

Bijlage.Ontwerp voor "Letter to the Manufacturers".

Dear Sirs,

At some time in the future the Department of Mathematics of the Technological University, Eindhoven, will need a new general purpose digital computer. In order to make a motivated choice possible we must have a survey of the equipment which will then be commercially available. This letter, sent to the companies mentioned below is our first step in an effort to obtain the required information. We hope that you will see sufficient reason to contribute to this effort. The information we hope to obtain from your firm, will be treated confidentially and will be used only for the purpose mentioned above.

In order to make some "preselection" from your side possible, we shall now give a more detailed description of our wishes. We are aware that it is highly improbable that one of your products fits in completely, and we therefore ask you not to regard all the desires mentioned below as absolute "musts". This list should give you a picture of what we have in mind and should assist you in deciding whether you think that further negotiations may be profitable for both of us.

Time of delivery: in the course of 1965, i.e. not earlier and not much later. For an otherwise very attractive machine, spring 1966 as time of delivery should not be regarded as an absolute veto. As a consequence of this date our interests are very definitely not restricted to equipment available now. Our promise to treat your information confidentially is given in the hope that you will assist us in being up to date in 1965.

Place of delivery: Eindhoven, Netherlands. If your service organisation is such that you will have to decline the responsibility for a computer placed here this will be a serious objection. If your sales organisation and your methods of communicating with your customers is such that any piece of information only reaches us here by the time that it is obsolete, this also will be a serious objection.

Price. A million dollar is the upper limit. One or two years after the delivery we might be able to spend a quarter of a million to extension of the installation if desired.

Number system: binary. None of the arguments in favour of the decimal system applies to our situation, where the machine shall be used mainly for scientific work, whereas the arguments in favour for an information representation on bits are growing stronger with the growth of non numerical activity. (translation of algorithmic language, dynamic storage allocation techniques etc.) We have the impression that the virtues of a mixed binary - decimal machine are subject to doubt, as long as the addressing system is in binary; for this is an invitation to disregard the decimal facilities completely. A machine with a decimal addressing system and decimal arithmetic might be not to unattractive, provided a convenient way to represent binary information is still available. If you feel inclined to disagree with us, we should be glad to hear so.

Memory organisation: A random access memory with a capacity of say, one or two million bits. As far as our opinions are formed we do not think it very important whether the store is addressed in words - of say 48 bits - or in syllables - of say 8 bits. A "mixed" addressing system, where the main subdivision of the memory is in words, but where other facilities enable one to address the constituent syllables seems a workable arrangement. Again, if you have stronger views on this point or should like to defend an alternative solution, we should be glad to hear so.

Backing store. Discs or drums, or any alternative solution with comparable accessibility and reliability.

The very limited accessibility of the information on magnetic tapes makes it very hard to use this medium efficiently as an automatically controlled backing store. The facility that one can dismount reels does not seem to be extremely important because it is improbable that the machine will be used to update files etc. .

The central computer should be able to continue its work in other parts of the high speed memory during transports to and from the backing store.

We think that a capacity of 20 million bits would be sufficient.

Interrupt system. We should like to regard the interrupt system as a general purpose feature and should welcome a machine in which this has been properly designed as such. Experience has shown that these facilities are hard to use unless the design has been made following some sound guiding principles. We feel inclined to stress the point that multiprogramming techniques should be more than a theoretical possibility because we see a number of possibly interesting applications.

- 1). Automatic organisation of transfers to and from backing store at run time. When one program cannot proceed for the time being the central computer should have the possibility to switch over to another program. We are aware that the efficiency of this technique depends on the ratio of transfer speed and processing speed on the one hand and the size of the immediate access memory on the other. We don't know any details about this dependence; if you have any information on this based either on experience or on Monte Carlo experiments, we should appreciate to get informed.
- 2). Real time applications are to be expected in the environment of a Technological University. (Process control, traffic control etc.). The requirement of a quick reaction to infrequent incoming signals leads to unacceptably long idle periods, unless multiprogramming is feasible.
- 3). Experience seems to indicate that multiprogramming techniques provide a means of overcoming synchronisation difficulties with communication mechanisms. An alternative solution is external buffering and "synchronizers". The last solution requires considerable investment per piece of communication equipment, whereas multiprogramming should enable one to pay the price - in the form of computer time - only when the piece of equipment is actually used. A relatively non expensive way of coupling the digital computer to a varied collection of communication mechanisms might, in our situation be very attractive. (We think about the simulation of analog computers by a digital computer coupled to suitable conversion apparatus). We are aware that the arrangement of "two channels for eight tape decks" shows the simplification in the above argument in favour of multiprogramming techniques, in other words every alternative solution you may feel inclined to propose will be welcome.

Communication mechanisms

Under the assumption that we shall not use the machine for work of the nature of file maintenance and that the size of the backing store shall be sufficient for the intermediate results of any single computation - if a program uses the complete backing store, it will not allow any companions and the computer will be idle during transfer times, but this is a reasonable price to pay - the need for bulk communication will be low.

For pure digital communication one or more paper tape readers with the in the mean time conventional speed of 1000 char/sec and one or more input-output writers for monitoring purposes and one or more on line line-printers seems to be sufficient, (The term "one or more" means in this connection at "least one, but provision for more"). An on line paper tape punch is an attractive "complementary device" for the tape reader.

We should like the machine to be such, that inclusion of curve-followers, curve plotters, cathode ray tubes and other analog devices is not excluded a priori.

We are not very attracted by punched-cards.

Compared with other media they make a somewhat bulky impression. (The computer will not be located at the ground floor of the building: other people have to live and to work under it. If you have noisy line-printers and silent line-printers we should prefer the silent ones!). The second objection is that their inclusion tends to introduce unhappy conventions that go back to the time when punched cards were processed by less flexible machinery, but which cannot be justified any longer (e.g. the superstition, that only a single alphabet should be allowed). Finally their sensitivity to the humidity makes them less attractive.

Speed. Considerations about the speed of arithmetic operations are postponed until now intentionally, because they do not matter as much as is often supposed. If a full length multiplication takes 10 msec, it is fine; if it takes 25 msec we think it would be fine also. We should like to stress that the difference hardly matters when in

practice the machine spends eighty percent of its time winding and rewinding tapes! Furthermore: the machine will be used truly as a general purpose computer and the average life time of the different programs will be relatively short. This versatility puts heavy demands as far as software is concerned. Under these circumstances it is, for instance, clear that we are strongly in favour of a "load-and-go-system"; this, together with the requirement of multiprogramming, puts some emphasis on the "clerical activity" at run time. As a result efficient methods for advanced higher order addressing techniques - a good balance between memory access time, addition time and possibly the multiplication of small numbers - might very well turn out to be just as important as the multiplication time for two full length numbers, or the addition time for two floating point numbers.

Software requirements. We have a feeling that it would be unrealistic to demand that the manufacturer produces software, smoothly meeting all our needs. Furthermore we think that the task to develop the software is not void of interest and we have an indication that our group comprises some people the experience of which might be adequate for this task. As a result the information on which we should like to found our choice should concern the hardware more than the software you intend to supply. And we hope to find a machine for which the task of software development does not degenerate into the tricky exploitation of rather "ad hoc" hardware facilities.

Trusting that you will react to this letter in the spirit in which it has been written, we remain,

Yours sincerely,

Prof.dr. J.J. Seidel. Prof.dr. E.W. Dijkstra.