



# ISGC 2016



Ministero degli Affari Esteri

*Ubiquitous e-infrastructures and Applications*



*13-18 March 2016, Academia Sinica, Taipei, Taiwan*



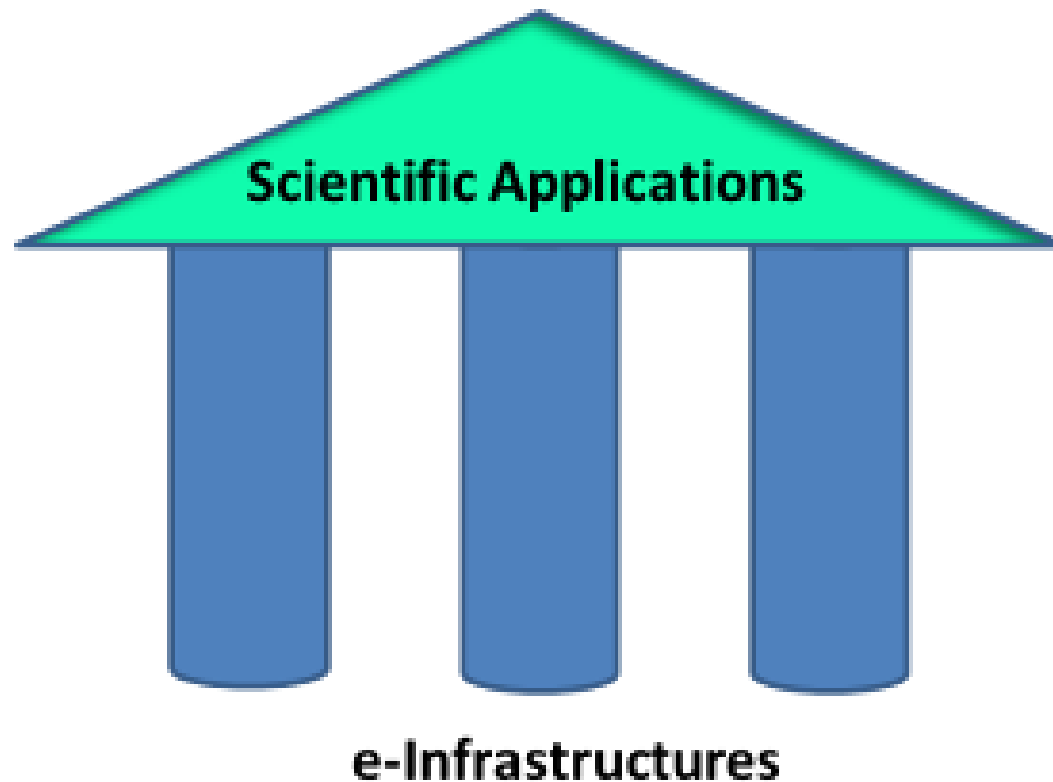
## EU-India cooperation on e- Infrastructures: from EU- IndiaGrid to CHAIN-REDS & e-INIT project

Alberto Masoni

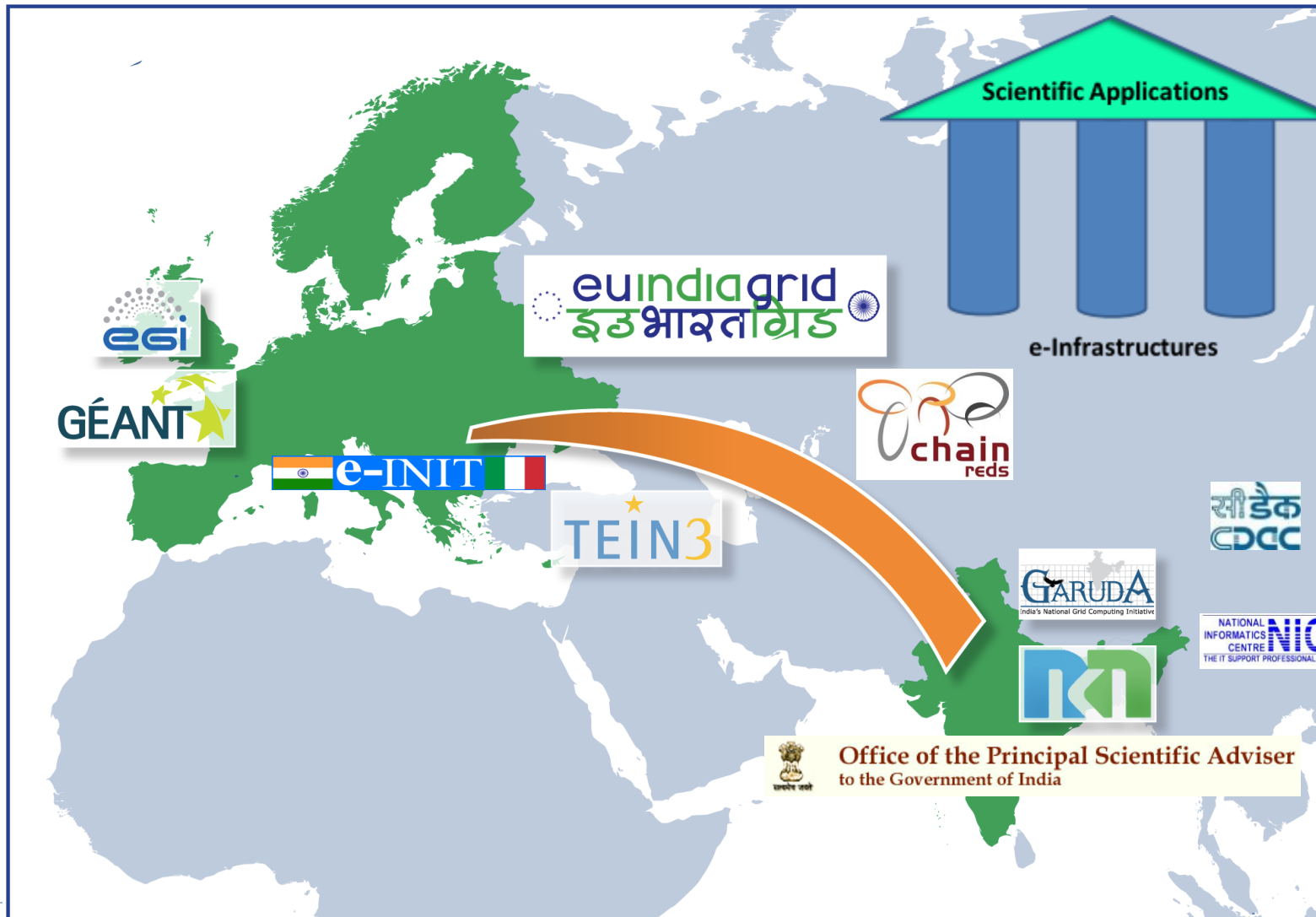


▶ INFN – National Institute of Nuclear Physics - Italy

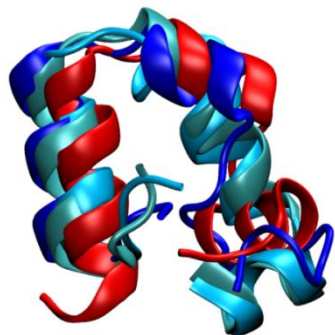
- ▶ My thanks to the organisers, It has been my pleasure to be here attending this conference, as it has been in all these years since 2003
- ▶ Contributions from:
  - ▶ R. Chidambaram, Principal Scientific Adviser to Government of India
  - ▶ S. Raghavan, Scientific Secretary & Deputy to Principal Scientific Adviser to Government of India,
  - ▶ Federico Ruggieri, CHAIN-REDS Project Coordinator
  - ▶ P.S. Dhekne, Scientific Consultant to Principal Scientific Adviser to Government of India, e-INIT India Project Coordinator
  - ▶ O. Prnjat, GRNET, CHAIN-REDS Project
  - ▶ R. Barbera, INFN, CHAIN-REDS Project
  - ▶ S. Chattopadhyay, CDAC-India, CHAIN-REDS Project



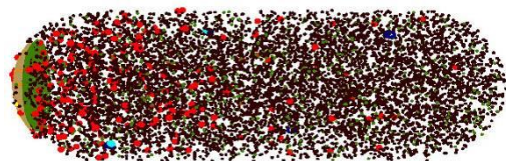
## across Europe and India



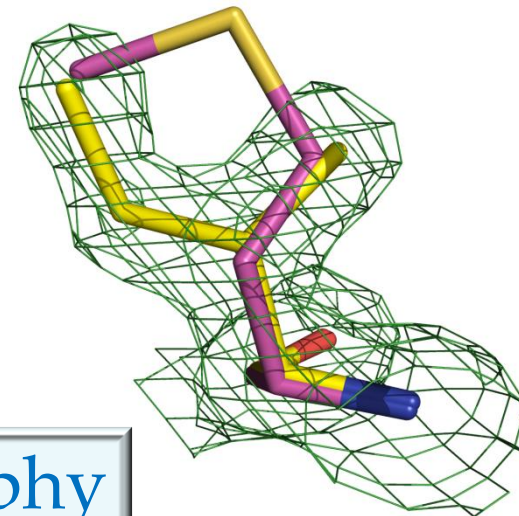
# across Europe and India



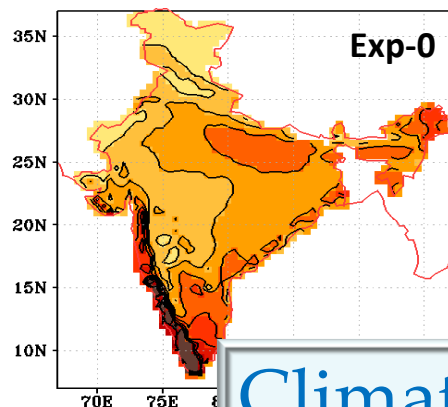
Biology



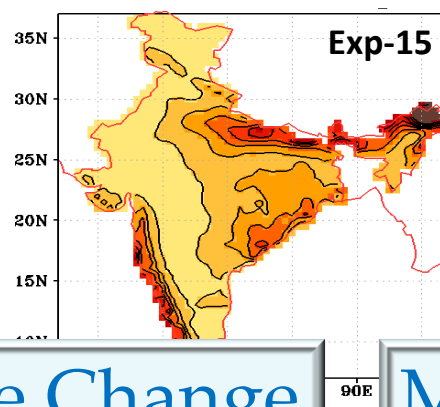
Crystallography



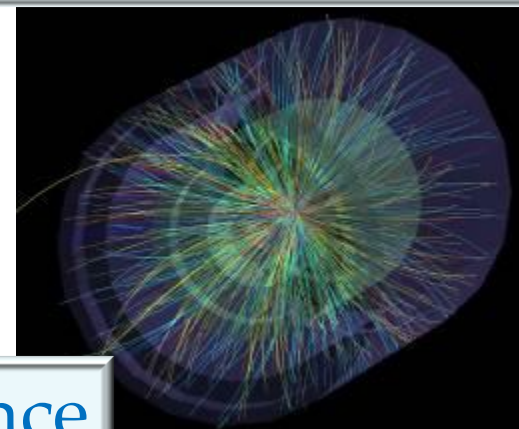
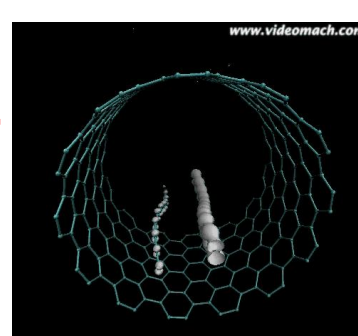
High Energy Physics



Climate Change

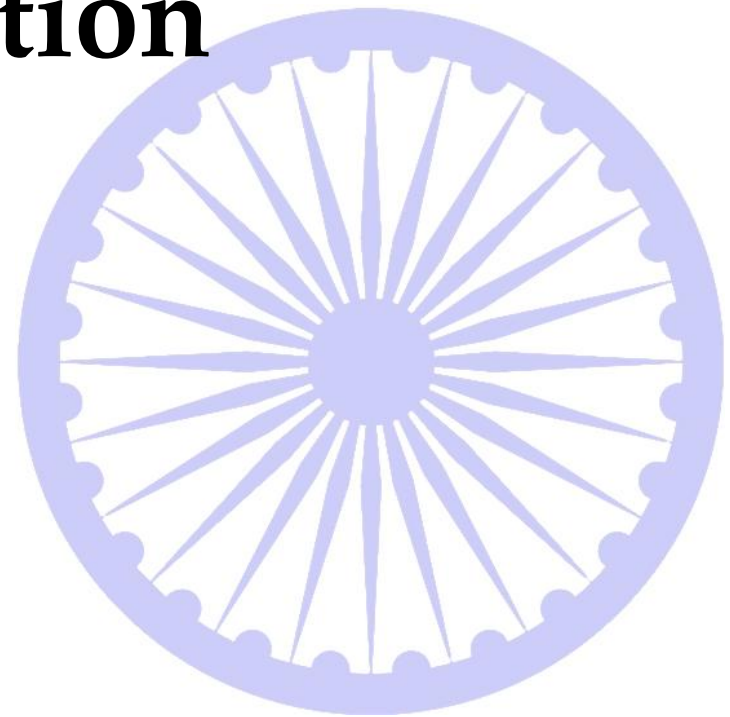
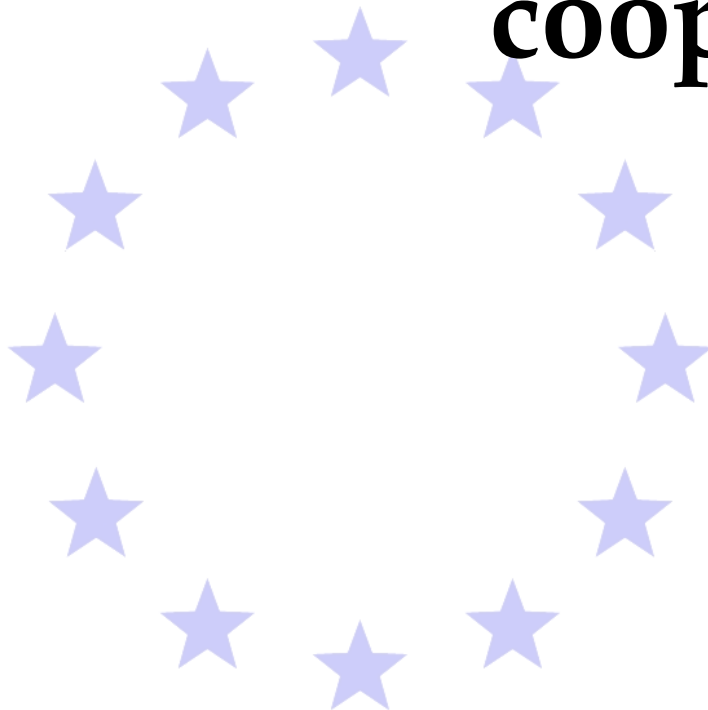


Material Science





# India-EU Projects on e-Infrastructures cooperation





# European Commission Projects & Bilateral Projects 2006-2015



## EU-IndiaGrid / EU-IndiaGrid2

Bridge across European and Indian Grids  
Sustainable e-infrastructures across Europe and India

2006-2012

### CHAIN

Coordination and Harmonisation of Advanced e-INFrastructures

2010-2012

### CHAIN-REDS

Coordination and Harmonisation of Advanced e-INFrastructures for  
Research & Education Data Sharing

2012-2015

### e-INIT

INdia-ITaly S&T cooperation on e-INFrastructures

A long standing collaboration with ASGC



e-infrastructure

# BEYOND

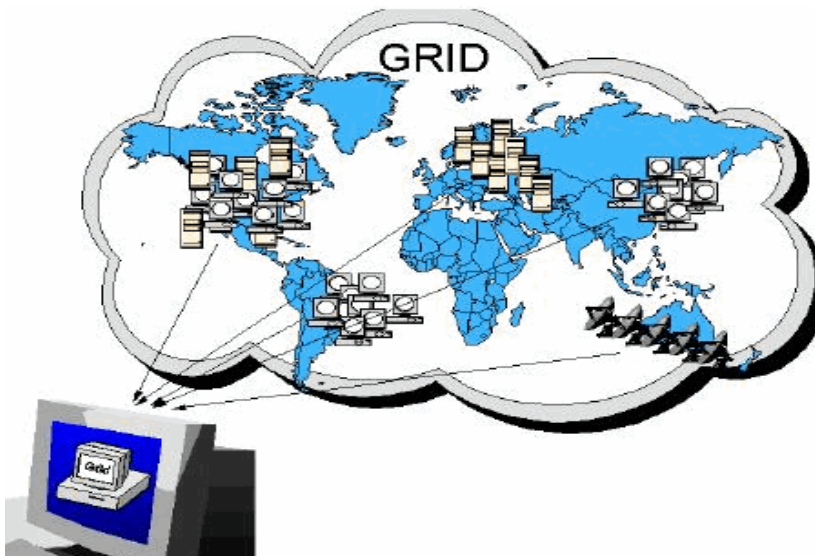
## EU-IndiaGrid & EU-IndiaGrid2

- ▶ EU-IndiaGrid projects paved the way towards sustainable e-Infrastructure cooperation across Europe & India
- ▶ This include Network, grid computing, supercomputing and related applications.
- ▶ Other projects continued this process entering the cloud era
- ▶ CHAIN/CHAIN-REDS, e-INIT (INdia-ITaly S&T cooperation on e-Infrastructures...)

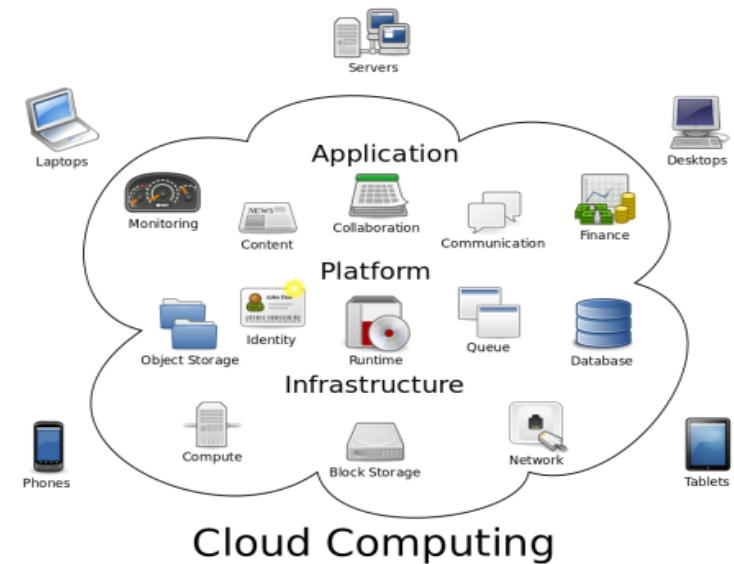


# From Grid to Cloud

## 00's-10's Grid Computing



## 10's- Cloud Computing





# Co-ordination & Harmonisation of Advanced e-Infrastructures for Research and Education Data Sharing

*Research Infrastructures  
Grant Agreement n. 306819*

**Targeted regions:  
Africa, Arab Region, Latin America,  
China, India, Far-East Asia**



**Globalisation of  
Grid Infrastructures**

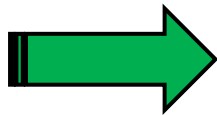
**2012-2015**





# The CHAIN-REDS Project

([www.chain-project.eu](http://www.chain-project.eu))



## Objectives



Extend and consolidate the international cooperation of Europe with other regions of the world in the domain of e-Infrastructures for R&E, thus reinforcing the scientific collaboration and broadening the impact of the European Research Area



Promote, coordinate and support the effort of a critical mass of non-European e-Infrastructures for R&E to collaborate with Europe by addressing interoperability and interoperation of Grids and other DCIs such as potential upcoming Cloud federations and HPC centres



Study the opportunities of data sharing across different e-Infrastructures and continents thus widening the scope of the existing CHAIN Knowledge Base to Data Infrastructures and Cloud implementations



Promote trust-building towards open Scientific Data infrastructures across the world regions, including organisational, operational and technical aspects



Demonstrate the relevance of intercontinental cooperation in several scientific data fields addressing existing and emerging Virtual Research Communities (e.g. Earth Science, Climate Change, Genomics, etc.) and propose pragmatic approaches that could impact the everyday work of the single researcher, even if not structured in the framework of a Virtual Research Community

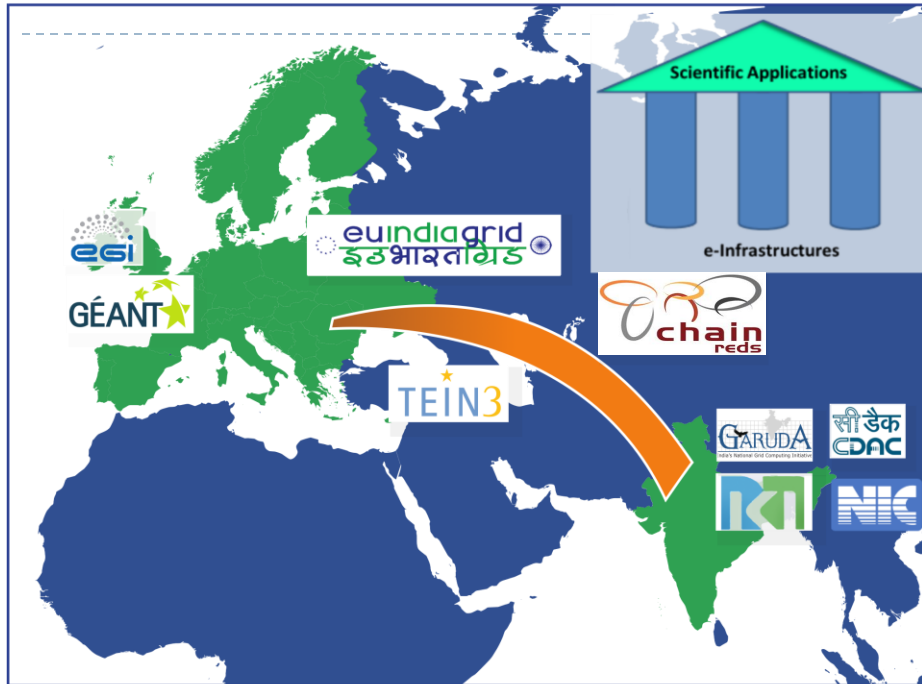


Provide guidance and recommendations for roadmaps for long-term global collaboration in e-Infrastructures and harmonisation of existing policies. These are envisaged to act as input to policy and decision-making mechanism, harmonised with the European Digital Agenda and Horizon 2020

Partner for India:  
CDAC



# Cooperation India Italy



One of the six Significant research projects  
within the frame of the Executive Programme of  
Scientific and Technological Cooperation between  
the Italian Republic and the Republic of India  
for the years 2012-2015

*India-IT*aly cooperation  
on *e-IN*frastructures  
support for High Energy  
Physics applications

Co-funded by Italian Ministry  
for Foreign Affairs



Ministero degli Affari Esteri

One of the six Significant  
research projects within the  
frame of the Executive  
Programme of Scientific and  
Technological Cooperation  
between the Italy and India

## Leading Partners:



**INFN - National Institute of Nuclear Physics - Italy**



**Office of Principal Scientific Adviser to  
Government of India - India**

## CONTACTS:

**Alberto Masoni**  
Director of Research  
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**P.S. Dhekne**  
FNAE, Scientific Consultant to Principal Scientific Adviser to  
Government of India and  
Raja Ramanna Fellow, Bhabha Atomic Research Centre  
dhekne@barc.gov.in or dhekne@yahoo.com





From  
EU-IndiaGrid /  
EU-Indiagrid2  
to  
CHAIN  
/CHAIN-REDS



भारत सरकार  
Government of India  
भाभा परमाणु अनुसंधान केंद्र  
Bhabha Atomic Research Centre

डा. आर. चिदम्बरम्  
भारत सरकार के प्रमुख वैज्ञानिक सलाहकार  
एवम्  
डी. ए. इ. होमी भाभा प्रोफेसर

**Dr. R. Chidambaram**  
Principal Scientific Advisor to Govt. of India  
&  
DAE-Homi Bhabha Professor

Ref: RC/PSA/161/09

November 9, 2009

### Letter of Support

Dear Dr. Alberto Masoni,

I am happy to learn about the second phase Eu-IndiaGrid2 project - Sustainable e-Infrastructures across Europe and India. The first phase has benefited immensely a variety of scientific disciplines including biology, earth science, materials science, and the Indian collaboration for the Large Hadron Collider (LHC).

The successful working of the initial phase of multi-gigabit National Knowledge Network (NKN), Indian Grid Certification Authority, and participation in Trans-Eurasia Information Network (TEIN3) phase 3 are some of the important building blocks for supporting virtual research communities in India and their collaboration work with other countries.

I am sure that this Co-ordination and Harmonization of Advanced e-Infrastructures (CHAIN) project activity would strengthen the mutually beneficial EU-India collaboration. I shall be very happy to extend support of my Office to this initiative.

With best regards,

Yours Sincerely,

*R. Chidambaram*  
( R.Chidambaram)

# e-Infrastructures in India

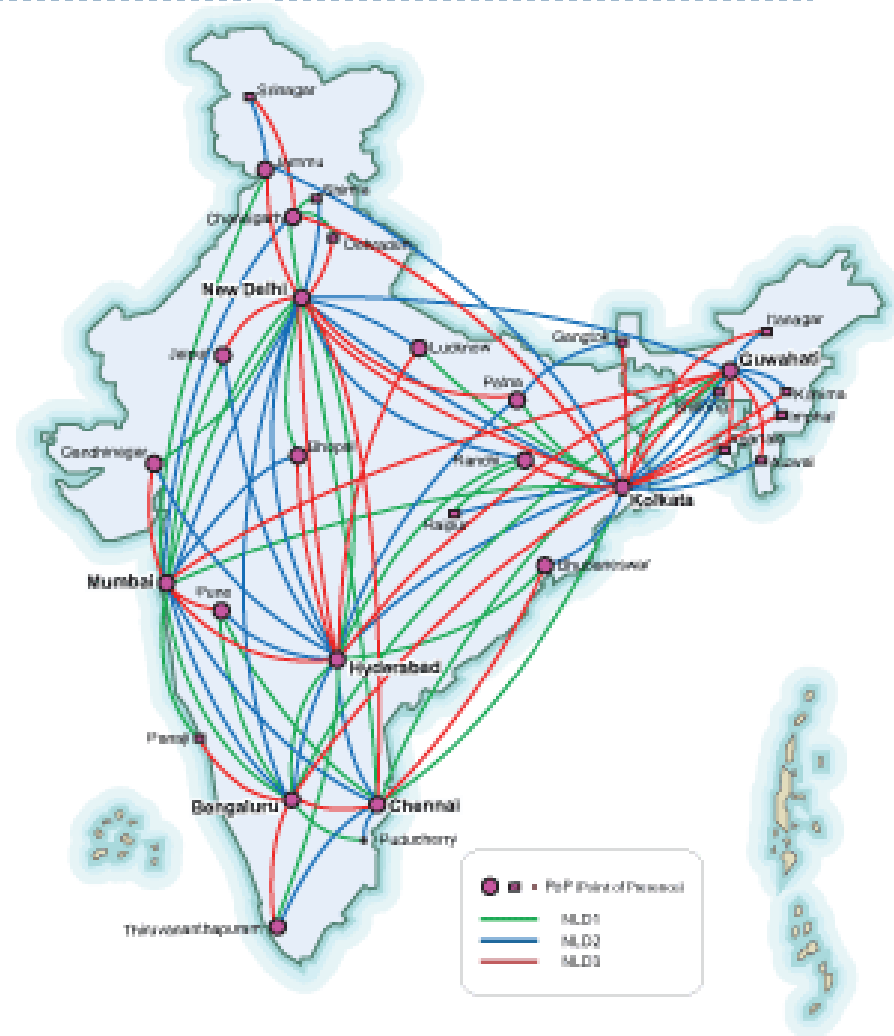
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- ▶ National Knowledge Network (NKN)
    - ▶ 10 years 1 B-€ Government of India project for a multigigabit Pan-India network connecting knowledge Institutes, about 1500 Institutes connected so far
    - ▶ Support to flagship applications in Climate Change, High Energy Physics, Cancer grid, Neuroscience...
    - ▶ **Project coordinated under the Chairmanship of Principal Scientific Adviser to the Government of India**
  
  - ▶ Grid infrastructures
    - ▶ GARUDA India National Grid Initiative
    - ▶ India Regional Component of Worldwide LHC Computing Grid (WLCG)
-



# National Knowledge Network

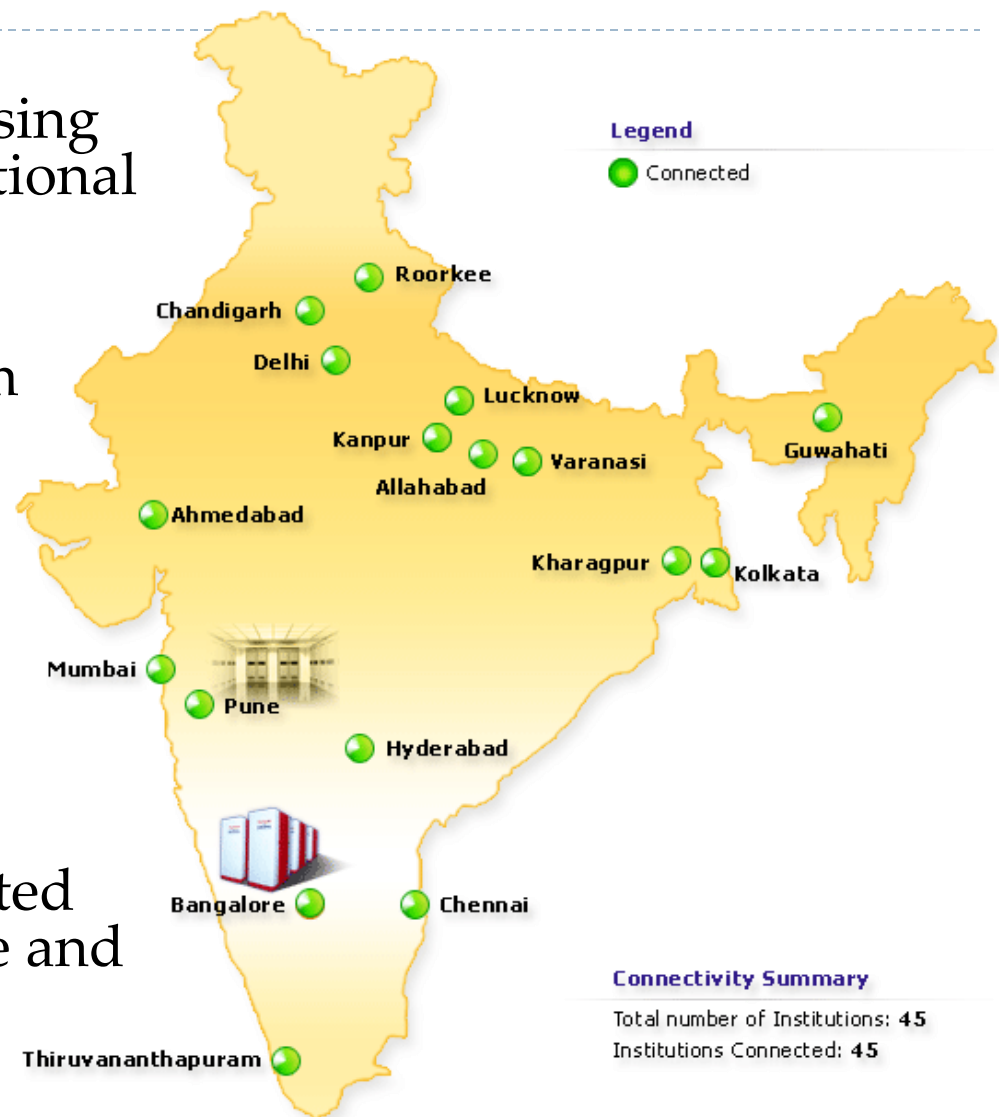
- ▶ A state-of-the-art multi-gigabit pan-India network for providing a unified high speed network backbone for all knowledge related institutions in the country
- ▶ An ultra-high speed CORE (multiples of 10 Gbps), with a distribution layer at speeds of 1 Gbps or higher.



Multiple 10G Connecting all the State Capitals  
Gigabit Connectivity to all the 640 Districts

## GARUDA - on NKN

- ▶ Global Access to Resources Using Distributed Architecture – National grid initiative by C-DAC
- ▶ Aggregates HPC clusters from C-DAC centres and partners
- ▶ Currently over 10000 CPUs (~ 550 teraflops) and 220 TB of storage to provide distributed data
- ▶ The GARUDA is interconnected by the NKN - a highly reliable and secure national backbone



# Interoperability a Key Issue

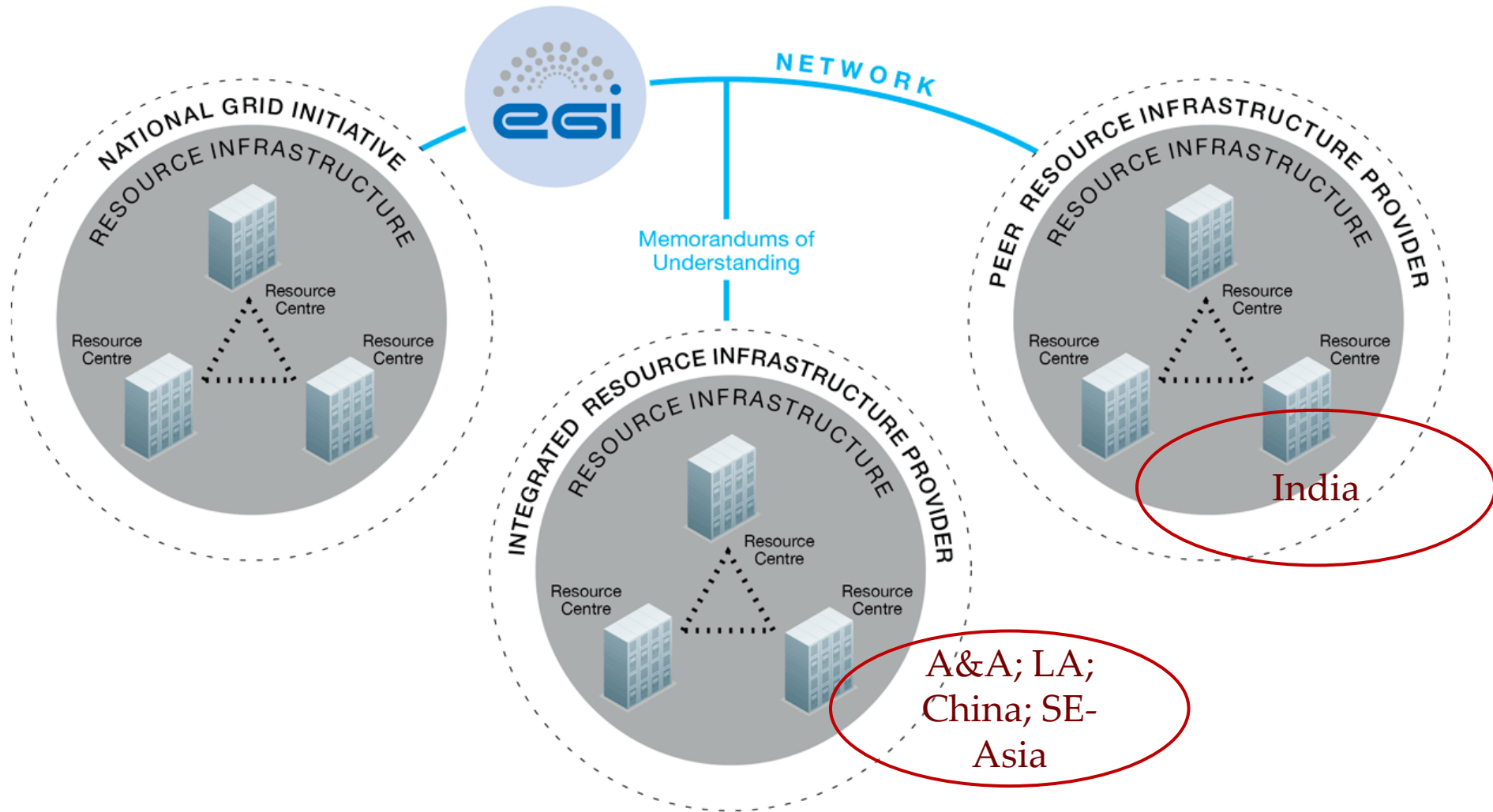
We are happy to acknowledge the *good collaboration between India and Europe in the field of Scientific Research* in general and in the ICT domain in particular. Europe has some *unique science and research facilities to share: from sub-atomic particles in the Large Hadron Collider to looking into the deepest universe with the EXPRoS project to the EU-IndiaGrid project supporting a common, interoperable grid infrastructure between India and Europe.*

From a Letter of **Head of Cabinet of Ms Viviane Reding (European Commissioner, Information Society and Media)**  
to Dr. Anil Kakodkar (Chairman of the Atomic Energy Commission & Secretary of the Department of Atomic Energy)- April 2008

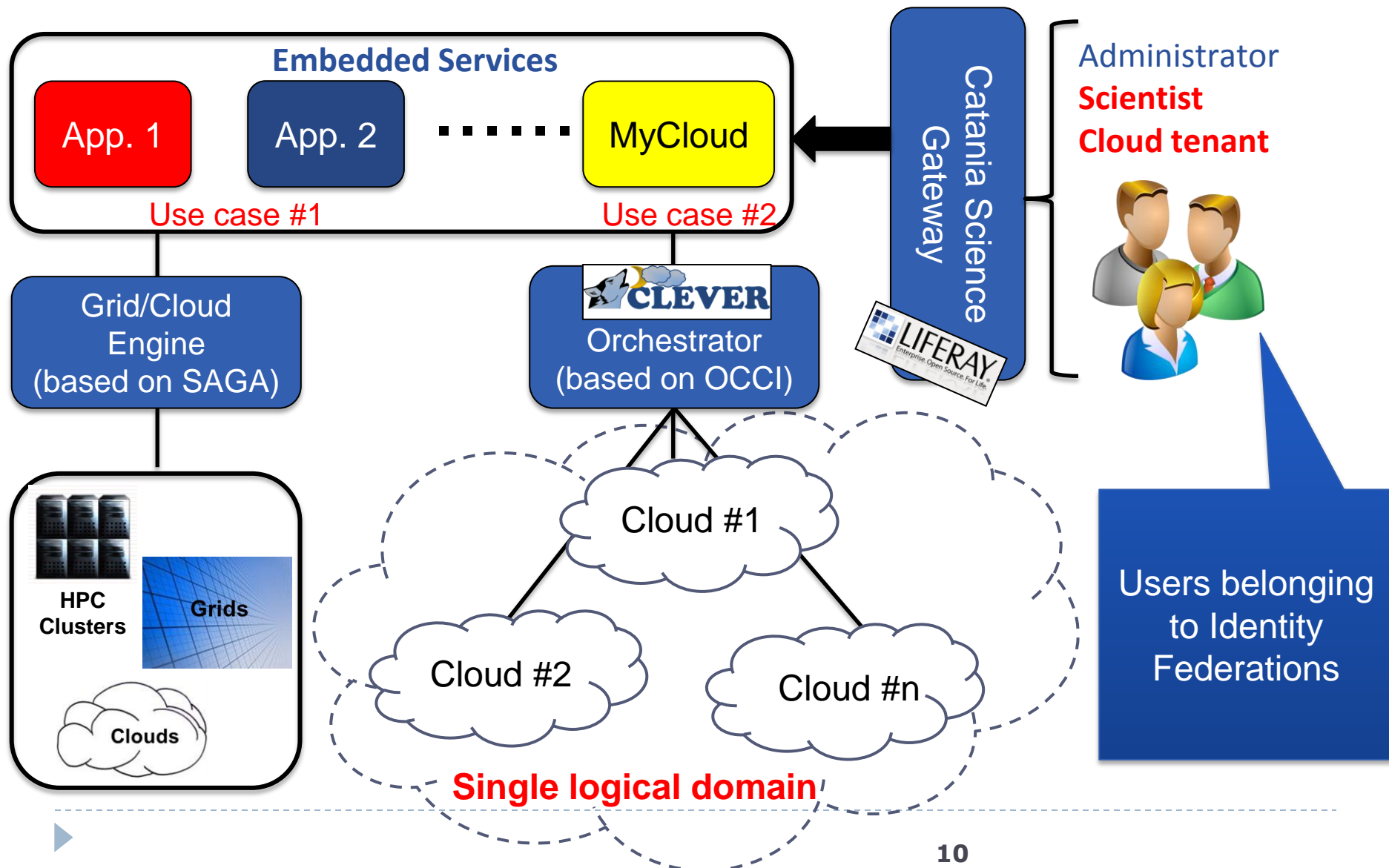
# Bridging European & Indian Grids & Clouds



# Grid collaboration architecture

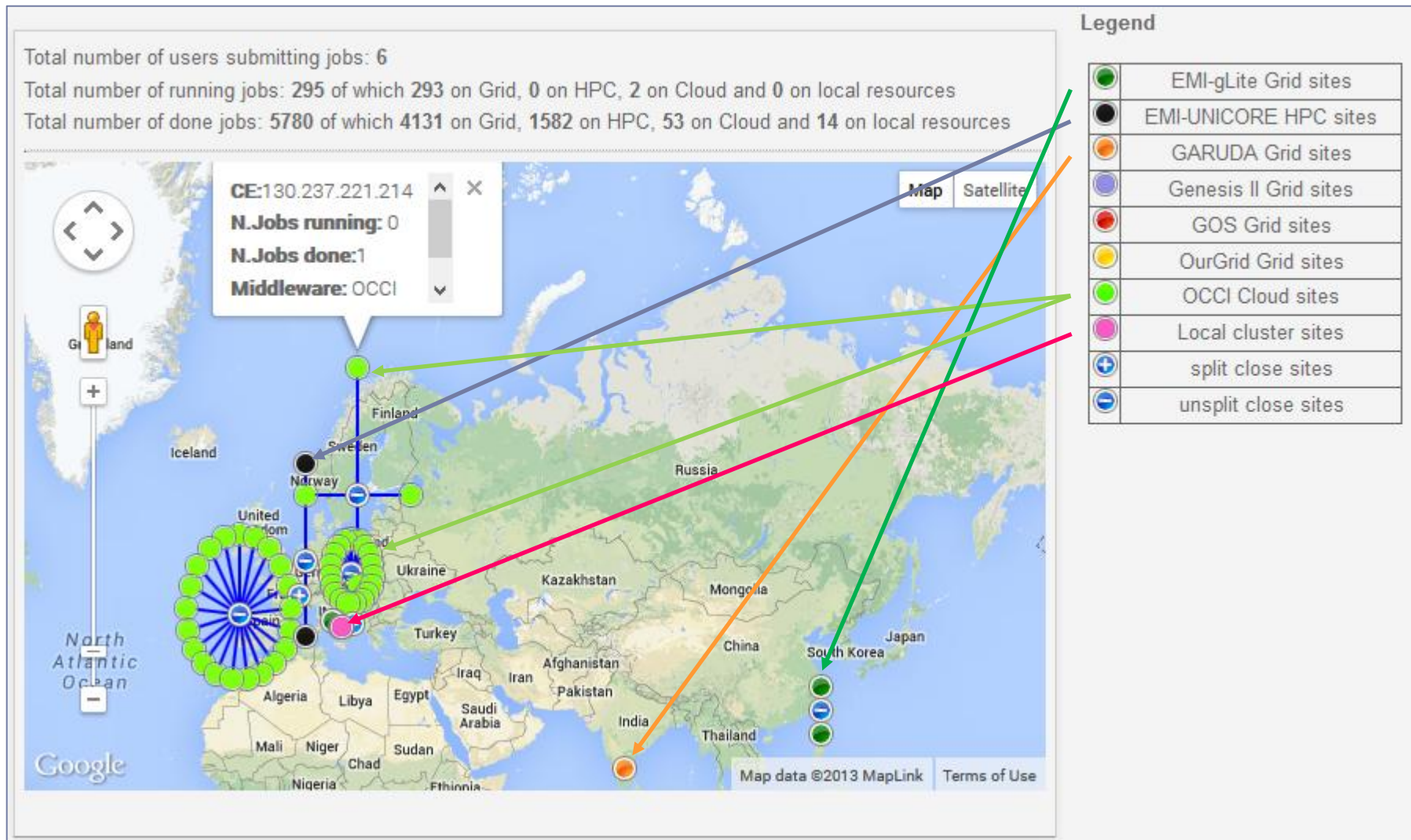


# Catania Science Gateway Framework architecture

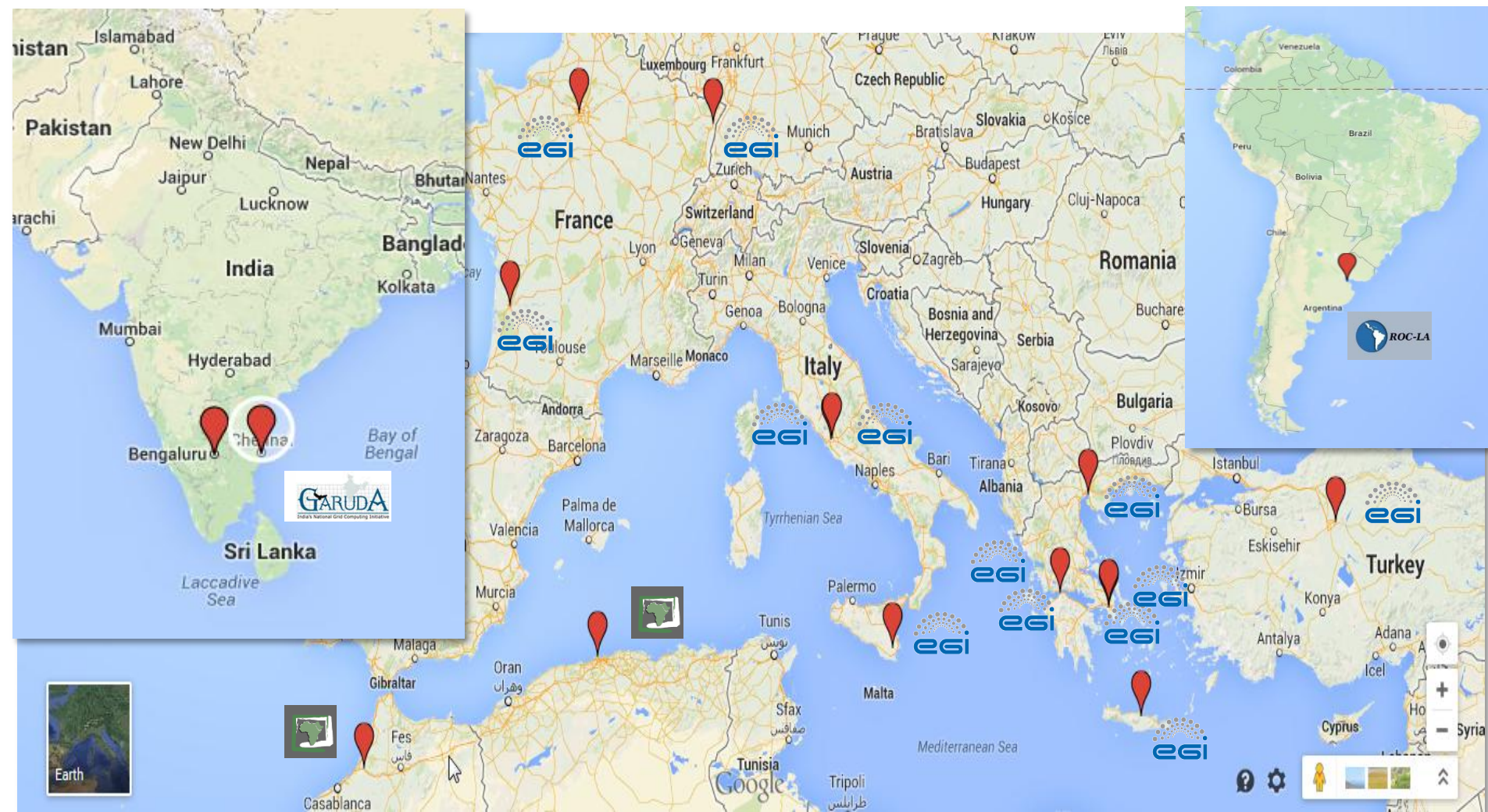




# Running applications on various e-Infrastructures



# GROMACS (Molecular Dynamics Application) on GARUDA, Arab, EGI and ROC-LA sites



# Interoperability Summary

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- ▶ Catania Science Gateways successfully bridge e-Infrastructures built on different architectures (Grid, HPC, Cloud, local clusters, desktops, etc.) and make them interoperable at user application level thanks to standard adoption (SAGA, SAML, OCCI, etc.)



- ▶ EU and bilateral projects worked successfully supporting EU-India cooperation on e-Infrastructures for over 10 years
- ▶ Collaboration with ASGC since the very beginning
- ▶ Key aspects
  - ▶ Applications
  - ▶ Involvement of policy makers
  - ▶ Interoperability
  - ▶ adoption of standards as a concrete investment towards sustainability
- ▶ More info: [www.chain-project.eu](http://www.chain-project.eu), <http://einit.ca.infn.it>