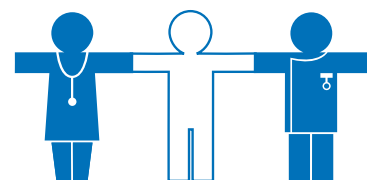




# The suitability of XDS-I for national sharing in the NHS in England

Moving to an XDS-I architecture to support image and report sharing across the LSP-provided PACS and RIS estate in England is technically possible but, considering the technology's current level of maturity, would require significant development and funding.

NHS Connecting for Health believes a pragmatic approach is required, monitoring the progress of any XDS-I implementations in England and the development of the XDS-I standard, and supporting and influencing these where appropriate, but in the meantime continuing to make available solutions which meet the majority of clinicians' image sharing requirements now.



# Background

This paper presents a summary of work completed by, and on behalf of, NHS Connecting For Health (NHS CFH) over the last nine months to assess the feasibility of using IHE<sup>1</sup> XDS-I<sup>2</sup> based solutions to enable the national sharing of diagnostic images and reports. This work was undertaken as an output of an NHS CFH and Royal College of Radiologists working group and focused on determining the answers to three fundamental questions:

- Does the national Spine infrastructure and some of the incumbent applications associated with it provide a suitable platform for an IHE XDS registry and repository<sup>3</sup>?
- Do the PACS and RIS products implemented by our Local Service Providers (LSPs) have the necessary interoperability capabilities to act as 'providers' and 'consumers' to a Spine-based Registry and thus participate in an XDS-I based national sharing solution?
- What is the capability and maturity of the XDS-I profile and how suitable is it for an implementation on the scale of the NHS in England?

The study involved engagement with a wide range of stakeholders including IHE, industry and clinical representatives. Its conclusions were formed following extensive desk-based analysis, stakeholder interviews and presentation and discussion of findings at a number of forums.

---

***“This paper presents a summary of work completed by, and on behalf of, NHS Connecting For Health (NHS CFH) over the last nine months to assess the feasibility of using IHE XDS-I based solutions to enable the national sharing of diagnostic images and reports”***

---

---

<sup>1</sup> IHE (Integrating the Healthcare Enterprise) is an initiative by healthcare professionals and industry to improve the way computer systems in healthcare share information. IHE promotes the coordinated use of established standards such as DICOM and HL7 by encapsulating them in Profiles to address specific clinical needs in support of optimal patient care (<http://www.ihe.net>).

<sup>2</sup> Cross-Enterprise Document Sharing for Imaging (XDS-I) is an IHE profile dedicated to sharing diagnostic imaging.

<sup>3</sup> A Spine-based registry/repository would form part of a national sharing solution, providing a national index and storage facility for reports and pointers to the corresponding images.

# XDS-I definition

The XDS profile allows participant systems to exchange clinical documents. To that extent it works in a manner similar to a document management system. The profile uses a document 'registry' for the capture of metadata about a document, including a pointer to the location of the document in a 'repository'.

The subject of this investigation was XDS for Imaging (XDS-I). XDS-I builds on the XDS standard by allowing images - typically DICOM images - to be located and retrieved remotely. The overall result is then a three stage process for retrieval of images:

1. Locate documents/reports for a patient in the registry.
2. Retrieve the document/report from the repository.
3. Follow a reference from the document/report to the image source and retrieve the image(s).

XDS and XDS-I reference a number of logical 'actors' that are able to send and receive specified 'transactions'. The focus of the investigations was to assess the relative suitability of Spine and LSP-provided PACS and RIS applications in England for playing these actors, taking particular note of the maturity of the standard and evidence of scalability. Figure 1 summarises the XDS-I.b actors and where they might logically reside.

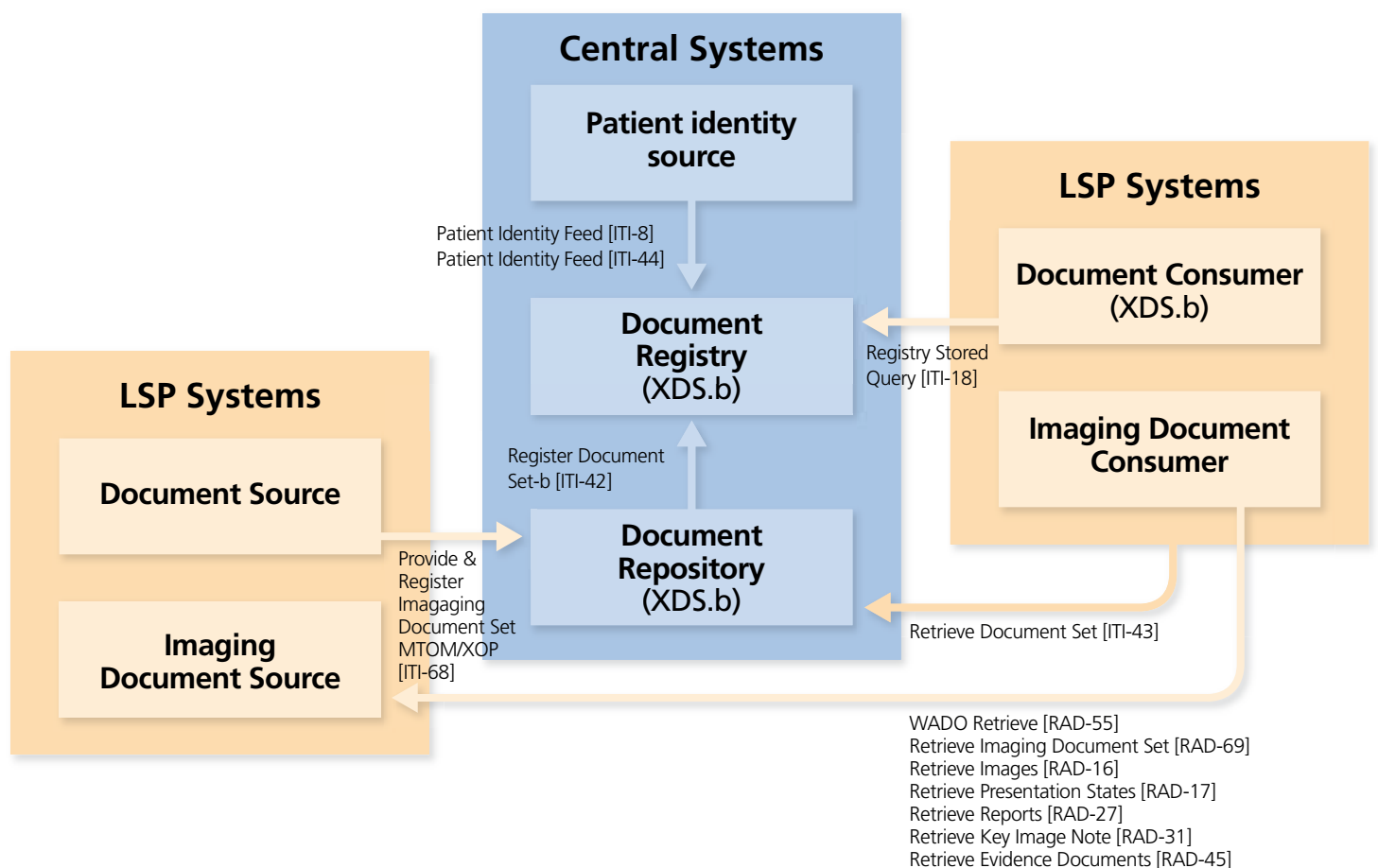


Figure 1 – XDS-I.b actors and transactions.

# XDS-I's suitability for national sharing

In assessing XDS-I's suitability we can draw from the conclusions of a national feasibility study relating to the Spine. Many of the findings in this document were not Spine-specific but rather general conclusions that apply to national scale implementations of XDS-I. This study summarised a mix of technical and professional findings:

- IHE profiles (XDS, XDS-I) do describe much of the framework required to create national sharing solutions.
- IHE leaves a number of significant aspects of any solution up to the particular implementation to define. This means that large parts of a national solution would need to be specified and built, including:
  - Security
  - Repository document semantics
  - Affinity domain/Information Governance (IG) policies/NHS Care Record Guarantee
  - Version and configuration management
- A number of gaps in a national solution would be covered by profiles that have only recently been proposed by IHE. These will take a number of years before they reach a maturity suitable for a national solution:
  - Endpoint resolution
  - Image transfer standards suitable for a large implementations
  - Notification mechanisms
- Spine components will provide a head start for some of the IHE actors and are likely to cost a similar amount to building a product from scratch. Aspects that the national solution already provides to a greater or lesser extent are:
  - Security
  - Endpoint resolution
  - Information governance policies
- A national sharing solution would present challenges of scale that no current IHE-based solutions address today.

# XDS-I and the PACS and RIS estate in England

There is currently little evidence of available XDS-I content from the LSP-supplied products deployed in the majority of acute trusts in England. Only one out of the three LSPs supplying PACS has been openly spending time looking at XDS-based solutions and how they might be incorporated into longer term development and deployment strategies. Although it has not been possible to get a detailed baseline position of the English PACS and RIS estate during the course of our investigations, we can see from publicly available information that there is a significant amount of development work required, including support for the NHS Number, to support the XDS and associated profiles as defined by IHE, as well as the additional implementation considerations.

## The challenges of implementing XDS-I across acute trusts in the NHS in England

Although our study showed that XDS-I could be implemented within the Spine and with the willingness of PACS and RIS suppliers, it would take time as the standard is not yet proven on the scale of NHS in England. A number of challenges are worth noting, many of which can be overcome with the necessary funding and time (although further development would require a very robust business case clearly outlining costs and benefits):

- A national XDS-I implementation would require a single affinity domain which defined the characteristics of the sharing community. It would require a consistent patient identity scheme which, in the case of acute trusts in England, would need to be the NHS Number. The affinity domain demands a consistent approach to security and audit and it is recommended that restrictions on agreed IHE profiles (known as a 'specificity', in IHE parlance) should be published in an external interface specification. There would also need to be agreement on document semantics across the domain, i.e. all aspects of document naming and content would need to be agreed at a national level.
- There are a number of gaps – albeit intentional ones - in the IHE profiles where implementers are required to devise their own solutions. In particular, the need to resolve endpoints both for repositories and image providers was identified. This would introduce the need for a directory service that would register and manage endpoint definitions so they could be transformed into the required physical internet addresses.

## *The challenges of implementing XDS-I across acute trusts in the NHS in England (continued)*

- A point-to-point interface - relying on a Public Key Infrastructure (PKI)<sup>4</sup> for security – is the recommended option for the transfer of image files across boundaries. PKI is something not currently implemented across the NHS and would be expensive item.
- In addition to supporting the required XDS actors and transactions, the XDS-I profile specifies additional transactions for the purpose of transporting the imaging files located using the standard XDS actors. For image transfer, the current HTTP-based WADO transaction should be used in the short term, later moving to a web services-based transaction implementation, versions of which are currently under development. This is because the current WADO transfer is not suitable for large scale implementations, while WADO for web services is expected to provide better support.
- As well as supporting the XDS and XDS-I profiles, a successful national solution would also need to support suitable authentication and authorisation techniques. Current approaches to authentication and message security<sup>5</sup> would need to be maintained or – where necessary – freshly implemented as the recommended profiles for IHE (EUA) are not suitable for the current national infrastructure.
- The level of choice, particularly with regards to RIS, available to acute trusts in England would challenge the roll-out of a national solution as all RISs would have to be compliant to the single affinity domain specificity before national sharing could become effective. This is likely to remain a feature of the national landscape and will need to be addressed by the RIS suppliers so that they achieve compliance to XDS should the national registry be required.

---

***“As well as supporting the XDS and XDS-I profiles, a successful national solution would also need to support suitable authentication and authorisation techniques”***

---

<sup>4</sup> Public Key Infrastructure - a framework for creating and managing a secure method for exchanging information based on public key cryptography across a non-secure network.

<sup>5</sup> This would include the smart card-based IDM infrastructure and the TLS-based mutual authentication of messages.

# Direction of travel

Moving to an XDS-I architecture to support image and report sharing across the LSP-provided PACS and RIS estate in England is technically possible but, considering the technology's current level of maturity, would require significant development and funding.

We have learned that while IHE has gone a long way towards enabling system interoperability through its definition of the XDS profiles, the XDS-I profile is still maturing and there are a number of important features (the XDS-I.b enhancements) that are still in trial implementation. NHS CFH as an active participant in IHE, and working with the Royal College of Radiologists and other stakeholders, will track and seek to influence a number of profiles relevant to a national sharing solution as mentioned in this paper<sup>6</sup>.

Additionally, further profiles and additional transactions which we believe will be required (e.g. configuration management and the improved security capabilities of the WADO for web services transaction) are still being defined. Furthermore, there is a significant amount of additional implementation guidance which needs to be defined in support of a national sharing affinity domain. Many of the challenges are driven by the scale of the LSP PACS and RIS deployments across England: as of today, XDS-I has only been deployed at small scale, in no way comparable to that of the NHS in England.

Based on these findings, NHS CFH plans to monitor and influence the progress of any XDS-I implementations in England and the XDS-I standard, given that technology changes constantly, and to support small-scale pilots where these are desired by groups of acute trusts and/or strategic health authorities (SHAs). In parallel with this, NHS CFH, working with SHAs and trusts, will continue to deploy image and report sharing technology that works and is affordable today, and which already meets many of the requirements imaging and other healthcare professionals have of image sharing.

This approach implicitly acknowledges that such solutions may fall short of the full potential offered by a mature XDS-I solution. However, the business benefits of the latter would need to be robust and clearly defined in order to secure the level of investment that would be required at this stage.

Should resources allow, providing implementation guidance and encouraging its use would be a useful step in supporting smaller XDS or XDS-I implementations at a trust or care community level, easing the transformation to a national affinity domain at some future date when the frameworks have matured and a clear benefits case exists.

## Further information

If you have any queries about this paper please email the national PACS programme at [pacs.query@nhs.net](mailto:pacs.query@nhs.net)

---

<sup>6</sup> For example WADO for Web Services, SDDS (for endpoint resolution) and DSUB (Document - meta-data - Subscription).

# Glossary

Actor	An actor in this context is any of the functional entities (for example the <b>registry</b> or <b>repository</b> ) defined within an <b>IHE profile</b> that transacts with other functional entities within that <b>IHE profile</b> .
Affinity domain	The affinity domain defines the scope of an <b>XDS</b> sharing community. An affinity domain always has one <b>Registry</b> and it defines a set of rules and policies that govern how the members of the affinity domain participate in sharing within that community.
DICOM	Digital Imaging and Communications in Medicine (DICOM) is a standard for file format definition and a network communications protocol for the handling, storing, printing, and transmitting of diagnostic imaging.
Domain	Delineates the scope of an area of interest which in this context refers to the <b>affinity domain</b> .
Endpoint resolution	A method by which logical addresses qualifying the location of an <b>XDS repository</b> or any image store (such as a <b>PACS</b> ) are translated into physical web addresses that enables the location and retrieval of documents and images.
EUA	Enterprise User Authentication (EUA) is an <b>IHE profile</b> that defines a single user registration and authentication scheme across an <b>affinity domain</b> enabling all participating systems to be accessed using the same user ID.
HTTP	Hypertext Transfer Protocol (HTTP) is the standard protocol that defines how messages are formatted and sent over the internet.
IHE	Integrating the Healthcare Enterprise – a not-for-profit organisation set up by the healthcare industry to promote the interoperability of healthcare systems by the definition of frameworks that simplify and constrain existing standards to ease their implementation.
IHE profiles	An IHE Profile defines an area of focus for interoperability definition by prescribing a set of <b>actors</b> with their associated transactions which enable a related set of functions to be performed (e.g. <b>XDS</b> ).
Local Service Provider (LSP)	A Local Service Provider, as part of the National Programme for IT is responsible for delivery of services at a local (Trust) level and supporting local organisations in delivering the benefits from these services. They ensure the integration of existing local systems and, where necessary, implement new systems to enable national applications to be delivered locally.

## Glossary (continued)

NHS Care Record Guarantee	The NHS Care Record Guarantee for England sets out the rules that govern how patient information is used in the NHS and what control the patient can have over this. It covers people's access to their own records, controls on others' access, how access will be monitored and policed, options people have to further limit access, access in an emergency, and what happens when someone cannot make decisions for themselves.
NHS Connecting for Health	NHS Connecting for Health supports the NHS in providing better, safer care, by delivering computer systems and services that improve how patient information is stored and accessed.
NHS Number	The NHS Number is the nationally unique patient identifier, used to help healthcare staff and service providers match patients to their health records. Everyone registered with the NHS in England (and Wales) has their own NHS Number allocated at birth.
Notification mechanisms	Notification mechanisms are automated procedures that notify interested parties that information previously received (or viewed) from an external organisation as part of, for example, an <b>XDS</b> or <b>XDS-I</b> transaction has been updated.
PACS	Picture Archiving and Communications System (PACS) is a computer system that manages the short and long-term storage, retrieval and presentation of diagnostic images.
Public Key Infrastructure (PKI)	A framework for creating and managing a secure method for exchanging information across a non-secure network based on using key pairs to encrypt and decrypt data.
Registry	The registry in the context of the <b>XDS</b> profile holds an index of the meta data cataloguing documents held in the <b>repository</b> . The index is queried by users in order to identify documents they wish to retrieve.
Repository	A repository in the context of the <b>XDS</b> profile holds documents made available for sharing by those participating in an <b>XDS affinity domain</b> . There may be more than one repository associated with the single <b>affinity domain registry</b> .
RIS	Radiology Information System (RIS) is a computer system used by hospital radiology departments to store, manipulate and distribute patient radiological data and imagery. The system generally consists of patient tracking and scheduling, result reporting, workflow management and tracking the images stored on a <b>PACS</b> .

## Glossary

(continued)

WADO	Web Access to <b>DICOM</b> persistent objects is a standard by which native <b>DICOM</b> objects or rendered <b>DICOM</b> objects (i.e. converted to a more readable format such as PDF or JPEG) are retrieved using the standard web <b>HTTP/HTTPS</b> (secure) protocol.
Wado for web services	WADO for web services is a further development of <b>WADO</b> that wraps an additional standard object layer around the transaction which simplifies and improves, amongst other things, the security and reliability features.
XDS	Cross-enterprise Document Sharing (XDS) – an <b>IHE profile</b> dedicated to simplifying the sharing of documents across enterprises by providing a standards based interoperability framework focused around the use of a document <b>registry</b> and <b>repository</b> .
XDS-I	Cross-enterprise Document Sharing for Imaging (XDS-I) – an <b>IHE profile</b> which is a development of the <b>XDS</b> profile using the same <b>registry</b> and <b>repository</b> capability to locate and retrieve diagnostic images.



When you have finished with  
this leaflet please recycle it

This document is printed on paper made from recycled  
fibre and fibre from sustainably managed forests.