Data Transmission and Online Processing in the KASCADE Data Acquisition System

H. Schieler[a], J.R. Hörandel[a], H.-J. Mathes[a], D. Mühlenberg[a], T. Wiegert[a], K. Bekk[a], D. Bormann[b], H. Keim[a], H.-W. Klein[b], M. Kretschmer[a], H. Leich[c], U. Raidt[a,d], U. Schwendicke[c], P. Wegner[c], J. Wentz[a]
[a]Forschungszentrum Karlsruhe, IK, D-76021 Karlsruhe, Germany
[b]Forschungszentrum Karlsruhe, HPE, D-76021 Karlsruhe, Germany
[c]DESY-Zeuthen, D-15738 Zeuthen, Germany
[d]Universität Tübingen, D-72076 Tübingen, Germany

Fig. 1 shows the Extensive Air Shower Experiment KASCADE at the laboratory site of the *Forschungszentrum Karlsruhe*. More than 170 *transputers* form the data network of KASCADE (Fig. 3), using the fast serial transputer links, partly via fiberoptic cables. They connect the various local, VME-based frontend electronics systems via Ethernet gateways (*B300*) with the central UNIX workstation. The *central KASCADE-Eventbuilder* (Fig. 2) correlates data from all parts of the experiment – *16 Array-Clusters [Fig. 4,5,6], Triggerplane, Topcluster [Fig. 7], Muonchambers (MWPCs) [Fig. 8], Calorimeter [Fig. 9,10,11,12], Muontunnel (streamer tubes)* – by means of a common clock (5-MHz Time Labels).

Fig. 1:

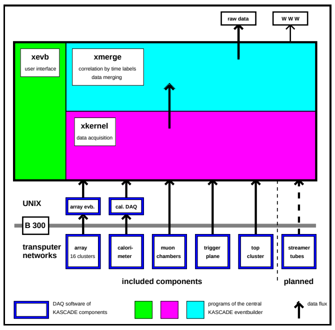

Fig. 2:

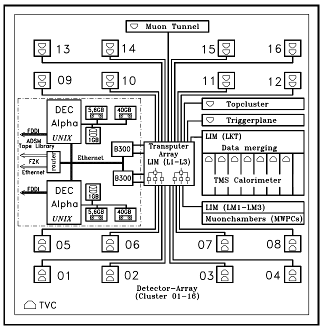

Fig. 3:

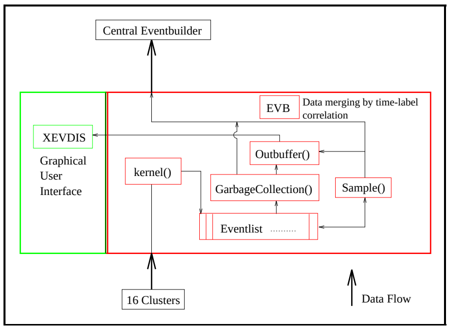

Fig. 4: Scheme of the *Array*-Eventbuilder *EVB* with its display- and control-program *XEVDIS* showing the main functions involved in the data flow.

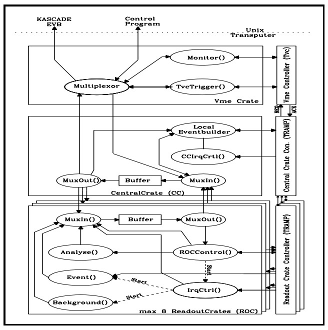

Fig. 7: Processes on the transputer chains for the *Triggerplane* and *Topcluster* DAQ branch. Synchronization between the data taking processes is done by message passing.

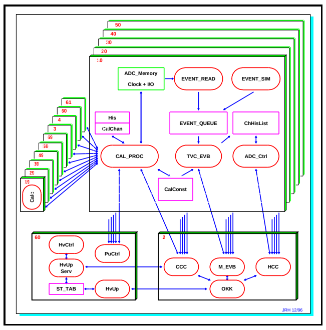

Fig. 9: The processes for DAQ, eventbuilder and detector monitoring of the *Calorimeter*. Calculations, like fits on measured data, are done in parallel by several processors.

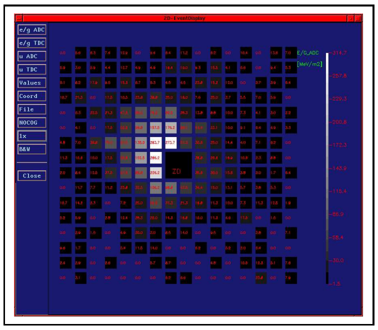

Fig. 5: 2D-Online-Eventdisplay showing calibrated ADC values ($[MeV/m^2]$) of the detectors in the *Array*. The shower core is located near the central detector building.

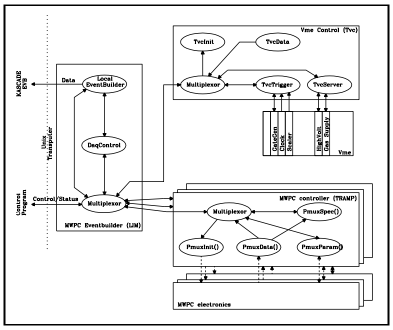

Fig. 8: Process layout of the *MWPC*-DAQ branch and their interaction with the readout hardware. All non DAQ relevant processes are implemented according to the C/S model.

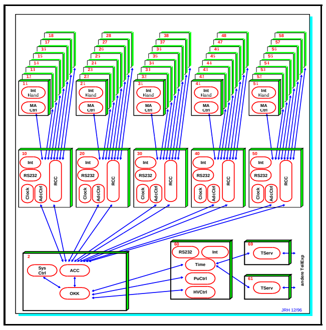

Fig. 10: The processes for the *Calorimeter* electronics control. Commands are executed hierarchically in different layers.

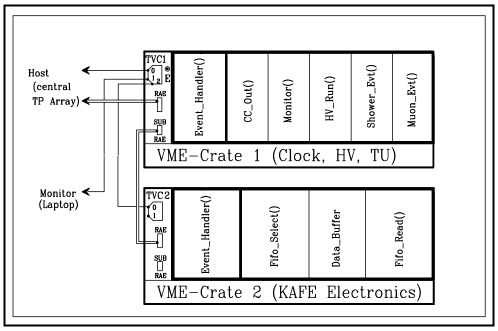

Fig. 6: The main parallel processes running on the two transputers of the local DAQ in each of the 16 *Array-Clusters*. Shower-Interrupts are served within 30 μs (dead time) and fully processed after $\simeq$ 5 ms. The total uncorrelated event rate is 20–30 kHz/*Cluster*.

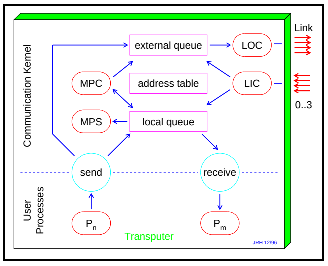

Fig. 11: The Communication Kernel on each transputer of the *Calorimeter* network.

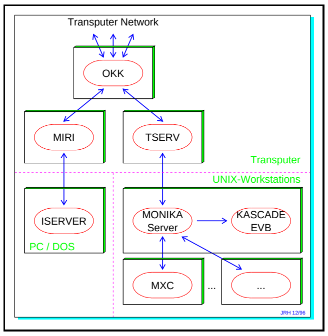

Fig. 12: Up to 50 user interfaces can be connected to the *Calorimeter* transputer network via a BSD-socket based UNIX server.