

An abstract network diagram with various nodes and connecting lines, some thicker than others, set against a white background.

# Exciting New Technologies Being Researched in CERN openlab V

Fons Rademakers  
CERN openlab CTO



# CERN openlab in a nutshell

A science – industry partnership to drive R&D and innovation with over a decade of success

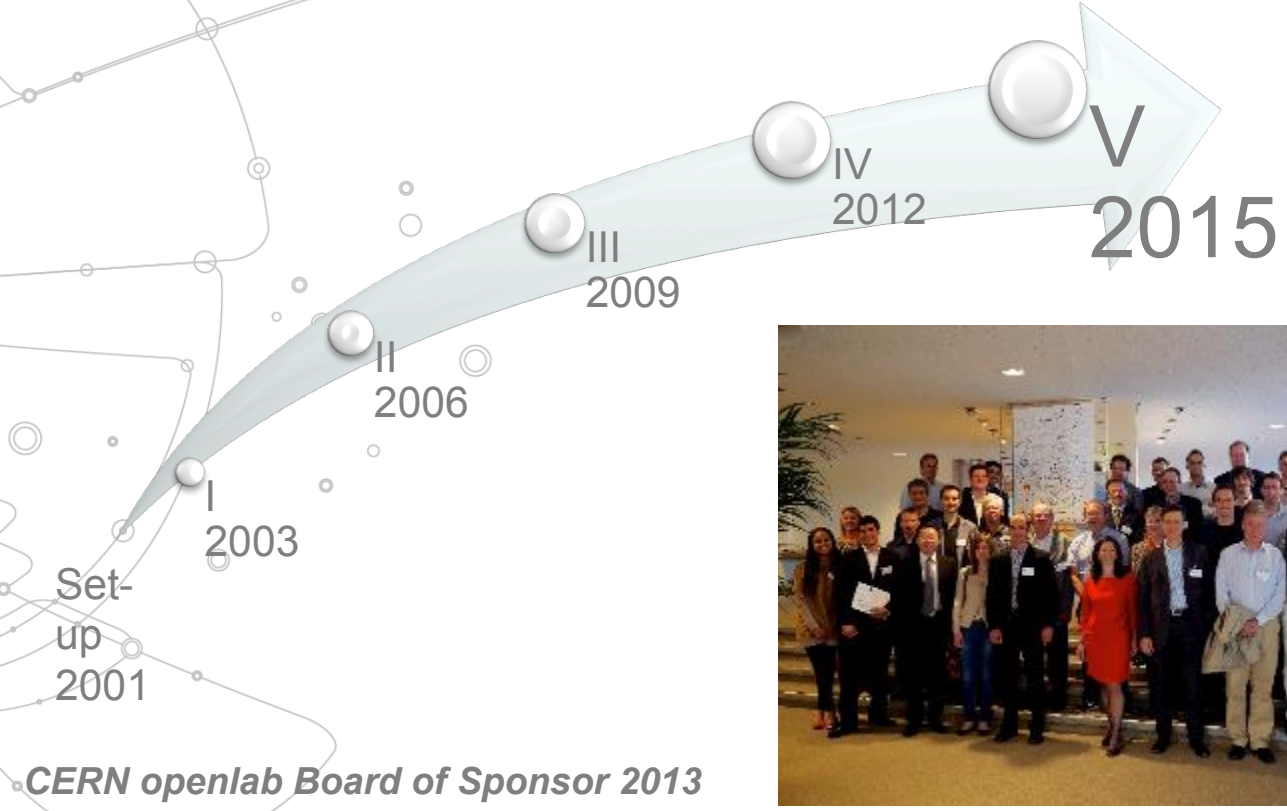
• Evaluate state-of-the-art technologies in a challenging environment and improve them

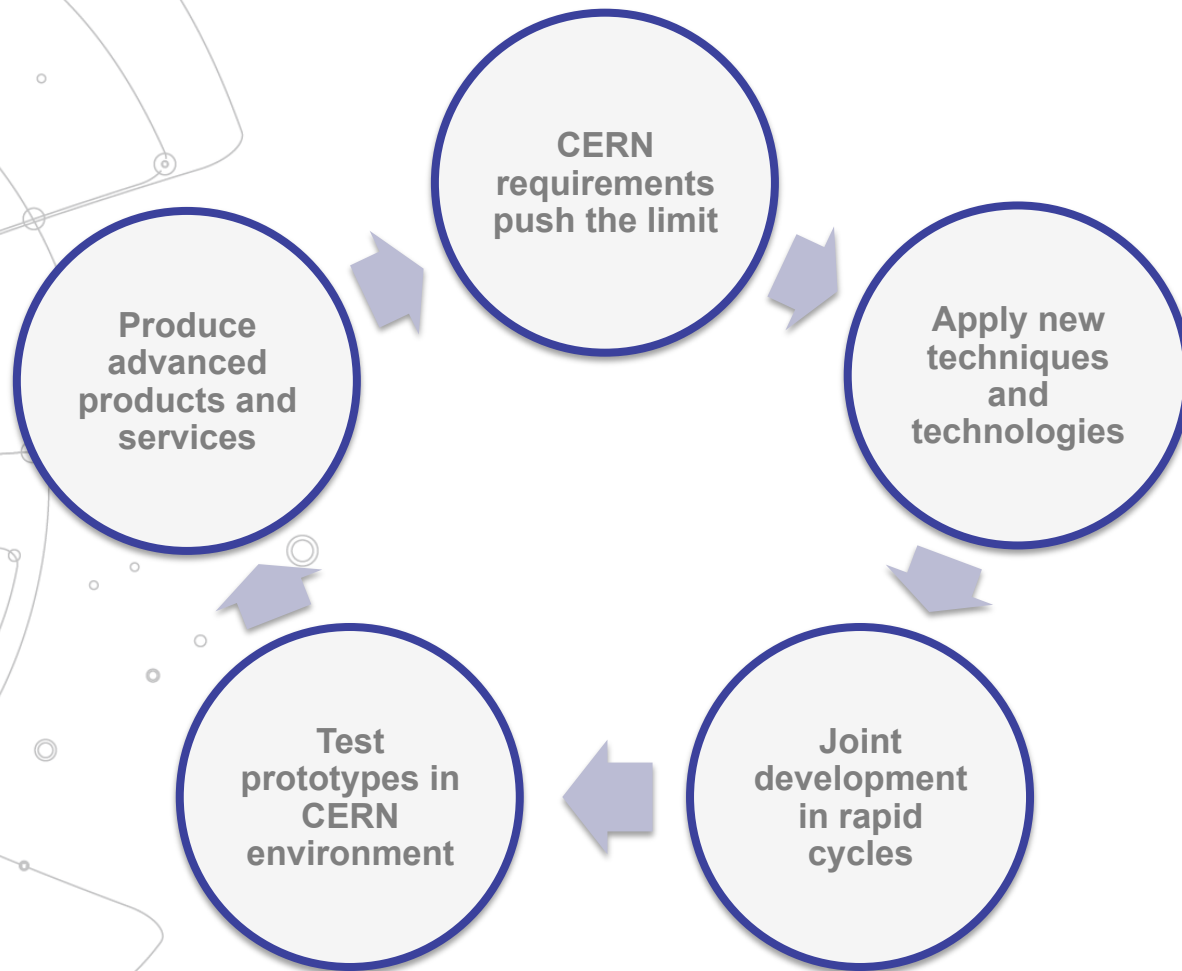
• Test in a research environment today what will be used in many business sectors tomorrow

• Train next generation of engineers/employees

• Disseminate results and outreach to new audiences

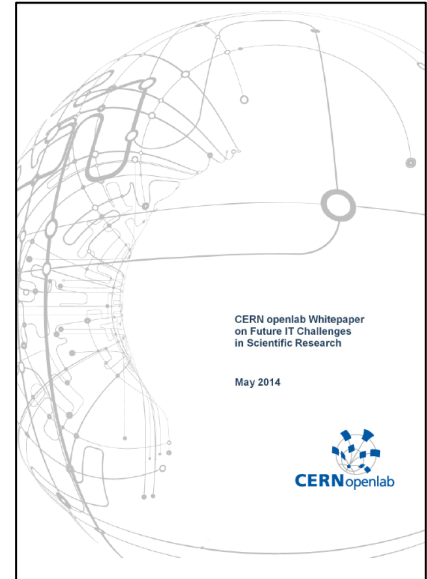
# The history of openlab





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

- IT Challenges Whitepaper
  - Workshops, discussions, presentations
  - Published in April 2014
- Internal discussions, workshops, initial use cases definitions
- New projects starting or being defined



# Information Technology Research Areas



Data acquisition and filtering



Computing platforms, data analysis, simulation



Data storage and long-term data preservation



Compute provisioning (cloud)



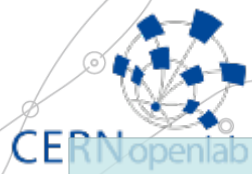
Networks

Medical applications



Data analytics

# Who we have talked to



New partners



# A Solid Educational Program

## > **At CERN**

- Regular workshops
- Special workshops and lectures
- Requirements workshops
- Training courses on hardware platforms,
- Parallel programming, etc.

## > **Outside the lab:**

- CERN School of Computing in Portugal (August 2014)
- Thematic CSC in Split (June 2014)

## > **Summer student program**

## > **The ICE-DIP project**



Programs is highly structured, with different tiers and specializations – students, young researchers, professional researchers and experts - including summer student lectures as well as numerous invited talks at CERN



# Summer Student Program

## > Summer student program 2013

- 720+ applicants
- 22 selected candidates
- 13 lectures (including new lectures from external labs)
- A new lightning talks session
- 22 technical reports



## > Summer student program 2014

- 850+ applicants
- 23 selected candidates
- Lectures and visits program in collaboration with, other Labs/ Institutes and companies

## > Summer student program 2015

- 1500+ applicants
- 34 selected candidates
- Lectures and visits program in collaboration with, other Labs/ Institutes and companies



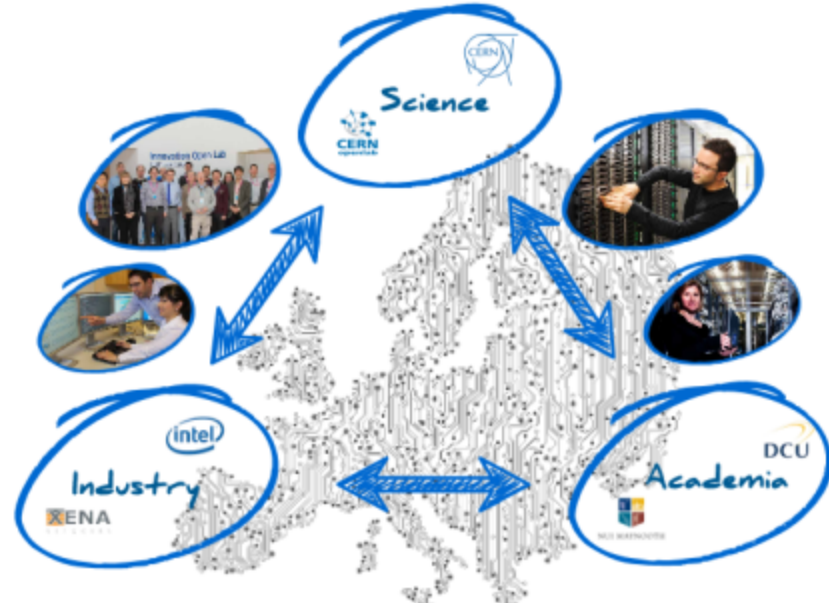
Started February 2013  
Recruited 5 fellows

Model can be extended to  
other areas (e.g. data  
analytics)



# ICE-DIP 2013-2017: The Intel-CERN European Doctorate Industrial Program

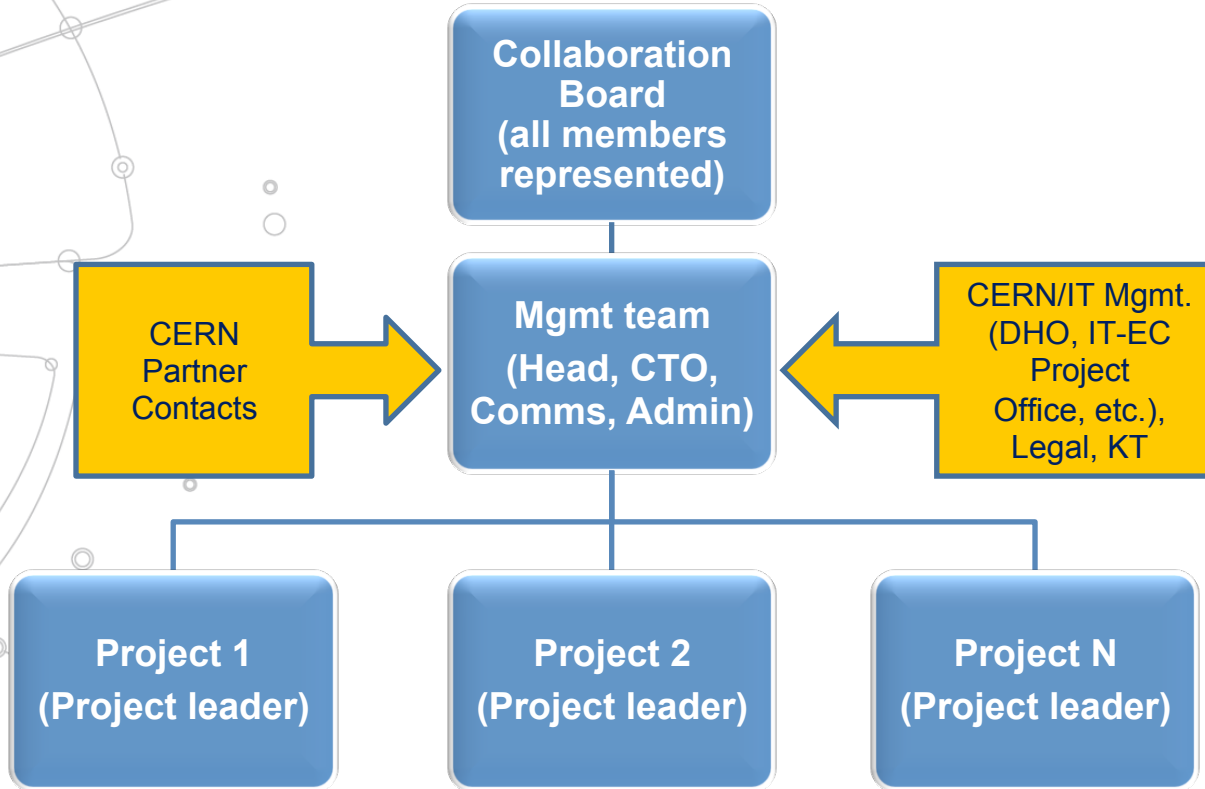
» A public-private partnership to research solutions for next generation data acquisition networks, offering research training to five Early Stage Researchers in ICT



Research topics:

- ▶ Silicon photonics systems
- ▶ Next generation data acquisition networks
- ▶ High speed configurable logic
- ▶ Computing solutions for high performance data filtering

# Organizational Structure



# Membership Levels

The membership level for industry members corresponds to their total accumulated contributions across all the projects

**Partner**

**Yearly fee + 2 or more FTE + in-kind**

**Contributor**

**Yearly fee + 1 FTE + in-kind**

**Associate**

**Yearly fee + in-kind**

**Research**

**Own costs, participation to common activities**

Membership benefits as described in the Framework Agreement – Annex 1

# Members

CERNopenlab

## Partners



ORACLE

SIEMENS

## Contributors



BROCADE

## Associates

Yandex

## Research



- High throughput computing project
  - Xeon + FPGA + omnipath, LHCb TDAQ
- Code modernization project
  - Geant V, FairRoot, Cx3D brain dev simulation
- Rackscale project
  - Software defined racks
- Training, consultancy

## ■ Cloud and OpenStack

- OVM integration with CERN OpenStack

## ■ Data Analytics

- Analytics as a Service (Endeca, Oracle R, etc.)

## ■ Database and Systems Management

## ■ Java Platform

## ■ Replication using GoldenGate

■ Improve functionality, efficiency, and predictability of CERN control systems

- Data Analytics
- High performance archiving
- Visualization
- Development environment



## ■ Storage server projects

- Test S3 compatibility
- Test performance

## ■ Cloud Federations

- Create full orchestration capability
- Manage virtual machines in remote clouds with a single identity
- Done within the OpenStack development process

## Current architectures built on layers of traditional technology

Translation overhead

Tiers of storage servers

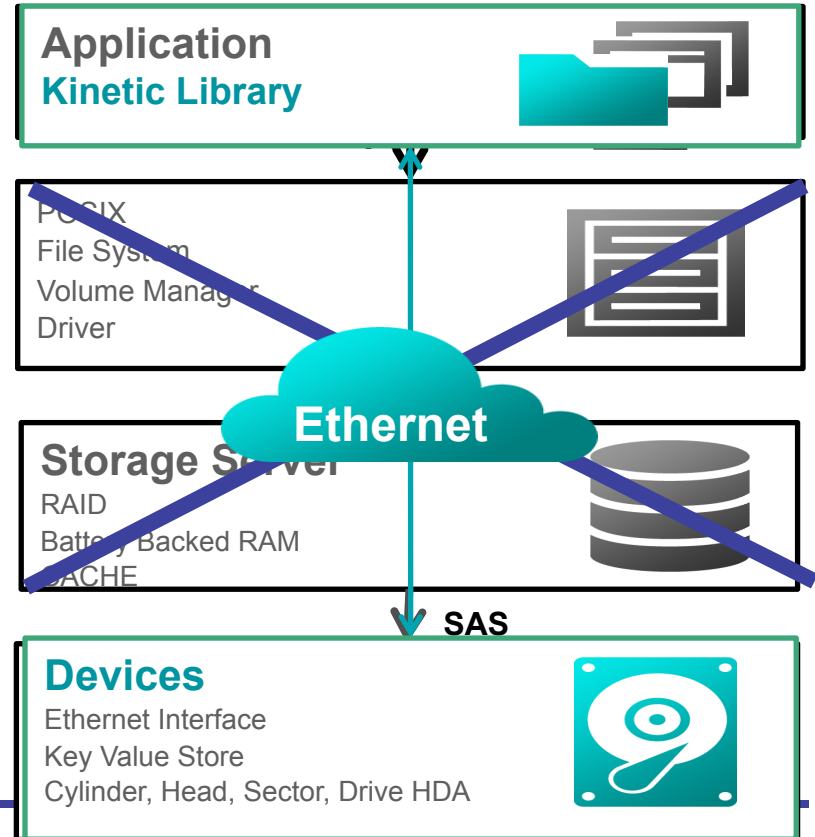
## Kinetic cuts through these layers

Applications communicate directly

## Drive at a higher abstraction level

More efficient than objects in file systems

Enables feature agility



- **RapidIO low-latency switch technology**
  - Test and evaluate in analytics clusters
  - Test and evaluate in TDAQ environment

■ **Build a rack-scale system with a modern OS including the following ideas:**

- **Data plane OS for virtualized high-throughput I/O**
  - Multi-kernel operating systems (Arrakis, Barrelfish)
  - Data transfer without kernel mediation
- **Multicore systems**
  - Decouple the CPU, kernel and the OS
- **Scaling beyond a single chassis**
  - Using asynchronous message exchange

- Build intelligent system that can optimize routing of data traffic entering and leaving an organization and drop network attacks
- The optimal routing or drop will be decided based on the information coming from network itself, from db of trusted applications and other sources

## ■ Data popularity project

- Based on data usage patterns determine the data storage class

## ■ Data verification project

- Automatic detection of anomalies in the LHCb detector operating mode

# Close to Joining



CERNopenlab

- **Comtrade**

- Customization and packaging of EOS

- **DSI (Data Storage Institute)**

- NVram project



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