Simulation results of BM@N computing infrastructure

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Introduction

The software complex for simulation of distributed data processing systems is being developed at the MLIT.

The important task

The data processing simulation of the BM@N experiment.

Simulation goal

- to find out how the data storage and processing system will work with the available computing power;
- to calculate the load on computing farms and communication links with the specified parameters of data flows and jobs flows.

The simulation software complex

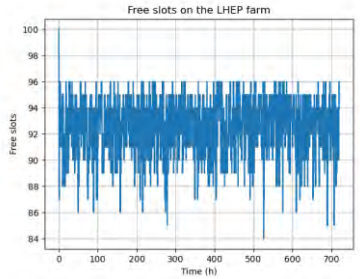
- equipment parameters
- list of jobs for processing

Database

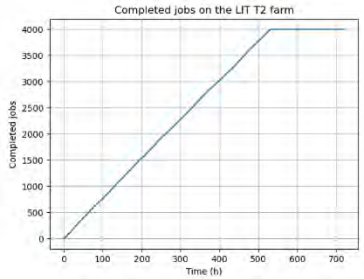
- simulation results

Module for setting of equipment configurations

Stable core for transfer and processing data modelling



Module for presenting results



Completed works to upgrade the software complex
(from 8th BM@N meeting)

1. Python program simulates processes:

- generating data, file and job flows;
- data transfers between storage and computing components;
- starting jobs on computing components with the help of pilots.

2. New graphs has been added that present more detailed information about the processes occurring in the simulated system.

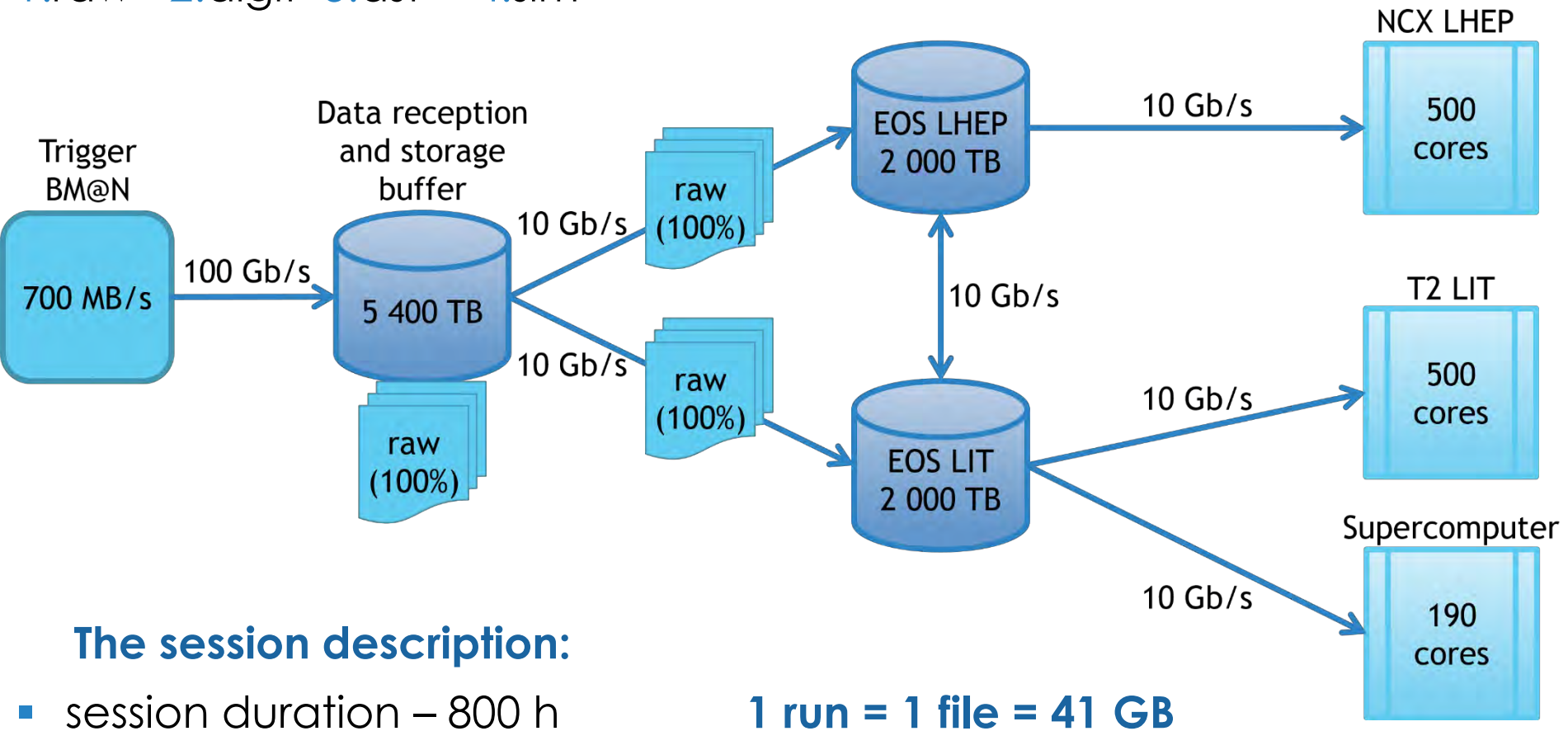
3. Software complex has been prepared for launch on HybriLIT resources and the MLIT farm.

Computations were held on the basis of the Hybrid heterogeneous computing platform.

The simulated structure

Classes of data

1.raw 2.digit 3.dst 4.sim



The session description:

- session duration – 800 h
- run duration – 60 sec
- time between runs – 30 sec

1 run = 1 file = 41 GB
1 event = 0,4 MB

Classes of jobs

№	Class	The average amount of input (GB)	The average amount of output (GB)	Job execution time (s)	Number of jobs	Job start frequency (s)
1	RawToDigit	41	1	200 000 (NCX, T2)	12 100	238
2	DigitToDst	1	1	86 000 (NCX, T2)	12 100	238
3	GenToSim	0,084	8	5 000 (HPC) 15 000 (NCX, T2)	5 250	549
4	SimToDst	8	0,4	12 000 (HPC) 35 000 (NCX, T2)	5 250	549

- Each job processes 1 file.
- Each file is processed 1 time.

$$Frequency = \frac{session\ duration\ (s)}{number\ of\ jobs}$$

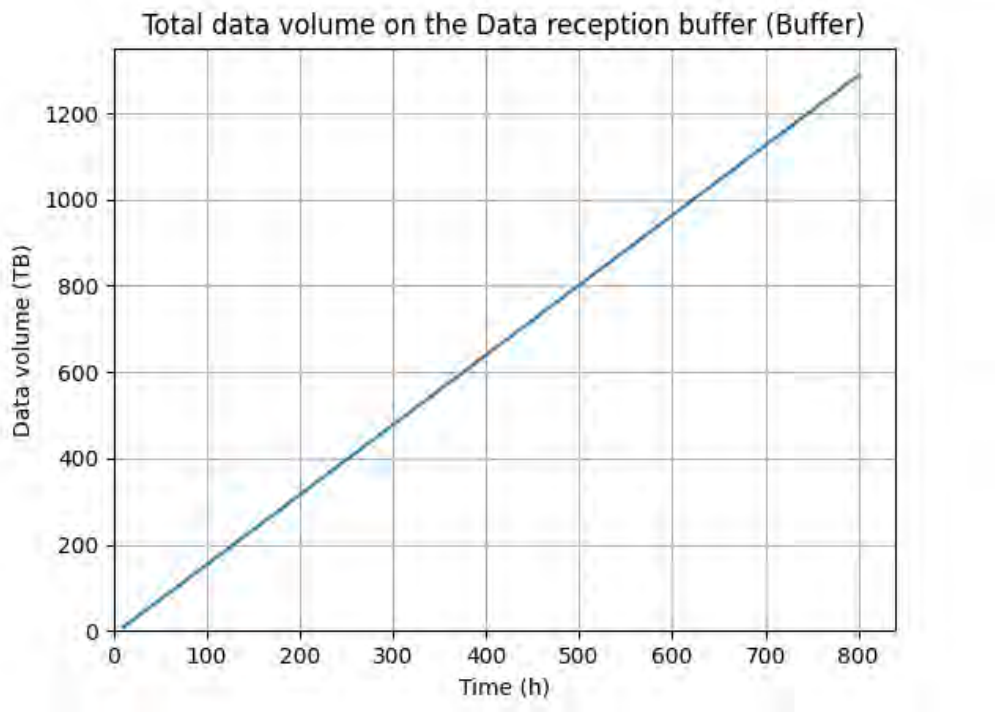
Distribution of computing power

№	Class	NCX LHEP	T2 LIT	Supercomp.
1	RawToDigit	400	-	-
2	DigitToDst	100	-	-
3	GenToSim	-	250	95
4	SimToDst	-	250	95

Jobs are run on computing components in a percentage in accordance with the allocated resources.

Results

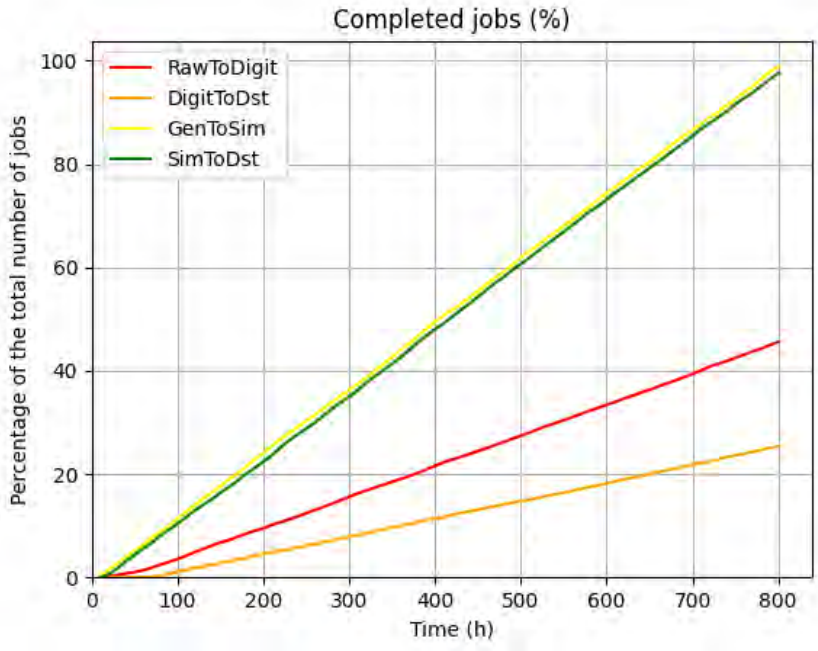
The amount of data on the buffer

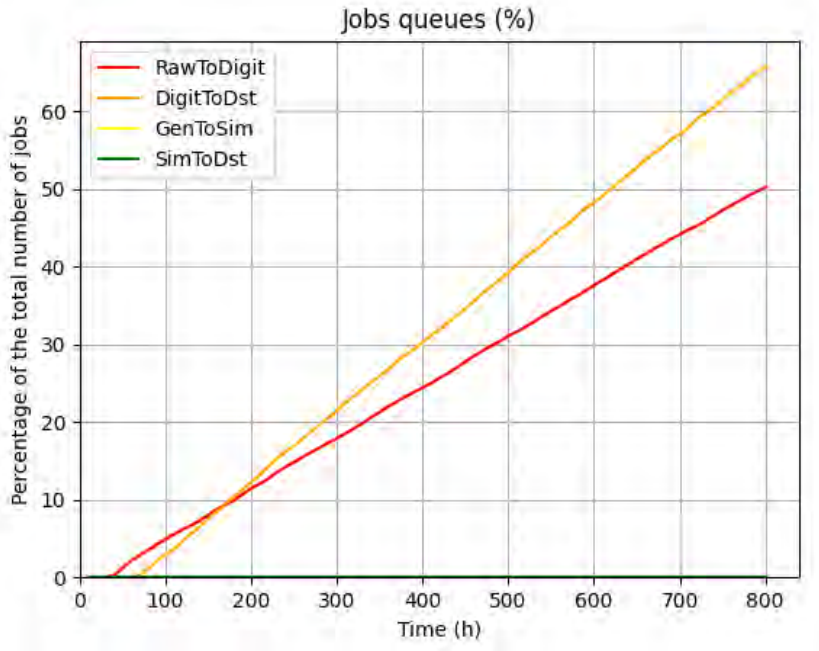


800 hours ≈ 1 300 TB raw-data

Results

Completed jobs & Jobs queues





Completed jobs in 800 hours:

RawToDigit ≈ 45% **GenToSim** ≈ 99%

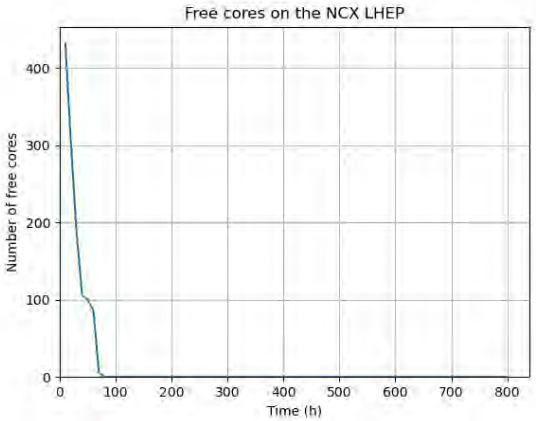
DigitToDst ≈ 25% **SimToDst** ≈ 97%

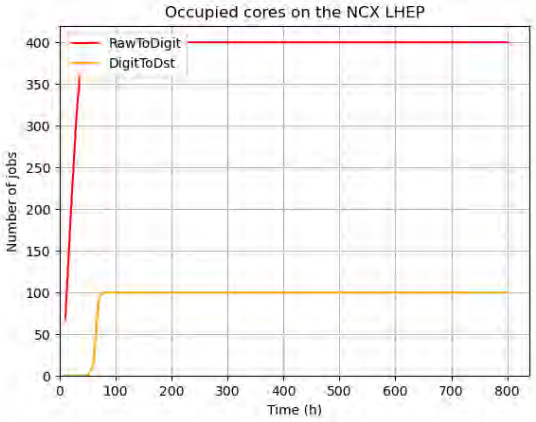
Queues are not formed for **GenToSim** jobs & **SimToDst** jobs

Results

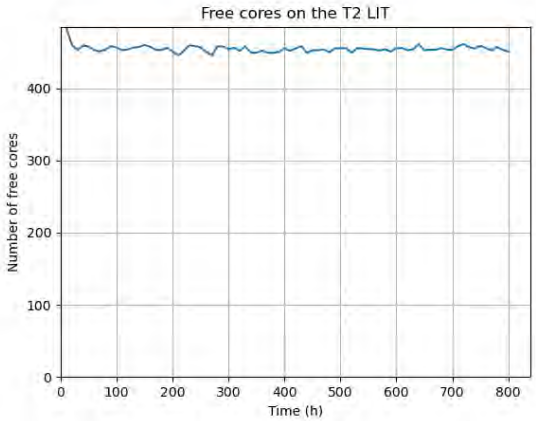
Computing resources usage

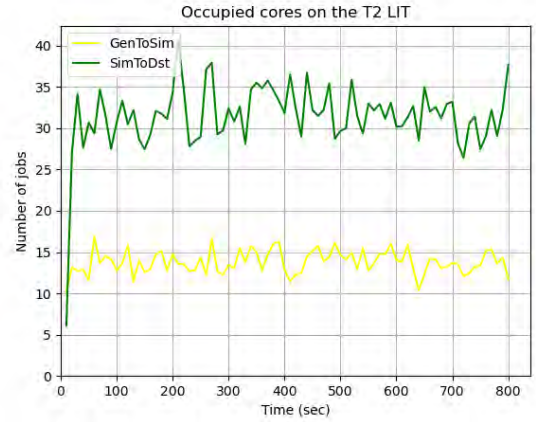
NCX LHEP



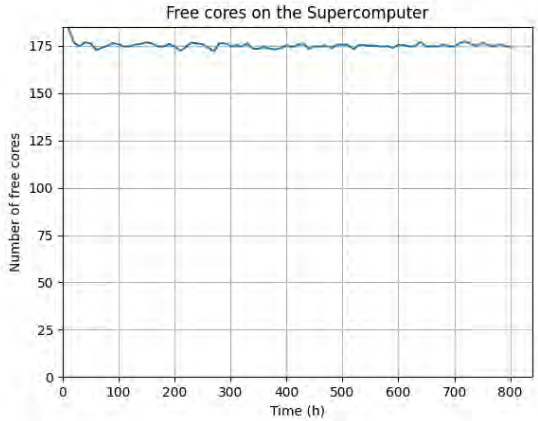


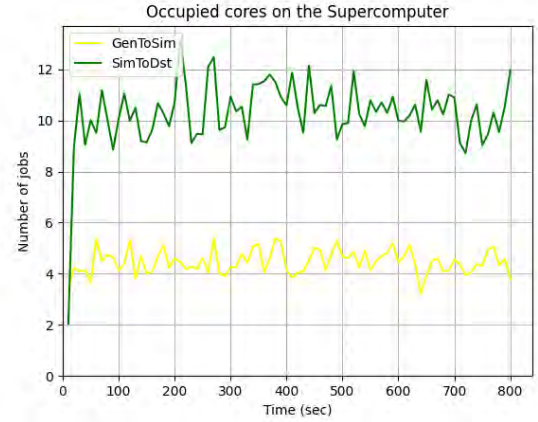
T2 LIT





Supercomputer

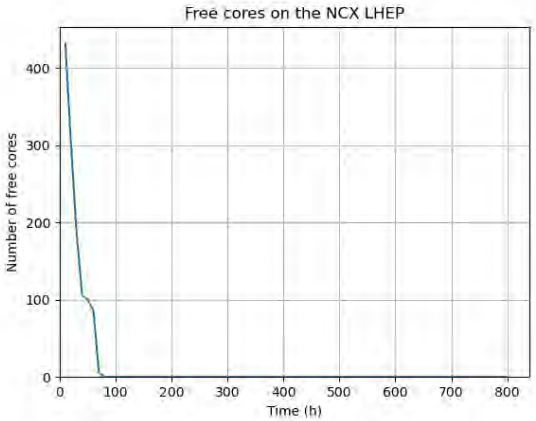




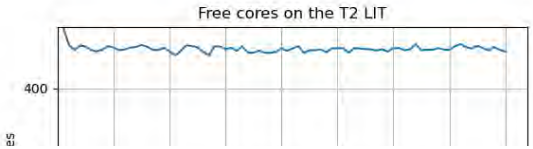
Results

Computing resources usage

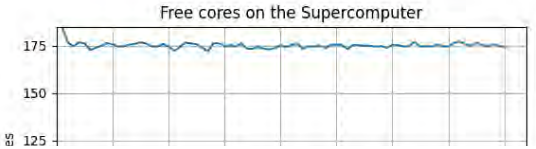
NCX LHEP



T2 LIT

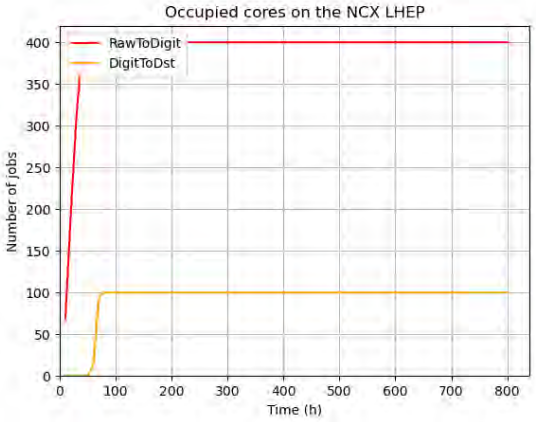


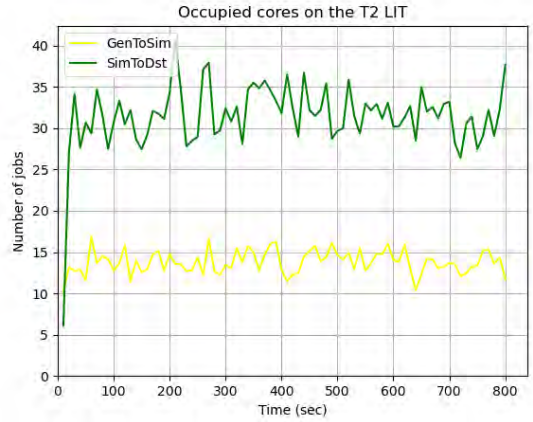
Supercomputer

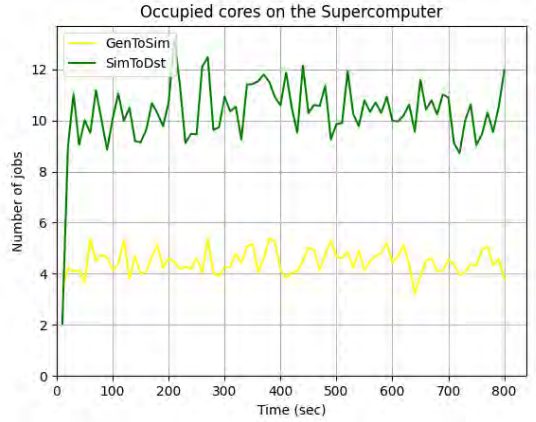


A large number of resources are not used !

RawToDigit and DigitToDst jobs should also be processed to speed up the processing of experimental data.

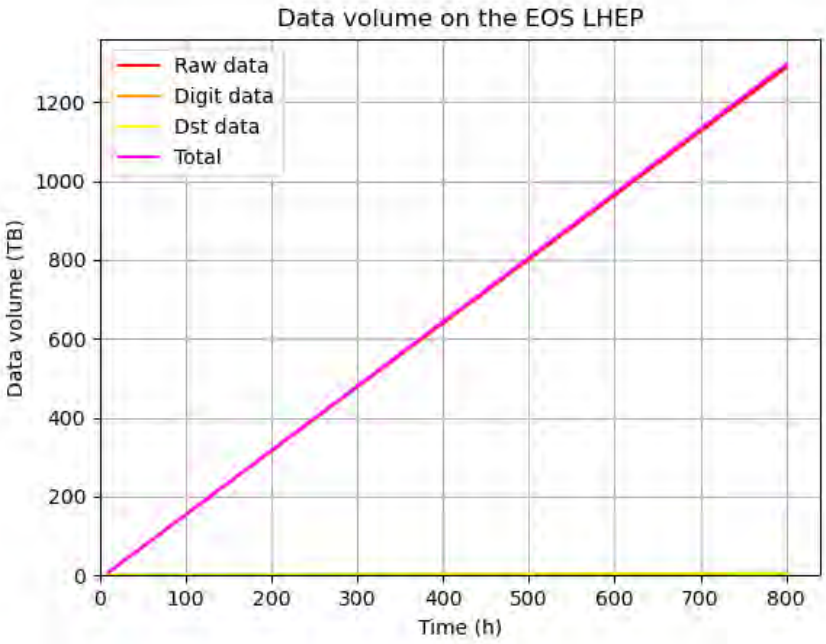


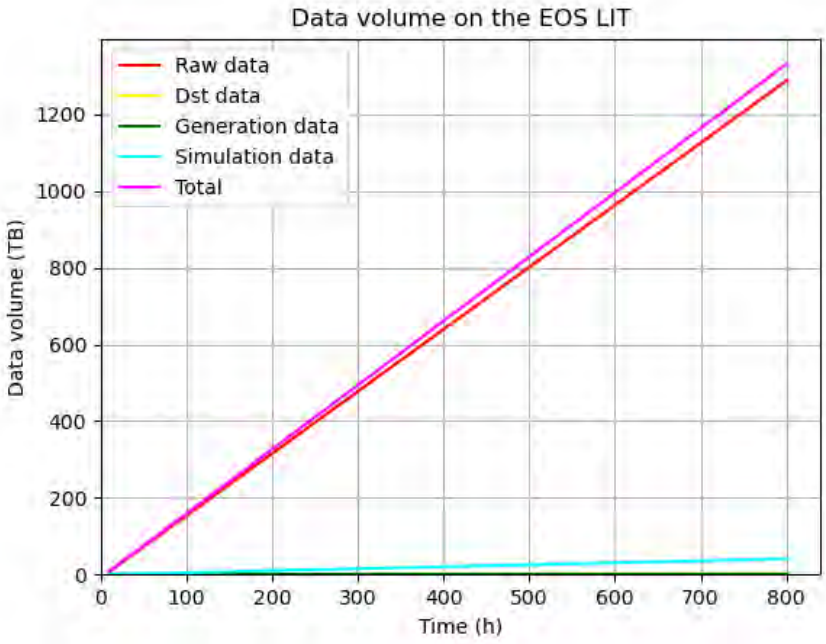




Results

Data volume on storages





Total volume on the EOS LHEP: 1 300 TB

Total volume on the EOS LIT: 1 300 TB

EOS LHEP capacity: 2 000 TB

EOS LIT capacity: 2 000 TB

The allocated resources on the EOS LHEP and the EOS LIT are enough to store all types of files in full.

Conclusions

- Upgraded the software simulation complex.
- Based on the simulation results, we can predict problems that may appear during the experiment and data processing.

- **Simulation results of BM@N computing infrastructure:**
  - ≈ 1 300 TB of raw data is accumulated on the data reception and storage buffer during 800 hours of the experiment;
  - completed jobs in 800 hours:

≈ 45% of RawToDigit jobs and ≈ 25% of DigitToDst jobs – on the NCX LHEP;

≈ 99% of GenToSim jobs and ≈ 97% of SimToDst jobs – on the T2 LIT and the Supercomputer;

  - GenToSim and SimToDst jobs are processed quickly and do not form queues;
  - a large number of resources on the T2 LIT and the Supercomputer are not used → RawToDigit and DigitToDst jobs should also be processed on these resources to speed up the processing of experimental data;
  - The allocated resources on the EOS LHEP and the EOS LIT are enough to store all types of files in full.

Further plans

- Optimizing the running time of the software complex.
- Updating the parameters of the job classes and equipment parameters in order to redistribute the resources allocated to each job type.
- Modelling the processes taking place during the physical experiment, as well as show how much time is needed to complete all the jobs of various classes.
- Finding optimal equipment parameters that will ensure data processing according to the specified requirements.

Thank you for the attention!

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