Interview of John Pugh

Interviewed by:
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Recorded: February 25, 1988
Canton, MA

CHM Reference number: X5671.2010

James Pelkey: It's February 25th, I'm with John Pugh at their beautiful offices in Canton Massachusetts, and thank you very much for your time. And as I indicated, I will transcribe this and get it back to you, and anything I attribute to you out of this tape that goes into the book, I'll send you a copy and make sure that I haven't misrepresented anything as well. I thank you very much for your time.

John Pugh: Good.

Pelkey: It's good to be here.

Pugh: Okay. I guess my first background with the intersection of computers and communications was way back in 1957, when, in the military, we were using a IBM 650 to determine which commands had which keys for crypto codes. And it was strictly a sorting job. And I think the militaries in the early days were some of the very early drivers in what we see today. For example, I worked with the Defense Communications Agency for four years and there we installed probably the first on-line, real-time database. And certainly it was the first one to try and use computers to keep track of the status of communications circuits worldwide.

Pelkey: And when was this?

Pugh: This was back in 1961.

Pelkey: Okay. And DCA had just been --

Pugh: DCA was only founded in '59.

Pelkey: Right, okay.

Pugh: And it was founded to try and solve the inter-agency communications problems.

Pelkey: Right.

Pugh: Each agency had its own network, and DCA came in and developed some common networks.

Pelkey: And it was around that time that you were there that each agency wanted to have its own communications network --

Pugh: Oh, yeah.

Pelkey: And they were kind of incompatible...

Pugh: Right. And DCA came in and built the first -- what was it called? It was called AUTODIN. AUTODIN was the first network. HARPO at that time wasn't even thought of. But AUTODIN was an automatic digital network, which was under the auspices of DCA. They also had AUTOVON that was Automatic Voice Network, worldwide voice network. And the section that I was in was the communications status and control, where we brought in the first application of computers to try and keep track of what was going on worldwide in the communications networks of the -- anything that served the Department of Defense. IBM got the contract.

Pelkey: Do you remember Paul Baran from those days?

Pugh: Paul Baran...No, was he a DCA?

Pelkey: Actually, he was a [unreadable]. He was on a [unreadable] that was looking at what these combination of the networks should be or what the networks should be, and...

Pugh: The first contract that DCA let went to System Development Corporation, SDC. System Development Corporation was the prime contractor for a worldwide single computer located down in Washington that took reports from all over the world. And they had big display boards that displayed the status, which in themselves was quite an accomplishment in those days.

Pelkey: Right.

Pugh: The computer contract went to Philco. It was a Philco 2000 computer that was at that time a very, very advanced computer: very powerful. Of course, they're out of business, like a lot of people now. And then the second round of effort was to try and decentralize -- put in area centers -- and IBM got the contract for that. And there were various centers set up in Colorado Springs, Hawaii, Europe and Alaska, where we put in IBM 1410s, which was a interim computer between the 1401 and before they came out with the 360 Series. We built communications links to allow the various computers to talk together, real-time databases, so they could update, and display boards that would display in real time. The real problem in those days was there was just not enough computing power. The 1410 just didn't -- the response time to was too slow. That's when I first got into the modem business, because you could not get modems that ran faster than 1200 bps.

Pelkey: And they were either from AT&T or from [unreadable]?

Pugh: Well, you could only have a modem that was supplied by AT&T, because they had end-to-end control, including the modem. The Government didn't have to follow those rules. So we got some 1200 bit modems that were made by Stelma.

Pelkey: S-t-e...

Pugh: S-t-e-l-m-a. Stelma was acquired by Data Products back maybe 15 years ago or something. But we get some Stelma modems, which were 1200 bit modems which was as fast as you could go --

Pelkey: They were synchronous.

Pugh: They were asynchronous modems.

Pelkey: Asynchronous.

Pugh: Yeah, asynchronous. And --

Pelkey: Full duplex or half duplex?

Pugh: They were full duplex.

Pelkey: Okay.

Pugh: Not error protected. Errors were a big problem because there weren't any protocols to protect against errors. We had to develop our own protocols. But the system went in, it worked -- I don't know what DCA has today, because I've lost track of them. But they obviously still have some kind of control system that... Today, if you look at the way the technology has grown, things that we all had to do manually in those days, such as measure the status of the line, determine when lines went out -- this can all be done automatically today and it is done automatically by the many little companies out there that have four or five lines and have control systems that tell them when the lines go out. The contract was about a $15 million contract in 1960. So it was big bucks. And most of it was oriented... Well, Stelma also built some automatic consoles that went out into the major stations to generate reports. Because formatting the reports was a major problem. A person actually assembled the reports -- they all had to be formatted just right, because when you came in, you had to know which fields to use. You didn't have the sophistication of databases and processing cards you have today. And so if the format was wrong, the

message got rejected. So we built small computers that were provided by Stelma and I think they cost about a quarter of a million dollars apiece. And the processing power on them was very, very limited. It certainly wasn't anything near what a minicomputer or PC does today.

Pelkey: Incredible.

Pugh: Well, enough of that.

Pelkey: Now, your background, then -- So you --

Pugh: I got out of the military.

Pelkey: So you had exposure to computers at this point.

Pugh: Oh yeah.

Pelkey: And programming concepts.

Pugh: Yeah. I was running the programming effort for the area centers. IBM was the main contractor, and we had some programmers that were government employees, and some programmers that were tech reps out of Philco, and then we had the IBM group, the Federal Systems Group out of Washington. And programming the area centers was my job.

Pelkey: Good.

Pugh: Of course, I didn't do programming, but as an Army officer, I was just a supervisor.

Pelkey: Okay. And then you left the military.

Pugh: Then I left the military and went to work for Computer Control Company. They were out in Framingham, Mass.

Pelkey: And this is what year?

Pugh: This was 1965.

Pelkey: Okay.

Pugh: They had just come out with a new 16-bit computer, and it was the world's first 16-bit machine. That's an interesting story in itself, but that's not the subject of your book. And they felt that one of the applications for that was in communications. And so I came in as Marketing Manager for Communications Applications. And we succeeded in selling the computer. The biggest sale that we had in communications was to General Electric for their timesharing network. They used our 16-bit computer as a concentrator/processor for their timesharing network. And, let's see, the other group that was a major user in communications was, uh... Keydata. Keydata's disappeared now. They were merged and combined to death and things, but they used it the same way.

Pelkey: Okay. So modem lines would come in to --

Pugh: Well, what would happen was all the nested modems would come into one hub, and then you'd go out, high speed. And you would do your echo back at the hub with the 116 and the 516 computers, the Honeywell machines -- Computer Control Company in those days, before we were bought by Honeywell -- they would do the communications processing and the error control and then send the data back on a single link, so it did what a simple digital multiplexer would do today.

Pelkey: Is that one of the first instances of that in commercial circles?

Pugh: As far as I know that was the first instance. DEC was also playing around with it, but DEC didn't have any contracts that I know of.

Pelkey: And they only had the PDP-8 then.

Pugh: They had the PDP-8, they had the PDP 9 which was the bigger machine. The 9 never made it. It had reliability problems, but the 9 was an 18 bit machine. The 8 was an eight bit machine.

Pelkey: The 10 was 16 bit.

Pugh: The PDP-10 was 36 bits.

Pelkey: It was 36 bits.

Pugh: Yeah, big word, the 10. Then 8 became the standard for a lot of reasons. One was the ASCII code came in about that time, the ASCII code was an 8 bit code. So processing 8 bits, particularly in communications, made sense.

Pelkey: Okay.

Pugh: And 8 became the standard, and of course, multiples of 8.

Pelkey: Do you know why ASCII was 8 bit?

Pugh: I was involved in the ASCII, in the standards committees at that time... Honeywell bought us in, and I represented the communications end on it, and it -- they just felt they needed 256 combinations. So the other codes at that time were the 5-bit Baudot code, which was way too short, because it could only represent 32 characters unless you used a shift character, and then IBM had some 6-bit codes that they were using. But the argument then was to be more universal. You just needed to represent two-to-the-eighth.

Pelkey: I was told they picked the Signal Corps Field Code.

Pugh: I never heard that, but it might be.

Pelkey: 1962. The OD Committee did that. They also picked the 75 two-to-the-nth as a data service. That was arbitrary. When they were trying to put these three networks together, each network was proposing a different speed.

Pugh: Right.

Pelkey: -- a different speed.

Pugh: I think that's true. I do recall something when I was back at DCA where the 75 times two-to-the-nth was the speed. But also, there was also some big argument for 1200 n, which gives you different speeds.

Pelkey: Right.

Pugh: And I think that 1200 n actually became a speed, too.

Pelkey: Okay.

Pugh: Now where that came out of, if it came out of DCA, or if it came out of a one of the other government agencies, I don't know. But it did become a standard.

Pelkey: Okay. So you were at this company supplying -- Tartron was big at this point.

Pugh: Tartron was big. And also, the other thing we just started to see come in, back in the 1965 to '70 timeframe, was remote job entry processing, RJE terminals A few companies started up -- both DEC and 3C 16-bit computers were being used for remote job entry terminals. And what was happening during that timeframe I think, and this is very significant as far as I'm concerned in terms of the development of the technology, was decentralization. During the period from '55 to roughly '65, computers were centralized. And then they decided that it was better to have remote computing centers, and so what happened was, particularly in the '65 to '70 timeframe, was that remote job entry terminals really started coming in. And what this did was move the printing and move some of the processing out to the various sites. And the people that were at these sites lost their computers, because they had probably, in that timeframe, maybe the small 360 class, or even the 1401 or the Honeywell 200 class computers out at the remote sites, and it was too expensive to maintain programming staffs at all the remote sites. So the argument was to come in and put in a large, centralized host. And out came the 360/50, the 360/75, the big Honeywell machines, the big Univac machines. So now you could have one data processing site where all your programmers were, and you could put your remote job entry terminals out. Okay, so now the remote guy had to print fast, because he had a 1200 lpm printer, and with the modem speeds at that time which were running up to essentially 1200 bps, you just couldn't provide the same functionality – enough speed.

So now, Codex was founded in '62. And we were involved in the implementation of some exotic error-correcting codes primarily for the military. t was very expensive stuff. But the idea was that -- at that time there was no ARQ systems. So some of the lines that came in, particularly on BMEWS, had to be error protected. And we built codes that would span outages of up to six or eight seconds, and you never lost a bit of data. It turned out to be incompatible with ARQ systems, because of the delay that we put in. It puts in a certain amount of absolute delay. But the codes worked very well, and we built them for tactical applications for the military, all the way to the big BMEWS systems.

Pelkey: What is BMEWS?

Pugh: Ballistic Missile Early Warning System.

Pelkey: Okay.

Pugh: And it was this line that we had all around the Artic, through Canada and Greenland, Iceland, and that funded a lot of technology, because the military had the money to pay for it. But, uh... One of the problems that we ran into was that when you start doing error correction, what it essentially does is double the speed that you have to transmit -- if you're trying to transmit at 1200, and you had a halfway code, you had to now transmit at 2400 because you put in one parity bit for every data bit. And that drove the speeds up. We saw at that time that we had to have faster modems.

Pelkey: Now at that point in 1965, who was supplying the modems at that point that they used for timesharing? They were --

Pugh: Most of them were AT&T.

Pelkey: Most of them...

Pugh: Most of them came out of AT&T. AT&T -- See… I forget when Carterfone happened.

Pelkey: '68.

Pugh: '68. Okay, up to '68, AT&T was the only supplier, except for the military. The military didn't have to follow the same rules. So the military got their modems from Stelma. Milgo came in with modems for some of the Kennedy launch sites, downrange instrumentation. Again, that was for Goverment lines. So there was nothing really available, and AT&T was very complacent in terms of pushing new technology. Very, very complacent. We saw the need to go up higher in speed, because it was primarily being pushed by our error correction business that essentially doubled the rate at which you had to transmit. So there was a small company that we found out in California that was called -- I can't remember the name, In, Tel, Teldata. Teldata.

Pelkey: T-e-l?

Pugh: Yeah, T-e-l-d-a-t-a.

Pelkey: One word or two words?

Pugh: One word.

Pelkey: Okay.

Pugh: And that was started by a guy by the name of Dr. Jerry Holsinger. You maybe have talked to Holsinger.

Pelkey: His name's come up. And he'd been at MIT. He has a Ph.D. from MIT.

Pugh: I think he's a Ph.D. from MIT. But he had a company in California that had this modem that he had developed --

Pelkey: You mean, northern California, do you recall?

Pugh: Jeez, I cannot recall. I think it was northern -- I think it was the Stanford area. So it probably was northern California. That's why I'm wondering if he really got a Ph.D. out of MIT or out of Stanford. I'm not sure. But he's still around someplace. We bought the company. He had a contract from --

Pelkey: What year is this, now?

Pugh: This is back in 1968.

Pelkey: After Carterfone?

Pugh: It must have been right around the Carterfone time.

Pelkey: Was it prompted by Carterfone?

Pugh: No, because the modem he was building was for the government. He had an NSA contract. NSA was trying to build a secure speech system. And in order to build secure speech, you had to digitize the speech. The speech digitizers that they had worked at around 9600bps. And to run these over voice lines, they needed a 9600- bps modem. So, Holsinger got a contract from NSA to develop a 9600-bit modem. And he did. The modem was really for voice, and voice has a great deal of redundancy, so the bit error rate didn't have to be good. So if it could get by -- if you could transmit data at one bit in 10 to the fourth, in terms of accuracy, that's plenty good for voice. So we acquired the company. We privatized the modem. We continued to supply some small amount of these modems to NSA. But we felt that there was a growing need, as a result of the remote job entry terminals that were being installed, to transmit at 9600. So we used this same modem which in those days we called an AE96 -- it weighed 125 pounds -- [Laughter] I still have, I still keep -- it had -- that was one of the analog boards in it. It had 66 boards. Sixty-six boards of that size.

Pelkey: It must have been a very reliable product.

Pugh: It was very reliable. It would run, if we could get it to run at all, for 30 hours, but we shipped it! [Laughter]And I tell you, it gets --

Pelkey: [unreadable]

Pugh: It took two men and a spare board or two to even get it to run 30 hours. And it was all manually tuned. You had to tune it for every line.

Pelkey: Look at that circuit.

Pugh: Yeah. Isn't that something? It's RTL logic. These are multi-pin, so they must be RTL. This is actually one of the analog boards.

Pelkey: And how much is this modem?

Pugh: The modem -- we first started selling it -- we sold the modem for $25,000. It was the world's first 9600-bit per second modem, but it sold for $25,000.

Pelkey: And how many of these did you sell?

Pugh: During its life, we sold close to a hundred.

Pelkey: A hundred.

Pugh: And we lost money on every one we shipped at $25,000, because there was just too much --

Pelkey: Servicing this in the field must have been --

Pugh: Well, it was a terrible thing to service, because you could not isolate it down to one card. You could isolate it down to about a dozen cards. And then you replaced all dozen cards. [Laughter]

Pelkey: I'll bet.

Pugh: Then we cut the price, we cut the price on the product -- The only other one that was available --

Pelkey: If you were losing money on every one, you figured you cut the price, that would --

Pugh: -- That we'd make it up in volume. Well, the company had just gone public. Codex had just gone public.

Pelkey: When was this?

Pugh: In 1968.

Pelkey: And who took you public?

Pugh: Kuhn, Loeb. And --

Pelkey: Were you at Codex at this time?

Pugh: I was just in the process of joining them. They went public in August of '68, and I started interviewing here about August of '68. And I'd actually joined in January '69. So I missed the public offering.

Pelkey: Is it possible to get a copy of that original offering? Do you know if there'd be a copy of that around? The original prospectus?

Pugh: I might have one at home.

Pelkey: If you do have -- if I could get a copy of that, that'd be great.

Pugh: Yeah. The --

Pelkey: Okay, so. How big a company was it at this point?

Pugh: We were one million dollars. And --

Pelkey: How many employees?

Pugh: About a hundred.

Pelkey: And you were profitable presumably.

Pugh: I think we were profitable because we had a lot of military business. But the military business had started to dry up, and that was one of the reasons why I joined them. They wanted somebody that knew the commercial business.

Pelkey: Okay. And when you came on board, what did you come in as?

Pugh: I came in as head of marketing, as Director of Product Marketing. And there was the head of marketing, the Vice President of Marketing, a guy by the name of Art Carr, who is also a pioneer in this business. And I had worked for Art at Computer Control Company.

Pelkey: Okay. And who else was there at that time?

Pugh: Jerry Holsinger was still there.

Pelkey: Okay, was he head of engineering?

Pugh: Jerry was head of the blue engineering team, which was the modem team. And there was a guy by the name of Ferrell Peltz, who was the head of the red engineering team, which was the non-modem engineering team. And he also ran manufacturing for the company. There was a -- I know the other senior guys -- well the two company officers that founded the company were Arthur Kohlenberg. Kohlenberg was --

Pelkey: K-o...

Pugh: K-o -- -Kolen -- K-o-h -- I'd have to write it. (writing) Arthur Kohlenberg. H-o -- -yeah.

Pelkey: K-o-h-l-e-n-b-u-r-g.

Pugh: Right. And Jim Cryer. C-r-y-e-r. Cryer was the president, and Kohlenberg was Chief Scientist.

Pelkey: Okay. And was David Forney there?

Pugh: Forney was here. Forney was a wiz kid out of MIT, and he joined Codex back in the '65 timeframe, '65, '66', probably part time at first. And I think he came on full time around '68. But his role in the company was just a scientist, kind of. Now there were other people that were -- Both Kohlenberg

and Cryer died the same year. They both died in their early forties. Kohlenberg had Hodgkin's Disease and Cryer dropped dead playing tennis of a heart attack on Sunday morning. And that was in 1970.

Pelkey: Was it the Spring or Summer?

Pugh: It was Spring. Cryer died about May. Kohlenberg -- they detected Hodgkin's Disease in him sometime in '69, around the middle of '69. And so he was in and out -- he actually was in remission when Cryer died. And the Kuhn, Loeb came in, and they formed a committee of Carr, Jim Storey, and a guy from Kuhn, Loeb, and I cannot remember his name right now. They ran the company, because we needed money, too. So we were also out looking for money.

Pelkey: And why did you need money if you'd gone public...

Pugh: They'd gone public, but the military business had dried up and the commercial business had not started yet. So the company was just about dead.

Pelkey: Oh, and you had the 9600 which was -- was it losing money?

Pugh: The AE96 would lose on every shipment. We had the only modem that worked. However, there was a very limited market for it at that point, because RJE was just coming in, and we would take it out and demonstrate it, and everybody would say, "My God, this is amazing. We never thought anybody could do this, and if we ever have a need for it, we know where to go." [Laughter]

Pelkey: And you were marketing manager.

Pugh: Right.

Pelkey: Must have been a frustrating period.

Pugh: It was frustrating. So we started to generate a market for it. But --

Pelkey: So you were losing money and you needed more money.

Pugh: We needed more money. We --

Pelkey: What was the timing of --

Pugh: There were two things that saved the company, in my opinion, during that period of time. One was we got some airline business. The airlines were the only people that could afford to pay the high price -- at that time the modem price was down to… I think we were now charging about $16,900. Forney had come up with an invention that took the modem from a 10 to the fourth error rate to a 10 to the sixth.

Pelkey: Was that QAM?

Pugh: No, QAM, he invented later. But what it was, was -- the modem was a single side band, suppressed carrier modulation scheme, and he discovered a way to -- there was some information in the stream that he could detect within a span of errors, a span of bits, that an error had been made. Now if you knew what bit was in error, you just changed it. You couldn't tell the bit, but you could tell in the span of bits. And so he put in something that we initially called the Forney Decoder. And there wasn't any board space in the chassis because it had 66 boards and everything was full, so we hung it under the lid of the modem. That was the Forney Decoder. “Forney Decoder” wasn't a very salable marketing name, so I changed it to a Threshold Decision Computer. [Laughter]

Pelkey: Oh, marketing!

Pugh: Right. And we offered it as an option. I was never supposed to, but the company president said, "We gotta get some money for this." And I said, "Come on, this is like selling a car with tires or without tires, right? It's no good without tires." And this modem was no good without our TDC, our Threshold Decision Computer. But he said, "We gotta get some money for it." So we charged $2,000 for it. Everyone that went out was obviously sold with it, and it was --

Pelkey: And that was on top of the $16,900?

Pugh: That was on top of the $16,900. British Airways came in. That was a contract that I had worked on, and we closed British Airways. That was followed by Iberia.

Pelkey: And when did you close British Airways?

Pugh: 1970. It started in '69, and moved into 1970. Iberia bought it, Air France bought it, and it was all for the transatlantic planes. At the same time, we came up with a multiplexer that would break this down into four channels. So we'd take the 9600-bit stream -- they didn't need 9600 for the reservations -- but what they had was, they all had multiple transatlantic links. And these transatlantic links were going for about $15,000 a month. So we could come in with one modem, and do away with three of their circuits. And it was just an enormous cost savings. They paid for this $16,000 modem in a matter of a few months. And so we installed those. As soon as the airlines signed up for it -- the airlines were technology leaders in those days as far as being early adopters -- it told the financial community that maybe we had something. Maybe this product was something that was worthwhile. And that we had the people who could do it. So, as soon as we got that, then we… – that, combined with some other small successes that we had in the United States on very long circuits, the Stock Exchange I think, Midwest Stock Exchange bought some for their remote locations, and Westinghouse bought some, and there were a small number of salesman in the United States. But it was enough to say that we probably did have something.

Pelkey: You were making these sales, although at the same time these sales weren't enough --

Pugh: No, no --

Pelkey: -- to make the company profitable when you lost the military business.

Pugh: Right. They were nowhere near enough. So in 1970 -- '69 was a -- I think we lost -- let's see, no, '69 Cryer was still -- money. Okay, Kuhn, Loeb, Carr and Storey were out raising money. We succeeded in bringing in about three or four private venture people. Biscayne Industries -- I can't remember the other. But they came in and they bought stock for about four dollars.

Pelkey: And this a private -- this is really a private --

Pugh: This was private placement, private placement, yeah.

Pelkey: Cryer was involved.

Pugh: No, Cryer was dead. It was Carr, Storey and the guy from Kuhn, Loeb.

Pelkey: And it started before Cryer passed away?

Pugh: It was before Cryer died. It was my understanding that we had money lined up. But when Cryer died, the money dried up immediately, because the investors didn't know what was going to happen. o we almost folded when Cryer died, which is in the May timeframe of '70, until we got money. We got money in, it must have been, about the November timeframe. The only thing that saved us was we were into the First National Bank of Boston for about $4 million in short-term debt. And every week to meet payroll, Art Carr went down to the bank and got the payroll, and they just handed us some money on a weekly basis. They wanted to push us into Chapter 11. And Carr said he would not go into Chapter 11.

He said, "If you push me, I'm just going to fold the company up, and you lose your $4 million." So they kept feeding us.

Well, the airline business came in, we got some investors, they raised four or five million dollars in private placements, which was enough to keep us going. In the meantime, Forney had been working with a guy at MIT whose name was Gallager, who's still over there, Bob Gallager, and a guy from Northwestern, Jim Massey. And they were working on what they called Modem X. And we were looking for a modem that was much more resilient to the types of abnormalities that the telephone company didn't know existed until we started going 9600- bps. Things such as harmonic distortion and phase jitter -- phase jitter in particular. They didn't know it was a problem, because it never bothered anybody else. So we needed a modem that was in fact much more resilient. In the meantime, we'd started another development of the single side band modem, and it was coming along, but we never were satisfied with from a technology standpoint, because it just didn't have the kind of resistance to phase jitter and harmonic distortion that we needed. But, the Modem X was not quite ready yet. By this time, the 9600- with the Forney Decoder was running pretty well. So we decided that what we wanted rather than another 9600- immediately was more products. I mean we were a product-poor company. We needed more -- we needed another modem line; we wanted a 4800-bit line. So what decided was could use the QAM technology at 4800 very nicely. So we pulled in that development, and we did a --

Pelkey: Excuse me, QAM was Modem X?

Pugh: QAM was Modem X, yeah. That was a combination of the three scientists, primarily lead by Forney. So from the day we decided to do a 4800-bit modem until we did a beta test on the first ones was nine months, because we really needed it.

Pelkey: What year was this?

Pugh: That was in 1970. It started in the Spring of '70. And we introduced the modem and showed it for the first time publicly at the Fall Joint Computer Conference in Houston in December of 1970. And that was what we later came to call the C-Series modem. That was the first QAM modem. And that modem was absolutely phenomenal in terms of performance. We took that out on lines that nobody could run on, and that modem would run 10 to the eighth. It would never make an error. It was so resilient to all the parameters. We had done simulations in the lab, I remember I came back from the first demonstration using a circuit that was out at Interdata in Waltham. Interdata I think now has been bought by Citicorp or something. They were a financial timesharing service of some kind. And they had a line that nobody could run on. And we took that modem out and measured the parameters and put the modem on it and [snaps fingers] just like that, it ran. And the guy out there was a guy by the name of Norm Daggett. He could not believe it. He became one of our major references that we would subsequently use for getting more money. And also, he spread the word around that if you got a tough circuit, the only place to go was with Codex. So the 4800 was an immediate success. We just couldn't build it fast enough. And it was going primarily into applications of RJE terminals. Well the 4800, when I brought the modem back that day, and I talked to Forney, I said, "You know, this thing ran perfect." And he said, "What were the parameters?" And I told him, and he said well, "Naturally. I would expect it to." It was no surprise to him. [Laughter]

Pelkey: At that time, were there 4800 competing modems on the market?

Pugh: Milgo had a 4400. AT&T -- they had a modem that was intended to run faster, but they ran it at 4800. It was in a great big box. It was about this big. It was bigger than our 9600-. Milgo had a 4800 at that time, but it wasn't nearly as robust. It used some kind of a single side band I think, or a phase modulation or something -- I think it was phase modulation. But the QAM was clearly superior.

Pelkey: And were there 2400 baud or 1200 baud?

Pugh: At that time, there was some 1200. In 1970, there was 1200 because Carterphone opened it up, and I think Milgo was the first one. Milgo really had the 2400 bit market.

Pelkey: And these are still asynchronous?

Pugh: These were synchronous. Yeah.

Pelkey: At what time did you switch from asynchronous to synchronous?

Pugh: Once it got above 1200. So, you know, when the 2400s came out, they changed it to synchronous. Because the modulation scheme had to be synchronous as opposed to the frequency shift that they used in the 300 and 1200, which were very easy to do in an asynchronous fashion. So anything above 2400, just by its nature, will be synchronous. Some people still want to go asynchronous above 2400, and in that case you put in a converter. That essentially brings in asynchronous data and converts it to synchronous. That's part of the modem. And we still make those -- it's an option to our modems today. But the modem, technically, is synchronous.

Pelkey: So Milgo was the dominant modem manufacturer at the 1200, 2400, and then they had the 4400 bps?

Pugh: In terms of the companies that were around at that time, Milgo was one of them. Milgo had earned their money on the downrange instrumentation for NASA, for Kennedy. Rixon was around. Rixon was primarily government. And they were early experimenters in modems, too, but they were all operating using either frequency shift, or was some kind of a sideband technique. When we came out with the AE96, a suppressed carrier, single side band modulation, a lot of people moved in an copied that, which was a mistake for them, too, because we had the QAM modem on the drawing boards. And about the time that both Milgo and AT&T came out with single side band machines, we had announced our 9600-, which was a QAM machine. And we had the market all to ourselves for several years. It took them that long to catch up. We took our machine, our 9600- machine that we came out about a year later, in '72, and replaced the AE96. And now we had a 96, but also a 72, just a marketing game, because we took a 96 and just cut back on the speed. It was essentially a 9600- bit modem with some disablers in it, and we sold it for less money to try and attract people that only needed 7200. And there was a little bit of a market. That modem lasted for four or five years, and it was, as I say, a marketing game. The 96 became an instant hit.

Pelkey: And that was introduced in '72?

Pugh: That was introduced in '72.

Pelkey: Do you recall what timeframe?

Pugh: Again, it was at the Joint Fall Computer Conference.

Pelkey: In '71.

Pugh: In '71, yeah.

Pelkey: And where was that conference that year?

Pugh: I can't remember where the conference was, but we introduced it. We sold the machines. At that time, we only had about three or four prototypes. And we were demonstrating it, and I made one sale right off the floor, which was first time that's ever happened. Martin-Marietta came in, saw the machine, and we demonstrated it -- we had a line parameter simulation box, and I could demonstrate -- it would actually show what we called the eye pattern of the modem. You introduce phase jitter, you could see the eye pattern rock, harmonic distortion, the eye pattern got circular, and that essentially was the first time

that a modem was able to give you the kind of information that you could go back to the telephone company with, and say, "You got phase jitter on this line," or "You got harmonic distortion on this line," and so that became a marketing product for us. We actually sold what was called an eye pattern generator, and the customer would bring a scope in and plug into the X-Y axis, and then he could watch what was wrong with the line. Subsequently, we did our own analysis. And we would print out that there was phase jitter on this line, but that came several years later. So we could do the analysis, and then we could tell the customer what was wrong with the line. Now it's all automated with big network management systems.

It was interesting from a marketing standpoint that we really didn't design this as a product per se. It was designed as laboratory testing equipment, and one day the engineers got me up to the lab, and they said, "I want to show you something. This is what the pattern looks like when you got phase jitter, this is what it looks like when you got harmonic distortion, this is noise, these are phase hits, these are dropouts." And I said, "My God, you could tell exactly what's wrong with the line." So we had to sell it as product. And that sold a lot of modems. It sold a lot of people on the idea, because now for the first time they can go back to the telephone company and say, "This is the kind of problem you got." The telephone company before that, their answer was, "Well, you know, of course if you're transmitting 9600-, you don't expect it to work, do you?" But now the customer can go back and say, "You got phase jitter on this line. You've got about 20 degrees of phase jitter. And I want it cleaned up." And the telephone company would say, "Well, that's not in the specs." But if the customer was insistent -- the telephone company would never admit that they had it -- but it would always disappear.

Pelkey: Now was that separate -- was that test equipment you sold?

Pugh: Yeah.

Pelkey: It was separate from the modem --

Pugh: That was a piece of test equipment, and as I remember, we had space on one of the boards that we could put it in. And then we had a couple of leads that would come out the back that you would plug your scope into. And it became a very major piece of test equipment for people that were trying to transmit 9600-. The modem itself was very, very good in terms of its ability to get through. But there were times when you couldn't run 96. And the customer wanted to know why, so they needed something to go back to the phone company with.

Pelkey: And when you introduced the C Series 4800 and Milgo was there as a dominant vendor at that point, were they aware -- they must have gotten their hands on one and seen that there was a different kind of an architecture than was their 4800 product. Weren't they alerted then as to the fact that that technology could go the 9600-, and when did the patent get filed on QAM that gave them some answers.

Pugh: Well, the patent was filed back in 1970 on the basic modulation scheme. And in fact that was the basis for the lawsuit that we finally -- Milgo was running around suing everybody, and they sued Rixon. Rixon had been acquired by United Telecommunications I think, out in Kansas City. And Milgo actually collected two or three million dollars from Rixon.

Pelkey: Do you know when that was?

Pugh: That was, it must have been around '73, something like that, '74.

Pelkey: Why was Milgo so lawsuit-happy?

Pugh: Don't know. And then they came and they sued Codex. They didn't sue us, but they sued one of our customers. They sued Yellow Freight.

Pelkey: What year was this?

Pugh: I can't remember exactly, but it must have been around 1975, '76, in that timeframe. And we went to court for our customer in that case, and there was a lot of -- we were not going to lay down to the lawsuit like Rixon and couple of the other companies had, and so we fought them and had a change of venue and a lot of the maneuvering that goes on, and we beat them.

Pelkey: And when did judgment get rendered?

Pugh: I think it was finally settled in about 1984, that timeframe. So it took a long time. I mean, we were in the courts for a long, long time.

Pelkey: And what was the settlement?

Pugh: Eight million dollars. And one of the punishments that the court laid on them was that in the U.K. they had to take out every single 9600-, which they did and it just wiped them out. And at that time, the company was now owned by Racal. You see, Milgo had been bought by Racal, which was a U.K. company. So --

Pelkey: When did Racal buy Milgo?

Pugh: About '74, '75.

Pelkey: When did they buy Vadic?

Pugh: Shortly thereafter. It was all in that same timeframe. They bought Milgo first. Racal had been the international distributor for Milgo. Milgo had a company called ADDS -- A-D-D-S -- which was in the terminal business, made an unfriendly acquisition attempt on Milgo. Milgo didn't want to be acquired by ADDS. So they fought it, but they saw they were losing, so they went to Racal, and they told Racal that they wanted to be acquired. And so Racal acquired them. ADDS is -- I don't know where ADDS is, they've probably since disappeared, too. They're not in the business any more. But that was interesting, because among other things, the Securities Exchange Commission got involved because Milgo had taken private company data that was not available to the public and given it to Racal.

Pelkey: Was Milgo public at that point?

Pugh: Yeah.

Pelkey: When did Milgo go public?

Pugh: They were public -- it must have been back in '68, '67.

Pelkey: After you?

Pugh: No, about the same time.

Pelkey: About the same time.

Pugh: Yeah. They were twice as big as we were. I mean, twice as big, that was two million dollars instead of one million, but they stayed twice as big as us for a long time.

Pelkey: Until the C Series.

Pugh: Yeah, and then we caught up, and then they were acquired by Racal. It's been a disaster for Milgo. And at this point in time, it's our understanding they're on the market to be sold. They just laid off 20 percent of their employees last week. So they're hurting. Their technology has really slipped, really slipped. I don't why, but they haven't had any original technology in 10 years.

Pelkey: Now, coming back to the lawsuit. Codex at that point in time, if I understand it, was more amenable to trading patents.

Pugh: We did a swap with AT&T, and we also had to -- on the 9600- QAM technique -- we were the standard for the CCITT V29, which was another very good situation for Codex, because we had the only modem that met the standard. And since it was our modem, the standard came out, and the next day we showed the modem.

Pelkey: When did you go the committee with your standard at that time?

Pugh: That was the plenary session of 1976. We were very involved in the standards, standard activity, and we pushed the standard into QAM. And when they tested it, it was an obvious winner. But we had a patent on it. And there never had been a standard selected in which one of the companies had a patent position. So we had to agree to license. So that was part of the deal. So we had to license anybody. Nobody ever took a license.

Pelkey: Really?

Pugh: Yeah.

Pelkey: The Milgo suit preceded the standard?

Pugh: The Milgo suit started about the time of the standard: in that timeframe. But Milgo would not license us. They chose a was a suit/countersuit situation, and --

Pelkey: It must be strange to be suing someone when you had to license them the technology.

Pugh: Yeah, but they didn't want to license it. They would not take out a license.

Pelkey: What would the license have cost somebody?

Pugh: Oh, I don't know. It had to be reasonable, because we had to agree to make it a reasonable license. But it would have been, on a per-unit basis, not much. But when you figure the number of units, it would have been -- I never ran through the calculations on it, so I don't know.

Pelkey: It must have been at least $50,000 or some amount of money -- a royalty.

Pugh: Since nobody ever did it... The ironic part of that was that after we won the suit with Milgo, the Japanese, and a lot of other people, were obviously violating our patents. We decided that before we went through another experience like that again, spending much money, and that much time, that we would ask for a reissuance of the patent. And a reissuance of the patent means that they go back and investigate it, and if you get it reissued, then it is a rock-solid patent. There's no question about that. And they wouldn't reissue it. [Laughter]

Pelkey: Is that a fact?

Pugh: That's a fact.

Pelkey: When was this?

Pugh: I think that finally happened some place after the payment.

Pelkey: So in '85, maybe?

Pugh: So it had to be in the mid 1980s. They would not reissue the patent, because it was so plain there wasn't anything wrong with it the way we had filed it, but they were just…On a reissuance, they get much more critical. And there was some question about whether it was really a patentable idea. And what we actually patented was the pattern. The QAM pattern was the patent, and it was the placement of the dots on the pattern.

Pelkey: Which is called the constellation?

Pugh: Which is the constellation, yeah.

Pelkey: At some point, you must have almost laughed when that didn't happen after Milgo. You had just milked them for eight million dollars.

Pugh: Right. Now, there probably is more to the details on that than I've related here, because it was a very complicated suit. It was a suit/countersuit, and...

Pelkey: Were there any other lawsuits that you were involved in around the technology?

Pugh: Mm-mm. No.

Pelkey: Okay. Now coming back to again the Modem X. Where in your understanding did those ideas come from that led to QAM. Was it just Gallager and Forney, was it original or was there something else out there, what caused it?

Pugh: No, there was nothing else out there. It was a…it was a classic. It really became classical, because we knew enough about the circuit abnormalities.

Pelkey: Through your…

Pugh: Through our experience with the AE96. And so, when we wrote our marketing requirement for our next generation modem, we were very specific with our engineering people, "This is what's out there. And we need a modem that is going to run 10 to the sixth on lines that have these kind of abnormalities."

Pelkey: And you were involved in writing this, too.

Pugh: Yeah. It was the marketing organization, which was only two or three people.

Pelkey: So you were involved in --

Pugh: So we wrote the spec, and we actually provided our engineering people with the settings in the simulators that we wanted the modem to run 10 to the sixth on.

Pelkey: And did you also define a cost parameter, what cost it had to be?

Pugh: Yeah, we defined a cost objective.The classic that people always remember… The AE96 was here when I arrived at the company. We bought the company and like I said we sold someplace around a hundred, probably never quite got to a hundred. When we did the marketing requirement statement for the C Series or the QAM machine, my estimate for the number of units that we would sell for the 9600- was 465.

Pelkey: You went really right out on a limb, didn't you?

Pugh: Right out on a limb. And at that time, we had sold --

Pelkey: It was 65, it wasn't 466, it was 65.

Pugh: We'd been selling modems for two years, and we'd only sold a hundred. So 465 sounded pretty good.

Pelkey: And you priced it --

Pugh: At breakeven. We priced the modem at $9,995.

Pelkey: This was a 4800 --

Pugh: 96. The 48 was priced at -- it originally came out at about $6,000, and we eventually drove the price down to a buck a bit, both the 9600- and 4800. The 4800 sold for $4800, and the 96 sold for $9600-.

Pelkey: And -- and -- and -- just for a moment. The buck a bit: was there anything magical about that?

Pugh: No. It was -- it probably was a carry over of the computer days when you were trying to get memory down to a cent a bit.

Pelkey: So it was kind of a cultural --

Pugh: A cultural objective, yeah: a buck a bit. And we made very good profit at it. The modem -- the 9600- that we were selling for $9,600 had a factory cost that was in the range of $2,000.

Pelkey: So you created the spec for the Modem X -- it must have been, then the end of '69? You were working --

Pugh: Yeah. In '69 and '70, we were working on the spec.

Pelkey: And again, you joined in sixty --

Pugh: January '69.

Pelkey: In January '69. So when you came aboard, was this -- did you come aboard knowing that you were going to create the spec for the next generation modem --

Pugh: Yeah.

Pelkey: -- or did you come aboard --

Pugh: Well, my job was to take this military stuff and warm it over and sell it in a commercial marketplace. Now at that time, you can't believe it. They didn't even have standard connectors on the back of this thing. But the RS-232 connectors, they didn't have RS-232's -- they didn't make any sense to the engineers, the military engineers.

Pelkey: Because they had all kinds of --

Pugh: They had -- yeah. All kinds of stuff, and, you know -- if a connector had 22 pins, you had to be able to do more -- 24 pins -- you had to be able to do more than bring one circuit out on it. So they would bring all kinds of circuits out, and it was non-standard. So that was one of the simple things we had to do. And also we had to make it so that the average guy could install it. It didn't take three oscilloscopes and db meters to install it. We succeeded in doing that with the AE96. Part of the spec on the QAM machine was that it would be self-installed, and no adjustments. I want no adjustments on that machine. Because you can't expect the customer to buy test equipment that he doesn't have.

Pelkey: When you presented this kind of spec -- I mean, I presume there must have been interactions between you, Dave, and other people in terms of what you were thinking --

Pugh: Yeah.

Pelkey: -- to see whether or not what you were thinking was doable. So they must have encouraged you at one level, saying --

Pugh: Yeah. I mean, it was a small company. I mean we all sat in one small section.

Pelkey: There were only a hundred people at this point or so?

Pugh: Well, there were a hundred people including manufacturing. And in terms of engineering it was probably 20, marketing there were four or five in marketing.

Pelkey: So you interacted a lot.

Pugh: So we interacted all the time. Yeah. So it was very close interaction.

Pelkey: So they had some idea what you were saying was needed.

Pugh: Oh, yeah.

Pelkey: So you knew -- you had some idea what was possible --

Pugh: Yeah.

Pelkey: -- looked at the marketing for it. And when you finally delivered the spec, was there a reaction saying --

Pugh: Well there was --

Pelkey: "You gotta be kidding me -- "

Pugh: No, no. It became obvious, first of all, that the single side band machine that we were working on would not do it. And -- so that was one of the reasons for pulling in -- I mean, I remember a meeting where we -- we didn't want another 9600- bit modem that was going to have just a slightly better performance than the AE96. And like I said, at that time, our AE96 had started to work reasonably well. I mean it would work in 80 percent of the cases. So we decided to go with the 4800. As soon as we went with the 4800, then Forney was more convinced at that time that he could build a 4800 machine that would run well. But if we had asked him for a 96, he would not have gone along with a 96. But the 4800 had everything in it that we needed to take it the next step to the 96.

Pelkey: So there's the combination of both wanting more products --

Pugh: Right.

Pelkey: -- plus the safeness of doing 48 with this new technology --

Pugh: Right.

Pelkey: -- that you thought was extensible to 96, but if you --

Pugh: Right.

Pelkey: -- could get it working at 48...

Pugh: To sell this machine, and we had to sell every machine two or three times, because you -- in some cases, you just couldn't make it work. You know, you'd send engineers out and technicians out and do all the fine tweaking on it and you just couldn't make it work. So the customer returned it.

Pelkey: Then you go back and sell --

Pugh: We had, you know -- I remember selling serial number 56 about six times. 'Cause you couldn't make it stick.

Pelkey: To the same customer or multiple customers?

Pugh: All different customers.

Pelkey: That's great. Who was in that meeting then? Where you decided the 4800 --

Pugh: Carr, Holsinger, Forney, myself, one of my marketing guys, my only marketing guy, who was a guy by the name of Richard Young, who is now down in Texas.

Pelkey: ITC?

Pugh: Yeah.

Pelkey: I know Richard.

Pugh: Young -- Young was an engineer that had a lot of knowledge in the analog world as he had came out of Western Union. So he was very instrumental in the specs mission.

Pelkey: So he was involved in writing the specs --

Pugh: Oh, yeah, he was involved in writing the specs, because he knew the analog world very well. And so that's when we threw out the single side band machine and Forney then agreed that he could bring in a QAM machine at 4800.

Pelkey: And that was in...

Pugh: That must have been in about January, February timeframe of 1970.

Pelkey: 1970?

Pugh: Yeah.

Pelkey: So that was a pretty important meeting to the company.

Pugh: Oh, yeah, very important meeting.

Pelkey: And was there a sense at that point in time that you -- that this was really -- that you had made a right decision, or was it just another meeting. Was it perceived at the time as an important decision?

Pugh: It was an important decision, because we were essentially killing our major program. And the major program was the --

Pelkey: Plus you were -- plus you were -- you were having --

Pugh: A major program in those days only had three or four engineers on it.

Pelkey: Right. But they were less --

Pugh: It was a new direction for the company, and --

Pelkey: Your financial fortunes are starting to dwindle --

Pugh: Yup, that's right.

Pelkey: -- and you really needed something to get somewhere...

Pugh: We also made the basic decision on the 4800 that we would spend nothing until -- that we would take it on the chin as far as recurring costs. That we would spend nothing on tooling, because we didn't have money. We didn't have, you know, fifty or a hundred thousand dollars to buy the kinds of tooling that we needed. And as a result, we built 60 of them. And it was what was called the training machine. And it was made out of three boards, each slightly bigger than a piece of paper. And the boards were connected with connectors. And the boards were placed in some kind of a fitting machine.

[Tape side ends]

It was actually copied from a military machine that we had. That was very durable. It was the error corrector that we had built for...

Pelkey: So you had kind of the...

Pugh: We had sort of the package, but the military machine was far too expensive. So we used the same concept, but it was done a whole lot cheaper. It just would keep it working. It was a very unreliable machine from the standpoint of there were too many connectors. So a QA guy would never believe that we -- if we had QA guy in the company --

Pelkey: He would say, "No way."

Pugh: -- he would say, "No way. Too many connectors."

Pelkey: So when did you go back and retool?

Pugh: Well, we started retooling as soon as we started selling the modem. We sold all 60 of them. It worked -- you know, once you'd get it in place, it never worked when you didn't send somebody in to reseat all the connectors after you shipped it. But once -- if the guy didn't move it, it would run indefinitely. It was a reliable machine if you didn't move it. But it just couldn't stand moving. So we eventually replaced them all. The first 9600- was built using some tooling and it had plenty of cards. And then as soon as we got the 9600- out, then we went back and redid the 48. We redid the 48 in the same package as the 96. And we used all the tooling down there. And then we -- the training machines, we just took them back and junked them.

Pelkey: Now this conference -- the computer conference in Houston in 1970. The reaction was, I presume, pretty positive to the 4800.

Pugh: Oh, yeah.

Pelkey: Were you kind of the hit of the show?

Pugh: I don't think so, no.

Pelkey: So it wasn't that big a --

Pugh: It wasn't that big, no. But we were --

Pelkey: But from your perspective, it was --

Pugh: We were a very small company. From our perspective, it was very big. We also came up with a line of modems --

Pelkey: What was Milgo's reaction at that point in time do you think?

Pugh: I don't think they really viewed us as that much of a competitor.

Pelkey: Because they were much larger, and you were having financial problems?

Pugh: Yeah. They were really pushing in the 2400. Looking back today from a market standpoint, they could have eliminated us because they had a 96 that didn't work at all. We had a 96 that sort of worked and the AE96. And we were getting -- let's see, as I said when we announced the C Series 96, it was at, I think, $12,000, and we brought it eventually down to $9600-. Milgo had nothing that was comparable. But what they should have done was cut their prices. They should have cut the price to maybe seven thousand or six thousand dollars for a 96,'Cause they couldn't deliver anyway. And what it would have done is forced us down and it would not have given us the margin in our product that allowed us to grow the company. There was another significant event in this same timeframe that happened that was very good for the company and that ended with the -- what we call Worldwide Channel Packing. The U.S. Government had the same problems in terms of circuits. And particularly in the 1970 timeframe, there were no circuits available in the Pacific because of the Vietnam War. And so they came to us and they said, "Can you use this 9600- bit modem, build a multiplexer, and allow us to generate more circuits?" They weren't trying to save money; they just were trying to get more circuits.

Pelkey: 'Cause they needed bandwidth.

Pugh: They needed bandwidth. And we said, "Sure, we could." And they paid us what we called the Vietnam Upgrade Program that the government had a blank check on. And we put in a triangular system for the Air Force: Hawaii, Fuji, Phillipines. Triangular.

Pelkey: Which was in Vietnam?

Pugh: Japan. We did have -- we never ran -- we had something called the Vietnam error corrector, but... And then we put another link in Europe as part of the same Air Force upgrade. And it was also funded on the Vietnam Upgrade. The Air Force said, "This is terrific. We really love it." And we built a new kind of multiplexer that had never been built before that would handle independently clocked synchronous data. Which was what your cryptos are. And you had to have that, because if you ever slipped a bit, with independently clocked circuits, if you slip a bit, you knock your cryptos out of set. So it was a major problem for the Air Force. We had a technique that we could watch and we could stuff bits, so that you'd never lose crypto set. And we built these multiplexers for the Air Force. And then the Air Force -- and this is wonderful -- we were going to equip all of our circuits with this channel packing, they called it. And we started, and then DCA heard about it. And DCA says, "Oh, wait a minute, wait a minute, you know, this is big bucks. These are going on DCA circuits, and Air Force you can't do that. We're going to take over control." So DCA took over control on it, and then they wanted to go competitive procurement. So then we had the Fuj-Phillipines link, and we had one in Germany. And then the DCA came in, and they wanted to go competitive. So we had a big competitive procurement. It was a big shootout -- the final vendors on it were IBM, Harris, and Codex. And we were at that time probably two million or three million.

Pelkey: What year is this?

Pugh: This was back, again, in 1970, because we still had the AE96.

Pelkey: Okay. And so you had these circuits installed.

Pugh: We had the circuits installed all for the Air Force.

Pelkey: And that proceeded --

Pugh: That preceded -- the DCA got involved, and DCA said, "Okay, this is a great thing, we want to put in -- " They wanted to replace FDM equipment that they had that had been running for twenty years -- frequency division equipment -- and they wanted to replace it. And so the three vendors were involved in it. We were a very small company. The whole company with the exception of two guys, myself and another guy, which continued to operate in the commercial business, all totally dedicated to this channel packing job and to write the proposal for it and...

Pelkey: This was in '69?

Pugh: This was in the '69, late '69 or early '70 timeframe.

Pelkey: So after you'd done the Modem X package --

Pugh: Well, Modem X was still being done by Forney. So, Forney was never involved in channel packing. There was Forney and Gallager and Massey and there were a couple of other engineers that were working. So those people were still working on Modem X. In the meantime, everybody else was involved with channel packing. The channel packing was going to be a lease -- a lease job from the government. Just like the old Robert Shaw FDMs were leased by the government. And so we won it.

Pelkey: And when was that Board formed?

Pugh: That board was made in -- it must have been in the Fall of '71, I guess, about that timeframe. They had to go out and get more money for it to fund it. And again, we had a private placement.

Pelkey: So your second private placement.

Pugh: The second private placement to get money to fund the channel packing job.

Pelkey: And was Kuhn, Loeb -- did they manage that --

Pugh: Kuhn, Loeb I think was still involved, yeah, still involved.

Pelkey: So they raised the second private money?

Pugh: They raised the second round, and I think we got a little more for it then. I think it was the -- the stock probably then was eight to 12 dollars, I think. IBM protested the bid, and went to DCA and said, you know --

Pelkey: "Who is this little company?"

Pugh: Yeah, "Who is this little company?" What are you going to do, you know? And, ah, DCA threw IBM out. And we kept the contract, we delivered right on time. We delivered the performance, and that was in -- I don't know, we started making deliveries late '71 or early '72, or some place in that timeframe.

Pelkey: Okay, they awarded the contract in '71.

Pugh: We did all the engineering and all the development that was done in under year.

Pelkey: So 1972 you must have delivered.

Pugh: We must have delivered '72, but we were still delivering AE96s into that. No -- we didn't convert. That contract was worth -- It gave us an instant lease base that was providing us -- The contract was worth about 10 million dollars. The company was two million dollars in size. There was a lease base bringing in, oh, based on 10 million dollars. We still have the contract today. Now, it's been upgraded many times. We had -- there was service involved in it, but -- and the equipment is not the same stuff that was there then, but a lot of it is. They've got probably 30 or 40 people located throughout the world. And the contract still goes on.

Pelkey: Now, where did you fund this 10 million dollars' worth of equipment at that point?

Pugh: Well, of course, it didn't cost 10 million. The amount of money we needed, probably, to finance it, was probably only the range of two or three million.

Pelkey: Okay. And then you got lease payments.

Pugh: And we also were starting to generate something in the commercial marketplace, too.

Pelkey: From your 4800.

Pugh: Yeah, 4800. Now it was all fitting together from a financial standpoint.

Pelkey: Now, when did you come up with the STAT MUX?

Pugh: The --

Pelkey: Which must have been an outgrowth of that program.

Pugh: No, the STAT MUX was not, That is another interesting story. We built a time division multiplexer … Our first time division multiplexer came out about 1970. And it was called the 800. And it was essentially a four-channel, asynchronous multiplexer. And that, again, was something that was a change in the direction of the industry, because up to that time, there were multiplexers that came out of American Data Systems, which was started by Bill Norred who then turned around and started Micom after ADS went -- that's yet another long story. But they had built a multiplexer which was a 64-channel unit. Timeplex had some big multiplexers that were in the 64-channel area. But what I saw happening in the marketplace was the need for much smaller sized multiplexers. And as more companies got involved and there was more distributive processing, you needed to really bring it in groups of eight rather than groups of 64. And so we came up with a multiplexer that was an eight-channel unit that you could build up but in a very expense -- uh, the way it was engineered was very expensive. It was twice as much to have 16 channels as eight channels. And our crossover point between us and the competition was relatively low, but we had an eight-channel unit. Nobody else did. And that sold pretty well. We sold that for several years. We replaced that in about '74, '75 with a new MUX that was very successful in the business, too, it was --

Pelkey: Still an FDM MUX.

Pugh: No, it was TDM. All TDM. It was string TDM, allocated, dedicated circuits. Then, about the same time, we knew we had to get much more heavily involved in the computer business. Every engineer we had was either an analog or a non-computer digital engineer. And we had no computer engineers, and with both Carr and myself coming out the computer business, it bothered us. At one of the trade shows, this guy came up to us, and said he had -- he was from the University of Illinois -- an idea for a front-end processor for an IBM 360. The replacement for the 2703. He said he had built it for the University of Illinois and that it was a great product and could sell it for the third of a price of an IBM and he wanted to know if we were interested. So we weren't very interested in the product, but we were interested in the guy. And so he came to Codex with this whole crew of engineers from the University of Illinois.

Pelkey: Who's this?

Pugh: Dr. VanderMey, Jim VanderMey.

Pelkey: V-a --

Pugh: V-a-n-d-e-r-m-e-y.

Pelkey: All one word.

Pugh: All one word. He eventually left the company to form Integral Data Systems.

Pelkey: Do you remember when that was?

Pugh: He left the company in '78, and formed IDS, and then they sold that to Centronics Data Corp. and he retired with twenty million dollars. He's a young man now that lives up in Florida someplace. But he was a brilliant, brilliant computer engineer. I've never run into anybody as good as him. And the crew he brought along with him were also brilliant, young computer engineers. So what we did was we got him to fool around with this front-end. And finally, I went out and I hired front-end engineers, marketing people, and --

Pelkey: Where'd you get them?

Pugh: I got them out of Memorex. Memorex was then the only other front-end that was competing with the 2703. And the more we got into it, the more we saw this was not the business for Codex. It was just too support-intensive. And you had to know much more about the higher levels of the ISO model -- than we were ready for. 'Cause we were always operated in layer one, layer two, and that's a nice place to be, because it's not support intensive -- it's transparent. So we did this front-end and we kept these guys busy for probably nine months. And we decided not to market it.

Pelkey: That was VanderMey's --

Pugh: That was VanderMey's group. And VanderMey was not too upset. Now that was just about the time that Intel released their first microprocessor. And it was …

Pelkey: The 4004.

Pugh: It was an 8-bit machine.

Pelkey: 8008.

Pugh: Yeah, 8008. Intel 8008. And VanderMey and I were talking, and Forney was also involved in this discussion, and I said, "You know, the way we do multiplexers today with dedicated lines doesn't make any sense. Don't have to do it that way." I kept going back to my concentrator experience back at 3C, and said, "The thing about a concentrator that is nice is that you don't allocate bandwidth unless you're using it. The thing that's bad about a concentrator is that it requires special host software." Because now the data's in a form that the computer is not used to seeing. So that was always a handicap. So I said, "If we could use this new microprocessor to give us the power to come up with a statistical type of device, and then break it down at the other end so it looked -- it was transparent." So VanderMey said, "Let's work on it." And it wasn't three days before he came back and said, "How would you like *this*?" So we -- I think we came in on Saturday, and we worked on it.

Pelkey: What year was this?

Pugh: It must have been in about '74. About 1974. And I said, "That's exactly what the communications industry needs." Well, he started off using an 8008, and then they came up with the 8080, another 8-bit machine, but more powerful. And so he restarted after about a month. He restarted and started doing it on the 8080, and then Motorola came up with the 6800. And they did an intensive sales pitch on the 6800, so he said, "I want to change it again." So we said, "Fine, okay, change it." This was the third time he had changed now within about three, three or four months. Then Intel came up with the 2900 Series. The 2900 was a bit slice processor series, and he wanted to use that. And I talked to Forney, I said, "Hey, Forney. We have to stop this guy. 'Cause he's, you know, he'll go on and continually look for the latest thing and at the rate these things are coming out, you know, we're never going to get this product done." So he worked for Forney at that time, and Forney went back and said, "We want to stick with the 6800." Well, eventually VanderMey had his way anyway, 'cause he brought in this 2900 that he used as a master controller. Now what we ended up with on that product was really quite remarkable. VanderMey did everything he always ever wanted to do in his wildest dreams in terms of implementing latest ideas and technology in that box, and it was the first -- it was the first application of microprocessors in a truly multi-processing environment. We put up to eight of the 6800s. The reason for doing that at that time, it made sense, because the microprocessors sold for about three or four hundred dollars a piece, even a 6800. And so to use them in a multiprocessing approach and any byte that came in could be assigned to any processor. And they shared common memory through a bus: very, very sophisticated machine. However, we couldn't get it working. And it was so complicated that -- and the test equipment at that time was not available, such as the HP 64000s, where you can watch, you know, 200 inputs at the same time. The test equipment wasn't there. So we had one hell of a time trying to get it working.

Pelkey: When did you introduce that product?

Pugh: We introduced it in '76.

Pelkey: Early '76?

Pugh: It was done at a trade show -- it was done at trade show in '76 in probably one of the computer conferences again.

Pelkey: Do you recall, was it the first part of the year, the second part --

Pugh: It was the first part of the year. It was the first part of the year. And it really set the industry back. I mean, that was a -- it was a major announcement at that show. All the competitors just went bananas.

Pelkey: What was the product?

Pugh: It was the 6030. We called it the 6030 Intelligent Network Processor.

Pelkey: So you introduced that in early '76.

Pugh: Yeah.

Pelkey: And what happened?

Pugh: Well, it didn't work very well.

Pelkey: Okay. And how much did it cost?

Pugh: A typical price on it was probably in the neighborhood of 8 to 10 thousand dollars.

Pelkey: It was that much.

Pugh: Yeah. Then we came up with a 40-line which would have multiple network ports. So you could go out in more than one direction. VanderMey was a brilliant guy, but he could not stand the day-to-day details. So we set up a special group that I ran and... I was an engineer, I was a marketing guy, but I was trained as an engineer, and I had all the engineers reporting to me, and we proceeded to try and get the damned thing working. VanderMey just couldn't -- he just couldn't put up with the day-to-day, and he -- then he finally left. But most of the crew that he brought with us stayed here, by that time we had probably 30 guys in the company at that point that knew microprocessor technology and programming, and so forth. And one of the guys that finally pulled this all together was a guy by the name of Steve Finn. Steve Finn now is the Chairman of Bytex. And so, Finn worked for me at that time, and he completely rewrote the code. And another brilliant engineer that came out of the University of Illinois by the name of Jim Hart. Hart I've sort of lost track of now, but Hart was -- Hart went to work for VanderMey for a while and then he started his own company and, ah, I think he lost all his money.

Pelkey: Now, so, VanderMey left in --

Pugh: VanderMey left, now -- Our chief engineer on the job then was Steve Finn.

Pelkey: But then, excuse me. Did VanderMey leave in '76?

Pugh: He left about '78.

Pelkey: So he stuck with it for a little bit.

Pugh: He stuck with it for a while, but then he was taken out of the day-to-day.

Pelkey: Okay. And when did Steve Finn join the company?

Pugh: Finn must have joined us about -- he joined us after the product had been announced. And it wasn't --

Pelkey: Was he right out of school, or...

Pugh: I don't think so. I don't think so. I think he was -- he was a young fellow, I mean, he hadn't -- he certainly didn't have more than a couple years' experience.

Pelkey: So in '77 or so did he take over the -- When did you take over the project?

Pugh: I took over the project in about -- right after it was announced, about '76. And we couldn't get it working. It sort of worked. But it didn't work --

Pelkey: Had to kind to ship an engineer with it.

Pugh: Yeah, it kept crashing. A product like that we would never ship today. Because the industry's changed. I mean, people expect more today than they did then. But it really set the -- it set everybody back. I made a tour through Europe and I hit all the major cities and I talked about it and had some really interesting things to talk about in terms of the data compression that he used, which was a Huffman coding that had never been used like this before. The whole idea of the efficiency of both the STAT MUXing and the Huffman coding on it was just phenomenal. And it was fun to talk about. And so I went through Europe and I -- we talked to all our distributors and I had big sessions with 200 people, you know, twice a day, in every city, and it was very tiring. I feel like you feel in terms of travel. And one of our distributors came back over, and said, "You know, after you made that trip through Europe, three months after that, everybody announced a product that was a STAT MUX." And he said, "And six months after that, they had all unannounced it" because they found out how hard it is to do. Well it took us over a year to get it working.

Pelkey: So into '77.

Pugh: Yeah, into '77. It also was a major change in our sales force, because sales force was a modem sales force. They were used to sitting down with a customer and saying, "You need 96, your need 48, you need 72. If you need 10 lines, you buy a multiplexer with 10 lines." All of a sudden, you're telling the sales guy, "Hey, you don't have to -- " When you figure this thing out, you have to figure line utilizations and how much -- what kind of application the guy has and what kind of protocols he has, and -- because it was no longer transparent. And so it took the sales force a long time. Besides, modems were selling so well. I mean, they could make big bucks just selling modems. They didn't need to screw around with things like STAT MUXes. So it took them a long time, and it finally took a threat of their life by Art Carr to force them to get out and start selling this product.

Pelkey: Which happened in...

Pugh: About '78 is when it really started to take off.

Pelkey: '78.

Pugh: Yeah.

Pelkey: Okay.

Pugh: The product finally ran -- We introduced it in '76. We finally dropped the product in about '86. It ran for about 10 years. t's now superseded with all kinds of other related tech products and everybody else has got one, too. But that really was the first one and we were the first one by several years.

Pelkey: Okay. Now, Digital Communications Associates.

Pugh: DCA. Yeah.

Pelkey: Do you remember them?

Pugh: Yeah.

Pelkey: When did they come out with their stuff? They were -- some people say that they had the original STAT MUX.

Pugh: No, no. They did not. They -- I recall viewing their product. It probably was -- They probably announced it, I would guess, about '78, when they announced the first one. The...

Pelkey: What about Micom?

Pugh: Micom came up with the first small one. We were -- we missed the market on the low-end, because we had everybody tied up in trying to make the high-end work. It was typical of Codex in those days, because of the type of engineers and scientists that we had. We always did the hard thing first. And it was -- We could have built a 2400 bit modem like everybody else, we could have gone out and sold it like everybody else, but we had to build a 96.

Pelkey: And where did that culture come from?

Pugh: I think it came from -- it came from Forney and probably from Kohlenberg, his influence, and the type of people that we had here then, and the MIT influence of not doing something simple. So we always did the hard thing first.

Pelkey: Did Art Carr and you resist that? Did you want to do the things differently, or was that just the talent pool you had, and you just wanted to do --

Pugh: We -- Carr and I were talking about it in terms of why not apply the kind of technology we have to doing simple products better than anybody else could do them. And we talked about it, you know, and Holsinger said, "It's a good idea." And so he left.

Pelkey: And when did he leave?

Pugh: He left about -- he must have left about '72. And he formed Intertel. And what he did, he --

Pelkey: Where was Intertel? Here in Boston?

Pugh: Yeah it was in Burlington. And he founded Intertel, and he did exactly what Carr and I had been talking about, and that is taking this advanced technology and applying it to the low-end products.

Pelkey: What was his first product?

Pugh: His first product was a 2400 bit machine.

Pelkey: Did he have venture capital when he left, or did he try to do it on his own?

Pugh: He used -- essentially, he used stock that he had with Codex, Codex stock, and it was actually -- and there was a big to do about it, I don't know exactly what happened, but he used restricted stock, sold restricted stock, that he shouldn't have done, and there was always a question of whether we were going to sue about it or not. We tended not to try and sue people because it's a dilution of your attention.

Pelkey: Absolutely. Did he take a lot of people with him?

Pugh: He took one other guy, two other guys, two other guys.

Pelkey: Good guys?

Pugh: They were good --

Pelkey: They were -- was it a problem he had taken them?

Pugh: No, it wasn't a big issue. It wasn't a big issue. Actually, one of them died of Hodgkin's Disease, too, one of the guys he took out.

Pelkey: So he left in '72 and formed --

Pugh: He left in '72.

Pelkey: -- Intertel.

Pugh: Intertel. And he was focusing at the low end. You know, applying advanced technology to the low-end. We continued, like I said, to do the hardest thing first.

Pelkey: One thing, I'd kind of like to come back to Micom. When did you become aware of Micom?

Pugh: Well, I knew Micom when they were American Data Systems. We had -- before we had a multiplexer line, we tried to get an OEM deal so we could offer a MUX line to go along with our high-speed mode lines. We needed to break the channels down in async. We didn't have an async MUX.

Pelkey: That was ADS?

Pugh: That was ADS. And that never worked out.

Pelkey: Why?

Pugh: We were in the same market, and they just didn't have an OEM -- they didn't want to sell OEM, just like Codex.

Pelkey: Was Roger there then?

Pugh: No, Evans wasn't there.

Pelkey: So, Bill. You talked to Bill about it.

Pugh: Well, actually I talked to -- Bill, I had only met later. I forget the sales -- the head of marketing, I forget what his name was. But we -- I talked to him. They, like Codex, would not sell OEM, either. We had a lot of people that came to us and wanted to buy our modem. We said, you know, "No way." And Micom -- and ADS -- said the same thing. When Norred founded his new company -- they ran into money problems, they expanded too fast, they were in debt. Terminal business and front-end business and they ran out of money. And they were funded by Rockwell.

Pelkey: Do you remember any of the circumstances around that?

Pugh: Well, let's see, no not the details. Rockwell bought them for -- They were very heavily into one of the venture people, over to one of the banks -- Rockwell came in and bought them for, you know, 10 cents on the dollar, or something. And eventually, Rockwell had a falling out with the people that held ADS's debt. And Rockwell decided just to close them. They said, "We can't come to agreement, so close it up." So they closed it up. It was then the banks or the owners, whoever it was, sold it off to another company -- sold the rights off to another company -- but they didn't last long either. I can't even remember the name of that company. It was a company out in Livermore. But they came up with a product that was a warmed-over ADS product. Norred then founded ADS.

Pelkey: Micom.

Pugh: Micom. And we used to talk a lot, and so he was... His approach then was strictly low-end products. To sell it OEM, to not develop his own sales force through either distributors or through other people. It was an interesting because he needed money. We, at that point in time, would have invested in him.

Pelkey: You would have.

Pugh: We would have invested in him. Norred had made a list. The list of his investors that he wanted to to call. The guy that was right before us on the list was the guy that ended up owning a good portion of Micom.

Pelkey: Thornton.

Pugh: Thornton. Thornton never put a penny in. All Thornton did was guarantee bank loans.

Pelkey: That's not exactly correct.

Pugh: Isn't it?

Pelkey: They put $21,000 into it.

Pugh: They put $21k, okay. Thornton was right before us on the list. We would have owned Micom if our name would have been ahead of Thornton's.

Pelkey: What happened -- if he had come to you, you would have put money up?

Pugh: Oh, yeah.

Pelkey: -- or were you in discussions with him?

Pugh: No, no.

Pelkey: But the other guy saw him first.

Pugh: We would have put money up. We would have put money up and guaranteed it, because we needed that technology.

Pelkey: Now, but, he -- There was no concept of the STAT MUX at this point in time, it was just --

Pugh: No. It was strictly --

Pelkey: -- TDM.

Pugh: -- TDM. But while we were -- after we announced the STAT MUX, then he came up with a low end STAT MUX.

Pelkey: Right. Even though when you first saw this --

Pugh: No, I can't remember -- it had to be in the timeframe of '76 to '78. Because we were so obsessed with trying to get our high-end product working that we had nobody working on the --

[Tape side ends]

Pelkey: So you signed --

Pugh: We signed a deal with Micom to take, I think -- As I remember, the first product we took was a very small, straight TDM. t a two- and four-channel TDM. And I think that's the first product we took. And then we went into their line of low-end STAT MUXes which were oriented -- He designed it exactly the right way for the sales channels that he wanted to use. He wanted to use channels that were non-technical, that were distributor channels so that you could plug it in and go. So there were no adjustments, nothing to do on it. And it was nice for a low-end product. And we sold a lot of them. We felt that --

Pelkey: When do you think you signed that agreement with them?

Pugh: That must have been about '77. And that carried on until we finally came up with our first low-end STAT MUX which had to be sometime in the -- I think it was back sometime -- it must have been sometime like '81, '82. So we had a long-standing agreement with Micom, and they were a very good supplier for us. Because he knew how to deal with OEMs. That's all he did. And if we had a conflict with direct salesman, you know, Dave was right on top of it. Evans came in about the same time. He came in -- he must have come into Micom in the '76 timeframe or something like that, from the U.K.

Pelkey: Did you sign the OEM deal with Micom with Bill or with Roger?

Pugh: I think it was with Roger. I think it was with Roger.

Pelkey: Now when you --

Pugh: The local salesman had set the whole thing up. And --

Pelkey: Do you remember his name?

Pugh: It's in my card file some place, I can't -- He was a rep.

Pelkey: Okay. Now, when you first saw their product, what did you think? Because you're a marketing -- you'd been thinking about STAT MUXes --

Pugh: Very good.

Pelkey: So you were impressed with it.

Pugh: Yeah. I was very impressed with the product, and I knew Norred -- we had talked over the years -- and I knew Norred well enough to know that he was going to do a good product. So it was a good product. It caused us no trouble. We did have one major problem with the Micom from an Underwriters Laboratories standpoint. But they stood behind it. The other thing we did back in that same timeframe, in the '74 timeframe, was that I signed deal with Universal Data Systems to supply us with low-speed modems.

Pelkey: And when was this?

Pugh: That was about -- it must have been about 1974. It was -- I signed the deal because we needed a low-speed modem to go with our 900 multiplexer, which was a straight TDM. That was the -- we did that before we did the 6000 -- the STAT MUX. And we needed low-end stuff, so that was actually the first OEM that Codex ever signed.

Pelkey: With UDS.

Pugh: With UDS.

Pelkey: And George Grumbles was there?

Pugh: And George Grumbles -- yeah. And that was -- I was looking at General Datacomm, Vadic and UDS. Vadic was still independent. They were not tied up with Milgo at that time. And when -- I told George what I wanted, and George showed up, opened up the box, and it had the Codex name on it, Codex colors and the Codex name. And he was the only guy that did that. And the other thing, the reason we got the contract, was his form factor would allow you to mix different kind of modems in the same nest. And that's what we needed. And so we signed the contract with him. They were very good supplier for a couple of years and then we decided that -- Mark Smith, who was the president, decided that -- the company was about 10 million then -- and he either had to go public or sell out. And he decided that he would sell out. So we started the acquisition. About that time, we sold out (to Motorola).

Pelkey: So you started to acquire UDS?

Pugh: Yeah. Yeah, we started the acquisition.

Pelkey: When was this?

Pugh: It must have been in late '76, when we first started talking to them. And it took -- it probably took about six months of talking before they finally decided that they would sell out rather than go public. I wasn't involved in those discussions myself. That was being done by Carr and Storey. And so we started the acquisition and then we ended up by selling out to Motorola.

Pelkey: When did you do that?

Pugh: That started in '77, probably early '77. I think it was finally closed in -- gee, I can't remember my years -- it was either -- it either started in late '76 and closed in '77 or it started in '77 and closed in '78. But I think it was '76 that we started with Motorola. What happened was Motorola sold their television business to Matsushita. And they had a couple hundred million dollars cash floating around. They wanted to get into the datacomm business. They used consultants -- Arthur Andersen was one of them that they used use -- what they wanted was one strong, healthy company that they could buy that would get them into the data business. And I think Codex came up probably first on the list. So they started talking to us. Now, I had nothing to do with that. I was, there was only three people that were involved in those discussions, because we were a public company, too. It was Carr, Storey and Dave Forney. Dave Forney was on the board, the Codex board. It was never quite clear to me why we sold out. Because we were doing very well. We just couldn't make -- we couldn't make enough money. I mean I -- there were years back then when I could -- we could not spend all the development dollars -- we just couldn't hire the people. The modem was generating so much money for the company. But Carr felt that there was going to be a change in the industry, a shake-out in the industry, that you had to be -- you would have to be a good size company in order to be a major player. We had also -- We had been through an experience in terms of LSI, VLSI. Codex had the very first LSI modem. Actually, Rockwell had the first one. ADS. But that was -- they did that for the Japanese fax market. Rockwell did the modem for American Data Systems, which is how Rockwell got involved with ADS. What ADS got out of it was an LSI modem. What Rockwell got out of it was a modem that they could sell in the fax business in Japan and then, of course, ADS came apart, and Rockwell ended up with them, and... But in the meantime, here we were, we had the C Series modem, and we knew we had to go LSI. And it was a major effort for a company of our size to go LSI, and most of the people that were in the semiconductor business were looking for quantities of millions of units a year. And when you started talking about modems, you weren't talking millions, you were talking, you know, if you lied a little bit, you were talking about tens of thousands of modems a year. And you couldn't get anybody to listen. Rockwell again was interested, because they wanted a better modem for the fax business. And they felt that we had the modem technology and so we made a deal with Rockwell where they -- The deal says that they paid us a license. They could not sell the modem to anybody else if was going to be used as a modem. But they could sell it in Japan for the fax business where the modem was buried in the fax machine. And for that they had to pay us a license fee of, I think, five to 10 dollars per modem, which turned into a major revenue source for us, too. They agreed to do the LSI for us. So the first LSI Series modem that we did was done by Rockwell using very ancient technology in terms of LSI. But the modem was a real winner. We sent people out there to do all the modem technology, Forney was still involved in it, we had a -- we hired a new, young guy by the name of Qureshi, Shahid Qureshi, a Pakistani, and he spent a lot of time at Rockwell on the West Coast helping them. Rockwell had some good people on it, and we turned out the first LSI modem.

Pelkey: Which came out when?

Pugh: It came it -- there were -- I think it came out in early '77, because we didn't want to announce the 6000 and our modem at the same announcement. We wanted to spread it out. So we spread it out by about six months. And we needed the MUX more than we needed the modems, since we had a good C Series line that was selling all by itself. So the LSI modem was announced -- we initially brought it out in -- oh, God, and we had all the varieties that we had on the C Series. At that time, we probably had 48, 72, 96, we had some multipoint versions, we had some dial line versions, and we had a -- We hired a young engineer out of Sylvania that was the program manager, a guy by the name of John Lockitt who now is the president of Codex. And he had led that program and we just came up with a line of LSI modems. When we announced that line of modems, I tell you it really wiped out the competition, because nobody else had LSI.

Pelkey: And LSI logic was lower cost?

Pugh: Oh, it was far smaller in size, it was lower in cost, much more reliable, MTBF on it running 40, 50, 60 thousand hours, and nobody else had one. Milgo at that time was the major competition, IBM was just starting to come on the scene, AT&T was still trying, but we had an LSI modem. And I tell you, that -- We

got feedback back from Milgo on that, people that we had since talked to, who claim that it was doomsday down in Miami when we announced that machine. They had long hours, they finally signed a deal with the Japanese to try to get themselves an LSI machine, but they were still two years away.

Pelkey: When did you sign the deal with Rockwell?

Pugh: The Rockwell deal was signed about '74. Carr and Storey did that, and we signed the deal, and Carr tells the Storey that the morning that they were going to go into Rockwell to negotiate the deal, they said "Well, what if Rockwell asks us how many we're gonna sell -- Obviously, Rockwell is going to ask us how many we're going to sell of this thing." Up to that point in time, in terms of the total number of modems that had been sold, we probably still had only sold in the total life of Codex probably less than 10,000 modems. And this was spread over a period of '68 to '74. So Carr said, "Well, let's tell them we're going to sell 50,000." In turns out we sold a lot more. So they bought it, they did their part, they came through very well. We had, you know, lots of ups and downs in terms of this -- They made damn good money on us. They made really good money on us. We started thinking about replacing --

Pelkey: Excuse me. LSI was so successful. You came out with that in at least '77, and you also realized the power of that technology, and so Art probably got concerned and said, "Wait a minute. This semiconductor's going to have a big impact upon this data communications business."

Pugh: Oh yeah, yeah.

Pelkey: And Rockwell --

Pugh: You had to drive the cost down.

Pelkey: -- wasn't a great partner, necessarily. And so he said, "You've got to drive the cost down. We need some more technology in here to be able to build a bigger company and become a dominant company" which why when Motorola came to you -- since they were a big semiconductor operation -- that it seemed to make sense?

Pugh: Well that -- that was one of the reasons why we sold out to Motorola. There were several reasons. First of all, from a cultural standpoint, we viewed Motorola as being very culturally simpler to Codex. Engineering, very engineering-oriented, very technology-oriented, very leading edge technology-oriented, like, you know, a leader in the electronics business in general. From a people standpoint, there was a good fit with the type of -- At that time, the leadership was Galvin, Weiss and Mitchell. Weiss and Mitchell are both hard-nosed engineers. Our management was very engineering-oriented. And so it all fit together. In addition, we knew that we had to have the LSI technology, semiconductor technology, and Motorola had it. And I guess immediately after the acquisition, there was nothing we could do about the Rockwell deal. The Rockwell deal was a good deal. It sort of bothered Motorola a little bit, because Rockwell was a competitor, but Motorola did not have that technology, the same technology that Rockwell had. So we had no alternate sources for the Rockwell chips. Unless it was a complete re-engineering, complete design change. But we immediately started at that point. We knew that another LSI development was going to take probably three to four years. So we started a program at that point to redo it with Motorola technology. And then we came up with a new series of modems which were announced in -- oh, gee, when was that announced, must have been -- announced in about 1984, which we called the 2600 Series modem. And that was all based on the VLSI technology, where we had -- where -- we built a group of VLSI engineers, and put them down in Phoenix, right next to the Motorola facilities, so that we could –so the technology would rub off. And we did a series of chips, and the chips were in some cases more complex than the 68000, in terms of size, area. And we would run it right down the 68000 line, so we took advantage -- What Motorola delivered to us were wafers. And then we would either contract to them or we'd go over off-shore to have them cut and mounted. And so we essentially had our own control, we owned the chips. And this modem is quite revolutionary in terms of, in terms of -- This time, we had run the performance up to 19 2. And I don't know if we were the first ones at 19.2 Kbps or not, probably not. I think Paradyne might have been the first ones.

We actually went through a period where we decided as a corporate decision not to push beyond 9600-bps. And this was after we came out with our L Series modem in '77, the first LSI Series, '77, we said, "Frankly, we've had enough of being pioneers." As Art Carr used to say, "You can always tell the pioneers, because they got the arrows in their ass." And we sure had a lot of them from the AE96 days, and from the STAT MUX days. And so Carr decided he wasn't going to push technology. He -- we -- we could not get our engineers to guarantee the kind of performance at 14.4 Kbps that we were getting at 96, and we wanted no more part of shipping the same thing twice to two different customers. When we shipped a product, we wanted it to work. And so Carr purposely backed off on doing any new development like 14.4. And our development engineers were not working on it as a matter of principle or direction. Now what happened is Paradyne came up with a 14.4. And Paradyne was now growing in importance in terms of being a competitor --they were growing very fast.

Pelkey: Do you remember when this was?

Pugh: Paradyne must have come up with their 14.4 in probably 1980. About the 1980 timeframe. And we decided that -- What happened was Paradyne was getting into our accounts, where we had good, solid accounts. And we didn't have a 14.4, they were getting into our accounts. Earlier, in the late 70's, we had acquired a company in Canada called ESE. They were sort of a skunkworks. And they did a lot of their own things, and we sort of used them as an engineering facility, and they were very strong modem engineers. And I could still not get our engineers to commit to a 14.4 that would run at the performance of the 96.

Pelkey: And Forney was here at that point?

Pugh: Yup, Forney was here.

Pelkey: And he would not commit to that?

Pugh: He would not commit to it. So when I was talking to the people in Canada, they said, "Yeah, we can do it." And so we gave the job to Canada, and Canada came up with a modem which was -- which we marketed as a 14.4. In retrospect, it never was a very profitable device because it cost too much. But it worked. It ran at 14.4, and it ran reasonably well at 14.4. And reliability was not what we'd want today, because it didn't have any VLSI in it. But we sold a lot of them, and we kept Paradyne out of our accounts. Now our engineers got very interested again, and Qureshi now had taken over as the head of research for the modem line. And Qureshi had been -- he was enthralled with this Trellis Coding technique that I think originally came out of IBM, as I remember. There were some IBM papers on it back in the '70s on Trellis Coding. And so we extended some of the principles on Trellis Coding, and we came up with a…When we announced the 2600 Series, we had 14.4 as the flagship product. And knowing that we could also take that to 19.2. And we did some work on automatic, what we call "fall back/fall forward," because up to that time, you had to set the speed. If it didn't work at 14.4, you set it back at 12.8, or whatever the next speed was. But you did it manually. What we did in that machine was that if it wouldn't work at 14.4, it would automatically fall back to the next multiple. And then both ends would operate completely unattended. But it would tell you what speed it was running at. And so that worked out. Then we went up to 19.2 on that with yet another level of Trellis Coding.

Pelkey: When did you come out with that?

Pugh: 19.2 must have come out in about, probably about '85. And we were about the same -- about the same time. I think Paradyne probably beat us out by four or five months. But from a performance standpoint, ours was much better. So today the 19.2 is the flagship. Back in about, it must have been about 1980, we started to see the tariff structure start to change, and more and more of the digital T1 circuits started to become available. DES was available back in the early '70s. But you started to see more of the T1 become available, and we could see the direction of the tariffs, and up to this point, we were able to continue to market for dedicated line dial modems, because we were able to continue to up the speed and to reduce the sale price, the average sale price, to make it more economical to go analog than digital. So we could still show the customer that it was better to go analog. In about the '80 or '81, as

a result of some work my marketing department was doing at that time, we could see that we're not going to be able to keep up anymore. And even at 19.2, it was only going to be a matter of time before the customer could do much better by going with T1, digital. And so we decided that we had to get into this digital business, the T1 business. We were not very successful in terms of getting a program going. We actually screwed around with it for about two years, and never came up with a product. So we got --

Pelkey: Lack of talent? Or management commitment?

Pugh: Management commitment. I think it was management commitment. The company was getting a whole lot bigger. It was getting more difficult to manage. There was much more competition for funding of the various programs, and nobody put together a good program. At that point in time, we also decided we wanted to get into the LAN business. So we started spending money in the LAN area, and the T1 area, we just got behind. So we solved that by OEMing products from Stratacom, we also got some from Avanti.

Pelkey: And you did the Avanti deal first?

Pugh: Yeah, we did the Avanti deal first.

Pelkey: When did you first do Avanti?

Pugh: That started -- it must have started about '84.

Pelkey: And Stratacom was --

Pugh: Stratacom was '87.

Pelkey: '87?

Pugh: Yeah.

Pelkey: Um, the fact that you weren't successful, um, how much of that rests on your shoulders in the sense of being head of marketing and not getting support within the organization for the program?

Pugh: I wasn't head of marketing any more then. We reorganized in 1982, and they took marketing and broke it up and we formed product lines. So marketing now -- we had multiple marketing organizations. I ran a group called corporate marketing which had promotions, advertising, market research, strategic planning. But not product planning or product management.

Pelkey: Was there a product line management group for T1?

Pugh: Yes. That was in multiplexer product line. And that was headed up by -- it was headed up by an engineer. He just didn't have the marketing people in there.

Pelkey: Did you know that?

Pugh: Yeah. Yeah, we knew they were falling behind, and Jim Storey was extremely frustrated, because he could not get the programs moving. I made a major presentation to Motorola, and talked about the same thing I'm talking about to you in terms of the tariff structures, why you had to be in this business, what the threat was to Codex in the analog business, and that we had to move. And Storey bought it. He was president of the company then, and he bought it. He tried to get the program going. The engineering manager that was trying to get it started was essentially a small company guy. He would not staff up the place. It was staffed at much too low a level. The program never really got started, he never brought the right kind of engineers in, the people that had the knowledge, the marketing people that had the knowledge, and the program just stumbled along for two or three years. And we had a lot of turnover,

because the marketing people became frustrated and they left. A lot of marketing people left. And it just never got anyplace. Finally, we signed the deal with Avanti - -

Pelkey: In terms of this book I'm writing, in terms of small companies and how we grow technology, and this small company versus the bigger company, yet you're competing with much bigger companies, like the Japanese, and how are we going to push forward…If you look at a lot of the developments, I mean, the datacom business is a great example that came from small companies.

Pugh: Right.

Pelkey: Here's Codex that was a small company, now it's part of a bigger company, Motorola, but there are a number of you over there from when it was a small company. And here's this new technology which we're aware of -- and I'll come to the LAN in a minute -- but the T1 technology was just really --

Pugh: -- couldn't pull it off.

Pelkey: -- and you couldn't pull it off. And some of it was just because you had to decentralize the organization --

Pugh: It is.

Pelkey: -- and you were trying to create management structures and layers and were trying to get things done through --

Pugh: That's some of it. It's also --

Pelkey: Some of it was incompetence in the people who were doing the program.

Pugh: Yeah. But you -- when you come up with your development priorities, okay, your first focus in a large company goes to defending your current good businesses. You do everything necessary to defend your current good businesses. Secondly, if you have any money left over, then you try to expand your market base in your current good businesses. By that, maybe adding some products that broaden your base a little bit. And if you got any money left over after that, now you go into new areas. And the T1 area was a new area as far as Codex was concerned. So the amount of money that we put into that was relatively small. The amount we could put into that was relatively small. In the meantime, we were doing a lot of other things.

Pelkey: Small because you had this predisposition about --

Pugh: Well, first of all we had to protect these --

Pelkey: -- protect these first two categories first.

Pugh: We spent everything necessary on the modem business.

Pelkey: How much of that was also a function of that -- When you looked at that product, that also kind of reminded you of the statistical multiplexer, and the early modem, and it's a big, complicated product, maybe lots of service, and maybe it wasn't going to ship and play. Was there any of that kind of thinking about that? Was that a resistance factor?

Pugh: No, I really -- If I look back at the meetings, I think it was really a matter of just plain not funding it enough, and not having the right guy managing it. And we just didn't put enough money into it. And when it started to fall behind, we didn't do anything about it. As a management team, we didn't do anything about it.

Pelkey: So it wasn't the fault of strategic management -- of strategic marketing.

Pugh: I don't think it was the fault of strategic marketing, because I think strategic marketing did what they had to do. And they pointed out the threat and the need for this type of product.

Pelkey: But there wasn't really the commitment in the organization amongst the management to the strategic marketing program --

Pugh: Right. The threat was not --

Pelkey: -- that obvious.

Pugh: The threat was not obvious. I mean we told them the direction, but on the other hand, you tell them a lot of things that happen at a different time scale.

Pelkey: Now if that had been over in the modem business where the threat of modem obsolescence would have been much more apparent -- as opposed to being the STAT MUX group. Would that have made a difference?

Pugh: Oh, yeah. We never would have been caught. I mean, we had been caught one time by not pushing the speed on the modems, and would never be caught again. And besides, Motorola watches very closely what you defend.

Pelkey: So why didn't you put T1 over at the modem group, because that was what was being threatened by T1.

Pugh: Because for one thing, the modem group was totally involved in doing the next generation modems, and that's more important. I mean the other thing -- you can ask the same question -- in terms of modems -- why the leading guy in the PC modem business didn't even exist in 1980?

Pelkey: That's right.

Pugh: So the guys that should have been the leaders in that should have been Codex, and Milgo, Paradyne --

Pelkey: Vadic and UDS.

Pugh: Vadic and UDS.

Pelkey: Vadic and UDS were the ones who --

Pugh: Right. I mean, that was their business. Vadic -- Mark Smith at UDS -- That was their business. We were not in it because it was not our charter, but we kept, and Motorola kept, pounding UDS. Why aren't you in the PC modem business?

Pelkey: Is this before or after Hayes?

Pugh: This was after Hayes. It was about the same time. And when we first started seeing it, Mark Smith said that because there won't be a business there. There won't be a business there, because that is going to become part of the PC business. IBM will gobble it up. Apple will gobble it up. And there won't be any business there. But we all know they never did. They don't make their modems yet.

Pelkey: That's right.

Pugh: And Hayes -- Hayes came in as a -- I think they're still a -- they're still privately held -- Hayes is probably the --

Pelkey: They're half your size?

Pugh: Yeah. So we missed that. Now that's another good question. Why didn't the leaders, that could do this with one hand tied behind them, participate?

Pelkey: Right.

Pugh: And the different channels of distribution. There was a lot of change that was involved. It wasn't terribly different for UDS, because they were still -- they were working through distributors, but not with retail stores. So Hayes came in and approached it fresh. It was not a technology breakthrough by any means. To do a PC modem.

Pelkey: Actually, the first ones didn't work very well.

Pugh: It was nothing. And they captured the market while the big guys didn't. IBM and the PC business --

Pelkey: Talk about that a little bit. You said something about -- Since you're a marketing person -- That issue is the guts of what I'm talking about. How we evolve technology. And we're going to come back to LANs --

Pugh: And it's --

Pelkey: [unreadable]

Pugh: You're really dedicated to your current business. And it's very hard to get people --

[Tape side ends]

Pelkey: So anyway, why they missed the market -- why UDS and Vadic, in particular. That's because they had to protect their own businesses...

Pugh: You're very busy protecting your current, ongoing businesses. It's very difficult to make the change into a new market. And I think that there was -- People didn't recognize -- they did not recognize the importance of the personal computer.

Pelkey: Why?

Pugh: Well the big question everybody asked: "What are you going to use it for?" And that was a concern of the people in that business, too. Well, what people failed to see was you'd have people like Lotus that come out with the spreadsheet packages. That created a need for it. And the software that was developed just created the enormous need for it. I got two of them in my office here.

Pelkey: Yeah, I noticed that.

Pugh: And I wouldn't do without it, I couldn't do without it. I got two at home.

Pelkey: Just on the side, while we're on this issue, what do we American engineering businessmen -- what, based upon your experiences, because you've obviously thought about this -- what do we need to do different in terms of the way we look at doing businesses and running businesses that would --

Pugh: Well, there's nothing wrong.

Pelkey: Yeah, deal with that.

Pugh: Well there's nothing wrong with the way we do business in this country in terms of the entrepreneur. The guy that works for Codex and can't convince Codex to get into a business that we should get into. What he does is, he leaves. And he comes from a good company and so there are the venture people willing to give him money. And he's now got a small lean, mean organization that's willing to work seven days a week, 16 hours a day, and he comes up with something. And when it's a proven technology or a proven market, then the bigger guys start getting into the business. And from a country standpoint, from an economic standpoint, there's nothing wrong with that. From the standpoint of an investor in Motorola, he shouldn't miss this kind of an opportunity window. He shouldn't allow the company to miss this kind of a window.

Pelkey: Right. But we're also competing more and more with -- as the example -- Japanese companies. Where the larger scale, the longer term commitment, technology and so on is -- You're starting to see that they're starting the new things that -- I was at at the FCC the other day. In 1987, only 15 percent of the Part 68 registrations were U.S.-based companies.

Pugh: Is that right?

Pelkey: Eighty-five percent were foreign.

Pugh: Is that right?

Pelkey: Fifteen percent! Does that tell you something? LANs. We can come back to this, but let's talk about LANs. When did you start to -- The issue of LANs is something else that Codex missed out on.

Pugh: Well, what happened on that was --

Pelkey: Because your other business went right to the core.

Pugh: Yes.

Pelkey: You got a data PBX, right?

Pugh: We had a data PBX and a matrix switch.

Pelkey: And a matrix switch. And --

Pugh: We invented that. I mean that was -- we were the first ones on the market.

Pelkey: With a matrix switch?

Pugh: With a matrix switch. We invented that business, we never built the second one. Well, we built the second one, we never built the third one. That starts getting into the premise. Our focus had been primarily from the walls out. And that's where our expertise was. When the LAN business start coming along, it. -- We kept getting -- Bill Weiss was the Motorola president. Well, he was the deputy chairman and they wanted this organization change. You keep getting notes. It would come down to Jim Storey and said, "What about the LAN business? What are you guys doing in the LAN business?" What it would be was a note written on top of a news clipping about a competitor’s product that does this or that -- So these things would come down to me, and I was in strategic marketing at that time, and we'd take a look at it, and we would send them back an answer of, you know, "We're looking at it." So what we did was we kicked off -- I kicked off a study within the company to say, "What is this LAN business?"

Pelkey: When did you kick the study off?

Pugh: 1982. In fact, I got the study in my drawer here. It's one of the things I've kept. And we had -- it was two part. One was to educate the management of Codex. Because when you started talking about LANs, the first thing that would happen was, "Well, we're not in the copper business." And so they couldn't understand -- the management couldn't understand what was in it for Codex. And part of the reason was because we'd always operated at the first of layers of the model. Never gone beyond that. We started to get into the network layer a little bit in the 6000 Series STAT MUX. But essentially we're operating in the transparent layer, and they couldn't understand what the business was. And they kept saying, "Well, there's an Ethernet transceiver. And that's going to be buried on the board. That's gonna be a chip. And so, you know, what's the business for Codex?" So we went through with this study, we defined the segments of the LAN business, and what, indeed, there was in it for Codex and why it was important for Codex to be in this in terms of our strategy to be a networking supplier. And that was presented to the management --

Pelkey: And when did you do that?

Pugh: 1980 -- it must have been 1982, maybe '83.

Pelkey: So networking. Was that a new conceptualization in your business? Networking?

Pugh: November of '82.

Pelkey: November of '82 was the report.

Pugh: November of '82.

Pelkey: And was that part of it reconceptualizing your business or what your business was? 'Cause you said you were kind of the "walls out." Could you see yourself as a networking product company?

Pugh: Well I think the point that we were trying to make in this report was that we -- We had a couple of other programs going on at that time within the company that we were investigating, and one of them was the PBX business. And the other was in the teleconferencing area.

Pelkey: Really.

Pugh: Because what we were trying to do during that timeframe was that we were trying to define, redefine the Codex strategy for -- as we go into the '80s. And we had -- we had all felt that the modem business had been dying in theory since the mid '70s. And that was the good news, because it kept people out of it.

Pelkey: Right. That's right.

Pugh: And we knew that we had to do something else. Motorola kept pushing you on what you're going to be doing. What are you going to be when you grow up. We had studies like -- Galvin says, "Forget about it, you can do it. I want you to come up with some ideas -- you can do anything you want except acquire IBM. What do you want to do when you grow up." And so we did a lot of these studies. We read all the reports that everybody else read, and the PBX business and teleconferencing was going to be a multi-million dollar business. And they were all related to telecommunications. And the LAN business was going to be a good business. We had actually spent a great deal of time and effort as a result of pressures from Motorola on the PBX business. And we finally, after going through all the studies, we said, "This is the business that we really have to be in." And Carr, who was the head now, he had moved to a Motorola position called the Information Systems Group -- he finally said, "No way. We are not going to get in that business." And we had gotten in a guy from IBM. We got him in to head up the LAN business, and he was also heading up the PBX business and a couple of other ideas. What he essentially brought to Codex at that time was IBM thinking. And he had been -- he was high enough up in IBM so he knew all the things that IBM had been thinking about and was spending money on and said, "This is a good

business." So he was pushing this into Codex. And there were essentially three things: The LAN, which we had already signed up to, and that's what we hired him in for, teleconferencing, and PBX. And so when -- Motorola really felt they wanted to be in the PBX business.

Pelkey: I'm sure they did.

Pugh: And Carr refused. Carr said, "There's no way." I said, "My gut feeling says that I don't care what the studies show, it's going to cost you 50 to 100 million dollars to get into that business." And we should have known that the guys that were in there were not going to give it up easy. So when it -- after we'd gone through all of these massive studies, and even lined up potential deals with Nixdorf and a couple of other companies, and Carr said, "No way. We will not do that. I will not bring Codex into that business." And Motorola didn't push him. Motorola said, "Okay. Then we won't do it." Which was one of our better decisions, obviously.

We had a couple of other areas that really looked good. And we spent a lot of money on it. And again, it was a result of some strategic planning, of knowing where the market's going, and one of them was in teleconferencing. We had -- we were working on a system that would provide -- that would use the techniques that we used for adaptive equalization on modems to cancel out the effects of room acoustics. So that we could -- we thought that we could be able to use low-cost rooms for teleconferencing by using this cancellation method. And what we were going to -- our product was going to be -- not only combine the voice, but also we had a TV projector that would allow you to do slow-scan television, and essentially conduct meetings using slide transparencies. You would project a transparency, and it would also copy on a TV. And it would transmit this along with good voice, so that you could have two conference rooms, essentially linked with perfect voice. And be able to show your projectors instantaneously. But we had trouble doing the voice. We had the projection worked out. But we -- The group that was running it had their own marketing people and I was in corporate marketing. They came to me and they wanted to -- they wanted my opinion, and so I said, "Okay. Well, let's do a focus group on this." So we did a couple of focus groups. And the problem that we were running into was cost. And so we did the focus groups and we explained the whole concept and everybody was very excited about it. Good, great, quality voice, like two linked conference rooms, and being able to use the projectors. But the problem was we had to sell them for $50,000. And the customers, when they heard 50,000, they said, "No way." If you had talked, maybe on the outside, $7,000. But you know you really had to be -- IBM ran into exactly the same snake. IBM had a system that they actually installed in a couple of places, but they had to sell theirs for $50,000 and they killed the program. We killed it. That was another dilution. Fortunately, the modem business was paying for all this screwing around.

Pelkey: That was November of '82?

Pugh: That was November of '82, yeah, when the report came out.

Pugh: And so we convinced that company that that Ethernet was a good business. It was necessary -- it was a necessary business to -- because we were not going to be in the PBX business, we had decided that, and that we felt that capturing the data at its source was going to be important to maintaining our strategic thrust in the right area. Outside the walls. And so the first thing we did was sign a deal with Ungermann-Bass.

Pelkey: And when did you sign that? After that report --

Pugh: We signed it -- The Ungermann-Bass deal was signed in -- it must have been signed in '84.

Pelkey: So over a year later.

Pugh: Yeah. We had looked at several companies to sign the deals with, and then we got the IBM guy in, he picked it up, and he had already had experience with Undermann-Bass through IBM. And he -- We felt that it was important to go with a leader, because they would keep the technology moving and give us

the best product. It was a great deal of investment on our part to get Ungermann started and we sold a lot of the Ungermann-Bass systems. We could not -- The problem was that we were competing in the same marketplace. And Ungerwood-Bass was not an OEM supplier. They sold to the end user. And we kept competing and they -- They were in the process of developing their product line and broadening their product line and for us to bring in -- we just couldn't keep up with them. We could not evaluate their product and sell it on a timely basis. Their salesman was always out ahead of us, saying, "You need that, fine, we'll give you that." And he'd come back and would say, "Well, we have to get it from Ungermann-Bass." We started doing our own product line that was going to -- We used some of the Ungerwood-Bass software which we licensed from them. And we brought our own line in, and we started focusing on that. And the idea was eventually to move Ungermann-Bass out and substitute our own product line. In the middle of that, Storey left and Motorola moved Lockitt up as president. Lockitt came out of the modem area of business. And so his focus was much more in terms of modems and the MUXes, because he also had the MUX line for a while before he became president. And so the focus in terms of the LAN business started going down. And it was right in that period of time that we needed the most support from the company. And then what happened was --

Pelkey: Which probably now is '86?

Pugh: No, that was still in '85. Early '85. Then in -- The guy that was heading it up left. The IBM. His name was Murray Bolt.

Pelkey: Murray Bolt.

Pugh: Oh, you'll -- I'll tell you in a minute. I was sitting at home, reading the paper. Breakfast. And all of sudden, Murray Bolt's picture in the paper. I look at it, it said, "Murray Bolt joins Z-Tel as their President." That's the way we all found out about it.

Pelkey: Ohhhhhhh!

Pugh: It was a real class act. Real class act.

Pelkey: He handled himself well.

Pugh: He handled himself well. So he was gone. Bolt had been running into implementation problems. He was running into problems in terms of dilution of … Storey was still here then. Lockitt had not taken over as president. But he was running into more and more problems to get the kind of funding that he wanted because he was a big spender, and he proved that at Z-Tel, too. But he had all kinds of programs going on. And all of a sudden he was gone. And so Storey asked me if I would run the group. So I moved into the group, took over, and then immediately did an inventory, and I called on the managers, too, of everything that was going on, and as a result of him not getting the kind of support that he wanted, certain programs had started and stopped, and we had -- I had some engineers in my group that had been on nine different programs that had been started and stopped. And it wasn't all Murray's fault. A lot of it was the company couldn't afford to put the money into it, and the other problem we ran into was that we had decided ourselves that we were going to stop investing so heavily in the modem business, and Motorola said, "No way." Motorola said, "You're going to first of all do everything you have to do to maintain your position and grow market share in the modem business. And so we don't want to hear you guys come in and saying that you're going to stop investing what you should in the modem business." Which was a good decision on their part. And so we had to back off. And what I had to do was to get rid of the programs that didn't make sense anymore, because if you looked at the market segments -- it was like a checkerboard. A little bit here, a little bit there, a little bit in industrial networking, a little bit in broadband, little bit in Ethernet, token ring, and so we pulled way back.

Storey left, and essentially I lost most of the support for funding. And the other problem that I think was Bolt came in and he had to build up fast. He was staffing up fast. So he went to all parts of the company, and he pulled people in. And these people had no expertise in the LAN business. He had hired a few

outside people from the engineering standpoint that did have some experience in the LAN, but it was pretty hard to find anybody who had LAN experience, but the marketing, he had no people that had LAN experience. nd I came in and the first thing I did was get rid of the marketing people, the head of marketing, because he had no background in it. I brought in another guy that had a limited background. And I essentially had to get rid of him, too, because he just didn't bring enough expertise. We were foundering from a marketing standpoint. I think we had good engineers. But we couldn't define the programs well enough so that they would stick. And at the same time, I was suffering from a lack of funding. Because the funding now was starting to move into the T1 area, and the networking area, so we pulled back a couple of times. Our LAN business today is essentially focusing on the gateways; gateways into the wide area. We're completely out of the premise LAN business from the standpoint of servers or devices that interface with async. And we would like to get back in there, but we'll do it through acquisition, not through internal development, because there's just not enough money.

Pelkey: Good. Let me come back. If I understand correctly, network management, per se, really came about because of multi-drop, multipoint modems. And that was innovated by Jerry Holsinger at Intertel who were the first ones to came up with that kind of a modem technology. And that was the first place where higher speed protocol, the protocol issues within modems became, started to become an issue in terms of network management and managing the first two layers. You had to know something else. You had to know about addressing, and you had to know -- it was more than the link.

Pugh: Yeah, I guess you had to know some of the technologies.

Pelkey: Why did Codex miss out on that? That was your bread and butter. I mean you built all these big blue networks, and --

Pugh: I saw the need -- I saw the need for this. I sound like a guru, but from a marketing standpoint back in ‘70 -- it must have been 1973, '74, when we first got into multipoint. During that period of time, we announced the first 4800 that multipoint modem. And we did it in a very clever way.

Pelkey: When was this?

Pugh: It was in about '74. We took our old C Series modem, and we -- I told the engineers what I wanted -- and it was a result of talking to customers. And what we wanted -- most of the polls are -- you get a NAK for a poll. You send the poll out and the guy's got nothing to send. So what you wanted to get was that information back very fast. So that you didn't want to take the -- The training time for 4800 in those days was about, let's see, what was it running? It must have been running about 50 milliseconds. A 2400 had essentially no training time. So I told the engineers that I had to get back one or two characters very fast, so that if it was a NAK, you didn't bother going through the waiting time of 50 milliseconds, or a 100, maybe it was even 200, I just can't remember what the time was, but it was too much time to wait. And so they came back, and they said, "Here's what we can do. We can have the modem essentially start transmitting at 2400, and we can get you back your answer immediately. And while we're transmitting the answer, we will be adapting to the circuit -- doing the adaptive equalization on the data. So that if it lasted longer than three characters, by that time they were equalized, now they could shift immediately to 4800 to get the rest of the data. It was an automatic shift. And we called it a “gear shift” modem. That was the slang for it, and I said, "You can't market it as a gear shift," so we named it the Fast Poll modem. And it would run at 4800. It was the first 4800 bit multipoint polling modem.

As we start to install them, we could see that it -- a 4800 bit multi-poll, multipoint network -- was a hard thing for the customer to manage. And if he had eight or ten lines, all of a sudden he had a real problem in managing the modems. So I told the engineers that we needed some kind of a network management system. And, again, it was a matter of funding and personnel issues that we could not do that and the modem at the same time. So we did the modem first. We finally -- we came up with our first management system in about '76. We called it the CQMS - Circuit Quality Monitoring System. And it was very much of an engineering tool. It had all kinds of dials and lights and it could do things like store events that would happen over the night so you'd come back and you could recreate the events through a memory system so you could find out what happened and play it back again. But it was a very engineering-oriented tool.

Although a lot of the customers liked it, most of the customers wanted something much more sophisticated. So we knew we needed a network manager. Again, we started out and we understaffed it. In the meantime, Intertel had come up with its banking business. They had the first one, the first advanced system. I think probably CQMS was before him, but... CQMS was an engineering tool. And then Paradyne came up with a much more sophisticated system. And the Paradyne was a -- it raised hell with us in the '79 timeframe. '79, '80 timeframe. We were behind. We were developing it, but we were -- we were having a very bad time trying to develop it from the technology standpoint. And some of the problem was choosing the wrong computer to put it on. But we worked -- we spent a lot of money, we worked hard at it, and we essentially fell behind. Paradyne took a lot of our acccounts, because they had a better system. Milgo was also behind. Milgo and Codex, we were running just about neck and neck on management Intertel had other problems. And so they never were able to capitalize. Paradyne's the one that really cleaned up with their network manager -- network management system.

Pelkey: These were all introduced after Intertel, though.

Pugh: They were all introduced -- they were all in the 1980 timeframe. Intertel was probably in there as early as '76, '77 timeframe, yes. And we were in there with our crude system at that point in time, which was great for dedicated lines, but not right for multipoint lines. I think we came out with our first network manager probably about 1980. The first one was based on a terminal that we got from Motorola. It was a Motorola terminal they sold out of their -- out of a group out in Phoenix. And it just didn't have enough power. It didn't have enough software tools to develop the kind of management software that you needed to do it. Paradyne probably used the terminal that they had developed for Social Security on their first system. We got behind. We stayed behind for several years, and it cost us a lot of business. Today we've caught up with them, and we're the leaders.

Pelkey: In that case, did you go back -- were you able to take back those accounts that you'd lost to Paradyne?

Pugh: Yeah, we'd get some of them back.

Pelkey: Some of them back. But they would keep the majority of the ones that they took away from you.

Pugh: Well, Paradyne had so many quality problems that we got a lot of them back just based on better quality. They couldn't keep the modems running. So from a quality standpoint, many customers came back to us. Essentially, they've run into all kinds of problems as you know.

Pelkey: Why didn't guys get involved in dial-up, rather than your OEM deal. Why didn't you go over -- take your engineering, I mean, you knew this modem technology. Why didn't you become a factor in dial-up?

Pugh: That's a very good question. We had our first dial modem back in the early '70s. We had a 4800 that we built, and we had a terrible time understanding what was involved in the dial business. And then we sort of got out of it again, and then we were on the fringes of it... Again, I think it was primarily because we were focusing on your mainstream business. The dial business is a little bit different, and it's marketed a little bit different than your dedicated line business, and we separated them in terms of our business. And we still have them separated.

Pelkey: Now, now --

Pugh: I mean that doesn't explain it. I don't really know, except it's just a matter of focus.

Pelkey: Was it a function of ...? You were direct sales almost from the beginning, right?

Pugh: Right.

Pelkey: And when your salesman went in, they could sell -- but they went and sold their modems to a Big Blue shop, because you must have been 90 percent IBM.

Pugh: Yup, yup.

Pelkey: It was -- I mean, they sold a lot of them. It was a big order. It wasn't a onesie, twosy.

Pugh: That's right, right.

Pelkey: Dial-ups were sold -- dial-ups weren't largely sold direct.

Pugh: That's right. They were sold through alternate channels --

Pelkey: -- alternate channels. Now Racal/Milgo wasn't direct either, were they?

Pugh: They were --

Pelkey: They had reps.

Pugh: They had both. They had a mixture of direct, and they had -- They had reps far longer than we had reps.

Pelkey: When did you have -- You didn't start reps 'til later?

Pugh: We never started reps until 1980.

Pelkey: But they had reps way back in the '60s.

Pugh: Oh, yeah. They started out that way.

Pelkey: Why did they go to direct? Do you know?

Pugh: Well they started going direct in the '70s, some areas.

Pelkey: Some areas. But not all over --

Pugh: But not all over. I think they probably still are not all total direct. Right now, we have -- we've gone -- we have a catalog, we have distributors, we have -- we don't have any reps any more. We have value-added resellers, you know, everything you can think of. And the catalog business is a great business.

Pelkey: Now, Paradyne -- when Paradyne came in, they came in as an OEM.

Pugh: Into the dial business.

Pelkey: Well, I though -- Didn't they start out in the lease line business?

Pugh: They started off in the lease line business, but I don't think they were OEM.

Pelkey: Oh, I thought they were OEM.

Pugh: I don't think so. I think they were --

Pelkey: I thought they supplied the computer manufacturers and such.

Pugh: No, they went -- they were --

Pelkey: I thought that was the opening you guys left. That you weren't focusing in the OEM business, and they got the foothold into the business through the OEMs.

Pugh: I think Milgo had more of the OEM business than Paradyne. I --

Pelkey: 'Cause you guys weren't OEM at all.

Pugh: No we weren't OEM at all, no.

Pelkey: You were direct -- big customers.

Pugh: Well, we feel -- Because we were not about to sell our technology to anybody.

Pelkey: No.

Pugh: Except an end-user. That was -- Again, it was a company policy -- it was an Art Carr policy. He would not sell, he would not sell OEM. He said, "Well what do you mean? We've got the best modem here, and why should we sell it to somebody else? Let them sell it.We'll sell it ourselves." And that was the policy that we used for years.

Pelkey: Was that the right policy?

Pugh: I think it was. I think it was the right policy because we had the best product.

Pelkey: You finally OEM'ed the modem to Micom.

Pugh: Yeah, we OEM'ed the boards to Micom.

Pelkey: The boards.

Pugh: Yeah.

Pelkey: You sold a lot of those to Micom.

Pugh: We did that through UDS.

Pelkey: Oh, you did do it through UDS.

Pugh: Yeah.

[Tape side ends]

Pelkey: I understood that Rockwell wouldn't sell you chips...

Pugh: For the first -- I think for the first four or five years of our relationship with Rockwell, they would not sell us chips. They would only sell us boards. And we finally -- they finally negotiated a deal where we could get so many chips in relation to the number of boards we got.

Pelkey: Around what timeframe? Late '70s.

Pugh: Let's see, it must have been late '70s.

Pelkey: '70s.

Pugh: Yeah. And then we had -- then we started selling the chips to UDS. UDS then turned -- I think we negotiated the deal. As I remember, Lowry -- Ralph Lowry used to work for me -- negotiated the deal with UDS -- with Rockwell. And so UDS essentially built the boards up with the chips that we bought from Rockwell, and moved them out to Micom. But that was never a very big business.

Pelkey: That wasn't. But was it -- From your perspective as a marketing person, you perceive yourself as selling a lot of Micom STAT MUXes.

Pugh: Yeah.

Pelkey: But when you started selling modems to them, did it surprise you how many they took...of your modems, relative to the number of their STAT MUXes you were selling? Or was it kind of a noise issue?

Pugh: I don't recall it ever became an issue one way or the other. I'm not even sure that we followed -- that I followed the number of modems they took.

Pelkey: Okay. Was the fact of what Micom was doing in the late '70s and early '80s -- did that ever...?

Pugh: Yes, that bothered us.

Pelkey: It did. Okay.

Pugh: Yeah it bothered us. It bothered us for one reason and that is that we had -- we felt we were very successful, very instrumental in making them successful with the deal that we had signed with them in the mid-'70s.

Pelkey: Of buying their --

Pugh: Of buying their product. We bought a lot of their product when they were a small company. So we felt that --

Pelkey: The TDM.

Pugh: Yeah the TDM. And so one of the thing that always bothered us was the fact that the -- that it became the policy of the company for a while that we would not OEM unless we got a part of the business. Unless we were either warrants or investment in the company. And that was a strict policy of Storey. And it really complicated the negotiating.

Pelkey: Do you still have that policy?

Pugh: No. So that complicated the deals enormously. But it was because of Micom's success. Now Micom is falling into difficult times.

Pelkey: Why?

Pugh: Because the box business has started to disappear. And Micom's been in the box business. Customers are -- customers no longer want to buy boxes. What customers want to buy are solutions. And so the -- Micom which has always sold boxes and through distributors, that business is flattening and starting to dry up. We made some major changes in our company, too. And we recognized that the box business is -- it's a wonderful business to be in, but it's disappearing. And so you have to start selling solutions and selling systems. By systems, that's a little bit of an ambiguous term, but what it really says is that you got to sit down with a customer and solve their problems. And when it comes to installing it, you've got to provide the customer with installation services and support services and follow-up services from a system standpoint, as opposed to, say, "Mr. Customer, here's your boxes. We know they all work together, all you got to do is buy the cables and plug them in. And if it doesn't work, we'll fix it."

Customers don't buy that anymore. They're buying solutions. Micom recognized that and they tried to make the change. But making the change from a company that is primarily selling through distributors is awful hard. They've got a -- it's awful hard to change.

Pelkey: Was that also a problem for UDS?

Pugh: Yeah, that's right. And they tried to -- they tried to bring Interlan into the fold, and they screwed around with it for a long time, and they couldn't do it. And Barker went out there and ran Interlan and he has his own sales force and he runs independently and it's doing reasonably well. he black box catalog is doing very well for Micom. But the basic -- the mainstream business -- of Micom, the boxes, the STAT MUX boxes, the low-end modem boxes, the data PBXs -- are just not selling any more. And that's their problem. And we see it, too.

Pelkey: But data PBX was never an important product to you. You had it in your product line, but it was --

Pugh: Well, we never really had a data PBX. When we got into that business, we didn't actually know what we had. It was a development program that was not specified by marketing. It was something that one of the engineers wanted to do. And the engineer -- he did this, and then he came to marketing, and said he did it for a couple of customers. And apparently our controls weren't tight enough, because we let him do it. And then he came to marketing and he said, "Gee. I got this thing here that will do all these things." So the first product that we -- When the marketing people -- and that was under me at that time -- looked at it and said, "Gee, this is a data PBX or a matrix switch. It can be used all the way from switching front-ends, to providing a switch selector for dial-in." They didn't recognize it was two markets. And so we first tried to market it as one product, with options of making it go this way or that way, and that was very difficult from a delivery standpoint, from a manufacturing/delivery standpoint and configuration standpoint, and also we found it was two different markets. Then we split the product in two and we said, "Okay, this is the matrix switch and this is the data PBX." It was a much better matrix switch than it was a data PBX. So the matrix switch business really took off. And we couldn't build them fast enough. And that's when Bang-woel Lu and Steve Finn left the company. And they were looking for something to do. When Bang-woel left the company, he didn't know what he was going to do.

Pelkey: And he was the one who kind of -- he was the engineer who went wild and created the stuff.

Pugh: That was Finn.

Pelkey: Oh. Finn went wild and crazy.

Pugh: Oh, you mean at Codex?

Pelkey: Yeah.

Pugh: Oh, no, no. At Codex, he was one of the VPs.

Pelkey: So they left -- they left about '79.

Pugh: About that time. And they were looking for something to do, and Bang-woel had a lot of ideas that he was exploring, and I don't know exactly how -- where he got venture funding, but eventually -- One of the reasons he got into the matrix switch business is because we had stumbled into a product where we had the only one on the market and our backlog was just enormous. We couldn't supply them fast enough.

Pelkey: And they knew it.

Pugh: And they knew it. And it was a little bit deceiving, because the reason we had such a big backlog on it was because we were having a hell of a time building it. Okay? So we had a --

Pelkey: Okay. You weren't shipping --

Pugh: We weren't shipping. The backlog kept building up, and all of a sudden when we solved the manufacturing problems, the backlog went away, and then it settled down to about a $5 million a year business. And then we came up with a replacement product. We completely dropped the data PBX, because we were having so much trouble with it from an implementation standpoint. And again, it wasn't our mainstream market. But the data switch --

Pelkey: Why do you say it wasn't mainstream?

Pugh: Well, because it was really more of a premise type, it was a premise-type product, as opposed to a wide-area network product like the matrix switch. And the matrix switch was a survival-type product that was involved in dedicated lines and the data PBX was really a dial-type product and we weren't strong in the dial business.

Pelkey: Was it because it sold mainly where it was remote job entry --

Pugh: Yeah.

Pelkey: -- and where it was lease lines, and wide-area network. You got no asynchronous, which tended to be more intra-facility, inter- building.

Pugh: Yeah, yeah. So we never did replace the data PBX. We did replace the first matrix switch with a new model switch that was more cost effective, different size, and had some of the restrictions pulled out. But we never followed through in terms of support engineering. That product for Codex has been selling for -- God, I don't know -- we still run at about a $5 million a year rate, and we have no engineering support, no marketing people on it --

Pelkey: You sell it because it's a -- The customer buys a solution from you.

Pugh: He buys a solution from us, and he doesn't then go out and say, "Now, who's got the best matrix switch?" Okay? What he says is he says, "I want a solution." We got a matrix switch that if it fits, we use it. If it doesn't fit, we figure out some other way.

Pelkey: Or if you figure out a solution with another box.

Pugh: Yeah. But in the meantime, Vadic picked that business up and they've probably got a decent market share in it now. Micom on the other hand went more towards the PBX, the data PBX.

Pelkey: Which was not your concern, because it was an asynchronous market.

Pugh: Yup.

Pelkey: Do you -- The modem business then, the leased- line modem business, which was really the growth up until probably '76 after Part 68. Once you started using the universal jack, and you didn't have a separate DAA. The dial-up business really didn't strengthen until you got rid of that DAA. Right? Which came as a consequence of Carterfone.

Pugh: I don't know if that really restricted it or not, because DAAs were only $10 boxes.

Pelkey: Okay, but you had to get installed, which was --

Pugh: Yeah, that was a bit of a nuisance, and so when they started -- when you had integral DAAs or they had registration, it did away with that, but I'm not sure that -- I don't think that caused the market change. I mean, the market took off because -- You see, you've got to recognize, people in the

communications business like us don't generate the business. I mean, we are secondary sale. The business is driven by the computer manufacturers, terminal manufacturers, the valued-added-type manufacturers, and we had to be there to satisfy the need. Now there are segments of the business where you do generate primary demand, and that is in the area of T1 business. I mean, the line is there, but what you're doing is showing the guy a way to save money.

Pelkey: STAT MUX?

Pugh: And STAT MUX is closer to that. They're closer to that where you can -- you build a guy a network.

Pelkey: You're building, selling product into existing networks [unreadable] --

Pugh: We sell cost-effective, up-time, reliability, maintainability, and so forth. And so it's more of a primary sale than -- But still, nobody goes out to buy a network. They go out and they buy a computer system, an information system, and then the network is a necessary part of it.

Pelkey: Yes, I agree.

Pugh: Certainly the computer manufacturers are creating primary demand, because they're showing customers how to do the things they're doing today, in a different way. And in a way, we do that, too, in the networking business. We sell them what they're doing today in a different and better way.

Pelkey: Gotch ya. Do you perceive from your standpoint that this issue of application-specific networks, where you buy yet another applications-specific computer to do something and so you put a network in to satisfy that need – has this helped create this movement towards what we call the utility networks? Is this in fact a real trend where the corporations are saying, "Wait a minute. We have all these networks around. Let's start to put them on one single backbone," to save money.

Pugh: That's been -- That was the prime motivation for us doing the 6030. And back in the mid-'70s, I thought people were going to be going that direction. And that is combining the various networks. And the 6030 was spec'ed so that it could combine IBM SDLC networks, it could have some async networks in there, and you had all the special protocols... And so the idea was that you could build a network that would bring in all the IBM stuff, all the Univac stuff, all the various and sundry vendors that you had, into one backbone network. And that was a major idea behind the 6030 product.

Pelkey: And that's been a good product for you.

Pugh: That's been a very good product, yeah. But that product now is starting to – STAT MUXes are starting to flatten out and die, too. We really think the STAT MUX business is finished.

Pelkey: Yeah. I can't disagree with that. When you saw the Micom orange juice can ad, as a marketing person, what did you think of that?

Pugh: I thought it was terrible.

Pelkey: In retrospect, now do you think it was terrible?

Pugh: I still think it was, yeah.

Pelkey: Why?

Pugh: I think it was -- it is -- It didn't communicate enough information. It was -- It may have been a stopper for a while, but I'm not sure that in the long-term that people really associated that with Micom. Do

you remember the old Honeywell ads that used to have the animals made up of resistors and all that stuff?

Pelkey: Oh, I think so, yeah.

Pugh: Yeah. I mean, that was the same thing. You remember the animal, but you don't remember who had the animal, who the company was. And I think their orange juice -- I never did like those ads.

Pelkey: Do you remember in the data communications business any marketing campaigns or marketing communication campaigns or anything that from your perspective distinguished an organization by its marketing? As opposed to its technology.

Pugh: I think the -- We had one series of ads that lasted a little over a year that I think were very good. And I think it really did set us apart for a while. And it was a series of ads we called "Beyond the Computer." And it was a whole campaign that we -- that one of the guys who worked for me came up with. And --

Pelkey: What year was this?

Pugh: That was about '78. And the whole theme of it was you select your terminals, you select your computers, and -- It was what was beyond the computer that was what Codex supplied. And so we used "Beyond the Computer" in all of our ads. And I think it meant something -- To me, it meant something to the customer. And we did get a great deal of recognition for it. In fact, it was in those years when the surveys would come out -- people associated Codex with things that we weren't even in. Because when you asked for, you know, "Who's in the front-end business, who comes to your mind, top of mind recognition." They'd have IBM, who was definitely in the business, they'd list AT&T, who was not in the business, they'd would list Codex, who was not in the business. And they might have listed Memorex or Comten on front-ends. We weren't, you know, we weren't in that business. In one year in particular, I think it must have been around '79 or '80, which was while we were still in that ad series, when you went through the data communications magazines brand recognition study, we were -- IBM was noted for being in I think some 40 different product segments, and Codex was in it for about 36. So we were -- And it was many things we weren't in. But people thought we were in it because of the image, and we tried to create that image particularly because what we were trying to do was to get people to think Codex no matter what their data communications requirement. So if they called us, you know, maybe we could satisfy it, maybe we couldn't. But the idea was to try and get the recognition. And I think we really got it, and we still could get that kind of recognition in ads, but we no longer advertise products. We just don't spend enough money to advertise individual products. So we have to advertise at a higher level, and hope people associate us with the product categories. What we also saw during that period of time was very interesting, and we did studies every year in terms of recognition, and, boy, in the '73, '74, '75 timeframe, we saw Hayes come from nowhere.

Pelkey: From '83.

Pugh: Maybe it was '83. Yeah. Hayes came from no place until they were up some place around 60 percent recognition level. Because every time you turned on your damn computer, you know, it says, "What kind of a modem do you have? Do you have a Hayes modem?" Didn't say you had a Codex modem. So it was just, you know, we missed the -- we missed the importance of that.

Pelkey: Apparently in the modem business, Hayes was a real phenomenon. Spin-outs of Codex, there was -- Holsinger left with Intertel and Steve Finn left with Bytex, and Ken Miller went with --

Pugh: Went with Concord Data.

Pelkey: -- Concord Data.

Pugh: And VanderMey left for Integral Data Systems.

Pelkey: Integral Data Systems.

Pugh: Yes, in the printer business.

Pelkey: Anybody else that left and went into the communications business?

Pugh: Hmmm, let's see. Can't think. I'd have to see a list of names of the companies.

Pelkey: Any -- were there any -- During this timeframe, were there any events or get togethers of people or situations that in your memory were important in terms of how it shaped the industry, or the...

Pugh: You mean formal events?

Pelkey: Yeah, or informal.

Pugh: Well, I still go to the 3C reunion. The 3C reunion, there was -- there probably is more knowledge when you get a good reunion. That's say about every two years. The 3C reunion brings in people like Gardner Henry. Gardner was the founder of the 16-bit computer. He went on to Data General, and then he was one of the founders of Stratus. There is, oh let's see... Bob Barron. Barron was one of the founders of Prime. And there were several other people that -- Prime was really a spin-off of 3C. So, they get together once a year. And you get all these people together. There's also -- Every Codex reunion that we have, be it a retirement party for somebody or something, it brings together just an enormous number of people. Well, Richard Young's company for one thing, I mean, he didn't leave Codex directly. But he left through Timeplex and ended up out of there, but Richard was a -- he was a spin-off of Codex, and he still shows up.

Pelkey: Was Timeplex ever a factor during those years? Their name hasn't come up.

Pugh: They were -- Timeplex was a factor in the multiplexer business. They were -- I always blamed them for screwing up the multiplexer business. And making it bad business for everybody.

Pelkey: Because...

Pugh: Because they priced too low. The modem business for some reason, for some reason, it's hard to say, people were much -- And it probably was the influence of AT&T in there, I mean, in the umbrella that AT&T formed.

Pelkey: So you always priced a little bit lower than AT&T.

Pugh: Yeah. And so that umbrella was there. And in the dedicated line business, Codex essentially became the price leader, and people just started to price a little bit under us.

Pelkey: And you allowed that. You didn't go down and try to beat them.

Pugh: We never did.

Pelkey: Because you're the market share leader. Why take the --

Pugh: We didn't. And we got really complacent, too, in terms of not changing prices back in the late '70s.

Pelkey: Encourages competition.

Pugh: Yeah, it encourages competition. It causes some loss of market share, because we allowed the people to come in under us --

Pelkey: Like who?

Pugh: -- and take our business. Paradyne.

Pelkey: Paradyne in particular. Okay.

Pugh: Paradyne in particular. But Timeplex in the nux business -- The multiplexing pricing was alway too low for the value received. And, just in terms of the cost of the product. I mean the products never had the margins. The only way you made money in the multiplexer business was leasing. And the small companies couldn't afford to lease. We -- we always carried our own lease paper. So if we had to price our multiplexers based upon return on a purchase price, it's bad business. But the good news is when they went out on lease, they stayed forever. Because it was too hard to change them out. And so the margins were very good, because we carried our paper. Timeplex never carried their paper. Paradyne never carried their paper. And so they were -- Timeplex always suffered from a profitability standpoint. They were always marginally profitable until they got the T1 business. And the T1 business propelled to profitability, and still they weren't terribly profitable.

Pelkey: General Datacomm kind of -- they never were a factor?

Pugh: No, they were slack-offs.

Pelkey: They were what?

Pugh: Slack-offs.

Pelkey: Yeah. I mean Charlie Johnson's always talked a big game, but they never pulled it off.

Pugh: They got their technology -- their modem technology -- out of Holsinger.

Pelkey: I didn't know that.

Pugh: And they did because Holsinger essentially defaulted on a contract. Charlie --

Pelkey: After he left you?

Pugh: Yeah. He built the 2400, and he had a dial -- he had a very good 2400. We didn't even have a 2400 at that time. General Datacomm was- -they got started in the MUX business, and they needed a 2400. They went to Holsinger, they got a 2400, but they had the intellectual rights and the designs on it in the event Holsinger couldn't deliver. Holsinger had problems delivering, Johnson took the product, and Holsinger lost it. Didn’t get a penny for it. He took the Holsinger product and learned -- they learned the modem business by taking the Holsinger product. So that's how he got into the modem end of the business.

Pelkey: And what -- Holsinger then went and founded Intertel?

Pugh: Well, no, Intertel, Intertel -- They had to use -- they had to give up the name Intertel. 'Cause Intertel was being used by another company. So they just changed the name.

Pelkey: Just changed the name.

Pugh: Yeah. Then you had to sell out. He never could get it profitable enough to take it public.

Pelkey: So he could keep the technology, too, but he had nonexclusive rights, because --

Pugh: Right.

Pelkey: -- took over.

Pugh: General Datacomm had the right to -- since he defaulted on the contract, they took over the rights to it and built the 2400 bit product. GDC was a factor in the MUX business in the early days. They had some fairly good multiplexers.

Pelkey: They focus on the RBOC's.

Pugh: Yeah.

Pelkey: Selling the telephone system.

Pugh: Yeah. And that was Johnson's expertise. He was -- he did -- Prior to General Datacomm, he had -- I don't think he came out of the RBOC's, but I think he had always been selling to them.

Pelkey: The other [unreadable] this time was Hayes-- I mean, DCA buying the Irma board.

Pugh: Yeah. I'm not sure they knew what they were doing. But, DCA had a great deal of trouble in the early days just hanging together. In fact, we almost bought them one time.

Pelkey: Did you really?

Pugh: Yeah.

Pelkey: When they were in trouble?

Pugh: Yeah.

Pelkey: Do you remember when that was?

Pugh: It had to be like in '74. We also almost bought Timeplex.

Pelkey: Did you really?

Pugh: Yeah. Timeplex --

Pelkey: When?

Pugh: Timeplex was -- that was in the early '70s.

Pelkey: Before Botwinick was there?

Pugh: I think it was before Botwinick. I think they put Botwinick in as a result of the trouble they were having. We went down and kicked the tires and we didn't see anything worthwhile. And that was before Botwinick. I think Carson was the president then. Guy by the name of Carson. Maybe he was VP of marketing. But we had a policy in the company of growing through internal development, and not through acquisition. Which is no longer the case. Nothing you can do. You've got to --

Pelkey: Acquire.

Pugh: So that's essentially the work I'm doing now.

Pelkey: Anything that we haven't discussed that's relative to data communications business from your perspective or Codex perspective or a useful perspective or something that was significant in the development of the industry that we haven't kind of touched on that comes to mind?

Pugh: Nothing comes to mind. I think we've covered most everything. Most of the important events. The important events have been the changes in the computing industry that have driven change and the ability to be at the right time with the right product.

Pelkey: Deregulation, which I think -- that and the tariff changes in T1. Because the customers --

Pugh: I'm not sure deregulation really did anything one way or another.

Pelkey: I say that because now the customer can't get into managed services. And so the whole concept of going to other parties leaves this opportunity --

Pugh: That's true.

Pelkey: -- for companies like you to provide end-to-end services.

Pugh: Yeah. I think the biggest thing that deregulation did for our business was that it slowed down ISDN. And it put ISDN --

Pelkey: Fortunately, it didn't kill it.

Pugh: Didn't kill it, it put it into turmoil, and --

Pelkey: It's a boondoggle.

Pugh: It's going to be years before it is a factor.

Pelkey: I agree, I agree. And 144 kilobits still works.

Pugh: The other important event that we haven't talked about is the announcement of DDS.

Pelkey: No, we haven't talked about that.

Pugh: What DDS did for us was it kept the competition out of the modem business.

Pelkey: Oh, yeah. Let's see, when was that?

Pugh: That was '70 -- they started talking about it in '72. And I think the first DDS circuits started going in in about '74. And --

Pelkey: So you just didn't see that there was much of a market --

Pugh: That was a very key, very key time, because that was the time when we had our C Series modem that was -- we just couldn't build it fast enough. It was the only thing that worked. And we were growing so fast. The company was doubling in size every year. And we had no competition. I mean, we had the traditional competition that had nothing better to do, for instance, Milgo and Rixon. And -- but it kept the new guys out of it. IBM fooled around and stayed out of it. AT&T was the one that said modems were going to die, but they had -- they always had two or three programs going on at Bell Labs to bring out new series of modems. But it kept the Honeywell's and all the other guys that could have come in and been a factor in it because it was a -- you know, if you run through the strategic analysis of it, you're going to say who wants to spend money on modems when DDS is coming? And it scared us, too, and it probably -- it certainly would limit the amount of venture capital that would go into startups in the modem business. So

it was good for us, and maybe not necessarily good for the industry, but it was good for us, because we were already there.

Pelkey: Were you aware of in the '70s, in the late '70s, of Arpanet?

Pugh: Oh, yeah.

Pelkey: Did you think that that was going to be important or what was coming out was going to be important, or...? Or is that just kind of a government thing that was just off there and who knows what?.

Pugh: Actually, the first computers that were sold into the Arpanet were Honeywell. I think it was either the 116 or the 516, and I was involved with that a little bit back in the early '70s, when we were selling the product to BB&N when I worked for Honeywell. The packet switching, I felt was not going to win over circuit switching, because of protocol sensitivity. And nobody was signing up to do, to do the X.25 interface. So I was very skeptical if X.25 would ever take off. And in the international marketplace, which was taking off faster, I was concerned myself, and probably wrong, that there were going to much intense nationalism that they would not buy a packet switch from a foreigner. In the States, we saw Tymnet and Telenet struggling and not making any money. And I'm not sure that they make any money today on it. Now where the business is today in the X.25 area, I think, is first in the government. The government is still big in the X.25, and some of the private networks are going X.25. However, X.25 as an interface standard is probably a good standard, in wide enough use today so that it's going to continue to be a factor. But the way that things are handled between nodes is rapidly changing. The fast packet technology that is just starting to come in and the hybrid packet/circuit technology, which is a subset really of fast packet, is the way things are going to go.

Pelkey: Fast packet meaning voice and data? Stuffing the line?

Pugh: Yup, stuffing the line. And doing it on a statistical basis. So I think that, as we get into the '90s, that the idea of a hybrid packet/circuit switch where it makes sense to do circuit switching. You just come in on a port, there's a circuit switch, and you set up a virtual circuit. Or if you need to have something much more packet oriented, or lumpy like packet, that you'll select the packet way to do it. The hybrid, the fast packet technology, may well supersede both of them.

Pelkey: I see. My tape's running out.

Pugh: Okay.

Pelkey: I want to thank you immensely for a very, very enjoyable morning and for obviously your care for Codex and your experiences and thanks very much.

Pugh: You're welcome.

END OF INTERVIEW

