NEXOF-RA

NESSI Open Framework – Reference Architecture

IST- FP7-216446

Deliverable D8.0.b
Proof-of-Concept Overall Process

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1 EXECUTIVE SUMMARY

The main contribution presented in this document is a process to guide the activities of WP8. WP8 has the goal of validating some of the key architectural choices and patterns coming from the work undertaken at the architectural level. To this purpose, software artefacts to validate the architectural choices and patterns have to be set-up.

The above mentioned set of software artefacts is referred to as Proof-of-Concept (PoC) and the process presented in this document is devoted to giving guidelines and criteria to identify, evaluate, select, design, implement and execute a PoC.

At this stage, it is neither feasible nor useful to bind PoC activities to a specific formal method for evaluation and validation of architectural choices and patterns. This is because the heterogeneity of both patterns (e.g. top level patterns, abstract design patterns, implementation design patterns) and architectural choices to validate (e.g. quality attributes, cost benefits, functional requirements) means that any single approach is unlikely to be appropriate for all cases. However, when identifying a PoC the proposer must clearly state the methods to be adopted for validating, a set of assessment criteria and measurement metrics for validation. If not, according to the process presented here, the PoC is not selected.

Since the only objective of the PoC is to validate architectural choices and patterns, the proposed process is strongly committed to support this task.

At the same time, however, the process encourages the identification of software artefacts that, besides validating the architectural choices and patterns, can also demonstrate (but only as side effect of the validation) innovation and potential business value for ICT players, and can address the requirements defined in the project. In this way, some of the software artefacts (i.e. part of a PoC) can be considered as basic building blocks upon which more complex software can be designed and developed in the perspective of a NESSI Compliant Infrastructure development.

It is worth mentioning that we do not claim that the proposed process is an advancement with respect to the state of the art in terms of methodology for validation, nor that we have identified a process able to validate the whole NEXOF Reference Architecture.

Both aspects are out of the scope of our work.

The motivation behind the work described in this document is to validate some of the most promising (also from an innovation perspective) architectural patterns of the Reference Architecture and to give useful feedback to the team leading the Reference Architecture activities in order to improve the overall quality of the Reference Architecture.

Document Information

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Status			final ☑	
Nature	Report ☑ Demonstrator ☐ Other ☐			
Abstract (for dissemination)	The main contribution of this document to the NEXOF-RA project is the definition of a process to guide the evaluation and validation of the patterns that will build the Reference Architecture.			
Keywords	Proof of Concept, Validation, Architectural Choice, Architectural Pattern			

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3 INTRODUCTION

3.1 Ambition of NEXOF-RA and of the Proof-of-Concept

The overall ambition of NEXOF-RA [1] is to deliver a Reference Architecture for the NESSI [2] Open Service Framework ranging from the infrastructure up to the interfaces with the end users. It aims to leverage research in the area of service-based systems to consolidate and trigger innovation in service-oriented economies.

As such, one of the goals of NEXOF-RA is to deliver the NEXOF Reference Architecture, following an Open Architecture Specification Process, which will allow contributions from many sources also including those outside NEXOF-RA.

The specification of the NEXOF Reference Architecture will result in a set of architectural choices and patterns.

The key objective of WP8 Proof-of-Concept (PoC) is to validate some of the Architectural Choices and Patterns (ACPs) coming from the work undertaken at architectural level (including in other NESSI Strategic Projects) through the setup of PoCs.

A PoC is defined as a (set of) software artefact(s) the WP8 team will use to validate the key ACPs.

3.2 Purpose and structure this document

The main purpose of this document is to define a process for the activities of WP8. The document will:

- Clarify the purpose of a PoC

- Provide guidelines and criteria to identify, evaluate and select a PoC

- Provide guidelines to validate the ACPs

The document is structured as follows.

Section 4 clarifies what is a PoC and what it serves for. Section 5 and its subsections present and describe the PoC lifecycle management process. For each step of the process we state the objective, the description of inputs and outputs, the actors involved in the execution of the step, and an estimation of its duration. These sections also present the guidelines and criteria WP8 intends to adopt for identification, evaluation and selection of PoCs.

Section 6 summarises the key features of the proposed process.

Section 7 stresses the role of the NESSI Strategic Projects (NSPs) and Investigation Teams, and, lastly, section 8 states our conclusions and lessons learnt from the previous activities of WP8.

3.3 Acronyms

ACP – Architectural Choice and Pattern

CA – Chief Architect

CP – Collaboration Point

IP – Interaction Point

IT – Investigation Team

NCI – NESSI Compliant Infrastructure

NSP – NESSI Strategic Project

OCC – Open Construction Cycle

OSP – Open Specification Process

PoC – Proof of Concept

PM – Project Manager

RA – Reference Architecture

RM – Reference Model

WP – Work Package

4 THE PURPOSE OF A PoC

A PoC has the purpose of validating some ACPs of NEXOF-RA. In order to give to the Reference Architecture (RA) team valuable feedback on the validation of ACPs, WP8 is expected to receive information on the specific aspects / features to validate as well as on their relevance for the RA by the workpackage leading the RA activities.

Examples of validation of an ACP can be: validating a pattern's claim with respect to the quality attributes (refer to [3] for a set of quality attributes), or the reusability of a pattern, or even that a pattern or a family of patterns addresses their functional requirements.

Thus, a PoC can be set up for one or more of the above purposes.

With this objective in mind, the role of the PoC process is to:

- Ensure a proper and well balanced coverage of the ACPs to be validated – for example, validate ACPs covering large part of the elements of the RA structure [4]

- Avoid redundant validation – for example, if a specific pattern is a recognized way (i.e. validated in literature) to implement an architectural choice, it is useless to set-up and execute a PoC

- Identify the most suitable way to validate the ACPs – via identification, definition, design, development and execution of the PoCs

The above points are achieved via the execution of the process presented in the next section.

5 THE PoC PROCESS

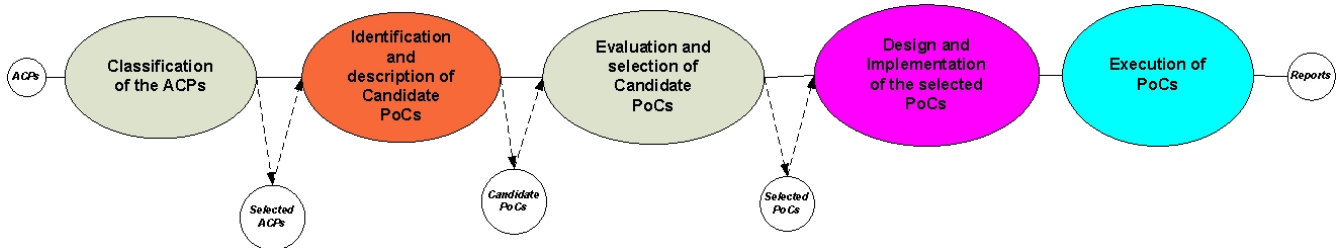To validate ACPs, we follow the steps of the process depicted below:

Figure 1: The PoC process

It consists of the following steps:

- Classification of ACPs. The ACPs are analysed by WP8 and then classified with respect to, for example, elements of the RA structure [4] or to their objective of validation. This helps WP8 to have a comprehensive view of the ACPs to be validated. In case of large number of ACPs, in this step WP8 performs a selection of ACPs if the available partners' effort would not suffice to proceed with all of them

- Identification of the Candidate PoCs. ACPs to be validated are assigned to WP8 partners that start the identification and description of candidate PoCs. A partner identifying and describing a PoC becomes the PoC owner

- Evaluation and Selection of Candidate PoCs. The set of candidate PoCs produced by WP8 is evaluated in combination with CA and WP7 leader to select a subset of them (i.e. the selected PoCs)

- Design and Implementation of selected PoCs. This step provides a detailed design and implements the selected PoCs, setting up all the assets required for the validation

- Execution of the PoCs. In this step test cases or benchmarking applications are executed to validate the ACPs, according to the selected method and assessment criteria of each PoC, and evidence of the validation is collected.

The inputs to this process are the ACPs. WP8 expects these inputs to arrive mainly from WP7 which leads the RA activities. However, as section 7 will clarify, WP8 is also fostering contributions from NSPs.

The intermediate results of this process (e.g. ACPs to be validated, Candidate PoCs and Selected PoCs) will be presented in the documentation accompanying the release of the PoCs, i.e. the D8.1.x.

The final results of the process are a set of reports on the validations performed. Reports will be jointly analysed with WP7 and released in the D8.2.x.

The following subsections detail each step of the process in terms of objectives, inputs and outputs, actors involved and an estimation of the time required to execute the step. Each description clearly presents the guidelines and criteria WP8 will follow during the execution of the step.

5.1 Step 1: Classification of the ACPs

Objective of the step: To classify the ACPs and perform a selection in case of a large number of ACPs.

Description: ACPs are the input to the overall process. For each ACP, WP8 expects also indications on the specific aspects to validate.

WP8 classifies the ACPs with respect to the following[1]:

- Number of key concerns[2] addressed by the ACP

- Number of key functionalities[3] addressed by the ACP

- Related patterns[4]

- Objective of the validation

- Domains covered (e.g. Enterprise SOA, Internet of Services, Cloud, Web 2.0, SaaS)

Most of the required information for the classification can be extracted from the pattern template WP7 has produced [5] or from the ACP template WP8 proposes for external contributions (see Annex A)

The classification has to give WP8 a comprehensive view on the ACPs to be validated and also to understand both whether they address a sufficient number of elements of the RA structure and which domains they cover.

The classification can:

- Support an eventual selection of ACPs. WP8 cannot exclude the possibility of performing a selection of the ACPs even if WP7 indicates them as all equally important. This depends on the number of inputs and available effort. In case of selection, the classification can help in ensuring a well balanced coverage of the ACPs to be validated with respect to the elements of the RA, objectives of validation, pattern correlation and domain coverage

- Support the distribution of ACPs to proper WP8 partners on the basis of criteria such as expertise of the partners or their involvement in research topics the ACPs relates to

- Support the identification of relationships between PoCs understanding, for example, if some patterns are related to common architectural choices

The output of the step is a classification of the ACPs.

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[1] WP8 is open to add further views that WP7 and / or CA would like to propose to classify the ACPs.

[2] Key concerns are the ones presented and described in [4]. WP8 will of course consider any update / evolution of the key concerns that WP6 will provide

[3] Key functionalities are the ones presented and described in [4]. WP8 will of course consider any update / evolution of the key functionalities that WP6 will provide

[4] Related patterns are the ones received in input by WP8 as well as other patterns of the reference architecture.

Actors involved: This step is executed by the WP8 that in case will interact with the ACPs producers (i.e. WP7 and / or NSPs).

Estimated duration of the step: between one and two weeks.

5.2 Step 2: Identification and description of candidate PoCs

Objective: to identify and describe the candidate PoCs.

Description: the identification of a candidate PoC is the most difficult step of this process. To identify a candidate PoC means that a WP8 partner has to:

- Identify the ACP or the ACPs to be validated

- Identify the most appropriate methods to validate the ACPs on the basis of the specific objectives of validation

- Identify the most suitable environment (e.g. technologies and scenario) to implement the selected methods

- Identify clear, effective and measurable assessment criteria

- Identify measurement metrics, and the way to document the results of the validation

The above are the guidelines WP8 will follow in identifying a PoC.

It is worth mentioning that WP8 does not impose a particular method, or specific assessment criteria or a particular way to document the results since the details can be different case by case.

For example, if the objective of the validation is to prove quality attributes of a system of patterns, a scenario-based method such as the Architecture Tradeoff Analysis Method (ATAM) [6] can be identified and partially followed. However, if the objective is to validate the costs and benefits associated with an architectural decision, other methods such as the Cost Benefit Analysis Method (CBAM) [7] or a combined approach [8] could be more suitable.

There can also be cases in which less formal methods can be identified or defined which may be more appropriate for the required validation.

WP8 will try to maximise the required validations with respect to available resources and effort. To this purpose the classification of ACPs may help, for instance, in identifying groups of ACPs that can share the same method and same environment, so WP8 can reasonably save effort in setting-up a common framework implementing formal methods for validation (since, in this case, it can be shared for several validations)

Once identified, a candidate PoC has to be described according to the template presented in Annex B. Besides describing the aspects pointed out above, the description of a PoC will present the rationale behind the identification of each PoC providing thus a clear motivation for the PoC.

The output of the step is a set of candidate PoCs.

Actors involved: This step is executed by WP8.

Estimated duration: about two weeks.

5.3 Step 3: Evaluation and selection of the candidate PoCs

Objective: to evaluate the candidate PoCs and select the ones to design, implement and execute.

Description: the step is shown in the next picture that provides a detailed view of the third step of Figure 1.
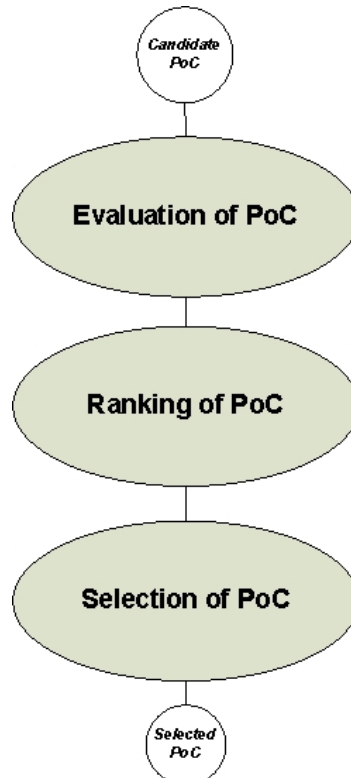

Figure 2: Detailed view of step 3

The candidate PoCs are evaluated against the following selection criteria:

- Presence and effectiveness of the proposed methods for validation

- Presence and effectiveness of the assessment criteria

- Presence of measurement metrics

- Presence of a way to document the validation results.

Basically, in combination with the CA and WP7 leader, WP8 evaluates if the proposed methods for validation and assessment criteria are clear and rigorous enough to allow the ACPs validation. This includes whether there are metrics and a clear way to document the results of a PoC.

The motivation behind these criteria is simple: if the methods or assessment criteria are not clearly stated, the execution of the PoC may be useless for the validation of the ACPs. If both the methods and assessment criteria are clearly stated, there is a reason for designing, developing and executing a PoC. Besides this, there must be presented a set of measurement metrics and a way

to document the results of the validation executed. All the criteria pointed out above have to be positively assessed; otherwise the PoC is not selected.

A PoC requires effort to set-up an environment, develop a pattern, instantiate a scenario, etc. As a side-effect the PoC could also (partially) provide reusable software that can be considered as building blocks for more complex software development in the perspective of a future NCI.

The candidate PoCs which receive a positive assessment based on the above criteria are then ranked against the following:

- Number of NEXOF-RA requirements addressed

- Innovation: are there innovative aspects of a PoC of interest beyond the validation?

- Business value for ICT players: are there aspects of the PoC relevant for NESSI Stakeholders? Is there a business case behind the scenario of a PoC?

The assessment of these criteria follows the schema presented in the table below:

	High	Medium	Low
# of addressed requirements	More than 5 requirements are addressed	From 1 to 5 requirements are addressed	No requirement is addressed
Innovation	Part of the PoC is representative of an innovative solution.	Part of the PoC is representative of a solution at the state of the art	None of the assets of a PoC presents innovation
Business value for ICT players	Part of the PoC is relevant for ICT players	Part of the PoC is useful for ICT players even if not mandatory	None of the assets of a PoC is relevant to the ICT players

It is worth mentioning that in case of enough effort WP8 will consider all the PoCs having had a positive evaluation to the first set of criteria, independently from the above ranking. Otherwise WP8 will propose to CA and WP7 that all the PoCs presenting High and Medium assessment of the above three criteria are selected.

The output of this step is the set of selected PoCs.

Actors involved: This step is executed by WP8 in combination with the CA and WP7.

Estimated duration: about one month.

5.4 Step 4: Design and Implementation of the selected PoCs

Objective: to produce a detailed design of the selected PoCs, implement the PoC and set-up the demonstration environment.

Description: the selected PoCs are designed and implemented. This step foresees the design and implementation of all the assets of a PoC: a framework

to apply the validation methods, the patterns, the scenario, the test cases or benchmark applications.

The output of this step is a PoC and accompanying documentation (including system requirements, detailed description of the PoC, architectural diagram of the PoC, how to install, user guide, etc.)

Actors involved: PoC owner.

Estimated duration: it depends on the complexity of the PoC. It should be limited anyway between one and two months.

5.5 Step 5: Execution of selected PoCs

Objective: to validate the ACPs.

Description: for each PoC, test cases or benchmark applications will be executed to accumulate evidence of the validation. The results will be documented.

Test cases are written in accordance with the selected methods and the assessment criteria. Proof of the validation is accumulated and reported in a validation report for each PoC that will include also lessons learnt during the design, implementation and validation of the PoC.

Actors involved: This step is executed by WP8. Validation Reports will be provided to WP7 and CA for joint evaluation before their public release in D8.2.

Estimated duration: about one week.

6 KEY FEATURES OF THE POC PROCESS

The PoC process presented in this deliverables has the following features:

- It is focused on allowing the validation of ACPs. The process presents guidelines for identification of PoCs to validate ACPs. Furthermore, it strongly commits each PoC owner to identify and describe clear and effective methods and measurable assessment criteria for validation. (Otherwise the PoC will receive a negative assessment against the effectiveness of methods and of assessment criteria and will not be selected)

- It is not strictly tied to the source of inputs. This process applies to ACPs whatever they come from NEXOF-RA or from NSPs. As previously stated, WP8 expects inputs mainly from WP7 but is open also to contributions from NSPs and is currently working to foster these contributions (see section 7 for more information on this). To simplify interactions with external contributors, WP8 has prepared a template for presenting ACPs. This template is shown in Annex A of this deliverable

- It aims to ensure that the ACPs to be validated cover a sufficient number of the RA structure elements. The classification of ACPs has also this objective

- It fosters the development of software artefacts that could be reused in the perspective of developing a NCI. The PoC has the only objective of validating ACPs, but as a side-effect part of a PoC may be also a reusable software artefact.

7 ROLE OF NSPs AND INVESTIGATION TEAMS IN SUPPORTING THE WHOLE PoC PROCESS

NSPs are committed to support and contribute to NEXOF and to the NEXOF-RA project and to adopt the architecture specifications which may result from it.

As such, these projects are requested to share with NEXOF-RA their results related to all topics that are at the heart of the NEXOF-RA research. This includes the Reference Model/Reference Architecture material but also PoC work they will undertake.

In view of this, WP8 has a specific plan to collaborate with NSPs in the PoC area:

- Perform a recognition activity (already started) in order to understand potential contributions from NSP

- Share with NSPs the WP8 foundations: motivations, objectives and definition of PoC, the ACP template

- Prepare a Call for External Contribution where we invite NSPs to share with WP8 their software implementations for validating architectural pattern and choices

- Ask NSPs to complete the ACP template (in order to allow WP8 a better understanding of the patterns and architectural choices behind their implementation)

- Share with NSPs the eventual PoC that WP8 will build on top of their contribution

- Share with NSPs the validation results

It is worth emphasising that in the process presented in this deliverable we consider NSPs a possible source of inputs at the same level as the rest of NEXOF-RA.

We clearly recognise the difficulty in obtaining inputs from other projects. To this purpose WP8, as previously stated, has already started a recognition activity in order to understand potential contributions from NSPs. The candidate contributions from NSPs will be jointly assessed with WP7 that can give WP8 indications on the relevance of NSPs contribution for the RA.

A direct contribution from the Investigation Teams to WP8 is not expected although an indirect one would be encouraged. Indeed their contribution, however, is attached to the research WPs and thus considered via the contribution that those WPs give to the RA.

Anyway, each team can be involved in the process defined by WP8 at any applicable stage, in particular to support WP8 in the identification of PoCs or design and development of a PoC that addresses the research topics investigated by the teams.

8 CONCLUSION AND LESSONS LEARNT

8.1 Conclusion

WP8 consists of activities devoted to the validation of some of the key ACPs of the NEXOF-RA. In this document we have presented and described a process to support the activities of WP8.

This process does not impose a specific method to validate the ACP, instead it provides guidelines to clearly identify, describe, design and set up a PoC that is the way by which WP8 validates the ACPs.

The proposed process represents a common framework for WP8 activities but, obviously, its effectiveness can be mainly assessed during the concrete execution of the activities (concrete execution can also help WP8 in refining or improving some of the steps if required).

8.2 Lessons Learnt

The process presented has a constraint: it requires inputs from WP7 and, also, from NSPs. If the overall goal is to assess the ACPs of the NEXOF Reference Architecture, WP8 needs such inputs which need to arrive mainly from WP7 which is responsible for the aggregation and consolidation of results from WP1-4, and is also responsible for indicating the main objective and expectation from the validation of the patterns.

WP8 has experienced some difficulties in its past activities on receiving these inputs and this difficulty was behind the past decision of starting from results of WP1-4.

As a lesson learnt, we have understood that the different granularity and level of maturity of results from WP1-4 makes a proper PoC identification difficult. Moreover, it resulted in an unbalanced coverage of aspects to validate (most of them relating to WP4 concerns).

Anyway, the work performed on the first set of patterns has had a positive side-effect in allowing WP8 a better understanding on what to do and how to work with the producer of ACPs in order to deliver results exploitable by them.

The lessons learnt have been considered in re-working the PoC process and WP8 has also identified internal milestones in its operational plan in which it collaborates closely with producers of ACPs in order to reduce the risk of not receiving inputs for the second phase PoC.

9 REFERENCES

[1] NEXOF-RA Project, http://www.nexof-ra.eu/

[2] NESSI, http://www.nessi-europe.com/Nessi/

[3] Quality Model for NEXOF-RA Pattern Designing report

[4] Deliverable D6.2 RA Model V2.0

[5] Deliverable D7.4 RA Specification Sample

[6] Architecture Tradeoff Analysis Method, http://www.sei.cmu.edu/architecture/ata_method.html and Evaluating Software Architectures, Methods and Case Studies [Clements, Kazman, Klein, Addison-Wesley ISBN 0-201-70482-X]

[7] Cost Benefit Analysis Method, http://www.sei.cmu.edu/architecture/cbam.html

[8] Robert L. Nord, Mario R. Barbacci, Paul Clements, Rick Kazman, Mark Klein, Liam O'Brien, James E. Tomayko, Integrating the Architecture Tradeoff Analysis Method (ATAM) with the Cost Benefit Analysis Method (CBAM) (CMU/SEI-2003-TN-038).

10 ANNEX A: THE ACP TEMPLATE FOR EXTERNAL CONTRIBUTION

The following structure can be used by external contributors to propose the ACPs. It is very similar to the pattern template produced by WP7.

For inputs coming from WP7, WP8 (also to speed up the interactions with WP7) will work directly on the pattern template produced in the context of WP7.

ACP Template	
General Information	
Name of the ACP	Simple and descriptive. For example the "factory pattern" describes a thing which makes other things, much like a factory.
Intent (or Problem Description)	What should be achieved; the problems it should resolve
Also Known As	Alternative names of the ACP, if known
Motivation	Description of a scenario that shows the problem addressed by the ACP.
Applicability	Explanation of situations when is it appropriate and useful to use the ACP.
Non Functional Requirements (Quality attributes according to the IEEE Standard 1061-1992)	An evaluation of the quality attributes affected by the pattern. For each quality attribute it must be indicated if the pattern affects positively (+) or negatively (-) the attribute
Structure	A graphical representation of the parts which make up the pattern (e.g. UML diagrams)
Participants	The components and actors which make up the ACP and their responsibilities
Collaboration	How do the components work together to achieve the pattern (e.g. Collaboration diagram)
Consequences	The results of using the ACP, including both positive and negative (i.e. bottleneck) aspects
Related ACP	Other ACP which can be used with or are related to this ACP
Further Information (optional)	
Relationship to RA	Clarify the relationship with the NEXOF-RA. For example, you can relate the ACP to the RA structure elements.
Added value for the RA	Clarify the value for the RA. The added value can be clarified for example by one or more of the following: • Technical innovation: the ACP is innovative wrt to state of the

	art alternatives
	• Process innovation: the adoption of the ACP allows to do better, faster or cheaper something
	• Business Value: the ACP enables, facilitates or supports a new business model otherwise difficult to achieve
Sectors Coverage	Select one or more of these sectors and motivate the selection • Enterprise SOA • Cloud computing • Web X.0 • SaaS • Internet of Services • Internet of Things Other (please, specify)
Any other info the ACP proposer would like to provide	Indication of the objective of the evaluation, expect feedbacks.

11 ANNEX B: THE POC TEMPLATE

The following template is used to describe a PoC. The template requires the following details: *i)* What is the objective of the PoC, *ii)* Why the objective of the PoC is relevant, especially for the project, and *iii)* How the validation should be proven (methods, criteria, metric, way to document).

POC Name	
What	
Owners	Owners Short Name
Description of the PoC	A clear description of the PoC
ACPs involved	Description of the ACPs involved.
Objective of the PoC	What is the objective of the validation?
Functionalities	Description of the functionalities of the PoC
Dependencies	Describe the relationships with other ACPs not included in this PoC.
Why	
Rationale	The motivation behind the identification of the PoC in NEXOF-RA.
Architecture Component(s) affected	Specify the architecture components (according the model provided by WP7) affected by this PoC.
Alternatives	Are there alternatives to the proposed PoC?
Relationship with the NEXOF-RA	Clarify the relationship with the NEXOF-RA
How	
Scenarios for validation	Specify scenarios. Scenarios can be linked to WP10.
Suggested Architecture	Provide a detailed design of the PoC
Environment	Specify the environment in which the validation will be performed. This section will report tools, frameworks, standards, etc. and requested integrations among them
Estimated Effort	Describe and detail the required effort for the proposed PoC.
Methods	Describe the methods adopted for validation of the ACPs
Assessment criteria & metrics & way to document	Give clear and measurable assessment criteria to validate the ACPs and metrics to measure the assessment. Presents also the foresaw modality to document the result.
Further Information	Further information considered useful for describing the specific aspects that should be implemented or stressed, any additional feedback required (i.e. for improving other aspects), significant warning related to specific topics, generic comments, etc.