



H2020 5GASP Project

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D6.3 Final progress report on Network Applications Community & Certification process

Abstract

This document is the final deliverable report i) on 5GASP community portals, namely, Network Applications Community and the Network Applications Store; ii) on the delivered community events for the reported period; and iii) on the 5GASP-C certification progress. Regarding community portals, this report summarises the details of the finalised version of Network Applications Community and the Network Applications Store. Regarding events, we present the outcome of the successful delivery of community engagement events and the successful launch of the Network Applications Lab programme attracting SME organisations into training, advising, and learning about 5G Network Applications and 5GASP test bed facilities across all European 5GASP test bed sites. Finally, the document presents updates on processes regarding 5GASP-C certification, including Certification testing.

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Disclaimer

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Executive Summary

This deliverable report is the final iteration in a series of three deliverable reports scheduled for M13, M23 and M39 respectively (this current iteration, postponed from an initial delivery schedule of M36). The present final report provides updates according to the progress of WP6 tasks and milestones, the running of community events and the Network Applications Lab programme. Respective to the community engagement events, it was taken into consideration the feedback received during the interim review process of June 2023, to engage with other ICT-41 ventures, and to enable synergistic events, within the ICT-41 base, as a showcase of the integration, and collaboration among the projects. The report also summarises the progress and maintenance activities of the two project community portals that support SMEs, and other developers engaging with 5GASP Network Applications development and/or other activities or events. Last, the present report discusses updates on the certification (5GASP-C) process, describing the status of the programme, and the progress made in the reporting time frame. This reporting includes relevant information regarding the current implementation of test definitions in the overall certification scheme and iterates with a complete description of the 5GASP certification scheme.

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List of Acronyms

5GASP-C	5GASP Certification
AT	Authorized Testbed
CA	Certification Authority
CI/CD	Continuous Integration - Continuous Delivery
EENA	European Emergency Number Association
FAQ	Frequently Asked Questions
ITS	Intelligent Transportation Systems
PSCE	Public Safety Communication Europe
SME	Small and Mid-size Enterprise
Telcos	Telecommunication service providers
V2C	Vehicle-to-Cloud
OSS	Open-Source Standards
ETSI	European Telecommunications Standards Institute
PPDR	Public Protection and Disaster Relief
IEEE	Institute of Electrical and Electronics Engineers

1. Introduction

1.1. Objectives of this document

This document presents the progress, and the final state on three tasks within WP6, namely, Task 6.1 on “5GASP Platforms”, Task 6.2 on “Community Engagement Events”, and Task 6.3 regarding the “Certification process for SMEs”.

The Network Applications Community building is an essential part of WP6. To support this activity, the Network Applications Community portal has been developed as a part of Task 6.1. This task was completed in compliance with two milestones: MS6.1 ‘Network Applications Community portal – beta version’ in M6 and MS6.3 ‘Network Applications Community portal – final version’ in M20. The Network Applications Community Portal has been developed as part of Task 6.1 to drive the engagement of internal and external stakeholders to the 5GASP ecosystem. The Developer-facing platform of 5GASP, The Network Applications Store Portal, is now in final stage and has been developed as part of Task 6.1. This document will present the updates appended to both Platforms, during the final reporting period and up to M39 of the project, and focus on the improved functionality, and results achieved through the usage of the portals.

Next, Task 6.2 supports the 5GASP Network Application Lab initiative by promoting and hosting Community Engagement Events that are an essential part of 5GASP. During the final reporting period, and up to M39, relevant activities to Task 6.2 includes the completion of the Fourth Community Event series (November 2023), the on-boarding of a third-party Network Applications Developer through the Orange Fab open call program, and the ICT-41 PlugFest (October 2023), as an output of the collaboration efforts in the ICT-41 realm of projects, and a final in-person public event organized in Athens (March 2024)

Finally, we report the progress made on Task 6.3 in support of the certification process to ensure its efficiency. This includes updates on the 5GASP certification process, the enhancements added to the test definitions and the inclusion of additional test definitions. The principal focus of the Consortium, in Task 6.3 during the final reporting period was the enhancement of the overall 5GASP Certification Program, to include additional tests and to streamline the End-to-End On-boarding, Testing and Certification Processes.

1.2. Document structure

This document is structured as follows. Section 1 outlines the purpose of the document and its structure. Section 2 presents the progress status of two 5GASP platforms: *Network Applications Community Portal* and *Network Applications Store Portal*. Section 3 provides the details on the community engagement events held in the reported period. Section 4 presents the status of the certification process of Network Applications. Finally, section 5 summarizes and concludes this final delivery report.

2. 5GASP Platforms

The Network Application Community Portal [1] and the Network Application Store Portal [2] are complementary portals aimed at supporting Network Applications' developers and users. These two portals developed within the projects' Task 6.1. The final versions of these assets are available online.

2.1. Network Applications Community Portal

As it was indicated in Deliverable "D6.2 Interim progress report on Network Applications Community & Certification process" [3] the Community Portal consists of six sections:

- Network Application Community,
- Wiki Space,
- Developer Forum,
- Public Repository,
- Multimedia,
- Register.

The section 'Network Application Community' maintained the same structure as reported in D6.2, and it includes four pages - 'About', 'Network Application Community Members', '5G Network Application Lab', and '5GASP Project'.

The section 'Wiki Space' have been reorganized and extended from five to eight pages in comparison to what was reported in D6.2 [3]. Currently this section includes the following pages: 'Knowledge Center', 'Tutorials', '2023 IEEE WFiot Plugfest', 'Certification Guidelines', 'Network Application Case Studies', 'Blog', '5GASP Documentation', and 'FAQ'. The 'Knowledge Center' page includes two sub-sections: 'Definitions' and 'Papers'. The 'Tutorials' page (Fig. 1) is a subject of regular update. Currently it includes five sub-sections:

- Tutorials on how to Develop and Manage a Network Application (6 tutorials are available on the date of this report preparation).
- Tutorials on how to Develop Network Application Tests (2 tutorials).
- Tutorials on Infrastructure Orchestration and Application Packaging (1 tutorial).
- Tutorials on how to Undergo 5GASP's Certification Process (1 tutorial).
- Other Tutorials (1 tutorial).

Each tutorial is presented as a separate page. All tutorials can be accessed through the "Tutorials" Hyperlink.



Tutorials

Tutorials on how to Develop and Manage a Network Application

Build your VNF from scratch

Basic Architecture OSM requirements Installing OSM Check the installation in the browser by accessing your host IP (by default user and password are admin). Adding a VIM account It is also possible to add the VIM through the OSM GUI: What is a Virtual Deployment Unit (VDU) VDU is a ... Continue reading

 Network Application Community - 5GASP



How to develop a Helm Chart

This tutorial assumes that you have basic knowledge of Kubernetes and a working Kubernetes cluster. What is Helm? Helm is a package manager for Kubernetes that allows developers and operators to more easily package, configure, and deploy applications and services onto Kubernetes clusters. Helm is now an official Kubernetes project ... Continue reading

 Network Application Community - 5GASP



Juju Charms tutorial

Software installation Installation of juju and charmcraft: Creation of the Charm structure After running these commands, you should have the following structure: Changing files Changing files to create a basic charm metadata.yaml You should replace the maintainer: *series* and *actions* with *series* and *actions* in local context and *charm* with *charm* in mind that *series* should

Day-1 and Day-2 VNF Operations

Day-1 vs Day-2 Code Used This tutorial uses code from previous tutorials: Both are available here. Code modifications Basic structure The first step is to download the resources from the previous tutorials. Notice that you are recreating the content of mod/operator and mod/charms.osm. This is not entirely mandatory, but if ... Continue reading

 Network Application Community - 5GASP



How to manage your VNF with an Helm Chart-based Execution Environment (EE) tutorial

Introduction to Execution Environments in OSM OSM's Execution Environments (EE) provide a runtime framework to run day-1 and day-2 primitives. These EE provide the means for NF-specific management code to run it into a dedicated helm chart, which is deployed into OSM's system cluster. From there, the EE interacts with ... Continue reading

 Network Application Community - 5GASP



From a Helm Chart to CNF tutorial

What is a CNF? A Cloud-native Network Function (CNF) is a software-based network

Figure 1 - The 'Tutorials' Page

The ‘2023 IEEE WFiot Plugfest’ page provides relevant content and information regarding the PlugFest Event.

The ‘Certification Guidelines’ and ‘Network Application Cases Studies’ pages have the same purpose and the structure as described in D6.2 [3].

The ‘Blog’ page (Fig. 2) is a new page which is an instrument of dissemination activity that is carried out within the 5GASP ‘WP7 – Exploitation, Dissemination and Standardization’. This page is the subject of regular updates. Each blog has a date of publication and demonstrates the timeline of the blog posts published. Currently, there are 35 blog posts available on this page.



Category: Blog



Automated Certification

This post describes the automated 5GASP certification and how the certification process is determined. 5GASP has defined different 4 test areas with more than 50 specific test cases to provide an automated certification for network applications. The test areas of 5G Readiness, Security, Performance, and Availability are selected to cover [...]

[Read more >](#)



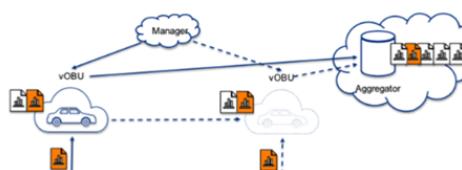
Advancements in Telecommunications: The Evolution of Test Beds for Network Experimentation

Introduction: The rapid evolution of telecommunications networks demands continuous innovation and experimentation to ensure their seamless functioning and optimization. As technology progresses, the need for robust test beds becomes increasingly essential to simulate real-world scenarios, assess performance, and pave the way for future developments. This article explores the development of [...]

[Read more >](#)



Figure 2 - The 'Blog' page



The ‘5GASP Documentation’ page and ‘FAQ’ have the same purpose as it was defined in D6.2 [3].

The section ‘Developer Forum’ is intended to support Network Applications’ developers and users by answering their questions. The Developer Forum (Fig. 3) is designed as a separate page powered by Discourse Platform [5]. It allows users to see the pre-defined categories, the most recent posts and top Q&As.

Category	Topics	Latest
5GASP	27	C * Welcome to Discourse Sep '21
Uncategorized	11	R What changes do I need to do to my code to port it for 5GASP? 10h 5GASP
Network Application Design and Development	13	K Does this project has any whitepapers? 3d
OSM	15	J Evolving an existant solution as Network Application 0 ■ Network Application Design and Development 10d
Site Feedback	1	G How to Perform Day-1 and Day-2 VNF Operations 2 ■ Network Application Design and Development Jan 22

Figure 3 - The 'Developer Forum' page

The section ‘Public Repository’ presents the Network Applications that are currently under development and validation on the 5GASP infrastructure. It has the same purpose and structure as indicated in D6.2 [3].

The section ‘Multimedia’ [4] presents video recordings of the 5GASP project events and the Photo Gallery. Currently, this section provides access to 32 videos. The ‘Multimedia’ section has been updated since reporting in D6.2 [3] by adding a new page - ‘Webinars’ which provides access to the videos recorded during the 5GASP project webinars.

The section ‘Register’ with the page ‘Login’ provides access to the internal part of the portal. There are no changes in its functionality in comparison to its description in D6.2 [3].

During the past 12 months over 670 users visited the Community portal with more than 18000 page views. The statistics on the portal usage are shown in Fig. 4.

Page path and screen class	Views	Users	Views per user	Average engagement time	Event count
					All events
	18,136 100% of total	696 100% of total	26.06 Avg 0%	57s Avg 0%	23,786 100% of total
1 /	4,511	235	19.20	20s	5,262
2 /index.php/netappcommunity-knowledge-center/	2,018	81	24.91	27s	2,141
3 /index.php/login/	196	78	2.51	22s	462
4 /index.php/netapplab/	141	60	2.35	21s	336
5 /%3Fs=&cat=plus-5-results	121	23	5.26	2s	139
6 /index.php/2023/11/24/rise-6g-training-workshop/	101	31	3.26	0s	117
7 /index.php/category/blog/	97	23	4.22	41s	187
8 /index.php/build-your-vnf-from-scratch/	92	36	2.56	26s	239
9 /index.php/2022/03/14/isolated-operations-in-5g-ppdr/	91	51	1.78	45s	254
10 /index.php/post_grid/news-archive	62	2	31.00	1m 17s	118

Figure 4 - The Community portal statistics.

The final structure of the Network Application Community portal is presented in Fig. 5.

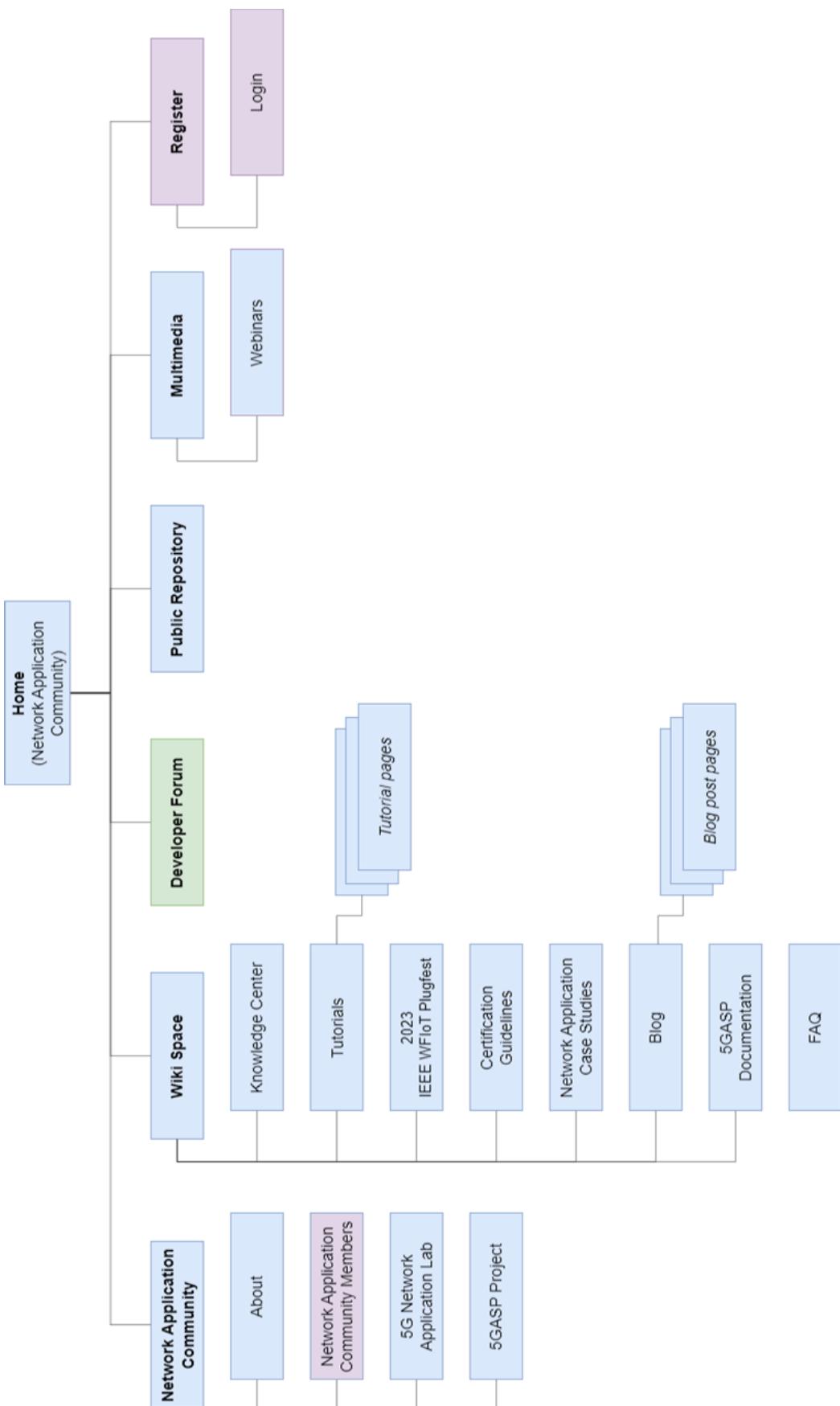


Figure 5 - The updated site map for the Network Application Community Portal

2.2. Network Applications Store Portal

The Network Application Store portal is materialized through the 5GASP Services Marketplace. Since reporting in D6.2 [3], the final version of this portal has been released. The portal is structured under catalogs, which comprises of categories including the offered services. This structure was selected to support the cognitive navigation through the portal, while also enabling the dynamic of the displayed Network Applications boosting their seamless onboarding. The latter can be considered as the main reason, along with the adoption of standardized interfaces, for the 5GASP Services Marketplace to serve as a cross-ICT-41 projects' common hosting environment, as further presented later in this document at 3.5.

The structure of the Network Application Store portal is built around six core sections:

- Catalog,
- Demo Catalog,
- Development Catalog,
- Experimental Catalog,
- ICT-41 Repository
- Network Applications.

The final structure of the Network Application Store portal is shown in Fig. 6.

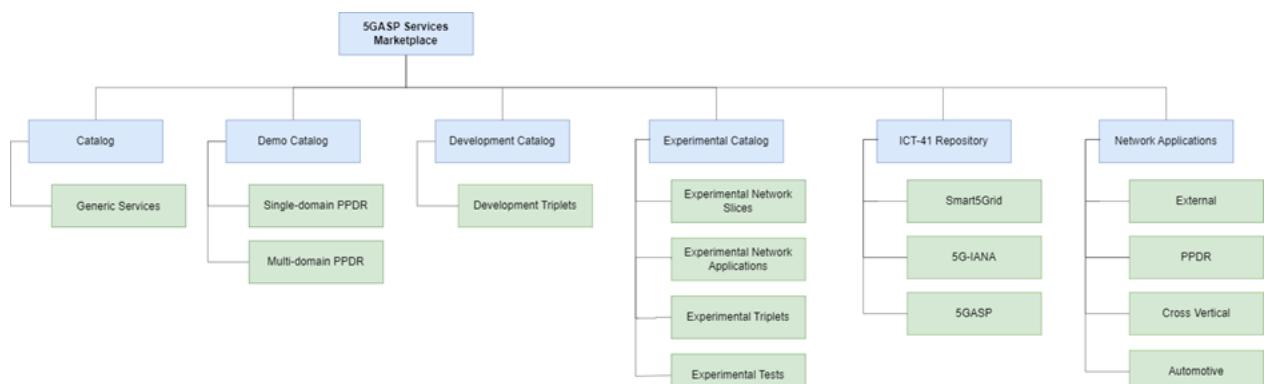


Figure 6 - The final version of the Network Application Store portal site map.

The section 'Catalog' provides template specifications of the generic services (Fig. 7), which could provide an introductory insight towards 5GASP's service design models. Currently, there are three specifications:

- A GST(NEST) Network Application Service Example
- A GST(NEST) Service Example
- Certification and Publishing Service.

Welcome to the 5GASP Services Marketplace

Browse available services and sign in to order

Service Specifications of **Generic Services** category

Generic Services of this catalog

Filter services...

A GST(NEST) Network Application Service Example

Version: 5.0.0
Generic Services

GST external example

5GASP powered by openslice

Preview

Last updated at 13 Sept 2021, 11:37:47 (Local Time)

A GST(NEST) Service Example

Version: 5.0.0
Generic Services

GST external example

5GASP powered by openslice

Preview

Last updated at 13 Sept 2021, 11:37:47 (Local Time)

Certification and Publishing Service

Version: 0.1.0
Generic Services

This is a service that accepts 5GASP's test results and app ...

5GASP powered by openslice

Preview

Last updated at 2 Oct 2023, 14:45:31 (Local Time)

Figure 7 - Generic Services

The section ‘Demo Catalog’ includes two pages: ‘Single-domain PPDR’ (Fig. 8) and ‘Multi-domain PPDR’ (Fig. 9). It is exclusively dedicated to a cross-border PPDR scenario, which encapsulates two inter working 5GASP Network Applications, i.e., 5G Isolated Operation for Public Safety (5G IOPS) and Fire Detection and Ground Assistance using Drones (FIDEGAD). More details about the demonstration can be found later in this document, at Section 3.1 – PPDR Webinar.

Welcome to the 5GASP Services Marketplace

Browse available services and sign in to order

Service Specifications of **Single-domain PPDR** category

Description not available

Filter services...

FIDEGAD & IOPS Core Network Application @ ININ - PPDR Operation

Version: 0.1.0
Single-domain PPDR

This deploys 5GASP's IOPS Core Network Application in IOPS ...

5GASP powered by openslice

Preview

Last updated at 12 Oct 2023, 14:31:39 (Local Time)

FIDEGAD Network Application @ ININ - Normal Operation

Version: 0.1.0
Single-domain PPDR

This is 5GASP's Network Application 11 - Fire detection and ...

5GASP powered by openslice

Preview

Last updated at 12 Oct 2023, 14:19:50 (Local Time)

Figure 8 - Single-domain PPDR



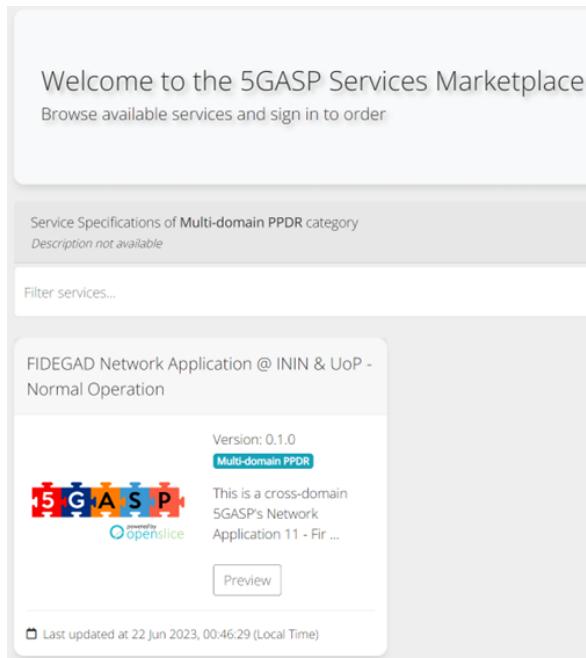


Figure 9 - Multi-domain PPDR

The section ‘Development Catalog’ provides service specifications of development triplets and has been used throughout the project’s life span for testing purposes, resembling a sandbox environment (Fig. 10).

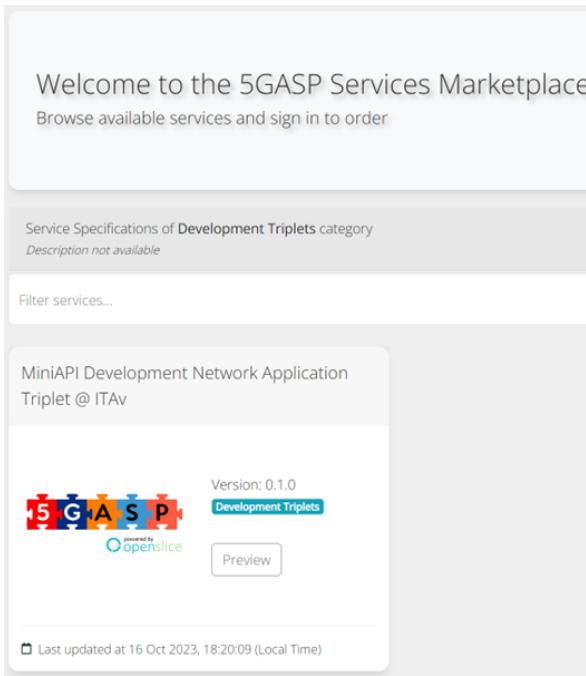


Figure 10 - Development Triplets

The section ‘Experimental Catalog’ provides information on service specifications of the experiments contacted within the project. It encapsulates the introduced 5GASP data model, i.e., the 5GASP four subcategories and its comprising entities. Therefore, this catalog includes:

- Experimental Network Slices
- Experimental Network Applications

- Experimental Triplets
- Experimental Tests.

The page ‘Experimental Network Slices’ is shown in Fig. 11.

Welcome to the 5GASP Services Marketplace
Browse available services and sign in to order

Service Specifications of Experimental Network Slices category
Experimental category containing offered network slices (development)

Filter services...

eMBB slice @ ININ	eMBB slice @ ITAv	eMBB slice @ OdinS
 Version: 0.1.0 Experimental Network Slices Basic eMBB slice offered at ININ tested (Ljubljana) Preview	 Version: 0.1.0 Experimental Network Slices Basic eMBB slice offered at ITAv tested (Aveiro) Preview	 Version: 0.1.0 Experimental Network Slices Basic eMBB slice offered at OdinS tested (Murcia) Preview
Last updated at 15 Jun 2023, 21:31:43 (Local Time)	Last updated at 11 Jan 2024, 19:27:01 (Local Time)	Last updated at 19 Dec 2023, 18:49:53 (Local Time)
eMBB slice @ ORO	eMBB slice @ UnivBris	eMBB slice @ UoP
 Version: 0.1.0 Experimental Network Slices Basic eMBB slice offered at ORO tested (Bucharest) Preview	 Version: 0.1.0 Experimental Network Slices Basic eMBB slice offered at UnivBris tested (Bristol) Preview	 Version: 0.1.0 Experimental Network Slices Basic eMBB slice offered at UoP tested (Patras) Preview
Last updated at 29 Jun 2022, 14:46:22 (Local Time)	Last updated at 27 Mar 2023, 18:18:32 (Local Time)	Last updated at 25 Jul 2023, 16:42:42 (Local Time)

Figure 11 - Experimental Network Slices

The section ‘ICT-41 Repository’ presents service specifications of Smart5Grid, 5G-IANA, and 5GASP (Fig. 12). Its services as the common across-ICT-41 projects’ marketplace.

Welcome to the 5GASP Services Marketplace
Browse available services and sign in to order

Service Specifications of 5GASP category
This is a category for 5GASP network applications

Filter services...

Central P2 Station Network Application (Innolab)	P25GHO Network Application (UoP)	M2C Handover Enhancer Network Application (UnivBris)
 Version: 0.1.0 The available network application 3 - Central P2 Station ... Preview	 Version: 0.1.0 The available network application 4 - P25GHO Network ... Preview	 Version: 0.1.0 The available network application 7 - M2C Handover Enh ... Preview
Last updated at 15 Jun 2023, 18:18:32 (Local Time)	Last updated at 10 Dec 2022, 19:22 (Local Time)	Last updated at 15 Jun 2023, 18:18:32 (Local Time)
Migration Service Network Application (ORO)	P25GAI isolated Operators Network Application (Innolab)	Image Analyzer Network Applications (UnivBris)
 Version: 0.1.0 The available network application 5 - Migration Service ... Preview	 Version: 0.1.0 The available network application 6 - P25GAI isolated Oper ... Preview	 Version: 0.1.0 The available network application 8 - Image Analyzer Netw ... Preview
Last updated at 21 Dec 2022, 14:46:22 (Local Time)	Last updated at 15 Jun 2023, 18:18:32 (Local Time)	Last updated at 15 Jun 2023, 18:18:32 (Local Time)
Remote Human Driving Network Application (BLB Drive)	Vehicle Route Optimizer Network Application (Innolab)	Virtual RoadSide Unit (RSU) Network Application (Innolab)
 Version: 0.1.0 The available network application 6 - Remote Human Driv ... Preview	 Version: 0.1.0 The available network application 10 - Vehicle Route Opti ... Preview	 Version: 0.1.0 The available network application 11 - Virtual RoadSide Un ... Preview
Last updated at 15 Jun 2023, 18:18:32 (Local Time)	Last updated at 15 Jun 2023, 18:18:32 (Local Time)	Last updated at 15 Jun 2023, 18:18:32 (Local Time)
iOBU programming Network Application (ORO)		
 Version: 0.1.0 The available network application 1 - iOBU programming N ... Preview		
Last updated at 15 Jun 2023, 18:18:32 (Local Time)		

Figure 12 - 5GASP Repository Categories



The section ‘Network Applications’ is a standalone catalog, which aims to offer a quick-access directory of the available Network Applications, ordered by the respective vertical industry they belong. For that reason, it includes categories ‘External’ (Fig. 13), ‘PPDR’, ‘Cross Vertical’, and ‘Automotive’.

Welcome to the 5GASP Services Marketplace
Browse available services and sign in to order

Service Specifications of External category
This is a category that hosts Network Applications external to the 5GASP project

Filter services...

5G-EPICENTRE Media Services Network Application
Version: 0.1.0
External
This is 5G-EPICENTRE's Media Services Network Application d ...
Preview
Last updated at 20 Dec 2023, 18:16:00 (Local Time)

5G-IANA CITS Application
Version: 0.1.0
External
This is 5G-IANA CIT Application deploying in a 5GASP facili ...
Preview
Last updated at 21 Feb 2024, 20:29:55 (Local Time)

AI Vision Platform
Version: 0.1.0
External
Visual recognition Analytics Tools solution. Can be deploy ...
Preview
Last updated at 22 Oct 2023, 16:02:47 (Local Time)

Figure 13 - External Categories

Finally, 5GASP has also introduced a discrete section within the Network Applications Store portal, i.e., the Products Marketplace. The latter differentiates from its already discussed Services equivalent primarily at the model used. As its title implies, this marketplace’s exhibits are categorized as products. The product entity is a common ground among Business Support Systems (BSSs) and its adoption promotes the derived interoperability with such external systems. Specifically, it contains 5GASP Network Applications that have undergone its certification procedure and therefore considered as off-the-shelf products within the scope of 5GASP. The Products Marketplace contains an expected differentiation between Under Certification/Certified Network Applications, as depicted in Fig. 14.

Product Catalog Explorer

- Network Applications
- 5GASP
- Under Certification
- Certified**
- External

Welcome to the 5GASP Products Marketplace
Browse available products and sign in to order the respective services

Product offerings of Certified category
This is a category incorporating 5GASP's certified Network Applications

Filter products...

Central ITS Station Network Application (YoGoKo)
Version: 0.1.0
C-ITS standards are based on the ITS station architecture. ...
Preview
Last updated at 13 Jun 2023, 13:59:48 (Local Time)

FIDEGAD Network Application (UoP)
Version: 0.1.0
Wildfires are one of the costliest and deadliest natural di ...
Preview
Last updated at 2 Jun 2023, 18:31:44 (Local Time)

MEC Handover Enhancer Network Application (UNIVBRIS)
Version: 0.1.0
UNIVBRIS will develop Network Application(s) in support of ...
Preview
Last updated at 2 Jun 2023, 18:33:02 (Local Time)

Figure 14 - Products Marketplace Page

3. Community Engagement Events

The Community Engagement Events continued to be an important part of the 5GASP project, disseminating the progress on 5GASP platforms, certification progress and engaging with Network Applications developers – SMEs, startups, researchers, developers, as well as other Horizon 2020 projects.

We have now held our second physical event (M.S. 6.6 Second Physical Engagement Event, as a PlugFest event, hosted by ITAv) and continued maintaining online presence, as well, through two webinars. In the PlugFest we engaged other ICT-41 Projects, and it was very successful, both regarding dissemination and collaboration discussions. The two webinars have attracted some attention and demonstrated some useful interactions and potential for 5G-based development with industry, in the automotive and PPDR verticals.

3.1 Fourth Community Event

The two webinars, organized on the 14th and 15th of November 2023, on the two main verticals approached by the 5GASP Project had good engagement and showcased technical achievements both inside and outside the project. The events were organized via Zoom and Eventbrite link and the full recordings are available on the 5GASP YouTube channel [6].

The main goals of the two webinars were to reach out to industry and discuss the impact of 5GASP and the interconnected, international 5G NetOps-based development environment provided by it and other ICT-41 projects, on industry and standardization within and outside Europe.

In the first webinar we included Johannes Springer, Director General of the 5GAA (5G Automotive Association), who is also the CTO of the 5G and Connected Car Program division at Deutsche Telekom, as a panelist for our first (automotive) webinar. Chris Nicolaescu coordinated the first webinar, that had an agenda starting off the meeting with an introduction to the 5GASP Automotive and Mobility vertical, by Dirk Hetzer, Senior Project Director, EANTC AG, together with Thierry Ernst, CEO & Co-founder of YoGoKo; then a presentation on the implementation of an automotive-vertical-specific vertical testbed and Network Application, for vehicular and associated app mobility followed, by Ana Hermosilla, Industrial Predoctoral Researcher (PhD Candidate) at Computer Science Faculty, University of Murcia (FIUM); followed by an ITS-specific presentation by Head of Innovation at YoGoKo, Christophe Courtier, which then smoothly transitioned into the panel discussions, which involved the invited industry expert, Director General of the 5GAA (5G Automotive Association) and CTO 5G and Connected Car Program at Deutsche Telekom, Johannes Springer, Co-Founder and CTO of Neobility and UrbanAir, Andrei Rădulescu, and all the other previously-mentioned speakers. The discussions were very insightful and innovation-forward. Experts shared and/or unique experiences of cross-project, international, practical, and theoretical developments and implementations contributed to different conversations and Q&As, all targeted at a more widely accepted standardization and market adoption of 5G-based automotive, ITS and mobility technologies.

The second webinar, concentrating on the PPDR vertical, was also successful, gathering the attention of several different domains of the industry, since it included a PPDR application which developed on the concept of chatbot-enabled PPDR assistance, with fallback to Large Language Models and it showed much promise for distribution, containerization, and enhancement, through its extension to 5G (and possibly 6G) deployment. The coordinator of this webinar was Diogo Gomes, 5GASP Project Coordinator, Instituto de Telecomunicações Portugal, and the agenda included a Network Application-driven session, which was presented by Kostis Trantzas, Research Software Engineer, working as a partner, for the University of Patras, and TSC Chair on the ETSI Software Development Group (SDG) for OpenSlice and Luka Koršić, Co-founder and Head of R&D at INTERNET INSTITUTE Ltd; followed by a seminar session, led by Jumanah Al Awfi, who, at the time of the webinar, was a Software Engineer Intern at one2many (an Everbridge company). The Q&A session at the end of the webinar seminar was also insightful on the ENGAGE project and towards potential 5G MEC implementations that could potentially even use a platform such as 5GASP.

The proceedings of both webinars have been recorded and are available on the 5GASP Youtube channel [6], in dedicated playlists for the Automotive Webinar [7] and the PPDR Webinar [8]

3.2 ICT-41 PlugFest (Milestone 6.6)

In the scope of Horizon 2020 Framework Program call for Information and Communication Technologies (ICT-41), several projects gathered at the World Forum on IoT in Aveiro, Portugal in October 2023 to validate various network applications across different platforms and provide proof of their open nature and interoperability characteristics.

In a technical session that involved the presentation and demonstration of an application developed by a given project on the platform of a different project, developers from all projects were able to put to test their architectures and solutions, exposing the strengths and weaknesses of each project, but also finding the commonalities between each other and debating future improvements and open issues.

A photo of this event is presented in Fig. 15.



Figure 15 - Network Applications Presentations at the ICT-41 PlugFest

The applications tested in this PlugFest followed an NFV approach to network architecture that is focused on reducing the degree of dependency that traditional network elements have on the physical equipment. This common architecture between all projects was the key for an easy integration.

Regarding the participants, the ICT-41 PlugFest involved not only partners from the ICT-41 projects: (i) 5GASP, (ii) 5G-EPICENTRE [9], (iii) 5GMETA [10], (iv) 5G-IANA [11], and (v) VITAL-5G [12], but also an SME (AlVision) [13] invited by the 5GASP consortium member Orange Romania.

During the event, several integrations have been achieved:

1) FIDEGAD on 5G-EPICENTRE

Fire Detection and Ground Assistance using Drones (FIDEGAD) is a cloud-native Network Application, within 5GASP's ecosystem, that serves the purpose of detecting and provisioning a first assessment of structures and forests on fire. This Network Application comprises a drone along with services that run on the Edge of the Network, ensuring low latency. Telemetry data, as well as information from infrared sensors, conventional video, and thermal vision, are transmitted to the 5G System and, consequently, to the operating teams. FIDEGAD also enables 3GPP-based interaction with the 5G System, namely with Network Exposure Function (NEF) and Policy Control Function (PCF), to substantially cover its mission-critical purpose.

During the technical session, FIDEGAD showcased its functionality, operating outside of its established environment, specifically within a 5G-EPICENTRE testbed. This infrastructure was hosted by Altice Labs and offered a 5G-oriented environment with various capabilities for experimentation and validation of solutions on the PPDR domain. The mutual challenge laid to incorporating the 3GPP-defined PCF interface (N5), both from application and infrastructure perceptive, to affect network quality within the boundaries of a mission-critical situation.

Ultimately, the showcased implementation verified the application of Quality of Service (QoS) management with notable results.

To 5G-EPICENTRE, this was an opportunity to assess and validate the deployment of a 3GPP-compliant application using the standard N5 interface to inter-operate with the PCF function. The lack of compliance of the local 5G core to 3GPP was overcome by developing a simple adaptation layer. The successful onboarding and operation of the FIDEGAD indicates that this experiment can be replicated in other cases.

2) Network Applications for 5GMETA Users on 5G-IANA

This demonstration highlighted the integration between the 5G-IANA and 5GMETA Platforms. While 5G-IANA platform facilitates the development and testing of automotive 5G Applications, 5GMETA offers an IoT-based platform for CAM services. The goal of this demonstration was to deploy two network applications from 5GMETA on 5G-IANA's platform: one to generate and send C-ITS messages from vehicles to 5GMETA and another to retrieve data from 5GMETA. These applications demonstrated the successful communication between

the platforms, suggesting that future 5G-IANA Network Applications can similarly integrated with 5GMETA for streamlined communication in CAM contexts.

3) 5G-IANA ITS Communication Network Application on 5GASP

This demo showcased the LINKS Foundation's (5G-IANA) integration of an ITS communication network application within the 5GASP Platform. This Network Application implements the communication stack that is needed to have ITS stations (e.g., onboard unit, roadside unit, traffic control centers) intercommunicating through the standards released by the ETSI TC ITS. It involved testing two applications: one simulating a vehicle's OBU, sending ITS messages, and another emulating a traffic control center that monitors the received messages. Both were deployed as docker containers on the 5GASP Platform with ease. The successful demonstration confirmed the straightforward deployment and usability of 5G-IANA project applications on the 5GASP Platform.

4) Data Collection Network Application Integration with Onboard Unit

This demonstration showcased the interoperability between VITAL-5G's Applications and the 5G-IANA testbed, aiming to prove cross-project application utility. The demo focused on enhancing the VITAL-5G "IoT Management Platform" for the 5G-IANA environment, turning it into a data collector for virtual OBUs. This adaptation allowed for the collection and analysis of automotive data in virtual scenarios. The application's deployment was achieved using 5G-IANA's Automotive Open Experimental Platform (AOEP), integrating VITAL-5G's application with 5G-IANA's network for efficient communication between OBUs and Edge servers. This experiment showcases once more the interoperability among ICT-41 projects, stressing the value of following a unified approach.

5) A.I. Vision – Computer Vision Network Application on 5GASP

A.I. Vision is a SaaS Platform that employs AI Visual Recognition. This platform was developed by a startup in the Orange Fab Program, which aims to facilitate the development and deployment of 5G applications in network operators. Since the 5GASP platform provides testing and certification tools for 5G Network Applications, it comes naturally for A.I. Vision to rely on such platform to conduct tests on its application. Therefore, A.I. Vision participated in the ICT-41 PlugFest by developing a PPDR use-case demonstrator for road crossings and intersections in Romania. The process involved its onboarding via the 5GASP Portal, the execution of both custom and 5G readiness-related tests. Moreover, in this demonstration, various PPDR capabilities were also showcased. During the PlugFest event, this demonstration validated the 5GASP Platform's ability to facilitate third-party developers with 5G readiness-level tests in a DevOps-centered environment.

6) Mission Critical Communications Network Application on 5GASP

During this demonstration, a PPDR Network Application from the 5G-EPICENTRE project was validated in one of 5GASP's testbeds. While the 5GASP platform is not tailored for PPDR applications, this experiment showed its broader applicability for mission-critical Network Applications, emphasizing its compatibility with diverse infrastructures.

This cross-project experiment emphasized the importance of interoperability and scalability. The success of this validation demonstrates collaborative efforts in advancing next-generation network architectures, encouraging the exploration of synergies for future technologies.

7) Deep Learning object detection Network Application on VITAL-5G

This demonstration presents a joint effort between 5G-IANA and VITAL-5G, showcasing a Network Application developed in 5G-IANA for remote driving and relying on deep learning object detection to identify persons. VITAL-5G offers an experimentation platform that enables deployment and validation of the Network Application and services. Therefore, 5G-IANA's Network Application was deployed through it.

After being deployed, 5G-IANA's Network Application was attached to a video feed at the Athens testbed, automating the detection of persons and objects. The objectives of this demonstration relied on validating an AI application in the Transport and Logistics facilities offered by VITAL-5G, to confirm the Network Application portability across experimentation platforms. Achieving this goal required designing the technical solution, onboarding the 3rd party application into VITAL-5G, and developing/integrating new functionality to support compatible video encoding formats.

8) Quality Monitor Network Application 5G-INDUCE on VITAL-5G

Quality Monitor (QMON) is a Network Application developed within 5G-INDUCE to monitor 5G network quality of service and overall performance. During the ICT-41 PlugFest, QMON was deployed through the VITAL-5G Platform in the Antwerp testbed. This deployment aimed at (i) Validating 5G QoS metrics from VITAL-5G Platform and QMON, (ii) Validating QMON in Port environments, and (iii) Validate Network Application portability. The deployment relied on emulated data from a QMON agent. To achieve these objectives, tasks included designing deployment, installing a 5G Gateway with a QMON agent to collect metrics, and onboarding the QMON 3rd party Network Application. Attaching the 5G Gateway to the testbed's network proved most complex and time-consuming, while application onboarding was less complex due to common software images and orchestration descriptors.

9) 5G EPICENTRE's Media Services Network Application on 5GASP

This demonstration showcased the interoperability between 5G-EPICENTRE's Applications and the 5GASP testbed, aiming to address cross-project application utility. This demo focused on making available a Media Services Network Application, from Airbus, in 5GASP's ecosystem, which was achieved by packaging Airbus' application Helm Chart in an OSM-deployable CNF and deploying it through the 5GASP NODS. The deployment of such application in a 5GASP testbed allowed to showcase the seamless portability of 5G-EPICENTRE's application. Moreover, during this demo, the Media Services application from Airbus took advantage of 5G network capabilities to guarantee the low latency and increased bandwidth required for the video streaming services offered through the application. This experiment showcases once more the interoperability among ICT-41 projects.

3.3 5G innovations for verticals - contributions on testing and certification workshop

During a one-day Workshop, held in Athens on March 13, 2024, we approached the achievements of 5GASP and of other ICT-41 projects, and highlighted the technological progresses made in these initiatives, assessed, and discussed the integration of projects and the novel solutions of 5GASP to the community through standardization of software components and Open-Source Software contributions.

The event was organized in Athens, co-hosted with 5GASP's final General Assembly, and gained participants from 5G-IANA, 5G-Epicentre and Smart5Grid and two local SME's.

An introductory setting reviewed 5GASP's main results and contributions to OSS / ETSI, through OpenSlice and NEF Emulator followed by a review of the 5GASP Certification and Testing process and OSS Repository of Tests.



Figure 16 - ICT-41 Projects Roundtable

A cross-project, common-results discussion, and roundtable was followed, with representatives of ICT-41 Projects and concluded with presentations from Network Application developers, on the two principal verticals of focus in 5GASP - Automotive and PPDR.

3.4 Other Events, Plans and Cross-project events

CAMARA

CAMARA is an open-source project within Linux Foundation to define, develop and test the APIs. CAMARA (Telco Global API Alliance) works in close collaboration with the GSMA Operator Platform Group to align API requirements and publish API definitions and APIs. Harmonization of APIs is achieved through fast and agile created working code with developer-friendly documentation.

DriveU and EANTC AG are member in the CAMARA initiative. As such, the consortium partners are promoting the 5GASP solutions to be adapted for CAMARA.

Mobile World Congress '24 (MWC)

MWC Barcelona (formerly but still commonly referred to as Mobile World Congress) is an annual trade show dedicated to the mobile communications industry. The event is held in Barcelona, Spain. It is attended primarily by device manufacturers, network equipment providers, representatives of wireless carriers, and the press, among others.

EANTC AG have presented automated testing solutions for Network Applications, at MWC'24 References to 5GASP ideas, and the project's logo have been used in the presentations.

3.5 Analysis of engagement with ICT-41 projects

There has been very active in engaging the remaining ICT-41 projects, besides the PlugFest described in a previous section, 5GASP has maintained contacts with these projects to proceed with testing of Network Applications across projects (e.g., C-ITS Station from YoGoKo is being tested on 5G-IANA) and has promoted the use of 5GASP service portal as a marketplace for other ICT-41 Network Applications.

The 5G-IANA project aims to establish an open 5G experimentation platform, particularly catering to SMEs in the automotive sector. The project offers standardized APIs that facilitate service development, targeting different visualization technologies and integrating various management frameworks. The project focus on automotive-related use cases across two 5G standalone testbeds makes it very interesting for 5GASP Automotive Network Application developers. In this scope partner YoGoKo, which is the owner of Network Application 2 (Virtual RoadSide Unit (vRSU)) and Network Application 3 (C-ITS Station), has been collaborating with 5G-IANA to deploy their network applications and be able to test them in 5G-IANA own testbeds.

Another important collaboration across projects has been the use of 5GASP service portal marketplace as a host of other ICT-41 Network Applications. The portal hosts 5GASP Network Applications and provides the means to order these applications into 5GASP testbeds. In a collaborative effort with 5G-IANA, Smart5Grid but also with AI Vision (SME that joined our Network Applications Lab effort) we have onboarded several Network Applications that are now featured and promoted in our portal marketplace.

We hope that, by the closing of our project, more Network Applications from more projects, can be also onboarded.

The screenshot shows the 'Services Marketplace' interface. On the left, a sidebar titled 'Service Catalog Explorer' lists categories: Catalog, Demo Catalog, Development Catalog, Experimental Catalog, and ICT-41 Repository. Under 'ICT-41 Repository', 'SGASP' is selected. The main area displays a 'Welcome to the 5GASP Services Marketplace' message and a sub-section titled 'Service Specifications of SGASP category'. Below this, there's a search bar labeled 'Filter services...' and a grid of service cards. The grid includes:

- Central ITS Station Network Application (YoGoKo)**: Version 0.1.0, Experimental Network Application, SGASP, Automotive. Last updated at 13 Jun 2023, 11:59:16 (Local Time). Preview button.
- FIDEGAD Network Application (UoP)**: Version 0.1.0, Experimental Network Application, SGASP, PPDR. Last updated at 20 Dec 2023, 15:51:20 (Local Time). Preview button.
- MEC Handover Enhancer Network Application (UNIVBRIS)**: Version 0.1.0, Experimental Network Application, SGASP, Cross Vertical. Last updated at 2 Jun 2023, 16:32:52 (Local Time). Preview button.
- Migration Service Network Application (OdinS)**
- PPDR Isolated Operations Network Application (ININ)**
- Privacy Analyzer Network Applications (Lambda Networks)**

Figure 17 - ICT-41 Repository

4. 5GASP Certification Processes Updates

5GASP has defined four test areas with more than 50 specific test cases to provide an automated certification for network applications.

The test areas of 5G Readiness, Security, Performance, and Availability are selected to cover the most essential features for network applications in 5G networks. The automated certification will provide a powerful tool for application developers to test the behavior of the dedicated application.

The certification process is essential to support professional CI/CD pipelines. New software versions of applications will get fast and automated information about the proper functionality in the network environment.

4.1 Certification Criteria

This section presents the various certification criteria used in the 5GASP certification process.

4.1.1 Test Types and Weights

Tests for the certification are divided into two types: mandatory and conditional mandatory.

- Mandatory: All these tests must be executed by any Network Application.
- Conditional mandatory: A subset of these tests must be executed by Network Applications based on their selected test conditions.

Additionally, conditional test cases have a weight (an integer between 1 and 10) that indicates the significance of the tested feature or element.

4.1.2 Test Conditions and Test Profiles

Test conditions represent features or aspects of a Network Application. Specific test cases can only be executed by Network Applications that support specific features or have certain aspects. Hence, mandatory test cases do not have test conditions as they must be executed by all Network Applications. Each other test case is a conditional mandatory test and must have at least one test condition assigned to it, but it can also have more than one.

A **test profile** is a pre-defined set of test conditions. The goal is to simplify the selection of test conditions for applicants. Thus, selecting a test profile is equivalent to manually selecting each test condition included in a profile and has no additional effects.

Before the certification test execution, the applicant must select the test conditions that apply to their Network Application. These conditions determine the list of conditional mandatory test cases that it must execute for the certification. This list consists of each test case whose test conditions are a subset of the Network Application's selected conditions.

The available test conditions are:

- Application layer traffic
- Data plane app
- Deployment type (VM or container)
- Location-based app
- Mobility-based app
- NEF support
- Premium quality of service (QoS) app
- Scalable on the number of Network Application instances
- Scalable on the number of users

4.1.3 Test Axes and Axis Scores

Network Applications will be evaluated based on these four axes:

- 5G Readiness
- Security & Privacy
- Performance & Scalability
- Availability & Continuity

For a clearer categorization of test cases, the axis "Baseline/prerequisites" mentioned in D6.2 [3] has been integrated into the other four axes by sorting its test cases into one of these axes and setting the test type to "mandatory".

Each test axis will be graded separately with a score in the range from 0 to 10, with 0 being the lowest and 10 being the highest possible score to achieve. The score is calculated (per axis) as follows:

- If all mandatory tests have been passed, the score is 1, otherwise it is 0.
- For all executed conditional mandatory tests, the weighted average is calculated, and the result is the score.
- The final score for the axis is the result of multiplying the scores from the two previous steps.

In the certificate document, the axis scores will be depicted in a radar chart, see Fig. 16.

4.2 Issuing of the Certificate

This section describes the process for generating and issuing of the certificate to be provided to Network Applications tested in the 5GASP Platform.

4.2.1 Certificate Grades

After the test execution is finished, a document is automatically generated. The test results are retrieved from the CI/CD Manager, while basic information about the tested Network Application and the applicant are retrieved from NODS. This workflow is presented in Figure 18.

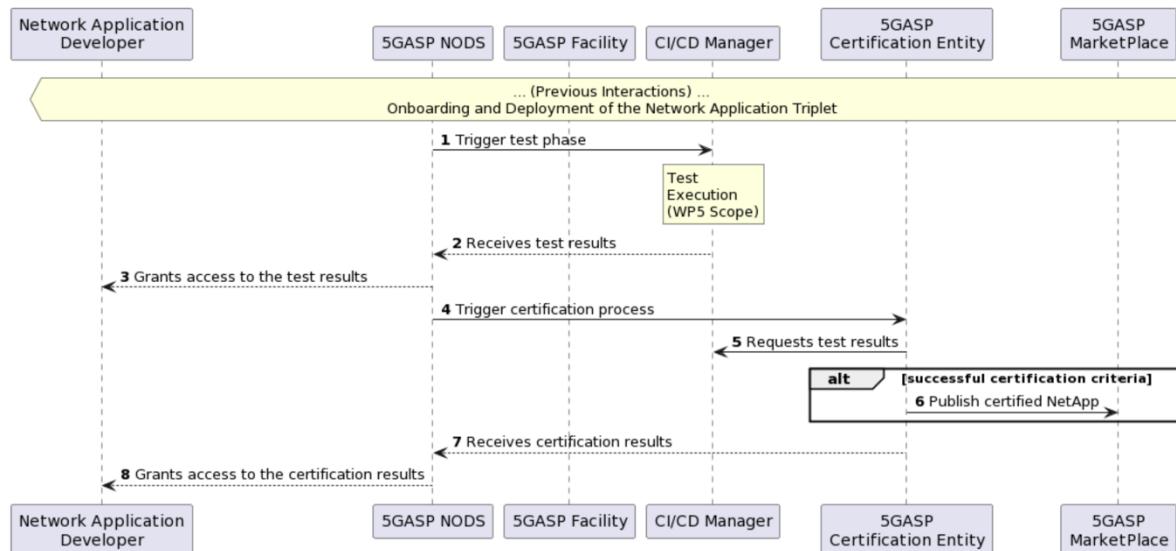


Figure 18 – Network Application Certificate Generation Workflow

After this, the applicant can download this document through a link provided in NODS. The document is a certificate if at least the lowest grade was achieved; otherwise, it is a regular document showing the intermediate result.

4.2.2 Certificate Document

The general format of a certificate document with example values for demonstration purposes, is shown in Fig. 17, and Fig. 18.

From top to bottom, the document consists of the following parts:

- The achieved certificate grade,
- Network Application information (application's name, applicant's name, selected test conditions),
- The achieved axis scores (as a radar chart),
- The Network Application's name and version and a table of the mandatory and conditional mandatory test cases (including execution date, test axis, test case name, test type, test bed name, test result),
- A link to the CI/CD Manager showing the details of the test execution,
- A link to NODS showing the Network Application's deployment details,
- Date of issue.



Certificate Of Compliance Bronze

This is to certify that

OdinS-NetApp

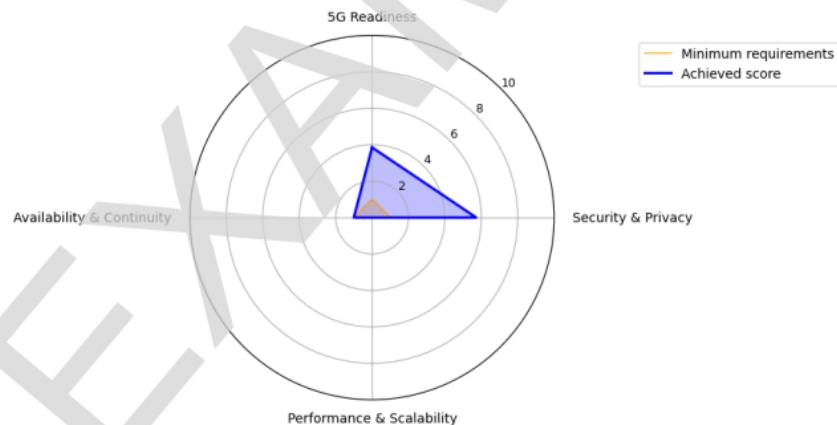
Registered by

OdinS

Under the test conditions

*Data plane app,
Deployment type VM
Location-based app
NEF support*

Has been developed in accordance with the 5G Application and Services experimentation and certification Platform (5GASP) guidelines.



The 5GASP Certification board verified that *OdinS-NetApp* on its version 1.0 has successfully passed the 5GASP-C certification criteria under the following scenarios:

Date	Axis	Name of test**	Type of test	Testbed of experimentation / Execution Partner	Test result
	5G Readiness	nef_authentication	Conditional	Testbed ITAv	Not tested
2023-06-22 10:07:56	5G Readiness	nef_authentication_test	Mandatory	Testbed ITAv	Passed

Figure 19 - Example of a Certificate Document (1/2)

2023-06-22 10:08:05	5G Readiness	nef_monitoring_subscription_test	Conditional	Testbed ITAv	Passed
2023-06-22 10:05:13	Security & Privacy	open_ports	Mandatory	Testbed ITAv	Passed
2023-06-22 10:05:23	Security & Privacy	openstack_port_security	Mandatory	Testbed ITAv	Passed
2023-06-22 10:05:40	Security & Privacy	ssh_audit	Mandatory	Testbed ITAv	Passed
	Security & Privacy	ssl_audit	Conditional	Testbed ITAv	Not tested
2023-06-22 10:05:50	Security & Privacy	ssh_brute_force	Conditional	Testbed ITAv	Passed
	Availability & Continuity	bandwidth	Conditional	Testbed ITAv	Not tested
	Availability & Continuity	bandwidth2	Conditional	Testbed ITAv	Not tested
	Availability & Continuity	transmission_speed	Conditional	Testbed ITAv	Not tested
2023-06-22 10:06:55	Availability & Continuity	api_performance_response_time	Mandatory	Testbed ITAv	Passed
	Availability & Continuity	web_performance_static_page	Conditional	Testbed ITAv	Not tested
2023-06-22 10:07:25	Availability & Continuity	network_application_performance_rtt	Mandatory	Testbed ITAv	Passed

** For more details, please check the test description [here](#) on 5GASP CI/CD Service.

Observations [optional]: Deployment details can be viewed [here](#) on 5GASP NODS.

This document was created on 08/11/2023.

5GASP - This project has received funding from the European Union's Horizon 2020 research and innovation programme (5GASP H2020 - ICT- 2020). Grant agreement ID: 101016448



Figure 20 - Example of a Certificate Document (2/2)

4.3 Linking to an Ecosystem of Certification Programs

As noted in 5GASP D6.2 [3] many telecommunication service providers, telco vendors and alliance organizations host 5G VNF/CNF certification programs. The field has expanded since last reporting, with offerings like the Red Hat OpenShift CNF certification program [14], the Dell Technologies Telecom Ecosystem [15] program the Microsoft Azure Operator Nexus program [16] and the LF Networking's Cloud Native Telecom Initiative (CNTI) [17], all coming to the fore.

Regarding the possible integration of the 5GASP certification process into a broader ecosystem, discussions have been held with the Dell Open Telecom Ecosystem lab in Ireland. Also, 5GASP partner VMware hosts a Ready for Telco program [18] where over 340 5G network functions have been validated for use and deployment on the infrastructure of CSPs worldwide.

The VMware program has two certification branches that a Network Application developer can choose, an on-premises lab verification process or a self-certification process. There has been on-going discussion with the VMware Ready for Telco product management regarding integration of the 5GASP-C process and test cases into the self-certification branch of the VMware program. 5GASP Network Application developer Lambda Networks has been assisting in fleshing out the integration points and stumbling blocks, with a view to being available in a representative marketplace soon. At the time of writing this process is still on-going.

5. Conclusions

This deliverable is our third and final iteration of the presentation of the 5GASP Consortium's efforts to build, and grow a Network Applications Community, through means of developing and maintaining of platforms, tools, and certification program.

This report highlights the updates to the community portal and the Network Applications Store, and key usage statistics for the platforms' websites, relevant for the Y3 reporting period of the 5GASP Project.

Furthermore, this reports on the Consortium's community engagement activities for the third year of the Project, and in the timespan since the submission of D6.2[3], including the Fourth Community Events series of Webinars, the ICT-41 "PlugFest" in Aveiro, October 2023 and the 5G innovations for verticals - Contributions on Testing and Certification Event in Athens, March 2024. We, then, focus on past and ongoing collaborative activities with several of the ICT-41 Projects, and the 8 successful integrations within this framework. As a key result of the community engagement activities, it is noted that 5GASP managed to attract a third-party SME through collaboration with Orange Fab, the corporate start-up acceleration program of partner ORO, thus concluding the overall appeal for third parties to onboard, test and certify their Network Applications for 5G-Readiness, on existing testbeds.

Finally, this iteration of our yearly report shows the overall end-to-end certification process, the progress made on the testing criteria and the test composition and the issuing of certificates to the end-users. An overview of possible linking of the 5GASP Platform to existing Certification Programs, of reputable vendors, is offered as a conclusion on the testing and certification work provided in 5GASP.

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