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Upgrade of the KEDR detector DAQ system and beyond

The KEDR experiment is ongoing at the VEPP-4M e^+e^- collider at Budker
INP in Novosibirsk. The collider center of mass energy range covers
a wide spectrum from 2 to 11 GeV. Most of the up-to-date statistics were
taken at the lower end of the energy range around the charmonia region.
Activities at greater energies up to the bottomonia lead to
a significant increase of event recording rates and accelerator backgrounds,
thus stressing the existing DAQ and trigger systems beyond their
limits, so its upgrade was required.

The data acquisition system hardware consists of three types of devices: digitizers,
readout processors (RP) which transfers data from digitizers to DAQ computing cluster and
sinchronization and control modules (SCM), which accept signals from trigger, enumerate events
and distribute commands and reference frequency to readout processors (and from them to digitizers).

The DAQ computing cluster is composed of several similar computers, running the same specially developed software,
interacting with each other. It receives data from readout processors via DAQ network, process them according to hardware configuration
and builds the events from the fragments transmitted by each RP.

The data acquisition system software covers a full set of management and control tasks,
such as hardware management and diagnostics, network diagnostics, management of the software services
and the data acquisition itself.
It logically binds all hardware components together.
The software takes care of the hardware configuration, monitoring and failover.
For example, coordination service at initialization phase determines number of required event building services its configuration and
placement according to hardware description and available computing resouces.
Then at data recording time monitors and maintains the availability of the required services, starts and stops
them on request.

The system is scalable horizontally by design, provides high level of parallelization of data transfers and events
processing, have improved reliability based on readout computing cluster with redundancy.

Wide features range in hardware and flexibility of the software gives opportunity to use this.
data acquisition system for other experiments. For example, the described DAQ system is considered as a prototype
of the projected BINP Super Charm-Tau Factory or other future BINP HEP experiments.

Significance

Distributed data acquisition system with automatic load balancing and self healing capabilities.

References

Experiment context, if any

KEDR (https://kedr.inp.nsk.su/), SCTF (https://sct.inp.nsk.su/)

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