Design Automation Conference Roundtable: The future of the VLSI workstation

Ware Myers, Contributing Editor

Only two or three years ago computer assistance for VLSI designers was largely provided by in-house or purchased programs running on large computers, a situation largely confined to major companies. Then several small vendors introduced the engineering workstation—at a reasonable cost—almost simultaneously, enabling both large and small firms to invest in CAD.

The workstation and its software have improved both designers’ productivity and design quality. Workstations have mechanized repetitive tasks, reduced errors, and in effect shortened the design cycle. That, in turn, has reduced product lifetimes, putting renewed pressure on designers and leading them to ask for better workstations.

Workstation vendors are at the center of this circle of cause and effect. What do they have in store for VLSI designers? In a roundtable held in conjunction with the 1985 Design Automation Conference, D&T queried five industry representatives.

Participants were Frederick Cohen, product line manager, VLSI design tools, Mentor Graphics Corporation, Beaverton, Oregon; Hung-Fai Stephen Law, director, design methods, SDA Systems, Santa Clara, California; Michael J. Price, director of CAE development, Valid Logic Systems, San Jose, California; Michael Turner, marketing manager, Methus-Computervision, Hillsboro, Oregon; and Nicholas P. Van Brunt, senior vice president, research and development, Zycad, Arden Hills, Minnesota.

Asking the questions were Prathima Agrawal, AT&T Bell Laboratories, Murray Hill, New Jersey, a member of the DAC Program Committee and organizer of the workstation panel at the conference; Charles E. Radke, IBM, Hope well Junction, New York; and J. Daniel Nash, Raytheon Company, Bedford, Massachusetts. Sitting in were Vishwani Agrawal of AT&T Bell Laboratories, D&T editor in chief; and Mickey C. Schach, D&T managing editor.

D&T: Workstation companies provide tools for low-level VLSI design functions.

In systems and VLSI design, however, much work occurs at higher levels, such as the architectural and register-transfer levels. What types of tools are planned to deal with these higher levels of design?

Cohen: Workstation vendors have taken a first step by offering behavioral-level design and simulation capabilities. With this capability you can write a description of a functional block and then simulate that within the workstation. There is an ongoing trend toward an architectural description language, although I don’t know of any that are effective.

Law: I think mixed-level simulation is the next direction for system design. Supporting the transformation from architectural representation to physical realization is also very important.

Price: Workstation companies have emphasized the back end of the design process more than the front. We need tools and languages that allow functional descriptions at the very high, even abstract, level. We need to experiment at that level before we get down to a more concrete representation.

Cohen: Workstation vendors started off automating very familiar processes, such as capturing schematics and creating net lists. The workstations take the tedious out of that part of the design process. The type of simulation you’re talking about—doing automatic test pattern generation—will require innovation.

Turner: Agreed, but at the same time there are some design style issues. We have a behavioral simulator that runs on our system. Customers think it’s an interesting curiosity, but they’re not set up
to take advantage of it. I agree that the tools have to develop further, but design styles haven’t developed yet to take advantage of some current tools.

Van Brunt: I disagree. Design styles have to change for people who are used to designing single chips of a few thousand gates capacity, but are now moving up into the 100K-gate range. Design style at that level is similar to what people exercise at the system level in places like IBM, AT&T Bell Labs, Control Data, and Univac. Designers will have to adopt those sorts of design styles, and the tools that support those styles are typically available in-house at large system houses. A lot can be copied from the ideas they already have.

Going back to high-end functions, I agree that we need to support the different levels of simulation, especially behavioral. That gives us a way to describe our designs before we know exactly how we’re going to build them. Verifying a system-level design, perhaps involving a collection of chips, not just one VLSI chip, requires more than an order of magnitude improvement in performance.

D&T: Can workstation vendors indeed break into that area? This is one of the major steps to changing the way in which companies design, but wouldn’t this kind of program border on proprietary information?

Van Brunt: I think the workstation companies can definitely break into this area, although I don’t consider it a classic workstation task. That gets us back to the definition of a workstation, which might be that it is the tool that a single designer uses that is economically, physically, and capability-wise in line with what a single person does. In that case, putting together whatever it takes to do whole-system-level verification is outside that definition. It is a different market.

Design creativity

D&T: The high end of the design process can be called more creative. What plans do workstation vendors have to enhance the designer’s creativity, rather than just increase efficiency at low-end chores?

Cohen: At Mentor Graphics we focus not just on designer productivity, but also on innovativeness, which comes from enabling the designer to go from design capture to analysis and back very quickly. Interactivity in all stages of the design process permits the user to try alternatives and see the implications quickly. Module generators enhance the designer’s ability to try alternatives by facilitating work at the architectural level.

D&T: Rather than spending two days on a supercomputer, simulating a highly complex design, why not create designs that are correct to start?

Turner: You want something that will go directly from the behavioral description through to the layout. It’s a good concept, but it implies that many designers initially think about their design algorithmically, as opposed to functionally. We may disagree about how designers work, but I don’t think most of them think algorithmically; they work by sketching out blocks.

Van Brunt: The notion of starting with a high-level description, working down, and having a detailed thing fall out assumes that the original specification is correct. That usually isn’t true. High-level description of the kind of complexity that we’re dealing with must take on the same complexity as the design itself. The worst and most subtle problems exist in the high-level description in the first place.

Law: First, you have to be able to verify that the function is correct. Second, you have to be able to establish whether one architecture for certain functions will be quicker or more efficient than some other architecture.

To answer “what if” questions quickly, you want to be able to find out, for a given implementation method, what the result will be like. It will be this big and have this performance within an error margin of 10 or 20 percent.

Some vendors are providing predesigned module generators, but we’ll probably see this area open up for some users to write their own module generators. This development, being closer to the user, would bring the implementation style closer to the user’s needs.

D&T: Are there any workstations that now have synthesis capability?

Law: The closest to that capability is the PLAs, I believe. It is beginning to appear on workstations. A limited set of module generators is available, and some of them let the user input changes to actually generate the module, but we are still in the early stages of this effort. Synthesizing logic from functional equations still has a long way to go, but we are beginning to see the first such systems.

D&T: New programs or capabilities seem to come into other environments first and then gravitate into the workstation area. For instance, synthesis programs are in the large-computer environment now. Is there a reason for this?

Law: Programs of this sort are first developed for research purposes on large computers. It takes time for them to reach the workstations.
Price: Also, it's easier to develop such tools for a special technology or a specific company's methodology. It's much harder to generalize a tool so that it can be adopted by a broad spectrum of companies. Of course, workstation vendors are in business to sell to the broad marketplace. Those tools right now are more focused, rather than broadbased.

Turner: But at the same time, the module-generation or silicon-compiler companies are focusing their efforts in the workstation area, both for developing and distributing their tools.

Computing power

D&T: During the last two or three years we have seen workstations go from an 8088- or 8086-type machine to the 68000, 68010, and 68020. We are seeing MicroVAX 2-based workstations. As VLSI density and complexity increase, how will workstations answer the demand for more and more computing power?

Van Brunt: Workstations are typically compared to the DEC VAX 11/780. Well, again, the technologies that are making workstations more powerful are finding their way into the higher-end machines. There is a lot of work going on to produce much more powerful supercomputers, and what used to be called a minicomputer is also getting more powerful.

The whole spectrum keeps scaling up, as do the problems and applications. We should stand back and look at the problem in an overall context. The workstations are getting more powerful, and they're viewed as competing against mainframes. But the mainframes are getting more powerful, too. So I think that the relative position of the various classes of computers stays fairly fixed.

If capabilities like design synthesis become available on workstations, it means that people are comfortable undertaking much bigger design tasks. It is similar to what ensues when you build the interface, and many people are looking closely at it as a way of using the computer more effectively. We must make sure that designers come up to speed on a new workstation in a matter of a few hours, rather than a few days of training or two weeks of use. This factor is critical if workstations are to be adopted as extensively as we all think they should be.

Turner: Again, it's a two-sided issue. It's nice to have that easy, interactive interface on which people can learn rapidly, but there also has to be an easy progression into more powerful capabilities that go beyond the easy-to-use features that can be cumbersome for the advanced user.

I think we'll see a three- to four-tiered interface. For the infrequent or novice user, we will see an iconic interface like Macintosh's. Then there will be pop-up menus that are several tiers deep. Beyond them, as people gain system familiarity, we will have more of a standard menu approach. Finally, we'll move into the programmable interface, where the user can define macros and have complete access to the database.

Cohen: We often find users familiar with an existing design tool, and for them, ease of use may mean similarity to the existing tool. The design tool must be flexible and enable the user to customize the interface.

D&T: As soon as we get a workstation on everybody's desk, won't they want more power—such as a Zycad accelerator—behind them?

Price: If they are using a PC, at least they are going to have a large disk resource someplace. The workstation on the designer's desk will be just a gateway to that network.

D&T: Will standards such as EDIF or the hardware design languages improve designers' productivity?

Law: There are two issues here: transferring data from machine to machine, and from person to person. A standard—EDIF or the like—would help in the first case.

Transferring data from the user to the machine—userfriendliness—is a different story. A consistent user interface would certainly be very helpful, but it should be modifiable for the advanced user.

Cohen: This industry strives for a common interface, but I don't think there should be a standard user interface. The need for friendlier interfaces keeps us moving forward; standardizing may diminish the incentive to advance.

Turner: I agree with a lot of that. A standard will lag behind innovation, so your tools won't be the most up-to-date and productive that are possible, and the user will lose.

D&T: What is being done to provide a good programming environment?

Cohen: The emphasis for our users is more on access to programs purchased from outside vendors that complement our tools than it is on a programming environment on which they can develop tools internally. Workstations must have standard Unix capability. However, very few users take advantage of Unix to develop their own tools.

Testing on workstations

D&T: What about testing?

Law: We are already seeing workstations interfacing with testing hardware. Effort is going into making testing more visible to the designer at the front end. You will see more coupling of design and test, and there will be more products in the near future.

Cohen: Tools for prototype testing have been available on workstations for some time.
D&T: Do you expect to see a workstation strictly for the test environment?

Cohen: There are already configurations specifically defined for test engineers. They are networked into the entire engineering design environment so that they can easily share design data.

Law: The design and test groups do not work together very well in many cases, partly because of different backgrounds and partly because of the available tools. The workstation and its tools can bring them together and make each group more familiar with the other's function.

D&T: Workstations have made the design steps less expensive, but we still have million-dollar testers that are used for debugging. Is there a workstation solution that can bring down the cost of testing?

Cohen: The solution is a logic analyzer-type tool integrated into a low-cost workstation so that the design engineer doesn't have to go onto the manufacturing floor and tie up a million-dollar tester just to test a few prototypes or develop test programs.

D&T: How far are we from that?

Cohen: We have those now.

Price: There's another approach that considers the chip design part of the larger system design. When you get your chip back and come to your simulation, you substitute the chip for whatever model you were using and run the same stimulus patterns through it and do your testing at the systems level.

Turner: The situation is similar to what we are finding in the other areas of computing equipment that we have been talking about. When you want a piece of equipment to test parts of the system, you also want to be able to interface to Fairchild or Genrad machines—the million-dollar testers—and to do all the things they do. You want to be able to interface to your special test equipment—a GPIB (general purpose instrument bus) setup of some sort. Most of the vendors are working to get interfaces to that kind of equipment.

Accelerators

D&T: Are the workstation people putting together accelerator capabilities? Do you want to compare your approach to that of Zycad?

Price: No, I think that our approach is to provide some acceleration at a reasonable price compared to the cost of the workstation. The accelerator is integrated with the simulation and verification tools to provide an interactive workstation environment, rather than trying to build a

Participants in this year's D&T Roundtable included Vishwani Agrawal, AT&T Bell Laboratories (top, left) and J. Daniel Nash, Raytheon (top, right); Michael Turner, Metheus-Computervision (middle, left) and Frederick Cohen, Mentor Graphics (middle, right); Michael J. Price, Valid Logic Systems, (near right).
very high performance simulation accelerator, as does Zycad. The tools that Daisy and Valid provide are moderate accelerators of a few hundred thousand events per second and maybe a million or two components. Their cost is on the order of the workstation or less. The advantage is that I can enter my design into simulation in just a few minutes, interact with it, get the results, and close that loop as quickly as possible.

D&T: Would you recommend your approach to a small company, as opposed to a big corporation that can support a lot of Zycad accelerators?

Price: Yes, I would.

Law: The small accelerator gives you the advantage of rapid turnaround for a small simulation, but if you want to run a regression test or some other large task, it is much more economical to do it on a bigger machine, like the Zycad.

---

**"The full blown workstation is what you want for the star performer. You want something with less capability for the lesser design tasks."**

---

Van Brunt: The distinctions you’re making between size and cost aren’t exactly true any more. We have announced some new products that at the high end run at billions of events per second and at the low end are down to a couple of hundred thousand events per second, for only a few thousand dollars. We want to focus on a particular tool, instead of trying to offer the whole CAD system.

Cohen: I think it is OK for a company like Zycad to focus on a particular task and do it very well, but I disagree with some of the approaches to acceleration that have been taken at the workstation level. A more useful approach is one that doesn’t accelerate just one part of the design process, but accelerates a number of different levels—all the bottlenecks of the design process. In addition, accelerators must be a network-wide resource, not just a tool to be used by a single designer.

Let’s not ignore software acceleration. New software simulators such as the MSIMON circuit simulator are showing a dramatic performance and capacity improvement. Hardware acceleration is not a panacea.

**Productivity**

D&T: We have mentioned several times the engineer’s increase in productivity. Are we talking about the average engineer? There are superstars who are very productive and are trusted to do good designs; there are others who graduated with C-grades. Which kind of engineers do workstations make more productive?

Cohen: We are going to make the better design engineers much more innovative and enable them to make more creative use of their tools. For the average engineer who probably makes mistakes with a pencil and paper, the workstation will provide a way of making sure that when a designer compiles a net list, it is absolutely accurate.

---

**Turner:** While that may be true, what is not widely known is how strongly that installed CAD base has been trying to pull the traditional CAD companies into the front end or "CAE" business. That is how Methus and Computervision got together. There is at least as much pressure from these people who have large databases of existing designs. They want an integrated system that builds on this installed database. That is why we became the front end of the integrated CV approach.

D&T: How effective are we at integration?

Cohen: It has been easy to develop the integration because we started from scratch. Traditional CAD companies have taken a different method of developing the front-end tools, in some cases through acquisitions. Now their challenge is to integrate them.

**The workstation market**

D&T: Do you see CAE companies expanding from the electronic CAD market to the much larger mechanical market?

Price: When somebody pays $20,000 to $50,000 for a workstation and comes across a new application that doesn't currently run on that machine, the natural tendency is to tell the vendor, "I need this application. Either you find a third party and cooperate with them to integrate their program into the system, or develop it yourself. I don’t see any point in buying another workstation for this application."
Cohen: The question is much broader than that. The CAE companies are going to keep their focus on electronic design, perhaps looking at packaging issues. But where do we go from there? The workstation companies should remember what happened to the traditional CAD companies when they spread themselves too thin. We will be exposed in the same way.

D&T: How elastic is the market for workstations? How large can the market become?

Cohen: It is very elastic. However, today's low-cost PC doesn't have the power for complex VLSI design. Many of our customers purchase high-performance machines, looking not only at our current tools, but at the tools we expect to make available over the next few years. They want to have the hardware base to run these new programs.

Turner: I think a PC is powerful enough to be used by many team members of a group doing VLSI design, along with other computing resources like high-performance workstations or mainframes.

Cohen: The performance of low-cost PCs will improve. As it does, we will see the opportunity for a VLSI design workstation at every person's desk.

Turner: Still, I believe the machine that will be at every engineer's desk will be a lot more powerful than today's PC. We need to integrate the PC with the rest of the workstations. Then I can do most of my work at the PC on my desk. When I need to move on to something considerably more computationally intensive, I'd like to be able to move that task onto a machine that allows me to do it, but doesn't make me walk down the hall; I want to be able to access that power from my PC. After all, a PC is a very low-cost front end into an entire network of computational capability.

Van Brunt: That's right. The hardware has to be made in such high volumes that you get the manufacturing and marketing efficiencies that bring down the price so it's possible to have one on everybody's desk. Specialized workstation hardware can do that.

We have to look at the whole spectrum of design. For some tasks all the power I need is a piece of paper and a pencil. I do some on a Macintosh, some on Apollo DN300 workstations, and others on still bigger machines. I do some things on accelerators. People who work for me are the same way.

D&T: Then the potential size of the market is limited to the number of designers—one on each desk and that's it?

Turner: Yes, except that the size of the market is not limited to the current number of designers, but to a number that will grow over time as more engineers get educated. There are four to five hundred thousand systems engineers in the United States, and 2000 IC designers. Those boundaries will change as we get more tools. Still, four to five hundred thousand users is a big market.

D&T: What would happen to this market if IBM, AT&T, or NEC were to market workstations and their own software?

Cohen: That's a question that none of us wants to answer! (Laughter) More seriously, if the company offers equipment, we will evaluate its system as a potential hardware base for our own products.

D&T: Do you feel threatened by these big companies entering the marketplace?

Turner: Would I feel threatened if IBM came out with a complete schematic entry through layout and verification package? It would certainly have a large impact.

Cohen: We have anticipated major competition for three years, but every year they are still a year out. Eventually they will come into the market and they will take their share. This market currently favors the smaller company culture, and here, adjustments can be made rapidly. Moreover, the users' major investment is not in their workstations, but in the database. Over time, this increases the conversion cost and becomes a barrier to new entrants.

D&T: How are the workstation companies affected by the current slowdown in semiconductor production?

Cohen: Even during tough economic times, the semiconductor companies have to maintain new product development because new products offer high margins. This demands continuing investment in design tools.

Law: Because of the market pressure to lower costs, companies have to provide lower cost solutions that yield higher performance. For that reason I do not believe there will be a wind-down in our industry.

Turner: The ups and downs in the IC marketplace are certainly not unusual. The issue is a little broader than that—it is the proliferation of electronics into all areas of new product development. People are even putting ICs into ranges and refrigerators. They need workstations to do board design and layout. From a workstation vendor's point of view, I don't see any sort of danger, certainly not in the long term.

D&T: You have just made the market more elastic by going from chip designers to system designers, from a few thousand to hundreds of thousands.

Turner: Absolutely. That's right.

Price: The market for designers in the big silicon houses isn't particularly interesting. It's not very large and they are entrenched in their own design styles, even some of their own design hardware. But the sys-

"We have to look at the whole spectrum of design. For some tasks all the power I need is a piece of paper and a pencil."

October 1985