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ESDIN

Underpinning the European spatial Data Infrastructure with a
Best Practice Network

**D 11.6 Operational view/download
services and access control
conforming to INSPIRE
implementation rules into the
academic sector geospatial
testbed(s)**

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¹ OJ L 79, 24.3.2005, p. 1.

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Executive Summary

This document is an account of efforts undertaken as part of the ESDIN project towards ensuring that European academic sector requirements in respect of the emerging European SDI as underpinned by INSPIRE are accounted for.

The Higher and Further Education sector is a large and important consumer of digital geospatial content. It is important if we in Europe want in the future a well educated workforce capable of making the most of the network of harmonised interoperable services currently being rolled out under INSPIRE on top of National Mapping and Cadastral Agency (NMCA) geospatial reference data.

Evidence collected during the project indicates that this sectors needs are not being well met despite its recognised importance and it constituting a significant underexploited market for NMCA geospatial data.

The ESDIN project has helped address some of these shortcomings.

There are elements within the remit of the INSPIRE initiative that are not well understood and which are still within the realm of research and development. Under these circumstances, it is appropriate that recourse should be made to the academic sector.

Access control emerged in ESDIN as one of the main areas that the academic sector could contribute to the project and the broader eContentPlus programme.

For several years, Shibboleth Access Management Federations have been used to exchange identity information so that only properly authenticated subjects, eg, students, from federation organisations, eg, universities, can get access to the web resources for which they are authorised.

Building on work originating from the objective of enabling students to securely access protected OGC Web Services (OWS) directly from their desktop, the ESDIN project has shown how Shibboleth Access Management Federations can be used as an organisational model for the European SDI.

Shibboleth is an open source implement of OASIS Security Assertion Markup Language (SAML). Working within the OGC's interoperability programme processes (two interoperability experiments), the ESDIN project demonstrated how the flexibility of SAML could be used to allow existing OWS clients to be modified so that they could be used to consume Shibboleth protected OWS.

A number of GI software producers (open source and proprietary) participated and showed a variety of OWS clients (desktop and browser-based) consuming INSPIRE compliant services in a prototype ESDIN Shibboleth Access Management Federation.

The important aspects to note are that this is a production strength standards based solution. No changes are required to either the OGC service interfaces or Shibboleth.

The latter is important as Shibboleth is mass market, it is mature software used by millions round the globe, it is open source with a well established support community, it is a well understood mainstream IT initiative and not a geospatial specific development.

This is solid, concrete, technical output from the ESDIN project. Achieving interoperability at the security level has always been a major barrier to SDI development – major content providers like the NMCAs will not make web services available on top of their valuable protected data unless it can be guaranteed they are secure. Most solutions in the past have been point solutions.

The solution presented in this document addresses questions of technical interoperability. However, creating a pan-European Access Management Federation is a far from trivial proposition, and it is likely that the financial and political issues that will arise will prove challenging, as will numerous issues relating to legal and organisational interoperability.

At the moment, there is interest in taking this work forward within the geospatial community, most notably within the EuroGeographics led European Location Framework. The consequences for the academic sector are positive if this happens.

We have established a number of INSPIRE conformant services for use by students and demonstrated that they can be made securely available. More importantly, through networking and stakeholder engagement, we have established a best practice network in the European academic sector to further represent the sectors interest in respect of INSPIRE and which is placed to take advantage of the progress made through ESDIN and

The latter is particularly true in respect of access control, as Shibboleth is used primarily in the academic sector, we have laid an important interoperability foundation for continuing to improve access to high quality geospatial reference data for students as the European SDI develops.

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1 Introduction

This document summarises the work undertaken during the ESDIN project to ensure that operational view/download services conforming to INSPIRE implementation rules can be made available into academic sector geospatial testbed(s).

The author of this document is an EDINA² staff member. EDINA is a Joint Information Systems Committee (JISC)³ funded UK national data centre based at the University of Edinburgh (UEDIN). EDINA's primary role within the ESDIN consortium has been to try and represent academic sector interests (concentrating on Higher and Further Education) and work towards improving access for the European academic sector to harmonised geospatial content from the European National Mapping and Cadastral Agencies (NMCA).

For EDINA, one of the benefits of working in partnership with a wide range of non-academic sector organisations is the cross-fertilisation of ideas and requirements that occurs. It quickly became apparent during the ESDIN project that EDINA could best contribute to the project and the broader eContentPlus programme by concentrating on using its expertise in the area of federated access control to address major NMCA problems in this area. This is the reason that "access control" was added to the title of this deliverable.

Historically, the problem of how to secure the web services that underpin Spatial Data Infrastructure (SDI) in an interoperable way has proven to be a major barrier to SDI development. The ESDIN consortium was asked by the EU to concentrate on pragmatic solutions. The indications are that the access management area work that took place under ESDIN go some way towards providing a concrete, production strength solution to a major problem.

These advances have applicability and consequences beyond the academic sector. In particular, this may provide an organisational model for the European SDI as envisaged by INSPIRE. The current intention is to take this work forward as part of the emerging EuroGeographics led European Location Framework (ELF).

We have also demonstrated in this project that there is an academic sector demand (and underexploited market) for European wide NMCA data. Having addressed a major technical barrier, EDINA will, in so far as is possible, continue to try to represent our sectors interest through the ELF.

² <http://edina.ac.uk>

³ <http://www.jisc.ac.uk/>

2 Background

2.1 Academic Sector and the ESDIN Description of Work

This section contains extracts from the original ESDIN Description of Work (DoW) relevant to the academic sector. It is presented here as essential context; a summary of what it was that we were aiming for in respect of this aspect of the ESDIN project. The degree to which these expectations were met, or will be met in the future as a consequence of work undertaken during ESDIN, is covered in the concluding sections of this document.

2.1.1 Target Users and their needs

“To maximise benefit to the European Economic area. Students, researchers, etc, should have access to services which allow them to be educated and conduct research using the highest quality interoperable pan-European data available from the NMCAs.” *Page 30, DoW.*

2.1.2 Expected results

“Seamless INSPIRE- conformant access to the above data through a distributed technical architecture to key elements within the European academic sector: A significant number of academic users using INSPIRE conformant ExM data and geoprocessing services, enabling research and education predicated on harmonised data capable of being combined with additional content. This will be a significant contribution towards the establishment of a European academic SDI through involvement of the European Persistent Testbed for Research and education (PTB) an initiative of the OGC, EuroSDR and AGILE.” *Page 9, DoW.*

2.1.3 Success indicators

| Indicator Expected Progress Number | Objective/expected Result | Indicator name | Expected Progress | | |
|------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------|--------------------------------|-------------------|----------------|-----------------|
| | | | Year 1 | Year 2 | Year 3 |
| 5 | Significant number of academic users Engaged in research and education using the harmonised ESDIN geospatial services hosted by UEDIN. | Spatial Information (5) | n/a | 5 institutions | 30 institutions |

2.1.4 Sustainability

"UEDIN will continue, with the agreement of EuroGeographics, to make pan-European datasets based view and download services available to the academic sector post project for a minimum of 6 months and longer if funding becomes available. The latter will be possible as ESDIN, and related projects, will lay the foundations for a European academic SDI." *Page 35, DoW.*

2.2 The OGC and Interoperability Experiments

The OGC is a standards defining organisation, an international industry consortium established in 1994 consisting of approximately 400 companies, government agencies and universities participating in a consensus process to develop publicly available interface specifications. OGC specifications support interoperable solutions that "geo-enable" the Web, wireless and location-based services, and mainstream IT. The OGC functions through the operation of 3 programmes:

1. Through the Technical and Planning Committee the **Specification Development Program** works in a formal consensus process similar to other industry consortia, eg, W3C, OMG, to arrive at approved Specifications. The academic sector is involved in many aspects of the OGC's work and has its own Universities Domain Working Group.
2. The **Interoperability Program** is a series of hands-on engineering initiatives engaged in by OGC members to accelerate the development and acceptance of Specifications.
3. The **Outreach and Community Adoption Program** participates in awareness raising, education and training activities.

OGC standards underpin SDI development across the globe and are central to INSPIRE. Liaison with the OGC was built into the ESDIN Description of Work and the project has had several points of contact with the OGC. In the context of this deliverable, one of the most significant developments was the use of one of the Interoperability Program mechanisms.

Interoperability Experiments (IE)⁴ are intended as relatively simple, low overhead, means for OGC members to get together and, facilitated by OGC staff, advance specific technical objectives within the OGC baseline. They are more lightweight than the OGC Web Services initiatives and are intended to be focussed on specific interoperability issues. All effort is viewed as voluntary and supported by in-kind contributions from participating member organisations. The duration is normally of the order of 6 months or so as identified in the IE activity plan. With permission from the Project Management Group, ESDIN participated in two

⁴ <http://www.opengeospatial.org/ogc/policies/ipp>

Interoperability Experiments through EDINA: the Authentication IE and the OGC Web Service Shibboleth IE. These are discussed further below (section 3).

2.3 Geospatial Testbeds

The title of this deliverable and document refers to geospatial testbed(s). The ambiguity introduced through the use of the plural in brackets is in recognition of the fast moving nature of the field we are working in, i.e., the landscape now, at the time of writing, is very different from that in 2008 when the ESDIN proposal was originally written

Geospatial testbeds can be taken to mean several things, and in the course of this project we have encountered a variety of different testbeds in different sectors. An indication of this diversity can be gained by a consideration of the variety of presentations delivered at the Association Geographic Information Laboratories Europe (AGILE) 2009 pre-conference workshop on the European Persistent Geospatial Test-Bed for Research and Teaching (PTB)⁵.

As the PTB was explicitly mentioned in the DoW and was the focus of attention within the project, for the purposes of this document, we will concentrate on the PTB.

2.3.1 European Persistent Geospatial Test-Bed for Research and Teaching (PTB)

The PTB⁶ emerged from discussion at a joint AGILE-EuroSDR-OGC workshop held in conjunction with the AGILE conference in May 2007.

The workshop at AGILE 2007 proposed that work on the test-bed be initiated based on existing capability. Consultation on the organisation and content of subsequent test-bed development should also be undertaken with the European communities of the above three founding organisations. Subsequently, a consultation document including a call for proposals in relation to phase 1 of the PTB was issued. The following four **PTB objectives** were articulated:

Table 1. The Objectives of the PTB

- | |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <ol style="list-style-type: none">1. <i>To act as a research test-bed for collaborative European research in geospatial interoperability,</i>2. <i>To aid the assessment of the current standards for geospatial interoperability in terms of research compatibility, completeness, consistency and ease of use and extensibility</i> |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

⁵ <http://www.ikg.uni-hannover.de/agile/index.php?id=460>

⁶ <http://sdi-testbed.eu/>

3. *To provide an environment for teaching standards and techniques for geospatial interoperability*
4. *To provide a resource to AGILE/EuroSDR/OGC for the coordination of research requirements as well as definition, testing, validation and development of open standards*

In addition, it was made clear that the test-bed will be distributed and comprise data, web services, hardware, software, tools and human resources. It will be based upon both ISO/OGC geospatial standards and appropriate IT standards (e.g. from W3C and OASIS).

To date, the PTB has had two phases:

Phase 1

There were approximately 26 responses to the phase 1 call from a variety of organizations across not only the European academic sector, but also the private and public sector. The responses were extensively discussed at the first PTB Coordinating Committee meeting in Barcelona and at the OGC Technical Committee meeting in Stresa. Two of the most significant outcomes of these deliberations were:

1. Development of a draft PTB charter
2. Identification of the need for a further call for specific use cases to guide phase 1 development

The call for use cases was issued in Jan 08 and resulted, after scrutiny by the management committee, in four use cases being selected for implementation in Phase 1. The main criteria behind the selection of these Use Cases was the need to develop components which could be reused and built upon in subsequent phases of the PTB. However, the fact that the PTB was unresourced at the time and dependent upon goodwill, meant that, in reality, there was limited scope for selection and that much of the work undertaken in phase 1 was predicated upon existing projects.

Phase 2

Following discussion at the AGILE 2009 pre-conference PTB workshop in Hannover⁷ a Call for Proposals (CfP) for further developing the PTB was issued. In respect of this report, of interest is that EDINA specifically linked the phase 2 call to ESDIN and requested responses from organisations willing to participate in an "access management federation of European universities". This is further discussed below. The PTB workshop held in association with AGILE 2010 was used to review and evaluate the responses to the CfP.

Future development of the PTB

All the evidence indicates that the need for coordinated academic sector representation and activity in respect of standards based SDI is clearly

⁷ <http://www.ikg.uni-hannover.de/agile/index.php?id=460>

there and the objectives listed in table 1 have proven robust. However, creating the PTB has proved more difficult than originally expected back at the founding workshop in 2007.

What has proven to be exceptionally difficult is funding coordinated activity. The most concerted activity contributing towards the development of the PTB has happened where separately funded projects managed to align their objectives and associated resource allocation with those of the PTB. The best examples of this are ESDIN and the FP7 funded GIGAS⁸ project (GEOSS, INSPIRE and GMES an Action in Support). The latter provided project management for the PTB during a critical period and produced recommendations for the establishment of a permanent testing infrastructure.^{9 10}

The PTB management committee is comprised of one elected representative from each of OGC, EuroSDR and AGILE affording a powerful and unique mandate. The need to have coordinated academic sector interests represented in this area at the European level is such that the PTB is likely to continue. Unless direct funding can be secured it is likely that the PTB will continue in the current ad hoc way it has to date or evolve into a purely networking organisation. A further workshop is planned for AGILE 2011¹¹.

In 2009 concerns were raised within the OGC that the PTB did not fit within the formal OGC processes. The consequence of this was that the PTB was recast as a rolling Interoperability Experiment (the PTB IE), with future planned developments presented to the OGC membership as phases of the PTB IE. The approach has found favour with all the founding organisations and is likely to be the way future developments, e.g., phase 3, proceeds from the perspective of the OGC. It has the advantage of not only being formally within the policies of procedures of the OGC Interoperability Programme, it also provides a well understood means for OGC staff to get more involved as well as the OGC membership.

2.3.2 ESDIN and the PTB

The PTB was explicitly mentioned in the original ESDIN proposal and subsequently proved itself useful for the project in several ways: examples being opportunities for networking, awareness raising and dissemination. With the stated PTB objectives (table 1), the way the PTB is constituted and originating as it does from OGC, AGILE and EuroSDR, it is highly representative of academic sector interests in respect of issues relating to European level SDI. Having access to the mechanisms of all three of the founding organisations was useful, and was used, throughout the ESDIN

⁸ <http://www.thegigasforum.eu/project/project.html>

⁹ http://inspire.jrc.ec.europa.eu/events/conferences/inspire_2010/abstracts/69.doc

¹⁰ <http://www.thegigasforum.eu/project/material/deliverables.html>

¹¹ http://www.uu.nl/SiteCollectionDocuments/GEO/Agile/Testbed_extended_description.pdf

project for stakeholder engagement. It was also good for providing opportunities for liaison with key groups, related initiatives and organisations such as JRC and the GIGAS project. In terms of the Description of Work, the large network of universities across Europe that the PTB connects with matches the expected results and success indicators, and there was a also good match with target users and their needs. The emphasis on persistence matches the ESDIN sustainability objectives and will continue to be a good vehicle for reaching out to more institutions. In short, the PTB has been important in building the Best Practice Network in this group of target users.

Phase 1 of the PTB started before ESDIN, although ESDIN benefited from phase 1 in that some of the preliminary work on access control around OGC Web Services had a PTB Phase 1 component – it used one of the Use Cases and provided the vehicle for initial collaboration.

As noted in the section above, elements of the phase 2 call for proposals were directly related to ESDIN. In 2009, with approval from the ESDIN Project Management Group and the relevant Work Package Leaders, EDINA gained permission to participate in the OGC Authentication Interoperability Experiment and engage the services of Dr. Andreas Matheus in a consultancy role.

Work began on building the ESDIN Federation and further developing OGC Web Service clients capable of consuming Shibboleth protected services. The NMCA's were approached and invited to join the Federation and install Shibboleth with technical support being provided by EDINA. Work also began at EDINA on creating ExM/INSPIRE compliant services on top of the EuroGeographics pan-European products (EuroGlobalMap EuroRegionalMap and EuroBoundaryMap) for use with the academic sector. The PTB phase 2 call specifically called for institutions who demonstrated:

"Willingness to participate in an "access management federation of European universities" project as part of an OGC Authentication Interoperability Experiment. The objective here is to demonstrate securely sharing licensed data across the European academic sector using OGC Web Services. A briefing summary about the IE can be found here¹²:"

The intention was that through EDINA the participants would get access to suitably licensed INSPIRE compliant services from EDINA (the ExM services above) protected within the ESDIN Federation. The following organisations responded positively:

- EDINA, University of Edinburgh

¹² http://plone.itc.nl/gitestbed/phase-1-documents/PTB-AuthN-IE-briefingv1.pdf/at_download/file.

- FIUGINET¹³ (Finnish Universities Geoinformatics Network) and CSC¹⁴ – IT Center for Science Ltd
- Technical University of Dresden¹⁵
- Centre for Geospatial Science¹⁶, University of Nottingham

3 Access Control, Shibboleth, SAML and OGC Web Services

Typically, content providers with responsibility for high value datasets, e.g., large scale reference datasets from NMCA's, INSPIRE Annex 1 datasets, are not prepared to make their data freely available, or are only prepared to make it available under circumstances where they have a high level of assurance that they know who is accessing their data. Consequently, the subject of access control, or controlling access to web services established on top of these datasets is an important area of concern for both suppliers and consumers.

Authentication is a mandatory part of access control and is concerned with establishing that claims made concerning a subject who is attempting to use a particular resource are authentic, i.e., true. Typically, this involves confirming the subject's identity. This kind of information is essential before it can be established that the subject is authorised to use the service or access the data.

Note this is not geo rights management (geoRM), geo digital rights management, e-commerce or authorisation: we are concerned here purely with the authentication aspect of access control. Being able to securely pass around identity information in a genuinely interoperable way is a basic security issue and a fundamental SDI enabler. Once we have an interoperable and secure means of identifying who is accessing the data with a high degree of confidence, as long as the architecture is modular and flexible, layering a wide range of e-commerce, geoRM, authorisation solutions on top becomes possible.

The work described here addresses only this fundamental access control layer; historically, the lack of an interoperable solution to this intractable problem has been a major barrier to SDI development.

¹³ <http://www.geoinformatics.fi/en/>

¹⁴ <http://www.csc.fi/english>

¹⁵ http://www.inf.tu-dresden.de/portal.php?node_id=1&ln=en&group=13

¹⁶ <http://www.nottingham.ac.uk/cgs/index.aspx>

3.1 Shibboleth

Shibboleth¹⁷ is an initiative from the US based Internet2 research and education networking consortium used primarily in the academic sector. It is an open source package that allows the establishment of federations of trusted Identity Providers and Service Providers. It is a production strength solution to the problem of how to securely exchange user information based on open standards. Shibboleth is being used daily by 100's of millions of users around the globe and there are Shibboleth based access management federations in most developed countries, including most of Europe. For example, the UK Access Management Federation¹⁸ has approximately 8 million users. See also:

<https://www.aai.dfn.de/links/>

<https://spaces.internet2.edu/display/SHIB/ShibbolethFederations>

Shibboleth is based on open security standards such as SAML¹⁹ (Security Assertion Markup Language), XML Signature, XML Encryption, etc.

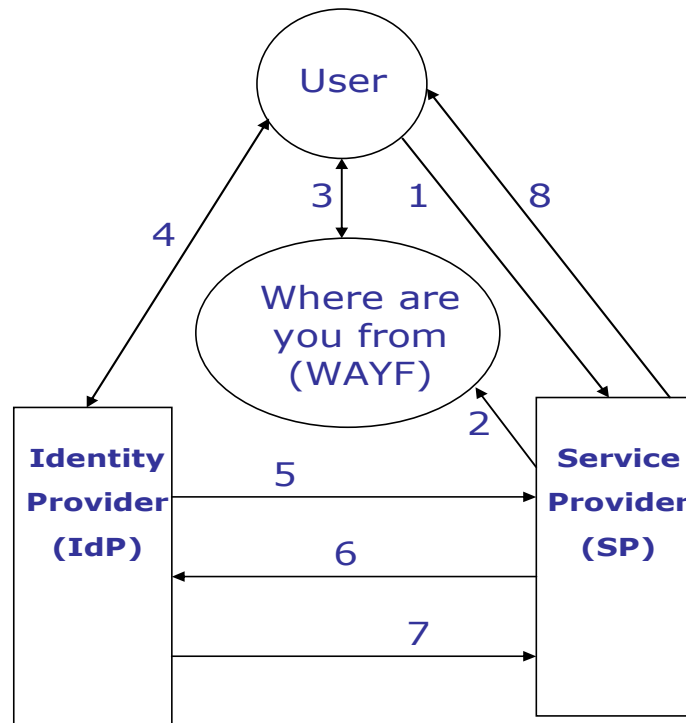


Fig 1. Typical Shibboleth Interactions

¹⁷ <http://shibboleth.internet2.edu/>

¹⁸ <http://www.ukfederation.org.uk/>

¹⁹ <http://docs.oasis-open.org/security/saml/v2.0/>

A decentralised approach is taken; organisations within the federation take responsibility for authenticating their own users using whichever method their organisation traditionally uses or prefers. In the language of Shibboleth, they act as Identity Providers (IdPs). Figure 1 provides an example series of Shibboleth exchanges typical of the UK Access Management Federation.

1. User attempts to access a Shibboleth-protected resource on the Service Provider (SP) site.
2. User is redirected to the WAYF in order to select their home organisation (IdP).
3. Part of same exchange as 2.
4. IdP ensures that user is authenticated, by whatever means IdP deems appropriate
5. After successful authentication, a one-time handle (a SAML artefact) is generated for this user session.
6. SP uses the handle to request attribute information from the IdP for this user
7. IdP allows or denies attribute information to be made available to this SP
8. Based on the attribute information made available, SP makes authorisation decision, i.e., allows or denies the user access to the resource.

This may look complicated, but from the users perspective; they attempt to access a Shibboleth protected resource and the following happens:

- they gain access immediately as they have previously authenticated - Shibboleth supports **Single Sign On**, or
- they get redirected to a list of organisations participating in the federation (WAYF) where,
- they select their home organisation and provide their (familiar) credentials
- they then either get access, or they don't, with appropriate information supplied, e.g., your institution does not subscribe to our service

Behind the scenes, there is what can be a complicated sequence of exchanges taking place, involving the resolution of SAML artefacts and the release of SAML assertions concerning the subject in accordance with the IdPs attribute release policy. Depending upon which SAML Profile or Binding is being used, this may be conducted over a secure encrypted back channel using SSL, SOAP, XML Encryption and XML Digital Signature.

Note that whereas the philosophy behind Shibboleth is to devolve responsibility as much as possible – in the belief that enterprises themselves are best positioned to manage the identities of their members, there are still some components that must be centralised. In the UK Access Management Federation, the main WAYF (effectively a list mapping institution names to IdP URLs) is centralised in a trusted organisation (JANET), although many SPs choose to setup their own WAYF (although

there is still a dependency on the central WAYF). Of course, policy has to be centralised, in the UK, this responsibility is shared between JANET and EDINA's SDSS team. Figure 2 gives a view on how the three main roles: IdP, SP and coordinating centre, relate to one another in a typical operational federation.

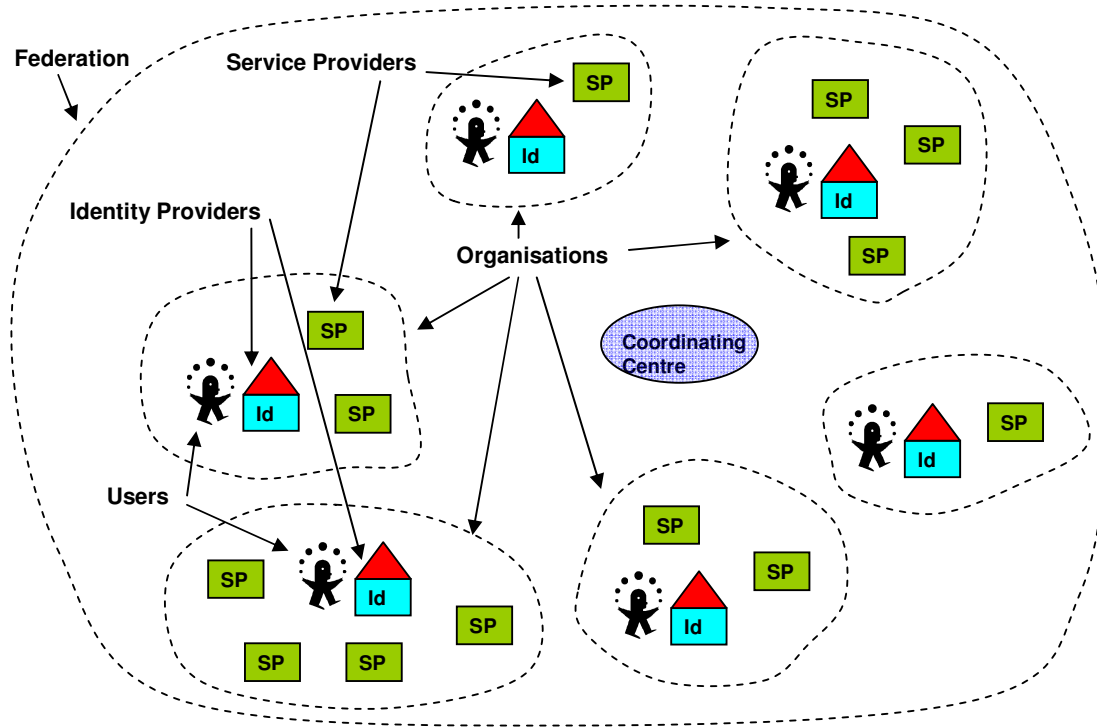


Fig 2. Key roles with a SAML Access Management Federation

As might be expected in an area as delicate as sharing information about users, policy is often the most involved aspect in establishing access management federations. For example, each IdP maintains an attribute release policy. Which attributes get released depends upon who the agent is and the resource being protected. Data protection and privacy considerations may prevent the users name being made known (not necessarily a unique ID though), certain attributes may only be released if its a student and SP 1, a lecturer and SP 2, etc. This is the sequence of exchanges 6 and 7 in Fig 1 above.

3.2 Authentication Interoperability Experiment

Partly as a consequence of work undertaken in the JISC funded Secure Access to Geospatial Web Services project²⁰ demonstrating how WMS can be protected using Shibboleth, and partly in recognition that an approach

²⁰ <http://edina.ac.uk/projects/seesaw/seegeo/outputsandactivities.html>

to authentication acceptable to the open geospatial standards community is both important and missing, the OGC Security Working Group initiated discussion on an Authentication Interoperability Experiment. A call for participation was subsequently announced on the 25th July 2009 with the formal kickoff being held in association with the Mountain View Technical Committee (TC) meeting in Sept 09. A pre-kickoff meeting was held at the Darmstadt TC.

The aim of the Authentication Interoperability Experiment was to test standard ways of transferring authentication information between OGC clients and OGC services by leveraging mechanisms already existing in the transport protocol (HTTP and SOAP). The original idea was to test the following mechanisms: HTTP Authentication, HTTP Cookies, SSL/X509, SAML, Shibboleth, OpenID and WS-Security (OpenGIS Project Document 09-092r1).

The main output from this activity was an Engineering Report²¹ approved by the OGC in Dec 2010. In the event, not all the mechanisms listed above were tested.

As agreed with the ESDIN consortium, EDINA concentrated on testing SAML2 based Single Sign On authentication for a small federation of protected OGC Web Services. The main outcomes from our participation in this experiment were:

- Further evidence that it is possible to protect WMS using Shibboleth
- This requires no changes to the standard OGC interface
- This requires no changes to the standard Shibboleth download
- This **does** require changes to the OWS clients. EDINA developed and demonstrated two clients during this exercise: one desktop (based on OpenJump) and one browser based (OpenLayers).

3.3 OGC Web Service Shibboleth Interoperability Experiment

Throughout the ESDIN project, as part of broader awareness and dissemination activities, EDINA has encouraged discussion and ideas from a variety of organisations and individuals as to how to take the project forward. In one such discussion, it was suggested by a representative from a GIS vendor that a good way of encouraging the software producing members of the OGC to modify their client software to be able to undergo the Shibboleth/SAML interactions was to hold an event where a variety of software producers publicly demonstrated their software working with the ESDIN federation.

After discussion with the OGC it was decided to cast this “plugfest” or “Technology Integration” type event as an IE. A press release inviting

²¹ <http://www.opengeospatial.org/standards/per>

participation in the OGC Web Service Shibboleth Interoperability Experiment (OSI) was issued on the 31st Aug 2010 with the first meeting taking place during the Toulouse TC in September 2010.

The stated aim in OSI was to provide the OGC software producing community with the means and opportunity of modifying their OWS client software to be able to work with Shibboleth Access Management Federations. The emphasis was on desktop clients as this is harder than browser based clients and having a range of different proprietary and open source client types demonstrated is more valuable. We would then provide the participants the opportunity to demonstrate their software in action by granting temporary access to the ESDIN federation.

To achieve the above; EDINA managed the IE, provided an open source reference implementation²² of a modified desktop client (the *openjump* client), provided technical support and organised the Technology Integration Experiment event as a webinar.

The webinar took place on the afternoon of Thurs 18th Nov. Approximately 30 people attended and the following organisations all demonstrated modified OWS clients accessing ESDIN federation protected services: EDINA, Snowflake²³, Cadcorp²⁴, Envitia²⁵, con terra²⁶ and the EU's Joint Research Centre²⁷.

At the end of the webinar, we had demonstrated different clients (desktop, browser, proxy), different services (WMS and WFS), and different federations (ESDIN and a test federation established by the BKG (the German NMCA)).

Probably the most significant outcomes from this exercise are the further evidence that Shibboleth/SAML based access management federations offer a practical means of organising operational SDI. There is an inevitable organisational overhead, but the modifications required on the server side are straightforward (install and configure mainstream Shibboleth), the required browser based client modifications are relatively easy while the required desktop based client modifications harder but doable.

If the decision is taken to operationalise it is highly likely that community support and tooling will be available. Several of the participants in OSI

²² <http://esdin.fgi.fi/wiki/index.php/Esdin:AuthIE:Client>

²³ <http://www.snowflakesoftware.co.uk/index.htm>

²⁴ <http://www.cadcorp.com/>

²⁵ <http://www.envitia.com/home/>

²⁶ <http://www.conterra.de/>

²⁷ <http://inspire.jrc.ec.europa.eu/>

have indicated that they are going to continue to develop their Shibboleth enabled clients and two of the vendors will make these modified products available on the market.

4 Results from NMCA Higher Education Geospatial Data Market Survey

The Higher Education sector in Europe has around 4,000 institutions, over 17 million students and 1.5 million staff. It should, in theory at least, be an important market for the NMCAs.

The sector has a long history of seeking to use geospatial data in teaching and research - a trend which is set to only increase in the future. One only has to look at the key strategic areas for scientific research in the coming years (e.g. climate change, population movement, human health, globalisation, and sustainability) to see how many relate to location.

By definition, researchers are often pushing the boundaries of knowledge and, in the process, will push the limits of datasets providing feedback on fitness for purpose of data products, innovative applications and uses, as well as unearthing fundamentally new business areas and applications. In respect of standards, this was much of the thinking behind the formation of the PTB.

It is also easy to forget that many students and researchers subsequently enter employment and are therefore the customers of tomorrow for NMCA data products. But just how real is the demand for data from this group? And how well do the NMCAs currently satisfy their needs?

As a starting point, EDINA, with the support of AGILE and Eurogeographics undertook two online surveys between January and April 2009.

The first of these surveys targeted the NMCA network, the second the European Higher Education Community.

The study revealed that:

- There is a 'healthy' demand for NMCA data from the Higher Education community and consequently a latent, untapped market.
- There is demand for local reference data, at relatively large scales.
- This demand is also 'pan European', with many Higher Education users seeking to access data from countries other than the one in which they live and study or carry out research.
- The majority of the NMCAs surveyed had arrangements in place for Higher Education. However, for many this arrangement is the provision of data at a discount and/or free samples of data rather than an agreement for access to national coverage.

- The majority of users wanted access to data products with national coverage. Approximately 50% of the Higher Education users found gaining access to these data a problem – with the high cost, licensing and usage restrictions being the main barriers.
- The main data sets made available by the NMCAs are topographic data, aerial photography and historic maps. In some cases cadastre information is provided. However, there is a perception, by the Higher Education community, that many more types of data could be made available. This has the potential of leading to frustration especially when NMCAs are unable to meet requests for data they don't hold.
- Of the countries who responded, only four countries had national agreements in place: Denmark, Norway, Great Britain and Sweden.

The full report is available from the ESDIN website with the conclusions and recommendations reproduced in Annex A below.

5 INSPIRE and the Academic Sector

The title of this document and deliverable is "Operational view/download services and access control conforming to INSPIRE implementation rules into the academic sector geospatial testbed(s)". This section reviews the relationship between INSPIRE and academia in the context of the ESDIN project.

The European Union INSPIRE (Infrastructure for Spatial Information in Europe) Directive entered into force in May 2007. INSPIRE provides the legislative basis for the European SDI and builds on national SDI developments within the member states.

The ESDIN project is closely linked to INSPIRE with the central aim of "helping Member States, candidate countries and EFTA States prepare their data for INSPIRE Annex I themes and improve access to them" (*DoW, p3*). In many member states, the main, or sole, custodian of Annex 1 themes is the NMCA and it is often the case that the NMCA is the main INSPIRE point of contact in each country.

In the first instance, INSPIRE is intended to assist public authorities in the formulation, implementation, monitoring and evaluation of policies; primarily in relation to the environment. The academic sector is mentioned explicitly only in that it is one of several user groups which are also expected to benefit from INSPIRE related developments. Note however, that there may well be instances where academic institutions are the legally mandated organisations, especially with Annex 3 data, and that in some countries, eg, the UK, universities are categorised as public authorities.

EDINA's participation in ESDIN has been strongly informed by the belief that the academic sector needs to get organised and respond positively to

INSPIRE. The strategic aim is to get involved and identify ways of cooperating with related initiatives, eg, through projects like ESDIN, INSPIRE motivated National SDI developments, etc, so as to achieve mutual benefits.

The aim is to create a virtuous circle, where students and researchers use the highest quality reference data available via INSPIRE network services, and in return, the public authorities feed back real world SDI research and education requirements and are able to recruit graduates educated with the appropriate skillsets who are accustomed to using their data and services. Benefits to the NMCAs are covered more exhaustively in the NMCA academic sector market study (section 4).

Examples of the kind of mutual benefits that might accrue have been forthcoming through ESDIN, eg, there were related presentations at both the INSPIRE conference in 2009 and 2010, eg, see "*Shibboleth Access Management Federations and Secure SDI: ESDIN Experience from the OGC Authentication Interoperability Experiment*²⁸". Note also the JRC active participation in the OGC Web Service Shibboleth Interoperability Experiment.

Probably of greatest interest to parties within the academic sector though, is the extent to which ESDIN has helped further the aim of securing access for the higher education sector to the operational view/download services established during the lifespan of the project.

6 Operational Services available to Academia through ESDIN

EDINA developed a number of services for different purposes during the course of ESDIN:

- Early on in the project, in cooperation with OSGB, Snowflake, Registers of Scotland and HMLR, as part of the ESDIN ad hoc INSPIRE Testing Work Package, we established WFS/Download Services for the following INSPIRE Annex 1 themes: Geographical Names (GN), Administrative Units (AU), Transport Networks (TN) and Cadastral Parcels (CP). In so far as is possible, these test services are conformant with the version 3 Data Specifications - the results from this exercise were reported back to JRC.
- For the purposes of developing and running tests in association with Work Package 12, we established View Services compliant with the INSPIRE Technical Guidance²⁹ on top of the same large scale datasets as above. This results from this exercise was reported back to JRC and used within WP12 and the UK Location Programme.

²⁸ http://inspire.jrc.ec.europa.eu/events/conferences/inspire_2010/presentations/71_pdf_presentation.pdf

²⁹ http://inspire.jrc.ec.europa.eu/documents/Network_Services/Technical_Guidance_View_Services_v2.12.pdf

- Around the same time as the ExM (medium/small scale) specifications became available in mid 2010, EDINA also took receipt of the following pan-European data products from EuroGeographics: EuroGlobalMap, EuroBoundaryMap and EuroRegionalMap. We established both View and Download services on top of these data mapping them to the GN, AU, TN and Hydrography ExM themes.

It is the latter services (details in Annex B) on top of the pan-European EuroGeographics products that may be considered as operational and available to the academic sector.

Note: as the ExM schemas are a strict superset of the INSPIRE schemas, these services may be regarded as "...conforming to INSPIRE...".

Currently, these data have been made available to EDINA on an evaluation licence (expires Sept 2011) for the following licenced use:

"The data will be used for making good EDINAs commitments under the EuroGeographics led ESDIN project. Services established on top of the data will be made available to members of the ESDIN consortium and to those members of the European academic sector participating in the European Persistent Geospatial Testbed for Research and Education (PTB). In particular, organisations cooperating in the EDINA led ESDIN participation in the OGC Authentication Interoperability Experiment."

Access is controlled using Shibboleth and restricted to the current ESDIN Federation. Negotiation is underway with EuroGeographics on how to extend the licence beyond 2011 in the light of ESDIN and in the context of ELF.

7 ESDIN and the Academic Sector

ESDIN is a wide ranging and ambitious project. Under the umbrella of, and with leadership from, EuroGeographics, the consortium is comprised mainly of NMCAs and, although the academic sector is identified as a target user group, it is not the primary focus. This section attempts to summarise where the EDINA contribution on behalf of the academic sector fits within that wider context.

Table 2 Academic sector contribution by Work Package

| Work Package | Title | Main EDINA contribution |
|--------------|-----------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------|
| 2 | Awareness and Dissemination | Engagement with the OGC, JRC, UK Location Programme, International Steering Committee for Global Mapping. Through the PTB, with AGILE and EuroSDR. |

| | | |
|----|-----------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 3 | Stakeholder Engagement | Creation of Use Cases around access control and networking to build a Best Practice Network with the academic sector. |
| 4 | Data Access and Licencing Policy | Use of Shibboleth/SAML federations for access control is a major SDI enabler. Main contributions were to D4.4 highlighting how this enables the use of INSPIRE “framework agreements”. |
| 5 | Technical Architecture and Coordination | Federated access control is a fundamental pre-requisite. Other layers, eg, e-Commerce, geoRM, can be built on top of this building block once it is in place. |
| 11 | Interoperability Services | The technical work on federated access conducted under this WP provides a concrete production strength example of how protected view/download services from the NMCAs can be made available. |
| 12 | Test environment | Developed tests for view services and authentication. Contributed to broader development of the test environment. Collaborated with the UK Location Programme. |

8 Conclusion

To conclude, we begin by revisiting section two’s statement of what we were aiming for as articulated in the ESDIN Description of Work. The document finishes by expanding on sustainability issues, particularly focussing on whats needed if the federation is to exist beyond ESDIN.

8.1 Academic Sector and the ESDIN Description of Work Revisited

8.1.1 Target Users and their Needs

As a general aspiration there remains a lot of work to be done in this area. Most organisations and individuals, irrespective of sector, would agree with the proposition that students should be educated and be able to conduct research using the highest quality interoperable pan-European data available from the NMCAs. But as the survey (section 4) showed, the situation across Europe is highly variable and there is widespread dissatisfaction from academia in many countries.

The situation in respect of the network being built as a consequence of the INSPIRE directive is that the focus is public sector environmental policy making and the academic sector is generally considered as of peripheral importance. The exact situation within individual countries is unknown and could form useful subject matter for followon activities.

ESDIN has helped though:

- The project resourced EDINA to network and raise these questions in several fora.
- The “INSPIRE compliant” small and medium scale pan-European services (section 6) are of direct benefit to this group of target users
- If Shibboleth progresses as a candidate organisational model for INSPIRE, then, as Shibboleth is used primarily in the academic sector, the sector will be well placed to negotiate access agreements.
- Similarly, if the GI vendors continue to modify their software to work with Shibboleth, then this will benefit education and research.

8.1.2 Expected Results

The small and medium scale services (section 6) meet this expected result directly. In terms of the INSPIRE roadmap, it is still early days, the first view services are not scheduled to be published until May 2011 and download services in 2012.

8.1.3 Success Indicators

The year 2 progress indicators were met with the institutions that responded positively to the PTB phase 2 Call for Proposal (section 2.3.2) getting access to the small and medium scale services. The Finnish Universities Geoinformatics Network is particularly exciting as this is a live, production Shibboleth federation comprising 7 universities and affords us the opportunity to explore some inter-federation issues.

The year 3 indicators have not been realised yet but probably can depending on ongoing discussion with EuroGeographics concerning licencing and the shape of the ELF. EDINA’s direct role in servicing the UK academic sector should make realising this target relatively straightforward, with the PTB network continuing to provide the main vehicle for reaching out to academic institutions across Europe.

8.1.4 Sustainability

Notwithstanding resourcing issues, currently the prospects for sustainability look good. There is a lot of interest in the access management federation work both within the project consortium and beyond. There is some evidence that the Shibboleth approach to securing OGC Web Services is receiving some traction within the community and as the main users of Shibboleth, this can only be good for the academic sector. They will be well placed to form relationships with organisations using Shibboleth to protect geospatial services as they have the technology, expertise and people in place already.

8.2 Evolution of the ESDIN Federation

From the above, it should be clear that the work undertaken (mainly in WP11) in respect of Shibboleth/SAML Access Management Federations is probably the most significant contribution from EDINA to the ESDIN project.

SAML is an international interoperability standard from OASIS, Shibboleth is an open source implementation used mainly (but not exclusively) in the academic sector. There is no reason why Shibboleth's use in other sectors cannot be extended, indeed, this is to other sectors benefit as:

- The open source community round Shibboleth is well developed
- The software is mature and production strength.
- As use is widespread, it is well understood
- Pool of people with the relevant skill sets
- Longevity guaranteed
- It is a mainstream IT initiative, typical use is non-geo and is intended for use with wide variety of different kinds of distributed internet resources.

This is not to say that all problems are solved and moving towards federated access to pan-European geospatial reference data is straightforward. All that ESDIN has done has prove that it is technically possible.

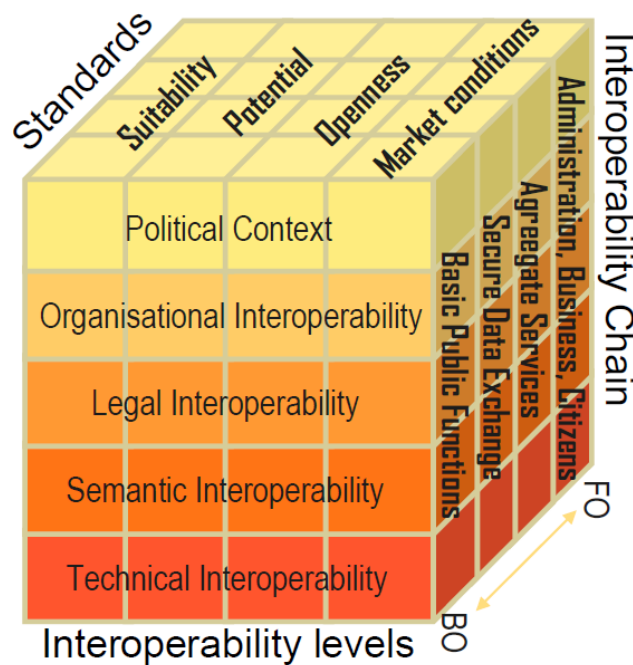


Fig 3. Dimensions of Interoperability

Figure 3 from the *European Interoperability Framework for Pan-European eGovernment Services*³⁰ illustrates that technical interoperability is only part of the problem.

³⁰ <http://ec.europa.eu/idabc/servlets/Docb0db.pdf?id=31597>

8.2.1 Whats needed to sustain the ESDIN Federation

At this juncture; legal interoperability, organisational interoperability and politics come to the fore. Creating a pan-European production federation is not straightforward proposition and not without significant cost. If the will is there to take the next step towards operationalising the work begun under ESDIN, there will be a need for greater understanding of the consequences, a great deal of commitment and a lot of work.

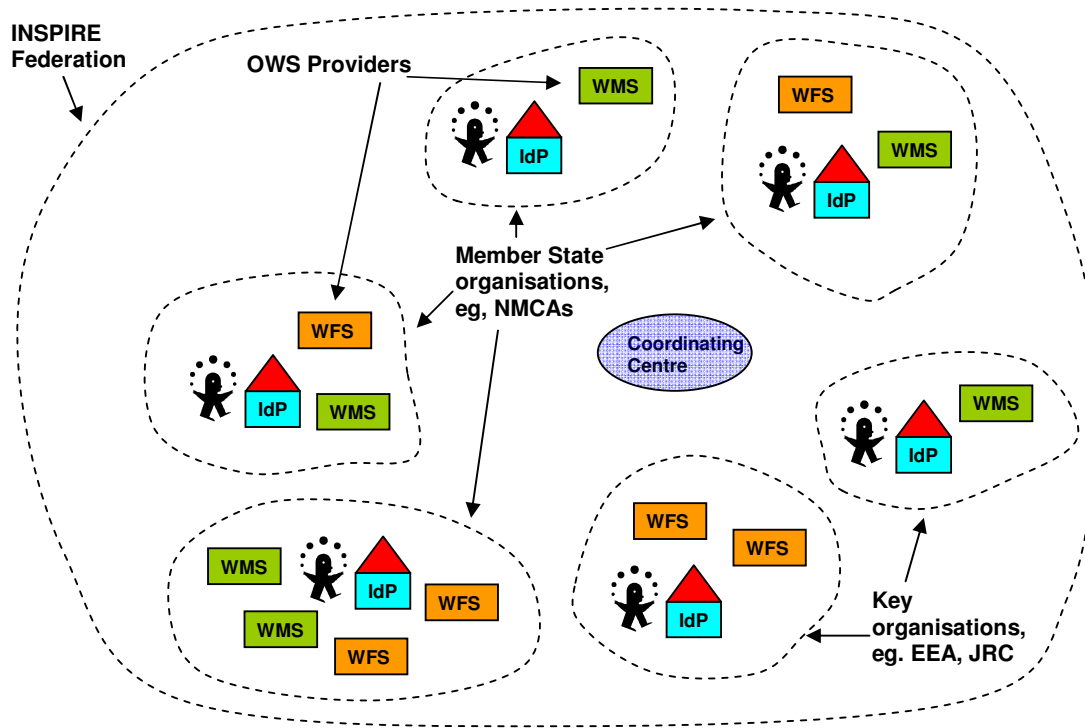


Fig 4 A Possible Evolution for the ESDIN Federation

Figure 4 builds on Fig 2, its illustrates how in the ESDIN/INSPIRE Federation scenario the Service Providers are the NMCAs and the services being provided are WMS/View and WFS/Download services. There are a number of different ways the different roles within the federation can be filled.

Each organisation can become an Identity Provider (IdP) itself, or a larger organisation can fulfill this role on behalf of several smaller organisations – this happens within the UK Access Management Federation.

In an INSPIRE context, there are likely to be more than one public authority within each member state standing up protected services. This leads to several (non-exclusive) options:

1. One federation and every legally mandated organisation joins.
2. Multiple federations: one in each country and one pan-European.

3. One federation: one organisation in each country, the INSPIRE point of contact or NMCA (often the same), joins the single pan-European federation and acts as the gateway for all the other legally mandated organisations in the country that are standing up INSPIRE services.

Option 1. Unlikely as not every public authority in every country is going to have the capacity. Even within the ESDIN project, with resourcing and expert technical support to hand, it proved difficult to persuade NMCAs to join and of those that did, some were difficult to support as they had their own agendas (political context in Fig 3) or their systems administration made it difficult (organisational interoperability in Fig 3).

Option 2 is possible in some cases, eg, where the members states own national e-government interoperability framework mandates the use of SAML for transferring identity information and at the time of writing, there is some evidence that this is happening. On the other hand, it is difficult to see this happening where member states already have major commitment and investment in alternative means of identity management, eg, the UKs Government Gateway³¹.

Option 3 is probably the most sensible next step.

Assuming the not insignificant political, organisational, legal and financial issues can be negotiated, and the will is there to proceed, it is likely some kind of phased roadmap type approach dovetailing with INSPIRE will be needed:

- Agreement would be needed between each NMCA (or INSPIRE point of contact if they are not the same thing) that the NMCA would join the federation. Key users, eg, EEA, EuroStat, JRC, establish "framework agreements" with the federation. When a request comes through from a key user for access to a protected federation service, they are proxied through the relevant NMCA and are challenged exactly once (single sign on) for their credentials. If they are authorised, they get access to this service and other similar federation services in different countries where necessary to get the task completed.
- How the Federation is constituted would need to be established.
- Need to get key users as well as the LMO's to buy in
- More software producers to modify their software to undergo the SAML/Shibboleth interactions
- Program of Research and Development to address issues such as:
 - How do e-commerce solutions bolt onto this architecture?
 - What's the best way of approaching inter-federation interoperability, eg, with academic sector Shibboleth federations.

³¹ <http://www.gateway.gov.uk/>

- Whats best practice in respect of interoperability with different member states identity management systems?
- Similarly, pan-European identity management systems?
- Whats best practice in terms of authorisation infrastructures?
- How do the processes and roles involved in governing an access management federation map to those required for SDI governance?
- How may the more advanced service chaining patterns be realised where some or all of the services in the chain are protected?

A start has been made in addressing some of these questions and ESDIN has proven that the overall approach is technically feasible using a modular, flexible architecture based on open standards. It can be achieved without requiring changes to the OGC interfaces, it doesn't require changes to the main Shibboleth download, it can be realised using a wide variety of different OGC Web Service clients, and the software producing community is willing and able to make the modifications to their systems.

We were asked by the EU to come up with concrete solutions and have delivered a production strength solution to how to achieve security interoperability.

As is often the case, addressing the financial, political, organisational and legal interoperability issues necessary to take this work forward will likely prove to be the real challenge. This aspect is well captured by a quote from David Schell, Chairman and Founder of the OGC:

"Interoperability seems to be about the integration of information. What it's really about is the coordination of organizational behavior."

Annex A: The European National Mapping and Cadastre Agencies and Higher Education - A Market for Geospatial Data– Myth or Reality

Only the concluding sections are provided here, the full report can be downloaded from the ESDIN³² website.

Conclusions

In an ideal world Europe would have an academic Spatial Data Infrastructure (SDI) under coordinated development closely allied to the SDI's being established in association with the EU INSPIRE directive (licensing permitting). However, while the European academic SDI comes into being (for example, in association with initiatives such as the AGILE, EuroSDR, OGC, European Persistent Geospatial Test-Bed for Research and Teaching), more pragmatic solutions to data supply need to be considered.

EDINA believes that with a mutual willingness for NMCA's and academics to collaborate, it would be possible to put in place a pan-European system that would allow researchers, teachers and students across Europe the opportunity to benefit from easier access to data.

For this to happen there is a need to organise the sharing of information about the initiatives, policies and procedures that are currently in place across Europe to help the Higher Education community access geospatial data. If the European NMCA network is prepared to share such experiences it may be possible to agree some common ground rules, and put in place reciprocal arrangements that will allow users at European Higher Education institutions the opportunity to work creatively with the rich geospatial data resources managed by the NMCA's.

This study has revealed that:

- There is a 'healthy' demand for NMCA data from the Higher Education community and consequently a latent, untapped market..
- There is demand for local reference data, at relatively large scales.
- This demand is also 'pan European', with many Higher Education users seeking to access data from countries other than the one in which they live and study or carry out research.
- The majority of the NMCA's surveyed had arrangements in place for Higher Education. However, for many this arrangement is the provision of data at a discount and/or free samples of data rather than an agreement for access to national coverage.
- The majority of users wanted access to data products with national coverage. Approximately 50% of the Higher Education users found gaining access to these data a problem – with the high cost, licensing and usage restrictions being the main barriers.

³² <http://www.esdin.eu/>

- The main data sets made available by the NMCAs are topographic data, aerial photography and historic maps. In some cases cadastre information is provided. However, there is a perception, by the Higher Education community, that many more types of data could be made available. This has the potential of leading to frustration especially when NMCAs are unable to meet requests for data they don't hold.
- Of the countries who responded, only four countries had national agreements in place: Denmark, Norway, Great Britain and Sweden.

There are many benefits for NMCA's to gain from taking the Higher Education market more seriously. It provides a potentially extensive, geoliterate and motivated user base. It can provide an opportunity to gather feedback on fitness for purpose of data products; innovative applications and uses as well as unearthing new business areas and applications. Finally, many academic users subsequently enter employment and thus are the customers of tomorrow. However, much more needs to be done to improve the availability of geospatial data for the Higher Education community both within and between countries.

Recommendations

- Future work should consider that the various types of data required are wide ranging and should form part of any agreement.
- Delivery mechanisms need to also be considered
- The NMCAs should carefully study well known examples, eg, Digimap in the UK, where the market for NMCA reference data has extended well beyond traditional disciplines, eg, Digimap has shown less than 20% of users of OS GB maps and data accessed through the service are geographers
- Licences need to be flexible enough to allow users to do their business whether for teaching or research.
- Negotiating on an institution by institution basis is neither cost or time effective, national agreements are the way to go.
- Reciprocal licences are required for cross border access and sharing but also requires a European wide authentication and authorisation scheme to be in place.
- The academic sector has not received enough attention under INSPIRE – whether universities are designated public bodies in member states or not could be important. The importance of academia as users of the outcomes of INSPIRE needs to be promoted to those leading INSPIRE at a European Level.
- Champions need to be found in each country and given assistance through a pan European body in getting national stakeholders together to thrash out a deal.
- Best practice from those countries that have national agreements and infrastructure in place need to be published for the use of others.
- The importance of access to geospatial data from NMCAs needs to be made clear to organisations such as the European Research Council and others.

- Organisations like EuroGeographics, AGILE, EuroSDR, SPARC Europe, etc, need to come together to push through change.

Next steps

The most obvious next step is to organise a workshop with representatives of NCMA's and academic users to discuss the above recommendations. We would hope to progress the initiative with the aim of persuading NCMA's to make available more of their data products to the Higher Education community within their own country. Following on from this, we would hope that reciprocal arrangements could be made for access to data between member states across the European Academic Community.

Annex B: Details on the services available

Table 3 Download Services

| Themes, feature types | GN (ExM) | AU (ExM) | HY (ExM) | TN (ExM) |
|-----------------------|-----------------------------------------------------------------------------------------------------------------------------------|--------------------|-----------------------|--------------------|
| | NamedPlace | AdministrativeUnit | DamOrWeir | AerodromeArea |
| | | | Falls | ControlTower |
| | | | GlacierSnowField | FerryCrossing |
| | | | LandWaterBoundary | PortArea |
| | | | Lock | PortNode |
| | | | Pipe | RailwayLink |
| | | | Shore | RailwayNode |
| | | | ShoreLineConstruction | RailwayStationNode |
| | | | SpringOrSeep | Road |
| | | | StandingWater | RoadLink |
| | | | Watercourse | RoadNode |
| | | | Well | RunwayLine |
| | | | Wetland | WaterwayLink |
| Coverage | Full | Full | Full | Full |
| Scale | Middle | Middle | Middle | Middle |
| URLs | GN: https://esdin.edina.ac.uk:7111/deegree-wfs-erm/services | | | |

| | |
|---------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| | <p>GetCapabilities: https://esdin.edina.ac.uk:7111/deegree-wfs-erm/services?SERVICE=WFS&VERSION=1.1.0&REQUEST=GetCapabilities</p> <p>DescribeFeatureType: https://esdin.edina.ac.uk:7111/deegree-wfs-erm/services?SERVICE=WFS&VERSION=1.1.0&REQUEST=DescribeFeatureType&TYPENAME=xgn:NamedPlace</p> <p>GetFeature: https://esdin.edina.ac.uk:7111/deegree-wfs-erm/services?SERVICE=WFS&VERSION=1.1.0&REQUEST=GetFeature&TYPENAME=xgn:NamedPlace&OUTPUTFORMAT=text/xml; subtype=gml/3.2.1&MAXFEATURES=10</p> |
| | <p>AU: https://esdin.edina.ac.uk:7111/deegree-wfs-erm/services</p> |
| | <p>GetCapabilities: https://esdin.edina.ac.uk:7111/deegree-wfs-erm/services?SERVICE=WFS&VERSION=1.1.0&REQUEST=GetCapabilities</p> <p>DescribeFeatureType: https://esdin.edina.ac.uk:7111/deegree-wfs-erm/services?SERVICE=WFS&VERSION=1.1.0&REQUEST=DescribeFeatureType&TYPENAME=xau:AdministrativeUnit&OUTPUTFORMAT=text/xml; subtype=gml/3.2.1</p> <p>GetFeature: https://esdin.edina.ac.uk:7111/deegree-wfs-erm/services?SERVICE=WFS&VERSION=1.1.0&REQUEST=GetFeature&TYPENAME=xau:AdministrativeUnit&OUTPUTFORMAT=text/xml; subtype=gml/3.2.1&MAXFEATURES=10</p> |
| | <p>HY: https://esdin.edina.ac.uk:7111/deegree-wfs-erm/services</p> |
| | <p>GetCapabilities: https://esdin.edina.ac.uk:7111/deegree-wfs-erm/services?SERVICE=WFS&VERSION=1.1.0&REQUEST=GetCapabilities</p> <p>DescribeFeatureType: https://esdin.edina.ac.uk:7111/deegree-wfs-erm/services?SERVICE=WFS&VERSION=1.1.0&REQUEST=DescribeFeatureType&TYPENAME=xhy:Watercourse&OUTPUTFORMAT=text/xml; subtype=gml/3.2.1</p> <p>GetFeature: https://esdin.edina.ac.uk:7111/deegree-wfs-erm/services?SERVICE=WFS&VERSION=1.1.0&REQUEST=GetFeature&TYPENAME=xhy:Watercourse&OUTPUTFORMAT=text/xml; subtype=gml/3.2.1&MAXFEATURES=10</p> |
| | <p>TN: https://esdin.edina.ac.uk:7111/deegree-wfs-erm/services</p> |
| | <p>GetCapabilities: https://esdin.edina.ac.uk:7111/deegree-wfs-erm/services?SERVICE=WFS&VERSION=1.1.0&REQUEST=GetCapabilities</p> <p>DescribeFeatureType: https://esdin.edina.ac.uk:7111/deegree-wfs-erm/services?SERVICE=WFS&VERSION=1.1.0&REQUEST=DescribeFeatureType&TYPENAME=xtn:RoadLink&OUTPUTFORMAT=text/xml; subtype=gml/3.2.1</p> <p>GetFeature: https://esdin.edina.ac.uk:7111/deegree-wfs-erm/services?SERVICE=WFS&VERSION=1.1.0&REQUEST=GetFeature&TYPENAME=xtn:RoadLink&OUTPUTFORMAT=text/xml; subtype=gml/3.2.1&MAXFEATURES=10</p> |
| <p>Notes</p> | <p>Data content based on EBM/ERM data sets. Small scale data set EGM content represents a subset of the feature types presented here.</p> <p>The data sets have full European coverage.</p> |

Table 4 View Services

| Themes, feature types | GN (ExM) | AU (ExM) | HY (ExM) | TN (ExM) |
|-----------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------|-----------------------|--------------------|
| | NamedPlace | AdministrativeUnit | DamOrWeir | AerodromeArea |
| | | | Falls | AerodromeNode |
| | | | GlacierSnowField | ControlTower |
| | | | LandWaterBoundary | PortArea |
| | | | OceanRegion | PortNode |
| | | | Pipe | RailwayLink |
| | | | Shore | RailwayNode |
| | | | ShoreLineConstruction | RailwayStationNode |
| | | | SpringOrSeep | |
| | | | StandingWater | RoadLink |
| | | | Watercourse | RoadNode |
| | | | Well | RunwayLine |
| | | | Wetland | WaterwayLink |
| Coverage | Full | Full | Full | Full |
| Scale | Middle | Middle | Middle | Middle |
| URLs | ERM: https://esdin.edina.ac.uk:7111/cgi-mapserver/mapserver?map=mapfiles/esdin_erm.map& | | | |
| | GetCapabilities: https://esdin.edina.ac.uk:7111/cgi-mapserver/mapserver?map=mapfiles/esdin_erm.map&request=GetCapabilities&version=1.3.0&service=WMS GetMap: https://esdin.edina.ac.uk:7111/cgi-mapserver/mapserver?map=mapfiles/esdin_erm.map&SERVICE=WMS&VERSION=1.3.0&REQUEST=GetMap&BBOX=51.580726,4.099713,52.080420,4.742352&CRS=EPSG:4326&WIDTH=1044&HEIGHT=811&LAYERS=EuroRegionalMap&STYLES=&FORMAT=image/png&TRANSPARENT=TRUE | | | |
| | EGM: https://esdin.edina.ac.uk:7111/cgi-mapserver/mapserver?map=mapfiles/esdin_egm.map& | | | |
| | GetCapabilities: https://esdin.edina.ac.uk:7111/cgi-mapserver/mapserver?map=mapfiles/esdin_erm.map&request=GetCapabilities&version=1.3.0&service=WMS GetMap: https://esdin.edina.ac.uk:7111/cgi-mapserver/mapserver?map=mapfiles/esdin_egm.map&SERVICE=WMS&VERSION=1.3.0&REQUEST=GetMap&BBOX=51.580726,4.099713,52.080420,4.742352&CRS=EPSG:4326&WIDTH=1044&HEIGHT=811&LAYERS=EuroGlobalMap&STYLES=&FORMAT=image/png&TRANSPARENT=TRUE | | | |
| | EBM: https://esdin.edina.ac.uk:7111/cgi-mapserver/mapserver?map=mapfiles/esdin_ebm.map& | | | |



| | |
|--------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| | <p>GetCapabilities: https://esdin.edina.ac.uk:7111/cgi-mapserv/mapserv?map=mapfiles/esdin_erm.map&request=GetCapabilities&version=1.3.0&service=WMS</p> <p>GetMap: https://esdin.edina.ac.uk:7111/cgi-mapserv/mapserv?map=mapfiles/esdin_ebm.map&SERVICE=WMS&VERSION=1.3.0&REQUEST=GetMap&BBOX=41.140897,8.639982,48.730807,18.401113&CRS=EPSG:4326&WIDTH=1043&HEIGHT=812&LAYERS=AdministrativeBoundarySS,AdministrativeBoundaryMS,AdministrativeBoundaryLS,AdministrativeBoundarySSTxt,AdministrativeBoundaryMSTxt,AdministrativeBoundaryLSTxt,AdministrativeBoundaryDSTxt&STYLES=&FORMAT=image/png&TRANSPARENT=TRUE</p> |
| Notes | <p>Data content based on EBM/ERM data sets. Small scale data set EGM content represents a subset of the feature types presented here.</p> <p>The data sets have full European coverage.</p> |