Semantically Enhanced Resilient and Secure Critical Infrastructure Services

Project Objectives and Scope

1: Airport Turnaround Process in Progress

The goal of the SERSCIS project is to develop adaptive service-oriented technologies for creating, monitoring and managing secure, resilient and highly available information systems underpinning critical infrastructures such as air traffic control and airport management systems. Such systems must be able to survive faults, mismanagement and cyber-attack. SERSCIS aims to achieve this by allowing interconnected information systems to adapt to dynamically changing requirements arising from natural events, accidents and malicious attacks. Our case study is based on information systems used in airports to manage aircraft turn around, and to interact with air traffic control systems and networks.

Interconnection now threatens to undermine the resilience of critical infrastructure. In the past, airport systems were designed to manage specific airport services (e.g. aircraft refuelling, baggage handling, etc), and problems at the airport would have had little effect on international air traffic control networks. Today, airport systems are closely coupled to each other and to air traffic control networks, so they can share information and improve the efficiency through 'joined up' management. But this also means that a failure or security breach in one system at one airport could now have consequences for the whole airport, and disrupt air traffic management for many airports even in other countries. To address these problems, SERSCIS aims to develop and use semantic models and reasoning to analyse critical infrastructure requirements and vulnerabilities, including ICT failures and the cascading of failures through interconnected ICT systems. These models will then be used to describe, develop and operate service-oriented systems with a high level of security and dependability, capable of adaptation to compensate for faults or changing requirements, or to prevent the spread of disruptive effects between interconnected ICT systems.

The main scientific and technological aims of SERSCIS from a critical infrastructure perspective are as follows:

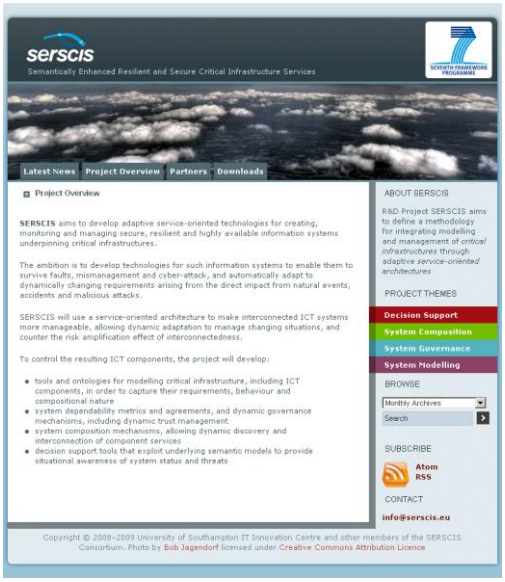
- to develop adaptive service-oriented technologies for creating, monitoring and managing secure, resilient and highly available Information and Communication systems able to underpin critical transport infrastructures: the physical transport infrastructure should be mirrored in the ICT system that serves its needs, so if the physical part changes, the ICT should also adapt to continue servicing the remaining structures;

- to provide automatic adaptation to dynamically changing needs and requirements arising from the direct impact on the critical transport infrastructure from natural events, accidents, incidents, security issues and malicious attacks; and
- to enable the capacity to survive faults, mismanagement and cyber-attacks in order to continue offering a minimum level of services, including the ability to prevent faults escalating through propagation to interdependent ICT systems.

Validation case studies are drawn from collaborative decision making in airports, in the context of expected innovations in European air traffic management.

Achievements in Year 1

The focus in the first year of the project has been on reviewing the state of the art, identifying possible validation scenarios in air traffic management, and establishing the starting points and scope of the project. We have also engaged with the security community from the earliest stages, including a presentation of the SERSCIS project by QinetiQ at the NATO working group on network visualisation held in November 2008, and at a ReSIST project workshop where SERSCIS was used as a case study. During this period, the project website was also launched, and this now provides a channel for partners to publish information about and related to the project. SERSCIS welcomes collaboration with other projects working in related fields, and can share some of its technology as open source, where appropriate. For more information, please visit http://www.serscis.eu.



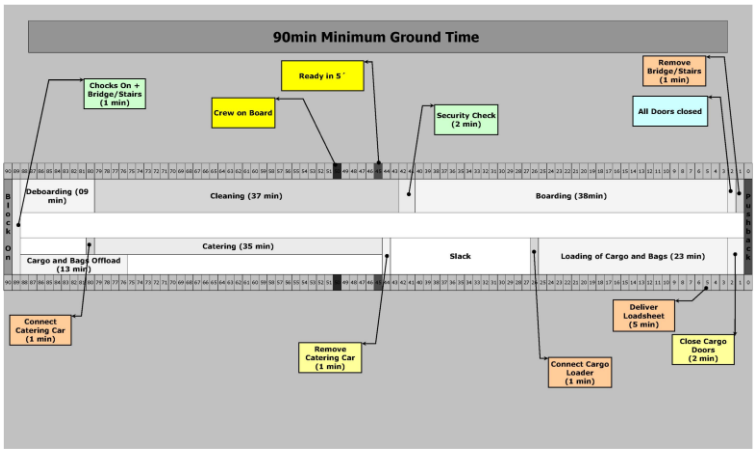
2: The SERSCIS.EU Website

The most significant technical outputs from the project in the first year have been:

- a market survey identifying the main opportunities for adaptive Service Oriented Architecture (SOA) technology applied to enhance security and dependability of critical infrastructure: the strongest opportunities are in inter-modal transport hubs including airports and also port area community operations, urban transport, etc.;
- an initial architecture for combining the main technology components for modelling critical infrastructure including ICT components, automatic management of service commitments and resources, adaptive service composition to manage service interdependencies, and decision support tools for system designers and operators;
- system modelling tools developed by QinetiQ in part based on their DBSy® and Springboard toolsets for information security system modelling and analysis, along with an initial ontology describing the validation case study domain developed with input from all partners;
- system governance tools developed by IT Innovation based on ideas from their GRIA inter-enterprise SOA infrastructure, including tools for managing commitments and resources via service level agreements with the relevant information consumers and suppliers, a service manager to autonomically balance these commitments, and (with input from JRS) an SOA registry based on WSO2 allowing dynamic discovery of information suppliers on demand;

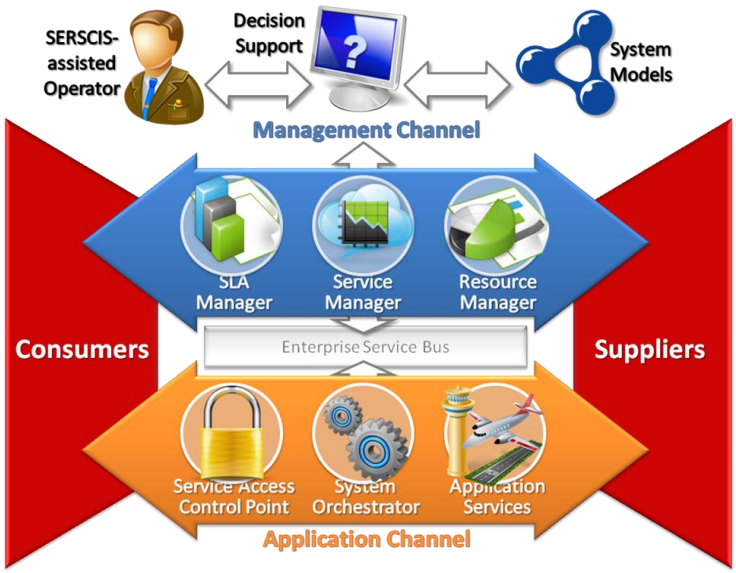
- system orchestration tools developed by JRS based on the Apache ODE workflow execution engine, the process description language BPEL (with semantic extensions), workflow management tools to design and deploy abstract workflow templates describing information flows with 'on-demand' and adaptive binding of information services at run-time, and (with input from IT Innovation) an event management system based on Apache ServiceMix supporting messaging between workflow and other components;
- decision support tools developed by QinetiQ with support from KEMEA, allowing management information generated by the governance (and potentially orchestration) components to be collected, analysed against system models, and presented to human operators in an easily understood form highlighting the source of any problems that may be impacting the dependability of the ICT or the critical infrastructure itself.

A validation case study has also been defined in detail. This is based on collaborative decision making in airports (A-CDM), focusing on the management of services needed to turn around an aircraft between landing and taking off on its next flight. The speed and efficiency of these services determines whether the aircraft will make its take-off slot allocated to it by the European air traffic control network. Nowadays, the take off slot is assigned in advance based on A-CDM information, so it is crucial to ensure high dependability in the A-CDM system itself and the service providers that use it.



3: Airport Turnaround Timeline

SERSCIS Architecture



4: SERSCIS Architecture

The SERSCIS architecture is illustrated on the left. This shows how SERSCIS technology components would be deployed within a single organisation, allowing it to mediate interconnections to external suppliers and consumers of information. A key feature of the SERSCIS architecture is that it should facilitate the management of ICT in relation to critical infrastructure applications within organisations. This allows it to improve the dependability of ICT interconnections, but taking account of each organisation's business goals and priorities. SERSCIS will help individuals working in organisations to be more aware of their external interdependencies and potential impact, and support actions, some of which can be automated, to address problems with the flow of information to and from their organisation, but without forcing them to transfer their loyalties to some external agency in

day-to-day operations. The architecture also means SERSCIS can be adopted by different interacting organisations at different times, allowing a more flexible approach to be adopted by potential users in a given application sector.

In Summer 2009 the first workshop was also held with external stakeholders: Operators, Handlers, Airline Companies, IT experts and Security Personnel from a well known International Airport. Input from these experts has been taken into account in the design of validation case studies, which will focus on collaboration and data exchange between actors involved in aircraft turn-around. This process determines whether aircraft will be ready for take-off slots assigned to them by Air Traffic Management (ATM). It is therefore critical to ensure that the information provided to local ATM operators and EUROCONTROL about when aircraft will be ready is reliable, and that any disruption affecting the turn-around process of an aircraft does not produce knock-on consequences for other aircraft or for the overall ATM network.

Future Work

In the second year of the project, the first integrated SERSCIS test bed will be developed. This will be based on the above architecture, and include semantic models and ontologies, and service monitoring, management and orchestration technologies for joining up and coordinating between different information providers. The test bed will also include application emulators representing a subset of these information providers in a single airport: the air traffic network providing flight arrival times and take-off slots, the A-CDM service operator providing the information exchange services, and various air-side service operators involved in preparing the aircraft for its next flight, who share information with the ground handler and the airport. This test bed will be used for initial evaluation studies to check how well the SERSCIS approach works to manage a dynamically composed information sharing network.

Many of the test bed software components will also be made available via the SERSCIS website. Please sign up to the RSS feed to be notified when releases of the software become available. We would be interested to collaborate with other projects who may want to try our approach and middleware on other critical infrastructure applications.

Contacts

Please visit www.serscis.eu for the latest information or contact info@serscis.eu with specific questions.