Framework Upgrade of The Detector Control System for JUNO

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Outline

- Background Introduction
- Requirement
- Framework Schema
- Key Technology
  - Data Acquisition
  - Real-time access and data format
  - Database Schema
  - Remote Monitoring
- Realization
  - Test-bed of the JUNO Prototype
- Milestone

The Daya Bay Reactor Neutrino Experiment

Daya Bay Experimental Layout

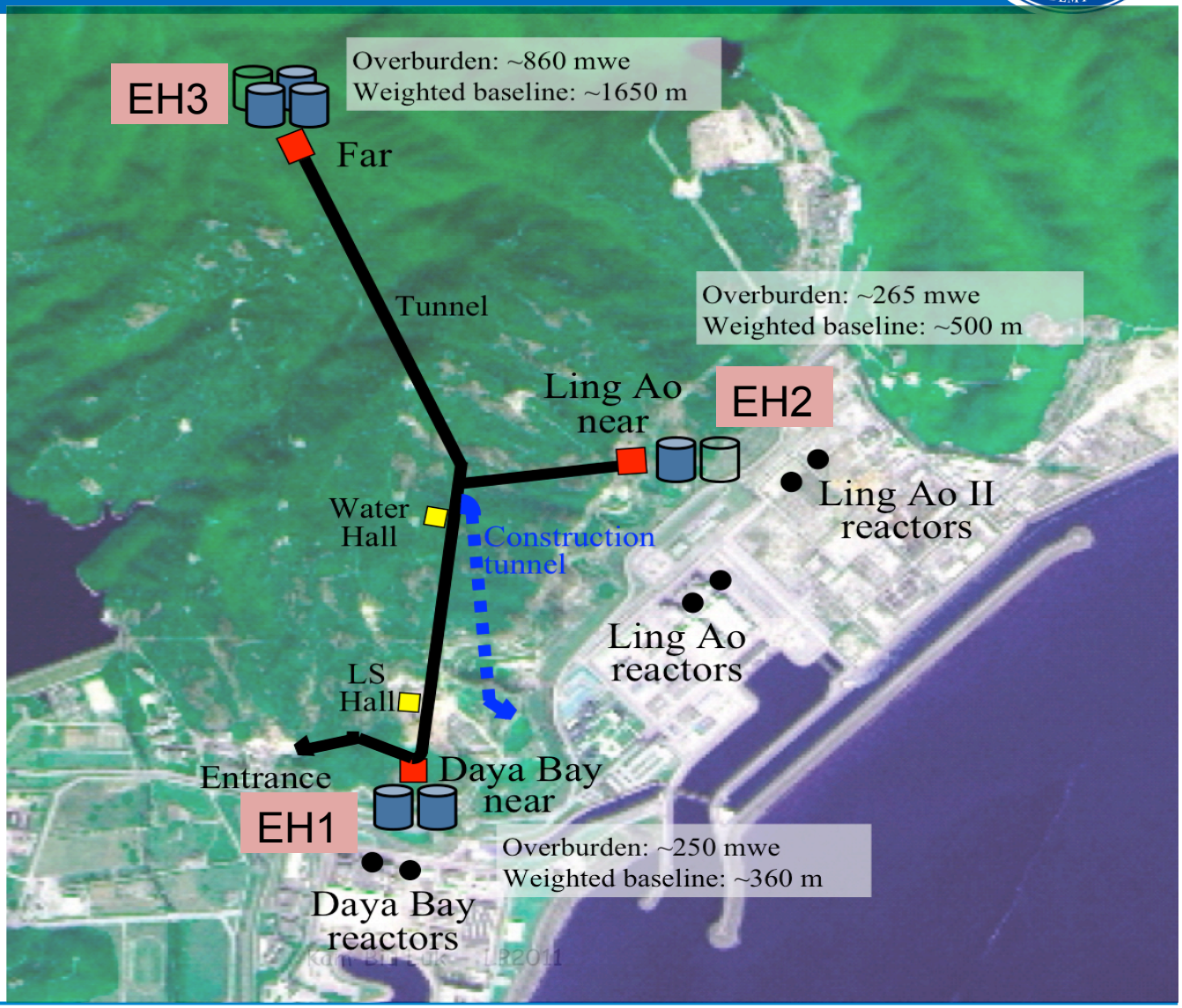
- **Electron anti-neutrinos are produced in copious amounts in nuclear reactors.**

We position our detectors around the Daya Bay Power Plant in China, among the most powerful in the world.

- **Main principle:**

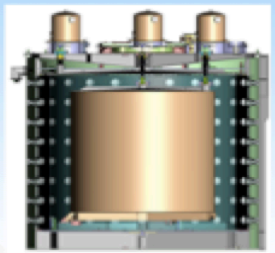
(i) sample the reactor anti-neutrino flux in the near and far locations

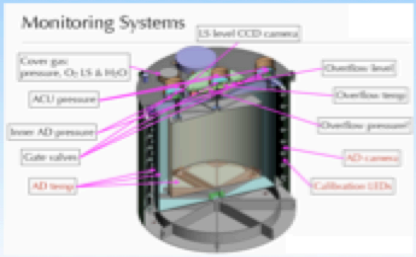
(ii) look for evidence of disappearance



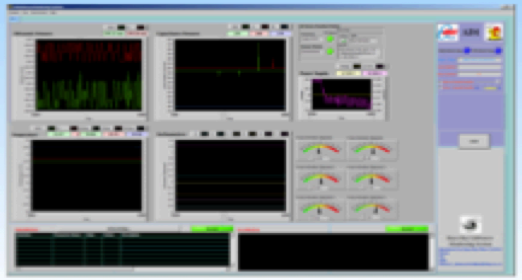
The DCS of Daya Bay

AD Detector





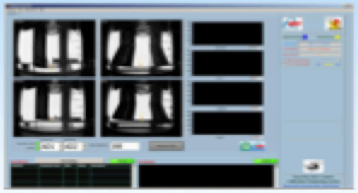
AD Monitoring During Filling



AD Lid Sensor Monitoring

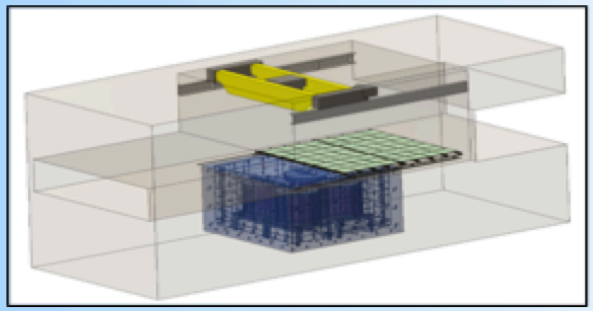
Calibration

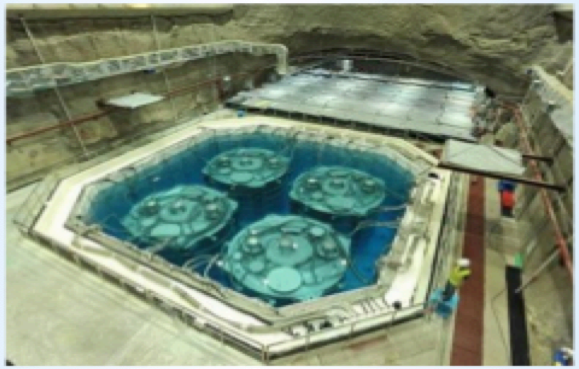
Monitoring Items:
2 detectors per near site
4 detectors at far site



Liquid Level CCD

Muon Detector





Muon Water Pool, RPC & 4 ADs in Far Hall

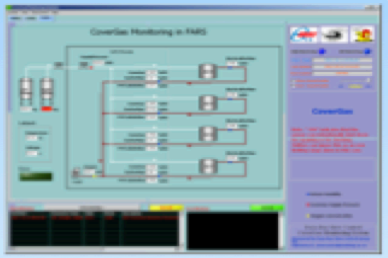
RPC GAS Monitoring GUI

Subsystem include: RPC, RPC GAS, In/out water system, Muon LED calibration, RPC FEE low voltage monitoring etc.

Equipment DAQ

Embedded Linux Integrated & Distributed Data Shared from Data Pool of Equipment:

- High Voltage, Front End Electronics
- Pressure/Temperature/Humidity Sensors
- Pure Water System, Gas System
- Liquid Level, Internal Visual Cameras
- AD Lid Sensors, Calibration



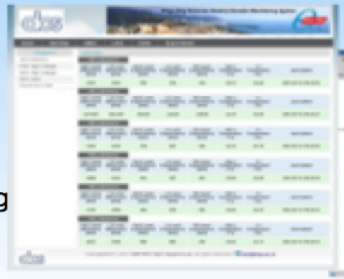
AD Cover Gas GUI from Data Pool

Data Pool

Environment & Remote Control

Monitoring Items

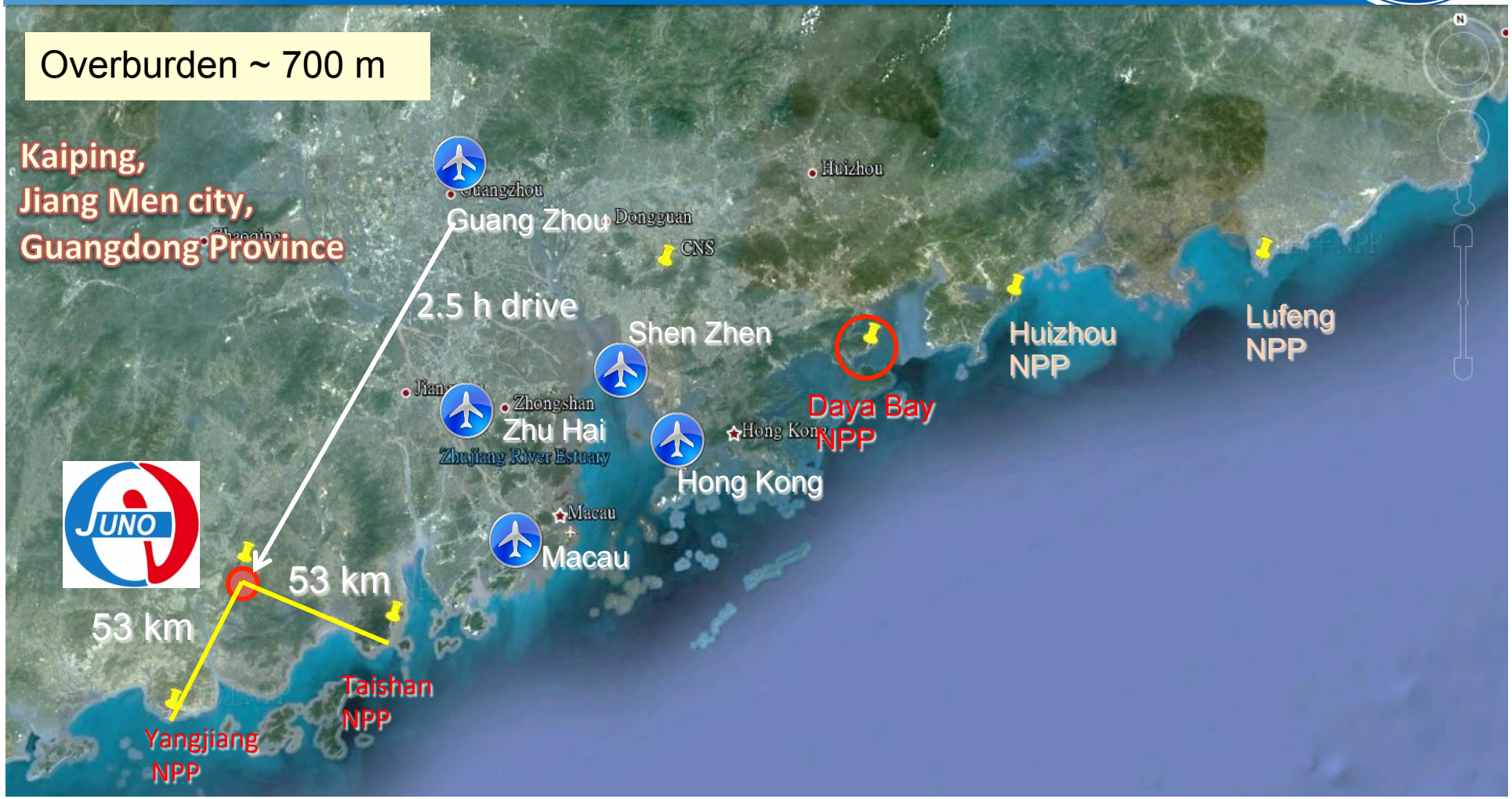
- Temperature
- Humidity
- Air Pressure
- Radon Monitoring
- Video & Pictures



Webpage Remote Monitoring

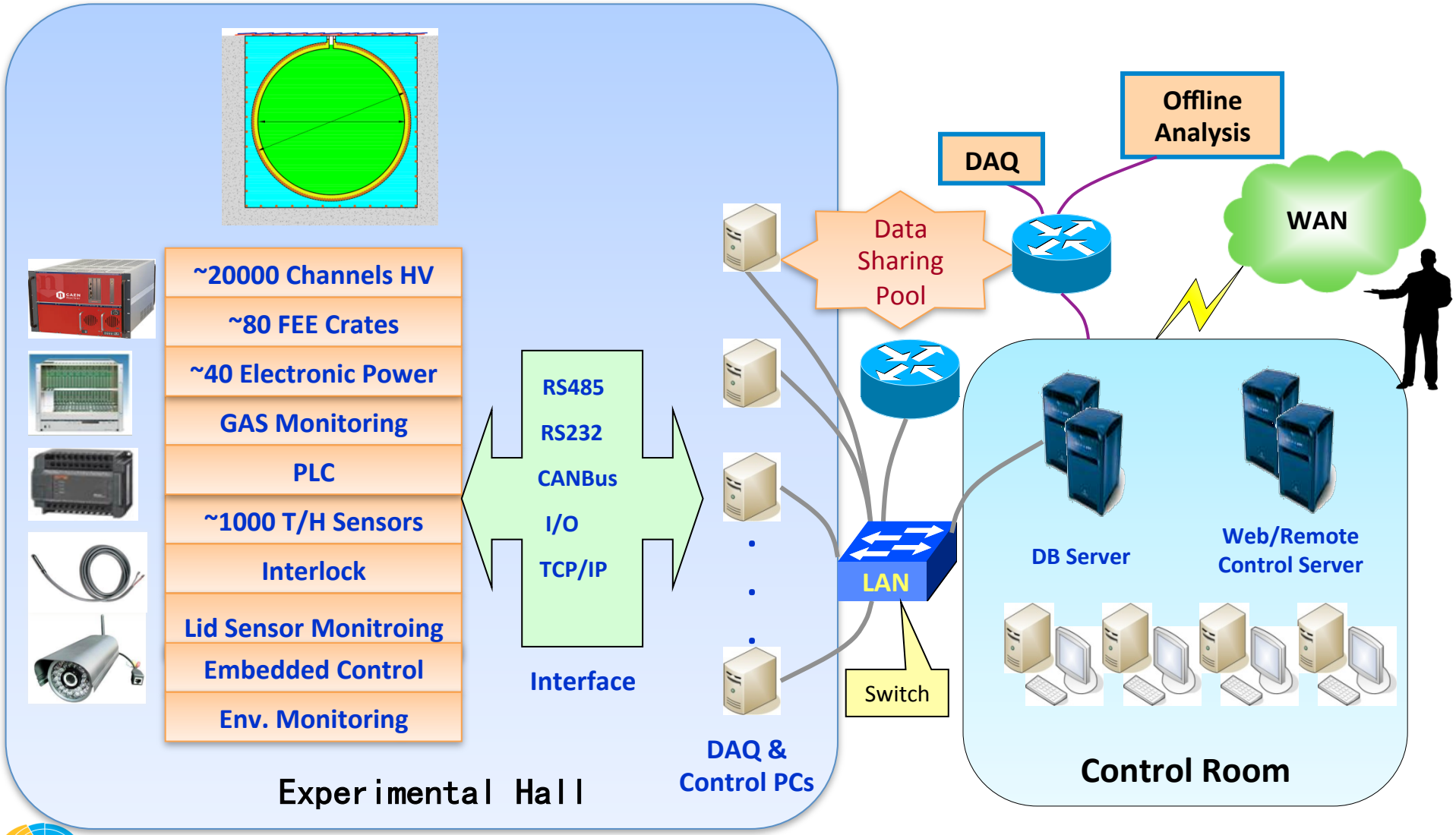
Picture Gallery

The JUNO Experiment



The site: Kaiping county, Jiangmen City

Framework of the Detector Control System

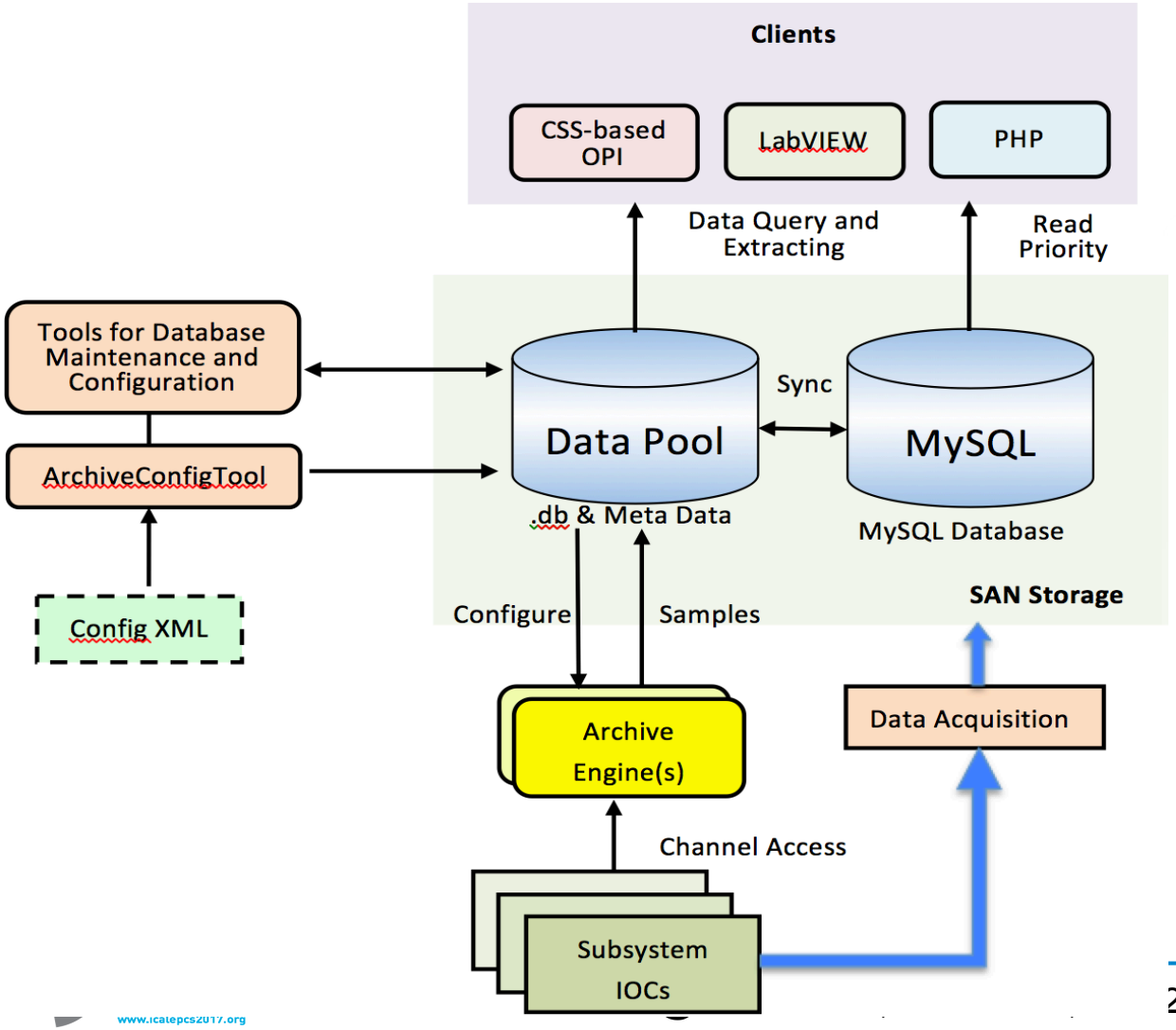


Requirements Collection of Detector Control System

- **Monitoring and Run Control**
  - High voltage, Electronics, Environment of the Experiment Hall
  - Controls Devices like Calibration, GAS System, Water System, Power Supply etc.
- **Functions**
  - Front end sensor digitalization & data acquisition
  - GUIs for monitoring & control
  - Database recording
  - Logic for alarms/errors/events
  - Interlock to keep safe
  - Embedded remote control modules
  - Interface to DAQ & offline software

System Schema

- **Monitoring and Run Control**

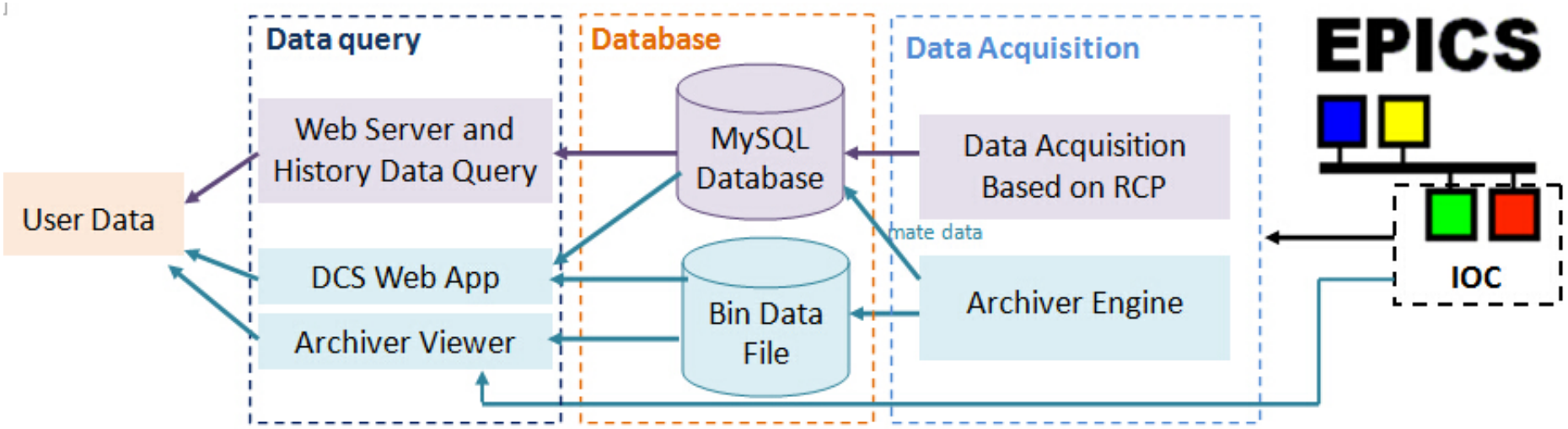


- **High voltage**
- **Electronics**
- **Calibration**
- **GAS System**
- **Water System**
- **Power Supply**
- **Environment of the Experiment etc.**

Data Acquisition

- **Two ways to get data**
  --- PyEpics through channel access
  --- Archiver App

- **Data acquisition interface** : CAJ(Channel Access JAVA)/JAC(JAVA Channel Access)、PyEpics(python)、CA_Lab(LabVIEW)、WebCA

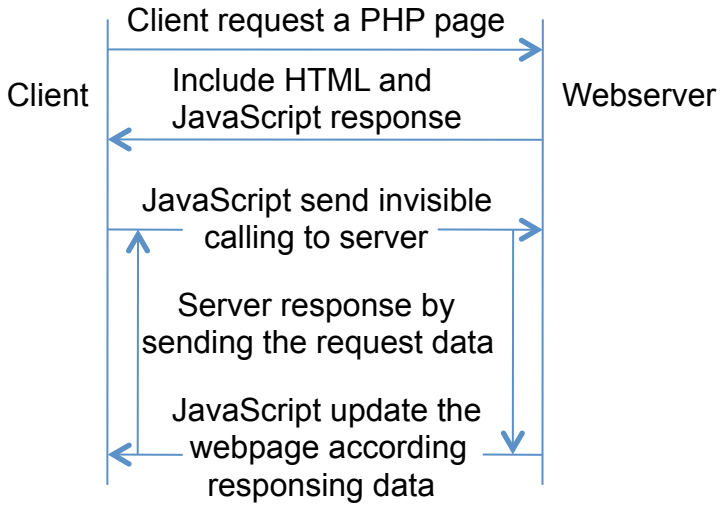


The way to get date from IOC and show data in web server

Realtime Data Trasmission and Data Format

Realtime data trasmission:Ajax

Workflow of Ajax:



Component of Ajax:

- JavaScript:the kernel of Ajax
- XMLHttpRequest: fetch and send datas asynchronously.
- PHP:obtain the request from JS client

Data format:Json

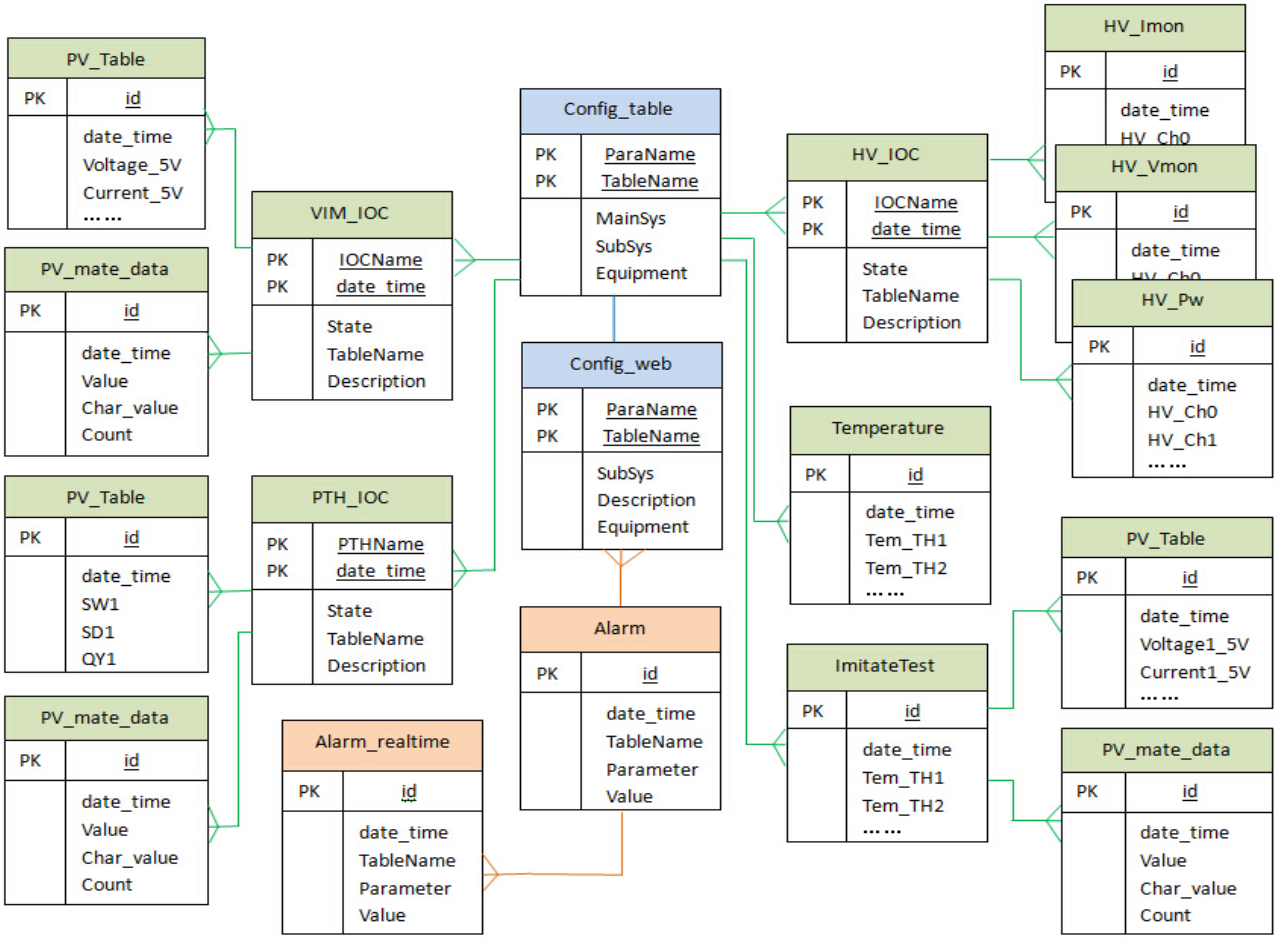
- Supported by nearlly all modern programming languages.
- Compare to XML,it is easy to deal with.

```
var req=new XMLHttpRequest();
req.onreadystatechange=function(){
   if (req.readyState == 4){
     var responseHeaders=req.getAllResponseHeaders();
     var data = req.responseText;
     var jsonObj = JSON.parse(data);
     }
    }
req.open('GET',url,true);
req.setRequestHeader('X-Requested-With','XMLHttpRequest');
req.send(null);
```

Database Design

Database tables structure

- Configuration tables
- Alarm tables
- Data tables



Naming Convention

- **variable names of software integration**
  - **High voltage, Electronics, Environment of the Experiment Hall**
- **Table names**

  Ex. [site]_[MainSys]_[SubSys]
- **Word format:**

  each word begins with an uppercase, for example DeviceSpecificPart. If it is an abbreviation, then all uppercase, such as HV, FEE
- **Abbreviations**
- **PV name format**
- **The output signal**
- **DIM names when sharing data**
- **Shared variable names used in LabVIEW**

Rules

- **PV name format:**

  System: SubSystem: Device: Device Specific Part

- **System: The total system, for example: JUNO**
- **SubSystem: subsystems,**

  such as: CD, LS, PMT …

- **Device: device name and number:**

  for example:. NIM8304_50 where 50 is the chassis number

- **DeviceSpecificPart:**

  The device signals a specific name, for example: ISet, ISet. RBV

- **The output signal is generally Set at the end:**

  for example ISet corresponding input signal is to be: RBV,

  for example: ISet: RBV read into the signal for the general,

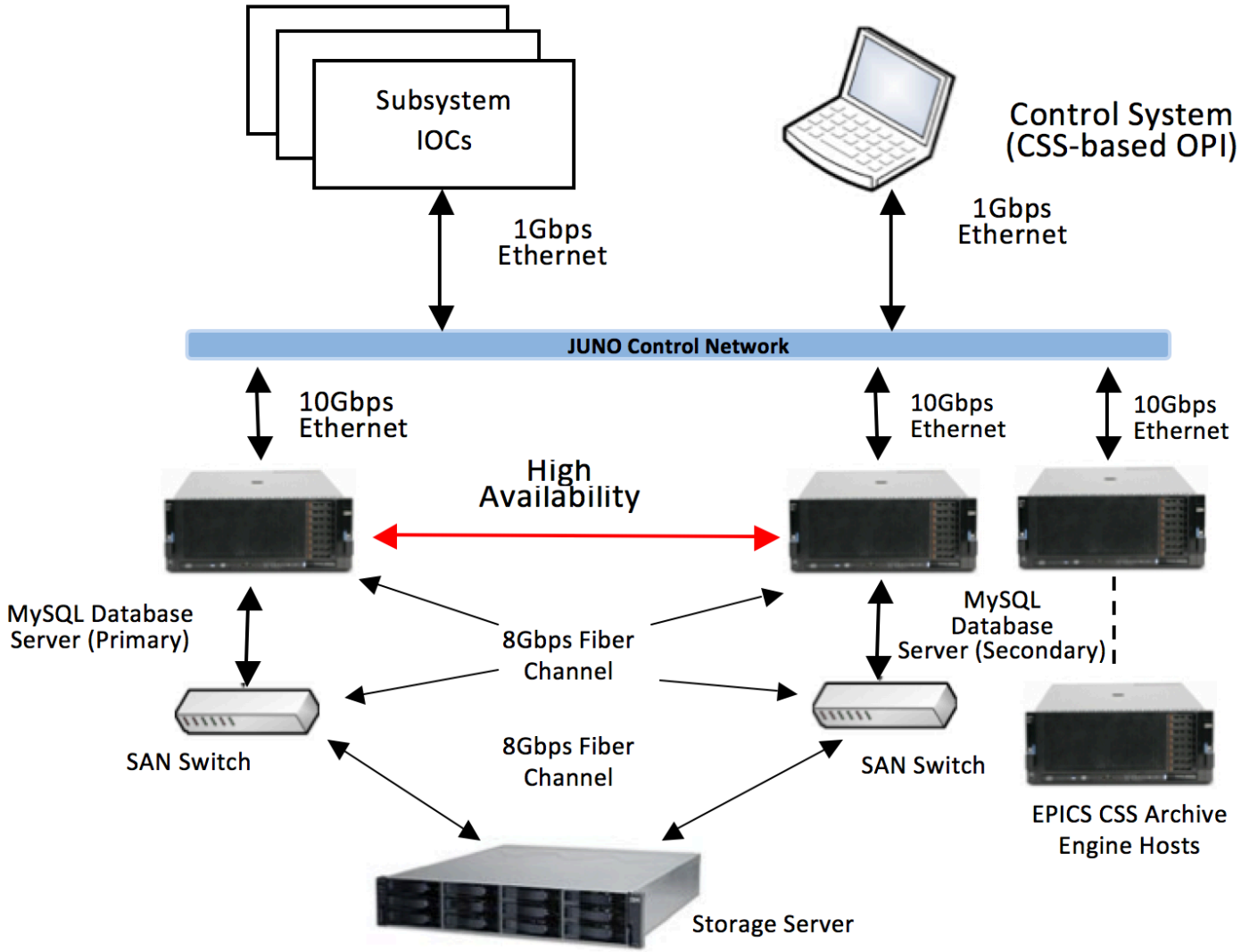
  if there is no corresponding output signal, you do not add:. RBV.

DCS in Prototype

- Crates:
  - 1 high voltage crate and 4 modules of PMT.
  - 1 NIM crate of FEE.
  - 1 wiener crate of FEE .
  - 4 temperature sensors.
  - 2 temperature/humidity/pressure sensors.

- Servers:
  - 1 IOC firmware server.
  - 1 IOC/Database server.
  - 2 temperature/humidity/pressure server.
  - 1 IPC for GUI.

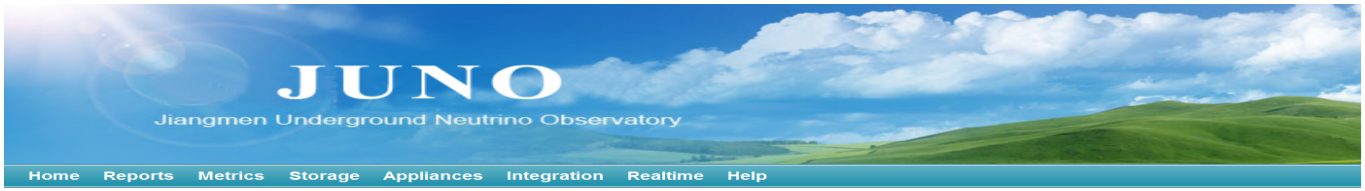
Servers & Network of the Prototype



- IBM X3850 x 2
- IBM X3650 x 2
- 10 TB Storage
- IPC x 6

Several Ways of Remote Monitoring

- **Archiver** based development



To check the value of PV's, please type in some PV names here.

File Crate Tunnels

VME :

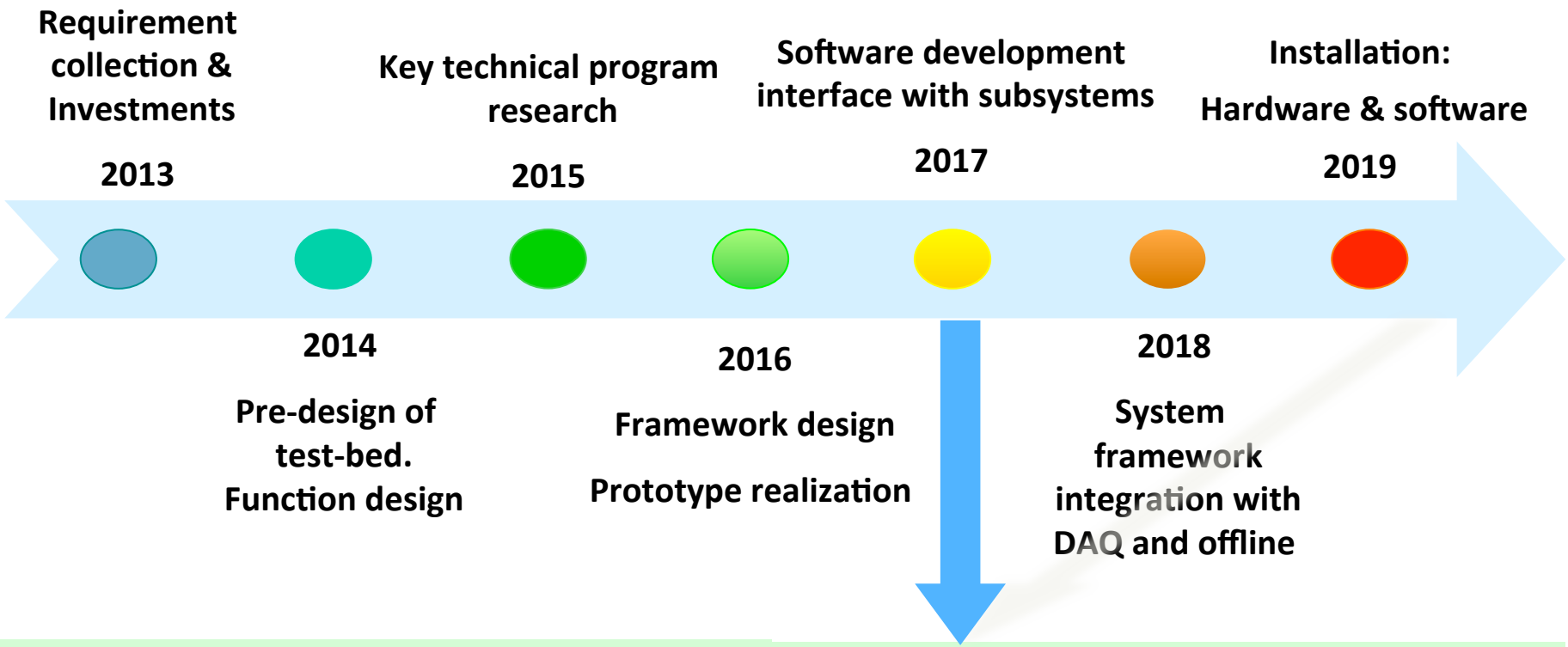
Search

VME:Temperature1	VME:Temperature2	VME:Temperature3	VME:Temperature4	VME:Temperature5	VME:Temperature6	VME:Temperature7	VME:Temperature8
7.45723659113	3.69329365988	9.38094148165	2.6878767071	2.37613488975	4.48325322347	4.64637216754	4.70389868009
VME:Current_12V	VME:Current_3V3	VME:Current_5V	VME:Current_N12V	VME:Current_N5V2	VME:FanTemperature	VME:Fanspeed	VME:Voltage_12V
8.11779964904	6.32104982071	1.94552529183	4.36881055924	9.20851453422	8.36148622873	9.88693064775	2.89066910811
VME:Voltage_3V3	VME:Voltage_5V	VME:Voltage_N12V	VME:Voltage_N5V2				
3.25215533684	7.40215152209	9.24925612268	0.817273212787				

- Functions
  - ➢Realtime data
  - ➢Realtime chart
  - ➢History chart
- Features
  - ➢Realtime monitor
  - ➢Update frequency:20s
  - ➢Configurable

- Plot PV chart on Archiveviewer (Client App.)

Milestone



- Function realization
- Interface define with subsystem
- Test-bed maintenance
- Sensors installation of LS filling

- IOC study of the embedded system
- R&D of the embedded system of TH
- Archive and Database demo
- Remote monitoring R&D


Thanks / Gracias / 谢谢