



# THE WHITE ROSE GRID e-Science Centre of Excellence

## Integration Broker for Heterogeneous Information Sources (IBHIS)



Integration Broker for  
Heterogeneous Information Sources  
A Collaborative EPSRC Computing  
Research Project in Healthcare

### Introduction

The purpose of IBHIS is to create an *information broker service (IBS)* that will support the reliable integration of heterogeneous forms of information owned and managed by autonomous agencies. The potential for employing this approach can be found in many domains, but for this project we are focussing on the needs of the healthcare domain in order to motivate and direct the research.

Keele University, UMIST and Leeds), together with Keele's *Centre for Health Planning & Management*, and our NHS and Social Service partners in Solihull. A key role for the latter is to ensure that our work is based upon, and relevant to, the needs of a variety of healthcare roles.

### The IBHIS Broker - Prototype

The current IBHIS prototype utilises service-based technologies to integrate sample healthcare data from distributed, autonomous sources. It offers a Web interface to enable users to formulate queries about specific patients, using a global healthcare ontology. The broker locates suitable data sources, decomposes and authorises the query, and integrates the results for display. The architecture employed to realise the prototype broker is illustrated in Figure 2.

### Technologies Employed

The query is formulated firstly in terms of RD-QL, and later translated into XML. The

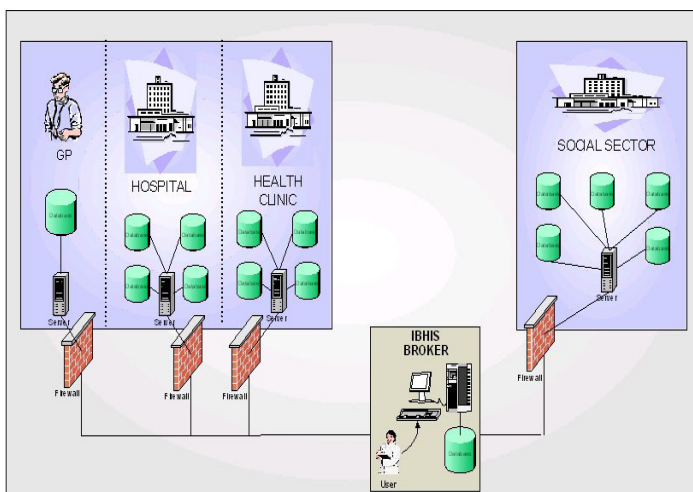


Figure 1: The healthcare application example

and health authorities are all independent organisations, each with its own information system; with social services adding another important dimension (Figure 1).

The IBHIS project is funded by EPSRC, and is being undertaken by the Pennine Group (software engineering researchers from the University of Durham,

In the healthcare domain, the NHS is, in systems terms, a classic large dysfunctional organisation, yet within it autonomous agents are expected to deliver seamless care. Primary care practices, hospitals, community trusts, mental health trusts,

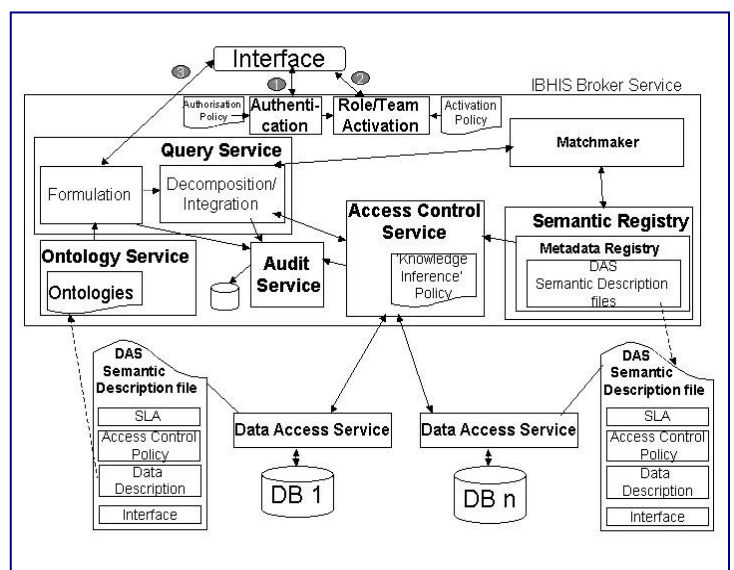


Figure 2: The IBHIS broker prototype





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functionality within the broker has been developed as a set of Java/J2EE classes and servlets, which are exposed as Web services using current technologies for description (WSDL, OWL-S), messaging (SOAP document style) and discovery (UDDI). XACL and XML were used to build the policies.

Three data sources are available to the broker, simulating a primary care practice, a hospital, and a social services organisation. The whole system, both Web services and data, is physically distributed across the three university sites, running within IBM Websphere application servers.

### Research Issues

The research issues addressed by the prototype include:

### Service-oriented Data Access

In order for the broker to locate and dynamically bind to suitable data sources, we have created a new form of service, a Data Access Service (DAS). A DAS provides a service-oriented front-end to complex data sources, with a description file that provides details about:

- **Interface** – describes the DAS interface and data in local terms, using WSDL/XML schema.
- **Data Description** – a semantic description of the data, which is linked to the global ontology and grounded to the interface. Both the description and ontology use the OWL-S format.
- **Access Control Policy** – a policy specifying data access permissions, using extended XACL.
- **SLA** – a service level agreement, to describe mappings between the subjects in the global access control model and those of the local data providers, expressed in XML

### Semantic Interoperability

The IBHIS broker must interact seamlessly with autonomous DASs, regardless of any heterogeneity within their data formats and semantics. The prototype achieves this through the use of three elements: semantic data descriptions, a Semantic Registry, and a Query Engine. The semantic registry is based upon an extended form of UDDI, incorporating a matchmaker to match OWL-S data descriptions from the registry to the user's queries. The query engine formulates the users' queries, interacts with

the matchmaker for query decomposition, and integrates the final results for display.

### Distributed Access Control

The prototype includes a new data access control model, developed to meet the needs of the healthcare domain. It incorporates a user's role, team, and identity, as well as the data content, and contexts. It also includes the ability for users to appoint roles or teams to other users and the facility to override privileges in emergency situations. The broker includes role and team activation within sessions, as well as an Access Control Service to dynamically map subjects across domains, and to perform attribute and content authorisation. The problem of inference is tackled using a centralised policy.

### Current and Future Developments

The experience gained from the prototype has identified a number of potential future developments. A particularly promising one is to extend the broker structure to include the run-time binding of processing services as well as data sources, to support research activities in healthcare and criminology (a domain which has many parallels in terms of organisational structures). We are also investigating the potential for a large-scale field trial with practitioners in the healthcare domain.

### Further Information

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The IBHIS Project Web site:

<http://www.co.umist.ac.uk/ibhis>

The Pennine Group Web site:

<http://www.service-oriented.com>

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