Domain: Integration

DESCRIPTION

The Integration Domain addresses how information, transactions, security, systems management and Business Services are integrated across intra-enterprise entities, e.g. agencies, as well as extra-enterprise entities, e.g. business partners.

STRATEGIC IMPORTANCE

The manner in which government information, transactions and business services are integrated is critical to creating an Enterprise SOA Architecture where:

- Integration timeliness, efficiency and cost effectiveness is facilitated
- Application security can be extended to Government to Business and Government to Government Services
- Open standards provide consistent integration methods across diverse technologies

Although IT integration is not a new phenomenon, this level of cross platform integration using open standards has no historical precedent.

RELATED TRENDS

- The IT industry is evolving from hub & spoke Enterprise Application Integration architectures (EAI), to more distributed SOA based integration architectures
- Major IT vendors are collaborating with open standards bodies to develop a set of interoperable standards to achieve the goal of cross enterprise, cross-platform, Business Service Integration
- XML semantics are the lingua franca to achieve Integration between diverse agencies and/or businesses using diverse technologies

VISION

To create an enterprise messaging environment based on open standards that facilitates trusted and timely communications between Business Services. This environment is a fundamental building block of the Commonwealth's SOA.

ROADMAP

Current State

- Currently a majority of agency applications are mainframe or client-server based limiting access to transactions and data
- Some business service integration is possible through the use of proprietary protocols and standards

- The Commonwealth's infrastructure has not yet been fully upgraded to provide support for SOA open standards

Target State

- The creation of an Enterprise Web Service Registry to facilitate the software reusability and the creation of composite Business Services
- The creation of an Enterprise Service Bus to provide standards based SOA Reliable Messaging, Routing, Transformation, Orchestration and Choreography Services
- The ability of government applications to support on demand business integration, using open standards, consistent with security and privacy requirements.

BOUNDARY

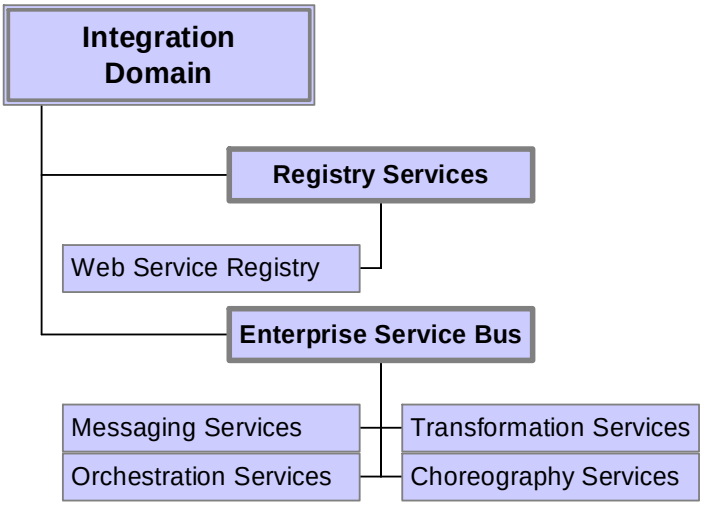
This domain addresses technology specifications for Registry Services and the Enterprise Service Bus. Technology specifications for non-SOA related directories and integration services are not addressed in this document. Security specifications and standards are defined in the ETRM Security Domain.

RELATED POLICIES

- Enterprise Open Standards Policy
- Enterprise IT Acquisition Policy
- SOA Governance (TBD)

ASSOCIATED DISCIPLINES

- Registry Services
- Enterprise Service Bus


Integration Domain
Registry Services
Web Service Registry
Enterprise Service Bus
Messaging Services
Transformation Services
Orchestration Services
Choreography Services

Domain: Integration
Discipline: Registry Services

DESCRIPTION

All IT Enterprises utilize a variety of proprietary and standards-based Registry Services. A Registry is a catalogue of items, including:

- Devices
- Applications
- People
- Telephone Numbers
- Email addresses

In some cases the terms Registry and Directory are used interchangeably. Examples of Registry Services include:

- Operating System Registries
- Telephone Directories
- Email Directories
- Web Service Registries
- Identity Management Directories

Registry Services play an important role in the Service Oriented Architecture. They allow for the registration, governance, and discovery of those critical items that are crucial for the conduct of electronic government services.

RELEVANT STANDARDS ORGANIZATIONS

- **OASIS** – Organization for advancement of structured information standards is a not-for-profit, international consortium that drives the development, convergence and adoption of e-business standards. Members themselves set the OASIS technical agenda, using a lightweight, open process expressly designed to promote industry consensus and unite disparate efforts. OASIS produces worldwide standards for security, Web services, conformance, business transactions, supply chain, public sector, and interoperability within and between marketplaces. More information about OASIS can be found at http://www.oasis-open.org.
- **WS-Interoperability –** The Web Services Interoperability Organization is an open industry effort chartered to promote Web Services interoperability across platforms, applications, and programming languages. The organization brings together a diverse community of Web services leaders to respond to customer needs by providing guidance, recommended practices, and supporting resources for developing interoperable Web services, e.g. UDDI and WSDL. The organization's deliverables are targeted at proving resources for any Web services developer to create interoperable Web services, and verify that their results are compliant with

both industry standards and WS-I recommended guidelines. More information about WS-I can be found at http://www.ws-i.org.

STAKEHOLDERS/ROLES

- external and internal users of government information and services
- business service architects
- analysts and application developers

ROADMAP

The Commonwealth does not have enterprise Web Service Registries at this time. Our goal is to make available a standards based Enterprise Registry for use by agencies, which can be implemented as a Shared Service for registering and publishing Web Services. It is envisioned that this Enterprise Registry will:

- Provide a repository for Business Service Metadata, e.g. Policies, Schema
- Have the capacity to be partitioned to provide "virtual agency registries" as a Shared Service
- Have the capacity to be Federated with agency managed UDDI Registries

ENTERPRISE TECHNOLOGY SOLUTION

ITD is currently working on an Enterprise Web Service Registry project with the goal of implementing a standards based Registry that can be used by agencies as a Shared Service for registering, publishing and governing Web Services in FY'06.

ASSOCIATED TECHNOLOGY AREAS

- Web Service Registry

Domain: Integration
Discipline: Registry Services
Technology Area: Web Service Registry

DESCRIPTION

A Web Services Registry provides an enterprise catalogue for Service Providers to publish Web Services to, and for Service Consumers to search and find Web Services. The Registry facilitates service reuse with management of service publication and subscription data, to extend the value of Web services by providing developers with powerful search, notify, browse and API support.

SOA Web Service Registry Services provide easy discovery of Web Services. SOA Business Services are meaningful only if potential users can find information sufficient to permit their execution. If you can't find it, you can't reuse it. The focus of the SOA Service Registry is the definition of a set of services supporting the description and discovery of:

- Businesses, Organizations/Governments, and other Service Providers
- The specific Business Services they make available
- The technical interface standards that may be used to access those Services

In addition, at run time, an application queries UDDI Services to discover the service policy and binding information for the services it needs, and then connects directly to those services.

Based on a common set of industry standards, including HTTP, XML, SOAP, and UDDI, the Web Service Registry provides an interoperable, foundational infrastructure for an SOA-based software environment for both publicly available services and services only exposed internally within an enterprise.

TECHNOLOGY SPECIFICATION: UNIVERSAL DESCRIPTION, DISCOVERY AND INTEGRATION (UDDI) REGISTRY

Description – UDDI registries provide easy discovery of Web services and other programmatic resources inside an organization. They also facilitate the governance of web services.

Two common scenarios for Registry Services inside an organization are Developer Reuse and Dynamic Application Configuration:

- **Developer Reuse:** At design time, developers should search Registry Services for Web services and other programmatic resources to reuse in building new applications. UDDI Services expose all of the information needed to invoke a service, making it easy for the developer to integrate the service into an application.
- **Dynamic Application Configuration:** At run time, an application should query UDDI Services to discover the current binding information for the services it needs,

and then connects directly to those services. The Registry must ensure that mission critical services are not exposed to unauthorized applications.

Guidelines – When evaluating and/or acquiring an SOA Business Service Registry it is important to look for compliance with the UDDI standard, to insure interoperability with other Technology Areas which comprise the Enterprise SOA.

Standards and Specifications –

- UDDI v. 2.0 – The Universal Description, Discovery and Integration (UDDI) protocol version 2.0 has been tested by the WS-Interoperability group to insure successful integration with SOAP 1.1 and WSDL 1.1, thus providing the Commonwealth with a level of interoperability assurance.
  Refer to: http://www.uddi.org/

Migration Strategy– UDDI v. 3.0 has now been ratified by OASIS. However, it has not yet been included in the WS-I Basic Profile. Therefore, the latest UDDI version has not yet been tested for interoperability. Use of this new standard will require agencies to do their own interoperability testing until such time as the WS-I Basic Profile is updated. The ETRM standards will be revised to reflect revisions to the WS-I Basic Profile.

Domain: Integration

Discipline: Enterprise Service Bus

DESCRIPTION

An Enterprise Service Bus (ESB) is a grouping of services that facilitate integration including:

- Messaging Services - The ESB has evolved from message-queuing technology, which was originally point-to-point in nature. One of the most fundamental functions of an ESB is the sending and receiving of messages between SOA Service Providers and Service Consumers.
- Transformation Services – In an SOA, the message payload is typically an XML document. Given the plethora of XML standards, and the continued use of legacy formats (e.g. EDI), the ESB needs to provide Transformation Services to convert legacy formats to XML, as well as transform XML from a Service Provider to the format expected by the Service Consumer. An ESB can be used to extract and transform data from legacy systems to enable information access without the need to replace systems.
- Orchestration Services – As more and more Web Services are created there is significant business value in orchestrating them to provide composite and workflow applications, as well as managing transformations and routing. Orchestration takes place between services within an enterprise.
- Choreography Services – As Web Services start crossing organizational boundaries there is a need to orchestrate services across enterprises.

Analysts increasingly refer to ESBs as a method of making application integration simpler and cheaper. Furthermore, through the use of Transformation Services, distributed processes can include legacy applications as well as Web Services.

RELEVANT STANDARDS ORGANIZATIONS

- **OASIS** – Organization for advancement of structured information standards is a not-for-profit, international consortium that drives the development, convergence and adoption of e-business standards. Members themselves set the OASIS technical agenda, using a lightweight, open process expressly designed to promote industry consensus and unite disparate efforts. OASIS produces worldwide standards for security, Web services, conformance, business transactions, supply chain, public sector, and interoperability within and between marketplaces. More information about OASIS can be found at http://www.oasis-open.org.
- **W3C** - The World Wide Web Consortium was created in October 1994 to lead the World Wide Web to its full potential by developing common protocols that promote its evolution and ensure its interoperability. W3C has around 400 Member organizations from all over the world and has earned international recognition for its contributions to the growth of the Web. More information about W3C can be found at http://www.w3.org.

- **WS-Interoperability –** The Web Services Interoperability Organization is an open industry effort chartered to promote Web Services interoperability across platforms, applications, and programming languages. The organization brings together a diverse community of Web services leaders to respond to customer needs by providing guidance, recommended practices, and supporting resources for developing interoperable Web services, e.g. UDDI and WSDL. The organization's deliverables are targeted at proving resources for any Web services developer to create interoperable Web services, and verify that their results are compliant with both industry standards and WS-I recommended guidelines. More information about WS-I can be found at http://www.ws-i.org.

STAKEHOLDERS / ROLES

- external and internal users of government information and services
- business service architects
- business analysts
- application developers
- operations managers

ROADMAP

The Commonwealth currently offers a shared messaging service called CommBridge, which is built on top of IBM's WebSphere MQ (see Enterprise Technology Solution below). Building on CommBridge , the shared messaging service will be enhanced to create the enterprise CommBridge Service Bus (CSB):

- Java Messaging Services (JMS) have recently been added to the CommBridge Service Bus
- Transformation Services will be added to the existing WebSphere MQ ESB via an Integration Broker
- Transformation Services will include exposing existing queue managers as Web Services to enable access using SOAP

ENTERPRISE TECHNOLOGY SOLUTION

The existing Enterprise ESB Shared Service, CommBridge Service Bus (CSB), is based on WebSphere MQ. It provides assured once-only delivery of messages across more than 35 different vendor platforms using a variety of communications protocols. The transportation of message data is made possible through the use of a network of WebSphere MQ queue managers. Each queue manager hosts local queues that are containers used to store messages. Through remote queue definitions and message channels, data can be transported to its destination queue manager.

To use this Enterprise Shared Service an agency application must make a connection to a WebSphere MQ queue manager, the services of which will enable it to receive (*get*) messages from local queues, or send (*put*) messages to any queue on any queue

manager. The application's connection may be made directly (where the queue manager runs locally to the application) or as a client to a queue manager that is accessible over the network. WebSphere MQ supports a variety of application programming interfaces (including JMS), which provide support for several programming languages as well as point-to-point and publish/subscribe communication models.

ASSOCIATED TECHNOLOGY AREAS

- Messaging Services
- Transformation Services (TBD)
- Orchestration Services (TBD)
- Choreography Services (TBD)

Domain: Integration
Discipline: Enterprise Service Bus
Technology Area: Messaging Services

DESCRIPTION

The most critical requirement for SOA Messaging Services is guaranteed delivery. Guaranteed messaging ensures that messages are reliably delivered once, and only once, to their intended customers. Guaranteed messaging, traditionally a key requirement for financial and B2B supply chain markets, is increasingly a "must have" for government as well. Additionally, mobile clients need to be able to retrieve their messages on demand--as opposed to having to stay logged on and subscribed to a particular topic all the time. To support an on-demand delivery of messages, they need to be marked as *persistent.*

Persistent messages must be recovered in the case of an MQ or client failure, and the MQ server must provide the retrieve-on-demand flexibility discussed above. JMS-compliant MQ servers that support guaranteed delivery of persistent messages implement an offline storage mechanism for persisting messages to local disk or databases or across storage devices attached to a storage area network (SAN). This storage ensures message recoverability in the event of an MQ or client failure.

SOAP over HTTP, and SOAP over MQ, are widely accepted and interoperable messaging and transport protocols that are supported in a broad variety of environments. JMS and RMI are not supported on platforms other than the Java platform. They form a good framework for integrating applications running within J2EE environments.

TECHNOLOGY SPECIFICATION: JAVA MESSAGING SERVICE (JMS)

Description –At its simplest level, JMS sends messages between Service Providers and Service Consumers. The format of these messages is quite flexible and can include ordinary text messages (including raw text, SOAP, and XML), entire Java objects, and "empty" messages that are suitable for basic communication (like acknowledgments). What's different about JMS compared with low-level TCP/IP packets and Java Remote Method Invocation (RMI) is that while the other methods normally require real-time connectivity and messages that are sent synchronously, JMS systems are more flexible. In asynchronous mode, which is the default mode for JMS, clients don't have to be connected all the time.

Guidelines – JMS is not recommended for .NET to .NET messaging. JMS is recommended for J2EE to J2EE server messaging. JMS supports two modes of message delivery, in JMS specification terms, PERSISTENT and NON_PERSISTENT. The NON_PERSISTENT mode has the least overhead, and therefore is more efficient and considered “reliable,” but can lose data if there is a JMS provider failure, such as power loss. There is no requirement for messages to be logged to stable storage. PERSISTENT mode requires message logging in the case of a JMS provider failure. There is more overhead to this method, but because of the logging and stored data feature, this mode is considered “guaranteed.”

Standards & Specifications –

- JMS 1.1 Specification - The JMS 1.1 specification is a set of interfaces described in the J2EE specification that defines how a J2EE application component interacts with an enterprise messaging system. The actual implementation of the JMS interfaces is provided by enterprise messaging system vendors. The JMS specification allows developers to write vendor-neutral messaging applications without having to learn the native APIs of different enterprise messaging systems.

  Refer to: http://java.sun.com/products/jms/docs.html

Migration – Although CommBridge still provides much value for legacy application integration, it is a proprietary API. Agencies looking for Java interoperability and support for service oriented applications based on open standards, should consider JMS with a WebSphere MQ JMS Provider. JMS isn't a direct competitor to Web Services. One of its main uses is to make SOAP-based Web services more robust on the Java platform (pending WS-Reliability). With the capability for reliable, asynchronous messaging, JMS will have a role to play in SOA for the foreseeable future.

TECHNOLOGY SPECIFICATION: SIMPLE OBJECT ACCESS PROTOCOL (SOAP)

Description – SOAP is a standard that defines application-level structure for messages. For two applications to integrate, they must agree upon an explicit message structure. SOAP provides an application-level message structure for use over numerous transport protocols. Applications that speak SOAP can easily exchange information with other applications that speak SOAP, facilitating integration between disparate systems. The SOAP message structure consists of a body that contains the request content and headers that contain extended information for security, routing, transactions, etc.

Guidelines – When using SOAP 1.1 an application can expose its data over one of several transport protocols, such as HTTP or MQ, and provides a standard request and response structure as defined by the SOAP specification. This structure allows other SOAP-enabled applications to easily integrate.

Standards & Specifications –

- Simple Object Access Protocol (SOAP) 1.1 - The SOAP 1.1 standard consists of three parts:
  - The SOAP envelope construct defines an overall framework for expressing what is in a message; who should deal with it, and whether it is optional or mandatory.
  - The SOAP encoding rules defines a serialization mechanism that can be used to exchange instances of application-defined data types.
  - The SOAP RPC representation defines a convention that can be used to represent remote procedure calls and responses.

  Although these parts are described together as part of SOAP 1.1, they are functionally orthogonal. In particular, the envelope and the encoding rules are defined in different namespaces in order to promote simplicity through modularity.

Refer to:
http://www.w3.org/TR/2000/NOTE-SOAP-20000508/

Migration Strategy – SOAP 1.2 has now been ratified by the W3C and supports the binding of SOAP with multiple transport protocols. However, it has not yet been included in the WS-I Basic Profile. Therefore, the latest SOAP version has not yet been tested for interoperability. Use of this new standard will require agencies to do their own interoperability testing until such time as the WS-I Basic Profile is updated. The ETRM standards will be revised to reflect revisions to the WS-I Basic Profile.