Oral History of George E. Gerpheide

Interviewed by:
Günter Steinbach

Recorded February 10, 2017
Mountain View, CA

CHM Reference number: X8088.2017

Steinbach: All right. For the record, today is February 10, 2017. My name is Günter Steinbach and I am interviewing Dr. George E. Gerpheide.

Gerpheide: Gerpheide, exactly, right, one of the few people in the world who know how to pronounce my name.

Steinbach: I'm good with languages. And thank you very much for coming to give us this interview to record your oral history.

Gerpheide: My pleasure.

Steinbach: Originally, I contacted you because of your contribution to the touchpad as a computer input device but we want to get your whole history, not just one little thing, so let's start with your background.

Gerpheide: Great. Well, I was born in Kalamazoo, Michigan. Yes, Kalamazoo really is a place; many people think it's just a myth from a song. It's a cold place there [in the winter] and I believe that cold weather makes for warm-hearted people so I was surrounded by a family and just a lot of people who were really good, solid people. They gave me the idea that the world is full of good people and full of good things and I think that helped a lot because I had to go through some kind of tough times. And I have one brother. I started off with a dad who loved to build things, really liked to work with his hands, gave me a lot of creative ideas. We built model airplanes, we built model cars, we built model rockets, we built little toy robots out of Erector sets, all this stuff back in the late '50s, early '60s, and it was… I feel I was really privileged to have a lucky childhood there. Dad brought home one day a couple 2N404 transistors and a book from General Electric about how to build a flip-flop so my brother and I (in I guess junior-high school) figured out how to make circuit boards. We built this little circuit board, populated it with parts and built our first working flip-flop with the grandiose idea that we could build a computer if we could build one flip-flop. Needless to say, that was a little tough for two kids in junior high. I guess a few things I might want to mention: Dad gave us a great start, camping, hiking, canoeing, love of the outdoors and that's really carried me through my life; I've always liked the outdoors. And Mom gave us a great thing; she forced me to get a paper route to earn some money for myself. Too bad those don't exist anymore, but what a great way for a kid to learn how to persevere, tough out-- especially in Michigan-- tough out the elements and keep going. Dad was an early skier and he taught me how to ski, which also has shaped my life quite a bit. So that's my early life.

Steinbach: Okay. So I already see that you kind of were headed toward electrical engineering or something like that. Right?

Gerpheide: I kind of was.

Steinbach: How about your degrees and studies?

Gerpheide: Well, I started out loving engineering as you mentioned and MIT was one of the big names in town. It turned out my dad had gone there so it was between MIT and Cal Tech. I picked the East Coast thinking the skiing might be better in New England. (The decision process for an adolescent isn't always very optimal but it was a great school, I loved it. Boston was wonderful.) Graduated with an EE degree and went on to get a Ph.D. in computer science at the University of Utah. Strangely enough, the reason I went to the University of Utah is that I took a lot of courses as an undergraduate, saw that I was going to graduate half a semester early, which seemed like a waste to a silly college kid, and my friends were all skiing in Utah. I came out (to my parents' dismay) -- spent the entire winter washing dishes and skiing the deep and steep of Snowbird, Utah, and after that, that strongly influenced my choice of graduate school. They did have nonetheless... At the University of Utah they had a very competent computer science department. Dave Evans and Ivan Sutherland were there just opening up computer graphics. But I only took a few courses in computer graphics; I didn't really benefit from that huge legacy that was there. And instead I started working on speech recognition, a topic that was probably also like the computer [my brother and I had started to build in high school]. It was a little too big for me to bite off, and I got probably three years into that dissertation topic, got distracted working on another project I'll tell you about in a moment, came back, reevaluated and decided I probably would never graduate with that thesis topic. I completely scrapped it, started again with Suhas Patil who was doing an interesting sort of VLSI design; it was a spatially oriented VLSI design, much like a PLA on steroids. And we turned that into an asynchronous concept where each bit was occupying one small cell of this geographical layout and the bits were communicating asynchronously with each other so that you could pipeline at the bit level. That meant you could build an adder where the least significant bits came in first, got added, then sent up the pipeline and the next word to be added for example would come in so you got very high utilization out of the silicon.

Steinbach: Was that programmable?

Gerpheide: It was not programmable; it was simply a design tool. This was, keep in mind, about 1979, 1980, and we didn't actually build it; it was a theoretical undertaking. Suhas went on to form Cirrus Logic here in the Bay Area, which garnered a pretty good share of its marketplace, and I went on to do completely unrelated things <laughs> so that's my background academically.

Steinbach: But your Ph.D. thesis was about that-- I'm not even sure how to call it--

Gerpheide: We called it Bit-Driven Logic and that was my thesis topic. That's right.

Steinbach: So what did you go on to do right out of school?

Gerpheide: Actually, right before that at the end of my speech recognition undertaking I got distracted with a company called Optronics Ltd. in Salt Lake. They built a room-size golf simulator [Part T Golf]. It was one of the first on the market, certainly the highest-quality one, with optoelectric [ball] sensors. It was a little scary to tee up your golf ball, take a driver, and smack it into a screen that was only that far away <indicating nearby wall>, hoping that it wouldn't rebound and hit you in the noggin, but that got me kind of started on sensors. After they got started up, I came back to school -- thought I'd better finish this almost-in-my-hand Ph.D. degree, and so I did that. Shortly after graduating I started a company with a friend of mine. He was a geophysics guy, and he had the idea, which was a little novel at the time, that you could use induced polarization to prospect subsurface geology -- the idea being that different kinds of geologic structures would be related to microbe activity. Actually that would put different kinds of conductivity into regions of the soil, and we're talking deep, deep regions. So you'd go out with dipoles that are about a mile apart and inject a large high-power signal into the ground and another dipole with two electrodes about a mile apart and measure the resulting signal, which usually had a phase shift due to the polarization properties of the minerals and from that you could model the subsurface structures.

Steinbach: So this is high frequency or--

Gerpheide: Very low actually because you're going for very deep penetrations and I think frequencies were typically on the order of a few hertz -- so very, very low.

Steinbach: Oh, I'm not used to thinking of polarization in such--

Gerpheide: <laughs> No. It's a different world and frankly I relied on him for all the science I was simply the nuts and bolts – built it into a portable unit that replaced what previously had been a truck-mounted unit. When you're prospecting there are a lot of places a truck can't get to so the hand-held unit was a great idea. It was right at the peak of one of the oil cycles which, just as we were exhibiting at the Society of Exploration Geophysicists, was crashing and exploration money was being shut off completely. So we more or less made back the money that we'd put into it and that was the end of that.

Steinbach: One more question: So you say a mile apart sensors and you need a phase so how do you get them to synchronize?

Gerpheide: That's a great question. So actually the electrodes -- the two electrodes of the transmitting dipole -- are perhaps a mile apart and that's done simply with a very long wire.

Steinbach: Okay, an equal-length--

Gerpheide: Yes, and causing a lot of practical difficulty in the field because you're dragging this wire through sagebrush, up mountains and everything else. Previous systems had to use a wire connecting the receiver to the transmitter to get the phase reference. Our innovation was simply to use a very -- at that time -- very high-quality oven-controlled crystal oscillator that was synchronized at the beginning of the day and then maintained good enough synchronization while being carried around the field that we didn't need the wire. So that was a pretty big asset for that kind of prospecting.

Steinbach: Okay.

Gerpheide: Great question though but it's spoken by a true analog guy. <laughs>

Steinbach: That's right and an HP guy. Of course they had atomic clocks and things--

Gerpheide: We did not have atomic clocks on this. <laughs>

Steinbach: Okay. All right. So after that?

Gerpheide: After that—

Steinbach: You had to find something new.

Gerpheide: I had to find something new and I'm going to refresh my memory because it's a while back. I worked on a small company that measured the partially filled bottles of liquor at the bar. My cousin was a bar owner up in Montana. Drinking is pretty big in Montana. The typical small town has a post office, a gas station and six saloons. What he pointed out is that you can have your well drinks on the gun to monitor and make sure that the bartender is pouring appropriately and charging customers appropriately. But unfortunately all of the expensive drinks are in bottles behind, which are completely unmonitored, so if he wants to pour a drink for his friends it's from the expensive liquor. With my cousin, Craig Anderson, the idea was that if we built a scale and a bar code we could scan the bottles, and measure the difference in weight. It got a little complex because there are differences of specific gravity among the different liquors and so forth and so on. But with adjustments for all that we could get a pretty good handle on which ones were being consumed. That turned out to be not really accepted by the marketplace because of the difficulty of entering all the data for all of these special liquors, and bartenders really are more interested in meeting customers, making money and this kind of paperwork—

Steinbach: --they had to enter data about every liquor.

Gerpheide: Yeah. They didn't really like that so—

Steinbach: But you did get a patent--

Gerpheide: We did get a patent on that idea. I think technically it was a pretty good idea but the market just didn't match up to the implementation.

Steinbach: I guess you would have had to instrument the shelves or something.

Gerpheide: Something. These days perhaps you could have a small robot that would roam around and do all the legwork for you by reading the labels but at that time that was way beyond the technology of the day.

Steinbach: Okay. So--

Gerpheide: What next? So you can see I've got a consistent theme and I'm always working on the same kind of technology and leveraging that for the next -- not! Probably if I were doing my life over it might be more productive if I were to stick with one thing but I didn't. After that I worked with the University of Utah guiding a couple students on a project -- oh, I thought I had a picture here; here we are-- <shows a picture> a project to test how microgravity might improve the crystallization of long-chain proteins. And the problem there is that long-chain proteins tend to not crystallize very well because they're so long that the gravity actually distorts the shape of the molecule preventing the appropriate crystal—

Steinbach: It droops?

Gerpheide: Apparently so. I was relying on the expert Kay Ely here who was researching protein crystallization. And some folks at the university-- Utah State University-- had put together these Getaway Special packs. It was basically about a garbage can form factor with six of these hexagonal packs layered up and it flew in the bay of the space shuttle. And so with almost no budget a number of students put together this small system that would hopefully preserve the proteins through launch, then at the right time when the canister was activated, they would squeeze out of the storage areas into another vessel where another chemical would cause the crystallization to occur. And as it turned out there was a fault in the wiring of the canister and when the astronauts flipped the switch there was no power: The best-laid plans of mice and men... But that was a fun project, got to go see early shuttle launches, tour the cape and a lot of good stuff like that. And it turned out Utah had a fairly active space presence because ATK, in those days called Thiokol, was building the SRBs—

Steinbach: --boosters, right?

Gerpheide: Yeah, and in fact is still building SRBs for the new space transportation system. So that was pretty fun. Also, there was a group called the Center for Engineering Design at the University of Utah headed up by Steve Jacobsen, a very smart guy, and he liked to think -- he was a mechanical engineer -- he liked to think that human evolution had developed a lot of pretty good solutions to mechanical problems. And so his concept was -- in terms of building a robot hand -- that we should model it after the human hand. This hand here <shows a picture> -- it's a little bit hard to see behind this mechanism but there are three fingers -- the little finger has been discarded just for the sake of simplicity —

Steinbach: Evolution.

Gerpheide: Evolution, yes, it may happen anyway. [… three fingers] and a thumb. They're roughly the same geometry -- scaled up a bit -- roughly the same geometry as the human hand with the same joints, same degrees of freedom at each of the joints. So you've got a total of 16 degrees of freedom there, and just like the human hand in order to get really good dexterity you need a very high-speed feedback loop. However, in order to get a high-speed feedback loop you have to have minimal mass. That means you can't have the motors, the actuators, out there in the fingers because they add too much mass. So what human evolution (or animal evolution in general) has done is to provide all the actuators here in the forearm, run tendons up to the fingers which have very little mass, and it's a pretty elegant solution. So Steve designed essentially the same concept. You can barely see the tendons coming down here run by pulleys, and what you can't see in the forearm area down here is a set of pneumatic actuators with some pretty fancy control. It's a complex control problem because -- if you think about it -- when someone's trying to move this distal joint here, they're activating the tendons which are running over the proximal joints. So the motion of the proximal joints (or the forces on them anyway) are a function not only of the proximal tendons but of all the more distal tendons, together. So we built a control system with 16 microprocessors, one for each joint -- in those days we didn't have much power, remember. And he arranged that I be a visiting scientist at MIT (at the AI lab) to take this particular mechanical contraption over there and integrate it into their environment, and it was really a pretty cool thing. This had such high performance that (in an unstable condition anyway) the fingertip could move at 60 Hertz. For a mechanical object that's pretty darn good. As you can kind of see here in the name -- the moniker says "Dexterous robot hand." It had quite good dexterity because of this very high performance.

Steinbach: So for feedback did it have touch sensors or something?

Gerpheide: After I left their group, they started to work on touch sensors for the fingertips. That's also a hard problem partly because of the wiring problems of how to get all that information from these moving distal locations back to some central processor. But the version I had did not have that. It simply had angle sensors on the joints and so it was doing position control and force control was really not -- at the time I was there -- was really not developed.

Gerpheide: Let's see what else. I got hooked up with a group called Dayna Communications. Keep in mind this was in the very early days of personal computing. Macintosh had just come out. A lot of people loved it but there was no spreadsheet. That made it tough for business guys.

Steinbach: That's the days of VisiCalc, correct?

Gerpheide: VisiCalc and Lotus 1-2-3 were on the PC, exactly, so some folks in Salt Lake had an idea that we could provide a coprocessor. This box here, <shows a picture> being the coprocessor, hooked in in such a way that it used the screen and keyboard, mouse, and so on of the Macintosh. So it looked kind of like you were using the Macintosh but it would run software actually on this hardware, which was a PC clone. Pretty neat concept, pretty tricky engineering to make all that work together as it turned out, but that was a lot of fun. And they went on to do some other compatibility things. Novell, which at that time was a big, big name in networking, was located in Utah just south of Salt Lake City and they didn't have a solution for Macintosh. So we built an AppleTalk protocol stack for them and then we did some sort of supercharging of AppleTalk (which at that time was pretty low-speed serial communication); supercharging it to support higher-speed protocols and in fact a variety of higher-speed protocols with some sensing to determine what the highest speed was and so forth.

Steinbach: That was for Mac to Mac communications or Mac to peripheral?

Gerpheide: Mac to Mac networking, and in the context of Novell it actually could provide integration into a LAN that had a bunch of different devices on it, PCs and so forth.

Steinbach: And you would auto-sense what protocols are used and so on.

Gerpheide: Exactly, kind of fancy stuff.

Steinbach: So you got into software in--

Gerpheide: There was a lot of software writing there. Let's see if I'm forgetting something--

Steinbach: And you got a patent; I think I saw a multi-protocol patent--

Gerpheide: The company did file a patent on that. As it turned out this concept of the MacCharlie as it was very cutely named after the -- I don't know if you remember the Charlie Chaplin commercials for IBM PC? So, this was the MacCharlie -- this concept didn't quite work out for them because the speed of innovation of software came along and the need kind of dissipated. …But a patent was filed. Frankly, I

wasn't heavily involved in that; I was busy beavering away in the back room and they said, "Oh, we should patent this" so the lawyer created some patent but I can't really claim a lot of inspiration there. It was basically a group of us engineers who all just did what we could to make it work and I think we shared that patent.

Steinbach: Did you have support from Apple for that?

Gerpheide: We had very limited support actually. We had of course the developer's toolkit and that had a lot of information in it but beyond that I don't think we had almost any support so—

Steinbach: Okay. So they didn't actively encourage you to do the MacCharlie.

Gerpheide: Bill Sadleir --who was the CEO of this company Dayna Communications -- I think that he had some level of business interaction but at that time I was an engineer. I didn't put my nose in those business issues, but that was kind of a fun project. Coincidentally -- and I'll touch on this in a second, I think you're going to ask me a question about this but -- that had to do with the development of touchpads although it's probably a little hard to see the linkage there.

Steinbach: Well, I was going to say so about that time you started working on touchpads. Right?

Gerpheide: That's true.

Steinbach: And what made you want to have a touchpad or something other than what was out there at that time?

Gerpheide: Günter, it was driven purely by my personal need. I was a guy who had learned to type in seventh grade and had done a bunch of typing in the interim on these projects; almost every one of these projects had a bunch of firmware or software associated with it. I was using the wonderful Emacs editor, all control keys and if you don't know them it's a nightmare but if you do know them it's pretty darn efficient.

Steinbach: I'm a 'vi' guy.

Gerpheide: Yeah, okay, so almost the same. Then I got involved with MacCharlie, my first experience in the Macintosh world. "What is this mouse thing? I mean it's kind of cool when you wiggle it around but my hands are on the keyboard; I've got to take them off and move around." I thought "I can fix this. I'm an engineer. I'll put a pointing device right there on the keyboard so I can run it with my thumbs so I won't

have to leave the home row." Naiveté spurred me on to think that first of all this would be a very easy problem and second of all that there's no one else doing this. So … you know, they say there are a lot of things in life that -- if they weren't so easy to get into and kind of hard to get out of -- they wouldn't happen. Like children! There are many times when one might abandon the childrearing idea and the human race would dwindle away to nothing. But fortunately children are easy to start and once they get started they—

Steinbach: You've got to--

Gerpheide: --you've got to finish them. Anyway, this was sort of the same thing. I got started on it—

Steinbach: But from the start you thought it would be something to slide your thumb on?

Gerpheide: Yes, and I was initially thinking thumb because I wanted to keep my home row position. I'd had some experience with a resistive membrane concept and I thought "Well, I'll just get that!" This resistive membrane was used as a potentiometer in some kind of instrumentation. And I thought "Well, I can just adapt that, put it on the keyboard, move my thumb on there and it would give me what I want; how easy is that!" Well, I called the things "Cats" because I had this aversion to the mouse anyway. By the way I don't mean to knock on graphical user interfaces; I think they're really neat but the idea of moving my hands off [the keyboard] I didn't like. And so the Cat Prototype 1 -- I built it up, I started to use it, and I said, "Oh, this is terrible." It didn't really work-- I mean it kind of worked but I had to push with my thumb so hard on this resistive membrane to get it to operate. There was no real way to know if I was pushing hard enough or not quite hard enough. As I would slide my hand sometimes it would make contact and track the motion of my thumb, and sometimes it wouldn't, and it would just appear to me that it was just flaky. It just wouldn't work. So anyhow that was terrible. And it might be a good time to just talk for a second about what else was out there technologically. There were these resistive membranes and there were even big-size resistive membranes that were put on the front of a computer monitor. Most of this, what I'm going to tell you, I had no idea when I started. In retrospect I now know there was lots of competition. There was a technology of optoelectronic sensing where there were a bunch of LEDs and emitters arranged in a frame on the front of the CRT. When you put your finger in, it would block the beam of light in X and Y directions and then thereby track.

Steinbach: And HP had that in their HP PC or whatever they called it--

Gerpheide: Yes.

Steinbach: --but that's kind of limited in resolution.

Gerpheide: Resolution very limited, not too good at sensing when there's contact and when there isn't.

Steinbach: And I remember one HP instrument that had that, an instrument on the bench. You kind of lean over it and your shirt sticks to the PC--

Gerpheide: <laughs> I hated that, automatically reset all of your work for the week -- right -- exactly. There was a surface acoustic wave technology where surface acoustic waves were sent across the front of the CRT, which was typically glass, and the presence of a finger would dampen the transmission of the surface acoustic waves and thereby detect the position.

Steinbach: If you have your hand off the keyboard.

Gerpheide: Well, any of these touchscreen ones you had your hand [off the keyboard] -- that's right! I was actually let me say cool on the idea of touchscreens. I felt that they were very good for limited use like in an information kiosk in the airport. Move up to it, touch it. Gambling at Las Vegas is a big market, touch the cards. But if you're using it eight hours a day like I was using my computer to program, I thought of Jane Fonda and "feel the burn" after going up to the touchscreen four thousand times in a day. Nonetheless those were technologies that could have been built into a smaller size. There was a company in the Boston area called MicroTouch Systems that actually owned much of the touchscreen market, probably 60 percent, and they took their touchscreen technology [to a smaller size]. In their case it was a technology that was resistive capacitive. So on the sides, the periphery of the screen, there were four electrodes. There was a resistive coating on the glass. When your finger contacted the glass a small amount of alternating current would flow through those resistive paths and then through your hand to ground, and by measuring the resistive paths in each direction you can kind of see how the X and Y position could be determined. They took that technology and built a cool little product called UnMouse, about this big <indicates size with hands>. Form factor, very similar to today's touchpads. Plugged into a Macintosh, which at that time was the big graphical user interface opportunity, and they had some limited success with that. It was exhibited and they were selling them retail -- but like all of the other technologies the problem was that it wasn't easy to glide your fingers smoothly across the surface. It was almost impossible because you had to maintain contact, which took a certain amount of pressure to get an electrical contact in the case of UnMouse, or in the case of my failed resistive membrane a significant amount of pressure. And it was so easy as you casually glide your finger to just lose that contact a little bit in which case it looked like it was flaky; it stopped working, just jerky motion of the cursor. So all of those were pretty limited success. But here I was with my Cat-1 Prototype that didn't work.

Steinbach: Was there already the IBM stick with the eraser tip--

Gerpheide: Not quite yet.

Steinbach: --keyboard--

Gerpheide: Not quite yet. Ted Selker at Almaden, just up the street here, invented that and that became really quite popular partly because of the promotion of IBM and partly because it took no space. So, that was a strong competitor to us as we got into operation, but at this time there were a couple other guys. There was one that was a ring mouse. You wore this ring device with some kind of wireless linkage and it would sense the spatial location of the ring and the idea was you'd move your hand around. But you can see how hard it would be to decouple the motion of your hand that's unintentional (scratching, whatever) from intentional pointing operations. There was a little knob that you could kind of slide back and forth in a small mechanical area like that <indicates size> by some guys in Wyoming. That one had a cat name too; I can't remember what it was but another play on the mouse. Let me think if I missed some. Oh, there was Isopoint. Craig Culver developed a kind of cool technology. It was a roller that replaced the space bar and so you could roll your thumb on it and slide it back and forth so it was kind of like a trackball but right there for your thumb to use at a moment's notice.

Steinbach: Uh huh. Two dimensions?

Gerpheide: Yes, some limited—

Steinbach: So the space bar could roll and--

Gerpheide: It could roll that way, forward and back, and it could slide left and right slightly, a mechanical nightmare but another—

Steinbach: It still worked. Yeah.

Gerpheide: Yeah, I think the prototype worked and, when you think about it, it just showed how much need there was for something, really a need. Now keep in mind the time frame here is 1987/1988 kind of timeframe, so, very early in the graphical user interface world. Macintosh was GUI. On the IBM-PC compatible side, only Windows, I don't know, Version "One-Point-Something" was starting to be used, but not very widely. And some guys were doing CAD, but they were using big specialized tablets and high-quality trackballs, stuff like that. Anyhow, that was Cat Prototype 1. And then I tried something capacitive after that. That totally didn't work. Didn't even register. It didn't do anything. And you know, I'd get discouraged, and I'd go off and ignore it for a month or two, and come back and try something else, and something else. I had ones with a really thick bulk of sort of piezo-material in them. All kinds of stuff I was trying! All kinds of stuff. And then, you know, it was a little bit like the guy (was it Goodyear who invented vulcanization kind of by accident?) Anyhow, we all know about how capacitors work, right? The classic description: there's a parallel plate here <gesturing>, there's a parallel plate here, there's a medium in-between, the amount of capacitance relates to the areas and the medium. But if I was building a touchpad

or a sensor, how would that work? You know, how would I get my finger in-between those two plates? It didn't seem possible. Sort of by accident, I found that if I had a grid -- and I was trying all kinds of electrode shapes -- if I had a grid of X-electrodes, and a grid of Y-electrodes, and I was measuring the mutual capacitance from one to the other, in theory that just depended on the intervening material, which, of course, the finger couldn't touch. But what I found out was that it actually responded to the presence of a finger above the grid. Of course, everybody knows this now in the touch field. But to me that was, "Wow, it's magic!" And then I realized, "Okay, well, there's some fringing [electric] field that goes up and then back down, and that's what the finger is interacting with." And anyhow, that kind of became the basis for a couple of the very later prototypes. So I started with Cat-1. About 15 months, I guess it was, later I'm at Cat-19 and I'm calling my wife, "Honey! Come downstairs! Look at this! I can move my finger!" And this was all done in my basement.

Steinbach: So this is just you alone.

Gerpheide: Pretty much just me on a shoestring in my basement. I'm still doing this consulting work, which is paying the bills as my day job, and I'm doing this at night. I hired a couple people part-time, helping me do wire-wrapping and bread-boarding of various kinds. And then I hired a gentleman, Jack Kelliher, who was really a sharp guy, and he helped me do firmware and stuff like that, again, part-time, because I didn't have money to do it full-time. And we were in my basement. And okay, I've got to tell you about this. In Silicon Valley, it's well-known (starting with the icon of Hewlett and Packard) that all those good old companies started in garages. Apple, Hewlett-Packard. In Utah, it's too cold to have a garage startup. You can't do that! They're all basement startups! So anyway, mine was a basement startup. But it's mostly me and a couple guys helping out. And anyhow, in the sort of late 1980s I got to this point where, "Look, honey! It works!" And so I filed a patent. The patent, I think it says here, I started -- I guess I started work on the patent in '88, but it didn't actually file until '89. And that's the one that with a couple continuations became my '017 patent, which was sort of the basis of modern touchpads, I'd guess you'd say. It was a mutual capacitance technology, because we're talking about capacitance from one set of electrodes to another, rather than self-capacitance from an electrode to a finger. That had pros and cons. At the time, I didn't know all this, but in retrospect I can see a lot of good stuff. One of the pros was that the location of touch was quite localized to the intersection of those electrodes. Which was handy, because as the world moved on and the market moved on, and people wanted to support multi-finger (which we didn't do, by the way, but), as it moved on to that, mutual capacitance was just fine with that because you could have one finger here <gesturing>, and one finger here and they'd sense independently. The other big approach is self-capacitance, where there's essentially a set of X-electrodes and we sense which one of the X-electrodes has a finger on it, and build a profile in the X-direction. And then a profile in the Y-direction for the Y-electrodes, and then we figure there's one finger and it's located at that intersection. Or we might figure if there are two fingers, I can kind of figure it out, but there are some pathological finger configurations that don't work. So mutual capacitance had a benefit there. And it had a benefit in terms, I think, of sensitivity when there's no ground line connected. This has always been a bit of a mystery to me, and not fully explored, but it seemed to work better. And it seemed to give a little better tracking. Let's see, a couple other things on the con side, self-capacitance could detect, or had the advantage of being able to detect, relatively large amounts of capacitance change caused by the finger.

Because that capacitance to ground of the body was maybe tens of picofarads or so. And the mutual capacitance dealing only with this fringe field at the time was a truly tiny amount of capacitance change, so we were trying to sense a capacitance change with a resolution of down to one femtofarad. And keep in mind, this is in my basement, we're not talking about foundries and silicon and stuff, we're talking about wire-wrap or the old 3M prototyping (you know, where you push the wires in, kind of prototyping). And we're talking about analog circuits made out of 4049 CMOS inverters that are biased into the linear region. And things like that. So since that level of capacitance change was truly a challenge, I developed some pretty interesting approaches all based around the concept of differential circuits. So we'd get common mode rejection obviously, we'd get rejection against process parameters when we go to integrated circuits and so on. And virtually everything in my design was differential, including the electrodes being organized into what I call Virtual Dipole Electrodes. So the electrodes themselves were differential electrodes. And to my way of thinking that meant that it worked fine with no ground connection, and it helped to localize the behavior. It gave really good tracking, even through the plastic insulator.

Steinbach: Which you need, too.

Gerpheide: Which you need to have, as opposed to, for example, the UnMouse, where you had to actually make electrical contact. And by the way, there were many, many touch sensing devices in the patent prior art at this time. Maybe a hundred of them! And some of those were capacitive. Some of those were mutual capacitive, some of those were self-capacitive. But apparently none of them worked, well enough to bring a product to market. And there were a number of reasons: partly the practical difficulties of sensing these tiny capacitances, and partly some were based on resistive technology, resistive capacitive, and so on. And so anyhow, I was kind of in a field … at this point, I went out and did the patent research, and I was poring through all these patents to see what was out there. “Oh, my goodness! These guys tried all this stuff!” But it was just a hard problem. And as my friend used to say, "The devil's in the details." So even though some guys had ideas of doing a capacitive sensor, to actually get it to work was darn near impossible.

Steinbach: Until 19 tries.

Gerpheide: Until 19 tries! <laughter> And good luck on top of that! So it was a pretty complex system, too. It did a kind of a dynamic tracking to move these Virtual Dipole Electrodes around the surface, as opposed to the more conceptually simple process of build an X-profile, build a Y-profile, look for a peak, and you're done. But it seemed to work pretty well. It didn't need an earth-ground connection. And at this point, I had a prototype which was built out of wire-wrap, PLAs and you know, maybe 30 chips or so, all wire-wrapped together in this big mess in a box like this <gesturing, about 2 feet>. The plastic overlay was plastic from my son's model kit that I had cut out with scissors, held on with scotch tape, literally. And we'd etched the grid pattern professionally, with a professional printed circuit board guy. But other than that, it was really quite the basement amateur kind of operation. So that's kind of where I was at the end

of roughly around 1990-ish, with a laboratory prototype that could work, Cat-19. I guess I could talk a little bit about the really big challenge that came next.

Steinbach: Please. <laughs>

Gerpheide: Well, so I'm a techy guy. You might know that. Sometimes us techy guys are called nerds. That's the kind of life I'm happy in. I like working with circuits and problems and technical stuff. Maybe marketing and sales isn't really my forte. But anyhow, I didn't have too much choice, so I said, "Okay, I've got this thing, it's pretty cool. Someone must want it!" And I hit the road. And I talked to all of the notebook, or portable, or luggable as they were called at that time, computers. And Compaq had a luggable. It was about that <gestures> thick, about like that.

Steinbach: I remember that, yeah.

Gerpheide: Yeah, that was quite a unit. And we did a lot of our prototyping with that good old machine. Zenith, a name we don't think of much now, had branched out from televisions, which they'd kind of lost to Japan. They branched out into computers. And Zenith was one of the big names in IBM compatibles. Digital Equipment Corporation had one. They'd gone from minicomputers to realizing they had to get into this new micro market, and so DEC had a big plant in Taiwan. So we called up all these people, and at this time, I had a friend of mine, Jim O'Callaghan, who had had experience in the computer biz. He was still working in a day job, but he would give me advice and sometimes make some calls and get some meetings lined up and then I would load up my little prototype. In later days, we built that prototype into a black metal -- I think they were made by Zero Corporation-- aluminum box with a key lock. In case I left it in my hotel room, I didn't want anyone coming in and stealing my precious idea. And of course, I was traveling by airplane. So here I am with my long hair, this box that can't be opened, metal box, can't be x-rayed (well, they didn't have x-rays, whatever) walking through-- there was no security-- and life was so much different. But I took it everywhere. For DEC, they said, "Well, the people that really need to make the decision is our design team at the manufacturing plant in Taiwan." This was my first opportunity to go overseas. And I remember being in the cafeteria, with 3,000 Chinese, all these back heads, you know, a sea as far as I could see of Asian hair, and me, standing up there with my blond ponytail and thinking, "I don't quite fit in here, do I?" And anyhow, took it everywhere. Zenith had the idea that it was really pretty neat. Somehow the gentleman there at Zenith sort of had the vision. And many of the other guys said, "You know, we don't really need this. In the PC world, almost none of our customers are using a graphical user interface, first of all. If they do, well, they can plug in their mouse. And if it's portable and that's too much trouble, well, we've got this little tiny trackball thing. It's sort of like a marble, and we can wheel that. So we think we're covered. No need for your technology." But at Zenith, he said, "You know, that's pretty cool!" And we'd pointed out that there were some big trackballs, like the Apple trackball, about like this <gesture about an inch> that worked pretty darn well. Those little trackballs? Not too well. And being a sphere, there's really no way to miniaturize the device and make it thinner without making it smaller. And so we felt we had this sort of fundamental market need that was coming up as the devices got thinner and

thinner. And the Zenith fellow shared our vision. But he said, "You know, we make computers. We buy components like mice, and pointing devices, and so on, from vendors and we put them together and sell them. We don't develop pointing devices, that's way outside our limit. Why don't you go to KeyTronic?" (which was the big American game in town building keyboards and mice). So we went up to Spokane, and got a really good reception. And they said, "You know what? Let's do a joint project for COMDEX." This was fall of '89 coming up. "Let's do a joint project where you put your touchpad into a keyboard, and we'll have it on our booth and we'll start selling this jointly, and if it seems to take off, we'll buy this whole thing from you for $75,000, lock, stock and barrel, all IP." And at this time, I had these guys helping me. I'd taken my IRA, and rolled it over. You were supposed to roll it over into something else, but I rolled it over into payroll. So that wasn't quite right. And I was starting to run a little thin, as they say. So $75,000 sounded like a pretty good deal at that time. Beavering away, COMDEX is coming up, I get on the phone. "So… let's coordinate the marketing materials!" "George, you know, I'm sorry, we've had a change of heart. We're not going to do it." <laughter> And I'm thinking, "Arrggghhhhh!" So as luck would have it, not too long after that, maybe the next month… We'd been trying to get in to talk to Apple. We'd written some letters. Apple was already a pretty big company. And just somehow hadn't been able to get hold of the right guy. And a gentleman called up from Apple, David Levy was his name. He was an engineer who was working to try to find a touchpad solution for them.

Steinbach: And they were looking, out of their own need for a touchpad?

Gerpheide: They were! And they had … I believe … I'd heard rumors that they had contracted with two or three other people, including MicroTouch, who had this successful, or somewhat successful (on the market anyway) little UnMouse product. And they'd contracted with these others, but none of them really worked. And Macintosh early on was all about the sort of integrated experience, the touch and feel. It's got to be good. High quality. And so something that's kind of jittery, shaky, that didn't fly for them. So I bring in my suitcase with my prototype, and we put it on the table there and Dave [says], "Oh, hey! This is pretty neat!" Starts calling people in, all this excitement, "Hey, this is really neat! This is great! Oh, cool!" And all kinds of good energy, I'm thrilled, this is good. "Okay, George, we'll give you a call!" I go back to Salt Lake. And at this time air fare was pretty expensive. Delta had a corner on the market. It was about $700 to make a trip from Salt Lake out here to Silicon Valley. And so I get back and I'm kind of waiting by the telephone. Waiting, waiting, waiting. No call, no call. Finally, three weeks later, Dave calls up, "George! We've decided! We really want to do it! You got to come right back out! We've got to get the Senior VP to see it and sign off on it." And I said, "Well, Dave, I'm about out of money. I just went through this thing with KeyTronic, and you know, if Apple's really serious, why don't you buy my ticket out there?" He said, "No, no, you don't understand, George. It's not an official program. It's just us guys in the back room, it'll take two or three weeks to cut a check." And then he says, "You know what? I'll just write you a personal check and put it in a FedEx envelope." Which he did. Sent it to me. I bought the tickets with it. Went out to Apple, and one thing led to another. So David Levy was a pivotal -- you know, just his vision and insight right then, and chance maybe -- was the pivotal thing that allowed that to go forward. So anyhow, kind of a thank you, Dave!

Steinbach: So at that time, did you already have a company that you had started? Or still kind of you as a private person, single inventor?

Gerpheide: Well, that's a great question. When I said, "Hey, honey! It works!" and I decided to do a patent, that's when I said, "I'm going to commercialize this thing." And so I came up with the name Proxima, which made sense to me, because when your finger is in proximity it works.

Steinbach: Oh, I just thought, "The next big thing!" <laughter>

Gerpheide: Could have been. And it turned out there was another company named Proxima that made a bunch of LCD projectors and it was fairly successful with that, but I didn't know that at the time. But it was basically just me. And so it was me and these part-time folks that were helping me. So there was a company, but it wasn't funded, and it was still in my basement. Let's see. I mentioned Jim O'Callaghan and, as we were able to do this license agreement with Apple which was widely reported in the press, that provided some money. It was an upfront license, paid upfront license. Gave me a nice little chunk of money, and so I was able to say, "Hey, Jim, we've got some funding, why don't you come do this?" And he came on board, which was a wonderful thing, because Jim had a lot of business experience. Accounting, sales, just generally being in the industry. And we formed the company, Cirque. Because now we had funding.

Steinbach: So you did not use venture capital.

Gerpheide: Did not have any venture capital.

Steinbach: Would there have been any in Salt Lake City, or--?

Gerpheide: There was very limited. There were just a few companies. One of the banks had a fund. And there was one venture fund. And that was it for the whole State, I guess, of Utah. So we might have knocked on their door a little bit, but we had a pretty good chunk of money from Apple -- compared to where I was living, where you recycled pencils, it seemed like a lot of money. And we had this one problem: that the arrangement had a period of exclusivity, during which we couldn't do anything with the technology.

Steinbach: How long?

Gerpheide: I probably shouldn't -- that may be some confidential information. But it was a few years. And during that period, the idea was … I thought Apple was doing something pretty sensible. We

negotiated this idea that they'd have a couple years head start. And after that we could take it to the PC world, and that would help kind of boost the visibility, and build the concept, so that made sense. And Apple, of course, had huge resources, which we didn't have. There were a lot of steps from taking this box of electronics into a touchpad that had tiny size, low weight, low power consumption, and all this. Mostly building a custom integrated circuit. So Apple embarked on that project.

Steinbach: Okay, so Apple did put it into a silicon, like a single chip or something? Or a few chips.

Gerpheide: Yes, yes.

Steinbach: Not Cirque.

Gerpheide: That's correct, at that time, and they had resources. You know, the TIs of the world were glad to work with them, because they were Apple. When we called up, they didn't answer the phone the same way somehow. So we had a couple years where we couldn't really do anything, and Jim and I said, "Well, okay, let's try to do something in the video storage area." So we started beavering away on that, beavering away. Like everything, it's harder than it seems. And we weren't able to come up with a really good solution there. A few years had gone by, our period of exclusivity had ended, and we said, "You know what? Let's go back to the touchpad." So … the problem was the integrated circuit. So … virtually impossible to do it without an integrated circuit. We started calling up, no one really had much interest. Then through some luck … my wife, her family where she grew up, was in Pocatello, Idaho, north of Salt Lake about three hours. And you wouldn't guess it, really, but in Pocatello, Idaho, there was a foundry, an integrated circuit company, AMI, one of the very first, American Microsystems, Inc. I guess, for some reason they'd moved from the Bay area to Pocatello, where they had lots of space, lots of labor and so on. And people could go out hunting whenever they wanted. So it had kind of a lifestyle that way. And my wife's friend happened to be in the business school, and knew Conrad Wredberg, the head of AMI. So we were able to get an introduction to Conrad, went up, showed him our stuff. And he had the vision. He caught it. And with a little bit of work he signed on. He said, "Okay, we'll build the chip for you." And AMI had these other customers, like, either Ford or General Motors. I don't know why they wanted to spend all their time on those customers instead of on our chip, but they seemed to always get sidetracked from working on our stuff. So I'd drive up every Monday. And stay in my wife's parents' basement, go into AMI and harass them until they'd work on our stuff, instead of GM (or whoever this other one was). And at the same time, you know, there was some pretty custom, fancy analog circuitry going on here. So, our team, technically, really consisted mostly of Jack Kelleher, that I mentioned, and then Mike Layton, who we'd brought on. And Mike was doing the firmware. And Jack was doing the digital sort of layout. We bought some tools and designed the gate array, and took that up, and AMI was going to be able to plop that into our mixed signal chip just fine. But there was this analog problem. So I scratched my head, and I came up with this concept of what I called a "dual [output] transconductance amplifier." And basically, the idea was that if you built a transconductance amplifier, but you had two outputs to it, you could … and I'm trying to remember just how this worked -- it was a long time ago. But you could mirror the amount of charge that

was siphoned off of one of these electrodes. And one part of the operational amp would be a charge amplifier, and the other part would mirror the amount of charge and send it off to be integrated in a synchronous integrator. And everything was differential, differential everything, complete differential layout. But it was all full custom, you know, designing this, the transistors, everything. And so I did a lot of that up there with AMI's tools. And thanks to Conrad Wredberg and his vision and AMI's participation, we got working silicon. This was probably 1993, November, we got our first working silicon. It just about worked! There were a few little glitches. Something with the reset circuitry or something. But basically, it was a functioning touchpad circuit.

Steinbach: So at the same time, Apple must have had their own silicon, too, but they would not let you have it, or it was-- they just had their license and did their thing?

Gerpheide: Yeah, and you could imagine they wanted the proprietary position, first of all. And second, a couple bad things happened to Apple. Just at that time, in the early '90s, they were going through tremendous financial upheaval. People were leaving, finances were every which way. And to make matters worse, there was a huge argument, "Are our customers going to like this little pad? They might want their trackball, which they're used to. This might completely devastate our product launch." And you know, a big company is thinking about a rectangular hole in the front of their device that has to be filled. Interestingly, as a result of touchpads … you might remember that early laptop computers had the keys located down here <gesture to front of laptop computer>. And there was a sort of a blank area up here <gesture above keyboard toward screen>. And it was really Apple, with David Levy's mechanical design input that said, "No, we're thinking about a touchpad down here, so we're going to move the keys up." So that was a pretty big change to the industry. But in any event, they were having lots of arguments about whether this would work. As a result of those two things… plus the fact that this silicon was not so easy to do. Sensing femtofarads. As an analog guy, you know that's, you know… analog is a tricky little art form. It's not like gate layout, right? So for all those reasons, Apple had not yet fielded a product, and maybe other reasons, I don't know of. But it was a tough thing to get it working. And here we were with a kind of a prototype now, but it wasn't quite market ready. There were some little glitches in the circuit. And we didn't really have any other funding. It was starting to run low.

Steinbach: A recurring theme.

Gerpheide: A recurring theme. Right? Money goes quickly, right? New round, whatever. So at this point, I want to introduce a couple other gentlemen who were really key to our success. Larry Holmstrom, who was an early IBM guy from way, way back, Boca Raton, was settled in Utah, and had started -- was one of the first engineers -- at a company named Iomega, making some kind of innovative storage stuff. And he was advising the State of Utah with a venture which they called UTFC. It was an idea for the State to provide seed funding for technology ventures to try to build up a technology industry in Utah. And so he looked at our stuff, and he said, "You know, I get it! We're going to invest!" It was seed financing, so it was $75,000. But Larry brought some contacts. And together, with those contacts, he helped us make

some presentations and kind of boosted it. And we were able to convince some local angels, Ken Woolley and David Spafford, who had been a couple of the key guys building a company named Megahertz, which was a big modem company at that time. They owned the modem market [for portable computers]. Subsequently acquired by U.S. Robotics, and so on. But they had exited that, and so they had some cash, and they-- with Larry's prompting and especially Ken Woolley seeing the vision -- they invested and put in about a million dollars of our first venture funding. And so things were really starting to cook now, 'cause this is '93. In '94-- well, let me get these dates right-- in '94, we were able to sign a license with Alps Electric. And I should point out that during this whole time, after our exclusivity period had lapsed, we had been pounding the pavement with principally Logitech. But also everyone else we could think of. Sony, we'd made several trips to Japan, thinking, "Sony, you could build this into a TV remote control." And anyway, Sony was doing all kinds of cool consumer electronics. And we said.. you know, we just tried all kinds of stuff. Logitech … interestingly enough, sitting on the Board of Directors of Logitech was Federico Faggin. And it's quite possible that he sort of got the idea of, "There's a need for touchpads, it's possible, some guys have done it." And he had great analog designer expertise, and he had a company that was already funded, maybe 17 million of venture funding, I think, is the number I remember. And so Synaptics, at that point, roughly, must have started in working on touchpads.

Steinbach: They started in '91, actually.

Gerpheide: Okay, and that probably makes sense, because we'd actually been talking to Logitech since the very beginning. They were our first candidate, because they were the big game in mice. And Pierluigi Zappacosta had come out to Salt Lake a couple times to our humble abode, and looked around and said, "Wow! You guys sure did a lot with almost no funding!" <laughs> And he was very interested in the feel, the touch and feel, he was very sensitive to exactly how that worked. But we never quite worked out an arrangement with him. And we ended up in '94 with Alps [Electric Co., Ltd.] as our licensee. And Alps had been making the small little tiny trackballs, which they now believed were going to become obsolete. And so for them, it made a ton of sense. Alps is about a five billion dollar revenues manufacturer of all kinds of components, keyboards, switches … they had all the ISO manufacturing, all that good stuff. They were already selling to the Compaqs, and so on, of the world. And so we were thrilled when in '94 they said, "Okay, we'll take you on as a licensee." In April of that year, we had had our second turn of silicon, and we'd built a little plastic shell, and we came out with the GlidePoint Portable. And so when I was back in Michigan recently, I got from my dad the very first GlidePoint Portable to roll off the assembly line, which he had purchased. You know, proud father. Here it is: <shows it> basically a small custom plastic, on the inside are the initials of everyone in the company, who inscribed them in the mold. We were thrilled about this little device. PS2 interface could plug into almost any laptop computer. We built this real snazzy-looking box, like this <shows box>. And I'd come up with the name GlidePoint. So we were pretty excited about that, in late April [/ early May] we started actually selling these. We didn't really have any kind of advertising, but a couple guys in the media had been alerted ahead of time, and had gotten samples, and they were pretty excited. They were saying things like, "Wow, this is really something new. It's almost like magic. How does this work? Is it heat? Is it radioactivity? How does that work?" And we used to say, "EMS. Electrical Magical Stuff," or some other word. And.. in May, Apple had fielded their product, it was called [code name] the Blackbird, it was the PowerBook line. And between the two, there was just all this

buzz starting to build up. Apple was making a real big deal of it, and calling it the trackpad of course, to try and maintain continuity with trackballs, which they had before. In November -- Alps had been working hard with OEMs in Japan -- and Sharp and some other OEMs brought out their laptop computers, with little touchpads built in.

Steinbach: And some I remember had also the rubber thing, the IBM kind of thing, right? Together with..

Gerpheide: Yes, hedging their bets.

Steinbach: <laughs>

Gerpheide: They weren't quite sure whether this thing was going to catch on. And a customer could have both that way. That's exactly right, a lot of them did. Probably the rubber -- the little eraser, the pointing stick -- was our major technological competitor for several years.

Steinbach: But it went away eventually.

Gerpheide: Eventually went away, everyone..

Steinbach: I'm not sure that anybody still has it.

Gerpheide: I'm not sure either, I'm not sure. For IBM it was a bit of a brand image. Because here you had a picture of a keyboard, with this little red dot in the middle. And it was right there, very convenient. Kind of like my original vision, of being able to do it from the home row, point from the home row. But from a technical viewpoint, touchpads had what we called "isomotive operation." Move your finger here, cursor moves there.

Steinbach: Right.

Gerpheide: Really nice control. Whereas with the little trackball, the pointing stick rather, you're translating force into acceleration, which is zooming this thing around.

Steinbach: It's kind of..

Gerpheide: Great for a video game..

Steinbach: …an integral of what you do and..

Gerpheide: Yeah, it's just harder.

Steinbach: …less natural.

Gerpheide: Just less natural. So we'd launched into the retail world, with our little GlidePoint product. And Jim and.. with help from Dave Spafford, who had already been in the retail market with Megahertz, Jim did a great job of getting all this good press. And at the end of the year, PC Magazine came out with the best products of '94. And there we are, with some great company. I mean we were just thrilled about this. And sure enough, that retail business kind of took off. And partly due to Jim's sales expertise, and partly due to kind of the buzz and the wow factor. So that really started to build up.

Steinbach: But your main income would have still been from licenses? Or was it..

Gerpheide: Actually not..

Steinbach: …sort of rivalling..

Gerpheide: Let me share some numbers, approximate numbers. In '94, [spring,] we sold our first one. And we took a credit card over the phone, but we didn't even know how to process it yet <laughs>. So that gives you an idea where we are. And by the way, at this time we're not in my basement anymore. We had a small office, tiny office building, and ramping up. But by '96, we're up to 10 million of sales of retail products. But OEM-- as a result of Synaptics entering the market -- the royalty on the… the amount that OEMs would pay for touchpads became very competitive. And consequently, our royalty was reduced to a fraction of what we had anticipated for a unique product. And so royalty was a lot of.. relatively lot of units, but very little money. Pure dollars, no cost of goods, but not that much revenue.

Steinbach: Oh, because you didn't sell the thing, you only had the royalties..

Gerpheide: That's right. Alps was manufacturing..

Steinbach: …whereas Synaptics was manufacturing.

Gerpheide: That's right, that's right.

Steinbach: So where did you manufacture the GlidePoint?

Gerpheide: We tried a lot of different things. First off Iomega, I mentioned, was a Salt Lake company. But they had some kind of ups and downs. And they'd built up quite a manufacturing plant, and then their business went down, so they had excess capacity. So they were manufacturing for us as a contract manufacturer, for a while. Then they decided they needed their capacity back, and now we had to go somewhere else. And we actually built a manufacturing line in Salt Lake City. And then we had a couple different companies, who were building circuit boards, and complete assembly modules.

Steinbach: In the US?

Gerpheide: Mostly in the US at that time. And Alps was manufacturing in Japan. Strangely enough, Alps had decided that this very unique product was a good entry point for them to get into the retail market. They were completely an OEM company, and they saw the huge margins that are in the retail business compared to OEM, and they said, "We'd like to get in there." And they launched first of all a line of GlidePoint products almost identical to ours.

Steinbach: Competing with you.

Gerpheide: <laughs> Well yes. And they launched some other stuff. There was an Alps printer, which had some novel technology in it and some things like that. So they went into the retail market in a pretty big way. And here we were feeling kind of beat up, and butting heads at the retailers-- obviously the retailers do everything they can to… sort of like the election of this past year. They just kind of fan the flames, to make it so the two companies are competing. So we had kind of a bad feeling about Alps, even though they were a licensee, and vice versa. So we didn't use them for manufacturing. And anyway, they were oriented toward much higher volumes, OEM volumes, and we were still kind of small potatoes. But we did fairly soon move to Taiwan manufacturing, and China. And then bounced kind of back and forth, some of that, some of local Utah.

Steinbach: So when Cirque manufactured, it was always the retail product? You did not manufacture in an OEM?

Gerpheide: Primarily. However, we did start-- we realized we couldn't sell to the Compaqs of the world because we didn't have ISO, and we didn't have supply chain, we didn't have all that stuff. Credit management, we didn't have any of that. But we built a line of small products, small touchpad modules, and we sold them to kind of unique, niche markets. One fellow was building a dentist chair, and he wanted to be able to control that. Things kind of like that. Some keyboard manufacturers incorporated our modules into their keyboards. So we did make some modules ourselves, but lower volume. And then as we moved to China manufacturing, we were able to do kind of higher volume, and service these keyboard

opportunities. But basically our business was retail, if you looked at the revenue. It was a highly retail-focused business. And so we started bringing in keyboards and other products, to extend our line.. and sell into retail.

Steinbach: Oh, so Cirque had branded keyboards also?

Gerpheide: We had branded keyboards, several different kinds. And we had a variety of these kind of portable products. Synaptics came with a partner to do the same thing. So we had Cirque, Alps and Synaptics, all trying to get into retail. Not Synaptics, but this partner, I can't remember their name. So it was a crowded office, when <laughs> the retailers wanted to play our prices off against each other. But Jim did a wonderful job on that, and we built ourselves up to about 70 people. And like I said, we were doing about 10 million of revenue, mostly retail. Oh and I want to back up, and two things I forgot to mention. One was.. I've been talking about the key people here, I really ought to mention my ex-wife, K. C. Sato, who.. you know, she did everything to take care of the kids, so I could beaver away on this stuff. It never would have got there without her work. And also I want to mention something that's not quite so serious. But I like to ski, Jim liked to ski, we like to ski at Snowbird, where there's an area called "The Cirque."

Steinbach: Ah, hence the name?

Gerpheide: Hence the name.

Steinbach: Oh. That was one of my questions, going to be.

<laughter>

Gerpheide: Didn't mean to spoil the-- steal the thunder of the question. But we really like to ski in Utah, it's probably the best in the world. Where I live now it's about 15 minutes [to Snowbird]. At 2:00 in the afternoon I can say, "You know, I really ought to go skiing." Drive up, get in four or five runs, come back. It's a wonderful place for outdoors. And just to promote Utah a little bit, it's become a bit of a tech hub. A lot of people are moving where the costs are much lower, it's very business-friendly, there's a lot of space. The government's working hard to incent people to come. And they even have a slogan, which is "Silicon Slopes," as opposed to Silicon Valley.

<laughter>

Gerpheide: So all that's kind of fun. So anyhow, here we are in about the '96 timeframe, '97. And we've got this retail-- we've been in it a couple years, we've got this retail business built up. There's some competition, Alps and Synaptics are kind of fighting it out in the OEM market. Logitech is working really hard to field the technology like this, they really want to have that technology. But it proves to be pretty difficult. So there were all these previous patents in the patent landscape, there were capacitive patents that didn't quite work. We'd carved out our little niche, Synaptics carved out a self-capacitance niche, and there wasn't too much other space. So it was tough for Logitech. They finally fielded a product, but it didn't seem to catch on with the OEMs. And they discontinued that business, and sold it after that… So there we are, kind of.. all this excitement, and we got the idea -- might call it a swelled head -- that we were doing pretty dang well in this retail stuff, and maybe we could replace the mouse. You know, the mouse was obsolete. And we were talking about Cats from the beginning anyway. We hired a gentleman from Procter and Gamble, who was a VP of Marketing. Extremely bright guy. And he came in with a Procter and Gamble-type approach and skills and contacts, and we raised about four million dollars of additional funding, of venture funding. With the idea that we were going to replace the mouse, we're going to really fund this. Because up until now we had no advertising, it was simply good word from press reviews and so on, word of mouth and stuff. And so he did a real bang-up job on the image side.. <rustles through papers> and he took.. let's see if I can find it, here it is… <shows advertisement> He took the Cat concept, he put in "good, better, best" market position, straight out of Procter and Gamble. We had the Power Cat, the Smart Cat, and the Easy Cat, with different levels of functionality. We had this cool Madison Avenue image <shows picture>. And he did a market survey. And Procter and Gamble is a lot about taking stuff out to the streets, and asking the consumers what they think. And he took out a survey that basically said, "You use a computer, don't you? How do you like that mouse? What if you could just move your finger and the cursor would move, you didn't need your mouse?" And he got something like 95 percent of people said, "Yes! That's wonderful, I would love that." And in his experience with, you know, I don't know, Procter and Gamble kind of products, 95 percent is unheard of. That is so much better than any survey he's ever done. So we were pretty darn enthusiastic. We had this money, we had this cool look. He put ads in People magazine, you know, we'd been barely known to the Bytes and the PC mags of the world before, but we were in the mainstream, this was a consumer product. He got a pretty good level of success for a while. At Computer City, there was one month where we actually sold more of our products than Microsoft sold of their mice. And Microsoft was the big game in mice, other than Logitech. So that was pretty darn good. But there were some things we didn't realize. One of those things was, that survey wasn't quite right. Because it didn't take into account the fact that it's a little hard to click with a touchpad. Sometimes it happens unintentionally, sometimes it's hard for people to get the hang of it. That kind of palm rejection sort of problem. And so in actual use, people weren't as happy with their touchpads. Some people were raving about it, but some people were saying, "You know, I would go back to the mouse." So that was one problem. The other problem, we didn't realize how the retail channel really worked. Which is, you put a lot of product in, and they might pay you for it or they might not, but it isn't really sold until it goes to the consumer. So you can build up a pretty big inventory out there, in all of these many computer stores. And retailers have a lot of negotiating power. The Computer City's-- we were in Computer City, CompUSA, Sam's Club, companies like that. It's not easy to maintain your margins. And they're going to ask a lot of expenses like end caps, and promotional expenses, and rebates and things, that kind of come after the fact. After you think you've made the sale, with 50 percent gross margin, and it all got eaten up with this stuff that comes later. So we had all this enthusiasm about

the Cat line, and.. about one year into it, we started seeing the financials start to turn. And we were about four million dollars upside down, for the end of the year. And the venture people who were in it had relatively small parts. I had a pretty large part of the company, and everything I had was wrapped up in it. No one really wanted to push forward with Cirque. There were ideas, “Let’s sell it for pennies on the dollar to whoever we can, get what money we can back.” There was some of that. We had these 70 people, we couldn’t continue, so-- And this gentleman from Procter and Gamble, his background didn’t encompass working on a shoestring..

Steinbach: <laughs>

Gerpheide: …and emptying wastebaskets by yourself, and stuff like that. So as talented as he was, had to let him go. And then that unfortunately put me in charge of letting everyone else go. And after a very painful three rounds of layoffs, where each time we thought we’d laid off enough to make ends meet, but we didn’t, we were down to 35 people. And sort of scrabbling away to disentangle ourselves from the retail world, where we didn’t have the margins we thought we had, and we had all these liabilities. And trying to refocus the business to the dentist chairs of the world, and stuff like that, and supporting Alps on the royalty side. And by now… You know, it took a while for the market to accept touchpads. These days everyone says, “Touch? Of course.” Those days, nah, not so much. It took probably four, five, six years before people really adopted touchpads fully. But nonetheless, volumes were starting to build, so our royalties were starting to build with Alps, and that helped a little bit. And after a couple years, I was able to get back to where we had kind of a skeleton crew, everyone was working like crazy. A lot of good people, like Jim O’Callaghan, a lot of other good people had left, because there just wasn’t money. And it was a real tough time for me. You can probably tell, I’m more of a creative kind of guy, I’m not really a turnaround company kind of guy. And it was my baby, so it really hurt. But after a couple years, we got back to where we were profitable again. And my number one job then, was to find a way to sell the company. Because by this time my heart was just not in it. And I was just pained, I just hurt, it just hurt. And in 2003 we were able to sell the company to Alps. It made a ton of sense for them. And I exited the company, it was a good transaction for everybody. I think Alps went on to continue to make a lot of money on touchpads, and some other directions that the company took. And almost all the employees stayed with the company in Salt Lake, under Alps Management. But mostly doing what they wanted to do anyway, under Alps ownership. And so it was really a win-win situation, and I was free. And in answer to the question, you know, am I still involved, after that I was kind of allergic to Cirque and touchpads and..

Steinbach: <laughs>

Gerpheide: They’re all good guys and I go back every so often, but no, I haven’t done anything more with that. So I’ve been separate.

Steinbach: That’s that chapter.

Gerpheide: Yeah, yeah. I look back on it.. one of the things that happened was, Apple had our initial license, they were already experienced with the idea of mutual capacitance. They had since started going outside to other vendors for touchpads, but still, they had that technology base. And then Wayne Westerman.. at FingerWorks did a fabulous job coming up with multi-touch technologies, which then Apple acquired. And so somewhere along the way -- I have a happy spot in my heart that -- that whole mutual capacitance touchpad thing has kind of evolved itself, into where now it's used in almost all devices that are electronic, it seems. And so it's fun to know that. And kind of sadly, from our point of view, Alps was a wonderful partner focused on the early part of the portable computer market, which was based mostly in Japan. Not too long after that, most of the momentum shifted, for lower manufacturing costs, into China. And Synaptics had sort of set China as their base, from the very beginning, and proved to be much more competitive than Alps was able to be, for notebook computers. And so Synaptics certainly has the very much lion's share of the market. Alps has some more specialty kind of stuff, I would say. So that's, you know, I feel a little bit sad for our partner there, on that. And it would be nicer…some of the other touchpad… a number of other vendors have come into the market now, as IP has expired and so on, and just because of the huge demand driven by mobile phones, and tablets and so on. And some of the current touchpads don't have the kind of quality that I would like to see in tracking. As they've tried to add in all the features that everybody wants, they've kind of given up on some of the basics of, "Let's make sure this just works really well." So those give me a little bit of sadness. But all in all I'm real happy. It's been a good run, I was lucky to have that happen.

Steinbach: Yeah, quite an accomplishment.

Gerpheide: With a lot of luck. And I didn't even mention all the good people we had at Cirque by name. It was a team thing, it was all kinds of people. And as you know, I'm not the sales guy, that was all Jim O'Callaghan and his team that he put together. And so it was really all those guys that did it. But I had the fun of tinkering.

Steinbach: <laughs>

Gerpheide: I had the fun.

Steinbach: Yeah, that's what I like most about electronics too, the..

Gerpheide: That's right.

Steinbach: …attention to get something to work. It's..

Gerpheide: Making it work. Yeah, you have to go through all those details, all those iterations.

Steinbach: Okay. So after the touchpad, let's briefly touch on what you do now. You have a strange-sounding email address, C2MW4.com.

Gerpheide: That's right. C2MW4. I don't publicly want to tell anyone what it means, although it's easily enough figured out, as you've done. But the big thing is, if anyone asks me I say, "Well, if you can guess it I'll buy you a beer." So I think I owe you one.

<laughter>

Gerpheide: And C2MW4 is basically a consulting company, to house various things I want to experiment with, and work I do for clients. And..

Steinbach: So this is just you now?

Gerpheide: Basically just me.

Steinbach: Okay.

Gerpheide: Yeah. Every so often there's a few other people involved, but it's basically just me. And I've looked at a lot of things in the alternative energy space, over the last five, ten years. As interesting as those all are, it's hard to make them turn out. And I've put a lot of time into thinking of one and modeling it, but so far, without being able to get any people to bite on the potential. And that's the idea that photovoltaic technology is kind of a tough nut to crack. You need a pretty large surface area, because sunlight is relatively diffuse. So you need a lot of something, whatever that something is has got to be pretty darn cheap. And you're talking about making these things in an… extravagant plant, with silicon processing technologies. It's just hard to get it to be really economical, like people would like. But the problem of solar thermal in contrast -- low-grade thermal energy from sunlight -- is like falling off a log it's so easy... and cheap. And a gentleman in France a number of years ago, developed a dryer for forage. So when someone cut the hay in their farmland, they could use this dryer: a solar-powered dryer. And it was basically a two-meter diameter tube, about three hundred feet long, maybe a thousand feet long. Just plastic, a fan on one end that blows air through it. And it heats up in the sun, and out comes two, three hundred kilowatts of thermal energy. At a cost of approximately-- this was a while back, but I think his cost was something like four dollars a kilowatt of capacity. Compared to around a thousand dollars a kilowatt in rough terms, for photovoltaic. So immensely cheaper. How could you put that to work in a practical system? And I thought that if you looked at the mining industry, the mining industry generates all these tons, megatons of overburden, rock. And it's really good for nothing, they just try to put it back and make the ground look as good as they can. What if you could do something with that? And so I thought, "Well low-quality thermal energy, the main problem there is you get it during the summer in the daytime, you need it during the winter and in the nighttime." It's all about storage, all about storage. How do you

store thermal energy? Well rocks are one of the age-old solutions. And here you can get a boatload of rocks, almost for free. And in fact if the… I did a lot of studies on the porosity of a rock pile, basically. Just a pile of these broken up rocks, how hard is it to blow air through this pile of rocks? And I found that it looks quite feasible: you do a minor amount of sorting on the rocks as they're dug up, so that they have a somewhat more even distribution of sizes, therefore relatively good porosity. And then you can collect solar energy in a solar farm. Basically a whole bunch of these tubes of black plastic, just like the gentleman in France did. Blow air through them, the air blows down through the rocks, heats up the rocks. And since you're talking about truly immense scales, you can get time constants on the order of a year.

Steinbach: Oh.

Gerpheide: So you can store heat from summer into winter. And then what do you do with the stuff? <laughs> So.. I thought a little more about that. And in a typical open pit, or surface mining kind of operation, you're generating all this landscape, all covered with a bunch of overburden debris. And they try to revegetate it, and do whatever, but it isn't really being used for anything. How about if you could put greenhouses on it? So half the surface is covered with greenhouses, half the surface with these solar farms. And then obviously when you need the heat… greenhouses aren't very well insulated, right? Because they're just thin. And in many greenhouses, something like a third of the operating cost is actually heating. So it's worse than one might think, because you have to blow air through it, in order to get the humidity down. Because the plants are constantly transpiring all this moisture. And so in order to get the humidity out, you blow the air out, then you lose a lot of heat. So greenhouses take a lot of heat. And I did a bunch of modeling, and when you add it all up, it looks like you could be producing this greenhouse heat for roughly a quarter of the cost of natural gas. Which for an alternative energy play, is pretty darn economic. And it also has the social component that in a lot of developing countries, you know, they don't have too much, one of the things they've got typically is mineral. So a big mineral company comes in, they build a little city there, they do all this mining. And then the mine starts to peter out, and it's boom and bust. And all of a sudden, instead of having an economic asset in their developing country, they're stuck with a huge social problem, and really a disaster economically. But what if, as it was being built up, and all this overburden is being placed, and these greenhouses and solar farms are being developed… I did a few studies that make it look like, if you had a mine with about five thousand employees, that size of mine after 10 years of running would generate a greenhouse and solar farm that would require about ten thousand employees. So now instead of saying, "Okay, it's going bust. Everyone's out of a job." You're building up a sustainable, follow-on industry, with an economic advantage of lower-cost energy. So it seems like a pretty neat concept. But I think mining companies generally are focused on the business of getting mineral out of the ground, and not too much on the business of green technology. And you're talking about different players that are pretty disjoint. So… so far I haven't been able to get anyone to bite on it, and take it somewhere. But I put a lot of time into that. That would be a fun one to do. The other thing I'm working on right now, is <laughs> quite different. There's a.. pretty high incidence of people who have performance anxiety. Which manifests itself as test anxiety, or.. trouble public speaking, or all kinds of performance things. And I have some ideas about how you might be able to deploy something online, in a scalable fashion, that could provide really good access

to training oneself to get around those problems. Right now mostly your options are a fairly expensive psychotherapy kind of thing that's also unpalatable to a lot of people. And so I think there are a lot of people who are in need of a solution, for anxiety. And if I can make this work, it's kind of like touchpads..

Steinbach: If you could make them willing to pay for it.

Gerpheide: Well the cost could be so much lower with internet deployment, that the cost, I think, is not the real impediment. And performance anxiety is so frustrating. To know that you know all the material for the math test, and then you go in and totally blow it because you just freeze up. To think that you have no social life, because as soon as you get around someone, you're so jittery you act like an idiot. To get up for your big presentation to sell something, and then totally space out and not be able to remember what it is. I think the market would appreciate a solution to that, and would easily pay a nominal fee. But can I make it work? I don't know. It's kind of like touchpads, it might take 19 tries.

Steinbach: <laughs> Well, I wish you luck.

<laughter>

Gerpheide: Thank you. I need it.

Steinbach: It could be something useful, yeah.

Gerpheide: Yeah, I think so. The other thing I'm working on is my family. And the first time around, touchpads sort of absorbed all of my time. And.. now I've got a new family, new young kids, I've got a four and a six. And able to have the luxury to spend quite a lot of time with them. And that's just a wonderful thing, and it sort of got me started on this development.

Steinbach: Oh.

Gerpheide: …anxiety combating thing. So that kind of all ties together. Teaching them skiing right now.

Steinbach: Oh.

<laughter>

Steinbach: Okay.

Gerpheide: I don't think I have anything to add.

Steinbach: Alright.

Gerpheide: I sure appreciate you inviting me down here and..

Steinbach: Well..

Gerpheide: …I'm looking forward to seeing the museum.

Steinbach: Okay, okay. So thanks again for coming, and.. yeah, thank you <laughs>.

Gerpheide: You're very welcome. Alright.

END OF THE INTERVIEW

