

Remote Operations of an Accelerator Using the Grid

Milan Prica

ELETTRA Sincrotrone Trieste

GRIDCC Project: www.gridcc.org

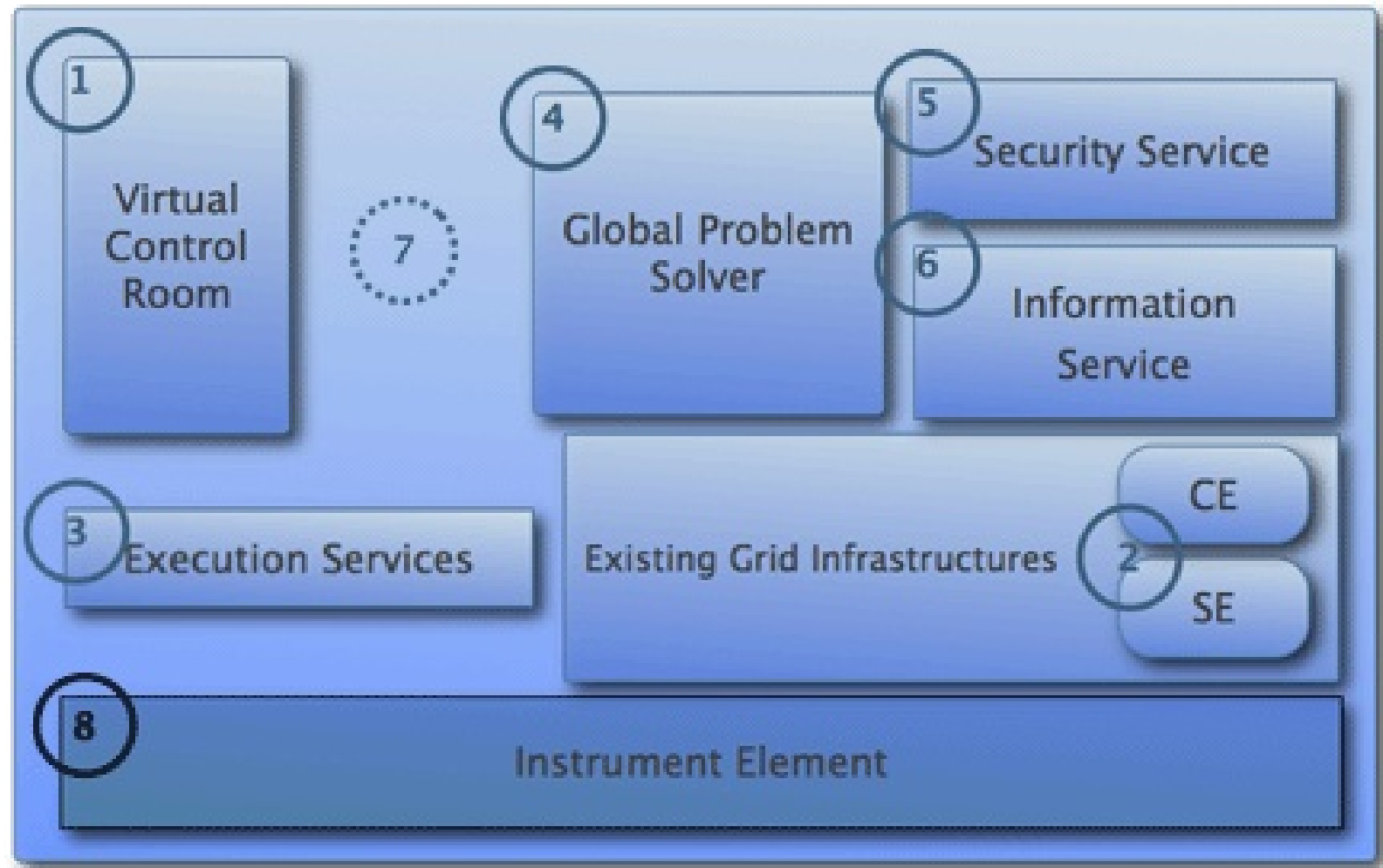
Grid Enabled Remote Instrumentation with Distributed Control and Computation

The goal of the GRIDCC project was to build a **widely distributed system** that is able to **remotely control and monitor complex instrumentation**

Partners:

- INFN – Istituto Nazionale di Fisica Nucleare (Italy)
- IASA – Institute of Accelerating Systems and Applications (Greece)
- Brunel University (UK)
- CNIT – Consorzio Interuniversitario per Telecomunicazioni (Italy)
- ELETTRA Sincrotrone Trieste (Italy)
- IBM – Haifa Research Labs (Israel)
- Imperial College of Science, Technology and Medicine (UK)
- Istituto di Metodologie per l'Analisi Ambientale, CNR (Italy)
- University of Udine, HCI Lab (Italy)
- GRNET Greek Research and Technology Network (Greece)

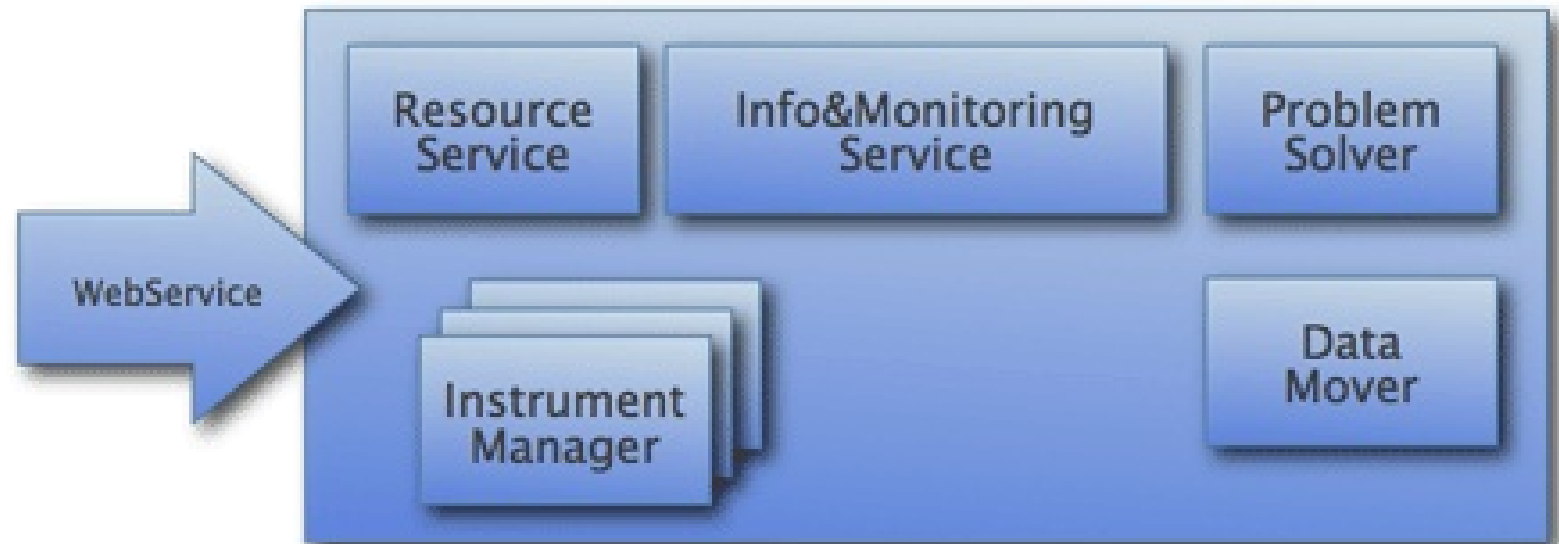
GRIDCC Components



Virtual Control Room

- The VCR provides a web-based collaborative environment where users:
 - **Meet and collaborate** by means of groupware tools (e.g. chat, shared calendar, logbook, video conference tools)
 - **Browse resources** such as people, instruments and other Grid resources (e.g. computing and storage ones)
 - **Transparently operate with remote Grid / non Grid resources**, including the GRIDCC instruments and services

Instrument Element



- **Instrument Element** describes a set of services that provide the needed interface and implementation that enables the remote control and monitoring of physical instruments.
- **Instrument Managers** are the parts of the instrument element that perform the actual communication with the instruments. (Protocol Adapters.)

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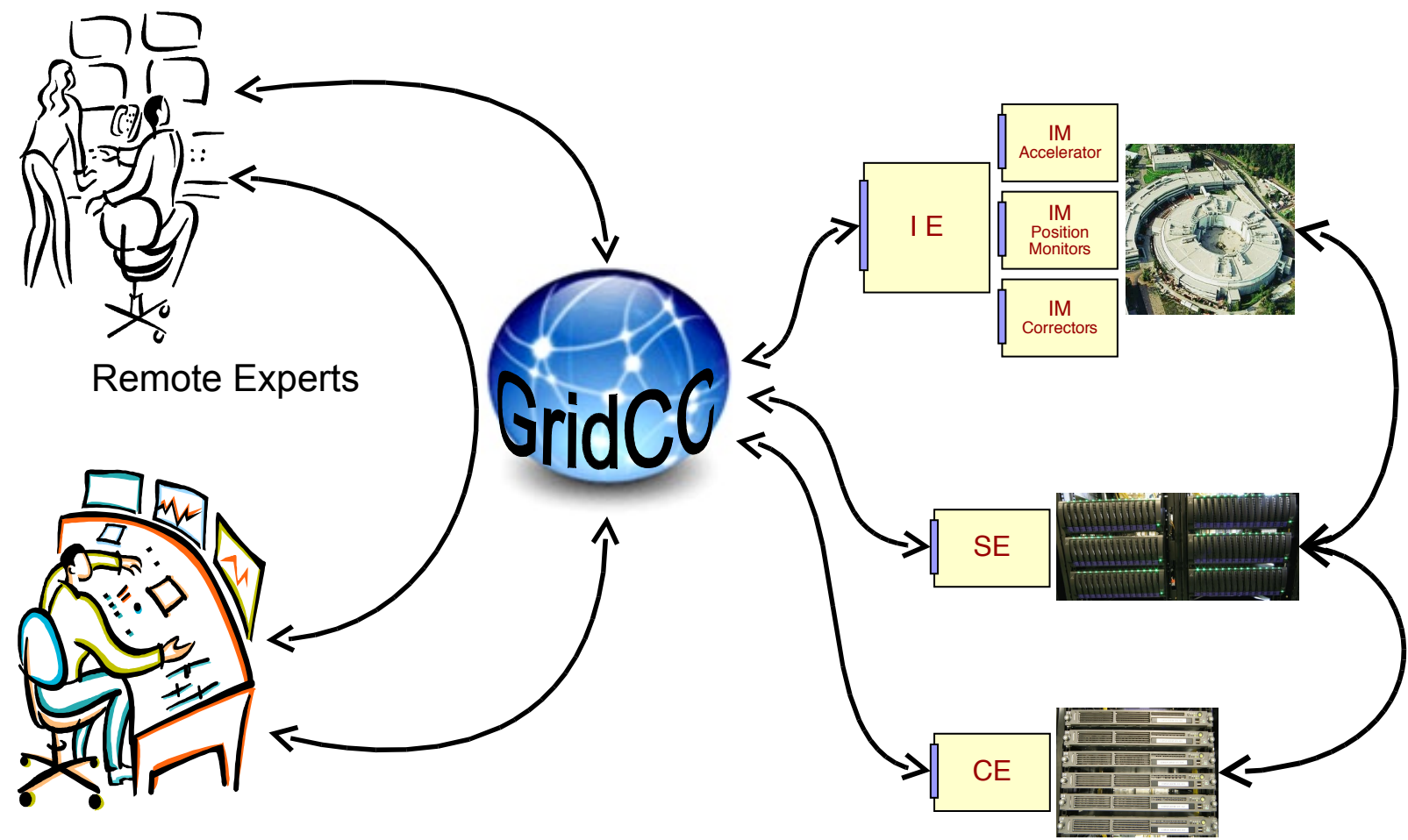
Remote Operations

- Remote operations of an accelerator involve:
 - maintenance and troubleshooting of the accelerator
 - repair of delicate equipment
 - understanding and pushing performance limitations
 - performing commissioning and set ups
 - routine operations
- Grid technologies enable integration with computing farms where complex machine physics models can run.

Remote Operations

- All the High Level Software (HLS) of ELETTRA is suitable to be implemented using the GRIDCC testbed.
- Elettra HLS for Remote Operations consists of
 - workflows like OneBM & OrbitFB
 - a set of data files describing the accelerator from the machine physics point of view, parameters and calibration files
 - utility functions to access the control system and the machine simulator

Remote Operations of Elettra using GridCC



Troubleshooting Scenario

Orbit distortion occurs...

- The Problem Solver rises an alarm, visualized by the VCR Notifier
 - The operator sees the alarm and acknowledges it in the *Alarm Viewer*
- The operator seeks expert advice
 - Starts a Skype session with an expert selected from the *People Browser*
 - Verifies the distortion with the *Position Monitors*
 - Launches the *OrbitFB* workflow and monitors its progress
 - (IE, CE, SE, glite security)
 - Checks the orbit after the correction in the *Instrument* workspace
- The Operator returns to the Alarm Viewer
 - Verifies that the alarm has been turned off.
 - Deletes the entries from the alarms table with the *ACK* button
 - Registers the distortion and its correction events in the *Logbook*

VCR Snapshots – Alarm ON

Welcome demo - Logout Oct 17, 2007 - 14:52:33
Close All

Oct 17, 2007 2:52:33 PM CEST from [plumcake.grid.elettra.trieste.it]:

▲ [PositionMonitors] - On: Medium orbit distortion registered.

Elettra Virtual Control Room
Home MobileVCR ControlRoom Workflows Grid-resources

Personal Workspace
Settings
Credentials

Message Viewer

Alarms
Events

Filter by:

Level: ALL

IE id: IM id:

Description:

Filter Clear filter

Level	I...	I...	Alarm's description	St...	Time	Command
WARN	plu...	Posi...	Medium orbit distortion register...	ON	14:52:33 2007/1	Ack

logbook

Title	Category	Author	Location	Keyword	Last Post
Orbit distortion registered	Warning	Idelcano	Sincrotrone Trieste	Accelerator	Oct 11, 2007 7:14:15 PM
corretta orbita H e V	Fatal	demo	Sincrotrone Trieste	Accelerator	Aug 1, 2007 4:57:20 PM
...	Sincrotrone	...	Aug 1, 2007

October 2007

Su	Mo	Tu	We	Th	Fr	Sa
	1	2	3	4	5	6
7	8	9	10	11	12	13
14	15	16	17	18	19	20
21	22	23	24	25	26	27
28	29	30	31			

From 00:00 **No appointments**
To 24:00 [add]

- Both Private and Workspace Events
- Private Event(s)
- Workspace Event(s)

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Remote Operation using the Grid - ICALEPCS, Oct. 17, 2007

11

sadgw.lnl.infn.it:5353/rcms/
 gladgw.lnl.infn.it:2010/rcms/
 gladgw.lnl.infn.it:8110/rcms/

Tunnel Resources

- <http://plumcake.grid.elettra.trieste.it:8088/rcms/>
- VNC Instrument control panel example

People Browser

Select: [All](#), [None](#), [On-line](#), [Off-line](#)

Organization

- HCI Lab
 - Augusto Senerchia
 - Roberto Ranon
 - Luca De Marco
- ELETTRA
 - Roberto Pugliese
 - Milan Prica
 - demo
 - Laura del Cano

Communicate...

No Transition Selected

COMMANDS

Commands List: Arguments:

MONITORING

Name	Min	Max	Value	Unit	Op.
Horbit	--	--	0.0,0.46092,0.28217,0.7	--	Set...
Vorbit	--	--	0.0,0.0416,0.05083,1.38	--	Set...
num_bpm	--	--	96	--	Set...

[Add Time chart](#), [Add Bar chart](#), [Add Scatter plot](#)

Show/Hide Parameter

Show/Hide Parameter

AVAILABLE WORKFLOWS

[Refresh list](#)

Select a Workflow:

- Full_FeedbackCorrection
- Full_FeedbackCorrection_withCREA...
- Full_FeedbackCorrection_withWMPrc
- Full_OneButtonMachine
- demo
- hello

SUBMITTED WORKFLOWS

Id	File Name	Status	Date Submitted	Operation
<input type="checkbox"/>	1 Full_OneButtonMachine-wfms-withBPR.xml	submitted	Mon Oct 15 16:12:35 CEST 2007	<input type="button" value="Monitor"/>
<input type="checkbox"/>	2 Full_FeedbackCorrection-wfms-withBPR.xml	submitted	Wed Oct 17 14:05:50 CEST 2007	<input type="button" value="Monitor"/>
<input type="checkbox"/>	3 Full_FeedbackCorrection-wfms-withBPR.xml	submitted	Wed Oct 17 14:48:15 CEST 2007	<input type="button" value="Monitor"/>
<input type="checkbox"/>	4 Full_FeedbackCorrection-wfms-withBPR.xml	submitted	Wed Oct 17 14:54:27 CEST 2007	<input type="button" value="Monitor"/>
<input type="checkbox"/>	5 Full_FeedbackCorrection-wfms-withBPR.xml	submitted	Wed Oct 17 14:57:11 CEST 2007	<input type="button" value="Monitor"/>
<input checked="" type="checkbox"/>	6 Full_FeedbackCorrection_withCREAM-wfms-withBPR.xml	submitted	Wed Oct 17 15:07:30 CEST 2007	<input type="button" value="Monitor"/>

BPEL Designer | WSDL | BPEL | Submission Document | Deployment Descriptor | WSDL Catalog | QoS | **Workflow Monitoring**

Inactive

Executing

Finished

Suspended

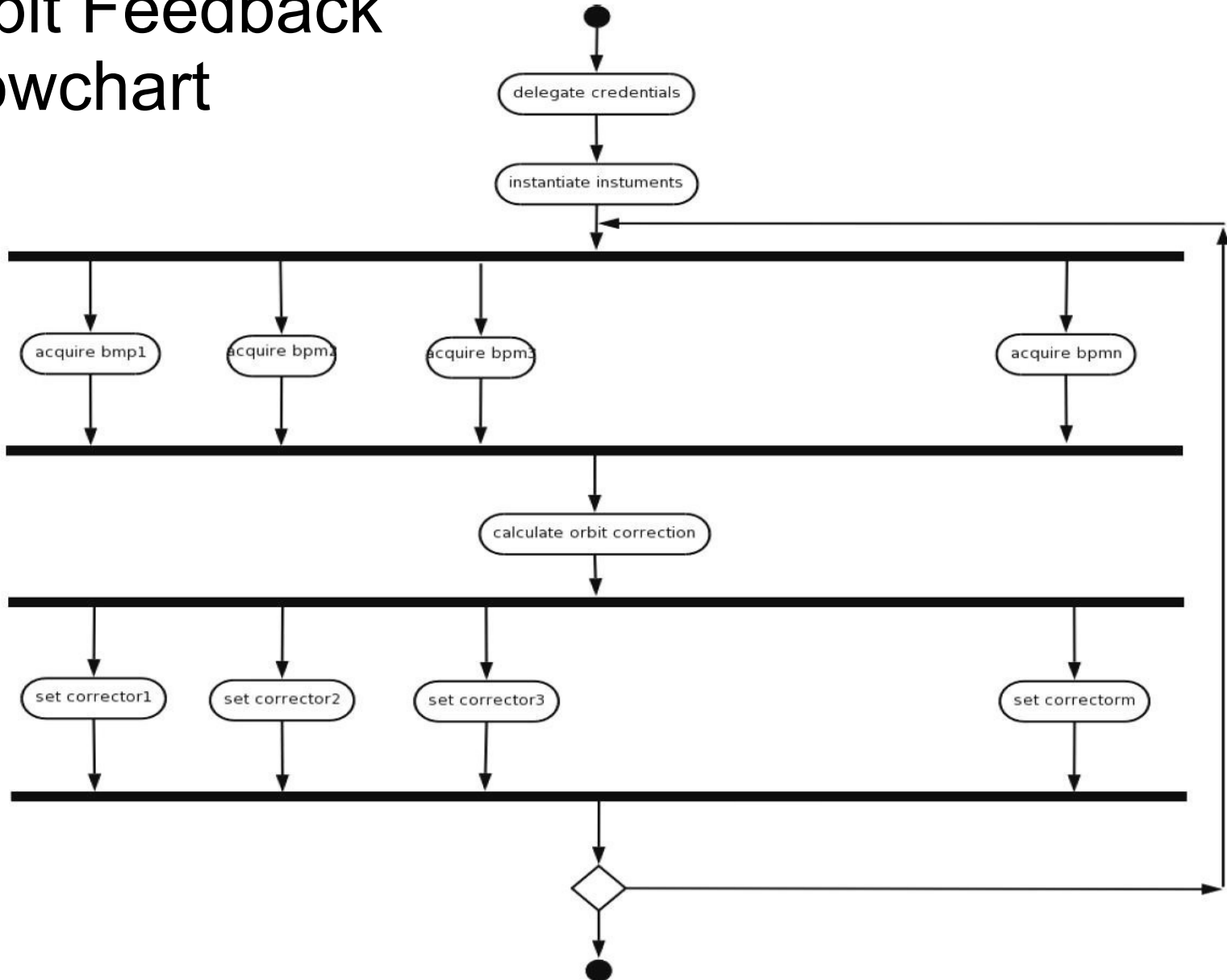
Terminated

Faulted

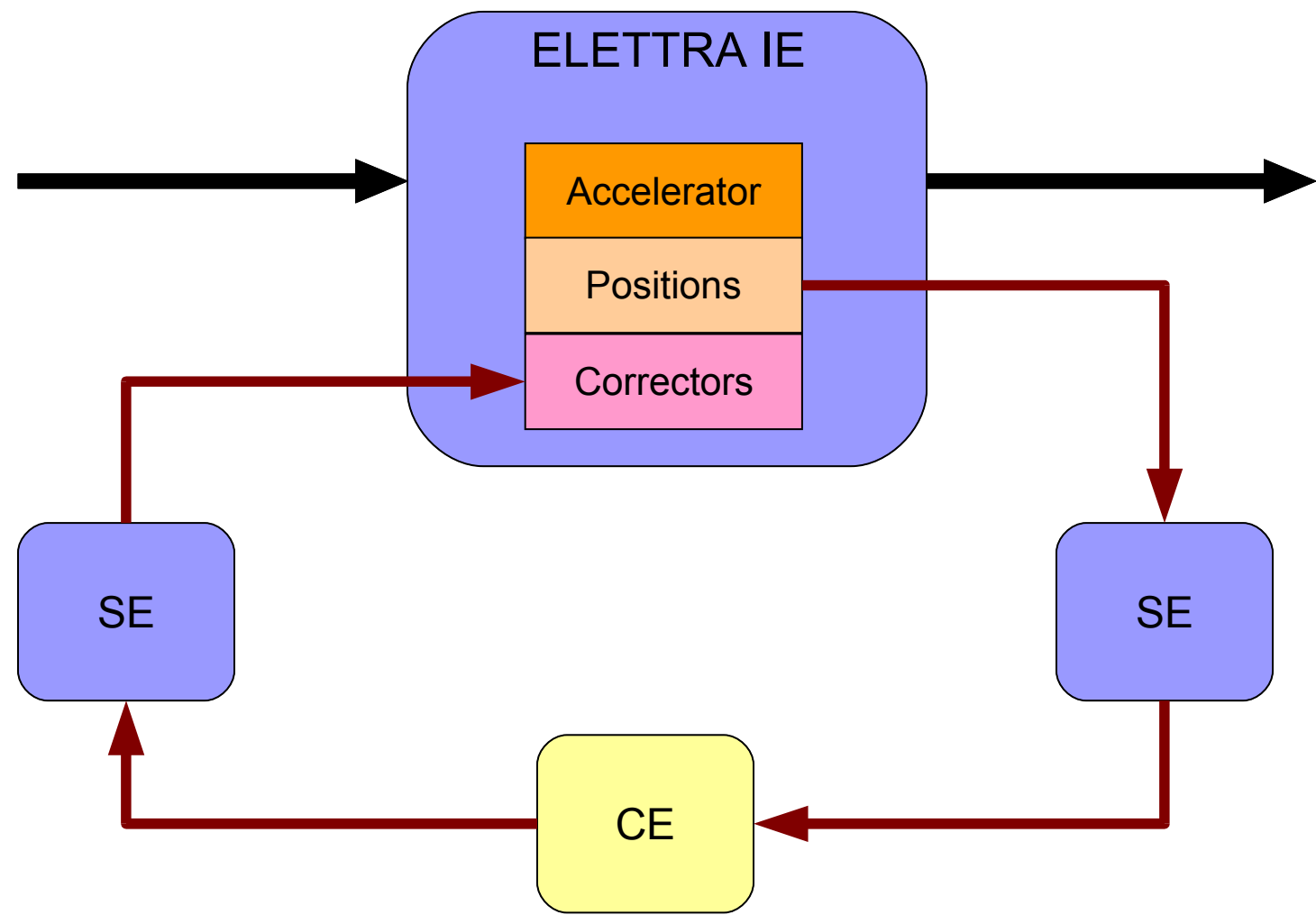
```

graph TD
    Started[Started] --> R1[Report_Submitted_Invoke_monitor]
    R1 --> R2[Report_InitialisationAndSetup_Invoke_monitor]
    R2 --> A1[AS_SE_createAgreement_Invoke_monitor]
    A1 --> R3[Report_SE_ReservationInvoke_monitor]
    R3 --> A2[AS_IE_createAgreement_Invoke_monitor]
            
```

Orbit Feedback Flowchart



Orbit feedback correction via GRID



sadgw.lnl.infn.it:5353/rcms/
 gladgw.lnl.infn.it:2010/rcms/
 gladgw.lnl.infn.it:8110/rcms/

Tunnel Resources

<http://plumcake.grid.elettra.trieste.it:8088/rcms/>
[VNC Instrument control panel example](#)

People Browser

Select: All, None, On-line, Off-line

Organization

- HCI Lab
 - Augusto Senerchia
 - Roberto Ranon
 - Luca De Marco
- ELETTRA
 - Roberto Pugliese
 - Milan Prica
 - demo
 - Laura del Cano

Communicate... Show User Details

No Transition Selected Close All

COMMANDS

Commands List: Arguments: No Command

Oct 17, 2007 5:23:23 PM CEST from [plumcake.grid.elettra.trieste.it]:

⚠ [PositionMonitors] - Off: Medium orbit distortion registered.

MONITORING

Name	Min	Max	Value	Unit	Op.
Horbit	--	--	-0.4089175983078594,0	--	Set...
Vorbit	--	--	0.3520213566671733,-0	--	Set...
num_bpm	--	--	96	--	Set...

[Add Time chart](#), [Add Bar chart](#), [Add Scatter plot](#)

Show/Hide Parameter

Horbit

Show/Hide Parameter

Vorbit

VCR Snapshots – Alarm OFF

Welcome demo - Logout
Oct 17, 2007 - 14:54 CEST
Close All

Oct 17, 2007 2:54:29 PM CEST from [plumcake.grid.elettra.trieste.it]:
▲ [PositionMonitors] - Off: Medium orbit distortion registered.

Message Viewer

Alarms Events

Filter by:

Level: ALL

IE id: IM id:

Description:

Level	I...	I...	Alarm's description	St...	Time	Command
WARN	plu	Pos	Medium orbit distortion register	ON	14.52.33 2007/1	Ack
WARN	plu	Pos	Medium orbit distortion register	OFF	14.54.27 2007/1	Ack

October 2007

Su	Mo	Tu	We	Th	Fr	Sa
	1	2	3	4	5	6
7	8	9	10	11	12	13
14	15	16	17	18	19	20
21	22	23	24	25	26	27
28	29	30	31			

Timetable: (2007-10-17)

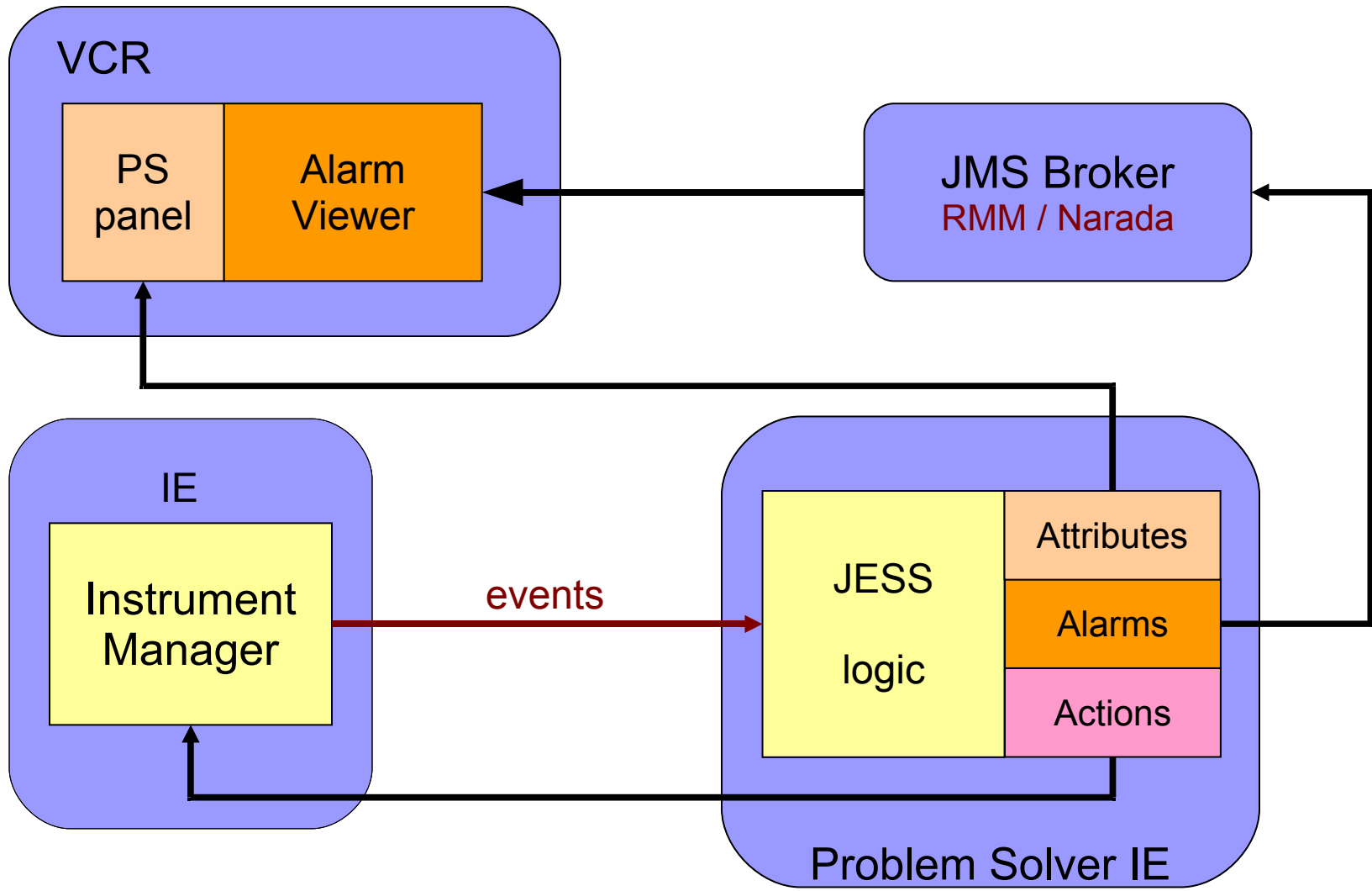
- Both Private and Workspace Events
- Private Event(s)
- Workspace Event(s)

From 00:00 **No appointments**
 To 24:00 [\[add\]](#)

logbook

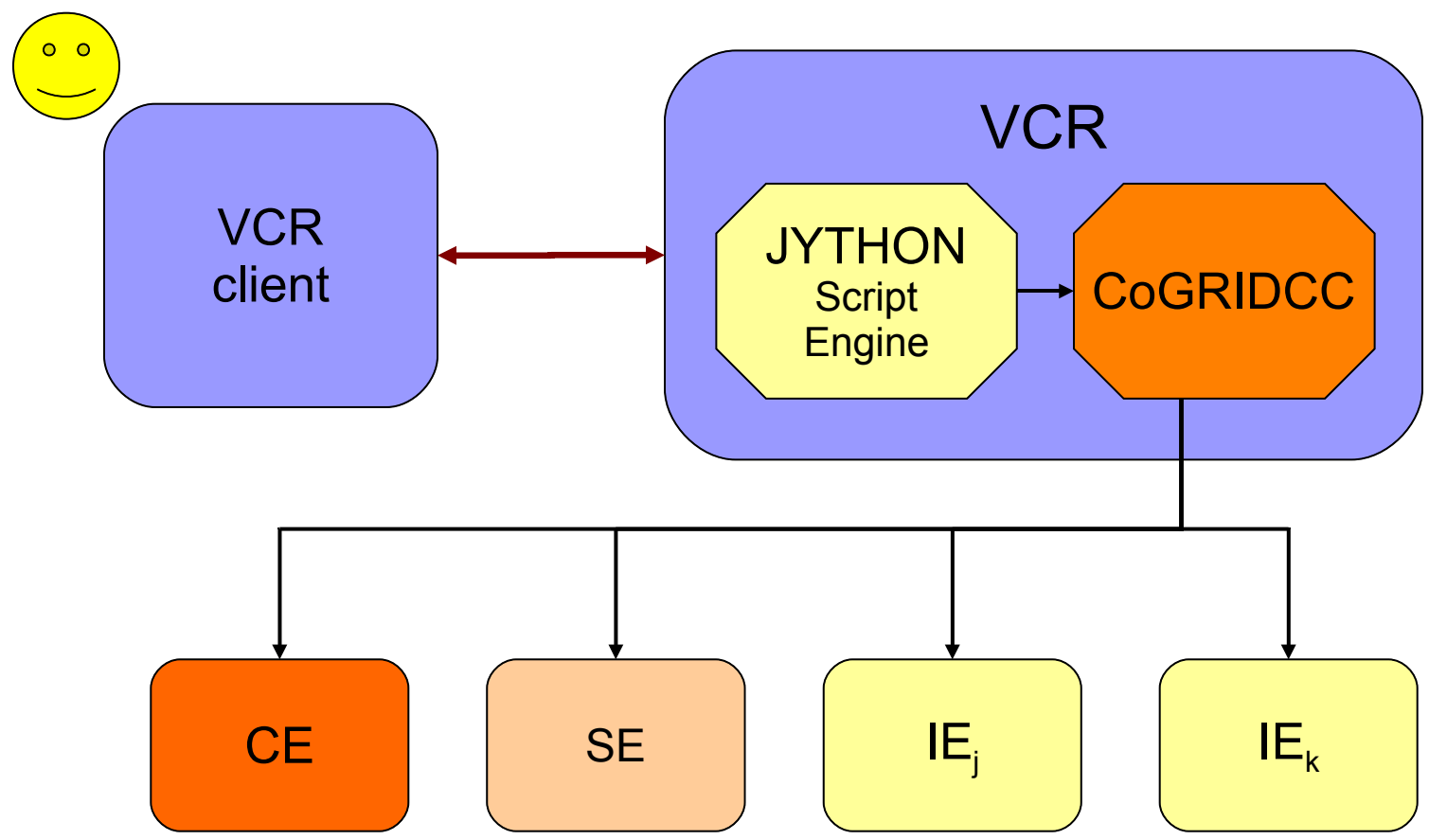
Title	Category	Author	Location	Keyword	Last Post
Orbit distortion registered	Warning	Idelcano	Sincrotrone Trieste	Accelerator	Oct 11, 2007 7:14:15 PM
corretta orbita H e V	Fatal	demo	Sincrotrone Trieste	Accelerator	Aug 1, 2007 4:57:20 PM
			Sincrotrone		Aug 1, 2007

Event handling with the Problem Solver



VCR CoGRIDCC

Alternative approach: Integrated scripting environment offers a simple tool for building workflows



VCR Script Manager – OneBM workflow

Elettra Virtual Control Room
Home
mceinstruments
ControlRoom
Workflows
Grid-resources

Workflow Manager
Workflow Submission
Script Manager

Script Manager

AVAILABLE SCRIPTS

[Refresh list](#), [New Script](#),
[Upload/Download Scripts](#)

Select a Script:

onebuttonmachine.py
outputScript.txt
errorScript.txt

Edit
Delete

SCRIPT EDITOR

Script Name:
onebuttonmachine.py

Script Body:

```

* Import resources
from org.gridcc.mce.mceinstruments.services.ie import InstrumentElement, InstrumentElementFactory
from org.gridcc.mce.mceinstruments.services.is import *
from java.util import *
* Get a resource
resource = ResourceItem("http://plumcake.grid.elettra.trieste.it:8088/rcms/services/IEService", Resource.IE, "", "Resource
Description", Resource.NONE)
# Connect to an Instrument Element and open a session
instrumentElement = InstrumentElementFactory.getInstance(resource)
print instrumentElement
session = instrumentElement.openSession("demo")
# Get an Instrument Manager
if instrumentElement is not None:
    if
instrumentElement.getIM("http://localhost:8088/urn:rcms-fm:fullpath=/rcms/Elettra/Accelerator,group=Elettra,owner=rcms") is
not None:
        instrumentManager =
instrumentElement.getIM("http://localhost:8088/urn:rcms-fm:fullpath=/rcms/Elettra/Accelerator,group=Elettra,owner=rcms")
        print instrumentManager.getDescription()
        for cmd in instrumentManager.getCommands():
            if cmd.getName() == "StopMachine":

```

Save
Run

Script Output:

```

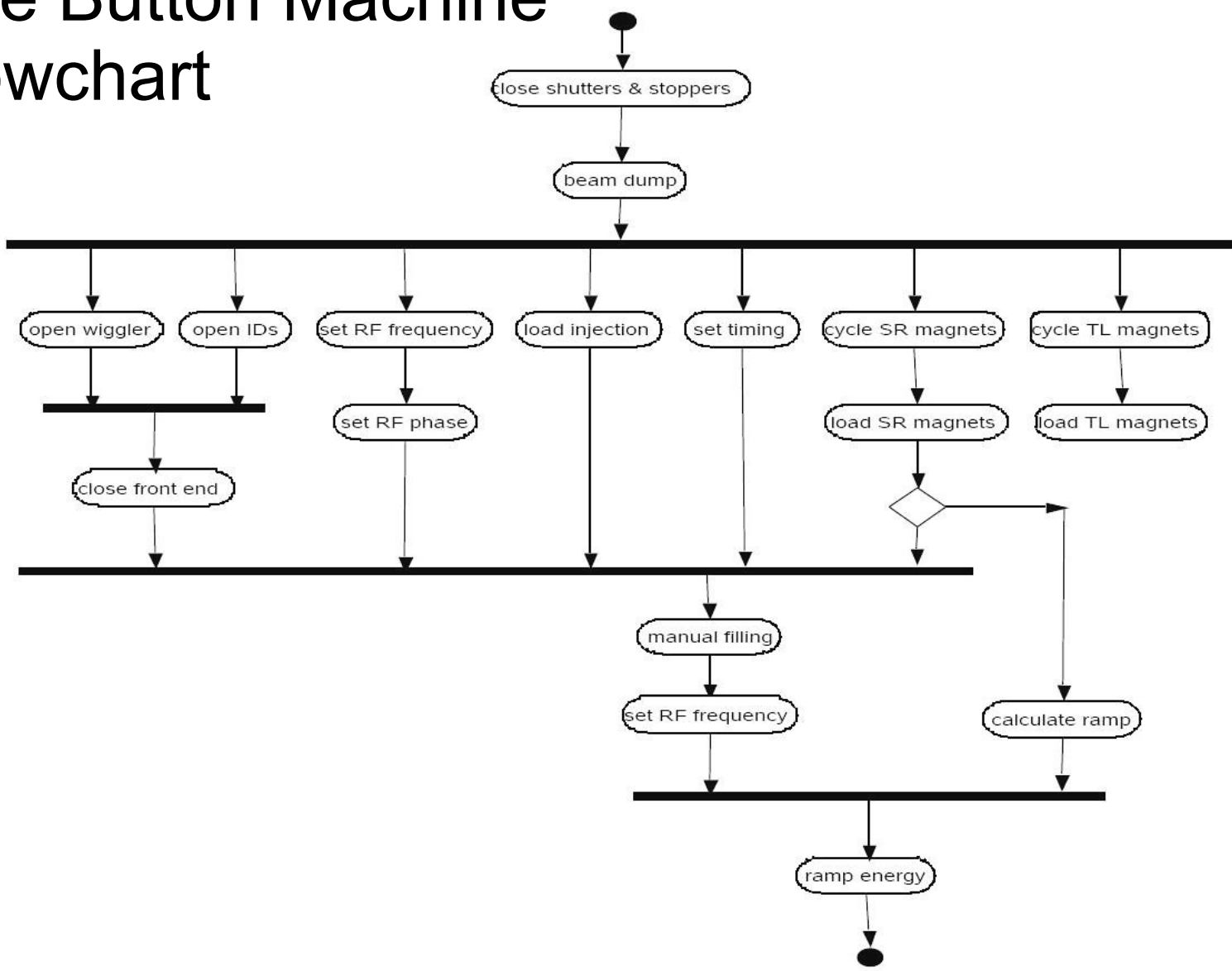
org.gridcc.mce.mceinstruments.services.ie.InstrumentElementItem@112fe6

current value is 50.0 mA
current value is 100.0 mA
current value is 150.0 mA
current value is 200.0 mA
Machine Status
current value is 200.0 mA
lifetime value is 86400.0 h
OneButtonMachine Script Done

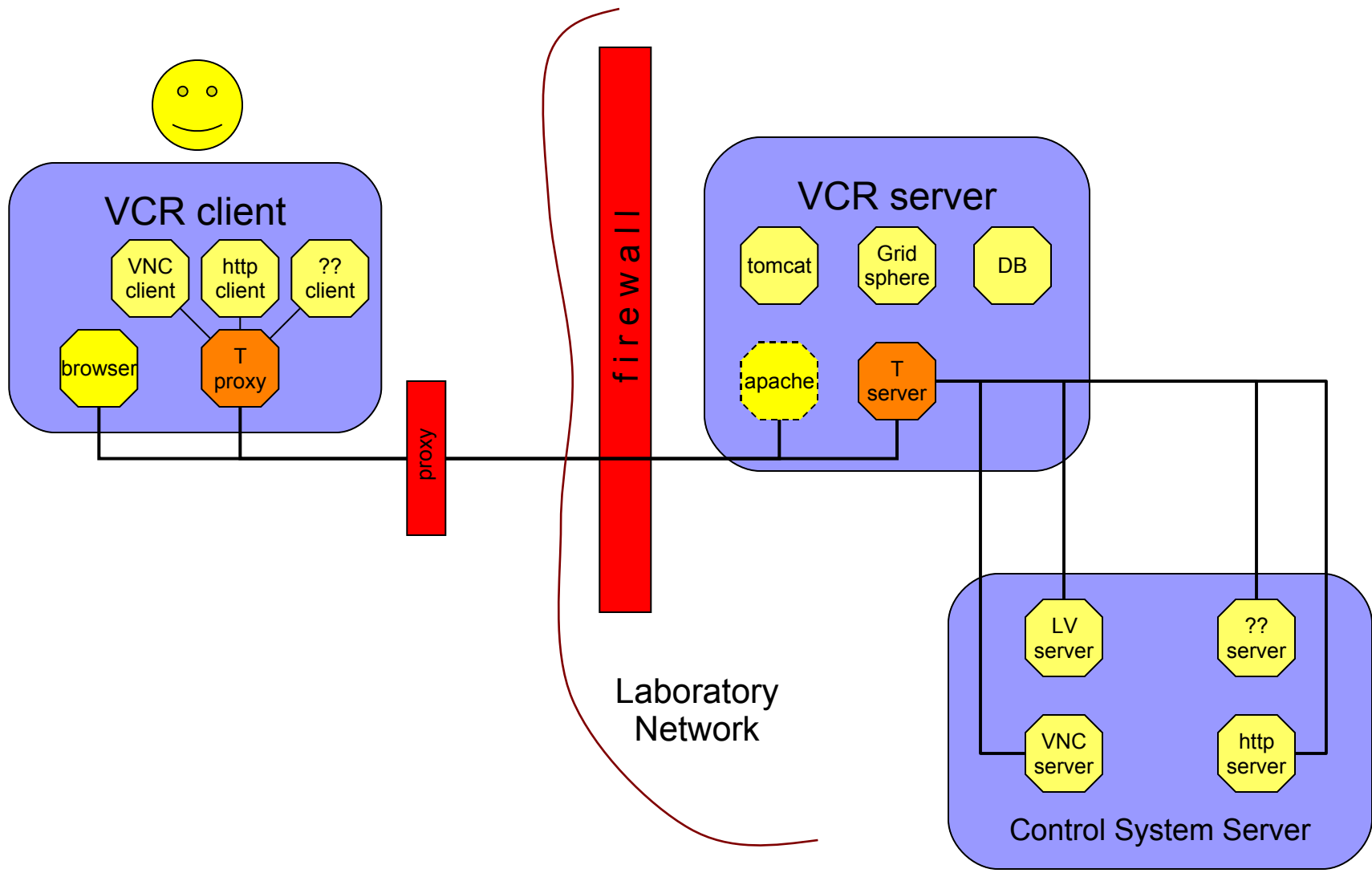
```

Clear

One Button Machine Flowchart



Remote Desktop (tunneling)



Disconnect Options Clipboard Record Send Ctrl-Alt-Del Refresh

VNC config



eletra/orbit/1/Inject_current

Input 50

Help Apply Cancel Close

AtkPanel : elettra/orbit/1

File View Preferences Help

nada Inject_current

nada

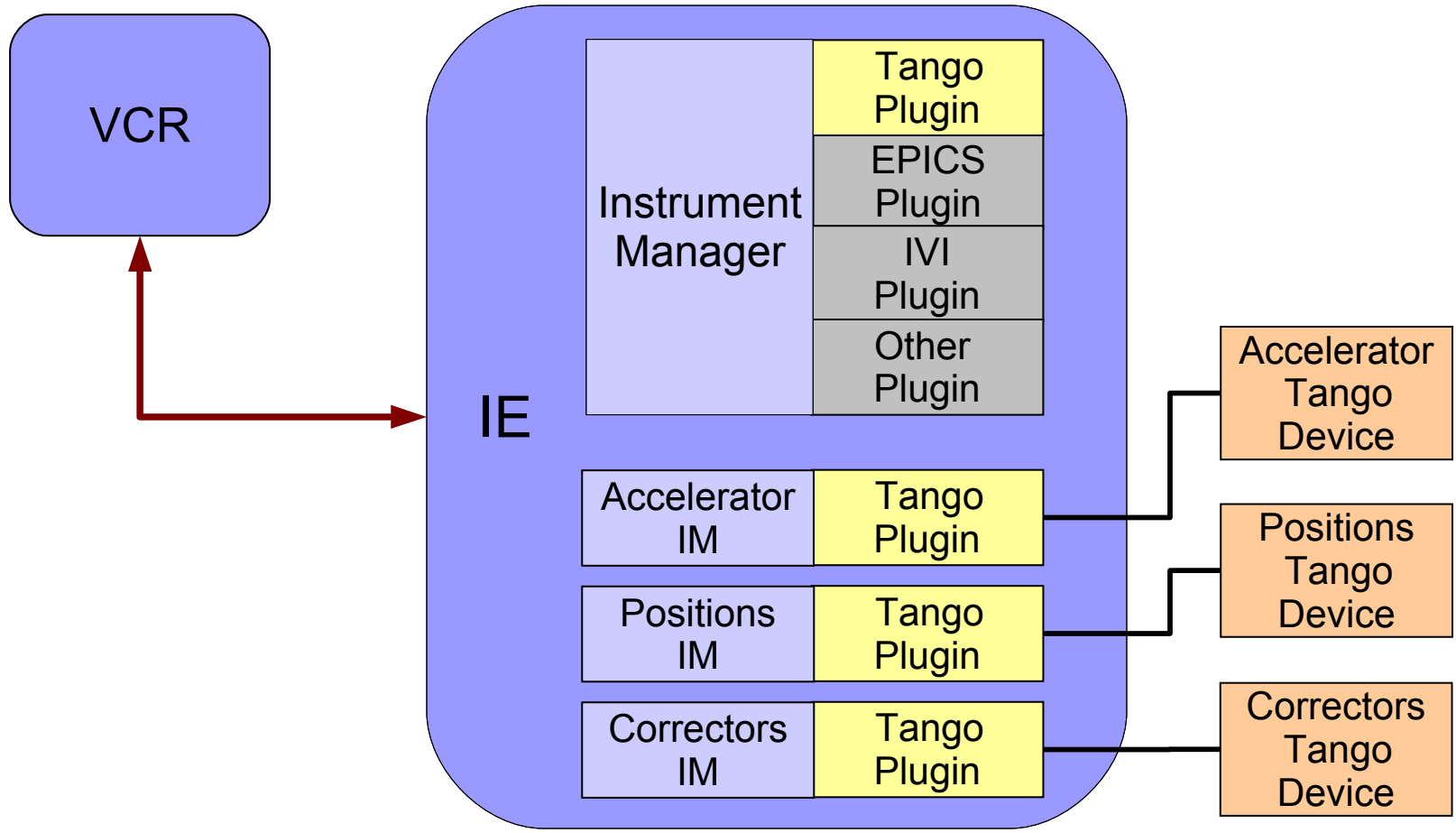
The device is in ON state.

current	196.028 mA	...
Num_bpm	96.00 No unit	...
Num_correctors	82.00 No unit	...
Lifetime	86400.00 No unit	6400.00

Scalar Horbit Vorbit Hcorrector Vcorrector

AbsoluteVcorrector AbsoluteHcorrector

Control Systems Plugins: Tango Plugin



Deployment in the ELETTRA Control Room

Grid Enabled Remote Instrumentation with Distributed Control and Computation



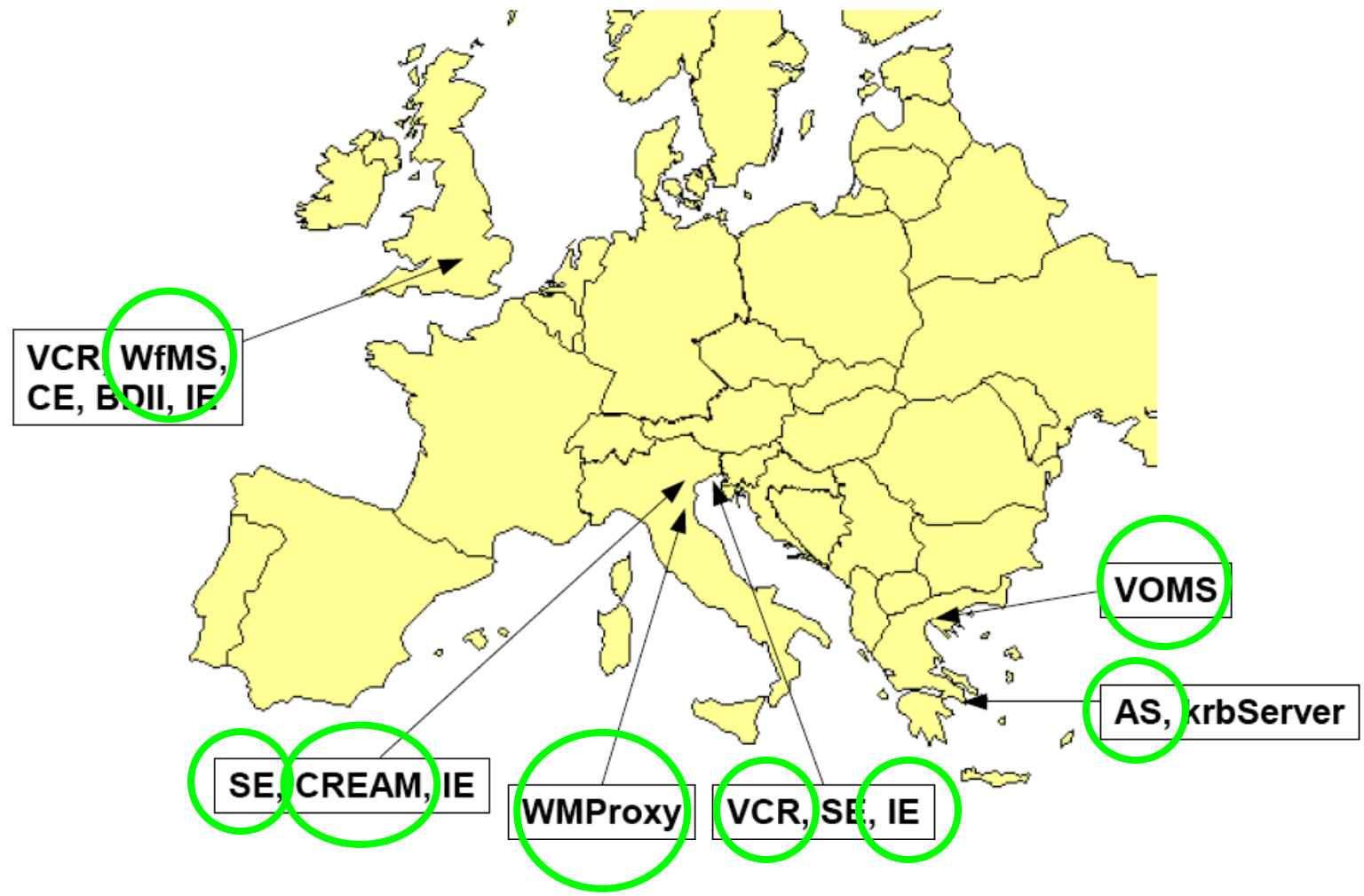
DEFENSE DE FUMER
RAUCHEN VERBOTEN

01.001	0000	0000
01.002	0000	0000
01.003	0000	0000
01.004	0000	0000
01.005	0000	0000
01.006	0000	0000
01.007	0000	0000
01.008	0000	0000
01.009	0000	0000
01.010	0000	0000
01.011	0000	0000
01.012	0000	0000
01.013	0000	0000
01.014	0000	0000
01.015	0000	0000
01.016	0000	0000
01.017	0000	0000
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01.019	0000	0000
01.020	0000	0000
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01.022	0000	0000
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01.026	0000	0000
01.027	0000	0000
01.028	0000	0000
01.029	0000	0000
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01.031	0000	0000
01.032	0000	0000
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01.034	0000	0000
01.035	0000	0000
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01.038	0000	0000
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01.040	0000	0000
01.041	0000	0000
01.042	0000	0000
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01.045	0000	0000
01.046	0000	0000
01.047	0000	0000
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01.049	0000	0000
01.050	0000	0000
01.051	0000	0000
01.052	0000	0000
01.053	0000	0000
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01.067	0000	0000
01.068	0000	0000
01.069	0000	0000
01.070	0000	0000
01.071	0000	0000
01.072	0000	0000
01.073	0000	0000
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01.076	0000	0000
01.077	0000	0000
01.078	0000	0000
01.079	0000	0000
01.080	0000	0000
01.081	0000	0000
01.082	0000	0000
01.083	0000	0000
01.084	0000	0000
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01.086	0000	0000
01.087	0000	0000
01.088	0000	0000
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01.090	0000	0000
01.091	0000	0000
01.092	0000	0000
01.093	0000	0000
01.094	0000	0000
01.095	0000	0000
01.096	0000	0000
01.097	0000	0000
01.098	0000	0000
01.099	0000	0000
01.100	0000	0000

Conclusions

- GRIDCC testbed pilot application
- The demo shows the capabilities of the GRIDCC middleware in accessing and controlling of distributed instrumentation in a large experimental physics facility.
- Grid technologies can be used to integrate operations with computing farms where complex machine physics models can run.
- The VCR provides a set of tools that allows for collaborative efforts in coping both with everyday tasks and exceptional events.
- Shows the use of VCR, IE, WfMS, PS, AS, VOMS (+ CE, SE)

GRIDCC Testbed used in the Demo



Thank you kindly for your attention!

Questions?