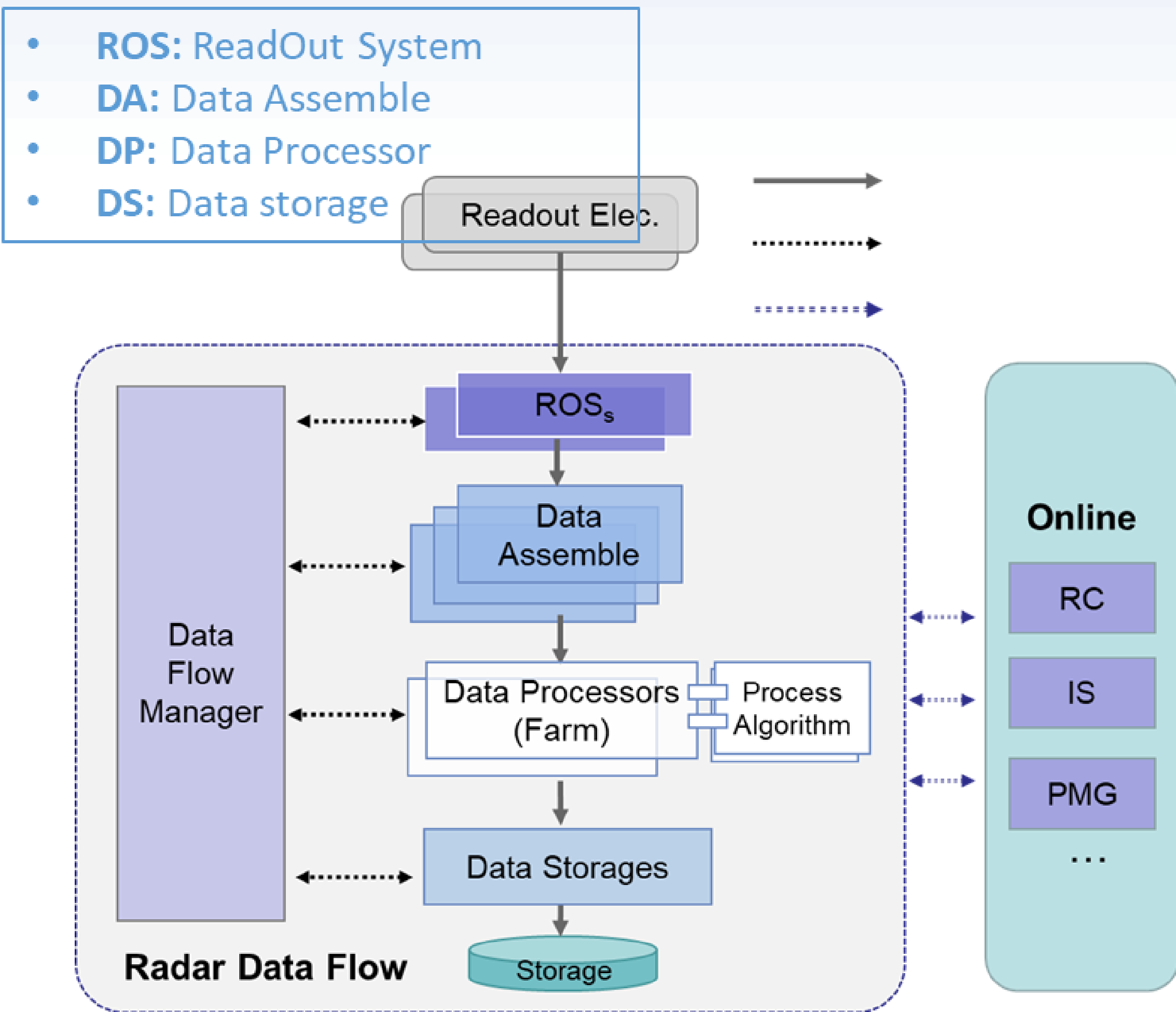


1. Introduction



- **Radar** (heterogeneous Architecture of Data Acquisition and processing) is a software framework for high energy physics experiment data acquisition and online processing.
- The LHAASO DAQ and JUNO DAQ systems are developed based on RadarV1.0 and RadarV2.0, respectively.

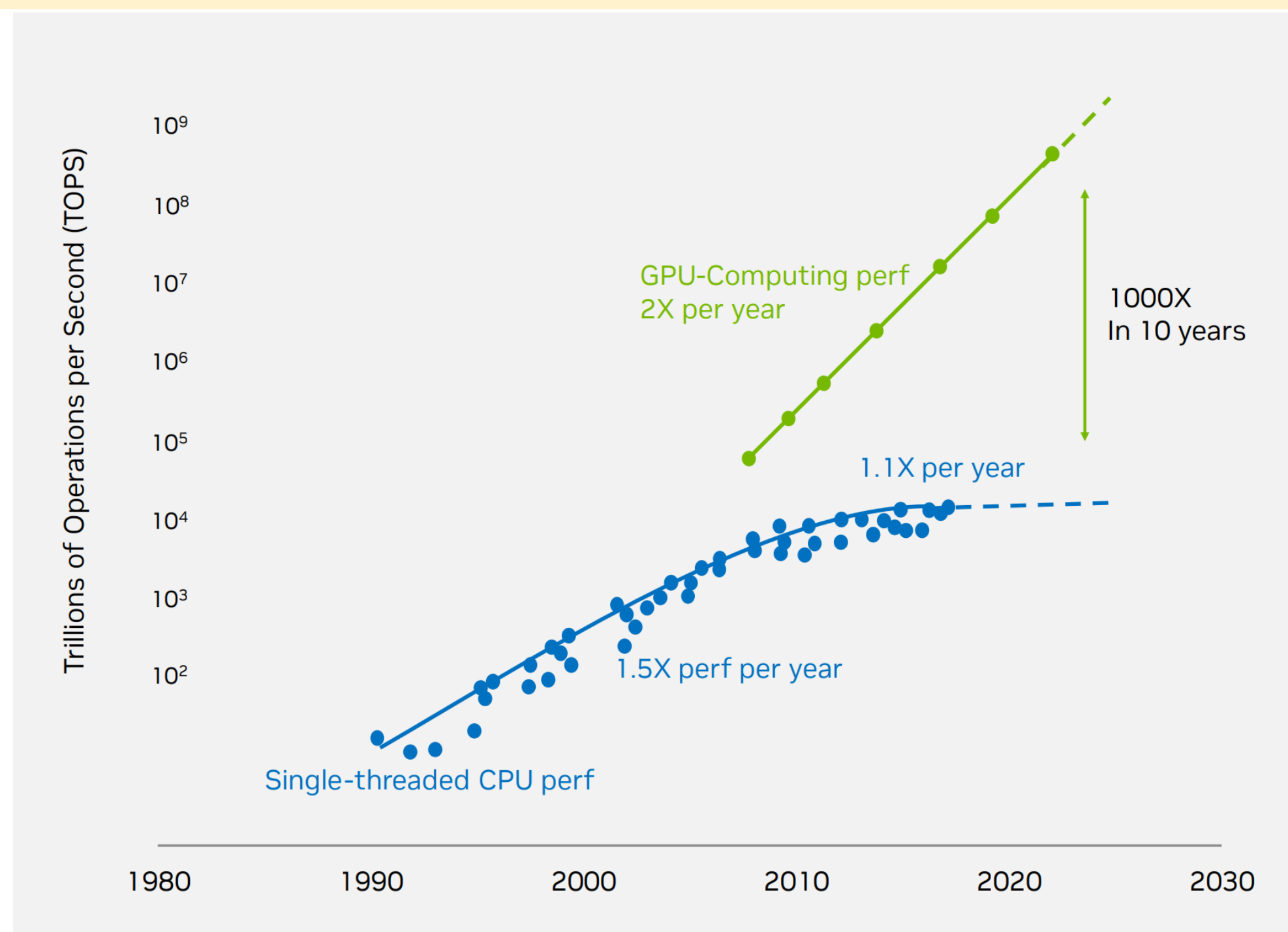
2. Motivation

Resource consumption of JUNO

ROS Total CPU (cores)	DA Total CPU (cores)	DP Total CPU (cores)	DS Total CPU (cores)
1165 cores	47 cores	1026 cores	0.3 cores
ROS Total Memory	DA Total Memory	DP Total Memory	DS Total Memory
566 GiB	55 GiB	1632 GiB	2 GiB

~70 Server Nodes, ~2000 valid CPU cores, for 40GB/s data.

Assuming that JUNO's data rate is 2 TB/s, the number of nodes used at this point goes up to 3500. We predict that CEPC will also use thousands of servers if it reuses RadarV2.0.

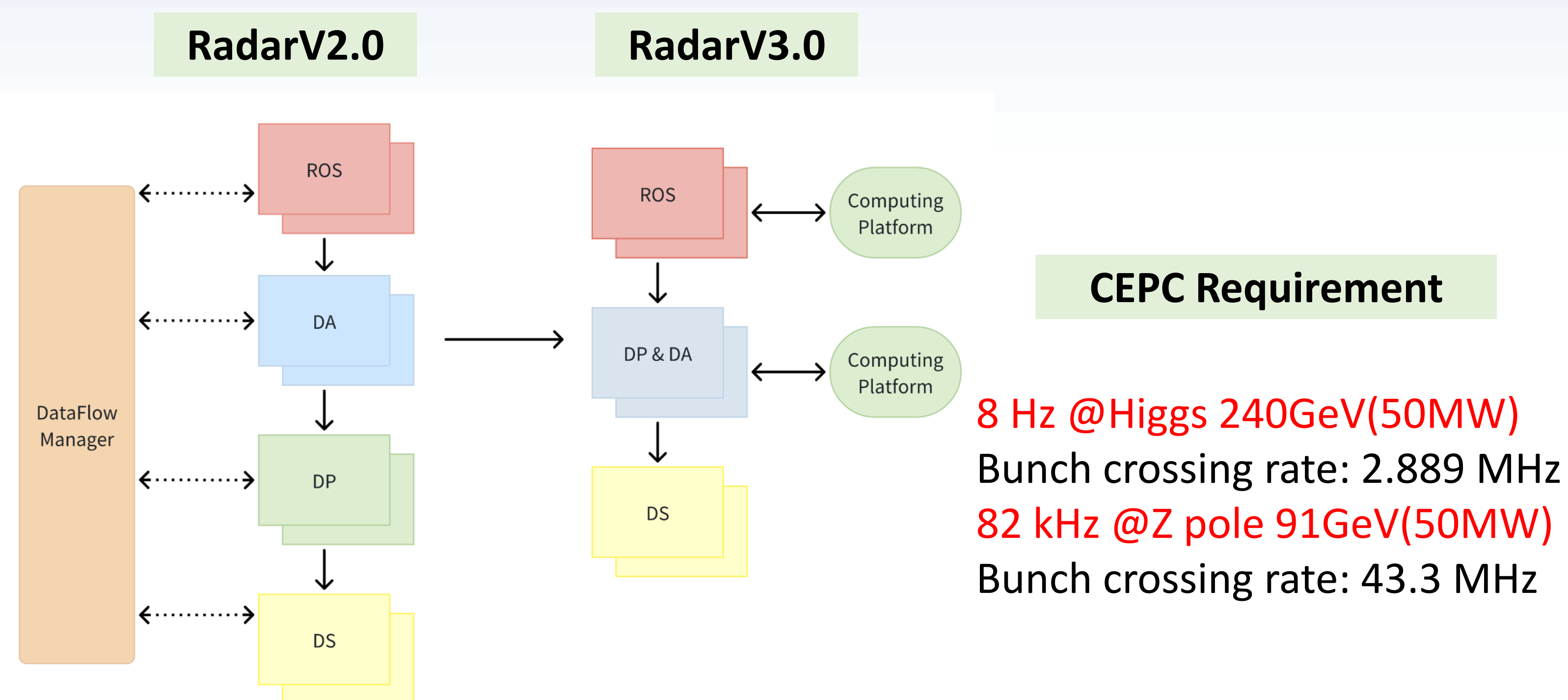


Ref: NVIDIA Investor Presentation. October 2022

Applying GPUs to improve computational performance on a single node.

- **GPUs have good potential.**
GPU computing performance has increased 1000 times in the last 10 years.
- **GPUs can accelerate CEPC-related processing.**
For example: Track reconstruction.

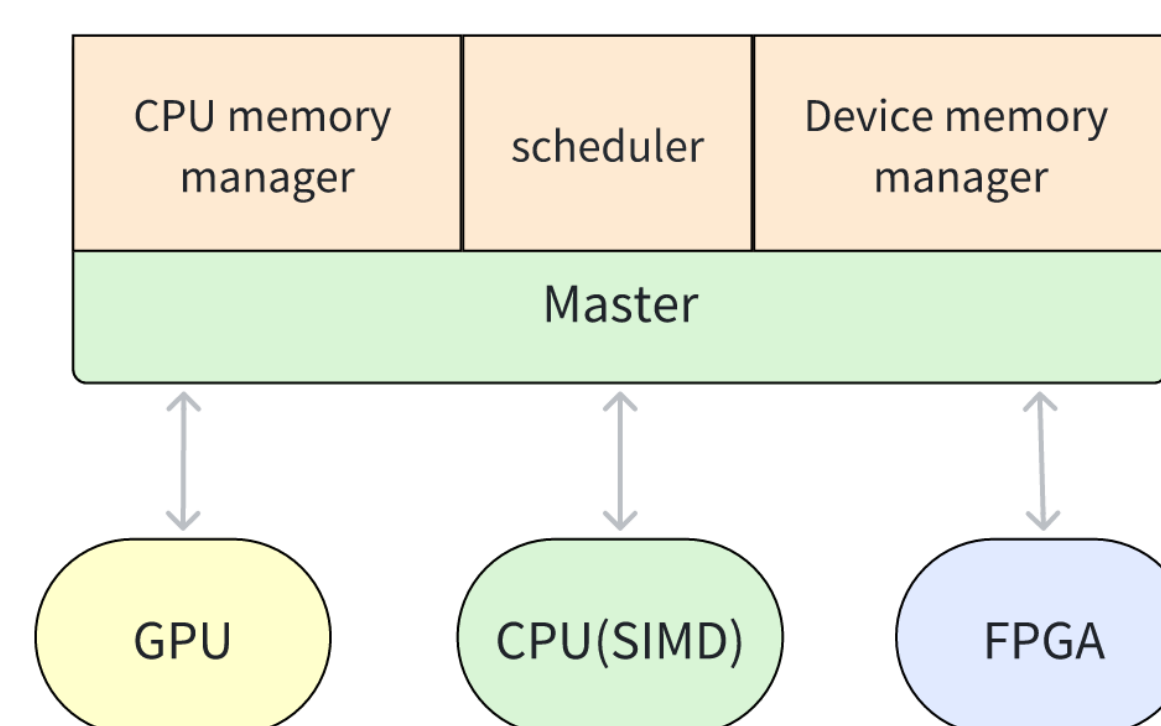
3. Architecture Design



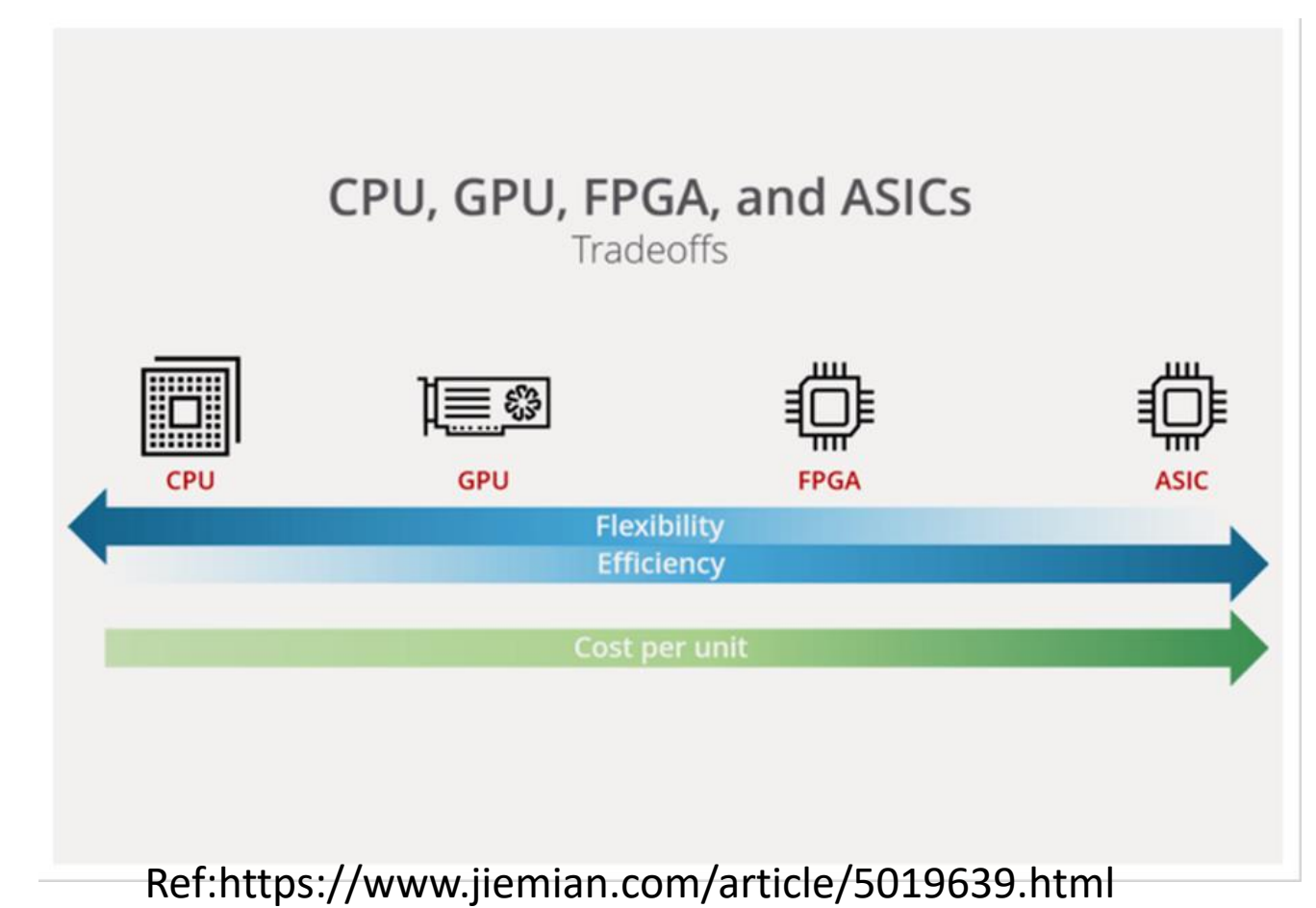
CEPC has higher data rate, so RadarV3.0:

- Remove the DFM to increase the frequency of dispatch.
- Merge DA and DP reduces data transfer.
- Build **heterogeneous computing platform** to improve computing performance.

FPGA/GPU Computing Platform



Select device based on task



Ref: <https://www.jiemian.com/article/5019639.html>

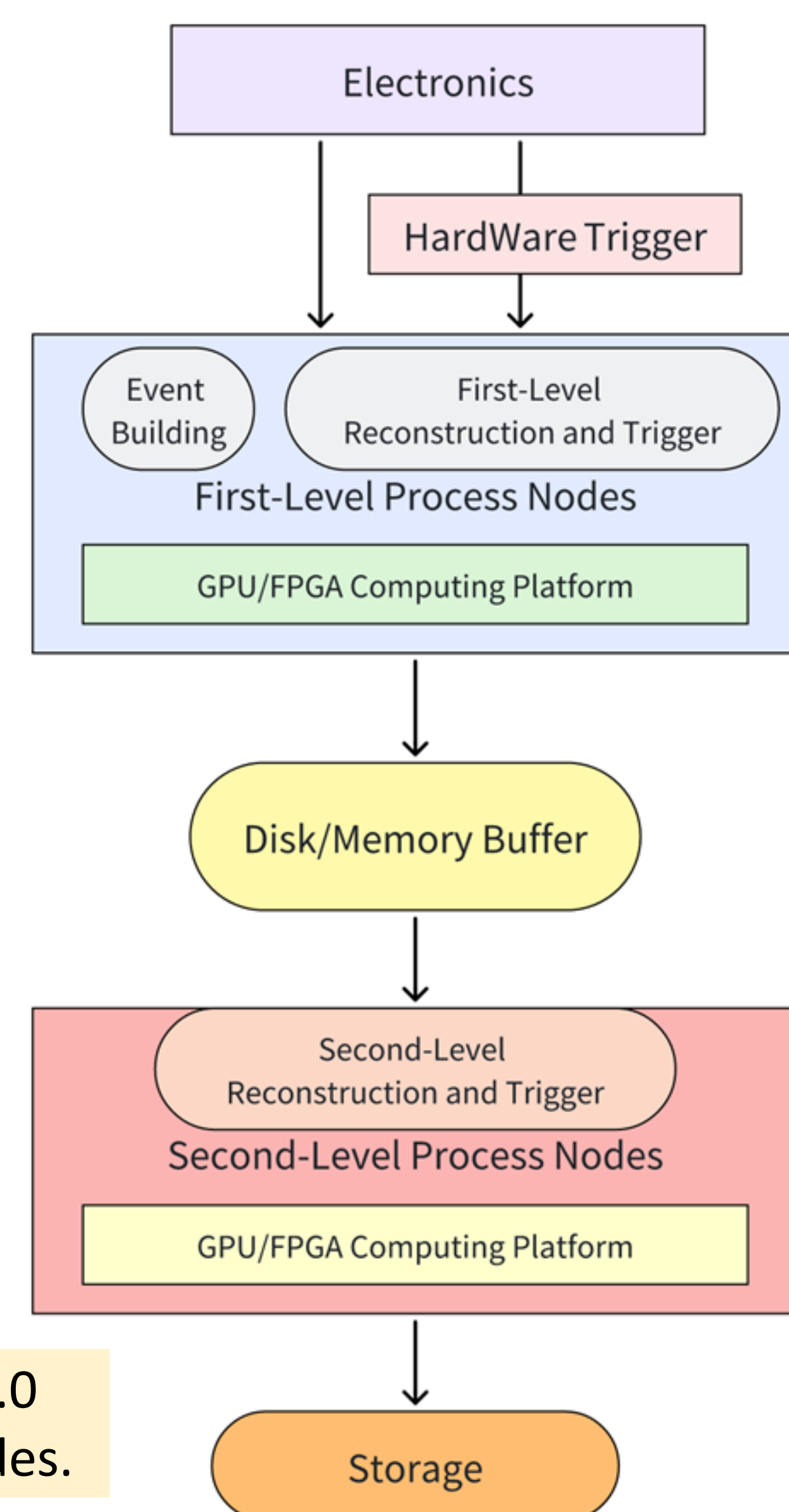
- **Scheduler:** Assign algorithms to different devices and manage data transfer.
- **CPU Memory Manager:** Organize parallel computing data structures.
- **Device Memory Manager:** Manage device memory for reducing data transfer.

4. Application Scenario

CEPC Requirement for TDAQ

Event Type	Data rate	Storage rate
Higgs	< TB/s	< 200 MB/s
Z	Several TB/s	< 200 GB/s

CEPC TDAQ System Architecture



The CEPC online framework is divided into:

- ❑ Two levels of nodes:
- ❑ The buffer that link them.

- **First-Level Process Nodes:** Event building and fast Reconstruction.
- **Second-Level Process Nodes:** Full Reconstruction.
- **Buffer:**
 1. Buffer data for calibration.
 2. Isolate software on different level nodes.

As an online computing framework, RadarV3.0 will be implemented on level1 and level2 nodes.

5. Conclusion

- For CEPC TDAQ, RadarV2.0 has the prospect of optimization.
- We are conducting research on heterogeneous computing and developing a high throughput and high bandwidth online heterogeneous computing framework RadarV3.0 for CEPC.