Steve Biklen, David Moldoff & Clare Smith-Larson Recognized with Distinguished Service Awards

Steve Biklen has served on the PESC Board of Directors since November 2002; and for most of those years, as Treasurer. Mr. Biklen is the founding President of the Citibank Student Loan Corporation and served on the Advisory Committee on Student Financial Assistance for eight years (note: we inadvertently reported in a previous communication that Mr. Biklen was also chair of the Advisory Committee. He was not and we apologize for the error). Mr. Biklen, who currently sits on the Board of Directors at American Student Assistance, has decided that he will not be reominated when his current term on the Board expires this June 30. David Moldoff has served on the PESC Board of Directors since July 2003 and currently Co-Chairs PESC’s Academic Progress XML Development Workgroup. Mr. Moldoff joined the Board as Senior Vice President of Solutions Architecture and Infrastructure at SCT (now SunGard Higher Education) and currently serves on the PESC Board as Founder and CEO of AcademyOne, Inc., a company he launched several years back. Clare Smith-Larson of Iowa State University is a long-time champion of PESC having been involved with PESC since its launch. Ms. Smith-Larson has also served as Chair of AACRAO’s SPEEDE Committee and currently serves as Chair of PESC’s Steering Committee for the Standards Forum for Education.

NASFAA Proposes New Student Loan Program Model

New Loan Concept Incorporates Best Aspects of Perkins, FFEL, and Direct Loan Programs

The National Association of Student Financial Aid Administrators recently forwarded to its members, the Obama administration, and selected members of Congress a new approach to student loans that would replace the Federal Family Education Loan Program, the Direct Loan Program, and the Federal Perkins Loan Program with a program that integrates the best aspects of all three.

Drawing on the expertise of thousands of student aid professionals through its National Conversation Initiative on College Access (NCI), NASFAA developed a conceptual framework for a new student loan model combining the most desirable features of today’s existing loan programs.
NASFAA, from Page 1

This new, integrated loan program would be simpler and more equitable for students while expanding the amount of capital available to make loans through the capital markets. The proposed loan model encourages all beneficiaries of postsecondary education (i.e., borrowers, state governments, private employers, friends and families, and all Americans) to help pay down borrowers’ debt levels and raise capital for a self-sustaining loan fund.

NASFAA’s proposed student loan model:
• Provides consistent and equal terms, conditions, and benefits to all borrowers
• Offers a seamless loan origination, disbursement and repayment experience for students
• Ensures a predictable and continuous source of capital for student loan funding that isn’t dependent on any single entity
• Allows individuals, families, companies, financial institutions, and all Americans to express their support for higher education by using government-backed special purpose bonds
• Reduces federal expenditures by creating a self-sustaining funding source that relies on new, safe investment vehicles
• Leverages technological and business innovations in the private sector by creating a common servicing platform that relies on a centralized database of all borrowers and can be used by multiple servicing agents
• Creates new incentives for businesses, individuals, and states to help students repay student loan debt
• Capitalizes on the expertise and best practices developed by all entities currently participating in the existing loan programs

• Is not the FFEL, Direct Loan, or Perkins Loan program, but rather an entirely new loan program created from the most positive aspects of all three

"We now have a unique opportunity to dramatically redesign the program to better serve students," said NASFAA President and CEO Dr. Philip Day. "Our new model offers the groundwork for productive discussions that I expect will ultimately result in a simple, efficient, reliable, and transparent system of providing education loans to families."

This preliminary student loan model is just one piece of a larger set of NCI student aid policy recommendations that NASFAA will make public shortly. The recent release of President Obama’s FY 2010 budget has convinced us to release our student loan model in advance to ensure that it is considered as part of the continuing conversation and dialogue on changes to the student loan program.

NCI represents the collective recommendations of thousands of financial aid professionals, input from renowned public policy experts, and careful analysis of more than 40 prominent research studies. The overall goal of the NCI campaign is to create policy recommendations that increase college access, reduce the financial burden placed on students and families, and increase the numbers of students who ultimately graduate with a college degree--especially those who have been historically underrepresented and underserved. To learn more about NCI, go to nasfaa.org/redesign/nci/ncicenter.html.

Members of the media and others are welcome to contact NASFAA Vice President of Planning and Development Justin Draeger for more information about NASFAA’s student loan model at (202) 785-6960 or DraegerJ@NASFAA.org.
Keeping Up With PESC

6th Annual Conference on Technology & Standards

The final program is now posted on the PESC website. We thank NCHELP and SHEEO for partnering with PESC on the 6th Annual Conference on Technology & Standards; and we thank our generous sponsors that help make this event possible: AcademyOne, Inc, NASLA, and USA Funds.

PESC Board of Directors Elections

Elections for PESC’s Board of Directors will be held during PESC’s 11 Annual Membership Meeting scheduled for Tuesday April 7, 2009 from 5:30pm - 6:30pm EDT at the Hyatt Regency Washington on Capitol Hill (400 New Jersey Ave NW, Washington DC, 20001). Membership meetings are open to all PESC Members and Affiliates and with prior notification, other interested parties. Backgrounds and biographies of nominees are on page 4 of this edition of The Standard.

11th Annual PESC Membership Meeting

Please be advised that PESC’s 11th Annual Membership Meeting will take place on Tuesday April 7, 2009 from 5:30pm - 6:30pm EDT at the Hyatt Regency Washington on Capitol Hill during the Spring 2009 PESC Member Summit. Membership meetings are open to all PESC Members and Affiliates, and with prior notification, other interested parties. Registration for the Summit is not required in order to attend the Membership Meeting.

New Members

• University of California at Berkeley
• Washington State University
• unisolution

Authentication: The Status of Shibboleth by Arnie Miles

PESC has recently released a Technical Briefing on Authentication: The Status of Shibboleth. Authored by Georgetown University’s Arnie Miles, this briefing provides an in-depth account of Shibboleth, its relationship to SAML, and its use with higher education. The Briefing is on page 7 of The Standard and also posted on the PESC Website.

Technology Tidbits and Standards Snippets

- “Electronic portfolios provide a vehicle for a transition into the future of higher education,” according to a recent Academic Commons article. The authors illustrate their views through four key purposes of the ePortfolio; integrate student learning, connect disparate parts of a student’s education, improve engagement in learning process and a tool for student assessment. To access the full article, visit http://www.academiccommons.org/commons/essay/making-common-cause-electronic-portfolios.

- A recent U.S. House of Representatives hearing challenged the effectiveness of PCI rules, claiming that the standard is overly complex and fails at preventing data thefts and fraud. One example was a grocery store’s PCI certification being achieved at the same time its network was being hacked and credit card numbers and expiration dates were being stolen. While no proposals have come from the hearing, it was clear that Congress will be calling for increased in oversight in how credit card data is secured. http://www.computerworld.com/action/article.do?command=viewArticleBasic&articleId=9130901
Jeffrey Alderson  
**DIRECTOR OF DATA STANDARDS**  
**CONNECTEDU, INC.**  

Jeff serves as ConnectEDU’s primary liaison to data standards bodies such as SIFA and PESC, and is an active member of PESC’s Functional Acknowledgement, Education Record and Academic Progress workgroups. While actively guiding the development of new products and services for the p20 landscape at ConnectEDU, Jeff collaborates with other vendors of student information systems, electronic transcript exchange systems and key stakeholders in secondary and postsecondary institutions. Through his leadership, ConnectEDU became the first vendor of an electronic transcript exchange network to use the PESC High School XML Transcript standard in an operational capacity in August of 2006. Prior to joining ConnectEDU in 2004, Jeff was a security engineer in Oracle Corporation’s advanced programs group. Jeff carries professional certifications that are directly applicable to his work with PESC, including PMI Program Management, Oracle Database Administration, Microsoft Certified Systems Engineer, Microsoft Certified Database Administrator, and Cisco Certified Network Administrator. Jeff has over 10 years experience in deploying secure, standards-based, data solutions for education and government, as well as five years service as a commissioned officer in the U.S. Air Force. Mr. Alderson received his B.S. in Electrical and Computer Engineering from Worcester Polytechnic Institute in Massachusetts.

Russell Buyse  
**COO AND VICE PRESIDENT OF R & D, RECORD AND TRANSCRIPT SOLUTIONS**  
**NATIONAL TRANSCRIPT CENTER**  

Russell is a software executive with over 20 years experience. The last 4 years have been with the National Transcript Center (NTC) and ESP Solutions Group. Both companies are pioneers in the adoption of new technologies to the problems of education. NTC in particular was the first transcript solution to adopt the PESC standard and has been a major proponent of PESC with all its customers and the industry in general. NTC, now a part of Edustructures/Pearson, is a web-based software-as-a-service solution designed to improve the efficiency, reliability, cost and security of academic transcript exchange for PK-12 schools, state education agencies, colleges and universities, and co-academic organizations. Russell managed product development and customer delivery for NTC since its founding. As COO, he has responsibility for product development and services. He leads the team responsible for all aspects of product development and services including product roadmap, quality assurance, software, and documentation. He also manages executive level relationships for all key accounts including senior representatives in Texas, California, Colorado, Virginia, West Virginia, and Wyoming. Mr. Buyse hold a bachelor’s degree in Computer Science and is a graduate of the Institute for Managerial Leadership from The University of Texas at Austin.
MANUEL DIETZ  
**FOUNDER AND MANAGING DIRECTOR**  
**UNISOLUTION**

Unisolution was co-founded in 2001 by Manuel Dietz in the TU Darmstadt and since then specializes in the development of high quality and future-oriented software solutions and consulting services for the internationalization of higher education institutions. From headquarters in Stuttgart, Germany, Mr. Dietz serves as managing director of unisolution and also serves on the Steering Committee of the Rome Student Systems and Standards Group (RS3G), the European initiative to implement systems and standards to support the Bologna process.

WILLIAM HOLLOWSKY  
*Incumbent*  
**MANAGING DIRECTOR**  
**SUNGARD HIGHER EDUCATION**

Bill Hollowsky currently serves as Managing Director of SunGard Higher Education, where he has been for the past several years. Prior to SunGard Higher Education, Oracle, Mr. Hollowsky served as Senior Director of Applications Development at Oracle where he was for over eight years focused on product strategy and development. Mr. Hollowsky was previously with KPMG Peat Marwick, LLP and also worked at the University of Maryland for ten years.

RUSSELL JUDD  
**CHIEF INDUSTRY AND GOVERNMENT RELATIONS OFFICER**  
**GREAT LAKES EDUCATIONAL LOAN SERVICES, INC.**  
*REPRESENTING NASLA – THE NATIONAL ASSOCIATION OF STUDENT LOAN ADMINISTRATORS*

Russell Judd is Chief Industry and Government Relations officer for Great Lakes Educational Loan Services, Inc. an affiliate of Great Lakes Higher Education Corporation (Great Lakes), headquartered in Madison, WI. Great Lakes is the 4th largest student loan guarantor and among the top 5 largest student loan servicers. Russ has been in the postsecondary student aid industry for over 20 years serving in various senior management capacities at Great Lakes, including both Information Technology and business areas. Russ’ IT experience spans 30 years with an emphasis on Application Architecture, Data Management, Software Product Development, and Quality Assurance. Russ has been very active in industry standardization and collaboration initiatives beginning with the NCHELP team that developed the initial CommonLine standards and he has been an active participant in several standards focus groups led by the Department of Education. Russ is an original member of the Meteor Advisory Team and is its current Chair for the Business Development Team. Russ has developed and presented numerous presentations for various industry conferences and groups including NCHELP, state, regional and national financial aid administrator association conferences, Financial Aid Management Systems user groups, and the Department of Education’s Electronic Access Conferences. He has spoken on such topics as: Benefits of Standards Utilization, Emerging E-Commerce standards; Authentication Standardization; and the use of standards in open systems.

DAVID MOLDOFF  
*Incumbent*  
**FOUNDER AND CEO**  
**ACADEMYONE, INC.**

David K. Moldoff, Founder and CEO of AcademyOne, Inc., is a visionary in higher education responsible for AcademyOne’s overall strategy with specific emphasis on the technology infrastructure, integration of applications and services as well as exploiting his vast industry network with regards to sales, strategic partnerships, associations, etc.
Mr. Moldoff is a successful entrepreneur with over 30 years of experience in launching and managing new companies and new products in technology for higher education. Before forming AcademyOne in 2005, he was SVP of Solutions Architecture and Infrastructure for SCT, which he was instrumental in selling to SunGard in 2004. Mr. Moldoff has been an active board member with several organizations including PESC, Bommi, Inc, and the Open Enterprise Application Integration Foundation for Higher Education; and has been an active member of Educause, NACUBO, NASFAA, NACUBO and AACRAO through his company affiliations, sponsoring keynote speakers, and national awards for innovation. Mr. Moldoff is a Gundaker Fellow and multiple Paul Harris Fellow, lives in West Chester, Pennsylvania with his wife and two children, and is a graduate of Drexel University.

**DIRECTOR OF ACADEMIC RECORDS**  
UNIVERSITY OF OKLAHOMA  
REPRESENTING AACRAO – AMERICAN ASSOCIATION OF COLLEGIATE REGISTRARS AND ADMISSIONS OFFICERS

Rick Skeel is the Director of Academic Records at the University of Oklahoma. In his 30+ years at that institution he has been responsible for the business design and development of most of the administrative systems used at the University. He is an active and current member of AACRAO’s SPEEDE Committee and has served on the Committee for eighteen years including as its Chair. Mr. Skeel has also served as Chair of AACRAO’s Nominating Committee and as President of SACRAO and currently serves as liaison between the SPEEDE Committee and PESC and as Co-Chair of the Course Inventory Workgroup.
Authentication
The Status of Shibboleth

Arnie Miles
Georgetown University
February 24, 2008
Technical briefs are prepared for use by PESC Work Groups. They provide a historical perspective, a comparison of a proposed standard with others, an assessment of a related technology, or materials used for training. Tech Briefs are directly related to PESC’s mission and judged to be accurate and fair. As all PESC work, these are authored by volunteers.

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The opinions in these Tech Briefs are those of the author(s) and are not those of the Postsecondary Electronic Standards Council or the institutions or organizations with whom the authors are affiliated.

The PESC Board appreciates the volunteer efforts of authors, editors, and others who contributed to this effort.

I hope you find these useful.

Michael Sessa
Executive Director
Executive Summary

This paper discusses the current status of the Internet2 project Shibboleth. While the target audience is higher education, extra efforts have been made to discuss issues beyond higher education, including United States Federal government certification. Shibboleth is described, as is the Organization for the Advancement of Structured Information Standards (OASIS) Standard Security Assertion Markup Language (SAML) on which Shibboleth is based. Commercial projects that implement the SAML standard are touched on in a very general fashion.

Steven Carmody was interviewed for this paper over a 2-week period in September 2008, and his quotes are used liberally throughout. Carmody is an IT Architect at Brown University, and the Project Manager for the Shibboleth Initiative. These discussions give the reader a flavor of how the Shibboleth team views its charter. Being an open source project, contributors come from all over the world, and Carmody has the responsibility for compiling their work and attempting to publish product on time. Carmody has taken great pains not to speak poorly of what some would consider his competition.

Having said that, there are commercial products available that comply with the SAML 2.0 standard. Some of these products go so far as to tailor their product to comply specifically with government certification processes. However, adoption of Shibboleth is more than just the adoption of a piece of middleware. Rather, adoption of Shibboleth is the adoption of the critical concept of Federation. Carmody observed:

I think it’s worth differentiating the concept of Federation from Shibboleth as a specific “product” (implementation of a set of protocols that support Federation). Federation is clearly taking hold in the Higher Education space (although much more slowly in the US than in many other countries).

He further observed “Shibboleth is the market leader in standards-based interoperability. Its worldwide adoption in the higher education community supports that statement.”

Shibboleth was created to be standards based from the beginning, and has contributed back to the standard. The
concept of anonymity was first introduced by Shibboleth to solve the anonymous access to library materials problem and subsequently introduced to the SAML v2 standard. This concept alone has opened doors to a vast array of new use cases, and has added new levels of scalability to the consumption of authentication assertions.

Most readers should not be concerned with the Federal Government certification processes, as it only applies to inter-federal government uses. It would be of passing interest if it had specific bearing on the quality of the software or its compliance to real world uses of the SAML profile, so the discussion of certifications enclosed are mostly to explain why potential implementers of Shibboleth should not be concerned by the lack of certification.

6 Common definitions are that middleware is the "glue" between software components or between software and the network or it is the slash in Client/Server. See (Defining Technology Inc., 2009).

7 Under the Federal eAuthorization program (eAuth). The General Services Administration now has a requirement that the Liberty Alliance provide interoperability testing. See (General Services Administration, 2008).
Preface

Shibboleth is an implementation of the OASIS SAML standard. It is not the only implementation, nor is it the only open source implementation. However, Shibboleth has significant market share in the higher education community, partially due to the creation, adoption and contribution back to the standard of the concept of anonymous authentication as requested by higher education librarians to prevent the use of online journals and books to create a profile of the user’s reading.

Robert Metcalf’s law states that the "value" or "power" of a network increases in proportion to the square of the number of nodes on the network. Marc Andressen stated it:

A network in general behaves in such a way that the more nodes that are added to it, the whole thing gets more valuable for everyone on it because all of a sudden there's all this new stuff that wasn't there before. You saw it with the phone system. The more phones that are on the network, the more valuable it is to everyone because then you can call these people. Federal Express, in order to grow their business, would add a node in Topeka and business in New York would spike. You see it on the Internet all the time. Every new node, every new server, every new user expands the possibilities for everyone else who's already there.

Unfortunately, this tends to discourage early adopters, and increases the resistance in the path towards reaching the point where the value is perceived to be more than the cost. Every aspect of new networking technology tends to have a massive upfront cost that must be overcome prior to widespread adoption. SAML in general and Shibboleth in particular may be approaching that critical mass where this tipping point is achieved. Historical evidence is that once this tipping point is achieved, growth is overwhelming, and Metcalf’s law is cited as an example of the exponential growth of the Internet.

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8 As used here the term anonymous authentication is "...an individual's membership in a group without revealing that individual's identity and without restricting how the membership of the group may be changed" (Schecter. 1999). The phrase is also used to mean there is no assertion of the person's identity, i.e. "public."

9 From (Robertson, 1996, paragraph 1). See also (Metcalfe 2006).

10 From (Allison, 1995, Section 15 "Costs of the Internet").
Now, many are considering the implementation of Shibboleth. More accurately, many are considering the implementation of Federations, which SAML examples make possible, which will lead to an explosion of installations of Shibboleth and other SAML products. With the release of Shibboleth 2.0, increased functionality and improved stability are encouraging immediate adoption.
Background

Shibboleth implements a standards-based federation model to provide authentication information about users to service providing applications for the exchange of data among institutions, and for validation of digitally signed documents. Users authenticate at their home institution and manage the release of their information, which service providers use to make access control decisions. Internet 2 describes Shibboleth, saying: “The Shibboleth System is a standards based, open source software package for web single sign-on across or within organizational boundaries. It allows sites to make informed authorization decisions for individual access of protected online resources in a privacy-preserving manner.”

Shibboleth was established as a separate effort to create a useful example of the SAML specification to meet a requirement of university librarians: provide anonymous authentication. Anonymous authentication was not part of the original SAML specification, but the Shibboleth team extended the SAML specification to allow for anonymous authentication, which was then added to SAML in version 2. Shibboleth may be used to identify the user as affiliated with a set of attributes, e.g. a specific university or that user's role as a student, faculty, or alumni, rather than the specific identification of the individual. Thus an individual cannot be linked with use of specific journals or books.

Shibboleth 2.0 enhances the ability for identity providers to use and manage "anonymous identifiers" to protect user privacy but still allow for personalization. The identity provider assigns a persistent unique identifier to a specific user which allows service providers to tailor and improve services based on the needs of that user without knowing their specific identity. For instance, a medical student searching for articles on a specific disease or treatment via an online medical journal could save his or her searches using the anonymous identifier and then build on their research over time. For the user, this is a transparent process; no knowledge of the identifier is needed.
This functionality is applicable beyond the requirements of anonymous authorization of users who have authenticated at their Identity Providers. By default, since anonymous authentication is available, additional authorization schemes can be created around attributes that group these anonymous users by the attributes assigned to these users at their home institutions. The impact is greater then what is immediately visible, or initially intended, as authorization based upon user attributes allows the creation of scalable yet secure distributed applications, and potentially solving a host of challenges. One example is computational and data grids.

According to Ian Foster:

A Grid is a system that:

1) *coordinates resources that are not subject to centralized control* …
(A Grid integrates and coordinates resources and users that live within different control domains—for example, the user’s desktop vs. central computing; different administrative units of the same company; or different companies; and addresses the issues of security, policy, payment, membership, and so forth that arise in these settings. Otherwise, we are dealing with a local management system.)

2) … *using standard, open, general-purpose protocols and interfaces* … (A Grid is built from multi-purpose protocols and interfaces that address such fundamental issues as authentication, authorization, resource discovery, and resource access. As I discuss further below, it is important that these protocols and interfaces be *standard* and *open*. Otherwise, we are dealing with an application-specific system.)

3) … *to deliver nontrivial qualities of service*. (A Grid allows its constituent resources to be used in a coordinated fashion to deliver various qualities of service, relating for example to response time, throughput, availability, and security, and/or co-allocation of multiple resource types to meet complex user demands, so that the utility of the combined system is significantly greater than that of the sum of its parts.)

Computational and data grids require anonymous authentication to enable scalable authorization mechanisms, which has been lacking until now. This lack has largely

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13 Ian Foster, “What is the Grid? A Three Point Checklist” published in GRIDToday, Vol. 1, No. 6. (July 20, 2002), but no longer available at On-Demand Enterprise formerly known as “GRIDToday”. See (Foster, 2002) for a copy of his paper.
contributed to the perceived failure of grid systems outside huge government funded projects. Therefore, one example would be a new class of grid middleware that rid owners of services of the responsibilities for maintaining awareness of user identities. Any situation where an owner of a service is more concerned with a general attribute about a user than exactly who the user is can be an ideal candidate for a Shibboleth implementation. Other examples of previously unrecognized uses for anonymous authentication include corporate mergers and takeovers, vertical integrations of companies and academic institutions, and other places where sharing of resources is open to groups of users en masse.
Current Status

Shibboleth 2.0 was released 19 March 2008. This version provides “Support for SAML 2.0 and SAML 1.1.”

Shibboleth implements a crucial but incomplete set of SAML profiles, as indicated by the attached table prepared by Chad La Joie and Scott Cantor. These profiles can be found in the “Profiles for the OASIS Security Assertion Markup Language (SAML) V2.0.” In section 1.1 of this document, the authors state:

Another type of SAML profile defines a set of constraints on the use of a general SAML protocol or assertion capability for a particular environment or context of use. Profiles of this nature may constrain optionality, require the use of specific SAML functionality (for example, attributes, conditions, or bindings), and in other respects define the processing rules to be followed by profile actors.

The decision about which profiles to implement is based on requirements of the worldwide Higher Ed community, in conjunction with evaluation of which elements are under the control of Shibboleth. Shortly after the attached table discussing implemented SAML profiles was released on the Internet, a posting to the Shibboleth Users mailing list observed that people were unaware that a number of the profiles listed as being in development were being worked on, and a Shibboleth roadmap was requested. An updated Shibboleth development roadmap was published on September 2, 2008. This roadmap lists the functionality that will be included in Shibboleth 2.2, including additional SAML 2 functionality, such as back-channel support for Single Logout (SLO). This roadmap also includes a call for use cases to further refine requirements.

According to Shibboleth developer Chad La Joie, interoperability testing was done at “Interop Fests” by Scott Cantor, principal author of the SAML 2.0 specification and developer of OpenSAML on Shibboleth 2.0 with Sun Microsystems’ Federated Access Management, Ping Identity Corporation’s PingFederate, and Oracle Corporation’s Access Manager for the profiles
that Shibboleth implements. It was found that each of these products interacted with Shibboleth and with each other.

Because of the maturity of SAML 2.1, interoperability is expected, so this is nothing new. Interoperability has been improving since SAML 2.0. Carmody continued, stating “Shibboleth differentiates itself by providing the Higher Education community with functionality beyond the basic protocols, functionality that addresses the unique needs of this community.” Some of these functionalities include attribute release policies, the ArpViewer, and federation scalability, which is required by the Higher Education community’s more than 3000 members. Attribute Release Policies allow sites to easily manage the release of attributes and specific values to individual service providers, another requirement for simplifying management of partner relationships and inter-federated operations. The ArpViewer gives users the ability to manage what is released about them.

The strength of Shibboleth lies in part with the concept of the Federation, where communities build trust relationships and join together. Carmody pointed out Shibboleth’s wide deployment in the global higher education arena and Shibboleth’s status as a key component of the broader Internet2 Middleware initiative. He stated “…although the initial use cases were related to licensed library resources, it appears that a) collaboration spanning campus boundaries, and b) cross-registered students are the use cases that are really driving adoption of Federation.”

Individual states in the United States are building state-level Federations that span all academic grade levels, local and state governments and higher education. According to Carmody, “Federations based on Shibboleth (or compatible software) now exist across all of western and middle Europe, North America, Australia, New Zealand, China, and Japan (starting up right now!). Federation is an actuality. Inter-federated operation will soon be a reality.”

Additionally, the United Kingdom higher education has committed to implement Shibboleth. Established under the Joint Information Systems Committee (JISC), Shibboleth
will replace Athens as the method of authenticating UK university students for publishers to provide access to electronic books and journals.

Today [31 July 2008] nearly 500 institutions and organizations will complete the transition to a new open standard SAML compliant access management system and the UK Access Management Federation. The federation will be providing access to approximately 8 million users across the UK.

The Federation is operated by JANET (UK) on behalf of JISC and Becta and brings the entire UK education and research sector a step closer to achieving single sign-on to network and online resources. The Federation now has over 150 Service Provider platforms registered with over 100 educational publishers such as the BBC, Elsevier, ProQuest, Thomson Scientific, Institute of Physics and a range of smaller publishers, such as Rock's Backpages.

But Shibboleth provides value beyond the Federation. To a large measure, the real strength of Shibboleth is the ability to provide standards compliant, open source and robust mechanism for implementing a federated model. The initial mission of SAML was to provide real identities across boundaries. Anonymous authentication was part of the initial mission of Shibboleth 1.1, and continues to be of vital importance in the library community, as well as in higher education and beyond. This anonymous authentication, enabled by the generalized use of attributes, has added scalability to authorization schemes. This was later incorporated into the SAML 2.0 specification. No longer does each individual user need register with a service provider to obtain services, this work is done based upon the attributes the user can advertise. SAML, via Shibboleth, makes this possible. While these benefits are multiplied exponentially in the Federation, they are valid even within a single administrative domain. It will be interesting to see federations that handle huge numbers of transactions per second, but even without evidence of this level of transactional scale the power of attribute based authorization should not be dismissed. Carmody asserts
that since “access control occurs at the start of a session; once a session is created, there is no further overhead.” There is no reason to assume that this is not completely correct, but the demonstration in the real world will be critical.
Defusing the United States Government Certifications Discussion

The United States Federal Government has made efforts to establish certifications for SAML compliance within its confines, including the Federal eAuthorization program (eAuth)\(^\text{23}\) and the General Services Administration requirement that the Liberty Alliance provide interoperability testing.\(^\text{24}\)

Identity federation requires a common standard that can be embedded by product manufacturers. The e-authentication program started with SAML 1.0 as the identity protocol for user authentication when it first went live in 2005. Two months ago, the program upgraded to SAML 2.0 and the GSA, which had previously performed testing, turned over the testing of the standard to the Liberty Alliance Project. Liberty Alliance chose Drummond Group to provide SAML 2.0 interoperability testing.\(^\text{25}\)

The Drummond Group is a company that provides test lab services and verifies software interoperability.\(^\text{26}\) Federal Government certifications only apply to inter-agency uses of SAML based projects, and therefore do not apply to higher education or commercial use. The lack of such certification is discussed here mostly to defuse concerns about the importance of certifications to the potential implementer of Shibboleth.

SAML defines discrete profiles, each describing a specific functionality. To date, certification efforts have required conformity with the entire set of profiles, which has prevented Shibboleth certification.

The certification that should have made the most sense for Shibboleth is federal eAuth. The eAuth mission is:

- Enable millions of safe, secure, trusted online transactions between Government and the citizens and businesses it serves.
- Reduce online identity management burden for Government agency application owners and system administrators.
• Provide citizens and businesses with a choice of credentials when accessing public-facing online Government applications.27

However, according to Carmody:

The vision of the Federal E-Authentication Federation offers a lot of promise to the Higher Ed community. It could greatly simplify authenticated access to federal agency websites for faculty, researchers, students, and campus administrators. Unfortunately, the current E-authn membership model will not scale to allow thousands of campuses to join the E-Authn Federation. Consequently, E-Authn and the US Higher Ed InCommon Federation opened discussions on creating a framework for inter-federated operation. Unfortunately, E-Authn reallocated their resources, and these discussions stopped before completing. As a result, US Federal agencies have begun to directly join InCommon, rather than waiting for an inter-federation framework to arise. The E-Gov session at the October 2008 Internet2 member Meeting will showcase this process.

The US Government Services Administration (GSA) reports that Shibboleth is not certified, but acknowledges that those agencies receiving waivers to use Shibboleth have demonstrated interoperability.

As of September 26, 2007, a pre-requisite for interoperability testing, GSA requires that product vendors complete the Liberty Alliance SAML 2.0 v2.0 interoperability testing requirements.28

In an e-mail on September 16, 2008, Jane McInerney from the eAuth organization of the GSA wrote:

Shibboleth 1.0 is not an approved product and Shibboleth 2.0 (SAML) has not even undergone E-Authentication Interoperability testing. Shib 1.0 is used by a couple of agency Relying Party Applications which received waivers to use the product. When the applications were deployed using Shib, those apps, were proven interoperable in the Federation.29

27 From (General Services Administration, 2008, para. 2). This appears unrelated to the first paragraph that announces the November 5, 2008 "Identity Management Services Industry Day." Speaker slides, agenda, speaker biographies and resources are available from (General Services Administration 2008a) and as a single consolidated file from (instructional media + magic, inc., 2008a). Additional notes are available (instructional media + magic, inc, 2208b).

28 The GSA text is available via the federal CIO website under E-Authentication. See (General Services Administration, 2007). The Liberty Alliance press release provides additional detail about the announcement. See (Liberty Alliance, 2007).

29 Jane McInerney describes herself in LinkedIn as “Consultant – E-Authentication Solutions at General Services Administration.” (Inerney 2008).
Additionally, the U.S. General Services Administration now requires Liberty Alliance SAML 2.0 interoperability testing for products used in the U.S. federal government:

“E-Authentication Solutions wants federal agencies to be able to select the software that meets their unique business requirements while also delivering assurances that it will interoperate with other applications used within the Federation,” said Myisha Frazier-McElveen, Acting Program Executive, E-Authentication Solutions. “The US GSA is requiring vendors to pass Liberty Alliance SAML 2.0 interoperability testing to help ensure identity products can interoperate from day one and provide long-term business value to US Government Agencies.”

The problem with all of this is that the Liberty Alliance conformance testing, performed by the Drummand Group, requires compliance with all profiles defined by SAML (see attached table).

Therefore, it is impossible to get either eAuth or GSA Liberty Alliance certification unless every requirement of the SAML profile is met. The customer base the Shibboleth team serves has given them clear directions concerning which profiles they are interested in. Higher Ed has not indicated that every profile is required.

The fall 2008 Internet2 Member Meeting has a session scheduled titled “Federation and e-Government,” with representatives of the National Institutes of Health, the National Science Foundation and Internet2. The abstract as published by Internet2 seems particularly relevant to this discussion.

Session Abstract: The Internet2 Middleware Initiative and the InCommon Federation have been working with partners at US government agencies for quite some time. This year there have been significant breakthroughs in federated access to agency services, and prospects of more to come. This work has led to engagement with key campus sectors, in particular grants management, and a better understanding of complex agency application requirements. Representatives from government agencies and participating campuses will provide updates and discuss opportunities.
It could be that the certification discussion will take a whole new direction, and in the arena of higher education may become irrelevant. This subject bears attention. Carmody agrees, observing, “as US Federal agencies join the InCommon Federation, certification becomes increasingly irrelevant.” Once the certification issues are removed, Shibboleth has a clear advantage in the federal government arena, as it already has outside the federal government. Carmody points out “because Shibboleth is standards-based from the beginning as opposed to standards compatibility being an add-on, and because of close connections to the standards process, we think that Shibboleth is the market leader in standards-based interoperability. Its worldwide adoption in the higher education community supports that statement.” Thus, interoperability and standards compatibility is more important in higher education then government certification.
Summary

Shibboleth is the most widely deployed open source implementation of any part of the SAML v2.0 specification, and one of the key developers is a co-author of the specification. The US federal government has made some decisions regarding certification that may appear to be a stumbling block to those who wish to use Shibboleth to perform the work it was created to do within the federal government, but no potential adopter outside the confines of the federal government should allow themselves to be concerned. There are reports of government agencies implementing Shibboleth despite the lack of certification and the lack of a current mechanism for waivers. According to Carmody, the higher education community appears to be unconcerned with US Federal Government certification issues, “as Federal agencies bypass E-Authn and join InCommon directly.”

The Federal Government’s efforts to enforce standardization through certification appear well intentioned. However, in the case of higher education, it may be irrelevant at best, and damaging at worst, as potential implementers misunderstand the meaning of the lack of certifications. Breaking apart the certification to apply to specific SAML profiles or sub-groups of profiles may be a short-term solution, but a fundamental change in the way the federal government views the process of certification is in order. Acceptance of open source solutions within the federal agencies responsible for making certification decisions should also be encouraged.

If a consumer wants to install a web user based Single Sign-On solution that provides anonymity while using data from any properly formed identity store, Shibboleth is an appropriate solution. Shibboleth provides standards compliant set of the most demanded SAML profiles. Further, if guaranteed continued interoperability and Federation membership and growth is seen as a priority, Shibboleth appears to be a logical choice.
Acknowledgements

This paper grew from a 2 page conversation to what you have before you over the course of several months. The author hopes you find it to be useful.

It would have been impossible to achieve this document without the generous support and guidance of Jim Farmer and Jon Allen, who guided the discovery of vast resources, edited mercilessly and accurately, and handled much of the detail work involved in correctly and accurately documenting what was written.

Charlie Leonhardt generously provided the time necessary to do the research and writing of this document.

Interviews were cited in the body of the paper, but special thanks go to Stephen Carmody for his extended e-mail interview.
References

More information about the topics in this technical brief can be found on the internet. Below is a list of web references that coincide with the notes above. At the time of this writing, each of these links was verified to be active and accurate to their topic. However as web links are often changing and unreliable, they have been compiled here rather than placed in the content of this brief.


Technical Brief

Authentication: The Status of Shibboleth

Arnie Miles, Georgetown University

19

24 February, 2009


SAML 2.0 Specifications

The “SAML 2.0 Specifications” consist of seven documents authored 15 March 2005 and an accumulative errata last published 14 August 2007. These are:


Appendix 1
Liberty Alliance (Drummand Group)
Requirements for Conformance Testing
Extracted from the Conformance Requirements for the OASIS Security Assertion Markup Language (SAML) V2.0
http://docs.oasis-open.org/security/saml/v2.0/

The following matrices identify unique sets of conformance requirements by means of a triple taken from Table 1 with the form: profile, message(s), binding The message component is not always included when it is obvious from context.

<table>
<thead>
<tr>
<th>Feature</th>
<th>IdP</th>
<th>IdP Lite</th>
<th>SP</th>
<th>SP Lite</th>
<th>ECP</th>
</tr>
</thead>
<tbody>
<tr>
<td>Web SSO, &lt;AuthnRequest&gt;, HTTP redirect</td>
<td>MUST</td>
<td>MUST</td>
<td>MUST</td>
<td>MUST</td>
<td>N/A</td>
</tr>
<tr>
<td>Web SSO, &lt;Response&gt;, HTTP POST</td>
<td>MUST</td>
<td>MUST</td>
<td>MUST</td>
<td>MUST</td>
<td>N/A</td>
</tr>
<tr>
<td>Web SSO, &lt;Response&gt;, HTTP artifact</td>
<td>MUST</td>
<td>MUST</td>
<td>MUST</td>
<td>MUST</td>
<td>N/A</td>
</tr>
<tr>
<td>Artifact Resolution, SOAP</td>
<td>MUST</td>
<td>MUST</td>
<td>MUST</td>
<td>MUST</td>
<td>N/A</td>
</tr>
<tr>
<td>Enhanced Client/Proxy SSO, PAOS</td>
<td>MUST</td>
<td>MUST</td>
<td>MUST</td>
<td>MUST</td>
<td>MUST</td>
</tr>
<tr>
<td>Name Identifier Management, HTTP redirect (IdP-initiated)</td>
<td>MUST</td>
<td>MUST NOT</td>
<td>MUST</td>
<td>MUST NOT</td>
<td>N/A</td>
</tr>
<tr>
<td>Name Identifier Management, SOAP (IdP-initiated)</td>
<td>MUST</td>
<td>MUST NOT</td>
<td>OPTIONAL</td>
<td>MUST NOT</td>
<td>N/A</td>
</tr>
<tr>
<td>Name Identifier Management, HTTP redirect</td>
<td>MUST</td>
<td>MUST NOT</td>
<td>MUST</td>
<td>MUST NOT</td>
<td>N/A</td>
</tr>
<tr>
<td>Name Identifier Management, SOAP (SP-initiated)</td>
<td>MUST</td>
<td>MUST NOT</td>
<td>OPTIONAL</td>
<td>MUST NOT</td>
<td>N/A</td>
</tr>
<tr>
<td>Single Logout (IdP-initiated) – HTTP redirect</td>
<td>MUST</td>
<td>MUST</td>
<td>MUST</td>
<td>MUST</td>
<td>N/A</td>
</tr>
<tr>
<td>Single Logout (IdP-initiated) – SOAP</td>
<td>MUST</td>
<td>OPTIONAL</td>
<td>MUST</td>
<td>OPTIONAL</td>
<td>N/A</td>
</tr>
<tr>
<td>Single Logout (SP-initiated) – HTTP redirect</td>
<td>MUST</td>
<td>MUST</td>
<td>MUST</td>
<td>MUST</td>
<td>N/A</td>
</tr>
<tr>
<td>Single Logout (SP-initiated) – SOAP</td>
<td>MUST</td>
<td>OPTIONAL</td>
<td>MUST</td>
<td>OPTIONAL</td>
<td>N/A</td>
</tr>
<tr>
<td>Identity Provider Discovery (cookie)</td>
<td>MUST</td>
<td>MUST</td>
<td>OPTIONAL</td>
<td>OPTIONAL</td>
<td>N/A</td>
</tr>
</tbody>
</table>
Appendix 2

Shibboleth 2 Implemented Protocols and Profiles

Extracted directly from the Shibboleth 2 Documentation Internet2 Wiki
[https://spaces.internet2.edu/display/SHIB2/ShibProtocols](https://spaces.internet2.edu/display/SHIB2/ShibProtocols)

The following table shows whether Shibboleth implements various SSO-related protocols and protocol profiles.

- A YES does not indicate that every possible option has been implemented as some protocol/profiles have many tens or hundreds of possible options. It does indicate that at minimum all required options are supported.
- Some protocols implementations may not be available in the base download, but are available as extensions.

<table>
<thead>
<tr>
<th>Protocol/Profile</th>
<th>Identity Provider</th>
<th>C++ Service Provider</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>SAML 1</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Shibboleth SSO</td>
<td>YES</td>
<td>YES</td>
</tr>
<tr>
<td>Attribute Query</td>
<td>YES</td>
<td>YES (1)</td>
</tr>
<tr>
<td>Artifact Resolution</td>
<td>YES</td>
<td></td>
</tr>
<tr>
<td><strong>SAML 2</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SSO</td>
<td>YES</td>
<td>YES</td>
</tr>
<tr>
<td>Attribute Query</td>
<td>YES</td>
<td>YES (1)</td>
</tr>
<tr>
<td>Artifact Resolution</td>
<td>YES</td>
<td></td>
</tr>
<tr>
<td>ECP</td>
<td>NO (IN DEVELOPMENT)</td>
<td>YES</td>
</tr>
<tr>
<td>Single Logout</td>
<td>NO (BACK CHANNEL SUPPORT IN DEVELOPMENT)</td>
<td>YES</td>
</tr>
<tr>
<td>Name ID management</td>
<td>NO</td>
<td>YES (2)</td>
</tr>
<tr>
<td>Name ID mapping</td>
<td>NO</td>
<td>NO</td>
</tr>
<tr>
<td><strong>WS-Federation</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Active</td>
<td>NO</td>
<td>NO</td>
</tr>
<tr>
<td>Passive (ADFS)</td>
<td>NO</td>
<td>YES (INCLUDED WITH SP, BUT NOT ENABLED)</td>
</tr>
<tr>
<td>US eAuth v1</td>
<td>NO</td>
<td>YES (VIA SAML 1.0 ARTIFACT SUPPORT)</td>
</tr>
<tr>
<td><strong>Microsoft Cardspace</strong></td>
<td>NO (IN DEVELOPMENT)</td>
<td>NO</td>
</tr>
<tr>
<td><strong>WS-Trust 1.3</strong></td>
<td>NO</td>
<td>NO</td>
</tr>
<tr>
<td><strong>OpenID 1</strong></td>
<td>NO</td>
<td>NO</td>
</tr>
<tr>
<td><strong>OpenID 2</strong></td>
<td>NO</td>
<td>NO</td>
</tr>
<tr>
<td><strong>OAuth</strong></td>
<td>NO</td>
<td>NO</td>
</tr>
</tbody>
</table>

(1) Implemented as part of SSO profile support, not currently exposed separately.
(2) Implemented only in the form of application notification hooks for IdP-initiated protocol. SP-initiated not supported.

**ALSO IMPLEMENTED:**
- Shib 1 Discovery (WAYF) Protocol by the Shib Discovery Service
- SAML 2 Discovery Service Protocol by the Shib Discovery Service
Secretary Duncan, NGA Chair Rendell, Congressman Miller Urge States to Use Data Systems for Continuous Education Improvement

Data Quality Campaign Releases Action Guide for State and Federal Policy Makers; Receives $4.8 Million from the Gates Foundation

March 12, 2009 – Washington DC – Tuesday, U.S. Secretary of Education Arne Duncan urged states and school districts to continue their momentum towards building longitudinal data systems and developing the capacity of educators, policymakers, and other education stakeholders to understand and use this data to proactively drive continuous improvement throughout the education system.

"Now that the Data Quality Campaign has put data quality on the map, we need to work together to leverage this work and push it to the next level by using data to drive reform," said Secretary Duncan Tuesday at a forum held in Washington DC convened by the Data Quality Campaign. "The Department has made an early commitment to this by providing funding in the stimulus package for data systems so we can assess what's working and what's not. The path to real reform begins with the truth - and we must keep facing the truth and finding the answers until every classroom has a great teacher, and every child has an education that prepares him for college, for work, and for life."

The forum, "Leveraging the Power of Data to Improve Education," brought together hundreds of state and federal policymakers and education leaders to discuss the integral role of data to the national education improvement agenda, the challenges to growing and using these systems, the necessary leadership of state and federal policymakers, and how the newly available stimulus funds can be used to improve student achievement and close achievement gaps. The entire forum can be viewed via webcast at http://ne.edgecastcdn.net/000172/dataqualitycampaign/031009/DQCArchive.htm
To guide state and federal policymakers in building capacity of education stakeholders to understand and use longitudinal data in effective decision making, the Data Quality Campaign released “The Next Step: Using Longitudinal Data Systems to Improve Student Success.” The guide provides ten action steps states need to take to move from collecting data for compliance to using data for improvement. These ten state actions ensure effective data use will expand the ability of state longitudinal data systems to link across the P–20 education pipeline and across state agencies; ensure that data can be accessed, analyzed and used, and communicate data to all stakeholders to promote continuous improvement; and build the capacity of all stakeholders to use longitudinal data for effective decision making. The guide, with examples of states which have implemented model efforts, is available at http://www.dataqualitycampaign.org/resources/384.

The ten action steps are:

1) Link state K–12 data systems with early learning, postsecondary education, workforce, social services and other critical state agency data systems.
2) Create stable, sustained support for robust state longitudinal data systems.
3) Develop governance structures to guide data collection, sharing and use.
4) Build state data repositories (e.g., data warehouses) that integrate student, staff, financial and facility data.
5) Implement systems to provide all stakeholders timely access to the information they need while protecting student privacy.
6) Create progress reports with individual student data that provide information educators, parents and students can use to improve student performance.
7) Create reports that include longitudinal statistics on school systems and groups of students to guide school-, district- and state-level improvement efforts.
8) Develop a purposeful research agenda and collaborate with universities, researchers and intermediary groups to explore the data for useful information.
9) Implement policies and promote practices, including professional development and credentialing, to ensure that educators know how to access, analyze and use data appropriately.
10) Promote strategies to raise awareness of available data and ensure that all key stakeholders, including state policymakers, know how to access, analyze and use the information.

Chairman of the National Governors Association, Governor Ed Rendell (PA), told the forum that state policy leaders should ensure that all state agencies work together and share vital information to inform a common goal of ensuring
individual state citizens are prepared for the demands of the knowledge based competitive economy.

"Longitudinal data is not just a K-12 issue; it requires gubernatorial commitment because all of our systems - from early childhood, to K-12 education, to colleges and universities, to workforce development, to employment databases - must work together to make data collection possible," Governor Rendell said. "And we need to do more to make the data useful, because even the best data collection system is worthless if it does not change what goes on in the classroom."

In 2005, the Data Quality Campaign identified ten essential elements that states must include to build a highly effective longitudinal data system. At that time, no state had all ten elements in place. In 2008, six states had all ten elements, and 48 had five or more elements in place. Within the next three years, 47 states plan to have eight or more elements. To learn more visit http://www.dataqualitycampaign.org/survey/elements.

The recent federal economic stimulus package included $250 million for funding statewide education longitudinal data systems. The Institute of Education Sciences (IES) is developing the competitive grants process to distribute the funds to states which will be used to implement and use statewide longitudinal data systems which include education data for elementary and secondary students as well as postsecondary and workforce information. In addition, to tap into the State Fiscal Stabilization formula funds, a state must assure the USDOE that it is building its longitudinal data system across the P-20 education pipeline and linking it with workforce data.

**Congressman George Miller, Chairman of the Committee on Education and Labor in the U.S. House of Representatives**, also voiced strong support for the new federal investment.

“Congress has stepped up to make this investment a priority, and we will be watching implementation of the data systems very carefully,” said Chairman Miller. “It is our hope that states and districts will take a serious and thoughtful approach about how they can use this data to help improve student learning.”

This week, The Bill & Melinda Gates Foundation granted the Data Quality Campaign $4.8 million to support continuation of its work over the next three years. The new grant will allow the DQC to continue to assist states in developing data systems based on the ten essential elements as well as encouraging states to take actions necessary to help support effective data use. The DQC will continue to survey states and provide resources and assistance around the ten essential elements as well as on the new ten state actions to ensure effective data use.
"Thanks to the tireless efforts of the Data Quality Campaign, educators and policymakers have a much better understanding of the critical role effective longitudinal data systems play in improving opportunities for all students in America," said Stefanie Sanford, Deputy Director, U.S. Program Advocacy, The Bill & Melinda Gates Foundation, who also presented at the forum. “The Bill & Melinda Gates Foundation is pleased to continue its support of the campaign with a new grant to further its efforts."

Other participants in the forum included: T. Kenneth James, Chair of the Council of Chief State School Officers and Arkansas Commissioner of Education; Reggie Robinson, Chair of the State Higher Education Executive Officers and President & CEO of the Kansas Board of Regents; Eric Smith, Florida Commissioner of education; Michael Casserly, Executive Director, Council of the Great City Schools; Michael Cohen, President of Achieve, Inc.; Kati Haycock, President of The Education Trust; Dane Linn, Education Division Director of the National Governors Association Center for Best Practices; and Gene Wilhoit, Executive Director of the Council of Chief State School Officers. Jay Pfeiffer, retired Florida Deputy Commissioner of Education, received a Lifetime Achievement Award from the Data Quality Campaign for his leadership in developing Florida’s model data system which provides best practices and lessons for other states.

“States have made great progress in building their longitudinal data systems, but now we need a cultural shift to build the political will and take the practical steps needed to ensure that this data is accessed, shared, and used for continuous education improvement, said Aimee Rogstad Guidera, Director of the Data Quality Campaign. “That’s what the Campaign will focus on now - helping states identify and put in place the necessary policies and practices so that key stakeholders actually use longitudinal data to help students succeed.”

The Data Quality Campaign (http://www.dataqualitycampaign.org/) (DQC) is a national, collaborative effort to encourage and support state policymakers to improve the availability and use of high-quality education data to improve student achievement. The campaign provides tools and resources that help states implement and use longitudinal data systems, while providing a national forum for reducing duplication of effort and promoting greater coordination and consensus among the organizations focused on improving data quality, access and use. The Campaign has 14 managing partners and 39 endorsing partners. The Bill & Melinda Gates Foundation is DQC’s founding funder; additional support has been provided by the Casey Family Programs, the Lumina Foundation for Education and the Michael & Susan Dell Foundation.

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