ENVELOPE

Evaluation and validation of connected mobility in real open systems beyond 5GS

Project deliverable D8.4

Updated communication and dissemination strategy and plan

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Legal Disclaimer

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Project executive summary

ENVELOPE aims to advance and open the reference 5G advanced architecture and transform it into a vertical-oriented one. It proposes a novel open and easy-to-use 5G-advanced architecture to enable a tighter integration of the network and the service information domains by

- exposing network capabilities to verticals,
- providing vertical information to the network; and
- enabling verticals to dynamically request and modify key network aspects,

all performed in an open, transparent, and easy-to-use, semi-automated way.

ENVELOPE will build APIs that act as an intermediate abstraction layer that translates the complicated 5G System (5GS) interfaces and services into easy to consume services accessible by the vertical domain. The experimentation framework and the main innovations developed in the project are: MEC (Multi-access Edge Computing) with service continuity support, zero-touch management, multi-connectivity and predictive QoS (Quality of Service).

It will deliver 3 large scale Beyond 5G (B5G) trial sites in Italy, Netherlands and Greece supporting novel vertical services, with advanced exposure capabilities and new functionalities tailored to the services' needs. Although focused on the Connected and Automated Mobility (CAM) vertical, the developments resulting from the use cases (UCs) will be reusable by any vertical. The ENVELOPE architecture will serve as an envelope that can cover, accommodate, and support any type of vertical services. The applicability of ENVELOPE will be demonstrated and validated via the project CAM UCs and via several 3rd parties that will have the opportunity to conduct funded research and test their innovative solutions over ENVELOPE.

Social Media link:

@envelope-project

For further information please visit www.envelope-project.eu

Deliverable executive summary

D8.4 summarises the first 18 months of Communication & Dissemination (C&D) activities for the ENVELOPE project. It also updates the D8.2 - Communication & Dissemination Strategy and Plan, which was produced early in the project to guide the effective communication and dissemination of ENVELOPE's objectives, activities, and results, while maximising outreach and stakeholder engagement.

The dissemination actions described in this document are also included in the project's annual reporting.

The main elements of the C&D activities are:

- **Communication tools and techniques**, including the development of ENVELOPE's visual identity and branding, the project website (envelope-project.eu) and social media as primary dissemination tools, as well as other materials.
- **The Dissemination Strategy**, which outlines ENVELOPE's target audiences and key messages, providing consortium partners with useful guidelines for planning and carrying out dissemination activities to ensure the proper sharing of project results.
- **Media, press relations, and articles**.
- **Conferences and events**, including participation and organisation of project-related activities.
- **Key Performance Indicators (KPIs)** for measuring the effectiveness of the C&D strategy and activities, along with a reporting process.

This document provides an update of the initial C&D Strategy and Plan and follows the same structure as D8.2. It also revisits and refines the original approach. It reports on actions such as the launch of the ENVELOPE website (envelope-project.eu), with regular updates including the publication of all public deliverables to date: events where ENVELOPE was presented, including conferences and demonstration activities; papers and publications produced during this period; and the monitoring of KPIs to assess the progress and impact of the communication and dissemination efforts.

As a living document, the ENVELOPE Communication & Dissemination Strategy is updated midway through the project (M18) in the present deliverable based on an evaluation of its effectiveness, with changes made accordingly and communicated to the consortium. In addition, the dissemination activities and their respective results will be reported at the end of the project as well (M36).

List of abbreviations and acronyms

Acronym	Meaning
5GS	5G System
API	Application Programming Interface
B5G	Beyond 5G
CAM	Connected and Automated Mobility
CCAM	Connected, Cooperative, Automated Mobility
C&D	Communication and Dissemination
EC	European Commission
ICT	Information and Communication Technology
ITS	Intelligent Transport System
KPI	Key Performance Indicator
LL	Living Lab
MEC	Multi-access Edge Computing
MNO	Mobile Network Operator
OEM	Original Equipment Manufacturer
Q&A	Question and Answer
QoS	Quality of Service
RTO	Research and Technology Organisation
SME	Small and Medium Enterprise
SNS JU	Smart Networks and Services Joint Undertaking
TBD	To Be Defined
UCs	Use Cases
WP	Work Package

1 Introduction

1.1 Project Overview

The main objective of ENVELOPE is to advance and open up the reference 5G advanced architecture, and also to transform it into a vertical-oriented with the necessary interfaces tailored to the CAM UCs that i) expose network capabilities to verticals, ii) provide vertical-information to the network; iii) enable verticals to dynamically request and modify certain network aspects in an open, transparent and easy to use, semi-automated way. ENVELOPE aims to deliver 3 large-scale B5G trial sites in Italy, Netherlands and Greece for CAM services and beyond, implementing functionalities tailored to the CAM services and advanced exposure capabilities. Although focused on the CAM vertical, the resulting developments will be reusable by any vertical. The applicability of ENVELOPE capabilities will be demonstrated via the project CAM UCs and via at least 9 open call projects.

1.2 Scope and deliverable structure

This deliverable is part of Work Package 8 (WP8) on Dissemination, Exploitation, and International Cooperation. WP8 is structured into four main tasks:

- **Task 8.1:** Communication Strategy and Tools
- **Task 8.2:** Dissemination Activities and Events
- **Task 8.3:** Liaison Activities and International Cooperation
- **Task 8.4:** Exploitation Strategy and IPR Management

The present deliverable is an update of D8.2, "Initial Communication and Dissemination Strategy and Plan," submitted at the end of Month 4 (April 2024). The purpose of this document is to provide an updated version of that plan and to report on the progress of ENVELOPE's communication and dissemination actions and tools during the first 18 months of the project (January 2024 to June 2025).

The deliverable is composed of the following sections:

- A recap of ENVELOPE'S C&D Strategy, including dissemination objectives and key messages (**Chapter 2**).
- Fulfilment of the communication strategy, along with a summary of the KPIs, monitoring and reporting of the communication activities, and the future communication strategy for the next 18 months of the project (**Chapter 3**).
- Fulfilment of the dissemination strategy, along with a summary of the KPIs, monitoring and reporting of the dissemination activities, and the future dissemination strategy for the next 18 months of the project (**Chapter 4**).
- Conclusions summarising the main outcomes of the deliverable (**Chapter 5**).

1.3 Intended audience

D8.4 is a public document intended for the European Commission, external stakeholders, and interested readers. Specifically, it serves as a guide for the ENVELOPE project partners on planned communication and dissemination activities and the use of internal and external branding resources. It also informs the EC/CINEA about the project's progress, activities, and future plans.

2 ENVELOPE Communication and Dissemination Strategy

The Communication and Dissemination strategy and plan (outlined in D8.2) provides the foundation for all C&D activities and aligns with the project's overall goals. It ensures that partners understand the project's objectives, target audiences, key messages, and tools, fostering awareness and visibility of ENVELOPE's activities and outcomes.

The strategy establishes a framework enabling ENVELOPE to raise awareness and ensure extensive visibility of the project's activities and outcomes among targeted stakeholders in Europe and beyond. Project communication and dissemination activities are tailored towards nurturing stakeholder engagement and participation in the project's objectives and outcomes. To ensure the enduring impact of the project's results, a cohesive and integrated plan has been devised for the consortium.

2.1 Objectives of the ENVELOPE communication and dissemination strategy

The C&D strategy is designed to:

- Raise awareness of ENVELOPE's objectives and activities.
- Disseminate project results widely to engage stakeholders.
- Build synergies with related projects to share knowledge.
- Generate media coverage for ENVELOPE at various levels.

These goals are supported by objectives (outlined in detail in D8.2) such as creating a strong brand identity, developing communication tools, participating in events, and using channels like publications and social media to share developments.

2.2 Project's phases

The strategy spans the project's 36-month timeline and is divided into three phases (see D8.2 for more details). Each phase targets specific audiences, using appropriate channels as detailed in Table 1: ENVELOPE Phases below.

Table 1: ENVELOPE Phases

Phase	Timeline	Target Audience	Channels
Establishing ENVELOPE as a brand: Creating visibility of ENVELOPE and its objectives, expected results and impact.	M01-M12	Industry, operators, research and academia, potential end users	Website, social media, leaflet, participation in conferences and events

Spreading the word: Expand communication efforts, engage stakeholders, liaison with related initiatives.	M13-M24	Industry, operators, research and academia, potential end users	Website, social media, leaflet, participation in conferences and events, newsletter, project events, technical presentations at events, project video, public deliverables
Consolidating and transferring knowledge: maximising the project's impact and disseminating the final results.	M25-M36	Industry, operators, research and academia, potential end users, public authorities in the EU	Website, social media, leaflet, participation in conferences and events, newsletter, project events, technical presentations at events, project video, public deliverables, final event

2.3 Target audience, messages and channels

Identifying the stakeholder groups to target with the communication and dissemination activities of ENVELOPE is mandatory for the success of the C&D strategy. The target audiences were identified by the project's consortium and are delineated in the Grant Agreement. These selected stakeholders comprise of groups for whom the project outcomes hold potential benefits at policy, economic, technological, and/or societal levels. Throughout the duration of the project, the ENVELOPE partners will actively engage with these stakeholders.

To effectively communicate and disseminate the project to the stakeholder groups and the target audience, a set of key messages has been outlined to ensure the maximal impact of communication and dissemination activities. These key messages aim at conveying the project's vision in the most compelling manner possible. Both the stakeholder groups and the target audiences can be found in **Error! Reference source not found.** (from D8.2).

2.3.1 Stakeholder group and key audiences

The target audiences include industry, institutions, the scientific community, and end users. Each group comprises sub-audiences such as policymakers, researchers, operators, and associations, as outlined in detail in D8.2. Until now, the stakeholder groups have been addressed through the following channels and activities (Table 2: Stakeholder groups addressed via which activities and channels), as outlined in the communication and dissemination strategy and plan.

Table 2: Stakeholder groups addressed via which activities and channels

Phase	Stakeholder group	Channels	Activities
Establishing Envelope (M01-M12)	Industry (ICT suppliers, OEMs, Road operators, etc.)	Website, social media, leaflet, participation in conferences and events	ICT suppliers (via LinkedIn, events like EuCNC), OEMs (Teoresi at Turin

			events), Road operators (events, newsletters)
Establishing Envelope (M01-M12)	Research & Academia	Website, social media, leaflet, participation in conferences and events	Academic institutions (e.g., IEEE CAMAD, EuCNC publications), Research centres (NCSRD, SIEMENS publications)
Establishing Envelope (M01-M12)	End Users	Website, social media, leaflet, participation in conferences and events	User associations (via newsletters, social media posts), sector organisations mentioned in webinars/news articles
Spreading the word (M13-M24)	Industry (ICT suppliers, OEMs, Road operators, etc.)	Website, social media, leaflet, conferences, newsletter, project events, technical presentations, project video, public deliverables	Same as above, with deeper engagement via project video, open calls, technical presentations
Spreading the word (M13-M24)	Research & Academia	Website, social media, leaflet, conferences, newsletter, project events, technical presentations, project video, public deliverables	Expanded academic outreach through co-authored papers, conference presence (e.g., CAMAD, CITDS)
Spreading the word (M13-M24)	End Users	Website, social media, leaflet, conferences, newsletter, project events, technical presentations, project video, public deliverables	User engagement via demonstration planning, YouTube demos, and newsletter updates

2.3.2 Key messages

The core message highlights ENVELOPE's work on advancing 5G-Advanced architecture for CAM use cases. Tailored messages are crafted for specific stakeholder groups to ensure relevance and clarity, as outlined in detail in D8.2.

2.3.3 Roles and responsibilities

In ENVELOPE, communication and dissemination activities are encompassed within WP8 "Dissemination, exploitation and international cooperation". ERTICO serves as the leader of this WP and oversees two key tasks: T8.1 "Communication strategy and tools" and T8.3 "Liaison activities and international cooperation". ERTICO assumes responsibility for coordinating and monitoring all communication and liaison activities, assuming the role of the ENVELOPE Communication Manager.

ERTICO collaborates closely with ICCS and EBOS, who respectively lead T8.2 “Dissemination activities and events” and T8.4 “Exploitation strategy and IPR management”. ICCS holds the position of Dissemination Manager for ENVELOPE.

All partners are actively engaged in the communication and dissemination activities of ENVELOPE to ensure the success of the C&D strategy and plan (Table 3). This involvement encompasses various tasks such as drafting news items, providing content for the project website and social media (including infographics, studies, or reports), translating communication materials, collaborating with local media to amplify project results, monitoring news items related to the project, assisting in the organization of workshops and webinars, and representing the project at external events and conferences.

Table 3: WP8 participation per partner

Partner short name	WP8 effort
ICCS	11
HPE	2
TIM	1
LINKS	4
NXW	4
TEO	2
COTO	6
COSM	4
NCSRD	7
FOGUS	6
ISFM	3
TNO	3
KPN	1
SISW	6
CMS	3
LNVO	3
UDE	2
ISI/ATH	7
IQU	7
VICOM	4
ERT	12
EBOS	14
INC	7

2.4 Timing of dissemination activities

ENVELOPE WP8 includes the following milestones and deliverables (Table 4):

Table 4: ENVELOPE WP8 milestones and deliverables

Milestone	Partner	Due date	Date delivered
Communication and Dissemination Strategy ready	ERTICO	M4	M4
D8.1 Brand identity and guidelines	ERTICO	M3	M3

D8.2 Initial Communication and Dissemination Strategy and plan	ERTICO	M4	M4
D8.3 Communication tools	ERTICO	M4	M4
D8.4 Updated communication and dissemination strategy and plan	ERTICO	M18	To be delivered
D8.5 Exploitation plan	EBOS	M18	To be delivered
D8.6 Report on the dissemination activities	ICCS	M18	To be delivered
D8.7 Report on liaison activities and international cooperation	ERTICO	M36	To be delivered
D8.8 Exploitation report	EBOS	M36	To be delivered
Final event	ICCS	M36	To be delivered

2.5 Dissemination and communication procedures

During the project's lifecycle and for a period of 1 year after the end of the project, the dissemination of results by one or several partners, including but not restricted to publications and presentations, shall be governed by the procedure of Article 17.4, Communication, Dissemination, Open Science and Visibility of the Grant Agreement and its Annex 5, Section Dissemination.

The dissemination procedure is to be followed by all partners equally to:

- Produce high quality ENVELOPE publications and presentations.
- Avoid overlaps and possible disclosure of restricted or confidential information.
- Efficiently monitor, record and promote the dissemination activities of the project.
- Secure the brand identity of the project and the EC rules to be followed.

The WP8 leader (ERTICO) and the Task 8.2 leader (ICCS) are responsible for ensuring compliance with the procedure.

For project presentations and overall participation in conferences or events, partners should notify the Project Coordinator and T8.2 Leader at least 15 days before the dissemination activity (according to the G.A, COMMUNICATION, DISSEMINATION, OPEN SCIENCE AND VISIBILITY (—ARTICLE 17), p 10-11). Any objection by other partners regarding the planned participation should be given within 15 days of receiving notification.

2.5.1 Correct use of the EC disclaimer and JU Acknowledgement

All recipients of EU funds have the legal obligation to explicitly acknowledge that their action has received EU funding. This requirement is to ensure visibility and transparency. For projects funded by Horizon Europe, this requirement is specified under Article 17 of the Grant Agreement.

The obligation requires all beneficiaries, managing authorities and implementing partners of EU funding to acknowledge the support from the European Union on all communication materials. An important element with this regard is the European Union emblem and the funding statement, which must be displayed prominently on all printed and digital products, websites, social media channels and other communication products.

In addition to the obligations set out in Article 17, communication and dissemination activities as well as infrastructure, equipment or major results funded under JU actions must also display the Joint Undertaking's 6GSNS special logo**.**

Any dissemination of results (in any form, including electronic) must: (a) display the EU emblem and (b) include the following text:

"*ENVELOPE has received funding from the Smart Networks and Services Joint Undertaking (SNS JU) under the European Union's Horizon Europe research and innovation programme under Grant Agreement No 101139048. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or the SNS JU. Neither the European Union nor the granting authority can be held responsible for them.*"

2.5.2 Open access to scientific publications

ENVELOPE consortium is committed to providing benefit to the European Community in terms of open access to scientific knowledge, standardization, and economic impact. Open access will be given to all scientific publications. All research publications produced in ENVELOPE will be deposited in repositories enlisted in OpenAIRE (Open Access Infrastructure for Research in Europe), such as ZENODO, in a machine-readable electronic copy, at the latest upon publication. To ensure open access policy, ENVELOPE consortium partners will be free to choose between self-archiving ("green" Open Access) and open access publishing ("gold" Open access).

In addition, the information about research outputs, tools or instruments required to validate the conclusions of scientific publications will be provided as well as the access to the results needed for validation. In the area ENVELOPE is addressing, cooperation is key. The general principle in ENVELOPE is therefore to build on open standards and share and discuss developments wherever and as early as possible. To make the results as relevant as possible, potential stakeholders are involved early, e.g., by input in standardisation or by involving via liaison activities. Some project partners will also use open-source code and implement standard-based solutions in their deliverables or contribute their deliverables to the open-source communities and standard specifications.

3 Communication Strategy

3.1 Summary

The following objectives (from D8.2, 'Initial Communication & Dissemination Strategy and Plan' and summarised in the previous chapter) have successfully been achieved during the first 18 months of the project:

- Create an impactful brand identity and establish clear guidelines for communication and dissemination activities.
- Develop solid communication tools, including the project website and promotional materials to ensure a strong online presence of ENVELOPE.
- Identify and participate in events to disseminate the project's findings.
- Select and pursue appropriate dissemination opportunities, such as publication in specialised journals and magazines, to share the project's developments and results.
- Identify and pursue joint initiatives, including participation in events, webinars, or collaboration in technical papers.
- Promote the project's progress and results through the ENVELOPE channels, leveraging the consortium's own channels and tools.

3.2 Key Performance Indicators

All communication activities must have the expected impact on the target audience and help advance the project's goals. ENVELOPE consortium has defined a set of quantitative indicators to monitor and evaluate the impact and targets of the communication plan and ensure its success. The KPIs of the project's communication activities are presented in Table 5. The KPIs will be reassessed and amended, if necessary, in the scheduled updates of the communication plan. This will ensure that the communication efforts are impactful and successful.

Table 5: Communications KPIs

Tools/Channels	Key Performance Indicators	Expected value		Actual value
		Year 1	Year 2	M18
Communication tools	Project website: • Total visits per month • Number of articles	>100 per month >10	>150 per month >10	4600 in total (255 per month) 24 articles
	LinkedIn: Followers of ENVELOPE page	100	200	296
	Video: Number produced	>1	>2	1
	Project brochure: Number produced	1	Update	1 (update to be done)
	Newsletter: Number of issues	2	2	2

3.3 Communication activities

3.3.1 Website

The ENVELOPE website, accessible via https://envelope-project.eu/, serves as a centralised hub, housing key project information. Presented in a clear and accessible format, it offers the public a comprehensive overview of the project's key details.

The website (Figure 1. ENVELOPE Website Preview) contains the following sections:

- Homepage introducing the project
- About section with the project description: the project's objectives, the ENVELOPE architecture and the consortium
- Trial site section leading to a respective page on each trial site
- News & event section
- Resource section with links to download the project's public deliverables, media kit, and open call knowledge base
- Open call section, with all relevant information about the open calls (WP5)
- Contact section

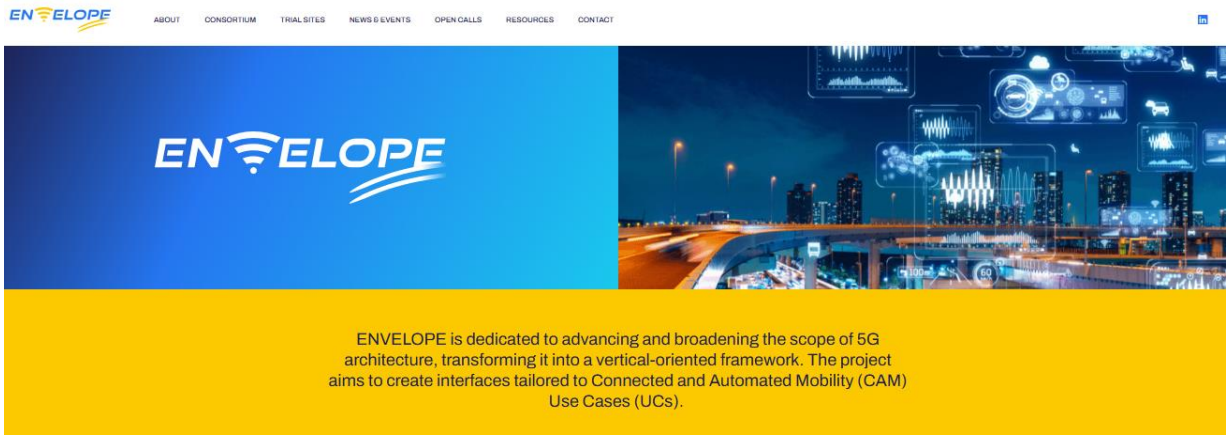


Figure 1. ENVELOPE Website Preview

Since the website launch in April 2024 and until 24 June 2025, it has recorded a total of 4,600 visits, which translates to 255 visits per month, surpassing the KPI of 150 visits per month in year 2.

The site has registered 2,300 unique visitors during these 18 months, however, it's important to note that this figure is likely underreported due to cookie policy restrictions. Users who decline cookies are not tracked, meaning their visits are excluded from the unique visitor count. For this reason, unique visitors may not serve as the most reliable KPI for evaluating website reach and engagement.

The most visited sections of the site include the Open calls page, Open call 1 page, the home page and the resource page, reflecting user interest in the project's background, latest updates, and available materials.

3.3.2 Social media

3.3.2.1 LinkedIn

The ENVELOPE LinkedIn page (Figure 2), has been established early in the project by the Dissemination task leader. The purpose of the page is to share project information and news and to establish a community relevant to the project. Since the page was created, the project has reached 296 followers (number from 24 June, 2025), which is in line with the KPI of 300 followers by the end of Year 2. The number of followers is expected continue growing with the promotion of the open calls and as partners promote the page via their networks. The page has 51 posts (number from 24 June, 2025).

The page is accessible here: https://www.linkedin.com/company/envelope-project/

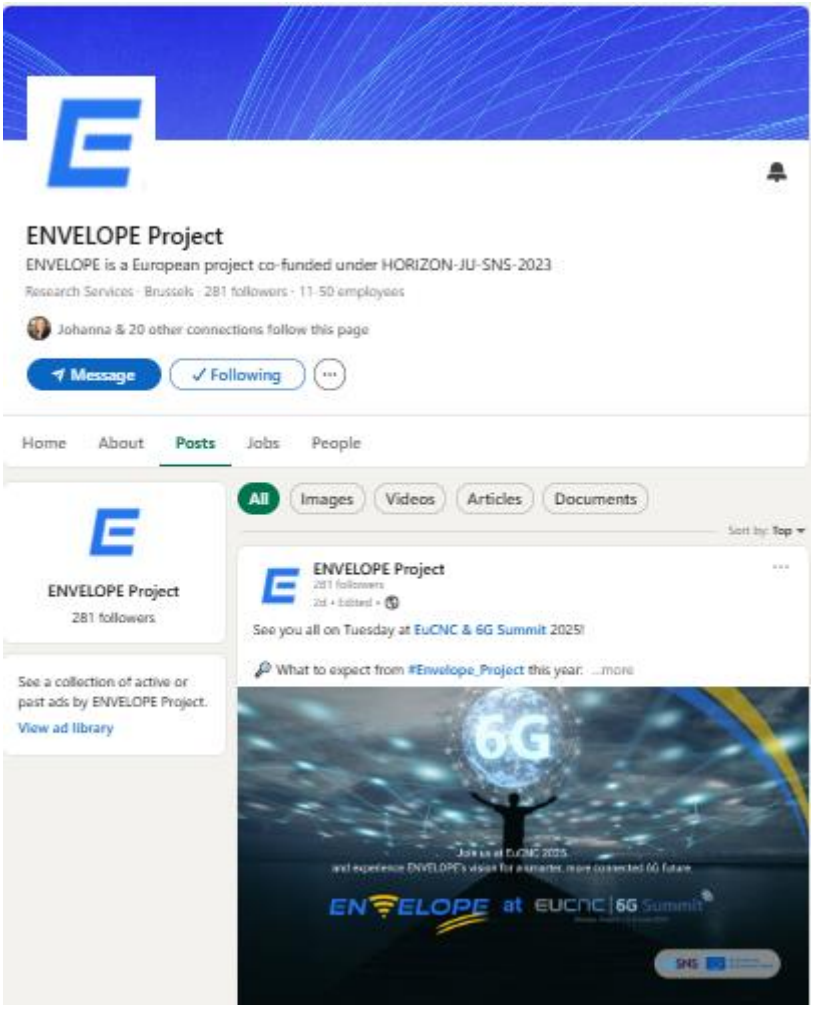


Figure 2. ENVELOPE LinkedIn Page

3.3.2.2 YouTube

An ENVELOPE YouTube Channel (Figure 3. ENVELOPE YouTube Channel) was created as a public engagement tool to promote the project narrative through videos. YouTube delivers information in video format, which can sometimes be more effective than written format for comprehension and engagement purposes, supporting and improving people's understanding of the given information. The project YouTube Channel is available at: https://www.youtube.com/@EnvelopeProject

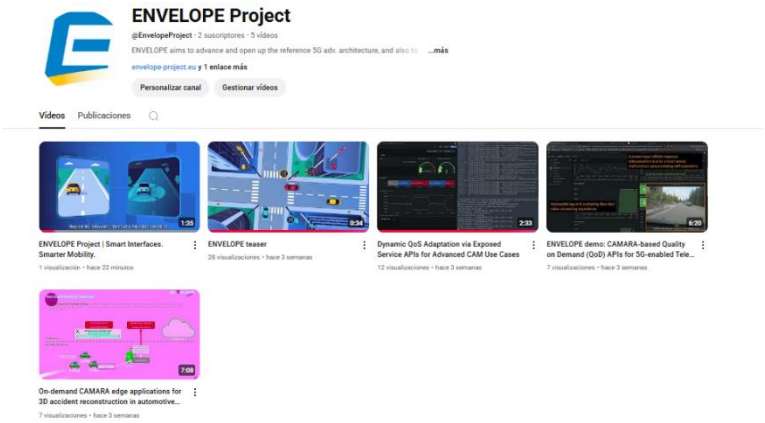


Figure 3. ENVELOPE YouTube Channel

Four videos have been uploaded to the YouTube Channel: the introductory video, a video demo on the "CAMARA-based on-Demand Edge Application Deployment for 3D Accident Reconstruction in Automotive Scenarios", a video demo on the "CAMARA-based Quality on Demand (QoD) APIs for 5g-enabled Tele-operation in Connected Vehicle Scenarios", and a video demo on "Dynamic QoS Adaptation via Exposed Service for Advanced CAM Use Cases". The videos are also embedded in the latest ENVELOPE newsletter (Figure 4).

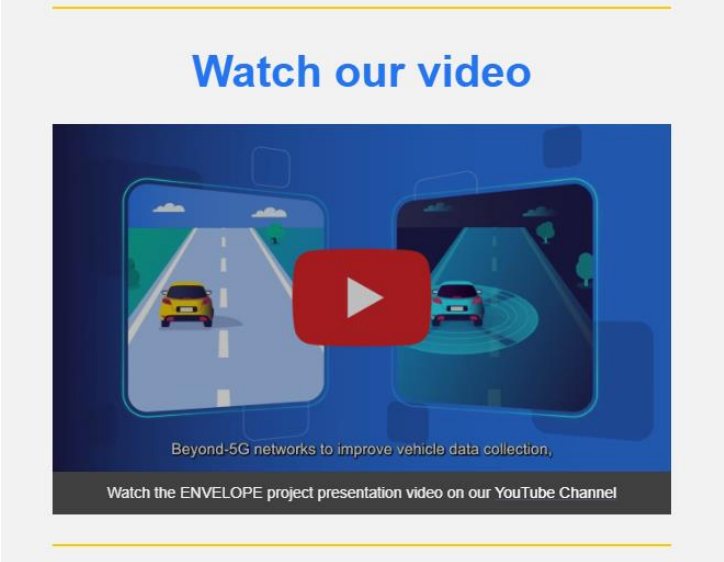


Figure 4. Video in newsletter

3.3.2.3 Twitter / X

Although the Grant Agreement stated that the ENVELOPE project would also have a Twitter / X profile, this social media channel was not included in the original Communication and Dissemination strategy. The ENVELOPE consortium decided to create only a LinkedIn account as part of its social media strategy, as this platform aligns more closely with the project's objective to engage a professional audience, including researchers, industry stakeholders, and policy-makers. LinkedIn offers an effective environment for disseminating project updates, results, and events within relevant professional networks. In contrast, Twitter has increasingly shifted towards more politically charged and fast-paced content, which is less compatible with the nature and tone of EU-funded research communication. The platform's current dynamics make it harder to ensure meaningful visibility and engagement for scientific content, especially when not supported by a high-volume posting strategy and subscription payment to access analytics. As a result, the consortium opted for a more focused and strategic presence on LinkedIn, ensuring consistency with the project's professional identity and communication goals.

3.3.3 Communication materials

A general project brochure, leaflet, roll-up banner, poster and introductory video were developed during the first 18 months of the ENVELOPE project, offering detailed insights into ENVELOPE's objectives, use cases, pilot sites and consortium partners.

These materials are available on the ENVELOPE website at https://envelope-project.eu/resources/ to be downloaded as a media kit. These materials can be found in **Annex 2: Communication materials**.

3.3.4 News articles

Written content is key of the ENVELOPE project's communication strategy. Through news articles on the website, the project shares updates on events, project milestones, and 5G architecture innovations. 24 news articles have been published on the website (https://envelope-project.eu/news/) covering a range of topics from the ENVELOPE kick-off event, events in which ENVELOPE was presented, interviews with project partners, and journals and podcasts featuring ENVELOPE (Figure 5).

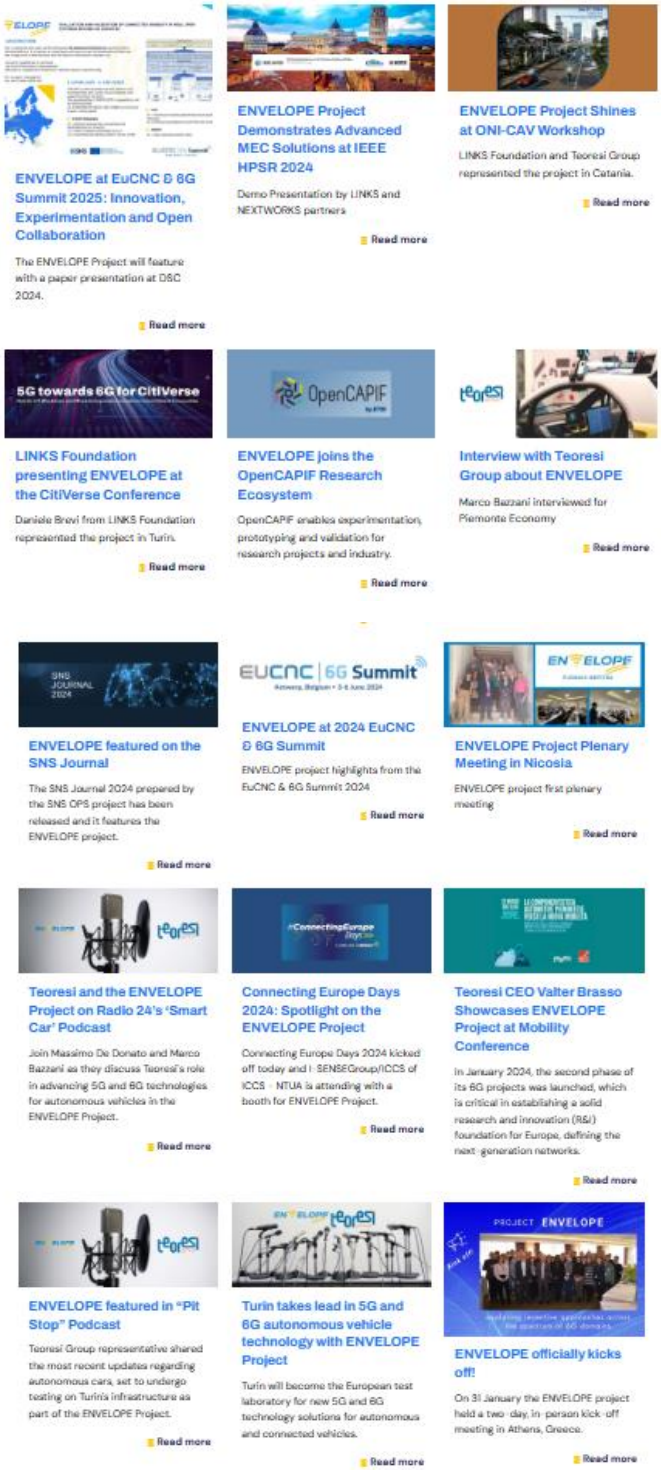


Figure 5 - Website news overview

All published articles are recorded in the project's Dissemination Register, hosted on SharePoint (see Annex 3: Monitoring Tool).

As of M18, 24 news items have been published on the ENVELOPE website, surpassing the M1 to M18 KPIs of 15 English-language news articles (10 per year).

To maintain momentum and meet the communication targets for M12 to M24, a series of interviews with project partners is currently being prepared. These interviews are scheduled in line with the project's editorial calendar (see next chapter) and aim to increase content output and engagement across project channels.

3.3.5 Newsletter

ENVELOPE aims to send a bi-annual newsletter via Mailchimp, collecting project updates and partner news. The goal is to keep stakeholders updated on project developments, sent exclusively to subscribers who have opted in via the ENVELOPE website's subscription form, ensuring GDPR compliance.

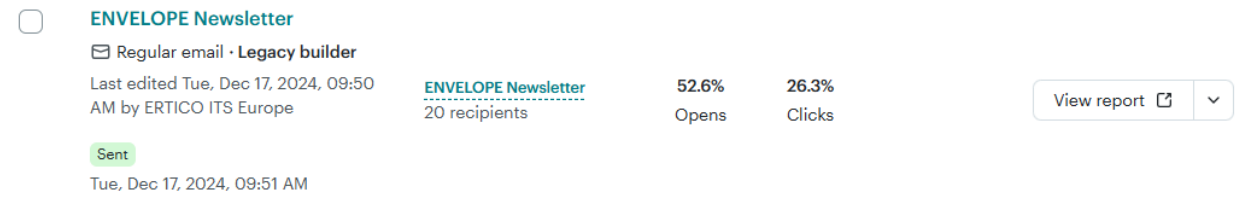


Figure 6: ENVELOPE newsletter numbers

As shown in the screenshot above (Figure 6: ENVELOPE newsletter numbers), after some initial delays, the first ENVELOPE newsletter (see preview in Figure 7) was sent out in December 2024 to 20 subscribers, achieving an open rate of 52.6% and a click rate of 26.3%. The second edition, scheduled for June 2025, will be sent to 33 direct subscribers. In addition to reaching our growing mailing list, the newsletter is also shared by project partners through their own communication channels and promoted on the ENVELOPE website and social media platforms to maximise visibility and engage a wider audience.

Figure 7: ENVELOPE project Newsletter preview

3.4 Future communication strategy

In the next 18 months of the project, the Communication Strategy outlined in Chapter 2 will continue to be followed.

This chapter highlights currently planned activities.

3.4.1 Editorial calendar

The editorial calendar includes dates, topics and contributors of the project in order to ensure there is a regular flow of content on the website. Content will include interviews with partners, release of project results and achievements, and reports on any events that are able to take place. This will ensure that the KPIs of 10 newsfeeds by the end of M24 is met, that the KPIs of 10 newsfeeds by the end of M36 is met as well, and that interviews with all partners and updates from all pilot sites are provided by the end of the project.

A preliminary editorial calendar for the next few months is included in Table 6: Editorial Calendar below.

Table 6: Editorial Calendar

Number	Expected Publication Date	Topic	Contributor
1	July 2025	From Concepts to Use Cases: WP2 Outcomes	NSRD, ISI, ERTICO
2	August 2025	ENVELOPE's Architecture: Key Technical Specifications	ICCS, CMS, ERTICO
3	September 2025	Trial site update: Greece	NCSRD, ICCS, ERTICO
4	October 2025	Second Open Call: Scope, Timeline, and How to Apply	EBOS, ICCS, ERTICO
5	November 2025	Technical Innovation in Action: Highlights from WP3 Midway	LINKS, NCSRD, IQU, ERTICO
6	December 2025	CAM and Beyond: What Makes	IQU, VICOM, ERTICO

		ENVELOPE's AI Framework Unique	
7	January 2026	Trial site update: the Netherlands	TNO, KPN, CMS, ERTICO
8	February 2026	Trial site update: Italy	LINKS, TIM, NXW, TEO, ERTICO
9	March 2026	Integrating Innovations: WP4 Deployment Insights	ICCS, NCSRD, ERTICO
10	April 2026	Open Call Success Stories: Selected Projects in the Spotlight	EBOS, ERTICO
11	May 2026	Evaluation in Practice: ENVELOPE's Testing and Metrics Strategy	VICOM, ISI, ERTICO
12	June 2026	Co-Creation in Practice: How ENVELOPE Involves Stakeholders in CAM Innovation	ISI, VICOM, ICCS, ERICO
13	July 2026	Behind the Scenes of ENVELOPE's Zero-Touch Service Management	IQU, LINKS, UDE, ERTICO
14	August 2026	Spotlight on Selected Open Call Projects from Round 2	EBOS, ERTICO
15	September	ENVELOPE's Legacy: Final Impact and What Comes Next	ICCS, VICOM, EBOS

3.4.2 KPIs for the next 18 months

The communication and dissemination activities for the next 18 months of the project will closely monitored and evaluated against a set of predefined Key Performance Indicators (KPIs) as presented in Table 7: Communication KPIs for the next 18 months of ENVELOPE below.

Table 7: Communication KPIs for the next 18 months of ENVELOPE

Tools/Channels	Key Performance Indicators	Expected value	
		Year 2	Year 3
Communication tools	Project website: • Total visits per month • Number of articles	 >150 >10	 >200 >10
	LinkedIn: Followers of ENVELOPE page	200	300
	Video: Number produced	>2	>3
	Project brochure: Number produced	Update	Update
	Newsletter: Number of issues	2	2

4 Dissemination Strategy

4.1 Summary

ENVELOPE's dissemination strategy remains focused on ensuring broad, inclusive, and open communication of project outcomes to all relevant stakeholders — from scientists, telecom professionals, and industry players to policymakers, public authorities, and the wider public. Building upon the foundation laid in Deliverable D8.2, this updated dissemination chapter presents a comprehensive overview of M1 to M18 dissemination performance, the tools and mechanisms used for tracking progress, and the roadmap for the upcoming dissemination phase.

This updated version reflects the evolution of the strategy from initial awareness-building to a more focused, strategic approach driven by project maturity, technical progress, and stakeholder engagement opportunities.

The strategy now incorporates expanded dimensions, including campaign-based communication, policy alignment, and stakeholder-targeted webinars. Key updates include:

- **Dissemination Means and Channels (Section 4.2):** An in-depth presentation of the mechanisms used to promote ENVELOPE's outputs, including publications, conferences, joint activities, webinars, and demonstration events. These efforts have enabled the project to establish presence across the scientific, industrial, and innovation landscapes.
- **Dissemination Tools (Section 4.3):** A description of the internal monitoring framework, templates, and collaborative tools (e.g., Excel trackers, SharePoint procedures) that ensure consistency and traceability of all dissemination actions, including the ENVELOPE Zenodo community and EC portal uploads.
- **Dissemination KPIs (Section 4.4):** A data-driven evaluation of ENVELOPE's dissemination performance during M1 to M18, mapping both qualitative and quantitative progress against initial targets and offering insights into reach, visibility, and engagement.
- **Future Dissemination Strategy (Section 4.6):** A forward-looking strategic framework that outlines how the project will deepen its outreach through demonstration-driven visibility, thematic campaign communication, and webinar engagement.

This chapter functions both as a reflective summary of what has been achieved and a strategic guide for future actions. As the project advances toward its second phase — including Living Lab trials, Open Call implementations, and final evaluations — dissemination will play a key role in amplifying impact, consolidating partnerships, and ensuring that ENVELOPE's innovations resonate across both technical and non-technical audiences.

4.2 Dissemination Means and Channels

During M1 to M18 reporting period, dissemination efforts were implemented across all major formats, including scientific and technical publications, conference participation, trade exhibitions, webinars, press and podcast coverage, and institutional outreach (e.g. newsletters). Building upon the foundation outlined in the initial dissemination plan, the project has successfully activated both digital and physical means of outreach, ensuring that its objectives, activities, and early results are shared with relevant communities across Europe and beyond.

These complementary dissemination means have enabled ENVELOPE to maintain consistent engagement across its stakeholder spectrum, increase awareness of its mission, and prepare for higher-impact outreach in the upcoming phases of the project.

4.2.1 Scientific and Technical Publications

Publishing in peer-reviewed journals and conference proceedings remains a cornerstone of ENVELOPE's dissemination efforts, ensuring that the project's technical advancements are accessible to the broader scientific community. During the first 18 months of the project, ENVELOPE partners produced a total of **five scientific and technical publications**, all of which were presented at relevant and high-level international conferences or included in edited volumes. These contributions reflect ENVELOPE's active engagement in key thematic areas such as 6G networks, AI-assisted orchestration, digital twins, and CAM-specific architectural frameworks.

All publications are open access and available through the ENVELOPE Zenodo community, ensuring compliance with Horizon Europe's dissemination guidelines and Open Science principles.

List of Publications from M1 to M18:

1. **"Application of Digital Twins for Connected, Cooperative and Automated Mobility"**
    - **Authors:** A. Forrai, A. Gali, I. Barosan
    - **Conference:** IEEE CITDS 2024, Debrecen, Hungary
    - **Date:** 26–28 August 2024
    - **Partner:** SIEMENS
    - **Link:** IEEE CITDS 2024 Website
    - **Zenodo:** https://zenodo.org/records/14892056

2. **"A Proof of Concept Implementation of an AI-Assisted User-Centric 6G Network"**
    - **Authors:** N. Gkatzios, H. Koumaras, D. Fragkos, V. Koumaras
    - **Conference:** EuCNC 2024, Antwerp, Belgium
    - **Date:** 26–28 August 2024
    - **Partner:** NCSRD
    - **Link:** Full Paper (PDF)
    - **Zenodo:** https://zenodo.org/records/13602899

3. **“A Design Methodology for Compositional Simulation: The Digital-Twin Interconnect Framework”**
    - **Authors:** Mohamed Abd El Salam Ahmed, Alexandru Forrai
    - **Conference:** DSC2024, Strasbourg, France
    - **Date:** 18–20 September 2024
    - **Partner:** SIEMENS
    - **Link:** DSC2024 Program
    - **Zenodo:** https://zenodo.org/records/14892017
4. **“An AI-assisted User-Intent 6G System for Dynamic Throughput Provision”**
    - **Authors:** I. Alexandropoulos, V. Rentoula, D. Fragkos, N. Gkatzios
    - **Conference:** IEEE CAMAD 2024, Athens, Greece
    - **Date:** 21–23 October 2024
    - **Partner:** NCSRD
    - **Link:** IEEE Xplore Abstract
    - **Zenodo:** https://zenodo.org/records/14892109
5. **Book Chapter: “Virtual Verification and Validation of Autonomous Vehicles: Toolchain and Workflow”**
    - **Authors:** Alexandru Forrai, Mohsen Alirezaei, Tajinder Singh, Amit Gali, Jeroen Ploeg
    - **Publisher:** IntechOpen, London
    - **Date:** 6 February 2025
    - **Partner:** SIEMENS
    - **Link:** IntechOpen Chapter
    - **Zenodo:** https://zenodo.org/records/15424562

All the above publications have been submitted to the **ENVELOPE Zenodo community**, ensuring they are accessible to stakeholders and the general public.

4.2.2 Conferences and Events

Throughout the reporting period of M1 to M18, the ENVELOPE consortium has maintained strong visibility across the European and international innovation landscape. Partners actively contributed to high-level conferences, workshops, and strategic fora, showcasing project objectives, technical enablers, and preliminary results. These efforts have been central to positioning ENVELOPE within the 5G-Advanced and Connected and Automated Mobility ecosystems.

Between March 2024 and June 2025, ENVELOPE participated in **over 20 dissemination events**, including scientific conferences, industry forums, policy dialogues, and cross-project sessions. Below is an updated chronological overview of key activities:

4.2.2.1 Envelope Participation at Events

Table 8: Table of Events below shows ENVELOPE's participation in events during the first 18 months of the project.

Table 8: Table of Events

No	DATE	EVENT	ACTION
1	14 March 2024	*SNS Webinar (Online)* & on LinkedIn	ICCS introduced the ENVELOPE project during the official SNS Call 2 webinar series.
2	21 March 2024	IRES Piemonte Conference (Turin) & on LinkedIn	Teoresi mentioned ENVELOPE during a session on mobility innovation.
3	22 March 2024	*VTM Workshop: "Vehicles are Devices" (Turin)*	Teoresi participated in a session redefining connected mobility.
4	3–6 June 2024	*EuCNC 2024 (Antwerp)* & photos in 6.1	NCSRD presented: *"A Proof of Concept Implementation of an AI-Assisted User-Centric 6G Network"* ICCS participated in a joint session on vertical architectures with PoDIUM.
5	3–6 June 2024	*IFIP Networking 2024 (Thessaloniki)* & photos in 6.2	LUH (UDE) presented a paper on *Collaborative Optimization of Age of Information*.
6	18 June 2024	*5G towards 6G for CitiVerse Conference (Turin)* & on LinkedIn	LINKS participated in a roundtable on future mobility solutions.
7	24–28 June 2024	*ECC 2024 (Stockholm)* & on the programme	SIEMENS presented on *Modular, Traceable and Certifiable Verification and Validation of Automated Driving Systems*.
8	3 July 2024	*ONI-CAV Workshop (Catania)* & on LinkedIn	LINKS presented: *"From research to the road: on ADAS and Connected Car"* Teoresi presented: *"Connectivity, Automation and Personalisation: The Car of the Future"*

9	22–24 July 2024	*IEEE HPSR 2024 (Pisa)* & on LinkedIn	NXW and LINKS demonstrated *Position-Aware Dashcam Video Streaming with Zero-Touch MEC App Handover*.
10	26–28 August 2024	*IEEE CITDS 2024 (Debrecen) & in LinkedIn & 6.3*	SIEMENS presented: *Application of Digital Twins for Connected, Cooperative and Automated Mobility*.
11	18–20 September 2024	*DSC 2024 (Strasbourg)* & in 6.4	SIEMENS presented: *A Design Methodology for Compositional Simulation: The Digital-Twin Interconnect Framework*.
12	3 October 2024	*EUWENA Private Networks Event (Paris/Online)* & on LinkedIn	HPE presented ENVELOPE's relevance for industrial 5G networks.
13	17–18 October 2024	*Simulation & Digital Twin Conference (Munich) & in 6.5*	SIEMENS delivered a poster on digital twin validation for autonomous vehicles.
14	21–23 October 2024	*IEEE CAMAD 2024 (Athens)* & on LinkedIn	NCSRD presented: *An AI-assisted User-Intent 6G System for Dynamic Throughput Provision* ICCS co-organised a workshop with SAFE-6G on trustworthiness in 6G networks.
15	6 November 2024	*University of Padua Seminar (Padua)*	HPE discussed private 5G networks and ENVELOPE's use cases.
16	20 November 2024	*SNS ICE/Guide Webinar (Online)* & in 6.6	ENVELOPE was presented during a thematic webinar on transport and logistics.
17	17 December 2024	*5G-ROUTES Workshop (Online) & in 6.7*	ICCS showcased ENVELOPE's trial scenarios and architecture positioning
18	22 January 2025	*INW2025 (Moena, Italy)*	HPE gave a keynote on private 5G architectures and ENVELOPE's industrial relevance.
19	21 May 2025	*ITS EU Congress 2025 (Seville)* & on LinkedIn	ICCS presented ENVELOPE's use of space-based PNT technologies.
20	3–6 June 2025	*EuCNC & 6G Summit 2025 (Poznan)* & on LinkedIn 1, 2, 3, 4	**Exhibition Booth and Demonstration** ENVELOPE's booth, led by ICCS with contributions from NXW, TNO, and LINKS. A live demo along with two pre-recorded videos will be supported. – Pavlos Basaras (ICCS)

			Workshops and Special Sessions **Konstantinos Katsaros** (ICCS) - Special Session 9 (SPS9): "Unlocking 5G-Advanced and 6G for Verticals Through Service Based Architecture, Network Exposure and Beyond". Presentation: "Network exposure for Connected and Automated Mobility (CAM) Services: insights from the ENVELOPE project" **Konstantinos Katsaros** (ICCS) – Workshop 4 (WS4): "Results and findings from SNS B5G Large-Scale Trials and Experimentations". Presentation: "Beyond 5G Trials and Experimentations for Connected and Automated Mobility (CAM) Services: the ENVELOPE project approach." **Dimitris Tsolkas** (**Fogus Innovations and Services P.C.**) – Special Session 15 (SPS 15): Software-based evolution towards the 6G era in telecommunications, 4 June 2025. Presentation: "Contribution to the presentation of Chapter 1 of SNWG white paper, where ENVELOPE has contributed to". **ENVELOPE Regular Tracks Contributions** • "Experimental Integration of Non-5G Capable Devices into 5G Networks via Untrusted WLAN: the UNIF Approach". OPE Track - Apostolis Salkitzis (**Lenovo**) • "The Experimentation-as-a-Service Approach in the ENVELOPE Project". OPE Track – Matteo Minotti (**Fondazione LINKS**) • "Dynamic QoS Adaptation via Exposed Service APIs for Advanced CAM Use Cases" NET Track – Ramon de Souza Schwartz (**TNO**) **ENVELOPE Poster Contributions**

			• "Beyond 5G Network Exposure for the Automotive Sector: the ENVELOPE Approach" – Fofy Setaki (OTE)

The dissemination team, in collaboration with all partners, will continue to update and report on these activities using the internal monitoring tool, SharePoint repository, and official dissemination channels.

Table 9: List of Exhibition Participationbelow shows ENVELOPE's participation in exhibitions during the first 18 months of the project, which fulfills the KPI of three (3) exhibitions.

Table 9: List of Exhibition Participation

DATE	EVENT NAME	LOCATION	DETAILS	PARTNER
2-5 April 2024	Connecting Europe Days 2024	Brussels, Belgium	Joint booth with EU-funded projects EVENTS and PoDIUM to showcase objectives and advancements in the field and introduce ENVELOPE project to a target audience.	ICCS
03 - 06 June 2024	EUCNC 2024	Antwerp, Belgium	Poster booth at the EuCNC Exhibition	ICCS
16 - 20 September 2024	ITSWC2024	Dubai, UAE	'Participation at the Commsignia and ERTICO booths	ERTICO, Commsignia
Ferbuary 6 2025	DataMite Meet Up Event	Athens, Greece	Participation with a roll-up banner	ICCS
07 - 08 May 2025	ITS Hellas Conference	Athens, Greece	Participation with a roll-up banner	ICCS
03 - 06 June 2025	EUCNC 2025	Poznan, Poland	ENVELOPE Dedicated Booth	ICCS

4.2.3 Webinars

As outlined in D8.2, ENVELOPE will organise a total of seven webinars throughout the project's duration, each focused on presenting the project's outcomes, trial activities and strategic impact. The webinars are strategically distributed to coincide with key technical milestones and project phases, ensuring timely and targeted engagement with both expert and general audiences.

Flexibility remains a core principle of the webinar series, allowing adjustments in topics, dates, and speaker composition as the project evolves.

The first ENVELOPE webinar is currently in preparation and is scheduled for delivery on **7 July 2025**. This initial session will introduce the ENVELOPE project and its reference architecture (as defined in Deliverable D2.2), setting the foundation for subsequent thematic webinars. Titled **"Introducing ENVELOPE: A Look into the Architecture, Technology Enablers, and Real-World Applications"**, the webinar will familiarise stakeholders with the project's technological backbone and its contributions to the Beyond 5G landscape.

To build on this introduction and respond to ongoing engagement needs, a **second session will follow immediately after**, dedicated to the project's first Open Call. This webinar, titled **"ENVELOPE Open Call 1: Experiment with Future Mobility over B5G Architectures"**, will present the scope, experimentation opportunities, eligibility criteria, and expected results of the Open Call. A live Q&A segment will offer participants the chance to clarify application details and explore synergies with ENVELOPE's platform.

The remaining webinars will follow during the next reporting period, with three dedicated to the Greek, Italian, and Netherlands Living Labs, offering in-depth views into the corresponding trial sites and use cases. Additional sessions will support the two Open Call periods and explore architecture deployment, impact assessment, and business-related outcomes during the final project phase.

Table 10: List of Webinars below shows a preliminary calendar of the webinars that will take place during all 36 months of the project.

Table 10: List of Webinars

No.	Date	Description	Partner Responsible
1.	~end of Year 1	"Introducing ENVELOPE: A Look into the Architecture, Technology Enablers, and Real-World Applications", "ENVELOPE Open Call 1: Experiment with Future Mobility over B5G Architectures"	ICCS, NCSRD
2.	M13 – M24	Description of the Greek Living Lab and Use Cases	NCRSD, OTE, ICCS, FOGUS, ISFM
3.	M13 – M24	Description of the Netherlands Living Lab and Use Cases	TNO, Commsignia, KPN, Siemens
4.	M13 – M24	Description of the Italian Living Lab and Use Cases	LINKS Foundation, HPE, Nextworks, TIM, Teoresi, Municipality of Turin
5.	M18 – M24	ENVELOPE Open Call Info Webinar(s)	EBOS
6.	M25 – M36	Deployment of the ENVELOPE architecture in trial sites: Challenges and lessons learned	ICCS
7.	M25 – M36	Shaping the future of the 5G adv./6G CAM functionalities: impact assessment and B5G utilisation	EBOS, INC

4.2.3.1 Future Dissemination Strategy

Each webinar will be designed with a tight and professional agenda, typically 60–75 minutes in length, and will feature a mix of presentations, short use case spotlights, and live Q&A. Dedicated moderation and technical support will ensure a smooth user experience, while promotion will be coordinated across LinkedIn, the project website, consortium channels, and relevant external networks (e.g. SNS JU, 5G PPP, 6G-IA).

To support the reach and longevity of the webinars, each session will be suggested to the consortium to:

- **Recorded and published** on the ENVELOPE website and YouTube.
- **Summarised in an event recap**, published on LinkedIn and newsletter.
- Accompanied by **speaker slides**, downloadable factsheets, and shareable highlights.

The success of this webinar strategy will be tracked via metrics such as attendance rates, participant feedback, post-event visibility, and content reuse (e.g. webinar clips embedded in newsletters or final deliverables).

4.2.3.2 Open Call Campaign

This communication effort focuses on promoting ENVELOPE's unique value proposition as a testbed for experimentation, inviting SMEs, research teams, and innovators to engage with the architecture and its services. The campaign has been designed as a multi-phase, multi-platform initiative and includes the following elements:

- A **dedicated Open Call landing page** on the ENVELOPE website with full documentation, eligibility criteria, timelines, and submission instructions.
- A series of **LinkedIn announcements and visual posts (e.g. 1st Open Call Launch, ENVELOPE at EuCNC + Meet Us at the Booth for more info about the Open Calls, Feasibility Check deadline extension post)**, including teaser messages, the basic information, Open Call reminders and more, supported by branded visuals and Open Call banners.
- **Partner-driven outreach**, leveraging mailing lists, networks (e.g. 6G-IA, SNS JU clusters), and newsletters to boost reach and visibility.
- A scheduled **Open Call webinar** (see 4.2.3) designed to explain the call objectives, technical focus areas, and the integration process for selected experiments.
- Coordination with other **dissemination activities and external events** (e.g. EuCNC & 6G Summit) to amplify the campaign during peak visibility periods.

This form of campaign will be implemented also in Open Call 2.

4.2.4 Demonstration Events

The ENVELOPE project remains on track to organise four demonstration events, as originally planned: three dedicated to the project's large-scale trial sites in **Greece**, **Italy**, and **the Netherlands**, and one final event showcasing project results and strategic alignment with the 6G-IA vision. These demonstration events are designed to present real-world applications of the

ENVELOPE architecture and technology enablers, offering immersive experiences to stakeholders through live trials and interactive sessions.

As from M1 to M18, the demonstration events have not yet taken place, as they are scheduled from M25 to M36, in accordance with the timeline laid out in the Grant Agreement and Deliverable D8.2. However, initial planning activities have begun, including early coordination between the dissemination team and Living Lab leaders, the definition of stakeholder lists, and the identification of strategic events to potentially align with.

The **Greek, Italian, and Dutch Living Labs** have started defining the demonstration scope and logistics, ensuring that each site will be ready to showcase ENVELOPE's capabilities across diverse CAM use cases:

- In **Greece**, preparations are focused on demonstrating MEC service handovers across MNOs.
- In **Italy**, the use of dynamic collaborative mapping and accident reporting services will be featured.
- In **the Netherlands**, digital twin-assisted teleoperation and predictive maintenance are expected to be the central themes.

These events will be supported by targeted promotional efforts, including press releases, media invitations, and on-site materials such as roll-up banners. Post-event materials—including photos, presentation slides, and more— will be made available on the project website and social media channels to ensure widespread dissemination.

The **ENVELOPE Final Event**, set to occur at the end of the project, will act as a capstone for the entire initiative. Expected to host approximately 150 participants, this event will highlight the project's key findings, policy recommendations, and innovations that support a more inclusive and responsive European digital infrastructure. It will also reinforce ENVELOPE's contributions to the 6G-IA roadmap and provide a forum for engaging with EU-level decision-makers.

4.2.4.1 Future Dissemination Strategy

Each demonstration will be designed as a flagship visibility moment. Activities will be supported by a media and communications package, including:

- Press releases in English and local languages;
- Social media promotion and teaser videos;
- Live and recorded video documentation;
- And more after consortium discussions.

To maximise local relevance and turnout, each LL demo will be co-organised with local authorities, infrastructure partners, and ecosystem multipliers (e.g. municipalities, transport operators, innovation hubs). Invitations will be extended to press, SME clusters, and public authorities with a stake in CAM and future mobility. A template communication kit will be prepared centrally and adapted to the needs and language of each region.

A key objective will be to create two-layered communication value:

1. Immediate visibility and impact through press, social media, and partner outreach in the days surrounding the demo.
2. Long-term knowledge value via content that can be reused — such as video highlights, demo recap articles, and interviews with technical leads — across newsletters, webinars, stakeholder briefings, and policy contributions.

Each event will also include an internal dissemination component, offering the consortium the opportunity to align messaging, collect feedback, and validate the perceived value of the architecture and enablers being tested.

4.2.5 Other Dissemination Activities

In addition to traditional dissemination channels, ENVELOPE partners have actively pursued diverse and engaging formats to ensure broad visibility and outreach to both specialist and non-specialist audiences. These complementary activities have contributed to raising awareness about the project across various segments of society and stakeholder communities, aligning with the original plan while expanding ENVELOPE's presence in the media, at industry events, and in institutional dialogues.

Up to M18, ENVELOPE was featured in multiple press releases, podcasts, stakeholder meetings, and institutional forums. These activities played a key role in communicating the societal and technological relevance of the project beyond academic and technical circles.

More details can be found in Table 11: Media outreach & Press (regarding media outreach and press), Table 12: Podcastsand

Table 13 - Stakeholder & Institutional Meetings (regarding stakeholder and institutional meetings) below.

Table 11: Media outreach & Press

TITLE	ACTIVITY
Press Release (Feb 2024)	Teoresi and the City of Turin issued a bilingual press release highlighting ENVELOPE's role in the city's smart mobility initiatives.
SNS Journal 2024 Feature (June 2024)	ENVELOPE was included in the official **SNS JU Annual Journal**, distributed during EuCNC 2024 and accessible online.
Interview (July 2024)	Teoresi's Innovation Manager was interviewed by **Piemonte Economy**, outlining ENVELOPE's role in advancing 5G-based smart mobility.

Table 12: Podcasts

TITLE	ACTIVITY

RAI Radio1 "Pit Stop" (March 2024)	Marco Bazzani (Teoresi) presented ENVELOPE's CAM innovations.
Radio24 "Smart Car" (April 2024)	The project was again discussed in a dedicated segment by journalist Massimo De Donato and Marco Bazzani.

Table 13 - Stakeholder & Institutional Meetings

TITLE	ACTIVITY
CCAM Multi-Cluster Meeting (March 2024)	ERTICO and ICCS presented ENVELOPE in front of 100+ participants at a joint EU brokerage and strategy event.
5GAA Meeting (July 2024)	TNO and Commsignia introduced ENVELOPE in discussions around connected vehicle use cases.
Commsignia Indoor Demo (Oct 2024)	ENVELOPE appeared in a visual slideshow at the **5GAA F2F event in Berlin**, within Commsignia's demo space.
ETSI MEC#40 (Dec 2024)	During the ETSI MEC#40 meeting held in Athens (9–12 December 2024), ENVELOPE—represented by Lenovo—presented its approach to integrating edge computing into the B5G CAM ecosystem, exchanging technical insights and reinforcing the alignment of its solutions with the evolving ETSI MEC Phase 4 specifications.

4.3 Dissemination Tools

ENVELOPE's dissemination tools continue to provide a structured framework for planning, monitoring, and coordinating the project's outreach activities. The tools defined in D8.2 remain in use and have supported the collection of dissemination data, facilitated approval processes, and ensured compliance with EU visibility requirements. Below is a summary of their current status and usage.

4.3.1 Dissemination Procedure

The dissemination procedure, as defined in Article 17.4 of the Grant Agreement and detailed in Annex 2 of D8.2, has been followed by partners throughout M1 to M18. All publications, presentations, and public communication activities were approved by the Dissemination Manager (ICCS) and WP8 Leader (ERTICO) as per the established process. No objections or conflicts have been raised to date, and the coordination mechanism has proven effective in ensuring consistent quality and branding – also mentioned in **2.5 Dissemination and communication procedures**.

4.3.2 Monitoring Tool

The dissemination **Monitoring Tool**, hosted on SharePoint, has been actively used to record dissemination activities from all partners. It includes multiple sheets tracking:

- Conference presentations

- Publications
- Webinars
- Press mentions
- Events with booths
- Planned journal submissions
- KPIs

Partners have consistently logged their activities, enabling transparent and accurate reporting. Data from this tool forms the basis of M1 to M18 update and will continue to inform future evaluations.

4.3.3 Calendar of Events & List of Open Access Journals

The **Calendar of Events** and the **Open Access Journal list** are maintained as living documents on SharePoint and updated quarterly. Partners have used the calendar to identify relevant conferences and ensure visibility across strategic venues. The journal list has guided scientific dissemination efforts, helping ensure alignment with the project's thematic areas and open access obligations.

Notably, journals and conferences listed in these resources were targeted in M1 to M18, including **IEEE CAMAD, EuCNC, DSC, ECC, CITDS and more**.

4.4 Liaison Activities and International Cooperation

Liaison activities and international cooperation are an integral part of the ENVELOPE dissemination and impact strategy. As defined in D8.2, these activities aim to foster collaboration with other EU-funded initiatives, contribute to standardisation dialogues, and amplify the visibility of the project within global R&I networks such as the 5G-PPP, SNS JU, CCAM Partnership, and 6G-IA.

The execution and strategic coordination of these actions fall under **Task 8.3 – Liaison Activities and International Cooperation and these will be reported in D8.7 – Report on Liaison Activities and International Cooperation (M36)**, which is led separately and will be reported in detail in a dedicated deliverable. As such, this dissemination update provides only a high-level view of relevant liaison efforts that have directly intersected with WP8 dissemination actions to date.

4.5 Dissemination Key Performance Indicators

The ENVELOPE consortium has exceeded several of the M1 to M18 targets set for dissemination activities. The table below provides a summary of the KPIs alongside the actual achievements recorded in the first reporting period. These figures reflect the consortium's commitment to widespread visibility, stakeholder engagement, and alignment with both scientific and public outreach goals. Find more information in Table 14: Dissemination KPIs below.

Table 14: Dissemination KPIs

Tools/Channels	Key Performance Indicator	Target (M1-M18)	TOTAL	Achieved (Year 1)
Project Events / Webinars	Participants in project-organised events = Number of events/ participants	>1/50	*7/50*	*Not yet applicable (planned for future phases)* ***(Table 10)***
Conferences	Presentations (papers, sessions, workshops, posters, webinars)	>5	*30*	**19 (Table 8)**
Trade Shows	Exhibition booths or stands	>1	*3*	**5** | ***Completed*** | ***(Table 9)***
Scientific Publications	Number (journals & conference proceedings)	>5	*35*	**5 published | (4.2.1)**
Non-Scientific Publications	Press, media, podcast, trade articles	>1	*5*	**5** | ***Completed*** | ***(Table 11 & Table 12)***

5 Conclusions

During the first 18 months of the ENVELOPE project, significant progress was achieved across both communication and dissemination fronts. This updated strategy outlines the transition from an initial awareness-raising and brand-establishing phase to a more structured, audience-targeted, and campaign-driven model — with communication and dissemination working in tandem to maximise visibility and impact.

From a communication perspective, ENVELOPE successfully established a clear and recognisable identity, supported by consistent visual language and tone of voice across all channels. The project's brand manual, templates, and partner communication kit have ensured coherence in all public-facing outputs. Strategic use of LinkedIn as the primary social media platform led to measurable growth in audience engagement, supported by regular editorial content including milestone updates, visual posts, teaser campaigns, and press outreach. The ENVELOPE website has served as a central information hub, while the ENVELOPE YouTube channel and upcoming webinar recordings will add multimedia depth to the project's digital presence.

The introduction of campaign-style communication, a key innovation of this phase, enabled the project to create thematic visibility around major milestones such as the Open Call launch. This included coordinated LinkedIn campaigns, visual assets, tailored hashtags, landing pages, and cross-posting via partner channels. These campaigns will intensify in the second half of the project, supporting both Living Lab activities and third-party engagement.

From a dissemination standpoint, the project has achieved strong visibility in the European research and innovation landscape. This includes five scientific publications, participation in over 25 events, and presentations at high-level conferences such as EuCNC, IEEE CAMAD, and ITS World Congress. These activities were tracked and supported through a shared monitoring tool, internal reporting procedures, and a growing repository on the ENVELOPE Zenodo community and the EC portal.

A set of KPIs was used to measure progress and identify areas for refinement. While many targets — including publication output and event participation — were successfully met, others such as video production and sustained website engagement will be addressed through enhanced storytelling and campaign execution in the upcoming period.

6 ANNEXES

Annex 1: Overview of ENVELOPE visual identity

Overview of the ENVELOPE visual identity guidelines document, showing the cover of the visual identity (Figure 8), logo positioning (Figure 9), colour palette (Figure 10), and fonts (Figure 11). For detailed instructions, please refer to the complete guidelines accessible on the project's SharePoint and forthcoming on the ENVELOPE website.

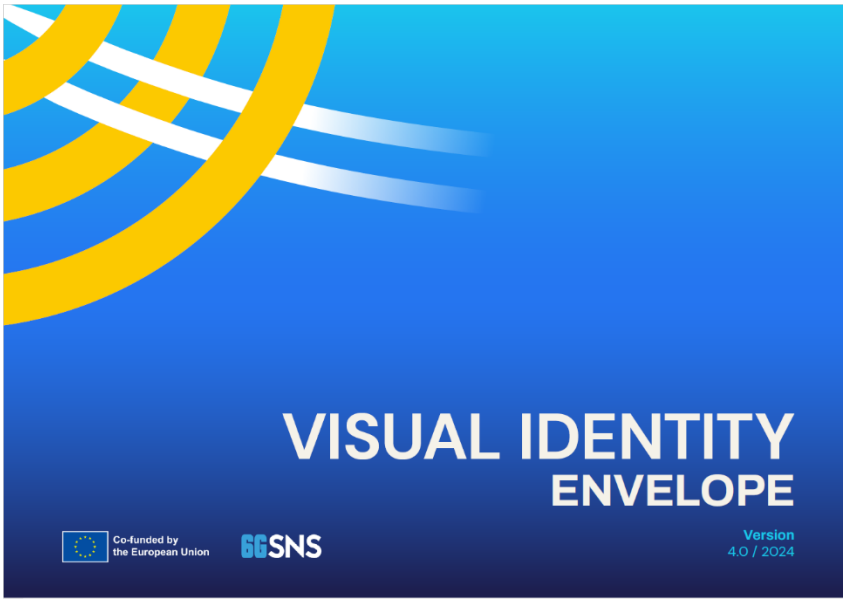


Figure 8. Visual Identity ENVELOPE

Figure 9. Logo Positioning

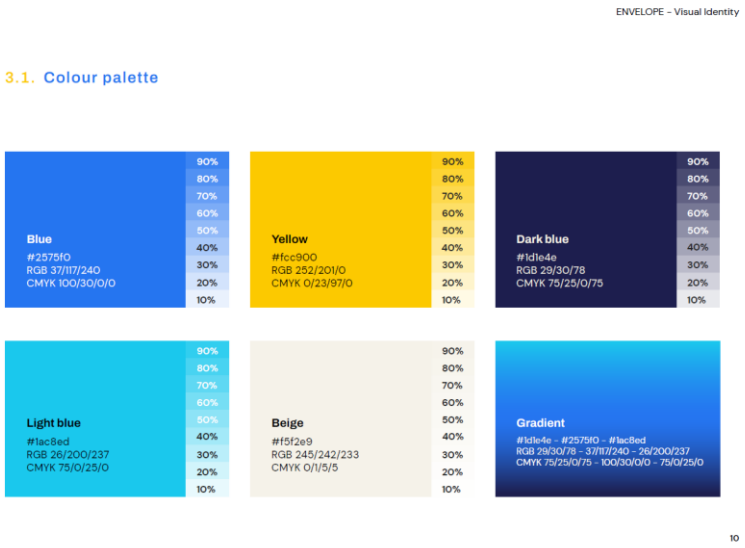


Figure 10. Color palette

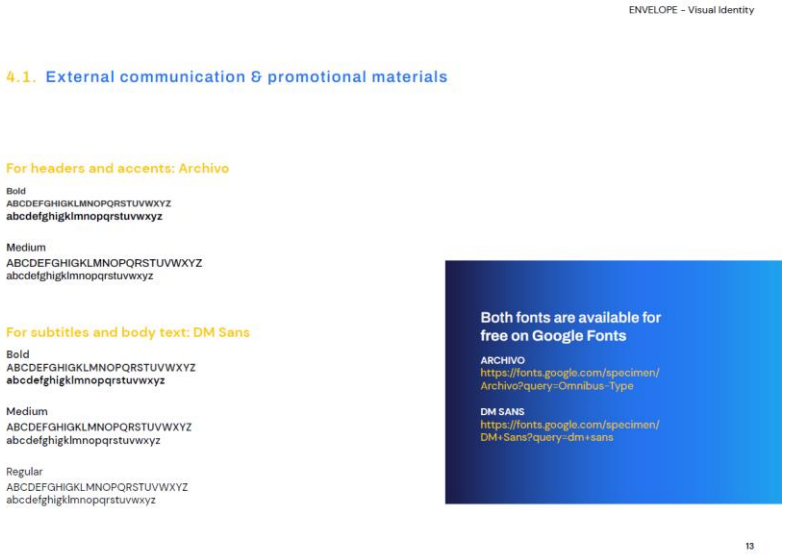


Figure 11. Fonts for communication and promotional materials

Annex 2: Communication materials

A **roll-up banner** (Figure 12. ENVELOPE roll-up banner) was developed to provide key information on ENVELOPE, such as the project's objectives, and links to its website and social media profile, presented in a visual and attractive way. The roll-up banner will be used to promote the project to the wider audience at various events and exhibitions, whether organised by the consortium or external events.

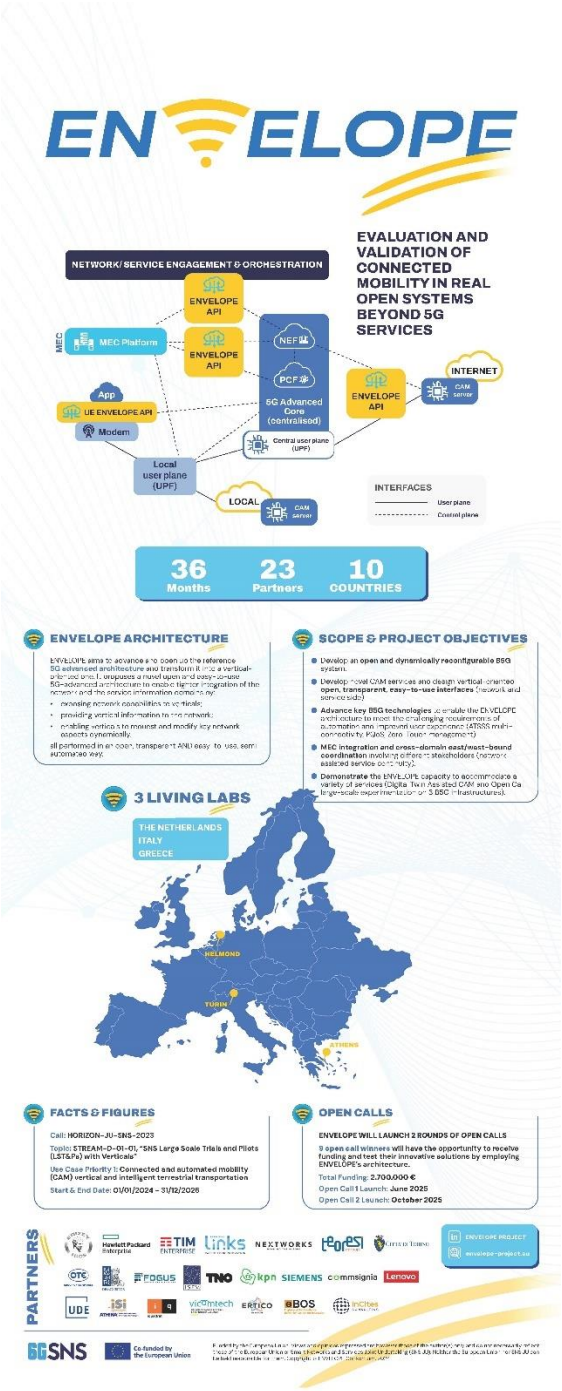


Figure 12. ENVELOPE roll-up banner

A flagship **brochure** (Figure 13. ENVELOPE brochure) was developed in the first year of the project. The document presents the project in greater detail and includes the objectives of ENVELOPE, information on the use cases and the pilot sites, and the consortium partners.

Figure 13. ENVELOPE brochure

A **poster** (Figure 14. ENVELOPE poster) presenting key information on ENVELOPE will be developed in Year 1 and updated in Year 2. Other posters may also be produced if needed to highlight specific results and achievements or any other aspect of the project.

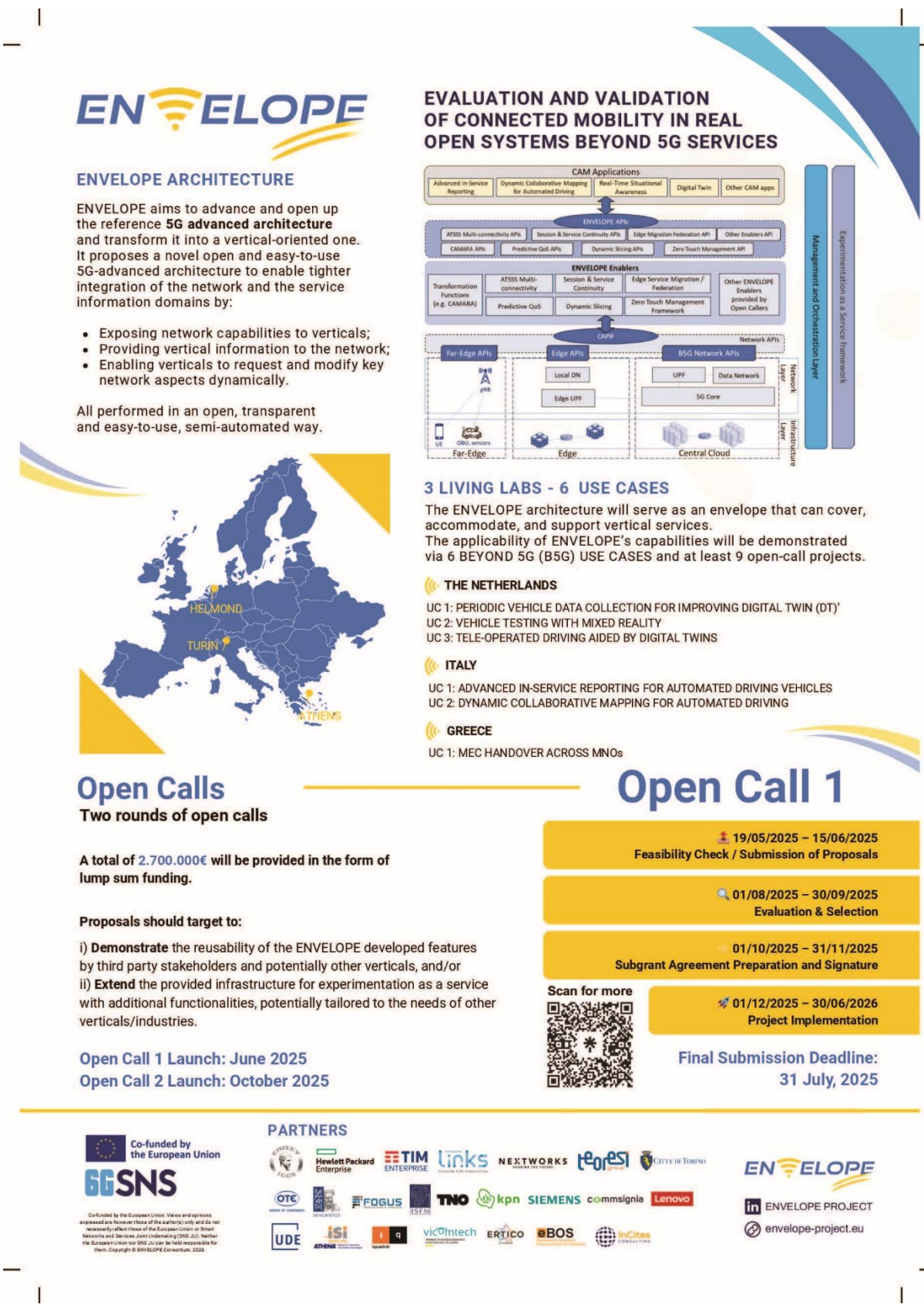
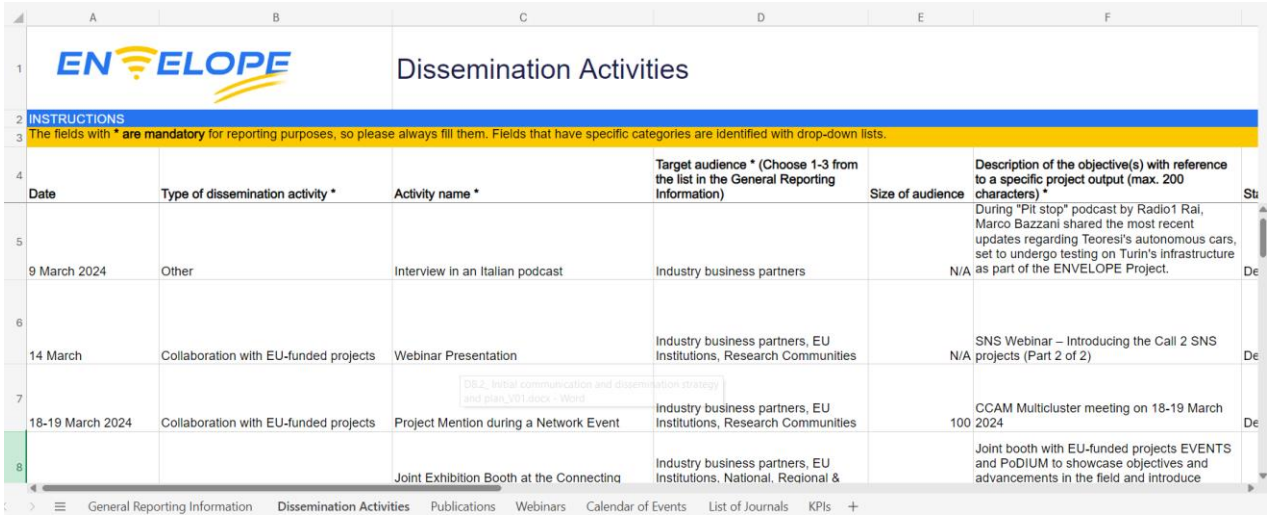


Figure 14. ENVELOPE poster

Annex 3: Monitoring Tool

All dissemination activities are recorded in the project's Dissemination Register, hosted on SharePoint. The Dissemination Register has different tabs for Dissemination Activities (Figure 15: Monitoring Tool, Dissemination Activities), Publications (Figure 16: Monitoring Tool, Publications), and events (Figure 17: Monitoring Tool, Calendar of Events).



Dissemination Activities

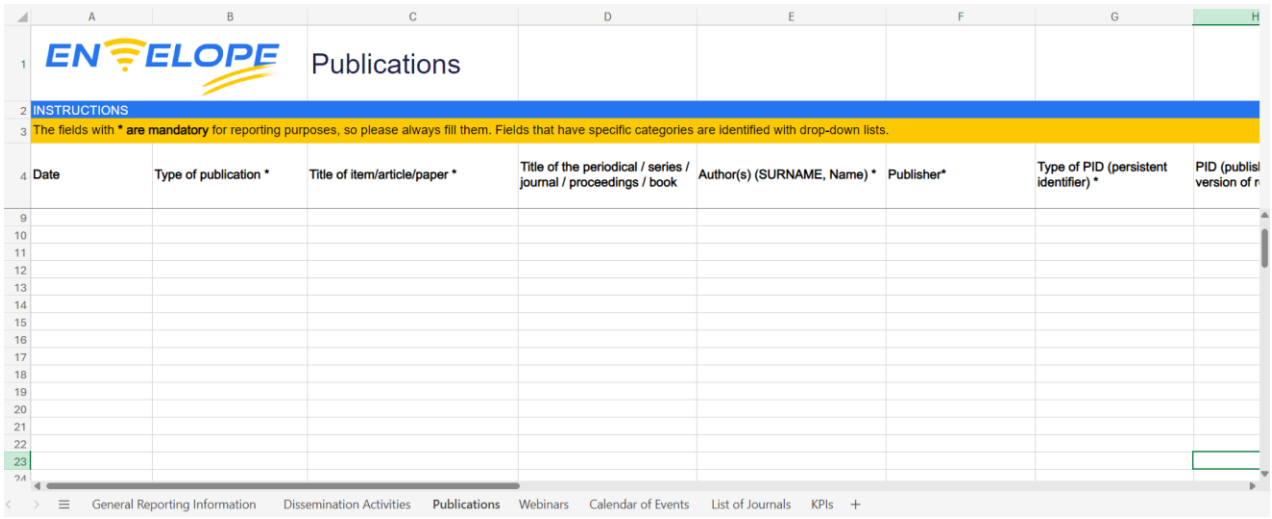
INSTRUCTIONS

The fields with * are mandatory for reporting purposes, so please always fill them. Fields that have specific categories are identified with drop-down lists.

Date	Type of dissemination activity *	Activity name *	Target audience * (Choose 1-3 from the list in the General Reporting Information)	Size of audience	Description of the objective(s) with reference to a specific project output (max. 200 characters) *	St
9 March 2024	Other	Interview in an Italian podcast	Industry business partners	N/A	During "Pit stop" podcast by Radio1 Rai, Marco Bazzani shared the most recent updates regarding Teoresi's autonomous cars, set to undergo testing on Turin's infrastructure as part of the ENVELOPE Project.	De
14 March	Collaboration with EU-funded projects	Webinar Presentation	Industry business partners, EU Institutions, Research Communities	N/A	SNS Webinar – Introducing the Call 2 SNS projects (Part 2 of 2)	De
18-19 March 2024	Collaboration with EU-funded projects	Project Mention during a Network Event	Industry business partners, EU Institutions, Research Communities	100	CCAM Multicluster meeting on 18-19 March 2024	De
		Joint Exhibition Booth at the Connecting	Industry business partners, EU Institutions, National, Regional &		Joint booth with EU-funded projects EVENTS and PoDIUM to showcase objectives and advancements in the field and introduce	

General Reporting Information | Dissemination Activities | Publications | Webinars | Calendar of Events | List of Journals | KPIs

Figure 15: Monitoring Tool, Dissemination Activities



Publications

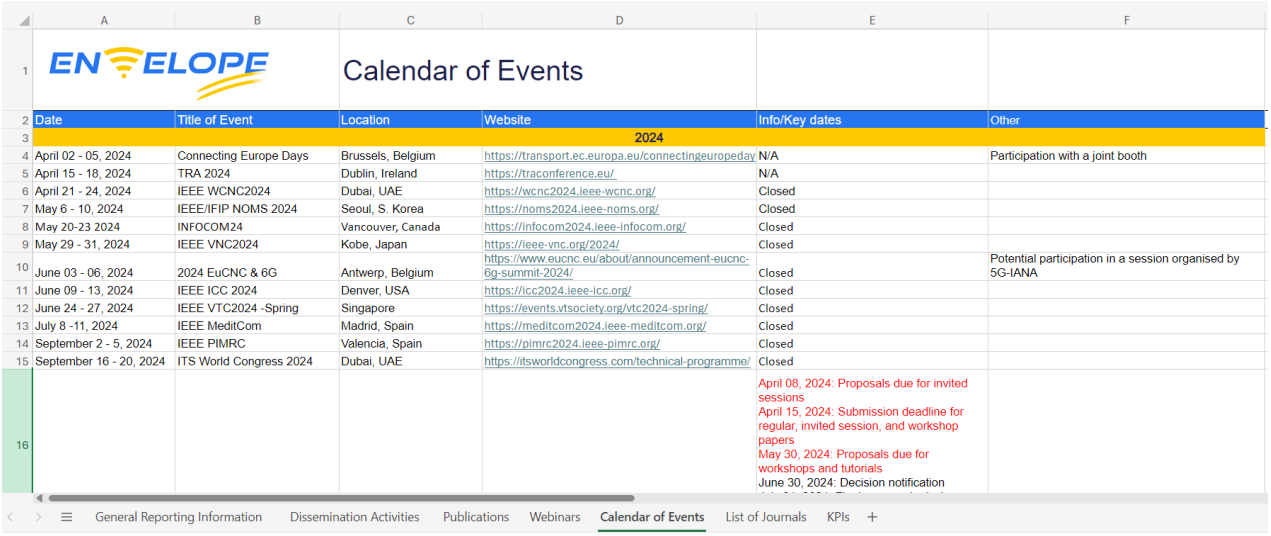
INSTRUCTIONS

The fields with * are mandatory for reporting purposes, so please always fill them. Fields that have specific categories are identified with drop-down lists.

Date	Type of publication *	Title of item/article/paper *	Title of the periodical / series / journal / proceedings / book	Author(s) (SURNAME, Name) *	Publisher*	Type of PID (persistent identifier) *	PID (publis version of r

General Reporting Information | Dissemination Activities | Publications | Webinars | Calendar of Events | List of Journals | KPIs

Figure 16: Monitoring Tool, Publications



Calendar of Events

Date	Title of Event	Location	Website	Info/Key dates	Other
2024					
April 02 - 05, 2024	Connecting Europe Days	Brussels, Belgium	https://transport.ec.europa.eu/connectingeuropeday	N/A	Participation with a joint booth
April 15 - 18, 2024	TRA 2024	Dublin, Ireland	https://traconference.eu/	N/A	
April 21 - 24, 2024	IEEE WCNC2024	Dubai, UAE	https://wcnc2024.ieee-wcnc.org/	Closed	
May 6 - 10, 2024	IEEE/IFIP NOMS 2024	Seoul, S. Korea	https://noms2024.ieee-noms.org/	Closed	
May 20-23 2024	INFOCOM24	Vancouver, Canada	https://infocom2024.ieee-infocom.org/	Closed	
May 29 - 31, 2024	IEEE VNC2024	Kobe, Japan	https://ieee-vnc.org/2024/	Closed	
June 03 - 06, 2024	2024 EuCNC & 6G	Antwerp, Belgium	https://www.eucnc.eu/about/announcement-eucnc-6g-summit-2024/	Closed	Potential participation in a session organised by 5G-IANA
June 09 - 13, 2024	IEEE ICC 2024	Denver, USA	https://icc2024.ieee-icc.org/	Closed	
June 24 - 27, 2024	IEEE VTC2024 -Spring	Singapore	https://events.vtsociety.org/vtc2024-spring/	Closed	
July 8 -11, 2024	IEEE MeditCom	Madrid, Spain	https://meditcom2024.ieee-meditcom.org/	Closed	
September 2 - 5, 2024	IEEE PIMRC	Valencia, Spain	https://pimrc2024.ieee-pimrc.org/	Closed	
September 16 - 20, 2024	ITS World Congress 2024	Dubai, UAE	https://itsworldcongress.com/technical-programme/	Closed	
				April 08, 2024: Proposals due for invited sessions April 15, 2024: Submission deadline for regular, invited session, and workshop papers May 30, 2024: Proposals due for workshops and tutorials June 30, 2024: Decision notification	

General Reporting Information | Dissemination Activities | Publications | Webinars | Calendar of Events | List of Journals | KPIs

Figure 17: Monitoring Tool, Calendar of Events

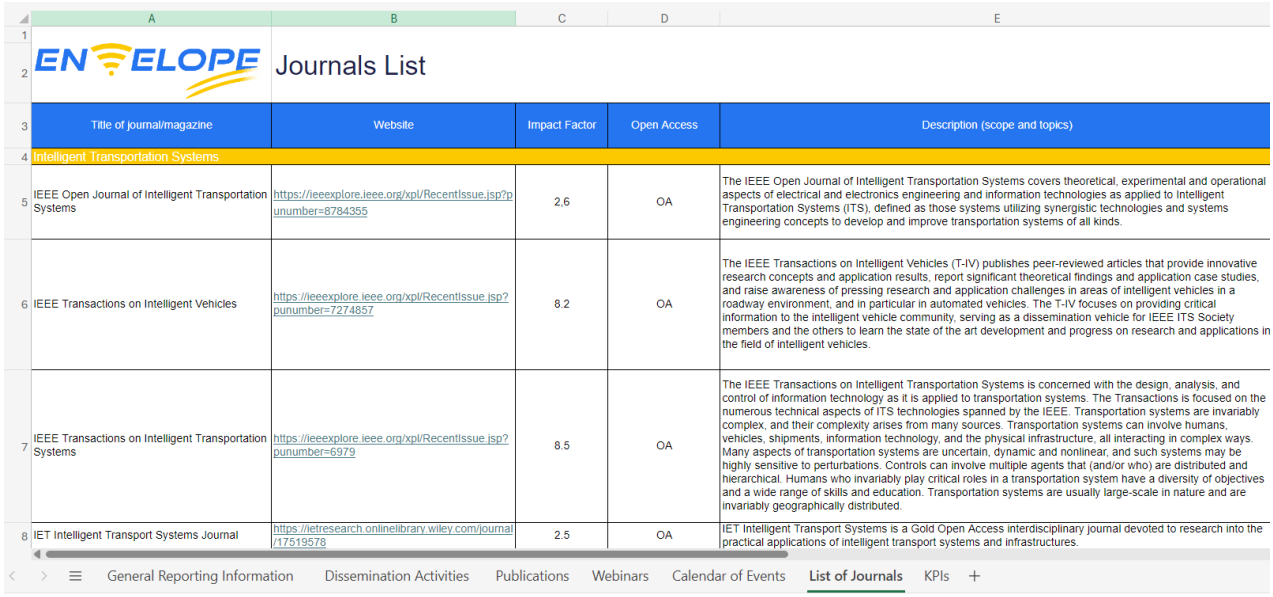
Annex 5: List of Journals

The Open Access Journal list (as seen in Table 15: List of Journals and Figure 18: Monitoring Tool, List of Journals) is maintained as a living document on SharePoint and updated quarterly. Partners have used the calendar to identify relevant conferences and ensure visibility across strategic venues. The journal list has guided scientific dissemination efforts, helping ensure alignment with the project's thematic areas and open access obligations.

Table 15: List of Journals

Intelligent Transportation Systems	
IEEE Open Journal of Intelligent Transportation Systems	https://ieeexplore.ieee.org/xpl/RecentIssue.jsp?punumber=8784355
IEEE Transactions on Intelligent Vehicles	https://ieeexplore.ieee.org/xpl/RecentIssue.jsp?punumber=7274857
IEEE Transactions on Intelligent Transportation Systems	https://ieeexplore.ieee.org/xpl/RecentIssue.jsp?punumber=6979
IET Intelligent Transport Systems Journal	https://ietresearch.onlinelibrary.wiley.com/journal/17519578
Journal of Intelligent Transportation Systems	https://www.tandfonline.com/action/journalInformation?show=aimsScope&journalCode=gits20
International Journal of Intelligent Transportation Systems Research	https://www.springer.com/journal/13177
Journal of Advanced Transportation	https://www.hindawi.com/journals/jat/
IEEE Open Journal of Vehicular Technology	https://ieeexplore.ieee.org/xpl/RecentIssue.jsp?punumber=8782711

Communication, Computing and IoT Technologies	
IEEE Open Journal of the Communications Society	https://ieeexplore.ieee.org/xpl/RecentIssue.jsp?punumber=8782661
IEEE Transactions on Mobile Computing	https://ieeexplore.ieee.org/xpl/RecentIssue.jsp?punumber=7755
IEEE Transactions on Wireless Communications	https://ieeexplore.ieee.org/xpl/RecentIssue.jsp?punumber=7693
IEEE Transactions on Industrial Informatics	https://ieeexplore.ieee.org/xpl/RecentIssue.jsp?punumber=9424
Elsevier Computer Networks (ComNet)	https://www.sciencedirect.com/journal/computer-networks
Elsevier Journal of Network and Computer Applications	https://www.sciencedirect.com/journal/journal-of-network-and-computer-applications/about/aims-and-scope
Elsevier Computer Communications	https://www.sciencedirect.com/journal/computer-communications
IEEE Transactions on Communications	https://ieeexplore.ieee.org/xpl/RecentIssue.jsp?punumber=26
IEEE Communications Magazine	https://ieeexplore.ieee.org/xpl/RecentIssue.jsp?punumber=35
IEEE/ACM Transactions on Networking	https://ieeexplore.ieee.org/xpl/RecentIssue.jsp?punumber=90
IEEE Journal on Selected Areas in Communications (JSAC)	https://ieeexplore.ieee.org/xpl/aboutJournal.jsp?punumber=49
IEEE Transactions on Big Data	https://ieeexplore.ieee.org/xpl/RecentIssue.jsp?punumber=6687317
Robotics and Automation	
International Journal of Automation and Control	https://www.inderscience.com/jhome.php?jcode=ijaac
IEEE Transactions on Automation Science and Engineering	https://ieeexplore.ieee.org/xpl/RecentIssue.jsp?punumber=8856
International Journal of Vehicle Autonomous Systems	https://www.inderscience.com/jhome.php?jcode=ijvas
Machine Perception	
International Journal of Computer Vision	https://www.springer.com/journal/11263
IEEE Trans. on Pattern Analysis and Machine Intelligence	https://ieeexplore.ieee.org/xpl/RecentIssue.jsp?punumber=34



Journals List

Title of journal/magazine	Website	Impact Factor	Open Access	Description (scope and topics)
Intelligent Transportation Systems				
IEEE Open Journal of Intelligent Transportation Systems	https://ieeexplore.ieee.org/xpl/RecentIssue.jsp?punumber=8784355	2,6	OA	The IEEE Open Journal of Intelligent Transportation Systems covers theoretical, experimental and operational aspects of electrical and electronics engineering and information technologies as applied to Intelligent Transportation Systems (ITS), defined as those systems utilizing synergistic technologies and systems engineering concepts to develop and improve transportation systems of all kinds.
IEEE Transactions on Intelligent Vehicles	https://ieeexplore.ieee.org/xpl/RecentIssue.jsp?punumber=7274857	8.2	OA	The IEEE Transactions on Intelligent Vehicles (T-IV) publishes peer-reviewed articles that provide innovative research concepts and application results, report significant theoretical findings and application case studies, and raise awareness of pressing research and application challenges in areas of intelligent vehicles in a roadway environment, and in particular in automated vehicles. The T-IV focuses on providing critical information to the intelligent vehicle community, serving as a dissemination vehicle for IEEE ITS Society members and the others to learn the state of the art development and progress on research and applications in the field of intelligent vehicles.
IEEE Transactions on Intelligent Transportation Systems	https://ieeexplore.ieee.org/xpl/RecentIssue.jsp?punumber=6979	8.5	OA	The IEEE Transactions on Intelligent Transportation Systems is concerned with the design, analysis, and control of information technology as it is applied to transportation systems. The Transactions is focused on the numerous technical aspects of ITS technologies spanned by the IEEE. Transportation systems are invariably complex, and their complexity arises from many sources. Transportation systems can involve humans, vehicles, shipments, information technology, and the physical infrastructure, all interacting in complex ways. Many aspects of transportation systems are uncertain, dynamic and nonlinear, and such systems may be highly sensitive to perturbations. Controls can involve multiple agents that (and/or who) are distributed and hierarchical. Humans who invariably play critical roles in a transportation system have a diversity of objectives and a wide range of skills and education. Transportation systems are usually large-scale in nature and are invariably geographically distributed.
IET Intelligent Transport Systems Journal	https://ietresearch.onlinelibrary.wiley.com/journal/17519578	2.5	OA	IET Intelligent Transport Systems is a Gold Open Access interdisciplinary journal devoted to research into the practical applications of intelligent transport systems and infrastructures.

Figure 18: Monitoring Tool, List of Journals

Annex 6: Events

Below are some indicative photos from selected events ENVELOPE participated in, included here to complement the references in section 4.2.2.1.

6.1 EuCNC2024

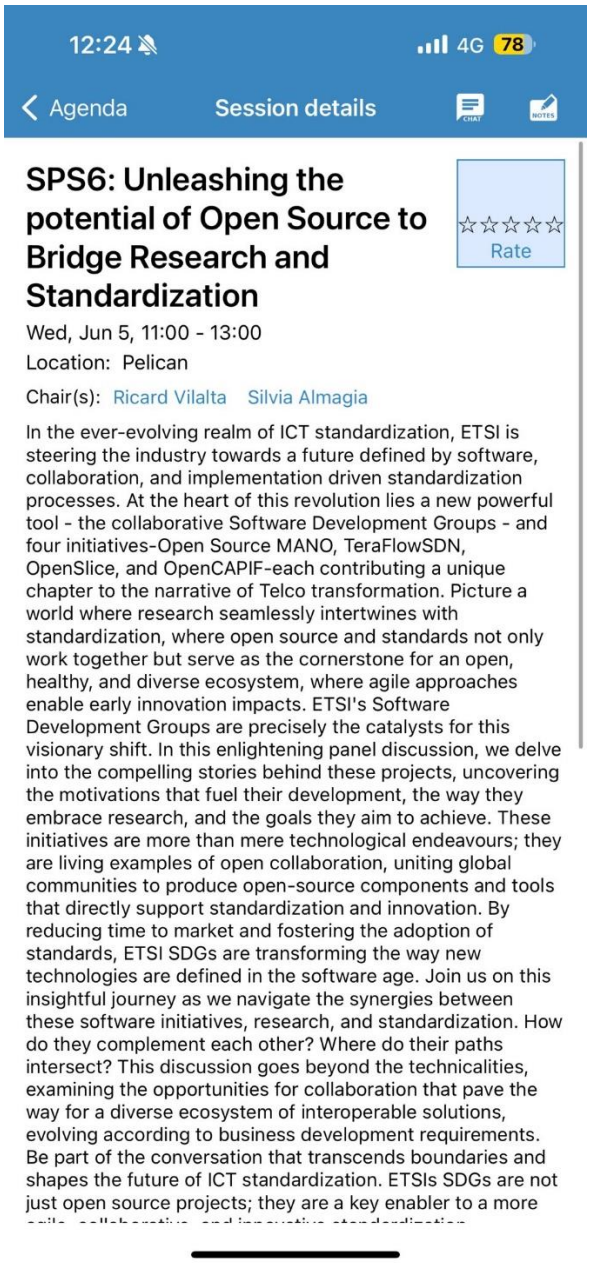


Figure 19 - EuCNC 2024 | Session Details

Figure 20 - Image from "Advancing and Opening Up the reference 5G-Advanced Architecture for automotive sector" presentation by Pavlos Basaras at EuCNC 2024

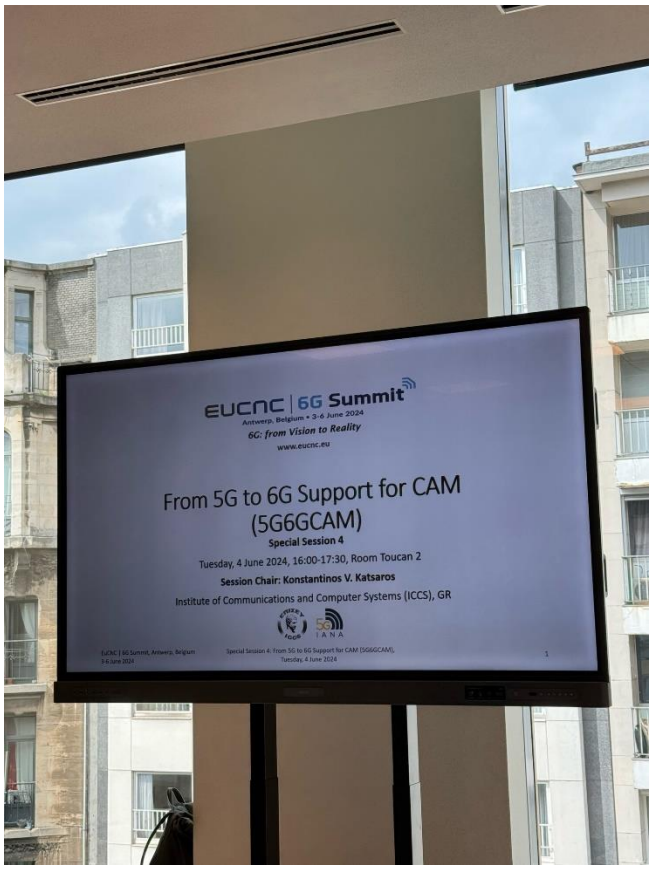


Figure 21 - Image from "From 5G to 6G Support for CAM" Presentation by Konstantinos Katsaros at EuCNC 2024

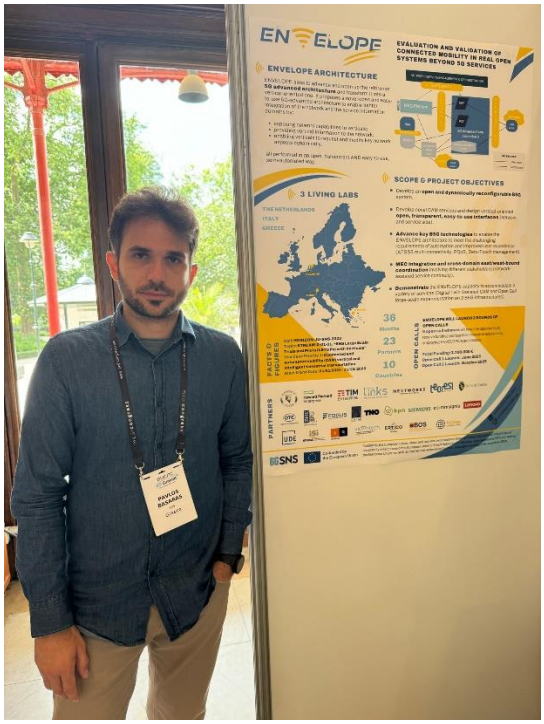
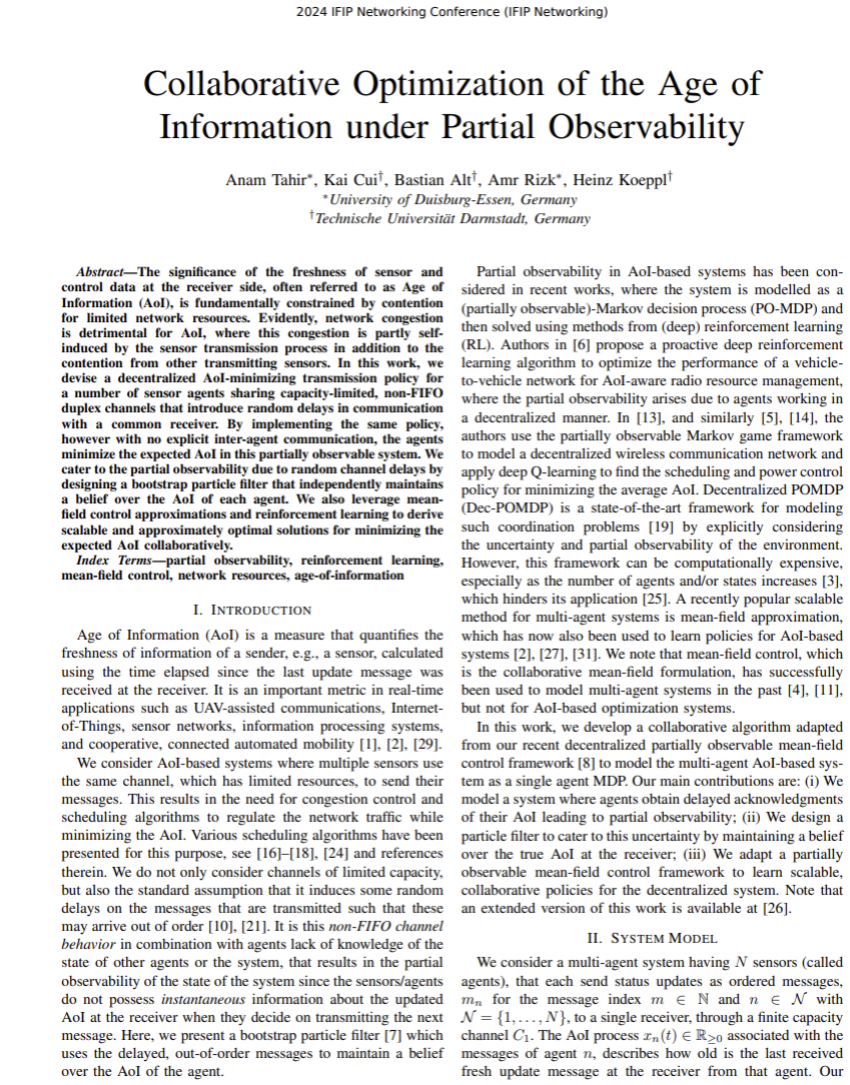


Figure 22 - Poster at EuCNC 2024

6.2 IFIP Networking 2024



2024 IFIP Networking Conference (IFIP Networking)

Collaborative Optimization of the Age of Information under Partial Observability

Anam Tahir*, Kai Cui†, Bastian Alt†, Amr Rizk*, Heinz Koeppl†
*University of Duisburg-Essen, Germany
†Technische Universität Darmstadt, Germany

***Abstract*—The significance of the freshness of sensor and control data at the receiver side, often referred to as Age of Information (AoI), is fundamentally constrained by contention for limited network resources. Evidently, network congestion is detrimental for AoI, where this congestion is partly self-induced by the sensor transmission process in addition to the contention from other transmitting sensors. In this work, we devise a decentralized AoI-minimizing transmission policy for a number of sensor agents sharing capacity-limited, non-FIFO duplex channels that introduce random delays in communication with a common receiver. By implementing the same policy, however with no explicit inter-agent communication, the agents minimize the expected AoI in this partially observable system. We cater to the partial observability due to random channel delays by designing a bootstrap particle filter that independently maintains a belief over the AoI of each agent. We also leverage mean-field control approximations and reinforcement learning to derive scalable and approximately optimal solutions for minimizing the expected AoI collaboratively.**

***Index Terms*—partial observability, reinforcement learning, mean-field control, network resources, age-of-information**

I. Introduction

Age of Information (AoI) is a measure that quantifies the freshness of information of a sender, e.g., a sensor, calculated using the time elapsed since the last update message was received at the receiver. It is an important metric in real-time applications such as UAV-assisted communications, Internet-of-Things, sensor networks, information processing systems, and cooperative, connected automated mobility [1], [2], [29].

We consider AoI-based systems where multiple sensors use the same channel, which has limited resources, to send their messages. This results in the need for congestion control and scheduling algorithms to regulate the network traffic while minimizing the AoI. Various scheduling algorithms have been presented for this purpose, see [16]–[18], [24] and references therein. We do not only consider channels of limited capacity, but also the standard assumption that it induces some random delays on the messages that are transmitted such that these may arrive out of order [10], [21]. It is this *non-FIFO channel behavior* in combination with agents lack of knowledge of the state of other agents or the system, that results in the partial observability of the state of the system since the sensors/agents do not possess *instantaneous* information about the updated AoI at the receiver when they decide on transmitting the next message. Here, we present a bootstrap particle filter [7] which uses the delayed, out-of-order messages to maintain a belief over the AoI of the agent.

Partial observability in AoI-based systems has been considered in recent works, where the system is modelled as a (partially observable)-Markov decision process (PO-MDP) and then solved using methods from (deep) reinforcement learning (RL). Authors in [6] propose a proactive deep reinforcement learning algorithm to optimize the performance of a vehicle-to-vehicle network for AoI-aware radio resource management, where the partial observability arises due to agents working in a decentralized manner. In [13], and similarly [5], [14], the authors use the partially observable Markov game framework to model a decentralized wireless communication network and apply deep Q-learning to find the scheduling and power control policy for minimizing the average AoI. Decentralized POMDP (Dec-POMDP) is a state-of-the-art framework for modeling such coordination problems [19] by explicitly considering the uncertainty and partial observability of the environment. However, this framework can be computationally expensive, especially as the number of agents and/or states increases [3], which hinders its application [25]. A recently popular scalable method for multi-agent systems is mean-field approximation, which has now also been used to learn policies for AoI-based systems [2], [27], [31]. We note that mean-field control, which is the collaborative mean-field formulation, has successfully been used to model multi-agent systems in the past [4], [11], but not for AoI-based optimization systems.

In this work, we develop a collaborative algorithm adapted from our recent decentralized partially observable mean-field control framework [8] to model the multi-agent AoI-based system as a single agent MDP. Our main contributions are: (i) We model a system where agents obtain delayed acknowledgments of their AoI leading to partial observability; (ii) We design a particle filter to cater to this uncertainty by maintaining a belief over the true AoI at the receiver; (iii) We adapt a partially observable mean-field control framework to learn scalable, collaborative policies for the decentralized system. Note that an extended version of this work is available at [26].

II. System Model

We consider a multi-agent system having N sensors (called agents), that each send status updates as ordered messages, m_n for the message index $m \in \mathbb{N}$ and $n \in \mathcal{N}$ with $\mathcal{N} = \{1, \dots, N\}$, to a single receiver, through a finite capacity channel C_1. The AoI process $x_n(t) \in \mathbb{R}_{\geq 0}$ associated with the messages of agent n, describes how old is the last received fresh update message at the receiver from that agent. Our

Figure 23 - Paper at IFIP Networking 2024

IFIP Networking | 03-06 June 2024

Collaborative Optimization of Age of Information under Partial Observability

Anam Tahir, Kai Cui, Bastian Alt, Amr Rizk, Heinz Koeppl

Affiliations: University of Duisburg-Essen, Germany; Technische Universität Darmstadt, Germany

PALUNO
The Ruhr Institute for Software Technology

Figure 24 - Presentation at IFIP Networking 2024

6.3 IEEE DT for CCAM

Application of digital twins for connected, cooperative and automated mobility

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***Abstract*—This paper investigates the use of digital twins (DT) in connected, cooperative automated mobility (CCAM). At first, it provides a basic introduction to digital twins and their significance in expanding automated driving systems, which are crucial to Connected, Cooperative, and Automated Mobility (CCAM). The paper outlines three distinct scenarios in which digital twins play a vital role: monitoring vehicles from a remote location, conducting mixed reality testing, and ensuring the safe control of autonomous vehicles during emergency maneuvers and stops. Furthermore, it describes the architecture of an experimental test environment specifically created to implement and validate these use-cases. The study finishes by discussing the software implementation and presenting preliminary test results that provide evidence for the proposed concepts and the built architecture.**

***Index Terms*—Autonomous vehicles, digital twins, connected, cooperative and automated mobility, distributed driver-in-the-loop environment, control over networks.**

I. Introduction

Autonomous vehicles have enormous potential for providing safer, more convenient, and more enjoyable commutes [1]. These advantages include reduced driver stress, enhanced productivity, improved fuel efficiency, decreased demand for parking at destinations, and better accessibility for individuals with disabilities [1]. However, despite these potential benefits, the technology still encounters significant challenges related to safety and reliability [2].

On the other hand, highly automated vehicles are rapidly progressing and are currently in use on European roads. With the arrival of each consecutive generation, these vehicles increase their computational capacities and integrate an increasing number of sensors. They collect significant amount of real-world data, which is crucial for further improving the development. However, building a system that can create and handle, process, analyze such a large amount of data is a difficult but essential challenge [3].

Co-funded by the European Union 6GSNS
HORIZON JU Innovation Actions - 101139048 - ENVELOPE - HORIZON-JU-SNS-2023. This project has received funding from the European Union's Smart Networks and Services Joint Undertaking (SNS JU) under grant

Connected, cooperative and automated mobility continues to benefit from the expanding deployment of 5G and the emergence of 6G. In the future, technologies and services will converge offering even higher levels of automation, which enables the realisation of CCAM services for shared multimodal transportation of people and goods [3].

The objective of this study is to explore relevant CCAM use-cases from the perspective of digital twins and emphasize the interoperability of services at application level. The considered use-cases rely on internet of things (IoT), deployed over 5G and 6G networks.

The current investigations intend to contribute to the advancement of remote monitoring and predictive maintenance, testing of automated driving systems using mixed reality testing as well as safe teleoperation of autonomous vehicles after emergency maneuvers. The conclusions and suggestions from this study have the potential to direct future research efforts, enhance CCAM services based on digital twins and IoT.

The structure of this paper is as follows: Section 2 presents the digital twin concepts and relevant prior research. Section 3 outlines the potential applications for autonomous vehicles and CCAM. In Section 4, we discuss the practical implementation of a distributed driver-in-the-loop test environment. Section 5 covers the vehicle model identification and validation. Section 6 details the experimental results of the distributed driver-in-the-loop test. Finally, Section 7 provides the conclusions and suggests directions for future research.

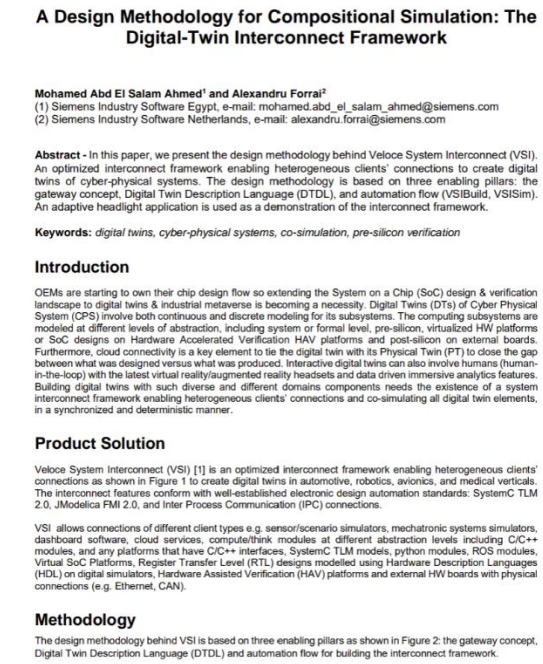
II. The Digital Twin concept

Digital twin (DT) is a relatively new concept in product design and manufacturing, having been around for less than 10 years. Hence, minimal research exists on how DT-driven design and manufacturing can improve product design and product quality. Moreover, much of the technology required to realize DT is still in the development, such as big data analytics and Internet of Things (IoT) communication [4].

In this section, a five-dimensional DT for a product is

Figure 25 - Paper at IEEE DT for CCAM 2024

6.4 23rd Driving Simulation Conference, DSC2024



A Design Methodology for Compositional Simulation: The Digital-Twin Interconnect Framework

Mohamed Abd El Salam Ahmed[1] and Alexandru Forrai[2]
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Abstract - In this paper, we present the design methodology behind Veloce System Interconnect (VSI). An optimized interconnect framework enabling heterogeneous clients' connections to create digital twins of cyber-physical systems. The design methodology is based on three enabling pillars: the gateway concept, Digital Twin Description Language (DTDL), and automation flow (VSIBuild, VSISim). An adaptive headlight application is used as a demonstration of the interconnect framework.

Keywords: *digital twins, cyber-physical systems, co-simulation, pre-silicon verification*

Introduction

OEMs are starting to own their chip design flow so extending the System on a Chip (SoC) design & verification landscape to digital twins & industrial metaverse is becoming a necessity. Digital Twins (DTs) of Cyber Physical System (CPS) involve both continuous and discrete modeling for its subsystems. The computing subsystems are modeled at different levels of abstraction, including system or formal level, pre-silicon, virtualized HW platforms or SoC designs on Hardware Accelerated Verification HAV platforms and post-silicon on external boards. Furthermore, cloud connectivity is a key element to tie the digital twin with its Physical Twin (PT) to close the gap between what was designed versus what was produced. Interactive digital twins can also involve humans (human-in-the-loop) with the latest virtual reality/augmented reality headsets and data driven immersive analytics features. Building digital twins with such diverse and different domains components needs the existence of a system interconnect framework enabling heterogeneous clients' connections and co-simulating all digital twin elements, in a synchronized and deterministic manner.

Product Solution

Veloce System Interconnect (VSI) [1] is an optimized interconnect framework enabling heterogeneous clients' connections as shown in Figure 1 to create digital twins in automotive, robotics, avionics, and medical verticals. The interconnect features conform with well-established electronic design automation standards: SystemC TLM 2.0, JModelica FMI 2.0, and Inter Process Communication (IPC) connections.

VSI allows connections of different client types e.g. sensor/scenario simulators, mechatronic systems simulators, dashboard software, cloud services, compute/think modules at different abstraction levels including C/C++ modules, and any platforms that have C/C++ interfaces, SystemC TLM models, python modules, ROS modules, Virtual SoC Platforms, Register Transfer Level (RTL) designs modelled using Hardware Description Languages (HDL) on digital simulators, Hardware Assisted Verification (HAV) platforms and external HW boards with physical connections (e.g. Ethernet, CAN).

Methodology

The design methodology behind VSI is based on three enabling pillars as shown in Figure 2: the gateway concept, Digital Twin Description Language (DTDL) and automation flow for building the interconnect framework.

Figure 26 - Paper at DSC2024

6.5 Simulation & Digital Twin Conference (Munich)

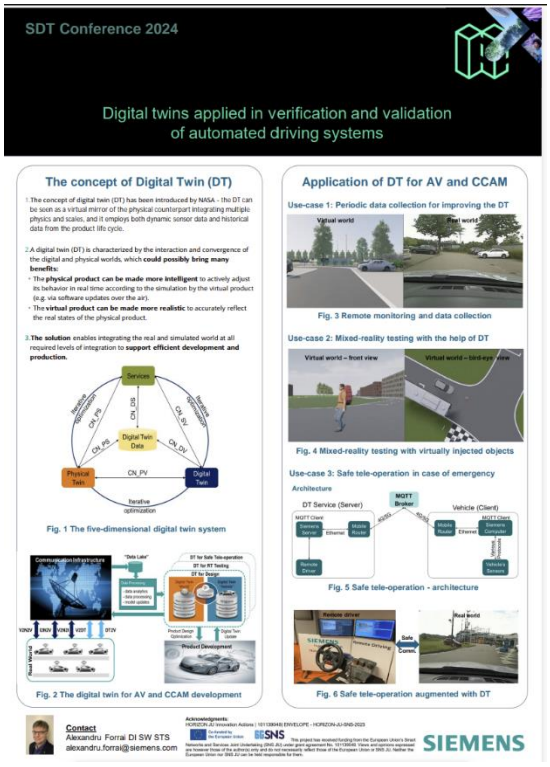

Figure 27 - Poster at Simulation & Digital Twin Conference (Munich)

6.6 SNS ICE / GUIDE: Automotive, Transport & Logistics Solutions Webinar

Figure 28 - Envelope Presentation at SNS ICE / GUIDE: Automotive, Transport & Logistics Solutions Webinar

6.7 5G-ROUTES: Workshop on 5G-CAM in terrestrial and maritime environments

Figure 29 - Envelope Presentation at 5G-ROUTES: Workshop on 5G-CAM in terrestrial and maritime environments