

INFORMATION TECHNOLOGIES @ JINR DEVELOPMENT STRATEGY

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on behalf of the LIT strategy group

126th JINR Scientific Council

19.09.2019

Dubna

Working and Experts' Group

International group

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Gaetano Maron – INFN

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Petr Zrelov

Irina Filozova

Vladimir Gerdt

Oxana Streltsova

Nikolay Voytishin



Meetings and discussions

- Conferences
- Workshops
- Visits/Seminars



JINR is a part of Worldwide LHC Computing Grid

WLCG:

An international collaboration to distribute and analyse LHC data integrates computer centres worldwide, which provide computing and storage resources, into a single infrastructure accessible by all LHC physicists.

Tier-0 (CERN):

data recording,
reconstruction and
distribution

Tier-1:

permanent storage,
re-processing,
analysis

Tier-2:

simulation,
end-user analysis

~170 sites

42 countries

1 000 000 cores

1 EB of storage

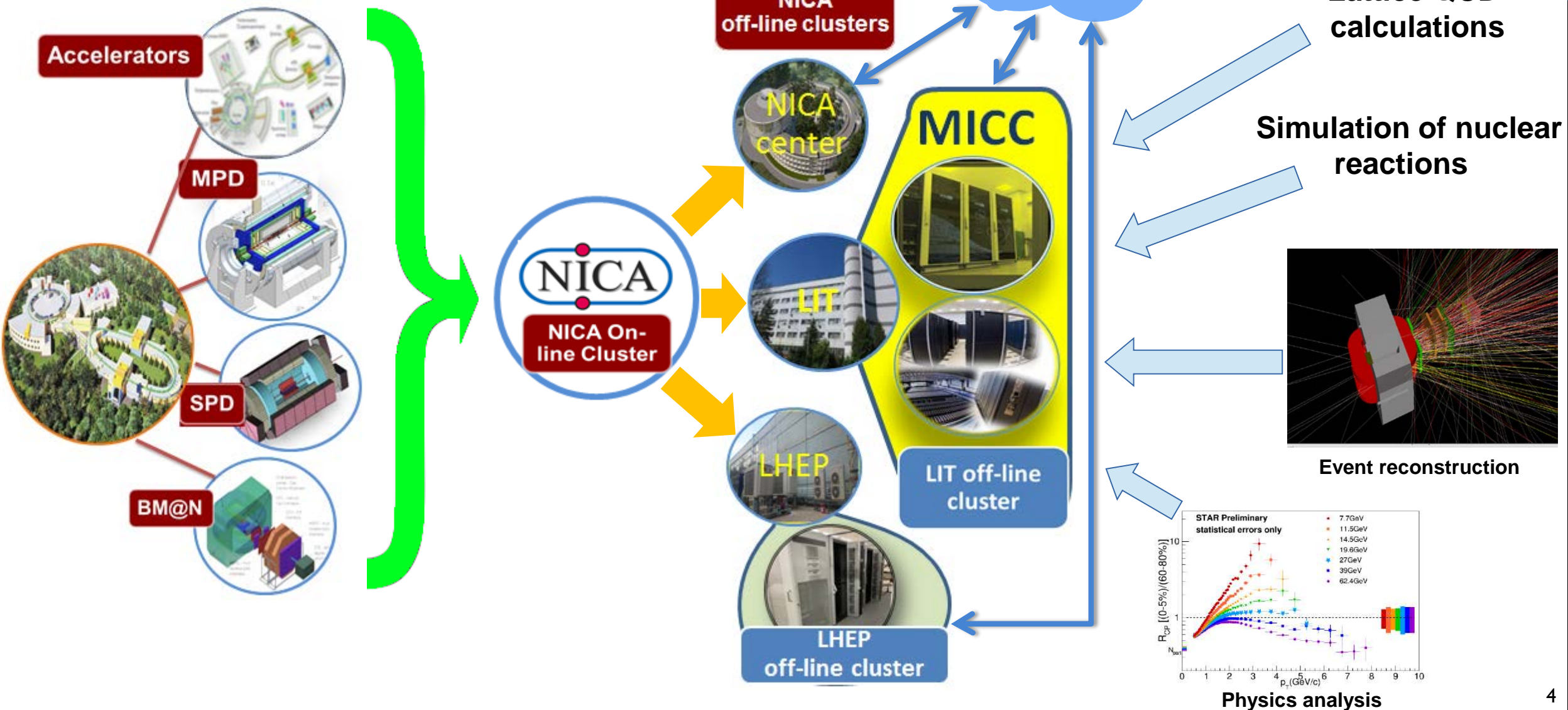
> 3 million jobs/day

10-100 Gb links



Worldwide LHC Computing Grid - 2019

NICA Computing Concept & Challenges



New Joint Computing Platform for Neutrino Experiments



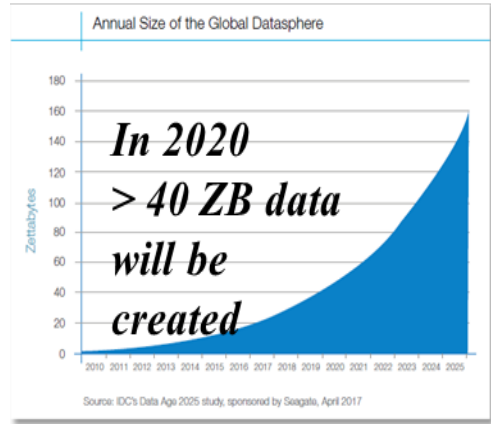
LIT contribution:

engineering infrastructure (electricity, UPS, cooling, network, racks, manpower)

DLNP contribution:

computing and storage resources (CPUs/GPUs&disks)

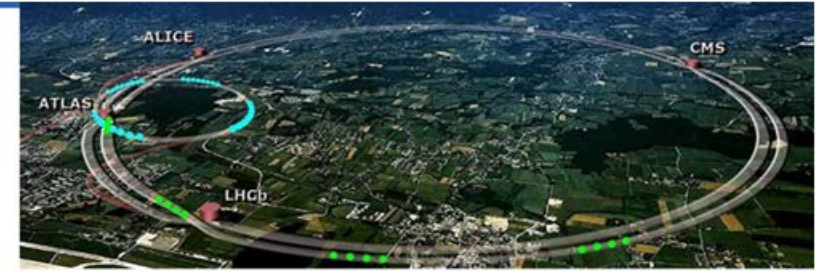
CHALLENGE: *R&D of software to acquire, manage, process and analyze large amounts of data to be recorded*



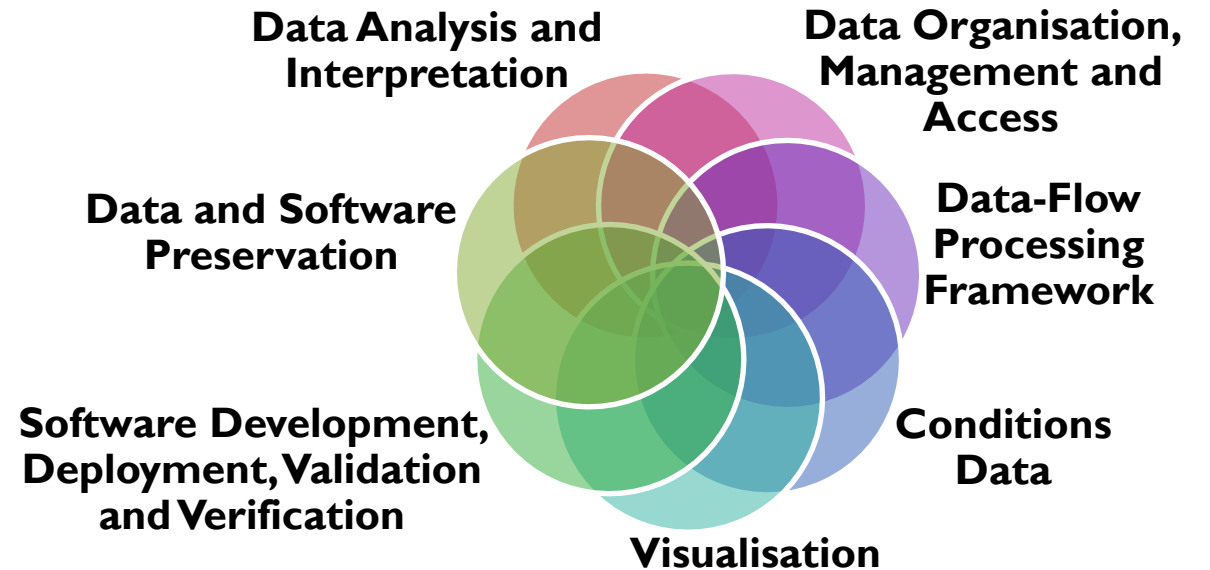
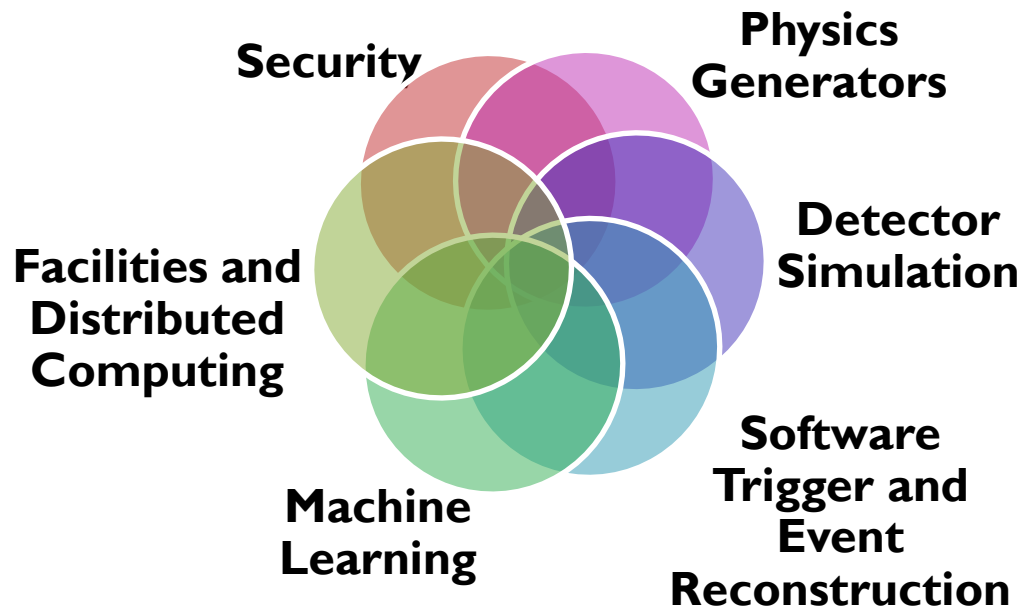
The annual data production follows the exponential law.



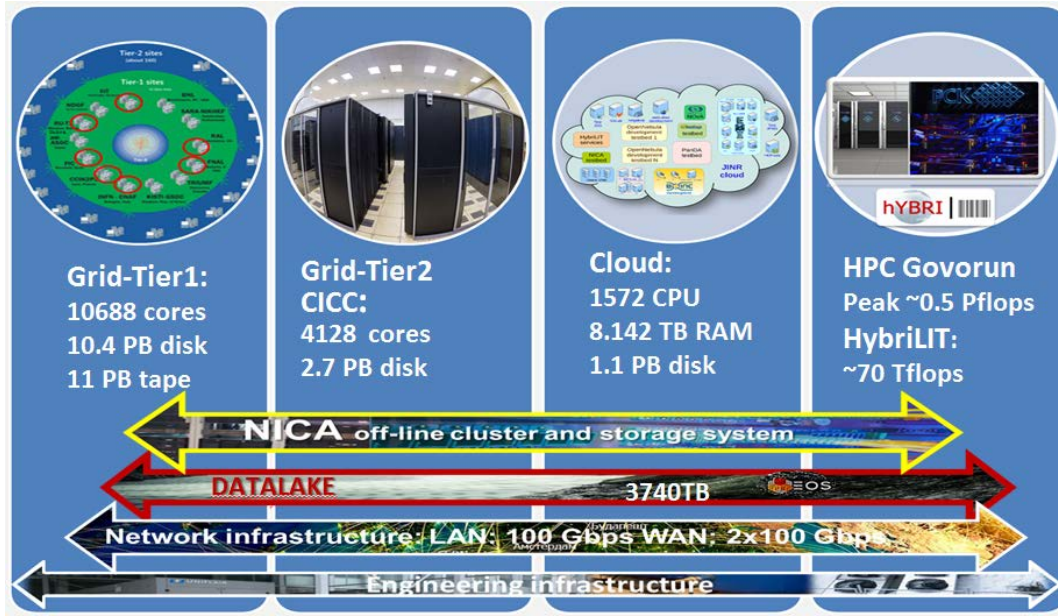
Square Kilometer Array radio telescope (SKA)
> 1 Eb/Year (estimation)



CERN Large Hadron Collider
> 20 Pb/Year, > 200 Pb stored

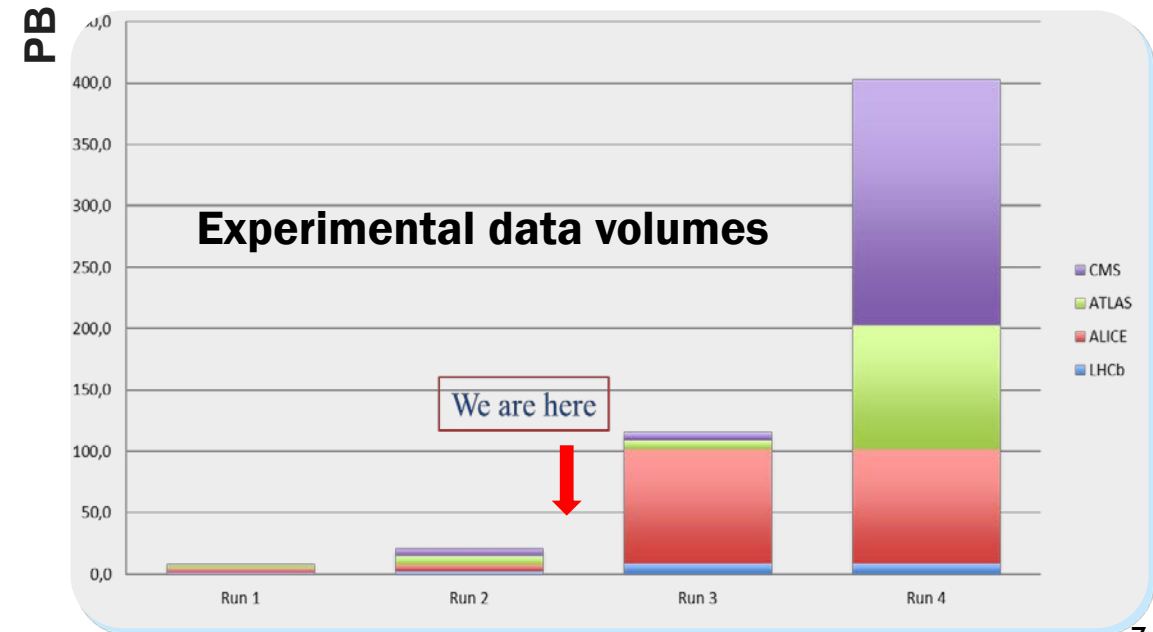
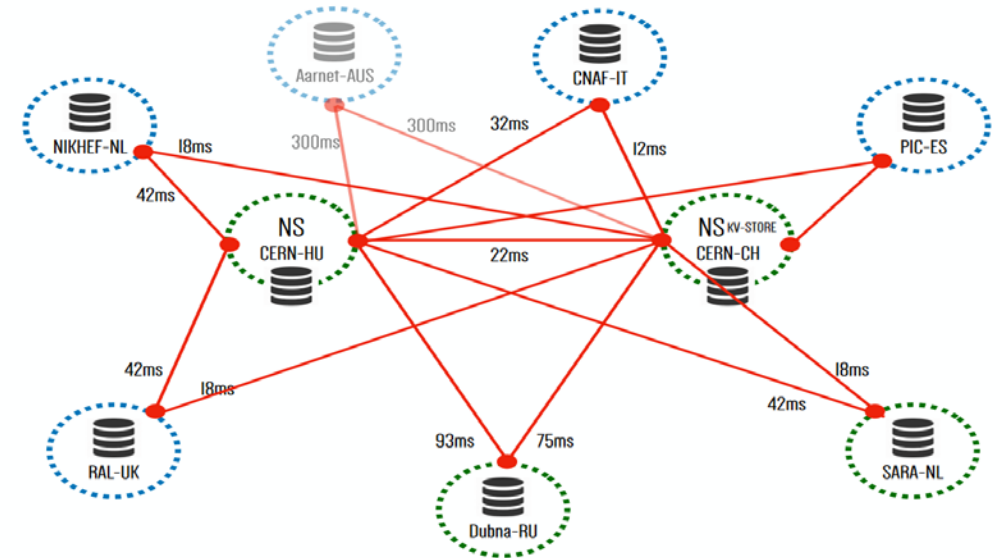


JINR DataLake

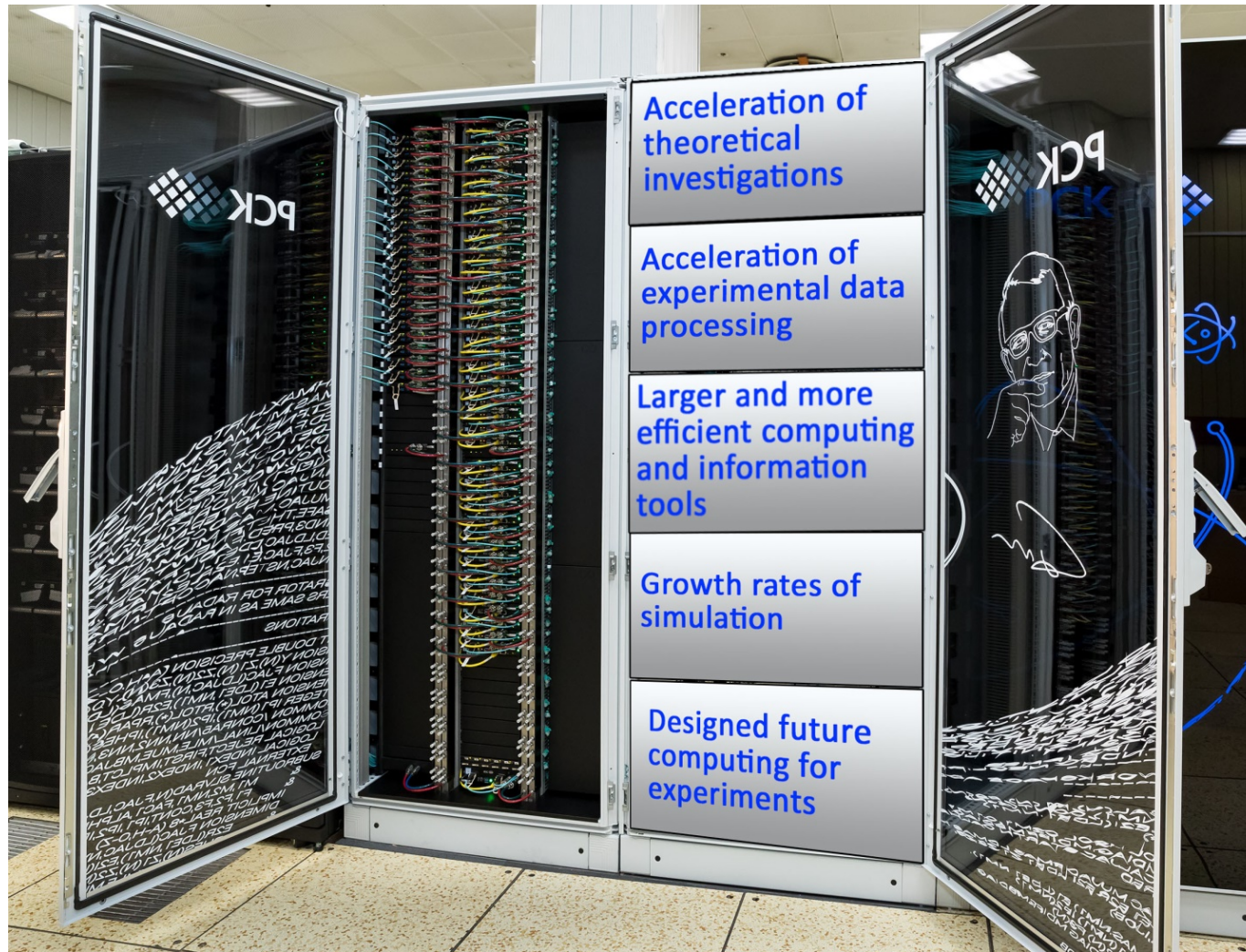


Multifunctional Information and Computing Complex

- DataLake deployed at JINR
- The new storage system successfully integrated into the MICC structure
- It shows great performance for storing and accessing big arrays of information.
- It can be applied for all the steps of data handling.



Extension of the HybriLIT heterogeneous platform including the “GOVORUN” supercomputer








- ❖ Unique heterogeneous and hyper-converged system (**500 Tflops** for double-precision operations)
- ❖ Multipurpose high-performance system with direct hot liquid cooling of all system components
- ❖ The most energy-efficient system in Russia (**PUE = 1,06**)
- ❖ First 100% hot liquid cooling of Intel® Omni-Path interconnect
- ❖ Record power density – up to **100 kW per 42U cabinet**

The total enlargement in the performance of CPU and GPU components will amount up to **90 TFlops** for double-precision operations per year.

Long-Term Concept of a Scientific IT-ecosystem at JINR

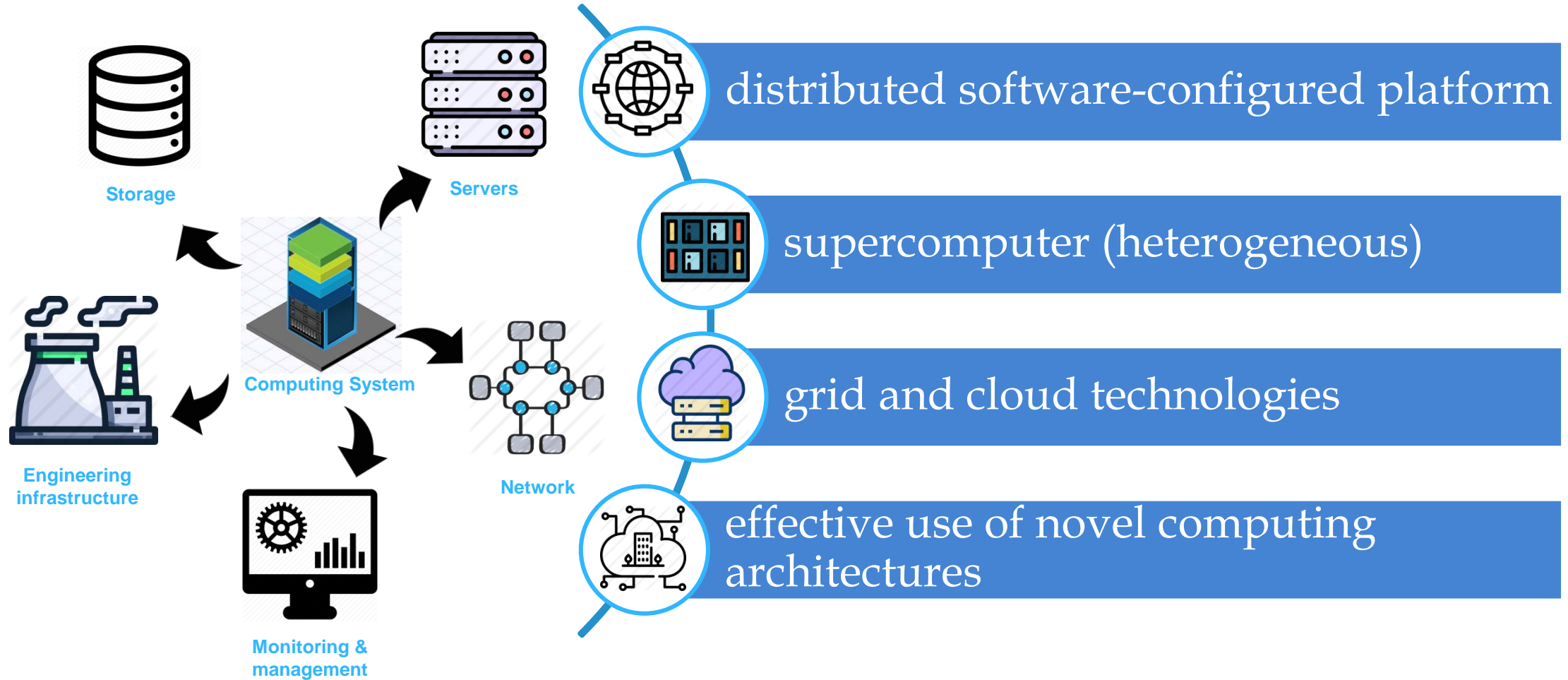
Telecommunication technologies



-  terabit networks
-  on-demand networks, networks of networks, software-defined networks, etc.
-  dynamic resource allocation network systems
-  networks enabling the large amount of data transfers
-  networks allowing distributed processing of the exabyte data volume.

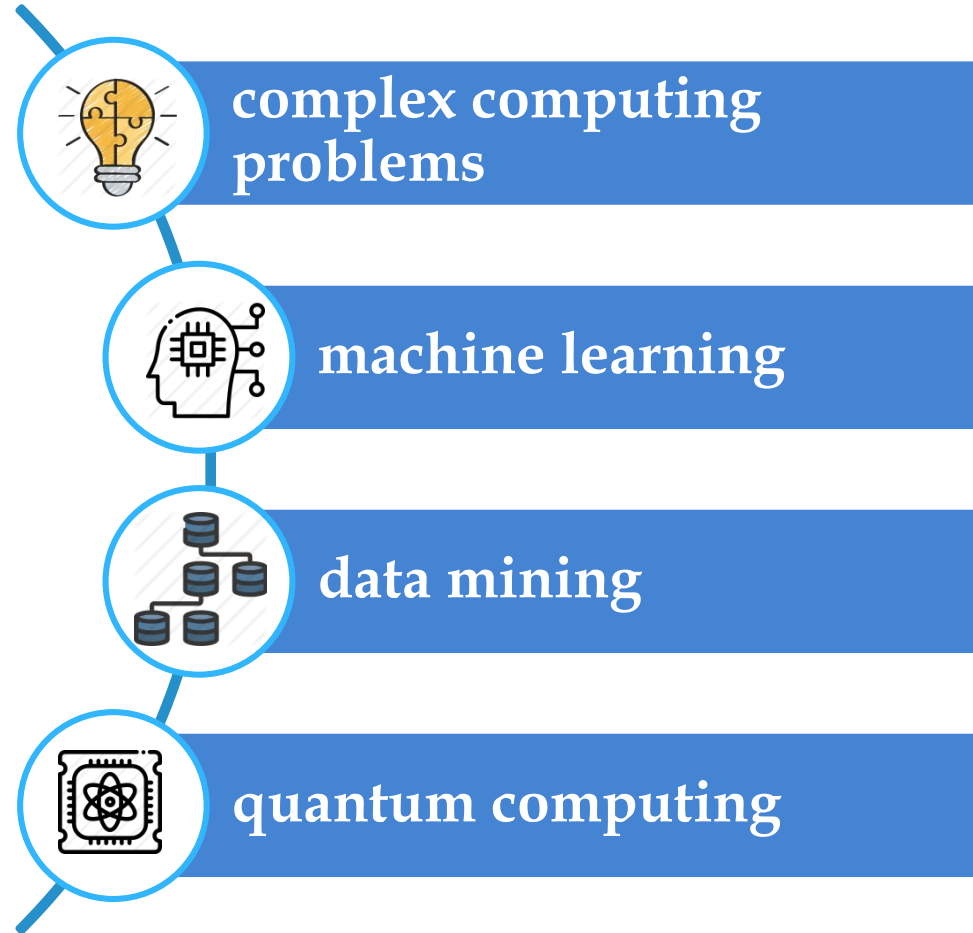
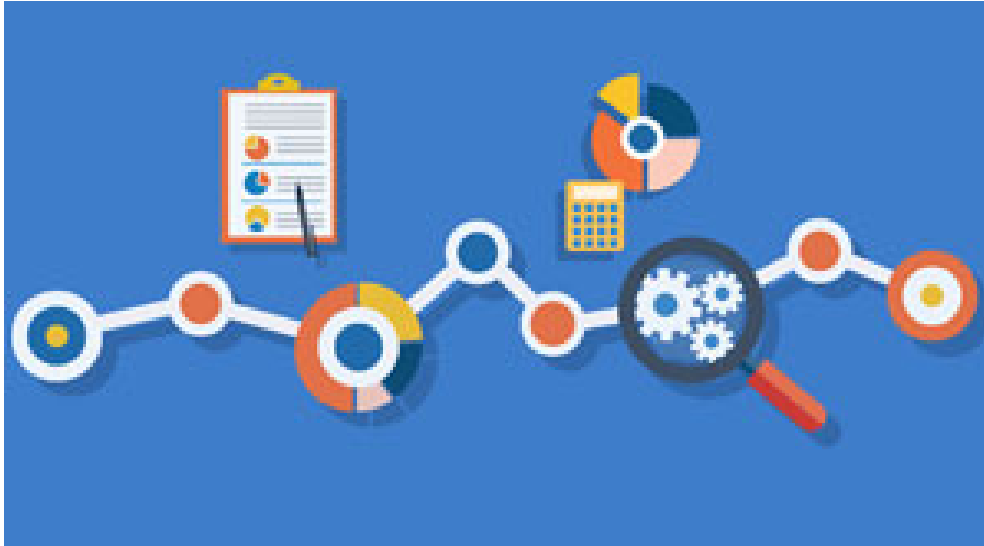
Long-Term Concept of a Scientific IT-ecosystem at JINR

Computing systems



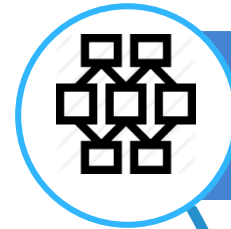
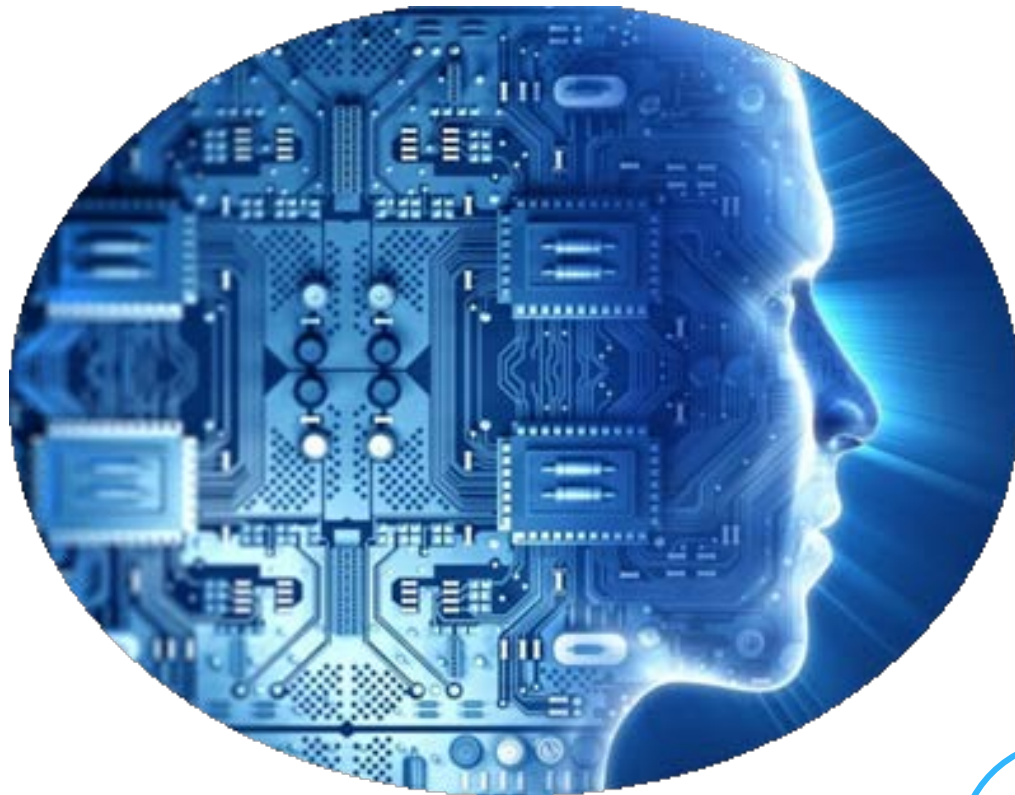
Long-Term Concept of a Scientific IT-ecosystem at JINR

Algorithms and software

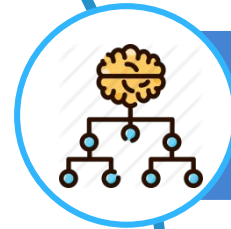


Long-Term Concept of a Scientific IT-ecosystem at JINR

Technologies of data processing and analysis



computing with the use of supercomputers



processing of multi-dimensional and hierarchical data of Exabyte volumes



Big Data analysis and processing



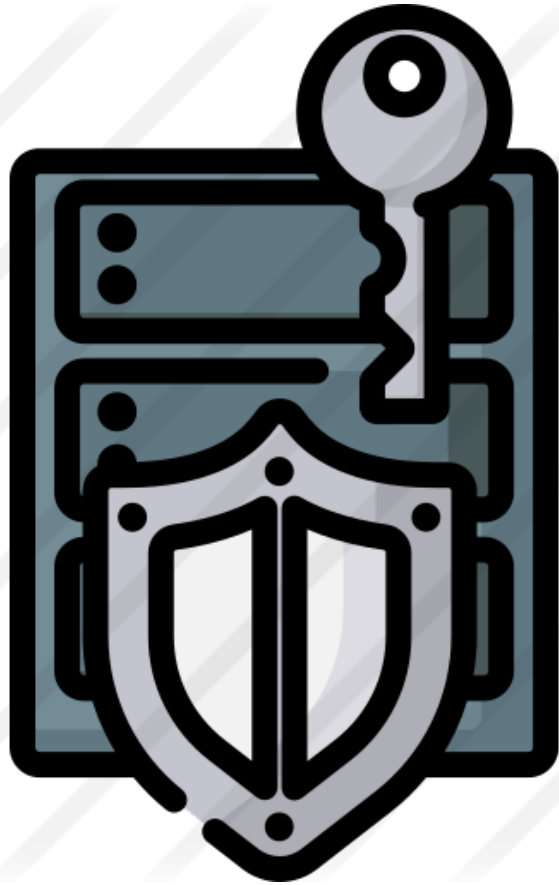
AI and robotics

SyMSim

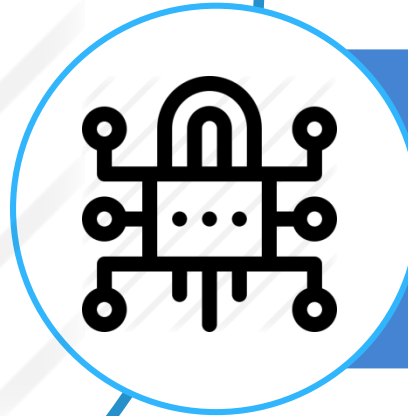
modeling of computing architectures and workflows

Long-Term Concept of a Scientific IT-ecosystem at JINR

Information security



new security paradigms including quantum cryptography and neurocognitive principles



novel and up-to-date tools and software systems for data and information protection

Development of the system for training and retraining IT-specialists

Training courses, tutorials and lectures

HybriLIT group
leading scientists from JINR and its
Member States

Leading manufacturers of
modern computing
architectures and software

Parallel
programming
technologies

OpenMP

MPI



Tools for debugging and
profiling of parallel
applications



Work with packages of applied
software

COMSOL
MULTIPHYSICS

ROOT
Data Analysis Framework



Wolfram
Mathematica

GEANT4
simulating particle physics

Maple

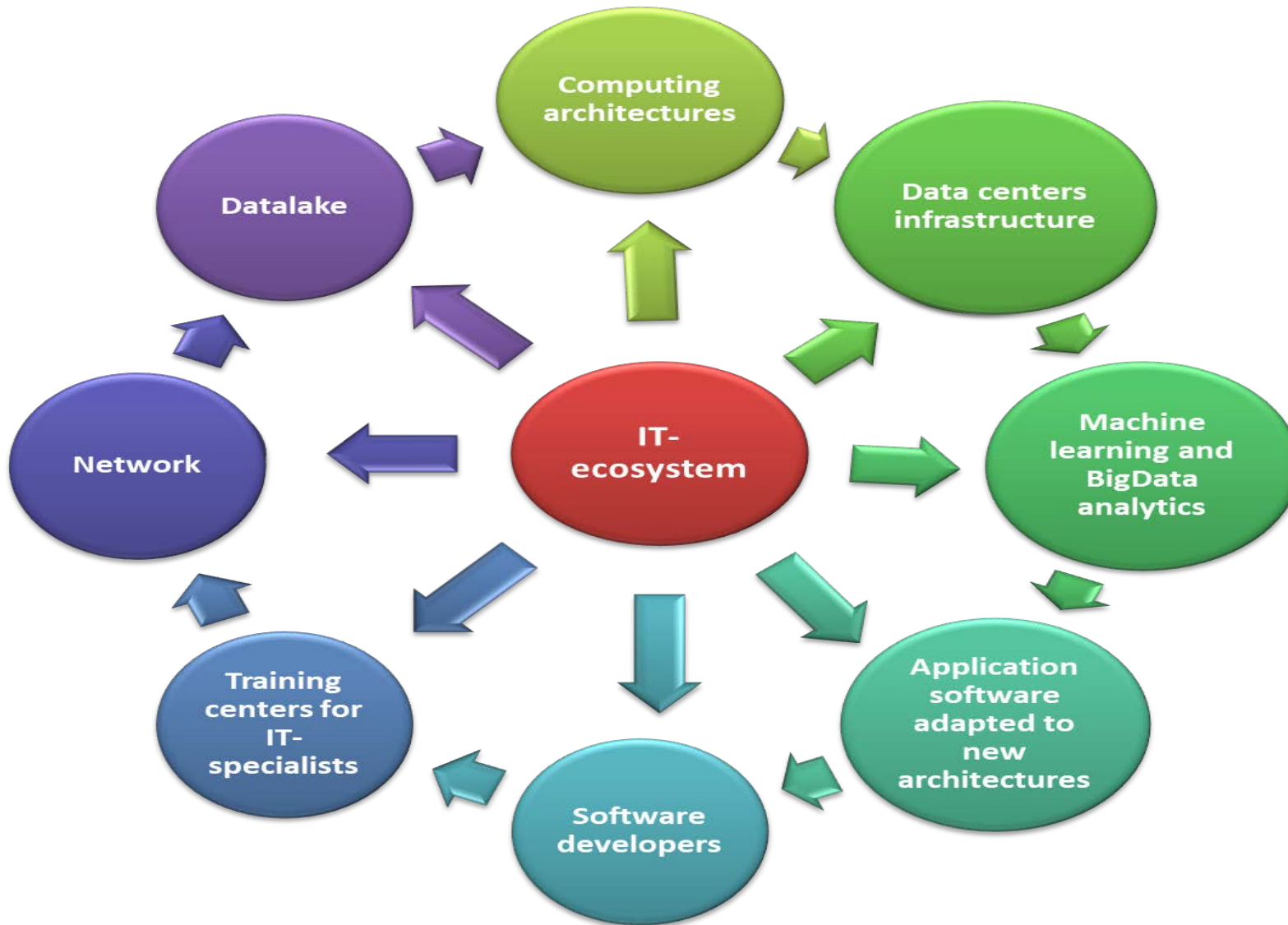
Frameworks and
tools for ML/DL
tasks



Training of the Institute staff, students and young scientists from the JINR Member States is carried out within :

- activities organized by the JINR University Centre;
- the framework of special courses from leading software developers;
- conferences and schools organized by JINR;
- international cooperation programs at JINR Member States institutes.

STRATEGIC LONG-TERM PLAN



AIM

Expandable worldwide dynamically evolving IT-ecosystem that combines a variety of technological solutions, state-of-art computing concepts and methodologies.

PURPOSES

Significantly reduce the time spent on the implementation of projects that require computing resources and IT expertise

BENEFICIARIES

JINR, its Member States and international collaborators