European perspective

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Big Data and Exascale Computing (BDEC2) Application Roundtable, Dallas, TX

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Agenda

- European Open Science Cloud
- PRACE scientific case
- Edge to cloud projects

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EOSC

European Open Science Cloud (EOSC)

- Vision of the European Commission of a large infrastructure to support and develop open science and open innovation in Europe and beyond

- Europe's virtual environment for all researchers to store, manage, analyse and re-use data for research, innovation and educational purposes, projected for 2020

- The vision in action:
  - The EOSCpilot project is supporting the first phase in the development of the EOSC
  - The EOSChub project, which aims to create the integration and service management structure of the European Open Science Cloud

EOSCpilot project

- The EOSCpilot project has been funded to support the **first phase** in the development of the European Open Science Cloud (EOSC). It will:

  - Propose and trial **governance frameworks** for the EOSC and contribute to the development of **European open science policy** and best practice

  - Develop a **number of demonstrators** functioning as high-profile **pilots** that integrate services and infrastructures to show **interoperability** and its benefits in a number of scientific domains

  - Engage with a broad range of stakeholders, crossing borders and communities, to build the trust and skills required for adoption of an open approach to scientific research.

  - The EOSCpilot represents a first step towards the development of the European Open Science Cloud.

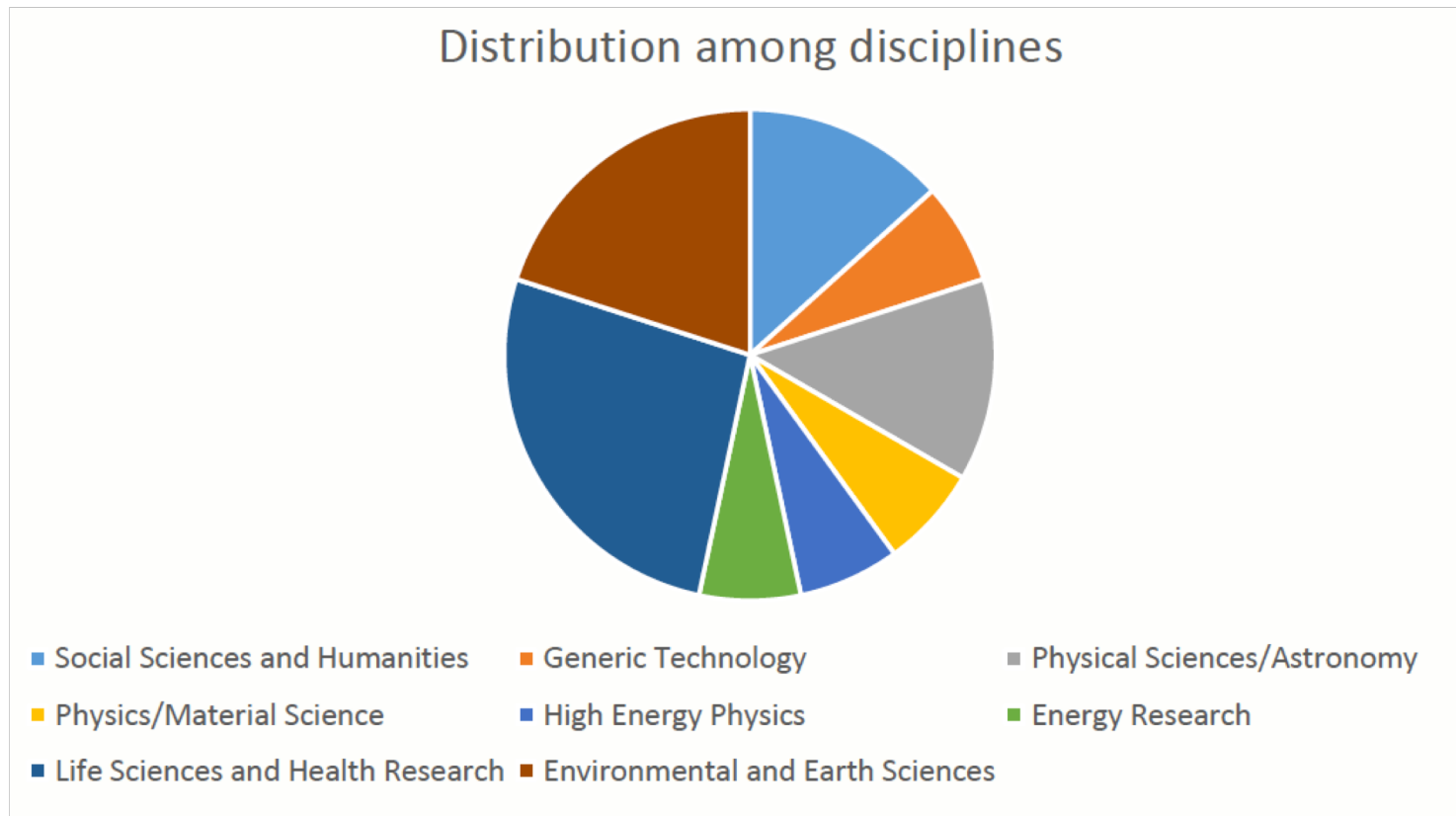Budget: 10 M€

Coordinator: STFC (UK)

Duration: 1.1.2017 – 31.12.2018
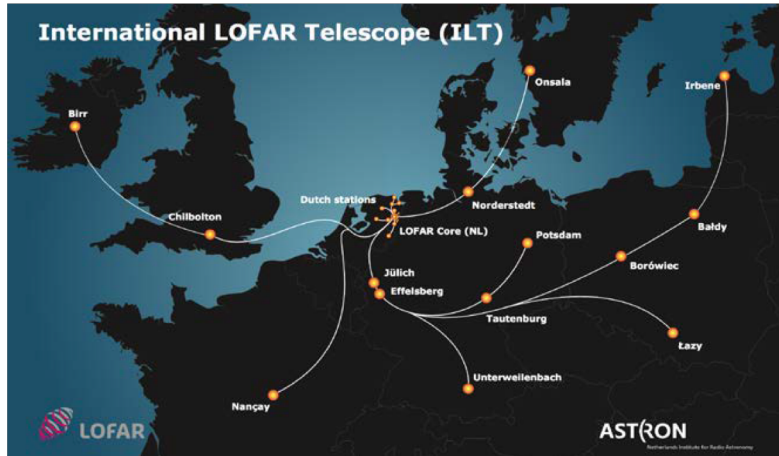
33 partners, 15 third parties (Europe wide)

https://eoscpilot.eu

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EOSCpilot demonsrtators

- 5 initial pilots, 10 more demonstrators selected through an open call

Distribution among disciplines

- Social Sciences and Humanities
- Generic Technology
- Physical Sciences/Astronomy
- Physics/Material Science
- High Energy Physics
- Energy Research
- Life Sciences and Health Research
- Environmental and Earth Sciences

International LOFAR telescope demonstrator

- LOFAR telescope

Resource & interoperability requirements
- Access to data in the LOFAR Long Term Archive (LTA) @ SURFsara
- Acces to compute facilities @ SURFsara
- Access to data in the LOFAR LTA @Juelich
- Transport of data between LTA sites, Contact with GÉANT
- Access to compute facilities at other sites
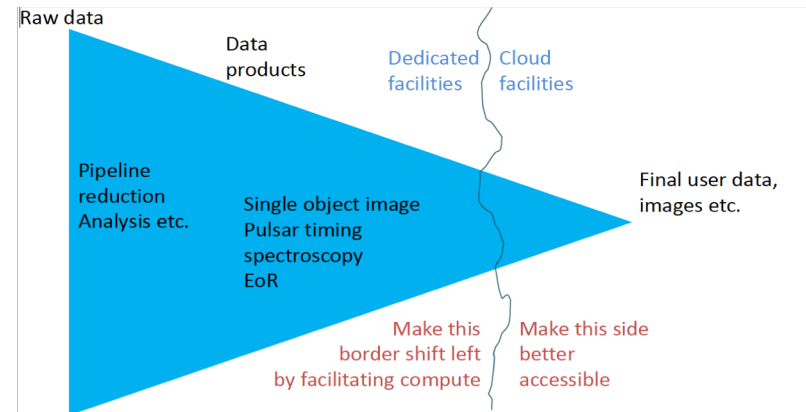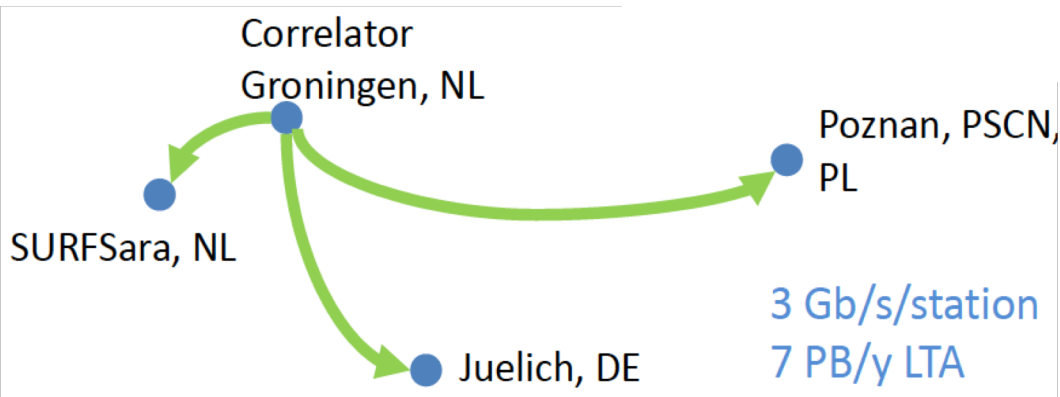
EOSC-hub project

- EOSC-hub brings together multiple service providers to create the Hub**: a single contact point for European researchers and innovators to discover, access, use and reuse a broad spectrum of resources** for advanced data-driven research

- **Simplify access** to a broad portfolio of products, resources and services provided by different actors through an **open service catalogue**

- **Remove fragmentation** of service provisioning and access to digital services

- Increase **innovation capacity** of digital Infrastructures

- **Extend access to integrated compute, storage, data and software** to new user groups including high-education and industry, increase the user base

- **Expand human capacity** (consolidate/expand a distributed network of experts and service operators at local/national level)

Budget: 30 M€
Coordinator: EGI Foundation (EGI.eu)
Participants: 100 partners from 53 countries,
including 19 research communities
from 36 countries
Duration: 36 months (Jan 2018 – Dec 2020)

PRACE SCIENTIFIC CASE

The PRACE Scientific Case

- The PRACE Scientific Steering Committee (SSC) has formulated a third version of the **scientific case** in relation to a number of areas of major societal relevance, and **identified both success stories and breakthroughs** that will be possible with investments in next generation infrastructure

- The document "The Scientific Case for Computing in Europe 2018-2026" presents the finding of the SSC for the different scientific disciplines
  - Illustrates importance of complexity and data-driven research
  - Defines key infrastructure requirements
  - Gives recommendations

# Computing drives Science - and Science Computing

Remarkable Repeated Success Stories:

- Recurring core part of **Nobel Prizes** in Physics & Chemistry
- Saving billions with **better weather forecasting**
- **Improving human health** with genomics, personalized medicine
- 3-4% **better fuel efficiency** of aircraft & wind turbines every year
- Disrupting communication, transportation and manufacturing
- **Design of future materials** from scratch based on desired properties
- **Batteries & supercapacitors**
- **Artificial intelligence**, machine learning, sensors, open data

Scientific computing keeps delivering impact, but European impact is limited by resources.

The Scientific Case for Computing in Europe showcases the achievements we predict will come true within the next 5-10 years with a factor 50-100x more computing power in Europe
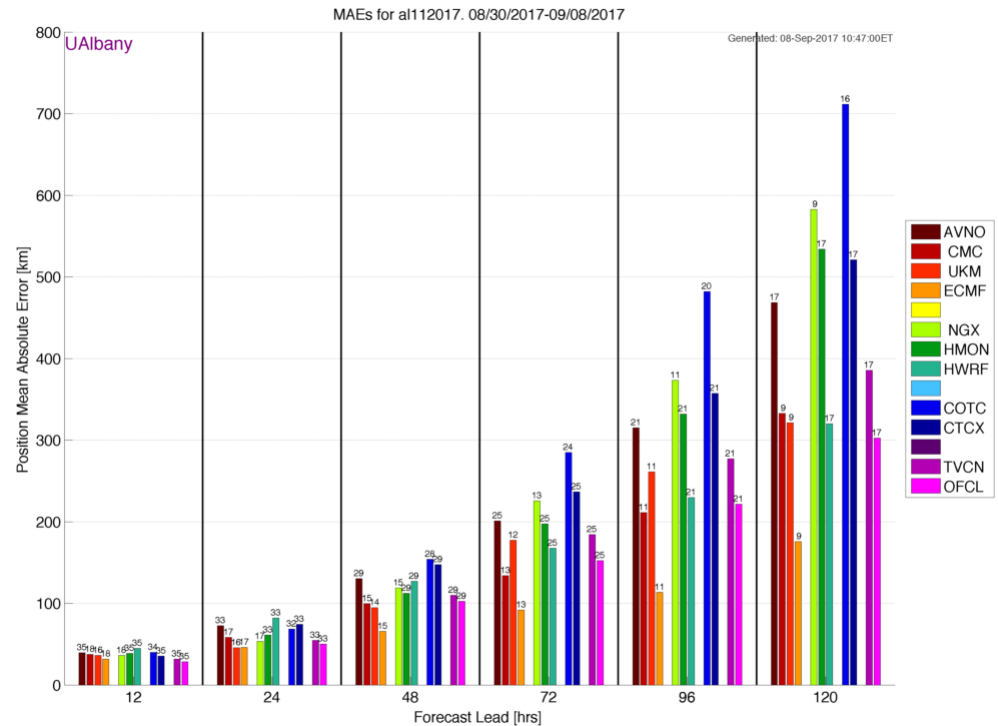
Europe leads international code development

Irma & José
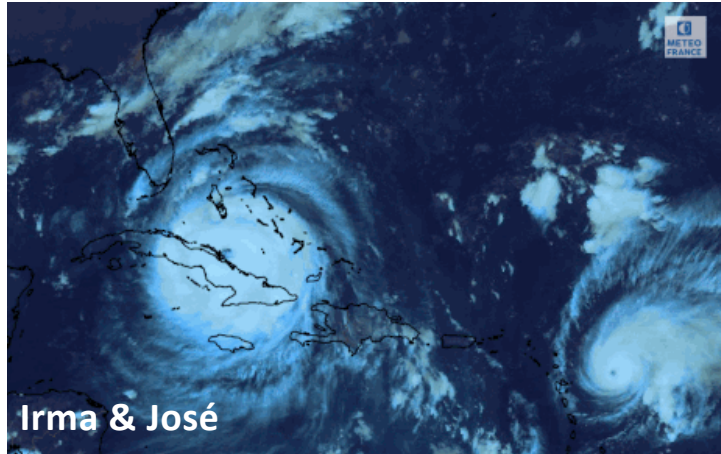
Predicting evacuation needs is a life/death matter – but avoiding it saves €250M

Maintaining our European lead on software should be one of the Europe investment priorities

Europe is leader in forecast codes

Exascale is causing even traditional fields to turn to AI

Full Waveform Inversion models combined with Convolutional Neural Networks provides drastically faster reservoir predictions
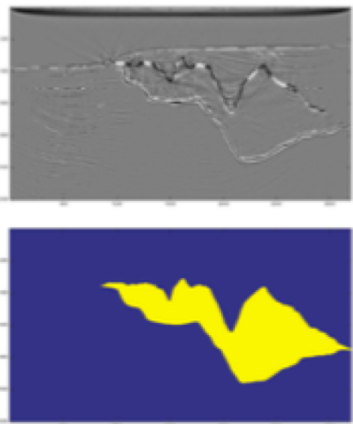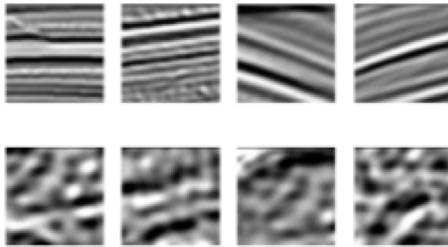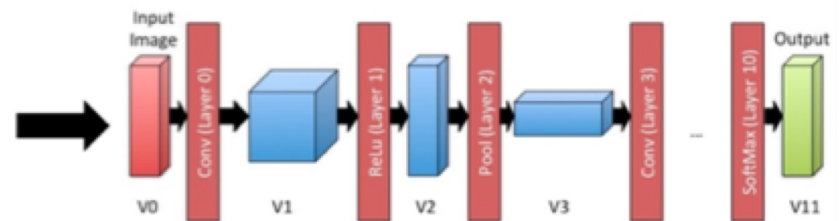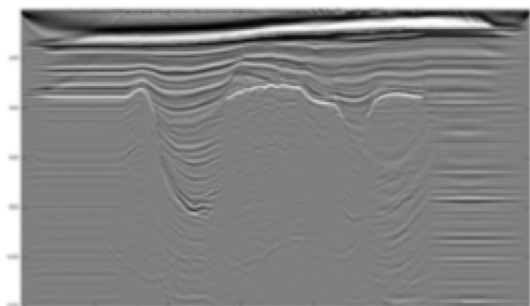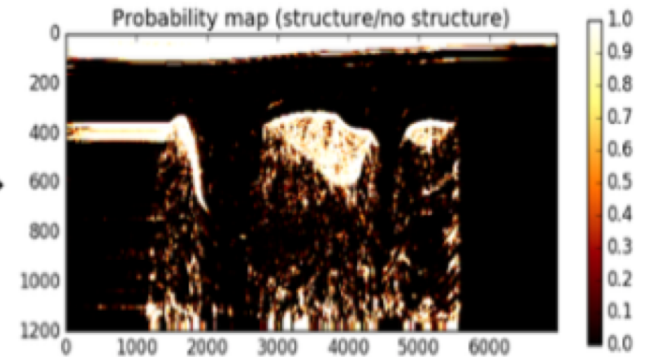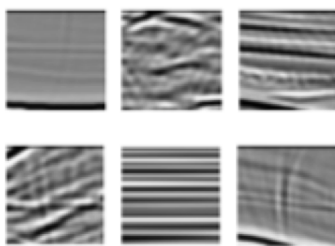
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EDGE TO CLOUD

mF2C goal is to design and develop an open, secure, decentralized, multi-stakeholder Fog-to-Cloud (F2C) management framework.

Novel programming models

Privacy and security

Data storage techniques

Service creation

Brokerage solutions

SLA policies

Resource Orchestration Techniques

FOG & CLOUD LAYER

CLOUD LAYER

FOG LAYER

mF2C FRAMEWORK

Cloud & Fog Providers

Service Providers

Technology providers
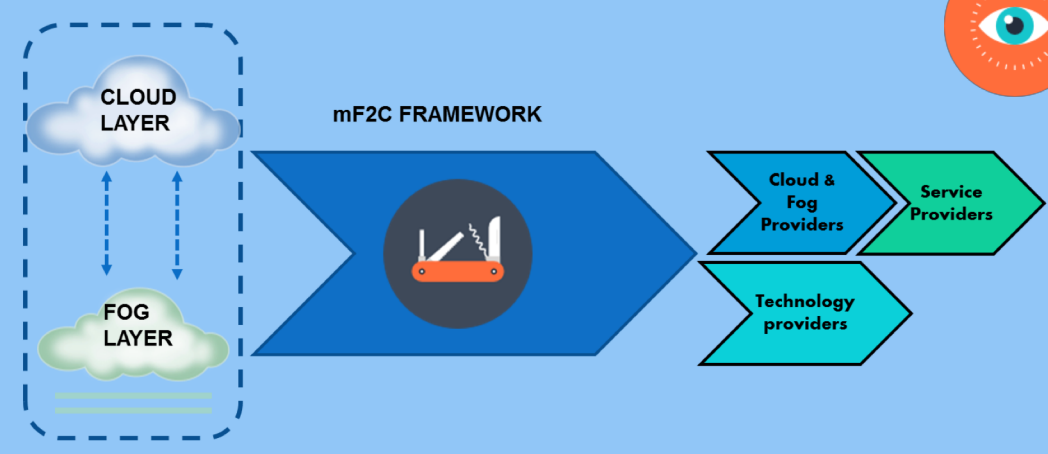
Emergency Situation Management in Smart City

Smart Boat

Smart Fog-Hub Service

Deployed on the *Automotive Smart Area* in the city of Modena (Italy)
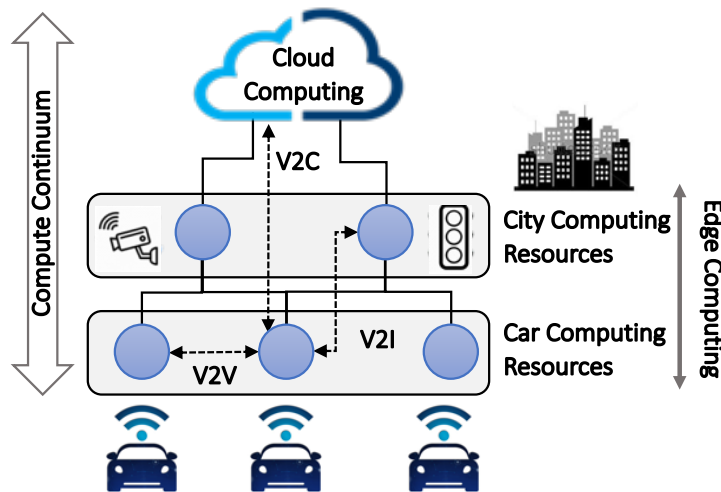
Smart City Use-case

- **Data analytics** and **real-time** requirements
- **11.4 GB/s** of heterogeneous data-sets considering 3 cars and a 1 km^2 sensing area

Three highly-connected cars equipped with *Vehicle-to-infrastructure* (V2I), *vehicle-to-cloud* (V2C), *vehicle-to-vehicle* (V2V) Cameras @4K, long-range and middle range radars and ultrasound sensors
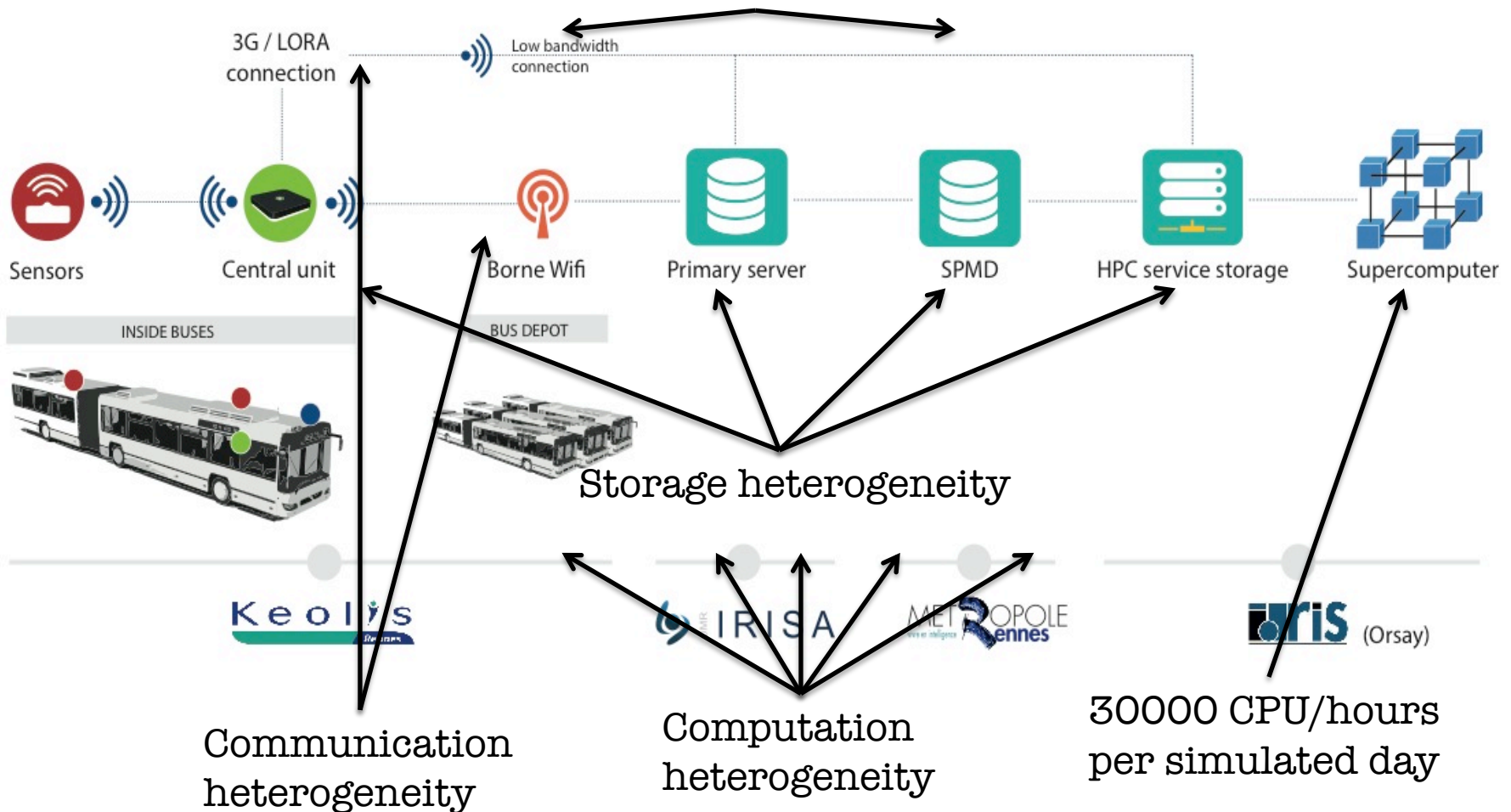
1. *Intelligent traffic management*, acting on traffic lights and smart road signals
   - "Green routes" for emergency vehicles
   - Traffic enhancement based on intelligent cross road management

2. *Advanced driving assistance systems*
   - Intelligent cross road management based on obstacle detection
   - Automated valet parking systems

Data in motion vs data at rest
Real time aspects

An Example: Air Quality Measurement and Analysis (Including Urgent Computing)

New users / applications

3G / LORA connection

Low bandwidth connection

Sensors

Central unit

Borne Wifi

Primary server

SPMD

HPC service storage

Supercomputer

INSIDE BUSES

BUS DEPOT

Storage heterogeneity

Keolis

IRISA

METROPOLE Rennes

iris (Orsay)

30000 CPU/hours per simulated day

Communication heterogeneity

Computation heterogeneity

Current project in Rennes, FR

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EC CALLS ON RELATED TOPICS

European Data Infrastructure: HPC, Big Data and Cloud technologies

- ICT-11-2018-2019: HPC and Big Data enabled Large-scale Test-beds and Applications
  - November 2018 - development of **large-scale IoT/Cloud-enabled** industrial pilot test-beds for big data applications by combining and taking advantage of relevant technologies (**Big Data, IoT, cloud and edge computing, etc**.) (15 – 18 million)

European Data Infrastructure: HPC, Big Data and Cloud technologies

- ICT-14-2019: Co-designing Extreme Scale Demonstrators (EsD)
  - Nov 2018 - Proposals are expected to address the research, co-design, integration, validation and experimentation of extreme scale computing systems driven by a set of ambitious **extreme data and HPC applications** (20 – 40 million)

THANK YOU !

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