



# The TransContinuum-Initiative (TCI) in a nutshell

Introduction and update

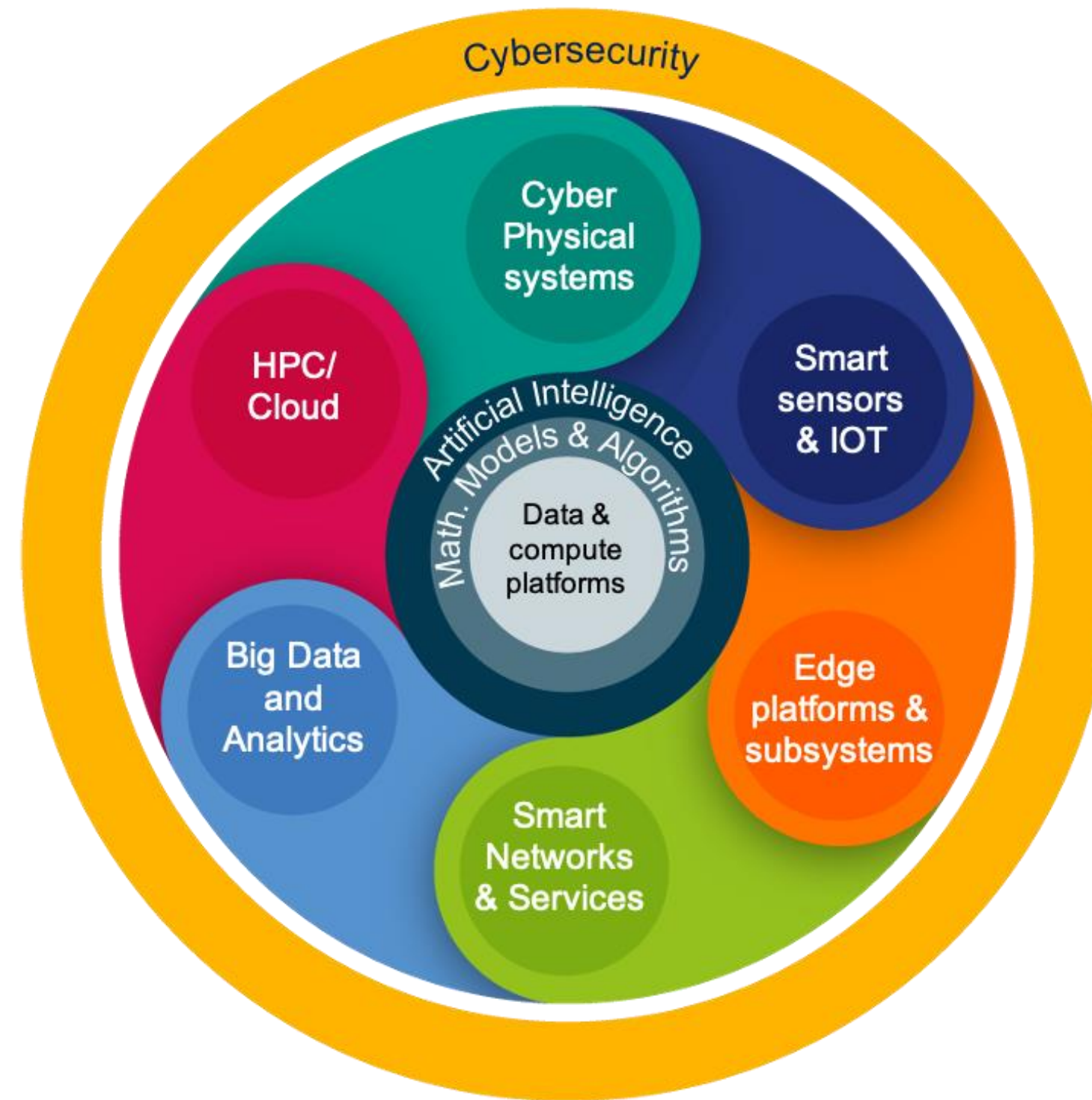
M. Malms, ETP4HPC

M. Duranton, CEA

September 9th 2021

# Our vision of future applications

**More and more use cases spread all over the « *continuum of computing* » from deep edge to cloud/HPC.**



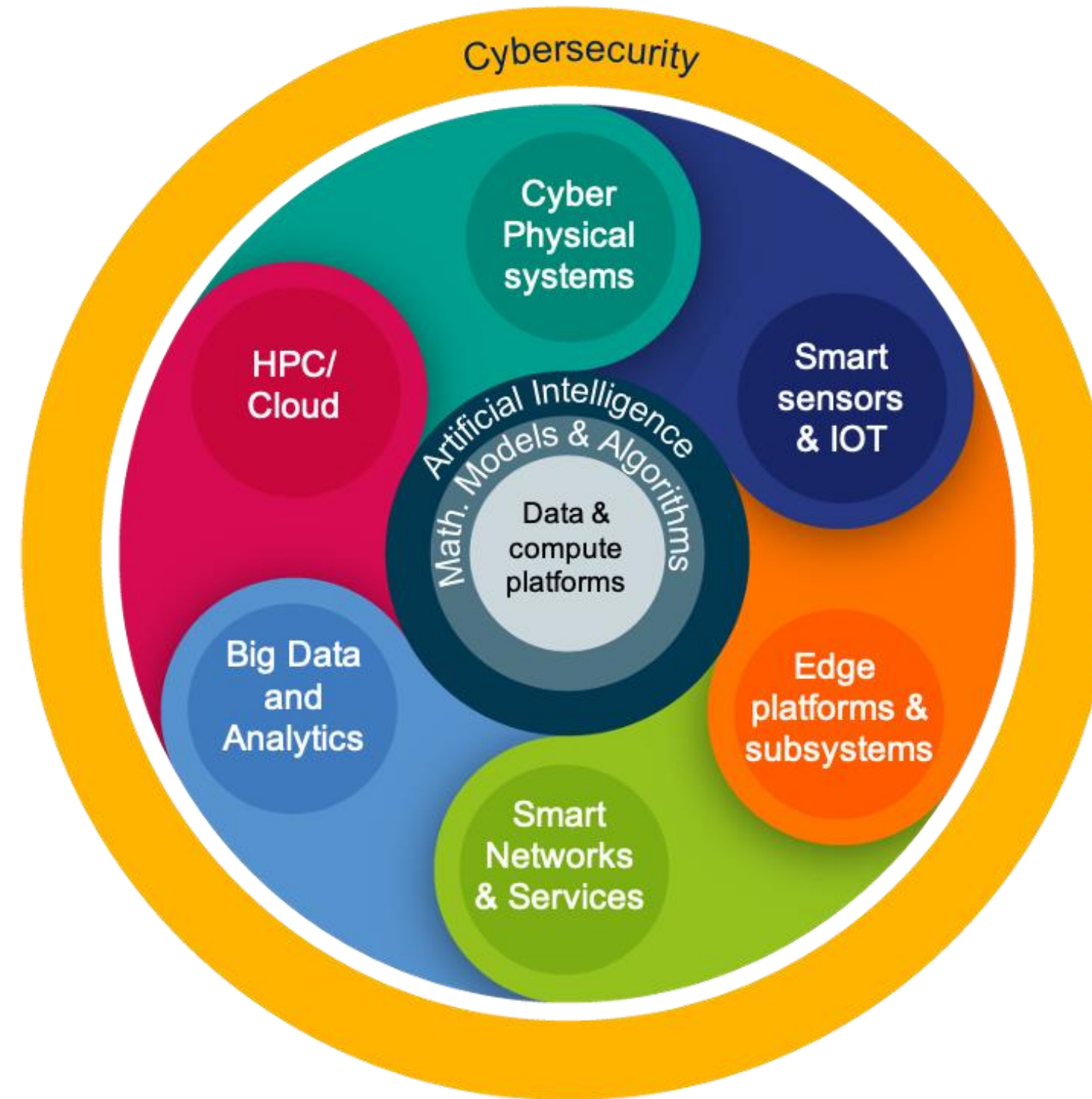
Original courtesy HiPEAC

\* ML: Machine Learning

\*\* MSODE: Modelling, Simulation and Optimization in Data-rich Environment

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## A continuous dynamic workflow

Between  
**Smart Sensors and IOT devices**

and  
**HPC / cloud centers**

passing through  
**Edge platforms & subsystems**

as well as  
**Smart Networks and Services**

executing  
**Simulation & Modelling,  
Big Data Analytics and ML\***

based on  
**Math. Methods & Algorithms incl.  
MSODE\*\***

pervasively augmented by  
**Artificial Intelligence**

protected and secured by  
**Cybersecurity**

back to  
**Cyber-Physical Systems,**

all based on  
**Data and compute platforms (hw and sw)**

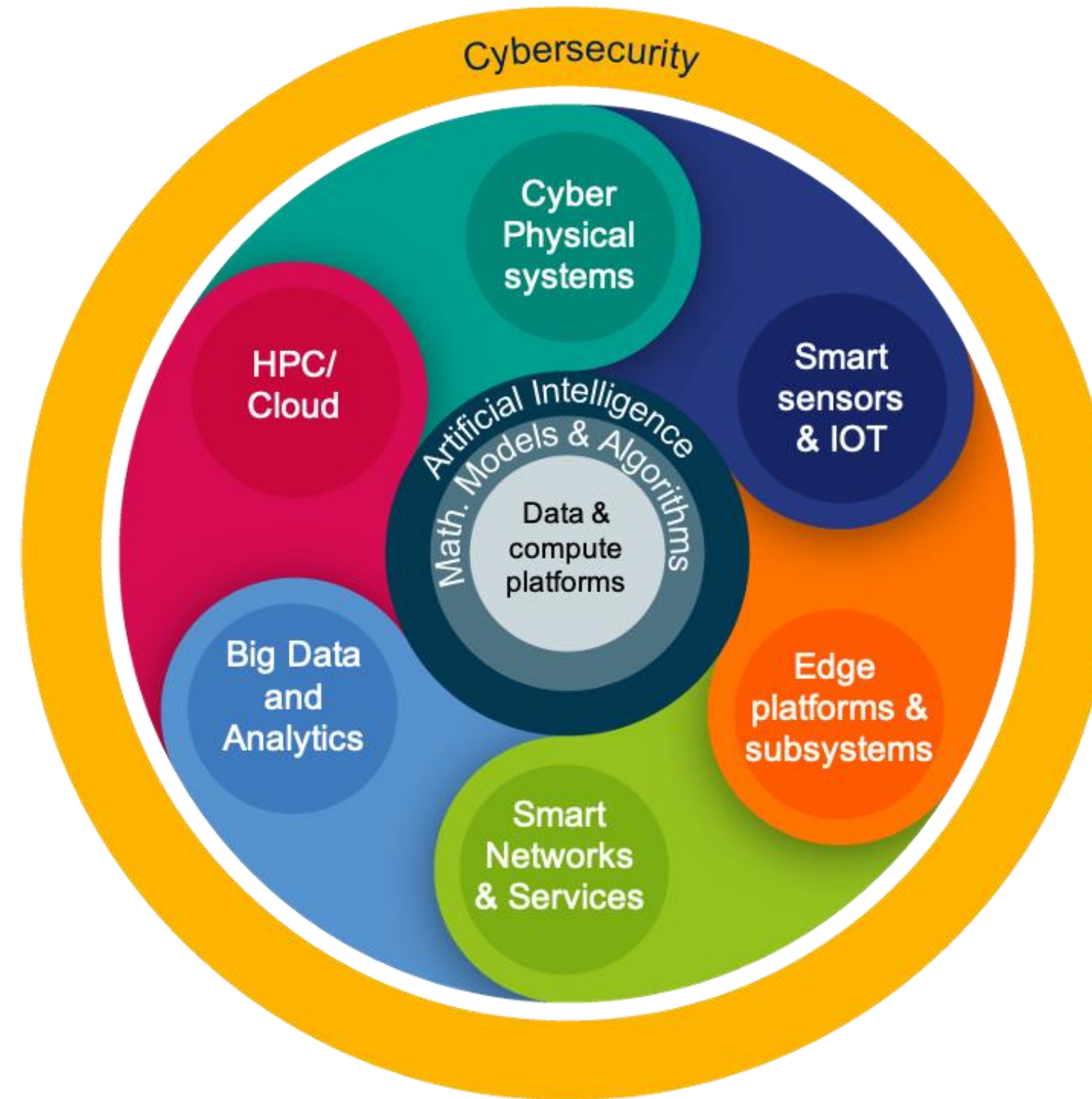


# Our vision of future applications

More and more use cases spread all over the « *continuum of computing* » from deep edge to cloud/HPC.

How to ensure that all elements/communities are efficiently orchestrated?

We need to have global exchanges and identify interoperability and challenges that are between communities...



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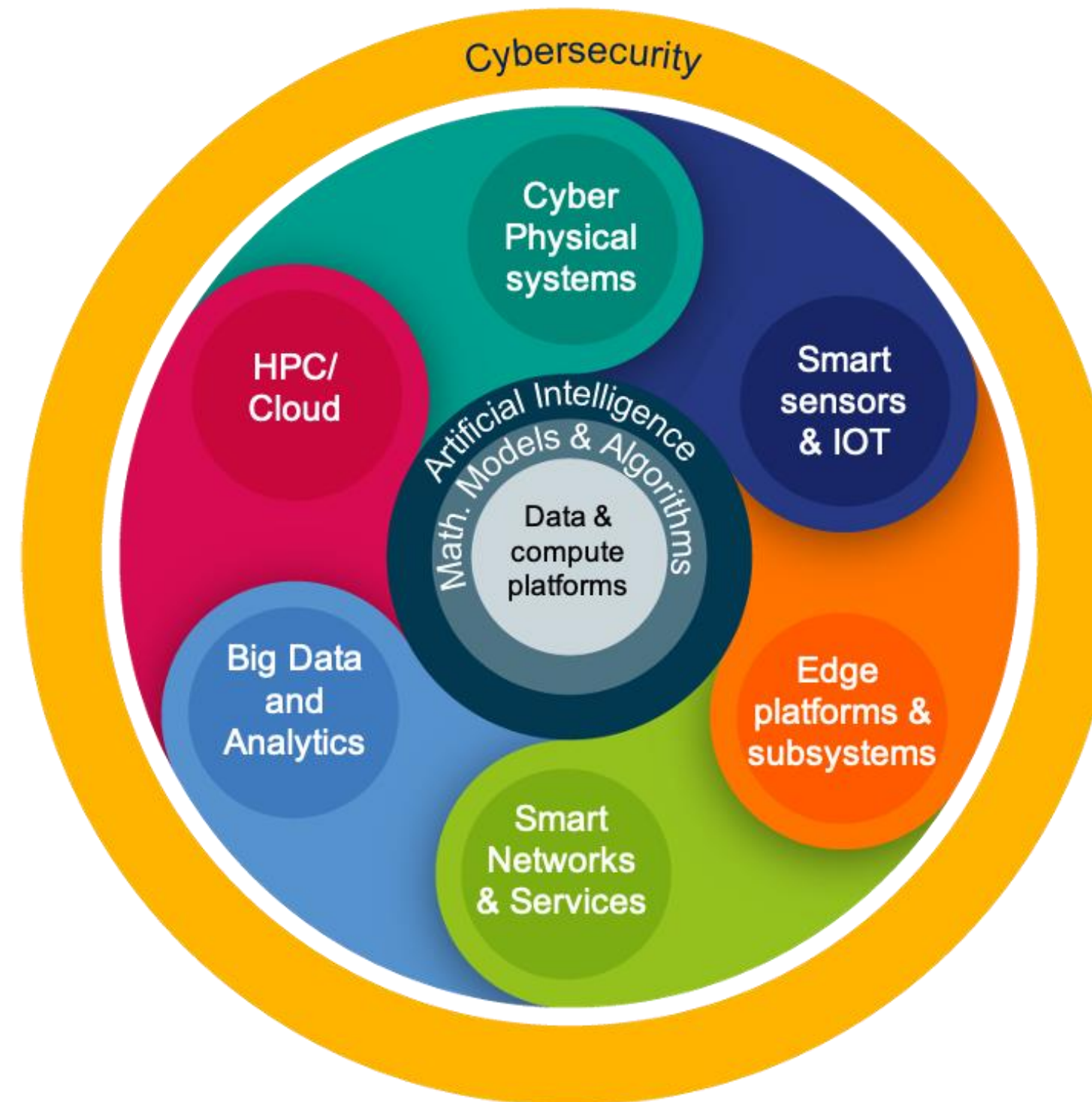
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### Participating organisations



Jean-Pierre Panziera, ETP4HPC chairman



Luigi Rebuffi, ECSO Secretary General



Thomas Hahn, president of BDVA



Colin Willcock, 5GIA chairman



Wil Schilders, president of EU-MATHS-IN



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



Koen De Bosschere, HiPEAC coordinator



Jürgen Sturm, Chairman of the Management Board



**8 European Associations Commit to TransContinuum Initiative for EU R&D Cross-domain Collaboration**

[insidehpc.com/2020/12/8-european-associations-commit-to-transcontinuum-initiative-for-eu-rd-cross-domain-collaboration/](https://insidehpc.com/2020/12/8-european-associations-commit-to-transcontinuum-initiative-for-eu-rd-cross-domain-collaboration/)  
Doug Black

December 11, 2020



# The basic concept: TCI scope and objectives

- Identify priorities and recommendations for European R&I workprogrammes
- Engage with European R&I funding agencies and R&D programmes
- Generate and foster an interdisciplinary network of experts in science and industry
- Contribute to SR(I)As and other partner's documents
- Contribute to the 5 Horizon Europe Missions



➤ see also [“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.

The Digital Continuum



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Original version courtesy of HIPEAC

Working groups started early 2021

# First steps: Digital Twin use case analysis

- In-depth analysis of three Digital Twin use cases:  
“What are the implementation challenges in the next 3-5 years – throughout the entire digital continuum ”





### Urban air pollution use case

Zoltán Horváth, SZE  
Uwe Iben and Björn Rocker, Bosch

TCI Use Case Analyses, 2021-02-11





## Extremes prediction & the Digital TransContinuum

Technical dimension

The TransContinuum Initiative: exploiting the combined benefit of digital technologies for the prediction of weather and climate extremes

By Peter Bauer, Marc Duranton, Michael Malms

### The Extremes Prediction Use Case

Dealing responsibly with extreme events requires not only a drastic change in the ways society addresses its energy and population crises. It also requires a new capability for using present and future information on the Earth system to reliably predict the occurrence and impact of such events. A breakthrough in Europe's predictive capability can be made manifest through science and technology solutions delivering as yet unseen levels of predictive reliability with real value for society.





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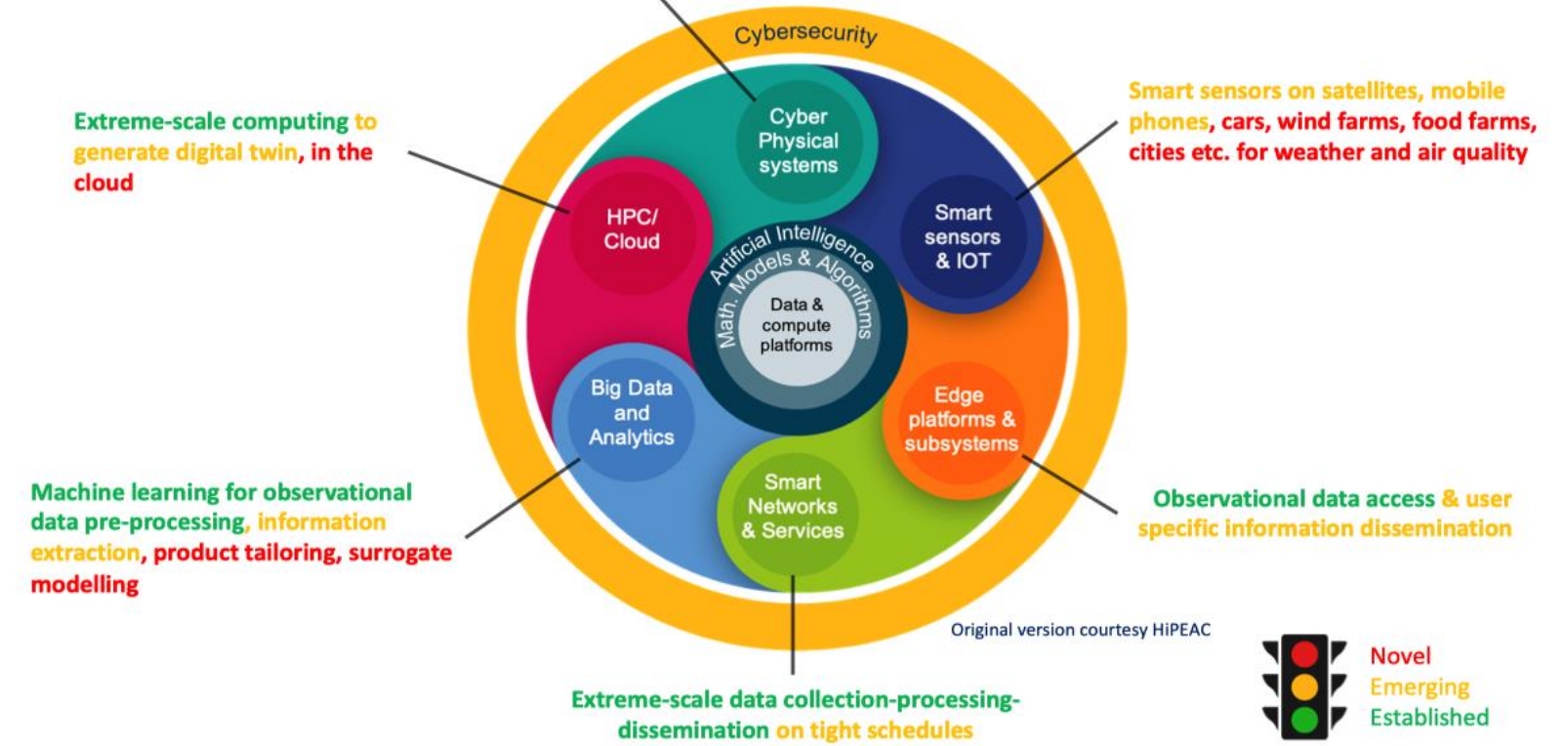
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## Present state of development

Cyber-physical entanglement of real-time, digital twin of Earth system, optimal information of user-specific information on demand and physical systems in impact areas: energy, water, food, health, disaster management



ECMWF

EUROPEAN CENTRE FOR MEDIUM-RANGE WEATHER FORECASTS

Original version courtesy HiPEAC



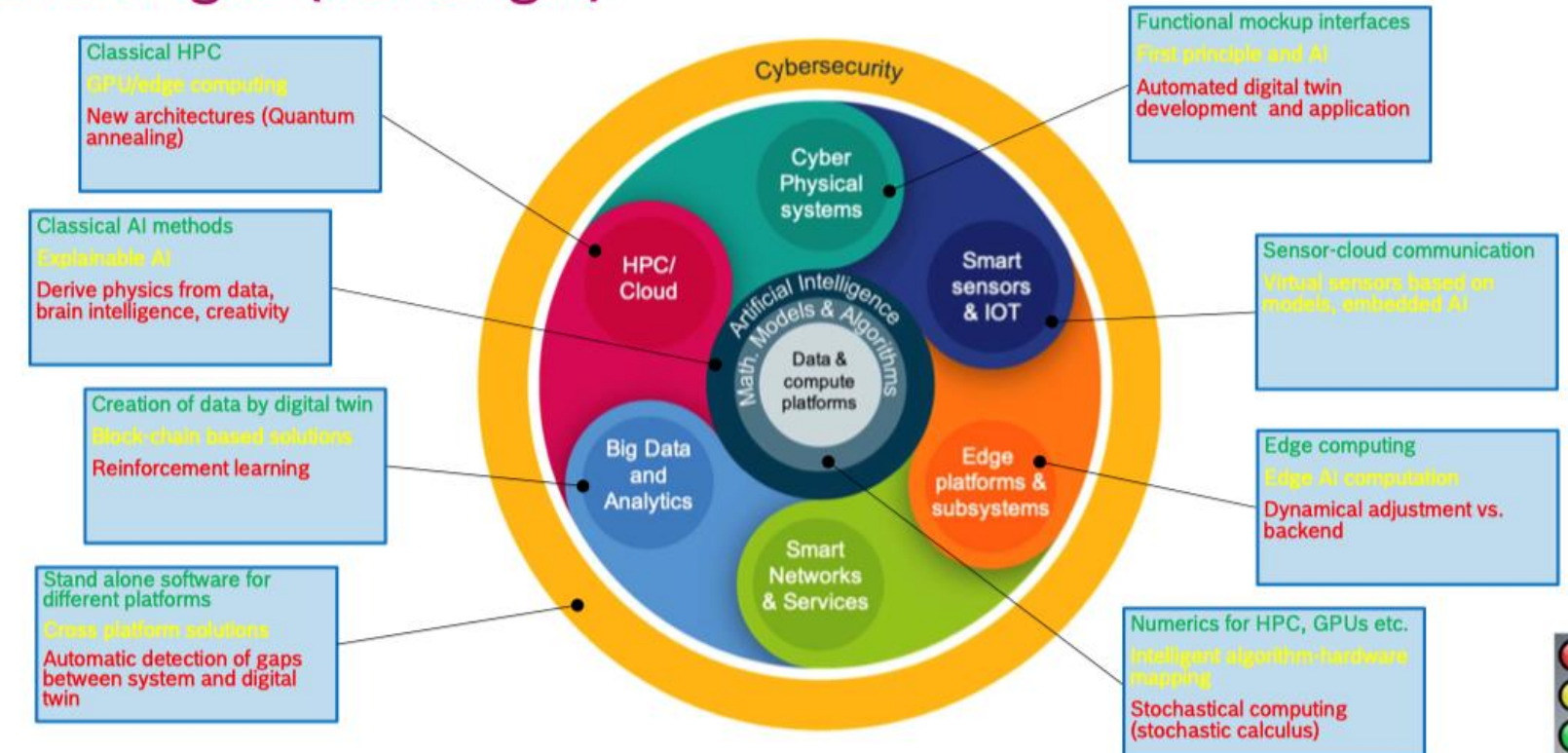
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## EU-MATH-IN 2021 Challenges (traffic light)







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## Key recommendations

- Future systems will require at least 100 times more computational power for producing reliable predictions of Earth-system extremes with short lead times. It will require implementing an Earth-system digital twin – a cyber-physical entanglement. A solution is a layered federation with fewer elements near the heavy workloads and more elements at the observational data pre-processing front-end and the data analytics post-processing back-end.
- The extensive use of edge computing needs low-cost yet high-performance computing facilities and to overcome the data-transfer bottlenecks between the computing and data intensive parts of the digital twin and downstream applications
- Interoperable machine learning tool-kits facilitating the portability of data processing in the cloud and workflow management options in the cloud for orchestrating the rather complex data assimilation and Earth-system simulation workloads should be developed
- Several domains need to be simultaneously promoted:
  - for software: interactive workflows, mathematical methods and algorithms, high-productivity programming environments, performance models and optimization tools.
  - for hardware: heterogeneous processor configurations through accelerators and data-flow engines, high-bandwidth memory, deep memory hierarchies for I/O and storage, super-fast interconnects and configurable computing including the supporting system software stack.



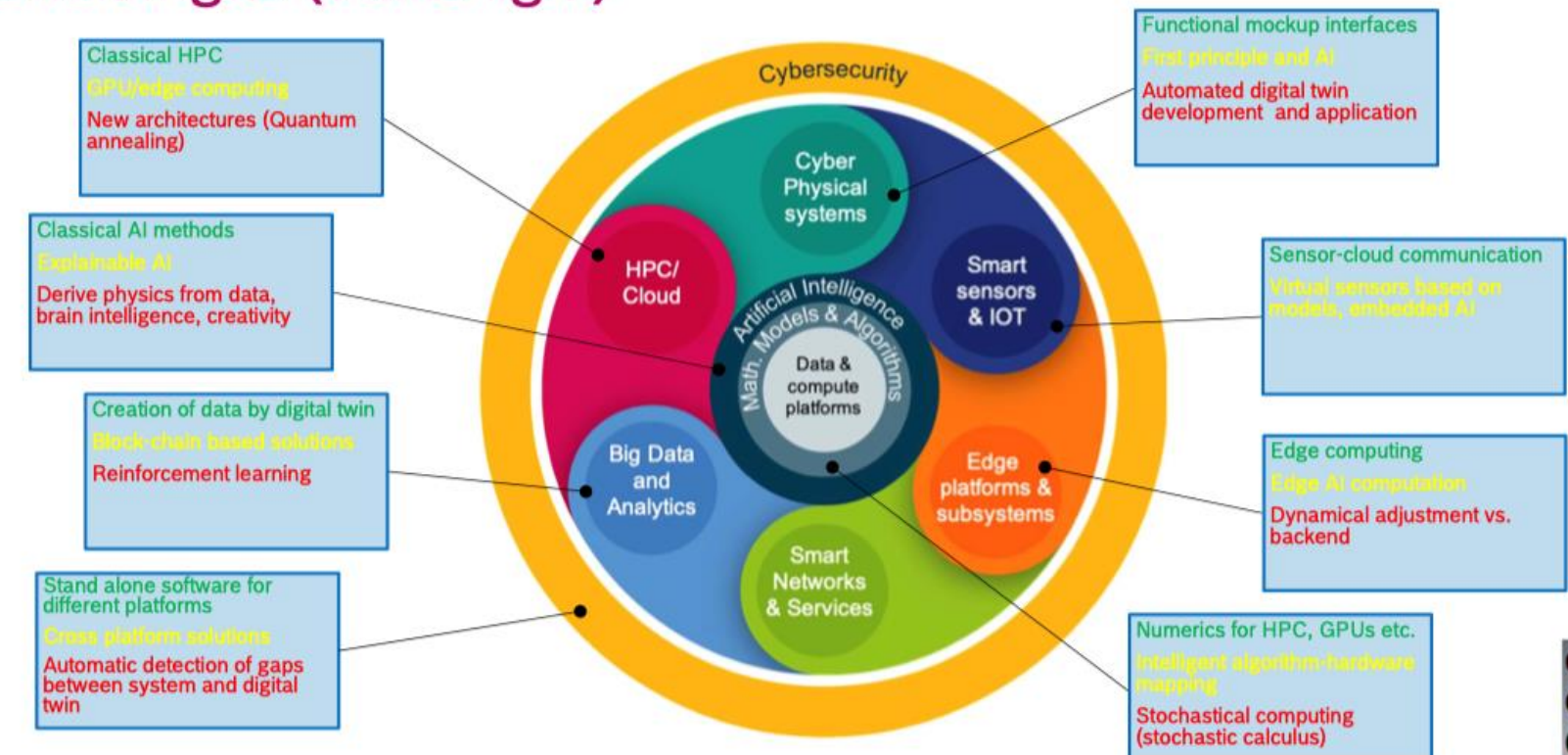
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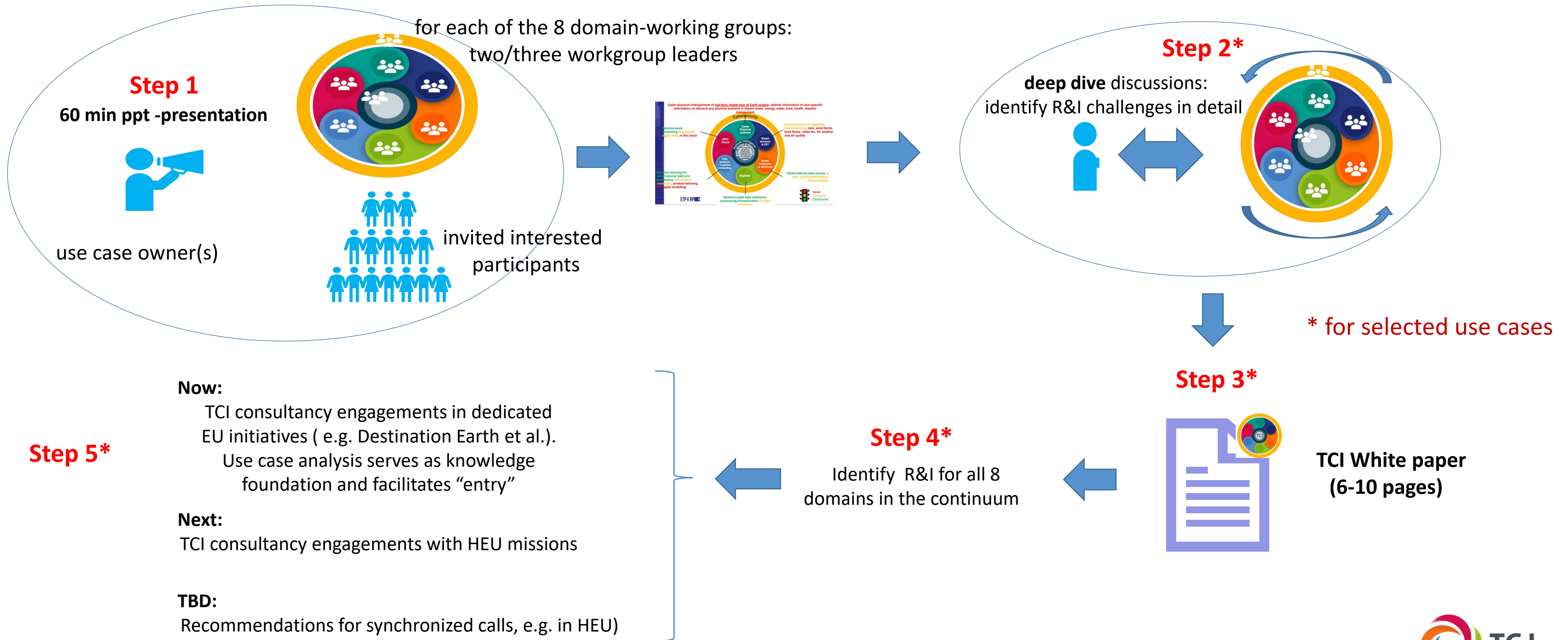
# TCI – how are we organized?

- 8 associations/projects on board
- Interlocks on 3 levels:
  - **Core team** for steering and decisions
    - meets 'on demand'
  - **Use case analysis team**
    - kickoff was Dec 14<sup>th</sup> 2020
    - meets every 3-4 weeks
  - **Quorum calls** for general information sharing
    - average every 8-12 weeks, currently 40+ participants

Domain	Analysis workgroup leaders	Analysis workgroup members
HPC	Jens Krüger, FRAUNHOFER Hans Christian Hoppe, SCAPOS Nicolas Tonello, CONSTELCOM	Sabri Pllana, LNU Antonio Cervone, E4
Big Data	Maria Perez, UPM Gabriel Antoniu, INRIA	Nenad Stojanovic, NISSATEC
AI	Valerio Frascolla, INTEL	
Cyber Security	Alexey Kirichenko, F-SECURE Evangelos Markatos, ICS-FORTH Fabio Martinelli, IIT-CNR Matthias Hiller, AISEC-FRAUNHOFER	Aidan O Mahony, DELL Jose Francisc Ruiz, ATOS
Cyber Physical Systems	Marc Duranton, CEA Martin Törngren, KTH Charles Robinson, THALES	
Mathematical Models and Algorithms	Zoltan Horvath, EU-MATHS-IN Christophe Prud'homme, CEMOSIS Peter Maass, UNI-BREMEN	
Industrial IOT and Edge Subsystems & Platforms	Georgios Karagiannis, HUAWEI Ovidiu Vermesan, SINTEF	David Faura THALESGROUP Anatole PHAM NGUYEN DUY
Smart Networks and services	Pierre-Yves Danet, ORANGE Valerio Frascolla, INTEL	Ahmed Khalid, DELL



# Use case analysis: the process



## Next step: TransContinuum-Initiative - Network of Experts (TCI-NE): Consultancy for Destination Earth

- TCI partners to engage in consultancy project for Destination Earth
  - DestinE to go live in November 2021
  - Project scope: “Generate a SRA like document tailored to the needs of DestinE”
    - In-depth interactive analysis of DestinE technical implementation plans
    - Identify R&I priorities supporting DestinE’s 7- year roadmap
    - Recommend priorities for calls issued by DestinE in phase 2 and 3 ( 2025+)
- could be model for further engagements ( e.g. for the 5 Missions )

## Destination Earth (DestinE)

### PAGE CONTENTS

Implementation

Digital twins

Preparing for DestinE

Related links

The objective of the Destination Earth initiative is to develop a very high precision digital model of the Earth to monitor and simulate natural and human activity, and to develop and test scenarios that would enable more sustainable development and support European environmental policies.



<https://digital-strategy.ec.europa.eu/en/policies/destination-earth>



## To conclude:

### TCI positioning and USPs:

- “Breaking the silos” between IT R&D disciplines & related organisations in Europe
- Agile, “bottom up” initiative based on a common vision and desire to strongly collaborate
- Open to new players interested in drafting R&D priorities for the digital continuum in the forthcoming years
- TCI is a “means/tool” to generate a holistic R&D view for specific use scenarios
- TCI does “not have the answers” for any scenario right away, but intends to “pave the way to the answers”



Thank you !



**Dr. MICHAEL MALMS**

ETP4HPC Office

[michael@office.etp4hpc.eu](mailto:michael@office.etp4hpc.eu)

Mobile. +49 151 1943 2736

[office@etp4hpc.eu](mailto:office@etp4hpc.eu)

[www.etp4hpc.eu](http://www.etp4hpc.eu)