



Rational decomposition and orchestration for serverless computing

Deliverable D2.2 Final requirements (Companion Document)

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The RADON project partners

IMP	IMPERIAL COLLEGE OF SCIENCE TECHNOLOGY AND MEDICINE
TJD	STICHTING KATHOLIEKE UNIVERSITEIT BRABANT
UTR	TARTU ULIKOOL
XLB	XLAB RAZVOJ PROGRAMSKE OPREME IN SVETOVANJE DOO
ATC	ATHENS TECHNOLOGY CENTER ANONYMI BIOMICHANIKI EMPORIKI KAI TECHNIKI ETAIREIA EFARMOGON YPSILIS TECHNOLOGIAS
ENG	ENGINEERING - INGEGNERIA INFORMATICA SPA
UST	UNIVERSITAET STUTTGART
PRQ	PRQ A/S



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1 Overview

This companion document offers a static snapshot of the project requirements listed in the RADON Github repositories. The following repositories have been parsed for open Github issues and the corresponding requirement tables are listed below.

- <https://github.com/radon-h2020/radon-ctt/issues>
- <https://github.com/radon-h2020/radon-delivery-toolchain/issues>
- <https://github.com/radon-h2020/radon-decomposition-tool/issues>
- <https://github.com/radon-h2020/radon-defect-prediction-api/issues>
- <https://github.com/radon-h2020/radon-functionhub-client/issues>
- <https://github.com/radon-h2020/radon-gmt/issues>
- <https://github.com/radon-h2020/radon-ide/issues>
- <https://github.com/radon-h2020/radon-monitoring-tool/issues>
- <https://github.com/radon-h2020/radon-particles/issues>
- <https://github.com/radon-h2020/radon-verification-tool/issues>
- <https://github.com/radon-h2020/xopera-opera/issues>

2 Requirement snapshot

ID	R-T3.2-10
Type	USABILITY
User Story	As an Operations Engineer, I want to optimize the deployment of an application with different solution methods.
Requirement	The DECOMP.TOOL should be able to allow the option of specifying the solution method for deployment optimization and obtain the optimal deployment scheme with that method.
Extended Description	The available methods may include genetic algorithms and other suitable ones.
Priority	Could have
Affected Tools	DECOMP.TOOL
Means of Verification	Code review, unit tests and use cases
Dependency	R-T4.2-1 to R-T4.2-3

ID	R-T3.2-11
Type	USABILITY
User Story	As an Operations Engineer, I want to optimize the deployment of an application in a definite time.
Requirement	The DECOMP.TOOL should be able to allow the option of specifying the time limit for deployment optimization and return a sub-optimal deployment scheme upon time-out.
Extended Description	A sub-optimal deployment scheme is the best among those found feasible so far.
Priority	Should have
Affected Tools	DECOMP.TOOL
Means of Verification	Code review, unit tests and use cases
Dependency	R-T4.2-1 to R-T4.2-3

ID	R-T3.2-10
Type	USABILITY
User Story	As an Operations Engineer, I want to optimize the deployment of an application with different solution methods.
Requirement	The DECOMP.TOOL should be able to allow the option of specifying the solution method for deployment optimization and obtain the optimal deployment scheme with that method.
Extended Description	The available methods may include cutting planes, branch and bound and generic heuristics.
Priority	Should have
Affected Tools	DECOMP.TOOL
Means of Verification	Code review, unit tests and use cases
Dependency	R-T4.2-1 to R-T4.2-3

ID	R-T3.2-9
Type	USABILITY
User Story	As an Operations Engineer, I want to decompose the architecture of an application at different granularity levels.
Requirement	The DECOMP_TOOL should be able to allow the option of specifying the granularity level for architecture decomposition and generate a grained RADON model at that level.
Extended Description	The available levels may include coarse-grained, fine-grained and mixed-grained.
Priority	Should have
Affected Tools	DECOMP_TOOL
Means of Verification	Code review, unit tests and use cases
Dependency	R-T4.2-1 to R-T4.2-3
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ID	R-T3.2-8
Type	FUNCTIONAL_SUITABILITY
User Story	As a Software Designer, I want to distribute an application across multiple cloud platforms.
Requirement	The DECOMP_TOOL should be able to carry out architecture decomposition, deployment optimization and accuracy enhancement for a RADON model across multiple cloud platforms.
Extended Description	The supported platforms may include Amazon Web Services, Google Cloud and Microsoft Azure.
Priority	Should have
Affected Tools	DECOMP_TOOL
Means of Verification	Code review, unit tests and use cases
Dependency	R-T4.2-1 to R-T4.2-3
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ID	R-T3.2-7
Type	FUNCTIONAL_SUITABILITY
User Story	As a Software Designer, I want to integrate an application with heterogeneous cloud technologies.
Requirement	The DECOMP_TOOL should be able to carry out architecture decomposition, deployment optimization and accuracy enhancement for a RADON model with heterogeneous cloud technologies.
Extended Description	The supported technologies may include containers, virtual machines, object storages, block storages, databases, message queues, data streams and in-memory caches.
Priority	Should have
Affected Tools	DECOMP_TOOL
Means of Verification	Code review, unit tests and use cases
Dependency	R-T4.2-1 to R-T4.2-3
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ID	R-T3.2-6
Type	FUNCTIONAL_SUITABILITY
User Story	As a Software Designer, I want to add new features to a monolithic application as microservices or serverless functions.
Requirement	The DECOMP_TOOL should be able to carry out architecture decomposition, deployment optimization and accuracy enhancement for a mixed-grained RADON model.
Extended Description	A RADON application or model is said to be mixed-grained if it consists of a monolith, microservices or serverless functions with separate storages.
Priority	Should have
Affected Tools	DECOMP_TOOL
Means of Verification	Code review, unit tests and use cases
Dependency	R-T4.2-1 to R-T4.2-3
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ID	R-T3.2-5
Type	FUNCTIONAL_SUITABILITY
User Story	As an Operations Engineer, I want to enhance the accuracy of the description for an application.
Requirement	Given a deployable RADON model, the DECOMP_TOOL could be able to refine certain properties of the nodes and relationships using runtime monitoring data.
Extended Description	The refined properties may include arrival rates, numbers of users, think times, network latency and service times.
Priority	Could have
Affected Tools	DECOMP_TOOL
Means of Verification	Code review, unit tests and use cases
Dependency	R-T4.2-1 to R-T4.2-3
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ID	R-T3.2-4
Type	FUNCTIONAL_SUITABILITY
User Story	As an Operations Engineer, I want to optimize the deployment of an application on a particular cloud platform.
Requirement	Given a platform-specific RADON model, the DECOMP_TOOL must be able to obtain an optimal deployment scheme that minimizes the operating costs on the target cloud platform under the performance requirements.
Extended Description	A platform-specific RADON model comprises nodes and relationships that are dependent on a particular cloud platform.
Priority	Must have
Affected Tools	DECOMP_TOOL
Means of Verification	Code review, unit tests and use cases
Dependency	R-T4.2-1 to R-T4.2-3
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ID	R-T3.2-3
Type	FUNCTIONAL_SUITABILITY
User Story	As an Operations Engineer, I want to optimize the deployment of an application on any cloud platform.
Requirement	Given a platform-independent RADON model, the DECOMP_TOOL must be able to obtain an optimal deployment scheme that minimizes the operating costs on a specific cloud platform under the performance requirements.
Extended Description	A platform-independent RADON model comprises nodes and relationships that are agnostic of any cloud platform.
Priority	Must have
Affected Tools	DECOMP_TOOL
Means of Verification	Code review, unit tests and use cases
Dependency	R-T4.2-1 to R-T4.2-3
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ID	R-T3.2-2
Type	FUNCTIONAL_SUITABILITY
User Story	As a Software Designer, I want to decompose the architecture of a coarse-grained application based on serverless functions.
Requirement	Given a coarse-grained RADON model, the DECOMP_TOOL should be able to generate a fine-grained RADON model.
Priority	Should have
Affected Tools	DECOMP_TOOL
Means of Verification	Code review, unit tests and use cases
Dependency	R-T4.2-1 to R-T4.2-3
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ID	R-T3.2-1
Type	FUNCTIONAL_SUITABILITY
User Story	As a Software Designer, I want to decompose the architecture of a monolithic application based on microservices.
Requirement	Given a monolithic RADON model, the DECOMP_TOOL should be able to generate a coarse-grained RADON model.
Extended Description	A RADON application or model may be said to be monolithic, coarse-grained or fine-grained depending on whether it consists of a monolith, microservices or serverless functions with separate storages.
Priority	Should have
Affected Tools	DECOMP_TOOL
Means of Verification	Code review, unit tests and use cases
Dependency	R-T4.2-1 to R-T4.2-3
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ID	R-T3.2-10
Type	USABILITY
User Story	As an Operations Engineer, I want to optimize the deployment of an application with different solution methods.
Requirement	The DECOMP_TOOL should be able to allow the option of specifying the solution method for deployment optimization and obtain the optimal deployment scheme with that method.
Extended Description	The available methods may include genetic algorithms and other suitable ones.
Priority	Could have
Affected Tools	DECOMP_TOOL
Means of Verification	Code review, unit tests and use cases
Dependency	R-T4.2-1 to R-T4.2-3
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ID	R-T3.2-11
Type	USABILITY
User Story	As an Operations Engineer, I want to optimize the deployment of an application in a definite time.
Requirement	The DECOMP_TOOL should be able to allow the option of specifying the time limit for deployment optimization and return a sub-optimal deployment scheme upon time-out.
Extended Description	A sub-optimal deployment scheme is the best among those found feasible so far.
Priority	Should have
Affected Tools	DECOMP_TOOL
Means of Verification	Code review, unit tests and use cases
Dependency	R-T4.2-1 to R-T4.2-3
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ID	R-T3.2-10
Type	USABILITY
User Story	As an Operations Engineer, I want to optimize the deployment of an application with different solution methods.
Requirement	The DECOMP_TOOL should be able to allow the option of specifying the solution method for deployment optimization and obtain the optimal deployment scheme with that method.
Extended Description	The available methods may include cutting planes, branch and bound and generic heuristics.
Priority	Should have
Affected Tools	DECOMP_TOOL
Means of Verification	Code review, unit tests and use cases
Dependency	R-T4.2-1 to R-T4.2-3
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ID	R-T3.2-9
Type	USABILITY
User Story	As an Operations Engineer, I want to decompose the architecture of an application at different granularity levels.
Requirement	The DECOMP_TOOL should be able to allow the option of specifying the granularity level for architecture decomposition and generate a grained RADON model at that level.
Extended Description	The available levels may include coarse-grained, fine-grained and mixed-grained.
Priority	Should have
Affected Tools	DECOMP_TOOL
Means of Verification	Code review, unit tests and use cases
Dependency	R-T4.2-1 to R-T4.2-3
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ID	R-T3.2-8
Type	FUNCTIONAL_SUITABILITY
User Story	As a Software Designer, I want to distribute an application across multiple cloud platforms.
Requirement	The DECOMP_TOOL should be able to carry out architecture decomposition, deployment optimization and accuracy enhancement for a RADON model across multiple cloud platforms.
Extended Description	The supported platforms may include Amazon Web Services, Google Cloud and Microsoft Azure.
Priority	Should have
Affected Tools	DECOMP_TOOL
Means of Verification	Code review, unit tests and use cases
Dependency	R-T4.2-1 to R-T4.2-3
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ID	R-T3.2-7
Type	FUNCTIONAL_SUITABILITY
User Story	As a Software Designer, I want to integrate an application with heterogeneous cloud technologies.
Requirement	The DECOMP_TOOL should be able to carry out architecture decomposition, deployment optimization and accuracy enhancement for a RADON model with heterogeneous cloud technologies.
Extended Description	The supported technologies may include containers, virtual machines, object storages, block storages, databases, message queues, data streams and in-memory caches.
Priority	Should have
Affected Tools	DECOMP_TOOL
Means of Verification	Code review, unit tests and use cases
Dependency	R-T4.2-1 to R-T4.2-3
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ID	R-T3.2-6
Type	FUNCTIONAL_SUITABILITY
User Story	As a Software Designer, I want to add new features to a monolithic application as microservices or serverless functions.
Requirement	The DECOMP_TOOL should be able to carry out architecture decomposition, deployment optimization and accuracy enhancement for a mixed-grained RADON model.
Extended Description	A RADON application or model is said to be mixed-grained if it consists of a monolith, microservices or serverless functions with separate storages.
Priority	Should have
Affected Tools	DECOMP_TOOL
Means of Verification	Code review, unit tests and use cases
Dependency	R-T4.2-1 to R-T4.2-3
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ID	R-T3.2-5
Type	FUNCTIONAL_SUITABILITY
User Story	As an Operations Engineer, I want to enhance the accuracy of the description for an application.
Requirement	Given a deployable RADON model, the DECOMP_TOOL could be able to refine certain properties of the nodes and relationships using runtime monitoring data.
Extended Description	The refined properties may include arrival rates, numbers of users, think times, network latency and service times.
Priority	Could have
Affected Tools	DECOMP_TOOL
Means of Verification	Code review, unit tests and use cases
Dependency	R-T4.2-1 to R-T4.2-3
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ID	R-T3.2-4
Type	FUNCTIONAL_SUITABILITY
User Story	As an Operations Engineer, I want to optimize the deployment of an application on a particular cloud platform.
Requirement	Given a platform-specific RADON model, the DECOMP_TOOL must be able to obtain an optimal deployment scheme that minimizes the operating costs on the target cloud platform under the performance requirements.
Extended Description	A platform-specific RADON model comprises nodes and relationships that are dependent on a particular cloud platform.
Priority	Must have
Affected Tools	DECOMP_TOOL
Means of Verification	Code review, unit tests and use cases
Dependency	R-T4.2-1 to R-T4.2-3
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ID	R-T3.2-3
Type	FUNCTIONAL_SUITABILITY
User Story	As an Operations Engineer, I want to optimize the deployment of an application on any cloud platform.
Requirement	Given a platform-independent RADON model, the DECOMP_TOOL must be able to obtain an optimal deployment scheme that minimizes the operating costs on a specific cloud platform under the performance requirements.
Extended Description	A platform-independent RADON model comprises nodes and relationships that are agnostic of any cloud platform.
Priority	Must have
Affected Tools	DECOMP_TOOL
Means of Verification	Code review, unit tests and use cases
Dependency	R-T4.2-1 to R-T4.2-3
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ID	R-T3.2-2
Type	FUNCTIONAL_SUITABILITY
User Story	As a Software Designer, I want to decompose the architecture of a coarse-grained application based on serverless functions.
Requirement	Given a coarse-grained RADON model, the DECOMP_TOOL should be able to generate a fine-grained RADON model.
Priority	Should have
Affected Tools	DECOMP_TOOL
Means of Verification	Code review, unit tests and use cases
Dependency	R-T4.2-1 to R-T4.2-3
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ID	R-T3.2-1
Type	FUNCTIONAL_SUITABILITY
User Story	As a Software Designer, I want to decompose the architecture of a monolithic application based on microservices.
Requirement	Given a monolithic RADON model, the DECOMP_TOOL should be able to generate a coarse-grained RADON model.
Extended Description	A RADON application or model may be said to be monolithic, coarse-grained or fine-grained depending on whether it consists of a monolith, microservices or serverless functions with separate storages.
Priority	Should have
Affected Tools	DECOMP_TOOL
Means of Verification	Code review, unit tests and use cases
Dependency	R-T4.2-1 to R-T4.2-3
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ID	R-T3.4-9
Section	WP3: Methodology and Quality Assurance Requirements
Type	FUNCTIONAL_SUITABILITY
User Story	As an Operations Engineer I want the tool to allow me to select the source (e.g., GitHub repository) from which the tool gathers data
Requirement	The defect-prediction tool must be able to ingest data, also in real-time, from multiple sources.
Extended Description	The tool must provide data ingestion connectors to multiple sources (e.g., repositories like GitHub, Jira, etc.) to allow the users to link their repositories to the tool. This allows the real-time data ingestion and defect prediction as well as to gather more data on which to constantly train the defect predictor model.
Priority	Must have
Affected Tools	DEFECT_PRED_TOOL
Means of Verification	Direct implementation of connectors to at least Github VCS, Feature checklist
Dependency	R-T3.4-10
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ID	R-T3.4-10
Section	WP3: Methodology and Quality Assurance Requirements
Type	PERFORMANCE_EFFICIENCY
User Story	As an Operations Engineer I want the tool to find more defects than manual inspection
Requirement	The defect-prediction tool must improve performances over manual inspection
Extended Description	The tool needs to finish its analysis in less time with respect to manual inspection, without loss of effectiveness
Priority	Must have
Affected Tools	DEFECT_PRED_TOOL
Means of Verification	User study with performance improved by at least 15 percent
Dependency	
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ID	R-T3.4-11
Section	WP3: Methodology and Quality Assurance Requirements
Type	PERFORMANCE_EFFICIENCY
User Story	As an Operations Engineer I want the tool to decrease the time to inspect the infrastructure manually considerably
Requirement	The tool must diminish the time to detect defects with respect to manual inspection by at least 20 percent
Priority	Must have
Affected Tools	DEFECT_PRED_TOOL
Means of Verification	User study with time improved by at least 20 percent
Dependency	R-T3.4-10
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ID	R-T3.4-5
Section	WP3: Methodology and Quality Assurance Requirements
Type	FUNCTIONAL_SUITABILITY
User Story	As an Operations Engineer/QoS Engineer/Release Manager I want the tool to show me a score of the correctness of my infrastructure's elements (e.g., a score of the defect threat-level)
Requirement	The defect-prediction tool must provide a defect threat level to architecture elements and predict threat-level defects under certain infrastructure assumptions.
Extended Description	The user must have the opportunity to prioritize the actions to solve defects.
Priority	Must have
Affected Tools	DEFECT_PRED_TOOL
Means of Verification	Direct implementation on IDE, feature checklist, case-study
Dependency	R-T3.4-1
ID	R-T3.4-3
Section	WP3: Methodology and Quality Assurance Requirements
Type	USABILITY
User Story	As an Operations Engineer I want to use the tool with a Command Line Interface
Requirement	The defect-prediction tool could provide a command-line interface.
Extended Description	A command-line interface will display information in a raw fashion which can be parsable by other tools and applications (e.g. presenting the results as json, xml, etc.). Mainly, the requirement will be fulfilled to make sure the defect-prediction tool to be integrated with Winery/IDE as well as the delivery toolchain
Priority	Could have
Affected Tools	DEFECT_PRED_TOOL
Means of Verification	Direct implementation on IDE, feature checklist, case-study
ID	R-T3.4-1
Section	WP3: Methodology and Quality Assurance Requirements
Type	FUNCTIONAL_SUITABILITY
User Story	As an Operations Engineer I want the tool to be integrated with the IDE and other tools in RADON
Requirement	The defect-prediction tool must provide APIs to be easily integrated with other tools in RADON and with the IDE
Extended Description	The tool must be integrated with other tools in RADON as well as a plugin in popular IDEs such as Eclipse (e.g., Eclipse Che). Mainly, the requirement will be fulfilled to make sure the defect-prediction tool to be integrated with Winery/IDE as well as the delivery toolchain
Priority	Must have
Affected Tools	DEFECT_PRED_TOOL
Means of Verification	Direct implementation on IDE, feature checklist, case-study
Dependency	

ID	R-T4.1-13
Section	WP4: Modelling Environment Requirements
type	FUNCTIONAL_SUITABILITY
User Story	As a QoS Engineer/Operations Engineer, I may have difficulty expressing complicated constraints in the CDL. I would, therefore, like to be able to use the verification tool to find a set of constraints which correctly classify a set of valid/invalid RADON models and therefore need to be able to specify a space of possible constraints in which the VT can search.
Requirement	The CDL input format must be able to represent a space of possible constraints.
Extended Description	To limit the amount of expertise required by the user the expression of this space will be as a set of predicates/CDL constructs over which the VT can search. It may be best of this to be input using a graphical form.
Priority	Could have
Affected Tools	CDL
Means of Verification	
Dependency	
ID	R-T4.1-12
Section	WP4: Modelling Environment Requirements
type	FUNCTIONAL_SUITABILITY
User Story	As a QoS Engineer/Operations Engineer, I may have difficulty expressing complicated constraints in the CDL. I would, therefore, like to be able to use the verification tool to find a set of constraints which correctly classify a set of valid/invalid RADON models and therefore need to be able to specify examples of valid/invalid RADON models in the CDL input format.
Requirement	The CDL input format must be able to represent sets of valid/invalid RADON models.
Extended Description	
Priority	Could have
Affected Tools	CDL
Means of Verification	
Dependency	
ID	R-T4.1-14
Section	WP4: Modelling Environment Requirements
type	FUNCTIONAL_SUITABILITY
User Story	As a QoS Engineer/Operations Engineer, I may have difficulty expressing complicated constraints in the CDL. I would, therefore, like to be able to use the verification tool to find a set of constraints which correctly classify a set of valid/invalid RADON models.
Requirement	Given a set of valid and a set of invalid RADON models, a space of possible constraints, and a partial CDL specification, the VT must be able to complete the specification such that all the valid models conform to the completed specification and none of the invalid models do so.
Extended Description	This computation will occur offline.
Priority	Could have
Affected Tools	VT
Means of Verification	Validation on a set of CDL learning tasks
Dependency	R-T4.1-1, R-T4.1-2, R-T4.1-3, R-T4.12, R-T4.13

ID	R-T4.1-11
Section	WP4: Modelling Environment Requirements
type	FUNCTIONAL_SUITABILITY
User Story	As a QoS Engineer/Operations Engineer, I want to be able to guarantee that in a dynamic situation, where new devices are being continually added and taken away, these dynamic changes are guaranteed not to cause my RADON model to violate my hard constraint.
Requirement	Given a space of possible RADON models (in a dynamic situation, new devices such as robotic assistants may be added/taken away), the tool could verify that any RADON model in the space complies with a set of hard constraints.
Extended Description	This computation may take place offline.
Priority	Could have
Affected Tools	VT
Means of Verification	Proof of soundness and completeness. This constitutes proving that any violating RADON model within the space will be found (completeness) and that if a RADON model in the space is reported to be violating, it does indeed violate at least one hard constraint (soundness).
Dependency	R-T4.1-1, R-T4.1-2, R-T4.1-3
ID	R-T4.1-10
Section	WP4: Modelling Environment Requirements
type	PERFORMANCE_EFFICIENCY
User Story	As a QoS Engineer/Operations Engineer, I would like the suggestion of how to correct a RADON model that violates some of my constraints to be provided in real-time.
Requirement	This computation should complete within a predefined maximum time.
Extended Description	In case conditions are not satisfied, the tool should be able to provide a counterexample as an explanation, detailing which nodes violate which constraint. For some hard constraints it may be necessary to give a search space (e.g. a maximum bound on the time steps).
Priority	Could have
Affected Tools	VT
Means of Verification	Empirical evaluation on a test set of large violating RADON models.
Dependency	R-T4.1-9
ID	R-T4.1-9
Section	WP4: Modelling Environment Requirements
type	FUNCTIONAL_SUITABILITY
User Story	As a QoS Engineer/Operations Engineer, I would like to be able to use the verification tool to get a suggestion of how to correct a RADON model that violates some of my constraints.
Requirement	Given a RADON model that violates some constraints, the tool could provide corrections to the RADON model to ensure that it complies with the constraints.
Extended Description	We may search for minimal changes. Minimal changes are desirable to keep the model as close to the model that the user intended.
Priority	Could have
Affected Tools	VT
Means of Verification	Formal proofs of completeness (the algorithm finds a correction if one exists), soundness (any correction reported by the algorithm is guaranteed to be valid).
Dependency	R-T4.1-1, R-T4.1-2, R-T4.1-3

ID	R-T4.1-8
Section	WP4: Modelling Environment Requirements
ype	PERFORMANCE_EFFICIENCY
User Story	As a QoS Engineer/Operations Engineer I want to test RADON model for existence of race conditions and/or execution loops in real time.
Requirement	The computation to check for race conditions, execution loops and deadlocks should return within a predefined maximum time.
Extended Description	
Priority	Should have
Affected Tools	VT
Means of Verification	Emperical evaluation on a test set of large RADON models, some with race conditions, loops and/or deadlocks, some without.
Dependency	R-T4.1-7
ID	R-T4.1-7
Section	WP4: Modelling Environment Requirements
ype	FUNCTIONAL_SUITABILITY
User Story	As a QoS Engineer/Operations Engineer I want to test RADON model for existence of race conditions and/or execution loops.
Requirement	The verification tool should be able to check for the existence of potential race conditions and/or execution loops and related deadlocks that could happen.
Extended Description	For instance different operators receiving requests for different actions regarding the same patient or which require sharing of resources of robotic assistants. In the case that such events can occur, the tool should provide an example trace as explanation.
Priority	Should have
Affected Tools	VT
Means of Verification	Formal proof of the soundness and completeness of the verification algorithm
Dependency	R-T4.1-1, R-T4.1-2, R-T4.1-3
ID	R-T4.1-6
Section	WP4: Modelling Environment Requirements
ype	PERFORMANCE_EFFICIENCY
User Story	As a QoS Engineer/Operations Engineer I want to verify if specified constraints are satisfied for a given RADON model in real-time.
Requirement	This computation to check whether hard constraints are satisfied by a RADON model should return within a predefined maximum time.
Extended Description	
Priority	Must have
Affected Tools	VT
Means of Verification	Empirical evaluation on a test set of large RADON models.
Dependency	R-T4.1-5

ID	R-T4.1-5
Section	WP4: Modelling Environment Requirements
type	FUNCTIONAL_SUITABILITY
User Story	As a QoS Engineer/Operations Engineer I want to verify if specified constraints are satisfied for a given RADON model.
Requirement	The verification tool must be able to check that hard constraints are guaranteed to be satisfied by a given RADON model.
Extended Description	In case conditions are not satisfied, the tool should be able to provide a counterexample as an explanation, detailing which nodes violate which constraint. For some hard constraints it may be necessary to give a search space (e.g. a maximum bound on the time steps).
Priority	Must have
Affected Tools	VT
Means of Verification	Formal proof of the soundness and completeness of the verification algorithm.
Dependency	R-T4.1-1, R-T4.1-2, R-T4.1-3
ID	R-T4.1-4
Section	WP4: Modelling Environment Requirements
type	FUNCTIONAL_SUITABILITY
User Story	As a QoS Engineer/Software Designer I want to express soft constraints on security and performance of serverless functions, microservices and data pipelines using the CDL.
Requirement	The CDL should be able to express soft constraints on the required security/performance.
Extended Description	For example, there may be a hard constraint on the maximum latency, but a soft constraint expressing that even if the latency is within the required level, the lowest possible latency is preferred. The soft constraints should be weighted and prioritised, in order to allow us to reason about trade-offs (e.g. in some cases, soft constraints on latency may be less important than soft constraints on security).
Priority	Should have
Affected Tools	CDL
Means of Verification	A check that the CDL can express a set of required soft constraints for a set of different use cases.
Dependency	
ID	R-T4.1-3
Section	WP4: Modelling Environment Requirements
type	FUNCTIONAL_SUITABILITY
User Story	As a QoS Engineer/Software Designer I want to express that a set of nodes respect a given architectural pattern (e.g. a Lambda).
Requirement	The CDL must be able to express hard constraints on the architectural patterns of sets of nodes.
Extended Description	
Priority	Must have
Affected Tools	CDL
Means of Verification	A check that the CDL can express at least three different architectural patterns using simple built-in predicates, and that the user is able to define these same architectural patterns manually, without using the built-ins.
Dependency	

ID	R-T4.1-2
Section	WP4: Modelling Environment Requirements
ype	FUNCTIONAL_SUITABILITY
User Story	As a QoS Engineer/Software Designer I want to express hard constraints on security and performance of serverless functions, microservices and data pipelines using the CDL.
Requirement	The CDL must be able to express hard constraints on the required security/performance.
Extended Description	Security conditions include constraints on the encryption / access control of personal data. One example of a performance constraint is a guarantee of low-latency.
Priority	Must have
Affected Tools	CDL
Means of Verification	A check that the CDL can express a set of required hard constraints for a set of different use cases.
Dependency	
ID	R-T4.1-1
Section	WP4: Modelling Environment Requirements
ype	FUNCTIONAL_SUITABILITY
User Story	As a QoS Engineer/Software Designer I want to express pre/post conditions for serverless functions using a CDL.
Requirement	The CDL must be able to express pre/post conditions of serverless functions regarding security/performance.
Extended Description	
Priority	Must have
Affected Tools	CDL
Means of Verification	A check that the CDL can express pre/post conditions for a set of different serverless functions.
Dependency	
ID	R-T3.3-4
Section	WP3: Methodology and Quality Assurance Requirements
ype	FUNCTIONAL_SUITABILITY
User Story	As a QoS Engineer, I want the testing tool to generate performance metrics for the data pipeline under testing.
Requirement	The data pipeline testing module of the TESTING_TOOL should be able to analyze log data of the data pipeline under test to generate performance metrics.
Extended Description	The goal is to analyse log data to generate performance metrics (e.g. latency/delay, error rate, dropped packets), which are required for evaluating the quality of the data pipelines.
Priority	Should have
Affected Tools	TESTING_TOOL
Means of Verification	Tests with different data pipeline test cases to verify that the performance metrics are generated correctly.
Dependency	R-T5.1-3

ID	R-T3.3-15
Section	WP3: Methodology and Quality Assurance Requirements
Type	USABILITY
User Story	As a QoS Engineer, I want to be able to specify tests using CLI.
Requirement	The FaaS testing module of the TESTING_TOOL should have a command line interface.
Extended Description	A CLI can be used to specify test execution. Furthermore, a CLI can be useful to display, e.g., to display raw results, in a format parsable by other tools and applications (e.g., CSV, XML, JSON).
Priority	Should have
Affected Tools	TESTING_TOOL
Means of Verification	Tests and demos
Dependency	N/A
ID	R-T3.3-8
Section	WP3: Methodology and Quality Assurance Requirements
Type	USABILITY
User Story	As a QoS Engineer, I want to be able to configure a set of different data production profiles that will be checked/evaluated in a sequence in an automated manner.
Requirement	It could be useful for the data pipeline testing module of the TESTING_TOOL to support running multiple different tests in a sequence on the same data pipeline.
Extended Description	The goal is to support running a sequence of performance tests without requiring user intervention.
Priority	Could have
Affected Tools	TESTING_TOOL
Means of Verification	Tests with a prepared set of testing configurations on different data pipelines to verify that all tests were run successfully
Dependency	R-T5.4-1 (using the RADON Orchestrator data pipeline plugins to deploy and control data pipelines under testing)
ID	R-T3.3-7
Section	WP3: Methodology and Quality Assurance Requirements
Type	USABILITY
User Story	As a QoS Engineer, I want to be able to use a graphical user interface for configuring the tool and displaying generated metrics and visualizations.
Requirement	It could be useful for the data pipeline testing module of the TESTING_TOOL to have a graphical user interface for configuring tests and displaying test results.
Extended Description	The goal is to provide a more user friendly interface for configuring tests and displaying results
Priority	Could have
Affected Tools	TESTING_TOOL
Means of Verification	Tests with different data pipeline test cases to verify that all necessary information is displayed correctly on the user interface.
Dependency	N/A

ID	R-T3.3-6
Section	WP3: Methodology and Quality Assurance Requirements
Type	FUNCTIONAL_SUITABILITY
User Story	As a QoS Engineer, I want to be able to configure critical lower and upper bounds of performance metrics and visualize them.
Requirement	It could be useful if users can configure upper and lower bounds in the data pipeline testing module of the TESTING_TOOL for the performance metrics that are computed.
Extended Description	Specifying upper and lower bounds for performance metrics could be used for defining visual alerts that indicate when the data pipeline under test is performing supoptimal to the desired performance.
Priority	Could have
Affected Tools	TESTING_TOOL
Means of Verification	Tests with different data pipeline test cases and production profiles to verify that the tool recognises when upper and lower bounds of performance metrics have been reached
Dependency	N/A
ID	R-T3.3-5
Section	WP3: Methodology and Quality Assurance Requirements
Type	USABILITY
User Story	As a QoS Engineer, I want to see the visualization of the computed performance metrics.
Requirement	The data pipeline testing module of the TESTING_TOOL could be able to display graphical representation of performance metrics.
Extended Description	The goal is to have visual graphs generated from the log data for each of the performance metrics.
Priority	Could have
Affected Tools	TESTING_TOOL
Means of Verification	Tests with different data pipeline test cases to verify that graphs have been generated correctly
Dependency	N/A
ID	R-T3.3-4
Section	WP3: Methodology and Quality Assurance Requirements
Type	FUNCTIONAL_SUITABILITY
User Story	As a QoS Engineer, I want the testing tool to generate performance metrics for the data pipeline under testing.
Requirement	The data pipeline testing module of the TESTING_TOOL should be able to ingest and analyze log data of the data pipeline under test to generate performance metrics for the deployed data pipeline.
Extended Description	The goal is to parse and process the log data to generate performance metrics (e.g. latency/delay, error rate, dropped packets), which are required for evaluating the quality of the data pipeline.
Priority	Should have
Affected Tools	TESTING_TOOL
Means of Verification	Tests with different data pipeline test cases to verify that the log data was parsed correctly.
Dependency	R-T5.1-3

ID	R-T3.3-3
Section	WP3: Methodology and Quality Assurance Requirements
Type	FUNCTIONAL_SUITABILITY
User Story	As a QoS Engineer, I want to be able to inject data producing components into the data pipeline (under testing) for generating test data into the pipeline.
Requirement	The data pipeline testing module of the TESTING_TOOL must be able to inject additional pipeline components into the data pipeline for generating synthetic input data.
Extended Description	The goal is to support creating and adding data pipeline components that mock the input streams by generating synthetic data into the data pipeline.
Priority	Must have
Affected Tools	TESTING_TOOL
Means of Verification	Tests with different RADON data pipelines to verify that the components were injected and the modified data pipeline can be deployed successfully
Dependency	N/A
ID	R-T3.3-2
Section	WP3: Methodology and Quality Assurance Requirements
Type	FUNCTIONAL_SUITABILITY
User Story	As a QoS Engineer, I want to be able to define custom data production profiles, based on which load testing data will be generated.
Requirement	The data pipeline testing module of the TESTING_TOOL should support user configurable data production profiles.
Extended Description	Data production profiles define what type and format data needs to be generated and to specify what is the profile of generated data flow.
Priority	Should have
Affected Tools	TESTING_TOOL
Means of Verification	Using test case data production profiles for generating data into data pipeline and verifying that the produced data matches the profile.
Dependency	N/A
ID	R-T.3.3-16
Section	WP3: Methodology and Quality Assurance Requirements
Type	USABILITY
User Story	As a Software Engineer, I want continuous testing to be integrated into my development workflow
Requirement	The FaaS testing module of the TESTING_TOOL must be integrated into DevOps practices.
Extended Description	This includes DevOps properties such as multiple teams, continuous development, fast feedback cycles, etc.
Priority	Must have
Affected Tools	TESTING_TOOL
Means of Verification	Qualitative by demonstrating based on the RADON methodology and case studies
Dependency	N/A
ID	R-T.3.3-14
Section	WP3: Methodology and Quality Assurance Requirements
Type	USABILITY
User Story	As a QoS Engineer, I want to be able to specify tests using a GUI.
Requirement	The FaaS testing module of the TESTING_TOOL must have a graphic user interface.
Extended Description	The FaaS module of the TESTING_TOOL must graphically provide information about the generated tests, as well as the input data and state of the infrastructure, which will be used.
Priority	Must have
Affected Tools	TESTING_TOOL
Means of Verification	Tests and demos
Dependency	N/A

ID	R-T.3.3-13
Section	WP3: Methodology and Quality Assurance Requirements
Type	FUNCTIONAL_SUITABILITY
User Story	As a QoS Engineer, I want the test results to be visualized.
Requirement	The FaaS testing module of the TESTING_TOOL could have a report feature.
Extended Description	The results might even be presented in the UI.
Priority	Could have
Affected Tools	TESTING_TOOL
Means of Verification	Tests and demos
Dependency	Possibly R-T4.3-7
ID	R-T.3.3-12
Section	WP3: Methodology and Quality Assurance Requirements
Type	FUNCTIONAL_SUITABILITY
User Story	As a QoS Engineer, I want my tests to be updated automatically based on production data.
Requirement	The FaaS testing module of the TESTING_TOOL must be able to analyze monitoring data from production and update the annotations in the RADON model.
Extended Description	The focus of the extraction is on the workload data but may also include inputs. Actually not the tests are updated but the RADON model annotations.
Priority	Must have
Affected Tools	TESTING_TOOL
Means of Verification	Comparison of original measures with the results of running the extracted tests.
Dependency	RADON models must provide the respective annotations, The runtime platform must provide the respective data
ID	R-T.3.3-11
Section	WP3: Methodology and Quality Assurance Requirements
Type	FUNCTIONAL_SUITABILITY
User Story	As a QoS Engineer, I want the CD pipeline to execute manually specified and generated tests.
Requirement	The FaaS testing module of the TESTING_TOOL must support the execution of tests cases in the CD pipeline.
Extended Description	The tool must be able to interpret and execute the test specifications. The execution involves potentially spawning parts of the testing environment.
Priority	Must have
Affected Tools	TESTING_TOOL
Means of Verification	Tests with different test cases
Dependency	R-T.3.3-10
ID	R-T4.2-8
Section	WP4: Modeling Environment
Type	FUNCTIONAL_SUITABILITY
User Story	As a Software Developer, I want to model API Gateway resources in AWS that trigger functions in AWS Lambda.
Requirement	Being able to model API Gateway resources in AWS.
Extended Description	A RADON Model should contain an API Gateway resource with respective configuration to trigger a FaaS function hosted in AWS Lambda.
Affected Tools	GRAPHMODEL_TOOL
Means of Verification	Model review with partners and PRQ case study.
Dependency	N/A

ID	R-T4.2-7
Section	WP4: Modeling Environment
Type	FUNCTIONAL_SUITABILITY
User Story	As a QoS Engineer/Software Developer, I want to define test case specifications in the models.
Requirement	The models must be able to include the description of test cases for certain components (annotate test-related information).
Extended Description	There must be test case specifications for components in the model, which are used to generate tests in the final runtime.
Affected Tools	GRAPHMODEL_TOOL
Means of Verification	Model review with partners and case study.
Dependency	N/A
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ID	R-T4.2-6
Section	WP4: Modeling Environment
Type	FUNCTIONAL_SUITABILITY
User Story	As a Software Designer/Software Developer/QoS Engineer, I can define data (un-)compression for data pipelines.
Requirement	The models could define configurations regarding data compression and uncompression for certain processing components.
Extended Description	For example to reduce the size of data that is flown through the specified data pipeline.
Affected Tools	GRAPHMODEL_TOOL
Means of Verification	Model review with partners and case study.
Dependency	T5.4
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ID	R-T4.2-5
Section	WP4: Modeling Environment
Type	FUNCTIONAL_SUITABILITY
User Story	As a Software Designer/Software Developer/QoS Engineer, I want to express scaling attributes for data processing components in my application models.
Requirement	The models should be able to define how and when to scale certain computing resources.
Extended Description	For example, the computing resources allocated to data pipelines in order to be able to respond to the changes in the rate of ingested data.
Affected Tools	GRAPHMODEL_TOOL
Means of Verification	Model review with partners and case study.
Dependency	T5.1, T5.4
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ID	R-T4.2-4
Section	WP4: Modeling Environment
Type	FUNCTIONAL_SUITABILITY
User Story	As a Software Designer/Software Developer/QoS Engineer, I want to define preconditions for data pipelines in the application model.
Requirement	The models should be able to define certain preconditions for filtering which data objects to move/stream through the pipeline.
Extended Description	For example to filter which types of log entries should be ingested or to only move files that are older than X hours.
Affected Tools	GRAPHMODEL_TOOL
Means of Verification	Model review with partners and case study.
Dependency	T5.4
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ID	R-T4.2-3
Section	WP4: Modeling Environment
Type	FUNCTIONAL_SUITABILITY
User Story	As a Software Designer/Software Developer/Operations Engineer, I want to represent behavioral aspects (e.g. data pipelines, event flow) in my application models.
Requirement	The models must be able to define different kinds of data processing tasks and control flow elements in order to express the behavior of my application.
Extended Description	For example, jobs that process analytics data or moving files between different storage systems. Further, the modeling of timed schedules must be supported.
Affected Tools	GRAPHMODEL_TOOL
Means of Verification	Model review with partners and case study.
Dependency	T5.4
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ID	R-T4.2-2
Section	WP4: Modeling Environment
Type	MAINTAINABILITY
User Story	As a Software Designer/Software Developer/Operations Engineer, I want to use a library/repository of existing blueprints to model desired applications.
Requirement	In RADON we should provide a repository (e.g., GitHub) to provide reusable types and blueprints.
Extended Description	To simplify modeling of complex topologies, existing and deployable blueprints must be available as building blocks for reuse.
Affected Tools	GRAPHMODEL_TOOL
Means of Verification	Case study
Dependency	T5.2
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ID	R-T4.2-1
Section	WP4: Modeling Environment
Type	FUNCTIONAL_SUITABILITY
User Story	As a Software Designer/Software Developer/Operations Engineer, I want to model heterogeneous application topologies (FaaS, microservices, third-party and cloud-native resources).
Requirement	The models must allow expressing combinations of different deployment types including paradigm-specific elements, e.g., events and triggers.
Extended Description	RADON model must allow expressing combinations of different deployment types including paradigm-specific elements, e.g., events and triggers.
Affected Tools	GRAPHMODEL_TOOL
Means of Verification	Model review with partners and case study.
Dependency	N/A
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ID	R-T2.3-25
Section	Integrated Framework
Type	USABILITY
User Story	As a Software Developer/Operations Engineer/QoS Engineer I want to interact with the RADON framework by means of a custom RADON menu providing custom commands (e.g. to open an help page or a monitoring view and to launch the integrated RADON tools)
Requirement	The IDE must provide a custom RADON menu providing custom commands in order to interact with the RADON framework
Extended Description	The IDE will provide a RADON menu and custom commands through which the user can interact with the RADON framework (e.g. launching the the integrated RADON tools, opening the RADON Help page, opening a browser windows with monitoring information etc.)
Priority	Must have
Affected Tools	IDE
Means of Verification	Availability of the RADON Menu and demo based
Dependency	N/A
ID	R-T2.3-24
Section	Integrated Framework
Type	USABILITY
User Story	As a Software Developer/Operations Engineer/QoS Engineer I want to interact with the integrated RADON tools via UI elements (e.g. menu, popup window, views, tree)
Requirement	The IDE must provide UI elements (e.g. menu, popup window, views, tree etc) for the interaction with the integrated RADON tools
Extended Description	In order to increase usability, the IDE will support the interaction with the integrated RADON tools using the UI elements (e.g. menu, popup window, views, tree etc) that best fit to the tool's needs
Priority	Must have
Affected Tools	IDE
Means of Verification	Demo based
Dependency	N/A
ID	R-T2.3-22
Section	Integrated Framework
Type	FUNCTIONAL_SUITABILITY
User Story	As an Operations Engineer/Release Manager I want to monitor the status of the deployment process
Requirement	The IDE must provide support in showing the monitoring information collected by the MONITORING_SYSTEM
Extended Description	The IDE will connect to a dashboard to keep users updated on the status of the deployment stages
Priority	Must have
Affected Tools	IDE, MONITORING_SYSTEM
Means of Verification	Connection to the monitoring information from the IDE and demo based
Dependency	R-T5.1-3

ID	R-T2.3-20
Section	Integrated Framework
Type	FUNCTIONAL_SUITABILITY
User Story	As a Software Developer, I want to use a source code editor with support for TOSCA grammar
Requirement	The IDE should provide a source code editor with support for the TOSCA grammar
Extended Description	The IDE should provide a source code editor with syntax highlighting and code completion for the TOSCA grammar
Priority	Should have
Affected Tools	IDE
Means of Verification	Availability in the IDE of a source code editor with TOSCA grammar support
Dependency	N/A
ID	R-T2.3-16
Section	Integrated Framework
Type	FUNCTIONAL_SUITABILITY
User Story	As a Software Developer, I want to visualize changes made within the IDE in the GMT and vice versa
Requirement	The IDE must support the synchronization of changes made from within IDE with the GMT and vice versa
Extended Description	Changes made from within IDE will be synchronized with GMT and vice versa, e.g. when function's source code or a TOSCA definition is changed directly in the workspace, GMT has to highlight that the corresponding entity was modified
Priority	Must have
Affected Tools	IDE, GMT
Means of Verification	Integration of the GMT into the IDE and demo based
Dependency	N/A
ID	R-T2.3-15
Section	Integrated Framework
Type	FUNCTIONAL_SUITABILITY
User Story	As a Software Developer, I want to access projects inside a workspace from the GMT
Requirement	The IDE must support the integration of a Winery plugin in order to navigate from the GMT to the respective workspace where the source code is maintained
Extended Description	Winery/GMT will need to register a plugin in order to interact with a workspace (e.g. to open a respective source code editor if someone wants to edit an attached TOSCA code artifact)
Priority	Must have
Affected Tools	IDE, GMT
Means of Verification	Integration of the GMT into the IDE and demo based
Dependency	R-T4.3-2, R-T4.3-3
ID	R-T2.3-12
Section	Integrated Framework
Type	FUNCTIONAL_SUITABILITY
User Story	As a Software Developer, I want to create a RADON-based workspace
Requirement	The IDE must provide the opportunity to create a new RADON-based workspace
Extended Description	The RADON-based workspace will provide a stack having all the tools, plugins and extensions enabled (e.g. Theia IDE, cloning of TOSCA type repo, Winery, Verification Tool, Decomposition Tool, etc.)
Priority	Must have
Affected Tools	IDE
Means of Verification	Availability of a RADON-based workspace in the IDE
Dependency	N/A

ID	R-T2.3-11
Section	Integrated Framework
Type	FUNCTIONAL_SUITABILITY
User Story	As a Software Developer, I want to model deployment configuration to automatically generate deployment scripts
Requirement	The IDE must support the deployment process in order to automatically generate and execute deployment scripts
Extended Description	The IDE will support the deployment of FaaS-based applications on the target clouds
Priority	Must have
Affected Tools	IDE, DELIVERY_TOOLCHAIN
Means of Verification	Tests and demo based
Dependency	N/A
ID	R-T2.3-10
Section	Integrated Framework
Type	FUNCTIONAL_SUITABILITY
User Story	As a Software Developer, I want to progressively refine the application model and the application code through periodic commit on the source repositories
Requirement	The IDE must provide connectors to CI/CD tools in order to enable the continuous release of applications via the automatic management of repository update notifications
Extended Description	Once received a notification about the repository update the CI/CD tools will manage it by fetching the updates from the repository and performing compilation and assembly operation of source code. The IDE will provide connectors to CI/CD pipelines to automate application releases
Priority	Must have
Affected Tools	IDE, DELIVERY_TOOLCHAIN
Means of Verification	Tests and demo based
Dependency	N/A
ID	R-T2.3-8
Section	Integrated Framework
Type	FUNCTIONAL_SUITABILITY
User Story	As a QoS Engineer, I want to receive test results in the form of a comprehensive report
Requirement	The IDE must provide access to a report based on the results received from the TESTING_TOOL
Extended Description	The IDE must be able to retrieve the results of the tests from the TESTING_TOOL and show them with a graphical representation and textual explanation of the data
Priority	Must have
Affected Tools	IDE, TESTING_TOOL
Means of Verification	Tests and demo based on the case study scenarios
Dependency	R-T3.3-5, R-T3.3-7, R-T.3.3-13
ID	R-T2.3-7
Section	Integrated Framework
Type	FUNCTIONAL_SUITABILITY
User Story	As a QoS Engineer, I want to be able to maintain my continuous tests
Requirement	The IDE must provide support in launching the TESTING_TOOL and to trigger the execution of tests
Extended Description	The TESTING_TOOL will be integrated on the IDE in order to support the annotation of the RADON models with test-related information
Priority	Must have
Affected Tools	IDE, TESTING_TOOL
Means of Verification	Tests and demo based on the case study scenarios
Dependency	R-T3.3-6, R-T3.3-7, R-T.3.3-14, R-T.3.3-14

ID	R-T2.3-6
Section	Integrated Framework
Type	SECURITY
User Story	As a Software Developer, I want to secure application workspaces from unauthorized users
Requirement	To secure application and services the IDE must provide identity and access management functionalities
Extended Description	Authentication and authorization management capabilities will be applied to regulate access to different IDE's entities (e.g. workspaces, stacks etc..)
Priority	Must have
Affected Tools	IDE
Means of Verification	Support of access control policies
Dependency	N/A
ID	R-T2.3-1
Section	Integrated Framework
Type	FUNCTIONAL_SUITABILITY
User Story	As a Software Developer, I want to develop application in a parallel manner
Requirement	The IDE must be able to support development by teams that work in parallel on the application
Extended Description	Several developers will be able to work on the same application without the need to install software.
Priority	Must have
Affected Tools	IDE
Means of Verification	Collaboration between team members
Dependency	R-T2.3-6
ID	R-T2.3-25
Section	Integrated Framework
Type	USABILITY
User Story	As a Software Developer/Operations Engineer/QoS Engineer I want to interact with the RADON framework by means of a custom RADON menu providing custom commands (e.g. to open an help page or a monitoring view and to launch the integrated RADON tools)
Requirement	The IDE must provide a custom RADON menu providing custom commands in order to interact with the RADON framework
Extended Description	The IDE will provide a RADON menu and custom commands through which the user can interact with the RADON framework (e.g. launching the the integrated RADON tools, opening the RADON Help page, opening a browser windows with monitoring information etc.)
Priority	Must have
Affected Tools	IDE
Means of Verification	Availability of the RADON Menu and demo based
Dependency	N/A

ID	R-T2.3-24
Section	Integrated Framework
Type	USABILITY
User Story	As a Software Developer/Operations Engineer/QoS Engineer I want to interact with the integrated RADON tools via UI elements (e.g. menu, popup window, views, tree)
Requirement	The IDE must provide UI elements (e.g. menu, popup window, views, tree etc) for the interaction with the integrated RADON tools
Extended Description	In order to increase usability, the IDE will support the interaction with the integrated RADON tools using the UI elements (e.g. menu, popup window, views, tree etc) that best fit to the tool's needs
Priority	Must have
Affected Tools	IDE
Means of Verification	Demo based
Dependency	N/A
ID	R-T2.3-22
Section	Integrated Framework
Type	FUNCTIONAL_SUITABILITY
User Story	As an Operations Engineer/Release Manager I want to monitor the status of the deployment process
Requirement	The IDE must provide support in showing the monitoring information collected by the MONITORING_SYSTEM
Extended Description	The IDE will connect to a dashboard to keep users updated on the status of the deployment stages
Priority	Must have
Affected Tools	IDE, MONITORING_SYSTEM
Means of Verification	Connection to the monitoring information from the IDE and demo based
Dependency	R-T5.1-3
ID	R-T2.3-20
Section	Integrated Framework
Type	FUNCTIONAL_SUITABILITY
User Story	As a Software Developer, I want to use a source code editor with support for TOSCA grammar
Requirement	The IDE should provide a source code editor with support for the TOSCA grammar
Extended Description	The IDE should provide a source code editor with syntax highlighting and code completion for the TOSCA grammar
Priority	Should have
Affected Tools	IDE
Means of Verification	Availability in the IDE of a source code editor with TOSCA grammar support
Dependency	N/A
ID	R-T2.3-16
Section	Integrated Framework
Type	FUNCTIONAL_SUITABILITY
User Story	As a Software Developer, I want to visualize changes made within the IDE in the GMT and vice versa
Requirement	The IDE must support the synchronization of changes made from within IDE with the GMT and vice versa
Extended Description	Changes made from within IDE will be synchronized with GMT and vice versa, e.g. when function's source code or a TOSCA definition is changed directly in the workspace, GMT has to highlight that the corresponding entity was modified
Priority	Must have
Affected Tools	IDE, GMT
Means of Verification	Integration of the GMT into the IDE and demo based
Dependency	N/A

ID	R-T2.3-15
Section	Integrated Framework
Type	FUNCTIONAL_SUITABILITY
User Story	As a Software Developer, I want to access projects inside a workspace from the GMT
Requirement	The IDE must support the integration of a Winery plugin in order to navigate from the GMT to the respective workspace where the source code is maintained
Extended Description	Winery/GMT will need to register a plugin in order to interact with a workspace (e.g. to open a respective source code editor if someone wants to edit an attached TOSCA code artifact)
Priority	Must have
Affected Tools	IDE, GMT
Means of Verification	Integration of the GMT into the IDE and demo based
Dependency	R-T4.3-2, R-T4.3-3
ID	R-T2.3-12
Section	Integrated Framework
Type	FUNCTIONAL_SUITABILITY
User Story	As a Software Developer, I want to create a RADON-based workspace
Requirement	The IDE must provide the opportunity to create a new RADON-based workspace
Extended Description	The RADON-based workspace will provide a stack having all the tools, plugins and extensions enabled (e.g. Theia IDE, cloning of TOSCA type repo, Winery, Verification Tool, Decomposition Tool, etc.)
Priority	Must have
Affected Tools	IDE
Means of Verification	Availability of a RADON-based workspace in the IDE
Dependency	N/A
ID	R-T2.3-11
Section	Integrated Framework
Type	FUNCTIONAL_SUITABILITY
User Story	As a Software Developer, I want to model deployment configuration to automatically generate deployment scripts
Requirement	The IDE must support the deployment process in order to automatically generate and execute deployment scripts
Extended Description	The IDE will support the deployment of FaaS-based applications on the target clouds
Priority	Must have
Affected Tools	IDE, DELIVERY_TOOLCHAIN
Means of Verification	Tests and demo based
Dependency	N/A
ID	R-T2.3-10
Section	Integrated Framework
Type	FUNCTIONAL_SUITABILITY
User Story	As a Software Developer, I want to progressively refine the application model and the application code through periodic commit on the source repositories
Requirement	The IDE must provide connectors to CI/CD tools in order to enable the continuous release of applications via the automatic management of repository update notifications
Extended Description	Once received a notification about the repository update the CI/CD tools will manage it by fetching the updates from the repository and performing compilation and assembly operation of source code. The IDE will provide connectors to CI/CD pipelines to automate application releases
Priority	Must have
Affected Tools	IDE, DELIVERY_TOOLCHAIN
Means of Verification	Tests and demo based
Dependency	N/A

ID	R-T2.3-8
Section	Integrated Framework
Type	FUNCTIONAL_SUITABILITY
User Story	As a QoS Engineer, I want to receive test results in the form of a comprehensive report
Requirement	The IDE must provide access to a report based on the results received from the TESTING_TOOL
Extended Description	The IDE must be able to retrieve the results of the tests from the TESTING_TOOL and show them with a graphical representation and textual explanation of the data
Priority	Must have
Affected Tools	IDE, TESTING_TOOL
Means of Verification	Tests and demo based on the case study scenarios
Dependency	R-T3.3-5, R-T3.3-7, R-T.3.3-13
ID	R-T2.3-7
Section	Integrated Framework
Type	FUNCTIONAL_SUITABILITY
User Story	As a QoS Engineer, I want to be able to maintain my continuous tests
Requirement	The IDE must provide support in launching the TESTING_TOOL and to trigger the execution of tests
Extended Description	The TESTING_TOOL will be integrated on the IDE in order to support the annotation of the RADON models with test-related information
Priority	Must have
Affected Tools	IDE, TESTING_TOOL
Means of Verification	Tests and demo based on the case study scenarios
Dependency	R-T3.3-6, R-T3.3-7,R-T.3.3-14, R-T.3.3-14
ID	R-T2.3-6
Section	Integrated Framework
Type	SECURITY
User Story	As a Software Developer, I want to secure application workspaces from unauthorized users
Requirement	To secure application and services the IDE must provide identity and access management functionalities
Extended Description	Authentication and authorization management capabilities will be applied to regulate access to different IDE's entities (e.g. workspaces, stacks etc..)
Priority	Must have
Affected Tools	IDE
Means of Verification	Support of access control policies
Dependency	N/A
ID	R-T2.3-1
Section	Integrated Framework
Type	FUNCTIONAL_SUITABILITY
User Story	As a Software Developer, I want to develop application in a parallel manner
Requirement	The IDE must be able to support development by teams that work in parallel on the application
Extended Description	Several developers will be able to work on the same application without the need to install software.
Priority	Must have
Affected Tools	IDE
Means of Verification	Collaboration between team members
Dependency	R-T2.3-6

ID	R-T5.16
Section	WP5: Toolchain
Type	USABILITY
User Story	As a user I want to bootstrap my workflow by selecting from a template of CI configurations
Requirement	Provide Jenkinsfiles with suggested setup for CI/CD
Extended Description	The Jenkinsfile should provide the end-user with a best practice approach for getting started with CI/CD in the scope of RADON.
Affected Tools	CI/CD
Means of Verification	Manual
Dependency	N/A
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ID:	FR-T5.2-16
Type:	USABILITY
User story:	As a user I would like to list all the versions of a template.
Requirement:	Template library CLI must support listing versions.
Extended Description:	Listing versions should be done by the name of a template or by the ID of the template.
Priority:	Must have
Affected Tools:	TEMPLATE_LIBRARY
Means of Verification:	Using template library CLI command to list all versions of a template (by name or id of the template).
<hr/>	
ID:	FR-T5.2-15
Type:	USABILITY
User story:	As a user I want to be able to save entities by versions and retrieve them when needed.
Requirement:	Template library publishing service needs to enable saving entities and adding new versions. User needs to be able to retrieve a version.
Extended Description:	Versions need to be unchangeable entries that offer stability in the development stage of RADON applications.
Priority:	Must have
Affected Tools:	TEMPLATE_LIBRARY
Means of Verification:	Use template library CLI to save a version of an entity and retrieve it.
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ID:	FR-T5.1-13
Type:	USABILITY
User story:	As a user of the xOpera tool I would want to point the orchestrator to my private key that needs to be used for the connection to the remote machine.
Requirement:	As of now xOpera orchestrator offers 'OPERA_SSH_USER' environment variable which is used by the Ansible executor when establishing the connection to a remote machine to tell which user someone wants to connect as. Currently xOpera does not offer to choose ssh keys to connect but it expects that user managed that before by himself either with putting keys to the /.ssh folder or by creating /.ssh/config configuration file which offers matching IPs and ssh keys for connection. Similar to that there could be a variable called 'OPERA_SSH_IDENTITY_FILE' that would point to the file with a private ssh key that needs to be used when establishing a connection to the host.
Priority:	Could have
Affected Tools:	DELIVERY_TOOLCHAIN, ORCHESTRATOR
Means of Verification:	Try to deploy an application blueprint (e.g. OpenFaaS setup) on the remote VM by using the 'OPERA_SSH_IDENTITY_FILE' env var.
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ID:	FR-T5.2-14
Type:	USABILITY
User story:	As a user I would like to be able to generate a basic entity.
Requirement:	User should be able to generate an entity directory structure.
Extended Description:	Template library CLI command for generating an entity directory structure with all necessary files, so that creating a template is made easier for the user and common issues regarding the entity structure are avoided.
Priority:	Could have
Affected Tools:	TEMPLATE_LIBRARY
Means of Verification:	Use template library CLI command to generate an entity.
ID:	FR-T5.2-13
Type:	USABILITY
User story:	As a user I would like to use the same credentials for the whole RADON project including template library publishing service.
Requirement:	The TLPS needs to support the use of agreed upon security measures.
Extended Description:	The TLPS needs to support the use of general RADON credentials as CLI login credentials.
Priority:	Should have
Affected Tools:	TEMPLATE_LIBRARY
Means of Verification:	Using template library CLI and template library API with RADON IAM credentials.
ID:	FR-T5.1-12
Type:	USABILITY
User story:	xOpera users would usually want to distinguish each deployment and when they run they would want to be treated separately from all other deployments that have been/would be created before/after.
Requirement:	xOpera TOSCA orchestration tool should implement a different behaviour of treating the deployment runned by 'opera deploy'. This means that user would tell if he needs to resume the actual deployment or start over the completely new one.
Means of Verification:	Try to deploy a service template with all the aforementioned options.
ID:	FR-T5.1-11
Type:	USABILITY
User story:	As a user I would want to use the prepared orchestration artifacts (e.g zipped FaaS function files) directly in a sevice template.
Requirement:	xOpera tool should have a support for 'get_artifact' TOSCA function that is used to retrieve artifact location between entities defined in the same service template.
Extended Description:	Here the support for full TOSCA artifact function should be added and then the function could be used like this: 'get_artifact: [;modelable_entity_name;, ;artifact_name;, ;location;, ;remove;]'.
Priority:	Should have
Affected Tools:	DELIVERY_TOOLCHAIN, ORCHESTRATOR
Means of Verification:	Try to deploy a service template that uses 'get_artifact' TOSCA function.

ID:	FR-T5.1-10
Type:	USABILITY
User story:	As a user I would want to easily prepare TOSCA CSAR file for the orchestration and compress it with all the accompanying files needed for the deployment
Requirement:	xOpera tool could provide a simple packaging command that would prepare the zipped version of the CSAR archive which could then be used for the deployment or to transfer it somewhere.
Extended Description:	This could be resolved by establishing the 'opera package' command which would create a CSAR file from the service template and all the accompanying files in the root directory.
Priority:	Could have
Affected Tools:	DELIVERY_TOOLCHAIN, ORCHESTRATOR
Means of Verification:	<u>Package orchestration files to CSAR and deploy it with xOpera</u>
ID:	FR-T5.3-6
Type:	USABILITY
User story:	A lot of users use TOSCA Policy Types which are a logical grouping of TOSCA nodes that use an implicit relationship and need to be managed together during the orchestration process in order to give some result. To exploit the policies to their full potential users would desire to be able to use all the supported keywords for policies along with the TOSCA orchestrator.
Requirement:	As of now xOpera orchestration tool does include the support for policies so it is possible to declare TOSCA policy definition inside the 'topology_template' section of the TOSCA or a separate policy type definition in 'policy_types' section of the service template but there is currently no support for policy targets and triggers.
Extended Description:	The first thing that would need to be done is to updating the opera's TOSCA parser to add the support for policy type targets (which represents an optional list of valid node types or group types the policy type can be applied to) and the second step would feature adding support for triggers and trigger events definitions.
Priority:	Should have
Affected Tools:	DELIVERY_TOOLCHAIN, ORCHESTRATOR
Means of Verification:	Try to deploy a service template with policy type that uses targets and triggers.
ID:	FR-T5.2-12
Type:	USABILITY
User story:	As an Operations Engineer I want to be able to filter template library entities by groups (AWS, lambda, FaaS) and types of entities (nodetype, policytype, relationshiptype,...).
Requirement:	The TLPS needs to label new entities and filter existing entities.
Extended Description:	a) The TLPS needs to label entities by groups and by type at upload. b) The TLPS needs to be able to filter and list entities by user provided input.
Priority:	Shuld have
Affected Tools:	TEMPLATE_LIBRARY
Means of Verification:	Add a new entity with a nodetype that belongs to a group AWS and list entities by those tags.

ID:	FR-T5.3-5
Type:	USABILITY
User story:	As a user I would want to use the SaaS orchestartor component independently from other users. To me it would be important to be able to manage my user account settings and to be sure that my secrets are safe and that the orchestration process that use those secrets can do no harm or expose them to some public place.
Requirement:	It seems necessary that the SaaS orchestrator would have user and access management included.
Priority:	Should have
Affected Tools:	DELIVERY_TOOLCHAIN, ORCHESTRATOR
Means of Verification:	Test user management and the deployment process using secrets.
ID:	FR-T5.1-9
Type:	USABILITY
User story:	As a user I want to deploy my prepared TOSCA templates/CSARs using the SaaS orchestrator and I would only need to supply the prepared files and then the orchestration would begin.
Requirement:	For users it would be useful to have multiple interaction modes. One of them is already supported and is a CLI that is meant to be used in shell sessions. Another one would be the SaaS component that would offer an API which would provide the endpoints for the orchestration and managing other stuff (users, secrets and so on).
Extended Description:	One possible way to implement the SaaS component would feature two APIs - one that would serve as xOpera API and would offer the endpoint calls which would correspond to the CLI commands (like validate, deploy, undeploy, outputs) and the second one which would be on top of the first one and would provide everything else (user and secrets management, projects, storing templates etc.). Another thing that would be welcome is the Web user interface which would simplify the interaction with the SaaS component.
Priority:	Must have
Affected Tools:	DELIVERY_TOOLCHAIN, ORCHESTRATOR
Means of Verification:	Successfully deploy prepared CSAR with the SaaS orchestartor component
ID:	FR-T5.1-8
Type:	USABILITY
User story:	As a user I would want to directly deploy the prepacked compressed CSAR file that includes all TOSCA templates accompanied by all other necessary artifacts (like prepared FaaS functions, Ansible playbooks, config files and so on)
Requirement:	The xOpera command line interface now supports deploying only the uncompressed CSARs. So it would be helpful that could recognize zip compressed TOSCA template files and will allow to either deploy or undeploy the service template from CSAR.
Priority:	Must have
Affected Tools:	DELIVERY_TOOLCHAIN, ORCHESTRATOR
Means of Verification:	Test to deploy a zipped CSAR file or the prepared CSAR files from Winery or RADON particles

ID:	R-T5.5-1
Type:	USABILITY
User story:	As an Operations Engineer I want my deploy stage to go through a CI tool so that my release is traceable
Requirement:	The xOpera command line interface needs to have a dry run mode to verify changes without asking for input in execution
Extended Description:	a) The dry-run flag (or something similar) can give the user information about which changes will be activated. b) if the cli has input to verify. A workaround is to add a auto-approve flag.
Priority:	Could have
Affected Tools:	DELIVERY_TOOLCHAIN, ORCHESTRATOR
Means of Verification:	Setting up a CI server
ID:	R-T5.1
Type:	COMPATIBILITY
User story:	As an Operations Engineer I want to use different FaaS/serverless providers at same time
Requirement:	The TOSCA blueprint must be able to enable Operations Engineers to define the usage of different FaaS/Serverless providers for different parts of their application.
Extended Description:	An Operations Engineer can decide to use different FaaS/serverless provider for different parts of his application in one RADON model. The delivery toolchain must support such deployment and monitoring of such application
Priority:	Must have
Affected Tools:	DELIVERY_TOOLCHAIN
Means of Verification:	Simple test if application is up and running should verify if deployment using mixed providers was successful.
ID:	R-T5.3-4
Type:	PORTABILITY
User story:	As an Operations Engineer, I want to configure automatic scaling in a Docker based environment
Requirement:	The tool should be able to support configuring automatic scaling of Docker services based on TOSCA auto scaling policies.
Extended Description:	The goal is to set up auto scaling for components that have been deployed as a service in a Docker swarm or Kubernetes. Depending on the target platform, it may be required to deploy a separate component for enacting the auto scaling decisions.
Priority:	Should have
Affected Tools:	ORCHESTRATOR
Means of Verification:	Use simple load tests to verify that the data pipeline tasks deployed to docker environment are scaled up and down according to the policy setting when autoscaling trigger thresholds are reached.
ID:	R-T5.3-3
Type:	PORTABILITY
User story:	As an Operations Engineer, I want to configure automatic scaling in Amazon EC2 cloud
Requirement:	The tool must be able to support configuring AWS EC2 auto scaling service based on the TOSCA auto scaling policy.
Extended Description:	The goal is to set up auto scaling for components that have been deployed in Amazon EC2 as instances or containers. This will involve configuring CloudWatch alarms and AWS Auto scaling groups and rules based on TOSCA policies.
Priority:	Should have
Affected Tools:	ORCHESTRATOR
Means of Verification:	Use simple load tests to verify that the data pipeline tasks deployed to AWS EC2 are scaled up and down according to the policy setting when autoscaling trigger thresholds are reached.

ID:	R-T5.3-2
Type:	FUNCTIONAL_SUITABILITY
User story:	As an Operations Engineer, I want to define auto scaling policies of my application
Requirement:	The tool must be able to configure automatic scaling of the deployed components based on the auto scaling policies defined in the RADON models.
Extended Description:	The goal is to support policy-based (expressed in TOSCA blueprints) automatic scaling of deployed components, that are not fully managed by the cloud provider as long as the target platform supports automatic scaling. Examples of fully managed services are FaaS functions and managed database services.
Priority:	Should have
Affected Tools:	ORCHESTRATOR
Means of Verification:	Use simple load tests to verify that the deployed data pipeline tasks are scaled up and down according to the policy setting when autoscaling trigger thresholds are reached.
ID:	R-T5.3-1
Type:	SECURITY
User story:	As an Operations Engineer, I want to define security and privacy policies of my application
Requirement:	The TOSCA blueprint needs to be able to support the definition of security and privacy policy of specific serverless/FaaS provider.
Extended Description:	The definition of security and privacy policy in TOSCA blueprint must be reflected after the deployment step is finished.
Priority:	Must have
Affected Tools:	DELIVERY_TOOLCHAIN
Means of Verification:	Test if security and privacy policy rules has been applied to deployed application by penetration testing methodologies.
ID:	R-T5.4-10
Type:	FUNCTIONAL_SUITABILITY
User story:	As a Operations Engineer, I want to be able to design and deploy data pipelines which send or receive data from Google BigQuery data warehouse.
Requirement:	Support Google BigQuery data warehouse as a data source when deploying data pipelines.
Extended Description:	The goal is support designing and deploying data pipeline applications which to use Google BigQuery data warehouse as a data source and data flow should be possible in both directions (consuming and producing into BigQuery).
Priority:	Should have
Affected Tools:	ORCHESTRATOR
Means of Verification:	Tests with data pipeline service template which includes Google BigQuery input and output data sources to verify that the data pipeline is deployed correctly.
ID:	R-T5.4-9
Type:	PORTABILITY
User story:	As an Operations Engineer, I want to deploy data pipelines to Private clouds
Requirement:	The data pipeline module of the Orchestrator should support deploying data pipelines expressed using TOSCA models into a private OpenStack cloud.
Extended Description:	The goal is to support deploying data pipelines in open source cloud platforms designed for setting up private clouds. OpenStack is chosen as the reference case. Open Source data pipeline platform (e.g. Apache NiFi) will be used as the runtime for the data
Priority:	Must have
Affected Tools:	ORCHESTRATOR
Means of Verification:	Tests to verify that deployment to private cloud platform is successful

ID:	R-T5.4-8
Type:	PORTABILITY
User story:	As an Operations Engineer, I want to deploy data pipelines to AWS data pipeline service
Requirement:	The data pipeline module of the Orchestrator should support deploying data pipelines expressed using TOSCA models into the AWS data pipeline service.
Extended Description:	The goal is to support deploying data pipelines into an existing data pipeline service provided by Public clouds. AWS data pipeline service is a reference case.
Priority:	Must have
Affected Tools:	ORCHESTRATOR
Means of Verification:	Tests to verify that deployment to AWS data pipeline service is successful
ID:	R-T5.4-7
Type:	SECURITY
User story:	As an Operations Engineer, I want to be able to configure encryption for data moving through the data pipeline
Requirement:	The data pipeline module of the Orchestrator should support configuring encryption between data pipeline tasks when data needs to be moved between systems
Extended Description:	Goal is to support automatic data encryption pipes when data is transported between/outside cloud environment. Service mesh can be adapted for this.
Priority:	Should have
Affected Tools:	ORCHESTRATOR
Means of Verification:	Test data pipelines that move data between two systems. Analyze network traffic and verify data is not sent unencrypted.
ID:	R-T5.4-6
Type:	FUNCTIONAL_SUITABILITY
User story:	As an Operations Engineer, I want to be able to deploy data pipelines that trigger NLP data analytics jobs
Requirement:	The data pipeline module must support data pipelines tasks that initiate data analytics tasks for processing data moving through the pipeline
Extended Description:	Goal is to support defining data pipelines that initiate analytics jobs in large scale data processing frameworks (e.g Hadoop, Spark, Flink) as one of the pipeline actions.
Priority:	Must have
Affected Tools:	ORCHESTRATOR
Means of Verification:	Test data pipelines that include initiating data analytics jobs as one or more pipeline tasks and verify that resulting data is correct.
ID:	R-T5.4-5
Type:	FUNCTIONAL_SUITABILITY
User story:	As an Operations Engineer, I want to be able to deploy data pipelines across multiple (cloud) systems
Requirement:	The data pipeline module of the Orchestrator should support deployment of data pipelines which automate movement of data between two or more clouds
Extended Description:	Goal is to support data pipelines that migrate data between different cloud providers and availability zones.
Priority:	Should have
Affected Tools:	ORCHESTRATOR
Means of Verification:	Test data pipeline orchestration where different parts of the pipeline are deployed on different clouds

ID:	R-T5.4-4
Type:	RELIABILITY
User story:	As an QoS Engineer, I want to be notified if the data pipeline execution fails
Requirement:	It would be useful for the data pipeline module of the Orchestrator to support logging and generating alerts on pipeline task failures.
Extended Description:	Goal is to support notifications for more critical data pipelines, which would be raised when data pipeline tasks fail or are overloaded.
Priority:	Should have
Affected Tools:	ORCHESTRATOR
Means of Verification:	Test data pipelines that have notifications enabled, force critical situations to happen (e.g. by sending malformed data, shutting down specific services or generating too much data) and verify that alarms are raised
ID:	R-T5.4-3
Type:	FUNCTIONAL_SUITABILITY
User story:	As an Operations Engineer, I want to be able to trigger the data pipeline execution in Event-driven manner
Requirement:	The data pipeline module of the Orchestrator should support event based scheduled data pipelines
Extended Description:	Goal is to support data pipelines that are executed on demand or in an event-driven manner.
Priority:	Should have
Affected Tools:	ORCHESTRATOR
Means of Verification:	Test data pipeline execution with different event based triggers and verify that pipeline is executed every single time
ID:	R-T5.4-1
Type:	FUNCTIONAL_SUITABILITY
User story:	As an Operations Engineer, I want to be able to deploy data pipelines and control their life-cycle using RADON toolchain
Requirement:	The data pipeline module of the Orchestrator must be able to orchestrate data pipelines
Extended Description:	Orchestrator must provide support for orchestrating data pipelines.
Priority:	Must have
Affected Tools:	ORCHESTRATOR
Means of Verification:	Evaluate whether the tool is able to successfully deploy data pipelines which have been defined using RADON models.
ID:	R-T5.2-11
Type:	PORTABILITY
User story:	As an Operations Engineer, I want to be able to deploy my containerized application to microservices architecture
Requirement:	Support deployment to microservices architecture
Extended Description:	The TOSCA blueprints and Ansible playbooks should be developed to deploy RADON model on microservices architecture using Docker or Kubernetes container technologies
Priority:	Must have
Affected Tools:	TEMPLATE_LIBRARY
Means of Verification:	Test if such playbooks and blueprints are available in Template Library repository and its possible to deploy toy example to microservices architecture.

ID	R-T5.1-8
Section	WP5: Toolchain
Type	USABILITY
User Story	As a user I want to deploy a Function as a part of an Application based on the URL available at cloudstash.io
Requirement	Deploy FaaS based on URL
Extended Description	URL as a source for deployment. Similar to how you would use a local zip file for uploading today.
Affected Tools	FunctionHub
Means of Verification	Unit test
Dependency	N/A
ID	R-T5.1-8
Section	WP5: Toolchain
Type	USABILITY
User Story	As a user I want the option to chose Functions from a selection based on numerous cloud providers
Requirement	Google Cloud, AWS, Azure and OpenFaas must be supported
Extended Description	One should be able to upload Functions for all the four mentioned serverless platforms
Affected Tools	FunctionHub
Means of Verification	Unit test
Dependency	N/A
ID	R-T5.17
Section	WP5: Toolchain
Type	USABILITY
User Story	As a user I want to create private repositories for private Functions
Requirement	Only logged in user can view private repositories
Extended Description	When creating a repository, you can decide if the repo is private or public.
Affected Tools	FunctionHub
Means of Verification	Unit test
Dependency	N/A
ID	R-T5.1-8
Section	WP5: Toolchain
Type	USABILITY
User Story	As a user I need to prove my ownership of a specific repository.
Requirement	You need a token to upload a function.
Extended Description	When you create a user you will be provided by a token. This token is used whenever you are uploading content to FunctionHub. Using the client, you have to set the token as an environment variable or pass it as a parameter in order to upload the function to your repository.
Affected Tools	FunctionHub
Means of Verification	Unit test
Dependency	N/A
ID	R-T5.10
Section	WP5: Toolchain
Type	USABILITY
User Story	As a user I want more information about the Function
Requirement	Added a 'description' field in the config.ini file
Extended Description	As you upload a function, relevant information about the Function must be passed along
Affected Tools	FunctionHub
Means of Verification	Unit test
Dependency	N/A

ID	R-T3.3-4
Section	WP3: Methodology and Quality Assurance Requirements
Type	FUNCTIONAL_SUITABILITY
User Story	As a QoS Engineer, I want the testing tool to generate performance metrics for the data pipeline under testing.
Requirement	The data pipeline testing module of the TESTING.TOOL should be able to analyze log data of the data pipeline under test to generate performance metrics.
Extended Description	The goal is to analyse log data to generate performance metrics (e.g. latency/delay, error rate, dropped packets), which are required for evaluating the quality of the data pipelines.
Priority	Should have
Affected Tools	TESTING.TOOL
Means of Verification	Tests with different data pipeline test cases to verify that the performance metrics are generated correctly.
Dependency	R-T5.1-3
ID	R-T.3.3-15
Section	WP3: Methodology and Quality Assurance Requirements
Type	USABILITY
User Story	As a QoS Engineer, I want to be able to specify tests using CLI.
Requirement	The FaaS testing module of the TESTING.TOOL should have a command line interface.
Extended Description	A CLI can be used to specify test execution. Furthermore, a CLI can be useful to display, e.g., to display raw results, in a format parsable by other tools and applications (e.g., CSV, XML, JSON).
Priority	Should have
Affected Tools	TESTING.TOOL
Means of Verification	Tests and demos
Dependency	N/A
ID	R-T3.3-8
Section	WP3: Methodology and Quality Assurance Requirements
Type	USABILITY
User Story	As a QoS Engineer, I want to be able to configure a set of different data production profiles that will be checked/evaluated in a sequence in an automated manner.
Requirement	It could be useful for the data pipeline testing module of the TESTING.TOOL to support running multiple different tests in a sequence on the same data pipeline.
Extended Description	The goal is to support running a sequence of performance tests without requiring user intervention.
Priority	Could have
Affected Tools	TESTING.TOOL
Means of Verification	Tests with a prepared set of testing configurations on different data pipelines to verify that all tests were run successfully
Dependency	R-T5.4-1 (using the RADON Orchestrator data pipeline plugins to deploy and control data pipelines under testing)

ID	R-T3.3-7
Section	WP3: Methodology and Quality Assurance Requirements
Type	USABILITY
User Story	As a QoS Engineer, I want to be able to use a graphical user interface for configuring the tool and displaying generated metrics and visualizations.
Requirement	It could be useful for the data pipeline testing module of the TESTING_TOOL to have a graphical user interface for configuring tests and displaying test results.
Extended Description	The goal is to provide a more user friendly interface for configuring tests and displaying results
Priority	Could have
Affected Tools	TESTING_TOOL
Means of Verification	Tests with different data pipeline test cases to verify that all necessary information is displayed correctly on the user interface.
Dependency	N/A
ID	R-T3.3-6
Section	WP3: Methodology and Quality Assurance Requirements
Type	FUNCTIONAL_SUITABILITY
User Story	As a QoS Engineer, I want to be able to configure critical lower and upper bounds of performance metrics and visualize them.
Requirement	It could be useful if users can configure upper and lower bounds in the data pipeline testing module of the TESTING_TOOL for the performance metrics that are computed.
Extended Description	Specifying upper and lower bounds for performance metrics could be used for defining visual alerts that indicate when the data pipeline under test is performing suboptimal to the desired performance.
Priority	Could have
Affected Tools	TESTING_TOOL
Means of Verification	Tests with different data pipeline test cases and production profiles to verify that the tool recognises when upper and lower bounds of performance metrics have been reached
Dependency	N/A
ID	R-T3.3-3
Section	WP3: Methodology and Quality Assurance Requirements
Type	FUNCTIONAL_SUITABILITY
User Story	As a QoS Engineer, I want to be able to inject data producing components into the data pipeline (under testing) for generating test data into the pipeline.
Requirement	The data pipeline testing module of the TESTING_TOOL must be able to inject additional pipeline components into the data pipeline for generating synthetic input data.
Extended Description	The goal is to support creating and adding data pipeline components that mock the input streams by generating synthetic data into the data pipeline.
Priority	Must have
Affected Tools	TESTING_TOOL
Means of Verification	Tests with different RADON data pipelines to verify that the components were injected and the modified data pipeline can be deployed successfully
Dependency	N/A

ID	R-T3.3-2
Section	WP3: Methodology and Quality Assurance Requirements
Type	FUNCTIONAL_SUITABILITY
User Story	As a QoS Engineer, I want to be able to define custom data production profiles, based on which load testing data will be generated.
Requirement	The data pipeline testing module of the TESTING_TOOL should support user configurable data production profiles.
Extended Description	Data production profiles define what type and format data needs to be generated and to specify what is the profile of generated data flow.
Priority	Should have
Affected Tools	TESTING_TOOL
Means of Verification	Using test case data production profiles for generating data into data pipeline and verifying that the produced data matches the profile.
Dependency	N/A
ID	R-T.3.3-16
Section	WP3: Methodology and Quality Assurance Requirements
Type	USABILITY
User Story	As a Software Engineer, I want continuous testing to be integrated into my development workflow
Requirement	The FaaS testing module of the TESTING_TOOL must be integrated into DevOps practices.
Extended Description	This includes DevOps properties such as multiple teams, continuous development, fast feedback cycles, etc.
Priority	Must have
Affected Tools	TESTING_TOOL
Means of Verification	Qualitative by demonstrating based on the RADON methodology and case studies
Dependency	N/A
ID	R-T.3.3-14
Section	WP3: Methodology and Quality Assurance Requirements
Type	USABILITY
User Story	As a QoS Engineer, I want to be able to specify tests using a GUI.
Requirement	The FaaS testing module of the TESTING_TOOL must have a graphic user interface.
Extended Description	The FaaS module of the TESTING_TOOL must graphically provide information about the generated tests, as well as the input data and state of the infrastructure, which will be used.
Priority	Must have
Affected Tools	TESTING_TOOL
Means of Verification	Tests and demos
Dependency	N/A
ID	R-T.3.3-13
Section	WP3: Methodology and Quality Assurance Requirements
Type	FUNCTIONAL_SUITABILITY
User Story	As a QoS Engineer, I want the test results to be visualized.
Requirement	The FaaS testing module of the TESTING_TOOL could have a report feature.
Extended Description	The results might even be presented in the UI.
Priority	Could have
Affected Tools	TESTING_TOOL
Means of Verification	Tests and demos
Dependency	Possibly R-T4.3-7

ID	R-T.3.3-12
Section	WP3: Methodology and Quality Assurance Requirements
Type	FUNCTIONAL_SUITABILITY
User Story	As a QoS Engineer, I want my tests to be updated automatically based on production data.
Requirement	The FaaS testing module of the TESTING_TOOL must be able to analyze monitoring data from production and update the annotations in the RADON model.
Extended Description	The focus of the extraction is on the workload data but may also include inputs. Actually not the tests are updated but the RADON model annotations.
Priority	Must have
Affected Tools	TESTING_TOOL
Means of Verification	Comparison of original measures with the results of running the extracted tests.
Dependency	RADON models must provide the respective annotations, The runtime platform must provide the respective data
ID	R-T.3.3-11
Section	WP3: Methodology and Quality Assurance Requirements
Type	FUNCTIONAL_SUITABILITY
User Story	As a QoS Engineer, I want the CD pipeline to execute manually specified and generated tests.
Requirement	The FaaS testing module of the TESTING_TOOL must support the execution of tests cases in the CD pipeline.
Extended Description	The tool must be able to interpret and execute the test specifications. The execution involves potentially spawning parts of the testing environment.
Priority	Must have
Affected Tools	TESTING_TOOL
Means of Verification	Tests with different test cases
Dependency	R-T.3.3-10 25, Requirements for the CD pipeline for execution
ID	R-T.3.3-10
Section	WP3: Methodology and Quality Assurance Requirements
Type	FUNCTIONAL_SUITABILITY
User Story	As a QoS Engineer, I want to be able to generate test cases from the test-annotated RADON models.
Requirement	The FaaS testing module of the TESTING_TOOL must support the generation of test cases from RADON models that are augmented by the test-related annotations.
Extended Description	The tool must be able to read and interpret the annotated RADON models, and to generate executable tests.
Priority	Must have
Affected Tools	TESTING_TOOL
Means of Verification	Tests with RADON models, including synthetic ones and those from the case studies
Dependency	RADON models must provide the respective annotations (R-T4.1-2, R-T4.1-3, R-T4.2-7, R-T4.3-8)

ID	FR-T5.1-17
Section	USABILITY
User Story	As an Operations Engineer, I want to monitor the runtime behavior of a cloud deployment and when it performs on full capacity a redeployment should be triggered with updated configuration.
Requirement	Push alerts to support deployment reconfiguration.
Extended Description	The RADON users should be able to define thresholds with regard to monitoring of specific metrics and in cases where those thresholds exceed predefined values the deployment should adapt to the new requirements. Push alerts on the rest of the Delivery Toolchain components should be triggered to provide feedback and let the xOpera orchestrator to redeploy and scale parts of the topology that work on full capacity.
Affected Tools	Delivery Toolchain, Monitoring tool
Means of Verification	The application adapts to the workload expected.
Dependency	-
ID	FR-T5.1-16
Section	USABILITY
User Story	As an Operation Engineer, I want to be able to export metrics by parsing application logs.
Requirement	Export monitoring metrics from application logs.
Extended Description	TOSCA node/configuration types have to be specified to support an additional monitoring component that attaches to a log file and constantly tailing it to parse the generated log records. Each log record is parsed according to a set of pattern matching rules (based on regular expressions) and the collected metrics are then exposed to the monitoring server.
Affected Tools	Monitoring tool
Means of Verification	The metrics extracted by the logs are flowing into the monitoring system.
Dependency	-
ID	FR-T5.1-15
Section	USABILITY
User Story	As an Developer, I want to be able to monitor a FaaS without having to manually inject code for exporting the metrics.
Requirement	Provide an elegant way to attach monitoring capabilities on a FaaS by avoiding to scatter the function handler with injected code.
Extended Description	FaaS are considered batch/short-lived jobs. Since these kinds of jobs may not exist long enough to be scraped by the monitoring server they should push the collected metrics by their own to a Prometheus PushGateway instance. This implies injecting monitoring code inside the application code which is an error prone procedure.
Affected Tools	Monitoring tool
Means of Verification	Monitoring metrics at FaaS level are flowing to the monitoring platform.
Dependency	FR-T5.1-14
ID	FR-T5.1-14
Section	USABILITY
User Story	As an Operations Engineer, I want to be able to configure monitoring components when deploying an application.
Requirement	The runtime toolchain need to provide a way to dynamically configure monitoring components on different level of abstraction (FaaS, container, server, log files).
Extended Description	Using different technologies for monitoring the deployment process, a service or tool must be developed to allow users to configure the monitoring components in TOSCA.
Affected Tools	Monitoring tool
Means of Verification	Once the application is deployed the metrics configured are exported to the monitoring platform.
Dependency	-

ID	R-T4.3-14
Section	WP4: Modeling Environment
Type	FUNCTIONAL_SUITABILITY
User Story	As a Software Developer, I want to manage my RADON Models using the RADON Template Publishing Service.
Requirement	Push and load RADON Models to or from the RADON Template Publishing Service once users decide to finalize a model or want to modify an existing one.
Extended Description	The GMT must be able to push RADON Models to the RADON Template Publishing Service once users decide to finalize a model and put it into production. Similarly, the GMT needs to be able to pull a model from the service to modify it and push it as a new version back.
Affected Tools	GRAPHMODEL_TOOL
Means of Verification	Manual testing based on case studies.
Dependency	N/A
ID	R-T4.3-13
Section	WP4: Modeling Environment
Type	FUNCTIONAL_SUITABILITY
User Story	As a Software Developer, I want to generate and save a CSAR to my Eclipse Che workspace to utilize other RADON tools, e.g., to analyze my CSAR prior to deployment.
Requirement	Save generated CSARs to Eclipse Che's workspace to enable further processing by other RADON tools.
Extended Description	This requirement arose when we first integrated RADON tools with the RADON IDE based on Eclipse Che. The GMT is the central tool to generate a TOSCA CSAR, which is required by the RADON Orchestrator to deploy the application therein. Also, the integration point with other tools is also an executable CSAR, e.g., the Defect Prediction can analyze the content prior to deployment. Therefore, the GMT must be able to save the generated CSAR to Eclipse Che's workspace. This enables other tools to further process the CSAR prior to deploying it using the RADON Orchestrator.
Affected Tools	GRAPHMODEL_TOOL
Means of Verification	Manual testing based on case studies.
Dependency	N/A

ID	R-T4.3-12
Section	WP4: Modeling Environment
Type	FUNCTIONAL_SUITABILITY
User Story	As a Software Developer, I want to store and version my company-specific RADON Model separately from RADON Particles.
Requirement	GMT must be initialized and start based on the RADON Particles, but company-specific RADON Models as well as custom TOSCA entity types must be stored differently.
Extended Description	In RADON, we publish and maintain RADON Models as well as reusable TOSCA entity types to a public GitHub repository called the RADON Particles. This repository, on the one hand, serves as an example of a public RADON Template Library (cf. D5.4 Technology Library and D4.4 RADON Models II) and, on the other hand, provides a modeling baseline for RADON users that want to use the GMT to compose application blueprints. So, it is important to use the current RADON Particles master branch when starting the GMT. However, at the same time, companies that model applications want to store their models separately from the public one, e.g. to push and manage them in their internal and private Git repository, such as GitLab. Therefore, there must be the possibility to initialize and start the GMT based on the RADON Particles, but company-specific RADON Models as well as custom TOSCA entity types must be stored differently. The GMT needs a way to separate the modeling entities into multiple repositories.
Affected Tools	GRAPHMODEL_TOOL
Means of Verification	Manual testing based on case studies.
Dependency	N/A
ID	R-T4.3-11
Section	WP4: Modeling Environment
Type	FUNCTIONAL_SUITABILITY
User Story	As a Software Developer, I want to change my application's business logic but don't want to update my RADON Model after any change.
Requirement	There must be the possibility to reference business logic as a URL to make it possible to change the business logic of the application without changing the RADON Model.
Extended Description	The GMT at M12 expected all files to be physically present in a RADON Model. This means that any business logic (e.g., the function code for FaaS) needs to be uploaded in a respective packaging format (e.g., ZIP for Python- or NodeJS-based functions or JAR for Java-based functions) prior to deploying the applications. As developers may utilize multiple functions, and these functions may change very often, the manual task to push the new business logic to the GMT becomes tedious and is not very DevOps-like where you want to automate things. Therefore, there must be the possibility to reference any business logic as a URL, either staged in an accessible storage location or in a binary and build artifact management tools, such as Sonatype Nexus or JFrog Artifactory. This will make it possible to change the business logic of the application but does not require to update the RADON Model.
Affected Tools	GRAPHMODEL_TOOL
Means of Verification	Manual testing based on case studies.
Dependency	N/A

ID	R-T4.4-3
Section	WP4: Modeling Environment
Type	FUNCTIONAL_SUITABILITY
User Story	As a Software Designer/Software Developer/Operations Engineer, I want to reflect/import the output of other RADON tools inside the GMT.
Requirement	The GMT could provide the possibility to import different output formats produced by the integrated RADON tools.
Extended Description	As many tools work with RADON models, it could be the case that Winery need to consume different formats.
Affected Tools	GRAPHMODEL_TOOL
Means of Verification	Manual testing
Dependency	T4.1; T3.2; T3.3
ID	R-T4.4-2
Section	WP4: Modeling Environment
Type	FUNCTIONAL_SUITABILITY
User Story	As a Operations Engineer/Release Manager, I want to have support for different orchestration engines/tools.
Requirement	The GMT could provide an option to export a blueprint in different formats to use other orchestration tools, such as OpenTOSCA or Terraform.
Extended Description	To support applications modeller with additional options for orchestrating the deployment of modeled cloud applications, GMT could support export into different deployment model formats.
Affected Tools	GRAPHMODEL_TOOL
Means of Verification	Direct testing using xOpera based on the case studies from T4.2
Dependency	T5.1
ID	R-T4.4-1
Section	WP4: Modeling Environment
Type	FUNCTIONAL_SUITABILITY
User Story	As a Software Designer/Software Developer/Operations Engineer, I want to export available blueprints in an orchestrator supported format.
Requirement	The bundle which is exported from the modeling tool must be processeable by the RADON orchestrator.
Extended Description	A user must be able to export the application model (including all required artifacts, such as business logic and deployment logic artifacts) to a portable archive.
Affected Tools	GRAPHMODEL_TOOL
Means of Verification	Direct testing using xOpera based on the case studies from T4.2
Dependency	T5.1
ID	R-T4.3-10
Section	WP4: Modeling Environment
Type	PERFORMANCE_EFFICIENCY
User Story	As a Software Designer/Software Developer/Operations Engineer, I want to have the possibility to handle the visual complexitiy of a huge amount of FaaS elements.
Requirement	The GMT could provide a feature to group or abstract certain elements in order to reduce the visual complexity of tens or hundreds of FaaS components.
Extended Description	Pure FaaS applications mostly consist of tens or hundereds of elements and components, such as functions, events, and used cloud services. This could result in a visual overload of elements on the drawing canvas of the GMT.
Affected Tools	GRAPHMODEL_TOOL
Means of Verification	Manual testing using serverless application deployments having 100 functions with one event trigger per function
Dependency	N/A

ID	R-T4.3-9
Section	WP4: Modeling Environment
Type	PERFORMANCE_EFFICIENCY
User Story	As a Software Designer/Software Developer/Operations Engineer, I want to model tens or hundreds of elements without any serious performance impact.
Requirement	In the GMT, it must be possible to model an amount of up to two hundred elements (i.e., nodes, relations).
Extended Description	When modeling functions, events, and triggers it is most probably required to model a bunch of elements (tens or event hundreds). This requirement makes sure that a certain degree of performance is guaranteed when using the modeling tool.
Affected Tools	GRAPHMODEL_TOOL
Means of Verification	Manual testing using serverless application deployments having 100 functions with one event trigger per function
Dependency	N/A
ID	R-T4.3-8
Section	WP4: Modeling Environment
Type	FUNCTIONAL_SUITABILITY
User Story	As a QoS Engineer/Software Developer, I want to annotate blueprints with test-related information.
Requirement	In the GMT, it must be possible to use predefined or to create new test case specifications that a user can use to annotate modeled components.
Extended Description	To support continuous testing of modeled cloud applications, the GMT must support specification of test-related information using a graphical user interface.
Affected Tools	GRAPHMODEL_TOOL
Means of Verification	Unit testing, manual testing in the IDE based on case studies from T4.2
Dependency	N/A
ID	R-T4.3-7
Section	WP4: Modeling Environment
Type	FUNCTIONAL_SUITABILITY
User Story	As a QoS Engineer/Software Designer, if my RADON model violates hard constraints in the CDL I would like to see a graphical explanation of which constraints are violated and by which parts of the RADON model.
Requirement	Given a RADON model which does not comply with a set of hard constraints, the graphical modelling tool should be able to graphically represent the explanation generated by the verification tool.
Extended Description	For example highlighting which nodes are involved in the violation and which constraints are violated.
Affected Tools	GRAPHMODEL_TOOL
Means of Verification	Manual testing in the IDE.
Dependency	T4.1
ID	R-T4.3-6
Section	WP4: Modeling Environment
Type	COMPATIBILITY
User Story	As a Software Designer/Software Developer/Operations Engineer, I want my modeling tool to support integrations to other ones.
Requirement	A user should be able to trigger certain tools from the modeling tool.
Extended Description	For example to trigger the decomposition tool or the verification tool.
Affected Tools	GRAPHMODEL_TOOL
Means of Verification	Manual testing in the IDE.
Dependency	T4.1; T3.2; T3.3

ID	R-T4.3-5
Section	WP4: Modeling Environment
Type	MAINTAINABILITY
User Story	As a Software Designer/Software Developer/Operations Engineer, I want to import existing blueprints for reuse or modification.
Requirement	A user could be able to import existing models that can then be reused when creating new ones.
Extended Description	This could be done through the IDE or directly in the modeling tool.
Affected Tools	GRAPHMODEL_TOOL
Means of Verification	Unit testing, manual testing in the IDE based on case studies from T4.2.
Dependency	T5.2
