

ALICE Detector Control System Management and Organization

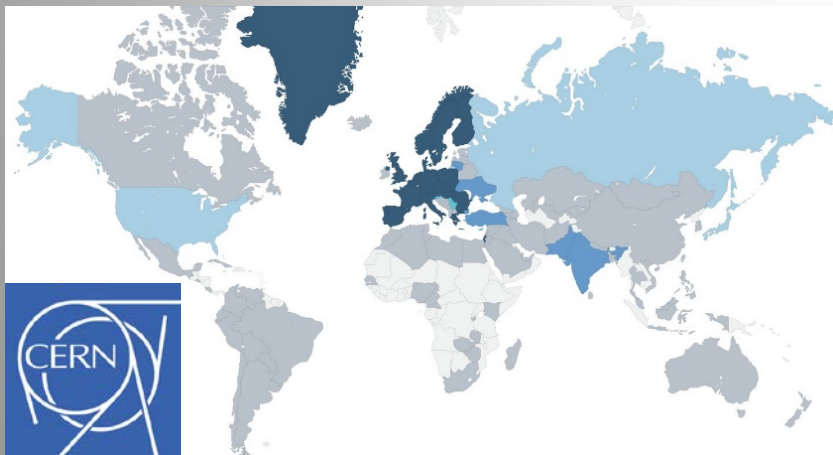
Peter Chochula, Mateusz Lechman
for ALICE Controls Coordination Team

Outline

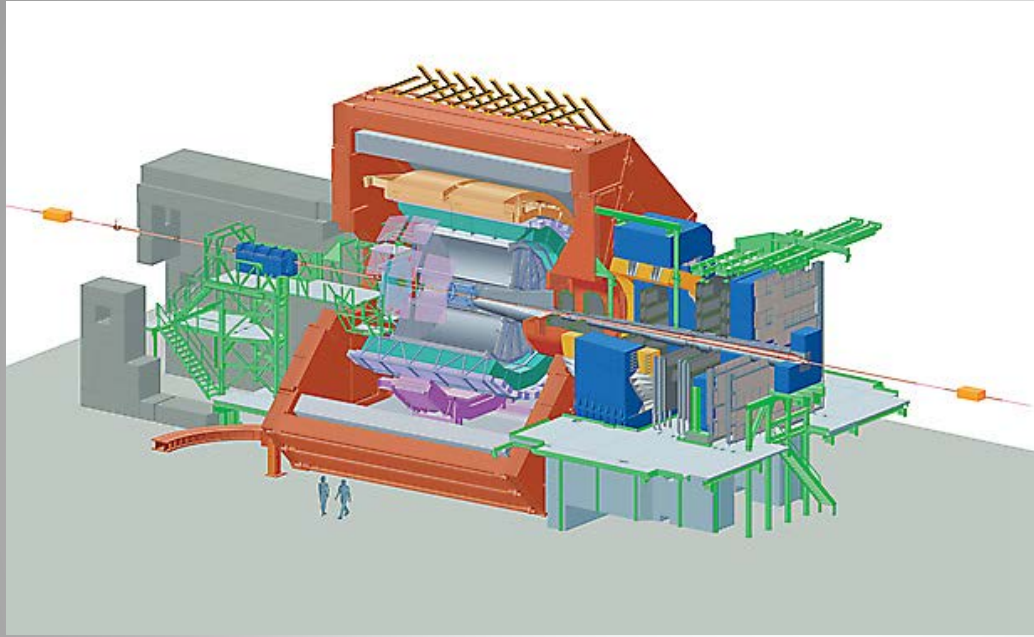
- ▶ The ALICE experiment at CERN
- ▶ Organization of the controls activities
- ▶ Design goals and strategy
- ▶ DCS architecture
- ▶ DCS operation
- ▶ Infrastructure management
- ▶ Summary & Open discussion

CERN & LHC

- ▶ European Organization for Nuclear Research
 - ▶ *Conseil Européen pour la Recherche Nucléaire*
- ▶ Main function: to provide particle accelerators and other infrastructure needed for high-energy physics research
- ▶ 22 member states + wide cooperation: 105 nationalities
- ▶ 2500 employees + 12000 associated members of personnel
- ▶ Main project: Large Hardron Collider



ALICE – A Large Ion Collider Experiment



Collaboration:
Members: 1500
Institutes: 154
Countries: 37

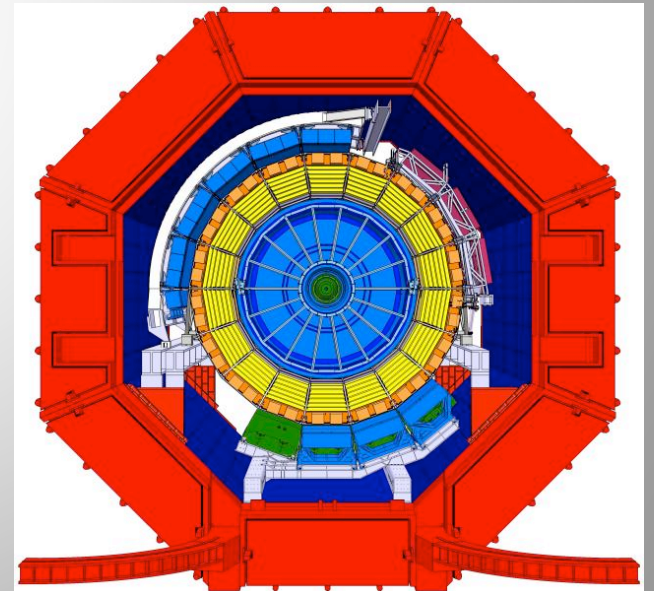
Detector:

Size: 16 x 16 x 26 m (some components installed >100m from interaction point)

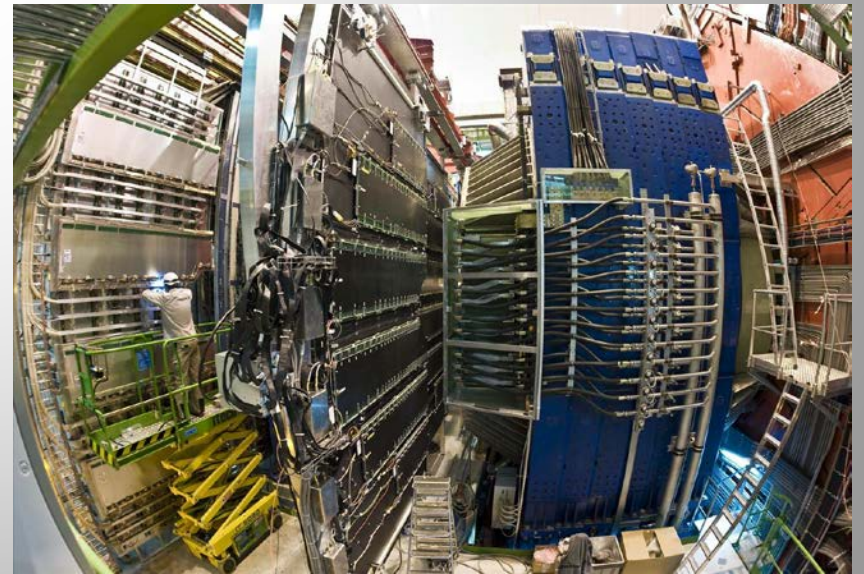
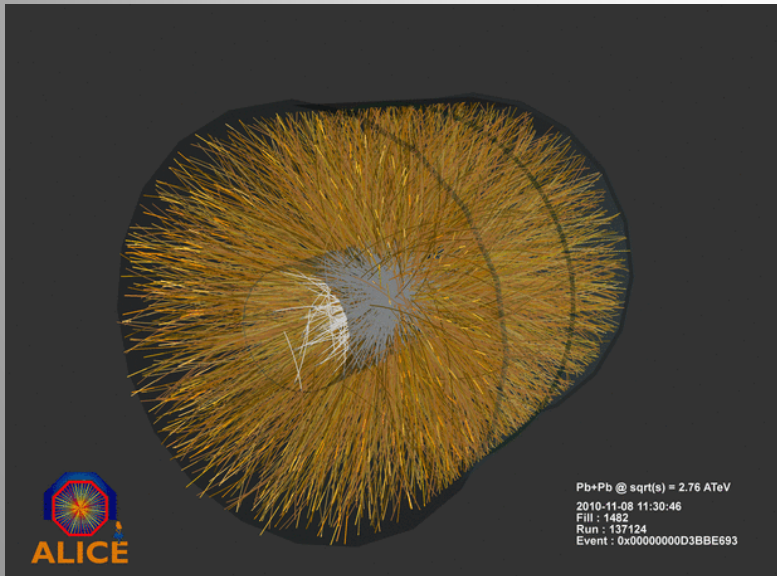
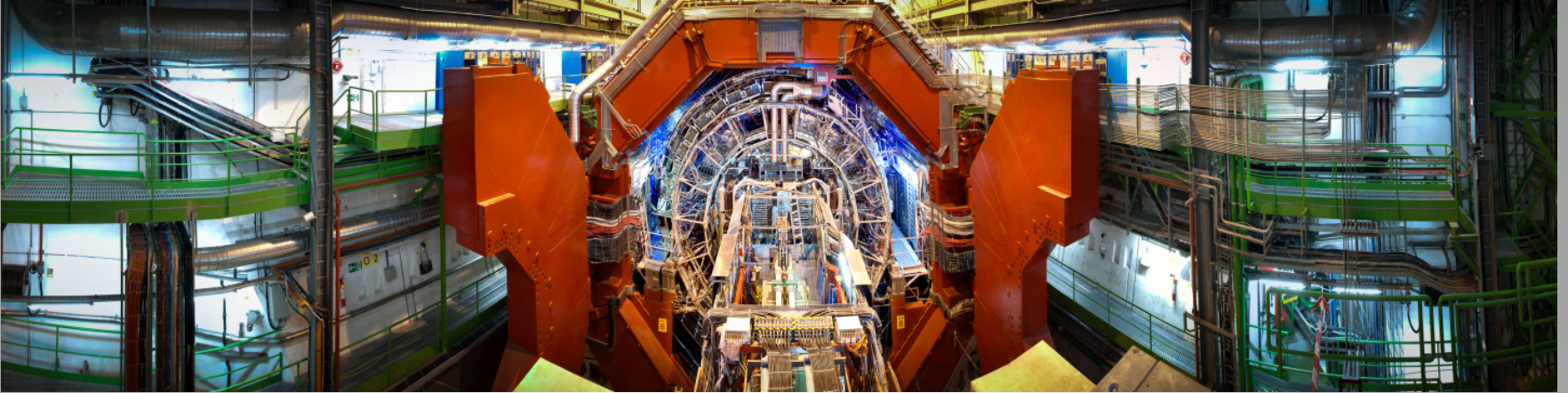
Mass: 10,000 tons

Sub-detectors: 19

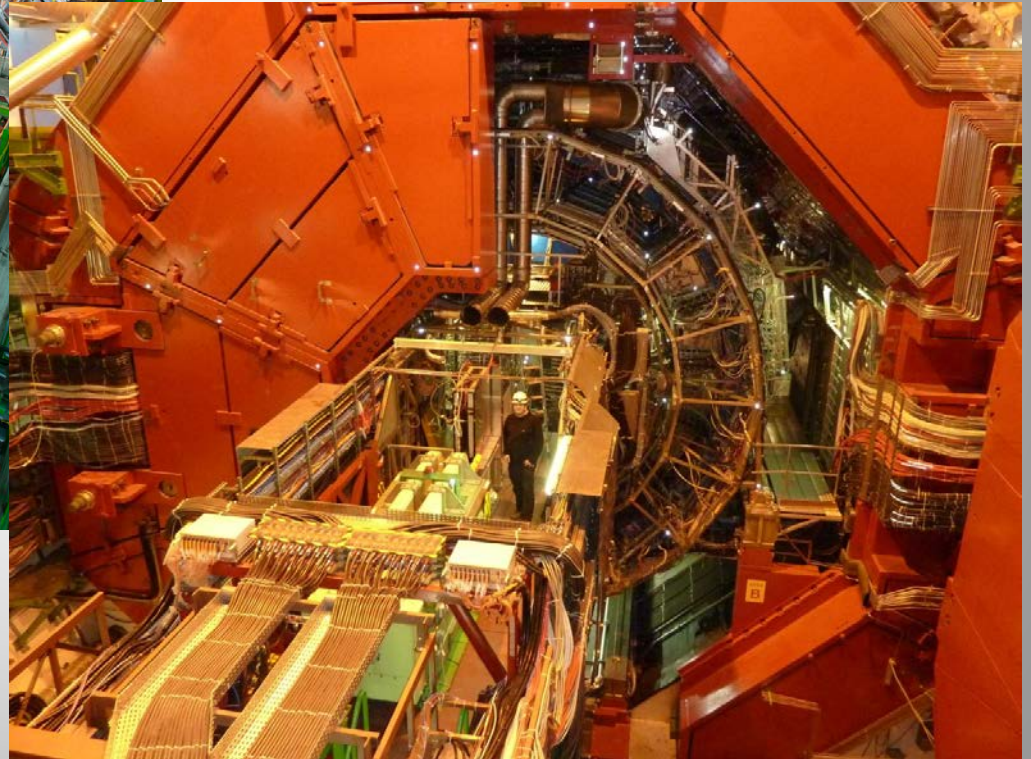
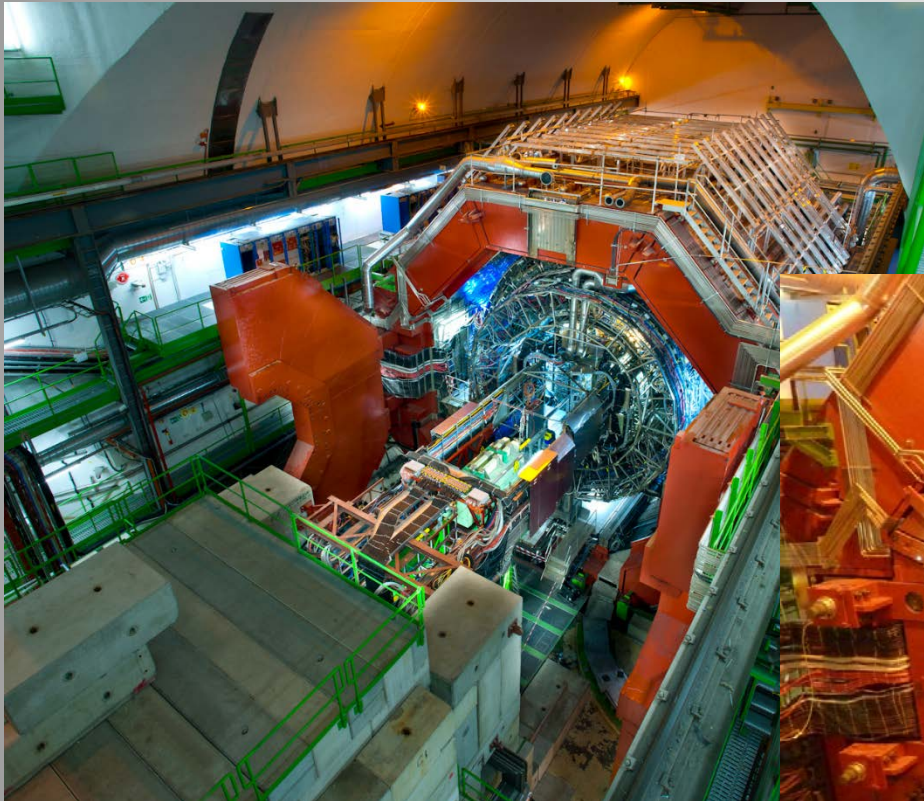
Magnets: 2



ALICE – A Large Ion Collider Experiment

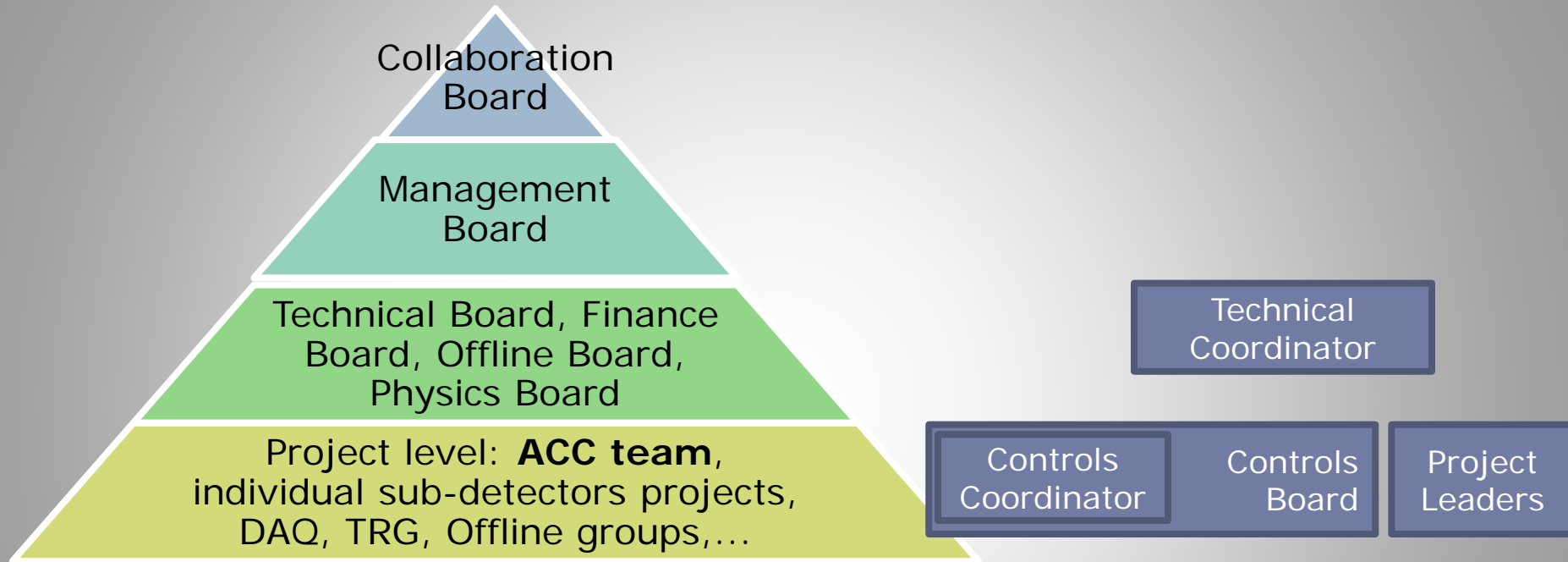


ALICE – A Large Ion Collider Experiment



Organization of controls activities

Decision making in ALICE



- ▶ Mandate of **ALICE Controls Coordination (ACC)** team and definition of Detector Control System (DCS) project approved by Management Board (2001)
 - ▶ Strong formal foundation for fulfilling duties

Organization structures

- ▶ ALICE Control Coordination (ACC) is the functional unit mandated to co-ordinate the execution of the Detector Control System (DCS) project
- ▶ Other parties involved in the DCS project:
 - ▶ Sub-detector groups
 - ▶ Groups providing the external services (IT, gas, electricity, cooling,...)
 - ▶ DAQ, Trigger and Offline systems, LHC Machine
- ▶ Controls Coordinator (leader of ACC) reports to Technical Coordinator and Technical Board
- ▶ ALICE Controls Board
 - ▶ ALICE Controls Coordinator + one representative per each sub-detector project and service activity
 - ▶ The principal steering group for DCS project, reports to Technical Board

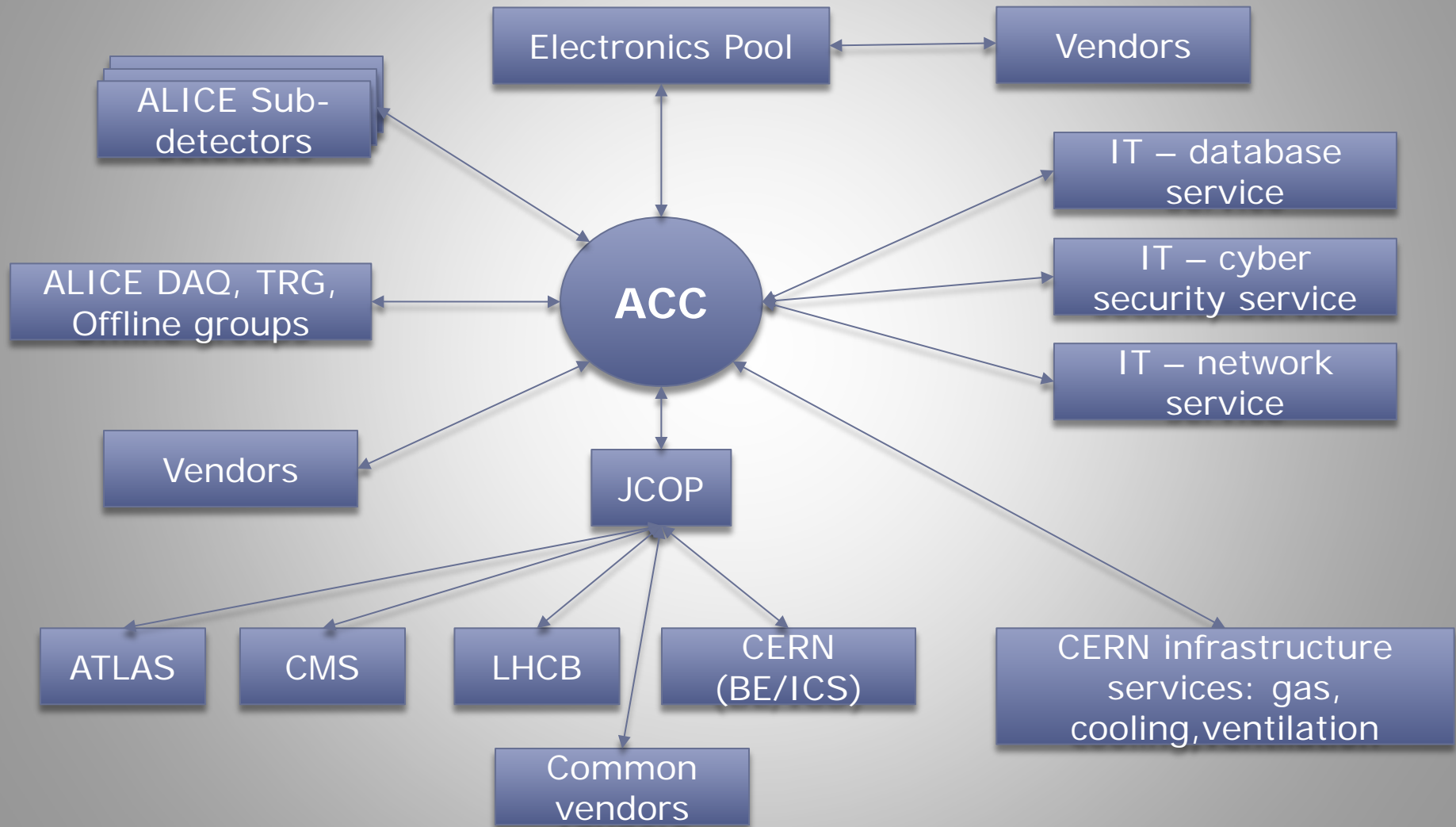
Controls activities

- ▶ The sub-detector control systems are developed by the contributing institutes
 - ▶ Over 100 developers from all around the world and from various backgrounds
 - ▶ Many sub-detector teams had limited expertise in controls, especially in large scale experiments
- ▶ ACC team (~7 persons) is based at CERN
 - ▶ Provides infrastructure
 - ▶ Guidelines and tools
 - ▶ Consultancy
 - ▶ Integration
 - ▶ Cooperates with other CERN experiments/groups

Technical competencies in ACC

- ▶ Safety aspects (member of ACC is deputy GLIMOS)
- ▶ System architecture
- ▶ Control system developement (SCADA, devices)
- ▶ IT administration (Windows, Linux platforms, network, security)
- ▶ Database development (administration done by the IT deparment)
- ▶ Hardware interfaces (OPCS, CAN interfaces)
- ▶ PLCs

ACC- relations



Cooperation

Joint COntrols Project (JCOP) is a collaboration between CERN and all LHC experiments to exploit communalities in the control systems

- ▶ Provides, supports and maintains a common framework of tools and a set of components
- ▶ Contributions expected from all the partners
- ▶ Organization: two types of regular meetings (around every 2 weeks):
 - ▶ Coordination Board
 - defining the strategy for JCOP
 - steering its implementation
 - ▶ Technical (working group)



JCOP Coordination Board - mandate

- ▶ Defining and reviewing the architecture, the components, the interfaces, the choice of standard industrial products
 - ▶ SCADA, field bus, PLC brands, etc
- ▶ Setting the priorities for the availability of services and the production as well as the maintenance and upgrade of components
 - ▶ in a way which is --as much as possible- compatible with the needs of all the experiments.
- ▶ Finding the resources
 - ▶ for the implementation of the program of work
- ▶ Identifying and resolving issues
 - ▶ which jeopardize the completion of the program as-agreed, in-time and with the available resources.
- ▶ Promoting the technical discussions and the training
 - ▶ to ensure the adhesion of all the protagonists to the agreed strategy

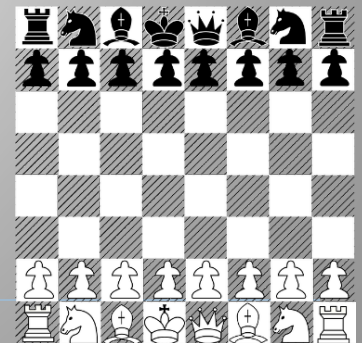
Design goals and strategy

Design goals

- ▶ DCS shall ensure safe and efficient operation
 - ▶ Intuitive, user friendly, automation
- ▶ Many parallel and distributed developments
 - ▶ Modular, still coherent and homogeneous
- ▶ Changing environment – hardware and operation
 - ▶ Expandable, flexible
- ▶ Operational outside datataking, safeguard equipment
 - ▶ Available, reliable
- ▶ Large world-wide user community
 - ▶ Efficient and secure remote access
- ▶ Data collected by DCS shall be available for offline analysis of physics data

Strategy and methods

- ▶ Common tools, components and solutions
 - ▶ Strong coordination within experiment (ACC)
 - ▶ Close collaboration with other experiments (JCOP)
 - ▶ Use of services offered by other CERN units
- ▶ Standardization: many similar subsystems in ALICE
 - ▶ Identify communalities through:
 - ▶ User Requirements Document (URD)
 - ▶ Overview Drawings
 - ▶ Meetings and workshops

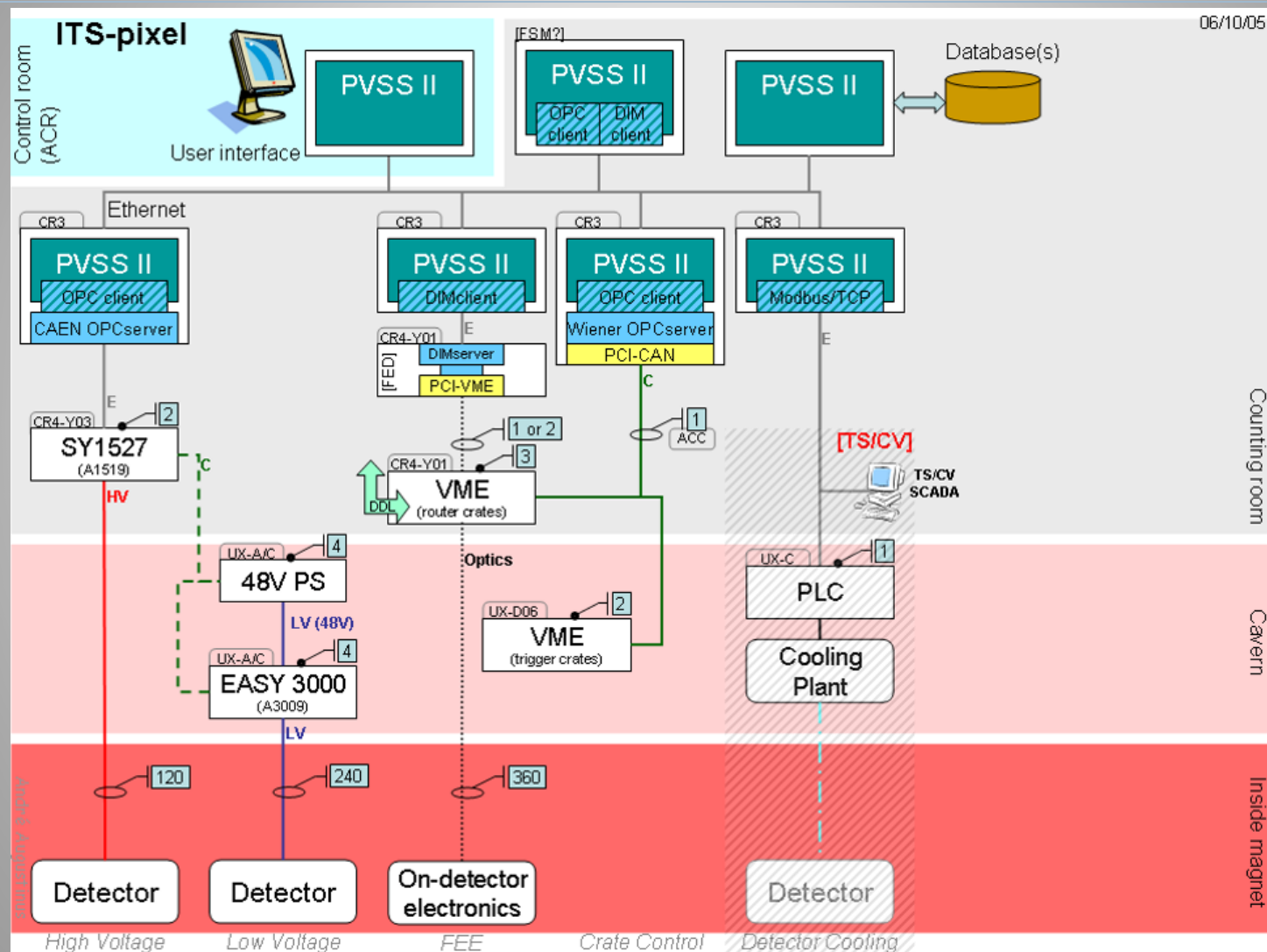


User Requirement Document

- ▶ Brief description of sub-detector goal and operation
- ▶ Control system
 - ▶ Description and requirement of sub-systems
 - ▶ Functionality
 - ▶ Devices / Equipment (including their location, link to documentation)
 - ▶ Parameters used for monitoring/control
 - ▶ Interlocks and Safety aspects
 - ▶ Operational and Supervisory aspects
 - ▶ Requirement on the control system
 - ▶ Interlocks and Safety aspects
 - ▶ Operational and Supervisory aspects
- ▶ Timescale and planning (per subsystem)
 - ▶ For each phase:
 - ▶ Design, Production and purchasing, Installation, Commissioning , Tests and Test beam



Overview Drawings





Prototype development

- ▶ In order to study and evaluate possible options of 'standard solutions' to be used by the sub-detector groups it was necessary to gain "hands-on" experience and to develop prototype solutions
- ▶ Prototype developments were identified after discussions in Controls Board and initiated by the ACC team in collaboration with selected detector groups
 - ▶ Examples:
 - ▶ Standard ways of measuring temperatures
 - ▶ Control of HV systems
 - ▶ Monitoring of LV power supplies
- ▶ Prototype of complete end-to-end detector control slices including the necessary functions at each DCS layer
 - ▶ from operator to electronics

ACC deliverables – design phase

- ▶ DCS architecture layout definition
- ▶ URD of systems, devices and parameters to be controlled and operated by DCS
- ▶ Definition of 'standard' ALICE controls components and connection mechanisms
- ▶ Prototype implementation of 'standard solutions'
- ▶ Prototype implementation of an end-to-end detector controls slice
- ▶ Global project budget estimation
- ▶ Planning and milestones



Coordination and evolution challenge

- ▶ Initial stage, development
 - ▶ Establish communication with all the involved parties
 - ▶ To overcome cultural differences: Start coordinating early, strict guidelines
- ▶ During operation, maintenance
 - ▶ HEP environment: original developers tend to drift away
(apart from 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
- ▶ The DCS has to
 - ▶ follow the evolution of the experiment equipment and software
 - ▶ follow the evolution of the use of the system
 - ▶ follow the evolution of the users

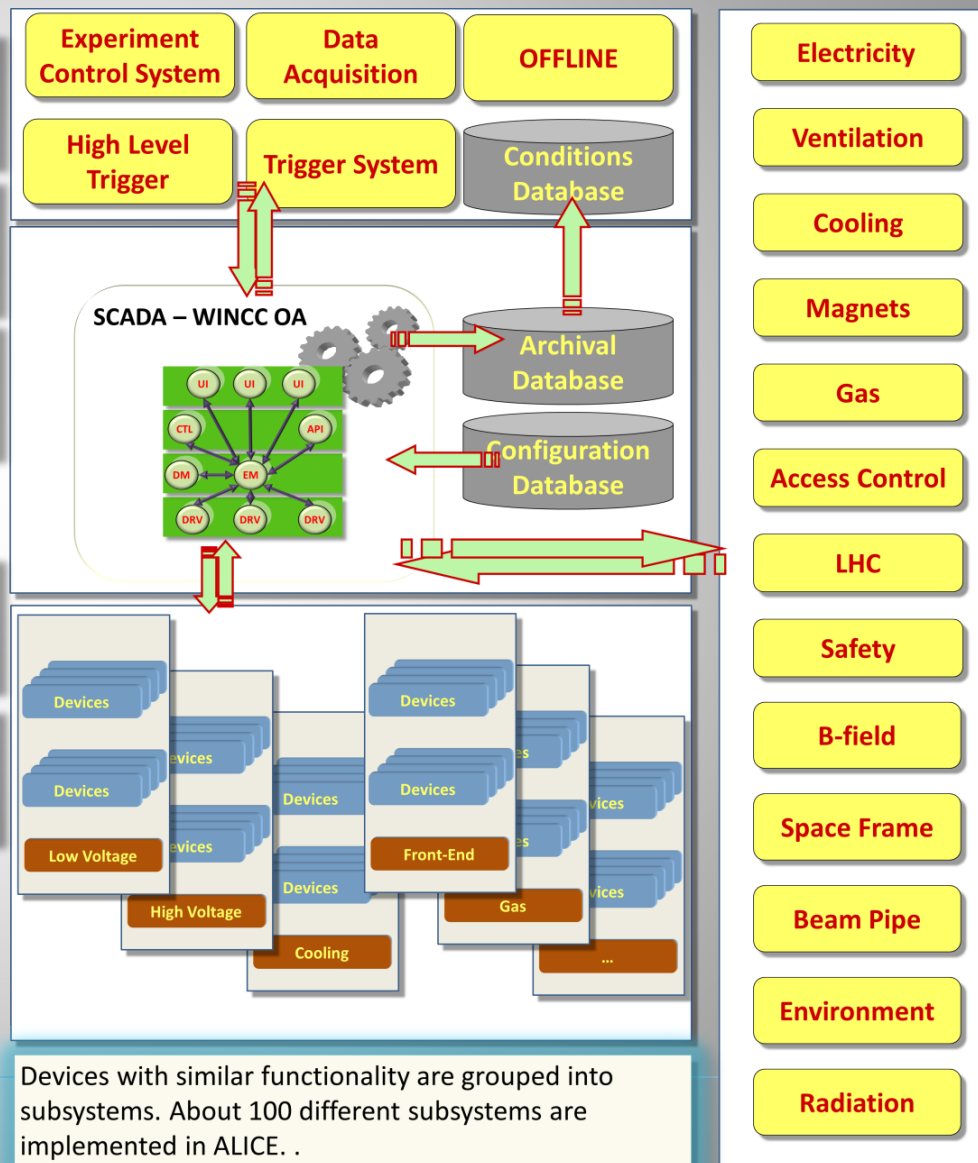
DCS Architecture

The Detector Control System

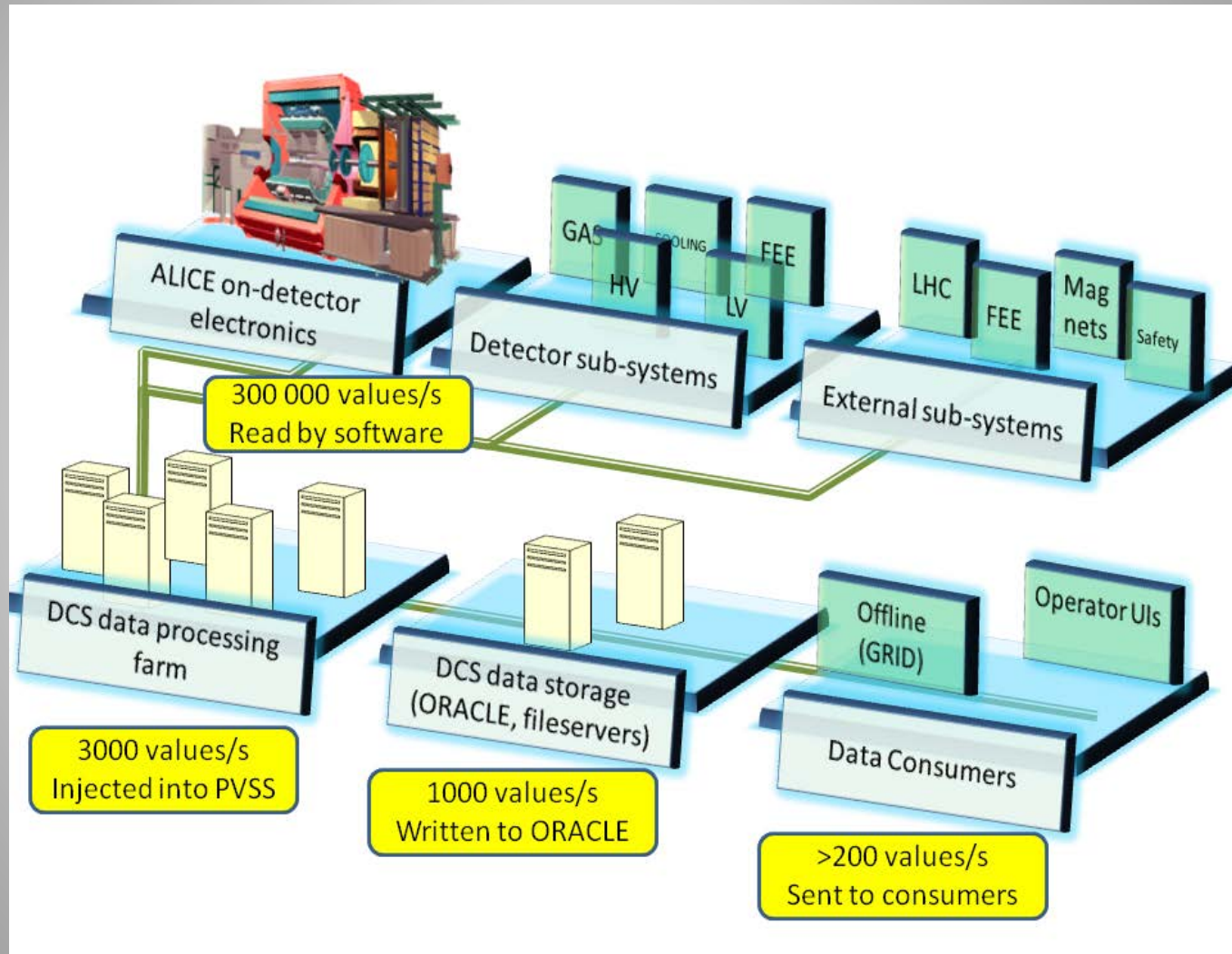
- ▶ Responsible for safe and reliable operation of the experiment
 - ▶ Designed to operate autonomously
 - ▶ Wherever possible, based on industrial standards and components
 - ▶ Built in collaboration with ALICE institutes and CERN JCOP
 - ▶ Operated by a single operator

The DCS context and scale

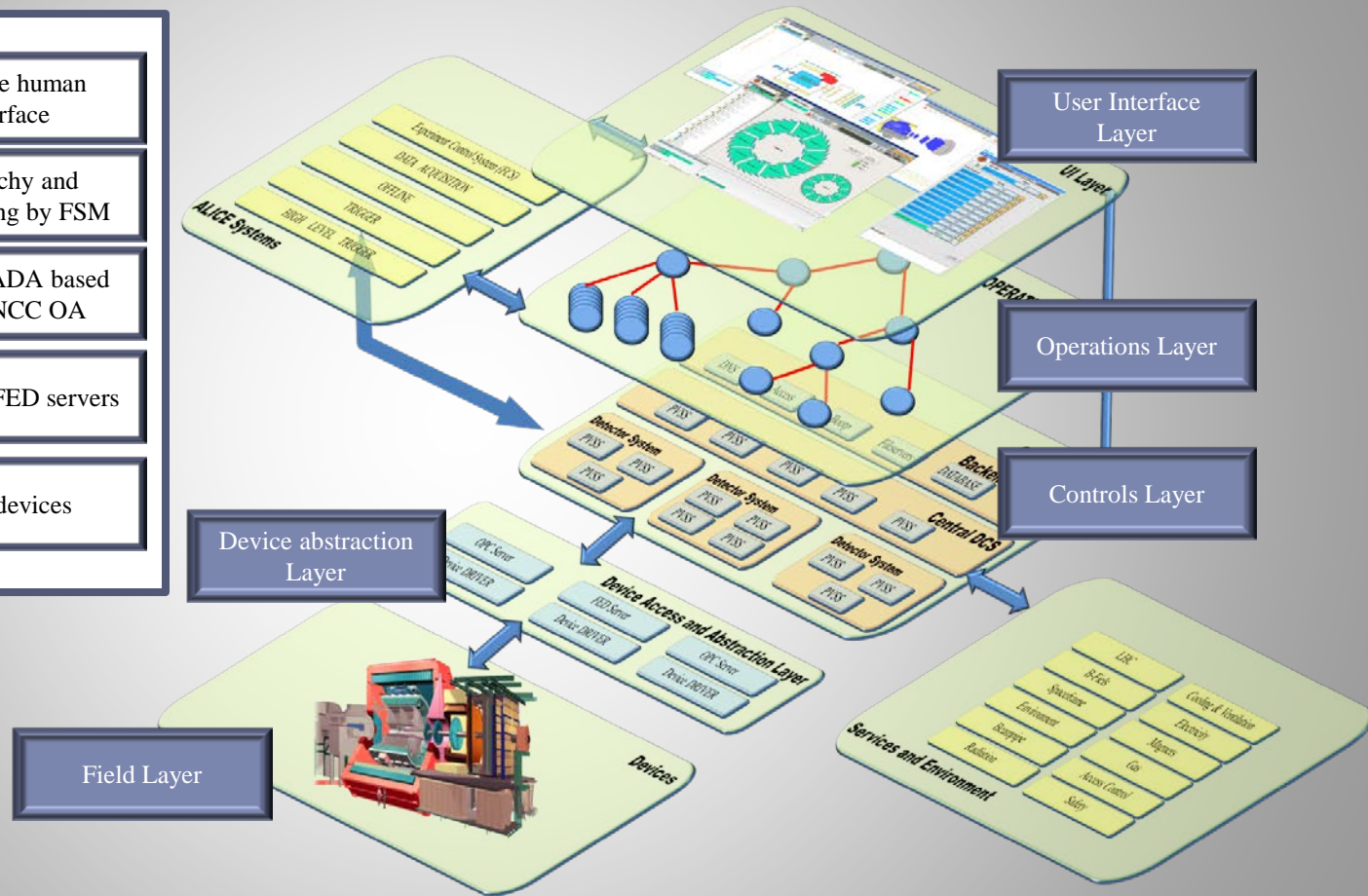
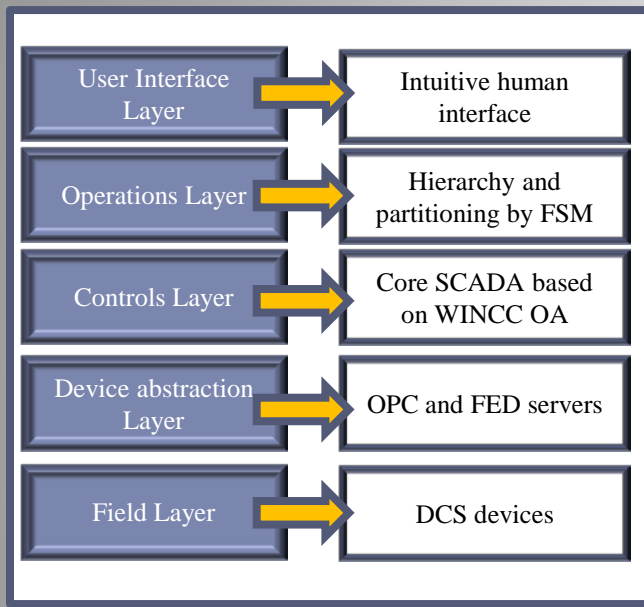
19 autonomous detector systems	1200 network attached devices
100 WINCC OA systems	> 700 embedded computers
> 100 subsystems	170 control computers
270 crates	200 000 OPC items
1 000 000 supervised parameters	100 000 frontend services



The DCS data flow

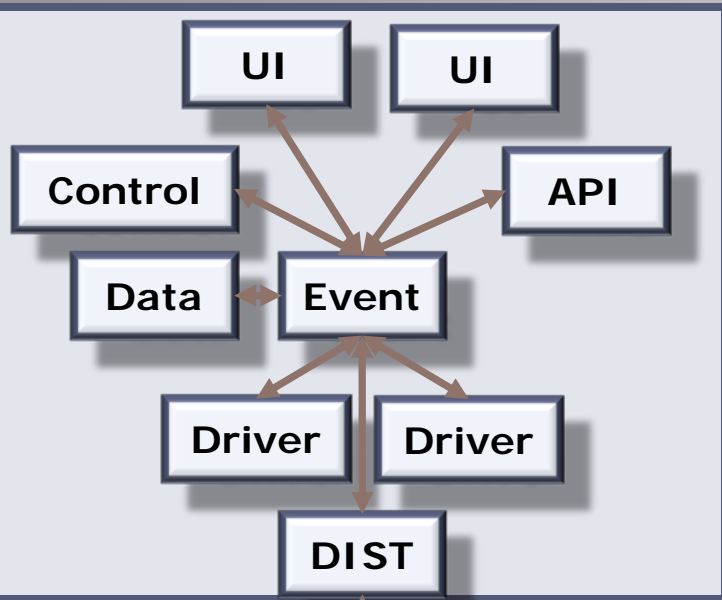


DCS Architecture

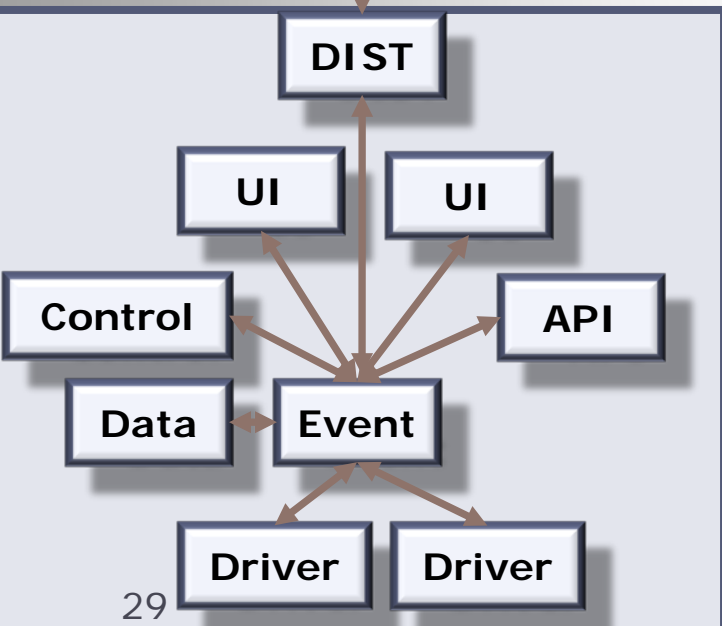


DCS Architecture

The DCS Controls Layer

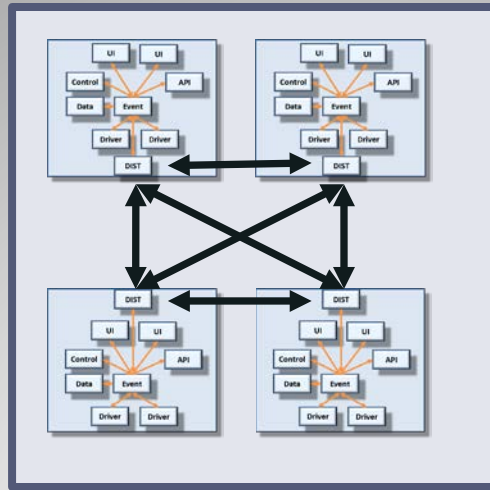
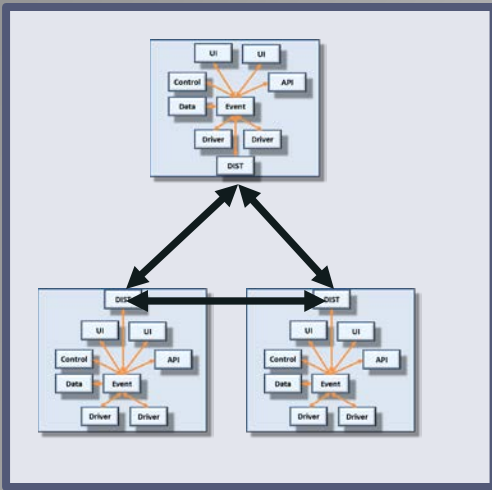


- Core of the Control Layer runs on WINCC OA SCADA system
- Single WINCC OA system is composed of managers
- Several WINCC OA systems can be connected into one distributed system

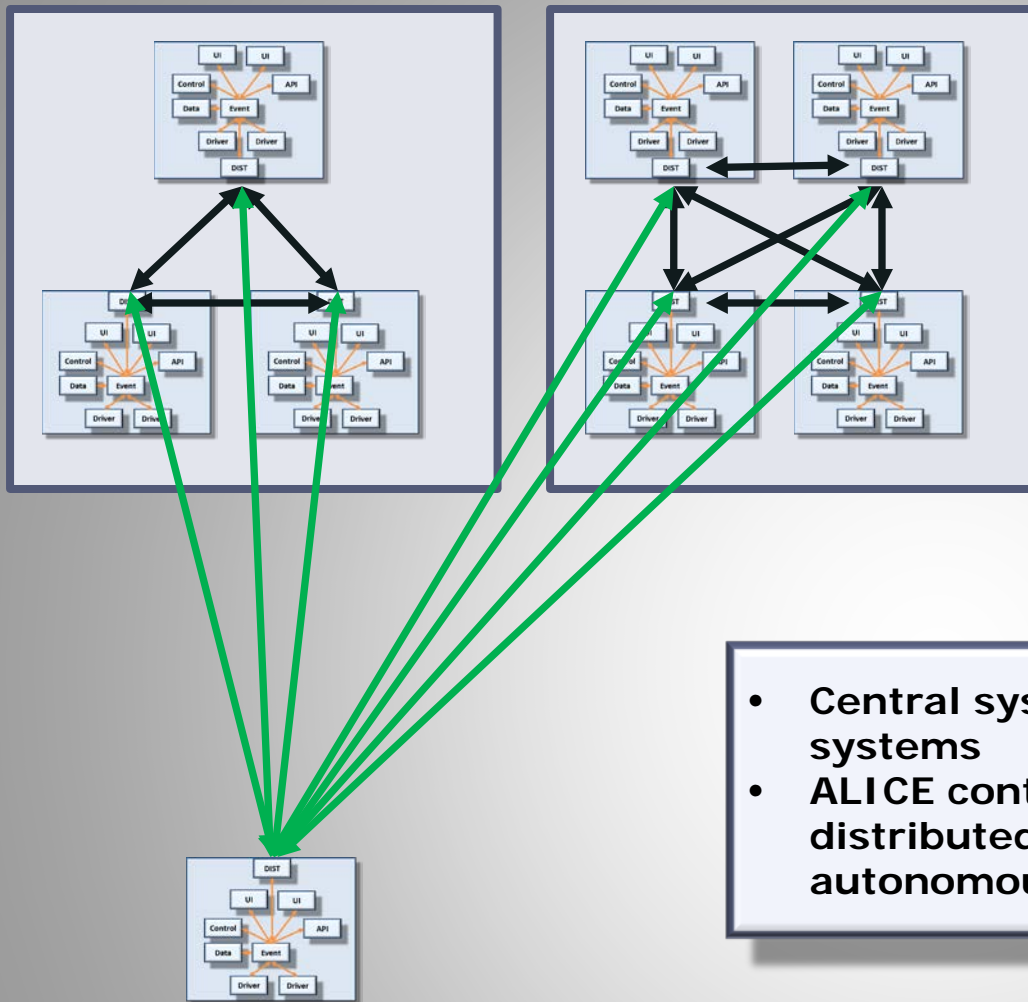


100 WINCC
OA systems

2700
managers

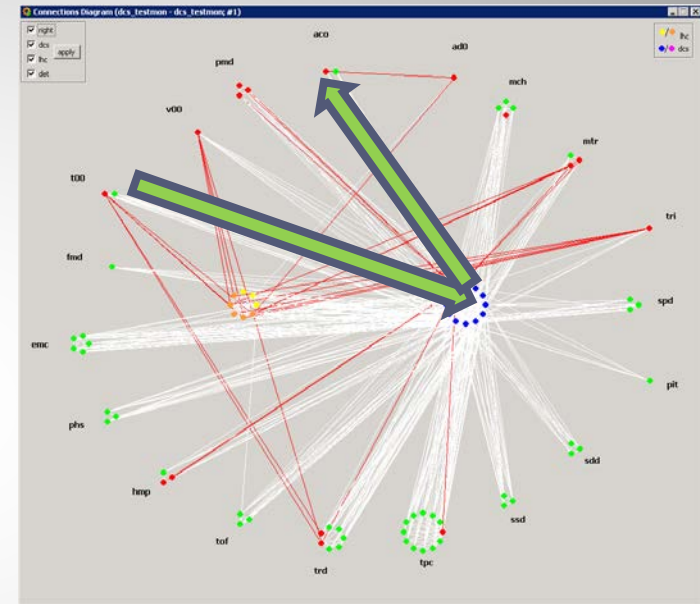
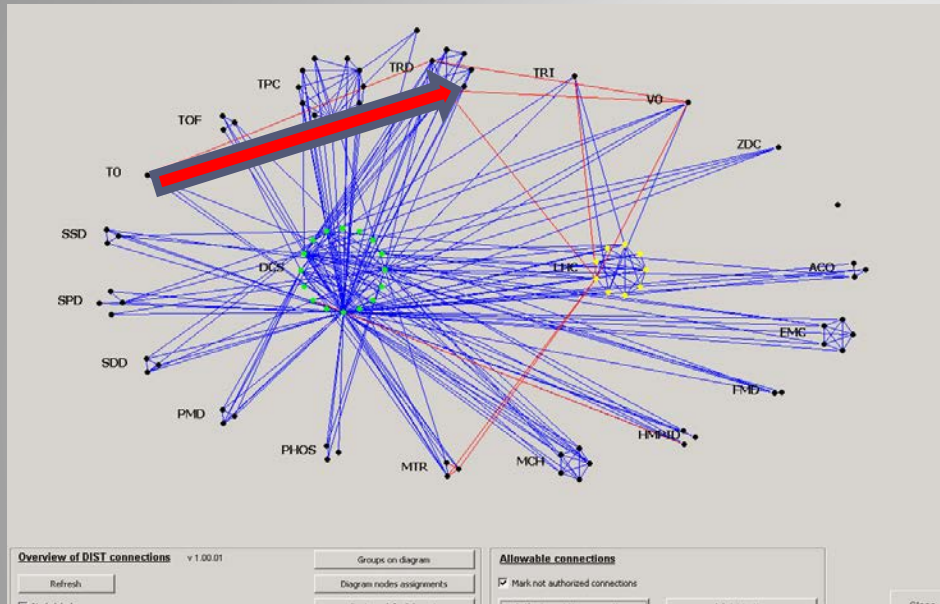


- An autonomous distributed system is created for each detector

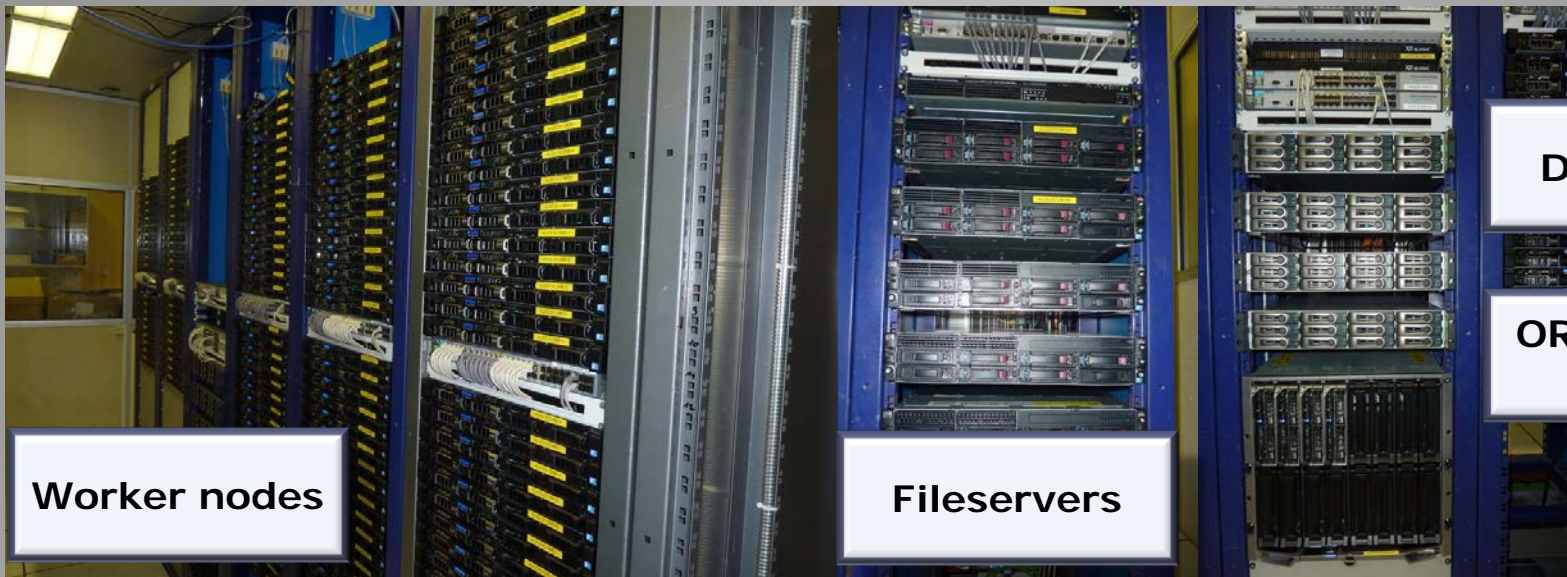


- Central systems connect to all detector systems
- ALICE controls layer is built as a distributed system consisting of autonomous distributed systems

'illegal' connection



- To avoid inter-system dependencies, connections between detectors are not permitted
- Central systems collect required information and re-distribute them to other systems
 - New parameters added on request
- System cross connections are monitored and anomalies are addressed

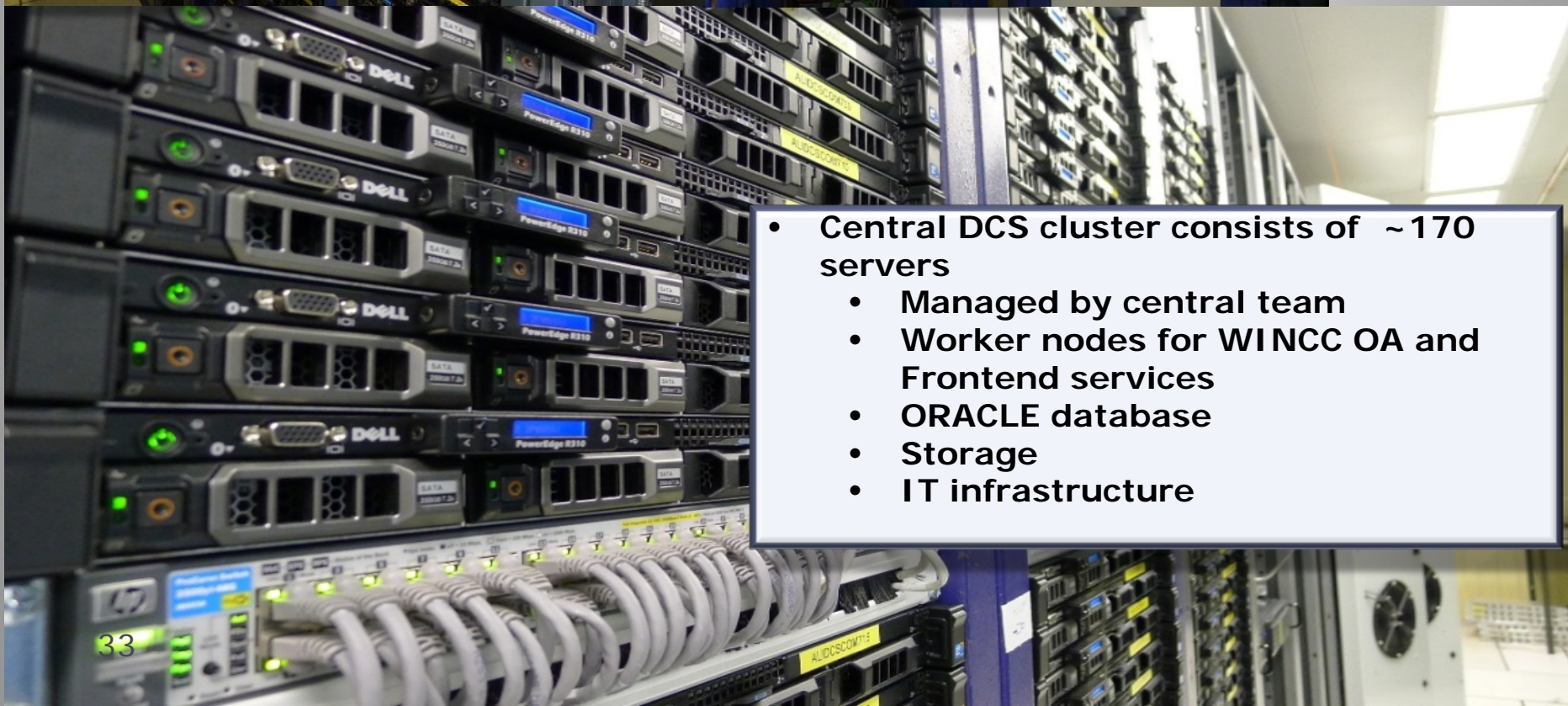


DB servers

**ORACLE size:
5.4 TB**

Worker nodes

Fileservers

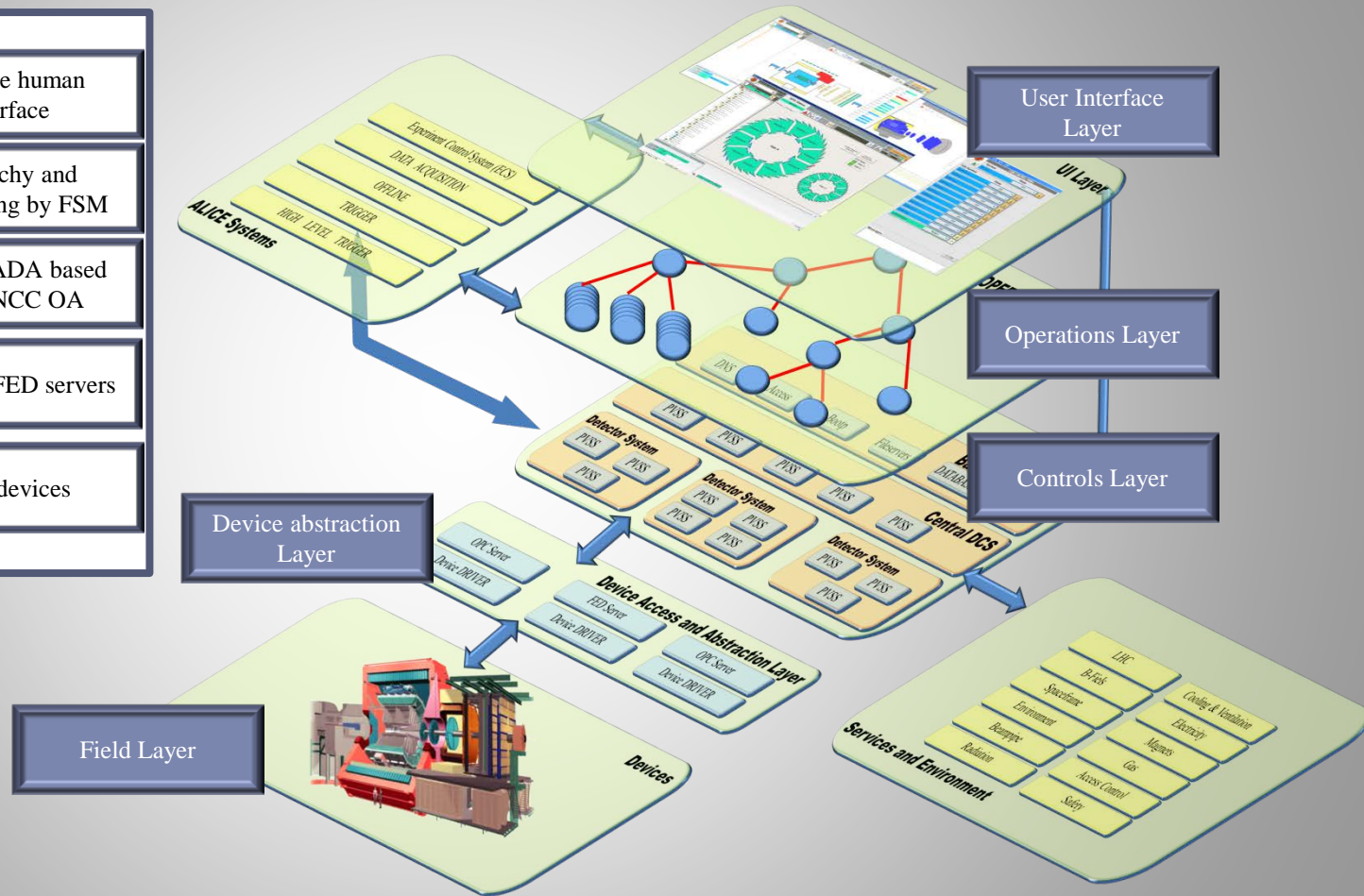
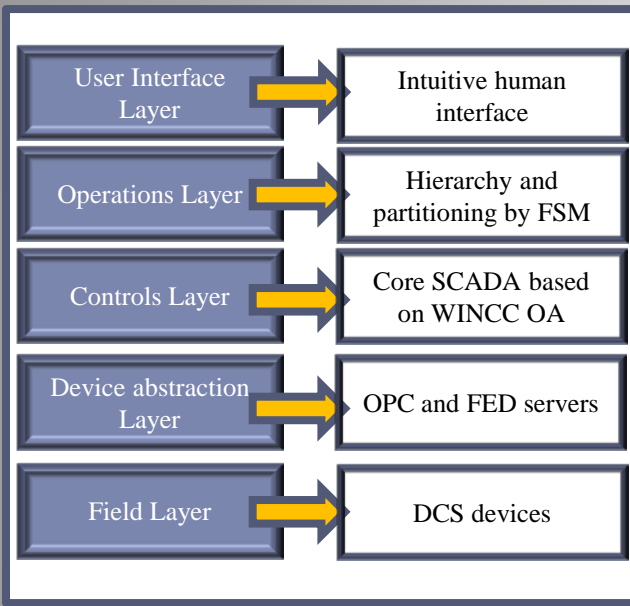


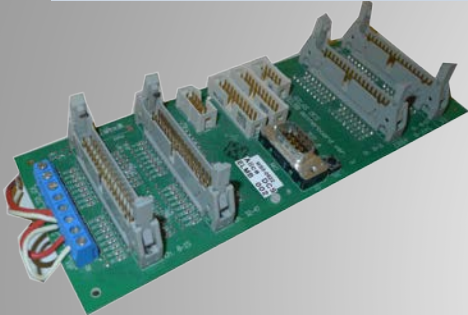
- **Central DCS cluster consists of ~170 servers**
 - Managed by central team
 - Worker nodes for WINCC OA and Frontend services
 - ORACLE database
 - Storage
 - IT infrastructure

DCS Architecture

Field Layer
The power of standardization

DCS Architecture

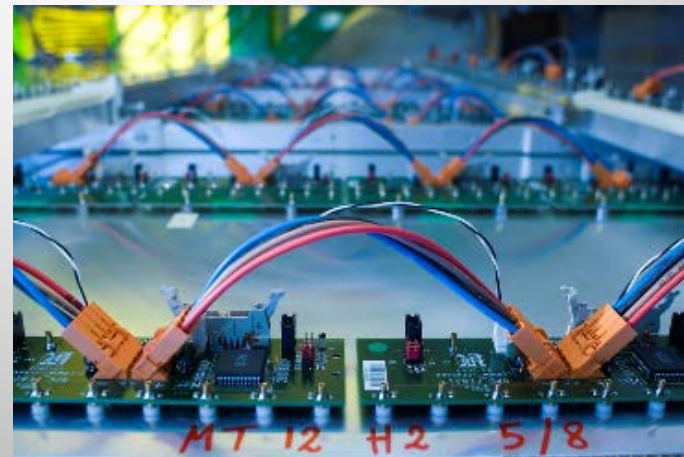
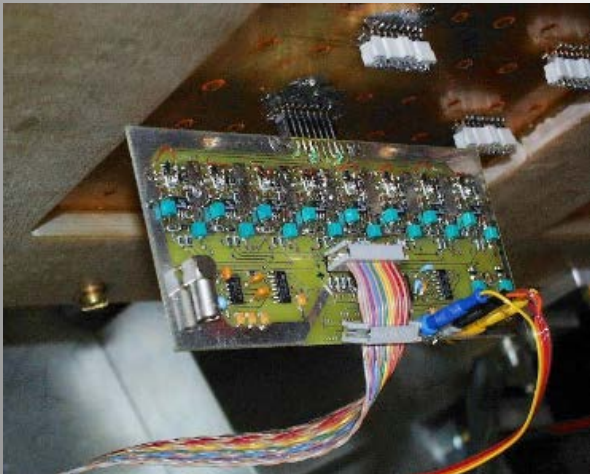
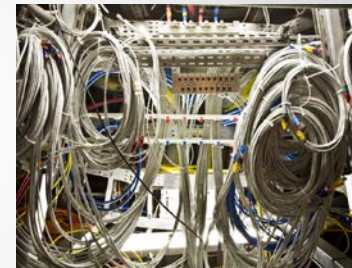
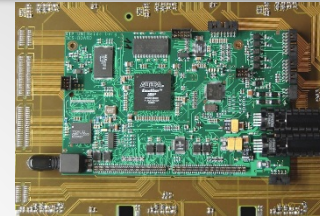
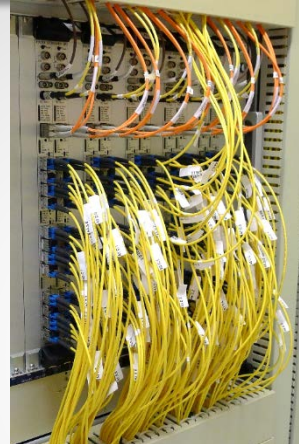




- Wherever possible, standardized components are used
 - Commercial products
 - CERN-made devices



- Frontend electronics
 - Unique for each detector
 - Large diversity, multiple buses and communication channels
 - Several technologies used within the same detector



CAN

ETHERNET

EASYNET

VME

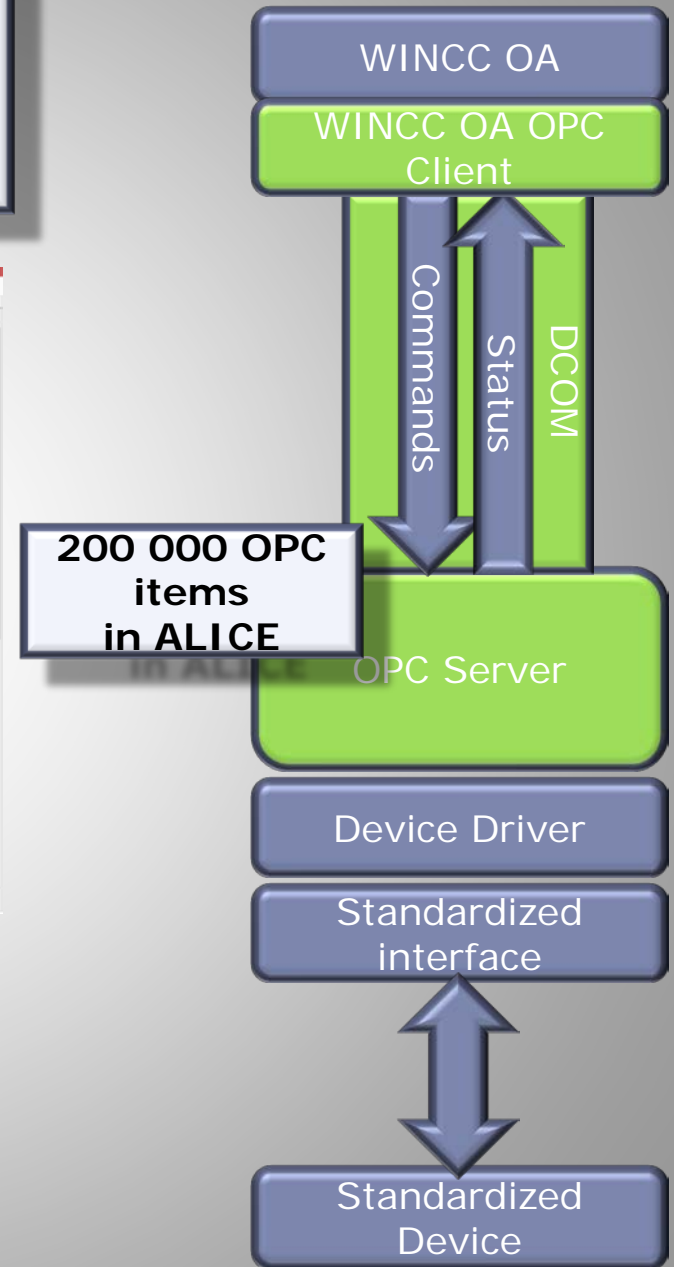
JTAG

RS 232

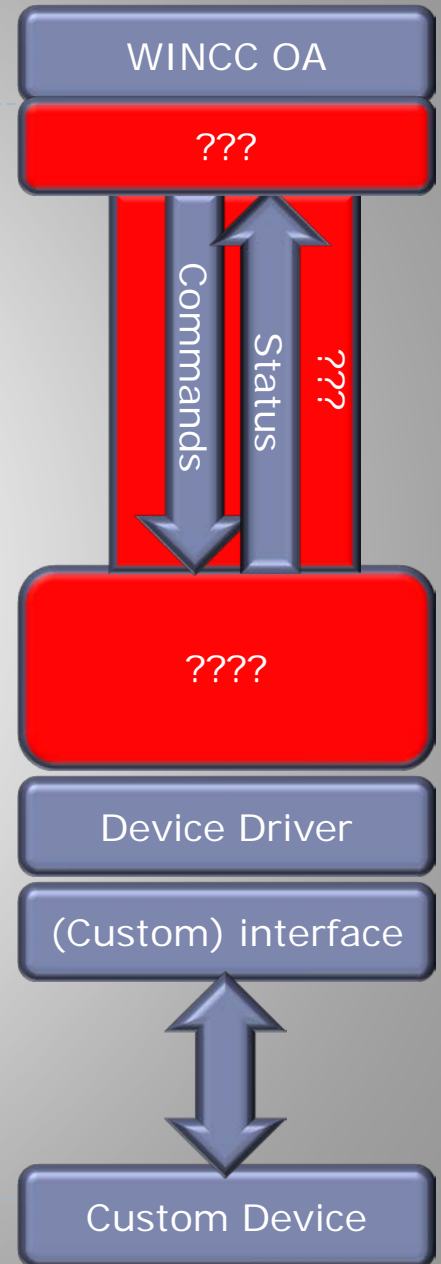
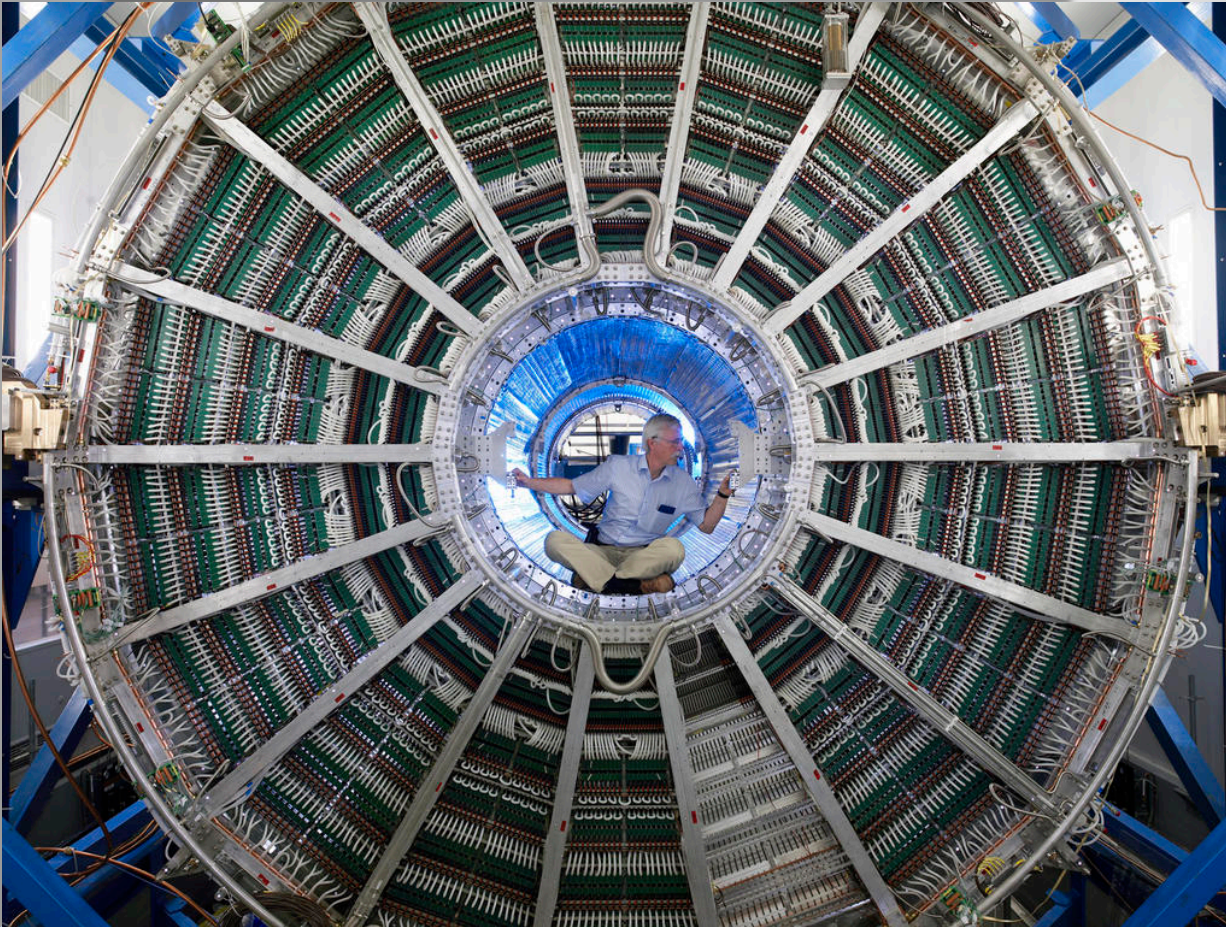
PROFIBUS

Custom
links...

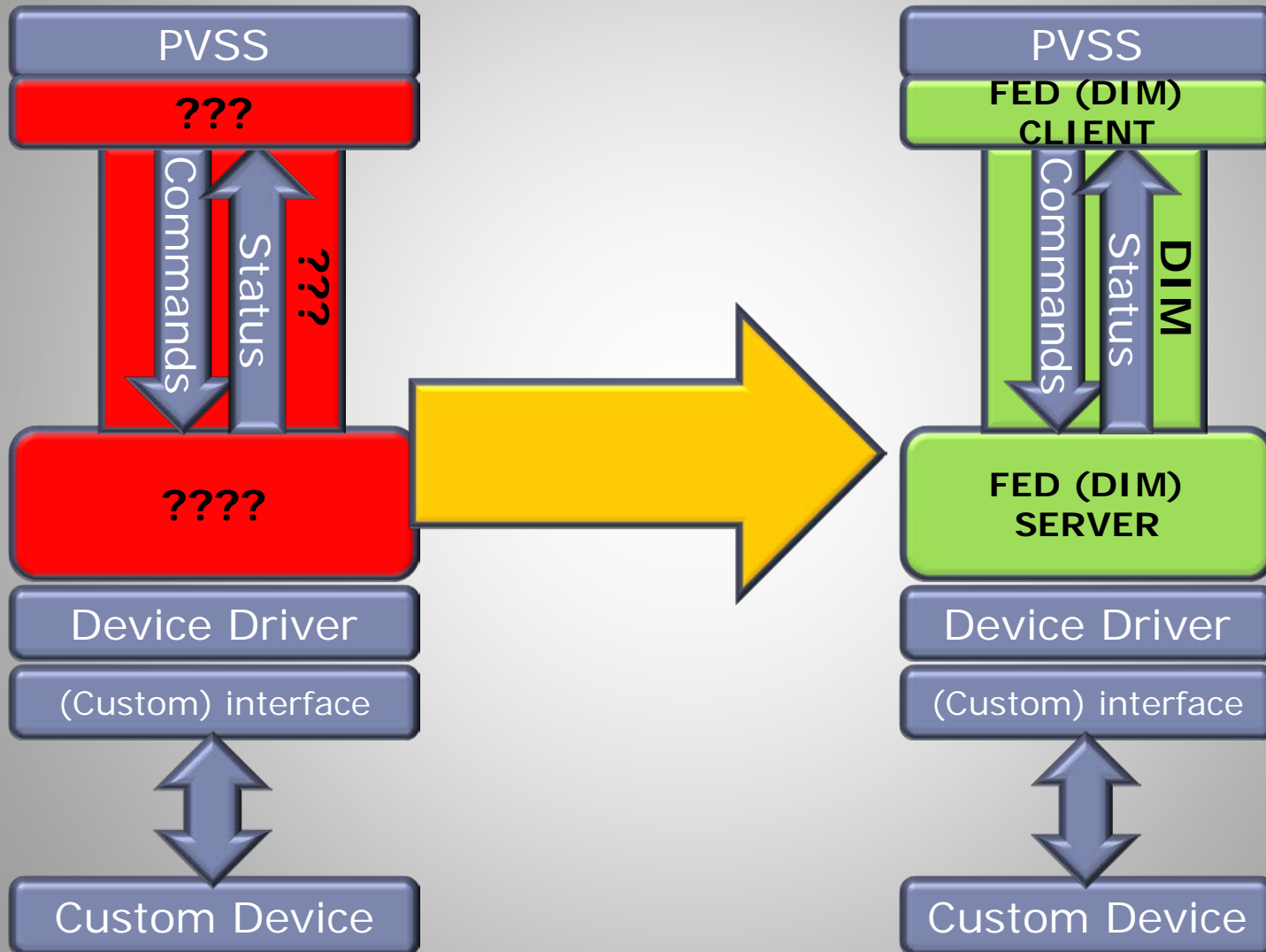
- OPC used as a communication standard wherever possible
 - Native client embedded in WINCC OA



- Missing standard for custom devices
 - OPC too heavy to be developed and maintained by institutes
 - Frontend drivers often scattered across hundreds of embedded computers (Arm Linux)



Filling the gap



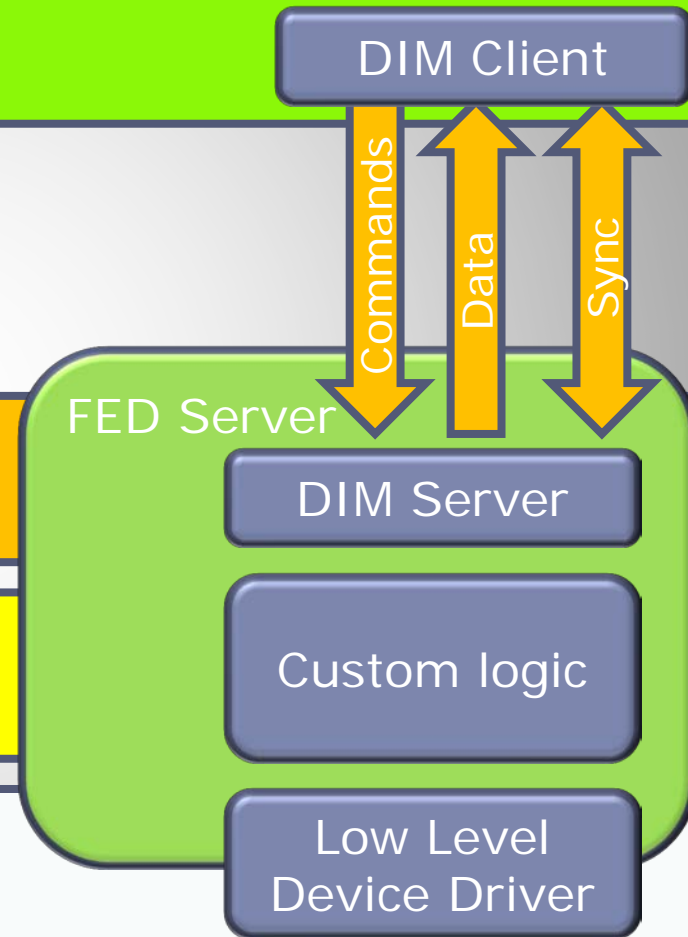
Generic FED architecture

Generic client implemented as PVSS manager

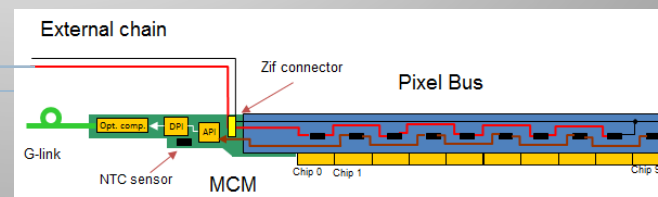
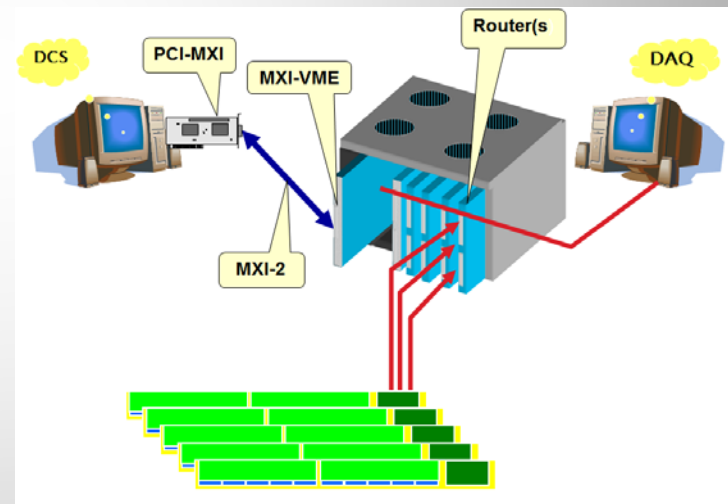
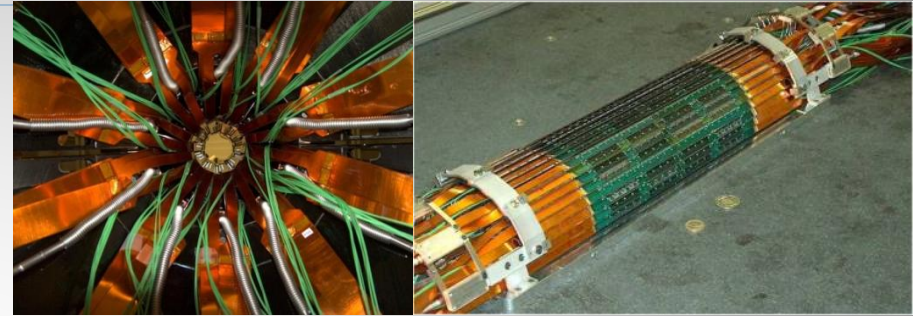
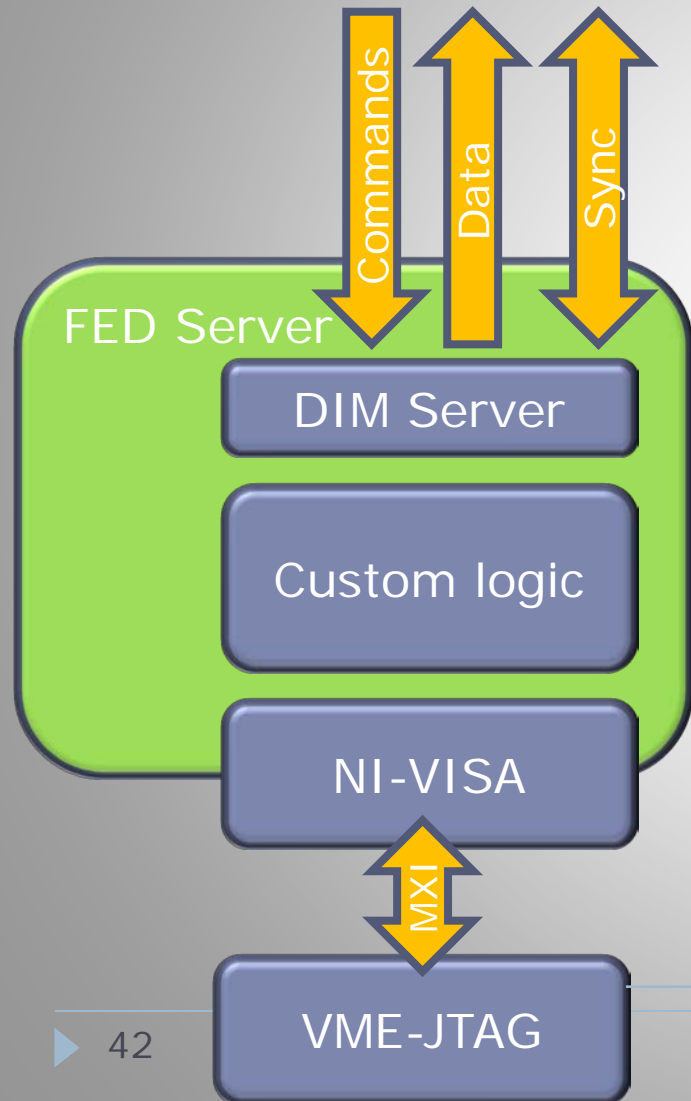
Communication interface with standardized commands and services

Device/specific layer providing high-level functionality (i.e. Configure, reset...)

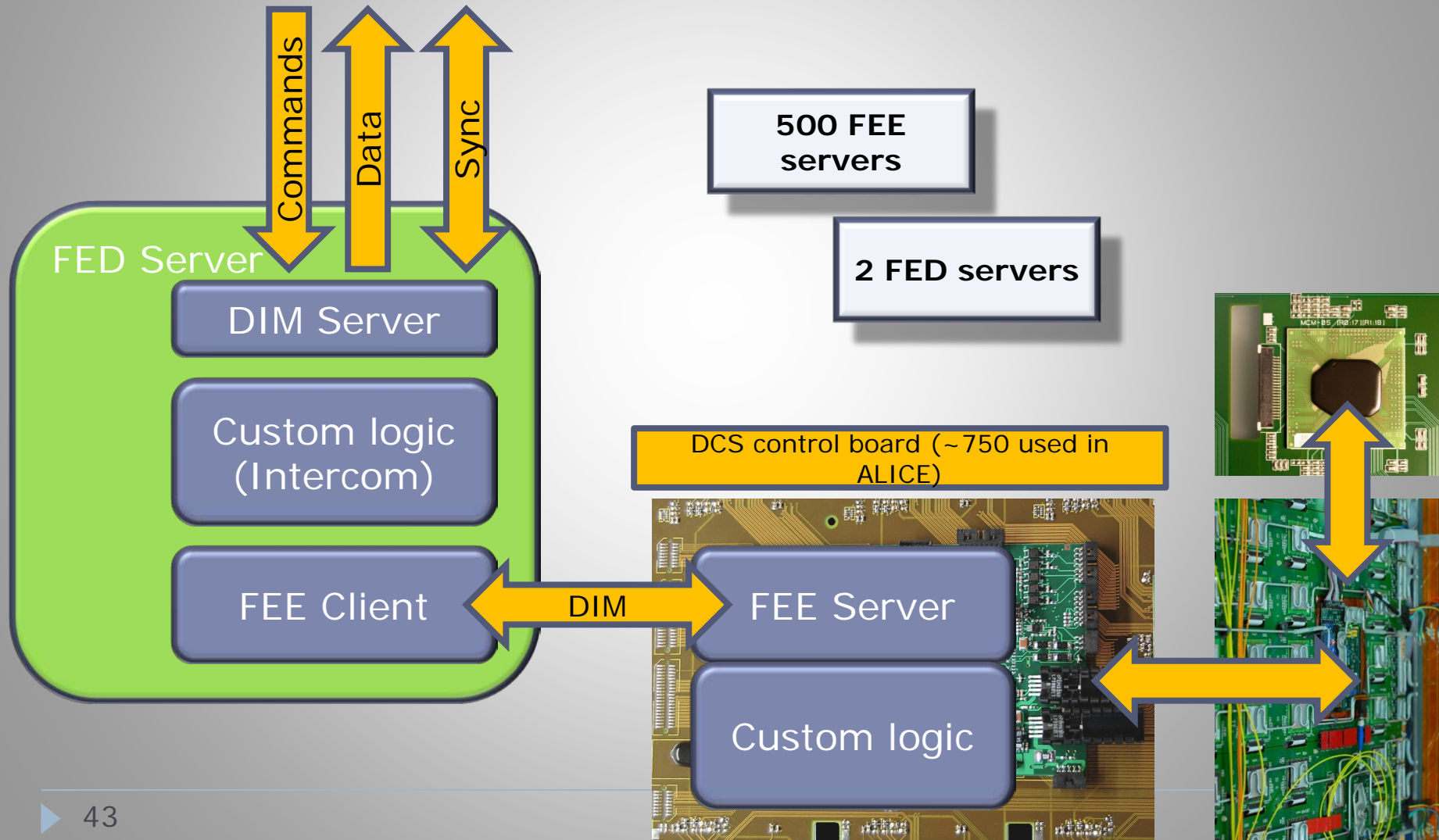
Low-level device interface (i.e. JTAG driver and commands)



SPD FED Implementation



TRD FED Implementation



DCS Architecture

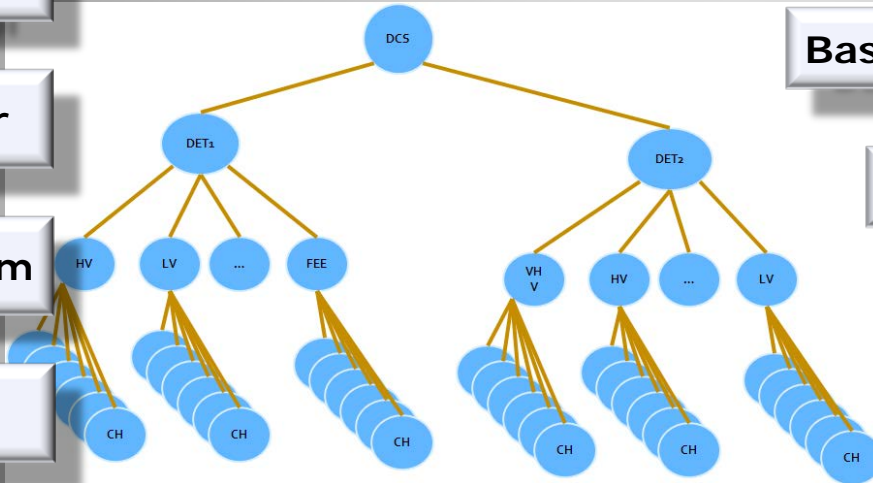
Operation Layer

Central
control

Detector

Subsystem

Device

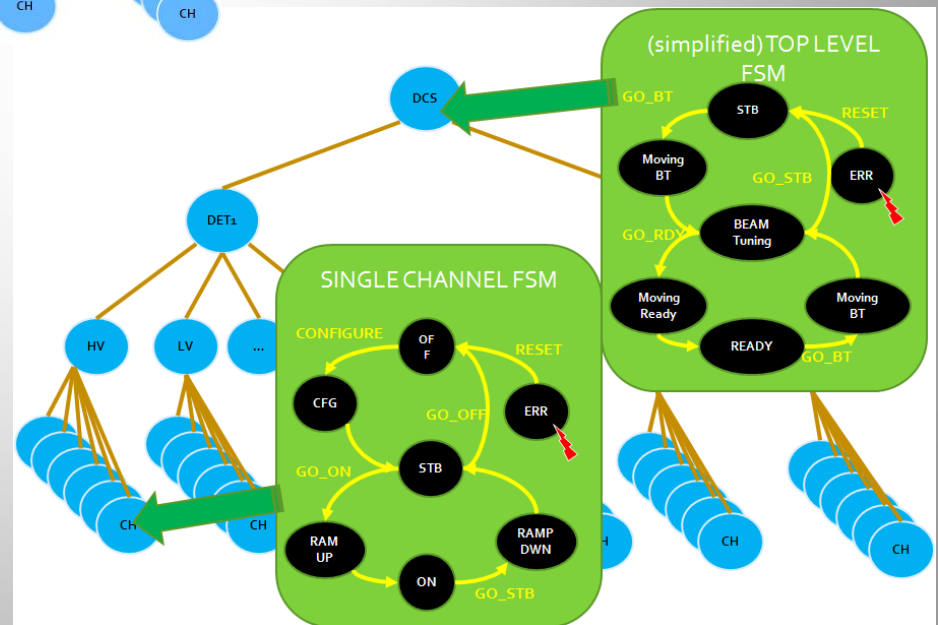


Hierarchical approach

Based on CERN toolkit (SMI++)

Each node modelled as FSM

Integrated with WINCC OA



ALICE central FSM hierarchy

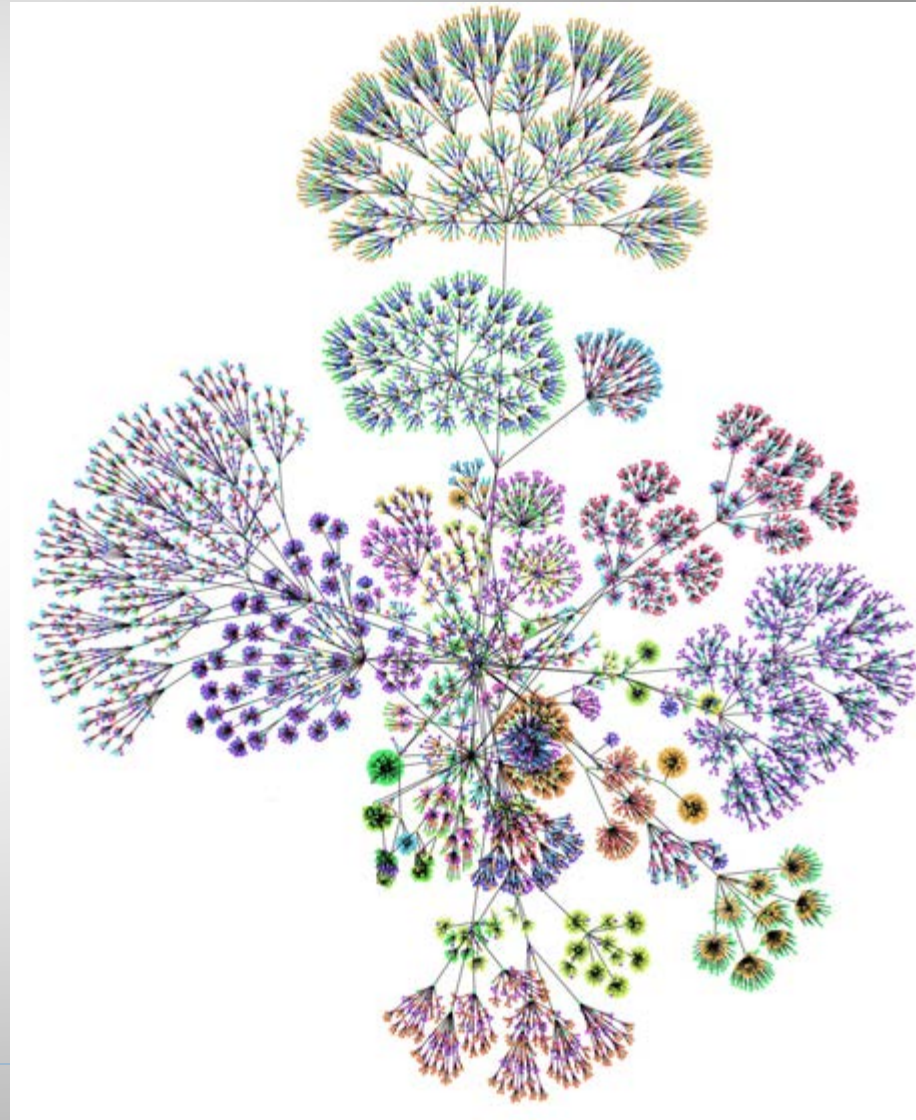
**1 top DCS
node**

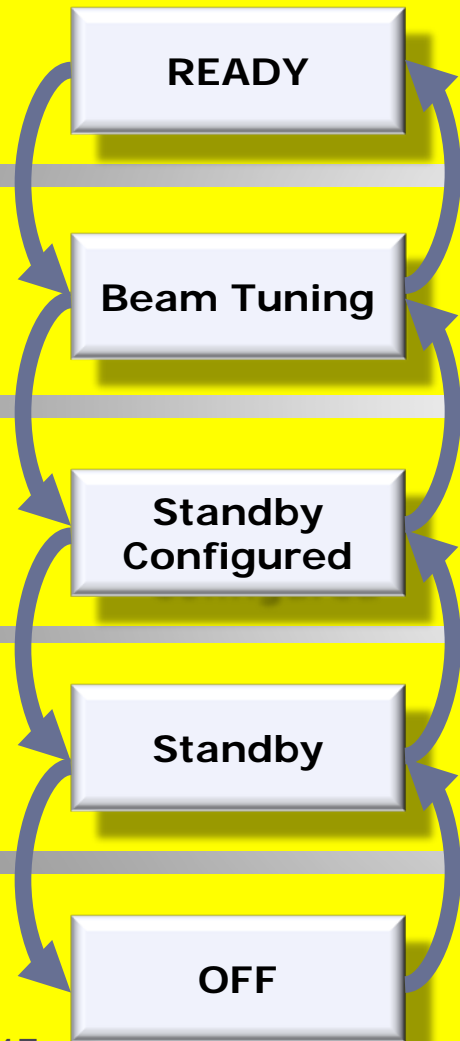
**19 detector
nodes**

**100
subsystems**

**5000 logical
devices**

10000 leaves





READY for Physics

Compatible with beam operations

Configuration loaded

Devices powered ON

Everything OFF



Atomic actions sometimes require complex logic:

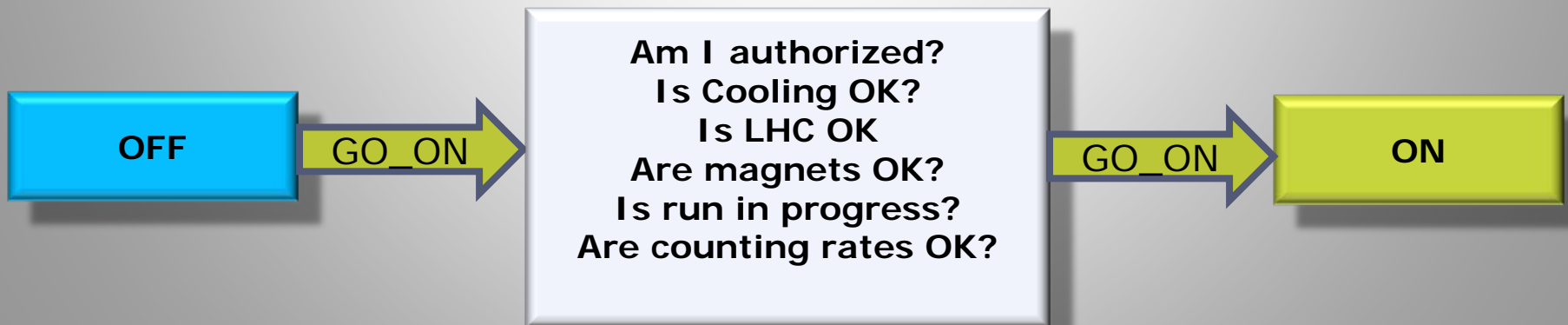
Some detectors require cooling before they turn on the low voltage
But
Frontend will freeze if cooling is present without low voltage

Unconfigured chips might burn (high current) if powered
But
The chips can be configured only once powered



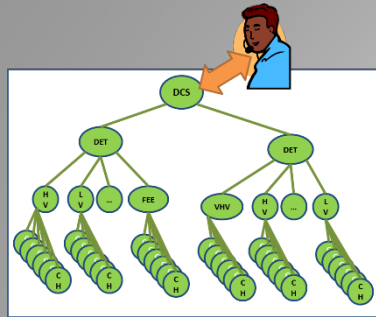


Originally simple operation become complex in real experiment environment
Cross-system dependencies are introduced.

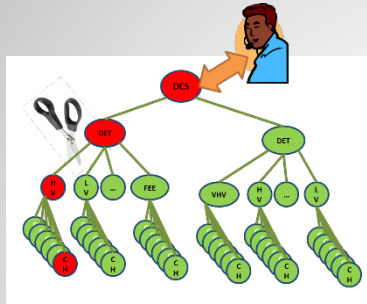


- ▶ Each detector has specific needs
- ▶ Operational sequences and dependencies are too complex to be mastered by operators
- ▶ Operational details are handled by FSM prepared by experts and continuously tuned

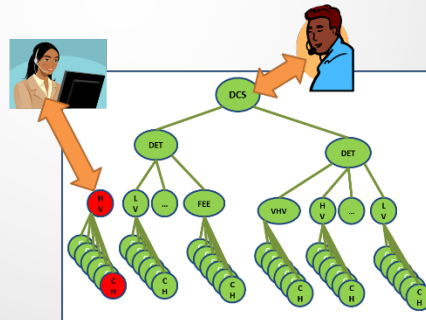
Partitioning



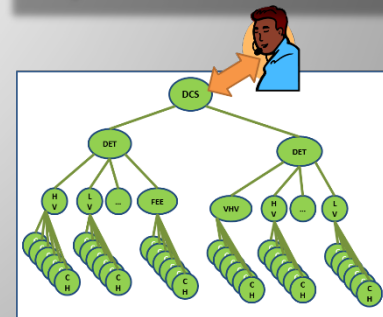
Single operator controls
ALICE



Failing part is removed
from hierarchy



Remote expert
operates excluded part



- ALICE is primarily interested in ion physics
- During the LHC operation with protons, there is a small room for developments and improvements
- Partitioning is used by experts to allow for parallel operation

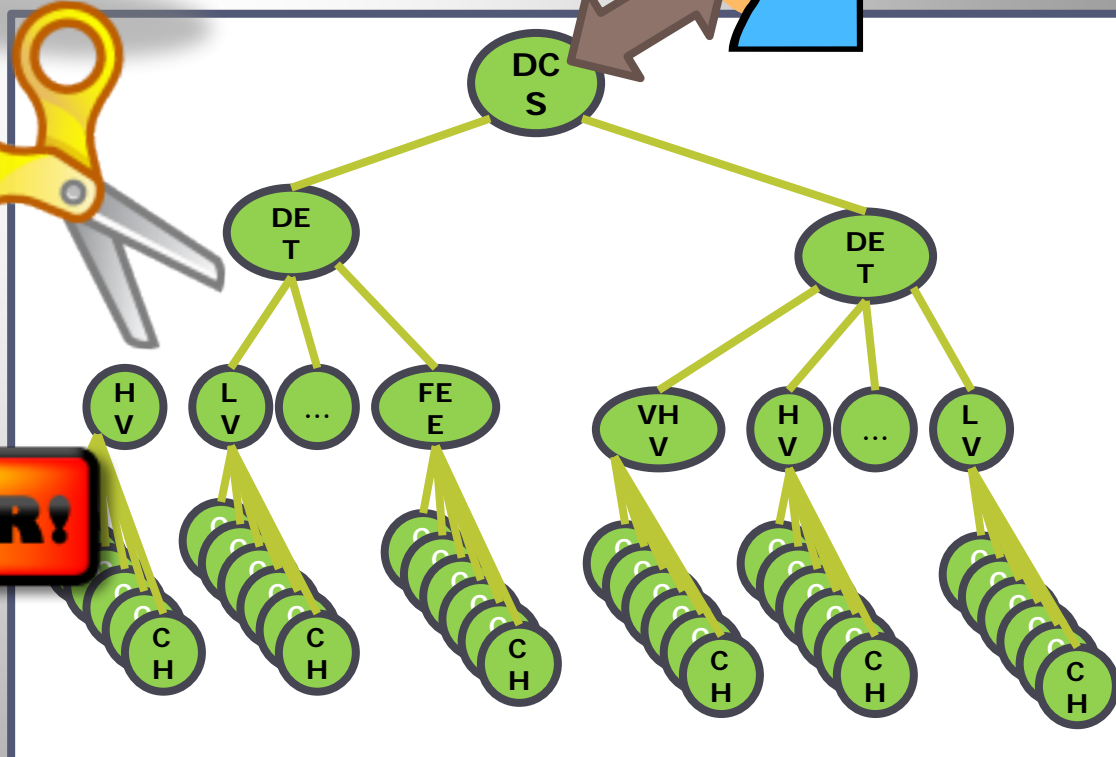
Layout of LHC Injection Transfer Lines

Certain LHC operations might be potentially dangerous for detectors

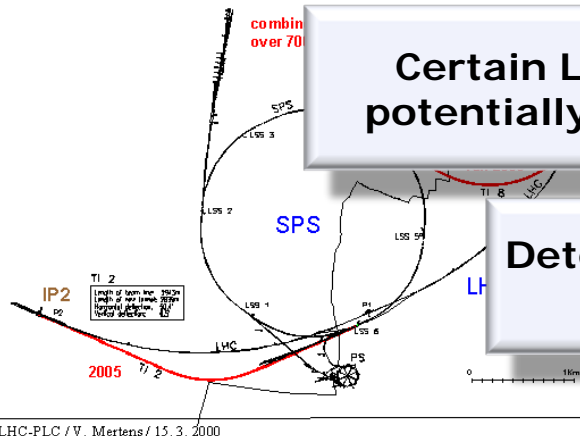
Detectors can be protected by modified settings (lower HV...)

But.....

Excluded parts do not receive the command!



DANGER!



- ▶ For potentially dangerous situations a set of procedure independent on FSM is available
- ▶ Automatic scripts check all critical parameters directly also for excluded parts
- ▶ Operator can bypass FSM and force protective actions to all components

PopUp.HC.AlicePanelModule: LHC_MESSAGE

LHC Injection WARNING

LHC is preparing for the injection;

(1) Select the command PREPARE in the HANDSHAKE STATUS box; the INJECTION status should become WARN_CONFIRMED;
(2) Inform the shift leader and ask the ECS operator to stop all the runs;
(3) If the ALICE Safety condition is NOT SAFE, send the command GO_SAFE using the button in the GLOBAL SAFETY box.
-> If the condition remains NOT SAFE, first affected detector and FORCE_GO_SAFE from main UI.
-> Contact the relevant detector on call to inform about the falling 'GO_SAFE'.
(4) Once ALICE is SAFE, select CONFIRM in the HANDSHAKE STATUS box. The INJECTION status should become READY and the Injection Permits should turn into green;
(5) Wait for the LHC to move to READY_CONFIRMED;
(6) In case of problems select the command PROBLEM in the HANDSHAKE box.
-> When the problem is solved select the ACKNOWLEDGE command in the HANDSHAKE box.

CURRENT OPERATOR ACTION >> TURN ALICE into SAFE

Handshake status
COMMUNICATION INTERFACE WITH LHC
Injection WARN_CONFIRMED

Global Safety
ALICE CONDITION
NOT SAFE
GO SAFE
FORCE GO SAFE

User Permits
Beam Permit
Injection permit 1
Injection permit 2

SAFE SUMMARY LHC-ALICE MESSAGES (Experts use)

6:08
Estimated CountDown Time

NO PROBLEMS

In case of problem, detailed info will appear here

Click on the buttons above to open specific information panels

Global Safety

ALICE CONDITION

NOT SAFE

GO SAFE
FORCE GO SAFE

Global Safety

ALICE CONDITION

SAFE

PopUp.HC.AlicePanelModule: LHC_MESSAGE

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(5) Wait for the LHC to move to READY_CONFIRMED;
(6) In case of problems select the command PROBLEM in the HANDSHAKE box.
-> When the problem is solved select the ACKNOWLEDGE command in the HANDSHAKE box.

CURRENT OPERATOR ACTION >> SEND CONFIRM command from the INJECTION box

Handshake status
COMMUNICATION INTERFACE WITH LHC
Injection WARN_CONFIRMED

Global Safety
ALICE CONDITION
SAFE

User Permits
Beam Permit
Injection permit 1
Injection permit 2

SAFE SUMMARY LHC-ALICE MESSAGES (Experts use)

3:45
Estimated CountDown Time

NO PROBLEMS

In case of problem, detailed info will appear here

Click on the buttons above to open specific information panels

ALICE safe condition

ALICE supersafe condition

Global actions disabled (default)
enable GO_SAFE/SUPERSAFE (normal procedures)
enable FORCE_GO_SAFE/EMERGENCY (emergency procedures)

Detector	Safe	Supersafe
Aco	safe	supersafe
Emc	safe	supersafe
Emc2	safe	supersafe
Emc3	safe	supersafe
Emc4	safe	supersafe
Emc5	safe	supersafe
Emc6	safe	supersafe
Emc7	safe	supersafe
Emc8	safe	supersafe
Emc9	safe	supersafe
Emc10	safe	supersafe
Emc11	safe	supersafe
Emc12	safe	supersafe
Emc13	safe	supersafe
Emc14	safe	supersafe
Emc15	safe	supersafe
Emc16	safe	supersafe
Emc17	safe	supersafe
Emc18	safe	supersafe
Emc19	safe	supersafe
Emc20	safe	supersafe
Emc21	safe	supersafe
Emc22	safe	supersafe
Emc23	safe	supersafe
Emc24	safe	supersafe
Emc25	safe	supersafe
Emc26	safe	supersafe
Emc27	safe	supersafe
Emc28	safe	supersafe
Emc29	safe	supersafe
Emc30	safe	supersafe
Emc31	safe	supersafe
Emc32	safe	supersafe
Emc33	safe	supersafe
Emc34	safe	supersafe
Emc35	safe	supersafe
Emc36	safe	supersafe
Emc37	safe	supersafe
Emc38	safe	supersafe
Emc39	safe	supersafe
Emc40	safe	supersafe
Emc41	safe	supersafe
Emc42	safe	supersafe
Emc43	safe	supersafe
Emc44	safe	supersafe
Emc45	safe	supersafe
Emc46	safe	supersafe
Emc47	safe	supersafe
Emc48	safe	supersafe
Emc49	safe	supersafe
Emc50	safe	supersafe
Emc51	safe	supersafe
Emc52	safe	supersafe
Emc53	safe	supersafe
Emc54	safe	supersafe
Emc55	safe	supersafe
Emc56	safe	supersafe
Emc57	safe	supersafe
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Emc71	safe	supersafe
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Emc88	safe	supersafe
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Emc90	safe	supersafe
Emc91	safe	supersafe
Emc92	safe	supersafe
Emc93	safe	supersafe
Emc94	safe	supersafe
Emc95	safe	supersafe
Emc96	safe	supersafe
Emc97	safe	supersafe
Emc98	safe	supersafe
Emc99	safe	supersafe
Emc100	safe	supersafe

enable checkboxes for excluded/included detectors

By Screen Settings

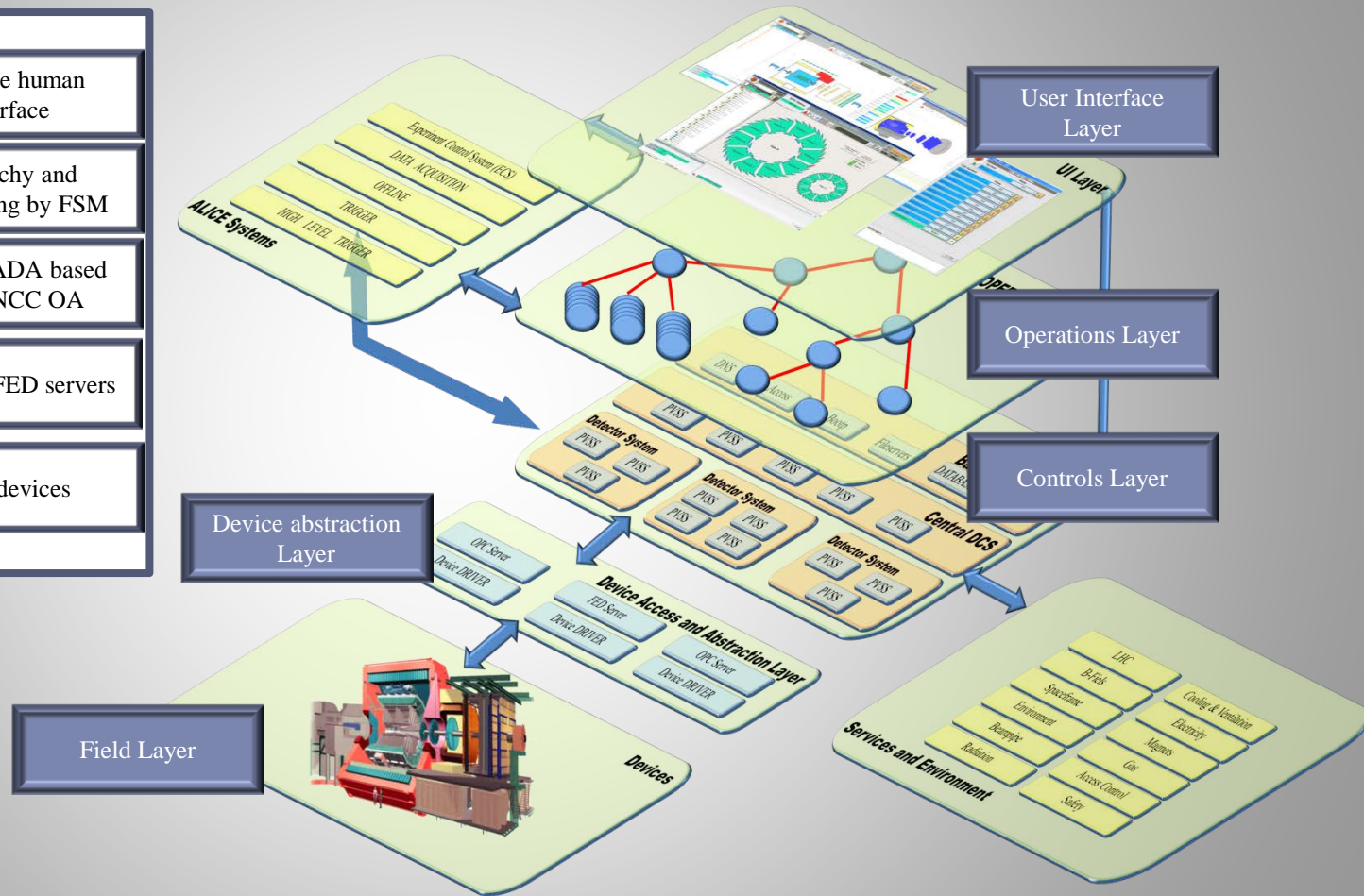
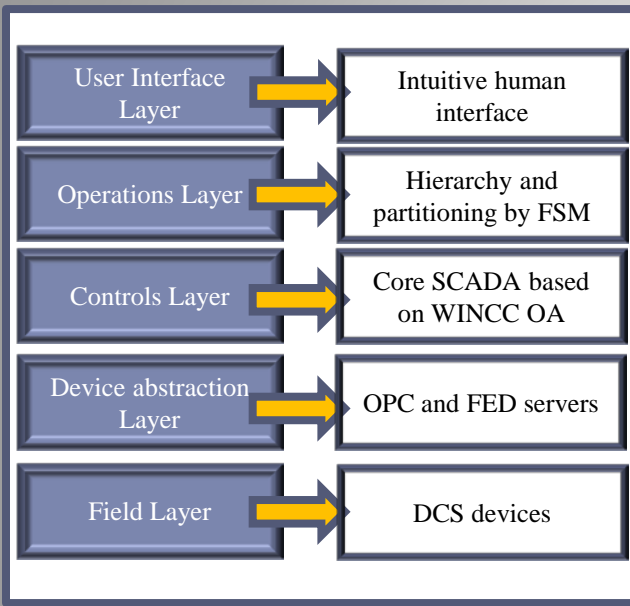
ELM

Close

DCS Architecture

User interface layer

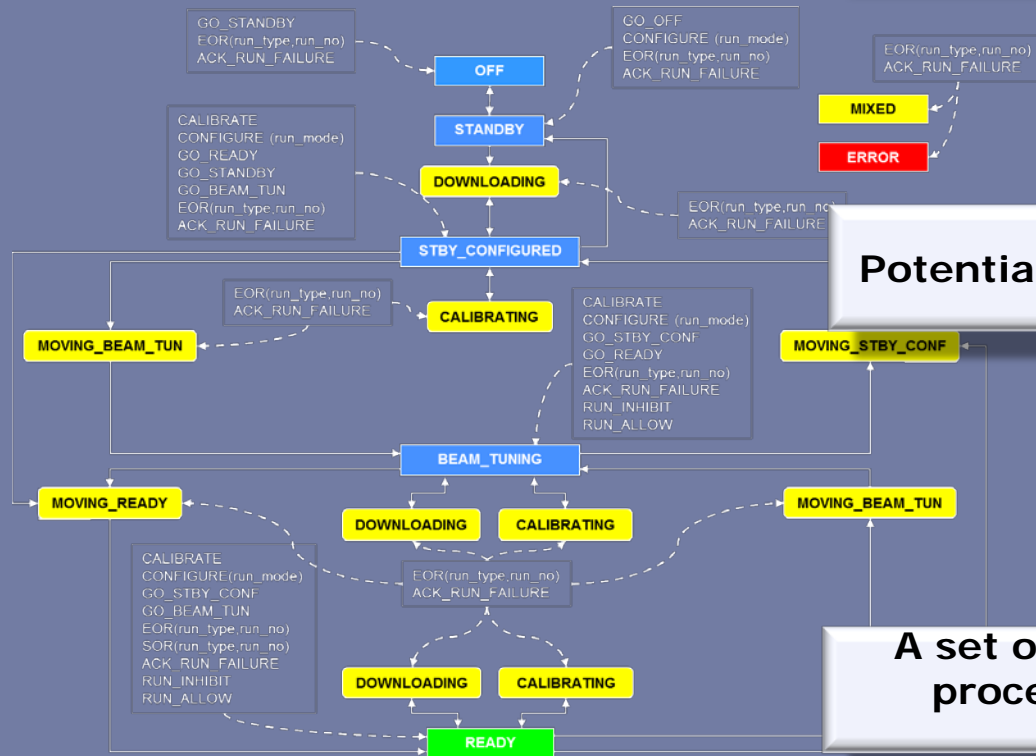
DCS Architecture

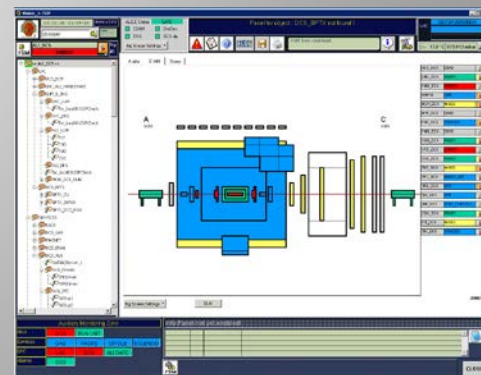
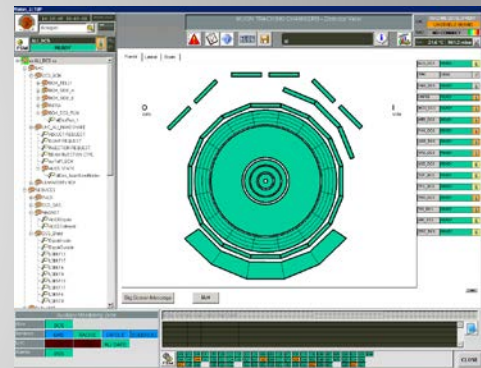
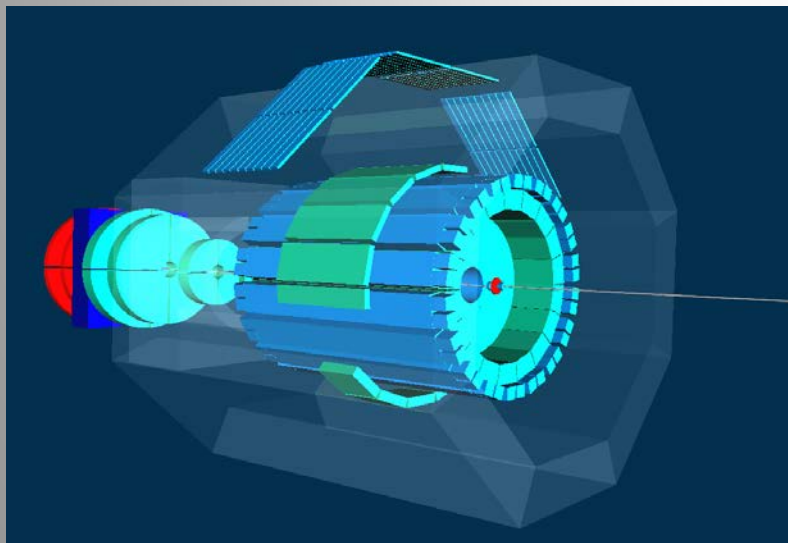


The original simple FSM layout got complex with time

Potential risk of human errors in operation

A set of intuitive panels and embedded procedures replaced the direct FSM operation





DCS Operation

Organization

- ▶ Central operator is responsible for all subdetectors
 - ▶ 24/7 shift coverage during ALICE operation periods
 - ▶ High turnaround of operators – specific to HEP collaborations
 - ▶ Shifters training and on-call service provided by the central team
 - ▶ Requires clear, extensive documentation understandable for non-expert, and easily accessible
- ▶ Sub-detector systems are maintained by experts from the collaborating institutes
 - ▶ Oncall expert reachable during operation with beams
 - ▶ Remote access for interventions
 - ▶ In critical periods, detector shifts might be manned by detector shifters
 - ▶ Very rare and punctual activity e.g. few hours when heavy ion period starts – the system has grow mature

Emergency handling

- ▶ Sub-detectors developers prepare alerts and related instructions for their subsystems
 - ▶ These experts very often become on-call experts
 - ▶ Automatic or semi-automatic recovery procedures
- ▶ 3 classes of alerts:

Fatal	high priority - imminent danger, immediate reaction required
Error	middle priority - severe condition which does not represent imminent danger but shall be treated without delay
Warning	low priority - early warning about possible problem, does not represent any imminent danger

Alert handling

- ▶ Reaction to DCS alerts (classes fatal and error) is one of the main DCS operator tasks
- ▶ Warnings:
 - ▶ Under responsibility of subsystems shifters/experts
 - ▶ No reaction expected from central operator
- ▶ Dedicated screen displays alerts (F,E) arriving from all connected DCS systems as well as from remote systems and services

The screenshot displays the 'Vision 1: fwAlarmHandling/fwAlarmScreen.pnl' interface. It features a top menu bar with 'Module', 'Panel', 'Scale', and 'Help'. Below the menu is a toolbar with various icons. The main area is titled 'Alarms' and shows a grid of alarm groups categorized by subsystems: ACO, AD0, CPV, DCS, EMC, FMD, HMP, LHC, MCH, MTR, PHS, PMD, SDD, SPD, SSD, T00, TOF, TPC, TRD, TRI, V00, and ZDC. Each group shows the number of alerts and their status (e.g., '0 unack; 0 new').

Below the grid is an 'Alarm filter' section. The main part of the screen is a table listing individual alarms with the following columns: Sh, Device DP element, Description, Alarm text, Dir, Value, Ack, Time, Co, Logical name, and a status icon.

Sh	Device DP element	Description	Alarm text	Dir	Value	Ack	Time	Co	Logical name	
E	lhc_exchange.myTell1 BCM		FSM Summary	CAME	TRUE		2017.12.04 09:28:50.235	1	myTell1 BCM	
E	mch_environment.ELMB/MCH.ELMB	Chamber 9 Left	ELMB not OPERATION	CAME	1		2018.01.16 14:36:29.485	1		
E	tof_dcs.tofMagnetSafe_Actual.qotGoMa		MAGNET SAFE ERROR	CAME	FALSE	xxx	2018.02.14 12:06:26.273	1		
E	dcs_globals.Rack RD2.temp		TEMPERATURE ERROR	CAME	25.00		2018.02.19 10:47:03.461	1		
E	dcs_globals.Rack RD1.temp		TEMPERATURE ERROR	CAME	25.004465519		2018.02.19 10:58:47.455	1		
E	dcs_electricity.OPCCANOpen.Connect		No OPC DA connection	CAME	FALSE		2018.02.19 14:07:50.771	1		
E	aco_dcs:CAEN/aco_hv_crate1/aco_hv	HV supply for one module	ERROR	CAME	585.75	x	2018.03.05 16:01:59.214	1	ACO HV/ACO_FACE_I/ACO_MODULE	
E	ernc_lv.SRU_SOR.Alert.SORAlert		EMC SRU reconfigured	CAME	1	x	2018.03.12 10:03:54.992	1		
E	trd_gas.TRD_GC.FSM.StateHeartbeat		Gas chromatograph heartbeat	CAME	0	x	2018.03.21 00:15:57.765	1		
E	trd_lv.Wiener/alidcswie030/Channel0.Mi		trd_lv.Current too high	CAME	139.2421875	x	2018.03.22 19:27:25.092	1	TRD_SEC06 LV/SEC06L01/LV/SEC06U	
E	lhc_exchange.myTell1 BCM.error.ccp		CCPC Not Accessible	CAME	TRUE	x	2018.03.26 11:14:41.579	1	myTell1 BCM	
E	pmnd_pre.ELMB/my_lvdbusQ/ELMB57		MOD_9 CHAIN TRIPPE	CAME	2.606051		2018.03.26 15:12:26.140	1		
E	dcs_gas.ALIMTR_Hu_XHAT5128.Value	Humidifier moisture	LOW HUM	WENT	7489	III	2018.03.26 20:25:37.220	1		
E	trd_hv.lseg/can/ra12c3/ra12c3ma11/ch		anode overcurrent	CAME	2.3870522975	III	2018.03.26 20:37:06.316	1	Sector17/Stack4/Layer3/Anode/SEC17	
E	trd_hv2.lseg/can/ra14c3/ra14c3ma14/c		anode overcurrent	CAME	16.000053405	III	2018.03.26 20:47:04.345	1	Sector10/Stack1/Layer3/Anode/SEC10	
E	trd0_dcs.wrongConfiguration.value		Magnetic field changed	WENT	FALSE	III	2018.03.27 08:23:19.748	1		
E	pmnd_pre.CAEN/CAENHVPS/branchCo		HV MAX ERROR	WENT	FALSE	III	2018.03.27 11:15:19.741	1	PMD PRE/PMD PRE SM06/PMD PR	
E	pmnd_dcs.CAEN/CAENHVPS/branchCo		HV MAX ERROR	WENT	FALSE	III	2018.03.27 11:16:10.670	1	PMD DCS/PMD CPV/PMD CPV SM4	
E	pmnd_dcs.CAEN/CAENHVPS/branchCo		HV MAX ERROR	WENT	FALSE	III	2018.03.27 11:16:10.670	1	PMD DCS/PMD CPV/PMD CPV SM4	
E	pmnd_dcs.CAEN/CAENHVPS/branchCo		CROCUS TRIPPED	WENT	FALSE	III	2018.03.27 11:17:03.101	1		

At the bottom of the screen, there is a status bar showing '20 alarms', '8 unacknowledged', and an 'Acknowledge' button. On the right, there are buttons for 'Deselect rows' and 'Close'.

Alert instructions

- ▶ Available directly from the alerts screen

Alarm Help

TRD FED ERROR state

TRD FED went to ERROR.

Warning	na
Error	na
Fatal	FSM ERROR state

Action for the Expert

The ERROR is not propagated to the top node, because of the majority units, and should not disturb the run. Leave chamber in ERROR. After the end of the fill, recover the chamber. Make a logbook entry.

Action for the Central Operator

After the end of the fill, recover and configure the chamber in the FSM. Navigate in the FSM hierarchy to the chamber in ERROR. Chambers are identified by sector, stack, layer. For chamber Sec xx Stack y Layer z in Error, navigate to TRD_DCS -> TRD_FED -> TRD_SECCxx_FED -> SECxxSyFED -> SECxxSyLzFED. Click on the ERROR and select RECOVER. The chamber will go to STANDBY. Click on STANDBY and select CONFIGURE. You will be asked for a 'RUN TYPE'. Type in 'PHYSICS' and push SEND. The chamber will initialize and configure and finally go to the READY state. In case the same chamber repeatedly goes to ERROR or several chambers go to ERROR within a short period of time (typical error rate < 1/2 h), inform the TRD OnCall.

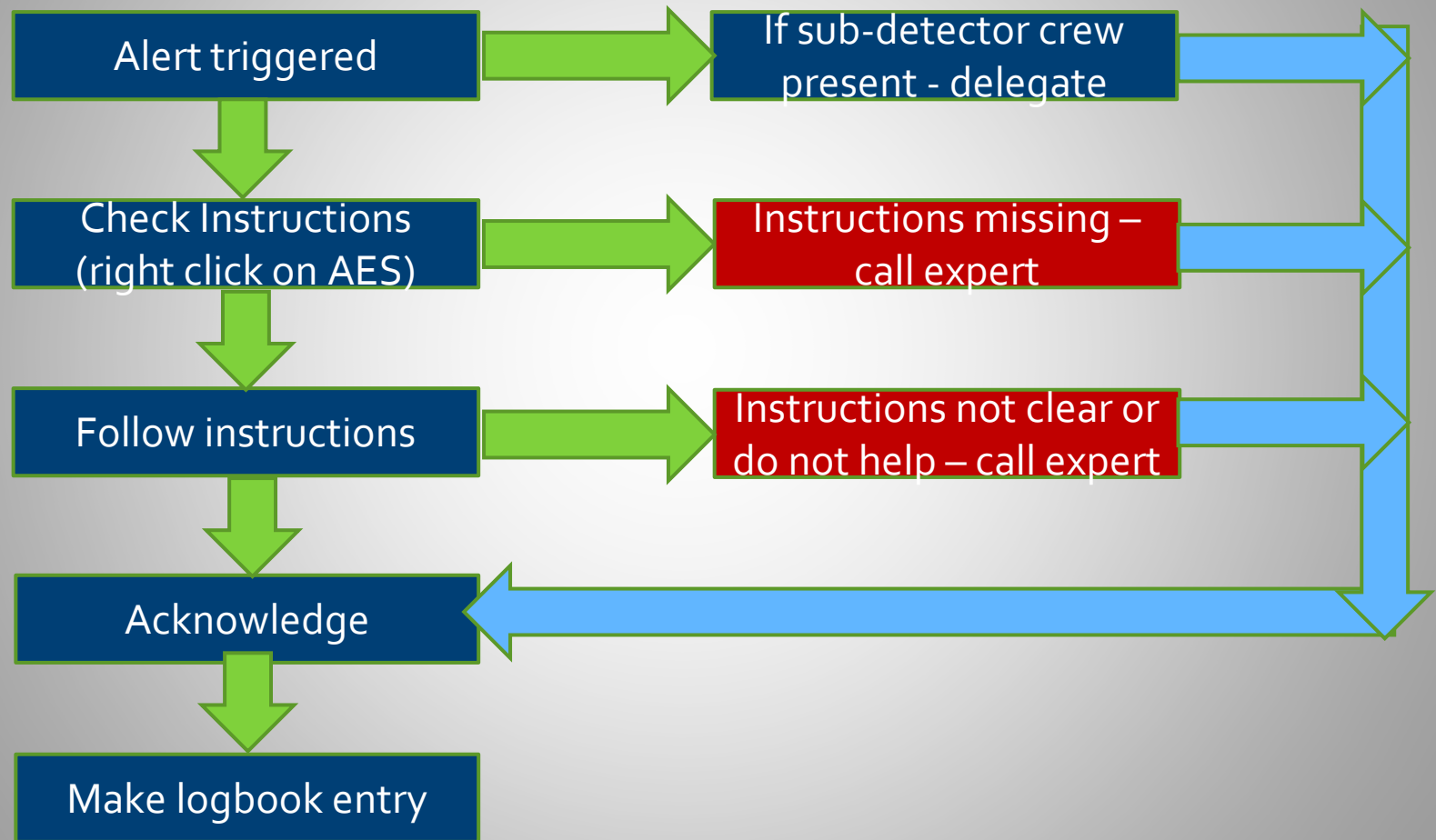
Contact details

Name: Jochen Klein
Email:
Phone: 16 5698

Sh	Device DP element	Details	Trend	Alarm Help
E	tof_dcs:CAEN/alito			
E	trd_gas:TRDGoofie			
E	sdd_dcs:SDD_FEF			
E	sdd_dcs:SDD_FEF			
E	tri_dcs:Wiener/CAI			
E	tri_dcs:Wiener/CAI			
E	sdd_dcs:SDD_FEF			
E	sdd_dcs:SDD_FEF			
E	hmp_lcs:HMPID			
A	pit_dcs:pitPhasesA			
E	hmp_lcs:HMPID			
E	lhv_instrumentation			
F	trd_fed:SM17S2L1			

Device DP element	Details	Trend	Alarm Help	Value	Unit	Time
trd_hv2:lseg/can/ra14cr2/rs	HV trip	WENT	FALSE	!!!		2012/05/29 08:30:53.492
mch_hvLvLeft:Wiener/alidc	Wiener PL512(TCP/IP) Crate	WENT	TRUE			2012/05/29 09:45:23.088
mch_hvLvLeft:Wiener/alidc	analog negative channel	Bad	WENT	TRUE		2012/05/29 09:45:24.072
mch_hvLvLeft:Wiener/alidc	analog negative channel	TemperatureFailure	WENT	FALSE	!!!	2012/05/29 09:49:03.072
mch_hvLvLeft:Wiener/alidc	Wiener PL512(TCP/IP) Crate	OutputFailure	WENT	FALSE	!!!	2012/05/29 09:49:07.103
tpc_fed_C:TpcFera/ICOMD/TPC-FEE_1.0	Error in FEE (FECERR)	CAME	4096	!!!		2012/05/29 09:55:32.412
trd_hv1seg/can/ra12cr2/ra12cr2ma00/ch1	overcurrent drift	WENT	199.32893371	!!!		2012/05/29 09:55:59.191

Alert handling procedure



Infrastructure Management

DCS Network

- ▶ The *controls network* is a separate, well protected network
 - ▶ Without direct access from outside the experimental area
 - ▶ With remote access only through application gateways
 - ▶ With all equipment on secure power



Computing Rules for DCS Network

- ▶ Document prepared by ACC and approved on the Technical Board level
- ▶ Based on
 - ▶ CERN Operational Circular Nr. 5 (baseline security document, mandatorily signed by all users having a CERN computing account)
 - ▶ Security Policy prepared by CERN Computing and Network Infrastructure (CNIC)
 - ▶ Recommendations of CNIC
- ▶ Describes services offered by ACC related to computing infrastructure

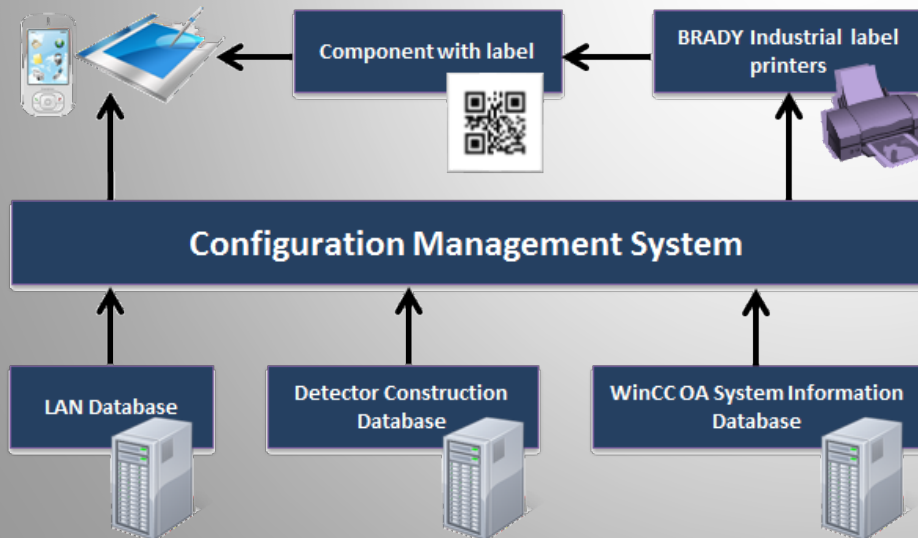
Scope of Computing Rules

- ▶ Categories of network attached devices
- ▶ Computing hardware (HW) purchases and installation
 - ▶ Standard HW -> by ACC
 - ▶ Rules for accepting non-standard HW
- ▶ Computer and device naming conventions
- ▶ DCS software installations
 - ▶ Rules for accepting non-standard components
- ▶ Remote access policies for DCS network
 - ▶ Access control and user privileges
 - ▶ 2 levels: operators and experts
 - ▶ Files import and export rules
- ▶ Software backup policies
- ▶ Reminder that any other attempt to access the DCS network is considered as unauthorized and in direct conflict with CERN rules and subjected to sanctions



Managing Assets

- ▶ DCS services require numerous software and hardware assets (Configuration Items)
- ▶ Essential to ensure that reliable and accurate information about all these components along with the relationship between them is properly stored and controlled
- ▶ CIs are recorded in different configuration databases at CERN
- ▶ Configuration Management System - integrated view on all the data
- ▶ Repository for software



ALICE Components Information Service

Browse components Search DCS Inventory DCS Software

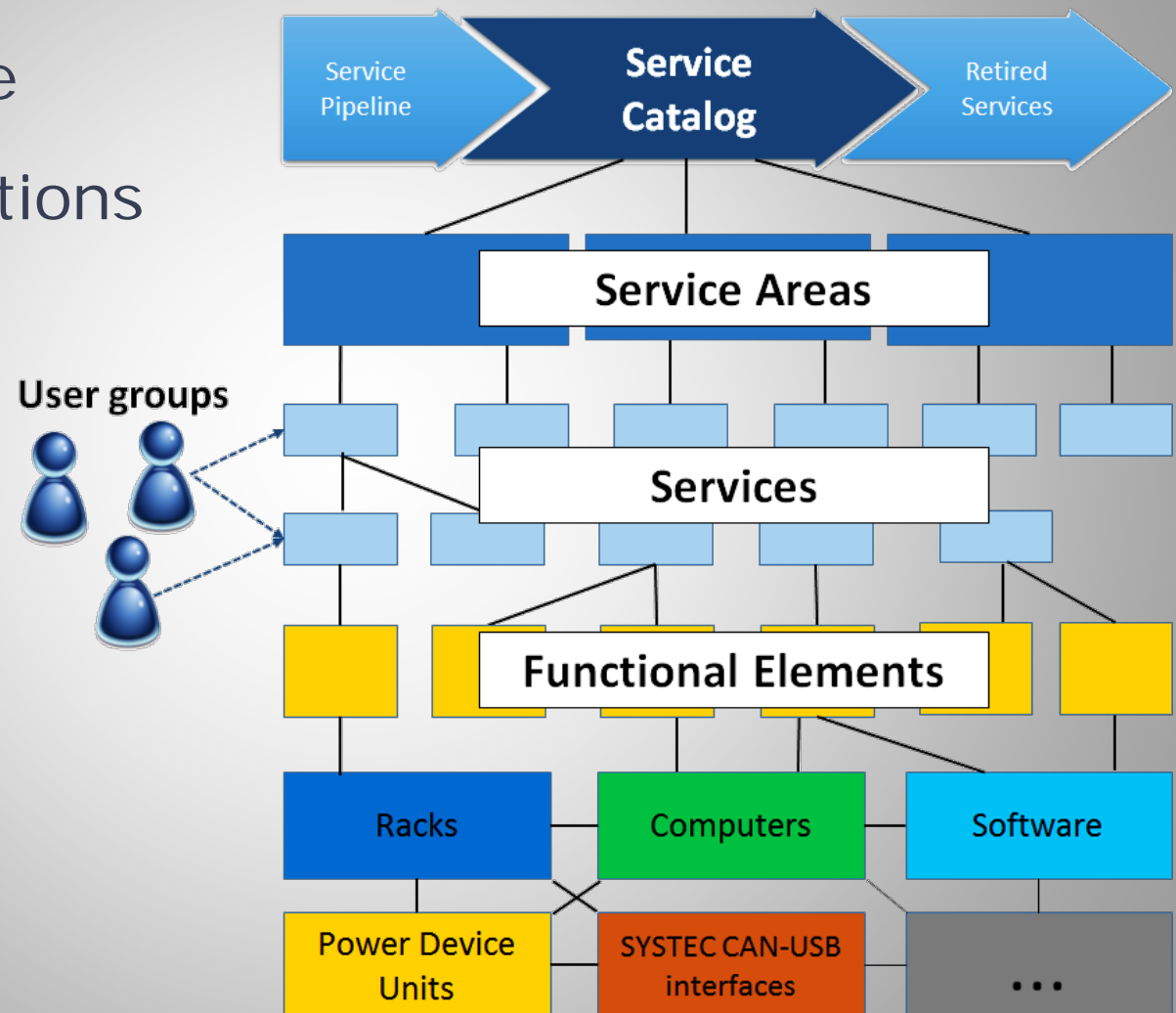
Initial data filtering

Allocation: LI C Refresh

PartID	LocalID	Allocation	Engineered In	Project Name	System Name	Site	Lab	Aliases	Hardware	Operating	Description
10C03G000000000	ALICE0000000	LHC	TRUE	Br-Job	Br-Job	116	ALICE0000000	ALICE0000000	32222	WINDOWS	Down time Controller for the 116 beam background monitoring
10C03G000000007	ALICE0000008	LHC	TRUE	Br-Job	Br-Job	121	ALICE0000001	ALICE0000001	32222	WINDOWS	Interface for the Br-Job project
10C03G000000008	ALICE0000009	LHC	TRUE	Br-Job	Br-Job	117	ALICE0000002	ALICE0000002	32222	WINDOWS	LHC-GPP files for the offline. Backed by Br-Job. Publications for LHC-Tensor
10C03G000000009	ALICE0000010	LHC	TRUE	Br-Job	Br-Job	118	ALICE0000003	ALICE0000003	32222	WINDOWS	BCM
10C03G000000010	ALICE0000011	LHC	TRUE	Br-Job	Br-Job	119	ALICE0000004	ALICE0000004	32222	WINDOWS	ALICE and LHC related information published for the control and detector control systems
10C03G000000011	ALICE0000012	LHC	TRUE	Br-Job	Br-Job	120	ALICE0000005	ALICE0000005	32222	WINDOWS	EPYC
10C03G000000012	ALICE0000013	LHC	TRUE	Br-Job	Br-Job	121	ALICE0000006	ALICE0000006	32222	WINDOWS	ALICE Luminosity calculations, production of Luminosity maps, LHC Luminosity, van der Meer scan, Integrated Report Generation
10C03G000000013	ALICE0000014	LHC	TRUE	Br-Job	Br-Job	122	ALICE0000007	ALICE0000007	32222	WINDOWS	Proton Top mode, tracks and publishing ALICE/LHC rfc, V02 control, Background

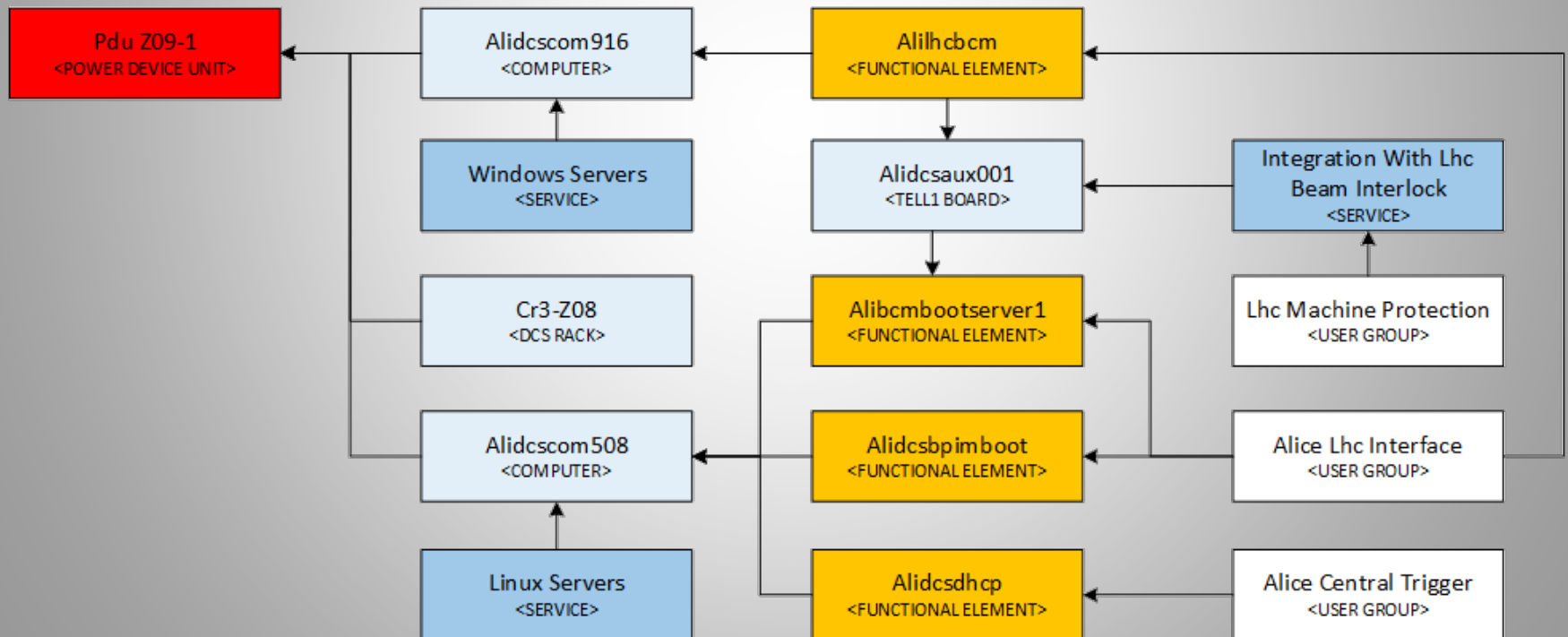
Hierarchy of Configuration Items

- ▶ Based on IT Infrastructure Library (ITIL) recommendations



Managing dependencies

- ▶ Generation of diagrams showing dependencies between CIs for impact analysis



Knowledge Management

- ▶ Implemented via:
 - ▶ MS SharePoint - documents management and collaboration system
 - ▶ before TWiki & custom ACC webpages were in use
 - ▶ JIRA – issues tracking

- ▶ Scope – all deliverables from ACC
 - ▶ Technical documentation for experts
 - ▶ Operational procedures
 - ▶ Training materials
 - ▶ DCS Computing Rules
 - ▶ Known Errors register
 - ▶ Operation reports
 - ▶ Publications
 - ▶ ...



Summary

- ▶ Standardization is the key to success
- ▶ Experiment environment evolves rapidly
 - ▶ Scalability and flexibility play important role in DCS design
 - ▶ Stable central team contributing to the conservation of expertise
- ▶ 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
- ▶ ALICE DCS provided excellent and uninterrupted service since 2007

Summary

- ▶ Operational experiences gained during the operation are continuously implemented into the system in form of procedures and tools
- ▶ Relatively quiet on-call shifts for ACC members
 - ▶ Number of calls decreased significantly over time (from ~1 per day at the start to ~1 per week now)
 - More automation
 - Better training and documentation
 - Better procedures
 - Better UIs that make operation more intuitive (hiding complexity)



THANK YOU FOR YOUR
ATTENTION



ALICE

Pb+Pb @ $\sqrt{s} = 2.76$ ATeV

2010-11-08 11:30:46

Fill : 1482

Run : 137124

Event : 0x00000000D3BBE693