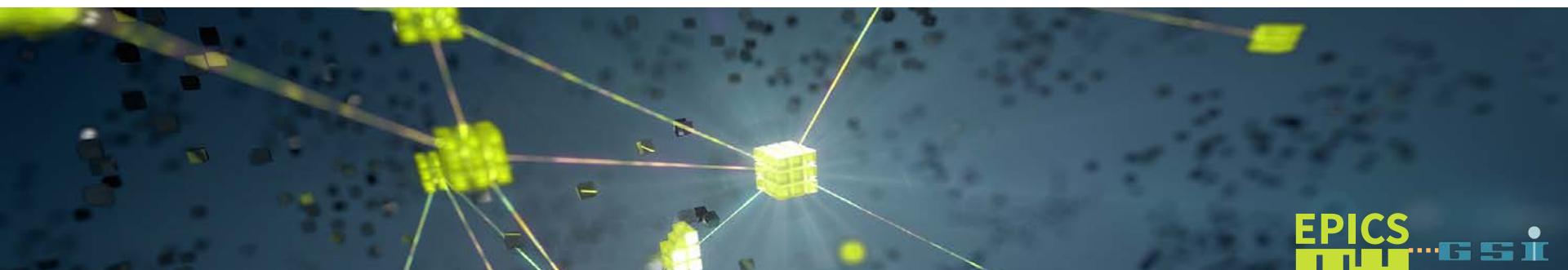


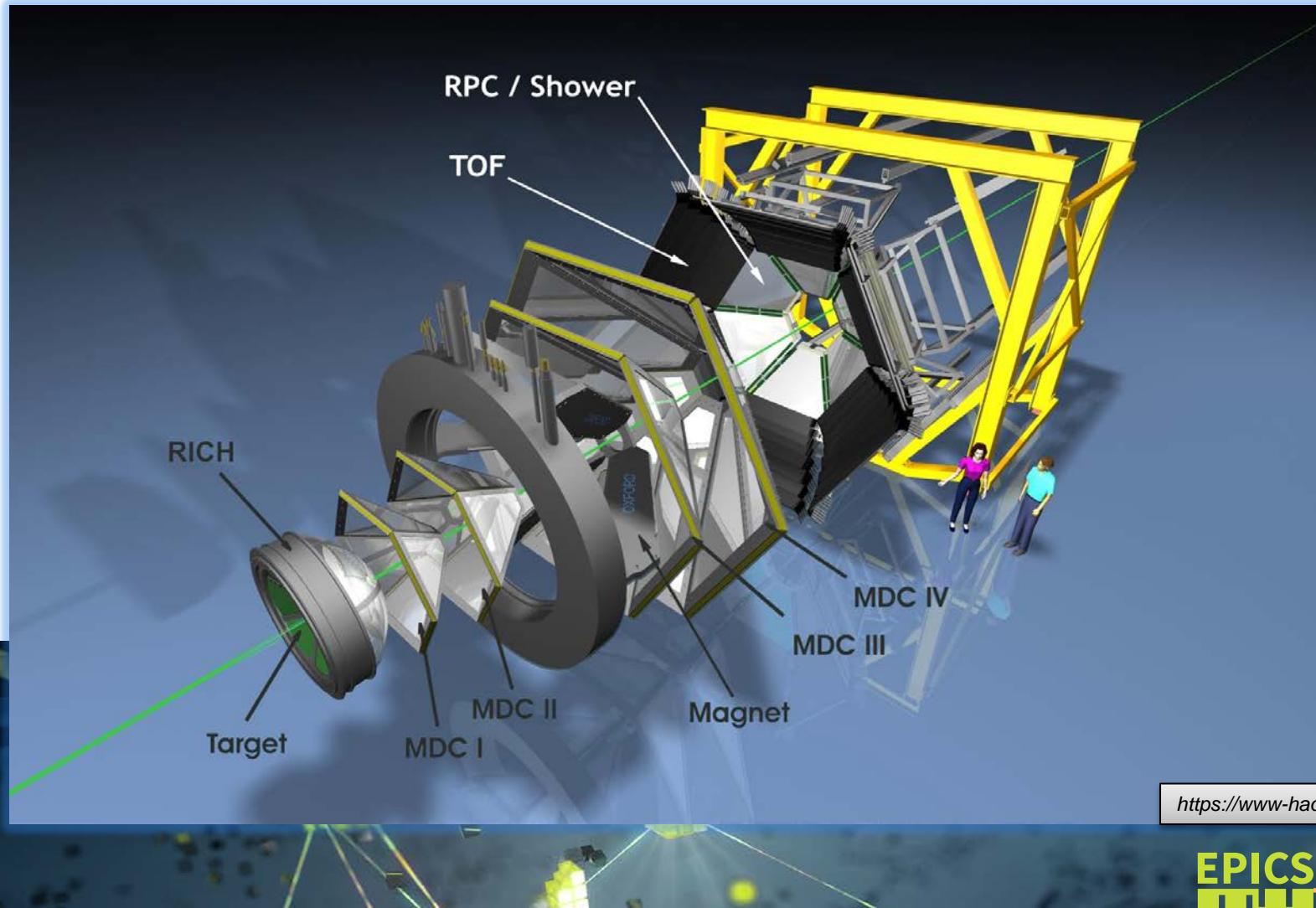
HADES Detector Control System

Peter Zumbruch, GSI/EEL/EKS

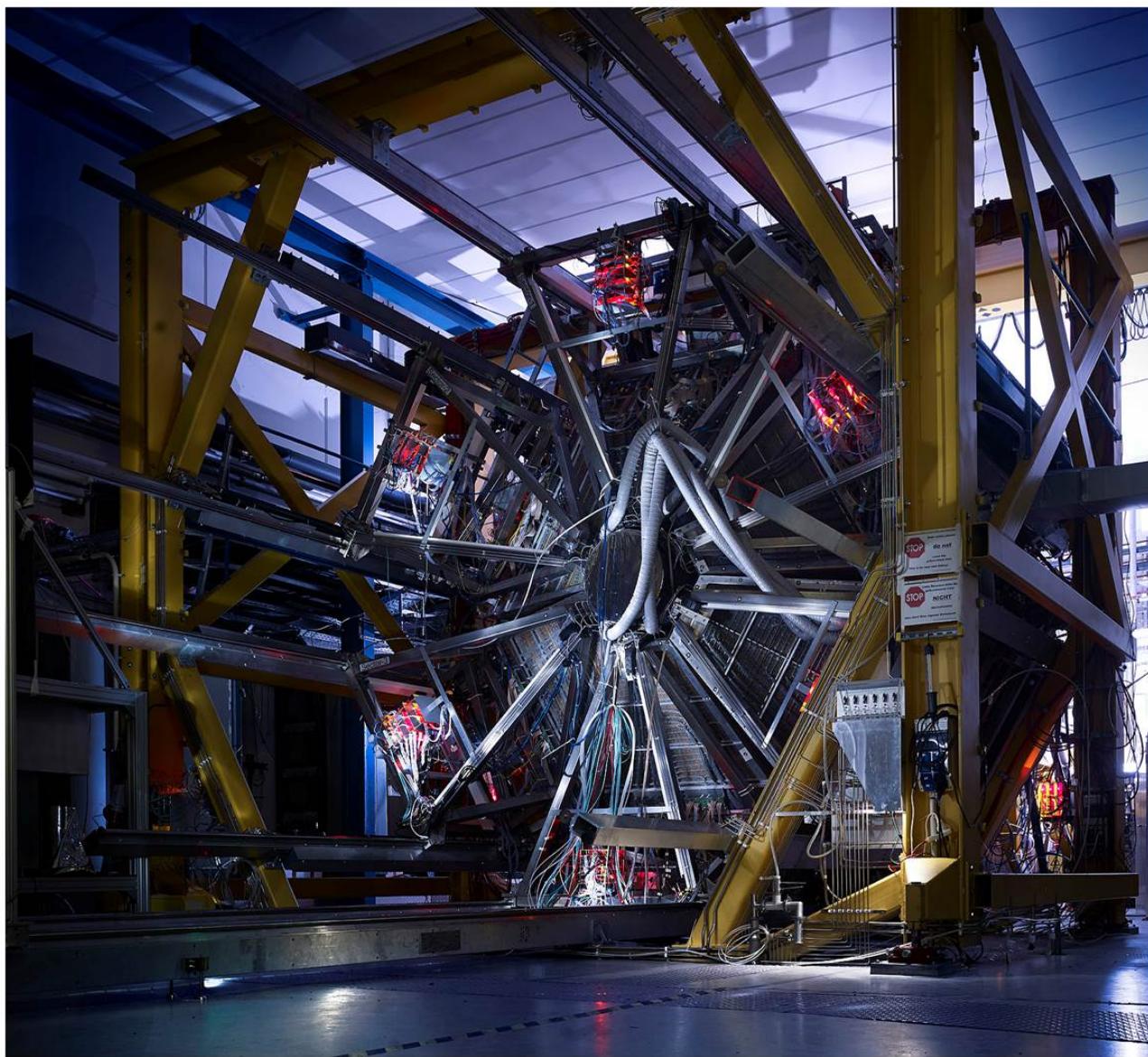
HADES



High Acceptance Dilepton Spectrometer



<https://www-hades.gsi.de>

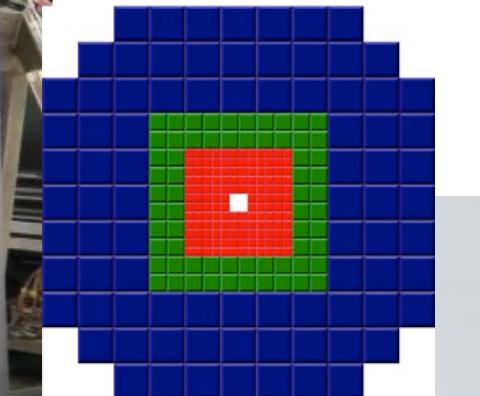


- HADES
- ~ 80.000 channels

<https://www-hades.gsi.de>

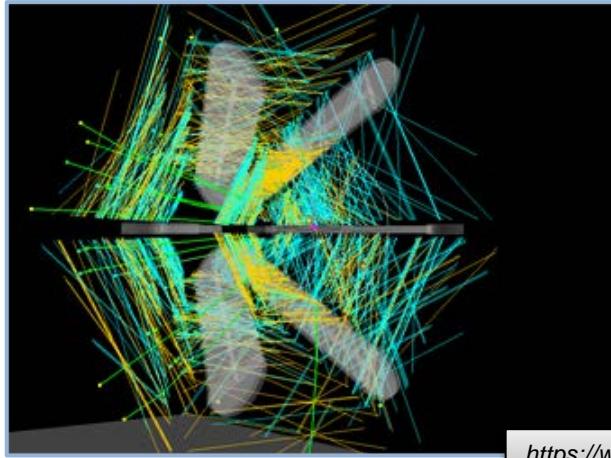


- New ECAL
 - (not shown: additional)
**Forward
wall**

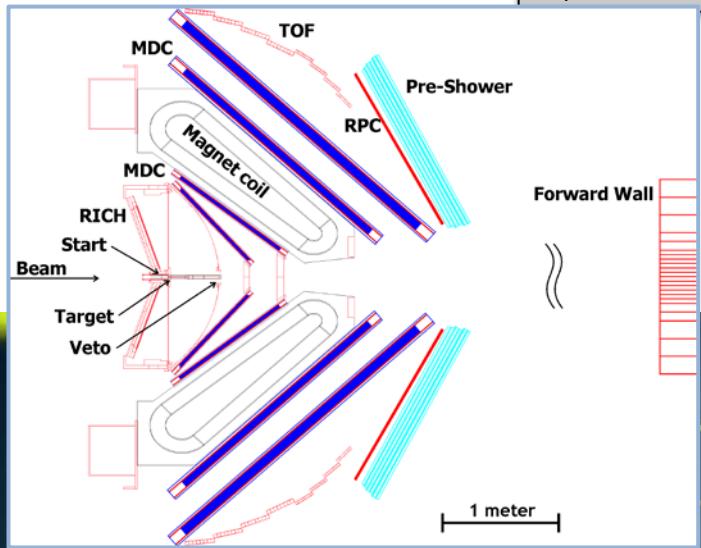


<https://www-hades.gsi.de>

Components



<https://www-hades.gsi.de>

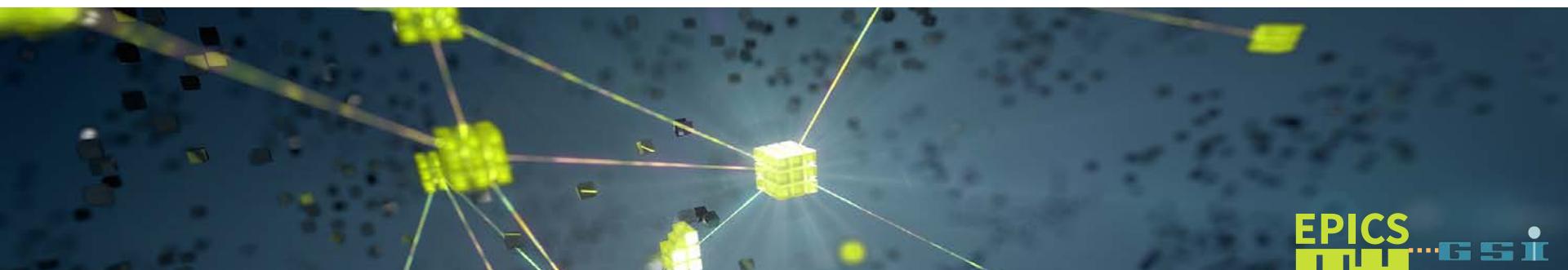


<https://hades-new.gsi.de/sites/default/files/web/media/documents/EPJA2009.pdf>

- A diamond START and VETO system
- A Ring Imaging Cherenkov (RICH) gas radiator for electron identification with a position sensitive photon detector, covering the full azimuthal range.
- Two sets of Multiwire Drift Chambers (MDC) before and after the magnetic field region form HADES tracking system.
- A superconducting toroidal magnet with 6 coils in separate vacuum chambers.
- A multiplicity/electron trigger array (formerly) consisting of granular Pre-shower detectors at forward angles (between 18° and 45°) and
- two time of flight walls: a scintillator based time-of-flight wall (TOF) at angles above 45° and the RPC wall built from resistive plate chambers at angles below 45°.

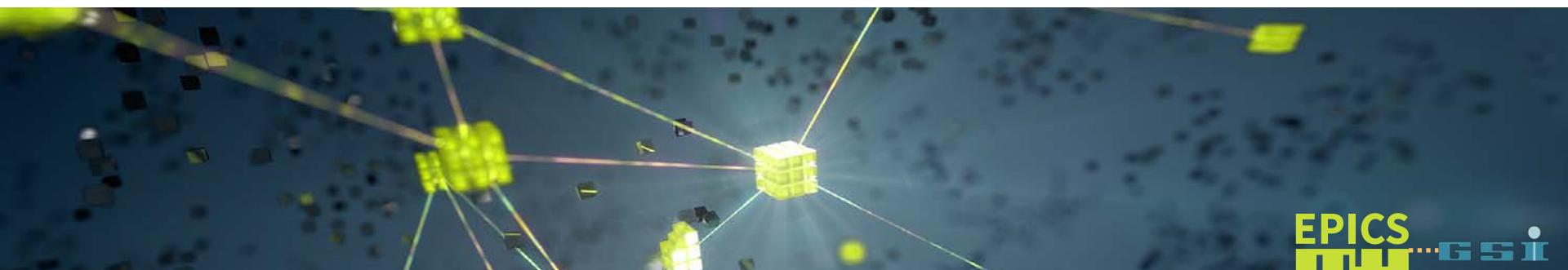
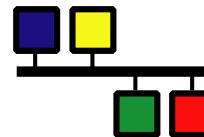
<https://www-hades.gsi.de>

DETECTOR CONTROL SYSTEM



EPICS BASED

EPICS
mu



EPICS
mu 

What is EPICS?

...short answer:

EPICS: Experimental Physics and Industrial Control System

...a bit more elaborate:

...EPICS is a set of Open Source software tools, libraries and applications developed collaboratively and used worldwide to create distributed soft real-time control systems for scientific instruments such as particle accelerators, telescopes and other large scientific experiments. (From the [EPICS Home Page](http://www.aps.anl.gov/epics/): <http://www.aps.anl.gov/epics/>)

...**striking** - is three things at once:

- A **collaboration** of major scientific laboratories and industry (> 100)
 - A world wide collaboration that shares designs, software tools and expertise for implementing large-scale control systems
- An **architecture** for building scalable control systems
 - A client/server model with an efficient communication protocol (Channel Access) for passing data
 - The entire set of Process Variables establish a Distributed Real-time Database of machine status, information and control parameters
- A **Software Toolkit** of Open Source code and documentation
 - A collection of software tools collaboratively developed which can be integrated to provide a comprehensive and scalable control system

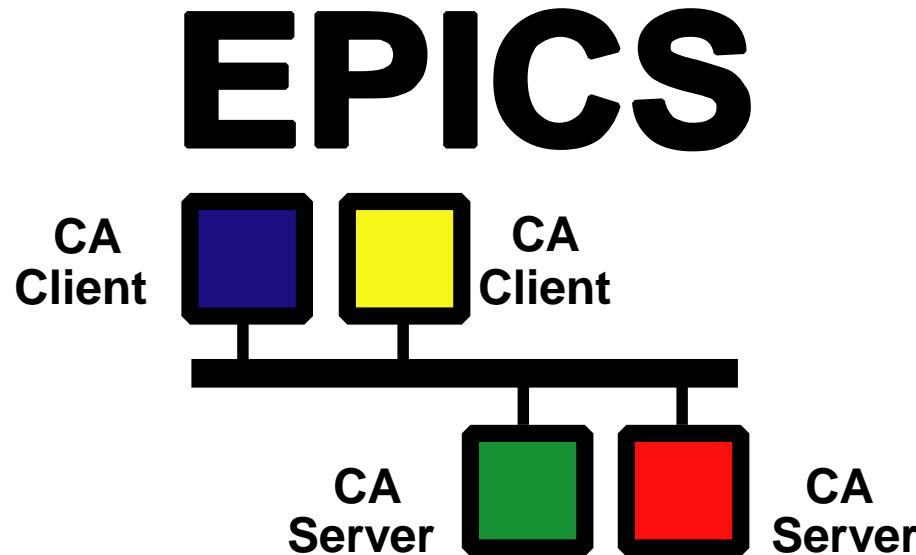
What is EPICS?

(Getting Started with EPICS: Introductory Session I)



A Control System Architecture

Network-based “client/server” model (hence the EPICS logo)



For EPICS, *client* and *server* speak of their Channel Access role
i.e. Channel Access Client & Channel Access Server

Why EPICS ?

- scalable Control System Architecture
 - rule of thumb: ~ 10 control channels per 1 data channel
 - ~ 1-10 Million channels
- runs on many OS architectures (Linux, Windows, Arm, RTOS)
- used world-wide in huge applications, e.g. ITER, HADES
- far reaching perspective, q.v. ITER
- GUIs are (one sort of) clients, displaying/changing process variables which are provided by the server. They are not part of the server
- support at GSI (P.Zumbruch)
- support world-wide
 - tech-talk
 - use-case e.g.
 - PANDA EMC Endcaps, Florian Feldbauer, Bochum



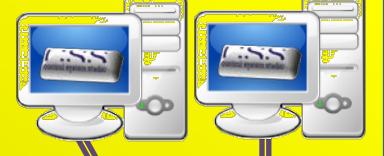
Supervisory Layer

HADES VLAN

Control Layer / EPICS

I-W CA I2C SP TTL AN I2C SPI TTL WiFi bnc the

Process/Device Layer

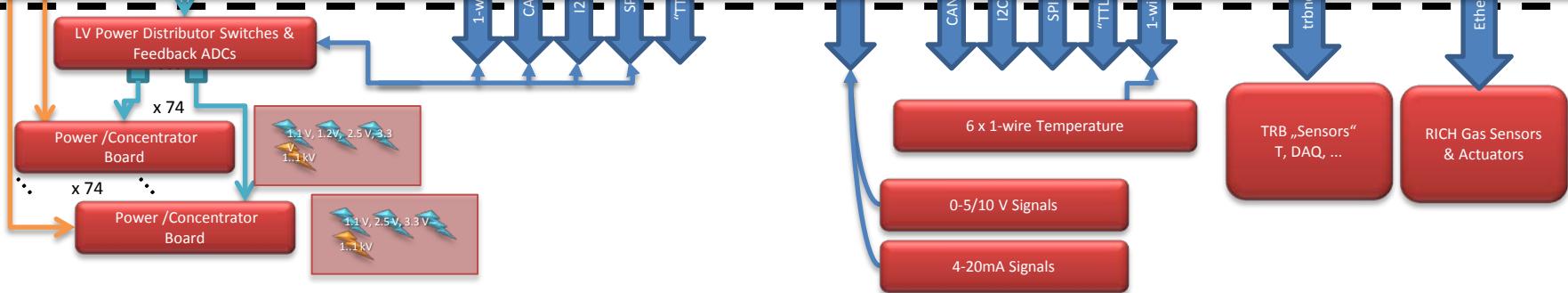


Supervisory Layer

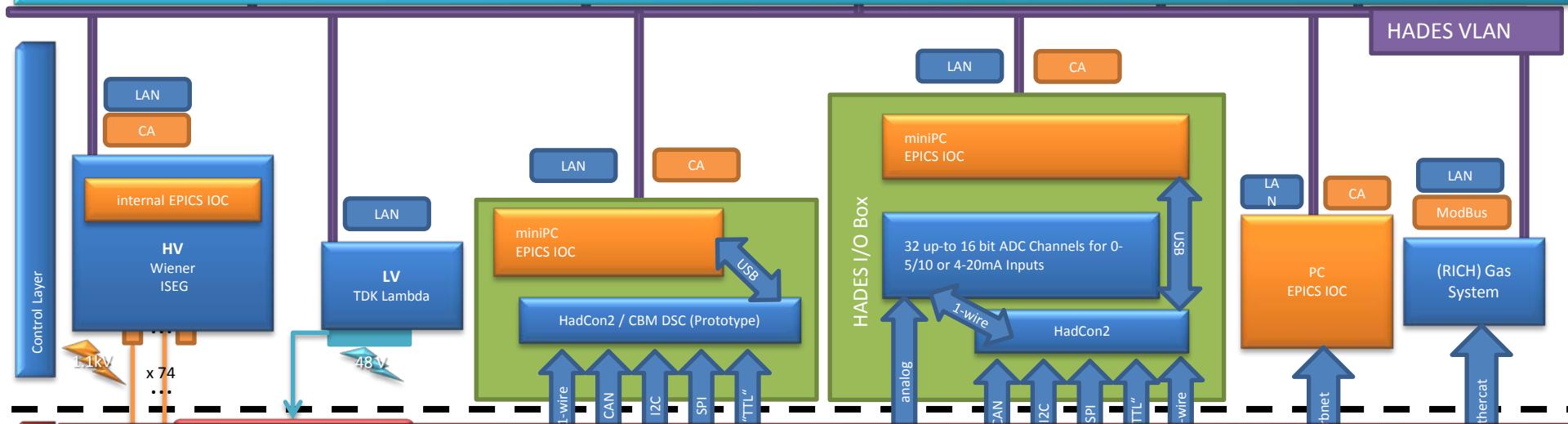
HADES VLAN

Control Layer / EPICS

Process Layer

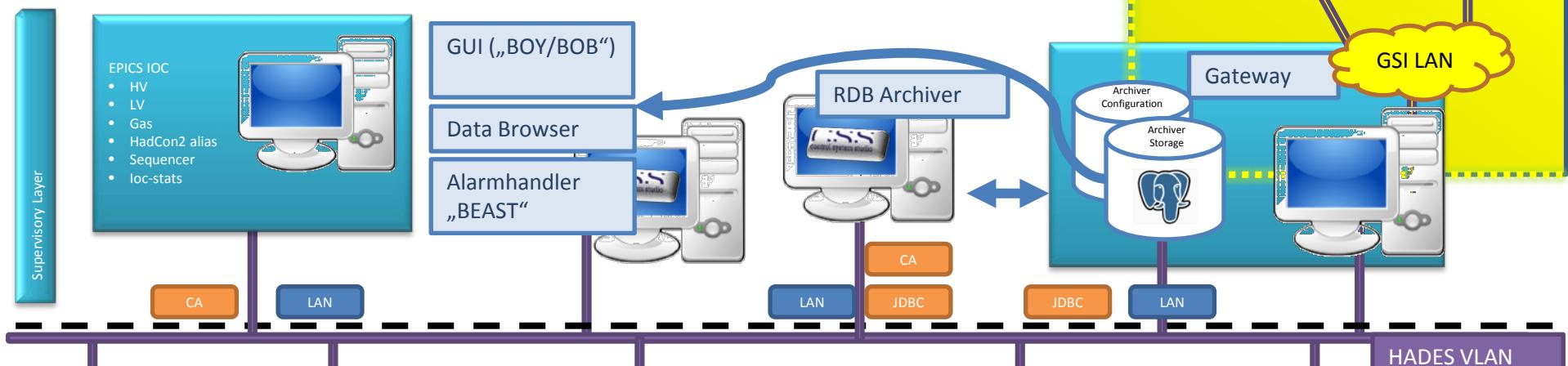


Supervisory Layer



Process/Device Layer

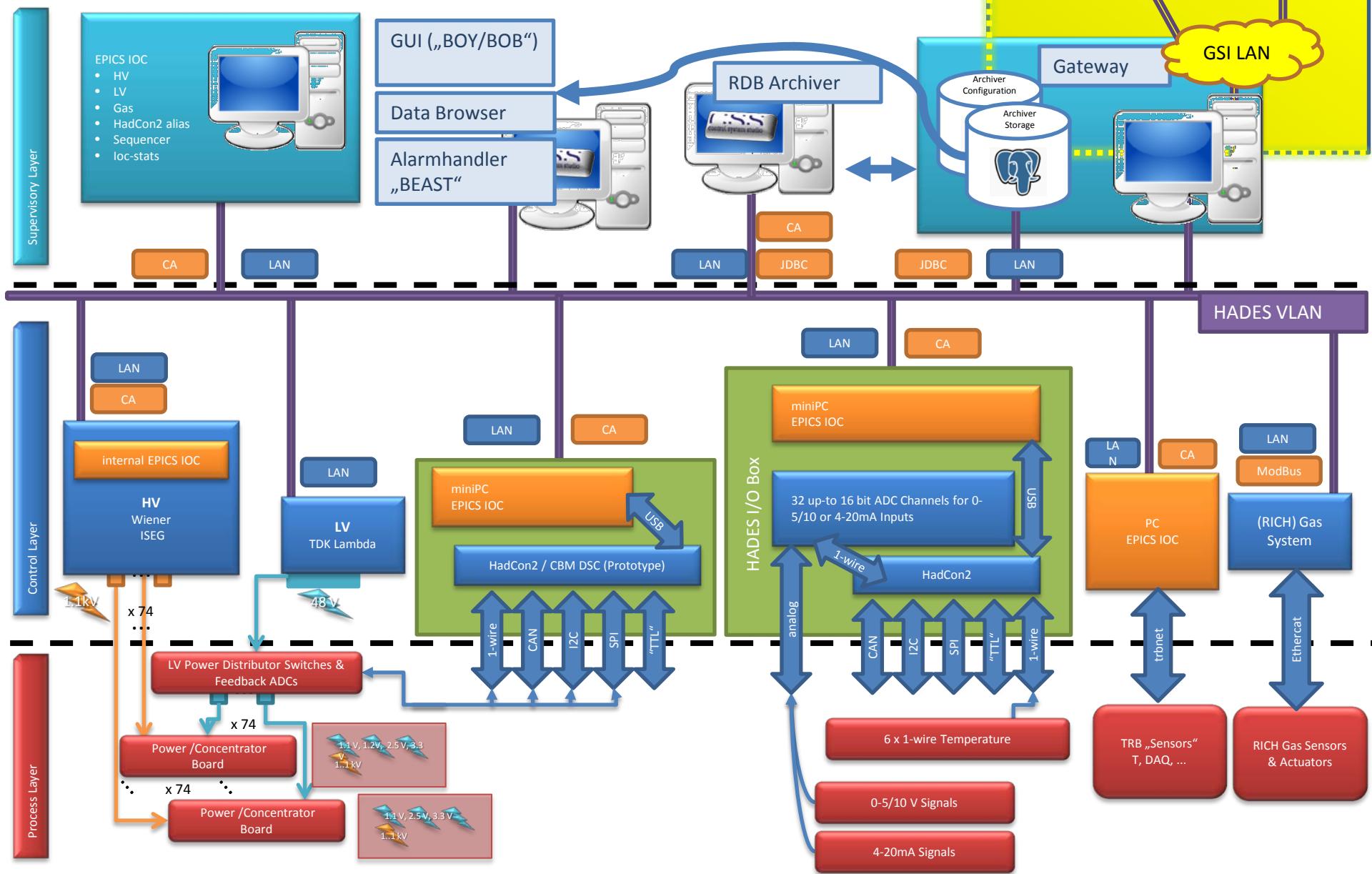
DCS Overview



Control Layer / EPICS

Process/Device Layer

DCS Overview



Overview

➤ HADES control system

- EPICS based client server system (main focus)
- ~ 25 compute nodes “IOCs“ (Input Output Controller
 - 5 central (linux-x86(_64))
 - „Main IOC“, Gateway Hades Network – GSI Network, FSM Sequencer, HV and LV control
 - 1 RICH PC + embedded ISEG IOC
 - 1 CAEN 4527 EPICS IOC
 - 17++ smaller (linux-arm, etrax)
 - HadCon1 (etrax FX)
 - HadCon2 + dreamPlug/Raspberry PI
- ~ 163.000 Process Variables
 - Temperature, HV, LV, Pressures, Scales, Switches, Gas Systems, ..
- Visualization / GUI client
 - Still MEDM
 - Old CSS 3.x (MDC, RPC, DCS beta)
 - CSS 4.4
- Archiving
 - CS-Studio based headless RDB Archiver
 - connecting to
 - local PostgreSQL database
 - future: GSI PostgreSQL Database Services
 - archiving for ~7000 Process Variables at 0.1 to 10 Hz
- Involved institutes
 - GSI, Gießen

Process Variables

PVs per type

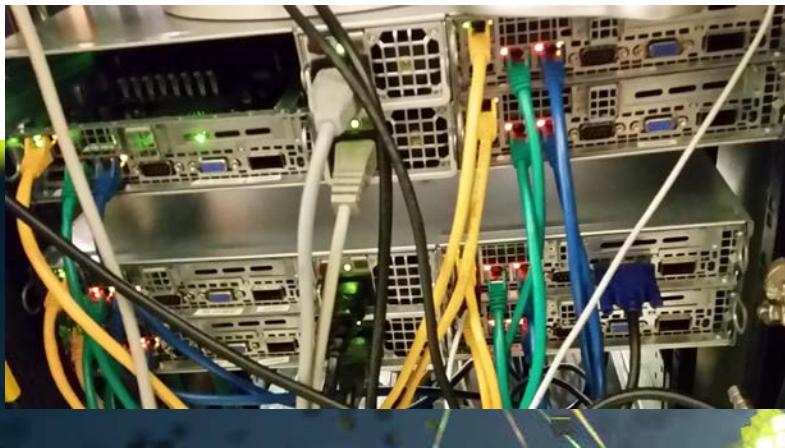
- Main IOCs (5)
 - 133572 (121373 / 90.8%)
- Dreamplug (4)
 - 2142 (1877 / 87%)
- HadCon1 (11)
 - 7074 (6866 / 97%)
- ISEG HV
 - ~10.000
- CAEN HV 4527
 - ~10.000

in total

- ~ 163,000 PVs (150,000 / 92%)



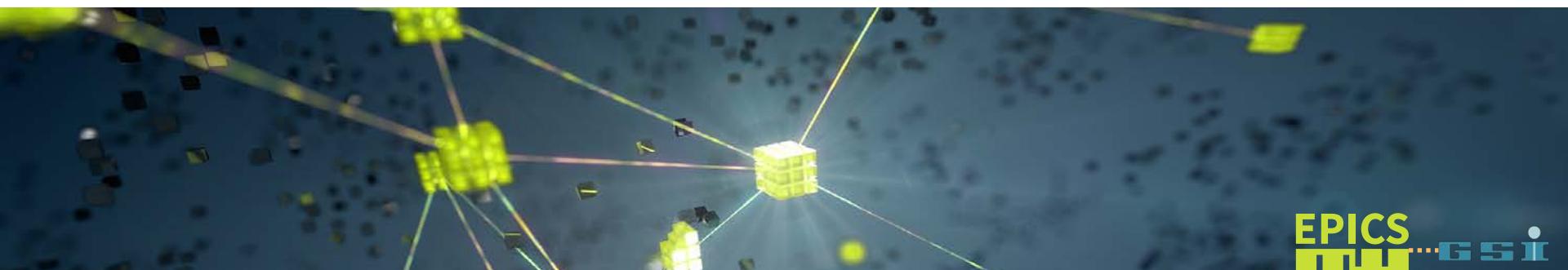
DCS Server



- DCS got two segregated server units of GSI batch farm nodes from IT
- Allows
 - further modularization
 - virtualization/container of servers and graphical clients.
 - improved redundancy
 - network (3 VLANs)
 - IT department OS



GRAPHICAL USER INTERFACES



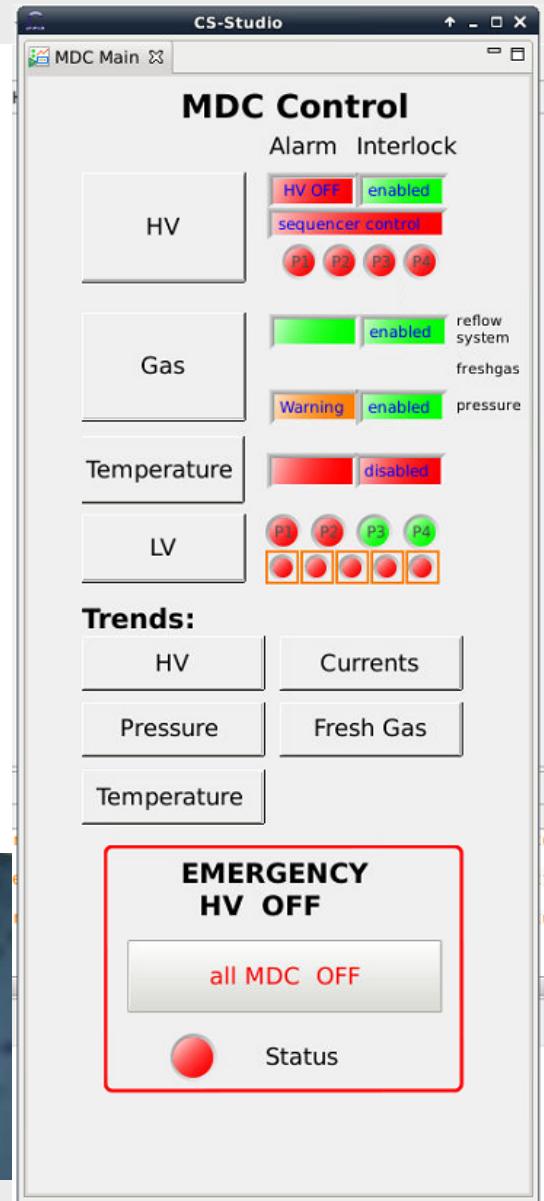
EPICS 

Current and Future Projects

GUI

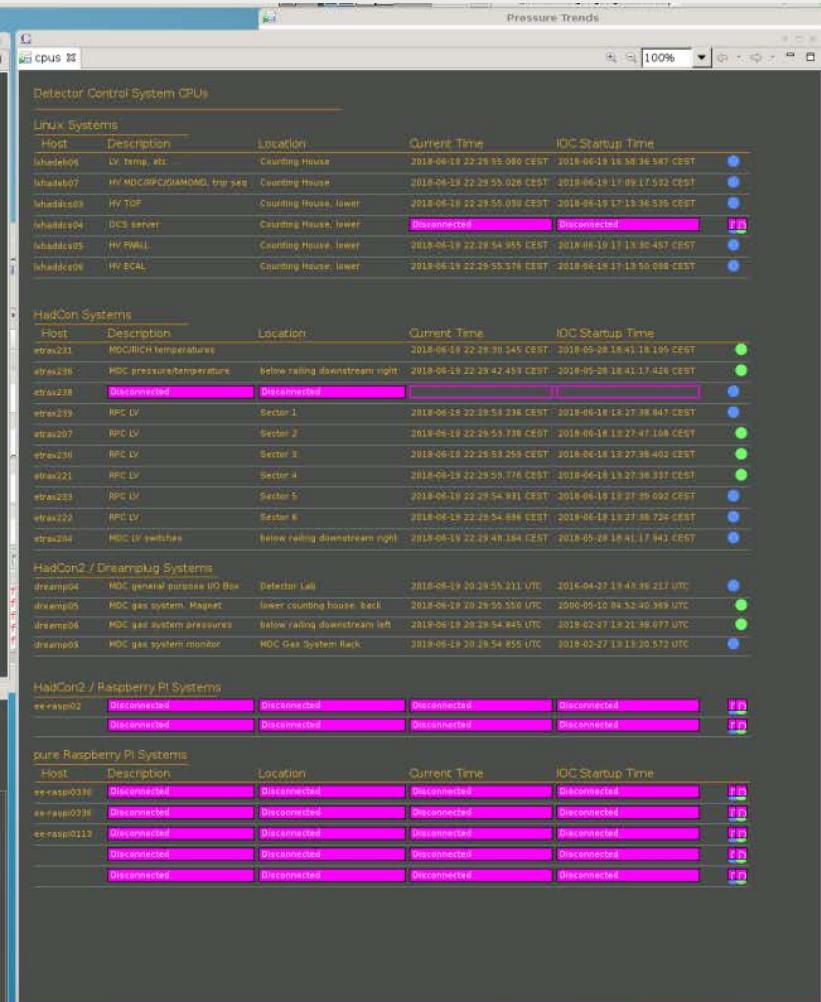
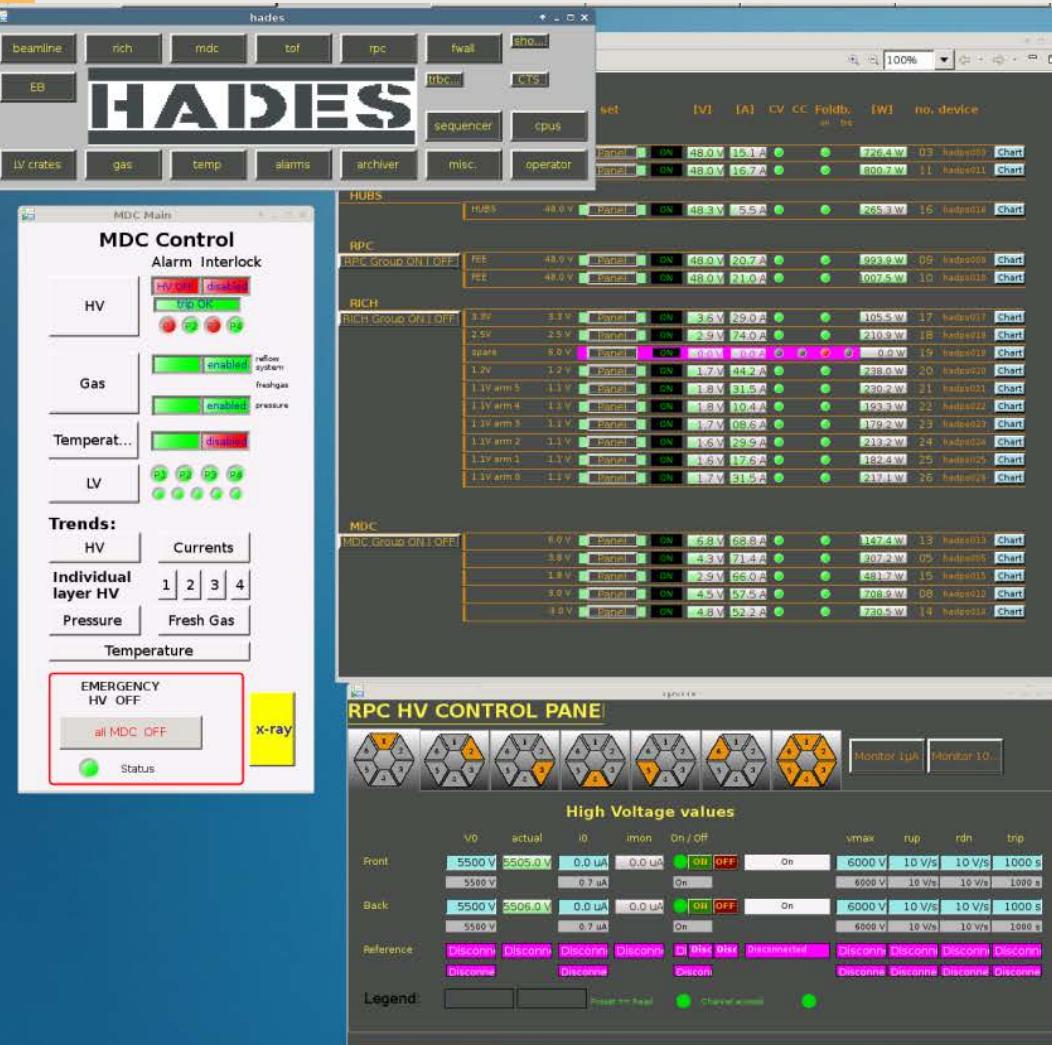


- CS-Studio - Replacement of MEDM displays
 - automatic conversion tools do exist



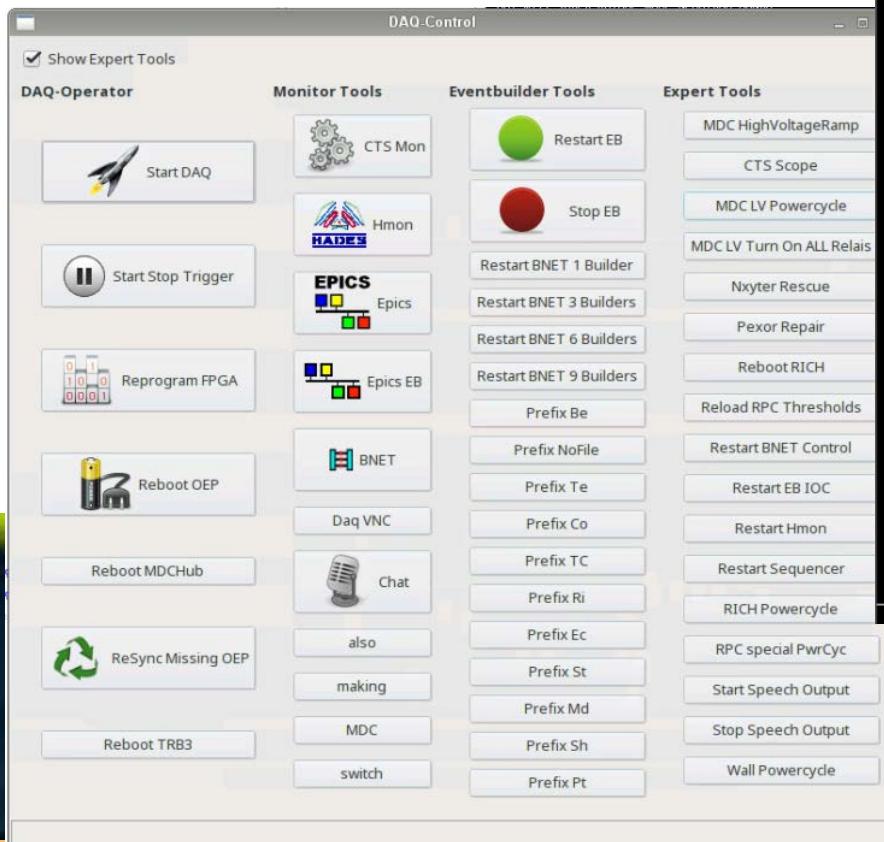
NEEDS DETECTOR'S INITIATIVE
FOR NEW DESIGN FEATURES

To get detector oriented DISPLAYs



hmon: perl based ECS and DAQ controls

- acting as an EPICS client

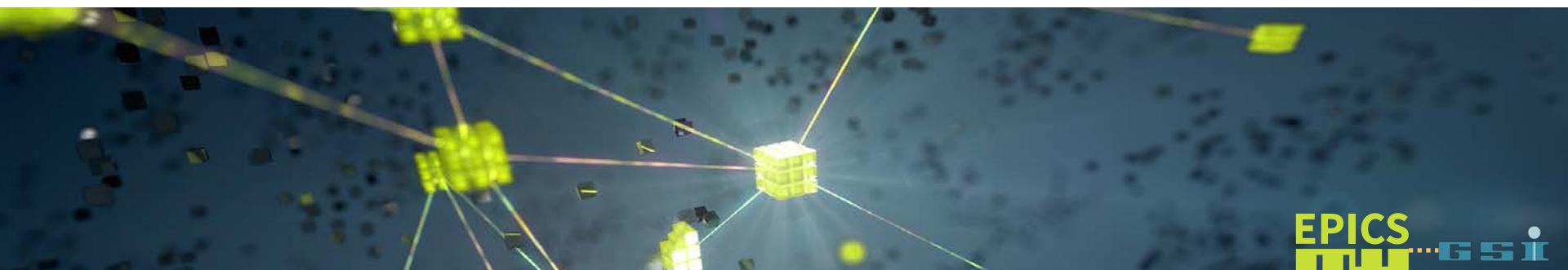


<http://hades33 - Hmon 1-QA - Mozilla Firefox>

Tactical Overview				
Main	Wall Clock 23:13:15	Current Rate 26112	Online QA Not found	Last Restart 44m30s ago
DAQ	TrbNet OK	Timeouts on 1 boards	Busy 25.1%	Read-out 611MB/s
Trig	Spill Sum No Spills	Accept. PT1 0% / 0%	Trigger Source 20kHz S2 M2C	Hodo Count 0 / 0
Rate	PT1 Rate 1.2k / 0	Start Rate 0 / 0	Hodo Rate 0 / 0	Pion1 Rate 0 / 0
Srv	Disk Level 55%	Max. CPU 100%	Icinga Problem	TRB Problem
EB	#EB running act: 6/1 (te)	ΔRate EB-CTS -8614 (-40%)	Data Rate 318 MB - 20 kB	#Evt Discarded 5534
MDC	MBO Reinit	MBO w/o data	Temperature 67/66/60/59	Link Errors 13 Errors
Endp	MDC 1 missing	RICH 23 missing	TOF/RPC/FW OK	Voltages 23 warnings
FEE	mdcinvalid	TRB TDC	FEE Error	ECal OK
RICH	Temperature 20 - 50	Voltages	Currents	Hub/St/CTS OK
Ecal			Temperature 23 - 31	Trigger 57456 Errors
Other	Magnet OFF	goofy		HV Sequencer 25/69

Below the table, there is a small image of a detector component and the EPICS GSI logo.

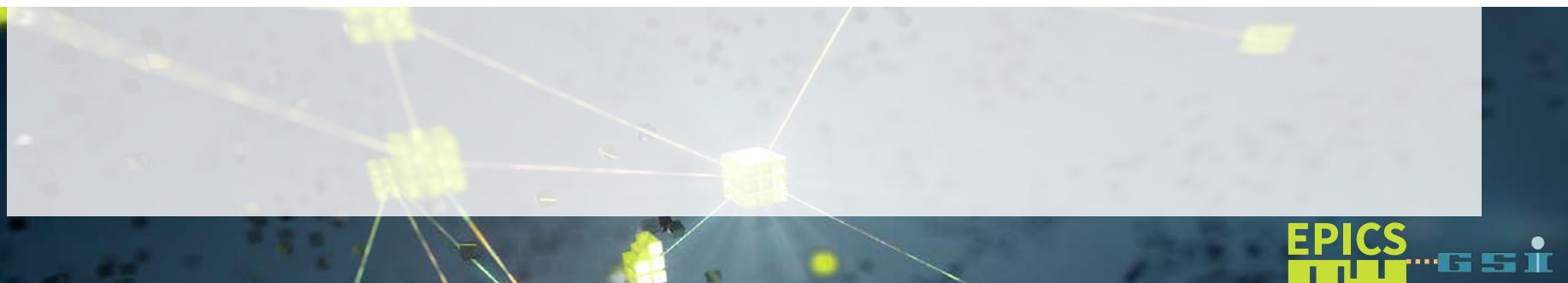
ORGANISATIONAL



Management (1)

People

- 1 core developer
- 1 detector (MDC) power user
- 1 advanced (RICH) user
- ~ 5-10 clients „I (would) need“
- In general no real detector group DCS experts
- 1 impatient/unhappy group/user (DAQ)



Management (2) System

- Up to a few days ago:
 - one main IOC
- Now
 - could be easily split up into 5 using \$(hostname) based configuration files
 - i.e. one type of executable configured for different setups
 - git.gsi.de/HADES git repository growing use for all used IOC
 - including automatic nightly update of resources for the main IOCs



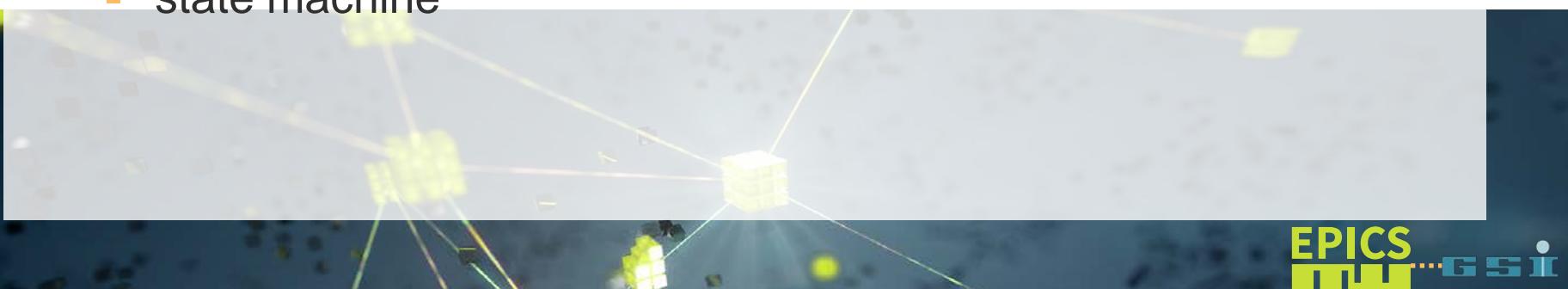
Management (3)

Vital, unwritten Rules

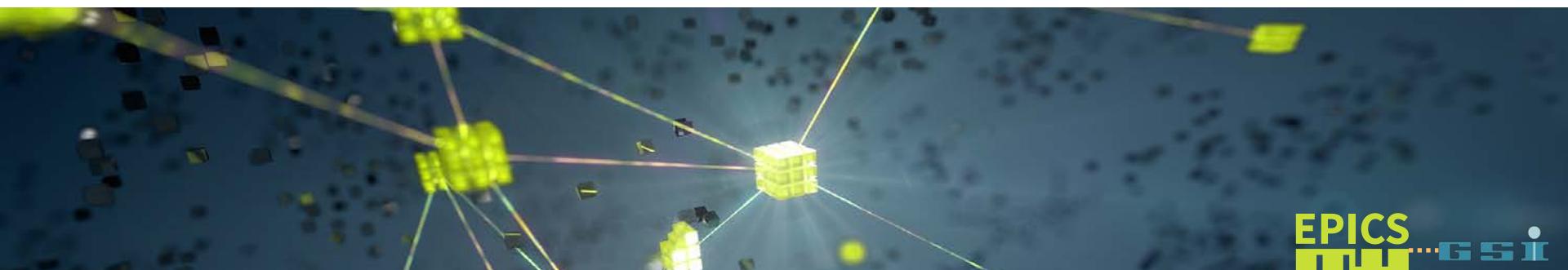
- PV naming scheme
- Modularization and templates!
 - No dump copy and paste
- Configuration instead of coding.
- Use of git or other type of CVS.
- Restrictions: no
- Hardware decisions, getting more involved by experienced users
- Server Platforms:
 - linux/unix (not EPICS driven)



- (Core) IOCs
 - Core Developer
- GUIs, Clients
 - User
- NO
 - user requirements
 - no database
 - processes
 - list of responsible sub system detector people
 - state machine



SUMMARY



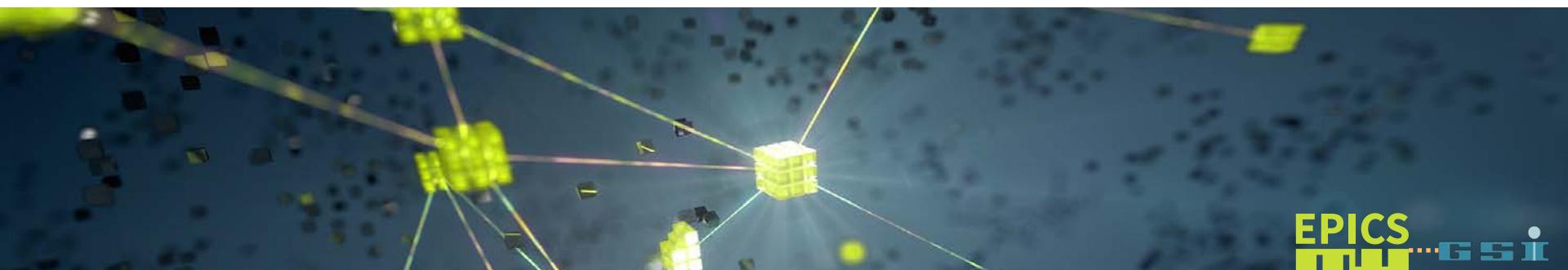
EPICS  **GSI**

HADES DCS

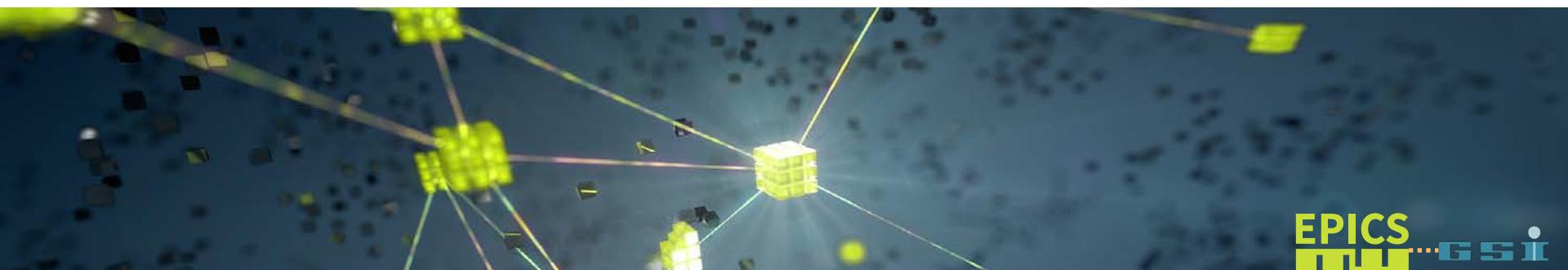
- HADES DCS System
 - with approx. 130,000 PVs
 - distributed over ~ 25 EPICS Server
 - with about 20 client applications (GUIs, etc.)
- is running
- maintained by 1 core developer and coordinator
 - gaining experience for bigger experiments
- Modularization and Templates
- Configuration instead of coding.



THANK YOU.

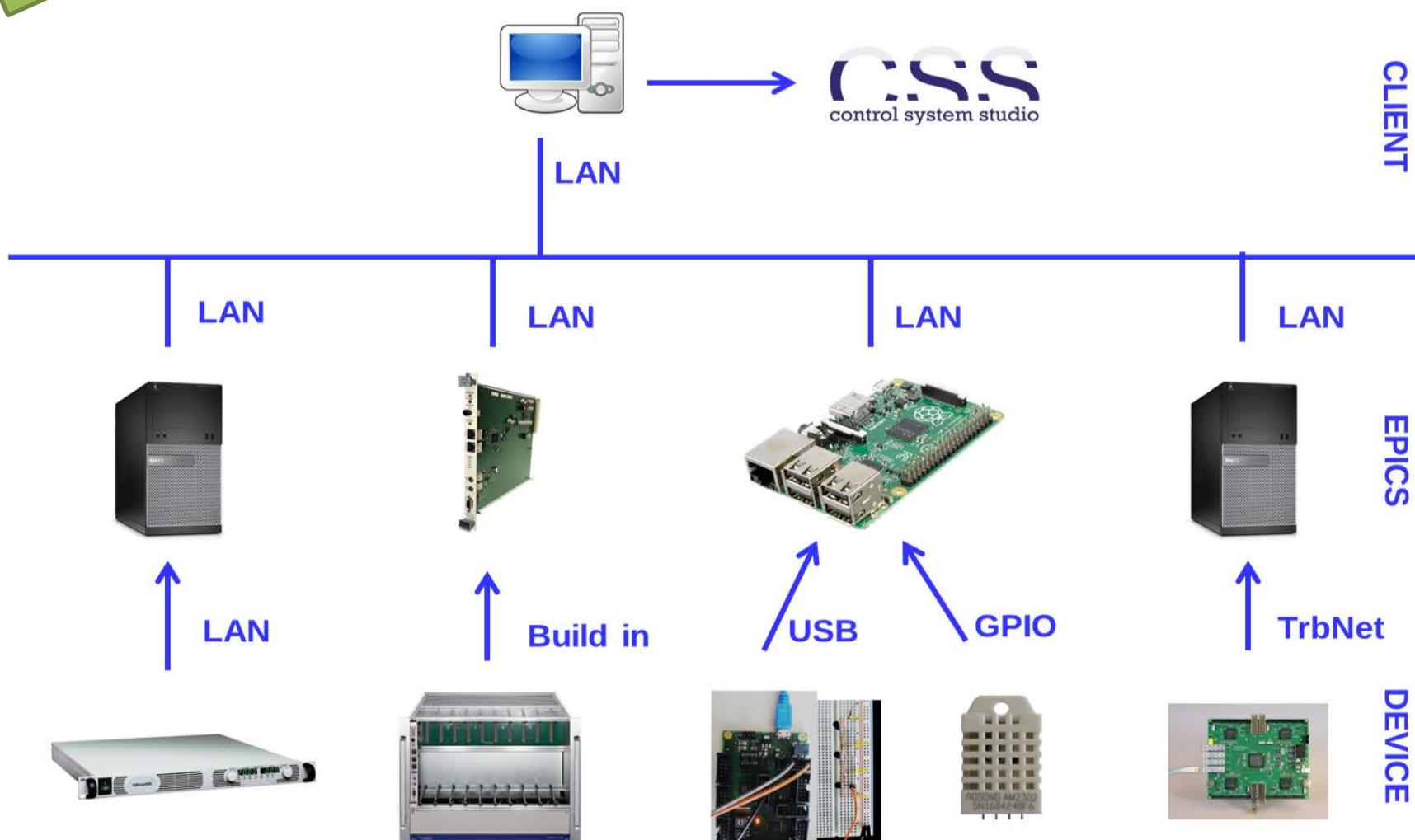


BACKUP SLIDES



EPICS
 **gsl**

Overview



Status of development

- **Low Voltage Power Supply**

- TDK LAMBDA GEN60-40 via LAN
- EPICS IOC
- GUI
- **System is ready**



- **High Voltage Power Supply**

- ISEG Crate with CC24 Master
- EPICS IOC / database files
- GUI
- **HV works fine at TEST Crate (ECH 242)**
- **final Crate (ECH 44A): Waiting for delivery from ISEG**
- **(should be delivered today)**

