will focus on task progress, increasing communication between project members (drawn from multiple IS&T units, mainly UIS and UCCS), and using an iterative review and discussion process to flesh out documentation and implementation details. WebCT provided prime driver initially, now provisioning for student email is the driver. Another driver is to support access to the new student recreation center opening in August 2001.

**Georgia Enterprise Information Security Program – February 20, 2001**

Following ongoing discussions with John Wandelt at Georgia Tech Research Institute, participated in Feb 20, 2001 meeting with members of Georgia Technology Authority’s “Converged Communications Outsourcing Project” project management team. Discussion focused on how GTRI’s proposed “Georgia Enterprise Information Security Program” would support CCOP and accomplish goal of security infrastructure for State of Georgia. Pending funding, tentative agreement is that ACS and Georgia Tech IT Security Officer will participate in GEISP.

**Consensus on USG Consolidated Directory Architecture – February 23, 2001**

February 23, 2001 meeting of Enterprise Directory Infrastructure TWG arrived at consensus on architecture for GSU, GaTech, USG, and BOR central office consolidated directory. Solution is based on model of directory-of-directories, which it is agreed can scale well, at least at the level of 34 institutions of USG. Model enables institutions to manage institutional LDAP directories locally, satisfying local policies as far as access to information.

**MetaMerge (formerly ArchiTech) Toolset Acquired – February 26, 2001**

Requested and received access on February 26, 2001 to MetaMerge (<http://lab.architech.no/index.html>), a set of tools for “information integration and transformation, creating intelligent data flows between heterogeneous systems.” MetaMerge (formerly ArchiTech) was described by Keith Hazelton, an Internet2 Middleware player, in Internet2 Fall 2000 conference presentation on directories. It is being distributed freely to the higher education community and is described in a July 24, 2000 press release:

> “‘Ever since the Burton Group implanted the concepts of metadirectory into the public consciousness four years ago, the demand for directory integration tools has matured… But… there is a surprising dearth of “next generation” metadirectory products in the marketplace. The announcement of...”
ArchiTech Server breaks the mould, and represents an exciting development that will be welcomed across the board,' commented David Goodman, Senior Product Manager, Lotus Development…”
   “‘For the myriad networking issues we are addressing on campus, the ArchiTech Server is already proving to be a tremendous asset. The ArchiTech approach demonstrates great potential for addressing a number of the thorny problems in shared infrastructure development facing administrators in both corporate enterprises and institutions of higher education. Their products could well end up playing key roles across the whole infrastructure spectrum,’ said Keith Hazelton, Senior IT Architect, University of Wisconsin…” [14]

CIS Graduate Student Resources – February 28, 2001
Following through on discussion with Dr. Navathe at Georgia Tech, ACS contacted his collaborator Dr. Vaishnavi, GSU CIS faculty on February 28, 2001. ACS is looking to line up graduate student resources for ACS as well as possible collaborative work with CIS in the area of directory services. Initial task assignment will include working with MetaMerge toolset and applying it to GSU person registry provisioning.

Internet2 Conference, Vide Initiative Collaboration Infrastructure – March 7-9, 2001
Attended Internet2 Spring 2001 conference and committed to participation in development of “middleware” services supporting the ViDe Video Development Initiative – an initiative supported by Internet2 as well as current ViDe participants at University of Tennessee, University of North Carolina at Chapel Hill, Georgia Tech and others.

SURA Proposal for Vide Directory Services – In Progress
Consensus with Gordon Wishon, SURA IT Committee, and Michael Gettes, Georgetown University/Internet2 on preparing proposal to SURA on community-of-interest directory services for Vide Video Development Initiative.

Outcome
Significant progress has been made as of March 2001 in Advanced Campus Services’ first year. Resources have been discovered (GartnerGroup, The Burton Group, Internet2 Middleware Initiative, Educause Net@Edu, CREN Tech Talks, Federal PKI Working Group, Directory Interoperability Forum, legislative citations, etc.) Data sources have been mapped to LDAP attributes, the person registry has been designed, and functional data stewards have developed consensus on the strategic importance of the project and drafted an Enterprise Directory Policy. Other University System institutions have committed to creating a consolidated “system” directory. The LDAP directory implementation at GSU and the University System of Georgia is being built with attention to national initiatives, the Internet2 Middleware recommendations, and following Educause/Internet2 “eduPerson” schema. White papers and University System presentations have served to educate our community on the issues and helped align enterprise strategies. Collaborative proposals have been made with other institutions in an effort to seek funding and support for our mutual directory and public key infrastructure needs.

Perhaps most important in this first year, indeed maybe fundamental to success, has been the relationships built between people, here at Georgia State University, with individuals at the University System of Georgia, and with other higher education Internet2 members. The vision of GSU’s CIO was instrumental in putting “directory and public key infrastructure” forward as a strategic enterprise commitment. The steps Advanced Campus Services has taken in fulfilling this vision have been focused on education, discovery of resources, following through on connections, and focusing on specific actions to generate forward motion.
Conclusion
Any institution looking to establish directory and PKI capabilities is faced with great challenges in overcoming the inertia of past practices and sorting through the complexity of directory and PKI technology. How to start, what resources to use, what strategies to use, how to structure the project — these are lessons that GSU has learned and can share. Establish some basic goals, dedicate someone to start working the issues, educate your organization on the issues, communicate and pay attention to relationships, and stay open to opportunity.


