COMPUTING CHALLENGES OF SUPER C-TAU FACTORY

Ivan Logashenko

BINP/NSU

Super c-tau factory workshop, May 26-27, 2018

at Budker INP

Disclaimer

- Most of the numbers shown in the talk were estimated several years ago
- We estimate the numbers are realistic within factor 2
- Obviously, they have to be updated and refined. To do that, we have to refine detector and electronics design.

Expected data rate and volume

- Maximum trigger rate

  300 kHz
- Raw event size

  30-50 kB
- Total number of raw events recorded

  2×10^{12}
- Total volume of raw data

  60-100 PBytes

Hadronic decays			
	J/ψ	Ψ(2S)	Ψ(3770)
E, МэВ	3097	3686	3770
σ, нб	1400	370	≈6
f, кГц	**110**	34	0.6
Background processes			
Cosmics, kHz	≈2		
Hadrons, kHz	19	17	16
Bhabha, kHz	90	80	80

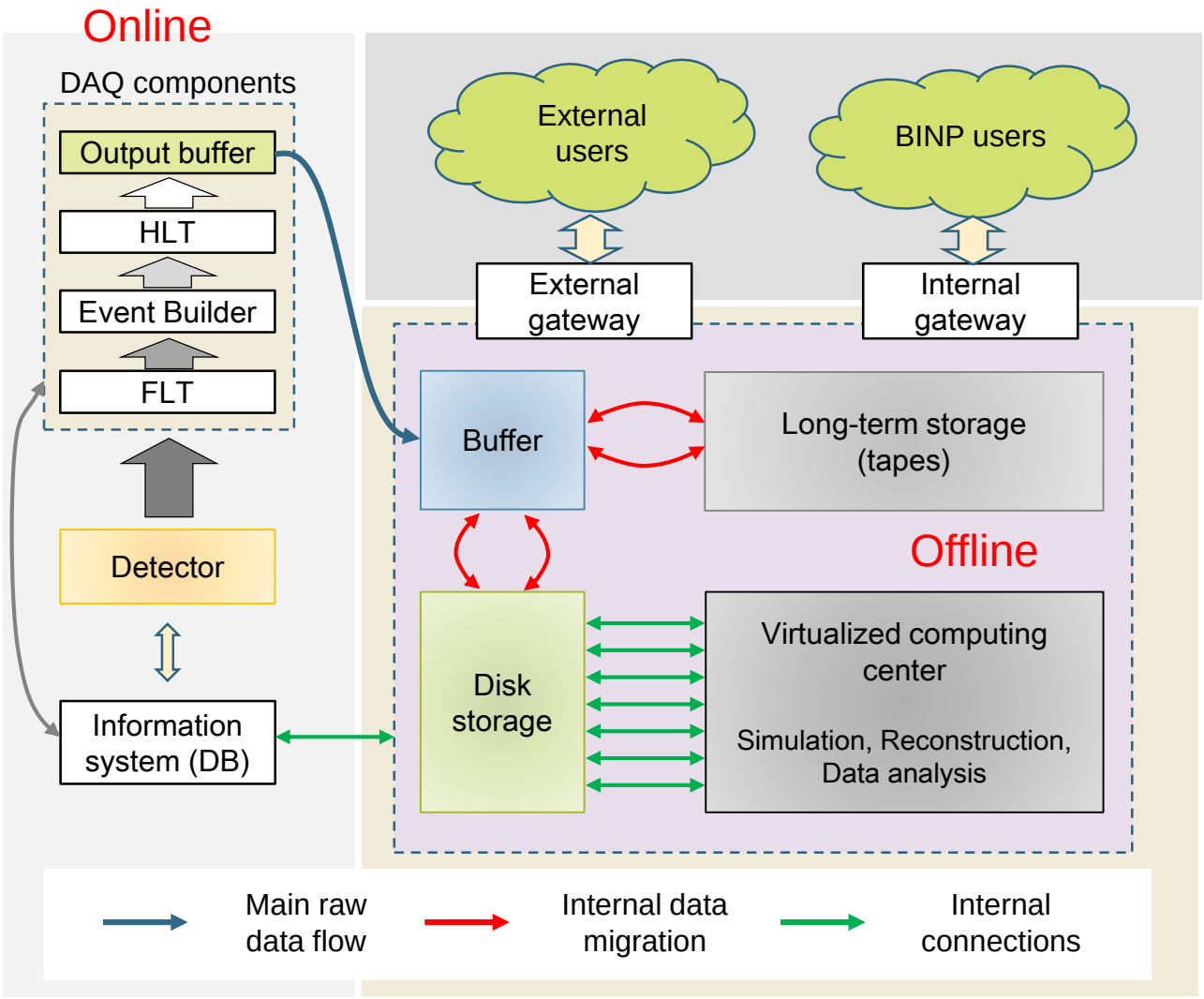
Expected trigger rates at full luminosity

Comparison with existing experiments

We can compare Super $c-\tau$ factory with other e^+e^- facilities: experiments at B-factories (BABAR, BELLE, BELLE-2) and at $c-\tau$ factory (BES-III)

	SCTF	BABAR	BELLE	BELLE-2	BES-III
Luminosity integral, 1/ab	**10**	0.5	1	50	~0.02
Number of events, 10^{10}	**200**	1			1
Event size, кБ	**30-50**	30	38	300	12
Raw data volume, PBytes	**60-100**	0.7	1	200	
Reconstructed data volume, PBytes	**10**	1	0.2	80	

General overview of IT infrastructure



Main parameters (requiremets)

Maximum input data rate:
10 GB/s

Total storage system capacitance
240 Pbytes (→300?)

Computing power
0.6 Pflops (→1?)
(1 MW) (→0.5MW)

Can be realized with commercial solutions

Major components of the local IT infrastructure

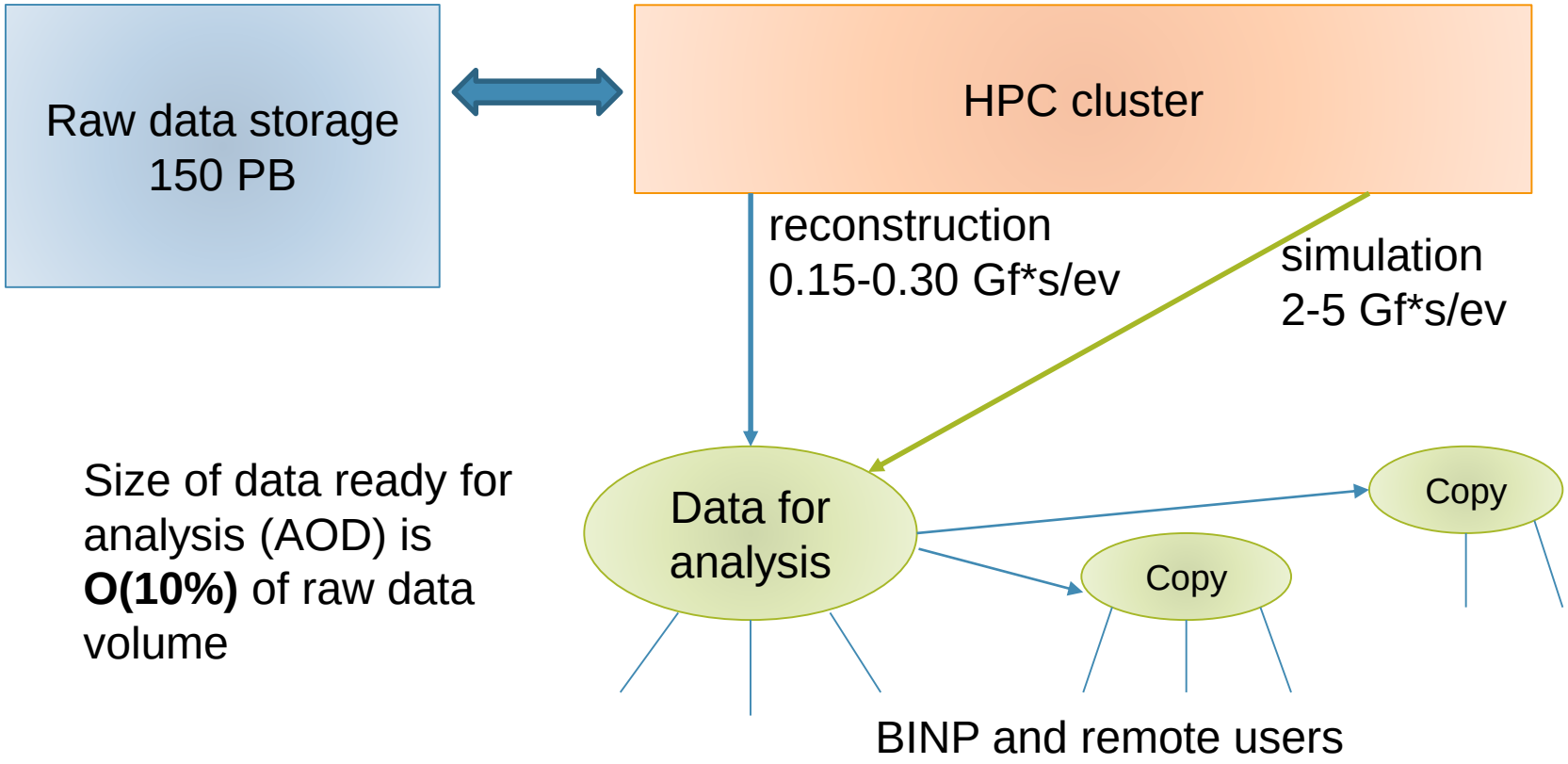
- Online computing farm
  - High level trigger
  - Connectivity to offline: 100-1000 Gb/s
  - Architecture to be determined (GP/GPU/FPGA/?)
- Offline computing farm
  - General purpose architecture
  - Virtualization
  - Computing power of ~0.6 Pflops (or higher)
  - Integrated with data storage system
- Data storage system
  - Has disk-based and tape-based sybsystems
  - Total capacity of 240 Pbytes (or larger)

Program infrastructure

Experiments at Super $c-\tau$ factory will adopt typical solutions (de facto standards), used in other high energy physics experiments:

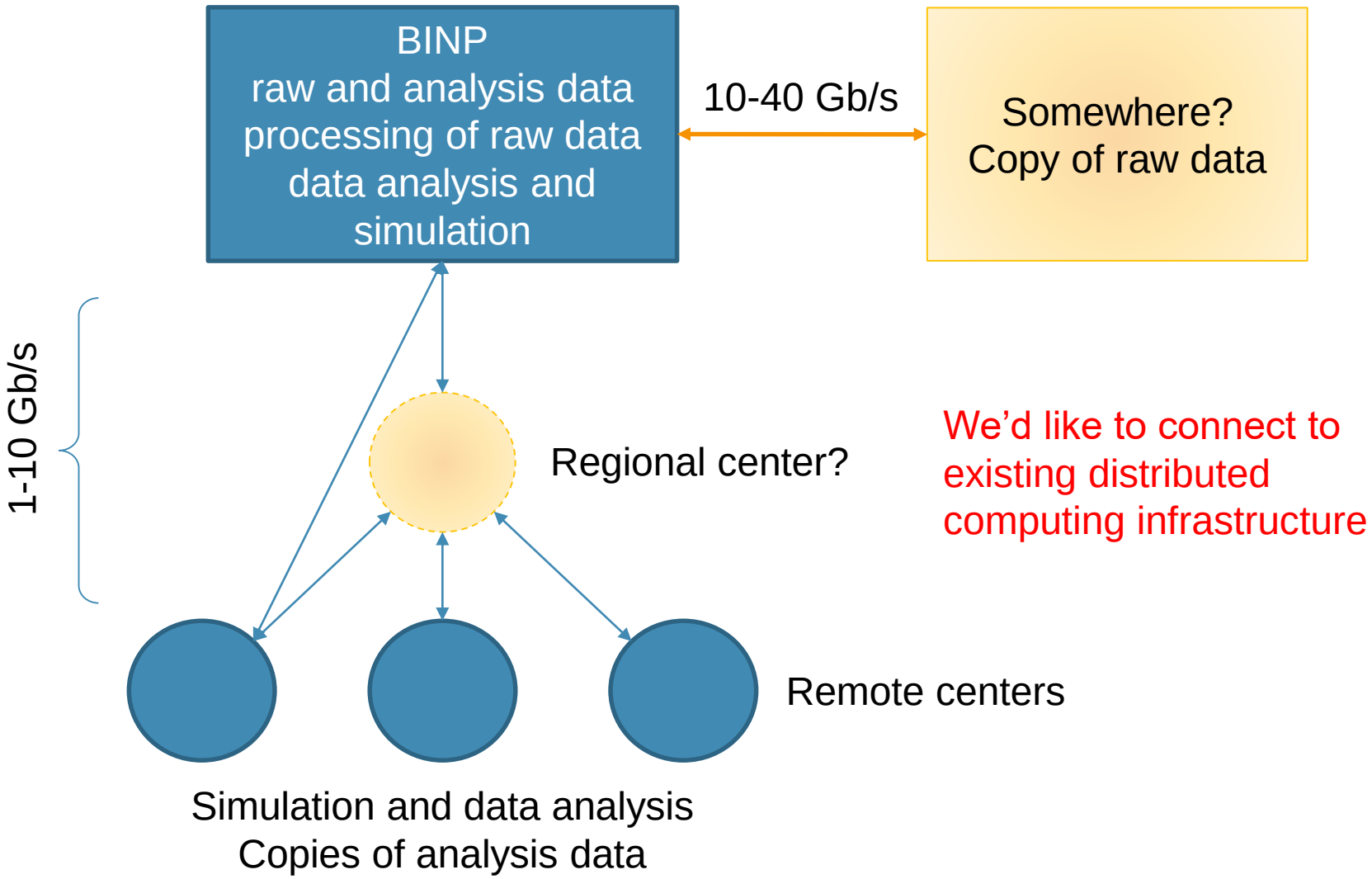
- LINUX operation system
- Virtualized infrastructure
- Tools for collaborative software development (version control, continuous integration,…)
- Modular software framework (GAUDI, ART,…)
- Simulation is GEANT4-based
- Data analysis using ROOT and popular non-HEP tools (R, TensorFlow,…)
- Middleware for distributed data analysis (DDM, PANDA, AGIS,…)
- …

Typical scenario



- Raw data volume is much larger than analysis data volume
- Computing power is mostly used for simulation

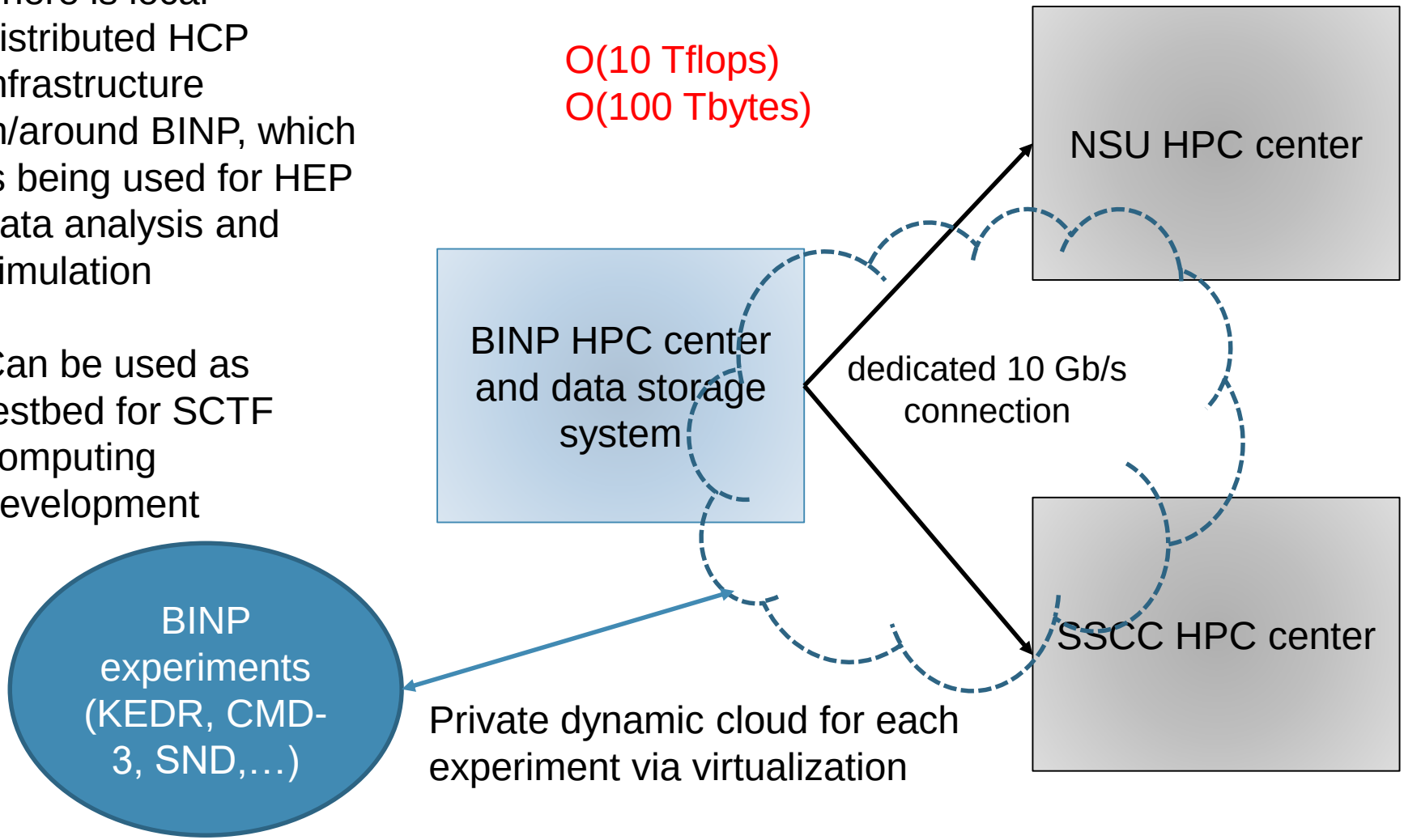
Distributed computing model



Existing computing infrastructure

There is local distributed HCP infrastructure in/around BINP, which is being used for HEP data analysis and simulation

Can be used as testbed for SCTF computing development



Tier 0

- There are government plans to invest to Akademgorodok infrastructure
- There are proposals to establish national data analysis and storage center in Akademgorodok with capacity few times of SCTF requirements
- If these proposals will go forward, Tier 0 of SCTF can be organized as a part of such center
- Otherwise we'll have to establish dedicated SCTF center

There are no technical challenges to build data analysis and storage center of required capacity

Very preliminary implementation plan

- Now our focus is the development of the software infrastructure
  - **ROOT**, **Geant4**, **Gaudi** framework, **DD4HEP** for detector description, **HepMC3** for event generation, **PODIO** for data model, **git**, **cmake**,…
  - Goal is to have full scale software environment for detailed detector simulation and data reconstruction
- Next step will be development of the distributed computing infrastructure for simulation and reconstruction
  - Build on existing resources (including remote) with scalability in mind
- As the financial resources become available, build a data center for SCTF in few steps

Conclusion

- For experiments at Super $c-\tau$ factory a local computing infrastructure is required with the following tentative requirements: 600-1000 Tflops, 200-300 Pbytes.
  - There are centers like that in the world, and even in Russia
  - Right now we have O(1%) of computing power and O(0.1%) of storage capacity
- The simulation and data analysis can be effectively done at remote centers – possibility for collaboration
- The focus now is the development of simulation/reconstruction software and middleware for distributed computing