



# New operator assistance features in the CMS Run Control System

22<sup>nd</sup> International Conference on Computing in High Energy and  
Nuclear Physics (CHEP)

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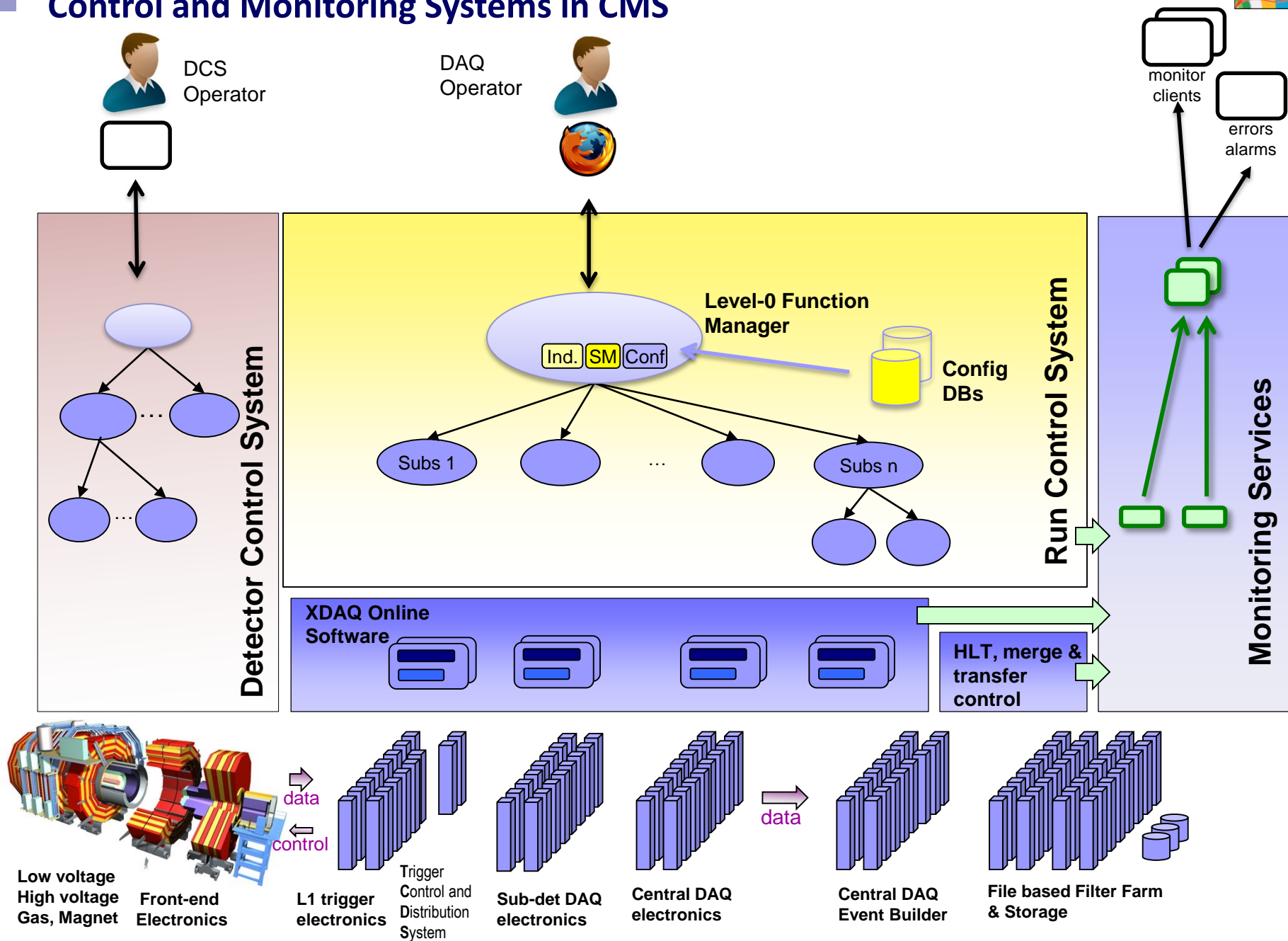
on behalf of the CMS DAQ group



# System Overview

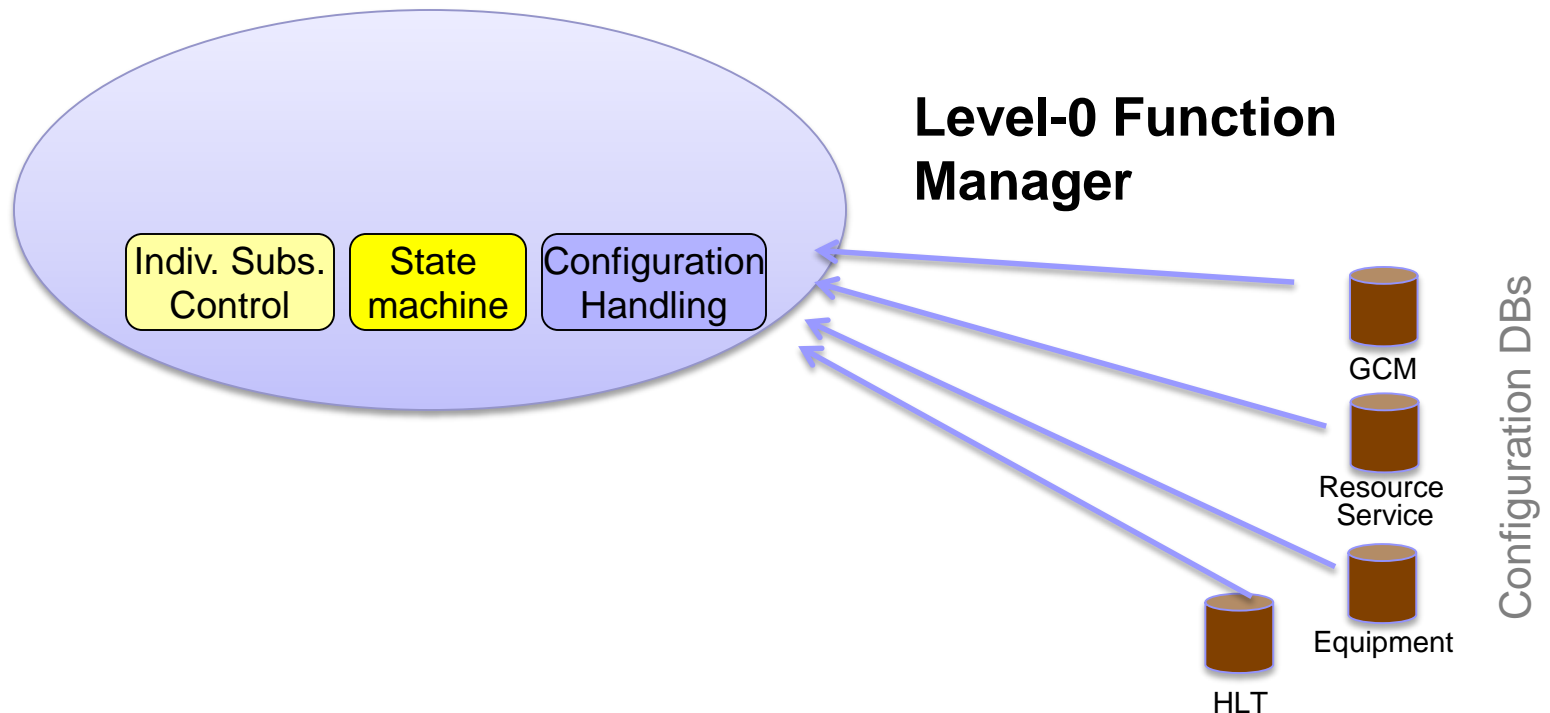


# Control and Monitoring Systems in CMS





# Level-0 Function Manager – the top-level control node







# Level-0 Function Manager GUI

Level0-FM (RCMS\_3\_5\_3\_LEVELZEROFM\_v6) - Mozilla Firefox

File Edit View History Bookmarks Tools Help

http://rcms/gui/servlet/FMPilotServlet?PAGE=/gui/jsp/controlPanel.jsp

Most Visited Red Hat, Inc. Red Hat Network Support Shop Products http://cmsrc-trigger.39... Training

Status Table PCMonitor FED & TTS **HLT Keys** Lock save Refresh Detect Destroy

Running 00:24.1

Connect Configure Get Ready Start

Pause Resume Stop Halt ColdReset

ForceStop ForceHalt Recover Interrupt

TTCSync TTChadReset TTTestMode TestTTS

DCS/LHC flag state force

PIX\_HV\_ON N/A FROM DCS

TK\_HV\_ON N/A FROM DCS

PHYSICS\_DECLARED false FROM DCS

LHC\_RAMPING false FROM DCS

LHC machine mode ACCESS

LHC beam mode NO BEAM

LHC clock stable false

Next clock source LOCAL force\_LOCAL

Current clock source LOCAL

Configuration: /approPublicGlobal/levelZeroFM

Run Number **134746**

SID 133644

Seq Name GLOBAL-RUN

Global Key /GLOBAL\_CONFIGURATION\_MAP/CMS/CENTRALGLOBAL\_RUN

HLT Config Name /cds/physics/firstCollisions10v5.1/HLT\_Cosmics/V1

L1 Trigger Key L1\_20100508\_144832\_997 => TSC\_20100501\_002208\_cosmics\_BASE made current 22 minutes and 25 seconds ago.

HWCFG Key Clock type: LOCAL => ML\_KEY\_boneInternal-manual /cmseag\_100308.RUN\_20101010\_all\_rev100420 /cp\_8alice\_5TC\_BUFD\_848UTMasterFU\_16SM\_NR\_brev74.0

Level-0 Action Tasks completed.

Level-0 Error

Subsystem	ECAL	ES	HCAL	[LUM]	TRG	DT	CSC	RPC	DAQ	DOM	SCAL	CASTOR	DCS
State	Running	Running	Running	Running	Running	Running	Running	Running	Running	Running	Running	Running	Connected
Time:	00:04.0	00:02.3	00:11.6		00:06.7	00:10.3	00:09.0	00:00.1	00:16.3	00:00.5	00:00.8	00:00.5	00:06.7

EnabledSlices

Run Key SelectiveReadout HighGain 25 HF AND LUM FOLLOW HCAL Automatic TERO\_TRANSFER ON

Commander

ECAL

ES

HCAL

TRACKER Configured

TRG TRG NR=990487 Rate: 898.8 Hz orbit=1.2267855 (prev=985891.5113.990487)

DT

CSC

RPC String

DAQ

DOM running

PIXEL

SCAL

CASTOR running like hell ...

COW

DCS DCS\_LHC\_FLAGS at 2010-05-03 14:02:30 CEST: LHC\_RAMPING:false TK\_HV\_ON:N/A PIX\_HV\_ON:N/A PHYSICS\_DECLARED:false

Run History 2010-05-03 16:52:45 CEST: LS= 1.00 Trg=0 Evts=0 Start Run 134746 TK\_HV\_ON:N/A PIX\_HV\_ON:N/A LHC\_RAMPING:false PHYSICS\_DECLARED:false

Done

**Top level Run Control GUI**  
Initially flexibility needed – many manual settings

## At the beginning of Run-1 ...



- Full control possible
- But everything had to be done manually

**Only experts able to operate run control  
manual operation very error prone**



# Configuration Handling



## Configuration handling

- Operator initially had to select
  - Compatible first and high level trigger configurations
  - Compatible set of RUN\_KEYS for each sub-system
  
- We grouped these
  - First into a combined trigger key
  - Then into a combined CMS run mode
    - Combines all subsystem and trigger configuration into a single configuration item
    - Run modes for
      - Collisions
      - Cosmics
      - Various special runs
    - Run mode may be automatically selected based on LHC beam mode





# The top-level Run Control web GUI

Status Table RCMonitor FED & TTS Lock save Refresh Detach Destroy

Running 00:21.4

Connect Configure **Start**

Pause Resume Stop Halt ColdReset

ForceStop ForceHalt Recover Interrupt FixSoftError

TTCResync TTCHardReset TTSTestMode TestTTS

Auto Soft Error Recovery: ☒

DCS/LHC flag	state	force
ES_HV_ON	true	FROM DCS
PIX_HV_ON	true	FROM DCS
TK_HV_ON	true	FROM DCS
PHYSICS_DECLARED	true	FROM DCS
LHC_RAMPING	false	FROM DCS

LHC machine mode: PROTON  
LHC beam mode: PHYSICS  
LHC clock stable: NO BEAM  
LHC clock stable: false

SETTING	CURRENTLY APPLIED VALUE	NEXT VALUE	from LHC
<b>CMS Run Mode</b>	N/A	MANUAL	cosmics <b>autoselect</b> <input type="checkbox"/>
<b>L1/HLT Trigger Mode</b>	cosmics2016	cosmics2016	<b>autoselect</b> <input type="checkbox"/>
L1/HLT Key	l1_hlt_cosmics2016/v115		
HLT Key	/cdag/cosmic/commissioning2016/CRAFT/v1.0/HLT/V2		
HLT SW ARCH	CMSSW_8_0_7_slc6_amd64_gcc493		
L1_TRG_CONF Key	cosmics2016_TSC/v61		
L1_TRG_RS Key	cosmics2016_RS/v46		
<b>Clock source</b>	LOCAL	LOCAL	<b>autoselect</b> <input type="checkbox"/>
<b>TCDS System</b>	PRIMARY	PRIMARY	

Configuration: /toppro/PublicGlobal/levelZeroFMwithAutomator

Run Number: **272858**

SID: 279182  
Seq Name: GLOBAL-RUN  
Global Key: /GLOBAL\_CONFIGURATION\_MAP/CMS/CENTRAL/GLOBAL\_RUN  
HWCFG Key: /daq2/eq\_160404/ft\_all\_withTCA\_consolidated3\_no1240\_TOTEM/dp\_bi228\_72BU:0  
Level-0 Action: Tasks completed.  
Level-0 Error:

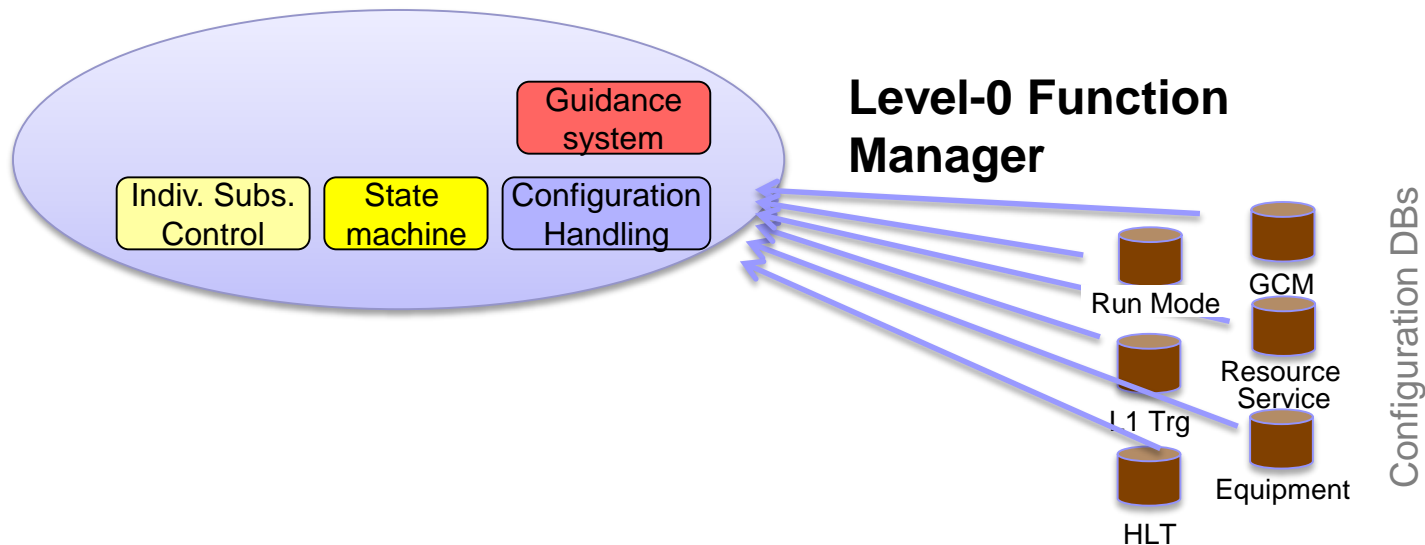
Subsystem	PIXEL	PIXEL_UP	TRACKER	ES	ECAL	CSC	RPC	TCDS	TRG	SCAL	DAQ	DQM	DCS
State	Running	Running	Running	Running	Running	Running	Running	Running	Running	Running	Running	Running	Connected
Time	00:03.5	00:00.1	00:14.5	00:02.6	00:08.1	00:08.4	00:05.9	00:00.4	00:06.2	00:11.2	00:00.5	00:00.0	00:01.5
Applied Run Key	N/A	N/A	DEFAULT	GR_Phys:LowGain-TCDS	Cosmics-SR	N/A	N/A	NoBxInfoFromDip	Automatic	N/A	TIER0_TRANSFER_ON	cosmic_run	N/A
New Run Key			DEFAULT	GR_PhysLowGain-TCDS	Cosmics-SR			NoBxInfoFromDip	Automatic		TIER0_TRANSFER_ON	cosmic_run	
Commander	select	select	select	select	select	select	select	select	select	select	select	select	select

auto-select run mode based on LHC

run mode in turn determines most other settings

## Configuration handling (II)

- Initially shifter needed to know
  - what subsystems need to be reconfigured / recycled after a certain configuration change
  - When to change / recover the clock
- Now a guidance system constantly compares the applied configuration with the selected configuration for each sub-system
  - Indicators are displayed prompting operators to do the correct action
  - Checks for updates to the selected configuration ( configuration databases )
  - Selected configuration can be tied to LHC mode through run mode





# Guidance system

change.

DT	RPC	TCDS	TRG	SCAL	
Configured	Configured	Configured	Configured	Configured	
00:54.1	01:19.4	00:10.7	01:01.0	00:00.0	
N/A	N/A	NoBxInfoFromDip	Automatic	N/A	TIER0

Reconfigure is needed for subsystem RPC

**Ck:** The clock potentially changed after this subsystem has last been configured.  
 The clock is considered changed if TCDS is reconfigured  
 a) with a different clock source  
 b) with clock source LHC during a time of potential instabilities of LHC clock (e.g. INJECT, RAMP, ...).  
 TCDS configuration changed clock at: Sat Oct 08 2016 16:22:44 GMT+0200 (CEST)  
 RPC was configured at: Sat Oct 08 2016 16:22:37 GMT+0200 (CEST)  
 reason for clock change: Clock source changed: LHC => LOCAL

TRG	DAQ	DQM	DCS
Running	Running	Running	Connected
00:00.0	00:00.0	00:00.0	00:00.0
N/A	TIER0_TRANSFER_ON	pp_run	N/A

Reconfigure is needed for subsystem TRG

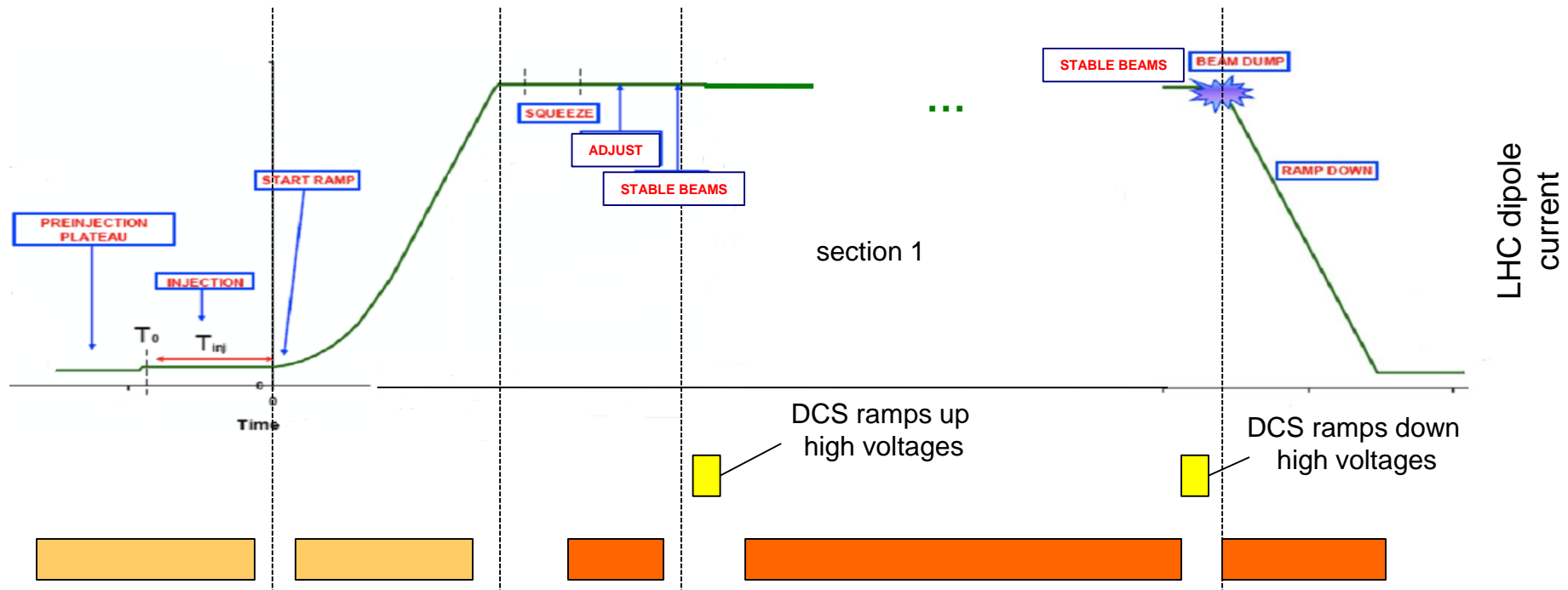
**L1:** The L1 trigger configuration has changed:  
 new L1\_TRG\_CONF key: cosimcs2016\_TSC/v180  
 old L1\_TRG\_CONF key: collisions2016\_TSC/v143  
 new L1\_TRG\_RS key: cosimcs2016\_RS/v94  
 old L1\_TRG\_RS key: collisions2016\_RS/v201  
 new L1/HLT Key: l1\_hlt\_cosimcs2016/v289  
 old L1/HLT Key: l1\_hlt\_collisions2016/v414  
 The following sub-keys / run settings changed: (old => new)  
 CONFIG\_SEQUENCE: ConfigRules => NoRules  
 EMTF\_KEY: EMTF\_Base\_Key/v15 => EMTF\_Base\_Key\_single\_hits/v13  
 L1\_KEY\_DESCRIPTION: changes wrt collisions2016\_TSC/v142: EMTF\_KEY='EMTF\_Base\_Key/v15' => changes wrt cosimcs2016\_TSC/v179: UGT\_KEY='UGT\_BASE\_KEY/v59'  
 RPC\_KEY: LHC10 => LHC10\_BOTTOM  
 RUNTYPE: collisions => cosimcs  
 TWINMUX\_KEY: TwinMux\_base\_newlatency/v31 => TwinMux\_base\_newlatency\_super/v31  
 UGMT\_KEY: UGMT\_base/v22 => UGMT\_bottomOnly/v22

Ensures that all settings are applied ... in the correct order.



# Following the cycle of the LHC

# Manual actions throughout an LHC cycle ...



- Initially, new run needed
  - when LHC start/stops ramping
  - when high voltages are ramped
- Subsystem operators needed to change settings:

**ramp start**

Mask  
sensitive  
trigger  
channels

**ramp done**

Unmask  
sensitive  
trigger  
channels

**Tracker HV on**

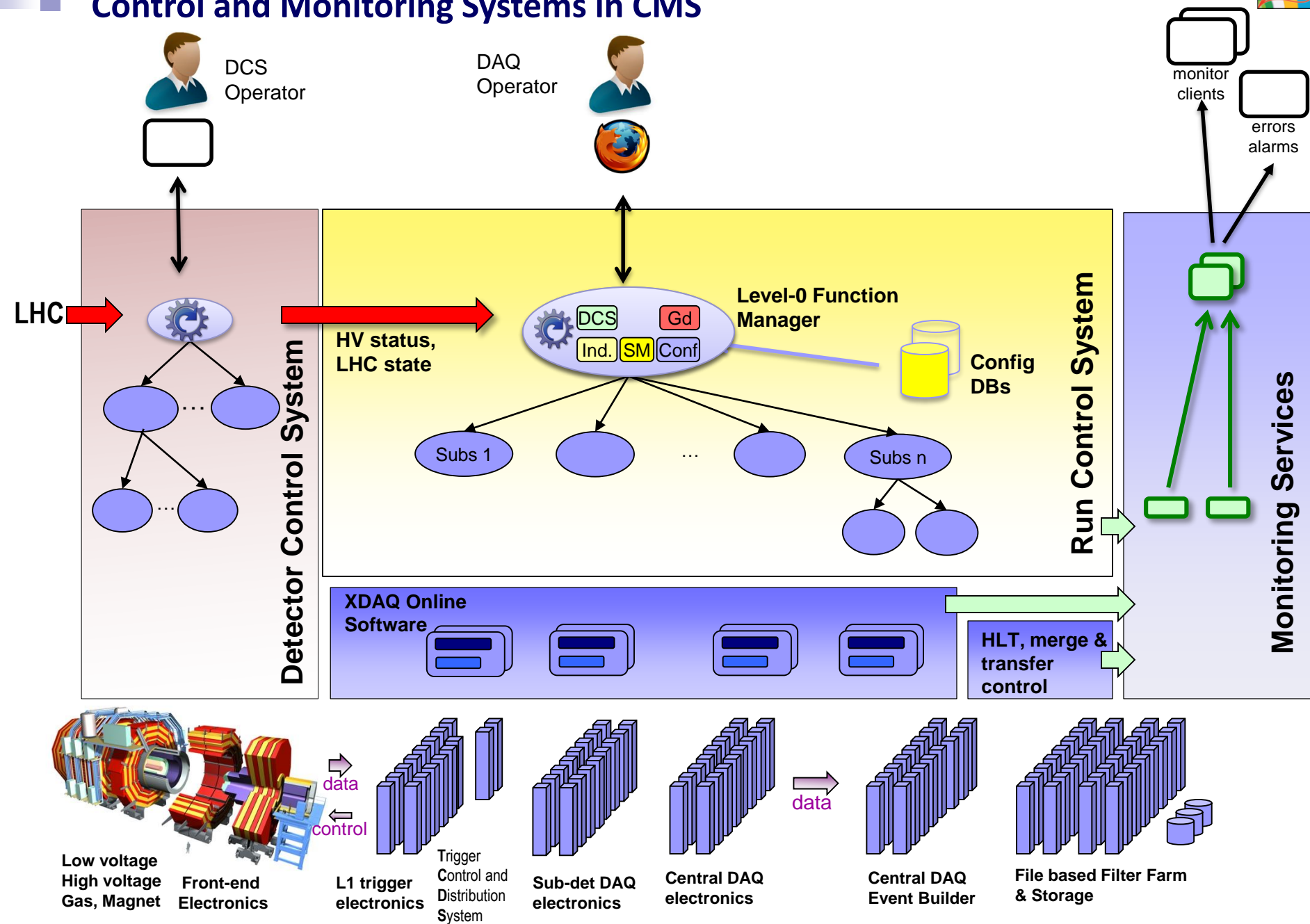
Enable payload (Tk)  
raise gains (Pixel)

**Tracker HV off**

Disable payload (Tk)  
reduce gains (Pixel)

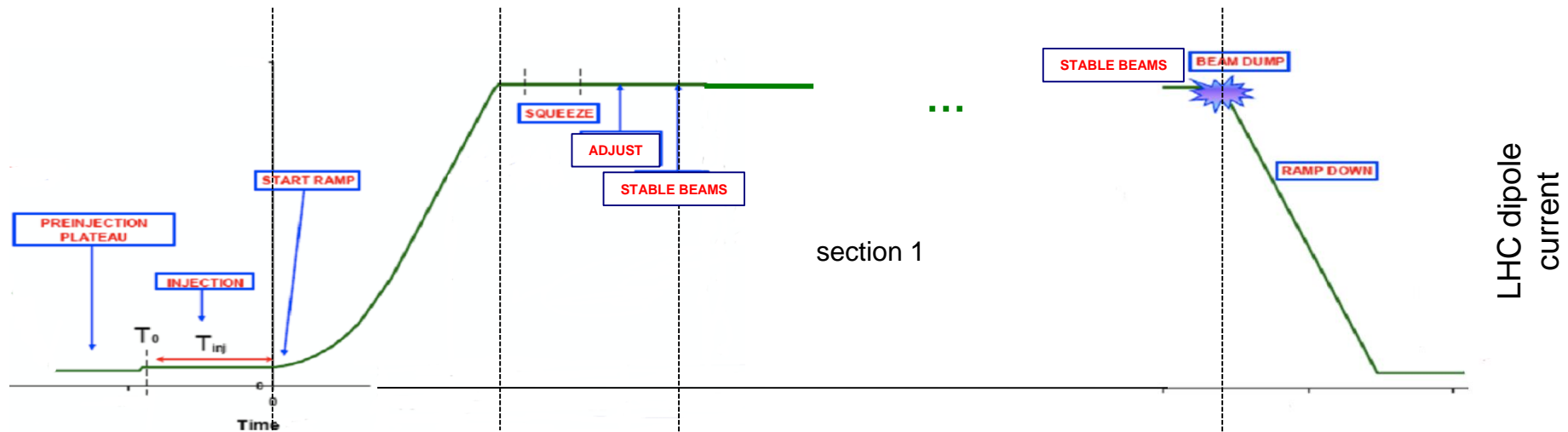


# Control and Monitoring Systems in CMS

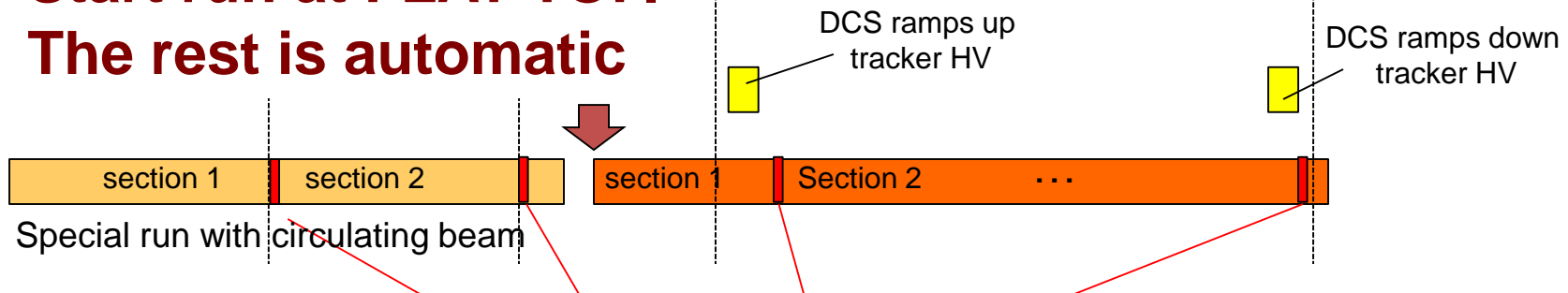




# Run control automatically handles run section changes



**Start run at FLAT TOP.  
The rest is automatic**



**Automatic actions in DAQ :**

**ramp start**

Mask  
sensitive  
trigger  
channels

**ramp done**

Unmask  
sensitive  
trigger  
channels

**Tracker HV on**

Enable payload (Tk)  
raise gains (Pixel)

**Tracker HV off**

Disable payload (Tk)  
reduce gains (Pixel)



# Soft Error Recovery

# Automatic soft error recovery

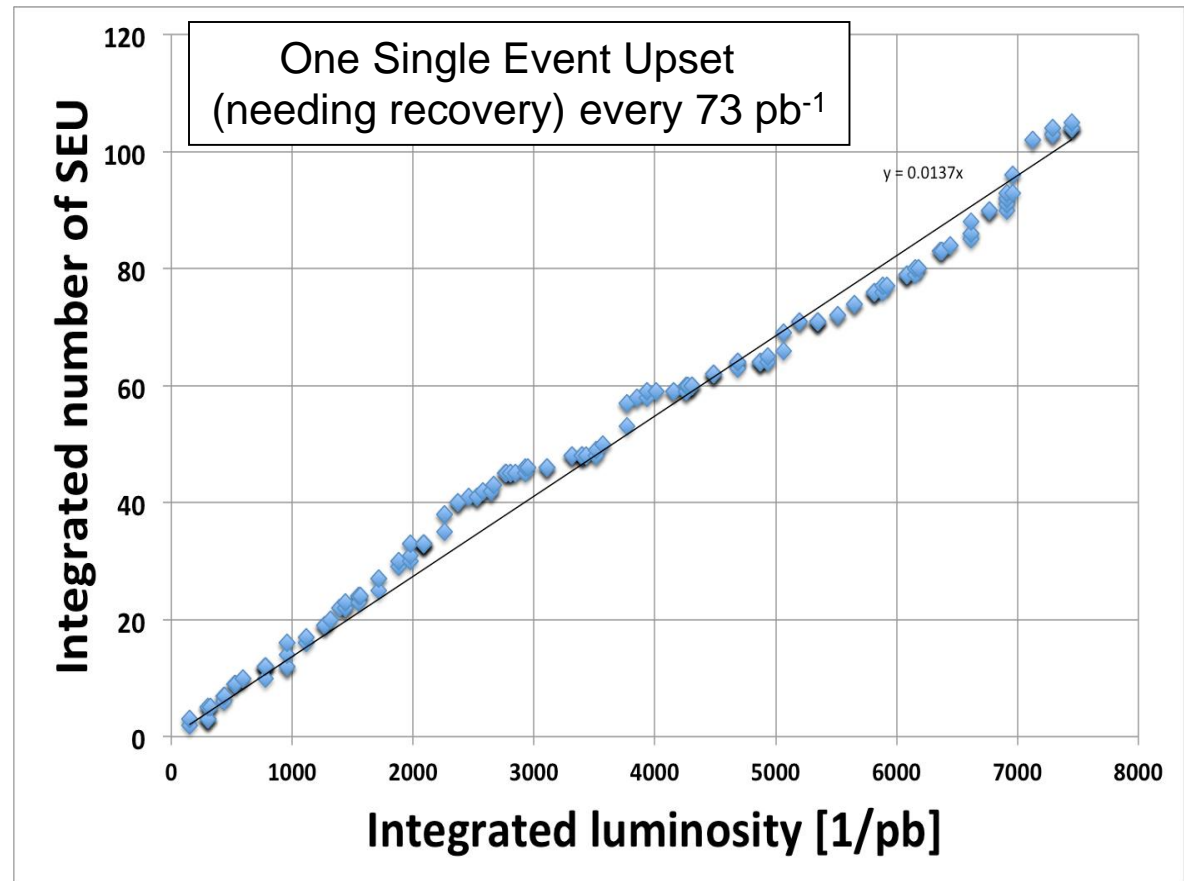
- With higher instantaneous luminosity in 2011 more and more frequent “soft errors” causing the run to get stuck

- Proportional to integrated luminosity
- Believed to be due to single event upsets

- Recovery procedure

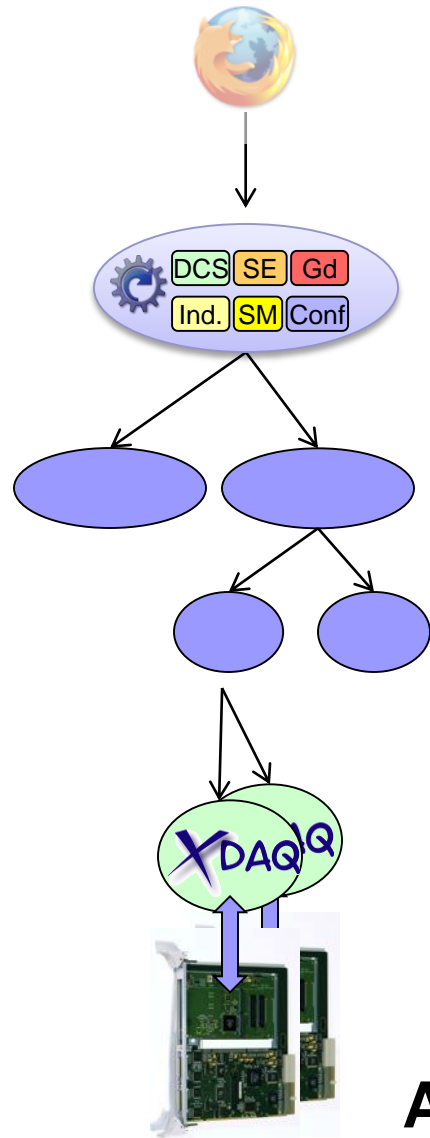
- Stop run (30 sec)
- Re-configure a sub-detector (2-3 min)
- Start new run (20 sec)

3-10 min down-time



Single-event upsets in the electronics of the Si-Pixel detector. Proportional to integrated luminosity.

# Automatic soft error recovery



- From 2012, new automatic recovery procedure in top-level control node

1. Sub-system detects soft error and signals by changing its state
2. Top-level control node invokes recovery procedure
  - a) Pause Triggers
  - b) Invoke newly defined selective recovery transition on requesting detector
  - c) In parallel perform preventive recovery of other detectors
  - d) Resynchronize
  - e) Resume

12 seconds down-time

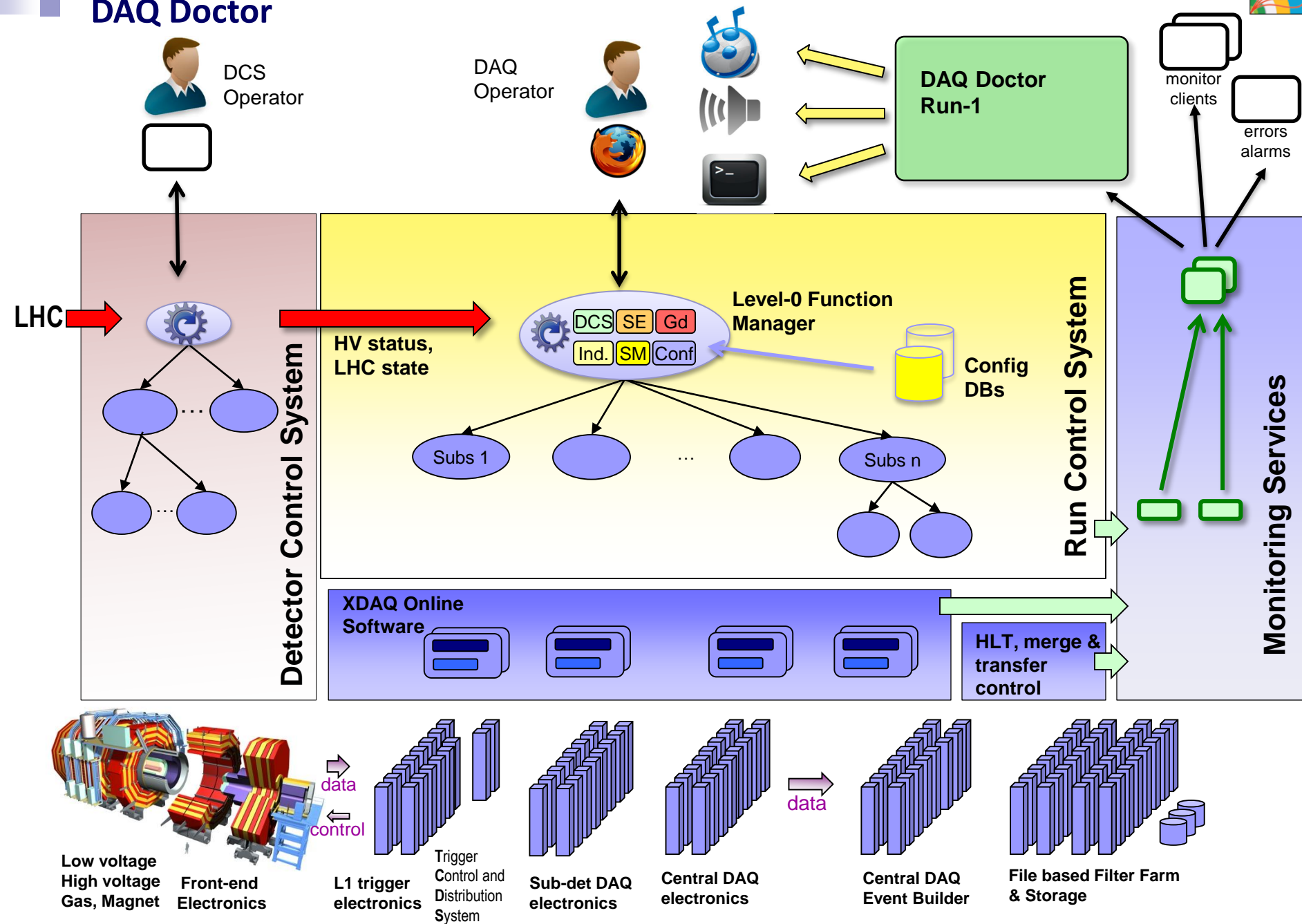
**At least 46 hours of down-time avoided in 2012**



# DAQ Doctor



# DAQ Doctor





## Towards the end of Run-1



- Improved configuration handling
- Guidance
- Automatic actions following DCS / LHC state changes
- Soft Error recovery
- DAQ Doctor



# **New operator assistance for Run-2**

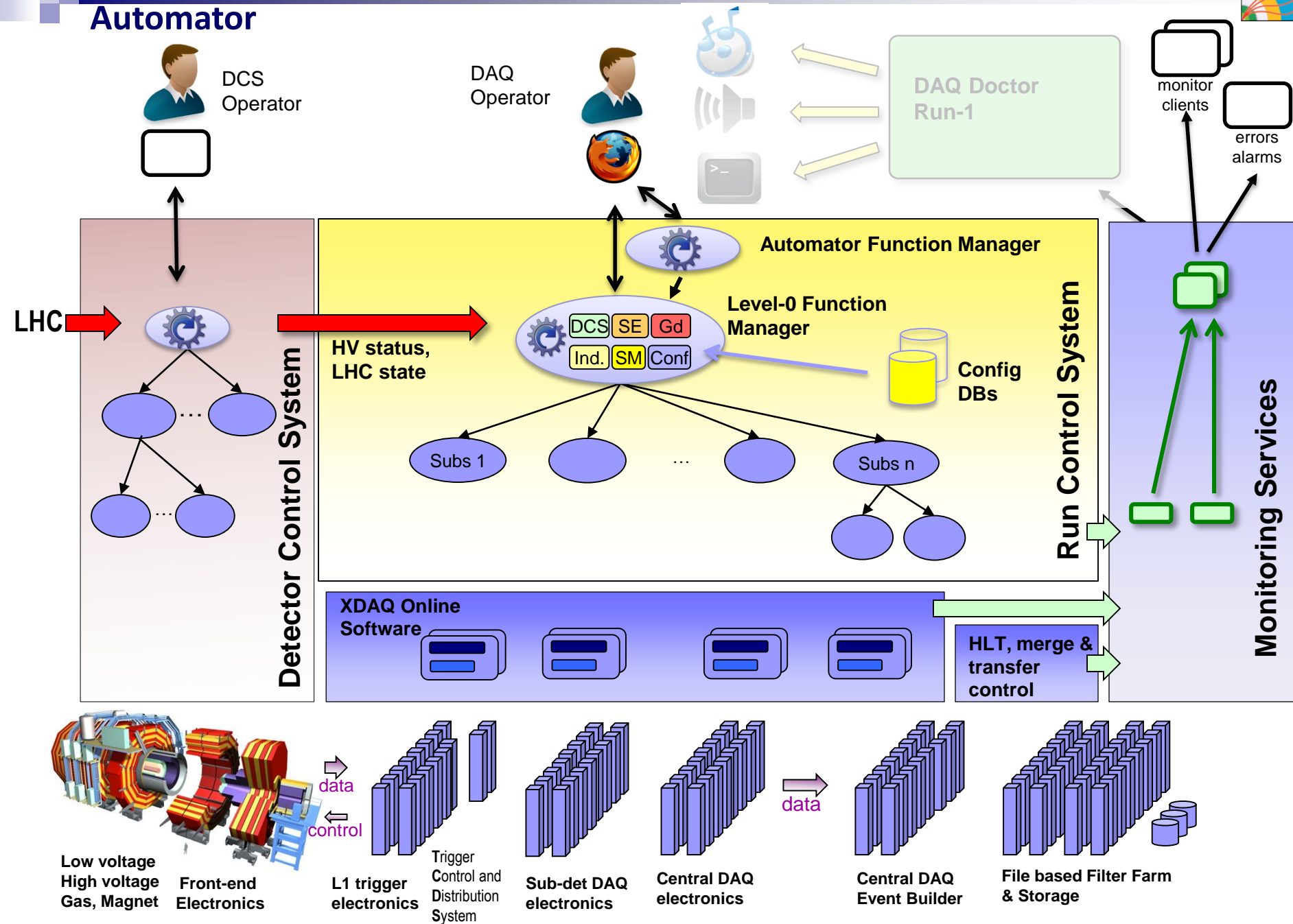


## How to improve further

- ✓ Guidance indicates all necessary steps to the operator ...  
... but operator still needs to follow them manually
  - ❑ Click, wait, click, wait a few minutes, click  
... not always efficient
- Some errors still need to be recovered manually
  - ❑ Rare / new / not well understood errors
- Want to speed up the typical recovery
  - ❑ Stop the run
  - ❑ Reconfigure / recycle a sub-system
  - ❑ Start a new run
  - ❑ Potentially recover secondary errors
- Prepare to trigger typical recovery by expert system



# Automator





# Level-0 Automator



# The top-level Run Control web GUI with Automator

Recover run with 2 clicks

(1) (2)

Refresh Details Destroy Lock

Start Run Recover Run Interrupt

Action: Idle

Timeline History: 3 hours Load

Subsystem	PIXEL	PIXEL UP	TRACKER	ES	ECAL	HCAL	HF	DT	CSC	RPC	TOTEM	TCDS	TRG	SCAL	DAQ	DQM
at fault																

Starting 00:24.9

Connect Configure Start

Pause Resume Stop Halt ColdReset

ForceStop ForceHalt Recover Interrupt FixSoftError

TTCTResync TTCTHardReset TTCTTestMode TestTTS

Auto Soft Error Recovery: ☒

GUI locked by parent FM.

Configuration : /toppro/PublicGlobal/levelZeroFMwithAutomator

Run Number **282652**

DCS/LHC flag	state	force
ES_HV_ON	true	FROM_DCS
PIX_HV_ON	N/A	FROM_DCS
TK_HV_ON	true	FROM_DCS
PHYSICS_DECLARED	false	FROM_DCS
LHC_RAMPING	true	FROM_DCS

LHC machine mode	PROTON PHYSICS
LHC beam mode	RAMP DOWN
LHC clock stable	trueForCMS

SETTING CURRENTLY APPLIED VALUE

CMS Run Mode cosmics

L1/HLT Trigger Mode cosmics2016

L1/HLT Key l1\_hlt\_cosmics2016v297

HLT Key /cdag/cosmic/commissioning2016/CRAFT/v4.1/HLT/v1

HLT SW ARCH CMSSW\_8\_0\_19\_patch2 sic6\_amd64\_gcc493

L1\_TRG\_CONF Key cosmics2016\_TSCv185

L1\_TRG\_RS Key cosmics2016\_RSv97

Clock source LOCAL

TCDS System PRIMARY

SID	285137
Seq Name	GLOBAL-RUN
Global Key	/GLOBAL_CONFIGURATION_MAP/CMS/CENTRAL/GLOBAL_RUN
HWCFG Key	/daq2/eq_150913_01/lb_all_with1240_withCASTOR_w582_583/dp_b1375_75BU.0
Level-0 Action	Executing: Starting L1 subsystems.
Level-0 Error	

Subsystem	PIXEL UP	TRACKER	ES	ECAL	HCAL	HF	DT	RPC	TCDS	TRG
State	Running	Starting	Starting	Starting	Starting	Running	Starting	Running	Configured	Running
Time	00:00.0	00:04.2	00:04.2	00:04.2	00:04.2	00:00.4	00:04.2	00:02.6	00:10.7	00:20.4
Applied Run Key	N/A	DEFAULT	GR_Phys.LowGain-TCDS	Cosmics-SR	N/A	N/A	N/A	N/A	NoBxInfoFromDip	Automatic
New Run Key		DEFAULT	GR_Phys.LowGain-TCDS	Cosmics-SR					NoBxInfoFromDip	Automatic
Commander	select	select	select	select	select	select	select	select	select	select

Full Level-0 functionality still accessible





# Timeline

history of all manual or automatic actions

Recovery triggered by operator  
schedule: start/stop only

Refresh Detach Destroy Lock

Start Run Recover Run Interrupt

Action: Idle

Starting 00:24.9

Connect Configure Start

Pause Resume Stop Halt ColdReset

ForceStop ForceHalt Recover Interrupt FixSoftError

TTCHResync TTCHardReset TTSTestMode TestTTS

Auto Soft Error Recovery: ☒

GUI locked by parent FM.

Configuration : /toppro/PublicGlobal/levelZeroFMwithAutomator

Run Number 282652

Subsystem	PIXEL_UP	TRACKER	ES
State	Running	Starting	Starting
Time	00:00.0	00:04.2	00:04.2
Applied Run Key	N/A	DEFAULT	GR_Phys.LowGain-TCDS
New Run Key	<input type="text"/>	DEFAULT	GR_Phys.LowGain-TCDS
Commander	<input type="button" value="select"/>	<input type="button" value="select"/>	<input type="button" value="select"/>



**Can do this from any state of the system**  
**all indications of the guidance system are followed**

Configuration :	/toppro/PublicGlobal/levelZeroFMwithAutomator	SID	279182
Run Number	272858	Seq Name	GLOBAL-RUN
		Global Key	/GLOBAL_CONFIGURATION_MAP/CMS/CENTRAL/GLOBAL_RUN
		HWCFG Key	/daq2/eq_160404/fb_all_withuTCA_consolidated3_no1240_TOTEM/dp_bi228_72BU:0
		Level-0 Action	Tasks completed.
		Level-0 Error	



# One-click start of run - timeline

Refresh Detach Destroy Lock

Start Run Recover Run Interrupt

Action: Idle

Status Table RCMonitor FED & TTS

Running 00:21.4

Connect Configure Start

Pause Resume Stop Halt ColdReset

ForceStop ForceHalt Recover Interrupt FixSoftError

TTCResync TTCHardReset TTSTestMode TestTTS

Auto Soft Error Recovery: ☒

Configuration: /toppro/PublicGlobal/levelZeroFMwithAutomator

Run Number **272858**

SID 279182  
Seq Name GLOBAL-RUN  
Global Key /GLOBAL\_CONF  
HWCFG Key /daq2/eq\_16040  
Level-0 Action Tasks completed  
Level-0 Error

Subsystem	PIXEL	PIXEL_UP	TRACKER	ES	ECAL
State	Running	Running	Running	Running	Running
Time	00:03.5	00:00.1	00:14.5	00:02.6	00:08.1
Applied Run Key	N/A	N/A	DEFAULT	GR_Phys:LowGain-TCDS	Cosmics-SR
New Run Key	<input type="button" value="select"/>	<input type="button" value="select"/>	<input type="button" value="select"/>	<input type="button" value="select"/>	<input type="button" value="select"/>
Commander					

DCS/LHC flag state

ES\_HV\_ON true FROM

PIX\_HV\_ON true FROM

TK\_HV\_ON true FROM

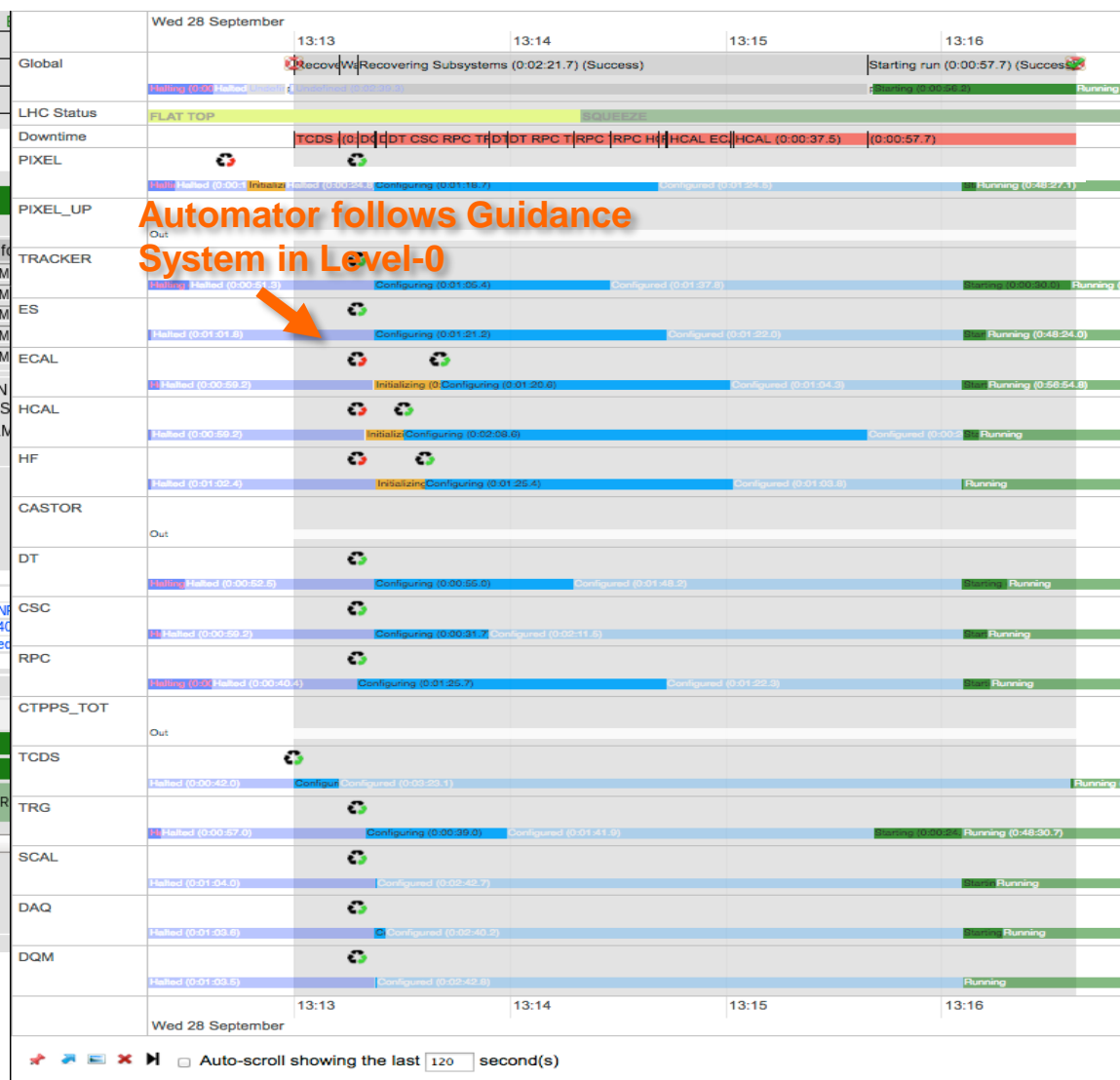
PHYSICS\_DECLARED true FROM

LHC\_RAMPING false FROM

LHC machine mode PROTON PHYSICS

LHC beam mode NO BEAM

LHC clock stable false

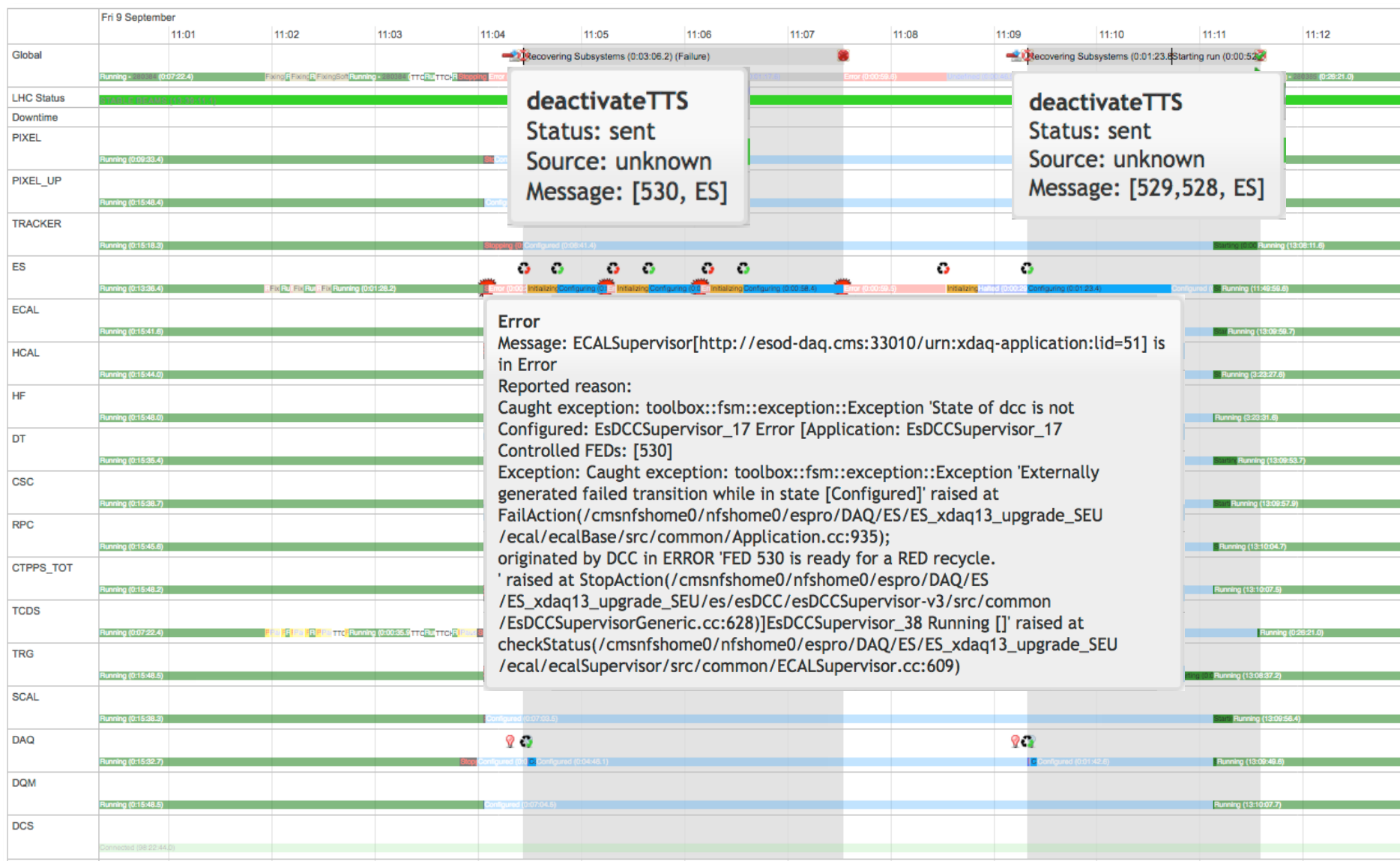


**Timeline**

shows history of all manual or automatic actions



# Offline timeline – for post mortem analysis

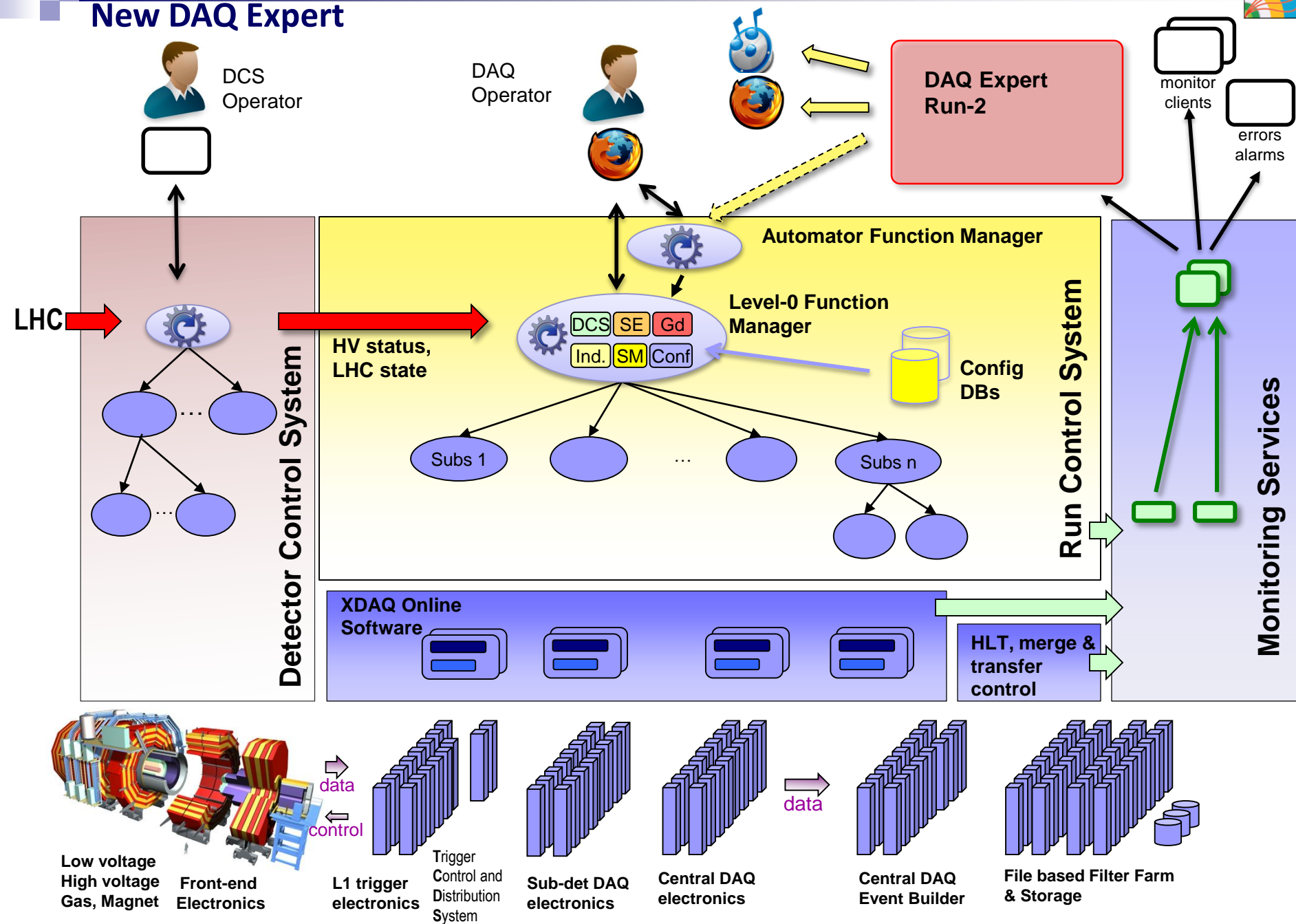




# New DAQ Expert



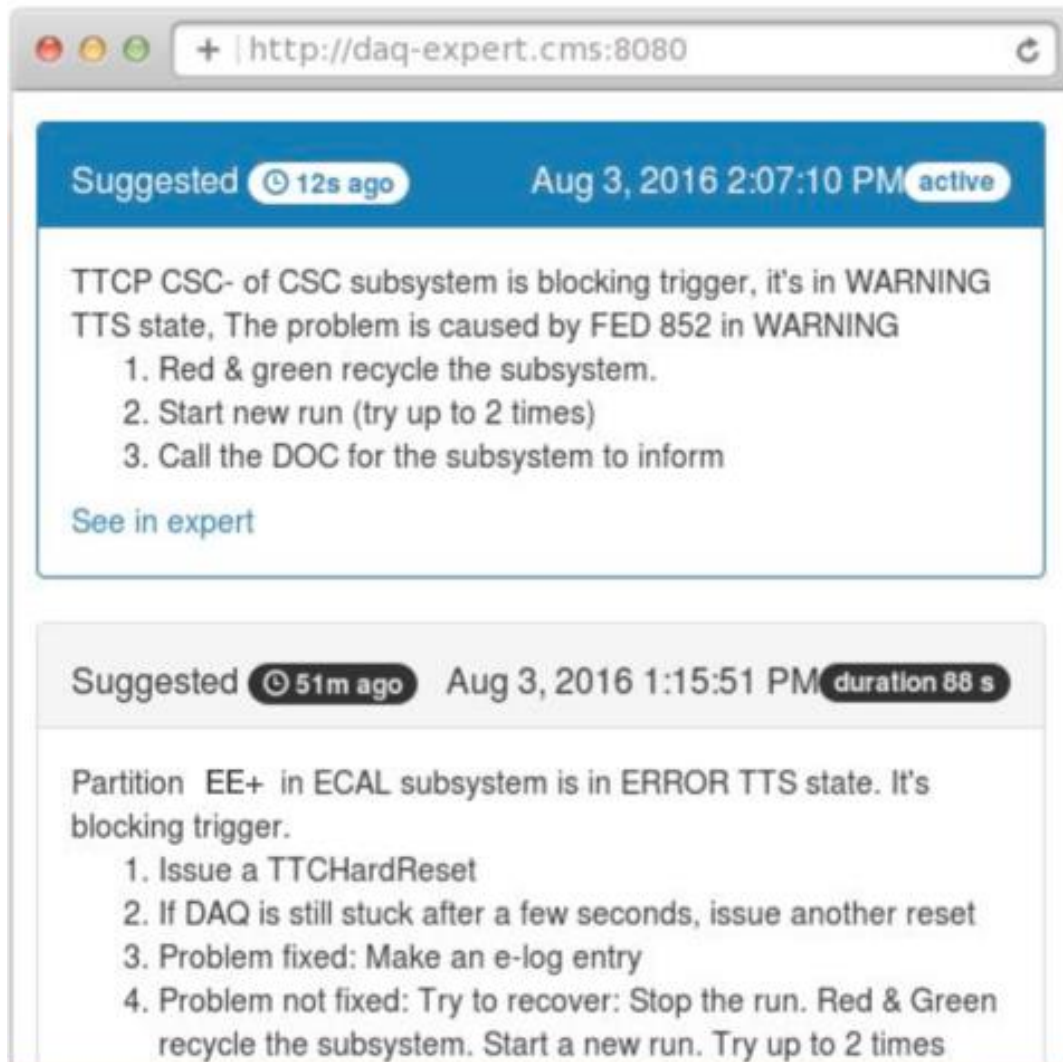
# New DAQ Expert







# New DAQ Expert



- New tool based on Java / Web Technologies
- New rules for DAQ-2 system
- Gives detailed recovery instructions for known error situations
- Simplified model of monitoring data
- Reasoning encapsulated in logic modules
  - Easy to extend

# Today



- Automatic actions following DCS / LHC state changes
- Improved configuration handling
- Guidance
- Soft Error recovery
- Automator : two-click recovery / 1-click start of run
- Recovery instructions by the DAQ Expert

## Summary

System controlled by  
DAQ Expert



Automator: 2-click recovery  
DAQ Expert advice



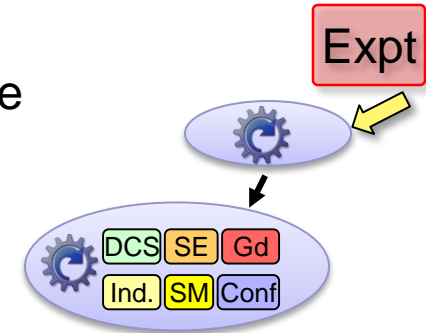
Automatic actions,  
Guidance,  
Soft Error recovery  
DAQ Doctor (Run-1)



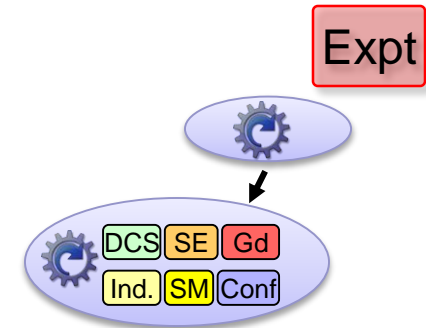
Manual Operations



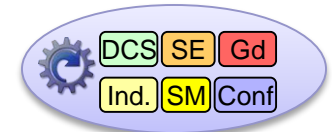
Future



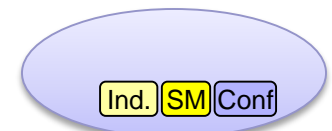
Run 2



End of  
Run 1



Start of  
Run 1





# Thank You

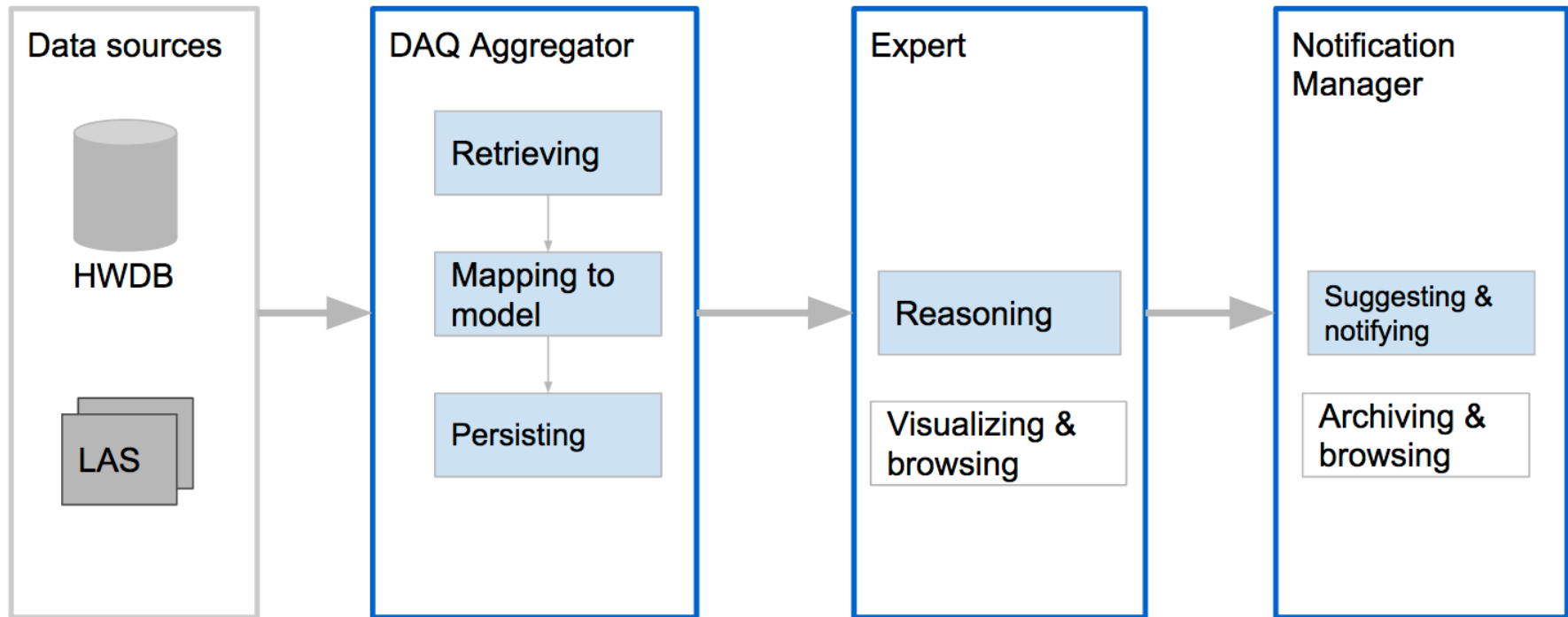


# Run-2 DAQ Expert

## DAQ Expert

# DAQExpert introduction

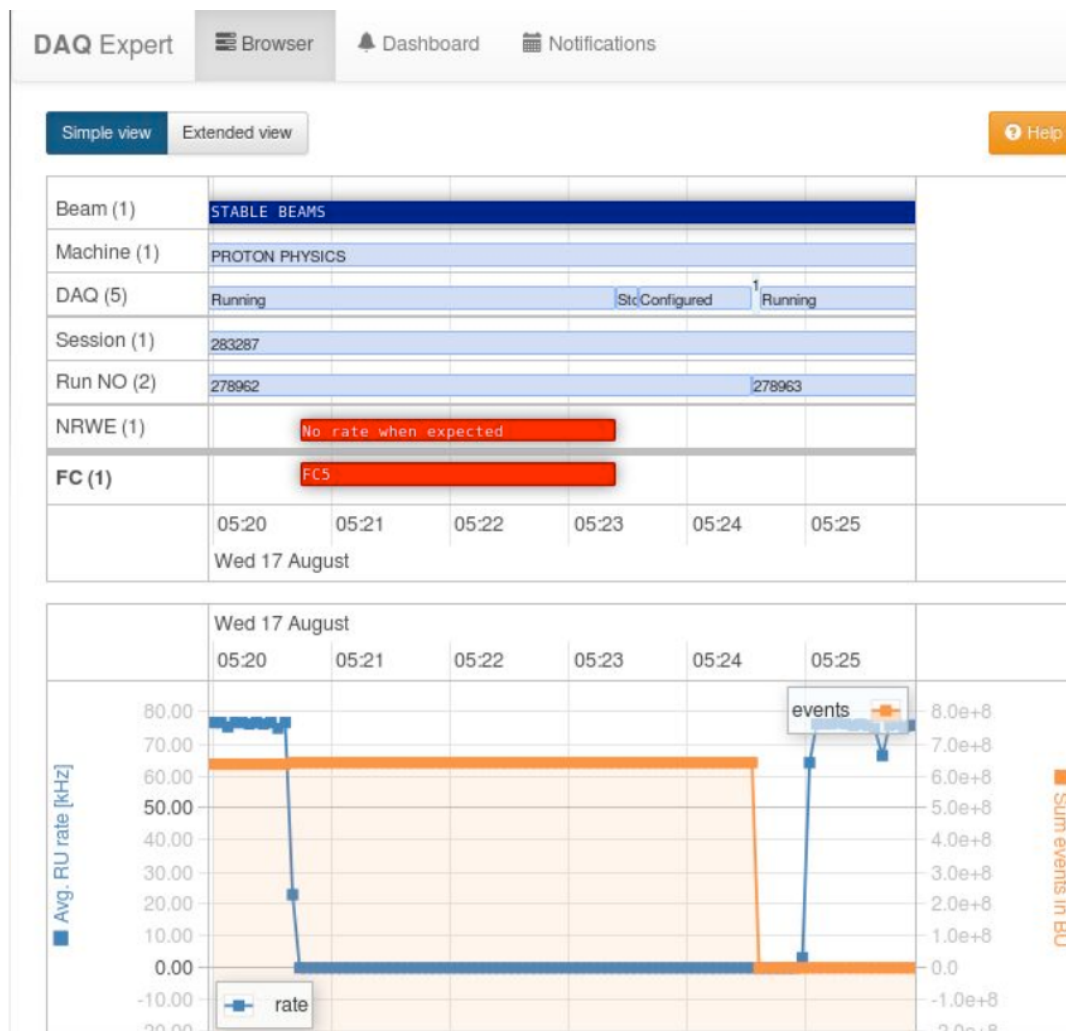
- 3 sub projects
- Source -> shifter data flow



# New DAQ expert

## Tools (browser)

- Visualizes analysis in time
- Goal: post-mortem analysis
- Analysis panel
  - 1 Row - 1 Logic Module\*
  - Color coding
  - Details popup
- Raw data panel
  - Parameters from snapshots
  - Raw snapshot popup (JSON)
- Freely move and zoom in time
- simple/extended view

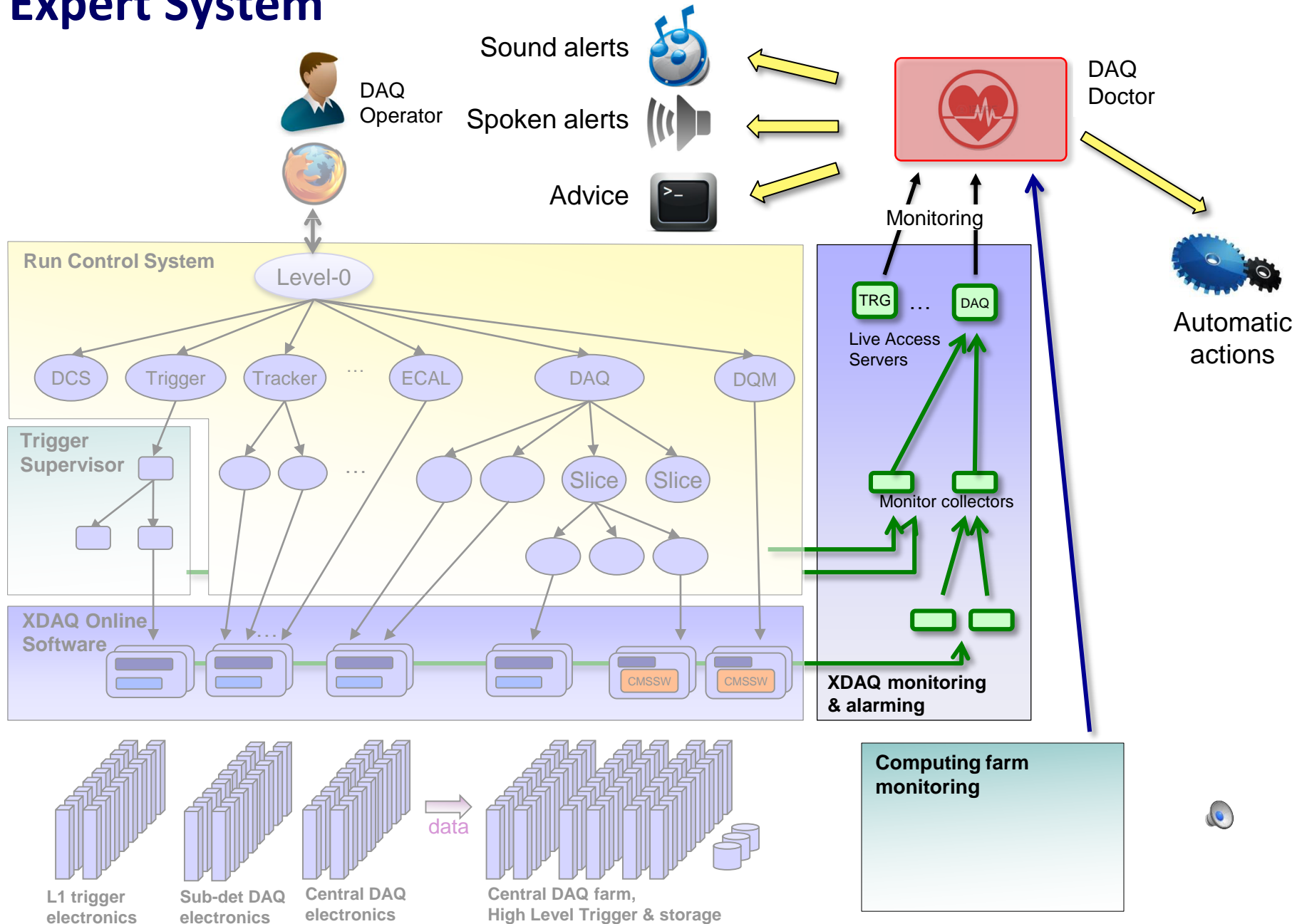




# Run-1 DAQ Doctor

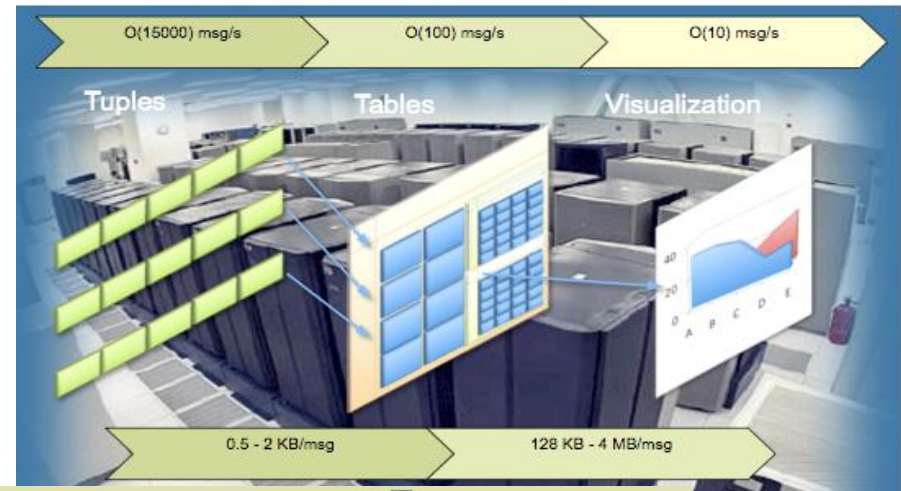


# Expert System



# The DAQ Doctor

- Expert tool based on the same technology as **Booking.com**
  - High level scripting language (Perl)
- Generic framework & pluggable modules
- Detection of high level anomaly triggers further investigation
- Archive (web based)
  - All Notes
  - Sub-system errors
  - CRC errors
- Dumps (of all monitoring data) for expert analysis in case of anomalies



**An extract of the DaqDoctors Notes for the year** 2012

Note that not all subsystem errors are contained in this list. For a full error list browse the [archive of the DaqDoctor!](#)

	ALL	CASTOR	CSC	DAQ	DT	DTTF	ECAL	ES	GCT	HCAL	PIXEL	SCAL	RPC	Tracker	Trigger
Date															
2012-05-18 18:18:26	STABLE BEAMS	PIXEL	PMSSoftware	oldstate: Faulty											
2012-05-17 17:48:28	SETUP	PIXEL	PMSSoftware	oldstate: Initializing											
2012-05-17 03:39:08	STABLE BEAMS	PIXEL	PMSSoftware	oldstate: FixingSoftware											
2012-05-17 03:39:23	SETUP	PIXEL	PMSSoftware	oldstate: Configuring											
2012-05-14 13:50:20	SETUP	PIXEL	PMSSoftware	oldstate: Configuring											
2012-05-14 13:48:32	RAMP DOWN	PIXEL	PMSSoftware	oldstate: Initializing											
2012-05-14 13:47:37	RAMP DOWN	PIXEL	PMSSoftware	oldstate: Halted											
2012-05-08 14:31:41	SETUP	PIXEL	PMSSoftware	oldstate: Initializing											
2012-04-28 00:32:32	NO BEAM	PIXEL	PMSSoftware	oldstate: Initializing											
2012-04-27 15:23:59	NO BEAM	PIXEL	PMSSoftware	oldstate: Starting											
2012-04-27 15:19:38	NO BEAM	PIXEL	PMSSoftware	oldstate: Initializing											
2012-04-20 15:22:08	SETUP	PIXEL	PMSSoftware	oldstate: Initializing											
2012-04-19 16:09:52	SETUP	PIXEL	PMSSoftware	oldstate: Initializing											
2012-04-19 12:56:32	SETUP	PIXEL	PMSSoftware	oldstate: Initializing											
2012-04-19 00:49:53	STABLE BEAMS	PIXEL	PMSSoftware	oldstate: Initializing											
2012-04-19 00:48:30	STABLE BEAMS	PIXEL	PMSSoftware	oldstate: Initializing											
2012-04-19 00:48:06	STABLE BEAMS	PIXEL	PMSSoftware	oldstate: Initializing											
2012-04-19 00:47:30	STABLE BEAMS	PIXEL	PMSSoftware	oldstate: Initializing											
2012-04-19 00:46:56	STABLE BEAMS	PIXEL	PMSSoftware	oldstate: Initializing											
2012-04-18 20:30:42	STABLE BEAMS	PIXEL	PMSSoftware	oldstate: Initializing											
2012-04-15 12:54:52	SETUP	PIXEL	PMSSoftware	oldstate: Initializing											
2012-04-15 09:44:28	SETUP	PIXEL	PMSSoftware	oldstate: Initializing											
2012-04-12 23:36:13	SETUP	PIXEL	PMSSoftware	oldstate: Initializing											



# The DAQ Doctor

## ■ Diagnoses Anomalies in

- ☐ L1 rate
- ☐ HLT physics stream rate
- ☐ Dead time
- ☐ Backpressure
- ☐ Resynchronization rate
- ☐ Farm health
- ☐ Event builder and HLT farm data flow
- ☐ HLT farm CPU utilization
- ☐ ...

2013-02-02 00:02:31	ADJUST	The average event size is suspiciously SMALL: 237 kB. Normally around 700kB are expected during a Physics run with all subdetectors in and at the beginning of a fill. Check with the shiftleader and the DQM shifter if something is going wrong. (Check the Radar plot of event sizes, DQM, Detectors which are missing in the readout, ...) (...I could do this also ... but I am too lazy and something also YOU have to do...)
2013-02-02 00:05:27	ADJUST	The total datarate written by the StorageManagers to disk has changed by 932.471560311376%. It is now 114.9 MB/s.
2013-02-02 00:05:35	ADJUST	sTTS of TIBTID is in Out-Of-Sync. Please follow the instructions in the DAQ Shifter Action Matrix (in the bulletin board)!
2013-02-02 00:05:41	ADJUST	Number of resyncs in this run now: 4
2013-02-02 00:05:43	ADJUST	sTTS of TIBTID is not anymore in Out-Of-Sync.
2013-02-02 00:05:51	ADJUST	TTS Alarm for partition CSC+: FMM fmmpec-s1d12-07.cms slot 3 is 9.25% in busy!

## ■ Automatic actions

- ☐ Triggers computation of a new central DAQ configuration in case of PC hardware failure(great help for on-call experts since 2012)

2013-02-02 01:48:32	INJ PROBE BEAM	I did not find a reason yet why the DAQ is in ERROR... may be the monitoring system is slow and I need more up to date data. I try again in 10 seconds. (try no: 2/3)
2013-02-02 01:48:47	INJ PROBE BEAM	====> !!! Trouble ahead !!! <==== The machine ru-c2a05-15.cms does not respond to ssh connections. It is probably crashed.
2013-02-02 01:48:47	INJ PROBE BEAM	I am now trying to generate and register a new configuration without the offending host ru-c2a05-15.cms in slice 1... some patience please...
2013-02-02 01:49:27	INJ PROBE BEAM	The new configuration has been generated and created. Probably stopping the run will fail. When you recycle the DAQ the new configuration without the broken computer will be picked up and you should be able to continue. But remember: if you are happily taking data at the moment defer the recycling of the DAQ as much as possible! Only interrupt this run when really necessary!



# Technology

# Control and Monitoring Systems in CMS



DCS  
Operator



DAQ  
Operator

## Run Control System – Java, Web Technologies

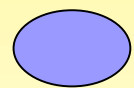
Defines the control structure



GUI in a web browser

HTML, CSS, JavaScript, AJAX

Run Control Web Application  
Apache Tomcat Servlet Container  
JSP, Tag Libraries

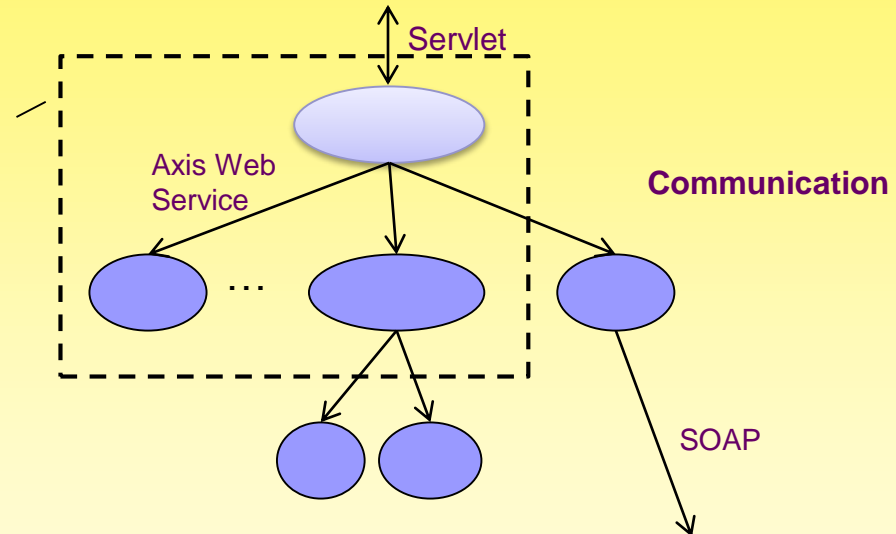


### Function Manager

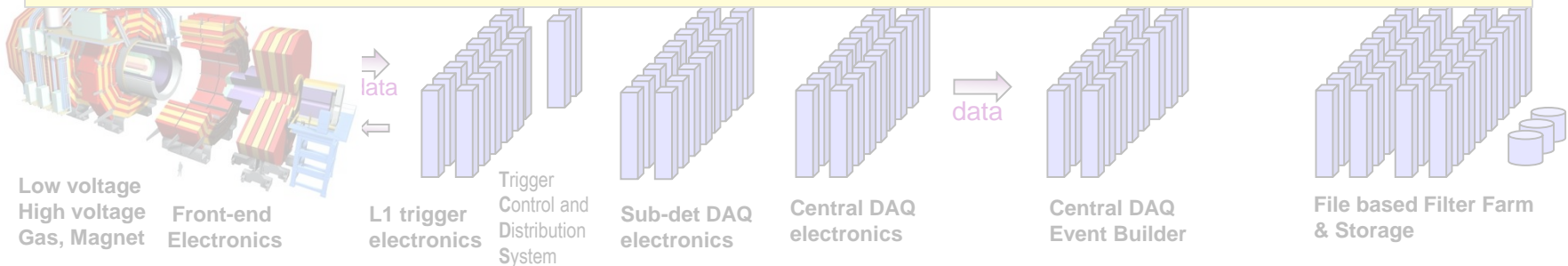
Node in the Run Control Tree  
defines a State Machine & parameters

Specific actions, automation etc.  
implemented in Java

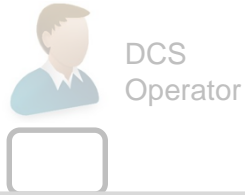
User function managers dynamically  
loaded into the web application



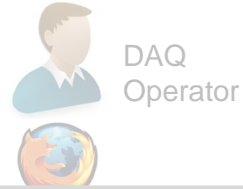
Production system:  
40 tomcats on 20 virtual machines



# Control and Monitoring Systems in CMS



DCS  
Operator



DAQ  
Operator

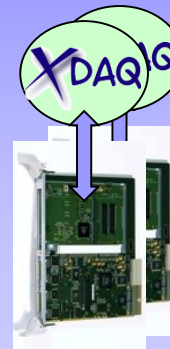
## XDAQ Framework – C++

XDAQ applications control **hardware** and handle **data flow**

Hardware Access, Transport Protocols,  
XML configuration, SOAP communication,  
HyperDAQ web server



XDAQ Application



data

SOAP

Several 1000  
applications to control

