TRANSPARENT APPLICATION DEPLOYMENT IN A SECURE, ACCELERATED AND COGNITIVE CLOUD CONTINUUM

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23.05.22	Aristotelis Kretsis	Draft	0.1	Update website description, social media accounts, project factsheet and presentation
01.06.22	Panagiotis Kokkinos	Draft	0.2	Add promotional video and newsletters
15.06.22	Aristotelis Kretsis	Draft	0.3	Editing and minor fixes
27.06.22	Aristotelis Kretsis	Revision	0.4	Integrate review changes and address review comments, final enhancements
30.06.22	ICCS	Final	1.0	

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Abstract: The deliverable contains the description of the intermediate version of the project dissemination material activities. The SERRANO project website (https://ict-serrano.eu) was launched in February 2021 and populated with relevant information about the SERRANO project. Moreover, the project established additional dissemination channels like social media accounts and dissemination materials, e.g., project fact-sheet, presentations, a promotional video, and newsletters to help the dissemination of the SERRANO project.

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Abbreviations

BPaaS	Business Processes as a Service
CDSSaaS	Cognitive Distributed Secure Storage as a Service
D	Deliverable
EC	European Commission
ESAaaS	Extreme Scale Analytics as a Service
HPC	High-Performance Computing
IaaS	Infrastructure as a Service
ICCS	Institute of Communication and Computer Systems
PaaS	Platform as a Service
SaaS	Software as a Service

1 Executive Summary

This deliverable provides the intermediate version of the SERRANO project dissemination materials created for advertising the project outcomes and advances. The website (https://ict-serrano.eu) constitutes the primary online tool for disseminating all relevant outcomes of the project. Moreover, the website will present additional general information, news, and events regarding the SERRANO project.

The website went online on February 2021 according to the proposed timeline schedule. There are seven main pages, namely: “Home”, “Consortium”, “Vision”, “Objectives”, “Work Packages”, “Use Cases”, “Public Deliverables”, “Publications”, “Communication Material”, “News” and “Contact”. The website has been designed in such way that it is easy for every user to find all the necessary information effectively and accurately.

In addition to the website, the project established other dissemination channels like social media pages to enhance the project visibility and advertise the project outcomes. Complementary, we have created dedicated communication materials, e.g., a factsheet to summarize the main takeaway of the project concept, a project presentation to be used by all the partners for presenting the SERRANO project in a unified manner, a promotional video, and newsletters to keep the potential SERRANO subscribers up to date with the project advances.

2 Introduction

2.1 Purpose of this document

The objective of this deliverable is to present the SERRANO dissemination material that has been produced to advertise the SERRANO project. The package includes the website and the social media accounts used by SERRANO partners for project dissemination and communication activities. Moreover, the document contains the factsheet of the SERRANO project along with a high-level presentation of the project, a promotional video, and four newsletters.

2.2 Document structure

The present deliverable contains the following chapters:

- Executive Summary
- Introduction
- SERRANO Website
- Social Media Accounts
- Promotional Video
- Newsletters
- Updated Factsheet
- Updated Project Presentation

2.3 Audience

This document is public.

3 SERRANO Website

The SERRANO website has been created and already hosts all the basic information regarding the project and its partners; it can be reached at this address: https://ict-serrano.eu.

The site is updated regularly by the site administrator (ICCS) by uploading public documents, news and publications, in order to maximize dissemination of the achieved results and increase project awareness.

The SERRANO website follows a neat design that provides a modern feel and ease of access for its various pages. The key features include:

- an attractive, user-friendly and professional design;
- easy access to the key project information (objectives, work packages and use cases);
- a comprehensive presentation of the project consortium, by using links to each partner's webpage;
- links to the project's social media pages;
- news and events pages to keep users up to date with the latest project developments;
- "Communication Material" to present useful information regarding the project;
- contact information;
- ability to update the website's content.

The structure of the SERRANO website is the following:

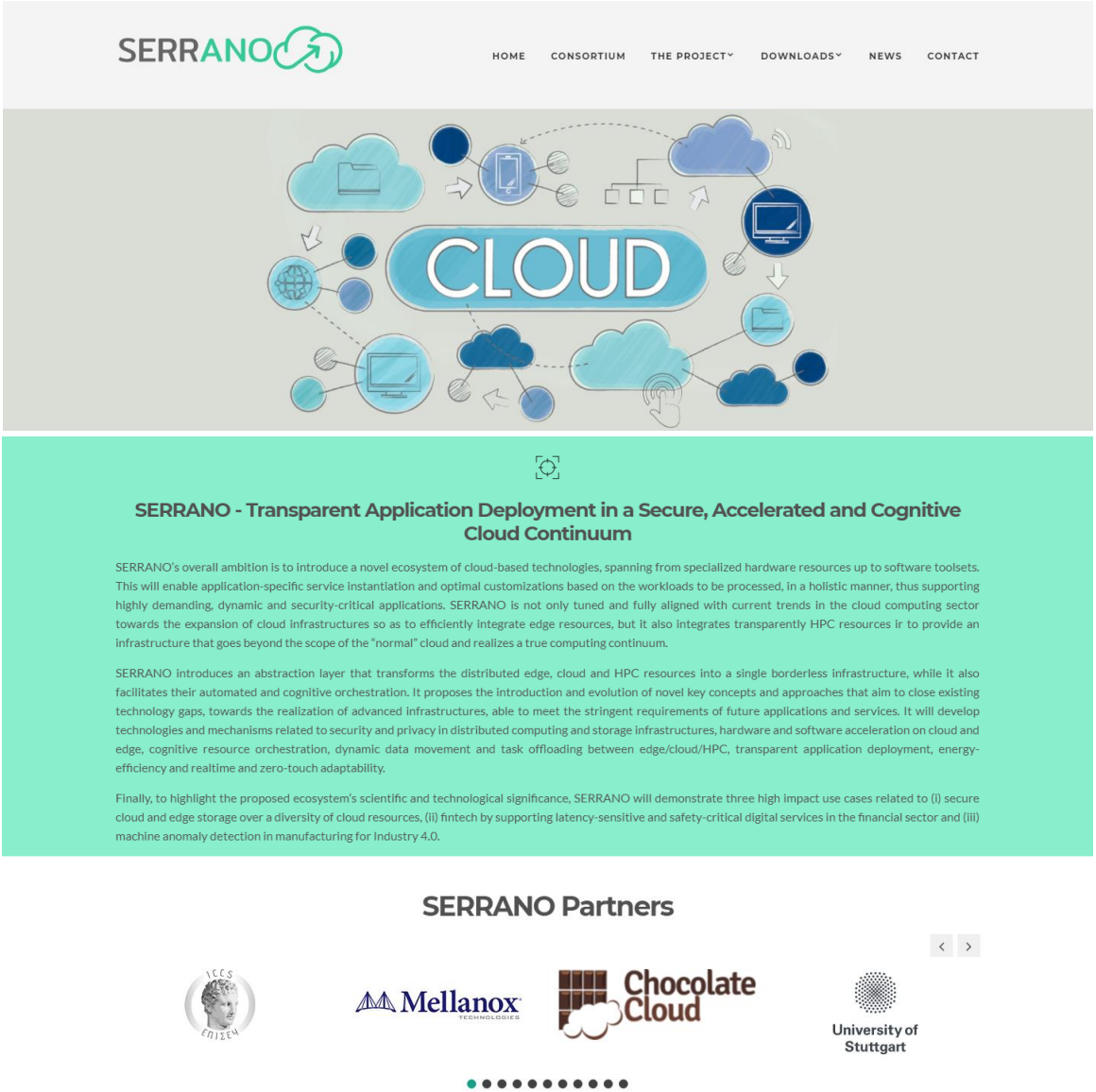
- Home
- Consortium
- The Project
    - Vision
    - Objectives
    - Work Packages
    - Use Cases
- Downloads
    - Public Deliverables
    - Publications
    - Communication Material
- News
- Contact

As the project progresses, ICCS will continuously update the website content and possibly its current structure to reflect the updated state of the project and ensure user-friendliness in browsing the content.

In what follows, we provide screenshots and a brief description of each page of the website.

Home Page

The SERRANO's portal home page (https://ict-serrano.eu) in Figure 1, provides a brief introduction to the project, the consortium members and the latest news. The header and footer sections are the same for all the pages of the website and are always visible.



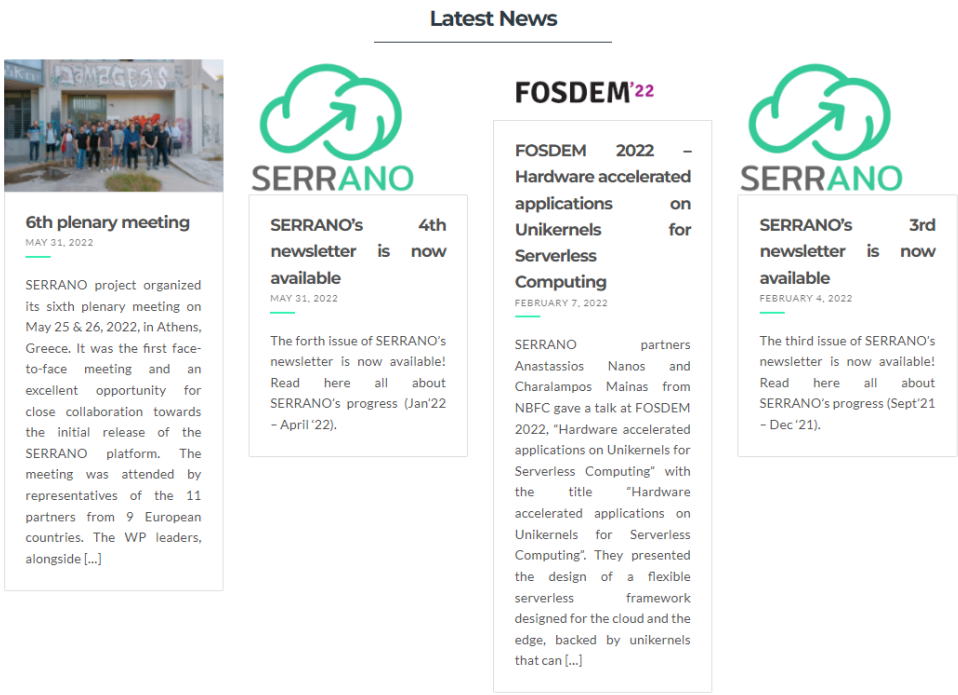


Figure 1: SERRANO Home Page

The header (Figure 2) consists of the SERRANO logo and the website menu, through which the users are able to navigate to the individual pages. The "Project" menu option includes the following four sub-sections: “Vision”, “Objectives”, “Work Packages” and “Use Cases”. The “Downloads” menu option includes the following three sub-sections: “Public Deliverables”, “Publications” and “Communication Material”. The footer (Figure 3) includes an acknowledgment to the European Union’s Horizon 2020 framework, the grant agreement number and links to project’s social media accounts (e.g., Twitter, LinkedIn, YouTube).

Figure 2: SERRANO website header section

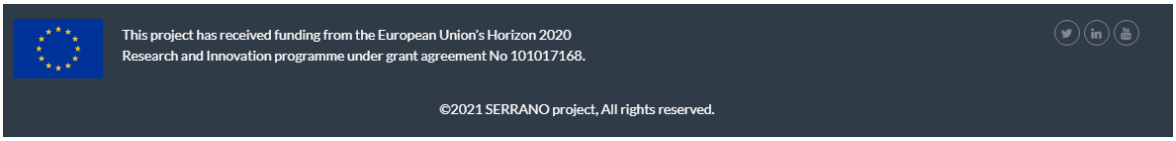


Figure 3: SERRANO website footer section

Consortium

The "Consortium" page (Figure 4) provides basic information regarding the project partners and links to their websites.

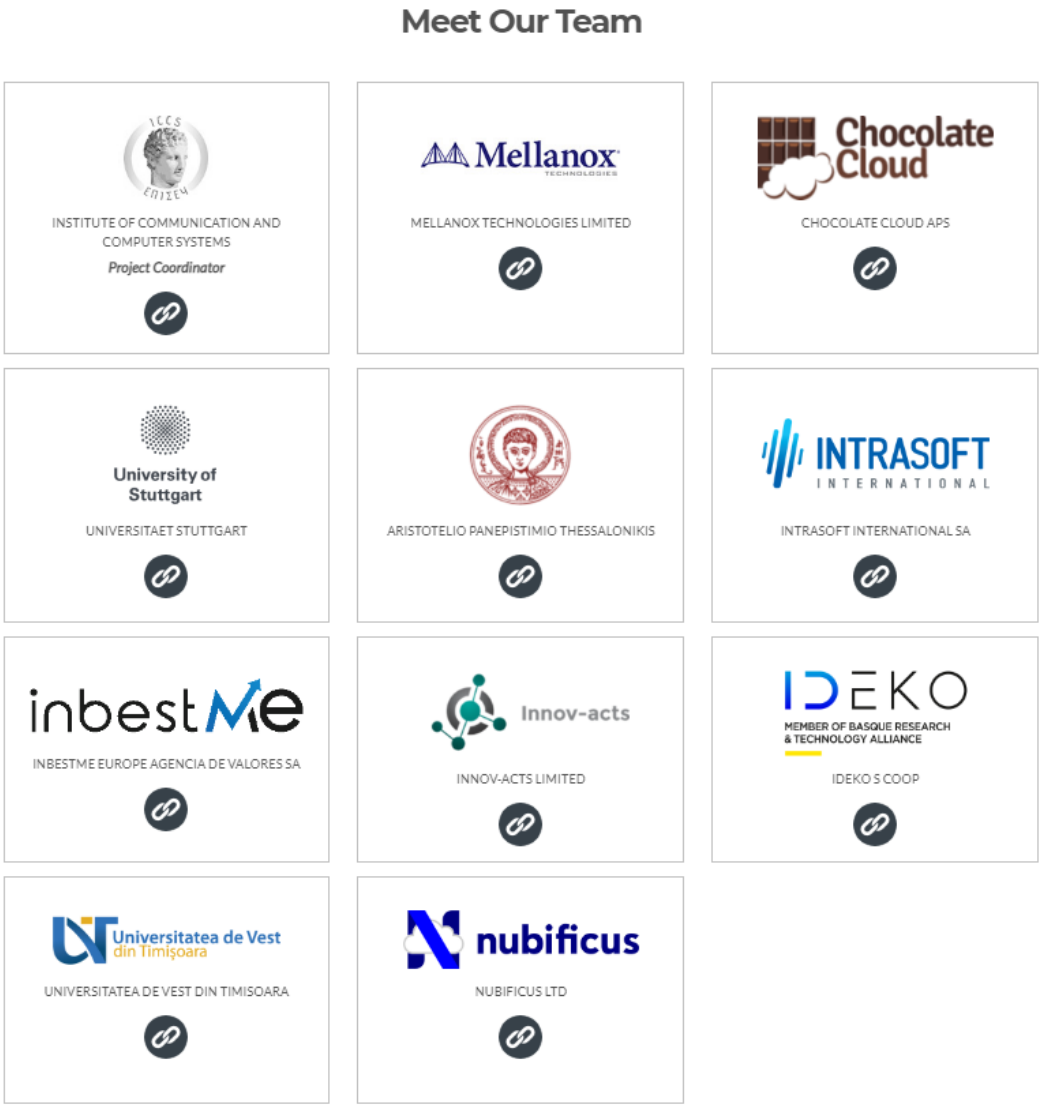


Figure 4: Website section "Consortium"

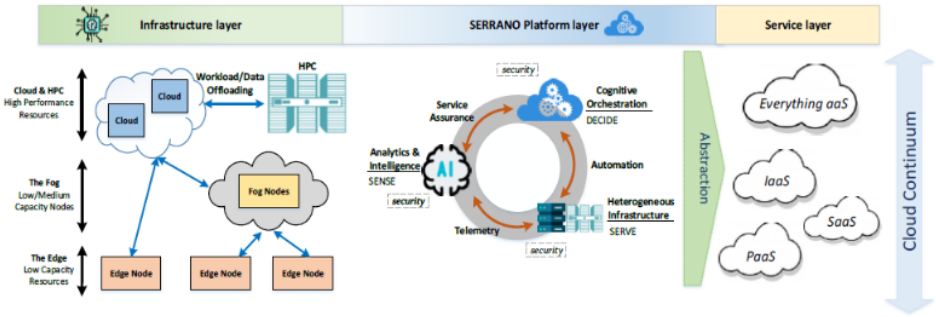
Vision

The "Vision" page (Figure 5) presents briefly the SERRANO concept and the overall vision of the project.

Vision

We are witnessing a wave of emerging cloud computing technologies and services that empower advanced applications from different vertical sectors, with diverse requirements. In addition, there is a movement from top-down-designed architectures that apply centralized resource control, towards federations of loosely coupled autonomous or semi-autonomous systems, managed by multiple independent actors that are self-organized in a distributed manner. These trends give rise to a number of fundamental challenges that relate to the application deployment, the support of heterogeneous infrastructures and the provided security.

Inline with the above, SERRANO steps in to define an intent-based paradigm of operating federated infrastructures consisting of edge, cloud, and HPC resources, which will be realized through the SERRANO platform. At the top, SERRANO will create an abstraction layer that automates the process of application deploying functionality across the various computing technologies. This layer will be part of an infrastructure agnostic automation process that translates applications' high-level requirements to infrastructure-aware configuration parameters. The SERRANO platform will automatically determine the most appropriate (computing, storage, networking) resources of the cloud continuum to be used by an application, and then transparently deploy workloads and coordinate data movement.



The SERRANO platform, utilizing edge, cloud and HPC resources and empowering the everything as a service notion towards the cloud continuum

A sense, discern, infer, decide, and act, continuous control loop will run over an infinite to adjust resources and migrate the tasks based on feedback regarding the application's and the resources' state. Service assurance mechanisms based on artificial intelligence and machine learning techniques will facilitate the autonomous adaptation and management of the deployed services and resources. These mechanisms will be dynamically triggered by a data-driven cloud and network telemetry framework that collects and analyses telemetry data across the distributed edge/cloud/HPC infrastructure.

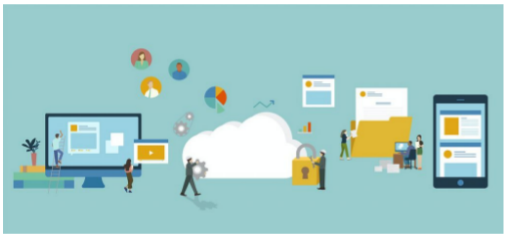
SERRANO platform will also develop hardware and software-based mechanisms that provide security, privacy and multi-tenancy by design. In this way, applications and users will be able to maintain control over their data integrity and privacy when relying on publicly shared edge and cloud infrastructures. SERRANO will capitalize on the benefits offered by hardware accelerators used to execute prototype tasks that arise often in applications, coupled with novel transprecision computing mechanisms to exploit the accuracy versus resource usage tradeoff. These will enable the dynamic adaptation of the computations' precision, based on application requirements, further improving the overall performance and energy efficiency of the infrastructures.

Finally, SERRANO will demonstrate its advanced and innovative capabilities through three well-defined use cases in cloud storage services, fintech and manufacturing, utilizing edge, cloud and HPC infrastructures. The use cases correspond to high-demanding, safety-critical, dynamic, greatly impactful applications that pose heterogeneous demands.

Figure 5: Website section "Vision"

Use Cases

The "Use Cases" section (Figure 6) presents an overview of the three SERRANO use cases along with the expected important limitations that SERRANO is expected to address.

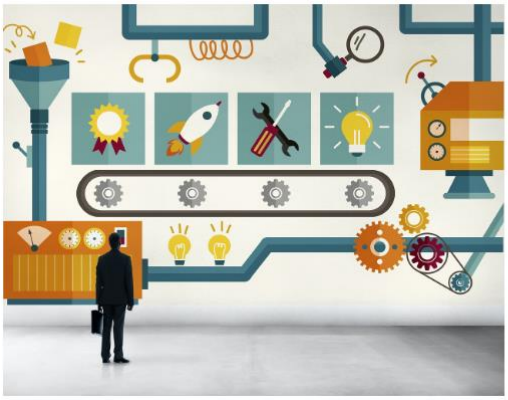


Use Case 1 – Secure Storage

This use case focuses on providing secure and high-performance storage and sharing of various data types at the edge of the network. In particular, SERRANO aims to break the typical trade-off between security and performance, by utilizing a combination of multiple edge locations and even multiple cloud computing and storage services/providers. Providing security and privacy guarantees for storing various types of data, e.g., IoT sensors, video, images, at the edge is critical for enabling the development of new applications, while ensuring compliance with the GDPR and other privacy regulations. Since this compliance typically comes at the cost of reduced performance or speed, there is a need for efficient mechanisms for secure storage that exploit the capabilities of both edge and cloud. The architecture consists of multi-cloud and multi-edge subsystems that will (i) deliver a more robust and secure platform, and (ii) use novel security and resource allocation techniques to manage data privacy for the stored and processed data. SERRANO considers a system model with multiple edge and remote clouds, aiming to tackle the challenges of managing: the heterogeneity of the QoS requirements from different applications, the limited resources of the edge clouds, and the policy restrictions from a multi-cloud system. In this way, a security-by-design solution for storage will be delivered.

Use Case 2 – High-performance Fintech Analysis

The management of investment personalized portfolios entails continuous monitoring and adjustment so that it has optimal return and risk balance. The markets and the portfolios are simulated for what if conditions. The result of these operations is trading orders that are subsequently executed. SERRANO's ability to determine automatically the optimal execution platform enables the intelligent and transparent deployment of computationally and data intensive applications into a diverse set of cloud and HPC platforms. This capability will enable unprecedented innovation in investment management (higher return and lower risk), peer-to-peer lending (credit scoring and lower interests), insurance (premium calculation) and banking (fraud detection) with the application of compute intensive AI and ML algorithms. SERRANO will address three important limitations for high-performance fintech analysis. First, the enhanced security will simplify the implementation of secure channels between processes that run on different clouds, decreasing its dependence on a single cloud platform. Second, the HPC access through the cloud would enable innovation in using compute intensive operations for portfolio and market analysis. Third, the transparent deployment across different cloud platforms will enable the seamlessly integration of private infrastructures with various public infrastructures in a federated cloud setting.



Use Case 3 – Machine Anomaly Detection in Manufacturing Environments

Companies that manufacture extremely expensive, high added-value parts (e.g. for the aerospace sector) are very demanding in terms of machine availability and quality assurance. Predictive maintenance, remaining lifetime assessment and diagnosis of critical machine elements are state-of-the-part practices. However, some of the utilized techniques require from the machine to stop, before performing the analysis. As a result, the various hardware components are idle most of the time, waiting for the analysis procedures to start, something that the manufacturing industries are keen to avoid. Another approach is to perform these analyses continuously, while the hardware equipment keeps running at 100% and the state of the various independent components, along with the overall status is continuously reported. However, the high-frequency and high-accuracy sensors used for data acquisition, generate high volumes data, which are difficult to process in real-time at the edge due to limited availability of resources. Introducing mechanisms that orchestrate optimally data and computational movement in the edge, cloud and HPC can overcome this obstacle. This is the role of the SERRANO platform in this UC, highlighting it as a key enabler for the fourth industrial revolution.

Figure 6: Website section "Use Cases"

Objectives and Work Packages

The first section (Figure 7) enumerates the project objectives, while the second one (Figure 8) presents a short description for the project Work Packages.

SERRANO Objectives

Objective 1: Define an intent-driven paradigm of federated infrastructures consisting of edge, cloud, and HPC resources.

Objective 2: Develop security and privacy mechanisms for accelerated encrypted storage over heterogeneous and federated infrastructures.

Objective 3: Provide workload isolation and execution trust on untrusted physical tenders.

Objective 4: Provide acceleration and energy efficiency at the edge and cloud.

Objective 5: Cognitive resource orchestration and transparent application deployment over edge/fog-cloud/HPC infrastructures.

Objective 6: Demonstrate the capabilities of the secure, disaggregated, and accelerated SERRANO platform in supporting highly-demanding, dynamic and safety-critical applications.

Figure 7: Website section "Objectives"

Work Packages

In order to achieve the objectives of SERRANO, the work plan is divided into seven (7) Work Packages (WP):

- **WP1** – Project Technical and Administrative Management
- **WP2** – Requirements and System Design
- **WP3** – Hardware and Software Platforms for Enhanced Security
- **WP4** – Cloud and Edge Acceleration
- **WP5** – Intelligent Service and Resource Orchestration
- **WP6** – Platform Integration and Testing, Use Cases Development and Evaluation
- **WP7** – Business Modelling, Dissemination, Exploitation and Standardization

WP1 is responsible for the overall management and coordination, and the interaction of partners, monitoring the progress of the technical outcomes and the accomplishment of the project milestones and deliverables. Work in **WP2** focuses on the requirements collection and analysis, the state-of-the-art analysis, the detailed use case description, and the specification of the SERRANO platform architecture. **WP3** focuses on security and privacy mechanisms for accelerated encrypted storage over heterogeneous and federated infrastructures and development of workload isolation on multi-tenant nodes. **WP4** deals with the development of software and hardware -based methods for workload acceleration in edge, fog and cloud. **WP5** deals with the models, algorithms and mechanisms development that enable the AI-based service orchestration, resource allocation and infrastructure monitoring. The integration of the platform and the technological developments for the three (3) use cases and their evaluation is part of **WP6**. Finally, **WP7** includes the dissemination, communication, exploitation, sustainability, standardization, innovation and IPR management activities.

Figure 8: Website section "Work Packages"

Public Deliverables and Publications

The "Public Deliverables" and "Publications" sections contain information regarding the publications performed by the partners in the context of the SERRANO project. Moreover, the public deliverables will be available through the respective section. Both sections will be updated regularly throughout the duration of the project.

Communication Material

The "Communication Material" section (Figure 9) provides easy access to dissemination and communication content. It includes all public dissemination documents. Currently, there are available for download the project factsheet and the SERRANO presentation. Moreover, the users can also navigate to the project promotional video and the available newsletters. New material will be added as the project progresses.

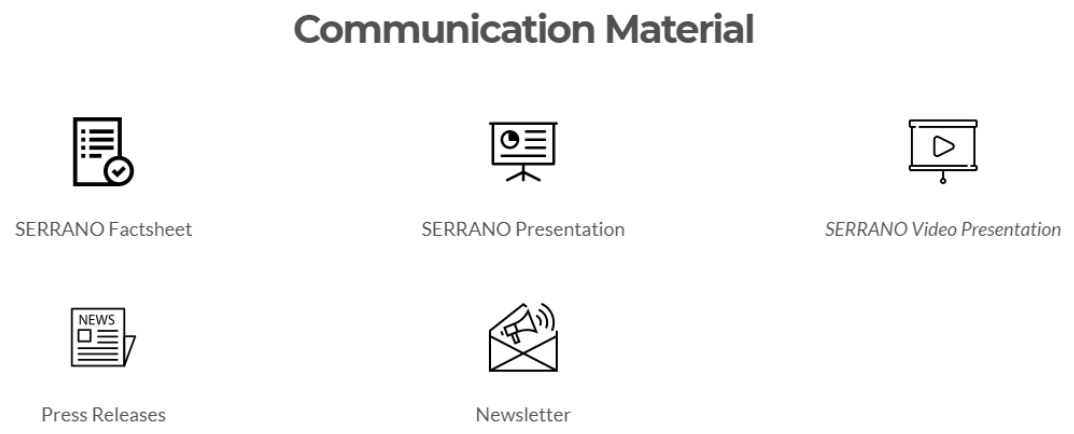


Figure 9: Website section "Communication Material"

Newsletters

The "Newsletters" section (Figure 10), accessible through the "Communication Material" section, lists the available Newsletters for download and enables users to subscribe through email to project newsletters.

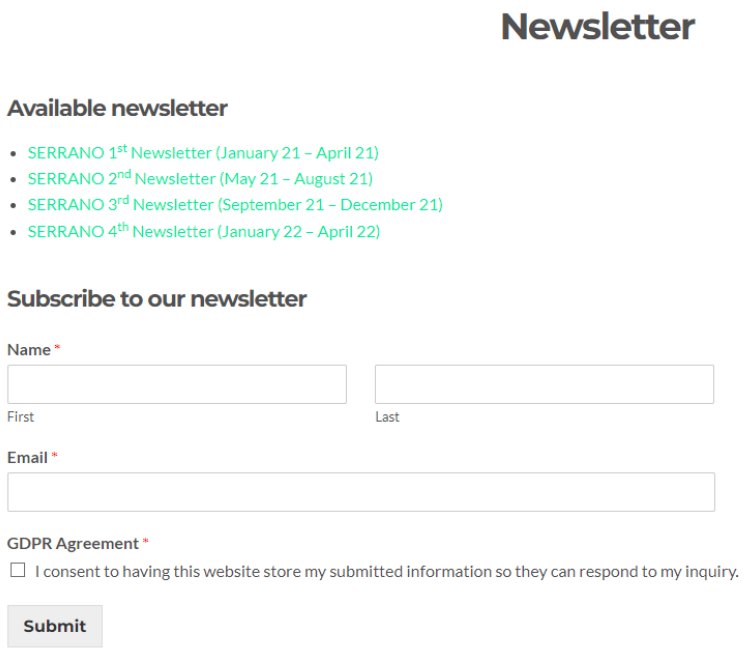


Figure 10: Website section "Newsletters"

News

The "News" section (Figure 11) includes news relevant to the project in the form of short, concise headings with additional links where necessary.

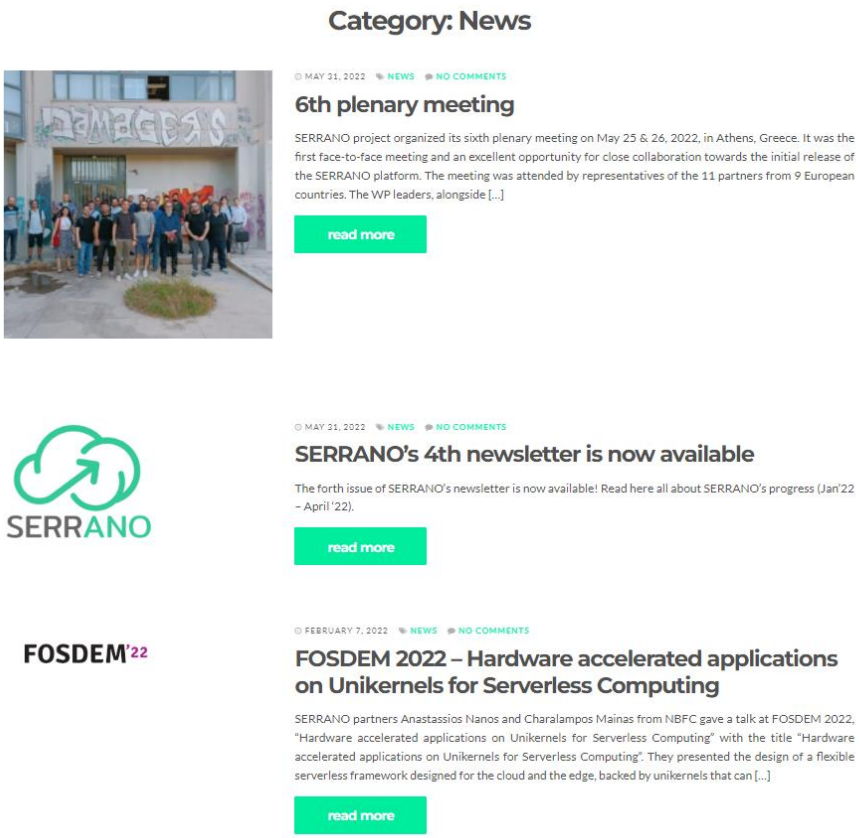


Figure 11: Website section "News"

Contact

The "Contact" section (Figure 12) provides information (email, phone and address) for contacting the SERRANO project coordinator. An e-mail message application is also available through which it is possible to communicate directly with the coordinator.

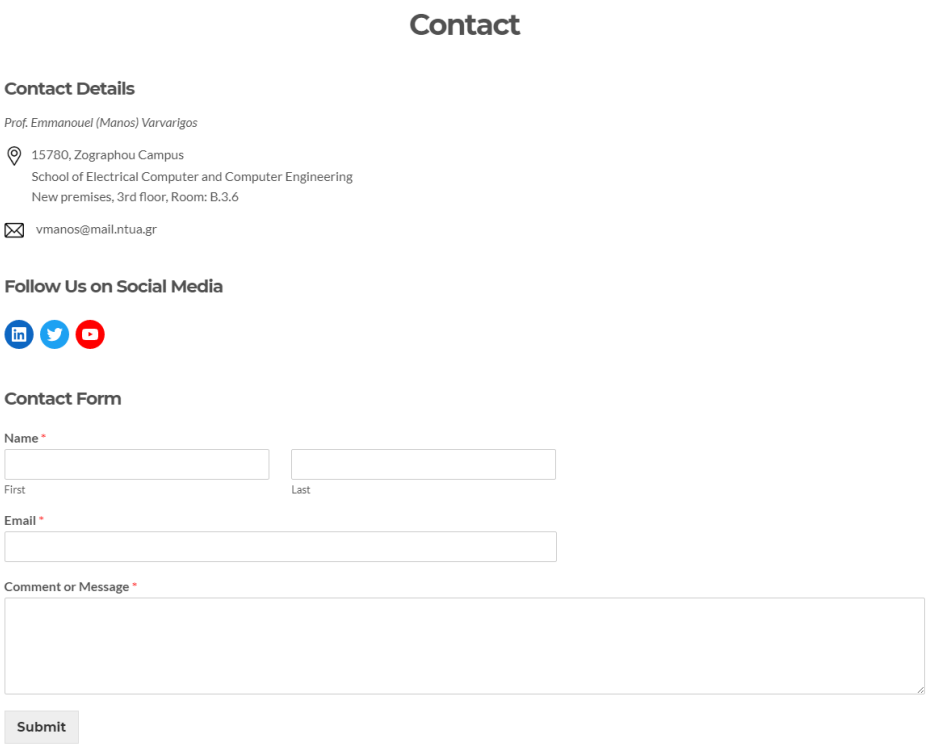


Figure 12: Website section "Contact"

4 Social Media Accounts

SERRANO has established accounts at various social networking platforms, such as Twitter, LinkedIn, ResearchGate and YouTube, as additional dissemination tools. ICCS created and will manage the following social media accounts and groups.

Twitter

SERRANO Twitter account (Figure 13) can be found at the following address:

- https://twitter.com/ProjectSerrano

Figure 13: SERRANO twitter account home page

The project follows 53 other accounts (Figure 14), while it has 62 followers (Figure 15), including other EU projects.

Figure 14: SERRANO follows many H2020 projects and respective initiatives

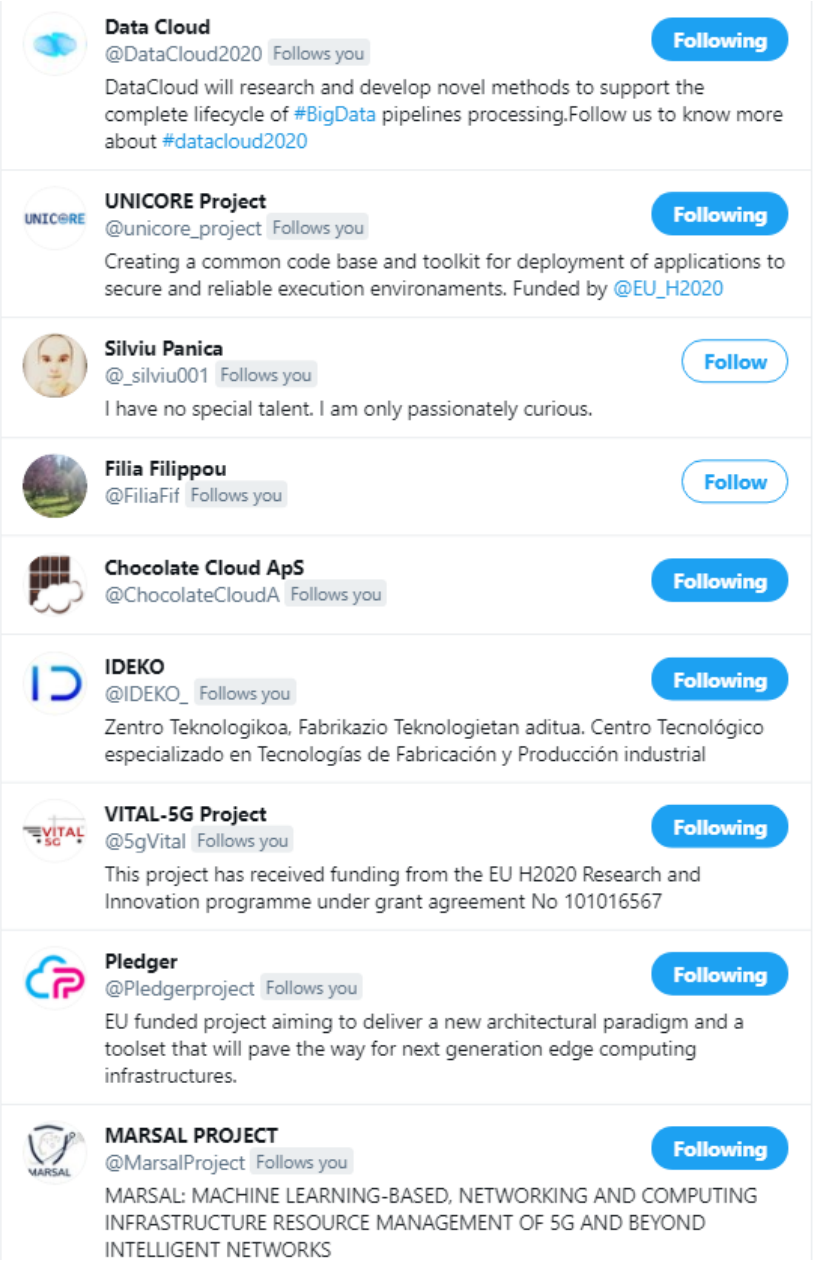


Figure 15: SERRANO followers

LinkedIn

The LinkedIn account of SERRANO (Figure 16) can be found at the following link:

- https://www.linkedin.com/company/serrano-project

This account has currently (M18) 48 followers and 19 posts.

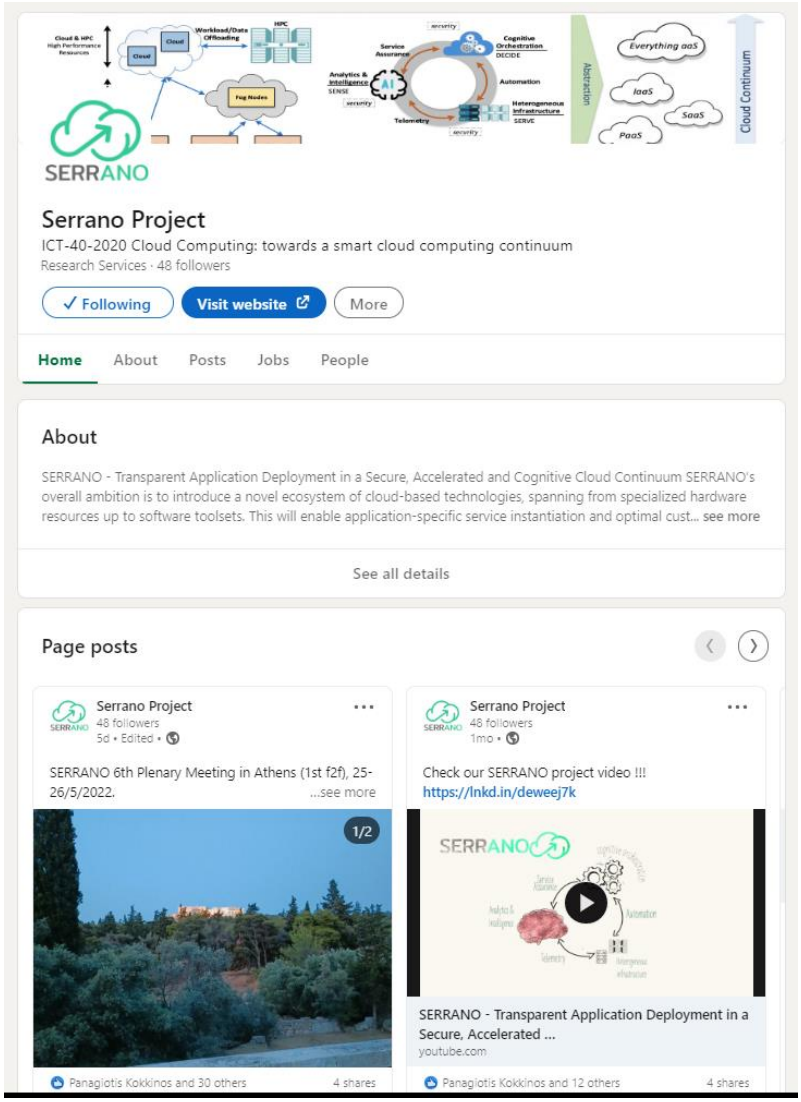


Figure 16: SERRANO LinkedIn profile

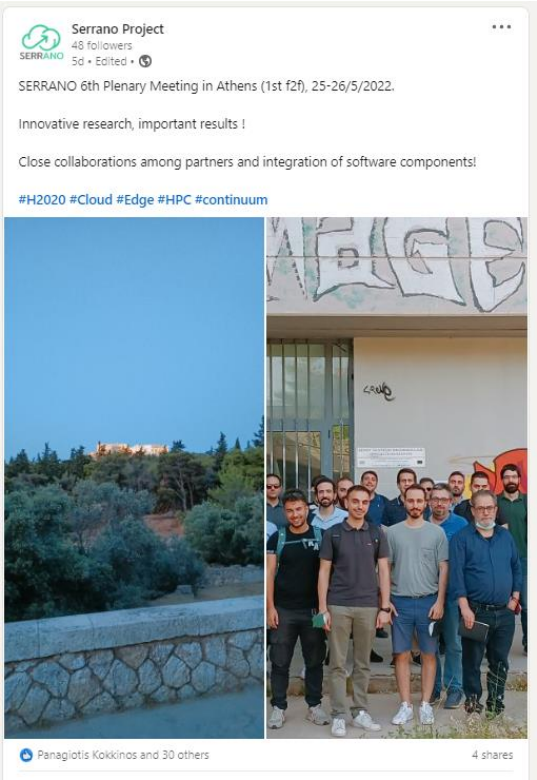


Figure 17: Dissemination of 6th plenary meeting through SERRANO LinkedIn page

ResearchGate

The ResearchGate account of SERRANO (Figure 18) can be found at the following link:

- https://www.researchgate.net/project/SERRANO-Transparent-Application-Deployment-in-a-Secure-Accelerated-and-Cognitive-Cloud-Continuum

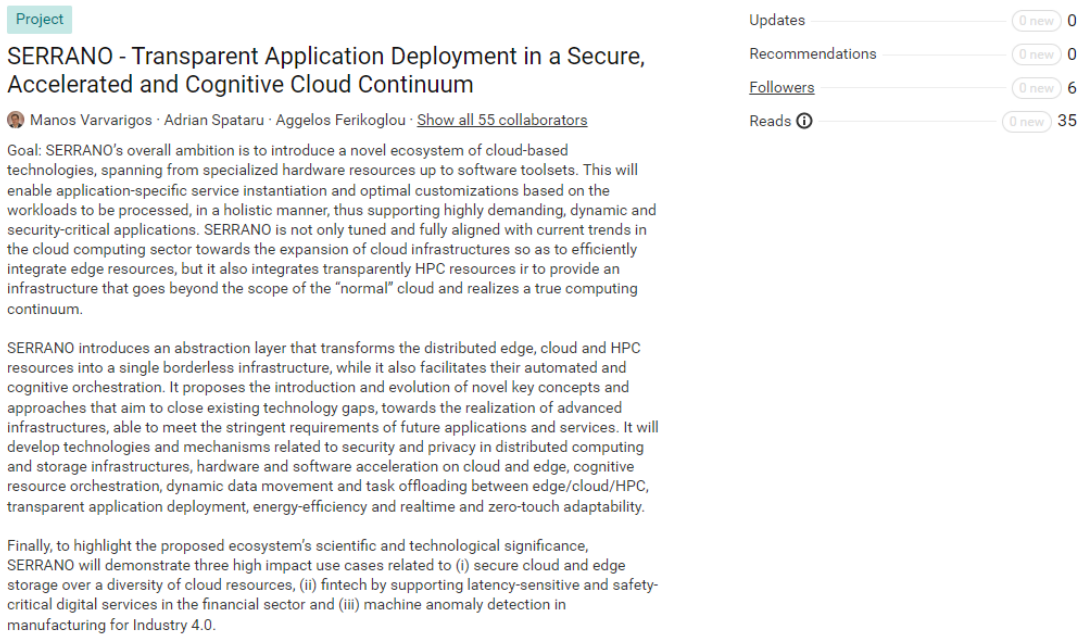


Figure 18: SERRANO ResearchGate profile

YouTube

The Official Video Channel on YouTube of SERRANO (Figure 19) can be found at the following address:

- https://www.youtube.com/channel/UC76DXLVZQauLxyHpGW9qIuw

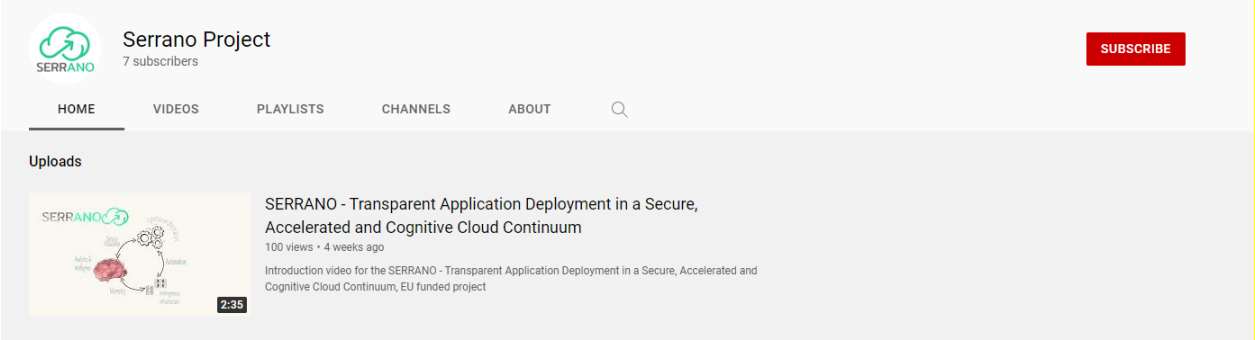


Figure 19: SERRANO YouTube channel home page

5 Promotional Video

The consortium has also produced one promotional video targeting the general public. In this video the very basic concepts and targets of the project are presented, and having in mind the nature of this video, the consortium has uploaded it on the YouTube platform in order to gain the maximum possible visibility (link: https://www.youtube.com/watch?v=ae35MfIWsGY). The video can be found under the title "SERRANO - Transparent Application Deployment in a Secure, Accelerated and Cognitive Cloud Continuum" as seen in the picture below. The video link has also been added to the project's website.

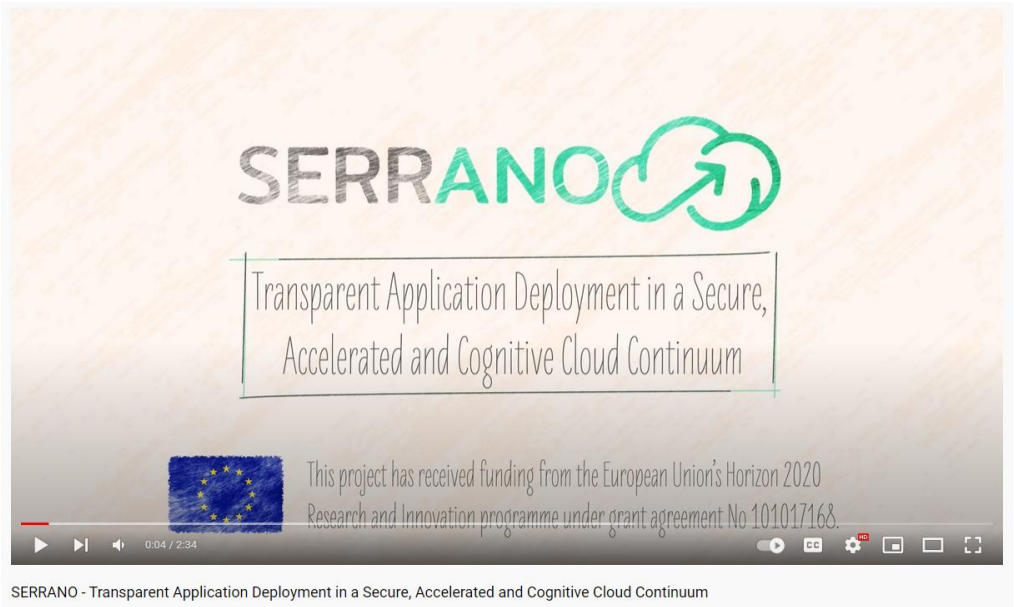
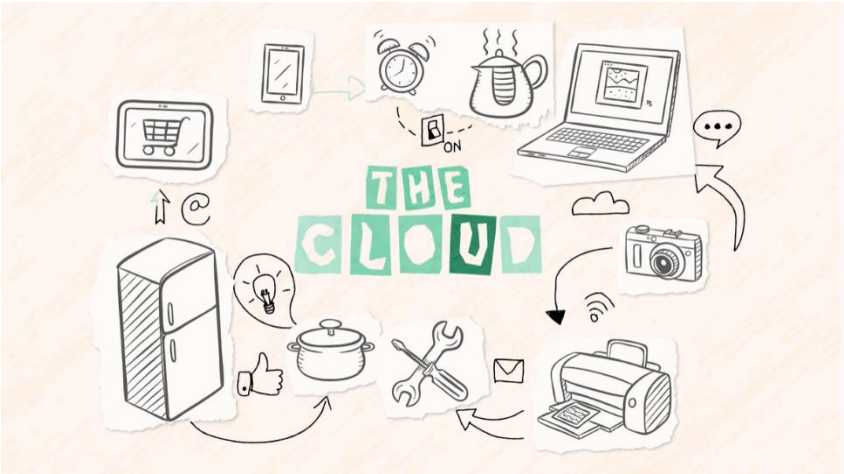


Figure 20: SERRANO promotional video in YouTube

5.1 Video Presentation

The video starts with the presentation of the ever-evolving cloud landscape.



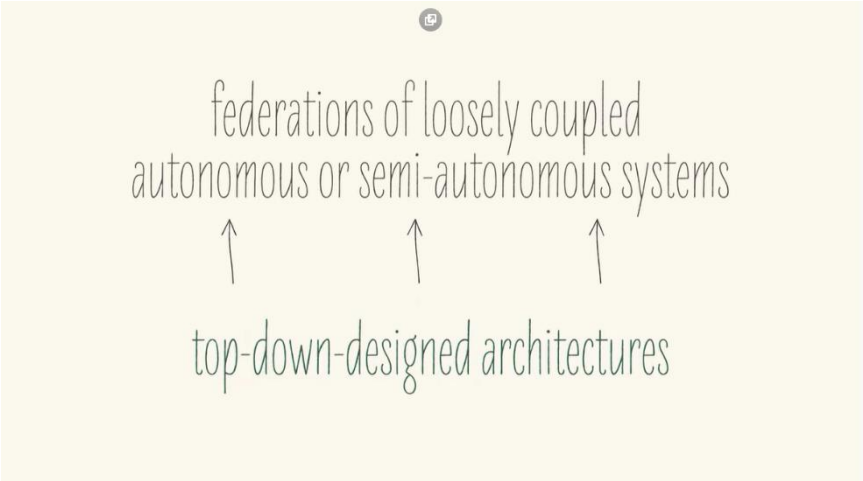


Figure 21: The evolving cloud landscape

Next, it describes (Figure 22) the SERRANO vision that aims to introduce a cognitive abstraction layer that transforms the distributed edge, cloud, and HPC resources into a single borderless infrastructure. It also highlights (Figure 23) the key technologies and mechanisms that SERRANO will develop.

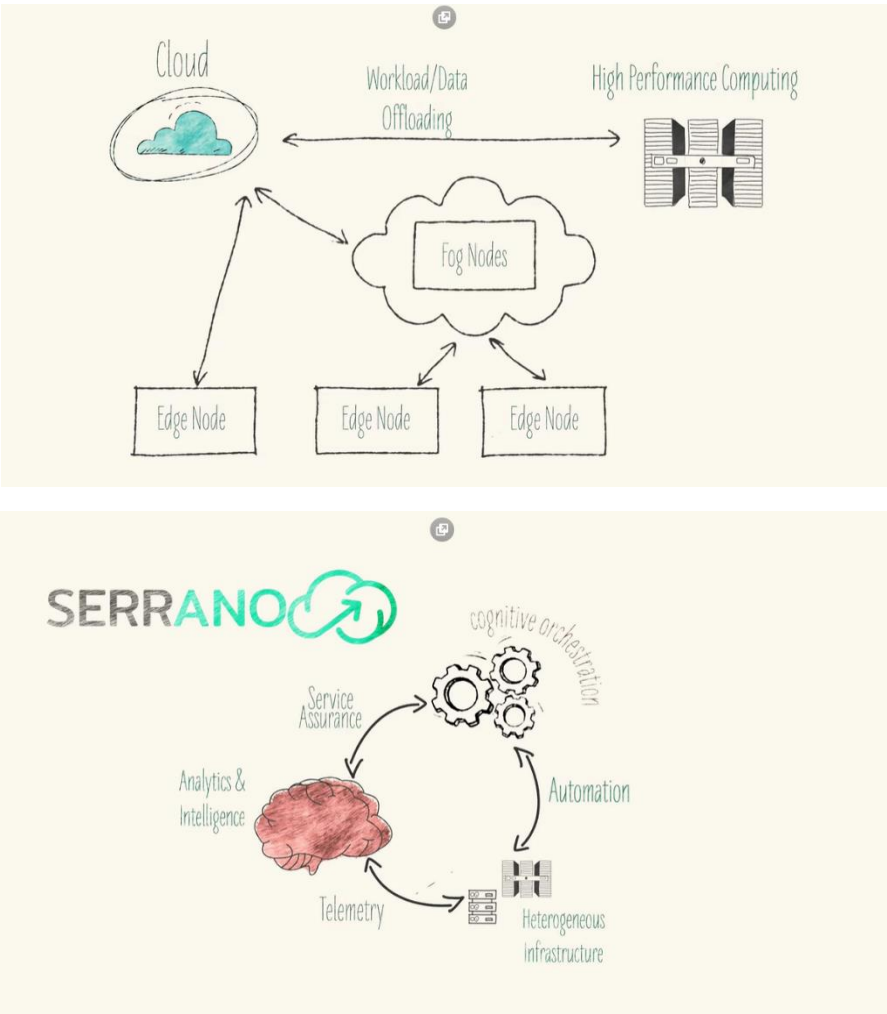


Figure 22: Presentation of the SERRANO vision

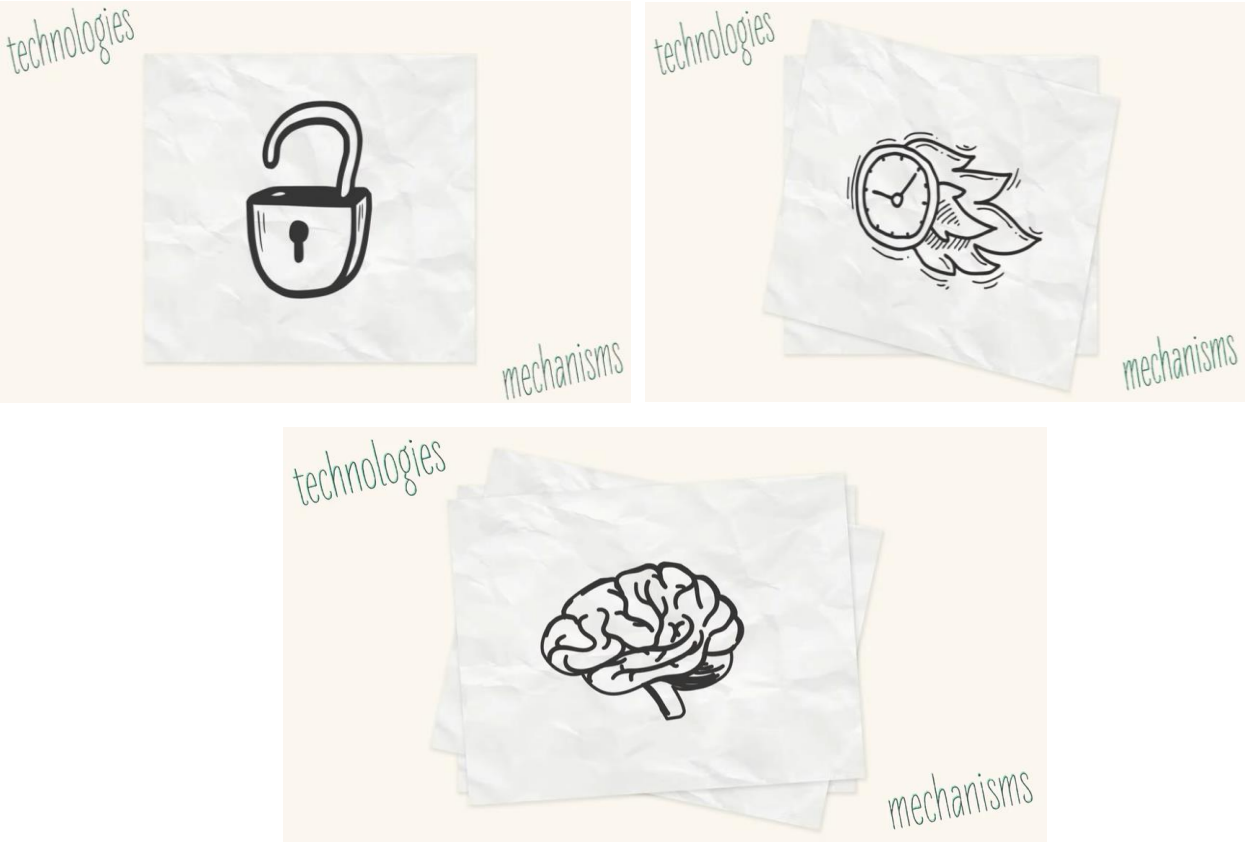


Figure 23: Presentation of the key technologies that will be developed within the SERRANO project

It continues with the presentation of the three project use cases.

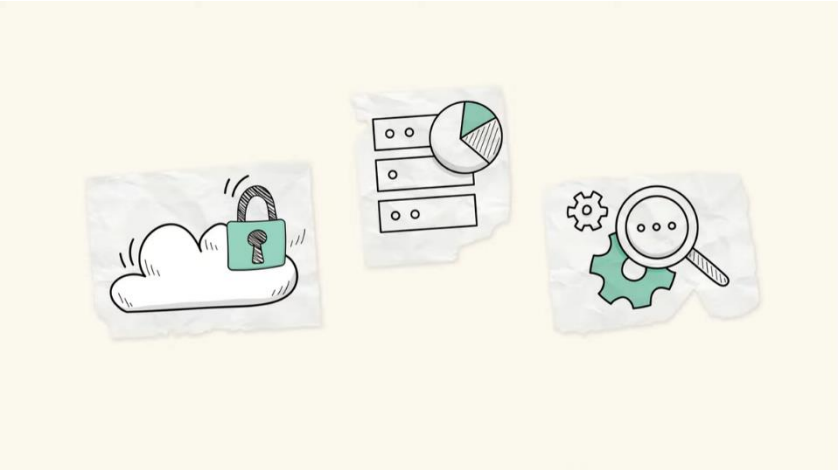


Figure 24: Introduction of the project use cases

Finally, the project consortium is introduced.

Figure 25: Project consortium presentation

5.2 Video Narration Script

The video narration script is attached below:

We are witnessing a wave of emerging cloud computing technologies and services that empower advanced applications.

In addition, there is a movement from top-down-designed architectures towards federations of loosely coupled autonomous or semi-autonomous systems.

SERRANO is not only tuned and fully aligned with current trends in the cloud computing sector toward the expansion of cloud infrastructures so as to efficiently integrate edge

resources, but it also integrates transparently HPC resources to provide an infrastructure that goes beyond the scope of the "normal" cloud and realizes a true computing continuum.

SERRANO introduces an abstraction layer that transforms the distributed edge, cloud, and HPC resources into a single borderless infrastructure while it also facilitates their automated and cognitive orchestration.

SERRANO will develop technologies and mechanisms related to:

- *security and privacy in distributed computing and storage infrastructures*
- *hardware and software acceleration on cloud and edge*
- *cognitive resource orchestration*
- *transparent application deployment*
- *energy-efficiency and autonomous adaptability*

Finally, SERRANO will demonstrate three high impact use cases related to:

- *secure cloud and edge storage over a diversity of cloud resources*
- *fintech by supporting latency-sensitive and safety-critical digital services in the financial sector*
- *and machine anomaly detection in manufacturing*

6 Newsletters

SERRANO has also released four newsletters so far that has been disseminated in various mailing lists and is also available on the project website (https://ict-serrano.eu/newsletters/). SERRANO plans to release newsletters at least every four months, and in addition also release newsletters when great achievements have been accomplished.

SERRANO 1st Newsletter (January 21 – April 21)

SERRANO EU Project

1st Newsletter (Jan '21 – Apr '21)

SERRANO

WE STARTED

On 28 January 2021, EU ICT-40-2020 SERRANO Project (H2020 GA No 101017168): Transparent Application Deployment in a Secure, Accelerated and Cognitive Cloud Continuum, kicked-off with the participation of 11 partners.

Consortium partners include: ICCC/NTUA (Cooridnator), MELLANOX/ NVIDA, Chocolate Cloud, Universitaet Stuttgart, Aristotelio Panepistimio Thessalonikis, Intrasoft, Inbestme, Innovation-Acts, IDEKO, Universitatea de Vest din Timişoara and Nubificus.

SERRANO will investigate the transparent deployment of applications in a secure and accelerated infrastructure of edge, cloud and HPC resources, based on FPGAs, GPUs, Virtual Platforms and Smart NICs, while facilitating their automated and cognitive orchestration.

The 2nd plenary meeting of the SERRANO Project took place on the 12th of April 2021,. The meeting offered a great opportunity for collaboration among partners, presenting the progress achieved and discussing the next steps.

at a glance

Project Title: Transparent Application Deployment in a Secure, Accelerated and Cognitive Cloud Continuum

Grant Agreement no: 101017168

Topic: ICT-40-2020 - Cloud Computing: towards a smart cloud computing continuum

Duration: 01/01/2021 – 31/12/2023 (36 months)

EC Contribution: 4.343.180.00 €

Project Coordinator: Prof. Manos Varvarigos, ICCS/NTUA vmanos@central.ntua.gr

Project Website: ict-serrano.eu

Social Media: twitter.com/ProjectSerrano www.linkedin.com/company/serrano-project

SERRANO

SERRANO PRESENCE

SERRANO partners present the project and disseminate its objectives and early results in various events.

SERRANO and BRAINE (braine-project.eu) EU projects are co-organizing the Workshop "Intelligent operations, security, and acceleration for edge computing" in the IEEE International Mediterranean Conference on Communications and Networking – Meditcom (meditcom2021.ieee-meditcom.org/).

The workshop seeks to attract high-quality contributions covering both theory and practice over edge computing. In particular, the topics of interest include, but are not limited to the following areas:

- Security, privacy and data integrity in the edge
- Orchestration of edge resources
- Network and cloud telemetry Integrating AI with Edge Computing
- Machine Learning integration with Edge Computing
- Application of AI/ML at the edge
- Edge intelligence
- Applications / VNFs deployed at the edge
- Acceleration of intensive workloads
- Networking programmability at the edge
- Verticals running in the edge

Nubificus Ltd - SERRANO's consortium partner - is co-organizing the 16th Workshop on Virtualization in High-Performance Cloud Computing - VHPC'21 (vhpc.org).

IEEE MeditCom

GPUs
FPGAs
Virtual Platforms
HPC
Smart NICs
SERRANO

This project has received funding from the European Union's Horizon 2020. Research and Innovation programme under grant agreement No 101017168.

Contact:
Prof. Emmanouel (Manos) Varvarigos
vmanos@central.ntua.gr

SERRANO 2nd Newsletter (May 21 – August 21)

SERRANO EU Project

2nd Newsletter (May '21 – Aug '21)

SERRANO

SERRANO PRESENCE

Events

On the 2nd of July 2021 SERRANO partners, ICCS/NTUA and Nubificus, made two presentations in the 16th Workshop on Virtualization in High-Performance Cloud Computing (VHPC'21), held in conjunction with the International Supercomputing Conference: i) Transparent deployment of applications in a secure and accelerated infrastructure of edge, cloud and HPC resources, ii) ML inference hardware acceleration with unikernels

On the 7th of July 2021 SERRANO hardware acceleration aspects where presented in SAMOS conference: A. Ferikoglou, et. al, Towards efficient HW acceleration in edge-cloud infrastructures: The SERRANO approach.

Meetings

On the 12th of July 2021, the 3rd plenary meeting of the ICT-40-2020 SERRANO Project (H2020 GA No 101017168) took place with all 11 partners in attendance.

Achievements

The Telekom Challenge (telekom-challenge.com) jury has nominated the Top 10 finalists. In recognition of their ideas for new products, Berlin-based O&O Software GmbH together with its Danish partner Chocolate Cloud ApS (the latter being a SERRANO partner) are among the best ten participants in the category Development, beating out competition from 35 countries and 5 continents.

TELEKOM CHALLENGE BY T LABS

at a glance

Project Title: *Transparent Application Deployment in a Secure, Accelerated and Cognitive Cloud Continuum*

Grant Agreement no: *101017168*

Topic: *ICT-40-2020 - Cloud Computing: towards a smart cloud computing continuum*

Duration: *01/01/2021 – 31/12/2023 (36 months)*

EC Contribution: *4.343.180.00 €*

Project Coordinator: *Prof. Manos Varvarigos, ICCS/NTUA vmanos@central.ntua.gr*

Project Website: *ict-serrano.eu*

Social Media: *twitter.com/ProjectSerrano www.linkedin.com/company/serrano-project*

This project has received funding from the European Union's Horizon 2020. Research and Innovation programme under grant agreement No 101017168.

Contact:
Prof. Emmanouel (Manos) Varvarigos
vmanos@central.ntua.gr

SERRANO 3rd Newsletter (September 21 – December 21)

SERRANO EU Project

3rd Newsletter (Sept'21 – Dec '21)

SERRANO

THE SERRANO *EFFECT*

Events

SERRANO partners NBFC and ICCS organized a thematic session in HiPEAC Computing System Week (CSW): "Towards a smart cloud computing continuum with secure and accelerated edge, cloud and HPC resources", October 2021.

https://lnkd.in/d_tCKWqD

SERRANO partner AUTH organized the IEEE School "Innovation for Data Era: Power the Era of Artificial Intelligence", where more than 80 Master and PhD students participated, November 2021.

https://innoai.web.auth.gr/

Meetings

The 4th plenary meeting of SERRANO project was held online in November 2021. The primary objective was the discussion of the platform's architecture.

Achievements

SERRANO partner, Chocolate Cloud ApS won the third place in the Telekom Challenge 2021 (development stream), September 2021.

https://lnkd.in/dgZh6fUy

ICCS researchers won the Best Paper Award in the IEEE International Conference on Cloud Networking (CloudNet), November 2021.

IEEE International Conference on Cloud Networking

BEST INNOVATIVE PAPER AWARD

PRESENTED TO

Secured Distributed Storage Resource Allocation on Cloud-Edge Infrastructures

Konstantinos Kontodimas, Polyzois Soumplis, Aristotelis Kretsis, Panagiotis Kokkinos, Emmanouel Varvarigos

at a glance

Project Title: *Transparent Application Deployment in a Secure, Accelerated and Cognitive Cloud Continuum*

Grant Agreement no: *101017168*

Topic: *ICT-40-2020 - Cloud Computing: towards a smart cloud computing continuum*

Duration: *01/01/2021 – 31/12/2023 (36 months)*

EC Contribution: *4.343.180.00 €*

Project Coordinator: *Prof. Manos Varvarigos, ICCS/NTUA vmanos@central.ntua.gr*

Project Website: *ict-serrano.eu*

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This project has received funding from the European Union's Horizon 2020. Research and Innovation programme under grant agreement No 101017168.

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SERRANO 4th Newsletter (January 22 – April 22)

SERRANO EU Project

4th Newsletter (Jan'22 – Apr '22)

SERRANO

THE SERRANO *PROGRESS*

Events

Serrano Project partner Nubificus Ltd gave a talk at FOSDEM 2022, with the title "Hardware accelerated applications on Unikernels for Serverless Computing". Nubificus presented the design of a flexible serverless framework designed for the cloud and the edge, backed by unikernels that can access hardware accelerators.

https://fosdem.org/2022/schedule/event/anano/

FOSDEM

Achievements

SERRANO partners have a number of papers accepted in IEEE ICC 2022, COMPSAC 2022, HCII 2022 and MOCAST 2022.

Other

SERRANO project video was published:

https://www.youtube.com/watch?v=ae35MfIWsGY

Meetings

The 5th plenary meeting of SERRANO project was held online in February 2021. The development and research activities of the project were discussed.

at a glance

Project Title: *Transparent Application Deployment in a Secure, Accelerated and Cognitive Cloud Continuum*

Grant Agreement no: *101017168*

Topic: *ICT-40-2020 - Cloud Computing: towards a smart cloud computing continuum*

Duration: *01/01/2021 – 31/12/2023 (36 months)*

EC Contribution: *4.343.180.00 €*

Project Coordinator: *Prof. Manos Varvarigos, ICCS/NTUA vmanos@central.ntua.gr*

Project Website: *ict-serrano.eu*

Social Media: *twitter.com/ProjectSerrano www.linkedin.com/company/serrano-project*

This project has received funding from the European Union's Horizon 2020. Research and Innovation programme under grant agreement No 101017168.

Contact:
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vmanos@central.ntua.gr

7 Updated Factsheet

SERRANO

ict-serrano.eu | Horizon 2020

Transparent Application Deployment in a Secure, Accelerated and Cognitive Cloud Continuum

SERRANO envisages the creation of an infrastructure agnostic automation process that will translate applications' high-level requirements to infrastructure-aware configuration parameters, which are then applied on secure and accelerated resources.

At a glance: SERRANO

Project Website: ict-serrano.eu

Project Coordinator:
Emmanouel (Manos) Varvarigos
Professor, ICCS/NTUA
vmanos@central.ntua.gr

Duration: 36 months

Partners:
Institute of Communication and Computer Systems – ICCS (Greece), Mellanox Technologies Ltd – MLNX (Israel), Chocolate Cloud ApS – CC (Denmark), Universitaet Stuttgart – USTUTT/HLRS (Germany), Aristotelio Panepistimio Thessalonikis – AUTH (Greece), INTRASOFT International SA – INTRA (Luxembourg), Inbestme Europe Agencia de Valores S.A. – INB (Spain), Innovation Acts Limited – INNOV (Cyprus), IDEKO S COOP – IDEKO (Spain), Universitatea de Vest din Timişoara – UVT (Romania), Nubificus Ltd – NBFC (United Kingdom)

Grant Agreement no: 101017168

Topic: ICT-40-2020 - Cloud Computing: towards a smart cloud computing continuum

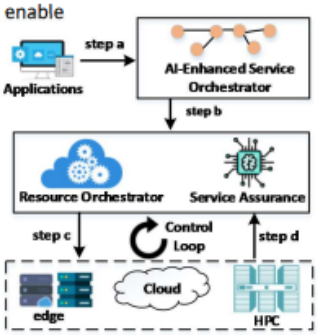
EC Contribution: 4,343,180.00 €

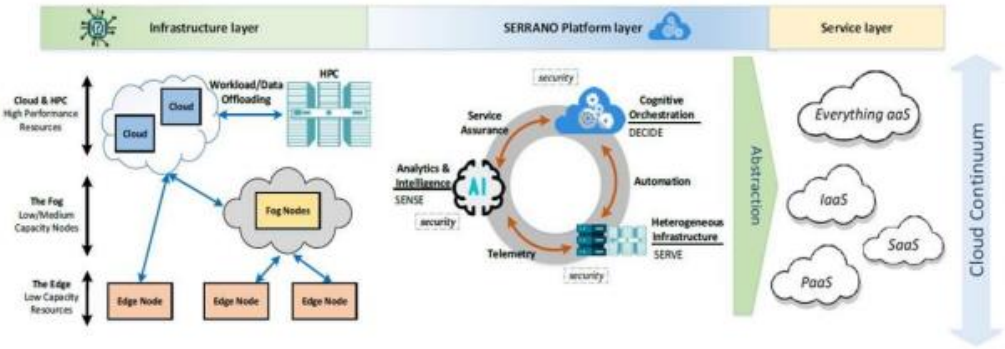
The Challenge

We are witnessing a wave of emerging cloud computing technologies and services that empower advanced applications from different vertical sectors, with diverse requirements. Also, there is a movement from top-down-designed architectures, applying centralized resource control, towards federations of loosely coupled autonomous or semi-autonomous systems, managed by multiple independent actors that are self-organized in a distributed manner. These trends give rise to several fundamental challenges that relate to the application deployment, the support of heterogeneous infrastructures and the provided security.

Vision

SERRANO targets the efficient and transparent integration of heterogeneous resources, providing an infrastructure that goes beyond the scope of the "normal" cloud and realizes a true computing continuum. SERRANO will introduce a novel ecosystem of cloud-based hardware and software technologies. This will enable application-specific service instantiation and optimal customizations, thus supporting highly demanding, dynamic and security-critical applications. The overall orchestration will be performed in a lean, automated, holistic and integrated manner.



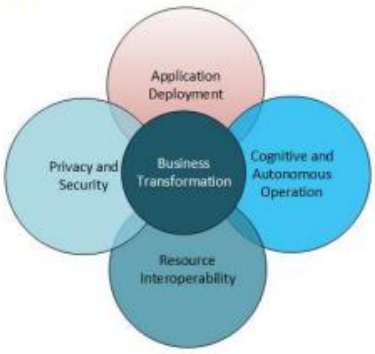


Project Objectives

SERRANO will create an abstraction layer that translates applications' high-level requirements to infrastructure-aware configuration parameters. The SERRANO platform will automatically determine the most appropriate resources to be used, and then transparently deploy workloads and coordinate data movement. Service assurance mechanisms based on artificial intelligence and machine learning techniques will facilitate the autonomous adaptation and management of the deployed services and resources. These mechanisms will be dynamically triggered by a data-driven cloud and network telemetry framework. SERRANO platform will also develop hardware and software-based mechanisms that provide security, privacy and multi-tenancy by design. In this way, applications and users will be able to maintain control over their data integrity and privacy when relying on publicly shared edge and cloud infrastructures. SERRANO will capitalize on the benefits offered by hardware accelerators used to execute prototype tasks that arise often in applications, coupled with novel transprecision computing mechanisms to exploit the accuracy versus resource usage tradeoff. Finally, SERRANO will demonstrate its advanced and innovative capabilities through three well-defined use cases in cloud storage services, fintech and manufacturing.

Technology Exploitation

SERRANO's modular-by-design approach supports the creation of a plethora of services that can be placed in the center of an innovative market ecosystem, which drives business innovation and enterprise transformation. These SERRANO services include: (i) secure, accelerated, federated infrastructures consisting of edge, cloud and HPC resources that also utilize novel cognitive mechanisms for the automation and optimization of their internal operations (SERRANO IaaS), (ii) domain specific and generic platforms for deploying and executing safety-critical, low-latency, data-intensive applications and other workflows (SERRANO PaaS), (iii) Cognitive Distributed Secure Storage as a Service (CDSSaaS) and Extreme Scale Analytics as a Service (ESAaaS) (SERRANO SaaS), (iv) business processes (e.g. for fintech and manufacturing) as a service (SERRANO BPaas). The SERRANO enabled IaaS, PaaS, SaaS and other product variants can be introduced in the today's and future's cloud computing market.



8 Updated Project Presentation

The SERRANO high-level project presentation is presented in the following pages.

SERRANO

Transparent Application Deployment in a Secure, Accelerated and Cognitive Cloud Continuum

Project Presentation

Call : H2020-ICT-2020-2
Topic : ICT-40-2020 - Cloud Computing: towards a smart cloud computing continuum
Type of Action: RIA

Grant Agreement no: 101017168
Project start: 01/01/2021
Duration: 36 months
Budget: 4,343,180.00
Site: ict-serrano.eu

Project Administrative Information

SERRANO

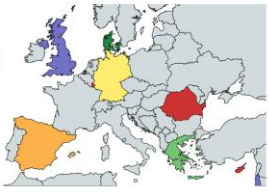
- **Project Name**: Transparent application development in a secure, accelerated and cognitive cloud continuum
- **Call identifier**: ICT-40-20 on "Cloud Computing: towards a smart cloud computing continuum"
- **Project Type**: Research & Innovation Action (RIA)
- **Grant Agreement Number**: 101017168
- **Project Coordinator**: Institute of Communication and Computer Systems – ICCS
- **Duration**: 36 months (01/01/2021 – 31/12/2023)
- **Funding from the EC**: 4,343,180 €
- **Total Budget of the project**: €4,343,180 €

SERRANO project presentation 2

Consortium (11 partners)

SERRANO

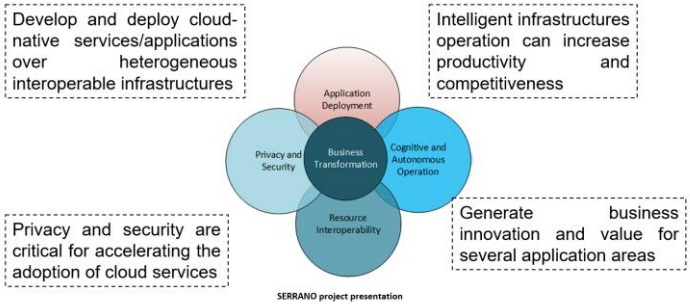
- Institute of Communication and Computer Systems – ICCS (Greece)
- Mellanox Technologies Ltd – MLNX (Israel)
- Chocolate Cloud ApS – CC (Denmark)
- Universitaet Stuttgart – USTUTT/HLRS (Germany)
- Aristotelio Panepistimio Thessalonikis – AUTH (Greece)
- INTRASOFT International SA – INTRA (Luxembourg)
- Inbestme Europe Agencia de Valores S.A. – INB (Spain)
- Innovation Acts Limited – INNOV (Cyprus)
- IDEKO S COOP – IDEKO (Spain)
- Universitatea de Vest din Timişoara – UVT (Romania)
- Nubificus Ltd – NBFC (United Kingdom)



SERRANO project presentation 3

Motivation

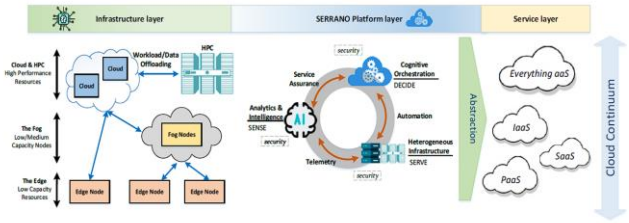
- Cloud transformation of enterprises towards the adoption of the cloud continuum
  - everything as a service
  - edge, cloud, high-performance cloud infrastructures



SERRANO project presentation 4

SERRANO vision

- SERRANO envisages the creation of an abstraction layer that will fully exploit the available resources and automate their use
- This layer will be part of an infrastructure agnostic automation process
- It will translate applications' high-level requirements to infrastructure-aware configuration parameters that are then applied on secure and accelerated resources
- SERRANO targets a hierarchical architecture for end-to-end cognitive orchestration together with closed-loop control, based on the principles of observe, decide and act



SERRANO project presentation 5

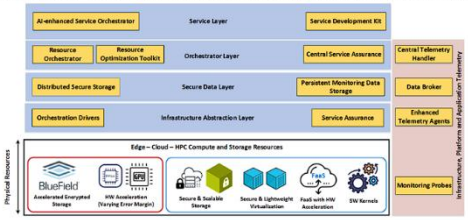
SERRANO objectives

- **Objective 1**: Define an intent-driven paradigm of federated infrastructures consisting of edge, cloud and HPC resources
- **Objective 2**: Develop security and privacy mechanisms for accelerated encrypted storage over heterogeneous and federated infrastructures
- **Objective 3**: Provide workload isolation and execution trust on untrusted physical tenders
- **Objective 4**: Provide acceleration and energy efficiency at the edge and cloud
- **Objective 5**: Cognitive resource orchestration and transparent application deployment over edge/fog-cloud/HPC infrastructures
- **Objective 6**: Demonstrate the capabilities of the secure, disaggregated and accelerated SERRANO platform in supporting highly-demanding, dynamic and safety-critical applications

SERRANO project presentation 6

SERRANO architecture

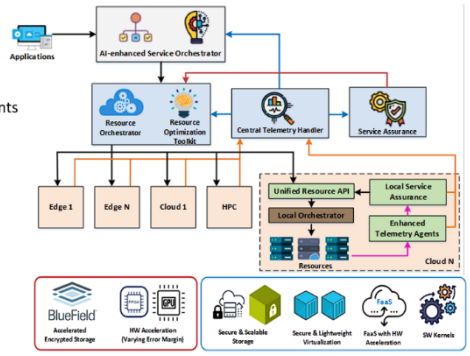
- The **Service Layer** analyses applications to automatically translate their high-level requirements into specific infrastructure operational constraints and orchestration objectives
- The **Orchestration Layer** ensures efficient service orchestration and resource management in the disaggregated and heterogeneous SERRANO infrastructure
- The **Secure Infrastructure Layer** contains all the mechanisms required to enable the secure and trustworthy sharing and access of the resources
- The **Infrastructure Abstraction Layer** abstracts the management and interaction with the individual resources
- The **Resource Layer** consists of heterogeneous computational, storage and networking resources



SERRANO project presentation 7

SERRANO ecosystem

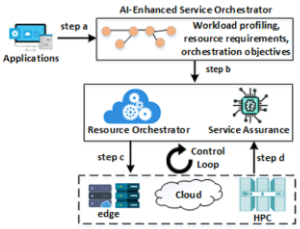
- Orchestration building blocks:
  - AI-enhanced Service Orchestrator
  - Resource Orchestrator, Local Orchestrators
  - Resource Optimization Toolkit
  - Central Telemetry Handler, Enhanced Telemetry Agents
  - Service Assurance
- SERRANO-enhanced resources:
  - Accelerated Encrypted Storage
  - Multi-level Approximate H/W Acceleration
  - Secure and Scalable Distributed Storage
  - Secured and Lightweight Virtualization
  - Software Kernels for computationally Intensive Tasks
- Exposed Software Development Kit:
  - Unified Resource API
  - Telemetry API
  - Distributed Secure Storage API



SERRANO project presentation 8

SERRANO lifecycle

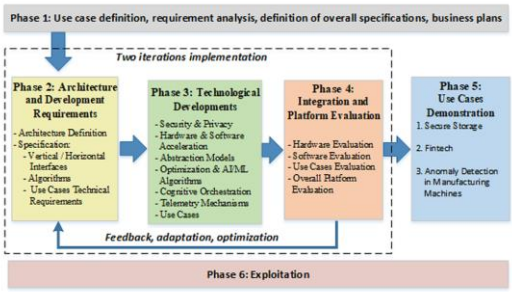
- Enable transparent application deployment: *develop once, deploy everywhere.*
- Lifecycle methodology:
  - **Step a**: Users provide applications along with a high-level infrastructure agnostic description of their requirements.
  - **Step b**: SERRANO profiles applications and decompose high-level requirements into resource and performance requirements.
  - **Step c**: SERRANO allocates resources to applications' and coordinates their deployment and data movement.
  - **Step d**: SERRANO uses real-time telemetry and proactively executes any required re-optimization.



SERRANO project presentation 9

SERRANO methodology

- **Phase 1 -** Initiates technical work:
  - UCs detailed definition and analysis
- Incremental implementation and evaluation.
- **Phase 2:**
  - Detailed SERRANO architecture
  - Ensure integration and interoperability
- **Phase 3** - Implements innovations
- **Phase 4** - Integrates and verifies technological developments
- **Phase 5:**
  - Full functionality demonstration
  - High impact components identification



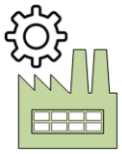
SERRANO project presentation 10

SERRANO (3) use cases

- **Secure Storage**
  - Provide secure and high-performance storage at the edge
  - Integrate SERRANO with a multi-cloud storage service

- **High-performance Fintech Analysis**
  - Apply AI and ML algorithms in financial operations
  - SERRANO will provide security and intelligent fintech app deployment

- **Machine Anomaly Detection in Manufacturing Environments**
  - Detect machine anomalies in real-time
  - SERRANO will orchestrate computations and data from high-frequency machine sensors



SERRANO project presentation 11

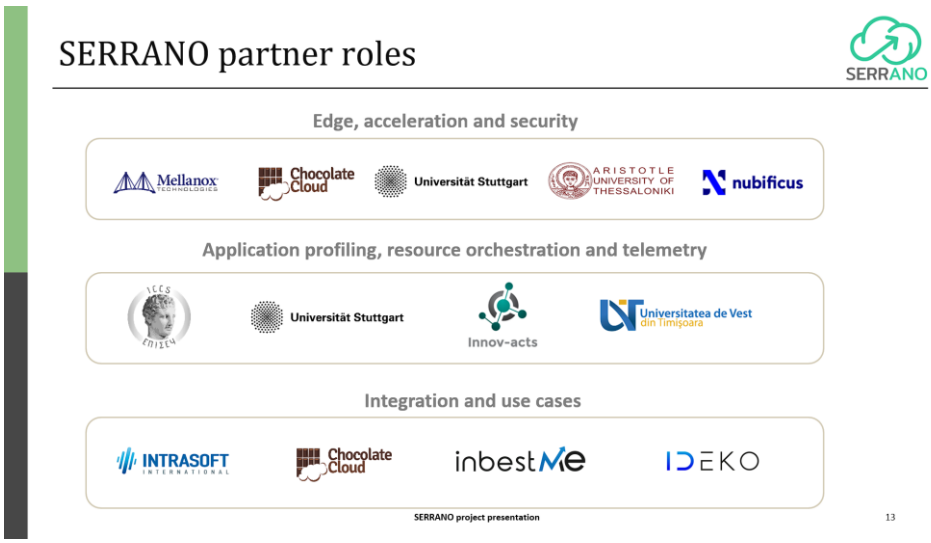
SERRANO market opportunities

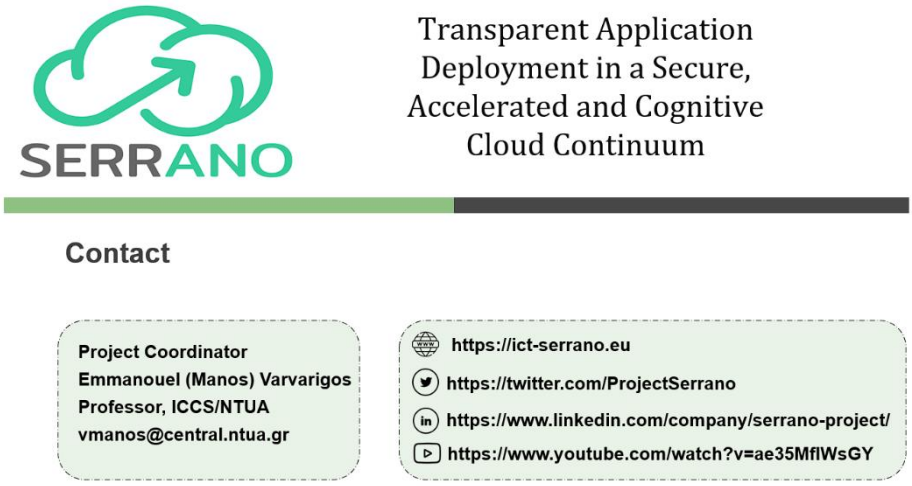
- **Cloud market is soaring**
  - Public cloud service market will grow to $331.2B in 2022, attaining a compound annual growth rate (CAGR) of 12.6%
  - The cloud security market is expected to grow to $12.7 billion by 2022, with a CAGR of 25.5%

SERRANO will boost EU's cloud infrastructures and cloud-native applications markets towards the competitive global market landscape

- SERRANO will develop a novel ecosystem of hardware and software-based technologies, contributing to critical cloud related areas
- A vigorous multi-billion Euro market is addressed and leading industrial players are involved
- Near-market exploitation targeted through specific value propositions, validate by diversified use cases from respective vertical industries

SERRANO project presentation 12


SERRANO partner roles
SERRANO
Edge, acceleration and security
Mellanox
Chocolate Cloud
Universität Stuttgart
ARISTOTLE UNIVERSITY OF THESSALONIKI
nubificus
Application profiling, resource orchestration and telemetry
Universität Stuttgart
Innov-acts
Universitatea de Vest din Timişoara
Integration and use cases
INTRASOFT
Chocolate Cloud
inbestme
IDEKO
SERRANO project presentation
13


SERRANO
Transparent Application Deployment in a Secure, Accelerated and Cognitive Cloud Continuum
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