iSPHERE

integrated Scientific Platform for HEterogeneous Research and Engineering

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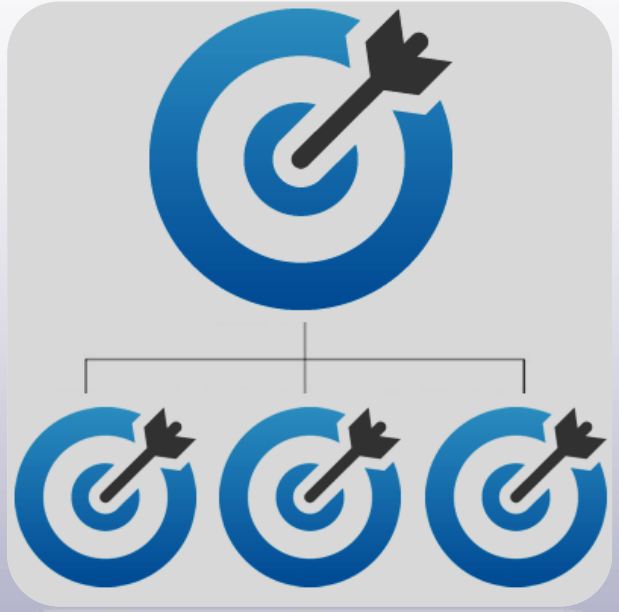
General Facts & Figures

- ***iSPHERE*** has mainly grown out of the **FP7 Project IMPEx.**
- ***iSPHERE*** is currently represented by a **14 member** European consortium, including **4 SME's**
- **8 countries** involved: ***Austria, Spain, Romania, Germany, Finland, France, Belgium and Russia***
- There are **12 Work Packages** covering all aspects from **science and technologies** to **requirements** engineering and professional **software engineering** and **development**.
- Requirements are based on **four complex science scenarios** (2x *space physics*, 2x *experimental physics*)**.**
- **Requirements engineering** and **software development** to be carried out in an **agile manner**.

Main Objectives & Goals

- Creation of a **versatile platform** for **generation**, **storage**, **analysis** and **processing** of **scientific data**
- **Observational**, **experimental** and **simulation data** unified in one single environment.
- Transparent access to **commercial cloud resources** for the **execution** of complex modelling codes and *chains*.



- Integration of multiple **data sources**, **access protocols** and **data models** via a ***Scientific Service Bus***.
- **Provision of an API** to allow for new applications to be added.

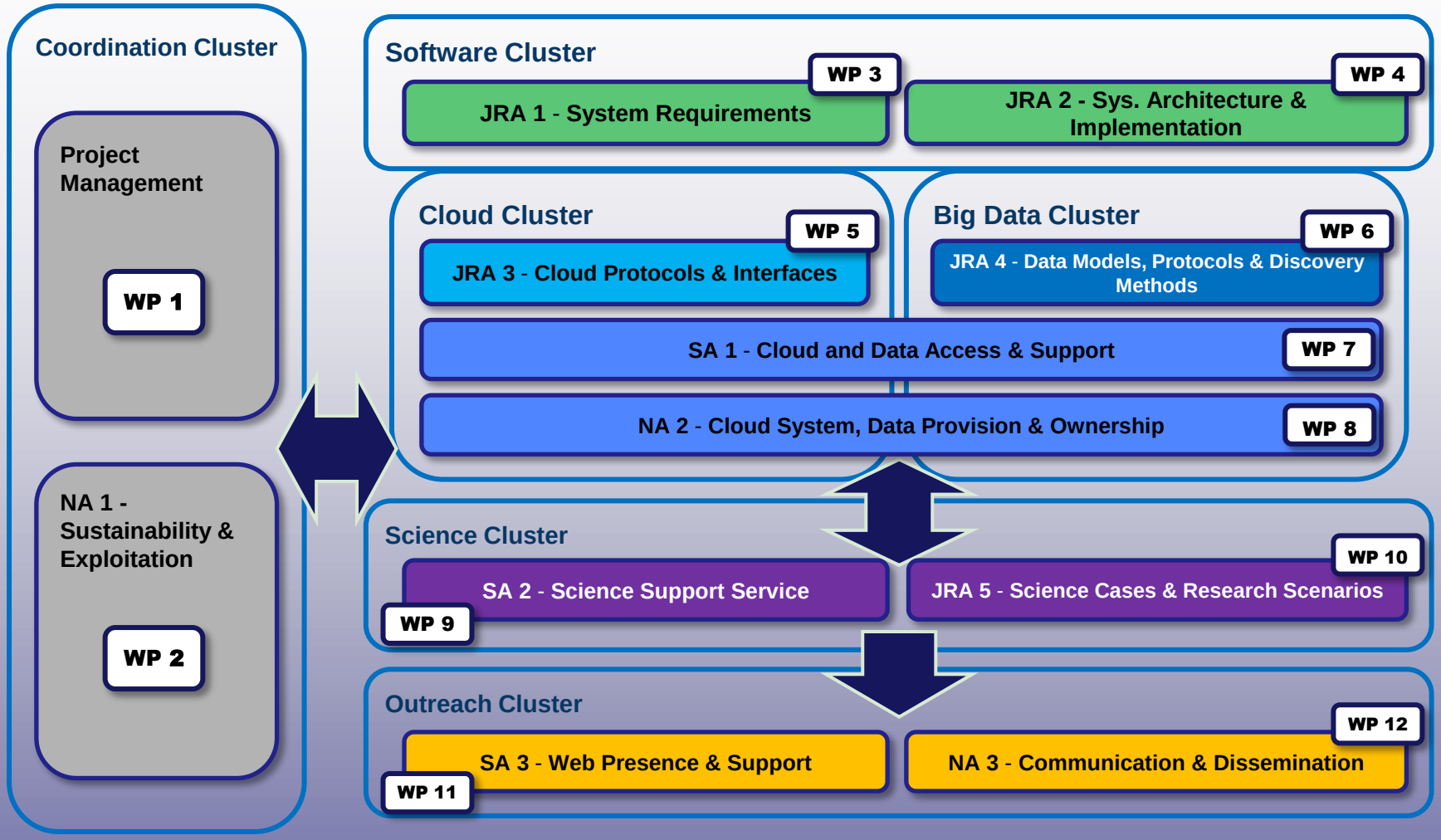
Target User Groups

- Main target group of the system are **scientists and (post-)graduate students** working in one of the covered fields (e.g. *plasma physics* or *planetary science*).
- The system also aims to address **engineers** as well as **users from industry** and **education.**
- The range of physical phenomena covered is **expected to grow along with its community** and hence the inclusion of **new data** and **simulation models** as well as **data sources**.
- The system is expected to attract **experimental** as well as **theoretical physicists** including **modelling experts**.

Targeted Scientific Challenges

- **Comparative studies** of experimental results, **observational data and simulation** outputs.
- **Simulations** of complex physical phenomena that are **not covered by a single** model and/or need **extensive computing power**.
- **Interdisciplinary research** that requires to set up **complex simulation chains** and *overlay* the results with empirical data.
- Investigations over a **broad range** of (empirical or modelled) **data (sources)** that require advanced *data mining, visualization* and *analysis* tools.

Project Structure



Project Structure

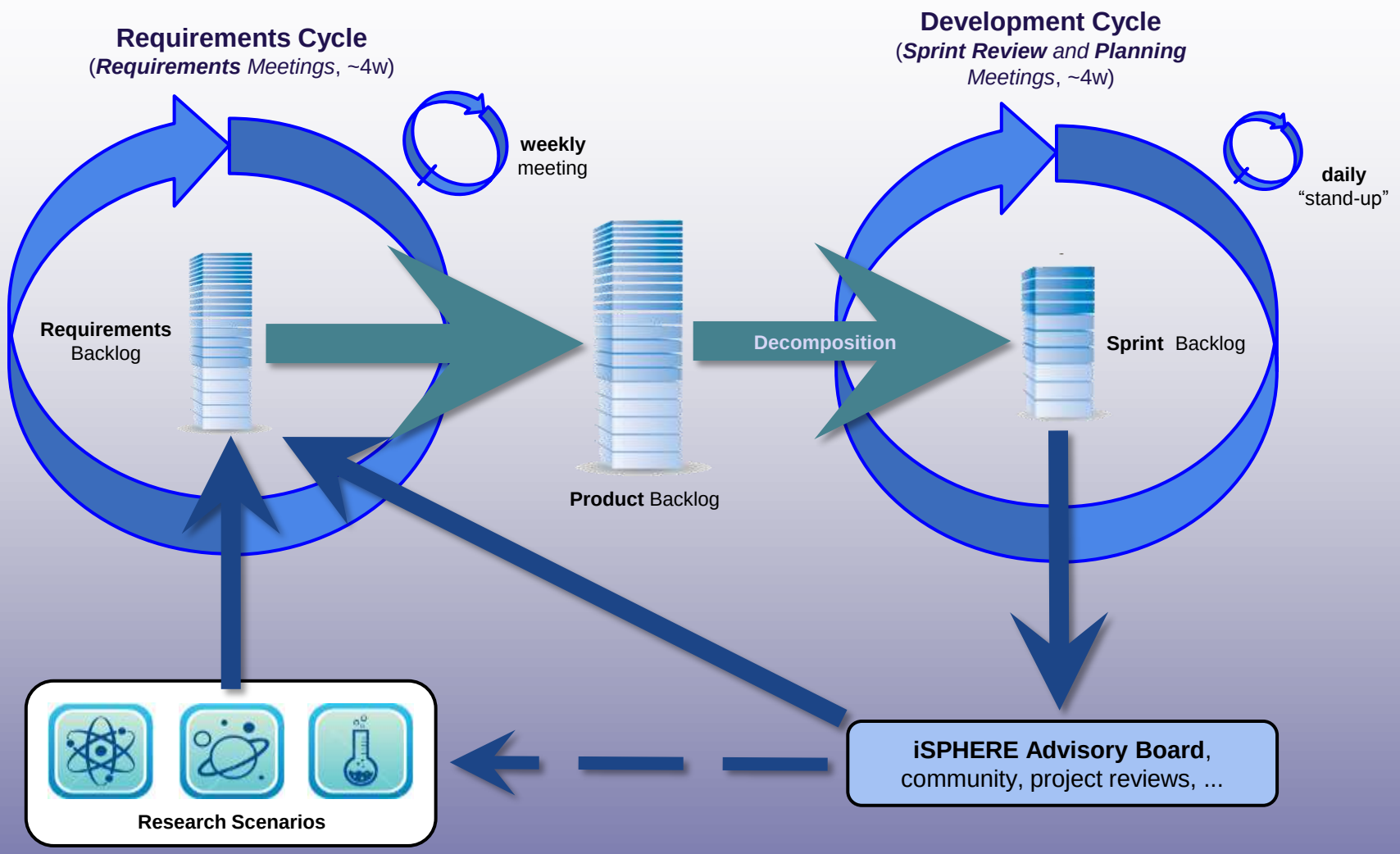
Science Cluster

WP 10

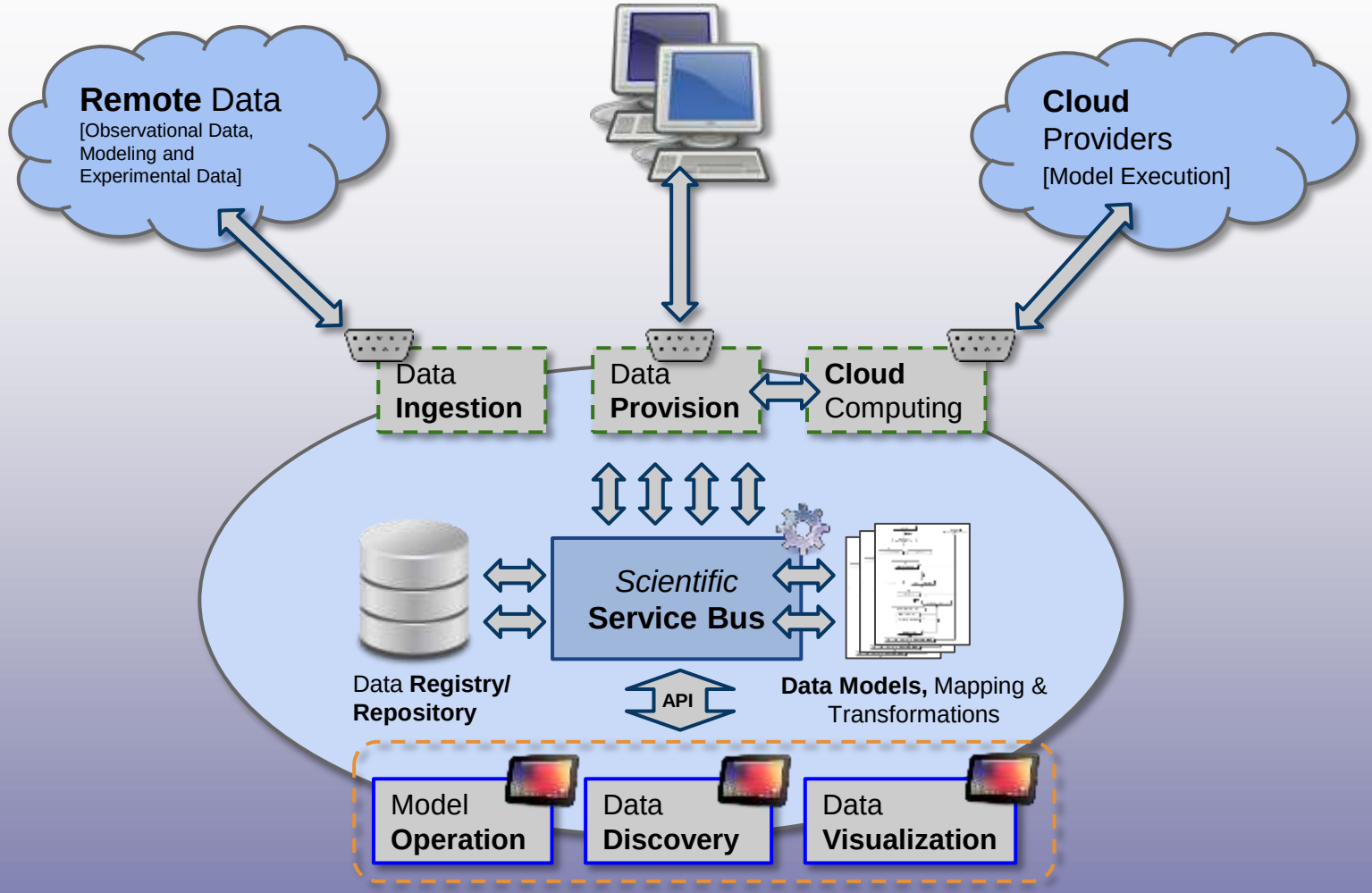
JRA 5 - Science Cases & Research Scenarios

- ✓ Space Weather (SW-SC)
- ✓ Planetary Atmospheres (PA-SC)
- ✓ Entry Flows (EF-SC)
- ✓ Material characterization (MC-SC, including *Uncertainty Quantification*)

Project Structure



System Architecture



Cloud Support

- Public and private cloud infrastructures will be integrated for the **on-demand provision of virtualized resources** (mainly processing).
- Cloud integration via **virtual appliances** and support of **protocols** for cloud access (**WP5**) and **billing systems** (**WP8**).
- Support of 4 basic types of *cloud* infrastructures:
  - ✓ **Commercial Public Clouds** (*IaaS* (*Amazon Web Services*, …)
  - ✓ **Science Public Clouds** (*SurfSARA*, *CESGA*, *SurfSARA*, …)
  - ✓ **European e-Infrastructures** (*EGI Federated Cloud*, *Helix Nebula*)
  - ✓ **Private Clouds**
- Web based interfaces for **model upload and seamless integration** into the *iSPHERE* cloud including **model operation**.

Data Model Support

- Clear definition of **meta data** and **taxonomies** is essential for basic **data discovery** and **search tools**.
- *iSPHERE* will support **multiple data models** including clear **procedures for the extension** of the data model suite.
- *SSB* will provide “translators” to **support modelling chains** and to foster **interoperability** with other infrastructures.
- A common **meta data standard for experimental plasma physics** will be defined and introduced to the experimental physics community via the *iSPHERE* platform.

Tool Support

- iSPHERE SSB will support a (probably *REST* based) ***API*** for web clients to communicate with the infrastructure.
- The *HTML5/CSS3* based **standard interface** will use the ***API*** and provide functionalities for: **data discovery**, **visualization**, **model operation** and **data processing**.
- Depending on **user rights** and available resources, operations can be carried out on the client, the *SSB* or in the *cloud*.
- **Additional user interfaces** can be developed, leveraging the *API*, providing additional functionalities.
- **SSB** will also support **custom extensions** via “plug-in” architecture.

Tool Support – Data Discovery

- Design and implementation of **advanced discovery methods**, **filtering**, **content-based search**, constraint based **pattern recognition** (including **AI**).
- Investigation of **domain dependent query languages**.
- **The goal** is to provide optimal support to users who attempt to:
  - ✓ **Overlay** observational, simulation and experimental data.
  - ✓ **Analyse empirical data** by identifying relevant simulation runs.
  - ✓ **Verify numerical data** by identifying real-world reflections of the obtained results.

Tool Support - Visualization

- The system aims to provide **purely web based 3D visualization** based on latest *WebGL* Technology.
- No need to install local (*Java*, …) applications etc., **only an up-to-date browser needed.**
- The visualization will hence be **tightly integrated.**
- Released as an **open source** library – can be **re-used** for e.g. other web clients developed for the *iSPHERE API*.
- Visualization can **grow** along with the simulations suite and data.
- *WebGL* is **supported by most major browsers** in their latest version and is leveraging locally installed **graphics acceleration**.

THANK YOU!

QUESTIONS…?