6 Slow control

The slow control system of H1 [49] is designed to take care of all parameters of the experiment which would be constant in an ideal world. Except for central control and monitoring of all VME crates, all subdetectors described above are equipped with a slow control system of their own. All systems use VME crates controlled by Macintosh or OS-9 computers and some of them use a VME-controlled multichannel slow control system developed at H1 [50]. The integration of subsystems is achieved in two ways, a simple hardware alarm system and a computer control network (CCN). A combined database is used for maintenance of static data and storage of measurements.

Throughout the slow control system we use the notions of slow channel (SC) and slow event (SE) [51]. A slow channel is a single measurable quantity of a single signal type of a single physical channel (e.g. a real setting of a high voltage power supply channel, or the value loaded into this channel). Each SC is uniquely identified by its code (ID). All slow channels are first initialized by their subsystem computer according to the central database. A microevent occurs when a significantly new result is obtained from the measurement on a SC. Microevents are accumulated in their slow event buffer until the status of some SC has changed, the time allowed for a SE accumulation has expired, the command to send a SE was received or the maximum number of microevents within a SE has been reached. As a result of any of the above conditions (SE triggers) a slow event is sent to the central slow control computer.

We use a relational database management system for the maintenance of slow control data. We use the structured query language (ANSI SQL) for the purpose of data integrity, control of access and commitment, and for queries. The complete history of the databases is kept. Any set of reports from queries can be automatically formatted into H1 standard records suitable for production programs. Slow events are stored in two standard files. The slow event archive file uses keyed access to SEs. Both of these history files are zero-suppressed in the sense of microevent definition. We have a good interactive access to slow control data stored on the mainframe IBM computer. A menu tree can be used to guide casual users. Remote access to all databases and history files is made transparent by a TCP/IP database server.

The control network consists of subsystem control computers (Macintosh and OS-9) attached to different detector parts (Figure 19). They are connected via Ethernet (TCP/IP). CCN is used to monitor all parameters of H1. All slow control computers produce SEs and transfer them to the central slow control (CSC) computer. The CSC computer provides data for the online display of the detector status [52] running on Macintosh computers. SEs are also injected into main data acquisition event data stream. On the mainframe IBM computer they are copied to the history files. The CSC computer itself monitors some 200 VME-crates and other devices not linked to a particular subdetector.

Hardware alarms do not depend on computers. Only hardwired combinatorial logic is involved to handle critical situations immediately (e.g. to switch off high voltage power supplies). The central logic [53] uses open/close switch signals. It is connected to the experiment via a routing array which makes it possible to receive input from or deliver output to any location within H1. The central logic drives an alarm signalization panel in the control room and provides status flags read out by the data acquisition and included into the event data.

In summary, the hardware alarm system presently monitors some 170 signals. It works reliably and can readily accommodate new input or output anywhere within the whole experiment. The only change foreseen is automatic interaction with the accelerator.