Introducing Live ePortfolios to Support Self Organised Learning

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ABSTRACT
This paper presents a platform on which a new generation of applications targeted to aid the self-organised learner can be presented. The new application is enabled by innovations in trust-based security of data built upon emerging infrastructures to aid federated data access in the UK education sector. Within the proposed architecture, users and data providers (within Virtual Organisations formed for specific learning needs) collaborate in a more dynamic and flexible manner by defining their own data-object-based security policies. This is enabled using a Service Orientated Architecture (SOA) that presents trusted services to ensure that these policies are both applied and enforced. The work is significant because it presents a new level of both distributed and live data integration into the ePortfolio domain. New data objects can be integrated into the learning process from emerging areas like social networking, giving the learning processes more depth. For the learner this approach enhances the quality and range of data that they can use in the ePortfolio, and has the potential to enhance the self-organised learning process, which for society in general will enhance learning processes.

Keywords
ePortfolio, Service Orientated Architecture, trust, virtual organisation security, federated data access

Introduction
Data capture, and its effective use and management in relation to user attainment in terms of learning inside and outside of the workplace, is a vital process for aiding personal development in both learning and working environments. Using ePortfolios as a central point of focus for this data has proved to help individuals in terms both of reflective learning and also future planning. Sharing attainment data also assists the user in the process of seeking to secure better-quality employment and more suitable learning. However to date, despite various efforts, ePortfolio solutions that link to live data from organisations and users in a flexible and dynamic manner have yet to be realised effectively.

Dynamically sharing live data from various sources is restricted by the issues associated with information security and sharing. Although the data is often specific to the user, the policies related to sharing this data and granting access to the repositories that store it are fixed at organisational level. The security policies associated with access to the data are not sufficiently fine-grained to be applied dynamically on a user basis, nor specific to data content in a live situation. As a result, the development of ePortfolios to date often requires manual input of data from one system to another as the learner makes a transition, or else provision of separate portfolios in each institution, which often results in data loss, lack of adoption and third-party access – a complex and non-standard process.

Addressing these data integration challenges is the main aim of the TAS³ (Trusted Architecture for Securely Shared Services) project (TAS³ 2009). The University of Nottingham is a partner in this project and has the brief to provide an ePortfolio-based demonstrator to support UK employability. The research detailed in this paper is focused on the work the University has been doing around the integration and development of ePortfolios to support live data integration using the TAS³ infrastructure.

Service Orientated Architectures
Service Orientated Architectures (SOA) are largely implemented using Web Services and are proven to increase the accessibility to shared software and data, as opposed to vendor-specific, often client and server solutions (Papazoglou et al 2003, Foster et al 1999). This is because loosely-coupled service-based architectures present the user with standardised interfaces to otherwise differing and often complex computing environments. Services also
present increased flexibility in applications so that they can adapt better to user requirements and often require fewer resources to support in terms of both hardware and cost (Woods et al 2006). The business computing application of SOA in supply chain management (Lee et al 2000) to eHealth (Omar et al 2006) illustrates how various computing communities are embracing SOA. The increased flexibility using SOA in these communities has decreased the cost for business users by changing business models, and specifically allowing application providers to compete alongside each other around specific elements of wider SOA.

Flexibility in loosely-coupled SOA is driven by the need to support real-time, dynamically-selected services and data. For example, web services on devices are present in a new generation of pervasive computing applications: the use of GPS devices in transportation or personal communication devices can both link the user to information that is influenced by location (Aktas et al. 2005). The use of Web Service standards makes access to this information standards-based using the internet as the communication medium. By increasing application pervasiveness on the one hand and application flexibility and dynamicity on the other, SOA presents users with a new generation of personalised specific real-time services.

As real time information is incorporated into distributed applications the relationships of data and services become complex and have to be managed. The majority of this management has to be done automatically to support the needs of both the user and service providers in the architecture. These needs are specified when the parties join the SOA-driven application which is referenced by the services when using real-time data sources (Nguyen et al 2005). In terms of the learning process, the ability for the application to change in real time has a great advantage over existing eLearning applications. For example, the learning environment can change to suit a variety of environmental factors, which could include changes in the workplace, the economy, user requirements or even personal changes of interest generated by the user’s updating of social networking data.

Thus, distributed services can form composite applications that combine data from various sources that can present users with a new dimension in terms of learning resource. However this greater ability to combine and deliver data needs to be matched with technical advances in terms of data management and security; within the computing community these advances are emerging from the security policy domain. The definition of policies associated with data objects varies between users and domains: for example, in the learning domain of ePortfolio, policies associated with the data objects for learning may not be as restrictive as those associated with records in the medical domain. Therefore policy definition and enforcement will vary in these emerging distributed architectures on organisational, personal and application-specific lines, thereby presenting integration difficulties.

The challenge of cross-domain policy integration in dynamic distributed architectures has to be automated in order to maintain application flexibility. This automation of integration is achieved via policy negotiation mechanisms; these involve the negotiation of security policy to establish levels of trust effectively between large numbers of users and organisations. Trust negotiation between parties has been the subject of previous SOA-based projects in various domains (Yang et al 2006, Jesang et al 2007) and is an essential area of research vital for the development of cross-domain SOA. For ePortfolio development this research is equally essential as without cross-domain co-operation and trust the potential of live, real-time ePortfolios will not be realised.

**Trusted Federation**

The ‘Internet2 Middleware Initiative’ has played an active role in the development of an ‘an interoperable Identity and Access Management infrastructure for Research and Education’ which forms the foundation of federated access. One such framework implemented in the UK is the ‘UK Access Management Federation for education and research, developed jointly by the JISC, JANET(UK) and SDSS of the University of Edinburgh to support the UK education system. The federation exists as an advanced example of a Trust Fabric using the SAML 2.0 based Shibboleth software.

A number of National Research and Education Networks (NRENs), both in Europe and the rest of the world, have adopted technology which allows learners to gain access to facilities when away from their home institution. Two of these technologies are Eduroam, the European roaming service which gives wireless access to individuals from institutions who have signed up, and ‘Shibboleth’, which provides the basis of ‘The UK Access Management Federation for Education and Research’ and many other European federations. These federations have adopted 'trust fabric' which is central in open learning systems such as the development of the live ePortfolio. In such systems the fundamental principle of the Identity Provider is used to provide the authentication for users who need access to a
service. At one time, if users required access to a service the provider would need to have their specific details: this is not the case with the trust fabric.

Instead, once the users are granted access via a federated access management login, they are able to gain automatic access to other services available to them as members of the same federation without having to sign on again. This principle can easily be applied to the ePortfolio concept in one of two ways. The service providers and institutions can either join an existing federation such as ‘The UK Access Management Federation for Education and Research’, or the project leaders can set up an isolated federation or outsource to a third-party organisation. Whatever the choice, the use of standardised protocols, for example SAML 2.0, is recommended. The exchange of attributes between federations would have greater transparency using similar standards. SAML 2.0 is considered as the emerging standard for such attribute exchanges. One of the objectives of federated access is to allow Single Sign On and this is being explored as part of the TAS³ framework in the ePortfolio trials.

ePortfolios and learning

Within the UK the development of personal records of achievement for school learners began to be adopted in the 1990s (Assister et al 1993). This area of support has evolved a major focus on ways in which holistic views of the learner from school to workplace can be achieved. This can be seen as linked to the growth of the concepts surrounding the knowledge society, in particular around the greater focus on the role of the individual within and outside of organisations (Delanty 2001), particularly when these seek to continue developing individuals throughout the full span of their working lives. Lifelong Learning, collaborative environments, communities of practice and ePortfolios are all important concepts in the role of personal development: hence a new emphasis on pedagogy and design of learning systems, in particular e-learning environments, as a structure for learning outside of the institution and within the workplace. Learning theories such as Constructivism are used to complement these structures as researchers seek to study the associated pedagogy.

Significantly the emergence of ePortfolios as a central tool to support autonomous and dynamic learning and knowledge exchange between institutions and organisations is increasingly being recognised. The use of ePortfolios allows both the individual and the organisation to make informed choices regarding users’ development. In terms of learning process, the use of ePortfolios allows individuals to organise, structure and reflect on learning, providing the opportunity for both to adopt a constructivist approach to learning.

The online learning platform currently includes many positive attributes for learner support, providing an ideal framework to promote higher order thinking for students. In terms of learning movements, this concept fits well under the Active Learning umbrella. The basic principles of Active Learning are to allow students to be more interactive and reflective through open lines of communication (Silbeman 1996). The challenge the ePortfolio system faces in terms of Active Learning is how it can provide the group dynamics and problem-based learning environments required. Through ePortfolio use students have the opportunity to take responsibility and ownership of learning and to reflect not only on the learning but also the processes; however the onus is often on the student to manage the main content of the folio. Increasing the live nature of the data in the ePortfolio can enhance the ability of the student to function around real-world problems, aiding learning and the ability to authenticate strategies towards real world skills through co-operative collaboration between tutors, peers and mentors (Bostock 1997).

ePortfolio Development

Typical ePortfolio

As already discussed, ePortfolio development can be seen to originate from learning practices such as records of achievement. The ePortfolio can be seen as a more student-focused means of maintaining records of learning and development. Technically, the most typical ePortfolio implementation can be seen as a portal-based website in which the learner and teacher can access different elements. The main actors and their relationship with the ePortfolio can be seen in Figure 1.
Figure 1 illustrates how the ePortfolio is a central point of collaboration between the four main parties illustrated. Within these, only the recruitment agency uses information from the ePortfolio without adding any data back. As an agency to recruit either for college or a workplace, the relationship with the user is a one-way process. However before the actual use phase, it could be possible for an agency to collaborate with the other parties in the design/purpose of the ePortfolio, for example to aid recruitment for specific job categories.

Within the UK the Government agency Becta (formerly known as the British Educational Communications and Technology Agency) funded a study into the main purposes of ePortfolio development. Becta summarised these as:

*Showcase or Presentation Portfolio:* Enables the student/author to share examples of their work which may be in specific collections for differing purposes.

*Qualification or evidence Portfolio:* Evidence gathering for formal qualification validation. Requires external authentication of held records and provides the e-assessment interface. This may also contain the student's qualification history.

*Learning or Development Portfolio:* Personal Development Planning (PDP) provides the student’s learning plan with identified goals and learning outcomes. Interface may allow support and feedback from peers, mentors, coaches and tutors.

*Lifelong learning Summary Portfolio:* This is the student's continuing professional development area. It provides summary information on a timeline. This may include a CV generator.

*Transaction Portfolio:* This area is for the student's eyes only. Enables capturing and editing of information before posting into another area. Contains personal diaries, journals and 'Blog' information. Information filing and retrieval utilities.

(Becta 2008)

What is significant about the Becta study is that the model for ePortfolio deployment can be seen as inadequate. This is because it presents a the static view on the types of ePortfolio. It is assumed that separate ePortfolio software packages are created for specific tasks. Therefore as discussed, the ePortfolio is specific to the organisation and application. In this respect, the ePortfolio can be seen as no more useful than a CV that is created as a static, time-stamped document in a specific format; in both cases, sharing requires the receiver to open documents manually and interrogate the information inside. It is much more desirable to create the themes as described in the Becta study as views of data from single points of ePortfolio, otherwise the amount of ePortfolio has to be integrated along with the data.

**Live ePortfolios**

Service-based improvement for ePortfolio use is the integration of the users with the data. This will enable the different types of ePortfolio to be present within a single application and interchange as different data views, as
opposed to requiring separate ePortfolios. This can be seen as a live use of ePortfolio and will create new levels of integration of data approach to how data is handled by the various parties involved. Essentially, the relationship around greater automated use of data by these parties will need a delicate and secure data management framework. As illustrated in figure 2, the ePortfolio is owned by the various organisations, all of which have maintenance roles within it. The ePortfolio no longer becomes a separate object as it is in Figure 1, but rather it can be now seen as a area of focus for collaboration between parties.

![Figure 2](link-to-figure)

Within Figure 2 the ePortfolio forms a domain of collaboration, within which all the parties are present. This concept of a collaboration domain can be seen in previous distributed computing research, particularly in the field of Virtual Organisations (VOs); the creation of a collaboration domain using the concepts of VOs will provide the actors in VO with a secure and reliable system to support the automated sharing of specific data from each partner (Foster et al 2001). Within this domain, services will provide both application-specific support, such as data sharing between the user and workplace, and also infrastructure services, such as security and monitoring of data use.

For the user, the new model will present greater access to data to aid reflective learning and development. However other third party services can also be developed within the VO framework to enhance this data use within the domain of Active Learning. For example, one such use may be the fusion of the user’s social networking data within the VO. This could then be used by college and workplace services to tailor learning and personal development to suit the user’s individual social interests.

**Implementation**

The main use case for the live ePortfolio at the University of Nottingham for the TAS³ project is in the domain of personnel development. In order to merge data from various institutions a trusted federation framework has had to be developed. A trial to pilot a student placement demonstrator is being designed between the Placementmaker scheme run for the University’s International office and local Small to Medium Enterprises (SMEs) in the area. This pilot brings together the four main parties of the learner, SME, University and placement provider (replacing recruitment agency in figure 2) around an ePortfolio for learner development.

**Existing system**

The learner development ePortfolio can be seen to contain two main elements, the first being recording of personal learning development and the second relating to more formal records. To date, the linkage between the user and the
placement scheme has been a manual one, based on the automated validation of the user’s student ID when they register for the program. Once the student is on the placement an ePortfolio is shared by the three parties involved, but the frequency of updating depends on their motivation. Therefore the standards and use of ePortfolio can differ widely during placements and there is no real way to help either party regulate the development of the ePortfolio. This is despite the fact that it is likely that useful data for the ePortfolio will be stored in separate record systems. Again this separation can be seen as linked to dependency on legacy system and organization specific data security policies.

The trial at Nottingham proposes to illustrate how these barriers can be broken down within the three phases of development of the test bed.

**Phase 1 Joining**

Phase 1 is concerned with linking the University systems into the ePortfolio. Here we are looking to link associated student data directly into the ePortfolio from the registration process. This will enable the user to be presented with an ePortfolio already containing data about both their placement details and also any assessment requirements the organisation or the University may have. This data can also be linked to the University’s learning objects to aid the student in the self learning process.

Initially this linkage will enable the user to use the ePortfolio as a resource to aid integration into the workplace via the use of learning objects provided by both the employer and educational institution. In addition, student data will automatically be available for use within the workplace, which will in turn ease any workplace induction process. Both uses of the ePortfolio will introduce both parties to its potential uses.

![Figure 3. Live ePortfolios and third party services](image)

**Phase 2 Population**

Phase 2 can be seen as the ePortfolio population phase and aims to enforce Active Learning around the ePortfolio. Here the ePortfolio is linked into the workplace staff appraisal systems. This will allow ePortfolio to keep records of work-based assessment.
Furthermore, from the learning side the ePortfolio is linked to a project plan reflecting both the main aims of the placement and the student’s academic development. The work-based assessment will compare against this and other student learning data using services aimed at enhancing the learner’s experience. These extra sets of services can be seen as adding value to the learning process and can be introduced by specialist third parties as in Figure 3.

**Phase 3 Evaluation**

Phase 3 of the implementation aims to place the data gathered in the placement in a more global perspective. Using the same policy frameworks, data from various placements can be compared and evaluated in terms of student attainment and also achievement. Placement providers and students can be grouped and encouraged to join special interest groups around areas of both learning and industrial development.

**Future Work**

The implementation at the University of Nottingham is handling both technical and cultural challenges in terms of this new level of ePortfolio use and adoption. A key hurdle in terms of use is the interaction between users and the way that the security policies for their data is defined. To date, although standards that can express security policy are available, there are no effective tools to aid users in the creation of policies from a non-technical perspective. Therefore the policies are often set either through default or via rather basic interfaces with the users. A richer method of policy setting is vital to ensure both the flexibility and effectiveness of this new level of collaboration around the ePortfolio.

In terms of the trial, another phase of development will look at tailoring the ePortfolio to recruiters and other educational institutions, as the recruiter or other potential learning/training provider will have different interests in how the data in the ePortfolio is presented. This phase will link the needs of these institutions and will require a more flexible level of data viewing in the ePortfolio. This will give the project the opportunity to develop the template idea for live ePortfolios. As for recruiters, a range of templates will be used either to interrogate the ePortfolio or to match the information within it to the legacy systems of their customers, for example using XSLT, or work around the emerging XCRI standard (XCRI 2009) being developed for describing course-related information in the educational community.

**Conclusion**

Live ePortfolios will push forward the adoption of service-oriented computing into the world of learning. This process will combine learning data with information previously separated from learning processes due to technical and application restrictions. For example, the combination of social networking data with learning data is a relatively new area of research and implementation. However, the vision of the live ePortfolio is dependent on the development and adoption of a trusted infrastructure that can support both users and service providers. To date this is being achieved in the academic community in projects such as Internet 2; however the real enhancements will come through the adoption of greater levels of policy usage and refinement as being tested by TAS³.

The work in this paper sheds more light on how the current innovations in trust within the academic community can be joined with innovations in learning around ePortfolios. These two separate interest areas are linked technically, and have the potential to demonstrate to the wider community how learning, technology and users can be combined in a new generation of learning applications.

**References**


