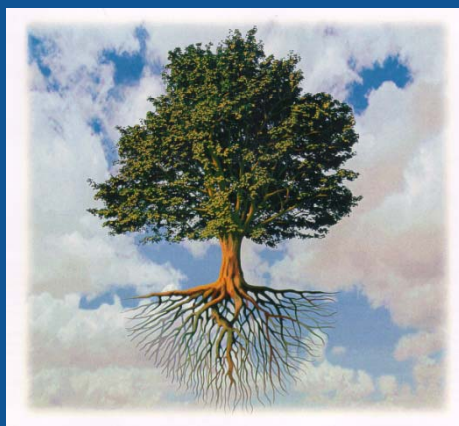


# ICT in Excellent Science



**Kostas Glinos, Head of e-Infrastructure**  
**19-20 November 2013**  
European Commission - DG CONNECT  
Directorate C - Excellence in Science



## *Excellent Science pillar in H2020*

- European Research Council
- Marie Skłodowska-Curie actions
- **Future and Emerging Technologies**
- Research infrastructures programme

**FET: Pathfinding Europe's technological future**



## FET in Horizon 2020

*"**Future and emerging technologies** shall support collaborative research in order to extend Europe's capacity for advanced and paradigm-changing innovation. It shall foster scientific collaboration across disciplines on radically new, high-risk ideas and accelerate development of the most promising emerging areas of science and technology as well as the Union wide structuring of the corresponding scientific communities."*  
**COMMISSION PROPOSAL ON ESTABLISHING HORIZON 2020 - THE FRAMEWORK PROGRAMME FOR RESEARCH AND INNOVATION (2014-2020)**





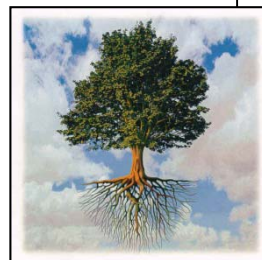
## FET's missions

- *To uncover radically new technology areas that will renew the basis for future European competitiveness and growth and will make a difference for society in the decades to come.*
- *To grasp European leadership in research and innovation on the most promising such future and emerging technologies early on.*
- *To turn Europe into the best environment for responsible and dynamic multi-disciplinary collaborations on such future and emerging technologies.*
- *To kick-start European research and innovation eco-systems around such future and emerging technologies, as seeds of future industrial leadership and the tackling of grand societal challenges.*



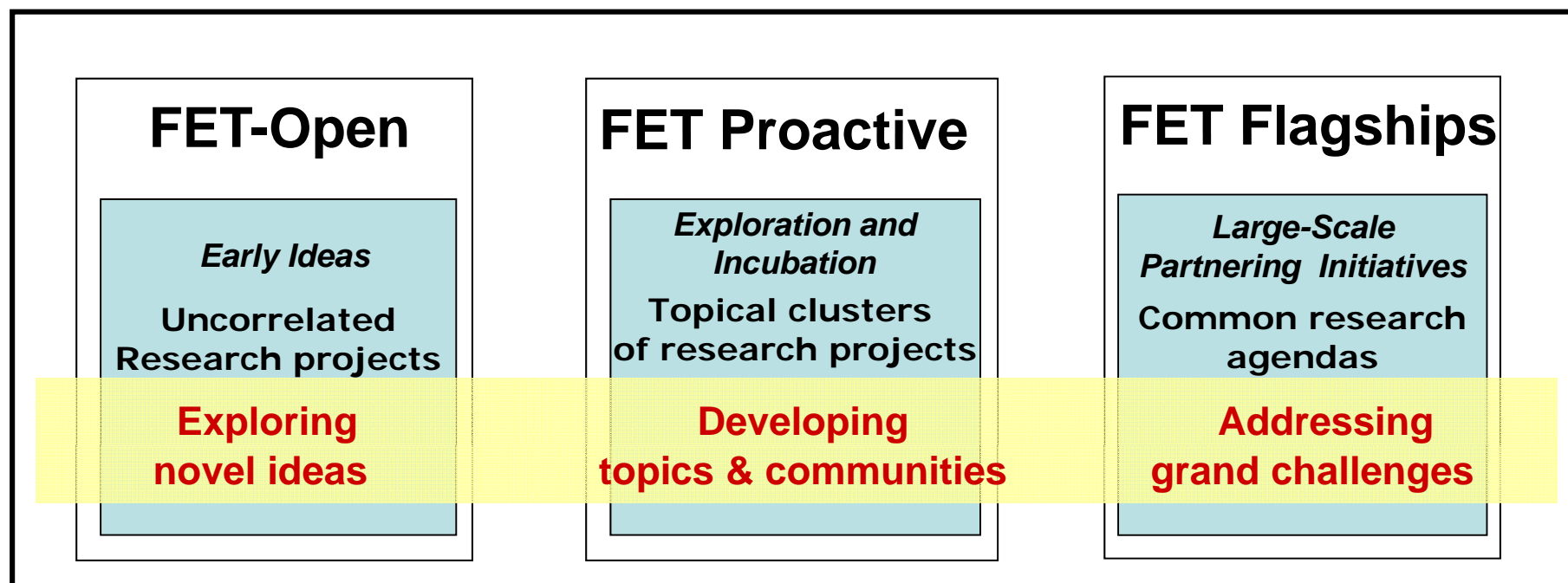
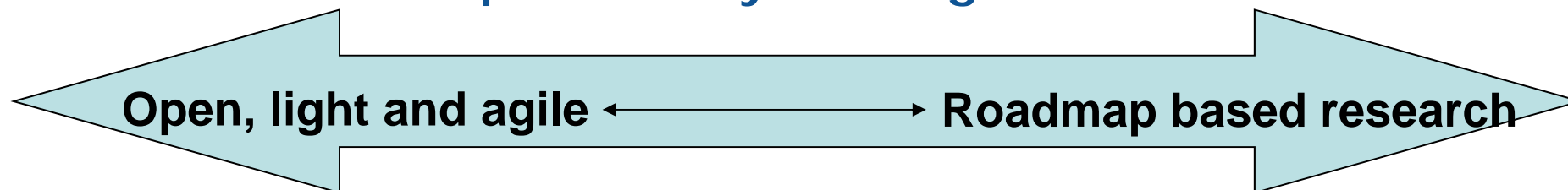
## A new level of ambition

- *Pathfinding Europe's technological future*
- *Bootstrapping new R&I eco-systems*
- *Prominent large-scale partnering initiatives*
  - FET Flagships
  - High-Performance Computing (PPP)
- *A new actor in the S&T funding landscape*
  - Pathfinding
  - Dialogue
  - Engagement



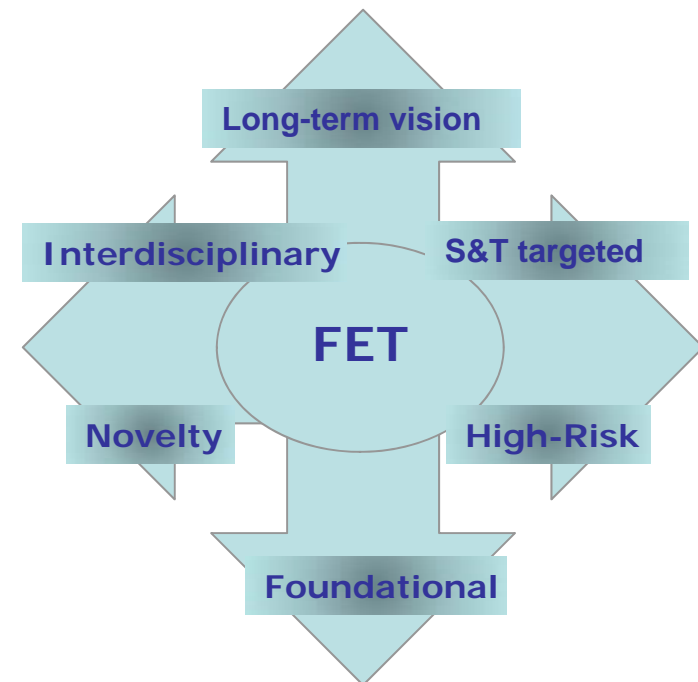


## FET – three complementary funding schemes

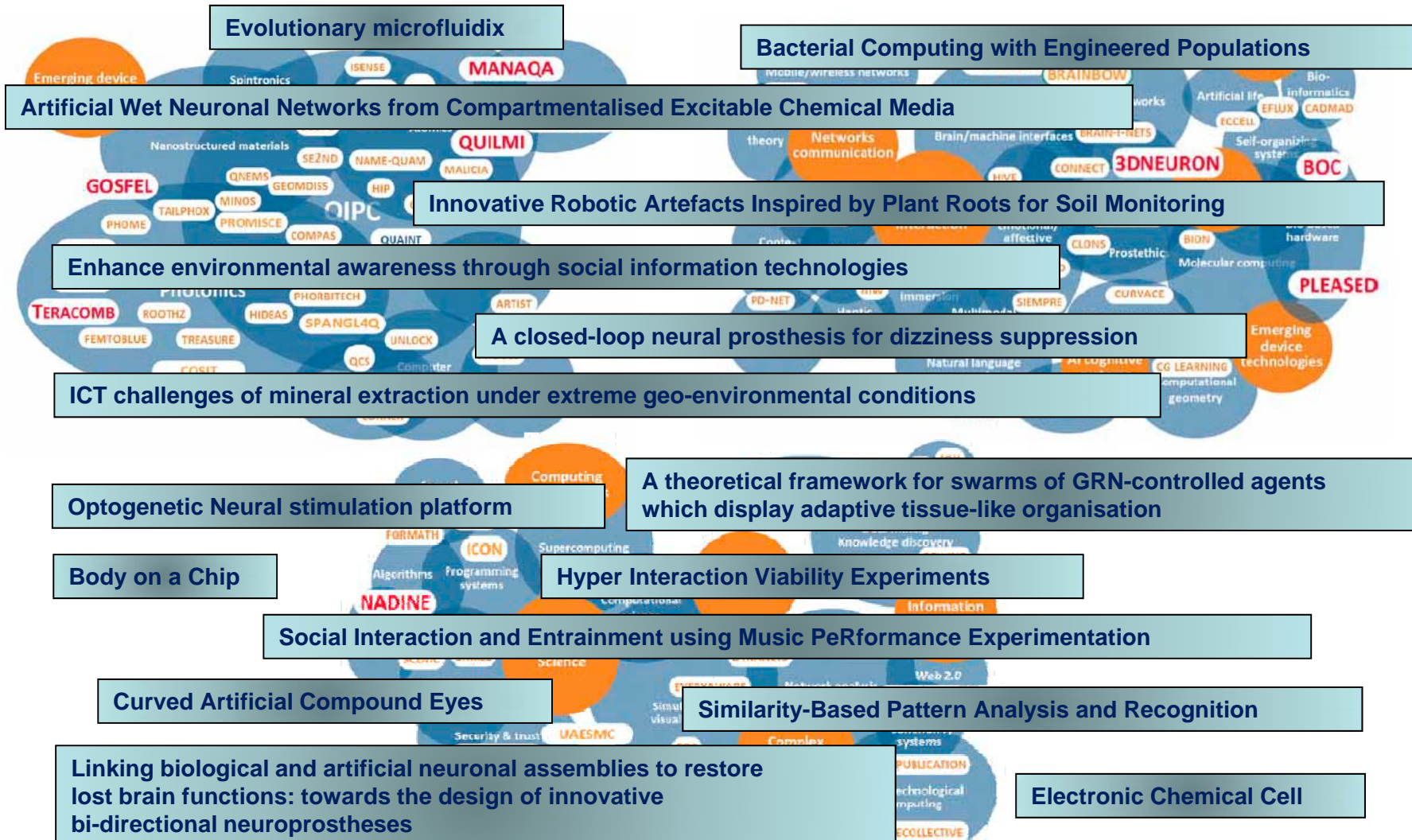


# FET Open: fostering novel ideas

- *'Open is open': all technologies, no topical scope.*
- *40% of the FET budget in H2020 (> 1B€).*
- *FET gatekeepers define the kind of research that FET is looking for.*
- *An end-to-end light and fast scheme:*
  - **Deadline free, open 24/7**
  - **15 pages proposal**
  - **1 step submission, 1stage evaluation**
  - **FET specific evaluation criteria**
- *Instrument*
  - **Research and Innovation Action**
  - **Coordination and Support actions**



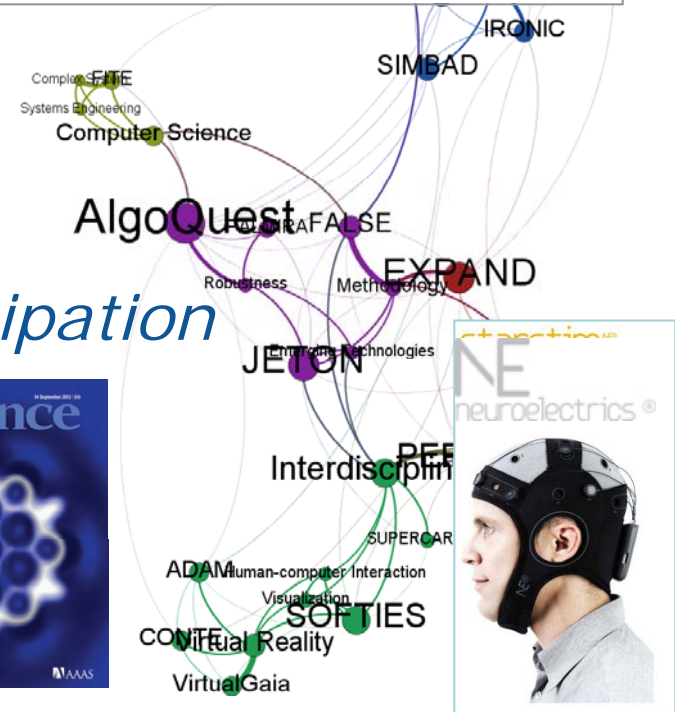
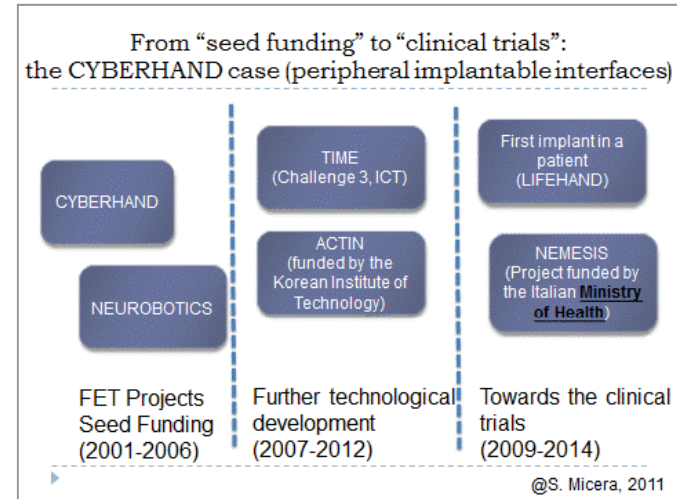
# FET Open in FP7 a portfolio snapshot







- + Popular FET-hallmark scheme
- + Attracts new disciplines and actors, including many young ones and SMEs
- + Numerous success stories
- + A source of new directions and early signals
- + Largely academic, with some high-tech industry and SME participation
- + Highly competitive!





# FET Proactive - nurturing emerging themes and communities

- A set of thematic initiatives on promising emerging research themes.
- Building up a European pool of knowledge and new interdisciplinary communities.
- Joint exploration or consolidation of promising future technologies.
- Topics defined bottom-up (FET Observatory):
  - FET-Open portfolio analysis
  - Consultations
  - Participatory engagement with industry and society
  - Coordination and support actions

# FET Proactive Initiatives in FP7



## Foundations of Computing & Communication

- Nano-Scale ICT Devices and Systems
- Science of Complex Systems for Socially Intelligent ICT
- Unconventional computation
- Dynamics of Multi-Level Complex Systems
- Concurrent Tera-Device Computing
- Quantum Information Foundations & Technologies
- Quantum ICT
- Molecular Scale Devices and Systems
- Towards Zero-Power ICT
- Minimising Energy Consumption of Computing to the Limit
- Atomic and molecular scale devices and systems

## Intelligence and interaction

- Embodied Intelligence
- Pervasive adaptation
- Science of complex systems for Socially Intelligent ICT
- ICT Forever Yours
- Human-Computer Confluence
- Self-Aware Autonomous Systems
- Fundamentals of Collective Adaptive Systems
- Fundamentals of Creativity

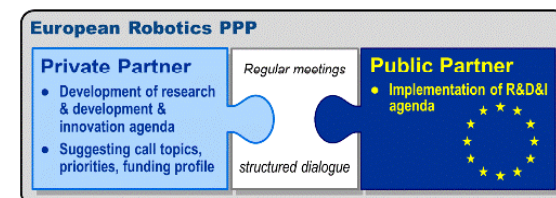
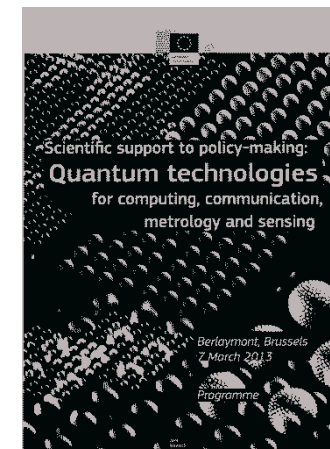
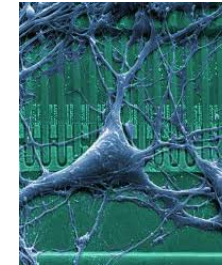
## Convergence and symbiosis

- Bio-ICT Convergence
- Bio-Chemistry based ICT
- Brain-Inspired ICT
- Neuro-Bio-Inspired Systems
- Evolving Living Technologies
- Symbiotic human-machine interaction



# FET Proactive

- + *Balance between continuity and new directions*
  - + **It can take time to mature an avenue**
- + *Creation of communities*
  - + **for instance in, Bio-ICT, quantum technologies, Neuro-IT, complex systems**
- + *Successful transfers*
  - + **for instance in quantum cryptography, cognition, nano-tech, robotics, bio-ICT**



# Future FET Proactives

*Topics coming out of the on-line consultation*

- **1297 contributions received to the FET on-line consultation on future pro-actives**
- **Structured around 9 candidate topics** (see next slide)

[http://cordis.europa.eu/fp7/ict/fet-proactive/fetconsult2012-topics\\_en.html](http://cordis.europa.eu/fp7/ict/fet-proactive/fetconsult2012-topics_en.html)

*Complemented by a special action:*

- **Towards exascale high-performance computing,** as part of the High Performance Computing Public-Private Partnership.

# FET Proactives in WP2014-15

## *Knowing, doing and being: cognition beyond problem solving*

- New foundations for future robotics and other artificial cognitive systems
- Deeper understanding of non-performing aspects of social robotics and interaction in mixed human/technological settings

## *Global Systems Science (GSS)*




- Scientific evidence-based policy responses to societal and global challenges
  - climate change, financial crises, pandemics, growth of cities

## *Quantum computing*

- Focus on quantum simulation

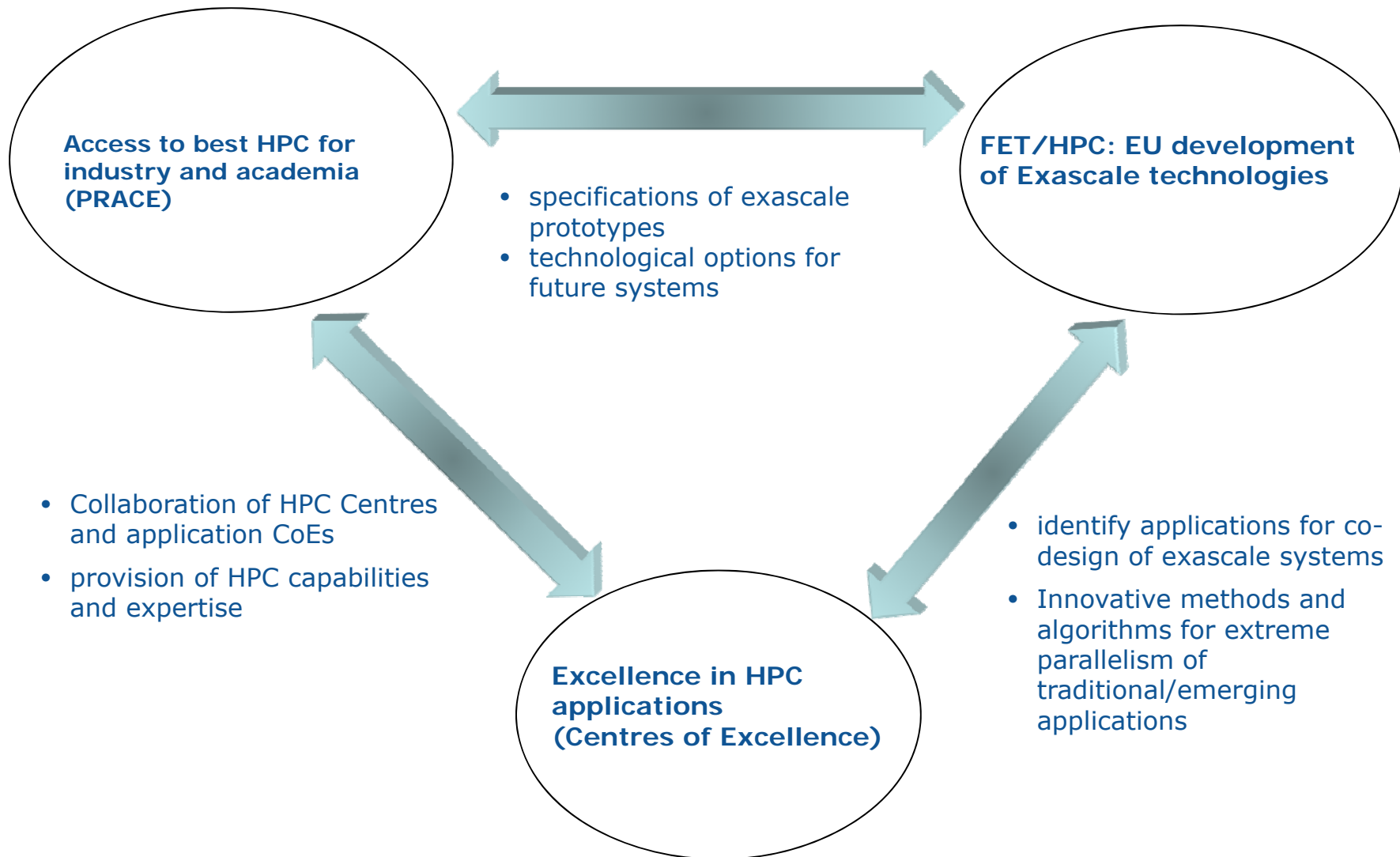
# High Performance Computing PPP

*The EC Communication "High-Performance Computing: Europe's place in a global race", adopted 15 Feb 2012, describes an ambitious strategy for HPC, combining three elements:*

-  (a) Development of exascale High Performance Computing;
-  (b) providing access to the best supercomputing facilities and services for both industry and academia;
-  (c) achieving excellence in HPC applications;

Complemented with training, education and skills development in HPC

# Interrelation between the three elements





# HPC in FET Scope



- The exascale computing frontier requires **fundamental science and technology developments** to ensure the transition to extreme parallelism and extreme data with low energy
  - evolution of most of the key technological solutions that are satisfactory today will be **insufficient** to meet the exascale challenge
  - Co-design approach to develop applications in tandem with architectures and systems
- R&D covering the whole spectrum from processors and system architectures to high-level software and tools and novel applications (e.g. encompassing system software, file systems, compilers, programming environments and tools, algorithms etc.)
  - engaging a European-wide effort to develop technology to build exascale systems and applications within ~10 years





# FET Flagships

*FET Flagships are ambitious, large-scale, long-term, science-driven, goal-oriented, roadmap-based research initiatives, which are expected to:*

- **provide a strong S&T basis for future technological innovation and substantial benefits for society**
- **help overcome fragmentation and increase the impact of European research and innovation efforts**

*and which will require:*

- **cooperation among a range of scientific communities/disciplines, with industries and with the involvement of representatives from the civil society**
- **a long-term commitment of all key stakeholders sharing a common scientific vision and under a strong leadership**
- **a joint effort of EU and national programmes to provide a large financial support (~ 100 M€/year) over a long period (~ 10 years)**

# Graphene & Human Brain Project selected



Stimulating ideas & structuring the scientific community  
2009 - 2010

Call for Preparatory Actions  
21 → 6  
July 2010

Preparatory Phase Pilots  
05/2011 - 04/2012

Flagship selection  
6 → 2  
end 2012

FP7 ramp-up phase  
10/2013- 03/2016

## SCIENCEWORLD REPORT scienceworld.com

Home Space & The Future Nature & Environment Health & Medicine **Tech** Physics Human V

### Brain Simulation and Graphene Research Receive Billion Euro Each

0 Comments  7  3  Share  E-mail  Print

Mark Hoffman First Posted: Jan 28, 2013 09:57 AM EST

The result of the highly anticipated decision of which two research projects will receive a one billion Euro research grant, the largest single research award ever, from the European Commission were announced by the European Commission's Vice-President Neelie Kroes today.



The first project is the [Human Brain Project](#), led by neuroscientist Henry Markram at the Swiss Federal Institute of Technology (EPFL) in Lausanne, which aims to simulate the human brain in a supercomputer, in order to aid medical advancement in brain disorders.

Like Us on [Facebook](#)  

The second, called [Graphene Project](#), is led by theoretical physicist Jari Kinaret at Chalmers University of Technology in Gothenburg, Sweden. It's goal is to develop the awesome

# FET Flagship: Graphene



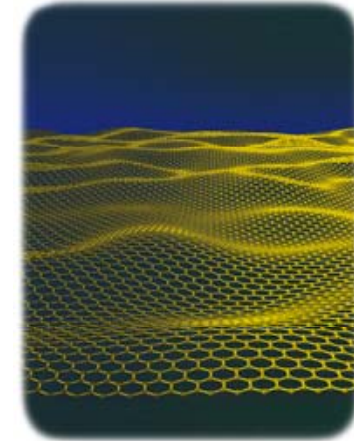
Graphene, is a 2D material , a single layer of carbon atoms, stronger than diamond, yet lightweight and flexible and an exceptional electricity conductor.

The Graphene Flagship will bring graphene, and related 2D materials, **from academic labs to industry, manufacturing and society.**

Examples of products:

- ✓ electronic paper
- ✓ bendable smartphones
- ✓ enhanced solar cells and batteries
- ✓ lighter and more energy efficient airplanes

On the longer term, graphene is expected to give rise to new computers and revolutionary medical applications such as artificial retinas.



*Artistic impression of a corrugated graphene sheet  
Credit: Jannik Meyer*



*Nokia Morph concept - Credit: Nokia Research Center*

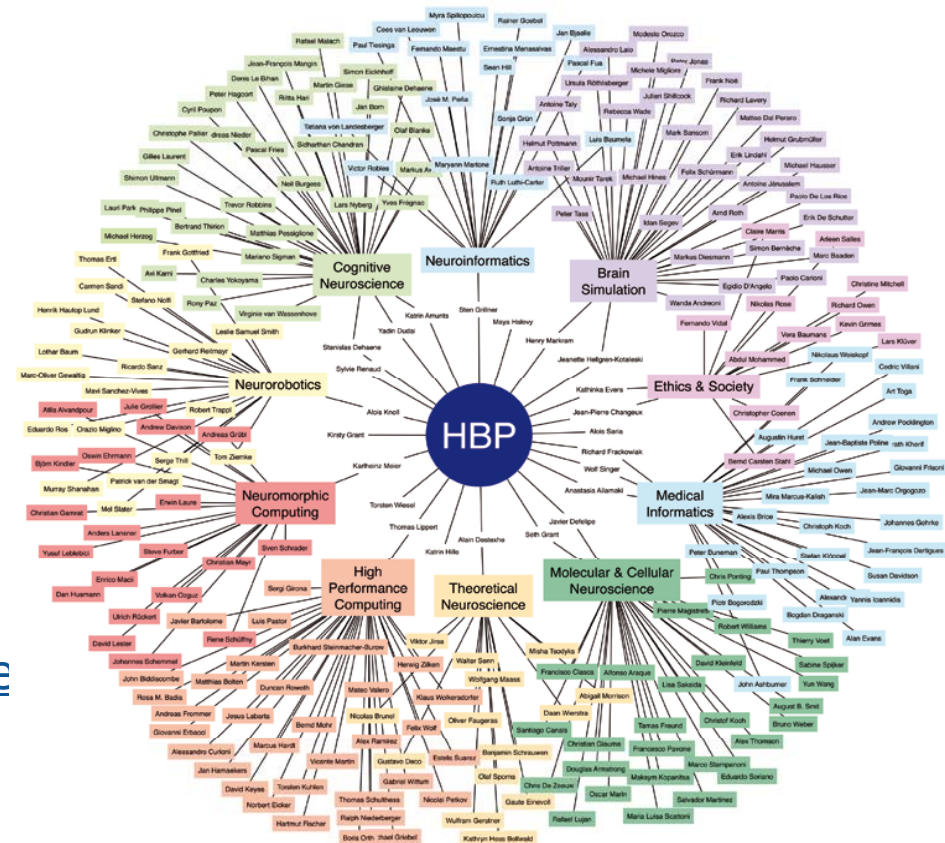
# FET Flagship: Human Brain Project



HBP will create the world's largest **experimental facility for developing the most detailed models of the brain** (from genes to mind), for studying how the human brain works and ultimately for simulating and developing personalised treatment of brain diseases.

This research lays the scientific and **technical foundation for medical progress**: identifying new drug targets and treatment, in response to the urgent need to combat brain diseases and their associated costs to society.

HBP will also produce brain-inspired **'neuromorphic' computing** systems that could drastically reduce power-consumption for super-computers and enhance robots.



# Flagships: European R&I Partnerships

- **Framework Partnership Agreements** between the EC and the Flagship partners (call in 2014) to formalise:
  - the EC long-term commitment to support the Flagships
  - the partners' commitment to implement the strategic research agenda of each of the Flagships

A **core project** will progress FET Flagship along the defined roadmap (WP2014-2015)

**Complementary projects** are foreseen to complement expertise and ensure openness (WP2016)

An **ERANET** ("FLAG-ERA") has been started involving 22 National and regional funding organisations and ministries from 17 countries, aiming at enhanced complementarities and synergies and identifying joint calls



# FET WP2014-15 Structure

DRAFT

## Call FET-Open - fostering novel ideas

- Topic 1: FET-Open research projects
- Topic 2: Coordination and Support Activities

## Call FET-Proactive - nurturing emerging themes and communities

- Topic 1: Knowing, doing and being; cognition beyond problem solving
- Topic 2: Global Systems Science (GSS)
- Topic 3: Quantum simulation

## Call FET Proactive - towards exascale High Performance Computing

- Topic 1: HPC Core Technologies, Programming Environments and Algorithms for Extreme Parallelism and Extreme Data Applications
- Topic 2: HPC Ecosystem Development

## Call FET-Flagships - tackling grand interdisciplinary S&T challenges

- Topic 1: Framework Partnership Agreement
- Topic 2: Graphene FET Flagship Core Project
- Topic 3: Human Brain Project FET Flagship Core Project
- Topic 4: Policy environment for FET Flagships

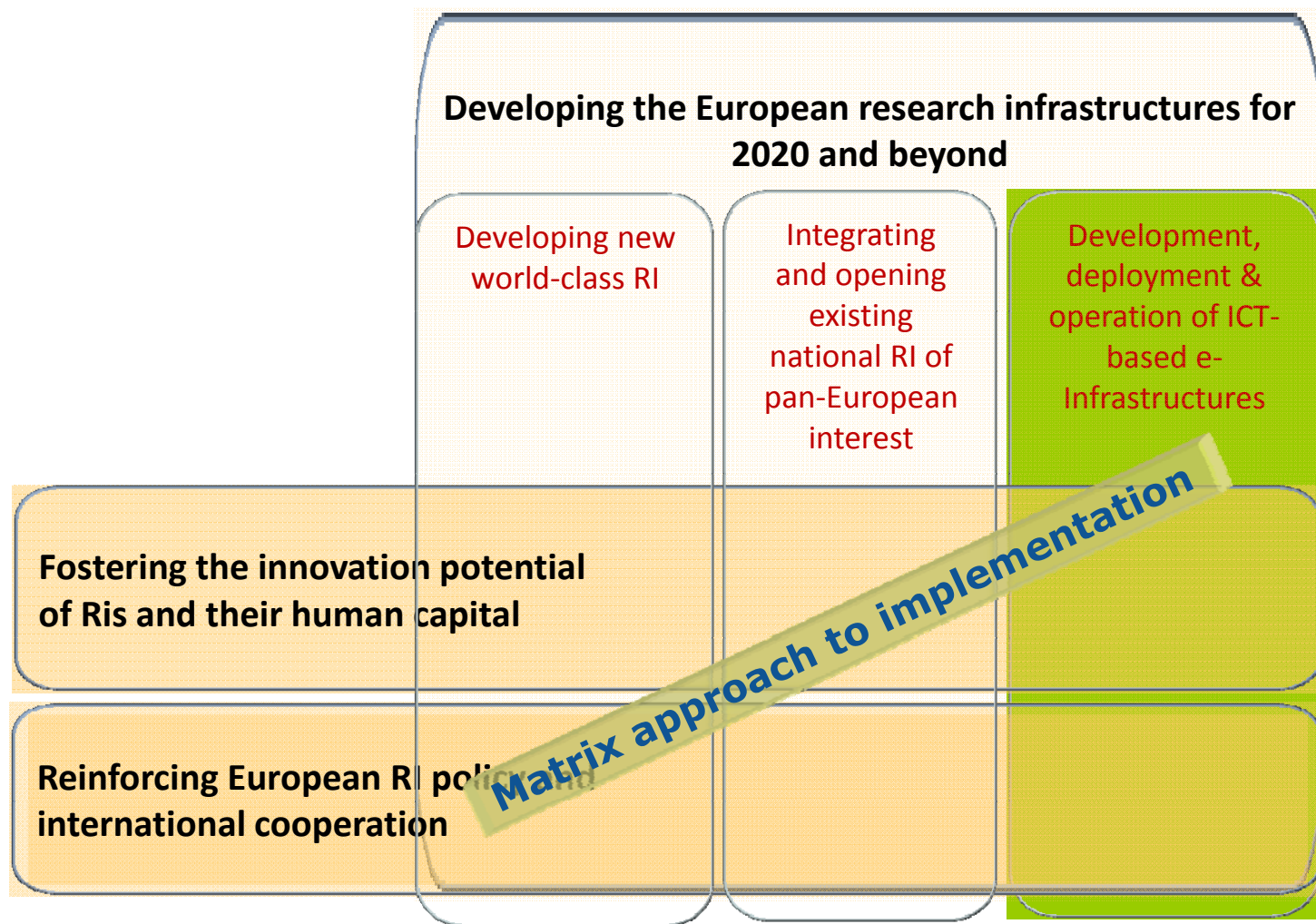


## *Excellent Science pillar in H2020*

- European Research Council
- Marie Skłodowska-Curie actions
- Future and Emerging Technologies
- **Research infrastructures**



# Research Infrastructures in Horizon 2020





European  
Commission

# e-Infrastructure Vision

- ACHIEVING DIGITAL ERA
- BRIDGE DIGITAL DIVIDES
- EVERY RESEARCHER DIGITAL





# Research & Innovation: Staying Competitive

- Large scale collaborations becoming the norm
  - *Transnational, often global*
  - *virtual research and innovation communities*
  - *access to talent and remote resources*
- Big Data: Data-intensive science and innovation
  - *Use and manage exponentially growing sets of data*
- Experimentation in silico, simulation
  - *Use of high-performance computing*
- *Open is (usually) better*





European  
Commission

# GLOBAL CONNECTIONS ...



Map of scientific collaborations from 2005 to 2009  
Computed by Olivier H. Beauchesne @ Science-Metrix, Inc.  
Data from Scopus, using books, trade journals and peer-reviewed journals



European  
Commission

# BIG DATA ...

## GROWTH OF THE DIGITAL UNIVERSE, 2010-2020

Digital Universe in Exabytes (Billions of Gigabytes)





# e-infrastructure approach in Horizon 2020

## **Transversal**

**Cutting across disciplines and sectors**

## **Support tomorrow's science**

**Open science, open access, best solutions**

## **Enabling innovation everywhere**

**Developing and testing innovative solutions**

**Servicing industry and SMEs**

**Spinning out technologies**

## **Skills development across all actions**



## *Policy Background: Digital ERA, Open Access, "Riding the Wave of Data", HPC Strategy, Géant Expert Group Report, ...*

### **ERA Communication COM(2012)392**

- Federation of researcher electronic identities

### **Commission Communication on Scientific Information COM(2012)401**

- Access, preservation and e-infrastructure (publications and data)

### **Europe is "Riding the Wave" Report**

- Data e-infrastructure that supports seamless access, use, re-use and trust of data
- Physical and technical infrastructure become invisible and **data become the infrastructure**

### **Commission Communication "High-Performance Computing: Europe's place in a Global Race" (2012)**

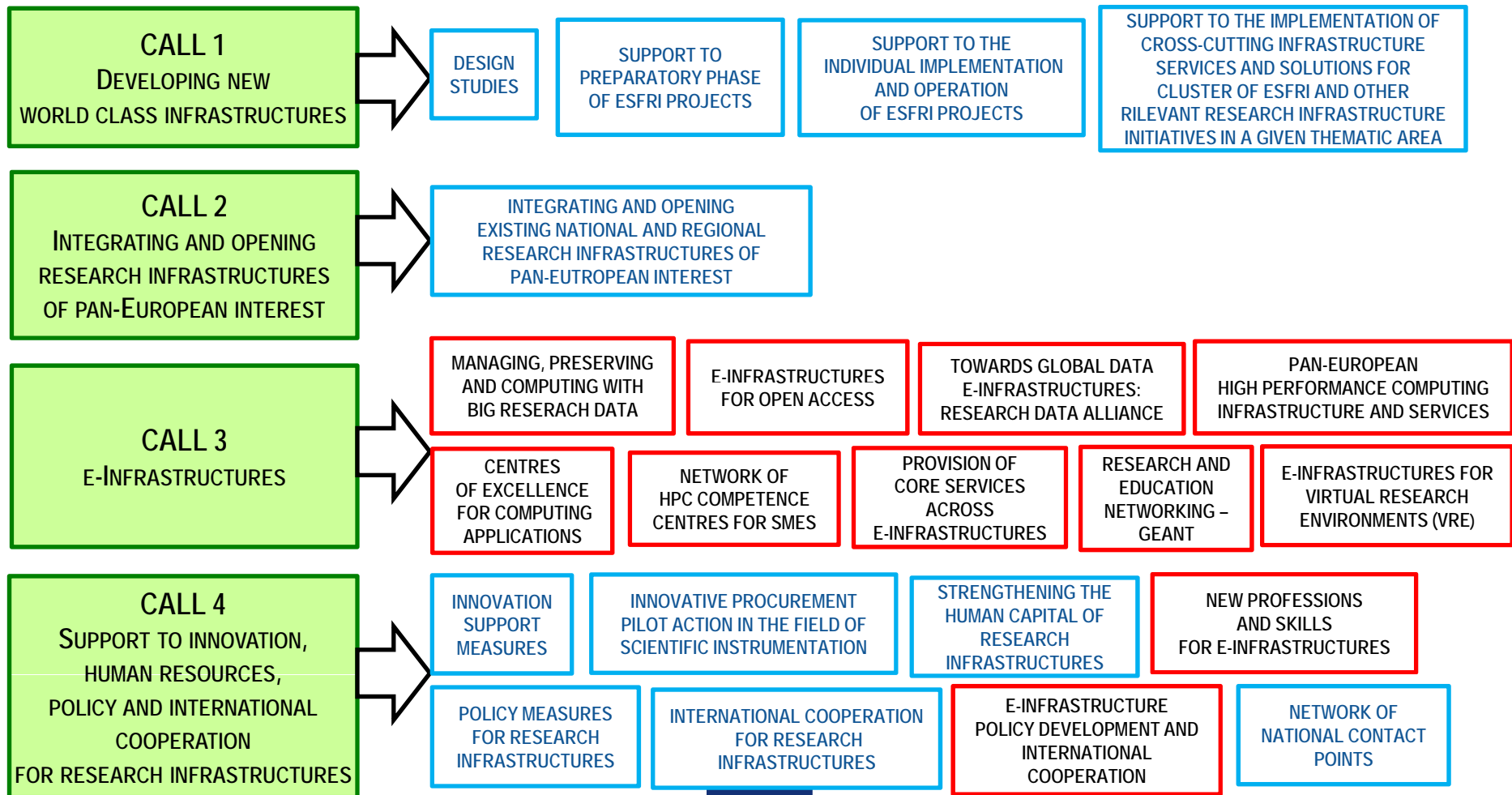


Riding the Wave  
High Level Expert Group on Scientific  
Data, October 2010

<http://cordis.europa.eu/fp7/ict/e-infrastructure/docs/hlg-sdi-report.pdf>



# RESEARCH INFRASTRUCTURE Work Programme 2014-2015







## INTEGRATED e-INFRASTRUCTURE SERVICES

### VRE

E-INFRASTRUCTURES FOR  
VIRTUAL RESEARCH  
ENVIRONMENTS (VRE)

PROVISION OF  
CORE SERVICES  
ACROSS  
E-INFRASTRUCTURES

### DATA

### COMPUTING

NETWORK OF  
HPC COMPETENCE  
CENTRES FOR SMES

MANAGING, PRESERVING  
AND COMPUTING WITH  
BIG RESEARCH DATA

RESEARCH AND  
EDUCATION  
NETWORKING –  
GEANT

CENTRES  
OF EXCELLENCE  
FOR COMPUTING  
APPLICATIONS

E-INFRASTRUCTURES  
FOR OPEN ACCESS

### CONNECTIVITY

PAN-EUROPEAN  
HIGH PERFORMANCE COMPUTING  
INFRASTRUCTURE AND SERVICES

TOWARDS GLOBAL DATA  
E-INFRASTRUCTURES  
RESEARCH DATA ALLIANCE

### SUPPORT

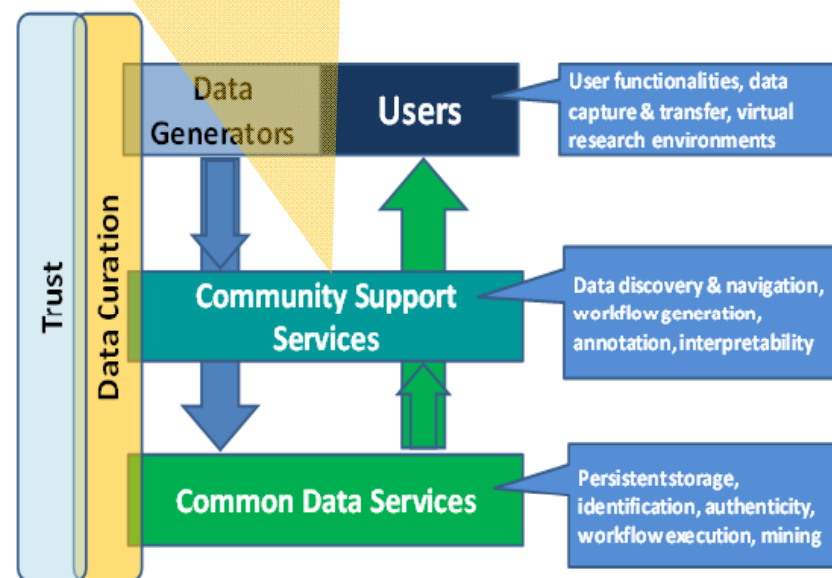
E-INFRASTRUCTURE  
POLICY DEVELOPMENT AND  
INTERNATIONAL  
COOPERATION

NEW PROFESSIONS  
AND SKILLS  
FOR E-INFRASTRUCTURES

## Implementing interoperable data infrastructures

- (a) **data generators**; research projects, big research infrastructure, installations or medium size laboratories, simulation centres, surveys or individual researchers
- (b) **discipline-specific data service providers**, providing data and workflows as a service
- (c) **providers of generic common data services** (computing centres, libraries)
- (d) **researchers as users**, using the data for science and engineering

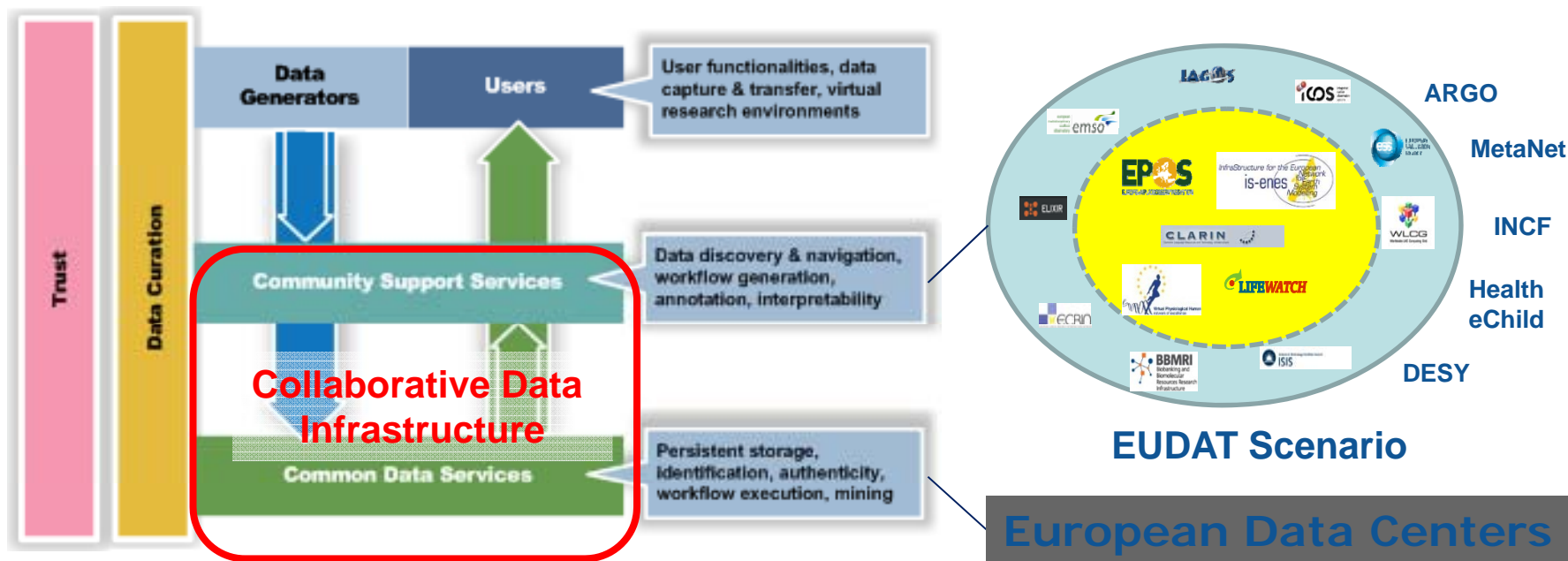
community driven data infrastructure, including ESFRI, ESFRI clusters and others





European Commission

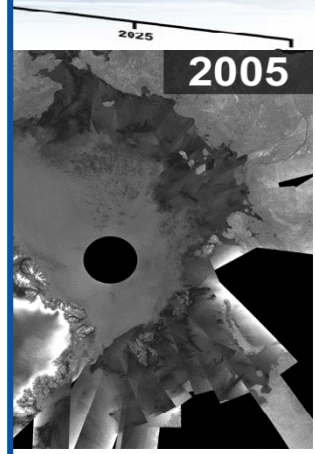
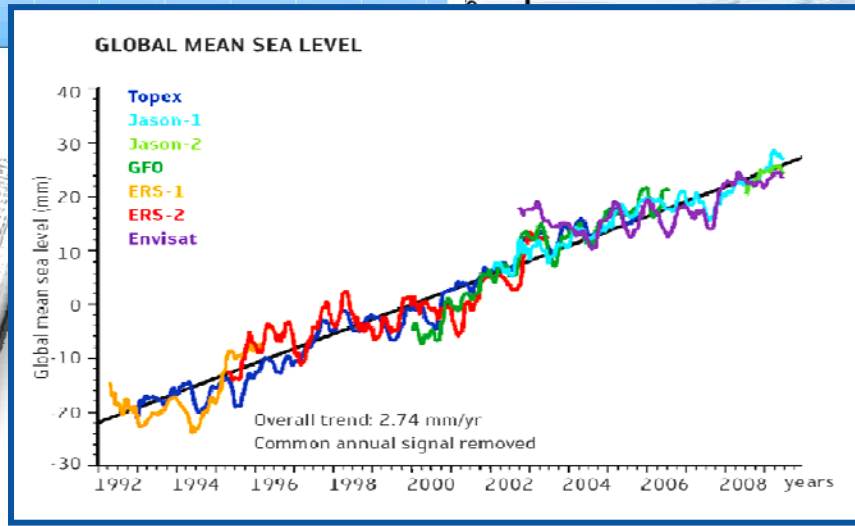
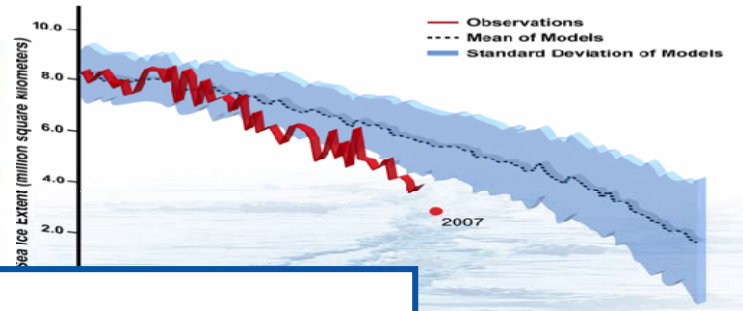
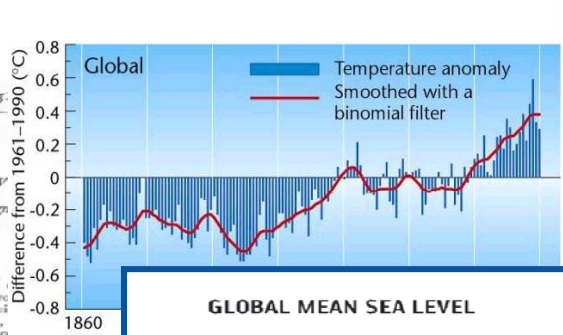
Data driven research across disciplinary and geographical boundaries  
 Register relevant data objects stored in certified repositories  
 Virtually integrate data objects in trusted federations  
 Foster advancements in interoperability of object content  
 Fragmentation and heterogeneity of data require standardization vs. innovation dynamics





European Commission

# community-driven data e-infrastructure SCIDIP-ES (Earth Observation Long Term Data Preservation)



Adapted from a slide of Dr. Mirco Albani (ESA), project leader of SCIDIP-ES

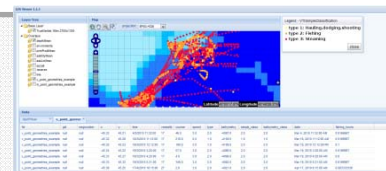


European  
Commission

# community-driven data e-infrastructure



- \* Vessel Activity Analysis
- \* Biological Niche Modeling
- \* Fishery Country Profile Product
- \* Global Catch Statistics Quality Improvement
- \* ...



## Simplified access and exploitation of tools for data analysis and processing

harmonization, aggregation, access to heterogeneous, multi-disciplinary and multi-format data

GEOSeas



EMODNET



GENESI-DR



GBIF





# community-driven data e-infrastructures



The **Virtual Observatory** is a community-led response to the challenges the astronomical community faces in data management and storage.

### NVO VO DataScope Query

Hosted by: HEASARC NASA/GSFC

[NVO Home](#) | [Help](#) | [VO Tools and Services](#) | [NVO Feedback](#)

#### Query VO resources for a given region of a sky

**Note:** DataScope V2.1 released March 26, 2007 (many cosmetic changes and some bug fixes)  
What do we know about a given point or region in the sky?  
To find out, just enter a target or position. The NVO DataScope will show you the results from hundreds of resources.

Position:   
Use a target name (e.g., 3c273) or position (e.g., 10 10 10.1, 20 20 20.2)

Size:   
(in degrees, max is 2)

Run query:

Skip cache?  Refresh registry?   
Do not add to list of recent queries?

Some recent queries:

- [CGCG 456-050 \(0.25\)](#)
- [30 dor \(0.25\)](#)
- [186.66, -63.13 \(0.0833\)](#)
- [VCC 2062 \(0.25\)](#)
- [M87 \(0.25\)](#)

**Positions** may be entered in decimal (dd.f, sdd.f) or sexagesimal (hh mm ss.f, dd mm ss.f) notation or as targets recognized by NED or SIMBAD.  
The **Size** should be entered in decimal degrees.

---

Data found(143) No data (356) Errors(24) Waiting(0) 100% complete  
Position:m1 Resources/hits: 623/36295


[Summary](#) | [Resources](#) | [Data Table](#) | [No.Data](#) | [Still Processing](#) | [Errors](#) | [Help](#)

#### Data for 2nd Digitized Sky Survey (Blue)

Quick Links: [ASCII](#) | [MetaData](#) | [XML](#) | [VOPlot](#) | [Overlay](#)

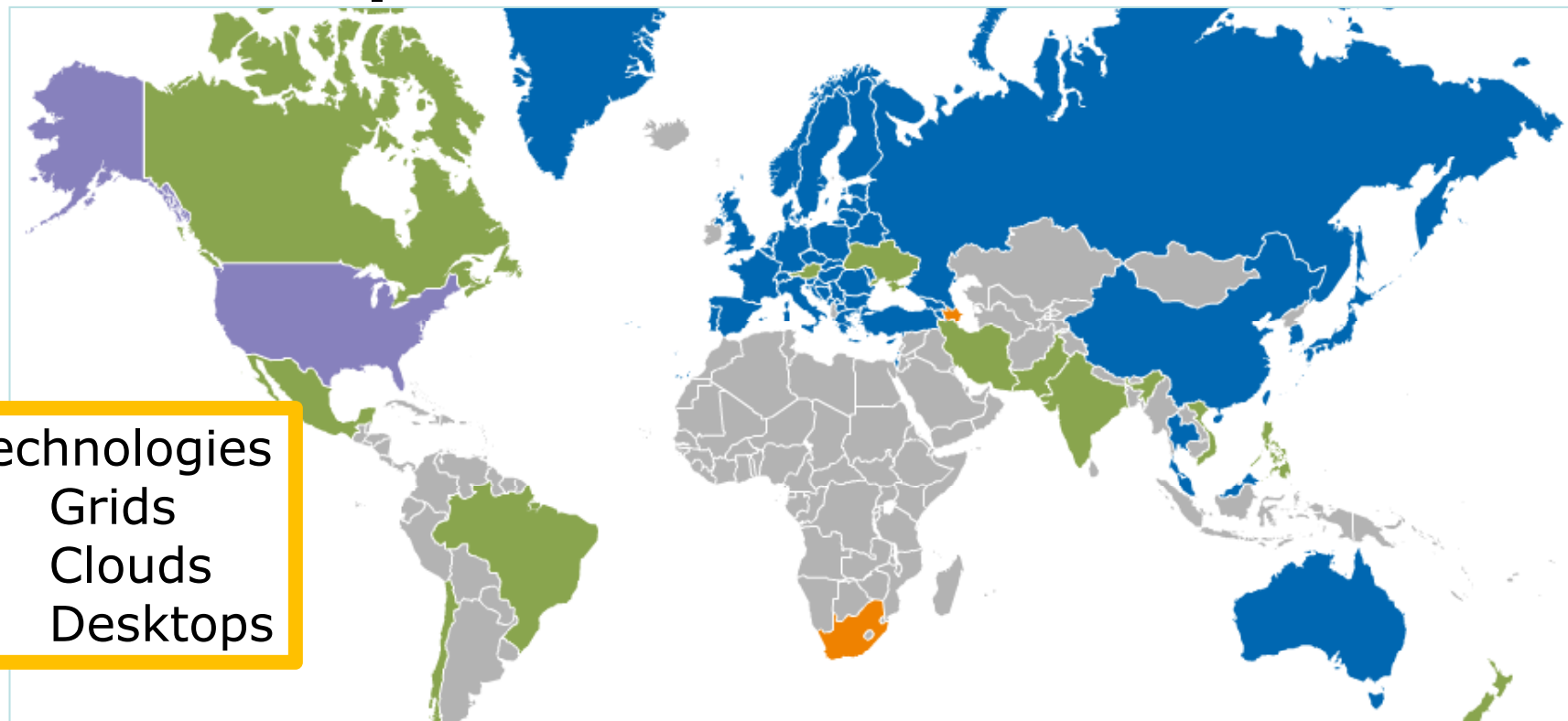
	All	Survey	Ra	Dec	Dim	Size	Scale	
1.	<input type="checkbox"/> View	FOV	dss2b	05 34 32.0	22 00 52.1	300 300	0.25 0.25	-8.33333333333334E-4 8.33333333333334E-4
2.	<input type="checkbox"/> View		dss2b	05 34 32.0	22 00 52.1	300 300	0.25 0.25	-8.33333333333334E-4 8.33333333333334E-4
3.	<input type="checkbox"/> View	FOV	dss2r	05 34 32.0	22 00 52.1	300 300	0.25 0.25	-8.33333333333334E-4 8.33333333333334E-4
4.	<input type="checkbox"/> View		dss2r	05 34 32.0	22 00 52.1	300 300	0.25 0.25	-8.33333333333334E-4 8.33333333333334E-4
5.	<input type="checkbox"/> View	FOV	dss2r	05 34 32.0	22 00 52.1	300 300	0.25 0.25	-8.33333333333334E-4 8.33333333333334E-4
6.	<input type="checkbox"/> View		dss2r	05 34 32.0	22 00 52.1	300 300	0.25 0.25	-8.33333333333334E-4 8.33333333333334E-4

Hosted by the Astrophysics Science Division and the High Energy Astrophysics Science Archive Research Center (HEASARC)  
HEASARC Director: Dr. Nicholas E. White,  
HEASARC Associate Director: Dr. Roger Brissenden,  
Responsible NASA Official: Phil Newman  
[Privacy](#) [Security](#) [Notice](#)





# The European Grid Infrastructure today



## Technologies

- Grids
- Clouds
- Desktops

From 14 regional to 34 operations centres in 53 countries  
From 188,000 jobs/day with 80,000 cores on 250 Resource Centres  
to 1,200,000 jobs/day with 430,000 cores on 337 Resource Centres



# A European Cloud Partnership: big science teams up with big business

**HELIX NEBULA THE SCIENCE CLOUD**

**Strategic Plan**

- ▶ Establish multi-tenant, multi-provider cloud infrastructure
- ▶ Identify and adopt policies for trust, security and privacy
- ▶ Create governance structure
- ▶ Define funding schemes

**CERN**  
To support the computing capacity needs for the ATLAS experiment

**EMBL**  
Setting up a new service to simplify analysis of large genomes, for a deeper insight into evolution and biodiversity

**esa**  
To create an Earth Observation platform, focusing on earthquake and volcano research

**Partners:** Atos, Capgemini, CloudSigma, CSA cloud security alliance, esi, interoute, Logica, OpenNebula.org, orange Business Services, SAP, the SERVER LABS, sixsq, Telefonica, terradue 20, THALES, Trust IT, T-Systems

Slide courtesy of Helix Nebula





## INTEGRATED e-INFRASTRUCTURE SERVICES

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E-INFRASTRUCTURES FOR  
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HIGH PERFORMANCE COMPUTING  
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TOWARDS GLOBAL DATA  
E-INFRASTRUCTURES  
RESEARCH DATA ALLIANCE

### SUPPORT

E-INFRASTRUCTURE  
POLICY DEVELOPMENT AND  
INTERNATIONAL  
COOPERATION

NEW PROFESSIONS  
AND SKILLS  
FOR E-INFRASTRUCTURES

Scientific  
Information  
Infrastructure

Open. Share. Re-use.

*Science. Set Free.* ■

*Research results. Linked.*



**OpenAIRE**  
Open Access Infrastructure for Research in Europe

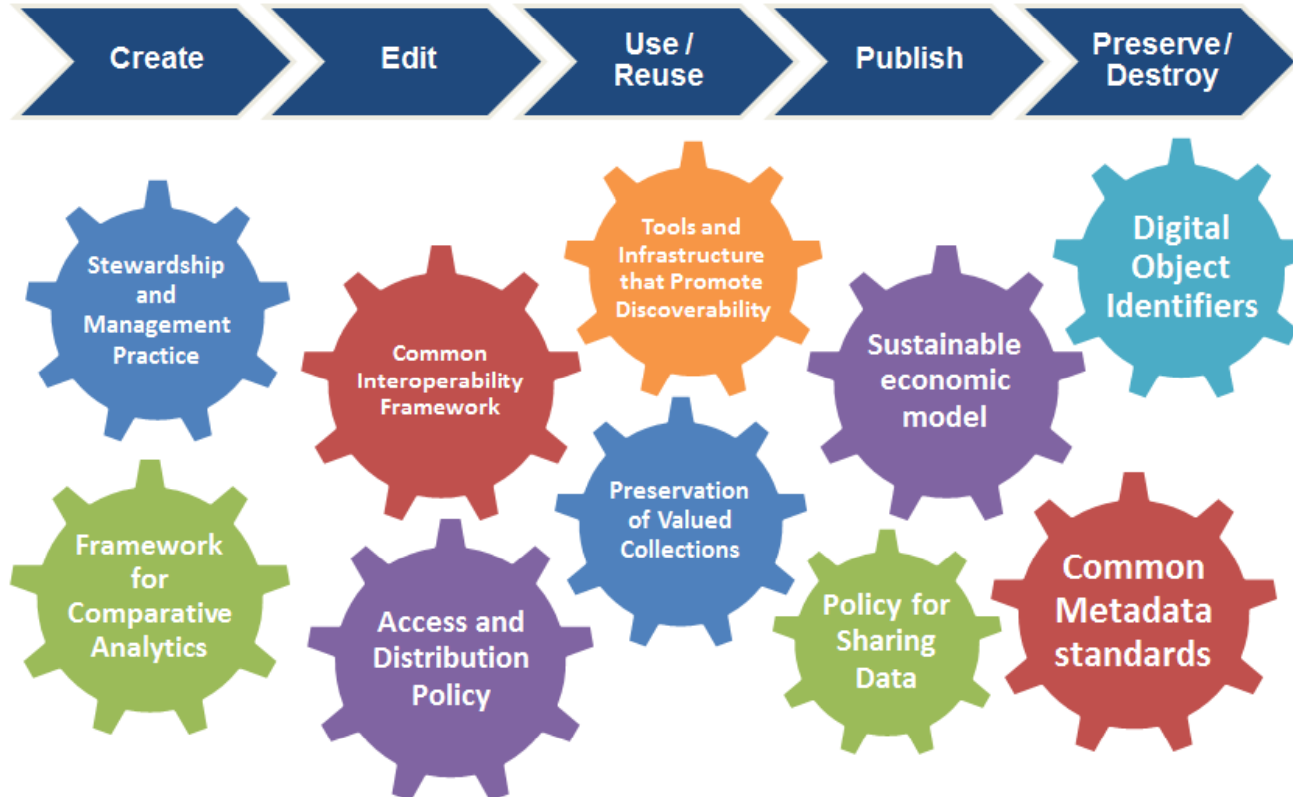
**launched 18 March**



## Research Data Alliance:

Common Infrastructure, Policy and Practice

Drives Data Sharing and Exchange throughout the Data Life Cycle



*From Prof. Fran Berman and Prof. John Wood, Members of the RDA Council*





## INTEGRATED e-INFRASTRUCTURE SERVICES

### VRE

E-INFRASTRUCTURES FOR  
VIRTUAL RESEARCH  
ENVIRONMENTS (VRE)

PROVISION OF  
CORE SERVICES  
ACROSS  
E-INFRASTRUCTURES

### DATA

### COMPUTING

NETWORK OF  
HPC COMPETENCE  
CENTRES FOR SMES

MANAGING, PRESERVING  
AND COMPUTING WITH  
BIG RESEARCH DATA

RESEARCH AND  
EDUCATION  
NETWORKING –  
GEANT

CENTRES  
OF EXCELLENCE  
FOR COMPUTING  
APPLICATIONS

E-INFRASTRUCTURES  
FOR OPEN ACCESS

### CONNECTIVITY

PAN-EUROPEAN  
HIGH PERFORMANCE COMPUTING  
INFRASTRUCTURE AND SERVICES

TOWARDS GLOBAL DATA  
E-INFRASTRUCTURES  
RESEARCH DATA ALLIANCE

### SUPPORT

E-INFRASTRUCTURE  
POLICY DEVELOPMENT AND  
INTERNATIONAL  
COOPERATION

NEW PROFESSIONS  
AND SKILLS  
FOR E-INFRASTRUCTURES

# PRACE



a European  
e-Infrastructure  
in the ESFRI list

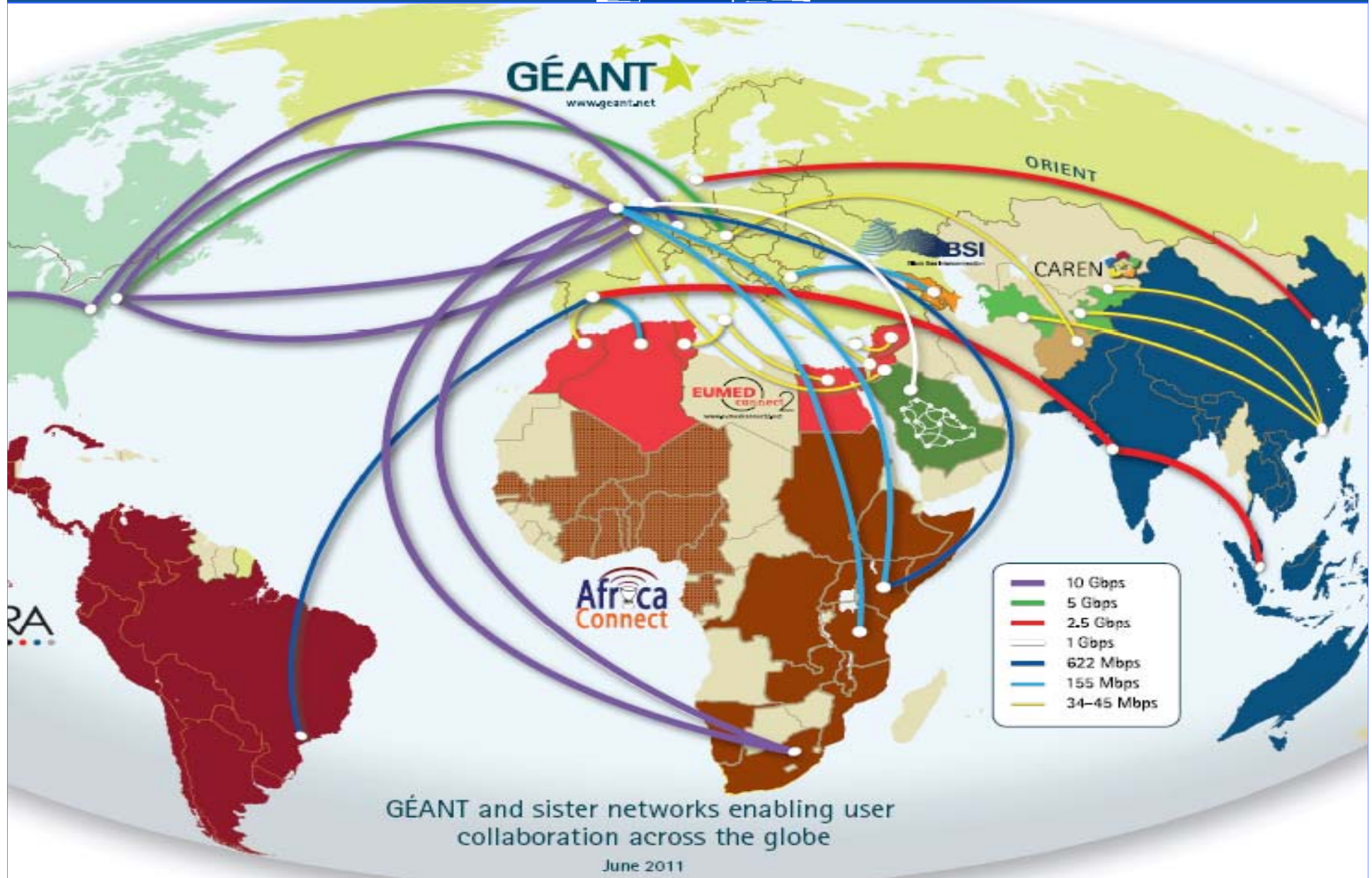
- deliver world class high performing computing and data management resources and services (Tier-0 systems)
  - *to all European researchers*
  - *to all Countries even with no HPC capabilities*

- In operation since April 2010
  - PRACE (AISBL) legal entity – 25 new members



- *Machines are funded nationally (400 Million € from France, Germany, Italy and Spain provided as Tier-0 services on Total Cost of Ownership basis)*  
**Funding for 2010-2015: 530 M€ (from MS + EC)**







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chemical safety and toxicogenomics:  
non-animal tests for predicting  
chemical safety

*diXa*

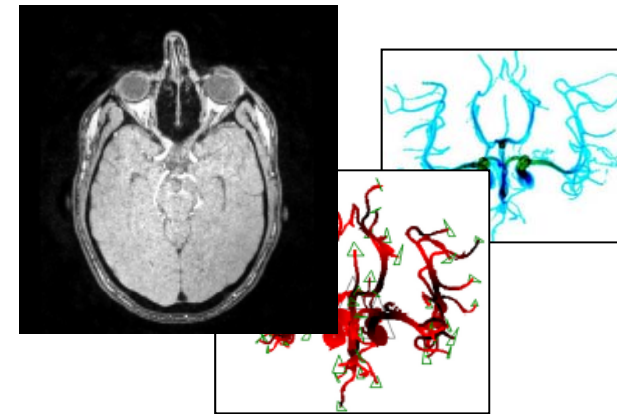
hydrometeorology e-Infrastructure  
for natural disasters prediction

*DRIHM(S), eiAfrica*

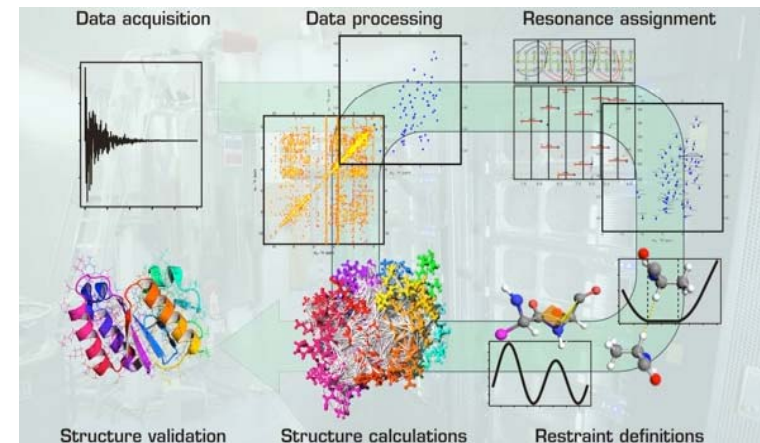


global virtual brain scan imaging laboratory

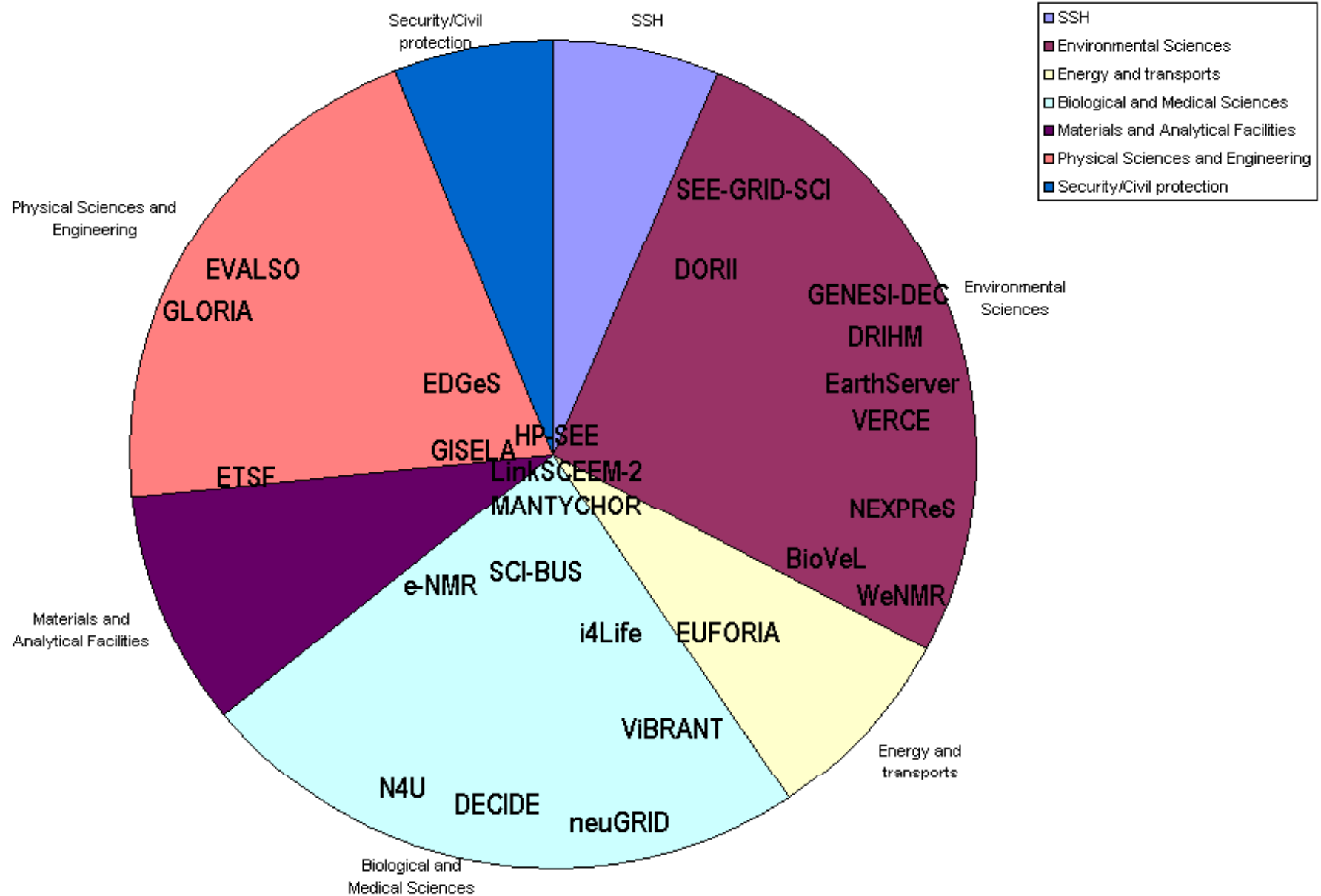
*outGRID* harmonises  
EU neuGRID, Canada CBRAIN and US LONI-ADNI



WeNMR - A worldwide e-Infrastructure for  
NMR and structural biology









## Putting emphasis on:

- *Services*
- *Thinking innovation*
  - With both suppliers or users
- *Mainstreaming skills development*
- *Integration between data and computing*
- *Business plans for financial sustainability*
  - ...and partnerships with the private sector
- *Supporting policies; Open data and software*
- *Sharing basic operations services and building blocks*
- *Monitoring performance (KPIs)*



# Thanks for your attention!

