SUCCESS-6G: EXTEND – DEVISE - VERIFY

WP6 Deliverable E16

Final report on dissemination, standardization, and exploitation activities

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Executive Summary

The key research objectives underpinning SUCCESS-6G reside in the design of a robust, secure, and computationally efficient framework that builds on the extracted knowledge from vehicular streams to offer: i) real-time vehicle condition monitoring and fault provisioning, and ii) over-the-air vehicular software updates in an autonomous manner. In the context of SUCCESS-6G, various communication and dissemination activities have been accomplished, and the involved partners have devised their plans towards exploiting the project results through individual exploitation and standardization efforts.

This deliverable (E16) reports the dissemination, communication, and exploitation activities during the execution of the coordinated SUCCESS-6G project for the three subprojects: EXTEND, DEVISE, and VERIFY. In particular, this includes i) communication and dissemination activities, in terms of popular events, liaisons with other 6G-IA initiatives, scientific publications, etc.; ii) a standardization plan with targeted standardization bodies; and iii) an exploitation plan that includes the exploitation vision of the SUCCESS-6G partners.

The deliverable is structured in the following sections:

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1 Introduction

Dissemination activities have targeted the public disclosure of the SUCCESS-6G project outcomes, including the novel use cases, concept, architecture, algorithmic solutions, and the obtained results in proof-of-concepts, reflecting the achievable benefits. Within the SUCCESS-6G project organization, WP6 has been responsible for dissemination, standardization, and outreach activities for all three subprojects: EXTEND, DEVISE, and VERIFY.

The consortium defined a careful plan of activities to be performed, including a specific methodology outlined in E15. Furthermore, for each dissemination and communication action, the different types of target audience (i.e., industry verticals, manufacturers and service providers, network operators, Small and Medium-sized Enterprises (SMEs), open-source communities, Standards Development Organizations (SDOs), academia and research centres, and general public) were identified. The dissemination strategy was adapted to each partner's profile and role in the project. For example, it was expected that academic and research centres would be mainly in charge of driving publications in journals and conferences and would conduct courses and seminars. In turn, industrial partners were expected to disseminate the project among their internal and external channels and would drive the relationships towards external stakeholders.

As part of the methodology for managing communication and dissemination activities, SUCCESS-6G consortium has been monitoring and tracking dissemination activities using a shared Excel file in the project's Teams repository. The document provided an easy overview of activities and results, and it facilitated the process of organizing dissemination actions.

Moreover, following the open access practices of the SUCCESS-6G project, a GitHub repository was used and regularly updated with open-source contributions mainly related to the vehicular condition monitoring use case and proof-of-concept (https://github.com/5uperpalo/success6g-edge). Figure 1 illustrates the homepage of the repository.

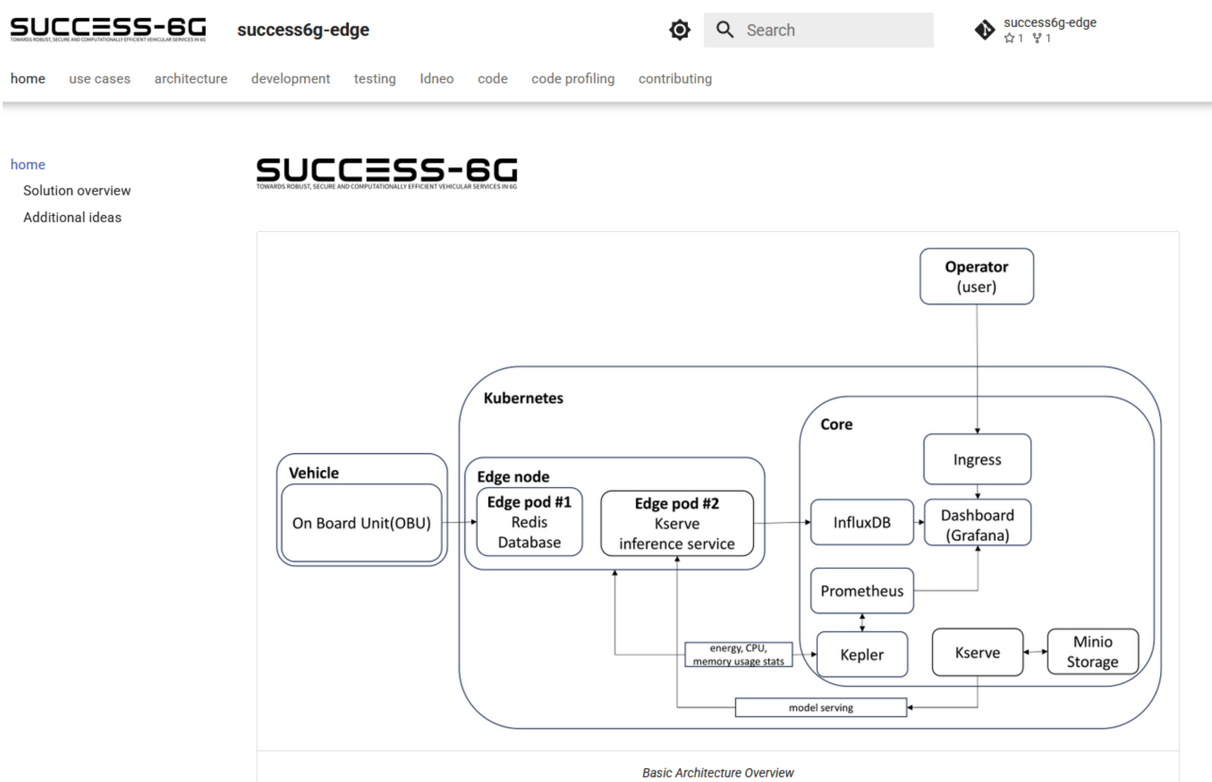


Figure 1: GitHub repository for SUCCESS-6G project

2 Communication and Dissemination Activities

2.1 Publications

SUCCESS-6G aimed at disseminating the achieved research and innovation results in top-ranked scientific journals and magazines, as well as in international conferences and workshops. Table 1 summarizes the accepted papers pertinent to SUCCESS-6G research activities, while Table 2 provides details about their relevance to the SUCCESS-6G project.

Table 1: List of accepted scientific papers

ID	Paper	SUCCESS-6G partners
Scientific Journals		
J1	R. Sedar, C. Kalalas, F. Vazquez-Gallego, L. Alonso, J. Alonso-Zarate, “A Comprehensive Survey of V2X Cybersecurity Mechanisms and Future Research Paths," in IEEE Open Journal of the Communications Society, vol. 4, pp. 325-391, January 2023, doi: 10.1109/OJCOMS.2023.3239115	CTTC
J2	J. Camargo, E. Coronado, W. Ramirez, D. Camps, S. Sanchez Deutsch, J. Perez-Romero, A. Antonopoulos, O. Trullols, S. Gonzalez-Diaz, B. Otura, G. Rigazzi, "Dynamic Slicing Reconfiguration for Virtualized 5G Networks Using ML Forecasting of Computing Capacity", Computer Networks, vol. 236, September 2023, doi: 10.1016/j.comnet.2023.110001	NBC
J3	R. Asensio-Garriga, P. Alemany, A. Molina Zarca, R. Sedar, C. Kalalas, J. Ortiz, R. Vilalta, R. Munoz, and A. Skarmeta, “ZSM-based E2E Security Slice Management for DDoS Attack Protection in MEC-enabled V2X Environments”, in IEEE Open Journal of Vehicular Technology, vol. 5, pp. 485-495, March 2024.	CTTC
J4	B. Ojaghi, M.M. Dehshibi, and A. Antonopoulos, "A supervised active learning method for identifying critical nodes in IoT networks“, the Journal of Supercomputing, Springer, April 2024.	NBC
J5	M. Dalgitsis, N. Cadenelli, M. A. Serrano, N. Bartzoudis, L. Alonso and A. Antonopoulos, "Cloud-Native Orchestration Framework for Network Slice Federation Across Administrative Domains in 5G/6G Mobile Networks," in IEEE Transactions on Vehicular Technology, vol. 73, no. 7, pp. 9306-9319, July 2024.	NBC
J6	B. J. D. Gort, G. M. Kibalya, M. A. Serrano and A. Antonopoulos, "Forecasting Trends in Cloud-Edge Computing: Unleashing the Power of Attention Mechanisms," in IEEE Communications Magazine, vol. 63, no. 1, pp. 108-114, January 2025	NBC
J7	R. Sedar, C. Kalalas, P. Dini, F. Vazquez-Gallego, J. Alonso-Zarate, L. Alonso, “Knowledge Transfer for Collaborative Misbehavior Detection in Untrusted Vehicular Environments”, IEEE Transactions on Vehicular Technology, vol. 74, no. 1, pp. 425-440, January 2025	CTTC
J8	D. Gutierrez-Rojas, C. Kalalas, I. Christou, G. Almeida, E. Eldeeb, S. Bakri, N. Marchetti, J. M. S. Sant’Ana, O. L. Alcaraz López, H. Alves, C. Papadias, M. Haroon Tariq, and P. Nardelli, “Detection and Classification of Anomalies in WSN-enabled Cyber-physical Systems," in IEEE Sensors Journal, vol. 25, no. 4, pp. 7193-7204, February 2025	CTTC

Conferences		
C1	A. Beattie, P. Mulinka, S. Sahoo, I. Christou, C. Kalalas, D. Gutierrez-Rojas, P. Nardelli, "A Robust and Explainable Data-Driven Anomaly Detection Approach For Power Electronics", in Proc. of IEEE International Conference on Smart Grid Communications 2022 (IEEE SmartGridComm '22), Singapore, October 2022.	CTTC
C2	Anton Aguilar-Rivera, Ricard Vilalta, Raúl Parada, Fermín Mira Perez, Francisco Vázquez-Gallego, "Evaluation of AI-based Smart-Sensor Deployment at the Extreme Edge of a Software-Defined Network", 2022 IEEE Conference on Network Function Virtualization and Software Defined Networks (NFV-SDN), Chandler, AZ, USA, November 2022	CTTC
C3	R. Sedar, C. Kalalas, P. Dini, J. Alonso-Zarate, F. Vazquez-Gallego, "Misbehavior Detection in Vehicular Networks: An Ensemble Learning Approach", in Proc. of IEEE Global Communications Conference 2022 (IEEE Globecom '22), Rio de Janeiro, Brazil, December 2022.	CTTC
C4	A. Pastore, S.H. Lim, C. Feng, B. Nazer, M. Gastpar, "Distributed Lossy Computation with Structured Codes: From Discrete to Continuous Sources", 2023 IEEE International Symposium on Information Theory (ISIT), Taipei, Taiwan, June 25-30, 2023, pp. 1681-1686.	CTTC
C5	C. Manso, R. Vilalta, L. Gifre, R. Casellas, R. Martínez, R. Muñoz, "Introducing End-to-End Location Awareness in Packet-Optical Networks", European Conference on Optical Communications, Glasgow (UK), 2023.	CTTC
C6	M. Dalgitsis, N. Cadenelli, M. A. Serrano, N. Bartzoudis, L. Alonso, A. Antonopoulos, "NSFaaS: Network Slice Federation as a Service in Cloud-native 5G and beyond Mobile Networks", IEEE NFV-SDN 2023, 7-9 November 2023, Dresden, Germany	NBC
C7	R. Sedar, C. Kalalas, F. Vazquez-Gallego, J. Alonso-Zarate, "Deep Reinforcement Learning-Based Adversarial Defense in Vehicular Communication Systems", IEEE International Conference on Communications (ICC) 2024, Denver, CO, USA, 9-13 June 2024.	CTTC
C8	L. Liatsas, G. Kibalya, A. Antonopoulos, "XAI-driven Model Design for Resource Utilization Forecasting in Cloud-native 6G Networks", IEEE MeditCom, Madrid, Spain, 8-11 July 2024.	NBC
C9	A. Abishek, R.Vilalta, Ll. Gifre, P.Alemany, C. Manso, R. Casellas, R.Martínez, R.Muñoz, "Network Extensions to Support Robust Secured and Efficient Connectivity Services for V2X Scenario", ICTON, 2024.	CTTC
C10	J. Gómez-Vilardebó, B. Hasırcıoğlu and D. Gündüz, "Generalized Multivariate Polynomial Codes for Distributed Matrix-Matrix Multiplication," 2024 IEEE Information Theory Workshop (ITW), Shenzhen, China, 2024, pp. 723-728, doi: 10.1109/ITW61385.2024.10807016	CTTC
C11	G. Kibalya et al., "Joint UPF and Application Placement in Multi-Slice Edge Networks: A Reinforcement Learning Strategy," 2025 IEEE Wireless Communications and Networking Conference (WCNC), Milan, Italy, pp. 1-6, March 2025.	NBC
C12	C. Kalalas, P. Mulinka, G. Candela Belmonte, M. Fornell, M. Dalgitsis, F. Paredes Vera, J. Santaella Sánchez, C. Vicente Villares, R. Sedar, E. Datsika, A. Antonopoulos, A. Fernández Ojea, M. Payaro, ``AI-Driven Vehicle Condition Monitoring with Cell-Aware Edge Service Migration," accepted in	CTTC, Optare, Idneo, NBC,

	the 2025 8th International Balkan Conference on Communications and Networking (BalkanCom '25), Piraeus, Greece, June 2025	Cellnex
C13	F. Famá, R. Pereira, C. Kalalas, P. Dini, L. Qendro, F. Kawsar, M. Malekzadeh, ``Contrastive Self-Supervised Learning at the Edge: An Energy Perspective," in Proc. of 2025 IEEE Annual Congress on Artificial Intelligence of Things (AIoT '25), Osaka, Japan, December 2025.	CTTC

2.1.1 Relevance to SUCCESS-6G

Table 2: Relevance of publications to SUCCESS-6G activities

ID	Relevance
J1	This paper surveys current literature on vehicle-to-everything (V2X) security and provides a systematic and comprehensive review of the most relevant security enhancements to date. An in-depth classification of V2X attacks is first performed according to key security and privacy requirements. Our methodology resumes with a taxonomy of security mechanisms based on their proactive/reactive defensive approach, which helps identify strengths and limitations of state-of-the-art countermeasures for V2X attacks. In addition, this paper delves into the potential of emerging security approaches leveraging artificial intelligence tools to meet security objectives. Promising data-driven solutions tailored to tackle security, privacy and trust issues are thoroughly discussed along with new threat vectors introduced inevitably by these enablers. The lessons learned from the detailed review of existing works are also compiled and highlighted. A structured synthesis of open challenges and future research directions is finally provided to foster contributions in this prominent field. This work is part of WP3 research activities.
J2	This paper introduces an ML model that can predict slices' traffic and dynamically reconfigure computational capacity. With these forecasting capabilities, the virtualized resources can be fine-tuned to suit the slices' requirements, guaranteeing their Quality of Service (QoS). By doing so, Mobile Network Operators can make optimized use of the equipment, tailoring their needs to each service while complying with the QoS level. The results obtained demonstrate that the proposed ML model, in combination with a specific set of hysteresis rules, can accurately predict the saturation of virtualized capacity with up to 91% accuracy and proactively adapt it to the network slice requirements. This work contributes to the data-driven approaches that is part of WP3 activities.
J3	Research on vehicle-to-everything (V2X) is attracting significant attention nowadays, driven by the recent advances in beyond-5G (B5G) networks and the multi-access edge computing (MEC) paradigm. However, the inherent heterogeneity of B5G combined with the security vulnerabilities of MEC infrastructure in dynamic V2X scenarios introduces unprecedented challenges. Efficient resource and security management in multi-domain V2X environments is vital, especially with the growing threat of distributed denial-of-service (DDoS) attacks against critical V2X services within MEC. Our approach employs the zero-touch network and service management (ZSM) standard, integrating autonomous security into end-to-end (E2E) slicing management. We consider an entire 5G network, including vehicular user equipment, radio access networks, MEC, and core components, in the presence of DDoS targeting V2X services. Our framework complies with security service-level agreements (SSLAs) and policies, autonomously deploying and interconnecting security sub-slices across domains. Security requirements are continuously monitored and, upon DDoS detection, our framework reacts with a coordinated E2E strategy. The strategy mitigates DDoS at the MEC and deploys countermeasures in neighboring domains. Performance assessment reveals effective DDoS detection and mitigation with low latency, aligned with the mission-critical nature of certain V2X services. This work is part of ETSI ZSM PoC "security SLA assurance in

	5G network slices”
J4	The energy efficiency of wireless sensor networks (WSNs) as a key feature of the Internet of Things (IoT) and fifth-generation (5G) mobile networks is determined by several key characteristics, such as hop count, user’s location, allocated power, and relay. Identifying important nodes, known as critical nodes, in IoT networks that involve a massive number of interconnected devices and sensors significantly affects these characteristics. However, it also requires a significant computational overhead and energy consumption. To address this issue, we introduce a novel supervised active learning method for identifying critical nodes in IoT networks aimed at enhancing the energy efficiency of WSNs in 5G environments. Our experimental results, designed to closely replicate varied and complex IoT network scenarios focusing on mission-critical multi-hop IoT applications, demonstrate the proposed method’s capability to improve adaptability and computational efficiency. These results suggest a strong potential for mission-critical applications in real-world large-scale multi-hop WSN environments in 5G, as well as massively distributed IoT.
J5	The recent advancements in cellular Vehicle-to-everything (C-V2X) and edge computing paradigms foster novel use cases for connected and automated vehicles that come with strict performance requirements. These guarantees can be provided by network slicing, which is currently enabled by the virtualization and cloudification of mobile networks, following the 5G/6G core service-based approach and the cloud-native Open Radio Access Network (O-RAN) principles. However, a significant challenge arises when considering the movement of end users: ensuring network slice continuity as they transition between different network operators. In this paper, we introduce a novel cloud-native orchestration framework for network slice federation that incorporates well-defined interfaces to exchange federated service and slice resource templates among operators. The proposed framework is fully compliant with i) standardized slice service models, and ii) GSMA efforts that are building the fundamental aspects for Edge Federation to allow the sharing of network resources across mobile operators. To validate our approach, we have designed and deployed a cloud-native federated 5G experimental platform. An extensive series of experiments have been carried out, revealing that the federation implementation directly influences federation time, and the operator's slice deployment strategy significantly impacts both infrastructure and end user performance.
J6	In the face of expanding digital landscapes, cloud-edge computing infrastructures struggle with an ever-increasing demand for real-time data management. This demand has a direct impact on the energy consumption of cloud-edge networks, which has spiked dramatically, stressing the need for accurate time-series forecasting. As conventional machine learning models encounter difficulties in predicting volatile workloads, attention mechanisms have emerged thanks to their capability of capturing long-range dependencies. This article pioneers the exploration of attention mechanisms for time-series forecasting in cloud-edge environments, particularly focusing on a promising low-complexity attention mechanism (i.e., informer model). Through comprehensive discussions and experimental validations, we demonstrate that informers significantly outperform traditional models in the prediction accuracy of compute workload forecasting. The outcome of this work not only highlights the importance of attention mechanisms in cloud-edge scenarios, but also paves the way for future optimizations, ultimately aiming at reducing the environmental impact of digital growth.
J7	Vehicular mobility underscores the need for collaborative misbehavior detection at the vehicular edge. However, locally trained misbehavior detection models are susceptible to adversarial attacks that aim to deliberately influence learning outcomes. In this paper, we introduce a deep reinforcement learning-based approach that employs transfer learning for collaborative misbehavior detection among roadside units (RSUs). In the presence of label-flipping and policy induction attacks, we perform selective knowledge transfer from trustworthy source RSUs to foster relevant expertise in misbehavior detection and avoid

	negative knowledge sharing from adversary-influenced RSUs. The performance of our proposed scheme is demonstrated with evaluations over a diverse set of misbehavior detection scenarios using an open-source dataset. Experimental results show that our approach significantly reduces the training time at the target RSU and achieves superior detection performance compared to the baseline scheme with tabula rasa learning. Enhanced robustness and generalizability can also be attained, by effectively detecting previously unseen and partially observable misbehavior attacks.
J8	Detection and classification of anomalies in industrial applications has long been a focus of interest in the research community. The integration of computational and physical systems has increased the complexity of interactions between processes, leading to vulnerabilities in both the physical and cyber layers. This work presents a model structure for anomaly detection in the Internet of Things (IoT)-enabled industrial cyber-physical systems (CPSs), enabled by wireless sensor networks (WSNs). The model comprises three primary data blocks in the cyber layer: sensor-based data acquisition, data fusion to convert raw data into useful information, and analytics for decision-making. The rationale behind these blocks highlights the critical role of anomaly detection and is demonstrated through three use cases, namely fault selection in power grids, anomaly detection in an industrial chemical process, and prediction of the CO2 level in a room. Furthermore, we integrate explainable AI (XAI) algorithms into an IoT-based system to enhance error detection and correction, while fostering user engagement by offering useful insights into the decision-making process. Our numerical results demonstrate high accuracy in anomaly detection across these scenarios, significantly improving system reliability and enabling timely interventions, which could ultimately reduce operational risks.
C1	Timely and accurate detection of anomalies in power electronics is becoming increasingly critical for maintaining complex production systems. Robust and explainable strategies help decrease system downtime and preempt or mitigate infrastructure cyberattacks. This work begins by explaining the types of uncertainty present in current datasets and machine learning algorithm outputs. Three techniques for combating these uncertainties are then introduced and analyzed. We further present two anomaly detection and classification approaches, namely the Matrix Profile algorithm and anomaly transformer, which are applied in the context of a power electronic converter dataset. Specifically, the Matrix Profile algorithm is shown to be well suited as a generalizable approach for detecting real-time anomalies in streaming time-series data. The STUMPY python library implementation of the iterative Matrix Profile is used for the creation of the detector. A series of custom filters is created and added to the detector to tune its sensitivity, recall, and detection accuracy. Our numerical results show that, with simple parameter tuning, the detector provides high accuracy and performance in a variety of fault scenarios.
C2	The introduction of AI-based smart-sensors on the network might suppose stringent requirements for the network edge, including the necessity to process real-time video feeds. Moreover, the introduction of vehicular communications allows the multiple location placement of necessary computational processes. To this end, we have proposed an AI-based smart sensor solution that is able to be deployed at the extreme edge of the network (i.e., on the vehicle). The architecture for the connected vehicle is presented and accuracy results are provided for the proposed smart-sensor.
C3	In this paper, we introduce a data-driven ensemble framework which jointly leverages clustering and reinforcement learning to detect misbehaviors in unlabeled vehicular data. A rigorous detection assessment using an open-source dataset reveals meaningful performance trends for various attacks. While the majority of attacks can be effectively detected, detection may be curtailed for certain misbehavior types due to partly inaccurate clustering and erratic activity of the attacker over time. Performance comparison against benchmark detectors reveals the robustness of our approach in the presence of potentially inconsistent or mislabeled training data. The real-time detection capabilities of our

	framework are also explored in an effort to evaluate its practical feasibility in mission-critical V2X scenarios. This work is part of WP3 research activities.
C4	This paper considers the problem of distributed lossy compression where the goal is to recover one or more linear combinations of the sources at the decoder, subject to distortion constraints. For certain configurations, it is known that codes with algebraic structure can outperform i.i.d. codebooks. For the special case of finite-alphabet sources, recent work has demonstrated how to incorporate joint typicality decoding alongside linear encoding and binning. This work takes a discretization approach to extend this rate region to include both integer- and real-valued sources. As a case study, the rate region is evaluated for the Gaussian case. The resulting joint-typicality-based rate region recovers and generalizes the best-known rate region for this scenario, based on lattice encoding and sequential decoding. This work is part of WP3 research activities.
C5	This paper delves into End-to-End packet-optical connectivity services, with a particular focus on their deployment across the edge-cloud continuum. Emphasizing the significance of location awareness, the authors propose a comprehensive framework that encompasses architecture, data models, and placement algorithms. These elements are specifically designed for the provisioning and dynamic updating of services within the ADRENALINE Testbed. The paper takes a practical approach by leveraging the ETSI TeraFlowSDN controller to implement and manage these services. The ADRENALINE Testbed serves as a real-world testing ground, providing valuable insights into the feasibility and efficiency of the proposed solutions. Furthermore, the work outlined in the paper is situated within the broader context of research activities under WP5.
C6	Network slicing has emerged as a revolutionary solution to fifth generation (5G) network design and operation. However, the inherent mobility of the end users introduces important new and unexplored challenges with regard to the network slice continuity across different administrative domains (i.e., networks controlled by different operators). In this paper, we introduce Network Slice Federation as a Service (NSFaaS), a novel cloud-native orchestration framework for network slice federation that incorporates well-defined interfaces to exchange federated service and slice resource templates among operators. The proposed framework is fully compliant with existing standards on network slicing and operator federations. In addition, we have designed and deployed a cloud-native federated 5G experimental platform to demonstrate the feasibility of the proposed framework and assess its performance in terms of "post-federation" slice creation. This work is part of WP3 research activities.
C7	One of the key concerns related to the pervasive integration of artificial intelligence and machine learning (AI/ML) models in vehicular-to-everything (V2X) communication systems pertains to adversarial attacks, which may lead trained models to exhibit undesirable behaviors. As security and user safety are tightly coupled in V2X, ensuring the resilience of AI/ML models against adversaries becomes indispensable. However, addressing adversarial attacks poses a challenging task, requiring appropriate countermeasures to elevate the trustworthiness of the targeted AI/ML models. In this paper, we propose a deep reinforcement learning (DRL)-based approach to defend against two data poisoning attacks, namely label-flipping and policy induction. Extensive evaluation with the aid of an open-source dataset demonstrates that our scheme outperforms benchmark classifiers, achieving significantly superior detection performance in the presence of label-flipping attacks. The effectiveness of our DRL-based approach is also showcased under different adversarial strategies in the policy induction attack.
C8	As cloud-native 6th Generation (6G) networks emerge, the resource utilization forecasting becomes crucial for effective service and network orchestration. While Artificial Intelligence (AI) holds promise in this domain, the diverse nature of the 6G underlying infrastructure and services poses significant challenges on the customization and the efficient design of the AI

	models. In this paper, we introduce the adoption of eXplainable AI (XAI) to generate spatio-temporal insights on the predictions of advanced AI models. Additionally, we present DuCAT, a Dual Cumulative Attribution Thresholding (DuCAT) heuristic algorithm, for feature and time window size selection towards AI model reduction. Experimental results on a publicly available dataset of cloud resource traces demonstrate that our proposed approach can efficiently reduce the AI model's complexity (up to 60% decrease in inference time) without compromising prediction accuracy, addressing critical requirements for agile and resource-efficient 6G networks.
C9	This paper introduces enhanced network control and management methods for Over-the-Air Vehicular Software Updates (OTA-VSUs), emphasizing robust connectivity, security assurance, and computational efficiency. Firstly, we present a robust Vehicle-to Everything (V2X) connectivity framework to guarantee prompt OTA-VSU delivery. Our novel Location-Aware Software-Defined Networking (SDN) Controller and Service Orchestrator allows network management and service delivery across contemporary data centers and communication networks. This advanced approach synergizes software-defined networking with intelligent service orchestration, fostering a highly adaptive and efficient networking ecosystem. The paper also details security enhancement strategies for OTA-VSUs. It encompasses the deployment of sophisticated security measures, proactive identification and mitigation of potential security threats, and the creation of virtual security functions. A key innovation is our Security as a Service component, which operationalizes security service level agreements into actionable, network specific rules. Finally, the paper advocates for the adoption of computationally efficient methodologies to expedite OTA-VSU data processing. This includes integrating Multi-Access Edge Computing (MEC) with European Telecommunications Standards Institute (ETSI) TeraFlowSDN (TFS) network control system. A novel feature is our MEC Bandwidth Management (BWM) service, crucial in managing bandwidth allocation and prioritization for MEC applications. This mechanism allows MEC applications to precisely define their bandwidth needs, ensuring seamless OTA-VSU update transmissions.
C10	Supporting multiple partial computations efficiently at each of the workers is a keystone in distributed coded computing in order to speed up computations and to fully exploit the resources of heterogeneous workers in terms of communication, storage, or computation capabilities. Multivariate polynomial coding schemes have recently been shown to deliver faster results for distributed matrix-matrix multiplication compared to conventional univariate polynomial coding schemes by supporting multiple partial coded computations at each worker at reduced communication costs. In this work, we extend multivariate coding schemes to also support arbitrary matrix partitions. Generalized matrix partitions have been proved useful to trade-off between computation speed and communication costs in distributed (uni-variate) coded computing. We first formulate the computation latency-communication trade-off in terms of the computation complexity and communication overheads required by coded computing approaches as compared to a single server uncoded computing system. Then, we propose two novel multivariate coded computing schemes supporting arbitrary matrix partitions. The proposed schemes are shown to improve the studied trade-off as compared to univariate schemes.
C11	The virtualization and softwarization of 5G/6G mobile networks have enabled the deployment and orchestration of cloud-native network and application functions. The deployment of these functions is crucial, as the placement of data plane elements (i.e., User Plane Function (UPF)) and vertical services can significantly impact the overall user latency. However, in multi-slice edge scenarios, characterized by users with distinct levels of criticality, the problem of UPF and application placement is becoming increasingly complex due to i) the various costs involved and ii) the limited computational resources at the edge. In this paper, the problem of joint UPF and application placement for a multi-slice user scenario is studied, taking into account multiple cost components that influence the

	placement decision, including service migration, traffic forwarding, server activation and processing costs. To tackle this problem, we introduce a Joint UPF and Application Reinforcement Learning-based (JUAP-RL) algorithm, which decides the UPF and application deployment location and coordinates the placement stages. Extensive experiments have shown that JUAP-RL demonstrates up to 17% gain in terms of user acceptance ratio and up to 23.4% reduction in provisioning cost compared to baseline schemes.
C12	Artificial intelligence (AI) has been increasingly applied to the condition monitoring of vehicular equipment, aiming to enhance maintenance strategies, reduce costs, and improve safety. Leveraging the edge computing paradigm, AI-based condition monitoring systems process vast streams of vehicular data to detect anomalies and optimize operational performance. In this work, we introduce a novel vehicle condition monitoring service that enables real-time diagnostics of a diverse set of anomalies while remaining practical for deployment in real-world edge environments. To address mobility challenges, we propose a closed-loop service orchestration framework where service migration across edge nodes is dynamically triggered by network-related metrics. Our approach has been implemented and tested in a real-world race circuit environment equipped with 5G network capabilities under diverse operational conditions. Experimental results demonstrate the effectiveness of our framework in ensuring low-latency AI inference and adaptive service placement, highlighting its potential for intelligent transportation and mobility applications.
C13	While contrastive learning (CL) shows considerable promise in self-supervised representation learning, its deployment on resource-constrained devices remains largely underexplored. The substantial computational demands required for training conventional CL frameworks pose a set of challenges, particularly in terms of energy consumption, data availability, and memory usage. We conduct an evaluation of four widely used CL frameworks: SimCLR, MoCo, SimSiam, and Barlow Twins. We focus on the practical feasibility of these CL frameworks for edge and fog deployment, and introduce a systematic benchmarking strategy that includes energy profiling and reduced training data conditions. Our findings reveal that SimCLR, contrary to its perceived computational cost, demonstrates the lowest energy consumption across various data regimes. Finally, we also extend our analysis by evaluating lightweight neural architectures when paired with CL frameworks. Our study aims to provide insights into the resource implications of deploying CL in edge/fog environments with limited processing capabilities and opens several research directions for its future optimization.

2.2 Events

2.2.1 EuCNC´23

Miquel Payaró (CTTC), PI of SUCCESS-6G project, participated as an invited speaker at the EuCNC'23 workshop "The Role of AI in Edge 6G topologies" (more info can be found in the following link: https://www.eucnc.eu/programme/workshops/workshop-2/). The goal of this workshop was to discuss the close synergy between Artificial Intelligence (AI) and edge computing, as two key enabling technologies shaping 6G, and identify the roadmap for more holistic, sustainable, and future-proof design of AI- and edge-enabled solutions. Miquel (Figure 2) provided the talk "*Experimental validation of edge-hosted AI/ML approaches in B5G/6G networks"* where, among other activities, he presented a summary of the SUCCESS-6G project, highlighting the relevance of edge computing in the two vehicular use cases developed in the project.

Figure 2 CTTC presence at EuCNC 2023

2.2.2 Mobile World Congress

The GSMA Mobile World Congress is the world's largest exhibition for the mobile industry, incorporating a thought-leadership conference that features prominent executives representing mobile operators, device manufacturers, technology providers, vendors, and content owners from across the world. SUCCESS-6G has been present in the 2023, 2024, and 2025 editions.

2.2.2.1 MWC 2023

SUCCESS-6G project was presented by Nearby Computing during the Mobile World Congress 2023 in Barcelona (Figure 3). Mobile World Congress 2023 attracted more than 88.000 attendees from more than 200 countries. More than 50% of the attendees were from sectors adjacent to the mobile ecosystem, something that boosted the interest attraction in the NBC stand. More specifically, more than 2.000 people visited our booth, expressing interest either from a technical point of view or a management perspective to get ideas on the impact that SUCCESS-6G solutions could have in their companies/projects.

Figure 3 SUCCESS-6G presented by Nearby Computing at MWC 2023

2.2.2.2 MWC 2024

Mobile World Congress 2024 closes with more than 101.000 attendees from 205 countries and territories, exploring industry topics including AI, the usage gap, GSMA Open Gateway, and the investment gap. Over 59% of attendees representing industries adjacent to the core mobile ecosystem aligned with the experimental research activities of the SUCCESS-6G project. The project has been presented by Cellnex Telecom and Nearby Computing in their booths.

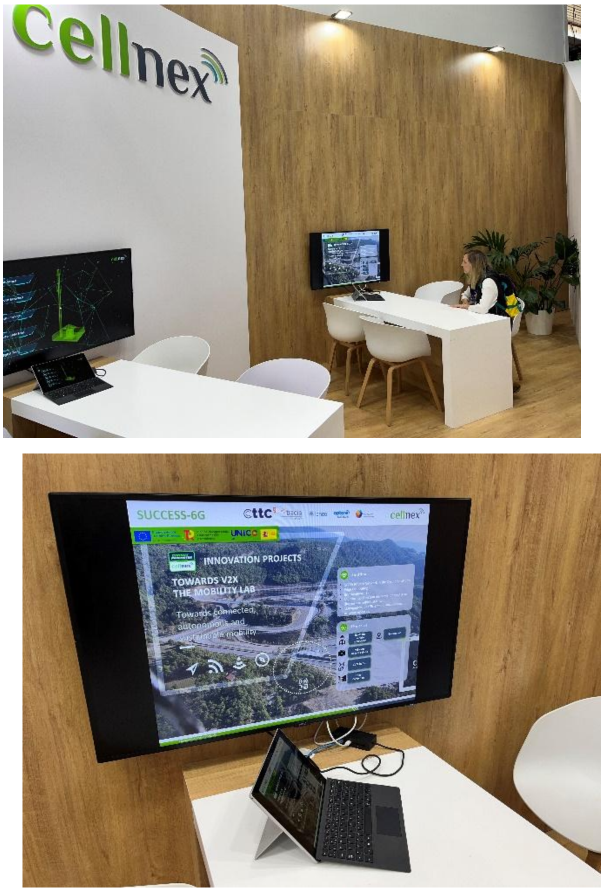


Figure 4: SUCCESS-6G project showcased at the Cellnex Telecom booth at MWC 2024

2.2.2.3 MWC 2025

Mobile World Congress 2025 welcomed 109.000 attendees from 205 countries and territories for a week of AI, innovation, and industry-defining debate. Over 56% of attendees represented industries adjacent to the core mobile ecosystem, which is the scope of the SUCCESS-6G project. The project has been presented by Cellnex Telecom and Nearby Computing in their booths.

For Cellnex, Mobile World Congress 2025 was a unique platform for showcasing innovations and engaging in pivotal discussions about the future of mobile technology. Over 600 visits have been registered in the Cellnex stand.

Figure 5: SUCCESS-6G project showcased at the Nearby Computing booth at MWC 2025

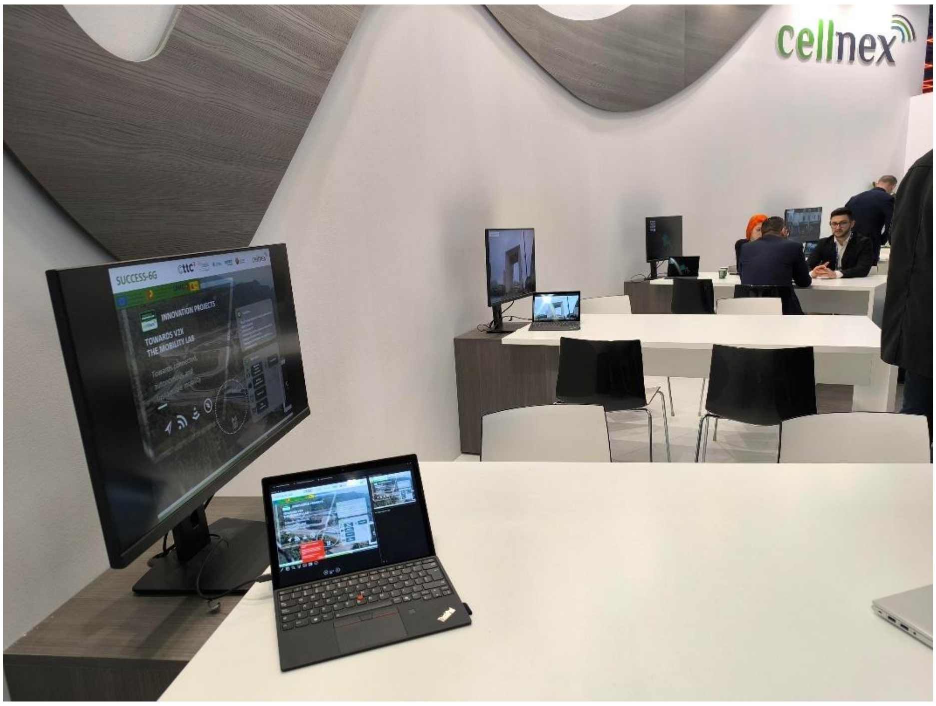


Figure 6: SUCCESS-6G project showcased at the Cellnex Telecom booth at MWC 2025

2.2.3 IEEE ICMLCN 2025

SUCCESS-6G project was also showcased in the booth of Nearby Computing during the IEEE International Conference on Machine Learning for Communication and Networking (IEEE ICMLCN), held between 26-29 May, 2025, in Barcelona.


NearbyOne
Transforming
innovative ideas
to tangible benefits
unity-6G
VERGE
CloudSkin
ETHOR
CLOUD STARS
ELIXIRION
FREE6G
6GOASIS
ADV 5G TWN
3D AROMA
UNICO

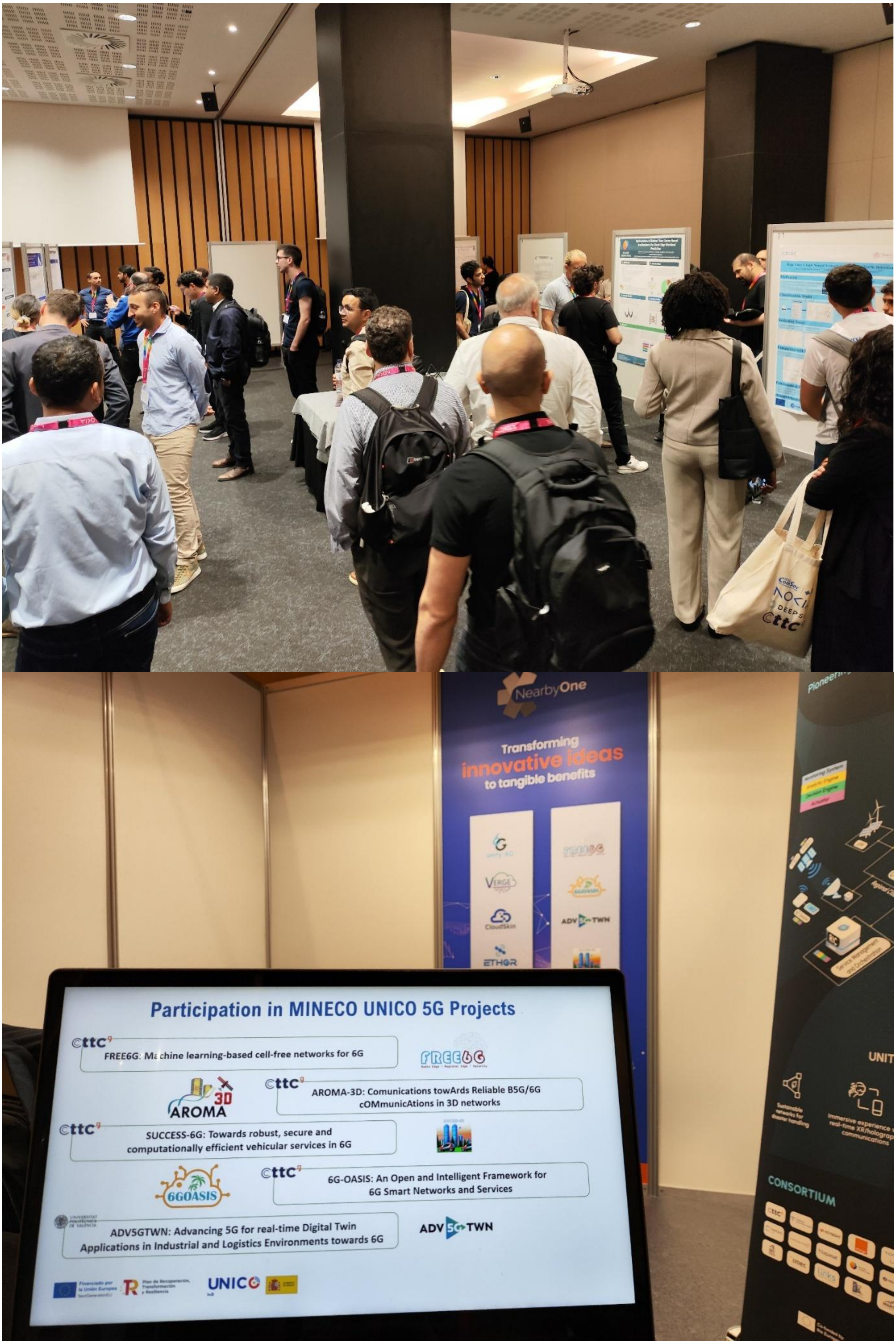


Figure 7: SUCCESS-6G project showcased at the Nearby Computing booth at ICMLCN 2025

2.3 Liaisons with 6G-IA/SNS JU and other initiatives

This section includes other research projects and initiatives that SUCCESS-6G partners participated during the project lifetime and provides a connection between these activities and the SUCCESS-6G project.

2.3.1 5GMED

The 5GMED project, with a global investment of 16 M euros of which 75% is financed by the European Commission, aims to bring a sustainable 5G deployment model for future mobility in the Mediterranean Cross-Border Corridor. Through 4 pilot tests in the railway and highway between Figueres and Perpignan, 5GMed will demonstrate advanced cross-border trials of 5G application scenarios in Cooperative Connected and Automated Mobility (CCAM) and Future Railway Mobile Communications System services (FRMCS). The services to be tested will rely on a broad range of technologies beyond 5G, including on-board sensors and Artificial Intelligence (AI), providing advanced connectivity services in a scalable and replicable manner across transport paths. The infrastructure will support a remote driving use case, advanced traffic management, applications, and business service continuity in railway, and follow-me infotainment both in highway and railway scenarios. The use case demonstrations will be carried out in three small-scale testing facilities in order to replicate real conditions. Based on the outcomes of the tests, a final integration and validation will be carried out in the cross-border section between Figueres and Perpignan. A strategic section in the Trans-European Transport Network since it sustains 55% of the road traffic between the Iberian Peninsula and the rest of Europe and 65% of the rail traffic.

Relevance to SUCCESS-6G: Network and service orchestration are key concepts in the 5GMED project. In addition, the small-scale tests have been conducted in the Castelloli circuit, an environment that was leveraged in the SUCCESS-6G project.

2.3.2 CRETA

CRETA is a project selected by the UNICO-5G Sectorial program that will demonstrate the synergy of three different technologies: 5G (communications sector), remote measurement technology for traffic emissions (transport-mobility sector), and advanced analytics and artificial intelligence (digitization sector), for the optimal management of traffic mobility in three strategic areas (Barcelona, Madrid, and País Vasco) through three demonstrations:

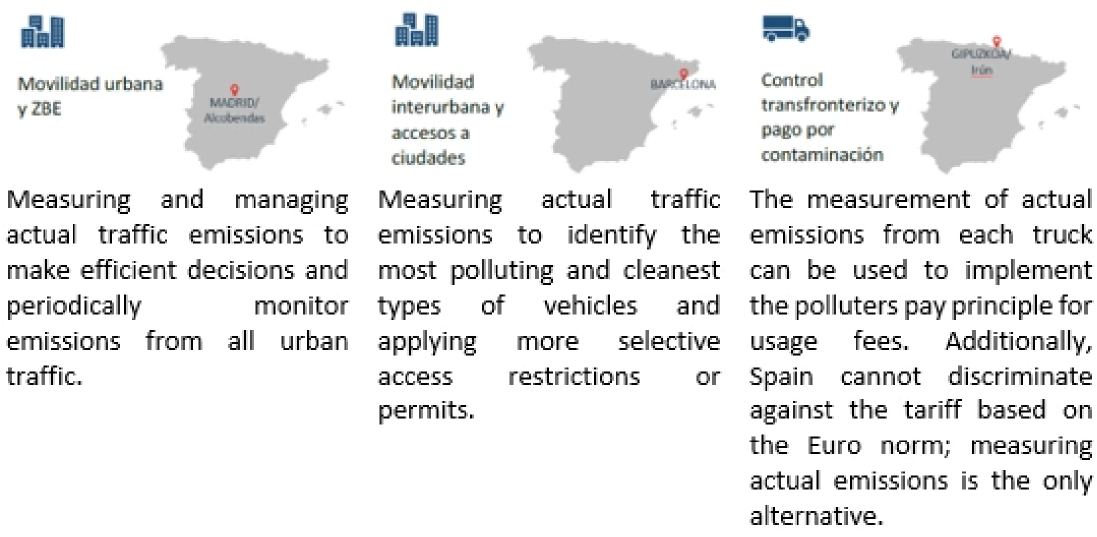


Figure 8 Demonstrations in CRETA project

The project is led by a major telecommunications company, Grupo Masmóvil (MSM), with significant participation from its subsidiary, Euskaltel. The rest of the consortium consists of 3 large companies (Indra, Abertis Autopistas, and Cellnex) and 4 SMEs (Opus RSE, Abertis Mobility, Syltec, and Vinces Consulting). Challenges: Validating the synergy between 5G and C-V2X and testing use cases for providing advanced traffic services. Solution: A scalable 5G and C-V2X architecture enabled for AI, supporting mobility services focused on pollution reduction; designing a dynamic tariff system based on the detection of individual vehicle emissions levels.

Relevance to SUCCESS-6G: In the CRETA project, innovative use cases based on V2V, V2I, V2X communications are involved, which use both modes of C-V2X: PC5 and cellular Uu (5G). This pilot makes the learning and experience obtained can be replicated in similar projects such as SUCCESS-6G.

2.3.3 CLOUDSKIN

CloudSkin aims to design a cognitive cloud continuum platform to fully exploit the available Cloud-edge heterogeneous resources, finding the “sweet spot” between the cloud and the edge, and smartly adapting to changes in application behavior via AI. To facilitate automatic deployment, mobility and security of services, CloudSkin will build an innovative universal container-like execution abstraction based on WebAssembly that allows the seamless and trustworthy execution of (legacy) applications across the Cloud-edge continuum.

The goals of CloudSkin are the following:

- Smart management for the Cloud-edge continuum: The overall objective is to leverage the generated knowledge from state-of-the-art AI methods to transparently orchestrate Cloud-edge resources. The key goal is to build a “Learning Plane” that, in cooperation with the application execution framework and continuum infrastructure, can enhance the overall orchestration of Cloud-edge resources. Such plane is the materialization of the cognitive cloud, where decisions on the cloud and the edge are driven by the continuously obtained knowledge and awareness of the computing environment through AI, and particularly, neural networks and statistical learning, taking the challenge of enabling these methods into low-power edge devices.
- Virtual execution for the Cloud-edge continuum: This goal focuses on a new universal and flexible execution abstraction, we called it “Cloud-edge cells”, that will enable the execution of legacy and highly granular applications in the cloud continuum. The new container-like execution abstraction will be based on the WebAssembly technology. It will enable the execution of the same computation on a wide range of cloud and embedded devices and make task execution migratable across different servers and devices in the continuum infrastructure. We will integrate our WebAssembly executor with Kubernetes. More specifically, we will contribute new features to Kubernetes that will support the efficient migration of WebAssembly containers between different levels of the continuum, exploiting WebAssembly’s capability for state serialization.
- Infrastructure support for the Cloud-edge continuum: This objective is to prepare the infrastructure to turn it into a virtual resource continuum, where the large set of Cloud-edge cells composing applications can be allocated flexible resources, according to their dynamically changing needs. One of the major challenges here is to design an infrastructure to support extremely short-lived Cloud-edge cells and tasks (of 1 to 10ms, or less) and extremely intense bursts with fast data access requirements. This requires delivering bare metal resource performance to storage, despite virtualization and dynamic reallocation, which today is not possible in the cloud continuum. CLOUDSKIN will achieve this by leveraging high-performance I/O (RDMA networking) and near-storage CPU compute capacity (GPUs, FPGAs) to the fine-grained application tasks.

Relevance to SUCCESS-6G: Orchestration of automotive-related applications is one of the main use cases in Cloudskin. The Castelloli environment (provided by Cellnex) and the NearbyOne orchestrator (provided by Nearby Computing) are key elements in this use case, and the developments in Cloudskin were leveraged in the proof-of-concept of use case 1 in the SUCCESS-6G project.

2.3.4 PODIUM

PoDIUM will address the realistic needs of advanced CCAM (Connected, Cooperative and Automated Mobility) services with the goal of shaping the Physical Digital Infrastructure (PDI) landscape by relying on 5G connectivity. The CCAM initiative is designed to support EU countries and the European automotive industry in their transition to connected and automated driving, while ensuring the best mobility environment for the public. CCAM focuses on moving people and goods along our road networks in a safe, quick, cost-effective, comfortable, and environmentally friendly manner using automated vehicles, leveraging Mobility-as-a-Service (MaaS) platforms.

The PoDIUM consortium will use and enhance three key European facilities called Living Labs (LL) in the following countries:

- Germany – city of Ulm
- Italy – city of Turin and highway tunnel (A22/Brenner cross-border)
- Spain – city of Barcelona and Spain-France cross-border highway

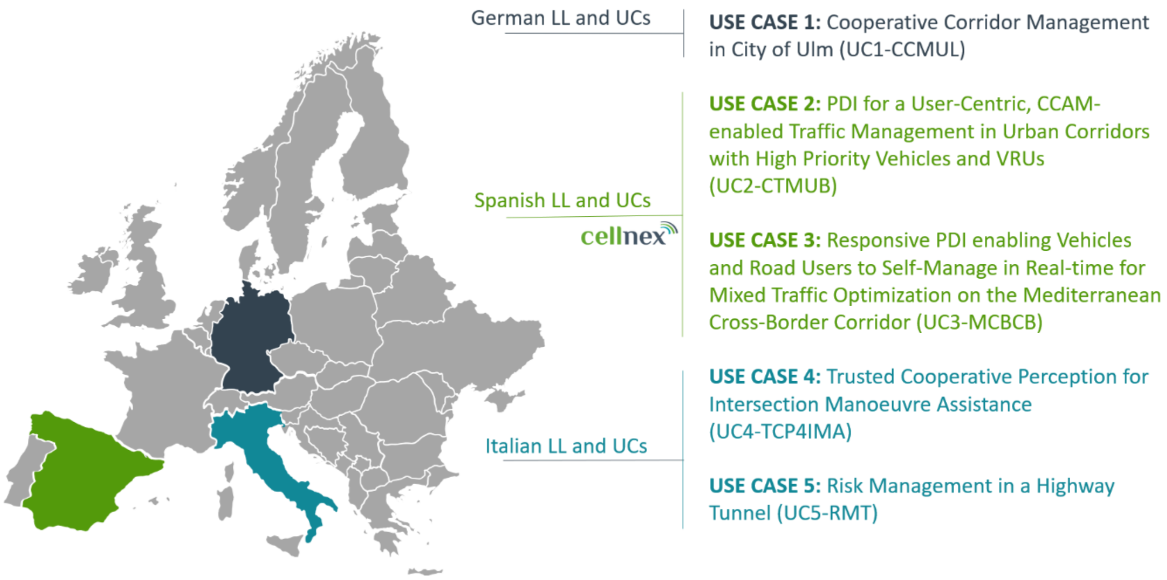


Figure 9 PODIUM use cases

Relevance to SUCCESS-6G: The Spanish LL, which supports use cases based on 5G and Mobility (e.g., Traffic Optimization), serves as a mirror guide for the development of use cases and infrastructure in the Castelloli environment, which was used in the SUCCESS-6G project.

2.3.5 ECOMOBILITY

EcoMobility will support European industry and cities in transitioning from isolated and static transportation means towards a service-centric, connected mobility ecosystem by sharing data and services across involved stakeholders. The project will enable and simplify cooperative development, deployment, operation, and life cycle management of connected adaptive end-to-end mobility solutions in a sustainable manner.

EcoMobility will establish devops practices within the supply chain with continuous and customized cloud-based addition and improvement of mobility services support contract-based runtime coupling of mobility services within edge/cloud-based service for deployment of AI solutions, coupled with monitoring, analysis and coordination of vehicles, transportation infrastructures and people deliver reliable & enhanced vision, perception, including HD maps, and localization systems for safe, connected, and automated vehicles deliver customized and improved fail-operational ADAS systems reflecting technology capabilities of heterogeneous vehicles and protecting vulnerable road users provide energy-aware control and scheduling of electric vehicles including smart Battery Management Systems (BMS) and coordination with other transportation means contribute to increased public acceptance of electrified autonomous vehicles and bridge gaps between technological advancements and legal and regulatory frameworks. The demonstrators within EcoMobility will showcase the project's findings and capabilities for the end-to-end sustainable mobility ecosystem with impact on improved trust, safety, security, efficiency, and ecology of mobility solutions to a level appropriate for mass-market deployment. Emerging innovations will leverage the expertise of world-renowned industrial and research partners within the mobility value chain, giving Europe a competitive edge in a growing market with direct contributions to the European goal of zero road fatalities by 2050.

Relevance to SUCCESS-6G: ECOMOBILITY developed the OBU that was used, with some adaptations, in the SUCCESS-6G project. This OBU had been the basic piece to provide real vehicle data needed for SUCCESS-6G use cases.

2.3.6 VERGE

VERGE is a research and innovation project under the European Smart Networks and Services Joint Undertaking (SNS JU), a Public-Private Partnership that aims to facilitate and develop industrial leadership in Europe in 5G and 6G networks and services. The main goal of VERGE is to provide an integrated approach on how to tackle the challenges of edge computing evolution, described around three main pillars:

1. "Edge for AI", namely a flexible, modular, and converged edge platform design, unifying the lifecycle management and closed-loop automation for cloud-native applications, Multi-access Edge Computing (MEC), and network services across the edge-cloud compute continuum for ultra-high computational performance.
2. "AI for Edge", namely, an AI-powered portfolio of solutions leveraging the multitude of collected metrics for intelligent management and orchestration.
3. "Security, privacy and trustworthiness of AI-based models at the edge", providing a suite of methods to protect AI models against adversarial attacks, increase their explainability and reliability, and ensure data privacy.

Relevance to SUCCESS-6G: VERGE designed a cloud-native edge platform that was adopted in SUCCESS-6G. In particular, this cloud-native nature was instrumental for the automated orchestration employed for the SUCCESS-6G use case 1.

2.4 Participation in white papers

The outcomes and insights obtained during the validation of use case 1 of the SUCCESS-6G project are expected to be reported to the **White Paper on Large-Scale Trials and Pilots**, organized by the SNS Trials Working Group. In particular, the document will include the technical achievements, use cases, and lessons learned across the SUCCESS-6G project, showcasing the value and impact of our work towards 5G evolution and 6G. The release of the White Paper is planned for the EuCNC & 6G Summit 2026.

2.5 Social media

The social media mechanisms together with some other dissemination actions (e.g., newsletters, white papers) provide a sufficiently broad number of channels to reach all type of stakeholders. During the project lifetime, use of social media was envisaged for communicating project results, building potential user communities, evaluating ideas and seeking feedback.

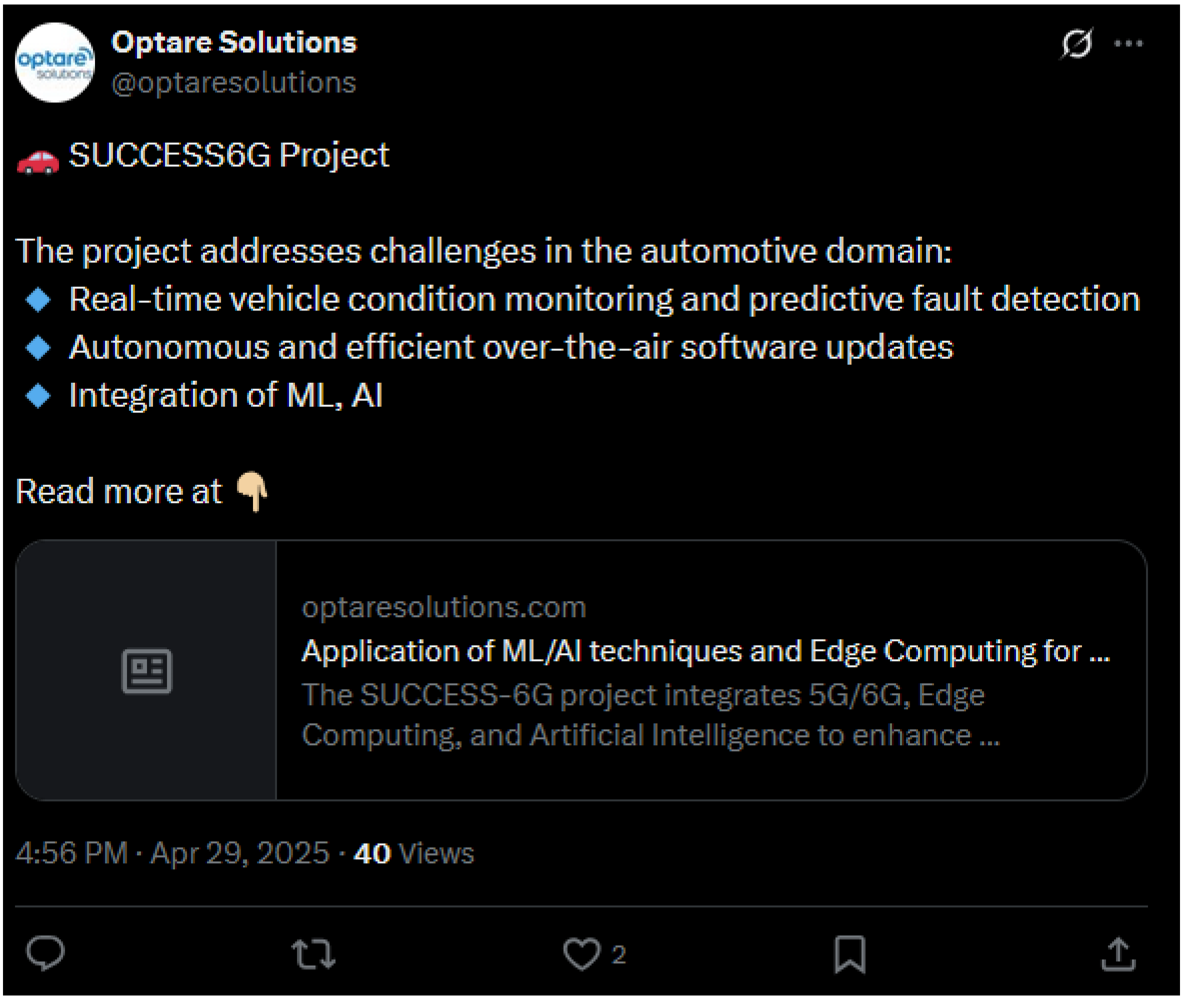


Figure 10: Optare's post on X

optare solutions

Insights / Articles /

Application of ML/AI techniques and Edge Computing for Sustainable Mobility: Perspectives from SUCCESS-6G Project

16 April, 2025
Projects

Several key technological advancements in the ability to transmit, process and analyse vast amounts of vehicular data are deeply transforming and opening new possibilities within the domain of autonomous and connected vehicles.

5G and emerging 6G networks enable vast data acquisition and scalable and flexible system deployments, allowing for connectivity and vehicle operations to function effectively. Artificial intelligence (AI) has been increasingly applied to the condition monitoring of vehicular equipment, aiming to improve safety, reduce costs, and optimize maintenance strategies. MEC (Mobile Edge Computing) enables faster processing and local decision-making by keeping data close to its source.

SUCCESS-6G project, led by CTTC and with the collaboration of several industry partners, takes on the challenge of integrating these technologies to facilitate the identification of vehicular anomalies and optimize operations through two use cases: i) real-time vehicle condition monitoring and fault provisioning and; ii) over-the-air vehicular software updates.

Figure 11: Optare's blog

Optare Solutions
5,509 followers
5mo •

+ Follow

🚚 #SUCCESS6G | Intelligent and Secure Mobility

Led by Centre Tecnològic de Telecomunicacions de Catalunya (CTTC) and supported by a strong network of partners, the project addresses key challenges in the automotive domain, including:

🔹 Real-time vehicle condition monitoring and predictive fault detection
🔹 Autonomous and efficient over-the-air software updates
🔹 Integration of ML, AI, V2X communication, and Mobile Edge Computing in B5G/6G environments

Proud to be part of #SUCCESS6G, a research project focused on developing smart, robust and efficient services for connected vehicles in next-generation networks.

🔗 Read more about our key takeaways in the article: https://lnkd.in/dErmEmuU

This project was carried out under the UNICO-5G I+D program, promoted by the Ministerio para la Transformación Digital y de la Función Pública within Spain's Recovery and Resilience Plan #NextGenerationEU.

#SUCCESS6G #ConnectedVehicles #6G #Innovation #Communication #Continuous

Figure 12: Optare's post on LinkedIn

Javier Santaella Sánchez • 1st
Innovation & Product Strategy | Engineer - Project Manager at Cellnex | 5...
7mo •

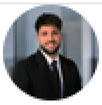
Productive day at the Circuit Parcmotor Castelloli - Barcelona in Castelloli. Cellnex Telecom, along with our colleagues from Centre Tecnològic de Telecomunicacions de Catalunya (CTTC), IDNEO, Nearby Computing and Optare Solutions, conducted the second tests of the Mobility use case for the #SUCCESS6G.

Project based on monitoring of system elements for predictive diagnosis of vehicle status and management of efficient and autonomous software updates using the 5G SA Private Network in the Circuit ParcMotor and EDGE/CLOUD infrastructure provided by Cellnex Telecom.

The details of the project will be shown at our Cellnex booth at the MWC25. 📢

Let's continue progressing! 🚀

Figure 13: Cellnex LinkedIn post on use case 1 demo



Javier Santaella Sánchez • 1st
Innovation & Product Strategy | Engineer - Project Manager at Cellnex | 5...
7mo •

Last day of testing in Circuit Parcmotor Castelloli - Barcelona for the #SUCCESS6G project. And as the project's name suggests, it has been a complete SUCCESS! 👌

Today, we successfully migrated critical edge services from one node to another dynamically. How did we do it? Let me explain: 👀 👀 👀

The vehicle shown in the video is equipped with a 5G OBU, which connects to the 5G SA network in Castelloli deployed by Cellnex Telecom. This 5G SA network consists of two nodes (sites), each with a 5G radio node providing coverage to half of the area. Each of the two nodes has an EDGE running critical services. When the vehicle is connected to the first node, the orchestrator detects it and deploys the critical services on the edge of that node. As the vehicle moves towards the other node, the 5G attach switches to the next node (RAN HANDOVER). This trigger is detected by the orchestrator, which migrates the services to the second node automatically, transparently, and quickly. The results have been outstanding, with critical service migration times of less than 4 seconds! 🌠

This is an important step, but not the last! What if, in addition to dynamically migrating critical services, we also migrated the network services themselves? And what if we complemented it with AI to do it autonomously? We can say that we are getting closer to the future of 6G! 💡

Thanks to Centre Tecnològic de Telecomunicacions de Catalunya (CTTC), Nearby Computing, IDNEO, and Optare Solutions for all the collaboration, and a special mention to Druid Software and Sunwave Communications for their support in optimizing the 5G network.

A chapter closes at Cellnex for Carmen Vicente and me, but not the book. Let's go! 🔥

Figure 14: Cellnex LinkedIn post on final demo activities for use case 1

2.6 Logo and visual identity

At the start of the project, the consortium created a logo to make all visual communication and dissemination easily recognizable. The consistent use of the SUCCESS-6G project logo (Figure 15) had been the major factor contributing to the project's visual identity. The logo was available in the Teams repository of SUCCESS-6G for anyone in the project to use. It was also consistently embedded in templates for deliverables, presentation slides, and more.

Figure 15 SUCCESS-6G logo

Additionally, the UNICO-5G logo was included in all the SUCCESS-6G communication channels, deliverables, presentation slides, leaflets, posters, etc., as an identifier that easily allowed the target audience to relate SUCCESS-6G to the specific call (Figure 16).

Figure 16 UNICO logo

2.7 Website

The project website https://success-6g-project.cttc.es/ was launched at the start of the project and it has been the principal means for disseminating and communicating the activities of the project. It compiles information about SUCCESS-6G public deliverables, as well as information related to dissemination activities and results. As shown in Figure 17, the project website provides dedicated pages for the reporting of scientific publications with acknowledgement to the SUCCESS-6G project, and for news items which are relevant to outreach activities and promote the digital visibility of the project. The website was regularly updated over the lifetime of the project. Finally, Google Analytics was used to monitor and measure relevant metrics (e.g., number of users, sessions, page views, and average session duration) that indicate the traffic of the website to understand if the content provided was well-received by visitors.

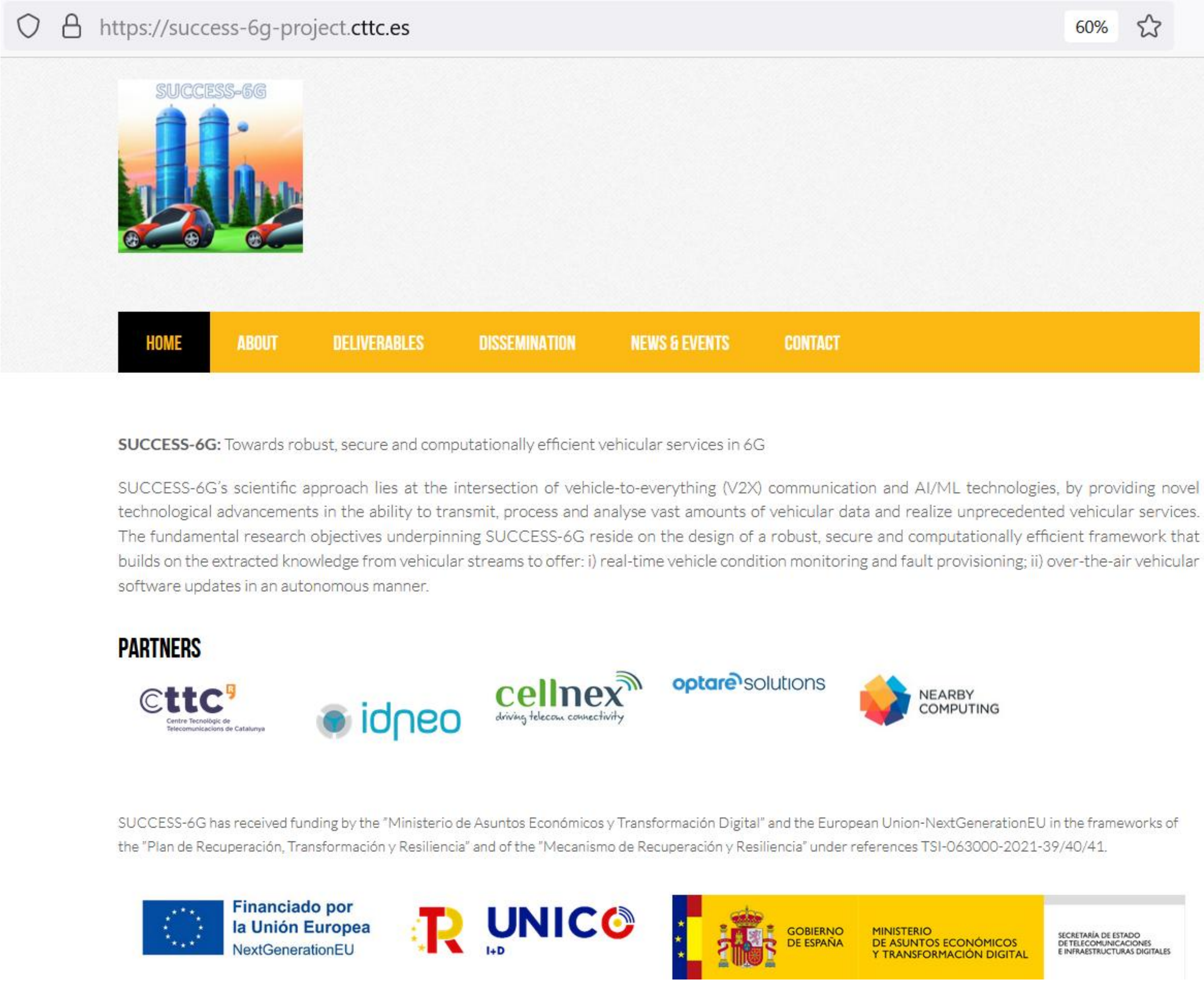


Figure 17 SUCCESS-6G project website

3 Standardisation plan

3.1 Standards-related strategy

The standardization activities carried out in SUCCESS-6G were based on the following principles:

- Focus on the most relevant target organizations, bodies, and professional societies where SUCCESS-6G could contribute with the project's key innovations.
- Constantly evaluate the applicable standardization bodies to identify new opportunities, reconsider, and pivot efforts towards those most suitable to increase the impact of SUCCESS-6G results.
- Update and promote the tracking file in TEAMS, to assess progress, coordinate activity, raise awareness of new standardization opportunities, and increase commitment and participation among consortium partners.
- Combine the impact of standardization with the participation of partners in open-source software communities. Besides, create a parallel "fast track" in the standardization processes through "de facto" adoption through these open-source projects with high impact, some of them promoted by the standardization organizations themselves.

In particular, as an automotive component manufacturer, Idneo must adhere to specific standards within the automotive sector. These standards are nearly mandatory for any product embedded within a vehicle. The capabilities regarding the services provided by Idneo are as follows:

- Functional safety. ISO 26262 Road vehicles
- SW development. AUTOSAR 4.x, SPICE level 3, Cybersecurity ISO/SAE 21434
- HW development. AEC-Q200 grade in components, Cybersecurity ISO/SAE 21434
- Testing and compliance. EN ISO/IEC 17025 accredited testing laboratories by ENAC

3.2 Targeted standardisation bodies and standards-related organisations

3.2.1 6G-IA

Website: 6g-ia.eu

The 6G Smart Networks and Services Industry Association (6G-IA) is the voice of European Industry and Research for next-generation networks and services. Its primary objective is to contribute to Europe's leadership on 5G, 5G evolution, and SNS/6G research. The 6G-IA represents the private side in both the 5G Public Private Partnership (5G-PPP) and the Smart Networks and Services Joint Undertaking (SNS JU). In the 5G-PPP and SNS JU, the European Commission represents the public side. The 6G-IA brings together a global industry community of telecoms & digital actors, such as operators, manufacturers, research institutes, universities, verticals, SMEs, and ICT associations. The 6G-IA carries out a wide range of activities in strategic areas, including standardization, frequency spectrum, R&D projects, technology skills, collaboration with key vertical industry sectors, notably for the development of trials, and international cooperation.

3.2.2 EIT Urban Mobility

Website: www.eiturbanmobility.eu

EIT Urban Mobility is an initiative of the European Institute of Innovation and Technology (EIT). Since January 2019 we have been working to encourage positive changes in the way people move around cities in order to make them more liveable places. We aim to become the largest European initiative transforming urban mobility. Co-funding of up to € 400 million (2020-2026) from the EIT, a body of the European Union, will help make this happen.

3.2.3 3GPP

Website: www.3gpp.org

The 3rd Generation Partnership Project (3GPP) unites seven telecommunications standard development organizations (ARIB, ATIS, CCSA, ETSI, TSDSI, TTA, TTC), known as "Organizational Partners" providing their members with a stable environment to produce the Reports and Specifications that define 3GPP technologies. 3GPP specifications cover cellular telecommunications technologies, including radio access, core network and service capabilities, which provide a complete system description for mobile telecommunications. The 3GPP specifications also provide hooks for non-radio access to the core network, and for interworking with non-3GPP networks. The 5G and LTE-Advanced ecosystem will allow for global network evolution, at the appropriate pace for the market need and the local state of readiness. The 3GPP model is one that maximises on its compatibility with legacy 3GPP infrastructure and equipment, delivering the promise of a ubiquitous end-to-end ecosystem that can support a growing number of use cases.

3.2.4 Car2Car

Website: www.car-2-car.org

The CAR 2 CAR Communication Consortium (C2C-CC) aims at assisting towards accident-free traffic (vision zero) at the earliest possible date. It further aims at supporting the highest safety level at improved traffic efficiency anywhere, anytime at the lowest cost to the end user and the environment. While working on solutions supporting all driving levels from manual to fully automated it considers specific needs of stakeholders, types of vehicles and users. The C2C-CC contributes to the development and specification of robust and reliable solutions that allow for a continuous and seamless evolution of required functionalities. It enables technologies driven by innovation and competition, thereby fostering concepts of cooperation between the road users and with the road infrastructure. This is based on sharing information, awareness, perception, and intentions while focusing on tactical level and considering strategic and planning level as required.

3.2.5 CCAM

Website: www.ccam.eu

Stablished in 2021, the international not-for-profit organisation CCAM Association represents the private side of the CCAM Partnership, regrouping more than 180 innovation stakeholders involved in the connected, cooperative, and automated mobility field. CCAM brings all the relevant stakeholders from divers sectors such as industry, research, services, public and local authorities, associations, SMEs, the CCAM Association aims to accelerate the development of new technologies and their deployment in real life with all that implicate.

4 Exploitation plan

4.1 Cellnex

Cellnex deploys, facilitates, and manages the CELLNEX Mobility Lab, located at the Circuit Parcmotor Castellolí near Barcelona (Spain). It is a pioneering and innovative test space for the development of technological solutions for Intelligent Transport Systems (ITS) and computing infrastructure associated with 5G networks, sustainable mobility, and autonomous vehicles. The circuit has been equipped with Edge Computing technologies and a private 5G wireless network that covers the Mobility Lab, enabling an experimental space to test and validate innovative mobility services. Thanks to the SUCCESS-6G project and use cases, Cellnex was able to update the technology and facilities in the CELLNEX Mobility Lab, and test different ICT infrastructure and network configurations to be able to replicate them in other locations or improve and optimise technological solutions in future opportunities or new use cases.

4.2 Idneo

Idneo develops, validates, and manufactures a comprehensive range of Telematic Control Units, from ultra-compact, low-cost units for small mobility products, to high-end 5G connectivity units with a complete set of hardware and software features for automotive customers, as well as On-board services in our TCUs, like eCall, location remote OBU programming, and vehicle diagnostics and control. With the development of SUCCESS-6G, we will be able to implement many features within our VMAX platform that were previously undeveloped. For instance, this includes establishing communication with the vehicle's CAN bus and deploying a specific 5G SA modem variant for North America, incorporating C-V2X capabilities. This will help us expand the scope of demonstrators to include other clients outside of Europe.

4.3 Optare Solutions

Optare Solutions has been working for over 5 years on projects related to the field of digital service infrastructures, specifically focusing on 5G Edge Computing and Artificial Intelligence technologies. Throughout this time, the 5G proposal has matured, acting as a catalyst for other technologies. The combination of these technologies facilitates the creation of architectures that serve as enablers for different digital services. Use cases present on this project involve a combination of communication and computing optimizations to create solutions that address challenges associated with V2X security. Optare Solutions will exploit the achievements obtained in the development of this project to ensure software loads securely, as it is vital to prevent inappropriate behaviors, and to validate that the information received from the car sensors is appropriate and free from erroneous information. It is important to consider that in the near future, autonomous and connected vehicles will be a reality and susceptible to malicious programming. This could pose a serious problem due to the large number of vehicles in the automotive fleet.

4.4 NBC

NBC is active in the area of end-to-end (E2E) network and service orchestration, focusing on the challenges at the Edge. NBC will provide their NearbyOne platform, which carries intra- and inter-domain orchestration capabilities and addresses the problem of NFV and application orchestration in the cloud continuum. NBC will exploit the achievements of the project to improve their flagship product in a multifaceted manner: i) the AI models developed in the project are expected to enhance the orchestration capabilities and place NearbyOne in an advantageous position in the market of zero-touch service and network management; 2) The project-specific use cases will open new directions and foster new collaborations and partnerships with vertical stakeholders (e.g., automotive); and 3) the upgrade of the product is expected to facilitate the participation of the company in future research projects on Cloud-Edge/6G networks, where zero-touch principles will be inherent by design. To that end, progress and results of this project will be shared with the development team and discussed with interested stakeholders and potential customers in innovation venues.

4.5 CTTC

The exploitation plan of CTTC is threefold since the project coordination of SUCCESS-6G and the active participation in its research activities i) generated knowledge and expertise in the intersection of AI/ML and V2X communication areas, strengthening the national and international reputation of CTTC as a key reference institution within the field of data-driven V2X connectivity; ii) strengthened the visibility of CTTC as a key player in devising robust, resilient, and sustainable solutions for AI/ML-based vehicular systems, thus facilitating further collaboration in future research programs involving relevant challenges; and iii) strengthened the collaboration with leading National and European industry players, thus maximizing the technology transfer generated by CTTC. One of the main objectives of CTTC was to build bridges between academia and industry, promoting a new economy based on knowledge and technology. The participation of CTTC in SUCCESS-6G, acting as project coordinator, established connections with big industrial players in Spain and Europe, within the V2X and edge computing areas, as well as in other sectors with similar research objectives.

5 Conclusion and Outlook

This deliverable (E16) completes the previous one (E15), reporting the dissemination, communication, and exploitation activities done during the time of the coordinated SUCCESS-6G project for the three subprojects: EXTEND, DEVISE, and VERIFY. In this final report, we have listed i) communication and dissemination activities, in terms of popular events, liaisons with other 6G-IA initiatives, scientific publications, etc.; ii) a standardization plan with targeted standardization bodies; and iii) an exploitation plan that includes the exploitation vision of the SUCCESS-6G partners.