Exciting New Technologies Being Researched in CERN openlab V

Fons Rademakers
CERN openlab CTO

CERN openlab

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

Set-up
2001

I
2003

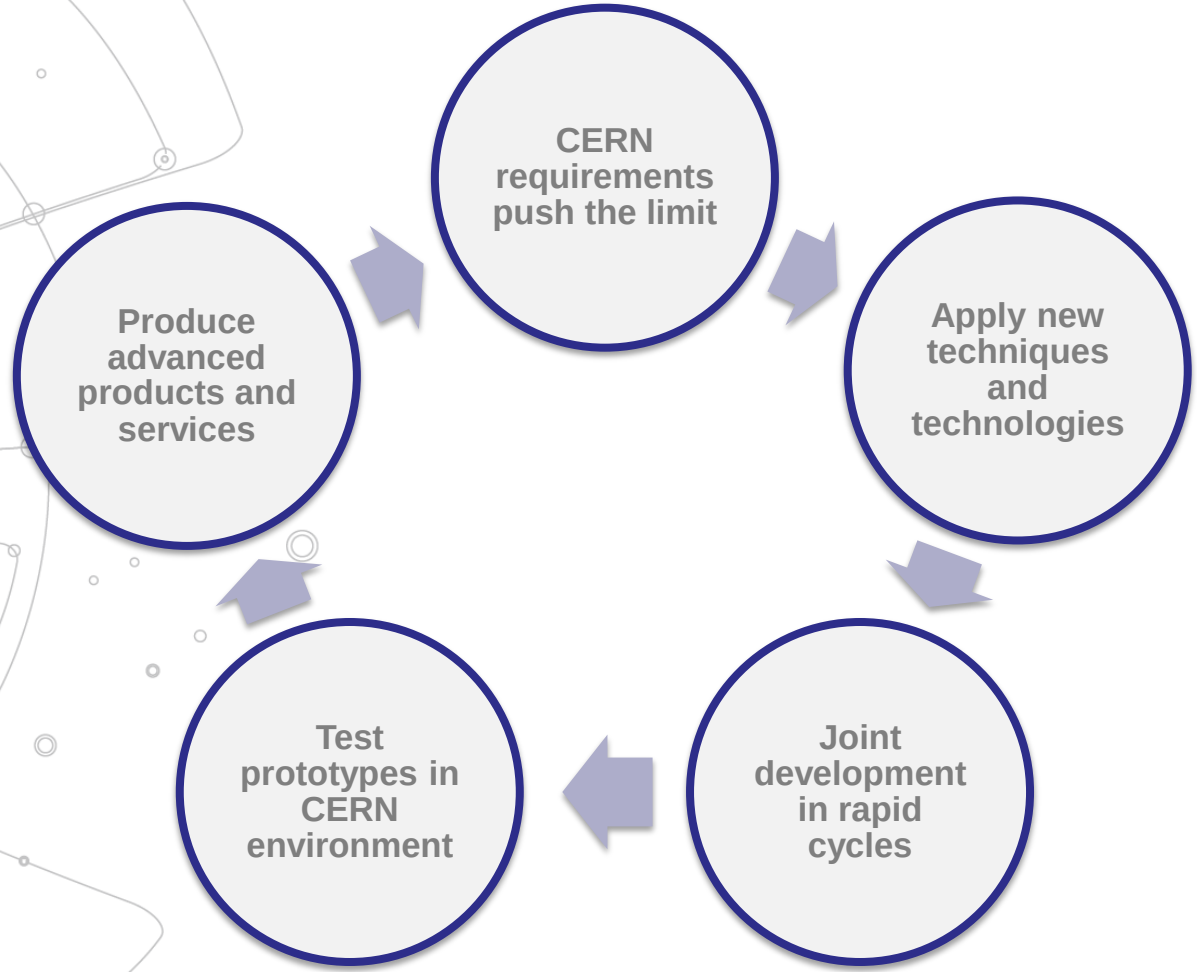
II
2006

III
2009

IV
2012

V
2015

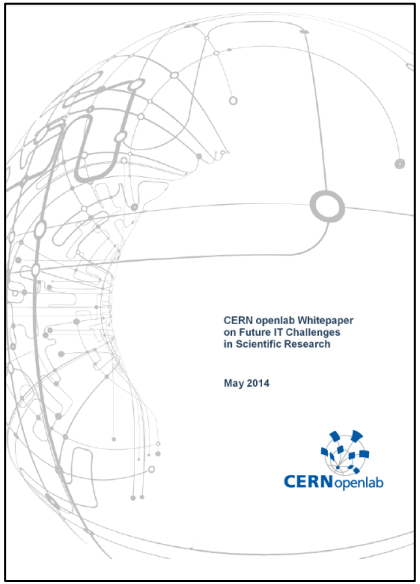
CERN openlab Board of Sponsor 2013



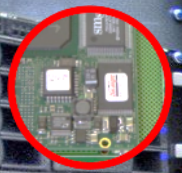
A public-private partnership between the research community and industry

Phase V Preparation

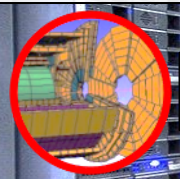
- IT Challenges Whitepaper
  - Workshops, discussions, presentations
  - Published in April 2014
- Internal discussions, workshops, initial use cases definitions
- New projects starting or being defined



Information Technology Research Areas

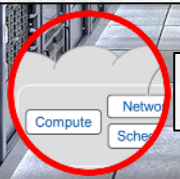


Data acquisition and filtering



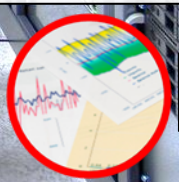
Computing platforms, data analysis, simulation

Data storage and long-term data preservation



Compute provisioning (cloud)

Networks



Data analytics

Medical applications

Who we have talked to

CERN openlab

intel
ORACLE
SIEMENS
HUAWEI
rackspace. the open cloud company
Yandex

New partners

EIROforum
CERN
esa
European Molecular Biology Laboratory
NEUTRONS FOR SCIENCE
ESRF
ESO
European XFEL
EUROfusion

CERN openlab

WLCG Worldwide LHC Computing Grid
CMS
ALICE
LHCb
ATLAS
European Commission




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

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

Started February 2013

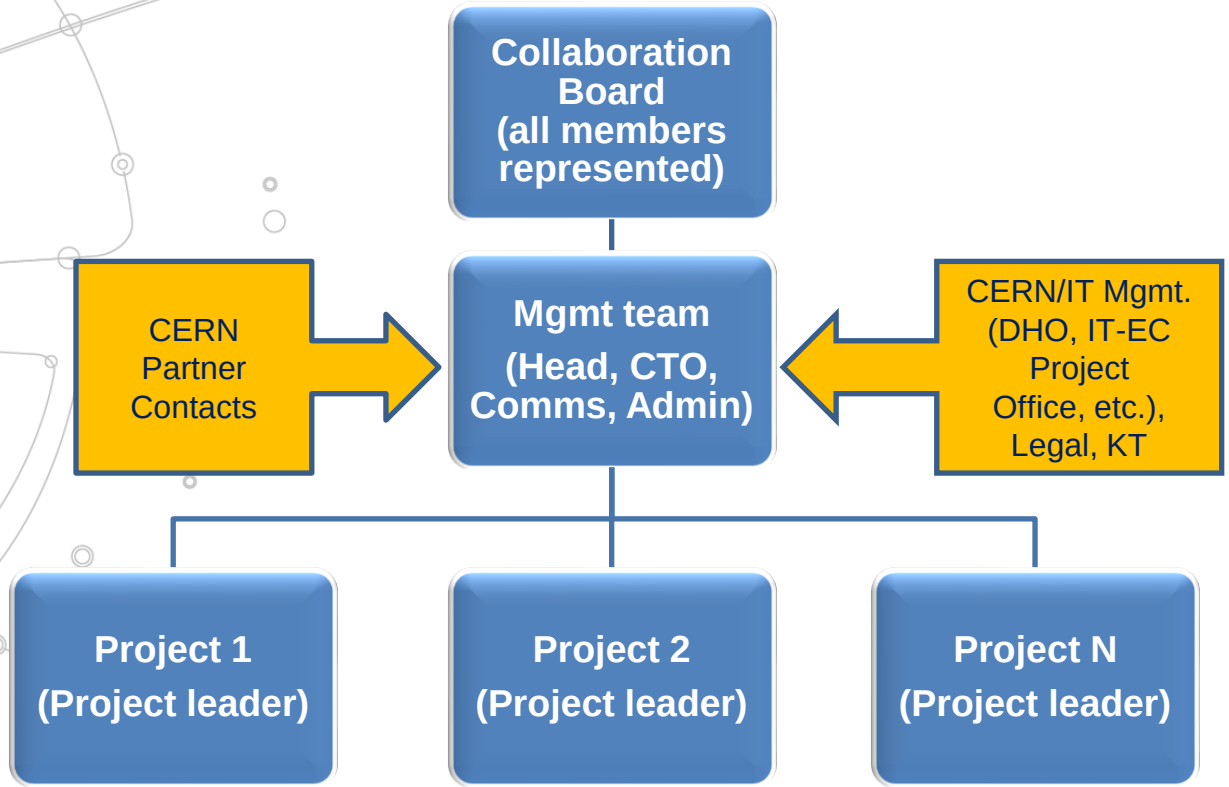
Recruited 5 fellows

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

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

Partners

Contributors

Associates

Research

Intel

- 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

Oracle

- 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

Siemens

- Improve functionality, efficiency, and predictability of CERN control systems
  - Data Analytics
  - High performance archiving
  - Visualization
  - Development environment

Huawei

- Storage server projects
  - Test S3 compatibility
  - Test performance

Rackspace

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

CERN openlab

SEAGATE

Current architectures built on layers of traditional technology

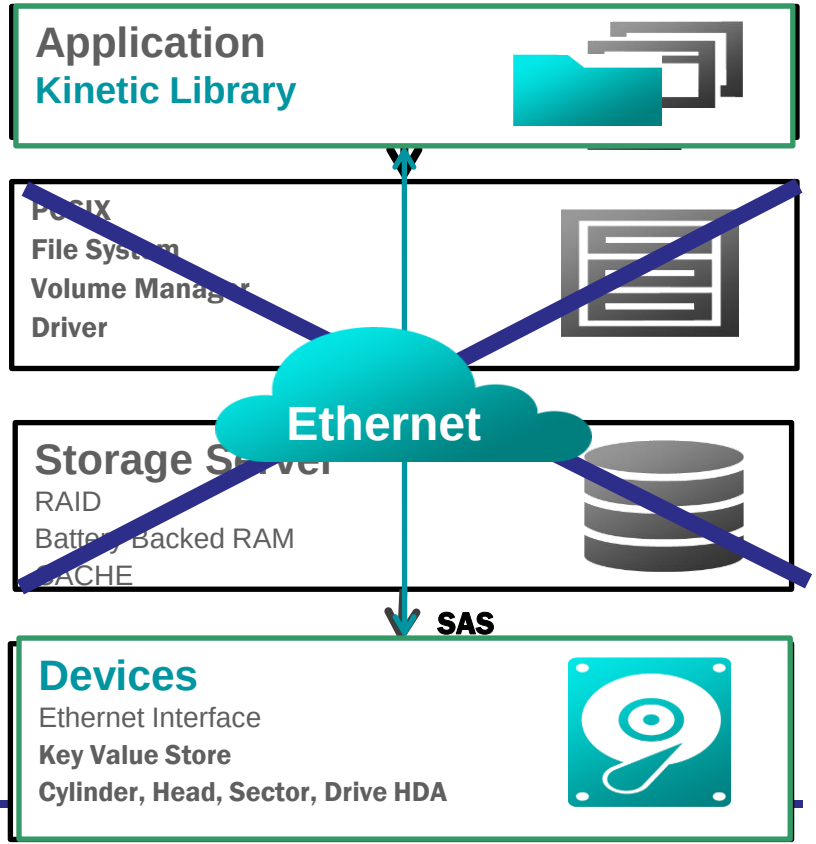
- Translation overhead
- Tiers of storage servers

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

Cisco

- 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

Brocade

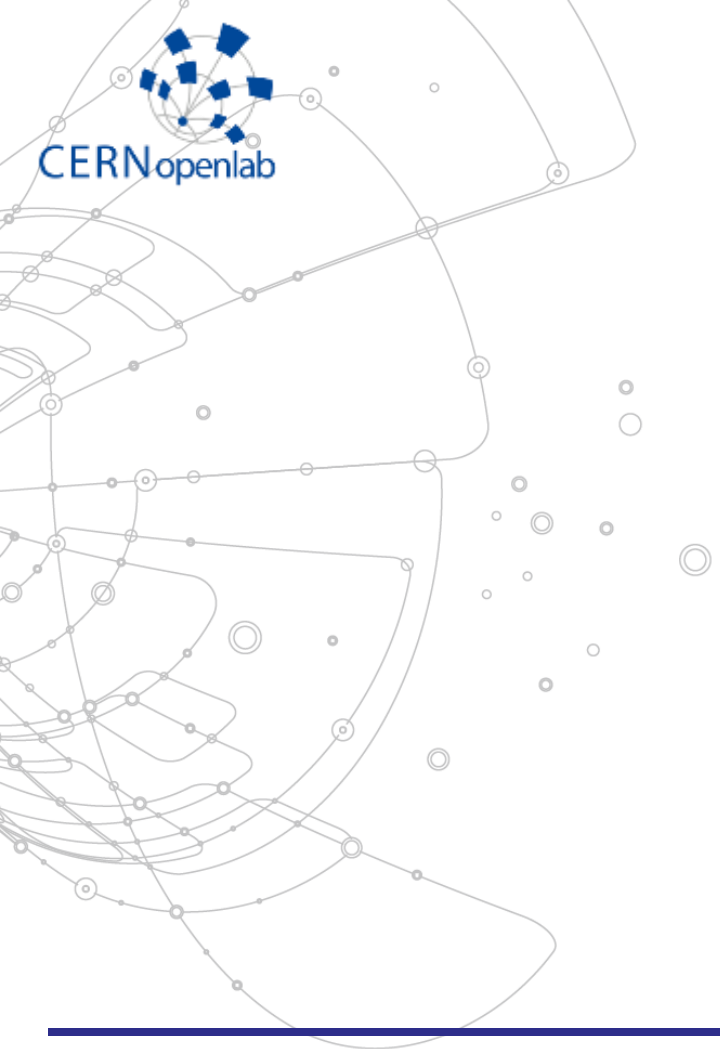
- Build intelligent system that can optimize routing of data traffic entering and leaving an organization and drop network attacks
- The optimal routing or drop will be decided based on the information coming from network itself, from db of trusted applications and other sources

Yandex

- 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

- Comtrade
  - Customization and packaging of EOS
- DSI (Data Storage Institute)
  - NVram project



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