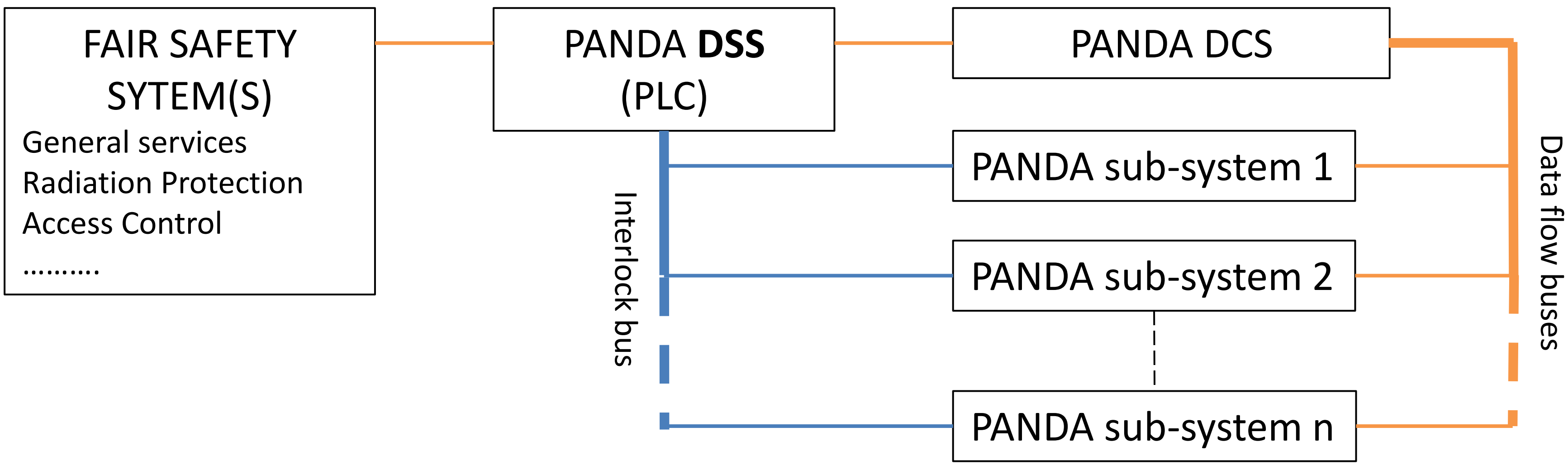
# PANDA DCS Technical Design

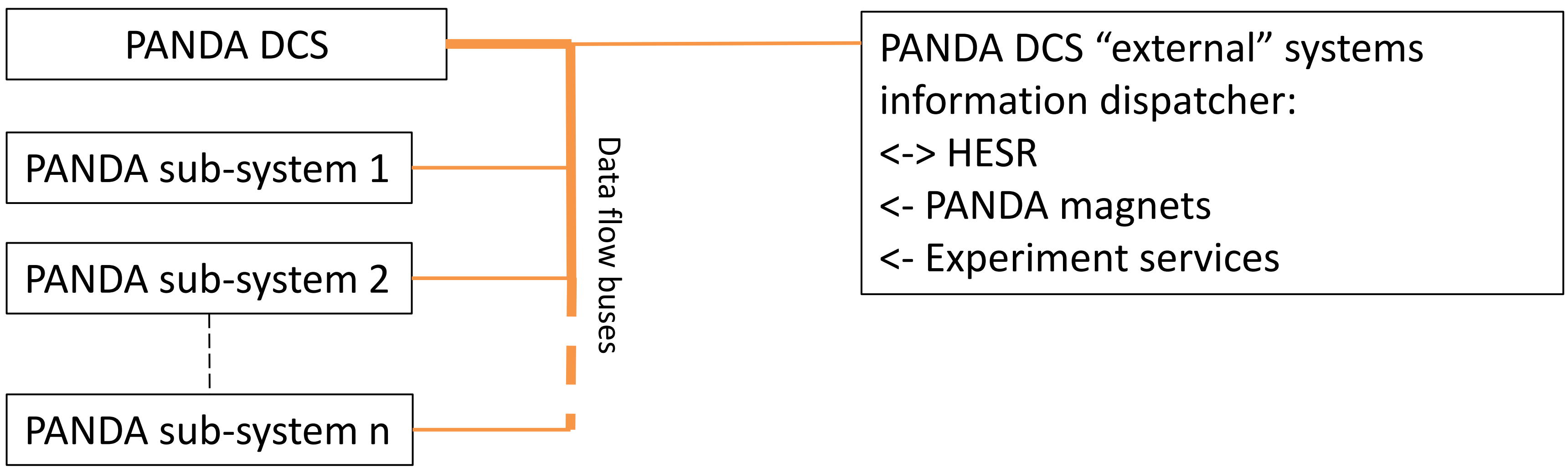
# PANDA DCS ( & Class 1 External Control Systems )

- Mainly **designed to monitor, control and configure** the hardware components of **PANDA experimental setup**;
- **Not considered to provide personnel protection**;
- Operate independently of **Detector Safety System** ?! ;
- **Complementary** to other **FAIR Safety System(s)** .



# PANDA DCS (& Class II External Control Systems)

PANDA Magnets and (probably some) Services are delivered with Autonomous Supervisory Control System >> treated as "external"



# PANDA DCS interface with HESR

**HESR** can be treated as **CLASS I system** >> **during injection and beam development** can turn into a **major safety issue** for some PANDA sub-systems (MVD, LUMI) <=> FAST Beam dump request ( HW ? )

**HESR** < = > LUMI – luminosity & background; detector position control & firmware;

< = > PANDA MAGNETS !?

< = > PANDA TARGET(S) ? ( we need a feedback loop ?)

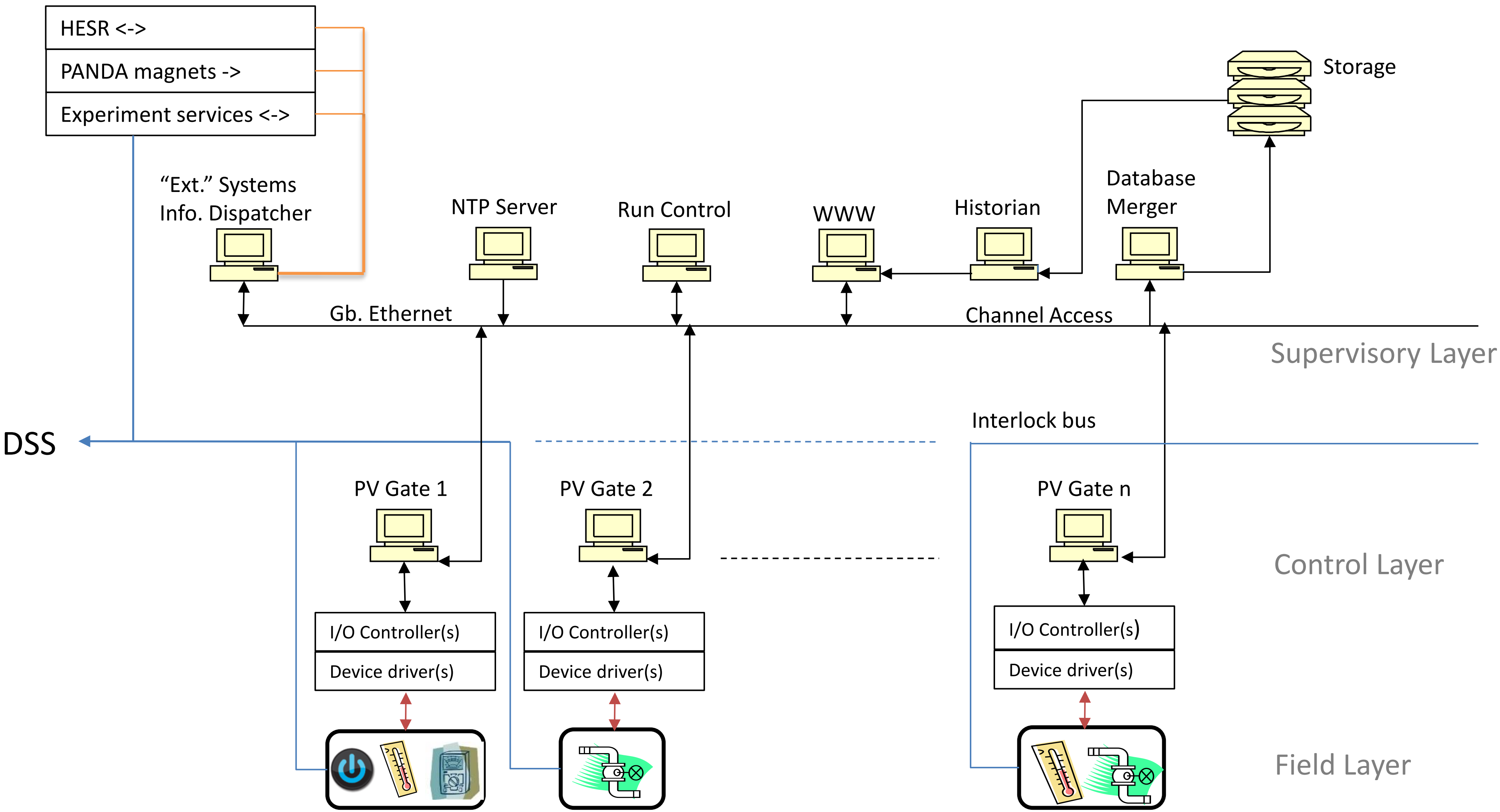
< = background levels from other PANDA sub-detectors;

**HESR status = >** filling, ramping, tuning, stable beams available to **ALL PANDA** sub-systems;

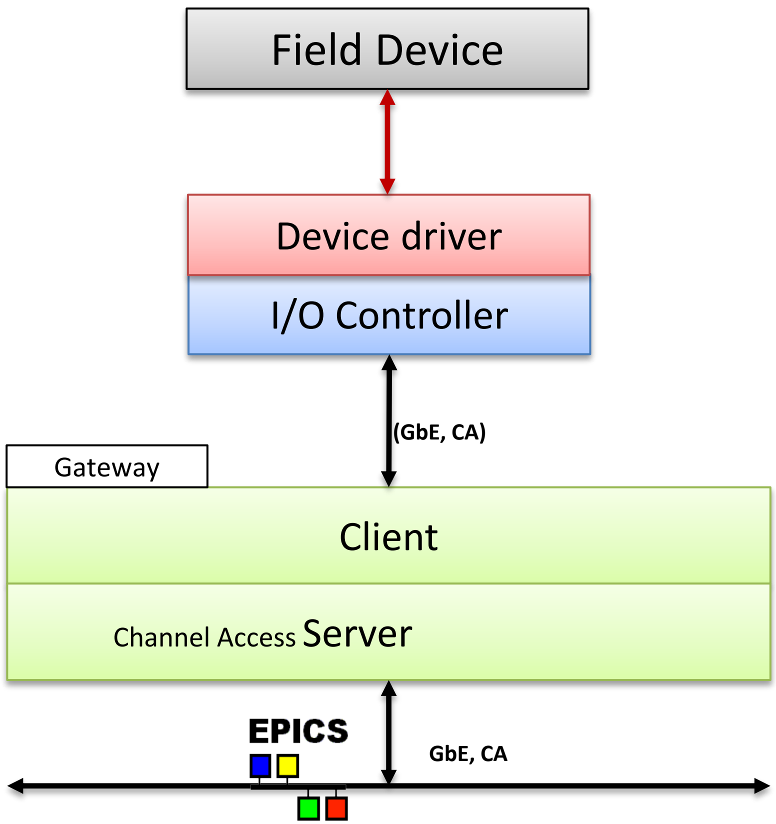
**HESR beam parameters =>** current, energy, etc available to **ALL PANDA** sub-systems.

We need to plan **a dedicated interface with HESR at the DCS Supervisory level acting** also as an **information dispatcher for ALL PANDA sub-systems**.

# PANDA DCS Layers



# PANDA DCS Unit




**I/O Controller (IOC)**: Any computing device (PC, SBC, micro-controller board, FPGA board etc.) able to manage the I/O of the field devices;

- If National Instruments hw. is used (PC, PXI, CompactRIO, ..) LabView 2009 (or higher) + LabView DSC Module (EPICS I/O Server) are mandatory;

- If > 1 IOC is required we advise the usage of soft IOC running on embedded Linux devices with GbE interface;

**Gateway:** Linux server with at least 2 NIC, EPICS 3.14 & Gateway 2.0 extension;

- Reduces the load on critical IOCs;
- Provides convenient access from one subnet to another;
- Provides extensive additional access security.

# Locations of DCS equipment

Counting House E10 : 45 racks (47U each)

- dedicated mainly to supplies: HV, LV , Gas Mixing

Target spectrometer platform(s): 14 + 6 racks

Forward spectrometer platform: 8 racks

Devices and equipment's making the DCS Field Layer together with the I/O Controllers will be set-up in the above locations.

The **PV Gateways** together with some servers belonging to the DCS Supervisory Layer can be hosted by Counting House E20 (**DAQ floor**, 61 racks) and/or Counting House E30 (**Online computing**, 59 racks)

# Locations of DCS equipment

Accurate reading of sensors and actuators placed **inside the PANDA Detector requires Field Layer devices immune to magnetic fields and radiation tolerant**.

Eq.

- ECAL and LUMI DCS: Temperature and Humidity Monitoring (THMP) board – designed to Read-Out PT100 temperature sensors and HIH-4000 humidity sensors;

- Temperature data from MVD ASIC's (TOPIX, PASTA) and dedicated temperature sensors placed near the beam pipe.

**Some DCS Field Layer Devices should be qualified for radiation and intense magnetic fields.**

# PANDA DCS Finite States

- *Simple commands* sent from the Supervisory Layer to sub-systems should trigger well defined actions directing to the transition of the sub-system from an initial steady state to a final one

Eq.: *Get ready for physics* (HV up, detector moving, etc)
*Go to safe mode* (HV down, detector moving, etc)
*Calibration* ( ………..)
*Shutdown* (……….)

HESR messages should also trigger well defined actions
*Beam dump* (…….)
*Unstable beam* (…..)
*Machine development* (……)

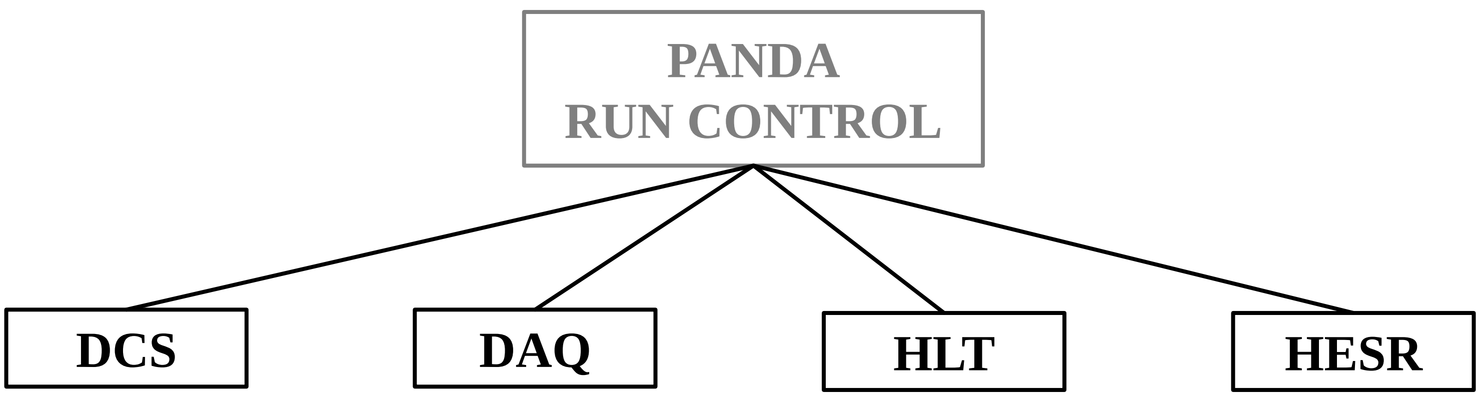
# PANDA DCS & DAQ & HLT

PANDA DCS: time stamped (Jan.01.1970 and /or Jan. 01. 1990 reference ) “slow” data;

PANDA DAQ: $t_0$ referenced to HESR RF;

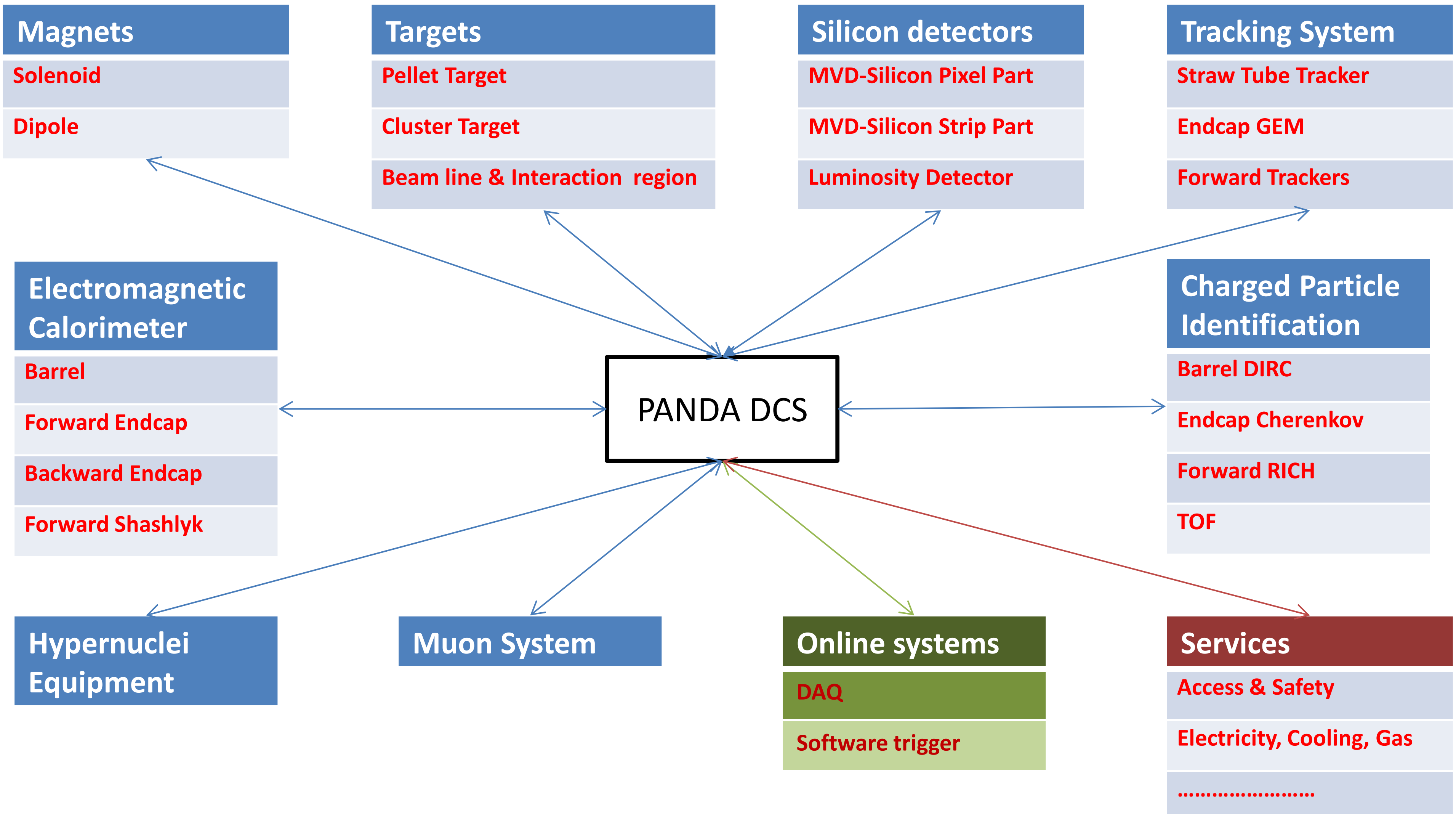
HLT: event filtering => interacting with the DCS mainly during CALIBRATION (?);

**DCS – DAQ – HLT interface**: exchange ( or **transmit to a higher level)** informal messages, commands & alarms.



# BACKUP SLIDES

# PANDA DCS Architecture – centralized view



# PANDA DCS Architecture - Complexity

| Rough estimation of PANDA DCS complexity |
|---|
| 16 sub-det., 2 magnets, targets, beam |
| ↓ |
| ~ 100 sub-sub-systems ( ~ 5 / sub-det.) |
| ↓ |
| ~ 400 devices (~ 4 / sub-sys.) |
| ↓ |
| order of $10^4$ "slow" channels |

➡

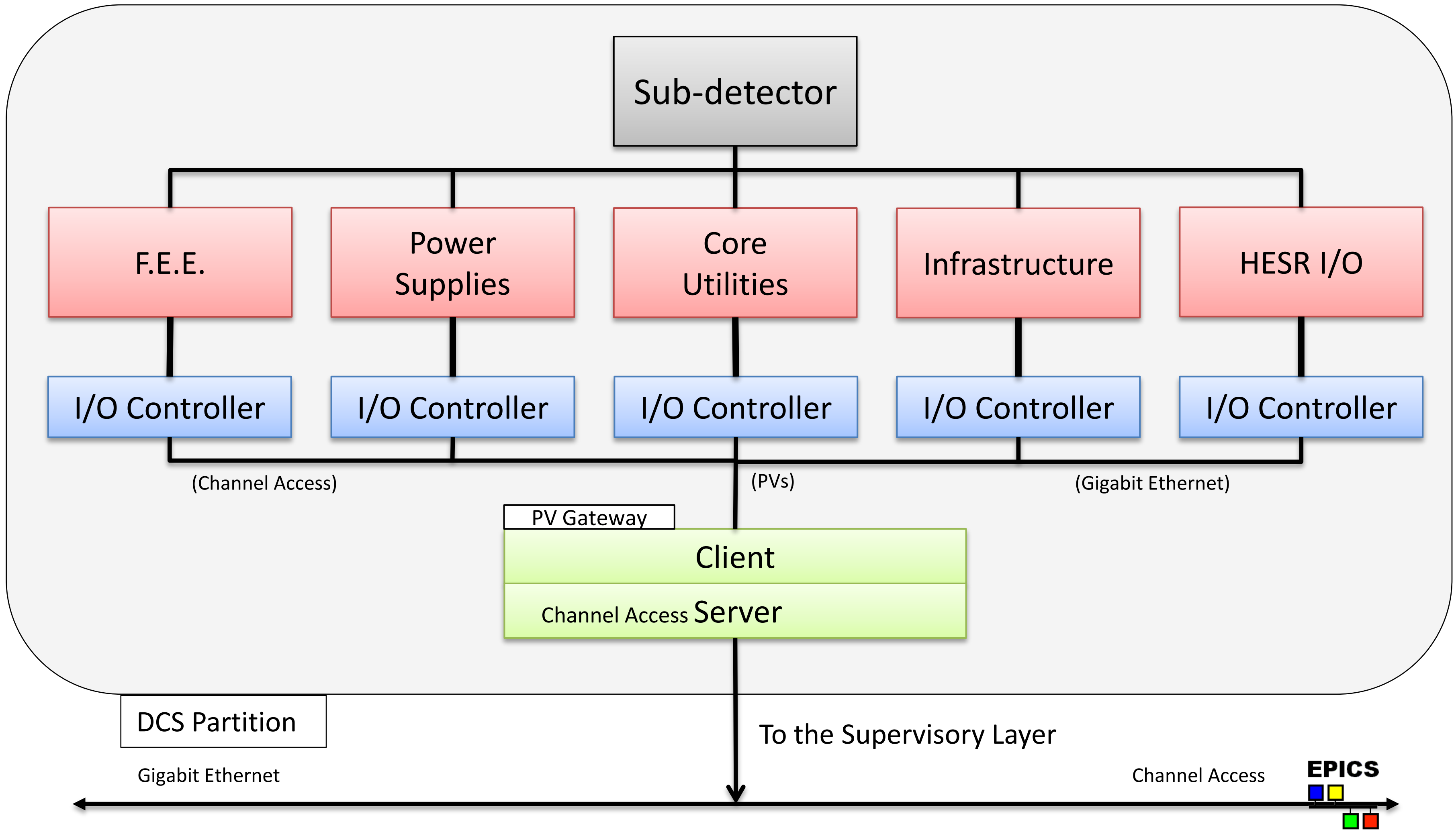
| (Some) Requirements |
|---|
| - Scalable, Modular |
| - Graphical UI |
| - Non-expert operation |

# PANDA DCS Architecture

Due to the anticipated complexity of the whole PANDA DCS and the expected staged assembly of PANDA detector, the DCS is highly needed to be modular and scalable.

In order to accomplish this, each PANDA sub-detector or sub-system is foreseen to be basically autonomous but manageable from a supervisory layer.

# PANDA Sub-detector DCS Architecture (example)

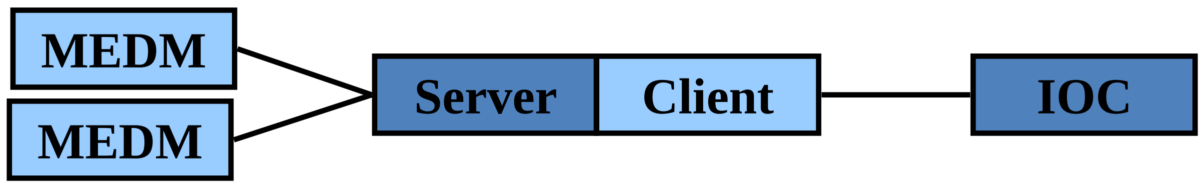


# PANDA DCS Partition developers responsibilities

- the implementation of controls for the hardware devices belonging to the Field Layer of the partition;
- the development of software running on the Control Layer of the partition (*EPICS I/O server compliant*);
- the development of the partition GUI software (*CSS framework*);
- the autonomous operation of the partition.

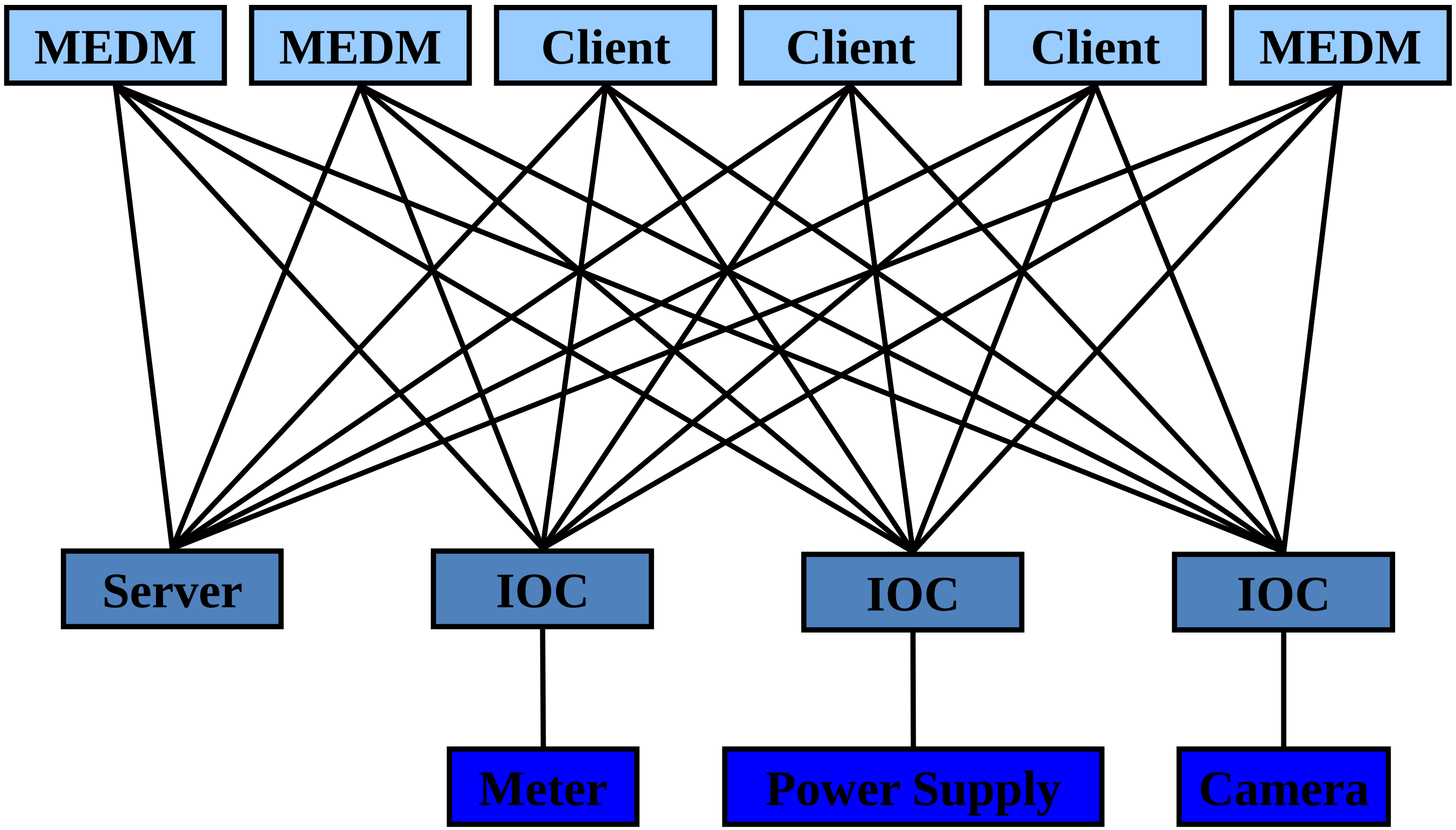
# What is the Gateway ?

- Both a  Channel Access server and a Channel Access client
  - Clients such as MEDM connect to the server side
  - Client side connects to remote servers such as IOCs

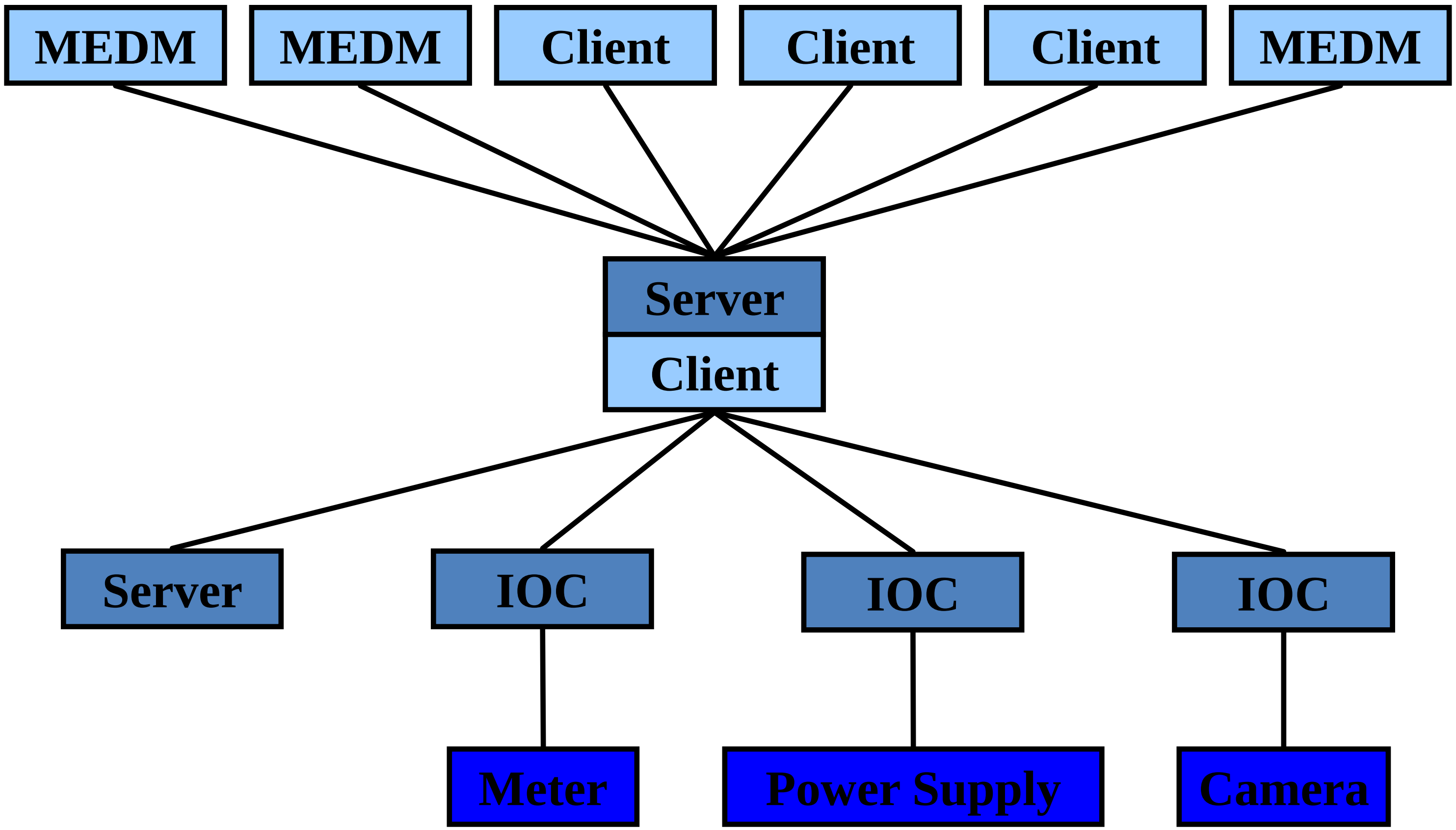



- Allows many clients to access a process variable while making only one connection to the remote server
  - Reduces the load on critical IOCs or other servers
- Provides access from one subnet to another
  - For example, from an office subnet to a machine subnet
- Provides extensive additional access security
  - For example, only read access from offices
- Can provide aliases for process variable names

# EPICS Overview



# Gateway


MEDM
MEDM
Client
Client
Client
MEDM
Server
Client
Server
IOC
IOC
IOC
Meter
Power Supply
Camera