



THE WONDERLAND OF OPERATING THE ALICE EXPERIMENT

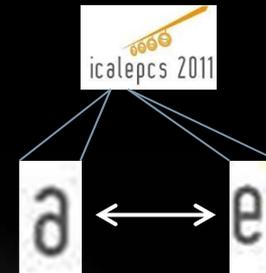
The Challenges of Operating a Large Physics Experiment



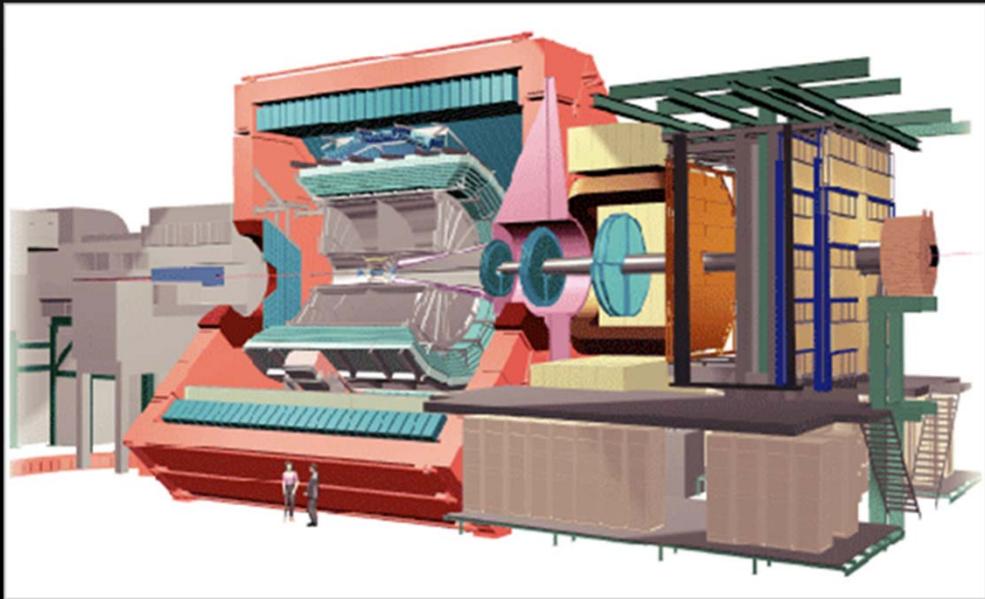
OUTLINE



- Introduction and context
- The evolution of the experiment
- The challenges and how to master them
 - How these challenges are different between experiments and accelerators
 - Justify the 'a' and 'e' in ICALEPCS...



INTRODUCTION

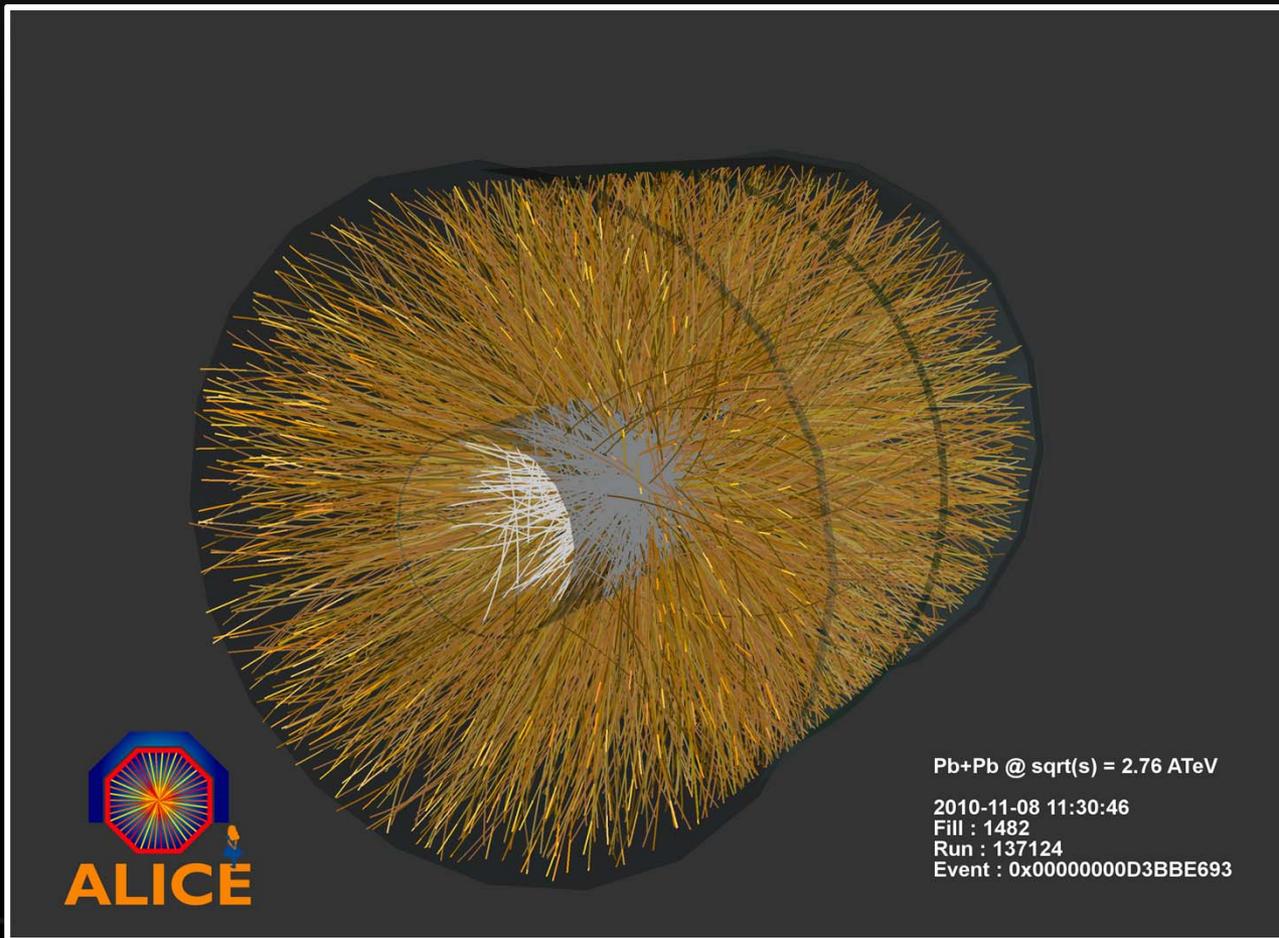


- Heavy Ion experiment
- 20 sub-detectors
- 16 x 16 x 26 m
- 10 000 tons

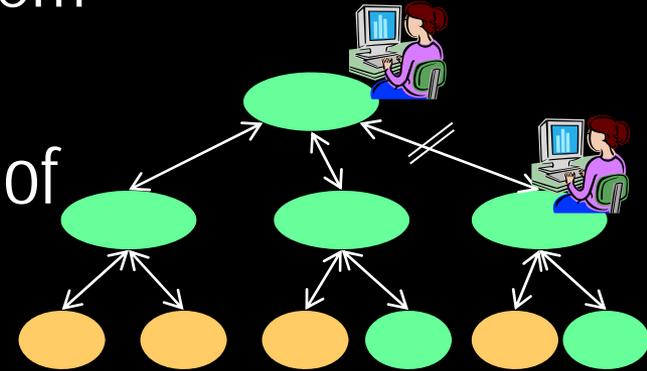
- 1300 collaborators
- 116 institutes, 33 countries



Pb – Pb Event

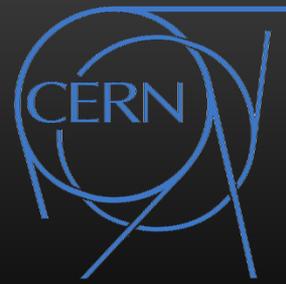


- Control & Monitoring 20 sub-detectors, 2 magnets, various services
 - 1 000 000 *channels*
- Designed as strict hierarchical system
 - Strict separation between sub-detectors
- Behaviour modelled with hierarchy of Finite State Machines
 - Commands going down, states coming up
 - *Partitioning* feature





Detector Control System



- Implemented with commercial SCADA (PVSSII)
 - With CERN and ALICE specific extensions
- Applications developed by detector teams
- Over 150 controls PCs, 1200 networked devices



Experiment Evolution:

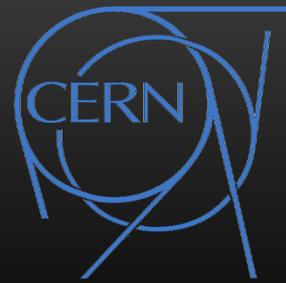
From Installation to Routine Operation



- 2006: installation, debugging
- 2008: first collisions
- 2009: cosmics data, restart
- 2010: first full year of operation, first HI
- 2011: 'routine' operation



The Evolution Challenge



- The Detector Control System has to
 - follow the evolution of the experiment equipment
 - follow the evolution of the use of DCS
 - follow the evolution of the users of DCS



The Evolution Challenge

Experiment Equipment

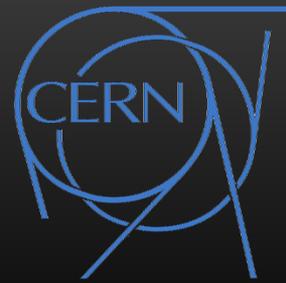


- The experiment is a very dynamic object
 - Squeeze in more detectors at each opportunity
 - Devices to control (or the way to access them) is changing
- Likely to be more dynamic than the accelerator environment
 - If only because of 20 different, independent detector groups



The Evolution Challenge

Use and Users of DCS



- Evolution of the use of DCS
 - Started off with debugging
 - Moved from local operation to central operation
- Evolution of the users of DCS
 - Started off with developers and experts
 - Evolution to detector experts to non-expert users



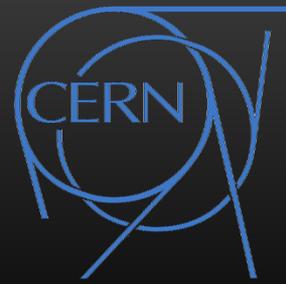
From local to central operation



- Reducing number of operators
 - From 25 local, detector, operators to 5 central operators
- DCS was designed with central operation in mind
- More a psychological than a technical issue
 - Convince detectors to transfer control of their baby to a central operator



The Single Operator Challenge



- The central operator needs dedicated tools
 - All sub-detectors need proper integration in central top level control system
 - Importance of homogeneous development upstream
 - Major coordination challenge
 - Tools to operate groups of detectors
 - Automation wherever possible
 - recurrent actions, actions that need to be performed to guarantee safety of detector equipment e.g. on change of LHC beam mode

DCS groups

	Group A	Group B	Group C	Group D	Group E	Group F	Others
	IS READY	IS READY	UNKNOWN	NOT READY	NOT READY	NOT READY	NOT READY
Aco	READY	Aco	Aco	Aco	Aco	Aco	<input type="checkbox"/> Aco
Emc	READY	Emc	Emc	Emc	Emc	Emc	<input type="checkbox"/> Emc
Fmd	READY	Fmd	Fmd	Fmd	Fmd	Fmd	<input checked="" type="checkbox"/> Fmd
Hmp	READY	Hmp	Hmp	Hmp	Hmp	Hmp	<input checked="" type="checkbox"/> Hmp
Mch	MOVING_READY	Mch	Mch	Mch	Mch	Mch	<input checked="" type="checkbox"/> Mch
Mtr	READY	Mtr	Mtr	Mtr	Mtr	Mtr	<input checked="" type="checkbox"/> Mtr
Phs	STANDBY	Phs	Phs	Phs	Phs	Phs	<input type="checkbox"/> Phs
Pmd	STBY_CONFIGURED	Pmd	Pmd	Pmd	Pmd	Pmd	<input checked="" type="checkbox"/> Pmd
Sdd	READY	Sdd	Sdd	Sdd	Sdd	Sdd	<input type="checkbox"/> Sdd
Spd	READY	Spd	Spd	Spd	Spd	Spd	<input type="checkbox"/> Spd
Ssd	READY	Ssd	Ssd	Ssd	Ssd	Ssd	<input type="checkbox"/> Ssd
T00	READY	T00	T00	T00	T00	T00	<input type="checkbox"/> T00
Tof	READY	Tof	Tof	Tof	Tof	Tof	<input checked="" type="checkbox"/> Tof
Tpc	READY	Tpc	Tpc	Tpc	Tpc	Tpc	<input type="checkbox"/> Tpc
Trd	READY	Trd	Trd	Trd	Trd	Trd	<input checked="" type="checkbox"/> Trd
V00	READY	V00	V00	V00	V00	V00	<input type="checkbox"/> V00
Zdc	READY	Zdc	Zdc	Zdc	Zdc	Zdc	<input checked="" type="checkbox"/> Zdc
V0 rate =	163.22 kHz	400	300	none	none	200	none

enable radioboxes for changing groups/partitions

panel by: Ombretta Pinazza

Vision_1: TOP
 Module Panel Scale Help
 13:07 06-04-11 ResUi v3.0.12
 dcsoper
 ALICE Status: SAFE
 CSAM DimDns
 DSS FieldMapAv
 Big Screen Settings
 MONITORING PANEL TITLE
 FSM Tree: end load!
 LHC BEAM SETUP
 INJECTION PHYSICS BEAM
 Env. 19.4°C 981.0mbar
 ALI_DCS NOT READY
 FSM

A side O side Boxes Safe/SuperSafe RestoreReady MagnetSafe LHC cycle

Popup Message
 Condition: Beam mode == PREPARE RAMP
 Detector(s): TRD
 Command: GO_SUPERSAFE
 Do you want to execute the procedure?
 Ok Cancel

BEAM DUMP
 CYCLING
 UNSTABLE BEAMS
 STABLE BEAMS
 DUMP HANDSHAKE
 ADJUST HANDSHAKE
 ADJUST
 SQUEEZE
 FLAT TOP
 RAMP
 PREPARE RAMP
 RAMP DOWN
 RECOVER
 ABORT
 INJECTION SETUP BEAM
 INJECTION PHYSICS BEAM
 A action present, enabled
 A action present, disabled
 Define new action
 View list of actions

ACO_DCS	READY
EMC_DCS	READY
FMD_DCS	OFF
HMP_DCS	STBY_CONFIG...
MCH_DCS	STBY_CONFIG...
MTR_DCS	STBY_CONFIG...
PHS_DCS	READY
PMD_DCS	STBY_CONFIG...
SDD_DCS	READY
SPD_DCS	BEAM_TUNING
SSD_DCS	READY
T00_DCS	STBY_CONFIG...
TOF_DCS	BEAM_TUNING
TPC_DCS	BEAM_TUNING
TRD_DCS	MIXED
V00_DCS	BEAM_TUNING
ZDC_DCS	BEAM_TUNING
PIT_DCS	READY
TRI_DCS	READY

Auxiliary Monitoring Zone
 Start Vision_1: TOP
 panel by: Ombretta Pinazza



The Single Operator Challenge



- All these tools need to be flexible and configurable
 - Cope with changes in operation of the experiment
- Central operator need to react on anomalies in ALL sub-detectors
 - Tools to access procedures (and ensure they are valid)
 - Make sure only relevant messages reach the operator



The Single Operator Challenge



- High turnaround of operators
 - Very specific to HEP culture
 - Many operators that only do few shifts
 - Not necessarily controls nor detector expert
 - As opposed to accelerator world
 - limited number of operators, that usually are controls or machine experts, that do many shifts
 - ALICE 2011: 926 shifts, more than 80 operators, on average only 11 days of operator shift work



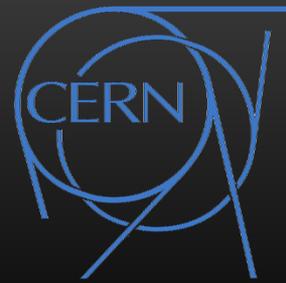
The Single Operator Challenge



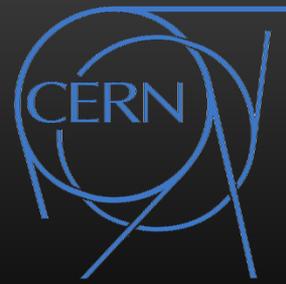
- Requires huge effort for training
 - and administration
- Requires clear, extensive documentation understandable for non-expert, and easily accessible



The Coordination Challenge



- Initial stage, development
 - To overcome cultural differences: Start coordinating early, strict guidelines
- During operation, maintenance and operation
 - Again, due to HEP culture, original developers tend to drift away
 - (apart for a few exceptions) very difficult to ensure continuity for the control systems in the projects
 - In many small detector projects, controls is done only part-time by a single person



Conclusions

- Experiment environment evolves rapidly
 - DCS design: think scalability, flexibility
- Central operation
 - Cope with large number of operators
 - Adequate and flexible operation tools, automation
 - Easily accessible, explicit procedures
- Experiment world is dynamic, volatile
 - Requires a major coordination effort