



IMAGE

Interoperable Management of Aeronautical Generic Executive software

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D 2.4: Supervision, Administration and Security (SAS) requirements

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1. Introduction

1.1 Introduction: IMAGE project

IMAGE project aims at implementing a generic and universal environment in order to make complex, distributed and heterogeneous integrated simulators cooperate. IMAGE focuses on such themes as interoperability, modularity, flexibility, cost reduction, etc.

One of the main goals of the project is to create a generic environment allowing to facilitate the cooperation between different platforms federated in a same simulation.

1.2 Task WP 2.4

1.2.1 WP 2.4 Introduction

The purpose is to set up the detailed user's specifications w.r.t. the Supervision, Administration and Security components (SAS).

1.2.2 WP 2.4 scope

The sub-task will primarily focus on Supervision, Administration and Security. WP 2.4 sub-task should produce a first link with the future IMAGE System Requirements Document (SRD).

1.2.3 WP 2.4 background

Outputs of the earlier IMAGE sub-tasks that will be used as inputs, i.e.:

- WP 2.1: D2.1
- WP 2.2: D2.2
- WP 2.3: D2.3

The sub-task output will serve as input to the following IMAGE sub-tasks:

- WP 3.1

2 Security: Detailed user requirements

2.1 General

2.1.1 Introduction

A computer system can be subject to:

- *Unauthorized access to data*
- *Clandestine alteration of data*
- *Identity fraud*
- *Denial of service*

2.1.2 High Level Security Requirements

- **Confidentiality**
- **Authentication**
- **Availability**
- **Accountability**

2.2 IMAGE Security requirements

RTR.5.1.1 IMAGE must allow a safe run of multi-sites simulations in terms of access to the simulation (unauthorized hosts cannot join a simulation).

Access control

RTR.5.1.2 IMAGE must allow to safely run multi-sites simulations in terms of access to the simulation information.

Access control supports this requirement.

RTR.5.1.3 IMAGE must allow to safely run multi-sites simulations in terms of data exchange (unauthorized hosts cannot spy the exchanged data).

Information hiding: data is unintelligible to external parties.

RTR.5.1.4 IMAGE must handle the interaction between secured/unsecured networks. Using access control and information hiding enforces this requirement.

RTR.5.1.5 IMAGE must make sure that the exchanged information is not changed altered or modified without authorization.

Authentication and **non-repudiation mechanisms** verify the origin of data and prove that a certain user originated/received a message.

RTR.5.1.6 IMAGE must provide multi-user distributed simulation data propriety protection capabilities.

Access control makes only the required services available and **administration services** provide network statistics to detect unauthorized access attempts.

2.3 IMAGE Security services

2.3.1 Information Hiding

2.3.2 Authentication

2.3.3 Access Contro

2.3.4 Integrity check

2.3.5 Non-repudiation

2.3.6 Security administration

2.4 Security system requirements

IMAGE requirement	Is related to	Is considered by
<p>RTR.5.1.1 The IMAGE system must allow a safe run of multi-sites simulations in terms of access to the simulation (unauthorized hosts cannot join a simulation)</p> <p>R.5.1.1.a Only authorized users can join a simulation</p> <p>R.5.1.1.b Subjects' identity verification must be necessary to gain entry to the simulation</p> <p>R.5.1.1.c Subjects' authorization must be checked</p>	<p>Confidentiality</p> <p>Authentication</p> <p>Availability</p>	<p>Access control service</p> <p>Authentication service</p>
<p>RTR.5.1.2 The IMAGE system must allow safely the running of multi-sites simulations in terms of access to the simulation information (unauthorized hosts cannot access some information)</p>	<p>Confidentiality</p>	<p>Access control service</p>
<p>RTR.5.1.3 The IMAGE system must allow safely the running of multi-sites simulations in terms of data exchange (unauthorized hosts cannot spy on the exchanged data)</p>	<p>Confidentiality</p>	<p>Information Hiding service</p>
<p>RTR.5.1.4 The IMAGE system must handle the interaction between secured/unsecured networks.</p>	<p>Confidentiality</p>	<p>Access control service</p> <p>Information Hiding service</p>
<p>RTR.5.1.5 The IMAGE system must make sure that the exchanged information is not changed, altered or modified without authorization.</p>	<p>Integrity</p> <p>Authentication</p> <p>Accountability</p>	<p>Access control service</p> <p>Non-repudiation service</p> <p>Authentication service</p> <p>Integrity check service</p>
<p>RTR.5.1.6 The IMAGE system must provide multi-user distributed simulation data propriety protection capabilities.</p>	<p>Confidentiality</p> <p>Accountability</p>	<p>Access control service</p> <p>Administration service</p>

2.5 Security enabling technology

2.5.1 Cryptography

2.5.2 Certificates

2.5.3 Access control mechanisms

2.5.4 Virtual Private Networks (VPN)

2.5.5 Internet Protocol Security (IPSEC)

2.5.6 Secure Channels

2.5.7 Firewalls

3 Administration

3.1 Introduction

3.1.1 General

Reusability

Compatibility

Portability

Independence

Flexibility

Fault tolerance

Modularity

Separability

Distributability

Interoperability

Vertical scaling

Web-ready

Manageability

3.1.2 High level administration requirements

3.1.2.1 Time management

3.1.2.2 Scenario management

3.1.2.3 Data management (access + generation + quality)

3.1.2.4 Distributed resource management

3.1.2.5 Configuration management

3.1.2.6 Communication management

3.1.2.7 Memory management

3.1.2.8 Load Balancing

3.2 IMAGE Administration requirements

RTR_1_3 IMAGE must allow incompatible simulations to cooperate.

RTR_1_4 IMAGE must allow similar simulators to cooperate.

RTR_1_5 IMAGE must handle time constraints for modules handling different times by supervision.

RTR_2_1 IMAGE must handle simulators or simulation running on different Operating systems, platforms, network protocols, etc.

RTR_3_1 IMAGE must be generic with regards to numerous types of applications.

RTR_3_1_1 IMAGE must allow the use of existing simulators or simulation applications by encapsulating them.

RTR_3_1_2 IMAGE must allow the use of simulation modules designed for IMAGE for other applications.

RTR_3_2_1 IMAGE must allow any module matching the IMAGE format to join or leave a simulation during the run and being aware of all the other participants.

RTR_3_2_2 IMAGE must allow any module matching the IMAGE format joining a simulation to be able to detect dynamically the available services and participants.

RTR_3_2_5 IMAGE must allow the modules to run without being part of a simulation.

- RTR_3_2_6 IMAGE must allow modules to run independently and exploit each other's data.
- RTR_3_3_2 IMAGE must ensure the compatibility of the different user profiles of a distributed simulation.
- RTR_5_1_1 IMAGE must allow a safe run of multi-sites simulations in terms of access to the simulation (unauthorized hosts can not join a simulation).
- RTR_5_1_2 IMAGE must allow a safe running of multi-sites simulations in terms of access to the simulation information.
- RTR_5_1_3 IMAGE must allow safe running of multi-sites simulations in terms of data exchange.
- RTR_5_1_5 IMAGE must make sure that the exchanged information are not changed, altered or modified without authorization.
- RTR_5_3_4 IMAGE must detect if a connecting participant has a sufficient power and so will not degrade the performance of the networked simulation.
- RTR_6_1_1 IMAGE must integrate more efficiently in the simulation the learning supports associated to the different modules.
- RTR_6_1_2 IMAGE must reinforce the guidelines for the experimentation supports of the simulation.
- RTR_6_1_3 IMAGE must improve the experimental framework (duration of the experimentation execution, number of replications needed, etc.).
- RTR_6_1_4 IMAGE must provide simulation analysis tools.
- RTR_6_1_5 IMAGE must provide learning and training support.
- RTR_6_2_1 IMAGE must allow simulation services management.
- RTR_6_2_2 IMAGE must provide off-line simulation resource management.
- RTR_6_2_3 IMAGE must be easily maintainable.
- RTR_6_2_4 IMAGE must store relevant data and provide tools to replay or redisplay a simulation.
- RTR_6_2_5 IMAGE should provide debugging facilities.
- RTR_6_2_6 IMAGE must enable data management in distributed simulation environment.
- RTR_6_2_7 IMAGE must provide implementation constraints management capabilities.

- RTR_6_2_8 IMAGE must allow distributed and heterogeneous simulations interfaces management.
- RTR_6_2_9 IMAGE must provide consolidated statistical facilities.
- RTR_6_2_10 IMAGE must ensure distributed cross-referencing capabilities.
- NSR_02_1 Allow heterogeneous simulations to co-operate.
- NSR_05_2 Allow any module matching the IMAGE format to join or leave a simulation during the run and being aware of all the other participants.
- NSR_05_3 Be able to detect dynamically the available services.
- NSR_05_7 Allow the modules to run without being part of a simulation.
- NSR_05_8 Allow modules to run sequentially and exploit each other's data.
- NSR_08_2 Provide testing and controlling tools to test and control modules and whole simulation behaviour.
- NSR_09_3 Be able to follow part or all the simulation, to access data without perturbing the simulation.
- NSR_10_1 Decrease existing lack of difficulty of learning packages associated to simulations and simulator environment. There is a need to implement user-friendly interfaces and online help modules for several modules.
- NSR_10_2 Enhance guidance for simulation experimentation support. There is a need to provide online help documentation with examples of the modules and simulations and perhaps a small wizard to start the simulations.
- NSR_10_3 Allow for better experimental design support.
- NSR_10_4 Improve of the simulation environment output design analysis facilities.
- NSR_11_1 Enable data management in distributed simulation environment.
- NSR_11_2 Provide off-line simulation resource management.
- NSR_11_3 Provide implementation constrains management capabilities.
- NSR_11_4 Allow simulation services management.
- NSR_11_5 Allow distributed and heterogeneous simulations interfaces management.
- NSR_11_6 Provide consolidated statistical facilities.
- NSR_11_7 Ensure distributed cross-referencing capabilities.

NSR_12_1 Ensure that the simulation environment can be configured to correspond to the users' needs.

NSR_12_2 Build simulation environment from library of distributed simulation systems to extract ready-built components of simulation.

NSR_13_1 Provide facilities for compatibility of various simulation packages used.

3.3 IMAGE administration services

3.3.1 Federation management services

3.3.2 Declaration management services

3.3.3 Object management services

3.3.4 Ownership management services

3.3.5 Time management services

3.3.6 Time advancement services

3.3.7 Data distribution services

3.3.8 Transportation services

3.3.9 Configuration management services

3.3.10 Configuration maintenance services

3.4 Administration system requirements

IMAGE requirement	Is related to	Is considered by
RTR_1_3	Interoperability Compatibility	Federation management Declaration management Object management Data distribution
RTR_1_4	Interoperability Compatibility	Federation management Declaration management Object management Data distribution
RTR_1_5	Interoperability Compatibility Time management	Time management Time advancement
RTR_2_1	Interoperability	Federation management

	Compatibility Modularity Flexibility	Declaration management Object management Ownership management Time management Data distribution Transportation
RTR_3_1	Reusability Flexibility	Object management
RTR_3_1_1	Reusability Modularity Inheritance	Declaration management Object management Data distribution
RTR_3_1_2	Reusability Modularity Portability Separability	Declaration management Object management Data distribution
RTR_3_2_1	Separability Interoperability	Federation management Declaration management Object management Ownership management Data distribution
RTR_3_2_2	Separability Interoperability	Federation management Declaration management Object management Ownership management Data distribution
RTR_3_2_5	Interoperability Compatibility Independence	Declaration management Object management Data distribution Transportation
RTR_3_2_6	Interoperability Compatibility	Federation management Declaration management Object management Ownership management Data distribution
RTR_3_3_2	Interoperability Compatibility	Federation management Declaration management Object management Data distribution
RTR_5_1_1	Data management	Federation management Declaration management Object management Ownership management Data distribution Transportation
RTR_5_1_2	Data management	Federation management Declaration management Object management Ownership management Data distribution

		Transportation
RTR_5_1_3	Data management	Federation management Declaration management Object management Ownership management Data distribution Transportation
RTR_5_1_5	Data management	Federation management Declaration management Object management Ownership management Data distribution Transportation
RTR_5_3_4	Interoperability Compatibility Data management	Federation management Declaration management Object management Ownership management Data distribution Transportation
RTR_6_1_1	Manageability Scenario management Data management	Federation management Declaration management Object management Data distribution
RTR_6_1_2	Manageability Scenario management Data management	Federation management Declaration management Object management Data distribution
RTR_6_1_3	Manageability Scenario management Data management	Federation management Declaration management Object management Data distribution
RTR_6_1_4	Scenario management Data management	Federation management Declaration management Object management Data distribution
RTR_6_1_5	Manageability Scenario management Data management	Federation management Declaration management Object management Data distribution
RTR_6_2_1	Manageability	Federation management Declaration management Object management Ownership management Time management Data distribution Transportation
RTR_6_2_2	Manageability Scenario management Data management	Declaration management Data distribution

RTR_6_2_3	Manageability Scenario management Data management	Declaration management Data distribution Configuration management Configuration maintenance
RTR_6_2_4	Scenario management Data management	Declaration management Data distribution
RTR_6_2_5	Scenario management Data management	Declaration management Data distribution
RTR_6_2_6	Interoperability Compatibility Distributability Scenario management Data management	Declaration management Data distribution
RTR_6_2_7	Distributability Configuration management Scenario management Data management	Declaration management Data distribution Configuration management
RTR_6_2_8	Distributability Interoperability Configuration management Scenario management Data management	Declaration management Data distribution Transportation Configuration management
RTR_6_2_9	Scenario management Data management	Declaration management Data distribution
RTR_6_2_10	Interoperability Distributability	Declaration management Data distribution Transportation
NSR_02_1	Interoperability Compatibility Modularity Flexibility	Federation management Declaration management Object management Ownership management Time management Data distribution Transportation
NSR_05_2	Flexibility Distributed resource management	Declaration management Object management Data distribution
NSR_05_3	Flexibility Distributed resource management	Declaration management Ownership management Time management Transportation Configuration management
NSR_05_7	Interoperability Compatibility Independence	Declaration management Object management Data distribution Transportation
NSR_05_8	Interoperability Compatibility Data management	Federation management Declaration management Object management

	Scenario management	Ownership management Data distribution
NSR_08_2	Configuration management Data management Scenario management	Declaration management Time management Time advancement Data distribution Transportation Configuration management Configuration maintenance
NSR_09_3	Configuration management Data management Scenario management	Declaration management Time management Data distribution Transportation Configuration management Configuration maintenance
NSR_10_1	Data management Scenario management	Federation management Declaration management Object management Data distribution
NSR_10_2	Data management Scenario management	Federation management Declaration management Object management Data distribution
NSR_10_3	Data management Scenario management	Federation management Declaration management Object management Data distribution
NSR_10_4	Data management Scenario management	Federation management Declaration management Object management Data distribution
NSR_11_1	Interoperability Compatibility Distributability Scenario management Data management	Declaration management Data distribution
NSR_11_2	Manageability Scenario management Data management	Declaration management Data distribution
NSR_11_3	Distributability Configuration management Scenario management Data management	Declaration management Data distribution Configuration management
NSR_11_4	Manageability Data management	Federation management Declaration management Object management Ownership management Time management Data distribution

		Transportation
NSR_11_5	Distributability Interoperability Configuration management Scenario management Data management	Declaration management Data distribution Transportation Configuration management
NSR_11_6	Scenario management Data management	Declaration management Data distribution
NSR_11_7	Interoperability Distributability	Declaration management Data distribution Declaration management Data distribution
NSR_12_1	Configuration management	Declaration management Object management Configuration management
NSR_12_2	Compatibility Interoperability Data management Configuration management	Declaration management Object management Data distribution Configuration management
NSR_13_1	Compatibility Interoperability Data management Configuration management	Declaration management Object management Data distribution Configuration management

3.5 Administration enabling technology

3.5.1 Agents

3.5.2 Determining Routing Paths

3.5.3 Event Time Management

3.5.4 Event Communication

3.5.5 Memory management

3.5.6 Persistent Virtual Worlds

3.5.7 Virtual Verisimilitude

3.5.8 Application Service Provision (ASP)

3.5.9 Web based simulation centres (WBSC)

3.5.10 GRIDS

- Building the application frameworks that allow discipline scientists to express and manage the simulation, analysis, and data management aspects of overall problem solving
- Providing a uniform look and feel to a wide variety of distributed computing and data resources
- Supporting construction, management, and use of widely distributed application systems
- Facilitating human collaboration through common security services, and resource and data sharing
- Providing remote access to, and operation of, scientific and engineering instrumentation systems
- Managing and securing this computing and data infrastructure as a persistent service

<p align="center">Discipline Portals / Frameworks (problem expression; user state management; collaboration services; workflow engines; fault management)</p>
<p align="center">Applications and Utility Services (domain specific and general components)</p>
<p align="center">Language Specific APIs (Python, Perl, C, C++, Java)</p>
<p align="center">Grid Collective Services (resource brokering; resource co-allocation; data cataloguing, publishing, subscribing, and location management; collective I/O, job management)</p>
<p align="center">Core Grid Functions (resource discovery; resource access; authentication and security; event publish and subscribe; monitoring / events)</p>
<p align="center">Communication Services</p>
<p align="center">Security Services</p>
<p align="center">Resource Managers (export resource capabilities to the Grid, handle execution environment establishment, hosting, etc., for compute resources)</p>
<p align="center">Physical Resources (computers, data storage systems, scientific instruments, etc.)</p>

4 Supervision

4.1 Introduction

Solutions mainly focus on the supervision of low levels of a distributed system.

4.1.1 General

Human interfacing

Simplicity:

Genericity:

Entity Life cyclin

Entity discovering

System Safety

Load balancing

Reliability

Robustness

4.2 IMAGE Supervision requirements

- RTR_1_3 IMAGE must allow incompatible simulations to cooperate.
IMAGE must provide facilities to make simulations compatible.
- RTR_1_5 IMAGE must handle time constraints by supervision.
- RTR_1_6 IMAGE must remain coherent: all participants should be aware of each other's action on objects concerning them.
- RTR_2_4 IMAGE must be able to be simply used by "heterogeneous users".
- RTR_3_1 IMAGE has to be generic with regards to numerous types of applications.
- RTR_3_1_1 IMAGE must allow to use existing simulators or simulation applications by encapsulating them.
- RTR_3_1_2 IMAGE must allow the use of simulation modules designed for IMAGE for other applications.
- RTR_3_2_1 IMAGE must allow module matching the IMAGE format to join or leave a simulation during the run and being aware of all the other participants.
- RTR_3_2_3 IMAGE must be able to run several simulations
- RTR_3_2_6 IMAGE must allow modules to run independently and exploit each other's data.
- RTR_3_2_7 IMAGE must allow a simulation to stop/restart.
- RTR_4_2 IMAGE must handle important data flows.

- RTR_4_4 IMAGE must be able to exchange data on LAN, WAN or on the Internet.
- RTR_4_5 IMAGE supervision module should be able to cast data only to the module interested
- RTR_5_2_2 IMAGE must provide testing and controlling tools to test and control modules and whole simulation behaviour.
- RTR_5_2_3 The interaction between real world and simulation must be particularly safe.
- RTR_5_3_1 IMAGE must detect and handle errors (handled by the supervision part).
- RTR_5_3_2 IMAGE must go on running even if a simulation module goes off (handled by the supervision part): being able to restart a module that went off.
- RTR_5_3_3 IMAGE must be able to follow part or all the simulation, to access data without perturbing the simulation.
- RTR_6_3_1 IMAGE must be able to configure the simulation with regards to the user needs as simply as possible.
- RTR_6_3_2 IMAGE must be able to record/load a configuration.
- RTR_6_3_3 The IMAGE system must build a hosting structure for a distributed simulation from a library of systemic and reusable components.
- RTR_6_3_4 IMAGE must allow the user to build simulation clusters.

4.3 IMAGE supervision services

4.3.1 Image users

4.3.2 Human interface

4.3.3 Middleware

4.3.4 Event Service

4.3.5 Publish and Subscribe service

4.3.6 Scheduler service

4.3.7 Simulation Federate service

4.3.8 Simulation Time service

4.3.9 Simulation State service

4.3.10 Simulation Recording and Replay service

4.3.11 Simulation service management

4.3.12 Application management

4.3.12.1 Assembling and Deploying simulation component

4.3.13 Simulation controlling tools

4.3.14 Simulation testing tools

4.3.15 Clustering

4.3.16 Load balancing

Fault Tolerance

4.3.17 Network protocols

4.4 Supervision system requirements

IMAGE requirement	Is related to	Is considered by
RTR_1_3	Interoperability Compatibility	Middleware Event Service Publish and Subscribe service Scheduler service

IMAGE requirement	Is related to	Is considered by
RTR_1_5	Interoperability Compatibility Time management	Simulation Time service
RTR_1_6	Interoperability Compatibility Data management	Publish and Subscribe service
RTR_2_4	Simplicity Human interfacing	Image users Human interfacing
RTR_3_1	Genericity Reusability Flexibility	Middleware
RTR_3_1_1	Reusability Modularity Inheritance	Middleware
RTR_3_1_2	Reusability Modularity Portability Genericity	Middleware
RTR_3_2_1	Entity life cycling Entity discovering	Simulation Federate service
RTR_3_2_3	Configurability	Simulation State service
RTR_3_2_6	Interoperability Modularity Compatibility Data management	Simulation State service Publish and Subscribe service
RTR_3_2_7	Time management	Simulation State service
RTR_4_2	Data management Network management	Publish and Subscribe service Network protocols
RTR_4_4	Flexibility Network management	Network protocols
RTR_4_5	Data management Network management	Network protocols Publish and Subscribe service
RTR_5_2_2	Safety Manageability	Simulation testing tools
RTR_5_2_3	Safety Reliability	Middleware
RTR_5_3_1	Robustness Reliability	Simulation service management Error handling
RTR_5_3_2	Robustness Modularity Reliability	Simulation service management Fault Tolerance
RTR_5_3_3	Interoperability Compatibility Data management	Publish and Subscribe service

IMAGE requirement	Is related to	Is considered by
RTR_6_3_1	Configuration management Human interfacing	Image users Human interfacing
RTR_6_3_2	Configuration management	Simulation Recording and Replay service
RTR_6_3_3	Genericity, Reusability	Middleware
RTR_6_3_4	Interoperability Modularity Flexibility.	Clustering Load balancing

4.5 Supervision enabling technology

4.5.1 GenesSys