Interview of Kim Maxwell

Interviewed by:
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James Pelkey: Thank you for your time.

Kim Maxwell: Let me just give you a couple of law-like statements. It seems to me that we have a lot of backward predictability, where we try to fit pieces together that were not fit-able as they were occurring, and I sometimes liken people like myself to bacteria on a slide. We can see the other bacteria moving around and we can look up and see a little bit of an eyeball, but we haven't the foggiest idea what we are; whether we're a disease or whether we're saving somebody, and how each individual contributes. We know that if an antibiotic is attached to us, some of us won't make it, and we haven't the foggiest idea who those are. I think that's what described embryonic industries, and I think there's one today that would be worth watching, from your perspective, and that's the image communications market. Absolutely clear, right now, that it is the next growth market in switched communications.

Pelkey: Absolutely.

Maxwell: Absolutely clear that there are certain standards that will bind and constrain technology, absolutely clear to me what should be done, absolutely clear that there are still substantial missing standards to bind the rest of it together so that it can happen, two or 300 companies in it, and I would put a lot of money on that table that you can't predict which one makes it.

Pelkey: I would agree with that statement. It's really stocastic.

Maxwell: And the companies that should be doing it aren't. The companies that should be doing it are not, and the companies that are doing it are all teensy; none of them having critical mass to, by themselves, grab a standard and drive it to their own benefit, or collect with others and get together and make a standard, and there is no standard making body doing image work.

Pelkey: It is amazing, isn't it?

Maxwell: And it's going to happen. Ten years from now there will be standard, and there will be two or three of the small companies that get very big on the back of it, and there will be several millionaires made, and you couldn't predict any more than I could or anybody else who they are. That's where Vadic was in 1970, '71.

Pelkey: You were a founder, right?

Maxwell: I was a founder.

Pelkey: Who founded it with you?

Maxwell: There were seven of us. First of all I should tell you that we hadn't the foggiest idea what Carterfone was all about.

Pelkey: When, exactly, did you found Vadic?

Maxwell: 1969, about a month after Carterfone happened, and in our public presentations we always say that we were driven to take the opportunity of Carterfone, which is an absolute balderdash lie.

Pelkey: Everybody else says the same thing; they had no idea about Carterfone.

Maxwell: We were a –

Pelkey: So that would have been July?

Maxwell: Well, we started in July. Just to give you a little personal background, I went to school for ten years, studied philosophy during most of it. The last two years I spent in mathematics. I supported myself -- I was going over here at Stanford -- and I supported myself by writing. I was a technical and promotional writer, and I got a job with a -- a freelance job with a company -- and after ten years of school, the guy that I was working for thought I was smart enough and he hired me to do software work. My officemate was developing filters for some analog modems that we were trying to develop to replace RFL modems. This company did telemetry equipment; pipeline and oil- line and power station telemetry and control systems -- a small, $2 million company up in San Carlos. The guy who hired me was in the process of getting fired. His wife was working for National Semiconductor, and she persuaded him to start a company. He walked into my office and said: "You want to start a company?" I said: "Sure, why not?" and the guy that was with me said: "Sure, why not?" and he collected up a friend of mine who was a bean counter at Fairchild and a guy who called on us from Texas Instruments as a salesman, and a technician and a draftsman, and that was the founding group. His background was digital technology. He should have been fired. He left the company six months after it started. We were going to go into control systems and modems, because I knew nothing about modems -- nothing. Didn't know a modem from a coffee table, but I knew something about control systems from the six months that I had been working. We decided to go into control systems and modems, because we had a guy who knew a little about control systems and a guy who knew a little bit about modems, and it didn't take us too long. We weren't stupid; naive, but we weren't stupid, and we decided relatively early that doing both, probably, with seven people with that kind of background, would be a little tough, so we decided to do the modems because it was easier.

Pelkey: Was that a big decision for you at that point?

Maxwell: No, it just sort of happened. I've got the minutes of all these meetings that went on. They were pretty hysterical. I'll be a little egotistical during some of this, because the question after we decided to do modems was 'why the hell should Maxwell be involved in all of this?' and the answer was that I'm bright, and they would rather have me for them and against them, and I could write. So I ended up writing the business plan, and I also was sort of the sponsor of the first idea, which was a systems idea, which was instead of building modems on a board we would build modules, and we would go after the OEM market because that was accessible. We would be able to build the printed circuit board easily because there wouldn't be very many wholes to connect, and we could do it quickly and get prototypes done, and it was on the back of that idea that we raised some original capital. One of the funny things was that the guy who

really sort of put the capital together was a guy named Dan Sully. He had been the president of the company I had worked for before. I had never met him there.

Pelkey: The company in San Carlos?

Maxwell: The company in San Carlos. He had been president of it. He left it the day I joined. He sold it and went on into private consulting, but he was a good friend of the first president. He and I had battles. We had power battles from the very beginning. During one of the meetings we had, he advised the multitude that we should never go into the switched modem business, because it was a black art. My little gong went off -- because we were doing leased-line modems at this other company -- my little gong went off and said: "Black art. There's got to be something there is there's black art." So, we decided, collectively -- I don't think anybody -- we decided to go. We looked around, and then Carterfone sort of began to dawn on us as we went around and talked to some potential customers. "What kind of modems would you like?" Well, people said things like 103s. So we decided we better go find out what a 103 was, so we bought the technical book -- the blue book -- from AT&T and we read through it, and discovered that it was mostly there, but for example, the one thing in the book that they didn't tell you was what was the zero and what was the one, the frequencies. It was an FDM system, and there was one frequency for one and one frequency for the other, zero and one, but we didn't know which. So we found out by calling a timesharing company and measuring the answer tone, because we knew that was a one. Now that tells you the level of knowledge and sophistication of this company that created the dial-up modem business.

Pelkey: So when you started thinking about modems, even originally, it was really a leased-line modem, because that's what there were, just leased-line modems at that point in time.

Maxwell: We had no idea. We didn't use modems. I had never used a modem in my life. I didn't know what they were. We were designing modems that had these great big potted filters that we were trying to make an active filter for. That's what this guy was doing to replace -- there were these frequency division things where you would stick 15 or 20 of them on one phone line that would stretch over 1,000 miles of cable on a pipeline. That was our background. Of course, my background was zero.

Pelkey: How long into this was it before the switch?

Maxwell: Very soon, because customers told us. By the way, that's the message. At the end of the day, it's demand and applications that create businesses, not technology.

Pelkey: Absolutely. By the end of '69, you were in –

Maxwell: Well, we actually had a product by the middle of the summer, and we took it to some companies and got a company called Novar, at that time, and they ended up liking it enough that they invested in us. By the way, I'll give you some numbers. The early round -- we financed ourselves for about three months on nothing. We raised, at the end of the summer of 1969, $185,000. With each share of stock at a dollar a share, we issued a warrant that was exercisable

in June of 1970 for $2 per share, and that was to be our financing. We got this one customer, Novar. We then did all the kinds of crazy things that you do.

Pelkey: What kind of valuation was the $185,000? How much of the company did they get for it?

Maxwell: I think they got 45, 50% at the outset, and ended up with about 70%. I see what you mean. They were all individuals.

Pelkey: This is the group that Dan Sully participated in?

Maxwell: Yeah, they were a collection of individuals. There was a guy named Alan Bailey who was the biggest original shareholder who was the president of a company called GRT, General Recorded Tape, and he was the president of it. The wife of the marketing guy worked for him. Then there were a couple or three individuals around here; there was a guy that one of them knew at Hewlitt Packard who had made some money at Hewlitt Packard, so he put $20,000 in. These were not high rollers, although one of them, a guy named Edwin Seip, is a very wealthy man. He put some money into it. Immensely wealthy these people were not, because we got two big contracts in the following spring, and we started actually beating our business plan, and we ran out of money. We decided in April -- we had a meeting in April of 1970: should we ask the existing shareholders to exercise their warrants for $1.75, bring them in a little bit to get some money, or do we go to the bank. Well, we made a decision to go to the bank. In 1970 in May, the stock market dropped 200 points, which was a huge number at that point in time, in about three weeks. The two big customers we had went bankrupt. The third customer, this terminal company, we had to put on credit hold because they couldn't pay their bills. We had no money. The founders did not take salary for six months, and the second key ingredient -- first of all, you've got to not know what you're doing. The second key ingredient, which came into play, is you've got to not know when you're beat. Any intelligent, rational judgment of that company says: "Insolvent. Liquidate and go find jobs elsewhere. There's nothing even to liquidate." We didn't know that, and we had a company in southern California that had gone public and had a bunch of cash and was looking for little companies to acquire, and we were talking to them, and got together with them, and there was a possible acquisition of the people -- really nothing more than the people and a little bit of the technology and the customers.

Pelkey: What company was this?

Maxwell: I'll tell you in a minute, because it's ironic. The world is full of ironies. We borrowed $60,000 from three of our investors. By the way, June came and margin calls had clobbered everybody, so nobody could exercise the warrants, and what we did was we said: "If we can't get above $200,000, we'll give all the money back," and we got to $175,000 or something like that. It wasn't fair to these people, so we gave it all back, borrowed $60,000 from these guys on the grounds that we were going to be acquired. They took from us, in return, 12% of the founders' stock, because they knew that would roll through an acquisition. In August, the deal fell through. Now, the irony is that this company was called Dana Labs. Dana Labs is now owned by Racal. Well, the bads are followed by the goods, and in September we were still struggling along, and we were picking up a little business. We did things I wouldn't want to tell

you about to stay going, but of course our cash flow was down to practically nothing. We had plenty of inventory and it was just a matter of keeping going, in a building without air conditioning in hot Palo Alto, over on Commercial.

Pelkey: How many people were there? There were the seven founders - -

Maxwell: There were seven founders. We scratched enough money to keep two of them with some income, the two that had to have it. The rest of us found other ways. I borrowed some money from my parents and other people had other sources of income that they could rely upon just to get through it, although our house went into foreclosure during it. It was more delinquency than anything else. I remember being afraid. It just was sort of happening. I had a one-year old child, and it was just sort of going on. I couldn't do it now.

Pelkey: How old were you at this point?

Maxwell: Twenty-nine. Average age of the founding group was about 27. In September, the company that owed us all this money was bought by GTE, paid their bills and gave us a big order, and the second thing that happened was that we got an opportunity, because of some friendships that one of -- our east coast person who was working as an agent for us had with another guy who worked CSC who had a contract with the Off-Track Betting Corporation, that we could get the modem business if we could deliver a modem of a certain description in three or four weeks. Well, it was a 202, which we had never made. We had the modules for the 202, but we didn't have any control logic, and we had never made a stand-alone box. We had been making these little things that go inside terminals. This was a stand-alone application, so I designed a wooden box on Saturday morning, and the power supply in the afternoon, and laid out and developed some control logic, and we delivered a working prototype in two weeks and got the business. In October, we shipped $40,000 and were profitable. Spent the entire monthly profits on a Chinese dinner over here in Palo Alto, and then in December, things had cooled off. There was some money, and we raised an additional $250,000, paid ourselves our back salaries, and things never looked back.

Pelkey: Where was that money from?

Maxwell: Same people. We dragged in a couple. In fact, it later proved to be very embarrassing, because this guy that had done this work for us at CSC put together a shadow beneficial trust that encompassed little old ladies in tennis shoes like you wouldn't believe, represented himself as the single shareholder, and we tried to go public in 1974. We probably spent 200, $300,000 just trying to make sense of the shareholders, because we clearly had a large number of non-qualified investors; a terribly large number of non-qualified investors. We never did count them. We tried it in 1974. There were two IPOs, and we weren't one of them.

Pelkey: Who went public that year, do you remember?

Maxwell: I don't remember.

Pelkey: So October of 1970 was a gratifying month.

Maxwell: The numbers I'm proudest of as a business, is that we have cumulatively, in our history, produced $75 million in pre-tax profits on that less than $500,000 of original investment, without a single dime of capital investment from that point forward.

Pelkey: Is that a fact?

Maxwell: That's a fact. We borrowed money, but when we were bought by Racal, there was no investment, there was no cash infusion. We've produced cash for Racal like crazy.

Pelkey: That's awesome. You should be proud of that.

Maxwell: Racal paid $20 million for us and got $65 million in pre-tax profits out of it.

Pelkey: Now at this point in time, in '70, are there other switched dial-up modem companies?

Maxwell: Oh, there were 50 or 60 of them. They were all over the map.

Pelkey: They were popping up all over the place.

Maxwell: They were all over the place, and all of them seemed to have better technology and better prices and know more about the market and knew more about modems, had smaller units -- seemed to -- and GDC survived, we survived, Peneril sort of survived, UDS survived, and the rest of them went south.

Pelkey: Why did Vadic survive?

Maxwell: If I could answer that question, I'd do it again.

Pelkey: That's a fair answer.

Maxwell: I don't know. I know the history, and I can report on one business, and I can attribute it to understanding the customers. I say things like: "I wasn't an engineer, and so I wasn't invested in the solution. I was invested in the problem," and fortunately I ended up designing these solutions with the technology that these guys developed, and they turned out to be very good ones. There were some interesting strategies that we developed, like, in 1971 we realized the OEM business was never going to go anywhere. There are some fundamental reasons why the OEM did not, has not, and will never go anywhere in the modem world. There is a power to the RS-232 interface which is incalculable, and it actually has to do with the same thing that makes PC DOS so powerful. It was a standard that allowed two things made by heterogeneous groups to work together, and even though there were an inordinate number of better alternatives for accomplishing the same end, they would not provide that one piece of glue that let Vendor A make this thing and talk to something made by Vendor B. Of course, when you make an OEM product and you put it inside the terminal, that power is lost. The RS-232 interface is lost; the flexibility that comes with it, the ability to deal with even

integral-term modems, that's still only 25% of the PC business. It comes down to one very simple thing: it's the tyranny of standards.

Pelkey: But in that case, can't one argue that the telephone line coming in to the integrated modem -- that's what you bring in at that point –

Maxwell: But that has nothing to do with the real application. The real problems don't occur at the telephone line, the real problems occur between the –

Pelkey: Communicating devices.

Maxwell: -- between the terminal and the modem. See the telephone has been organized by one company, and the standards are absolute. There is absolutely no mystery about the characteristics -- electrical and physical and signalling characteristics of a telephone line, absolutely none. That's one of the reasons, I believe, that IDCMA had very little real effect on this business. What happened was inevitable, absolutely inevitable, and probably didn't even greatly change the size of the market. It might have changed the speed with which the market grew.

Pelkey: At that point in time, there were all kinds of different terminal standards.

Maxwell: Yeah, but there was only one RS-232 standard, also developed by Bell, but adopted. While there were a myriad of minute alterations which everybody had to understand over time, the fundamentals were the same. There was a connector whose physical properties were well understood. People made them and you could buy them for a buck or a buck and a half. There was a cable that went between the two, and there was another connector on the other end, and the pins were all the same, the electrical properties were well defined. You didn't necessarily conform to them, but they were well defined, and while the functionality -- actually, today, nobody makes a modem that conforms to the RS-232 interface, because an RS-232 prevents -- precludes -- strictly interpreted precludes automatic dialing. Of course, every modem built today does automatic dialing. The RS-232 interface requires that the transmit data lead be inactive until the modem is connected to the phone line. Well, if it's inactive you can't pass dialing information across, and that's how you get dialing information across.

Pelkey: Now, going back to 1970, a dial-up modem required an acoustic couple.

Maxwell: No, a dial-up modem required -- you see, with Carterfone came the requirement for the telephone company to provide access to the network for terminal apparatus, and the telephone company provided that by limping out these data access arrangements. They came out in 1969 and 1970.

Pelkey: So every time you had to –

Maxwell: We never made an acoustic coupler.

Pelkey: But your customers would have to have a DAA.

Maxwell: Yeah, they would have to order, from the telephone company, a DAA. They ordered a telephone line and they got a DAA.

Pelkey: And my understanding is that they weren't in a great hurray to provide DAAs because they wanted to sell their modems.

Maxwell: I think that's wrong. I think they were not in any great hurray because that's the way the phone company, with their billion employees, works. Actually, they came out with them with incredible rapidity, given their normal time frame of bringing hardware into the field. It's funny, I testified at the anti- trust trial with great trepidation, because the last thing I wanted, although on this I have turned out to be wrong about, the last thing I wanted was a liberated AT&T.

Pelkey: Because you thought they could be competitive?

Maxwell: I thought they might be competitive, and they certainly weren't. Now, of course, they've proved that they don't know how to market. They'll never know how.

Pelkey: There wasn't a dial-up market before the DAA?

Maxwell: Well, there was the dial-up market serviced by acoustic couples, and there was the dial-up market serviced by AT&T.

Pelkey: And that was it?

Maxwell: That was it, because it was illegal to attach to the phone line otherwise until the Carterfone decision.

Pelkey: When did Anderson-Jacobson –

Maxwell: They came before 1969. They actually built acoustic couplers -- they and a couple of other small companies built acoustic couplers before 1969. They're an example -- we're a living example -- of why that chart you have in your book is the way it is. It is very, very difficult -- I think it's almost a law -- that companies learn how to do something and they can't do anything else. Every multiplexer company has tried to be modem company, and every one of them have failed. Every modem company has tried to build a multiplexer, and every one of them have failed, with the exception of GDC. By failed, I don't mean that –

Pelkey: Codex.

Maxwell: Possibly. Yeah, I guess you have to give Codex –

Pelkey: Begrudgingly, some credit there.

Maxwell: Yeah.

Pelkey: But you're right. It is an astounding –

Maxwell: Xerox can't make computers. IBM can't make point of sale terminals. Hewlitt Packard only had the blessings of a cash cow in their instrument business to survive years of turmoil before they could make any sense of their computer business. Digital Equipment has tried to do software. There's a bandwidth. Companies develop a bandwidth, and it's much narrower than almost anybody in that company believes.

Pelkey: One of the issues in that area is that most people look at the modem/multiplexer business and they think of it as being analog -- that's analog engineers -- and they look at the LANs and WANs and they say that's digital, that's computers. That's not totally true, but certainly in the LAN portion, that's computers, computer scientists and digital engineers, not analog engineers. But the case of the multiplexer was really analog as well in the early days.

Maxwell: They're pretty strictly digital devices.

Pelkey: Why do you think that happened, the multiplexer guys not being able to compete in modems and modem guys not being able to do multiplexers?

Maxwell: I think two things happens to you. When you start a company, there are only two entities: there's you and there's the market, and I don't know any start-up company that actually ended up doing, successfully, what they started out doing exactly. We certainly didn't. We ended up -- started in modems and ended up with modems, but we started out with one idea about how to do it which was just completely wrong, but we were very adaptable. We had to be, and you have no choice, but you had nothing hanging on you either. You could take what you got. You jumped into the market, and the market told you some things, and then you figured out which one, and what you said earlier. There are more opportunities than capabilities. You pick the opportunity that looks the best to you at the time, because of somebody you know, or you made a sales call and something great happened, you were at the right place at the right time, and it got you somewhere. I know that's the history of Vadic. It's the history of Milgo, it's the history of Codex, it's the history of Microcom, all of which had bounced around until they finally found something where they were in the right position in a growing market that carried them to success. When you get there, though, there's a third ingredient, which is your past, which you can never escape. Once you become successful, you have a market position. That market position then dictates what you do, to the extent that you can never develop enough resources inside the company that are separable, to be flexible again, and to repeat the process. As you know, in the early '80s in this valley, most companies, including Vadic, decided to own 'intrapreneurship.' They were going to set up these little entities and become doomed. I didn't know that. I unwound ours completely not less than six months ago, but they were doomed. They were doomed because, 1) the totality of the company couldn't support it; you couldn't get salesmen's time, and you didn't have any salespeople because these little entities were usually marketing and engineering combinations. Secondly, the people in them, if they worked for a big company, weren't the right people, because what you really want is a guy who wants to be president of a small company, but he's not going to sit there and do this horseshit and work for $70,000 a year. So you end up with an engineer and a marketing guy out there doing something

that you thought that you did when you were 28 years old, and they can't do it. They just can not do it. There is not a single success that I know of of intrapreneurship in this valley.

Pelkey: Right, because if they were intrapreneurs, they'd be entrepreneurs.

Maxwell: They'd be entrepreneurs. I mean intrapreneurs in some respects is a self-contradicting phrase.

Interruption in the Interview

Maxwell: . . . I've been going to it for several years. There is something to be said for -- a new person can cut off everything but the heart and start over. Now, I think it's only a Jack Tramiel who, of course brought also a lot of money, who can take something from the ashes, because usually you reach a point where you can't even protect your own market, and you end up in some kind of downward spiral like Corvus has gone through. In some odd ways, all of us in the mature business -- Codex, I heard today, laid off 15% this week. They passed Milgo and Vadic this last year in size. It could be a rumor; I hear these things all the time, but it came from a pretty good source, because they're not making their numbers. They're growing, but not growing at the rate that Motorola expects. That's very difficult, and it's not restricted to communications.

Pelkey: Do you think the process of venture capital is healthy -- constructive or destructive, relative to the process of you as a manager inside a company, to this process of creating economic growth? If there wasn't so much venture capital, do you think that these entrepreneurs would, in fact, become intrapreneurs? Or is it independent of that issue?

Maxwell: I think it's independent. I am constantly amazed at how constrained I am. I had an experience last week where I was conducting a conversation about marketing with our marketing VP and it was a general conversation, and I, at the end of it realized, that the language alone of the conversation said that we were still thinking in terms of asynchronous dial-up modems in the United States, and more than half of our revenues today come from non-asynchronous modems worldwide. They fight like hell for life, because the ability to adapt declines to a point where even the people who are adaptable can not adapt a company. Your history becomes the dominant influence in your company, and if you're in a mature market, as at least a good portion of the dial-up modem business is today, you find yourself in a tough spiral that's well documented. Margins go away; you have to lay people off in order to keep yourself above water. That restricts the amount of resource you can apply to the future; you're still fixing the past. You've probably created a reasonable collection of problems by then which are also sucking up an awful lot of resource that appears terribly unproductive, and you think: "Isn't it awful now," and you realize ten years ago it was actually a lot worse and you're a lot better now, but it looks terrible because you're not growing like crazy and there's no market tugging you along. There are 68 competitors out there, and Rockwell puts three more in a week, although now people are realizing they can't get in the modem business, no new ones.

Pelkey: I want to get some more of the pure history while we have the momentum. The DAA allowed other companies to begin to participate in the dial-up modem business, and that was a direct consequence of Carterfone. You indicated that when you started this, the customers were

saying: "Build a 103," and then they started saying: "We want a switched modem," so the marketplace started pulling you in that direction. Why was the marketplace looking to you for a switch? Why didn't they just go to Bell and get it?

Maxwell: Because Bell couldn't sell. Until divestiture, Bell could only lease, at $45 a month for a product that could be made for less than $100. That was one reason. The second reason was -- and this is why we went after the OEM business –

Pelkey: So you sold most of your modems, you didn't lease them?

Maxwell: We never leased.

Pelkey: So the customers wanted to buy it because it was better to buy it than have this lease obligation?

Maxwell: Well, at the beginning, the customer was a terminal supplier, and the terminal supplier saw the modem as added value. They could get money from their customer for the modem, and if the terminal supplier happened to also supply service, then they would rather have their modem rather than the telephone company's modem.

Pelkey: These were asynchronous terminals being connected mostly to some minicomputer?

Maxwell: Usually a minicomputer, or a mainframe, or a timesharing service. There were embryonic timesharing services around -- small ones, but Timeshare was in existence then.

Pelkey: So there were some emerging timesharing companies?

Maxwell: There were some emerging timesharing companies, and of course Hewlitt Packard, in the '71, '72, came out with the 3000, which was a timesharing computer and was sold as such, and had a timesharing operating system and was trying to compete with IBM's whatever-it-was-called -- TOS or whatever. It was falling on its tush in dramatic fashion.

Pelkey: So the demand was coming in for remote linking of terminals, some remote office or something, into some kind of a minicomputer, and/or a timesharing application, and the terminal manufacturer's were your primary customers up front who were trying to get value added. They wanted to buy it as opposed to lease it and capture that revenue and value added to their product.

Maxwell: And there were some -- that's a pretty good description. Our two early customers were Frieden, who was making a point of sale terminal, and we made a little module that fit into a store and forward device that they would put in smaller stores. It would collect information during the day and then relay it to a central computer at night. They could have used AT&T with that, but they felt they could get more money for it and had some control over it if they bought it from us. The other was a real -- it was a typewriter terminal, made with an IBM Selectric mechanism, that had a tape in it that you could store information with, some electronic memory, and it was sort of a glorified teletype with memory and built in control functions so that you could take it to a financial firm, for example, and you could customize it so that the keystrokes

would mean certain things. You had built in hardware macros, and these required communications, and they were not applications that required constant communications.

Pelkey: You were explaining what happened to you during this period of time up until 1970. You went through the market crash in May of '70 to the drop until October, and then October you had a profitable month, and then you raised more money at the end of '70. At this point, your product line has –

Maxwell: Well, we had the wooden box, and the wooden box got us to make a plastic box, because Off-Track Betting ended up being a pretty big customer -- a million dollar customer.

Pelkey: This was a 202 compatible?

Maxwell: This was a 202 compatible, leased-line, point-to-point modem.

Pelkey: Your dial-up was a 300 bit per second?

Maxwell: And the 202 was also dial-up, but the Off-Track Betting application was actually leased lines.

Pelkey: So you had both leased-line and dial-ups at this point in time. What was the next big step in the evolution of Vadic?

Maxwell: Well, in 1971, and exactly when I don't remember, we decided that the OEM business was simply not going to be -- we had sort of believed, even at that time, the rhetoric that said that semiconductors would own the business in five years. There would be a modem on a chip and terminal manufacturers would simply buy them on a chip and stick them inside their terminals, and there wouldn't be a modem business for independent suppliers. That story has actually been around -- that prediction has been around -- since 1970, and it gets renewed and reinvigorated about every five years, and its no more true today than it was then.

Pelkey: Around that same time was the issue of Digital Dataphone Service, or was that later?

Maxwell: That was quite a bit later.

Pelkey: That was '76.

Maxwell: So, in 1971 we had gotten to be a million, $2 million a year company. We were making money, but we were having a hard time finding incremental business, and we recognized that the RS-232 interface was pretty compelling. So we took a major and critical strategic turn, and decided to make a stand-alone product line, which we had not wanted to do before because it was competing with AT&T. What we did was we said to ourselves, and then -- I probably can take most of the credit for this, not all of it -- we should go after that segment of the market that a small company with no reputation and no service organization can do, and we should take a marketing position that amplifies us as much as possible. So we decided that we would take on Ma Bell, that we would ignore everyone else, that we would go after the computer site end of the

business, and that we would attack Bell on the grounds that they couldn't sell and that you had to pay for service. What we would do is make a product that was serviceable by the customer, and we would go after those kinds of accounts that were willing to do their own installation and maintenance. That got us involved with the timesharing companies, because they tend to be technician intensive, small and crazy themselves, and not very in-love with the telephone company because they had to fight with the telephone company all the time.

Pelkey: What a bold stroke at that point.

Maxwell: So we designed a chassis system that would hold 16 cards with dual-redundant power supplies, so that if one failed, the other one would keep it going. That was one of the tricks, and we -- it was really all me -- I came up with a system of multiplexing the diagnostics so that you could always see, on any one selected card, all eight interface leads. I'd been around the trenches enough -- I had gone out and diagnosed enough stuff in my day with scopes under my arms by then -- to know that really, the most valuable information you get is the information that passes across the interface, but you need to see all of it. What other companies did was they made a rack whose cards fit in the front, but you had to connect these 25-pin connectors up in the back, so there really wasn't much space, so what they did was mounted lights on the front of the card. Well, power and all that stuff -- LEDs took a lot of power then, and so you'd only put on, say, Data Terminal Ready, to say that the terminal was there and on, and maybe a Clear to Send. You had a limited number of lights, and you also had a limited number of switches you were willing to put on there for things like diagnostics. What we did was we mounted the boards in from the back, put a motherboard on the front which didn't have to carry any connecting terminals, built a bus system in the front, and connected up each modem card to a panel of lights that could be selected by a thumb switch -- one to 16 -- and then we put two common diagnostic buttons. The feeling was you would only diagnose one modem at the time, so we put one light for the status of each modem, and we put eight LEDs up there for looking at the interface leads and then two diagnostic switches, and then a single switch for each modem to busy them out. That was a front panel which was completely clean. You didn't have six holes in it because you only had it half full, and the modem stuck in from the rear. We sold 60,000 chassis.

Pelkey: You sold how many?

Maxwell: A million slots. We still make them, we still ship them.

Pelkey: What an incredibly successful product.

Maxwell: Yeah it was, it really was the most successful product. Now, of course, we had to put modems in it and we had to make the right kinds of modems, but -- It had some maintenance problems because, of course, you had to take the card out to get -- you had to take the cables off the card to get the card out, which was a royal pain in the ass, and everybody said: "Oh, you can't do that, nobody will buy it." Well, we owned, and still own, actually, a large part of central-site modem business as a consequence of that system.

Pelkey: Because diagnostics and ease of diagnostics –

Maxwell: Actually, not really. The thing that really made us was the full-duplex 1200.

Pelkey: But I'm saying that particular product –

Maxwell: That particular product, which later carried the full-duplex 1200, was a successful product on its own . . .

Tape Side Ends

Maxwell: . . . same card, it slid in from the back, lights on the front, so we only had to make one card, and that allowed us to sort of slip into the remote site for customers who wanted to buy it from us rather than leasing from the phone company, and that sort of got us going. You could just do things then. We had one contract -- the guy wasn't very good, a mechanical designer, and I would think about these things riding my bike over to his house telling him what I wanted to do, and he would do it.

Pelkey: Were you the president at that point?

Maxwell: No. I might have been. I was president from 1972 to '74, so no, I was not president then.

Pelkey: What happened in '74?

Maxwell: I was fired for incompetence, negligence, arrogance, irascibility, and doing bad things with the company. I should have been fired. I would have fired me if I was in their shoes.

Pelkey: Let's come back. When did you come out with the 3400?

Maxwell: See if you get the same story you get from Bingham, since you've talked to Bingham. In 1971 I hired a guy named John Anderson. One of the things that happens -- preaching to the choir, I'm sure, but -- when you start a company is that you work 16 hour days, seven days a week, and you reach a point of diminishing returns that you don't understand. I made a critical personal decision in 1971 that I couldn't do it all myself, and I had to have an engineering manager who would come in and begin to do real engineering management. I hired a guy named Dennis Anderson –

Pelkey: You were running engineering at that point?

Maxwell: Yeah. So I hired a guy named John Anderson who had been at Lenkurt -- another company, another example of a company that could never get out. There was a company that was in the modem business before 1969. You would think they would grab this thing and go run with it, right?

Pelkey: Collins.

Maxwell: Collins, RFL Industries. So Dennis Anderson knew John Bingham. John Bingham had also been at Lenkurt but had gone to work at Memorex, and at Memorex he was designing a 201, a 2400 bit per second modem. During the course of his work at Memorex, he came up with an idea, and the idea was an elegant one, a clever one. He recognized that, if you use a coherent demodulator of a synchronous modulation system, and you used a particular method of recovering the carrier where you take a reference carrier in the receiver and you 'X' it with the receive signal, the band that is right around the reference carrier will be around zero, and any other frequency bands that are mixed in with this thing will actually be found at other places on the frequency spectrum. So, if you take a low-pass filter in the receive and simply clop it off at the bandwidth of the (unintelligible), then you can, in effect, select the channel that you are interested in without having to have filters in the front. You could have one filter, a low-pass filter, and all you do is change the frequency. Now, this is actually not a miracle; it's what's done in televisions and radios. When you switch the knob, all you're really doing is changing a reference carrier, but it hadn't been applied to data communications, and at that time, the business that this previous-to-Vadic company was in was one where you would string modems along a phone line, and each one would have its own frequency slot, and there would be these big, humongous filters that were terribly difficult to design because they were very narrow and you would want to get as many of these things on one line as possible. That's how you saved the money. So you tried to push the channels as close together, which made the filter design just that much more difficult, and John's theory was that he could double the number of modems that you could get on one of these phone lines with this technique, because you could shove them closer together because you didn't have to worry about the impairments created by your own filters. John talked to Dennis Anderson about that, and we called a meeting in the conference room, and John presented it.

Pelkey: Was he still at Memorex?

Maxwell: He was still at Memorex, but he had tried to present this idea to Memorex, and Memorex said: "No, we're not interested." There was a lot of legal crap about making sure that it was really his. When he left, there were never any problems, but we were concerned. So I sat there and looked at this thing -- it might be worth, to give myself a little credit, telling you the state of mind and what I had learned by then. The 202 modem is a half-duplex modem. It transmits in one direction, receives in the other direction, but not simultaneously, and it's because it uses the whole bandwidth of the phone line. The 103 is a full- duplex modem, made full-duplex by separating two channels on the phone line by filters. So you transmit with one frequency, or pair of frequencies, and you receive with another pair of frequencies, and you can do so constantly.

Interruption in the Interview

Pelkey: You were going to go into describing your state of mind at this point in time.

Maxwell: There's a lot more to what made this business go than speed. The 202 was then, and is still today, the cheapest modem to build per baud. They are less expensive to build than a 103, and you get four times as much speed out of them. Furthermore, most applications are, in fact, half-duplex, really. You're not sending and receiving all the time at the same time. You're

typically sending something -- and it's particularly true now with file transfer applications -- you're sending something, and then something is coming back. So theoretically, the 202 was an optimum modem. It never went anywhere. Why? History, the wonderful mysteries in the tyranny of history. When Bell developed the 103, they developed it for the teletype and TWIGS system. They took a teletype which has three leads -- transmit and receive data and ground -- and said: "How are we going to get information from here to there? Well, we're going to have a transmit side and we're going to have a receive side," and there's nothing in the teletype that will tell the modem that it should change direction. The modem had to be full-duplex with constant carrier because it was simply replacing wire. There was no method of passing control information from the teletype. The teletype just wasn't an RS-232 interface. A teletype was a contact closure and a relay, and the interface from the modem to the teletype was another contact closure and a relay sensor. Now, the two things that came out of that were 1) full-duplex, and the second was asynchronous -- that the teletype generated a character at a time and stuck a zero bit at the front and a one bit at the end to identify it -- to mark it -- so that the receiving terminal only had to make a wild-ass guess at that actual rate of the transmitting terminal and only had to hold it up for 11 bits, because all of these machines were electro- mechanical. They didn't have crystal frequencies in them, and they were damned lucky to be within a couple of percent of one another. Well, the next thing that happened were electronic terminals. What were electronic terminals but replacements for teletypes? Because it didn't come up in a grand fashion by one great system designer -- some God in the sky -- it came up by people making electronic terminals and somebody else, in this case AT&T, making the modems, and they created this RS-232 interface. What did they do with the 103? They bound the control signals in such a way in the 103 that you only had one lead coming on to tell you that the line was there. You still couldn't change the direction of the line. Now, that meant that all the people who wrote software and developed hardware for terminals made the assumption that the interface looked like a 103, which required full-duplex and asynchronous. Now, there was a second thing that happened, or a third thing that happened here, which added trouble later on, which is the way error control was accomplished. In an old teletype, if you put the teletype in the remote mode, there was a little switch on the teletype that said local/remote. When you put it in the remote mode and it was wired properly, when you hit a key, it would create openings and closings on a contact, but it would not do anything to the printer. What happened was that it transmitted the thing out, and then it would come back on the receive line, and then receive line was connected to the printer. Now, if it was being transmitted to a remote location, it meant that if what you got printed was what you types, it got to the other end -- you made the assumption that it got to the other end properly. That was error control. Now, that requires full-duplex. So, what happened? Fourth point: I was pretty much aware of most of this by 1972. The fourth point is the switched telephone network requires a method of connection, which at that time was simply dialing the phone and making the switch to the modem, but it also requires disconnection. Now, if you have a full-duplex modem, you know that the other end is there because you're communicating with it constantly. If you have a half-duplex modem, you have no idea if the other end is there, because there are quiescent states where neither side is transmitting. If you put a half- duplex modem on a timesharing service, and somebody logs in, some reasonable percentage of the time they don't log out; they simply hang up the phone. You don't know they've gone away. Now, the simple answer is you put an activity timer in. The president is in the habit of calling up the service at 8:00 in the morning and expects to be on line all day even thought he only uses it for an hour; you don't put an activity timer on his line. You don't know what line he's calling in on. Activity

timers went away. They were a dysfunctional solution. As a result of these things, the terminals were designed to support full duplex, which was simpler because it was essentially hard- wired communications. Echo control was the method of error control, for the most part, and the communications were asynchronous. Now the 202 is an asynchronous modem, so that isn't relevant until later, but it's very relevant to the question of a full-duplex 1200, and 4) the disconnect procedures were not invoked in any elegant fashion by the terminals. Now, the irony is, looking backward, is that synchronous modems are incredibly more efficient than asynchronous modems because they can get much more bandwidth on the telephone line. Synchronous protocols are inherently error controlled and were known then. There was no mystery then. There were synchronous protocols running around then, and they were more efficient in terms of the use of bandwidth because they don't have to add a start and stop bit for every character. Three, if properly done, you were always polling one end or the other, and you will know when the other end goes away because he won't respond to you. A simple minded algorithm will simply say: "I've always got to be talking to this guy," and of course, that's how leased-line systems were designed. So had the world started differently in 1958 to 1960, and if AT&T had designed a synchronous modem, half-duplex, with a fast poll algorithm, the modem industry would have developed entirely differently, and people like Vadic would never have existed.

Pelkey: Now, I've held the opinion that some of this was IBM's solution to the world, the way they built terminals, versus the teletype view of the world. You're saying it's not that at all.

Maxwell: It had nothing to do with IBM. IBM views the switched telephone network as an act of the devil. IBM -- there's the world defined –

Pelkey: But they started out doing synchronous. Their terminals, they built -- they did the error correcting locally.

Maxwell: But those were all leased-line systems; central controlled, leased-line, dedicated systems.

Pelkey: So their terminal came after the synchronous –

Maxwell: Well, synchronous protocols have been around for a long time. The point is, I think, that AT&T was, of course, they owned teletype. They were trying to solve a particular problem. The teletype existed before the modem. The teletype was inherently asynchronous, and was inherently full-duplex, even though the applications were inherently half-duplex. There was no way you could get -- so they made the modem to suit, and had views at that time that there wasn't any need to go faster than 300 bits per second because you couldn't read faster than 300 bits per second, and besides, you couldn't get a mechanical printer to work faster than 300 bits per second. Besides, that's all a telephone line would carry with reasonable economy in a full-duplex mode.

Pelkey: But 'full-duplex' and 'synchronous' were different issues and grouped differently.

Maxwell: Absolutely. Well, full duplex was simple on a leased telephone line. You put two wires, two different phone lines. See, a leased line is almost always what's called a four-wire line. You have separate transmit and receive paths, so you get the whole bandwidth of both phone lines, so you can take a 202 and make it full-duplex on a leased phone line. When you have a dial telephone line, it's a full-duplex line in that you can get signals back and forth, but they're mixed together, and so if you use the whole band to transmit –

Pelkey: Then you can't –

Maxwell: Well, you can; V-32 for example does that, it uses the whole band for transmit and receive, but it has to figure out a way of cancelling the transmit signal into the receiver. That's the echo cancellation.

Pelkey: So the 103 was full-duplex because of the characteristics of making it, having to deal with this mechanical device and having only the two signals of transmit and receive, and you've got to know whether it's there, but the issue about synchronous, that didn't come from AT&T.

Maxwell: No, that came from IBM.

Pelkey: Right, and IBM's view of the world was a synchronous view of the world, because of the way they built their terminals. They built their terminals different than a teletype terminal. They built a terminal that had some intelligence at its site, as opposed to being at –

Maxwell: Well, yeah, because the synchronous protocols are fairly hardware intensive at that stage. They were expensive. You had to have a lot of memory, and you had to store blocks of information and keep them until it's been released by the other end.

Pelkey: In your opinion, did IBM have a commitment to synchronous before it had a commitment to its terminal type, or did the terminal type drive the choice?

Maxwell: I don't know.

Pelkey: I've asked a bunch of IBM people and nobody can give me an answer to that.

Maxwell: I suspect that they're integrally related, because the minute you decide to take a power terminal, which IBM made -- they were going after power applications, people who sat at terminals all day -- and the minute you decide to go into that level of application, which is non-casual, non-demand applications that are host controlled, you're almost obliged to incorporate error control; almost obliged.

Pelkey: For the efficiency of the host, you have to be synchronous.

Maxwell: You have to be synchronous. You then are pretty well –

Pelkey: You can't do echo.

Maxwell: Well, you can't do echo and asynchronous obliges you to stick an extra 20% on the link. You also have some other issues that synchronous helps you with.

Pelkey: But if you're going to be a power application, you're right.

Maxwell: So you end up with error control, and I think you end up pretty automatically with synchronous, and if you go back and read the books -- and I haven't done this for a long time -- the history of modems -- and I'm going to say something that I might not, I have very little real grounding in, but it seems right -- during the 50's, I suspect that the very earliest technology came out of the space business and the military.

Pelkey: Aviation.

Maxwell: Those were simplex systems very often. That is to say, they only transmitted in one direction. Those systems required, 1) robustness in the context of noise, because the channels were often very noisy, and synchronous communications give you, theoretically, much better immunity to noise than asynchronous systems. That doesn't say that -- the modems are asynchronous. Secondly, you need to be able to recover timing. A synchronous modem allows you to recover the absolute data rate at which the information is being transmitted, whereas asynchronous does not, generally, allow you to do that. So if you look at the books -- and I did try to read as many as I could of them in the early '70s -- the bulk of the discussions were about phase shift and amplitude and quadra-triamplitude modulation. There was discussions of frequency shift modulation, but it was not at the depth of, and the discussion of how to make the detectors and all that stuff were really devoted to the synchronous area. That kind of tells you that there were applications out there that were pretty strong, and many of these books were written by people at AT&T. Of course, coming out of that was the 201 modem, which emerged in the middle '70s -- earlier than that, actually - - early '80s, because that's what John was working on at Memorex, so it must have been late '60s.

Pelkey: During the '50s and '60s, there were some small modem companies around, but modem technology was Bell Labs/AT&T technology.

Maxwell: Well, Bob Lucky would shoot me if I said this in his presence, but modem technology out of AT&T has never been worth a damn. They were so big, and they had a monopoly on the market, and therefore they controlled standards, and therefore they controlled the outer dimensions of our business, gut they never did it very well.

Pelkey: Witness the fact of what happened once they faced competition, they were not even a factor.

Maxwell: They were terrible. The 201 was a piece of junk.

Pelkey: Is that because they did have a view towards data?

Maxwell: It's because they didn't have the customer perspective, and because they got all tied up in their theoretical underwear, but without sometimes understanding their own theories. They

did some gimmicks in the 201 that they thought would work, but -- there are people that are analytic bound, and sometimes people that are analytic bound don't think. You know the nine dot problem? Turn your machine off.

Interruption in the Interview

Maxwell: . . . the statistics of their own phone line, seriously, and the think doesn't work on 15% of the connections. It's statistically ok, but it doesn't make the customer happy.

Pelkey: When John walked in you were talking about coming to some of these issue, starting to conceptually understand these constraints

Maxwell: I was puzzled. We had made 202s, timesharing companies bought them. By 1972 there were tape units, at least, that would work at 1200 bits per second, and of course there were Class T teletypes that would work up to 19.2; they were only constrained by the speed of the phone line. So there was some pressure. We should be able to go faster, and actually some timesharing services installed 202s, but they could never deal with the protocols, and they could never deal with this disconnect issue. The normal look at it from outside the industry was 'too much, too expensive,' or something, and the people couldn't quite figure out why. Well, it had nothing really to do with the speed. It had to do with the historical protocol context in which the modem was put. Well, when John came to me -- came to us, really, he didn't come to me, he came to the company and gave us his presentation -- it was a synchronous modem, and the most important question asked in the history of Vadic was the question I asked John after he made his presentation, which was: "Can you take that technique, apply it to a two-wire line, transmit at 0 dbm in one direction and receive at -50 dbm in the opposite direction at 1200 bits per second?" He looked at me and scratched his head, couldn't understand why I had asked the question, but said: "Well, I'll go think about it," and a week later he said: "Yes," he thought he could; did some calculations and said he thought he could, and the world changed. We hired him. We gave him a contract, a licensing contract, so that he had royalties that would spin out from this product if it was ever successful, and he got to work. Now, the keys to the product still had to be done, and it took me a long time to persuade him that it had to have an asynchronous interface. So we had this synchronous modem, now, which of course is much more efficient -- and really the synchronous protocols are much more efficient -- that we've got to make asynchronous, so we have to add something to the modem to make it asynchronous. So he and I actually concocted an asynchronous/asynchronous interface that was pretty clever, and the we put in a remote loop testing capability so that we could go to the remote end and test it. It was full-duplex, and we had this signalling system, and we started doing some very clever things about making the modem work right, and we announced a product, unfortunately in the winter of 1972, early 1973, didn't apply for the patent in time and therefore lost it later in court, but that's a completely different issue. Now, what are some of the funny things about all of this. 1), John's idea didn't work. He couldn't make it work. It turns out that to get that much filtering in the baseband, with this filter, required this filter to be so sharp, and when the filter gets very, very sharp, the signal through it gets very delayed, and the sharper the filter the more delayed the signal. Well, in order to get the rejection of the adjacent channel in the baseband, he put so much delay in the signal -- and that's the signal used to correct the information that's coming in -- that he couldn't converge, so we ended up with a hybrid. We had to have front-end filters that would do some

channel separation, and then we used this technique for separating the rest. Actually, when AT&T developed their product, they used no baseband filtering, because they used a differential, not a coherent, detector. So the idea that prompted all of this ultimately had nothing to do with the final product -- with the possibility of the final product. It was just that there was an absolutely serendipitous connection in time of me, a guy who knew sort of what the market had to have in order for it to go forward without knowing how to do it, and Bingham who had an idea about how to do something but no concept of how to make -- what was the market, because I said: "There's not market out there," for the product he presented, because there wasn't. From that point forward, AT&T copied it and did something we should have done, which they did, which was put the 103 in it as well, and make automatic recognition, and that's become another integral element of the dial-up modem business. You have to have full-duplex, asynchronous, and every sub-rate that was ever popular.

Pelkey: Now, that was the 3400, right? When the 3400 came out –

Maxwell: Does that conflict with John's story too much.

Pelkey: No, actually it doesn't. I haven't talked to John in a bit, I talked to him in March.

Maxwell: I think of myself as the father and him and the mother. I put the seed in, he produced the baby.

Pelkey: There's a lot of overlap, but I hadn't looked at his specific words recently. He said that it wasn't until '75 that you shipped the thing without (unintelligible) wires.

Maxwell: Oh, it was a mess. It was a technical nightmare. He did some things -- he did them too. He did some things that were criminal, engineering-wise, just criminal. He tried to get away with things that -- he didn't put crystals in it. We had tuned filters, we had RC timing circuits. He did exactly this nine dot number; he got himself all tied up in his theories, and we produced junk -- dysfunctional junk -- for two years at least. We had a power supply on there which wasn't regulated well enough.

Pelkey: But you were selling them, because the market –

Maxwell: We didn't sell very many. We did not sell very many.

Pelkey: Consciously?

Maxwell: No.

Pelkey: Because they didn't work or because the market didn't want them?

Maxwell: We were a $4 million a year company with an absolutely unique technology, where you had to have our product at both ends, that was expensive, and that really didn't have a terrific, great need then. There were terminals out there that could use it, but it was –

Pelkey: It was fast for then.

Maxwell: Yeah, but not for a glass terminal, and by that time the 208 was out, so you had 4800 bit per second dial-up on the synchronous end of the spectrum. This was the early, early, early, early adapters. You had to have a lot of courage to buy one of those modems; a lot of courage.

Pelkey: Was it UDS were you got into the patent –

Maxwell: Got in a patent suit with UDS, but that was quite a bit later. What happened was that AT&T saw it; they were one of our first customers. They bought them and said: "Jesus, these guys have got something," and the decided to build their own. I ended up meeting most of the people who were involved in the design process, including Bob Lucky, who was a famous -- I don't know if the name means anything to you -- but he is considered the father of adaptive equalization, and in his last years with AT&T became a public spokesman for them, and a very nice guy, a great guy, but did most of the really seminal work on adaptive equalization, and is sort of the -- at least in the modem world -- is up there with Nyquist and Shannon -- Shannon has nothing to do with modems, but Nyquist had a lot to do with modems -- but Lucky is in the pantheon.

Pelkey: Do you know where he is now?

Maxwell: No. Might still be working for AT&T for all I know, for Bell Labs.

Pelkey: So you introduced this in May of '73?

Maxwell: We introduced it. We shipped 20. We may have shipped a couple hundred in the first year, but through 1976, a good deal of our business was still in 202s and 103s.

Pelkey: And then, in '75, it started to sell strongly for you?

Maxwell: It became stronger. We began to get it installed and seated, and there were people out there really willing to buy them, but then AT&T. In 1976, AT&T announced their product, the 212. Now, I don't remember exactly how many we had shipped, but we had shipped enough so that there was enough of an installed base that people were -- and they worked well, in fact they worked better than the Bell unit, performed better than the Bell unit; finally got it right -- and, I don't remember when we did it, I think it was actually after the AT&T unit came out, but our unit could be acoustically coupled, and the AT&T unit could not. They had reversed the transmit and receive frequencies, and the acoustic coupler is almost always from the originate end and the transmit. We consciously and intentionally put the transmit originate channel above the transmit/receive channel, because the microphone in the handset is non-linear. It produces second harmonic distortion. Well, second harmonic distortion, which creates frequencies twice those of what you're transmitting, fall above and you don't care about them if you're transmitting in the high band. If you're transmitting in the low band, where do they end up? In the high band, and they clobber the receive signal. It wasn't quite that simple and it didn't work out quite that well, but the things that happened from that point forward that really made us were 1), AT&T came out with a product that was different, which is the best thing that happened to us.

Everybody, of course, wanted to do AT&T, but they had to scramble. They had to figure out how to do it. UDS had come out with a product, meanwhile, using a different technique altogether, and it, of course, disappeared. The second thing that happened was that Texas Instruments came to us and said they wanted to put a 3400 in their new Silent 700 1200 bit per second thermal printer terminals because they needed acoustic coupling. It was a portable terminal, and the only way of making a portable terminal was to make it acoustic coupled. So we designed -- and we knew what we were doing -- we took this contract, we never made a nickel on the contract. We took this contract and developed this awful, ugly modem for Texas Instruments to put in their box that they didn't sell -- it didn't work -- but in the late '70s, Texas Instruments was THE supplier of timesharing terminals. The Silent 700 was THE terminal, and so when they came out with a new -- the 785 and the 787 -- everybody went around and said: "My God, I've got to support this thing," the timesharing companies, because they're going to be out there. Users are going to be buying them and I've got to support it. It's got a 3400 in it, so I better go buy myself a 3400. Meanwhile, these same timesharing companies were saying: "But I've got to support the 212," so yours truly created, on an airplane, a modem which did three; the 103, the 3400, the 212. I came back and it took me a while, but I persuaded Bingham that he could do it, and he could, and we developed a product which was a triple modem. It meant we could go to the timesharing companies and say: "You want it to look like a 103, it'll look like a 103. You want it to look like a 212, it'll look like a 212. You want it to look like a 3400, it'll look like a 3400." No problem, and we sold probably 400,000. They cost us $165 to make and we never sold them for less than $700. That's why, in 1981, we made 33% pre-tax profits. Now you can ask me why we can't do it again.

Pelkey: A point of clarification: I asked Ken Krechmer -- Ken's recollection of the creation of the triple witch was that you and he met at your house one weekend. Your recollection is that it was on an airplane flight in which you kind of –

Maxwell: My recollection is very specific, and I have a notebook. It happened in my – Krechmer may have been involved in it. He was national sales manager at the time, but I had gone to General Electric, Gysco. Gysco was the first trial of the 3400 in 1973, and we had developed a terrific relationship with them, but they had bought very few 3400s. They're very slow company to accept things, even though the engineering people loved it, but we had installed quite a few 3400s. Gysco has saying to us -- and we considered them a major customer because we had sold them a ton of 103s -- we want to be able to support, at the answering end, your product and Bell's. You have to know a little bit about me. I'm a guy who functions only usually when my back is to the wall. So I took a plane there and I said: "We'll do it," which is my wand. I took a plane back, and I had to figure out if we could do it, and I had figured out on the plane there -- I had decided that the key was to take -- because AT&T had done the asynchronous/synchronous conversion differently.

Pelkey: And your 3400 did not support 103?

Maxwell: No, but that was simple. That part was simple. The real key, in my mind, was 'could we make a single asynchronous to synchronous converter that would look the same to both?' because we wouldn't know necessarily, and we couldn't tell the terminal, to change the way it was going. We had to get information back and forth between the terminal in the course of

deciding what kind of device was on the other end. So I scratched out some diagrams and persuaded myself that we could make one circuit that would transparently, without changing the circuit, do the AT&T technique and do our technique. Now, the AT&T technique required a receive buffer as well, and then I had to persuade myself -- and this is what I did on the plane coming back -- that we could make a receive buffer that would, in fact, ignore -- I guess we switched it out in the 3400 mode. Then I came back and told Bingham he had to make the analog stuff, and he said: "I can't." I said: "Sure you can," and he did. Then we put it -- we did it in a microprocessor. It was our first microprocessor product.

Pelkey: That wasn't -- you knew, both you and other people that were there, that if you could do this product, not only was it critical to do this product, but if you could do this product, it was going to be a successful product. Once you had made that commitment, once you understood what the marketplace wanted -- there's 103s out there and there was going to be 212s out there and there was nothing you could do about that, and you had your own base -- if you could support all those, given that you know your 3400 was better than their 212 –

Maxwell: It performed better and it allowed acoustic coupling and Texas Instruments was behind it –

Pelkey: And they were selling –

Maxwell: There was going to be perceived demand, even if it wasn't real for the 3400 mode, and we were the only ones that knew how to make the 3400, because everybody else had run like lemmings to the 212.

Pelkey: That if you could support all of those, it would be successful. Was there a sense of excitement once you conceptually broke through and said: "We're going to do it."?

Maxwell: I don't remember it that way.

Pelkey: Was it just workman-like?

Maxwell: We had such a hard time making it. We pre-announced it by months to keep customers. It was a real trial, that product, because we kept thinking we could do it and we couldn't.

Pelkey: When did you finally get it out in the market?

Maxwell: Oh, God, '79 probably -- '78, maybe.

Pelkey: What was the name of that model?

Maxwell: 3467.

Pelkey: Could you get me the dates on that when I send you this transcript back, when that was introduced?

Maxwell: There were three dates: when we said it would be available, when we shipped the first ones, and when we shipped the first ones that worked well, and there were many months –

Pelkey: All three of those would be useful dates.

Maxwell: -- because we.

Pelkey: That must have been a frustrating period of time. You were back at the company at this point. If I understand correctly you had been –

Maxwell: Oh, I was fired as president, but I stayed on as technical director. I never left the company.

Pelkey: Oh, you were just fired as president. When did you go back as president?

Maxwell: Four years ago. Just about the time the company started falling in the toilet, which I supervised with great grace and elegance. There are certain things about me that are yet to be known, and one is whether I can run a company.

Pelkey: I think you can.

Maxwell: I'm probably actually going to get the chance. There's some things I can tell you about later.

Pelkey: So that was an incredibly frustrating period of time. Now, the marketplace at this point was -- the dial-up market had really settled down to AT&T, UDS and yourself.

Maxwell: By that point in time, I think that's an overstatement.

Pelkey: The market had clearly gone to leased-line and dial. That differentiation was there. There was Codex –

Maxwell: And AT&T was a player, but they were -- they really weren't much of a player even then when they brought it out. They set the standard, but a lot of people went out and made them. Who was there? Peneril was certainly there, Prentice was there -- of course Prentice was (unintelligible) the last year -- Anderson- Jacobson was there, and we had a cross-license with Anderson- Jacobson where we gave them 3400 technology and we took their acoustic technology.

Pelkey: That's how you got the acoustic technology?

Maxwell: Well, they developed the acoustic coupler part of it and we did a trade, which was ultimately very good for them, not so good for us. It wasn't bad for us, but it really was much more beneficial to them.

Pelkey: You said the 3400 worked in an acoustic coupler mode. Did that technology come from Anderson-Jacobson?

Maxwell: The acoustic coupler technology. The ability for it to work in the acoustic coupler mode had to do with how we arranged the frequencies.

Pelkey: So you did that on your own?

Maxwell: We did that in '73.

Pelkey: So Anderson-Jacobson benefited more, economically, from the relationship.

Maxwell: Quite a bit, ultimately.

Pelkey: Because the acoustic coupler portion of it just went –

Maxwell: Yeah, it didn't do well, and they didn't do well with it, but they had the hardware version.

Pelkey: Let me come back -- it strikes me that the period of time when John Bingham first got involved –

Maxwell: '72, '73.

Pelkey: That meeting in the office where you asked him if he could do this with the two-wire technology, that was a very critical juncture in the companies history. That led to getting this technology that led to the 3400. Was there anything unusual or exciting about that moment, or was it another meeting with some guy who had an idea?

Maxwell: Oh, no, it absorbed us. It was absorbing, because -- and I don't know quite what you're getting at.

Pelkey: I want to relay this experience in this book, and I want to make it more human.

Maxwell: There was a -- certainly . . .

Tape Side Ends

Pelkey: There are critical points in companies' histories. It strikes me that this was one. There was this point and the airplane flight and the Gysco meeting of coming up with that modem. There may be other events, but those two events have to stand high in the history of Vadic.

Maxwell: Yeah, although the decision to make the MVS-1 and then the decision to make the MVS-2 were equally important.

Pelkey: The MVS-1 and the MVS-2?

Maxwell: The MVS-1 was the central site system that we did in 1971. The decision to go into the end-user business, which is really what allowed us to get in contact with the customers who told us things about the problems and why they were constrained, which provided the context that allowed the serendipitous experience to occur.

Pelkey: I stand corrected.

Maxwell: It was 1972, 1973. I became president during that period. We were small; no management, no systems, kind of young crazy people, people who liked to come in at noon, people who worked very hard, but –

Pelkey: How big a company were you at this point?

Maxwell: Oh, we couldn't have been more than 40 or 50 people.

Pelkey: Doing how much in revenue?

Maxwell: Well, in '72, we would have done -- let's see. We did $300,000 our first year, 1.3, 2.6, about three to four million. We were pretty small, and very unsure of ourselves.

Pelkey: Was John perceived as being somebody who was special at that point, in terms of what he had? Clearly, with time, it became a love/hate relationship with John.

Maxwell: No, actually, never a hate relationship with John.

Pelkey: Frustration.

Maxwell: John is a wonderful person, an absolutely wonderful person.

Pelkey: Hate is not the right word, but the fact that –

Maxwell: There were frustrations with John because -- I at one time made John engineering manager, and he was a terrible engineering manager; he never, ever accepted that, but he was, to this day (unintelligible). He was a rotten habit of getting 90% there and not sometimes knowing how to get the last 10%. He analyzes himself to death at times, and then wanders into alleys that he doesn't know how to get out of. That was frustrating, and he's got what a lot of us have, and optimism about what he can do that is significantly disproportionate to our real capacities.

Pelkey: When John left that meeting where you posed your question, did you and Dennis talk afterwards? Was there a sense that 'if we can do this, this is something that's really important to us'?

Maxwell: It was certainly a renowned meeting, a well known meeting.

Pelkey: Were there other people in the meeting?

Maxwell: There were other people in the meeting. I don't remember that much about the meeting except asking that question, and afterward saying: "I don't think there's any market for the product that he has proposed, but if he could do that, it would really be something." The reason I know it was important is that somebody who was an engineer at the company at the time came up to me when we sold the company in 1978 to Racal, and he said: "Well, Kim, congratulations," and I sort of shrugged my shoulder, and: "Well, you know, we've got a lot to do." He said: "You know, you're worth whatever you got for one thing, the question you asked Bingham," and that made me -- so it was a meeting with some internal notoriety.

Pelkey: I would think. When John came back, was he excited?

Maxwell: John was pretty cautious, actually, because he was very nervous about the problems. Apparently something had happened at Memorex, or this was a time when trade secrets or things were stewing, so the euphoria of discovery was clouded by technical copyrights, intellectual property rights and successfully extricating himself and not taking any documents, and 'did these ideas really belong to Memorex?'

Pelkey: Then, for that to happen and then falling on your own petard on it, relative to having a lawsuit around it –

Maxwell: Well, but we did that.

Pelkey: Yeah, you did it to yourself.

Maxwell: We sued UDS.

Pelkey: Oh, excuse me.

Maxwell: We were the patent holder. They were the infringer. We sued them.

Pelkey: Then you lost on some technicalities.

Maxwell: Lost it on the time bar.

Pelkey: Because you didn't file within the time.

Maxwell: We did not file within one year.

Pelkey: So you fell on your petard in a sense. Here you thought that was a big issue and –

Maxwell: John didn't believe it was patentable. I didn't know any better. I didn't know one way or the other. John didn't believe it was patentable.

Pelkey: That was a big issue to him, in terms of dealing with Memorex and the rights –

Maxwell: Yeah, but I think he felt it was sort of obvious, and it's only when you get a few patents -- I have a few on things that are absolutely trivial -- that you begin to realize what a patent means. There are some really trivial ones out there, and this one actually was an invention. This one really stood up. This was the kind of thing that really was meritorious enough.

Pelkey: Right, that invention plus the Constellation at Codex were two of the critical intellectual contributions of the modem industry. There may be others, but –

Interruption in the Interview

Pelkey: Coming back to the triple witch -- or whatever -- did you call it the 'triple witch?'

Maxwell: We called it a triple modem.

Pelkey: The triple modem, when you came back from that trip and realized that you had committed yourself to doing this, but also realizing that if you could do it you had a winner on your hands, was there anything about that incident –

Maxwell: I don't remember. I really don't remember. I think we were panicked, quite honestly, because we didn't have a 212. We only have this 3400.

Pelkey: 'What have you done to us, Kim?'

Maxwell: Well, I don't think that was so much the feeling. It was 'how the hell are we going to get out of this?' and 'how are we going to support the 3400?' We were sort of beginning that stage where you have this product line, you've got somebody else over here doing a different product line, you want two product lines, you really don't have the resources to do two product lines, and the customers want this product line, and it's unique to us, and we'll make a lot of money on it, and everybody in the world is going to make this darned 212 and the prices will go down. Ultimately, though, it was the customer who forced us to look seriously at doing the right thing.

Pelkey: Why did you not innovate a 2400 bit per second?

Maxwell: Well, first of all, we did in a way.

Pelkey: But Concord is –

Maxwell: Yeah, but there's an entirely different history around 2400 bit per second, entirely different. The answer, in some respects, lies in the boundedness. Concord started -- they didn't start with a 2400, but they kind of started with a 2400, and the 2400 was a product blessed with a standard before the market; very rare in the annals of modems. CCITT, with my help, my strong -- if you want to go to the CCITT part of fence, that was pretty exciting stuff. I don't know how relevant it is here, but I can talk for hours on the standards process -- hours. There's V-22, which is the predecessor to V-22-BIZ, has enough of a germ of 3400 in it that it kept

everybody out of the marketplace for three years. V-22-BIZ is a direct descendant of the V-22, which is a direct descendant of the 212, which is a direct descendant of the 3400, and the stimulation for having V- 22-BIZ -- well, there were a lot of forces now that have changed, and the biggest, most significant change was the prospect, at that point -- it hadn't actually occurred -- but the inevitability of divestiture, and the clear failure of AT&T to have any significant influence on the modem business after the 212.

Pelkey: In fact, you blunted a lot of the 212.

Maxwell: Well, we became so successful with the triple modems that even though they were, as often as not, used in the 212 mode, they were still thought of as 3400s. They just didn't do things right. Now, of course, we don't make 3400s any longer. They're gone. Ultimately the 212 has prevailed, but that's in large measure a technical problem. It's very expensive to make a 2400 bit per second modem that includes the 3400 mode. In fact, one of the mistakes we made was that, in 1979, we, with Texas Instruments, embarked on a program to make a single chip 212/3400/103, and they couldn't make it. We spent five years farting around with that, and by the time we were through, we lost the technology edge we've never recovered.

Pelkey: So you bet on (unintelligible)?

Maxwell: And we've been scrambling ever since. We lost our own internal technology, and we've been dependent on Rockwell ever since. That's been tough. With TI we were riding an old horse. TI has all but gotten out of the terminal business.

Pelkey: So they're not going to be able to do the job, plus they're just losing their position in the terminal business and the technology moving beyond you –

Maxwell: And the speeds moving beyond 1200, and the costs -- I mean, you can buy a 212 chip now for four dollars. You can buy a chip set for V-22-BIZ for twenty.

Pelkey: But you were, at least in '79, aware that you had to start to move toward semiconductors. You just happened to pick the wrong implementor.

Maxwell: Yeah, and we -- well, yeah, I suppose that -- that puts more of the blame on them then is really justified. We were at fault as well, but certainly it didn't work. We were counting on it, and it didn't come to pass.

Pelkey: So again, going back to the 2400, you didn't anticipate and push 2400 because -- You were involved in the standards-making process. You must have known 2400 was coming.

Maxwell: I sat there. I was part of it, and we made one, and we came out with a product that was within two or three months of the Concord product. It had a 3400 in it. It was a quad-modem, it cost us $1,100 to make; we had to sell it for $2,000. It was strong performing –

Pelkey: Oh, you got yourselves locked into the paradigm of being compatible with your old history.

Maxwell: We got caught in the paradigm of being compatible with our old history and, at that point in time, we were growing so fast at 1200 that 2400 didn't appear to be important. It didn't appear to be something we had to really get in there and do something with. This was when we couldn't make enough. This is a time period when we were going from -- we shipped $10 million in 1978 and we shipped $90 million in 1984, and it was a time when we began to unravel the company.

Pelkey: You also sold yourselves in '78.

Maxwell: Sold ourselves in '78, that's why I remember the number.

Pelkey: In 1978 you did $10 million? I want to come back to the sale in a moment, but how much of it was because you were part of a bigger company at that point?

Maxwell: Nothing; nothing to do with it. We sold –

Pelkey: You were just growing so rapidly –

Maxwell: We sold the company –

Pelkey: But you were on the standards committee –

Maxwell: We sold the company and we had an executive buy-out, which took three years, so I got my money in 1981. My wife left in 1979. I'm, in some respects, still probably and regrettably the marketing backbone of the company. I went into an emotional tailspin –

Pelkey: After '81?

Maxwell: No this was in '79, but the seed had been laid by then. We decided to do the triple remote, we decided on a new packaging system, we were making another fundamental commitment which I have to give Krechmer credit for, which was to make our reps into stocking reps and ultimately into distributors, and we and Micom, who shared many reps, did that simultaneously, although not in concert.

Pelkey: But that was done in '75, '76 --

Maxwell: No, it didn't really get started until -- we tried, but –

Pelkey: Because Micom, in '76, came out with their statmux.

Maxwell: No. Micom -- well, let's see. We bought Micom in '77.

Pelkey: You did what?

Maxwell: We bought Micom in 1977.

Pelkey: What do you mean by bought.

Maxwell: We bought them. We met their payroll for two weeks so they could stay in business, and we had a contract to purchase them. The contract was constructed in such a way that if they could find other capital, they could take it, and they found other capital from this guy from WaveTech, and they took it. Roger Evans had just joined them. We knew of Roger. I knew Bill Norred from some contacts I had with him before. Roger Evans had joined them from Case. I knew Roger because Case was Vadic's distributor in the UK, and Roger went down there and shook Bill Norred's trees, because Bill Norred's trees -- because Bill Norred was a guy who got 95% done and never got the last 5% done, and he customized everything -- and Roger said: "We're going to make a standard product line," and then they came out with their multiplexer line. It had been in the works, but -- I don't think it was earlier than that. I think it was '77, because they had been involved with Datran.

Pelkey: Right, but that was '72. That was really early, much earlier. [Leafing through papers] I think I have it here.

Maxwell: It might have been '76.

Pelkey: I think they came out with (unintelligible) in '76.

Maxwell: I do know that in the late '70s, there was a very strong bond between Micom and Vadic, because we shared distributors and we –

Pelkey: They piggy-backed on your distribution.

Maxwell: -- shared reps, and we didn't have distributors. We shared reps, and we went to seminars together. We would go around the country; they would take the morning, we would take the afternoon, or we would take the morning and they would take the afternoon.

Pelkey: I'm pretty sure it was '76 that they came out with their statmux.

Maxwell: The last -- I can probably find some dates but -- the last - -

Pelkey: And they credit Vadic, and therefore Krechmer, with the stocking rep idea, although they took it and made something of it. It may have been '78 before they got their orange juice can stuff going and –

Maxwell: Well we forced our reps to become stocking reps, and then, in 1980, we started the process of -- absolutely inevitable process of -- going to full distribution. We did that by hiring -- we brought on GE as a national distributor, and some of our reps who had now become distributors and began to love it because they made more margins, began to invade other people's territories, because the owner of the property is not restricted to where it can sell. So we started doing it; the reps became distributors and we tried to enforce some rules -- which we couldn't, of course -- and finally, in the early '80s, we said: "If you're going to be a rep, you can't be a

distributor, and if you're going to be a distributor, you can't be a rep," which we tried to enforce, and to this day have been completely undone. We were wrong about it, and of course, then we started bringing in other distributors who were just pure distributors.

Pelkey: And you got your channel so fucked up –

Maxwell: Well, actually they weren't. I have become fond, in the last three years, of saying: "A happy channel is a channel that complains bitterly about over-distribution," because you've only got two states. There's no equilibrium. You're either over- distributed, which means everybody is demanding your product and everybody's trying to sell it, or you're under-distributed, which means you're in deep shit. So I consider over-distribution and the complaints to be music.

Pelkey: Why did you sell?

Maxwell: Well –

Pelkey: You didn't need capital.

Maxwell: No.

Pelkey: Had they bought Milgo at this point?

Maxwell: Yes. They bought Milgo the year before.

Pelkey: Had UDS been bought?

Maxwell: No, but Codex, I think, had been bought by Motorola.

Pelkey: You tried to go public in '74 –

Maxwell: We tried to go public in '73 and '74.

Pelkey: And then you tried to go again?

Maxwell: No. A new president came in, and he was –

Pelkey: Had you tried to go public twice?

Maxwell: No, just once. The new president came in -- a fellow named Pete Bowles, who was wonderful for the company in a lot of ways, but mostly in his ability to stabilize things. He was an ex-TRW, I think, or some big, big, big company, and he ran a 1,200 person division for that company. He was an older fellow and he retired two years ago. He's either at or approaching 60. He had a very winning, infectious way with people, and probably most importantly, he and I worked very well together because he never tried to do what I could do and I never tried to do what he could do. We formed a great team, however, at that point in time, the actual equity owned by the executives in the company amounted to 15%. I owned about five, Pete owned

about five, Tom McShane owned about five, and everybody else in the executive group owned practically nothing; there were some options floating around. Pete never got along with the board, and of course the board didn't care much for me, having discharged me and some pretty ugly things they did in so doing. So the staff of the company decided we ought to get rid of the board of directors. Well, you don't get rid of the people who represent the owners of the company without changing the ownership of the company, and we were now -- it was 1977 when we started this process, we had been in existence eight years, the clock was spinning, people thought we were growing, we were doing well, we were $10 million, profitable, very profitable, so it seemed like it was time, so we persuaded the board to hire a merchant banker and sell us.

Pelkey: Who did you hire?

Maxwell: Warburg, Pincus and Becker as they were then. We created a business plan and did all the things you're supposed to do, and we told them where to peddle it, and practically the first place they went to was Racal.

Pelkey: Why did you tell them Racal?

Maxwell: Because we knew they had bought Milgo, and we knew they were acquisition minded. We thought it would be a good fit.

Pelkey: Did you also tell them to go to Motorola?

Maxwell: No. I don't remember where else we told them to go to. It happened so fast. They went to Racal, it was two hours. I mean, Harrison -- if you ever get a chance to meet Ernie Harrison do it. He is Racal's chairman.

Pelkey: When I was in England, originally, I wanted to meet with someone from Racal to hear their side of the story.

Maxwell: He is an incredible man; absolutely incredible man. He does every deal. I'll give you a story about him to tell you how incredible he is. He is a man who works from the soul. He's a bean counter. He became chairman of Racal in 1959 or sometime like that, has taken the company from $25 million to $2.5 billion, almost monotonic profit -- I mean, only one year did they actually earn less money than the year before during that entire period of time. Started out in the military radio business. In 1971 they formed a joint venture with Milgo -- Racal-Milgo Ltd, which was half owned by each. Milgo was under pressure by ADDS to buy them. Racal got it, and he did it by going to Paris. He did it by going to the government and getting him to have tax free money to come over here and purchase it. The deal with us was -- they came over and it was done. He said: "I want it, here's the price." We said: "That's the price, and I want the executives at risk," shook hands and left.

Pelkey: So he paid you $20 million.

Maxwell: He paid his $10 million, and then $10 million for the executives three years later, but in 1981 -- this is a guy who goes against the odds. This is a guy who goes against the odds. In

1981, he looked at the military business, he looked at the middle east which is where they were doing a lot of their military business, he looked at the oil business and said: "Things aren't going to go so well," and then again -- a rather serendipitous thing -- Racal was offered the right to bid for one of the two license for cellular radio in the UK. They put in a last minute bid, they were practically the last people in the door, and they won it. He had the balls to put a quarter of a billion dollars into that thing. Last year it billed a quarter of a billion dollars, it made $90 million, and is going to be valued, when it goes public, at 2.5 to $3 billion, and it will create enough money that the companies that are currently root- bound in their own markets are going to get out of it, and the rich will get richer. The guy has never lost it. He just pats things, and they go gold, and he's got the balls to turn them off when they don't -- all by himself.

Pelkey: So at this point in time –

Maxwell: He doesn't operate anything; absolute rule of autonomy.

Pelkey: Because you and Milgo aren't –

Maxwell: We could belong to Codex, it wouldn't make any difference; or be completely independent.

Pelkey: Yeah, there's not much commonality between you.

Maxwell: Well, it's changing but, not for the good. We've been completely left alone.

Pelkey: The same thing is true with UDS and Codex –

Maxwell: Yeah, except that Codex resells a lot of UDS stuff, whereas Milgo resells very little of our stuff.

Pelkey: That's true, and UDS benefited from the Rockwell relationship. After acquisition and you had the triple modem working, you missed out on the 2400 because of the reasons we talked about. Then, the commitment to TI –

Maxwell: By the way, you say we missed out on the 2400; we are probably the second largest supplier of 2400 bit per second modems today behind Hayes.

Pelkey: Oh really?

Maxwell: And in aggregate, certainly are the second behind Hayes.

Pelkey: So you eventually got it.

Maxwell: We weren't there first.

Pelkey: Thank you for correcting me. I see Concord as kind of being the leader there.

Maxwell: Well, they -- see, Concord -- companies have styles. Concord's style is to get an adequate product on the market early, but then they fold their tent. They are a non-player at 2400 right now, practically speaking. They do ok, but if they didn't have V-32, they'd be out of business. Then they came out with the V-32 with an adequate product; it worked, and they didn't have any competition. They still don't have any competition, really. That'll change soon, and then they're going to have some real interesting problems, real interesting problems, because I don't know where else one goes now.

Pelkey: So anyway, you've got the 2400, and you continue to build the business. The technology issue, relative to TI, became an issue. Let me go back to one issue we talked about but didn't cover fully, which is the IDCMA. I made the comment that that was an important event in the industry because of the different modem companies getting together and being able to build positions for dealing with what was happening within AT&T and at the FCC. You hold a view that the IDCMA was not particularly important, that those things would have happened anyway. In fact, Vadic didn't participate in the IDCMA.

Maxwell: Oh sure we did, in the early stages. In fact, we were very, very active in IDCMA when Part 68 was being written.

Pelkey: So IDCMA was important up to that point?

Maxwell: Van Alden, is that his name? We paid our money and went to the meetings, and had a lot to say about it.

Pelkey: Were you ever on the executive committee?

Maxwell: I don't remember, quite honestly.

Pelkey: Were you there when it got formed?

Maxwell: Very soon thereafter. It was really formed by Carr, Johnson and Bleckner, and Bleckner is now president of it. Those three people -- well, Carr left it -- but Johnson and Bleckner are still virtually what IDCMA is about, and it probably never got more than 10 or 12 members at any one time. We joined shortly thereafter and were very active in the mid '70s.

Pelkey: When it was doing Part 68 registration.

Maxwell: And Marx and I go back a ways. We were really only interested in the Part 68 stuff –

Pelkey: Marx?

Maxwell: Herb Marx.

Pelkey: Oh, yes, the lawyer.

Maxwell: He was the first real rabid lawyer. I have never held a draconian view of AT&T, or a view that AT&T is draconian. I think they are a big, huge, stumbling, very smart organization at what they know how to do and terrible at almost everything else, and they've demonstrated that now for all to see since divestiture. Very impressive company. They've made the most incredible machine man has ever devised, and yet a lot of little things they just can't do -- the just don't know how to do -- and this was one of them. They had -- those guys in Basking Ridge and on Number 1 Broadway believed that the user community was going to harm the network, and if they let them get attached to the network, the network was doomed. They believed it! They weren't trying to be competitive or anti-competitive. They were trying to protect the family jewels, and they had technicians down there who thought 'we can not let people affect the longitudinal balance of our circuits.' I felt, and most of the people on our side of the fence felt, that 1) there were adequate measures that could be taken that were reasonable to supervise, and secondly the market was going to determine -- because over time, the people who caused a lot of grief for the phone company would not succeed and they would have to fix their products -- and therefore there was some self-regulation involved that meant if you did a reasonable job of controlling the way products are brought into the market, network harm would not be an issue, which has proved to be the case. So IDCMA probably had some influence on the structure of the registration process, which was to -- there was a time when -- in fact, it was structured this way for a short period of time -- where AT&T was going to be the testing body. I think, actually, AT&T realized that was going to go nowhere. First of all, nobody was going to pay them to do it, and they tried a few of them and they said: "These things look alright. Why are we doing this?" The other thing, though, that AT&T realized -- and I know this -- AT&T realized by 1974, '75, that plugs and jacks were the way they should do business, period. It had nothing to do with excluding or including. The plugs and jacks had been in the works for years; they didn't just all of a sudden have it. There are people in AT&T who will claim that the data coupling units -- the DAAs -- were simply a known stop-gap, because there were too many ways they could not control -- and they really could not control -- the ways of physically connecting to the phone line, and that until they had some experience and were able to get the actual data jacks out there where they could control the transmit level into the system -- and the transmit level was the biggest problem; biggest problem. They were really concerned about the transmit signal level. Most of the rest of the stuff they could probably live with, but transmit level was their biggest single headache, and the rules that emerged were simple, and the rules were all proposed by AT&T. I don't want to belittle -- I know those guys, and I think they were important, but did they change the course of history? No. Carterfone changed the course of history, and what happened after that, I believe, was inevitable, and it's going to happen in the rest of the world. The fact that it's inevitable -- you watch what's happening in the EEC now, in Europe. Within ten years, there will be a uniform interconnection standard. Within three years, there will be a uniform homologation standard, and it will involve testing by third parties, which most everybody does now because it's too expensive and too crazy to do it inside, and you will get a certification and away you go.

Pelkey: I agree with you. How about some dinner?

Maxwell: Sounds like a good idea.

END OF THE INTERVIEW