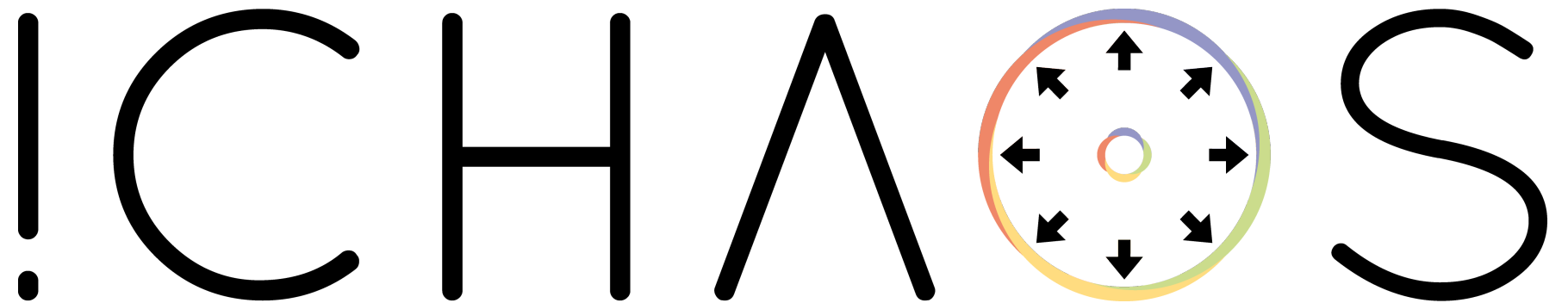


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Project proposal

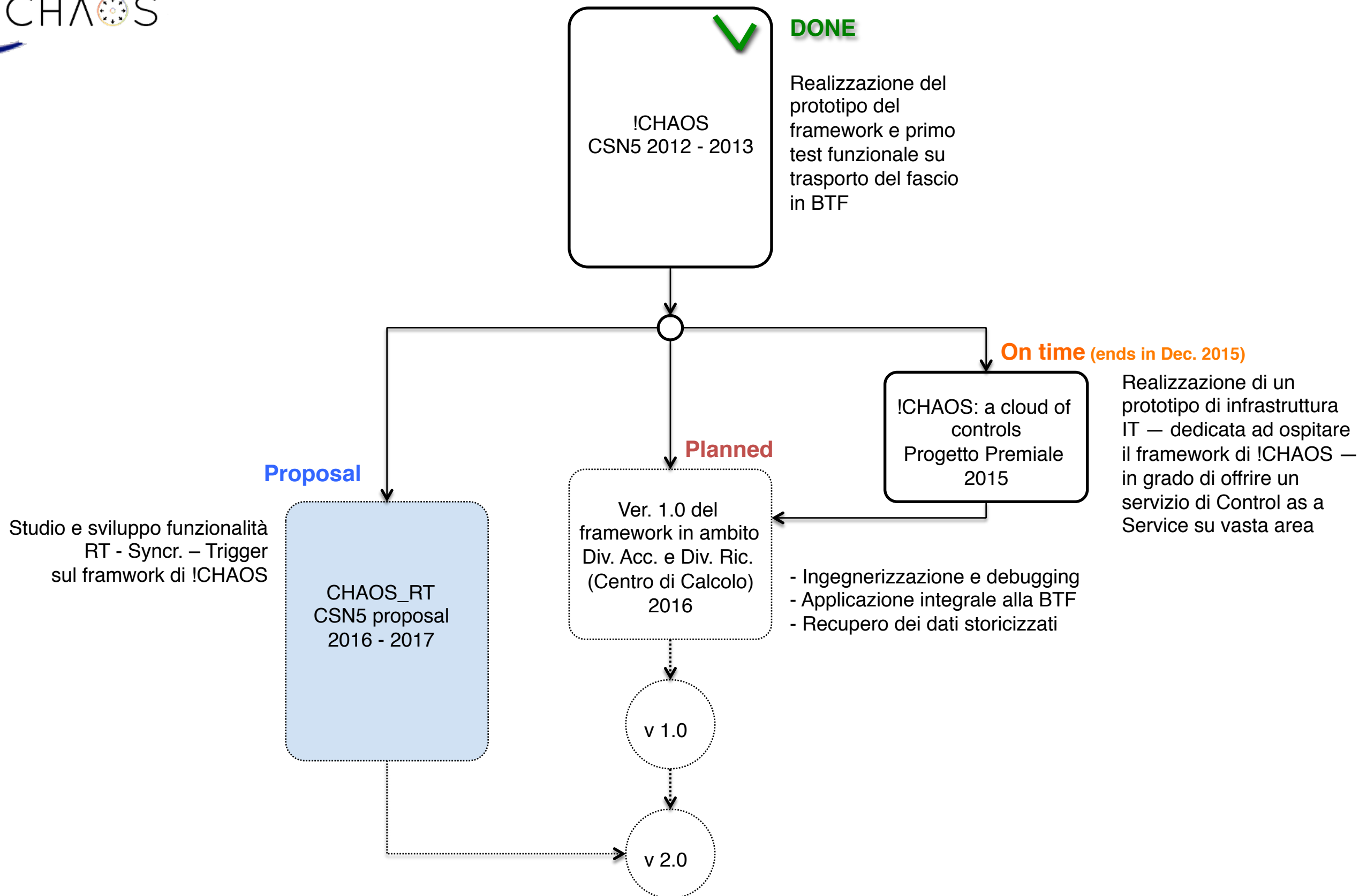
CHAOS_RT *(!CHAOS Real Time)*

Luca Foggetta *on behalf of Andrea Michelotti*

Agenda

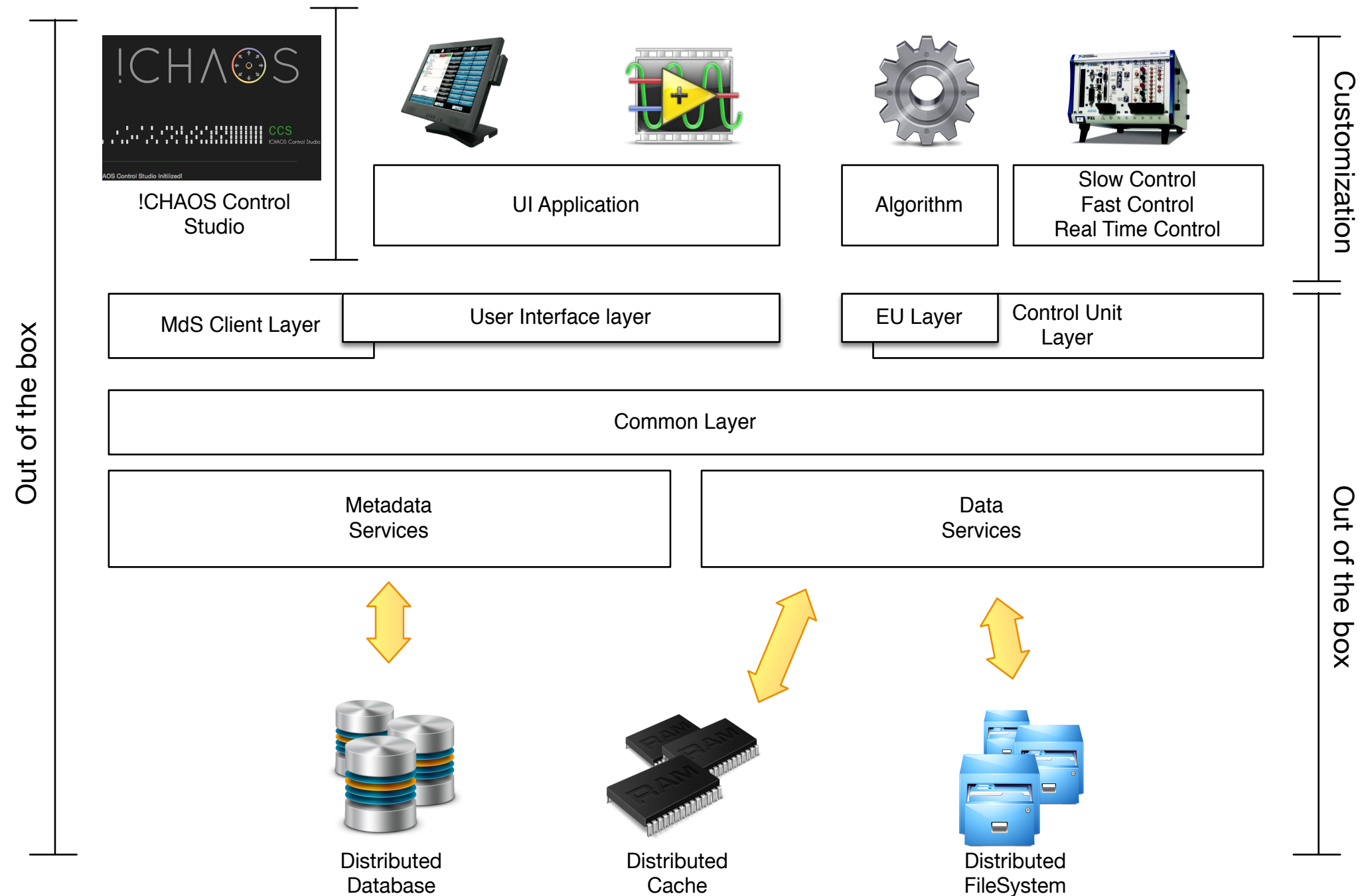
- Genesis and status of !CHAOS
- !CHAOS outline
- !CHAOS_RT project proposal
- !Conclusions

Genesis and status of !CHAOS



!CHAOS outline

General architecture

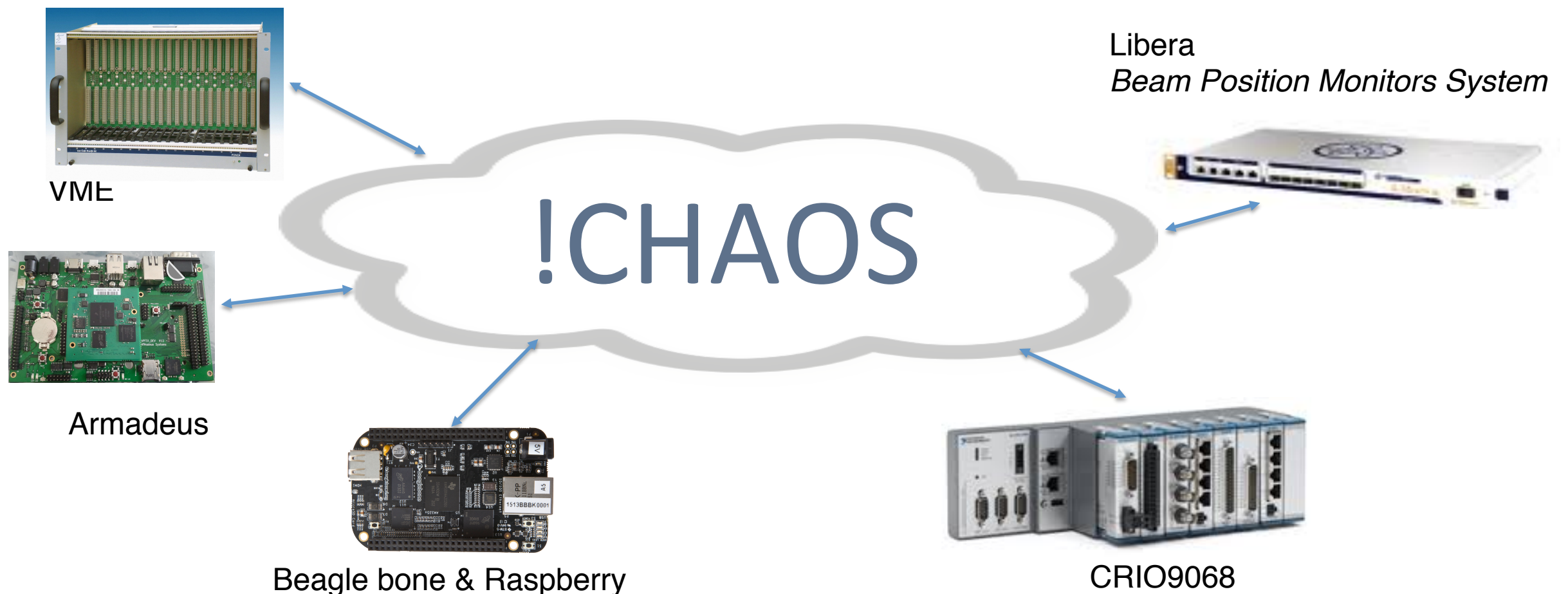


!CHAOS outline

Embedding !CHAOS

!CHAOS has been ported on a multitude of HW

- ✓ Reducing overall cost
- ✓ Reducing the number of different protocols to manage
- ✓ Distributing processing power

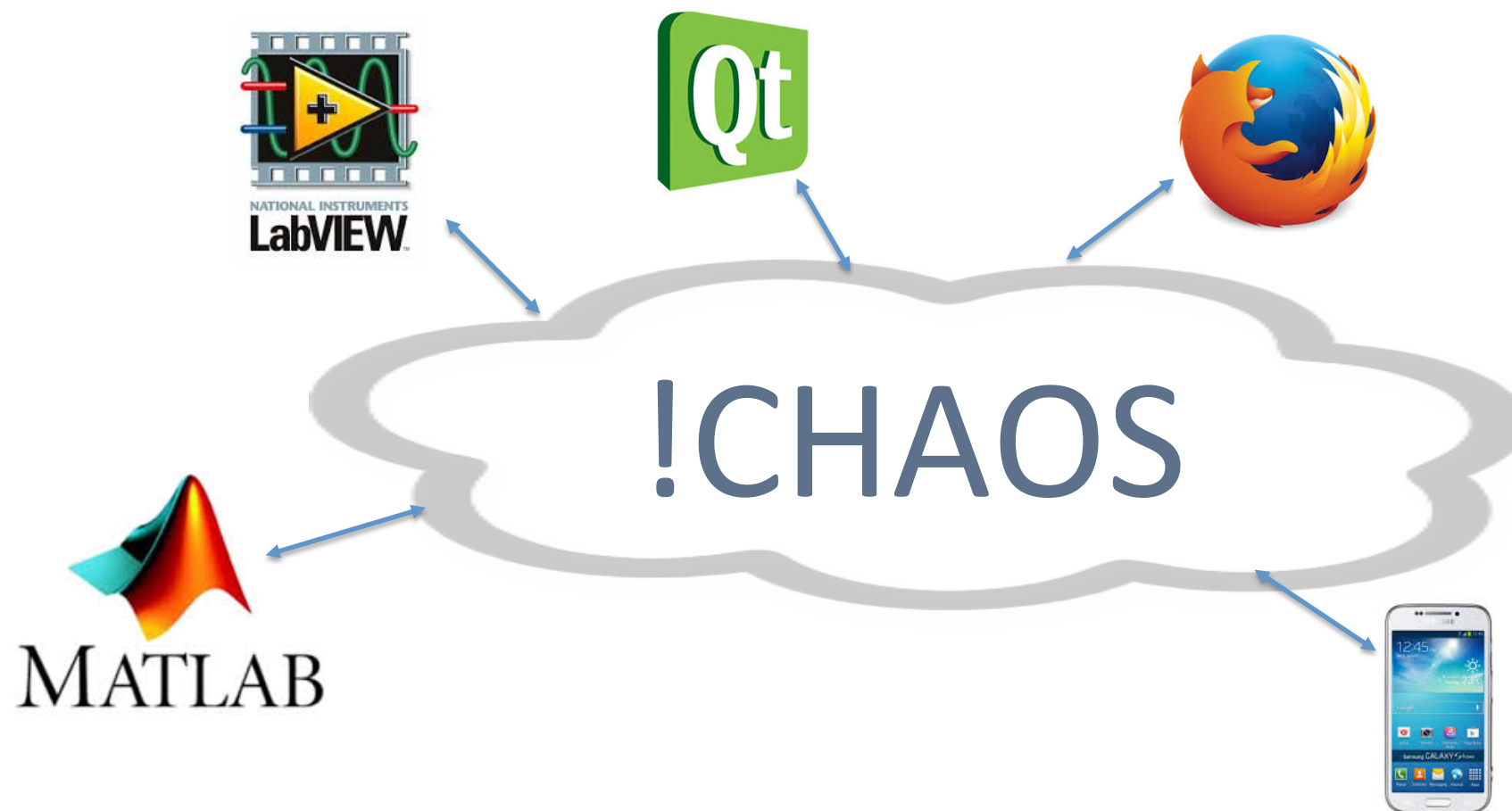


!CHAOS outline

Access from multiple platforms

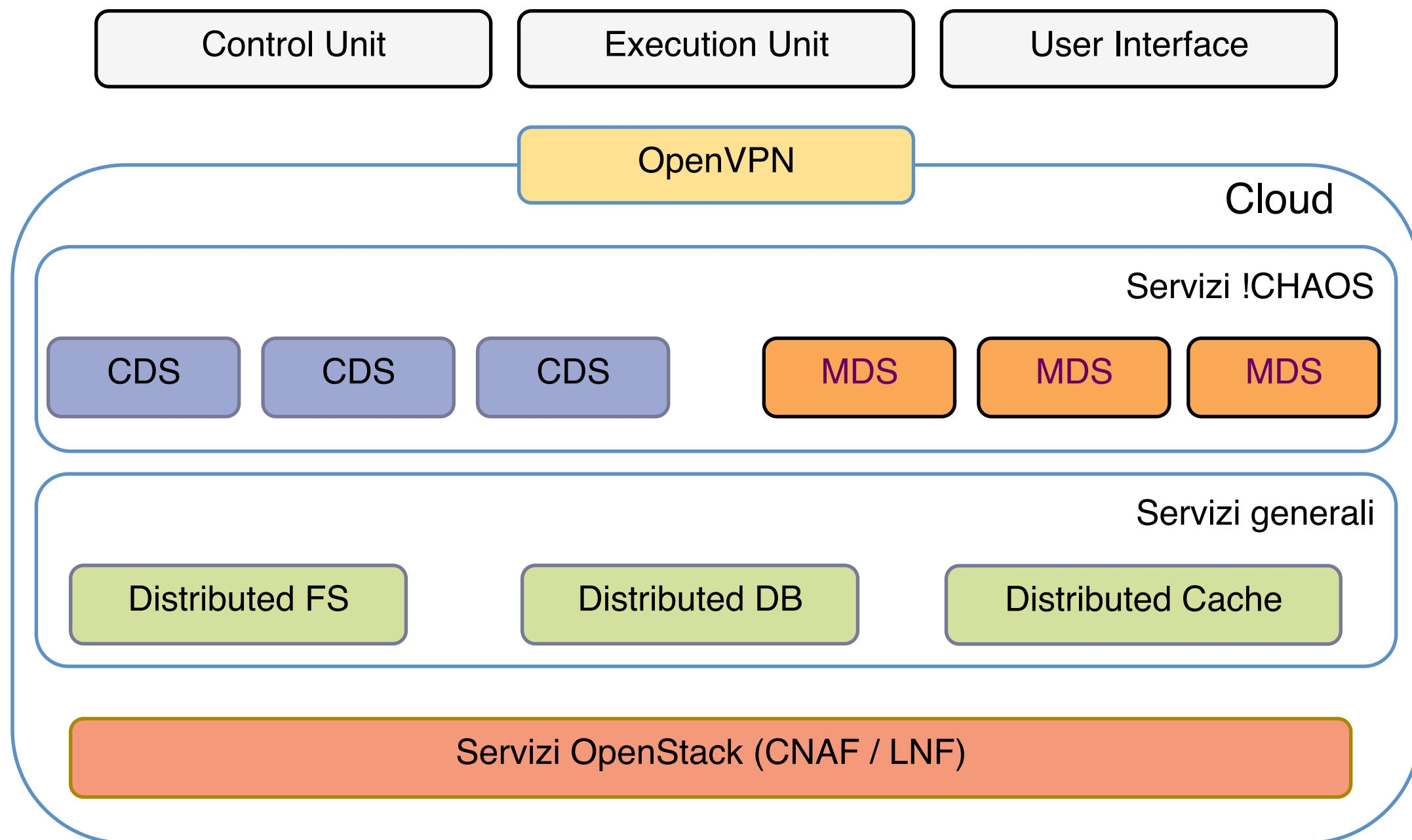
!CHAOS is being ported on a multitude of SW

- ✓ Support WEB and mobile applications access via http REST
- ✓ Support LabVIEW access via http REST & native !CHAOS API
- ✓ Support MATLAB access via native !CHAOS API



!CHAOS development

Status of “Premiale !CHAOS”: *cloud* infrastructure @Calcolo LNF / CNAF

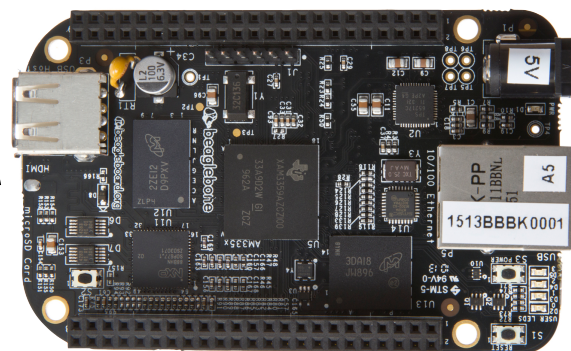


!CHAOS Use Case

Status of "Premiale !CHAOS": "ESCO" use case @ Ed. 36

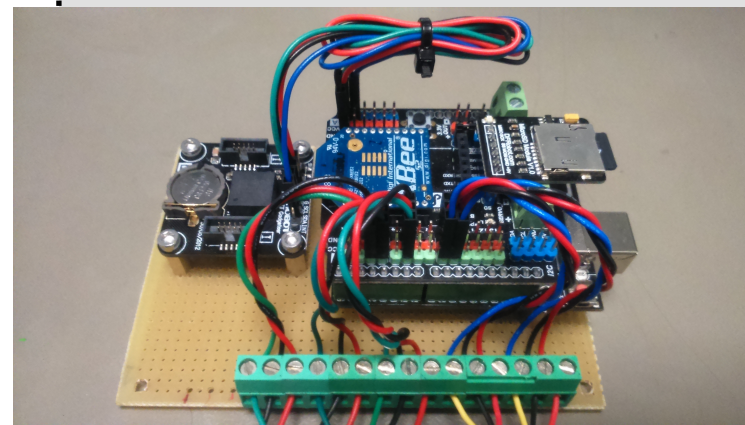
A preliminary setup of a network of Zigbee nodes and sensors is monitoring the Aula Touschek. These nodes provide environmental information (Temp., Humidity, CO₂) and a !CHAOS CU gets and pushes such information into the "Cloud".

An "intelligent algorithm" will drive the UTA through another !CHAOS CU, in order to achieve an optimum comfort trying also to minimize power consumption.



!CHAOS CU on Beagle Bone
with Zigbee wireless link

Zigbee
wireless
protocol



Sensors nodes with Zigbee wireless links



Touschek room sensors distribution

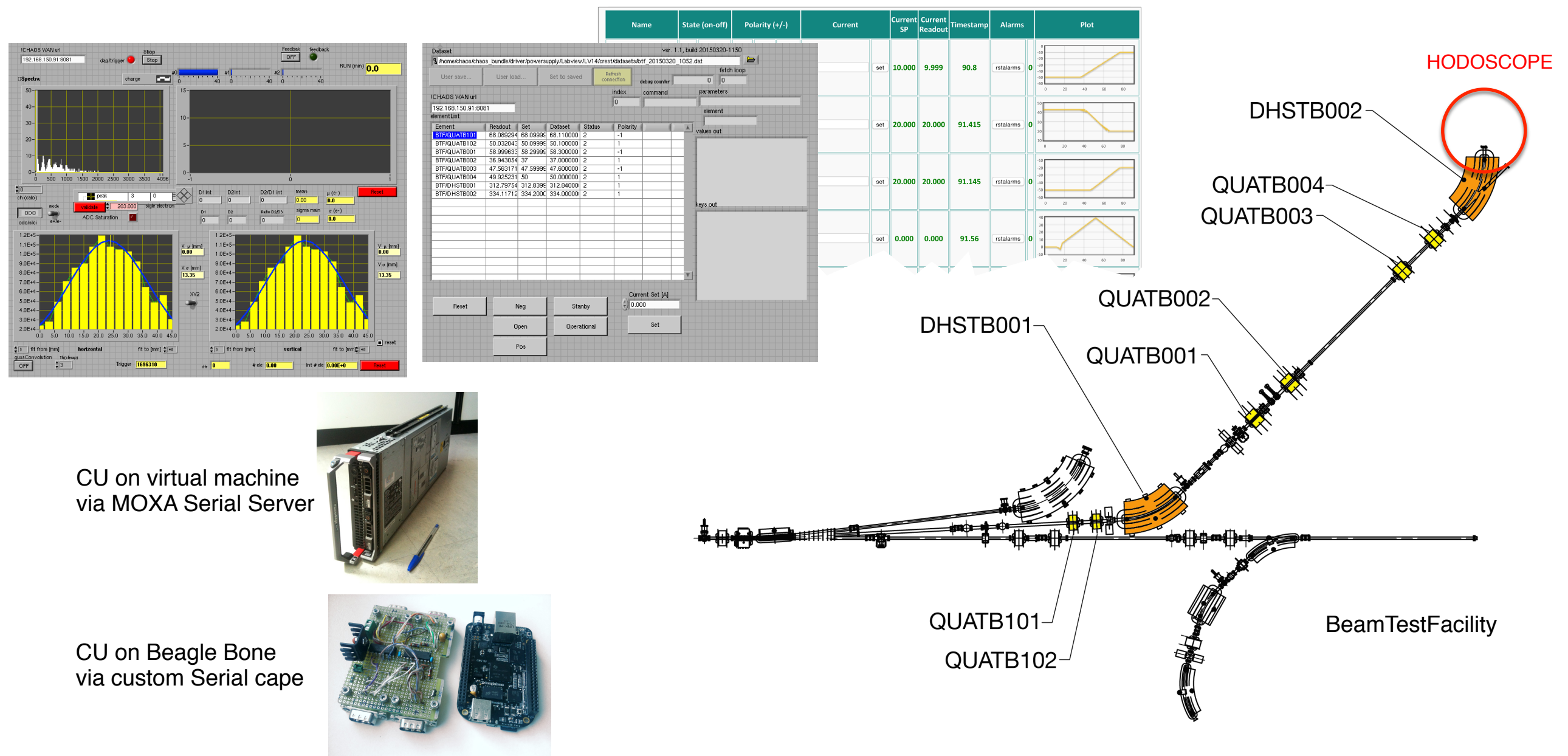
<http://chaost-webui1.chaos.inf.infn.it/ED36.html>

!CHAOS cloud

!CHAOS Use Case

Status of "Premiale !CHAOS": "accelerators" use case @BTF

In March 2015, !CHAOS replaced parts of the traditional control and implemented a simplified version of the BTF DAQ. The beam has been driven through the TL and a feedback process successfully locked the beam position.



HOW TO DEVELOP THIS PROJECT:

This R&D project aims to the integration of the following features in the !CHAOS framework (i.e. CU):

- ❑ **Temporization** > distribute a common time among nodes
(NTP vs PTP, White Rabbit...)
- ❑ **Synchronization** > action/command synchronization among nodes
(i.e. common arming among different type of CUs)
- ❑ **Trigger handling** > node reaction to SW/HW events implemented in the plugin layer
(i.e. reaction time of the CU process, depending on the used CU HW)
- ❑ **Determinism** > execute actions in a well defined amount of time
(i.e. known maximum execution time)

Determinism (Real Time) involves further developments regarding the support for:

- ❑ **Real Time OS (Linux RT, VxWorks)**
- ❑ **Bare Bone Targets (controllers without OS)**
- ❑ **FPGA**

It will need wide support from LNF Computing Centre
(i.e. WR network, further !CHAOS infrastructure
development)

WHERE TO DEVELOP THIS PROJECT:

This project is not only oriented to INFN accelerator facilities @LNF and @LNS but also suitable for industrial and civil applications.

Concerning LNF, some structures are ready to be targetted by the !CHAOS_RT development such as parts of the DAFNE diagnostics, SPARC and BTF.

As an example, BTF — for its intrinsic nature — is an excellent *gym* where this new features can be tested:

- ❑ Fast rolling back to “conventional control”
- ❑ Huge amount of nodes with different bus, timing needs (magnets, detectors, instrumentation acting on ETH, USB, Serial, VME...)
- ❑ At the end, BTF requires frequent reconfigurations so that it's the ideal field to test the !CHAOS modularity and abstraction capabilities
- ❑ Future BTF activities will profit on RT system
 - To give a DCS standard for the BTF-based experiments that needs integration with BTF DCS via released !CHAOS API

WHY TO DEVELOP THIS PROJECT:

- Acquire knowledge of the newest embedded system controlled by RT systems
→ it will be possible to achieve new diagnostic standards (runtime timed and tagged data correlation among different nodes)
- Develop an high experienced group with the newest !CHAOS features
- !CHAOS is **naturally bound to** industrial and civils applications that often requires Real Time. The CHAOS_RT results will widen the employment opportunities of !CHAOS even outside the INFN institutional field.

*Production lines
On-the-fly Quality Control
Traffic control
.....*

!CHAOS_RT Project

Work plan

Collaboration

- **LNF** (Coord. naz. Andrea Michelotti, !CHAOS developer group)
- **LNS** (Coord. loc. Agata Scordina, !CHAOS developer group)
- **INFN-TV** (tbd, some study about WR timing applied to telescope arrays already in progress)

Task	primo anno												secondo anno											
1. Analisi architettura SW	■	■	■																					
2. Sviluppo infrastruttura SW			■	■	■	■	■	■	■	■	■	■												
3. Test e validazione HW/SW				■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■		
4. timing/synch/trigg HW testbed 1 setup				■	■																			
5. testbed 2 setup					■	■																		
6.testbed 3 setup					■	■																		
7. testbed 4 setup					■	■																		
8. !CHAOS testbed drivers						■	■	■	■	■	■	■	■	■	■									
9. Analisi&sviluppo Estensioni RT	■	■	■									■	■	■	■	■								
10. Analisi&sviluppo !CHAOS no OS	■	■	■									■	■	■	■	■								
11. !CHAOS BTF drivers						■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■		
12. BTF integrazione							■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■		

!Conclusions

CHAOS_RT **results** will merge with the !CHAOS 1.0 release and will lead to the ver 2.0.

We aim to put in production a unique Control System with embedded timing, synchronization and triggering features.

We hope to push further and harder this promising stage of development to improve the status of DCSs standard!

