!CHAOS

Alessandro Stecchi
on behalf of the !CHAOS development team

Project Overview

!CHAOS at a glance

To design a new Control System — using cutting-edge software technologies — with the following aims:

- independence from the hardware
- scalability, redundancy, no single points of failure
- format free data and processes abstraction
- devices (to be controlled) hot-integration and auto-configuration
- native integration of a DAQ system
- compatibility with commercial standards

!CHAOS is a *System that offers Services* rather than a mere *Control System*

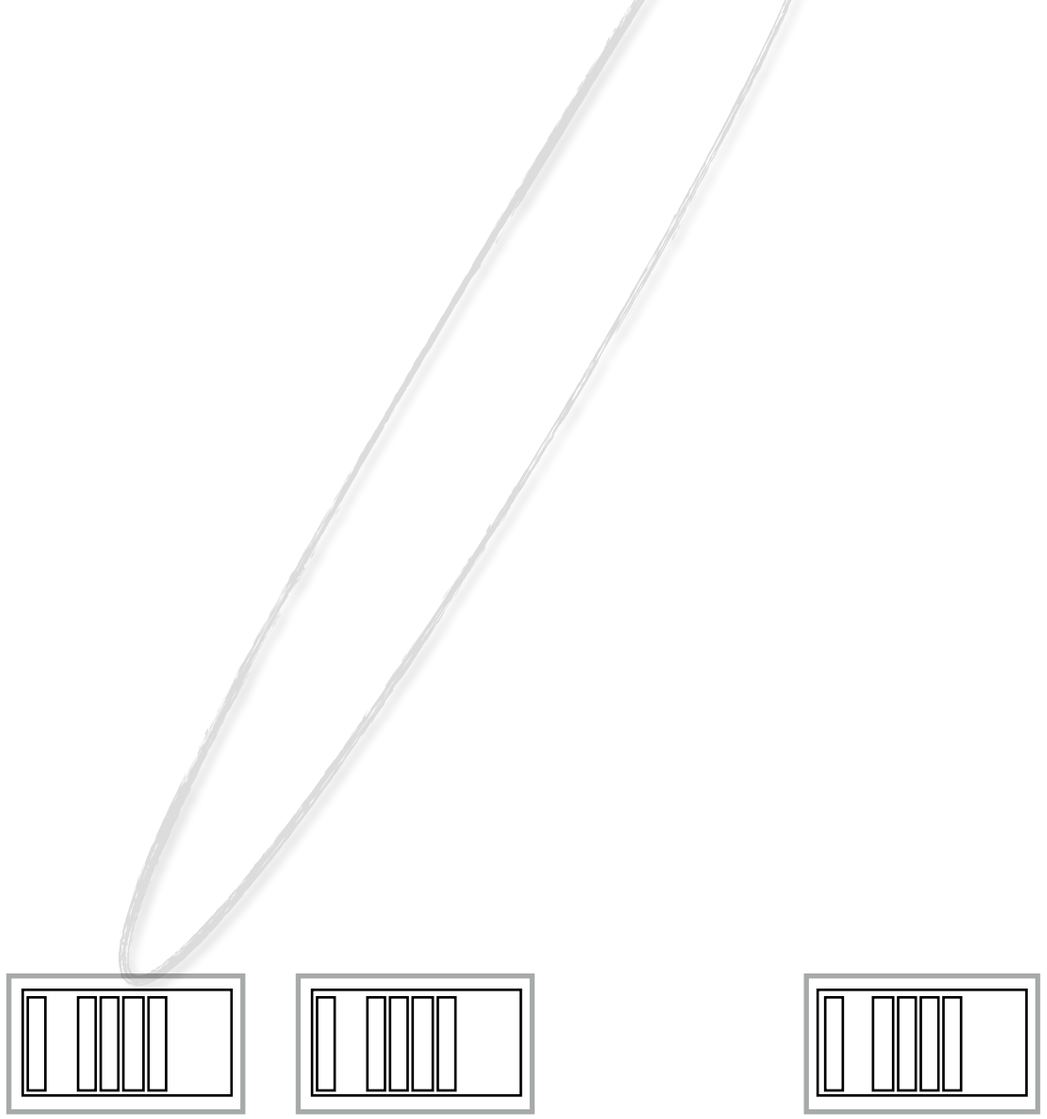
!CHAOS at a glance

… and therefore it is suitable for:

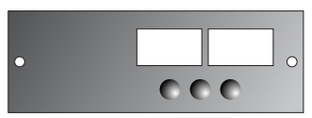
- application to different contexts
  (besides accelerators and large experiments)
- collaborations with industry
- INFN *Progetto Premiale*

!CHAOS is a *System that offers Services* rather than a mere *Control System*

control room

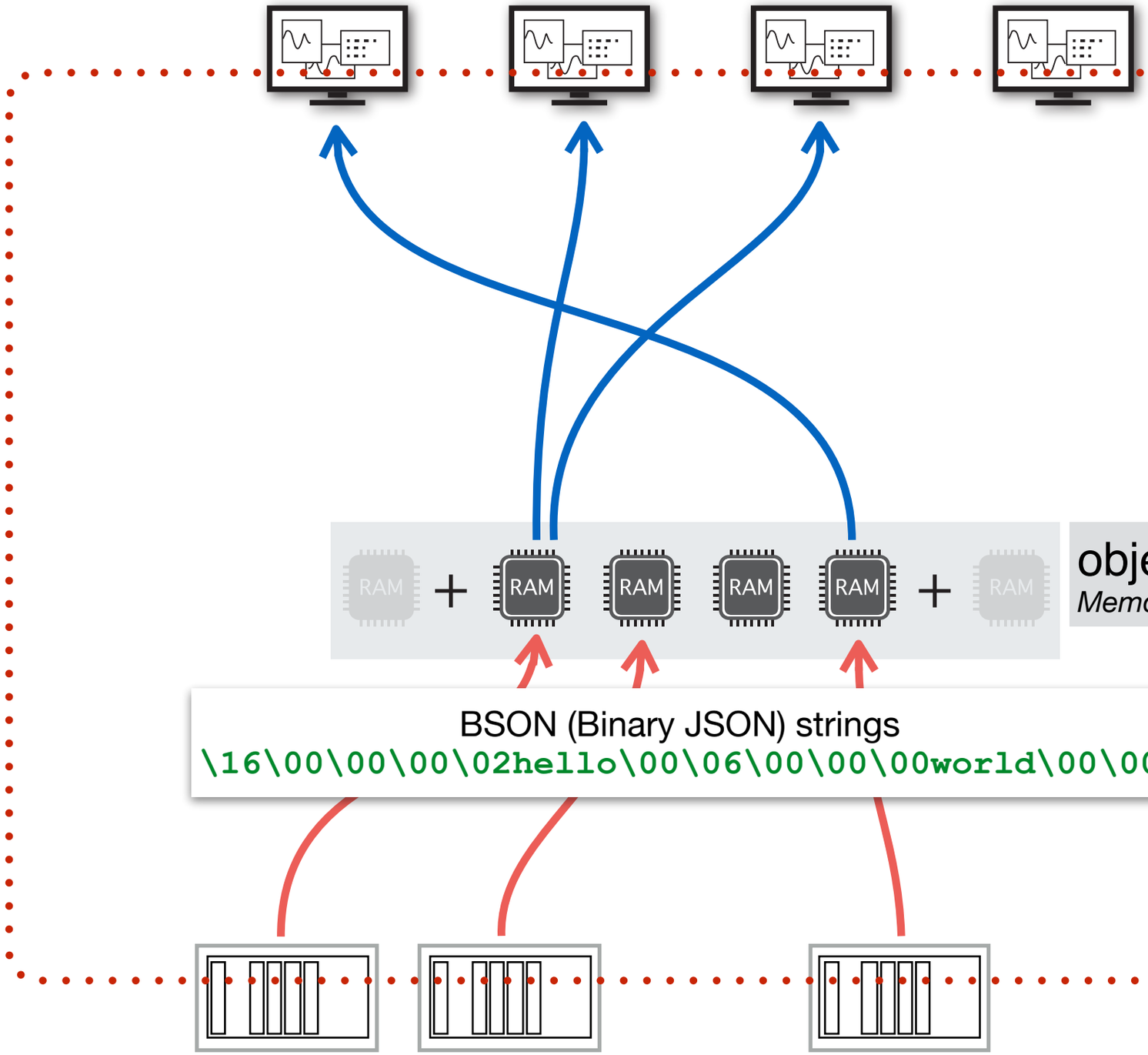


control units (CUs)



device

control room



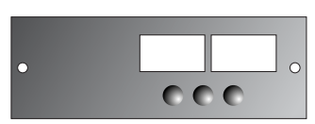
RAM + RAM RAM RAM RAM + RAM

object caching
Memcached / Couchbase

WP2
+WP5

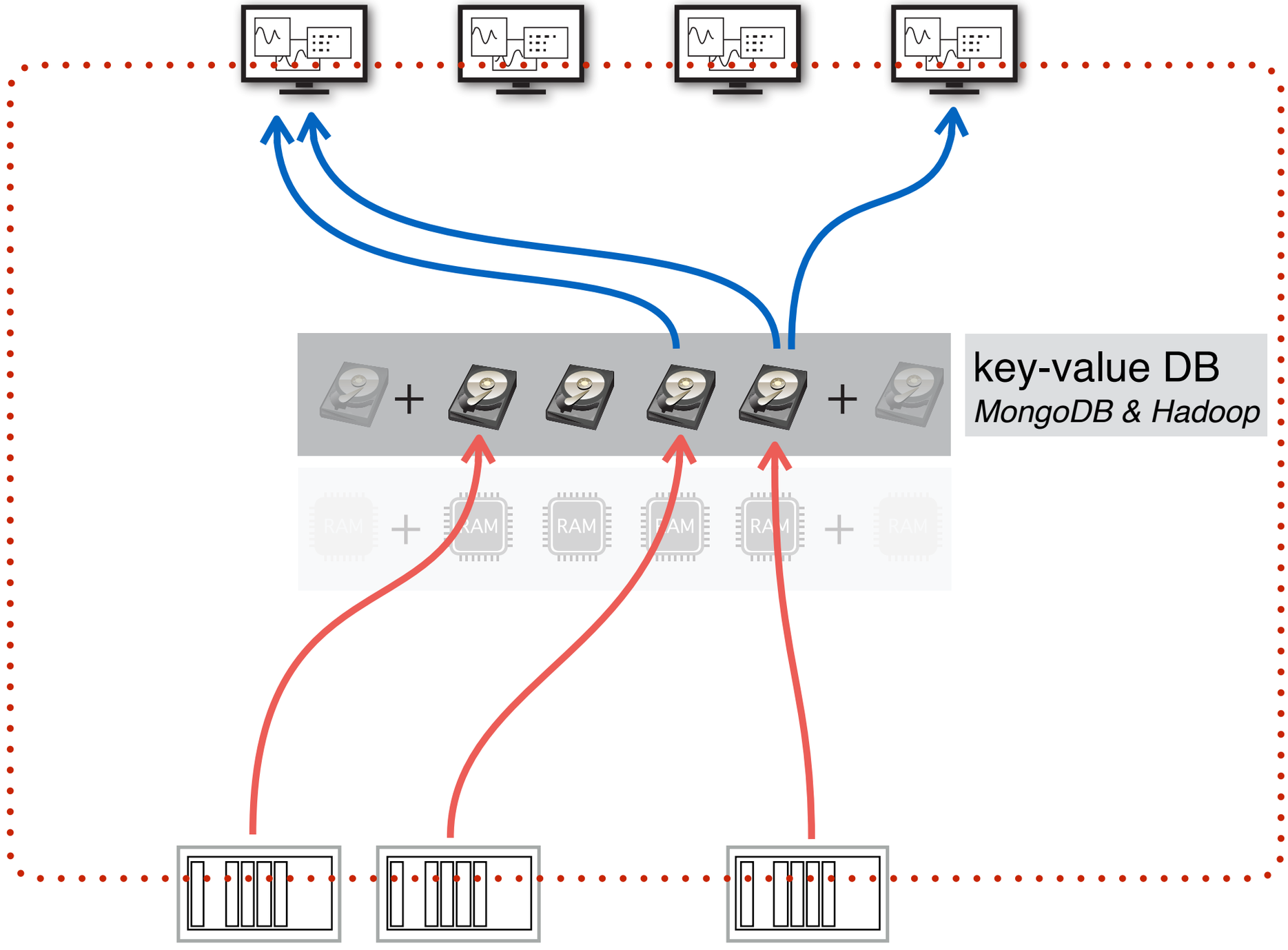
BSON (Binary JSON) strings
`\16\00\00\00\02hello\00\06\00\00\00world\00\00`

control units (CUs)



device

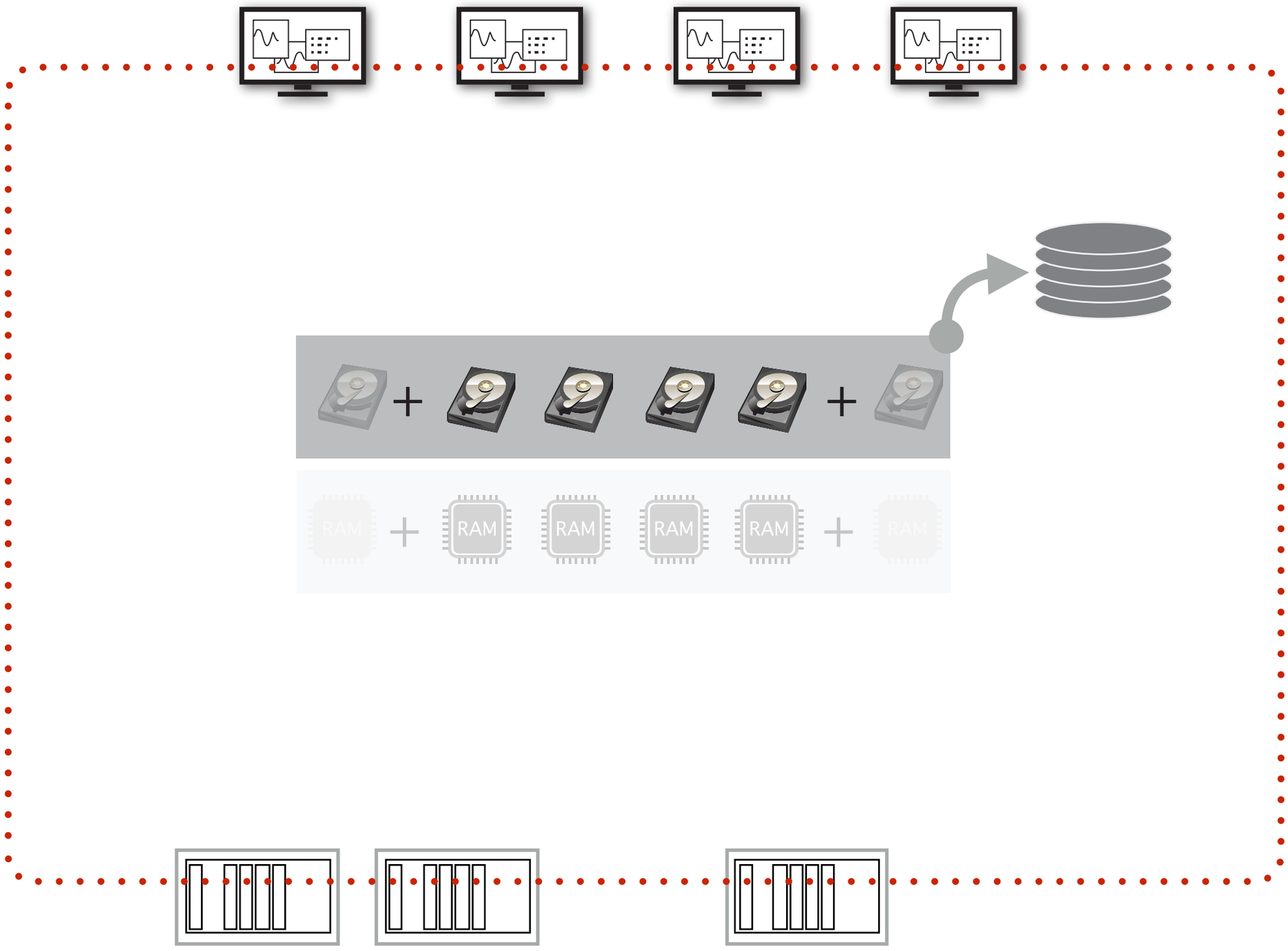
control room



control units (CUs)

device

control room



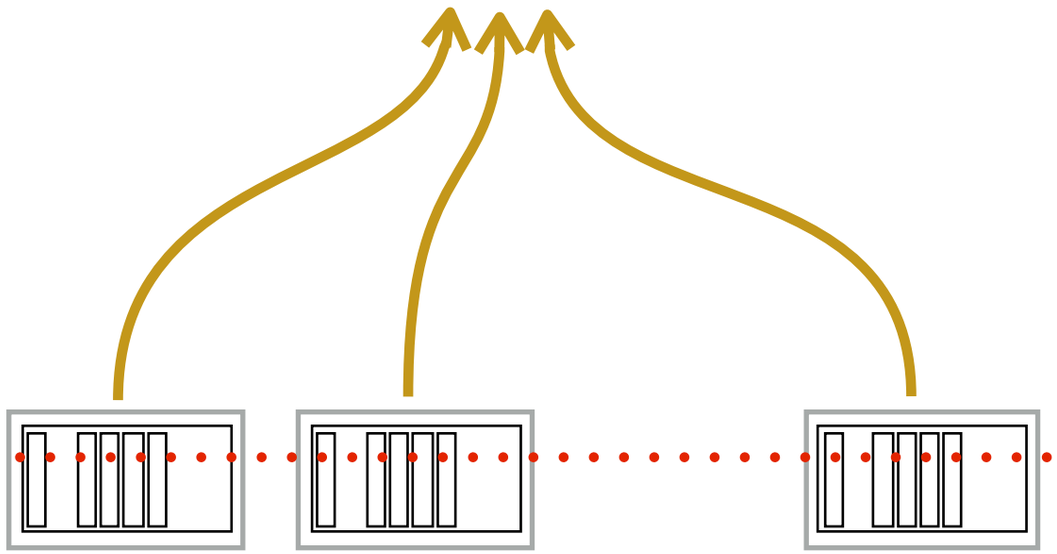
control units (CUs)

device

control room

Metadata server
system dynamic configuration

WP2



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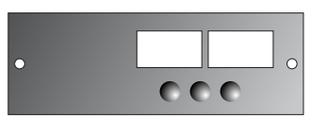
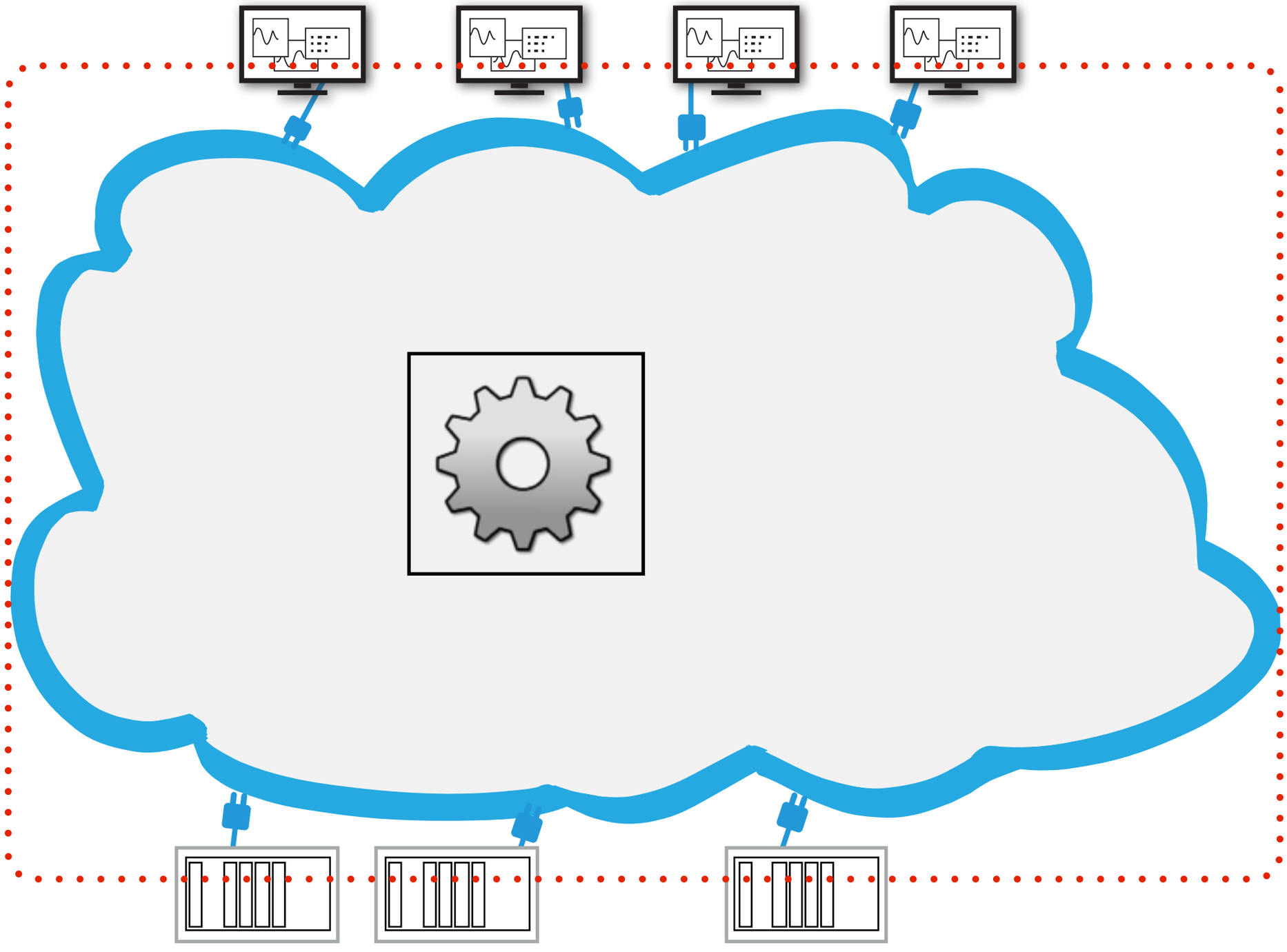


device

control room



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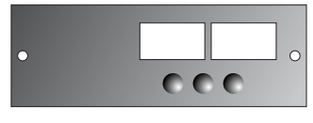
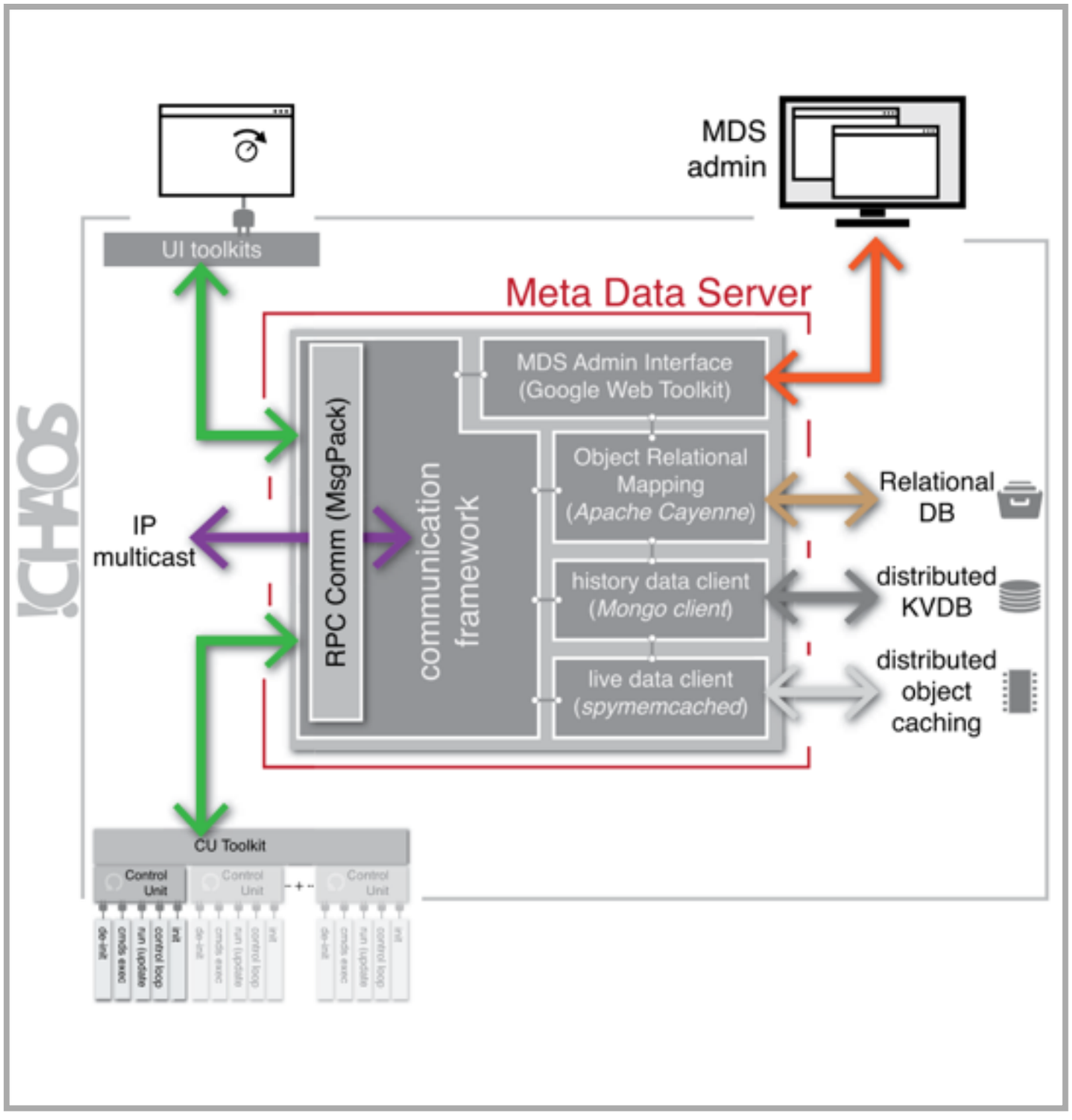
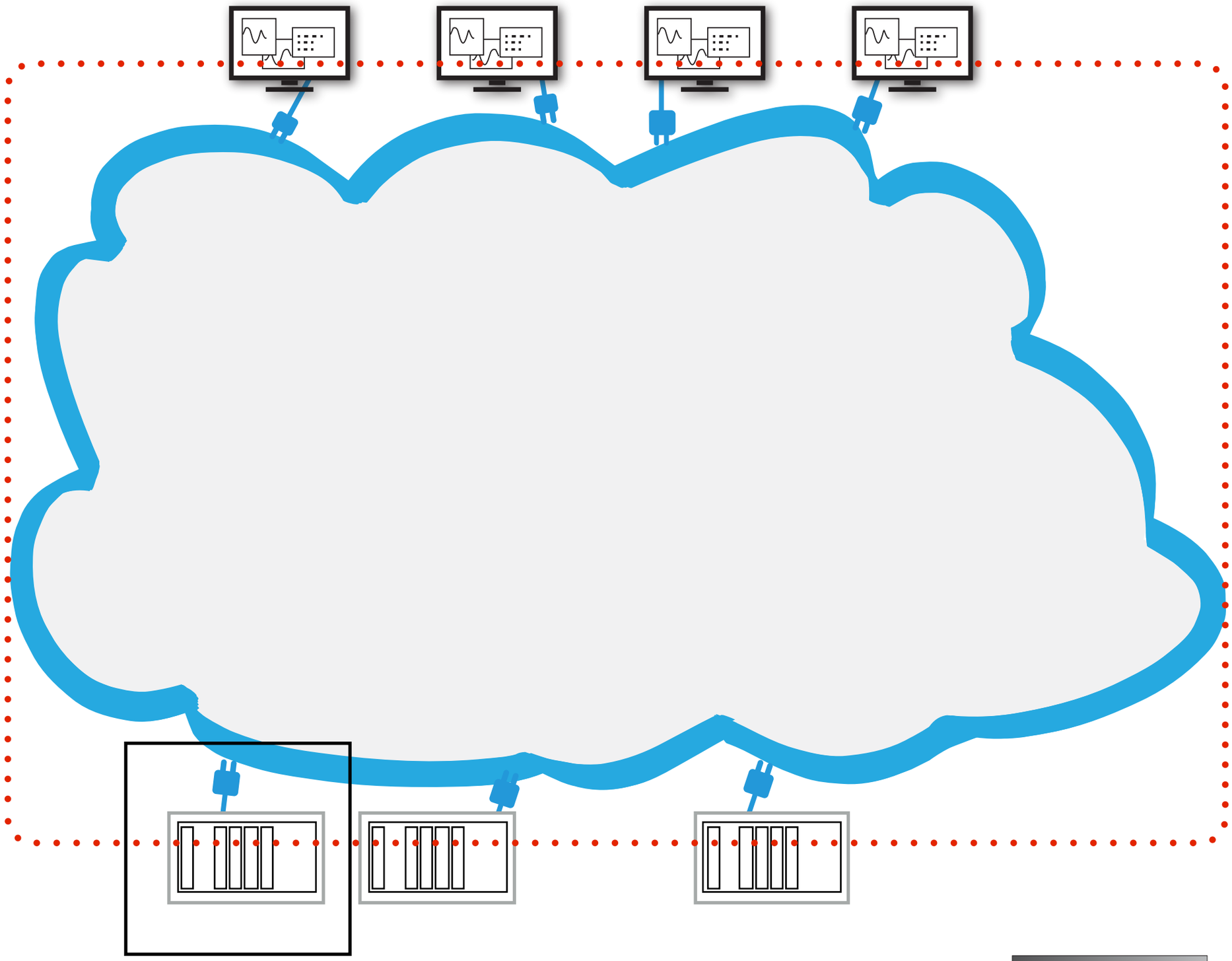


device


MDS
admin
UI toolkits
Meta Data Server
MDS Admin Interface
(Google Web Toolkit)
Object Relational
Mapping
(Apache Cayenne)
history data client
(Mongo client)
live data client
(spymemcached)
Relational
DB
distributed
KVDB
distributed
object
caching
IP
multicast
RPC Comm (MsgPack)
communication
framework
CU Toolkit
Control
Unit
Control
Unit
Control
Unit
de-init
cmds exec
run (update
control loop
init

WP2

control room



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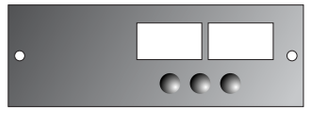
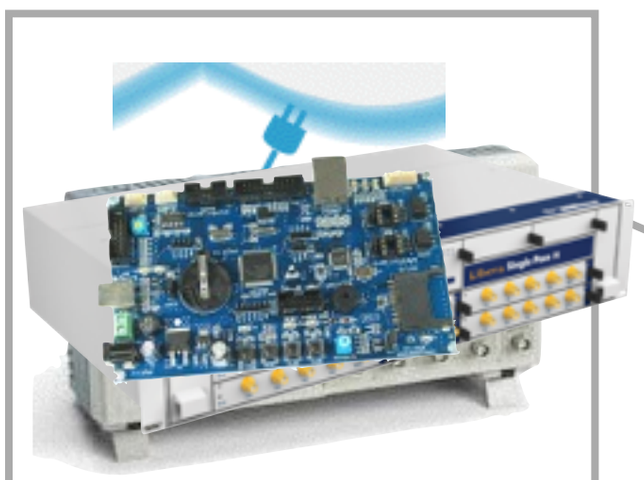


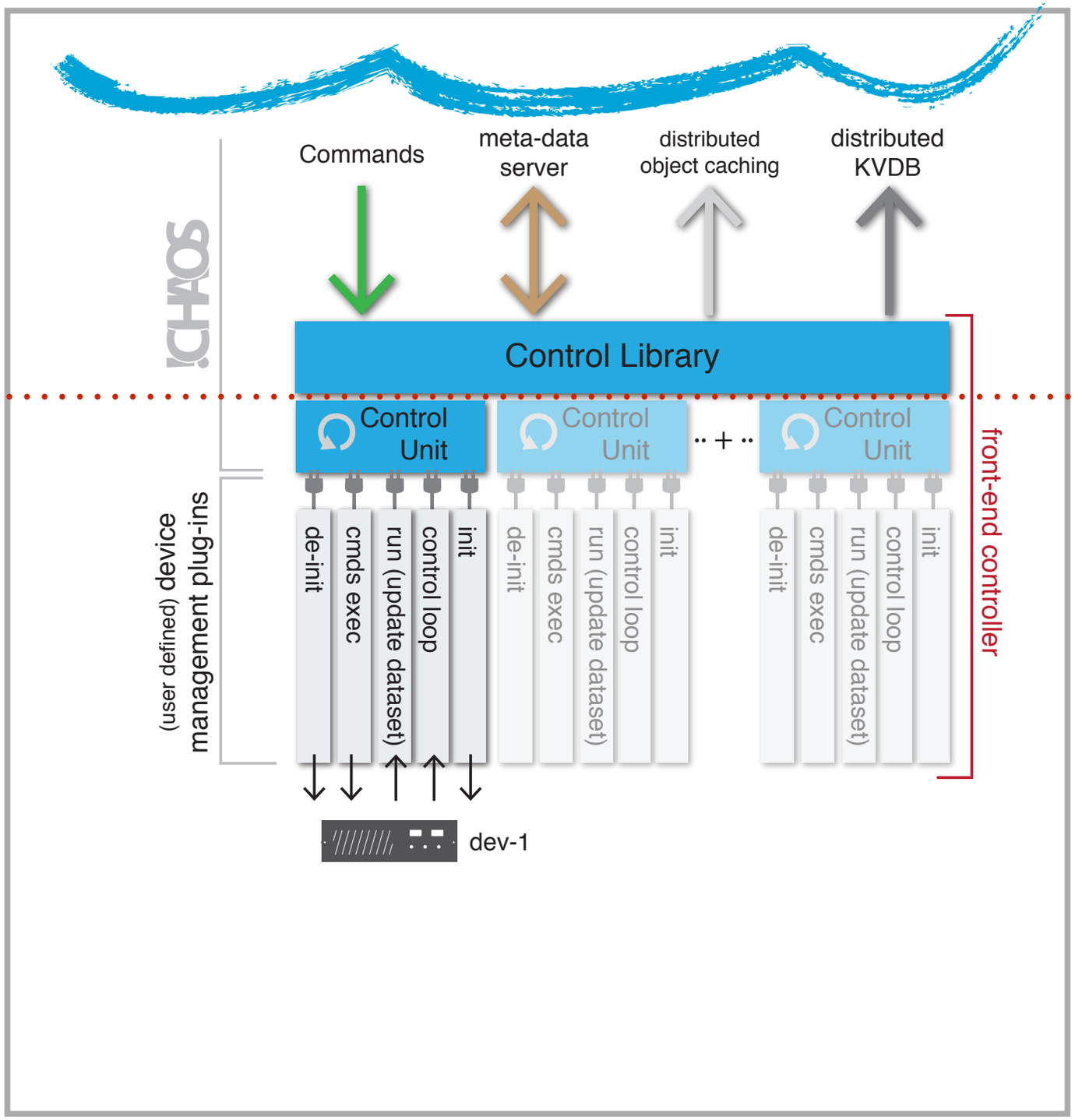
device



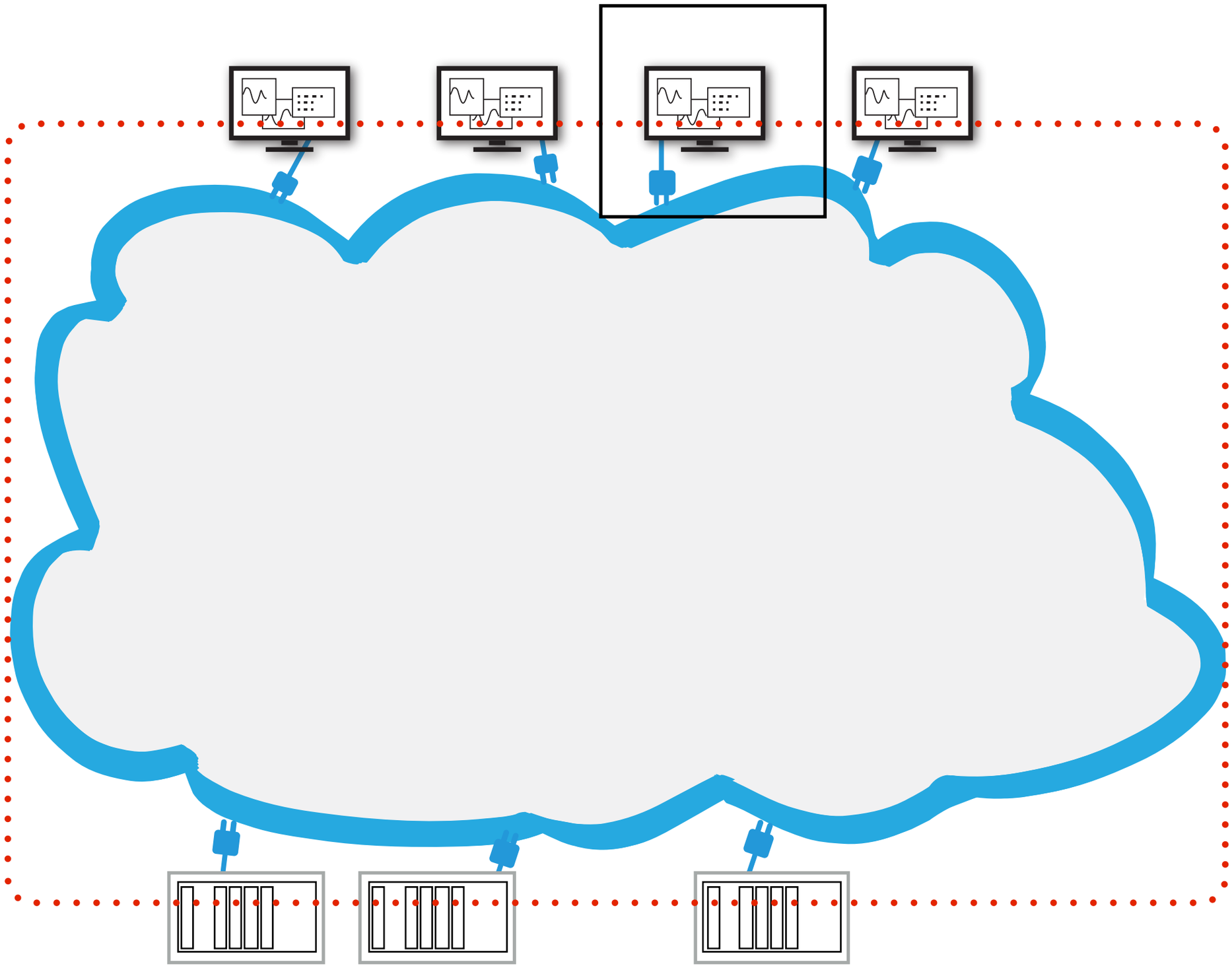
WP3

WP4

WP2
WP3



control room



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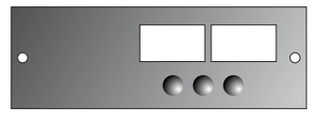
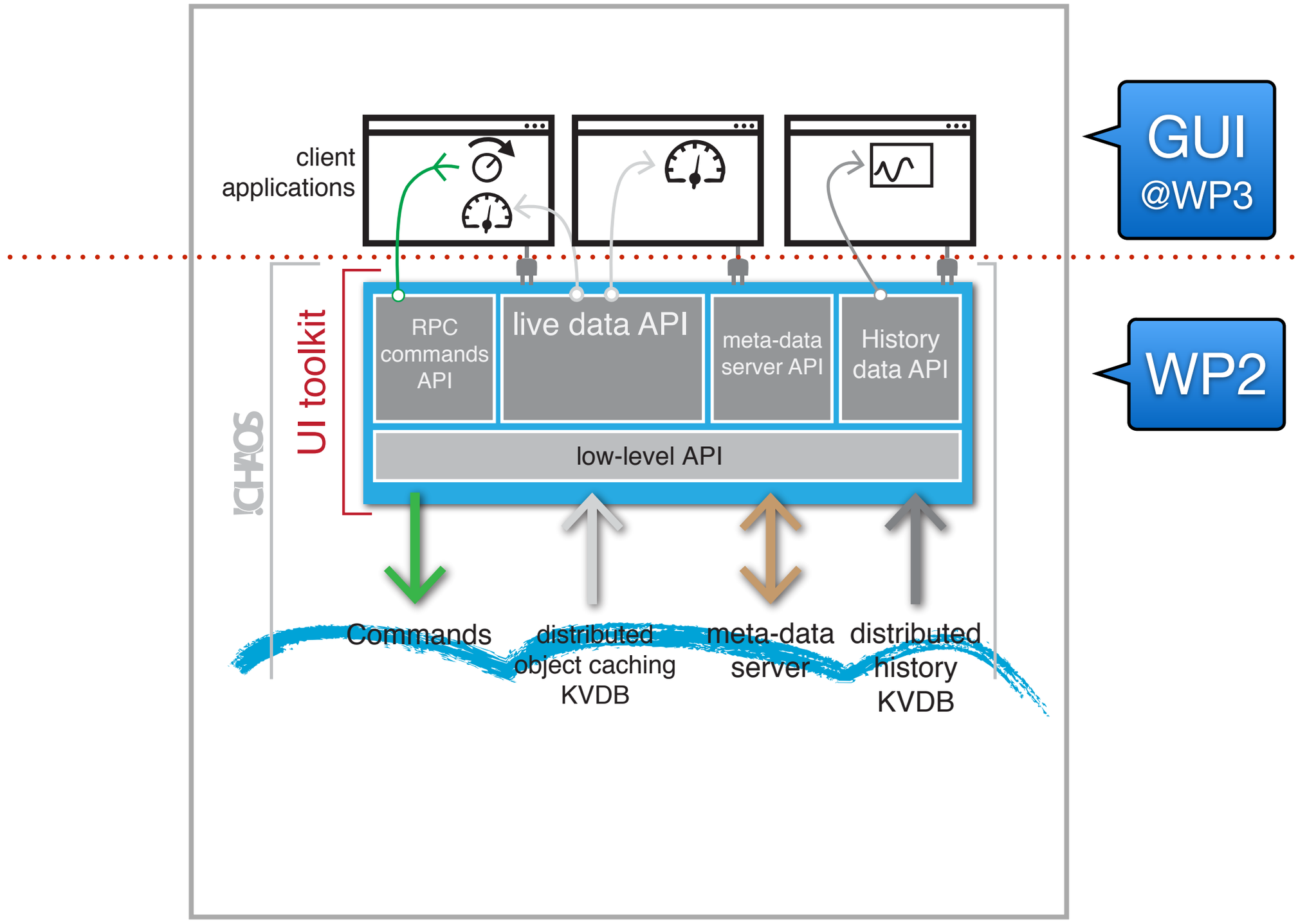


device


client
applications
UI toolkit
RPC
commands
API
live data API
meta-data
server API
History
data API
low-level API
Commands
distributed
object caching
KVDB
meta-data
server
distributed
history
KVDB
GUI
@WP3
WP2

!CHAOS components on DAFNE & SPARC

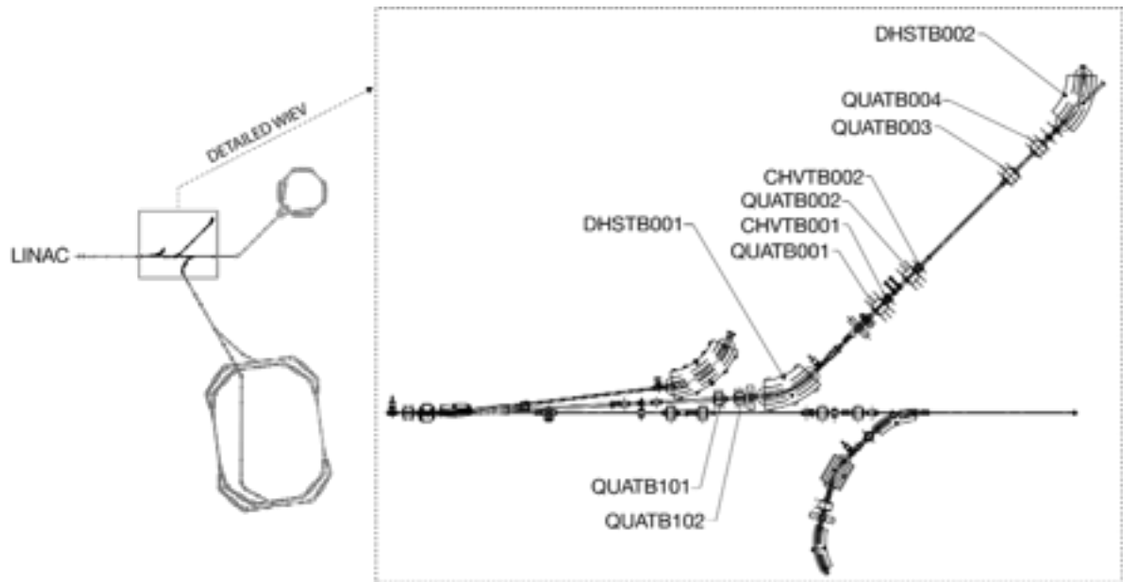
DAFNE

- 80% of the machine devices are on Memcached Give a look…
- !CHAOS compliant drivers: WCM, Magnet PSs (OCEM), odoscope
- bench-test system for PSs (OCEM) using a CU on Beagle Bone board

SPARC

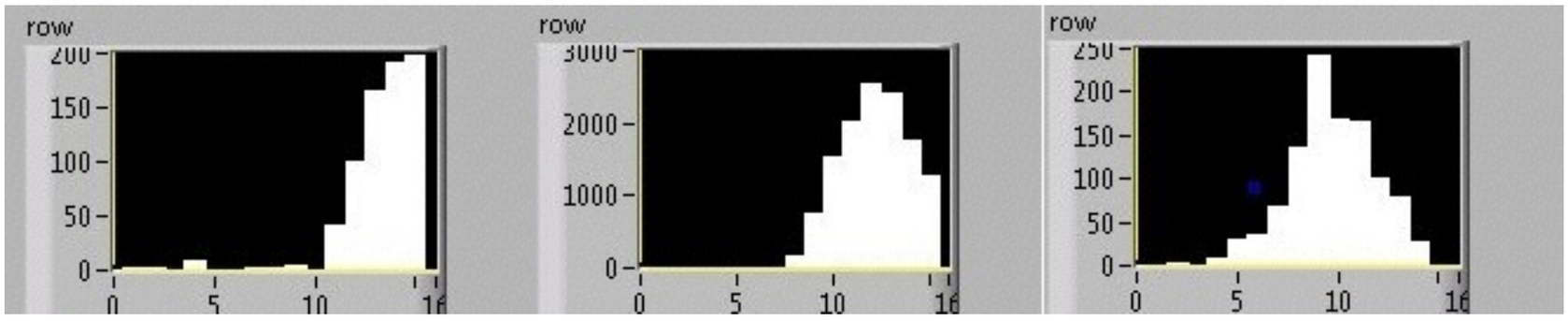
- 100% of the machine devices are on Memcached

!CHAOS first operational experience

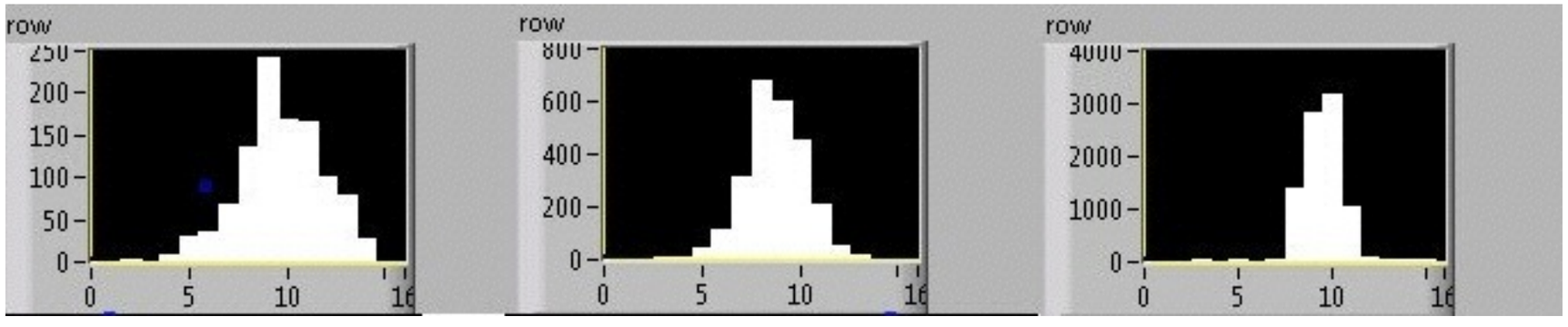


In order to carry out an effective test, we decided to apply the !CHAOS Control System to the Beam Test Facility (BTF) of the Frascati accelerator DAΦNE

447 MeV electron beam detection at the end of the transport on a GEM tacker



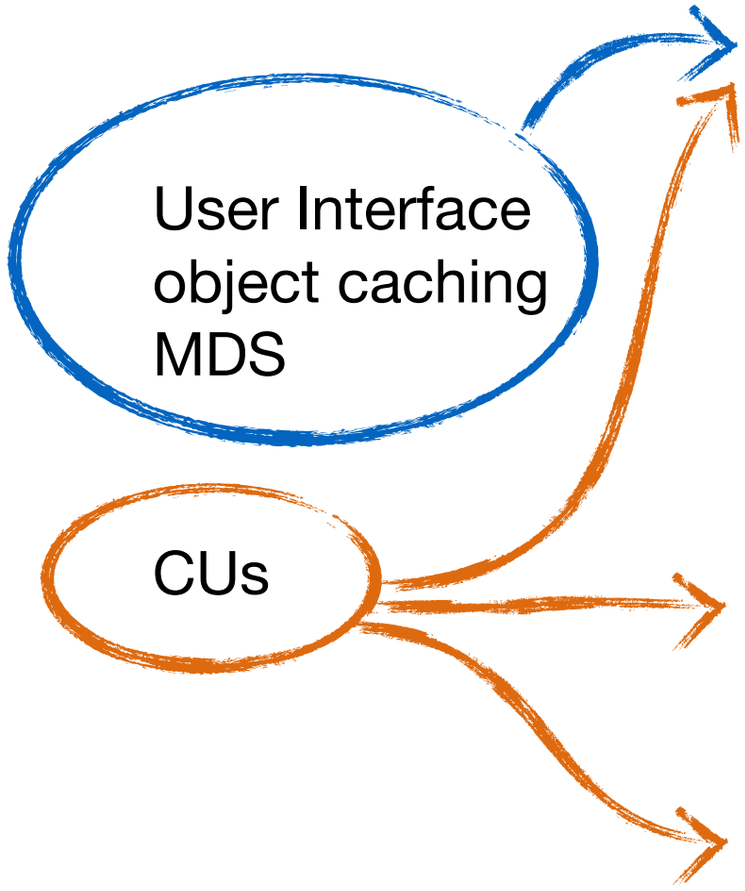
steering optimisation in a step of 2A



horizontal focusing with QUATB004 in a step of 4A

!CHAOS first operational experience

We setup different platforms for running the !CHAOS components:



Virtual machines

The virtualisation environment has been implemented on a system employing Dell® PowerEdge M610 blade servers. The host machines are equipped with 2x Intel Xeon® X5660 @2.80GHz, 48 GB of RAM, 2x Gbps Ethernet and 1 HBA fiber channel 8 Gbps dual port. We installed CentOS 5 64 bit as host Operating System with Red Hat® cluster suite and XEN 3 as virtualisation environment.
One virtual machine (4 cores, 8 GB of RAM) with CentOS 6 64 bit has been set up to run the MDS and the object caching services.
A second virtual machine (4 cores, 4 GB of RAM) with CentOS 6 32 bit has been set up to run the UI and the CUs.

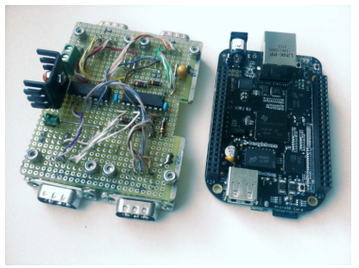
Physical machine

Dell PowerEdge R320 with an Intel Xeon E5-1410 @2.80 GHz and 16 GB of RAM.
The Operating System was Ubuntu 12.04.3 64 bit.

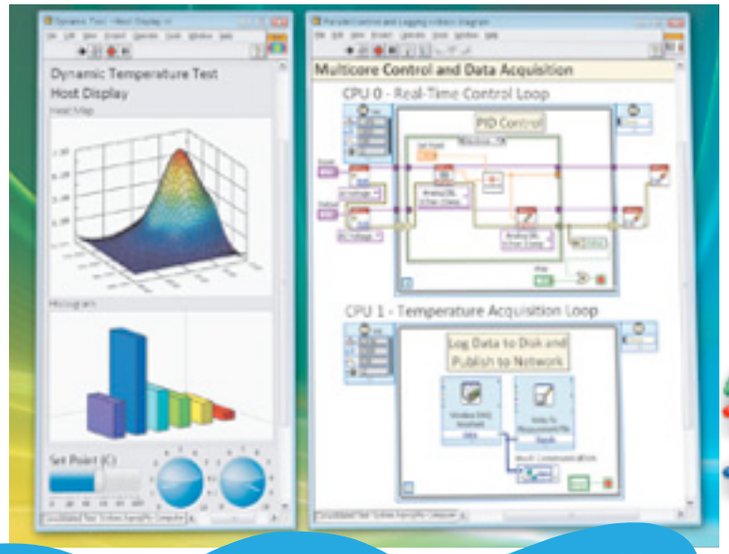
Linux computer ARM board (BeagleBone® Black)

Credit-card-sized Linux computer ARM board (see par. xx). The main characteristics of this small device are:

- AM335x 1GHz ARM Cortex-A8
- 512MB DDR3 RAM
- 2GB 8-bit eMMC on-board flash storage
- NEON floating-point accelerator
- 2x PRU 32-bit microcontrollers
- 3D graphics accelerator



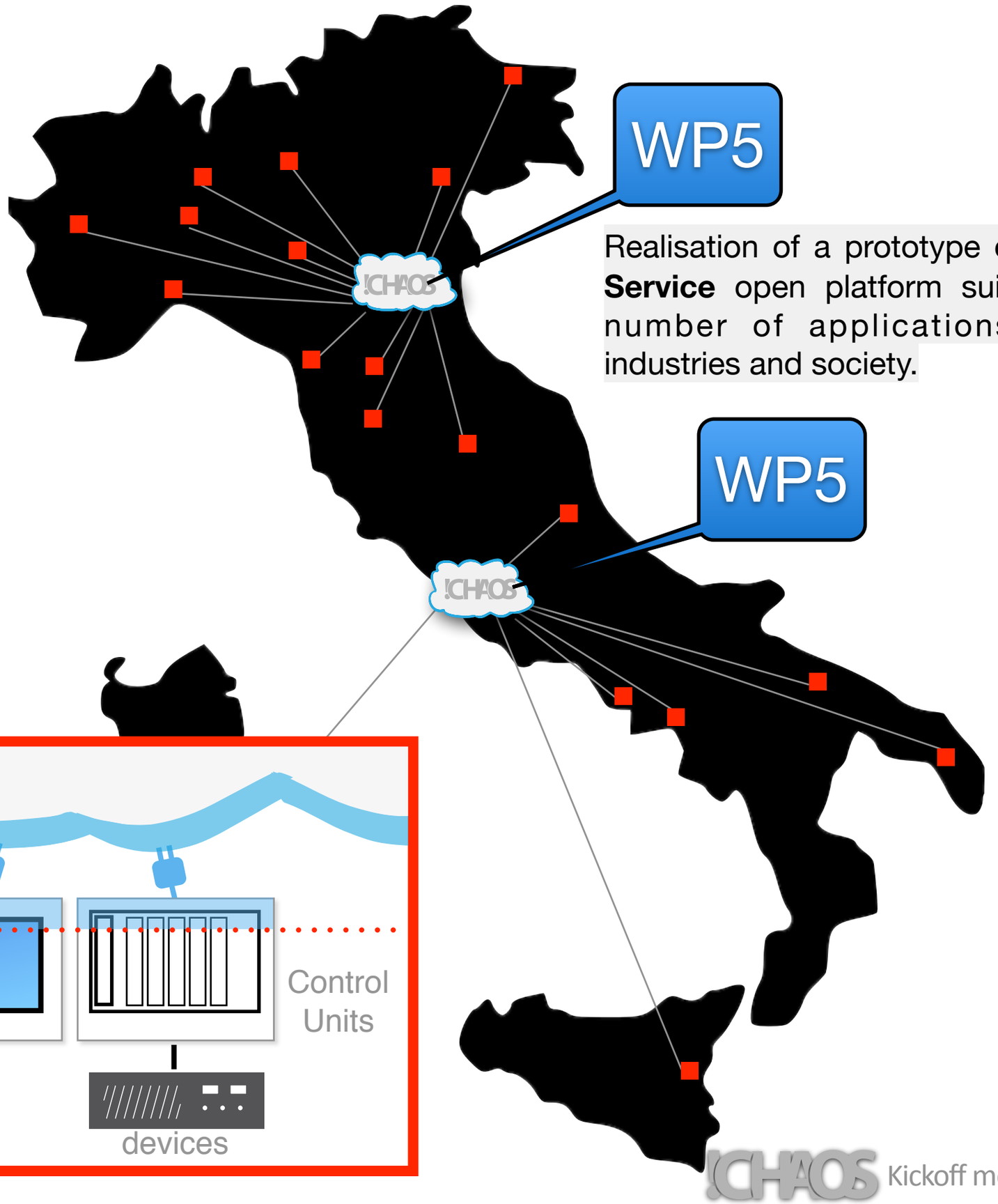
NI LabVIEW® integration in !CHAOS



GUI
@WP3

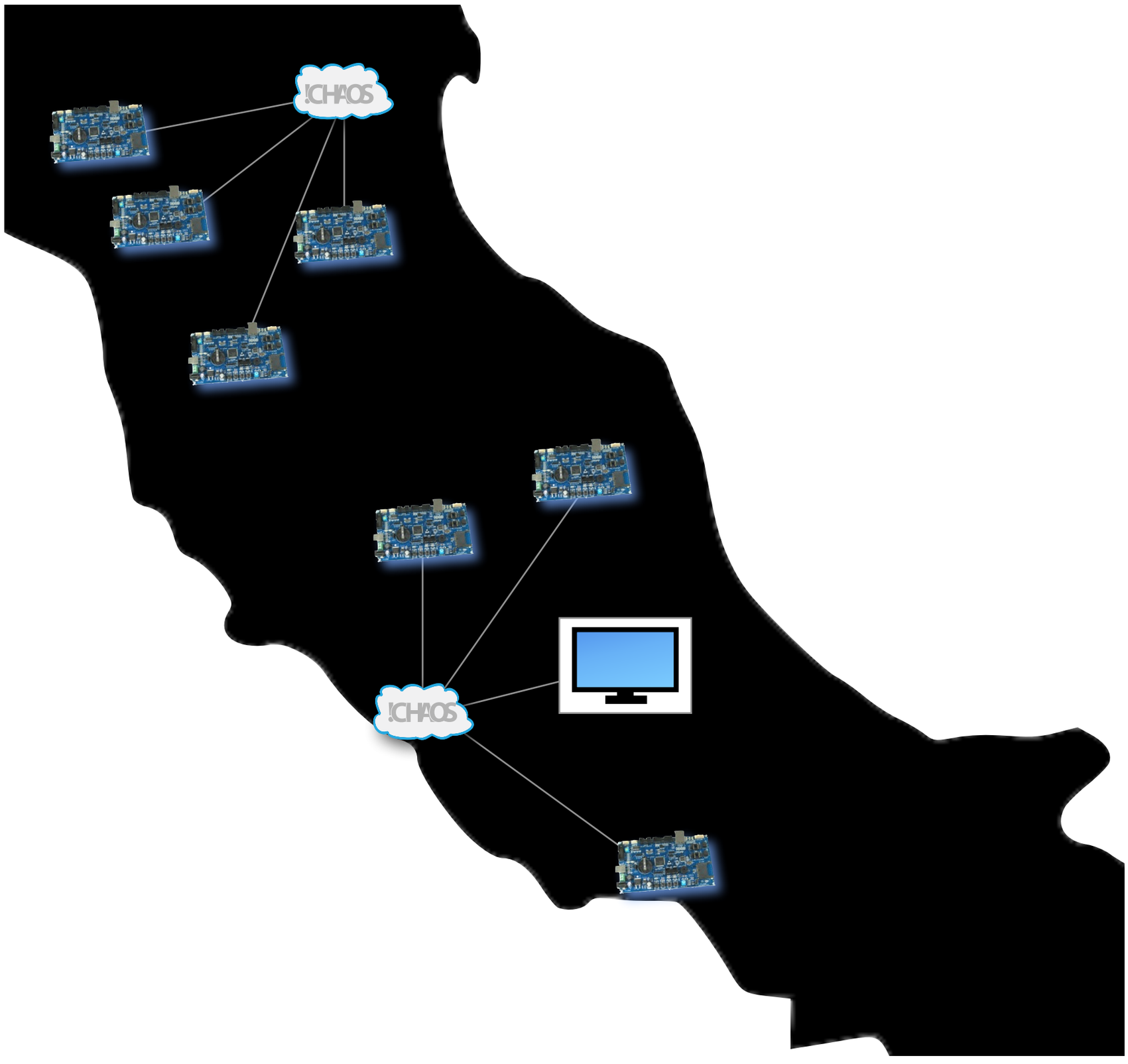
!CHAOS

!CHAOS INFN *"premiale"*



Realisation of a prototype of **Control as a Service** open platform suited for a large number of applications in science, industries and society.

!CHAOS INFN *"premiale"*



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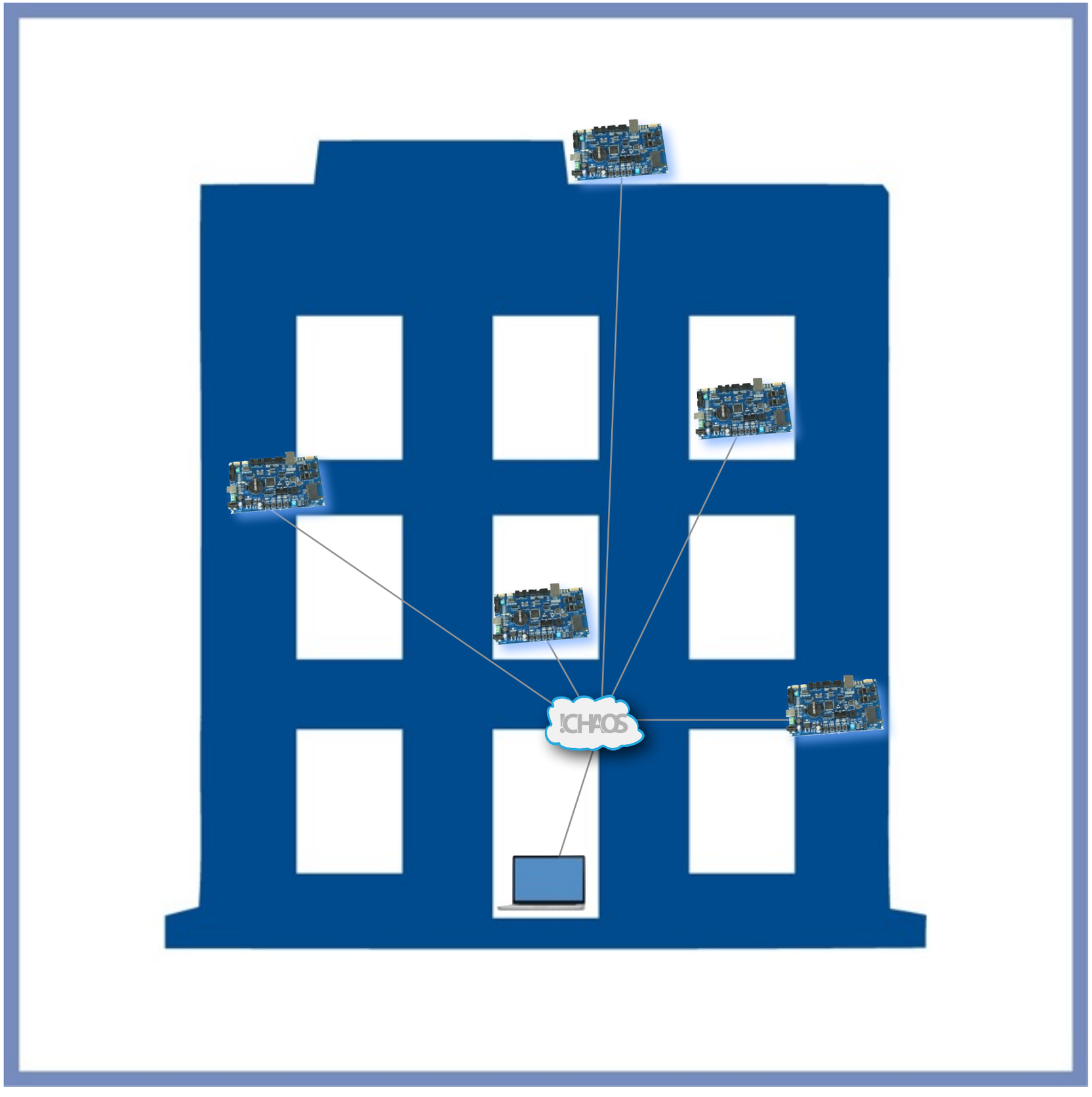

WP3

WP4