

VMEbus in research

*** On 18 November, first protons were accelerated to 50 MeV in the new proton linac at the German DESY Laboratory, Hamburg.**

More than 500 participants, more than 40 exhibitors, the largest ever ESONE conference, the largest ever VMEbus-only event: these were some of the superlatives coming from the ESONE 'VMEbus in Research' conference held in Zurich from 11-13 October.

Associated with ESONE (the European Standards on Nuclear Electronics committee of European Laboratories) in the organization of the conference were CERN, the European CAMAC Association (ECA), the International Federation for Information Processing (IFIP), the Paul Scherrer Institute (PSI, formerly SIN, Switzerland), the Swiss Automation Pool and the VMEbus International Trade Association (VITA).

The Swiss Institute of Technology (ETH) generously allowed the use of their magnificent building overlooking the city of Zurich, as well as providing the technical support for the presentations and exhibition. The conference was a sequel to 'VMEbus in Physics' sponsored by, and held at CERN in October 1985, where the development and application of the standard, as well as problems specific to its use in high energy physics, were explored.

VMEbus, 'the most popular microprocessor backplane bus ever', to quote one speaker at the conference, was introduced at CERN in 1982 in response to the requirement for a platform for the then newly introduced Motorola M68000 family of 16/32 bit microprocessors.

In simple terms, VMEbus can be considered as the basis of a modular computer, allowing elements such as processors, memories and communications links to be combined into the desired system, and which may be reconfigured and en-



larged almost at will. Coming from the adaptation of Motorola's proprietary 'VERSAbus' onto 'Euromechanics', the VMEbus ('VERSA Module Europa') was jointly developed as an 'open' bus by Motorola, Mostek and Philips/Signetics.

In this context its 'openness' is very important since the VMEbus specification was placed in the public domain and has, subsequently, been standardized by the IEEE and the IEC. There are no copyrights, no royalties and no ties to any one manufacturer, in fact there are now several hundreds of companies producing VMEbus boards world-wide. The standard is now under the guardianship of VITA, a non-profitmaking association of manufacturers and users.

Since its introduction to CERN, VMEbus has had considerable success in control systems, test equipment and experimental data acquisition. The pioneers of the latter application, the big UA1 experiment at the proton-antiproton collider, first installed VMEbus in their updated detector in 1984. Since then several other experiments have based their data acquisition in whole or in part on VMEbus; notably OPAL, one of the four experiments currently being installed at CERN's new LEP electron-positron collider, and several of the experiments at the LEAR low energy anti-

At a panel discussion on software at the 'VMEbus in Research' meeting held in Zurich in October – left to right – Martin Timmerman (VITA Benelux User Group), Shlomo Pri-Tal (VITA Technical Committee Chairman), Kim Kempf (Microware), Chris Eck (CERN), Hugh Maaskant (Philips), John Rynearson (Mizar).

proton ring.

The control system for LEP itself is based on multi-microprocessor systems using VMEbus, and the control systems for both the PS and SPS proton synchrotrons are being rebuilt with VMEbus replacing their previously used minicomputers.

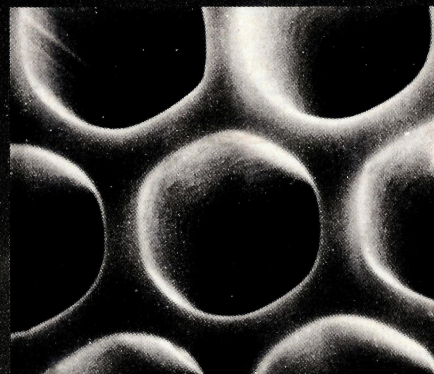
VMEbus also plays an important role in test systems, for the development of hardware in VMEbus itself as well as in other standards such as CAMAC and FASTBUS, and for checking out detector subsystems. It has also recently been applied to the calibration of the magnets for the OPAL and ALEPH experiments at LEP.

Other high energy physics laboratories are also using VMEbus extensively; the H1 and Zeus experiments on the HERA ring at DESY and the Advanced Computer Program (ACP) at Fermilab are some notable examples. However industry at large provides the major market for VMEbus. It is heavily used in test, control and data acquisition in all branches of industry and research, the consequent economies of scale enabling all users to benefit from the available choice of equipment and the cost savings.

The conference participants were welcomed by Alex Zehnder of PSI, which hosted the conference as an associate organization

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At the VMEbus in Research welcome party hosted by the city and canton of Zurich – left to right – Marc-Rene Jung (University of Zurich), Wilfried Schoeps (Paul Scherrer Institute and Chairman of the Organizing Committee), Chris Eck (CERN and Chairman of the Paper Selection Committee).



Bob Dobinson of CERN sums up the VMEbus in Research meeting.



of the ETH, by Organizing Committee Chairman Wilfried Schoeps also of PSI, and by Ted Owen of Daresbury Laboratory, UK, as Chairman of ESONE, the conference's principal sponsor.

Many topics and developments were discussed during the three days, but one of the important messages to emerge was the need to 'improve the breed'. Although VMEbus is by now a mature standard as modern backplane bus systems go, its specification covers only the lowest levels of hardware transactions. System level concepts such as interprocessor communication in multiprocessor systems and multicrate installations are each treated in different ways by individual manufacturers and users. These aspects are now being addressed by the VITA Technical Committee (TC), which is also tackling the thorny problem of software standardization, and the Software Sub-committee of the VITA TC expects to publish its first results for

comment next Spring. The current thinking was explored during a stimulating panel discussion on the first day of the meeting.

Other hot topics included the 'VXIbus' (VMEbus Extensions for Instrumentation). Although VMEbus is a successful microprocessor backplane bus, it is not well suited to the construction of front-end electronics. It has a relatively small board size and lacks support for ECL and analog signals. VXIbus, recently developed from the basic VMEbus by a consortium of instrumentation manufacturers, attacks all these problems, as well as the need for systems level concepts, and may provide a future platform for integrating VMEbus into the front-end of experiments.

An insight into the future was given by Shlomo Pri-Tal of Motorola, Chairman of the VITA TC, and by Paul Borrill of National Semiconductor Corporation, an acknowledged expert on backplane buses. They both made the point that with

the advent of very high performance microprocessors (above 100mips), the need for corresponding bus systems is becoming essential.

The VITA TC is discussing what form the 'Next Generation Architecture' should take, and how to marry it to VMEbus, which will nevertheless continue to play an increasingly important role in its own right well into the '90s. There was some crystal gazing from Ernst Kristiansen of Norsk Data who reported the work of the IEEE P1596 committee on a Gigabyte/second throughput 'Scalable Coherent Interface' (previously known as 'Superbus').

In parallel with the conference, VITA held a successful trade show, where more than 40 exhibitors displayed their latest hardware and software. Since unlike previous standards used in research, such as CAMAC and FASTBUS, VMEbus comes from industry, and intimate contacts between users and

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manufacturers are essential. Thus the third day of the conference was devoted to presentations from industry.

The three days of 'VMEbus in Research' provided a most stimulating atmosphere: a mixture of interests from the user, manufacturer and those attempting to promote the standards – a melting pot for ideas from all sides. At the end of this hectic activity, Bob Dobinson of CERN was able to summarize the 60 sessions, 20 posters and the exhibition in just 30 minutes. Finally Chris Eck of CERN and Chairman of the Paper Selection Committee proposed a vote of thanks to all concerned, including the City and Canton of Zurich, and looked forward to the next, as yet unspecified, venue for the conference.

By Chris Parkman (On-line Computing Group, DD Division, CERN)

CERN/FERMILAB Collider records smashed

The second half of 1988 has seen world record production of antiprotons, with both CERN and Fermilab displaying impressive prowess at manipulating antimatter.

Although CERN's new Antiproton Accumulator Complex (AAC) came into action for the first time last year, it is only this year that the real benefits are being reaped. With improved antiproton production techniques and with the new AC Antiproton Collector ring complementing the AA Antiproton Accumulator, the goal was to boost considerably the rate of proton-antiproton collisions for experiments.

(In the original version, the AA collected, cooled and stacked the antiprotons. Now the new AC ring collects and precools before passing the antiparticles to the AA for more cooling and final stacking.)

With the AAC benefiting from a run earlier this year for the LEAR low energy antiproton ring, an interim world record store of antiprotons got this year's proton-antiproton collider run in September off to a flying start.

Once the collider was back in its stride with six bunches each of protons and antiprotons, the records started to tumble, with luminosity (a measure of the collision rate) regularly exceeding $10^{30}\text{cm}^{-2}\text{sec}^{-1}$, eclipsing CERN's previous record of a few 10^{29} .

Then resourceful groups all along the long antiproton production chain added something extra. The Booster did some spectacular radiofrequency gymnastics to in-

crease the number of protons available for producing antiprotons. Some delicate radiofrequency manoeuvres ('ion shakers') in the AA overcame troublesome ion effects which had been limiting the size of the antiproton stack, pushing the stack to a new record figure of 8.5×10^{11} .

As well as lots of antiprotons, long coasts in the collider ensured that physicists were clocking up plenty of collisions. In less than one month of running, the accumulated number of proton-antiproton collisions sailed past the inverse picobarn (1000 inverse nanobarn) milestone. About a day later, the collider cruised past the total collision score amassed in the seven years 1981-7, including the historic Nobel-earning 1983 run which discovered the W and Z particles! The accumulated collision score continued to grow steadily, passing two inverse picobarns on 8 November.

The muon detection capacity of the UA1 experiment has been substantially improved for the 1988 Collider run. Additional iron shielding has been installed between the main magnet and the outer muon chambers and is fully equipped with planes of larocci gas tubes. The data acquisition system has been redesigned, using VME and multi-event buffering, to provide a flexible second level trigger system. Events are recorded on IBM 3480 cartridge drives at a rate in excess of 1 Mbyte per second. The central detector has been equipped with a laser calibration system so that potential distortions at high luminosity can be carefully monitored. The faithful 'gondola' and 'bouchon' electromagnetic calorimeters have been removed in preparation for later installation of the new uranium/TMP (room tem-