



Oral History of Avram Miller

Interviewed by: Dane Elliot

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Elliot: All right. I'm here with Avram Miller today. It's August 19, 2013. And we're interviewing Avram specifically on how Intel invests in their future.

Miller: How Intel invested in their Future

Elliot: Very good. I'm Dane Elliot, and this is:

Miller: Avram Miller.

Elliot: Let's start off with a little bit of background here.

Miller: Okay.

Elliot: And the background that I'd like to get is education and significant contributions in your career path that led you to Intel. So education?

Miller: Well, I basically am self-educated. I always say that I graduated from Avram U. I studied music when I was in high school and then I became a Merchant Seaman for a while. Eventually, I got into science. I was always interested in electronics, and I started doing science at the University of California Medical School in San Francisco. Long story short, I ended up in Holland, at the Faculty of Medicine, Erasmus University. By the time I was 28, I was in an assistant professor in Medicine (medical informatics). When I was 29, I moved with my family to Israel where I was an Adjunct Associate Professor at the Medical Faculty of the University of Tel Avi and started up a medical computer business.

What's probably most relevant to our discussion is that I returned to the United States in 1979 and joined Digital Equipment Corporation. I had always used Digital Equipment Corporation computers and had actually consulted for them. I knew Gordon Bell, the head of Engineering, I knew a number of other executives at the company had a kind of like standing offer to join them. I decided to leave the world of medicine, because I couldn't leave the world of computing. I went Digital and I got a job in Central Engineering, Gordon Bell's organization, because I wanted to prove that I could engineer. I knew that that was an important factor in making my way in that corporation. I ended up running half of the Central Engineering hardware the low end, at Central Engineering. Central Engineering was divided into large computer and small computer hardware and large computer and small computer software as well as things like disks, terminals and printers. So I was in the quadrant hardware, small computer hardware.

Elliot: What were the models of the computer?

Miller: And example was the PDP-11/23. I managed all the Qbus computers. We also sold them as components. I had also had responsibility for a time, for the DECmate, which was the word processing machine. At one point I also had the LP printers. So I was responsible for a variety of products. My organization both designed the new ones and supported the old ones.

Elliot: Okay. So was this architecture work, or mainly managing the efforts?

Miller: I got to do some architecture work during my first year there. There were many technical decisions that we had to take, especially about how to evolve the Qbus architecture.

Elliot: Yes.

Miller: We were running out of memory space, which was a problem in the day's 16-bit computers, How would we deal with that was a major issue which I resolved? But after about a year there, I was drafted, well, actually, I guess I volunteered, but I was taken out of that job to run a new program, and that program was directly under the sponsorship of Ken Olsen, the CEO.

Elliot: Mm-hm.

Miller: We called it KO to begin with, for Knock Out, although some people thought it was Ken Olsen. Later it was called the CT Project for Computing Terminal. It became Digital's kind of foray into personal computing. We didn't know about personal computing when we started. We knew about the Apple II. IBM came a bit later with the PC in 1981. We had a major program to build a single-user computer. My group was focused pretty much on the professional market. The product name when it was released was called the Professional Series.

Miller: And we also did some work on some other products like Rainbow, which was kind of an IBM PC compatible product, a project run by Barry Folsom. That work <laughs> taught me a great deal. But it also taught me about engineering a high-volume product. It also taught me in the importance of having a good marketing strategy, which Digital did not have.

Elliot: Can we say that you were sowing some of the seeds of Digital's fall at that point in time, retrospectively?

Miller: I don't know that I was that prescient. I was pretty close to Ken Olsen, in those days. And I would talk to him often, one-on-one. We'd have these funny meetings. Once I said to him, "We've got to have great marketing and a really good product if we're going to win in this space." And Ken said, "No. We've got to have a great product and good marketing." And I said, "No." And we went back and forth. And

finally he got really upset with me and he said, "You don't understand. We are not capable of having great marketing."

<laughter>

Elliot: That's hilarious.

Miller: And this has been documented in a book called "The Ultimate Entrepreneur," I got one of the first IBM PC's and I brought it into our lab, and Ken came down to see it. He got a screwdriver out and we took it apart. Ken thought it was the crummiest thing he ever saw. He said to me, "You wouldn't be here if you built a product like that." So it was a piece of junk as far as he was concerned. But he had no concept of software. He just didn't have any idea where it came from.

Elliot: And I think it's fair to say that at that time people had no idea of what the market for that product really was.

Miller: No. And it hadn't really taken off. And there were things, a lot of things, that weren't decided yet. For instance, what would be the network architecture? It was totally up for grabs. Digital could've dominated that with their network technology called DECnet, which was really the best networking technology out of the market. But it only used it for its own proprietary products.

Elliot: Exactly.

Miller: In 1983, I actually thought about starting a company, starting a local area network company. But I got offered a job to become the chief operating officer, president, of Franklin Computer. And Franklin Computer was an Apple II clone.

Miller: And it was just starting to go into operations. To give you a idea of how successful it was, in the first year of operations it did \$80 million. Now, this was in 1983.

Miller: And it was growing faster than Compaq. Apple had tried to sue Franklin, before I joined. And they lost that suit. But it was out on appeal. And I thought "oh". But the lawyers at Franklin said, "Don't worry about this. This is just a formality." We started working on our initial public offering. <laughs> But it wasn't a formality. The appellate court did not find against Franklin, it just found that there were matters of law that it did not agree with the lower court, particularly the famous issue, which was, "Could you copyright firmware?" And the appellate court said, "We think you can." And since the lower court thought not, that was one of the reasons, one of 10 reasons, that they had not granted Apple its injunction against Franklin. They said, "Go back and rehear this court case." And so everybody thought we lost, and our

bank wanted the money they lent us back and it was a difficult time. I always describe it as like driving down the freeway at 100 miles an hour without any brakes and no gas in your tank. That's how I felt.

<laughter>

Elliot: It's interesting, because from a lay perspective at that time, which I had, and because I wasn't in the Apple court at that time, I had the impression that Franklin had everything they needed to be very, very successful. And albeit they had an issue of firmware, but one always assumed that you could probably rewrite that firmware and get away with it.

Miller: Not so easy.

Elliot: And it never happened.

Miller: Well, I mean, it's not so easy because they used constants that were in the bios.

Elliot: Ah.

Miller: In ways that there was no way around it, at least, not any good way around it. But actually, after that kind of played out, and I felt disappointed. I had gone to Franklin because I thought the company was doing really well. We'd raised a lot of money. That I could be strategic and figure out how to grow the company and not just be an Apple clone. But that wasn't going to happen. And I left. And then I went out and I did some consulting and whatever, and then I got a, I think. I can't remember if was a letter or phone call, I think from Mike Richmond.

Elliot: Right.

Miller: Mike, who's still at Intel had seen an article about me in some newspaper, and had sent it to Les Vadasz and said, "This guy looks like the kind of guy we should get here." And Les said, "Oh, good. Find him."

Elliot: So before we talk about how that happened, talk about what a strategic effort Les was managing and what a strategic hire is.

Miller: Well, let me do that in the context of how I got to meet Les.

Elliot: Okay.

Miller: Because it took, evidently it took, Mike Richmond a couple months to find me. And he called me and said, "Would you like to talk to Intel?" And I couldn't figure out why in the world I would talk to Intel. As far as I was concerned Intel made memory chips and maybe some microprocessors, but it wasn't a computer company. It was a chip company and what would I do with a chip company? I don't know anything about that. But Mike said some things to me that made me interested. And the other thing was that the lawyers who represented Apple in its case against Franklin were the lawyers representing Intel in the AMD suit. So I thought, "Well, one thing I know is these people have the right lawyers."

<laughter>

Miller: So I came and I talked to Les on the phone. And then we set up three days' worth of interviews. It was a lot. I had to go up to Oregon where I met a number of people, including Ed Slaughter Justin Rattner, Bill Latin. I then came to Santa Clara and met JC Cornet, Albert Yu and Mike Aymar. I am sure there were others.

Miller: I probably saw six people, seven people a day, for three days.

Miller: This included Andy and Gordon. Well, course, Les several times. Andy was interesting, because I took his book, I read his book, "High Output Management."

Miller: And then I thought, "You know, I'm going to write down a bunch of things." I never write down anything. I can't even read my handwriting. So I wrote down all these things so that when I had a meeting I took my notes out, which impressed Andy that I had read his book and I had questions there for him and so on. But I didn't need that because I could do it in my head. But <laughs> it had the right effect, and Andy actually got up in the meeting and called Les and said, "Hire this guy." So he probably regretted it later. I don't know. Les is this most amazing man who I think is the unsung hero of Intel. Not that Andy and Gordon and Bob were not fantastic people. They were, remarkable. And I had the privilege of meeting all three of them. But people know about them.

Elliot: Yes.

Miller: Nobody knows about Les. And I won't take our time to go back through his whole background, but Les played a really prominent role in Intel's development. When I met him, he was responsible for something called Corporate Strategic Staff. And why that name exactly, I don't know. It was a hodgepodge. So in it there was Mark Aymar who was running corporate CAD, so that was a corporate activity at the time. And so no place to put it; put it under Les.

Elliot: Give it to Les.

Miller: Albert Yu was running some process that had to do with product line planning. I think product line business plan, or PLBP or something like that. Some acronym. And he was managing that process, working for Les. And then Ed Slaughter was there, and Ed had a group called IDO, Intel Development Organization. And the mission of Intel Development Organization was to create new business for Intel. And two of them were reasonably successful, and the others I've forgotten. One is the Super Computer Group, which Justin Rattner, who was up until very recently, a few months ago, CTO of Intel.

Elliot: Yes.

Miller: And the other was PCEO, which was basically a retail group developing new businesses. Computer retailing was just kind of starting then, and they were developing retail products, the most famous at that time became the fax board. They developed, the first step for using a computer to do fax.

Elliot: Right. Now, this would've been '84 time frame?

Miller: I joined August 4, 1984.

Elliot: Okay.

Miller: Les had this group with a problem. It was a joint development project with Siemens. Sudhir Bhagwan was the Intel manager for the systems activity and Randy (forgot his last name) was responsible for the component development. The project was developing a new mini computer focused on high reliability computing. They were developing a new Operating System, as well as a processor architecture called the P7. It was an object oriented technology and had a 33-bit word length. Les wanted to bring somebody in to a staff that really understood more about the computer industry. I think that was kind of the role he was considering for me. When I talked to him I said, "What would be my job?" And he said, "Whatever you want it to be." He says, "I can hire somebody at a very high level once a year as a strategic hire". We're hiring you because we want you. We don't know what you're going to do, but we want what you can bring to us." I liked that. <laughs> That appealed to me. <laughs> But in the process of interviewing, of being interviewed by Intel, I interviewed Intel.

Elliot: Yes.

Miller: And I asked to see the strategic long-range plan. And so I was given a copy of the strategic long-range plan. I sat in a conference room. I couldn't take it away. And the beginning of that plan it said, "Change is our ally." And I thought, "Wow. That's great. Because I really like change." <laughs> And so,

“Maybe this is the right place for me, because I can help them change.” I used to joke about this, that when Andy was interviewing me and he said, “We really need help to change,” I think I must not have heard him correctly. I think he may have said, “We need to change; you make us change.”

<laughter>

Elliot: Very likely.

Miller: Because it wasn't so easy. <laughs> Change may have been Intel's ally, but it wasn't an ally that many people in the company embraced. I found out later, sadly.

Elliot: Yes.

Miller: So I said, “Okay.” And then I said, “Where shall I locate?” And he says, “I don't care.” So we had traveled to Oregon and we had traveled to Santa Clara with my family. So I let them decide. They decided they wanted to go to Oregon because they could get a bigger house. <laughs> We were coming from the East Coast. We were already used to bigger houses than we could get. So compelling at the time. <laughs>

Miller: Yeah. So that brought me to Intel.

Elliot: So that's August 4th.

Miller: Yeah.

Elliot: Okay. And what projects were you associated with during the time that you were in the Oregon operation, working in Oregon? And how do you think they influenced or didn't influence the strategic nature and change at Intel?

Miller: Yeah. Well, it's funny, because I think I came to Intel with a hope or an ambition that I soon discovered I could not pursue. And that was I was really interested in the consumer market. And not necessarily even for computers. I was just really interested in consumer electronics. I have a very close friend, Steve Mayer, who was the co-founder of Atari, and I had seen the whole growth of Atari and was always interested in stuff like that. But soon as I joined Intel and I learned about all the activities in Intel and I had decided to go to Oregon, and that was the home of The Systems Group, which was run by Bill Lattin, who was the vice president, and they had people in, a lot of people in Oregon, but they also had

people in Phoenix. They had people, I guess, in Santa Clara. They were doing development systems and boards, memory boards and other kinds of things that were being done.

Elliot: Richie Bader's stuff?

Miller: Well, Richie Bader's stuff was not part of the System Group.

Miller: He reported directly to Ed Slaughter and as part of the corporate strategic staff. Later it got merged in with the System Group.

Elliot: Right.

Miller: But that's another story. So I looked around and I said, "Oh. Well, what is System Group doing?" And at first I found out they were thinking about getting into the PC business, building PC's and OEM-ing them. I spent some time trying to help them understand that market. Actually, I wasn't very positive about their plan. I didn't think that Intel had the cost structure. I took them to some other companies, and showed them their cost structures

But there was also this project that was going on with Siemens in a different building. It was like a secret project. And the project was to develop a whole new computer architecture using a new processor, which, guess, what, was a 33-bit computer. It was an object-oriented computer and it was going to run the only computer language designed for object-oriented computers, Ada. I haven't even said that word probably in 15 years. And there were a group of developers from Siemens and a bunch of people from Intel. They were collaborating. They were in this building together and trying to develop a full-tolerant, high-transaction-oriented computer system that Siemens would use for the factory market. Intel would then bring the microprocessor as a successor, can you imagine this, as a successor to the Intel architecture of the 286, 386. Okay. That was going to be the next architecture. We were going to give up all the x86 and use this. I was asked to figure out the business and be the marketing arm of whatever Intel would do there including the component business. Fortunately for Intel, it realized that the x86 architecture should continue. So we sold the chips into specialize markets like avionics. We sold chips actually to Boeing. I ran that too. And tried to put this together. We were looking for software developers. We were doing the normal thing you would do developing a computer company. I couldn't see how that company could ever be successful if after the joint development everybody went their own way, because there would be two companies with exactly the same architecture not cooperating in the marketplace, and we're just starting out and I just thought that was going to be messy. I also didn't see how Intel could ever make a business in the computer industry since they didn't really have salespeople that could do that.

Elliot: So let me ask a couple of background questions here. Okay. Number one, this is actually the second object-oriented effort.

Miller: Right. There had been earlier one.

Elliot: There'd been an earlier one.

Miller: 432.

Elliot: Okay.

Miller: Yeah. So Intel had some kind of object-oriented fixation

Miller: <laughs>

Elliot: And it was interesting but it didn't live up to the performance cost levels at all that they thought.

Miller: Right. Right.

Elliot: So this was kind of the second attempt to do this type of thing.

Miller: Yes. Yeah.

Elliot: And you mentioned another very important thing here. And this is a place that I had some insight even though I'd left Intel by this time. And you might want to elaborate on it. The fact that Intel saw this as a replacement for the x86 architecture in the PC market.

Miller: Yeah.

Elliot: And why was that? Why did they even want to do that?

Miller: It's funny, you know. I think there were different reasons. One was that they still had competition. You know, there was AMD.

Elliot: Cyrix

Miller: And this was in the 286 times.

Elliot: Yeah.

Miller: And there was a feeling that somehow the architecture would become a commodity, and Intel would be back into the memory business again, selling silicon by the ton. And so they didn't want to do that. There were concerns about not being able to get to the right performance. These were also the time of RISC, the RISC computers.

Elliot: Right.

Miller: I remember Steve Jobs was at NeXT, and he didn't come up himself, but he sent bunch of his people up to talk to us about this. And we were going around to Sun who had the SPARC, and trying to convince them that this should be the next generation, and because this machine was a RISC machine.

Miller: So it was a kind of RISC-plus. You know, it had characteristics that made it much more reliable than other computers. But it had RISC kinds of performance, and it was very scalable so you could add more and more processors, you could build any size computer you wanted. And on paper it sounded wonderful. <laughs>

Elliot: So did the 432.

Miller: Yeah. But it didn't have an install base, and without an install base of software, I mean, that installed base of software that was on the 86 architecture was so good and somehow Intel was able to pull away with the 386. We had had a deal with IBM where IBM was allowed to manufacture a certain amount. They were still a big player. They had given up their ability to build a 386 in order to get, to be allowed to build, more 286. They made a strategic decision that 286 was more important than 386. They didn't want to build a 386 computer. We actually went, I think, to Dell and got Dell to do it.

Elliot: Compaq.

Miller: Or Compaq, sorry. It was Compaq. Yes. We got Compaq to do it. And yeah, we used to call them our "rabbit", We used to call those companies, to get them go out there and get everybody to chase them, the "rabbits". So that's how they must've come to this conclusion, that this new architecture. And that was going to be the architecture. When I joined the company I don't think there was any question about it. You know, it wasn't going to be the 86 architecture; it was going to be the P9 architecture.

Elliot: But Intel was still going to own, and even in more secure terms, the PC marketplace.

Miller: Yeah. I don't think that Intel, when it started this program, and even in 1984 when I joined, had any concept of how big the PC market was going to be. I mean, they didn't really. It was just a small part of the computer industry.

Elliot: Yes.

Miller: Remember, Digital Equipment Corporation was still a major company. Big player. I think IBM was also. It wasn't the computer industry we know today. I think that's very important to understand.

Miller: Only with the IBM AT and then things started, people started using, really using, them in corporations. Corporations weren't really using PCs in '84 that much. They were using terminals. They're still connected to TimeSharing systems.

Elliot: Right.

Miller: Wasn't today's thing. So you can't understand what happened in the context of Intel for sure. For sure, Intel had no idea, No idea about the PC industry at that time.

Elliot: How big it was going to be?

Miller: No.

Elliot: Or what it was going to be?

Miller: No.

Elliot: You mentioned the fact that the Aerospace industry was putting effort into and buying the 80960 I think was the right number for it.

Miller: Yeah.

Elliot: Was it successful in some markets. Okay. You mentioned Boeing. I had the general feeling that it was military types of applications

Miller: Well, the chips. Yeah.

Miller: Yeah. The chips were, but the computer... So what happened is that for good or bad, I felt that the only way that this effort could succeed was from the computer business point of view, not from the chip perspective. I thought Intel could sell the chips, no problem. But from the computer point of view, Siemens and Intel had to give up their rights to be in the computer business by merging their rights into a joint venture company.

Elliot: Right.

Miller: And Siemens would then become a customer, and Siemens would market that product to the industrial market where they had a very strong position. They had their own proprietary computers.

Elliot: Absolutely.

Miller: And so it was decided. It was a lot of work. It was very hard to get both Intel and Siemens to re-own the structure of this joint venture. But eventually, they agreed. And then Intel made a decision that they wanted to bring in an outside CEO to run it.

Elliot: Right.

Miller: And they hired Joe Kruger who was president of Sperry Computer, or Sperry Univac. I think it was two companies merged into Sperry Univac, I think at the time.

Miller: It was like a beauty contest. They wanted to get somebody who had real name from the old computer industry. It bothered me a little bit because one hand I thought that was the wrong thing to do, but the good news was they weren't asking me to do it.

<laughter>

Miller: And I might've felt like I had to, given that I proposed doing this thing. What would I say? But I didn't really want to do it. So they hired Kruger was the last name, yeah. And he went up there and I left and went to Santa Clara. And I don't know how long it continued. Couple years. And somehow I guess it was just phased out. It was never very successful as a business.

Elliot: Yeah. Never really successful, but certainly the chips did sell into some military and I believe a bunch of printer applications. HP used it some.

Miller: Maybe. But there was a real benefit to Intel. It turned out to be very successful for Intel. In a way, extremely successful, because Intel was able to build up a tremendous amount of computer industry technical skills funded actually by Siemens.

Elliot: Right.

Miller: For the most part, people like Kevin Kahn, and then, oh, name's going to escape me, but he was the CTO for the microprocessor business for such a long time. Without this program we would not have attracted people like Steve McGeady. They would never have joined Intel and Intel would never have hired them. But they were so necessary for the next phase of the business.

Miller: And they were right there. So when that business faded out, those people moved into what became Intel Architecture Labs.

Miller: And before they were Intel Architecture Labs, Craig Kinnie was running an advanced development group for Bill Lattin in The Systems Group. And then later that got spun out along with these people and that became the Intel Architecture Labs (IAL) under Ron Whittier.

Elliot: Right.

Miller: Ron became the corporate guy, the lead guy there. And Les, strangely enough, went up to run The Systems Group, which had expanded and had done what I had always questioned them not to do which is to become OEM supplier of PCs. And they started to sell to AT&T and others. And they got a little bit over committed and Les went up there I think for four years and ran The Systems Group. I continued to report to him but from Santa Clara from 1988.

Elliot: One thought on that I'd like to know a little bit more about on The Systems Group. Intel eventually became and a few other chip suppliers became the source of systems architecture for the entire PC world. I mean Dell didn't know what to do with architecture.

Miller: Yeah. Yeah.

Elliot: Was that a direct outgrowth of this effort?

Miller: So I believe that most of those designs, all that design stuff that Intel would do and also all the things they would do in software areas, was called the Native Signal Processing.

Elliot: NSP.

Miller: NSP project and all the rest, all came out of the architecture labs and mostly came out of people that had been hired for the joint development project with Siemens.

Elliot: Incredibly important then.

Miller: It turned out. I don't know if it's really understood. It turned out to be incredibly important.

Elliot: I find one of the things is very poorly understood in the PC industry is that in the beginning every PC company had their own set of architects. They did their own design. They decided which chips to use. And a few years later you bought the motherboard design or you licensed the motherboard design from AMD, or Intel, or Cyrix. Whoever was supplying the chip had to supply the whole solution.

Miller: Right. Well, I, you know, I always thought of them as being—all those PC OEMs as being our distributors. And, you know, not only our distributors but also Microsoft's distributors. So those were the days when Intel and Microsoft had 120 percent of the profits of the computer industry because everybody else was losing money. <laughs>

Elliot: Okay. So that pretty much brings us to a close on background. Are there any other comments about the Oregon stuff that you can think of?

Miller: No.

Elliot: Okay. So let's move on to coming down here to Santa Clara, another big move for your family. Hopefully, you found a house that was a little larger than you had seen before.

Miller: Well, Intel stock had increased a little bit too. And, yes, we moved to Palo Alto. My wife went on to do her PhD at Stanford. My kids were there. And I was working in Santa Clara, which I think. You know, everybody always said, "You know Intel doesn't have a headquarters. There is no such thing." And, you know, I discovered that that's what you told people that weren't living in Santa Clara because when you were in Santa Clara you knew it was a different situation because you just had hallway conversations with people that you would have never have met otherwise. And so I began to work on mostly on networking. I was convinced. I had always been interested in networking. And in fact, one of my—the only project I ever had with Intel before I joined Intel was Ethernet. Because when I was at Digital my group had been selected to work with Intel and Xerox to bring Ethernet to the market. And I built the first what essentially was the first personal computer. I have one in my home. I still, that actually had a built-in Ethernet.

Elliot: This was the old vampire connection stuff?

Miller: Yeah. It was, you know, the yellow cable. Yeah. I was always interested in networking. And I really felt that networking, first in the business area, was going to be really important to grow. To make it possible to actually use personal computers as opposed to terminals as the way for corporations to communicate. And so I kind of approached that from a number of areas. I thought Intel could become a big major networking company. And that was my ambition. So I put together a roadmap on how to get there. Primarily we didn't have the skills. We had some of the skills because we could do all the chips and we knew what to do. But we needed some other skills. I thought about, well, first of all I thought about acquiring a big company. So 3Com was a large company and Cisco was also becoming a larger company. Cisco was on the ascent and 3Com was on the descent. I knew the guys at 3Com. I had given them their first order when I was at Digital. They built a board that plugged into the computer I was responsible for developing, Bob Metcalfe and Bill Krause were the two founders.

Elliot: Yes, I know them both.

Miller: And so I thought, "Well." And they were kind of being beaten up in the market a bit. I thought, "Maybe that would be the company." So I made a presentation to Andy and to other people. I don't think it was at the board, but pretty high level about 3Com. "Let's buy 3Com." And, "We don't want 3Com. There has-beens." So then I went and I met with Cisco. I did a bunch of work on Cisco. I had investment bankers. I did all this stuff, all the presentations. They said, "That's a great company but it's too expensive." So then I understood. I said, "I got it. I got it. We don't want anything we can afford and we can't afford anything we want." Right. But that was it, you know. So then I decided we could buy something smaller because that wouldn't affect the stock price. I found a company called Jupiter Systems that had a lot of software for networking. And I'm talking about really complex stuff. Not just simple local area networks but I'm talking about the whole shebang of of routing emulations, other kinds of stuff. And it had a strong CEO, Jim Flash I thought, "Wow, this is a great group of people. Let's buy the company and then they'll become the foundation for our Networking Business. We'll be able to use their technology and more importantly we'll be able to use these people." There was another company called LAN Systems and I looked at them. And they had some relationship with PCEO. And they had a guy, Tyrone Pike, running it. And I thought, "Oh, well, this is a bunch of people also with good skills." And there were a large number of them were located in Phoenix and I thought, "This is perfect." So we bought both of those companies and both those gentlemen, Jim Flash and Tyrone Pike became officers of The Systems Group. And then Jim eventually ran the networking business, PCEO. The guys were running PCEO that merged The Systems Group and they left and he took over.

Elliot: So this is an early strategic investment basically?

Miller: Yes.

Elliot: An early example of what Intel did with their money in order to grow their business.

Miller: Right. We also I think in '88 or '89. I think it's '89. I got Les to agree to fund the development of an Ethernet business in PCEO. So we took some of our funds our corporate money and we funded them to develop an Ethernet business. They developed a business plan. I worked with them on it. And we got chips from a company called Broadcom, which became one of our greatest investments ever and a company that we should have acquired, but didn't. And we got into the Ethernet business rather successfully in the beginning of that business. And we probably had the leading or certainly one of if not the leading add-on board for Ethernet, branded with Intel.

Elliot: Yeah. I bought a few of them.

Miller: Yeah, one of the few things the Intel brand that a consumer could buy. I think we also had eventually the Math chip was something you could buy, I think.

Elliot: Oh, the floating-point math coprocessor.

Miller: Yeah, the coprocessor. I think that was branded at one point. I forget about that. So we started doing that and it became really apparent to me that we weren't going to become a networking company. And that there was just too much, it was too different and there was just too hard to do it. I didn't see these guys lasting and they didn't.

Elliot: So back to Andy's admonition: "You're responsible for bringing change".

Miller: Yeah. So I think I was two strikes down already. So in trying to do that and I kept trying to understand Intel. I mean not only Intel the culture but what was Intel as a company. The culture was kind of hard for me to understand because I was so different. But as a company, I thought, you know, I started to understand how powerful the core competency of this company was. It was like nothing else I could imagine. We could just take sand virtually and create this thing that would change the world. I would actually give talks later and say that Intel was the energy source of the information age. We were like the sun; the Microprocessor was the energy that propelled the whole thing. I just was trying to think about, "Well, what do we do? How do we grow this business?" I didn't have much to offer microprocessor business. I didn't know much about it. I knew about the computer industry and I saw the stuff happening.

I remember I had a lot of conversations with Professor David Yoffie who was writing a case study on the company. David Yoffie is now one of the Intel Board members. I am still friendly with David. Since he was a professor I would talk to him about business strategy. I just came to conclusion that acquisitions were not going to work for Intel. But that if we could invest in early stage businesses maybe we could have

some strategic impact that way and we would get some insight. So that's what I was thinking about. How can we have strategic impact and how can we get insight? And I started to talk to Les about that and he said, "Okay", we could do some of that. We can buy some companies and do some investments." Remember I'm a strategic hire. So I started doing that. Sometimes this kind of comes back to, I guess, what was really was the beginning of CBD. So in '88 there wasn't a CBD. I was doing the stuff but Les was running The Systems Group. Les came back in '91. I was still doing the same stuff. Les went away for about six months in '90, '91. I wasn't the only one; there were a few people. There were a few investments that had been done by the Microprocessor Group. I think Harold Hughes started them and then Stingen and a couple other people. Forgive me for not remembering everybody's names maybe they'll come to me. But they did a few investments in the microprocessor business unit.

Elliot: So this is kind of a watershed change if you will in the way Intel thinks. Up to this point and time and clearly back in my time it was strategic investment. We did cross licenses. We helped people develop software for our stuff. But the software wasn't commercial software in the sense of user-friendly software. It was a compiler. It was an operating system an RTOS or something like that.

Miller: Yeah. Yeah.

Elliot: So those were our strategic investments and I think you pretty much confirmed that that's the way Intel thought about investing for a long, long time. But this when you start talking about minority investments in the marketplace that Intel sells into, that is a watershed change. Was it recognized as that?

Miller: No, not at first of course. I mean, God forbid that they recognize it. They would have stopped it. Intel didn't want to be involved in anything it couldn't control. One of the biggest problems I had as I started doing this was the fact that we couldn't control these companies. "What do you mean we're going to be minority investors in these companies? That our name is going to be somehow associated with a company but we don't control what the company does? The company could do something that might reflect badly on us." The control issue was huge, a huge obstacle for Intel doing things, because it didn't want to do anything it couldn't control. And it couldn't control everything. I started doing this stuff and I also was doing, you know, some deals that The System Group wanted to do. I would put those together. I started building up a small organization to do this. In the very beginning Andy would come to the meetings where we'd discuss these investments. That was a little bit painful because in the short time that we had to talk about them we would be talking about something that most people didn't know anything about because of by definition they weren't us. They were something else. How in an hour, can you explain to somebody not only about the company and the management and the financials and the deal and all the rest but a whole new industry?

Elliot: "And why is it important to us?"

Miller: Yeah. And, "Why should we invest in it and how we're going to manage it?" So we had to go through those things again. Thank God, again, for Les's relationship with Andy. Otherwise, I could never have gotten these things done. Andy would have killed me. So we started doing those deals. And then Les realized this is not the most efficient thing. Because Les had a strong relationship with Andy, Craig Barrett, with Gordon Moore and the other people on the board, he was able to get Andy to agree allow Les to make the decisions up to \$50 million. Andy sort of moved out of the way. Les would socialize something if he thought he should, but Andy didn't come to the meetings. So the meetings were just the dealmakers. When Les came back from Harvard, this is really the important thing that happened, we created CBD (Corporative Business Development), which then became Intel Capital in 2000, which was only a name change. While Les was still at Harvard Andy said, "Look. Why don't you come back? We have business development happening every place in the company." Every group in Intel had something called business development. It's like having engineering and marketing. And they did deal. Some of them might be a licensing deal. They could be in some cases, loans. There could be even some cases, could be some equity. I don't think it's very often used until I started doing it.

Elliot: But development?

Miller: Development agreements. All kinds of stuff, and they're all over the place and they're all done differently. And the only group that tried to keep some control over it was the legal group. And people like Ted Vian. So Andy said, "Why don't you look at this from a corporate perspective?" Look at all the things we are doing. Put some kind of structure into it. Rationalize it. Get it to working, including the crazy stuff that Avram does, you know." So Avram, put him in there too. We created Corporate Business Development. And created the idea of "corporate development" being the whole corporation. Business development became the generic term for all the things that were going on. But kind of quickly it became pretty much just minority investments, or joint ventures, loans minority investments and from time to time, acquiring companies. But we didn't do licensing stuff. That part never really happened.

Elliot: Licensing tended to fall off in later years.

Miller: Yeah. It just, it wasn't part of what we did. I spent a lot of time talking to Les about the strategy that I had. The strategy I had was "let's grow the market". Let's not just support, the business units so they do better deals. You know, cleaner deals, better financially, better legalese, better operational deals but the discipline it.

Elliot: Structured the same or?

Miller: Structure it. "That's good. Let's do that." But let's also do things that actually go out further in time and can grow the market for Intel's products, particularly for the personal computer. Since we had 85 percent of the computer market I argued it doesn't matter if we grow it also for the 15 percent that AMD

had, Let's just grow the market and not worry that it might benefit somebody else. So that was my fixation on growing the market. In the beginning Les wanted the buy-in from business units for every deal. You know, who's the person? Who's the expert? Whatever. That really slowed things down because I would have to find a business unit that could somehow benefit with from something that I wanted to invest in but that might not pay off for three or four years. They weren't thinking that far out in time. So eventually it was agreed that I didn't need to have their buy-in, that I didn't need a business unit. I could just do deals, so then a lot more deals got done.

Elliot: Okay. So let's just go forward from here in terms of the kinds of minority investments you were making and how this is actually growing this marketplace. Because I think there were a lot of different areas that you guys made investments in. It wasn't just all down one channel. Although a large amount of it was focused on, "How do we make the PC market itself grow?"

Miller: Right. Well, so but what happened is that I was working for Les. And then Les decided that he wanted to do more investing and that this was a good concept. And he wanted to go into some other areas that I didn't care about, for instance, semiconductor-manufacturing technology was one. We actually went into healthcare. We did Enterprise Computing. I remember I said my dark secret was that I was really interested in the consumer market. So I was focused on that. And then after being at Intel for seven years I took my sabbatical. I came back from my sabbatical in '91 and said, I wanted to work on the consumer market. Andy Grove said to me there wasn't a consumer market for computers and I disagreed. And he said, "Well, if you want to waste your time, go ahead."

And then, something very important had happened that made a big difference certainly for me, and I think for Intel. Bill Gates called Andy Grove up and he said, "You know, Andy, we're really interested in doing something in the consumer market. We can't seem to find anybody at Intel that really is interested. So we assume that you're not interested and that you wouldn't really care if we worked with AMD on the consumer market." So Andy said, "Bill, that's totally not true. We have a Vice President that's devoting himself entirely to the consumer market, Avram Miller. I'll send him to Redmond right away." So before I knew it, I was up in Redmond meeting with Rob Glaser who became my counterpart for a while at Microsoft. Later he went to start Real Networks. Microsoft told me they had a number of different projects they wanted to pursue. One of them was a multimedia computer game machine using CD-ROM. This was the day of enhanced CD-ROMs. Another was like an iPod Touch kind of product, like Apple's. We worked on that a little bit. But the main thing they wanted to focus was in the interactive set-top box.

Time Warner had started a project that had everybody's attention. They said that the Interactive Device of the future was going to be the set-top box. Bill Gates said, "You know, the square foot on top of your TV is the most valuable real estate in the world." I remember him saying that. So Microsoft is really hot to go after this market. So I said, "Fine. We'll put together a group. And I actually pulled together a group of people out of Intel Phoenix and some people out of the Intel architecture labs in Oregon and we started working on what we called a Pandora (Pandora's Box). We started putting together an interactive set-top box. So I wasn't just doing business development in the sense of minority investments, I was like

managing the Intel relationship—consumer relationship with Microsoft. Intel's Senior Executives together with the Microsoft Senior Executives would meet every quarter. I would attend those meetings. Later, Craig Mundi took over from Rob Glaser; he eventually became CTO of Microsoft and became my counterpart. We had these meetings of set-top box and in that process I realized there was never going to be an interactive set-top box, not anytime soon because there was no way that we could build one cheap enough that the cable companies would offer it to their customers. The other thing I realized was that there were just not enough pixels on the TV. Furthermore, you don't want to interact from 12 feet. So I learned during that process how the cable industry actually worked technically and business wise. But I also grew to understand the technology of the cable. I realized, "My God, there's so much bandwidth in this coax cable." You know there are gigabits of bandwidth in these cables. I kind knew, you know, we were baseband and Ethernet but there had been some broadband local area networks that had been developed earlier. So I knew how much bandwidth was there. I was really excited about that. And then I discovered the suppliers to the cable industry were working on chips to do digital television. You could do HD TV and also to provide more channels digitally than they could do with analog.

One of the leaders of the cable industry, John Malone, was talking about the 500-channel universe. He was talking about all these channels that would exist basically to pump up a stock price. But his cable plant, which he bought by acquiring old cable plants, was the worst plant anybody had. It was the nosiest plant. And so he wasn't able to add more channels analog and he was really interested when somebody told him, "Well, we could do it digitally." So their suppliers like General Instruments needed these chips. And I found out that Broadcom was one of the companies working on the chips, which we had an investment in. So I learned about how these chips worked and I realized they were packet based. Oh, my God I understood that we could do the same thing as Ethernet over them. And I came to that realization together with the CTO of General Instruments who's name is also Miller, Matt Miller. We decided, "You know what? Why don't we go and build a way for personal computers to connect to the Internet at high speeds through the cable network but let's not tell Microsoft." So we didn't tell Microsoft and we kept working on our other project. So Intel and General Instruments had this additional project going on. It was called Edison. I have the business plan for Edison. Guess who was the CEO of General Instruments, Don Rumsfeld the former and then future Secretary of Defense. I would meet in his office with the American Flags, Eagles and things like in the background. So we started working on that the cable modem. I want to bring this back to Corporate Business Development. Les supported me in this activity. He thought that doing this was really made a lot of sense. I told him that I needed to get the Intel labs to design the technology because the cable industry didn't have the ability. I said I wanted to use the CBD funds to do it. Well, that was crazy. I mean why would you take money from the Venture Group of the company and give it to the Architectural Labs, the advanced development people up in Oregon. That just seemed nuts. So I said, "No. No. I'll get technology from them and I'll license the technology for options in the companies that we invest in later when we give them the technology." This way we could close the circle. So we did that. We made hundreds of millions of dollars. We turned the Intel Architectural Labs into a business. The labs were really happy to do the stuff because: 1) it was interesting and 2) they never had enough money. I think about 20 percent of the Intel Architecture Labs were working on the projects that I funded.

Elliot: I had no idea it was that large a group.

Miller: Yeah. Yeah. And so later after we did the cable modem, for instance, we developed DOCSIS, which became the cable modem standard protocol. We gave it to the cable industry. Later, we developed DSL and worked with the phone companies. We took ADSL and modified it to work with PCs. I went around to all the cable companies and met with the CEOs and told. I said, "Guess what? You're not in the TV business. You are a communications company. TV is an application of your platform. The Internet is also going to be an application of your platform." You can imagine how difficult that was for them to understand. In .We did the first cable modem trials in 1994. We did them with Viacom who had a Cable Company at the time and we did it with Comcast who is now the leading Cable Company. Our definition of success we decided would be if people were willing to pay to continue to run. I think almost everybody was. People were just blown away. But we had no content. So we had to go to companies and get them to let us connect via the Internet. Then we actually put what we called a jukebox, which had enhanced CD-ROMs and then we could download them over the Internet. So that if you wanted to play a game or whatever then that was how you got it. That's how we bootstrap residential Internet.

Elliot: Wow. I never realized that.

Miller: Yeah.

Elliot: Not being a game player I would never.

Miller: We then went to the cable shows. The first was the Western Cable Show in 1993. We were there with computers. People said, "Why are there computers here and what is the Internet?" We were in the General Instruments booth. Later in the 1994 we had our own booth at the cable show. So I started investing in all the companies that I thought would make money from the development of residential broadband, the consumer internet. I thought the consumer Internet was going to be huge because I could see people staying over at work to use their computers. I saw secretaries, and assistants staying at their desks at lunchtime on their computer doing things. There was a term "work at home". I termed this "home at work." You went to work so you can do your consumer stuff. So I thought this was going to be huge and started trying t invest in every parts of it. We invest in things like VeriSign that did the security stuff. We invested in the one of the first music companies, Launch Media that was bought later by Yahoo. We invested in Broadcast.Com, Mark Cuban's company. I love it when I see the TV show "Shark Tank". Mark Cuban was on that show because I remember when I was the shark and he was in the tank. You know, he had to come to me and give me the presentation and I invested in his company. There were a lot of success stories like that. There were some investments that we didn't do unfortunately. We didn't do Netscape for instance. My focus was primarily in anything that touched the consumer. I would invest in things that would be on the business side but it got to have kind of a consumer component to it.

Elliot: How was this being received by Intel, the corporation that makes semiconductors?

Miller: In the beginning, not very well. I remember one Intel executive saying to me, "Do you think it's really moral to make profit from investments?"

Elliot: I beg your pardon?

Miller: I said, "What do you mean?" And he says, "Well, you know, don't you think that a company should make money by actually building and selling things?" He implied that there was something wrong with what I was doing. In general, either people didn't care of they thought it was weird. But they didn't have any reason to go after it. We started making a lot of money and so I always said that profit was strategic, too. Les and I both came to the conclusion that while making money was not our strategic goal, our goal was first rationalizing the process. The second goal was then growing the market. I think a third goal was maybe influencing Intel's long-term path. We didn't succeed there. But making money wasn't it. We just didn't want to lose money. Then we started realizing that they weren't uncorrelated, that for a company to have impact in the marketplace it had to be successful, and if it was successful it made money. But it wasn't the driver. We would never have done a deal—at least in my time, we've never done a deal just because it would've made money. You know, we would've said, "No, that's not our business. Our business is growing Intel, you know, making Intel successful." But evidently we've made a lot of money, so by the year 2000 we were probably the most successful venture fund in the world.

Elliot: Yeah, absolutely.

Miller: Probably had about \$10 billion in assets at that time. We probably had liquidated \$3 billion. But the reason Intel's corporate business development became Intel Capital was because it was so significant now on the balance sheet and in the earnings that people felt that we needed to make it sound like something more substantial, like Capital. <laughs>

Elliot: Well, that, and I think also separate from Intel the semiconductor company, to a certain extent.

Miller: Yeah, but of course we were in there and we were totally a part of Intel, and we didn't recruit that many people from the outside. The ones that we did didn't stay very long because of the culture. We didn't compensate people the way people would've been compensated in the venture world, so good people would leave because with the exception of a few of us who were corporate officers and had gotten a lot of stock and were treated well by Intel there was not a lot of money to be made. While I did quite well, I would've done a lot better if I had been at a venture firm and had a participation or (carry-interest). But did that matter? Well, I guess you would say no because we were very successful. <laughs> So that's proof.

Elliot: Well, Intel is certainly perceived as being amazingly successful in that, but you mentioned one area that you don't think they were successful in and that was influencing the strategic direction of Intel. In addition to that, all the investing that you were doing was basically focused on growing the market that Intel sold into, the PC market, the consumer market. And some of the other ones you've mentioned like equipment to build semiconductors, et cetera, those are all areas that are, again, right up Intel's alley. They were the business they were already in. So the things that I'm always curious about here are Intel has yet to really successfully move outside of that marketplace.

Miller: Well, Intel was growing, yeah. I mean, Intel made one big move, which was from your time, you know, was a memory company that became a microprocessor company and one of the great stories of all time. And it was a crisis. The company was almost dead. It could've died. It could've been taken over by the Japanese. It was really, I don't want to say on life support, but it could've been.

Elliot: Close.

Miller: The Intel that we know is so different than what Intel could've been. And Andy and Gordon took such a courageous decision, and I think a third, more than a third of the people were let go.

Elliot: And the decision you're talking about is to get out of DRAMs and to become a microprocessor company.

Miller: Right, right. And to focus on that, and that's what they did. But I used to say that we were selling silicon by the ton when we were in the memory business, and then we found gold. So we found vein of gold, but what I was trying to say, "You know, guys, eventually all of the gold's going to be in a big hole. That's where we're going to be." So I didn't see it lasting forever because nothing lasts forever. And I would've liked to have seen the company evolve, particularly still in the networking communication areas. That would've been kind of what I wanted to do, but it didn't happen, and the Intel, I mean, I don't know Intel now, but the Intel that I read about is the same Intel that I left except the world isn't the same world. Intel was one of the top companies of the world and had a market cap higher than almost anyone; in fact, it was the highest at one time. Now it has a market cap lower than Amazon, and that's just shocking to me. And you see companies like Google, particularly Google; I wouldn't say Facebook but maybe Facebook and these companies that are a real platform for this current phase, Apple is something apart. Apple is a very different situation. Nothing is like Apple, and even Apple may not be like Apple. And Apple may become the next Intel, you know, if they can't break out of the mold they're in. I don't know. I can't speak to that. But I ask myself all the time, "What could Intel have done? Should we have done something, you know, what could have happened? Why did it not happen I guess the most important question for me always was, "Was there something I could've done differently"? And I don't know. I don't think so, but maybe there was. I just think the company was so focused and the business it was in was so lucrative.

Elliot: And overwhelmingly growing like a weed at the time.

Miller: Hard to imagine that it would change, and yet we were created by that same kind of change. And the history of businesses is exactly this. We used to have this guy, Clayton Christensen, he's a professor at Harvard, who wrote "The Innovator's Dilemma," about how little companies get into the markets and then take over from the big companies. He came out and he taught us the Intel executives this, and yet we just kept on. So I'm sorry about that.

Elliot: Well, I've often wondered where those decisions weren't made. For instance, there was one development of the Intel television chip, okay? And from what I can tell of that there was a technical problem that it just ultimately couldn't work, wouldn't be reliable. But I have to think that there's another dozen instances where business decisions were made or maybe not made that prevented Intel from getting into some of those markets. And a lot of it is the foundation business of dollars per pico-acre of Silicon.

Miller: Yeah, but I also think Intel had a very bad experience with the Microma problem. Microma, as you know, was one of the first digital watches. I think Timex bought it. And Intel invested in this because they saw this as a semiconductor business. They didn't recognize it as a fashion business, and they lost a lot of money. And in my early days at Intel when we would be talking about investments I would see Gordon Moore, who still wore a Microma watch <laughs> take his watch off and put it on the table in front of everybody, seeking to remind everybody about Microma. So I think that may have had some effect, but I think it's also this just focus, focus, focus.

We had a really kind of funny relationship with Microsoft, and I think you can't understand Intel without understanding Intel's relationship with Microsoft. So we were like brothers except we weren't the powerful one in the relationship. Microsoft had more power in the Intel/Microsoft relationship, partly because of the sheer audacity of Bill Gates, you know, and the ferociousness of Bill Gates. It's hard to imagine Andy Grove intimidated until you saw him in front of Bill Gates. <laughs> So I think that Intel might have had, maybe in their subconscious, corporate collective subconscious, the idea that Microsoft knows what they're doing and Microsoft will make sure we're okay. If we just stay with Microsoft we'll be okay.

Elliot: Interesting. And now we see Microsoft moving to the ARM architecture and a few other things as well.

Miller: Well, what happened is Bill left, too.

Elliot: Yes, he certainly did.

Miller: So, I mean, I think once the real founders of these companies left and once Andy was gone and Gordon was gone and Bill was gone, you know, maybe they would've figured it out. I don't know. But I know that Intel didn't believe in the Tablet market, didn't believe it would ever have an effect on the PC market. And it's pretty clear that Microsoft didn't believe that it would have an effect. So did Intel not believe it because Microsoft told them? You know, did Intel just think that Microsoft would figure it out? Did Intel have trouble understanding that Microsoft didn't know what was going on? I find that incredible because it was very clear that with the advent of Netscape and other things like that that Microsoft was having a really hard time with the same transition.

Elliot: It's always been my observation that the first founding team that has a major success on their hands, they're effectively a bunch of risk takers.

Miller: Yeah. Otherwise, by definition—

Elliot: Otherwise they wouldn't have been founded. Otherwise they wouldn't have made decisions like, "Oh, we're getting out of DRAMs and we're going to be a microprocessor company." And I don't think it's fair to say caretaker per se, but the later management of the company takes far fewer risks. They have a big entity. They have huge number of employees. They have a business, and they get into protection mode. And I fear that that's what's happening in all these situations.

Miller: Well, and without getting into names or personalities but we went from design to a guy who ran manufacturing to a guy whose background was finance and sales to a guy now whose job was, what was it called? The manufacturing

Elliot: He's an operations guy.

Miller: No, no, but duplicating the factories

Elliot: Oh, the exact copy?

Miller: Yeah, the exact copy. <laughs> And so there aren't any, I don't think they're risk takers, and I certainly don't know who you would identify from the strategic side, and maybe that's the nature of all companies, you know? And we should be really happy that we were in Intel when Intel was the company.

Elliot: When we were in.

Miller: Yeah. I'm grateful for it.

Elliot: But on the other hand it's interesting to look at the few companies, the GEs, the IBMs and whatnot who have constantly reinvented them selves over the years.

Miller: But IBM's a shadow of what it was.

Elliot: They certainly are. Different business. Software services, not a hardware business, and so it's a very different situation. But it's interesting to look at the ones that are over 50 years old to see what they did to stay in business and continue to grow their business or change their direction.

Miller: Well, Intel is not going away and Intel will be a successful company. And we're being a little bit unfair sometimes because we're comparing what otherwise would look like a wonderful company to what had been an extraordinary company.

Elliot: Yeah, I think that's fair. And from my perspective, I mean, they've just announced that they're accelerating 14-nanometer process production and they're so far ahead of the rest of the world in terms of process technology.

Miller: They just don't know what to do with it.

Elliot: Just don't know what to do with it. Where's the vision on what to do with this stuff, and I think hindsight is pretty good, okay, so they're all saying or everyone in the industry is even saying, "Well, they got to get in and control and manage mobile."

Miller: Well, as I think you know I have a blog "Two Thirds Done," and I've been working on a series of posts called "The Resurrection of Wintel." And not that I really think Wintel will resurrect, but I thought it was such an interesting intellectual challenge. How would it be that Intel and Microsoft could regain their prominence? And so one conclusion that I would share now is that I'm sure that you cannot, as there are waves of computing and when you're the master of one you're usually not the master of the next one, and I think it's very difficult for you to go from being in one phase and trying to become the master of the current prominent phase, okay? It's just too hard. Whoever's the incumbent in that phase is just too strong. So the only way would become the new guy on the block for the phase after that. So I've been spending my time thinking about what will happen after the current phase called cloud computing, What will be after that, and if you knew what it was and you were Intel or Microsoft or both, what could you do to take lead in it.

Elliot: How would you invest?

Miller: How would you take your capability because you have money. You have the talent. How would you intersect that and become the leader of the next phase? It's never happened before. I haven't been able to find anybody who's done this, and I don't know that I'll be able to come up with the ideas that will do it. And one thing for sure that even if I come up with the ideas that it won't be done because they're not going to listen to me, but I always offer my ideas to them, by the way. I offer them free of charge first because Intel was very good to me. But they never take me up on it. <laughs>

Elliot: Well, I find it interesting that they have the technology from a process performance standpoint to be a leader in a mobile situation. What bothers me about it is the fact that I don't think they look at the business model and the issues with the business model.

Miller: But mobile is being hollowed out because everything's being sucked into the net.

Elliot: Right. Because it's what's collapsing the business they're in.

Miller: Yeah, so why would you go there, you know? That's not the right place to go, in my opinion. They could've gone. I mean, they could've owned Qualcomm. They could've been Qualcomm.

Elliot: Yes. Qualcomm and Broadcom were two missed opportunities, I think.

Miller: Yeah, and we knew that. Les and I went to Qualcomm when they were first starting.

Elliot: Jacobs.

Miller: Yeah, Irwin Jacobs. We went there. "My God, what a fantastic company. Can we do something?" "No, no. We didn't do anything. Les said: "This is not our business." I said, "So, can I invest in the IPO?" "Okay," so I did. Broadcom was another one. I brought that up with Les recently he said to me, "If we had bought those companies we would've destroyed those companies." couldn't argue with him because that was the conclusion I had come to. So then the question would've been, "Well, could we have competed with those companies? Could we have done the same thing?" And the answer is no because we didn't know how to do it.

Elliot: You didn't have the resources. I mean, we see Intel investing in the Fujitsu thing right now basically to get RF/microwave capabilities that they don't have because they needed four single chips. But it's technology that they don't get.

Miller: Yeah. Well, Intel is doing some things that maybe make sense to Intel, I don't know because I don't know. I mean, a while back they bought a computer security business and then they have a big project to do something in the television area, which is where everybody goes to die.

<laughter>

Elliot: Sounds like it's resurrecting the set-top box stuff, almost. It's not clear, not clear.

Miller: There have been several times between the first one and this one that Intel tried to do something in the set-top box area. But, I mean, if Apple can't do it why in hell can Intel do it? That's very hard for me to understand, but maybe they'll do something. Although now that they have new management the emphasis on that has declined, so maybe they're not as interested in that anymore.

Elliot: When you were making investments and making strategic efforts before you left in '99 was there any emphasis or any intent to consider the foundry business, become a foundry for other manufacturers? Intel certainly has done that on and off, but it's never been a primary focus. It's been a, "Oh, we got extra capacity. Let's go use it."

Miller: Right, there was no discussion of that. And, of course, we didn't have capacity, at least through the boom years of the PC. So there wasn't anything like that. There are a couple things that I should point out, though, that we did. We grew the international investment business, so we were the first people to really do that. We invested in China in 1995. We went to Israel. We went to India. Probably 40 percent of Intel's investments now are international. When I left it was about 20%. So we kind of pioneered that, which is right because we were an international company.

But no, we didn't develop any concept of well, so the only one that I tried to get Intel to invest in. This was before notebook computers. I found what was the first notebook computer, the first computer that would fit in your attaché case was being developed by this small company. They had no money. I gave them some money. We had a prototype, and I came up with the concept. I made a proposal to Intel that we should license the technology from the company exclusively, give them some money or buy the technology, and we should manufacture the motherboards and never sell anything but a motherboard because I said, "That way we will control more of the architecture. We'll be able to integrate more. We'll be able to drive kind of the platform better, you know. And we'll let everybody package it, you know, for their own brand and their own market, whatever, but only us will do it," and we did a whole thing, and it was actually quite compelling, it made a lot of sense. I still think it makes sense. And we got almost everybody to agree, and I thought everybody agreed. We had a board meeting. It was in Oregon. I attended that board meeting and formally presented the proposal. Either Andy didn't know before or he changed his mind, but he said there was no interest in having a notebook, I mean, it's like the kind that we have today, okay? This would've been earlier, maybe even in '89 even or earlier; The 386 was just

coming out. I had this notebook and it worked. And Andy said, "Where's the floppy disk?" And I said, "It has an external floppy disc. He says, "Nobody would want a computer with an external floppy disc." With that everybody in that room turned against me. It took a microsecond. There was not one supporter in that room. The project was killed, and I was so upset that I, and Rich Bader who was helping me, with this project, the guy who had been PCEO, got on an airplane and we flew to Japan and we went and we met with a number of the major Japanese companies, and then we flew to Korea and we met up with Samsung and a couple of other Japanese companies. We flew to Hong Kong. I can't remember who we met there. We went to Taiwan. At each of the meetings we were talking to them about things we were doing in PCEO and other kinds of stuff, and I would take this computer out. And the meeting would just stop and everybody would look at this computer. <laughs> And they said, "What is this?" I said, "I can't tell you. "That was the first time that they had been exposed to the idea that you could have a computer that you could put in your attaché case. And I have recently written in my blog that I believe that Intel now, not this next generation I've been talking about, the resurrection, now should start building its own brand of machine.

Elliot: OEM?

Miller: No. Intel brand.

Miller: Yeah, Intel brand because who gives a damn, I mean, Compaq, Dell, HP now, Dell, you know, Lenovo Acer or whatever. None of those brands are worth anything. Those brands have no cache compared to an Apple brand, but Intel still has a brand. And so who needs them? So if I was Intel, if I was the CEO of Intel I would immediately start forward integrating and build my own brand of product.

Elliot: Well, I think a lot of us were surprised that even at the PC level when they were building and OEM-ing these things that they never decided to come up with their own brand, rather that they were scared

Miller: They were scared.

Elliot: They were scared of doing that, competing with their own customers.

Miller: I even told them, "We've got to have a keyboard. We've got to have, you know, something." PCEO had the only brand of products, and I said, "A consumer never sees a product from us."

Elliot: Was this before or during the Intel Inside phase? Were you there for that?

Miller: Oh, it was during that. You know, Intel Inside started pretty early. I can't remember, with Dennis Carter.

Elliot: Yeah, well, we hope Dennis will to do a piece for us on that.

Miller: Yeah, and that was a brilliant thing. But still, so fine, you had Intel Inside. So I mean, it didn't internalize in the same way. It did have a lot of brand recognition and Intel did pretty good marketing, but at that time we were afraid of our OEMs. We were afraid that the OEMs would dump us and go to AMD or somebody else and all of the sudden they would still be in the market and they'd have all their channels and they'd go after us because what were they going to do if we had a branded machine? And they would do that. I don't think they would've done that. I think they would've continued to buy from us because if we had the best products, but anyway, we didn't do that but it's not too late.

Elliot: Interesting observation. I've dealt with a lot of companies in the mobile space, and I've had a number of them talk to me about the Intel, who makes money business on this thing? And almost every single one of them says, "Intel's making 40, 50, 60 percent gross margin on all this stuff and we get put aside for single-digit type of stuff," so Microsoft and Intel make all the money in the PC market, in the laptop market, whatever, and the Dells don't. The Lenovo don't. They live on a very, very thin margin because all they're really doing is packaging. And a lot of PR activity and their distribution channels, they're all very important things, but the margin that they make is very small. And I've had a lot of mobile guys say, "That's why we don't do business with Intel because if we did business with, if we chose Intel's processor architecture for this thing then they control us, they make all the margin and we're stuck back here making four percent, seven percent, nine percent margins."

Miller: Well, because let's face it. The semiconductor industry is not a good neighborhood, you know. So Intel had a beautiful house in a bad neighborhood, but the other people don't have that house.

Elliot: And they're also all saying, "Well, you know, and I don't have to do that now. I can license the ARM stuff. I've got design teams that can design something that's specific to my needs I don't see the advantage of going to Intel for this type of thing." So is that an issue? You say they ought to have their own brand and whatnot.

Miller: Well, no, but I'm saying the reason to have your own brand is to control the message and to be able to control the integration of the technology. And so there are always reasons to not do it and there were some reasons to do it. The reasons to not do it have evaporated but Intel hasn't realized it, or at least I don't know if they've realized it. They don't talk to me.

Elliot: <laughs> I understand. Okay. I'm about out of questions, but let me ask the obvious last one, and that is what have we missed? What's an item or two that you think we ought to cover here relative to CBD and investing and all that we haven't talked about?

Miller: Yeah, there are two. One is, you know, CBD to a large extent, which became Intel Capital, was a partnership between Les and me, and I can say that because I feel that way and because he feels that way. Les was the senior partner, but we worked together to develop it. But we had very complimentary skills. So I really want to give credit to what Les did. So this would never have happened, all the success that I had, would never have happened without him. He was able to do this in this very harsh environment called Intel. He was able to navigate within Intel, and he was able to put in the processes that would allow this to work within a company like Intel and work at scale. So by the time I left we were doing 100 or more investments every year. Not every investment worked out but none of them blew up. We didn't have lawsuits. You know, we did a good job. We learned how to bring people together. We were the first people doing investments that would bring all of our portfolio companies together and help them. We put in a process, a formal process, for how we approved things. We got the legal organization to dedicate people to this. We got the financial organization to dedicate people to this. And so that was as much a reason for success as having the insight or the ability to go out and kibitz with people. And so that was one thing.

The second thing I want to say is that, you know, we were partners but there were a lot of other people in CBD, and I don't want to take credit for everything. I can take a lot of the credit <laughs> but I won't take credit for everything. So there were many people in CBD. By the time I left there were a few hundred that were working there or supporting the work in Legal and the Treasury Depts. They all did a great job. I'm not going to start naming them because then I'd have to name all of them and I can't remember all of them <laughs>, and I think the people that were there enjoyed their time there, and I try to stay in touch with the ones that worked for me. They've done well, and I'm proud of them.

Elliot: Excellent. Okay.

Miller: Well, thank you.

Elliot: Thank you very much. I've learned a lot, and I think this will go down very well.

Miller: Thank you.

END OF INTERVIEW