Interview of Howard Salwen

Interviewed by:
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James Pelkey: Over lunch we were talking about a number of things relative to the history of Proteon, and your experience with the modem area, on a peripheral basis, and then eventually in 1979 getting involved in local area networks.

Howard Salwen: So, what I found in my filing cabinet was a loose-leaf notebook with meeting notes and comments. This is a beauty. It says: "Ring can go optical, Ethernet can't." Still true.

Pelkey: This is in 1979 -- early 1979.

Salwen: This is -- it has no date on it, but it's got to be. This is a 1979 book. This is -- it looks like most of this is from February of '79, when I was working on it, and this is 8 megabit per second system. Ethernet was, at that time, here's some notes on Ethernet. Advantage: one cable. Disadvantage: can't hear your own signal, must by asynchronous, burst mode, should use RF modem. Out and back cable. Out and back is basically broadband.

Pelkey: Now this was a contract that, according to these notes, 1978, you were asked by MIT -- MIT was looking for an outside contractor.

Salwen: They had lots of people that worked on computer architecture, and they had experts on network architecture like Dave Clark, and in that I'm referring to the paper which was published around this time. And when a paper is published in November of '78, what it means is, it was submitted a year earlier and written maybe a year before that. So Dave Clark had been in the business for years when I showed up on the scene, and our contribution was not with respect to the architecture of the machine or the architecture of computers, but with respect to how to move the bits from one place to another, the modem designs, the kind of thing I had been doing all the time. And if you look at these -- as you look at these notes, you can see that I'm down to getting rid of the relay or some logic diagrams here or waveform design with multiple level Manchester, and different ideas were coming out here. Here's multiple level balanced code thing. Different kinds of locked structures with divides to work clocks and so forth. I was just scratching away. Here, on this page I'm looking at some modems that you could buy that were sort of in black cubes, and looking at all kinds of approaches and just free thinking, and thinking about -- here, right timing. With respect to ring timing, I worked a lot. I went to the library. This was not the kind of thing that Dave Clark could do. Dave Clark knows nothing about -- well maybe I shouldn't say that because he knows a lot about a lot of things, but that's not his area of expertise -- but to do synchronization, distribution of timing, is something that I do very well. Like, at lunch I was talking about the Global Positioning System. The Global Positioning System is all timing. I did -- the loose-leaf notebook that's next to this notebook is a world wide time transfer system that I did for Goddard, which was good to 10 nanoseconds, so that they could synchronize all of their sites, so that when they time tagged ranging data, you know position location data, the more precisely it was time tagged, the better the three dimensional solution for position. So I had done things like that, and that's what I focused on. Al Marshall focused on the next layer down, even the lower level stuff, not just synchronization but wire connectors, fail safety, compatibility with fiber, what was available in fiber, and so forth. And Al did some of the basic design, and then people like -- well, as you can see here, we were just feeling around for different ways. Here I've got a better way to synchronize Ethernet.

Pelkey: Al and you founded Proteon Associates in 1972?

Salwen: No, Al came in 1974. I started Proteon Associates with another guy named Jack O'Donnell, and Jack --

Pelkey: In 1972?

Salwen: In 1972. Jack had to leave at the end of '72 because of personal problems, so he took -- he had a very large contract with a secret agency, and he took his contract and went to work for Lincoln. What he needed was, he had tremendous medical bills because of a family problem and so -- the insurance that we bought didn't work.

Pelkey: Right, so you then put --

Salwen: Then Al joined later on.

Pelkey: And during this period of time you were doing one-off contracts?

Salwen: Mostly contracts for NASA in Goddard, and for the DOT in Cambridge, and doing consulting work for people like Charles Stark Draper Laboratory or doing designs for private clients like Pearce-Simpson or South Bend client where we did a marine band radio design. Real production, I mean they were making 40 radios an hour, so it was not a -- and we did everything including setting up the production line so this stuff would pour out the end of the building. So we did lots of things, mostly involving communication. And, as I said, we were recommended to MIT because we had a good reputation for being creative, having good hardware skills that, in Al's area, and good theoretical skills, my area, but those were modem skills, they were not computer architecture or network architecture skills; they were different. In other words, my area of expertise is near the lowest layer. It's at the bottom of layer one. And above that layer MIT could -- how many buffers and how to arrange the buffers, they had a building full of people called the Laboratory of Computer Science, and those people knew -- they had more answers than they needed in that building. They had lots of different answers and lots of expertise. What they needed though was soldering skills. You know, if we designed it, could we build it? They couldn't build it. They couldn't build it. They weren't set up for it. Soldering skills and of course the theoretical communication folklore.

Pelkey: Now the contracting agent at MIT during this period of time who you communicated with was a friend of yours --

Salwen: Well, he wasn't -- the head, the Director of the Laboratory for Computer Science was and still is Mike Dertouzos, who was my officemate in college. We lived in a place called the Electronic Systems Laboratory in -- most of the people that lived in our little group have become notorious for one reason or another. Mike Dertouzos, I started a company, other people did different things. Three or four professors, full professors, major factors at MIT, were in our little bullpen together.

Pelkey: And what time frame was this?

Salwen: I was there from '59 to '64. I was a graduate student and -- sometime graduate student, sometimes employee, sitting in the same place. And that was a real good experience because I learned everything.

Pelkey: And during that period of time, do you recall if there was contact between the kind of ARPA funding activities and ESL?

Salwen: Well, ESL got its money mostly from -- we did lots of different things. Other people, like the company called Softech, you know Pete Peterson, all those people were in there. Doug Ross, you know Doug Ross, he's a company founder, not Softech but another 128 company. ESL was a good place to work. We did government contracts, mostly, a lot of defense related work, but we -- again, it was very leading edge. It was working with computers very early on. They had people that were doing -- we had a ballistic missile defense contract. We had a bomber defense contract. As I said, I did high-resolution radar experiments and got some patents on that -- very interesting experience. So, in 1978, MIT wanted to build a local area network, was looking to the outside for a party, organization, to in fact build these local network interface devices.

Salwen: There were meetings at MIT that were attended by Metcalfe who, at that time, was a visiting professor at MIT, so he was there too. Quite a bit of talent in that building, and the meetings were to discuss a philosophy that would be adopted by the whole group for networking. Of course, Metcalfe was very strongly in favor of Ethernet. Ethernet at that time was running at 3 megabits per second and had been installed at Xerox PARC and a couple of other places. There was a group which later formed the heart of Symbolics, the artificial intelligence group, had a network called CHAOS, which was also an Ethernet type, a CSMA system, and they were arguing in favor of their design. Dave Clark and Jerry Saltzer were in favor of token passing ring, and I came in as a consultant with Al and started attending these meetings. And the meetings were very exciting. There was a lot of screaming and yelling in those meetings.

Pelkey: Do you recall who else attended those meetings?

Salwen: It's hard. I wish I could find some notes on it.

Pelkey: So, Dave selected you and, at that point in time you were also president of the IEEE society.

Salwen: I wasn’t president -- I was chairman of the local section of the IEEE Communications Society, the Boston section, which -- Boston section's got 8,000 members or something like that, a lot, I don't remember what the right number is but thousands of members, so it's a big organization -- but it's just the Boston section and not the whole thing. And so I was recognized as some kind of a theoretical authority, and Al was recognized as a practical authority for this very low layer part, very low part of the layered structure of local area networks. And of course we could point out things like, you know, the origin of our criticism of the Ethernet was that, for example, the Ethernet specification that came out had no probability of bit error requirement, because the people that laid out the spec were computer engineers. That's not to belittle them,

because, you know, they're -- they did very, very well with what they did and did even better later on, but they didn't know anything about data communication. I feel like I'm talking to a reporter now. I go off the record. Metcalfe presented a thing called Fibernet-II. He had a paper published in the Communication Transaction on Fibernet-II, and what it was, he had a pulse position modulation. The pulse was either in the first slot or the second slot, and I said to him: "You know, that's really Manchester code, because if you look at it, it's either this or this. That looks like the pulse in the first slot or the pulse in the second slot." He says: "Manchester? What's that?" I said: "Manchester, it's -- what you're using is Manchester. See, it's got balance. If you put it -- it'll go through a capacitor or transformer, and that's what we use to write on the disks." He said: "Really." I said: "Yeah." So he invented Manchester all by himself, so this is -- I was there to bring that kind of folklore and, that was kind of basic, but to bring that kind of folklore to the meetings, because here were these guys with tremendous knowledge and skills in a different area, and they were -- they ended up inventing things that were well known in my area, because they just didn't know. So that's what was going on there. The outcome was, I guess that maybe Mike Dertouzos was the moderator, but Jerry and Dave prevailed upon Mike Dertouzos to take the Arpanet money and use it to design a token passing ring. The first application of the token passing ring was the hooking together of 20 or 30 VAXs that were going to go on the 9th floor of that building, and DEC had given or sold them at well below cost or something like that, very cheaply, had given them these VAXs, they were VAX 11/750s, they were not there yet, but everybody knew they were coming, DEC had given them to the laboratory with the provision that they were going to be single VAX per user. DEC had already envisioned the MicroVAX, the VAX on a chip, and had envisioned, basically, the workstation revolution, at that point. That had to be 1978, '79, and what they were doing was, they were giving them these fairly big VAX 11/750s, but insisted they be used as if they were fairly small MicroVAXs. And that was in the contract or something. I'm not quite clear on this. So the token passing ring was chosen to hook together -- hook the VAXs together. Jerry and Dave went to DEC and tried to convince Ken Olsen and Gordon Bell that the Ethernet was not a sound concept. I convinced these guys pretty solidly that, you know, among the other notes like, it just wasn't compatible with fiber. It still isn't. They have a lot of trouble making the Ethernet run on fiber, and all of the new systems like FDDI are rings, and the reason is that it's point to point. The ring is broken up into point to point links, pretty simple concept. But then again, some people didn't think fiber was important. Certainly the 802.4 committee was dead set against fiber when they started out. They insisted that it was going to be coax because it is said that GM had just completed training all their people to do the connectors. Throw that on the tape. Yeah, that's true.

Pelkey: That's outrageous.

Salwen: Yeah, it is. I think it's outrageous. I think it's wildly shortsighted.

Pelkey: This was what time frame?

Salwen: Well, that was also, when we worked for MIT and the committee started meeting, I'll go off in different directions, so that, before I go off, let me finish this thought. Dertouzos or the powers that be decided we would make a token passing ring. That was the winner. I, by the way, as the notes showed, I was doing an RF design. I was doing basically a CATV design, with

a head end frequency translation and then back on the same wire. I had designed a waveform, proper kind of FMD modulated waveform, and you just saw the performance analysis of the FM, what I could expect if -- I presented it to the seminar, and they shot me down. They didn't like it. They thought the head end frequency translation was a single point of failure that they couldn't tolerate. They wanted a completely decentralized system, where it was totally symmetrical. Every node was like every other node, totally egalitarian, and Ethernet and the token ring, as we envisioned it, could fulfill those requirements. Decentralization was a goal, an academic goal, and so when we started the design, and we were given another contract to start the design, when we started the design, it was -- there was an element of it that was like a PhD thesis. Jerry Saltzer wanted to see if every node could look exactly like every other node, and of course you have problems like how do you start the token, and this had to be done in a symmetrical decentralized way, with everybody running the same software, and that's the way ProNET-10 works. Dave Clark actually cracked the problem, not me. Dave Clark designed a contention token started, and it works like this: everybody listens on the ring, and within a few milliseconds, you know whether the ring is healthy or not, because you can see the control signal circulating. If you don't see them, you run a timer, and when it times out, a flag voltage goes up inside the box that says: "Ring not ok," but nobody does anything, because we would all collide with each other under certain circumstances, so we do nothing. The heart of the idea is the first user that decides that he wants to use the thing, just launches his packet, as if he has received the token, but really didn't receive the token. He saw "ring not ok," he launches his token, and there's a chance that two or more people will do this simultaneously, not seeing each other's messages. The thing is set up so that those packets that are launched, where there will be a collision, are absorbed. Let's say you and I are at extreme ends of the ring, and we both see the ring as not ok. You start to transmit, and I start to transmit, so it comes around. I drain your message, I throw it on the floor, ok. I'm looking for one thing, I'm looking for my message. Everything else is garbage, so I drain your message. You never see it coming back. You're looking for your message. You see mine. You think it's garbage. You throw my message on the floor and we both get a timeout that says message lost, because you never saw your message come back. Now, the chance of that happening again and again and again is very, very low, because it's low that we'll have a collision in the first place. So, if these two guys come on at the same time, that's two of these collisions in a row. It's like one in 10,000, and for three such collisions in a row, it's like one in a million, so chances are that situation is not going to exist. Eventually, somebody will come on when there aren't two other people there. He will successfully launch and drain his own message, and then he puts a token on as if he took it off, and everything is initialized. Ok, Dave invented that and at a meeting a year or two later, we were talking about difficulties with the damned initialization scheme, and he -- at this point you know Dave pretty well, he said: "Well, you know, you should have used my -- ," and we said: "We did use your scheme. This is exactly what," and he was dumfounded. He had written a memo on it and we took it to heart. We thought it was great, and he never realized that we were using it. I don't know why that was, but basically at that moment he realized that we were actually doing that, and that's what we do today, and probably it's the way FDDI will be done, so it was a fun thing. Ken Pogran, who works at BBN now, by the way, did analysis of the VLSI-ing of this thing and that never went anywhere for a number of reasons. But he did a lot of good work, nonetheless, on VLSI-ing on the front ends and so forth.

Pelkey: Now when did you deliver your first boards?

Salwen: Well they were working in the -- they were working from PDP-11 to PDP-11 in the winter of '80 / '81, and in June of '81, we were convinced that the thing was actually working, and in June of '81, we delivered a system to UCLA, which is still there, and it hooked together -- it's the backbone in the computer science department. They don't like to admit that it's there, but it's there. Board number two is there working.

Pelkey: Even though you were contracted by MIT to deliver boards to MIT --

Salwen: Well, we did deliver boards to MIT at the same time, but the first real commercial -- but that was under contract. The first commercial sale on a purchase order was for Popek, Jerry Popek, founded a company that, Locus, yeah Jerry Popek, ok. It took me a little while to get that back from the cerebellum. Jerry --

Pelkey: Was he at UCLA?

Salwen: He was a professor at UCLA, and we were about a year late delivering to him. We thought we would be finished in the fall of '80, but we delivered in the spring or June of '81. We also delivered to a guy named Roger Vossler at TRW in Redondo Beach, and then we delivered to a guy named Pål Spilling, in the Norwegian Defense Research Establishment, so we immediately went international, by August. And Spilling made a fairly large network in Oslo. In the fall we delivered to Verbex, which is out of business. It was an excellent company -- and to Purdue, University of Wisconsin, Lawrence Berkeley Laboratory. Doing pretty well.

Pelkey: Now you were still capitalized on your own at this point.

Salwen: Absolutely. We worked our profits. Another off the record, but I got to tell you that, I loved that Wang box that I described at lunch SO much that I invested in Wang in '73 and '74, and the Wang money went into the development, so actually I put in my own capital for a little while, but no one can put in - - I guess there are some people, but hardly anybody has enough capital to support one of these things, but at first I put in my own capital to develop some of the stuff and to carry the company, because as soon as we started getting commercial business, running advertising and all or the usual things that you do, we were running at a loss. The government provides R&D funds, and that was part of the money. In other words, we had an ARPA contract, or a subcontract, and we had other government contracts, and you're allowed to bill the government on those contracts, because they're cost plus contracts, for independent research and development, and that's a negotiated rate. And so the government funded part of it in that way. The government funded part of it through the subcontract itself and then I put in some money and then Proteon general profits funded part of it. That's how we went through '82, hand to mouth, borrowed some money from the bank too. By the beginning of '83, we had quite a few customers, maybe fifty, we can't go through them right now, and the need for capital was obvious, and it wasn't that I denied the need for capital before that, it was that I didn't want to give up the research business. I had a fairly good business by, you know '82 - '83 we had 30 to 40 employees. When we took venture capital, we had just short of 40 employees. That was in December of '83. That's a nice consulting business.

Pelkey: And how much did you raise then?

Salwen: $2.35 million.

Pelkey: And who invested. Who was the leading investor?

Salwen: Sevin Rosen and Kleiner Perkins. Jon Bayless basically made the contact. The contact was made at -- the first meeting with Bayless was at Interface in 1982, which was in the spring of '82, so it's only nine months after we started making things, and you can see, we started advertising in the fall of '81 and in April of '82, we went to Interface with a booth that could fit in a suitcase, you know, one of the early ones. A polyurethane foam core thing that fit into an aluminum frame, and I have a picture of it over here, which I'll show you. Anyway, we had a booth that was a fold-up install your own booth, and we were showing people our wares. By that time, by April of '82, there were basically two competitors, 3Com and Interlan. They were both there. This was in Dallas. Because it was in Dallas, L. J. Sevin and Bayless were walking around the show, and they had already picked the name ProNet for one of their companies, for Jackie --

Pelkey: For mobile paging systems.

Salwen: So there was this thing called ProNet, and one of the things they found out was that this manager, and I emphasize the word manager for other reasons, registered -- had owned ProNet as a registered trademark, and we had sent Barry Cash a cease and desist letter. Oh yes, we own it, Proteon still owns it, absolutely.

Pelkey: And this was, just for the record, March 24 - the 28th, 1986, called "Interface 86" in Dallas, Texas.

Salwen: No, no, no. Which picture. This is -- there's two pictures here. One of them is the original booth --

Pelkey: Oh, I see. So this one was in --

Salwen: This is '82, (referring to another picture) this is '86.

Pelkey: Oh, Ok.

Salwen: They're both Interface shows.

Pelkey: Gotcha. So the '82 was what L. J. Sevin and John Bayless saw.

Salwen: Ok, wait a minute. Wow, this is really interesting, ok. Well, anyway, we told them what we were doing and, you know Bayless is a really good thinker in this kind of business, especially in communications. And he appreciated everything we said to him and, in their usual way, they said: "You guys need any venture capital?" And I said: "Well, what the hell do I want that for?" I'm free and happy as can be and by the winter of 19 -- you know beginning of

'83, I realized why I wanted venture capital. We had decided that we weren't going to just be dilettantes in this thing; that we really wanted to make something out of it. We knew that we had a bunch of happy customers. Bayless and L. J. came to visit us one day. They visited us a couple of times before that, over -- from April '82 'til January '83, they might have visited us twice. They were going to a board meeting at Emulogic in Canton or someplace around here, and on the way to the airport they stopped off at Proteon, but in the beginning of '83, we started -- I said: "Ok. I need money. We're going to do this seriously," and they did their due diligence. They checked our customers. We had, as I say, about 50 customers, and every single one of them was on the air and happy, and it was not easy to do that with no money. And that got us -- but now we're off the subject of the theoretical part.

Pelkey: But that Interface show in '82, the only other local area network companies there were 3Com and Interlan?

Salwen: As far as I can remember. There weren't -- and they had just begun shipping. Wait a minute; Ungermann was there.

Pelkey: Oh, right. Ungermann must have been there.

Salwen: Ungermann, that's right, so there really -- Ungermann started shipping very early on. They started shipping in April. We started shipping in June. 3Com started shipping in January of '82, after us, and Interlan around that time also.

Pelkey: So you were shipping in '81.

Salwen: We were shipping in '81. Ungermann had an ad --

Pelkey: He was shipping an Ethernet product?

Salwen: Well, no, it was a broadband channelized thing, and what they were doing was, they were a low -- what I call a lowest common denominator vendor, and they still are. Not that this is bad. At that time, it was definitely right. They provided an RS232 wire rationalizer. They had RS232 in and RS232 out, and they provided and controlled a medium that took RS232 signals in and put them out wherever you want them, ok. So it was for terminal connection and for relatively slow host-to-host connection, and it was the lowest common denominator approach. It doesn't get you involved in host software, protocols or anything else. That was not part of their business. Other people that were in that business that came out during that time frame were Sytek and so forth. ARCnet was already running at that time and Corvus was a factor. Orchid started. Nestar started around that time.

Pelkey: This was all in '81, '82.

Salwen: All in '81, '82, yeah.

Pelkey: Now, the people who started all these different companies, was there interaction amongst your grouping? Did you know Ralph and Charlie of Ungermann, Charles Bass?

Salwen: No.

Pelkey: You knew Metcalfe.

Salwen: I knew Metcalfe, but I wasn't friendly with him. We had run into Ungermann and Charlie Bass. I would say the views of all people concerned were very parochial. Before the market competition, the battles that went on in that seminar room at MIT were just precursors.

Pelkey: So it was discussing broadband / baseband, and what type of media and all those issues?

Salwen: That's right. And so there were very -- as far as I could tell, people were not friendly with each other. Maybe the Bridge people got along with the 3Com people, always, but basically, I've made some friends, like the Harry Zal from Nestar is a real friend at this point. Our friendship is based more on VC experiences than networking experiences.

Pelkey: Now Prime was a, according to Paul Severino who I ran into, he was saying that Prime had an early network.

Salwen: That's right. Prime had a token passing ring before I knew about it. They had something running in '78, maybe '77, but they were not a multi -- they were not in the multi-vendor environment.

Tape side ends.

Salwen: Prime had a system that was working just for their own products, and they selected token passing ring. One of the -- let me get to the more theoretical for the book. One of the things that came out in the early '80s was that Ethernet had been there forever, and that token rings were the new guy, and very complicated. That was the positioning. It sounds to me -- I won't accuse them of this, but it sounds to me like a Regis McKenna joke. That was the positioning, that token rings were complicated and Ethernet was the established standard and had been there for a long time, and really --

Pelkey: And Ethernet's roots were back to --

Salwen: I would say the Ethernet roots go back to the ALOHA experiments -- Len Kleinrock type things. I'm not really sure, but the token ring was -- our token ring was based on the UC Irvine ring as you just actually saw documentary evidence earlier, before the tape was turned on, of some notes that compared what -- the design of the UC Irvine ring, which was done by Dave Farber.

Pelkey: Do you know where Farber is now?

Salwen: He's at the University of Delaware. I'll give you his phone number. Dave Farber based his design, with documentation, on the Farmer and Newhall -- it was Bell Labs, AT&T, Farmer and Newhall, and so there's a pedigree for our system that goes back to Farmer and Newhall.

Pelkey: And where -- that was at Bell Labs and when was that documented?

Salwen: That was -- there's a big battle with respect to Soderblom and the Lab notebook for Farmer and Newhall misses Soderblom by about three weeks, it's 1968. I might have some notes on that here. I see some. Yeah, I recognized, as you can see, I recognized some BSTJ, Bell System Technical Journal reprints here, but this is not it. This is something else.

Pelkey: And did Bell Labs ever build any networks, or was it just kind of theory.

Salwen: They built a whole system in the late '60s. Here, the paper that I looked for the Farmer and Newhall thing and what I found here was Mutual Synchronization of Geographically Separated Oscillators, a paper by Allen Gershow who's a friend of mine, and some other guy I never heard of here, and what it is is, it's just what I do. Here's the loops and the stability and all the rest of that stuff and there, as I remember there are two pieces to this thing. One of them was a big experiment and --

Pelkey: Newhall and who?

Salwen: Farmer.

Pelkey: Do you know where they are now?

Salwen: No, I don't, but their patent, it was a very important patent. What I'm looking at is basic pictures of the design here.

Pelkey: Do you recall -- were you ever told as to why Bell Labs built this same network?

Salwen: I just showed a note from Bob Metcalfe. I don't know what that's all about, but -- I didn't mean to interrupt you that much.

Pelkey: No, no, but do you recall any of the circumstances around the Bell Labs thing?

Salwen: The Bell Labs thing? Some of the synchronization had to do with how to work a nationwide network of digital sources and syncs of data, some of which might be voice, digitized voice, like how do we synchronize the T1 systems across the country, and they've had several different approaches over the years. They've actually changed the design several times since the '60s or '70s. So part of the research was for that purpose. I've shown you those papers by J. R. Pierce -- that was part of it. And they had a nationwide ring and regional rings and local rings for basically the switching of data signals, which might -- they might be digital voice, not necessarily data, but part of those projects included synchronization and propagation problems and so forth, things that I was interested in, so I was working on it. But they were also worried about maintenance, like the -- and that's why they did the wire center, and some of the group did the invention of token ring. I believe that Farmer and Newhall's is the real invention, and the Farmer and Newhall ring, it literally addresses the peer-to-peer communication. Soderblom does not have a closed loop invention. You can't do peer-to-peer with Soderblom's invention.

Soderblom's claim is that he has the three-legged stool from which the four-legged stool has grown, so he has the fundamental pioneering invention. I really don't believe that, but that's just my view, in any case --

Pelkey: Soderblom did his work in Sweden at that point?

Salwen: It's not clear. No, he might have done it here, but he'd be patented in Sweden. He did it as a consultant. There are some people that say the idea was given to him, I mean they've said that in writing, not just hearsay, Sperry people.

Pelkey: Where were – Soderblom's patent is one of the few instances in the data communications industry where a patent played some sort of a role, in slowing the thing, potentially, or the patent was being enforced. Mostly every other instance where there was a patent, they weren't enforced or whatever. Where can I go to get some information on this particular issue?

Salwen: On the patent?

Pelkey: Yeah, or the issues surrounding it.

Salwen: Well, you can talk to Borovoy. I know a lot about the patent. I've been asked -- I've been working on this patent since 1981, and --

Pelkey: Let me come back to that so I have another source. I want to talk about something else. Did you know Prime's token ring -- their roots were the same -- this Farmer and Newhall?

Salwen: I don't know. I really don't know. I know that they had a token ring, and the big point is, that there were token rings deployed and running and in service before the beginning of Ethernet and CHAOSnet and those other things, yet the positioning was quite the opposite. It was also a position that token rings were far too complicated, and as I showed you in Dave Clark's paper, his conclusion in November of '78 was that Ethernet was more complicated. And most of the time when people talk about the complexity of Ethernet, they ignore the transceiver. Well, you know, we're having trouble with an Ethernet board out there. It's a transceiver problem, as usual. The transceiver is not very well -- conceptually it's not a great idea, and it makes a lot of trouble for the designers. Certainly there's a lot of complexity in it, and in the first products that came out, like we had a Unibus board and Metcalfe had a Unibus board, and our stuff was simpler by gate count. What is more complicated?

Pelkey: Why did 3Com and Ethernet get the early market share?

Salwen: They almost didn't do it, you know. Well first of all, we weren't going to get market share because we had no venture capital. We weren't really serious, and if it's anybody's fault, it's mine.

Pelkey: Did you perceive at that point in time that Metcalfe was going to be serious?

Salwen: Oh, sure.

Pelkey: Why didn't you, seeing that, why didn't you --

Salwen: I saw it, but I had a thriving consulting business.

Pelkey: So you were enjoying what you were doing. It was fun. It was interesting.

Salwen: I was making a lot of money. I owned a big company that had $2 million in bookings, in billings, all by myself. I owned it 100%. You know, looking back on it, it wasn't a bad deal. If it had grown a little bit, I'd be just as well off now as I was then, I mean whether I switched or not, ok, but I got bitten by the competitive bug. I knew that I had a really good thing here. It'd be a damned shame to just throw it on the ground.

Pelkey: And it was a good thing because you saw what was happening at 3Com?

Salwen: And! Another one. There were a bunch of factors, like everything else in human function. First of all, the product was a good product for the market. We saw that we had a bunch of happy customers, and there were more customers available. Expanding on that, we saw the revolution that you're exploring, the fact that machines were getting smaller and that communication that no one ever heard about -- when I started in communication, my parents -- my parents don't know to this day what I do, but they had a little more idea that communication is important -- than they did then. Now, communication is written up in Time magazine. It wasn't written up in Time magazine in the '60s. But we could see that the advent of smaller machines was going to cause a real growth in this data communication business beyond what we had seen before.

Pelkey: Was there an instance in which you recall, in which you said: "I want to get money?"

Salwen: Sure. Do you know about this or are you just guessing?

Pelkey: No, I'm just guessing.

Salwen: I was -- we were working on a thing called the 406 Emergency Location Transmitter, part of a worldwide search and rescue system called SARSAT, Search and Rescue Satellite. It was a U.S., French, Russian, Canadian and later British, Norwegian effort. There was a meeting in Toulouse, where the French space agency is, CNES, and I went across on a TWA flight, and before the movie they had these little shorts, you know, and they had a short subject on the office of the future, and there was the goddamn yellow cable. And I said -- I had nothing to do but to think about it as this plane droned across the Atlantic, and I said: "This is ridiculous. I'm not going to just -- I'm just frustrated as hell. I know I've got this really good product, and I'm not going to get anywhere myself, and I got to decide either," and this is January of '83, "either I'm going to take in venture capital, stop the research business, and throw all of my energies into this token passing ring communication explosion, or I'm just going to forget about it, because the frustration isn't worth it, because I see the other guys --" During '82 it looked like Metcalfe was going to fail, and all of the -- if you go back -- this is something I can't provide to you. If you go

back and you look at the -- if there was some way to see the old Computerworlds or something, maybe there is, you would find that lots and lots of consultants doubted the functionality of Ethernet, and it was getting very bad marks, but they fixed a lot of the problems. They couldn't fix the generic problems ever, but they fixed a lot of the problems, and it took off. It was a massive successful marketing coup. Massive! And that was beginning to show in January of '83. In November of '82, they were on the ropes.

Pelkey: Do you recall, from your impression, what it was that caused this marketing coup to come into being?

Salwen: Difficulties with maintenance.

Pelkey: How did they solve it, though? What did they accomplish that --

Salwen: I think they solved it with money.

Pelkey: Ok. So there's nothing specific in terms of a program or advertising or anything that turned the corner, from your perspective?

Salwen: Getting VLSI to work was an element. I would say that the PCs coming along, you know, the PCs were starting to show up and, you know in '83, the market started to take off, because there were more and more PCs. Let's see, when the hell did I -- I got my PC in '83 sometime, my first one.

Pelkey: The IBM PC.

Salwen: I bought a Compaq. I did. It's still here, too.

Pelkey: It'll be on the record.

Salwen: I think the one in Patrique's office is mine. I bought that in --

Pelkey: So when you came back from France, you had resolved in your own mind.

Salwen: I called Jon.

Pelkey: You called Jon and said: "Jon, I'm ready to get together."

Salwen: That's right, I said: "Alright, I give up." You know, my head was -- I had put a lot of money into it. I owned.

Pelkey: Do you know how much money by that point that you had invested in the company?

Salwen: Besides all of the profits and everything else, my own cash was around -- don't put it in the book -- I put in about $240,000, and then we also borrowed maybe, you know, I was starting to pledge my house and stuff, which I didn't like to do -- maybe $100,000, so I had -- MIT had

put in about $150,000 as a contract money, then there was -- but that, as you know, is just the beginning. The advertising and more development, it was running into a lot of money.

Pelkey: Let me before, I know you have a 1:30 meeting, again going back to these kind of -- the standards committees now, in terms of having 802, the 802 committee, and formalizing around Ethernet and token ring and token bus and so on, when did all those activities start?

Salwen: They started around '82 -- '81, '82.

Pelkey: Was there initially -- was IEEE on their own accord doing this, or were they prompted to by the university community, or government?

Salwen: I'm not an expert on how it started. I don't know that.

Pelkey: Do you know someone who would? If someone comes to mind I'd appreciate a name.

Salwen: Maris Graube. Now he used to work for Tektronix in Oregon, but I think he's moved. You can probably get his phone number through the IEEE headquarters in New York, because he was the initial 802, the head of the 802 Committee under which everything happened, and I used to communicate with him, so that's the right guy. He might be able to point you to a written history. I have an original 802.5 document, which I keep near me on the shelf here, and 802.5 went through many iterations. Jerry and Dave went to the committee. I got a few things to say about that. Jerry and Dave went to the committee and talked about standardizing an interface between the network specific part of a network and the host specific part of a network. The network specifics could deal with any kind of network. You can have any kind of network; you could have a bus network or a ring network, a fiber network or a broadband network; that would be network specific. Host specific could be a Unibus or a Multibus or they had a thing called the Newbus. That would be, you know, how you do DMA on a Newbus is not the same as how you do DMA on a PC or whatever, so you would have a host specific portion and a network specific portion, and the idea was to define a standard interface looking across from the host side to the network side and from the network side back to the host side. You know, you could do very standard signals. Surprisingly, Interlan took some steps to accommodate the same kind of design at that time. If you look at some of their early products, they have a network specific board that sits on a host specific board, ok. I thought that was a pretty good idea. It avoided all the crap.

Pelkey: Larry Green used to preach that to me.

Salwen: That kind of -- really?

Pelkey: You look at CMC boards, they have that architecture.

Salwen: That would have solved everything. I think the committee focused in the wrong places. They should have focused on the protocols in the host and on this gap between the network side and the host side. And even now, when we go to FDDI, and being very foolish, because they're trying to pick one fiber size, one connector. That isn't going to work. That's where there is variability. For example, we think -- oh never mind. Jerry and Dave, of course, didn't get

anywhere. There were competitive commercial forces at work by that time. We were really surprised when at one of the meetings, token bus was introduced. Somebody at MIT said that it was an awful idea. It combined the worst features of both technologies. It was forced into existence at a committee meeting. The standards committees --

Pelkey: Do you recall who forced it into existence?

Salwen: No.

Pelkey: To jump ahead for a moment, Novell obviously has become a major portion of this marketplace as a consequence of, just on the software side. Did you anticipate that or think that was going to happen?

Salwen: We liked Novell for a number of reasons.

Pelkey: When did your contact -- when did you start working with Novell, because you worked with them early on as I recall?

Salwen: Well, we clearly didn't have any contact with Novell until there was an IBM PC. When the IBM PC came out, they called us, and we talked to them. Made contact through Al Marshall. We were also, other people were interested in our technology, but had no way to use it. We could do Multibus and Unibus and Q-bus, and that was it, but they liked the idea of the token passing ring. A fellow from National Advanced Systems named Larry Corey insisted that we do a PC card and do it now. I had no money, I mean, I was strangulating for lack of funds. You have to understand this, and we committed to him to do a PC card, which led to P-1300. We started in August and we delivered --

Pelkey: August of '82?

Salwen: August of '83.

Pelkey: By this time you had money, though, right?

Salwen: No, no. We started to talking to John and LJ and Borovoy in January of '83. We didn't close until December of '83, and I was crawling out on this plank, ok. One of the providers for closing, for the second round, for the second half of the first round, the second tranche, was to produce a PC card, a card for PCs, and what happened was, we had the PC running before we closed the deal, and that's where the contact with Novell started. We got the PC card running because Larry Corey pushed on us as a friend and a customer.

Pelkey: And how did the contact with Novell start?

Salwen: They wanted to be -- they wanted all --

Pelkey: Did they contact you?

Salwen: Yeah. They wanted their software to run on everything that ran, and when they tried our thing, and they were able to do that in mid-November of '83, they were really impressed with the speed. They had nothing like it, I mean it just flew. And so what they did was, in the -- at the end of November, they gave us part of their booth at Comdex, in the November '83 Comdex, and Ray Noorda helped us tremendously by bringing people over, and I can remember, and I just reminisced about this with LJ, I can remember John Doerr standing there and talking to me, and Ray Noorda, again and again, with his arm around somebody, bring him over to our part of the booth and saying: "Now here's -- I'd like to show you something really special," is what he kept saying. And Doerr is watching what's going on, and Doerr of course, John had a real appreciation for what we were doing. Ray Noorda was helping us quite a bit. I mean he helped us tremendously all through that period. And his concept, and I think he's had a very consistent approach, his concept was to work with every good network to provide a fairly maturely well designed file server with good file locking, the kind of thing you -- the kind of architecture you find in a mainframe. They had that philosophy from day one, and they haven't budged. You know, one of the things he says, when he says it, the last time I heard him say it it sounded awful, but it's true, they picked their direction and they have not budged from it. They are going right down their plan.

Pelkey: I unfortunately must leave, but you and I will pick up, and I greatly appreciate your time.

END OF INTERVIEW

