Oral History of John Murphy

Interviewed by:
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Len Shustek: It is the 3rd of June, 2004. Behind the camera is Len Shustek with Harry Saal. Okay, and why don't you introduce yourself?

John Murphy: Introduce myself. Well, you will find that I, as the years have gone on, my hearing has degenerated. My doctor says it's selective hearing and my wife says I don't hear worth a darn. I'm John Murphy.

Shustek: Why don't you talk a bit about your background?

Murphy: My background.

Shustek: Your family, your siblings, your parents.

Murphy: Okay. I was born in Tulsa, Oklahoma in 1943. I was the youngest of five children, the youngest by a long shot. When my eldest sister celebrated her 80th birthday; she said it didn't bother her a bit to admit that she was 80 years old but it disturbed her quite a bit that her baby brother was 60. There was quite a span there. So, I grew up basically as an only child with some very attentive older siblings, went to Gradesville High School in Tulsa, went to college at the University of Notre Dame.

Shustek: Were you a good student?

Murphy: Was I a good student? I got through. I was a super student in grade school. In high school I remember being astonished that my grades were better in English than in math, which seemed completely backwards to me and I always suspected that there was a glitch in the grading system. When I went through the university, I think I became a better and better student and I think it was because as you progress you had to take less liberal arts courses and more technical courses. I've known people who, "Oh, you know, I had to take liberal arts classes my senior year to get my grade point up." And I said, I wanted to stay just as far away from those things. We were required one year to take two liberal arts electives and I nearly died. I took art history and television production, in which I had a ball. When I was in school I was chief engineer of the campus radio station, so TV production was a real ball. But if I had had-- in fact, I think I did graduate on the dean's list in engineering. I was going to say if I'd had one more semester I could have probably got my grade point up. I think I did actually graduate on the dean's list for whatever that was worth years later. Harry, what did you say?

Harry Saal: At what age did you start to notice your interest in matters technical?

Murphy: When I was in the seventh grade and we moved to a different part of town, new house, started a new school, met a fellow who was in grade school, same age, who was interested in electronics. And, I had built crystal sets and stuff like that before but, you know, no more interested in technical stuff than any other kid that age. We went downtown on the bus, which was kind of an unusual thing, one day. This guy took me into a place called Radio, Inc., Radio Incorporated. I guess there are not supply stores of that ilk anymore but they had a counter for parts. They had a little ham radio room in the back and he

bought a 1N-34. I think that was probably the diode was his only purchase. You know the counter people loved kids like us. He went home and connected that to an antenna and the ground and a pair of earphones and we heard a radio station and I was hooked. That was-- you know I was in the seventh grade and that was it.

So, by the time I started college I was one of the lucky ones. I knew what I wanted to do. There was no question. I didn't change majors five times in the freshman year. I knew what I wanted to do. I remember in the senior year coming out of a lab. We were three weeks from graduation and we had spent the lab working on a one tube audio amplifier and, as we came out of the lab, one of the guys said to me, "Hey, Murph, is there any practical application for that thing we played with today?" I said, "What thing is that?" And he said, "That tube thing and the amplifier. Does that have any practical application?" And I said, you know, we're three weeks from being degree holding electrical engineers and you're asking me if there's a practical application for an amplifier and I think about that often since then. There were in my graduating class of 40 electrical engineers, I believe eight of us were in law school the next year and I've always felt sad that there's no way for people to realize what it's all about. You know it's-- a lot of these guys, "Oh, hey, I want to be an engineer because they make a lot of money," and I'm convinced it's the guys who go into engineering for that reason do not make a lot of money. Maybe they do. <Laughs> It would really upset me.

Shustek: Was there some expectation against your going into this kind of profession from your family, parents, what was that like?

Murphy: No. I was the first one to go to college actually because of the age span. I think one of my sisters had some college classes. Both my brothers were in the service in World War II. In fact, one of my sisters convinced my parents that I really ought to go to college. You know it was not the big thing at that time. One of my brothers was an electronics technician. He had been a radio technician in the Navy. They had run a TV shop and that sort of thing. So, he was very excited that I was going into the technical field, although during my childhood he didn't live in the same town, so I have very little contact with him. So, although he would love to think that he encouraged my interest in electronics, it developed pretty much independently of him, so maybe that's a family gene or something. There was certainly no opposition to me going into engineering and I would hope there was some degree of pride in the family, although I never heard about it.

Shustek: Did you develop any hobbies around this? For example, I think you're involved in ham radio.

Murphy: I was involved in ham radio for quite a few years. I am one of those people who's convinced that there is a sense of rhythm involved in learning Morse code or in dancing, neither one of which I do well, in fact, neither one of which I do at all anymore. You know, in grade school under coercion for one reason or another that I had to. I sweated blood learning five words a minute Morse code to get a technician class license and held that for, I don't know, ten or 15 years and that interest kind of drifted way, although the fact that I had done that was extremely valuable in later years. When I was in college, I was chief engineer of a campus carrier current radio station, which was an interesting experience and installed during that same time, we went into a genuine on-the-air 10-watt FM radio station.

Shustek: The first one was broadcast through the power lines?

Murphy: Through the power lines. Through the power lines to all of the residence halls on campus and we had telephone lines across the road to St. Mary's. At the time I was at Notre Dame, it was an all male institution. There was a girls' school literally across the street. We had phone lines over there and, of course, as a member of the staff of the radio station, I could wander the halls of places where men were not allowed and when I was challenged I would say, "Well, I'm here with the radio station," and they would act like I was father confessor or something. "Oh, okay." So that was great fun. But I, from the time I saw that first diode I think I lived and breathed electronics and then somewhere along the line long after I graduated from school I discovered computers for real and got interested in software. When I was at Notre Dame, I used to say I took all the computer courses that were offered, both of them. We had--

Shustek: What year are we talking about?

Murphy: I graduated in 1965. We had at Notre Dame at that time a 1620 and a Univac 1107 and my understanding was it was-- the 1107 serial number three. The first one went in the Pentagon. The second one went in SAC headquarters and the third one went onto the campus at Notre Dame. And, those were the days when huge air-conditioned, very closely temperature controlled room. When they took tours they would not take more than three people into the computer room at the same time because the body heat would raise the temperature enough that bad things would happen and, of course, we submitted jobs on punch cards and there were people who figured out ways to crash the system. So, if there was a test or a final coming up, the word would get around campus that don't worry. The machine's going down at 3:15 this afternoon. It will take them at least a day to get it online again. Sure enough, you know.

Shustek: Was your interest in software, hardware, both applications?

Murphy: At the time when I was in school it was hardware. We had, like I said, the two computer classes. I guess it was actually one computer class that had been two. They combined it into one semester, hardware/software analog and digital and, of course, software at that time was Fortran. That was the only thing I was aware of. I was not terribly enthusiastic about it but I did some programming in Fortran. We had a very interesting class project for that class in teams of three people. I detested team projects but we split it up pretty well, teams of three. We were to take a mechanical problem with a board and a brick connected with a spring and shock absorber dropped from some height and hit the ground and would it bounce or what would it do? And we were to solve this both with a digital computer program, with a Fortran program running on the 1107 and with analog computers. And, I said, "Oh, I'll do the analog computer program." And we had all these little racks. I don't remember who made them but a bunch of op amps and one that was pretty nice. It had comparators and more stuff. And we'd go into the lab and there'd be somebody using this one that had some features and all this other hardware sitting idle. And, without asking anybody, which amazes me but without asking I went in one night and just took all the modules out of all and put them all in one rack, brought in a couple of electromechanical relays from the radio station I had in the junk box, built my own comparator from an op amp and some relays and the lab instructors were real upset when they came in the next morning. The first thing they saw when they came through the door was all these empty racks, oh, what happened? There was one in the corner that was very full. And we got a super grade on that project. We had a pen plot of what happened when this thing hit the ground and the guy that was doing the Fortran program did an asterisk printed on the line printer plot and you could hold them up to the light and it was exactly the same line. And, there was a fellow who was very proud of the work he did. The reports would be dumped out on the table in the

hall and they would grade it and two of the three of us were standing in the hall and this fellow came around the corner and said, “Look at this. I got an A+ on this report. This is so cool. I knew we could do it.” And very innocently the third guy in our team comes around the corner. He says, “Would you look at this? This said A+++. May I have permission to print up your report for use in instruction next year?” And we’re like, oh, you know, that was not the thing to say at the moment but we were happy anyway, so that was interesting. That was some wandering response to a question of some sort but I don’t remember what the question was now.

Shustek: At the time did you have a good sense of what you would do in your career and who you would work for?

Murphy: I thought I would go to work for Motorola. That was my goal. I was a ham radio operator. I was into radio, you know. This computer stuff was cute but, you know, it was a room full of equipment and you I couldn’t really get my arms around that, literally and figuratively. And I wanted to go to work for Motorola. It turned out, let’s see, at that time they would have campus interviews and you’d go in a room where there would be clipboards along the wall with what company was coming to interview and you’d sign up, you know. But I watched for Motorola and I signed up and I think that was the interview that somehow I lost track of the day and as I was walking across campus in my typical campus mode of dress, which was probably different at that period of history because it was an all male campus, you know, so old sweatshirt, looked like the dickens, the profs didn’t care. And, all of a sudden, “Oh, my gosh I’m supposed to be at a job interview.” So, I ran across the campus and went in and went through all the apologies. That’s fine, went through the interview, and this was fairly early in the year. I think this was perhaps the first job interview I’d ever had on campus and we finished. The interviewer said, “Okay, great, you’ve got a job. Contact us about May. Give us a call and we’ll have you come in for an office visit, plant tour, meet your new boss, find out what your project is going to be as well.” Cool. This is great. I had no idea that it didn’t work that way, you know. An interviewer’s got no right to say something like that. So, I went to one or two other interviews just because it was interesting. I think I interviewed Collins Radio just because, you know, it sounded like a lot of fun. It came to be about May and I called Motorola to find out about my job and it was like, “What are you talking about kid?” “Oh, I don’t have a job?” “No, you don’t have a job.” Run over to the interview center. Is there anybody still coming? Hey, IBM is still coming. Hey, okay, we’ll sign up for IBM. And, as it turned out, I got a job with IBM at Endicott, New York. Interesting and every now and then I mean to research this, I did the interview at Collins Radio, several places I interviewed for some reason, at least at that time, a kid coming out of college who had some experience, had some knowledge, they wanted to put you in a test equipment department and, that just sounded incredibly boring to me. Hey, I want to design something. I don’t want to design test equipment. The several places I talked to, “Oh, yes, you should design test equipment.” And I wound up designing, well, working with test equipment at IBM. It was the funniest thing. The Collins Radio interview was interesting. They obviously didn’t have very many college kids come in who had any knowledge, any experience at all and they were quite fascinated that I actually knew some radio terms and the fellow decided to give me a test. So, he got up on the blackboard and he drew a picture of a couple resistors and a capacitor and a switch and a diode, a semiconductor diode with the arrowhead and asked what happens? And, I said what happens when the switch closes. No, no, you know, the diode will block the current. I said, “No, no, the diode is forward biased.” So, we got into this discussion of which way does current flow through the diode. So, he opens his desk drawer and he pulls out a semiconductor diode and he says, “See, there’s a plus right there on the banded end. That means that when you put positive there it flows.” I said, “No, no, that means when you use it as a rectifier in a power supply that’s where the plus comes out.” So, he was getting quite frustrated. Finally, he turned around, went to the board, erased the semiconductor diode, drew a picture of a 6AL5 tube diode reversed and

now what does it do? <laughter> Great fun, you know. And, of course, again here I'm a 22-year-old kid, and I don't think it occurred to me until many years later, maybe I shouldn't have corrected the guy that I was asking for a job. It turns out an attitude problem there.

Shustek: Did they make you a job offer?

Murphy: No, as a matter of fact they did not.

Shustek: And there was a connection.

Murphy: There was a connection. It was the test equipment department anyway. But I think it was a long time before I realized that that's probably why I didn't get the job at Collins. I was a slow learner. But I went to work for IBM and it was very interesting. I left after a year because, at that time, IBM seemed to be stockpiling engineers in Endicott, New York, which is an interesting place. But there were a whole bunch of us that left after about a year because they hired us and we didn't have anything to do and that was probably one of the most fatiguing things. Sit there with an absolutely clean desk all day.

Shustek: What was the group doing in that area?

Murphy: The group was building test equipment. This was at a time when the IBM 360 was brand new, first coming out. There was a new packaging system, which I do not remember now.

Shustek: SLT.

Murphy: Yeah, I believe it was.

Shustek: Solid logic technology.

Murphy: Yes, that was.

Shustek: Plug in cards.

Murphy: Plug in cards with an integrated circuit with a metal cap on it that was maybe half an inch, three-quarters of an inch square. I mean you could take the cap off and look at them and virtually see the schematic. Oh, yeah, there's the transistor and, oh yeah, the collector goes up to that load resistor and they were very proud that they could get a whole JK flip flop on one of those. And they had several different sizes of cards that they fit on and I was working on a tester, Colt 45. It was a computer-oriented logic tester for four and five wide SLT cards. And, the testers were interesting. They could drive over to the pins and measure what came back but they were very interested in having highly accurate D to A so they could control these logic levels to ridiculous levels and sense the response and incredible accuracy.

Shustek: …what manufacturing process?

Murphy: This was for stuff coming off the line and we had this tester that was the size of a kitchen counter full of cards for every pin on one of these cards to be tested. There was a good sized card full of D to As and everything. And my first job was to figure out how to package this thing so that we could get wires from all these test cards up to the test pin and I spent some days doing the possibilities and very proud of myself that I wound up that the longest piece of mini coax that was three feet from a test pin to the card that was actually driving and sensing things and there were hundreds of pins. And I took that to the guy who was designing the card and he went ballistic. "Three feet, what do you think we're doing a telemetry system? I can't get any signal down three feet." I started to learn about getting signals down cables and we did make it work down three feet. But it was very little design work. I mean I was doing basically the packaging, so it was a few days and, okay; this is the way it goes. I'd come in, in the morning, we had one technician who was wire wrapping this huge piece of equipment, and walk in and say, "How's it going?" "Okay." "Do you need any help?" "No." "You got any questions? Can I do anything to help you?" "No." You want to flip for coffee? That's where I believe I learned to drink coffee and I'm now an absolute coffee nut. I'm addicted to coffee. I got that at IBM. We spent more time flipping for coffee. They had more different games. You'd stand out in the hall. Everybody take all the change out of your pocket. Randomly take out two coins, put it in your pocket. Add up what you've got and the guy closest to the median buys the coffee today. It was like that. And it would be a different game every time and on and on.

So, there wasn't much to do. So, I started wandering and I'd find places where people who were somehow connected to this department were testing new computers or primarily new pieces of test equipment and "Guys can I help you work on this?" And I learned a lot that way. I drove the time card people nuts because at IBM everybody was supposed to punch a time card and I was never at the office, so I was always late. I was always, something wrong with the time card or being transferred to a new area. I was always in trouble with my time card. Most of this test equipment was driven by a previous generation of a machine to test the next generation machine. We had 1401s all over the place that were controlling testers and they would calibrate. In fact, it was calibration I guess that I spent a lot of time on. We would calibrate these testers every week or so and the calibration would consist of going and checking the levels that they were driving to the cards and the levels on the sense amplifiers and gates was the term. They had logic gates that swing open as wire wrapped panels full of cards. And every card had a trim pot on it and they all had to be adjusted and the test procedure they used at the time that I got there for this particular system, they had a program that ran on the 1401 and checked every pin on a dummy device under test and printed an asterisk if it was a one and nothing if it was a zero or something and did this repeatedly. So, the printer sat there cranking paper out and you would go and adjust a trim pot and listen to the printer until you heard the note change and now it was printing one less character on every line. This struck me as so primitive and I said, "You know, I'll bet there's one point in this system where the go, no-go signal is," spent a lot going through the schematics. Yeah, if we put a scope on this point we can actually see it change levels and not have to run the printer. Ah, revelation. This was a great new test technique. We could actually look at a signal on a scope instead of listening to a printer.

Shustek: You were innovating.

Murphy: Huh?

Shustek: You were innovating?

Murphy: Yes, it was a mixed feeling. It was like, wow I can't believe they're so primitive and, on the other hand, it was wow, hey I've contributed something here. The other thing I remember from that same exercise was when they calibrate these things they would open up one of the wiring panels and pull out half a dozen wire rap wires and rewrap them to change the wiring slightly and they would do this on the same pins once a week forever and I scrounged around and, oh, there's some space between some of these cards and here's an old SMS card that was a system module. I don't remember what SMS was. That was the packaging before SLT, discreet components on a PC card, found a card and a switch and mounted a switch on the card and I had a calibrate and run switch. Oh, this was the greatest thing ever. We were working on a machine that was being shipped to Poughkeepsie. There was a team from Poughkeepsie and we'd go through the initial set up and test of this thing and when they got done with it, they took out my calibration cards and rewired it for the book, sent it off to Poughkeepsie and right away they go, "Where's the calibration switch? How do we calibrate this thing?" So, it was great fun, great fun and an interesting, as in many times I said nobody should have ever gone to work for IBM right out of school, although I know people that went with me that same year who are still there.

Shustek: That was their practice was to hire people out of school.

Murphy: Yes, that was their practice and to keep them. It was very difficult to appreciate what they did for you though. It was like they'd say, "Okay, you are covered by" and I don't remember "by Blue Cross/Blue Shield." If you have any sort of health insurance coverage for you, get rid of it because we're giving you better at no cost to you. Hey, I'm 22 years old. What do I care? It was a company country club for $1 a year, golf club, I don't play golf, shooting range, and ooh, indoor shooting range with weapons provided, so I didn't have to buy a gun and, of course, in New York I wouldn't have lived long enough to get a permit to buy a gun anyway. So, I shot in a pistol range, and a pistol league. They had a very interesting handicapping. You would shoot a few rounds to establish a baseline and then they'd take the best guy and the worst guy to make a team. So, I was paired with the best guy in the league and I'd never shot a pistol before, so I had to improve. So, we won first place and I left the company before they ever gave me my trophy. But another dumb thing that kids do. It never occurred; this was supposed to be a .22 league. There were not supposed to be anything bigger than a .22. There would always be a guy standing next to me with a .45 but nobody ever told us. It never occurred to me, hey, I ought to put something over my ears. I don't hear so well anymore and I suspect that a lot of that was damage that was done to me when I was 22, 23 years old and too stupid to wear ear protection while I was firing a pistol.

Shustek: What's your assessment now of the quality of both the IBM engineers and IBM management at that time?

Murphy: And what was the first part before IBM management?

Shustek: IBM engineers.

Murphy: Oh, engineers. I didn't come into contact with many. There were only a couple of engineers that I actually came into close contact with. I was very impressed with them. There have been places where I've thought how did this guy ever get a job and how does he keep it? I never felt any of that at IBM. My only problem at IBM besides I grew up in Oklahoma, I did not like Endicott, New York. Endicott's an interesting place too if you've never been anywhere else. The two major industries there are IBM and Endicott Johnson Shoe Factory and there are an amazing number of high tech little companies. I want to say McIntosh amplifier but the word McIntosh has such a different connotation in your mind and I think that used to be one of the high end audio amplifiers. They were in a Quonset hut somewhere around there, a lot of that kind of thing. But the big employers were IBM and Endicott Johnson. The shoe factory kicked out soot like you would not believe. When it stopped snowing, and occasionally it did, when it stopped snowing it wouldn't be 15 minutes before the snow was black because there was so much soot in the air. Yeah, it was not a nice place to live.

Shustek: What triggered your departure from IBM?

Murphy: What was that?

Shustek: What triggered your departure?

Murphy: Boredom of not having anything to do. I was going to say that was my complaints of IBM were the place and there was just nothing to do. And, I talked to them about going somewhere else and, in fact, they sent me down to Cape Canaveral. I interviewed IBM at Cape Canaveral, which was fascinating. At that time, IBM had no equipment at Cape Canaveral, no hardware at all. They had system responsibility and it was very piece meal. The government was apparently trying to keep everybody in the computer business happy so they would buy a printer from one company and a disk drive from another company and a tape drive from another company and I don't know who did the CPUs and it was IBM's responsibility to make all of these things connect and play. And, I heard somebody saying. You didn't want to have to be in the control room at launch time. When there was a launch, if you could, you wanted to be off that base so you could go off and watch it, get off the property and watch it go up. That was fun. But standing in the back of the control room and having Werner von Braun come running up to you saying, "My console is not working," was not fun. That was not part of the fun part of the job. For one reason or another, I don't think I was very impressed with the opportunities down there. It did not sound like a lot of fun either and I still wanted to work for Motorola. After about a year of saying, I'm just not doing anything at IBM, they're nice people; I have no gripe against the management. I could still be there today if they'd given me some engineering work to do. I really wanted to work on those radios and I wrote Motorola another letter in Chicago and they called me in and hired me to work in a specialties group, which was wonderful fun, as every job was a one-off, all special radio systems. It was all for government agencies because nobody else could afford this sort of thing but the California State Disaster Office, Missouri Highway Department, Airedale County Fire Department, I couldn't even tell you what state Airedale County is in. I think it was the first job I worked on and there was just Airedale County Fire Department had a nice ring to it. I always enjoyed, there used to be a show on TV years ago called "Emergency," the guys in the ambulance and the fire department and I enjoyed that show because every time the alarm went off, you'd hear <makes alarm sound> and the doors would automatically open and I'd think, yeah, boy I'll design more of those. The thing that went <makes alarm sound>, did a lot of those.

Shustek: So you were doing primarily analog engineering at this point, no computer involvement.

Murphy: No computer involvement at that time, yes. When I worked at Motorola, a lot of what we did was audio control and logic, so we did a lot of relay logic and I was one of the guys that said, "You know, there's starting to be these things called integrated circuits where we can actually get a package that does everything we do with this handful of transistors to build an and gate and there was a lot of opposition to that. And there was an outfit I think called Amelco, I think, that made 12-volt power supply logic, which just fit in with, you know, we were building base station stuff, didn't go in automobiles but 12-volts was a very common power supply because of the automobile connection. So, we started doing a lot of stuff with Amelco integrated circuits there and that was fun stuff. I was there for a couple years, had a lot of fun. We did a system that went on President Johnson's ranch that I think was one of the electronic systems that there was some fuss about they didn't want to give up when he was no longer president. It was interesting. They had eight repeaters, all 250-watt transmitters to cover his ranch. It was a big system. I did have some problems. Motorola had an interesting pay policy, which I didn't understand until I went to work elsewhere that we were apparently dramatically underpaid by industry standards and that caused me a lot of problems. I was there until they decided that they didn't need a specialty group anymore that the field engineers could do everything that was required for building special systems for special customer requirements. Which we never quite understood how that worked out but I got moved to a department as an application engineer for a couple of products that did not yet exist. Including a mobile printer which was a first. It was a very interesting printer. It was a rotating spiral, so there was like a sharp edge on a barber pole, rotating behind six wide pieces of electric hammers and they would fire a pulse to the hammer and it would come down, and depending on where this edge was, it would put a dot at a particular place on the paper. So, it was basically a dot matrix paper or dot matrix printer that printed the characters a dot at a time as the opportunity arose and it was enormously noisy. I remember hearing one of these things in the lab and said something to the fellow that was working on it about well I guess that will be a lot more reasonable when you get to all the sound packing insulation and sound ending material around it. And he said, "Well, actually that one has all the sound ending material." He said, "Actually," he said, "you would be surprised." He said, "In the field, we did a test with some state police." And he said, "In the field," he said, "you really don't notice the sound of the printer in the car when the siren's on and you're doing 90 miles an hour."

Murphy: The other project in this little group I got moved into was a security device, radio scrambler, a speech inverter which was an interesting application and my job was to work with customers for applications for these products that weren't in production yet. One of the tests I did was on the effect that the speech encoder, the speech scrambler, had on the range of the radio, which it turned out was quite dramatic and I'm not sure what they ever did about that problem but there's an FM radio. There is a concept of a noise triangle and then the noise increases as the audio frequency increases and so forth and so on and the speech inverter, which reversed the characteristics of high and low components of speech just played havoc with the whole concept of FM radio and nobody every thought about that. And, the early indications were that you put this on a system you're going to have to increase the transmitter power by a factor of about 100, which probably would not go over well. And, I don't know whatever happened to that project. I'd gone from doing some really exciting stuff to kind of sitting around watching the world turn again. About that time, my father passed away.

Shustek: What year was that?

Murphy: This would have been about around 1968, 1969, somewhere in that. Now, I ought to know what year my father passed away but I'm not one of those people that has that info. My wife would know to the day. I was not married at the time. I decided it would be a good idea to move back to Tulsa. I moved back home with my mother while she adjusted. Went back to Tulsa, went to work for America Airlines as a test equipment engineer for about six weeks and decided that I could not handle American Airlines. Now, I do have some opinions about their engineers. I probably should not go into those.

Shustek: They had a big operation in Tulsa.

Murphy: They had a very big, very big maintenance place in Tulsa They had some new radar equipment and I was supposed to -- I'm not sure what my responsibility was but take a look into what was required for servicing it. And, I got one of the manuals and was reading the manual and I was upgraded and reprehended for reading a technical manual. That was none of my business. My job was to take the maintenance manual, go to the page that had required equipment, go down the list and see if these things existed in the shop. I'm sure I commented that a demented secretary could have done this job very well and I'm sure that did not go well . I remember with one of their engineers there was a discussion of, gosh I hadn't thought of this in years, they were thinking about testing meter movements and they were wondering if you could take a Simpson 260, which some of us remember, which was a VOM, volt, ohm multi meter, with an actual moving meter needle. It was VCOM and piece of test equipment in everybody's bag and so if you could type one of these on the resistance range and measure another meter movement, if you could predict what the meter movement ought to do. And, they spent quite a while talking about this and decided that you probably couldn't and I remember opening the drawer of the desk that I had recently inherited. There was a Simpson 260 manual and I flipped through and, oh, here is the equivalent circuit of the meter on an ohms range and I remember drawing on a board and saying, "Here is a battery. Here is a resistor. Here is a meter movement with a known resistance. I think we should be able to figure out how much current is flowing in this circuit." And the two or three engineers who were involved in this discussion spent another half hour thinking about it and decided that it was just too complicated for them and they gave up. So, this didn't sound like my kind of place. Also, a strike came along and I decided I did not really want to work in this environment and it was a very long time before I'd get on an airplane again after having some experience in an aircraft maintenance shop, a long time before I'd fly.

Shustek: Where did you go next?

Murphy: I left there, went down the street to Telex Computer Products. Telex was one of the first really big conglomerates in the country. At one time, the Telex Corporation had 60 or 70 companies doing everything in the world. The Viking tape recorders when we were kids was a big name in home tape recorders, which Jonathan pointed out to me, Jonathan Schmidt pointed out to me the other day that nobody today knows what a tape recorder is. Oh, well I guess that's true. They've pretty much gone away but Viking was produced by a Telex division. Magnacord, which at the time was one of the big names in broadcast tape recorders was a Telex product. Every Navy ship on the line had at least one Telex tape recorder for one purpose or another.

Shustek: <inaudible>

Murphy: I don't remember if it was Ford, GM, one of the -- maybe both, the big auto makers, all of their tape players in cars were produced by another Telex division so from one end of the spectrum to the other. The division that I went to work for they had bought a company in Tulsa called Midwestern Instruments which was in the seismograph instrumentation field. Actually, when I went to work for Telex Computer Products there were two divisions here on the hill and I was working for Midwestern Instruments initially.

Midwestern Instruments built light beam oscillographs, which was a fascinating instrument that is used in oil fields, seismograph type. I mean you're talking about at what frequency does the earth shake when you set off a small explosion. You're not talking about a great deal of bandwidth, so an extremely wide bandwidth oscillograph might go to 20 kilohertz or 20 kilocycles, as we called it at the time and most of them were nowhere near that. And, so I designed some instrumentation amplifiers and designed some power supplies for turning on the lamps in these things. They used a very high intensity lamp. The whole idea of the light beam oscillographs, there's a high intensity lamp. There's a mirror with a coil that moves back and forth and it shines light on paper that is light sensitive. The lights it turned out were very difficult to fire off and they required a power supply that could supply something like 1,500 volts at very low current and something like 30 volts at many amps at the same time out of the same terminal or not at the same time but -- so that was an interesting project. I remember right after I was there watching a test on a new light beam oscillograph and the paper when it comes out of the rollers has to be litensified which I've never bothered to look up that word and see what it means but it basically means there isn't any image on the paper for a while and, as I recall, there were some fluorescent lamps that hit the paper as it came out to start this process. And we've got a recorder sitting here at the one end of a long bench. The paper's coming out, running down the bench and off to the other end and the figure of merit for frequency response was if you could see the zero crossings on the paper like a sine wave. And the fellows down there are standing there looking saying, "Oh, yeah, this is beautiful. This is great." Not knowing that the image doesn't appear for a few seconds and few feet, I'm up next to the machine looking at the paper and I'm real worried because I don't see anything. What am I going to do? I've got a job building an instrument that for whatever eye defect I have I can't see the output of the instrument. I was so worried and then pretty soon I looked down and said, "Oh," one of those moments that strikes terror into your heart and remains in your mind forever.

While I was there at Midwestern Instruments, the company got a request from Ross Perot's EDS for an electronic equivalent of a teletype paper tape punch and we set to work building a tape recorder that would perform the equivalent of a paper tape punch using a Phillips cassette. And there were all sorts of interesting twists and turns in there. The president of the division was absolutely convinced that teletype signals were parallel signals. You put your finger on a key and something printed. It all happened at once. That had to be parallel. I got in deep trouble trying to say that this was basically a serial system that went down one wire and several meetings and many phone calls and I remember him calling one consultant after another looking for somebody to tell him that I was nuts and he kept hanging up on them saying, "Well that guy doesn't know anymore than the last one." He was a good guy though. The funniest thing is when he finally realized that he had a misconception everything was fine. I enjoyed a lot working there. So, he came up with a, what did we call it, a termicorder. It was a terminal recorder and this was, I believe, the first effort of certainly one of the first efforts to use cassette tape with a digital system and we did a few of those and it was a very interesting approach that we'd taken. This was to replace a paper tape punch, so it didn't run like a tape recorder. It was going to start the tape, record a character, a keystroke, stop the tape and a very clever mechanical guy came up with a spring clutch that can start and stop the tape very quickly. I don't remember whatever became of that first system but pretty soon they decided well, we needed better tape handling and I still remember this mechanical engineer

rolling a little cart into the lab area with three or four ingots of aluminum, a cylinder like this. <Makes motion with hands> what are those? Oh, those are the next generation of recorders. And he went into the machine shop and honed out a tape deck like a sculpture making a statue of a horse. You take a big piece of rock and you chip away everything that doesn't look like a horse and that's what he did with this ingot, chip away everything that doesn't look like a tape deck and it was a mechanically stable tape deck.

Shustek: What was the recording technique? Were you doing frequency 15 or saturated recording?

Murphy: It was saturated recording. As I recall, we had a consultant who was going to use audio tones. We just went saturated recording. We were doing very low speed, very lot bit density and we gradually enhanced that product and we wound up moving to Minneapolis and I don't remember, I don't remember whether the Midwestern Instruments division was -- it seemed like it got closed down. We got temporarily moved into the Telex Computer Products division. One of the things that Midwest had done for the seismograph service end of the business was build some large tape recorders that were instrumentation tape recorders that were basically like computer room tape recorders and they were very proud of them. They worked very well. And somebody decided there's a bunch of those things that IBM sells that go on computers. We could get into that business and the mechanical guy said, "Yeah, well we looked at that and they don't handle the tape right and when the tape starts it takes a jog across the head and you can't recover the data properly." Management said, "There's a lot of business here." So, the story went that the mechanical guys held their noses and went and messed up their beautiful drives so that they took the same jog as IBM machines did and they could read an IBM tape and they were wildly successful with that business. That became, that spun off as Telex Computer Products and they did tape and disk drives that were plug-for-plug replacement for IBM. I remember asking one of their engineers about filter design for the tape head amplifier and we were using basically saturated recording and so I went and talked to this lead engineer and said, "What kind of filter have you got?" He said, "What do you mean what kind of filter?" And you know it's been so long since I've done filters I don't think I'm going to be able to even say the names but I rattled off what I thought was and he said "I've never heard of any kind of filter but a Butterworth filter." I said, "Well, but a Butterworth filter has all the wrong characteristics." How -- he said, "Well, let me tell you how we designed the amplifier we use." He said, "We've got a lot of service guys out in computer rooms that have IBM tape drives and we asked several of them to put an oscilloscope on the output of the filter and the read amplifier, run a test tape through there, take pictures and we just fooled around with parts until our scope traces look like they're pictures." I thought, "What am I doing here?"

So, I got a chance to move out of there and several of us were on the team at Midwestern Instruments, moved to another division of Telex, which I do not remember the name of, in Minneapolis and these guys had the Waters Connolly division that did consumer audio equipment. They had a hearing aid division that did hearing aids and we were going to bring the world of digital electronics to them for some reason. I don't remember the exact but I do remember the fellow who had been vice president or VP of engineering at Midwestern Instruments told me, "We'll go to Minneapolis. We will not live there for more than two years. Win, lose or draw we'll be out of there in two years." I was just recently married at this time within a year I think and I said, "Do you want to move to Minneapolis for two years?" And we did. I think the company got some products out of that. Again, we were doing high performance for the time, digital cassette recording. One of the more interesting contracts that we had. We went to a trade show in Las Vegas and met with a fellow from a fabric operation in Dallas and they wanted a machine. Their thing was they had terrific fabric stores and they had these places all over the country and their thing was to get a couple little old ladies who like to sew in there to sell fabric and they didn't want them to have to

worry about running the business. They wanted them to sell fabric. So, they decided that what they needed was a daily report of everything they'd sold and then they could do all the reordering and billing and everything possible out of a central location in Dallas. And they wanted to know if we would build them something that they could enter on a keyboard what they'd sold and then send this data back to them at night. "Oh, wow, what a concept." I don't remember when the point of sale terminal concept came out but it was certainly new to us.

So, one of the interesting things I found is how many times that we thought we were doing something groundbreaking and realized that we don't have the foggiest notion what this business is about. It's come up many times. We were sitting in Cleopatra's barge in Las Vegas talking about this and sketching out what it should do and I don't believe, this was a show where Intel introduced the 4004 microprocessor. It was not in their booth. It was in a hotel room. We didn't know about it. We didn't go see it. We found out about it later because it was a calculator part. They didn't think it was going too be anything special. We found out about it and decided this was just what we needed for the logic for this point of sale terminal, so we became one of the first users of the 4004. And, I often wondered how many of us there were using it. I would call the number at Intel and talk to the nice girl that answered for that division, that department or whatever, tell her what I needed, needed an amp node or whatever it was and I'd say, "This is John Murphy" and she'd say, "Telex Communications Products, 9600 Aldridge Avenue, South Minneapolis, Minnesota and the zip code." Telex Communication Products that's what it was called. And I was always astonished. Either this girl has the most incredible memory or the most fantastic Rolodex or Intel has the most limited number of customers with this thing and I never knew which. So, we did some stuff with the 4004, with no assembler, no compiler, writing down on a notepad the binary op codes for every instruction and going and typing them into a teletype and I think we did have paper tape. It was very interesting and we did build a product which I don't believe ever sold for one reason or another.

Shustek: You needed software and stuff. This is a hardware project.

Murphy: It was a hardware project. It was kind of my introduction to really doing software. This is when I started becoming a programmer and part of the way this outfit sold fabric cheap is they bought huge runs or huge quantities of flawed fabric and they went through and would cut out the bad spot and make smaller rolls. They had an old Ford production factory in Dallas that was their cutting floor and that was one of the test facilities. We had to make a machine run in this environment because they had great doubts that you could use magnetic tape in a fabric store because of the out gassing of the fabrics. Not only dust but out gassing of the fabrics has a terrible effect on magnetic oxide, so we had to be able to make something run in this factory, which was full of dust and we had a problem and brought the machine back to Minneapolis and found that the tape was molecularly bonded to the tape head. The tape would no longer move. And we had a mechanical guy there who was an ex 3M tape engineer and he said, "Ah, tape stiction." He said, "I thought this problem was solved years ago." And it turns out especially with low speed/high speed tape, the tape floats away from the head and there's an air bearing there. Low speed tape, the tape drags across the tape head and there's friction and there's heat and there's enough heat to actually start melting the binder that's holding the oxide to the tape and when the tape stops moving everything solidifies again. You can pick the machine up by the tape. So, Gene started calling 3M and complaining about this problem. There hadn't been a tape stiction problem for ten years. We've solved that formulation problem years ago. We couldn't duplicate it in Minneapolis. It's a very environment sensitive and we tried. We brought in humidifiers and we put machines in plastic bags and we couldn't. Gene came to work one morning. He said, "Let's do the test. It's a bad tape day." I said, "It's a bad tape day?" He said, "Yeah, I can just feel the air. It's a bad tape day." Sure enough we

ran the tape for a couple of minutes and it stuck. He gets on the phone and calls 3M and says, “Okay, we’ve got a tape, molecularly bonded to a head here. Who do I bring to show it to?” And they said, “Ah, what are you using? Give me the part number on the cassettes.” He said, “Okay. Order such and such a part number.” “Well, what do you mean order such and such part number?” “Well, that’s the fix.” He said, “You’ve been telling me for several months that there was no problem.” And they said, “Look, we’ve got a warehouse full of those cassettes. We are not going to admit that there’s anything wrong with those to anybody who can’t absolutely prove it.” That was one of my lessons in corporate ethics. <laughs> , I think the phone company bought some of these recorders with the start and stop and they were going to use them in training labs to actually speed up audio recordings that people could listen on and they had some scheme that because they could start and stop the tape very quickly they could make speech sound fairly natural at different speeds.

Shustek: Did you have any awareness at that time of the potentially revolutionary impact of using a micro controller instead of discreet logic?

Murphy: I don’t think it occurred to me at all. I think it was during that time when I was at Telex that I saw an ad for a Datapoint product. I don’t remember what product. And I noticed, oh they have cassette tape too. I wonder what they’re doing? It turned out it was a completely different approach, much more based on the ham radio experience of the fellows who had done it but that was -- I don’t know why the ad stuck in my mind. It was just, oh, somebody else is in the tape business and, of course, by the time we left there, there were lots of people in the cassette tape business. But Datapoint was to have a large impact on my life later. No, it was interesting that the 4004 because it was a calculator and it was very strange. While we were looking at this and wondering if for the next version of this product, which we were already thinking about, would this be enough power and an Intel salesman told us, “Well, you might be interested in the next offering that we’re going to have. It’s an 8008.” And he says, “And if you’re really interested, we could let you talk to the fellow who designed it Hal Feeney.” And I said, “Hal Feeney?” And he said, “Yeah.” I said, “I wonder if that’s the Hal Feeney that I went to school with?” The salesman looked at me and he said, “How many electrical engineers named Hal Feeney do you suppose there are?” I said, “Well, I guess it probably is considerably less than the number named John Murphy.” I never really thought about a name being that unique. And Hal and I were classmates at Notre Dame and he did the 8008, which I don’t believe I ever did use at Telex. Like I say, I’m not sure what project we went up there for but that group was dissolved. I was getting a feeling for a while that I had the touch of dissolving groups. The specialty group at Motorola was dissolved. The division I went to work for at Telex was dissolved. The group I went to work for at Telex Minneapolis was dissolved.

Shustek: How long did you stay in Minneapolis for?

Murphy: I was in Minneapolis for two years during which time our daughter was born and like we said that was the only good thing to ever come out of Minneapolis was her. And it turned out that, especially at the time, Minneapolis had very good doctors, so we were -- in a way we were very lucky to be there at that time. And, I sent out a resume to various places in the sunnier parts of the country that started out, “I’m an electrical engineer in Minneapolis looking for a chance to thaw out.” That was the first requirement, some place sunny. And, met with some people from Singer, Singer Business Machines, San Leandro and didn’t sound bad. I went out, took a tour and it didn’t look bad, looked around San Leandro and environs looking for a place to live. I said there is no way in the world you’re going to get me to come here. And after a few more weeks and things were getting a little more desperate, well let’s

have another look, and the fellows I was going to work with said, “Let’s take you out over the first range of hills and get out a little farther.” And, “Yeah, okay, we can deal with this.” So, we were out there for a couple years working on cash registers.

Shustek: Starting in what year approximately?

Murphy: Oh, golly, this must have been 1974. Singer had huge contracts with Sears and Penney’s for cash registers in all the stores and I never really saw very much about those machines. I don’t know what technology was in them. They did not have microprocessors or anything. It predated that. So, we were going to do a cash register with a microprocessor of our own design and the interesting part, which apparently was quite revolutionary at the time, is the decision was that this would be a processor that -- and at the time I think there were nine chips in the chip set. They would all be designed such that they could be produced by a number of semiconductor houses. Their corporate lab is in New Jersey that got the design rules of how close traces could be and blah, blah, blah from a bunch of manufacturers and came up with a composite set of design rules that met everybody’s specifications and it worked. We had parts from at least three vendors that worked. I interviewed one time at Motorola in Austin and they told me I was crazy that such a thing was impossible. I certainly had not worked on any such project and certainly had not got results because it was absolutely impossible to have design rules that could go through two vendors. So, that was apparently -- and I had nothing to do with that. They had this clever scheme that we designed logic and somehow it got turned into a mask that multiple people could make. I remember one of the interesting experiences there. I built a simulator so that they could test software and I was still doing primarily hardware, built a simulator to simulate the whole system so the programmers could get to work on this thing. Well, the chip people were trying to build chips and there’s all the toggle switches and all the LEDs. And I went out one morning and one of the programmers is down leaning against a panel and he’s got his hand over his eyes and his eyes right up and I said, “What’s the matter?” And he said, “Well, I have a hard time seeing these.” I said, “They’re very bright.” That was my first time I learned that there is something like five percent, seven percent of the population that cannot see the red in red LEDs and it’s another one of those things that stuck with me for many years. I don’t know that I’ve ever really made use of that fact other than I took a tour at Intel and saw Hal Feeney and at the time Intel was working on an electronic wristwatch and it was the size of a sardine can and had a, it wasn’t quite a knife switch, but there was a button that you pushed on the side of the sardine can and the LEDs lit up and there were three of us. I don’t remember how the three of us happened to be there. Another fellow, who had been with us at Notre Dame, who I’d roomed with when we went to work for IBM and Hal, this was obviously the badge of honor for higher-ups at Intel and he was showing us the watch and the other fellow, Bill, had this same colorblindness problem. And I knew Bill was colorblind but I had never connected the LED. Hal shows us the watch and isn’t this cool and Bill looks at it and says, “It’s kind of garish jewelry for you.” It didn’t occur to him it was a watch and it’s one of these cases where you’re standing there as a middle man, not involved, but you understand what neither one of them understand. Oh, my golly.

But, yes, we built this cash register and Singer went out of business before the cash register ever went into production. There was a very interesting, another one of these lessons learned or at least heard; one of the big challenges in this new generation cash register was to provide the same programmability functionality they’d had in the older machines. In the previous generation machine what they called programmability, they could program things like, well you had to have this kind of key to be able to do a refund and there was a certain degree of flexibility on what each button did and what the sequences were. But there was a huge manual for understanding this and you programmed enormously wide words

in binary and it was just an incredible chore. And the way they replicated these, it was a core memory device and they had an extra socket where they could plug in another core plane and they went through some sequence where they would read from one and write both, so they basically made a copy of the core plane and take it out and plug it in other machines because the programming was so terrible. So, this functionality had to be in the new machines, so we couldn't use PROMs for the programmability. They had to be rewriteable memory and it had to be battery backed up memory. The requirement was that on Friday night of a long weekend they could pull the power cord out and on Tuesday morning plug it back in and everything had to be working. Intel was just coming up with the first CMOS memories at that time and we read the specs and boy it sounded really hard that you couldn't -- there were all kinds of requirements about, well, the voltages on the signal pins couldn't get above the power supply pin even when things were discharging. It was confusing enough that we set up a meeting with Intel and we went across the bay, big conference table, and a bunch of us from Singer on one side, a bunch from Intel on the other, including the guys who designed the chip and this is cool. We get to talk to the real guys. And I started off saying the ground rules. I said, "Well, what we want to be able to do is have a battery backed up memory in this machine, can pull the power cord on Friday night, plug it in on Tuesday morning and everything be there." The guy who designed the chip looked at me across the table and said, "Wow that sounds hard. How are you going to do that?" And our hearts all sank. <Laughter> It was like well that's what we came to have you tell us. So, there was an incredible amount of effort that went into this project and it dawned on me one day to ask how many separate programs are there? How many times has anybody ever changed the program? Well, there's the Sears program and there's the Penney's program and they were both written by the fellow down the hall, whose name I don't remember, who claimed the word point of sale terminal. I said, "We're going to all this engineering expense. We're going to all this production expense for a feature that will never, ever be used?" He said, "Well, it's a marketing requirement." So that was an interesting -- and as that wound down, Singer went through, I think I survived two 80 percent layoffs, 80 percent of the remaining staff were laid off and the company was up for sale.

And I read the, I don't remember the magazine, read the famous article about Vic Poor and how Datapoint had designed the Intel microprocessor. So, I sent Vic a letter and I think I was down in Southern California somewhere interviewing somebody when Jonathan Schmidt called my home. I think he forgot about the time difference, called my wife at 2:00 in the morning or something and he wanted me to come to visit. When I left Singer it was most interesting. They were enraged. They took me to lunch. One of the higher-ups who I had never met was enraged that I was leaving the company. And I said, "I've survived two 80 percent layoffs. I'd rather not be caught. The company is going away. It's been announced that it's for sale. Nobody is interested in buying it. Why would I stay?" "Well, because you're crucial to this project and you're a horrible engineer because you never made it clear to me that you were a crucial to the project." And it's like "I really want to stay with these guys." You know. <Laughs>

<pause to change tape>

Murphy: One last thought on Singer. There was a sort of operation here, I think it was fairly common that when a manager left town, well, one of his subordinates became acting manager for the day or the week or whatever. And as luck would have it there was one day when my manager was gone so I was acting manager for him. His manager was out of town so he should have been acting-- so I was acting manager for three levels. And this was the day that status reports came in. So I'm not sure what to do with these things and I got to look at the folders for status reports that had filed up from the engineer to their manager to their manager to their manager for the last several weeks and found all of the problems

that the engineers were reporting as horrible instrumental problems didn't exist by the time it got up two levels and by the time they got three levels, everything was great and ahead of schedule. So there was a lesson in management that, yes, I mean, I couldn't do much about it. But it's interesting to realize how that sort of thing happens. So Jonathan flew me to San Antonio and showed me around which was just amazing.

Shustek: What year are we in?

Murphy: We are in 1976. Jonathan's such an amazing individual. He would go all over the offices, all through the factory at Datapoint and everybody knew Jonathan by name, the girls on the production line. Everybody probably knew Jonathan and he knew them and their families. And I was just so impressed that this bunch of people who are all having a good time, all enjoying what they're doing, just, you know, what a marvelous opportunity. And we packed up everything; put both cars in a moving van <laughs>. I've often heard that the three cross-country moves is equivalent data to a totally burnt out fire. We haven't been quite that bad but, you know. I have no desire to ever move again. But, yes, I probably would. We moved to San Antonio in 1976. I've always said it was the 31st of February that we got here and there's a joke about that but at one time, you know, it was meaningful in my life. I still remember, we got here on the 31st of February. And I've just had a ball. Ever since then and working with Jonathan Schmidt, the Donzis brothers.

Shustek: And did you know at that time what project you were going to be working on at Datapoint? Was there a specific reason that you, your skills were?

Murphy: I don't believe I knew what I was going to be doing at Datapoint. I found out later that part of the reason, was there was no job opening. I had framed on the wall on my office somewhere, the rejection letter from the Datapoint Personnel Department that I received before I saw the article about Vic. So I eventually framed that and kept it for a long time. It's not that there was a job opening; it was, again partly because of the ham radio background. They liked something about what they saw. Plus the fact that the last project I worked on at Singer was a communication chip for the cash register which combined both synchronous and asynchronous interfacing one chip which, at that time, was not on the market. So I'd had that experience and they were already thinking about some sort of communications in the future I was still doing primarily hardware although I'd been doing some software. So while I was at Singer I got tasked with finding out why the bi-sync comline between San Leandro and Corporate Headquarters in New Jersey didn't work. And it turned out there was a bug in the con software in the 360 in New Jersey which was impossible, couldn't be. I was a transcontential 4800 baud line. It had errors. They had never seen the case before of getting an error while trying to execute the error correction algorithm. It didn't work. So there was a lesson in testing there that I hope I'll always remember. So I thought, "I'm still mostly a hardware guy." I did some disk controllers--

Shustek: That was the point of pride that you were working on.

Murphy: Let's see, Datapoint had just, let's see, the Datapoint 6600 was in production, they were doing their first computer that had a large screen. Most machines had a 12-line screen. It seemed perfectly adequate until we got used to twice that many. I don't remember, it must have been fairly early that we got into the, what was to become known as the ARCNET project. Datapoint was producing this-- well, it

started out as a terminal. It was a terminal emulator that they would replace anybody's terminal and decided that it would be a lot easier if it was a programmable device and they didn't have to build new hardware for every version. And then one of the customers, perhaps Pillsbury, started actually programming this terminal; and using it for business data applications. So that became a big thing and they had a machine that was certainly less powerful than the first IBM PCs. It had perhaps 64k of memory and it was supporting a dozen dumb tubes doing interactive business applications, let the users fully interlock with each other. And there started to be a problem that well, because the customers wanted more users, they wanted more than that, well, there's only so much this machine could do. And one of the field people said, "You know what would be really neat if we had shared disk controller. If we had a disk controller, we could connect two or three or four computers to and they can all be at the same disk information, then we could get more users". And that sounded cool. But it wasn't the Datapoint way of doing things. It was like "Well, you know," in fact, I think I looked at doing special hardware for this and, you know, we ought to just build some sort of communication scheme so that another computer can become the disk controller, It has the disks and it will have some high-speed communication to everything else and then it's trisymetrical. If this one machine dies, you can stick another terminal in there to be the server for awhile. So we needed a way to do this communication. Harry Pyle, had done something they called the "Combus," the communications bus running around the offices which had telephone wiring running around and open collector drivers. So, you know, every time there's a thunderstorm we run around replacing transistors all over the place. And it did some sort of priority scheme based on a serial number. It waited for the line to be quiet and all we ever did with that is we made printer drivers out of it so we could use a remote printer. I don't recall that we had any file copier. We may have actually had a file copier. But it was a starting point because it seemed like it was a good idea. This was really handy; everybody began to share the same printer. So I started on this thing, the whole idea was, "Well, this is kind of like a disk controller." So the architecture looked like a disk controller at the time. We had disk controllers that had four buffer pages, 256 bytes each. We had-- I don't know where the history of that but Datapoint disks had 256 byte sectors not 512 byte sectors. So we started out with, well, you know, we'll push disk sectors across the network. Even after it became obvious that, "Oh, yes you need some header bytes and some addressing and you need some more bytes," that was still a basic idea. I remember years later, trying to explain to somebody at a large semiconductor house that, "You know, there are more bytes than just the payload," and there's an interesting challenges there. It was like well, "How fast does this thing go?" "Well, the disk put out data at 2 and a half megabytes a second," you know. "It's as fast as we needs to go," and it seemed like a good goal. "Nah, maybe we want to go faster than that for future expansion."

Shustek: Who was we? Who was having these conversations?

Murphy: Jonathan Schmidt was, I don't remember, he was VP at the time but he was the boss. He was the director of R&D under Vic Poor. Harry Pyle, at the time, I don't think had a title but was kind of chief bright kid. You know, he was one of those people that I still, I think of as a kid. You know he always had that bubbly, you know-- and he did a lot of the initial conceptualizing. Yes, we don't want to build special hardware. We want to adaptor or we want a communications adaptor. And-- that was about as far-- every now and then we'd sit down and, put our feet up on the table and talk about problems and he'd toss in some ideas. Gerry Aswell was in the group at the time as chief hardware designer. Harry was basically a programmer. And we'd kind of toss ideas around but it was pretty much my baby. It was, you know, yes, we're here and well, what kind of advice do you want.

Shustek: And did you think of this as a network? Was that word being used at that time?

Murphy: Oh, on, oh, no. The word was not used. It was to be avoided. Networks were big and slow and clunky-- phone companies had a network,

Shustek: That was never.

Murphy: -- were, you know, the

Shustek: 4800 baud bi-sync-- that was--

Murphy: Well, or just the phone system itself.

Shustek: This was a bus.

Shustek: The geographical building block of the network was a comnet. The response time to measure in epochs. Networks were huge and clunky. You did not ever want to imply network. This was like a back plane. This wasn't anything that a user or a customer would ever hear about. It was an internal part of a computer. When this thing finally hit the market it was ARC, the attached research computer. Who cares what the wires are between it, anymore than it's an S-100 bus., It was not a matter of interest that what we were working on --

Shustek: So from a technical point of view then, you didn't kind of study networks in order to think about the properties of this communication-- well, it is a communication system?

Murphy: I studied everything I could find on data communications at the time. I even toyed with the idea of making the communications compatible with the T1 line-- the T1 line program at the time, and that didn't seem practical for what we wanted to do.

Shustek: Did you look at using serial communication chips or HP instrumentation bus. Those things were becoming standardized?

Murphy I wasn't aware of the HP bus at the time. Yes, we looked at all the chips that were available and nothing seemed to fit in. I did some work on the serial system at Singer. They had a very, very unusual system for communication between the cash registers and the computer in the store. It was all optically coupled but it was like at one end they were modulating the current generator and at the other end they were shunting a resistor so it was one end was watching voltage transitions and the other end was watching current transitions and it was-- it didn't work very well. I did an analysis of it and said, "You know, not only does this does not work in the worst case, it doesn't work in the typical case." You have to have best-case components. I must be doing something wrong in the analysis. My boss who had been a field service technician for a long time said, "That sounds exactly right. When you install a system, you have to pick ports to find ones that work." So, yes, I read everything I could find about any kind of communication scheme and nothing seemed to really fit. We wanted something that was really simple. It was foolproof as we could make it. Is it reliable, easy to manufacture, easy to test? And we thought

about, “Well, we could go to a higher speed but,” I wanted to make it basically asynchronous like a teletype signal or like a uart.

Shustek: The start-stop sense.

Murphy: The universal asynchronous receiver/ transmitter-- that was an early chip that did this sort of thing and one of the things they required was a higher frequency clock so that you had to take several samples of the bit and make sure things were what you thought they were. And at that time, a 20 MHz clock seemed like about as high as you want to try to go. It was going to take special parts, special manufacturing techniques to make any thing faster than that. If you did go with a higher speed clock, than you were going to have to go with some sort of phase lock on the signal I’ve always been fascinated, all my engineering work with phase lock and always came to the conclusion that I don’t really want to mess with that stuff. That’s very mathematically deep. I know it works; I don’t want to be responsible for making it work. You want to stay away from phase lock systems. 2.5 Mbits was adequate and it was fast as we could do with very simple hardware.

Shustek: Because this was viewed as an internal bus for the system, there wasn’t any marketing department that got involved in setting specs or customer requirements or any of that stuff.

Murphy: No, absolutely not. At least not that I was aware of, I designed the hardware. Anyway, of course at the time this was really fast stuff. We didn’t have ROMs for microcode if we wanted the speed. We simulated something like 10% of the speed on wire wrap boards. Harry, although he was a software guy, got interested in hardware and he would get interested in the middle of the night and he’d come in and he’d look at the schematics and say, “Well, I wonder what would happen if,” and he’d go change things on the wire wrap board and forget to make any notations about it and we’d come in the morning and, “What’s going on!”, you know, “Oh, it’s another Harry,” you know, like Harry’s been in and changed the boards overnight.

Shustek: How long did it take from conception to actually--

Murphy: Well, I don’t now.

Shustek: -- built the first--

Murphy: It was under a year and probably very much under a year but I really don’t remember. Because we got the software people involved fairly early on so they were working on software before they had anything to run it on. At one point before we came up with the token passing idea which, of course, that phrases didn’t exist at that time. We thought about trying to use a random timer something like the combus had and we said, “Well, things have been quiet for some random timer.” We actually wired something like that up. We had a random number generator on the board and decided we didn’t like that. It sounded hard to test. It didn’t sound reliable or predictable. So we disconnected it but we left it on the board while we were doing experiments. We’re going to do feasibility study, you know, the parts were still ton the boards. The heart of the hardware was a little sequencer that we’d used in other projects. There

wasn't really much to it to use. It was like, "Oh, well, you know, you can count an address register," and you read something out of a ROM and you make some decisions based on it. And for various reasons, I decided well this thing was going to run at one instruction per bit time now that it won't run any faster So we did one decision per bit time which meant that there had to be no ops at certain places there to make everything come out right to deal with the signal. And it turned out that I was using too much of the memory for instructions that said don't do anything but kill time. I said, "Well, what I need is a no op generator that will say 'insert 3 no-ops at this point and only use one word of ROM.'" We thought of this late one night and we wanted to go home. My technician wanted to go home and I said, "You know, it would be really cool to try this out," and he said, "You know, we've still got those random number generators on the boards. That's a counter that counts in a funny sequence. And, you know, if you make these four wire-wrap connections, we could put those counters back in there. I could write some code. I don't want to count some number. I don't need to count 1-2-3-4, I could figure it out. So I changed the code around, you know. I mean, try this out and this is really a silly way to do it. We'll fix this in the morning. And we never fixed it. I remember when the first ARCNET chip was done by another group, and I got to see the drawings. It was like, "Here's my random number generator. They're still doing it that way. I have a very vivid memory of seeing that and it has stuck with me forever. The fellow who was in charge of that chip design was also in my class at Notre Dame swears that couldn't possibly have happened because of the way the chip was designed and that just couldn't be. So my memory integrates, it was ingrained in my mind as that moment of saying, "There is my." Sorry, saw it somewhere. I certainly thought it was--

Shustek: In designing the protocols for this system, how much did you know about work that other people were doing? Did you know about ALOHANet, did you know about the work at Xerox?

Murphy: I believe I had read about ALOHAnet. It was very, very late in the ARCNET project when I heard about the work at Xerox. There was an article in the *ACM* whatever that publication is called, Communications of the *ACM*. There was an article about Metcalfe and Boggs working on this thing called Ethernet. I know one of the problems that we faced was, "Well, how do you make the physical connection?" The logical thing that everybody says is, "Oh, you run a wire around through the ceiling and then pull the tap down where you want it." Well, I was a radio guy. I knew something about transmission lines and we really don't want to do that. That's just going to cause so many problems. We're going to use coax the way God intended it to be used. Point to point, terminator at each end and that's it. And as soon as we had more than two boxes, it's like, "Okay now what we do?" Since I had worked in broadcasting while in school, a splitter! We had a 4 port passive hub with some resistors networked and then we built the active hub and the first of those were huge, one board per channel. Early on as we started building the first of these things, long before we had chips. I think we might have had a double shoebox size cabinet for the power supply and couple of boards in there. I guess there was one board that was the power supply and maybe two boards were the power supply; big box. Well, everybody wanted one of those so we were cranking those out as fast as we could just for the programmers in the office. And I think we built 50 or 60 of those things. And as we couldn't build the hubs fast enough. I never intended for anybody to use a passive hub and an active hub together. One of the programmers had a machine in his office down the hall from where the active hub was and decided he wanted two machines. And he put a passive hub in his office and it brought the system down and we figured out what was going on and I remember Harry Pyle and I sitting around saying, "How are we going to handle this? We know what the problem is, we know how to avoid it, how are we going to explain it to customers?" We're not going to have customers who understand transmission line theory and reflections. And we had, I don't know how many different sets of rules. We had "Okay, if this then--"and finally, and I remember this very well, they said, "How about the rule is you can't do it. You cannot mix

active and passive hubs because it doesn't work .I said, "That solves all the problems!" <Laughs> so that's where that rule came from. It doesn't work. I remember when we were trying to figure out how far we could go and we were throwing around numbers and Vic Poor walked through the lab and he said, "IBM can run a bloody terminal over 2,000 feet of wire. If you can't do that, I don't want to hear about it. Do a thousand feet." "Okay, that goes into the spec." And that was the other number. We had the first one channel active hub card. We sat there with the scope looking at the jitter through this thing, running random data, looking at the jitter. . We only got one, you know. Aren't going to build nine or ten more to see what happens to this thing. We're looking at this one and say, "Well, what had to happen? How bad it would be if that eye pattern opened up." All we had to do was ten of these things. <Laughs> Ten jumps and then that of course got cast in silicone because that was the total population we wanted the system to be and that's all over the microcode. But, you know, I said, "Where are these numbers coming from?" urghhh "Don't you think that ought to be a right?" you know, and--

Shustek: What about the addressing scheme? It was an 8 bit address hardcoded. Did you think about the implications of that and what system design would be based on that?

Murphy: Well, obviously not enough, you know, but at the time, 250 computers! You got to be kidding. It was a long time before we had a customer that exceeded that. <Unintelligible> the first place that had problems with those numbers. And I remember there was some discussion of putting a switch on there and we talked about, "Well, we can actually draw a unique part you put a unique address and everything. It would be a manufacturing disaster, you know. We don't want to be stuck with that." So I dug out a paper, yesterday as a matter of fact, I used to give a talk in the post Datapoint days. We did a series of tours. I went around with one of the marketing guys and he'd try to sell them on our product and I'd go along as the entertainment. And the theory was that they would come listen to me tell stories, and then he'd sell them something. And it was always, "John, we're going to have, you know, a full house," and I remember looking out and, you know, there'd be three or four people. It was very disheartening, but I got a little bit of time telling the stories. And-- I've just forgotten what part of the story I was going to tell.

Shustek: Addressing <inaudible>?

Murphy: Addressing. Part of the story was that I realized that I was getting ready for this talk about the history of ARCNET at that time in the 1978, 1980, whenever it was. It had to be close to the 1980s. I said when I was designing ARCNET, without ever having heard of Ethernet, I considered and rejected every one of the major design elements of Ethernet. The unique address burned into the board, the random back-off, the tapping the cable, what I considered major design elements. Every one of those I thought about and I didn't like them. You know, at that time at that target I probably would have some comments about that. I'm not selling anything. But I would have designed it the same way today. And I've had a number of people whose opinion I highly respect say very complimentary things about the basic design of the ARCNET so it was-- in fact, somebody asked me one time, "What's your advice to other engineers?." Based primarily on ARCNET experience, I'd say, "You know, go out and put your best into anything you do because you have no idea what's going to take hold and what you're going to be known for or what's going to last much longer than you think," so.

Shustek: One of the other important decisions, choices that were made at that same time was the difference between, sort of, an open, multi-vendor standard and more of a proprietary one, Datapoint having chosen the latter. What do you think about that decision?

Murphy: Well, I was an ivory tower techie, so I didn't get very involved in it. But my understanding of that is that it was not by choice. We tried to make it an open sort of thing. We went to every semiconductor manufacturer in the world and tried to get them to make the part. So there was all this-- I guess it depends on-- on the other hand, you know. So from that stand point, we were trying. , On the other hand, it was as much as making the protocol. We had no problem making it public. I remember Vic saying the last thing in the world that Datapoint needed was a bunch of people tweaking the ARCNET protocol and making incompatible systems that were called ARCNET or were called ARCNET reminiscent or based . So we didn't want that. We didn't' really want to say, "Okay, we'll turn this thing over to the Open Standards Committee and let some committee decide that, you know, 'Oh, really it should have been a nine bit address.'" Some minor thing that makes it totally incompatible. So in the early stages, I'm not an authority on the subject, but my guess would be nobody ever thought about it. This wasn't a big deal and, you know, we were doing it on the product. As it took hold, you start saying, "Oh, God, you know. What if we had started off doing something different?" you know, well, we didn't. The 256 bit addresses were-- or the 256 possible addresses was probably not a great idea. On the other hand, exceeding that number of nodes off a single network was probably not a great idea either because the token passing that used to be sold as the greatest thing in the world, it wasn't a real tiny token and in general terms. You know, you've got a couple hundred machines. You were burning up quite a lot of time passing the token around and while it was wonderful if you had had a lot of machines end-to-end talking to each other, that's not the way the networks evolved. You know, we thought it would be, but it wasn't. What turned out was a lot of clients talked to a few servers and putting a whole lot of them on one ARCNET ring, logical ring, hurt performance. So in retrospect, I wouldn't put the possibility to put more nodes on a network. I'm not sure how I would have handled that problem.--

Shustek: Given the parallel development of Ethernet and ARCNET as very different systems, what was your reaction when you learned that IBM had adopted a token passing system but one that was totally different from ARCNET?

Murphy: I don't-- you know, it was kind of disbelief and I don't think I ever really understood token ring load-off. You know, I read a lot of the advertising stuff. It always bothered me the idea that it was self-healing or whatever. It's like well, these nodes are going to figure out that they're broken and take appropriate action. And one of the things that I always tried to pound into people's heads is once you accept that something is broken, trying to predict how that manifests itself is pointless. If there has been a failure, nobody is clever enough to figure out all the possible failures and what they can produce. So the whole idea of token ring kind of bothered me on that notion. I remember when we read the article on CSC about the Ethernet, and we didn't want to tap the cables And clearly that's what they had in mind and it seemed like, in that article, that was before they got the fancy taps with the active devices in them. They were talking pretty much about dropping a tee can. I thought either these guys know some great secret of the universe that I don't know or they're all wet. So I called them, Metcalfe wasn't in the office Boggs was.. So I talked to him for awhile. I started out, I said, "Hey, I'm at Datapoint with Datapoint Corporation. I'm working on a system that is, in some ways, very similar to this thing you've just published as Ethernet. You want to talk to me?" "Oh, sure, sure." "Okay, what do we do about the reflections?" "What?" I said, "The reflections. The transmission line problems." He said, "The what?" I said, "The fact that when you hang one of those taps on there, you're going to send signals back on the

line." And then there was a long pause and he says, "You know, I'm not sure that Xerox might want to decide that one way to make a product this some day. I don't think I ought to talk to you anymore," and he hung up. And the technician who worked with me on this thing was sitting there in the office and he looked at me and he sat there looking at me and I hadn't said a thing, and he said, "He didn't have a clue what you were talking about, did he?" And I said, "I don't think he did. Then all the effort they went to later. Think before you publish. I think they really hadn't thought it through and then once they've said well we're going to drop these wires out of the ceiling, well they had to come up with a way to do it. And that may be a bit unfair. They may have had a plan and that just may not have been his responsibility. But it's one of those things that stick in your mind. And I think that's a very one-sided view on my part, but it sticks in my mind.

Shustek: You don't see too many of those systems around anymore with taps hanging out of the ceiling.

Murphy: No. Well, you don't, do you. And the Ethernet that took over the world is pretty different from the one they published in that magazine. On the other hand, as we say at Datapoint Xerox spent more money promoting the idea of Ethernet and grinding that into executives' minds before such a thing ever existed, than Datapoint's entire marketing budget.

Shustek: So, we were talking about some of the different decisions that were made in the network design between ARCNET, Ethernet and so on. But that sort of raises just a lot of questions about the ultimate demise of Datapoint and sort of, what happened? And-- separate the engineering part from other management issues.

Murphy: Well, as a lowly engineer, I never understood what happened there. Datapoint was an incredible company. For years, I said Datapoint was an industry leader that nobody realized they were following because they were so far ahead. The microprocessor, the concept of NTU, the keyboard, it was just one thing after another that came out of Datapoint years before anybody else thought of it. And it was a fun place to work and one of the things-- any place I'd ever worked before, there was always a hotshot. There was some guy who was, who was really clever, who was really good and everybody kind of looked to him. And at the Datapoint Research Development Department, there was a department full of those guys. It was like everybody was a topnotch guy. There were no just average guys, which made review time difficult. As Vic said, "if you don't walk on water, you don't belong in this department," It was just such a great place to work. And I don't know what happened, at least from my uneducated point of view, when Edelman took over the company. You know, that had far reaching repercussions and there were management changes at that point and I had no idea what brought them on but Vic left the company, Jonathan was removed from the company. We were told that we reported to different people with totally different cultures. And it was very disillusioning. In fact, when that happened, as I recall, it was like well, you know, try it you'll like it. If in six months you're not happy, we'll go back to the way it was. Well, in six months all the people were gone. They just couldn't stand it. All the people who hadn't been laid off were gone. Some of the best people had already been laid off. I had no idea.

Shustek: So you don't think it has to do with products and competitiveness in the marketplace and the way the technology was--

Murphy: There were some problems in that area because this was soon after the introduction of the PC from IBM. I think some of us thought, oh, finally the notion of a desktop computer has been validated. Now this will be good for Datapoint because people will realize, "Oh, yeah, even IBM has seen the way." I remember one high level executive said that the IBM PC was never going to be successful because it was ugly and that no business executive was going to have an ugly piece of junk like that in his office, no matter what it did for him, which was an interesting perspective and I don't know how widespread that was. I know there were comments that the IBM PC was a reality that Datapoint needed to deal with and at the decision making levels, there didn't seem to be any realization of that, any notice of it happening. So technology, in that sense, may have been part of the demise of the company but certainly the complete reorganization, in my mind, doomed it regardless of technology.

Shustek: Was there any awareness that as the concept of an office network grew that the idea of mixed-system systems that were not all Datapoint products connected together or IBM products connected together, that that was a technology that you needed to--

Murphy: I don't remember ever hearing, as I said, I was, by choice, a bottom level engineer. I never wanted to move up, never wanted to be a manager. I remember when I was still in school, at that time when I had an interview. The story was if you wanted a job anywhere in the Bell system, you could talk to anybody in the Bell system. And again, you know I'm a kid; I believe what people tell me. I thought Bell Labs sounded neat so if they told me that I could interview with a guy who worked at a Western Electric factory in Fort Wayne, Indiana I believed it. And I remember his big pitch was, "We'll have you in management in six months." And I remember telling him, "Well, I don't want to be in management in six months or six years or sixty years. I want to be an engineer," and that was the end of the interview. It was in the middle of the depression. <Laughs> I don't have the big picture like a Jonathan Schmidt does. We never, at my level, talked about a project that would allow integration of other people's systems. Certainly as we tried to push ARCNET for awhile, there was the feeling that if we could push this, then it might be possible. In fact, at one point when we had the new operating system which was based on ARCNET, we went through a phase of let's publish protocols, let's try to get other people to use the same protocols I spent a good deal of time trying to write up how the protocols worked which was very interesting and had all kinds of interesting stories with it. I don't think they ever got published. I think the demise happened before that came along. There were some feelings and some discussions of, let's try to get more people involved.

Shustek: Where did ARCNET plus come into this picture? Were you part of that project?

Murphy: No.

Shustek: Was this after you left?

Murphy: I was not. There were some very bright people came in and worked on that. I believe, I'm not sure, I believe the impetus for that came from the ARCNET Trade Association. I think they decided that they were going to be needing a marketing plan and Datapoint got interested in it. They put some very bright people on it. They spent, what I deemed, an inordinate amount of time with making it compatible for the existing ARCNET and I remember asking every customer that I talked to. We actually talked to customers occasionally at that point which was kind of neat too. Everybody that I every talked to, I said,

"You know, do you have any interest in this higher speed ARCNET?" "Oh, yeah." "How about the feature that you can mix fast and slow machines on the same network. Is that an issue for you?" And that was about 50/50 and it was either "Oh, yeah. We couldn't use it without that," or "Oh, no. That's of absolute zero value to us." So then you said, "Well, how about if there were a box that you put between the fast network and a slow network. "Oh, yeah. That would be fine". I'm not sure why they put all this effort into" we got to have the fast machine and the slow machine on the same wire". It made it incredibly complicated. But the break-up where we all left, occurred sometime during the development of ARCNET Plus because while we were at Performance Technology formerly known as Datapoint Research <laughs>, we got a contract from Datapoint to write a NetBIOS for ARCNET Plus and there were significant issues with the product that had to be addressed before we could get software to run on it. I think we were leaving about the time they were developing that product and there were actually some very brilliant people handled that project but it seemed like their goals were not understandable to me. And I'm not sure they ever sold much of that either.

Shustek: When you left to form Performance Technology did you leave on good terms with people at the Datapoint? It sounds like you must have if they were giving you contracts for work.

Murphy: Well it was some time later that they gave us contracts for work. But they were pretty upset by this. I don't want to say no good reason but we're taking customers away from them. Yes, they were pretty upset with us. Unfortunately, things had gotten to the point where it was really easy to take customers away from them. Performance Technology would go off and use the latest technology. The original idea was we would use technology of the day, we would not sell hardware. We would write high performance software aimed at emerging technology. Our distributors would go out and find whatever PCs that they could get a good deal on, whatever disk they could get a good deal on and they would assemble the system. Put our software on it and we would avoid the problem that we still face today of can't get a product into production because the parts are obsolete before we can get the design finished. You know, you still face that. So our solution was we'll write the software and we'll let the distributors at the last moment, before the customer gets the thing, pick what he's going to put on it. We found that was a little harder to do than we thought it was going to be and that people were willing to pay us to make those decisions and do that for them.

Shustek: This was targeted at the Datapoint installed base? THAT was the intention?

Murphy: I'm sorry.

Shustek: Did you intend at the very founding of Performance Technology that these products would be targeted at the Datapoint consumer base?

Murphy: Oh, yes. That was the goal. We realized that we could build a server based on a PC-A 2 that could run rings around the servers that Datapoint was selling. You know, yes, there was a technology issue. They were not keeping up with technology. And we could have done that at Datapoint R&D, but we weren't offered that choice and it was like, we know we can make this stuff go faster and we know there's a big customer base out there. And the original idea, I believe, was that we think Datapoint's kind of going away. We'll go do this for Datapoint, we'll provide servers. And then we started looking at all the other orphan networks that are either out there now or are going to be out there where the companies

have gone away or are not supporting the technology. We'll learn everything we know about Datapoint systems, about other systems and well, that never takes a pass. I used to think about that it's not in terms of what we left Datapoint knowing, but just we put a lot of time into understanding how this stuff worked and to do that for yet another system didn't sound terribly attractive. But, you know, other opportunities came up before that and this thing called the Internet came around and gave us some business opportunities.

Shustek: You were making a transition at that point from being a hardware engineer mostly, to being a software engineer mostly.

Murphy: Well, I made that transition at Datapoint shortly after designing ARCNET. I got interested in software and started writing a lot of the little utilities little test stuff. In fact, there's a fellow that came to work for us that had been a student at, I always say the wrong one, one of the Universities in Kansas, He'd been a student up there and worked in the computer center and they had a lot of Datapoint stuff. And one of the things that always bugged me about, especially in-house utilities, was, when this program's got a bug, this doesn't do exactly what I want it to do. I don't know who wrote it and I don't know how to get in touch with him. So there was always a help screen in my stuff and my name was Murph which I'd been fighting as Murf since I was in grade school. This fellow told me one time years later, he said, "You know, for a long time when I was in school," he said, "I thought Murf was a code name for a department at Datapoint that cranked out test code. You wrote so much stuff." And they were all very much, I like to think, in the Unix philosophy of the small tool that does one job and does it well and, not a huge project. But I did quite a few of them and he said, "I thought that was a code word for Utilities Department." So I'd been doing a lot of software and finally I was officially reporting to Gary Asbell as a hardware guy. He came into my office one day after talking to Jonathan and said, "You know, we think you ought to move across the hall," which was totally another way to say you are reporting to somebody else. So I started doing primary software and worked on AIM, Associated Index Method, which was a fancy hashing-based tech search thing that we did at Datapoint which we included in our word processing offering and I did of everything except the word processor itself for the word processing system.

Shustek: So was AIM full-text indexing system, search engine kind of thing?

Murphy: Full-text indexing actually what was clever about it was you could look for partial names or partial words. You didn't have to have a whole word. What it was actually indexing was character triplets. So you'd go type a word and it would break it up into triplets and it would look and see if "computer", let's see is it a "com" is there an "omp" you know. And the impetus was on emkanoufs[sp] and we figured out a more efficient way to do it and a way to invert, transform, change the rows and columns in the matrix. Boy, it's been a long time since I've thought about mathematical terms.

Shustek: Transpose.

Murphy: Transpose.

Shustek: But, where did this run? The workstation? The client? Or was it on the server?

Murphy: I don't think we ever had anything that ran on servers. Everything ran on clients. Now on RMS there may have been but basically severs were disk controllers. I mean at Datapoint we played with that as a stand-alone program it was a search thing. And they decided to build it into Databus which was Datapoint's interpretive language which was another one of the clever things that Datapoint did is this business language which was widely acclaimed as being very easy for secretaries to program. I'm not sure how true that was, but it was widely used. It was an interpretative thing. So that you could make major changes in processor technology and you could still execute the same executable programs which was kind of neat. We did an interpreter at Performance Technology that was faster than anything that Datapoint had. Then we went for a several technology swaps while we were at PT. We did a bunch of tools, like the sorts and the indexes. We decided, well, we got these fast servers; we could do these things faster than the Datapoint processor could. So we would build stubs where the customer didn't know about it., The customer installed it but didn't know anything had changed. He ran the same batch file scripts, whatever, but instead of actually doing a sort on his machine, it would submit all the parameters to the server, we'd do it there, assemble it and put the results on the disk and just send him the results. We went back and forth with this kind of stuff for awhile. At this stage of the world we looked faster then the client. Okay, they got a Unix box to go faster." And everything moved back and forth, it was interesting over a fairly short span of time, how fast technology changed. I remember at one point, let's see, it seems like the client sent a job to the server to be processed and we'd check a status file every so many time increments that seemed very reasonable at the time and by the next generation of hardware it turned out that that time increment was the major stumbling block, that it was done long before the first check, so we've had a lot of fun chasing technology. When we were at Performance Technology, we were doing sorts and indexes and stuff so it was very interesting that there were a couple of us, Datapoint had two operating system we were supporting and I was basically doing tools for one operating system and another fellow for another operating system. Oh, but that's not entirely true. I guess I did sorts for both and it was interesting looking at the trade-offs of, well on Datapoint DOS, I know that the biggest possible physical disk was 10 megabytes and I've got a machine that will hold that much in memory. So I can take one strategy for doing a sort. On RMS they could have really big disk so I've got no chance. I've got to go to disk or think of another strategy. And we had lots of fun tuning things that way. The same exact problem came up within the last week with the same people. While I was tuning sort algorithms, Lewis was working on memory tests and we had a common library of code and one morning, all of a sudden, all of my sorts got 20% slower and I just couldn't imagine what had happened. And it came up Lewis had built a faster compare routine in the library. But he was doing memory tests so his notion of what a fast compare routine was, something that almost always says "yes - these two huge blocks of memory are identical." I was doing sorts where my notion of a fast compare is something that says "yes - these first couple of bytes are strangely different," and which direction. He had optimized for 32 bit compares on an Intel architecture which means, "Oh, they're different." Now we've got to back-up and figure out because of the little endian architecture which way are they different. So we wound up saying, we really need two different compares depending on what you expect the outcome to be and then everything got faster. And darn if we didn't have that same thing happen this week and yes, that's really hard, you know.

Shustek: So is what PerfTech is doing very different from what Performance Technology was doing? What was the transition like?

Murphy: Yes. Very different. We started at Performance Technology with, okay, we're going to make different systems run faster and further we're going to make servers run faster. And Jonathan was out talking to customers finding out what they needed. and come back and say, "Yeah, they're killing a half a day doing it." We'd come up with another product. Jonathan's probably one of the most amazing, I think,

virtually every successful Datapoint product that I'm aware of resulted from Jonathan saying, "You know, I've talked to some customers and they could use this."

Shustek: He was the marketing department?

Murphy: Yes, you know, I'm an engineer. I don't like the term marketing. Jonathan is what a marketing department ought to be. He's probably the only one in the world that works that way. So we went through a series of products at PT and then we came up with this S internet. It was like the Internet is becoming very popular and yet a TCP/IP stack is a horribly intrusive thing. We've heard people saying, "Oh, well. Yes, can put a TCP/IP stack in a PC but it uses all of the memory, you can't do anything else. So John would add his, "Well, what if we put something that looked like a TCP/IP stack but didn't have any other smarts and talked to another machine." We went through a phase with them and with the program and we were very successful with that but we were running into displacement as well. So we came up with the idea of this box and software that you go into in a Novell system. You add this one file on your PC and we put this box on the network and it really is on the Internet. Jonathan always used whether it was a server or a system you take this box and put it a closet and that was the stock phrase. And I remember we at some talk, this one woman, she asks, "Does it have to be in a closet?. Can't people look at it" ,<laughs>. But, so yes, we did very well with that and got Bay's interest and blah,blah.

Shustek: And you were selling to the Novell customer set?

Murphy: Yes, a lot of those went into Novell Systems. And then it was like, we've done pretty well adapting to the changing world. What we're doing now is we're making list of the fact that we know a lot about networks and making stuff run fast. But it is a wholly different idea, It's one of these things where you're going down the tubes at Nortel and they were letting all of 75,000 people, including all of us. Jonathan went around talking to people and asking what do you need and found this idea of being able to deliver bulletins from an ISP to the customers. That's one of those things that, it's very difficult to explain. It either sounds like pop-ups, "Oh, my gosh" or it's this "Oh, if the ISP wants to talk to the customers. Why don't they send him an email?" On a good many systems, a great number of the customers don't use the email that is provided by their ISP and their ISP has no idea what their email address is. Which is one of those things where you tell some people and they roll their eyes and say, "Oh, no, these guys don't know the first thing about computers." We're still learning about this business and all the assumptions. One of the assumptions that we made at the beginning was the ISP is providing access to the Internet and has got a web page and you go, "They've got people who know how to write web pages." I guess if we had looked at enough web pages we would have realized there aren't many people who know how to write web pages. . So we were heading to provide that service, too. And we're finding out that there is no such thing as the typical ISP. There are major, major architectural differences in virtually every customer we've talked to. So that's one of the challenges we're facing now. But we're still writing software that involves moving bits around between computers and other than that, there's not a whole lot of similarity to what we've done before.

Shustek: One of the things you mentioned earlier is that you would go on customer visits with a marketing person and that your role would be to provide the entertainment. You've also gotten involved in other forms of entertainment. Why don't' you talk about that?

Murphy: When I was a kid, like the typical six year old who gets the magic kit. "Oh, boy! Magic!" And about the time I started high school, dropped that for awhile and about ten years ago I got back interested in magic., Got into a couple of clubs here in town, Holsters and a couple of other clubs and have got a great deal of enjoyment out of it. I did a talk on Career Day at one of the grade schools here a couple of years ago. I told the kids that I did not go into this planning to make a career as a magician. It's a lot of work, it's a lot of time on the road, it's probably not a great way to make a living. Plan to be a doctor, you know. Make a lot of money because it's also an expensive hobby but it's enormously satisfying hobby. Now, fortunately, the guy who was standing next to me sharing was a guy who is trying to at least supplement his income, so he had a totally different outlook. I spent a lot of time learning about magic; a lot of good friends. Occasionally, I get an offer to appear at a club, a bridge club or a seniors citizens' group or something. Every once in awhile I've appeared at nursing homes. It's interesting my mother-in-law is in a nursing home and we've come to know a lot of the people. It was on one occasion when I was doing my act and my wife said, "You know, there was a woman sitting back there that I've seen around here for a great many months and I've never seen the woman smile. Never seen her, she's always frowning. She was up. She was smiling. She was enjoying it." May not have been following exactly what was going on, but she was up.

Shustek: Do you think there's a chance you might show one --

Murphy: I think I might--

Shustek: Talents.

Murphy: < during this time John is performing a trick with a ring and shoelace> let's see, let's try something here that moves around a whole lot. I ask kids sometimes, ""Do you like puzzles?" "Oh, yeah, yeah,". I'll say, "Like crossword puzzles. Okay. and jigsaw puzzles". The puzzles I like are what we used to call Chinese puzzles. These were puzzles that you'd find on the store on the shelf and they looked like bent nails and rings and things and they're all twisted together. I like to make my own puzzles and when I'm on stage I use Texas sort of things like chain and hardware and horseshoes and spikes and here I've got a shoelace and an old ring. And you can make a puzzle a lot like the ones that you see in the stores and - these things are put together and the object of puzzles is to take them apart without using the ends in this case. And you do it just like you do when you're in a store and nobody's looking, you pick one of those things up and you just kind of give it a twist and it comes apart. Of course, if you're in a store then and you put it down and walk away. like, "Now what t do I do?" sometimes you put them down the wrong way but what you should do is if you took it apart you should put it back together. If you took it apart from the middle then you should put it back together in the middle. And do it the same way with this that you do in the store you just kind of wiggle things around until it goes back. < He finishes the trick>

Shustek: Well done.

Murphy: You know what's happening here. You know that it's a trick ring. There's a hole on the ring, right there. There's a hole in the ring and I can just pull that string right through it. I used to have trouble keeping track of where the hole was so I got a ring with a hole on either side so I pulled it through there. That's my puzzle.

Shustek: Very good.

John Murphy: < John stands up with a white rope about 3 feet long during the next routine> Let me show you. I'm going to stand up here and wander around a bit. My favorite, this is kind of my signature affect that I got a chance to lecture on to a group of magicians not long ago. Stand up here and what I've got here is very appropriate to a museum. This is an artifact from TV of many years ago. This is one of Ed Sullivan's shoelaces. You remember Ed Sullivan? He always comes down to see that tonight he had a really big shue. This is one of his shoelaces. I wouldn't kid you. This is the shoelace, and like every other shoelace you've ever seen, you never know when a knot's going to show up in it. At least that's the way my shoelaces have always been. I always found that, you know, while I was trying to figure out where the knot came from, like as not, another one would show up. And it wasn't until I grew up and became a magician that despite the fact that it always seemed like I could never do both that I learned how to get rid of knots. And one way is to kind of squeeze them down and slide them off the end and squeeze them up so small they become invisible and throw them away. And then when I'm feeling a little lazy and I don't want to do all that squeezing, I just shake them and throw them away. When I was little, I was one of these kids that was always having trouble getting too much of my shoelaces at the same time and finally when I grew up, I learned to get rid of two at the same time. When I was still quite small, I thought I had a very clever solution to the shoelace problem. I'd tie the ends together and then, that's got to solve all the problems. Did you know? Look at the knot in the shoelace. There's no way-- look that knot in the middle of it. That must have been there from when we started but didn't notice it. With these ends tied together you know there's no way I could get that knot out of there save by magic. I see that some of you are on the make and suspect that that knot is not a knot. You're not wrong. It's what we magicians call a breakaway knot. There's half a knot on this end and half a knot on this end and if you hold it together just right, give them a little twist, it looks almost like a real knot. On a good day, it looks so much like a real knot you could untie it. When I was a kid in grade school, I got to where I gave up using this to hold my shoes together but I used to go out on the playground and remember playgrounds and recess? We used to go out and kind of do all tricks, origami, and cat's cradle type stuff. There was a really cool one where you went like-- let's see, "Thonk!" I pulled the ends off my shoelace. And it was very embarrassing left with a whole lot of middle and no ends. And I've got this end with no middle. I find that very confusing. Tell you what; let me mark these for identification. Yes. We'll put a one-hand knot in there so I'll recognize them as ends and drape them over here and have a little psychic surgery for the magic words "computer history museum." You know, shoelaces are just such a pain that I often think that the only way to keep them under control was to put the ends in my pocket, nothing funny can happen but shoelaces being what they are, you just never know what's going to happen and that's why I wear boots.

<All clap>

Shustek: Thank you John.

END OF INTERVIEW

