

# LHCB ONLINE INFRASTRUCTURE MONITORING TOOLS

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# Motivation

- ▶ Large nature of the experiment:
  - Large number of PCs:
    - 1747 PCs (55 Windows, 1692 Linux)
    - 34 Virtual Machines
  - Different system architectures
- ▶ Need to monitor and maintain infrastructure operation parameters reliably
- ▶ Central tool to globally monitor the infrastructure

# Layered approach

- ▶ Heterogeneous nature of the computer infrastructure required a layered approach to monitor different sets of parameters:
  - Hardware Layer – The hardware infrastructure
  - Operating System Layer – The software infrastructure/environment
  - PVSS Infrastructure – The supervisory control software running the experiment
  - Application Layer – Specific software needed for system control and operation

# System Overview set of tools

- ▶ To monitor the parameters for the different monitoring layers a set of tools was developed:
  - Monitoring and Control Servers (FMC Tools):
    - Gather and publish computer parameters
    - Publish data based on DIM (Distributed Information Management)
    - Operating system dependent (Linux/Windows)
  - Graphical User Interface and “aggregation” Tools
    - Provide a centralized interface

# Monitoring and Control Servers

- ▶ OS dependent:
  - Slightly different approach according to the OS (Linux/Windows)
  - Linux:
    - Collaboration with Università di Bologna
    - Each of the monitoring servers must be running on the node to be monitored which publish the node data
  - Windows:
    - A server on a central PC connects to the windows nodes, gathers the data and publishes the data for all of the nodes

# Monitoring and Control Servers

## ▶ Hardware Layer:

- OS independent monitoring/control:
  - IPMI Server – gathers and controls PCs power status via the IPMI (Intelligent Platform Management Interface) interface
  - Virtual Machine Server – gathers and controls Virtual Machines power status
- OS dependent:
  - Memory Server – monitors memory usage
  - CPU Info Server – gathers CPU information
  - CPU Stat Server – gathers CPU usage
  - File System Server – gathers FS usage
  - Network Interface Server – monitors network traffic statistics

# Monitoring and Control Servers

- ▶ Operating System Layer:
  - OS server – gathers operating system and kernel information
- ▶ PVSS Infrastructure Layer:
  - PVSS pmon process – A process monitor agent linked to each PVSS Project that runs independently from it. This agent monitors and publishes the state of PVSS processes. It can also act on these processes (start/stop/reset)
- ▶ Application Layer:
  - Process Monitor Server – gathers info on the running processes on each PC
  - Task Manager Server – gathers the data for the running processes on each node and is also able to start processes on these nodes.

Note: For the Windows systems central starting/stopping of processes is not “yet” implemented

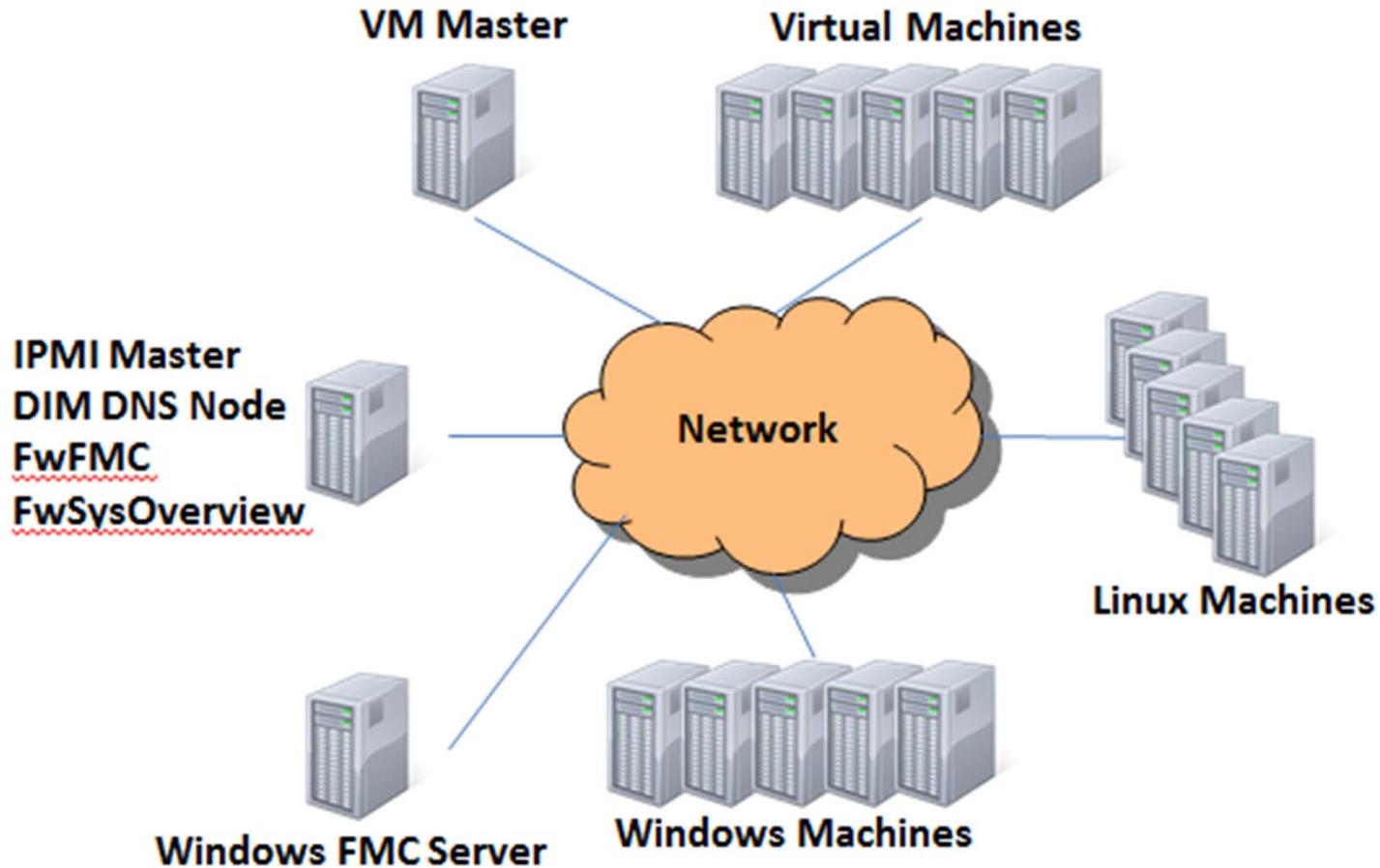
# GUI and “aggregation” tools

- ▶ Based on PVSS SCADA system and DIM
- ▶ Developed within the JCOP (Joint Controls Project) framework group at CERN
- ▶ FwFMC – Subscribes to the DIM services and commands published by the FMC Servers and provides a GUI for easy interaction and monitoring
- ▶ FwSystemOverview – Reutilizes the data subscribed from FwFMC and presents it in synoptic panels
  - Adds PVSS Project monitoring and control capabilities
  - Adds grouping capabilities
- ▶ PVSS provides easy data archiving and alarm handling capabilities

# LHCb Architecture

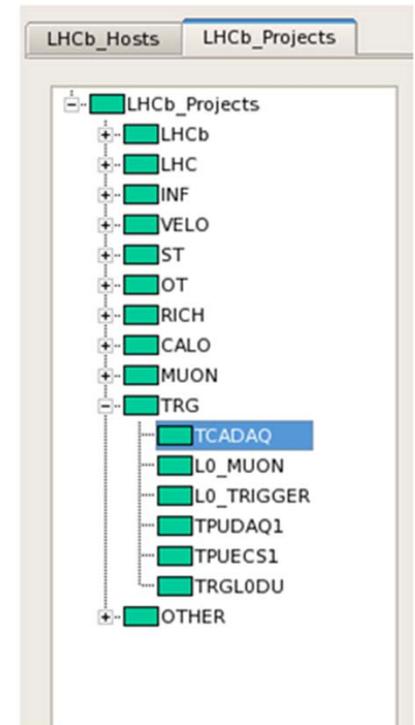
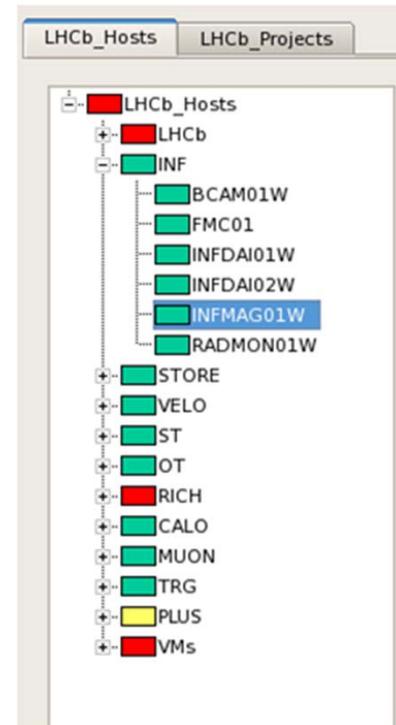
- ▶ 1747 monitored PCs:
  - 55 Windows / 1692 Linux
  - 34 are Virtual Machines
  - 1470 are for the HLT Farm
  - 167 controls PCs running PVSS Projects
  - 110 for infrastructure support, webservers, reconstruction, ...
- ▶ All PCs power control available (IPMI/VM Servers)
- ▶ Memory and CPU monitoring only the most sensitive ones
- ▶ All PVSS projects and individual managers are monitored
- ▶ Processes and Task Manager Servers running on all the control PCs

# LHCb Architecture



# LHCb Usage

- ▶ LHCb developed the interface using 2 hierarchies:
  - Hosts monitoring and control
  - PVSS Projects monitoring and control
- ▶ Hierarchies divided by sub-detector and function:
  - Easy to check global state of the system
  - Easy to check state of a particular system
  - Allows individual sub-detector access to their infrastructure



# LHCb Usage

- ▶ Host Management:
  - Easily switch ON/OFF Hosts
  - Check CPU and memory usage
  - Check File System usage
  - Monitor single processes and services memory usage
  - Possibility to act globally on a group (power wise)
- ▶ Great for recovering the system after a power-cut!

# LHCb Usage

Vision\_1: FW\_SYSTEM\_OVERVIEW\_TOOL (on ui01)

LHCb\_Hosts LHCb\_Projects

root Show/hide trees

**LHCb\_Hosts**

- LHCb
  - INF
    - BCAM01W
    - FMCO1
    - INFDAI01W
    - INFDAI02W
    - INFMAG01W**
    - RADMON01W
  - STORE
  - VELO
  - ST
  - OT
  - RICH
  - CALO
  - MUON
  - TRG
  - PLUS
  - VMs

**Host: INFMA01W**

Operating System: N/A

Distribution: N/A

CPU: Intel(R) Xeon(TM) CPU 2.80GHz

Current CPU Speed: 800 MHz

Total Memory: 2047 kiB

Last BootUp Time: 08/21 01:47 Node Time: 2011/10/05 11:42:18

Status: Readout: OK Power: ON

Performance: CPU 100% Memory 71.25%

Filesystems: / 60% /usr 99%

Processes: Processes: 93, Services: 111, Monitored Processes: 0, Monitored Services: 0

Projects

System	Hostname	Project	Project Status	Alerts	Total Num	Blocked	Abn.Stop	Last Update
INFMAG	INFMAG01W	INFMAG	RUNNING	YES	36	0	0	2011.10.05.11.43.08

Auto refres (Values are refreshed every 10 seconds) Table refresh interval 10 sec.

Summary Statistics

Number of Systems: 1 Number of Projects: 1 Number of Hosts:

Errors

Projects Stopped: 0

Project Name Mismatches: 0

Projects where Pmon is not responding: 0

Hardware command: OFF ON Power Cycle

Memory

**Process Information**

Processes and Services for node: INFMA01W in LBFMC

Running Processes

PID	Name	CPU	Mem	User	Started on	Command Line
812	svchost	11	416232	SYSTEM	08/21 01:48	C:\WINDOWS\system32\svchost
6138	PVSS00rdb	0	182448	ecs	09/15 18:18	C:\ETMPVSS2\3\@bnp\PVSS00rdb
4360	explorer	0	119972	granado	09/15 18:07	C:\WINDOWS\Explorer.exe
1752	ComExec	0	116416	SYSTEM	08/21 01:48	C:\WINDOWS\system32\ComExec
4920	el2lservice	0	114876	SYSTEM	08/21 14:09	C:\Program Files\El2\el2lservice
2360	CamOpen2A	0	102156	ecs	08/31 10:24	C:\Users\MAGNE\TOP\bin\camand
968	spoolsv	0	96532	SYSTEM	08/21 01:48	C:\WINDOWS\system32\spoolsv
2800	PVSS00ctrl	0	92160	ecs	08/21 01:48	C:\ETMPVSS2\3\@bnp\PVSS00ctrl
3740	PVSS00ctrl	0	91856	hcb_oper	08/21 01:49	C:\ETMPVSS2\3\@bnp\PVSS00ctrl
212	PVSS00ctrl	0	91856	hcb_oper	08/21 01:49	C:\ETMPVSS2\3\@bnp\PVSS00ctrl
2892	PVSS00ctrl	0	91140	ecs	09/05 10:04	C:\ETMPVSS2\3\@bnp\PVSS00ctrl
3104	PVSS00ctrl	0	91136	ecs	08/21 01:48	C:\ETMPVSS2\3\@bnp\PVSS00ctrl
5278	PVSS00ctrl	0	91136	ecs	09/05 09:52	C:\ETMPVSS2\3\@bnp\PVSS00ctrl
60820	hcb_oper	2	60820	hcb_oper	10/05 11:42	C:\ETMPVSS2\3\@bnp\PVSS00ctrl

Total: 93

Monitored

PID	Name	State	CPU	Memory	Command Line
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Services

Available Services

PID	Name	Start	Type	Start Mode	Desktop Int
812	Application Experience Lookup Service	TRUE	Share Process	Auto	FALSE
812	Application Management	TRUE	Share Process	Manual	FALSE
812	Background Intelligent Transfer Service	TRUE	Share Process	Manual	FALSE
812	Computer Browser	TRUE	Share Process	Auto	FALSE
1752	SMS Agent Host	TRUE	Own Process	Auto	FALSE
812	Cryptographic Services	TRUE	Share Process	Auto	FALSE
524	DCIM Server Process Launcher	TRUE	Share Process	Auto	FALSE
756	DHCP Client	TRUE	Share Process	Auto	FALSE
1104	DM DNS	TRUE	Own Process	Auto	FALSE
1132	Dimension4	TRUE	Own Process	Auto	FALSE
2910	Hummingbird Exceed Display Controller	TRUE	Own Process	Manual	FALSE
2152	Logical Disk Manager Administrative Service	TRUE	Share Process	Manual	FALSE
812	Logical Disk Manager	TRUE	Share Process	Auto	FALSE
756	DNS Client	TRUE	Share Process	Auto	FALSE
1004	Enlink	TRUE	Own Process	Auto	FALSE

Total: 111

Monitored

PID	Name	Started
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Close

# LHCb Usage

- ▶ PVSS Project Management:
  - Based on PVSS Pmon calls over TCP/IP
  - Have a global overview of the state of the individual PVSS projects and managers:
    - Statistics about projects running/stopped
    - Statistics about number of managers blocked/abnormally stopped
  - Detect mismatches between expected configuration and configuration running
  - Act on PVSS projects and managers like logging on the local machines
  - Act Globally on a group (Start/Stop/Restart Projects)

# LHCb Usage

- ▶ PVS
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The screenshot displays the 'FW System Overview Tool' interface. The main window is titled 'Vision\_1: FW\_SYSTEM\_OVERVIEW\_TOOL' and shows a tree view on the left with 'LHCb\_Projects' expanded to 'INF' and 'INFMAG'. The central panel shows system details for 'Host: INFAG01W', including CPU speed (2800 MHz) and memory (2047 KiB). Performance graphs for CPU (37%) and MEMORY (71%) are visible. A table lists running processes, with a context menu open over the 'PVS' process (PID 3104). A summary at the bottom indicates 36 total managers, with 16 running.

**System: INFAG:**  
 Number: 26  
 System Host: INFAG01W  
 Data Port: 12601  
 Event Port: 12602  
 Dist Port: 12610

**Host: INFAG01W**  
 Operating System: N/A  
 Distribution: N/A  
 CPU: Intel(R) Xeon(TM) CPU 2.80GHz  
 Current CPU Speed: 2800 MHz  
 Total Memory: 2047 KiB  
 Last BootUp Time: 08/21 01:47 Node Time: 2011/1/005 11:48:50

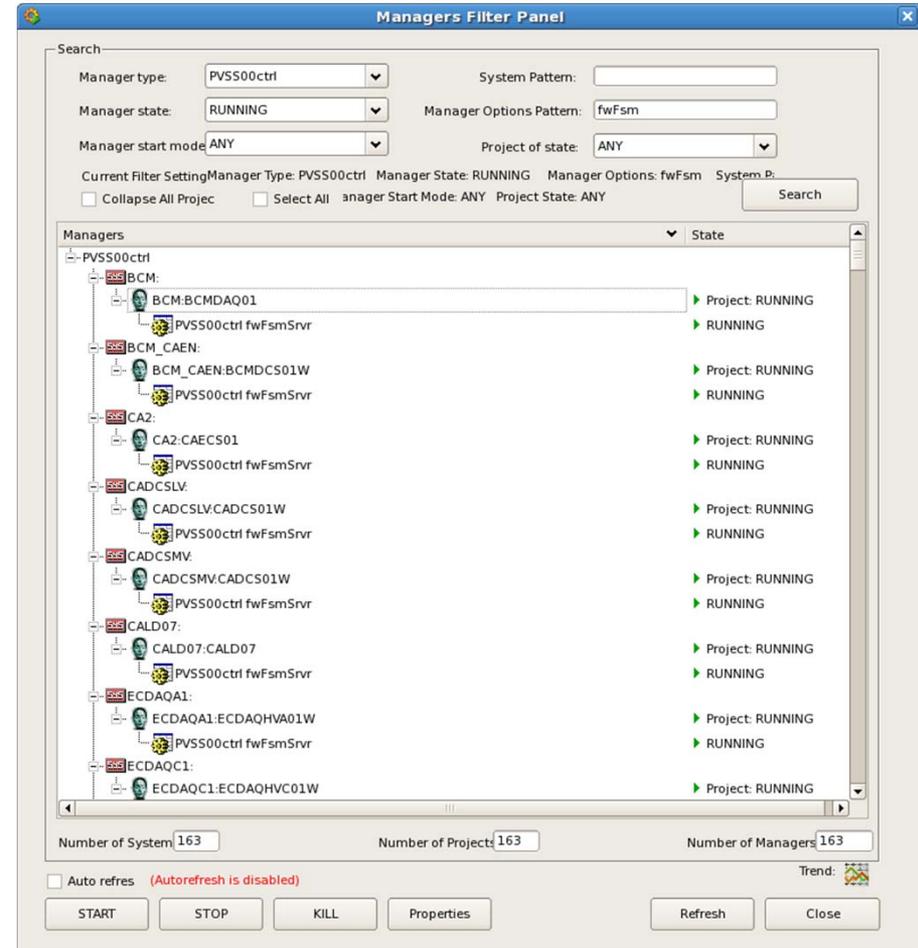
**Project: INFAG - Current State: RUNNING**

St	PID	Description	No	Options	Start Time	Mode
1	-1	Control Manager	2	-1 fwScripts.lst	2011.08.21 01:48:49.544	once
2	3032	Simulation Driver	13	-num 13	2011.08.21 01:48:49.934	always
0	-1	PVS Start manager	1			manual
0	-1	Arcl Stop manager	6	-num 6		manual
0	-1	Conf MagnetCalibrationServer.ctl	5		2011.08.21 03:27:26.650	manual
0	-1	User Kill manager	1	-p fwDIM/fwDim.pnl -menuBar -iconBar		manual
2	3104	Conf unDistributedControl.ctl	3		2011.08.21 01:48:50.231	always
2	5276	Conf fwFsmSrvr	4		2011.09.05 09:52:26.937	always
0	-1	User fwDeviceEditorNavigator/fwDeviceEditorNavigator.pnl -iconBar -menu	1			manual
2	6096	Conf PVSS00dim	5	-num 5 -dim_dp_config libCondDBConfig -dim_dms_node ecs01.libdaq.cer	2011.09.05 09:58:17.591	always
0	-1	Control Manager CondDBScript.ctl	1			manual
0	-1	User Interface libCondDB/libCondDB.pnl -iconBar -menuBar	1			manual
0	-1	Simulation Driver	13	-num 13		manual
2	3240	SNMP LiveAgent	1		2011.08.21 01:48:53.278	always
2	4428	OPC DA Client	7	-num 7	2011.08.31 10:24:16.632	always
0	-1	Simulation Driver	7	-num 7		manual
2	3432	Control Manager fwElmb/fwElmbCheckInvalid.ctl -num 70	70		2011.08.21 01:49:00.184	always
2	3464	Conf PVSS00DimErrInfo	1		2011.08.21 01:49:00.747	always
2	6136	RDB Archive Manager	99	-num 99	2011.09.15 18:18:34.707	always
0	-1	User Interface libArchive.pnl -iconBar -menuBar	1			manual
2	1072	Control Manager libMagnet/libMagnetTime.ctl	2		2011.08.21 01:49:45.278	always

Summary of managers:  
 Total: 36 Blocked: 0 Abnormally stopped: 0 Running: 16

# LHCb Usage

- ▶ Globally Manage PVSS Managers
  - Filter managers by type, system, state, options...
  - Start/stop filtered managers
  - Change filtered managers startup properties
- ▶ Great for updates to control software running from repositories!



# Conclusion

- ▶ Very elegant and user friendly central management tool
- ▶ Easy and complete monitoring
- ▶ Global overview and fine control:
  - PCs status
  - PVSS Projects and managers
  - Applications processes and services
- ▶ Monitor different systems with the same interface
- ▶ Expandable to other TCP enabled devices