



Newcastle Cyber-Physical Lab: A UK cross-disciplinary design centre

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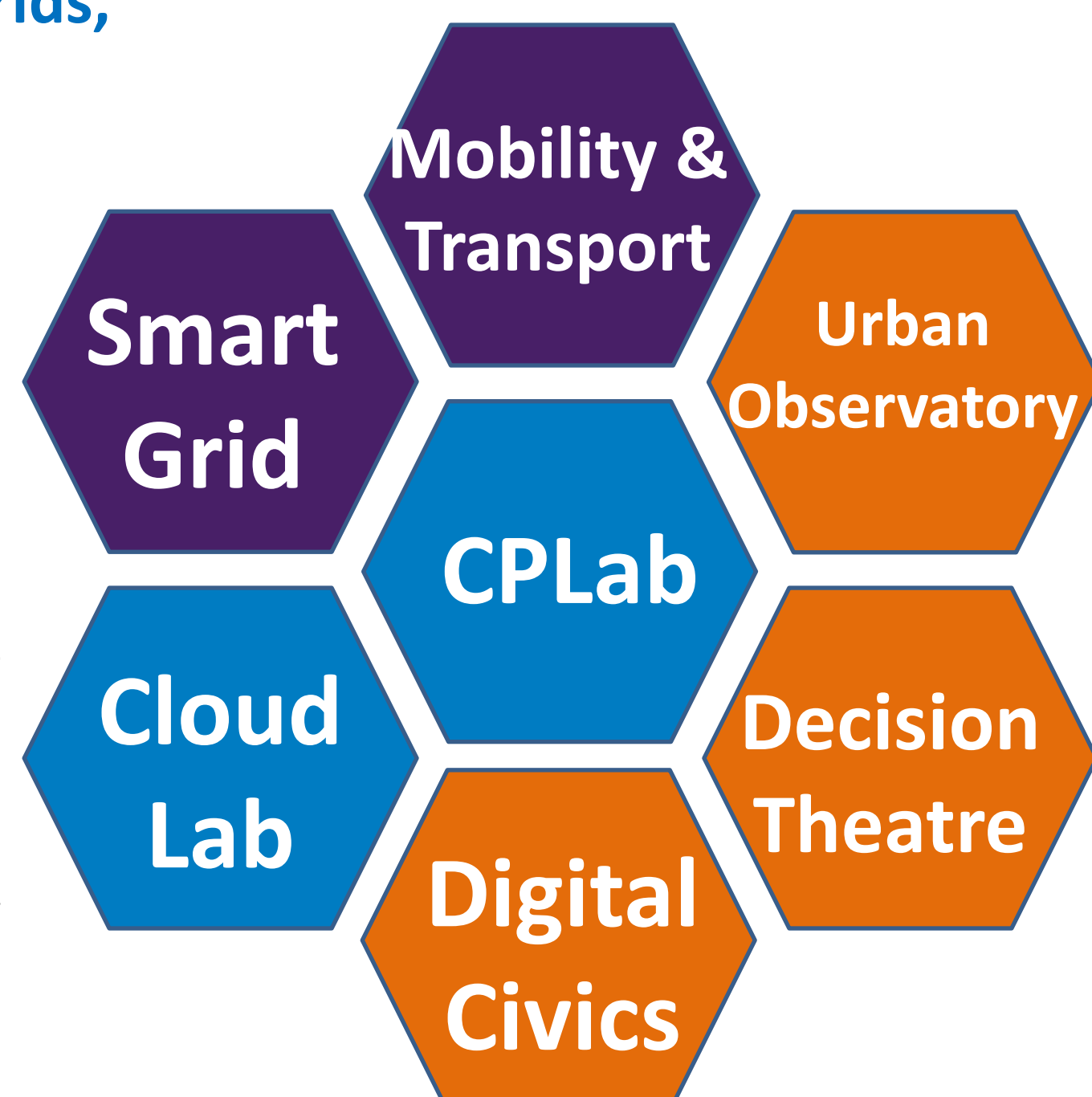
Introducing Cyber-Physical Systems

The rising prevalence of smart devices and ubiquity of high speed internet connectivity are contributing to the development of Cyber-Physical Systems (CPSs). These are networked coalitions of **cyber (software, computing) & digital** and **physical (electrical, mechanical, etc.)** elements. There are many challenges in developing trustworthy CPS:

- Control is distributed but needs to preserve global properties
 - Potential physical and communication failures means sophisticated error detection and recovery mechanisms are needed
 - Rapid development is required to keep ahead of the competition
- These challenges imply a need for **collaborative engineering** across the many CPS-related engineering and computer science disciplines.

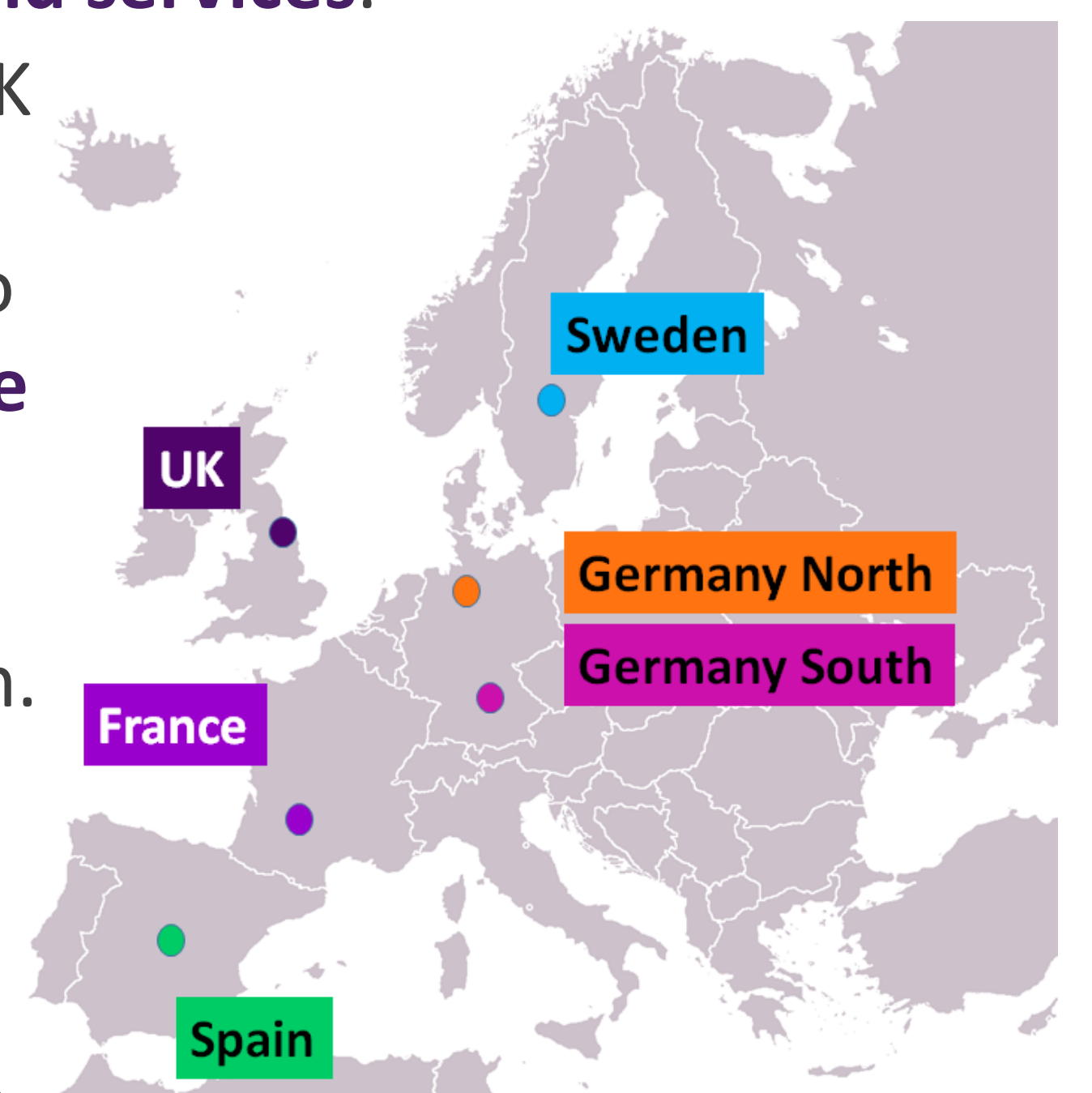
Establishing a Cyber-Physical Laboratory

In response to the engineering challenges of CPS, Newcastle University is founding a Cyber-Physical Laboratory (CPLab) to create a learning, research and innovation community in CPSs. As part of a **£58m investment** from Newcastle University in the "Science Central" initiative, **CPLab will be co-located with labs focussing on smart grids, transportation, digital interaction and cloud computing, as well as a decision theatre and an urban observatory.** All share a common theme of **digitally enabled urban sustainability** via integrated research, and together they provide a high quality, cross-disciplinary platform for tackling societal challenges. **Newcastle's CPLab will draw on this community to develop scientifically and semantically well-founded methods and tools that will enable collaborative development of CPSs across engineering disciplines, working closely with industry to enable innovation.**



In recognition of the Lab's expertise, Newcastle's CPLab is currently participating in a new EU-funded initiative called CPSE Labs, which supports Europe's innovators by providing **funding and technical support** to bridge the gap between cutting-edge CPS research and the marketplace. Under this scheme CPS businesses are invited to propose experiments that will result in **innovative new CPS products and services.**

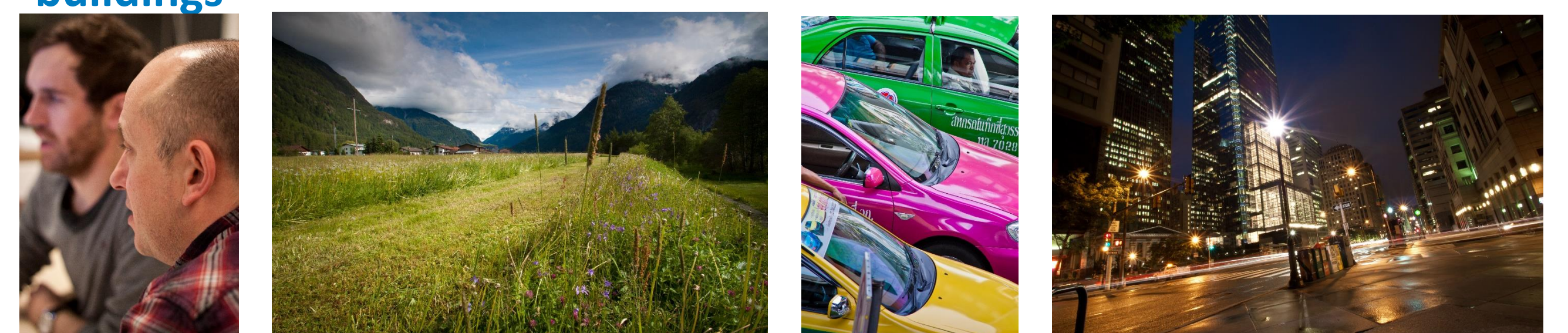
Newcastle's CPLab acts as the UK hub within the CPSE Labs project, allowing the initiative to **couple industrial needs with the CPLab's range of expertise in dependable design** to advance the state of the art in CPS design. Newcastle's CPLab is one of six top-flight CPS design centres drawn from Europe's prominent CPS research labs and institutes.



Why are Cyber Physical Systems Important?

CPSs are capable of making substantial contributions towards major societal challenges. We strive for CPSs which can collect information from a variety of sensors, process it in real time and produce optimisations that improve efficiency, wastage or performance in a variety of domains. Examples of CPSs include (amongst many others):

- **Smart manufacturing** and production systems
- Flexible, adaptive and efficient public utilities, such as **smart grids**
- Non-intrusive and intelligent **assisted living** systems
- **Public transportation** systems capable of optimising flow and safety
- **Precision agriculture**
- **Road traffic management** systems
- **Smart cities** and digitally-enabled **efficient commercial and residential buildings**



CPS Engineering Design Challenges

Achieving our vision for efficient, intelligent CPSs of the future, however, requires advances in many areas. CPSs are **highly distributed, with globally emergent** behaviours composed from a variety of components which may be independent to varying degrees, and this makes it **difficult to design, validate and verify dependable global behaviours.** CPSs are inherently cross-disciplinary and we need tools and techniques to support **collaborative, multi-disciplinary design teams.** Platforms supported by CPLab include:



Overture is a modelling environment supporting VDM, used to model and design computer software



Crescendo supports co-simulations of discrete-event models written in VDM and continuous-time models produced using Controllab's 20-sim



Symphony is a toolsuite supporting architectural and formal modelling of systems of systems

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Science Central www.newcastlesciencecentral.com/

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<https://smartanythingeverywhere.eu/>

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