



Final Project Report

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Abstract

The SWIM Technical Infrastructure (SWIM-TI) is the enabler for the SWIM concept realization. P14.01.04 aim was to define the SWIM-TI Technical Specifications (TSs) that consist of mandate functional, non-functional and interface requirements for the infrastructure enabling ATM-specific services provisioning and consumption technical interoperability. All technical interoperability needs of the System of Systems (SoS) have been taken into consideration and segmented into groups for each of which a satisfactory uniform and standard based solution is defined: the SWIM Profiles.

Apart of specification activities, P14.01.04 contributed also to additional programme level activities starting from the conceptual SWIM definition to the working method to be applied when identifying and designing ATM services (including technical design).

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This deliverable consists of SJU foreground.

Acronyms

Acronym	Definition
AIS	Aeronautical Information Service
ATC	Air Traffic Control
ATM	Air Traffic Management
BP	Blue Profile
FDD	Blue Profile Flight Data Domain Profile Part
ISRM	Information Services Reference Model
MET	Meteorological (service)
NFR	Non-functional requirement
OFA	Operational Focus Area
PCP	Pilot Common Project
PKI	Public Key Infrastructure
PP	Purple Profile
SESAR	Single European Sky ATM Research Programme
SJU	SESAR Joint Undertaking (Agency of the European Commission)
SESAR Programme	The programme which defines the Research and Development activities and Projects for the SJU.
STI	Security Token Infrastructure
SWIM	System Wide Information Management
SWIM-TI	SWIM Technical Infrastructure
TAD	Technical Architecture Description
TS	Technical Specification
YP	Yellow Profile
WP	Work Package

1 Project Overview

P14.01.04 contributed to the SESAR SWIM by defining the Technical Specifications for the SWIM Technical Infrastructure (SWIM-TI) [8]. These functional, non-functional and interface requirements represent mandate solutions to conform to in order to enable technically interoperable ATM service provisioning and consumption. The specifications have been defined in accordance with SWIM-TI TAD [4] and SWIM Profiles concept [5].

P14.01.04 contributed also to additional programme level activities [7] starting from the conceptual SWIM definition to the working method to be applied when identifying and designing ATM services (including technical design).

1.1 Project progress and contribution to the Master Plan

P14.01.04, in collaboration with other projects, defined the SWIM-TI design artefacts: i) TAD [4], ii) SWIM Profiles [5] and iii) Technical Specifications [8] (including, but not limited to, the SWIM Profiles specifications). The specifications have been iteratively refined applying both top-down and bottom-up approaches. The implemented improvements concern the ontology, terminology, approach and structure used in defining the SWIM-TI design artefacts (e.g. classification of NFRs) and the design artefacts content itself (e.g. specification of NFRs).

Examples of top-down inputs are the service activities and SJU's recommendations. ATM services design activities (including but not limited to the logical service design - ISRM [6]) provided the project with valuable inputs used to classify and group ATM services' NFRs. The results of this analysis have been used to refine available specifications (still independent of the specific ATM service). As part of the top-down inputs, the scope of each iteration of the SWIM-TI design artefacts have been discussed and agreed with the SJU.

Apart of the areas of improvement identified by the project itself, example of bottom-up activities includes feedback/inputs from other WP14 projects as documented in [7]. While defining the scope (tailoring of P14.01.04 specifications) of the different versions of the prototypes, SWIM-TI prototyping, verification and validation projects [7] provided P14.01.04 with feedback, requests for clarification, and change proposals that have been discussed and taken into account in the refinement of the specifications.

For what concerns the contribution to the Master Plan [2], the project contributed to IS-0901-A, IS-0901-B and IS-0901-C [2]. In particular the project defined requirements linked to Enablers applicable to SWIM-TI. In the table below, the project contribution to the applicable Dataset 15 (DS15) Enablers [39] is provided. It has to be noted that in many cases, the scope of the enabler is not fully covered by the SWIM-TI layer. In such cases, the full scope of the enable is covered by both application and infrastructure layers. The maturity at project end is based on prototyping, verification and validation activities that have been carried on by other projects responsible for the implementation of the provided specifications.

Code	Name	Project contribution	Maturity at project start	Maturity at project end
GGSWIM-59c	SWIM security in Step 3	The project defined several requirements that have been allocated/traced to this enabler. The project contributed to functional, technical and	TRL-1	TRL-4

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		<p>deployment views concerning the security at SWIM-TI level. Those views have be defined in the SWIM-TI TAD and then specified in terms of functional, non-functional and interface requirements in the Technical Specifications produced by the project. These requirements have been linked to this enabler and prototyped by other projects.</p> <p>Requirements concerning this enabler have been identified also as part of the coordination on risk assessment and statement of applicability of NIST security controls. NIST SP 800 53 gap analysis aim was to fill the gap between the Statement of Applicability of NIST SP 800 53 and SWIM-TI Technical Specifications.</p> <p>Applicable Technical Specifications:</p> <ul style="list-style-type: none"> - SWIM Yellow Profile (YP), Blue Profile (BP), and Purple Profile (PP) Information Security functions. - SWIM-TI Identity Management. <p>These specifications cover only the technical/SWIM-TI layer concerning this enabler.</p>		
SWIM-SUPT-03b	SWIM Supporting Security	<p>The project defined several requirements that have been allocated/traced to this enabler.</p> <p>The project contributed to functional, technical and deployment views concerning the security at SWIM-TI level. Those views have be defined in the SWIM-TI TAD and then specified in terms of functional, non-functional and interface requirements in the Technical Specifications produced by the project. These requirements have been linked to this enabler and prototyped by other projects.</p> <p>Requirements concerning this enabler have been identified also as part of the coordination</p>	TRL-1	TRL-4

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		<p>on risk assessment and statement of applicability of NIST security controls. NIST SP 800 53 gap analysis aim was to fill the gap between the Statement of Applicability of NIST SP 800 53 and SWIM-TI Technical Specifications.</p> <p>Applicable Technical Specifications:</p> <ul style="list-style-type: none"> - SWIM Yellow Profile (YP), Blue Profile (BP), and Purple Profile (PP) Information Security functions. - SWIM-TI Identity Management. <p>These specifications cover only the technical/SWIM-TI layer concerning this enabler.</p>		
SWIM-SUPT-03a	SWIM Supporting Security Provisions	<p>The project defined several requirements that have been allocated/traced to this enabler.</p> <p>The project contributed to functional, technical and deployment views concerning the security at SWIM-TI level. Those views have been defined in the SWIM-TI TAD and then specified in terms of functional, non-functional and interface requirements in the Technical Specifications produced by the project. These requirements have been linked to this enabler and prototyped by other projects.</p> <p>Requirements concerning this enabler have been identified also as part of the coordination on risk assessment and statement of applicability of NIST security controls. NIST SP 800 53 gap analysis aim was to fill the gap between the Statement of Applicability of NIST SP 800 53 and SWIM-TI Technical Specifications.</p> <p>Applicable Technical Specification:</p> <ul style="list-style-type: none"> - SWIM-TI Identity Management. 	TRL-1	TRL-4

		This specification covers only the technical/SWIM-TI layer concerning this enabler.		
GGSWIM-58c	SWIM registry in Step 3	<p>The project defined several requirements that have been allocated/traced to this enabler.</p> <p>The project contributed to functional, technical and deployment views concerning the Run-time Registry. Those views have be defined in the SWIM-TI TAD and then specified in terms of (initial) functional, non-functional and interface requirements in the Technical Specifications produced by the project. These requirements have been linked to this enabler and prototyped by other projects.</p> <p>Applicable Technical Specifications:</p> <ul style="list-style-type: none"> - SWIM-TI Run-Time Registry - Yellow Profile (YP) and Purple Profile (PP). <p>These specifications cover only the technical/SWIM-TI layer concerning this enabler.</p>	TRL-1	TRL-4
SWIM-SUPT-01a	SWIM Supporting Registry Provisions	<p>The project defined several requirements that have been allocated/traced to this enabler.</p> <p>The project contributed to functional, technical and deployment views concerning the Run-time Registry. Those views have be defined in the SWIM-TI TAD and then specified in terms of (initial) functional, non-functional and interface requirements in the Technical Specifications produced by the project. These requirements have been linked to this enabler and prototyped by other projects.</p> <p>Applicable Technical Specification:</p>	TRL-1	TRL-4

		<p>- SWIM-TI Run-Time Registry.</p> <p>This specification covers only the technical/SWIM-TI layer concerning this enabler.</p>		
SWIM-SUPT-01b	SWIM Supporting Registry	<p>The project defined several requirements that have been allocated/traced to this enabler.</p> <p>The project contributed to functional, technical and deployment views concerning the Run-time Registry. Those views have be defined in the SWIM-TI TAD and then specified in terms of (initial) functional, non-functional and interface requirements in the Technical Specifications produced by the project. These requirements have been linked to this enabler and prototyped by other projects.</p> <p>Applicable Technical Specifications:</p> <ul style="list-style-type: none"> - SWIM-TI Run-Time Registry - Yellow Profile (YP) and Purple Profile (PP). <p>These specifications cover only the technical/SWIM-TI layer concerning this enabler.</p>	TRL-1	TRL-4
GGSWIM-10c	SWIM Supervision for Step 3	<p>The project defined several requirements that have been allocated/traced to this enabler.</p> <p>The project contributed to functional, technical and deployment views concerning the SWIM Supervision and Security. Those views have be defined in the SWIM-TI TAD and then specified in terms of functional, non-functional and interface requirements in the Technical Specifications produced by the project. These requirements have been linked to this enabler and prototyped by other projects.</p> <p>Applicable Technical</p>	TRL-1	TRL-4

		<p>Specifications:</p> <ul style="list-style-type: none"> - Yellow Profile (YP) and Blue Profile (BP) Information Security and Supervision (only local supervision). <p>These specifications cover only the technical/SWIM-TI layer concerning this enabler.</p>		
SWIM-SUPT-06b	SWIM Supporting Supervision	<p>The project defined several requirements that have been allocated/traced to this enabler.</p> <p>The project contributed to functional, technical and deployment views concerning the SWIM Supervision. Those views have be defined in the SWIM-TI TAD and then specified in terms of functional, non-functional and interface requirements in the Technical Specifications produced by the project. These requirements have been linked to this enabler and prototyped by other projects.</p> <p>Applicable Technical Specifications:</p> <ul style="list-style-type: none"> - Yellow Profile (YP) and Blue Profile (BP) Information Security and Supervision. <p>(only local supervision)</p> <p>These specifications cover only the technical/SWIM-TI layer concerning this enabler.</p>	TRL-1	TRL-2
GGSWIM-51c	SWIM Ground-ground messaging services in Step 3	<p>The project defined several requirements that have been allocated/traced to this enabler.</p> <p>The project contributed to functional, technical and deployment views concerning Ground-ground messaging services. Those views have be defined in the SWIM-TI TAD and then specified in terms of functional, non-functional and interface requirements in the Technical Specifications produced by the project. These requirements have been linked to this enabler and prototyped</p>	TRL-1	TRL-6

		<p>by other projects.</p> <p>Applicable Technical Specifications:</p> <ul style="list-style-type: none"> - Yellow Profile (YP), Blue Profile (BP) and Purple Profile (PP) messaging. 		
SWIM-INFR-05a	General SWIM Services infrastructure Support and Connectivity	<p>The project defined several requirements that have been allocated/traced to this enabler.</p> <p>The project contributed to functional, technical and deployment views concerning Ground-ground messaging services. Those views have been defined in the SWIM-TI TAD and then specified in terms of functional, non-functional and interface requirements in the Technical Specifications produced by the project. These requirements have been linked to this enabler and prototyped by other projects.</p> <p>Applicable Technical Specifications:</p> <ul style="list-style-type: none"> - Yellow Profile (YP) and Blue Profile (BP) messaging. 	TRL-1	TRL-6
SWIM-INFR-05b	General SWIM Services infrastructure Support and Connectivity	<p>The project defined several requirements that have been allocated/traced to this enabler.</p> <p>The project contributed to functional, technical and deployment views concerning Ground-ground messaging services. Those views have been defined in the SWIM-TI TAD and then specified in terms of functional, non-functional and interface requirements in the Technical Specifications produced by the project. These requirements have been linked to this enabler and prototyped by other projects.</p> <p>Applicable Technical Specifications:</p> <ul style="list-style-type: none"> - Yellow Profile (YP). 	TRL-1	TRL-6

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		- Blue Profile (BP).		
SWIM-APS-05a	Provision and Consumption of Flight Object Sharing services for Step 1	<p>The project defined several requirements that have been allocated/traced to this enabler. These requirements have been prototyped by other projects.</p> <p>Applicable Technical Specification: - Blue Profile (BP) FDD profile part.</p> <p>This specification covers only the technical/SWIM-TI layer concerning this enabler.</p>	TRL-1	TRL-6
SWIM-APS-05b	Provision and Consumption of Flight Object Sharing services for Step 2	<p>The project defined several requirements that have been allocated/traced to this enabler. These requirements have been prototyped by other projects.</p> <p>Applicable Technical Specification: - Blue Profile (BP) FDD profile part.</p> <p>This specification covers only the technical/SWIM-TI layer concerning this enabler.</p>	TRL-1	TRL-6
ER APP ATC 160	ATC to ATC Flight Data Exchange Using The Flight Object	<p>The project defined several requirements that have been allocated/traced to this enabler. These requirements have been prototyped by other projects.</p> <p>Applicable Technical Specification: - Blue Profile (BP) FDD profile part.</p> <p>This specification covers only the technical/SWIM-TI layer concerning this enabler.</p>	TRL-1	TRL-6
SWIM-INFR-01a	High Criticality SWIM Services infrastructure Support and Connectivity	<p>The project defined several requirements that have been allocated/traced to this enabler. These requirements have been prototyped by other projects.</p> <p>Applicable Technical</p>	TRL-1	TRL-6

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		<p>Specification:</p> <ul style="list-style-type: none"> - Blue Profile (BP). <p>This specification covers only the technical/SWIM-TI layer concerning this enabler.</p>		
SWIM-INFR-01b	High Criticality SWIM Services infrastructure Support and Connectivity	<p>The project defined several requirements that have been allocated/traced to this enabler. These requirements have been prototyped by other projects.</p> <p>Applicable Technical Specification:</p> <ul style="list-style-type: none"> - Blue Profile (BP). <p>This specification covers only the technical/SWIM-TI layer concerning this enabler.</p>	TRL-1	TRL-6
A/C-57	Onboard migration from existing air-ground data link to air-ground SWIM for AIS/MET services	<p>The project specified several requirements that have been allocated/traced to this enabler. These requirements have been prototyped by other projects.</p> <p>Applicable Technical Specification:</p> <ul style="list-style-type: none"> - Purple Profile (PP). <p>This specification covers only the technical/SWIM-TI layer concerning this enabler.</p>	TRL-1	TRL-2
AGSWIM-34	New System AGDLGMS	<p>The project defined several requirements that have been allocated/traced to this enabler.</p> <p>Applicable Technical Specification:</p> <ul style="list-style-type: none"> - Purple Profile (PP). <p>This specification covers only the technical/SWIM-TI layer concerning this enabler.</p> <p>The term AGDLGMS is not part of the SWIM-TI TAD/TS. As documented in the TAD, the concept behind the AGDLGMS may be covered by the architecture and technical specification of the Purple</p>	TRL-1	TRL-2

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		Profile (that is mainly targeting A/G SWIM information exchange).		
AGSWIM-41	AGDLGMS in support to provide extended OTIS to the aircraft	<p>The project defined several requirements that have been allocated/traced to this enabler.</p> <p>Applicable Technical Specification: - Purple Profile (PP).</p> <p>This specification covers only the technical/SWIM-TI layer concerning this enabler.</p> <p>The term AGDLGMS is not part of the SWIM-TI TAD/TS. As documented in the TAD, the concept behind the AGDLGMS may be covered by the architecture and technical specification of the Purple Profile (that is mainly targeting A/G SWIM information exchange).</p>	TRL-1	TRL-2
AGSWIM-43	AGDLGMS in support to provide weather information to the aircraft	<p>The project defined several requirements that have been allocated/traced to this enabler.</p> <p>Applicable Technical Specification: - Purple Profile (PP).</p> <p>This specification covers only the technical/SWIM-TI layer concerning this enabler.</p> <p>The term AGDLGMS is not part of the SWIM-TI TAD/TS. As documented in the TAD, the concept behind the AGDLGMS may be covered by the architecture and technical specification of the Purple Profile (that is mainly targeting A/G SWIM information exchange).</p>	TRL-1	TRL-2
AGSWIM-44	Transmission by AGDLGMS of the airborne Weather information to the meteo system for weather model improvement	<p>The project defined several requirements that have been allocated/traced to this enabler.</p> <p>Applicable Technical Specification:</p>	TRL-1	TRL-2

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		<p>- Purple Profile (PP).</p> <p>This specification covers only the technical/SWIM-TI layer concerning this enabler.</p> <p>The term AGDLGMS is not part of the SWIM-TI TAD/TS. As documented in the TAD, the concept behind the AGDLGMS is however covered by the architecture and technical specification of the Purple Profile (that is mainly targeting A/G SWIM information exchange).</p>		
SWIM-INFR-06b	AIR/GROUND SWIM Services infrastructure Support and Connectivity	<p>The project defined several requirements that have been allocated/traced to this enabler. These requirements have been prototyped by other projects.</p> <p>Applicable Technical Specification:</p> <p>- Purple Profile (PP).</p> <p>This specification covers only the technical/SWIM-TI layer concerning this enabler.</p>	TRL-1	TRL-2

The Technical Specifications defined by the project have been implemented and used in the following SESAR solutions enabled by SWIM:

- #05: Extended Arrival Management (AMAN) horizon,
- #06: Controlled Time of Arrival (CTA) in Medium density / medium complexity environments,
- #17: Advanced Short ATFCM Measures (STAMs),
- #18: Calculated take-off time (CTOT) and target time of arrival (TTA),
- #19: Automated support for traffic complexity detection and resolution,
- #20: Initial collaborative network operations plan (NOP),
- #21: Airport operations plan (AOP) and its seamless integration with the network operations plan (NOP),
- #28: Initial ground-ground interoperability,
- #31: Variable profile military reserved areas and enhanced civil-military collaboration,
- #33: Free routing for flights both in cruise and vertically-evolving above a specified flight level in low-to-medium density airspace,
- #34: Digital integrated briefing,
- #35: Meteorological Information Exchange,
- #37: Extended flight plan,
- #52: Remote tower for two low-density aerodromes.

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P14.01.04 contributed also to different SESAR programme level transversal initiatives [7] starting from the conceptual SWIM definition (then adopted by ICAO) to the working method to be applied when identifying and designing ATM services (including technical design). Overall, thanks to these coordination activities, the consistency and coherency between artefacts produced by WP14 and those from others WPs have been incrementally improved over the programme.

1.2 Project achievements

P14.01.04 defined the Technical Specifications (TSs) for the infrastructure enabling the technical interoperability for ATM-specific services provisioning and consumption. The specifications have been defined in accordance with the SWIM-TI TAD [4] and especially applying the SWIM Profiles concept and principles [5].

These Technical Specifications cover some elements of the Pilot Common Project (PCP): SWIM infrastructure (including so called "common infrastructure components") and profiles. The defined infrastructure enables Aeronautical, Meteorological and Flight information exchanges as defined in the PCP. In particular, the Yellow Profile (TRL-6) and Blue Profile (TRL-5) technical specifications are part of the initial SWIM solution (PCP, sub-AF 5.2 SWIM Infrastructure and profiles).

Some parts of the Technical Specifications defined by the project are being industrialized in the context of the Deployment Manager whereas others (e.g. Purple Profile - TRL-2) will be further refined in the context of SESAR 2020.

Furthermore, parts of the specifications have been developed and used in global interoperability SWIM demonstrations including the Mini-Global II (MGII) that took place on 26th, 27th and 28th April 2016 in Embry-Riddle Aeronautical University (ERAU) NextGen testbed (Daytona Beach, Florida (USA)) and the SWIM Global Demo that took place on 8th and 9th June 2016 in ENAV's Prototype Systems Center Rome ACC.

1.3 Project Deliverables

The following table presents the relevant deliverables that have been produced by the project.

Reference	Title	Description
[8] D44-001	SWIM-TI Technical Specifications Catalogue	The SWIM-TI Technical Specifications Catalogue provides an overview of the available SWIM-TI Technical Specifications and it includes references to all the available Technical Specifications. It also includes references to applicable guidelines concerning requirements and the way the Technical Specifications are organized.
[9] D44-002	SWIM-TI Identity Management Technical Specification	The document is the SWIM-TI Technical Specification for the SWIM-TI Identity Management. It includes SWIM-TI functional, non-functional and interfaces requirements applicable to the Identity Management (STI and PKI).
[10] D44-003	SWIM-TI Run-Time Registry Technical Specification	The document is the SWIM-TI Technical Specification for the SWIM-TI Run-Time Registry. It includes applicable SWIM-TI functional, non-functional and interfaces requirements.
[11] D44-004	SWIM-TI Yellow Profile Technical Specification	The document is the SWIM Yellow Profile Technical Specification. It includes SWIM-TI functional, non-functional and interfaces requirements applicable to that profile.
[12] D44-005	SWIM-TI Blue Profile Technical Specification	The document is the SWIM Blue Profile Technical Specification. It includes SWIM-TI functional, non-functional and interfaces requirements applicable to that profile.
[13] D44-006	SWIM-TI Purple Profile Technical Specification	The document is the SWIM Purple Profile Technical Specification. It includes SWIM-TI functional, non-functional and interfaces requirements applicable to that profile.
[7] D30	Coordination Activities Report	The document is the report on coordination activities undertaken by P14.01.04 in the context of SESAR programme. The document describes main coordination areas and initiatives concerning internal to WP14 topics, others WPs and, in general, SESAR programme level transversal initiatives

The project produced several versions of the TSs. In the above table only the latest versions are provided (D44-*). The full list of TSs is provided in §2.

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1.4 Contribution to Standardisation

The project contributed to the SESAR SWIM definition adopted by ICAO: “SWIM consists of standards, infrastructure and governance enabling the management of ATM-related information and its exchange between qualified parties via interoperable services”. SWIM definition emphasizes the importance of standardisation at the different SWIM layers (SWIM-TI, Information, services) in order to ensure interoperability. The technical specifications produced by this project cover the technical interoperability and they represent input to applicable bodies in charge of the standardisation of the SWIM TI at regional and global levels.

The need of standardized SWIM-TI has been also triggered by the fact that the European Commission has started to engage in SWIM deployment through the Pilot Common Project (PCP) action. Yellow Profile and Blue Profile, specified by this project, have been recognized as key elements/enablers in the PCP.

The Blue Profile technical specification is the SESAR input to the EUROCAE WG-59 responsible for the maintenance (also according to SESAR activities) of the EUROCAE ED-133 (Flight Object Interoperability Specification) standard.

EUROCAE WG-104 (AMAN SWIM Service), as pilot project in standardization of services at EUROCAE level, is using specifications produced by this project to standardize the AMAN SWIM Service technical contract.

Hereafter is highlighted which technical specification produced by this project is recognized (at time of writing) as input for standardization activities included in the latest European ATM Standards Coordination Group (EASCG) rolling plan:

+ Domain: SWIM Technical Infrastructure and Profiles:

- Standardisation activity: TI Yellow Profile.
- Standardisation organisation: EUROCONTROL.
- Target date for standard publication: 2017.
- Status: Ongoing
- Applicable technical specifications: SWIM-TI Yellow Profile Technical Specification.

- Standardisation activity: TI Blue Profile.
- Standardisation organisation: EUROCONTROL.
- Target date for standard publication: 2020.
- Status: Planned.
- Applicable technical specifications: SWIM-TI Blue Profile Technical Specification.

+ Domain: Flight data exchanges:

- Standardisation activity: ED-133A.
- Standardisation organisation: EUROCAE.
- Target date for standard publication: 2020.
- Status: Planned.
- Applicable technical specifications: SWIM-TI Blue Profile Technical Specification.

+ Domain: Security:

- Standardisation activity: ATM information security EN 16495 (Version 2).

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- Standardisation organisation: CEN.
- Target date for standard publication: 2017.
- Status: Planned.
- Applicable technical specifications: SWIM-TI Identity Management Technical Specification.

- Standardisation activity: ATM information Cyber Security.
- Standardisation organisation: EUROCAE.
- Target date for standard publication: 2020.
- Status: Planned.
- Applicable technical specifications: SWIM-TI Identity Management Technical Specification.

Standardization activities at ICAO level may also use as input the specifications produced by this project. The technical layer of the information exchanges successfully demonstrated during the NextGen-SESAR SWIM Global demonstration, were all based on a sub-set of technical requirements included in the Yellow Profile and Identity Management technical specifications. This was true also for other joint interoperability demonstration between world regions, including Europe, Australia, United Arab Emirates, Mongolia and Brazil.

1.5 Project Conclusion and Recommendations

The project delivered valuable results enabling the realization of the SWIM concept together with all the linked benefits for the ATM community. The project has produced reference technical specifications of the SWIM-TI which are a valuable input for standardization activities and the reference input for concrete implementations.

In particular, the Yellow Profile (TRL-6) and Blue Profile (TRL-5) technical specifications are part of the initial SWIM solution (PCP, sub-AF 5.2 SWIM Infrastructure and profiles) and they have been handed over to the SESAR Deployment Programme ("Commission Implementing Regulation (EU) No 716/2014"). These specifications represent also a foundation for most of the SESAR 2020 IR and VLD projects.

Even if the relevance of provided artefacts has been recognized, there are still areas of improvement the project recommends to cover in further activities (standardization, R&D, etc.):

+ Heterogeneous maturity level: the different technical specifications and sub-parts of a given specification have heterogeneous maturity levels:

- Further R&D activities concerning:
 - The air-to-ground capabilities (Purple Profile TS).
 - The monitoring and SLA.
 - The policy-based approach (not just for information security).
 - The Run-time Registry.
 - Overall and layered Cyber Security.
- Further prototyping, verification and validations activities:

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- Not all the profile parts (especially for the Yellow Profile) have been prototyped, verified and validated.
- Not all the requirements have been prototyped, verified and validated (see requirement status of each requirement).
- The verification and validation of the PKIs solutions in a federated environment is not considered complete.
- Some requirements (and technologies) concerning the Security Token Infrastructure (STI) have not been prototyped (including identity federation).
- Verification and Validation of non-functional requirements is not complete.

+ Technical Specifications accessibility, consistency, coherency and completeness:

- accessibility: guidance for using, implementing and extending the TSs may be useful.
- completeness: because the maturity levels of the TSs is not homogenous, it is expected that they may be not complete (e.g. reference and standard based security profiles for PKI and/or STS based security solutions).
- consistency and coherency: the technical specifications include requirements of different type (functional, technical, etc.) and requirements at different level of abstraction (e.g. an high level requirement that is detailed in more than one technology specific requirements). The rules defined by the project to identify and document those relationships, have not been applied for all the requirements.

+ Process: the design process and supporting design artefacts (and the relationships among them) concerning the design of service oriented solutions should be improved. In SESAR1 the use of the design time Registry and the introduction of the Service Technical Design Description have been considered useful in improving the coherency and consistency of the designed services (including SWIM-TI elements). It is recommend to further refine and verify that process.

It is finally recommended that any further activity aiming at extending, refining and standardizing the SWIM-TI technical specifications is built on SESAR1 results in terms of available TSs (avoid to introduce new requirements already covered by SESAR1 TSs) and design principles and process. Even if the SWIM-TI ontology and SWIM Profiles may be further refined, it is recommended to avoid changes that may violate constitutive aspects/elements (e.g. avoid duplication of requirements among different SWIM Profiles, use the Profile-part concept, etc.)

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