PRIAM and VMEbus at CERN

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1. Introduction

PRIAM is the French acronym (PRojet Interdivisionnaire d'Assistance aux Microprocesseurs) for Interdivisional Project for Microprocessor Support.

The CERN management established the PRIAM project in June 1983 following the recommendation of CERN's Steering Committee for Microprocessor Standardisation. This committee studied the problem of hardware and software support for 8 bit and 16/32 bit micros at CERN and made the following main recommendations:

- 8 bit systems should use the MC6809 processor and the G-64 bus

- 16/32 bit systems should use the M68000 processor family
and the VMEbus

This paper will concentrate on the PRIAM work in the 16/32 bit area.

2. Areas of PRIAM Activity

2.1 Information

PRIAM has to market its services, to inform prospective users about them. And not the last of its services again is information distribution. How is this done?

The PRIAM project, together with the Online Computing group at CERN, publishes four times per year the "Mini and Micro Computer Newsletter", MMCNL [1],which is distributed free of charge in more than 800 copies (550 outside CERN). It contains articles on PRIAM work, contributions by users, and a reference section with pointers to people and additional information channels.

On CERN's IBM (HELP PRIAM under Wylbur) and on the PRIAM-VAX (use apropos and/or man commands) simple documentation access schemes have been installed. These tools are rather crude but have proven to be useful for people at CERN and regular collaborators. PRIAM plans to update/improve this information channel and to discuss how to make it available to a broader user community. The antisocial behaviour of a shabby group of people, Hackers and Co, make this a difficult task.

PRIAM organises, through the CERN stores, access to printed documentation like: Compatible Products Directory, Specification Manuals.

CERN, represented by the PRIAM project, is a Regular Member of VITA, maintaining a useful information flow in both directions.

And finally PRIAM organises seminars, presentations, and last but not least events like this conference.

2.2 Training

To offer training on various items connected with its support work is an important activity of PRIAM.
Courses on MC68000, VMEbus, RMS68K, UNIX, MC68020 have been and will be offered at CERN. It is a difficult task to find the right level of a course for people with widely differing prior knowledge and to get instructors for general, non commercial, courses.
PRIAM urges VITA to establish a comprehensive offer of courses on all aspects of the VMEbus family of standards.

2.3 Consultation

Compared to the size and complexity of its task, the PRIAM project has a very limited number of staff. PRIAM support has therefore to concentrate on general tools and services and cannot get involved in direct help for specific applications. Nevertheless good advice is available to people starting on a development or wanting to use a product in the area of PRIAM responsibility. These consultations are as important for PRIAM as they are for a client or prospective client of PRIAM. The client should not get lost in exotic choices and the project has to keep aware of what is going on and how well its services fit the users needs. PRIAM's developments need the innovative ideas which come from a wide user base.

2.4 Hardware Support

Again, full support of VMEbus hardware would require several times the number of staff PRIAM can count on. The project has therefore to concentrate on the most essential elements of such a support. They can be split into two broad classes: providing information and recommendations concerning the VMEbus market on one side, and helping that CERN staff and collaborations to obtain access to this market at the most favourable conditions. The first point requires a constant survey of the VMEbus market and multiple contacts with manufacturers. With a fast growing market this becomes more difficult. VITA's Compatible Products Directory will help us in this respect.

It is necessary to evaluate and test certain products in detail. Hopefully such evaluations can in the near future concentrate on the functionality of a module, the compatibility with the VMEbus specs having been tested in one of the certification labs being set up with the help of VITA. PRIAM will also offer its services to channel information back from CERN users to VITA and the manufacturers. After internal discussions this should allow for example to present a consistent demand for development of a certain module or even the VMEbus standards.

The second point, access to the market, can be partially fulfilled by keeping the most common parts (backplanes, connectors, chips etc) in the CERN stores. Providing access to board level products is much more complicated. Buying a large stock of CPUs, memories etc. for later redistribution would be a very risky operation considering the rapid development of the market. Random purchases of small quantities by numerous groups at CERN will not very likely achieve good commercial conditions, let alone the increased effort of justifying each purchase decision to the CERN administration.
The PRIAM project decided, therefore, to set up so called blanket orders with a small number of firms, selected on the basis of a formal request for information (sent out mid November '85). Selected firms would have to open up their complete product range to buyers from CERN with favourable conditions (discounts, delivery times, service and repair agreements). In return they will get the major part of CERN's orders of VMEbus equipment. This procedure will need regular revision, based on the experience with it and on major developments in the VMEbus market.

2.5 Software Support

Every group trying to set up a support for microprocessor software development will have to answer the crucial question: what can be bought from outside and what has to be developed in-house? Valid answers to this question will vary widely according to circumstances. PRIAM's decision to base its software support mostly on in house developments is the result of the following considerations:

- One cannot buy, what is not available yet. Some of the developments of PRIAM supported software started well before PRIAM (around 1980), little good quality micro-processor software was offered by industry.
- The distribution of PRIAM software without costly licences is a must. CERN collaborates with many small institutes.
- PRIAM software must be portable to different brands of computers used by the collaborating institutes. Portability allows software to be installed on new workstations coming on the market.
- PRIAM software should be consistent and coherent; following the same conventions, having the same user interface, allow free language mixing, supported by a common symbolic debugger.
- And finally, in a highly competitive research environment quick response to user demands for bug-fixes or developments has a non-negligible value.

The status and the next developments of PRIAM software are presented in the following sections.

2.5.1 Working Environment

A programmer using PRIAM software should be able to develop his code on a single-user workstation, networked to powerful servers, link it to executable packages and downline load it into the target for execution. Execution can be under the control of a symbolic debugger running mostly on the comfortable workstation with only a minimal part of the debug monitor executing in the target.

For a hardworking developer of microprocessor code this looks too good, to be true: and it is not yet completely true.
PRIAM software is however not far from this picture already and the plans are to provide exactly the above environment around the middle of 1986. Today most of the cross software development is still done on larger timesharing computers (IBMs, VAXes, ND-500s etc.), the main workhorse being a VAX-11/785 running Berkeley BSD 4.2 UNIX. But the cross software written in portable Pascal, has been ported to some small workstations with good networking capabilities and PRIAM will soon select a few supported types.

The symbolic debugger is still target resident (including its symbol tables) but work has started to split it up and define a suitable host/target protocol.

2.5.2 Language Support

PRIAM supports a macro assembler, M68Mil[2], and Pascal, Modula-2 (mainly for accelerator control applications), Fortran-77 (mainly for physics applications), and C (mainly for communications software).

Figure 1 gives an overview of PRIAMs cross-software. All language processors follow the same programming conventions [3], producing the same object code format, assuring free language mixing and a common symbolic debugger. A slightly modified version of the object code format CUFOM [4] (CERN Universal Format of Object Modules) has been standardised by IEEE under the name MUFOM. The pusher will either produce Motorola S-format for downline loading into the target or a format suitable for a DATA I/O PROM programmer.

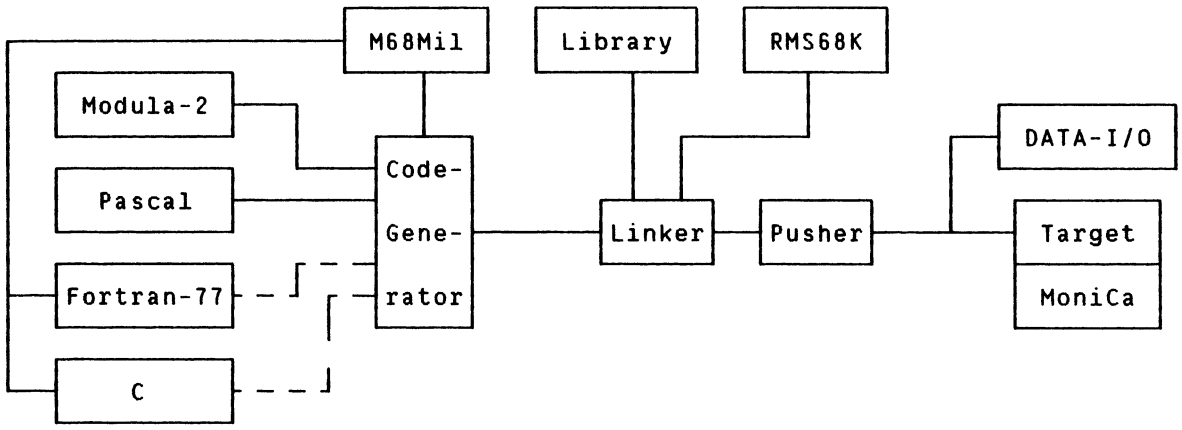

Figure 1: PRIAM Cross-Software

The elegant and practical choice of a common code generator for the compiler front-ends is at the moment only realised for Pascal and Modula-2 whilst Fortran-77 and C compilers (bought from industry) produce assembly code, which has to pass via M68Mil with a corresponding loss in symbolic debug information. A Fortran-77 front-end is in production and will be available mid 1986. Work has started on a C front-end, but lack of manpower does not allow a definite completion date to be quoted.
The code generator for the MC68020 is in its final test phase.

2.5.3 Debug Monitor

The name of PRIAM's debug monitor is MoniCa: "Monitor in Camac", where it originated in 1980. MoniCa provides interrupt driven I/O based on logical channels, named MIOS (MoniCa I/O System), run-time support in the form of integer and floating arithmetic and exception handling, and finally symbolic debugging for all languages following the PRIAM programming conventions. Version 1.0 of MoniCa [5] (in field test now) contains MC68020 support and a line by line assembler. 80% of MoniCa is written in portable Pascal, which will ease the task of splitting it into a host resident and a target resident part for remote debugging. MoniCa contains some 30 commands in an open ended structure, allowing specific user commands to be added.

2.5.4 Real Time Kernel

MoniCa is sufficient for single task systems plus interrupt driven I/O. Applications, which need multitasking, are supported by PRIAM via the RMS68K real time kernel. RMS68K is integrated into the PRIAM software. A directive library is callable from PRIAM supported high level languages. I/O is based on MIOS and MoniCa can run as exception monitor task of RMS68K providing symbolic debugging in a multi-task environment. Version 4.4 of RMS68K [6] runs also on the 68020 and multi-processor support is announced for a later version.

3. Standards and Support

As a conclusion of this short presentation a few words on these heavily inter-related terms, which will clarify the position of PRIAM.

A standard without the necessary level of support will never be accepted by users, and support can in no way achieve its goal without a prior selection of the items to be supported. Efficient support will therefore either create an "in-house standard" or, better, reinforce an existing, carefully chosen, standard.

Every choice is sometimes felt as a restriction. It is only natural that a support group will be put under pressure to change some of its decisions. And here another important term has to be considered, namely stability. Support decisions have to be stable to protect acquired know-how and capital investments. But how can one achieve stability in an area as rapidly changing as microprocessors and bus standards?

The only possible way out of this dilemma can be found by properly understanding what a standard should be. A healthy standard, a standard to which a support group should be able to stick to, should be seen as a living entity. It must be able to develop and adapt, either via compatible extensions or via new members within a family of standards.
Development needs a lot of pushing and pulling and lobbying. And the value of a chosen standard for a support group will depend heavily on the extent of the influence the community of users of this standard has on the body who is developing (maintaining) the standard.

VITA, the VMEbus International Trade Association, is the body maintaining the family of VMEbus standards. The constitution of VITA, which is not dominated by a single firm, and their attitude towards participation of the user community in the association should make the VMEbus standard ideal for a support group.

A lot will depend now on the activity of VITA user groups. Let us hope that this conference has helped to trigger activities in Europe.

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References

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