Final Project Report

Document information	
Project Title	Project Title
Project Number	14.01.02
Project Manager	EUROCONTROL
Deliverable Name	Final Project Report
Deliverable ID	D12
Edition	01.01.01
Template Version	03.00.00

Task contributors

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Rational for rejection
None.

Document History

Edition	Date	Status	Author	Justification
00.00.01	02/06/2014	Draft	[redacted]	New Document
00.01.01	01/07/2014	Final		Comments during Closure Gate.

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This deliverable consists of SJU foreground.

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1 Final Project Report

The Final Project Report is a summary of the project's goals and achievements and highlights the link between the project activities and the SESAR outcomes. The Publishable summary should not exceed 4 pages.

1.1 Progress and contribution to deployment activities

WP14.01.02 is about evaluating various technologies for Grounf-Ground communications and not about deployment of such.

1.2 Project achievements

This section reminds the project content (scope, approach and deliverables) as agreed at P14.01.02 Project Initiation Report (PIR) time. It also gives an overview of the achievements of the project.

The reader shall be aware that the Step1 and Step2 contributions have been completed already and all deliverables approved by SJU.

1.2.1 Project development approach & WBS

Considering the S-JU story board and its major steps (Step1, Step2 and Step3) with the project timescales, project work has been defined in order to provide concrete achievements for each of these SESAR steps.

Be reminded that P14.01.02 did not investigate technologies for the A/G segment.

P14.01.02 WBS followed a Step wise approach and thus proposed 3 cycles:

- **WA1 - Candidate G/G Technologies & Service Options (Step1**) - Given the short timescales for Step1, P14.2.x developed early foundation prototypes for which technologies have already been mostly chosen. Hence, WA1 simply issued a "technology assessment" that was documenting the chosen step1 technologies and service options, accompanied by a vendor market survey. WA1 also performed the pre-SWIM Inventory;
- **WA2 - Candidate G/G Technologies & Service Options (Step2)** - The bulk of the technology survey and evaluation occurred in this WA, contributing to OI Steps IS-0703, IS-0705, and IS-0707 (the GRD part only of the AGDLGMS);
- **WA3 - Candidate G/G Technologies & Service Options (Step3)** - An update of the WA2 work, ensuring the G/G technologies and service options identified are still appropriate, and identifying if necessary further mature technologies and/or service options. This WA contributes to OI Steps IS-0708 and IS-0709 (the GRD part only of the AGDLGMS).

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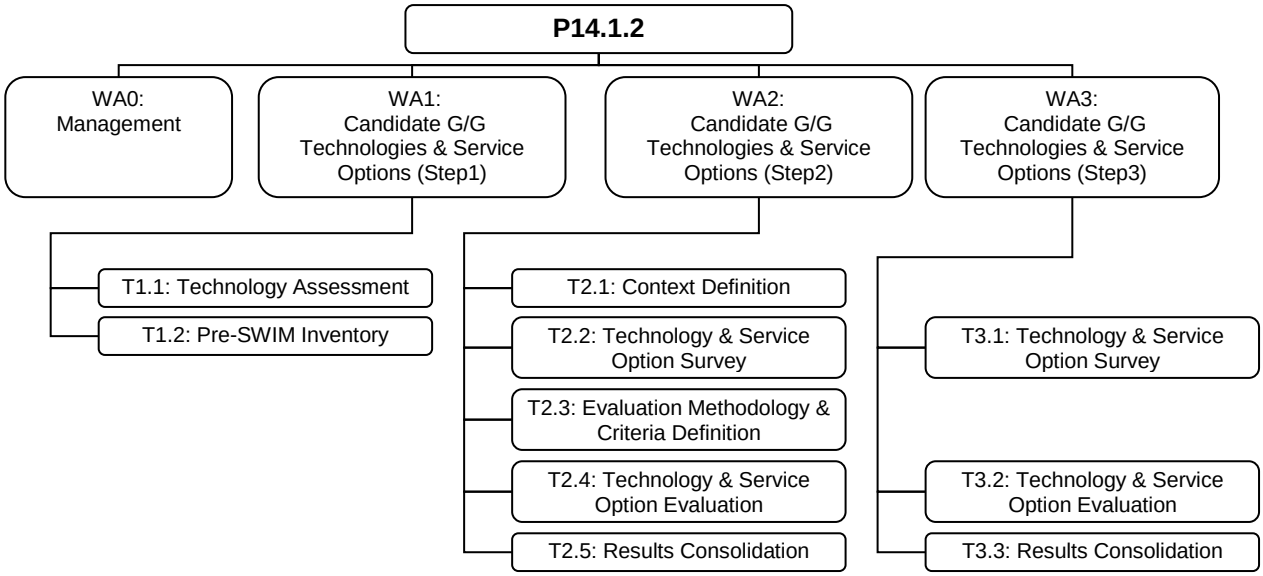

Fig 1. P14.01.02 WBS

WA1 and WA2 have been completed in 2011 and 2012 but WA3 has not started. After the Gate in July, 2012, the project has been frozen.

1.2.1.1 WA1 - Ground/Ground Step1

Given the short timescales for Step1, P14.02.09 developed early foundation prototypes based primarily on the core technologies chosen by the previous studies of SWIM-SUIT and ICOG, with a number of possible extensions concerning the service options deployed (e.g. security, registry).

Therefore, in step 1, P14.01.02 performed a brief "Technology assessment" task that was:

- Listing the technologies and service options chosen for P14.02.09 in step1;
- Performing an initial vendor survey, analysing the ESB/Application Server open source & COTS product offerings, their feature sets and their compliance with respect to known standards (e.g. OASIS WS). In view of the P14.02.09 plans for step1, particular attention was given to (a) security products & support of standards (b) registry products and support of standards (e.g. UDDI), (c) support for WS-Notification/WS-Addressing. The objective was to enable P14.02.09 to select rich COTS that can serve both its ICOG and mainstream SOA SWIM infrastructure needs in step1 and beyond.

Moreover, P14.01.02 performed a pre-SWIM inventory, identifying SWIM-like developments occurring in the ATM world in the coming years, and the technologies they employ. This pre-SWIM Inventory was used to influence the Step2 work (e.g. the list of candidate technologies).

1.2.1.2 WA2 - Ground/Ground Step2 & Step3

The work of the project was organised into five main tasks:

1. Task T2.1 - Define the context of the work: Determine the areas in which technologies will be required to support the design and implementation work of WP14;
2. Task T2.2 - Survey technology and service options: Identify technology/service options that fit within the context of WP14 and which should therefore be further investigated;
3. Task T2.3 - Define evaluation method: Document the processes to be followed in carrying out and documenting evaluations of technology and service options (including how to determine evaluation criteria);
4. Task T2.4 - Technology and service evaluation: Applicable to all items identified in task (T2.2), this task will follow the method defined in task (T2.3), to produce an evaluation of each technology. The evaluation will cover both individual evaluation (assessing with respect to

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criteria, and providing summary advice for potential adopters), and comparative evaluation i.e. ranking of technologies with similar purposes;

5. Task T2.5 - Results Consolidation & Further Evaluations: Consolidate the results of the previous tasks, producing the final report. This task shall include for technologies/services that achieved a high ranking in task (T2.4) further investigations providing more detailed advice and data for potential adopters.

In carrying out these tasks, the following guiding principles were followed:

- Regular contact with other WP14 project was used to ensure alignment between the projects. Early stages of the work in this project carried out in parallel with initial technology design/development work in other WP14 projects. Some assumptions about likely directions of the work in the other projects were made when carrying out the Context and Method tasks (numbers T2.1 and T2.3 in the list above). Although this involved some risk that some technologies may be evaluated unnecessarily, this was considered preferable to the alternative, which would be that P14.01.02 would start too late and therefore have reduced impact on the other projects. Regular contact between the projects were used, in the Context task, to gradually replace assumptions with decisions evolving in the other projects;
- Various projects such as ICOG and SWIM-SUIT have already performed literature surveys cataloguing middleware technologies. P14.01.02 built upon this existing work, refining, updating, and extended it as appropriate;
- The project aimed high in the protocol stack. Focus on a base technology (such as web services – SOAP+WSDL), but examined in detail the higher added-value service layers (e.g. W3C, OASIS and OGC standards), evaluating their maturity and suitability, thus permitting P14.02.01, P14.02.03 and P14.02.09 to then refine (and limit if necessary) the work needed in these areas;
- The project performed market surveys (what IT vendor products exist, what service options they support, reported experiences in using them etc.) in order to determine technology and service option maturity.

1.2.1.3 WA3 - Ground/Ground Step2 & Step3

This last 14.01.02 work activity (WA3) was to further refine the WA2 tasks in order to consider any new emerging technology or standard, or any change in technology and standard already assessed in WA2. The overall approach proposed was to redo tasks defined for WA2 (Step2 contribution) keeping unchanged the definition of the context of work (T2.1 from WA2) and the definition of the evaluation methodology (T2.3 from WA2). Therefore, the following tasks were proposed to be worked out in a Step3 context:

1. Task T3.1 - Survey technology and service options: Identify technology/service options that fit within the context of WP14 and which should therefore be further investigated;
2. Task T3.2 - Technology and service evaluation: Produce an evaluation of each technology. The evaluation will cover both individual evaluation (assessing with respect to criteria, and providing summary advice for potential adopters), and comparative evaluation i.e. ranking of technologies with similar purposes;
3. Task 3.3 - Results Consolidation & Further Evaluations: Consolidate the results of the previous tasks, producing the final report. This task shall include for technologies/services that achieved a high ranking in task (4) further investigations providing more detailed advice and data for potential adopters.

The Project Gate 2012 Report indicated that the P14.01.02 was considered to have completed SWIM Step1 and Step2 contributions. Nevertheless three tasks/deliverables remained as contribution to Step 3. At that moment these three deliverables were planned for 2013. The project manager reported that there was little value starting these tasks at the beginning of 2013 and that 2014 was a more reasonable period. On the other hand the question was also raised whether there was a need for a contribution of this kind (technology assessment) to SWIM Step 3 developments. The project was therefore tasked to prepare a project position paper the end of Q3 2012 or Q1 2013 on the perceived need for the remainder of the work (including a proposal for a possibly refined scope of the tasks/deliverables). This position paper was produced early 2013 with a NO-GO with WA3 recommendation agreed by all partners.

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1.2.2 *Which R&D question has been answered?*

P14.1.2 does provide SWIM technology state of the art and potential emerging technologies to be used for the SWIM Technical Infrastructure design (mainly P14.1.3, P14.1.4 and P14.2.2)

1.2.3 Which agreement has been reached (in terms of operational or technical solution)?

P14.1.2 does not contribute to any operational improvement. P14.1.2 provides recommendations to SWIM technical Infrastructure projects only (see chapter 1.5).

1.2.4 What contribution has been made to the ATM performance targets?

P14.1.2 does not contribute to any ATM performance targets. P14.1.2 provides recommendations to SWIM technical Infrastructure projects only (see chapter 1.5).

1.2.5 How achievements differ from the initial scope, summarising why the scope has evolved?

Step 3 was considered as non necessary

1.3 Project Key Deliverables

1.3.1 D01 - Ground-to-ground technology assessment.

As proposed in the PIR, this document is the “Technology assessment” (Task 1.1 of P14.01.02). It contains:

- A list of technologies and service options chosen for P14.02.09 in step1;
- An initial vendor survey, analysing the ESB/Application Server open source & COTS product offerings, their feature sets and their compliance with respect to known standards (e.g. OASIS WS-*). In view of the P14.2.9 plans for step1. Particular attention has be given to:
    a) security products & support of standards and
    b) Registry products and support of standards (e.g. UDDI), c) support for WS-Notification/WS-Addressing.

The objective is to enable P14.2.9 to select rich COTS that can serve both its ICOG and mainstream SOA SWIM infrastructure needs in step1 and beyond.

14 products have been surveyed using a multi-category questionnaire. A text description is also proposed (in annex). The major difficulty was to find key product differentiators in order to ease the choice in other projects.

As always in information technology, it is possible to re-assemble products in order to make them fulfill a requirement. We have identified the core building blocks that implement the Web Services specifications. As they can be combined in the products, we see that these products almost reach the same level of compliance regarding Web Services specifications.

The last aspect developed in this document is the impact of the architecture regarding ESBs or application servers. We see that the centralized architecture represents the natural approach for ESBs whereas the federated architecture raises important issues.

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1.3.2 D02 Pré-SWIM Inventory

This document presents an inventory of the existing data exchange types and their associated technologies currently being used among the different ATM stakeholders.

In addition of the description of the different data exchange types and technologies, the document provides an initial qualitative indication of the suitability of such technologies as potential candidate technologies for SWIM. It also provides an indication about the likelihood to have to support such technologies in the near and long term future (this will have to be considered in detail once the transition plans will be analysed and developed).

1.3.3 D07 Ground-ground Technology and Service Option Survey

The core technology list has been identified in the P14.1.2 PIR and further refined by the partners involved in the project task, reflecting mainstream IT trends, technologies already used in the ICOG context and SWIM-like projects (SWIM-SUIT, D-AIM, CFMU NOP B2B, FAA SWIM etc) and – last but not least – the partners' expertise and areas of interest. Core technologies are:

- CORBA
- DDS
- Message Oriented Middleware
- Web Services
- REST
- Collaborative Databases
- Conventional Data Exchange Protocols
- Open Geospatial Consortium Standards
- AMHS
- Transversal topics

Some technologies and service options were evaluated in P14.1.2 T2.4 on basis of criteria defined in T2.3.

1.4 Contribution to new Standards and Norms

P14.01.02 does not contribute in this area.

1.5 Recommendations

D02 is a good summary of the existing state-of-the-art currently used in the ATM world.

Any project that need to use the technologies evaluated by P14.1.2 should study deliverable D07 to find the differences, applicability and scope between them.

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2 References

Reference to main documentation, delete if not required

[1] SESAR Programme Management Plan, Edition 03.00.00

[2] European ATM Master Plan, Edition 2

[3] Multilateral Framework Agreement ("MFA") signed between the SJU, EUROCONTROL and its 15 selected members on August 11, 2009, amended on 14 June 2010, 19 October 2010 and 2 July 2012-END OF DOCUMENT-

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