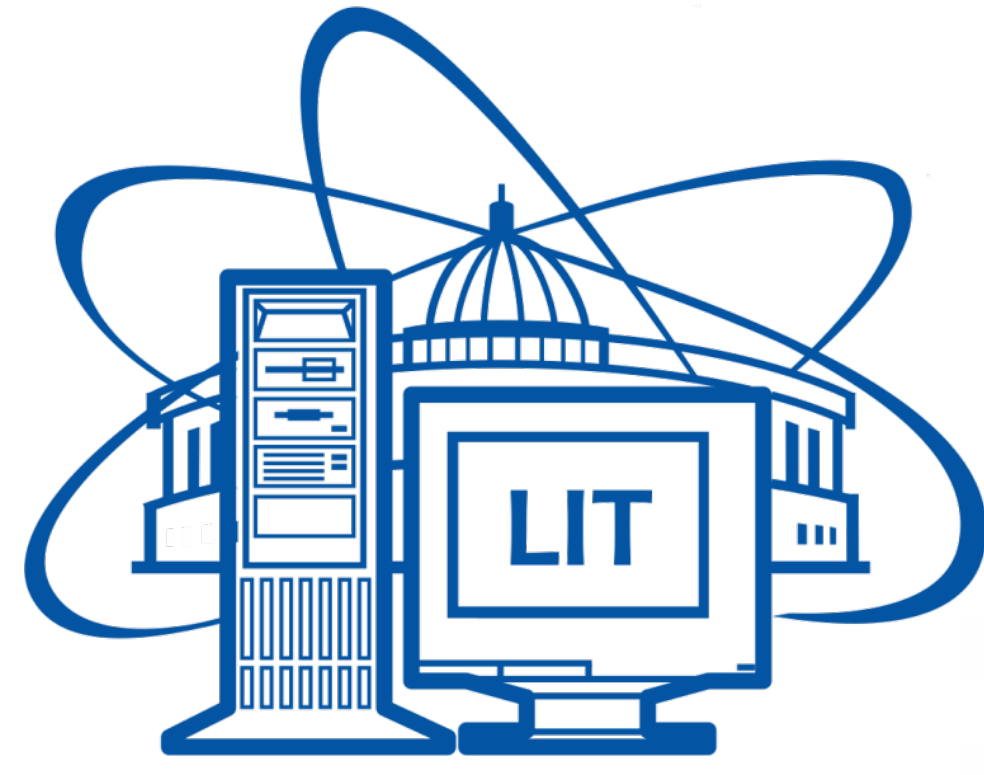


THE SERVICE FOR PARALLEL APPLICATIONS BASED ON THE JINR CLOUD AND HYBRILIT RESOURCES

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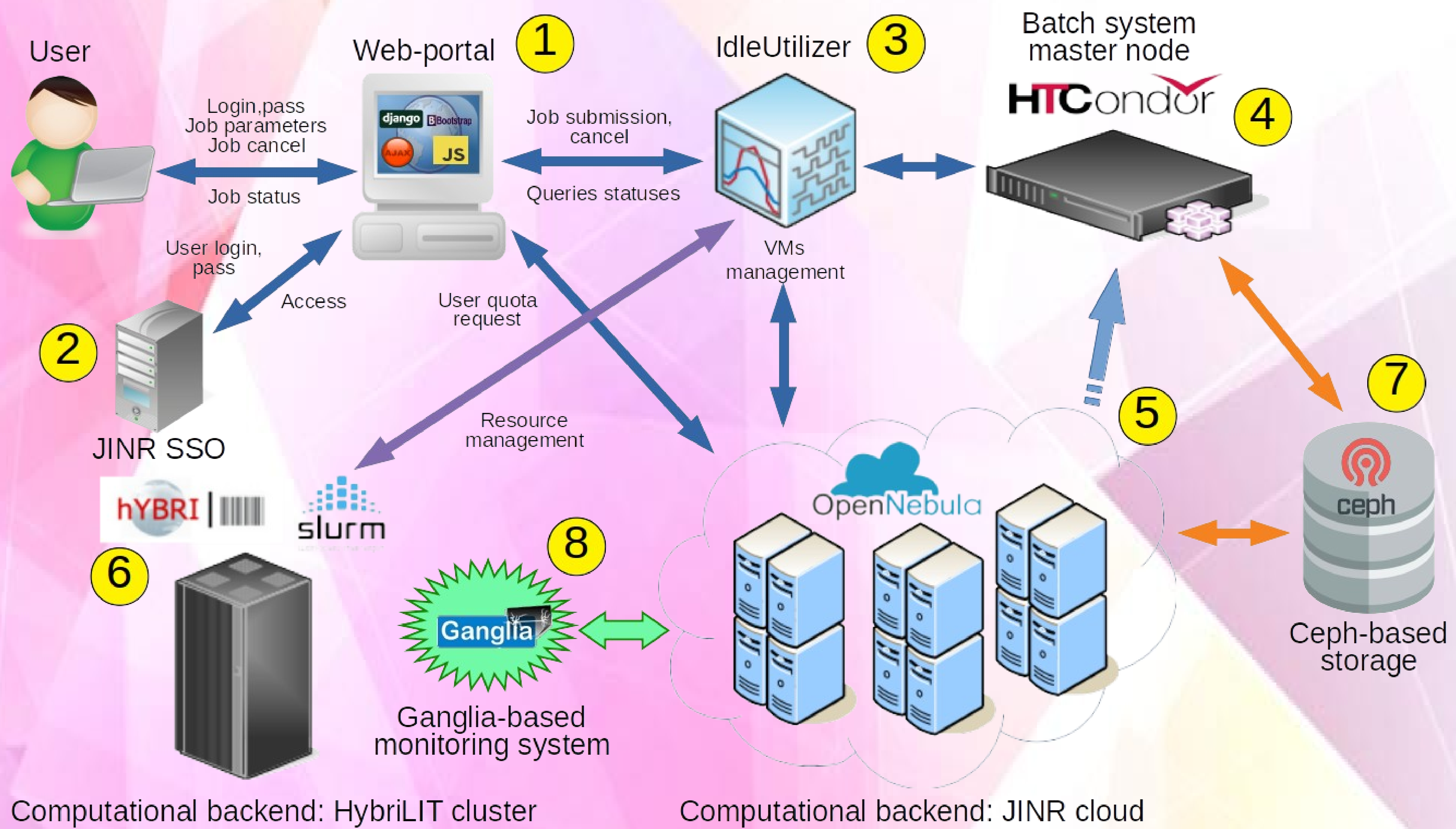


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The JINR cloud team developed a service which provides an access for scientists of small research groups from JINR and its Member State organizations to computational resources via problem oriented (i.e. application-specific) web-interface. It allows a scientist to focus on his research domain by interacting with the service in a convenient way via browser and abstracting away from underlying infrastructure as well as its maintenance. A user just sets a required values for his job via web-interface and specify a location for uploading a result.

The service implementation

- A user interacts with the whole service via **web-portal** only which is a client-server web-application. It allows to select a particular application, a computational backend, define its input parameters (it also validates them) and to initiate a job submission. The server part of the web-app gets these information and based on it forms a request for IdleUtilizer.
- A user authenticates on the web-portal via the **JINR Single Sign-on (SSO)** service what mitigates risk for access to 3rd-party sites, reduces password fatigue and has other benefits.
- IdleUtilizer** is a Python script for spawning or terminating hosts in OpenNebula cloud depending on the presence of idle tasks in HTCondor scheduler queue.
Main tasks:
 - gets information defined by the user for computational jobs execution including characteristics of required resources as well as input parameters for computational job;
 - manages VMs in the cloud (instantiates requests for VMs creation, checks requests status, deletes VMs, etc);
 - manages resources in HybriLIT cluster;
 - handles user jobs in a batch system (submits user job, checks its status, cancel submitted job upon user request and so on).
- If the JINR cloud is chosen as computational backend then each separate user job initiates a creation of dedicated set of computational resources – virtual machines in the JINR cloud infrastructure. These VMs become worker nodes for **HTCondor-based batch system**
- The JINR SaaS enables job submission to **OpenNebula-based clouds** where VMs are created for running a real workload. These VMs become worker nodes for HTCondor-based batch system. **The JINR cloud** is used as a computational back-end for the service for scientific and engineering computations. The JINR cloud is used as a computational back-end for the service for scientific and engineering computations. The schema of the JINR Cloud infrastructure is shown on Fig.2
- Resources of **HybriLIT cluster** operated by Slurm workload manager can be used as another computational backend for user jobs
- Other key component of the JINR cloud infrastructure and the JINR SaaS service is a **software-defined storage based on Ceph**. It delivers object, block and file storage in one unified system. The JINR ceph-based SDS deployment schema as well as each server's roles are shown on the Fig 3.
- To get an information about various metrics (CPU and memory usage as well as disk and network i/o) of HTCondor WNs what are deployed and run on cloud VMs a **ganglia-based monitoring system** is used. A screenshot of ganglia web-interface with overview of WNs and its CPU load is shown on the Fig. 4.



Computational backend: HybriLIT cluster

Computational backend: JINR cloud

Fig.1. A basic schema of workflow and main components of the JINR cloud service for scientific and engineering computations

LJJ simulation

An example of using the Cloud&HybriLIT resources in the scientific computing is the study of superconducting processes in the stacked long Josephson junctions (LJJ). LJJ systems are undergone the intensive research because of a perspective of practical applications in nano-electronics and quantum computing. Respective mathematical model is described by a system of the sine-Gordon type partial differential equations where the spatial derivatives are approximated with help of standard finite difference formulas and the resulting system of ODEs is numerically solved by means of the 4th order Runge-Kutta procedure. MPI-enabled implementation of the numerical algorithm was developed. In this contribution, we generalize the experience on application of the Cloud&HybriLIT resources for the high performance computing of physical characteristics in the LJJ system.

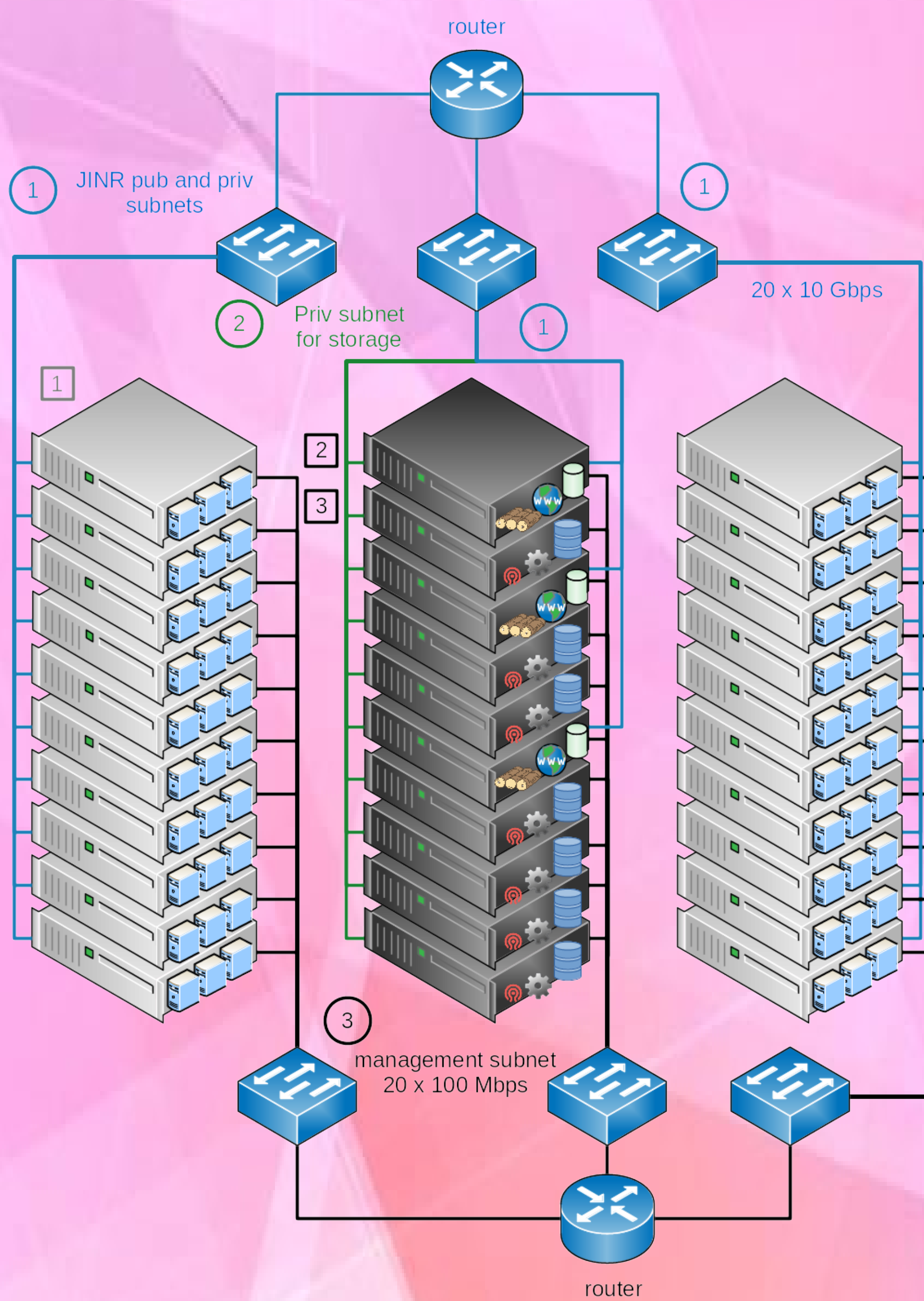


Fig.2. The JINR cloud Raft HA architecture

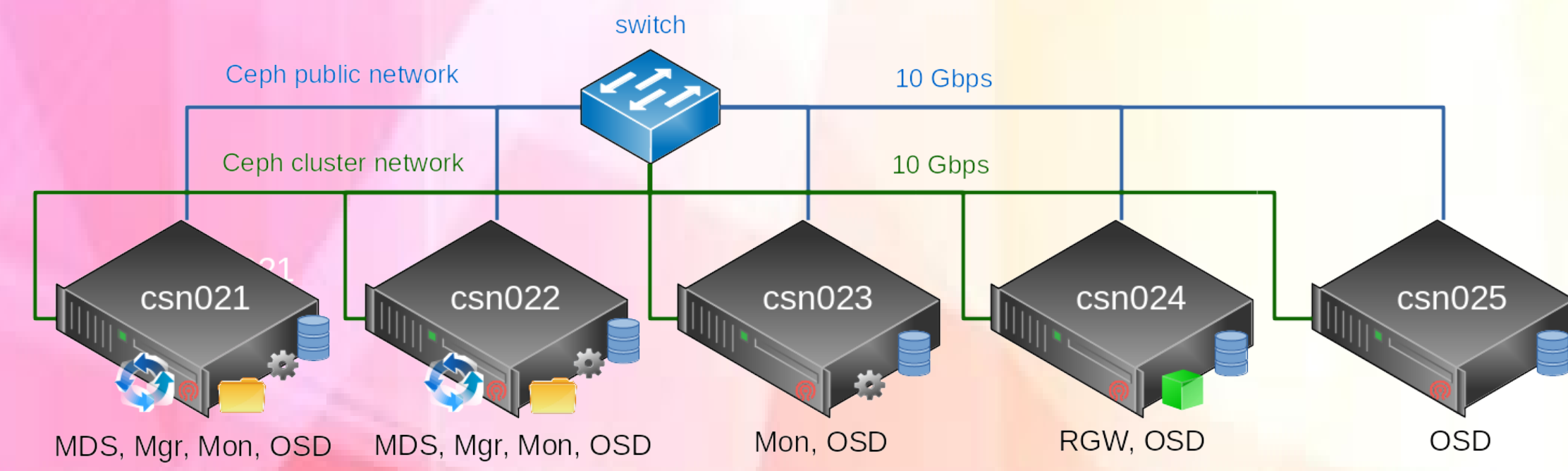


Fig. 3. The schema of the Ceph-based software-defined storage deployed at JINR

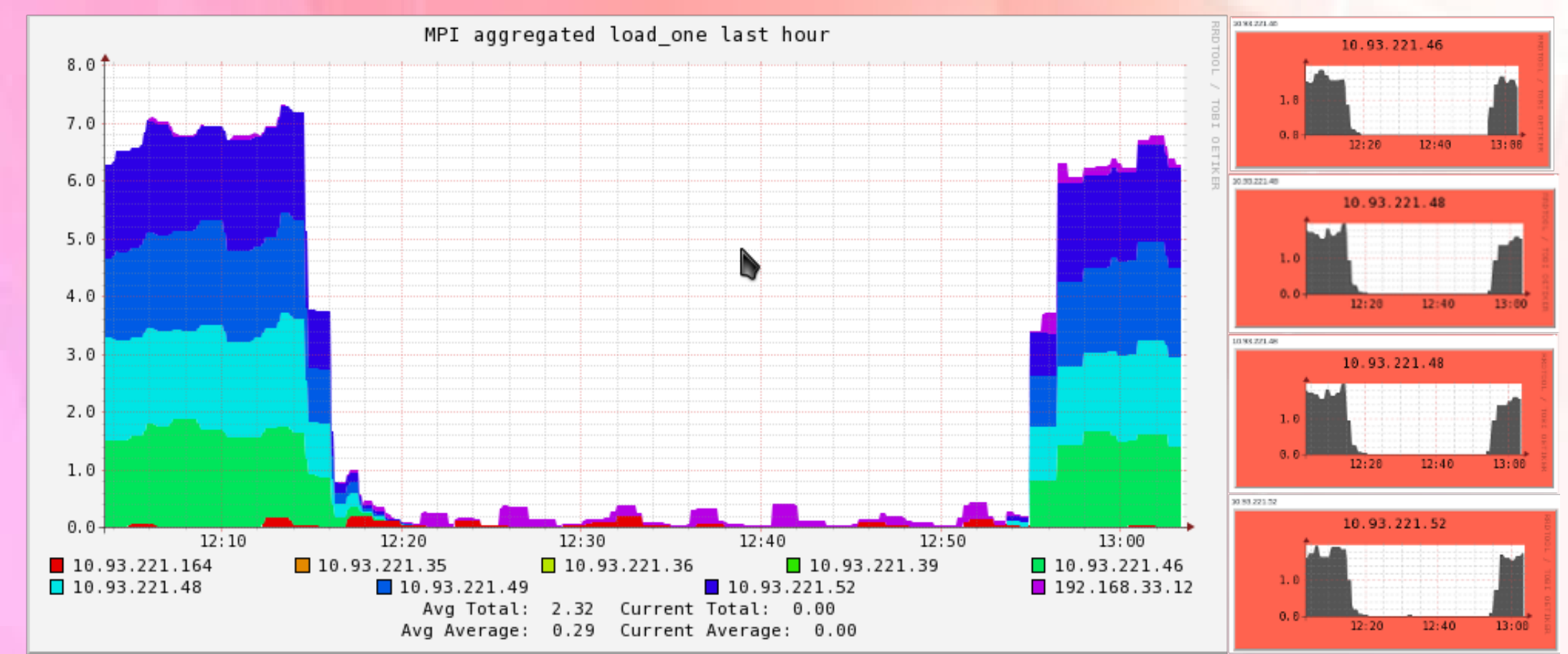
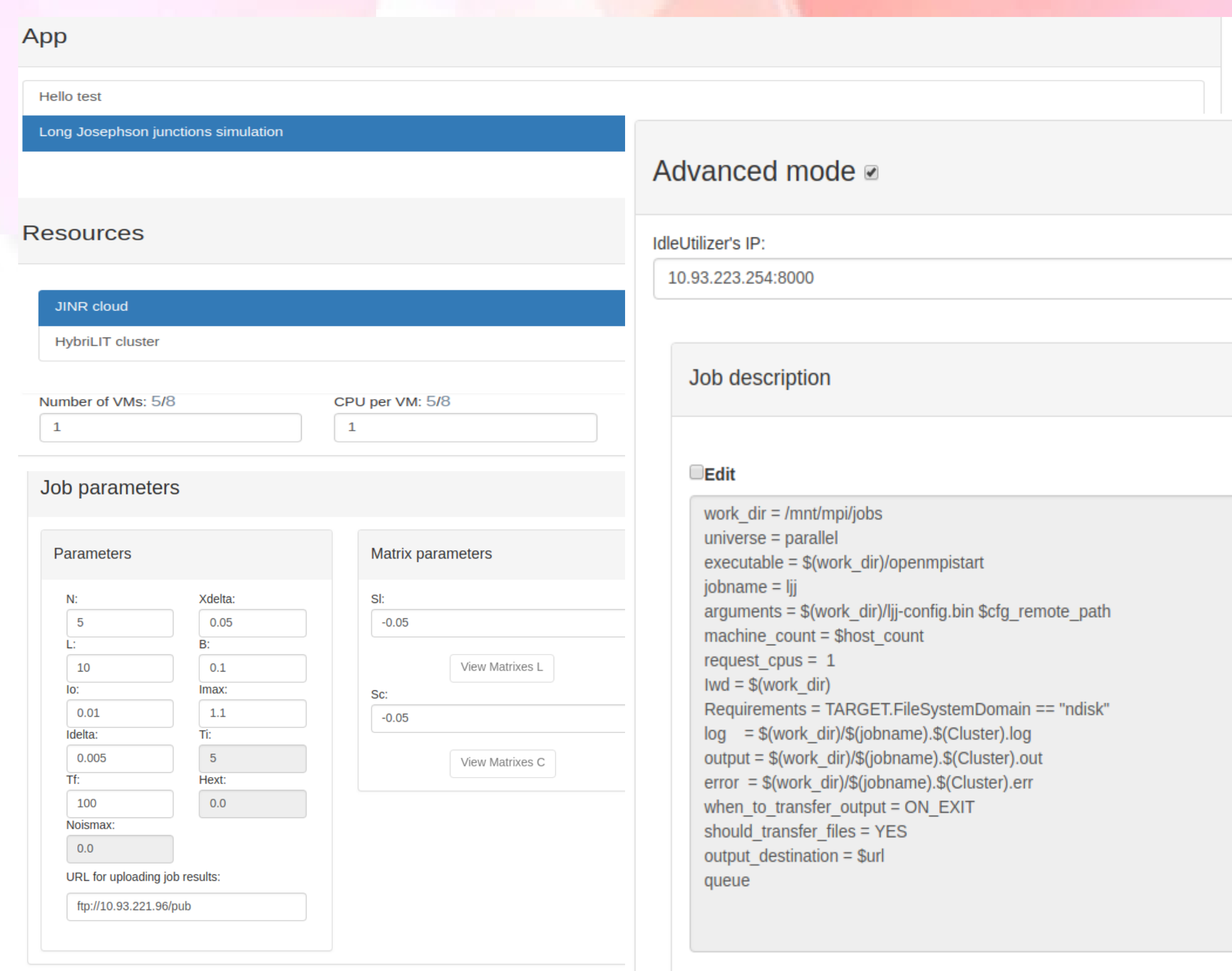
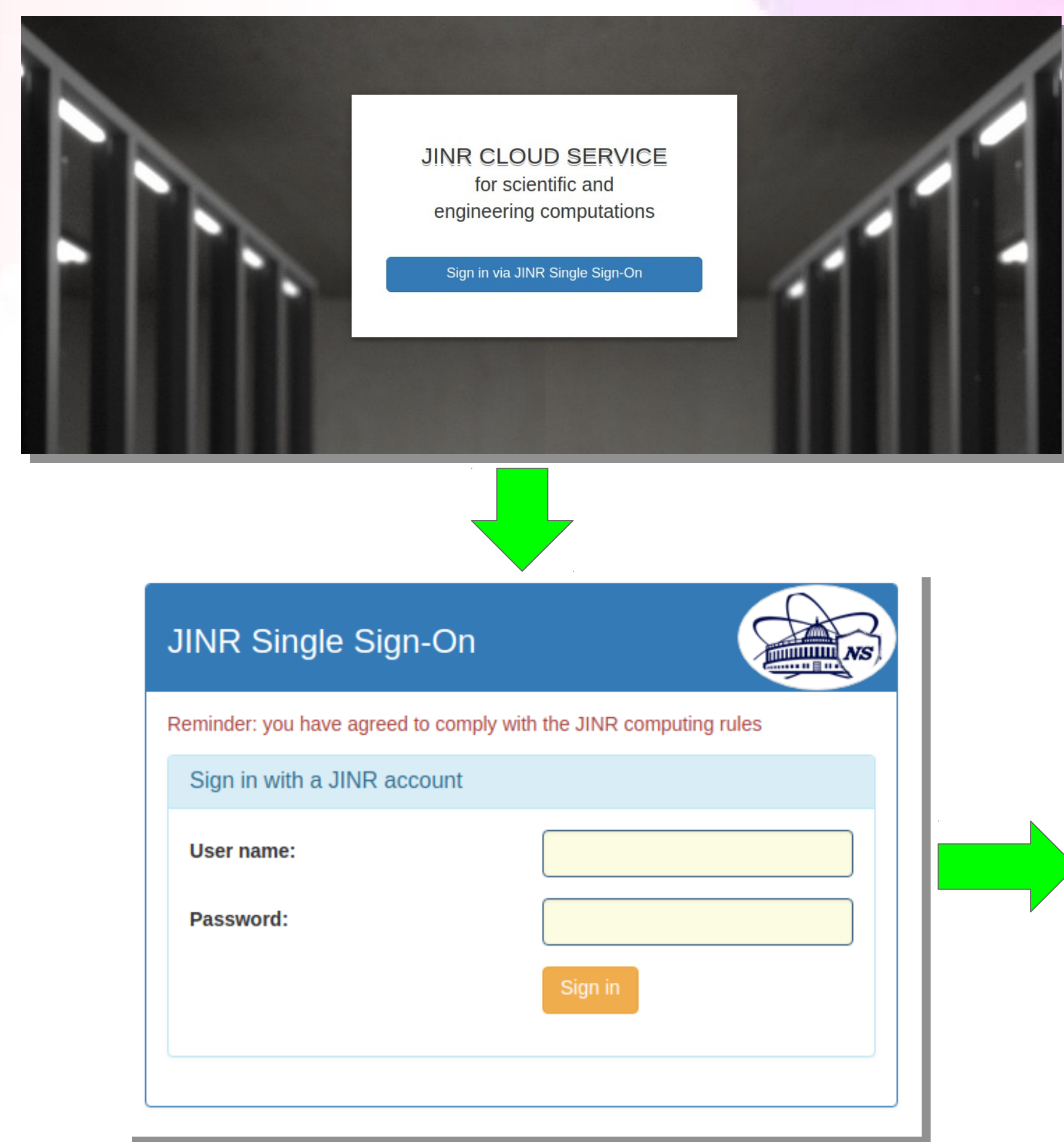


Fig.4. A screenshot of ganglia web-interface with overview of WNs and their CPU load

The scheme of interaction of the user with the system



List of jobs		
Job ID	Path	Status
121	ftp://10.93.221.96/pub	cancelled
120	ftp://10.93.221.96/pub	cancelled
119	ftp://10.93.221.96/pub	cancelled
52	ftp://10.93.221.96/pub	pending
51	ftp://10.93.221.96/pub	cancelled
50	ftp://10.93.221.96/pub	cancelled

Acknowledgment

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