



# Computing for Medical Applications

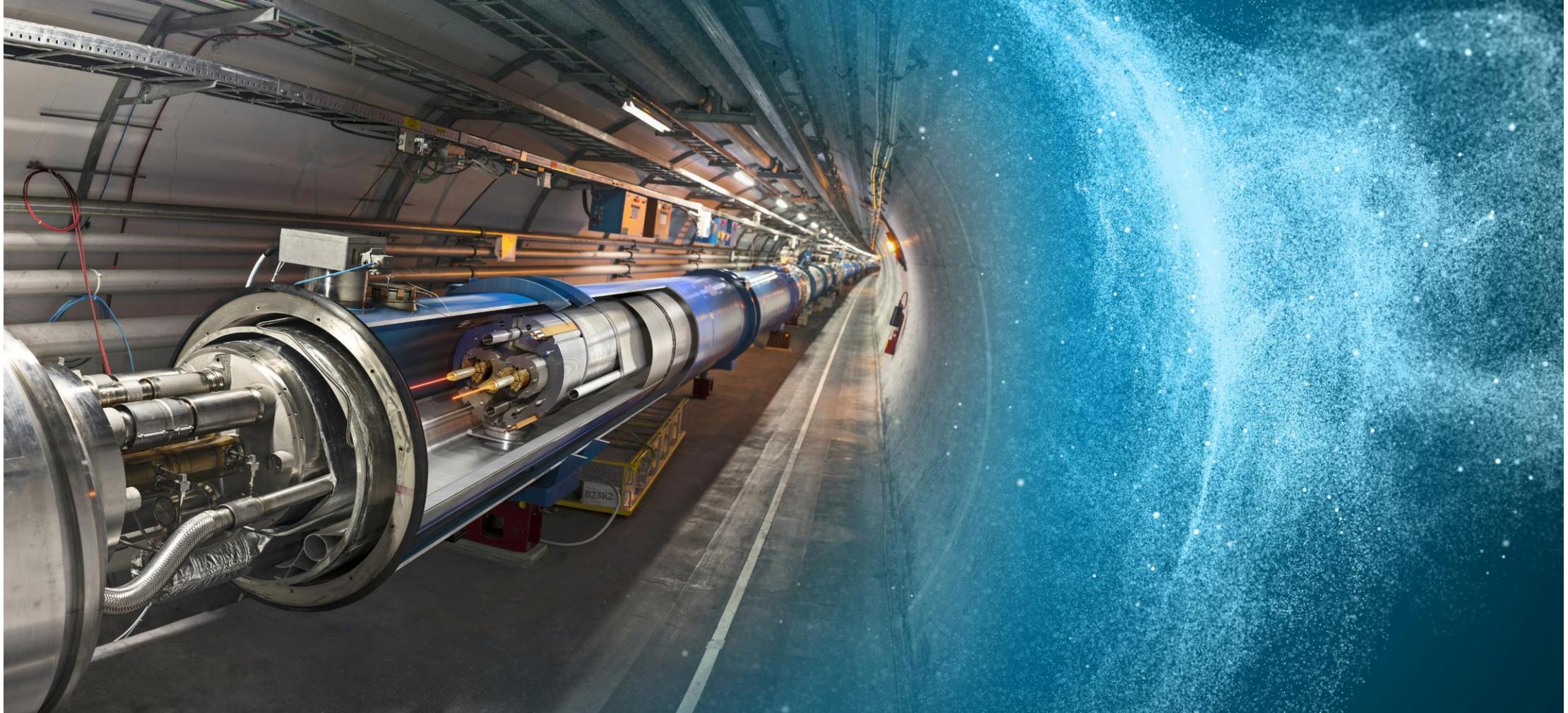
*Physics Meets System Biology Workshop*

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# CERN: A UNIQUE ENVIRONMENT

*Pushing technologies to their limits*



# CERN MEDICAL APPS STRATEGY

In June 2017 the CERN Council approved the  
**“Strategy and framework applicable to knowledge transfer by CERN for  
the benefit of medical applications”**

The document states that **“CERN’s medical applications-related activities shall focus on R&D projects, using technologies and infrastructures that are uniquely available at CERN”**.

**Data Analysis and Simulation for Health Applications  
is one of the areas of activity in the scope of the strategy**

**CERN unique expertise of CERN or deploying and operating large-scale  
data-intensive grid/cloud infrastructures and software**

# Historical Infrastructure projects

Longstanding tradition of participation and support for IT infrastructures for health research since 2002 in the EGEE, EGI, EMI projects



Health-e-Child

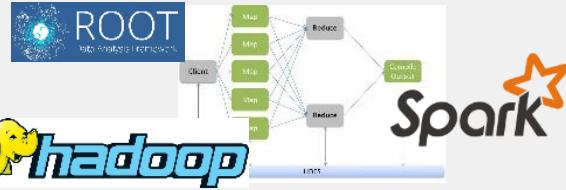
Mammogrid



Wisdom I and II (In-Silico Docking on Malaria), GPS@, Xmipp\_Mlrefine, GATE, CDSS, gPTM3D, SiMRI 3D, and many other projects and applications

## Information

### Software



Data visualization,  
representation



Data analysis  
and analytics platforms

### Platform



Large storage (disks, tapes,  
memory)



Fast data acquisition systems

### Infrastructure



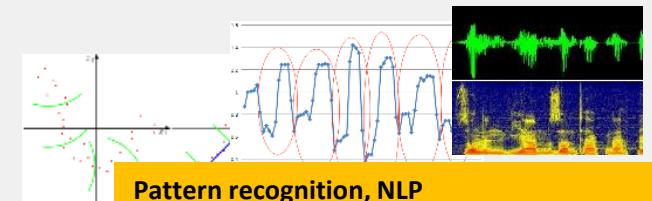
Flexible networks



Distributed Computing and Data Grids,  
Clouds, HPC, Crowd Computing



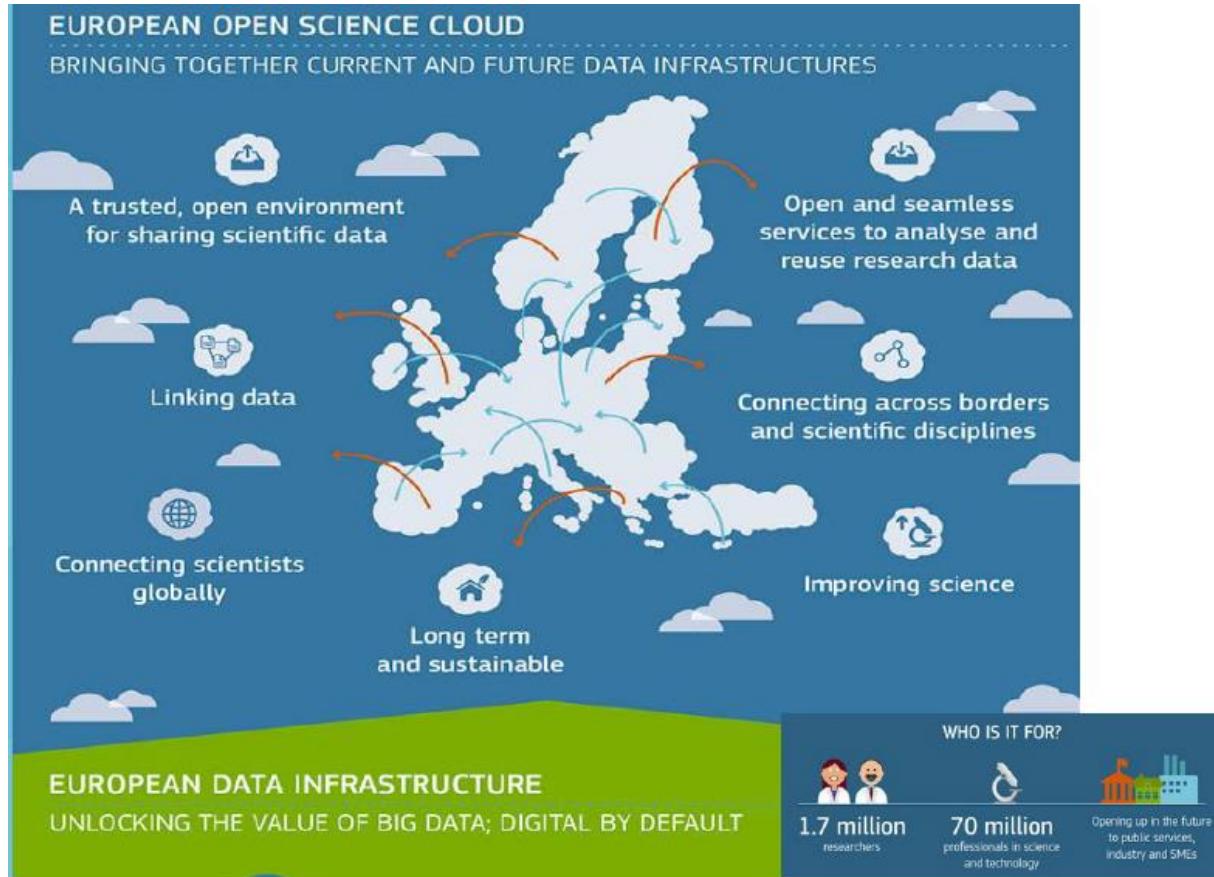
Applications designed  
for "big data"



Pattern recognition, NLP  
machine learning, predictive analytics

Value  
Veracity  
Variability  
Variety  
Volume  
Velocity

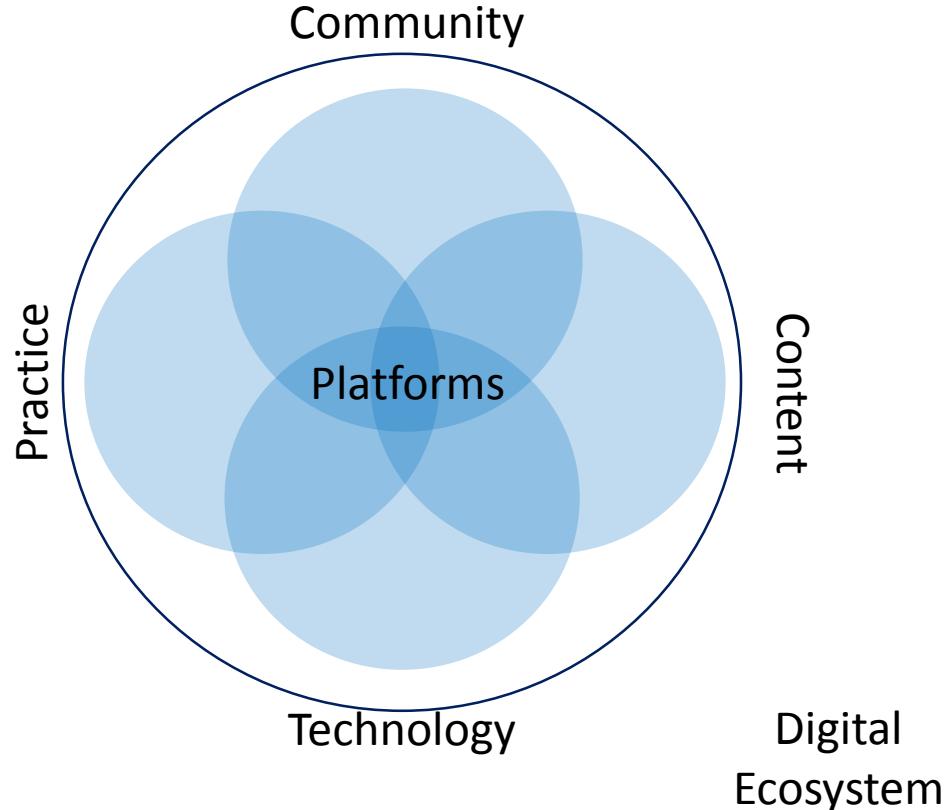
# OPEN SCIENCE CLOUDS



The objective of CERN's participation in the work programme is to develop policies, technologies and services that can support the Organization's scientific programme, promote open science and expand the impact of fundamental research on society and the economy.

European Open Science Cloud (EOSC) can build on the activities of PCP projects like HNSciCloud and provide the context for future multi-disciplinary projects.

# PLATFORMS AS ENABLERS OF LARGE-SCALE COLLABORATIONS

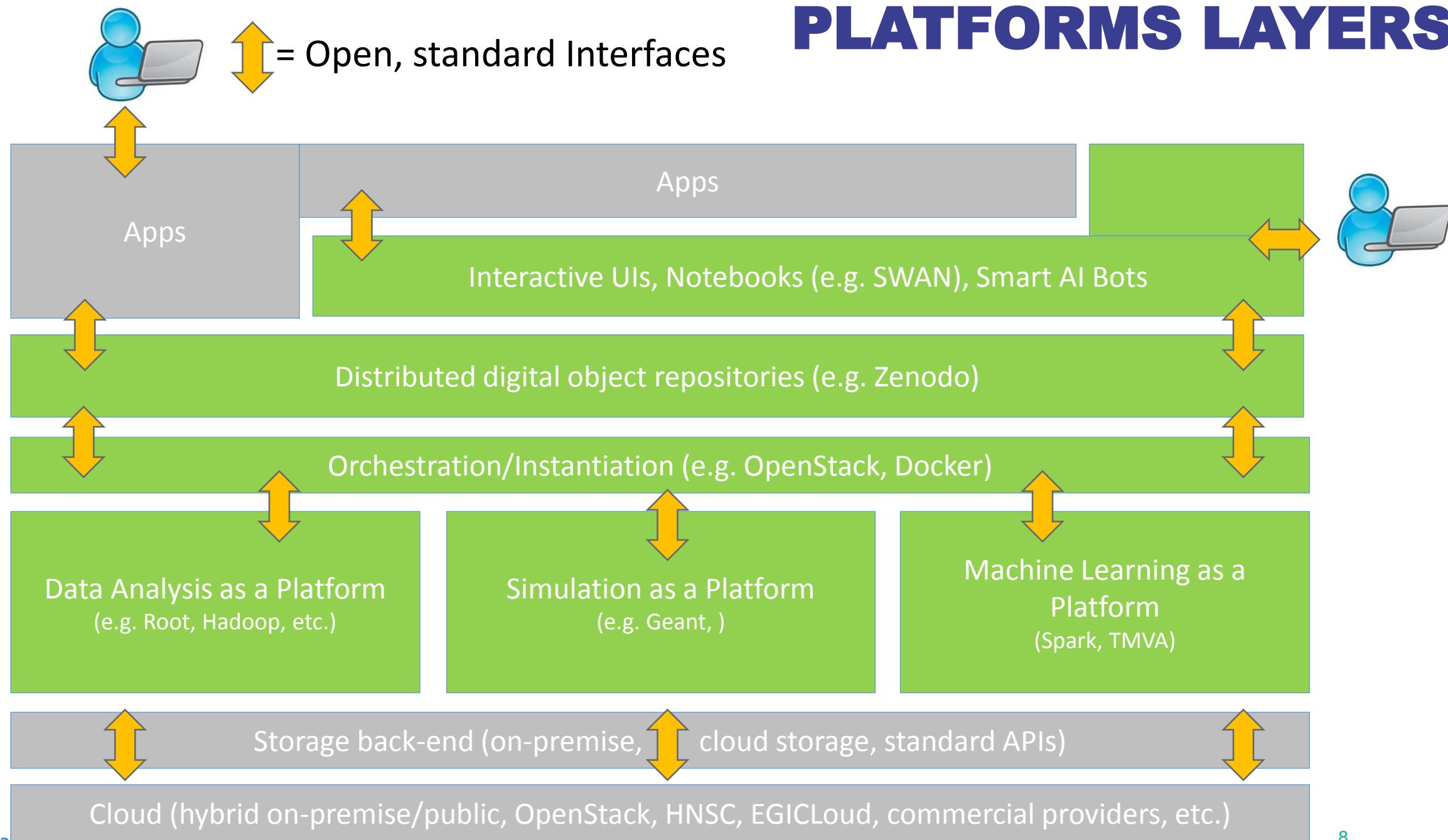


As scale grows, a sound digital ecosystem is generated by four main elements and a way for those elements to interact on common terms

Platforms are the unifying services at the intersections that enable

- commoditization
- best practices
- aggregation and integration
- share and reuse of data
- reproducibility
- collaborations, etc.

# PLATFORMS LAYERS

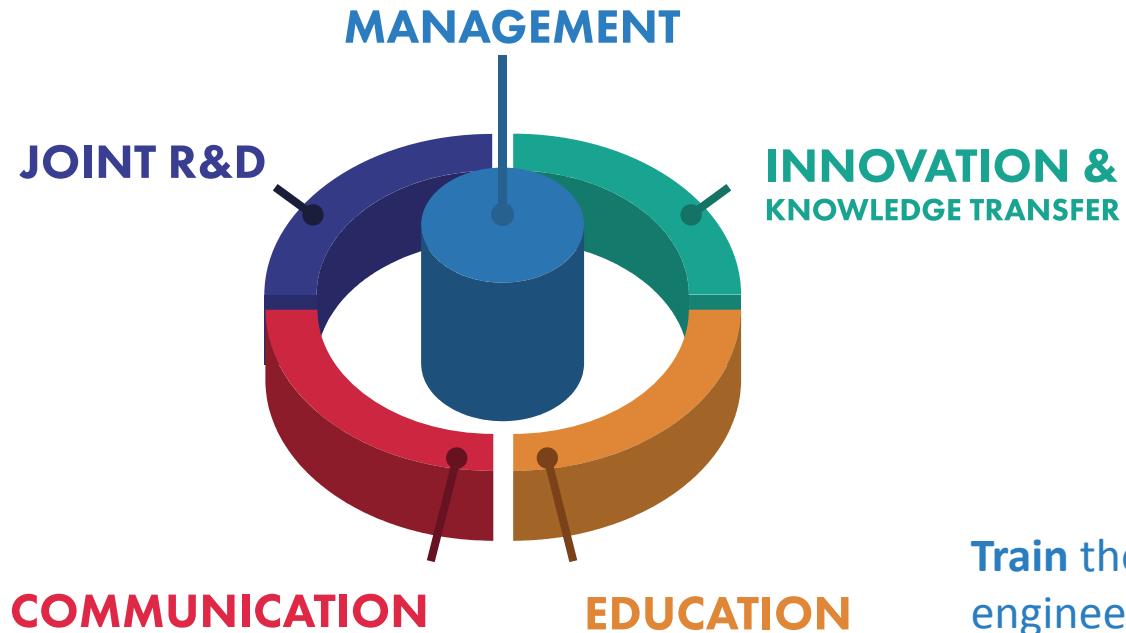


# CERN OPENLAB'S MISSION

*Our recipe for success*

**Evaluate and test state-of-the-art technologies in a challenging environment and improve them in collaboration with industry.**

Communicate results, demonstrate impact, and reach new audiences.

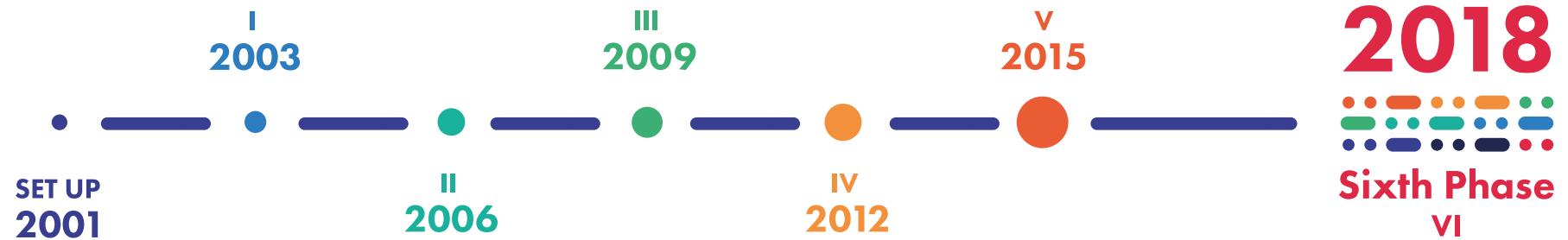


**Collaborate and exchange ideas with other communities to create knowledge and innovation.**

**Train the next generation of engineers/researchers, promote education and cultural exchanges.**

# DRIVING INNOVATION SINCE 2001

*Entering our sixth three-year phase*

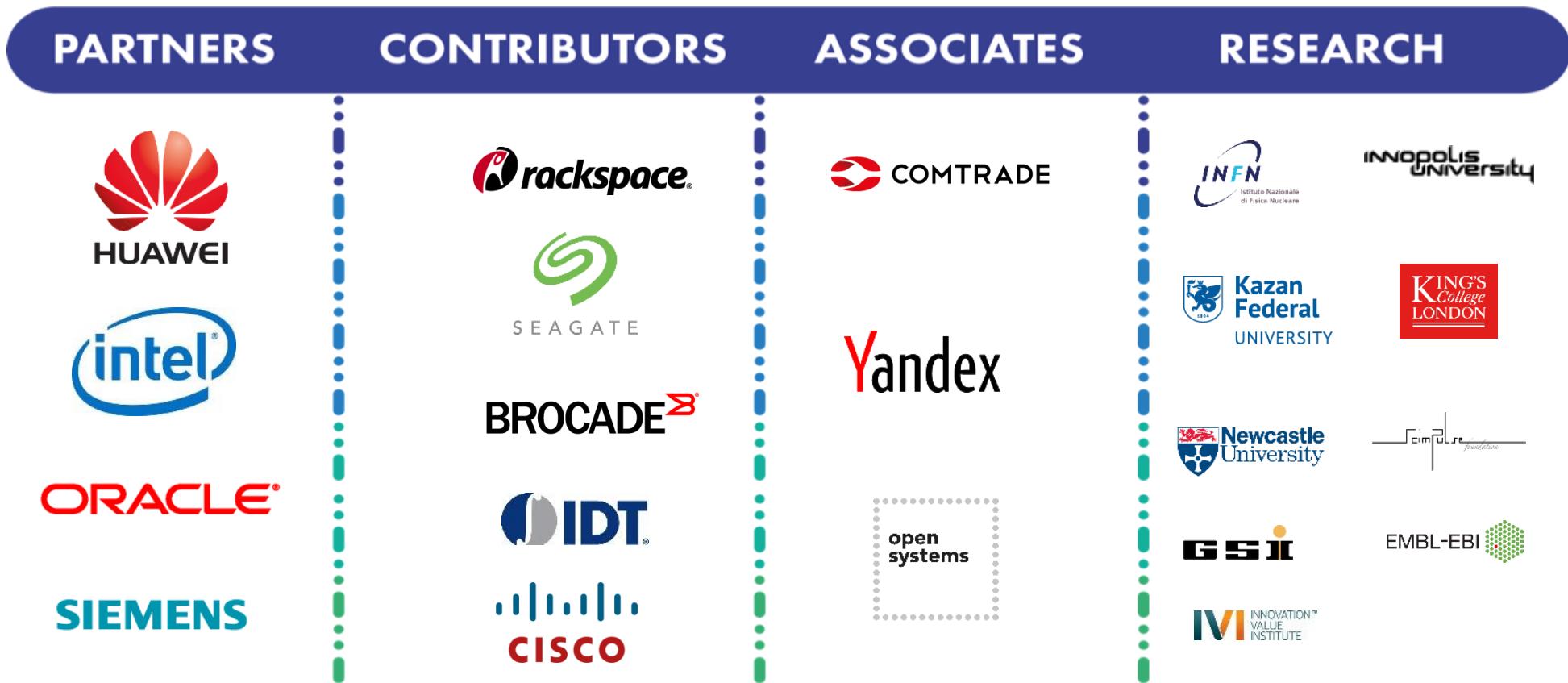


CERN openlab Collaboration Board 2017



# COLLABORATION MEMBERS

*A public-private partnership between the research community and industry*



# JOINT R&D PROJECTS



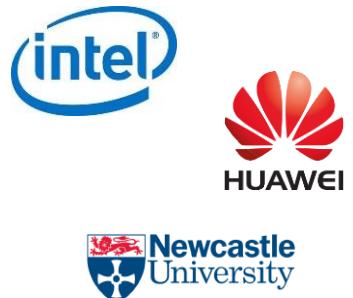
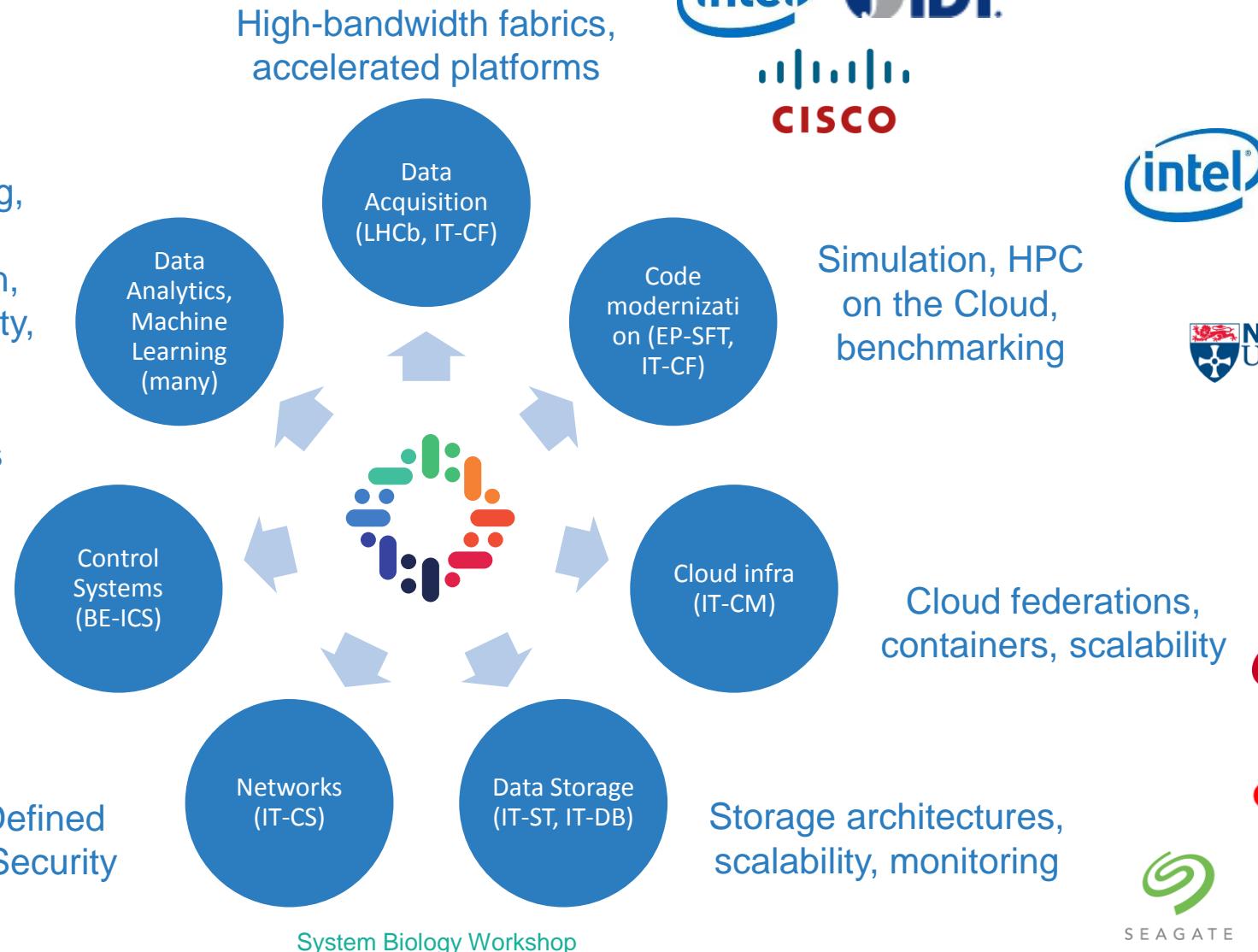
**SIEMENS**

Predictive/proactive maintenance and operations

**BROCADE**

Software Defined Networks, Security

CERN  
openlab



**ORACLE**

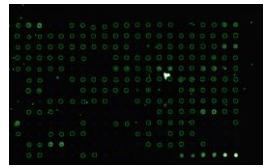
**COMTRADE**

**SEAGATE**

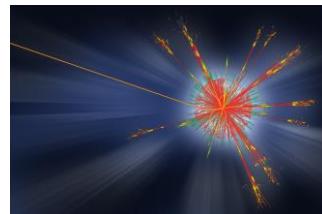
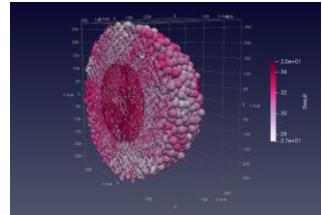
# Medical Applications Synergies



*Image Analysis*   *Genomic Analysis*



*Fast Simulation (GAN)*  
*Data Quality Monitoring*  
*System Biology*



DA/ML

CERN openlab  
KT/MA

Simulation

Controls/Automation

*Self-Diagnostics*  
*Self-Healing Systems*  
*Preventive Maintenance*

*Block Chain*  
*Edge/Fog Computing*



# GeneROOT

## ***Area: Genomics***

*Using ROOT\* to analyse and share large genomic data sets, pipelines and methods, software tools and best practices*

*Build a library of precompiled, cloud-ready, easy-to-install applications to facilitate analysis, benchmarking and reproducibility*

*Use standard file formats like BAM by implementing BAM support in ROOT*

**Looking for: research institutes willing to share data, test the software, contribute to implementation**

# BioDynaMo

***Area: Biological Development, In-Silico Medicine Research***

Large-Scale Cloud-Based biological development simulation platform, highly optimized for performance on different computing architectures (Desktop → Cloud → HPC flows)

Build a platform and a library of models as a tool for in-silico treatments simulation, development models validation, etc.

Applications in neurology, cancer treatment (chemio/radio, link with Geant V and -DNA), skin and bones treatments, environmental research (biodecomp)



**Looking for: pharma companies and institutes interested in testing and extending the system with data and models**

# BigHealth

## ***Area: System Biology, Medical Data Quality, Personalised Medicine***

Understand how to collect, curate, analyse large quantity of heterogenous data (EHR, \*omics information, lab results, images, nutritional and fitness data, etc.) on a large scale with emphasis on sharing

Data protection, anonymization methods, data integrity validation, ownership and sharing, (e.g. investigating applications of block chain techniques)

Investigate statistical/machine learning methods for correlating data and monitor and mitigate data quality issues

A platform to provide insights and diagnostic support to patients and doctors, build dynamic, personalized disease maps

**Looking for: hospitals, labs, universities willing to take part in providing requirements, testing the platforms, sharing (meta)data**

# Thematic Computing Schools

## *Area: Education and Training*

Organization of computing schools, hands-on training, hackatons, etc. focused on application of big-data tools to bioinformatics and medical research

**Looking for: hospitals, labs, universities willing to take part in providing requirements, use cases, teachers, students**



# Thanks!

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