PaaSage

Model Based Cloud Platform Upperware

Deliverable D6.2.1

Components, user scripts and component tests

Version: 1.1

PROJECT DELIVERABLE

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Project	
Grant Agreement number	317715
Project acronym:	PaaSage
Project title:	Model Based Cloud Platform Upperware
Funding Scheme:	Integrated Project
Date of latest version of Annex I against which the assessment will be made:	3rd July 2014
Document	
Period covered:	M6-24
Deliverable number:	D6.2.1
Deliverable title	Components, user scripts and component tests
Contractual Date of Delivery:	30/09/2014
Actual Date of Delivery:	03/10/2014
Editor (s):	Michaël Van de Borne (CETIC)
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Participant(s):	CETIC
Work package no.:	WP6
Work package title:	Requirements, integration and testing
Work package leader:	Stéphane Mouton (CETIC)
Distribution:	PU
Version/Revision:	1.1
Draft/Final:	Final
Total number of pages (including cover):	60

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PaaSage is a project funded in part by the European Union.

History

Date	Version	Author	Description
23/09/2014	0.1	M. Van de Borne	Initial version
25/09/2014	0.2	S. Mouton	Internal (CETIC) deliverable review
03/10/2014	1.0	M. Van de Borne & E. Charlier	Final version for review
03/10/2014	1.1	M. Van de Borne & E. Charlier	Changes due to reviewers comments

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1. Introduction

The original goal of this deliverable was to describe the PaaSage platform components and integration tests according to the Initial Requirements (D6.1.1). However, considering the PaaSage platform scope was less apprehended at the time D6.1.1 has been written, the related Initial Requirements were not detailed enough to establish test cases out of them.

It has then been decided to base the test cases in the current document (due for month 24) on the Final Requirements deliverable (D6.1.2), also due for month 24. Nevertheless, it is natural that the PaaSage platform development comes after the requirements definition. That explains why the current feature set of the PaaSage platform does not yet allow a successful execution of the use cases tests (hence the 'did not run' status).

Chapter 2 describes the continuous integration platform implemented by Task 6.2 to automate components building, deployment and testing.

Chapter 3 introduces the PaaSage components and gives an overview of the platform architecture.

The main part of the document stands in chapter 4, and describes the test cases.

2. Continuous Integration Platform (CIP)

The PaaSage Continuous Integration Platform is the basis for improving the platform continuously by integrating contributions from the whole community. Therefore, focus was on the deployment automation of the PaaSage platform; so that it is as easy as possible for a newcomer to get it running. The PaaSage CIP is made out of several software components.

Source code hosting

PaaSage developers push their component source code, together with their respective build scripts, in a Git[1] repository (http://git.cetic.be), temporarily located in the CETIC data centre (will soon be moved to OW2 public repository).

Build automation tools

PaaSage components are developed in various programing languages. Thus, several build automation tools are used:

- Maven[2] – for Java code
- SBT[3] – for Scala code
- Leiningen[4] – for Clojure code
- CMake[5] – for C++ code

Once the source code (i.e. in Java) and its build scripts (i.e. in Maven) are available, the component is ready to build.

Source code building

The building phase is automated thanks to a Jenkins[6] server, connected to the Git repo. Jenkins continuously monitors the Git repository and triggers an automated build every time a new commit is detected. It outputs one package (i.e. jar file) per component, ready to be installed in the PaaSage platform.

Automatic configuration

Next, multiple Chef[7] cookbooks and recipes have been developed in order to automate the installation and configuration of all the packages.

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1   Git is a distributed revision control and source code management system: http://git-scm.com/

2   http://maven.apache.org/

3   http://www.scala-sbt.org/

4   http://leiningen.org/#docs

5   http://www.cmake.org/

6   Jenkins is a continuous integration tool: http://jenkins-ci.org/

7   Chef is a configuration management tool: http://www.getchef.com/

Automatic deployment

An additional tool, named Test Kitchen[8], a layer on top of Chef, takes care of the PaaSage platform VMs provisioning and triggers the Chef cookbooks installation (see Figure 1).
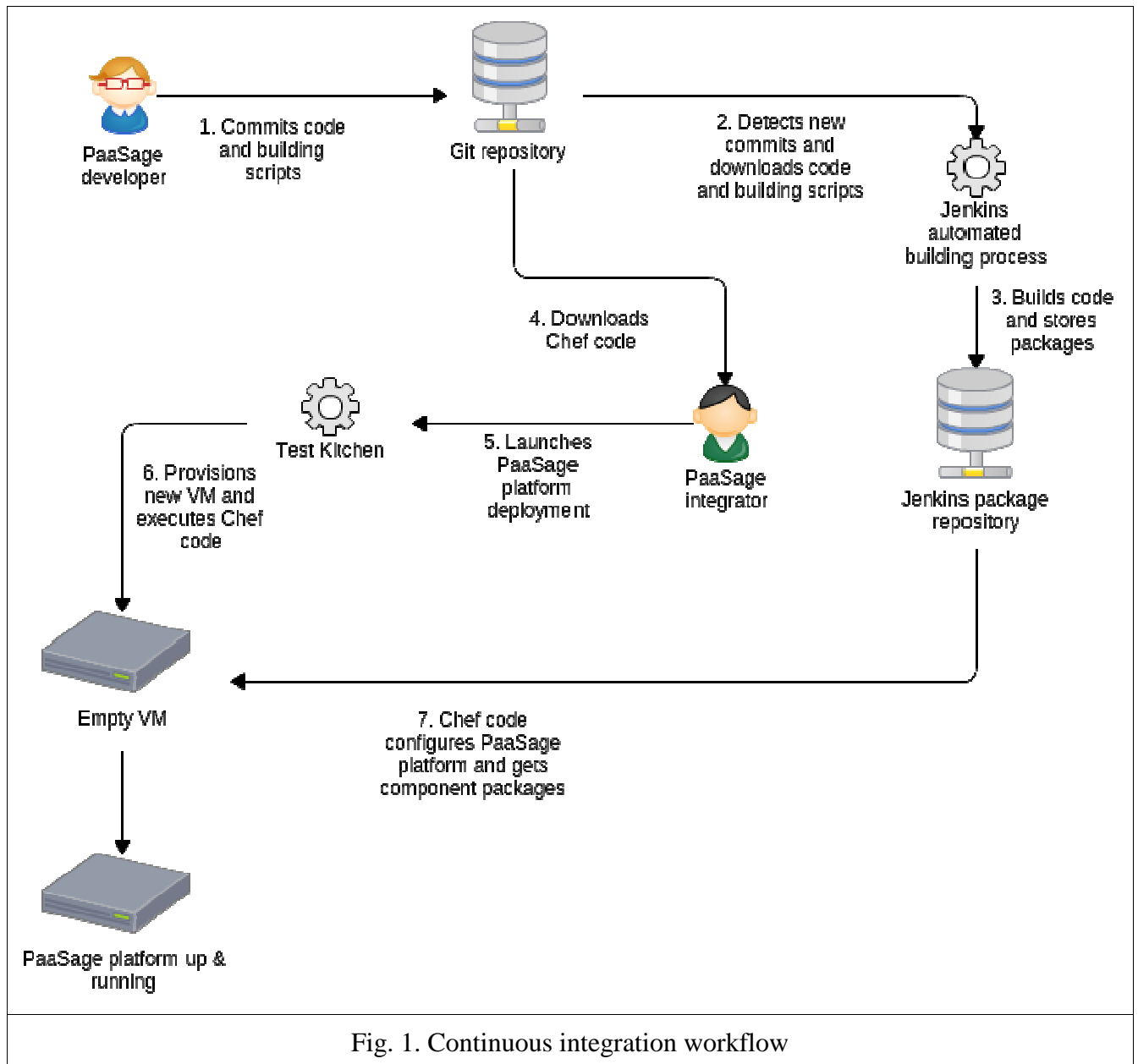
Fig. 1. Continuous integration workflow

Thanks to this continuous integration procedure, the fully automated deployment of a fresh PaaSage platform, including the latest version of all components requires minimal effort and takes less than 10 minutes; whereas the same procedure would take one working day if performed manually. This automation greatly eases and accelerates integration testing, thereby accelerating developers' work.

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8   Test Kitchen (or simply Kitchen) is an integration tool for developing and testing infrastructure code and software on insolated target platforms: http://kitchen.ci/

The practical instructions, along with the command lines, on how to set up and use the PaaSage platform can be found in the deliverable Open Source Prototype System 1 (D8.2.1).

3. Components overview

As other deliverables[9] already have described PaaSage components in details, this document won't overlap with those. Instead, an architectural overview of the integrated components is shown in Figure 2 below. In this figure, solid border boxes are individual software components of the PaaSage platform, whereas dotted border boxes are component groups implementing higher-level functionalities (e.g. the Reasoner mathematically solves deployment parameters to elect the best deployment scheme according to requirements and constraints; and the Executionware handles the application deployment model and triggers the actual deployment into cloud providers' infrastructure).

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9   Deliverables Prototype Upperware (D3.1.1), Prototype Database and social network system (D4.1.1) and Prototype Executionware (D5.1.1)
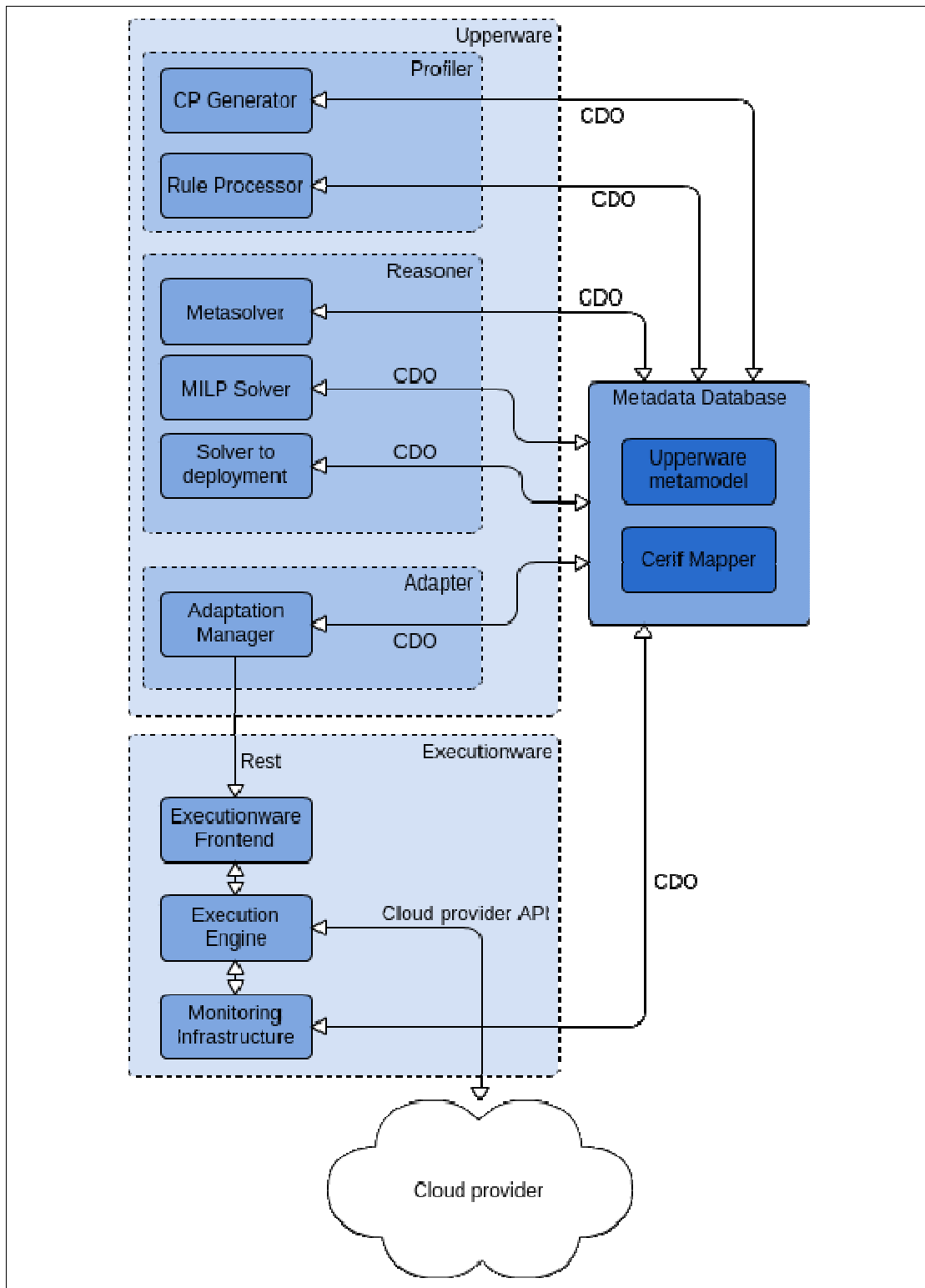
Fig.2. PaaSage platform architecture

As it is seen in Figure 1, most components of the workflow don't communicate with others. They instead embed the Metadata Database (MDDB) client, using the

Connected Data Object (CDO[10]) protocol. They get their input from and store their output into the MDDB.

For a typical PaaSage run (model processing and application deployment), a "masterscript" chains the execution of each component in the correct sequence. The usage of this masterscript is documented in the Open Source Prototype System 1 deliverable (D8.2.1)

3.1.   Components description

The following tables capture generic information about all platform components from Figure 2.

Rem.: Please note that the URLs to components code and documentation is temporary, as they will soon be moved to a public hosting infrastructure (OW2).

CP Generator	
Code repository	http://git.cetic.be/paasage/wp3_profiler/tree/master/paasage-wp3-profiler/wp3-cp-generator
Programming language	Java
Interface	CDO protocol with MDDB
Owning organization	INRIA Lille
Code documentation	http://jenkins.paasage.cetic.be/job/WP3_PROFILER_JAR/Javadocs
License	Mozilla Public License[11]
Reference	PaaSage Deliverable 3.1.1

Rule Processor	
Code repository	http://git.cetic.be/paasage/wp3_profiler/tree/master/rule_processor
Programming language	Java
Interface	CDO protocol with MDDB

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10   http://www.eclipse.org/cdo/documentation/

11   https://www.mozilla.org/MPL/

Owning organization	STFC
Code documentation	http://jenkins.paasage.cetic.be/job/WP3_PROFILER_JAR/Javadocs
License	Mozilla Public License
Reference	PaaSage Deliverable 3.1.1

Upperware metamodel

Code repository	http://git.cetic.be/paasage/wp3_model
Programming language	Java
Interface	None
Owning organization	INRIA Lille
Code documentation	http://jenkins.paasage.cetic.be/job/WP3_MODEL/Javadoc
License	Mozilla Public License
Reference	PaaSage Deliverable 3.1.

Metasolver

Code repository	http://git.cetic.be/paasage/metasolver
Programming language	Java
Interface	CDO protocol with MDDB
Owning organization	STFC
Code documentation	http://jenkins.paasage.cetic.be/job/WP3_META_SOLVER/Javadoc
License	Mozilla Public License
Reference	PaaSage Deliverable 3.1.1

MILP Solver

Code repository	http://git.cetic.be/paasage/milp-solver
Programming language	Scala
Interface	CDO protocol with MDDB
Owning organization	AGH University of Science and Technology
Code documentation	http://jenkins.paasage.cetic.be/job/WP3_MILP_SOLVER/Javadoc
License	Mozilla Public License
Reference	PaaSage Deliverable 3.1.1

Solver to deplotment	
Code repository	http://git.cetic.be/paasage/solver-to-deployment
Programming language	Java
Interface	CDO protocol with MDDB
Owning organization	INRIA
Code documentation	http://jenkins.paasage.cetic.be/job/WP3_SOLVER_TO_DEPLOYMENT/Javadoc
License	Mozilla Public License
Reference	PaaSage Deliverable 3.1.1

Adaptation manager	
Code repository	http://git.cetic.be/paasage/adaptation-manager
Programming language	Java
Interfaces	• CDO protocol with MDDB • REST client of Executionware frontend
Owning organization	INRIA
Code documentation	http://jenkins.paasage.cetic.be/job/WP3_ADAPTATION_M

	ANAGER/Javadoc
License	Mozilla Public License
Reference	PaaSage Deliverable 3.1.1

Metadata Database	
Code repository	http://git.cetic.be/paasage/cdo-server
Programming language	Java
Interface	- Server for CDO protocol - MySQL client
Owning organization	ICS FORTH
Code documentation	http://jenkins.paasage.cetic.be/job/WP4_CDO_SERVER/Javadoc
License	Mozilla Public License
Reference	PaaSage Deliverable 4.1.1

Cerif Mapper	
Code repository	http://git.cetic.be/paasage/wp4-cerif-mddb-plugin
Programming language	Clojure
Interface	None
Owning organization	AGH University of Science and Technology
Code documentation	http://jenkins.paasage.cetic.be/job/WP4-CERIF-MDDB-PLUGIN/Code_docs
License	Mozilla Public License
Reference	PaaSage Deliverable 4.1.1

Execution Engine	

Code repository	https://github.com/dbaur/cloudify/tree/2.7.0_paasage
Programming language	Java
Interface	Embedded in Executionware frontend
Owning organization	Ulm University
Code documentation	http://getcloudify.org/
License	Mozilla Public License
Reference	PaaSage Deliverable 5.1.1

Executionware frontend	
Code repository	http://git.cetic.be/paasage/execwarefrontend
Programming language	Java
Interface	- RESTful API - MySQL client
Owning organization	Ulm University
Code documentation	http://jenkins.paasage.cetic.be/job/WP5_EXECWARE_FRONTEND_PLAY/Javadocs
License	Mozilla Public License
Reference	PaaSage Deliverable 5.1.1

Monitoring Infrastructure	
Code repository	http://git.cetic.be/paasage/metrics-wrapper
Programming language	Java
Interface	CDO protocol with MDDB
Owning organization	ICS FORTH
Code documentation	http://jenkins.paasage.cetic.be/job/WP5_METRICS_WRAPPER/Javadoc

License	Mozilla Public License
Reference	PaaSage Deliverable 5.1.1

4. Test cases

This section describes the integration tests that have been, are, and will be performed on the PaaSage platform in order to validate its capabilities.

This chapter is split in three parts. The first one describes the test case template used in the rest of the document.

The next one illustrates the behaviour of each PaaSage component individually, whereas the third part is meant to test the functional requirements set from the use cases.

4.1. Test case template

The following template is used in order to describe each test consistently.

Test ID	Identification of the test case
Scenario ID	Scenario identification covered by this test
Initial conditions	State of the system in order to perform this test
Stimulus	The event or condition that triggers the expected behaviour of the platform
Response	The expected behaviour
Steps	The instructions to perform this test.
Success criterium	How to assess the failure of success of the test
Status	Possible values: Success, Failure, Did not run

4.2. Integration tests

Due to the sequential nature of a PaaSage run (e.g.: model processing, then application deployment ...), each test must be executed sequentially. Each test execution depends on the success of the previous one.

The Scalarm application (Scalarm.xmi model) is used as an example input to test the PaaSage platform components. This application is described in the Final Requirements deliverable (D6.1.2).

There is no automatic failure or success detection. A manual inspection of the MDDB content must be done to assert the test failure or success.

Test ID	INTEG-STEP-1
Scenario ID	INTEG-SCALARM
Initial conditions	- Scalarm model available in Jenkins - PaaSage Platform deployed (See 4.4)
Stimulus	N/A
Response	Meta models are loaded into the CDO server

Steps	- Bring system to initial conditions - Log into the PaaSage VM - Download the model from Jenkins `wget –output-document =$MODEL_FULL_FILE_NAME $MODEL_URL` - Run the init-cdo-server jar `pushd $BASE_DIR/init-cdo-server/app`
	`    java -jar init-cdo-server.jar $MODEL_FULL_FILE_NAME  $RESOURCE_NAME`
	`popd`

Success criterium	CDO server loaded with meta models, application model and cloud providers models
Status	SUCCESS

Test ID	INTEG-STEP-2
Scenario ID	INTEG-SCALARM
Initial conditions	- PaaSage Platform deployed (See 4.4) - INTEG-STEP-1 successful
Stimulus	N/A
Response	CP Model and PaaSage App Model are created and stored in the CDO server
Steps	- Bring system to initial conditions - Log into the PaaSage VM - Run the cp generator jar `  java -jar wp3_cp_generator.jar $RESOURCE_NAME` `$CP_MODEL_ID_FULL_FILE_NAME`

	``` NEXT_ID=$(cat $CP_MODEL_ID_FULL_FILE_NAME) ```
Success criterium	CDO server loaded with CP Model and PaaSage App Model
Status	SUCCESS

Test ID	INTEG-STEP-3
Scenario ID	INTEG-SCALARM
Initial conditions	• PaaSage Platform deployed (See 4.4) • INTEG-STEP-2 successful
Stimulus	N/A
Response	List of feasible deployment added to the CDO server
Steps	• Bring system to initial conditions • Log into the PaaSage VM • Run the rule processor jar <code>java -jar rule_processor.jar $NEXT_ID</code>
Success criterium	List of feasible deployment added to the Model stored in the CDO server
Status	SUCCESS

Test ID	INTEG-STEP-4
Scenario ID	INTEG-SCALARM
Initial conditions	• PaaSage Platform deployed (See 4.4) • INTEG-STEP-3 successful
Stimulus	N/A
Response	Choose solver to run and run it
Steps	• Bring system to initial conditions • Log into the PaaSage VM • Run the metasolver jar <code>java -jar metasolver.jar $NEXT_ID $CHOSEN_SOLVER_FULL_FILE_NAME</code>

Success criterium	Chosen solver has been launched.
Status	Failure: Meta solver runs but does not call any solver

Test ID	INTEG-STEP-5
Scenario ID	INTEG-SCALARM
Initial conditions	• PaaSage Platform deployed (See 4.4) • INTEG-STEP-4 successful
Stimulus	N/A
Response	Convert enhanced CAMEL deployment model into a Execware compliant format
Steps	• Bring system to initial condition • Log into the Paasage VM • Run the rule adaptation manager jar `java -jar adaptation_manager.jar $RESOURCE_NAME`
Success criterium	JSON document compatible with Execware
Status	Failure: Success based on hard coded solver output

Test ID	INTEG-STEP-6
Scenario ID	INTEG-SCALARM
Initial conditions	• PaaSage Platform deployed (See 4.4) • INTEG-STEP-5 successful
Stimulus	JSON Deployment model
Response	Deploy the application on the selected clouds environment
Steps	• Bring system to initial condition • Log into the PaaSage VM • Run the rule adaptation manager jar `java -jar adaptation_manager.jar $RESOURCE_NAME`

Success criterium	JSON document compatible with Execware
Status	Failure: Not run on actual input

The test results presented above reflect the state of the platform at the end of month 24. As the PaaSage platform is under heavy development, those results will have to be regularly updated.

4.3. Use case functional tests

This section describes the integration tests based on use cases requirements as they are mentioned in the Final Requirements deliverable (D6.1.2). That deliverable contains a comprehensive list and description of the required features and scenarios of the PaaSage platform; each scenario being mapped with the involved PaaSage components. The scenario ID parameter in this section refers to scenario ID values in D6.1.2.

> **Rem.:** As it has been stated in the introduction, the following test cases are based on requirements meant to drive the future platform developments. That's why:
>
> - the following tests have not yet been run (hence the 'Did not run' status)
>
> - their definition might be somewhat inaccurate, because the Final Requirements implementation has not been specified enough (CLI syntax, interfaces, test data sets are not ready yet) to allow accurate test case definitions.
>
> However, this work prepares in advance the Final integration tests deliverable (D6.2.2) due at the end of the project.

4.3.1. Flight scheduling application

Test ID	SU-CPU-1-TST-1
Scenario ID	SU-CPU-1
Initial conditions	• Flight scheduling application deployed • Steady CPU load • The max number of VCPUs the cloud provider could supply are not allocated to the deployed VMs.

Stimulus	VM monitoring signals a CPU bounded application-component. The trend of the CPU load indicates a steady rise or even a constant high load.
Response	The system increases the number of cores associated to the VM.
Steps	- Bring system to initial conditions - Check amount of VCPUs on VM - Generate CPU load or fake CPU load in monitoring system - Check that extra VCPU is added to the VM
Success criterium	extra VCPU is added to the VM
Status	Did not run

Test ID	SU-CPU-1-TST-2
Scenario ID	SU-CPU-1
Initial conditions	- Flight scheduling application deployed - Steady CPU load - The max number of VCPUs the cloud provider could supply are allocated to the deployed VMs
Stimulus	VM monitoring signals a CPU bounded application-component. The trend of the CPU load indicates a steady rise or even a constant high load.
Response	A scale out action is triggered.
Steps	- Bring system to initial conditions - Check amount of VMs - Generate CPU load or fake CPU load in monitoring system - Check that extra VM is created
Success criterium	The scale out action succeeds.
Status	Did not run

Test ID	SD-CPU-1-TST-1

Scenario ID	SD-CPU-1
Initial conditions	• Flight scheduling application deployed • Steady CPU load • The minimum number of VCPUs the cloud provider could supply are allocated to the deployed VMs
Stimulus	VM monitoring signals an less active or inactive application-component. The trend of the CPU load indicates a steady decrease or even a constant low load.
Response	The system decreases the number of cores associated to the VM.
Steps	• Bring system to initial conditions • Check amount of VCPUs on VM • Reduce simulated CPU load or fake it in monitoring system • Check that there are fewer VCPUs in the VM
Success criterium	Fewer VCPUs in the VM
Status	Did not run

Test ID	SD-CPU-1-TST-2
Scenario ID	SD-CPU-1
Initial conditions	• Flight scheduling application deployed • Steady CPU load • The minimum number of VCPUs the cloud provider could supply are allocated to the deployed VMs
Stimulus	VM monitoring signals a less active or inactive application-component. The trend of the CPU load indicates a steady decrease or even a constant low load.
Response	A scale-in action is triggered
Steps	• Bring system to initial conditions • Check amount of VMs • Reduce simulated load or fake it in monitoring system • Check that there are fewer VMs
Success criterium	The scale-in action succeeds.

Status	Did not run

Test ID	SO-CPU-1-TST-1
Scenario ID	SO-CPU-1
Initial conditions	- Flight scheduling application deployed - Steady and moderate CPU load - The max number of VCPUs the cloud provider could supply are allocated to the deployed VMs
Stimulus	SU-CPU-1 triggers scale-out.
Response	The system starts a new service instance within the cluster in the same Cloud or moves the cluster to a different cloud environment with more powerful CPU resources. This might also be a different Cloud provider.
Steps	- Bring system to initial conditions - Check amount of VMs - Generate additional CPU load or fake load in the monitoring system - Check that extra VM is created
Success criterium	Extra VM is provisionned and affected service is running
Status	Did not run

Test ID	SI-CPU-1-TST-1
Scenario ID	SI-CPU-1
Initial conditions	- Flight scheduling application deployed - Steady and moderate CPU load - The minimum number of VCPUs the cloud provider could supply are allocated to the deployed VMs
Stimulus	SD-CPU-1 triggers scale-out.
Response	The system shuts down the service instance running on a Cloud provider with the highest cost (maybe the one with high number of used cores).
Steps	Bring system to initial conditions

	• Check amount of VMs • Reduce simulated load or fake it in the monitoring system • Check that amount of VMs is lowered
Success criterium	One fewer VM, application still running
Status	Did not run

Test ID	SU-MEM-1-TST-1
Scenario ID	SU-MEM-1
Initial conditions	• Flight scheduling application deployed • Steady Memory usage • The max amount of memory the cloud provider could supply are not allocated to the deployed VMs
Stimulus	VM monitoring signals a memory bounded application-component. The trend of the memory consumption indicates a steady rise or even a constant high value.
Response	The system increases the amount of memory allocated to the VM.
Steps	• Bring system to initial conditions • Check amount of memory allocated to the VM • Generate memory pressure or fake memory pressure in monitoring system • Check that extra memory is added to the VM
Success criterium	extra memory is added to the VM
Status	Did not run

Test ID	SU-MEM-1-TST-2
Scenario ID	SU-MEM-1
Initial conditions	• Flight scheduling application deployed • Steady memory usage • The max amount of memory the cloud provider could supply are allocated to the deployed VMs

Stimulus	VM monitoring signals a memory bounded application-component. The trend of the memory consumption indicates a steady rise or even a constant high value.
Response	A scale out action is triggered.
Steps	- Bring system to initial conditions - Check amount of VMs - Generate memory pressure or fake memory pressure in monitoring system - Check that extra VM is created
Success criterium	The scale out action succeeds.
Status	Did not run

Test ID	SD-MEM-1-TST-1
Scenario ID	SD-MEM-1
Initial conditions	- Flight scheduling application deployed - Steady Memory usage - Deployed VMs are allocated a lot more memory than the actual usage
Stimulus	VM monitoring signals a low memory consumption of the VM. The trend of the memory consumption indicates a steady decrease or even a constant low value.
Response	The system reduces the amount of memory allocated to the VM by the cloud provider.
Steps	- Bring system to initial conditions - Check amount of memory allocated to the VM - Reduce memory pressure or fake memory pressure reduction in monitoring system - Check that memory is removed from the VM
Success criterium	Unused memory is removed from the VM
Status	Did not run

Test ID	SO-MEM-1-TST-1

Scenario ID	SO-MEM-1
Initial conditions	- Flight scheduling application deployed - Steady and high memory utilization on all the deployed VM's - Deployed VMs are allocated the max amount of memory the cloud provider could supply
Stimulus	SU-MEM-1 triggers
Response	The system starts a new service instance within the cluster in the same Cloud or moves the cluster to a different cloud environment with more main memory resources. This might also be a different Cloud provider.
Steps	- Bring system to initial conditions - Check amount of VMs - Generate additional memory pressure or fake load in the monitoring system - Check that extra VM is created
Success criterium	Extra VM is provisioned and affected service is running
Status	Did not run

Test ID	SI-MEM-1-TST-1
Scenario ID	SI-MEM-1
Initial conditions	- Flight scheduling application deployed - Steady and low memory usage on all nodes - Deployed VMs are allocated the minimum amount or memory the cloud provider could supply
Stimulus	SD-MEM-1 triggers scale-in.
Response	The system shuts down the service instance running on a Cloud provider with the highest cost (maybe the one with high number of used cores).
Steps	- Bring system to initial conditions - Check amount of VMs - Reduce simulated load or fake it in the monitoring system - Check that amount of VMs is lowered

Success criterium	One fewer VM, application still running
Status	Did not run

Test ID	SO-LAT-1-TST-1
Scenario ID	SO-LAT-1
Initial conditions	• Flight scheduling application deployed • Steady network latency
Stimulus	The Network monitoring facility indicates a significant high latency over the last (configurable) period of time.
Response	The system moves the service onto a cloud environment with lower latency. This might be a different provider. For components with extreme demands to responsibility (REST/HTTP service) the selected cloud environment should be located near to the user of the service (near-edge relocation).
Steps	• Bring system to initial conditions • Check current cloud environment • Generate network latency or fake it in the monitoring system
Success criterium	Check that impacted service has been relocated to another, lower latency, cloud environment
Status	Did not run

Test ID	SI-LAT-1-TST-1
Scenario ID	SI-LAT-1
Initial conditions	• Flight scheduling application deployed • Steady network latency • Service instance runs into a cluster
Stimulus	The Network monitoring facility indicates a considerable low latency over the last (configurable) period of time.
Response	The system shuts down the service instance running on a Cloud provider with the highest cost. If the component runs into a cluster, the load balancer redirects the requests to the remaining nodes.

Steps	• Bring system to initial conditions • Reduce simulated network latency or fake it in the monitoring system
Success criterium	Check that impacted service instance running on most expensive cloud provider environment is terminated
Status	Did not run

Test ID	SI-LAT-1-TST-2
Scenario ID	SI-LAT-1
Initial conditions	• Flight scheduling application deployed • Steady network latency • Service instance is the last remaining instance
Stimulus	The Network monitoring facility indicates a considerable low latency over the last (configurable) period of time.
Response	The system shuts down the service instance running on a Cloud provider with the highest cost. If the service instance is the last remaining instance, the system spawns a new instance on a cheaper Cloud environment.
Steps	• Bring system to initial conditions • Reduce simulated network latency or fake it in the monitoring system
Success criterium	Check that impacted service instance is redeployed on a cheaper cloud environment
Status	Did not run

Test ID	SO-NBW-1-TST-1
Scenario ID	SO-NBW-1
Initial conditions	• Flight scheduling application deployed • Steady network bandwidth
Stimulus	The Network monitoring facility indicates a significant low bandwidth over the last (configurable) period of time.

Response	The system moves the service onto a cloud environment with a better network connection. This might be a different provider. For components with extreme demands to responsibility together with higher amount of data to be transferred (read models) the selected cloud environment should be located near to the user of the service (near-edge relocation).
Steps	- Bring system to initial conditions - Check current cloud environment - Limit available bandwidth or fake it in the monitoring system
Success criterium	Check that impacted service has been relocated to a higher-bandwidth capable cloud environment
Status	Did not run

Test ID	SI-NBW-1-TST-1
Scenario ID	SI-NBW-1
Initial conditions	- Flight scheduling application deployed - Application scattered over two cloud environments, one being significantly more expensive than the other - Limited network bandwidth - Impacted service runs into a cluster
Stimulus	The Network monitoring facility indicates a considerable high network bandwidth not used by the application over the last (configurable) period of time.
Response	The system shuts down the service instance running on a Cloud provider with the highest cost. If the component runs into a cluster, the load balancer redirects the requests to the remaining nodes.
Steps	- Bring system to initial conditions - Check current cloud environment - Unlimit bandwidth or fake it in the monitoring system
Success criterium	Check that impacted service instance running on most expensive cloud provider environment is terminated
Status	Did not run

Test ID	SI-NBW-1-TST-2
Scenario ID	SI-NBW-2
Initial conditions	• Flight scheduling application deployed • Application scattered over two cloud environments, one being significantly more expensive than the other • Limited network bandwidth • Impacted service runs on one instance
Stimulus	The Network monitoring facility indicates a considerable high network bandwidth not used by the application over the last (configurable) period of time.
Response	The system shuts down the service instance running on a Cloud provider with the highest cost. If the service instance is the last remaining instance, the system spawns a new instance on a cheaper Cloud environment.
Steps	• Bring system to initial conditions • Check current cloud environment • Unlimit bandwidth or fake it in the monitoring system
Success criterium	Check that impacted service instance is redeployed on a cheaper cloud environment
Status	Did not run

Test ID	SU-RPT-1-TST-1
Scenario ID	SU-RPT-1
Initial conditions	• Flight scheduling application deployed • Steady request processing time • Deployed VMs are not allocated the max number of VCPUs the cloud provider could supply
Stimulus	The application monitoring (e.g. using KAMON, Akka monitoring etc.) signals a high processing time for incoming REST requests.
Response	The system increases the number of cores associated to the VM.
Steps	• Bring system to initial conditions • Check amount of VCPUs on VM

	• Simulate increasing response time or fake it in monitoring system
Success criterium	extra VCPU is added to the VM
Status	Did not run

Test ID	SU-RPT-1-TST-2
Scenario ID	SU-RPT-1
Initial conditions	• Flight scheduling application deployed • Steady request processing time • Deployed VMs are allocated the max number of VCPUs the cloud provider could supply
Stimulus	The application monitoring (e.g. using KAMON, Akka monitoring etc.) signals a high processing time for incoming REST requests.
Response	The system triggers a scale-out action.
Steps	• Bring system to initial conditions • Check amount of VMs • Simulate increasing response time or fake it in monitoring system
Success criterium	Scale-out action succeeds.
Status	Did not run

Test ID	SD-RPT-1-TST-1
Scenario ID	SD-RPT-1
Initial conditions	• Flight scheduling application deployed • Fake load that increases response time • Deployed VMs are not allocated the minimum number of VCPUs the cloud provider could supply
Stimulus	The application monitoring (e.g. using KAMON, Akka monitoring etc.) signals a low processing time for incoming REST requests.

Response	The system decreases the number of cores associated to the VM.
Steps	- Bring system to initial conditions - Check amount of VCPUs on VM - Reduce simulated response time or fake it in monitoring system - Check that there are fewer VCPUs in the VM
Success criterium	Fewer VCPUs in the VM
Status	Did not run

Test ID	SD-RPT-1-TST-2
Scenario ID	SD-RPT-1
Initial conditions	- Flight scheduling application deployed - Fake load that increases response time - Deployed VMs are allocated the minimum number of VCPUs the cloud provider could supply
Stimulus	The application monitoring (e.g. using KAMON, Akka monitoring etc.) signals a low processing time for incoming REST requests.
Response	A scale-in action is triggered.
Steps	- Bring system to initial conditions - Check amount of VMs - Reduce simulated response time or fake it in monitoring system - Check that there are fewer VMs
Success criterium	Scale-in action succeeds, application still running
Status	Did not run

Test ID	SO-RPT-1-TST-1
Scenario ID	SO-RPT-1
Initial conditions	Relates to SO-CPU-1-TST-1

Stimulus	SU-RPT-1 triggers scale-out.
Response	Relates to SO-CPU-1-TST-1
Steps	Relates to SO-CPU-1-TST-1
Success criterium	Extra VM is created
Status	Did not run

Test ID	SI-RPT-1-TST-1
Scenario ID	SI-RPT-1
Initial conditions	Relates to SI-CPU-1-TST-1
Stimulus	SD-RPT-1 triggers scale-out.
Response	Relates to SI-CPU-1-TST-1
Steps	Relates to SI-CPU-1-TST-1
Success criterium	One VM fewer in the system.
Status	Did not run

Test ID	SU-MBX-1-TST-1
Scenario ID	SU-MBX-1
Initial conditions	- Flight scheduling application deployed - Currently configured thread pool limit is below VM capabilities
Stimulus	The application monitoring signals increasing size of mailbox (queue) length.
Response	The system retunes the thread pool of the corresponding dispatcher within the limits of the used VM (no. of available cores).
Steps	- Bring system to initial conditions - Check thread pool limit parameter - Increase mailbox queue length

Success criterium	Higher thread pool limit parameter is set
Status	Did not run

Test ID	SU-MBX-1-TST-2
Scenario ID	SU-MBX-1
Initial conditions	- Flight scheduling application deployed - Currently configured thread pool limit has reached VM capabilities
Stimulus	The application monitoring signals increasing size of mailbox (queue) length.
Response	SU-MBX-2 action is triggered.
Steps	- Bring system to initial conditions - Check thread pool limit parameter - Increase mailbox queue length
Success criterium	SU-MBX-2 action succeeds.
Status	Did not run

Test ID	SU-MBX-2-TST-1
Scenario ID	SU-MBX-2
Initial conditions	Relates to SU-CPU-1-TST-1
Stimulus	The application monitoring signals increasing size of mailbox (queue) length together with a fully utilized thread pool configuration.
Response	Relates to SU-CPU-1-TST-1
Steps	Relates to SU-CPU-1-TST-1
Success criterium	Relates to SU-CPU-1-TST-1
Status	Did not run

Test ID	SU-MBX-2-TST-2
Scenario ID	SU-MBX-2
Initial conditions	Relates to SU-CPU-1-TST-1
Stimulus	The application monitoring signals increasing size of mailbox (queue) length together with a fully utilized thread pool configuration.
Response	Relates to SU-CPU-1-TST-2
Steps	Relates to SU-CPU-1-TST-2
Success criterium	Relates to SU-CPU-1-TST-2
Status	Did not run

Test ID	SD-MBX-1-TST-1
Scenario ID	SD-MBX-1
Initial conditions	- Flight scheduling application deployed - Current thread pool is underutilized - Currently configured thread pool limit is over a given limit
Stimulus	The application monitoring signals constantly small mailbox sizes.
Response	The system retunes the thread pool of the corresponding dispatcher (within given lower limits) of the used VM.
Steps	- Bring system to initial conditions - Check thread pool limit parameter - Decrease mailbox queue length
Success criterium	Lower thread pool limit parameter is set
Status	Did not run

Test ID	SD-MBX-1-TST-2
Scenario ID	SD-MBX-2

Initial conditions	• Flight scheduling application deployed • Current thread pool is underutilized • Currently configured thread pool has reached its lower limit
Stimulus **Response** **Steps**	The application monitoring signals constantly small mailbox sizes. A SD-MBX-2 action is triggered. • Bring system to initial conditions • Check thread pool limit parameter • Decrease mailbox queue length
Success criterium **Status**	The SD-MBX-2 action succeeds. Did not run

Test ID	SD-MBX-2-TST-1
Scenario ID	SD-MBX-2
Initial conditions	• Flight scheduling application deployed • Current thread pool is underutilized • Currently configured thread pool has reached its lower limit • Impacted VM is not allocated minimum amount of VCPUs the cloud provider could supply
Stimulus	The application monitoring signals constantly small mailbox sizes.
Response	Relates to SD-CPU-1-TST-1
Steps	Relates to SD-CPU-1-TST-1
Success criterium	Relates to SD-CPU-1-TST-1
Status	Did not run

Test ID	SD-MBX-2-TST-2
Scenario ID	SD-MBX-2

Initial conditions	- Flight scheduling application deployed - Current thread pool is underutilized - Currently configured thread pool has reached its lower limit - Impacted VM is allocated minimum amount of VCPUs the cloud provider could supply
Stimulus	The application monitoring signals constantly small mailbox sizes.
Response	Relates to SD-CPU-1-TST-2
Steps	Relates to SD-CPU-1-TST-2
Success criterium	Relates to SD-CPU-1-TST-2
Status	Did not run

Test ID	SO-MBX-1-TST-1
Scenario ID	SO-MBX-1
Initial conditions	Relates to SO-CPU-1-TST-1
Stimulus	SU-MBX-2 triggers a scale-out
Response	Relates to SO-CPU-1-TST-1
Steps	Relates to SO-CPU-1-TST-1
Success criterium	Relates to SO-CPU-1-TST-1
Status	Did not run

Test ID	SI-MBX-1-TST-1
Scenario ID	SI-MBX-1
Initial conditions	Relates to SI-LAT-1-TST-1
Stimulus	SD-MBX-2 triggers a scale-in
Response	Relates to SI-LAT-1-TST-1

Steps	Relates to SI-LAT-1-TST-1
Success criterium	Relates to SI-LAT-1-TST-1
Status	Did not run

Test ID	SI-MBX-1-TST-2
Scenario ID	SI-MBX-1
Initial conditions	Relates to SI-LAT-1-TST-2
Stimulus	SD-MBX-2 triggers a scale-in
Response	Relates to SI-LAT-1-TST-2
Steps	Relates to SI-LAT-1-TST-2
Success criterium	Relates to SI-LAT-1-TST-2
Status	Did not run

Test ID	SO-DBQ-1-TST-1
Scenario ID	SO-DBQ-1
Initial conditions	Relates to SO-CPU-1-TST-1
Stimulus	Relates to SO-RPT-1-TST-1
Response	Relates to SO-CPU-1-TST-1
Steps	Relates to SO-CPU-1-TST-1
Success criterium	Extra VM is created
Status	Did not run

Test ID	SO-DBQ-1-TST-1
Scenario ID	SO-DBQ-1

Initial conditions	Relates to SO-CPU-1-TST-1
Stimulus	Relates to SO-RPT-1-TST-1
Response	Relates to SO-CPU-1-TST-1
Steps	Relates to SO-CPU-1-TST-1
Success criterium	Extra VM is created
Status	Did not run

Test ID	SU-STO-1-TST-1
Scenario ID	SU-STO-1
Initial conditions	• Flight scheduling application deployed • Steady storage consumption
Stimulus	Database / storage subsystem monitoring indicates low free space on the (virtual) device.
Response	Add additional storage capacity of the same type (i.e. technology/transfer rate etc.) to the existing storage.
Steps	• Bring system to initial conditions • Check current allocated storage • Simulate low free storage capacity
Success criterium	Extra storage is allocated to impacted service
Status	Did not run

4.3.2. Industrial ERP application

Test ID	SUD-CPU-1-TST-1
Scenario ID	SUD-CPU-1
Initial conditions	Relates to SU-CPU-1-TST-1 & SD-CPU-1-TST-1
Stimulus	Relates to SU-CPU-1-TST-1 & SD-CPU-1-TST-1

Response	Relates to SU-CPU-1-TST-1 & SD-CPU-1-TST-1
Steps	Relates to SU-CPU-1-TST-1 & SD-CPU-1-TST-1
Success criterium	Relates to SU-CPU-1-TST-1 & SD-CPU-1-TST-1
Status	Did not run

Test ID	SUD-MEM-1-TST-1
Scenario ID	SUD-MEM-1
Initial conditions	Relates to SU-MEM-1-TST-1 & SD-MEM-1-TST-1
Stimulus	Relates to SU-MEM-1-TST-1 & SD-MEM-1-TST-1
Response	Relates to SU-MEM-1-TST-1 & SD-MEM-1-TST-1
Steps	Relates to SU-MEM-1-TST-1 & SD-MEM-1-TST-1
Success criterium	Relates to SU-MEM-1-TST-1 & SD-MEM-1-TST-1
Status	Did not run

Test ID	SUD-I/O-1-TST-1
Scenario ID	SUD-I/O-1
Initial conditions	• Industrial ERP application deployed • Steady I/O load
Stimulus	Monitoring of the I/O requests, lowest cost
Response	The system starts / stops an instance of the storage services
Steps	Relates to SU-STO-1-TST-1
Success criterium	Relates to SU-STO-1-TST-1
Status	Did not run

Test ID	SUD-PREVU-1-TST-1

Scenario ID	SUD-PREVU-1
Initial conditions	• Industrial ERP application deployed • Peak periods are configured
Stimulus	Peak periods arrived or past, lowest cost
Response	The system starts a configurable number of instances
Steps	• Bring system to initial conditions • Wait until configured peak period
Success criterium	Corresponding number of VMs have been launched/terminated
Status	Did not run

Test ID	SOI-CPU-1-TST-1
Scenario ID	SOI-CPU-1
Initial conditions	Relates to SO-CPU-1-TST-1 & SI-CPU-1-TST-1
Stimulus	Relates to SO-CPU-1-TST-1 & SI-CPU-1-TST-1
Response	Relates to SO-CPU-1-TST-1 & SI-CPU-1-TST-1
Steps	Relates to SO-CPU-1-TST-1 & SI-CPU-1-TST-1
Success criterium	Relates to SO-CPU-1-TST-1 & SI-CPU-1-TST-1
Status	Did not run

Test ID	SOI-MEM-1-TST-1
Scenario ID	SOI-MEM-1
Initial conditions	Relates to SO-MEM-1-TST-1 & SI-MEM-1-TST-1
Stimulus	Relates to SO-MEM-1-TST-1 & SI-MEM-1-TST-1
Response	Relates to SO-MEM-1-TST-1 & SI-MEM-1-TST-1
Steps	Relates to SO-MEM-1-TST-1 & SI-MEM-1-TST-1

Success criterium	Relates to SO-MEM-1-TST-1 & SI-MEM-1-TST-1
Status	Did not run

Test ID	SOI-I/O-1-TST-1
Scenario ID	SOI-I/O-1
Initial conditions	• Industrial ERP application deployed in a private cloud • Steady I/O load
Stimulus	Monitoring of the I/O requests, lowest cost
Response	The system starts / stops an instance of the storage services on a public cloud
Steps	Relates to SUD-I/O-1-TST-1
Success criterium	Extra VM launched / terminated on a public cloud provider environment
Status	Did not run

Test ID	SOI-AVAILABLE-1-TST-1
Scenario ID	SOI-AVAILABLE-1
Initial conditions	• Industrial ERP application deployed in a private cloud
Stimulus	The private cloud is available or not, lowest cost
Response	The system starts a configurable number of instances on a public cloud or restarts the instances on the private cloud when available again
Steps	• Bring system to initial conditions • Add/remove avaiable resources from private cloud • Trigger any scale out/in action
Success criterium	Extra resources are scaled out/in a public cloud environment
Status	Did not run

Test ID	SOI-NWLAT-1-TST-1
Scenario ID	SOI-NWLAT-1
Initial conditions	Relates to SO-LAT-1-TST-1 & SI-LAT-1-TST-1
Stimulus	Relates to SO-LAT-1-TST-1 & SI-LAT-1-TST-1
Response	Relates to SO-LAT-1-TST-1 & SI-LAT-1-TST-1
Steps	Relates to SO-LAT-1-TST-1 & SI-LAT-1-TST-1
Success criterium	Relates to SO-LAT-1-TST-1 & SI-LAT-1-TST-1
Status	Did not run

Test ID	SOI-BANDW-1-TST-1
Scenario ID	SOI-BANW-1
Initial conditions	Relates to SO-NBW-1-TST-1 & SI-NBW-1-TST-1
Stimulus	Relates to SO-NBW-1-TST-1 & SI-NBW-1-TST-1
Response	Relates to SO-NBW-1-TST-1 & SI-NBW-1-TST-1
Steps	Relates to SO-NBW-1-TST-1 & SI-NBW-1-TST-1
Success criterium	Relates to SO-NBW-1-TST-1 & SI-NBW-1-TST-1
Status	Did not run

Test ID	SOI-PREVU-1-TST-1
Scenario ID	SOI-PREVU-1
Initial conditions	Relates to SUD-PREVU-1-TST-1
Stimulus	Relates to SUD-PREVU-1-TST-1
Response	Relates to SUD-PREVU-1-TST-1
Steps	Relates to SUD-PREVU-1-TST-1

Success criterium	Relates to SUD-PREVU-1-TST-1
Status	Did not run

Test ID	LOC-1-TST-1
Scenario ID	LOC-1
Initial conditions	- Industrial ERP application ready for deployment - SLA require that application services are deployed in a given area (region, country, private cloud)
Stimulus	Deployment topology processed by Upperware
Response	The system instantiates application services on a SLA compatible cloud
Steps	- Bring system to initial conditions - Trigger application deployment
Success criterium	Application services actual deployment meets SLA
Status	Did not run

Test ID	LOC-2-TST-1
Scenario ID	LOC-2
Initial conditions	- Industrial ERP application ready for deployment - SLA require that application data are deployed in a given area (region, country, private cloud)
Stimulus	Deployment topology processed by Upperware
Response	The system instantiates application data on a SLA compatible cloud
Steps	- Bring system to initial conditions - Trigger application deployment
Success criterium	Application data actual deployment meets SLA
Status	Did not run

4.3.3. Financial services application

Test ID	PTP-CO-1-TST-1
Scenario ID	PTP-CO-1
Initial conditions	• Industrial financial services deployed in private cloud ready for deployment • Cheaper public cloud environment available
Stimulus	Objective function is triggered to minimize cost
Response	The system undeploys the financial service from the in-house private data centre and redeploys to the selected public cloud provider based on the company's preferences.
Steps	• Bring system to initial conditions • Trigger application deployment optimization
Success criterium	Application is undeployed from private cloud and redeployed to the cheapest public cloud
Status	Did not run

Test ID	PTP-LO-1-TST-1
Scenario ID	PTP-LO-1
Initial conditions	Relates to SOI-AVAILABLE-1-TST-1
Stimulus	Relates to SOI-AVAILABLE-1-TST-1
Response	Relates to SOI-AVAILABLE-1-TST-1
Steps	Relates to SOI-AVAILABLE-1-TST-1
Success criterium	Relates to SOI-AVAILABLE-1-TST-1
Status	Did not run

4.3.4. Hyperflow application

Test ID	HF-DEPL-1-TST-1

Scenario ID	HF-DEPL-1
Initial conditions	• Hyperflow application ready for deployment
Stimulus	Request from the end-user of infrastructure administrator.
Response	The system spawns the whole cluster in its initial configuration.
Steps	• Bring system to initial conditions • Trigger application deployment
Success criterium	Application actual deployment meets SLA
Status	Did not run

Test ID	HF-SOI-UTL-1-TST-1
Scenario ID	HF-SOI-UTL-1
Initial conditions	Relates to SOI-CPU-1-TST-1
Stimulus	Relates to SOI-CPU-1-TST-1
Response	Relates to SOI-CPU-1-TST-1
Steps	Relates to SOI-CPU-1-TST-1
Success criterium	Relates to SOI-CPU-1-TST-1
Status	Did not run

Test ID	HF-SOI-JBQ-1-TST-1
Scenario ID	HF-SOI-JBQ-1
Initial conditions	Relates to SO-MBX-1-TST-1 & SI-MBX-1-TST-1
Stimulus	Relates to SO-MBX-1-TST-1 & SI-MBX-1-TST-1
Response	Relates to SO-MBX-1-TST-1 & SI-MBX-1-TST-1
Steps	Relates to SO-MBX-1-TST-1 & SI-MBX-1-TST-1
Success criterium	Relates to SO-MBX-1-TST-1 & SI-MBX-1-TST-1

Status	Did not run

Test ID	HF-SOI-STG-1-TST-1
Scenario ID	HF-SOI-STG-1
Initial conditions	Relates to SOI-PREVU-1-TST-1
Stimulus	Relates to SOI-PREVU-1-TST-1
Response	Relates to SOI-PREVU-1-TST-1
Steps	Relates to SOI-PREVU-1-TST-1
Success criterium	Relates to SOI-PREVU-1-TST-1
Status	Did not run

Test ID	HF-SOI-TERM-1-TST-1
Scenario ID	HF-SOI-TERM-1
Initial conditions	Relates to HF-SOI-STG-1-TST-1
Stimulus	Relates to HF-SOI-STG-1-TST-1
Response	Relates to HF-SOI-STG-1-TST-1
Steps	Relates to HF-SOI-STG-1-TST-1
Success criterium	Relates to HF-SOI-STG-1-TST-1
Status	Did not run

4.3.5. Scalarm application

Test ID	SCAL-1-EM-SO-TST-1
Scenario ID	SCAL-1-EM-SO
Initial conditions	• Scalarm application deployed

	• Steady response time
Stimulus	Monitoring signals that the service response time is higher than expected over the specified time window.
Response	The system starts a new instance of Experiment Manager in a cloud close to other Scalarm services.
Steps	• Bring system to initial conditions • Check amount of VMs • Generate load on Experiment Manager or fake load in the monitoring system • Check that extra VM is created
Success criterium	Extra VM is created
Status	Did not run

Test ID	SCAL-2-EM-SI-TST-1
Scenario ID	SCAL-2-EM-SI
Initial conditions	Relates to SI-CPU-1-TST-1
Stimulus	Relates to SI-CPU-1-TST-1
Response	Relates to SI-CPU-1-TST-1
Steps	Relates to SI-CPU-1-TST-1
Success criterium	Relates to SI-CPU-1-TST-1
Status	Did not run

Test ID	SCAL-3-SM-SO-TST-1
Scenario ID	SCAL-3-SM-SO & SCAL-4-SM-SI
Initial conditions	Relates to SOI-I/O-1-TST-1
Stimulus	Relates to SOI-I/O-1-TST-1
Response	Relates to SOI-I/O-1-TST-1

Steps	Relates to SOI-I/O-1-TST-1
Success criterium	Relates to SOI-I/O-1-TST-1
Status	Did not run

Test ID	SCAL-5-SM-SO-2-TST-1
Scenario ID	SCAL-5-SM-SO-2
Initial conditions	Relates to SU-STO-1-TST-1
Stimulus	Monitoring signals low available disk space.
Response	The system starts a new instance of Storage Manager in a cloud close to other Scalarm services.
Steps	- Bring system to initial conditions - Check current allocated storage - Simulate low free storage capacity
Success criterium	Extra storage instance is started
Status	Did not run

Test ID	SCAL-6-SM-SO-2-TST-1
Scenario ID	SCAL-6-SM-SO-2
Initial conditions	Relates to SU-STO-1-TST-1
Stimulus	Monitoring signals very low disk space utilization on resources utilized by Storage Manager instances.
Response	The system stops the least utilized instance of Storage Manager.
Steps	- Bring system to initial conditions - Check current allocated storage - Simulate low storage usage
Success criterium	One fewer storage manager instance
Status	Did not run

Test ID	SCAL-7-SiM-SO-TST-1
Scenario ID	SCAL-7-SiM-SO
Initial conditions	Relates to SO-MBX-1-TST-1
Stimulus	Monitoring signals there is too few simulations finished in a specified time window.
Response	The system starts a new instance of Simulation Manager in the cheapest cloud, which fulfils Simulation Manager requirements.
Steps	Relates to SO-MBX-1-TST-1
Success criterium	Extra Simulation Manager instance started
Status	Did not run

Test ID	SCAL-8-SiM-SI-TST-1
Scenario ID	SCAL-8-SiM-SI
Initial conditions	Relates to SI-MBX-1-TST-1
Stimulus	Relates to SI-MBX-1-TST-1
Response	Relates to SI-MBX-1-TST-1
Steps	Relates to SI-MBX-1-TST-1
Success criterium	One fewer Simulation Manager instance
Status	Did not run

4.3.6. Resource intensive simulations application

Test ID	RIS-SO-JBQ-1-TST-1
Scenario ID	RIS-SO-JBQ-1
Initial conditions	- Resource intensive simulation application is deployed - Steady job queue waiting time

Stimulus	Queue monitoring signals a significant problem over the last minutes about the long waiting period.
Response	The system moves the application onto a different testbed. This might be a different HPC or cloud provider that is located nearby.
Steps	- Bring system to initial conditions - Check cloud provider - Simulate high job waiting time in queue
Success criterium	Application is redeployed onto another nearby HPC/cloud environment
Status	Did not run

Test ID	RIS-SO-JBQ-2-TST-1
Scenario ID	RIS-SO-JBQ-2
Initial conditions	- Resource intensive simulation application is deployed - Steady amount of jobs in the queue
Stimulus	Queue monitoring signals a significant problem over the last minutes about the high number of jobs exceeding the threshold.
Response	The system moves the application onto a different testbed. This might be a different HPC or cloud provider that is located nearby.
Steps	- Bring system to initial conditions - Check cloud provider - Simulate lots of jobs in the queue
Success criterium	Application is redeployed onto another cloud environment
Status	Did not run

Test ID	RIS-SO-NET-1-TST-1
Scenario ID	RIS-SO-NET-1
Initial conditions	Relates to SO-LAT-1-TST-1
Stimulus	Relates to SO-LAT-1-TST-1

Response	The system moves the application onto a different testbed. This might be a different HPC or cloud provider that is located nearby.
Steps	Relates to SO-LAT-1-TST-1
Success criterium	Application is redeployed onto another cloud environment
Status	Did not run

Test ID	RIS-SO-NET-2-TST-1
Scenario ID	RIS-SO-NET-2
Initial conditions	Relates to SOI-BANDW-1
Stimulus	Relates to SOI-BANDW-1
Response	The system moves the application onto a different testbed. This might be a different HPC or cloud provider that is located nearby.
Steps	Relates to SO-LAT-1-TST-1
Success criterium	Application is redeployed onto another cloud environment
Status	Did not run

Test ID	RIS-SO-NET-3-TST-1
Scenario ID	RIS-SO-NET-3
Initial conditions	- Resource intensive simulation application is deployed - Steady NFS response time
Stimulus	Network monitoring signals significant NFS problem over the last minutes.
Response	The system moves the affected artefacts onto a different testbed. This might be a different HPC or cloud provider that is located nearby.
Steps	- Bring system to initial conditions - Check NFS service location - Stop the NFS service

Success criterium	NFS service is redeployed onto another cloud environment
Status	Did not run

Test ID	RIS-SO-NET-4-TST-1
Scenario ID	RIS-SO-NET-4
Initial conditions	• Resource intensive simulation application is deployed • Connection to license server is up and running
Stimulus	Connection error to the license server
Response **Steps**	The system moves the application onto a different testbed with a successful connectivity to the license server. • Bring system to initial conditions • Check cloud provider • Stop the license service
Success criterium	Application is redeployed onto another cloud environment
Status	Did not run

Test ID	RIS-SO-CST-1-TST-1
Scenario ID	RIS-SO-CST-1
Initial conditions	Relates to PTP-CO-1
Stimulus	Relates to PTP-CO-1
Response	Relates to PTP-CO-1
Steps	Relates to PTP-CO-1
Success criterium	Relates to PTP-CO-1
Status	Did not run

Test ID	RIS-SO-LCS-1-TST-1

Scenario ID	RIS-SO-LCS-1
Initial conditions	Relates to LOC-1-TST-1
Stimulus	Relates to LOC-1-TST-1
Response	Relates to LOC-1-TST-1
Steps	Relates to LOC-1-TST-1
Success criterium	Relates to LOC-1-TST-1
Status	Did not run

Test ID	RIS-DT-LOC-1-TST-1
Scenario ID	RIS-DT-LOC-1
Initial conditions	Relates to LOC-2-TST-1
Stimulus	Relates to LOC-2-TST-1
Response	Relates to LOC-2-TST-1
Steps	Relates to LOC-2-TST-1
Success criterium	Relates to LOC-2-TST-1
Status	Did not run

Test ID	RIS-DT-LOC-2-TST-1
Scenario ID	RIS-DT-LOC-2
Initial conditions	Relates to RIS-DT-LOC-1-TST-1
Stimulus	Relates to RIS-DT-LOC-1-TST-1
Response	Relates to RIS-DT-LOC-1-TST-1
Steps	Relates to RIS-DT-LOC-1-TST-1
Success criterium	Relates to RIS-DT-LOC-1-TST-1

Status	Did not run

Scenarios RIS-AT-MGT-1, RIS-AT-MGT-2, RIS-SC-ENC-1 won't be tested as it depends on the application features and not the PaaSage platform.

Test ID	RIS-SC-TCY-1-TST-1
Scenario ID	RIS-SC-TCY-1
Initial conditions	• Resource intensive simulation application ready for deployment
Stimulus	SLA require to host all VMs on same physical server
Response	The system allocates dedicated physical server to run all the VMs
Steps	• Bring system to initial conditions • Trigger application deployment • Check in cloud provider management console the actual compute host of all VMs
Success criterium	All application VMs run on the same compute host
Status	Did not run

4.3.7. Human milk bank application

Test ID	PUBL-NEW-TST-1
Scenario ID	PUBL-NEW
Initial conditions	• Milk bank application ready for deployment • Humanly understandable deployment constraints and SLAs
Stimulus	Planned deployment as a result of a new customer agreement
Response	PaaSage will interpret the deployment model and act accordingly
Steps	• Bring system to initial conditions

	• Trigger application deployment
Success criterium	Actual deployment meets application provider constraints and SLAs
Status	Did not run

Test ID	PUBL-UPGR-TST-1
Scenario ID	PUBL-UPGR
Initial conditions	• Milk bank applications deployed in two different cloud infrastructures • Milk bank applications upgrade ready for deployment • Humanly understandable deployment constraints and SLAs
Stimulus	Planned deployment as a result of a planned release
Response	PaaSage will interpret the deployment model and act accordingly
Steps	• Bring system to initial conditions • Trigger application upgrade deployment
Success criterium	All milk bank applications have been upgraded, and the deployment meets application provider constraints and SLAs
Status	Did not run

Test ID	PUBL-FIX-TST-1
Scenario ID	PUBL-FIX
Initial conditions	• Milk bank applications deployed in two different cloud infrastructures • Error fix for single milk bank application available and ready for deployment • Humanly understandable deployment constraints and SLAs
Stimulus	Planned single deployment as a result of an error fix
Response	PaaSage will interpret the deployment model and act accordingly

Steps	• Bring system to initial conditions • Trigger error fix deployment for single application
Success criterium	Affected milk bank application have been upgraded, and the deployment meets application provider constraints and SLAs
Status	Did not run

Test ID	PUBL-TERM-TST-1
Scenario ID	PUBL-TERM
Initial conditions	• Milk bank applications deployed in two different cloud infrastructures • Humanly understandable deployment constraints and SLAs
Stimulus	Planned cleanup and removal of an application as a result of a terminated agreement
Response	PaaSage will interpret the deployment model and act accordingly
Steps	• Bring system to initial conditions • Trigger affected milk bank application termination
Success criterium	Affected milk bank application have been terminated, its VMs and data are deleted
Status	Did not run

5. Conclusion

This report identifies various PaaSage components, documents how they are integrated and describes how to test them.

As already stated above, the automation effort from the integration team saves the user from deeply diving into a long technical documentation in order to install and configure the platform. Almost everything that could be automated (building, installation, configuration, deployment and execution) has been, hence very little amount of technical knowledge and configuration parameters is required in order to start from an empty Ubuntu machine and get a functional and running platform.

Besides, the PaaSage platform is under heavy development at the time of writing; which means that new features, components, application models and cloud provider models will be added it in the coming weeks; which also means this document is meant to rapidly evolve. For instance, one of the pending tasks in the project consortium is to apply a common software license to the components and to migrate the code base from its current private location (GitLab [12] server in CETIC data centre) to a public code repository in OW2[13] in order to promote the project and grow a community. The impact of this migration is that all the URLs in this document related to the components code would be soon updated.

Further testing strategy

Up to now, the essential effort of Task 6.2 was dedicated on the platform integration. As the platform gets extended with new components and features, new tests could be run against it.

Future testing work is to develop the simplest application model and code capable of exercising specific features individually (e.g. scaling, cost optimization, multi-cloud ...).

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12   http://git.cetic.be/

13   http://www.ow2.org/