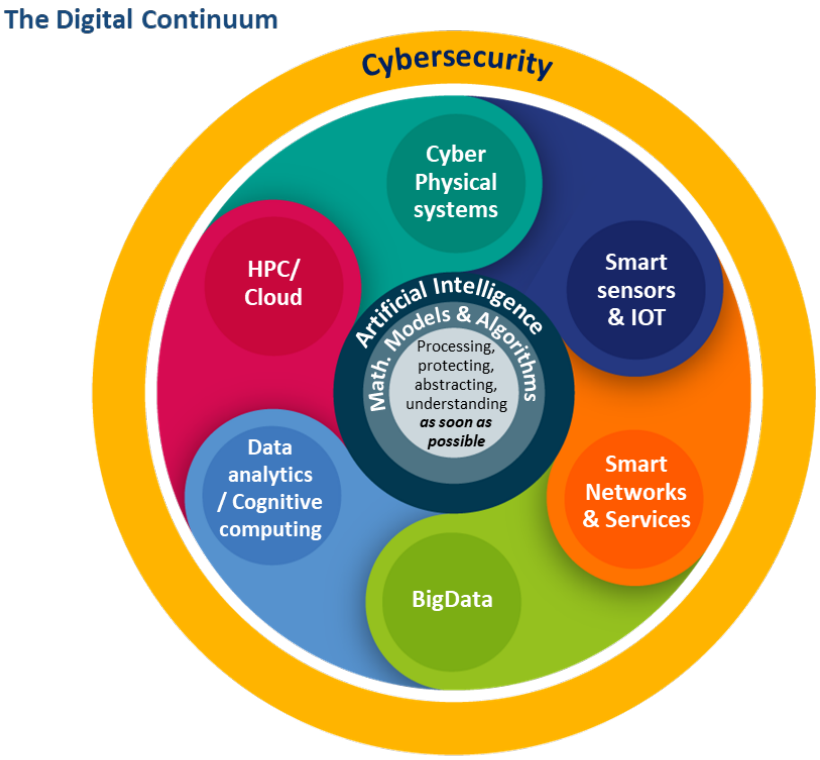
TransContinuum Initiative (TCI): our vision

Introduction

This document outlines a vision for a horizontal collaboration between European associations and projects involved in IT technology, application and services provisioning for the Digital Continuum.

The term TransContinuum describes the defining characteristic of the infrastructure required for the convergence of data and compute capabilities in many leading edge industrial and scientific use scenarios. A paradigm change is needed: we will have to design systems encompassing millions of compute devices distributed over scientific instruments, IoT, supercomputers and Cloud systems through LAN, WLAN and 5G networks.



A continuous dynamic workflow

Between
Smart Sensors and IOT devices at the edge
and
HPC / cloud centers
over
Smart Networks and Services
executing
Simulation & Modelling, Big Data Analytics, ML*
based on
Math. Methods & Algorithms incl. MSODE**
pervasively augmented by
Artificial Intelligence
protected and secured by
Cybersecurity
back to
Cyber-Physical Systems

* ML: Machine Learning
** MSODE: Modelling, Simulation and Optimization in Data-rich Environment

Original version courtesy of HiPEAC

The Digital Continuum

We observe a continuous miniaturisation of computing and storage devices, as well as their ubiquitous deployment ranging from data centres to the edge and beyond. There is also the need for enabling workflows beyond single control domains like a data centre. Therefore, a new overall system architecture must be designed to accommodate the ecosystem changes to be expected in the coming decades (environmental and technological) and horizontally integrate the different actors.

The new demands and challenges, having an impact on the need to combine data, storage and compute, to have them distributed across the continuum, and ensure lifecycle maintenance and resource efficiencies, are pushing for drastically increased software and hardware sustainability. Furthermore, the need to provide high-level cybersecurity to rely on dependable and resilient components, services and digital infrastructures is profoundly changing the game. Efficiency and resilience will have to reach levels never achieved thus far, while taking into account the intrinsic distributed and heterogeneous nature of the continuum. In addition, the question of dealing with very high volumes of data needs to be addressed, and the preponderance of quality versus quantity will become unavoidable. These considerations will spread out over all components.

Long-lifetime hardware devices will have to be reconfigurable, modular, exchangeable, and self-aware in order to be operational over extended periods. Algorithmic efficiency will need to be drastically improved (e.g. more efficient AI), which requires development of basic modelling, simulation and optimization methodologies in data-rich environments (MSODE), including model-order reduction. Management and deployment of large-scale application workflows will have to be adapted or invented. Network protocols will have to offer better control over the data logistics.

Furthermore, it is widely recognised that AI will play a central role in these extreme-scale, continuum infrastructures. This will occur at three levels:

- **AI for Digital Infrastructure** addresses how AI-inspired techniques can pilot and monitor the continuum and, in so doing, provide solutions to the points listed above.
- **Digital Infrastructure for AI** treats the question of re-designing the e-infrastructure to efficiently deal with data analysis and machine learning, which means, among others, tuning of data access, I/O, low precision arithmetic, and moving code and data to where it will be most efficiently performed.
- **AI for Science, Industry and Societal Challenges** deals with the ever-increasing need to exploit AI techniques for extreme-scale, combining Data and Compute through the interpretation and coupling of computing results, measurements and observations (e.g. Digital Twins in extreme earth modelling, combining climate models with satellite data and on-ground sensors).

The overall objective is to focus on high TRL solutions (7 and more), based on **horizontal synergies and interdependencies between all the concerned digital infrastructure technologies**: HPC, Big Data, Machine Learning, IoT, 5G, cybersecurity, processor technology (EPI) and robotics. All of these components of the digital infrastructure will *together* be able to address the critical societal challenges and sustainable development goals by mobilising their amazing potential all the way across the continuum.

Objectives and Scope

The Transcontinuum Initiative will focus on collaboration towards the following five objectives:

- **Identify priorities and recommendation for European R&I work programs**

  Jointly we will elaborate recommendations for R&D to be carried out in EU- or JU-funded work programs addressing challenges in the digital continuum. The recommendations will cover challenges in technological (hardware and software) functionality, interoperability, and APIs. New standards, best practices, methodologies and project-type related suggestions will also be generated. Applications deployed in the digital continuum are addressed wherever needed.

- **Engage in discussions with European R&I funding agencies and R&D programs (e.g. JUs, Missions)**

  The recommendations will be presented to EU-funding entities like Joint Undertakings (JUs) and applicable programs in the MFF 2021-2027. TCI representatives will be available for presenting and explaining the recommendations as well to discuss any possible further analysis and elaborations.

- **Generate and foster an interdisciplinary network of experts in science and industry**

  We look forward to a lively exchange of ideas about EC work programs, calls and related events, events of partner organisations and potentially joint activities. We will jointly analyse new industrial and scientific use cases to better understand the challenges presented, together with an identification of “weak signals” for preparing the future. On one side this is a pre-requisite for any R&I recommendations, on the other side it facilitates the forming of interdisciplinary consortia for upcoming calls. We would like to include recognised experts from industrial stakeholders in this process. Through this network, we also intend to promote skills that can be applied in both making use of the assets of the continuum and building extreme-scale applications on top of the continuum, targeting various audiences.

- **Contribute to SR(I)As and other partners’ documents**

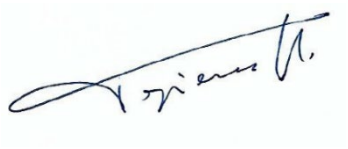
  Based on the results of the joint work mentioned above, contributions to the Research and Innovation Agendas or any other road mapping documents issued by participating partners will be offered. These contributions will focus on the interdisciplinary technical aspects and extend the concept of co-design to cover the entire continuum.

- **Contribute to the 5 Horizon Europe missions**

  One of the first pragmatic actions will be to design the contribution of the Digital Twin enabler to the Horizon Europe missions (adaptation to climate change including societal transformation, cancer, healthy oceans, seas coastal and inland waters, climate-neutral and smart cities, soil health and food.) These missions will need digital technologies to achieve their respective goals and Digital Twins should be one of the key elements.

Participating organisations

ETP 4 HPC — EUROPEAN TECHNOLOGY PLATFORM FOR HIGH PERFORMANCE COMPUTING



Jean-Pierre Panziera, ETP4HPC chairman

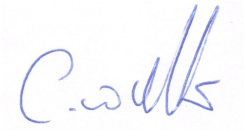
ECS — EUROPEAN CYBER SECURITY ORGANISATION

Luigi Rebuffi, ECSO Secretary General

BDV — BIG DATA VALUE ASSOCIATION

Thomas Hahn, president of BDVA

5G IA



Colin Willcock, 5GIA chairman

EU MATHS IN — EUROPEAN SERVICE NETWORK OF MATHEMATICS FOR INDUSTRY AND INNOVATION

Wil Schilders, president of EU-MATHS-IN

CLAIRE

Philipp Slusallek, CLAIRE Co-Founder and Member of the Board

HiPEAC

Koen De Bosschere, HiPEAC coordinator

Alliance for Internet of Things Innovation

Jürgen Sturm, Chairman of the Management Board