Interview of David “Dave” House

Interviewed by:
Chuck House

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Chuck House: Okay, well, are you on? So, Dave, I’m Chuck House, , we’re recording this for the Cisco Heritage Project this June 20th, 2014. We’re also doing it for the computer history museum because you’re a computer guy through and through and you’ve been on this board for what? 25 years now?

David “Dave” House: Yeah.

C. House: My God, that’s great. And my name and yours are pretty similar and I think we call ourselves brothers actually. You’ve gotta be my older brother, I don’t know.

D. House: We’re brothers by different mothers

C. House: Yeah, there you go.

D. House: And fathers.

C. House: So, welcome and I really appreciate you taking time today and one of the things that you didn’t cover too much in the history you did with Gardner Hendrie, what? A decade ago now?

D. House: Must have been.

C. House:, That was, kind-of your early history you were at Honeywell,. Actually you were at Raytheon

D. House: Raytheon

C. House: Raytheon and Honeywell Maybe you could just catch us up on that before we get started.

D. House: Well there’s a little bit of a communication story here as well. Well, my very first project at Honeywell Computer and Communication Operation in Foxborough Mass., was a data acquisition system, which was collecting information on missile launches when a missile goes to the ionosphere it sends a pattern that follows the ionosphere and can be detected over the horizon. And what we were looking for is the signature of the missile launch and so we had these antennas and then we had just a big analogue -multiplexer and a bunch of bandwidth filters and we were doing spectrum analysis the hard way

D. House: We’d switch between different filters and do an A to D conversion to get the energy in each band and then put it the memory and then put it in on the tape and then go process it. But that was my first project. I then worked on a communication processor for the Air France Airline Reservation System, one of the very first airline reservation systems, this would have been in 1966.

C. House: So that almost parallels the Sabre system here?

D. House: Right.

C. House: Neat.

D. House: I then was selected to work on the FAA Enroute Air Traffic Control System. Again, involved a lot of communication and a lot of display work, but it was replacing the old, purely analogue, radar, displays which were round big displays. Big displays mounted horizontally with radar trace blips of decreasing intensity where the plane had, when the sweep was made and what plane it was using phosphorous as the memory device and a little shrimp boats that plastic boats were they wrote on a slip of paper the airline flight number AA321, for American Airlines flight 321, would be moved along with the motion on the display. The display could zoom in and out and they could query a plane with a beacon, which would then report, and blip on the screen so you could make sure that you had the right shrimp boat at the right point that you were tracking. So this was the old system, the new system tried to imitate that, it was a horizontal display but we took the data in digitally and we drew the radar trace, we tried to simulate the radar actually by a digital representation using vector graphics. We moved the beam, we didn’t have pixels, we’d take the beam and we’d position it here and turn it on and move it to there and turn it off, and then move it to there and create an A and a B and a 2 and whatever.

C. House: So here we sit in Silicon Graphics’ old headquarters, which made a living on graphic displays like that.

D. House: So, then, I was one of the architects in charge of the bus structure that tied all the memories and processors, and communication devices together, and connected the displays. And it basically was a bus design problem with throughput, and reliability because 100 percent redundancies were fail soft, fail over. Anyway so then after the architecture was done I went on to design the graphics controller, a display controller. I was recruited out of Raytheon into Honeywell. Honeywell had bought Computer Control Corporation,. Computer Control at one time was as big as DEC . Both of them starting out making logic modules and then started making mini computers. They had made a 16-bit computer the 116 and 516, which was in the first Internet node..

C. House: And where were they based?

D. House: They were based in Massachusetts and Honeywell bought them because of their industrial control, ttheir building control systems. We competed with DEC which had the PDP8, which was 12 bits, we had the 116 and the 516, which was 16 bits so if performance mattered we won, if price , they won. Honeywell came up with a bright idea of bracketing Digital on the 12-bit machine by doing an 8-bit machine in the late 60s there were a bunch of them being developed in southern California. Bit and General Automation I think it was and Microdata and a whole bunch of them.

C. House: Now was Gardner at CCC?

D. House: Gardner was at Honeywell at that time; he was a project manager.

C. House: Was he with the company that got acquired or was he with Honeywell?

D. House: He was, I don’t know if he was there when it was acquired or if he joined after it was acquired but I joined after it was acquired. My job was to design an 8-bit machine to bracket the PDP8 and internally we used code names. It was called the H12, the X12, I’m sorry the X12 and because X11 was the one before that.

C. House: You’re right.

D. House: And I remember Bill Jordan, so I worked for the guy that had all computer development. He had a 32 bit machine and he had the 16 bit machine and now he had the 8 bit machine, and but the memories were developed by a separate department. It was run by Bill Jordan and as I was putting together the team and starting the development, I went to Bill and we talked about what I needed. I needed a 4K core memory and we talked about, well we should probably have a 1K core memory for real low end. 1K pints.

C. House: For the whole system right?

D. House: For the whole system.

C. House: Why not.

D. House: So, Bill came to me one day and he says, “Dave,” he says, “I would like to put a semi-conductor, I’d like to put a D/RAM memory on your machine.” And I said, “D/RAM ? What’s D/RAM ?” And he says, “dynamic random access memory.” And I said, “What’s dynamic about it?” He said, “Well the storage is on a capacitor.” And I said, “a capacitor?”

C. House: How does that work?

D. House: And he says, “well you have to come back and refresh it, you have to read it and rewrite it.” And I said, “how long?” And he said, “once a millisecond.” I said, “that’s crazy, the computer’s going to spend all of its time refreshing its memory.” “Oh no we’ll do a little controller that makes that happen.” So sometimes when I go to memory I can’t get the memory because it’s busy being refreshed. And I said, “What happens when the power goes off?” And he says, “Well you have to reload everything then.” And I said, “No, we’re not going to do that. That’s not going to happen”

C. House: Oh yeah, this is really going to be a hot product.

D. House: So Bill had been working with Intel at the time and Honeywell had a semi-conductor facility in the plant, it wasn’t a production company, it was really an engineering facility and Ed had been talking about making a memory and then Intel had come in with an idea of a 1K D/RAM, or at that time they had developed a four by four register array, four bits in four locations, which was great for the register set on the mini-computer. Ed had developed an MOS 256 bit product, the 1101.

C. House: That’s right the 1101 came out.

D. House: And they were working on the 1102 which was a full 1024 bits of D/RAM . So Bill comes to me one day and he says, while he’s developing my core memory he says, “you know I’ve got some internal research funds that I’ve got available and what I’d like to do is I’d like to develop a 1K memory that’s plug compatible for your machine.” And I says, “Okay, here’s the conditions. It’s gotta fit the same connector, you can’t require any more pins or any changes to the connector, it’s gotta work on the existing power supplies, you can’t demand any more power from any of the power sources than the core-memory does and it can’t affect the schedule on my core-memory design. You have to use different resources.” So I remember he had Bill Regitz and Hank Bodio, and I think one of them was doing the core and the other was doing the semi-conductor memory, they both later wound up at Intel. Well, I’m ignoring this project; I just care about the core memory. One day Bill comes to my office he says, “you’ve gotta come and see what I got.” So I come over there and go into his lab and he’s got this memory card and it’s on a bench and he’s got a little tester thing operating it and he’s got an oscilloscope hooked up to it and he’s demonstrating that this thing is reading and writing information. And he says, “I got the card working.” I looked at it and its got all these white ceramic packages with gold lids and every lid has a wire soldered to it and daisy chains around the whole card and it goes up to a power supply that’s up here on the bench. I said, “What’s that,” and he says, “well we discovered we have to back bias the substrate.” And I says, “so?” And he says, “well it turns out the lid is connected to the substrate and so by back-biasing the substrate we can actually make it work.” I said, “Well how is this going to work in a system?” Because at this point in time the largest dual memory package was a 16-bit package and it had gone from 14 to 16 and that was a big move.

C. House: Oh yeah.

D. House: Because TTL from TI, the 7400 series, which drove all conductor standards, was in a 14-bit, and now they had a 16-bit package. And he didn’t have an answer for me, I went back in my office and about two days later I got a memo, I’ll never forget this memo. It was from Bill to me, and it copied a bunch of other people, and the subject was, “The Industry Standard, 16-pin DIP.” No, “The Industry Standard 18-pin DIP.” I said, “Bill that’s an oxymoron. There is no industry [standard] set, and he says, “There is going to be now.”

<Laughing>

D. House: He says Intel’s going to get one created. And sure enough their original product called the 1102, didn’t have the back bias. There were some other changes on the dip as well. But they changed the cell a little bit I believe but it didn’t have back bias and by going to 18 pins would be it would be 1103, one 1K D/RAM, they were able to back bias the sub straight and they could make the thing work. So, I wound up with a core memory, plug compatible, 1103 memory and I’m thinking like, “nobody’s ever going to want a semi-conductor memory.” Control computers where you turn the systems off and back on again, you gotta reload the memory, that’s never gonna fly and about this time Honeywell bought GE’s computer business. Turns out-

C. House: Out of Phoenix?

D. House: Well it was in Phoenix, it was in-

C. House: Connecticut, there was some business there.

D. House: Yeah, I don’t remember where all it was I remember the combined company wound up having major locations in Phoenix, Oklahoma City, Massachusetts, and in Paris, France and in Italy.

C. House: Oh.

D. House: There was Honeywell Bull, in France, and the Italian Bull location, and Honeywell had brought in Louis Gagliardi from Harvard, this computer science architecture guy, to bring together these two product lines as Head of Development. And he, it turns out that earlier he had asked the general manager at Honeywell computer control to get him a briefing on Cache Memory Design. Why, I don’t know. He came to me and says, “Will you go brief Louis Gagliardi on Cache,” I didn’t have a Cache Memory on a system, I didn’t know much about Cache Memory. So I got the IBM manuals, I read them, I got the

UNIVAC manuals, I read those, I read a bunch of manuals, I got some text books and I went in and I made a presentation to Gagliardi and I said, “these, you know, you can have these, the replacement algorithms that are used et cetera et cetera etccetera,” and somehow he remembered me because when he creates his task force I get appointed as the Massachusetts representative. There’s somebody from Phoenix, there’s somebody from Oklahoma City, there’s somebody from Paris, there’s somebody from Italy, so there are five of us-

C. House: Wow.

D. House: Who are going to create this unified architecture between Honeywell and GE for the entry-level systems. They had a mid-range team and a high end team, now this is before the 360, well no it wouldn’t have been because this is ’64, somehow the compatibility issue hadn’t, I don’t remember it being a major issue because we were given pretty big, very flexible-

C. House: I don’t think anybody was trying to work across the corporations, I think that the questions had rationalized within the corporations.

D. House: No, we were one corporation because we bought GE’s computer systems.

C. House: Yeah, but you were trying to rationalize with IBM.

D. House: I wasn’t trying-

C. House: Yeah, you were trying to do your own stuff.

D. House: Honeywell’s big business was the H200, which was 1401 compatible. When IBM abandoned the 1401, Honeywell scooped up all those customers with the H200. But, we were supposed to come up with an entry-level system and we met in Paris, and we met in Phoenix, and we met in Oklahoma City, and in Massachusetts and all these long meetings and because of the 1103, and the Intel connection, I’d been following what was happening there with the micro-processor. Now step back to my first experience was, I’m walking down the hall, I’ll never forget, I can see the cork board on my boss’ office, that’s when we used to have doors on our office, and he used to put articles up there and he had this article about Intel introducing the computer on a chip. The was the 8008, I went immediately to the components group, the people that bought chips and I said, because there’s where I got my data sheets, and I said, “I gotta get a data sheet on this 8008.” And I got one and I read it and I said, “this isn’t really much of a computer, this is more of a test.” But, I had written an article for, together with Russ Hensel one of my cohorts, for a computer design magazine on the impact of semi-conductor technology on mini-computer architecture. That is we started out with, you know, just gates, then we got flip flops, then we got registers, and finally

we got the 4-bit ALU and we had register rays and so each time we were designing a machine we could do a lot more. So I wrote this article, so I had been cognizant of the, I didn’t know it was Moore’s law, but it was Moore’s law.

C. House: Yeah, exactly.

D. House: Kind of like the fourth guy that discovered America, I was the fourth person to discover Moore’s law. I just didn’t know about the first three.

C. House: Yeah.

D. House: So, I says, “well they can do this now, the next generation is going to be important.” I went home and I told my wife at the time, I said, I was living in Massachusetts, I says, “I learned two very important things today,” she said, “what was that?” And I said, “first of all, my job’s going to change industries. I design high-volume, low cost computers, they’re designing, system companies today, they’re going to be designed by some of the other companies in the future. Which she says, “oh okay, what else?” I says, “My job’s going to change coasts. Those companies are out west.” That got her attention.

C. House: Yeah, woke her right up huh?

D. House: So I was working on this.. Meanwhile I had been awarded the Harold W. Sweatt Engineer Scientist Award. Harold Sweatt was the engineer who Mister Honeywell teamed with and Honeywell was the salesman businessman and Sweatt was the engineer designer.

C. House: Okay.

D. House: When Honeywell got started.

C. House: I gave a Harold Sweatt lecture one time to Honeywell in Minneapolis and I didn’t know who the guy was but that was the name of the program.

D. House: So the Harold W. Sweatt Engineer Scientist Award was like becoming a Honeywell fellow.

C. House: Okay.

D. House: Because you kind of had your own budget then, you could work on your own project.

C. House: Neat.

D. House: You had great freedom and those guys tend to retire in place. I had become a Sweatt award winner and by this point in time and working in this committee and I said, and I’m aware of what Intel is doing and I’m aware that the 8080 is in development, and I said, “This is really simple. For our entry level business machine, we buy an 8080, we take a bunch of semi-conductor memory, we put it on a printed circuit board, we slide it into a chassis we put all the ports on it, we put the lights and switches and we load it with business software.”

C. House: And we’re good, yeah.

D. House: Well.. That was too simple. The people in Oklahoma City who would design the controllers for the printers and the tape drives, primarily, also discs but not, that was done other places, but the peripheral devices, electromechanical peripheral devices, it always developed controllers. They had developed this controller called, with custom chips, called the “Basic Logic Unit,” or BLU or blue. And it was eight chips. Pretty expensive, but in fairly low volumes, but they were quite proud of that and they wanted to use the eight chip solution as the deal. I pushed hard for commodity so they came up with new blue, new blue was not developed yet, it was just an idea, it would integrate all these eight chips into one.

C. House: We’ll call it the 8080.

D. House: And I argued about volumes of semi-conductor economics and standardization and all of this and I lost the political argument. And about that time, I’m giving a paper at the IEEE architecture workshop in Lake Arrowhead. Every year they had this architecture workshop, and I’m giving a talk there. I’m on a plane flying to southern California, sitting next to me is a guy who has been working with Microdata, actually had done funding around with them and we start talking and he says, “well you’ve gotta come, you know, you gotta come to Microdata,” and I don’t have time to come to Microdata you know, “I’m gonna be up there.” Well he gets ahold of me and he says the VP of Engineering is coming up to see you. So he came up to Lake Arrowhead and talked to me and he convinced me, on the way out, to take a later flight, and to stop by the company. Bottom line is, I’m fed up with Honeywell, with the stupid political decision, so I quit and become director of computer development at Microdata. . Meanwhile, because the Honeywell and this process has decided basically that there’s all this memory, this control stuff that we’re doing down, and Framingham isn’t really supporting because the H200 is really taking off, and we really have to focus on the business machines and de-focus from the stuff down in Framingham. So the memory guys bailed, you know Jordan went to Intel and met with Bob Noyce and made a proposal to Bob to create a memory systems position. And Bob bought it and brought Hank Bodio and Bill Regitz. Bill Jordan came in and by that time, I was out in California visiting, attending actually a conference in San Francisco, there were 18 guys I used to work with at Honeywell at Intel.

C. House: Is that right? They just downloaded the whole group?

D. House: So I said let’s, you know, have dinner, we wound up, I wound up by going into the Intel building on the corner of Bowers and Central Expressway, the first building they built.

C. House: Yep.

D. House: Before they were just starting to move into it. I mean they were moving the first people in that weekend and they showed it to me and I went out there and looked at the building and I says, “this is a great building, but why are you building out here in the middle of all this agriculture, why don’t you build it close to a city? Where are you going to go for lunch?”

C. House: Yes, I guess that makes sense.

D. House: Because it was all agriculture.

C. House: Yeah.

D. House: So this was about ’71, ’72? Anyway I wind up at Microdata and interestingly the thing at Microdata is Bill Roberts had designed this 16-bit machine and they said we just need to finish this machine up. You know it’s already laid out, we haven’t built the first prototype and I showed up and I started, “let me just check some of the timing loops on this thing,” and none of the math worked.

C. House: Is that right?

D. House: He had left, he was a consultant for the company, he had left, I talked to him and he said, “well these things all run faster than the max and the mins with the specs anyway.” And I said, “I know about semi-conductors and there’s variations and if it passes the spec than we have to accept it.”

C. House: Yeah we get the chip.

D. House: We get the chip. And if they have a slow batch, we owed them. And what happens when the temperature voltage changes? So I went through and basically converted the same machine to Schottky, the 74S series stuff that works. But the thing that was notable there was they had a semi-conductor memory from AMS, remember they had a 1K D/RAM and sure enough we get the thing, I get the 1K, I get the machine, now we have to guarantee it works. You have to put it in the oven, you’re gonna change the

voltages around, okay so I heat the thing up and I put the voltages at their limits, memory card fails, you know, “boom,” it doesn’t run. So I wound up getting Jamal from AMS, he was an engineer, I got him out there and together he and I worked on it and we figured out the issues that the ground plane would bounce around at different parts of the board, you know, measure at the pins is fine but you made sure out at the corner it was bouncing around and the signals were coupling into each other and they were coupling into the power supply so you know we had to do a bunch of changes. To that one I did it with copper bars.

C. House: Okay.

D. House: To fix it, but I, from way back in this data acquisition system I learned about noise and the problem..

C. House: Oh sure.

D. House: Because that system didn’t work either. And I had to redesign it, it was all about noise. So I got that system working. Meanwhile, Intel is trying to hire me because when I went to Microdata all the guys at Intel says, “you’re a Sweatt Award winner, we thought you’d never leave. If you’d known you’d leave, why didn’t you talk to us? We would have, you know, you need to come up there.” So, meanwhile I’d split up with the wife at the time, I moved her to California, amiable relationship but we were living in separate places and so I was seeing my kids mainly on the weekends and working most of my nights. And trying to get this machine done and Gelbach, Ed Gelbach got ahold of me and got me to come up and be interviewed, he made an offer to me to run applications engineering and basically work the liaison between marketing, the customer, and engineering. A kind of a project management job, but we didn’t call it that at the time, but it involved some technical stuff, we built memory systems in my lab but he offered me the job and I came back and I says, “you know my kids are more important. This would be a great job, this is a great company, but my kids want more.” Ed comes back about two months later and he says, “I need you to come out to our..” and I said, “I’m busy, I don’t have time,” and he said, “come up this weekend,” I said, “I’ve got a date,” and he said, “bring your date.” I said, “well you know, I’d bring my date but I can’t be spending...” He said, “No no, here’s the deal, you fly up, I’ll meet you at the San Jose airport, you spend an hour with me, I’ll pay for your weekend in San Francisco with you and your date.” Great, so I did it. He made another offer, I thought about it, turned it down. For the same reason, my kids. Finally Ed calls me up, he says, wants me to come up again, I said ugh come up again, you know we’ve been through this. “Well I’ll come down. We’ll have dinner.” I said, “I’m not having dinner with you, it’s not going to work,” he said, “Okay meet me for a drink.” Okay, I’ll meet you for a drink, he meets me at the.. Remember the Disneyland hotel I’m living in...

C. House: Didn’t have your kids with you?

D. House: Didn’t have my kids with me. And I meet him at like 6 o’clock at night and he says listen, here’s the deal. The rule is that because this is an engineering, marketing, sales job, that both Les Vadasz who runs engineering and me, who run sales and marketing, have to agree on the candidate and we have interviewed on 43 candidates and you’re the only one both of us agree on. So I got hired.

C. House: So you’re in.

D. House: So here’s the deal, you spend weekends with your kids, and I’m going to pay for airline tickets every Monday morning you fly up, every Friday night you fly back, I’m going to rent you an apartment, pay for your apartment in Northern California, you still live in southern California, you’re working at Intel 9 o’clock at night after the kids are in bed anyway, so you’re not seeing them during the week. You get to see them on the weekends. Took away all my objections, that’s what I wanted.

C. House: Well yeah.

D. House: Which is fine because I got a lot more stock than the first two offers.

C. House: Yeah there you go.

D. House: So I show up at Intel and the problem is that basically the 1103 kind of works. Before the 1103a, if you remember this, the 1103 kind of works, in a tester it’ll work. But, nobody’s got it working in the boards and it found a real niche, there a lot of the computer companies had counted on, you know, had counted on the semi-conductor memory to replace their, a plated wire memory that wasn’t working. IBM had gone to microprogramming and at that time microprogramming was the big thing and IBM had done hugely in the 360 series and everybody was designing control-stores with a control-memory and they did really fast access and plated wire promised that but nobody could seem to get it to work. And so they were converting these control-memories into level 3 memories. But the scenario would go like this, customer would call and say put my shipments on hold, we’d say, “why,” they says, “because we’ve got our production lines down.” “Why?” “Because our memory system’s not working.” So the, my job became, I’ll never forget, Gelbach would come into my office and he would say, I need you to go to Burroughs and I said, “when,” and he said, “now.” I said, okay I’ll go home and get back and he said, no don’t -- buy clothes when you get there, there’s a flight that’s leaving in an hour and ten minutes. Go to the airport, here’s your tickets.

C. House: Wow.

D. House: And the problem is that Burroughs has shut down production because the system wasn’t working and we have to get it working. Well, one of the things I was always known for is I could get

anything to work. I could find the problem and debug it, and fix it and get it to work. So I would fly out there and somebody, the sales guy would pick me up and he’d take me to the Burroughs plant and there’d be an engineer there pulling his hair out and we started picking up scope-probes and logic analyzers and start looking at signal traces and power supply. And they all made the same mistakes, meanwhile I hired some guys, we developed a prototype board, memory board, demonstrating what was required, problems were always the same. There were three problems, one is the current spikes in the semi conductor memories would cause the power lines to jump all around, give big noise, so you put high frequency decoupling capacitors in the power lines. You go to a four layer board to devote a plane to power, and a plane to ground on the inside so you’ve got a bit of a capacitor there anyway.

C. House: Right.

D. House: And then you put high frequency capacitors on it and.. The second problem was, the drivers for the signals would look perfect at the driver but when you let the far corner of the board..

C. House: Right, a foot and a half away..

D. House: You know there were ringing and everything was out of spec so you had to look very carefully at how you routed the clock lines. They were high current, high frequency lines so you had to be very careful about the actual writing. And the third was there was this thing on the 1103 called TOV, T overlap. It was a pre-charge clock, and a clock, and the pre-charge clock and the clock had a very tight spec as to their timing where they crossed. Everybody could get it right at the driver, but it wouldn’t be right when it got to the other end. And so, TOV was the other problem. So I wrote an app note, we did a reference design, built it up, wrote an app note and then that problem was solved. People could make 1103 memories work. Then 1103a came out, it was less tolerant, I meant more tolerant..

C. House: Yeah, more tolerant.

D. House: To the problem. We got rid of the preclock.

C. House: Yep.

D. House: And so we only had a clock to worry about and the TOV went away because it internally generated itself.

C. House: So we at HP, we use 1103s like they were going out of style for the 9800 desktops. And I think, I don’t know how much we bought, but I think we bought just a ton-load of that stuff from you. But they probably knew how to engineer it better than us.

D. House: It could be because I went to all the big guys but I never wound up going to HP so they probably had good enough engineers.

C. House: Well we were all engineers.

D. House: Right.

C. House: Okay that explains a lot of that. I remember that was, I mean it was like wow this is the greatest part in the history of time. And we used to buy the carload I mean we probably shipped, that was one of the early, I’d call it high volume, you know these were those little. Essentially these were HP35s in desktop versions and sold to engineers everywhere. We were selling probably 8,000-12,000 a year, Big for HP.

D. House: So it was more of a calculator or?

C. House: It was a calculator.

D. House: It was a calculator it wasn’t a?

C. House: We called it a desktop computer but it was..

D. House: It was really a complicated calculator.

C. House: It was a scientific calculator is what it was. And oh yeah, they used, I knew the numbers at one time and I compared them with somebody at Intel and we concluded we sold between 30 and 40 percent of your chips for you know, like a year and a half or two and you know, we didn’t know any better so we just... you know.

D. House: It’d be interesting when the timing was, do you know what the ramp of volume was on that product?

C. House: I think it was like February, March maybe, of ’72, something like that?

D. House: Okay, I joined in February of ’72. So that was back in the 1103, not the 1103a.

C. House: It was not the 1103a that was the 1103.

D. House: So this is what, this was the problem child memory.

C. House: Well, you know, they had some issues I remember.

D. House: We had big yield issues we would get huge variations in yield on, yields were low and highly variable, when they are well, they are highly variable.

C. House: But we were an instrument company. I mean we knew, we had, we knew ground planes for breakfast and we knew timing issues and we weren’t computer guys we were instrument guys. Very different mentality..

D. House: Oh yeah, absolutely.

C. House: You know.

D. House: You made oscilloscopes.

C. House: Well, sort of. Well you mentioned logic analyzers, I knew all about those. That was my baby and so let me ask a couple questions here. You know, sounds like HP wasn’t on your radar, sounds like it was the mini computer guys.

D. House: Well it was the mainframe guys.

C. House: Oh, okay.

D. House: Who were on the radar because they were the early adopters because their control store requirements, the mini computer guys, back in those early days, of course were still cheaper. And as amazing as we still remember, we ran an ad about the death of core memory, it was a very bold ad when Intel announces the death of core memory. And it was still cheaper and many computer guys were very cost sensitive so they would use it and the mainframe guys were largely using core memory for their main memory, they would use the 1103 for cache memories and for control store memories.

C. House: Okay, okay.

D. House: Smaller, high performance, memory applications where they could afford the additional cost and we kept chasing the price of cores. And the price of cores that we, that Bob Noyce would come in about, you know. It’s amazing how resourceful the technology can get when it’s under attack.

C. House: That’s still true. That is still true.

D. House: And how much margin there really was in there. But, eventually we got to the point where it was cheaper to buy semiconductor memories, remember we were chasing a penny a bit. Now, that’s hard to imagine a penny a bit, that’s a lot of money.

C. House: What would that be? Ten bucks? 1103 was ten bucks?

D. House: Ten bucks for one chip. And then we got the one tenth of a cent a bit and, but, eventually..

C. House: So what’s going, so you joined Intel ’73?

D. House: 74. February of 74, before the 8080 was introduced. So the 4004 and the 8008 were out. 4040 may have been out, the--

C. House: Think the 4040 was--

D. House: I remember it was May of that year, when we were-- introduced the 8080.

C. House: Yeah. Okay, so a lot of the questions you get is this dual set of product lines, lot of memory chips, and this cool little micro.

D. House: So- so I show up and- and--

C. House: Which side were you on?

D. House: I was on the memory side, in the beginning.

C. House: Okay. Okay.

D. House: So the first year, Gelbach offered me the job of manager of applications. And I took-- one of my conditions of acceptance is it’d be manager of application engineering, because the purist in me could not leave engineering. <laughs>

C. House: Okay. Okay.

D. House: Even though it reported into the head of sales marketing.

<laughter>

D. House: So- so then, after about a year, I- I got very-- after I basically wrote the app note, and every-- we’d- we kind of solved that problem. I was spending a lot of time working on the definition of the next generation memories. We had static memories and dynamic memories, and EPROMs.

C. House: Right.

D. House: And so I was really involved a lot with the engineers about-- because having designed systems-- they had somebody in-house that they could go and talk to.

C. House: Right. Right.

D. House: About what do you need, besides the systems division? People who were kind of-- there was a bit of an adversary relationship, because they wanted to get the lowest price, and they wanted to optimize, and they didn’t want other people to be able to compete with them. But there was-- I was in the same building, and down the hall, from the chip designers in the same organization. And so after about a year, they said, “Okay. We’re going to make you in charge of marketing and applications.” So I had marketing and applications for memories. So this would have been 74 and then in 75. And I was saying at the time, you know, “You’re really not taking advantage of my background. I’m-- I don’t understand the semiconductor physics like some people.”

C. House: Right. Okay.

D. House: “And I can do the memory job, but I’m- I’m a computer guy.”

C. House: Yeah.

D. House: “And you’ve got this microprocessor, and it’s clear to me that this is the hot thing that’s happening, and you could use some computer expertise on that side.” Well, they then made me manager of marketing for microprocessors. And then general manager for microprocessors, and then microprocessor peripherals, controllers and--

C. House: Right, right, right.

D. House: Everything from a f-- 83 to the 851 to the communication chips, and--

C. House: I’m working on some old memory here, but my sense is that that wasn’t viewed, at the top, as that important a side.

D. House: Well, it’s very interesting. In the early days, when I arrived, Bob Noyce and Andy Grove always had a little bit of strife going on between them. Gordon could get along with anybody.

C. House: He could, or could not?

D. House: Could. Could.

C. House: Could. Yeah, I--

D. House: Well, Gordon and- and Bob--

C. House: He just withdrew, didn’t he?

D. House: Not entirely.

C. House: Okay. Okay.

D. House: But- but Bob and Gordon had, earlier sometime in life, had their egos surgically removed.

C. House: <laughs>

D. House: And so there were no issues. Andy didn’t get that surgery.

<laughter>

C. House: Okay.

D. House: And Bob had a thousand ideas. He was an idea man. He was continually coming up with ideas, but he wasn’t-- he couldn’t-- he wasn’t that good at making decisions, and he certainly wasn’t disciplined. He loved everybody, and he- he was never-- Andy’s Mister Discipline, Mister Drive, Mister Make-it-happen-what’s-the-goal, et cetera. And so Andy was trying to get stuff done. He’s running operations. He’s trying to get the yield up, he’s got huge yield problems, he’s got huge production problems, and we-- our- our factory in- in Malaysia burned down, our assembly plant-- a test assembly-- test plant, and it-- I mean, he’s got all these issues, and Bob just keeps throwing new projects at the engineers, right?

C. House: <laughs>

D. House: So that was kind of the source of the-- of- of the conflict of the two. Well, Bob saw the magic of the microprocessor, and really drove that. And Andy thought it was a diversion, that- that, “We got a-- we’re going to die. This company is not going to be around to do a microprocessor if we can’t get the yield up on this memory chip.”

C. House: We’ll never be around for your cool idea. Yeah.

D. House: “So stop distracting people.” <laughs> So that was kind of the conflict that went on between the two of those.

C. House: Okay.

D. House: Gordon- Gordon was very interesting, in that Gordon didn’t say a lot in meetings, but when Gordon spoke, all conversation stopped.

C. House: Really?

D. House: And the direction-- everybody had to reassess things, because when Gordon said something, he had something to say. And Gordon would be sitting there, and he’d go, “<clears throat>.” Now that means “you guys shut up.”

C. House: Listen up.

<laughter>

D. House: And- and then he would say something, and you could talk. I mean, you- you-- there could be discussion around it, but it was always very insightful, and- and sometimes, it would seem so off base that you would think anybody had said it, you would have said they didn’t get it. But since Gordon said it, you had to think twice.

C. House: Okay.

D. House: I remember when he--

C. House: Got an example or two?

D. House: Yeah. We got a- a random bit error problem on the 1K D/RAM. The part is, every once in a while, having a soft error. You go-- you can’t reproduce it. You go back, and it reads- it reads and writes okay. But it- it’s a soft error. We can’t figure out what’s going on. They call for a weekly-- no. A weekly, or day-- no. A daily meeting, an 8 o’clock meeting. And I get appointed as the person representing the customer, basically, to this meeting. These are all guys passing around electron microscope photographs of stuff, and chemical analysis, and I’m like, “Nah.”

C. House: <laughs> Yeah.

D. House: I’m like, “This is really interesting. I wonder what it means.”

<laughter>

D. House: And they’re talking, and- and Gordon says, “You know, this could be gamma rays.” <humming>

<laughter>

D. House: They’re like, “Gamma rays?” Anybody else says that, you- you--

C. House: Yeah. Sure, yeah.

D. House: Everybody stops. “What do you mean?” “Well, you know, you got gamma rays coming in from outer space, and maybe a gamma ray hits this chip every once in-- it’s a bit, and every-- that’s what causes the flip.” So Gordon- Gordon’s a big fisherman-- big salmon fisherman.

C. House: Yeah.

D. House: And in those days-- today, they have these weights you pull back in. But in those days, when a fish struck, you-- it would drop the lead weight. Gordon also doesn’t spend anything he doesn’t have to spend. So instead of buying the weights, he found out he could buy lead and cast it himself. And he’s casting his own sinkers.

<laughter>

C. House: He and Dave Packard must have been cousins.

<laughter>

D. House: And so he says, “Well, I’ve got these lead blocks.” So he brings in these lead bobs-- we built an igloo. And sure enough, the soft error bits went away. We wound up creating a conformal coating, that was added to the top of the die, that stopped the gamma rays. And we fixed the problem. Now there’s an example of like--

C. House: That is a great example.

D. House: Something totally off base that anybody else had said--

C. House: Have you told that story?

D. House: I don’t know. <laughs> Prob-- well, not to a camera prop, maybe, but- but--

C. House: Yeah. That’s a fabulous story.

D. House: Yeah.

C. House: Absolutely.

D. House: And he-- I remember saying, “Remember at Fairchild, when we had this? This looks like that.” And everybody going, “Oh.” But yeah, there’d be a big debate about whether it could be the same thing, or not, and-- but everybody’d go run experiments. And he’ll sometimes even be wrong, but it’s amazing the stuff he came up with.

C. House: Sure.

D. House: So-- no, he- he would push back, but he just didn’t have to talk a lot. <laughs>

C. House: Yeah. So Bob left, when, 81? 82? Somewhere in there?

D. House: So w-- probably about then, when he went to run Sematech.

C. House: Sematech. Yeah.

D. House: Yeah. And basically, that was-- there wasn’t enough room for the two of them, and Bob wasn’t the kind that was g--

C. House: For he and Andy?

D. House: For he and Andy. And- and Bob wasn’t the type that was going to fight. He- he was-- he’s a non-confrontive [*sic*] guy, and Andy’s an excessively confrontive guy. So--

C. House: Yeah, I’ve encountered that myself.

D. House: So- so Gordon became CEO, and Bob became chairman, and Bob went off to Semaitech, et cetera.

C. House: So let’s back to-- so during this late 70’s period, here’s these micro’s, and they’re doing okay. And here’s this memory selling like striped-ass whatever.

D. House: So I remember--

C. House: And then the Japanese come along.

D. House: So I remember 1978-- the beginning of 1978. I’m made general manager of the microprocessor components division. And at that point in time, Bill Davidow had engineered a scheme where, when you sold a microprocessor, the memory that went with it, you got credit-- that division got credit for that-- those memories. We even came up with a-- we’d put an eight in front of the name. So we had a 2104, we had an 8104.

C. House: Really? I didn’t know that. Okay.

D. House: 1KD/RAM standard _____. And- and the whole logic was that the specs were different because the-- we made the spec for the 8104 exactly the timing of the bus of the 8080.

C. House: Okay.

D. House: And it-- but basically, it was trying to aggregate as much revenue as possible to justify the existence of this little teeny division that was losing money. I’ll never forget-- when I took it over, it was making 40 million a year, losing money. At--

C. House: Revenue of tw-- forty?

D. House: 40 million a year.

C. House: Yeah.

D. House: And I- I said, “This memory chip accounting thing is all hokey-pokey. The sales guys are having to decide whether the memory went here, or went there.” Because you could use the 2104 with an 8080.

C. House: Oh, yeah.

D. House: So they’d have to code the deal, and then- then there were the different groups who were trying to offer different incentives, and it was- it was stupid. I said, “Let’s just focus on the chip business, and sell the microprocessor chips.” So with 80 million dollars a year, losing money, I ran it for 13 years

and-- at which-- when I left that group to become chief marketing officer of the company, it was four billion a year.

C. House: Yeah. It did okay.

D. House: Making more than a hun-- Making more than a hundred percent of the corporate profit.

C. House: Yeah.

D. House: But what happened is, in the D/RAM business, we dropped the ball at 4K. Mostek came out with a 16-pin dual inline, and we had a-- I think it was a 20-pin. So they had a-- was three tenths wide, and ours was four tenths wide. Much bigger package. And they multiplexed the bus. They supply-- the- the address. They put in the- the first x-bit-- half the bits.

C. House: Yeah.

D. House: And then- then they clocked in the second. So they double clutched. And if you understand how a memory works, you read the row- the rows, and then the columns, so you don’t need that second half of the address until later. We had a parallel address, and our chip wasn’t as good as theirs, quite honestly. And they took the lead in 4K. We developed a- a compatible 4K, but it was too late. And then we made a big rush at the 16K, tried to compete in that market, the Japanese had gotten in the market at that point in time. Mostek and others were making the same part, it was all interchangeable at this point, and then the HP paper came out, which said the Japanese quality is certifiably better than the US quality. And shook the company to the bones.

C. House: Did it?

D. House: Oh, absolutely. I mean, that was a -- our attitude, at that point in time, was that our product was good enough.

C. House: <laughs>

D. House: And it did the job.

C. House: Yeah.

D. House: And the Japanese were being unreasonable on their quality demands. And I remember one of the issues was we used to ink print the part number and the logo on the top of the package, and the US company-- our customers would accept it if there was a little smear, but you could still read it. So the four’s got a little tail on it--

C. House: Yeah.

D. House: You could see that-- okay, you can still read it. The Japanese would reject it. And we said, “That’s ridiculous.” You can read it. It’s good enough. And there were a whole bunch of other issues that wound up differentiating quality that we said were irrelevant, until we got some pretty hard facts, that were hard to refute, from HP about real stuff. I created a program within Intel, at that point, and-- I don’t know if I’ve told this story either. I created a- a program called Japan Focus. I came to the conclusion-- I’d seen the Japanese take over the D/RAM business. They were making a huge run on the static RAM business, and being quite successful. They were trying to get the E/PROM business, which was the last profitable memory business we had. And they were starting to show signs of coming after the microprocessor. I looked at what they’d done in automobiles, what they had done in televisions--

C. House: Oh, yeah.

D. House: What they had done in radios, and I said, “I can connect the dots.”

C. House: Yeah, this isn’t hard to figure out.

D. House: And I- I told my staff, at the time, “You need to personalize this.” For me, what this means is, if this trend continues, the highest thing I can aspire to is to be president of the US division of a Japanese semiconductor company. That’s the highest I’ll be able to re-- because I’m not going to be CEO of a Japanese company.

C. House: Oh, yeah.

D. House: That’s not going to happen. And- and--

C. House: Yeah, you’re not short enough.

<laughter>

D. House: I don’t speak Japanese well enough. And I wasn’t born in Japan, and I’m not Japanese.

C. House: Yeah.

D. House: And- and--

C. House: And- and--

D. House: and I don’t smoke.

<laughter>

D. House: But- but the- the-- I-- they- they don’t give stock options. Guys, remember what this means. And so I created a team on a program called Japan Focus. First time went to Japan, we had a good team there. Guy by the name of Bob Derby was running the- line there, and Bill Howe, another ex-pat that we had there. We had some good Japanese leaders, and had a session with them, and talked about the problem. And we devised [*sic*] a plan called Japan Focus. And the-- it’s-- it started out with the Japan team. There were eight members of the Japan team. We had a hundred or two hundred people in Japan, but eight key guys who I appointed to this. And we studied all the Japanese companies, and we’d studied the individuals to the point where we did profiles on the general manager of the semiconductor division, and the engineering manager for DRAMs, the engineering for microprocessors,-- and the-- we knew where they went to school, we knew the culture of the company, and we had them come over, and they spent a full day briefing us on the details of the companies who we were competing with. Because I said, “If we’re going to compete with them, we got to know them.”

C. House: Oh, yeah.

D. House: And then we formed up teams, and we said, “Okay, you’re the general manager at NEC Semiconductor, and you’re this guy on the-- this team, and you’re this guy on this team, and- and you’ve got profiles of these people. You have to you-- and you got a description of the NEC culture from the Japan team, and you have to come up with a strategy, consistent with who you are in your company culture, to beat Intel on microprocessors. And e-- so we had an HP-- we had the NEC, Hitachi, Fujitsu, we had all the main semiconductor company teams. I think there were four or five, and they came up with strategies to beat us. And then we formed teams to beat them. That is, “How are you going to counter those strategies?” So we had-- we played the board games.

C. House: Yeah. Yeah.

D. House: We did this for three days, probably. Next thing we did is-- we said, “Okay, this big issue-- we have this big issue of-- called quality.” HP had published their paper by then. We said--there’s the Baldrige Award, in Japan.

C. House: Yep.

D. House: That’s the big award. So we formed-- I formed teams. I took all my direct reports, and we went to Japan, and we broke up and we went to each of the Baldrige winners, not only in semiconductors, but in some other related areas, and even like a car company. And we had an eight page questionnaire that we had that we didn’t give to the Japanese. It was-- the team had to fill out afterwards. I

D. House: We had an eight page questionnaire that- that the- the team had to fill out, and-- after they interviewed the company.

C. House: Okay.

D. House: And basically, it was all about what you thought of-- about quality, our quality, other peoples’ quality, what we needed to do, etcetera, etcetera. And it became clear that, if we were going to be successful-- my strategy was to win in Japan, because I had seen in all the other industries, they would compete amongst themselves in in Japan for the Japanese market, -- and a few leaders would emerge, and then they’d go the US. And that’s what they were doing in microprocessors. NEC was copying Intel processors, Hitachi had their own line. They were taking different strategies, and trying them out in Japan. And then they were going to come to the US. It was so clear -- and they started talking about it in the US. And so I said, “We’re going to go to Japan. We’re going to beat them in Japan before they can get to the US.”

C. House: Right.

D. House: And- and quality wound up being the big issue. And so we created a- a Japan test lab, and everything that we would produce in-- that was going to Japanese customers, went to that test lab and got retested to Japanese standards. And when it got shipped to the customer, now it’s to Japanese standards, and we’re continually improving that. Because I couldn’t change the big factory.

C. House: Right.

D. House: But I could stream.

C. House: You select. You stream. Sure.

D. House: I could stream. But then, the thing we did, is we took everything we learned there and put it back to the factory.

C. House: Okay.

D. House: Then we could move it back. I said, “My job is to eliminate the Japanese test lab and move it back in.” And it worked. We- we went to laser printing, because laser printing doesn’t smear. <laughs>

C. House: Yeah. Yeah.

D. House: Laser printed the stuff on the lids of the packages, and did a bunch of things like that. And we thereby increased our quality, and we were able to- to--

C. House: Stem the tide.

D. House: To stem the tide. You remember the Japanese trade agreement? It w-- the- the US government-- the argument that Sematech and the semiconductor made was-- it’s very interesting that, in the rest of the world, the US semiconductor companies are the majority of all consumption.

C. House: Right.

D. House: In Japan, we’re two percent.

C. House: Yeah.

D. House: So if it’s good enough for stuff that you ship to Germany-- why is it good enough for stuff that the Germans make, and use themselves? I mean, you’re saying it’s not good enough, but it’s good enough everywhere else. So there was an agreement that, after five years, the Japanese would import twenty percent of their semiconductors.

C. House: Oh, okay.

D. House: So it’d go from 2 percent to 20 percent, not 80 percent, 20 percent of semiconductors. And it was tracked, and they weren’t on track to make it, and in the end, they miraculously, in the last year, <laughs> wound up making it, and in fact, maintained it. What most people don’t know is that that 20 percent-- 12 percent of that 20 percent, or- or 8-- 60 percent of the 20 percent. 12 percent of all semiconductors used in Japan were Intel microprocessor products.

C. House: Okay.

D. House: They were importing more Intel microprocessor products than everything else to meet their 20 percent. And I-- that- that, I think, is very much related to the Japan Focus program.

C. House: Oh, yeah. Yeah, I bet.

D. House: Which is really aimed at winning there. One of the discussions I think we should cover is the early microprocessor. You mentioned the fact that HP had an early microprocessor.

C. House: Right.

D. House: Intel didn’t have the first microprocessor as-- you- you could argue that- that basic logic unit was a microprocessor.

C. House: Right.

D. House: It was a controller, but it was a programmable chip set. It was-- the thing that Intel had was a single chip, commercial--

C. House: Yep.

D. House: That was a product at Basic Four. You remember Basic Four in Cupertino, where Apple’s headquarters is now?

C. House: Yep. Yep. Yep.

D. House: That Basic Four. Was it- was it Basic Four? Think that’s the name of it. Anyway, the-- they had a- a product which was, arguably, a single chip microprocessor.

C. House: Okay.

D. House: It had a program counter on it, and it had registered at ALU. Took some other chips to make it run. There was a TI -- you remember TI tried to patent the microprocessor, based on some early work they did.

C. House: Oh, yeah.

D. House: And it was the Basic Four chip that- that-- it validated that- that patent.

C. House: Yep. That’s right.

D. House: But it wasn’t a commercial product.

C. House: Right.

D. House: So Intel was the first commercial single-chip microprocessor.

C. House: Yep. Right.

D. House: But the idea of higher integration of the- of the processing unit was obvious from the evolution of semiconductor technology. The Apollo computer was made out of a single logic element, a NOR gate.

C. House: Right, right.

D. House: Flip-flops to ALU, everything was made out of a single chip, and we used to make-- build stuff out of NORs-- NANDs and NORs.

C. House: Yeah. Oh, yeah.

D. House: And-- before we got the flip-flop.

C. House: Right. Hell, I’ve been in stuff like that, yeah.

D. House: And- and then we got-- as I said before, we got- we got the- the 4 bit registered chip, and then we got the 4x4 chip register array, 16 bits of register-- and we got the 4 bit ALU. And so the-- all the arrows were pointing towards “we need to integrate more and more of this”. And we kind of got to the point where you had to go custom, because the more you put on a chip, the more specialized it becomes.

C. House: Sure.

D. House: One of the dilemmas we used to talk about, at the beginning of the microprocessor age, is that as you- as you-- h- higher the integration, the more specialized, and so the smaller the market.

C. House: Yeah. So where’s the killer app? You got a--

D. House: And so the- the-- that building block integration was coming to an end, and so we needed to make this big leap to the processor on a chip. And now we could control stuff with software.

C. House: Right. So the question I think I was trying to get as with some of this is-- HP, in several ways, had a pretty strong relationship with Intel.

D. House: Uh-huh

C. House: They were a huge memory buyer, wound up becoming a fairly sizable microprocessor buyer, or microcomputer buyer. But along the way, we built our own stuff. And we were building logic analyzers, and then the next thing we know, there’s this Intellec system that looks smarter than ours.

D. House: <laughs> Well, when I was running-- when I took over microprocessors, and it was 40 million a year, the development system business was a lot bigger and a lot more profitable. We were making more money selling the development system for the microprocessor than we were the microprocessor.

C. House: Oh, I’m sure you were.

D. House: In fact, at one point in time, we were making more money selling 8080 manuals than we were 8080 chips.

C. House: Is that right?

D. House: That’s right.

<laughter>

C. House: Oh, I love it.

D. House: But- but the- the big conflict with- with HP came up over the- the in-circuit emulator, and the logic analyzer.

C. House: Okay. In which respect?

D. House: As we-- in that they were competition.

C. House: Okay.

D. House: People were buying HP products instead of Intel products to debug their systems. And there was-- I don’t know if you were there at the time, but there was a pretty big battle between the two companies over the in-circuit emulator. We set-- had developed the development system, and we had PLM programming language, and-- so we had compilers and- and assemblers, and debuggers, and- and then we developed the in-circuit emulator, where you would take the micro-- the 8080--

C. House: Right, yeah

D. House: The 8085, or the 8086, out of the socket, and you would plug in this connector that had a connector on top. And you plugged the microprocessor on top of that. And what that allowed us to do is like breakpoints. So you could run the program to a certain point, and stop the machine.

C. House: Sure. Right.

D. House: And- and do traces, and do a number of things like this. Well, that was a great product, but HP could do the same thing, and they started making a product. And-- but our engineer said, “You know, if you made some changes in this-- the processor chip, we could really do a lot more. Just put a little bit of logic in here, and a couple control places.” And we said, “Well, we could do that with a bonding option. We could make a die that would work for that chip, or the standard chip.” And we, in collusion <laughs> with the development system people, that is the chips side and the system side, came up with this system to block out HP in the debugging business.

C. House: Yeah, I remember that quite clearly, actually.

D. House: And--

C. House: It stymied us.

D. House: Pardon?

C. House: It stymied us pretty well.

D. House: Yeah. And- and so HP came and said, “We want to buy that other chip.”

C. House: Yeah.

D. House: And we said, “Oh, no. No, we can’t sell that other chip.” And they-- and there was-- every--

C. House: Yeah, yeah. “We don’t sell bond-out chips.”

D. House: The bond-out chip-- and every leverage point that HP had was applied to Intel. It was--

C. House: That right?

D. House: Oh, they-- the buying people says, “You know, we’re going to stop buying your memories, or it b--“ it was-- and it was a bit of a bluff on some cases, because some stuff, we said, “They don’t have any option --to buy this. The guy’s -- he’s bluffing.” <laughs>

C. House: Yeah.

D. House: And- and some of it, I think, you did divert business away from Intel, because w- we were making a lot more money on the development systems than we were on the stuff that you were refusing to buy. <laughs>

C. House: Oh, I’m sure you were.

D. House: We could make huge margins on that stuff, and we’re making really skinny margins. So if you bought a million less of these, that didn’t make near as much different as us selling a million more of those. <laughs>

C. House: Yeah. Yeah. So for a long time, all we built was logic analyzers, and we didn’t compete with the PDS stuff or the MDS stuff. And then, when we got in it, the question was, “What do you do to be disruptive against what you guys had?”

D. House: Yeah.

C. House: And there were two things. One is every other manufacturer of micros had a terrible development system. So we said, “Well, we’ll build ‘the universal system’.”

D. House: Yeah.

C. House: You can create here, and cross target over there. So you can shift from Zilog to National, or whatever.

D. House: Yep. I remember that. Because Motorolla had a really lousy--

C. House: Oh, yeah. Everybody else, except your system, sucked.

D. House: Yeah.

C. House: And so we mopped up a lot of business that way.

D. House: Yep.

C. House: But when you went to the bond-out chips, we were screwed.

D. House: Yeah.

C. House: There was no good way to stay current. And so that was a troublesome time for HP.

D. House: And then what happened is the PC came out.

C. House: Yeah, the PC came--

D. House: And people started writing compilers and debuggers of software.

C. House: Oh, yeah.

D. House: And it killed the whole thing.

C. House: Killed it. Yeah, I was going to say--

<laughter>

D. House: HP and Intel are--

C. House: We ultimately won that business-- we went by you as the whole thing was disappearing into the muck.

D. House: That’s right.

<laughter>

C. House: Yeah, that was a short lived major product line.

D. House: Yeah. But for a while, it made a lot of money in the late 80’s.

C. House: Yeah. But it was an interesting time. So that was one of the questions I had. Some of the people I met in that time frame-- like Sterling Hou, was in the program.

D. House: Oh, yeah.

C. House: Jim Lally was in it.

D. House: Yep. Jim and I were sort of purists, and he was the systems guy, and I was the components guy. So he ran the development system business. He was general manager of that division. I was general manager of the component division.

C. House: Okay. And Phil Kaufman?

D. House: Phil was kind of a- a senior engineer Renaissance man.

C. House: Okay.

D. House: He even worked for Andy Grove as a- a technical assistant for a while. He- he-- so he had a number of different jobs. He- he actually--

C. House:: He kind of talked like a visionary.

D. House: I, for one year, ran over-- I w- went over and ran development systems for a year after Lally went off to create the commercial systems division. We’re going to take the development system and turn it into a business computer.

C. House: Oh, really?

D. House: That never got off the ground.

C. House: Okay.

D. House: They moved him to Phoenix. We painted IBM cloud white. <laughs>

C. House: Is that right?

D. House: He tried to put software on it.

C. House: Yeah.

D. House: And- and so I took over the development system business. And for almost a year, Kaufman ran microprocessors.

C. House: Okay.

D. House: But he was not a manager. And soon, they put him underneath me, and I had development systems and microprocessors.

C. House: So somewhere in here, networking starts to appear.

D. House: Yes. Or that’s what the presentation--

C. House: And then that’s what I want to spend the rest of the time on, if we could.

D. House: <laughs> The presentations about the part guys-- I mean digital guys, came later. But the original part discussion-- with this yellow cable, and this piercing tap.

C. House: Oh, God. Yeah.

D. House: And- and I says, “Really?”

<laughter>

C. House: Same as with the D/RAM. You got to be kidding me.

D. House: You got to be kidding me.

<laughter>

D. House: I mean, the concept is right, but this doesn’t make any sense at all.

Chuck. Yeah. Yeah.

D. House: And- and you’re going to have electronics at the end of the box, after the tap-- the piercing tap. And they make it go anywhere, and put the screw thing in that goes through the insula-- through the- the coax conductor on the outside, and makes contact with the center, but doesn’t make contact with the outside, and that’s going to be reliable. <laughs> Oh, yeah. And the-- what’s it, the blue book? The yellow book? What was the color of the book? The- the original spec that DEC, Intel, and PARC put together with the init- initial spec. So- so PARC were the first guys. We talked to PARC, and then Digital came to us and said, “We’ve been talking to PARC, and we need a component player, okay? To- to go with us.” And the three of us generated the spec, and we had went out and started Evangelizing. And the whole concept-- there was an interesting with- with Digital. So I- I’ve got the component group, and so I’ve got to start a chip design. We had communication chips before that. Never had been terribly successful with our communication chips. The UART, the original 8251, that was very successful.

C. House: Yeah, remember the UART? Yeah.

D. House: But that was kind of the last big successful communication chip. And so we made the 82586, and- and we did it in Israel-- designed it in Israel.

C. House: Oh, really? Okay.

D. House: Which is-- we had some really great designers, but the Israeli design center, if it had one problem, it was lack of market connection.

C. House: Oh, yeah. To this day.

D. House: And they- they’re very smart.

<laughter>

D. House: They’re very smart, and they were almost as smart as they thought they were.

<laughter>

C. House: I love it.

D. House: And there was a issue that came up, I remember, with Digital, about collision detection and backoff-- the backoff algorithm. And the Digital guys said that our algorithm we’d come up with in- in Israel

could get in sync. That is, two people could backoff the same amount every time, and they’d just keep going like this, and it’d lock up. And this-- and I s-- so I got the Israeli guy in, and- and we get into all the mathematics of all this, and I’m- I’m trying to just figure out if they understand it. I’m not even trying to understand it, myself. And- and so- so we have this whole discussion, they’re convinced, I say, “Go talk to the Digital guys, then, if you’re so sure.” And they talked to the the Digital guys-- I talked to them later, and they says, “They just weren’t listening. The Israeli’s came back and said, “Oh, yeah. We got-- it’s all under control, now.”

C. House: <laughs>

D. House: Later, I talked to the Digital place, and they were just like-- so the Digital guys wouldn’t talk to AMD, and they had AMD develop a- a _____ chip.

C. House: Oh, really?

D. House: And they used the AMD chip, and there was a big-- I got involved with the Ken Olsen level-- Bob Noyce level kind of conflict with, “Come on, guys. We were supposed to -- be the chip guys.”

C. House: Yeah. Yeah, I mean--

D. House: And- and they -- their management came back and was-- I don’t know. Palmer, or somebody underneath Olsen that said, “Come on. Your guys didn’t listen to what we had to say.” And, “What-- oh.”

C. House: Oh.

<laughter>

D. House: Imagine that.

C. House: Yeah.

<laughter>

C. House: Love it.

D. House: So anyway, we- we sold a bunch of 82586’s, but not near as many as AMD did of their version of the chip.

C. House: Yeah.

D. House: And obviously, the local area networking was huge, because it helped the microprocessor sales, so dramatically, to be able to start networking these things. I mean, sharing printers.

C. House: Oh, yeah.

D. House: I mean, it starts out with just sharing printers. And--

C. House: So this is, what, 80 time frame? 81? PC was just out.

D. House: Yeah, the PC came out in August of 81. And so--

C. House: Somewhere in 82, you’re talking about. I thought--

D. House: We-- well, the- the discussion around local area networks started before the PC came out.

C. House: Yeah. I was going to say that was more like 80-- 79, 80.

D. House: Yeah. Yeah, I think so. Because IBM, of course, came out with token ring, and we had the big Ethernet token ring battles.

C. House: Talk about that idea. Whose time never came?

D. House: So you got a key, and you pass the key around a token, and you pass the token around a ring? Hmm. I don’t know where you--

C. House: <laughs> How’s that really going to work? Yeah.

D. House: And they says, “So you’re depending on statistics of backoff and indeterminate, and- and we’re--“ and so we’re- we’re talking right past each other. But of course, you start out with printer sharing,

and then you’ve got department level networks, and you-- using common storage- using common storage for shared storage, largely for sharing documents, at that point. You just dumped stuff on the server, and now you need to connect to a different department, and you start worrying about bridging and routing. And of course, about that time is the work up at Stanford-- let’s take a computer and let it figure this out.”

C. House: Right.

D. House: And the various routing algorithms-- the-- TreeNet--

C. House: Well, let’s stay with the Ethernet thing for a minute. So I know Bob Metcalfe was--

D. House: Oh, he was the Evangelist.

C. House: He was the guy, as we saw it.

D. House: Yeah, he was the seller.

C. House: And he tried to get HP interested, and we kind of all did a slow shuffle, and--

D. House: So what were you doing to connect stuff?

C. House: I wasn’t doing anything?

D. House: Oh. What was HP doing?

C. House: Well, we were doing our own local area network stuff, all private label stuff. All proprietary.

D. House: Because there were a number. Arpanet, one of the Datapoint networks, predated Ethernet. Arcnet was it?

C. House: Yeah, I think so.

D. House: Datapoint had a pretty good network for tying the terminals.

C. House: So when I took over engineering, I adopted TCP/IP as soon as I could get on it. We'd resolutely decided not to do that, so we had a G-job up in the labs that did it. Once we did that, then I could buy a Cisco router. I bought the first Cisco router ever sold.

D. House: Is that right?

C. House: Yeah.

D. House: Does it look like the one that's in the exhibit?

C. House: Worse. Worse. That's the first Boeing one. I bought mine two years and three months before they did. That was the second one that they sold. They sold to universities a lot, but they didn't sell to any commercial customers. Sandy didn't want to. Universities--

D. House: Sandy didn't-- oh, she was-- wanted to sell to university. Didn't want to get dirty with the commercial business.

C. House: Exactly.

D. House: It was basically a computer running algorithms at that point.

C. House: Oh yeah. But back then--

D. House: Interesting that routing is getting back to that.

C. House: But back to the Ethernet time. So Gordon, of course, got involved from DEC and he'd left and then he'd come back. I think he had some other people really playing around. The question at Intel, to me, always has been, who? So Phil was involved as Andy's guy, but my sense is, Phil wasn't the guy. Somebody else had to be looking.

D. House: No, the Israeli team got assigned fairly early.

C. House: Okay.

D. House: You wouldn't have seen them because they weren't here, while that was happening, by email--

C. House: And then since they didn't listen, that's why we never heard about it. Okay. And then Bob went over and set up 3-Com. Howard Charney showed up. He told me a great story on that. He was in his fraternity at MIT

D. House: Was in Bob's?

C. House: Yeah. No, Howard was.

D. House: Howard was in Bob's fraternity?

C. House: Yeah, Bob's a sophomore, Howard's a freshman. He said, "I followed him round like he was God." Then he came out to work on the first Winchester drive for IBM. Gets tired of being an engineer. Gets a business degree at Santa Clara. Gets tired of that, then gets a law degree. Sets up shop as a consulting IP guy in the mid '70s.

D. House: Charney did.

C. House: Yeah. Bob knows this, calls him and says, "Hey, I basically want to take code that DEC and Intel and PARC have done and use it to make my own company. Could you help me make that legal?" That's how they started 3-Com .

D. House: Well, the guy at Digital was Bill Hawe. He was the technical guy there.

C. House: Hall? H-A-L-L.

D. House: H-A-W-E.

C. House: H-A-W-E, okay.

D. House: He later became my CTO at Bay Networks.

C. House: Okay, so that's the name I'm looking for.

D. House: He's the Digital guy.

C. House: Okay. Anybody I didn't talk about by name that made any sense or did anything later?

D. House: I'm trying to think of who it was in Israel, whether it was Rafi Nave. It may have been Rafi Nave. I don't think it was Ellie Perat. I think it was Rafi that may have been the guy there, but I'm not positive on who was running the team in Israel. I had a number of people reporting to me. One of them had peripheral chips. That was one of the peripheral chips, so the product manager was two levels below me and the engineering team--

C. House: See, I remember this--

D. House: Under the Israeli design center that reported to my VP of engineering.

C. House: Do you remember the story about there were four Arpanet nodes when they did the first thing? It's Santa Barbara, UCLA, Stanford and U of Utah, right? There was always names for three of those and nobody for Santa Barbara. So the joke when I got down there was, "How did that happen?" They said, "Well, somebody just clipped on because the wire went by the campus, but we don't know who it was." Well, it turned out it was Glen Culler, when you finally dig in, and he tossed a tenured position to go start companies. So they wrote him out of the script. I've never known who at Intel would have been part of that consortium. This answers that question pretty well actually: no one.

D. House: It would be interesting. I could ask some more people that were in the organization about some of those early discussions. What I remember is them coming to me about the ideas and what we're going to do and what the deal was, the terms of the deal.

C. House: Well, I appreciate that. So now, fast forward. Andy's going to retire at 55. You're sitting there. You've run every part of Intel and you're kind of the fair-haired kid. You're young enough and he's ready to pass the torch. And then he has--

D. House: But Business Week runs an article about, Andy's going to retire at 55. Whose picture do they put in there but me? They say, "This is the guy that's most likely to replace him."

C. House: Talk about tar you.

D. House: Yeah. Andy came in. He said, "That's the worst thing that could ever happen. Everybody's going to have their arrows pointed at you now."

C. House: Well, then he has an epiphany.

D. House: So he goes away on sabbatical. Fortunately, just before he does, he says, "The worst thing that could happen is that I appoint a new CEO and all of the staff quit. It's going to be tough enough to make the transition with the staff I've got, but he's going to _____ it's going to be--" and that had happened to another company. So he put these golden handcuffs, these four year stock options that overlapped-- he said, "I'm going to leave in two years and you've got to stay two years to get this."

C. House: _____ stuff. There were none of us, yeah.

D. House: It was a pretty heavy set of golden handcuffs. So I'm like, okay, whatever happens, I'm in on this. But he'd done this before he had his epiphany, which was very helpful for me, because I still got the stock.

C. House: Yeah, you got the handcuffs, yeah.

D. House: I didn't have to worry about it. He comes back from sabbatical and he and I used to have dinner regularly. So all of us go have dinner, we come back and he tells me about his-- he'd worked with this guy at Stanford, a professor that he taught a class with. He's skiing with this guy and the guy's saying, "What better job is there? What's going to be better than this?" He says, "Well, Dave, I know this is going to be disappointing to you, but I've decided I'm going to stay. I've told the board I'm going to stay. What's your reaction?" I said, "Two things. First of all, I think from a stockholder standpoint and from a company standpoint, that's the best thing that could possibly happen, because I can't imagine somebody stepping into your shoes and doing a better job than you've done. The best thing that anybody could put on your successor's tombstone is, 'Well, at least he didn't fuck it up.'"

C. House: Exactly.

D. House: He says, "What about you?" I said, "Well, you know, I'm disappointed because I'd kind of thought about that, but that's okay. I enjoy my job. I'll be CEO of something someday. I'm having fun. This is okay. If I retire in this job even, it's a very good life I've had. Things are good." I was not near as disappointed as he expected me to be, and people who had projected the case. I was never in it for a contest. I was never there, like, "Boy, if I could just do this, I could become the next CEO." It was like, "Gee, I'm having fun. This is a great job, this is wonderful." I kind of pitied the next person, because it's going to be really hard.

C. House: Filling shoes of that size and you've seen it company after company, the next guy is savaged.

D. House: Yeah.

C. House: This is not a thankful deal.

D. House: No matter how good they are. They can't be better than.

C. House: How do you replace John Wooden or Vince Lombardi?

D. House: Hewlett and Packard.

C. House: Yeah, it's hopeless.

D. House: Watson at IBM. These legends. I think the best you'd get is a pass, following up. So I was a little concerned about the job, to be honest with you, and it turned out to be pretty difficult.

C. House: So a couple of years go by. A couple more years go by and one day, you decide--

D. House: Well, this networking stuff had started to happen and we weren't doing particularly well in it. Just like we'd moved from mini computers to microprocessors, it's not like it's the end of microprocessors, but the exciting stuff's all happened. There's a lot of commercialization to be made yet, but the networking business is really starting to look very interesting. I was running the server business at that time. After being chief marketing officer, I'd been chief strategy officer. Then I advocated, we should get in the server business. We had 5 percent or something in the server business at that time. I said, Moore's Law, just look at the economics. That's there as far to take and so Grove created desktops, laptops and servers and gave me all the chip and system server business and I ran that for two years. At Intel, you get a sabbatical. Every seven years, you get eight weeks plus your vacation, I think it is.

C. House: I got to six and a half years and quit. Can't remember why.

D. House: Crazy man. Couldn't have been that good or bad that you didn't stick it out. Sabbatical's one of the best things ever. Just before I go on sabbatical, John Thompson and Heidrick & Struggles gets a hold of me. He says, "You just have to talk to me about this." So I went and talked to him. Then he convinced me to meet with Paul Severino at the time, who was the Wellfleet half, and talked about it. Then I went on sabbatical. I'm on sabbatical and I'm thinking, and I knew Bay Networks. A really great engineering team, broad product line, strong customer support. Everybody wanted an alternative to Cisco. No adult supervision, totally lacking. It had an east coast company and a west coast company that merged and didn't ever really merge

C. House: So they'd already merged.

D. House: They'd already merged, two years before. They had been doing about 500 million a year apiece, so they're a billion. They went a billion, a billion five, two billion. Then everything was stagnant and it looked like it was headed down. Everybody was competing with everybody. The east coast would start a program, the west coast would start one to compete with it. Switching and routing was coming together. The level three functions were starting to enter the switch business. As I said, the children were starving for lack of birth control. Anybody could start a program. Nobody could kill a program. All the programs were understaffed, products were, as a result, coming out late, missing features and more buggy. This is a--

C. House: Recipe.

D. House: Recipe for disaster.

C. House: Oh yeah.

D. House: I look at the engineering resource and I see they've got some really good engineers. You talk to customers and there was a lot of support from the customers and they had the broadest product line after Cisco. I said, "Technology's hard to fix. Customer relations are hard to fix. Management's easy." I'd worked for Grove, as my direct supervisor, for 13 years.

C. House: So you knew about top management.

D. House: I knew. He'd written three books on management while I was working with him. "High Output Management," "One on One with Andy Grove," and "Only the Paranoid Survive." So I'd been versed in management theory. He and I owned a sailboat together. We used to go sailing and we used to ski together and our families would do vacation things together. We were always talking about management and leadership and these issues. So I said, "You know, I think I can do that."

C. House: Yeah, that was not hard.

D. House: I think I can fix that one. So I surprised everybody. I came back from sabbatical and I talked to the Bay Networks guys a few more times. I said to myself when I was on sabbatical, "I should do this." I never would have, in the heat of the day, left Intel, but I'm away, I'm on a cruise in the Mediterranean. Now I'm thinking about, "This thing actually sounds like it would be a pretty good deal." I told my Nancy,

my wife, I said, "I'm not going to quit as soon as I come back. I'm going to wait two weeks and see if it still feels like the right thing."

C. House: So you jumped into that.

D. House: Jumped into it.

C. House: And you gave a great little story about that in the interview with Gardner about how you built the teams and tried to get them going in one direction together.

D. House: Did the training.

C. House: Yeah, did the training.

D. House: New Bay Networks training, which soon because the House training, called the House training.

C. House: Is that right?

D. House: So we had House cleaning, House rules and House training. When I came in, there were 15 direct reports that I inherited. Sixty days later, there was one of them still reporting to me.

C. House: Is that right? Wow.

D. House: There were some people in different jobs. A bunch of them had left the company, but there was one left.

C. House: That was the House cleaning.

D. House: That was the House cleaning. And then there were the House Rules. I stood up and I said, "These are the things we're standing for. I stand for these things. If you ever see me violating any of these rules, you call me on it. You'll never be punished. I want the information and feedback, but I'm expecting everybody to live this way. Customers first. You make your commitments. You tell the truth." A bunch of things. And then there was House training.

C. House: Not exactly the Phil White or Larry Ellison school of thought but, you know.

D. House: Then I went out and did the training, which was decision making. Decision making in organizations is a very complex process. It's important we talk about the process and understand the process and we define the process of how we make decisions. You get decisions made because most companies have trouble because they can't make decisions or they can't keep them made. Managing for results. This is basic MBO 101, but it really needs to be aligned across the organization, squirted vertically up and down and horizontally, so that all the resources are aligned to one direction. The better we can focus, the more successful we will be. Straight talk. Conflict is good. It's important in the organization. Brings out different points of view. People should be encouraged to speak their mind, but when disagreements get emotional and start becoming personal, that friction is like sand in the gearbox and it's got to be addressed. Now here's the tools and how we're going to deal with conflict. The last one was effective meetings, which was titled, "Smaller, shorter, fewer, more effective meetings," and about how much time and energy we waste in meetings and how much we hate meetings, yet meetings have an important role. So how can we have shorter, fewer, smaller, more effective meetings? That was the training that I did at Bay Networks. That became the culture of the company, because it had the east coast culture and the west coast culture. I stood up in front of all the people. I'd called them together at the Santa Clara Convention Center, the Memorial auditorium out in Massachusetts. I said, "This is the way we're going to operate. I need you to make a decision. Either you're on this team or you're not. You're going to go with us or you're not going to go with us. I need you to decide now, because there's a hot market out there and there's a lot of people looking to recruit. I've got recruiters waiting in the lobby. So make your decision. You go talk to them, or you come to work with us, but you need to decide." Because I couldn't have these people waffling. And I lost a bunch of people. I lost some really good people.

C. House: Sure.

D. House: I lost the guys that created Juniper. They split out of Bay Networks. But we revamped the product line. The majority of all products shipped in the second year that I was there were less than 12 months old. So we totally revamped the product line. We wound up taking the market. When I came, the market cap was 3 billion. We merged with Nortel for $9 billion worth of their stock, 24 months later, so it turned out to be a good economical deal for everybody all the way around. But people still come to me and talk about, "Those days at Bay were the best days. We were kicking ass and taking names." But it became very clear. Cisco announced during the second year there that they were no longer bothering to-- I'm exaggerating here for the purpose of emphasis-- but no longer bothering to compete with Bay Networks and 3-Com. They were competing with Lucent and Nortel and Alcatel, and they were going into the carrier business in a big way.

C. House: That would be music to your ears.

D. House: Well, that was music to my ears.

C. House: Damn right. Go after them.

D. House: So I went to Lucent and Nortel and Alcatel and said, "They're your competitors. I'm your friend. Why are you selling so much of their stuff? They're out to get you and you're helping them. Why don't you sell my stuff instead? I'll work with you. I'm a lot more flexible than Cisco. I'm willing to customize my products for you. I'm willing to co-brand. I'm willing to OEM them to you and you can put your label on them. Let's work together and become partners and get these guys, these Cisco guys." I did this about the end of 1997, early part of 1998. I went to the tops of these organizations and said, "This is an alliance against Cisco." I thought it was going to work, but it backfired on me.

C. House: Really?

D. House: Because each one of them came back to me a little bit after that and said, "We like what you're saying, but this IP stuff is so important to our future that we're concerned, if we get that reliant upon you," and then they named the competitors, Alcatel, Lucent, you know. "One of them buys you, we're screwed, so we have to buy you."

C. House: Really? They independently reached that conclusion?

D. House: Yeah. "To do this deal, we can't do it just part way. We can't just partner." I said, "I'll partner with Alcatel in Europe and I'll partner with NEC in Japan. Then I'll pick Nortel or Lucent here in the US. You guys are kind of geographically oriented. That shouldn't be too bad." "No, we're a global company."

C. House: Is that right?

D. House: "This IP stuff is really important. We have to have a different kind of discussion." The Alcatel guys were slow. They were just too bureaucratic. Everybody assumed that Lucent would buy us. When I came in, we had this technology licensing agreement with Lucent that basically gave them free access to the IP.

C. House: Oh yeah.

D. House: I killed that. There's never a second sourcing guy. I'm the guy that stopped second sourcing--

C. House: Weren't you the guy that killed the AMD deal for the--?

D. House: Yeah. Carston was the guy who licensed our processes. I'm the one who unlicensed them.

C. House: A 360 _____.

D. House: Yeah. I didn't license.

C. House: You've had several spots where you've been the linchpin.

D. House: I've never been afraid to go into new territories, do things differently. I had been dealing a lot with Lucent, I'd been dealing a lot with Nortel. Lucent, I was not impressed with Lucent. They were just too bureaucratic, too slow. Where I find Nortel to be more nimble, more the kind of underdog who'd become big. I just thought I could work with them easier and yet I had to do the right thing for the stockholders. So we had both companies in the hunt here, which is what you always want.

C. House: Oh, yeah, you've got to have that.

D. House: You've got to get a good price.

C. House: Otherwise...

D. House: So it became clear to me at that point in time that, although I didn't want to sell the company--

C. House: I didn't have a choice.

D. House: That was the right thing to do for the stockholders. I had to do it. Then we did the Nortel merger. Then I learned what it was like to work for a big old company.

C. House: That didn't work out perfect.

D. House: Well, it was best described to me by an organizational development guy at Nortel who actually lived in North Carolina. They had a big design center there. He was one of the guys that really got it. I was talking to him one night at dinner and I said, "I just don't understand how this company is so political and the different teams don't work together and compete with each other. It's almost like they don't

understand the competition is on the outside." He said, "Let me explain it to you. Think of an industry that’s been regulated for 100 years," before 1984. The Bell Company in North America. Of course, Northern Telecom was actually spun out of the Bell Company. Grandma picks up her phone, no dial tone. PUC now has a hearing about this. Who's the hearing with? It's with the operator. Now there's one or two problems. Either the operator screwed up or the equipment screwed up. You're asking the operator, "It's the equipment that screwed up," right? Now the PUC and the operator come to the equipment company. They are looking for bad people and bad processes. They need to come back with heads on sticks and rules chipped into stone. They need to find out who are the bastards that made this mistake and they've got to get fired. They've got to take the rules, the decisions and they've got to move them up the organization to a higher level. Pretty soon, you get all the decisions moved up. Nobody can make a decision. It's all bureaucratic. And nobody sticks their head out. "We all worked on this. We all agreed. Oh by the way, and we did a study and here's the report. Go read it and you'll understand why we all agreed to do the same thing." He says, "Now you get that going on and that's the outward appearance of everything. But there are people who actually want to get things done, so what do they do? They go round behind doors." I said, "Nothing ever gets done in meetings." "You don't get things done in meetings here. You go talk to this guy and that guy." "Well, they don't cooperate with each other." "Well, look at it. These are all lifers at this company. They came out of college and they went to work for Northern Telecom. They have been working for this guy and then they were working for this guy, and this guy up here retires and one of them gets the job. And what does he do? He takes all of his people up and he fires these people. He gets rid of a layer here." And so what happens is, people are always looking at the politics. They say, "Oh, he's getting ahead," so these guys under here start going underground. They go over, start feeding information to this guy, because they're going to be the spy that gets taken in to the new team. Your team starts working against you for the other guy if they think, if the popular belief is, the other guy is going to get ahead. The whole focus is, we're not competing with Lucent. We're competing for jobs and promotions with other people at the company. This is real simple to understand. I said, "I never really thought of it that way. Boy, that is really different."

C. House: Yeah, whoa.

D. House: This is not Silicon Valley. So I had been there--

C. House: Have you ever thought about you doing a book?

D. House: Yes, I have. A lot of people have approached me to do that.

C. House: You have such lore. You've learned it in your fingertips and you're telling it beautifully. I think it would be Dave's House Rules. Seriously.

D. House: I think a book I'd like to write would be the book on leadership.

C. House: Yeah. Well, you could combine the rules and the process and the leadership.

D. House: You can't be a leader without knowing how to manage. There's a lot of books on management and leadership. Management is a key aspect of leadership, but there are a lot of managers that can't lead, and there are a lot of leaders that can't manage. It's really leadership and management together. I think leading is probably the least understood part.

C. House: I think you're right. So we're out of time, basically. Let me just come back on the Cisco thing. I imagine it was Chambers that actually put that out about, we're going to go after C/LECs

D. House: Yeah, well he's always the spokesman. You always wonder where all the stuff comes from.

C. House: Yeah, I don't actually know on that one, but that was a chapter where they arranged their sites, so to speak.

D. House: Yes.

C. House: Your strategic approach sounds great. What was your impression of Cisco prior to and during that period, just as an observer of the scene, as well as a CEO competing with them?

D. House: I'm sure that the people that competed with Intel had the same feelings about Intel that I had about Cisco, because when there's a powerful source in the industry, they have a lot of flexibility and a lot of control. You mentioned earlier about the fact that when IBM bought $250 million worth of Intel stock and basically saved them from a cash flow problem, HP felt like it wasn't getting any components anymore. But Intel, there have been a bunch of AI trust claims to get Intel about its pricing and how its Intel Inside program worked, and marketing incentives that it gave, etc. We were pretty creative about how to get our customers to do what we wanted them to do. How to play the total story. We had leverage that we controlled and some of those levers, our competitors did not have access to. So those would be good ones to use against the other competitor. Whether it's development systems we talked about, access to a bond out chip, some people would call that a dirty trick.

C. House: Yeah, on the other hand--

D. House: But if you're inside of Intel, you'd call it a brilliant move, a brilliant strategy.

C. House: I was at HP and I called it a brilliant move. Really, you had to respect that, and I knew some of the guys pretty well over there and we worked pretty hard. But the answer is, that's brilliant.

D. House: Well competing with Cisco is kind of like competing with Intel. They've got their hands on a bunch of levers and they're very skilled at how they use those levers. I would characterize Cisco-- so Bay Networks versus Cisco. We had better engineering. We developed better products. Cisco, I don't think has ever been known for having the best products.

C. House: I agree.

D. House: They’re a solutions company. You'd never get fired for buying an IBM. You'd never get fired for buying Cisco. Chambers came out of that with the Wang business and IBM business. He understands the buying motivations are not always speeds and feeds and functions and features. I used to describe it, I think that Cisco had the greatest success clearly in the corporate world as opposed to the carrier world. Juniper came in and did a very good job in carriers. In a corporate world, the network is central to the business. It's critical for the business. The business can't go on without the network, but it's not the business. Management is worried about the business. I just want the network to work. Cisco, with its breadth of products and its strong field organization and its customer focus-- and Chambers is a sales guy, first and foremost and he's going to take care of the customer. He's got a culture in that company that takes care of the customer. If the router's not quite as fast or quite as dense, or the switch is not quite as fast or doesn't have as many ports, but the network's working, the customer winds up buying. Cisco, we're selling technology against that and so we've got the second broadest product line after Cisco and most of our products are preferred by the engineers. So we're in, selling where it works for us, at the engineers. Cisco's in selling at management. Just like Intel would go in and say, "Okay, maybe the 68000 is a better microprocessor than the 8086, but look at our development system versus theirs and look at the money you're spending on software versus hardware, and look at the importance of software to this. Are you going to leave that decision to the guy who's the microprocessor guy? This is a company level decision you're making. This is not a technical decision, this is a company decision." Cisco does the same thing. Cisco and Intel have got some of the same deals and both of them are not above playing dirty tricks.

C. House: Oh really. That's been rumored, huh?

D. House: I have gotten calls from CEOs of companies where I had a deal to sell them equipment and the call goes like this: "I got a visit from John Chambers and he's pointed out that we're going to put some foreign equipment into our network. That's going to be a lot harder to support from a system engineering standpoint. We at Cisco have a big demand for system engineers and we're just trying to allocate them where they'd best be. You're going to make this job a lot harder, so I'm going to have to pull my system engineers out for another job."

C. House: Love it.

D. House: He says, "I can't run the network. The Cisco system engineers are running my network. I'm hiring. These are contract employees, basically, that are running my network and he's going to pull them out if I buy your equipment. I don't care if your equipment-- I'm sorry. I love you, Dave, and I want to buy it, but I can't. He's going to shut me down." Well, it's either a brilliant move or a dirty trick, depending on which side you're on.

C. House: Yeah, hardball though.

D. House: Yeah, it's hardball and I had that happen more than once.

C. House: I bet you did. Final question, of all the things you've done, what are you most proud of?

D. House: Well, clearly the success of the Intel microprocessor business in a whole. At the 16 bit level, we had the worst of three processors, the 68000, the Z8000 and the 8086. At the 286, we really had a turkey, versus the 68020. It wasn't until the 386 we really started to have a competitive product. Then we got attacked by the RISC guys and the general understanding is, RISC is better. RISC versus CISC. All the press was, CISC is dead, RISC is the future. I had to take that on. And of course, I talked earlier about Japan Focus and the early competition with the Japanese. But the team's ability-- I didn't do it, it was the team-- to have the honor and opportunity to lead the teams that did that. The team that came up with Intel Inside became the third best recognized brand on an international basis, after Coca-Cola and Marlboro. Intel Inside was number three.

C. House: Is that right?

D. House: That's right. On a worldwide basis. A lot of people have tried to emulate it. Nobody's ever been able to do so. Well, Teflon and Gore-Tex are good examples of ingredient brands, that we learned from by the way. But the opportunity to lead a team against all these various adversaries and to wind up creating a business that was making 80 percent margins at $40 billion a year kind of levels, that was--

C. House: Sustainable for a very long time.

D. House: Yes. Well, I'd been out of there forever, and it's still going on. Their death is still being forecasted, but they're still...

C. House: I'm proud to call you brother.

D. House: Well, thank you, brother.

C. House: Dave, thank you very much for this. This is great.

D. House: Well, it's been fun.

C. House: Thanks.

END OF INTERVIEW

