



A Holistic, Innovative Framework for the Design,  
Development and Orchestration of 5G-ready  
Applications and Network Services over Sliced  
Programmable Infrastructure

## DELIVERABLE D7.7

### COMMUNICATION ACTIVITIES REPORT - FINAL

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## Table of Contents

<b>DISCLAIMER</b> .....	<b>3</b>
<b>COPYRIGHT</b> .....	<b>3</b>
<b>TABLE OF CONTENTS</b> .....	<b>4</b>
<b>EXECUTIVE SUMMARY</b> .....	<b>5</b>
<b>1 INTRODUCTION</b> .....	<b>6</b>
1.1 PURPOSE AND SCOPE.....	6
<b>2 MATILDA COMMUNICATION ROADMAP</b> .....	<b>7</b>
<b>3 PROJECT LOGO</b> .....	<b>8</b>
<b>4 PROJECT PUBLIC WEBSITE</b> .....	<b>9</b>
4.1 COMMUNICATION ACTIVITIES.....	11
4.2 PROGRESS AGAINST KPIS .....	12
<b>5 SOCIAL MEDIA</b> .....	<b>19</b>
5.1 TWITTER.....	19
5.2 LINKEDIN.....	23
5.3 YOUTUBE.....	25
5.4 FACEBOOK.....	26
<b>6 PROJECT POSTER</b> .....	<b>27</b>
<b>7 PROJECT FLYER</b> .....	<b>27</b>
<b>8 PRESS RELEASES</b> .....	<b>33</b>
<b>9 NEWSLETTERS</b> .....	<b>34</b>
<b>10 CONCLUSIONS</b> .....	<b>35</b>



## Executive Summary

This deliverable D7.7 “Communication Activities Report - Final” presents the MATILDA communication results with reference to the second reporting period of the project from September 2018 to July 2020. This Deliverable is therefore the prosecution of the first version of the Communication Activities Reports, D7.3, covering the period from the start of the project, 1 June 2017, to M15, August 2018.

This document’s focus is about the activities of Task 7.7 “Communication Activities”, that are an important part of the work addressed within the more general context of WP7 “Dissemination, Communication, Exploitation and Business Planning”, that, in turn, represents a very crucial WP, since communication, dissemination and exploitation activities are among the most important elements for a successful and durable project.

This deliverable has no direct interdependency with other specific tasks of the workplan, because the communication process is a horizontal activity; its aim is mainly to highlight the communication activities achievements in order to evaluate their effectiveness.

During the reporting period, the MATILDA communication activities concentrated to communicate and disseminate the project completed framework mature results through all the available channels.



# 1 Introduction

In compliance with the guidelines presented in D7.1 “Communication Roadmap”, and with the contents presented in the D7.3 “Communication Activities Report Halfway”, the communication efforts of the MATILDA consortium are oriented to increase the project visibility to the identified target groups, highlighting the main outcomes, the results achieved and the future plans.

The communication activities have received a special care to attract the stakeholders’ interest, among the huge amount of information around, and therefore deserved the highest effort in planning, implementation and continuous verification against the defined Key Performance Indicators (KPIs) to decide and apply appropriate consequent actions in any deviation case.

This deliverable constitutes the final of two project communication reports, marked as public, and it covers the activities between 1 September 2018 and 30 July 2020. This deliverable clearly refers to the roadmap defined in D7.1 and follows the D7.3 covering the halfway part, from the project starting date 1 June 2017 to 31 August 2018; as explained in D7.3, since D7.1 is marked as confidential, relevant information from the original document has been enclosed, where appropriate, in the current document, which is open to public readers. This report is a direct output of Task 7.3 “Communication Activities and Data Management” and it complements the corresponding report D7.6 “5G-PPP Interaction, Dissemination, Clustering & Standardisation Activities Report - Final”, which describes the final report of the activities of Task 7.1 “Dissemination, Clustering and Standardization Activities”.

The document is structured in three main sections: *i)* introduction and purpose, *ii)* review of the MATILDA communication means, including, where appropriate, a comparison between the achieved results and the defined KPIs, *iii)* conclusions.

## 1.1 Purpose and Scope

Communication activities are of paramount importance for the success of the project, whose objective, beside technical and scientific achievements, is also, indeed, the most effective diffusion of knowledge, in order to raise awareness, interest and engagement of potential supporters, end users and customers. To this aim, MATILDA took advantage on all the most suitable tools, from electronic and printed means to the project portal web site, from social media to the delivery of customised (to the audience) presentations, and so on and so forth.

The main objectives of this final report are:

- Providing updated information about the communication of MATILDA’s outcomes.
- Providing a final assessment of the effectiveness of the communication roadmap (see deliverable D7.1) against the specified KPIs’ quantitative metrics.



## 2 MATILDA Communication Roadmap

The MATILDA communication roadmap defined in the deliverable D7.1 has been the main and key strategical source for the communication activities within the project. For this reason, the communication plan has been prepared and released very early in the project life (M3) as it constitutes the foundation of WP7, by defining a clear strategy in terms of responsibilities, scheduling, tools and communication channels.

The main objectives that MATILDA communication plan pursued:

- Catch the attention at the local, National and International levels about the project scope and outcomes
- Increase the MATILDA Consortium partners' reputation and visibility
- Generate industrial interest
- Generate market demand
- Facilitate the networking activity with potential partners for future collaboration including gifted scientists interested in joining the consortium's institutions and enterprises

The main communication items and channels covered in the current document are the following:

- Project Logo
- Project Website
- Social Media
- Project Poster
- Project Flyer
- Online Publications
- Press releases
- Newsletters

For each of the aforementioned item/channel, in the following sections we provided a concise description and, where relevant, additional information such their measured impact in terms of KPIs.



### 3 Project Logo

The official MATILDA project logo, already presented in D7.3, and depicted in Figure 1 and Figure 2, in horizontal and vertical version, respectively, has been maintained unchanged without any necessity for any restyling activity.

The originally conceived logo, inspired by the young, and genial, girl interpreter of the namesake movie and further elaborated and abstracted to remind an orange-similar cloud shape over a cyan server, has effectively world-wide represented the MATILDA holistic 5G innovative framework thorough all the project life in conferences, live demos, events, social, and so on and so forth.

Here are presented the MATILDA's logos that have successfully been used in all the past MATILDA's project phases, now in the project finalization and conclusive presentations and demonstrations and that will be associated to the project also after the project end for future references needs.



**Figure 1: Horizontal version of MATILDA logo**



**Figure 2: Vertical version of MATILDA logo**



## 4 Project public website

The MATILDA public website, reachable at the following URL: <http://www.matilda-5g.eu>, proved to be the most effective project communication tool.

It collected and presented the public information about the project since the starting phases. It was conceived and designed to provide the largest possible audience to the external communication activities and also as a powerful tool for the dissemination requirements.

The MATILDA public website was implemented with high usability standards in mind and, in fact, demonstrated to be a very user-friendly communication tool. The first version of the public website was launched early in July 2017, based on the Content Management System (CMS) *Joomla!* and with a template able to adapt the site layout to well fit both the standard PC monitors and the smartphone/tablet smaller screens. The website has been progressively updated and enriched during the whole project lifetime, presenting the project outcomes under the responsibility of WP7 leader from the first architectural deliverables and first events, in the first steps of the project, to the last release of the MATILDA code dedicated page that, at the time of writing, is just going to be added.

Referring to the communication plan defined in D7.1, the MATILDA public website has been one of the main communication channels<sup>1</sup> with which the project has been capable to expose the most relevant information to the wide public.

The public area comprises the following sections, accessible from the main menu:

- Home
- Vision
- Use-cases
- Outcomes
- Events
- News
- Partners

while the following sections have been highlighted in a dedicate stripe with icon menu:

- Our Vision
- Who We Are
- Latest News
- Flyers, Whitepapers & Newsletters

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<sup>1</sup> See for the entire list sec. 5 “Communication Channels” in D7.1 “Communication Roadmap”, p. 14.



Figure 3: The MATILDA public website, an updated snapshot of the homepage

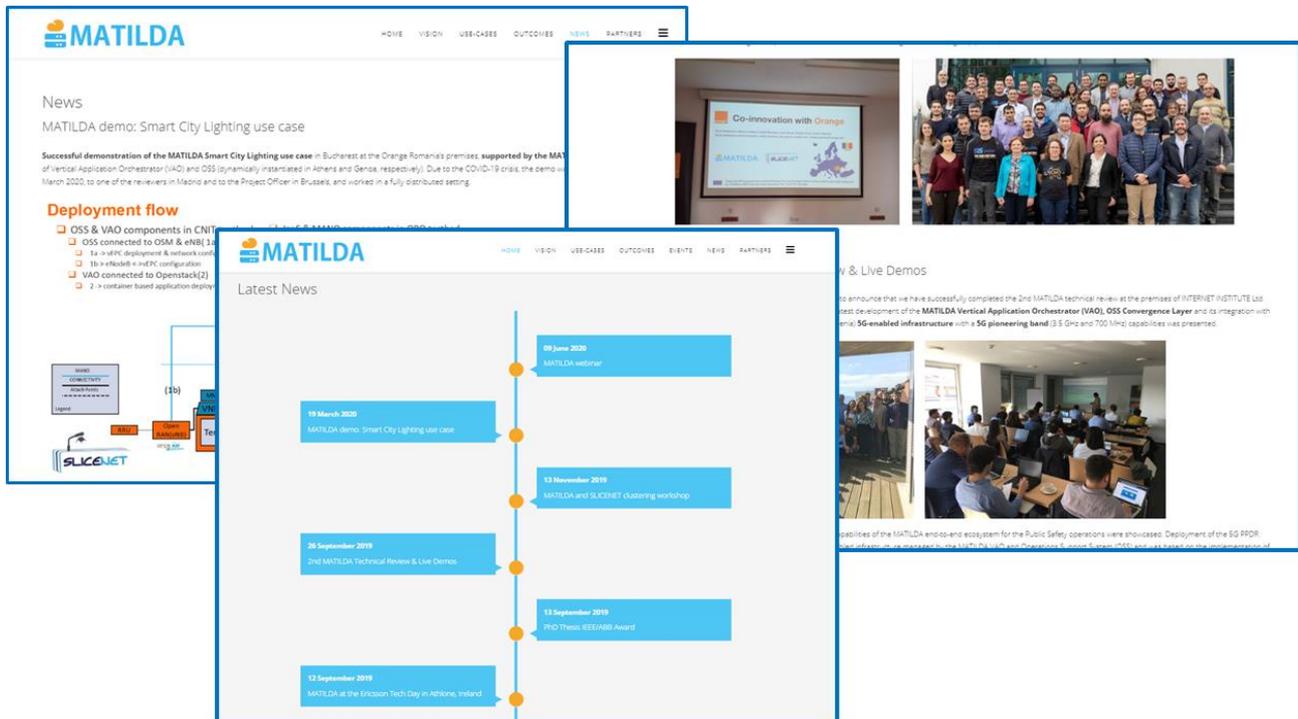
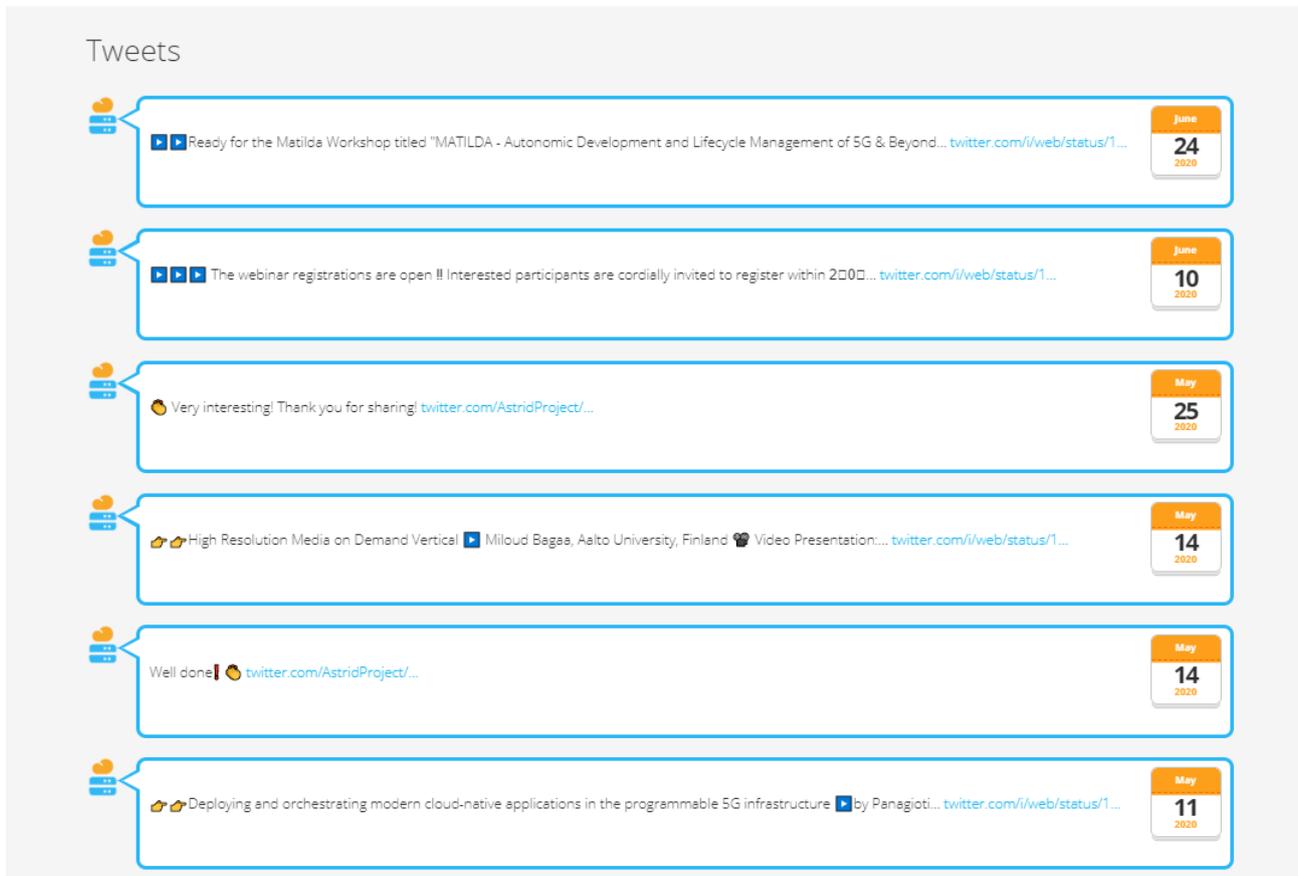


Figure 4: MATILDA public website, an updated snapshot of the “Latest News” section



**Figure 5: MATILDA public website, a snapshot of the “Tweets” section**

## 4.1 Communication Activities

The public website was indeed the privileged showcase for publicizing and disseminating the research activities carried out in the project.

The MATILDA partners continuously added into the public website any communication activity that they realized, by means of the dedicated form accessible from the private area. All the communication activities have been gathered and listed in the “Dissemination and Communication Activities” table under the “MATILDA Outcomes”<sup>2</sup> section; some of them have been also emphasized with dedicated *news* or *tweets*.

Please note that during the first phase of the project, news have been published as tweets; subsequently, upon suggestion of the reviewers, to separate sections for news and tweets have been introduced (please see Figure 4 and Figure 5).

<sup>2</sup> <http://www.matilda-5g.eu/index.php/outcomes>



## 4.2 Progress against KPIs

Website analytics provides an essential tool to monitor number of visits, number of unique visitors, number of downloads, visitors' distribution, and so on and so forth.

The following tables and figures present several statistics from the website for the period spanning from September 2018 to July 2020.

Table 1 reports the total number of visits per month for the MATILDA public website. Comparing them with the halfway project previous results (already presented on D7.3) we can appreciate how the increasing communication efforts, and the focus on the main communication tools have allowed to increase the average visitors' numbers to more than double.

Year	Month	Visits
<b>2018</b>	Sep	5391
	Oct	5254
	Nov	4132
	Dec	4546
<b>2019</b>	Jan	3401
	Feb	3755
	Mar	5032
	Apr	4398
	Maj	4502
	Jun	4005
	Jul	5605
	Aug	2679
	Sep	3747
	Oct	4049
	Nov	3932
	Dec	4768



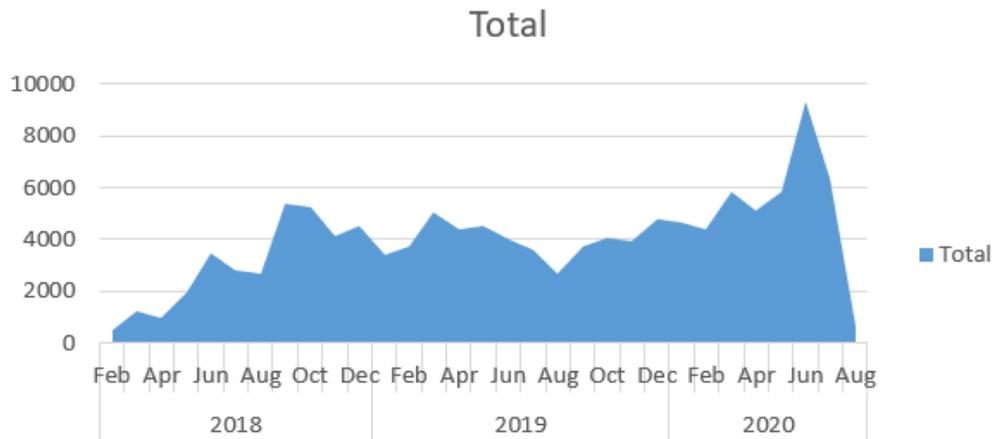
Year	Month	Visits
<b>2020</b>	Jan	4680
	Feb	4399
	Mar	5390
	Apr	5130
	Maj	5830
	Jun	9319
	Jul	6340

**Table 1: Number of website visitor - final view**

Year	Month	Visits
<b>2018</b>	February	504
	March	1235
	April	988
	May	1967
	June	3453
	July	2836
	August	2684

**Table 2: Number of website visitor - halfway view**

In Table 2, it is possible to better appreciate the positive trend of the monthly visits in a graphical representation. Please note that the worst point is positioned around the August vacation period, as expected, and the positive increasing ramp from August toward the project conclusion.



**Figure 6: Visitors' trend graphical representation**

It is indeed interesting to consider also the number of unique visitors by referring to following Table 3 and Figure 7, which show again a positive trend in the numbers of visits.

Year	Month	Visits
<b>2018</b>	Sep	2970
	Oct	2642
	Nov	2269
	Dec	2666
<b>2019</b>	Jan	1997
	Feb	2269
	Mar	1907
	Apr	2513
	Maj	2097
	Jun	2253
	Jul	2032
	Aug	1998
	Sep	1389
	Oct	1604
	Nov	1736
	Dec	2076



Year	Month	Visits
2020	Jan	2038
	Feb	1728
	Mar	2547
	Apr	1708
	Maj	1842
	Jun	3099
	Jul	1963

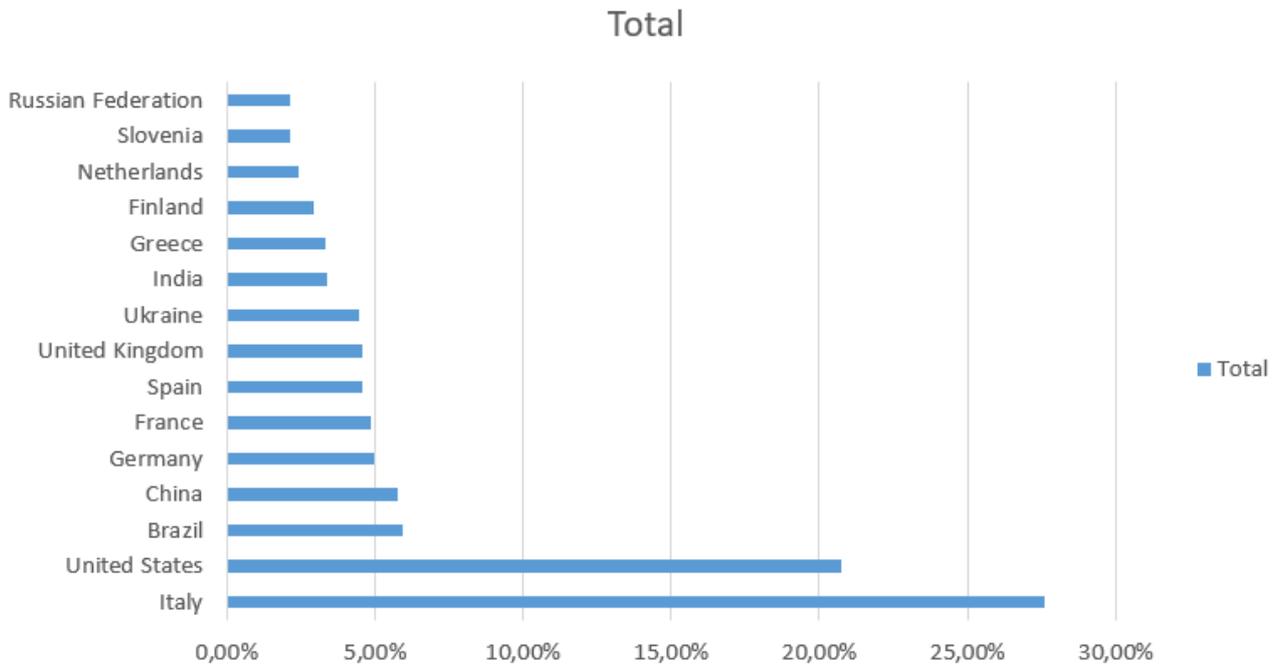
**Table 3: Number of website unique visitors**



**Figure 7: Unique visitors' trend graphical representation**



The visitors' distribution per country is represented in Figure 8, while in Table 4 the number of public documents' downloads is reported. A simple comparison with the Table 5 numbers presented in the first report makes clear the great improvements achieved also from this point of view.



**Figure 8: Visitors' distribution per country**

Public Document	Downloads
D1.1 - MATILDA Framework and Reference Architecture	1596
D1.2 - Chainable Application Component & 5G-ready Application Graph Metamodel	753
D1.3 - VNF/PNF & VNF Forwarding Graph Metamodel	747
D1.4 - Network-aware Application Graph Metamodel	434
D1.5 - Deployment and Runtime Policy Metamodel	432
D1.6 - Supported Verticals, Use Cases and Acceptance Criteria	632
D2.2 - 5G-Ready Applications and Network Services Development Environment and Marketplace	172
D3.2 - Intelligent Orchestration Mechanisms	286
D4.2 - Network and Computing Slice	493



Public Document	Downloads
D6.1 - Evaluation Framework and Demonstrators Planning	750
D6.7 - Validation Results, Performance Evaluation and Adoption Guidelines - First demonstration and evaluation phase	235
D7.2 - 5G-PPP Interaction, Dissemination, Clustering & Standardisation Activities Report - Halfway	404
D7.3 - Communication Activities Report - Halfway	322
MATILDA Flyer	954
MATILDA Newsletter - Issue 1	789
MATILDA Newsletter - Issue 2	377
MATILDA Newsletter - Issue 3	426
MATILDA Newsletter - Issue 4	435

**Table 4: Public documents' downloads - final view**

Public Document	Downloads
D1.1 - MATILDA Framework and Reference Architecture	235
D1.2 - Chainable Application Component & 5G-ready Application Graph Metamodel	152
D1.3 - VNF/PNF & VNF Forwarding Graph Metamodel	144
D1.4 - Network-aware Application Graph Metamodel	130
D1.5 - Deployment and Runtime Policy Metamodel	109
MATILDA Flyer	292
MATILDA Newsletter - Issue 1	96

**Table 5: Public documents' downloads - halfway view**

Table 6 reports the main KPIs that have been defined in the project's communication roadmap (please see deliverable D7.1) regarding the public website.



Communication means	KPI	Target range (throughout project lifetime)	Final value
MATILDA public website	Number of project updates	$\geq 20$	$\approx 30$
	Average number of views per project update	$\geq 500$	$> 1000$
	Number of distinct visitors	$\geq 2000$	$> 40000$
	Number of downloads of online material	$\geq 5000$	$> 7500$

**Table 6: MATILDA public website KPIs**

According to the statistics presented above in this section, the MATILDA public website exceeded the expectations; therefore, it can be deemed that it well demonstrated its capabilities of attracting readers and maintaining their interest.



## 5 Social Media

The MATILDA project leveraged on several social media for a better project communication and also to increase the experiences and knowledge exchanges among professionals and stakeholders.

For this reason, four different accounts have been created on:

- Twitter
- LinkedIn
- YouTube
- Facebook

Twitter was indeed the best media for conveying short messages to followers and therefore was considered crucial, especially during events where the consortium activity was advantageous to be populated instantly. LinkedIn, Facebook and YouTube (for videos) have also demonstrated to be useful ways to reach a larger audience on different segments.

Consolidated experience with social media has demonstrated that messages need to be customized to the social used and to the different audience (for example, Twitter users tend to more “dynamic” than those of other social media).

The primary Point of Contact (PoC) for the management of the MATILDA social media during the project lifecycle was Mr. Orazio Toscano (Ericsson), who took care of maintaining the social media accounts of MATILDA, providing updates on project events and responding to any post or question with the help of the whole consortium, to find out and invite people potentially interested in the project outcomes and to suggest any other important source of information.

In addition to the MATILDA website and SM is important, anyway, to mention the precious activities of the MATILDA’s partners that leveraged on their website, Social Media and different communication channels to effectively spread the MATILDA outcomes all over the world. Only as a practical example, the communication Work Package Leader, Atos, designed three powerful campaigns for the EuCnC event, the MATILDA Workshop and the BVME whitepaper, with a mean audience of around 300K Unique Visitors of each website per month (estimated using the online tool SiteWorthTraffic<sup>3</sup>).

### 5.1 Twitter

The MATILDA’s Twitter account username used for the MATILDA project is **@matilda5g**, and the homepage is reachable at the following URL: <https://twitter.com/matilda5g>.

Twitter resulted to be the best channel to inform the MATILDA’s followers with updated information about the project’s progresses and activities. Moreover, it demonstrated to be a very effective tool to follow other related projects and initiatives.

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<sup>3</sup> [www.siteworthtraffic.com](http://www.siteworthtraffic.com)



**Figure 9: MATILDA's Twitter account – Final view**

At present, MATILDA is following 103 Twitter accounts, related to other pertinent innovative projects, open source communities, magazines, journals, and highly innovative companies, and, has reached 301 followers, increasing the halfway project numbers (Figure 10) of 192%.



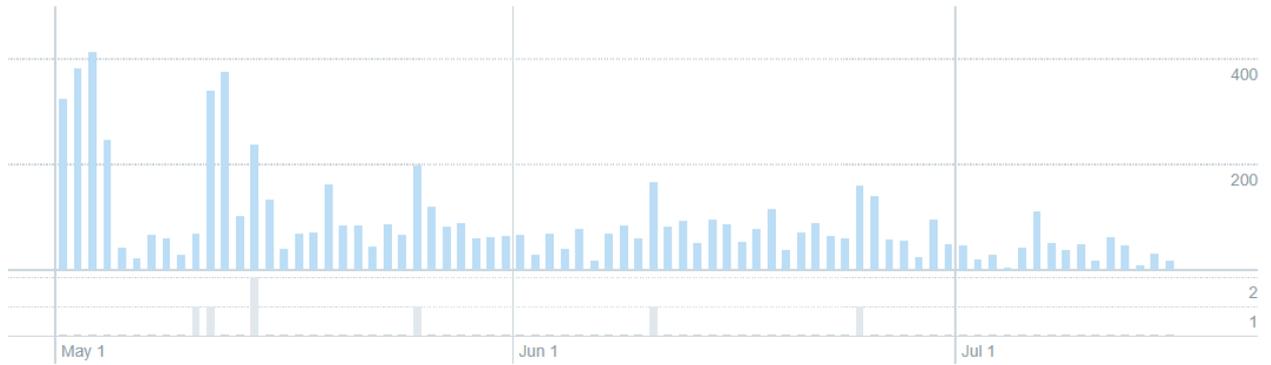
**Figure 10: MATILDA's Twitter account – halfway project view**

Hereinafter, we present some statistics and analytics data gathered from Twitter Analytics, the official Twitter site for statistics and audience concentrations.

Particularly interesting, Figure 11 and Figure 13 depict more in details the statistics related to the number of the tweets' impressions compared to the first reporting period of the project, reported in Figure 12 and Figure 14, and confirm a great increase, as expected considering the significant increase in the number of followers.

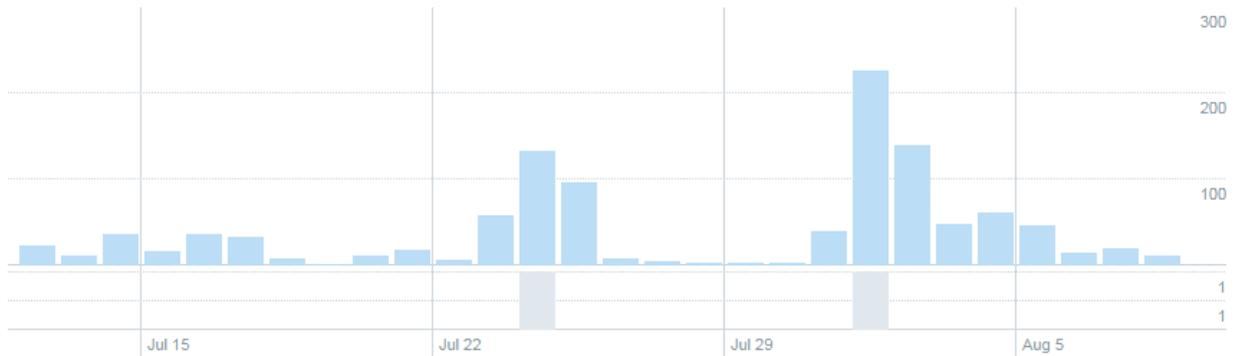


Your Tweets earned **7.0K impressions** over this **76 day** period



**Figure 11: MATILDA's twitter impressions sample - Final view**

Your Tweets earned **1.1K impressions** over this **28 day** period



**Figure 12: MATILDA's twitter impressions sample - halfway view**



Tweets	Top Tweets	Tweets and replies	Promoted	Impressions	Engagements	Engagement rate	
	<b>MATILDA Project</b> @matilda5g · Nov 13	<p>▶▶ Second day Matilda and Slicenet plenary meeting hosted by Orange @Bucharest</p> <p>🏠 Campus Research Center - Politehnica University</p> <p>👍 Great location and great work ongoing together!!!</p> <p>📅 1📍2📍-1📍3📍-1📍4📍/1📍1📍/2📍0📍1📍9📍</p> <p>#5G @orangeromania @upbcampus @matilda5g @SliceNet_5G pic.twitter.com/Eurn7ZINH6</p> <p><a href="#">View Tweet activity</a></p>		5,489	69	1.3%	<input type="button" value="Promote"/>
	<b>MATILDA Project</b> @matilda5g · Nov 12	<p>▶▶ Matilda and Slicenet plenary meeting hosted by Orange @Bucharest</p> <p>🏠 Campus Research Center - Politehnica University</p> <p>👍 Workshops, presentations, discussions and fruitful collaborations!!!</p> <p>📅 1📍2📍/1📍3📍/1📍4📍 November 2019</p> <p>#5G @orangeromania @matilda5g @SliceNet_5G pic.twitter.com/eEs2bp7OAO</p> <p><a href="#">View Tweet activity</a></p>		4,500	80	1.8%	<input type="button" value="Promote"/>
	<b>MATILDA Project</b> @matilda5g · Nov 20	<p>Looking forward for our upcoming demo at #OSMhackfest8, entitled "5G-ready applications in Matilda" by Roberto Bruschi and Chiara Lombardo :-)</p> <p>@OpenSourceMANO @5GPPP</p> <p><a href="#">View Tweet activity</a></p>		1,644	32	1.9%	<input type="button" value="Promote"/>

Figure 13: MATILDA top tweets – Final view

Tweets	Top Tweets	Tweets and replies	Promoted	Impressions	Engagements	Engagement rate	
	<b>MATILDA Project</b> @matilda5g · Aug 1	<p>Matilda communication: Matilda Poster #NFV #5G #Cloud #MEC #NetworkSLicing pic.twitter.com/POdjGVEddb</p> <p><a href="#">View Tweet activity</a></p>		746	31	4.2%	<input type="button" value="Promote"/>
	<b>MATILDA Project</b> @matilda5g · Jul 24	<p>5GNetApp Workshop on "5G-ready Network Applications and Services Development and Orchestration over Application-aware Network Slices" matilda-5g.eu/index.php/even... #NFV #5G #Cloud #NetworkSlicing pic.twitter.com/xH10AxbWgK</p> <p><a href="#">View Tweet activity</a></p>		446	16	3.6%	<input type="button" value="Promote"/>
	<b>MATILDA Project</b> @matilda5g · Jul 24	<p>Call for Papers for the 5GNetApp Workshop supported by the H2020 5G-PPP Projects MATILDA and 5GTANGO. nfvsdn2018.ieee-nfvsdn.org #NFV #5G #Cloud #NetworkSlicing</p> <p><a href="#">View Tweet activity</a></p>		253	9	3.6%	<input type="button" value="Promote"/>

Figure 14: MATILDA top tweets – halfway view

Communication means	KPI	Target range (throughout project lifetime)	Final Number
MATILDA account Twitter	Number of followers	≥ 200	301

**Table 7: MATILDA’s Twitter KPI**

Considering the target values for the MATILDA’s Twitter account KPI reported in Table 7 and the number of followers presented above, the MATILDA’s Twitter account exceeded the expectation of 46% and demonstrated to be able to serve its purpose very effectively.

### 5.2 LinkedIn

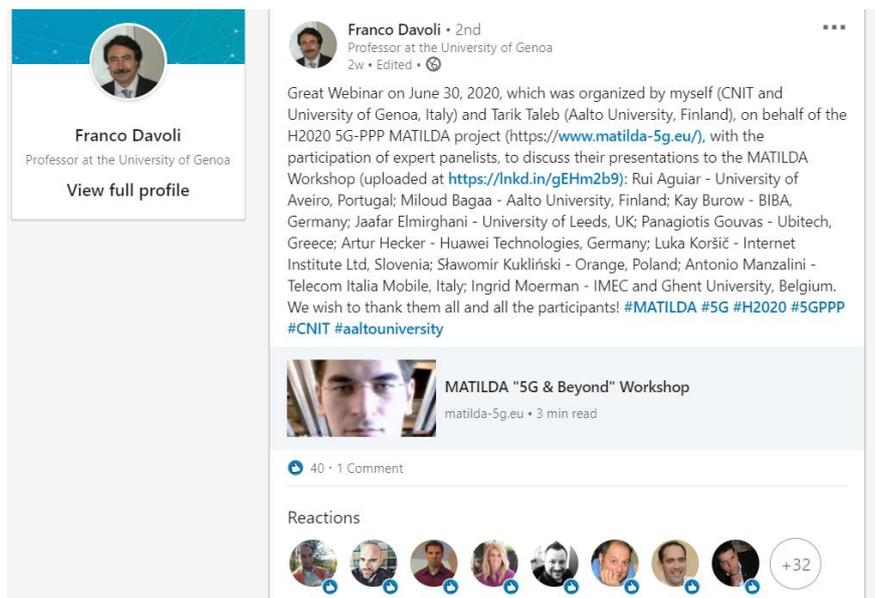
The MATILDA’s LinkedIn profile is named **Matilda Project**, and its homepage is reachable at the following URL: <https://www.linkedin.com/in/matilda-project-a43b6114a/>.

As of the time of writing, the MATILDA LinkedIn site has got 516 connections (see Figure 16) with a very good improvement in comparison to the halfway numbers.

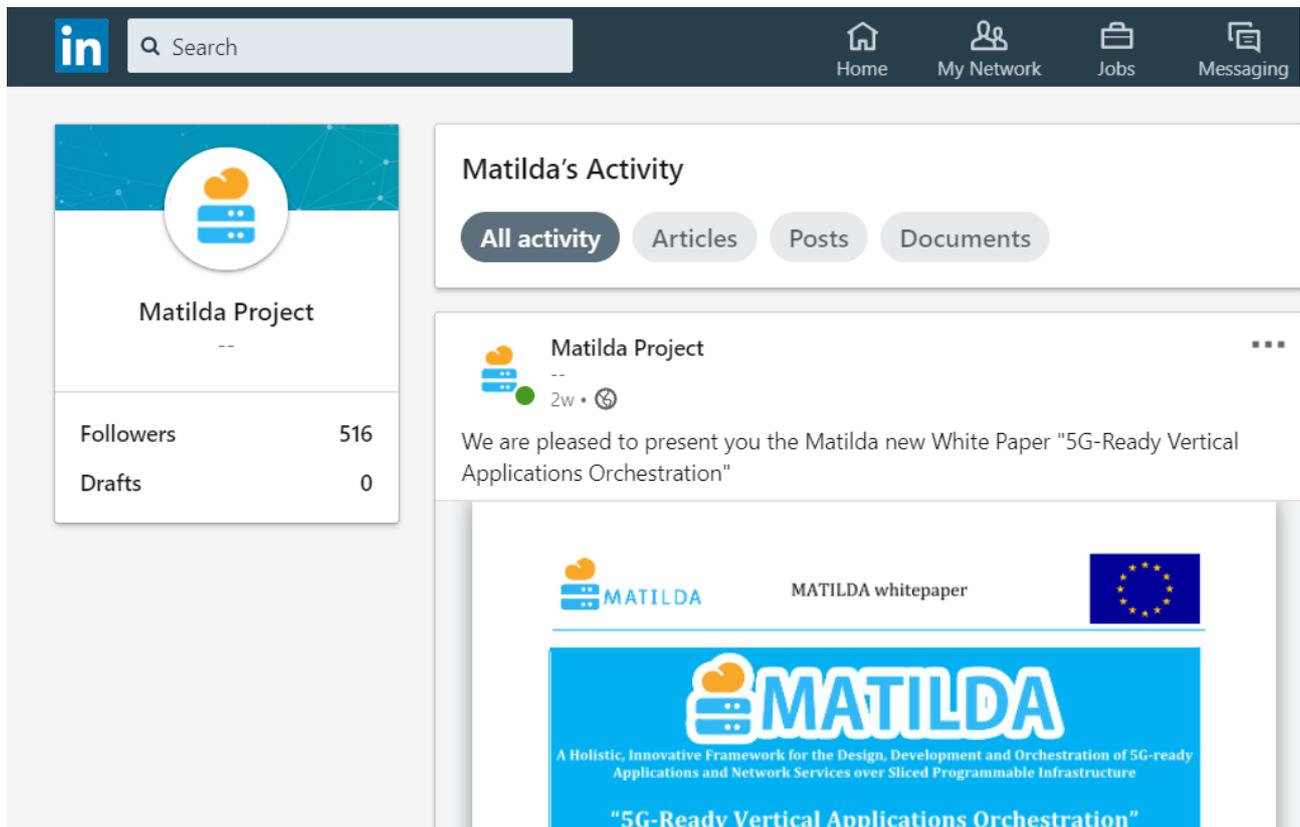
Considering that Twitter has been more intensively used for announcing project related events this can be considered a very interesting result.

Considering the target values for the MATILDA’s LinkedIn account KPI reported in Table 8 and the number of connections presented above, the MATILDA’s LinkedIn account exceeded the expectation of 69% and demonstrated to be able to serve its purpose very effectively.

To give an interesting example, the latest LinkedIn post, by MATILDA Project’s Coordinator, Prof. Franco Davoli, dealing with the latest MATILDA workshop, largely advertised in advance leveraging on the MATILDA website and Twitter, received so far 2965 views and 40 comments!



**Figure 15: LinkedIn Latest Post dealing with the MATILDA workshop**



**Figure 16: MATILDA's LinkedIn homepage**

**Table 8: MATILDA's LinkedIn KPI**

Communication means	KPI	Target range (throughout project lifetime)	Final Number
LinkedIn group	MATILDA Number of group members	≥ 300	516

### 5.3 YouTube

The MATILDA’s YouTube channel is named **Matilda Project**, and its homepage is reachable at the following URL:

<https://www.youtube.com/channel/UCFbGjARCa32akAXIVKy7-IQ>.

As of the time of writing, the MATILDA YouTube channel analytics showed 336 views for the different videos published so far (Figure 17).

We can appreciate in particular the significant number of views relative to the “The Matilda Project” video, prepared after the convergence of the project architectural phase, and the rapidly increasing numbers of views of the latest three videos, just published to give a final project phase appropriate perspective of many important topics.

Considering the target values for the MATILDA’s YouTube account KPI reported in Table 9 and the number of views presented above, the MATILDA’s YouTube account already exceeded the expectation of 41% and demonstrated to be able to serve its purpose very effectively. (Please note that, as shown in Figure 17, at the time of writing, the latest additional videos have been just added and, therefore, the KPI will further largely exceed the expectations).

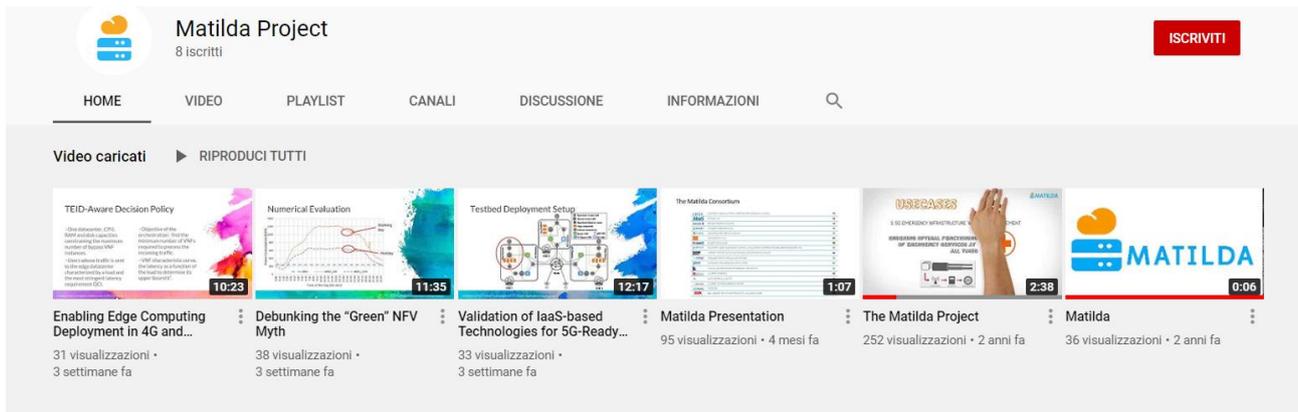


Figure 17: MATILDA’s YouTube page

Communication means	KPI	Target range (throughout project lifetime)	Final Number
MATILDA YouTube channel	Number of views	≥ 300	485

Table 9: MATILDA YouTube KPI

## 5.4 Facebook

The MATILDA's Facebook profile is named **Matilda Eu**, and its homepage is reachable at the following URL: <https://www.facebook.com/matilda.eu.37>.

In spite of the greatest focus reserved to the MATILDA website and to Twitter, as they provided to be the most effective and suitable communication tools, and in spite of the Facebook mediocre vocation for scientific matters, the relations KPI (please refer to Table 10), has been matched with a good margin especially targeting a less technical arena.



**Figure 18: MATILDA's Facebook homepage**

Communication means	KPI	Target range (throughout project lifetime)	Final Number
Facebook MATILDA relations	Number of relations	≥ 200	370

**Table 10: Facebook MATILDA relations KPI**



## 6 Project Poster

The MATILDA's poster, released after the end of the architectural phase, has been usefully used through the project life as a clear aid to illustrate information regarding the framework's architecture, the application-aware network configuration, along with some general content.

In particular, the poster was conceived to provide information about (see Figure 19):

- What is MATILDA: brief introduction to the MATILDA project
- Highlights: including main project benefits
- Partners and project details: including duration, Grant Agreement number, budget, and contact details
- Conceptual diagrams of the MATILDA high level architecture and of the Application-Aware Network Configuration

The poster has been disseminated through our social media accounts, and a printed version was effectively used to help dissemination in public events.

In addition to this main project poster, other ones have been dedicated to particular events or particular demos to better highlight the proper aspects according to the context and the purpose (please see Figure 20 and Figure 21).

## 7 Project Flyer

The MATILDA's flyer has been conceived and designed as an additional aid to support the communication and dissemination activities. It was prepared and released in an initial version in January 2018 and an upgraded version released in June 2018 was usefully used in communication and dissemination events.

The flyer has been designed as a three-column brochure in A4 size format.

This first version of the flyer provided information about (see Figure 22 and Figure 23):

- MATILDA Key Targets
- MATILDA Consortium and Contact Details
- MATILDA Main Vertical Demos
- MATILDA High Level Architecture
- MATILDA Top Deliverables

The second version of the flyer provided information about (see Figure 24 and Figure 25):

- MATILDA Key Targets
- MATILDA Consortium and Contact Details
- MATILDA Main Vertical Demos
- MATILDA Key Impact on Stakeholders
- MATILDA Goals
- MATILDA Architectural Framework

As of the time of writing, the project flyer has been downloaded 929 times.



## MATILDA

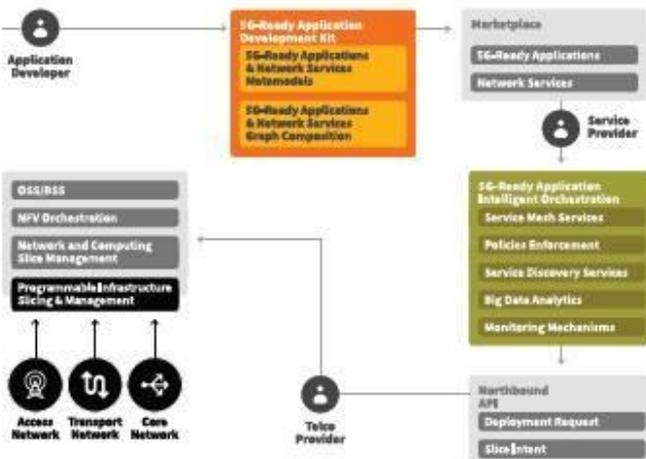
A Holistic, Innovative Framework for Design, Development and Orchestration of 5G-ready Applications and Network Services over Sliced Programmable Infrastructure

### Design, develop and deploy 5G-ready applications over application-aware network slices.

MATILDA comes up with a **novel and holistic approach** for tackling the overall **lifecycle of applications' design, development, deployment and orchestration** in a 5G ecosystem. MATILDA aims to devise and realize a **radical shift in 5G-ready vertical applications**, intrinsically **bridging cloud-native applications and network service domains**.

It follows a **top-down approach** where **applications design and development** leads to the **instantiation of application-aware network slices**, over which vertical industries applications can be optimally served. **Different stakeholders (application developers, service providers, telco providers)** are engaged in this process, however with **clear separation of concerns** among them.

#### High Level Architecture



#### Highlights

- **Design and develop 5G-ready applications**; applications able to take advantage of 5G programmable infrastructure.
- **Optimally manage and provide services/applications** through a set of **intelligent orchestration mechanisms**.
- **Dynamically create and manage application-aware network slices** able to serve 5G-ready application needs.
- **Separation of concerns** among vertical applications and network services orchestration.

#### Project Details

**Start Date:** 2017-06-01  
**End Date:** 2019-11-30  
**Duration:** 30 months  
**Total Cost:** € 8,378,945.36  
**EC Funding:** € 6,664,458.75

**URL:** <http://matilda-5g.eu>

MATILDA has received funding from the European Union's Horizon2020 Research and Innovation Programme, under Grant Agreement no. 761838.

#### Project Partners











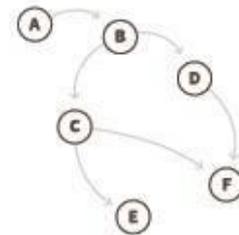






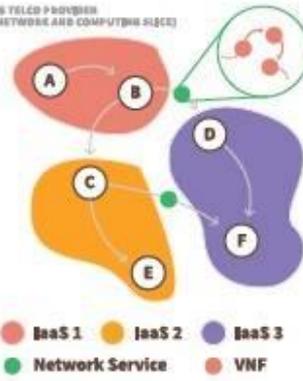
#### Application-aware Network Configuration

**SERVICE PROVIDER (VERTICAL APPLICATION ORCHESTRATION)**



○ Application Component

**5G TELCO PROVIDER (NETWORK AND COMPUTING SLICES)**



● IaaS 1
● IaaS 2
● IaaS 3
● Network Service
● VNF

Figure 19: MATILDA poster

# Enabling Smart Retail Through 5G Services and Technologies

**Claudio Meani, Pietro Paglierani**  
R&D  
Italtel S.p.A.  
Milan, Italy

**Athina Ropodi<sup>1</sup>, Nikos Stasinopoulos<sup>1</sup>, Kostas Tsagkaris<sup>1</sup>, Panagiotis Demestichas<sup>1,2</sup>**  
<sup>1</sup>Incelligent PC, R&D, Athens, Greece  
<sup>2</sup>University of Piraeus, Piraeus, Greece

## Introduction

In a Crowded Event, a high number of end users concentrate in a small area for a relatively short time.

- Well-known examples of CEs are
- Sport events in stadiums
- Exhibitions in dedicated venues
- High-season touristic locations
- Malls during peak-hours



During CEs, besides an impressive data traffic growth, one can clearly observe a shift of consumer behavior, with more video-related activities and social networking, and less voice calls and text messages.

The 5G Personal Assistant in Crowded Events (5GPACE) offers innovative, high-value services by tapping into the increased bandwidth, number of connected devices and decreased latency of the 5G infrastructure. It is a composition of two Software Components, Italtel's i-EVS and Incelligent's ML-powered Retail Recommendation Platform.

## 5GPACE Retail recommendations

A Customer moves around a Crowded Venue, such as a shopping mall or an open-air market area, shares high quality video with her peers while making purchases around the brick and mortar shops.

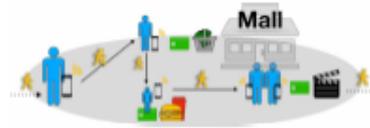


Figure 3: User journey through a Mall

She gets personalized notification about offers, based on her current location and modeled consumption behavior.

**"Move to next shop that offers an X% discount just for you!"**

## High Resolution Video Sharing

Users first download on their devices the Italtel i-EVS App.

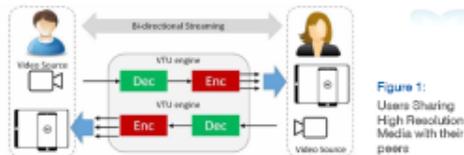


Figure 1: Users Sharing High Resolution Media with their peers

The i-EVS System is a composite Cloud Application for enhanced video services that runs on virtualized infrastructure located at the network Edge with the components:

- User and Group Database Management (UGDM)
- High Resolution Media Processing
- Content Storage (eSTORE)
- Geo-localization

## 5GPACE Components

A user gets identified, associated with a user profile at the backend component, and receives on screen a personalized/ localized offer by the edge recommendation service component.

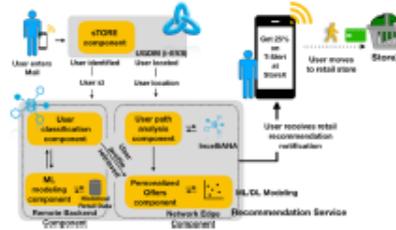


Figure 4: A User's Journey through 5GPACE Components

## ML-powered Retail Platform

The Incelligent Retail Platform provides personalized recommendations using advanced Machine Learning methods at the Network Edge.

A pipelined methodology involves:

- Data preprocessing and feature selection
- Advanced Customer Segmentation and profiling
- Customer Propensity Predictive Analytics
- Real-time recommendations



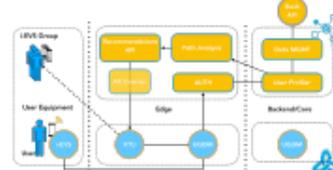
Figure 2: Recommendation using Customer Segmentation and Location

## 5GPACE Deployment

The combined application is deployed as a Network Slice microservices graph over a Virtualized 5G infrastructure that can reside both the Edge and the Core, thus being compatible with the MEC paradigm.

Its Deployment and DevOps aspects can be handled by a smart Application and Network-layer Orchestrator, such as the MATILDA project intelligent orchestration mechanism.

Figure 5: 5GPACE Microservices



**MATILDA**  
A HOLISTIC, INNOVATIVE FRAMEWORK FOR THE DESIGN, DEVELOPMENT AND ORCHESTRATION OF 5G-READY APPLICATIONS AND NETWORK SERVICES OVER SLICED PROGRAMMABLE INFRASTRUCTURE

**A VALUE PROPOSITION FOR TELECOMMUNICATION SERVICE PROVIDERS (TSPs) FOR VERTICAL APPLICATIONS' INTEGRATION IN A 5G-ECOSYSTEM**

5G networks bring a complete transformation in ICT by virtually slicing the network → NFV means - in multiple logical networks (slices) tailored for each vertical service requirements. This shift will trigger and facilitate the transformation of existing stakeholders' roles and interactions, and the closer collaboration of the IT and the telecommunications industry.

MATILDA aims at delivering a holistic 5G end-to-end services operational framework, tackling the overall lifecycle of design, development and orchestration of 5G-ready applications and network services over programmable 5G network infrastructures. The MATILDA framework addresses 3 main business roles providing its 3 major layers:

- "Application Developer" via the 5G-Ready Application Layer** to flexibly support the design and development of (5G-ready) vertical apps along with the specification of the associated networking requirements.
- "Vertical Service Provider" via the 5G-ready App Orchestration Layer** for the dynamic deployment and adaptation of the 5G-ready applications by means of optimization schemes (policies specifications/configuration) to provide the needed resources across the programmable infrastructure: slice intent creation.
- "Telco Service Provider" via the Network Slice Management Layer** for the vertical app aware network set up and lifecycle management, and the corresponding network service provisioning over a 5G network infrastructure (consisting of multiple network and compute resources domains).

**Key Architectural Building Blocks**

**MATILDA Value Proposition Analysis for Telecom Service Providers (TSPs)**

**Main customer segment:** Telecom Service Providers, including existing Telecom Network Operators, existing & emerging Virtual Network Operators (VNOs), emerging Network as a Service (NaaS) Providers (SMEs).

**Key Value Proposition:** Bridging the existing gap in End-to-End (joint Application and Network) orchestration solutions and delivering an easy and flexible environment for integration of vertical Apps into a 5G ecosystem.

**Challenges & Services:**

- How Telecom Operators can best leverage the 5G-ready applications capabilities to app-aware slices capabilities & management?
- Architecture of the 5G-ready Application Orchestration Layer: Design, Policy Engine and Orchestration Engine.
- Integration of the Network and Computing Slice Management Layer: the Orchestration, the Slice Management and the NFV.

**Role Questions:**

- Capability of designing and operating 5G-ready apps over an app-aware slice-aware network slice → service specific requirements vertical requests
- Efficient application of resources → cost savings

**Role Definition:**

- Application Developer: 5G-ready app requests at the 5G-ready app net up & management over the app-aware slice-aware network slice management
- Vertical Service Provider: 5G-ready app requests at the 5G-ready app net up & management over the app-aware slice-aware network slice management
- Telco Service Provider: 5G-ready app requests at the 5G-ready app net up & management over the app-aware slice-aware network slice management

**Gains:**

- Portable application to vertical industry service apps in an app-aware slice-aware way → new revenue streams
- Efficient provisioning of 5G resources (e.g. 5G, multiple slices for different apps, etc.)
- Cost-efficient utilization of resources & app-aware management for the app-aware network

**Challenges:**

- Application Developer: 5G-ready app requests at the 5G-ready app net up & management over the app-aware slice-aware network slice management
- Vertical Service Provider: 5G-ready app requests at the 5G-ready app net up & management over the app-aware slice-aware network slice management
- Telco Service Provider: 5G-ready app requests at the 5G-ready app net up & management over the app-aware slice-aware network slice management

**Customer Jobs:**

- Application Developer: 5G-ready app requests at the 5G-ready app net up & management over the app-aware slice-aware network slice management
- Vertical Service Provider: 5G-ready app requests at the 5G-ready app net up & management over the app-aware slice-aware network slice management
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www.matilda-5g.eu @Matilda\_EU www.linkedin.com/in/matilda-project-443861142

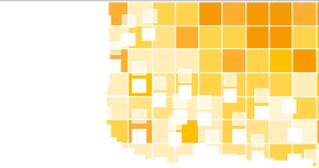
Figure 21: MATILDA poster for EuCNC 2019



### KEY TARGETS

- Improve performance, security and reliability specific requirements, by handling optimization mechanisms based on high level objectives and runtime adaptation of the application components and network functions based on defined policies.
- Shorten time to market: MATILDA will provide a novel holistic 5G end-to-end service operational framework tackling the overall lifecycle of the design, development and orchestration of 5G-ready applications and 5G network service over programmable infrastructure.
- New business opportunities: MATILDA will allow customization of application-aware network slices in order to support industry vertical applications in a optimal way.
- Environmental friendliness: based on the optimal use of the underlying infrastructure resources.





A HOLISTIC, INNOVATIVE FRAMEWORK FOR THE DESIGN, DEVELOPMENT AND ORCHESTRATION OF 5G-READY APPLICATIONS AND NETWORK SERVICES OVER SLICED PROGRAMMABLE INFRASTRUCTURE

**Project Coordinator:**  
Prof. Franco Davoli (University of Genoa, Italy)

**Technical Coordinator:**  
Dr. Panagiotis Gouvas (UBITECH, Athens, Greece)

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MATILDA has received funding from the European Union's Horizon2020 Research and Innovation Programme, under Grant Agreement no. 761898.




Figure 22: MATILDA Flyer, 1st version, p.1

**A HOLISTIC, INNOVATIVE FRAMEWORK FOR THE DESIGN, DEVELOPMENT AND ORCHESTRATION OF 5G-READY APPLICATIONS AND NETWORK SERVICES OVER SLICED PROGRAMMABLE INFRASTRUCTURE**

MAIN VERTICAL DEMOS	HIGH LEVEL ARCHITECTURE	TOP DELIVERABLES																																
<p><b>HIGH RESOLUTION MEDIA ON DEMAND</b></p>  <p><b>DISTRIBUTED SYSTEM TESTING</b></p>  <p><b>5G EMERGENCY INFRASTRUCTURE</b></p>  <p><b>INDUSTRY 4.0 SMART FACTORY</b></p>  <p><b>SMART CITY INTELLIGENT LIGHTING SYSTEM</b></p> 	<table border="1" style="width: 100%; border-collapse: collapse; text-align: center;"> <tr> <td style="background-color: #0070C0; color: white;">APPLICATIONS LAYER</td> <td style="background-color: #0070C0; color: white;">SMART CORES</td> <td style="background-color: #0070C0; color: white;">MEDIA</td> <td style="background-color: #0070C0; color: white;">INDUSTRY 4.0</td> </tr> <tr> <td style="background-color: #0070C0; color: white;">ORCHESTRATION LAYER</td> <td style="background-color: #0070C0; color: white;">APPLICATION ORCH.</td> <td style="background-color: #0070C0; color: white;">NETWORKS</td> <td style="background-color: #0070C0; color: white;">5G-READY APPLICATIONS</td> </tr> <tr> <td style="background-color: #0070C0; color: white;">NETWORK FUNCTIONS MANAGED LAYER</td> <td style="background-color: #0070C0; color: white;">NETWORK-AWARE APPLICATION ORCH.</td> <td style="background-color: #0070C0; color: white;">MACHINE LEARNING</td> <td style="background-color: #0070C0; color: white;">INTELLIGENT ORCHESTRATION</td> </tr> <tr> <td style="background-color: #0070C0; color: white;">INFRASTRUCTURE LAYER</td> <td style="background-color: #0070C0; color: white;">VIRTUALIZED RESOURCES</td> <td style="background-color: #0070C0; color: white;">SLICE POLICIES</td> <td style="background-color: #0070C0; color: white;">APPLICATION-AWARE NETWORK SLICE</td> </tr> <tr> <td style="background-color: #0070C0; color: white;"></td> <td style="background-color: #0070C0; color: white;">- SD-WAN</td> <td style="background-color: #0070C0; color: white;">- CONTEXT-AWARENESS</td> <td style="background-color: #0070C0; color: white;"></td> </tr> <tr> <td style="background-color: #0070C0; color: white;"></td> <td style="background-color: #0070C0; color: white;">- SD-WAN</td> <td style="background-color: #0070C0; color: white;"></td> <td style="background-color: #0070C0; color: white;"></td> </tr> <tr> <td style="background-color: #0070C0; color: white;"></td> <td style="background-color: #0070C0; color: white;">- SD-WAN</td> <td style="background-color: #0070C0; color: white;"></td> <td style="background-color: #0070C0; color: white;"></td> </tr> <tr> <td style="background-color: #0070C0; color: white;"></td> </tr> </table> <p>The proposed architecture comprises three distinct layers:</p> <ul style="list-style-type: none"> <li>The <b>Development Environment and Marketplace</b>, which supports all pre-deployment steps of a 5G-enabled application, through proper packaging and combination of cloud-native components. It provides developer-centric tools to create and publish reusable components, an Application Graph Editor that helps service providers to combine them according to a chainable approach, several searchable repositories, and a Policy Editor that allows the definition of runtime reactive behaviour.</li> <li>The <b>5G-ready Application Orchestrator</b> layer uses component-proxies to materialize a service mesh. The proxies constitute the data-plane and abstract network traffic management aspects, by performing tasks such as dynamic service discovery, load balancing, TLS termination, circuit breaking, health checking, traffic shaping (Layer 7), publication of metrics, etc. The service mesh is constantly monitored, analysed and optimised, regarding the installed components and allocated infrastructure, in order to guarantee the optimal usage of resources and enforce that network slice specifications are met.</li> <li>The <b>Programmable 5G Infrastructure Slicing and Management</b> aims, on one hand, to facilitate the operational demands of service meshes to be handled and, on the other hand, to retrieve feedback from the infrastructure. Therefore, it is responsible for managing the lifecycle of the application graph deployment, acquiring network and computing resources as-a-Service from the underlying blocks, managing the network services that compose the network slices and realizing the logical interconnectivity among geographically distributed points of presence.</li> </ul>	APPLICATIONS LAYER	SMART CORES	MEDIA	INDUSTRY 4.0	ORCHESTRATION LAYER	APPLICATION ORCH.	NETWORKS	5G-READY APPLICATIONS	NETWORK FUNCTIONS MANAGED LAYER	NETWORK-AWARE APPLICATION ORCH.	MACHINE LEARNING	INTELLIGENT ORCHESTRATION	INFRASTRUCTURE LAYER	VIRTUALIZED RESOURCES	SLICE POLICIES	APPLICATION-AWARE NETWORK SLICE		- SD-WAN	- CONTEXT-AWARENESS			- SD-WAN				- SD-WAN							<ul style="list-style-type: none"> <li>A conceptual architecture for supporting the provision of 5G end-to-end services tackling the overall lifecycle of design, development and orchestration of 5G-ready applications and 5G network services over programmable infrastructure.</li> <li>A set of metamodels representing the vertical industry applications' components and graphs, the virtual -and physical- network functions and forwarding graphs.</li> <li>An innovative collaborative development environment supporting the design and development of 5G-ready applications and VNF-FGs, including a web-based IDE, verification and graphs composition mechanisms.</li> <li>An orchestrator that undertakes the responsibility of optimal deployment and orchestration of the developed applications over the available programmable resources. Policies enforcement is going to be supported by a context awareness engine, able to infer knowledge based on a set of data monitoring, analytics and profiling production streams.</li> <li>A multi-site virtual infrastructure manager, along with a multi-site NFVO supporting the lifecycle management of the network functions embedded in the deployed application graph, as well as supporting a set of network monitoring and management mechanisms.</li> <li>Novel analytics and unified profiling framework consisting of a set of machine learning mechanisms, as well as design time profiling and runtime profiling, towards the production of advanced analytics and software runtime profiling.</li> <li>A marketplace including an applications' and virtual network functions' repository and a set of mechanisms for supporting the diverse 5G stakeholders.</li> </ul>
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Figure 23: MATILDA Flyer, 1st version, p.2



### KEY TARGETS

- High performance and reliability:**
  - Optimally deploy and manage 5G-ready applications over application-aware network slices through the definition of open APIs for interaction among service providers and telecommunication infrastructure providers.
  - Dynamically create and manage application-aware network slices by the telecommunication infrastructure providers, supporting the 5G-ready application needs.
- New business opportunities and business models:**
  - Enable vertical industries to take advantage of 5G technologies through the provision of a development kit for 5G-ready applications and a 5G-ready applications orchestrator.
  - Support separation of concerns among vertical applications and network services orchestration, enabling the various stakeholders to exploit the MATILDA framework without any prerequisite.
- Shorten time to market:**
  - Tackle the overall lifecycle of the design, development and orchestration of 5G-ready applications and 5G network service over programmable infrastructure.





**A HOLISTIC, INNOVATIVE FRAMEWORK FOR THE DESIGN, DEVELOPMENT AND ORCHESTRATION OF 5G-READY APPLICATIONS AND NETWORK SERVICES OVER SLICED PROGRAMMABLE INFRASTRUCTURE**

**Project Coordinator:** Prof. Franco Davoli (University of Genoa, Italy)

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Figure 24: MATILDA Flyer, 2<sup>nd</sup> version, p.1

**A HOLISTIC, INNOVATIVE FRAMEWORK FOR THE DESIGN, DEVELOPMENT AND ORCHESTRATION OF 5G-READY APPLICATIONS AND NETWORK SERVICES OVER SLICED PROGRAMMABLE**

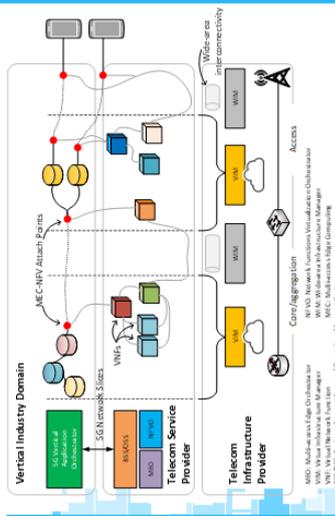
MAIN VERTICAL DEMOS	GOALS	ARCHITECTURAL FRAMEWORK
<p>The potential for industrial diversification and the application in different domains, which implies increased business prospects, is highlighted by different demonstrators that will be executed and validated. These include:</p> <ul style="list-style-type: none"> <li><b>HIGH RESOLUTION MEDIA ON DEMAND &amp; BANKING ON THE CLOUD</b></li> <li><b>DISTRIBUTED SYSTEM TESTING</b></li> <li><b>5G EMERGENCY INFRASTRUCTURE</b></li> <li><b>INDUSTRY 4.0 SMART FACTORY</b></li> <li><b>SMART CITY INTELLIGENT LIGHTING SYSTEM</b></li> </ul> <p>These vertical applications will be mapped over three different test beds:</p> <ul style="list-style-type: none"> <li>The <b>University of Bristol 5GUK</b> test bed, integrating an extensive Smart City environment of LTE radio, WiFi and mmWave devices, interconnected by fibre backhaul, and providing OpenStack on High Performance Computing nodes in Bristol, UK;</li> <li>The <b>CNIT-SITI</b> test bed in Genoa, Italy, based on WiFi and LTE radio devices, emulated Enhanced Packet Core, a MEC platform (OpenVolcano) and a cloud infrastructure stemming from a FIWARE Lab node, in a controlled laboratory environment;</li> <li>The <b>Orange Romania Smart City</b> test bed in Alba Iulia, Romania, integrating LTE/5G Lighting Sensors, radio access and VNFs hosted in the Orange Regional Datacentre, and a Cloud middleware IoT platform.</li> </ul>	<p>MATILDA aims to devise and realize a radical shift in 5G-ready vertical applications, intrinsically <b>bridging cloud-native applications and network service domains</b>. In a stronger integration of cloud and Mobile Edge Computing (MEC) environments, while recognising and conforming to the ongoing developments, MATILDA will <b>provide clear interfaces toward the multi-site management of cloud/edge computing and Internet of Things (IoT) resources</b>. It will support:</p> <ul style="list-style-type: none"> <li>The creation and maintenance of <b>5G-ready applications through the selection of their service components and the generation of their own Forwarding Graphs</b>;</li> <li>The lifecycle management of the required <b>network slices</b>;</li> <li>The <b>interaction with the multi-site Network Functions Virtualisation Orchestrator (NFVO)</b> residing in the Network Providers' domain.</li> <li>Network- and application-oriented analytics and profiling mechanisms;</li> <li>A <b>5G-ready Application Orchestrator</b> layer based on <b>component-proxying</b> (performing dynamic service discovery, load balancing, TLS termination, circuit breaking, health checking, L7 traffic shaping, publication of metrics, etc.) to materialize a <b>service mesh (SM)</b>.</li> <li>Tools for constantly monitoring, analysing and optimising the SM's installed components and the allocated infrastructure, in order to guarantee the optimal usage of resources and enforce that network slice specifications are met.</li> </ul> <p>The concept of <b>slice intention</b> will allow the application-level orchestrator to request, negotiate, deploy, maintain and discontinue the proper application-aware slice instantiation, tailored to the specific application's needs, by also providing a set of mechanisms for runtime adaptation of the application components and/or network functions, based on policies defined on behalf of the services' provider.</p> <p>The MATILDA architecture is divided into three distinct layers; namely:</p> <ul style="list-style-type: none"> <li>Development Environment and Marketplace</li> <li>5G-ready Application Orchestrator</li> <li>Programmable 5G Infrastructure Slicing and Management</li> </ul>	
<p><b>KEY IMPACT ON STAKEHOLDERS</b></p> <ul style="list-style-type: none"> <li><b>Application Developers:</b> flexibility in the design and development of 5G-ready applications by easy-to-access tools.</li> <li><b>(Vertical) Application Service Providers:</b> policies-based highly configurable network agnostic slice requests.</li> <li><b>Telco providers:</b> full lifecycle management of application-aware network slices over multi-site programmable infrastructure.</li> <li><b>VNF/PNF developers:</b> direct VNF products' distribution channel towards telco providers through the MATILDA marketplace.</li> </ul>	<p><b>AT A GLANCE</b></p> <p><b>Programme:</b> H2020-ICT-2016-2  <b>Duration:</b> 30 months  <b>Starting Date:</b> 1 June 2017  <b>Total Cost:</b> €8,378,945.36  <b>EC Funding:</b> €6,664,458.75</p>	

Figure 25: MATILDA Flyer, 2<sup>nd</sup> version, p.2



## 8 Press Releases

- COSMOTE:
  - Organization of company internal meetings with representatives of the Engineering and the Marketing Departments of COSMOTE where the project scope, expected results, and progress has been presented, as well as external meetings with other industry representatives e.g. from the Ministry of Greek National Defense (to a Committee responsible for the research and innovation activities of the Greek industries) in Feb/2020.
  - Information about the MATILDA project and direct link to the official MATILDA project website permanently hosted under COSMOTE's.  
URL: <https://www.cosmote.gr/cs/otegroup/en/matilda.html>
  - Likewise, the MATILDA project has been listed in the Annual Corporate responsibility report of OTE Group for 2018.  
URL: [https://www.cosmote.gr/otegroup\\_company/sustainability/reports/ote/eng/2018.pdf](https://www.cosmote.gr/otegroup_company/sustainability/reports/ote/eng/2018.pdf), p.51/80 (ENG, GR)
  - It has also been included in the Annual Corporate responsibility report of OTE Group for 2019 (to be published online within the next months).
- ORANGE:
  - Press Release for Orange's great achievements in the context of the first commercial 5G network launch in Romania, dealing with the Romania important testbed for Orange innovations and latest technologies and the important involvement on Europe's Horizon 2020 research and development projects with MATILDA in the first line.  
URL: <https://www.orange.com/en/Press-Room/press-releases/press-releases-2019/Orange-s-first-commercial-5G-network-launched-in-Romania>

## 9 Newsletters

The MATILDA’s newsletters demonstrated to be an exceptional mean to present, in a synthetic way, the various activities treated by MATILDA, detailing the project developments, the deliverables’ findings and the outcomes reached during the project progress, providing also some hints coming from the project’s meetings and the collaboration among partners.

MATILDA’s periodic newsletters have been issued according to the communication roadmap defined in D7.1 and reported in Table 11, which, in turn, has been defined in order to provide news, articles and information about the project progresses and results, and any other relevant material up-to-date at the publication time.

All the MATILDA Newsletters have been released according to schedule and published on the MATILDA public website. The last issue no. 4, released on November 2019, has been updated on March 2020 to report the changes in the planned events due to the COVID-19 outbreak.

As of the time of writing they received a significant number of downloads, please refer to Table 11.

Newsletter Issue	Publication Date	Download
MATILDA Newsletter #1	Month 10 (March 2018)	763
MATILDA Newsletter #2	Month 18 (November 2018)	353
MATILDA Newsletter #3	Month 22 (March 2019)	406
MATILDA Newsletter #4	Month 30 (November 2019)	414

**Table 11: MATILDA's Newsletter**



**Figure 26: MATILDA's Newsletter #4 cover and page layout**



## 10 Conclusions

This deliverable summarizes the communication activities carried out by the MATILDA Consortium during the second reporting period of the project, i.e. from 1 September 2018 to 31 July 2020.

The main points taken into account in the MATILDA communication roadmap have been highlighted; specifically, in the document a section has been dedicated to discuss each of the following communication item/channel: Project Logo, Project Website, Social Media, Project Poster, Project Flyer, Online Publishing and Press Releases, and Newsletters. Where applicable, the achieved KPIs in relation to the expected target have been indicated and compared with the final numbers.

These comparisons have shown that all the targets have been matched, often largely exceeding the expectations, demonstrating that the communication process has been effectively conceived and implemented.

The communication to the wide public of the project achievements is a continuing process that required a constant effort during the project lifecycle and will certainly be cared also after the project conclusion.