Interview of Ken Krechmer

Interviewed by:
James Pelkey

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James Pelkey: I obviously wanted to talk to you because of your early involvement in the data communications industry.

Ken Krechmer: It wasn't called data communications originally. It was called telemetry.

Pelkey: Was it really?

Krechmer: In the mid '60s I worked on a range status control system for the White Sands Missile Range and that system was telemetry. It was all discrete transistor logic, and it would transmit range status information on the launch, to the different locations watching/controlling the launch. There were large IEE read-outs, incandescent lights that would flash numbers referring to the launch. Advanced Data Systems a division of Litton Industries built that system and used FSK modems from a company called Radio Frequency Labs, which was one of the pioneers in making modems other than AT&T.

Pelkey: These would be leased-line modems-- out of Dallas?

Krechmer: Boonton, IL, I think.

Pelkey: They're obviously not around any longer.

Krechmer: I don't think they made the transition somewhere in there.

Pelkey: Although there were leased line modems during this period of time, but not very many.

Krechmer: The first published paper describing the implementation of a modem (650 bit/s) appeared in 1955 in the Bell System Technical Journal. TWA and IBM created the first large system that used modems commercially. The story I heard is that IBM's Watson and Hughes the president of TWA, met on an airplane, talked and decided that they would do a new system for implementing airline reservations. The airlines were in a classic position where they were technology leaders. They had access to a lot of capital because their business was growing fast, and was very profitable, and they were willing to take risks. Hughes said: "My problem is I've got all these seats on all these planes. I've got to reserve them in all different locations. How do I do that?" And Watson said: "I think computers could help." Their companies designed a system called PARS, Planned Airline Reservation Service, and that was the first large communication system that used leased line modems and established what became the IBM 2740 terminal. Later on IBM produced PARS-F, which is the financial version of this large transaction oriented system. The PARS were very successful. I think there may still be some PARS working in high volume transaction processing.

Pelkey: I guess they got their modems at that point in time from AT&T?

Krechmer: Right. AT&T had just started in that area, and that was one of the first big commercial data communications accounts.

Pelkey: Who were the first independent guys? Why did they build modems to compete with Bell Labs and AT&T?

Krechmer: At Vadic one engineer who came out of Bell Labs knew about modem circuit design. The opening for small companies was the low cost of operational amplifiers (op amps). Op amps made by Philbrick cost a couple of hundred dollars a piece for vacuum tube devices, and modems weren't cost effective. When op amps became available in integrated circuit form, they became realistic. Then, Bell Labs did the application work to understand how to use op amps in high gain modem applications.

Pelkey: Do you know who was the first supplier of these low cost op amps?

Krechmer: Philbrick did vacuum tube op amps, Burr Brown did modules, and Fairchild did an integrated circuit, the 709. That was the first big op amp.

Pelkey: So the engineer at Vadic said: "Here's -- "

Krechmer: He understood how to do the circuit design. He had basically learned it at Bell Labs. When Vadic started out it wasn't even focused on the modem business. They looked in multiple product/market directions.

Pelkey: Were they the first?

Krechmer: No. Milgo, General DataComm or Codex more likely. Codex was real early. Codex was working for the military.

Pelkey: Was that a venture capital start-up?

Krechmer: Before Art Carr joined, they had done modems for the military, but it was not very profitable. When Carr joined, which was late '60s, they got serious about making modems.

Pelkey: Was it part of Motorola at that point?

Krechmer: No, long before that.

Pelkey: Do you know when it became part of Motorola?

Krechmer: Mid 70's.

Pelkey: Did you ever run across a guy named David Forney?

Krechmer: Oh, sure. Brilliant technical guy, really brilliant, who in turn hired other outstanding engineers.

Pelkey: But Codex was real early and General Datacomm was really early.

Krechmer: Actually Codex probably is close to the first. I don't know if Forney was there at the beginning or not. He'd be the guy to ask, obviously.

Pelkey: I don't think he was there at the beginning, but very close.

Krechmer: You need to ask him about another guy early on, Jerry Holsinger. He was the founder of Intertel, which is now called something else.

Pelkey: A keyset company down in Phoenix?

Krechmer: No. They changed their name from Intertel to something else because of all these problems. A Canadian company acquired them a couple of years ago. I don't know, but Holsinger started Intertel, which was a modem company in the Boston area. If I recall, Holsinger did some early work at Codex as well, and Forney would probably know.

Pelkey: But all the modems were, in fact, just leased line modems.

Krechmer: In the beginning, yes.

Pelkey: And 9600 was the fastest?

Krechmer: When?

Pelkey: '60s.

Krechmer: Likely the 70's. Codex did the first 9600. They hold the patent on the modem constellation. Probably Forney was responsible.

Pelkey: Did that patent ever give them any protection?

Krechmer: It gave them some royalties.

Pelkey: So they licensed it out. Patents have never proven to be a barrier to entry in the modem business. It's never been a source of keeping somebody else from being able to compete in this business.

Krechmer: I think you have to recognize that the patent system, somewhere after the war, ceased to be able to operate as a sieve where it could say: "This is something that's patentable, like a light bulb, and this is something that is not, like fire." If you put fire in a different box, it's still fire. That's obvious. With a light bulb, that's not obvious. After the war, basically the technology went too fast, too far, too quick. What was obvious to somebody practiced in the art was no longer obvious to somebody at the patent office. Lawyers spend a lot of money hassling about it, and companies are getting more and more annoyed with the process. So Vadic and UDS went around about John Bingham's patent on coherent carrier detection, which is a key function. Ultimately Vadic lost on a technicality.

Pelkey: And Bingham was at Vadic.

Krechmer: Yes. So the patents tend to rise and fall on issues that have little to do with their uniqueness and value, and a lot to do with how much you are willing to spend on lawyers. It's hard to say that this level of technology is more complex than the patent office can deal with, but a patent is only a license to sue.

Pelkey: Now you joined Vadic when?

Krechmer: '73.

Pelkey: You were in the government side of things before that?

Krechmer: Before that I was with another modem company called Novation, and before that I had started a company that was doing something with modems in it, a library circulation and control system. And before that I was an engineer doing communication systems design for Litton, and before that I was working on that White Sands Missile Range system in the mid '60s.

Pelkey: Do you recall which companies, when Carterfone came about, recognized the potential for the dial-up modem business?

Krechmer: Nobody jumped on it. Nobody. In hindsight it looks like everybody should have, but nobody did.

Pelkey: Why?

Krechmer: Fundamentally, because there was no marketing. The process of artful planning of where I wish to go and what I wish to pursue, it did not and does not exist. People tend to operate on what they can see in front of them. My customer says I need to do this. The competition is doing this. That's what they tend to operate on, so the concept of marketing, in my view, is certainly not well understood and clearly not practiced, and the Carterfone is a good case in point. Many companies should have been sitting there saying: "Boy, oh boy, let's go do it." First off, the Carterfone decision was about an interconnection of a radio-to-telephone service to the public network, so it had nothing to do with modems. For that reason alone, the modem people never saw it. But technology, especially significant technical changes, emerges by random walk, not planning, in most cases. Vadic was just starting, and if

you asked the people who were at Vadic in '69 when they were starting in Kim Maxwell's garage, nobody heard about the Carterfone decision.

Pelkey: Was Vadic a venture capital start-up?

Krechmer: Yes. Dan Sulley brought in key venture funding.

Pelkey: Who was he with at the time? Do you recall?

Krechmer: He's on his own now. I can give you his number if you want to talk to him, because he would know a lot about the early stage.

Pelkey: Do you recall who did the first dial-up modem?

Krechmer: Well the first there were acoustic couplers. Anderson Jacobson was an early manufacturer of acoustic couplers. Dial-up modems were first connected to the network using Data Access Arrangements, DAAs. Vadic was an early supplier of such modems. I believe Vadic was the first with the VA 317, the first direct connect modem, after the FCC direct connect decision.

Pelkey: And what were you doing with Vadic at that point?

Krechmer: I ran their sales department.

Pelkey: How did the VA 317 modem come about? Was it recognizing a need in the market, or did the engineers come up with it?

Krechmer: Recognizing a need in the market.

Pelkey: What did you see?

Krechmer: Well, direct connect was going to eliminate the DAA. The DAAs were a real hassle. The phone company couldn't install them right. One of the issues that led to the break up of the phone company in my mind was the fact that they clearly operated in restraint of trade with DAAs. Anytime you tried to sell a customer a modem and get him to order DAAs, the DAAs were late in installing, they were installed wrong. The phone company seemed to do a remarkable number of things to try to make it hard for their competition.

Pelkey: But, when they installed their own modems, you didn't have to have a DAA.

Krechmer: Right, so it felt like restraint of trade. I always felt like, if this is the tip of the iceberg that I saw, from other vantage points it must have looked pretty bad, and that's why AT&T was broken up.

Pelkey: Do recall the moment of the idea that the DAA was a problem and let's design around it?

Krechmer: DAA was a problem from day one. The idea of data communications systems never really emerged separately; it was all Bell Labs, AT&T. They did it. After the Carterfone decision, a group of experts was pulled together populated by AT&T people, probably because they had the best experts at that point. They said: "If you're going to allow people to connect to the network, here's the features it should have, the functions it should have, in order to prevent harm to the network." They didn't do a terrible job, and they were certainly competent people technically; it was a commission or something that was empowered, basically, that provided the technical background to implement the FCC decision after Carterfone. What did happen was the phone company chose to -- kind of benign neglect. If we don't train our installers, if we don't demand that they install it right, if we don't --

Pelkey: Ok. So you could hook up to the network, you just had to hook up through a DAA. And DAAs existed before Carterfone?

Krechmer: No, DAAs were invented because of Carterfone. That was the mechanism to connect to the network.

Pelkey: And how much did it cost to rent one?

Krechmer: You rented them, depending on what type (CBS, CBT, etc.), and there were a number of different types, answer DAAs were more expensive than originate DAAs.

Pelkey: So there was a whole series of them.

Krechmer: Yes. The installation charges were around $30 with user charges of around four to ten dollars a month, depending upon the tariff. We were quite capable, the independent modem manufacturers, of providing a modem one hell of a lot cheaper than AT&T, counting the DAA.

Pelkey: So you saw this DAA and said we got to get around this because we can provide it cheaper, and we're building this DAA cost in, and the DAA is not doing anything. You obviously reverse engineered it and figured out what it did.

Krechmer: Well, it was known what it did. It is not true that it did nothing, but it is true that is wasn't worth four bucks a month forever. That was absurd. Nobody appreciated in the beginning, I guess, when the DAA was deleted how this market would grow, either.

Pelkey: So how did they get to the point where the companies didn't have to have a DAA there?

Krechmer: Well, there were a fair number of complaints given to the FCC. The FCC was quick to recognize that if AT&T didn't have to provide a four dollar a month widget, and you did, that competition was not really served here. That was not a difficult thing to see, so relatively quickly, as the market grew, the FCC tried to evolve around it. The first thing that had to happen was that you had to have enough field history that there was not a significant harms issue. The original concern was that somebody's going to pulse onto the network when Aunt Millie's is having a heart attack in some place down the road. She won't be able to get to the phone to get an ambulance, stuff like that. And the horror stories never emerged.

Pelkey: So people just started connecting up to the phone system without the DAA?

Krechmer: No. That wasn't allowed, and there weren't many people that foolish. I'm sure somebody did it, but certainly not in any numbers. The FCC started to deal with the issue of how to connect to the network, and this brought up the registered jack, which again was designed by AT&T. AT&T developed different ways this could be accomplished and came up with the programmable registered jack (RJ-45) because of concerns about signal levels. Then, low and behold, we had direct connect, and with direct connect, and then the emerging personal computer, the market for direct connect took off in the mid to late '70s.

Eventually all these things were standardized through the EIA and accepted by the FCC. Much later the Electronic Industries Association EIA 496 specification emerged, which is the interface between the telephone service and the equipment connected to it. It takes years for consensus to emerge in standardization organizations.

Pelkey: The modem business really didn't take off until direct connect?

Krechmer: Yes. It couldn't take off until then. Vadic was doing well for a small company, prior to direct connect. We sold lots of rack mount modems, connected to DAAs, for timesharing applications. In timesharing applications the calling-in locations most often used acoustic couplers.

The phone companies were burdened with depreciation rates on equipment of 20 years. So it was fiscally impossible for them to redesign stuff at the rate that technology required, so they were caught. The phone companies were selling people modems that they had designed five years ago or six years ago or eight years ago that were archaic, versus stuff that was designed a year or two ago. So the smaller companies had an advantage.

Interruption in the Interview

Pelkey: Bob Dolan is talking now.

Bob Dolan: Why Silicon Valley didn't turn into a hotbed of data communications went beyond just modems. But it dominated in local area networks. That's really mysterious to me. I understand why most of the modem companies ended up being acquired.

Krechmer: The distribution of Arpaneet nodes accounts for some of the distribution.

Dolan: That's a little bit of an influence.

Krechmer: It certainly supported you guys in Santa Barbara. You and ACC and CMC and -

Pelkey: Channel Systems.

Krechmer: That was an ARPA node spin out. But Silicon Valley has every different developer. Lots of modem companies. The modem companies spun out from the applied mathematicians who understood the mathematics and how to apply it to circuit design. Early on there were very few good applied mathematicians who understood how to apply the math to modem design. Dave Forney at Codex and John Bingham at Vadic were two leaders.

Pelkey: Did they come out of Bell Labs?

Krechmer: Bingham came out from GTE Lenkurt that had a facility in San Carlos, CA.

Pelkey: And they were doing modems for their own network.

Dolan: What's the scope that you're trying to focus on?

Pelkey: Well, I'm focusing on from '68 to '88. Post Carterfone. I'm focusing on product categories of modems, multiplexers, data PBX and T1 multiplexers and local area networks.

Dolan: How about packet switching?

Pelkey: And packet switching. I am trying to understand the roles of technology and capital and people, in terms of where they came from? The effect of government regulations and government buying? How the data communications industry fit into this overlap between the computer and communications industry? Kind of fitting between them and kind of pulling them together, influencing, for instance DEC's strategy today. Initially there was IBM and AT&T at the very beginning of the '60s and deregulation and anti-trust were emerging approaches trying to break up IBM and trying to break up AT&T. At some level, one could argue with the deregulation. So the big guys aren't even players in this industry.

Krechmer: Well, AT&T has not done well post divesture. IBM is getting better, but still notably bad. The interesting thing is, there's a fundamental difference between Data Processing (DP) and Data Communications (DC), and almost nobody recognizes it, and so nobody deals with it overtly.

Pelkey: The difference being?

Krechmer: The circles. (Drawing a diagram) The classic way you say: "I got a technology and I got a marketplace, and this is product." That's true for DP. It's not true for DC. DC looks like this. You've got interfaces.

Pelkey: To the network?

Krechmer: No. Standards: because two devices have to agree on how to communicate. IBM went crazy with the fact that they could sell 1401s. It's the same, with a printer, so many disk drives, maybe more disk drives or less disk drives, and to everybody, because the application was accounts payable and accounts receivable, which is pretty much the same for everybody. They modified and grew over time, but the beauty of it was that they saw they had a technology and there was a marketplace, and they built products. Nothing had to be standardized. Nothing at all, except an AC plug. The AC power had to be standard, but beyond that, which is easily a given, they didn't have that issue. In communications, standards are as big a part of making the market as any other issue, technology or customer need.

Pelkey: And the standards have historically all come from the AT&T side of thing.

Krechmer: Well, standards are funny things. Sometimes they can be de jour. Sometimes they're de facto. Always they're changing, but in this business (data processing), you listen to what your customers say, you try to understand what your technology can do, and you build it. In this business (data com), it became an order of magnitude more complicated, because of the number of linkages. The need for standards makes the problem more complex. These issues we're talking about, should it be an RJ-11 or which type of DAA, is it 103 or 212 modem or how do you put them together and make a 103/212, each of these issues impacts the product. No longer can the customer say: "Gee, if it did this, this and this, it would be really neat," and the engineer can say: "Oh, yeah, I can design that."

Pelkey: You also had to deal with --

Krechmer: You had to deal with the need to develop and/or work with all the other standards that it might affect. So that's the dividing line.

Pelkey: That's an interesting perspective. That's the first time I've hear that. I'm sure other people will share that.

Krechmer: I don't think so -- this is new to most. In John Bingham's book I wrote a chapter that presented this issue.

Pelkey: How about that. I tend to agree, because I wrote a lot about standards, so far, the role of standards. How they come about, for example, local area networking, with Intel and Xerox and DEC getting together. I was talking with John Shoch, who was instrumental in that, and he said, looking back on that, he wished they had never gone to IEEE. Rather they should have just said: "Here's a standard. You like it or leave it." He said once they went to IEEE, it got bogged down for years and really kept the technology away from the marketplace. That's different. How other local area networking, like token ring, have come about.

Dolan: The interesting thing about the EtherNet standard is that's one of the few standards where the application, or the commercial application, wasn't really well developed before the standard came along. In fact, it was really amazing how long it took for 3Com to really become successful after there was a standard already. That was extremely rare. What usually happened in Datacomm is that we had battles at each successive stage, and then the standard started to take.

Krechmer: ISDN clearly was being standardized long before applications. V.32, standardized began before applications. V.22 bis: standardized before applications.

Dolan: But that's a relatively recent phenomenon. ISDN is one where you have a big gap with standards first and then products.

Krechmer: In the standards bodies, we fight this stuff out. We have two classic approaches. We can create standards in advance of applications, in which case everybody thinks that we're a bunch of guys in ivory towers, when in fact the collective knowledge of the group far surpasses that view. Or, on the other hand, we can create standards to fit an existing application, in which we become incredibly bogged down in manufacturer issues.

Dolan: Places where a few companies have been successful is where they have a product either prior to or simultaneously with standards. The ones that came in after standards, in those examples, it is rare to find companies that were able to get a significant market share.

Pelkey: Let me come back to where we were before you came in, Bob. Ken was making a point in which we were talking about the modem business, and that the DAA came up after Carterfone. We were talking about the dial-up modem as a concept of how to get around the DAA, and that the --

Krechmer: Direct connect modem.

Pelkey: Direct connect modem, was a way of getting around the DAA, and that it wasn't until you moved beyond the DAA and had this jack, the RJ, the modem business really took off. That was probably the mid to late '70s.

Dolan: I'd say late '70s before it was ubiquitous enough that you could say: "This is the way we're going to . . . "

Tape Side Ends

Pelkey: We were talking a little bit about Codex as being really early --

Krechmer: Codex was working for the military doing communications.

Pelkey: They had a patent on --

Krechmer: Later on, they had a patent on the constellation of the V.29 modem or what became V.29. There was a big hassle early on about whether they should have a patent on a standard. Forney would know a fair amount about that.

Pelkey: What about Intertel with Jerry Holsinger?

Krechmer: Jerry Holsinger. I believe he was from MIT, and published a good paper in 1960 that included orthogonal multiplexing. So he is one of the early applied mathematicians. He founded Intertel, which is now called something else. It's owned by a Canadian company now.

Pelkey: Is it that the patch panel company?

Krechmer: No, that's Telebar.

Pelkey: And you joined Vadic in '73

Krechmer: Late '73.

Pelkey: And Vadic, at that point in time was real early.

Krechmer: Bingham had come to Vadic a couple years before that.

Pelkey: And he was out of GTE?

Krechmer: GTE Lenkurt, and he developed the idea of a full- duplex 1200 bit per second modem. Recognizing at this point in time not that many technical people had understood Shannon. So the idea of a full-duplex 1200 bit per second modem -- people were saying: "Is that right? Can it be done?" I read about it in a trade journal while I was at Novation (an acoustic coupler company in the LA area). I decided that I was going to go to work for him. So I flew up there -- well, I knew Bill Bennett, who was the president of Novar (were I had previously worked) at that time and he was on the board of Vadic, and so I called Bill up and said: "I want to go to work for these guys, because that full-duplex 1200 is going to be incredible." So I flew up there and I met with McShane and Maxwell, who was president, and told them I was joining the company, which is the way I usually operate, and after a while they agreed, and there I was. So that's how I moved from southern California to northern California. It was clear that Silicon Valley was coming, and I wanted to be in the right place at the right time.

Pelkey: After Carterfone and the DAA came the thing that -- until you could get direct connect, you had this cost of $30 or so installation and four to ten dollars a month --

Krechmer: For the DAA. Remember, the DAA was strictly for dial-up access. Leased-line access you could connect whatever you wanted, and that was where Codex and Milgo had started.

Pelkey: And General Datacomm (GDC).

Krechmer: Codex and Milgo were both earlier than GDC. The leased line modem business had started up by the late '60s, and Milgo and Codex were small, but none the less doing well. Matt Kenny (sales manager at Milgo) was in the process of building a very strong selling organization -- he was good at that. Codex was really the technology leader, but Milgo was no slouch. Lee-Fang Wei was there. So those two companies had focused on the leased-line side. They weren't really addressing the dial-up side. TimePlex took a shot at the dial-up side but never got really strong. It was UDS and Vadic that went after the dial-up business. Hammer and tong, tooth and nail we used to fight with each other. We finally sued each other over a full-duplex 1200 related patent (on coherent carrier detection).

Dolan: If I can interrupt for a second, I think one of the things Vadic still had to struggle with when they were making the dial- up modem was that they had to make a modem that could still be acoustically coupled, that was one of the major considerations still, because modular jacks just weren't available, so you still had to acoustically couple most terminals, because there was no way to make a direct connection. In fact, this was one of the later battles between Vadic and the Bell System, who made a 1200 bit per second dial-up modulation scheme that could not be acoustically coupled.

Krechmer: Well, yes and no. That's what Vadic wanted the world to believe. I agree with that.

Dolan: I did a lot of acoustically coupled stuff. Vadic -- they used it as a sales point. They thought they were doing that. Let's put it that way.

Krechmer: Absolutely right, but remember that when Bingham did the 1200 -- you can ask him -- the choice of the carrier frequencies, which is what determined that issue, the importance of placing the carrier frequencies the way they were, it was random. It was no big deal to make them that way. Vadic did not build an acoustically coupled 3400 until after the 212 came out, and that was because we developed the three-product strategy. This strategy was three things: when the 212 came out, it was clear (or I recognized) that Vadic had made a substantive error, that the -- right here, right in that little circle -- because the 3400, for all of its functionality, desirable features and things like that, was not backward compatible to a 103, and the 212 was. That was such a big thing. As soon as we saw the 212, it was so obvious how stupid we were. We had a better buffering scheme -- really quite clever -- that provided buffering that was basically transparent from zero to 300 and 1200. You could take the data rate up, and the buffer was transparent. Good enough so that we ultimately became Alternative-C in the V-22 spec, because it was a clever scheme. Kim Maxwell with other engineers did that. The real issue was we had totally missed the standards question. We were not downward compatible to the previous communications standard, 103. Here was this overwhelming company called AT&T releasing the 212, to

compete with the VA 3400. Our hope was the VA 3400 was a better design - and it was not backward compatible, which was very important in the central site modem market.

Interruption in the Interview

Krechmer: So, Vadic was in serious trouble. Kim Maxwell and I --

Pelkey: Now, this was what year?

Krechmer: The 212 was announced in '76, so this is somewhere around late '76.

Pelkey: And about what that time, what were the sales like at Vadic?

Krechmer: Seven - eight million.

Pelkey: It was mostly modems?

Krechmer: It was all modems. So Kim Maxwell and I sat around his house, as I recall, and tried to figure a strategy around it. What could we do? Out of that came the three-product strategy. One would be an acoustically coupled 3400, which we didn't have at all at that point. We had talked about the fact that a 3400 acoustic coupler would work and the 212 could not be acoustic coupled. But we didn't have one; we needed one. We licensed Anderson Jacobson to make one. We also needed an answer-only central-site rack-mount version which was 212 or 3400 so it could talk to both, and we needed a low-cost stand-alone version which would be available in three versions: 3400 only, the cheapest version; 212 only, the next most expensive version; and both 3400/212, the most expensive version. With those three products, he and I felt like we could take advantage of what was our installed base at that point in time, which was about 15,000 VA3400s. Then we could tell the world that 'you have to buy from us, because if you want to be compatible with everything, you needed Vadic.' That strategy changed Vadic from what it was then in the face of serious AT&T competition -- to a $100 million business by '84.

Pelkey: That's impressive.

Krechmer: That was the product strategy that did it.

Pelkey: You mentioned TimePlex. TimePlex started off as a modem business in the '60s sometime.

Krechmer: No, I think they started off as a multiplexer business.

Pelkey: Were they the first multiplexer?

Krechmer: Early, real early. They were doing both FDM and TDM. FDM was the first multiplexing technology; TDM was later.

Pelkey: And statistical came on the scene when?

Krechmer: Micom, was an early commercial supplier. Roger Evans of Micom came to Vadic from England.

Pelkey: So this was after Roger Evans had already bought Micom.

Krechmer: In England, right? I don't know if Roger acquired it or just came from it.

Pelkey: I think they acquired it, but I'll get the facts straight.

Krechmer: They came to Vadic, and some of us at Vadic wanted to fund it, because they were looking for capital, and Vadic was doing well, but there was enough reticence at Vadic to the funding of it that

they went off, got venture capital, and became twice the size of Vadic. So it was unfortunate that Vadic never participated in that piece of the business.

Pelkey: So the statistical multiplexer technology really came from England.

Krechmer: I don't know where it first developed.

Pelkey: The modem guys didn't jump into the statistical multiplexer business quickly, did they?

Krechmer: Companies like Vadic were faced with their markets growing very rapidly; their engineering platters absolutely full to overflowing; their sales and marketing organizations were not expanding fast enough. Vadic's growth in the late '70s was limited. We had no particular access to venture capital, we had been funded by a private investor, and we took the retained earnings to grow the next year. I would jump up and down at almost every management meeting and say: "You're not giving me enough resource to grow the damn business. We can grow more. We are losing market share every day because sales doesn't have the resources."

Pelkey: Were you selling modem by direct sales?

Krechmer: By manufacturer's representatives (reps).

Pelkey: Where did the reps come from?

Krechmer: We migrated them from instrumentation reps.

Pelkey: Was Vadic an innovator in that channel of distribution?

Krechmer: General Datacomm (GDC) was probably -- Vadic did it well, GDC did it badly. Reps are good when you use them well. I find very few companies seem to do that right.

Pelkey: Then Micom innovated the stocking rep.

Krechmer: No, Vadic innovated the stocking rep. Evans basically copied -- Evans took all the Vadic reps -- and I let him, because I knew that we needed the statistical multiplexer product line, so if I couldn't do it internally, my sales organization could get it externally – another advantage of reps.

Pelkey: Was that conscious on your part --

Krechmer: Absolutely.

Pelkey: So you and Evans met and said --

Krechmer: I don't think we ever discussed this. Jim Jordan, President of Moxon (our Southern CA rep), called me up and said: "What do you think about Moxon taking on the Micom line?" I said: "Yes. They're a small company starting out, but we need a statistical multiplexer in the line. Not only should you take it, but if it works out, let's make sure the other reps take it." Vadic, at that point, had sales meetings with our reps every year, and close relations with our reps. That wasn't just my doing; Dave Peters, who was the eastern regional manager, and Tom McShane, who was VP of Marketing were a big part of understanding how to manage reps. We all recognized that a strong relationship with the reps was important.

Pelkey: What were the other companies doing? GDC obviously used the reps badly, but what did the other companies do? Did everybody use reps?

Krechmer: Well, General Datacomm had reps for a while; then they fired them and went direct, and then fired them and went back to rep.

Pelkey: What about the other modem guys?

Krechmer: Both Codex and Milgo were building direct organizations, selling leased-line systems, because leased-line was a system sale that requires more training and support. Timeplex had reps for a while, then not. I wrote the first stocking rep contract, and I remember the hassles with the lawyer about all the restraint of trade issues, issues of how much you can control territories and the Schwinn Bicycle decision.

Pelkey: Do you recall when that was? I'd be interested in knowing more about the perceived legal issues and restraint of trade issues.

Krechmer: There was a Schwinn Bicycle decision about whether an OEM company could sell the Schwinn Bicycle in one town through one selling company, and tell another selling company in the same town they could not.

Pelkey: Who was your counsel at that point in time?

Krechmer: I don't remember. I remember attending a couple of legal seminars on restraint of trade issues, trying to understand that.

Pelkey: The channels of distribution were related to the Robertson-Patman Act. There were a lot of perceived legal obstacles to creating channels of distribution.

Krechmer: Absolutely.

Pelkey: And several of them influenced the outcome of what the channels of distribution became.

Krechmer: In order to be a stocking rep, you have to have an exclusive territory and you have to have inventory. A rep has an exclusive territory, no inventory. A distributor has inventory, no exclusive territory. Those were the issues. I wanted, and was limited by the lack of investment from Vadic, to build a larger sales organization.

Pelkey: You wanted to go direct?

Krechmer: No, no, we needed more feet on the street, more sales support, more field service support. The market was going like up like a rocket, and the Vadic sales organization was growing at a steady pace.

Pelkey: And the market was going like that because of what?

Krechmer: We built good modems. We were small, relative to the market size. The dial-up market exploded with the advent of personal computers.

Pelkey: This is in the '77 to '84 time frame? What was driving the market?

Krechmer: Well, the 212 had come out, and now the full-duplex 1200 was booming, and Vadic invented full-duplex 1200. It was our market. We took market share from AT&T; all day long, every day.

Pelkey: So whenever you competed with AT&T you won.

Krechmer: Well, and most everybody else too, because our product strategy was very successful.

Pelkey: What happened -- when did it go to 2400?

Krechmer: Well, Vadic lost. The personal computer modem market emerged and Vadic did not have the resources or strategy to grow fast enough and Hayes Microcomputer Products took over that market.

Pelkey: When did the 2400 bps modem come on the scene?

Krechmer: Concord Data Systems did the first 2400, V.22bis. The standard for 2400 was published by the CCITT (now the ITU) in '84.

Pelkey: When did Concord come out with a product?

Krechmer: Concord came out with their first 2400 product in '83.

Pelkey: Then Concord -- it was slow going at first, I imagine.

Krechmer: Oh yeah. I wrote an article in Data Communications Magazine in 1984 that described compatibility problems with 2400 modems implemented different ways by different companies. That helped cause a pause in the 2400 market growth, which was good, because I had just designed a 1200 bit/s modem for Prentice. That's why I wrote the article.

Pelkey: Was this the PopCom? When did you leave Vadic?

Krechmer: '79.

Pelkey: Did you go with another company at that point in time?

Krechmer: I went to Time and Space Processing as VP marketing. .

Pelkey: Oh yes. John Berg's company?

Krechmer: Yes. That was interesting for a short time, but the technology was not sufficient to develop commercial markets, which is what I was hired for. After that I began my consulting practice.

Pelkey: Data Communications Magazine was started in, what, '72? Was that an influential publication?

Krechmer: Yes. Sheldon Adelson ran Interface. There was also Communications Networks, which was called something different in those days -- I remember we had to make a big decision in the early '70s, which show we were going to support, and we chose to support Interface because it was supported by Data Communications Magazine which was a better magazine.

Pelkey: The other trade show was supported by Telephony Magazine? Did Interface exist as a show before? Do you know when their first show was?

Krechmer: No.

Pelkey: Was it primarily a data communications show?

Krechmer: It was. Sheldon did it as a data communications show. I remember making the decision -- "I'm not going to support two shows. I'm not going to be out of the office to support two shows for the same market. "

Pelkey: How important were the trade shows?

Krechmer: For small companies, very important. We got a tremendous amount of visibility for our buck at a trade show. All our reps in the region come; we have a regional sales meeting there; many of the region's customers are there also, and, of course, new prospects.

Pelkey: In connection with these trade shows or the trade publications, was there anything really significant that happened to change things, or some group that got together that really made something happen, or some company launching itself?

Krechmer: Sheldon started Computer Dealer Expo (later Comdex) in the early 80's.

Pelkey: So the multiplexer came along in the late '70s -- the statistical multiplexer. It must have been before '79 --

Krechmer: Probably '77.

Pelkey: At some level, that cut into the modem sales. It drove higher speed modems.

Krechmer: It never cut into dial-up modem sales. It created a new leased-line modem business. Statistical multiplexers enabled the beginnings of an OEM leased-line market, which had never existed before. Codex and Milgo sold end-user not OEM. Paradyne start selling OEM leased-line modems.

Pelkey: Do you recall when they started up?

Krechmer: I believe Bob Wiggins was a founder.

Pelkey: From Key Largo, FL.

Krechmer: Yeah, but he had done something else just before that floundered, and then he wound up with Paradyne.

Pelkey: And then Infotron came on the scene.

Krechmer: But Paradyne was helped by the fact that things like the statmux started to build an OEM market for leased-line modems, which neither Codex nor Milgo originally tried to serve, and Paradyne did.

Pelkey: Because people could put boards into computers that would be terminal muxes that allowed you to connect to leased-lines and central site systems? Now, the modem business was largely driven by the minicomputer business during the late '70s -- the minicomputers going in and having remote terminals connected to them.

Krechmer: The leased-line modem business was driven by IBM, because IBM had bisync, IBM had SDLC -- Synchronous Data Link Control -- synchronous systems, which were leased-line. Everything from PARS on was basically a leased-line communications system, and designed that way. So the Codex and Milgos focused on the IBM markets, the mainframe markets, and the Vadics and UDSs, and others as they came, focused on the dial-up markets -- and therefore they focused on the mini computer markets -- the growth of DEC, DG, and later HP.

Pelkey: Yeah, but DEC and DG, and that was basically a dial-up market? Why did that become dial-up, not leased line?

Krechmer: Timeshare was the big application of minicomputers.

Pelkey: (unintelligible).

Krechmer: There were leased-line markets around mini-computers, and Paradyne was the one who set themselves up to go after that market. The Vadics of the world should have gone early into the high-speed leased-line markets, but we were to busy just doing what we were doing.

Pelkey: So to some extent, the characterization of the modem companies at this period of time, each of them found their niche, and the underlying business was growing so rapidly because the jack had come

into place in the mid '70s or so, and AT&T was really uncompetitive in technology, that the computer business was growing rapidly underneath the industry, and so everybody, at some level, was just management and capital constrained. So what happened is you got people who became dominant in a particular niche --

Krechmer: And that's all you could do, because you didn't have the talent and capital to grow beyond that.

Pelkey: And there wasn't a sense of companies combining -- there wasn't anybody who tried to become dominant by buying up other companies, saying: "While I can't go off and do it myself, I can buy another company."

Krechmer: I don't believe that's practical.

Pelkey: And the capital markets -- companies weren't going public because there wasn't really a public market during most of the '70s.

Krechmer: The venture capital business had not boomed like it did later.

Pelkey: Nor had the IPO market, so there wasn't really access --

Krechmer: Remember Viatron? I think that company hurt the early venture capital business. Twenty years ago that company sucked up lots of capital and quickly went bankrupt.

Pelkey: Oh, yes. Wasn't that the company that everybody thought was going to be the leading remote access interactive application.

Krechmer: Could be. They got a lot of VC funding and told people they were going to design the cheapest terminal, the best modem -- they were going to do everything. I remember looking at them -- this was before the Vadic days, so this has got to be late '60s -- and saying: "I understand how to do this stuff, and they're insane. It takes a lot of work," and low and behold it was true, they were insane, and they went away, and with it went the VC market for a time. Investors often can't tell the difference between a good company and a bad company.

Pelkey: Viatron just failed.

Krechmer: That hurt the VC markets. Scientific Data Systems and Teledyne had made tremendous amounts of money for their investors, and people got real hot on investing in companies, and then Viatron came along and all of a sudden people recognized it was a crapshoot. Invest here it's good, invest there it's bad, and I can't tell the difference. The VC market was real hot there after Scientific Data Systems. Scientific Data Systems sold for $300 million to Xerox in the early '60s, which was a huge sum of money, and the original investors who invested their money, made a lot.

Pelkey: Were there any significant individuals in that '70 period that were dominant?

Krechmer: In Datacom? Technical guys, of course – Dave Forney, Bob Lucky, Richard Gitlin.

Pelkey: Where was Gitlin?

Krechmer: At Bell Labs.

Pelkey: So they really all came out of Bell Labs?

Krechmer: Certainly most.

Pelkey: Bell Labs was really -- to a lesser extent GTE with Bingham, but most of the talent that fed the industry came out of Bell Labs. Now I had a gentleman share with me the perspective that his view of local area networking. That local area networks really started out because AT&T controlled the network outside the building, so a lot of creative talent went into dealing with what was going on inside the building, because it wasn't controlled by standards, by AT&T. Do you subscribe to that theory, or is it just a rationalization?

Krechmer: It sounds a bit like rationalization. It's really clear that there was a need for nets. IBM had cluster controllers at that time. We had a bunch of polled multi-drop solutions for those kinds of areas, so there were things that were happening that were leading people towards networks. The classic issue -- really, the whole communications business technology-wise -- originally it started out that channels were expensive and . . .

Tape Side Ends

Pelkey: You were saying about channels --

Krechmer: Right, channels and logic were expensive in the beginning. That's why AT&T won (it had the channels) versus IBM in the terminal business. There were two kinds of terminals in the early days: 2741 and teletype. The 2741, which was IBM, had a very interesting property; it was based on a typewriter, so when you hit a key, you saw the character printed that you hit. There was literally a mechanical connection. The teletype was different, when you hit a key you had something called 'echoplex' which sent the character all the way to the end, and it came back, to print at the terminal. So, if you saw it printed on a teletype, it was received correctly at the far end system. Now, if it was wrong, you didn't know whether you typed it wrong or the network echoed it back to you wrong, but you backed up and retyped it. That was error control; a very good, very efficient, every effective system of error control. That kind of error control was needed because logic was expensive.

Pelkey: Slow speed, but good.

Krechmer: It worked great, and it was predicated on the fact that for AT&T the channel was cheap and the logic was expensive. Nowadays, you'll note, that we use error control systems that use lots of logic -- buffers and all kinds of logic -- but on the other hand, there's no cost at all because logic is cheap.

Pelkey: At some level, that concept of how IBM built a terminal really led to lots of other terminal designs. I don't know whether they came before or after, but --

Krechmer: These two early terminals were both vying for what is now the ubiquitous 'ASCII terminal market.' At that point in time, they were vying for it, and it was clear that IBM was going to lose, because from the user's viewpoint, it's not as reliable as a Teletype. Now, reliability actually was two issues. One was mechanical and I think that there were issues of mechanical reliability in the Selectric mechanism, but the second issue of reliability was the fact that it had no end-to-end error control.

Pelkey: You were saying at that point in time, the assumption was that the channel was cheap (only for AT&T) and logic was expensive. During that period of time the intelligence of networks, if you will, that came from AT&T. AT&T was all the switching and all the billing and everything. That was all dealt with, and so everything was centralized because of the fact that you shared that expensive logic, the switching and billing. Where we've emerged today is much like with the terminal, the logic is at the nodes, and the reason why T-1 lines emerged is that the channel has gotten cheap and the logic got cheaper to distribute it around.

Krechmer: Well, the channel is expensive, but the channel capacity is enormous, so the channels as bits/second continues to get cheaper.

Pelkey: Because of bandwidth.

Krechmer: Because of bandwidth and because of logic. The logic allows us to make them more usable. We can build compressors that get double the number of voice channels, multiplexing and stuff like that. It's logic. So that's really been the trend. The AT&T structure, the whole system, was designed on the idea that channels were very expensive for everyone else.

Pelkey: Yes.

Krechmer: Eventually, the channels became cheap after they were depreciated for twenty years; it was now free.

Pelkey: That's right, and you had these long depreciations and they capitalized everything, so it became cheap because of the depreciation.

Krechmer: And what we've transitioned to is the fact that, if you want to run a piece of wire from here to there, this is a really big deal, but the boxes that you put at either end, it's no big deal. We can put enormous amounts of logic in them. To my mind, the local area network is very much a continuation of that philosophy, which is 'the wire I have to run around the building is kind of a big deal, but I can put a lot of logic into each node to make that wire really efficient and serve lots of functions, serve lots of people,' and that was a local area network.

Pelkey: Why did modem/multiplexer datacom companies miss local area networks?

Krechmer: I think Dolan would say they didn't. Certainly he's a multiplexer guy who didn't miss the local area networks. He's clearly involved in it. He certainly got one foot in local area networks and one foot in muxes early on.

Pelkey: But in terms of the companies that were successful, there's no one who came out of that -- like Micom bought Interlan.

Krechmer: The fundamental issue goes back to the strategic marketing. Roger Evans understood strategic marketing, but few others do. There's no applied, organized methodology of 'how do we bring the three circles (markets, technology and standards) together'? There's no MBA in strategic marketing.

Pelkey: Wasn't it a function of the engineers, who were analog, having this view of the world that just weren't creative about digital? When did microprocessors start to impact modem design?

Krechmer: Late '70s.

Pelkey: So at that point, modems started to become more software and memory and microprocessors, versus hard circuits. Along those lines, what semiconductor developments impacted the data communications industry?

Krechmer: Well, every wave impacted it. Clearly the big one was micro-controllers. You replaced all this discrete logic -- the 74 Series stuff, or DTL, whatever it was -- with microprocessors. That allowed you to do things like this Vadic triple strategy I talked about, where you could have a modem that was three different kinds, because you could do that -- really, it was a code-based problem. It was no longer 'I've got to build one board for this modem, one board for that modem.' You couldn't do that kind of strategy if you didn't have microprocessors.

Pelkey: But there were many specific modem chips, per se, were there?

Krechmer: Not at that point, no.

Pelkey: The UART was an early communications chip. Do you know who did that chip?

Krechmer: Originally? No, I don't.

Pelkey: Then there was, of course, the Codex chip.

Krechmer: Well, Codex did a deal for a V.29 chip with Rockwell. They joined together, which turned out to be incredibly successful for Rockwell.

Pelkey: That was in the '80s.

Krechmer: No, that was in the '60s when that joint started. Now, of course the V.29 was later, but early on, probably because of their original military dealings, the two companies got together. Again, you'd have to ask somebody in Codex about this, but the two companies got together early on, and Codex was very much a technology leader company. It was clear that they were saying to Rockwell: "Gee, we're a little company and we need some help with semiconductors, because that's clearly the way this stuff is going. We'll teach you how to make modems if you give us an exclusive on the semiconductors." So Codex had an exclusive on Rockwell's semiconductors for a long time – 6-7 years, which was very good for them. They had a low cost of manufacture in their product versus anybody else. Of course, Rockwell came out of that, took that technology, and did very, very well with it also in the facsimile business.

Pelkey: Do you remember who first came out with micro-controllers?

Krechmer: Sure, that's Intel with the 8008.

Pelkey: That was in the late '70s.

Krechmer: Four-bit was pretty limited for this kind of application, but with the 8008 supporting eight bits, you had sufficient capabilities. But I do not recall which micro controllers were first used for modem controllers.

Pelkey: Foreigners have never really played a role because of the standards issue?

Krechmer: Because of the marketing and divesture issues, more substantively. The rapid growth of end user markets got US companies to deal with 'I've got to build what the end customer wants.' Internationally markets were usually offering what the PT&Ts want -- they don't operate on short design cycles. With the rapid changes in technology and markets, PT&Ts couldn't keep up; while the Japanese companies have been effectively excluded by this issue; and the American companies have been randomized by this issue. In other words, successful companies occur randomly, because whether they have the right product at a give point in time is not based on plan, but accident.

Pelkey: Why do you think that is?

Krechmer: Because they're not planning. They don't understand the issues, because there is no training. There are no schools that are talking about them, there are no methodologies that are organizing them, so it's not there. The background isn't there.

Pelkey: Some people believe that great companies are made because of great engineering, as opposed to --

Krechmer: It sure helps.

Pelkey: Like the president of Sony says: "If you wait for the marketing and planning department to get around to tell you what you should build, the market is gone."

Krechmer: No, what he is saying -- see, he makes a major mistake right there -- is that the sales department -- he's asking the sales department to tell him. He doesn't have marketing. Marketing -- most companies think, and most people use the word 'marketing' to describe basically sales strategies.

Pelkey: Yeah. I agree with you. They don't understand the difference.

Krechmer: And marketing is truly a long range planning function, which doesn't take the place, in any stretch of the imagination, of technology.

Pelkey: But how would you have planned - let's say in '76. Let's imagine --

Krechmer: I wanted to buy Micom when Roger walked in the door.

Pelkey: Ok, but you couldn't have planned, as an example, the personal computer. You couldn't have planned Apple.

Krechmer: The thing that I could plan is -- I clipped out the very early ads from Hayes in the back of the first PC books -- the little ads -- and I remember looking at those and saying: "Son of a bitch. This is really clever. We've been screwing around with -- Vadic in particular had been screwing around with -- auto-dial for a long time, and I said: "Damn, this makes a lot of sense."

Pelkey: What was it that was clever?

Krechmer: They had a little software program that ran on the personal computer that issued auto-dial commands to the modem, and the modem accepted them because they produced the software and they produced the modem. We had been screwing around with RS-366 interfaces and multi-line auto-dialers and all kinds of logic and never made a business, of the whole damn thing. I saw that and I said: "This is good. This will work. This is what we need." Interestingly enough, a very rapid calculation indicated that -- at that point in time, Vadic had been bought by Racal, and all of us, myself included, had a deal based on the next three years worth of profits in the company, so if we invested our money going after the personal computer market, it came out of our pockets, because we'd reduce profits in the next three years.

Pelkey: Since you're so knowledgeable about standards, let me ask you a question. Hayes is an example of a company that captures market share and the standard follows.

Krechmer: Right. They got a de facto.

Pelkey: Then there are other kinds of standards that happen because people go about consciously trying to create a standard in order to encourage competition --

Krechmer: Encourage a market.

Pelkey: In the data communications business, standards have played a major role in the way the industry has developed. Could you comment on that, on de facto versus committee-created?

Krechmer: Well, the de factos emerge where there's a vacuum, where there's a real customer need that's not being served because nobody figured out how to serve it right. Whether they didn't figure it out because they didn't have the time, or didn't think it was important, or didn't know how, is somewhat academic. They didn't. Vadic tried very hard to figure out a good way of auto-dialing, and we were never quite successful at it. The advent of the personal computer provided a new way to look at auto-dialing; the ability to combine together the software and the hardware functions effectively, and build an interface between them that then became a standard.

Pelkey: Because up until then, the modem itself had to have the capacity to do the auto-dialing.

Krechmer: Well, no. There was an interface called EIA RS-366, which is something developed by Bell, which is a parallel interface to do auto-dialing, which was the "standard way to do it." CCITT developed what became the V.25bis standard, which is another way of doing auto-dialing, but the Hayes approach was the right way, as it turned out.

Pelkey: It was made possible because of the PC.

Krechmer: Yes. I knew a good auto-dialing standard was needed, but no one had figured it out. The advent of the PC produced a new way of looking at that problem, and Hayes figured it out. The Hayes engineers came out of National Data, which was a big user of auto-dialing modems for credit verification. These guys recognized that personal computers could do it. They had personal computers, they played with modems, and they did it. The data communications manufacturers had been unable to fill it, so here, effectively, were people from the user side recognizing they could fill it.

On the other hand, the data com manufacturers go out and invent V.32 modems, British Telecom -- John Brownley, Louis Guidoux from TRT and many others – worked hard for years in the CCITT SG XVII standards committee to understand the issues of echo cancelling and trellis coding and more to create a V.32 standard, which emerged in '84. We saw the first V.32 compatible implementations in early '87, so there the standards people recognized the technology issue long before there was a product. Same way with the V.22bis before that. This is a clear technology path where first I make a 1200, next I make a 2400, next I made a 9600. The technology guys can walk that path before the need emerges. So they did.

ISDN is similar. People want to send data faster. It makes sense to provide digital data communications. Here's how I can modify the telephone system in a backward compatible manner, which is key, which is why it's so hard and takes so long, and why it'll be successful because it's downward compatible. They've started -- now, for almost ten years, we've been in the process of modifying the analog telephone system towards a digital system.

Pelkey: Other than for the leased-line modem, which was really IBM because of the terminal characteristics --

Krechmer: Yes, IBM never addressed the dial-up markets.

Pelkey: -- most of the data communications -- my reaction is that synchronous, other than in leased-line, has been a non-factor; that the innovation has really come on the asynchronous side of the business.

Krechmer: Well, yes, because the personal computer caused this incredible wave of innovation. Leased- line innovation has been pretty significant also. Many of the high-speed modulation approaches were first developed for leased-line modems.

Pelkey: And in your view, though, that's really an IBM market.

Krechmer: 'Mainframe market' would be a better term. At one time, it was not all IBM, it was only 70% IBM; still there was a lot of innovation, e.g., network management side channels and systems.

Pelkey: It's interesting, if you think about the '60s, when IBM and AT&T were big central, big mainframe, big switches, not much intelligence at the nodes, and where we've migrated to today, with IBM and AT&T both having some problems at this point in time because it's a distributed world, and how these two organizations respond.

Krechmer: The data communications industry, a lot of smaller companies tried many different approaches and, with more luck than planning, pulled it together.

Pelkey: They pulled it together, and in fact, reshaped the basis of competition from the '60s when we were worried about how these two guys were going to dominate -- and AT&T got deregulated and changed completely. It's unsuccessful in the computer industry and IBM is struggling with its voice business. The world has changed, and the data communications business has played a role in changing it so these big guys aren't as successful as these people thought they were ten years ago.

Krechmer: That's true. Consider the language -- the data processing people talk about bits per second, and the telephony people talk about baud. Telephony people talk about tip and ring, as opposed to data processing people talking about twisted pair. There's a whole litany of different languages that are not linearly translatable. The outside world tends to thing that they are and becomes confused. At Vadic, we used to have a little tutorial on what's a modem and data communications. We were trying to train DP people on communications stuff -- all these little buzz words, and how baud didn't mean bits per second -- all these other issues, what tip and ring was. When the phone company talks about call distributions in erlangs, and of course mathematicians, DP people, talk about Gaussian distributions, and how do you relate those? The phone business had risen up as a separate bit of technology, all by itself. The value of voice communications was such a big deal, obviously, to people. I have a book from Bell Labs the early history of the Bell System. It talks about the trouble they had -- Steinmetz and other brilliant engineers trying to figure out fields and interference. They were stringing lots of wires, and trying to figure out what happened.

Pelkey: So they had this AT&T/Bell Labs sort of thing. People hop out of it because the need for products, the markets, the technology is getting old because they're not innovating the technology, and people realizing that they can come out with better products than what AT&T has in the marketplace, and the data processing/computer market growing underneath it, you start to get this modem industry that develops. Out of it and the creativity, you get the multiplexer and then you get the data PBX and --

Krechmer: Well, the data PBX was a natural. We all wanted that. If the rack full of modems got big enough, you needed it.

Pelkey: But you had this incredible amount of innovation going on in these little companies where, once you freed yourself from either the domination of standards or the domination of market share leaders and you had this little industry to itself that got fueled by venture capital and entrepreneurs, now it's a $4 billion industry.

Krechmer: Right. It didn't get freed from standards. If Vadic had been smart enough to embed a 103 in a 3400, I think there would be a lot more 3400s out there. That's my theory. Now, the other argument is that AT&T was so big at that time you couldn't win anyway, but I tend to believe backward compatible communications products win most often.

Pelkey: But the industry coming alive -- the modem guys got out there and at some level forced the standards, they forced out the DAA, forced the jack.

Krechmer: Well, there's a good story here, and that is there was no modem standard committee in the United States, none, in 1974, '5, '6, when Vadic was trying to get a standard for 1200 bit per second modem, full-duplex 1200. There was nothing. If you went to EIA TR-30, which was data communication standards, there was no modem group. Why was there no modem group? Because the AT&T people who populated all the EIA committees said: "Don't need one. We do that." Well, Vadic didn't think that was quite the case, and Vadic, and General Datacomm finally, and Milgo jumped up and down, screamed, yelled, and finally got a guy by the name of Ted Dehass in the US State Department to form, under what was called US CCITT, which is the State Department's liaison to international CCITT, the modem working party, which wasn't ANSI sponsored -- which is the American National Standards Institute, which sponsored all standards in the US -- but because AT&T effectively blocked modem standards in the US-- they argue to this day they did not, but I disagree.

Pelkey: Ted Dehass. That's the State Department?

Krechmer: Yes. He was the guy who said: "Ok, there is such a thing, and you can be under this wing," because he was the State Department guy who ran the interface to CCITT; a great guy.

Pelkey: Do you know where I can find him or learn something about that?

Krechmer: He retired a year or two ago. He may well still be in Boulder. I probably have some old phone numbers that you could call at the National Bureau of Standards, and maybe a secretary could lead you forward.

Pelkey: You've been incredibly kind with your time. This has been absolutely fascinating, and as I document some this I'd love to be able to shoot it by you.

Krechmer: Sure. Of course. As I say, I've got a fair amount of stuff written on this as well, so I'll rummage through the old computer and see what springs out.

END OF INTERVIEW

