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Vision

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DISCOVER-US aims to develop a long-term vision for transatlantic computing continuum distributed computing and swarm intelligence (CCDCSI) collaboration.

Collaboration with NSF on fundamental research on new concepts for distribute computing and swarm intelligence

DISCOVER-US provides support and coordination for **EU-US cooperation** initiatives addressing ***fundamental research on new concepts for the continuum of computing, distributed computing and swarm intelligence*** to enable the ***emergence of technological developments in distributed computing*** supported by open technologies and platforms and through the coordination of complementary activities structured around the cloud-to-edge-to-IoT continuum.

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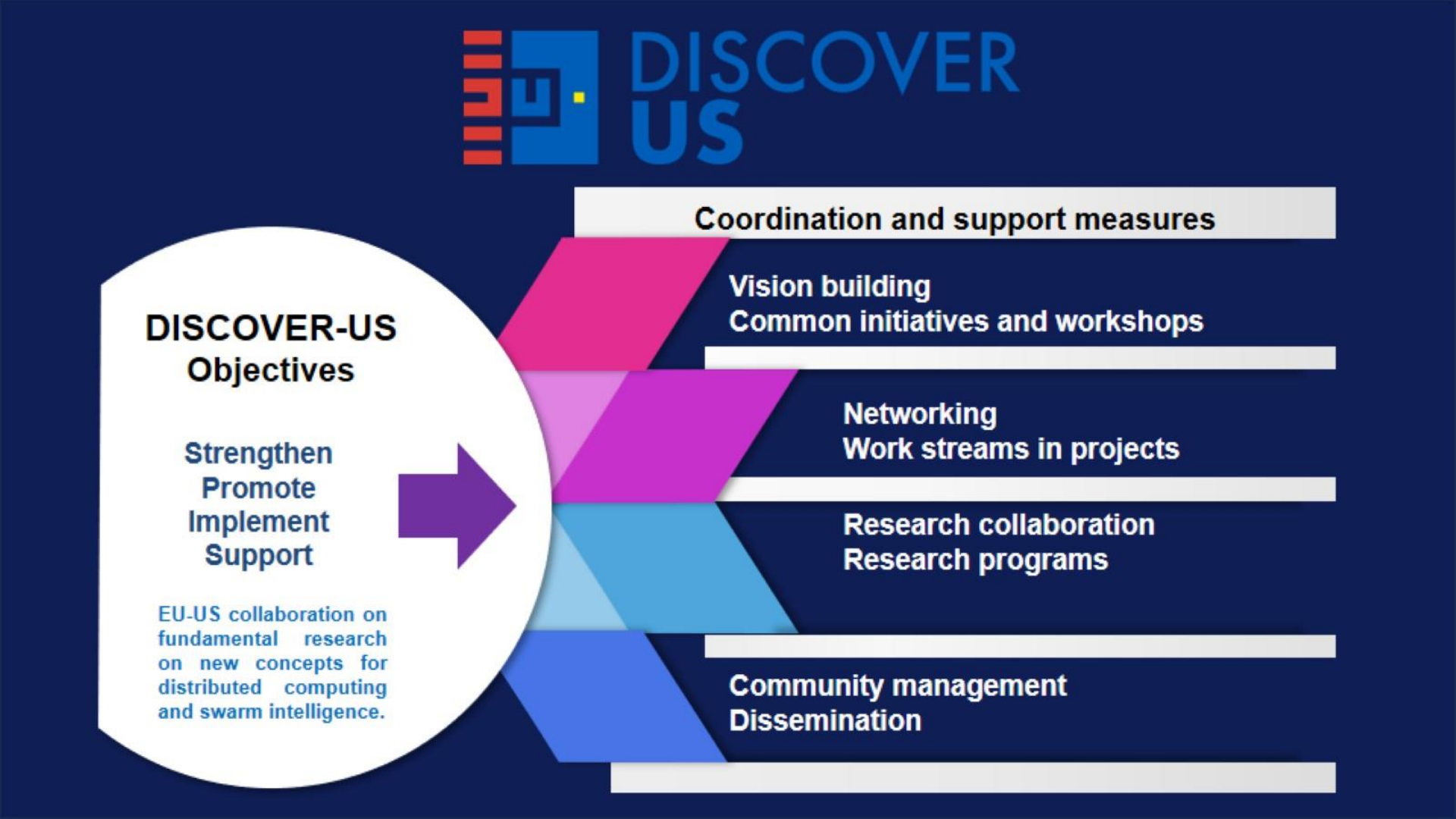
Start of the project:	2024-01-01
End of the project:	2026-05-30
Partners:	Barcelona Supercomputing Center (BSC) CEA Ghent University SINTEF University of Padova
Coordinating institution:	Ghent University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Coordination and support measures
DISCOVER-US
Objectives
Strengthen
Promote
Implement
Support
EU-US collaboration on fundamental research on new concepts for distributed computing and swarm intelligence.
Vision building
Common initiatives and workshops
Networking
Work streams in projects
Research collaboration
Research programs
Community management
Dissemination

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WP1 Cooperative Networking

WP2 Exchange Programs

WP3 Vision Events

WP4 Management and Infrastructure

Complexity through high levels of abstraction

New concepts for distributed computing, swarm intelligence and edge intelligent things

AI-based concepts for self-organised, dynamic, and adaptive management

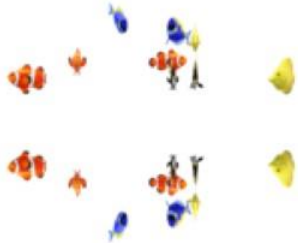
Collaborative programming frameworks and software development tools

Distributed Computing Swarm Intelligence Vision Workshop

Sabaudia, Italy – 24-26 June 2024

Distributed Computing and Swarm Intelligence

- Vision workshop organized over three days including six sessions provided an effective platform for in-depth discussions and knowledge sharing on several specific topics. The workshop included several keynote talks, short pitches of specific technological challenges, roundtable breakout groups discussions, plenary presentations, discussions, and brainstorming.
- The outcome of the workshop is a white paper outlining the short-term and mid-term research challenges. These research challenges are used as a basis for Transatlantic research collaborations funded by DISCOVER-US and the US National Science Foundation in the 2025-2026 timeframe.



Distributed Computing and Swarm Intelligence

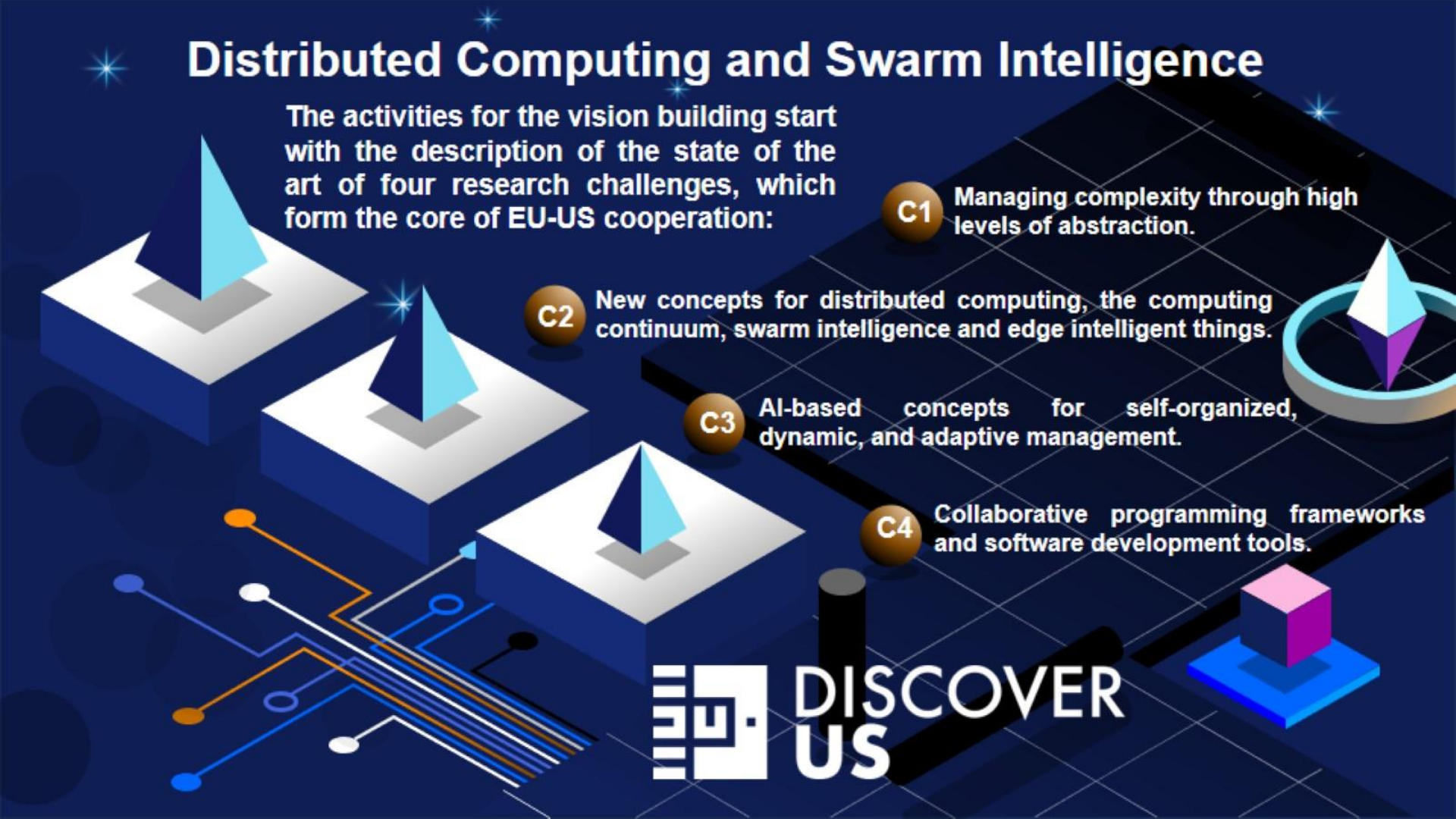
The activities for the vision building start with the description of the state of the art of four research challenges, which form the core of EU-US cooperation:

C1 Managing complexity through high levels of abstraction.

C2 New concepts for distributed computing, the computing continuum, swarm intelligence and edge intelligent things.

C3 AI-based concepts for self-organized, dynamic, and adaptive management.

C4 Collaborative programming frameworks and software development tools.



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Managing complexity through high levels of abstraction.

- **Which methods and languages will be needed for modeling these key abstractions?**

- **Languages** to express tasks (mappable to different levels of abstraction), assertions and pragmas; compilers to generate code deployable to different devices and precision levels.
- **Runtimes and configuration systems**: to express deployment plans for computation & data and to express relationships among such components through contract-based APIs.
- **Domain-specific and event-driven methods**: for optimal adaptive and dynamic placement and orchestration.
- **Methods** to set requirements for safety, security, and privacy-preserving computations.

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New concepts for distributed computing, the computing continuum, swarm intelligence and edge intelligent things.

- **How can swarm intelligence be use to enhance system efficiency and load-balancing?**

- **Metrics and Monitoring**: Use trace metrics, monitoring, swarm-enforced workflows, hybrid scheduling, and AI-enabled load balancing to optimize system efficiency.
- **Optimization and Decentralization**: Address multiobjective optimization problems, emphasizing the importance of decentralization to ensure global optimality.
- **Distributed Learning and Decision Making**: Leverage distributed/federated learning, data and model parallelism, and decentralized edge ML for efficient load balancing and performance monitoring.
- **Proactive Systems and Negotiation**: Implement proactive cognitive systems for self-monitoring and correction, automated negotiation for balancing providers and consumers, and models to manage resource trade-offs.

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AI-based concepts for self-organized, dynamic, and adaptive management.

- **Which are the trends in AI-based self-organization and adaptive management?**

- **Interaction and communication**: semantic communication, contract and collaborative learning models, service orchestration, resource sensing and prediction by anticipating and reacting to changes in available computational and data resources.
- **Adaptive and self-organizing systems**: self and environmental models to enhance decision making, adaptive training procedures, effecting responsive AI systems. Bio-inspired systems. Symbolic reasoning.
- **Foundational techniques and model building**: Large Language Models (LLMs) for self-organization and optimization frameworks. LLMs for telemetry data.
- **Data management data sets, trust**: synthetic data generation. monitoring tools to generate and process data, AI-human trust.

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Collaborative programming frameworks and software development tools.

- **How should AI be integrated in the development of digital continuum apps?**

- **AI Integration Levels**: Integrating AI at various levels (devices, data processing, verification, digital twins), using AI for apps and IoT/edge/HPC.
- **Monitoring and Interaction**: AI for monitoring, human interaction facilitation, and light AI algorithms.
- **Code and Resource Management**: AI for code generation (Carefully!), managing resources, and optimizing decision-making.
- **Workflow Automation**: AI-driven execution, harmonization, and applications in wireless networks for closed-loop performance.

Exchange Proposals

The DISCOVER-US project is calling for proposals of research exchanges from the EU to the US in **distributed computing**, the **compute continuum**, **swarm intelligence** and **edge AI**. Under this umbrella, the main areas of focus are:

- Managing **complexity** through high levels of **abstraction**
- **Self-organization**, **dynamic**, and **adaptive management**
- Collaborative **programming frameworks** and **software development tools**

To this end, DISCOVER-US calls for exchange proposals from EU-based researchers that meet the requirements listed adjacent. The project aims to fund 20 exchanges from the EU to the US in total, over three successive calls.

The National Science Foundation (NSF), which supports this project on the US side, has committed to fund research exchanges from the US to the EU. Further information on the US-side mechanics of this process will be available in due course.

The exchange proposals of interest to DISCOVER-US shall have the following characteristics:

- Relate to **pre-competitive research** efforts in the areas listed on the left.
- Refer to an exchange taking place between **universities or research centres**. To be eligible to participate, applicants must be affiliated to a research institution based in the EU. Private companies are not eligible.
- Establish collaborations that have clear potential to **last beyond the duration of the project**. For this reason, they should preferably be put forward by tenured or tenure-track researchers.
- Have a duration of **minimum 20 days and maximum 30 days**, for which the DISCOVER-US project shall provide reimbursement of travel costs and a per diem allowance.
- Deliver **concrete outputs that can be shared** with members of the DISCOVER-US community and beyond. Eligible outputs include, but are not limited to, joint academic publications, white papers, project concepts for joint grant proposals, new courses, and book proposals.

Successful applicants will become members of the DISCOVER-US network.

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Thank you!

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