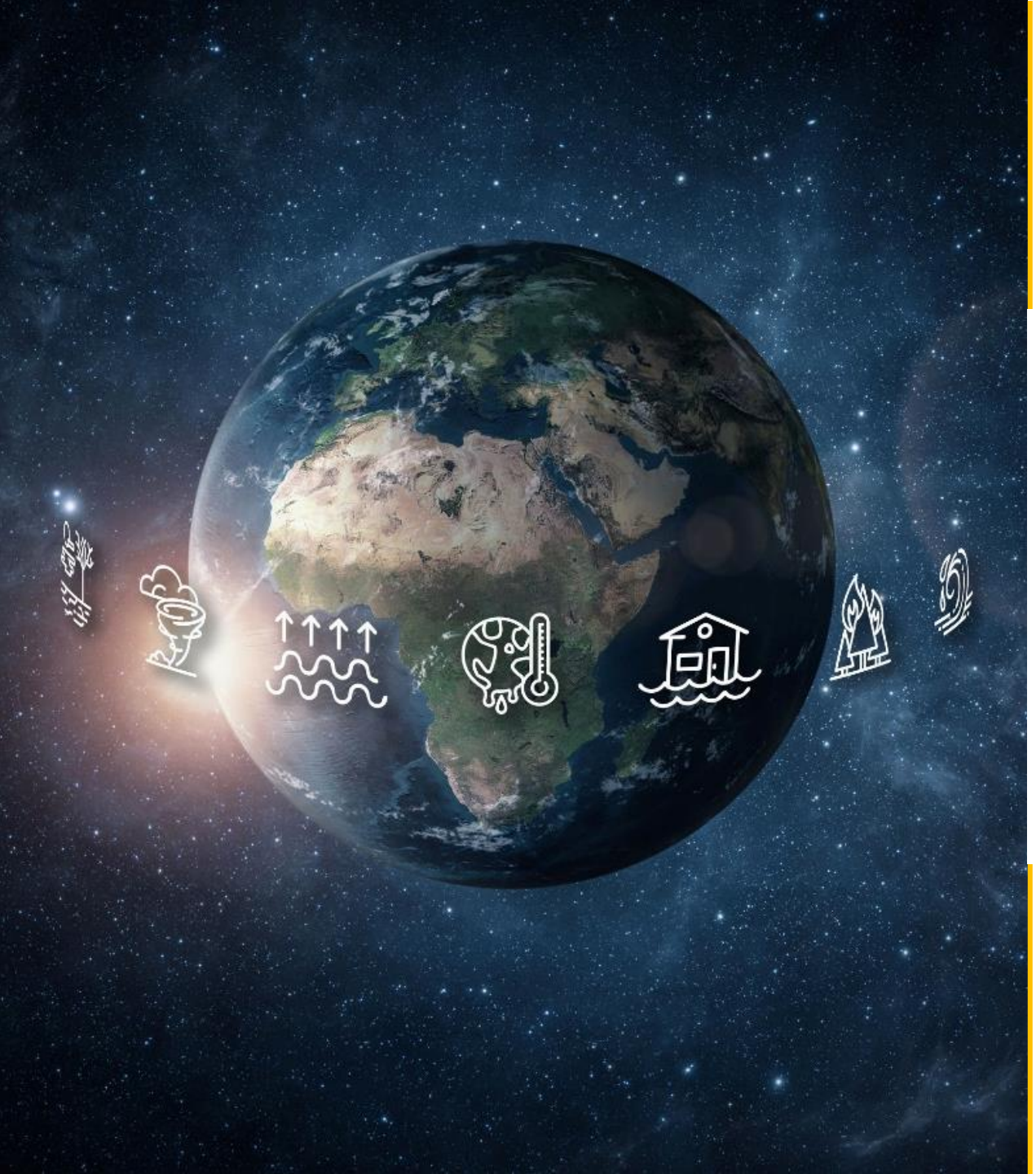
Destination Earth (DestinE)

EODC Forum 2022

15 June 2022

Charalampos (Babis) TSITLAKIDIS

European Commission, DG CONNECT C.1 – Open Science and Digital Modelling



“Study the past, understand the present and predict the future…”

European Commission

Destination Earth (DestinE)

Flagship initiative - Twin Green and Digital transition

A Lead for Europe

- A European Green Deal (2019)
- A European strategy for data (2020)
- Shaping Europe's digital future (2020)

An interactive and highly reliable knowledge generation system to support decision-making and generate insights tailored to the level of expertise of the users and their specific interests - to **develop,** gradually over the next 10 years, **a highly accurate digital model of the Earth.**

DestinE will provide unique digital modelling capabilities of the Earth to enhance the EU's ability to monitor and model environmental changes, predict extreme events, and adapt EU actions and policies to climate-related challenges (e.g. to assess the real impact and efficiency of environmental policies and relevant legislative measures), connecting environmental challenges with expected socio-economic impacts.

Provide a common support infrastructure for analysts and decision makers at various levels (e.g. EU, national, regional, local), building on EU investments in high-performance computing, massive space and socio-economic data sources at our disposal, and on the European excellence in data and AI technologies.

European Commission

DestinE added value

Evidence-based policy development and the user dimension

DestinE and its digital twins **will go beyond the current highly complex systems designed mainly for expert use**. The advances in km-scale representations of the atmosphere, land and ocean promise **significant breakthroughs in terms of simulation realism.**

By relying on geo-spatial and the socio-economic data coupled with simulation models into **'digital twins'**, a variety of users, with **different expertise and function (e.g. decision-makers**, **experts and non-expert users)** will have access to high-quality information, services, trustworthy models, scenarios, forecasts and visualisations in relation to major environmental and societal challenges (trusted and verifiable information for evidence-based policy and decision-making, together with information on the fidelity and reliability of the predictions):

- **Policy makers** at EU, Member State, regional and local levels:
  - To **better understand the impact of climate change** e.g. on land use, food security or water resources,
  - To **evaluate the impact of proposed legislative measures**, test the effectiveness of proposed solutions **against alternatives**, **monitor the enforcement** of existing legislation, or to **focus on priority challenges** for specific regions.
- **Public and business sector users**, who can test their **own models, applications, and data**. They will be **able to access**, via the **cloud**, the DestinE models, algorithms, applications and a vast amount of natural and socio-economic data and use them **to develop new applications and services** to suit their own needs.
- **The general public** who will be able to get informed more accurately about the intensity of the environmental, social and economic challenges, assess the efficiency of the proposed solutions, and the reliability of the underlying predictions.

European Commission

DestinE implementation

DestinE Actors

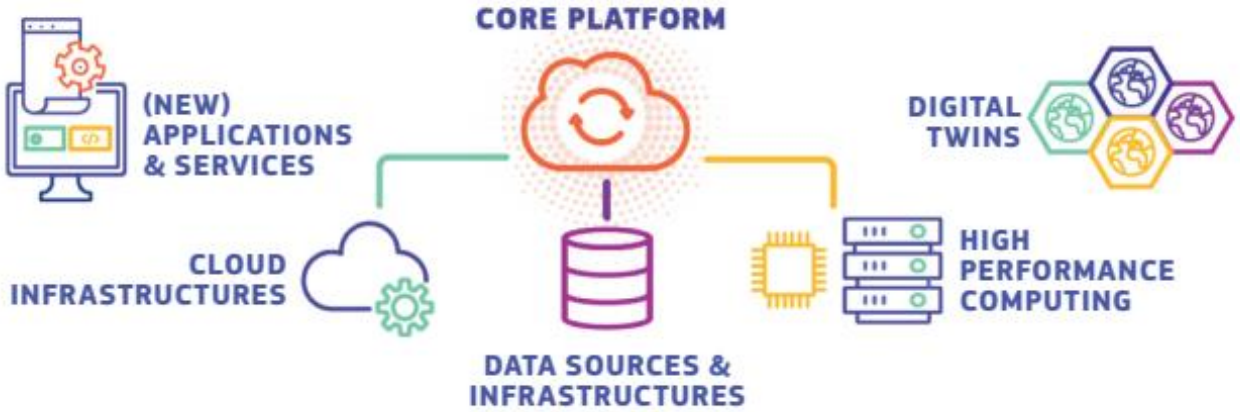
- The Commission (**business owner: DG CONNECT)** leads in coordination with Member States and Associated Countries

- **Strategic partnerships with:**
  - European Space Agency **(ESA)**
  - European Centre for Medium-Range Weather Forecasts **(ECMWF)**
  - European Organisation for the Exploitation of Meteorological Satellites **(EUMETSAT)**

- **External governance** through expert groups of the Commission
  - Strategic Advisory Board of Destination Earth
  - Destination Earth Coordination Group (EU MS/AC)

- Funding under the **Digital Europe Programme**
- Significant Involvement of the EU industry
- Important R&I activities under Horizon Europe to support evolution of Destination Earth

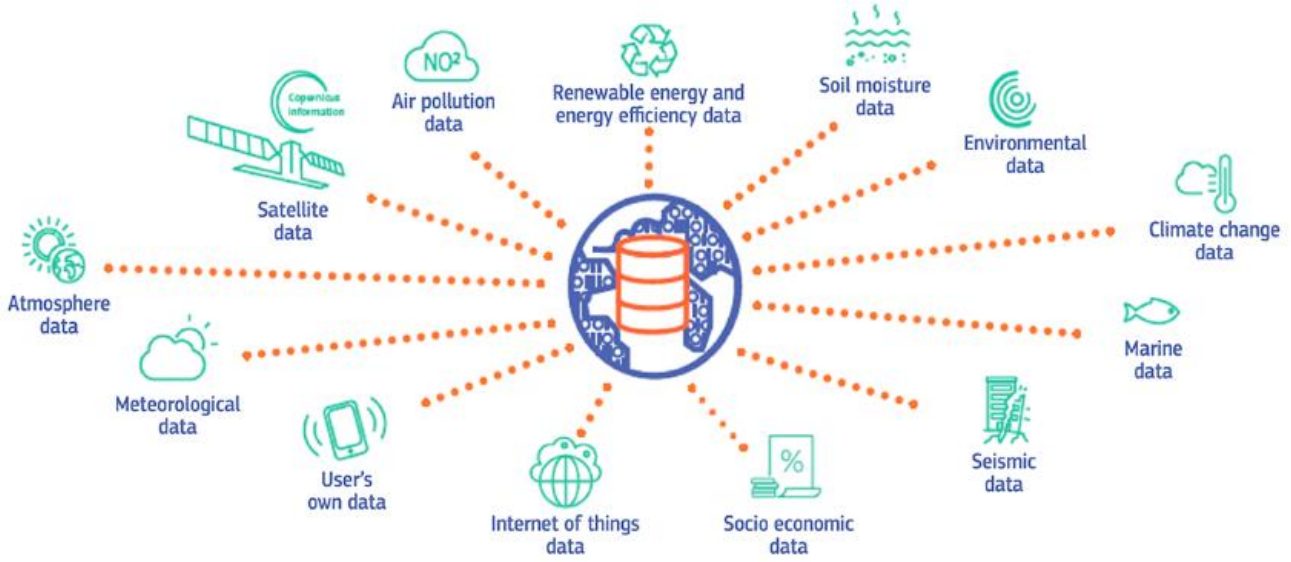
DestinE key components: The Core Platform



- A **user-friendly** platform that provides a large number of users (such as policy makers, the scientific community, members of the private sector, and the public) with **evidence-based policy and decision-making tools, applications and services**, based on an open, flexible, scalable and evolvable secure cloud-based architecture
- It will bring together data, cloud, and high-performance computing and it will integrate access to digital twins.
- At the same time, it will allow users to **customise the platform, integrate their own data and develop their own applications.**
- It will be operated by the **European Space Agency (ESA) – ESA** is going to serve also as the **integrator**.

European Commission

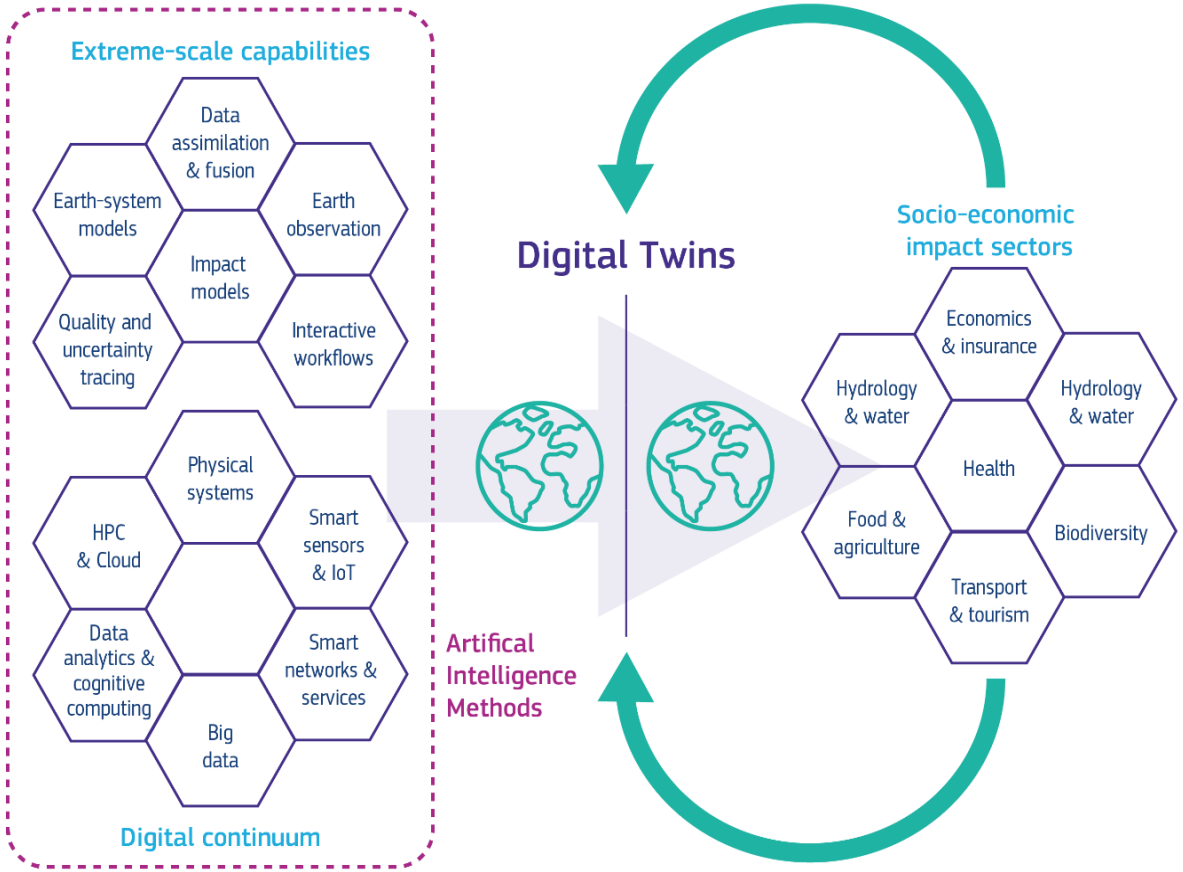
DestinE key components: The Data Lake



- The distributed DestinE Data Lake will provide storage and access to data coming, inter alia, from **Copernicus resources, the three Destination Earth partners, and other sources, including in-situ and socio-economic data**, providing a seamless access to data assets (federating data holdings).
- It will provide access to the data needed for the Digital Twins and the Core Service Platform operations but **also integrate the new data that will originate from the Digital Twins**.
- The DestinE Data Lake will also host **user data**, shared with the DestinE user community while supporting **near-data processing to maximize performance and service scalability**.
- **EUMETSAT** will be responsible for the data lake.

European Commission

DestinE key components: The Digital Twin Engine and the first two Digital Twins (DTs)



- Digital Twins are mirrors of reality, **simulators** that replicate reality constrained by real time data.
- In DestinE, digital twins represent **digital replicas of the highly complex Earth systems** in areas like extreme natural disasters, climate change adaptation, oceans or biodiversity, based on a seamless fusion of real-time observations and high resolution predictive modelling. The ultimate goal is to gradually integrate the thematic twins to form a comprehensive digital twin of the Earth.
- The DT engine constitutes the **computing and data handling workflow** of DTs. It fulfils the need to provide a common system approach for the **orchestration** of Earth-system simulations and the fusion of observations with models.
- The first two DTs will provide the EU with a real breakthrough in the level of **prediction capability, accuracy and accountability** of evidence-based decision making and significantly contribute to our ability to anticipate major challenges**,** in relation to **climate change** and the occurrence of **extreme natural disasters**.
- The **ECMWF** will be responsible for the Digital Twin Engine and the first two digital twins.

European Commission

The first two Digital Twins

Extreme Natural Disasters Digital Twin

- **The Extreme Natural Disasters Digital Twin** will combine data with simulation capabilities of unprecedented levels of speed and interactivity (**very high spatial resolution** and **close to real-time)**.
- Decision-makers will be able to anticipate the occurrence and impacts of extreme natural events **(e.g. flooding, droughts, forest fires, earthquakes, volcanic eruptions and tsunamis, geomagnetic storms)** with increased precision.
- Information on **reliability** of the underlying predictions will help them to assess how trustworthy their risk management strategies are likely to be.

Climate Change Adaptation Digital Twin

- **The Climate Change Adaptation Digital Twin** will be used to predict the impact of climate change with unprecedented reliability at regional and national levels. It will support the EU and MS in developing trustworthy and reliable adaptation strategies to mitigate the effects of climate change.
- Allow leveraging the societal influence through inclusion of **socio-economic feedback** for designing mitigation measures.
- Accurate monitoring of the changes **over the past decades** combined with Artificial Intelligence techniques and advanced Earth-system modelling will form the basis for **understanding the causes** and explaining the feedback mechanisms of change and **predicting possible evolution trajectories**.

DestinE – Initial Services

- Destination Earth will deliver **initial digital services by Q2-Q4 2024**. At first it will serve professional public sector users, and will be later expanded to scientists, private sector, and the general public. These services will be increasingly scaled up and extended during the programme.

- The open core service platform, data lake, the digital twin engine, and the first two digital twins will be funded from the Digital Europe Programme, **with €150 million for the first 30 months implementation period in 2021-2024**. **Horizon Europe will also provide over €55 million** in additional investment in related research and innovation to reinforce DestinE technologies and prepare for new twins.

- Synergies are established with other EU programmes like Copernicus, the EuroHPC Joint Undertaking and will link with related national initiatives, while bringing together European scientific and industrial excellence to achieve these ambitious goals.

European Commission

Destination Earth – implementation roadmap

2021-2024

- Operational cloud-based platform and data lake
- First two digital twins

2024-2027

Platform integrates the next operational digital twins and offers more services to its users

2027-2030

Towards a full “digital twin of the Earth” through a convergence of multiple digital twins on the platform

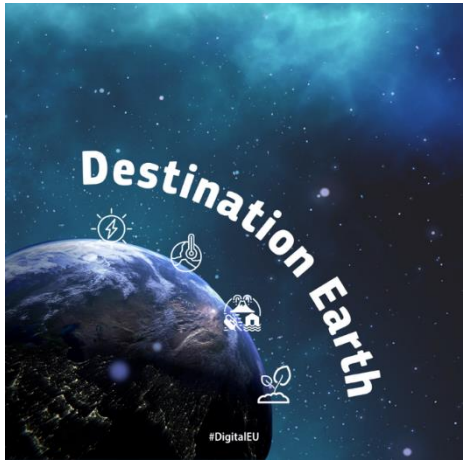
European Commission

Destination Earth

More information on:

- https://digital-strategy.ec.europa.eu/en/policies/destination-earth
- https://digital-strategy.ec.europa.eu/en/library/destination-earth
- https://digital-strategy.ec.europa.eu/en/library/destination-earth-factsheet
- DestinE video: https://www.youtube.com/watch?v=FKVHZlGqEyw

#DigitalEU #DestinE #DigitalDecade #DigitalEUProgramme #EUGreenDeal



European Commission

SIMPL

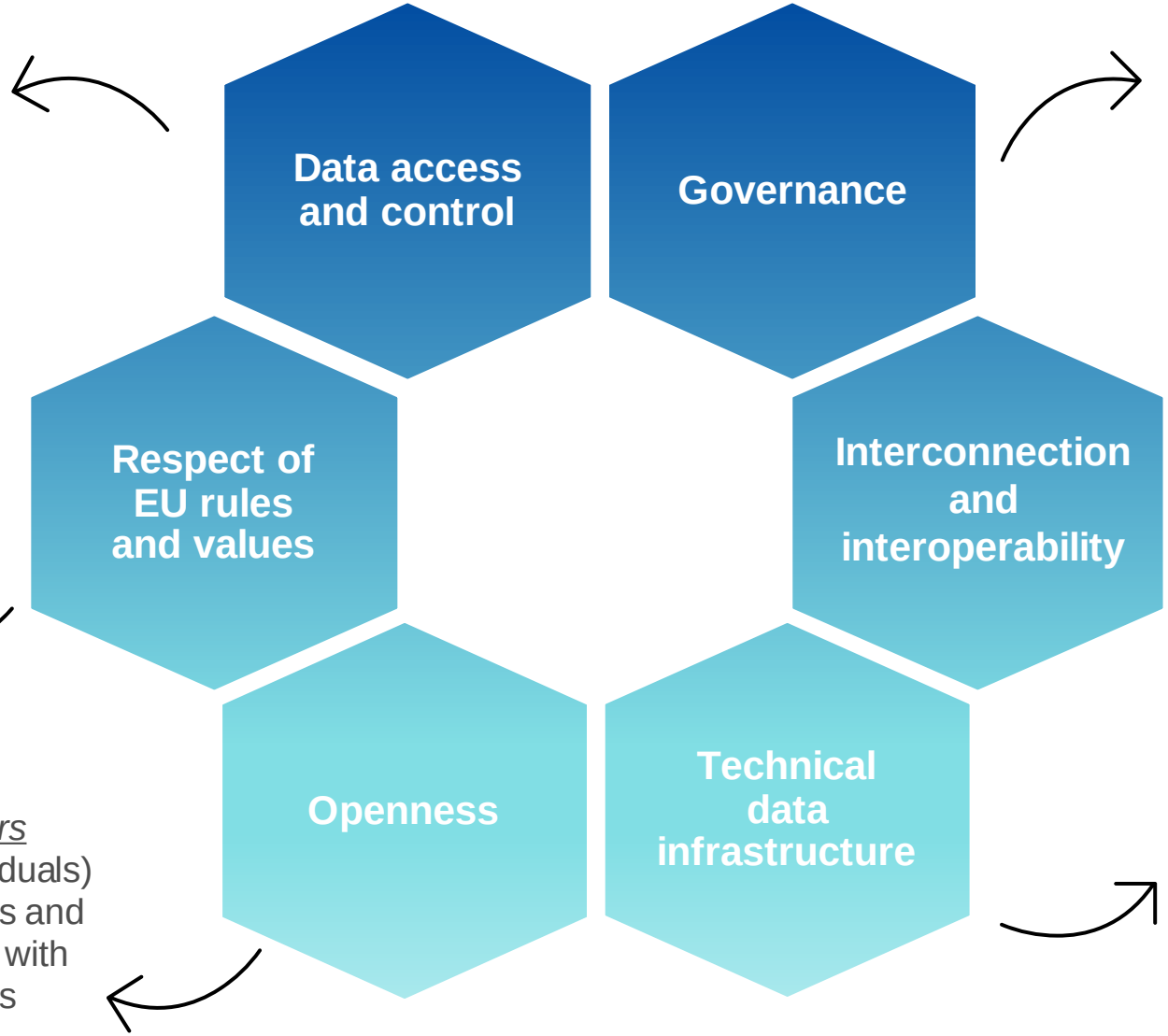
Smart Middleware Platform

for a European cloud federation and for the European data spaces

European Commission

Design principles for common European data spaces

Promote tools to control, pool, access, use and share all types of data favouring FRAND principles



Put in place an *appropriate governance structure* (mechanisms) to ensure fair, transparent, proportionate and non-discriminatory access to, sharing and use of data.

Comply with applicable *EU legal framework*, and put in place adequate measures to prevent unauthorised access to data

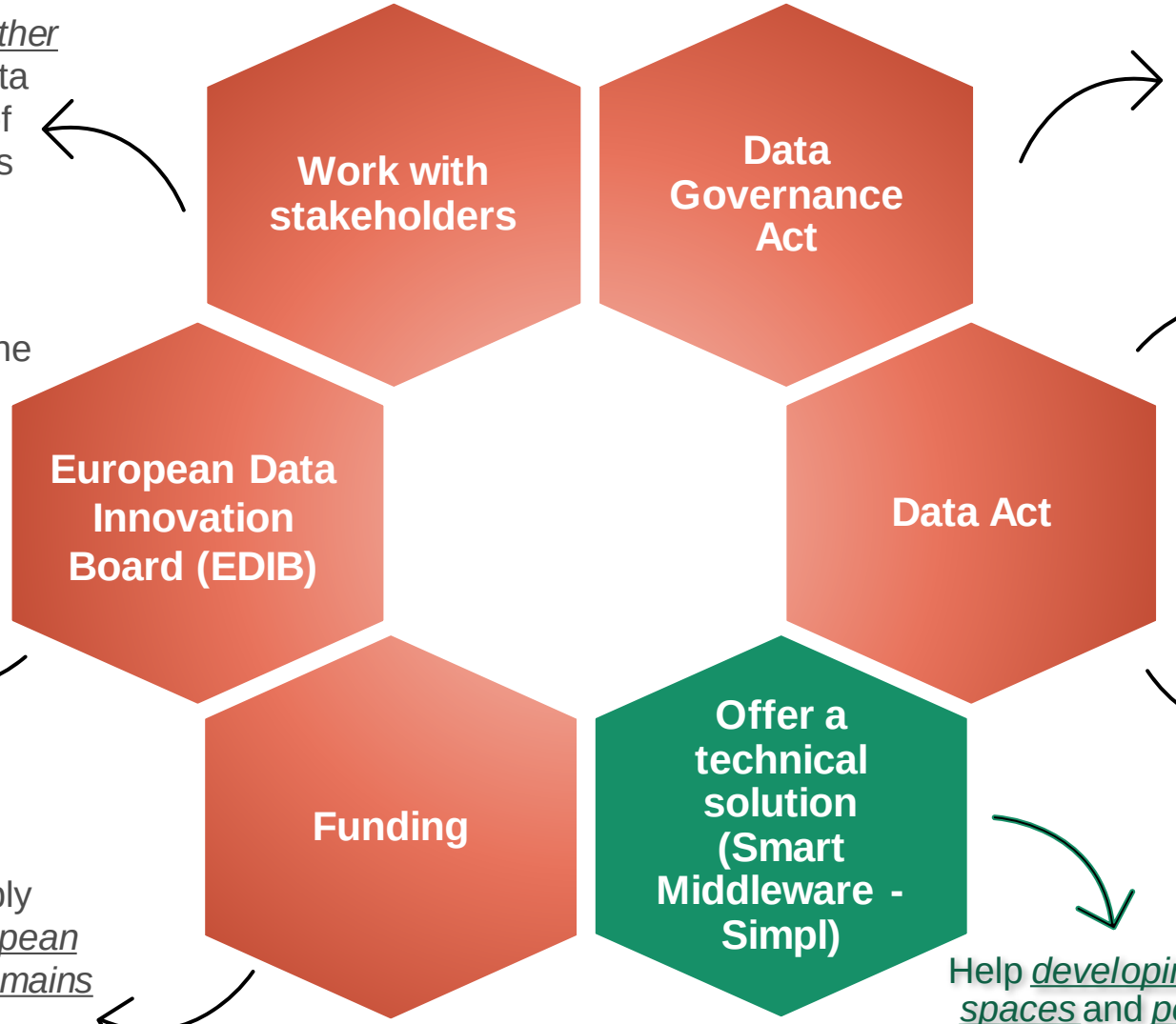
Develop on international *standards*, INSPIRE, FAIR principles to progressively lead to single EU data space

Open to all actors (organisations/individuals) that respect EU rules and values and comply with data space rules

Encourage actors to use *common technical data infrastructure* (including sector-specific framework and cybersecurity- and data protection-by-design principles)

European Commission

The EC's role in supporting the creation of data spaces



Bring stakeholders together with a common EU data policy, promote use of data space guidelines

Increase trust in data sharing (neutral data intermediaries, i.e., the orchestrators of the data spaces

Support the Commission in:

- *Issuing guidelines* to facilitate the development of the common European data spaces
- Identifying the relevant standards and interoperability requirements for *cross-sector data sharing*

Unlock the potential of the EU's *industrial data* (IoT data), ensure fairness in the allocation of data value among the actors of the data economy

Facilitate *interoperability* of data, data sharing mechanisms and services (incl. data spaces) between sectors

EU financial contribution (notably DIGITAL) to *deploy common European data spaces in strategic sectors/domains*

Help *developing data spaces* and *pooling existing data infrastructures* (cloud federation)

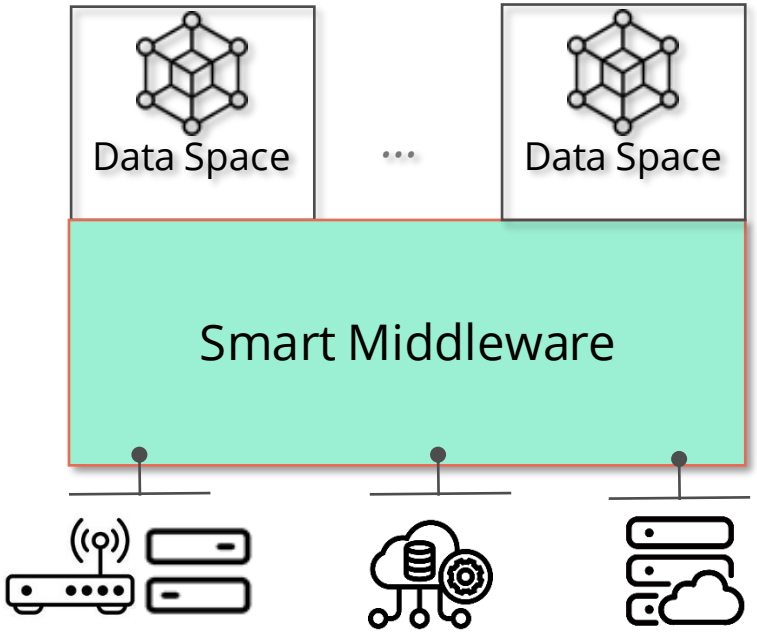
European Commission

Simpl – the concept

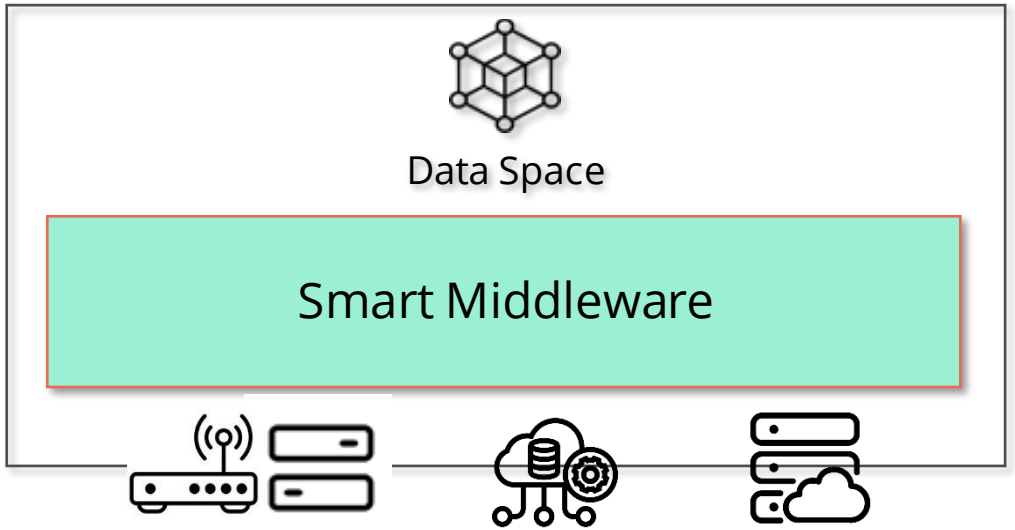
Smart Middleware is a **software stack** that provides **common services and capabilities** to **Data Spaces** on top of what is offered by the operating systems of **Edge and Cloud computing infrastructures**

- Offers generic services common across Data Spaces
- Software stack deployable on top of Cloud/Edge infrastructures
- Security and energy efficiency

Smart Middleware among data spaces



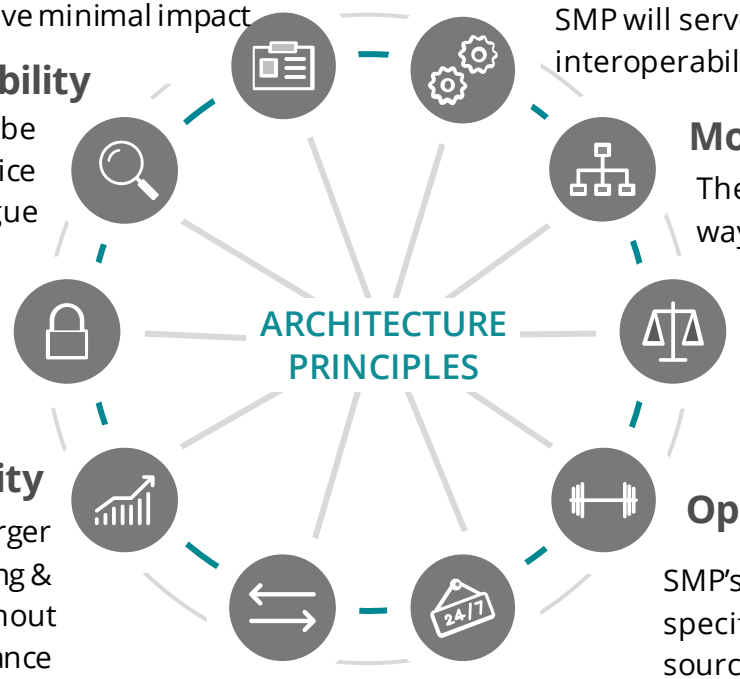
Smart Middleware within a data space



European Commission

Simpl – Architecture principles

Ten guiding principles for designing the architecture of the open-source smart middleware platform



Resilience

SMP's architecture components must be fault tolerant, so that failures have minimal impact

Federation

SMP will serve as a federation of both data and infrastructure, enabling interoperability and decentralization

Discoverability

All services provided by the SMP must be publicly exposed and discoverable in a service registry or catalogue

Modularity

The SMP architecture must be defined in a modular way and with open-source technologies

Security, privacy & trust

The SMP must provide a secure and trustworthy environment while complying with relevant regulations

Loose coupling

The implemented components should be loosely coupled to minimize dependencies between them

Scalability & elasticity

The SMP must provide means to accommodate larger workloads and assure correct resource pooling & allocation while allowing new entities and users without impacting performance

Openness and agnosticism

SMP's components must be designed following open specifications and standards and implemented using open-source technologies

Interoperability

The SMP must ensure that all participants will be able to interact with each other and exchange data and resources in a well-specified way.

Composability & extensibility

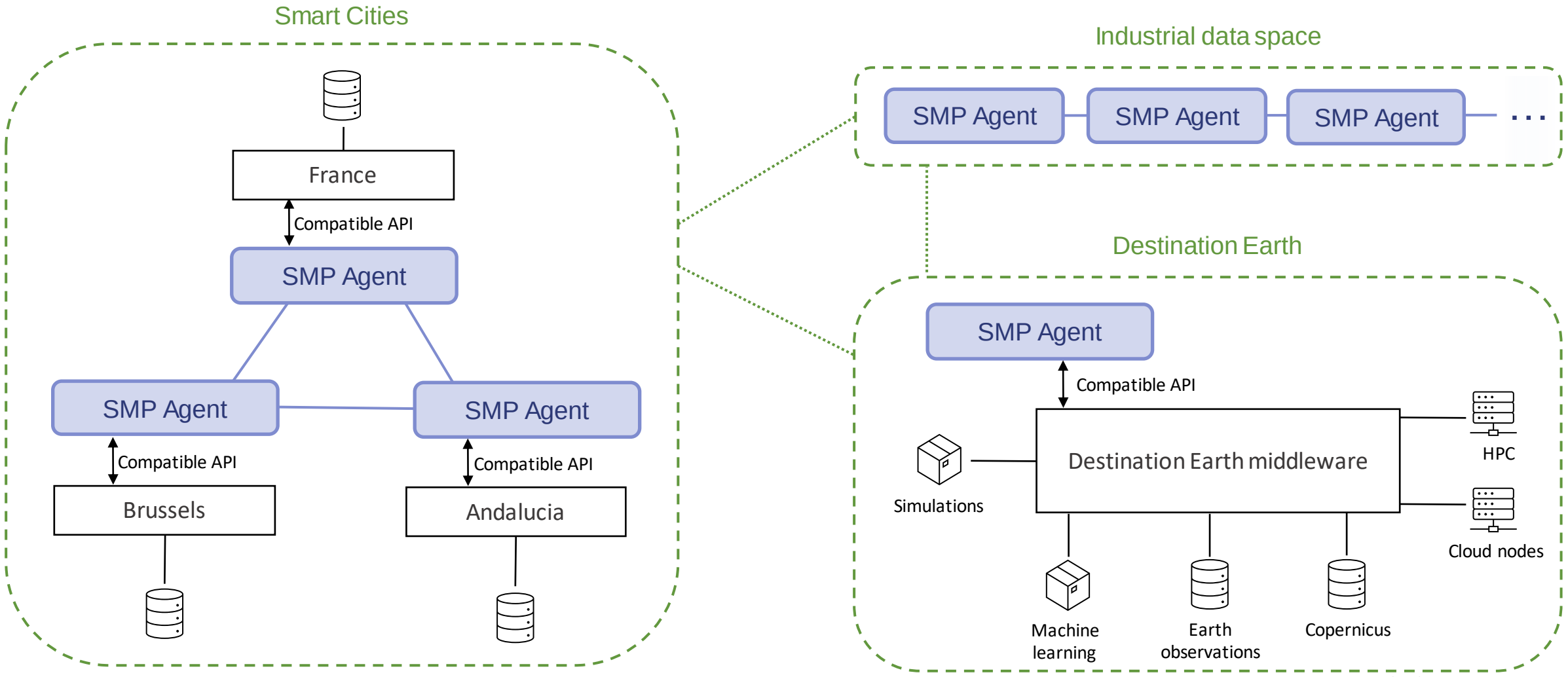
The SMP architecture must allow for open to iterative growth while allowing the addition of new services and capabilities

More details at Simpl website, The architecture vision;

European Commission

Simpl system architecture and deployment example

An **example** deployment of different initiatives and data spaces using Simpl - Smart Middleware among and within data spaces



European Commission

Preparatory Work in View of the Procurement of an Open-Source Cloud-to-Edge Middleware Platform

Deloitte.

EC Cloud to EDGE Task Force

Reports available at: [Simpl: cloud-to-edge federations and data spaces made simple]

European Commission

Thank you

© European Union 2022

Unless otherwise noted the reuse of this presentation is authorised under the CC BY 4.0 license. For any use or reproduction of elements that are not owned by the EU, permission may need to be sought directly from the respective right holders.

European Commission