Demo: TA6, Project 5, Services at the edge of the network
ACITA 2011 Demonstration

Christopher Gibson, Dominic Harries, Florence Adam, Tom Klapischak
IBM UK

Petros Zerfos
IBM US

Sahin Geyik, Boleslaw Szymanski
Rensselaer Polytechnic Institute, US

Abstract—This demonstrator will bring together new and existing work from BPP09 Project 9 and BPP11 Project 5 in the area of sensor network services. It will demonstrate the benefits of using service-oriented architecture (SOA) principles at the edge of the network, and show the ease with which domain experts can compose services with this approach.

The demonstrator will provide a graphical interface that allows service composition by selecting and wiring together component services from a palette. This is stored as a Controlled English model, which can be transformed into various representations and/or augmented with a variety of annotations. We will show several such transformations including deployment onto the Information Fabric, transformation to the Performance Analysis Process Algebra (PEPA), and transformation of service policy annotations to CIM-SPL that are enforced at runtime. We will show how new domain-specific annotations and transformations can be added.

The demonstrator will also incorporate dynamic service recomposition, which attempts to maintain the functionality of a service composition in the event that one or more of its components becomes unavailable. The demonstrator will utilize both semantic web technologies and Controlled English for data representation, as well as the GAIAN database for the Fabric registry. It will run on a version of the experimentation facility.

Keywords—Sensor Networks, SOA, Coalition Operations, Policy, Dynamic service recomposition, PEPA

I. BACKGROUND

IT architectural design principles and techniques that have matured within enterprise systems are now migrating from the core to the edge of the network, and are being applied to systems implemented on dynamic, unreliable network infrastructures that are primarily used for sensors. Sensor networks are commonly implemented as stovepipe systems with limited or no information sharing capabilities. The ITA has developed the Information Fabric, a middleware architecture that spans the network from the data center to deployed sensors and mobile personnel. It tracks the sensors, nodes, and users of the sensor network facilitating universal access to sensor data from any point, and maximizing its availability and utility to applications and users.

The service-oriented architecture (SOA) is a popular design methodology that is suitable for deployment out to the edge of the network (including sensor networks). SOAs consist of a set of architectural principles that have been widely adopted in the enterprise IT domain through their implementation using the open standards of Web services. In resource constrained sensor networks, alternative implementations must be considered whilst still retaining the fundamental architectural principles of an SOA. The tradeoffs that must be adopted in these circumstances have been shown to enable effective service deployment at the edge of networks.

Services on a sensor network do not follow the conventional process choreographic model of invocation. Our model uses the UML activity diagram as a starting point. UML activities match the semantics of sensors and services in the network, with them being synonymous with services having zero or more inputs and zero or more outputs.

Our model can be transformed into various formal models that allow analysis to be performed and the results fed back to the user in a process that we have called round-tripping. Round trips could include analysis of the policies that have been defined on the model, analysis of the performance of the model using PEPA, and deployment/monitoring of the model on the Information Fabric. The demonstration will show how our architecture makes it easy to introduce new annotations and add new model analysis and transformation capabilities.

One of the greatest challenges encountered when moving SOA to the edge of the network is the dynamic nature of the environment. The Information Fabric has been built to cope under these circumstances and has the ability to automatically discover and discard assets, and reorganize the topology of the network. We will demonstrate the dynamic service recomposition capabilities that have been developed, which exploit these features to maintain the operational capabilities of a composite service on top of a shifting network.

II. DEMONSTRATION REQUIREMENTS

1 large table, 2 large monitors, Ethernet or wireless connectivity (including Internet connectivity), 8 power adapters, 2 easels, 2 large monitors, 8 power adapters, 2 poster stands, 2 large table, 2 large monitors, Ethernet or wireless connectivity (including Internet connectivity), 8 power adapters, 2 easels, 2 large monitors, 8 power adapters, 2 poster stands.