

08-10 October 2024 13th Collaboration Meeting of the BM@N Experiment at NICA

Development of Infrastructure for BM@N Information Systems



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OUTLINE



Electronic Logbook (e-Log)

The Online Logbook System allows collaboration members to record information about events, system states, and detector operation during experiments, such as particle type, energy, magnetic field, and triggers. This data is crucial for analyzing particle collisions, making multi-user access essential for high-energy physics experiments.

Condition Database(UniConDa)

The Condition Database is designed for storing and managing parametric information related to the experiment systems, which is essential for data processing.

Event Metadata System

The Event Metadata System is built on the Event Database (Event Catalogue), which contains summary information about recorded particle collision events and allows for the quick selection of only those events needed for specific physical analysis.

BM@N Electronic Logbook					Logged in as shift					
Home	Find Last day Account			Number of items per page: 10 V Logout						
Date 🗘	Shift Leader ᅌ	Туре 🗘	Nº Run ≎	Trigger ≎	DAQ Status 🗘	Beam 🗘	Energy, O	Target 🗘	SP- 41, ≎ A	SP- 57,
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Geometry System

The geometry information system, based on the geometric database, stores and processes data about the composition and geometric structure of detectors used in experiments, providing a centralized repository for geometries.

Configuration System

The Configuration Information System is used to store and provide data on the configuration of hardware and software systems of the experiment during online data collection from the detectors.

BM@N Geometry DataBase	BM@N Geometry DataBase
	GENERAL INFORMATION
Menu	The Geometry Database is a part of the Geometry Information System, which provides a central storage of the del geometry modules and software assemblies of various versions of the setup as a combination of these modules field, detector materials and modia. Two user interfacions are available to work which the Geometry Database of the
HOME	programming interface (API) providing a set of ROOT macros for selecting and loading the setup geometry and reconstruction and physics data analysis of the particle collision events. The Geometry Database is intended for
VIEW GEOMETRY 🗸	geometries. The Web interface of the database provides the following functionality:
Get in touch	 viewing, adding and deleting files with geometry materials and magnetic fields; viewing and managing files with detector geometries of the setup, CENN ROOT, ASCII and GDML files are support viewing and managing geometry modules as these geometry files with corresponding transformation matrices detectors in the setup without changing an original geometry in the files;
Konstantin Gertsenberger	 constructing and approving various versions of the setup geometries as a combination of the stored modules, updating and deleting existing setup geometries;
	 search and download of detector geometries from the Web service;
© JNR VELHER MUT, 2019-2024. All rights reserved.	 download a full local version of the Geometry Database based on the SQuite DBMS, which is a local replica of th The available functionality of the Web interface depends on the user category: lead developer, developer or gene editing functions. More detailed information on the Geometry Database can be found in this article.

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	monStreamDecoder	BM@N:8	OnlineDataProcessing	InitProblem	Q

Official BM@N Website

Our website is the official BM@N website, serving as a crucial source of information about the experiment, participants, results, and project-related news and events.

BM@N Forum

This is a place where our scientists and participants can discuss, exchange ideas and experiences, explore new directions, and collectively address important questions.

Scheduler Interface

Scheduler is a module for the ROOT and FairRoot frameworks that simplifies task distribution on clusters using existing batch processing systems (SLURM, SGE, Torque) and supports parallel task execution.

BM@N Tango

BM@N Tango is a viewer for hardware parameters of the slow control system.

Cluster Inspector File Inspector





BM@N WIKI

The use of a content management system in experiments provides centralized storage and access to a variety of materials and documentation.

BM@N Project Manager

BM@N Project Manager is a project management tool that enables efficient task coordination and optimization of workflows.



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Plane

- ✤ Intuitive Interface
- Progress Tracking
- Real-time task updates
- ✤ SSO-enabled

✤ Kanban boards ❖ Lists ❖ Timelines

Past Infrastructure



conflicts

bmn-web.jinr.ru



Logbook Web service bmn-elog.jinr.ru

Tango Parameter Viewer bmn-tango.jinr.ru

NICA-Scheduler Configurator bmn-scheduler.jinr.ru

> Metadata Web service bmn-event.jinr.ru

Official BM@N Web site bmn.jinr.ru

> Forum system bmn-forum.jinr.ru

Wiki Document server bmn-wiki.jinr.ru

Configuration Web service bmn-online.jinr.ru

bmn-config.he.jinr.ru







Configuration Worker 1 bmn-config-w1.he.jinr.ru **Configuration Worker 2** bmn-config-w2.he.jinr.ru

bmn-user.jinr.ru



bmn-elogdb.he.jinr.ru

Logbook Database

elog_db

Inspection Database

integrity db

Cluster Inspection

cluster_db

InfluxDB Monitoring

mon_unidb

nc3.jinr.ru

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FreeIPA service

bmn-ipa.jinr.ru



nc24.jinr.ru



Event Catalogue event db **Event REST API**

nc13.jinr.ru

Condition Database bmn db

Logbook Database bmn_elog

Inspection Database integrity_db

Cluster Inspection cluster db

InfluxDB Monitoring mon_unidb

DAQ C4 Cluster

LHEP Building 201

Proxmox is a virtualization and resource management platform that allows you to create **VMs** and containers using virtualization technologies such as **KVM** for **VMs** and **LXC** (Linux Containers) for containers.

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PROXMOX

KEYCLOAK

- Versatility: Support for virtual machines and containers.
- ✤ High-Performance Storage: Utilizing Fast SSD Storage.
- Convenient Interface: Web interface for managing all aspects of virtualization.
- ✤ Backups and Recovery: Integrated tools for creating backups.
- ✤ Performance: Good performance for virtual machines with KVM.
- Free Software: Software based on open-source code.

Deployment and Service Management with Docker and CoDeS

We use Docker containerization and the CoDeS system for efficient deployment and management of our services.

- Isolated environment
- Image portability
- Resource efficiency (lightweight)
- Centralized configuration management
- Updates and scaling
- Uniformity



git

P

Run deploy script



Start

Deploy

libraries

Deploy

eLog

SO

deployment of the Electronic Logbook (eLog) as a docker co

php-pgsg

Web service

from GitLab

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Deploy

Database

from GitLab

Modifi

configuration

Deployed

eLog

Base server

(Web)

The Common Deployment System is based on Docker containers and shell scripts

Implementation of a Single Sign-On (SSO)

Keycloak—a modern and reliable solution for identity and access management.

Migrating to Keycloak for implementing Single Sign-On offers numerous benefits, including centralized management, user convenience, and enhanced security.



PROXMOX

User Convenience

- Enhanced Security
- Centralized User Management

Keycloak is based on two important protocols, OpenID Connect and OAuth 2.0

bmn-user-ipa.jinr.ru



FreeIPA service bmn-login.jinr.ru

bmn-user.jinr.ru



FreeIPA

User Federations

10



Keycloak service

Gateway Implementation

API GATEWAY

The **Gateway** acts as a single entry point,

managing and controlling all incoming requests to internal services.

Centralized Access

Traffic Routing

Reverse Proxy (nginx)

Single External IP Address

()

> Single point of failure



 Configuration and maintenance complexity



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Details of protection implementation

NGINX is a high-performance web server and reverse proxy that plays a crucial role in managing traffic and ensuring security within our infrastructure.

NGINX not only helps manage traffic but also protects the infrastructure, ensuring flexibility, security, and scalability.





Reverse Proxy

- SSL Termination
- Reverse Proxying
- Traffic Protection and Filtering
- Performance Optimization(GZIP)
- Centralized Logging



Details of protection implementation

More then 2000+ banned

- IPTABLES: Traffic filtering at the Linux kernel level.
- Fail2Ban: Automated IP blocking on suspicious activity.
- Regular Updates: Keeping systems and packages up to date to patch vulnerabilities.
- Logging and Analysis: Monitoring and analyzing all events to prevent threats.



- ✤ Rate Limiting
- ✤ Authentication Protection
- Malicious Bot Detection
- Sensitive File Protection
- ✤ Traffic Filtering
- ✤ Optimized performance.
- Simplified system management.



Development of Contemporary Log Management Solution for the Information Infrastructure of the BM@N Experiment

Current Infrastructure



Conclusions

- We have made significant progress in deploying new services, systems, and databases, ensuring a smooth transition to the new infrastructure.
- The integration of these services with Keycloak strengthens authentication and authorization processes, providing a higher level of security.
- We are committed to optimizing system performance and ensuring its seamless operation for the BM@N experiment.



Focus on further development

- 1. New service integration: Expanding functionality with new tools and applications.
- 2. Enhanced security: Implementing advanced threat detection and prevention systems.
- 3. Staff training and external courses: It would be great if we were sent to professional courses.





Thank you for your attention!



