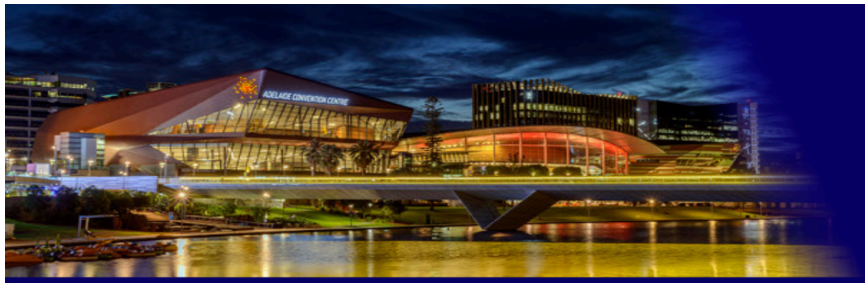

Development of the JUNO Conditions Data Management System

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Nov. 4-8 ,2019, Adelaide, Australia

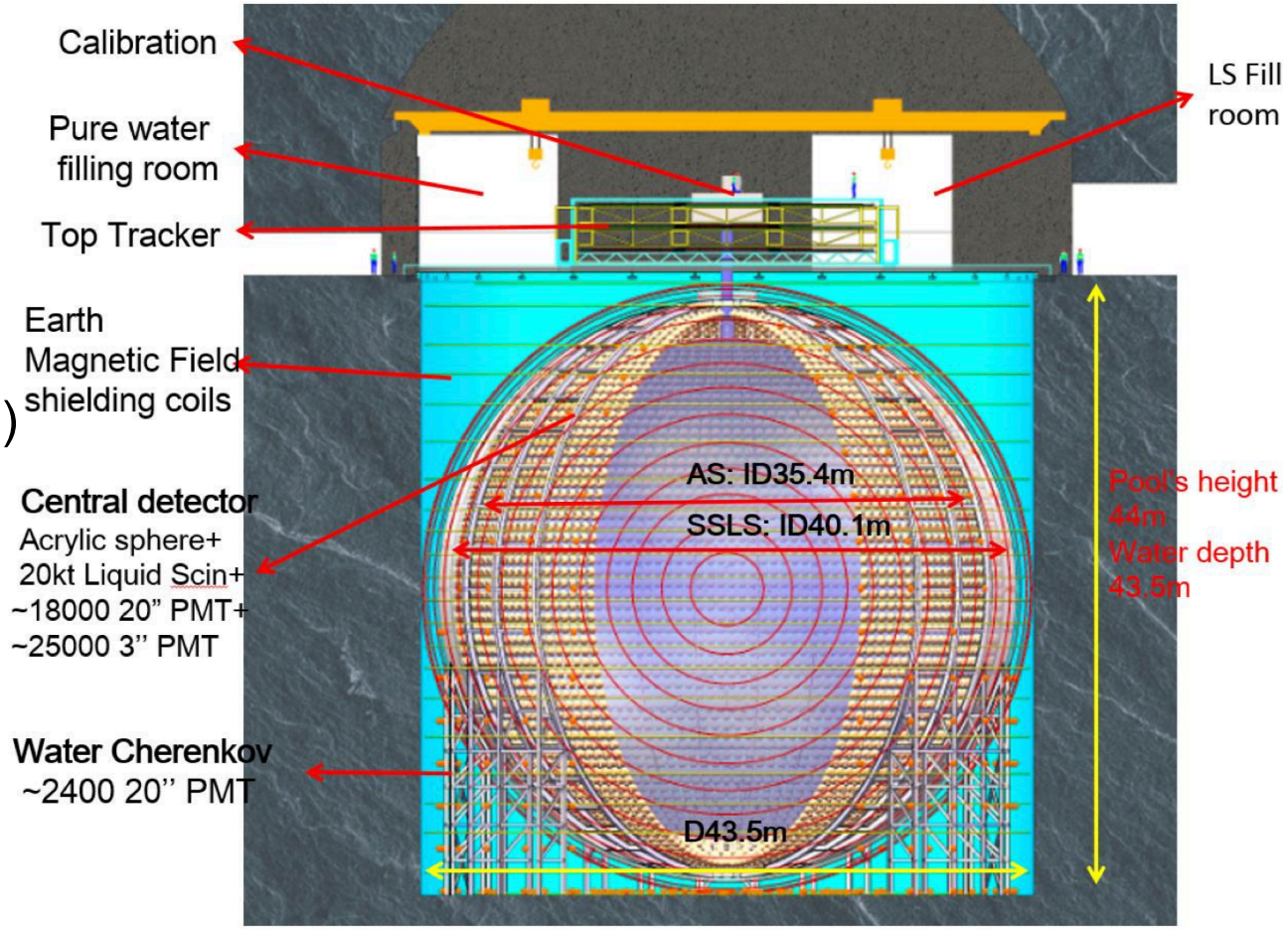
Outline

- JUNO Experiment
- Conditions Data
- Conditions Database System
  - Data Model
  - Web Interface
  - CondDB Service
  - Frontier/Squid for data caching
- Performance Testing
- Summary

Jiangmen Underground Neutrino Observatory (JUNO) Experiment

- Main Physics Goal: determine the neutrino mass hierarchy and precisely measure oscillation parameters with an unprecedented energy resolution of 3% at 1 MeV

- JUNO Detector
  - Central Detector (CD)
  - Water Cherenkov (WC)
  - Top Tracker (TT)



AS: Acrylic sphere; SSLS: stainless steel latticed shell

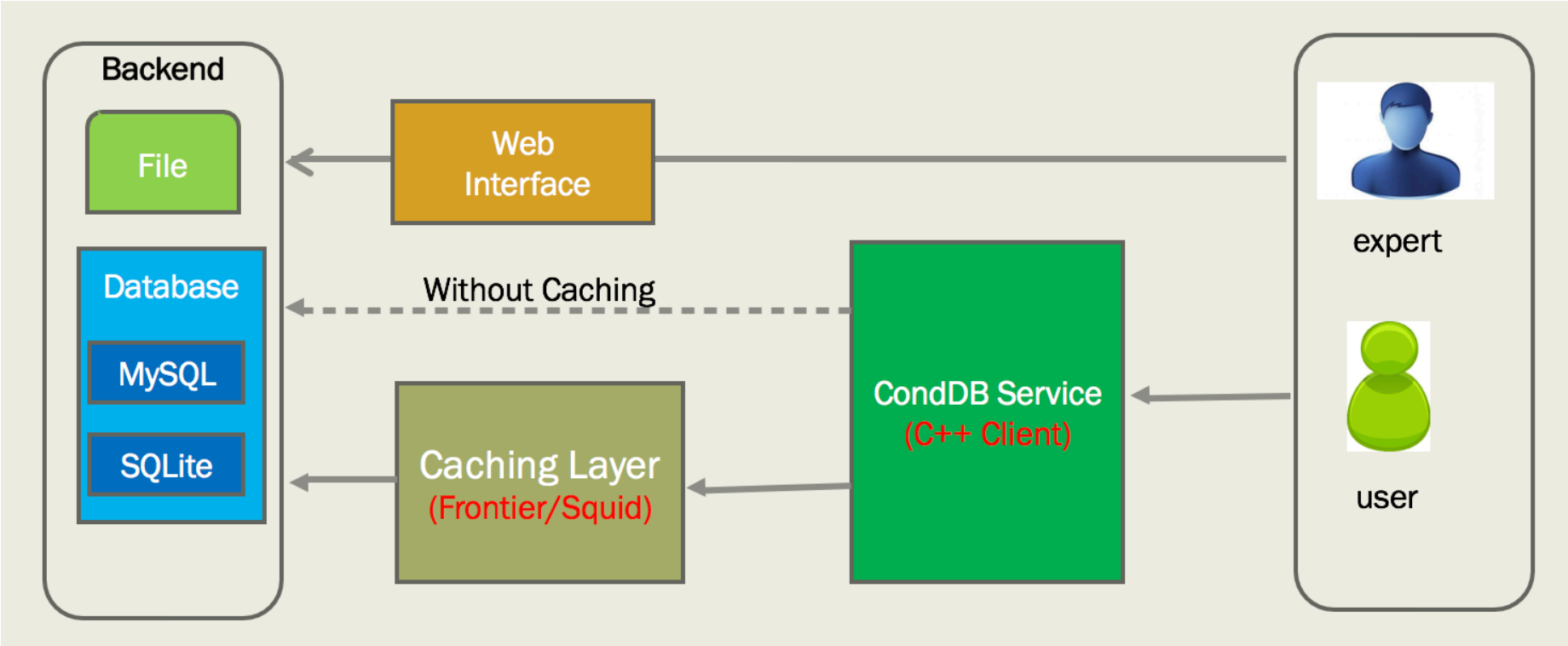
Conditions Data

- Conditions Data includes
  - Detector Configuration
    - Geometry, Material Optical Parameters and Calibration data
  - Detector Monitoring
    - High Voltage, Electronics Channels, LS Volume and Temperature,...
- Conditions Data are heterogeneous and varying with time
  - Different write rate, access rate, data volume and data format

Data Type	Write Rate	Access Rate	Data Volume
WC_PMT_Timing	Once Per Year	~ kHz	~ 100 MB Per Year
CD_PMT_Gain	Once Per Day	~ kHz	~ 10 GB Per Year
DqChannel	Once Per Mins	~ kHz	~ GB Per Year
Material_LS	Once Per Years	~ kHz	~ KB Per Year

How to effectively manage these Conditions Data is a crucial task!

Overview of Conditions Database System



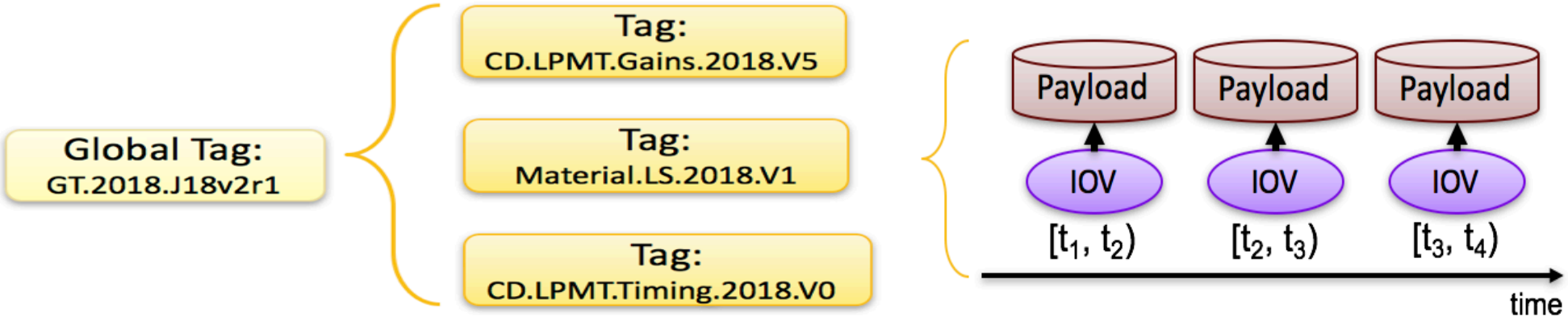
- Client-Server Structure
  - Server side: underlying database is flexible
  - Client side: Several methods are provided for access to DB
- Data caching capability is implemented with Frontier/Squid, which has been used by ATLAS and CMS

Data Model

Like CMS, Six database tables are used to manage conditions data and describe their validity

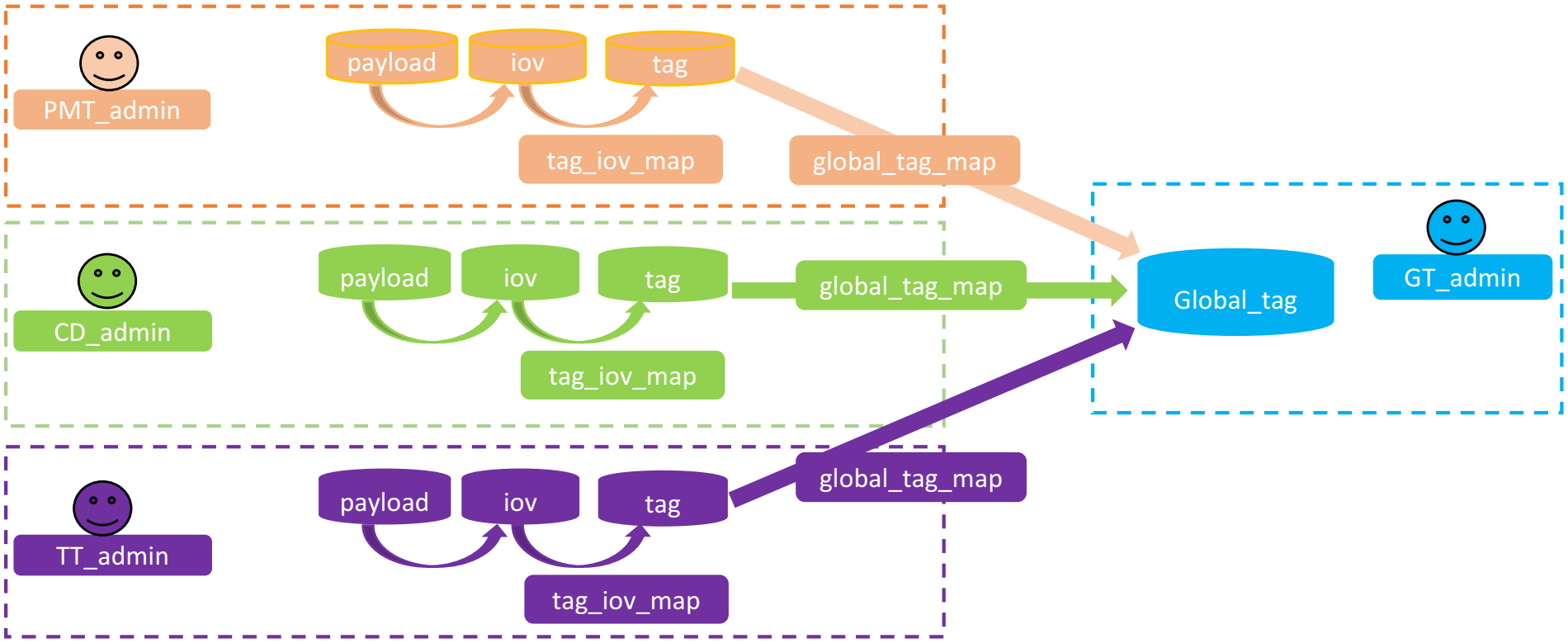
- 4 Metadata tables
  - **Payload:** holds conditions data or the path of the conditions data file
  - **IOV (Interval of Validity):** describes the period of payload validity
  - **Tag:** collect a set of IOVs
  - **Global Tag:** collects a set of Tags
- 2 Auxiliary tables
  - **Tag IOV Map**
  - **Global Tag Map**

With this design, Conditions Data is separated from Metadata, It is good for scalability and maintenance for the long-time running of Exp.

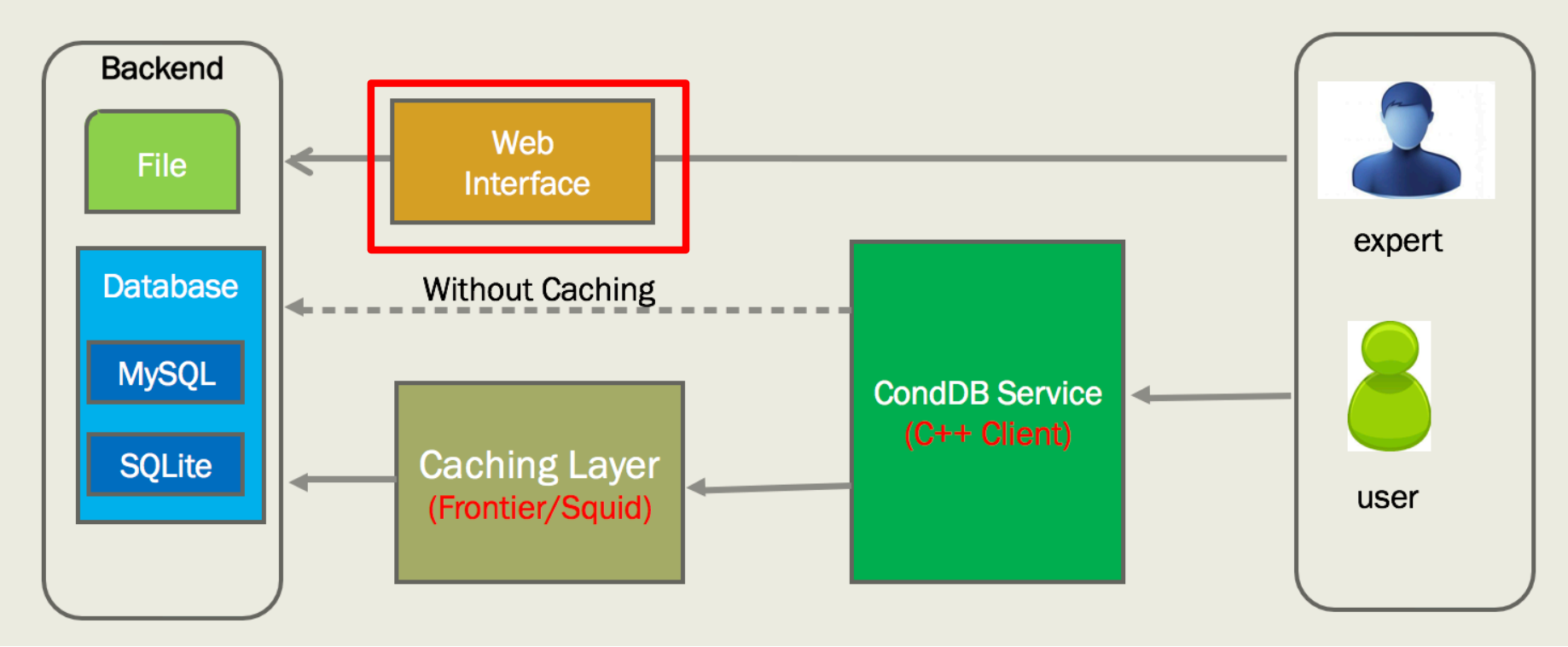


Data Management

- According to the features, conditions data is divided into different types, for example, PMT, Central Detector (CD) and Top Tracker (TT)
- There is one manager for each type of conditions data



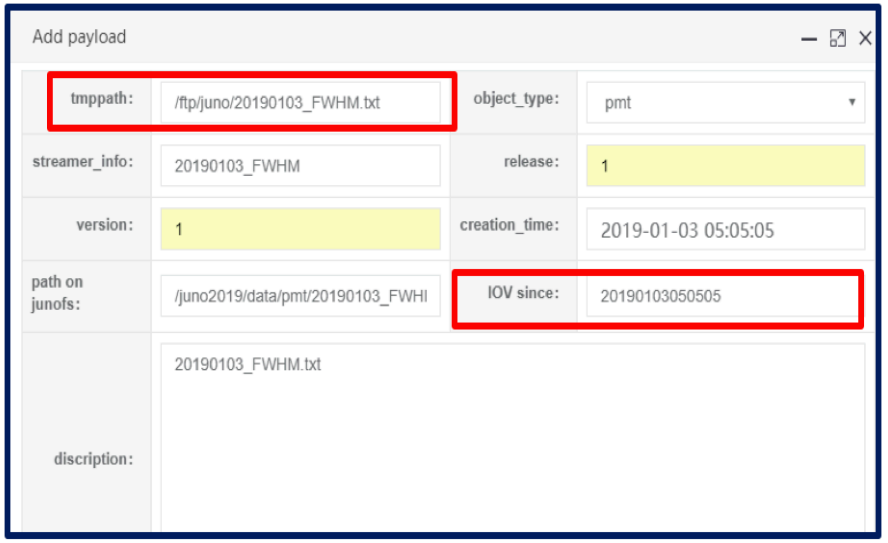
User Interface

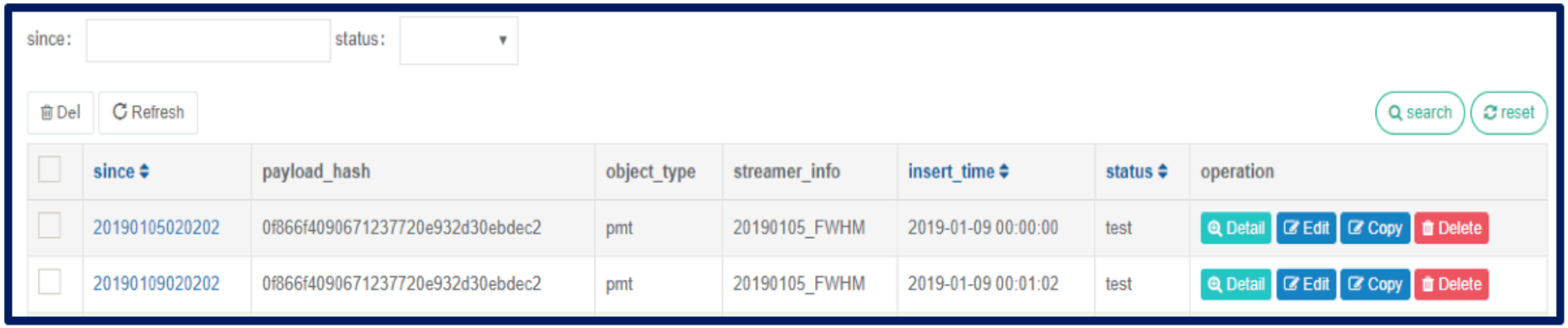


- User Interfaces are setup for managers/experts/users
  - Web Interface
  - CondDB Service

Web Interface to create new payloads

- Web interface is developed for Data Manager to
  - Upload the data files into web server by ftp command
  - Create new payloads
  - Create new IOVs
  - Create new Tags
  - Add IOVs into Tag





Web Interface to create new IOVs and Tag

- Web interface is developed for Data Manager to
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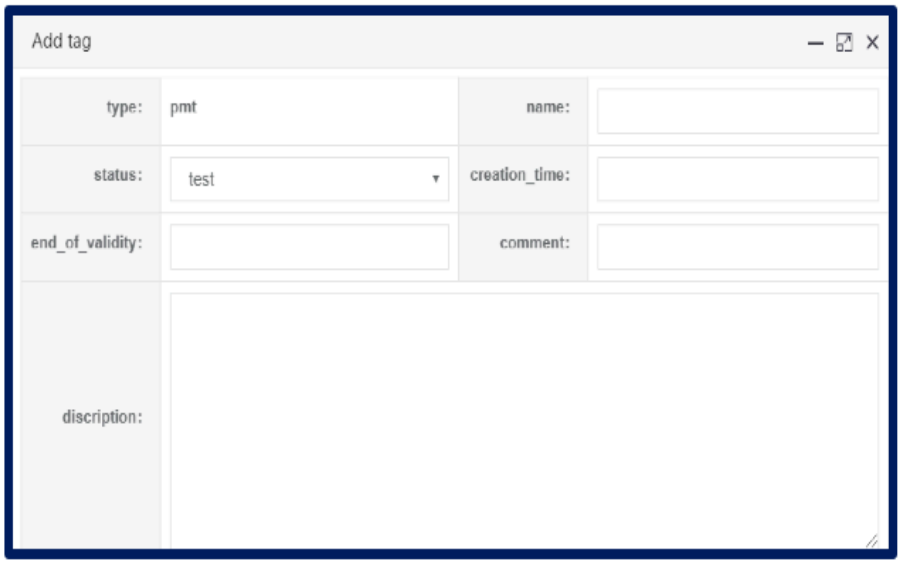


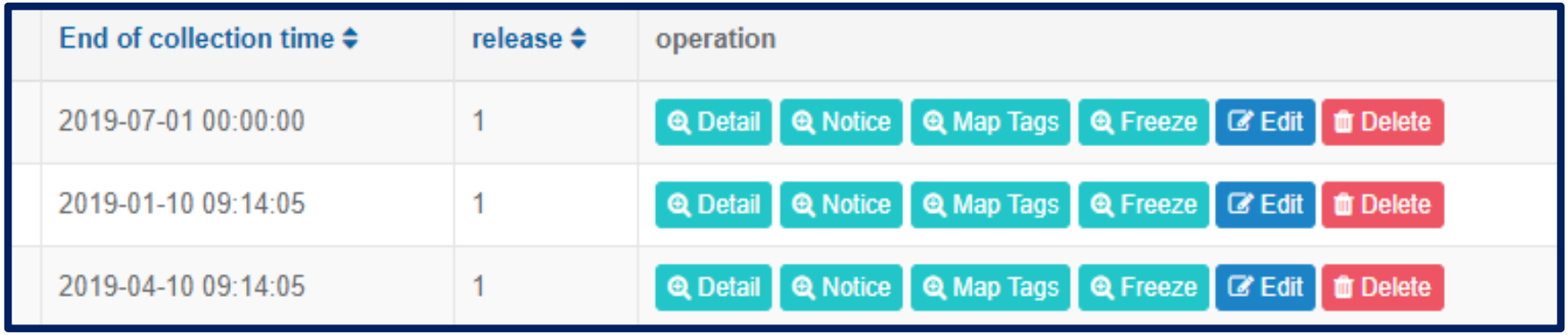
name: first_since: last_since: status:

+ Add | Edit | Del | Refresh | Search | Reset

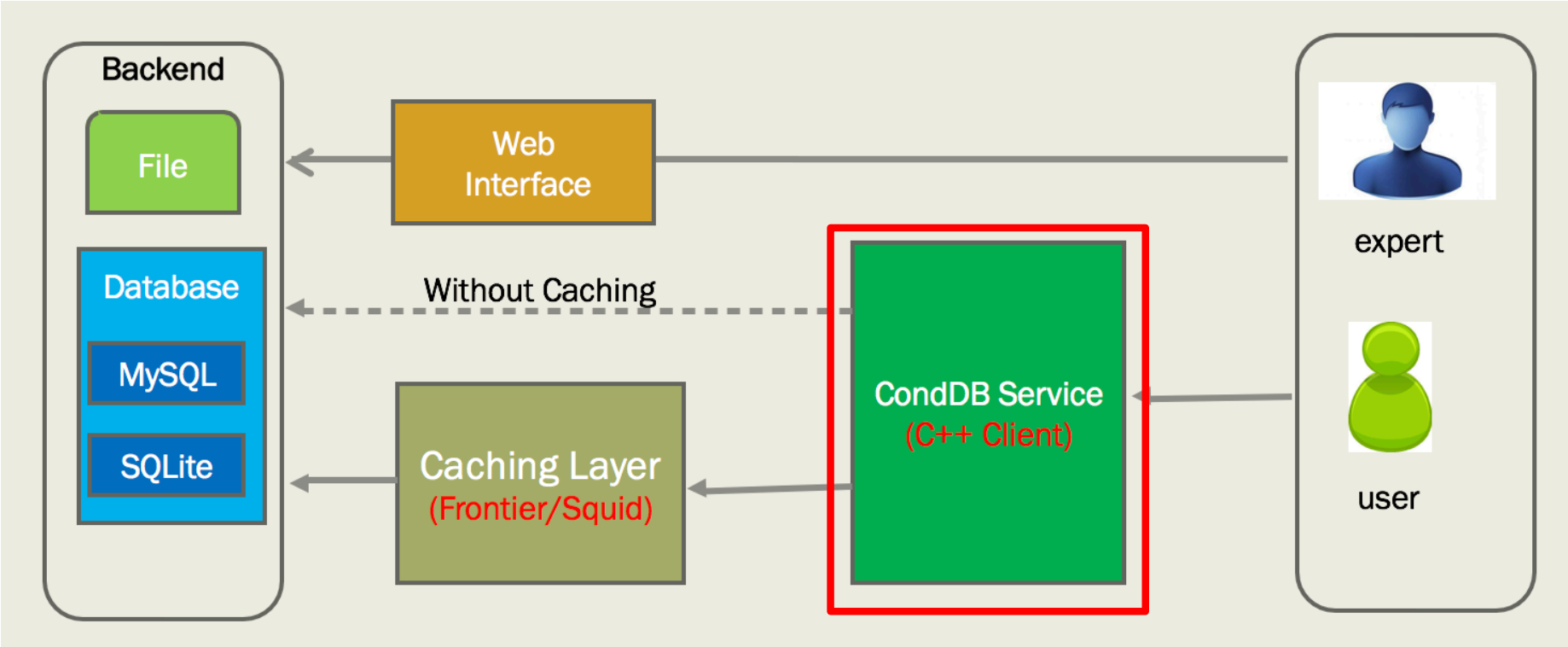
name	discription	type	end_of_validity	first_since	last_since	status	creation_time	operation
tagJuno201905	discription tagJuno201905	pmt		1	2	normal	2019-01-09 00:00:00	Tag IOV | Tag to Global | Edit | Copy | Delete
tagtagtag2018	discription	pmt		3	5	normal	2019-01-09 00:00:00	Tag IOV | Tag to Global | Edit | Copy | Delete
tagtagtag2019	copy discription2222	pmt	11111	2	5	normal	2019-05-09 00:00:00	Tag IOV | Tag to Global | Edit | Copy | Delete

Web Interface to create a global tag

- Top Manager creates a global tag for all types of conditions data
  - Create a global tag for certain purpose
  - Notify subsystem managers
  - Subsystem managers decide which tag should be included for this global tag
  - Global tag will be frozen after validation and testing



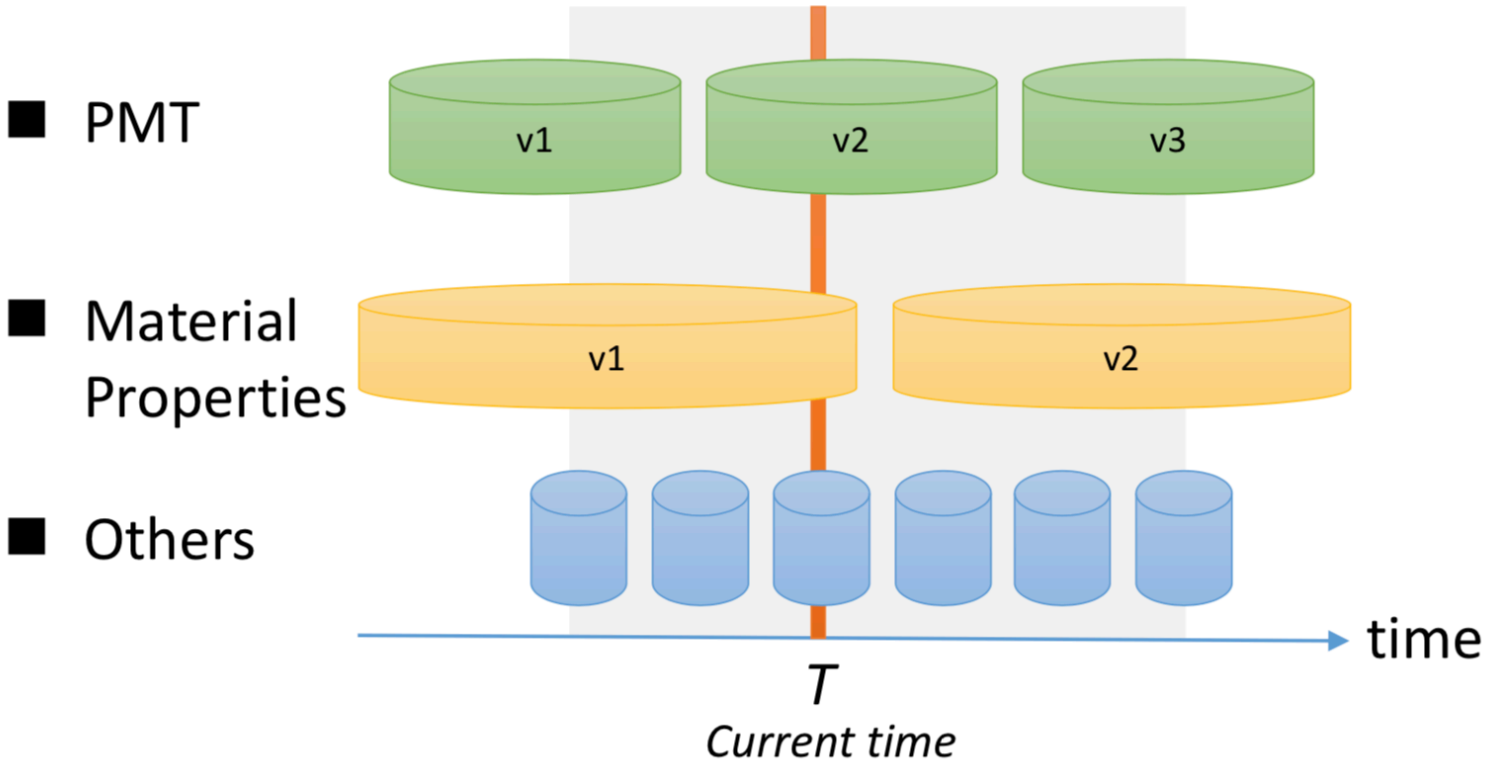
Conditions Database(CondDB) Service



- CondDB Service is provided for access to Database in the offline software system
- It is implemented with a service of SNiPER, which is the offline software Framework developed by JUNO collaboration

CondDB Service

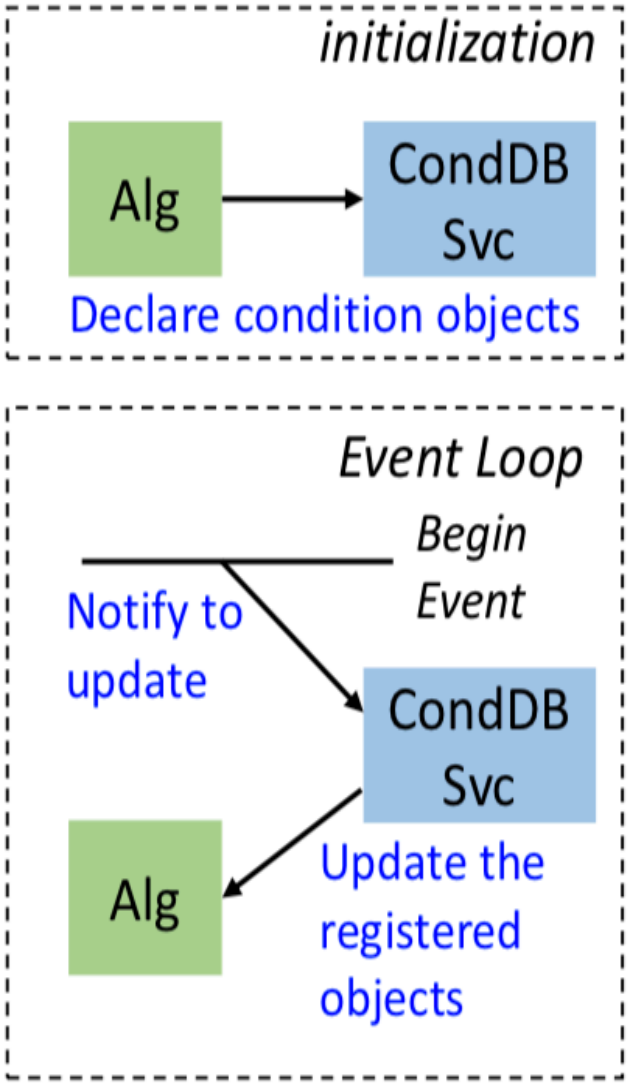
- CondDB Service retrieves the suitable conditions data (Object) from Conditions Database according to the current event time



CondDB Service

Conditions Data

- used by algorithms in term of C++ Object (Transient Condition Object)
- Varying with the time
- Need to declare which condition objects will be used in the algorithms



CondDB Service

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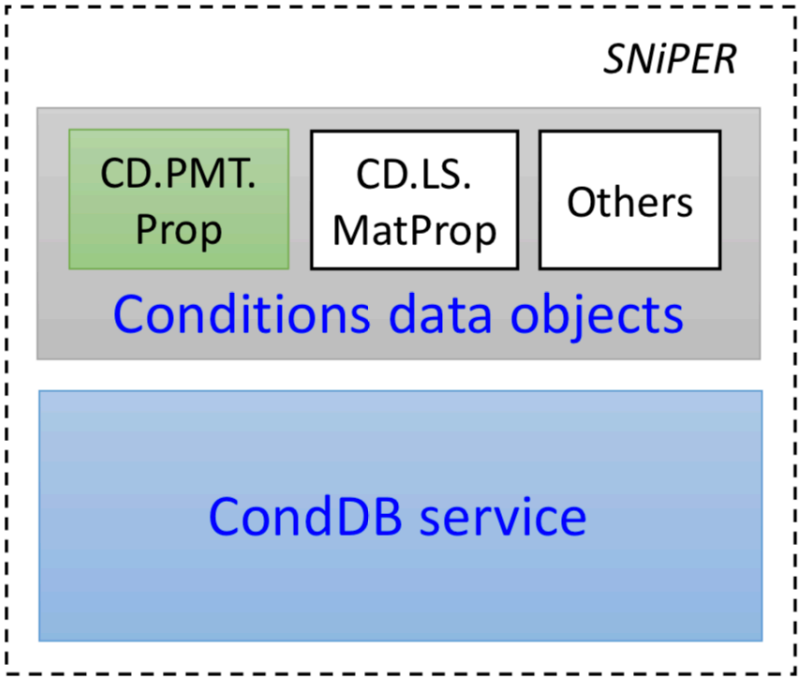
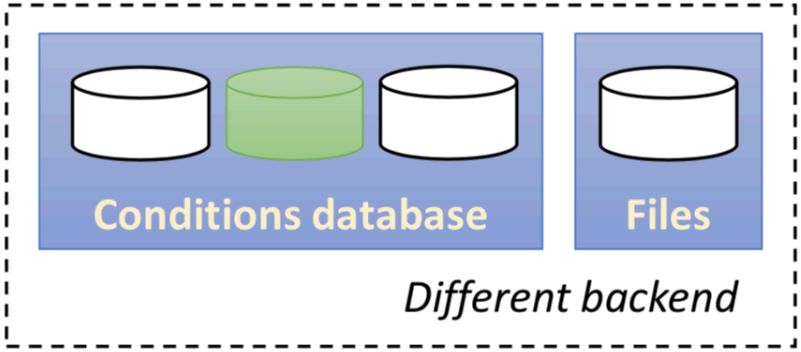


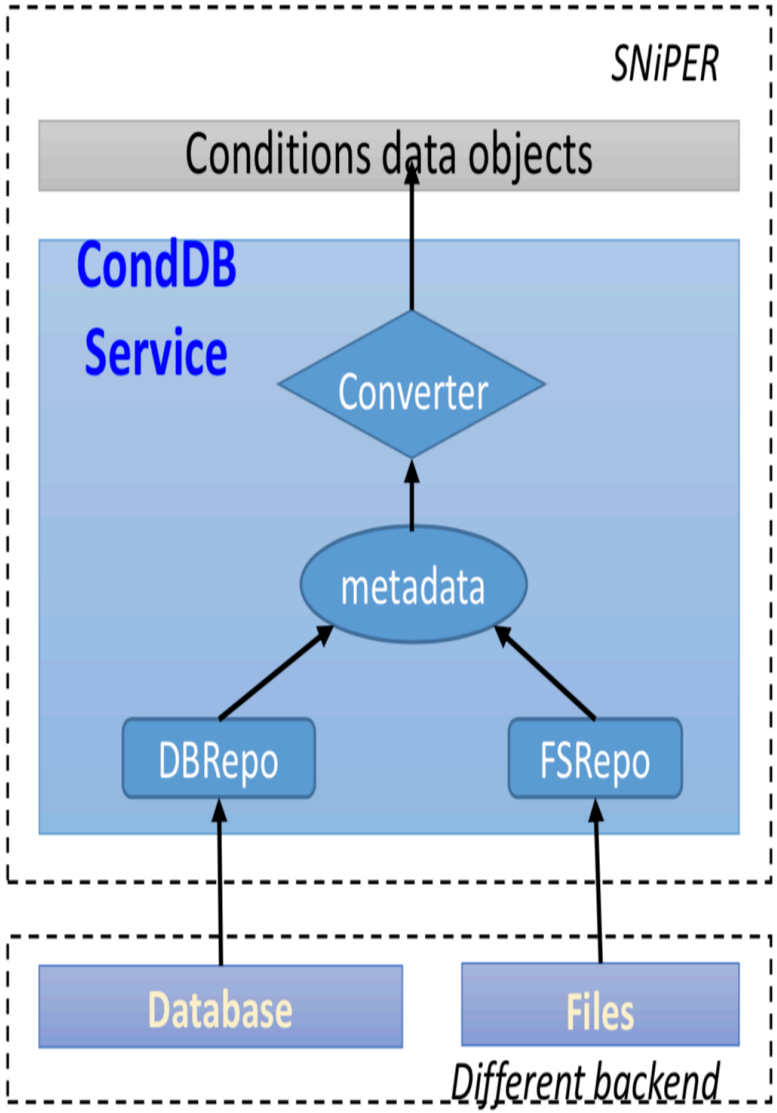
Persistent Condition Object

- Support several backend with different format and priorities
  - Temporal Database/Files for testing and validation
  - Official Database for data production



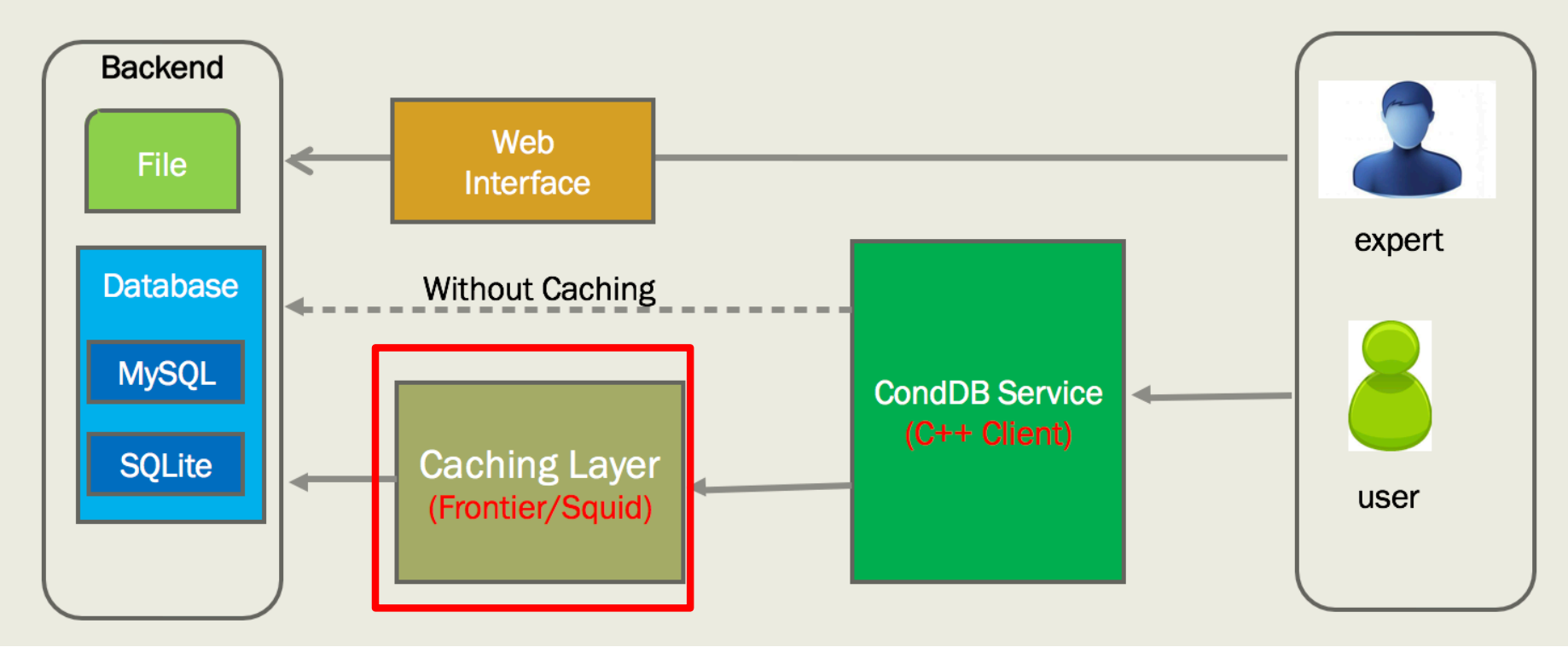
CondDB Service

- **Conditions Data** used by algorithms in term of C++ Object (Transient Condition Object)
- **Persistent Condition Object** in Multiple format and managed by conditions database
  - Database
  - Files
- **CondDB Service**
  - Perform conversions from Persistent Object to Transient Object
  - Updates the condition objects during the event loop



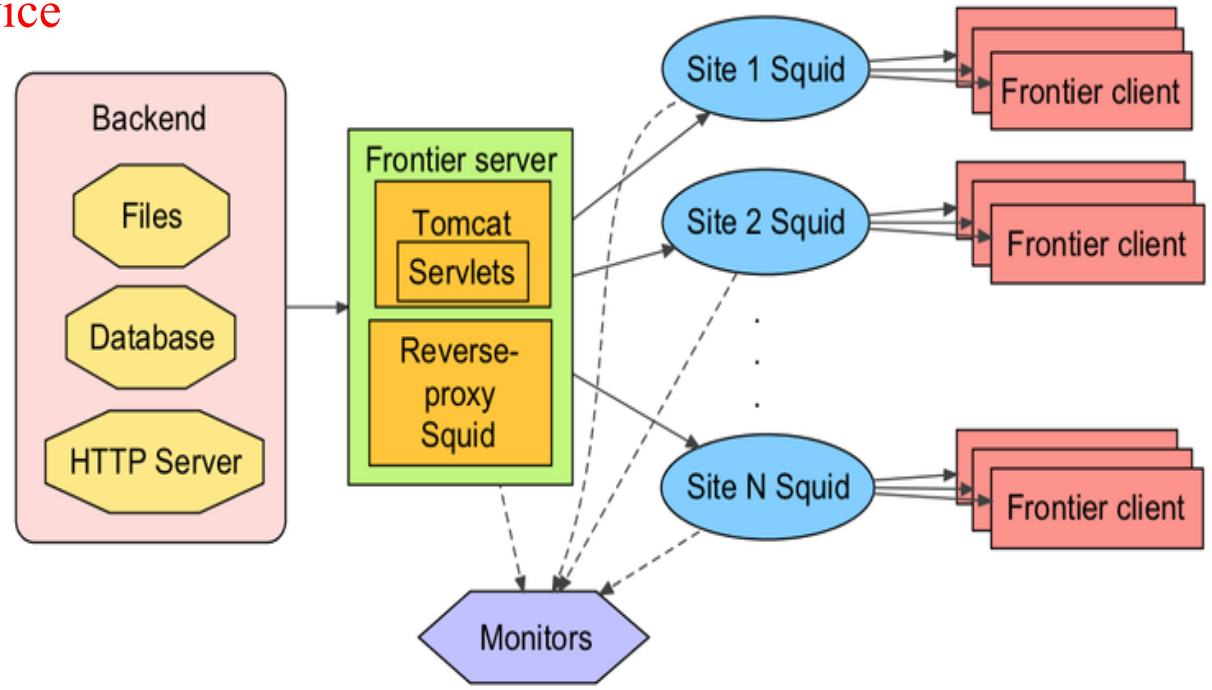
Data Caching Layer

- An intermediate layer (Frontier/Squid) between the client and server is adopted to provide data caching capability
- To decrease the heavy burden of center database when thousands of jobs query the same conditions data at the same time



Frontier System

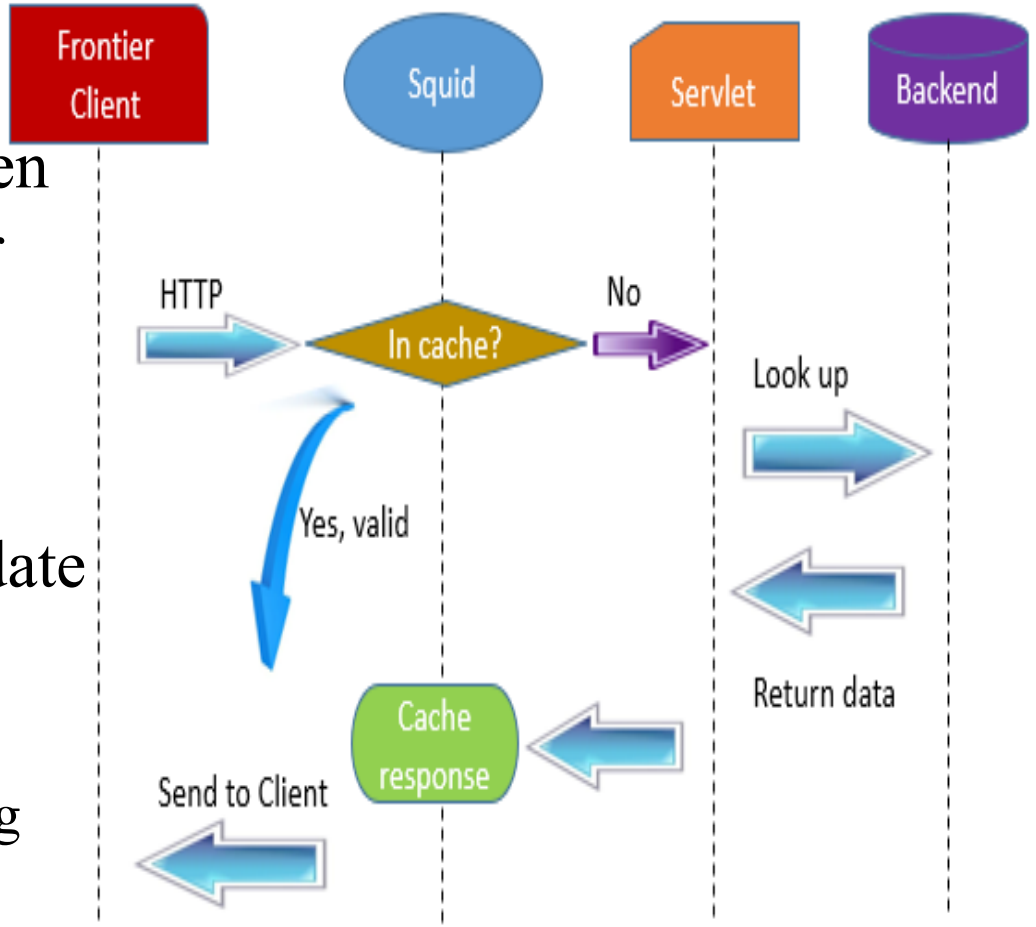
- Frontier Client
  - C++ API
  - Called by CondDB Service
- Squids
  - HTTP proxy
  - Cache data locally
- Frontier server
  - Decode requests
  - Contact with a backend



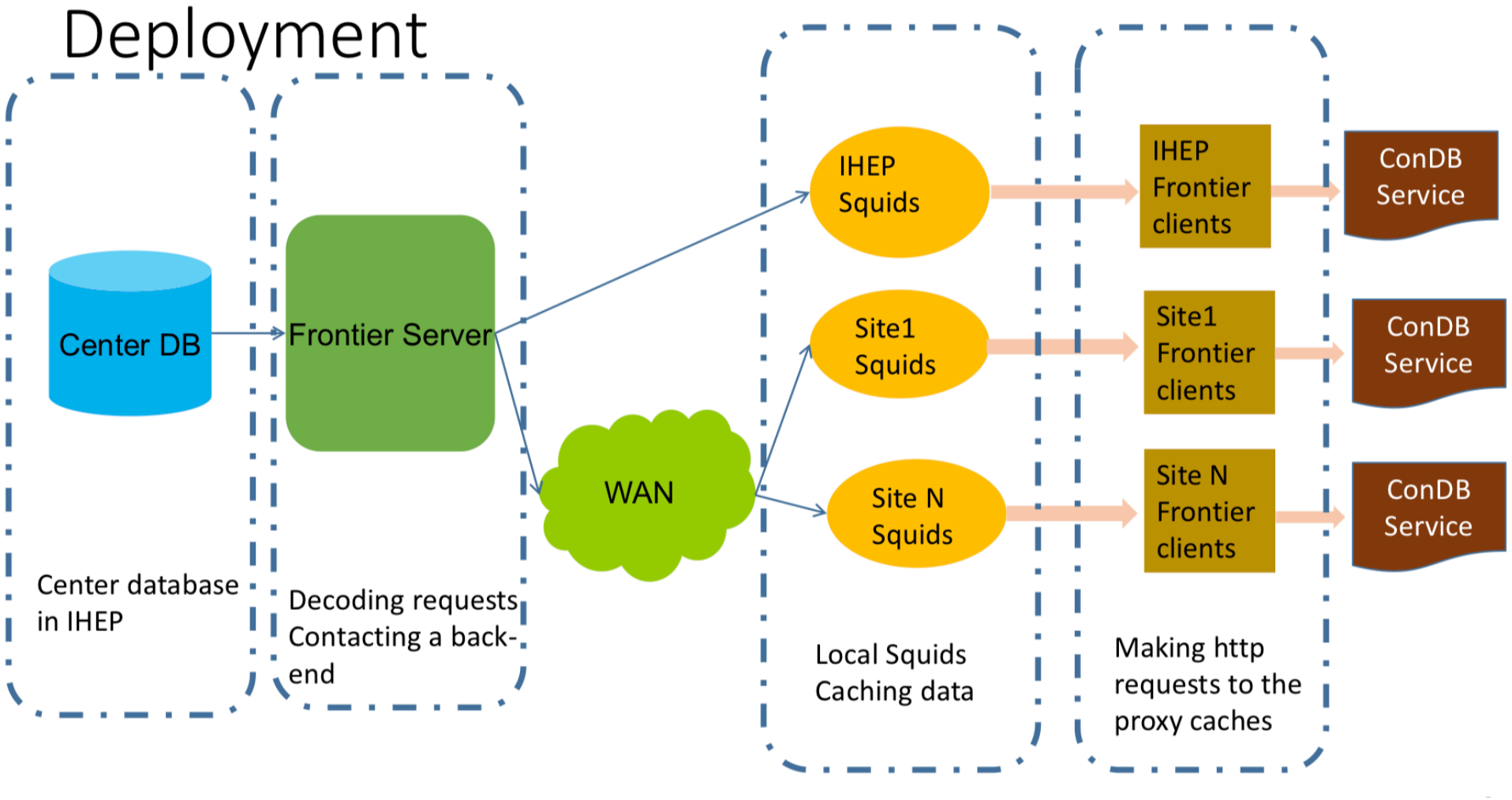
More details about Frontier :https://twiki.cern.ch/twiki/bin/view/Frontier/FrontierOverview

Workflow of Data Caching

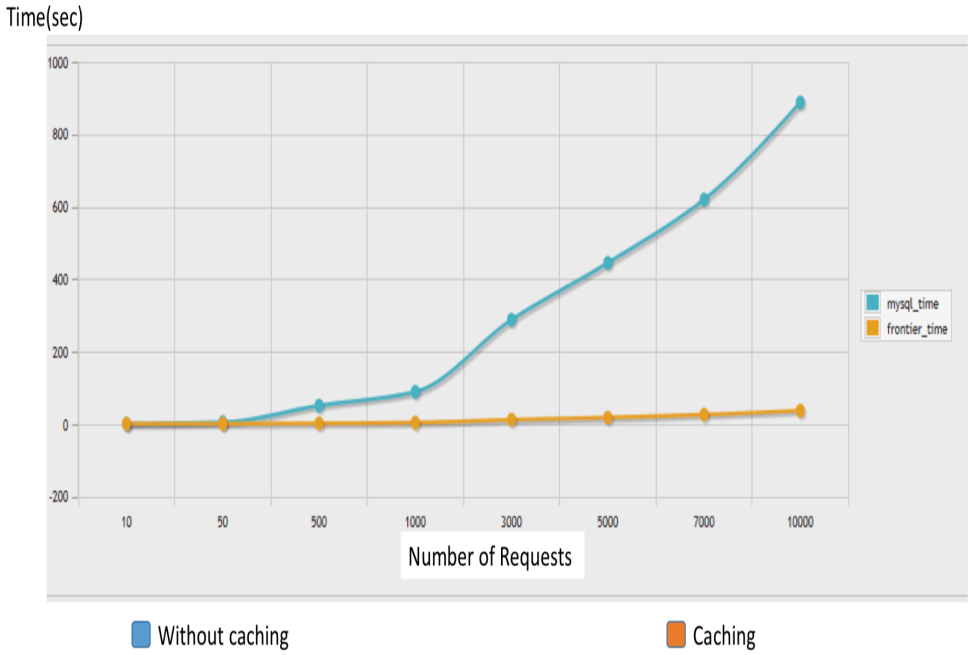
- Frontier Clients firstly send query to Squids, not the Center Database
- If the requested results has been cached in local squid, Frontier clients could get data directly from squid.
- The System automatically update the cached data frequently at very low cost
  - Make sure the cached data being updated in time
  - Frequency for updating is configurable



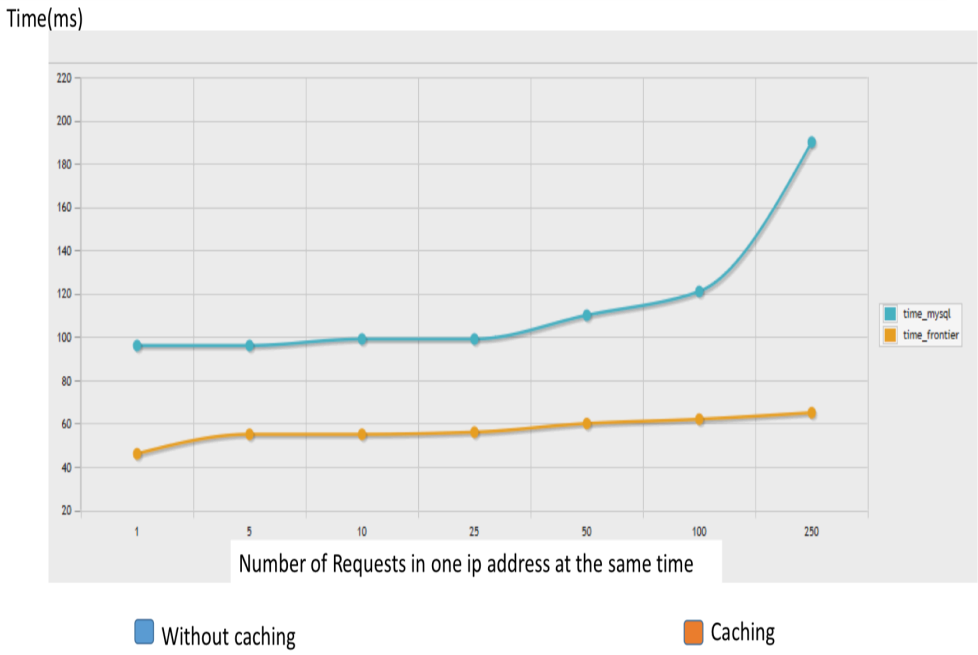
Testing System



Performance Testing



Data transmission



Responding time

- Every request is the same and needs to download some data
- The request with caching remain fast and stable with increased number of requests

Summary

- Conditions data takes very important role for the event data processing and physics analysis
- Conditions Data are heterogeneous and vary with time
- JUNO Conditions Database System is developed to homogeneously manage all Conditions Data
  - Data Model
  - Web Interface
  - CondDB Service
  - Frontier/Squid for data caching
- The System has been tested and optimized to have good performance, and is being used for JUNO M.C. Data Production

Thanks a lot!