Interview of Ken Miller

Interviewed by:
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Ken Miller: I got into the data communication business first when I joined Codex in '72. I came into Codex spring of '72 as a principal analog engineer, and at the time, Codex had a little bit of a checkered history in the '60s. They started out making coders, that's what – forward error correction coders for the military, in the '60s. That's how the name Codex came about.

James Pelkey: Early '60, right?

Miller: Early '60. They actually went public about '67. This is before my time, but I actually met some engineering people when I left my previous job, who had left Codex and went to this other company I was with, a little company.

Pelkey: What kinds of things were you doing before you went to Codex?

Miller: When I –I was with a very small company, and it's still around. It made voice scramblers, primarily with two-way radio – two way FM radio equipment, so I was in the communication business.

Tape is stopped to change batteries.

Miller: Joining Codex I was the primary analog engineer. At the time, as I say, it was a $2 million in revenue and about 120 people. AS I say, in '71, see Codex got into the modem -- they started out as coders, in the military business in the early '60s. They went public about '67. I'm not exactly sure what date it was but then – and they in the modem business because they acquired this little company that had Jerry Holsinger and a technician, and Jerry Holsinger implemented the first 9600 modem, -- his PhD thesis which was the first 9600 modem.

Pelkey: That was a MIT?

Miller: I think it was at MIT, yeah. And that was the AE-96. It was a partial response modem. It didn't really work very well. They made a 104 of them and it was done in RTL; a whole bunch of little cards, and they had to screw around with the power supply to make it work, and it's performance wasn't very good but because it was partial response, you could take advantage of some of the coding to actually improve the error rate performance. And Dave Forney had come in and done that and actually made it viable so you could actually use the product, but it really wasn't an economical success. It was a real pioneering product. And Forney and his PhD thesis advisor at MIT came up with QAM, and QAM is quadrature amplitude modulation. It was a much better approach to implementing 9600 and they devised that design, which led to what was the C series of modems. First they came out with a 4800 and then a 9600. The 4800 came out in late 1971 and the 9600 in '72, and that turned the company around. I mean, in '71 the company almost went bankrupt. The president and the VP of research died in the same year. The VP of research it was not a surprise because he had Parkinson's Disease, but the president was about to get a round of financing, was about to sign off on it on the next Monday, and dropped dead of a heart attack over the weekend.

Pelkey: My god. What was his name? Jim Cryer.

Miller: Kohlenberg was the VP or research. I didn't know the people persoanally, I only heard these stories, so you would get --

Pelkey: This was before you joined?

Miller: Before I joined. That was in '71, but then Art Carr become the president and it turned around the next year, and it was based on these new products. And at the time, it was timely because it was when some of the newer synchronous protocols came out from IBM, namely bi-synch. That was the new thing, and they had batch transmission, and so there was a need for high-speed communications at the time. It was a very fortunate turn of events and they did very well. And so Codex grew. It was really based on modems. The C series was all done in TTL an analog filtering and stuff, and I don't remember the exact

time. It probably was about ’73, on year later, when they started a project with Rockwell – a joint venture. It was really kind of a joint development with Rockwell, to come up with LSI chips to do a second-generation modem line. And it was all done in hard-wired logic and PMOS and it was very programmable. You could do a lot of things with the chips. And the deal was –and you’ll get a better idea from others involved. I was only an engineer at the time so you’ll get a better feel from Forney and Carr what the terms of the deal was, but as I understand it, it was Rockwell could not sell it to end users, to people who would put it in boxes for end user sales, so they couldn’t sell it to Milgo and Paradyne or competitors, but they could sell it as OEM products, and in fact that’s what Rockwell did. They went after the fax market. That’s in fact where Rockwell got their modem expertise.

Pelkey: Right. And you say that was in --

Miller: That got started about ’73, I think, and that product – I don’t know the exact date,’74, ’75 -- was a super success. They’re still – I think they’re still selling them. Well they’re pretty dated now, (Note: Codex stopped manufacturing in about ’85, but still sells refurbished units that come off lease) but that was a pretty long running product, the L series. They were called the L Series and looked like breadboxes.

Pelkey: They were only breadboxes in size?

Miller: Then there was another innovative product in the late ‘70s. Codex was always on the high end of things. In fact, they brought in a guy named Vandermay to start up a big project. Vandermay, Jim Vandermay was a PhD from University of Illinois, and they brought him in to run a project to do a very high end statistical multiplexer.

Pelkey: Do you remember when that was?

Miller: ’77, maybe.

Pelkey: It was that late?

Miller: ’76. I don’t – you have to find out when the Codex 6000 came out. They worked about two years on it before it finally – I mean, it was kind of a disastrous introduction, but again, a very innovative product. And, but all very at the high end, that was always their thing. I can remember Roger Evans from Micom coming around to Codex peddling his low end stat mux and sort of getting sneered at, cause that was not the marketplace that Codex was in. Now this little box they did OEM the Micom product for a while.

Pelkey: And you OEM’ed modems back to them. (Note: No they did not)

Miller: I don’t remember exactly, but yeah. Again, I had more of an engineering perspective when I was within Codex, or at least until the latter days of my time there. So then -- interestingly enough, I had the -- I was the engineering leader on the first network management product they had. It was called MNCS, Multi-point Network Control System, and it was very hard wired. No microprocessors were in it. It had a front panel from which you ‘d do functions. And they did a big job for Home Federal in California, and we learned a lot.

Pelkey: Do you recall when that was?

Miller: That was about ’78. Well, Intertel, which became Infinet, which is Jerry Holsinger’s company. See Jerry Holsinger, who did the first 9600, quit Codex before I came. It was the first spin out of Codex. He founded Intertel.

Pelkey: Do you remember when that happened?

Miller: That was probably about 1970.

Pelkey: 1970?

Miller: He left Codex before I even joined.

Pelkey: And he left before they got the product to market?

Miller: Well, they got the product that HE was in charge of to market, but it was not a real economic success.

Pelkey: Right, but did he leave – if I understand the time frames, he left before they even completed his modem--

Miller: No, no, no, no. The AE96 was out in '68, '69.

Pelkey: Ok. So he left to form Intertel.

Miller: Intertel, right.

Pelkey: Which then became Infinet.

Miller: Yeah.

Pelkey: Do you know if he is still there?

Miller: Oh, no, he's gone now.

Pelkey: Do you know where he is now?

Miller: He's – he lives up in this area. You ought to call Infinet. They could find out where he is. I think he's still on the board, but he may not even be on the board any longer, I'm not sure.

Pelkey: You mentioned that he's the first spinout. Were there other spinouts?

Miller: Well, this guy Vandermay, who did the 6000, was the leader for 6000, he quit and started a company in the late '70s, around '78, '79 maybe. I think it was about '79 he quit, and he initially had this concept to have some kind of pharmacy system where a druggist could call up some database to find out about somebody's history. I don't know where he got this idea that this would be such a wonderful thing, but that's what he was going after at first. So he then figured he had to get all the pieces to put a system like that together, and I remember him having me consult on the side, you know, what kind of modem would I need and this stuff, but also what really got him is he found out, he said: "Gee, there aren't any printers that are suitable for this. There's really an opportunity here. There's no printers," so he started working on doing an intelligent printer. Well, this whole pharmacy thing died, and he ended up in the printer business. And that was Integral Data Systems, which got bought by Data Products, and he ended up OEM'ing his printers to Prism, to IBM and …..

Pelkey: My goodness.

Miller: He started out with a very small requirement for cash flow. It was totally bootstrapped. It did very well because what he did was he put advertisements in Byte Magazine and it was all mail order, so they'd send in their check and he'd ship it out. He did very well. It was intelligent printers. He started out in Massachusetts, but then moved to New Hampshire. He set up a big building, and then the printer business got real tough, and he ended up selling out to Data Products.

Pelkey: Do you know if Jerry got venture capital money?

Miller: Jerry did, yeah. I'm not sure what happened in the early days. I don't know how they were financed in the early days, but TA, one of our investors, invested later on. That was a later stage investment. So they definitely had venture capital money, but a lot of it went in later.

Pelkey: Who else spun-out?

Miller: Well then, I left in the spring of 1980, but what happened is that I had become director of modem development, and I also became the CCITT representative for Codex. So I'd go to the meetings in Geneva and got to meet PTT people and so forth. This was in the late '70s, and so I got to understand what the market was in Europe. I'd come back and say: "Gee, we ought to do this, this and this," and there wouldn't be any responsiveness. I got real frustrated. A lot of people in Codex got frustrated then because they were used to the early days, the early go-go years when you could get things done easily, and you couldn't do it. And you got tied up in your knickers. So that was in combination with a long commute, which – you know, the company moved to Mansfield from Newton, and I didn't want to move, especially if I was uncertain, but then, I mean, I always liked small companies. I had a secret wish that Dave Forney would go start a new company so I could go join him, but – and at the time I didn't really – I had always a little bit of a dream of starting a company, but never really had the guts to do it.

So what happened was, I wasn't looking but in late '70s, it was the latter part of '79, I got a call from a guy who used to be at Codex, and he was up at Modicon, Gould Modicon, which was in the factory automation business. He said: "Hey, we're working on some future networking stuff, and it's really communications, and we got all the consultants in here and they don't know what they're doing and we need some help. Could you help consult?" I said: "Well, I don't know," so I took some time off between Christmas and New Years in '79 and looked. I said: "Ok, I'll go up and look," and I said: "Holy shit there's a – the man's right. There's a lot of potential business in here. Maybe this is my way of getting out and going on my own. I can go consulting." So I knew there was some –

Pelkey: Excuse me I'm not clear on times. You said you left Codex in the spring of '79?

Miller: No, no. I haven't left Codex yet.

Pelkey: You thought about leaving in the springtime?

Miller: No, no, it was the fall of '79. I went up to Modicon with this guy and looked at it, and said: "Hey, yeah, there's a lot of potential work here," so I made some calls in early – right after New Years, in 1980, and – to test the waters. If I left, would people be interested in my consulting talents? And I got an overwhelming positive response. And then, also, knowing that I'm not a loner, I thought: "Hey, I can't do this alone. I need somebody," and there was a guy, an engineer working for me that I knew was looking, so I said: "Hey, Bill, are you – have you done, have you made a move yet?" No, then I think I got something," so I talked to him, and he was interested. So I gave my notice and January, and it was a log notice. I had been there a long time and they wanted it that way. I was well though of there, so I finally left full time in the middle of March, doing consulting. That was the most gut-wrenching thing for me to do, because I was leaving a salary. I had a wife and kids and a mortgage and everything else and I mean, I would have to bring the bacon in and I didn't have a job. I had to go scrounge it up, but the opportunities that came by were just amazing.

Pelkey: You became a CCITT representative when?

Miller: About '78, and so what happened was, Milgo had a bunch of patents, Codex and Bell always used to trade patents. You know, they'd say: "Well we got this one. I think you – "so they'd trade patents, and it would be very friendly. Milgo got kind of hard this one time. "Today you're in violation of this patent, blah, blah, blah." And they looked at their patents: they were bullshit patents. So Codex sued them, actually sued them, and then there was a big trial, and counter-suits and everything else, and so

we were hired as an independent party to test, to be an expert witness in the trial, and to test all these old Milgo modems, as well as provide some history about what happened with the Codex modems. So that was a big job and Codex actually won the suit. They actually won about $8 million bucks out of Milgo. It was a very big suit back, oh it lasted a number of years. And in fact, Milgo sued Rixon too. Rixon is now – was bought by Case, and for the same patents, and actually the Rixon lawyers sat in on the trial and later on we also got hired by Rixon to testify down in Delaware or somewhere, cause initially they'd given in and Milgo had won, and they had to pay damages and they appealed, so we were involved in the appeal. That was another job that we had. A third job –

Pelkey: Did Rixon win the appeal?

Miller: I think they did, but I don't remember exactly what happened with that. A third thing we had as a consulting job was with a local company to put a built-in modem into a terminal, and that, what the heck was that, Datatrol was the name of that company. I'm not sure they even exist and longer, so we did a job for Datatrol, putting a leased line multi-drop modem, but it was before ATMs, and it was used for – you could go into a bank and you could put in your bank card and get your account balances, but it wasn't a full ATM. It was a precursor to the ATMs. That was the application. And another job we got was when Apollo first started up. They were a 20-man outfit at the time. We – their Domain system was a token ring, and so they didn't have anybody especially knowledgeable about the physical layer part of it and the timing issues, so we did some consulting for Apollo, back when they were 20 people.

Pelkey: This was in 1980?

Miller: 1980. Token ring. So anyway, based on the work with Modicon, mostly, we got involved with the IEEE 802 Committee. Now, back then, you know, local networks, that was really in their infancy, so I looked around and said: "Holy shit. There's opportunity here. This – all these people participating are all – are all computer people. This isn't a computer problem, this is a data communications problem." I mean who was there? It was Intel, DEC, Xerox and Hewlett Packard.

Pelkey: Apollo?

Miller: Well, Apollo didn't even participate back then.

Pelkey: But I mean, you were consulting to Apollo, and they're trying to build this network and –

Miller: Yeah, right, and, but I said: "Hey, this is a data communications problem." And the thing I got enamored with was token bus. You know the people were – I was influenced more sort of by factory people, hey this is – a token bus is a thing you can use anywhere, whether it be a real time requirement, guaranteed access to the medium because of the passing of the token, better performance – when there's a whole lot of traffic, because it's orderly. You don't get collisions like you do with Ethernet. There is a long distance window problem with Ethernet because the longer the distance, the longer the propagation delays, the longer the uncertainty of whether there's actually anybody on the medium. And the other thing is, it's a bus topology, which means it's a flexible architecture. A ring is a ring. It had to come back on itself and, in fact, unless you have a double ring, it's like the old Christmas tree lights: One light goes out, they all go out, whereas a bus, you could chop one off, it doesn't matter. You patch around it. So hey, we thought, token bus is the way to go. This is the right way, from a communications point of view. So there was a guy in 802 from Honeywell named Clancy, who was the chairman of the media access subcommittee of 802. Instead of splitting up the way they are now, back then there was a physical layer subcommittee, then there was a media access subcommittee, and then there was everything else, called the higher layers. This guy was head of the media access subcommittee, and at the time, in the early days, there was a desire to have one local network as the standard, not have multiple kinds. And at that time, the Blue Book came out -- the so-called Blue Book -- the Intel, Xerox, DEC troika that went out for Ethernet. And they said: "Ok, guys. You work's over. Here it is, just go for it." And this crazy guy, Kryskow who used to blabber around in the 802 committee, nobody could understand this guy except this one guy from Honeywell named Phinney, Tom Phinney, and he was from the factory automation group at Honeywell. This guy was very articulate, so he understood what Kryskow

was talking about, plus he wasn't totally unfamiliar with the token bus concept anyway. It had been used before in the factory environment, and so they started talking to people. They said: Gee, you know, with token bus there are a lot of advantages. You can use it in all kinds of applications. It doesn't have a long distance problems and, in fact, because you don't have to do collision detection, it makes, in some sense, it makes the thing simpler." And there was actually a vote at one point. It might have been late '81, which media access approach should we take -- token passing or collision detection -- and there was actually a majority for token passing. See what happened was that there was a bunch of engineering people running around saying: "We like token passing, but we don't have any big guy with us, so let's get IBM in with this too. We'll say we know IBM likes token ring, and while we don't like ring architectures very much – ring topologies very much -- we'll open up to say we'll have ring topologies as well," to get IBM as a counterweight to DEC, Intel and Xerox. And so there was actually a vote coming out, which kind of media access do you want, and it was voted in favor of token passing, but you had to get a two-thirds majority to make it pass and stick, and it didn't get a two-thirds.

Pelkey: And how many people were voting at that point?

Miller: Oh, I don't remember exactly, but it was probably 55, 60% for token passing, of the voting members, and it was right after that that they went for the compromise, we'll have multiple standards. So then we as a company said: "Hey, we still like token – "

Pelkey: Excuse me, and the 802 Committee was in existence before the Blue Book?

Miller: Yes.

Pelkey: So there was an awareness of local area networking –

Miller: Yeah, but it was in its infancy.

Pelkey: Ok. Why did IBM like token ring?

Miller: They had been working on the old 6100? They had a ring – they had some computers that they tied together with a ring early on, even in the "70s, so they had worked on ring topologies before. There was an old banking system that had a ring network. I can't remember the number, 6100 or something like that, 8100, an old banking system.

Pelkey: Who were the players?

Miller: I can give you some names. Tom Phinney is a good one.

Pelkey: Is he still at Honeywell?

Miller: He was actually a founder of the company. He was from Phoenix. The Phoenix facility got closed, so returned to Honeywell. I can give you his card.

Pelkey: Another question. The token bus, its roots and heritage, where did it come from, do you recall?

Miller: Well, it came out of this work that Modicon did to some extent. Modicon never really supported it, or capitalized on it, but other people in the factory environment had done token bus systems before, proprietary token bus systems, and in fact –

Pelkey: Where did they come up with those ideas?

Miller: They were just proprietary systems.

Tape side ends.

Miller: From a communication concept, you can think of token bus like, as in wide area networks, multi-point. You know what a multi-point network is? It's a polled network. The old IBM bi-synch networks are polled. What they do is they have one line, and there's a broadcast message from the computer outbound to all the terminal devices through the modems, and it's addressed, so all the receivers are in parallel, and then all the transmitters are in parallel as well, but only one of them responds at a time. It's a polled environment. That's called multi-point, and it's still pretty big, in fact. You can look at token passing as distributed multi-point, because who gets the right to speak, which is the polling part of it, gets transferred around. So from a communications concept, it's distributed multi-point.

Pelkey: That's very helpful.

Miller: As an aside, I might add, multi-point became a big deal in the mid to late '70s, and that's what drove network management.

Pelkey: Right, it makes sense.

Miller: I don't know if you realized that.

Pelkey: And '76 was the time frame.

Miller: Yeah, and the reason – the economic reason why multi-point became important -- was because it greatly reduced your line costs. So instead of having a series of point-to-point links, you could have one link that sort of snaked around and the total mileage was less than having a series of point-to-point links, so your line costs were much lower.

Pelkey: Who came out with the first multi-drop, multi-point modem network?

Miller: Well, people came up with – that became the big deal then. Fast train, and fast training meaning fast polling, fast setup time, because inbound, every one of these we had to resynchronize every time, or if the time to resynchronize became large, then it became inefficient, because most of the responses were just: "I'm ok, nothing to report," you know, very short messages. So the incentive was to have a very short so-called training period, or synchronization period.

Pelkey: And you always had to resynchronize it?

Miller: You always had to synchronize it because you always got the messages from a different guy, so you couldn't predict it, so the receiver had to train up every time at the master site, at the central site. But that was a bitch to troubleshoot. If anything went wrong, suppose some transmitter got stuck on, the whole network's down. If you had a problem, the fault diagnosis was a bitch, and as a result, that's what drove network management for modems.

Pelkey: That makes sense. IBM must have been a leader in putting these networks in?

Miller: Yeah, it was all IBM networks. No, there were some asynchronous networks too, mostly ATM – this thing we did for Datatrol, that was a multi-drop network too, using async FSK-202 type modems.

Pelkey: Who provided the modems to IBM?

Miller: I don't know. Codex sold a shitload to IBM.

Pelkey: So was Codex the first one that kind of supported multi-point?

Miller: Well, no, the first modems that went in in that environment were 2400bps. Milgo was big in that, so was Intertel, later Infinet. Intertel was the first one really to come out with sophisticated network management. That was their whole big thrust back then, and then, in this LSI based product that Codex

came out with, there was a fast train version, which was innovative in the sense that it started out at 2400, because it was only a 6 millisecond, 8 millisecond setup time for 2400, for the 201. The Codex approach was to start out at 2400, continue to train up when they were still passing data at 2400, which is more immune to impairments, and then after so many bit times, it gear shifted up to a higher speed.

Pelkey: Ah, that is clever.

Miller: And so you get the advantages of the lower speed modems, which have fast setup time and the higher speed modems if you have a long message to send, but the early ones were 2400s. And then there were 4800 fast trains too. Milgo and others had them. Later on, more in the '80s, it was 9600s. So that's an aside.

Pelkey: No, no, no. In fast, I'm going to come back and ask you another question about that later. That's incredibly useful, to understand the concept of where network management came from. It came from the asynchronous side of the house.

Miller: It was driven by multi-drop, or multi-point.

Pelkey: Multi-point, right.

Miller: And in fact, that's the big thing now. That's what lease line – leased-line modems -- have been what's been flat. There's no question, leased line modems have been the backbones for networks, and that's going digital today. And the thing that saved these, the companies like the Paradyne and Milgo and the Codex, in the face of a flat market, has been locking in customers with network management, and that's been a barrier for the customers to go digital.

Pelkey: Absolutely. So in '80 you had all these consulting assignments.

Miller: Right. So then, as I say in 1980, I was going to these 802 meetings and I'd look around and say: "Holy shit, there's a – look at all this activity here, and it's an infant industry. There are all these computer people and this is not a computer problem. It's a data com problem. In my opinion, the right way to do it is with token bus because I also thought that broadband is a real great solution, because it's a proven technology. You can have multiple channels, you can go long distances, it can be a great backbone. So, long distances, the token bus protocols supported it very well. So we were in favor of token bus.

Pelkey: Some of your thinking about this, your intellectual view must have been influenced by the fact that you had a modem background.

Miller: Yes.

Pelkey: Broadband and token bus and even token passing are modem-type technologies, where Ethernet was a different kind of technology. It wasn't really modem-oriented technology

Miller: Right, it was baseband. From a communications point of view, collision detection is the shittiest solution because, as you increase the load on the system, the actual throughput went down. So the argument was if you're actually in a network, and something important happens, traffic tends to go up, and that's when you want the reliability, and that's when the reliability goes down for Ethernet. So, and we also thought that broadband is the ideal medium because you could span long distances. It's a good backbone, it's a proven technology, multi-channel, and you can put video on it at the same time.

Pelkey: Right.

Miller: And Ethernet didn't make sense on broadband. It still doesn't make sense today on broadband.

Pelkey: Nor is it necessary on fiber.

Miller: Right.

Pelkey: Whereas your kinds of technologies – I guess you still needed a return token?

Miller: So anyway, as I say we became token-passing advocates and the token bus advocates brought IBM in as a counterweight to these other heavies that had vested interests in Ethernet.

Pelkey: Yeah, ok.

Miller: Now, as we thought about this crazy guy, Krysko, who was trying to get this guy from Honeywell, and they were talking about forming a company. The whole 802 committee at the time was just hotbeds of forming companies, all buzzing around.

Pelkey: Right, Dave Potter and –

Miller: Dave Potter was originally the DEC representative, then lo and behold he shows up and he's with Interlan. Sytek was there. Sytek didn't participate much, they were sort of by themselves, but the guy from Ungermann-Bass was there.

Pelkey: Ralph?

Miller: No, it wasn't Ralph.

Pelkey: Charley?

Miller: No, Charley Bass came once in a while. It was their VP of Research, John Davidson – he's still at Ungermann -Bass.

Pelkey: Who else was coming to the meetings that you recall?

Miller: Then there was some guy from MITRE who ended up joining Ungermann-Bass. It was a guy named – Jesus, he slipped my mind too. He's from Andover, came out of MITRE. MITRE was doing some local network stuff. The Honeywell guys, and Honeywell didn't really get any support from their corporation.

Pelkey: Was Metcalf going to those meetings?

Miller: He did sometimes. But there was another guy from 3-Com that came a lot, who at the time was their director of engineering. I don't know if he's still there or not.

Pelkey: Howard Charney?

Miller: No.

Pelkey: Bressler, Bob Bressler?

Miller: No.

Pelkey: What other companies –

Miller: There was a guy from Intel. Obviously, Hewlett-Packard, their guy was named Don Loughery.

Pelkey: So there was this hotbed of a lot of excitement and lots of controversy. Your viewpoint that token was the right way. Influenced by this token bus and –

Miller: I mean, it made sense to me as a communication –

Pelkey: It made logical sense.

Miller: So, I was a big champion even in my later years at Codex, to do dial modems, and the rationale being, hey we can do faster speeds now on the dial network. In fact, it had been my project at Codex to do the first full duplex 2400. We did a product for a government agency for secure speech applications that did full duplex 2400 on dial. It didn't become the V-22 BIS standard, but I said: "Hey, we got to make a product out of this thing," and the response was: "I think they offered it half-heartedly and said: "It's not selling:" I said: "It's not selling because the price isn't right." And there was talk in CCITT at the time of standardization for how to do 2400 full duplex dial and there were different approaches. So I'd come back and say: "Look, what's Codex's position here. We got to have a position." And then I sort of got out of it, because I had already left. But the V-22 BIS standard came out of it.

Pelkey: That was the Codex way?

Miller: No, it wasn't at the time. Anyway, after about six, eight months of consulting I said: "Hey, this isn't really for me."

Pelkey: Now this must be, when, the fall of '80.

Miller: This is the fall of '80, but look at all this opportunity. Oh, I'd been offered to run engineering for Vandermay up at his printer company IDS. Some guy approached me who did contract manufacturing. He says: "Hey, most of my contract manufacturing is in modems I'll go raise some money and take care of the manufacturing And you run marketing and engineering and everything else." I said: "Wait a minute, cut the shit." So all these things were popping out, and I didn't want to do consulting anymore. Also, concurrently or shortly after I left, a couple of other people left. One of them was this guy Bong Wei Lu, who ended up with Steve Finn starting Bytex.

Pelkey: Where does Steve come from?

Miller: Steve came from Codex. Didn't know that, eh? Steve was in the network side. He was not in the modem side. Matter of fact, he was at the same director level at Codex as me. And also another guy, who was a sales guy, had quit at that time, and was fooling around with some Australian company that wanted to start up here called Scitec. And I looked at that a little bit too. So a whole bunch of opportunities come out.

Pelkey: What was that S C I –

Miller: S C I T E C. You've heard of them?

Pelkey: Yeah.

Miller: So in the fall of 1980, I got a call from a friend of mine from Codex saying: "I want your advice, Ken. I have these guys – Steve Fin wants me to go join Bytex. What do you think of this, this matrix switch thing and all this stuff." I said: "Ross," his name was "Ross Seider.

Pelkey: Ross Seider.

Miller: I said: "Ross, I think I got something here. Don't do it." So between Christmas and New Years, we had a planning meeting, to come up with a business plan. Now at the same time, this is another interesting point, through my international contacts, because I was the CCITT representative, there was a guy in Sweden who was the president of the Codex distributorship. That company had been – well it started out as a Codex distributor about '73, something like that. At the time, there really weren't many data com distributors internationally, or in Europe even, and the company was Svea Diesel. It was

actually a diesel engine company, and they hired this guy out of ITT Sweden, who knew something about communications, to run a little subsidiary to do data communications, and it was called Svea Datacom. It was super successful, and ended up Svea Datacom became bigger than the parent, under this guy Hans Johansson, but this guy had no equity in this business. He wanted to get out from under. He was getting fed up with Codex too, not getting some products he wanted. So I had been – in 1980, actually, I went to the last CCITT meeting and I let people know that I had left Codex and all that at the time, and I saw the Swedish PTT guy, and he told me that there was a tender coming out for some little modem, and we – the guy from, this guy Hans Johanssen said: "Hey, if you – "The tender finally came out in the fall. "If you guys want to bid this, I'll sort of represent you," kind of thing. So we got the specs. It was for a V-21, which is an FSK-300, and the V-23, which is a 1200/75, fairly simple modems, and they actually called them mini-modems. They were going to be inexpensive things that the PTT would supply. So we ended up actually, we had to have prototypes to look at, so in the fall of 1980.

Pelkey: By when were the prototypes needed?

Miller: Oh, in the fall. We maybe had a month to give him prototypes, so we said: "Look, do we want to try – I mean it's a long shot, do you want to try this thing?" And we said: "Sure," so we –

Pelkey: This was just you and Bill?

Miller: Bill and myself and there was a technician. It was a friend of his.

Pelkey: And what was Bill's last name?

Miller: Bill Northam. N O R T H A M. So we designed this thing and delivered two, some prototypes in a month.

Pelkey: So you worked nights and weekends.

Miller: Oh, yeah. We were –

Pelkey: You must have been working lots of hours.

Miller: Oh yeah, we were working our asses off in somebody's – this technician's basement. We were putting them together and, it was blowing smoke to think that we'd ever get it – which we didn't.

Pelkey: Do you remember how much money you budgeted?

Miller: I don't even know.

Pelkey: Was it a big concept? Invest this money and –

Miller: No, it was mainly –

Pelkey: Hours

Miller: Hours, year. I mean, you'd have to spend some to put it together, but – and then because of that there was an old buddy of mine that I knew who was the – had lost contact with him. I knew him back from the '60s, and the job I had before Codex, and I said: "Hey, this is the best quick response manufacturing guy I know," and he helped us get the parts and purchase stuff, and so I had made contact with the guy again. And so between Christmas and New Years, we got this planning meeting together and this guy Ross from Codex, oh and then another guy that had been helping us when we were doing the testing of all these modems, we needed a place to do that. Well, the former VP marketing at Codex, who had left, was at the time VP of marketing at ASI Teleprocessing, which is now Amnet. That's an old

company. It's been around a long time. So we were at the old mill down there, and he was interested in us, and he was helping us too, the name is Jim Rothrock.

Pelkey: R O T H –

Miller: R O C K, yeah. So we had the first planning meeting and it was between Christmas and New Years of 1980.

Pelkey: At your house?

Miller: We had it at the Colonial Inn in Concord.

Pelkey: Was it done – did you work during the days?

Miller: No we just did. It was, I mean I came up with a basic approach that we talked about. It was a three or four hour meeting. It was a basic strategy. We said: "Hey, look. We want to do token bus, LANs, but that's a long-range thing, I mean, we're committed to standards, and a standard doesn't exist, so one of the things we have to do is get it through the standards committee. There's a lot of work. It's a systems oriented product. But we also have identified this other thing that we know a hell of a lot about. It's a market that's here and now. It's dial modems. And so, let's do both. There's a short range, relatively short range strategy, get the company going, and the longer range one which we thought, at the time, would be a higher growth field." So it was a two-pronged strategy from the beginning.

Pelkey: Now, that time, the dial-up market was really UDS and Vadic.

Miller: And we identified the first product in the dial modem area would be a V-22, that's like a 212 international, cause I was at -- when I went to the PTT in Sweden looking – I took a trip to Sweden in the fall with these modems to have them test these mini-modems, so called, I look in their PTT lab and I see the Vadic product, whey were the only one with a V-22 at the time, I said, "Holy shit, We can do better than that." That was the only vendor at the time. That was a new standard so, we said: "Ok, let's do that one." And plus the fact that, hey look, there's a shitload of 212 vendors in the states now. At the time, their approach was to buy Bell chips, AT&T licensed chips, that's how people got in the 212 market back then.

Pelkey: Licensed chips meaning?

Miller: Meaning they could license. They would license their patents. They would give you the total design, including PC design. You'd have to go buy chips from AMI.

Pelkey: And what kind of royalty rates did they –

Miller: I don't remember what the deal was. I knew it at one time, but that's how all – it was 50K up front and one or two percent, something like that. That's how everybody got into the 212 market at the time. But there were like 15 players at the time. Screw that. I don't want to do that. Let's go international. There are no players. There's one player. There's Vadic. Plus I have in's. I know the PTT people. So, and we know what the requirements are. There are some screwball requirements in some countries, most countries in fact, well in Europe anyway. So let's do the first to be a V-22 and we'll compete with these guys, so we knew of another Codex engineer looking. So we talked to him and we made the decision in December, at that meeting, we'll stop consulting activities. We'll pledge between us around somewhat over 100K. And when I really think back, that was a much more risky proposition than –-

Pelkey: Leaving Codex.

Miller: --than leaving Codex, that was nothing. That was a piece of cake.

Pelkey: Did you become president?

Miller: I became president, yeah.

Pelkey: And did the other people join the company?

Miller: Well, we had only Bill and this new guy, Andy Kameya, who was the guy first hired. He came in January.

Pelkey: And Bill was VP of engineering.

Miller: No, he was not VP. We didn't have a VP of engineering. Bill was not a manager. He was an individual contributor. Good individual contributor. Ross Seider pledged to come on board, but not until we got money. We decided we needed to do venture capital too. But we went charging off. If we didn't get venture capital, we could still do the modem piece. But to do the LAN bit, we needed venture money.

Pelkey: Right.

Miller: So, Jim Rothrock decided that he didn't want to – his personal life at the time was screwed up enough. He had lost his wife and he had daughters and so he didn't feel he could take the pressure of a start-up, so he stayed on the board and was advisor and informally helped me a lot, cause he had been somebody who had been an officer at Codex. And through him, there was another acquaintance I had who had been a VP of Finance at ECRM, not in the data com field but, we said: "Ok, we'll use him as a sounding board, because – so we found a little office, a thousand square foot office.

Pelkey: Where

Miller: It was in Lexington. And we – Bill Northam who was the original guy, and Andy Kameya were working on the first product, the V-22. They were on the payroll – so they were on the payroll and I was on the payroll.

Pelkey: Excuse me the V-22 is a 2400 –

Miller: It's a 1200 full duplex – it was like a 212. It's the international 212.

Pelkey: Ok, and there was only Vadic.

Miller: Only Vadic had a product at the time. So Bill and Andy were working on the first product. I was on the payroll and Jim Rothrock wasn't. Jim and I were working on the business plan. And then Mike Kryskow was also going to come too. This crazy man who knew all about token passing, but was a terrible communicator. And we had also tried – we were talking about trying to get Tom Phinney who was the guy from Honeywell who was a really sharp guy too, a sharp technical person. So we wrote the business plan and we said: "Well, ok, we'll use this other guy, Andy Kameya who was this financial type, we'll use him as a model venture capitalist." I mean I didn't know shit about writing a business plan. Jim was a big help and I – my first drafts we Andy Kameya re very techie oriented, too jargon-ish. So I said: "Ok, we'll use this guy John Plakans as a model. If he can understand what we're trying to say, it passes, and we'll launch it." So we went through a number of – we worked about three months, two or three months on the plan, and we got – we thought, well we'll have to go through multiple iterations and we won't get any money in the beginning and all this other stuff. Well it turns out that Plakans from his ECRM days knew Kevin Landry at TA, so we got an introduction through him, and Kevin and Andy McLane came out and visited. My neighbor knew the guy from – there's a guy from Fidelity, and so I went and talked to Fidelity and, in fact, Stevenson, there's a guy named Tom Stevenson who was the president of Fidelity ventures. I went in there. That was very interesting because I was preaching the gospel of token passing. I'll never forget that day because I went in and was telling him why token passing is better than Ethernet and this guy is giving all these technical arguments about Ethernet. I said:

"How the hell does this guy know this?" It turns out he had just gotten aced out from investing in 3Com and he had been filled with all of Metcalf's propaganda. I did not expect to get a technical grilling from a financial guy.

Pelkey: (Much laughter.) That's great.

Miller: And I also talked with Analog Devices Enterprises. My neighbor was employed by Analog Devices and he introduced me to Bob Boole. Right. And they actually – I'll tell you what happened, but, who was the fourth one I talked – oh, Fidelity brought in Greylock at the time, Greylock and Fidelity often went in together. Low-and-behold, we get offers both from TA and from Analog.

Pelkey: That was around March?

Miller: No, it was April, yeah.

Pelkey: You guys must have been flying high when that happened.

Miller: Yeah, and so what happened was, I got a little bit panicked because Kyskow was going bananas. We had a company meeting one time and he said: "You're not, you're not flamboyant enough to be president. You'd be a good VP of engineering. We need to go get another president." I said: "Go damn it, no." And the guy finally didn't make it, and didn't join. In retrospect it was great that he didn't, but I said: "Geez, How can I say we're big token passing guys. I don't have a token passing expert." So we pulled in Phinney, but he said: "I'd love to join, but I don't want to move." So I said: "Ok we'll keep you down in Phoenix and work it out." That's how we ended up with a Phoenix facility, which we had for – we don't have it anymore. It was for LAN. So we had, I thought, to have a token passing expert.

Pelkey: Right, absolutely.

Tape side ends.

Pelkey: So you raised $1.4 million?

Miller: $1.4 million.

Pelkey: From TA and –

Miller: TA only.

Pelkey: TA only? And then who came on your board?

Miller: Andy McLane. I remember at the time, he was always saying: "Why are you doing this modem shit?" Cause one thing, we always had the funny – over the years, the funny thing: "Well, the modems generate the revenues and the profits and the LAN generates the equity money." There's a lot of truth to that, but –

Pelkey: So now it's April and –

Miller: In April we got the offer. We got the money in May. We didn't want – even though the offer was a little more attractive from Analog Devices, we said: "Hey, who's going to be on the board?" And I liked Andy better than the financial guy; it wouldn't be Boole. It would have been a financial guy from Analog Devices on the board, and they said we'll only give you a certain amount of money and then you have a progress payment and, if you meet some milestone you get it. I said: "Ah, screw that shit." Who knows, this is a volatile business. You could end up changing direction. I don't want to get too constrained." And also, it was a clear direction. If you were with Analog, you were going to get acquired. I didn't want to do that either. So we went with TA.

Pelkey: Now, what was happening over on your little Swedish proposal?

Miller: Oh, well that died. There was –

Pelkey: When did you get word of that?

Miller: We got word of that in early 1980. I mean that was a long shot. We didn't – yeah.

Pelkey: So now you're working on your V22 –

Miller: V-22 which is a 1200, which is higher tech thing. So we came out with that. Oh, that was another interesting milestone. In June, then, after we got the money, I went to Europe. My friend from Sweden introduced me to some other European distributors who were looking for dial products. I made a clear decision, we were not going to do any leased line modems, just dial modems. And so he arranged to have a bunch of potential distributors come up to Stockholm because he was trying to peddle the product that he had as well. So I would have an opportunity to peddle what we were coming out with, to try to line up distribution in Europe. And that was really valuable because I was peddling the V-22 and the other thing we were going to do is we made it adaptively equalized. That meant that it was able to automatically adjust to different telephone lines, which no other 1200 could do at the time. So it would be the best performance of any of them at no increase in price or complexity. So, and that's important for a lot of PTTs who do some extensive testing. So we started doing some testing and we had a good enough modem so that they could do some testing. I went to Europe in about October or November, I think, of 1980. I actually went into the labs of BT, British Telecom; labs that had test-beds of bad lines and did some testing and, even with the modem not working fully, it was much better than anything they had seen. Meanwhile, we had signed up distributors for the UK. Oh and the UK guy, by the way, was a guy who had been hired by Hans to do manuals in English for his product. He and his partner had left a big distributor in the UK and they had introduced Micom in the UK with this distributor. And the whole basis for this new distributorship was to distribute a new statistical multiplexer from CompreCom. I don't know if you ever heard of that company. I think it's defunct now, but…….

Pelkey: A little.

Miller: Their whole point was that they would be half the price of the Micom stat mux, with a faster response time, or something like that. Well, it turns out – right after they went out on their own, Micom dropped their prices while the CompreCom product didn't work very well, and they were about to go under and they latched onto our product and they ran with it. If we hadn't been there, they would have gone bankrupt.

Pelkey: This was the end of '80"

Miller: Yeah, end of '80, right, so we signed them up at this meeting in June of '80. Hans was still with Svea Datacom and as soon as we got our V-22 he showed it to the PTT. There was a big tender of V-22s, and by the fall of '80 there were other competitors: Nokia, and other international competitors. Nokia is a big Finnish company, they make modems as well as other things such as Central Office equipment. Prentice I think had a V-22 as well. They came out with a V-22, and so there was this tender, and we won. We won the Swedish tender. It was for like 3000 modems in the spring of 1981.

Pelkey: Now, were you shipping your modem for domestic use at this point?

Miller: No, we were all international. We were shipping –it was an open market in the UK, so we were shipping mostly to the UK. Started shipping in December of 1980.

Pelkey: How much did the modem cost at that point? How much did it sell for?

Miller: It was up there, it was maybe $900, or something like that. And we won it because of superior performance and – it was a dumb modem, no auto-dial no nothing. It was manual-dial, auto-answer. It was a big win. We beat out Vadic. There was shock at Vadic from that. Total shock. Who the hell are we? And so there were shockwaves all over Europe with this new player out there: Concord Data Systems. And we had signed – we also were very fortunate at the time because Codex had a policy of, at the time, going direct in many countries. They were sort of tying in with Four Phase and Motorola, going with one entity, one business unit in each country, and the distributors weren't dumb. They wanted alternative products. Plus the fact that Codex had no dial products, and the only one in the Motorola family was UDS and UDS had never paid attention to international. So we could get signed up with Codex distributors and not have a conflict, cause they didn't have any dial products. So we got the Codex distributor in the Netherlands.

Pelkey: And did you hire an international person over in Europe?

Miller: No, I did most of it myself in the early days. And we got the Codex distributor in Italy. In France it was another friend of mine who was Codex Europe, who left and became sort of the forward thinker at SGB, a big bank in Belgium. Codex Europe was in Brussels, Belgium. So I asked my friend George: "What do I do in France? France is a big market but it's a bitch. Germany, forget because it's just closed. What do I do in France?"" So he said: "You know, you've got to go with a French face. You know, there are three modem companies. There's TRT, there's SAT, who's number two, and LTT, which is number three and LTT is probably the one to go with. I know they're looking for product and I think you even know who the guy is, the technical guy." LTT was a division of Thompson. So we went to LTT, this was probably '83. We started to talk like this: "What do we have to do to get approved?" and that was a bitch. Everything's different in France. So after a lot of hoopla, we finally got an OEM deal ready to go. We didn't ever sign the thing and they finally started taking product and we got screwed. This is an interesting story because it was a socialist government in France, and all of these companies were nationalized, these big –Thomson was nationalized and Alcatel was nationalized – SAT was a division of Alcatel. So they said: "Hey, they made a decision, gee, why would we have these big conglomerates competing with one another. They should specialize. So Thompson, you're going to specialize in defense, defense and semi-conductors I think it was. Alcatel, you're going to specialize in communications." Everything stopped. After we put in two years of spade work, just to get it approved, and had just started shipping –

Pelkey: That was in '83 now?

Miller: '83 or '84. We started shipping in '84, so we started it up in '83. We shipped 400 modems in one month to them. And they just stopped, just – that was a horror story. That was a heartbreaker.

Pelkey: Come back for a second. You start shipping your modem in '81.

Miller: Yeah, beginning of '81.

Pelkey: Beginning of '81.

Miller: That was V-22. That was 1200.

Pelkey: And did you sell much in '81?

Miller: Oh, sure. Well our fiscal year at that time was end of September. First year of doing business we did a million and a half.

Pelkey: So September '81 –

Miller: We did a million and a half. It was all one product, V-22 and 99% international.

Pelkey: Now why didn't you do it for domestic?

Miller: Because the V-22 wasn't exactly the – we didn't have distribution. We were just starting to try to set it up. V-22 was very much like 212, but it didn't have a 103, 200 fall back mode, so it was not the same as everybody else's 212s.

Pelkey: And the European PTT's didn't have that requirement.

Miller: Plus, there were 15 different 212 competitors.

Pelkey: Oh, yes. A lot of 212 modem competition. And V-22 didn't offer enough?

Miller: V-22 is different – it was an internationally oriented standard. It was very specialized. If somebody wanted to call somebody internationally, then they had to get a v-22. So it was 98, 99% international in that first year.

Pelkey: And didn't Vadic have a 1200-baud modem?

Miller: Yeah, 1200.

Pelkey: I forget what their product number was but it was also – you could run it as 212 and/or their Vadic protocol –

Miller: Yeah, it was. That was in the late '70s. That's really what made Vadic. That was one of the main things, but that didn't get standardized, and as soon as Bell came out with 212-modem, they soon took over. And V-22 is based on 212.

Pelkey: Yes, ok. So – now what happened in '82, fiscal year '82?

Miller: So immediately after we finished the V-22, V-22 BIS became the new recommendation. That was 2400.

Pelkey: Ok.

Miller: So immediately we started working on that. Now, one thing that we did do which was very innovative was we did DSP signal processing in standard micros. We did the receiver and adaptive equalization and such in an 8086 as the receiver, and in the 8031 transmitter we did transmit filtering and signal shaping. Very innovative. And then the filters, the splitting filters were discrete. Discrete, in other words, they were just analog filters. Active filters. So then we started work on the 2400, and we said: "OK, we'll do – "

Pelkey: When did you start the work on the 2400?

Miller: Right after the V-22 was done, which was '81, so it was another year –

Pelkey: Spring of '81?

Miller: Early '81. And we did the first –

Pelkey: Why did you pick that –

Miller: Oh, shit, you always go faster. V-22 BIS was a new standard.

Pelkey: And how did you know about this standard?

Miller: Oh, I knew. We kept in touch with the CCITT too. We're big standards believers.

Pelkey: Were you aware of other US companies that were using V-22 BIS?

Miller: Oh, sure. Oh, yeah. We said: "Eh, we can – we can get there first." Well, we didn't announce first. Vadic announced first in June of '82, but they couldn't ship the product. The thing was $2000 and it ran so hot that people said you could fry eggs on it. And so by – I think we announced at the TCA show of '82.

Pelkey: Which would have been when?

Miller: Fall, September of '82, and we started shipping in December. Again, it was not auto-dial. It was a dumb 2400, and that was also very innovative, with the adaptive equalization in the receiver in and 8086, and the transmitter in an 8031, so it was a somewhat similar architecture to the V-22 1200, but at 2400. And we used this as a basis to get to setup distribution domestically. That product took off. And it got pre-sold.

Pelkey: Was there much competition for that product?

Miller: Then, the year after that in '83, we came out with an auto-dial version, and it's really the auto-dial version, that's like a Classic Coke product.

Pelkey: And what – why didn't you put auto-dial in the first version?

Miller: It was too complicated. We wanted to come out with something to sell first.

Pelkey: But you knew you wanted it.

Miller: Yeah, we sort of knew we wanted it. I mean, we weren't very protocol oriented back then. You're sort of modems, and modems, you know, it was Hayes who really innovated the serial auto-dial.

Pelkey: So when you after introduction you saw the serial auto-dial. You said we better put that function in.

Miller: And say: "Hey, we can do a better job than Hayes," so we did the CDS command set, which is more user friendly, but we didn't really do a good enough marketing job to capitalize on it. I think back, there was a lot of missed opportunities, and hey, c'est la vive. But you learn, maybe.

Pelkey: Let's hope.

Miller: Meanwhile, let me go on. The LAN side –

Pelkey: Still a couple of things. So, at the end of '83, you introduced the V-22 BIS.

Miller: No, at the end of '82, it was at first a dumb V-22 BIS.

Pelkey: Yeah, excuse me. End of '82 was dumb BIS.

Miller: Right, with no auto-dial. It just an auto-answer.

Pelkey: And September '82 your sales were, you had gone from a million and a half –

Miller: Oh, so then September of '81 was our first year, September of '82 we did $5.3 million.

Pelkey: And were you profitable at this point.

Miller: No. It was very close.

Pelkey: Ok, and then you did what?

Miller: It was still a loss, though.

Pelkey: Ok, and then September of '83?

Miller: And September of '82 let me finish. So at that time, two thirds of the business was international. One third was domestic. So that gives you an idea of how you – it went from 99% international the previous year.

Pelkey: To 75% of sales.

Miller: The third year we were $15.3 million, of which $14.3 roughly was modems.

Pelkey: What was the other million?

Miller: And the other million was LAN.

Pelkey: Ok, and that was a profitable year.

Miller: That was a profitable year, yes.

Pelkey: And how much – how much of that was V.22 BIS?

Miller: Almost all of it. I mean, I can actually – good portion.

Pelkey: Good portion.

Miller: Yeah, good portion of it. So anyway, what – let me go back to LAN now. I was spending my time, a lot of time in the IEEE 802 committee. We were pushing. Phinney hired another guy in Phoenix called Bob Douglas, who became actually subcommittee chairman of 802.4, which was token bus. Ross Seider, the guy from Codex became VP of engineering for LAN, and it was a little like prima donnas, maybe, but the two modem engineers Northam and Kameya didn't want to work for Seider so, there was from the beginning, a split in engineering.

Pelkey: Was Seider down there?

Miller: Seider was here. So he ended up running LAN engineering only. And so also early on there was a – associated with LAN, there was a committee, and EIA committee having to do with RF modems, which I participated in. I went to this thing, this was probably '81, I said: "These guys are turkeys." They were out of the CATV industry and they wanted to do RF modems using partial response signal sideband, which was modem technology from the '60s. And the reason was because television is single sideband. They were used to television. That's what CATV is all about, and hey, the theory for a modem is, whether it's on telephone lines or whether it's on CATV system, broadband system, it's the same. And so I argued for an RF modem standard for token bus. And it was my proposal that got adopted.

Pelkey: And when did this happen?

Miller: This happened – in the EIA, that was probably '81 or '82. And then we also succeeded around '82 '83 getting token bus passed, so great, holy shit, a little company pushed that through. We pretty much wrote the standard. The other, oh the other one that participated was Amdax. Remember Amdax? Amdax was also a token bus advocate.

Pelkey: Boston.

Miller: No they weren't, they were down in Long Island.

Pelkey: Where did those guys work prior to that?

Miller: They'd been around a while. They were located in Bohemia. They were an RF modem company.

Pelkey: Ok.

Miller: And they had gotten another guy. They had gotten bunch of venture capital and their protocol guy was out in California. He was a pretty sharp guy, named Zak Kong. So he was a big token bus advocate too. So he was a real ally. Amdax was doing shit and finally got bought by Ungermann-Bass, as you probably know. So they had some people in the RF modem committee who were very good. So anyway, we – you know, I think in retrospect partly because the pressure wasn't on them, LAN development slipped. I mean, we were spending an inordinate amount of time getting the thing passed, getting it standardized.

Pelkey: And you had such a commitment to standards, you didn't really want to do much until you had a standard.

Miller: Yeah, right, and then we get the thing passed and we also find ourselves in the quandary: "Ok, whew, we got the thing passed. Where's the big company support? We may have gone through all of this effort, and if we don't have a big guy – "

Pelkey: IBM wasn't –

Miller: IBM was going token ring. They didn't give a shit about token bus. They were interested in token ring. So the best technical solution might not win. And the only big company that was sort of interested in it was Philips. And we actually had our first OEM with Philips. And we still have it. CCI still has an OEM agreement with Philips. So that was a conundrum at the time. Sytek was going gangbusters. They had a low cost product that they were selling. They had a low cost product that they were selling as their Local Net 20. I guess it was.

Pelkey: Right, 20. It was a broadband, right?

Miller: Broadband, right. But we thought broadband was the right way to go, and we had some difficulty getting RF people that knew – that were worth a damn. We finally ended up training a guy who was a modem, an analog modem, a telephone modem guy, teaching him RF technology. Because the RF guys were these old hackers. It was real difficult getting somebody who was worth a damn.

Pelkey: Isn't that fascinating.

Miller: They were all old RF hackers, and they were just – it was very difficult to find any talent.

Pelkey: So you trained this guy –

Miller: There was an old RF guy who was quite good from KEL, made this hand-held radio stuff. We had gotten a technician, a RF technician; I mean that's a whole different kind of discipline.

Pelkey: So when did you have your first product?

Miller: So, '84 we started shipping. We had a terminal server product, but it was a little expensive token bus.

Pelkey: What time of year was that?

Miller: I don't even remember exactly. Probably the last half of the year, and at that time also, we had the first major player stand up and be counted for token bus, General Motors.

Pelkey: Excuse me, General Motors.

Miller: So General Motors came to us and said: "Hey, we've had this MAP project going." Oh, the other one that was interested in token passing was Interactive Systems, which was this little group that got bought by 3M. That was another RF modem house.

Pelkey: That they then got bought by Allen Bradley?

Miller: That they got bought by Allen Bradley. Right. They were big in this.

Pelkey: So it was Interactive System, Amdax, Sytek, Ungermann-Bass was –

Miller: Ourselves. Ungermann-Bass kept talking to us about doing an RF modem. Davidson, John Davidson is the guy at Ungermann-Bass.

Pelkey: Ok so Ungermann-Bass was talking to you –

Miller: Charley Bass visited us when we – before we even got our money, when we were in our little thousand square foot office, 'cause he was interested in RF modems at the time. And he said: "Hey, don't do any more shit. Just do RF modems for us." We said: "No, screw you." So anyway, we got the thing passed and we find this problem with –the product wasn't finished. It kept having delays. The RF modem was a problem because we couldn't get people. Ended up training this guy and then, to do even a terminal server, we said: "Hey, we had to do the upper layers, so we thought, hey, it's going OSI?" You couldn't buy OSI layers so we ended up doing our own transport layer, which was a whole shit load of code.

Pelkey: Where did you get the talent to do that?

Miller: Phinney did it down in Phoenix, Phinney and Douglas. Douglas did the access mechanism before these was any chip. Token bus access mechanism.

Pelkey: Now, was this a bigger problem than you guys thought this was going to be when you charged into it?

Miller: Oh, yeah, we kind of were naïve, a little naïve but we were cocky.

Pelkey: You had this modem business going crazy. Now you just got this thing through a standards committee.

Miller: Right, yeah. So then –

Pelkey: The world was your oyster.

Miller: Oh, yeah, we were going gangbusters. We were darlings. And in mid 1983 that's when GM came to us and said they had this MAP project. They had been talking to Interactive Systems, and they had been talking to Allen Bradley about this. And as I said, they said: "Hey, you guys are the furthest along. We want token bus. We've already selected IEEE 802.4 to be the lower two layers of MAP. We want to tie this thing together in the factory. So we want this multi-vendor demonstration to happen at the NCC show in the summer of '84," so we diverted our resources. We hadn't finished the product, our terminal server product. We diverted the resources –

Pelkey: You said you had not finished it.

Miller: We had not finished it at that time, but we were further along than anyone else.

Pelkey: And how do you pass up General Motors?

Miller: Well, we couldn't pass that up. Here's the big corporate presence –

Pelkey: That you had been hungering for.

Miller: Yeah, right. And –

Pelkey: You had visions of sugarplums when this thing was coming down.

Miller: So we participated in that. It was a real splash. That was the first – there were only seven venders at the time. There was ourselves, DEC, IBM, Allen-Bradley, Gould, Motorola, Hewlett-Packard

Pelkey: And where were they getting their boards, their interfaces?

Miller: They didn't have interface boards, they used our external box. What we had to do was develop an external box –

Pelkey: So everybody's connections were through yours?

Miller: Yes ours. We provided the network.

Pelkey: And this was in the –

Miller: This was in the summer of '84 at the NCC show.

Pelkey: Yah, and where was it? Houston?

Miller: Where was it. I don't -- it might have been Atlanta.

Pelkey: Up until right before that show you guys must have been working your asses off.

Miller: Oh, they were working our – what we had to do was provide a – we came up with an interim kind of standard for the layer that these people had to interface to, so we provided a layer 2 interface with an RS-449 port, with a layer 2 interface, HDCC kind of interface. So we –

Pelkey: Now, what was your reaction at the show?

Miller: Oh, that show was euphoric. Unbelievable show. There was us, little us, you know, with only – I mean they were all billion dollar plus companies and there was a big press conference and all this shit. The first hoopla about MAP. So, that was – we were on top of the world.

Pelkey: All kinds of press. Everybody was looking to you.

Miller: We did another round of financing that summer. Raised $7 million.

Pelkey: After the show?

Miller: It didn't close till after the show. One of the potential investors was at the press conference and he signed up for more after the press conference.

Pelkey: And who came in in that round.

Miller: It was managed by Hambrecht and Quist. So I did a road show and everything else.

Pelkey: So you used them as an agent.

Miller: Used them as an agent. It was a whole bunch of people. Very widely dispersed.

Pelkey: So you were just – at that point in time, how much of your time – your mental time was being devoted to modems.

Miller: Virtually zero.

Pelkey: Zero. But you had launched your 22 BIS auto-dial product, and that business was taking off and it looked pretty good, and here now the future was coming into focus.

Miller: Right.

Tape side ends.

Pelkey: So when you left that show, did you strike any deals with these people?

Miller: Oh, yeah. Allen Bradley became on OEM.

Pelkey: Ok.

Miller: We talked a lot with IBM but we never won them. DEC became an OEM. We were talking with all of them.

Pelkey: Did the group of you have a party at the end of the show or something.

Miller: Oh, well we had an atmosphere of every Friday we had beers anyway in the company, so it was a very open atmosphere.

Pelkey: What happened when the group of you returned from the show?

Miller: Oh, everybody was on cloud nine in those days anyway.

Pelkey: Now how many employees did you have at this point?

Miller: Oh, Jesus, I'm not sure.

Pelkey: Roughly. A couple hundred?

Miller: No, no, not that many. It was 75 maybe?

Pelkey: So that beer party that Friday after you came back – did you have a company meeting or something when you got back to report all of it?

Miller: Oh, sure, yeah. It was always very open communications anyway and it was good stuff. So and we raised $7 million as I say.

Pelkey: Had a nice high valuation?

Miller: Yeah it was $34 million valuation.

Pelkey: Ooh! The public market at that point in time was starting to. –

Miller: Well, H&Q wanted us to go public at the time.

Pelkey: Well why didn't you?

Miller: I said: "Geez, you know, LAN really isn't launched. You know, I think we really ought to get our act together and have both sides of the business humming." I mean, you go to do a public offering and that can be very diverting. So, I mean, I went on the road. It was similar – the guy was telling me it was very similar to a public offering. Went on a road show. Went to Europe. Went to a whole bunch of cities.

Pelkey: And you were doing this at the same time, trying to pull together this NCC demo –

Miller: Yeah, well, NCC demo.

Pelkey: Excuse me, NCC demo.

Miller: Well, Ross was running that. Ross Seider was pulling that together.

Pelkey: But that was so critical. You were probably on it every day with questions; how is it going and –

Miller: Yeah, so I was on the road shows in June. NCC in July, I think that was it. I was on – I was Gonzo for a good portion of my time in June.

Pelkey: But what timing? You got all these investors and then have this real success at NCC, fortunately, I mean, you must have needed the money anyway.

Miller: Well it was originally going to be five million, but we ended up seven. Well, fall of '84 some bad things started to happen. There had been all these rumors that Rockwell was going to come out with BIS chips and flood the market with new entrants, and there was in fact at Comdex of the fall of '84 a flood of announcements. And up to that point, there had been a couple new entrants in the 2400 area. In fact the one we worried like hell about was Micom, cause Micom had distribution and everything else, but they totally screwed that up.

Pelkey: Why:

Miller: It was mismanaged. Mismanagement. But they had a low cost design.

Pelkey: That makes sense.

Miller: I've heard stories afterwards that engineering was totally screwed, totally screwed up.

Pelkey: But they had a product.

Miller: They had a product, but it didn't have the features that people wanted. I don't know how it got totally screwed up. You know, officially Micom said to the press: "Well, we're getting out of the modem business cause it's dying," and that's a bunch of horseshit. They just totally screwed up.

Pelkey: Now Steve Frankel was there at that point, right?

Miller: Yeah. I don't know what his –

Pelkey: Now, in September of '84, what were your revenues?

Miller: On – in fact – '84, that's when we did $15 million.

Pelkey: Oh, excuse me, $15 million. What was in the plan?

Miller: $12 million was planned. So then things started to go sour in the fall. A flood of entrants came in. People started panicking, you know prices started dropping. Even though Rockwell had so many bugs in their chips they couldn't really deliver. Now we had talked about having a new generation 2400, get the cost down and add features and so forth, but there weren't enough resources in modem engineering. It was sort of getting sucked up in LAN.

Pelkey: What was the price of your 22 BIS modem at this point in time?

Miller: End user $995, something like that.

Pelkey: And what were new products being introduced at, $595?

Miller: They were coming out – no, not that low. They were, it was somewhat under – the point was that we were not the only guys in town. And some big players, Hayes I think, announced a 2400. And some others. We'd been also beat on the head to do error correction, so we added in a third board to do error correction instead of –

Pelkey: Software?

Miller: Well, we had to add a features processor. We didn't have the architecture in the original design to be able to do it, so we added a third board. And – which was not a cheap solution. So anyway, the modem side just became somewhat less profitable, but the company as a whole started to become unprofitable, and in the spring of '85, we were looking to get the first big MAP contract.

Pelkey: General Motors?

Miller: General Motors.

Pelkey: You were almost a shoo-in for that?

Miller: Yeah, their truck and bus.

Pelkey: You were the leader in token bus.

Miller: And when INI got that, oh there was so much gloom.

Pelkey: Oh, I remember that. You could hear the shiver out in the world. INI?

Miller: Well, that happened in '84, right – this was interesting too. June of '84, and the two or three months ahead of that, we had been talking to one of our potential OEMs, GE. We even had a letter of intent from GE. And then all of a sudden they went quiet in June. Well, I had dinner with Jim Jordan when I was out there. I was talking about that. He said: "Yeah, we put that together. Started in June, took only four months," so they must have finished their proposal in June –

Pelkey: Right when you had you had a letter of intent?

Miller: Right when we had a letter of intent.

Pelkey: Ooh! Oh.

Miller: I had been down to Charlottesville a number of times.

Pelkey: But they just went quiet on you.

Miller: Just like that. We said: "What the hell's going on here"" They say: "I dunno," then we find out INI the joint venture with GE –

Pelkey: When was that announced"

Miller: It must have been the summer –

Pelkey: Of '85?

Miller: No, no. It was right after – no, no. It was probably the fall of '84

Pelkey: Fall of '84.

Miller: You know, we just thought, hey they went away as an OEM, but we were getting pursued by Allen Bradley, I mean, oh I don't give a shit about GE. Maybe that's a better thing because Allen Bradley is a bigger player in this business.

Pelkey: Right. So you rationalized this INI thing?

Miller: No, we didn't know about INI then until the fall, see, but when GE went away, we said -

Pelkey: That's right, you got all these other.

Miller: We've got all these, I mean, we got Allen Bradley.

Pelkey: And other OEM's?

Miller: Yeah, right. So then INI was announced, Ok, they got a lot of money but, holy shit, we've been working on this GM contract forever.

Pelkey: We just had this successful spring show and everybody loved our products and –

Miller: Yeah, the summer show. Well one other bad thing we did, our rationale – our RF modem, the first RF modem we had done, and it had already been in place before GM came to us, was five megabits. It took one TV channel and five megabits. Well GM said: "Hey, we want our standard to be 10." Change the speed to 10." Well Jesus Christ, that's not so easy, you know.

Pelkey: Yeah, that was a hard technology.

Miller: Yeah, so we took – kind of rationalized with it. Look, you're better off with six channels. You can make an argument you're better off with six 5 megabit channels than you are with three 10 megabit channels.

Pelkey: Right.

Miller: GM wouldn't buy it. Apparently they came up –oh, I know what it was, the rationale for 10 was: all the traffic they could think of it ended up at about one channel, so therefore for safety reasons we should go an order of magnitude higher.

Pelkey: How much was it influenced by Ethernet at this point?

Miller: Oh, it probably was, partially that too.

Pelkey: Ethernet was starting talking 10, right?

Miller: Yeah, it was 10, but that's bullshit. What's their throughput, you know. It was a little tougher sell.

Pelkey: Right, right, right.

Miller: So GM was beating us up then about you got five, you got to go to 10, you're not listening!

Pelkey: Now these conversations were in the fall, after INI?

Miller: Yeah, well they kept – they were beating us up that the next rev. of MAP was going to specify 10, and I probably didn't do enough selling with – well Kaminsky was impossible anyway. He was very opinionated. He was the guy in MAP, the MAP guru at GM, at the tech center. We used to call him "Little Napoleon." He was about 5 ft. 1. I always worry about a little short guy who has got –

Pelkey: This experience hasn't helped that prototype – that model.

Miller: So, truck and bus came. We said: "Oh, hey, we're going to win this thing. No way INI can win it because they don't have a product."

Pelkey: Right.

Miller: They won it. Oh, there was shock.

Pelkey: That was in the spring of '85?

Miller: Spring of '85. Oh my God.

Pelkey: What happened? Do you remember how did you hear about it? Did GM call you?

Miller: Oh, they had teams come and – oh, I mean, it was a whole big thing. I said –

Pelkey: You thought you were going to win it right up till the last minute –

Miller: Thought we were going to win it, yeah.

Pelkey: And did you comply with 10 megabits at this point?

Miller: How the hell – no, no, we specified five. We had a conservative approach. We'll have a migration path to get you to 10. But we said: "Hey, no way they can go with INI. They're not going to make it."

Pelkey: Do you get any signals before you found out that it wasn't you?

Miller: In retrospect, we probably did, but we didn't, you know –

Pelkey: Pay attention to them.

Miller: Didn't believe it. Couldn't believe it! Just couldn't believe it.

Pelkey: So, how did you hear?

Miller: Well, we heard from GM, sure.

Pelkey: So they called you and said they picked INI?

Miller: Well, it was EDS. It got all complicated then because EDS was in the fray. So part of the problem was EDS. UB and GE said they'd stand behind it. Yeah, we'll solve your networking problems, yea.

Pelkey: We'll make it right.

Miller: Yea, that was part of the problem. So I said: "Oh, shit."

Pelkey: What were the couple hours after hearing that decision like?

Miller: Oh, it was terrible gloom.

Pelkey: That must have been miserable.

Miller: Yeah.

Pelkey: Did you go walk around the building or –

Miller: I don't remember, but it was awful.

Pelkey: Bad!

Miller: Just bad. At the same time, spring of '85, Rockwell finally got their shit together and there were companies starting to ship 2400s.

Pelkey: So here you are having now fallen behind the power curve a little bit on the LAN, and the 2400 is now a real competitive market, and you don't have the right product.

Miller: And also INI had so much money. They were throwing money around like crazy. They were – Schoendorf was in all these articles. You know: "This is my LSI chip for MAP" And I said: "Oh my God," and they were putting salesmen in the field like it as going out of style, and then we were at a loss position. I had been beat up. You don't have enough marketing. It's not right. We hired a marketing guy and he turned out to be a disaster. There was – so there were some management problems unraveling at the same time.

Pelkey: Yeah, partly because things weren't working out, things were starting to get tense. Trouble and stress and –

Miller: Yeah, right, so – and the other problem was is that if you look at it, even though that wasn't our original intent, the LAN business became not a data com business. It was a factory automation business. By that time Ethernet had won the marketing war. Token bus was viewed as a factory LAN and so –

Pelkey: That was very different from your modem business, the data com business.

Miller: I mean already we knew – even from the beginning we thought it was going to be different in the sense that it's going to be a systems oriented business versus a box level business. Well, the fact of the matter is, it not only became a systems business, it became a factory automation business.

Pelkey: I'm not sure what you mean – interfacing all these different kinds of equipment and software?

Miller: You sold to the factory manager. You don't sell to any data com guy.

Pelkey: Oh, ok.

Miller: I mean, it's a data com product, but it's not sold to any data com market.

Pelkey: This must have been a pretty exciting period in your life?

Miller: Oh, shit. (Laughter.) Yeah that's when it was unraveling a bit. So I was under real pressure. We came to the conclusion, and I'm not even sure when we came to it, that we should split the company. I mean, you know, we were looking for – oh, oh, the first thing we said: "Oh, we'll go for a corporate partner."

Pelkey: Right. To bring credibility to you?

Miller: This was '85. Ok, that was the first – after we lost truck and bus.

Pelkey: After INI – after you lost GM, you go for a corporate partner on the LAN side.

Miller: Now, we were still selling. We had gotten Honeywell as an OEM. We still – we were still selling LAN stuff.

Pelkey: Right.

Miller: I mean the stakes got higher. The ratchet had gone up a couple of notches because now we have – now we have this well funded guy out there throwing money at the problem, got a big company – got two big companies, Ungermann-Bass was no small company then, you know even then, and GE was also behind them. All these bucks to spend. And hey, we'd spent net $10 million bucks on that, at that time. But we still had a good reputation. We still – I mean, it wasn't a total disaster. I mean, we're not out of the market. So it was us and one other big player. And then we always – if anybody was sophisticated enough to measure performance, we always won with INI. And INI was out making promises like crazy, while at that time you couldn't see whether they could deliver or not.

Pelkey: So they just stalled purchasing?

Miller: Oh, it was just, it was a mess.

Pelkey: They did an IBM on you.

Miller: To some extent. And at the same time, the modem business was historically horrendously profitable. You know, it became less so, it was more competitive, but at the time we also had all our financials combined together, so it was hard to determine what the hell was going on. So anyway, we decided we wanted a corporate partner. That was the thing to do. So Gould had been after us anyway. So we had some very strong discussions with Gould. In fact, we got an offer on the table for a minority investment, but the problem is it was like taking you over without taking you over. Betwixt and between is no good. Plus I didn't trust them worth a –

Pelkey: Yeah.

Miller: He was a real – and in retrospect that would have been no good. Then we also had very heavy discussions.

Pelkey: It would have been no good?

Miller: It would have been terrible. It wouldn't have been good.

Pelkey: Right

Miller: And then we had heavy discussion with Allen-Bradley and Rockwell had just taken over Allen-Bradley at the time. I mean, Allen Bradley was an OEM and it made a lot of sense. And at the last

minute, they said: "Well, we've decided, no we're not going to pursue this anymore," and they ended up taking over IS from 3M. And the problem was that –

Pelkey: And this is '85?

Miller: August of '85.

Pelkey: You must have felt at that point like you were jinxed.

Miller: Well, you know what the problem was, and right after that is when we started thinking about we should split it up. Both Gould and Allen Bradley said this modem business, we're not interested in this modem business. You know, the financials are going to shit, so they got scared off. And so we talked with a bunch of others too, we knew that MAP was being talked about as this fantastic market, it's going crazy, so we had a lot of people courting us. So pretty much after that we decided we've got to split. Let's go after – let's go get new management for the LAN side. So Andy McLane and I recruited Tony Helies to be president of CCI and he came on board in December of '85. And we also made the decision, hey I'd be best – I was pretty burnt out probably by then too.

Pelkey: Yeah, you must have been.

Miller: Hey, my strength wasn't operations anyway, so we made a decision to find – well we got a guy who has a friend of TA's to come in and be here two or three days a week to help in the operations of the modem side. And, Jim Rothrock came on board full time actually in the marketing side too. And we made the decision to split. We went out raising money for the LAN side alone. Financed it separately. And we got the money in May or June – June I think of '86. We raised $7 million.

Pelkey: So there were separate companies?

Miller: No, we hadn't -- we had to separate them at the time of the financing. If we split them before, the LAN side would go bankrupt.

Pelkey: Ok.

Miller: So we waited – and actually it bled the modem side. It was awful. So we couldn't hire people and, oh it was awful. And there was also a big rivalry in the company. Big jealousy in the modem people: "Oh, these fucking guys have been a bunch of prima donnas." So we split and now we're – to a sense, we're still turning around the modem side.

Pelkey: Now, the 9600. So you went from that point in time about the end of '85?

Miller: Oh, ok, then we – yeah, we were the first to introduce V-32. Same guy who did the 2400 did the first V-32. Then there was another guy underneath him who actually did far end echo.

Pelkey: When did that happen?

Miller: That was January of '86. But the problem was, it wasn't a good marketing job because it wasn't a good marketing introduction.

Pelkey: Why didn't you learn that lesson? Lack of resources? Lack of funds?

Miller: Marketing staff at the time was terrible.

Pelkey: Didn't you know that?

Miller: Ah, we couldn't – so many things going on at the time. I always seemed to have trouble finding marketing people for modems because LAN had too much glamour.

Pelkey: Ok. So now you have –

Miller: Two companies.

Pelkey: And Concord Data's future is the 32 BIS?

Miller: V-32.

Pelkey: V-32?

Miller: V-32 and we're going to change my role to get the strategy and future directions for CDS straightened out, and I think we've done a lot of work in that area. On the LAN side, it was pretty straight forward, but it had to happen over in LAN, because in the LAN area, MAP stalled.

Pelkey: If this ENE doesn't come off successfully or as much as possible -

Miller: Is that right? I think it's going to happen, but it's going to be longer than you expect. And meanwhile, CCI got a lot of money, and they've got their running in a relatively flat rate. The good news is INI is falling apart.

Pelkey: Right. It sure is.

Miller: So, we're taking their customers left and right away from INI.

Pelkey: Let me – when did – a couple of general –

Miller: So that's an interesting story?

Pelkey: Fantastic story. Some of the things that come out are obviously mental sets that you had. You're the dominant person, in terms of looking at things from the modem perspective and obviously the concept of the short-term modem and the long term LAN, the need for the big corporate partner. I mean there were certain kinds of mental –

Miller: Well, people got pushed – I mean, the corporate partner idea, I didn't come up with that idea that sort of got pushed on me by Andy. So I pursued it, and it made some sense at the time, especially since we got the shit kicked out of us by INI, so the corporate partner was for LAN, it wasn't for modems. And they got scared off because the financials started looking crappy. And what it really – if you really examined the financials, it – at the time it meant that the modem side was becoming less profitable.

Pelkey: Right.

Miller: I mean it could not stay obscenely – I mean we were like making, if it was only the modem side, we were like making 30%+ pre-tax. You know, it was really absurd; absurdly profitable.

Pelkey: Right. You did something that interests me in that most of the other companies didn't make that investment in that next technology, the next market. The modem guys stayed modem guys and they kind of wandered around that, but they didn't get into it, the next big products. I mean, if you look at data com companies, you're an exception. Timeplex was going into T1 out of the stat mux, which caused them to become a much bigger – but every other instance you can think of, it was a new start-up that went to market. What did you learn – was it just bad fortune because you bid token bus and INI?

Miller: In retrospect, I was probably too much the technologist. What I should have done, I should have gone: "Stop fighting the tide here, you know, if DEC, Intel and Xerox are behind it, it's good and come out with Ethernet products." That's one thing I learned. We were too much the pioneers, and I've got arrows in my back to prove it. That's a marketing issue and that's really – that's really something I wasn't at the time. I was a technologist.

Pelkey: Right, so if you had maybe gone Ethernet, if you had gone modems and Ethernet, things might have been different.

Miller: Absolutely. I mean what we probably would have done then is said: "Hey, token bus is great backbone. Let's have a combined product." As a matter of fact, I've heard a number of people after that – Sytek's a new announcement, they have token bus backbone for example. Token bus is a great backbone. It can run 25 miles, token bus and then have Ethernet subnets –

Pelkey: Right, on the backbone.

Miller: Or StarLAN, even.

Pelkey: But you – it was technological elegance that drove you towards token bus -- plus Ethernet wasn't really a modem type technology, it was a different kind of a technology as well.

Miller: Yeah well, token bus isn't – I mean, it's a combined technology. There's a modem – an RF modem that goes on it, but there's also a lot of protocol shit.

Pelkey: Right but it was closer to home than Ethernet, where there is no modem technology, right?

Miller: Well, no the Ethernet modem is called –

Pelkey: The transceiver?

Miller: The transceiver is a modem. Baseband modem.

Pelkey: Ok, but that wasn't RF technology, per say–

Miller: It's not, yeah, it's easier than RF, but it is sort of RF technology.

Pelkey: Why do you think these data com companies didn't make the next jump to new technology?

Miller: What, the people at Codex and Milgo and so forth? Paradyne?

Pelkey: Even Micom, any of them. Timeplex with T1 is the only example I can think of where somebody did it.

Miller: Yeah. Well, no GDC did it first and then lost their lead. They were the first one out with T1.

Pelkey: Yeah, excuse me, GDC did it.

Miller: They didn't execute very well.

Pelkey: They saw it, but they didn't execute. So in terms, I guess it's more appropriate – they saw it, they acted and they didn't do it competently. Why didn't that happen?

Miller: I think a lot of it is that modems were so profitable.

Pelkey: Why? Why didn't they make enough money?

Miller: Yeah, I mean even today Milgo, Paradyne, Codex, 70% of their business is modems. And the one who has done the best job has been Codex. They're growing because they are taking market share from Milgo and Paradyne is declining in size, I think. You believe that too?

Pelkey: Absolutely.

Miller: Codex isn't. They're the only one of the original three high-speed modem companies from the '70s. It used to be just Milgo and Codex. Paradyne was the upstart for a while and then they were the darlings.

Pelkey: They were the first ones to OEM?

Miller: Yeah. And Micom was always the box guy, the distribution guy, and the trouble with Micom was that it became too box oriented, they had this wide range of products that didn't fit together very well.

Pelkey: They never had network management systems?

Miller: So there were different reasons. I think, and in some respects, you could say there weren't that many players in data com. There really were only a handful of players and I mean none of them picked up on what personal computers were doing to the marketplace. It was only Hayes. I remember hearing about Hayes in about 1980. I said" "Who are these guys?"

Pelkey: None of you saw Hayes doing auto-dial and software on the PC –

Miller: Right. That was totally new.

Pelkey: It was the right solution.

Miller: See, because what happened is the guys who should have picked up on that should have been Vadic and UDS, because Vadic and UDS were the two big dial players.

Pelkey: Right.

Miller: And Codex, Milgo and Paradyne were the big leased line modem players. And Infotron and Timeplex were the two big Mux players. And Codex got into that too. And Milgo used to OEM Timeplex -- Timeplex Muxes. There was one year Timeplex had a terrible year, when Milgo pulled the plug and decided to build their own. Timeplex didn't have any distribution. So they had a terrible year one year.

Pelkey: And GDC and Gandalf were not –

Miller: And GDC had a wide range of products. They targeted the RBOCs.

Pelkey: They went along with RBOCs. So you had Codex doing direct sales. Big corporations. Big Blue shops.

Miller: Right.

Pelkey: Paradyne was kind of OEM and Racal-Milgo was rep organizations.

Miller: Yea, but Milgo was the biggest competitor for Codex. And Paradyne was the upstart. They started selling end-user too. But they were not in the PC environment at all. It was not async in general. Big networks.

Pelkey: When did Motorola buy Codex?

Miller: It was about ’77, ’78.

Pelkey: And do you recall why? That was before you left.

Miller: Yeah.

Pelkey: After it became part of Motorola did it change much?

Miller: It didn’t change much. No.

Pelkey: So they kind of left you alone.

Miller: That was a pretty benign acquisition, actually.

Pelkey: When did UDS get acquired?

Miller: Just shortly thereafter.

Pelkey: And was there much interaction between UDS and Motorola while you were still there?

Miller: You mean UDS and Codex?

Pelkey: Oh yeah,

Miller: Oh, yeah, there was a lot of fighting between the two. It was like this. It still is. Vadic and Milgo are the same way.

Pelkey: Right, yes it is.

Tape Side 4 Ends

Miller: I think I know why they missed personal computers; maybe because Vadic and UDS were not used to talking protocols. That was totally foreign. I mean; they were modem people. Modulation people. And they didn’t know shit about PCs and protocols or anything else like that.

Pelkey: Right.

Miller: Even today, UDS is not very good in protocols. UDS in the dial-modem area has been predominantly in synchronous dial, 208s and they’re not much of a player at 2400. They don’t have much market share at all in 2400.

Pelkey: Was Bell Labs a place where the modem guys went and stole engineering talent?

Miller: Maybe to some extent. AT&T was a player, but they were the most expensive and not really – I mean they were the ones –

Pelkey: Now the 212?

Miller: The 212 was their big winner.

Pelkey: But that was the last hurrah, too.

Miller: Yeah, it was kind of a last hurrah, but they’re still selling product now. They have a V-32.

Pelkey: Right, they do, but they’re not a factor in the marketplace.

Miller: No, we don't see them very often. We see them once in a while, really when the customer demands service or something.

Pelkey: Do you remember what happened with Western Union?

Miller: Well, Western Union is –

Pelkey: Halcyon right?

Miller: I don't really know much about what happened. I remember doing a job for Western Union when I was at Codex, which as a group band modem. But even back then, they were declining, becoming extinct. They're just somebody who hung on to telex and is –

Pelkey: Who else were the high-end modem guys in the '70s that people were concerned about or, in terms of Codex even by the time you left, had the players been set?

Miller: The players had been set. We (Concord Data Systems) were the first guys in the modem business to come out of left field.

Pelkey: Right. So there's you and then came Hayes?

Miller: No, Hayes came at the same time, actually. Hayes didn't really have a very good 212, it wasn't even fully 212 compatible. It was a piece of shit.

Pelkey: But it didn't matter.

Miller: It didn't matter. They didn't know any better and –

Pelkey: PC guys just needed a modem.

Miller: I mean it was a reliable product, but it didn't work worth a shit.

Pelkey: And then another entrant was Microcom .

Miller: Microcom, interestingly enough, didn't start out in the modem business.

Pelkey: Right it started the protocol.

Miller: It started out as an electronic mail software package for the PC business. That's where MNP came from. Jim Dow came to us about 1982 looking for a modem. Dow and his software guy named [Ed] Belove. Belove is now the software VP at Lotus. He was a Microcom founder.

Pelkey: Ok. And then there was -- I suppose at some level after Hayes --

Miller: Well, then there's another player, Octocom. You don't see them in the U.S., but they sort of followed our philosophy and have taken some market share away from us internationally. They targeted the international market first.

Pelkey: So I guess the next modem company to come on the scene was Telebit?

Miller: Yeah, but you can think about a whole bunch of them. Telebit was one, but US Robotics and Ventel and Datarace. There's a shit load of them.

Pelkey: At 9600.

Miller: Well, they're all different speeds, you know. Omnitel.

Pelkey: Almost all the strategies of all these companies are just lower cost.

Miller: I mean they're in different channels. The point of the matter is that dial modems are booming.

Pelkey: Why?

Miller: Why? Because the dial network is ubiquitous. Proliferation of PCs means that you can do local computing and you want to transfer files on a bursty basis, on a batch basis but when you transfer, you want to do it fast, so technology has allowed that to happen. And there's elasticity in the marketplace so when the prices come down, that makes it boom.

Pelkey: You mentioned earlier the issue of the fast train. Would you go back, I just want to make sure I understand that. It seems to me in terms of how the market was to evolve, in terms of network management and so on, that that was an important concept.

Miller: That was.

Pelkey: So the host was sending out a synchronization signal?

Miller: No, no, what happens is that – maybe I ought to draw. I'll draw a picture. (Drawing) You have a master site here. And there'd be these drops, and all the lines, leased lines are four wire, you know what that means/

Pelkey: Right.

Miller: So all the receivers are connected to this guy's transmitter. Here's the front end, right. Now here there's some kind of terminal device. Usually it's a cluster controller, actually, which is IBM. So it polls these. There's an address in the protocol, so synchronous modems are always dumb in this from a protocol sense. They are transparent. If you wanted to do any protocol kinds of things synchronously, it's a bitch. Bysync is a bitch. Ok, so it's synchronous, and you want the transmission device to be transparent. So there's a message. Back then it was a bisync message, now it can be SDLC, a kind of SNA type message. And it addresses this guy here. And basically it says: "Have you got anything to report?"

Pelkey: Yeah.

Miller: And it then sends it back – it turns this guy's transmitter on. It's normally off. And that has to come back before this guy's receiver –

Pelkey: Before he can do anything else.

Miller: Right, and it basically says: "I have nothing to report," or: "Gee. I've got all this data and here it is," kind of thing. And then he shuts up.

Pelkey: Ok.

Miller: Then this guys – this guy is constant carrier, so there's always a signal going outbound. So then it sends the next message with the next address, which might be this guy, and it says: "Have you got anything to report #2?" And he says: "No I don't," or "yes I do," and he has to turn his transmitter on, but when you send a transmitter on he has to send a synchronizing signal. It's called training. If you have an adaptive equalizer, what an adaptive equalizer is is an adaptive filter, which essentially is used to compensate for the linear distortions in the telephone line. In other words, you might have a filter that has an amplitude at – I don't know, crazy, and certain delay distortion, and it compensates for that in the

adaptive equalizer. So it has to do what's called "training," and training means you're training the receiver to whatever that line is.

Pelkey: Gotcha.

Miller: And it has to adapt to whatever that is. So that's adaptive equalization. And fast train means that it's very fast to synchronize, because if he says: "I don't have anything to report," that's a very short message, and it could be if the training is too long, most of the time is spent in training, and it's not very efficient. So you want that training to be short as possible. Now with 201s, which are 2400, there's no adaptive equalizer in general, because the training time was 8 milliseconds. Fast train 4800's are sort of the barrier where you have to put an adaptive equalizer in.

Pelkey: Because of speed?

Miller: Because of the speed and the points are closer together. The initial one was 50 milliseconds. But then the Codex innovative thing was you start out at 2400 8 milliseconds. After 64 bits at 2400, it gear shifts up to 4800.

Pelkey: Ok. And this rode on the back of the IBM bisynchronous protocol?

Miller: Bisync, and then when they came out with SDLC, they had multi-drop SDLC, and this kind of a configuration is extremely strong in banking and insurance, all those kinds of Big Blue shops – and airlines. All of the airline reservation systems are like this.

Pelkey: Right. Now before bisynchronous could you have done this?

Miller: You could – they did it with 202s async – like some ATM networks – like this thing I did for Datatrol back in 1980 was async, but most of it was at least bisynch. Bisync came in in the late '60s.

Pelkey: Ok, so it really came –

Miller: Then it came in multi-drop. It didn't really get popular till about '75.

Pelkey: Now where did these modems in those early seventies go? Didn't most of them go to IBM shops?

Miller: Yeah.

Pelkey: Was timesharing a factor?

Miller: Well there were two – there still was leased line and dial. Timesharing was dial, and so that was one alternative. That was low-end stuff. It was 300, and then Vadic made their market, 1200 baud, with their 3400 product. But before it was all 300.

Pelkey: And Codex and Milgo sold into the IBM –

Miller: They didn't do dial at all.

Pelkey: Right, so timesharing was a dial-up phenomenon. Then IBM was a leased line business.

Miller: Yes.

Pelkey: And leased line was starting to – what caused this market to take off was really these kind of –

Miller: No, no. It wasn't just that. There was a real need for high-speed communications in general. It wasn't – this became an economic benefit because multi-drop lines became available from the phone company. Before you did this, you just did this with – instead of having a bunch of – right, a bunch of point-to-point links.

Pelkey: How much of this protocol configuration was a function of the IBM in their early days made their terminal off the Selectric, where if you had to have – you send a whole bunch of stuff at one time, I guess it was. They put intelligence at the terminal, as opposed to async because the teletype terminal was kind of, you know (unintelligible) -- you knew it was right because it had the error correcting in, it was – it wasn't as sophisticated, but you knew it worked. Whereas IBM had a different approach to terminal design, right?

Miller: Yeah, well the IBM protocols were inherently well error protected. Bisync has – it's an ARQ error protection scheme.

Pelkey: Was that a function of the way they did their terminals?

Miller: No, that's the protocol. You know how MNP is a protocol that's async –

Pelkey: Where did the protocol come from?

Miller: IBM invented it.

Pelkey: Yeah, but why did they invent that kind of protocol versus another kind?

Miller: They developed it. I don't know. I mean they – SDLC then became a more advanced version that – well it was a totally different design.

Pelkey: Ok. So but Bell Labs with their applied mathematicians and so on, that was kind of the coupe de – where the resident (unintelligible)

Miller: Well, the original. Yeah, right. The original modems actually were AT&T modems. See, back in the '60s there were modems. They were not any standard ones. They were proprietary ones. In my early days at Codex, we did a big job for – matter of fact, General [Johnny] Johnson was a pioneer. I think he bought the first AE96s, the first 9600s from Codex, when he was with DCA, the Defense Communications Agency.

Pelkey: Did this concept of – someone told me that the modem business, the commercial modem business couldn't take off until you had the low cost operational amps [op amps]. That was kind of a chip right?

Miller: Yeah, yeah. Early '70s.

Pelkey: But then the people went and they didn't know how to design circuits. The modem guys didn't know how to design circuits, really. That technology, that know-how sat within Bell Labs or GT Lenkurt in terms of where Bingham –

Miller: Yeah, Lenkurt did the data modem. Yea, but Codex had it too.

Pelkey: Cause they had been building these kind of (unintelligible) modems for –

Miller: I came in as an analog designer, so I did op amp circuits and active filters and all that rap, back in the early '70s, but the guy – I mean the equalizer was all digital. Some of the other people did it analog, but Codex was a pioneer in doing it all digital. All TTL.

Pelkey: And that was Forney?

Miller: As a matter of fact the claim was that Forney was a PhD out of MIT, had never done any designing in his life. He picked up a TTTL book, did a paper, a design, gave it to another guy and put it together and it worked. It was unbelievable. He's a very bright guy.

Pelkey: (Laughter.) That's a great story.

Miller: Never seen – never designed in his life. And it's true. I mean, came out of MIT, PhD –

Pelkey: During these years, for you and the people in the modem business and so on, were there big events that took place where you would get together, were there watershed events that you remember like trade shows or –

Miller: Back then I didn't really go to trade shows. I was an engineer stuck in the back room kind of thing.

Pelkey: What happened when you started Concord, did you – were there things where –

Miller: Well, we were the first ones. I'll tell you an interesting story. One of our big customers over the years has been Ford, for 2400, and there was a case where we beat out Vadic because Vadic announced a product in June of '82 and couldn't – their biggest distributor sold 2400 to Ford and they couldn't deliver. So we showed up on the doorstep. We can deliver, put it in, the works. They've been a big customer ever since.

Pelkey: As an engineer or as, after Concord, an executive Arpanet, did any of that ever come into your consciousness?

Miller: Well, no, we sell a lot to data networks, X-25, I mean like Tymnet, is one of our biggest customers.

Pelkey: But what they were doing, none of that seemed to matter much in those days.

Miller: No, it didn't matter, except that there's dial-up access to them.

Pelkey: Right.

Miller: So that's big –

Pelkey: So the stuff that, the technology and so on that came out of –

Miller: Packet switching –

Pelkey: Packet switching and network designs and TCP/IP came out of that. OSI came –

Miller: Well, I mean I got involved with that because we ended doing OSI ourselves, not knowing what we're getting into, probably.

Pelkey: What do you think is going to happen know? When you look back on this industry, what are some of the things that came out in your mind, in terms of why did it develop the way it did?

Miller: I can say, well in the modem business, there were a lot of missed opportunities. I mean, we could have promoted what we did for error protection like MNP did. I mean, Dow did a super job in promoting. He's a real marketer. And our lack was marketing. Now, part of that was my problem and part of it was

because I don't really – I had not in the past had a good – I had never seen good marketing. Codex didn't have good marketing. To this day I don't think they have good marketing.

Pelkey: But marketing, now we really mean marketing stagiest.

Miller: Strategist and –

Pelkey: Not a marketing communications sort of person, it was more a strategist sort of person.

Miller: Well, not only strategist, but you know, understanding channels and understand of distribution and understanding the selling points.

Pelkey: But the channels are always a problem in this market.

Miller And they're very dynamic. I mean they're changing all –

Pelkey: All the time, and then you had Gandalf, the mail orders and –

Miller: But you have to have somebody understanding all of that or tracking it and figuring out what is the – how do we – what do we do here? And our early guy who was doing that kind of stuff was doing – was in charge of the modem side was more of a sales guy. He was not a strategist.

Pelkey: Do you remember the orange juice can ad of Micom? Did that stand out to you at the time?

Miller: It was stupid, I thought.

Pelkey: Looking back now do you think it was stupid?

Miller: Well, it got attention, so maybe that's the main thing.

Pelkey: Who did you think, as individuals, were influential or important in this industry?

Miller: Over the years? Oh there are a number of them.

Pelkey: Whom would you cite?

Miller: I mean, Carr is certainly a big one, which is – I think Carr, Forney, from a technology point of view, Roger Evans and Norred at Micom were early pioneers. Botwinick, Timeplex, Milgo, what – Matt Kenney. He wasn't president then, but he –

Pelkey: Mr. Salesman.

Miller: Yea, right with the Sherry, holy Christ. Did you ever see that, the girl that – the show. Oh, she's awful. They have this girl, Sherry that's, that was a sort of the trademark of Milgo. She'd be at the show shouting and everybody thought Sherry was wonderful. She was the spokesman for them. She was a loud mouth, I thought.

Pelkey: Attractive loud mouth?

Miller: Not bad, but –

Pelkey: Just a loud mouth.

Miller: Ah, awful. That was – it was always different than Codex, the reputation was Milgo was the flash and Codex was the solid engineering company.

Pelkey: Right.

Miller: And I mean I didn't know – I met Wiggins once. I didn't really know Wiggins, but certainly Wiggins was, had an influence. Kim Maxwell at Vadic. Dennis Hayes, I mean he made a big mark. George Grumbles at UDS. I got to say Dow.

Pelkey: This had been very helpful. You've answered all the questions I had. I think we've covered kind of everything.

Miller: I mean in the LAN business I'd say, Jesus there are a number of them. When did you guys invest in Proteon?

Pelkey: I don't think I have anything –

END OF INTERVIEW

