pdp11 memo

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SUBJ: Competitive Evaluation: HP3000

This evaluation summarizes our present knowledge of HP's System/3000, a new entry into the $100K-300K computation marketplace. Information has come in from several sources, including the public showing at FJCC, so the evaluation should be accurate.

1. History of the Product

The 3000 probably had its hardware roots in the legendary HP OMEGA, supposedly a 32-bit edp machine that the company developed at great expense, then canned at the last minute. We know nothing specific about the OMEGA, but if it did have an edp orientation; HP probably had a COBOL project going. If an OMEGA COBOL was developed, it might show up on the 3000 some day.

Ex-Burroughs people were apparently involved in the design of the OMEGA, and almost certainly in the design of the 3000. HP as a company has clearly swung to the Burroughs higher level language orientation. Even on the 2114, 2115, 2116 series, they concentrated on building good higher level languages, and succeeded. Their language processors are the best in the small computer industry. These include a 16 and 32-user BASIC, a FORTRAN IV and an ALGOL, all powerful and all rock solid. They also developed a disk operating system and a real-time operating system that are very competitive.

This approach has had good market acceptance, especially with the bigger systems. The time-sharing system in particular has demonstrated a market for a reliable, no-frills production system that is simple to use even at $90-130K a shot. The good production languages justify the cost. The smaller, single-user systems are well liked, too, but here cost has been much more of a factor. Customers take the lowest cost system, even if it's a little more complex to use and program. DEC has used its price advantage to chew them up here.

With this market orientation, the 2116 hardware must have been a source of enormous frustration. HP has done best in the $100K+, higher level language market for which their cpu was not designed. They have been getting killed in the small system and OEM business for which it was designed. As of a year ago, there was no competition (well, maybe the Honeywell 1640's) for the former market, but brutal competition down below.

HP had to follow their success in the sub-PDP-10 production computing market. It was only natural for them to develop new hardware specifically for this market. This they have done with the System/3000.

2. The System/3000 Product Concept

HP has specified a production computing system to sell for between $100K and $300K. Because it will be used for production computing, it is totally based on higher level languages: in this case BASIC and FORTRAN. Because it is production oriented, it includes a batch processing system. It also, of course, includes time-sharing terminal operation. Finally, it offers real-time capability, although this will probably receive less emphasis. It will, however, be good enough to allow HP to bring their instrumentation capabilities into the sales situation.

They have opted for a single operating system to service all three functions simultaneously. TOPS-10 proves the viability of this approach--the three functions share many common characteristics, thus cutting down on total implementation. More important, it allows the individual user to use whichever mode of operation best suits his need. Programs developed in one mode may be used in either of the other two.

Finally, they have designed hardware specifically for this one system. Because the system will be used almost exclusively to run higher level languages, the order code has been designed to do that efficiently. There are lots of stack operations, for example, and no general registers. Because it will always be used in a multi-programming mode, memory addressing and executive protection have been optimized for this purpose. And finally, because they have a whale of a lot of systems programming to do, they have designed an implementation language to do it in.

In short, the whole system is designed from the ground up to be a production computing system and nothing else. Nowhere in their promotional material are they emphasizing the new cpu, for example. It is not the product. The product is the computation system. HP is not going after the hardware market. (Just for the record, it's a 16-bit cpu. This fact does not show up in most HP literature.)

3. The 3000 Multi-Programming Executive (MPE) System

MPE is what holds System/3000 together. It seems to be a straightforward design which will probably end up looking like TOPS-10 on the inside. HP claims that the resident portion of Monitor will be under 5K. They point to the efficiency of the instruction set (instructions are 8 or 16 bits) in backing up this claim. However, the instruction set is optimized more around compilers than executives, so it may not pan out. (On the other hand, their BASIC time-shared exec plus the language interpretor on the 2116 fits in 9K, versus 18-20K for RSTS.) Program size on the 3000 will be very critical since they now have a 64K limit on memory.

All other Exec functions will be swappable, as will the user programs. Code is stored in pure segments, each of which is variable in size, up to 16K. Programs may consist of more than one segment, but there is a system limit of 256 total code segments. Each segment is logically separate and self-contained. Therefore, even a multi-segment program need only have one segment in core at a time. There are hardware instructions for procedure calls as well as subroutine calls. Procedure calls can probably cross segment boundaries while subroutine calls cannot. It is not clear how much of an external procedure call is implemented in hardware. Obviously, since the code segments are pure, they need never be swapped out. The are simply overlaid.

All user program data is stored in a single data segment, which is also variable in size, up to 32K. Assumedly, the exec also has a data segment. These segments are relocatable, so memory management seems to be relatively clean. There is room in a 64K system for the 5K resident exec, 11K of swappable exec, plus a 16K user code segment and a 32K user data segment. If user segments are smaller, several can be resident at a time. But there is the possibility of real swapping bottlenecks if too many users are using big data segments.

The core layout is consistent with the philosophy of the 2000A time-sharing BASIC system. It made no attempt to keep multiple users in core, relying instead on a very high speed swapping device to prevent bottlenecks. Again on the 3000, the 64K core limit means that a big job can hog the whole core. Their swapping store transfers a 16-bit word every 4+ microseconds, but even this high speed won't save them if user areas get big. The viability of the system depends on the ability of the compilers to produce tight code and thus keep the user areas small.

The I/O structure of the hardware is no prizewinner, but it appears to be good enough. It will not be a significant bottleneck in the overall production system they are selling. It is enough to handle their disks and tapes, and everything else on the system is relatively low speed. It is not clear how easy it is to program devices, but this would only be a problem if the handlers get big.

The system has the peripherals it needs to get the job done. High-speed disks and big disk packs should take care of swapping and file needs. HP's 1600 BPI tapes are more than good enough. They have good card equipment and an adequate line printer (600 lines a minute). One problem area may be terminals. They obviously realize they cannot go to this marketplace with Teletypes, so they're talking Datapoints and a new 30 cps hard copy terminal. They will have to succeed in producing these terminals at a good price to stay viable since terminal costs alone on a system like this can exceed $100K.

There are no details yet on the file implementation of the system. Multi-pack disk file systems are a problem for any 16-bit machine and probably will be here as well. Resource sharing for other peripherals is claimed but there are no details. Spooled batch input and output is claimed.

Another area where there is no concrete information is the system command language. There is every reason to believe, however, that it will stress simplicity of use. This was a key selling feature of the 2000 series. Since it is not a general purpose system, it obviates the need for the kind of complex command syntax that has frequently plagued PDP-10. Emphasis will be on doing the common production tasks simply rather than trying to do everything. Since users do have access to the implementation language, HP does have an answer to those who want to do more eccentric things.

4. The Language Processors

Languages are the key to System/3000's success, so the quality of the language processors is critical. Right now, they offer FORTRAN, BASIC and an implementation language. The specs on all of them are good.

The FORTRAN is standard ANSI FORTRAN, with an intelligent set of extensions. String handling is beefed up and seemingly complete file capability has been added. The ability to have 99 files open at a time seems adequate. Terminal oriented I/O has been added, as would be expected. Customers don't usually play the features game too much with FORTRAN. Either it is full FORTRAN IV or it ain't. This one is, so it's probably adequate. The big competitive question will be its speed.

BASIC is a language where the features game does get played, and HP has beefed up their language accordingly. They have closed the gap to RSTS by adding integers, double precision, lots of new string stuff, output formatting, and better files. (They seem to have missed virtual arrays.) Their BASIC (which is interpretive) is not as good a production language as RSTS, but the availability of FORTRAN probably makes this insignificant.

There are no details on what the implementation language (SPL) looks like. But its usability as an on-line language matters very little. The main question about SPL is whether it will support the building on good language processors and a good exec. There is no way of telling this yet. Obscure SPL bugs could wreak havoc on the development effort. Design mistakes could cause the code to get big. These are serious problems with a technology as new as implementation languages. Burroughs seems to have mastered it, but no one else has committed to it the way HP now has.

The question remains: how big will these language processors be, how tight will their output be, and how fast will it run? If any of these parameters gets out of control it will seriously degrade system performance by jacking up the swapping load. Right now, though, we have to assume that they will solve these problems. The order code is clearly optimized for compiler output, so it should be tight code. HP has good compilers now, so they know how to build them. It is impossible to predict

execution time at this point. They have no general registers and they have no solid state memories. An 11/45 compiler that makes good use of both these features should be significantly faster, but we still have to build that compiler.

Another factor that impacts throughput is the computation hardware. Hardware floating point is 32-bit only. They will probably implement 48-bit formats in software, averaging about 1000 microseconds per operation. Theoretically, they can add better floating point at any time (same is true of solid-state memory) but their engineering staff is undoubtedly over-committed now, and will be for some time to come. They'll do it, but not soon.

5. The Implementation Schedule

A product announcement as sweeping as System/3000 brings us back to the early Sigma 7 days. Can they pull it off and, if so, how soon? They are quoting delivery in a year. They had no software to show at FJCC.

First, it is clear that HP understands each of the components of the system, with the possible exception of the implementation language. They have built fast, tight language processors for both BASIC and FORTRAN. (They also have a very good ALGOL.) They have a time-sharing system, a batch system, and a real-time system. And they know what it takes to shake down software because they've brought each one of these packages to a rock-solid level of reliability.

Implementation language is the only component they've never done before. (If they do have ex-Burroughs people, they've picked up experience that way.) They are banking on it heavily. They are confident that it will allow them to develop their software three to six times faster and they're quoting software deliveries on this basis. It is not clear that this confidence is well placed. If there are problems in the implementation language itself, or undetected bugs in the SPL translator itself, they could find it taking longer to get their code written. A prudent guess would be that the implementation language will help some, but not as much as they're banking on. Software will be late, and will be flaky at first.

A far bigger potential problem is HP's lack of experience in multi-function systems. They've built a batch system, a real-time system, and a time-sharing system, each with one language at a time. Conceptually, it's easy to put them all together into one system, but everyone who does it finds it's harder than they thought. This is HP's first go at anything like a general purpose, multi-function operating system. They are bound to run into unexpected problems.

I think they have the talent and the determination to beat these problems eventually. They may (and probably will) be late, but they will get there. The company has invested heavily in this project. They will see it through.

6. Marketing Strategy

HP is already selling the System/3000 very hard, even at the expense of 2100 sales. They pushed it even before introduction, when they had zero to show. Interestingly enough, they have announced the BASIC time-sharing systems on the 2100 cpu (dubbed the 2000E for 16 users, the 2000F for 32) but have made no real noise about them. At $49K, the 16 user 2000E is a significant product that undersells both RSTS and TS-E. The fact that they let its introduction be completely overshadowed by the 3000 series suggests that they switched the selling effort to the 3000 now.

If so, they will undoubtedly convert their whole computer sales force into System/3000 specialists with each individual salesman having a market specialty. They will clearly take dead aim at the education market where they did $5 million in sales last year. They have a trained education sales force, a good reputation, and a product that will appeal to small colleges and departments within universities.

System/3000 salesmen will also follow the company's imstrumentation salesmen into large industrial accounts. They are undoubtedly looking for sales in the in-house scientific market. Their success here is less well assured. They tried a year and a half ago to get into this market with the 2000A, even offering a 6-month trial. They didn't get any takers according to Alex Lakatos, an HP salesman hired into the Parsippany office.

In other markets, they may have to wait till they can demonstrate what they say they've got. This will be a problem everywhere, but HP salesmen can bridge the credibility gap somewhat by pointing to their reputation for building reliable systems. The 2000E and 2000F may be a real hooker here, too. HP also announced month-by-month rental terms for these machines. They may be planning to sell customers on taking a 2000E until the System/3000 arrives.

7. DEC's Strategy versus System/3000

I doubt that we will have much luck simply bad-mouthing the System/3000. The spec is excellent; if it does what they say it will do, it is a very nice product. I also doubt that we can get away with simply saying that they'll never get it to run. They have too much quality software to point to.

We'll have better luck pointing to the fact that they will be late delivering the product. The precedents are unanimous--you don't get a system like this up on schedule. We can also point out that HP is spread dangerously thin on this project. Their computer division isn't that big, and the rest of the company can't help much at all. In this kind of a situation, minor problems often turn into major and disastrous delays because no one is free to work on them.

Finally, and most importantly, until they get everything working, they have nothing working. The whole system is based on an integrated design with many, many interdependent components. If they are having problems with time-sharing or real-time, the customer can't even limp along with batch because they're all interconnected. DEC, on the other hand, already has proven 11 Family software to build on. HP may counter with monthly rentals of the 2000E, but that doesn't really solve the problem.

HP is stretched very thin on a major multi-function monitor system (which they've never done before) that requires all components to be done and debugged before any components are usable. The potential for disastrous delay is so great that customers should hold off any commitments, if not avoid System/3000 altogether.

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