Abstract

This document provides an overview of the research work carried out in the research activity JRA3, Task 3 known as the GÉANT Multi-domain Bus (GEMBus). The research undertaken in GEMBus pursues a new area, which enables composition of services in a multi-domain scenario, typical of the GÉANT project. A high-level description of GEMBus features and related developments are provided within this document.
What is GEMBus?

The GÉANT Multi-domain Bus, GEMBus, is middleware infrastructure based on the industry-adopted Enterprise Services Bus (ESB) concept; one of most important features of an ESB is its ability to support deployment and composition of services spanning different management domains.

GEMBus architecture follows the Service-Oriented Architecture (SOA) principles, which allow managing, maintaining, and accessing heterogeneous and distributed resources in a unified way by providing standardized interfaces and common working environments to their users. GEMBus architecture has been designed to offer and support service composition (inherited by the SOA model). Within a SOA architecture, individual functions offered by a service are abstracted from the technical implementation and presented in order of the function they perform (business logic); this enables an application to be “reused” within a new service.

GEMBus is not a newly developed ESB; it builds on the assumption that each (GÉANT) domain may use their preferred ESB platform, or any other bus-type service communication or messaging environment, and that GEMBus would act as the link between these buses. In other words, GEMBus would ‘federate’ the buses.

This document will use the more general term ‘bus’ to indicate that GEMBus is not prescriptive about the technology used by the participating domains (NRENs and/or institutions), as long as it meets the SOA principles.

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1 By domain, we mean an organisation participating in GEMBus; this can be an NREN, a university etc.
What is the Difference Between GEMBus and an ESB?

GEMBus is one of the first attempts to federate buses operating in different domains; each domain decides which bus it wishes to use (if any at all), whilst GEMBus, by offering interfaces and policies, enables integration of the various bus instances and/or of the services offered by the different domains. The federated approach used in GEMBus guarantees independent management of each of the domains participating in GEMBus.

What is the Purpose of GEMBus?

GEMBus offers the ability to facilitate the deployment of services, supports the composition of services (spanning different management domains) and enables the automation of a particular task of business process.

For example GEMBus could be used to create a new service that:

(i) transparently obtains digital certificates (by automatically contacting a certification authority),
(ii) feeds them to a tool that generates scripts used to configure users devices (i.e. mail clients)
(iii) and makes the script available for download on a web page.

The alternative would be to add certificates functionalities and configurations generation script to a portal, meaning that users would have to first request the certificates, then invoke the configuration generation script (and feed the certificates to this script) and finally they would be able to use the script.

GEMBus could also be used to support the following scenario: an eScience project uses a GÉANT service (i.e. bandwidth reservation) to obtain a dedicated network capacity; the eScience project uses the network to send logs and other critical data generated from components located all over the world; another service is also used to analyse the data. GEMBus would provide the support to enable the various services to work with each other, without imposing technical restriction on the participating entities.

For a more detailed description of possible GEMBus use-cases please refer to the first GEMBus deliverable [DJ3.3.1].

GEMBus Architecture

As mentioned above, GEMBus architecture follows SOA principles, namely:

- SOA services are independently managed and communicated via well-defined messages, typically using Simple Object Access Protocol (SOAP) or Representational State Transfer Protocol (REST).
- Each bus in a domain maintains a local registry that lists the services available in that domain.
- Each service is described in the local registry using a well-defined (typically XML-based) standard.
- Each service wishing to be accessed via GEMBus should comply with a set of minimum requirements that define the service repository.
Client applications can request a service as a whole or just some of the functionalities offered by the service.

After an evaluation of the available ESB platforms (made at the beginning of the GN3 project in 2009), GEMBus selected the open source platform FUSE [FUSE] as the preferred ESB platform for GEMBus implementation. The GEMBus architecture described below was developed using the FUSE platform.

To support a multi-domain ESB/bus federation, GEMBus has developed a set of **GEMBus core components**:

1. **Federated Service Registry (also known as GEMBus Registry)**: The Federated Service Registry talks to the local registries to retrieve the list of services from the local domains and to announce them globally (for all participating domains); this registry has the capability to request additional information about the services.  
   **Status**: Developed, in beta version.

2. **Service Repository**: To store service bundles, thus allowing their deployment via GEMBus. The GEMBus Service Repository will be accessible via a Web interface, shell console and RESTful interface.  
   **Status**: Under development.

3. **Security Token Service**: The Security Token Service (STS), built as a WS-Trust implementation, issues, verifies and translates security tokens to allow the authentication of requesters in a federated, multi-domain environment. Requesters can use these tokens to request access to a service; in turn, the service checks the validity of the token before granting access to the requester.  
   **Status**: Basic functionality, extensions and improvements being worked on. A demonstrator is also available.

4. **Composition Service**: To enable composition of services. This can be offered as a centralised service via the orchestration engine that is typically part of an ESB, or as an on-demand, deployed service, by downloading and deploying the necessary components.  
   **Status**: Demonstrator available.

5. **Accounting Service**: This service provides configurable and aggregated access to the GEMBus log-in service to support monitoring, auditing, diagnostics and troubleshooting.  
   **Status**: Under development.

Figure 1 depicts a high-level view of the GEMBus core components described above.

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2. “Service bundles” refers to a group of services, typically in Open Grid Services Infrastructure (OGSI) format, but in this context it can mean any group of services.

3. The WS-Trust as one of the web-service (WS*) standards, specifically dealing with the issuing, renewing, and validating of security tokens.

**How Does GÉANT Benefit from GEMBus?**

For long time, the way for connecting two systems required custom, point-to-point, application-level data interfaces. Whenever one of the services changed, the interface needed to change accordingly. Clearly this approach is not scalable, particularly in the GÉANT context. GEMBus approach moves away from this paradigm; GEMBus offers an interface towards existing services that allows the selective deployment of only the functionalities that are really required in a business context.

GEMBus provides the opportunity to access existing GÉANT services in a unified way and to create new customised services interactively or on-demand for user-specific needs or projects. Using standard interfaces and interactive service composition will allow users to focus on service functionalities without needing to know details of service implementation and programming.

A further, added value of GEMBus is that users will be able to integrate GÉANT services in their daily used workflows.

The well-structured way of interacting with services proposed by GEMBus will simplify the uptake of the core GÉANT services (security, accounting, monitoring, etc.) by any other resource deployed in GÉANT.

**Why Should you Connect your Service to GEMBus?**

In the past, when developing a service, developers needed to consider every aspect of service delivery, from its instantiation in a server, to the mechanisms used by a client in order to use the service. It was also difficult to integrate the service with any other service in order to enhance the offered functionality and get what is called a 'mashup'.

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**Figure 1:** High-level overview of the GEMBus core components
Deploying a service in GEMBus means that the service does not need to include mechanisms to deal with specific instantiation aspects, such as the different protocols used by service consumers. Also, it will automatically be available for integration with other services (composition of services), but will always be subject to the security constraints set by service administrators. Moreover, the service deployed via GEMBus gains federation capabilities, so services deployed in other domains are able to consume or be composed with that service.

Finally, inside the GÉANT community, when a service is deployed in GEMBus, it may take advantage of consuming, being consumed by, or being composed with any other service deployed in GEMBus.

In summary, GEMBus permits service developers to focus on the business of the service and let the platform (GEMBus) provide the other aspects such as security, federation, composition, etc.; hence, by connecting a service to GEMBus, the chances for that service to be more widely used would be increased.

### GEMBus Today

At the moment GEMBus is in a beta version; there are some demonstrators available, but there is not yet a whole GEMBus test-bed that can be offered.

GEMBus could be deployed in different ways. For instance, all GEMBus core components could be offered by one domain or different domains could operate some of the core components.

Figure 2 depicts a possible scenario in which GEMBus could be deployed.
Further Developments

It is important to stress that GEMBus is a research project, and, as such, it is still under development.

During Y4 of the GN3 project (2012–13), development will focus on offering a test-bed for GEMBus, available to all GN3 project partners, as well as to those communities that have expressed an interest in testing GEMBus, such as the CLARIN [CLARIN] project and the eScience [eScience] projects.

A cookbook will also be created by the GEMBus team and made available to the community in the spring of 2012, which will facilitate wider acceptance of GEMBus.

References

[DJ3.3.1]  http://www.geant.net/Media_Centre/Media_Library/Media%20Library/GN3-09-198-
           DJ3_3_1_Composable_Network_Services_use_cases.pdf
[eScience] http://www.nesc.ac.uk/
[GEMBus]  http://www.geant.net/Research/Multidomain_User_Application_Research/Pages/GEMBus.aspx

Glossary

ESB  Enterprise Services Bus
FUSE Certified Open Source SOA Solution
GEMBus GÉANT Multi-domain Bus
GN3 The GN3 Project (3rd GÉANT project year)
JRA3 GN3 Joint Research Activity 3: Multi-Domain User Application Research
OGSI Open Grid Services Infrastructure
REST REpresentational State Transfer Protocol
SOA Service-Oriented Architectures
SOAP Simple Object Access Protocol
STS Security Token Service
WS-Trust Web Services Trust
XML Extensible Markup Language
Y4 Year 4